UOP RUSSELL LLC
Tulsa, Oklahoma

JOB NO: J-447 DATE: 7/27/2011
CLIENT: UOP Russell BY: JRG
SUBJECT: 60 MMscfd Cryo Plant

FIRED HEATER

Service: HMO Heater Tag No: H-781
Design Duty, MBTU/Hr 6,160 Type: Helical Coil
No. of Coils per Unit One No. Units: One Heatec Model: HCI-5010-40-G

Fluid		Therminol 55		Burners		
		Inlet	Outlet		Gas	Oil
Liquids	Lbs/Hr	103,416	103,416	LHV (BTU/cf)	894	
Density	Lbs/CuFt	51.55	48.75	Mol. Wt.	16.55	
Molecular Weight		320	320	Gravity		
Specific Heat	BTU/Lb °F	0.5135	0.5695	Pressure Avail. (psig)	100	
Thermal Cond.	BTU/Hr-Ft-°F	0.0697	0.0652	Pressure Req'd (psig)	10	
Viscosity	cP	3.740	1.250	Steam for Atomizing		
Vapor	Lbs/Hr	0	0	Fuel Gas Req'd (MSCFD)	202.77	N/A
Density	Lbs/CuFt			Mfgr:	Eclipse WiNOx	
Molecular Weight				Type:	Forced Draft - 20 Hp Blower	
Specific Heat	BTU/Lb °F			Number Req'd	One	
Thermal Cond.	BTU/HrFt °F			Pilots Req'd	Yes, electric ignition	
Viscosity	cP			NOx	< 40 ppmvd	
Operating Temp.	°F	195	305	**Structural Design**		
Operating Pressure	PSIA	75	55	Wind Load, MPH, (3)	120, Exp. C, Cf=0.7	
Velocity	Ft/Sec	Allow.	6 Calc.	Seismic Zone, (3)	I = 1.25	
Pressure Drop	PSI	20 Allow.	10 Calc.	Ambient, °F	-20 / 110	
Fouling Resistance	SqFt*F/BTU	0.002		Elevation, Ft	3000	
Design Press. / Temp.		150 PSIG	400 °F	**Stack Design**		
Min. Design Mtl. Temp.		-20 °F @	150 PSIG	Self-supporting	Yes	
Corrosion Allowance		0.0625		Minimum Height	8ft above top of heater	
Insulation Thickness		3" - 5" Ceramic Fiber on Interior		Minimum Wall Thickness:	0.125	
Efficiency-Based on LHV	(%)	84.0%	(Assume 3% Loss)	Lining Type	No	
Excess Air		15%		Lining Thickness:	No	
Firebox Unit Heat Release		27995	BTU/Hr- Ft^3	Damper:	No	
Number of Passes		One - Process, Two - Fireside				

Coil Design		Radiant	Convection-Bare	Convection-Finned	
Gas Temperature	In/Out	195 / 305			
Number Tubes		One			
Tube O.D.	In	4" Sch 40	4" 300# ANSI RFWN Flg.	Inlet and Outlet	
Tube Length	Eff. Ft	-----			
Bare Surface	Sq Ft	741			
Finned Surface	Sq Ft	N/A			
Avg. Heat Flux	BTU/Hr-Sq Ft	11405			
Tube Materials		SA-106 Gr.B Sch 40	SA-	SA-	

Convection Fins (inch): Height: Thickness: No. / inch: Material:
Overall Dimension: 25.5' L x 7.2' W x 7.9' H (Less Stack) Dry Weight: 15,800
Code Requirements: ASME VIII Div I Stamp: Yes Nat'l Board: Yes

Notes:
1) Add 10% to duty and flow rates for design.
2) See attached Scope of Supply.
▲ 3) Wind design per ASCE 7-10, Exp. C, V=120 MPH, Cat. III Seismic design per ASCE 7-10, I=1.25, Site D, S_S=100%, S_1=40%.
4) Electrical power to be 480 v / 3 ph / 60 hz. Control enclosures to be NEMA 4.
5) Add spare ignitor

REVISION	A	0	▲ 1	
ENGINEER/DATE	JRG 7/27/11	JRG 8/12/11	BH 11/21/11	
ISSUED FOR	RFQ	Purchase	Revised	

OPERATION
AND
MAINTENANCE GUIDE

HCI-5010-40-G HEATER
HEATEC W.O. # 16-251
UOP RUSSELL, LLC
P.O. # 4500755147
TAG #: H-781 / J-447

CAUTION

The contents of this “Operating and Maintenance Guide” should be read throughout and understood thoroughly before putting the equipment into operation. Failure to do so could result in physical harm to both person(s) and property.

Factory Service and Start-Up Technicians are available. They can be contacted by calling either your local representative or the Heatec Home Office at: 1-800-235-5200.

All applicable codes must be met when installing or applying this equipment. This is the responsibility of the user, as it is impossible for the original equipment manufacturer, to be informed of all applicable codes (Federal, State, County, or Parish, City, Areas, etc.)

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Index Guide for Heatec Job # 16-251/Customer PO #4500755147

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5. System Components

A.HEATER

Ashcroft Gauge 45 1279SS
Ashcroft Thermometer
Ashcroft Thermowells
Pyromation Thermocouple
UE H122 Differential Pressure Switch

B.BURNER

#Burner Documents
Allanson Ignition Transformer
Dwyer Pressure Switch 1950
Triac Actuator WE-500 Series

C. GAS TRAIN

ASCO Actuator AH2E
ASCO Gas Valve V710 V9566R1
ASCO Solenoid Valve 8215 V5993R4
Ashcroft Gauge 25-1009
Conbraco 60 Series Valve Needle
Fisher Regulator 133H
Fisher Valve Relief Regulator 289
Mueller 581-582 CS Strainer
Resun Plug Valve R1430
UE J400 Pressure Switches

D. PUMP

Apollo Valve 76-100
Dean Pump R400 R4000 Series IOM
Durabla WLC Check Valve
Kunkle Relief Valve
Mueller 782 Strainer
Vogt Valves

E.EXPANSION TANK

Apollo Valve Ball 73 Series
Fisher Regulator 67CFR Bulletin
Fisher Regulator 98H, 98L
Inferno 15A Level Gauge
Inferno Level Gauge Series RA
Magne-Sonic Level Switch MLS

F.ELECTRICAL

Eclipse Ignition Transformer
Federal Signal Horn Model 350WB
Federal Signal Vibra-Tone Horn 350_450
Fireye Annunciator YZ-300 & YZ-320
Fireye Burner Logix YB110 & YB230
Fireye Burner Mgm Base 129-178-4
Fireye Burner Mgmt Display BLV512
Fireye Flame Scanner 45UV5
Fireye Interconnecting Cable ED580
Fireye Programmer Module YP138
Fireye Wiring Base 60-2814-1
Fireye Wiring Base 60-2874-1
Hoffman Back Panel CP Series
Hoffman CMFK Foot Mounting Kit Installation
Hoffman Enclosure CSD12126SS6
Hoffman Enclosure CSD483612SS
Hoffman Window Kit AWDH Series
Siemens 3TG10 Mini Contactor
Siemens ED Frame Circuit Breakers
Siemens Rotary Handle
Yokogawa UT35A-L Digital Limit Controller
Yokogawa UT35A-L User Manual

SECTION 1
O&M GUIDE

TEC-NOTES
HELICAL COIL HEATERS

INDUSTRIAL SERIES

HEATEC
AN ASTEC COMPANY

Heatec Tec-Notes

Heatec thermal fluid heaters—industrial series

Title	Pub. No.	Revision.
Safety	7-04-141	7-12-12
Heatec commitment and warranty	7-04-138	4-14-10
Handling	1-10-221	-
Installation	1-10-222	7-12-12
Panels in hazardous locations	3-10-228	-
Choosing heat transfer fluids	3-04-114	7-12-12
Setting temperature controllers	1-10-223	-
Fireye burner management controls	2-09-212	4-12-13
Setting differential pressure switches	7-11-246	-
Thermal fluid—when should you replace it?	6-04-128	9-09
Thermal fluid—prolonging its life	6-04-129	8-8-11
Operation and maintenance	8-11-249	-
Honeywell modulation motors	1-07-184	4-24-07

These Tec-Notes apply to the Heatec "industrial" series of helical coil heaters that heat thermal fluid. They are identified as HCI, VHCI, HDI, and VHDI. These Tec-Notes also apply to terminal and marine heaters identified as HCT, VHCT and HCM. Heater identification appears on the serial plate of each heater. Some of the Tec-Notes also apply to other Heatec helical coil heaters.

In addition to these Tec-Notes, we include with each new product, a copy of important instructions published by manufacturers of key components. You will need these instructions for certain tasks mentioned in our Tec-Notes. Please contact Heatec if you have questions about instructions for components.

NOTICE: The publications listed above are available on the Heatec internet web site and on the CD furnished with this manual.
Heatec retains copyright on all publications listed above. You may download the files and make single printed copies for personal use. You may NOT print multiple copies of these publications or any portions of them without the express written permission of Heatec.

Publication 3-10-227 Revised 4-12-13

Heatec, Inc. 5200 Wilson Road Chattanooga, Tennessee 37410 www.heatec.com (423) 821-5200 (800) 235-5200 Fax (423) 821-7673

HEATEC TEC-NOTE

Publication No. 7-04-141, Revised 7-12-12

SAFETY
Heatec heaters

Following the instructions in the Tec-Notes applicable to Heatec heaters will help you avoid serious injury or death.

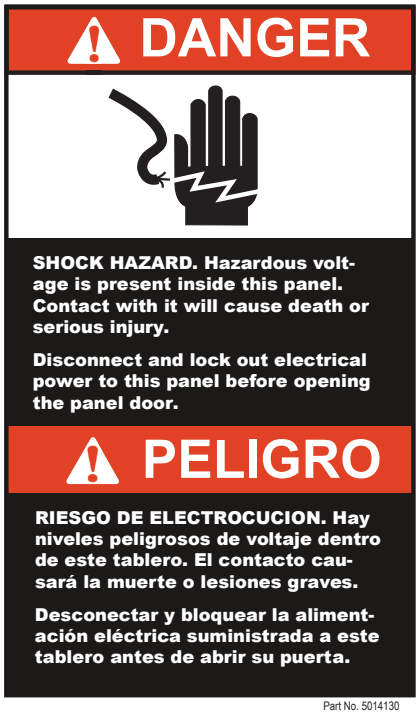
Read each Tec-Note in its entirety before performing operations it covers.

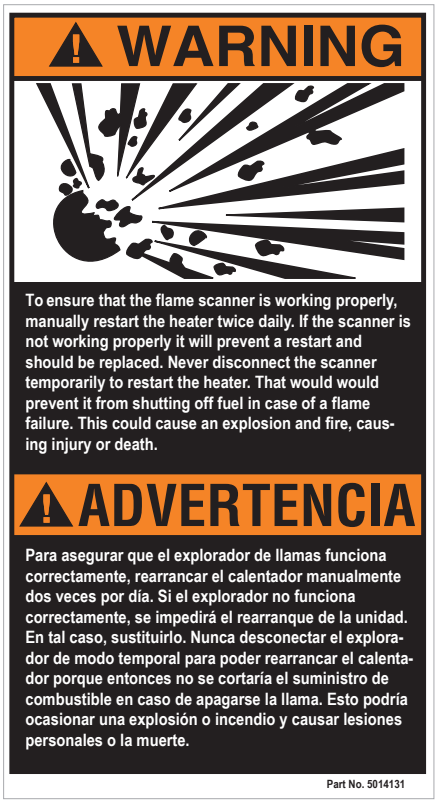
Hazard messages are included at appropriate places throughout these Tec-Notes. Safety may also be affected by the sequence of step-by-step instructions. So don't change their sequence or skip steps unless you are sure it is safe to do so.

Danger and warning messages also appear on decals at appropriate locations on the heaters. They identify known hazards, their severity and how you can avoid them. Pay special attention to them. Three are shown below to increase your familiarity with these decals.

You should also follow all applicable safety procedures and precautions issued by OSHA and/or other agencies that have jurisdiction where the heater is being used.

In addition to these Tec-Notes, we include with each new product, a copy of important instructions published by manufacturers of key components. **You will need these instructions for certain tasks mentioned in our Tec-Notes. And you should observe all safety information contained in these instructions.** Please contact Heatec if you have questions about instructions for components.





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THE HEATEC COMMITMENT

HEATEC IS COMMITTED to providing users of products we make with the best possible experience and satisfaction for the life of those products. To that end we provide expert assistance in choosing the product most suitable for your application.

Our experienced engineering and skilled manufacturing people design and build the product to the best of their ability using the latest technology in our industry.

We perform quality checks on the products to the maximum extent practical before our products are shipped.

We offer installation and startup service to ensure that the products will perform as intended.

Thereafter, if problems occur, we offer product support to help you fix them either by phone or by having our experienced technicians come to your facility.

When things go wrong

Despite all our efforts, things sometimes go wrong with a product you purchased from us. When this happens, you need to know the easiest and fastest way to get the product fixed.

You need to know who to call and what help you can expect. So, please read the following information carefully. It can save you time and reduce frustrations if you have a problem.

First, review your warranty

Your first step is to determine when you purchased the product and, if possible, its serial number. Then read the Heatec warranty shown in this document. Determine from the warranty if the problem is one that Heatec will fix under warranty at no charge.

You could find that it is out of warranty and that you will be expected to pay for parts and service.

When to report a problem

If you detect that something is not working right while a product is still under warranty, report the problem immediately and establish a claim. Be sure to do this even if your working schedule makes it impractical to fix the problem at that time. (Keep a record of the claim.)

Then, if you undertake to fix the problem a short time later, after your warranty has expired, you stand a better chance of getting it fixed under warranty. It depends on the management policies of the vendors affected.

You should not expect to get the benefit of a warranty if you had problems with a part while it was in warranty, but did nothing until after the warranty expired.

Parts we did not make

Parts not made by Heatec are covered by separate warranties from their manufacturers. Consequently, they are *not* covered under our warranty. As you would expect, the warranties and procedures for such parts will vary with the manufacturer.

Even though our warranty does not cover such parts we still have a strong interest in your satisfaction. If necessary we will intervene to help you resolve any problem you have with a non-Heatec part.

Moreover, if you have *any* problem during the *life* of Heatec products we will help you deter

mine the cause of the problem and resolve it no matter who made the parts involved. In some circumstances we will ship you a new replacement part and assist you with any warranty coverage you are entitled to from the parts manufacturer.

Replacing defective parts

If you have a major component that malfunctions because of a broken or defective part, we may be able to fix the problem by replacing only the broken or defective part instead of the entire unit. We reserve the right to do that when we determine that doing so provides a satisfactory solution that *will not put an undue burden on you*.

For example, if a new asphalt pump locks up at startup of a new plant because of foreign material in piping, a satisfactory solution may be to remove the foreign material and replace only damaged parts, such as the rotor. This could minimize disruption of the startup and avoid extensive dismantling of piping.

How to get help at Heatec

When you need help from Heatec, call our switchboard. Ask for our *Service* department if you need technical assistance. Ask for our *Parts* department if you need parts.

The toll-free number for our office switchboard is 1-800-235-5200. The regular number for our switchboard is 423-821-5200. Our FAX number is 423-821-7673. Our normal business hours are 8:00 AM to 5:00 PM, Monday through Friday, except on national holidays.

If you call our switchboard after normal business hours you can choose either parts or service. Your choice will connect you to a live operator with our answering service. If you need immediate help, the answering service operator will try to reach either a Heatec service technician or parts technician per your choice. In all cases, the operator will relay your message by FAX to either our service department or parts department the next business day and a technician will contact you without delay.

And don't forget the help we now offer on the internet at Heatec.com. We have posted a series of documents called Tech-Notes that can help you resolve numerous issues. It's available 24-7. You get printed copies of these documents with your products, but you might find newer or updated versions on the internet.

These documents have clearly written instructions, photographs and drawings that most people find easier to follow than phone explanations from a technician. In any case reviewing applicable documents before you call can make phone discussions much easier to understand.

HEATEC WARRANTY

Heatec, a subsidiary of Astec Industries, warrants each new piece of equipment or part manufactured by us to be free from defective material and workmanship for its normal use and service. We warrant our equipment and parts for a period of one year after shipment of such equipment to the original purchaser. However, if purchaser requests delayed shipment when notified that the equipment is ready to ship, warranty is from time of first notification.

Our obligation under this warranty is limited to replacing defective parts at our factory. Defective parts must be returned to our factory with transportation charges prepaid. We will replace only those parts that we judge, as a result of examinations we make at the factory, to be defective. Exceptions to the warranties are as follows:

Heatec warrants helical coils in our HCS and HCI *thermal fluid* heaters for three years.
Heatec warrants helical coils in our HC and HCM heaters for five years.
Heatec makes no warranty on refractory materials.

We do not warrant any equipment that has, in our judgement, been repaired or altered outside our factory in a way that affects its stability or reliability. Neither do we warrant any equipment that has been misused, neglected, accidentally damaged, or subjected to conditions contrary to our recommendations.

Parts and equipment produced by other companies are covered by separate warranties from their manufacturers. Such items include motors, motor starters, pumps, mixers, mills, scales, pump seals, valves, pressure regulators, solenoids, electronic drives, pressure differential switches, temperature sensing switches, flame scanners, gauge boards, modulating actuators, electronic displays, pressure transmitters, radar sensors and other electronic controls and instrumentation. Because such items are covered by separate warranties they are not included in the Heatec warranty.

We reserve the right to change or improve our products at any time without any obligation to make changes or improvements to equipment previously sold.

This warranty is expressly in lieu of any other warranties, including any implied warranty of merchantability or any implied warranty of fitness for a particular purpose on any product manufactured by Heatec. Heatec shall not be liable for any consequential damages for breach of any written or implied warranty on any of our products.

HEATEC®
an Astec company

Publication 7-04-138 Revised 4-14-10

HEATEC TEC-NOTE

Publication 1-10-221

Handling

Heatec heaters—industrial series

This document provides information for handling Heatec industrial heaters. It outlines our recommendations and responsibilities related to handling. Handling involves loading, unloading and placing the heaters at their installation site.

Heatec industrial heaters vary greatly in size and weight. Because of this, appropriate handling methods may vary from one heater to another. There are two major handling concerns:

1. Safety
2. Prevention of damage.

Heatec strongly recommends that you employ only licensed, certified riggers to handle heaters that require cranes for lifting. When you consider the time and cost of purchasing an industrial heater it is unwise to allow it to be handled by untrained people.

A rigger should have the following knowledge and skills in order to handle heavy heaters safely and efficiently:

1. Ability to calculate weight distribution.
2. Understand structural limitations of the load.
3. Read engineering drawings.
4. Know what tools, load lifting equipment and rigging are adequate for the specified weight.
5. Know that the rigging is in safe working condition.
6. Have extensive experience in rigging and safe handling.
7. Understand the effects of weather conditions on safety.
8. Know local regulations.

We provide an engineering drawing showing general arrangement for each large heater. It shows heater weight, dimensions and lifting points. A trained rigger can use this information to determine what lifting equipment, rigging and handling methods are appropriate.

Lift the heater only by its lifting lugs. Rig slings to avoid side-loading the lugs as much as possible. Keep the heater close to level when lifting and handling it.

DISCLAIMERS

1. **Heatec is not responsible for any damage to heaters or other property as a result of handling the heaters.**
2. **Heatec is not responsible for any deaths or injuries as a result of handling the heaters.**
3. **Heatec is not responsible for selection of lifting equipment, tools or rigging for handling the heaters.**
4. **Heatec is not responsible for the methods used to handle the heaters.**

The heaters pictured here show typical heaters we produce and how they vary in size. Some lifting lugs are painted red and are easy to spot.

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Publication No. 1-10-221

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HEATEC TEC-NOTE

Publication 1-10-222 Revised 7-12-12

Installation

Heatec heaters—industrial series

Some useful tips are presented here for installation of your Heatec heater. The information included is based on the most common concerns. *It does not cover all aspects and details of installation*.

Make sure that you comply with all local and national codes and standards that apply to installation of heaters. Heatec is not in a position to advise you on local codes and standards. Instead, we recommend that you contact local agencies and/or inspectors if you have questions. If you engage a local contractor to install your heater make sure they are prepared to deal with local codes and standards. Regulations pertaining to electrical safety, venting of gas trains and fluid discharge from relief valves are areas of special concern.

Follow all the instructions provided by Heatec when installing the heater:

- Piping and instrumentation diagrams
- General arrangement drawings
- Electrical drawings
- Foundation specifications

Set the heater on a concrete slab or concrete foundation or supporting structure. This provides a stable base for the heater.

When installing a vertical heater, make sure that its supporting structure is level. Otherwise you will need to shim its base to make the heater perfectly level. Use anchor bolts to secure the heater base to the supporting structure. Make sure you comply with local regulations for foundation design, especially in areas prone to windstorms and earthquakes.

Install the heater in a location where there is at least 3 feet of space around the heater for easy access to all sides of the heater. Leave enough space in front of electrical enclosures or panels to allow the doors to open fully. Consider the need for space to remove the helical coil if that ever becomes necessary. Don't place anything in that space that would be unduly difficult to clear.

Make sure that the exhaust stack is well supported. Some stacks are designed to be mounted on the heater without extra support, while some require additional support. When additional supports are used they should allow for expansion and contraction. If you have questions, please contact Heatec engineering.

Install provisions to ensure an adequate supply of air for combustion, ventilation and dilution of flue gases. Such provisions for gas-fired heaters should be in accordance with NFPA 54, National Fuel Gas Code, paragraph 5.3. Such provisions for oil-fired heaters should be in accordance with NFPA 31, Standard for the Installation of Oil-Burning Equipment, Chapters 5 and 6.*

Make sure that the fuel supply for the

heater conforms to requirements for pressure, flow, and pipe size as shown on the P&ID drawings furnished. Otherwise, please contact Heatec engineering for advice before you connect the fuel supply to the heater.*

When a gas-fired heater is installed in a hazardous location or inside a building, install venting provisions for all gas pressure regulators and relief valves. Such provisions should be in accordance with NFPA 54, National Fuel Gas Code,
paragraph 2.7.*

Make sure that there is a suitable relief valve in the thermal fluid piping. Some heaters are furnished with relief valves installed. If not, install one or more as needed in the piping near the outlet of the coil and upstream of shutoff valves.

Install vent piping for the thermal fluid relief valves. The piping can empty into a container at a safe, remote location.

Install insulation or shields as needed to prevent personnel from getting burned by contact with hot surfaces.

Install padding on hard surfaces of obstructions that are at heights or locations that are apt to cause head injuries.

When installing the thermal fluid piping system and making connections to the heater, use welded connections as much as possible. Welded connections are less prone to leakage than threaded pipe and flanged connections. Follow applicable welding codes and procedures.

Install suitable expansion loops in thermal fluid piping to minimize stress on piping and pumps caused by expansion and contraction due to variations in temperature.

Install valves that can be used to isolate pumps and tanks in the thermal fluid piping system.

Install 1/2-inch bleeder lines at all high points in the thermal fluid system to facilitate expelling trapped air and other gases such as water vapor. Make sure they are turned in a safe direction and do not accumulate water.

Install 1/2-inch drain lines at all low points in the thermal fluid system to facilitate expelling trapped water.

Leak test all fuel and media piping before filling systems.

All electrical installation should comply with NFPA 70, NEC (National Electric Code). Use only qualified electricians to install electrical service to the heater. All electrical wiring and components should be specified by a qualified engineer or electrician. Ampere loading information is shown on electrical drawings furnished with the heater.*

Make sure all controls on the control panel of the heater are in the "OFF" position before connecting and energizing the electrical service.

Run electrical power wiring to the control panel on the heater and connect the wires to its main disconnect breaker. Heatec heaters are normally intended for connection to a power source of 460 volts, three phase, 60 hertz. Voltage variations should be no lower than 440 volts or higher than 480 volts. Heaters are available for other power sources when specified at time of order. Verify that your power source matches the power requirements specified on the electrical drawings.

NOTICE

Before operating this heater for the first time make sure the drive shaft of each hot oil pump is properly aligned with its motor drive shaft. Do this after the heater is installed in a fixed location and not subject to additional handling. Alignment instructions are contained in applicable documents published by the pump manufacturer.

Heatec includes a copy of these documents with each new heater. If you do not have a copy, please contact Heatec to obtain a free copy.

Check alignment again immediately after initial operation of the heater, before the system has cooled down. Thereafter, follow maintenance instructions covered in the documents.

Misalignment can damage the pump and motor. Repairing damaged pumps and motors can incur significant costs for which the owner is fully responsible. Setting alignment is an exacting task and should be done only by a qualified technician.

***NOTE: Heaters installed outside the U.S. should meet applicable codes for the location.**

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HEATEC TEC-NOTE

Publication 3-10-228

Panels in hazardous locations

Heatec heaters—industrial series

This document presents precautions applicable to electrical panels on heaters that operate in locations classified as *hazardous* in NFPA code.

Class I, Divisions 1 and 2 in the code are locations where fire or explosion hazards may exist due to flammable gases or vapors. Division 1 is where existence of the hazard is either *continuous* or *intermittent*. Division 2 is where existence of the hazard may occur, but is *not normal*.

NEMA Type 7 panels **(Fig. 1)** are normally required on heaters in Class I, Division 1 locations. These are panels designed to contain and withstand an explosion caused by ignition of gases within the panel—without producing adverse effects outside of the panel. The panels are not purged with instrument air or gases.

NEMA Type 4 electrical control panels **(Fig. 2)** are designed to protect against windblown dust and rain, splashing water and hose-directed water. They can be used on heaters in Class I, Division 2 areas *only* when an appropriate purging system is used with them. They are usually purged with *instrument air*. However, some are purged with clean, dry, sulfur-free fuel gas or other inert gas. (Note: a NEMA Type 7 panel can be used in a Class I, Division 2 area instead of a NEMA Type 4 panel in order to eliminate need for a purging system.)

Type Z pressurization covers two types of purging methods typically used. One method is known as *continuous purge system* whereby instrument air flows continuously through the electrical panel **(Fig. 2, 3, 4).**

The other method is known as *leakage compensation system* **(Fig. 5)** whereby instrument air is applied only when special sensors in the panel indicate that leakage has occurred since the panel was last purged.

Note: Air that contains moisture will quickly ruin instruments and controls. Moisture and condensate are common problems and will void the warranties on components that are ruined as a result.

We strongly recommend installation of a small electric heater in the panel to the help prevent condensation.

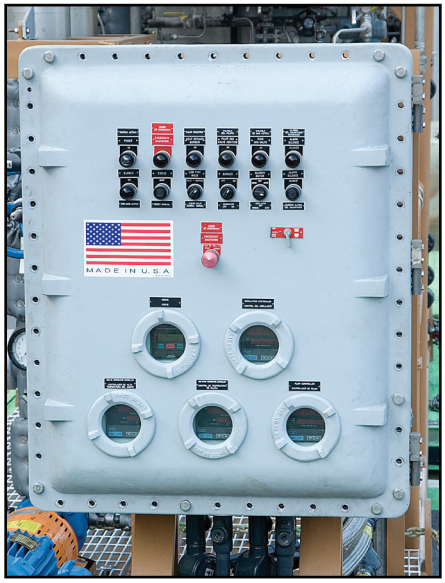

Figure 1. A typical NEMA Type 7 panel suitable for Class I, Division 1 areas. These panels are not purged. They can also be used for Class I, Division 2 areas to eliminate the need for purging.

Figure 2. A typical NEMA Type 4 panel for areas temporarily exposed to combustible gases. The panel is equipped for Type Z pressurization. The system also purges the small panel on the left.

The heater is needed in addition to dryers in the compressed air system.

To ensure the effectiveness of the purging system, follow these precautions:

- Make sure that the wires inside all conduit connections were sealed with approved sealants when the heater was installed.
- Make sure that the compressed air used to purge the panels is clean and dry. It should be "Instrument Quality Air."
- Make sure the air-compressor that provides the purging air is located in an area not subject to the presence of flammable gases.
- Make sure that the rubber seals on the door are not damaged or deteriorated.
- Make sure that the panel door is closed tightly and that all latch screws on the door are tight.
- When a panel is opened and then closed, do not activate its electrical power before it is adequately purged. The panels contain instructions on how much time to allow for purging.
- Regularly check the purging system to make sure it is working properly. Make sure its magnetic pressure relief valve and its exhaust outlet are working properly **(Fig. 4).** Periodically open the door of the panel to make sure that there are no signs of moisture or condensation.

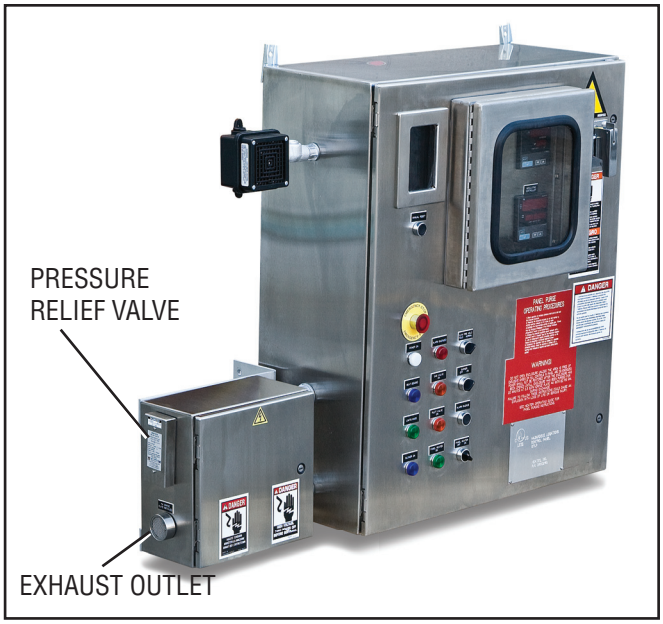

Figure 4. The exhaust outlet for the purging system is installed in the small panel on the left. The purging system also has a pressure relief valve located above the exhaust outlet. It opens if the pressure exceeds one-inch WC.

Figure 3. A typical continuous purging system incorporated in a NEMA Type 4 panel.

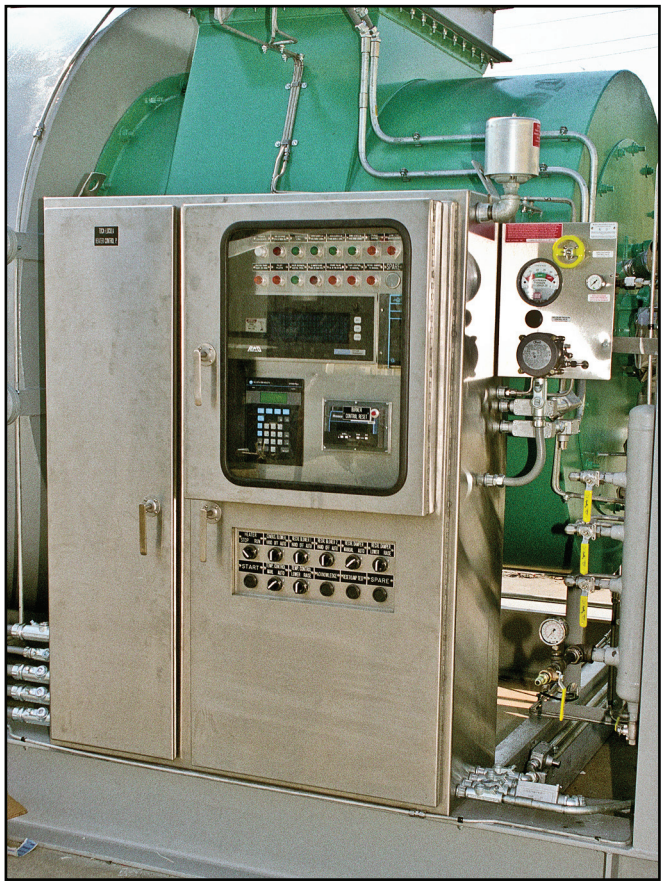

Figure 5. A NEMA Type 4 panel with a *leakage-compensation* purging system.

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HEATEC TEC-NOTE

Publication No. 3-04-114 Revised 7-12-2012

CHOOSING HEAT TRANSFER FLUIDS
for Heatec thermal fluid heaters

This document discusses heat transfer fluids (also known as thermal fluids) for Heatec thermal fluid heaters. Choosing a suitable heat transfer fluid for Heatec heaters is ***extremely*** important.

Do not use lubricating oils, turbine oils, diesel fuels or hydraulic fluids. They are not suitable for use in Heatec heaters! Unsuitable fluids can lead to the following problems:

- **Carbon deposits in the heating coils and fluid failure**
- **Greatly increased risk of fire**
- **Accumulation of sludge in the expansion tank**
- **Clogging of jumpers in hot oil jackets of asphalt lines**
- **Failure of pumps**

Fluids designed specifically for heat transfer have special properties. They include additives to help maximize heat transfer and minimize oxidation.

Oxidation is a common problem with fluids when heated unless they are designed for heating. Oxidation significantly degrades the fluid and contributes to the problems listed above.

Always choose a fluid product designed specifically for use in thermal fluid heating systems. These products are known as ***heat transfer fluids***. ***And don't rely upon claims that similar products from competitors are actually the same, unless confirmed by a qualified representative and backed up by applicable documentation.***

Industrial heaters

Heatec industrial heaters include the following models: HCI, VHCI and HCM. Fluids for these heaters are ***predetermined*** and named on the documentation furnished with each heater.

These heaters are designed for a specific heat transfer fluid that was designated by the customer. ***This is the fluid that should be used.*** Please contact Engineering at Heatec if you want to use an alternative fluid.

Construction heaters

Heatec construction heaters include models HC, HCS and HCT heaters. Fluids for these heaters are **not** usually predetermined. Therefore, you will need to choose one based on the heater type, its components and your usage.

Your choice should start with fluids that meet the requirements shown in this document. These are bare ***minimum*** requirements intended mainly to protect the heater and system components.

Accordingly, we have limited our concerns to ***startup*** temperature, ***operating*** temperature and ***film*** temperature. Explanations of these terms are provided on the next page.

Choosing a fluid

The fluid that you use in your construction heater should meet the following requirements:

CONSTRUCTION HEATERS	
Parameter	**Value**
Minimum fluid temperature **rating** (no manifold)	Operating temperature plus 50° F
Minimum fluid temperature **rating** (with manifold)	Operating temperature plus 100° F
Minimum **film** temperature **rating** (no manifold)	Operating temperature plus 100° F
Minimum **film** temperature **rating** (with manifold)	Operating temperature plus 150° F
Viscosity @ lowest startup temperature	Less than 500 cP
Viscosity @ normal operating temperature	Less than 10 cP

There are numerous other factors that affect fluid longevity and fluid cost. You should discuss your options with a reliable supplier. Reliable suppliers will need to know many things about your heating system, its environment, your operating practices, your maintenance practices, etc.

Explanations of terms

Startup temperature is the temperature of the fluid in the system when the heater is started under the coldest conditions expected. Temperature affects fluid viscosity. The lower the temperature, the higher the viscosity. This is a key concern because the fluid could damage seals in the pumps if its viscosity exceeds allowable limits.

"Operating temperature" is usually regarded as the temperature equal to the setpoint you set on the burner controller and monitored by a thermocouple at a single location. However, with normal modulation of the burner, actual temperatures may briefly swing higher. Moreover, HC heaters have additional temperature considerations due to their manifold.

The **"operating temperature"** on HCS heaters (which do not have a manifold) is the temperature of the fluid at the ***outlet*** of the heater coil and is controlled by the ***setpoint*** you set on the burner controller.

On HC heaters (which have a manifold) the **"operating temperature"** is the temperature of fluid in the ***manifold***—not the coil outlet. And this is the temperature that is controlled by the setpoint you set on the burner controller.

However, fluid at the coil outlet may be hotter than fluid in the manifold. That's because it mixes with cooler ***return*** fluid also entering the manifold. Accordingly, fluid at the outlet may exceed the operating temperature or manifold temperature as much as 100 degrees F. So when choosing a fluid it is necessary to allow for coil outlet temperatures that may be hotter than the "operating temperature." We made allowance for this in the table shown earlier.

In addition to normal burner modulation, an ***abnormal*** condition could cause fluid temperatures to exceed setpoint on the burner controller. Another controller (the media high temperature controller) limits how much any temperature increase can exceed the setpoint of the burner controller, regardless of the cause.

On HCS heaters the media high temperature controller is usually set for a temperature limit of about 50 degrees F above setpoint of the burner controller. On HC heaters it is usually set for a temperature limit of about 80 degrees F above setpoint on the burner controller. It will shut down the heater if the limit is reached. So these operating temperature variations should also be considered when choosing a fluid. We made allowance for this in the table shown earlier.

Film temperature is the highest temperature the fluid undergoes in the system. It is the temperature of a portion of fluid flowing inside of the heater coil and in contact with the surfaces of the coil. It may reach temperatures 100 to 150 degrees F higher than the ***operating*** temperature. We made allowance for this in the table shown earlier.

Precautions

Do not heat fluid in a ***standard*** construction heater to temperatures higher than 450 degrees F. Higher temperatures may damage plug-valves and cast iron strainers in the system.

Heatec can provide ***steel*** valves and strainers as replacements for those of cast iron. These replacements will allow heating of fluids to temperatures up to 550 degrees F. However, if fluids need to be heated to temperatures even higher than 550 degrees F, please contact Engineering at Heatec.

Selecting a supplier

When selecting a supplier for heat transfer fluid you may also want to consider the following factors:

- Does supplier have technical support capabilities?
- Does supplier offer testing/support service?
- Is supplier knowledgeable about your application?
- Does supplier's product line allow choices?
- Do you already use the supplier for other products?
- Does supplier have a return/credit program?
- Does supplier have a disposal program?
- Does supplier offer a delivery service?
- What is the regulatory status of the fluid they recommend?
- Does the fluid they offer have thermal stability?
- Does the fluid they offer produce obnoxious odors?
- Do you need heat transfer fluid listed by NSF (National Sanitation Foundation) as HT1 (for incidental contact)? Or certified for kosher use?
- How much is the initial cost of the fluid alone?
- What is the overall cost over the life of the fluid?

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HEATEC TEC-NOTE

Publication No 1-10-223

Setting temperature controllers
on Heatec thermal fluid heaters—industrial series

This document provides information for setting temperature controllers **(Fig. 1–4)** used on Heatec's helical coil heaters that heat thermal fluid for industrial applications. The controllers are located on the control panel.

Some heaters use Yokogawa controllers while others use Honeywell controllers. Three controllers are normally used on each heater. The function performed by each controller and its manufacturer designation is shown below:

Function	Yokogawa	Honeywell
Burner modulation	UT450E	DC2500-CE-0A00
Media high temperature	UT350L	DC2500-EE-0L00
Stack temperature	UT350L	DC2500-EE-0L00

This document along with manuals published by the manufacturers are furnished with Heatec heaters. If you need help on how to use the buttons on a controller, please refer to the applicable manual. You can call Yokogawa for technical assistance at 1-800-447-9656. Their web site is www.yokogawa.com/. You can call Honeywell for technical assistance at 1-800- 423-9883. Their web site for assistance is www.honeywell.com/imc.

Burner modulation

The burner modulation controller *regulates* the temperature of the media (thermal fluid) that flows through the heater. It monitors a thermocouple that senses the temperature of the fluid at the outlet of the heater. It continuously displays the actual fluid temperature, which is known as the process variable or PV. It also displays the set point or SP. Setpoint SP is the temperature to which the fluid is to be heated. The controller responds to any difference between actual fluid temperature (PV) and setpoint (SP) by re-positioning the modulation motor, which adjusts the firing rate of the burner.

Media high temperature control

The media high temperature controller *limits* the temperature of thermal fluid to a set point (SP) value that you set into the controller. (Do not confuse the set point of this controller with the set point of the controller used to modulate the burner.)

The media high temperature controller senses fluid temperature from a thermocouple in the outlet side of the helical coil. It displays the actual temperature of the fluid as well as the

Figure 1.Yokogawa UT450E controller.

Figure 2.Yokogawa UT350L controller.

Figure 3.Honeywell DC2500-CE-0A00 controller.

Figure 4.Honeywell DC2500-EE-0L00 controller.

set point (SP). If the temperature of the thermal fluid exceeds the preset limit (SP) the controller de-energizes the media high temperature relay, opening its contacts and shutting off the burner. The controller must be manually reset in order to restart the burner.

The controller cannot be reset until the temperature of the thermal fluid has decreased below the set point value.

The preset temperature limit (SP) should always be set to a value higher than the temperature modulating range of the burner. Otherwise, normal modulation of the burner may cause the burner to shut off prematurely.

Set the maximum limit to at least 50 degrees F above setpoint of the modulating controller.

Stack high temperature control

The stack high temperature controller shuts off the burner if the temperature of the gases exiting the exhaust stack exceeds a preset limit (set point). The controller senses the temperature of the gases from a thermocouple in the exhaust stack. It displays the actual temperature of the gases (process variable or PV) as well as the set point (SP).

If the temperature of the gases exceeds the preset limit (SP) the controller de-energizes the stack high temperature relay, opening its contacts and shutting off the burner. The controller must be manually reset in order to restart the burner.

The controller cannot be reset until the temperature of the exhaust gases has fallen below the set point value.

Setting up the controllers

To set up a new controller for Heatec heaters, make the settings shown on the printed sheets furnished with the heater. These sheets are packaged in a plastic bag and placed inside the control panel when the heater is shipped.

The controllers are normally set according to the these sheets before the heater is shipped. However, if a new controller is installed in the field, these settings must be made first.

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HEATEC TEC-NOTE

Publication No. 2-09-212, Revised 4-12-13

FIREYE® burner management controls
On Heatec thermal fluid heaters

This document applies to Fireye burner management controls used on Heatec thermal fluid heaters **(Fig. 1)**. The controls, known as BurnerLogix™, include three Fireye units located in the heater control panel **(Fig. 2)**:

1. Display Module BLV512
2. Burner control YB110 including Programmer Module YP100 or YP138
3. Annunciator YZ300 or YZ320

Burner management controls also include a flame scanner, which is installed in the burner housing. The display module is mounted on the face of the heater control panel. It is labeled **BURNER DISPLAY** **(Fig. 3)**. The burner control and annunciator **(Fig. 4)** are mounted inside the heater control panel. Fireye and BurnerLogix are trademarks of Fireye, a UTC Fire & Security Company.

Information in this document covers how the burner management controls work. This information should enable you to know when your heater is working properly. And it will help you to determine the cause if the heater is not working properly.

Figure 1. Typical helical coil heaters.

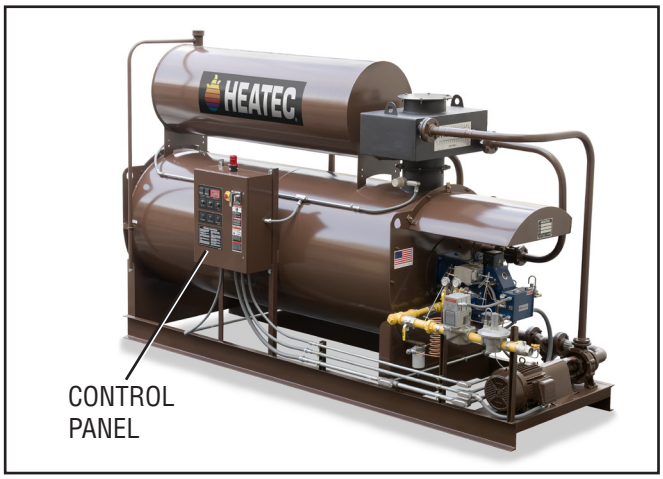

Figure 2. Typical control panel.

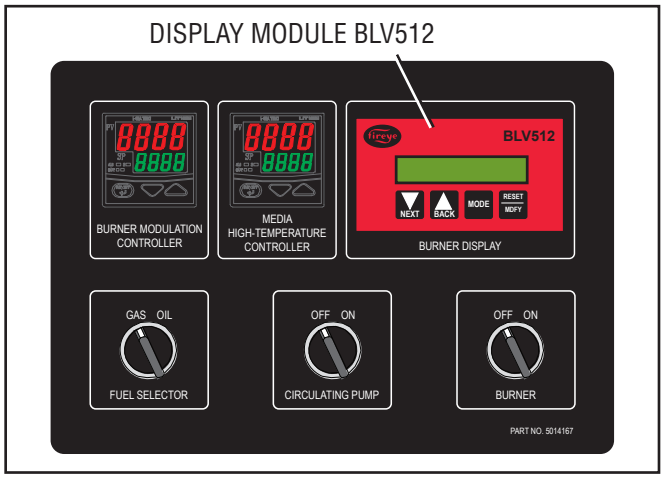

Figure 3. Fireye burner display unit on control panel.

Figure 4. Burner control (left) and annunciator (right).

The burner management controls provide important messages about the operating status of your heater. If you have an alarm condition with your heater, the message shown on the display is the *first* thing you should look at. If you phone a service technician at Heatec the first thing he will ask is, "what is the message shown on the display?"

SAFETY

Heatec helical coil heaters burn fuels that require safeguards to prevent accidental fires and explosions. Those safeguards are provided by the Fireye burner management controls operating in conjunction with other heater controls. **Never disable any control that has caused the heater to shut off or is preventing a restart.**

⚠ WARNING

If you ever need to replace the Fireye Programmer Module YP100 or YP138 on a Heatec heater always use one that was programmed at the Heatec factory. New modules obtained directly from Fireye or other suppliers may not be programmed to provide safe operation of Heatec heaters. Inappropriate programming could result in an explosion with serious injuries or death.

In order to comply with safety codes applicable to our heaters we re-program all new Fireye programmer modules that we use on our heaters. We lock the settings to ensure that they cannot be changed accidentally.

If a heater is operated using a new module with *unlocked* settings, those settings will be locked automatically after eight hours of operation. And once those settings are locked, they are permanent and cannot be changed.

To make sure that your programmer module has the appropriate Heatec settings, check all of its settings shown in the **Heatec settings** column of **Figure 5**. Heatec settings that differ from the Fireye factory default settings are shown in red. Heatec settings that are the same as Fireye factory default settings are marked **same as Fireye default.**

Please refer to Fireye Publication BL-1001 for instructions on use of the keypad to check factory default parameters. A printed copy of this document is furnished with Fireye BurnerLogix controls. It is also available as a pdf document from the Fireye web site at: http://www.fireye.net/pdf/BL-1001.pdf.

Heatec also programs the YZ300 and YZ320 module with messages pertaining to the 3–P interlock circuit. These messages identify the specific safety device that may have caused a lockout. A new module that was **not** programmed by Heatec will automatically display Fireye *default* messages. Some of the *default* messages do not apply to Heatec heaters and are misleading.

Figure 5. YP100 and YP138 Fireye factory settings vs Heatec factory settings.

Parameter	Fireye Factory Default	Heatec settings
Purge time	00:30s	**00:60s (see note below)**
Count method	DOWN	**Same as Fireye default**
Prove 3-P open at start	NO	**YES**
PTFI*MTFI timing	10/10*10/15 **(see note for YP138)**	**Same as Fireye default**
Terminal 6 interrupted or intermittent	INTRP	**Same as Fireye default**
Prove M-8 open	NO	**YES**
Prove M-D open	NO	**YES**
Post purge	0:15	**Same as Fireye default**
3-P Recycle	NO	**Same as Fireye default**
M-D WAIT 10m	YES	**Same as Fireye default**
PROVE M-D TFI	NO	**YES**
Baud rate	9600	**Same as Fireye default**
Unit address	00	**Same as Fireye default**
Lock Settings	NO	**YES**
DO IR LEARN	NO	**Same as Fireye default**

NOTE: Purge time may be 90 seconds or longer for some industrial heaters, depending on their size. Electrical drawings furnished with industrial heaters should specify the required purge time.

PTFI *MTFI timing for YP138 is 5/10*0/15 or as noted on electrical drawing.

WHAT FIREYE BURNER MANAGEMENT CONTROLS DO

The Fireye controls provide proper and safe operation of the burner. The burner control uses a microprocessor for its management functions. The processor provides the proper burner sequencing, ignition and flame monitoring protection.

The Fireye controls are affected by the *status* of the following heater components:

- Burner modulation controller
- Burner switch on heater control panel
- Fuel gas proof of closure switch ZSC 5-1 in main gas valve
- 3-P interlock or limit circuit
- Low-fire proof switch ZSL 4-1 in modulating actuator TZ 4-1
- High-fire proof switch ZSH 4-1 in modulating actuator TZ 4-1

The Fireye controls provide *control signals* to the following heater components:

- Honeywell modulating actuator TZ 4-1
- Ignition transformer IT 4-1
- Main fuel gas or oil shutoff valve
- Heater alarm strobe light
- Motor controller MC 4-1 (for blower motor)

3-P INTERLOCK CIRCUIT

The Fireye controls monitor the *overall* status of the 3-P interlock circuit. Moreover, the annunciator enables the unit to identify *individual* devices in the limit circuit. Consequently, if one of the devices in the 3-P interlock circuit is open, the Fireye display **(Fig. 3)** will show an abbreviated message that identifies which one of the interlock devices is open. (See **Figure 6** on last page.)

MENUS AND MESSAGES

The Fireye display has eight main menu items:

L1-3 OPEN
BNR HOURS
BNR CYCLES
BNR LOCKOUTS
SYS HOURS
PROGRAM SETUP
LOCKOUT HISTORY
SYSTEM INFO

The Fireye system shows up to 87 different messages related to the operating state of the heater. During a normal startup you will see run messages. You will also see a hold message during a normal startup while the damper travels to its open position. You should get familiar with what those messages mean. You need to know when those messages are displayed during the startup sequence. And you need to know what is happening to the heater as the messages are displayed.

Lockout messages, check messages, diagnostic messages and other hold messages appear only when there is an *abnormal* condition. After you understand all the events of a normal startup it will be much easier to understand messages displayed for various other conditions.

It is also possible for you to review historical messages on the Fireye display. Such information includes the total number of burner cycles, burner lockouts, and system hours.

FIRING SEQUENCE—A BRIEF SUMMARY

The firing sequence starts when the burner control is turned *on*. Consequently, the Fireye controls do the following:

1. Verify that the fuel gas proof of closure switch in the main gas valve is closed and turn on blower motor.
2. Verify that all heater interlock circuits are closed.
3. Open damper to the high-fire position.
4. Initiate a purge period allowing blower to clear heater combustion chamber. The purge period is typically 60 seconds, but may be longer for some heaters.
5. Close damper to its low-purge position.
6. Initiate *Pilot Trial For Ignition*. (This turns on the pilot gas and initiates ignition.)
7. Verify presence of pilot flame and initiate *Main Trial For Ignition* period of 10 seconds. (The main fuel valve opens at the start of this period.)
8. Verify presence of a flame with adequate signal strength.
9. Turn over control of the modulation motor to the modulating controller.

MESSAGES AND EVENTS DURING A NORMAL STARTUP

You can get a much clearer understanding of these messages by referring to the wiring diagram that is furnished with your heater.

When the door handle on the control panel is set to **ON**, electrical power is connected to terminals L1 and L2 on the Fireye burner control. And while the **BURNER** switch on the heater control panel is set to **OFF** the display will show:

STANDBY
BNR SWITCH OFF

Setting the **BURNER** switch to **ON** closes the circuit between terminals L1 and 3 of the burner control, causing the burner to start its firing sequence as follows:

1. If fuel-gas proof of closure switch ZSC 5-1 is closed (completing the circuit between terminals L1 and 13 on the burner control), terminal M of the burner control will be energized. This energizes motor controller MC 4-1, which powers the blower motor.

2. The Fireye controls will verify that all limit circuit devices connected in the circuit between terminals 3 and P (3-P) on the burner control are closed.

3. The circuit between terminals 10 and X on the burner control closes, causing Honeywell modulating motor TZ 4-1 to provide open damper purge. During the time it takes for the damper to reach its open position the display will show the following message and seconds of the timing starting at 0:60:

HOLD	**01:00**
M-8 LIMIT OPEN	

4. When the modulating motor reaches its open damper position, high fire proof switch ZSH 4-1 closes (completing the circuit between terminals M and 8 on the burner control) and a purge interval of 60 seconds is initiated. The display will show **PRE-PURGE** for 10 seconds and then change to the following message while continuing the count down:

PURGE	**0:50**
HIGH FIRE PURGE	

If high fire proof switch ZSH 4-1 does not close, the program will hold this position for 10 minutes waiting for it to close. If switch ZSH 4-1 is not closed after 10 minutes, the control will lockout, energizing terminal A on the burner control and setting off the heater alarms.

5. When purge is completed, the circuit between terminals 10 and 12 on the burner control closes, activating the modulating motor so it drives the damper toward the low purge position. The display will show the following message and seconds of the timing starting at 0:30 and counting down:

PURGE	**0:30**
LOW FIRE PURGE	

6. Following a 30-second delay (to permit the modulating motor to get to its low fire position), the program will wait for low-fire proof switch ZSL 4-1 to close the circuit between terminals M and D on the burner control. After the 30 second delay, the trial for ignition sequence will start. If the M to D circuit is not closed after 10 minutes, the program will lockout, energizing terminal A on the burner control and setting off the heater alarms.

7. The trial for ignition period begins when terminals 5 and 6 of the burner control are energized simultaneously. This is known as PTFI (*Pilot Trial For Ignition*). The monitor will show the following message and seconds of the timing starting at 0:10 and counting down:

PTFI	**0:10**
IGNITION TIMING	

The PTFI period is 10 seconds in duration. (The **IGNITION TIMING** message appears only for a moment.) If no flame is detected after 10 seconds, the program will de-energize terminals 5 and 6 of the burner control and will lockout, energizing terminal A on the burner control and setting off the heater alarms. When a flame is detected during the 10-second period, the display will show the following message with a numerical value indicating the strength of the flame signal:

PTFI	**20**
FLAME SIGNAL	

Flame signal values of 20 to 80 are normal. A value of 10 is the minimum acceptable. Values of 0 to 9 are not acceptable.

8. With flame proven at the end of PTFI, the main trial for ignition (MTFI) period begins. Terminal 7 on the burner control is energized. The display will show the following message with a numerical value indicating the strength of the flame signal:

MTFI	**20**
FLAME SIGNAL	

Terminal 5 on the burner control is de-energized 10 seconds later and terminal 6 is de-energized after another 5 seconds.

9. Next, the circuit between terminals 10 and 11 of the burner control is energized, sending the modulating motor to the auto mode under the control of the modulating controller. The display will show the following message with a numerical value indicating the strength of the flame signal:

AUTO	**20**
FLAME SIGNAL	

WHEN HEAT DEMAND IS SATISFIED

1. The circuit between terminals L1 and 3 on the burner control opens, de-energizing the main fuel valve. The circuit between terminals 10 and 12 on the burner control closes, activating Honeywell modulating motor TZ4-1 so it drives the damper toward the low purge position.

2. Following a 15-second post purge, the burner blower motor is de-energized. The display will show the following message and seconds of the timing starting at 0:15 and counting down:

POST PURGE 0:15 **CYCLE COMPLETE**

3. The burner is now off and the Fireye display will show:

STANDBY **BNR TEMP OFF**

MANUAL SHUTDOWN

When the burner control switch is set to **OFF** the burner control will initiate the same events as when the heat demand is satisfied as described above.

HOLD MESSAGES

All hold messages except one indicate an *abnormal* condition. The most common hold messages are as follows:

HOLD **3-P INTLK CLOSED**

This is an abnormal condition. All devices in the 3-P interlock circuit were closed at the start of the firing cycle. The burner control will hold this position for 60 seconds and then lockout if the 3-P circuit does not open. The timing is shown in upper right-hand corner of display.

Note: low combustion air pressure switch PSL 4-1 is in the 3-P interlock circuit and should remain open at all times except when the blower is operating. It should close and remain closed only when operation of the blower generates an adequate flow of combustion air. Otherwise, the switch may be defective. (All other devices in the interlock circuit should be closed at the start of the firing cycle.)

HOLD 01:00 **M-8 LIMIT OPEN**

This is a normal condition that occurs during a startup. It indicates that the circuit between terminals 10 and X of the burner control has closed, causing the modulating motor to drive the damper toward high purge. The burner control is waiting for the high fire proof switch ZSH 4-1 to close.

(Switch ZSH 4-1 is in the modulating motor and connects the circuit between terminals M and 8 of the burner control.) It will hold this position for 10 minutes and lockout if the switch does not close. The timing is shown in upper right-hand corner of display.

HOLD **M-8 LIMIT CLOSED**

This is an abnormal condition. High fire proof switch ZSH 4-1 was closed during the start of the firing cycle, but it should have been open. (This switch is in the modulating motor and connects the circuit between terminals M and 8 of the burner control.) The burner control will hold this position for 30 seconds and lockout if the M-8 circuit does not open. The timing is shown in upper right-hand corner of display. The usual problem is in the operation of the mod motor. Check all terminal connections first.

HOLD 00:00 **M-D LIMIT CLOSED**

This is an abnormal condition. Low fire proof switch ZSL 4-1 was closed at the end of the high-fire purge and beginning of low fire start, but it should have been open. (This switch is in the modulating motor and connects the circuit between terminals M and D of the burner control.) The burner control will hold this position for 30 seconds and lockout if the M-D circuit does not open. The timing is shown in upper right-hand corner of display. The usual solution is to re-adjust the cams for the low-fire switch in the modulating motor.

HOLD 00:00 **M-D LIMIT OPEN**

This is an abnormal condition. The burner control has finished purge and the modulating motor is driving the damper to the low-fire position and waiting for low fire proof switch ZSL 4-1 to close. (This switch is in the modulating motor and connects the circuit between terminals M and D of the Fireye unit.) The burner control will hold this position for 10 minutes and lockout if the M to D circuit does not close. The timing is shown in upper right-hand corner of display. The usual problem is in the operation of the mod motor. Check all terminal connections first.

STANDBY 25 **FALSE FLAME**

This is an abnormal condition. The Fireye flame scanner has sensed a flame while the burner was off or during purge. This message will hold for 60 seconds and then lockout if the scanner continues to sense a flame. A number in the upper right-hand corner of the display indicates flame strength.

If a flame or fire actually exists in the heater while burner controls are off, the cause may be a fuel valve that is malfunctioning and stuck open.

If a flame or fire is not actually present in the heater, but the message on the Fireye display indicates a false flame, the flame scanner is most likely defective.

It is entirely possible for sunlight shining directly into the sight glass of the heater to cause a false flame condition. However, this is rare and unusual.

LOCKOUT MESSAGES

All lockout messages indicate an abnormal condition. The most common lockout messages are as follows:

LOCKOUT STANDBY
3-P INTLK CLOSED

At the start of the firing cycle, the 3-P interlock circuit was closed and the control has waited 60 seconds for the 3-P circuit to open.

LOCKOUT PRE-PURGE
M-8 LIMIT OPEN

The control has held for more than 10 minutes waiting for high fire proof switch ZSH 4-1 connected between terminals M and 8 of the burner control to close.

LOCKOUT PRE-PURGE
M-8 LIMIT CLOSED

At the start of the firing cycle the circuit between terminals M and 8 of the burner control has been closed for 30 seconds.

LOCKOUT PURGE
M-D LIMIT CLOSED

At the end of high purge or at the beginning of low fire start the circuit between terminals M and D of the burner control has been closed for 30 seconds.

LOCKOUT STANDBY
T13 FVES OPEN

These letters stand for *fuel valve end switch*. This message means that the fuel gas proof of closure switch ZS 5-1 in the circuit between terminals L1 and 13 of the burner control opened during purge or at start up.

LOCKOUT PURGE
M-D LIMIT OPEN

The burner control has held for more than 10 minutes waiting for low fire proof switch ZL 4-1 connected between terminals M and D of the burner control to close.

LOCKOUT STANDBY
FALSE FLAME

Flame has been sensed during the burner off time (when the circuit between terminals L1 and 3 of the burner control is open) or during the purge period of 60 seconds.

LOCKOUT PTFI
FLAME FAIL

A flame failure occurred during the pilot trial for ignition period.

LOCKOUT MTFI
FLAME FAIL

A flame failure occurred during the main trial for ignition period.

LOCKOUT AUTO
FLAME FAIL

A flame failure occurred during the main burner on period.

3-P LOCKOUT MESSAGES

Fireye Annunciator YZ300 provides precise text messages that denote the status of the limit interlock devices in the 3-P circuit. Thus, if one of the limit devices in the 3-P limit circuit opens, a message will appear on Display Module BLV512. That message identifies which device in the 3-P limit circuit opened to lockout the burner circuit and cause the shutdown. Note: some of the interlocks are not single devices, but consist of multiple components.

There are three periods during *start up* of the burner when an abnormal condition could cause a limit device to open. This would cause one of the abbreviated messages shown in **Figure 6** to appear on the bottom line of the display.

LOCKOUT PRE-PURGE
(See messages in Figure 6)

Interlock circuit 3-P has opened during the purge period or failed to close within the first 10 seconds of purge.

LOCKOUT PTFI
(See messages in Figure 6)

Interlock circuit 3-P has opened during the pilot trial for ignition period.

LOCKOUT MTFI
(See messages in Figure 6)

Interlock circuit 3-P has opened during the main trial for ignition period.

During the burner *run* cycle one of the messages shown in Figure 6 would appear if one of the limit devices opened.

LOCKOUT AUTO
(See messages in Figure 6)

Interlock circuit 3-P has opened during the main burner on period.

Figure 6. Messages that identify 3-P interlock devices.

Message	Meaning
LO MEDIA LEVEL	Low media level relay contacts
LO GAS PRES	Low fuel gas pressure switch*
HI GAS PRES	High fuel gas pressure switch*
FUEL PUMP AUX CT	Fuel pump auxiliary contacts
HTR LO FUEL PRES	Low fuel oil pressure switch
HI MEDIA TEMP	High media temperature relay
HI STACK TEMP	High flue gas stack temperature switch
CIRC PUMP AUX CT	Circulating pump auxiliary contacts
LO MEDIA DP	Low media differential pressure switch
HI MEDIA DP	High media differential pressure switch
AIR AUX CT	Combustion air auxiliary contacts
LO AIR PRES	Low combustion air switch

*On some heaters fuel gas pressure switches (or contacts) are not used. A jumper is used instead. In such cases, the Fireye burner control will never show this switch (or contacts) as the cause of a shutdown.

Some heaters have interlock devices in addition to those listed here. These are devices that have been added per customer request. Although their messages are not shown here, a message for each device will show on the display and indicate its function.

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HEATEC TEC-NOTE

Publication No. 7-11-246

Setting differential pressure switches
on Heatec thermal fluid heaters—industrial series

WHAT THIS DOCUMENT COVERS

This document covers setting DP (differential pressure) switches used on Heatec heaters to prevent overheating their helical coils. This document applies only to switches on the following types of heaters:

1. HCI series heaters with helical coils.
2. Heaters that heat thermal fluid (not gas).
3. Heaters that use the switches to sense differential pressure across the helical coil (not an orifice plate).
4. Heaters that shut off the burner if differential pressure is too *low*.
5. Heaters that shut off the burner if differential pressure is too *high*.

SWITCHES USED

HCI heaters covered by this document use a variety of DP switches from a variety of manufacturers (Fig 1). Some heaters use a single DP switch that only detects low differential pressure. Other heaters use a dual switch so that one switch detects low differential pressure and the other detects high differential pressure. Some heaters use two separate switches, so that one switch detects low differential pressure and the other detects high differential pressure. The variations depend mainly on customer preferences and application.

HOW THE SWITCHES PREVENT OVERHEATING

Each DP switch is wired into a limit circuit that shuts off the burner if an abnormal differential pressure is encountered. The switch opens the circuit and shuts down the burner when differential pressure is lower or higher than the set point at which a particular switch is set.

HOW DIFFERENTIAL PRESSURE RELATES TO OVERHEATING

Differential pressure is related to the flow rate of thermal fluid through the coil. And flow rate is related to coil overheating. Therefore, differential pressure is used to monitor flow rate and prevent overheating. Accordingly, each heater has a *predetermined* range of differential pressures *suitable* for normal operation. Differential pressures either lower or higher than that range must be avoided to prevent overheating.

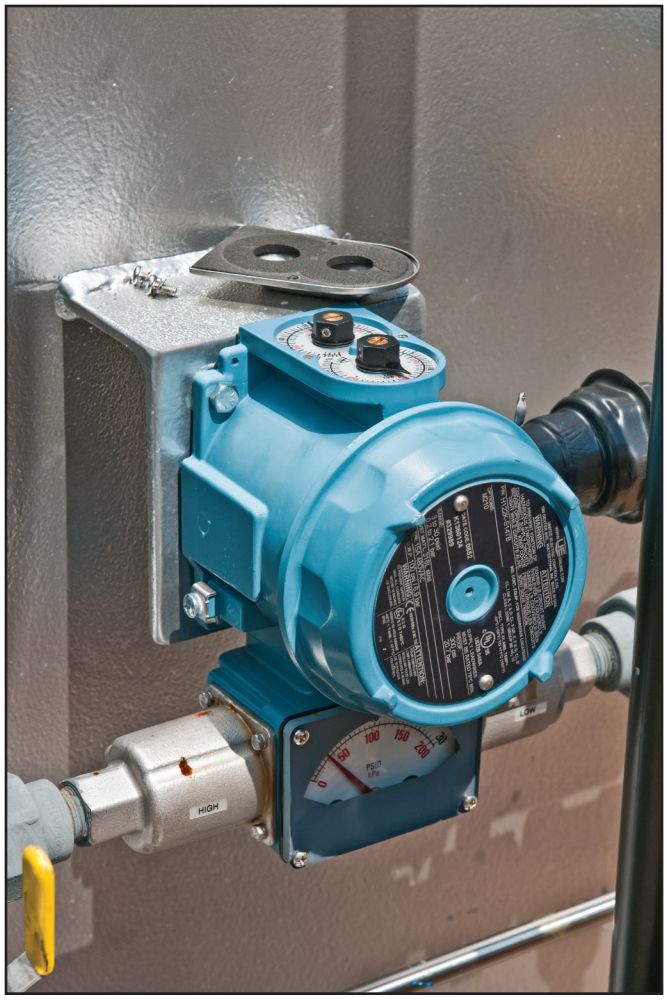
THE PERILS OF OVERHEATING

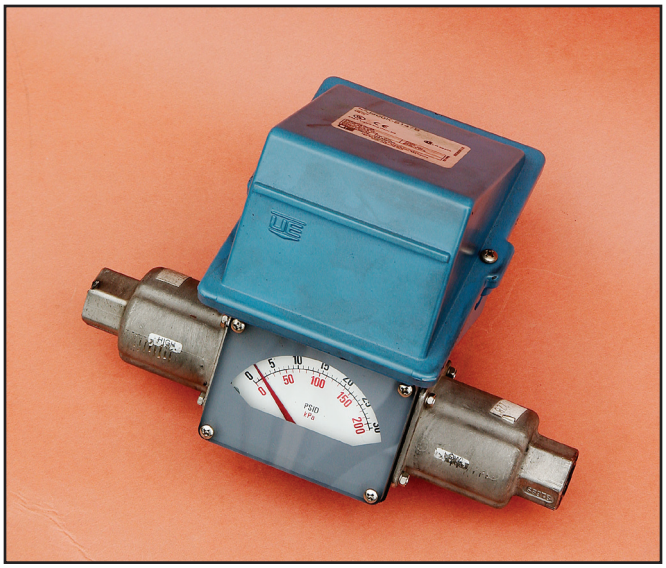
Overheating the coil can have serious consequences. The importance of a suitable flow rate cannot be overstated.

⚠ WARNING

Do not operate the heater at differential pressures other than those recommended by Heatec. Insufficient flow rates cause overheating. Overheating could cause the coil to crack or rupture, allowing thermal fluid to enter the combustion chamber of the heater and cause an uncontrolled fire. The fire could cause death, serious injuries and/or property damage.

Overheating will also cause the thermal fluid to breakdown, which causes the fluid to coke and deposit residues inside the coil. Residues can build up and clog the coil thereby reducing heat transfer and leading to even further damage. Moreover, the fluid will probably have to be replaced (at a considerable cost).





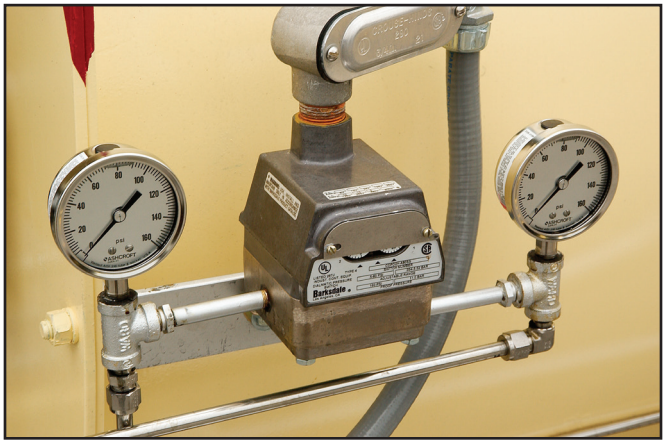


Figure 1. Some of the various DP switches used on Heatec HCI heaters.

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CAUSES OF ABNORMAL FLOW

If your heater operates normally when its DP switches are set as recommended, its flow rate is high enough to prevent overheating the coil. However, if the DP switch shuts down your heater when set as recommended, flow may be too low and you need to find the cause **(See Figure 2)**.

Possible causes of abnormally *low* differential pressure:

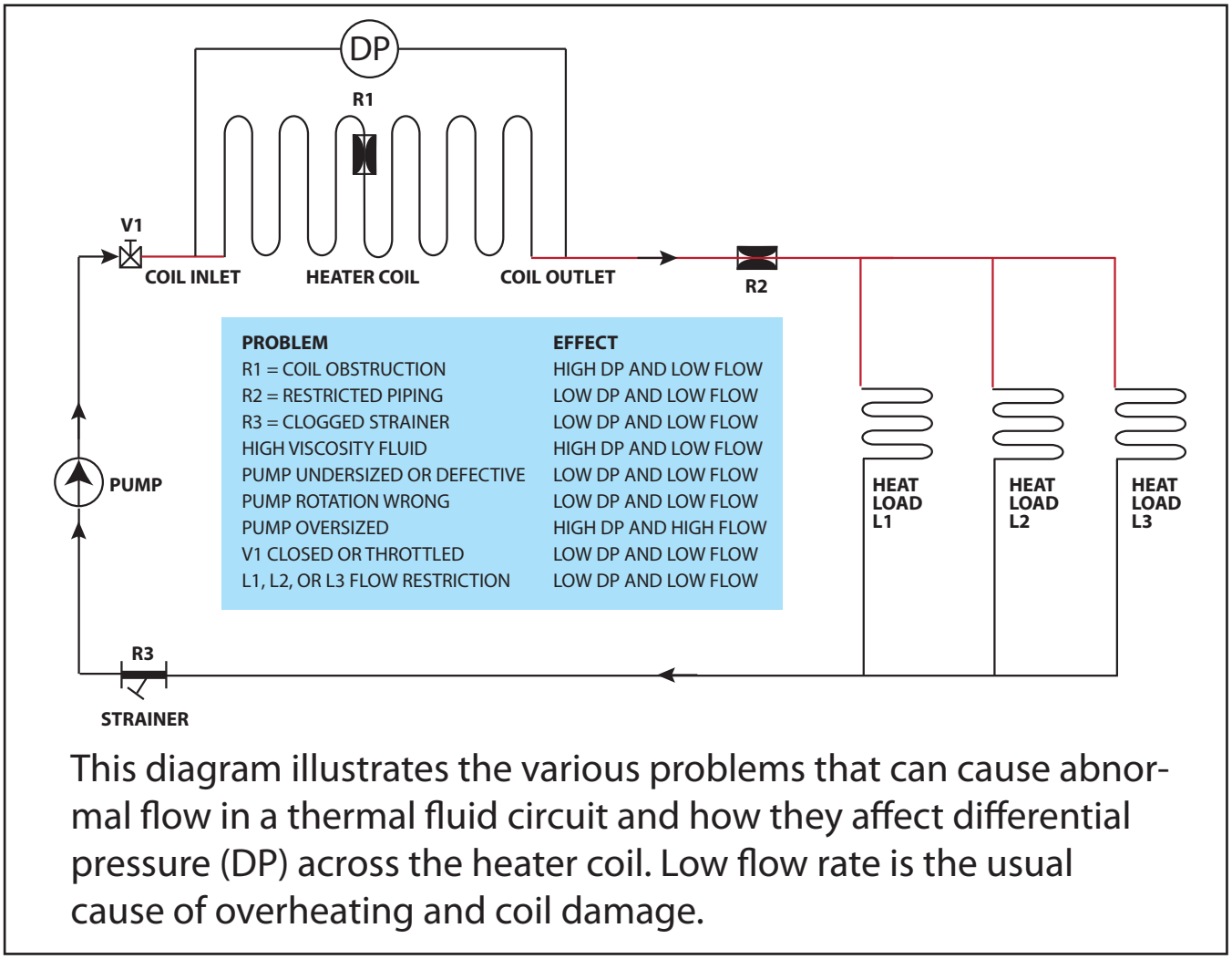
- Clogged pump strainer.
- Improper settings of one or more valves in the piping circuit.
- Excessive resistance to flow in the system being heated.
- Pump is either undersized or defective.
- Pump rotation is wrong.

Abnormally *high* differential pressure is another condition that may be encountered, but is less apt to cause overheating than *low* differential pressure. **NOTE: A low DP switch will *not* shut down the heater due to abnormally high differential pressure.**

Possible causes of abnormally *high* differential pressure are:

- Clogged helical coil (unlikely).
- Oversized pump.
- Viscosity of thermal fluid is too high.

NOTE: When the thermal fluid in the system is cold its viscosity is higher than when it is hot. Abnormally high viscosity can cause abnormally high differential pressure. But the viscosity of the fluid will decrease after it heats up and the differential pressure should return to normal.



This diagram illustrates the various problems that can cause abnormal flow in a thermal fluid circuit and how they affect differential pressure (DP) across the heater coil. Low flow rate is the usual cause of overheating and coil damage.

Figure 2. Effects of various problems on differential pressure.

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HOW THE SWITCH WORKS

This discussion pertains to the switch shown in Figure 3, which only detects *low* differential pressure. Other switches work in a similar way. One side of the switch is piped to a connection at the *inlet* of the helical coil and senses the pressure of the thermal fluid at that point. The other side of the switch is piped to a connection at the *outlet* of the coil and senses the pressure at that point. The difference in the two pressures is the *differential pressure*. Differential pressure is an operating condition and is known as *DP process variable.*

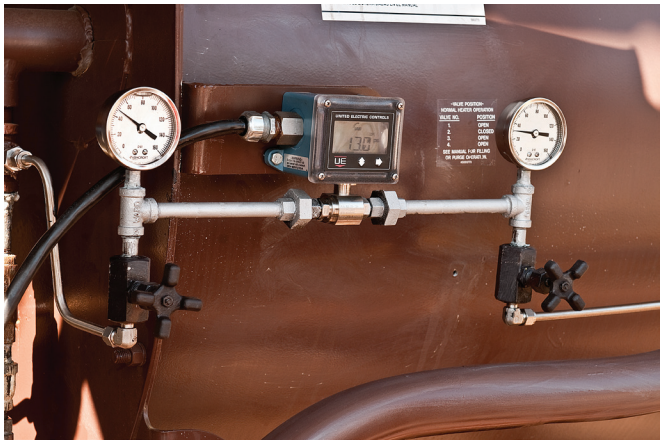

Figure 3. This DP switch only detects low differential pressure

Note the two gauges shown in **Figure 3**. The one on the left indicates actual pressure at the coil *inlet*. The one on the right indicates pressure at its *outlet*. The difference in values of these two indications is the differential pressure, which is what the display on the switch shows. Incidentally, if the pressure at the coil *inlet* is the same as the pressure at the coil *outlet*, the display would indicate 0 (zero) differential pressure.

The switch shown in Figure 3 also has a *DP set point* that must be manually set to the recommended value. The switch is closed while the DP process variable is higher than its set point. It will open and shut off the burner if operating conditions cause the DP process variable to go lower than the DP set point. But it will reset automatically when the DP pressure goes higher than its set point. However, the burner will have to be restarted manually after it is shut off by the DP switch.

The switch also has a setting known as DB or *deadband*. Deadband affects resetting the DP switch after it has opened because of low differential pressure. Its setting governs how much the differential pressure must exceed the set point to reset the switch.

Consider a switch with a set point of 10 psid and a deadband of 01.0 psid. If that switch opened because the differential pressure dropped to 10 psid or lower, the differential pressure would have to reach 11 psid to reset the switch. Or if the deadband was set to 05.0 psid, the pressure would have to reach 15 psid to reset the switch.

Increasing the deadband is sometimes necessary to prevent the switch from frequently recycling on and off. But this is only needed in systems where the normal differential pressures remain close to set point. We recommend a deadband setting of 01.0, which should be adequate for most Heatec heaters.

CHECKING SWITCH SETTINGS

Heatec HCI heaters are used in a wide variety of operating conditions, and must be customized for each application. Consequently, DP set points for their DP switches must be calculated for each heater based on customer input.

Recommended settings for their DP switches are usually shown on P&ID drawings furnished with the heater.

If P&ID drawings showing the DP set points are not available, call the Engineering Department at Heatec to obtain the recommended settings.

If actual operating conditions are different from those expected, the heater may not run when recommended settings are used. Or it might run, but without adequate flow protection. In either case call to obtain new settings.

You will need to follow the instructions provided by the switch manufacturer when setting the switches. If you do not have the switch instructions furnished with the heater you can obtain a copy from the web site of switch manufacturer.

If the switch is made by United Electric, go to **http://www.ueonline.com/support/m_support.htm**. The tech support phone number at United Electric is 617-923-6977.

NOTE: The switch manufacturer can help you understand how to operate the switch, but cannot tell you what settings to use. The settings need to come from Heatec.

WHAT TO DO IF THE DP SWITCH SHUTS THE HEATER DOWN

In some instances the recommended settings for the DP switch may prevent the burner from operating. This usually indicates that flow through the coil is not adequate. Make sure the problem is not low flow as a result of one of the causes mentioned earlier and illustrated in **Figure 2**.

You should not arbitrarily change the recommended settings of the switch in order to make the heater operate. Contact Heatec engineering so a qualified engineer can review design parameters for the heater and recommend a suitable remedy.

In some cases the thermal fluid piping system must be modified to achieve the minimum recommended flow through the heater coil. In other cases new settings for the DP switch may be possible without jeopardizing coil protection.

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HEATEC TEC-NOTE

Publication No. 6-04-128, Revised 9-09

Thermal fluid—when should you replace it?

If you are using a thermal fluid heating system, do you know when to replace its thermal fluid?

The fluid should be analyzed at least once a year. For plants that operate on a seasonal basis, an ideal time is at the end of the operating season, before the heating system is shut down.

Your thermal fluid supplier may offer fluid analysis as a service. Check to see if they have collection kits like this one available.

The analysis should be done by a specialist experienced and properly equipped to analyze chemical properties of the fluid. Fluid suppliers may do a free analysis for you. Or you may need to have an independent laboratory to do the analysis.

The sample should be taken while the heat is shut off and the fluid has cooled down somewhat, but while the system is circulating the fluid.

Take sample while heat is shut off and fluid has cooled, but while the system is circulating fluid.

Although you *cannot* reliably tell if the fluid is okay by visually inspecting it, you may be able to detect problems. So, every time you inspect the strainer on the heater, be sure to watch for signs of problems with the thermal fluid. (You should inspect the strainer once a month and clean it if it is dirty.) If the appearance of the fluid shows signs of a problem, you should have the fluid analyzed. Watch for the following signs:

- Flakes of carbon
- Foam or milky appearance
- Presence of asphalt that may have leaked into the fluid
- Unusual thickening of the fluid

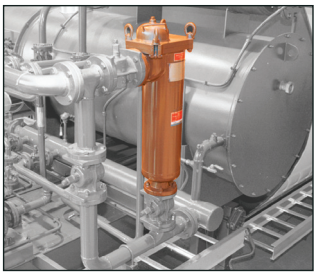
New thermal fluid.

Old thermal fluid with bad signs.

Remember, these may be early signs of a problem that could become more serious if allowed to continue. It is almost always better to correct problems at their early stages.

When you replace old thermal fluid with new fluid, the new fluid will loosen carbon and other debris left in the system by the old fluid. This debris will flow through your thermal fluid piping and rapidly begin to clog the strainer. Debris can bypass a clogged strainer and enter the circulating pump, causing unnecessary wear and damage.

A very effective solution to this problem is to install a sock filter in the heater's thermal fluid piping. The sock filter acts as a secondary filter to the strainer. The extra protection is worthwhile. It not only protects the circulating pump, it greatly helps to keep the new fluid clean.



Sock filter (in color) and bypass valves installed in the thermal fluid piping of a heater.

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HEATEC TEC-NOTE

Publication No. 6-04-129, Revised 8-8-11

Thermal fluid—prolonging its life

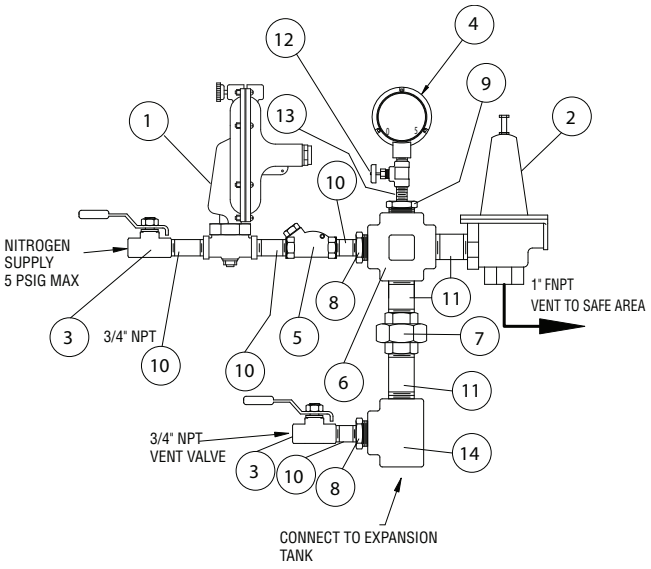
If you are using a thermal fluid heating system you can prolong the life of its thermal fluid by using nitrogen to minimize oxidation.

Oxidation occurs when heated thermal fluid contacts air in the expansion tank of your heater. Oxidation causes rapid deterioration of thermal fluid heated to over 300 degrees F as required in many applications. Oxidation also produces sludge. Sludge can build up in your system, reducing heating performance and leading to costly cleanouts.

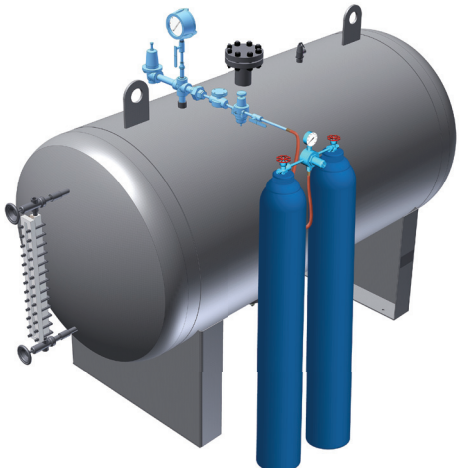
You can greatly minimize oxidation by replacing the air in the expansion tank with a "blanket" of nitrogen. To do so, you need to connect a regulated supply of nitrogen to a vented line in the expansion tank. The nitrogen supply should not exceed pressures higher than specified for the tank:

- On HC and HCS heaters, set the regulated nitrogen supply at 1 psi and set back-pressure relief valve at 2 psi. Also use these setings on HCI heaters that have low pressure (non-code) expansion tanks.
- On HCI heaters with ASME code tanks stamped for 50 psi @ –20 to +650 degrees F, set the regulated supply to 20 psi and the relief valve to 30 psi. For code tanks with other ratings, set the pressures as indicated on the applicable P&ID drawing.

Heatec offers a preassembled nitrogen system for maintaining a nitrogen blanket at appropriate pressure. The system includes the components illustrated at left. It is designed to accept a regulated nitrogen bottle supplied by the customer.



1	Secondary nitrogen pressure regulator	8	Bushing
2	Back pressure relief valve	9	Bushing
3	Ball valve	10	Pipe nipple
4	Pressure gauge	11	Pipe nipple
5	Check valve	12	Gauge valve
6	1" cross	13	Pipe nipple
7	1" union	14	1" Tee



Pre-assembled nitrogen system installed on expansion tank. Note that the nitrogen bottles have their own pressure regulator, in addition to the secondary pressure regulator on the nitrogen blanket system. These regulators are among several safeguards to ensure that pressure in the expansion tank never exceeds recommended settings.

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HEATEC TEC-NOTE

Publication No. 8-11-249

Operation and maintenance

Heatec thermal fluid heaters—industrial series

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Figure 1. Two Heatec horizontal helical coil heaters. One has an output of 60 million Btu/hour. The other has an output of 0.7 million Btu/hour.

IMPOPRTANT NOTICE!

We strongly recommend that you arrange for an experienced field technician from our service department to commission your heater. He will also instruct your operators in the safe operation of your heater.

Figure 2 . Heatec vertical helical coil heater. The burner is on its bottom and is up-fired.

Figure 3. Heatec 3-pass vertical heater. Its burner is on its top and is down-fired.

Intended users

Information in this document is intended for use by plant personnel responsible for operation and maintenance of your new Heatec heater.

Scope

This Tec-Note outlines the tasks that must be performed for initial startup (commissioning) of your Heatec helical coil heater. It also covers routine operation, maintenance and troubleshooting. It applies to Heatec industrial series of heaters that heat thermal fluid.

We make these heaters in various configurations and sizes according to customer specifications and preferences. **(See Figures 1, 2, and 3.)** Consequently, most have significant differences in components, differences in piping systems and differences in their use.

Because of these differences, some information in this document omits details on how to perform the tasks. Moreover, the figures shown are for a typical heater and may differ significantly from your particular unit. But despite differences, information herein gives a preview of what commissioning entails and serves as a guide for the tasks covered. Our field technician will thoroughly cover the details of your particular heater when he commissions it.

Interchangeable terms

The terms ***media***, ***thermal fluid*** and ***hot oil*** are used interchangeably. All three refer to the same thing.

Prior to initial startup

Please read the safety information shown in Heatec Tec-Note 7-04-141. It is the first Tec-Note in this manual.

The following tasks should be done prior to initial startup and prior to arrival of the person who will commission your heater:

- The incoming gas supply line pressure should match the pressure shown on the P&ID drawing furnished with the heater.
- The heater should be properly installed, piped, and wired.
- The control panel should be checked for proper supply voltage and for proper control voltage.
- The equipment that is to be heated by thermal fluid should be fully piped and leak-tested.
- The thermal fluid circuit should be filled with thermal fluid.
- Thermal fluid strainers should be cleaned after the system is filled.

Preliminary tasks:

When a Heatec technician commissions your heater, he will perform the following tasks before initial startup of your heater:

1. Make sure the valves for differential pressure switch(es) are open.
2. Make sure that sight gauge valves are open.
3. Turn on all breakers inside the control panel.
4. Lockout electrical power at the control panel and check thermal fluid pumps for proper alignment and free rotation of their shafts.
5. Restore power to the control panel and purge air from thermal fluid pumps.
6. Check all devices in the 3-P limit circuit.
7. Set up the temperature controllers on the control panel with their appropriate settings. Initial settings for purging water from the system are as follows: Set point of modulating controller is 230 degrees F. Set point of high media temperature controller is 280 degrees F.

Purging water from the system

The Heatec technician will purge water from your thermal fluid system as part of the commissioning operation. This task requires firing the burner and heating the thermal fluid.

Note: The burner on your heater must be tuned after the heater is installed at your facility for local altitude conditions. The Heatec technician that commissions your heater will do that.

If you do not plan to have a Heatec technician to commission your heater, you should have a qualified burner technician to perform the initial startup of the burner and tune it for the local altitude conditions.

Purging the system can take from two hours to two days or longer, depending on the amount of thermal fluid in the system and the amount of water in the thermal fluid.

Purging water from the thermal fluid system involves venting the expansion tank to atmosphere and boiling out the water entrained in the thermal fluid.

This is done using the modulation controller to gradually raise the temperature of the thermal fluid from 230 degrees F to about 20 degrees above operating setpoint (PV) in increments of 10 degrees. The high media temperature controller must also be reset about 50 degrees higher than the modulation controller each time the modulation controller is reset.

Before purging, valves must be set to circulate the thermal fluid through the expansion tank as it circulates through the system. After purging, the temperature controllers and valves must be reset for normal operation.

Routine operation

After your heater has been commissioned, your operators can take over its routine operation, maintenance and troubleshooting. Instructions for those tasks are included in the remainder of this document.

Starting and shutting down the heater (Fig. 9)

1. To start the heater, turn on the thermal fluid pump and the burner.
2. To shut down the heater, turn off the burner and the thermal fluid pump.

Cleaning strainers (F, Fig. 7)

1. Shutdown the heater.
2. Allow the heater and its thermal fluid to cool down.

!WARNING

Wear appropriate protective gloves and clothing suitable for handling liquids with temperatures of 350 degrees F or more. Contact with hot thermal fluid can cause severe burns. Handle it with extreme care to avoid contact or spills.

3. Set all valves to mode for **Clean Strainer** (**Fig. 4**).
4. Place a bucket or other container (with a capacity of at least 5 gallons) under each strainer drain.
5. Open drain valves to drain thermal fluid from the strainers. Do not re-use this fluid. Dispose of it according to applicable codes.
6. Unbolt the square flange from the bottom of the strainer. Remove the flange, allowing the strainer basket to slide out.
7. Clean the strainer basket.
8. Re-install the strainer basket.
9. Close drain valves.
10. Set valves to mode for **RUN** as indicated in **Figure 4**.

Lubrication

All Heatec heaters have components that require periodic lubrication. **Figure 5** lists the components and the recommended lubricants.

Maintenance schedule

The next page of this document provides a list of items that should be checked periodically to ensure safe, troublefree operation of your Heatec heater.

Figure 4. Valve settings for operating modes.

Operating mode	Valves in heater thermal fluid piping				
	Purge Block Valve A, Fig. 7	Inlet Valves E, Fig. 7	Purge Valve B, Fig. 7	Expansion Valve D, Fig. 7	Discharge Valves K, Fig. 7
Run	Open	Open	Closed	Open	Open
Purge	Closed	Open	Open	Open	Open
Clean Strainer	Open	Closed	Closed	Open	Closed

Figure 5. Lubrication requirements.

See Fig. 7	Name	Lubricant	Frequency
(all valves)	Valves with grease fittings	High temp lithium grease	monthly
H	Thermal fluid pumps	High temp lithium grease	2800 hrs operation
I	Thermal fluid pump motors	High temp lithium grease	3 months
(NOT SHOWN)	Modulating actuator linkage joints	General purpose oil	monthly

MAINTENANCE SCHEDULE

Heatec heaters should be checked periodically according to the requirements below. **Failure to properly maintain your heater could result in a fire or explosion.**

REQUIREMENT	WEEKLY	MONTHLY	QUARTERLY	YEARLY
Check for proper level of thermal fluid. Sight gauge on expansion tank should show at least 3 inches.	X			
Clean ultraviolet flame detector lens.	X			
Check intake area of blower to make sure it is not blocked by foreign material and is free from buildup of dirt.	X			
Check flame to ensure burner shows no symptoms of being in need of tuning.		X		
During normal operation check all pressure gauges and thermometers on heater for normal values.		X		
Check all operating and limit controls and settings to make sure they are set properly and are working properly.		X		
Check strainers to ensure they are not dirty.		X		
Check heater and piping to ensure there are no leaks of thermal fluid.		X		
Check heater to ensure there is no structural damage to heater shell, end plates, etc. or signs of over heating.		X		
Check pilot assembly to make sure spark gap is 1/8 to 3/16 inch.			X	
Check burner control linkage to make sure it is not binding or loose.		X		
Have exhaust stack gases analyzed and have burner tuned by a specialist				X
Have thermal fluid analyzed to ensure it is not degraded.				X
Lubricate heater components, including linkage, valves, motors, pumps. (Lubricate monthly or as recommended by the manufacturer.)		X		
Check fuel gas strainer **(Y, Fig. 8)** to ensure it is not dirty.		X		

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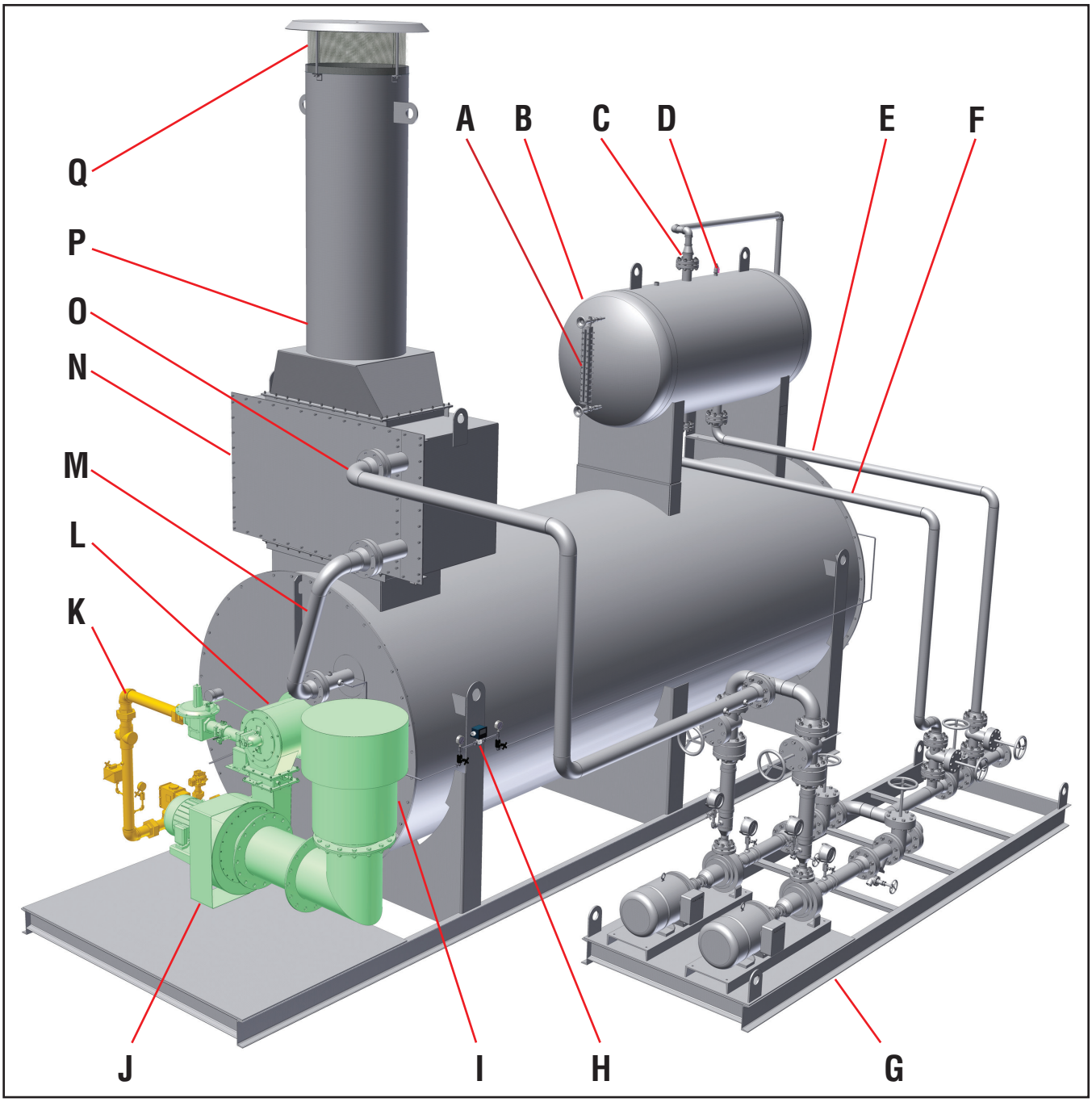
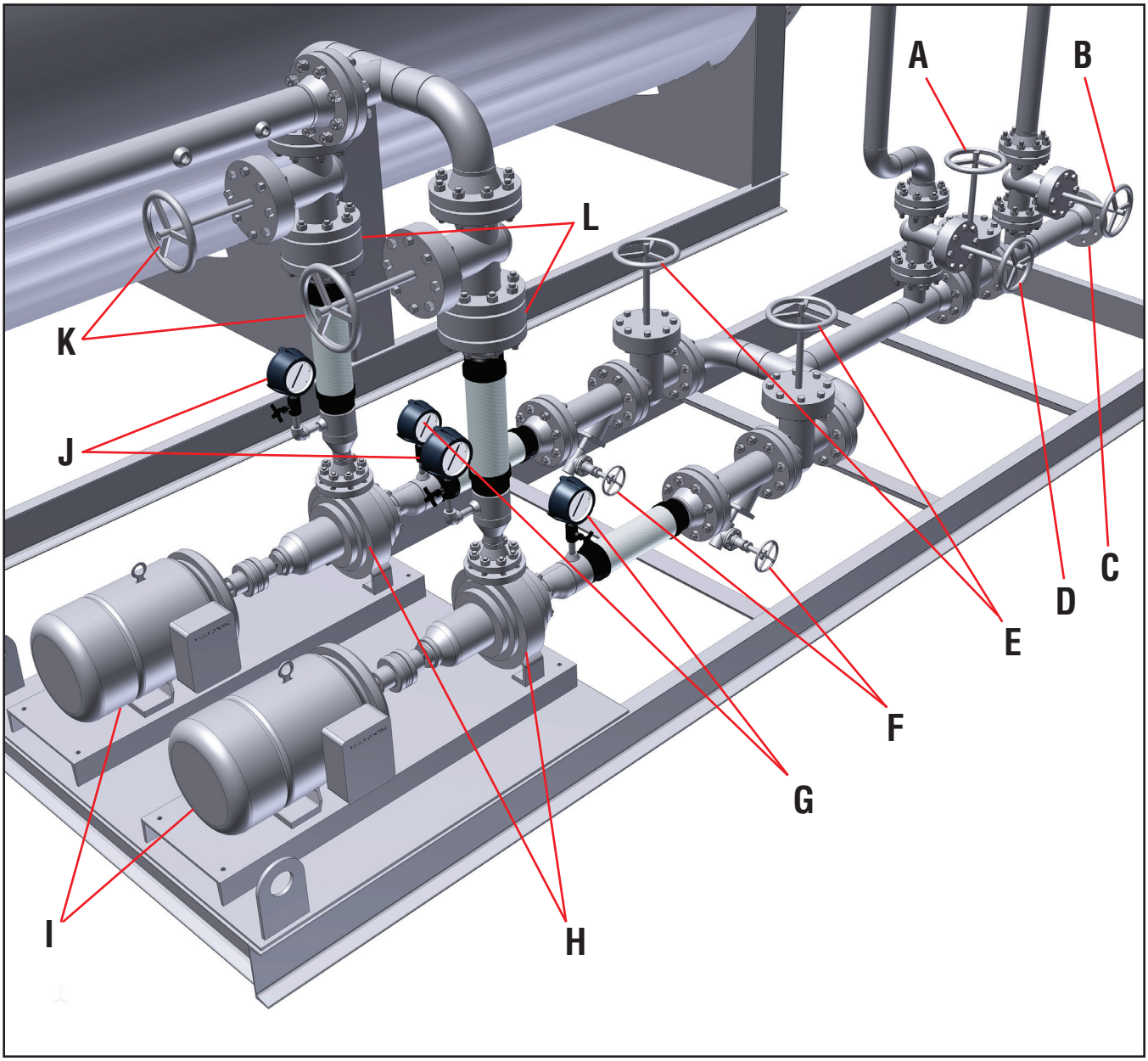


A. Level gauge
B. Expansion tank
C. Vent/fill connection
D. Nitrogen connection
E. Purge line
F. Expansion line
G. Pump skid (see Figure 7)
H. Differential pressure switch
I. Combustion air filter/silencer
J. Combustion air blower
K. Fuel train (see Figure 8)
L. Burner
M. Economizer thermal fluid outlet
N. Economizer
O. Economizer thermal fluid inlet
P. Exhaust stack
Q. Screen and rain cap

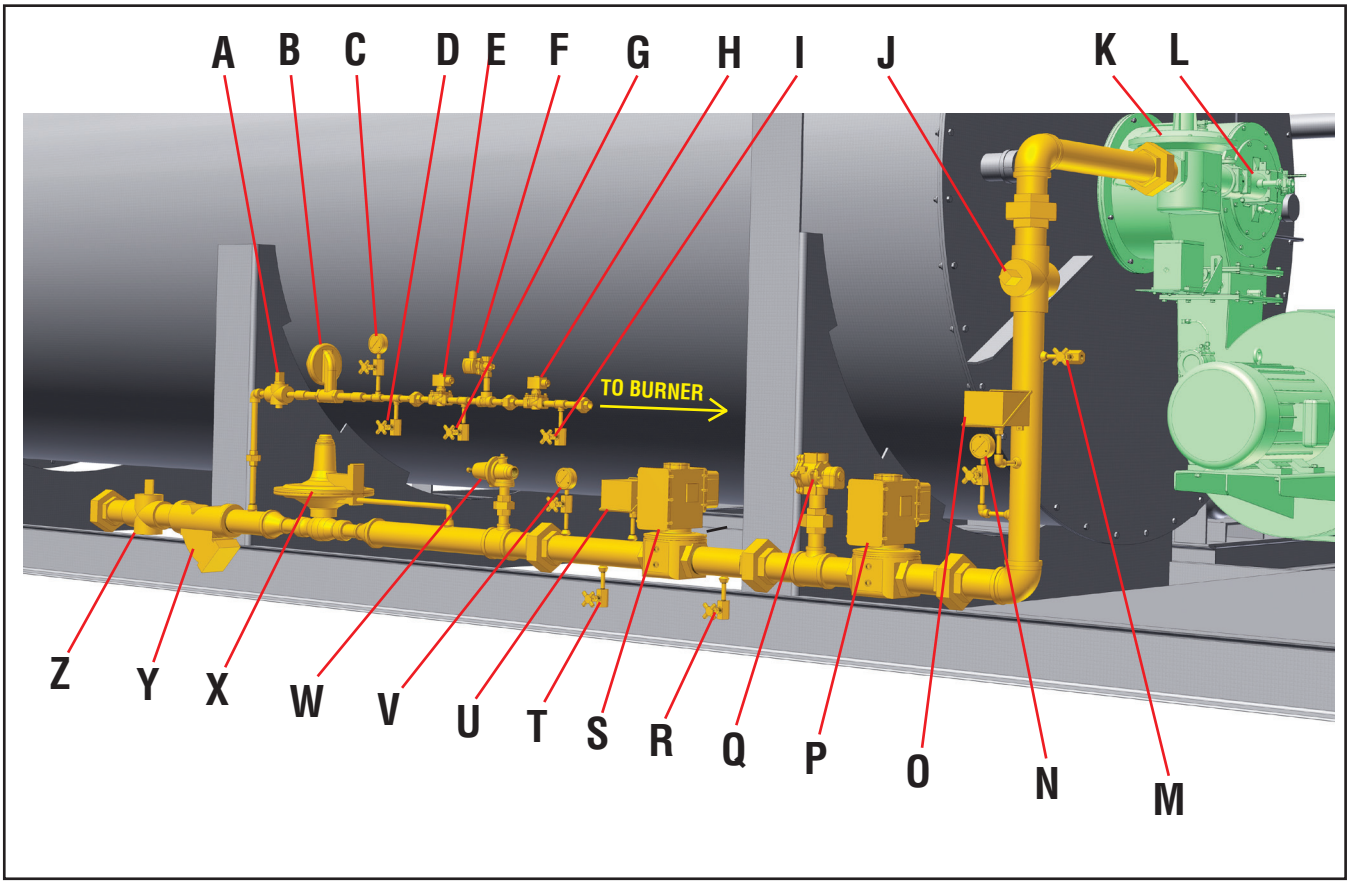
Figure 6. Typical industrial heater.



A. Purge block valve
B. Purge valve
C. Thermal fluid return inlet
D. Expansion valve
E. Inlet valves
F. Strainers with drains
G. Inlet pressure/vacuum gauges
H. Thermal fluid pumps
I. Pump motors
J. Discharge pressure gauges
K. Discharge valves
L. Check valves

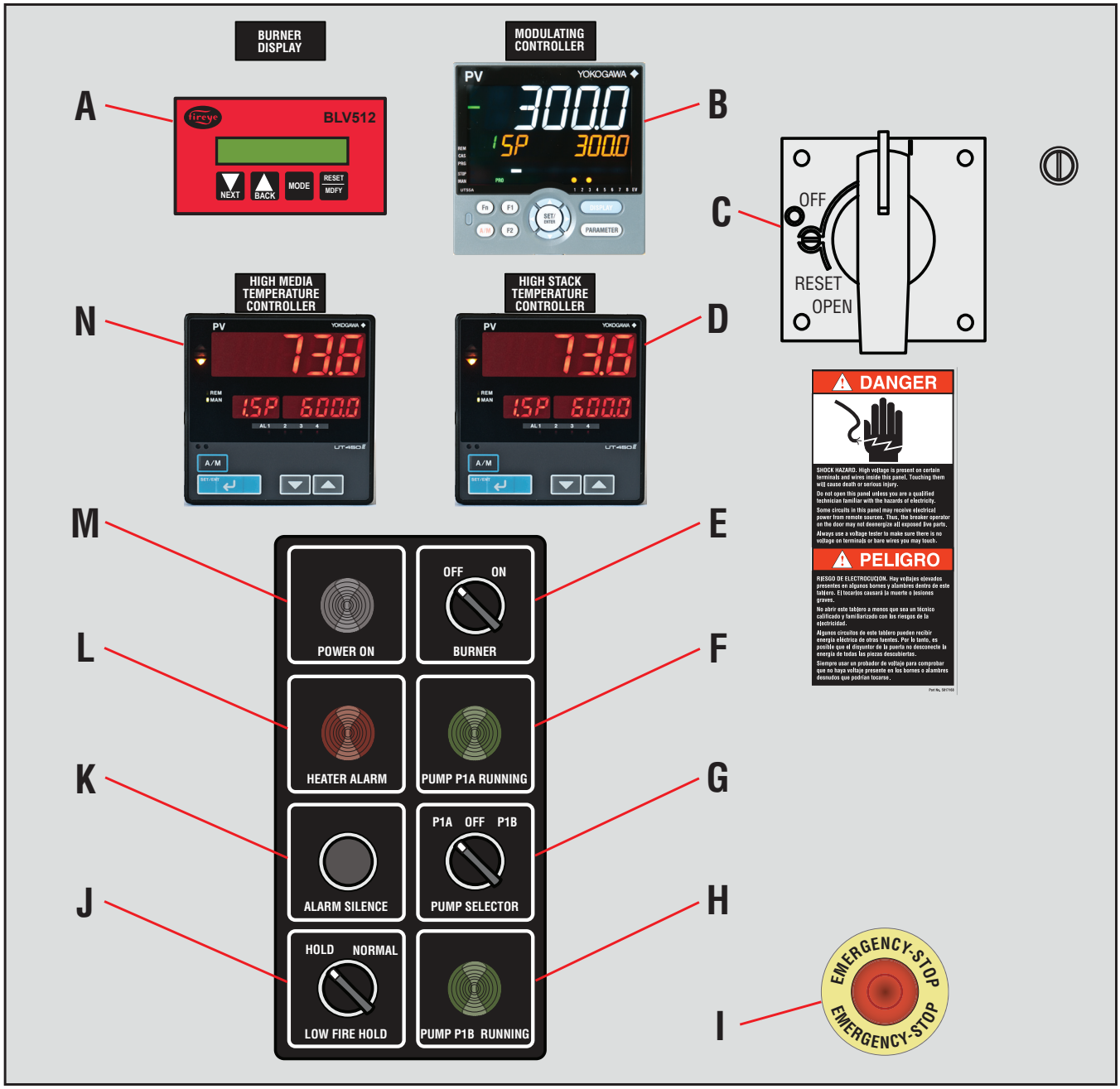
NOTE
This pump skid is shown with two sets of pumps and associated components. One serves as a primary while the other serves as a backup or alternate. Both are not normally operated simultaneously.
The control panel has separate controls for each pump. The controls and wiring diagrams are labeled to distinguish the two pumps from each other. The pumps should be labeled to match the controls when the heater is installed.

Figure 7. Pump skid with two pumps.



A. Pilot manual block valve
B. Pilot gas regulator
C. Pilot pressure gauge and isolation valve
D. Pressure test connection P1
E. Secondary pilot shutdown valve
F. Pilot vent valve
G. Pressure test connection P2
H. Pilot primary shutdown valve
I. Pressure test connection P3
J. Primary manual block valve
K. Ratio regulator
L. Limiting orfice
M. Pressure test connection M4
N. Pressure gauge
O. High gas pressure switch
P. Primary shutdown valve
Q. Normally open vent valve
R. Pressure test connection M2
S. Secondary shutdown valve
T. Pressure test connection M1
U. Low gas pressure switch
V. Main pressure gauge and isolation valve
W. Relief valve (when required)
X. Main Gas (trim) regulator
Y. Y-strainer
Z. Secondary manual block valve

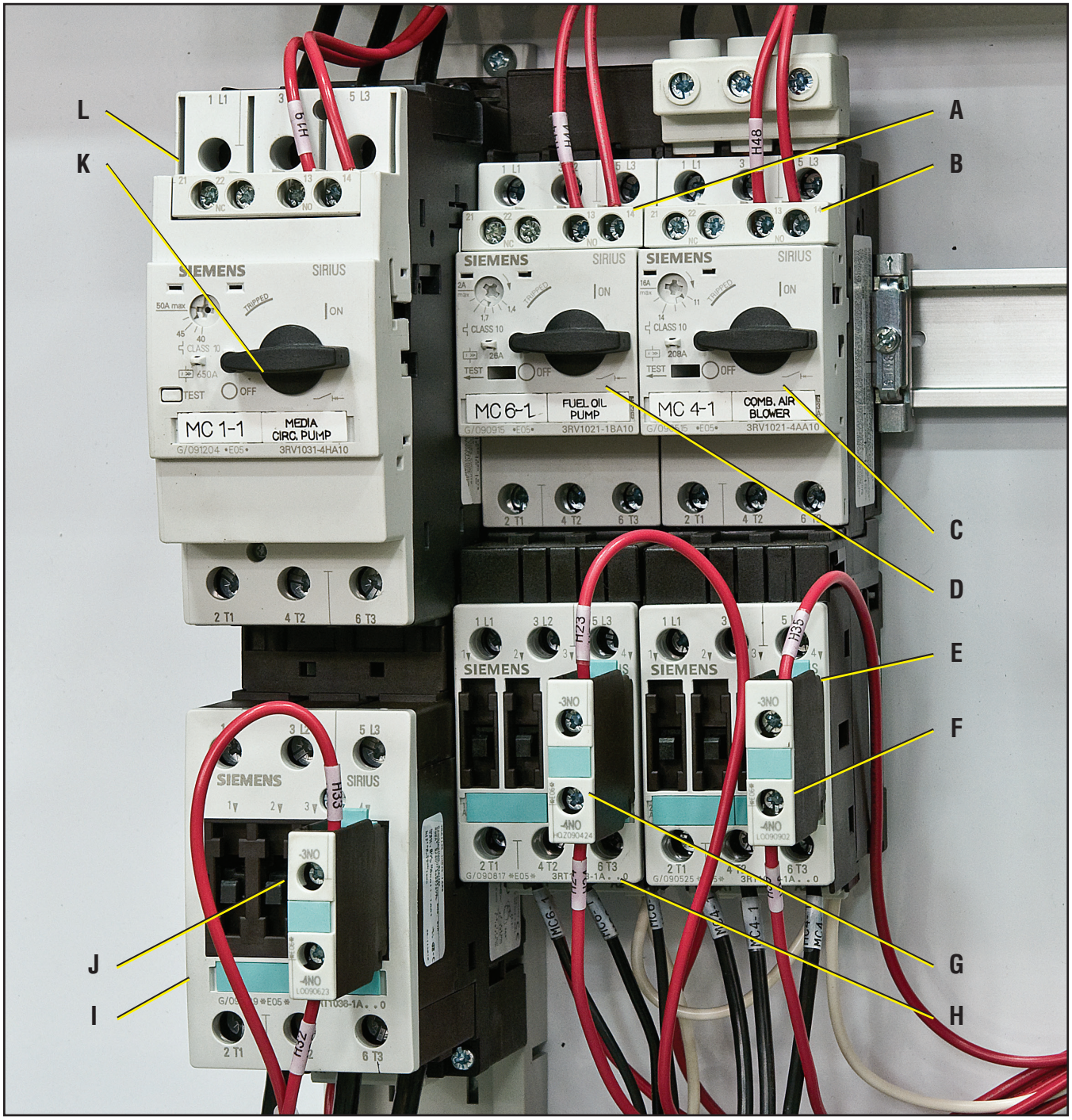
Figure 8. Fuel train.



A. Burner management control
B. Burner modulating controller
C. Power disconnect switch
D. High stack temperature controller
E. Burner switch
F. Pump P1A running indicator light
G. Pump selector switch
H. Pump P1B running indicator light
I. Emergency stop switch
J. Low fire hold switch
K. Alarm silence switch
L. Heater alarm silence indicator light
M. Power indicator light
N. High media temperature controller

NOTE:
Separate controls are provided for the two heater pumps. The controls and wiring diagrams are labeled to distinguish the two pumps from each other. However, their designations may vary from one heater to another. In any case, the pumps should be always be labeled to match the controls when the heater is installed.

Figure 9. Operating controls.



A. Breaker auxiliary contacts for fuel oil pump motor
B. Breaker auxiliary contacts for combustion air blower motor
C. Breaker disconnect for combustion air blower motor
D. Breaker disconnect for fuel oil pump motor
E. Contactor for combustion air blower motor
F. Auxiliary contacts for combustion air blower motor
G. Auxiliary contacts for fuel oil pump motor
H. Contactor for fuel oil pump motor
I. Contactor for media circulating pump motor
J. Auxiliary contacts for media circulating pump motor
K. Breaker disconnect for media circulating pump motor
L. Breaker auxiliary contacts for media circulating pump motor

Figure 10. Components of motor controllers inside the control panel.

Troubleshooting basics

Although troubleshooting is something you normally do only after your heater has a problem, it is useful to gain knowledge of how things work beforehand. We recommend that you get familiar with the information in this document without waiting for a problem to develop.

Most of the devices covered in this document are incorporated in the heater's 3–P interlock circuit. Each of these devices is intended to detect a specific abnormal operating condition. If any of these devices encounters the abnormal condition for which it is intended, it will shut down the burner and activate the heater's warning system.

On some heaters the warning system uses a red light on top of the panel. It flashes when an abnormal condition triggers a shutdown. Other heaters use an audible alarm. The heater may also be wired into a remote control system that indicates an abnormal shutdown.

You must find and fix the problem before you can restart the heater.

If a shutdown happens you will see a **LOCKOUT** message on the burner display **(Fig. 9)**.

The first line of the message indicates the operating condition when the lockout happened. The second line indicates what abnormal condition triggered the lockout.

The lockout message may identify one of the limit devices in the 3–P interlock circuit as the cause of the shutdown.

A clogged strainer is often the source of one or more abnormal conditions that will open an interlock device in the 3–P circuit. It can cause high media temperature. It can cause high stack temperature. And it can cause inadequate pressure differential across the coil. Improper settings of a differential pressure switch is also a common cause of 3–P interlock shutdowns.

Lockout messages on the burner display may indicate that a shutdown was caused by abnormal conditions *not* related to the 3–P circuit. A message that says **M-8 LIMIT OPEN** is usually caused by a problem with the burner modulation motor.

A message that says **LOCKOUT STANDBY FALSE FLAME** usually indicates a faulty flame scanner (when there is really not a flame in the burner).

A message that says **LOCKOUT PTFI FLAME FAIL** is usually caused by a problem with the flame scanner, or with fuel, or with ignition.

A message that says **LOCKOUT AUTO FLAME FAIL** is usually caused by a problem with fuel or combustion air.

There is also the possibility that an interlock device itself has malfunctioned and has caused a shutdown. Or there may be yet another cause. In reality, troubleshooting is a process of elimination that starts with the lockout message.

For example, assume the burner shuts down and the display says **LOCKOUT LO MEDIA LEVEL.** Obviously, the first thing to do is to check the level of thermal fluid in the expansion tank. If it is actually too low, fixing the problem may be as simple as adding thermal fluid to the system and making sure there is no leak in the piping system.

If it is not too low, the next thing to check is the media level switch located in the expansion tank. If the switch is okay the problem is almost certainly to be a faulty wiring connection or relay.

The information in this document should enable you to determine whether various interlock circuit devices are working properly.

Shock hazards

Troubleshooting instructions in this document are intended for use by plant personnel who understand electrical shock hazards and how to avoid them. Such persons should also know about the usual burn hazards present when working with thermal fluids heated to temperatures in excess of 300 degrees F.

Some procedures require making electrical tests and settings inside the heater electrical control panel while it is open and electrical power is turned on. This should be done only by persons authorized by their employer to work inside panels while significant electrical hazards are present. Employers and/or owners should have prescribed safety procedures for such work.

Low media level switch

This switch **(Fig. 11)** shuts down the burner if the level of media in the expansion tank gets too low for safe operation. The switch is wired into the 3–P interlock circuit.

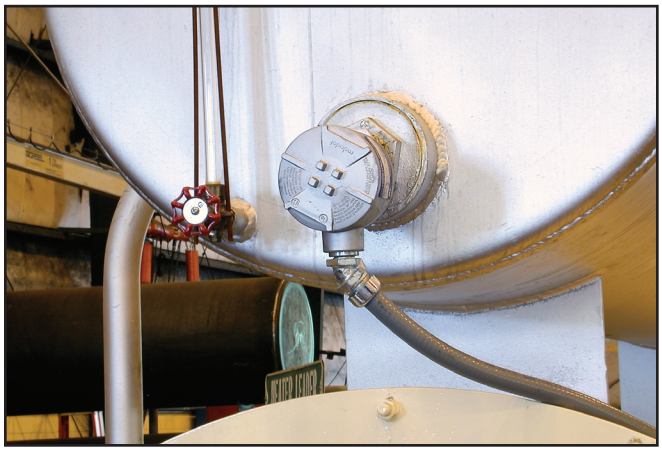


Figure 11. Low media level switch.

Before checking the switch for proper operation, confirm that the expansion tank **(B, Fig. 6)** contains an adequate level of thermal fluid media. Do this by viewing the level gauge **(A, Fig. 6)**. to make sure the level of the fluid is above the spot where the switch is installed in the tank.

Also verify that the float inside the tank is properly oriented by checking the bushing at the back of switch on the outside of the tank. One of the six flat sides of the hex on the bushing should be stamped with the letter T. This flat side of the bushing should be on top and should appear to be level.

There are two checks that you should make to determine if the switch circuit is working properly. The first check determines if the switch contacts are actually closed as they should be when there is an adequate level of media in the expansion tank. The second check makes sure that opening the switch contacts will actually shutdown the burner as it should.

To do the first check, open the control panel **(Fig. 9)** and turn on power to the panel while it is open**.** Locate the two terminals where the level switch wires are connected. Check for 120 VAC between each terminal and neutral. If the voltage is present at both terminals, the switch is closed and is working properly.

If voltage is present on one of the terminals, but not the other, the switch circuit is open and there is a problem with the switch circuit. Remove the screw-on cover plate from the back of the switch and see if there is a loose wire or an obvious problem with the micro-switch or the linkage that activates the switch. Otherwise, replace the entire switch, including the float portion.

> Note: The switch has two parts: a switch housing and a float housing. The float housing protrudes inside the tank and seals the opening so that thermal fluid cannot escape. There is no opening between the float housing and the switch housing. (The float mechanism has a magnet that activates the switch inside the switch housing.) You can open or replace the switch housing without draining the expansion tank. However, you must drain the tank before removing the float housing.

If the first check determines that the switch is working when closed, proceed with the second check to ensure that opening its contacts will shut down the burner. Remove the switch cover. Use the flat side of a screwdriver to depress the trip mechanism so as to open the switch contacts **(Fig. 12)**.

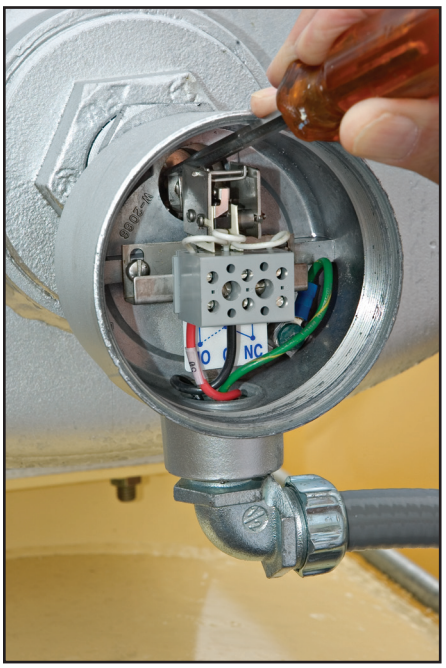


Figure 12. Opening the contacts of a low media level switch.

Opening the switch should cause the following reactions, which indicate that the switch is operating properly:

1. Circulating pump should shut off.
2. The burner should shut down.
3. The message on the bottom line of the Fireye display module should read **LOCKOUT LOW MEDIA LEVEL.**

Circulating pump motor auxiliary contacts

This is a module with contacts **(J, Fig. 10)** that prevent operation of the burner unless the contactor for the media circulating pump motor is actuated (closed). The contacts are wired into the 3–P interlock circuit.

The module has a plunger that opens and closes the contacts by engagement with the contactor. If the contactor opens, its plunger will open the contacts and shut off the burner.

Check the auxiliary contacts as follows:

With the burner operating, trip the breaker disconnect for the media circulating pump motor **(K, Fig. 10).**

This should cause the auxiliary contacts to open. The following reactions should occur, indicating that the contacts are operating properly:

1. The burner should shut down.
2. The message on the bottom line of the Fireye display module should read **CIRC PUMP AUX CT.**

Reset circulating pump circuit breaker.

Low gas pressure switch

This switch **(U, Fig. 8)** shuts down the burner if the gas pressure goes lower than the setpoint on the switch. The switch is wired into the 3–P interlock circuit.

Check the switch as follows:

Shut off the primary manual block valve **(J, Fig. 8)** and set **BURNER** switch **(E, Fig. 9)** to **ON**. Remove the plug from pressure test connection M1 **(T, Fig. 8)** below the pressure switch. Open its valve allowing gas to escape.

The following reactions should occur, indicating that the switch is operating properly:

- The display on the Fireye burner management control **(A, Fig. 9)** should read **LOCKOUT 3–P INTLK OPEN.**

Reinstall plug in the connection. Slowly re-open the primary manual block valve **(J, Fig. 8)**.

The low gas pressure switch **(U, Fig. 8)** should automatically reset. Reset the Fireye control **(A, Fig. 9)**.

High gas pressure switch

This switch **(O, Fig. 8)** shuts down the burner if the gas pressure increases higher than the setpoint on the switch. The switch is wired into the 3–P interlock circuit.

Check the switch as follows:

With the burner operating, remove the cover from the switch**. Be careful not to touch the live terminals.** Adjust the switch to a lower setting that causes the switch to open.

The following reactions should occur, indicating that the pressure switch is operating properly:

- The burner should shut down.
- The display on the Fireye burner management control **(A, Fig. 9)** should read **LOCKOUT 3–P INTLK OPEN**.

Re-adjust the high pressure switch to its previous position. The switch should automatically reset. Reinstall its cover.

High media temperature controller

This controller **(N, Fig. 9)** shuts down the burner if the media temperature exceeds its setpoint. The temperature controller is manually preset to a set point (SP) that has been established by the customer for the individual heater. It can be changed in the field by an operator. The controller monitors the temperature signal from a thermocouple mounted in the outlet of the helical coil.

Check the controller as follows:

With the burner operating, note the PV (process variable) temperature shown on the high media temperature controller **(N, Fig. 9).** Change the SP (setpoint) to a value lower than the temperature noted.

The following reactions should occur, indicating that the controller is operating properly:

1. The burner should shut down.
2. The message on the display on the Fireye burner management control **(A, Fig. 9)** should read **LOCKOUT HI MEDIA TEMP.**

Be sure to reset the controller to its previous setpoint and push **SET/ENT** button. Depress and hold the reset button on the controller for 3 seconds.

Temperature limits of exhaust gases

Each heater has a system to shut down the burner if the heater exhaust gas exceeds preset limits. Two different systems are used. One system employs a thermocouple and a temperature controller **(D, Fig. 9)** which can be adjusted in the field. The other system uses a temperature *switch* **(Fig. 13)** instead of a thermocouple and controller. The operating temperature of the switch should not be adjusted in the field.

The temperature controller **(D, Fig. 9)** is manually preset to a set point (SP) that has been established by the customer for the individual heater. It can be changed in the field by an operator. The controller monitors the temperature signal from the thermocouple, which is mounted in the exhaust stack. If the temperature of the exhaust gas exceeds the set point, the controller will open the interlock circuit and shutdown the burner.

The controller and thermocouple can be checked for proper operation as described below.

With the burner operating, note the PV (process variable) temperature shown on the high stack temperature controller **(D, Fig. 9)**. Change the SP (setpoint) to a value lower than the temperature noted and push the SET/ENT button.

The following reactions should occur, indicating that the controller is operating properly:

1. The burner should shut down.
2. The message on on the display on the Fireye burner management control **(A, Fig. 9)** should read **LOCKOUT HI STACK TEMP.**

Be sure to reset the controller to its previous setpoint and push **SET/ENT** button. Depress and hold the reset button on the controller for 3 seconds.

Temperature *switches* are preset by the manufacturer to open at a specified temperature. We usually order them set for 1,000 degrees F. Although they can be ordered for other temperatures, they should not be changed in the field. The switch is wired into the 3–P interlock circuit.

If the temperature of the exhaust gas exceeds the preset temperature, the switch will open the interlock circuit and shutdown the burner. The switch can be checked for proper operation as described below.

With the burner operating, remove cover from the high flue gas temperature switch. Use the flat side of a screwdriver to depress the tiny button on the switch to open its contacts **(Fig. 13)**. **Be careful not to touch live terminals on the switch.**

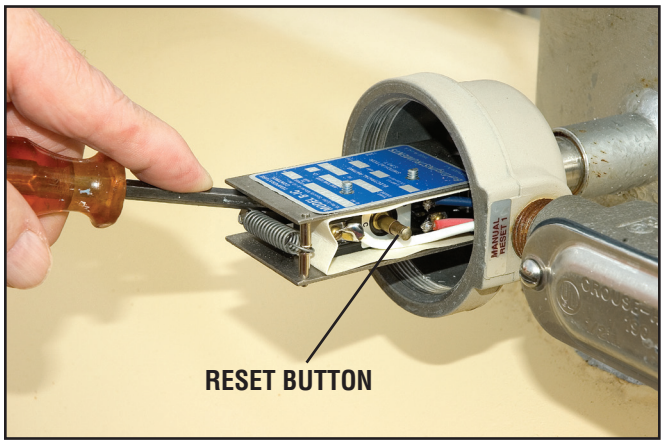


Figure 13. Checking high flue gas stack temperature switch.

The following reactions should occur, indicating that the switch is operating properly:

1. The burner should shut down.
2. The message on on the display on the Fireye burner management control **(A, Fig. 9)** should read **LOCKOUT HI STACK TEMP.**

Reset the switch, using the insulated handle of a screwdriver to press the reset button on the switch. This avoids the possibility of electrical shock from the exposed terminals next to the reset button.

Combustion air motor auxiliary contacts

This is a module with contacts that prevent operation of the burner unless the contactor for the combustion air motor is actuated (closed). The contacts are wired into the 3–P interlock circuit.

The module has a plunger that opens and closes the contacts by engagement with the contactor. If the contactor opens, its plunger will open the contacts and shut off the burner.

Check the auxiliary contacts as follows:

With the burner operating, trip the breaker disconnect for the combustion air blower motor **(C, Fig. 10)**.

This should cause its auxiliary contacts **(F Fig. 10)** to open. The following reactions should occur, indicating that the contacts are operating properly:

1. The burner should shut down.
2. The display on the Fireye burner management control **(A, Fig. 9)** should read **LOCKOUT AIR AUX CT.**

Reset the breaker disconnect for the combustion air blower motor.

Low combustion air pressure switch

This switch **(Fig. 14)** shuts down the burner if combustion air is too low for safe operation. The switch is wired into the 3–P interlock circuit.

Figure 14. Low combustion air switch.

Check the switch as follows:

With the burner off, unlatch the auxiliary contacts module and physically remove it from the burner circuit breaker with wires attached. Pull out the blue plunger on the module **(Fig. 15)** and hold it out so as to close its contacts.

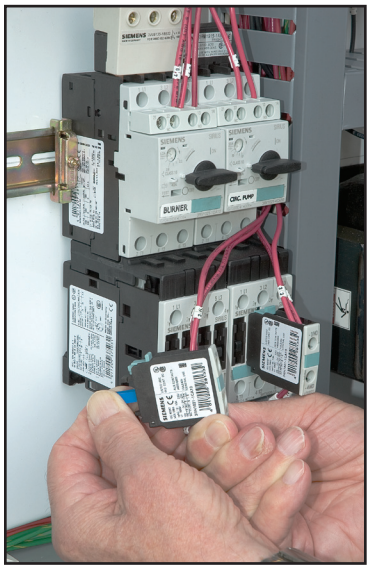


Figure 15. Pulling out plunger on an auxiliary contacts module.

Restart the burner. Trip the burner circuit breaker. The following reactions should occur, indicating that the pressure switch is operating properly:

1. The burner should shut down.
2. The display on the Fireye burner management control **(A, Fig. 9)** should read **LOCKOUT LO AIR PRES.**

Re-insert the auxiliary contacts module into the breaker disconnect.

Fuel oil pump auxiliary contacts

This is a module with contacts that prevent operation of the burner unless the contactor for the fuel oil pump motor is actuated (closed). The contacts are wired into the 3–P interlock circuit.

The module has a plunger that opens and closes the contacts by engagement with the contactor. If the contactor opens, its plunger will open the contacts and shut off the burner.

Check the auxiliary contacts as follows: With the burner operating, trip the breaker disconnect for the fuel oil pump motor. This should cause the auxiliary contacts to open. The following reactions should occur, indicating that the contacts are operating properly:

1. The burner should shut down.
2. The display on the Fireye burner management control **(A, Fig. 9)** should read **FUEL PUMP AUX CT.**

Reset fuel pump circuit breaker.

Low fuel oil pressure switch

This switch **(Fig. 16)** shuts down the burner if fuel oil pressure is too low. The switch is wired into the 3–P interlock circuit.

Figure 16. Low fuel oil pressure switch.

Check the switch as follows:

With the burner off, unlatch the auxiliary contacts module and physically remove it from the fuel pump circuit breaker with wires attached. Pull out the blue plunger on the module **(Fig. 15)** and hold it out so as to close its contacts.

Restart the burner. Trip the fuel pump circuit breaker. The following reactions should occur, indicating that the pressure switch is operating properly:

1. The burner should shut down.
2. The display on the Fireye burner management control **(A, Fig. 9)** should read **LOCKOUT LO FUEL PRES.**

Pilot gas regulator

This regulator **(B, Fig. 8)** controls pressure of the pilot gas. Its switch is *not* wired into the 3–P interlock circuit.

Check the regulator as follows:

1. Make sure that pressure in gas supply line is according to that specified in the applicable P&ID drawing. To check the pressure, connect a pressure gauge in place of the plug in the bottom of the Y-strainer **(Y, Fig. 8)**.
2. Connect a manometer to pressure test connection **(I, Fig. 8)**.
3. Start the burner. When Fireye flame monitor indicates **PTFI,** check to see that the pressure on the manometer is 6 to 8 inches WC. If not, remove cap from pilot gas regulator and adjust the regulator to attain this presure.

   NOTE: Some burners require pilot pressures other than 6 to 8 inches. Be sure to check the burner manufacturer's specifications for the pilot pressure required for the burner on your heater.

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HEATEC TEC-NOTE

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Troubleshooting modulation motors

Purpose

This document provides a guide for troubleshooting burner modulation motors (**Figure 1**), which are commonly called mod motors. They are also known as modulation actuators.

Scope

This document applies to Honeywell mod motors M7284C-1000, M9174C-1025, and M9184F-1034 used on Heatec HC and HCS heaters.

What the mod motor does

The mod motor is connected to mechanical linkage that opens and closes fuel valves and air dampers of the burner (**Figure 1**). It provides proportional control of its firing rate. The shaft of the mod motor operates the linkage as it rotates within an arc of 90 degrees.

Key components of concern

- Low-fire cam and low-fire proof switch.
- High-fire cam and high-fire proof switch.
- Resistor board or resistor harness.
- Transformer.

NOTICE: For clarity some photos of mod motor are shown not installed on the heater. It is not necessary to remove it to perform the checks and adjustments described.

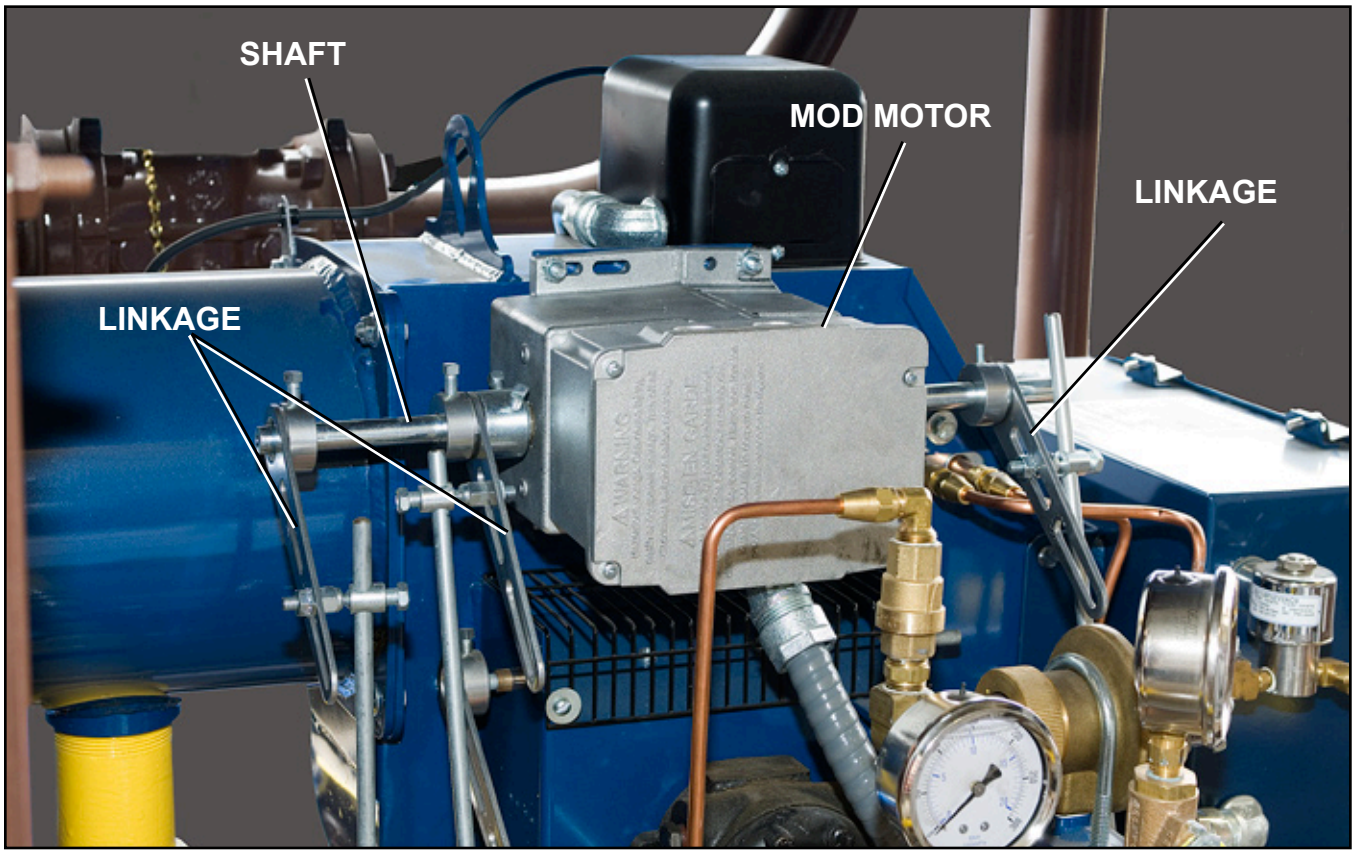


Figure1. Honeywell mod motor M7284C-1000 installed on heater.

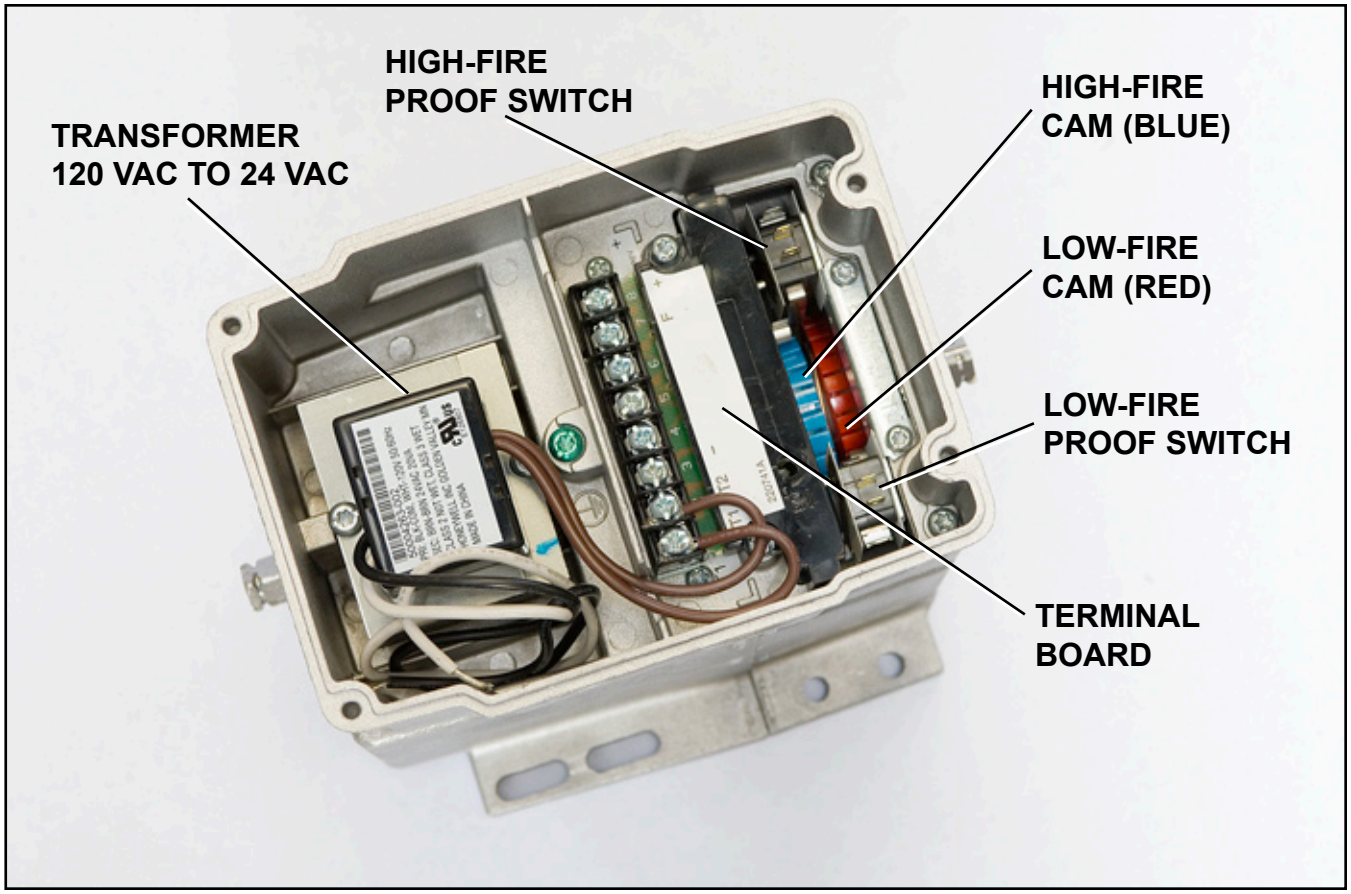
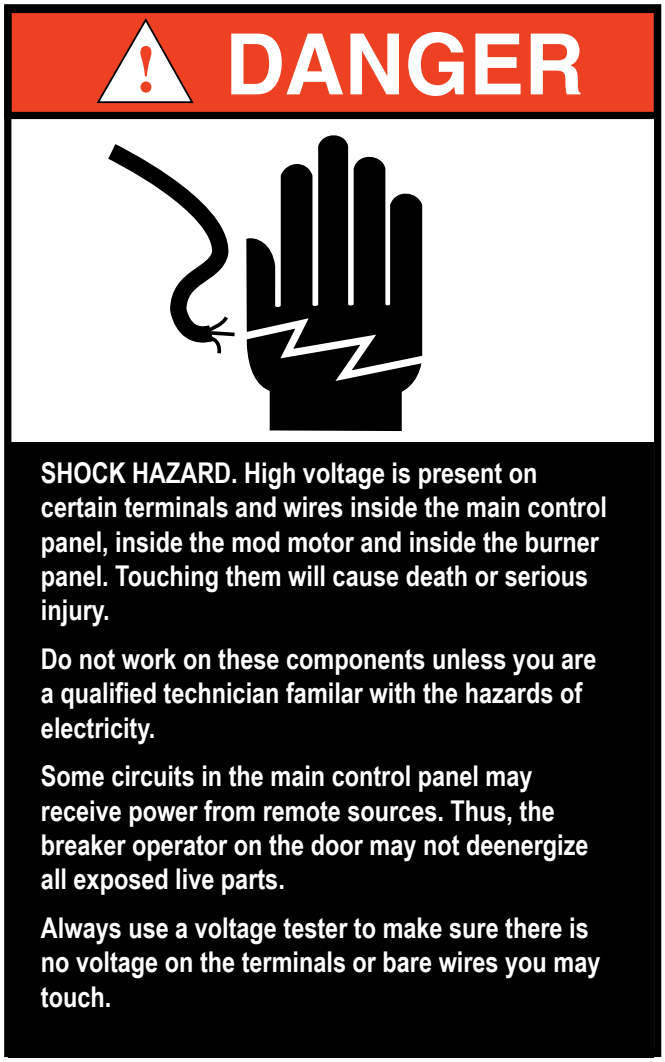


Figure 2. Top view of Honeywell mod motor M7284C-1000.

Model differences

The following table identifies the models of mod motors used on Heatec HC and HCS heaters that have modulating burners. There are important differences in the way the switches and cams are configured. **Figure 2** shows the motor now used.

Key differences	Honeywell mod motors		
	M7284C-1000	M9174C-1025	M9184F-1034
Heatec heaters used on	HC & HCS 12-06 & after	HC & HCS prior to 12-06	HC & HCS early units with modulating burners
Color of low-fire cam	Red	Blue	Red
Wiring of low-fire proof switch	Normally closed	Normally open (held closed)	Normally closed
Wires used, low-fire proof switch	Red=common Yellow=Normally closed	Red=common Yellow=Normally open	Red=common Yellow=Normally closed
Color of high-fire cam	Blue	Blue	Blue
Wiring of high-fire proof switch	Normally open	Normally open	Normally open
Wires used, high-fire proof switch	Black/red=common Black/blue=Normally open	Black/red=common Black/blue=Normally open	Black/red=common Black/blue=Normally open
Resistor board or resistor harness	(Not used)	Yes	Yes



Interaction with Fireye flame monitor (Figure 3)

The Fireye flame monitor monitors the open/closed status of the low-fire and high-fire proof switches in the mod motor while the burner is being purged. The low-fire proof switch is wired between terminals **M** and **D**. The high-fire proof switch is wired between terminals **D** and **8**. Thus, the flame monitor shows either **M-D LIMIT** or **D-8 LIMIT** when indicating the status of these switches. Each switch is activated and de-deactivated by its own rotating cam in the mod motor.

- On mod motors with a *red* low-fire cam the *low-fire proof switch* remains in its normally *closed* position while the damper is fully *closed*. After the damper begins to open, the cam opens the switch.
- On mod motors with a *blue* low-fire cam the cam holds the *low-fire proof switch* in its *closed* position while the damper is fully *closed*. After the damper begins to open, the cam opens the switch.
- On all mod motors, the high-fire cam closes the *high-fire proof switch* when the damper reaches a preset *open* position. After the damper begins to *close*, the cam opens the switch.

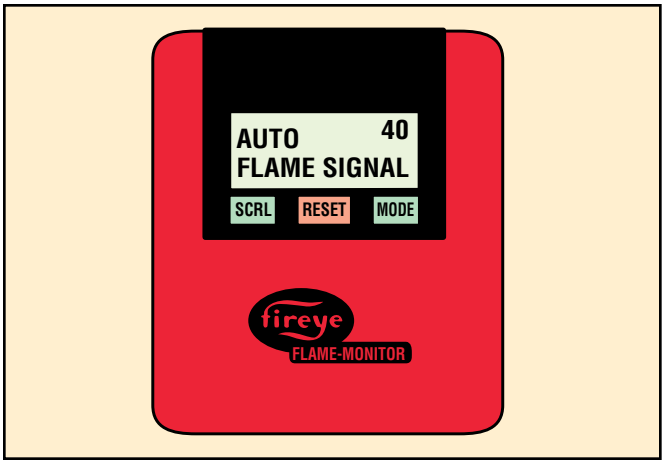


Figure 3. Fireye flame monitor.

Interaction with Honeywell modulation controller (Figure 4)

The modulation controller controls the mod motor using a circuit that provides an output of 4 to 20 mA. With a 4 mA signal the mod motor should be in the low-fire position with the damper fully closed. With a 20 mA signal the mod motor should open the damper to the high-fire position.

Figure 4. Honeywell modulation controller.

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A common problem

Faulty electrical connections are common causes of mod motor malfunctions. Faulty connections can be caused from loose connections, dust, or corrosion from moisture. Connection problems may occur at the following locations:

- Terminals in mod motor. (**Figure 5**)
- Terminals on Temperature controller (**Figure 6**).
- Terminal strip on back plate of heater panel (**Figure 7**).
- Terminal strip in burner junction box (**Figure 8**).

Other problems

- Failure of resistor board or resistor harness (**Figures 11 and 12**).
- Slippage of cams (**Figure 2**).
- Failure of transformer (**Figure 2**).

Symptoms of problems

- Mod motor fails to move when burner is first turned on.
- Flame monitor (**Figure 3**) indicates abnormal status of either M-D LIMIT or D-8 LIMIT.
- Mod motor fails to operate the linkage.
- Modulation controller (**Figure 4**) fails to modulate the mod motor.

Remedy for faulty electrical connections

All wire connections that pertain to the mod motor have either screw terminals or cage-clamp spring terminals. (**See Figures 5, 6, 7 and 8**) On connections with screw terminals use a screwdriver to slightly loosen the screws and retighten them. On connections with cage clamps, push on the wire, wiggle it and then pull on it to make sure it is held tightly.

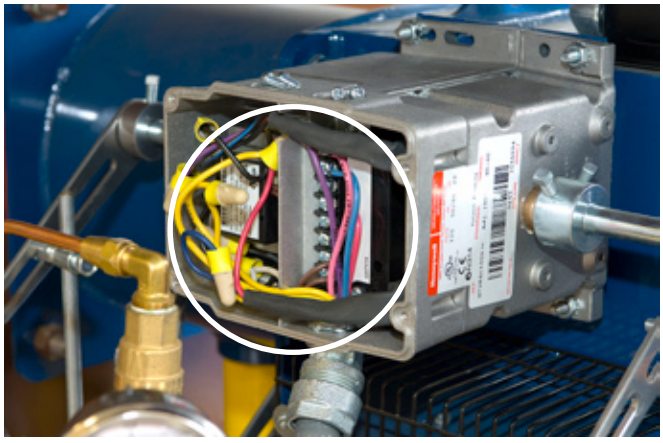


Figure 5. Terminal connections in mod motor.

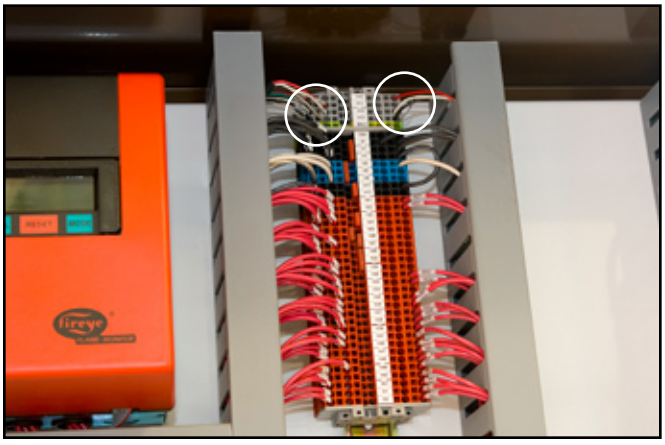


Figure 7. Terminal connections on back plate of heater panel.

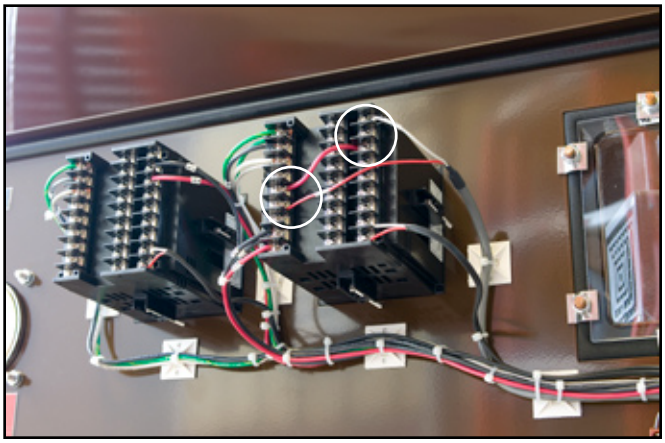


Figure 6. Terminal connections on Honeywell modulation controller.

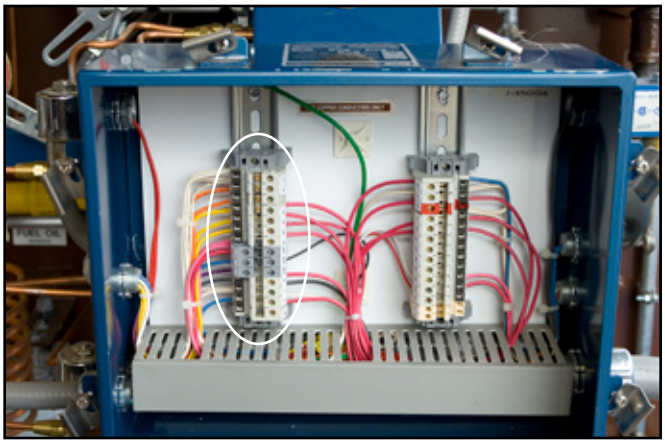


Figure 8. Terminal connections in burner junction box.

Checking and resetting cams

1. Remove the top cover so that you can gain access to the tops of the cams (**Figure 2**).
2. Make sure the shaft of the mod motor is rotated to its position for a fully closed damper.
3. Check positions of the *target* lobes of the cams. The cams have click stops that hold them in position. Repositioning a cam does not turn the drive shaft of the mod motor.
4. You may be able to rotate the cams with your fingers. Otherwise insert the blade of a screwdriver in the slots of the cam (**Figure 9**) and rotate them.

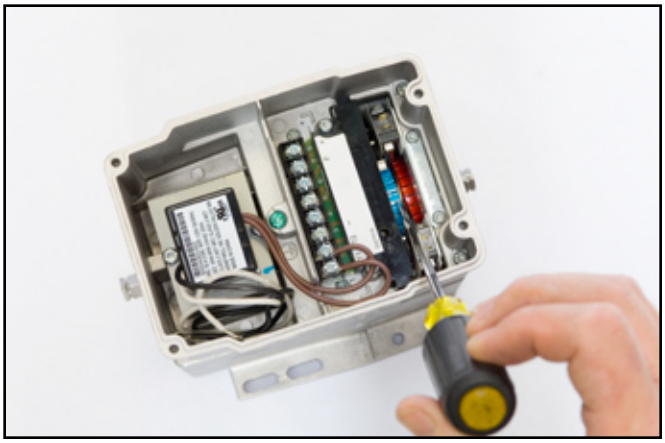
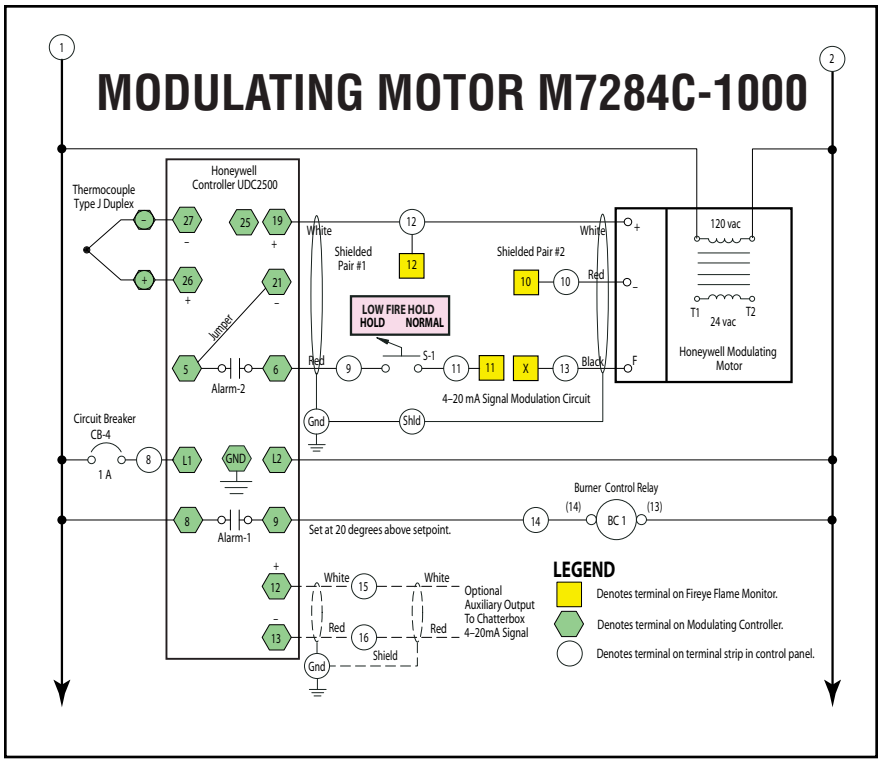


Figure 9. Using screwdriver to position cams.

5. In order to make sure the cams are positioned properly you may need to rotate them until you can see their *target* lobes (indicated by yellow dots in **Figure 10)** and then reset them to their proper positions. NOTE: The yellow dots are only shown in Figure 10. There are no dots on the actual lobes.
6. You can also use the blade of a small screwdriver to press on the actuating arms of the switches to determine whether they are actuated. All switches except the *blue* low-fire switch *should not* be actuated while the damper is closed. Thus you should hear a distinct click if you press on their actuating arms.
7. Because the *blue* low-fire switch *should be* actuated or held closed by the cam when the damper is closed, you *should not* be able to move its actuating arm. Note that it is shown with its arm in the actuated position in **Figure 10**.
8. Make sure the *target* lobes of the two cams are rotated to the positions shown relative to the actuating arms of the two switches as shown in **Figure 10**. The U-shaped ends of the switch arms should rest on the cams as shown in **Figure 10.**

Figure 9A. Wiring diagram for mod motor currently used.



Publication No. 1-07-184

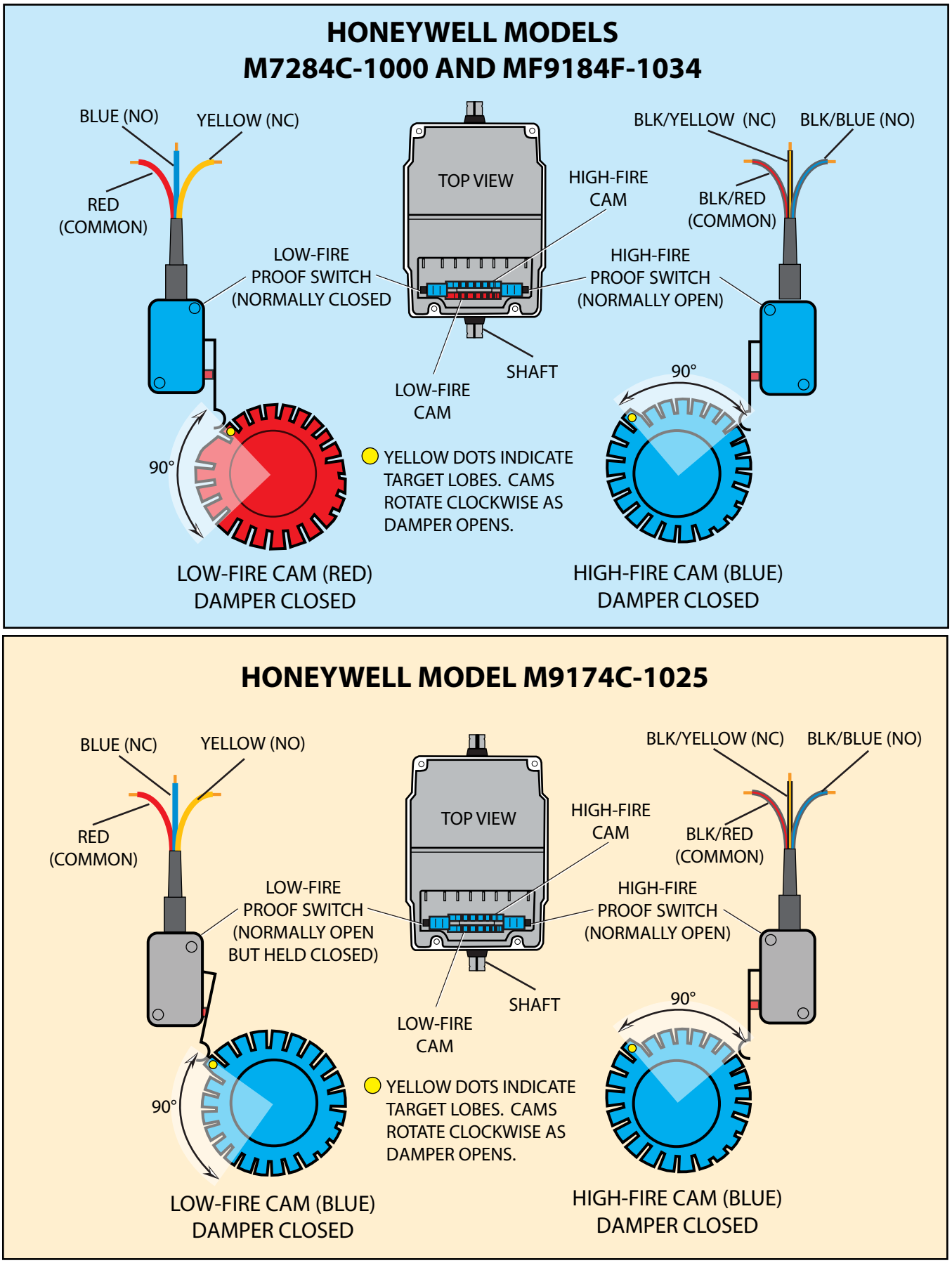


Figure10. Configuration of cams and switches.

Checking transformer in the mod motor

1. Make sure **HEATER CONTROL** switch is set to **OFF**.
2. Make sure there is 120 Vac on the primary winding of the transformer using an ac voltmeter. Check for 24 Vac on its secondary winding. The transformer is defective if there is no voltage on its secondary winding.

Checking resistor board and motor (Fig. 11)

1. Make sure **HEATER CONTROL** switch is set to **OFF**.
2. Make sure that the dipswitch settings are correct as indicated in **Figure 11**. Use a ballpoint pen to make sure that switches are fully depressed. (Partially depressed switches have been a problem in the past.)
3. Make sure its transformer is not defective. Refer to instructions above.
4. Disconnect wires from terminals **R**, **W** and **B** of the resistor board.
5. Temporarily connect a short jumper wire from terminals **R** to **B**. The motor of the actuator should go to high-fire, which indicates that the motor is okay and its particular circuit on the resistor board is okay. Otherwise, either the motor or the resistor board is bad.
6. Temporarily connect a short jumper wire from terminals **W** to **R**. The motor of the actuator should go to low-fire (if it is not already there), which indicates that the motor is okay and its particular circuit on the resistor board is okay. Otherwise, either the motor or the resistor board is defective and should be replaced.
7. Remove the resistor board.
8. Connect the two wires from the secondary side of the transformer to terminals **T1** and **T2** of the circuit board where the resistor board was removed.

DIP SWITCH SETTINGS									
1	2	3	4	5	6	7	8	9	10
OPEN	OPEN	OPEN	OPEN	CLOSED	CLOSED	OPEN	CLOSED	OPEN	OPEN

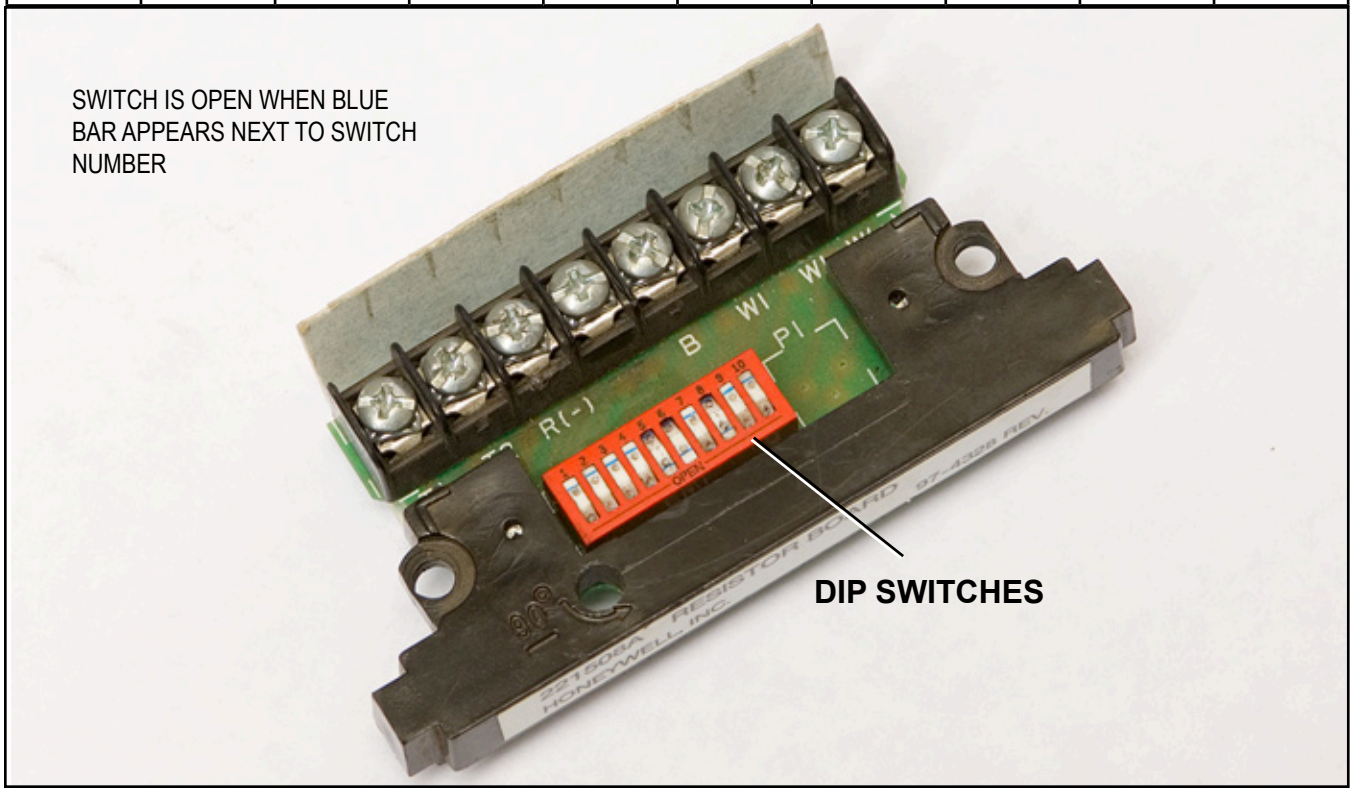


Figure11. Resistor board, Heatec PN 5004718, Honeywell PN 221508A.

9. Using a short jumper wire, temporarily connect from terminal R to B on the circuit board. If the motor works, the resistor board is defective and should be replaced.

Replacing mod motor

The Model M7284C-1000 Honeywell motor replaces all inoperable mod motors used on past and present Heatec HC and HCS heaters with modulating burner. Do not use a resistor harness or resistor board (**Figures 11 and 12**) with this motor.

Be sure to use the *new* wires that come with the new mod motor (**Figure 13**) and connect directly to the low-fire and high-fire switches. *Do not use the old wires.* Although the old wire colors may be the same as the new wires they may not be connected to the same terminals on the low-fire and high-fire switches.

See wiring diagram **(Figure 9A)** and cover of mod motor (**Figure 14**) for wiring information. Note differences in terminal markings indicated below:

TERMINAL MARKINGS IN MOD MOTORS	
M7284C-1000	M9174C-1025 M9184F-1034
+	W
–	R
F	B

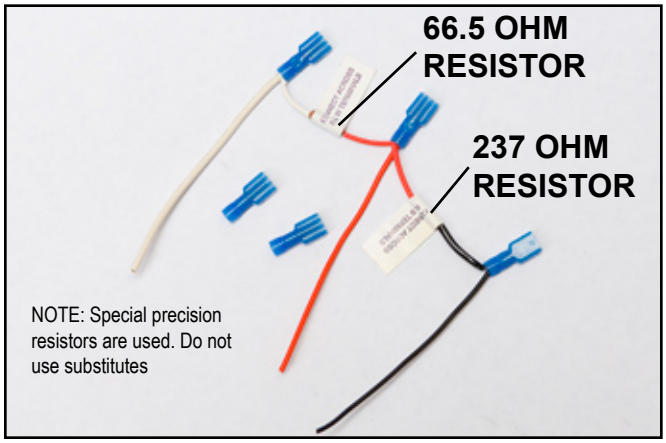


Figure 12. Resistor kit (harness), Heatec PN 5018099, Honeywell PN 4074EDC.

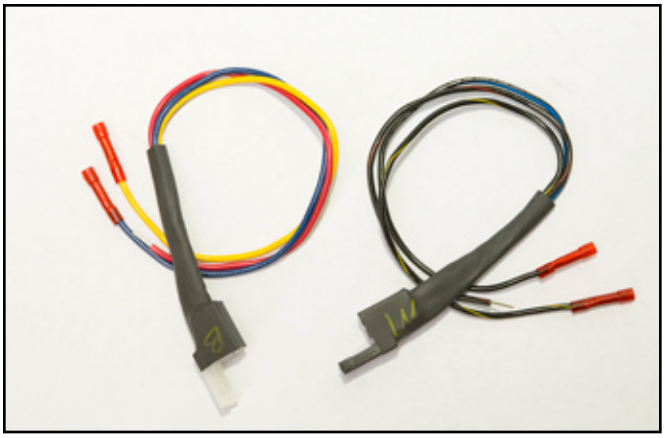


Figure 13. Wires furnished with Model M7284C-1000 Honeywell mod motor.

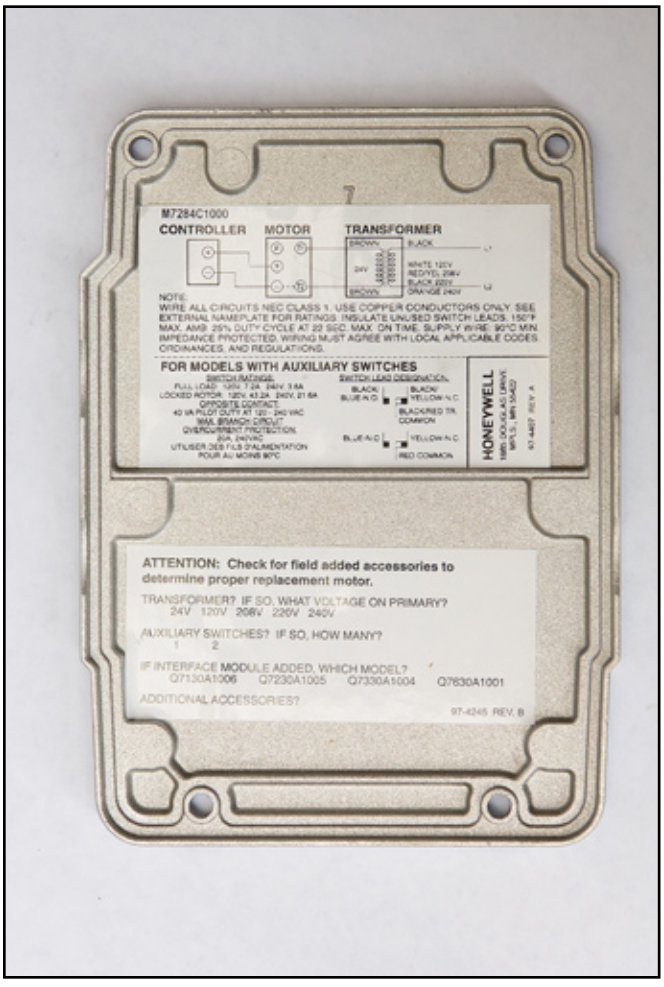


Figure 14. Information in cover of mod motor.

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SECTION 2
ELECTRICAL DATA

ELE TEST
16-251-551

HEATEC, INC. an ASTEC company

5200 Wilson Road, Chattanooga, TN 37405 Tel: (423)821-5200 | 1-800-235-5200 Fax: (423)821-7673 www.heatec.com

Customer: UOP RUSSELL LLC
Job Number: 16-251-551
Engineer: DIC
Equipment Model: HCI 30-0-40-G
Work Order Number: 16-251-551

Unit Was Tested with 120 Volts
Pump Pressure
Low Fire Pressure
High Fire Pressure
Average Flame Signal

Primary Fuel Type: NATURAL GAS
Panel Wired By: W BOZZA
Unit Wired By: KEN T GEORGE M
Unit Tested By: JWILLIAMS/KSTRECK
Comments By:

Testing Description Safety Interlocks & Circuit	Yes	No
High Gas Pressure	☑	☐
Low Gas Pressure	☑	☐
Low Media Pressure	☑	☐
High Media Pressure	☑	☐
Low Media Level	☑	☐
High Media Temperature	☑	☐
High Stack Temperature	☑	☐
Low Combustion Air Pressure	☑	☐
Combustion Blower Contactor Aux.	☑	☐
Circulating Pump Aux.	☑	☐

Visual Inspection		
Smoke Spot Number	Lo Fire	Hi Fire
Gas Valve Bubble Leak Test		
Pilot Flood Test		
Minimum Pilot Test		
Flame Impingement At Any Firing Rate?	☐ Yes	☐ No
Coil Inlet and Outlet Pressure	Inlet	Outlet
Differential Pressure	0	Set @
Circulating Pump Amps		
Auxillary Pump 1 Amps		
Auxillary Pump 2 Amps		
Combustion Air Blower Motor Amps		

Circulation Pumps

Pump Alignment Cold Hot
Pump Vented At Start Up ☐ Yes ☐ No

Circulating Pump(s)	Pump # 1	Pump #2	Pump #3
Manufacturer's Name	METPRO	METPRO	
Model Number	R4144	R4144	
Serial Number	200450	200451	
Size	2x3x13 1/2	2x3x13 1/2	

Circulating Pump Motor(s)	Pump # 1	Pump #2	Pump #3
Manufacturer's Name	WESTINGHOUSE	WESTINGHOUSE	
Horsepower	20	20	
RPM's	1760	1760	
Voltage / FLA	460/23.0	460/23.0	

Burner Information	
Manufacturer's Name	ECLIPSE
Model Number	WINNOX
Serial Number	10S0221087-0010-1
Invoice Number	PRJ101030776
Wiring Diagram Drawing Number	

Electrical Panel	
NEMA Rating	4
Supply Voltage / Ph / Hz	480/3/60
Main Breaker	20 AMP
Brand	SIEMENS

Burner Management Controller	
Burner Off/On Temperature Controller	FIRE EYE
Modulation Temperature Controller	YOKOGAWA
High Media Temperature Limit Controller	YOKOGAWA
High Stack Temperature Controller	YOKOGAWA
Special Controller(s)	
Special Controller(s)	
Pressure Switch Settings	

Fireye History	
Burner Hours	
Burner Cycles	
Burner Lookouts	
System Hours	

ELE TEST

Construction Use Only ☑ Not Applicable	Oil Fired					Gas Fired				
Combustion Data	0%	25%	50%	75%	100%	0%	25%	50%	75%	100%
% O2										
% CO2										
CO (PPM)										
NOx (PPM)										
% Excess Air										
Stack Temperature										
Thermal Fluid Temperature										
Air Damper Opening Top										
Air Damper Opening Bottom										
Hauck Micro Valve Position										
Oil Nozzle Supply Pressure (PSI)										
Oil Nozzle Bypass Pressure (PSI)										
Gas Meter Count										
Supply Gas Pressure (In. W.C.)										
Gas Train Pressure (In. W.C.)										
Firing Head Gas Pressure (In. W.C.)										
Input Rate (BTU/HR)										
Combution Chamber Pressure (in. W.C.)										
Fireye Flame Strength (0-80)										
Fireye Pilot Strength (0-80)										
Pilot Gas Inlet Pressure (In. W.C.)										

Final Heater Checklist	Yes	No	NA	Remarks
Is the panel clean?	☑	☐	☐	
Are the covers on and fittings tight?	☑	☐	☐	
Have manual reset controllers been checked?	☑	☐	☐	
Have all controls been cycled five (5) times?	☑	☐	☐	
Have all test wire been removed?	☑	☐	☐	
Have all breakers been placed in 'off' position?	☑	☐	☐	

J Williams / K Streck

Signed Off By

4/26/2017

Date

UOP RUSSELL,LLC

16-251-551

HEATEC,INC.
5200 Wilson Road
Chattanooga, TN 37410
Phone: (423) 821-5200

HEATEC

HI16-251 UT35A High Media Limit Setup

PROMPT	DESCRIPTION	SELECTION
SEt		
SEt.MCtL		
HI.LO	Limit Control type	HIGH
CNF	The Way of Confirming Operation	KEY
SEt.MPV		
IN	Input type	J
UNIt	PV input unit	F
RH	Maximum value of PV	400.0
RL	Minimum value of PV	0.0
bSL	PV input burnout	UP
A.bS	PV Analog input bias	0.0
A.FL	PV Analog input filter	OFF
SEt.M MPV		
P.UNI	Control PV input unit	F
P.dP	Control PV input decimal point position	1
P.RH	Maximum value of Control PV input range	400
P.RL	Minimum value of Control PV input range	0.0
SPH	SP High Limit	400.0
SPL	SP Low Limit	0.0
SEt.M Out		
RtS	Retransmission output type	PV1
RtH	Maximum value Retran. output scale of current	400.0
RtL	Minimum value Retran. output scale of current	0.0
REt.A	Current output range	41384.0
SEt.MR485		
PSL	Protocol Selection	MbRTU
bPS	BUAD Rate	19200
PRI	Parity	EVEN
StP	Stop Bit	1
dLN	Data Length	8
AdR	Address	1
SEt.MKEY		
F1	User function key action	Default: OFF
F2	User function key action	Default: OFF
FN	User function key action	Default: PID
SEt.MdISP		
PCMd	Active color PV display switch	9: SP deviation
PCH	PV Color Change High Limit	400.0
PCL	PV Color Change Low Limit	0.0
GUId	Guide Display on/off	ON
ECO	Economy mode	OFF
bRI	Brightness	3
MLSd	Least significant digital mask of PV display	OFF
SEt.MKLOC		
COM.W	Communication write enable/disable	OFF
dAtA	Front panel parameter data key lock	OFF
SEt.MdI.SL		
dI2.5	DI2 funtction selection	OFF

SEt.MSYS		
R.Md	Restart mode	1
FREQ	Power frequency	AUTO
QSM	Quick start setting mode	OFF
PASS	Password Setting	0
SEt.MVER		
PA.ER	Parameter Error Status	Default
OP.ER	Option Error Status	Default
AdI.E	A/D Converter Error Status	Default
PVI.E	PV Input Error Status	Default
MCU	MCU Version	Default
dCU	DCU Version	Default
ECU3	ECU Version	Default
PARA	Parameter Version	Default
H.VER	Product Version	Default
SER1	Serial Number	Default
SER2	Serial Number	Default
SEt.MLVL		
LEVL	Parameter display level	Std

OPE		
OPE.MSP		
SP	Target setpoint	335
A1	Alarm Setpoint	0.0
A2	Alarm Setpoint	0.0
A3	Alarm Setpoint	0.0
OPE.MSPS		
tMU	Time Unit for Duration Time	Default: HH.MM
OPE.MALRM		
AL1	Alarm Type	0.0.0.00: Disabled
AL2	Alarm Type	0.0.0.00: Disabled
AL3	Alarm Type	0.0.0.00: Disabled
Vt1	PV Velocity Alarm Time Setpoint	1.00
Vt2	PV Velocity Alarm Time Setpoint	1.00
Vt3	PV Velocity Alarm Time Setpoint	1.00
HY1	Alarm Hysteresis	1.0
HY2	Alarm Hysteresis	1.0
HY3	Alarm Hysteresis	1.0
OPE.MPVS		
bS	PV Input BIAS	0.0
FL	PV Input Filter	OFF
HYS	Limit Control Output Hysteresis	2.5

HEATEC,INC.
5200 Wilson Road
Chattanooga, TN 37410
Phone: (423) 821-5200

HEATEC

HI16-251 UT35A High Stack Limit Setup

PROMPT	DESCRIPTION	SELECTION
SEt		
SEt.MCtL		
HI.LO	Limit Control type	HIGH
CNF	The Way of Confirming Operation	KEY
SEt.MPV		
IN	Input type	J
UNIt	PV input unit	F
RH	Maximum value of PV	1000.0
RL	Minimum value of PV	0.0
bSL	PV input burnout	UP
A.bS	PV Analog input bias	0.0
A.FL	PV Analog input filter	OFF
SEt.M MPV		
P.UNI	Control PV input unit	F
P.dP	Control PV input decimal point position	1
P.RH	Maximum value of Control PV input range	1000.0
P.RL	Minimum value of Control PV input range	0.0
SPH	SP High Limit	1000.0
SPL	SP Low Limit	0.0
SEt.M Out		
RtS	Retransmission output type	PV1
RtH	Maximum value Retran. output scale of current	1000.0
RtL	Minimum value Retran. output scale of current	0.0
REt.A	Current output range	41384.0
SEt.MR485		
PSL	Protocol Selection	MbRTU
bPS	BUAD Rate	19200
PRI	Parity	EVEN
StP	Stop Bit	1
dLN	Data Length	8
AdR	Address	1
SEt.MKEY		
F1	User function key action	Default: OFF
F2	User function key action	Default: OFF
FN	User function key action	Default: PID
SEt.MdISP		
PCMd	Active color PV display switch	9: SP deviation
PCH	PV Color Change High Limit	750.0
PCL	PV Color Change Low Limit	0.0
GUId	Guide Display on/off	ON
ECO	Economy mode	OFF
bRI	Brightness	3
MLSd	Least significant digital mask of PV display	OFF
SEt.MKLOC		
COM.W	Communication write enable/disable	OFF
dAtA	Front panel parameter data key lock	OFF
SEt.MdI.SL		
dI2.5	DI2 funtction selection	OFF

SEt.MSYS		
R.Md	Restart mode	1
FREQ	Power frequency	AUTO
QSM	Quick start setting mode	OFF
PASS	Password Setting	0
SEt.MVER		
PA.ER	Parameter Error Status	Default
OP.ER	Option Error Status	Default
AdI.E	A/D Converter Error Status	Default
PVI.E	PV Input Error Status	Default
MCU	MCU Version	Default
dCU	DCU Version	Default
ECU3	ECU Version	Default
PARA	Parameter Version	Default
H.VER	Product Version	Default
SER1	Serial Number	Default
SER2	Serial Number	Default
SEt.MLVL		
LEVL	Parameter display level	Std

OPE		
OPE.MSP		
SP	Target setpoint	850
A1	Alarm Setpoint	0.0
A2	Alarm Setpoint	0.0
A3	Alarm Setpoint	0.0
OPE.MSPS		
tMU	Time Unit for Duration Time	Default: HH.MM
OPE.MALRM		
AL1	Alarm Type	0.0.0.00: Disabled
AL2	Alarm Type	0.0.0.00: Disabled
AL3	Alarm Type	0.0.0.00: Disabled
Vt1	PV Velocity Alarm Time Setpoint	1.00
Vt2	PV Velocity Alarm Time Setpoint	1.00
Vt3	PV Velocity Alarm Time Setpoint	1.00
HY1	Alarm Hysteresis	1.0
HY2	Alarm Hysteresis	1.0
HY3	Alarm Hysteresis	1.0
OPE.MPVS		
bS	PV Input BIAS	0.0
FL	PV Input Filter	OFF
HYS	Limit Control Output Hysteresis	2.5

HEATEC,INC.
5200 Wilson Road
Chattanooga, TN 37410
Phone: (423) 821-5200

HEATEC

HI16-251 UT55A Modulation Setup

PROMPT	*DESCRIPTION*	*SELECTION*
SEt		
SEt.M CtL		
CNt	Control type	PID
SPGR.	Number of setpoint groups	Default: 8
ZON	Zone PID selection	0
PIdG.	Number of PID groups	Default: 8
SMP	Input sampling period	100
SEt.M PV		
IN	Input type	J: -300°F to 2300°F
UNIt	PV input unit	F
RH	Maximum value of PV	400
RL	Minimum value of PV	0
bSL	PV input burnout action	UP
SEt.M RSP		
IN	RSP Remote input type	1-5V
UNIt	Remote input unit	F
RH	Maximum value of RSP remote input	5
RL	Minimum value of RSP remote input	1
SdP	Decimal point position	1
SH	Maximum value of RSP	400
SL	Minimum value of RSP	0
bSL	RSP Burnout action	OFF
SEt.M MPV		
P.UNI	Control PV input unit	F
P.dP	Control PV input decimal point position	1
P.RH	Maximum value of control PV input	400
P.RL	Minimum Value of control PV input	0
SPH	Setpoint high limit	400
SPL	Setpoint low limit	0
SEt.M Out		
Ot	Output type selection	00.02: OUT terminals (current)
Ct	Control output cycle time	30.0
RtS	Retransmission output type	PV1
RtH	Maximum value of retransmission output	400
RtL	Minimum value of retransmission output	0
O1RS	Retransmission output type of out current output	OFF
OU.A	Out current output range	4-20:4 to 20 mA
REt.A	Retransmission current output range	4-20:4 to 20 mA
SEt.M KEY		
F1	User function key action	Default: OFF
F2	User function key action	Default: OFF
FN	User function key action	Default: PID
SEt.M dISP		
dVb	Deviation display band	6.1
PCMd	Active color PV display switch	2: Linked alarm 1 (red screen = alarm)
bAR1	Upper bar graph display registration	5: Deviation
bAR2	Lower bar gragh display registration	1: Heating side OUT
bdV	Bar-gragh deviation display band	6.1
GUId	Guide display on/off	ON
ECO	Economy mode	OFF
bRI	Display brightness	5
MLSd	Least significant digital mask of pv display	OFF

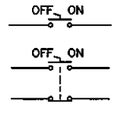
PROMPT	DESCRIPTION	SELECTION
SEt.M KLOC		
COM.W	Communication write enable/disable	OFF
dAtA	Front panel parameter data key lock	OFF
A/M	Front panel A/M key lock	OFF
SEt.M SyS		
R.Md	Restart mode	CONT: Follow action set before failure
R.tM	Restart timer	0
EPO	Input error preset output	0: Preset output
FREQ	Power frequency	AUTO
QSM	Quick start setting mode	OFF
LANG	Guide display language	ENG: English
PASS	Password setting	0
SEt.M LVL		
LEVL	Parameter display level	Std: Standard
OPE		
OPE.M MOdE		
R.L	Remote local switch	LCL
At	Auto-tuning switch	OFF
SPNO.	Setpoint number selection	1
Pld	PID number	1
OPE.M ALM		
AL1	Alarm 1 type	0.1.0.05: Deviation High limit
AL2	Alarm 2 type	0.1.0.00: Disabled
AL3	Alarm 3 type	0.0.0.00: Disabled
AL4	Alarm 4 type	0.0.0.00: Disabled
Vt1	PV velocity alarm time setpoint	1
HY1	Alarm 1 Hysteresis	20
dyN1	Alarm 1 on-delay timer	0
AMd	Alarm mode	0: Always active
OPE.M SP		
SP	Target setpoint	305
PIdN	PID number selection	1
A1	Alarm 1 setpoint	10
OPE.M SPS		
RMS	Remote input method	RSP: Via analog input
RFL	Remote input filter	OFF
Rt	Remote input ratio	1
RbS	Remote input bias	0
UPR	SP ramp-up rate	OFF
dNR	SP ramp-down rate	OFF
tMU	SP ramp-rate time unit	Default: HOUR
SPt	SP tracking selection	ON
PVt	PV tracking selection	OFF
OPE.M PVS		
bS	PV input bias	0
FL	PV input filter	OFF
OPE.M PId		
P	Proportional band	5: Default
I	Integral time	240: Default
d	Derivative time	60: Default
OH	Out-put High	100%: Default
OL	Out-put Low	0%: Default
OPE.M tUNE		
SC	Super function	OFF
At.tY	Auto-tuning type	0: Normal
AR	Anti-reset windup	Auto

OPR	Output velocity limiter	OFF
MPON	Manual preset output number selection	OFF: Hold control in auto

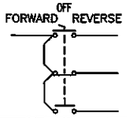
SECTION 3
DRAWINGS

Selector Switches

Two Position



Three Position



Push Buttons

Normally Open Momentary

Normally Closed Momentary

Ground Connections

Ground Termination Point (Terminal, etc.)

Equipment Ground

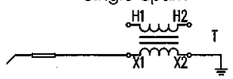
Alarms

Alarm Bell

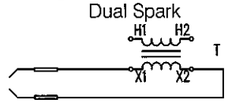
Alarm Horn

Transformers

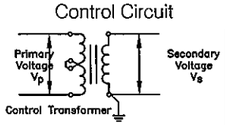
Ignition Transformer Single Spark

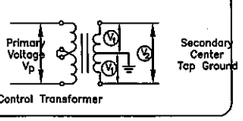


Ignition Transformer Dual Spark



Step-Down Transformer Control Circuit





Coil Loads

Time Clock Motor

Motor Contactor

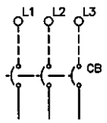
Control Relay

Solenoids

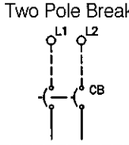
Pilot Light (Letter Denotes Color)

Circuit Protection

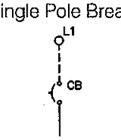
Three Pole Breaker



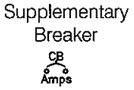
Two Pole Breaker



Single Pole Breaker



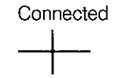
Supplementary Breaker



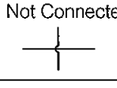
Fuse

Wire Connections

Connected



Not Connected



Contacts

Time Delay After Coil Energized Normally Open

Time Delay After Coil Energized Normally Closed

Time Delay After Coil De-Energized Normally Open

Time Delay After Coil De-Energized Normally Closed

Temperature Control Auxiliary Normally Open

Temperature Control Auxiliary Normally Closed

Limit Switch Auxiliary

Normally Open	Normally Open Held Closed
ZSH	ZSL
Normally Closed	Normally Closed Held Open
ZSL	ZSL

Temperature Controller Limit Switch

Normally Open	Normally Closed
TSH	TSH

Level Switch

Normally Open	Normally Closed
LSL	LSL

Pressure Switch

Normally Open	Normally Closed
PSL	PSL

Auxiliary Contacts

Time Clock Auxiliary

Normally Open	Normally Closed
TC	TC

Control Relay Auxiliary

Normally Open	Normally Closed
LML	LML

Motor Contactor Auxiliary

Normally Open	Normally Closed
MC	MC

Temperature Controller Auxiliary

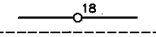
Normally Open	Normally Closed
TIC	TIC

Circuit Breaker Auxiliary

Normally Open	Normally Closed
CB	CB

Terminals

Local Terminal Strip Terminal



Remote Terminal Strip Terminal

PLC Terminal - I/O

Input : Slot Position / Input Address

I:3/14

Output : Slot Position / Input Address

O:3/14

Fused Terminals

Flame Safeguard Terminals

3

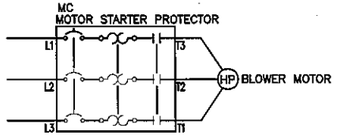
Temperature Controller Terminals

21

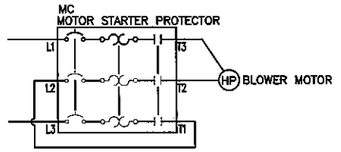
Flame Safeguard Annunicator Terminals

21

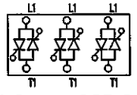
Motors and Controllers



Three Phase Motor



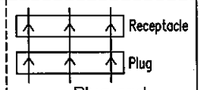
Single Phase Motor



Soft Start or SCR Controller

Amp Meter

Current Transformer



Plug and Receptacle

Legend For Electrical Enclosure

1. Enclosure Control Wiring Shall Be 18, 16 & 14 Awg as Required.
2. All Control Wiring Exiting Enclosure Shall Be 16 Awg Minimum.
3. All Dashed Wiring by Customer.
4. Enclosure and Junction Boxes Shall Be Nema 4 Minimum.
5. Thermocouple and Analog 4-20mA Wiring Shall Be Run In Dedicated Conduit.
6. Scanner Wiring Shall be Run in Dedicated Conduit.

Torque Setting Range for Terminal Screws

Fireye Base	0.50 to 0.59 Nm
IDEC Relay Base	1.01 to 1.29 Nm
Yokogawa Controller	0.5 to 0.6 Nm
GE Contacts/Pilot Lights	0.79 to 1.35 Nm
SQ D Control Transformer	0.67 to 1.01 Nm
AB CP Logix	0.68 Nm
AB Control Logix	1.36 Nm
Siemens Supplementary Breaker	2.0 to 2.5 Nm
Siemens 3TG Relays	0.8 - 1.2 Nm

Bussman Series: CH

18-12 Awg Single Conductor	2.3 Nm
18-10 Awg Dual Conductor	2.8 Nm

Siemens Series: ED (LN1E100)

14-10 Cu	32 lb-in. / 3.6 Nm
10 Cu/Al	30 lb-in. / 3.4 Nm
8 Cu/Al	36 lb-in. / 4.1 Nm
6-4 Cu/Al	45 lb-in. / 5.1 Nm
3 Cu/Al	50 lb-in. / 5.6 Nm
2-1/0 Cu/Al	60 lb-in. / 6.8 Nm
3-3/0 Cu	80 lb-in. / 9.0 Nm

Starter Frame Size	/	Torque
S00	/	0.8 - 1.2 Nm
S0	/	2.0 - 2.5 Nm
S2	/	3.0 - 4.5 Nm
S3	/	4.0 - 6.0 Nm

North American Wiring

1. Enclosure Power Wiring Colors
   Power - Black L1,L2,L3
2. Control Wiring Colors
   (120V HOT) Power - Black
   Switched - Red
   Ground - Green
   Neutral - White
   DC - Blue
3. Thermocouples
   Use the Thermocouple Wire
4. Tach or Signal Wire
   Use Belden Cable

Australian Wiring

1. Enclosure Power Wiring Colors
   Power: L1 - Red
   L2 - White
   L3 - Blue
   Ground - Green / Yellow
   Neutral - Black
2. Control Wiring Colors
   L1 - Red
   Control - Blue
   L2 - Black
   Ground - Green / Yellow
   DC - Dark Blue

European Wiring

1. Warning sign next to Disconnect
2. Drawing Pocket in each Power Panel
3. Ground all Console or Power Panel Doors to Enclosure
4. Color of Conductors:
   Black for Line
   Green & Yellow for Ground
   Light Blue for Neutral
   Red for Control Wiring
5. Emergency Stop Color Red only with Yellow Background
6. Push Button Start Color -- White, Gray or Black
   Push Button Stop Color -- Black, Gray, or White
7. Each Enclosure inside Panel Assembly will have One or More Name Plates

APPROVED FOR CONSTRUCTION

UOP Russell LLC
P.O. # 4500702110
TRCO. Job #TRJ-441
Tag Number: H-781
Heatec Job Number: HI16-251
HCI 5010-40-G Therm 55 Heater

REV.	DESCRIPTION	DATE	CHKD. APPR.	BY
2	As Built By Heatec	4/27/17	DJC	
1	Submitted to Customer for Approval	1/24/2017	DJC	

JOB # HI16-251
WO # 16-251-551
ISSUE DATE

CUSTOMER: UOP Russell

DRAWING NAME: Legend to Electrical Enclosure Cover Sheet FOR REFERENCE ONLY

HEATEC INC. an Andco company
P.O. BOX 72760 CHATTANOOGA, TN 37407
PHONE (423) 821-5200 FAX (423) 821-7573

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APPROVED DATE
CHKD DATE
DWN DATE DJC 1/23/2017
DWG/PART NO. 16251-CS

EQUIPMENT GROUND (PER NEC)
#12 AWG GREEN WIRE

480V / 3PH / 60HZ
Power Supply Provided
By Customer

L1 L2 L3

Motor Starters
And Wiring
By Customer

M 4-1
COMBUSTION AIR
BLOWER MOTOR
25 HP / 3520 RPM / 29 FLA

P 1-1
CIRCULATION PUMP
1A MOTOR
20 HP / 3450 RPM / 23 FLA

P 1-2
CIRCULATION PUMP
1B MOTOR
20 HP / 3450 RPM / 23 FLA

Place Label Inside Of Enclosure Door

Short circuit current:
65kA rms symmetrical, 120V maximum

WARNING
Risk of Fire or Electric Shock — The opening of the branch-circuit protective device may be an indication that a fault current has been interrupted. All current-carrying parts and other components protected by this device should be examined and replaced if damaged. If burnout of a current element of an overload relay occurs, the complete overload relay must be replaced.

NOTE:
See Heatec Standard
Electrical Practice Wire and
Terminal Colors Publication
HSP 7-11-002

Last Terminals
Used:
62 / C70

120 Volt Power
Supply by Customer

HTR CPB DISC 1
20 AMP MAIN
DISCONNECT

PHOENIX CONTACT
3031487 52 AMP MAX
TERMINAL FOR
CUSTOMERS INCOMING
POWER

GROUND LUG

#14 Awg BLK

#14 Awg WHT

HTR CPB ESD 1
EMERGENCY SHUTDOWN
LOCAL PUSHBUTTON

HTR CPB RESD 1
REMOTE EMERGENCY
SHUTDOWN FROM CUSTOMER

HTR CPB ESD 1
EMERGENCY SHUTDOWN
RELAY

ESD1 ESD2 ESD3

ESD

2 EMERGENCY SHUTDOWN RELAY
NO 44
NC 32

#16 Awg WHT

#16 Awg RED

#16 Awg BLK

#14 Awg BLK

F-2

To CW1 120 Volt
Control Wiring

To CW1 120 Volt Neutral
Control Wiring

POWER ON

APPROVED
FOR
CONSTRUCTION

UOP Russell LLC
P.O. # 4500755147
TRCO. Job #TRJ-447
Tag Number: H-781
Heatec Job Number: HI16-251
HCI 5010-40-G Therm 55 Heater

REV.	DESCRIPTION	DATE	CHKD.	APPR.	BY
2	As Built By Heatec	4/27/17			DJC
1	Submitted to Customer for Approval	1/24/2017			DJC

JOB # HI16-251
WO # 16-251-551
ISSUE DATE

CUSTOMER: UOP Russell LLC

DRAWING NAME: HCI 5010-40-G
Power Wiring
Eclipse WINNOX 850 Burner

HEATEC INC.
an Aalco company
P.O. BOX 72760 CHATTANOOGA, TN. 37407
PHONE (423) 821-2000 FAX (423) 821-7673

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APPROPRIATE

DWN. DATE DJC 1/20/2017
CHK. DATE
DWG/PART NO. 16251-PW

120VAC / 1Ph / 60Hz Overload Protected Power Supplied From Heatec Control Transformer

EQUIPMENT GROUND (PER NEC) #12 AWG GREEN WIRE

WIRE SIZE: #16 Awg

Note: 24 Volt Idec Relays for Customer Connection

- C1 — BLU — HTR CPB RBC 1 (14/13) — BLU — C2: 24VDC REMOTE BURNER CONTROL (CALL FOR HEAT); CUSTOMER USE NO 203 NC
- C3 — BLU — HTR CPB RESD 1 (14/13) — BLU — C4: 24VDC REMOTE EMERGENCY SHUTDOWN; CUSTOMER USE NO 37 NC

Note: Relay Contacts for Customer Connections

- C5 — ORG — HTR CPB LNA 1 (9/5) — ORG — C6: 115 LOW NITROGEN ALARM
- C7 — ORG — HTR CPB LNA 1 (10/2) — ORG — C8: 115 LOW NITROGEN ALARM
- C9 — ORG — HTR CPB LML 1 (11/7) — ORG — C10: 113 LO MEDIA LEVEL
- C11 — ORG — HTR CPB LML 1 (12/4) — ORG — C12: 113 LO MEDIA LEVEL
- C13 — ORG — HTR CPB LGP 1 (10/6) — ORG — C14: 119 LOW NATURAL GAS PRESSURE
- C15 — ORG — HTR CPB LGP 1 (11/3) — ORG — C16: 119 LOW NATURAL GAS PRESSURE
- C17 — ORG — HTR CPB HGP 1 (10/6) — ORG — C18: 121 HIGH NATURAL GAS PRESSURE
- C19 — ORG — HTR CPB HGP 1 (11/3) — ORG — C20: 121 HIGH NATURAL GAS PRESSURE
- C21 — ORG — HTR CPB LMDP 1 (10/6) — ORG — C22: 123 LOW MEDIA DIFFERENTIAL PRESSURE
- C23 — ORG — HTR CPB LMDP 1 (11/3) — ORG — C24: 123 LOW MEDIA DIFFERENTIAL PRESSURE
- C25 — ORG — HTR CPB HMDP 1 (11/7) — ORG — C26: 125 HIGH MEDIA DIFFERENTIAL PRESSURE
- C27 — ORG — HTR CPB HMDP 1 (10/2) — ORG — C28: 125 HIGH MEDIA DIFFERENTIAL PRESSURE
- C29 — ORG — HTR CPB LCA 1 (10/6) — ORG — C30: 127 LOW COMBUSTION AIR PRESSURE
- C31 — ORG — HTR CPB LCA 1 (11/3) — ORG — C32: 127 LOW COMBUSTION AIR PRESSURE
- C33 — ORG — HTR CPB ALM 1 (9/5) — ORG — C34: 228 ALARM RELAY
- C35 — ORG — HTR CPB ALM 1 (10/2) — ORG — C36: 228 ALARM RELAY
- C37 — ORG — HTR CPB HR 1 (10/6) — ORG — C38: 223 HEATER RUNNING RELAY
- C39 — ORG — HTR CPB HR 1 (11/3) — ORG — C40: 223 HEATER RUNNING RELAY
- C41 — ORG — HTR CPB PSRL 1 (10/6) — ORG — C42: 104 PUMP P1-1 PLAN RESERVOIR HIGH LEVEL
- C43 — ORG — HTR CPB PSRL 1 (11/3) — ORG — C44: 104 PUMP P1-1 PLAN RESERVOIR HIGH LEVEL
- C45 — ORG — HTR CPB PSRL 2 (10/6) — ORG — C46: 107 PUMP P1-2 PLAN RESERVOIR HIGH LEVEL
- C47 — ORG — HTR CPB PSRL 2 (11/3) — ORG — C48: 107 PUMP P1-2 PLAN RESERVOIR HIGH LEVEL

- HTR CPB LML 1 (10/5) — RED — 41 — HTR CPB HST 1 (10/5) — 159 — HIGH STACK TEMPERATURE LIMIT — 62 — HTR CPD Off P1-1 / P1-2 — 42 — RED — HTR CPB PSRL 1 (9/5) — 104 — PUMP P1-1 PLAN RESERVOIR HIGH LEVEL — 43 — RED — HTR CPB CPR 1 (10/6) — 86 — HTR CPD CPR 1 (G) — 44 — PUMP P1-1 RUNNING
- HTR CPB LML 1 (10/5) — 113 — LOW MEDIA LEVEL
- HTR CPD Off P1-1 — RED — HTR CPB CPS 1 (14/13) — CIRC PUMP M 1-1 RUN COMMAND (TO CUSTOMER) NO 94 NC
- HTR CPB CPR 1 (14/13) — CIRC PUMP RUN CIRC PUMP M 1-1 RUN CONFIRMATION NO 83,203 NC
- C49 — MCC M 1-1 (CUSTOMERS) MCC PUMP 1-1 MOTOR STARTER AUX CONTACT — C50 — 45
- HTR CPD Off P1-2 — 46 — RED — HTR CPB PSRL 2 (9/5) — 107 — PUMP P1-2 PLAN RESERVOIR HIGH LEVEL — 47 — RED — HTR CPB CPR 2 (10/6) — 91 — HTR CPD CPR 2 (G) — 48 — PUMP P1-2 RUNNING
- S-3 PUMP SELECTOR SWITCH
- HTR CPB CPS 2 (14/13) — CIRC PUMP M 1-2 RUN COMMAND (TO CUSTOMER) NO 96 NC
- HTR CPB CPR 2 (14/13) — CIRC PUMP RUN CIRC PUMP M 1-2 RUN CONFIRMATION NO 88,205 NC
- C51 — MCC M 1-2 (CUSTOMERS) MCC PUMP 1-2 MOTOR STARTER AUX CONTACT — C52 — 49

Pump & Combustion Air Motor start Signal Relay Contacts for Customer Connections

- C53 — ORG — HTR CPB CPS 1 (10/6) — ORG — C54: 84 CIRC PUMP M 1-1 RUN COMMAND (TO CUSTOMER)
- C55 — ORG — HTR CPB CPS 1 (11/3) — ORG — C56: 84 CIRC PUMP M 1-1 RUN COMMAND (TO CUSTOMER)
- C57 — ORG — HTR CPB CPS 2 (10/6) — ORG — C58: 89 CIRC PUMP M 1-2 RUN COMMAND (TO CUSTOMER)
- C59 — ORG — HTR CPB CPS 2 (11/3) — ORG — C60: 89 CIRC PUMP M 1-2 RUN COMMAND (TO CUSTOMER)
- C61 — ORG — HTR CPB SCAS 1 (9/5) — ORG — C62: 212 START COMBUSTION AIR BLOWER MOTOR SIGNAL TO CUSTOMER

Note: 120 Volt Idec Relay for Customer Connection

- C63 — COMBUSTION AIR BLOWER RUN CONTACT — C64 — RED — HTR CPB CABR 1 (14/13) — COMBUSTION AIR BLOWER STARTER ENERGIZED 131 SIGNAL FROM CUSTOMER NO 203 NC
- LSH 1-1 HIGH RESERVOIR LEVEL (L1 / L2/N) — 50 — RED — HTR CPB PSRL 1 (14/13) — PUMP P1-1 PLAN RESERVOIR HIGH LEVEL NO 78,84 NC
- LSH 1-2 HIGH RESERVOIR LEVEL (L1 / L2/N) — 51 — RED — HTR CPB PSRL 2 (14/13) — PUMP P1-2 PLAN RESERVOIR HIGH LEVEL NO 78,89 NC

Located Inside The Skid Mounted Junction Panel

- LSL 2-1 LO MEDIA LEVEL — 52 — RED — HTR CPB LML 1 (14/13) — LO MEDIA LEVEL NO 60,84,203 NC
- PSL 2-1 LOW NITROGEN LEVEL — 53 — RED — HTR CPB LNA 1 (14/13) — LOW NITROGEN ALARM NO 58 NC 58,117
- HTR CPB LNA 1 (11/3) LOW NITROGEN ALARM — 54 — RED — HTR CPB CPR 1 (R) — LOW NITROGEN ALARM
- HTR FUEL PSL 5-1 LOW NATURAL GAS PRESSURE — 55 — RED — HTR CPB LGP 1 (14/13) — LOW NATURAL GAS PRESSURE NO 62,203 NC
- HTR FUEL PSH 5-1 HIGH NATURAL GAS PRESSURE — 56 — RED — HTR CPB HGP 1 (14/13) — HIGH NATURAL GAS PRESSURE NO 64,203 NC
- HTR COIL PDSL 1-1 MEDIA LOW DIFFERENTIAL PRESSURE — 57 — RED — HTR CPB LMDP 1 (14/13) — LOW MEDIA DIFFERENTIAL PRESSURE NO 66,203 NC
- HTR COIL PDSH 1-1 MEDIA HIGH DIFFERENTIAL PRESSURE — 58 — RED — HTR CPB HMDP 1 (14/13) — HIGH MEDIA DIFFERENTIAL PRESSURE NO 68,203 NC
- HTR BNR PSL 4-1 LOW COMBUSTION AIR PRESSURE — 59 — RED — HTR CPB LCA 1 (14/13) — LOW COMBUSTION AIR PRESSURE NO 70,203 NC

APPROVED FOR CONSTRUCTION

UOP Russell LLC
P.O. # 4500755147
TRCO. Job #TRJ-447
Tag Number: H-781
Heatec Job Number: HI16-251
HCI 5010-40-G Therm 55 Heater

REV.	DESCRIPTION	DATE	CHKD. APPR.	BY
2	As Built By Heatec	4/27/17		DJC
1	Submitted to Customer for Approval	1/24/2017		DJC

ISSUE DATE

JOB # HI16-251

WO # 16-251-551

HEATEC INC. an Aztec company
P.O. BOX 72760 CHATTANOOGA, TN. 37407
PHONE (423) 821-5200 FAX (423) 821-7673

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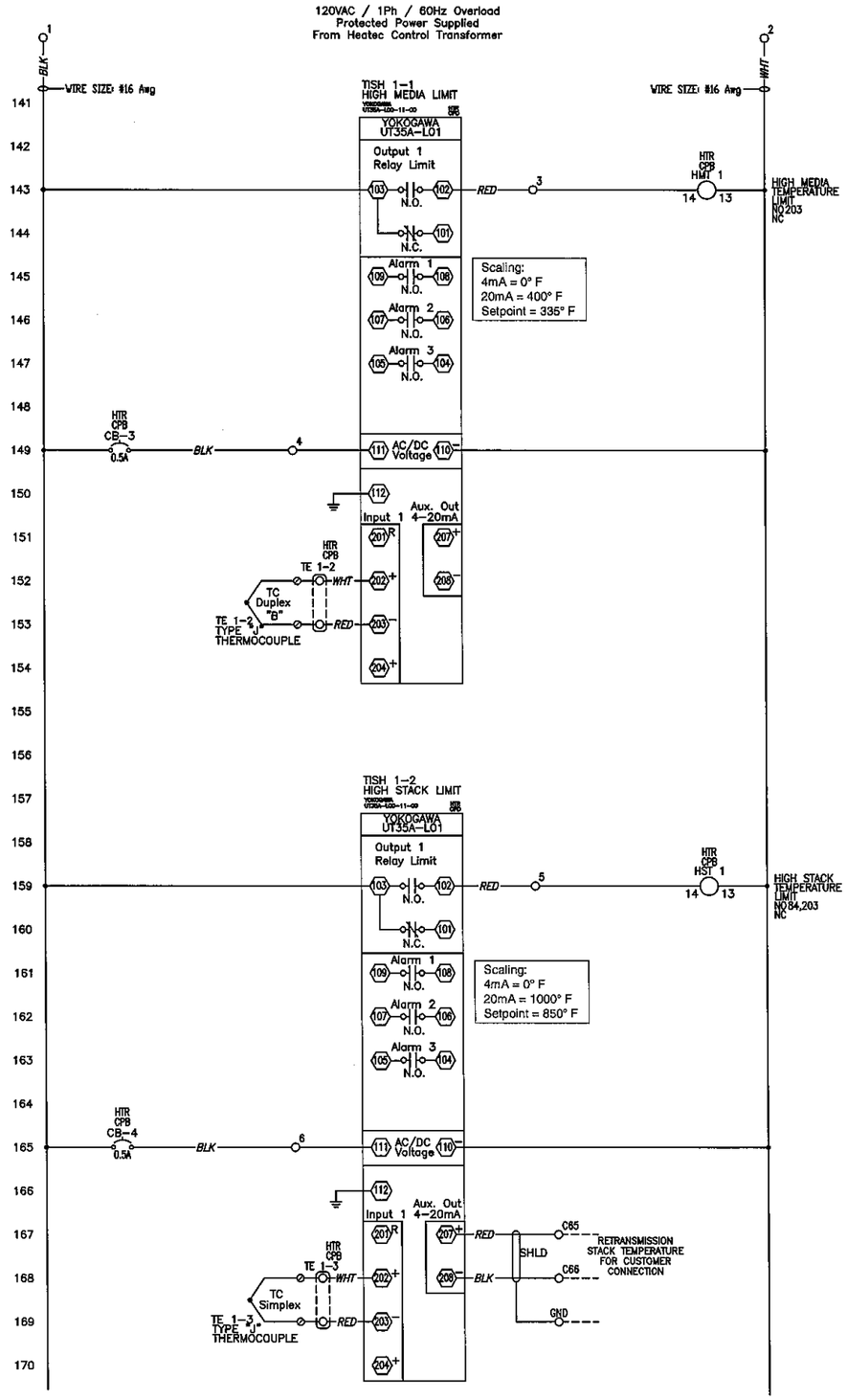
APPROVED DATE | CSKD. DATE

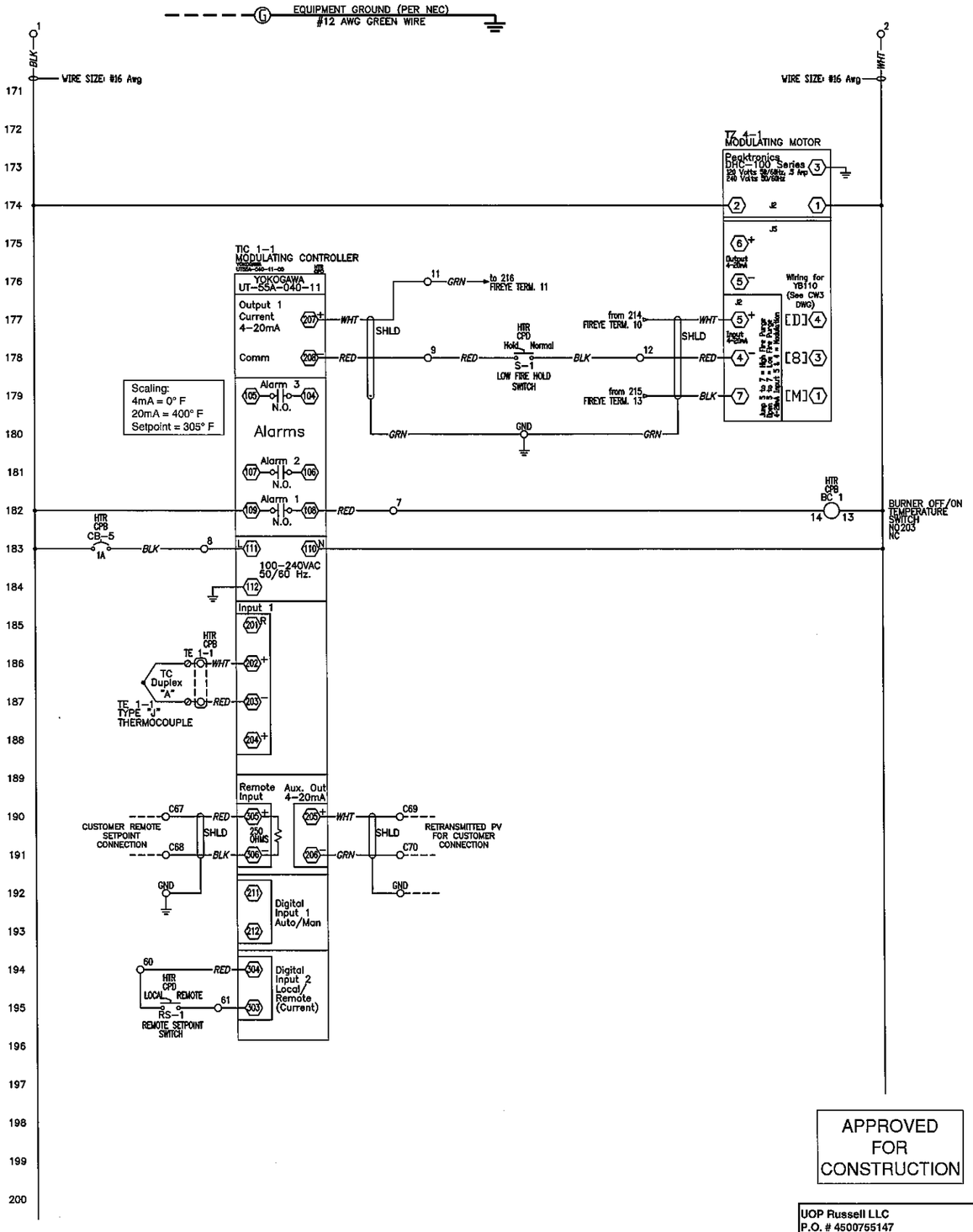
DWN. DATE DJC 1/20/2017

DWG/PART NO. 16251-CW1

CUSTOMER: UOP Russell LLC

DRAWING NAME: HCI 5010-40-G Control Wiring Page 1





APPROVED FOR CONSTRUCTION

UOP Russell LLC
P.O. # 4500755147
TRCO. Job #TRJ-447
Tag Number: H-761
Heatec Job Number: HI16-251
HCI 5010-40-G Therm 55 Heater

REV.	DESCRIPTION	DATE	CHKD.	APPRD.	BY
2	As Built By Heatec	4/27/17			DJC
1	Submitted to Customer for Approval	1/24/2017			DJC

ISSUE DATE

JOB # HI16-251

WO # 16-251-551

CUSTOMER: UOP Russell LLC

DRAWING NAME: HCI 5010-40-G Control Wiring Page 2

HEATEC INC. an Astec company
P.O. BOX 72760 CHATTANOOGA, TN. 37407
PHONE (423) 821-5200 FAX (423) 821-7673

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DRAWN DATE: DJC 1/23/2017
CHKD. DATE:
APPROVED DATE:

DWG/PART NO.: 16251-CW2

16251-CW3

BMS 1-1
BURNER MANAGEMENT
Fireye
YB110UVSC/YP138

120 VAC, 50/60 Hz Power

BMA 1-1
ANNUNCIATOR

FIREYE YZ300

YP100 Function: Terminal 10 to X = High Fire Purge, Terminal 10 to 12 = Low Fire Purge, Terminal 10 to 11 = Normal Modulation
Note: Jumper 6 to 7 on Straight Off Burners

YP138 Programming:
Purge Time = 90 Sec.
Count Method = Down
Prove S-P Open At Start = Yes
Prove S-P Open During Run = Yes
Terminal 5 = Interrupted Pilot

Baud Rate = 9600
Unit Address = 00
Lockout Select = Yes (After Startup)
DO IR LEARN = N/A

Prove M-S open = Yes
Prove M-D open = Yes
Post Purge Time = 15 Sec
Pilot Purge Time = 15 Sec
Prove M-D TR = Yes

WIRE SIZE: #16 Awg

HTR CPD S-2 BURNER OFF/ON
HTR CPB BC 1 182 BURNER OFF/ON
HTR CPB REC 1 53 REMOTE BURNER CONTROL (CALL FOR HEAT)
HTR CPB LML 1 111 LOW MEDIA LEVEL
Jumper
HTR CPB LGP 1 119 LOW NATURAL GAS PRESSURE
HTR CPB HGP 1 121 HIGH NATURAL GAS PRESSURE
HTR CPB LMDP 1 123 LOW MEDIA DIFFERENTIAL PRESSURE
HTR CPB HMDP 1 125 HIGH MEDIA DIFFERENTIAL PRESSURE
HTR CPB HMT 1 143 HIGH MEDIA TEMPERATURE LIMIT
HTR CPB HST 1 159 HIGH STACK TEMPERATURE LIMIT
HTR CPB CPR 1 86 CIRC PUMP RUN CIRC PUMP M 1-1
HTR CPB CPR 2 91 CIRC PUMP RUN CIRC PUMP M 1-2
HTR CPB CASR 1 101 COMBUSTION AIR BLOWER STARTER ENERGIZED SIGNAL FROM CUSTOMER
HTR CPB LCA 1 127 LOW COMBUSTION AIR PRESSURE
Jumper x5

HTR FUEL ZSC 5-2 FUEL GAS PROOF OF CLOSURE
HTR FUEL ZSC 5-1 FUEL GAS PROOF OF CLOSURE
HTR FUEL ZSC 3-2 PILOT GAS PROOF OF CLOSURE
HTR FUEL ZSC 3-1 PILOT GAS PROOF OF CLOSURE

HTR AIR DMPR HIGH FIRE PROOF SWITCH ZSH 4-1
TRIAC Actuator Peaktronics OTR-100 Terminals 1-7
HTR AIR DMPR LOW FIRE PROOF SWITCH ZSL 4-1

SHLD
GND
to 177 FIREYE TERM. 10
to 179 FIREYE TERM. X
from 176 TO FIREYE TERM. 11

RUN SEPARATE NEUTRAL FOR TRANSFORMER
HTR CPB IGNITION TRANSFORMER IT 4-1 H1 H2 X1 X2

HTR FUEL XV 3-1 NC PILOT GAS PRIMARY VALVE
HTR FUEL XV 3-2 NC PILOT GAS SECONDARY VALVE
HTR FUEL XV 5-3 NO MAIN GAS VENT VALVE
HTR FUEL XV 5-2 NC MAIN GAS SECONDARY VALVE
HTR FUEL XV 5-1 NC MAIN GAS PRIMARY VALVE
HTR CPB HR 1 14 13 HEATER RUNNING RELAY NO74 NC74
HTR CPB ALSL 1 227 ALARM HORN
HTR CPD AH 1-1 ALARM HORN
HTR CPB ALSL 1 227 HEATER ALARM SILENCED
HTR CPD IL-2 HEATER ALARM SILENCED
HTR CPD PB-1 ALARM SILENCE
HTR CPB ALSL 1 14 13 ALARM SILENCE RELAY NO226 NC225
HTR CPB ALM 1 14 13 COMMON ALARM RELAY NO72 NC72
HTR CPB SCAR 1 14 13 START COMBUSTION AIR BLOWER MOTOR SIGNAL TO CUSTOMER NO98 NC

Run scanner wiring in seprate conduit.
FIREYE 45UV5-1009 Self Check UV Scanner
120 VAC, 50/60 Hz Power
BE 4-1 SELF-CHECK SCANNER

Fireye Annunciator Messages

Message	Meaning
BNR SWITCH OFF	Burner switch in off position
BNR TEMP OFF	Burner Relay no call for heat
REM BNR CNTL	Remote Burner Control (Call for Heat)
LO MEDIA LEVEL	Low Media Level Switch
LO GAS PRES	Low Natural Gas Pressure
HI GAS PRES	High Natural Gas Pressure
LO MED DIF PRES	Low Media Differential pressure
HI MED DIF PRES	High Media Differential pressure
HI MED TEMP	High media temperature contact
HI STACK TEMP	High flue gas stack temperature contact
CIR PMP AUX CT	Circulation pump relay contacts signal
AIR AUX CT	Combustion air blower motor Running relay
LO AIR PRES	Low combustion air pressure contact

APPROVED FOR CONSTRUCTION

UOP Russell LLC
P.O. # 4500755147
TRCO. Job #TRJ-447
Tag Number: H-781
Heatec Job Number: HI16-251
HCI 5010-40-G Therm 55 Heater

REV.	DESCRIPTION	DATE	CHKD. APPR.	BY
2	As Built By Heatec	4/27/17		DJC
1	Submitted to Customer for Approval	1/24/2017		DJC

ISSUE DATE
JOB # HI16-251
WO # 16-251-551

CUSTOMER: UOP Russell LLC

DRAWING NAME: HCI 5010-40-G Control Wiring Page 3

HEATEC INC. an Astec company
P.O. BOX 72760 CHATTANOOGA, TN. 37407
PHONE (423) 821-5200 FAX (423) 821-7673

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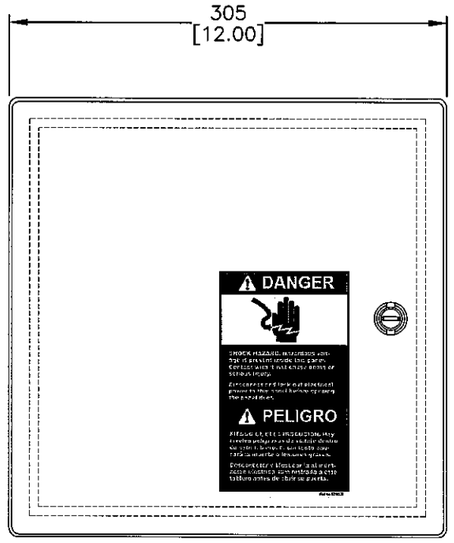
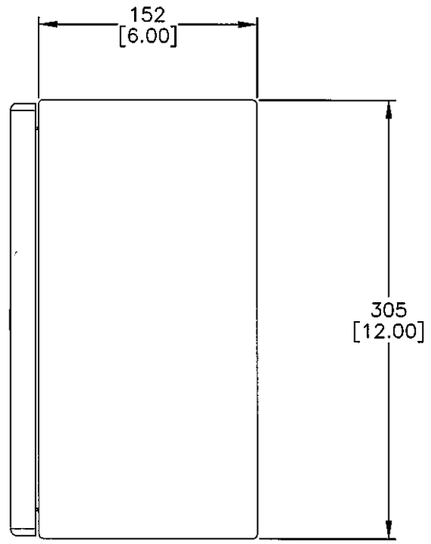
DWN. DATE DJC 1/23/2017 CHKD. DATE APPR. DATE

DWG/PART NO. 16251-CW3

16251-JPL

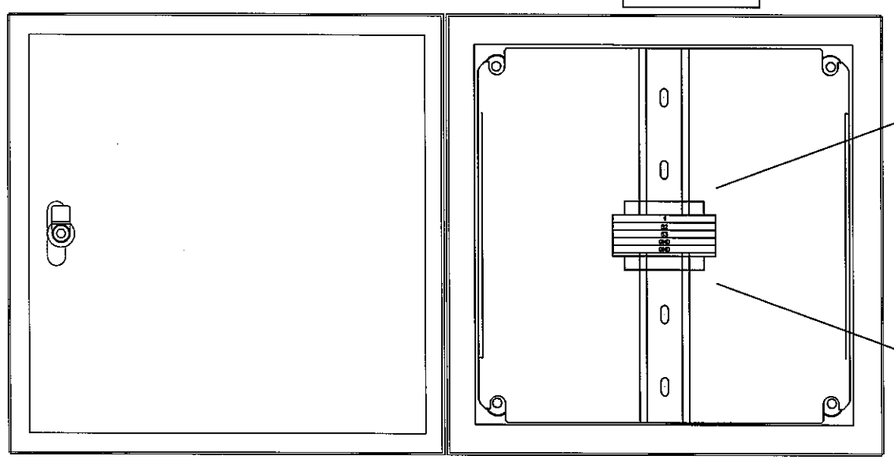


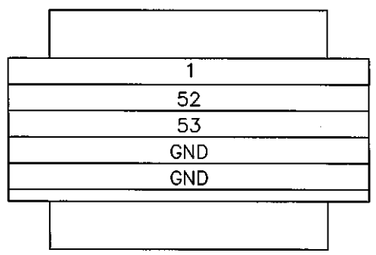
Front View



Right Side View

JP 1
NEMA 4X (316 STAINLESS STEEL)
JUNCTION PANEL
HOFFMAN
CSD12126SS6





Inside View

APPROVED
FOR
CONSTRUCTION

UOP Russell LLC
P.O. # 4500755147
TRCO. Job #TRJ-447
Tag Number: H-781
Heatec Job Number: HI16-251
HCI 5010-40-G Therm 55 Heater

REV.	DESCRIPTION	DATE	APPR.
2	As Built By Heatec	4/27/17	DJC
1	Submitted to Customer ofr Approval	1/24/2017	DJC

JOB # HI16-251
WO # 16-251-551
ISSUE DATE

HEATEC INC. an Aetos company
P.O. BOX 72760 CHATTANOOGA, TN. 37407
PHONE (423) 821-5200 FAX (423) 821-7673

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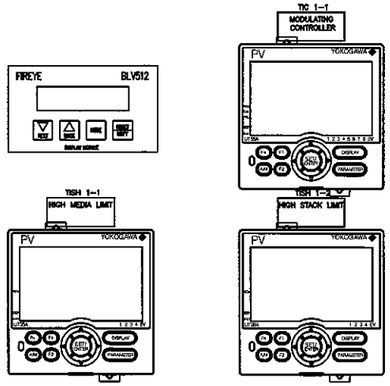
DWN. DATE	CHKD. DATE	APPROVAL DATE
DJC 1/23/2017		

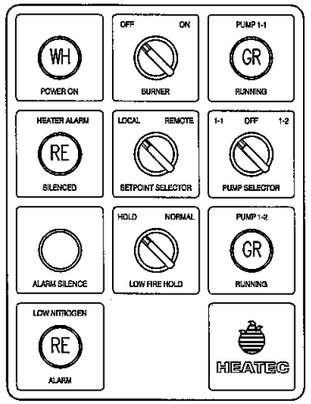
DWG/PART NO. 16251-JPL

CUSTOMER: UOP Russell LLC

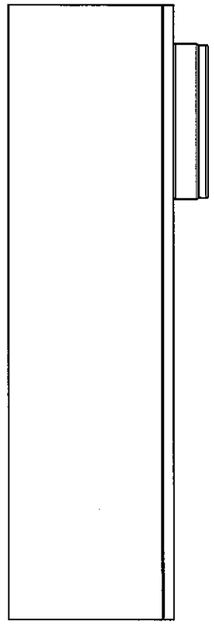
DRAWING NAME: HCI 5010-40-G Skid Mounted Junction Panel Therm 55 Heater

16251-CPL

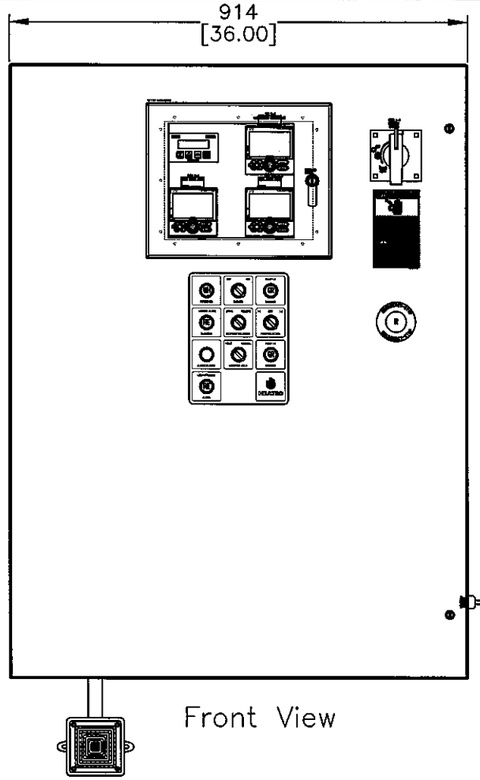




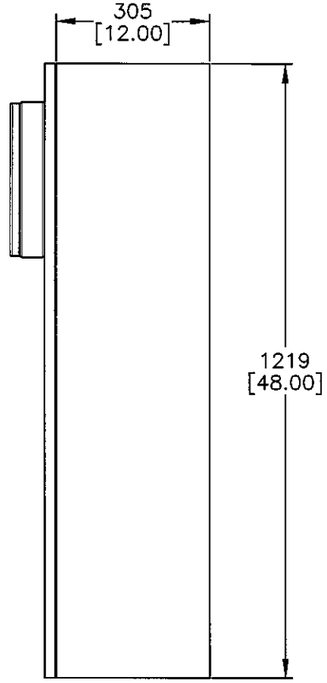
ENLARGED VIEW



Left View

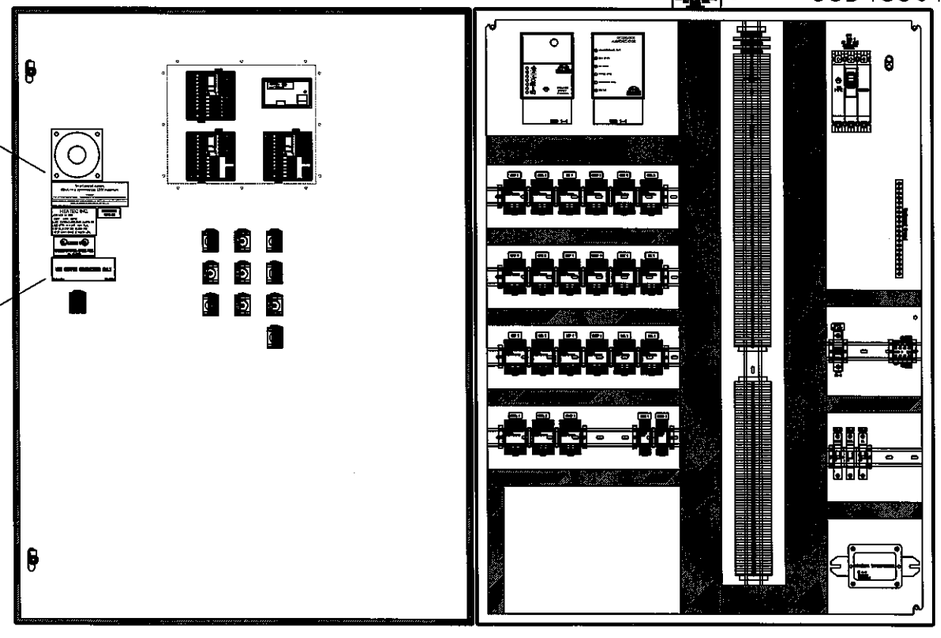


Front View



Right View

CPL 1
NEMA 4X (316 STAINLESS STEEL)
MAIN CONTROL PANEL
HOFFMAN
CSD483612SS6



Inside View

PANEL HOLES PUNCHED
BY WATERJET
HEATEC 5042441

APPROVED
FOR
CONSTRUCTION

UOP Russell LLC
P.O. # 4500755147
TRCO. Job #TRJ-447
Tag Number: H-781
Heatec Job Number: HI16-251
HCI 5010-40-G Therm 55 Heater

REV.	DESCRIPTION	DATE	APPR.
2	As Built by Heatec	4/27/17	DJC
1	Submitted to Customer For Approval	1/24/2017	DJC

JOB # HI16-251
WO # 16-251-551
ISSUE DATE

CUSTOMER: UOP Russell LLC

DRAWING NAME: HCI 5010-40-G Control Panel Layout Eclipse WINNDIX 850 Burner

HEATEC INC.
an Active company
P.O. BOX 72760 CHATTANOOGA, TN. 37407
PHONE (423) 821-5200 FAX (423) 821-7673

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DWG DATE DJC 1/23/2017 CHKD. DATE APPROVED DATE

DWG/PART NO. 16251-CPL

HEATER DESIGN DATA

INPUT: 8,445,514 X 1.1 BTU/HR
OUTPUT: 6,250,000 X 1.10 BTU/HR
FLOW RATE: 103,416 X 1.1 LBS/HR
TRANSFER MEDIA: THERMINOL 55
HEATING SURFACE: 741 SQ FT
COIL DESIGN CONDITIONS: 150 PSI @ 550 F
ASME CODE: SECTION VIII, DIV 1 2015 EDITION
OUTLET MEDIA TEMP: 305 F
PRESSURE DROP: 12 PSI

EXPANSION TANK DESIGN

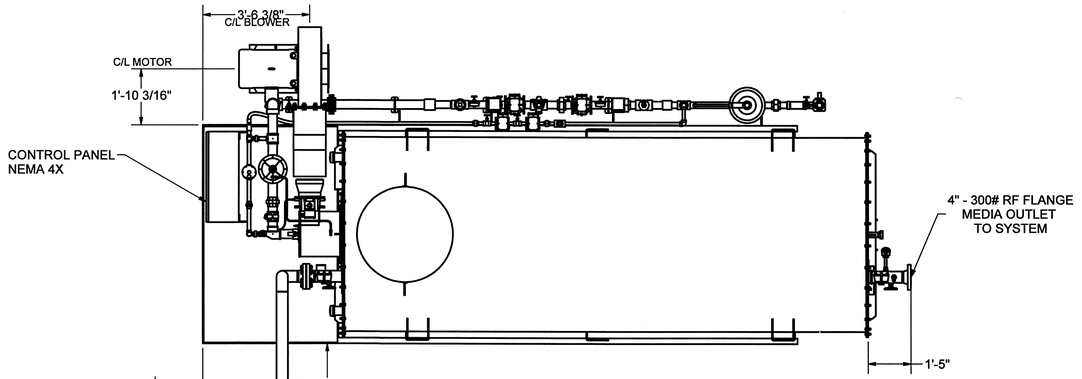
DESIGN : 150 PSIG @ 550° F
ASME CODE: SECTION VIII, DIV 1 2015 EDITION
CAPACITY: 550 GALLONS

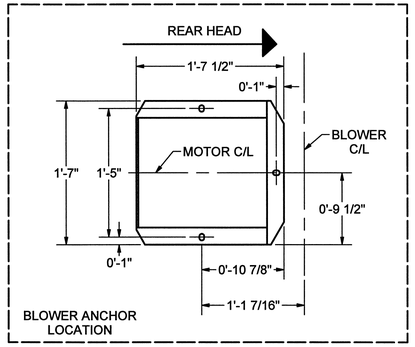
APPROX. SHIPPING WEIGHT

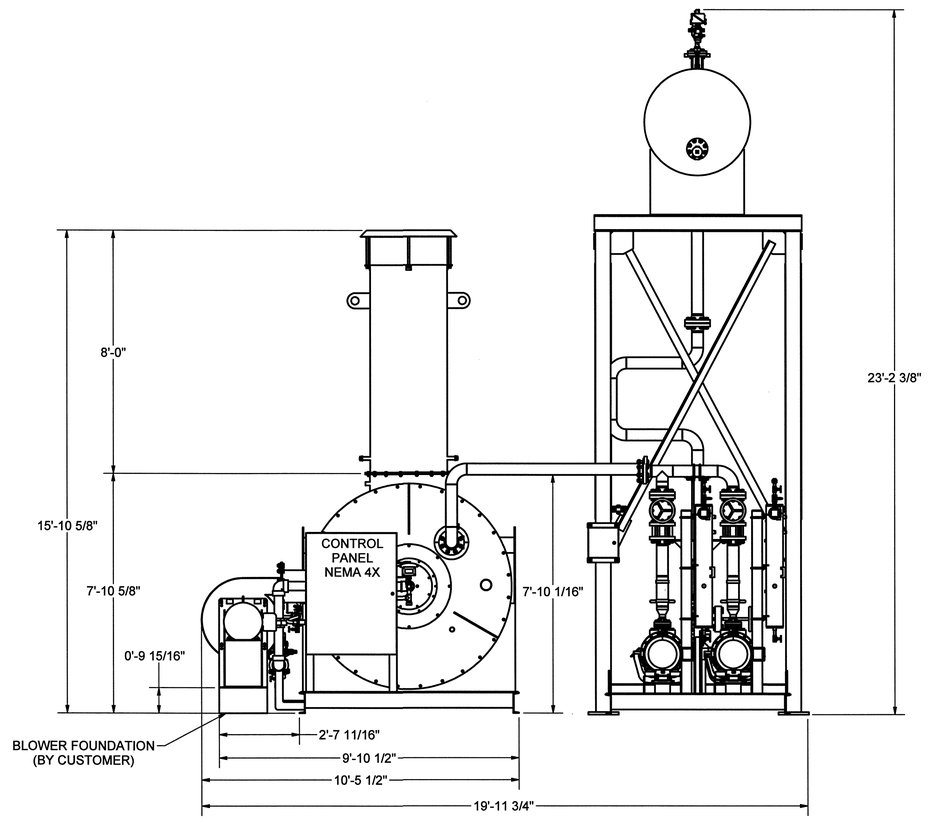
HEATER DRY WT:20,100 LBS
HEATER OPER.WT: 24,100 LBS

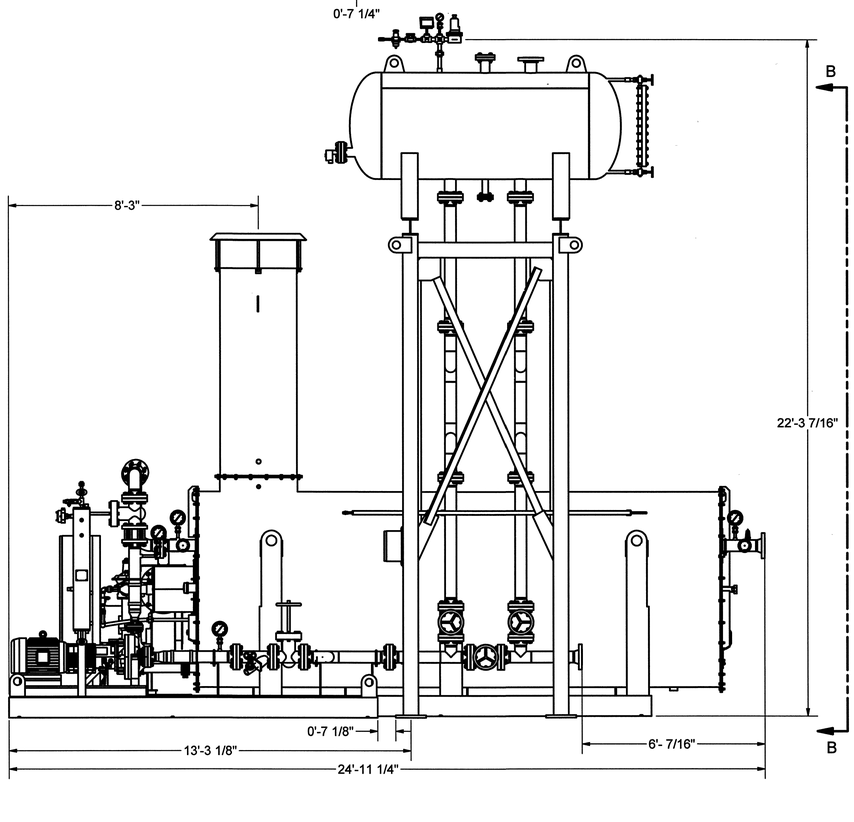
EXPANSION TANK DRY: 1,726 LBS
EXPANSION TANK FLOODED: 6976 LBS

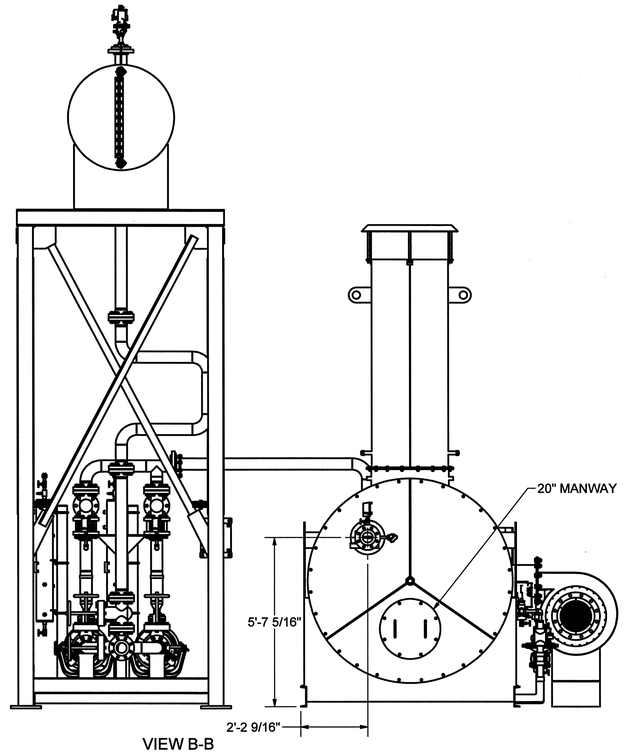
TOTAL PACKAGE APPROX DRY WT: 29,679 LBS
TOTAL PACKAGE APPROX FLOODED WT: 35,240 LBS











VIEW B-B
SCALE 1/30

CUSTOMER: UOP RUSSELL LLC.	JOB#: HI 16-251
DRAWING NAME: GENERAL ARRANGEMENT HCI 5010-40-G	WO#: 16-251-000
	ISSUE DATE: 1/30/17 mrp

HEATEC INC. an Aztec company
P.O. BOX 72760 CHATTANOOGA, TN 37407
PHONE: (423) 821-5200 FAX: (423) 821-7673

UOP RUSSELL LLC. PO:4500755147
TRCO. JOB NUMBER: TRJ-447
TAG NUMBER: H-781
THERMINOL 55 HEATER

DWG. DATE:	CHK DATE:	APPR. DATE:
1/11/2017 MRP	2/7/17	

DWG./PART#:	REV.:	SCALE:	WEIGHT:
16251-GA	0	NA	29,679

TOLERENCE IS +/- 1/4" UNLESS OTHERWISE NOTED.

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C:\Heatec-Vault\Job Files\2016\251 UOP RUSSELL\16251-GA GENERAL ASSEMBLY.idw

NOTES:

1. FUEL GAS VENT VALVES, PRESSURE REGULATOR VENTS, AND RELIEF VALVE VENTS TO BE PIPED TO SAFE AREA.
2. ALL ELECTRICAL EQUIPMENT SHALL BE NEMA 4 OR EQUIVALENT (PANEL TO BE NEMA 4X).
3. FINAL SET POINTS TO BE DETERMINED AT STARTUP.
4. DOTTED LINES DENOTE CUSTOMER SUPPLIED COMPONENTS.
5. HEATER DESIGNED FOR THERMINOL 55 @ 103,416 LBS/HR x 1.1 FLOW RATE. INLET TEMPERATURE 195 F, OUTLET TEMPERATURE 305 F.
6. INSULATION AND HEAT TRACING IS NOT IN HEATEC SCOPE.
7. HEATER DESIGNED FOR THERMAL OIL HEAT @ 6,249,843 x 1.1 BTUS/HR.
8. PSV PIPING INLET PRESSURE NOT TO EXCEED 3% OF INSTRUMENT SET POINT PER API 520.

LOCAL MOUNTED
REMOTE/PANEL MOUNTED
INTERLOCK
ELECTRICAL WIRING
MECHANICAL LINKAGE

HEATER CONTROL PANEL NEMA 4X
BY 1-1 | TIC 1-1 | TISH 1-1 | TISH 1-2

STACK
THERMAL FLUID HEATER
1" N.P.T. STEAM SNUFFING SUPPLY
BURNER
BU 4-1
BE 4-1
FILTER
MTR 4-1
25 HP
TCV 4-1
TIC 1-1 4-20 mA
ZSH 4-1 | ZSL 4-1 | TZ 4-1
PSL 4-1
XX 4-1
IT 4-1 | BY 1-1

SET @ 335 F
TISH 1-1
TIC 1-1 SET @ 305 F
TE 1-1 | TE 1-2 | TI 1-2 | TW 1-1 | TW 1-2
SET @ 850 F
TISH 1-2 | TE 1-3
PI 1-6 | HV 1-3
HV 1-4 | PDI 1-1 | PDSL 1-1 | PDSH 1-1
PI 1-5 | HV 1-3
SET AT 150 PSIG
PSV 1-1 NOTE #1 1 1/4" NPT
3/4" NPT
THERMINOL 55 @ 305 F 4"-300# FLANGED SUPPLY TO SYSTEM
BY CUSTOMER
BY HEATEC

TI 1-1 | TW 1-2 | 3/4"
4"-300 RRF FLGS.
HV 1-1 | CV 1-3 | PI 1-2 | HV 1-3 | 1/2" | 4 X 2" | XX 1-2
P 1-1 | MTR 1-1
HEATER PUMP, 20 HP
276 GPM @ 150 FT TDH
3 X 4"
PI 1-4 | HV 1-3 | CV 1-3 | 1/2" | 4 X 2" | XX 1-2
P 1-2 | MTR 1-2
HEATER PUMP, 20 HP
276 GPM @ 150 FT TDH
3 X 4"
PI 1-1 | HV 1-3 | 1/2" | ST 1-1 | HV 1-1 | XX 1-2 | HV 1-2
PI 1-3 | HV 1-3 | 1/2" | ST 1-1 | HV 1-1 | XX 1-2 | HV 1-2

SET @ 20 PSI
PSL 2-1 | HV 2-7
INERT GAS INLET 1/4" FNPT CONNECTION 125 PSIG MAX
HV 2-6 | PCV 2-1 | CV 2-1
1 x 1/2" | 1/4 x 1" | 1" | 1 x 1/2"
INERT GAS VENT 1" FNPT CONNECTION PIPE TO SAFE LOCATION
PCV 2-2
SET AT 150 PSIG
PSV 2-1
3" 150# CONNECTION PIPE TO SAFE LOCATION
2" 300# | 4" x 2"
PSV PIPING BY CUSTOMER SEE NOTE #10
4" 300#
1" NPT | 3" 150#
HV 2-5 | 3/4" NPT | LG 2-1 | HV 2-5 | 3/4" NPT
550 GALLON EXPANSION TANK
ASME SEC VIII DIV 1
STAMP FOR 150 PSI @ 550 F
LSL 2-1
HV 2-2 | HV 2-2 | 4" | HV 2-1 | 4"
103,416 LBS/HR THERMINOL 55 @ 195F FROM SYSTEM 4" 300# RF
BY HEATEC BY CUSTOMER

2" NPT NAT. GAS CONN. 9,400 SCFH @ 10 PSI
BY CUSTOMER BY HEATEC
HV 5-6 | 1/4" | HV 5-7
ST 5-1 | 2" | PCV 5-1
SET @ 100" W.C.
3/4" | 2 X 2 1/2"
SET @ 125"W.C. NOTE 1
PSV 5-1 | PI 5-2 | HV 5-5 | 1/4"
SET @ 80"W.C.
PSL 5-1 | ZSC 5-2 | XV 5-2 | HV 5-4
BY 1-1 | ZZ 5-2 | ZSC 5-1 | XV 5-1 | HV 5-3
2 1/2 x 1 1/4"
BY 1-1 | S | NOTE #1 | XV 5-3
SET @ 120"W.C.
PSH 5-1 | PI 5-1 | HV 5-2 | 1/4" | 2 1/2"
FE 5-1 | 2 1/2 X 3" | HV 5-1
1 x 3" | XX 5-1 | 3" | TCV 5-1 | NPT
XX 5-2 | PCV 3-1 | 1"
HV 3-1 | 3/4 x 1" | XX 3-1 | 1/4" | XV 3-1 | HV 3-2
ZSC 3-2 | ZZ 3-2 | M | XV 3-2 | HV 3-3 | 1/4"
HV 3-4 | 3/4" | CV 3-1 | SET @ 120"W.C.

HV 1-5 | M | VENT | LG | LSH | LSL
PLAN 7352 FLUSH DETAIL
PUMP 1-1 DETAIL
PUMP 1-2 DETAIL

APPROVED FOR CONSTRUCTION

UOP RUSSELL LLC. PO: 4500755147
TRCD. JOB NUMBER: TRJ 447
TAG NUMBER: H-781
HMD HEATER

REV.	DESCRIPTION	DATE	CHKD.	APPR.	BY
0	ISSUED FOR REVIEW	XXX			

CHANGE RECORD

CUSTOMER: UOP RUSSELL LLC
JOB# 16-251
DRAWING NAME: P & ID DIAGRAM HI 5010-40 HEATER
WO# 16-251-000
ISSUE DATE

HEATEC INC. an Aztec company
P.O. BOX 72760 CHATTANOOGA, TN. 37407
PHONE (423)821-5200 FAX (423)821-7673

DWN. DATE DMA 1 12 2017 | CHKD. DATE | APPR. DATE
DWG/PART NO. 16251 - PID
REV. 0 | SCALE N/A | WEIGHT
TOLERANCE IS ± 1/16" UNLESS OTHERWISE NOTED.

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HEATEC, INC.
an ASTEC company

P.O. BOX 72760. 5200 Wilson RD. Chattanooga, TN.
Phone: (423) 821 5200 / 1 (800) 235 5200
Fax: (423) 821 7673

UOP Russell PO: 4500755147

Paint Specification

ISSUE DATE

Customer	UOP Russell LLC.	***Spec Number***	16-251-SPCS	***Date***	12-Jan-17
W. Order	16-251-000	***Duty***		***Revision***	0
Equipment supplied	5010-40-G	***Engineer***	DMA	***Updated***	

Paint Systems

EQUIPMENT OR COMPONENT	**Heater Shell/Saddles**	**Heater End Plates**	**Blower Duct**	**Heater/Pump Skid Base**	**Gas Train/Supports**
Maximum Temperature	250F	250F	250F	250F	250F
Surface Preparation	SSPC-SP6	SSPC-SP6	SSPC-SP6	SSPC-SP6	SSPC-SP6
Primer Coat	1 COAT OF SILICONE ALKYD PRIMER HIGHLAND 860-4058. 2 TO 3 MILS	1 COAT OF SILICONE ALKYD PRIMER HIGHLAND 860-4058. 2 TO 3 MILS	1 COAT OF SILICONE ALKYD PRIMER HIGHLAND 860-4058. 2 TO 3 MILS	1 COAT OF SILICONE ALKYD PRIMER HIGHLAND 860-4058. 2 TO 3 MILS	1 COAT OF SILICONE ALKYD PRIMER HIGHLAND 860-4058. 2 TO 3 MILS
Top Coat	1 COAT OF SILICONE ALKYD ENAMEL HIGHLAND 835-5063 COLOR HEATEC GRAY. 2 TO 3 MILS	1 COAT OF SILICONE ALKYD ENAMEL HIGHLAND 835-5063 COLOR HEATEC GRAY. 2 TO 3 MILS	1 COAT OF SILICONE ALKYD ENAMEL HIGHLAND 835-5063 COLOR HEATEC GRAY. 2 TO 3 MILS	1 COAT OF SILICONE ALKYD ENAMEL HIGHLAND 835-5063 COLOR HEATEC GRAY. 2 TO 3 MILS	1 COAT OF SILICONE ALKYD ENAMEL HIGHLAND 835-4046 COLOR CEI YELLOW. 2 TO 3 MILS
EQUIPMENT OR COMPONENT	**HMO Pipe/Supports**	**Expansion Tank**	**Stack**		
Maximum Temperature	550F	550F	800F		
Surface Preparation	SSPC-SP10	SSPC-SP10	SSPC-SP10		
Primer Coat	1 COAT OF SILICONE ALKYD HIGH TEMPERATURE HIGHLAND 810. COLOR BLACK 1 TO 2 MILS	1 COAT OF SILICONE ALKYD HIGH TEMPERATURE HIGHLAND 810. COLOR BLACK 1 TO 2 MILS	1 COAT OF SILICONE ALKYD HIGH TEMPERATURE HIGHLAND 810. COLOR BLACK 1 TO 2 MILS		
Top Coat	NONE	NONE	NONE		

NOTES: All accessories such as Burner, Blower, Pumps, Valves, Instruments, etc. stay as they come from the suppliers.
Stainless Steel will not be painted

16251-PIBOM PI&D BILL OF MATERIALS

HEATEC®
an Astec Company

HEATEC JOB NO: 16-251
CUST. P.O. NO.: 4500755147
CUSTOMER NAME: UOP Russell
CUSTOMER JOB NO: TRJ-447

Item	Tag Prefix	Tag Suffix	Part #	Manufacturer	PART NAME	Description	W.O.	Visual	UM	Qty
HEATER COMPONENTS										
1	PDI	1-1	--	--	GAUGE	GAUGE DIFFERENTIAL PRESSURE (INTEGRAL TO PDSL/PDSH 1-1)	151-555	1	EA	1
2	PDSL/PDSH	1-1	5017400	UNITED ELECTRIC	DP SWITCH	SWITCH PRESSURE H122K-S147B 3 TO 30 PSIG	151-555	1	EA	1
3	PI	1-1	5029734	ASHCROFT	GAUGE	GAUGE PRESSURE 45 1279SS 04L XLL XSG 0-60 PSI LOWER CONNECTION ASHCROFT	151-555	1	EA	1
4	PI	1-2	5021351	ASHCROFT	GAUGE	GAUGE PRESSURE 45 1279SS 04L XLL XSG 0-100 PSI LOWER CONNECTION ASHCROFT	151-555	1	EA	1
5	PI	1-3	5029734	ASHCROFT	GAUGE	GAUGE PRESSURE 45 1279SS 04L XLL XSG 0-60 PSI LOWER CONNECTION ASHCROFT	151-555	1	EA	1
6	PI	1-4	5021351	ASHCROFT	GAUGE	GAUGE PRESSURE 45 1279SS 04L XLL XSG 0-100 PSI LOWER CONNECTION ASHCROFT	151-555	1	EA	1
7	PI	1-5	5021351	ASHCROFT	GAUGE	GAUGE PRESSURE 45 1279SS 04L XLL XSG 0-100 PSI LOWER CONNECTION ASHCROFT	151-555	1	EA	1
8	PI	1-6	5021351	ASHCROFT	GAUGE	GAUGE PRESSURE 45 1279SS 04L XLL XSG 0-100 PSI LOWER CONNECTION ASHCROFT	151-555	1	EA	1
9	TE	1-1 / 1-2	5009898	PYROMATION	THERMOCOUPLE	THERMOCOUPLE JJ20RL-SL4D0609-8HN31W (DUPLEX)	151-555	1	EA	1
10	TE	1-3	5004785	PYROMATION	THERMOCOUPLE	THERMOCOUPLE J14R-9-25-15-8C12-K-W	151-555	1	EA	1
11	TI	1-1	5022991	ASHCROFT	THERMOMETER	THERMOMETER 50EI60E040 50-400 DEG F	151-555	1	EA	1
12	TI	1-2	5022991	ASHCROFT	THERMOMETER	THERMOMETER 50EI60E040 50-400 DEG F	151-555	1	EA	1
13	TW	1-1	--	--	THERMOWELL	THERMOWELL 3/4" NPT (INCLUDED WITH TE 1-1 / 1-2)	151-555	1	EA	1
14	TW	1-2	5003086	ASHCROFT	THERMOWELL	THERMOWELL 3/4" NPT, 2-1/2" INSERTION LENGTH, SA240-304, ASHCROFT	151-555	2	EA	2
PUMP PIPING COMPONENTS										
15	PSV	1-1	5006419	TYCO	RELIEF VALVE	VALVE RELIEF 910BEDM01-JF0150	651-003	1	EA	1
16	ST	1-1	5007786	MUELLER	STRAINER	Y-STRAINER 4-300# RF FLGD CARB STEEL W/40 MESH SS BASKET #782 MUELLER	651-003	2	EA	2
17	XX	1-2	5007131	SOUTHEASTERN HOSE	FLEX HOSE	HOSE FLEX 4x12 WELD NIP EA END SS HOSE & BRADE; CARBON STL NIPPLES	651-003	4	EA	4
18	CV	1-3	5040767	DURABLA	CHECK	VALVE CHECK 4" WLC-150/300# RF #9036M11 DRAIN TAP, DURABLA 9036M11 RF-WAFER INCONEL X-750 SPRING 1/4" DRAIN TAP	651-003	2	EA	2
19	HV	1-1	5002235	--	VALVE	VALVE GATE 4-300# FLGD CARBON STEEL WITH GRAPHOIL PACKING	651-003	4	EA	4
20	HV	1-2	5011034	--	VALVE	VALVE GATE 2" VOGT 12111 NPT FS THREADED	651-003	2	EA	2
21	HV	1-3	5006432	CONBRACO	VALVE	VALVE NEEDLE 1/2" NPT. # 60-103-01	651-003	6	EA	6
22	HV	1-4	5010360	CONBRACO	VALVE	BALL VALVE 1/2" NPT, LOCKABLE APOLLO 76-103-19	651-003	2	EA	2
23	HV	1-5	5006432	CONBRACO	VALVE	VALVE NEEDLE 1/2" NPT. # 60-103-01	651-003	2	EA	2
24	MTR	1-1	--	--	MOTOR	MOTOR 20HP 1800RPM 460V/3 PH/60HZ TEFC 256T FRAME	651-003	1	EA	1
25	MTR	1-2	--	--	MOTOR	MOTOR 20HP 1800RPM 460V/3 PH/60HZ TEFC 256T FRAME	651-003	1	EA	1
26	P	1-1	5040404	Dean	PUMP	PUMP 2 X 3 X 13-1/2 R4144 CLASS 40	651-003	1	EA	1
27	P	1-2	5040404	Dean	PUMP	PUMP 2 X 3 X 13-1/2 R4144 CLASS 40	651-003	1	EA	1
EXPANSION TANK COMPONENTS										
28	HV	2-1	5002235	--	VALVE	VALVE GATE 4-300# FLGD CARBON STEEL WITH GRAPHOIL PACKING	251-003	1	EA	1
29	HV	2-2	5002235	--	VALVE	VALVE GATE 4" 300# RF CS GRAPHOIL PACKING	251-003	2	EA	2
30	HV	2-3	5003032	CONBRACO	VALVE	VALVE BALL 1/4" NPT 73-101-01 STEEL	251-555	1	EA	1
31	HV	2-4	5003426	CONBRACO	VALVE	VALVE NEEDLE 1/4" FNPT 60-101-01	251-555	1	EA	1
32	HV	2-5	--	--	VALVE	VALVE 15A (INCLUDED W/ LG 2-1)	251-555	2	EA	2
33	LG	2-1	5005710	INFERNO	LEVEL GAUGE	GAUGE LEVEL RA36 W/15A VALVES	251-555	1	EA	1
34	LSL	2-1	5043742	MAGNE-SONIC	SWITCH	CONTROL LEVEL MLS2553-BW 3"-300#	251-555	1	EA	1
35	PCV	2-1	5009130	FISHER	REGULATOR	REGULATOR 67CFR -226 1/4" NPT 0-125 PSI SPRING FISHER	251-005	1	EA	1
36	PCV	2-2	5016258	FISHER	REGULATOR	REGULATOR GAS #98H 1" NPT 300#, SPRING RANGE 15-35 PSIG, MAX INLET PRESSURE 270 PSIG	251-005	1	EA	1
37	PI	2-1	5011577	ASHCROFT	GAUGE	GAUGE PRESSURE 45 1279SSL 02L 0-100 PSI	251-005	1	EA	1
38	PSL	2-1	5008691	UNITED ELECTRIC	PRESSURE SWITCH	SWITCH PRESSURE J400-454 0-30 PSI 1/4 NPT	251-005	1	EA	1
39	PSV	2-1	5045884	CROSBY	RELIEF VALVE	VALVE RELIEF CROSBY 2H3-JBS-E-35-J 2" 300# INLET x 3" 150# OUTLET SET @ 150PSIG	251-555	1	EA	1
40	XX	2-1	5020265	--	CHECK VALVE	VALVE CHECK 1/4" NPT VOGT 701	251-005	1	EA	1
FUEL GAS PILOT LINE COMPONENTS										
41	HV	3-1	--	--	VALVE	VALVE BALL 1" (INCLUDED WITH BU 4-1)	151-555	1	EA	1
42	HV	3-2	5003426	CONBRACO	VALVE	VALVE NEEDLE 1/4" FNPT 60-101-01	151-005	3	EA	3
43	HV	3-3	5002650	RESUN	VALVE	VALVE PLUG 3/4" R1430 UL/CGA NPT	151-005	1	EA	1
44	PCV	3-1	--	--	REGULATOR	LOW FIRE PRESSURE REGULATOR, ECLIPSE, 1" NPT (INCLUDED WITH BU 4-1)	151-555	1	EA	1
45	PI	3-1	5029851	ASHCROFT	PRESSURE GAUGE	GAUGE 25 1490A 02L 0/160 IN H20, ASHCROFT	151-005	1	EA	1
46	XV	3-1	5042483	ASCO	VALVE	VALVE GAS V710EBSV22 0.75" ASCO	151-005	1	EA	1
47	XV	3-2	5042483	ASCO	VALVE	VALVE GAS V710EBSV22 0.75" ASCO	151-005	1	EA	1
48	ZZ	3-1	5021500	ASCO	ACTUATOR	ACTUATOR AH2E112S ASCO 120V/60HZ NEMA 4 WITH POC SWITCH	151-005	1	EA	1
49	ZZ	3-2	5021500	ASCO	ACTUATOR	ACTUATOR AH2E112S ASCO 120V/60HZ NEMA 4 WITH POC SWITCH	151-005	1	EA	1
50	ZSC	3-1	--	--	SWITCH	PROOF OF CLOSURE SWITCH (INTEGRAL TO ZZ 3-1) (SWTICHES ARE IN ACTUATOR)	151-005	1	EA	1
51	ZSC	3-2	--	--	SWITCH	PROOF OF CLOSURE SWITCH (INTEGRAL TO ZZ 3-2) (SWITCHES ARE IN ACTUATOR)	151-005	1	EA	1
52	XX	3-1	--	--	ORIFCE	PILOT/LOW FIRE GAS ADJUSTABLE LIMITING ORIFICE VALVE, ECLIPSE (INCLUDED WITH BU 4-1)	151-555	1	EA	1
53	XX	3-2	--	--	VALVE	VALVE CHECK 1" (INCLUDED WITH BU 4-1)	151-555	1	EA	1
COMBUSTION AIR/BURNER COMPONENTS										

16251-PIBOM PI&D BILL OF MATERIALS

HEATEC®
an Astec Company

HEATEC JOB NO: 16-251
CUST. P.O. NO.: 4500755147
CUSTOMER NAME: UOP Russell
CUSTOMER JOB NO: TRJ-447

Item	Tag Prefix	Tag Suffix	Part #	Manufacturer	PART NAME	Description	W.O.	Visual	UM	Qty
54	BE	4-1	--	--	SCANNER	FLAME SCANNER (SEE ELECTRICAL BOM)	151-555	1	EA	1
55	BU	4-1	5029825	ECLIPSE	BURNER	BURNER ECLIPSE WINNOX 850	151-555	1	EA	1
56	IT	4-1	5001132	ALLANSON	TRANSFORMER	IGNITION TRANSFORMER 6000 V 32000	151-555	1	EA	1
57	MTR	4-1	--	--	MOTOR	MOTOR 25HP / 3600 RPM / 480V / 3PH / 60HZ (INCLUDED WITH BU 4-1)	151-555	1	EA	1
58	PSL	4-1	5007896	DWYER	PRESSURE SWITCH	SWITCH PRESSURE DWYER 1950-20 4 TO 20" WC	151-555	1	EA	1
59	TCV	4-1	--	--	DAMPER	COMBUSTION AIR DAMPER (INTEGRAL TO BU 4-1)	151-555	1	EA	1
60	TZ	4-1	5026300	TRIAC	MODMOTOR	ACTUATOR TRIAC WEY-500 ELECTRIC	151-555	1	EA	1
61	XX	4-1	--	--	BLOWER	BLOWER COMBUSTION AIR (INCLUDED WITH BU 4-1)	151-555	1	EA	1
62	ZSH	4-1	--	--	POSITION SWITCH	HIGH FIRE LIMIT SWITCH (INTEGRAL TO TZ 4-1)	151-555	1	EA	1
63	ZSL	4-1	--	--	POSITION SWITCH	LOW FIRE LIMIT SWITCH (INTEGRAL TO TZ 4-1)	151-555	1	EA	1
						FUEL GAS MAIN LINE COMPONENTS				
64	FE	5-1	--	--	ORIFICE	ECLIPSE GAS ORIFICE 3" NPT CONNECTION (INCLUDED WITH BU 4-1)	151-555	1	EA	1
65	HV	5-1	5015031	RESUN	VALVE	VALVE PLUG 2 1/2 R1430 UL-CGA; 2 WAY;NPT	151-005	1	EA	1
66	HV	5-2	5003426	CONBRACO	VALVE	VALVE NEEDLE 1/4" FNPT 60-101-01	151-005	5	EA	5
67	HV	5-3	5010380	RESUN	VALVE	VALVE PLUG 2" R1430 UL-CGA, 2 WAY, NPT	151-005	1	EA	1
68	PCV	5-1	5023993	FISHER	REGULATOR	MAIN GAS REGULATOR 133H 2" NPT, 2 TO 5 PSI SPRING, CAST IRON	151-005	1	EA	1
69	PI	5-1	5029851	ASHCROFT	PRESSURE GAUGE	GAUGE 25 1490A 02L 0/160 IN H20, ASHCROFT	151-005	1	EA	1
70	PI	5-2	5029851	ASHCROFT	PRESSURE GAUGE	GAUGE 25 1490A 02L 0/160 IN H20, ASHCROFT	151-005	1	EA	1
71	PSH	5-1	5029727	UNITED ELECTRIC	PRESSURE SWITCH	SWITCH PRESSURE UE J400-525 10-250" WC	151-005	1	EA	1
72	PSL	5-1	5004910	UNITED ELECTRIC	PRESSURE SWITCH	SWITCH PRESSURE J400-443-95138 0-80" WC	151-005	1	EA	1
73	PSV	5-1	5026415	--	RELIEF VALVE	VALVE RELIEF #289H-41/V2 1" NPT 4 -15 PSIG VITON ELASTOMER	151-005	1	EA	1
74	TCV	5-1	--	--	VALVE	GAS CONTROL VALVE 3" ECLIPSE (INCLUDED WITH BU 4-1)	151-555	1	EA	1
75	XV	5-1	5009172	ASCO	VALVE	VALVE GAS V710KBSV22 2.5" ASCO	151-005	1	EA	1
76	XV	5-2	5009172	ASCO	VALVE	VALVE GAS V710KBSV22 2.5" ASCO	151-005	1	EA	1
77	XV	5-3	5016022	ASCO	SOLENOID	VALVE SOLENOID #EF8215C73 120VAC	151-005	1	EA	1
78	XX	5-1	--	--	ORIFICE VALVE	LOW FIRE ADJUSTING ORIFICE VALVE, ECLIPSE (INCLUDED WITH BU 4-1)	151-555	1	EA	1
79	XX	5-2	5022022	MUELLER	STRAINER	Y-STRAINER 2" SCRD 581 MUELLER NPT, CARBON STEEL BODY, 100 MESH BASKET	151-005	1	EA	1
80	ZSC	5-1	--	--	SWITCH	PROOF OF CLOSURE SWITCH (INTEGRAL TO ZZ 5-1) (SWTICHES ARE IN ACTUATOR)	151-005	1	EA	1
81	ZSC	5-2	--	--	SWITCH	PROOF OF CLOSURE SWITCH (INTEGRAL TO ZZ 5-2) (SWITCHES ARE IN ACTUATOR)	151-005	1	EA	1
82	ZZ	5-1	5021500	ASCO	ACTUATOR	ACTUATOR AH2E112S ASCO 120V/60HZ NEMA 4 WITH POC SWITCH	151-005	1	EA	1
83	ZZ	5-2	5021500	ASCO	ACTUATOR	ACTUATOR AH2E112S ASCO 120V/60HZ NEMA 4 WITH POC SWITCH	151-005	1	EA	1

SECTION 4
QC DATA

QC DATA INDEX

A.COIL
B.BURNER
C.PUMPS
D.EXPANSION TANK
E.PIPING
F.VALVES

National Board Number: 2935

Mfr. Representative: CC Date: 3/7/17

Authorized Inspector: [illegible] Date: 3-7-17

FORM U-1A MANUFACTURER'S DATA REPORT FOR PRESSURE VESSELS
(Alternative Form for Single Chamber, Completely Shop or Field Fabricated Vessels Only)
As Required by the Provisions of the ASME Boiler and Pressure Vessel Code Rules, Section VIII, Division 1

1. Manufactured and certified by HEATEC INC. 5200 WILSON ROAD CHATTANOOGA,TENNESSEE 37401
(Name and address of Manufacturer)

2. Manufactured for U O P RUSSELL 7050 S. YALE AVENUE, SUITE 210 TULSA, OK 74136
(Name and address of Purchaser)

3. Location of installation UNKNOWN
(Name and address)

4. Type SMLS PIPE COIL (Horizontal or vertical, tank) | 16-251 (Manufacturer's serial number) | NONE (CRN) | 16251-CD (Drawing number) | 2935 (National Board number) | 2017 (Year built)

5. ASME Code, Section VIII, Div. 1 2015 EDITION [Edition and Addenda, if applicable (date)] | NONE (Code Case number) | U-1H,UW-2(d)DIRECT FIRED [Special service per UG-120(d)]

6. Shell SA-106B (Material spec. number, grade) | 0.237" (Nominal thickness) | 0.0625" (Corr. allow.) | 4.026" (Inner diameter) | 19' - 11 5/16" [Length (overall)]

Body Flanges on Shells

No.	Type	ID	OD	Flange Thk	Min Hub Thk	Material	How Attached	Location	Bolting: Num & Size	Bolting: Bolting Material	Bolting: Washer (OD, ID, thk)	Bolting: Washer Material
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-

7. Seams SEAMLESS [Long. (welded, dbl., sngl., lap, butt)] | NONE [R.T. (spot or full)] | 85 (Eff., %) | NONE (H.T. temp.) | N/A (Time, hr) | WELDED,SNGL,BUTT [Girth (welded, dbl., sngl., lap, butt)] | NONE [R.T. (spot or full)] | 70 (Eff., %) | 32 (No. of courses)

8. Heads: (a) Material - (Spec. no., grade) (b) Material - (Spec. no., grade)

	Location (Top, Bottom, Ends)	Minimum Thickness	Corrosion Allowance	Crown Radius	Knuckle Radius	Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure (Convex or Concave)
(a)	-	-	-	-	-	-	-	-	-	-
(b)	-	-	-	-	-	-	-	-	-	-

Body Flanges on Heads

	Location	Type	ID	OD	Flange Thk	Min Hub Thk	Material	How Attached	Bolting: Num & Size	Bolting: Bolting Material	Bolting: Washer (OD, ID, thk)	Bolting: Washer Material
(a)	-	-	-	-	-	-	-	-	-	-	-	-
(b)	-	-	-	-	-	-	-	-	-	-	-	-

9. MAWP 150 psig (Internal) | 0 (External) at max. temp. 550 F (Internal) | 550 F (External).

Min. design metal temp. -20 F at 150 psig. Hydro., pneu., or comb. test pressure HYDROTEST 195 psig.

Proof test -.

10. Nozzles, inspection, and safety valve openings:

Purpose (Inlet, Outlet, Drain, etc.)	No.	Diameter or Size	Type	Material: Nozzle	Material: Flange	Nozzle Thickness: Nom.	Nozzle Thickness: Corr.	Reinforcement Material	Attachment Details: Nozzle	Attachment Details: Flange	Location (Insp. Open.)
INLET	1	4"	RFWN	SA-106B	SA-105	0.237"	0.0625"	NONE	WELDED	WELDED	END
OUTLET	1	4"	RFWN	SA-106B	SA-105	0.237"	0.0625"	NONE	WELDED	WELDED	END
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-

11. Supports: Skirt NO (Yes or no) Lugs NONE (Number) Legs NONE (Number) Other NONE (Describe) Attached NONE (Where and how)

12. Remarks: Manufacturer's Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of the report: NO SAFETY DEVICES INSTALLED BY HEATEC INC.SAFETY DEVICES BY END USER PER UG-125.
(Name of part, item number, Manufacturer's name and identifying stamp)

SEE ATTACHED FORM U-4.

National Board Number: 2935

Mfr. Representative: CC Date: 3/7/17

Authorized Inspector: [illegible] Date: 3-7-17

FORM U-1A (Back)

CERTIFICATE OF SHOP/FIELD COMPLIANCE

We certify that the statements made in this report are correct and that all details of design, material, construction, and workmanship of this vessel conform to the ASME BOILER AND PRESSURE VESSEL CODE, Section VIII, Division 1. "U" Certificate of Authorization Number 20348 expires 10/01/2018.

Date 3/7/17 Co. name HEATEC INC. (Manufacturer) Signed [signature] (Representative)

CERTIFICATE OF SHOP/FIELD INSPECTION

Vessel constructed by HEATEC INC. at 5200 WILSON RD.CHATTANOOGA,TENNESSEE 37401.

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and employed by Arise

have inspected the component described in this Manufacturer's Data Report on 3-7-17, and state that, to the best of my knowledge and belief, the Manufacturer has constructed this pressure vessel in accordance with ASME BOILER AND PRESSURE VESSEL CODE, Section VIII, Division 1. By signing this certificate neither the Inspector nor his/her employer makes any warranty, expressed or implied, concerning the pressure vessel described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his/her employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date 3-7-17 Signed [signature] (Authorized Inspector) Commissions NB 12488A TN 3499 [National Board (incl. endorsements)]

(04/14)

FORM U-4 MANUFACTURER'S DATA REPORT SUPPLEMENTARY SHEET
As Required by the Provisions of the ASME Boiler and Pressure Vessel Code Rules, Section VIII, Division 1

1. Manufactured and certified by HEATEC INC. 5200 WILSON ROAD CHATTANOOGA,TENNESSEE 37401
(Name and address of Manufacturer)

2. Manufactured for U O P RUSSELL 7050 S. YALE AVENUE, SUITE 210 TULSA, OK 74136
(Name and address of Purchaser)

3. Location of installation UNKNOWN
(Name and address)

4. Type SEAMLESS PIPE COIL (Horizontal, vertical, or sphere) | HEAT EXCHANGER (Tank, separator, heat exch., etc.) | 16-251 (Manufacturer's serial number)

NONE (CRN) | 16251-CD (Drawing number) | 2935 (National Board number) | 2017 (Year built)

Data Report Item Number	Remarks
LINE# 12	(2) 4" SCH 40 LR 45 DEGREE ELBOWS, SA-234WPB
	(2) 4" SCH 40 LR 90 DEGREE ELBOWS, SA-234WPB
	(1) 4" SCH 40 SML. SA-106B PIPE, 2' - 0" LNG.
	(1) 4" SCH 40 SML. SA-106B PIPE, 1' - 4" LNG.
	(2) 4" SCH 40 SML. SA-106B PIPES, 0' - 11 5/16" LNG.
	(4) 3/4" - 3000# THREAD-O-LETS, SA-105
	(2) 1/2" - 3000# THREAD-O-LETS, SA-105

Certificate of Authorization: Type U No. 20348 Expires 10/01/2018

Date 3/7/17 Name HEATEC INC. (Manufacturer) Signed Chris Cat (Representative)

Date 3-7-17 Name J. Ryan (Authorized Inspector) Commissions NB 12488A TN 3499 [National Board (incl. endorsements)]

(08/14)

Coil

JOB # 16-251

HEATEC INC.

QUALITY CONTROL RECEIVING INSPECTION REPORT

ITEM	THICKNESS OR SIZE	O.D.	MATL	MARKING	HEAT NO.	MILL TEST REP.	INITIAL & DATE
PLATE	3/16"	—	SA-36	✓	A7M0033	✓	CC 2/28/17
	3/8"	—	SA-36	✓	B7N2891	✓	CC 2/28/17
PIPE	4" sch. 40	4.50"	SA-106B	✓	483234	✓	CC 2/28/17
	4" sch. 40	4.50"	SA-106B	✓	MA6980	✓	CC 2/28/17
	4" sch. 40	4.50"	SA-106B	✓	490050	✓	CC 2/28/17
	4" sch. 40	4.50"	SA-106B	✓	487563	✓	CC 2/28/17
HEADS	4" sch. 40	4.50"	SA-106B	✓	MA6981	✓	CC 2/28/17
COIL							
(2) FLANGES	4" 540-300#	RFWN	SA-105	✓			CC 2/28/17
NOZZLES	4" 540 LR 45°	4.50"	SA-234WPB	✓			CC 2/28/17
& (2)	4" 540 LR 90°	4.50"	SA-234WPB	✓			CC 2/28/17
FITTINGS	1/2" - 3000#	TOL	SA-105	✓			CC 2/28/17
(4)	3/4" - 3000#	TOL	SA-105	✓			CC 2/28/17
MISC.							

NUCOR
NUCOR STEEL TUSCALOOSA, INC.

MILL TEST CERTIFICATE

3/16" PLATE

1700 HOLT RD N.E.
Tuscaloosa, AL 35404-1000
800 800-8204
customerservice@nucortusk.com

4400764

Load Number	Tally	Mill Order Number	PO NO | Line NO	Part Number	Certificate Number	Prepared
T140895	00000000702313	N-151708-002	C50671-S 2		S70231301-1	01/16/2017 07:16

Grade

Order Description:
Hot Roll Plate From Coil
A36, 0.1875 IN x 96.000 IN x 240.000 IN
Quality Plan Description:
A36/SA36/A70936: ASTM A36-14/ASME SA36-13/A709-36-13

Customer:

Sold TO:
SISKIN STEEL AND SUPPLY CO INC CHATTANOOGA TN
Ship TO:
SISKIN STEEL / RIVERFRONT CHATTANOOGA TN
Sent TO:

Shipped Item	Heat/Slab Number	Certified By	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Cb	V	Al	Ti	N2	B	Ca	Sn	CEV	ACI
7A0304D	A7M0033-03 ***	A7M0033	0.19	0.85	0.013	0.003	0.06	0.17	0.09	0.12	0.028	0.002	0.004	0.031	0.002	0.012	0.0001	0.0011			
7A0304E	A7M0033-03 ***	A7M0033	0.19	0.85	0.013	0.003	0.06	0.17	0.09	0.12	0.028	0.002	0.004	0.031	0.002	0.012	0.0001	0.0011			
7A0304F	A7M0033-03 ***	A7M0033	0.19	0.85	0.013	0.003	0.06	0.17	0.09	0.12	0.028	0.002	0.004	0.031	0.002	0.012	0.0001	0.0011			
7A0306C	A7M0024-01 ***	A7M0024	0.19	0.85	0.011	0.006	0.05	0.16	0.06	0.07	0.022	0.001	0.003	0.027	0.001	0.011	0.0001	0.0013			

Shipped Item	Certified By	Heat Number	Yield ksi	Tensile ksi	Y/T %	ELONGATION % 2"	ELONGATION % 8"	Bend OK?	Hard HB	Charpy Impacts (ft-lbs) Size mm	1	2	3	Avg	Shear % 1	2	3	Avg	Test Temp
7A0304D	S7A0304FTT	A7M0033 ***	48.0	69.5	69.1	34.4													
7A0304D	S7A0304MTT	A7M0033 ***	45.8	63.6	72.0	33.6													
7A0304E	S7A0304FTT	A7M0033 ***	48.0	69.5	69.1	34.4													
7A0304E	S7A0304MTT	A7M0033 ***	45.8	63.6	72.0	33.6													
7A0304F	S7A0304FTT	A7M0033 ***	48.0	69.5	69.1	34.4													
7A0304F	S7A0304MTT	A7M0033 ***	45.8	63.6	72.0	33.6													
7A0306C	S7A0306FTT	A7M0024 ***	48.2	70.8	68.1	30.8													
7A0306C	S7A0306MTT	A7M0024 ***	46.6	65.3	71.4	32.9													

Items: 4 **PCS:** 37 **Weight:** 45331 **LBS**

This Material Meets the
Chemical and Mechanical Testing
Requirements as Specified in:
ASME Section II Part A-2015 Edition.
QC Rep.: Date: 2/1/17

Mercury has not come in contact with this product during the manufacturing process nor has any mercury been used by the manufacturing process. Certified in accordance with EN 10204 3.1. No weld repair has been performed on this material. Manufactured to a fully killed fine grain practice. NUTEMPER TEMPER PASSED plate from coil
ISO 9001:2008 Registered, PED Certified

"***" indicates Heats melted and Manufactured in the U.S.A.

We hereby certify that the product described above passed all of the tests required by the specifications.

Dr. Quilin Yu - Metallurgist

140082 HEATEC INC 203978 50671 440076 (SEC)
HEAT NUMBER: A7M0033 CUSTOMER PO: V0647T
PAGE 1 OF 1

NUCOR

NUCOR STEEL TUSCALOOSA, INC.

MILL TEST CERTIFICATE

3/8" PLATE

1700 HOLT RD N.E.
Tuscaloosa, AL 35404-1000
800 800-8204
customerservice@nucortusk.com

443180

Load Number	Tally	Mill Order Number	PO NO | Line NO	Part Number	Certificate Number	Prepared
T143244	00000000706795	N-152464-007	C51852-S 7		S70679501-1	02/16/2017 12:43

Grade

Customer:

Order Description:
Hot Roll Plate From Coil
A36, 0.3750 IN x 96.000 IN x 480.000 IN
Quality Plan Description:
A36/SA36/A70936: ASTM A36-14/ASME SA36-13/A709-36-13

Sold TO:
SISKIN STEEL AND SUPPLY CO INC CHATTANOOGA TN
Ship TO:
SISKIN STEEL / RIVERFRONT CHATTANOOGA TN
Sent TO:

Shipped Item	Heat/Slab Number	Certified By	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Cb	V	Al	Ti	N2	B	Ca	Sn	CEV	ACI
7A3362B	B7N2891-03 ***	B7N2891	0.21	0.47	0.010	0.005	0.08	0.16	0.07	0.06	0.021	0.000	0.002	0.024	0.001	0.010	0.0000	0.0010			
7A3362C	B7N2891-03 ***	B7N2891	0.21	0.47	0.010	0.005	0.08	0.16	0.07	0.06	0.021	0.000	0.002	0.024	0.001	0.010	0.0000	0.0010			
7A3362D	B7N2891-03 ***	B7N2891	0.21	0.47	0.010	0.005	0.08	0.16	0.07	0.06	0.021	0.000	0.002	0.024	0.001	0.010	0.0000	0.0010			

Shipped Item	Certified By	Heat Number	Yield ksi	Tensile ksi	Y/T %	ELONGATION % 2"	8"	Bend OK?	Hard HB	Charpy Impacts (ft-lbs) Size mm	1	2	3	Avg	Shear % 1	2	3	Avg	Test Temp
7A3362B	S7A3360FTT	B7N2891 ***	48.2	67.0	71.9	36.1													
7A3362B	S7A3361FTT	B7N2891 ***	49.5	68.6	72.2	25.3													
7A3362B	S7A3360MTT	B7N2891 ***	48.8	65.7	74.3	37.5													
7A3362B	S7A3361MTT	B7N2891 ***	49.1	66.1	74.3	31.9													
7A3362C	S7A3360FTT	B7N2891 ***	48.2	67.0	71.9	36.1													
7A3362C	S7A3361FTT	B7N2891 ***	49.5	68.6	72.2	25.3													
7A3362C	S7A3360MTT	B7N2891 ***	48.8	65.7	74.3	37.5													
7A3362C	S7A3361MTT	B7N2891 ***	49.1	66.1	74.3	31.9													
7A3362D	S7A3360FTT	B7N2891 ***	48.2	67.0	71.9	36.1													
7A3362D	S7A3361FTT	B7N2891 ***	49.5	68.6	72.2	25.3													
7A3362D	S7A3360MTT	B7N2891 ***	48.8	65.7	74.3	37.5													
7A3362D	S7A3361MTT	B7N2891 ***	49.1	66.1	74.3	31.9													

Items: 3 PCS: 9 Weight: 44105 LBS

Mercury has not come in contact with this product during the manufacturing process nor has any mercury been used by the manufacturing process. Certified in accordance with EN 10204 3.1. No weld repair has been performed on this material. Manufactured to a fully killed fine grain practice. NUTEMPER TEMPER PASSED plate from coil
ISO 9001:2008 Registered. PED Certified

"***" Indicates Heats melted and Manufactured in the U.S.A.

This Material Meets the Chemical and Mechanical ... Requirements as Specified ... ASME Section II Part A-2015 Edi... Rep. ChinCat Date: 2/21/17

We hereby certify that the product described above passed all of the tests required by the specifications.

Dr. Quilin Yu - Metallurgist

144087 HEATEC INC 208961H 51852 443180 (CS)
HEAT NUMBER: B7N2891
CUSTOMER PO: V0667T
PAGE 1 OF 1

IPSCO

TUBE TEST REPORT

Form QA-003 12/02/09 - Rev 2

4" sch. 40 Q.C.C.Cox

ORDER: 068116 001	**HEAT:** 490050	**P.O.:** S13-41561	**PART NO.**

SOLD TO: CONSOLIDATED PIPE & SUPPLY CO
BOX 2472
1205 HILLTOP PARKWAY
BIRMINGHAM, AL 35204

SHIP TO: CONSOLIDATED PIPE & SUPPLY CO
INC/ROBERTS FIELD YARD
1200BROCK DRIVE
WEST BIRMINGHAM , AL 35204

SPECIFICATION(S) : ASME ASTM SA53/A53-12 GR B/ASME A106-13 GR B/C
ASTM A106-14 GR B
API 5L PSL2 GR B/X42 FORTY-FIFTH EDITION

GRADE: 1023M	**SIZE:** 4.500 X 0.237	**WPF:** 10.80	**QUALITY:** SEAMLESS HOT FINISH

CONDITION (SPECIAL) : ELECTRIC FURNACE
FINE GRAIN MELT PRACTICE
TEST METHODS USED: ASTM E415

TEST RESULTS CONFORM TO THE STANDARDS AND SPECIFICATION LISTED ABOVE.

	C	Mn	S	P	Si	Cr	Ni	Mo	Cu	Al	V	Cb	Ti	B
L	.22	.61	.005	.009	.29	.10	.08	.04	.18	.013	.004	.001	.0017	.0001
P	.22	.58	.003	.009	.29	.10	.08	.03	.17	.015	.002	.001	.0017	.0005
P	.22	.58	.004	.010	.29	.10	.08	.03	.16	.014	.001	.001	.0016	.0003

MATERIAL 100% MELTED AND MANUFACTURED IN THE USA.

Specimen ASTM E8	EUL	Yield KSI	Tensile KSI	ELNG 2 "	R/A	C.E.	Rockwell ASTM E18 Avg	Hydrotest
1.000 " STR	0.5	49.8	73.9	36.0		.37	MW 78.0 79.0 80.0 79.0 RB	3000 PSI 5 Sec Hold

FLAT(S) - SATISFACTORY
EMI INSPECTION WITH OD N10 NOTCHES
LONGITUDINAL - SATISFACTORY
CERTIFIED NACE MR 0175 DATED 10-15-2009
EN 10204 TYPE 3.1b DATED 01-2005

This Material Meets the
Chemical and Mechanical Testing
Requirements as Specified in:
ASME Section II Part A-2015 Edition.
QC Rep. Chris Cole Date 2/16/17

12 / 30 / 14 Melinda Ayers

DATE QUALITY ASSURANCE/KOPPEL

MATERIAL WAS NOT EXPOSED TO MERCURY DURING PROCESSING.
NO WELDING OR WELD REPAIR PERFORMED ON THIS MATERIAL.
MATERIAL IS FREE OF HARMFUL RADIATION.

THIS CERTIFICATION MAY NOT BE REPRODUCED EXCEPT IN FULL.

IPSCO KOPPEL WORKS
P.O. BOX 750
BEAVER FALLS, PA 15010

IPSCO AMBRIDGE WORKS
P.O. BOX 410
AMBRIDGE, PA 15003

IPSCO BAYTOWN WORKS
2600 SPUR 55
BAYTOWN, TX 77523

IPSCO

4" sch. 40
Q.C.C.Cox

TUBE TEST REPORT

Form QA-003 12/02/09 - Rev 2

ORDER: 060681 004	HEAT: 487563	P.O.: S13-40521	PART NO.

SOLD TO:	SHIP TO:
CONSOLIDATED PIPE & SUPPLY CO	CONSOLIDATED PIPE & SUPPLY CO
BOX 2472	INC/ROBERTS FIELD YARD
1205 HILLTOP PARKWAY	1200BROCK DRIVE
BIRMINGHAM, AL 35204	WEST BIRMINGHAM , AL 35204

SPECIFICATION(S) : ASME ASTM SA53/A53-12 GR B/SA106/A106-13 GR B/C
API 5L PSL2 GR B/X42 FORTY-FIFTH EDITION
CERTIFIED NACE MR0175 DATED 10/15/2009

GRADE: 1023M	SIZE: 4.500 X 0.237	WPF: 10.80	QUALITY: SEAMLESS HOT FINISH

CONDITION (SPECIAL) : ELECTRIC FURNACE
FINE GRAIN MELT PRACTICE
TEST METHODS USED: ASTM E415

TEST RESULTS CONFORM TO THE STANDARDS AND SPECIFICATION LISTED ABOVE.

	C	Mn	S	P	Si	Cr	Ni	Mo	Cu	Al	V	Cb	Ti	B
L	.21	.56	.004	.006	.26	.11	.09	.03	.24	.013	.003	.001	.0020	.0001
P	.21	.55	.002	.005	.27	.11	.08	.02	.22	.016	.002	.001	.0020	.0004
P	.21	.56	.003	.006	.27	.11	.08	.03	.21	.014	.002	.001	.0020	.0006

MATERIAL 100% MELTED AND MANUFACTURED IN THE USA.

Specimen ASTM E8	EUL	Yield KSI	Tensile KSI	ELNG 2 "	R/A	Rockwell ASTM E18 Avg	Hydrotest
.980 " STR	0.5	55.5	73.7	35.0		MW 77.8 81.4 80.3 79.8 RB	3000 PSI 5 Sec Hold

EMI INSPECTION WITH ID/OD N10 NOTCHES
LONGITUDINAL - SATISFACTORY
SEA INSPECTION - SATISFACTORY
FLAT(S) - SATISFACTORY
EN 10204 TYPE 3.1b DATED 01/2005

This Material Meets the Chemical and Mechanical Testing Requirements as Specified in: ASME Section II Part A-2015 Edition. Rep. Chris Cox Date: 1/16/16

7/7/14 Melinda Ayers

DATE QUALITY ASSURANCE/KOPPEL

MATERIAL WAS NOT EXPOSED TO MERCURY DURING PROCESSING.
NO WELDING OR WELD REPAIR PERFORMED ON THIS MATERIAL.
MATERIAL IS FREE OF HARMFUL RADIATION.

THIS CERTIFICATION MAY NOT BE REPRODUCED EXCEPT IN FULL.

IPSCO KOPPEL WORKS
P.O. BOX 750
BEAVER FALLS, PA 15010

IPSCO AMBRIDGE WORKS
P.O. BOX 410
AMBRIDGE, PA 15003

IPSCO BAYTOWN WORKS
2600 SPUR 55
BAYTOWN, TX 77523

IPSCO

TUBE TEST REPORT

Form QA-003 12/02/09 - Rev 2

ORDER: 065302 024	HEAT: 483234	P.O.: S13-40019	PART NO.

SOLD TO:	SHIP TO:
CONSOLIDATED PIPE & SUPPLY CO BOX 2472 1205 HILLTOP PARKWAY BIRMINGHAM, AL 35204	CONSOLIDATED PIPE AND SUPPLY ROBERTS FIELD 1121 BROCK INDUSTRIAL DRIVE BIRMINGHAM, AL 35208

SPECIFICATION(S) : API 5L GR X52 PSL1 FORTY-FIFTH EDITION
CERTIFIED NACE MR0175 DATED 10-15-2009

GRADE: 1522V	SIZE: 4.500 X 0.237 DRL	WPF: 10.80	QUALITY: SEAMLESS HOT FINISH

CONDITION (SPECIAL) : ELECTRIC FURNACE
FINE GRAIN MELT PRACTICE
TEST METHODS USED: ASTM E415

TEST RESULTS CONFORM TO THE STANDARDS AND SPECIFICATION LISTED ABOVE.

	C	Mn	S	P	Si	Cr	Ni	Mo	Cu	Al	V	Cb	Ti	B
L	.20	.78	.009	.008	.25	.10	.09	.03	.25	.013	.045	.001	.0010	.0001
P	.20	.78	.005	.006	.25	.09	.09	.03	.25	.012	.045	.001	.0020	.0001
P	.20	.78	.004	.006	.25	.09	.09	.03	.25	.013	.045	.001	.0020	.0001

MATERIAL 100% MELTED AND MANUFACTURED IN THE USA.

Specimen ASTM E8	EUL	Yield KSI	Tensile KSI	ELNG 2 "	R/A	C.E.	Rockwell ASTM E18 Avg	Hydrotest
1.000 " STR	0.5	54.4	74.9	36.0		.39	78.2 75.8 75.3 76.4 RB	3000 PSI 5 Sec Hold

4 "sch. 40

EMI INSPECTION WITH OD N10 NOTCHES
LONGITUDINAL - SATISFACTORY
REVISED TEST REPORT
PER CUSTOMER REQUEST ADDING
SA/A106 GRADE B

This Material Meets the
Chemical and Mechanical Testing
Requirements as Specified in:
ASME Section II Part A-2015 Edition.
QC Rep.: Chris Cox Date: 4/1/16

10 / 6 / 15 Amber Roknich

DATE QUALITY ASSURANCE/KOPPEL

MATERIAL WAS NOT EXPOSED TO MERCURY DURING PROCESSING.
NO WELDING OR WELD REPAIR PERFORMED ON THIS MATERIAL.
MATERIAL IS FREE OF HARMFUL RADIATION.

THIS CERTIFICATION MAY NOT BE REPRODUCED EXCEPT IN FULL.

IPSCO KOPPEL WORKS
P.O. BOX 750
BEAVER FALLS, PA 15010

IPSCO AMBRIDGE WORKS
P.O. BOX 410
AMBRIDGE, PA 15003

IPSCO BAYTOWN WORKS
2600 SPUR 55
BAYTOWN, TX 77523

Stock

U.S. STEEL TUBULAR PRODUCTS

FAIRFIELD TUBULAR OPERATIONS
CERTIFIED TEST REPORT
(IN ACCORDANCE WITH ISO 10474/EN10204/DIN50049 "type 3.1")

DATE: 03/31/16
TIME: 23:28:37
SERIAL NO: F0099839
EBS NO: 2001580388 1

MILL ORDER/ITEM NO	SHIPPERS NO.	P.O. NUMBER	VEHICLE I.D
DR94127 01		S13-60549	

SOLD TO ADDRESS
CONSOLIDATED PIPE & SUPPLY
PO BOX 2472
BIRMINGHAM AL 35201-2472

MAIL TO ADDRESS
CONSOLIDATED PIPE & SUPPLY
PO BOX 2472
BIRMINGHAM AL 35201-2472

VENDOR
U.S.S. SEAMLESS TUBULAR OPS
FAIRFIELD TUBULAR OPERATIONS
5700 VALLEY ROAD
P.O. BOX 599
FAIRFIELD, AL 35064

SPECIFICATION AND GRADE

SMLS STANDARD AND LINE PIPE API 5L 45TH EDITION DATED 12/1/12 GRADE B/X42 R N OR Q PSL-2, ASTM A106-14 GRADE B/C, ASTM A53-12 GRADE B, ASME SA106-2013 GRADE B/C, ASME SA53-2013 GRADE B REG MILL COAT PE BEV 30 DEGREE APPLICABLE REQUIREMENTS OF NACE MR0103-2012 ED AND NACE MR0175/ISO 15156-2 2009 ED

4" sch.40

This Material Meets the
Chemical and Mechanical Testing
Requirements as Specified in:
ASME Section II Part A-2015 Edition.
QC Rep.: Chris Cat Date: 10/29/16

MATERIAL COND: AS-ROLLED

O.D.: 4.500(114.300) in (mm)

WALL: 0.237 (6.019) in (mm)

PRODUCT IDENTIFICATION	TEST TYPE/ ORIENTATION	TEST COND.	GAUGE WIDTH	YIELD PSI	EXT % .50	TENSILE PSI	Y/T	ELONG % (IN 2")	HARDNESS SCALE:	MIN HYDRO PSI	DWELL(SEC)
			IN	MIN: 42,100 MAX: 71,800		MIN: 70,000 MAX: 95,000	MAX:	MIN: 25.0	MIN: MAX:	2660	5
MA6980	STRIP/L/B	AR	1.5	65,500	.50	87,500	0.75	39.8		2660	5
MA6981	STRIP/L/B	AR	1.5	58,500	.50	83,500	0.70	37.2		2660	5
		**	END OF DATA THIS SHEET **								

LEGEND: L - LONGITUDINAL, T - TRANSVERSE, QT - QUENCH & TEMPERED, AR - AS ROLLED, B - BODY, W - WELD
U - UPSET, NM - NORMALIZED, SR - STRESS RELIEVED, TR - THERMOMECHANICAL ROLLED

PRODUCT IDENTIFICATION	TYPE	C	MN	P	S	SI	CU	NI	CR	MO	AL	N	V	B	TI	CB	CO	C.E.* MAX .43
MA6980	HEAT	20	107	010	001	24	11	06	07	02	034		00	0003	003	004		.41
MA6980	PROD	21	108	011	003	23	12	06	08	02	029		00	0004	003	001		.42
MA6980	PROD	22	108	010	003	22	12	06	08	02	027		00	0004	002	001		.43
MA6981	HEAT	20	107	012	001	22	12	06	08	02	029		00	0003	003	004		.41
MA6981	PROD	22	107	010	003	22	12	06	08	02	028		00	0004	002	001		.43
MA6981	PROD	21	104	010	002	20	12	06	09	02	023		00	0004	002	001		.42
		** END OF DATA THIS SHEET **																

*C.E. IS BASED ON THE FOLLOWING EQUATION(S): C+MN/6+CR/5+MO/5+V/5+NI/15+CU/15 (EUROPEAN CEV)

DECIMAL POSITIONS FOR ELEMENTS ARE INDICATED BY THE LEFT MARGIN, VERTICAL DOTTED LINE OR DECIMAL POINT. ELEMENTS REPORTED IN MASS FRACTION (%)

U.S. STEEL TUBULAR PRODUCTS

FAIRFIELD TUBULAR OPERATIONS

CERTIFIED TEST REPORT

(IN ACCORDANCE WITH ISO 10474/EN10204/DIN50049 "type 3.1")

DATE: 03/31/16
TIME: 23:28:37
SERIAL NO: F0099839
EBS NO: 2001580388 1

MILL ORDER/ITEM NO	SHIPPERS NO.	P.O. NUMBER	
DR94127 01		S13-60549	

MATERIAL COND: AS-ROLLED

O.D.: 4.500(114.300) In (mm)

WALL: 0.237 (6.019) In (mm)

PRODUCT IDENTIFICATION	FLAT	BEND	GRAIN SIZE	MIN COLLAPSE	CHARPY V-NOTCH IMPACT TESTING											
					DIR	TEST LOC.	TEMP	SIZE	TEST COND.	FT-LBS				% SHEAR			
										1	2	3	AVG	1	2	3	AVG
					DEG												
MA6980	OK																
MA6981	OK																
				** END OF DATA THIS SHEET **													

LEGEND L - LONGITUDINAL T - TRANSVERSE B - BODY W - WELD HAZ - HEAT AFFECTED ZONE

TESTING / INSPECTION INFORMATION

TEST / INSPECTION	YES	RESULTS / COMMENTS
FULL LENGTH VISUAL	X	
FULL LENGTH EMI	X	OD ____ OD/ID ___X L ____ UT __X 10.0/10.0% NOTCH
FULL LENGTH MPI		
FULL LENGTH UT		ID ____ OD/ID ____ L ____ UT ____
END AREA INSPECTION (PLAIN END)	X	MPI __X UT ____
SPECIAL END AREA (SEA) INSP		MPI ____ UT ____
FULL LENGTH DRIFT		DRIFT MANDREL SIZE:

ADDITIONAL NOTES/COMMENTS

ALL MELTING AND MANUFACTURING TOOK PLACE IN THE USA.
MANUFACTURED IN AN ISO 9001 CERTIFIED FACILITY - CERTIFICATE #30727.
NO REPAIRS BY WELDING. NO MERCURY OR MERCURY COMPOUNDS ARE ADDED TO THE STEEL AND ALL MERCURY
** END OF DATA **

THIS IS TO CERTIFY THAT THE PRODUCT DESCRIBED HEREIN WAS MANUFACTURED, SAMPLED, TESTED AND/OR INSPECTED IN ACCORDANCE WITH THE SPECIFICATION AND FULFILLS THE REQUIREMENTS IN SUCH RESPECTS.

PREPARED BY THE OFFICE OF: MICHAEL HENRY -MANAGER, Q.A.
FAIRFIELD TUBULAR OPERATIONS

DATE 03/31/16

**

U.S. STEEL TUBULAR PRODUCTS
FAIRFIELD TUBULAR OPERATIONS

TUBULAR PRODUCTS
ADDITIONAL COMMENTS SHEET

DATE: 03/31/16
TIME: 23:28:42

MILL ORDER/ITEM NO	SHIPPERS NO.	P.O. NUMBER	HEAT	
DR94127 01		S13-60549		SERIAL NUMBER: F0099839

SOLD TO ADDRESS	MAIL TO ADDRESS	VENDOR
CONSOLIDATED PIPE & SUPPLY PO BOX 2472 BIRMINGHAM AL 35201-2472		U.S.S. SEAMLESS TUBULAR OPS FAIRFIELD TUBULAR OPERATIONS P.O. BOX 599 FAIRFIELD ALABAMA 35064

HEAT MA6980 - MELTED AT:NUCOR STEEL MEMPHIS, MEMPHIS, TN 38109
HEAT MA6981 - MELTED AT:NUCOR STEEL MEMPHIS, MEMPHIS, TN 38109
END OF DATA

HEATEC, INC.
5200 WILSON RD. CHATTANOOGA, TN 37410

Date Printed: 2/9/2017

CUSTOMER

UOP Russell LLC

,

VESSEL DESCRIPTION

HCI 5010-40

Vessel designed per the ASME Boiler & Pressure Vessel Code,
Section VIII, Division 1, 2015 Edition
with DesignCalcs, Version: 2016.2
Vessel is ASME Code Stamped

Wind Analysis performed in accordance with ASCE 7-10
Seismic Analysis performed in accordance with ASCE 7-10

Vessel Number: 16-251

NAMEPLATE INFORMATION

Vessel MAWP:	150.00 PSI at 550 °F
MDMT:	-20 °F at 150.00 PSI
Serial Number(s):	16-251
National Board Number(s):	
Year Built:	2017
Radiography:	NONE
Postweld Heat Treated:	NONE
Construction Type:	W

Notes

The loading in UG-22 were considered and deemed to be insignificant.

Signatures

PROJECT ENGINEER: _____ Date: 2 / 9 / 17

SUPERVISOR: _____ Date: 2 / 14 / 17

QUALITY CONTROL: _____ Date: 2 / 15 / 17

INSPECTOR (A. I.): _____ Date: 2 / 15 / 17

Table of Contents

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MAWP Summary	11
Summary Information	12
Hydrostatic Test Information Par. UG-99(b)	13

HEATEC, INC.

4" SA-106B Pipe

Customer: **UOP Russell LLC**

Vessel Number: 16-251

Number: 1 Mark Number: S1

Date Printed: 2/9/2017

Cylindrical Shell Design Information

Design Pressure:	150.00	PSI	Design Temperature:	550	°F
Static Head:	0.00	PSI	Long. Joint Efficiency:	85	%
Shell Material:	SA-106 Gr. B		Factor B Chart:	CS-2	
			Material Stress (hot):	17100	PSI
Shell Length:	12.0000	in.	Material Stress (cold):	17100	PSI
			Compressive Stress:	13907	PSI
Corrosion Allowance:	0.0625	in.	Actual Circumferential Stress:	2670	PSI
External Corrosion Allowance:	0.0000	in.	Actual Longitudinal Stress:	1492	PSI
Outside Diameter (new):	4.5000	in.			
Outside Diameter (corroded):	4.5000	in.	Specific Gravity:	1.00	
Shell Surface Area:	1.18	Sq. Ft.	Weight of Fluid:	5.53	lb.
Shell Estimated Volume:	0.66	Gal.	Total Flooded Shell Weight:	16.19	lb.
Circ. Joint Efficiency:	70	%	Shell Weight:	10.66	lb.

Minimum Design Metal Temperature Data

Min. Temperature Curve:	B	Pressure at MDMT:	150.00 PSI
UCS-66(b) reduction:	No	Minimum Design Metal Temperature:	-20 °F
UCS-68(c) reduction:	No	Computed Minimum Temperature:	-20 °F

Design Thickness Calculations

Longitudinal Stress Calculations per Paragraph UG-27(c)(2)

$$t = \frac{PR}{2SE + 0.4P} = \frac{150.00 * 2.0755}{2 * 17100 * 0.70 + 0.4 * 150.00}$$

= Greater Of ($0.0130_{(Calculated)}$, $0.0625_{(Minimum\ Allowed)}$) + 0.0625 (corrosion) + 0.0000 (ext. corrosion) + 0.0296 (12 1/2% for pipe)

= minimum of **0.1546** in.

Circumferential Stress Calculations per Appendix 1-1

$$t = \frac{PR_o}{SE + 0.4P} = \frac{150.00 * 2.2500}{17100 * 0.85 + 0.4 * 150.00}$$

= Greater of ($0.0232_{(Calculated)}$, $0.0625_{(Minimum\ Allowed)}$) + 0.0625 (corrosion) + 0.0000 (ext. corrosion) + 0.0296 (12 1/2% for pipe)

= minimum of **0.1546** in.

MAWP for this Shell Section Only

$$P = \frac{SEt}{R_o - 0.4t} = \frac{17100 * 0.85 * 0.1449}{2.2500 - 0.4 * 0.1449}$$

= maximum design pressure of **960.80** PSI

External loads do not control design.

Pipe Selected: Size = **4 in.**, Schedule = **40**, Diameter = **4.5000** in., Wall = **0.2370** in.

HEATEC, INC.

4" SA-234 WPB Fittings

Customer: **UOP Russell LLC**

Vessel Number: 16-251

Number: 2 Mark Number: S2

Date Printed: 2/9/2017

Cylindrical Shell Design Information

Design Pressure:	150.00	PSI	Design Temperature:	550	°F
Static Head:	0.00	PSI	Long. Joint Efficiency:	85	%
Shell Material:	SA-234 Gr. WPB		Factor B Chart:	CS-2	
			Material Stress (hot):	17100	PSI
Shell Length:	12.0000	in.	Material Stress (cold):	17100	PSI
			Compressive Stress:	13907	PSI
Corrosion Allowance:	0.0625	in.	Actual Circumferential Stress:	2670	PSI
External Corrosion Allowance:	0.0000	in.	Actual Longitudinal Stress:	1492	PSI
Outside Diameter (new):	4.5000	in.			
Outside Diameter (corroded):	4.5000	in.	Specific Gravity:	1.00	
Shell Surface Area:	1.18	Sq. Ft.	Weight of Fluid:	5.53	lb.
Shell Estimated Volume:	0.66	Gal.	Total Flooded Shell Weight:	16.19	lb.
Circ. Joint Efficiency:	70	%	Shell Weight:	10.66	lb.

Minimum Design Metal Temperature Data

Min. Temperature Curve:	B	Pressure at MDMT:	150.00 PSI
UCS-66(b) reduction:	No	Minimum Design Metal Temperature:	-20 °F
UCS-68(c) reduction:	No	Computed Minimum Temperature:	-20 °F

Design Thickness Calculations

Longitudinal Stress Calculations per Paragraph UG-27(c)(2)

$$t = \frac{PR}{2SE + 0.4P} = \frac{150.00 * 2.0755}{2 * 17100 * 0.70 + 0.4 * 150.00}$$

= Greater Of ($0.0130_{(Calculated)}$, $0.0625_{(Minimum\ Allowed)}$) + 0.0625 (corrosion) + 0.0000 (ext. corrosion) + 0.0296 (12 1/2% for pipe)

= minimum of **0.1546** in.

Circumferential Stress Calculations per Appendix 1-1

$$t = \frac{PR_o}{SE + 0.4P} = \frac{150.00 * 2.2500}{17100 * 0.85 + 0.4 * 150.00}$$

= Greater of ($0.0232_{(Calculated)}$, $0.0625_{(Minimum\ Allowed)}$) + 0.0625 (corrosion) + 0.0000 (ext. corrosion) + 0.0296 (12 1/2% for pipe)

= minimum of **0.1546** in.

MAWP for this Shell Section Only

$$P = \frac{SEt}{R_o - 0.4t} = \frac{17100 * 0.85 * 0.1449}{2.2500 - 0.4 * 0.1449}$$

= maximum design pressure of **960.80** PSI

External loads do not control design.

Pipe Selected: Size = **4 in.**, Schedule = **40**, Diameter = **4.5000** in., Wall = **0.2370** in.

HEATEC, INC.

1/2" Thread-O-Let

Customer: **UOP Russell LLC**
Vessel Number: 16-251
Number: 1 Mark Number: N1
ID Number: 1

Date Printed: 2/9/2017

Nozzle Design Information

Design Pressure:	150.00	PSI	Design Temperature:	550	°F
Static Head:	0.00	PSI	Nozzle Efficiency (E):	85	%
Nozzle Material:	SA-105		Joint Efficiency (E_1):	1.00	
			Factor B Chart:	CS-2	
External Projection:	1.0000	in.	Allowable Stress at Design Temperature (S_n):	19000	PSI
			Allowable Stress at Ambient Temperature:	20000	PSI
Inside Corrosion Allowance:	0.0625	in.	Correction Factor (F):	1.00	
External Corrosion Allowance:	0.0000	in.	Nozzle Path:	None	
Nozzle ID (new):	0.8550	in.	Nozzle Wall Thickness(new):	0.1425	in.
Nozzle ID (corroded):	0.9800	in.	Nozzle Wall Thickness(corroded):	0.0800	in.
External Limit of Reinforcement:	0.2000	in.	Upper Weld Leg Size(Weld 41):	0.2500	in.
Parallel Limit of Reinf (2Lpar):	1.9600	in.	Outside Groove Weld Depth:	0.1425	in.

Minimum Design Metal Temperature

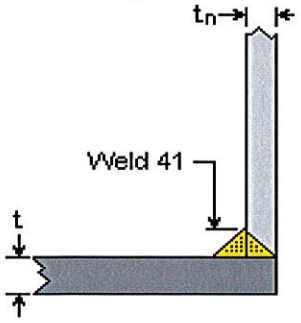
Min. Temp. Curve:	B	Pressure at MDMT:	150.00 PSI
UCS-66(b) reduction:	No	Minimum Design Metal Temperature:	-20 °F
UCS-68(c) reduction:	No	Computed Minimum Temperature:	-20 °F

Host Component: Shell 1 - 4" SA-106B Pipe

Material:	SA-106 Gr. B	Shell wall thickness(new):	0.2370 in.
Material Stress(S_v):	17100 PSI	ell wall thickness - 12½% for pipe (corroded):	0.1449 in.

Nozzle Detail Information

Abutting Groove



Upper Weld Leg Size(Weld 41): 0.2500 in.

Nozzle Wall Thickness(t_n): 0.1425 in.

Outside Groove Weld Depth: 0.1425 in.

Nozzle abuts the vessel, attached by a groove weld.
Nozzle is adequate for UG-45 requirements.
Opening is adequately reinforced for Internal Pressure.
Weld Strength Paths are adequate.

Required Shell Thickness per Paragraph UG-37(a)

$$\mathbf{tr} = \frac{PRo}{SE + 0.4P} = \frac{150.00 * 2.2500}{17100 * 1 + 0.4 * 150.00} = \mathbf{0.0197} \text{ in.}$$

Nozzle Required Thickness Calculations

Required Nozzle Thickness for Internal Pressure per Paragraph UG-37(a)

$$\mathbf{trn} = \frac{PRn}{SE - 0.6P} = \frac{150.00 * 0.4900}{19000 * 1 - 0.6 * 150.00} = \mathbf{0.0039} \text{ in.}$$

Strength Reduction Factors

$$r2 = \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{19000}{17100}, 1.0000\right) = 1.0000$$

UG-45 Thickness Calculations

Nozzle Thickness for Pressure Loading (plus corrosion)

$$t_a = \frac{PRn}{SE - 0.6P} + Ca + \text{ext. } Ca = \frac{150.00 * 0.4900}{19000 * 0.85 - 0.6 * 150.00} + 0.0625 + 0.0000 = \mathbf{0.0671} \text{ in.}$$

Nozzle Thickness for Internal Pressure (plus corrosion) Based on Host

$$t_{b1} = \frac{PRo}{SE + 0.4P} + Ca + \text{ext. } Ca = \frac{150.00 * 2.2500}{17100 * 1 + 0.4 * 150.00} + 0.0625 + 0.0000$$

$= \text{Greater Of } (0.0197_{(\text{Calculated})}, 0.0625_{(\text{Minimum Allowed})}) + 0.0625_{(\text{corrosion})} + 0.0000_{(\text{ext. corrosion})} = \mathbf{0.1250}$ in.

Minimum Thickness (plus corrosion) per Table UG-45

t_{b3} = minimum thickness (Table UG-45) + Ca + ext. Ca = **0.1785** in.

Nozzle Minimum Thickness Based on Host and Table UG-45

$t_b = \min[t_{b3}, \max(t_{b1}, t_{b2})]$ = **0.1250** in.

$t_{UG\text{-}45} = \max(t_a, t_b)$ = **0.1250** in.

Wall thickness = tn = **0.1420** is greater than or equal to UG-45 value of **0.1250**

Limits of Reinforcement (UG-40)

L_{par} = max(d, R_n + t + t_n) = max(0.9800, 0.4900 + 0.1449 + 0.0800) = **0.9800** in.
L_{noro} = min(2.5 t, 2.5 t_n + t_e) = min(2.5 * 0.1449, 2.5 * 0.0800 + 0.0000) = **0.2000** in.
L_{nori} = min(2.5 t, 2.5 t_i) = min(2.5 * 0.1449, 2.5 * 0.0000) = **0.0000** in.

Nozzle Reinforcement Calculations (Internal Pressure)

A = max(C d t_r F, 0) = max(1.0000 * 0.9800 * 0.0197 * 1.00, 0)
= **0.0193** sq. in.

A1 = max[(2 L_{par} - d) (E_1 t - F t_r), 0] =
max[(2 * 0.9800 - 0.9800) * (1.0000 * 0.1449 - 1.00 * 0.0197), 0]
= **0.1227** sq. in.

A2 = max{2 min(h_o, L_{noro}) [min(t_n, L_{par} - 0.5 d) - t_{rn}] f_{r2}, 0} =
max{2 * min(1.0000, 0.2000) * [min(0.0800, 0.9800 - 0.5 * 0.9800) - 0.0039] * 1.0000, 0} = **0.0304** sq. in.

A3 = max{2 min(h, L_{nori}) min(t_i, L_{par} - 0.5 d) f_{r2}, 0} =
max{2 * min(0.0000, 0.0000) * min(0.0000, 0.9800 - 0.5 * 0.9800) * 1.0000, 0} = **0.0000** sq. in.

A41 = f_{r2} [L_{41}^2 - (L_{41} - $L_{41pareff}$)^2 - (L_{41} - $L_{41noreff}$)^2] =
1.0000 * [0.2500^2 - (0.2500 - 0.2500)^2 - (0.2500 - 0.2000)^2] = **0.0600** sq. in.

A42 = f_{r4} $L_{42pareff}$ $L_{42noreff}$ =
0.0000 * 0.0000 * 0.0000 = **0.0000** sq. in.

A43 = f_{r2} $L_{43pareff}$ $L_{43noreff}$ =
1.0000 * 0.0000 * 0.0000 = **0.0000** sq. in.

A5
= **0.0000** sq. in.

Area Available (Internal Pressure) = A1 + A2 + A3 + A41 + A42 + A43 + A5 = 0.2131 sq. in., which is **>=** A (0.0193)

HEATEC, INC.

3/4" Thread-O-Let

Customer: **UOP Russell LLC** 16-251

Vessel Number:

Number: 2 Mark Number: N2

ID Number: 2

Date Printed: 2/9/2017

Nozzle Design Information

Design Pressure:	150.00	PSI	Design Temperature:	550	°F
Static Head:	0.00	PSI	Nozzle Efficiency (E):	85	%
Nozzle Material:	SA-105		Joint Efficiency (E_1):	1.00	
			Factor B Chart:	CS-2	
External Projection:	1.0000	in.	Allowable Stress at Design Temperature (S_n):	19000	PSI
			Allowable Stress at Ambient Temperature:	20000	PSI
Inside Corrosion Allowance:	0.0625	in.	Correction Factor (F):	1.00	
External Corrosion Allowance:	0.0000	in.	Nozzle Path:	None	
Nozzle ID (new):	1.0650	in.	Nozzle Wall Thickness(new):	0.1625	in.
Nozzle ID (corroded):	1.1900	in.	Nozzle Wall Thickness(corroded):	0.1000	in.
External Limit of Reinforcement:	0.2500	in.	Upper Weld Leg Size(Weld 41):	0.2500	in.
Parallel Limit of Reinf (2Lpar):	2.3800	in.	Outside Groove Weld Depth:	0.1625	in.

Minimum Design Metal Temperature

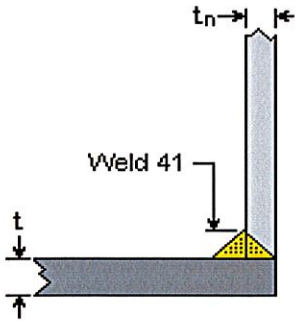
Min. Temp. Curve:	B	Pressure at MDMT:	150.00 PSI
UCS-66(b) reduction:	No	Minimum Design Metal Temperature:	-20 °F
UCS-68(c) reduction:	No	Computed Minimum Temperature:	-20 °F

Host Component: Shell 1 - 4" SA-106B Pipe

Material:	SA-106 Gr. B	Shell wall thickness(new):	0.2370 in.
Material Stress(S_v):	17100 PSI	ell wall thickness - 12½% for pipe (corroded):	0.1449 in.

Nozzle Detail Information

Abutting Groove



Upper Weld Leg Size(Weld 41): 0.2500 in.

Nozzle Wall Thickness(t_n): 0.1625 in.

Outside Groove Weld Depth: 0.1625 in.

Nozzle abuts the vessel, attached by a groove weld.
Nozzle is adequate for UG-45 requirements.
Opening is adequately reinforced for Internal Pressure.
Weld Strength Paths are adequate.

Required Shell Thickness per Paragraph UG-37(a)

$$\mathbf{tr} = \frac{PRo}{SE + 0.4P} = \frac{150.00 * 2.2500}{17100 * 1 + 0.4 * 150.00} = \mathbf{0.0197} \text{ in.}$$

Nozzle Required Thickness Calculations

Required Nozzle Thickness for Internal Pressure per Paragraph UG-37(a)

$$\mathbf{trn} = \frac{PRn}{SE - 0.6P} = \frac{150.00 * 0.5950}{19000 * 1 - 0.6 * 150.00} = \mathbf{0.0047} \text{ in.}$$

Strength Reduction Factors

$$r2 = \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{19000}{17100}, 1.0000\right) = 1.0000$$

UG-45 Thickness Calculations

Nozzle Thickness for Pressure Loading (plus corrosion)

$$t_a = \frac{PRn}{SE - 0.6P} + Ca + \text{ext. } Ca = \frac{150.00 * 0.5950}{19000 * 0.85 - 0.6 * 150.00} + 0.0625 + 0.0000 = \mathbf{0.0681} \text{ in.}$$

Nozzle Thickness for Internal Pressure (plus corrosion) Based on Host

$$t_{b1} = \frac{PRo}{SE + 0.4P} + Ca + \text{ext. } Ca = \frac{150.00 * 2.2500}{17100 * 1 + 0.4 * 150.00} + 0.0625 + 0.0000$$

$= \text{Greater Of } (0.0197_{(\text{Calculated})}, 0.0625_{(\text{Minimum Allowed})}) + 0.0625_{(\text{corrosion})} + 0.0000_{(\text{ext. corrosion})} = \mathbf{0.1250}$ in.

Minimum Thickness (plus corrosion) per Table UG-45

t_{b3} = minimum thickness (Table UG-45) + Ca + ext. Ca $= \mathbf{0.1855}$ in.

Nozzle Minimum Thickness Based on Host and Table UG-45

$t_b = \min[t_{b3}, \max(t_{b1}, t_{b2})] = \mathbf{0.1250}$ in.

$t_{UG\text{-}45} = \max(t_a, t_b) = \mathbf{0.1250}$ in.

Wall thickness = tn = **0.1630** is greater than or equal to UG-45 value of **0.1250**

Limits of Reinforcement (UG-40)

L_{par} = max(d, R_n + t + t_n) = max(1.1900, 0.5950 + 0.1449 + 0.1000) = **1.1900** in.
L_{noro} = min(2.5 t, 2.5 t_n + t_e) = min(2.5 * 0.1449, 2.5 * 0.1000 + 0.0000) = **0.2500** in.
L_{nori} = min(2.5 t, 2.5 t_i) = min(2.5 * 0.1449, 2.5 * 0.0000) = **0.0000** in.

Nozzle Reinforcement Calculations (Internal Pressure)

A = max(C d t_r F, 0) = max(1.0000 * 1.1900 * 0.0197 * 1.00, 0)
= **0.0234** sq. in.

A1 = max[(2 L_{par} - d) (E_1 t - F t_r), 0] =
max[(2 * 1.1900 - 1.1900) * (1.0000 * 0.1449 - 1.00 * 0.0197), 0]
= **0.1490** sq. in.

A2 = max{2 min(h_o, L_{noro}) [min(t_n, L_{par} - 0.5 d) - t_{rn}] f_{r2}, 0} =
max{2 * min(1.0000, 0.2500) * [min(0.1000, 1.1900 - 0.5 * 1.1900) - 0.0047] * 1.0000, 0} = **0.0477** sq. in.

A3 = max{2 min(h, L_{nori}) min(t_i, L_{par} - 0.5 d) f_{r2}, 0} =
max{2 * min(0.0000, 0.0000) * min(0.0000, 1.1900 - 0.5 * 1.1900) * 1.0000, 0} = **0.0000** sq. in.

A41 = f_{r2} [L_{41}^2 - (L_{41} - $L_{41pareff}$)^2 - (L_{41} - $L_{41noreff}$)^2] =
1.0000 * [0.2500^2 - (0.2500 - 0.2500)^2 - (0.2500 - 0.2500)^2] = **0.0625** sq. in.

A42 = f_{r4} $L_{42pareff}$ $L_{42noreff}$ =
0.0000 * 0.0000 * 0.0000 = **0.0000** sq. in.

A43 = f_{r2} $L_{43pareff}$ $L_{43noreff}$ =
1.0000 * 0.0000 * 0.0000 = **0.0000** sq. in.

A5
= **0.0000** sq. in.

Area Available (Internal Pressure) = A1 + A2 + A3 + A41 + A42 + A43 + A5 = 0.2591 sq. in., which is **>=** A (0.0234)

ASME Flange Design Information

Host	Description	Type	Size (in.)	Material	ASME Class	Material Group	MAP (PSI)
4" SA-106B Pipe	4" 300#	Weld Neck	4	SA-105	300	1.1	587.50

MDMT Report by Components
Design MDMT is -20 °F

Component	Material	Curve	Pressure	MDMT
4" SA-234 WPB Fittings	SA-234 Gr. WPB	B	150.00 PSI	-20 °F
4" SA-106B Pipe	SA-106 Gr. B	B	150.00 PSI	-20 °F
3/4" Thread-O-Let	SA-105	B	150.00 PSI	-20 °F
1/2" Thread-O-Let	SA-105	B	150.00 PSI	-20 °F

Component with highest MDMT: 4" SA-234 WPB Fittings.

Computed MDMT = -20 °F

The required design MDMT of -20 °F has been met or exceeded for the calculated MDMT values.

ASME Flanges Are Not Included in MDMT Calculations.

HEATEC, INC.

HCI 5010-40

Customer: **UOP Russell LLC**

Vessel Number: 16-251

Date Printed: 2/9/2017

MAWP Report by Components

Component	Design Pressure	Static Head	Vessel MAWP New & Cold UG-98(a)	Component MAWP Hot & Corroded UG-98(b)	Vessel MAWP Hot & Corroded UG-98(a)
4" SA-106B Pipe	150.00 PSI	0.00 PSI	1390.92 PSI	882.34 PSI	882.34 PSI
ASME Flange Class: 300 Gr:1.1	150.00 PSI	0.00 PSI	740.00 PSI	587.50 PSI	587.50 PSI
1/2" Thread-O-Let	150.00 PSI	0.00 PSI	1462.34 PSI	621.07 PSI	621.07 PSI
3/4" Thread-O-Let	150.00 PSI	0.00 PSI	1413.62 PSI	778.08 PSI	778.08 PSI
4" SA-234 WPB Fittings	150.00 PSI	0.00 PSI	1390.92 PSI	960.80 PSI	960.80 PSI

NC = Not Calculated Inc = Incomplete

Summary

Component with the lowest vessel MAWP(New & Cold) : **ASME Flange Class: 300 Gr:1.1**

The lowest vessel MAWP(New & Cold) : **740.00** PSI

Component with the lowest vessel MAWP(Hot & Corroded) : **ASME Flange Class: 300 Gr:1.1**

The lowest vessel MAWP(Hot & Corroded) : **587.50** PSI

Pressures are exclusive of any external loads.

Flange pressures listed here do not consider external loadings

Summary Information

	Dry Weight	Flooded Weight
Shell	21.33 lb.	32.38 lb.
Nozzle	0.24 lb.	0.24 lb.
ASME Flange	25.00 lb.	25.00 lb.
Totals	46.57 lb.	57.62 lb.

	Volume
Shell	1.32 Gal.
Nozzle	0.01 Gal.
Totals	1.33 Gal.

	Area
Shell	2.36 Sq. Ft.
Nozzle	0.08 Sq. Ft.
Totals	2.43 Sq. Ft.

HEATEC, INC.

Customer: **UOP Russell LLC**
Vessel Number: 16-251

Date Printed: 2/9/2017

Hydrostatic Test Information Par. UG-99(b)
Gauge at Top

Component	Const.	x	STest	/	SDesign	x	Pressure	=	Component Hydro Test Pressure
1/2" Thread-O-Let	1.3	x	20000	/	19000	x	150.00	=	205.26
3/4" Thread-O-Let	1.3	x	20000	/	19000	x	150.00	=	205.26
4" SA-106B Pipe	1.3	x	17100	/	17100	x	150.00	=	**195.00**
4" SA-234 WPB Fittings	1.3	x	17100	/	17100	x	150.00	=	195.00

Calculated Test Pressure: 195.00 PSI

Special Notes:

This calculation assumes one chamber.

This calculation is limited by the lowest component pressure per chamber.

HEATEC INC
P.O. BOX 72760 CHATTANOOGA, TN 37407
5200 WILSON ROAD CHATTANOOGA, TN 37410

SHOP TRAVELER

H=HOLD POINT

W=WITNESS POINT

SECTION VIII, DIV. 1
JOB # 16-257 Coil
QC Reviewed: Chim Cox 2/15/17
AI Reviewed: S. Allyar 2-15-17

Operation	QC H or W Points	AI H or W Points	QC Manager	Date	Authorized Inspector	Remarks	Date
Calculations	H	H	C.Cox	2/15/17	S. Allyar		2-15-17
Drawings	H	H	C.Cox	2/15/17	S. Allyar		2-15-17
Material(Ordered)							
Material(Received)							
Material Test Reports	H	H	C.Cox	2/23/17	S. Allyar		3-7-17
Final Internal							
MT of Spin Holes							
Transfer Heat Numbers	H		C.Cox	2/24/17			
Fit-up							
Weld Seam Alignment							
Joint Preparation							
PWHT							
NDE: RT MT PT UT							
RT: 1 2 3 4 (None)							
* Hydrotest @ 195 psi	H	H	C.Cox	3/7/17	S. Allyar		3-7-17
Test Gauge # HEA-127 DUE- 6-16-17	H	H	C.Cox	3/7/17	S. Allyar		3-7-17
Final Inspection	H	H	C.Cox	3/7/17	S. Allyar		3-7-17
Data Report/s	H	H	C.Cox	3/7/17	S. Allyar		3-7-17
Shipped							

Remarks * ACTUAL HYDROTEST PRESSURE ~~215~~ 215 psi.
QC Chim Cox 3/7/17

Notes

NCR# | AI ACCEPTANCE: | AI CLOSURE:

Control Services, Inc.

4729 Adams Road, Hixson, TN 37343
www.controlservicesTN.com

Certificate of Calibration

Traceable to NIST

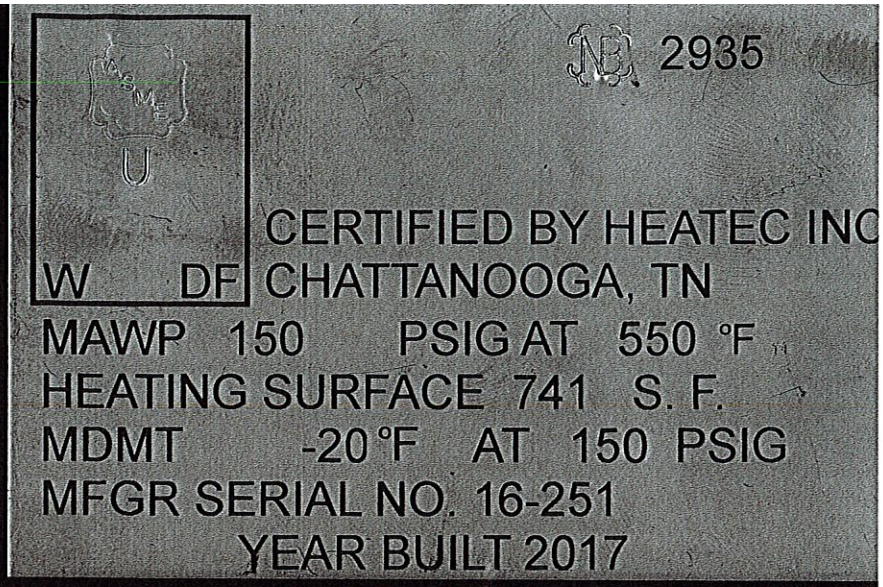
Customer	*HEATEC, INC.*	**ID Number**	HEA-127
Address	*5200 WILSON ROAD*	**Description**	4.5" PROCESS GAUGE
City	*CHATTANOOGA*		
State, Zip	*TN 37410*	**Manufacturer**	GENERAL INSTRUMENT
NIST Number	19933HEA-127	**Model Number**	4501-2LK
As Found	IN TOLERANCE	**Serial Number**	NONE
As Left	IN TOLERANCE	**Range**	0-600 PSI
Standard(s)	CRYSTAL DIGITAL TEST GAUGE	**Accuracy**	+/- 1.0% FS
		Calibration Date	6/16/2016
Serial No.(s)	307001	**Due Date**	6/16/2017
		Calibration Frequency	12 MONTHS

This instrument has been certified utilizing working standards with accuracies traceable to the National Institute of Standards and Technology, derived from natural physical constants, derived from ratio measurements or compared to consensus standards. All working standards used for certification are supported by a calibration system and quality control system that meets or exceeds the requirements of ANSI/NCSL Z540-1 and ISO/IEC 17025. The reported data is valid only at the time of the test and related only to the item calibrated. Calibration due dates are determined by the cliet and do not imply continued conformance to specifications. This certificate shall not be reproduced except in full, without written permission of Control Services, Inc.

Findings: NEW REPLACEMENT FOR HEA-102

Applied Standard	Minimum Allowed	Maximum Allowed	AsFound	AsLeft	Difference (as left)
50.0 PSI	44.0	56.0	49.1	49.1	-0.9
300.0 PSI	294.0	306.0	295.6	295.6	-4.4
550.0 PSI	544.0	556.0	547.5	547.5	-2.5

Calibrated by: _____


NB 2935
U
W DF
CERTIFIED BY HEATEC INC
CHATTANOOGA, TN
MAWP 150 PSIG AT 550 °F
HEATING SURFACE 741 S. F.
MDMT -20 °F AT 150 PSIG
MFGR SERIAL NO. 16-251
YEAR BUILT 2017

Datasheet 111-9
1/31/2012

Eclipse Winnox Burners

Model WX0850

Version 2

Parameter		Specifications	
Blower Type		**Packaged Blower** Nominal (60Hz)	**Remote Blower** Pressure at Air Inlet 1.5 psig (100 mbar)
Maximum Input, MMBTU/hr (kW)[1] *Contact factory for chamber pressures outside the given range, or varying chamber pressure conditions.*	Chamber Pressure "w.c. (mbar)		
	-5.0 (-12.5)	9.7 (2840)	13.6 (3985)
	-3.0 (-7.5)	9.2 (2694)	13.2 (3868)
	0.0	8.5 (2490)	12.5 (3660)
	1.0 (2.5)	8.2 (2416)	12.2 (3575)
	2.0 (5.0)	7.98 (2337)	12.0 (3516)
Minimum Input, BTU/hr (kW)	Natural Gas	500,000 (146)	500,000 (146)
	Propane, Butane	600,000 (175)	600,000 (175)
Fuel Inlet Pressure at Ratio Regulator, "w.c. (mbar)[2]	Maximum	82 (207)	110 (273)
	Minimum	27.7 (69)	55.4 (138)
Maximum Chamber Temperature, °F (°C) *Tube temperatures should be reduced 150°F when using propane or butane.*		Standard combustion tube: 1300 (704) High temperature combustion tube: 1400 (760)[5]	
Flame Length	Alloy Tube	Flame is inside tube at all times.	
Excess Air,% at High Fire		40% - 70%	
Pipe Connections		NPT or BSP/DN Flange connections available.	
Flame Detection		Flame rod or UV scanner.	
Fuels *For any other mixed gas, contact Eclipse Inc.*		Natural gas, Propane, Butane[3]	
Blower Motor Power, Hp		15	-
Weight, lbs (kg)[4]		1435 (651)	1135 (515)
Approvals		АИ30	

[1] Maximum inputs for packaged blower versions are given for the standard combustion air blower without an inlet air filter.

[2] For proper performance, this pressure must be kept constant across the burner operating range.

[3] See Design Guide 111 for more information about typical fuel composition and properties.

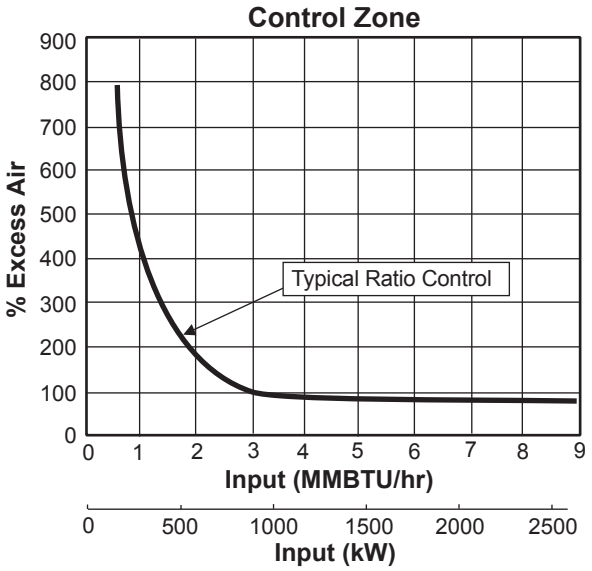
[4] All weights are approximate.

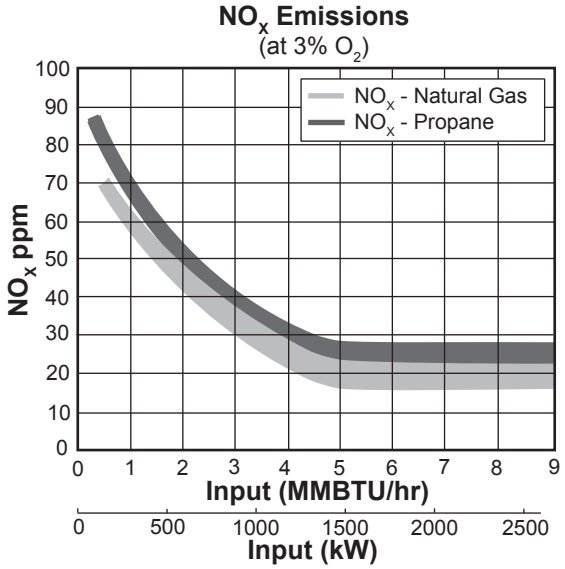
[5] Contact Eclipse for temperatures over 1400°F (760°C).

- All inputs are based on gross calorific values and standard conditions: one atmosphere, 70°F (21°C).
- All information is based on laboratory testing. Different chamber size and conditions will affect data.
- Eclipse reserves the right to change the construction and/or configurations of our products at any time without being obliged to adjust earlier supplies accordingly.

ECLIPSE®
Innovative Thermal Solutions

Performance Graphs





Fuel/Input Measurement

System design must include fuel flow measurement upstream of the burner. Eclipse recommends its 12-5 FOM (Fuel Orifice Meter) assembly number 302050-5 for natural gas. See Bulletin 930 for details.

Secondary By-Pass Fuel Setting:

Fuel	∆P "w.c. (mbar)*
Natural Gas	4.0 (10.0)
Propane	4.0 (10.0)
Butane	4.0 (10.0)

*Measured between Tap “E” and the chamber @ low fire.

NOTE: Input at low fire changes with ratio regulator adjustment.

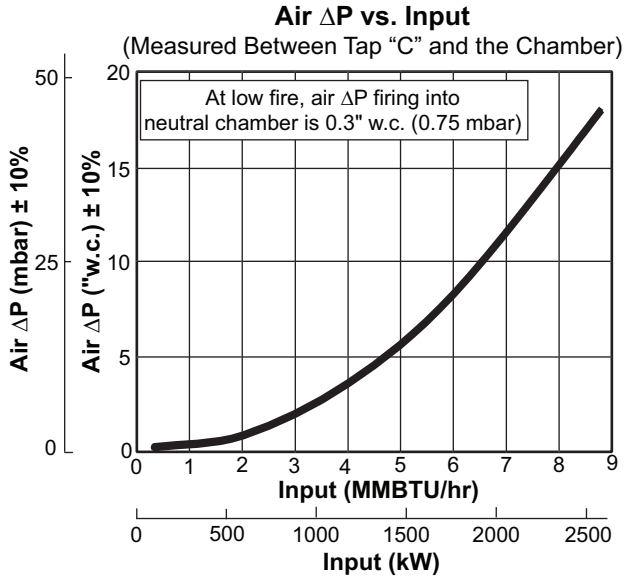
NO_x emission data is given for:

- Ambient combustion air (~70°F, 21°C)
- Less than 1000°F (540°C) firing chamber
- Minimal process air velocity
- Low fire input adjusted to 500,000 BTU/hr (88 kW)
- Neutral chamber pressure

Emissions are influenced by:

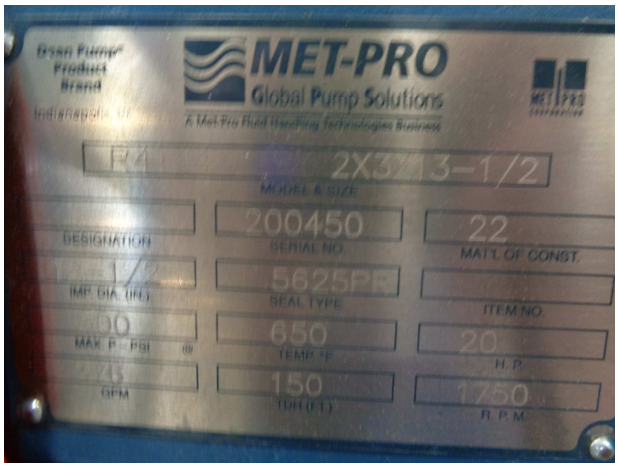
- Chamber conditions
- Fuel type
- Firing rate
- Ratio regulator adjustments
- Combustion air temperature
- Excess air

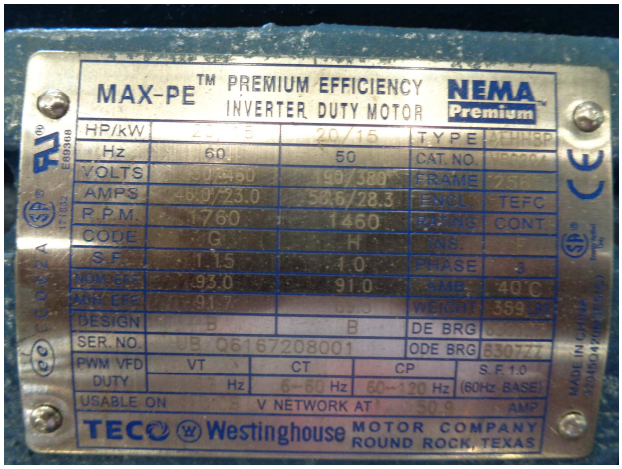
CO emission is largely influenced by chamber conditions. Contact your local Eclipse representative for an estimate of CO emission on your application.

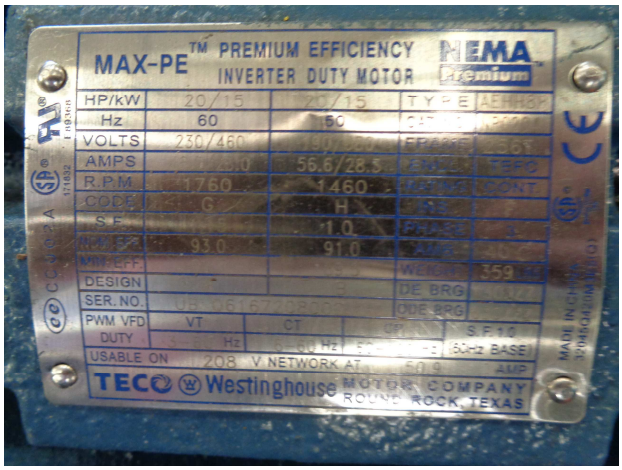


UOP Russell
P.O. 4500755147
Heatec Job # 16251
Tag # H781 / J447

Pump & Motor Serial Plates



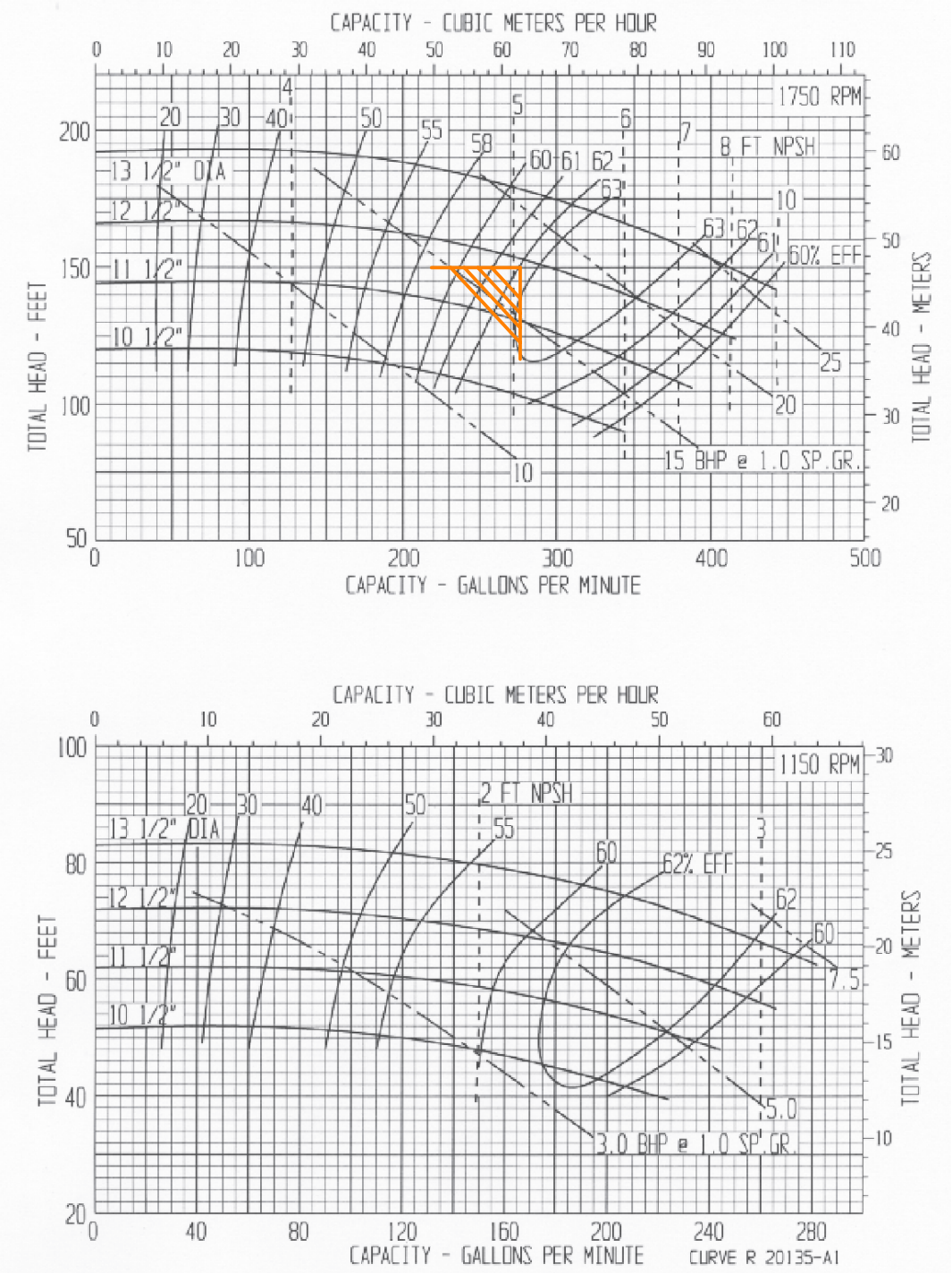




Dean Pump
A CECO Environmental Brand

CENTRIFUGAL PUMP PERFORMANCE DATA: CURVE R20135-A1
PUMP SIZE: 2 X 3 X 13.5
PUMP TYPE: R4140, R5140

2" DISCHARGE X 3" SUCTION



CERTIFICATION			
CUSTOMER	HEATEC INC		
CUSTOMER ORDER No.	V0365F	ITEM No.	R-4144
DEAN PUMP SERIAL No.	200450-1	IMPELLER DIA.	12.50"
CERTIFIED BY.	JON I	DATE	1-19-2017

PUMP PERFORMANCE: This curve, based on extensive tests, defines the average performance of this pump for liquids having a viscosity of 70 SSU or less. Actual performance of individual units may differ slightly from the performance indicated on this curve. Pump applications made from the data contained herein are subject to confirmation and acceptance by our Engineering Department at our Indianapolis Office.

National Board Number: 2944

Mfr. Representative: CC Date: 3/30/17

Authorized Inspector: [illegible] Date: 3-30-17

FORM U-1A MANUFACTURER'S DATA REPORT FOR PRESSURE VESSELS
(Alternative Form for Single Chamber, Completely Shop or Field Fabricated Vessels Only)
As Required by the Provisions of the ASME Boiler and Pressure Vessel Code Rules, Section VIII, Division 1

1. Manufactured and certified by HEATEC INC. 5200 WILSON ROAD CHATTANOOGA,TENNESSEE 37401
(Name and address of Manufacturer)

2. Manufactured for UOP RUSSELL 7050 S. YALE AVENUE, SUITE 210 TULSA, OK 74136
(Name and address of Purchaser)

3. Location of installation UNKNOWN
(Name and address)

4. Type HORIZONTAL (Horizontal or vertical, tank) | 16-251A (Manufacturer's serial number) | NONE (CRN) | 16251-ET (Drawing number) | 2944 (National Board number) | 2017 (Year built)

5. ASME Code, Section VIII, Div. 1 2015 EDITION [Edition and Addenda, if applicable (date)] | NONE (Code Case number) | NON-CORROSIVE SERVICE [Special service per UG-120(d)]

6. Shell SA-516-70 (Material spec. number, grade) | 0.375" (Nominal thickness) | 0.0625" (Corr. allow.) | 41 1/4" (Inner diameter) | 6' - 10" [Length (overall)]

Body Flanges on Shells

No.	Type	ID	OD	Flange Thk	Min Hub Thk	Material	How Attached	Location	Bolting: Num & Size	Bolting: Bolting Material	Bolting: Washer (OD, ID, thk)	Bolting: Washer Material
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-

7. Seams WELDED,DBL,BUTT [Long. (welded, dbl., sngl., lap, butt)] | NONE [R.T. (spot or full)] | 70 (Eff., %) | NONE (H.T. temp.) | N/A (Time, hr) | WELDED,SNGL,BUTT [Girth (welded, dbl., sngl., lap, butt)] | NONE [R.T. (spot or full)] | 65 (Eff., %) | 1 (No. of courses)

8. Heads: (a) Material SA-516-70 (Spec. no., grade) (b) Material SA-516-70 (Spec. no., grade)

	Location (Top, Bottom, Ends)	Minimum Thickness	Corrosion Allowance	Crown Radius	Knuckle Radius	Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure (Convex or Concave)
(a)	END	0.3117"	0.0625"	-	-	2:1	-	-	-	CONCAVE
(b)	END	0.3117"	0.0625"	-	-	2:1	-	-	-	CONCAVE

Body Flanges on Heads

	Location	Type	ID	OD	Flange Thk	Min Hub Thk	Material	How Attached	Bolting: Num & Size	Bolting: Bolting Material	Bolting: Washer (OD, ID, thk)	Bolting: Washer Material
(a)	-	-	-	-	-	-	-	-	-	-	-	-
(b)	-	-	-	-	-	-	-	-	-	-	-	-

9. MAWP 150 psig (Internal) | 0 (External) at max. temp. 550 F (Internal) | 550 F (External).

Min. design metal temp. -20 F at 150 psig. Hydro., pneu., or comb. test pressure HYDROTEST 195 psig.

Proof test -.

10. Nozzles, inspection, and safety valve openings:

Purpose (Inlet, Outlet, Drain, etc.)	No.	Diameter or Size	Type	Material: Nozzle	Material: Flange	Nozzle Thickness: Nom.	Nozzle Thickness: Corr.	Reinforcement Material	Attachment Details: Nozzle	Attachment Details: Flange	Location (Insp. Open.)
INLET/OUTLET	1 EA	4"	RFSO	SA-106B	SA-105	0.337"	0.0625"	NONE	WELDED	WELDED	BOTTOM
FILL	1	3"	RFSO	SA-106B	SA-105	0.300"	0.0625"	NONE	WELDED	WELDED	TOP
DRAIN	1	2"	RFSO	SA-106B	SA-105	0.344"	0.0625"	NONE	WELDED	WELDED	BOTTOM
BLANKET GAS	1	1"	COUPL	SA-105	NONE	3000#	0.0625"	NONE	WELDED	NONE	TOP
RELIEF VALVE	1	4"	RFSO	SA-106B	SA-105	0.337"	0.0625"	NONE	WELDED	WELDED	TOP
LEVEL SWITCH	1	3"	RFSO	SA-106B	SA-105	0.300"	0.0625"	NONE	WELDED	WELDED	END
LEVEL GAUGE	2	3/4"	PIPE	SA-106B	NONE	0.219"	0.0625"	NONE	WELDED	NONE	END

11. Supports: Skirt NO (Yes or no) Lugs 2 (Number) Legs NONE (Number) Other SADDLES (Describe) Attached BOTTOM,WELDED (Where and how)

12. Remarks: Manufacturer's Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of the report: RELIEF VALVE INSTALLED BY OTHERS.IMPACT TESTING EXEMPT PER UCS-66(b).
(Name of part, item number, Manufacturer's name and identifying stamp)

National Board Number: 2944

Mfr. Representative: CC Date: 3/30/17

Authorized Inspector: [signature] Date: 3-30-17

FORM U-1A (Back)

CERTIFICATE OF SHOP/FIELD COMPLIANCE

We certify that the statements made in this report are correct and that all details of design, material, construction, and workmanship of this vessel conform to the ASME BOILER AND PRESSURE VESSEL CODE, Section VIII, Division 1. "U" Certificate of Authorization Number 20348 expires 10/01/2018.

Date 3/30/17 Co. name HEATEC INC. (Manufacturer) Signed Chin Cat (Representative)

CERTIFICATE OF SHOP/FIELD INSPECTION

Vessel constructed by HEATEC INC. at 5200 WILSON RD.CHATTANOOGA,TENNESSEE 37401.

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and employed by Arise

have inspected the component described in this Manufacturer's Data Report on 3-30-17, and state that, to the best of my knowledge and belief, the Manufacturer has constructed this pressure vessel in accordance with ASME BOILER AND PRESSURE VESSEL CODE, Section VIII, Division 1. By signing this certificate neither the Inspector nor his/her employer makes any warranty, expressed or implied, concerning the pressure vessel described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his/her employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date 3-30-17 Signed [signature] (Authorized Inspector) Commissions NB 12488A TN 3499 [National Board (incl. endorsements)]

(04/14)

Expansion Tank

JOB # 16-251A

HEATEC INC.

QUALITY CONTROL RECEIVING INSPECTION REPORT

ITEM	THICKNESS OR SIZE	O.D.	MATL	MARKING	HEAT NO.	MILL TEST REP.	INITIAL & DATE
PLATE	3/8" Shell	—	SA-516-70	✓	B6V5670	✓	CC 3/16/17
	3/8" Lugs	—	SA-36	✓	7500139	✓	CC 3/16/17
	1/4" Saddles	—	SA-36	✓	B6X6384	✓	CC 3/16/17
PIPE	(2) 3/4" sch. 160	1.050"	SA-106B	✓	47523	✓	CC 3/16/17
	(1) 2" sch. 160	2.375"	SA-106B	✓	138398	✓	CC 3/16/17
	(2) 3" sch. 80	3.50"	SA-106B	✓	98B0842	✓	CC 3/16/17
	(3) 4" sch. 80	4.50"	SA-106B	✓	487490	✓	CC 3/16/17
HEADS	3/8"	42"	SA-516-70	✓	CGZT	✓	CC 3/16/17
COIL							
FLANGES	(1) 3"-300#	BF50	SA-105	✓			CC 3/16/17
	3"-150#	BF50	SA-105	✓			CC 3/16/17
	(3) 4"-300#	BF50	SA-105	✓			CC 3/16/17
	(1) 2"-150#	BF50	SA-105	✓			CC 3/16/17
NOZZLES & FITTINGS	3/4"-3000#	Couplings	SA-105	✓			CC 3/16/17
	(1) 1"-3000#	Coupling	SA-105	✓			CC 3/16/17
MISC.							

3/8" PLATE

NUCOR
PLATE MILL

P.O.Box 279
Winton, NC 27986
(252) 356-3700

Mill Test Report

Page 1

1505 River Rd
Cofield, NC 27922
(252) 356-3700

NUCOR
It's Our Nature

140083 HEATEC INC 21606 50824 443089 (CS)
HEAT NUMBER: 7500139 CUSTOMER PO: V0708T

Issuing Date : 01/11/2017 B/L No. : 461438 Load No. : 469769 Our Order No. : 142929/1 Cust. Order No. : C 50824-S

Vehicle No: TTPX 80673

Specification: 0.3750" x 120.000" x 480.000"
ASTM A36-14/ASTM A709 Grade 36-16a/AASHTO M270Grade 36/ASME SA36 2013/2015 AASHTO M270 36

Marking : 443089

Sold To: SISKIN STEEL AND SUPPLY CO INC
PO BOX 1191
1901 RIVERFRONT PKWY
CHATTANOOGA,TN 37401

Ship To: SISKIN STEEL AND SUPPLY CO INC
H-45
CHATTANOOGA,TN 37401

Heat No	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Al(tot)	V	Nb	Ti	N	Ca	B	Sn	Ceq	Pcm
7500138	0.16	0.82	0.009	0.002	0.12	0.25	0.09	0.07	0.02	0.011	0.007	0.001	0.002		0.0017	0.0002	0.008	0.34	0.23
7500139	0.17	0.84	0.010	0.001	0.16	0.23	0.07	0.07	0.02	0.023	0.006	0.002	0.003		0.0018	0.0000	0.009	0.35	0.24

Tensile Test								Charpy Impacts										
Plate Serial No	Pieces	Tons	Dir.	(psi) Yield	(psi) TENSILE	Elongation % in 2"	Elongation % in 8"	Dir.	1	(%) shear	2	(%) shear	3	(%) shear	Ave.	(%) shear	Size	Temp	Min Ave.
7500138-03	3	9.18	T	52,800	71,400		22.2												
			T	52,900	71,800		23.6												
7500139-09	3	9.18	T	51,200	71,400		26.2												
			T	53,500	73,700		24.2												

This Material Meets the
Chemical and Mechanical Testing
Requirements as Specified in:
ASME Section II Part A-2015 Edition.
QC Rep.: Chris Cf Date: 2/2/17

Lugs

Manufactured to fully killed practice by Electric Arc Furnace. Welding or weld repair was not performed on this material.
Mercury has not been used in the direct manufacturing of this material. Produced as continuous cast discrete plate as-rolled, unless otherwise noted in Specification. For Mexico shipments: nhc-SalesMX@Nucor.com
Yield by 0.5EUL method unless otherwise specified. Ceq = C+(Mn/6)+((Cr+Mo+V)/5)+((Cu+Ni)/15)
Pcm = C+(Si/30)+(Mn/20)+(Cu/20)+(Ni/60)+(Cr/20)+(Mo/15)+(V/10)+5B
Melted and Manufactured in the USA. ISO 9001:2008 certified (#010940) by SRI Quality System Registrar (#0985-09). PED 97/23/EC 7/2 Annex 1, Para. 4.3 Compliant.
DIN 50049 3.1.B/EN 10204 3.1B(2004), DIN EN 10204 3.1(2005) compliant. For ABS grades only, Quality Assurance certificate 14-MMPQA-723

We hereby certify that the contents of this report are accurate and correct. All test results and operations performed by the material manufacturer are in compliance with the applicable specifications, including customer specifications.

T. A. Depretis, Metallurgist

1/12/2017 7:58:46 AM

NUCOR
NUCOR STEEL TUSCALOOSA, INC.

MILL TEST CERTIFICATE

1/4" PLATE

1700 HOLT RD N.E.
Tuscaloosa, AL 35404-1000
800 800-8204
customerservice@nucortusk.com

441078

Load Number	Tally	Mill Order Number	PO NO. / Line NO	Part Number	Certificate Number	Prepared
T138312	00000000697342	N-151016-004	C49562-S 4		S69734201-1	11/29/2016 11:05

Grade

Order Description:
Hot Roll Plate From Coil
A36, 0.2500 IN x 96.000 IN x 480.000 IN
Quality Plan Description:
A36/SA36/A70936: ASTM A36-14/ASME SA36-13/A709-36-13

Customer:

Sold TO:
SISKIN STEEL AND SUPPLY CO INC CHATTANOOGA TN
Ship TO:
SISKIN STEEL / RIVERFRONT CHATTANOOGA TN
Sent TO:

Shipped Item	Heat/Slab Number	Certified By	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Cb	V	Al	Ti	N2	B	Ca	Sn	CEV	ACI
6K1570D	B6X6384-02 ***	B6X6384	0.19	0.86	0.011	0.006	0.05	0.14	0.05	0.06	0.016	0.001	0.003	0.025	0.001	0.012	0.0001	0.0011			
6K1570E	B6X6384-02 ***	B6X6384	0.19	0.86	0.011	0.006	0.05	0.14	0.05	0.06	0.016	0.001	0.003	0.025	0.001	0.012	0.0001	0.0011			
6K1570F	B6X6384-02 ***	B6X6384	0.19	0.86	0.011	0.006	0.05	0.14	0.05	0.06	0.016	0.001	0.003	0.025	0.001	0.012	0.0001	0.0011			

Shipped Item	Certified By	Heat Number	Yield ksi	Tensile ksi	Y/T %	ELONGATION % 2"	8"	Bend OK?	Hard HB	Charpy Impacts (ft-lbs) Size mm	1	2	3	Avg	Shear % 1	2	3	Avg	Test Temp
6K1570D	S6K1372FTT	B6X6384 ***	47.8	70.1	68.2	30.5													
6K1570D	S6K1697FTT	B6X6384 ***	49.2	72.1	68.2	32.7													
6K1570D	S6K1372MTT	B6X6384 ***	49.6	68.2	72.7	30.6													
6K1570D	S6K1697MTT	B6X6384 ***	49.7	67.8	73.3	26.9													
6K1570E	S6K1372FTT	B6X6384 ***	47.8	70.1	68.2	30.5													
6K1570E	S6K1697FTT	B6X6384 ***	49.2	72.1	68.2	32.7													
6K1570E	S6K1372MTT	B6X6384 ***	49.6	68.2	72.7	30.6													
6K1570E	S6K1697MTT	B6X6384 ***	49.7	67.8	73.3	26.9													
6K1570F	S6K1372FTT	B6X6384 ***	47.8	70.1	68.2	30.5													
6K1570F	S6K1697FTT	B6X6384 ***	49.2	72.1	68.2	32.7													
6K1570F	S6K1372MTT	B6X6384 ***	49.6	68.2	72.7	30.6													
6K1570F	S6K1697MTT	B6X6384 ***	49.7	67.8	73.3	26.9													

Items: 3 PCS: 14 Weight: 45739 LBS

Mercury has not come in contact with this product during the manufacturing process nor has any mercury been used by the manufacturing process. Certified in accordance with EN 10204 3.1. No weld repair has been performed on this material. Manufactured to a fully killed fine grain practice. NUTEMPER TEMPER PASSED plate from coil
ISO 9001:2008 Registered, PED Certified

"***" indicates Heats melted and Manufactured in the U.S.A.

SADDLES

We hereby certify that the product described above passed all of the tests required by the specifications.

Dr. Qullin Yu - Metallurgist

This Material Meets the
mical and Mechanical Testing
quirements as Specified in:
ection II Part A-2015 Edition.
By: Date: 2/15/17

110082 HEATEC INC 211452 49562 441078 (CS)
HEAT NUMBER: B6X6384 CUSTOMER PO: V0684I
PAGE 1 OF 1

3/8" PLATE HEADS

P-32118

SSAB

13609 Industrial Road, Houston, TX 77015, US

Test Certificate

Form TC1: Revision 2: Date 23 Apr 2014

Customer: DELTA STEEL, INC. 5599 SAN FELIPE-STE 600 P.O BOX 2289 HOUSTON TX 77252	**Customer P.O.No.:** DFW-244935	**Mill Order No.** 41-478810-01	**Shipping Manifest:** HT108043
	Product Description: ASTM A516-70(10/15)/ASME SA516-70(15) A20 S20.1 CEV.43%MAX TEST NORM 1650+/-25F 1HR/	**Ship Date:** 23 Sep 16 **Cert Date:** 23 Sep 16	**Cert No:** 031188187 (Page 1 of 1)
	Size: 0.375 X 120.0 X 480.0 (IN)		

Tested Pieces:				Tensiles:							Charpy Impact Tests								
Heat Id	Piece Id	Tested Thickness	Tst Loc	YS (KSI)	UTS (KSI)	%RA	Elong % 2in	Elong % 8in	Tst Dir	Hardness	Abs. Energy(FTLB) 1	2	3	Avg	% Shear 1	2	3	Avg	Tst Tmp	Tst Dir	Tst Siz (mm)	BDWTT Tmp %Shr
E61014	B13	0.371 (DISCRT)	L	58	77			23	T	157 KBW												
E61014	B13*	0.371 (DISCRT)	L	55	76			25	T													
E61014	B14	0.371 (DISCRT)	L	60	79			24	T	157 KBW												
E61014	B14*	0.371 (DISCRT)	L	55	77			26	T													

CGZT

Heat Id	Chemical Analysis C	Mn	P	S	Si	Tot Al	Sol Al	Cu	Ni	Cr	Mo	Cb	V	Ti	B	ITW		CRQM
E61014	.18	1.03	.010	.001	.22	.028	.027	.21	.14	.12	.06	.002	.005	.008	.0001	.41		USA

CGZT

KILLED STEEL
MERCURY IS NOT A METALLURGICAL COMPONENT OF THE STEEL AND NO MERCURY WAS INTENTIONALLY ADDED DURING THE MANUFACTURE OF THIS PRODUCT.
KILLED STEEL, PRODUCED TO A FINE GRAIN PRACTICE
CEV (IIW) = C + MN/6 + (CR+MO+V)/5 + (NI+CU)/15
RESULTS OF TESTS PERFORMED ON NORMALIZED TEST COUPONS ARE LABELED ABOVE WITH *
NACE MR0175/ISO15156-2:2015 ANNEX A2.1.2 COMPLIANT
NACE MR0103/ISO 17495-1:2016 13.1.1(A) AND 13.1.1(C) COMPLIANT
MTR EN 10204:2004 INSPECTION CERTIFICATE 3.1 COMPLIANT
100% MELTED AND MANUFACTURED IN THE USA.
PRODUCTS SHIPPED:
E61014 B14 PCES: 3, LBS: 18378 E61014 B13 PCES: 3, LBS: 18378

P.O 41051

Q.C. By J.D.

Cust Part #:

WE HEREBY CERTIFY THAT THIS MATERIAL WAS TESTED IN ACCORDANCE WITH, AND MEETS THE REQUIREMENTS OF, THE APPROPRIATE SPECIFICATION

Justin Ward
SENIOR METALLURGIST - PRODUCT

This Material Meets the
Chemical and Mechanical Testing
Requirements as Specified in:
ASME Section II Part A-2015 Edition.
QC Rep.: Date: 2/1/17

140082 HEATEC INC 220575 46667 E73329 (CS)
HEAT NUMBER: B6V5670 CUSTOMER PO: V0741T

NUCOR
NUCOR STEEL TUSCALOOSA, INC.

MILL TEST CERTIFICATE

3/8" PLATE

1700 HOLT RD N.E.
Tuscaloosa, AL 35404-1000
800 800-8204
customerservice@nucortusk.com

443080

Load Number	Tally	Mill Order Number	PO NO | Line NO	Part Number	Certificate Number	Prepared
T132648	00000000686550	N-149408-001	C46667-S 1		S68655001-1	09/16/2016 06:55

Grade

Order Description:
Hot Roll Plate From Coil
A516 70, 0.3750 IN x 96.000 IN x 380.000 IN
Quality Plan Description:
A/SA516-70: ASTM A516-70-10/15/ASME SA516-70-13/15AR

Customer:

Sold TO:
SISKIN STEEL AND SUPPLY CO INC CHATTANOOGA TN
Ship TO:
SISKIN STEEL / RIVERFRONT CHATTANOOGA TN
Sent TO:

Shipped Item	Heat/Slab Number	Certified By	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Cb	V	Al	Ti	N2	B	Ca	Sn	CEV	ACI
6H2151F	B6V5670-01 ***	B6V5670	0.22	1.06	0.007	0.005	0.17	0.13	0.06	0.05	0.029	0.001	0.003	0.028	0.001	0.010	0.0001	0.0018			

Shipped Item	Certified By	Heat Number	Yield ksi	Tensile ksi	Y/T %	ELONGATION % 2"	ELONGATION % 8"	Bend OK?	Hard HB	Charpy Impacts (ft-lbs) Size mm	1	2	3	Avg	Shear % 1	2	3	Avg	Test Temp
6H2151F	S6H21518TT	B6V5670 ***	51.6	70.8	72.9	31.9													
6H2151F	S6H2151FTT	B6V5670 ***	54.3	77.3	70.2	31.0													
6H2151F	S6H2151MTT	B6V5670 ***	52.1	71.9	72.5	31.3													

Items: 1 PCS: 4 Weight: 15519 LBS

This Material Meets the
Chemical and Mechanical Testing
Requirements as Specified in:
ASME Section II Part A-2015 Edition.
QC Rep. Chris Cox Date: 2/19/17

Shell

Mercury has not come in contact with this product during the manufacturing process nor has any mercury been used by the manufacturing process. Certified in accordance with EN 10204 3.1. No weld repair has been performed on this material. Hardness complies to NACE MR0175 Annex 2.1.2 < 22 HRC Manufactured to a fully killed fine grain practice. NUTEMPER TEMPER PASSED plate from coil
ISO 9001:2008 Registered, PED Certified

'***' indicates Heats melted and Manufactured in the U.S.A.

We hereby certify that the product described above passed all of the tests required by the specifications.

Dr. Quilin Yu - Metallurgist

PAGE 1 OF 1

Stock 7/12/16

EN 10204-3.1 QUALITY CERTIFICATE № 1258/09

Sheet 1 Sheets2

Seller (Exporter)

Joint-Stock Company "Pervouralsk New Pipe Plant"

m. S. **Made in Russia**

3/4" sch.160

Buyer (Address, country)

KELLY PIPE USA

Contract№ 27-03/13-01/KLF on 27.03.2013

Order-Nariad № 9,S-1

This Material Meets the Chemical and Mechanical Testing Requirements as Specified in: ASME Section II Part A-2015 Edition. Rep.: ChimCap Date: 7/12/16

Freight car №

Export Licence

Order № 2205198/14

Description of goods	Standard	Type of pack	Quantity
Seamless Carbon Steel Pipe for High-Temperature Service	ASTM A106(14)NDE/ASME SA106/ASTM A53(12)/ASME SA53/ASME B36.10M	in bundles	8

Item №	Nos. of Heats	Nos. of Lots	Grades of steel	Dimensions			Metrage	Number of pcs.	Mass (tons)	
				Diameter, inches	Wall, inches	Length, feet			Gross	Net
1	99322	э47	Gr.B/Gr.C	1.050	0.219	20-21	614	97		1.86
2	47523	э935	"	1.050	0.219	"	363	57		1.10
3	36716	э54	"	1.315	0.250	"	356	56		1.52
4	"	э51	"	1.315	0.250	"	222	35		0.94
5	"	э43	"	1.315	0.250	"	363	57		1.55
6	"	э45	"	1.315	0.250	"	498	78		2.10
7	v31204	э44	"	1.315	0.250	"	396	62		1.71
						Total:				

It is hereby certified that the quality of goods mentioned in this Quality Certificate is in conformity with standards and specifications. Visual and dimensional control: no remarks.

Quality characteristics of goods

Compositions (%)

Item №	C	Mn	Si	S	P	Cr	Ni	Cu	V	Mo
1	0.26	0.80	0.25	0.006	0.002	0.13	0.03	0.04	0.041	0.029
2	0.24	0.73	0.24	0.005	0.005	0.11	0.03	0.05	0.024	0.029
3-6	0.24	0.76	0.27	0.003	0.005	0.05	0.03	0.05	0.025	0.03
7	0.26	0.80	0.28	0.004	0.010	0.07	0.06	0.06	0.032	0.045

Mechanical Properties

Item №	Tensile strength, psi	Yield strength, psi	Elongation (%)
1	74000	47000	31
2	76000	46000	33
3	74000	49000	34
4	76000	46000	29
5	74000	49000	34
6	74000	46000	32
7	77000	49000	31

NOTE: Pipes have been tested by non-destructive method with satisfactory result. Pipes are produced ungalvanized, threadless. The present requirements are correspond to NACE MR 0175(2009).

Bend test is satisfactory.

Marking: is made as per requirements of the order

Signature: Alex

Date: 2/12/2014

ОТК ТЕХНИЧЕСКОГО КОНТРОЛЯ №51

CW00983

2" X 0.344" SMLS A53/API5L/A106 GR B/X-42 PEB SRL

Heat: 138398 *
Your PO: P1069392

vallourec

Vallourec Tubos do Brasil S.A
Barreiro Plant - Av. Olinto Meireles, 65
ZIP 30640-010 - Belo Horizonte - MG - Brazil

EcoTube

RINA
ISO 9001 - ISO/TS 16949
ISO 14001 - ISO 50001 - OHSAS 18001
Certified Management Systems

Inspection Certificate
(According to DIN EN 10204.3.1)
Nº.: 0030036097 Sheet:1 / 2

2" sch. 160

Customer: VALLOUREC USA CORPORATION

Country: USA

Material Number: 271733
Work Order: 395707 / 20
Customer Order: 21006584

Inspection: Vallourec Tubos do Brasil S.A.

PRODUCT: SEAMLESS STEEL PIPE, HOT FINISHED , BEVELED ENDS 30 DEG. , AS ROLLED
DIMENSIONS: 2 3/8" X 0.344" **GRADE:** GR X42 # GR B # GR B # GR C
STANDARD: API SPEC 5L. 12.2012, 45TH EDITION - PSL 1
IN ACCORDANCE ALSO TO THE STANDARDS: ASTM A 106 - 15 ASTM A 530 - 12 # ASTM A 53 - 12 # ASME SA-106 - 15 # ASME SA-53 - 13
SURFACE PROTECTION: EXTERNAL: LACQUER **PIPE ENDS PROTECTOR:** PLASTIC CAP
TOLERANCES: OUTSIDE DIAMETER (PIPE BODY): -0.018 " / +0.018 " **WALL THICKNESS:** -0.043 " / +0.051 "
LENGTH: RANDOM 38.00 FT - 42.0 FT
STANDARD MARKING: Paint stenciled in the pipe body: MANUFACTURER SPEC 5L-0150.4 API MONOGRAM MONTH/YEAR ASTM/ASME A/SA 53/106 2 3/8 X 0.344 X42 /B/C PSL1 SMLS HEAT NUMBER LENGTH 20500 KPA SCH 160 S WEIGHT NACE MR 0175
SHIPPING MARKING: P.O 162198-00 * VLR EUA P.O 21006584 * HOUSTON * TEXAS PIPE * MADE IN BRAZIL
TOLERANCES(PIPE ENDS): OUTSIDE DIAMETER: -0.016 " / +0.024 "

Heat	Pieces
138398	131
Total	131

THE PRODUCT IS SATISFACTORY IN THE FOLLOWING TESTS / INSPECTIONS: DIMENSIONAL # VISUAL # BENDING TEST # HYDROSTATIC TEST: 20500.0 KPA 5 S #

Chemical Composition (%)

Process: Basic Oxygen Furnace, heats fully killed

CE1: Nb + V CE2: Nb + V + Ti CE3: Cr + Cu + Mo + Ni + V

Heat	Control Lot		C	Mn	P	S	Si	Ni	Cr	Mo	Al	Cu	V	Nb	B	Ti	Ca	CE1	CE2	CE3
Heat Analisys		Min		0.290			0.100													
		Max	0.220	1.150	0.025	0.025		0.400	0.400	0.150		0.400	0.080		0.0010	0.040		0.060	0.150	1.000
Product Analisys		Min		0.290			0.100													
		Max	0.220	1.150	0.025	0.025		0.400	0.400	0.150		0.400	0.080		0.0010	0.040		0.060	0.150	1.000
138398	030002634575		0.17	1.02	0.019	0.001	0.21	0.01	0.07	0.020	0.030	0.010	0.004	0.0010	0.0002	0.001	0.0023	0.005	0.006	0.114
		Check 1	0.17	1.02	0.017	0.001	0.21	0.01	0.07	0.020	0.032	0.006	0.003	0.0010	0.0003	0.001	0.0022	0.004	0.005	0.109
		Check 2	0.17	1.00	0.016	0.001	0.21	0.01	0.07	0.020	0.032	0.006	0.003	0.0010	0.0003	0.001	0.0021	0.004	0.005	0.109

CE: Combined Elements;

This Material Meets the Chemical and Mechanical Testing Requirements as Specified in: SME Section II Part A-2015 Edition.
Rep.: Date 2/15/17

2" X 0.344" SMLS A53/API5L/A106 GR B/X-42 PEB SRL

Heat: 138398
Your PO: P1069392

vallourec

EcoTube — RED PRODUCTS SAVE ROOTS

RINA — ISO 9001 - ISO/TS 16949 — ISO 14001 - ISO 80001 - OHSAS 18001 — Certified Management System

Inspection Certificate
(According to DIN EN 10204.3.1)
Nº.: 0030036097 Sheet:2 / 2

Tensile Test

Specimen Direction: Longitudinal Temperature: Room Temperature Gage Length: L0= 2" Method:Elong.Total Under Load 0,50 %

Heat	Control Lot	Type of Specimen	Area (Sqin)	YS (PSI)	TS (PSI)	E (%)
		Required: Min		42100	70000	27
		Max				
138398	030002634575	STRIP WIDTH 19,05 MM	0.3	50328	73389	39

YS-Yield Strength; TS-Tensile Strength; E-Elongation;

Hardness Test

Scale: HV

Heat	Control Lot		
		Required: Min	
		Max	246.0
138398	030002634575	156.0	155.0

Remarks:
MATERIAL IN ACCORDANCE WITH NACE MR 0175
PAR. 3.2/ISO 15156-2, ANNEX A.2.1.2/NACE MR0103 PAR.2.1. ALL LATEST EDITIONS.

MATERIAL:-
- NO WELD REPAR - FREE OF MERCURY
- FINE GRAIN PRACTICE
- FULLY KILLED STEEL
- STEEL MELT COUNTRY OF ORIGIN: BRAZIL

The data presented were converted from SI measurement system, used for the original inspection.

We hereby certify that this product has been manufactured and examined in accordance with all requirements of the standards and specifications and all the results are found to be satisfactory. This testimonial and certificate respectively is recorded by a computer system and is valid without signature. Alteration or use for others products are regarded as falsification of documents and will be subject to criminal jurisdiction.

QUALITY CONTROL DEPARTMENT
FAX: (55-31) 3328-2617
e-mail:gustavo.pinheiro@vallourec.com

DR. GUSTAVO ALVES PINHEIRO - CREA/MG-109170/D
TECHNICAL RESPONSIBLE

DATE
09.08.2016

ECO TUBES: The tubes from Vallourec do Brasil S.A. are manufactured with steel which uses charcoal as a source of energy in its production. This coal comes from more than 100,000 ha of forest planted by Vallourec Florestal Ltda.. With the acquisition of 18.4 ton(s) os steel tubes from Vallourec do Brasil S.A., your company contributed to the reduction of the greenhouse effect, avoiding the accumulation of 33.1 ton(s) of Carbon Dioxide CO2 in the atmosphere.

3" sch.80 Stock.

33867 pg 3 of 4

ArcelorMittal South Africa Limited
Tubular Products
Genl. Hertzog rd.
P O Box 48 Vereeniging 1930
South Africa

Telephone +27 (0)16 450 4220
Fax +27 (0)16 423 4906

MATERIAL TEST CERTIFICATE
SEAMLESS TUBE

Licensed under API Spec 5L and 5CT
5L - 0319
5CT - 0419

ISO 9001: 2000
DE-395897 QM

Test Certificate
EN 10204:2004 TYPE 3.1

ArcelorMittal

Customer:	Dixie Pipe Sales, Inc.	Customer Order/Contract No:	SUS4 135550
Order No:	4000012191	Material No:	1000000710
Certificate Reference No:	040060074864	Cast/Heat No:	98B0842
Product:	FULLY KILLED HOT FINISHED CARBON STEEL SEAMLESS TUBES		
Specification:	ISO3183:2007/API 5L:2007 L245/L290/B/X42 PSL1 ASTM A106.08B/A53B.07/ A530.04 ASME SA106.08B/SA53B.07/SA530.04		
Product Marking:	ARCELORMITTAL SA ISO3183/Spec 5L-0319 MONOGRAM 03-11 ASTM/ASME A/SA106B A/SA53B 88.900 (3.500) 7.620 (0.300) 6.100 (20.000) L245/B L290/X42 PSL1 SMLS TESTED 20.7 MPa (3000 psi) CAST NO:98B0842 PROD/O NO: T7441219110 MADE IN RSA		

General Information

Quantity	Mass	Dimensions			Total Length
		Tube OD	Thickness	Length	
264	24,596.880(kg)	88.900(mm)	7.620(mm)	6.100(m)	1,610.400(m)
	54,226.282(lb)	3.500(")	0.300(")	20.000 (ft)	5,280.000(ft)

Steel making process	Final Rolling Operation
Electric Arc	Final hot rolling operation finished above 860°C and cooled in still air.

Chemical Composition

Element(%)	C	Si	Mn	S	P	Cr	Ni	Mo	Cu	V	Al	Ti	Sn	Ca	N	B	Nb	CE
Minimum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maximum	0.200	-	1.30	0.030	0.030	0.50	0.50	0.150	0.500	-	-	-	-	-	-	-	-	0.41
Heat	0.193	0.28	0.79	0.003	0.011	0.12	0.09	0.025	0.110	0.003	0.035	0.001	0.008	0.0012	0.0089	0.0002	0.0020	0.37
Product	0.193	0.280	0.790	0.003	0.011	0.120	0.090	0.025	0.110	0.003	0.035	-	-	-	-	-	-	0.368
Product (ADD)	0.193	0.280	0.790	0.003	0.011	0.120	0.090	0.025	0.110	0.003	0.035	-	-	-	-	-	-	0.368

Mechanical Properties

Specification Limits	UTS (Rm) MPa	UTS (Rm) psi	Yield (0.5%) MPa	Yield (0.5%) psi	% EL 50mm
Minimum	415	60000	290	42000	30.0
Maximum	-	-	-	-	-
(1) Actual	504	73099	336	48732	39.0
(2) Actual	500	72518	334	48442	39.0
(3) Actual					
(4) Actual					

	UTS (Rm) MPa	UTS (Rm) psi	Yield (0.5%) MPa	Yield (0.5%) psi	% EL 50mm
(5) Actual					
(6) Actual					
(7) Actual					
Orientation & type of tensile test	Longitudinal, Strip				
Width of tensile piece (mm)	19mm				
Orientation of impact test piece					

OTHER TESTS	
Flattening	Passed
Hydrostatic	20700 kPa (3000 psi) - 5 sec
NDI: EMI	PASS - ASTM E570 - 12.5% NOTCH
NDI: UT	UT not required
HV 10 Kg	153 154 155

Remarks:

Material in accordance with NACE MR0175:2003/ISO15156-2:2003, MR0103:2010. Dimensions to ANSI B36.10M-2004
The material conform to the hot yield strength requirements as per ASME, Sect II, Pt D, Table Y-1, 2010
All the material conform to the visual and dimensional requirements and is made to a suitable fine grain practice

Quality Assurance Manager: R. Bester *Date of Issue:* 2011.05.10 *Certified by:*

We hereby certify that the steel grade and quality level of all products are in conformity with the order and comply fully with specification requirements. No changes, amendments, additions or deletions to the information contained herein may be made after issue. Any changes which are effected shall invalidate this certificate.

This Material Meets the
Chemical and Mechanical Testing
Requirements as Specified in:
ASME Section II Part A-2015 Edition.
QC Rep.: Chris Cox Date: 1/8/17

Mill Test Reports
For PO# _____
Dixie Pipe Sales, Inc.

IPSCO

stock

4" sch. 80

TUBE TEST REPORT

Form QA-003 12/02/09 - Rev 2

ORDER: 061642 001	HEAT: 487490	P.O.: S13-40545	PART NO.

SOLD TO: CONSOLIDATED PIPE & SUPPLY CO
BOX 2472
1205 HILLTOP PARKWAY
BIRMINGHAM, AL 35204

SHIP TO: CONSOLIDATED PIPE AND SUPPLY
ROBERTS FIELD
1121 BROCK INDUSTRIAL DRIVE
BIRMINGHAM, AL 35208

SPECIFICATION(S) : ASME ASTM SA53/A53-12 GR B/SA106/A106-13 GR B/C
API 5L PSL2 GR BR/X42R FORTY-FIFTH EDITION
CERTIFIED NACE MR0175 DATED 10/15/2009

GRADE: 1023	SIZE: 4.500 X 0.337 DRL	WPF: 15.00	QUALITY: SEAMLESS HOT FINISH

CONDITION (SPECIAL) : ELECTRIC FURNACE
FINE GRAIN MELT PRACTICE
TEST METHODS USED: ASTM E415

TEST RESULTS CONFORM TO THE STANDARDS AND SPECIFICATION LISTED ABOVE.

	C	Mn	S	P	Si	Cr	Ni	Mo	Cu	Al	V	Cb	Ti	B
L	.21	.61	.004	.004	.30	.11	.08	.03	.17	.018	.003	.001	.0020	.0001
P	.21	.59	.004	.005	.29	.11	.07	.02	.16	.018	.001	.001	.0010	.0005
P	.21	.59	.003	.005	.30	.11	.07	.03	.16	.021	.001	.001	.0020	.0005

MATERIAL 100% MELTED AND MANUFACTURED IN THE USA.

Specimen ASTM E8	EUL	Yield KSI	Tensile KSI	ELNG 2 "	R/A	C.E.	Rockwell ASTM E18 Avg	Hydrotest
1.000 " STR	0.5	49.9	73.1	40.0		.36	MW 78.4 79.1 78.3 78.6 RB	3000 PSI 5 Sec Hold

EMI INSPECTION WITH ID/OD N10 NOTCHES
LONGITUDINAL - SATISFACTORY
SEA INSPECTION - SATISFACTORY
FLAT(S) - SATISFACTORY
EN 10204 TYPE 3.1b DATED 01/2005

This Material Meets the
Chemical and Mechanical Testing
Requirements as Specified in
ASME Section II Part A-2015 Edition.
Rep.: Chris Cole Date: 1/18/17

7 / 29 / 14 — DATE

Amber Rokonich — QUALITY ASSURANCE/KOPPEL

MATERIAL WAS NOT EXPOSED TO MERCURY DURING PROCESSING.
NO WELDING OR WELD REPAIR PERFORMED ON THIS MATERIAL.
MATERIAL IS FREE OF HARMFUL RADIATION.

THIS CERTIFICATION MAY NOT BE REPRODUCED EXCEPT IN FULL.

SUDHIR FORGINGS PVT.LTD 16-251-251-001 Control No. TC/01
KANGANWAL ROAD,P.O.JUGIANA, Rev. 01
G.T.ROAD,LUDHIANA (INDIA) 16-251-651-001

TEST CERTIFICATE

(in accordance with BS EN 10204 3.1 B)

ITEM	2" 150 WNRF STD	**CERTIFICATE No.**	SF/FLANGE/922/012 DATED 20-Nov-2012
QUANTITY	500 PCS	**LAB Ref. No.**	581
FINISH	BLACK PAINT	**CUSTOMER NAME**	T. A. USA
MAT. SPECIFICATION	ASME A105-10 / ASTM A105-10A	**INVOICE No.**	SF/2012-13/063
P.O. No.	1546-BB DT. 31-Aug-2012	**INVOICE DATE**	20-Nov-2012

Chemical Analysis

Heat No.	Supplier Heat No.	Description	C%	Mn%	P%	S%	Si%	Cu%	Ni%	Cr%	Mo%	V%	C.E %
581	C-962	Specified	0.25 max	0.60 - 1.05	0.035 max	0.040 max	0.10 - 0.35	0.40 max	0.40 max	0.30 max	0.12 max	0.08 max	0.47 max
		Observed	0.250	0.875	0.025	0.009	0.164	0.024	0.000	0.082	0.000	0.000	0.406

Physical / Mechanical Properties

Heat No.	Supplier Heat No.	Description	UTS N / MM^2	YIELD N / MM^2	Elongation%	R.A.%	Hardness (BHN)
581	C-962	Specified	485 min	250 min	22 min	30 min	187 max
		Observed	546.09	356.90	40.40	65.54	163

REMARKS.

- Material is in accordence with NACE STD, MR-0175/ISO-15156
- Flanges are forged steel and manufactured in strict accordance with latest provision of ASTM A/SA 105 & ANSI B16.5
- We certify that the Material Suits the Requirement of P.O./Relevant specifications.
- Flanges have serrated face as per MSS-SP-6 within the limit of 125 - 250 RMS.
- Flanges are painted with black paint & Marked as. 2 WNRF STD 150 A105 B16.5 H 581 INDIA

FOR SUDHIR FORGINGS PVT. LTD

For-

Q.C. Engg. **Q.C. Mgr**

AN ISO 9001:2008 COMPANY

ISO 9001 | NABCB QM011

BALKRISHNA STEEL FORGE PVT. LTD.

Works :
Sitlamata Temple Road,Beyond G.E.B. Substation,Village : Shapar (Veraval), Dist.: RAJKOT-360 024. GUJARAT, INDIA
Ph.: +91 2827 252777,Fax : +91 2827-252507,E-mail : info@balkrishnaforge.com Web.: www.balkrishnaforge.com

MANUFACTURING TEST CERTIFICATE

CERTIFICATION AS PER EN 10204: 3.1

TC NO. :- 1440 DT. 01/03/2016

CUSTOMER NAME :- **ALLIED FITTINGS ATLANTA** INV. NO./EC NO.- EXP 108/ EC KF 831

P.O. No.	112415GBI	P.O. DT.	23/11/2015

Sr. No.	DESCRIPTION	P.O. SR NO.	INV. SR NO.	QTY	MATERIAL	MILL HEAT NO.	H.L. NO.	DIMENSION STD
1	2" 150# BLD RF	11	1	850	A 105	18703	-	ASME B16- 2013
2	4" 150# WN RF STD	9	2	1792		18663	-	
3	4" 150# WN FF STD	10	3	112		B 11889	-	
4	3" 150# THRD RF	24	4	576		121716	-	

Chemical Composition		C%	Mn%	P%	S%	Si%	Cu%	Ni%	Cr%	Mo%	V%	Nb%	N%	CE.
Std. Reqmnt.	MIN.	0.18	0.60			0.10								
	MAX	0.25	1.05	0.035	0.040	0.35	0.40	0.40	0.30	0.12	0.02	0.02	-	0.43
Check Analysis	18703	0.20	0.92	0.017	0.011	0.22	0.01	0.00	0.03	0.01	0.00	0.00	-	0.36
	18663	0.20	0.90	0.012	0.011	0.22	0.01	0.00	0.02	0.00	0.00	0.00	-	0.35
	B 11889	0.20	0.99	0.022	0.007	0.20	0.01	0.01	0.01	0.00	0.00	0.00	-	0.37
	121716	0.20	0.98	0.025	0.018	0.30	0.07	0.03	0.04	0.00	0.00	0.00	-	0.38

MECHANICAL PROPERTIES		U.T.S. N/mm2	Y.S.(0.2% Offset) N/mm2	ELONGATION%	REDUCTION IN AREA%	HARDNESS (BHN)	HEAT TREATMENT DETAILS	IMPACT ENERGY ABSORBED AT °C Specimen (J) 1	2	3		Avg.(J)
Std. Requirement		485 MIN.	250 MIN.	22% MIN.	30% MIN.	137 TO 187						
Result	18703	569.10	312.90	38.50	65.30	152-156	AS FORGE					
	18663	498.30	300.90	33.50	53.90	149-152	AS FORGE					
	B 11889	603.50	412.50	29.10	52.50	152-159	AS FORGE					
	121716	511.70	329.50	31.50	44.70	149-156	AS FORGE					

Identification Size,Pressure Rating,Type,Nominal Bore,SA/A 105, B-16, Heat No, INDIA

Remark:-

* Materials Was manufactured,sampled,Tested and inspected in accordance with specification(s) solely by the manufacturer listed herein and was found to meet the requirments.
* No weld repair was performed & Material is free of mercury and radioactive contamination.
*All the above Heats are melted in India.

We hereby certify that the above mentioned items conform to requirements of - ASME SA 105 / ASTM A-105-2014, NACE MR0103-2012, NACE MR0175 / ISO15156-2009.

(Metallurgist)

F:LB:10 REV.00, Dt.-15.05.2013

QA/QC HEAD

NORMA (INDIA) LIMITED

48,Site IV industrial Area, Sahibabad, Ghaziabad-201010 (U.P) INDIA.
Tel: 91-120-2896091, 2895404 Fax: 91-120-2895930 E-mail: normaindia@gmail. com

Works Test Certificate

NORMA/LAB NO-3157/16-17 | INVOICE NO.E-143 | DATE:-08.09.16

P. Order. No:	81116GNI	Customer:-	ALLIED FTG. L.P. HOUSTON SAVANNAHA U.S.A	Forging specification	ASME SA105 -13 ASTM A105 -13
Item Code	L3SR3-NI				
Component	3"-300# SORF FLG.			Steel Supplier	P.G.I (Pvt) Ltd.
Drawing No.					
Machining STD	ANSI B16.5- 2013 ASME B16.5- 2013	Quantity:-	1040Nos.	Mill Heat No.	C4/27

NORMA HEAT NO-351

TEST RESULTS

CHEMICAL COMPOSTION

Elements %	Specified Composition	Actual	
		NORMA LAB	MILL T.C.
Carbon	0.35max.	0.20	0.19
Manganese	0.60-1.05	1.14	1.09
Silicon	0.10-0.35	0.259	0.26
Sulphur	0.040max.	0.0089	0.10
Phosphorous	0.035max.	0.0166	0.020
Chromium	0.30max.	0.0782	0.07
Nickel	0.40max.	0.0058	0.02
Copper	0.40max.	0.0108	0.01
Molybdenum	0.12max.	0.0024	0.01
Vanadium	0.080max.	0.002	0.002
Carbon Equivalent (CE)	0.47max.	0.412	0.391

MECHANICAL PROPERTIES.

PROPERTIES	SPECIFIED	OBTAINED
Yield Strength (mpa)	250.00 min.	339.64
Tensile Strength (mpa)	485.00 min.	535.24
%Elongation in 50mm / 4D	22.00 min	28.57
Hardness HB.	187. max.	159-163
% Reduction of Area	30.00 min.	66.14

Remarks:- We here by certify that the material described here in has been tested in accordance with the applicable specifications referred above and meets the requirements as per EN10204/3.1 & NACE Standard-MR0175-2015. MR0103-15
"As per ASTM A105 Table 1 Note:-For each reduction of 0.01% below the specified carbon maximum(0.35%).an increase of 0.06% manganese above the specified maximum (1.05%)will be permitted up to maximum 1.65%
No Weld Repair Performed.
Country of Origin/Melt : INDIA

Specified carbon as per Purchase Order 0.25max.

Serrated face as per MSS-SP-6 With in limits of 125-250AARH

CARBON EQUIVALENT (CE)

$$CE = C + \frac{Mn}{6} + \frac{Cr+Mo+V}{5} + \frac{Ni+Cu}{15}$$

MARKING AS PER MSS-SP-25-2008
3"-300 SA/A105 351 B16.5 NORMA INDIA.

Checked by: Metallurgist

Certified by: Quality Control Manager

R.N. GUPTA & COMPANY LTD., C-55, FOCAL POINT, LUDHIANA -141 010 (INDIA)

F-MTR-01-01

MATERIAL / MILL TEST CERTIFICATE EN 10204 : 2004 - 3.1

CERTIFICATE NO. 9987 DATE 27/05/2016

RAW MATERIAL SPECIFICATION : ASTM A105-14/ASME SA105-13

SPECIFICATION FOR INSPECTION :ANSI/ASME B16.5-2013

NAME OF BUYER
ALLIED FITTING L.P.

P.O NO. 40716RG DT. 07/04/2016
INVOICE NO. RNG/EXP/16-2038 DT. 23/05/2016

MECHANICAL REQUIREMENTS

Sr. No.	Description	Qty (PCS)	Heat No.	Supp. Code	Y.S(PSI) Min 36,000	T.S(PSI) Min 70,000	E% Min 22%	R.A% Min 30%	Heat Treatment	Soaking Time (Min.)	Hardness BHN 137-187
1	4 300# SORF FLGS L3SR4-RG	448	H 5453	1	49836	73501	34.10	68.33	AS FORGED		150 - 152
2	1 300# WNRF SCH160 FLG L3WRP1-RG	245	H 5445	6	51314	79913	28.24	64.89	AS FORGED		162 - 164
3	2 1500# WNRF SCH160 FLG L15WRP2-RG	288	H 5464	19	49395	74297	35.28	74.14	NORMALISED	100	152 - 154
4	1 300# WNRF XXH L3WRY1-RG	240	H 5445	6	51314	79913	28.24	64.89	AS FORGED		162 - 164
5	2 150# SORF FLGS L1SR2-RG	1125	H 5431	6	48529	79631	30.82	68.28	AS FORGED		160 - 162
6	3 150# SORF FLGS L1SR3-RG	600	H 5456	1	47494	77033	32.84	64.00	AS FORGED		156 - 158
7	4 150# SORF FLGS L1SR4-RG	21	H 5453	1	49836	73501	34.10	68.33	AS FORGED		150 - 152
8	4 150# SORF FLGS L1SR4-RG	651	H 5456	1	47494	77033	32.84	64.00	AS FORGED		156 - 158

CHEMICAL REQUIREMENTS

		SPECIFIED ELEMENTS						UNSPECIFIED ELEMENTS				
Sr. No.	Heat No.	C.E. 0.47% Max	C 0.35 Max	Mn 0.60-1.25	P 0.035 Max.	S 0.04 Max.	Si .10 -0.35 Max.	Cu 0.40 Max.	Ni 0.40 Max	Cr 0.30 Max.	Mo 0.12 Max.	V 0.08 Max.
1	H 5453	0.37	0.20	0.93	0.024	0.019	0.22	0.013	0.029	0.030	0.005	0.003
2	H 5445	0.39	0.22	0.98	0.024	0.010	0.26	0.004	0.020	0.008	0.005	0.003
3	H 5464	0.42	0.21	1.24	0.017	0.009	0.22	0.008	0.012	0.014	0.014	0.003
4	H 5445	0.39	0.22	0.98	0.024	0.010	0.26	0.004	0.020	0.008	0.005	0.003
5	H 5431	0.39	0.21	1.06	0.018	0.011	0.27	0.004	0.014	0.006	0.007	0.003
6	H 5456	0.37	0.21	0.90	0.022	0.007	0.21	0.014	0.028	0.029	0.003	0.003
7	H 5453	0.37	0.20	0.93	0.024	0.019	0.22	0.013	0.029	0.030	0.005	0.003
8	H 5456	0.37	0.21	0.90	0.022	0.007	0.21	0.014	0.028	0.029	0.003	0.003

Certificate that the materials described above are in accordance with the order and specifications.
Material in accordance with NACE MRO 175-2003 and NACE MRO 103
ALL NORMALISED MATERIALS ARE HEAT TREATED AT TEMP. 920 DEGREE CENTIGRADE
Note:- We hereby confirm that our QA system comply with requirements of Annex I, Clause4.3 of PED 97/23/EC and it is certified by M/s DNV BUSINESS ASSURANCE vide certificate No. 4487-2014-CE-IND-DNV Valid upto 31-03-2017. ISO 9001:2008 certificate No. Is 39752-2008-AQ-IND-RvA.03 Dated 22/07/2017. Products also conform to requirements of ASTM A105-05/ASME SA105

For R.N. GUPTA & COMPANY LTD.

METALLURGIST

NORMA (INDIA) LIMITED

48,Site IV industrial Area, Sahibabad, Ghaziabad-201010 (U.P) INDIA.
Tel: 91-120-2896091, 2895404 Fax: 91-120-2895930 E-mail: normaindia@gmail. com

Works Test Certificate

NORMA/LAB NO-4350/12-13		INVOICE NO. E-481		DATE:-24-12-12	
P. Order. No:	53412 NNI	Customer:-	ALLIED FTG. L.P. HOUSTON U.S.A	Forging specification	ASME SA105 -09 ASTM A105 -12
Component	3"-150# SORF FLG.			Steel Supplier	R.I.N.L
Drawing No.					
Machining STD	ANSI B16.5- 2009 ASME B16.5- 2009	Quantity:-	425Nos.	Mill Heat No.	207140

TEST RESULTS — NORMA HEAT NO-425

CHEMICAL COMPOSTION

Elements %	Specified Composition	Actual	
		NORMA LAB	MILL T.C.
Carbon	0.35max.	0.20	0.20
Manganese	0.60-1.05	1.02	1.00
Silicon	0.10-0.35	0.20	0.22
Sulphur	0.040max.	0.016	0.013
Phosphorous	0.035max.	0.022	0.026
Chromium	0.30max.	0.014	---
Nickel	0.40max.	0.008	---
Copper	0.40max.	0.010	---
Molybdenum	0.12max.	0.004	---
Vanadium	0.080max.	0.003	---
Carbon Equivalent (CE)	0.47max.	0.375	0.366

MECHANICAL PROPERTIES.

PROPERTIES	SPECIFIED	OBTAINED
Yield Strength (mpa)	250.00 min.	313.08
Tensile Strength (mpa)	485.00 min.	528.33
%Elongation in 50mm / 4D	22.00 min	31.20
Hardness HB.	187. max.	156-159
% Reduction of Area	30.00 min.	67.73

Remarks:- We here by certify that the material described here in has been tested in accordance with the applicable specifications referred above and meets the requirements as per EN10204/3.1B & NACE Standard-MR0175-2003.

"As per ASTM A105 Table 1 Note:-For each reduction of 0.01% below the specified carbon maximum(0.35%).an increase of 0.06% manganese above the specified maximum (1.05%)will be permitted up to maximum 1.35%.

No Weld Repair Performed.

Specified carbon as per Purchase Order 0.25max.

Serrated face as per MSS-SP-6 With in limits of 125-250AARH

CARBON EQUIVALENT (CE)

$$CE = C + \frac{Mn}{6} + \frac{Cr+Mo+V}{5} + \frac{Ni+Cu}{15}$$

MARKING AS PER MSS-SP-25-1978
3"-150 SA105 425 B16.5 NORMA INDIA.

Checked by: Metallurgist

Certified by: Quality Control Manager

RNG

R.N. GUPTA & COMPANY LTD., C-55, FOCAL POINT, LUDHIANA -141 010 (INDIA)

F-MTR-01-01

MATERIAL / MILL TEST CERTIFICATE EN 10204 : 2004 - 3.1

CERTIFICATE NO. 10159 DATE 31/07/2016

NAME OF BUYER
ALLIED FITTING L.P.

RAW MATERIAL SPECIFICATION : ASTM A105-14/ASME SA105-13

SPECIFICATION FOR INSPECTION :ANSI/ASME B16.5-2013

P.O NO. 41316ORG DT. 07/04/2016
INVOICE NO. RNG/EXP/16-2076 DT. 19/07/2016

MECHANICAL REQUIREMENTS

Sr. No.	Description	Qty (PCS)	Heat No.	Supp. Code	Y.S(PSI) Min 36,000	T.S(PSI) Min 70,000	E% Min 22%	R.A% Min 30%	Heat Treatment	Soaking Time (Min.)	Hardness BHN 137-187
1	3 150# BLRF L1BR3-RG	834	H 5513	6	46682	77632	30.16	66.75	AS FORGED		162 - 164
2	3 150# BLRF L1BR3-RG	225	H 5440	6	46828	75540	31.10	65.59	AS FORGED		154 - 156
3	3 150# BLRF L1BR3-RG	741	H 5471	6	50463	76369	30.60	66.48	AS FORGED		156 - 158
4	1 300# WNRF XXH L3WRY1-RG	10	H 5445	6	51314	79913	28.24	64.89	AS FORGED		162 - 164
5	2 1/2 150# SORF FLGS L1SR2.5-RG	1200	H 5506	6	50703	77274	30.40	65.75	AS FORGED		158 - 160
6	3 150# WNRF STD FLGS L1WRS3-RG	215	H 5471	6	50463	76369	30.60	66.48	AS FORGED		156 - 158
7	3 150# WNRF STD FLGS L1WRS3-RG	37	H 5489	20	47788	79333	30.80	65.06	AS FORGED		162 - 164

CHEMICAL REQUIREMENTS

Sr. No.	Heat No.	SPECIFIED ELEMENTS						UNSPECIFIED ELEMENTS				
		C.E. 0.47% Max	C 0.35 Max	Mn 0.60-1.25	P 0.035 Max.	S 0.04 Max.	Sl .10 -0.35 Max.	Cu 0.40 Max.	Ni 0.40 Max	Cr 0.30 Max.	Mo 0.12 Max.	V 0.08 Max.
1	H 5513	0.39	0.22	0.99	0.027	0.007	0.24	0.002	0.023	0.013	0.011	0.003
2	H 5440	0.36	0.20	0.94	0.027	0.024	0.20	0.004	0.017	0.007	0.007	0.003
3	H 5471	0.38	0.21	1.01	0.029	0.011	0.25	0.005	0.010	0.009	0.005	0.003
4	H 5445	0.39	0.22	0.98	0.024	0.010	0.26	0.004	0.020	0.008	0.005	0.003
5	H 5506	0.39	0.21	1.04	0.028	0.010	0.28	0.008	0.007	0.011	0.004	0.004
6	H 5471	0.38	0.21	1.01	0.029	0.011	0.25	0.005	0.010	0.009	0.005	0.003
7	H 5489	0.38	0.20	0.91	0.026	0.015	0.23	0.054	0.032	0.110	0.013	0.004

Certificate that the materials described above are in accordance with the order and specifications.
Material In accordance with NACE MRO 175-2003 and NACE MRO 103

For R.N. GUPTA & COMPANY LTD.

Note:- We hereby confirm that our QA system comply with requirements of Annex I, Clause4.3 of PED 97/23/EC and it is certified by M/s DNV BUSINESS ASSURANCE vide certificate No. 4487-2014-CE-IND-DNV Valid upto 31-03-2017. ISO 9001:2008 certificate No. is 39752-2008-AQ-IND-RvA.03 Dated 22/07/2017. Products also conform to requirements of ASTM A105-05/ASME SA105

METALLURGIST

Phoenix * Capitol * Camco
CapProducts

Certified Mill Test Report

Heat Code: 416CC
Heat Number: 166308
Item: 12202007: 3/4 FS 3M THD COUPLING

Material: ASTM A105-2014 / ASME SA105-2015 Edition

Chemistry Properties

C	Mn	P	S	Si	Cu	Cr
0.2100	0.9400	0.0060	0.0250	0.2200	0.1500	0.1010
Ni	**Mo**	**V**	**Co**	**Al**	**Cb**	**N**
0.0520	0.0130	0.0370				
Pb	**Sn**	**Ta**	**Ti**	**C Eq. Long**		
				0.4103		

Additional Chemical Properties

Mechanical Properties

Tensile(PSI)	Yield(PSI)	Elong. % in 2 in. or 4D	Reduction	HBW	HBW 2
75500	47000	30%	67	149	149

Charpy Minimum Impact - ft/lbs

Test 1	Test 2	Test 3	Avg.	Test Temp.

We hereby certify that these parts were manufactured, sampled, tested, and inspected in accordance with the product specifications stated and were found to meet the requirements. We further certify that this material was inspected using independent inspectors conforming to the requirements of EN 10204 3.1. These products meet the requirements of the latest editions of NACE MR0175, NACE MR0103, and ISO 15156. No weld repair has been performed on these products. This material was not exposed to mercury or any other metal alloy that is liquid at ambient temperatures during processing or while in our possession.

Meets ASME SA-181-70 2013 Edition. Manufactured in the USA.

Phoenix * Capitol * Camco CapProducts

Certified Mill Test Report

Heat Code: 413DDD
Heat Number: 166209
Item: 12202010: 1 FS 3M THD COUPLING

Material: ASTM A105-2014 / ASME SA105-2015 Edition

Chemistry Properties

C	Mn	P	S	Si	Cu	Cr
0.2100	0.9200	0.0070	0.0200	0.2300	0.1500	0.1430
Ni	**Mo**	**V**	**Co**	**Al**	**Cb**	**N**
0.0680	0.0200	0.0330		0.0030	0.0004	
Pb	**Sn**	**Ta**	**Ti**	**C Eq. Long**		
				0.4171		

Additional Chemical Properties

Mechanical Properties

Tensile(PSI)	Yield(PSI)	Elong. % in 2 in. or 4D	Reduction	HBW	HBW 2
89500	59500	27%	65	179	179

Charpy Minimum Impact - ft/lbs

Test 1	Test 2	Test 3	Avg.	Test Temp.

We hereby certify that these parts were manufactured, sampled, tested, and inspected in accordance with the product specifications stated and were found to meet the requirements. We further certify that this material was inspected using independent inspectors conforming to the requirements of EN 10204 3.1. These products meet the requirements of the latest editions of NACE MR0175, NACE MR0103, and ISO 15156. No weld repair has been performed on these products. This material was not exposed to mercury or any other metal alloy that is liquid at ambient temperatures during processing or while in our possession.

Meets ASME SA-181-70 2013 Edition. Manufactured in the USA.

16-251-151-010

INSPECTION CERTIFICATE

PANTECH STEEL INDUSTRIES SDN. BHD. (509731-A)
LOT 13258 & 13259, Jalan Haji Abd. Manan,
Off Jalan Meru, 42200 Klang, Selangor, Malaysia.
Tel: 603-3393 1633 Fax: 603-3393 1733 E-mail: info@pantechsteel.com

LLOYD'S REGISTER-LRQA
ISO 9001
Cert. No.: KLR 0403926
PED 97/23/EC Annex 1 Clause 4.3
Cert. No.: 0038/PED/MUM/0810070/1

WROUGHT CARBON STEEL BUTTWELDING FITTINGS

INSPECTION DOCUMENT: EN10204:2004 Type 3.1

Certificate No : PSI 96486
Date : 16-Jan-15

Purchaser : ALLIED FITTING CORP

Order No.	Invoice No.	Starting Material	Specification for Fittings- Seamless	Specification for Inspection
82414CPS-2	E 000011427	Seamless Pipe	ASTM A234-13 WPB/ ASME SA234-13 WPB / CSA Z245.11-05 Cat . I Gr.241/ NACE MR0175/ NACE MR 0103/ ISO15156*	ASME B16.9 - 12 / ASTM A960 - 10

Heat No.	Product & Size	Quantity (pcs)	Visual Examination	Dimensional Inspection	Heat Treatment	Magnetic Particle Testing
RL 609	4" 90 DEG LR STD ELBOW	2228	GOOD	GOOD	H	N.A
RL 805	4" 90 DEG LR STD ELBOW	4	GOOD	GOOD	H	N.A
RL 301	6" 90 DEG LR STD ELBOW	670	GOOD	GOOD	H	N.A

Specification / Heat No.	Chemical Composition (%)												Tensile Test *1			Hardness (HB)	
	C x100	Si x100	Mn x100	P x1000	S x1000	Ni x100	Cr x100	Mo x100	Cu x100	V x1000	Pb	CE x100	YS (KSI / MPa)	TS (KSI / MPa)	E (%)	1	2
Min	-	10	29	-	-	-	-	-	-	-	-	-	240	415	22	-	
Max	30	-	106	50	58	40	40	15	40	80	-	50	-	-	-	197	
RL 609	13	17	78	7	5	0	4	0	3	3	< 0.10	28	374	501	30.5	126	128
RL 805	10	22	85	9	5	1	4	1	3	8	< 0.10	27	392	494	30.4	129	132
RL 301	16	25	54	19	11	2	2	0	5	6	< 0.10	27	360	454	40.0	131	132

WE CERTIFY THAT ALL PRODUCTS WERE MANUFACTURED,SAMPLED,TESTED, AND INSPECTED SOLELY BY THE MANUFACTURER LISTED AT THE ADDRESS ABOVE IN ACCORDANCE WITH INDICATED SPECIFICATION AND FOUND TO MEET REQUIREMENTS. MATERIAL IS FREE FROM MERCURY AND RADIOACTIVE CONTAMINATION.
TENSILE REQUIREMENT: CONFORMS TO ASTM A370 STANDARD, LONGITUDINAL DIRECTION, GAUGE LENGTH 2" (50mm)
* HARDNESS ACCORDING TO NACE MR0175/ NACE MR 0103/ ISO15156

NOTE:
C: Cold formed at temperature below 620°C
S: Stress relieved in temperature between 595°C - 690°C and cooled in still air.
H : Hot formed in temperature between 845°C - 945°C and cooled in still air.
N: Normalised at 910°C
Q: Heated to 910°C and quench in water.
T: Temper between 590°C - 690°C.

*1: YS = Yield strength TS=Tensile strength E = Elongation

Made in Malaysia

PANTECH STEEL INDUSTRIES SDN. BHD. QA / QC MANAGER HOI YS 509731-A

Quality Assurance Manager

INSPECTION CERTIFICATE

PANTECH STEEL INDUSTRIES SDN. BHD. (509731-A)
LOT 13258 & 13259, Jalan Haji Abd. Manan,
Off Jalan Meru, 42200 Kapar, Selangor, Malaysia.
Tel: 603-3393 1633 Fax: 603-3393 1733 E-mail: info@pantechsteel.com

ISO 9001
Cert. No.: KLR 0403926
PED 97/23/EC Annex 1 Clause 4.3
Cert. No.: 0038/PED/MUM/0810070/1

WROUGHT CARBON STEEL BUTTWELDING FITTINGS

INSPECTION DOCUMENT: EN10204:2004 Type 3.1

Purchaser : ALLIED FITTING CORP

Certificate No : PSI 109759
Date : 24-May-16

Order No.	Invoice No.	Starting Material	Specification for Fittings- Seamless	Specification for Inspection
31016PS-5	E 000012495	Seamless Pipe	ASTM A234-14 WPB/ASME SA234-15 WPB NACE MR0175/NACE MR0103/IS015156*	ASME B16.9-12 / ASTM A960-14a

Heat No.	Part Code	Product & Size	Quantity (pcs)	Dimensional & Visual Inspection	Heat Treatment	Magnetic Particle Testing
TB 905	F9LS4-PS	4" 90 DEG LR STD ELBOW	1055	GOOD	H	N.A

Specification / Heat No.	Chemical Composition (%)												Tensile Test *1			Hardness	
	C x100	Si x100	Mn x100	P x1000	S x1000	Ni x100	Cr x100	Mo x100	Cu x100	V x1000	Pb	CE x100	YS (~~KSI~~ / MPa)	TS	E (%)	(HB) 1	(HB) 2
Min	-	10	29	-	-	-	-	-	-	-	-	-	240	415	22	-	
Max	30	-	106	50	58	40	40	15	40	80	-	50	-	-	-	197	
TB 905	13	16	77	14	5	4	6	3	4	0	<0.10	28	360	465	33.4	126	127

WE CERTIFY THAT ALL PRODUCTS WERE MANUFACTURED,SAMPLED,TESTED, AND INSPECTED SOLELY BY THE MANUFACTURER LISTED AT THE ADDRESS ABOVE IN ACCORDANCE WITH INDICATED SPECIFICATION AND FOUND TO MEET REQUIREMENTS. MATERIAL IS FREE FROM MERCURY AND RADIOACTIVE CONTAMINATION.

TENSILE REQUIREMENT: CONFORMS TO ASTM A370 STANDARD, LONGITUDINAL DIRECTION, GAUGE LENGTH 2" (50mm)

* HARDNESS ACCORDING TO NACE MR0103-12/ NACE MR0175/ISO15156-15

NOTE:

C: Cold formed at temperature below 620°C
S: Stress relieved in temperature between 595°C - 690°C and cooled in still air.
H : Hot formed in temperature between 845°C - 945°C and cooled in still air.
N: Normalised at 910°C
Q: Heated to 910°C and quench in water.
T: Temper between 590°C - 690°C.

*1: YS = Yield strength TS=Tensile strength E = Elongation

Made in Malaysia

Quality Assurance Manager

INSPECTION CERTIFICATE

PANTECH STEEL INDUSTRIES SDN. BHD. (509731-A)
LOT 13258 & 13259, Jalan Haji Abd. Manan,
Off Jalan Meru, 42200 Kapar, Selangor, Malaysia.
Tel: 603-3393 1633 Fax: 603-3393 1733 E-mail: info@pantechsteel.com

LLOYD'S REGISTER-LRQA
ISO 9001
Cert. No.: KLR 0403926

PED 97/23/EC Annex 1 Clause 4.3
Cert. No.: 0038/PED/MUM/0810070/1

WROUGHT CARBON STEEL BUTTWELDING FITTINGS

INSPECTION DOCUMENT: EN10204:2004 Type 3.1

Purchaser : ALLIED FITTING CORP

Certificate No : PSI 104318
Date : 21-Oct-15

Order No.	Invoice No.	Starting Material	Specification for Fittings- Seamless	Specification for Inspection
52315GPS-1	E 000012076	Seamless Pipe	ASTM A234-14 WPB/ASME SA234-15 WPB NACE MR0175/NACE MR0103/ISO15156*	ASME B16.9-12 / ASTM A960-14a

Heat No.	Product & Size	Quantity (pcs)	Visual Examination	Dimensional Inspection	Heat Treatment	Magnetic Particle Testing
SE 601	4" 45 DEG LR STD ELBOW	550	GOOD	GOOD	H	N.A

Specification	Chemical Composition (%)												Tensile Test *1			Hardness	
	C x100	Si x100	Mn x100	P x1000	S x1000	Ni x100	Cr x100	Mo x100	Cu x100	V x1000	Pb	CE x100	YS (KSI / MPa)	TS	E (%)	(HB) 1	(HB) 2
Min	-	10	29	-	-	-	-	-	-	-	-	-	240	415	22	-	
Max	30	-	106	50	58	40	40	15	40	80	-	50	-	-	-	197	
Heat No.																	
SE 601	21	21	41	20	3	1	7	1	5	0	<0.10	30	366	480	30.2	125	126

WE CERTIFY THAT ALL PRODUCTS WERE MANUFACTURED,SAMPLED,TESTED, AND INSPECTED SOLELY BY THE MANUFACTURER LISTED AT THE ADDRESS ABOVE IN ACCORDANCE WITH INDICATED SPECIFICATION AND FOUND TO MEET REQUIREMENTS. MATERIAL IS FREE FROM MERCURY AND RADIOACTIVE CONTAMINATION.

TENSILE REQUIREMENT: CONFORMS TO ASTM A370 STANDARD, LONGITUDINAL DIRECTION, GAUGE LENGTH 2" (50mm)

* HARDNESS ACCORDING TO NACE MR0175/ NACE MR 0103/ ISO15156

NOTE:

C: Cold formed at temperature below 620°C
N: Normalised at 910°C
S: Stress relieved in temperature between 595°C - 690°C and cooled in still ai Q: Heated to 910°C and quench in water.
H : Hot formed in temperature between 845°C - 945°C and cooled in still air. T: Temper between 590°C - 690°C.

*1: YS = Yield strength TS=Tensile strength E = Elongation

Made in Malaysia

Quality Assurance Manager

INSPECTION CERTIFICATE

PANTECH STEEL INDUSTRIES SDN. BHD. (509731-A)
LOT 13258 & 13259, Jalan Haji Abd. Manan,
Off Jalan Meru, 42200 Klang, Selangor, Malaysia.
Tel: 603-3393 1633 Fax: 603-3393 1733 E-mail: info@pantechsteel.com

LLOYD'S REGISTER · LRQA
ISO 9001
Cert. No.: KLR 0403926

PED 97/23/EC Annex 1 Clause 4.3
Cert. No.: 0038/PED/MUM/0810070/1

WROUGHT CARBON STEEL BUTTWELDING FITTINGS

INSPECTION DOCUMENT: EN10204:2004 Type 3.1

Certificate No : PSI 102805
Date : 4-Aug-15

Purchaser : ALLIED FITTING CORP

Order No.	Invoice No.	Starting Material	Specification for Fittings- Seamless	Specification for Inspection
52215PS-5	E 000011944	Seamless Pipe	ASTM A234-14 WPB/ASME SA234-15 WPB NACE MR0175/NACE MR0103/ISO15156*	ASME B16.9-12 / ASTM A960-14a

Heat No.	Product & Size	Quantity (pcs)	Visual Examination	Dimensional Inspection	Heat Treatment	Magnetic Particle Testing
SD 301	4" 45 DEG LR STD ELBOW	550	GOOD	GOOD	H	N.A

Specification	Chemical Composition (%)												Tensile Test *1			Hardness	
	C x100	Si x100	Mn x100	P x1000	S x1000	Ni x100	Cr x100	Mo x100	Cu x100	V x1000	Pb	CE x100	YS (KSI / MPa)	TS	E (%)	(HB) 1	(HB) 2
Min																	
Max	-	10	29	-	-	-	-	-	-	-	-	-	240	415	22	-	
Heat No.	30	-	106	50	58	40	40	15	40	80	-	50	-	-	-	197	
SD 301	22	24	41	18	7	1	7	3	5	3	<0.10	32	338	454	30.4	133	134

WE CERTIFY THAT ALL PRODUCTS WERE MANUFACTURED,SAMPLED,TESTED, AND INSPECTED SOLELY BY THE MANUFACTURER LISTED AT THE ADDRESS ABOVE IN ACCORDANCE WITH INDICATED SPECIFICATION AND FOUND TO MEET REQUIREMENTS. MATERIAL IS FREE FROM MERCURY AND RADIOACTIVE CONTAMINATION.

TENSILE REQUIREMENT: CONFORMS TO ASTM A370 STANDARD, LONGITUDINAL DIRECTION, GAUGE LENGTH 2" (50mm)

* HARDNESS ACCORDING TO NACE MR0175/ NACE MR 0103/ ISO15156

NOTE:

C: Cold formed at temperature below 620°C
S: Stress relieved in temperature between 595°C - 690°C and cooled in still ai
H : Hot formed in temperature between 845°C - 945°C and cooled in still air.
N: Normalised at 910°C
Q: Heated to 910°C and quench in water.
T: Temper between 590°C - 690°C.

*1: YS = Yield strength TS=Tensile strength E = Elongation

Made in Malaysia

Quality Assurance Manager

F-MTR-01-01

R.N. GUPTA & COMPANY LTD., C-55, FOCAL POINT, LUDHIANA -141 010 (INDIA)

RNG

MATERIAL / MILL TEST CERTIFICATE EN 10204 : 2004 - 3.1

CERTIFICATE NO. 10359 DATE 30/09/2016

NAME OF BUYER
ALLIED FITTING L.P.

RAW MATERIAL SPECIFICATION : ASTM A105-14/ASME SA105-13

SPECIFICATION FOR INSPECTION :ANSI/ASME B16.5-2013

P.O NO. 71116NRG DT. 08/07/2016

INVOICE NO. RNG/EXP/16-2130 DT. 28/09/2016

MECHANICAL REQUIREMENTS

Sr. No.	Description	Qty (PCS)	Heat No.	Supp. Code	Y.S(PSI) Min 36,000	T.S(PSI) Min 70,000	E% Min 22%	R.A% Min 30%	Heat Treatment	Soaking Time (Min.)	Hardness BHN 137-187
1	3 300# WNRF STD FLGS L3WRS3-RG	900	H 5559	20	48220	78443	33.20	69.13	AS FORGED		158 - 160
2	4 300# SORF FLGS L3SR4-RG	112	H 5519	29	48056	76967	30.70	65.35	AS FORGED		156 - 158
3	4 300# WNRF STD FLGS L3WRS4-RG	400	H 5568	19	48896	78128	30.46	67.14	AS FORGED		154 - 156
4	4 300# BLRF FLGS L3BR4-RG	96	H 5516	29	48727	77954	31.44	64.98	AS FORGED		154 - 156
5	2 1/2 150# WNRF STD FLGS L1WRS2.5-RG	15	H 5564	19	51462	84797	30.50	66.80	AS FORGED		160 - 162
6	2 1/2 150# WNRF STD FLGS L1WRS2.5-RG	33	H 5546	20	48836	78884	31.46	65.42	AS FORGED		158 - 160
7	2 1/2 150# WNRF STD FLGS L1WRS2.5-RG	197	H 5548	20	46792	74343	30.40	65.64	AS FORGED		150 - 152
8	3 150# WNRF STD FLGS L1WRS3-RG	1121	H 5559	20	48220	78443	33.20	69.13	AS FORGED		158 - 160

CHEMICAL REQUIREMENTS

		SPECIFIED ELEMENTS						UNSPECIFIED ELEMENTS				
Sr. No.	Heat No.	C.E. 0.47% Max	C 0.35 Max	Mn 0.60-1.25	P 0.035 Max.	S 0.04 Max.	Si .10 -0.35 Max.	Cu 0.40 Max.	Ni 0.40 Max	Cr 0.30 Max.	Mo 0.12 Max.	V 0.08 Max.
1	H 5559	0.38	0.20	0.93	0.031	0.014	0.21	0.043	0.035	0.085	0.008	0.003
2	H 5519	0.41	0.21	0.99	0.014	0.011	0.27	0.062	0.022	0.140	0.007	0.003
3	H 5568	0.41	0.20	1.24	0.024	0.012	0.25	0.004	0.008	0.014	0.003	0.003
4	H 5516	0.39	0.21	0.99	0.010	0.008	0.23	0.037	0.029	0.022	0.008	0.004
5	H 5564	0.41	0.20	1.24	0.013	0.013	0.24	0.004	0.008	0.010	0.003	0.003
6	H 5546	0.38	0.20	0.92	0.031	0.010	0.20	0.060	0.027	0.068	0.010	0.004
7	H 5548	0.39	0.21	0.94	0.031	0.012	0.22	0.066	0.033	0.093	0.006	0.003
8	H 5559	0.38	0.20	0.93	0.031	0.014	0.21	0.043	0.035	0.085	0.008	0.003

Certificate that the materials described above are in accordance with the order and specifications.

Material in accordance with NACE MRO 175-2003 and NACE MRO 103

For R.N. GUPTA & COMPANY LTD.

METALLURGIST

Note:- We hereby confirm that our QA system comply with requirements of Annex I, Clause4.3 of PED 97/23/EC and it is certified by M/s DNV BUSINESS ASSURANCE vide certificate No. 4487-2014-CE-IND-DNV Valid upto 31-03-2017. ISO 9001:2008 certificate No. is 39752-2008-AQ-IND-RvA 03 Dated 22/07/2017. Products also conform to requirements of ASTM A105-05/ASME SA105

Phoenix * Capitol * Camco
CapProducts

Certified Mill Test Report

Heat Code: 36HHHH
Heat Number: 156097
Item: 12810850: 36 -3/4 X 1/2 3M THRD

Material: ASTM A105-2014 / ASME SA105-2015 Edition

Chemistry Properties

C	Mn	P	S	Si	Cu	Cr
0.2100	0.9300	0.0050	0.0200	0.2400	0.1700	0.1160
Ni	**Mo**	**V**	**Co**	**Al**	**Cb**	**N**
0.1400	0.0280	0.0370		0.0020	0.0030	
Pb	**Sn**	**Ta**	**Ti**	**C Eq. Long**		
				0.4219		

Additional Chemical Properties

Mechanical Properties

Tensile(PSI)	Yield(PSI)	Elong. % in 2 in. or 4D	Reduction	HBW	HBW 2
87500	56500	28%	64	187	179

Charpy Minimum Impact - ft/lbs

Test 1	Test 2	Test 3	Avg.	Test Temp.

We hereby certify that these parts were manufactured, sampled, tested, and inspected in accordance with the product specifications stated and were found to meet the requirements. We further certify that this material was inspected using independent inspectors conforming to the requirements of EN 10204 3.1. These products meet the requirements of the latest editions of NACE MR0175, NACE MR0103, and ISO 15156. No weld repair has been performed on these products. This material was not exposed to mercury or any other metal alloy that is liquid at ambient temperatures during processing or while in our possession.

Meets ASME SA-181-70 2013 Edition. Manufactured in the USA.

Phoenix * Capitol * Camco CapProducts

Certified Mill Test Report

Heat Code: 37LL
Heat Number: C121925
Item: 12811050: 36 -1 1/2 X 3/4 3M- THRD

Material: ASTM A105-2014 / ASME SA105-2015 Edition

Chemistry Properties

C	Mn	P	S	Si	Cu	Cr
0.2100	0.9900	0.0090	0.0180	0.2300	0.1200	0.0400
Ni	**Mo**	**V**	**Co**	**Al**	**Cb**	**N**
0.0400	0.0090	0.0040				
Pb	**Sn**	**Ta**	**Ti**	**C Eq. Long**		
				0.3963		

Additional Chemical Properties

Mechanical Properties

Tensile(PSI)	Yield(PSI)	Elong. % in 2 in. or 4D	Reduction	HBW	HBW 2
87000	57000	28%	65	183	179

Charpy Minimum Impact - ft/lbs

Test 1	Test 2	Test 3	Avg.	Test Temp.

We hereby certify that these parts were manufactured, sampled, tested, and inspected in accordance with the product specifications stated and were found to meet the requirements. We further certify that this material was inspected using independent inspectors conforming to the requirements of EN 10204 3.1. These products meet the requirements of the latest editions of NACE MR0175, NACE MR0103, and ISO 15156. No weld repair has been performed on these products. This material was not exposed to mercury or any other metal alloy that is liquid at ambient temperatures during processing or while in our possession.

Meets ASME SA-181-70 2013 Edition. Manufactured in the USA.

HEATEC, INC.
5200 WILSON RD. CHATTANOOGA, TN 37410

Date Printed: 2/9/2017

CUSTOMER

UOP Russell LLC

,

VESSEL DESCRIPTION

550 Gallon Expansion Tank

Vessel designed per the ASME Boiler & Pressure Vessel Code,
Section VIII, Division 1, 2015 Edition
with DesignCalcs, Version: 2016.2
Vessel is ASME Code Stamped

Wind Analysis performed in accordance with ASCE 7-10
Seismic Analysis performed in accordance with ASCE 7-10

Vessel Number: 16-251

NAMEPLATE INFORMATION

Vessel MAWP:	150.00 PSI at 550 °F
MDMT:	-20 °F at 150.00 PSI
Serial Number(s):	16-251
National Board Number(s):	
Year Built:	2017
Radiography:	NONE
Postweld Heat Treated:	NONE
Construction Type:	W

Notes

The loading in UG-22 were considered and deemed to be insignificant.

Signatures

PROJECT ENGINEER: _____ Date: 2 / 9 / 17

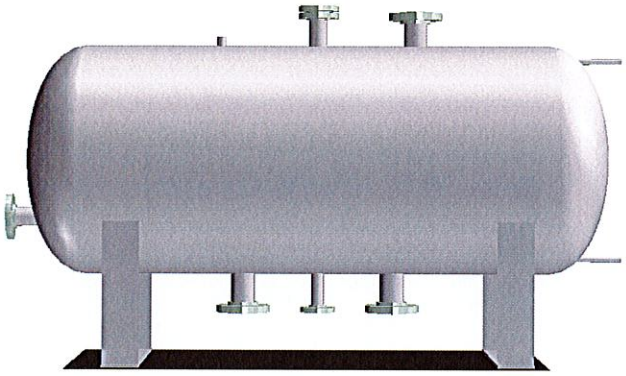
SUPERVISOR: _____ Date: 2 / 14 / 17

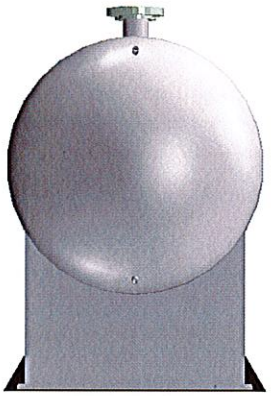
QUALITY CONTROL: _____ Date: 2 / 15 / 17

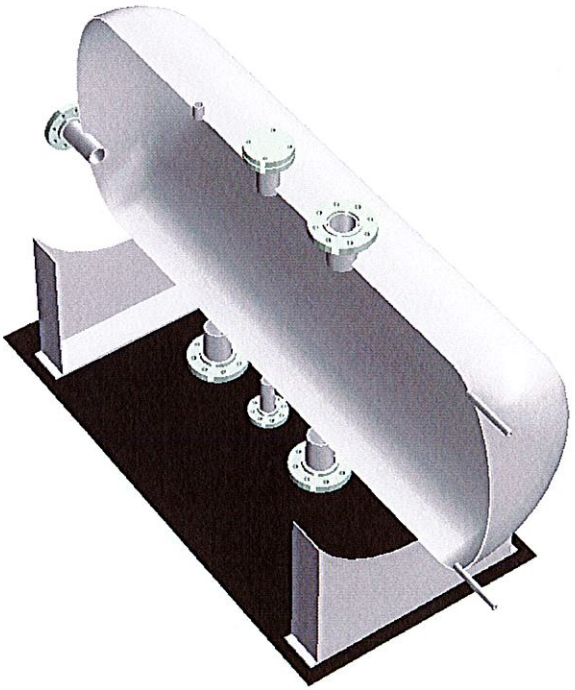
INSPECTOR (A. I.): _____ Date: 2 / 15 / 17

HEATEC, INC.
5200 WILSON RD. CHATTANOOGA, TN 37410

Date Printed: 2/9/2017







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HEATEC, INC.

Shell 1

Customer: **UOP Russell LLC**

Vessel Number: 16-251

Number: 1 Mark Number: S1

Date Printed: 2/9/2017

Cylindrical Shell Design Information

Design Pressure:	150.00	PSI	Design Temperature:	550	°F
Static Head:	0.00	PSI	Long. Joint Efficiency:	70	%
Shell Material:	SA-516 Gr. 70		Factor B Chart:	CS-2	
			Material Stress (hot):	19700	PSI
Shell Length:	82.0000	in.	Material Stress (cold):	20000	PSI
			Compressive Stress:	10116	PSI
Corrosion Allowance:	0.0625	in.	Actual Circumferential Stress:	17914	PSI
External Corrosion Allowance:	0.0000	in.	Actual Longitudinal Stress:	9531	PSI
Outside Diameter (new):	42.0000	in.	Extreme Fiber Elongation:	0.75	%
Outside Diameter (corroded):	42.0000	in.	Specific Gravity:	1.00	
Shell Surface Area:	75.14	Sq. Ft.	Weight of Fluid:	3987.63	lb.
Shell Estimated Volume:	477.33	Gal.	Total Flooded Shell Weight:	4927.31	lb.
Circ. Joint Efficiency:	65	%	Shell Weight:	939.67	lb.

Minimum Design Metal Temperature Data

Min. Temperature Curve:	B	Pressure at MDMT:	150.00 PSI
UCS-66(b) reduction:	No	Minimum Design Metal Temperature:	-20 °F
UCS-68(c) reduction:	No	Computed Minimum Temperature:	-20 °F

Design Thickness Calculations

Longitudinal Stress Calculations per Paragraph UG-27(c)(2)

$$\mathbf{t} = \frac{PR}{2SE + 0.4P} = \frac{150.00 * 20.7500}{2 * 19700 * 0.65 + 0.4 * 150.00} = 0.1213 + 0.0625_{\text{(corrosion)}} + 0.0000_{\text{(ext. corrosion)}}$$

= minimum of **0.1838** in.

Circumferential Stress Calculations per Appendix 1-1

$$\mathbf{t} = \frac{PR_O}{SE + 0.4P} = \frac{150.00 * 21.0000}{19700 * 0.70 + 0.4 * 150.00} = 0.2274 + 0.0625_{\text{(corrosion)}} + 0.0000_{\text{(ext. corrosion)}}$$

= minimum of **0.2899** in.

MAWP for this Shell Section Only

$$\mathbf{P} = \frac{SEt}{R_O - 0.4t} = \frac{19700 * 0.70 * 0.2500}{21.0000 - 0.4 * 0.2500}$$

= maximum design pressure of **164.95** PSI

External loads do not control design.

Nominal Shell Thickness Selected = **0.3125** in.

HEATEC, INC.

Head 1

Customer: **UOP Russell LLC**

Vessel Number: 16-251

Number: 1 Mark Number: H1

Date Printed: 2/9/2017

Ellipsoidal Head Design Information

Design Pressure:	150.00	PSI	Design Temperature:	550	°F
Static Head:	0.00	PSI	Joint Efficiency:	85	%
Head Material:	SA-516 Gr. 70		Factor B Chart:	CS-2	
			Material Stress (hot):	19700	PSI
Corrosion Allowance:	0.0625	in.	Material Stress (cold):	20000	PSI
External Corrosion Allowance:	0.0000	in.	Actual Head Stress:	19606	PSI
Head Location:	Right		Straight Flange :	2.0000	in.
Outside Diameter :	42.0000	in.	Head Depth (ho) :	10.6563	in.
Thin Out :	0.0625	in.			
$K = \frac{1}{6}[2 + (D/2h)^2]$:	1.00				
Extreme Fiber Elongation:	3.31	%			
Head Surface Area:	14.97	Sq. Ft.	Specific Gravity:	1.00	
Head Estimated Volume:	51.78	Gal.	Weight of Fluid:	431.87	lb.
Head Weight:	188.67	lb.	Total Flooded Head Weight:	620.54	lb.

Minimum Design Metal Temperature Data

Min. Temperature Curve:	B	Pressure at MDMT:	150.00 PSI
UCS-66(b) reduction:	No	Minimum Design Metal Temperature:	-20 °F
UCS-68(c) reduction:	No	Computed Minimum Temperature:	-20 °F

Design Thickness Calculations

Design Thickness Calculations per Appendix 1-4(c)

$$\mathbf{t} = \frac{PD_oK}{2SE + 2P(K - 0.1)} = \frac{150.00 * 42.0000 * 1.00}{2 * 19700 * 0.85 + 2 * 150.00 * (1.00 - 0.1)}$$

$= 0.1867 + 0.0625_{\text{(corrosion)}} + 0.0000_{\text{(ext. corrosion)}} + 0.0625_{\text{(thin out)}}$ = minimum of **0.3117** in.

MAWP per UG-32 for this Head Only

$$\mathbf{P} = \frac{2SEt}{KD_o - 2t(K - 0.1)} = \frac{2 * 19700 * 0.85 * 0.1875}{1.00 * 42.0000 - 2 * 0.1875 * (1.00 - 0.1)}$$

= **150.72** PSI

External loads do not control design.

Nominal Head Thickness Selected = **0.3125** in.

Minimum Thickness after forming, t_s (uncorroded) = **0.2500** in.

HEATEC, INC.

Threaded Coupling - 1"

Customer: **UOP Russell LLC** 16-251

Vessel Number:

Number: 1 Mark Number: N1

ID Number: 1

Date Printed: 2/9/2017

Nozzle Design Information

Design Pressure:	150.00 PSI		Design Temperature:	550 °F	
Static Head:	0.00 PSI		Nozzle Efficiency (E):	85 %	
Nozzle Material:	SA-105		Joint Efficiency (E_1):	1.00	
			Factor B Chart:	CS-2	
External Projection:	1.6250 in.		Allowable Stress at Design Temperature (S_n):	19000 PSI	
Internal Projection:	0.3750 in.		Allowable Stress at Ambient Temperature:	20000 PSI	
Inside Corrosion Allowance:	0.0625 in.		Correction Factor (F):	1.00	
External Corrosion Allowance:	0.0000 in.		Nozzle Path:	None	
Nozzle ID (new):	1.3300 in.		Nozzle Wall Thickness(new):	0.2175 in.	
Nozzle ID (corroded):	1.4550 in.		Nozzle Wall Thickness(corroded):	0.1550 in.	
External Limit of Reinforcement:	0.3875 in.		Upper Weld Leg Size(Weld 41):	0.2500 in.	
Internal Limit of Reinforcement:	0.2313 in.		Internal Weld Leg Size(Weld 43):	0.2500 in.	
Parallel Limit of Reinf (2Lpar):	2.9100 in.		Outside Groove Weld Depth:	0.3125 in.	

Minimum Design Metal Temperature

Min. Temp. Curve:	B	Pressure at MDMT:	150.00 PSI
UCS-66(b) reduction:	No	Minimum Design Metal Temperature:	-20 °F
UCS-68(c) reduction:	No	Computed Minimum Temperature:	-20 °F

Host Component: Shell 1 - Shell 1

Material:	SA-516 Gr. 70	Shell wall thickness(new):	0.3125 in.
Material Stress(S_v):	19700 PSI	Shell wall thickness(corroded):	0.2500 in.

Nozzle Detail Information

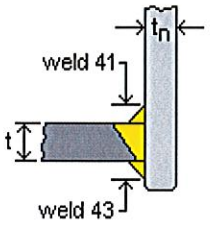


Fig. UW-16.1 (c)

Upper Weld Leg Size(Weld 41): 0.2500 in.

Internal Weld Leg Size(Weld 43): 0.2500 in.

Nozzle Wall Thickness(t_n): 0.2175 in.

Outside Groove Weld Depth: 0.3125 in.

Nozzle passes through the vessel, attached by a groove weld.
Nozzle is adequate for UG-45 requirements.
Opening is adequately reinforced for Internal Pressure.
Weld Strength Paths are adequate.

Required Shell Thickness per Paragraph UG-37(a)

$$\mathbf{tr} = \frac{PRo}{SE + 0.4P} = \frac{150.00 * 21.0000}{19700 * 1 + 0.4 * 150.00}$$ = **0.1594** in.

Nozzle Required Thickness Calculations

Required Nozzle Thickness for Internal Pressure per Paragraph UG-37(a)

$$\mathbf{trn} = \frac{PRn}{SE - 0.6P} = \frac{150.00 * 0.7275}{19000 * 1 - 0.6 * 150.00}$$ = **0.0058** in.

Strength Reduction Factors

$r1 = \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{19000}{19700}, 1.0000\right) = 0.9645$ **fr2** $= \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{19000}{19700}, 1.0000\right) = 0.9645$

UG-45 Thickness Calculations

Nozzle Thickness for Pressure Loading (plus corrosion)

$$t_a = \frac{PRn}{SE - 0.6P} + Ca + \text{ext. } Ca = \frac{150.00 * 0.7275}{19000 * 0.85 - 0.6 * 150.00} + 0.0625 + 0.0000$$ = **0.0693** in.

Nozzle Thickness for Internal Pressure (plus corrosion) Based on Host

$$t_{b1} = \frac{PRo}{SE + 0.4P} + Ca + \text{ext. } Ca = \frac{150.00 * 21.0000}{19700 * 1 + 0.4 * 150.00} + 0.0625 + 0.0000$$ = **0.2219** in.

Minimum Thickness (plus corrosion) per Table UG-45

t_{b3} = minimum thickness (Table UG-45) + Ca + ext. Ca = **0.1895** in.

Nozzle Minimum Thickness Based on Host and Table UG-45

$t_b = \min[t_{b3}, \max(t_{b1}, t_{b2})]$ = **0.1895** in.

$t_{UG\text{-}45} = \max(t_a, t_b)$ = **0.1895** in.

Wall thickness = tn = **0.2180** is greater than or equal to UG-45 value of **0.1895**

Limits of Reinforcement (UG-40)

L_{par} = max(d, R_n + t + t_n) = max(1.4550, 0.7275 + 0.2500 + 0.1550) = **1.4550** in.
L_{noro} = min(2.5 t, 2.5 t_n + t_e) = min(2.5 * 0.2500, 2.5 * 0.1550 + 0.0000) = **0.3875** in.
L_{nori} = min(2.5 t, 2.5 t_i) = min(2.5 * 0.2500, 2.5 * 0.0925) = **0.2313** in.

Nozzle Reinforcement Calculations (Internal Pressure)

A = max{C [d t_r F + 2 t_n t_r F (1 - f_{r1})], 0} = max{1.0000 * [1.4550 * 0.1594 * 1.00 + 2 * 0.1550 * 0.1594 * 1.00 * (1 - 0.9645)], 0}
= **0.2337** sq. in.

A1 = max[(2 L_{par} - d) (E_1 t - F t_r) - 2 t_n (E_1 t - F t_r) (1 - f_{r1}), 0] =
max[(2 * 1.4550 - 1.4550) * (1.0000 * 0.2500 - 1.00 * 0.1594) - 2 * 0.1550 * (1.0000 * 0.2500 - 1.00 * 0.1594) * (1 - 0.9645), 0]
= **0.1308** sq. in.

A2 = max{2 min(h_o, L_{noro}) [min(t_n, L_{par} - 0.5 d) - t_{rn}] f_{r2}, 0} =
max{2 * min(1.6250, 0.3875) * [min(0.1550, 1.4550 - 0.5 * 1.4550) - 0.0058] * 0.9645, 0} = **0.1115** sq. in.

A3 = max{2 min(h, L_{nori}) min(t_i, L_{par} - 0.5 d) f_{r2}, 0} =
max{2 * min(0.3125, 0.2313) * min(0.0925, 1.4550 - 0.5 * 1.4550) * 0.9645, 0} = **0.0413** sq. in.

A41 = f_{r2} [L_{41}^2 - (L_{41} - $L_{41pareff}$)^2 - (L_{41} - $L_{41noreff}$)^2] =
0.9645 * [0.2500^2 - (0.2500 - 0.2500)^2 - (0.2500 - 0.2500)^2] = **0.0603** sq. in.

A42 = f_{r4} $L_{42pareff}$ $L_{42noreff}$ =
0.0000 * 0.0000 * 0.0000 = **0.0000** sq. in.

A43 = f_{r2} [L_{43}^2 - (L_{43} - $L_{43pareff}$)^2 - (L_{43} - $L_{43noreff}$)^2] =
0.9645 * [0.1607^2 - (0.1607 - 0.1607)^2 - (0.1607 - 0.1607)^2] = **0.0249** sq. in.

A5
= **0.0000** sq. in.

Area Available (Internal Pressure) = A1 + A2 + A3 + A41 + A42 + A43 + A5 = 0.3688 sq. in., which is **>=** A (0.2337)

Nozzle Design Information

Design Pressure:	150.00	PSI	Design Temperature:	550	°F
Static Head:	0.00	PSI	Nozzle Efficiency (E):	85	%
Nozzle Material:	SA-106 Gr. B		Joint Efficiency (E_1):	1.00	
			Factor B Chart:	CS-2	
External Projection:	6.0000	in.	Allowable Stress at Design Temperature (S_n):	17100	PSI
Internal Projection:	1.0000	in.	Allowable Stress at Ambient Temperature:	17100	PSI
Inside Corrosion Allowance:	0.0625	in.	Correction Factor (F):	1.00	
External Corrosion Allowance:	0.0000	in.	Nozzle Path:	None	
Nozzle Pipe Size:	3		Nozzle Pipe Schedule:	80	
Nozzle ID (new):	2.9000	in.	Nozzle Wall Thickness(new):	0.3000	in.
Nozzle ID (corroded):	3.0250	in.	Nozzle Wall Thickness(corroded):	0.2375	in.
External Limit of Reinforcement:	0.5938	in.	Upper Weld Leg Size(Weld 41):	0.3750	in.
Internal Limit of Reinforcement:	0.4375	in.	Internal Weld Leg Size(Weld 43):	0.3750	in.
Parallel Limit of Reinf (2Lpar):	6.0500	in.	Outside Groove Weld Depth:	0.3125	in.

Minimum Design Metal Temperature

Min. Temp. Curve:	B	Pressure at MDMT:	150.00 PSI
UCS-66(b) reduction:	No	Minimum Design Metal Temperature:	-20 °F
UCS-68(c) reduction:	No	Computed Minimum Temperature:	-20 °F

Host Component: Shell 1 - Shell 1

Material:	SA-516 Gr. 70	Shell wall thickness(new):	0.3125 in.
Material Stress(S_v):	19700 PSI	Shell wall thickness(corroded):	0.2500 in.

Nozzle Detail Information

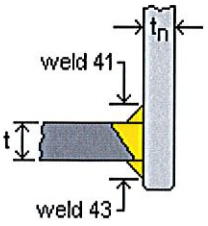


Fig. UW-16.1 (c)

Upper Weld Leg Size(Weld 41): 0.3750 in.

Internal Weld Leg Size(Weld 43): 0.3750 in.

Nozzle Wall Thickness(t_n): 0.3000 in.

Outside Groove Weld Depth: 0.3125 in.

Nozzle passes through the vessel, attached by a groove weld.
Pipe Size: 3 Schedule: 80
Nozzle is adequate for UG-45 requirements.
Opening is adequately reinforced for Internal Pressure.
Weld Strength Paths are adequate.

Required Shell Thickness per Paragraph UG-37(a)

$$\mathbf{tr} = \frac{PRo}{SE + 0.4P} = \frac{150.00 * 21.0000}{19700 * 1 + 0.4 * 150.00}$$ = **0.1594** in.

Nozzle Required Thickness Calculations

Required Nozzle Thickness for Internal Pressure per Paragraph UG-37(a)

$$\mathbf{trn} = \frac{PRn}{SE - 0.6P} = \frac{150.00 * 1.5125}{17100 * 1 - 0.6 * 150.00}$$ = **0.0133** in.

Strength Reduction Factors

$r1 = \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{17100}{19700}, 1.0000\right) = 0.8680$ **fr2** $= \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{17100}{19700}, 1.0000\right) = 0.8680$

UG-45 Thickness Calculations

Nozzle Thickness for Pressure Loading (plus corrosion)

$$t_a = \frac{PRn}{SE - 0.6P} + Ca + \text{ext. } Ca = \frac{150.00 * 1.5125}{17100 * 0.85 - 0.6 * 150.00} + 0.0625 + 0.0000$$ = **0.0782** in.

Nozzle Thickness for Internal Pressure (plus corrosion) Based on Host

$$t_{b1} = \frac{PRo}{SE + 0.4P} + Ca + \text{ext. } Ca = \frac{150.00 * 21.0000}{19700 * 1 + 0.4 * 150.00} + 0.0625 + 0.0000$$ = **0.2219** in.

Minimum Thickness (plus corrosion) per Table UG-45

t_{b3} = minimum thickness (Table UG-45) + Ca + ext. Ca = **0.2515** in.

Nozzle Minimum Thickness Based on Host and Table UG-45

$t_b = \min[t_{b3}, \max(t_{b1}, t_{b2})]$ = **0.2219** in.

$t_{UG\text{-}45} = \max(t_a, t_b)$ = **0.2219** in.

Wall thickness = tn * 0.875(pipe) = **0.2620** is greater than or equal to UG-45 value of **0.2219**

Limits of Reinforcement (UG-40)

L_{par} = max(d, R_n + t + t_n) = max(3.0250, 1.5125 + 0.2500 + 0.2375) = **3.0250** in.
L_{noro} = min(2.5 t, 2.5 t_n + t_e) = min(2.5 * 0.2500, 2.5 * 0.2375 + 0.0000) = **0.5938** in.
L_{nori} = min(2.5 t, 2.5 t_i) = min(2.5 * 0.2500, 2.5 * 0.1750) = **0.4375** in.

Nozzle Reinforcement Calculations (Internal Pressure)

A = max{C [d t_r F + 2 t_n t_r F (1 - f_{r1})], 0} = max{1.0000 * [3.0250 * 0.1594 * 1.00 + 2 * 0.2375 * 0.1594 * 1.00 * (1 - 0.8680)], 0}
= **0.4922** sq. in.

A1 = max[(2 L_{par} - d) (E_1 t - F t_r) - 2 t_n (E_1 t - F t_r) (1 - f_{r1}), 0] =
max[(2 * 3.0250 - 3.0250) * (1.0000 * 0.2500 - 1.00 * 0.1594) - 2 * 0.2375 * (1.0000 * 0.2500 - 1.00 * 0.1594) * (1 - 0.8680), 0]
= **0.2684** sq. in.

A2 = max{2 min(h_o, L_{noro}) [min(t_n, L_{par} - 0.5 d) - t_{rn}] f_{r2}, 0} =
max{2 * min(6.0000, 0.5938) * [min(0.2375, 3.0250 - 0.5 * 3.0250) - 0.0133] * 0.8680, 0} = **0.2311** sq. in.

A3 = max{2 min(h, L_{nori}) min(t_i, L_{par} - 0.5 d) f_{r2}, 0} =
max{2 * min(0.9375, 0.4375) * min(0.1750, 3.0250 - 0.5 * 3.0250) * 0.8680, 0} = **0.1329** sq. in.

A41 = f_{r2} [L_{41}^2 - (L_{41} - $L_{41pareff}$)^2 - (L_{41} - $L_{41noreff}$)^2] =
0.8680 * [0.3750^2 - (0.3750 - 0.3750)^2 - (0.3750 - 0.3750)^2] = **0.1221** sq. in.

A42 = f_{r4} $L_{42pareff}$ $L_{42noreff}$ =
0.0000 * 0.0000 * 0.0000 = **0.0000** sq. in.

A43 = f_{r2} [L_{43}^2 - (L_{43} - $L_{43pareff}$)^2 - (L_{43} - $L_{43noreff}$)^2] =
0.8680 * [0.2857^2 - (0.2857 - 0.2857)^2 - (0.2857 - 0.2857)^2] = **0.0709** sq. in.

A5
= **0.0000** sq. in.

Area Available (Internal Pressure) = A1 + A2 + A3 + A41 + A42 + A43 + A5 = 0.8253 sq. in., which is **>=** A (0.4922)

HEATEC, INC.

4" Relief Valve Connection

Customer: **UOP Russell LLC** 16-251

Vessel Number:

Number: 3 Mark Number: N3

ID Number: 3

Date Printed: 2/9/2017

Nozzle Design Information

Design Pressure:	150.00	PSI	Design Temperature:	550	°F
Static Head:	0.00	PSI	Nozzle Efficiency (E):	85	%
Nozzle Material:	SA-106 Gr. B		Joint Efficiency (E_1):	1.00	
			Factor B Chart:	CS-2	
External Projection:	6.0000	in.	Allowable Stress at Design Temperature (S_n):	17100	PSI
Internal Projection:	1.0000	in.	Allowable Stress at Ambient Temperature:	17100	PSI
Inside Corrosion Allowance:	0.0625	in.	Correction Factor (F):	1.00	
External Corrosion Allowance:	0.0000	in.	Nozzle Path:	None	
Nozzle Pipe Size:	4		Nozzle Pipe Schedule:	80	
Nozzle ID (new):	3.8260	in.	Nozzle Wall Thickness(new):	0.3370	in.
Nozzle ID (corroded):	3.9510	in.	Nozzle Wall Thickness(corroded):	0.2745	in.
External Limit of Reinforcement:	0.6250	in.	Upper Weld Leg Size(Weld 41):	0.3750	in.
Internal Limit of Reinforcement:	0.5300	in.	Internal Weld Leg Size(Weld 43):	0.3750	in.
Parallel Limit of Reinf (2Lpar):	7.9020	in.	Outside Groove Weld Depth:	0.3125	in.

Minimum Design Metal Temperature

Min. Temp. Curve:	B	Pressure at MDMT:	150.00 PSI
UCS-66(b) reduction:	No	Minimum Design Metal Temperature:	-20 °F
UCS-68(c) reduction:	No	Computed Minimum Temperature:	-20 °F

Host Component: Shell 1 - Shell 1

Material:	SA-516 Gr. 70	Shell wall thickness(new):	0.3125 in.
Material Stress(S_v):	19700 PSI	Shell wall thickness(corroded):	0.2500 in.

Nozzle Detail Information

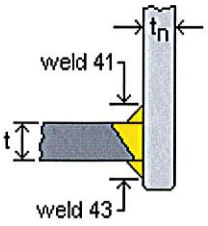


Fig. UW-16.1 (c)

Upper Weld Leg Size(Weld 41): 0.3750 in.

Internal Weld Leg Size(Weld 43): 0.3750 in.

Nozzle Wall Thickness(t_n): 0.3370 in.

Outside Groove Weld Depth: 0.3125 in.

Nozzle passes through the vessel, attached by a groove weld.
Pipe Size: 4 Schedule: 80
Nozzle is adequate for UG-45 requirements.
Opening is adequately reinforced for Internal Pressure.
Weld Strength Paths are adequate.

Required Shell Thickness per Paragraph UG-37(a)

$$\mathbf{tr} = \frac{PRo}{SE + 0.4P} = \frac{150.00 * 21.0000}{19700 * 1 + 0.4 * 150.00}$$ = **0.1594** in.

Nozzle Required Thickness Calculations

Required Nozzle Thickness for Internal Pressure per Paragraph UG-37(a)

$$\mathbf{trn} = \frac{PRn}{SE - 0.6P} = \frac{150.00 * 1.9755}{17100 * 1 - 0.6 * 150.00}$$ = **0.0174** in.

Strength Reduction Factors

$r1 = \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{17100}{19700}, 1.0000\right) = 0.8680$ **fr2** $= \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{17100}{19700}, 1.0000\right) = 0.8680$

UG-45 Thickness Calculations

Nozzle Thickness for Pressure Loading (plus corrosion)

$$t_a = \frac{PRn}{SE - 0.6P} + Ca + \text{ext. } Ca = \frac{150.00 * 1.9755}{17100 * 0.85 - 0.6 * 150.00} + 0.0625 + 0.0000$$ = **0.0830** in.

Nozzle Thickness for Internal Pressure (plus corrosion) Based on Host

$$t_{b1} = \frac{PRo}{SE + 0.4P} + Ca + \text{ext. } Ca = \frac{150.00 * 21.0000}{19700 * 1 + 0.4 * 150.00} + 0.0625 + 0.0000$$ = **0.2219** in.

Minimum Thickness (plus corrosion) per Table UG-45

t_{b3} = minimum thickness (Table UG-45) + Ca + ext. Ca = **0.2695** in.

Nozzle Minimum Thickness Based on Host and Table UG-45

$t_b = \min[t_{b3}, \max(t_{b1}, t_{b2})]$ = **0.2219** in.

$t_{UG\text{-}45} = \max(t_a, t_b)$ = **0.2219** in.

Wall thickness = tn * 0.875(pipe) = **0.2950** is greater than or equal to UG-45 value of **0.2219**

Limits of Reinforcement (UG-40)

L_{par} = max(d, R_n + t + t_n) = max(3.9510, 1.9755 + 0.2500 + 0.2745) = **3.9510** in.
L_{noro} = min(2.5 t, 2.5 t_n + t_e) = min(2.5 * 0.2500, 2.5 * 0.2745 + 0.0000) = **0.6250** in.
L_{nori} = min(2.5 t, 2.5 t_i) = min(2.5 * 0.2500, 2.5 * 0.2120) = **0.5300** in.

Nozzle Reinforcement Calculations (Internal Pressure)

A = max{C [d t_r F + 2 t_n t_r F (1 - f_{r1})], 0} = max{1.0000 * [3.9510 * 0.1594 * 1.00 + 2 * 0.2745 * 0.1594 * 1.00 * (1 - 0.8680)], 0}
= **0.6413** sq. in.

A1 = max[(2 L_{par} - d) (E_1 t - F t_r) - 2 t_n (E_1 t - F t_r) (1 - f_{r1}), 0] =
max[(2 * 3.9510 - 3.9510) * (1.0000 * 0.2500 - 1.00 * 0.1594) - 2 * 0.2745 * (1.0000 * 0.2500 - 1.00 * 0.1594) * (1 - 0.8680), 0]
= **0.3514** sq. in.

A2 = max{2 min(h_o, L_{noro}) [min(t_n, L_{par} - 0.5 d) - t_{rn}] f_{r2}, 0} =
max{2 * min(6.0000, 0.6250) * [min(0.2745, 3.9510 - 0.5 * 3.9510) - 0.0174] * 0.8680, 0} = **0.2790** sq. in.

A3 = max{2 min(h, L_{nori}) min(t_i, L_{par} - 0.5 d) f_{r2}, 0} =
max{2 * min(0.9375, 0.5300) * min(0.2120, 3.9510 - 0.5 * 3.9510) * 0.8680, 0} = **0.1951** sq. in.

A41 = f_{r2} [L_{41}^2 - (L_{41} - $L_{41pareff}$)^2 - (L_{41} - $L_{41noreff}$)^2] =
0.8680 * [0.3750^2 - (0.3750 - 0.3750)^2 - (0.3750 - 0.3750)^2] = **0.1221** sq. in.

A42 = f_{r4} $L_{42pareff}$ $L_{42noreff}$ =
0.0000 * 0.0000 * 0.0000 = **0.0000** sq. in.

A43 = f_{r2} [L_{43}^2 - (L_{43} - $L_{43pareff}$)^2 - (L_{43} - $L_{43noreff}$)^2] =
0.8680 * [0.2857^2 - (0.2857 - 0.2857)^2 - (0.2857 - 0.2857)^2] = **0.0709** sq. in.

A5
= **0.0000** sq. in.

Area Available (Internal Pressure) = A1 + A2 + A3 + A41 + A42 + A43 + A5 = 1.0183 sq. in., which is **>=** A (0.6413)

Customer: **UOP Russell LLC**
Vessel Number: 16-251
Number: 4 Mark Number: N4
ID Number: 4

Date Printed: 2/9/2017

Nozzle Design Information

Design Pressure:	150.00	PSI	Design Temperature:	550	°F
Static Head:	0.00	PSI	Nozzle Efficiency (E):	85	%
Nozzle Material:	SA-106 Gr. B		Joint Efficiency (E_1):	1.00	
			Factor B Chart:	CS-2	
External Projection:	5.1875	in.	Allowable Stress at Design Temperature (S_n):	17100	PSI
Internal Projection:	4.2500	in.	Allowable Stress at Ambient Temperature:	17100	PSI
Inside Corrosion Allowance:	0.0625	in.	Correction Factor (F):	1.00	
External Corrosion Allowance:	0.0000	in.	Nozzle Path:	None	
Nozzle Pipe Size:	3		Nozzle Pipe Schedule:	80	
Nozzle ID (new):	2.9000	in.	Nozzle Wall Thickness(new):	0.3000	in.
Nozzle ID (corroded):	3.0250	in.	Nozzle Wall Thickness(corroded):	0.2375	in.
Developed Opening:	3.0240	in.	Tangential Dimension L:	10.5000	in.
External Limit of Reinforcement:	0.4688	in.	Upper Weld Leg Size(Weld 41):	0.3750	in.
Internal Limit of Reinforcement:	0.4375	in.	Internal Weld Leg Size(Weld 43):	0.3750	in.
Parallel Limit of Reinf (2Lpar):	6.3082	in.	Outside Groove Weld Depth:	0.3125	in.

Minimum Design Metal Temperature

Min. Temp. Curve:	B	Pressure at MDMT:	150.00 PSI
UCS-66(b) reduction:	No	Minimum Design Metal Temperature:	-20 °F
UCS-68(c) reduction:	No	Computed Minimum Temperature:	-20 °F

Host Component: Head 2 - Head 2

Material:	SA-516 Gr. 70	Head wall thickness(new):	0.3125 in.
Material Stress(S_v):	19700 PSI	Head wall thickness - thin out (corroded):	0.1875 in.

Nozzle Detail Information

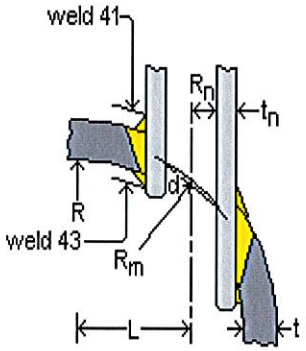


Fig. UW-16.1 (c)

Upper Weld Leg Size(Weld 41): 0.3750 in.

Internal Weld Leg Size(Weld 43): 0.3750 in.

Nozzle Wall Thickness(t_n): 0.3000 in.

Outside Groove Weld Depth: 0.3125 in.

tangential to the vessel wall, attached by a groove weld.
Pipe Size: 3 Schedule: 80
Nozzle is adequate for UG-45 requirements.
Opening is adequately reinforced for Internal Pressure.
Weld Strength Paths are adequate.

Required Head Thickness per Paragraph UG-37(a)

$$\mathbf{tr} = \frac{P\ K1\ Do}{(2SE + 0.8P)} = \frac{150.00 * 0.9000 * 42.0000}{(2 * 19700 * 1 + 0.8 * 150.00)}$$ = **0.1435** in.

Nozzle Required Thickness Calculations

Required Nozzle Thickness for Internal Pressure per Paragraph UG-37(a)

$$\mathbf{trn} = \frac{PRn}{SE - 0.6P} = \frac{150.00 * 1.5125}{17100 * 1 - 0.6 * 150.00}$$ = **0.0133** in.

Strength Reduction Factors

$r1 = \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{17100}{19700}, 1.0000\right) = 0.8680$ **fr2** $= \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{17100}{19700}, 1.0000\right) = 0.8680$

UG-45 Thickness Calculations

Nozzle Thickness for Pressure Loading (plus corrosion)

$$t_a = \frac{PRn}{SE - 0.6P} + Ca + ext.\ Ca = \frac{150.00 * 1.5125}{17100 * 0.85 - 0.6 * 150.00} + 0.0625 + 0.0000$$ = **0.0782** in.

Nozzle Thickness for Internal Pressure (plus corrosion) Based on Host

$$t_{b1} = \frac{P\ K\ Do}{(2SE + 2P(K - 0.1))} + Ca + ext.\ Ca = \frac{150.00 * 1.0000 * 42.0000}{(2 * 19700 * 1 + 2 * 150.00 * (1.0000 - 0.1))} + 0.0625 + 0.0000$$ = **0.2213** in.

Minimum Thickness (plus corrosion) per Table UG-45

t_{b3} = minimum thickness (Table UG-45) + Ca + ext. Ca = **0.2515** in.

Nozzle Minimum Thickness Based on Host and Table UG-45

$t_b = \min[t_{b3}, \max(t_{b1}, t_{b2})]$ = **0.2213** in.

$t_{UG\text{-}45} = \max(t_a, t_b)$ = **0.2213** in.

Wall thickness = tn * 0.875(pipe) = **0.2620** is greater than or equal to UG-45 value of **0.2213**

Limits of Reinforcement (UG-40)

L_{par} = max(d, R_n + t + t_n) = max(3.1541, 1.5125 + 0.1875 + 0.2375) = **3.1541** in.
L_{noro} = min(2.5 t, 2.5 t_n + t_e) = min(2.5 * 0.1875, 2.5 * 0.2375 + 0.0000) = **0.4688** in.
L_{nori} = min(2.5 t, 2.5 t_i) = min(2.5 * 0.1875, 2.5 * 0.1750) = **0.4375** in.

Nozzle Reinforcement Calculations (Internal Pressure)

A = max{C [d t_r F + 2 t_n t_r F (1 - f_{r1})], 0} = max{1.0000 * [3.1541 * 0.1435 * 1.00 + 2 * 0.2375 * 0.1435 * 1.00 * (1 - 0.8680)], 0}
= **0.4616** sq. in.

A1 = max[(2 L_{par} - d) (E_1 t - F t_r) - 2 t_n (E_1 t - F t_r) (1 - f_{r1}), 0] =
max[(2 * 3.1541 - 3.1541) * (1.0000 * 0.1875 - 1.00 * 0.1435) - 2 * 0.2375 * (1.0000 * 0.1875 - 1.00 * 0.1435) * (1 - 0.8680), 0]
= **0.1360** sq. in.

A2 = max{2 min(h_o, L_{noro}) [min(t_n, L_{par} - 0.5 d) - t_{rn}] f_{r2}, 0} =
max{2 * min(5.1875, 0.4688) * [min(0.2375, 3.1541 - 0.5 * 3.1541) - 0.0133] * 0.8680, 0} = **0.1824** sq. in.

A3 = max{2 min(h, L_{nori}) min(t_i, L_{par} - 0.5 d) f_{r2}, 0} =
max{2 * min(4.1875, 0.4375) * min(0.1750, 3.1541 - 0.5 * 3.1541) * 0.8680, 0} = **0.1329** sq. in.

A41 = f_{r2} [L_{41}^2 - (L_{41} - $L_{41pareff}$)^2 - (L_{41} - $L_{41noreff}$)^2] =
0.8680 * [0.3750^2 - (0.3750 - 0.3750)^2 - (0.3750 - 0.3750)^2] = **0.1221** sq. in.

A42 = f_{r4} $L_{42pareff}$ $L_{42noreff}$ =
0.0000 * 0.0000 * 0.0000 = **0.0000** sq. in.

A43 = f_{r2} [L_{43}^2 - (L_{43} - $L_{43pareff}$)^2 - (L_{43} - $L_{43noreff}$)^2] =
0.8680 * [0.2857^2 - (0.2857 - 0.2857)^2 - (0.2857 - 0.2857)^2] = **0.0709** sq. in.

A5
= **0.0000** sq. in.

Area Available (Internal Pressure) = A1 + A2 + A3 + A41 + A42 + A43 + A5 = 0.6443 sq. in., which is **>=** A (0.4616)

Customer: **UOP Russell LLC**
Vessel Number: 16-251
Number: 5 Mark Number: N5
ID Number: 5

Date Printed: 2/9/2017

Nozzle Design Information

Design Pressure:	150.00	PSI	Design Temperature:	550	°F
Static Head:	0.00	PSI	Nozzle Efficiency (E):	85	%
Nozzle Material:	SA-106 Gr. B		Joint Efficiency (E_1):	1.00	
			Factor B Chart:	CS-2	
External Projection:	7.0000	in.	Allowable Stress at Design Temperature (S_n):	17100	PSI
Internal Projection:	0.0000	in.	Allowable Stress at Ambient Temperature:	17100	PSI
Inside Corrosion Allowance:	0.0625	in.	Correction Factor (F):	1.00	
External Corrosion Allowance:	0.0000	in.	Nozzle Path:	None	
Nozzle Pipe Size:	4		Nozzle Pipe Schedule:	80	
Nozzle ID (new):	3.8260	in.	Nozzle Wall Thickness(new):	0.3370	in.
Nozzle ID (corroded):	3.9510	in.	Nozzle Wall Thickness(corroded):	0.2745	in.
External Limit of Reinforcement:	0.6250	in.	Upper Weld Leg Size(Weld 41):	0.3750	in.
Internal Limit of Reinforcement:	0.5300	in.	Internal Weld Leg Size(Weld 43):	0.0000	in.
Parallel Limit of Reinf (2Lpar):	7.9020	in.	Outside Groove Weld Depth:	0.3125	in.

Minimum Design Metal Temperature

Min. Temp. Curve:	B	Pressure at MDMT:	150.00 PSI
UCS-66(b) reduction:	No	Minimum Design Metal Temperature:	-20 °F
UCS-68(c) reduction:	No	Computed Minimum Temperature:	-20 °F

Host Component: Shell 1 - Shell 1

Material:	SA-516 Gr. 70	Shell wall thickness(new):	0.3125 in.
Material Stress(S_v):	19700 PSI	Shell wall thickness(corroded):	0.2500 in.

Nozzle Detail Information

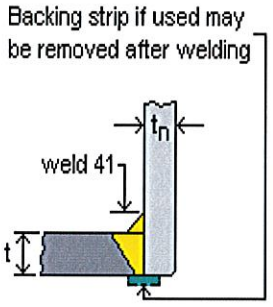


Fig. UW-16.1 (c)

Upper Weld Leg Size(Weld 41): 0.3750 in.

Nozzle Wall Thickness(t_n): 0.3370 in.

Outside Groove Weld Depth: 0.3125 in.

Nozzle passes through the vessel, attached by a groove weld.
Pipe Size: 4 Schedule: 80
Nozzle is adequate for UG-45 requirements.
Opening is adequately reinforced for Internal Pressure.
Weld Strength Paths are adequate.

Required Shell Thickness per Paragraph UG-37(a)

$$\mathbf{tr} = \frac{PRo}{SE + 0.4P} = \frac{150.00 * 21.0000}{19700 * 1 + 0.4 * 150.00}$$ = **0.1594** in.

Nozzle Required Thickness Calculations

Required Nozzle Thickness for Internal Pressure per Paragraph UG-37(a)

$$\mathbf{trn} = \frac{PRn}{SE - 0.6P} = \frac{150.00 * 1.9755}{17100 * 1 - 0.6 * 150.00}$$ = **0.0174** in.

Strength Reduction Factors

$r1 = \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{17100}{19700}, 1.0000\right) = 0.8680$ **fr2** $= \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{17100}{19700}, 1.0000\right) = 0.8680$

UG-45 Thickness Calculations

Nozzle Thickness for Pressure Loading (plus corrosion)

$$t_a = \frac{PRn}{SE - 0.6P} + Ca + \text{ext. } Ca = \frac{150.00 * 1.9755}{17100 * 0.85 - 0.6 * 150.00} + 0.0625 + 0.0000$$ = **0.0830** in.

Nozzle Thickness for Internal Pressure (plus corrosion) Based on Host

$$t_{b1} = \frac{PRo}{SE + 0.4P} + Ca + \text{ext. } Ca = \frac{150.00 * 21.0000}{19700 * 1 + 0.4 * 150.00} + 0.0625 + 0.0000$$ = **0.2219** in.

Minimum Thickness (plus corrosion) per Table UG-45

t_{b3} = minimum thickness (Table UG-45) + Ca + ext. Ca = **0.2695** in.

Nozzle Minimum Thickness Based on Host and Table UG-45

$t_b = \min[t_{b3}, \max(t_{b1}, t_{b2})]$ = **0.2219** in.

$t_{UG\text{-}45} = \max(t_a, t_b)$ = **0.2219** in.

Wall thickness = tn * 0.875(pipe) = **0.2950** is greater than or equal to UG-45 value of **0.2219**

Limits of Reinforcement (UG-40)

L_{par} = max(d, R_n + t + t_n) = max(3.9510, 1.9755 + 0.2500 + 0.2745) = **3.9510** in.
L_{noro} = min(2.5 t, 2.5 t_n + t_e) = min(2.5 * 0.2500, 2.5 * 0.2745 + 0.0000) = **0.6250** in.
L_{nori} = min(2.5 t, 2.5 t_i) = min(2.5 * 0.2500, 2.5 * 0.2120) = **0.5300** in.

Nozzle Reinforcement Calculations (Internal Pressure)

A = max{C [d t_r F + 2 t_n t_r F (1 - f_{r1})], 0} = max{1.0000 * [3.9510 * 0.1594 * 1.00 + 2 * 0.2745 * 0.1594 * 1.00 * (1 - 0.8680)], 0}
= **0.6413** sq. in.

A1 = max[(2 L_{par} - d) (E_1 t - F t_r) - 2 t_n (E_1 t - F t_r) (1 - f_{r1}), 0] =
max[(2 * 3.9510 - 3.9510) * (1.0000 * 0.2500 - 1.00 * 0.1594) - 2 * 0.2745 * (1.0000 * 0.2500 - 1.00 * 0.1594) * (1 - 0.8680), 0]
= **0.3514** sq. in.

A2 = max{2 min(h_o, L_{noro}) [min(t_n, L_{par} - 0.5 d) - t_{rn}] f_{r2}, 0} =
max{2 * min(7.0000, 0.6250) * [min(0.2745, 3.9510 - 0.5 * 3.9510) - 0.0174] * 0.8680, 0} = **0.2790** sq. in.

A3 = max{2 min(h, L_{nori}) min(t_i, L_{par} - 0.5 d) f_{r2}, 0} =
max{2 * min(0.0000, 0.5300) * min(0.2120, 3.9510 - 0.5 * 3.9510) * 0.8680, 0} = **0.0000** sq. in.

A41 = f_{r2} [L_{41}^2 - (L_{41} - $L_{41pareff}$)^2 - (L_{41} - $L_{41noreff}$)^2] =
0.8680 * [0.3750^2 - (0.3750 - 0.3750)^2 - (0.3750 - 0.3750)^2] = **0.1221** sq. in.

A42 = f_{r4} $L_{42pareff}$ $L_{42noreff}$ =
0.0000 * 0.0000 * 0.0000 = **0.0000** sq. in.

A43 = f_{r2} $L_{43pareff}$ $L_{43noreff}$ =
0.8680 * 0.0000 * 0.0000 = **0.0000** sq. in.

A5
= **0.0000** sq. in.

Area Available (Internal Pressure) = A1 + A2 + A3 + A41 + A42 + A43 + A5 = 0.7524 sq. in., which is **>=** A (0.6413)

HEATEC, INC.

3/4" Level Gauge Connection

Customer: **UOP Russell LLC**
Vessel Number: 16-251
Number: 6 Mark Number: N6
ID Number: 6

Date Printed: 2/9/2017

Nozzle Design Information

Design Pressure:	150.00	PSI	Design Temperature:	550	°F
Static Head:	0.00	PSI	Nozzle Efficiency (E):	85	%
Nozzle Material:	SA-106 Gr. B		Joint Efficiency (E_1):	1.00	
			Factor B Chart:	CS-2	
External Projection:	8.0000	in.	Allowable Stress at Design Temperature (S_n):	17100	PSI
Internal Projection:	1.2500	in.	Allowable Stress at Ambient Temperature:	17100	PSI
Inside Corrosion Allowance:	0.0625	in.	Correction Factor (F):	1.00	
External Corrosion Allowance:	0.0000	in.	Nozzle Path:	None	
Nozzle Pipe Size:	3/4		Nozzle Pipe Schedule:	160	
Nozzle ID (new):	0.6120	in.	Nozzle Wall Thickness(new):	0.2190	in.
Nozzle ID (corroded):	0.7370	in.	Nozzle Wall Thickness(corroded):	0.1565	in.
Developed Opening:	0.8290	in.	Tangential Dimension L:	18.1875	in.
External Limit of Reinforcement:	0.3913	in.	Upper Weld Leg Size(Weld 41):	0.2500	in.
Internal Limit of Reinforcement:	0.2350	in.	Internal Weld Leg Size(Weld 43):	0.2500	in.
Parallel Limit of Reinf (2Lpar):	1.9884	in.	Outside Groove Weld Depth:	0.3125	in.

Minimum Design Metal Temperature

Min. Temp. Curve:	B	Pressure at MDMT:	150.00 PSI
UCS-66(b) reduction:	No	Minimum Design Metal Temperature:	-20 °F
UCS-68(c) reduction:	No	Computed Minimum Temperature:	-20 °F

Host Component: Head 1 - Head 1

Material:	SA-516 Gr. 70	Head wall thickness(new):	0.3125 in.
Material Stress(S_v):	19700 PSI	Head wall thickness - thin out (corroded):	0.1875 in.

Nozzle Detail Information

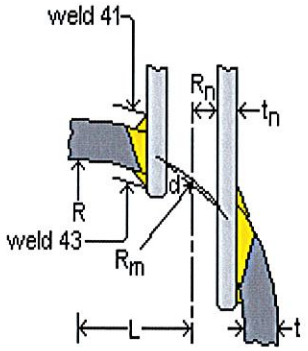


Fig. UW-16.1 (c)

Upper Weld Leg Size(Weld 41): 0.2500 in.

Internal Weld Leg Size(Weld 43): 0.2500 in.

Nozzle Wall Thickness(t_n): 0.2190 in.

Outside Groove Weld Depth: 0.3125 in.

tangential to the vessel wall, attached by a groove weld.
Pipe Size: 3/4 Schedule: 160
Nozzle is adequate for UG-45 requirements.
Opening is adequately reinforced for Internal Pressure.
Weld Strength Paths are adequate.

Required Head Thickness per Paragraph UG-37(a)

$$\mathbf{tr} = \frac{P\ K1\ Do}{(2SE + 0.8P)} = \frac{150.00 * 0.9000 * 42.0000}{(2 * 19700 * 1 + 0.8 * 150.00)}$$ = **0.1435** in.

Nozzle Required Thickness Calculations

Required Nozzle Thickness for Internal Pressure per Paragraph UG-37(a)

$$\mathbf{trn} = \frac{PRn}{SE - 0.6P} = \frac{150.00 * 0.3685}{17100 * 1 - 0.6 * 150.00}$$ = **0.0032** in.

Strength Reduction Factors

$r1 = \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{17100}{19700}, 1.0000\right) = 0.8680$ **fr2** $= \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{17100}{19700}, 1.0000\right) = 0.8680$

UG-45 Thickness Calculations

Nozzle Thickness for Pressure Loading (plus corrosion)

$$t_a = \frac{PRn}{SE - 0.6P} + Ca + \text{ext. } Ca = \frac{150.00 * 0.3685}{17100 * 0.85 - 0.6 * 150.00} + 0.0625 + 0.0000$$ = **0.0663** in.

Nozzle Thickness for Internal Pressure (plus corrosion) Based on Host

$$t_{b1} = \frac{P\ K\ Do}{(2SE + 2P(K - 0.1))} + Ca + \text{ext. } Ca = \frac{150.00 * 1.0000 * 42.0000}{(2 * 19700 * 1 + 2 * 150.00 * (1.0000 - 0.1))} + 0.0625 + 0.0000$$ = **0.2213** in.

Minimum Thickness (plus corrosion) per Table UG-45

t_{b3} = minimum thickness (Table UG-45) + Ca + ext. Ca = **0.1615** in.

Nozzle Minimum Thickness Based on Host and Table UG-45

$t_b = \min[t_{b3}, \max(t_{b1}, t_{b2})]$ = **0.1615** in.

$t_{UG\text{-}45} = \max(t_a, t_b)$ = **0.1615** in.

Wall thickness = tn * 0.875(pipe) = **0.1920** is greater than or equal to UG-45 value of **0.1615**

Limits of Reinforcement (UG-40)

L_{par} = max(d, R_n + t + t_n) = max(0.9942, 0.3685 + 0.1875 + 0.1565) = **0.9942** in.
L_{noro} = min(2.5 t, 2.5 t_n + t_e) = min(2.5 * 0.1875, 2.5 * 0.1565 + 0.0000) = **0.3913** in.
L_{nori} = min(2.5 t, 2.5 t_i) = min(2.5 * 0.1875, 2.5 * 0.0940) = **0.2350** in.

Nozzle Reinforcement Calculations (Internal Pressure)

A = max{C [d t_r F + 2 t_n t_r F (1 - f_{r1})], 0} = max{1.0000 * [0.9942 * 0.1435 * 1.00 + 2 * 0.1565 * 0.1435 * 1.00 * (1 - 0.8680)], 0}
= **0.1486** sq. in.

A1 = max[(2 L_{par} - d) (E_1 t - F t_r) - 2 t_n (E_1 t - F t_r) (1 - f_{r1}), 0] =
max[(2 * 0.9942 - 0.9942) * (1.0000 * 0.1875 - 1.00 * 0.1435) - 2 * 0.1565 * (1.0000 * 0.1875 - 1.00 * 0.1435) * (1 - 0.8680), 0]
= **0.0419** sq. in.

A2 = max{2 min(h_o, L_{noro}) [min(t_n, L_{par} - 0.5 d) - t_{rn}] f_{r2}, 0} =
max{2 * min(8.0000, 0.3913) * [min(0.1565, 0.9942 - 0.5 * 0.9942) - 0.0032] * 0.8680, 0} = **0.1041** sq. in.

A3 = max{2 min(h, L_{nori}) min(t_i, L_{par} - 0.5 d) f_{r2}, 0} =
max{2 * min(1.1875, 0.2350) * min(0.0940, 0.9942 - 0.5 * 0.9942) * 0.8680, 0} = **0.0383** sq. in.

A41 = f_{r2} [L_{41}^2 - (L_{41} - $L_{41pareff}$)^2 - (L_{41} - $L_{41noreff}$)^2] =
0.8680 * [0.2500^2 - (0.2500 - 0.2500)^2 - (0.2500 - 0.2500)^2] = **0.0543** sq. in.

A42 = f_{r4} $L_{42pareff}$ $L_{42noreff}$ =
0.0000 * 0.0000 * 0.0000 = **0.0000** sq. in.

A43 = f_{r2} [L_{43}^2 - (L_{43} - $L_{43pareff}$)^2 - (L_{43} - $L_{43noreff}$)^2] =
0.8680 * [0.1607^2 - (0.1607 - 0.1607)^2 - (0.1607 - 0.1607)^2] = **0.0224** sq. in.

A5
= **0.0000** sq. in.

Area Available (Internal Pressure) = A1 + A2 + A3 + A41 + A42 + A43 + A5 = 0.2611 sq. in., which is **>=** A (0.1486)

Customer: **UOP Russell LLC**
Vessel Number: 16-251
Number: 7 Mark Number: N7
ID Number: 7

Date Printed: 2/9/2017

Nozzle Design Information

Design Pressure:	150.00	PSI	Design Temperature:	550	°F
Static Head:	0.00	PSI	Nozzle Efficiency (E):	85	%
Nozzle Material:	SA-106 Gr. B		Joint Efficiency (E_1):	1.00	
			Factor B Chart:	CS-2	
External Projection:	7.0000	in.	Allowable Stress at Design Temperature (S_n):	17100	PSI
Internal Projection:	0.0000	in.	Allowable Stress at Ambient Temperature:	17100	PSI
Inside Corrosion Allowance:	0.0625	in.	Correction Factor (F):	1.00	
External Corrosion Allowance:	0.0000	in.	Nozzle Path:	None	
Nozzle Pipe Size:	2		Nozzle Pipe Schedule:	160	
Nozzle ID (new):	1.6870	in.	Nozzle Wall Thickness(new):	0.3440	in.
Nozzle ID (corroded):	1.8120	in.	Nozzle Wall Thickness(corroded):	0.2815	in.
External Limit of Reinforcement:	0.6250	in.	Upper Weld Leg Size(Weld 41):	0.3750	in.
Internal Limit of Reinforcement:	0.5475	in.	Internal Weld Leg Size(Weld 43):	0.0000	in.
Parallel Limit of Reinf (2Lpar):	3.6240	in.	Outside Groove Weld Depth:	0.3125	in.

Minimum Design Metal Temperature

Min. Temp. Curve:	B	Pressure at MDMT:	150.00 PSI
UCS-66(b) reduction:	No	Minimum Design Metal Temperature:	-20 °F
UCS-68(c) reduction:	No	Computed Minimum Temperature:	-20 °F

Host Component: Shell 1 - Shell 1

Material:	SA-516 Gr. 70	Shell wall thickness(new):	0.3125 in.
Material Stress(S_v):	19700 PSI	Shell wall thickness(corroded):	0.2500 in.

Nozzle Detail Information

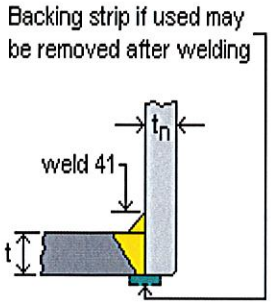


Fig. UW-16.1 (c)

Upper Weld Leg Size(Weld 41): 0.3750 in.

Nozzle Wall Thickness(t_n): 0.3440 in.

Outside Groove Weld Depth: 0.3125 in.

Nozzle passes through the vessel, attached by a groove weld.
Pipe Size: 2 Schedule: 160
Nozzle is adequate for UG-45 requirements.
Opening is adequately reinforced for Internal Pressure.
Weld Strength Paths are adequate.

Required Shell Thickness per Paragraph UG-37(a)

$$\mathbf{tr} = \frac{PRo}{SE + 0.4P} = \frac{150.00 * 21.0000}{19700 * 1 + 0.4 * 150.00}$$ = **0.1594** in.

Nozzle Required Thickness Calculations

Required Nozzle Thickness for Internal Pressure per Paragraph UG-37(a)

$$\mathbf{trn} = \frac{PRn}{SE - 0.6P} = \frac{150.00 * 0.9060}{17100 * 1 - 0.6 * 150.00}$$ = **0.0080** in.

Strength Reduction Factors

$r1 = \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{17100}{19700}, 1.0000\right) = 0.8680$ **fr2** $= \min\left(\frac{Sn}{Sv}, 1.0000\right) = \min\left(\frac{17100}{19700}, 1.0000\right) = 0.8680$

UG-45 Thickness Calculations

Nozzle Thickness for Pressure Loading (plus corrosion)

$$t_a = \frac{PRn}{SE - 0.6P} + Ca + \text{ext. } Ca = \frac{150.00 * 0.9060}{17100 * 0.85 - 0.6 * 150.00} + 0.0625 + 0.0000$$ = **0.0719** in.

Nozzle Thickness for Internal Pressure (plus corrosion) Based on Host

$$t_{b1} = \frac{PRo}{SE + 0.4P} + Ca + \text{ext. } Ca = \frac{150.00 * 21.0000}{19700 * 1 + 0.4 * 150.00} + 0.0625 + 0.0000$$ = **0.2219** in.

Minimum Thickness (plus corrosion) per Table UG-45

t_{b3} = minimum thickness (Table UG-45) + Ca + ext. Ca = **0.1975** in.

Nozzle Minimum Thickness Based on Host and Table UG-45

$t_b = \min[t_{b3}, \max(t_{b1}, t_{b2})]$ = **0.1975** in.

$t_{UG\text{-}45} = \max(t_a, t_b)$ = **0.1975** in.

Wall thickness = tn * 0.875(pipe) = **0.3010** is greater than or equal to UG-45 value of **0.1975**

Limits of Reinforcement (UG-40)

L_{par} = max(d, R_n + t + t_n) = max(1.8120, 0.9060 + 0.2500 + 0.2815) = **1.8120** in.
L_{noro} = min(2.5 t, 2.5 t_n + t_e) = min(2.5 * 0.2500, 2.5 * 0.2815 + 0.0000) = **0.6250** in.
L_{nori} = min(2.5 t, 2.5 t_i) = min(2.5 * 0.2500, 2.5 * 0.2190) = **0.5475** in.

Nozzle Reinforcement Calculations (Internal Pressure)

A = max{C [d t_r F + 2 t_n t_r F (1 - f_{r1})], 0} = max{1.0000 * [1.8120 * 0.1594 * 1.00 + 2 * 0.2815 * 0.1594 * 1.00 * (1 - 0.8680)], 0}
= **0.3007** sq. in.

A1 = max[(2 L_{par} - d) (E_1 t - F t_r) - 2 t_n (E_1 t - F t_r) (1 - f_{r1}), 0] =
max[(2 * 1.8120 - 1.8120) * (1.0000 * 0.2500 - 1.00 * 0.1594) - 2 * 0.2815 * (1.0000 * 0.2500 - 1.00 * 0.1594) * (1 - 0.8680), 0]
= **0.1574** sq. in.

A2 = max{2 min(h_o, L_{noro}) [min(t_n, L_{par} - 0.5 d) - t_{rn}] f_{r2}, 0} =
max{2 * min(7.0000, 0.6250) * [min(0.2815, 1.8120 - 0.5 * 1.8120) - 0.0080] * 0.8680, 0} = **0.2968** sq. in.

A3 = max{2 min(h, L_{nori}) min(t_i, L_{par} - 0.5 d) f_{r2}, 0} =
max{2 * min(0.0000, 0.5475) * min(0.2190, 1.8120 - 0.5 * 1.8120) * 0.8680, 0} = **0.0000** sq. in.

A41 = f_{r2} [L_{41}^2 - (L_{41} - $L_{41pareff}$)^2 - (L_{41} - $L_{41noreff}$)^2] =
0.8680 * [0.3750^2 - (0.3750 - 0.3750)^2 - (0.3750 - 0.3750)^2] = **0.1221** sq. in.

A42 = f_{r4} $L_{42pareff}$ $L_{42noreff}$ =
0.0000 * 0.0000 * 0.0000 = **0.0000** sq. in.

A43 = f_{r2} $L_{43pareff}$ $L_{43noreff}$ =
0.8680 * 0.0000 * 0.0000 = **0.0000** sq. in.

A5
= **0.0000** sq. in.

Area Available (Internal Pressure) = A1 + A2 + A3 + A41 + A42 + A43 + A5 = 0.5763 sq. in., which is **>=** A (0.3007)

HEATEC, INC.

Lifting Lug 1

Customer: **UOP Russell LLC**
Vessel Number: 16-251
Mark Number: LL1

Date Printed: 2/9/2017

Lifting Lug Information

Material:	SA-516 Gr. 70		Design Temperature:	100	°F
Condition:			Material Stress (Hot):	20000	PSI
Type:	Type 2		Material Stress (Cold):	20000	PSI
Length (L):	8.0000	in.	Yield Strength:	38000	PSI
Thickness:	0.3750	in.	Radius:	3.0000	in.
Weld Joint Efficiency:	45	%	Weld Leg:	0.3750	in.
Shackle Hole Diameter:	3.0000	in.	Shackle Hole Centerline Height:	3.7500	in.
Foot Height(h):	0.0625	in.	Angle (θ):	14	°

Vessel Information

Material:	SA-516 Gr. 70		Design Temperature:	100	°F
Condition:			Material Stress (Hot):	19700	PSI
Radius:	21.0000	in.	Material Stress (Cold):	20000	PSI
Thickness:	0.3125	in.	Yield Strength:	30050	PSI
Vertical Lift Angle:	45	°	Impact Factor:	1.50	
Weight:	1900.00	lb.			

Design Calculations

$$W_i = \frac{W * I}{2} = \frac{1900.00 * 1.50}{2}$$ **= 1425**

Vertical Lift Force, $F_v = W_i = 1425$ **= 1425** lb.

Horizontal Lift Force, $F_h = W_i * \tan(\theta) = 1425 * \tan(45)$ **= 1425** lb.

Total Lift Force, $F_t = \sqrt{v^2 + F_h^2} = \sqrt{1425^2 + 1425^2}$ **= 2015** lb.

Lug Stress Calculation

$$S_l = \frac{F_t}{T * (2 * r' - d)} = \frac{2015}{0.3750 * (2 * 3.0000 - 3.0000)}$$ **= 1791** PSI

Shear Stress Ratio, $S_{rl} = \frac{S_l}{0.4 * S_{ly}} = \frac{1791}{0.4 * 38000}$ **= 0.1178**

Vessel Stress Calculations

$Z_l = (T * L) + (L^2 / 6) = (0.3750 * 8.0000) + (8.0000^2 / 6)$ **= 13.6667** sq. in.

$M_l = F_h * (H + r) = 1425 * (3.7500 + 1.5000)$ **= 7481** in.-lb.

$$f_1 = \frac{M_l}{Z_l} = \frac{7481}{13.6667}$$ **= 547.4** lb.

$S_1 = 1.17 * \sqrt{R_m * T_v} * (f_1 / T_v^2) = 1.17 * \sqrt{(20.8438 * 0.3125)} * (547.4 / 0.3125^2)$ **= 16738** PSI

$L_{eff} = L + T = 8.0000 + 0.3750$ **= 8.3750** in.

$$f_3 = \frac{F_t}{L_{eff}} = \frac{2015}{8.3750}$$ **= 240.6** lb./in.

$$S_3 = 1.75 * \sqrt{R_m * T_v} * \frac{f_3}{T_v^2} = 1.75 * \sqrt{(20.8438 * 0.3125)} * \frac{240.6}{0.3125^2}$$ **= 11004** PSI

$S_v = S_1 + S_3 = 16738 + 11004$ **= 27742** PSI

Vessel Stress Ratio, $S_{rv} = \frac{S_v}{2 * S_{va}} = \frac{27742}{2 * 19700}$ **= 0.7041**

Lug Weld Calculations

$L_{wl} = 2 * (L + T) = 2 * (8.0000 + 0.3750)$ **= 16.7500** in.

$$Z_{wl} = (T * L) + \frac{L^2}{3} = (0.3750 * 8.0000) + \frac{8.0000^2}{3}$$ **= 24.3333** sq. in.

$$f_1 = \frac{M_l}{Z_{wl}} = \frac{7481}{24.3333}$$ **= 307.4** lb./in.

$$f_2 = \frac{F_h}{L_{wl}} = \frac{1425}{16.7500}$$ **= 85.1** lb./in.

$$f_3 = \frac{F_v}{L_{wl}} = \frac{1425}{16.7500}$$ **= 85.1** lb./in.

$f = \sqrt{((f_1 + f_3)^2 + f_2^2)} = \sqrt{((307.4 + 85.1)^2 + 85.1^2)}$ **= 401.6** lb./in.

$f_w = E * \min(S_{la}, S_{va}) = 0.45 * \min(20000, 19700)$ **= 8865** PSI

$$W_{La} = \frac{f}{f_w} = \frac{401.6}{8865}$$ **= 0.0453** in.

Lug Weld Leg Ratio, $W_{LRl} = \frac{W_{La}}{W_L} = \frac{0.0453}{0.3750}$ **= 0.1208**

Saddle Design Information

Design Temperature:	550	°F	Support Type:	Type II	
Material:	SA-36		Stiffener Quantity:	2	
Condition:			Material Stress (hot):	16600	PSI
Length (d):	36.3731	in.	Material Stress (cold):	16600	PSI
Top Width (b'):	6.5625	in.	Yield Strength:	28450	PSI
Bottom Width ($b_{b'}$):	6.5625	in.	Density:	0.2800	lb/in.^3
Outside Stiffener Thickness (t_{so}):	0.2500	in.	Web Plate Thickness (t_w):	0.2500	in.
Inside Stiffener Thickness (t_{si}):	0.2500	in.	Vessel Centerline Height (h):	36.7500	in.
Saddle Angle of contact (θ):	120.0	°	Elevation above grade (g):	0.0000	in.
t. from saddle centerline to tang. line (A):	7.7500	in.			
Support Design Condition:	Shell stiffened by heads (A/R <= 1/2)				

Base Plate Information

Design Temperature:	550	°F	Ultimate 28 Day Concrete Strength:	3000.00	PSI
Material:	SA-36		Yield Strength:	28450	PSI
Condition:			Length (m):	39.0000	in.
Width (b_b):	6.5625	in.	Thickness (t_b):	0.5000	in.

Anchor Bolt Information

Material:	SA-193 Gr. B5		Material Stress (hot):	20000	PSI
Condition:			Material Stress (cold):	20000	PSI
Size:	1/2"		Number of Threads per in. :	13.0000	
Quantity:	2		Root Area:	0.1260	sq. in.
Anchor bolt slot width:	0.7500	in.	Slot Length:	1.1220	in.
ing saddle to support longitudinal Loads:	Yes				
oeff. of thermal exp. from 70° to MDMT:	6.40	10^-6 in/in/°F			
eff. therm. exp. from 70° to design temp:	7.30	10^-6 in/in/°F			

ASME Flange Design Information

Host	Description	Type	Size (in.)	Material	ASME Class	Material Group	MAP (PSI)
3" Fill Connection	3" 150#	Slip On	3	SA-105	150	1.1	155.00
3" 150#	3" 150#	Blind	3	SA-105	150	1.1	155.00
4" Relief Valve Connec	4" 300#	Slip On	4	SA-105	300	1.1	587.50
4" Inlet / Outlet Conn	4" 300#	Slip On	4	SA-105	300	1.1	587.50
2" Drain Connection	2" 300#	Slip On	2	SA-105	300	1.1	587.50
4" Inlet / Outlet Conn	4" 300#	Slip On	4	SA-105	300	1.1	587.50
3" Level Switch Connec	3" 300#	Slip On	3	SA-105	300	1.1	587.50

Loading Summary

Type	Starting Point (in.)	Ending Point (in.)	Depth (in.)	Density (lb./Ft^3)	Wind Diameter (in.)
Liquid	-	-	42.0000	75.0000	-

Zick Analysis

ASCE 7-10 Wind Design Information

Basic Wind Speed (V): 90 MPH

ASCE 7-10 Seismic Design Information

0.2 s Spectral Response Accel (S_S):	0.250	1 s Spectral Response Accel. (S_1):	0.100
Response Modification Factor (R):	2.000		
Occupancy/Risk Category:	IV	Site Class:	D
Seismic Design Category:	D		

Operating Pressurized Condition - Sustained Loads

Saddle Support Loads

$$Q_L = \frac{F_L h}{L - 2A} = \frac{0 * 36.7500}{86.0000 - 2 * 7.7500}$$ = **0** lb.

$$Q_T = \frac{1.5\ F_T\ h}{d} = \frac{1.5\ * 0 * 36.7500}{36.3731}$$ = **0** lb.

$$Q_W = \frac{W}{2} = \frac{7187}{2}$$ = **3594** lb.

$Q_N = Q_W = 3594$ = **3594** lb.

Saddle Load for Vessel Stress Analysis

$Q = Q_N = 3594$ = **3594** lb.

Saddle Load for Support Stress Analysis

$Q_S = Q_N = 3594$ = **3594** lb.

Zick Calculations

Longitudinal Stress Due to Internal Pressure

$$S_p = \frac{P\,R}{2\,t} = \frac{150.00 * 20.8750}{2 * 0.2500}$$ = **6263** PSI

Longitudinal Compressive Stress Due to External Pressure

$$S_{pe} = \frac{-P_e\,R}{2\,t} = \frac{-0.00 * 20.8750}{2 * 0.2500}$$ = **0** PSI

Longitudinal Bending Stress in the Shell at the Midpoint

$Z_1 = \pi\,R^2\,t = 3.1416 * 20.8750^2 * 0.2500$ = **342** in.^{3}

$$S_1 = \frac{K_1\,Q\,L}{4\,Z_1} = \frac{0.57252 * 3594 * 86.0000}{4 * 342}$$ = **129** PSI

Longitudinal Bending Stress in the Shell in the Plane of the Saddle

$$S_1' = \frac{K_1'\,Q\,L}{4\,Z_1} = \frac{0.00421 * 3594 * 86.0000}{4 * 342}$$ = **1** PSI

Saddle Plane Tangential Shear Stress

$$S_2 = \frac{K_2\,Q}{R\,t} = \frac{0.87996 * 3594}{20.8750 * 0.2500}$$ = **606** PSI

$$S_{2H} = \frac{K_2\,Q}{R\,t_H} = \frac{0.87996 * 3594}{20.8750 * 0.1875}$$ = **808** PSI

Circumferential Stress at the Horn of the Saddle

$$S_3 = -\left[\frac{Q}{4\,t\,(b + 1.56\sqrt{R\,t})}\right] - \left[\frac{12\,K_3\,Q\,R}{L\,t^2}\right]$$

$$= -\left[\frac{3594}{4 * 0.2500 * (6.5625 + 1.56 * \sqrt{20.8750 * 0.2500})}\right] - \left[\frac{12 * 0.01321 * 3594 * 20.8750}{86.0000 * 0.2500^2}\right]$$

= **-2568** PSI

Additional Stresses in Head Used as a Stiffener

$$S_4 = \frac{K_4\,Q}{R\,t_H} = \frac{0.40107 * 3594}{20.8750 * 0.1875}$$ = **368** PSI

Ring Compression in the Shell Over the Saddle

$$S_5 = \frac{K_5\, Q}{t\,(b + 1.56\sqrt{R\,t})} = \frac{0.76027 * 3594}{0.2500 * (0.2500 + 1.56 * \sqrt{20.8750 * 0.2500})}$$ = **2866** PSI

Maximum Splitting Force

$F_S = K_8 Q_S = 0.20352 * 3594$ = **731** lb.

Saddle Calculations

Base Plate Stress

$$S_{BP} = \Omega \frac{0.75\, Q_s\, b_b}{m\, t_b^2} = 2 \frac{0.75 * 3594 * 6.5625}{39.0000 * 0.5000^2}$$ = **3629** PSI

Concrete Bearing Stress

$$S_C = \Omega \frac{Q_s}{b_b\, m} = 2 \frac{3594}{6.5625 * 39.0000}$$ = **28** PSI

Saddle Splitting Force

$$S_{T\ Splitting} = \frac{F_S}{A_{Saddle}} = \frac{731}{7.0938}$$ = **103** PSI

$$M_{\ Splitting} = F_S \left[h - C_2 - R_W \left(\frac{\sin(\theta/2)}{\theta/2} \right) \right] = 731 * \left[36.7500 - 4.4824 - 21.0000 * \left(\frac{\sin(1.0472)}{1.0472} \right) \right]$$ = **10892** in.-lb.

$$S_{B\ Splitting} = \frac{M\, C_1}{I} = \frac{10892 * 11.2676}{183.3211}$$ = **669** PSI

Bolting Shear Stress

$$S_b = \Omega \frac{F_{Bolt}}{N_b\, A_b} = 2 \frac{0}{2 * 0.1260}$$ = **0** PSI

Saddle Support Stiffener Stresses

Location	Length in.	Compressive Stress PSI	Bending Stress PSI	Allowable Stress PSI	Stress Ratio R_{ST}
Outside	25.7500	293	0	17070	0.0172

Vessel Stress Ratio Calculations

Any ratio greater than 1 represents an overstressed condition

$$R_{1t} = \frac{S_1 + S_p}{S_{Shell}\, E} = \frac{129 + 6263}{19700 * 0.65} = \mathbf{0.4991}$$

$$R_{1C} = \frac{-S_1}{-\,Min(S_{Shell}, B_{Shell})} = \frac{-129}{-Min(19700,10116)} = \mathbf{0.0128}$$

$$R_{1t}' = \frac{S_1' + S_p}{S_{Shell}\, E} = \frac{1 + 6263}{19700 * 0.65} = \mathbf{0.4891}$$

$$R_{1C}' = \frac{-S_1'}{-\,Min(S_{Shell}, B_{Shell})} = \frac{-1}{-Min(19700,10116)} = \mathbf{0.0001}$$

$$R_2 = \frac{S_2}{0.8\, S_{Shell}} = \frac{606}{0.8 * 19700} = \mathbf{0.0385}$$

$$R_{2H} = \frac{S_{2H}}{0.8\, S_{Head}} = \frac{808}{0.8 * 19700} = \mathbf{0.0513}$$

$$R_3 = \frac{S_3}{-\,(1.25\, S_{Shell})} = \frac{-2568}{-\,(1.25 * 19700)} = \mathbf{0.1043}$$

$$R_4 = \frac{S_4 + S_{pH}}{1.25\, S_{Head}} = \frac{368 + 19606}{1.25 * 19700} = \mathbf{0.8111}$$

$$R_5 = \frac{S_5}{0.5\, Y_{Shell}} = \frac{2866}{0.5 * 30050} = \mathbf{0.1907}$$

Saddle Stress Ratio Calculations

Any ratio greater than 1 represents an overstressed condition

$$R_{Base\ Plate} = \frac{S_{BP}}{0.6\ Y_{Base\ Plate}} = \frac{3629}{0.6 * 28450} = \mathbf{0.2126}$$

$$R_{Concrete} = \frac{S_C}{0.25\ S_{Concrete}} = \frac{28}{0.25 * 3000} = \mathbf{0.0373}$$

$$R_{Web} = \frac{S_{T\ Splitting}}{0.6\ Y_{Saddle}} + \frac{S_{B\ Splitting}}{0.66\ Y_{Saddle}} = \frac{103}{0.6 * 28450} + \frac{669}{0.66 * 28450} = \mathbf{0.0417}$$

$$R_{ST} = \frac{S_{stc} + S_{stb}}{0.6\ Y_{Saddle}} = \frac{293 + 0}{0.6 * 28450} = \mathbf{0.0172}$$

$$R_{Bolt} = \frac{S_B}{0.8\ S_{Ba}} = \frac{0}{0.8 * 20000} = \mathbf{0.0000}$$

MDMT Report by Components
Design MDMT is -20 °F

Component	Material	Curve	Pressure	MDMT
Shell 1	SA-516 Gr. 70	B	150.00 PSI	-20 °F
4" Relief Valve Connection	SA-106 Gr. B	B	150.00 PSI	-20 °F
Threaded Coupling - 1"	SA-105	B	150.00 PSI	-20 °F
2" Drain Connection	SA-106 Gr. B	B	150.00 PSI	-20 °F
4" Inlet / Outlet Connection	SA-106 Gr. B	B	150.00 PSI	-20 °F
4" Inlet / Outlet Connection	SA-106 Gr. B	B	150.00 PSI	-20 °F
3" Fill Connection	SA-106 Gr. B	B	150.00 PSI	-20 °F
Head 2	SA-516 Gr. 70	B	150.00 PSI	-20 °F
3" Level Switch Connecion	SA-106 Gr. B	B	150.00 PSI	-20 °F
Head 1	SA-516 Gr. 70	B	150.00 PSI	-20 °F
3/4" Level Gauge Connection	SA-106 Gr. B	B	150.00 PSI	-20 °F
3/4" Level Gauge Connection	SA-106 Gr. B	B	150.00 PSI	-20 °F

Component with highest MDMT: Shell 1.

Computed MDMT = -20 °F

The required design MDMT of -20 °F has been met or exceeded for the calculated MDMT values.

ASME Flanges Are Not Included in MDMT Calculations.

MAWP Report by Components

Component	Design Pressure	Static Head	Vessel MAWP New & Cold UG-98(a)	Component MAWP Hot & Corroded UG-98(b)	Vessel MAWP Hot & Corroded UG-98(a)
Shell 1	150.00 PSI	0.00 PSI	209.58 PSI	163.06 PSI	163.06 PSI
Threaded Coupling - 1"	150.00 PSI	0.00 PSI	299.44 PSI	193.48 PSI	193.48 PSI
3" Fill Connection	150.00 PSI	0.00 PSI	299.44 PSI	201.24 PSI	201.24 PSI
ASME Flange Class: 150 Gr:1.1	150.00 PSI	0.00 PSI	285.00 PSI	155.00 PSI	155.00 PSI
ASME Flange Class: 150 Gr:1.1	00 PSI	0.00 PSI	285.00 PSI	155.00 PSI	155.00 PSI
4" Relief Valve Connection	150.00 PSI	0.00 PSI	283.26 PSI	194.43 PSI	194.43 PSI
ASME Flange Class: 300 Gr:1.1	150.00 PSI	0.00 PSI	740.00 PSI	587.50 PSI	587.50 PSI
4" Inlet / Outlet Connection	150.00 PSI	0.00 PSI	212.95 PSI	163.06 PSI	163.06 PSI
ASME Flange Class: 300 Gr:1.1	150.00 PSI	0.00 PSI	740.00 PSI	587.50 PSI	587.50 PSI
2" Drain Connection	150.00 PSI	0.00 PSI	299.44 PSI	220.82 PSI	220.82 PSI
ASME Flange Class: 300 Gr:1.1	150.00 PSI	0.00 PSI	740.00 PSI	587.50 PSI	587.50 PSI
4" Inlet / Outlet Connection	150.00 PSI	0.00 PSI	212.95 PSI	163.06 PSI	163.06 PSI
ASME Flange Class: 300 Gr:1.1	150.00 PSI	0.00 PSI	740.00 PSI	587.50 PSI	587.50 PSI
Head 1	150.00 PSI	0.00 PSI	204.57 PSI	150.72 PSI	150.72 PSI
3/4" Level Gauge Connection	150.00 PSI	0.00 PSI	266.01 PSI	196.26 PSI	196.26 PSI
3/4" Level Gauge Connection	150.00 PSI	0.00 PSI	266.01 PSI	196.26 PSI	196.26 PSI
Head 2	150.00 PSI	0.00 PSI	204.57 PSI	150.72 PSI	150.72 PSI
3" Level Switch Connecion	150.00 PSI	0.00 PSI	266.01 PSI	180.09 PSI	180.09 PSI
ASME Flange Class: 300 Gr:1.1	150.00 PSI	0.00 PSI	740.00 PSI	587.50 PSI	587.50 PSI

NC = Not Calculated Inc = Incomplete

Summary

Component with the lowest vessel MAWP(New & Cold) : **Head 1**
The lowest vessel MAWP(New & Cold) : **204.57** PSI

Component with the lowest vessel MAWP(Hot & Corroded) : **Head 1**
The lowest vessel MAWP(Hot & Corroded) : **150.72** PSI

Pressures are exclusive of any external loads.

Flange pressures listed here do not consider external loadings

Summary Information

	Dry Weight	Flooded Weight
Shell	939.67 lb.	4927.31 lb.
Head	377.33 lb.	1241.08 lb.
Nozzle	45.75 lb.	45.75 lb.
ASME Flange	103.00 lb.	103.00 lb.
Totals	1465.76 lb.	6317.14 lb.

	Volume
Shell	477.33 Gal.
Head	103.57 Gal.
Nozzle	1.92 Gal.
Totals	582.81 Gal.

	Area
Shell	75.14 Sq. Ft.
Head	29.95 Sq. Ft.
Nozzle	4.44 Sq. Ft.
Totals	109.52 Sq. Ft.

Hydrostatic Test Information Par. UG-99(b)
Gauge at Top

Component	Const.	x	STest	/	SDesign	x	Pressure	=	Component Hydro Test Pressure
2" Drain Connection	1.3	x	17100	/	17100	x	150.00	=	**195.00**
3" Fill Connection	1.3	x	17100	/	17100	x	150.00	=	195.00
3" Level Switch Connec	1.3	x	17100	/	17100	x	150.00	=	195.00
3/4" Level Gauge Conne	1.3	x	17100	/	17100	x	150.00	=	195.00
3/4" Level Gauge Conne	1.3	x	17100	/	17100	x	150.00	=	195.00
4" Inlet / Outlet Conn	1.3	x	17100	/	17100	x	150.00	=	195.00
4" Inlet / Outlet Conn	1.3	x	17100	/	17100	x	150.00	=	195.00
4" Relief Valve Connec	1.3	x	17100	/	17100	x	150.00	=	195.00
Head 1	1.3	x	20000	/	19700	x	150.00	=	197.97
Head 2	1.3	x	20000	/	19700	x	150.00	=	197.97
Shell 1	1.3	x	20000	/	19700	x	150.00	=	197.97
Threaded Coupling - 1"	1.3	x	20000	/	19000	x	150.00	=	205.26

Calculated Test Pressure: 195.00 PSI

Special Notes:

This calculation assumes one chamber.

This calculation is limited by the lowest component pressure per chamber.

HEATEC INC
P.O. BOX 72760 CHATTANOOGA, TN 37407
5200 WILSON ROAD CHATTANOOGA, TN 37410

SHOP TRAVELER

SECTION VIII, DIV.1

JOB # 16-251A - EXPANSION TANK

H=HOLD POINT

W=WITNESS POINT

QC Reviewed: Chim Cox 2/15/17

AI Reviewed: L. Allgood 2-15-17

Operation	QC H or W Points	AI H or W Points	QC Manager	Date	Authorized Inspector	Remarks	Date
Calculations	H	H	C.Cox	2/15/17	L. Allgood		2-15-17
Drawings	H	H	C.Cox	2/15/17	L. Allgood		2-15-17
Material(Ordered)							
Material(Received)							
Material Test Reports	H	H	C.Cox	2/23/17	L. Allgood		3-30-17
Final Internal	H	H	C.Cox	3/23/17	L. Allgood		3-23-17
~~MT of Spin Holes~~	H	H					
Transfer Heat Numbers	H		C.Cox	2/24/17			
Fit-up 2nd HEAD		H			L. Allgood		3-24-17
Weld Seam Alignment							
Joint Preparation							
PWHT							
NDE: RT MT PT UT							
~~RT: 1 2 3 4~~ None							
* Hydrotest @ 195 psi	H	H	C.Cox	3/30/17	L. Allgood		3-30-17
Test Gauge # HEA-106 DUE-11/4/17	H	H	C.Cox	3/30/17	L. Allgood		3-30-17
Final Inspection	H	H	C.Cox	3/30/17	L. Allgood		3-30-17
Data Report/s	H	H	C.Cox	3/30/17	L. Allgood		3-30-17
Shipped							

Remarks * ACTUAL HYDROTEST PRESSURE 205 psi.
QC Chim Cox 3/30/17

Notes

NCR# | AI ACCEPTANCE: | AI CLOSURE:

Control Services, Inc.

4729 Adams Road, Hixson, TN 37343
www.controlservicesTN.com

Certificate of Calibration

Traceable to NIST

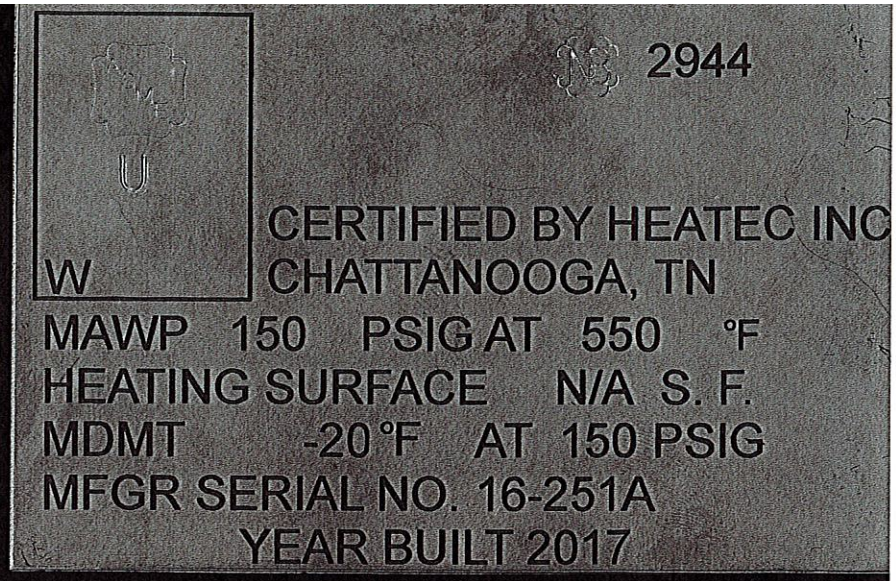
Customer	*HEATEC, INC.*	**ID Number**	HEA-106
Address	*5200 WILSON ROAD*	**Description**	4.5" PROCESS GAUGE
City	*CHATTANOOGA*		
State, Zip	*TN 37410*	**Manufacturer**	MARSH
NIST Number	20136HEA-106	**Model Number**	P5660F 02
As Found	IN TOLERANCE	**Serial Number**	NONE
As Left	IN TOLERANCE	**Range**	0-400 PSI
Standard(s)	CRYSTAL DIGITAL TEST GAUGE	**Accuracy**	+/- 1.0% FS
		Calibration Date	11/4/2016
Serial No.(s)	307001	**Due Date**	11/4/2017
		Calibration Frequency	12 MONTHS

This instrument has been certified utilizing working standards with accuracies traceable to the National Institute of Standards and Technology, derived from natural physical constants, derived from ratio measurements or compared to consensus standards. All working standards used for certification are supported by a calibration system and quality control system that meets or exceeds the requirements of ANSI/NCSL Z540-1 and ISO/IEC 17025. The reported data is valid only at the time of the test and related only to the item calibrated. Calibration due dates are determined by the cliet and do not imply continued conformance to specifications. This certificate shall not be reproduced except in full, without written permission of Control Services, Inc.

Findings:

Applied Standard	Minimum Allowed	Maximum Allowed	AsFound	AsLeft	Difference (as left)
50.0 PSI	46.0	54.0	50.1	50.1	0.1
200.0 PSI	196.0	204.0	197.2	197.2	-2.8
350.0 PSI	346.0	354.0	347.0	347.0	-3.0

Calibrated by: _____


U
W
2944
CERTIFIED BY HEATEC INC
CHATTANOOGA, TN
MAWP 150 PSIG AT 550 °F
HEATING SURFACE N/A S. F.
MDMT -20°F AT 150 PSIG
MFGR SERIAL NO. 16-251A
YEAR BUILT 2017

HYDROSTATIC/AIR TEST REPORT

Job #: 16-257-65/CPHSP Customer: UOP RUSSELL LLC

Date: 5-1-17 Test Medium: WATER (Air/Water)

Item: CIRCULATION PUMP HEATER SPOOL Gauge #: HEA-71401 Due Date: 9-23-17

INNER VESSEL TEST PRESSURE

_____PSIG

Hold Time: _____ Test Results Acceptable: ☐ Yes ☐ No

Tested by: _____ Date: _____

Witnessed by: _____ Date: _____

Cust. Inspector: _____ Date: _____

OUTER VESSEL TEST PRESSURE

195 PSIG Actual Pressure 205 psi. QC ChimCat 5/1/17

Hold Time: 1hr Test Results Acceptable: ☑ Yes ☐ No

Tested by: EGuffey & CSTACY Date: 5-1-17

Witnessed by: ChimCat Date: 5/1/17

PIPE COIL: PIG/S REMOVED FROM PIPE COIL: ☐ Yes ☐ No

Verified by: _____ Date: _____

GAS TRAINS

_____PSIG

Hold Time: _____ Test Results Acceptable: ☐ Yes ☐ No

Tested by: _____ Date: _____

Witnessed by: _____ Date: _____

This form must be completed for all pipe and gas trains in all departments. Once completed, turn the form into the QC Department for review and filing.

Heatec, Inc.
5200 Wilson Road
Chattanooga, TN 37410
423-821-5200

Control Services, Inc.

4729 Adams Road, Hixson, TN 37343
www.controlservicesTN.com

Certificate of Calibration

Traceable to NIST

Customer	*HEATEC, INC.*	**ID Number**	HEA-71401
Address	*5200 WILSON ROAD*	**Description**	4.5" PRESSURE GAUGE
City	*CHATTANOOGA*		
State, Zip	*TN 37410*	**Manufacturer**	MARSH
NIST Number	20079HEA-71401	**Model Number**	P0560
As Found	IN TOLERANCE	**Serial Number**	NONE
As Left	IN TOLERANCE	**Range**	0-400 PSI
Standard(s)	CRYSTAL DIGITAL TEST GAUGE	**Accuracy**	+/- 1.0% FS
		Calibration Date	9/23/2016
Serial No.(s)	307001	**Due Date**	9/23/2017
		Calibration Frequency	12 MONTHS

This instrument has been certified utilizing working standards with accuracies traceable to the National Institute of Standards and Technology, derived from natural physical constants, derived from ratio measurements or compared to consensus standards. All working standards used for certification are supported by a calibration system and quality control system that meets or exceeds the requirements of ANSI/NCSL Z540-1 and ISO/IEC 17025. The reported data is valid only at the time of the test and related only to the item calibrated. Calibration due dates are determined by the cliet and do not imply continued conformance to specifications. This certificate shall not be reproduced except in full, without written permission of Control Services, Inc.

Findings:

Applied Standard	Minimum Allowed	Maximum Allowed	AsFound	AsLeft	Difference (as left)
50.0 PSI	46.0	54.0	51.1	51.1	1.1
200.0 PSI	196.0	204.0	200.0	200.0	0.0
350.0 PSI	346.0	354.0	352.6	352.6	2.6

Calibrated by: _____

HYDROSTATIC/AIR TEST REPORT

Job #: 16-251-651 PSP Customer: VOP RUSSELL LLC

Date: 5-1-17 Test Medium: WATER
(Air/Water)

Item: CIRCULATION PUMP Gauge #: HEA-7401 Due Date: 9-23-17

SPOOLS #1
#2(X2)
#3(X2)
#4

INNER VESSEL TEST PRESSURE

_____PSIG

Hold Time: _____ Test Results Acceptable: ☐ Yes ☐ No

Tested by: _____ Date: _____

Witnessed by: _____ Date: _____

Cust. Inspector: _____ Date: _____

OUTER VESSEL TEST PRESSURE

195 PSIG

ACTUAL PRESSURE
205 psi.
QC Chim Cot 5/1/17

Hold Time: 1hr Test Results Acceptable: ☑ Yes ☐ No

Tested by: EGuffey & CSTACY Date: 5-1-17

Witnessed by: Chim Cot Date: 5/1/17

PIPE COIL: PIG/S REMOVED FROM PIPE COIL: ☐ Yes ☐ No

Verified by: _____ Date: _____

GAS TRAINS

_____PSIG

Hold Time: _____ Test Results Acceptable: ☐ Yes ☐ No

Tested by: _____ Date: _____

Witnessed by: _____ Date: _____

This form must be completed for all pipe and gas trains in all departments. Once completed, turn the form into the QC Department for review and filing.

Heatec, Inc.
5200 Wilson Road
Chattanooga, TN 37410
423-821-5200

Control Services, Inc.

4729 Adams Road, Hixson, TN 37343
www.controlservicesTN.com

Certificate of Calibration

Traceable to NIST

Customer	*HEATEC, INC.*	**ID Number**	HEA-71401
Address	*5200 WILSON ROAD*	**Description**	4.5" PRESSURE GAUGE
City	*CHATTANOOGA*		
State, Zip	*TN 37410*	**Manufacturer**	MARSH
NIST Number	20079HEA-71401	**Model Number**	P0560
As Found	IN TOLERANCE	**Serial Number**	NONE
As Left	IN TOLERANCE	**Range**	0-400 PSI
Standard(s)	CRYSTAL DIGITAL TEST GAUGE	**Accuracy**	+/- 1.0% FS
		Calibration Date	9/23/2016
Serial No.(s)	307001	**Due Date**	9/23/2017
		Calibration Frequency	12 MONTHS

This instrument has been certified utilizing working standards with accuracies traceable to the National Institute of Standards and Technology, derived from natural physical constants, derived from ratio measurements or compared to consensus standards. All working standards used for certification are supported by a calibration system and quality control system that meets or exceeds the requirements of ANSI/NCSL Z540-1 and ISO/IEC 17025. The reported data is valid only at the time of the test and related only to the item calibrated. Calibration due dates are determined by the cliet and do not imply continued conformance to specifications. This certificate shall not be reproduced except in full, without written permission of Control Services, Inc.

Findings:

Applied Standard	Minimum Allowed	Maximum Allowed	AsFound	AsLeft	Difference (as left)
50.0 PSI	46.0	54.0	51.1	51.1	1.1
200.0 PSI	196.0	204.0	200.0	200.0	0.0
350.0 PSI	346.0	354.0	352.6	352.6	2.6

Calibrated by: _____

HYDROSTATIC/AIR TEST REPORT

Job #: 16-251-E+TSP 3 Customer: UOP Russell LLC.

Date: 5-4-17 Test Medium: water (Air/Water)

Item: Exp. Tank Tower SPOOL 3 Gauge #: HEA-66901 Due Date: 12/12/17

INNER VESSEL TEST PRESSURE

_____PSIG

Hold Time: _____ Test Results Acceptable: ☐ Yes ☐ No

Tested by: _____ Date: _____

Witnessed by: _____ Date: _____

Cust. Inspector: _____ Date: _____

OUTER VESSEL TEST PRESSURE

ACTUAL PRESSURE 215 psi. Q.C. Chris Cof 5/4/17

195 PSIG

Hold Time: 1hr. Test Results Acceptable: ☑ Yes ☐ No

Tested by: C. Stacy Date: 5-4-17

Witnessed by: Chris Cof Date: 5/4/17

PIPE COIL: PIG/S REMOVED FROM PIPE COIL: ☐ Yes ☐ No

Verified by: _____ Date: _____

GAS TRAINS

_____PSIG

Hold Time: _____ Test Results Acceptable: ☐ Yes ☐ No

Tested by: _____ Date: _____

Witnessed by: _____ Date: _____

This form must be completed for all pipe and gas trains in all departments. Once completed, turn the form into the QC Department for review and filing.

Heatec, Inc.
5200 Wilson Road
Chattanooga, TN 37410
423-821-5200

Control Services, Inc.

4729 Adams Road, Hixson, TN 37343
www.controlservicesTN.com

Certificate of Calibration

Traceable to NIST

Customer	*HEATEC, INC.*	**ID Number**	HEA-60901
Address	*5200 WILSON ROAD*	**Description**	4.5" PROCESS GAUGE
City	*CHATTANOOGA*		
State, Zip	*TN 37410*	**Manufacturer**	MARSH
NIST Number	20187HEA-60901	**Model Number**	P5664
As Found	OUT OF TOLERANCE	**Serial Number**	NONE
As Left	IN TOLERANCE	**Range**	0-600 PSI
Standard(s)	CRYSTAL DIGITAL TEST GAUGE	**Accuracy**	+/- 1.0% F.S.
		Calibration Date	12/12/2016
Serial No.(s)	307001	**Due Date**	12/12/2017
		Calibration Frequency	12 MONTHS

This instrument has been certified utilizing working standards with accuracies traceable to the National Institute of Standards and Technology, derived from natural physical constants, derived from ratio measurements or compared to consensus standards. All working standards used for certification are supported by a calibration system and quality control system that meets or exceeds the requirements of ANSI/NCSL Z540-1 and ISO/IEC 17025. The reported data is valid only at the time of the test and related only to the item calibrated. Calibration due dates are determined by the cliet and do not imply continued conformance to specifications. This certificate shall not be reproduced except in full, without written permission of Control Services, Inc.

Findings: FOUND OUT OF TOLERANCE, ADJUSTMENTS WERE REQUIRED.

Applied Standard	Minimum Allowed	Maximum Allowed	AsFound	AsLeft	Difference (as left)
50.0 PSI	44.0	56.0	66.0	53.8	3.8
300.0 PSI	294.0	306.0	322.0	297.3	-2.7
550.0 PSI	544.0	556.0	566.5	551.4	1.4

Calibrated by: _____

HYDROSTATIC/AIR TEST REPORT

HEATEC® an Aztec Company

Job #: 16-251-551 Customer: UOP Russell LLC

Date: 4-24-17 Test Medium: Air (Air/Water)

Item: Pilot/Main Gas Train Gauge #: HEA- 099 Due Date: 11/4/17

INNER VESSEL TEST PRESSURE

_____PSIG

Hold Time: _____ Test Results Acceptable: ☐ Yes ☐ No

Tested by: _____ Date: _____

Witnessed by: _____ Date: _____

Cust. Inspector: _____ Date: _____

OUTER VESSEL TEST PRESSURE

_____PSIG

Hold Time: _____ Test Results Acceptable: ☐ Yes ☐ No

Tested by: _____ Date: _____

Witnessed by: _____ Date: _____

PIPE COIL: PIG/S REMOVED FROM PIPE COIL: ☐ Yes ☐ No

Verified by: _____ Date: _____

GAS TRAINS

12 PSIG (MAIN) 120 INCHES W/C

Hold Time: 1HR Test Results Acceptable: ☒ Yes ☐ No

Tested by: J. WILLIAMS/B STRECK Date: 4-24-17

Witnessed by: Chris Cox Date: 4/24/17

This form must be completed for all pipe and gas trains in all departments. Once completed, turn the form into the QC Department for review and filing.

Heatec, Inc.
5200 Wilson Road
Chattanooga, TN 37410
423-821-5200
1-800-235-5200

Control Services, Inc.

4729 Adams Road, Hixson, TN 37343
www.controlservicesTN.com

Certificate of Calibration

Traceable to NIST

Customer	*HEATEC, INC.*	**ID Number**	HEA-099
Address	*5200 WILSON ROAD*	**Description**	4.5" PROCESS GAUGE
City	*CHATTANOOGA*		
State, Zip	*TN 37410*	**Manufacturer**	MIREUR
NIST Number	20136HEA-099	**Model Number**	PH
As Found	IN TOLERANCE	**Serial Number**	NONE
As Left	IN TOLERANCE	**Range**	0-30 PSI
Standard(s)	OLYMPIC DIGITAL TEST GAUGE	**Accuracy**	+/- 1.0% FS
		Calibration Date	11/4/2016
Serial No.(s)	12254	**Due Date**	11/4/2017
		Calibration Frequency	12 MONTHS

This instrument has been certified utilizing working standards with accuracies traceable to the National Institute of Standards and Technology, derived from natural physical constants, derived from ratio measurements or compared to consensus standards. All working standards used for certification are supported by a calibration system and quality control system that meets or exceeds the requirements of ANSI/NCSL Z540-1 and ISO/IEC 17025. The reported data is valid only at the time of the test and related only to the item calibrated. Calibration due dates are determined by the cliet and do not imply continued conformance to specifications. This certificate shall not be reproduced except in full, without written permission of Control Services, Inc.

Findings:

Applied Standard	Minimum Allowed	Maximum Allowed	AsFound	AsLeft	Difference (as left)
3.0 PSI	2.7	3.3	3.04	3.04	0.04
15.0 PSI	14.7	15.3	14.95	14.95	-0.05
27.0 PSI	26.7	27.3	26.90	26.90	-0.1

Calibrated by: _____

HYDROSTATIC/AIR TEST REPORT

Job #: 16-25/652 ETTSP Customer: UOP RUSSELL LLC

Date: 5-1-17 Test Medium: WATER (Air/Water)

Item: TANK TOWER SPOOLS X2 Gauge #: HEA-7140 Due Date: 9-23-17

INNER VESSEL TEST PRESSURE

_____PSIG

Hold Time: _____ Test Results Acceptable: ☐ Yes ☐ No

Tested by: _____ Date: _____

Witnessed by: _____ Date: _____

Cust. Inspector: _____ Date: _____

OUTER VESSEL TEST PRESSURE

Actual Pressure 205psi. Q.C. Chin Cat. 5/1/17

195 PSIG

Hold Time: 1hr Test Results Acceptable: ☑ Yes ☐ No

Tested by: EGuffey & CSTACY Date: 5-1-17

Witnessed by: Chin Cat Date: 5/1/17

PIPE COIL: PIG/S REMOVED FROM PIPE COIL: ☐ Yes ☐ No

Verified by: _____ Date: _____

GAS TRAINS

_____PSIG

Hold Time: _____ Test Results Acceptable: ☐ Yes ☐ No

Tested by: _____ Date: _____

Witnessed by: _____ Date: _____

This form must be completed for all pipe and gas trains in all departments. Once completed, turn the form into the QC Department for review and filing.

Heatec, Inc.
5200 Wilson Road
Chattanooga, TN 37410
423-821-5200

Control Services, Inc.

4729 Adams Road, Hixson, TN 37343
www.controlservicesTN.com

Certificate of Calibration

Traceable to NIST

Customer	*HEATEC, INC.*	**ID Number**	HEA-71401
Address	*5200 WILSON ROAD*	**Description**	4.5" PRESSURE GAUGE
City	*CHATTANOOGA*		
State, Zip	*TN 37410*	**Manufacturer**	MARSH
NIST Number	20079HEA-71401	**Model Number**	P0560
As Found	IN TOLERANCE	**Serial Number**	NONE
As Left	IN TOLERANCE	**Range**	0-400 PSI
Standard(s)	CRYSTAL DIGITAL TEST GAUGE	**Accuracy**	+/- 1.0% FS
		Calibration Date	9/23/2016
Serial No.(s)	307001	**Due Date**	9/23/2017
		Calibration Frequency	12 MONTHS

This instrument has been certified utilizing working standards with accuracies traceable to the National Institute of Standards and Technology, derived from natural physical constants, derived from ratio measurements or compared to consensus standards. All working standards used for certification are supported by a calibration system and quality control system that meets or exceeds the requirements of ANSI/NCSL Z540-1 and ISO/IEC 17025. The reported data is valid only at the time of the test and related only to the item calibrated. Calibration due dates are determined by the cliet and do not imply continued conformance to specifications. This certificate shall not be reproduced except in full, without written permission of Control Services, Inc.

Findings:

Applied Standard	Minimum Allowed	Maximum Allowed	AsFound	AsLeft	Difference (as left)
50.0 PSI	46.0	54.0	51.1	51.1	1.1
200.0 PSI	196.0	204.0	200.0	200.0	0.0
350.0 PSI	346.0	354.0	352.6	352.6	2.6

Calibrated by: _____

16-251-251-555

INDUSTRIAL VALVE

NEW VALVE TEST REPORT

Mobile, AL

2008 rev.3 Revised 06/16/2016

Form No.62

Date: 1/26/2017

Customer: HEATEC,INC.

Plant: CHATTANOOGA,TN

P.O. No. ~~113600~~ V0456F

Job No. 601749263 Item No. 1

VALVE DATA: PSV No. N/A Equip. No. N/A

Manufacturer CROSBY ASME Cert #: 15208

Model Number: 2 H 3 JBS-E-35-J S/N: 6017492631

Valve Size: 2" X H X 3"

Set Pressure: 150 PSIG Spring No.: X36080

Back Pressure: N/A PSIG Spring Range: 143-161.9

C.D.T.P. 151.5 PSIG Service: Vapor Op. Temp 400 F

Cold Set for Heat Compensation: 151.5 PSIG ☐N/A

ASME Capacity: 2523 SCFM Code Stamp UV

Inlet: RF Outlet: RF Cap: Plain

Body Material: Carbon Steel Trim Material: Stainlees Steel

FINAL TEST DATA:

Test Media: Air

Cold Diff. Test Pressure: 151.5 PSIG

B.P. Test: Yes @ 30 PSIG Gauge No. S9 Gauge No. S10

Final Set Pressure: 150 PSIG

All measurements directly tracable to standards maintained by the NIST through use of calibrated instruments identified above. Values are certified correct to within +- 1.0% of full scale.

Close @ N/A Tested By: STEPHEN MAYERS Date: 1/26/2017

Tight @ 136 PSIG Witnessed and Final Inspected By: RICKY SPRATT Date: 1/26/2017

Comments:

INDUSTRIAL VALVE

CERTIFICATE OF COMPLIANCE

Customer: Heatec, Inc.

IVSS Job #: 601749263

Customer PO #: I13600

Date: 1-26-17

Be advised that all materials furnished on the above purchase order is OEM material and in accordance with Industrial Valve quality program at 5310 Highway 45 Eight Mile, AL 36613 and in strict compliance with manufacturers and National Board specifications. All materials supplied are new and unused and have been purchase from the manufacturer or from the manufacturer's representative in accordance with NBIC23. Part3, S7.5 Paragraph C. All pressure retaining parts have been pressure tested in accordance with the provisions of the National Board NBIC23, Section 4.5.4.

C.I.: Jay Williams

SECTION 5
SYSTEM
COMPONENTS

SYSTEM COMPONENT INDEX

A.HEATER

- Ashcroft Gauge 45-1279
- Ashcroft Thermometer
- Ashcroft Thermowell
- Pyromation Thermocouple
- US H122K Pressure Switch

B.BURNER

- Burner Technical Documents
- Allanson Ignition Transformer
- Dwyer DP Switch
- Triac Actuator WEY-500 Series

C.GAS TRAIN

- ASCO Actuator AH2E
- ASCO Gas Valve V710
- ASCO Solenoid Valve 8215
- Ashcroft Gauge 25-1490A
- Conbraco 60 Series Valve Needle
- Fisher Regulator 133H
- Fisher Relief Valve 289H
- Mueller Y-Strainer 581
- Resun Plug Valve 1430
- UE J400 Pressure Switch

D.PUMP

- Apollo Valve Ball 76
- Dean Pump R4000 Series
- Durabla Check Valve
- Kunkle Relief Valve
- Mueller 782 Strainer
- Vogt Valves

E.EXPANSION TANK

- Apollo Valve Ball 73
- Fisher Regulator 67CFR
- Fisher Regulator 98H
- Inferno Level Gauge 15A
- Inferno Level Gauge RA
- Magnesonic Level Switch MLS

F.ELECTRICAL

- Eclipse Ignition Transformer
- Federal Signal Horn Model 350WB
- Federal Signal Vibra-Tone Horn 350
- Fireye Annunciator YZ-300
- Fireye Burner Logix YB110
- Fireye Burner Mgm Base 129-178-4
- Fireye Burner Mgmt Display BLV512
- Fireye Flame Scanner 45UV5
- Fireye Interconnecting Cable ED580
- Fireye Programmer Module YP138
- Fireye Wiring Base 60-2814-1
- Fireye Wiring Base 60-2874-1
- Hoffman Back Panel CP Series
- Hoffman CMFK Foot Mounting Kit Installation
- Hoffman Enclosure CSD12126SS
- Hoffman Enclosure CSD483612SS
- Hoffman Window Kit AWDH Series
- Siemens 3TG10 Mini Contactor
- Siemens ED Frame Circuit Breakers
- Siemens Rotary Handle
- UT35A-DIC Operation Guide
- UT55A-DIC Operation Guide

ASHCROFT®

Type 1279 Duragauge® Pressure Gauge Available With *PLUS!™* Performance Option

- *Solid front case design, field convertible to hermetically sealed or liquid filled style*
- *Pressure ranges from vacuum — 30,000 psi.*
- *Select from various socket and Bourdon tube materials.*
- *Micrometer adjustable pointer.*
- *400 Series stainless steel movement wears better for longer life*
- *Teflon-coated pinion for longer life*
- *Patented Duratube™ with welded-tube construction controls stresses for longer life*
- *PLUS!™ Performance Option:*
  - *Liquid-filled performance in a dry gauge*
  - *Fights vibration and pulsations without liquid-filled headaches*
  - *Order as option XLL*

The Ashcroft® Duragauge® pressure gauge is the finest production gauge on the market for industrial use where precise indications are required. The product line offers a wide variety of case styles, Bourdon tubes and pressure ranges to meet your application needs .

With the component combinations available in the Duragauge gauge line, over ten million variations are possible to serve the needs of all types of industries, including process, power, nuclear, aerospace and cryogenics.

PRODUCT SPECIFICATIONS

Model Number:	1279
Accuracy:	½% full scale (Grade 2A, ASME B40.100)
Ranges:	Vac., compound to 30,000 psi
Dial Size:	4½″ diameter
Case Material:	Black phenolic, solid front
Weather Protection:	Dry Case: IP54 Liquid filled or hermetically sealed case: IP 65
Ring:	Threaded reinforced black polypropylene
Window:	Glass
Dial:	Aluminum, white background, black figures and intervals.
Pointer:	Micrometer adjustable
Movement:	Rotary, 400 SS, Teflon® coated pinion gear and segment
Bourdon Tube and Socket:	C510 Phos. bronze/brass brazed (A) 316L SS/steel (R) 316L SS/316L SS (S) K Monel/ Monel (P)
Connection Size:	¼″, ½″ NPT
Connection Location:	Lower or back

OPTIONAL FEATURES

Fill:	L-Glycerin-Standard XGV-Silicone-Optional XGX-Halocarbon-Optional
***PLUS!* Performance:**	XLL
Hermetic Seal:	H
Flush Mounting Ring:	X56
Receiver Gauge:	XPR
Shatter Proof Glass Window:	XSG
Acrylic Window:	XPD
Set Hand:	XSH
Maximum Pointer:	XEP

STANDARD RANGE TABLE*

Pressure – psi

Range	Figure interval	Minor Graduation
0/15	1	0.1
0/30	5	0.2
0/60	5	0.5
0/100	10	1
0/160	20	2
0/200	20	2
0/300	50	2
0/400	50	5
0/600	50	5
0/800	100	10
0/1000	100	10
0/1500	200	20
0/2000	200	20
0/3000	500	20
0/5000	500	50
0/6000	500	50
0/10,000	1000	100
0/20,000	2000	200
0/30,000	5000	200

Compound

Range	Figure Interval		Minor Grads	
	in Hg	psi	in Hg	psi
30″ Hg/15 psi	5	3	0.5	0.2
30″ Hg/30 psi	10	5	1	0.5
30″ Hg/60 psi	10	10	1	1
30″ Hg/100 psi	10	10	2	1
30″ Hg/150 psi	10	20	5	2
30″ Hg/200 psi	30	20	5	2
30″ Hg/300 psi	30	50	5	2

Vacuum

Range	Figure Interval	Minor Grads
30/0 in. Hg 34/0 ft H_2O	5 in 5 ft	0.2 in 0.5 ft

*Full standard and metric equivalent range table available on our web site.

ISO 9001
REGISTERED FIRM

BULLETIN DU-1 1279

All specifications are subject to change without notice.
All sales subject to standard terms and conditions.
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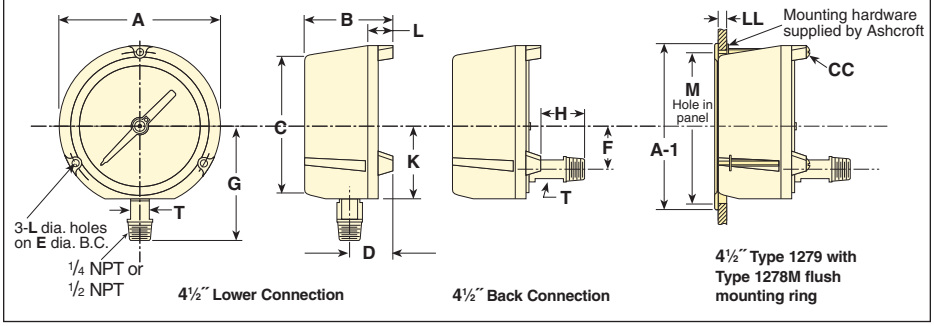
Ashcroft Inc., 250 East Main Street, Stratford, CT 06614 USA
Tel: 203-378-8281 • Fax: 203-385-0408
email: info@ashcroft.com • www.ashcroft.com

Type 1279 Duragauge® Pressure Gauge Available With *PLUS!™* Performance Option

Dimensions



Dial Size Inches	A	B	C	D	E	F	G	H	J	L	T	V	Weight (lbs)
4½	5 13/16 (148)	3⅜ (86)	5 1/16 (129)	1⅝ (41)	5⅜ (137)	1⅝ (41)	3 15/16 (100)	¾ (20)	1 (25)	.218 (6)	⅝ (16)	2⅝ (67)	2½

Type 1278 Flush Mounting Ring Gauge Type	A-1	M	CC	LL
4½˝ Types 1279 & 1379	6 (152)	5⅜ (136)	#10-24	⅛ - 5/16 (3)-(8)

Table A - Case selection & mounting

Dial Size (in)	Ordering Code	Case Type	Case: Material Finish	Ring: Style Material Finish	Mounting / Connection	
4½	(45)	1279(1)	Phenolic (Black)	Threaded Reinforced Polypropylene - Black	Stem – Surface – Flush –	Lower or back Lower or back Back: Specify X56

Table B - System Location and Connection Bourdon Tube & Tip Material(2) (all joints TIG welded except code "A")	Socket Material(2)	Tube & Socket Code	Case Style Code	NPT Conn. & Code	Conn. Location & Code	Range Selection Limits (psi)
C510 Grade A Phosphor Bronze Tube, Brass Tip, Silver Brazed	Brass	(A)	(S) Solid Front	(02) ¼	Lower (L)	Vac./1000
316 stainless steel	1018 steel	(R)	(S) Solid Front			Vac./20,000
316 stainless steel	316 SS	(S)	(S) Solid Front	(04) ½(4)	Back (B)	Vac./20,000
K 500 Monel©(3)	Monel 400	(P)	(S) Solid Front			Vac./30,000

NOTES:

(1) Liquid-fillable or hermetically sealed when kit 101A202-01 (lower) or kit 101A203-01 (back) is ordered.
(2) For selection of the correct Bourdon system material see the media application table.
(3) Use on applications where NACE MR-01-75 is specified for selection of the correct Bourdon system material.
(4) 30,000 psi range supplied with ¼ high pressure connection, ½ NPT optional.

HOW TO ORDER:

45	1279	RS*	04L	XXX	0/2,000 psi

From Table A, Dial Size: 4½˝:
From Table A, Case Type Number: 1279
From Table B, Bourdon tube and socket:
From Table B, Connection: ¼ NPT (02), ½ NPT (04), Lower (L), Back (B)
From Optional Features:
From Range Table: 2000 psi

(*) "S" denotes solid front case design

ISO 9001 REGISTERED FIRM

BULLETIN DU-1 1279

All specifications are subject to change without notice.
All sales subject to standard terms and conditions.
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Ashcroft Inc., 250 East Main Street, Stratford, CT 06614 USA
Tel: 203-378-8281 • Fax: 203-385-0408
email: info@ashcroft.com • www.ashcroft.com

ASHCROFT®

PRESSURE GAUGE INSTALLATION, OPERATION AND MAINTENANCE

I&M008-10098-5/02 (250-1353-L) Rev. 12/15

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Cover photo courtesy of Johnson/Yokogawa Co.

Chemiquip® is a registered trademark of Chemiquip Products Co. Inc.

1.0 SELECTION & APPLICATION

Users should become familiar with ASME B40.100 (Gauges – Pressure Indicating Dial Type – Elastic Element) before specifying pressure measuring gauges. That document – containing valuable information regarding gauge construction, accuracy, safety, selection and testing – may be ordered from:

ASME International
Three Park Avenue
New York, N.Y. 10016-5990
800-843-2763 (US/Canada)
001-800-843-2763 (Mexico)
973-882-1170 outside North America
email: infocentral@asme.org
www.asme.org

WARNING: To prevent misapplication, pressure gauges should be selected considering media and ambient operating conditions. Improper application can be detrimental to the gauge, causing failure and possible personal injury, property damage or death. The information contained in this manual is offered as a guide in making the proper selection of a pressure gauge. Additional information is available from Ashcroft Inc.

The following is a highlight of some of the more important considerations:

1.1 Range – The range of the instrument should be approximately twice the maximum operating pressure. Too low a range may result in (a) low fatigue life of the elastic element due to high operating stress and (b) susceptibility to overpressure set due to pressure transients that exceed the normal operating pressure. Too high a range may yield insufficient resolution for the application.

1.2 Temperature – Refer to Section 2 of this manual for important information concerning temperature related limitations of pressure gauges, both dry and liquid filled.

1.3 Media – The material of the process sensing element must be compatible with the process media. Use of a diaphragm seal with the gauge is recommended for process media that (a) is corrosive to the process sensing element; (b) contain heavy particulates (slurries) or (c) are very viscous including those that harden at room temperature.

1.4 Oxidizing media – Gauges for direct use on oxidizing media should be specially cleaned. Gauges for oxygen service should be ordered to variation X6B and will carry the ASME required dial marking "USE NO OIL" in red letters. Gauges for direct use on other oxidizing media may be ordered to variation X6W. They will be cleaned but carry no dial marking. *PLUS!*™ Performance gauges or Halocarbon filled gauge or diaphragm fill is required for use with oxidizing media; order variation XCF.

1.5 Pulsation/Vibration – Pressure pulsation can be dampened by several mechanisms; the patented *PLUS! Performance* gauge will handle the vast majority of applications. One exception to this is high frequency pulsation which is difficult to detect. The only indication may be an upscale zero shift due to movement wear. These applications should be addressed with a liquid filled gauge, or in extreme cases, a remotely mounted liquid filled gauge connected with a length of capillary line. The small diameter of the capillary provides excellent dampening, but can be plugged. The Ashcroft 1106 pulsation dampener and 1112 snubber are auxiliary devices which dampen pulsation with less tendency to plug.

1.6 Gauge fills. – Once it has been determined that a liquid filled gauge is in order, the next step is selecting the type of fill. **Glycerin** satisfies most applications. While being the least expensive fill, its usable temperature range is 20/180°F. **Silicone** filled gauges have a broader service range: –40/250°F. Oxidizing media require the use of **Halocarbon,** with a service range of –40/250°F. Pointer motion will be slowed at the low end of the low end of these temperature ranges.

1.7 Mounting – Users should predetermine how the gauge will be mounted in service: stem (pipe), wall (surface) or panel (flush). Ashcroft wall or panel mounting kits should be ordered with the gauge. See Section 3.

2.0 TEMPERATURE

2.1 Ambient Temperature – To ensure long life and accuracy, pressure gauges should preferably be used at an ambient temperature between –20 and +150°F (–30 to +65°C). At very low temperatures, standard gauges may exhibit slow pointer response. Above 150°F, the accuracy will be affected by approximately 1.5% per 100°F. Other than discoloration of the dial and hardening of the gasketing and degradation of accuracy, non-liquid filled Type 1279 (phenolic case) and 1379 (aluminum case) Duragauge® gauge, with standard glass windows, can withstand continuous operating temperatures up to 250°F. Unigauge models 2½″ and 3½″ 1009 and 1008S liquid filled gauges can withstand 200°F but glycerin fill and the acrylic window of Duragauge® gauges will tend to yellow. Silicone fill will have much less tendency to yellow. Low pressure, liquid filled Types 1008 and 1009 gauges may have some downscale errors caused by liquid fill expansion. This can be alleviated by venting the gauge at the top plug (pullout the blue plug insert). To do this the gauge must be installed in the vertical position.

Although the gauge may be destroyed and calibration lost, gauges can withstand short times at the following temperatures: gauges with all welded pressure boundary joints, 750°F (400°C); gauges with silver brazed joints, 450°F (232°C) and gauges with soft soldered joints, 250°F (121°C). For expected long term service below –20°F (–30°C) Duragauge® and 4½″ 1009 gauges should be hermetically sealed and specially lubricated; add "H" to the product code for hermetic sealing. Add variation XVY for special lubricant. Standard Duralife® gauges may be used to –50°F (–45°C) without modification.

2.2 Accuracy – Heat and cold affect accuracy of indication. A general rule of thumb for **dry gauges** is 0.5% of full scale change for every 40°F change from 75°F. Double that allowance for gauges with hermetically sealed or liquid filled cases, except for Duragauge® gauges where no extra allowance is required due to the elastomeric, compensating back. Above 250°F there may exist very significant errors in indication.

2.3 Steam service – In order to prevent live steam from entering the Bourdon tube, a siphon filled with water should be installed between the gauge and the process line. Siphons can be supplied with ratings up to 4,000 psi. If freezing of the condensate in the loop of the siphon is a possibility, a diaphragm seal should be used to isolate the gauge from the process steam. Siphons should also be used whenever condensing, hot vapors (not just steam) are present. Super heated steam should have enough piping or capillary line ahead of the siphon to maintain liquid water in the siphon loop.

2.4 Hot or very cold media – A five foot capillary line assembly will bring most hot or cold process media within the recommended gauge ambient temperature range. For media above

750°F (400°C) the customers should use their own small diameter piping to avoid possible corrosion of the stainless steel. The five foot capillary will protect the gauges used on the common cryogenic (less than –300°F (200°C) gases, liquid argon, nitrogen, and oxygen.) The capillary and gauge must be cleaned for oxygen service. The media must not be corrosive to stainless steel, and must not plug the small bore of the capillary.

2.5 Diaphragm seals – A diaphragm seal should be used to protect gauges from corrosive media, or media that will plug the instrument. Diaphragm seals are offered in a wide variety of designs and corrosion resistant materials to accommodate almost any application and most connections. Visit www.ashcroft.com for details.

2.6 Autoclaving – Sanitary gauges with clamp type connections are frequently steam sterilized in an autoclave. Gauges equipped with polysulfone windows will withstand more autoclave cycles than those equipped with polycarbonate windows. Gauges equipped with plain glass or laminated safety glass **should not be autoclaved.** Gauge cases should be vented to atmosphere (removing the rubber fill/safety plug if necessary) **before** autoclaving to prevent the plastic window from cracking or excessively distorting. If the gauge is liquid filled, the fill should be drained from the case and the front ring loosened before autoclaving.

3.0 INSTALLATION

3.1 Location – Whenever possible, gauges should be located to minimize the effects of vibration, extreme ambient temperatures and moisture. Dry locations away from very high thermal sources (ovens, boilers etc.) are preferred. If the mechanical vibration level is extreme, the gauge should be remotely located (usually on a wall) and connected to the pressure source via flexible tubing.

3.2 Gauge reuse – ASME B40.100 recommends that gauges not be moved indiscriminately from one application to another. The cumulative number of pressure cycles on an in-service or previously used gauge is generally unknown, so it is generally safer to install a new gauge whenever and wherever possible. This will also minimize the possibility of a reaction with previous media.

3.3 Tightening of gauge – Torque should never be applied to the gauge case. Instead, an open end or adjustable wrench should always be used on the wrench flats of the gauge socket to tighten the gauge into the fitting or pipe. NPT threads require the use of a suitable thread sealant, such as pipe dope or teflon tape, and must be tightened very securely to ensure a leak tight seal.

CAUTION: Torque applied to a diaphragm seal or its attached gauge, that tends to loosen one relative to the other, can cause loss of fill and subsequent inaccurate readings. Always apply torque **only** to the wrench flats on the lower seal housing when installing filled, diaphragm seal assemblies or removing same from process lines.

3.4 Process isolation – A shut-off valve should be installed between the gauge and the process in order to be able to isolate the gauge for inspection or replacement without shutting down the process.

3.5 Surface mounting – Also known as wall mounting. Gauges should be kept free of piping strains. The gauge case mounting feet, if applicable, will ensure clearance between the pressure relieving back and the mounting surface.

3.6 Flush mounting – Also known as panel mounting. The applicable panel mounting cutout dimensions can be found at www.ashcroft.com

4.0 OPERATION

4.1 Frequency of inspection – This is quite subjective and depends upon the severity of the service and how critical the accuracy of the indicated pressure is. For example, a monthly inspection frequency may be in order for critical, severe service applications. Annual inspections, or even less frequent schedules, are often employed in non-critical applications.

4.2 In-service inspection – If the accuracy of the gauge cannot be checked in place, the user can at least look for (a) erratic or random pointer motion; (b) readings that are suspect – especially indications of pressure when the user believes the true pressure is 0 psig. Any gauge which is obviously not working or indicating erroneously, should be immediately valved-off or removed from service to avoid a possible pressure boundary failure.

4.3 When to check accuracy – Any suspicious behavior of the gauge pointer warrants that a full accuracy check be performed. Even if the gauge is not showing any symptoms of abnormal performance, the user may want to establish a frequency of bench type inspection.

4.4 When to recalibrate – This depends on the criticality of the application. If the accuracy of a 3-2-3% commercial type gauge is only 0.5% beyond specification, the user must decide whether it's worth the time and expense to bring the gauge back into specification. Conversely if the accuracy of a 0.25% test gauge is found to be 0.1% out of specification then the gauge should be recalibrated.

4.5 Other considerations – These include (a) bent or unattached pointers due to extreme pressure pulsation; (b) broken windows which should be replaced to keep dirt out of the internals; (c) leakage of gauge fill; (d) case damage – dents and/or cracks; (e) any signs of service media leakage through the gauge including its connection; (f) discoloration of gauge fill that impedes readability.

4.6 Spare parts – As a general rule it is recommended that the user maintain in inventory one complete Ashcroft® instrument for every ten (or fraction thereof) of that instrument type in service.

5.0 GAUGE REPLACEMENT

It is recommended that the user stock one complete Ashcroft® instrument for every ten (or fraction thereof) of that instrument type in service. With regard to gauges having a service history, consideration should be given to discarding rather than repairing them. Gauges in this category include the following:

a. Gauges that exhibit a span shift greater than 10%. It is possible the Bourdon tube has suffered thinning of its walls by corrosion.

b. Gauges that exhibit a zero shift greater than 25%. It is likely the Bourdon tube has seen significant overpressure leaving residual stresses that may be detrimental to the application.

c. Gauges which have accumulated over 1,000,000 pressure cycles with significant pointer excursion.

d. Gauges showing any signs of corrosion and/or leakage of the pressure system.

e. Gauges which have been exposed to high temperature or exhibit signs of having been exposed to high temperature – specifically 250°F or greater for soft soldered systems; 450°F or greater for brazed systems; and 750°F or greater for welded systems.

f. Gauges showing significant friction error and/or wear of the movement and linkage.

g. Gauges having damaged sockets, especially damaged threads.

h. Liquid filled gauges showing loss of case fill.

NOTE: ASME B40.100 does not recommend moving gauges from one application to another. This policy is prudent in that it encourages the user to procure a new gauge, properly tailored by specification, to each application that arises.

6.0 ACCURACY: PROCEDURES/DEFINITIONS

Accuracy inspection – Readings at approximately five points equally spaced over the dial should be taken, both upscale and downscale, before and after lightly rapping the gauge to remove friction. **A pressure standard with accuracy at least four times greater than the accuracy of the gauge being tested is recommended.**

Equipment – A finely regulated pressure supply will be required. It is critical that the piping system associated with the test setup be leaktight. The gauge under test should be positioned as it will be in service to eliminate positional errors due to gravity.

Method – ASME B40.100 recommends that **known** pressure (based on the reading from the pressure standard used) be applied to the gauge under test. Readings including any error from the nominal input pressure, are then taken from the gauge under test. The practice of aligning the pointer of the gauge under test with a dial graduation and then reading the error from the master gauge ("reverse reading") can result in inconsistent and misleading data and should NOT be used.

Calibration chart – After recording all of the readings it is necessary to calculate the errors associated with each test point using the following formula: ERROR in percent = 100 times (TRUE VALUE minus READING) ÷ RANGE. Plotting the individual errors (Figure 1) makes it possible to visualize the total gauge characteristic. The plot should contain all four curves: upscale – before rap; upscale – after rap; downscale – before rap; downscale – after rap. "*Rap*" means lightly tapping the gauge **before** reading to remove friction as described in ASME B40.100.

Referring to Figure 1, several classes of error may be seen:

Zero – An error which is approximately equal over the entire scale. This error can be manifested when either the gauge is

FIG. 1

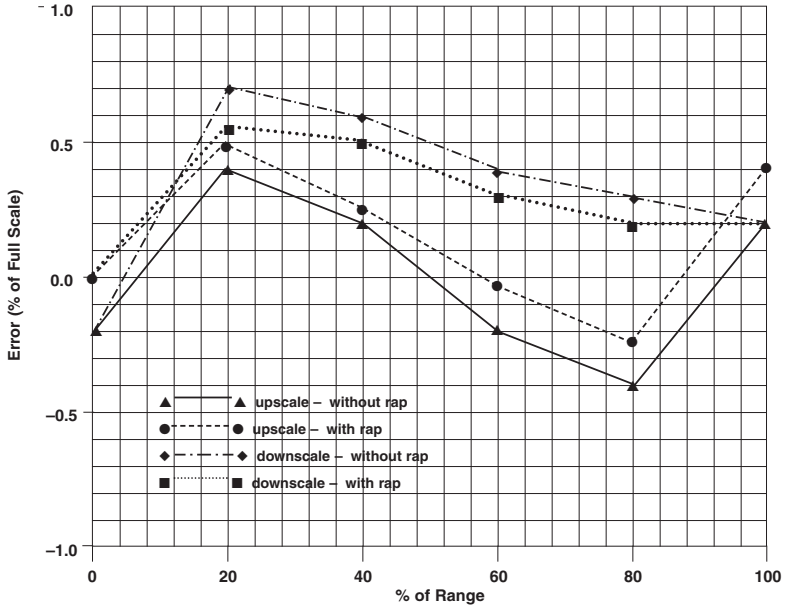
TYPICAL CALIBRATION CHART

INDICATED VALUE (PSI)

True Value – PSI	Increasing – Without RAP	Increasing – With RAP	Decreasing – Without RAP	Decreasing – With RAP
0	–.4	0	–.4	0
40	+.8	+1.0	+1.4	+1.1
80	+.4	+.5	+1.2	+1.0
120	–.4	–1.0	+.8	+.6
160	–.8	–.5	+.6	+.4
200	+.4	+.8	+.4	+.4

ERROR (% OF FULL SCALE)

True Value – % of Range	Increasing – Without RAP	Increasing – With RAP	Decreasing – Without RAP	Decreasing – With RAP
0	–.20	0	–.20	0
20	+.40	+.50	+.70	+.55
40	+.20	+.25	+.60	+.50
60	–.20	–.05	+.40	+.30
80	–.40	–.25	+.30	+.20
100	+.20	+.40	+.20	+.20



dropped or overpressured and the Bourdon tube takes a permanent set. This error may often be corrected by simply repositioning the pointer. Except for test gauges, it is recommended that the pointer be set at midscale pressure to "split" the errors.

Span – A span error exists when the error at full scale pressure is different from the error at zero pressure. This error is often proportional to the applied pressure. Most Ashcroft gauges are equipped with an internal, adjusting mechanism with which the user can correct any span errors which have developed in service.

Linearity – A gauge that has been properly spanned can still be out of specification at intermediate points if the response of the gauge as seen in Figure 1 (Typical Calibration Chart) is not linear. The Ashcroft Duragauge® pressure gauge is equipped with a rotary movement feature which permits the user to minimize this class of error. Other Ashcroft gauge designs (e.g., 1009 Duralife®) require that the dial be moved left or right prior to tightening the dial screws.

Hysteresis – Some Bourdon tubes have a material property known as hysteresis. This material characteristic results in differences between the upscale and downscale curves. This class of error can **not** be eliminated by adjusting the gauge movement or dial position.

Friction – This error is defined as the difference in readings before and after lightly tapping the gauge case at a check point. Possible causes of friction are burrs or foreign material in the movement gearing, "bound" linkages between the movement and the bourdon tube, or an improperly tensioned hairspring. If correcting these potential causes of friction does not eliminate excessive friction error, the movement should be replaced.

6.1 Calibration – Rotary Movement Gauges and Type 1259 Gauges – Inspect gauge for accuracy. Many times gauges are simply "off zero" and a simple pointer adjustment using the micrometer pointer is adequate. If inspection shows the gauge warrants recalibration to correct span and/or linearity errors, proceed as follows:

a. Remove ring, window and, if solid front case, the rear closure assembly.

b. Pressurize the gauge **once** to full scale and back to zero.

c. Refer to Figure 2 (Ashcroft System Assembly w/Rotary Gear Movement) for a view of a typical Ashcroft rotary system assembly with component parts identified. Refer to Figure 2A for link configuration of Type 1259 gauge.

FIG. 2 ASHCROFT SYSTEM ASSEMBLY W/ROTARY GEAR MOVEMENT

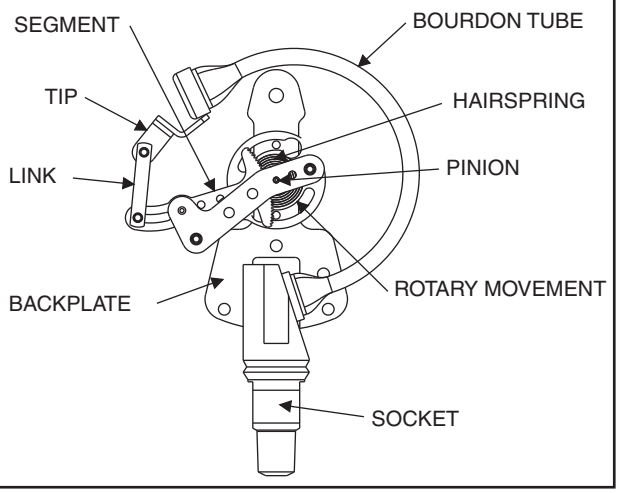
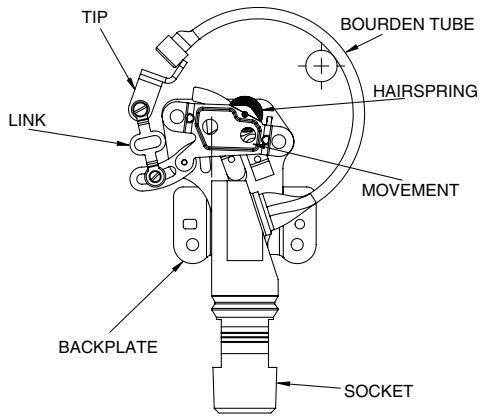


FIG. 2A ASHCROFT TYPE 1259 SYSTEM ASSEMBLY



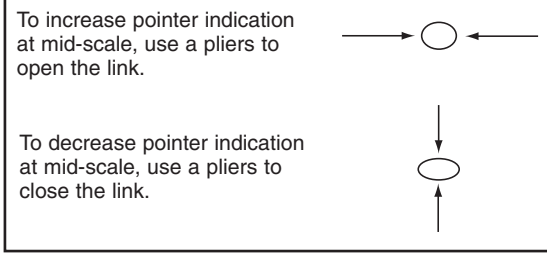
d. Adjust the micrometer pointer so that it rests at the true zero position. For open front gauges the pointer and dial must also be disassembled and the pointer should then be lightly pressed onto the pinion at the 9:00 o'clock position.

e. Apply full scale pressure and note the magnitude of the span error. With open front gauges, ideal span (270 degrees) will exist when at full scale pressure the pointer rests exactly at the 6:00 o'clock position.

f. If the span has shifted significantly (span error greater than 10%), the gauge should be replaced because there may be some partial corrosion inside the Bourdon tube which could lead to ultimate failure. If the span error exceeds 0.25%, loosen the lower link screw and move the lower end of the link toward the movement to increase span or away to decrease span. An adjustment of 0.004 inch will change the span by approximately 1%. This is a repetitive procedure which often requires more than one adjustment of the link position and the subsequent rechecking of the errors at zero and full scale pressure.

g. Apply midscale pressure and note error in reading. Even though the gauge is accurate at zero and full scale, it may be inaccurate at the midpoint. This is called linearity error. For corrections to linearity with the Type 1259 gauges refer to Figure 2B. For rotary movement gauges, note the following: if the error is positive, the movement should be rotated counter clockwise. Rotating the movement one degree will change this error by approximately 0.25%. Rotating the movement often affects span and it should be subsequently rechecked and readjusted if necessary according to step 6.1e and 6.1f.

FIG. 2B LINEARITY ADJUSTMENT & LINK CONFIGURATION FOR ASHCROFT TYPE 1259



h. While recalibrating the gauge, the friction error – difference in readings taken with and without rap – should be

noted. This error should not exceed the basic accuracy of the gauge. If the friction error is excessive, the movement should be replaced. One possible cause of excessive friction is improper adjustment of the hairspring. The hairspring torque,or tension, must be adequate without being excessive. The hairspring should also be level, unwind evenly (no turns rubbing) and it should never tangle.

NOTES:

1 For operation of test gauge external zero reset, refer to page 17.

2 For test gauge calibration procedure, refer to Figure 2 on page 18.

7.0 DIAPHRAGM SEALS

7.1 General – A diaphragm seal (isolator) is a device which is attached to the inlet connection of a pressure instrument to isolate its measuring element from the process media. The space between the diaphragm and the instrument's pressure sensing element is solidly filled with a suitable liquid. Displacement of the liquid fill in the pressure element, through movement of the diaphragm, transmits process pressure changes directly to a gauge, switch or any other pressure instrument. When diaphragm seals are used with pressure gauges, an additional 0.5% tolerance must be added to the gauge accuracy because of the diaphragm spring rate.

Used in a variety of process applications where corrosives, slurries or viscous fluids may be encountered, the diaphragm seal affords protection to the instrument where:

- The process fluid being measured would normally clog the pressure element.
- Pressure element materials capable of withstanding corrosive effects of certain fluids are not available.
- The process fluid might freeze due to changes in ambient temperature and damage the element.

7.2 Installation – Refer to bulletin OH-1 for information regarding (a) seal configurations; (b) filling fluids; (c) temperature range of filling fluids; (d) diaphragm material pressure and temperature limits; (e) bottom housing material pressure and temperature limits; (f) pressure rating of seal assembly; (g) accuracy/temperature errors of seal assembly; (h) diaphragm seal displacement. The volumetric displacement of the diaphragm must at least equal the volumetric displacement of the measuring element in the pressure instrument to which the seal is to be attached.

It is imperative that the pressure instrument/diaphragm seal assembly be **properly** filled prior to being placed in service. Ashcroft diaphragm seal assemblies should only be filled by a seal assembler certified by Ashcroft Inc. Refer to section 3.3 for a cautionary note about not applying torque on either the instrument or seal relative to the other.

7.3 Operation – All Ashcroft® diaphragm seals, with the exception of Type 310 mini-seals, are continuous duty. Should the pressure instrument fail, or be removed accidentally or deliberately, the diaphragm will seat against a matching surface preventing damage to the diaphragm or leakage of the process fluid.

7.4 Maintenance – Clamp type diaphragm seals – Types 100, 200 and 300 – allow for replacement of the diaphragm or diaphragm capsule, if that ever becomes necessary. The Type 200 top housing must also be replaced with the diaphragm. With all three types the clamping arrangement allows field disassembly to permit cleaning of the seal interior.

7.5 Failures – Diaphragm failures are generally caused by either corrosion, high temperatures or fill leakage. Process media build-up on the process side of the diaphragm can also require seal cleaning or replacement. Consult Customer Service, Stratford CT for advice on seal failures and/or replacement.

WARNING: All seal components should be selected considering process and ambient operating conditions to prevent misapplication. Improper application could result in failure, possible personal injury, property damage or death.

8.0 DAMPENING DEVICES

8.1 General – Some type of dampening device should be used whenever the pressure gauge may be exposed to repetitive pressure fluctuations that are fairly rapid, high in magnitude and especially when transitory pressure spikes exceeding the gauge range are present (as with starting and stopping action of valves and pumps). A restricted orifice of some kind is employed through which pressure fluctuations must pass before they reach the Bourdon tube. The dampener reduces the magnitude of the pressure pulse thus extending the life of the Bourdon tube and movement. This reduction of the pressure pulsation as "seen" by the pressure gauge is generally evidenced by a reduction in the pointer travel. If the orifice is very small the pointer may indicate the average service pressure, with little or no indication of the time varying component of the process pressure.

Commonly encountered media (e.g. – water and hydraulic oil) often carry impurities which can plug the orifice over time thus rendering the gauge inoperative until the dampener is cleaned or replaced.

Highly viscous media and media that tend to periodically harden (e.g., asphalt) require a diaphragm seal be fitted to the gauge. The seal contains an internal orifice which dampens the pressure fluctuation within the fill fluid.

8.2 Throttle Screws & Plugs – These accessories provide dampening for the least cost. They have the advantage of fitting completely within the gauge socket and come in three types: (a) a screwed-in type which permits easy removal for cleaning or replacement; (b) a pressed in, non-threaded design and (c) a pressed in, threaded design which provides a highly restrictive, helical flow path. Not all styles are available on all gauge types.

8.3 Ashcroft Pulsation Dampener – Type 1106 Ashcroft pulsation dampener is a moving pin type in which the restricted orifice is the clearance between the pin and any one of five preselected hole diameters. Unlike a simple throttle screw/plug, this device has a self-cleaning action in that the pin moves up and down under the influence of pressure fluctuations.

8.4 Ashcroft Pressure Snubber – The heart of the Type 1112 pressure snubber is a thick porous metal filter disc. The disc is available in four standard porosity grades.

8.5 Ashcroft Needle Valves – Type 7001 thru 7004 steel needle valves provide varying degrees of dampening. These devices, in the event of plugging, can easily be opened to allow the pressure fluid to clear away the obstruction.

8.6 Chemiquip® Pressure Limiting Valves – Model PLV-255, PLV-2550, PLV-5460, PLV-5500 and PLV-6430, available with and without built-in snubbers, automatically "shut off" at adjustable preset values of pressure to protect the gauge from damage to overpressure. They are especially useful on hydraulic systems wherein hydraulic transients

(spikes) are common.

9.0 TEST EQUIPMENT & TOOL KITS

See our website www.ashcroft.com for more details

9.1 Pressure Instrument Testing Equipment

Type 1305D Deadweight Tester

Type 1327D Pressure Gauge Comparator

Type 1327CM “Precision” Gauge Comparator

9.2 Tools & Tool Kits For Recalibration of 4½˝ and Larger Gauges

Type 2505 universal carrying case for 1082 test gauge

Type 266A132-01 span wrench for 1082 test gauge

Type 1281 socket O-Ring kit for 1279/1379 lower connect

Type 1285 4½˝ ring wrench for 1279/1379 lower & back connect

Type 1286 6˝ ring wrench for 1379 lower & back connect

Type 3220 pointer puller (all gauges except 1009 Duralife®)

Type 3530 pinion back-up tool for 1009 Duralife®

Type 3220 Handjack set

Type 1105 Tool Kit

9.3 Kits to Convert a Dry Gauge to a Liquid Filled or Weather Proof Case Gauge

Type 1280 conversion kit for 4½˝ lower connect 1279/1379

Type 1283 conversion kit for 4½˝ back connect 1279/1379

Type 1284 conversion kit for 6˝ lower & back connect

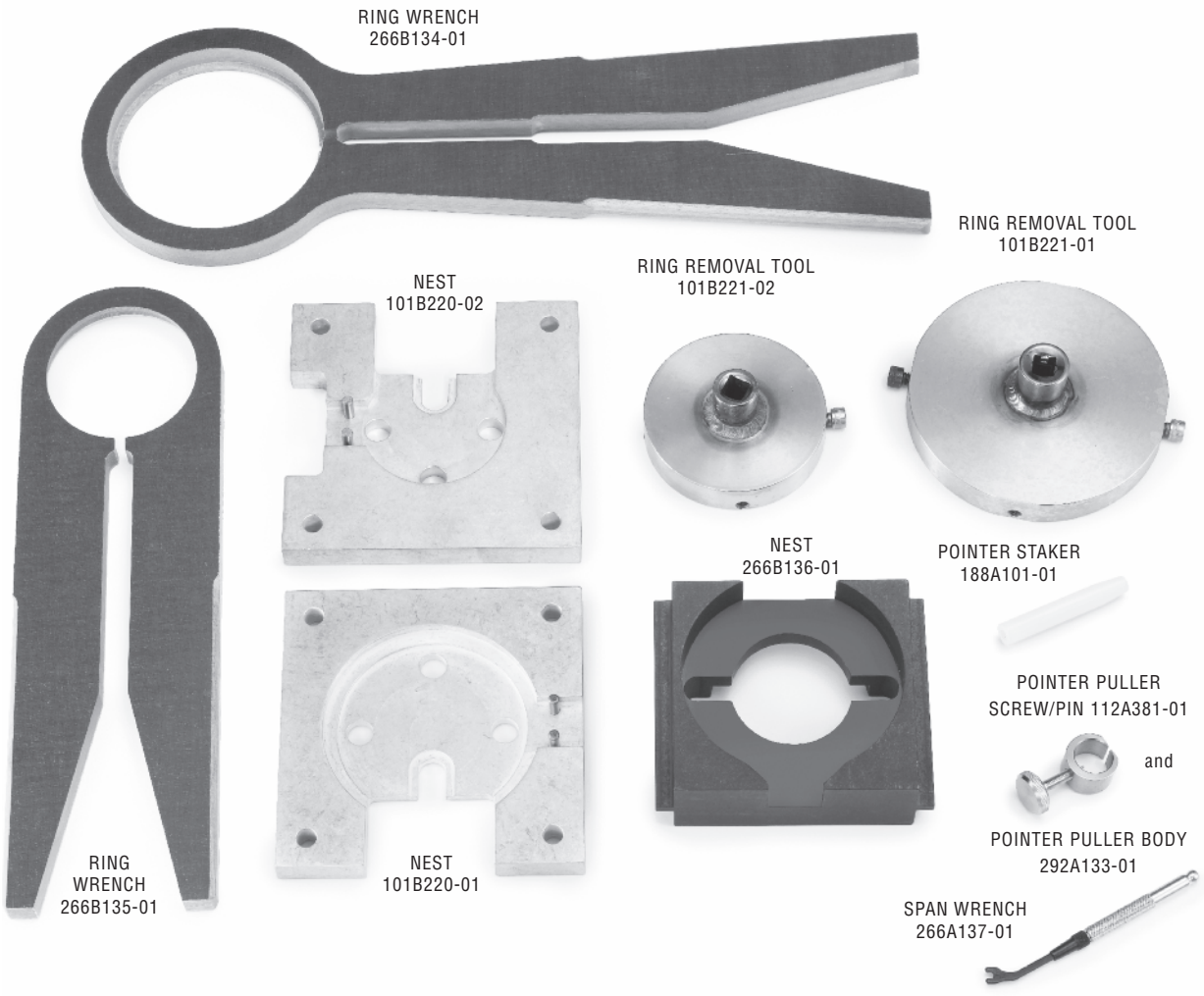
TYPE 1105
TOOL KIT

TYPE 3220
HAND JACK SET

9.4 2½ & 3½ 1009 Duralife® Gauge Tools

Description	Part No.
Pointer Puller Screw/Pin[2][3][4]	112A381-01
Pointer Puller Body[2][3][4]	292A133-01
Pointer Staker[2][4]	188A101-01
Span Wrench[2][5] (to adjust span)	266A137-01
Ring Wrench 3½″[1][5] (for ring removal) (35 1009)	266B134-01
Ring Wrench 2½″[1][5] (for ring removal) (25 1009)	266B135-01
Nest 2½″ & 3½″[1][5] (to hold gauge for ring removal) (25/35 1009)	266B136-01
Ring Removal Tool[6] (25 1009)	101B221-02
Ring Removal Tool[6] (35 1009)	101B221-01
Nest 2½″[6] (to hold gauge for ring removal) (25 1009)	101B220-02
Nest 3½″[6] (to hold gauge for ring removal) (35 1009)	101B220-01
Type 1230 throttle plug insertion (¼ NPT) for 1009 Duralife®	1230
Type 1231 throttle plug insertion (⅛ NPT) for 1009 Duralife® (body only)	1231
Tool to open orifice on push-in throttle plug	101A206-01

(1) Formerly 1206T Tool Kit.
(2) Formerly some parts in 1205T Tool Kit.
(3) Both parts must be purchased together.
(4) Previous and current design.
(5) Previous design only.
(6) Current design only.



ASHCROFT® Type 1188 Bellows Gauge Calibration Procedure

CALIBRATION & TROUBLE CORRECTION DIAGRAM

RANGE SPAN ADJUSTMENT

- **RANGE TOO SHORT** — Adjust slide "S" inward
- **RANGE TOO LONG** — Adjust slide "S" outward

POINTER JUMPING

- **STICKY PARTS** — Clean all bearings and gear teeth
- **LOOSE HAIRSPRING** — Remove backlash by disengaging pinion & rotate to tighten
- **COUNTER BALANCE RUBBING** — Bend if necessary to clear socket in travel

NOTE: After adjusting range span, set both movement stops. Set the underload stop so that the pointer will stop at zero. Set the overload stop so that the pointer will pass the maximum range approximately 5˝.

After adjusting span re-zero pointer by removing from pinion and re-assembling at the proper dial mark.

SLUGGISH MOVEMENT

TIGHT HAIRSPRING — Loosen by disengaging pinion & rotate

NON LINEAR

- **NON LINEAR FIRST 3RD.** → **ADJ. ANGLE OF PULL BY INCREASING ANGLE "A"**
- **NON LINEAR LAST 3RD.** → **ADJ. ANGLE OF PULL BY DECREASING ANGLE "A"**

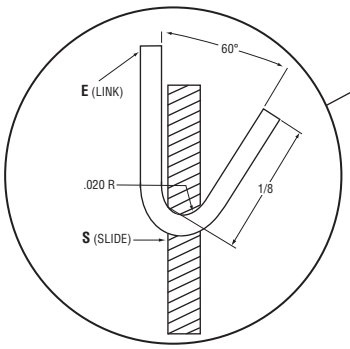
NOTE: To increase or decrease angle "A," bend tip inward or outward as required. Doing this may run the movement segment off the pinion. This can be corrected by cutting off one end off the link "E" decreasing its length, or makin a new length from .032 dia. phos. bronze wire.

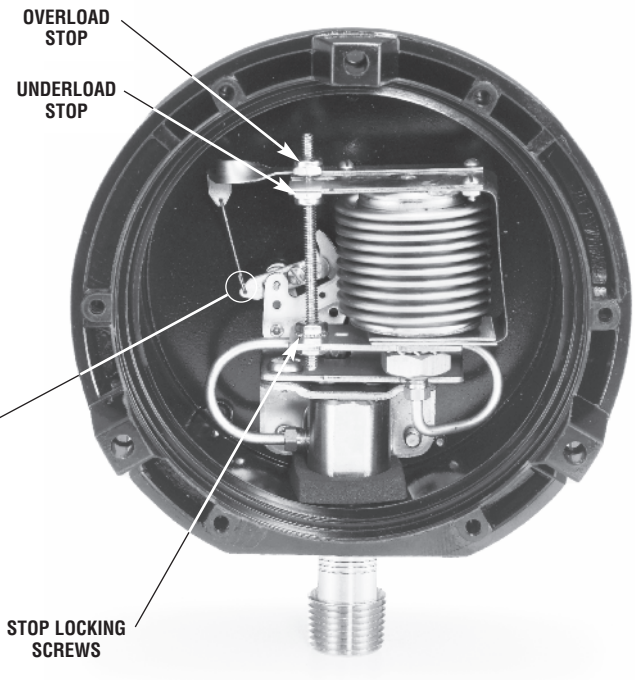
Caution: When reproducing link end, follow figure 44 very closely. this will prevent too much play, or, binding in operation.

REF: Replacing System Bellows

After assembling bellows to the gauge socket securely, subject system to 30 psi for five minutes, allowing bellows to travel approximately 1/8˝ against the overload stop. After this, heat treat system for 15 hours at 250°F, this procedure is necssary to prevent gauge drift.

SLIDE AND LINK (angle "A")
Enlarged view of slide and link





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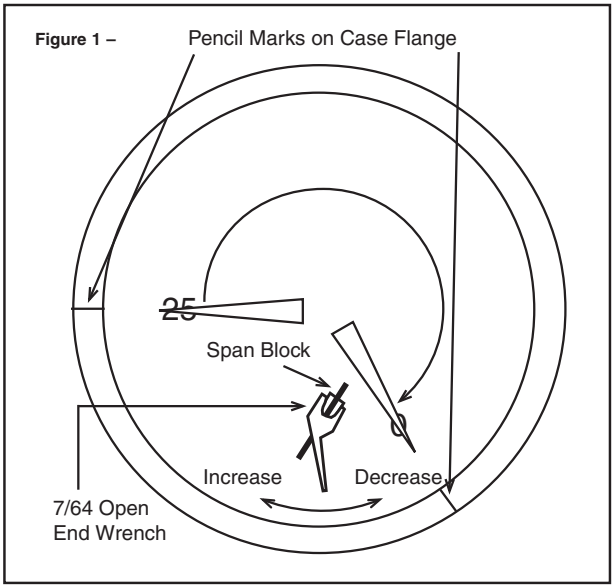
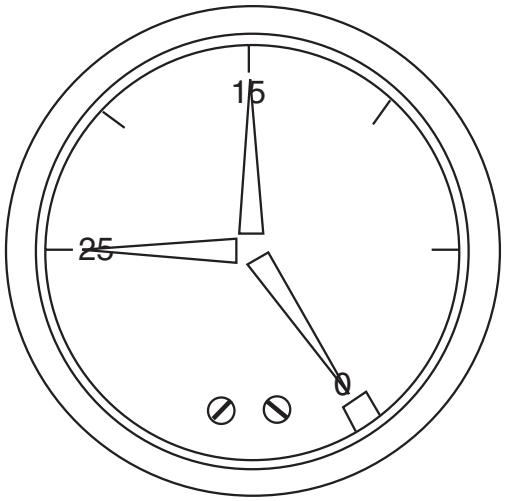
1. Remove ring, window and gasket pointer.
2. Using a pencil, refer to dial and mark the 0 and 25˝ Hg positions on the case flange.
3. Remove dial.
4. Apply 25˝ Hg vac.
5. Lightly press pointer onto pinion carefully aligning it with the 25˝ Hg vac. mark on the flange.
6. Release vacuum fully.
7. Note agreement of pointer to zero mark on flange.
8. If span is high or low, turn span block as shown in Figure 1.

Figure 1 –



9. Repeat steps 4 through 8 until span is correct.
10. Remove pointer.
11. With 25˝ Hg vac applied, reassemble dial, dial screws (finger tight) and point.
12. Apply 15˝ Hg vac. and note accuracy of indication. If required, slide dial left or right to reduce error to 1% maximum.
13. Firmly tighten dial screws.
14. Firmly tap pointer onto pinion.
15. recheck accuracy at 15 and 25˝ Hg vac. (Figure 2).
16. Reassemble window, gasket and ring.

Figure 2 –



Notes: See page 10 for any tools required to calibrate.

For models produced prior to September 2008 for 2½˝ version and December 2008 for 3½˝ version.
Back of gauge will have a date code sticker.

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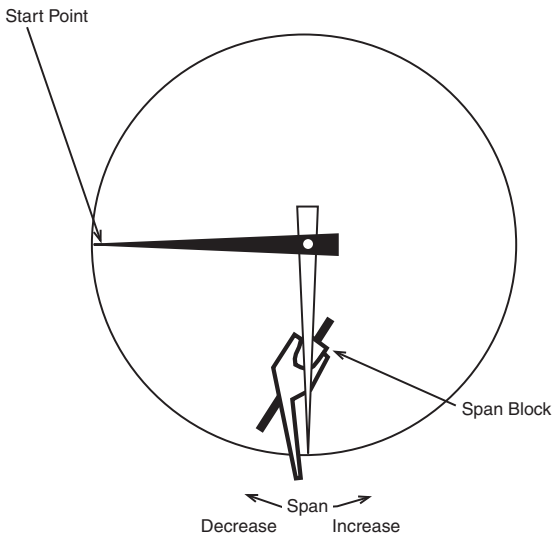
Step 1. With the dial off, install pointer at 9 o'clock "lightly," Figure 3.

Figure 3 –

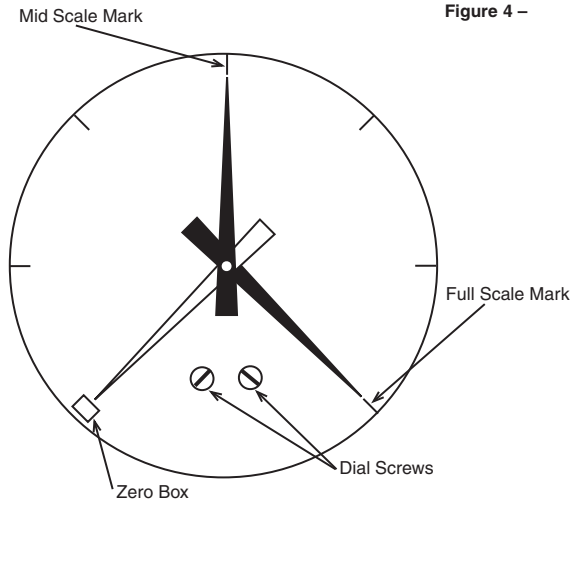


Step 2. Go to full scale pressure…rotate span block with tool until pointer rests at 6 o'clock.

Step 3. Go to zero pressure (9 o'clock)…if pointer has not moved away from start point, go to Step 4. If pointer has moved, repeat Step 1 until span is correct.

Step 4. Install dial with screws snug.

Figure 4 –



Step 5. Install pointer centered in zero box, Figure 4.

Step 6. Go to full scale pressure…check that pointer is within 1% of full scale mark. If not, remove pointer and dial and return to step 1, Figure 4.

Step 7. Go to mid-scale pressure…rotate dial until mid-scale mark is aligned with pointer, Figure 4.

Step 8. Tighten dials screws and stake on pointer.

Step 9. Check zero and full scale. Reassemble window, gasket and ring.

Notes: See page 10 for any tools required to calibrate.

For models produced prior to September 2008 for 2½˝ version and December 2008 for 3½˝ version.
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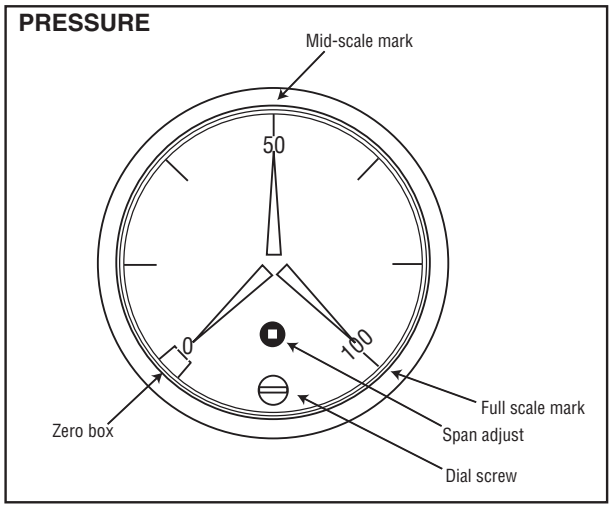
ASHCROFT® Current Type 1009 Duralife® Calibration Procedure – Pressure and Vacuum Range

Calibration – 1009 Duralife® Gauge –
Inspect gauge for accuracy. At times gauges are simply "off zero" and opening the ventable plug at the top of the gauge will relieve internal gauge pressure and correct the offset. If this is not adequate and inspection shows that the gauge warrants recalibration to correct zero, span and/or linearity errors, proceed as follows:

Remove ring, window, and gasket using Ashcroft Ring Removal Tools P/N 101B220-02 and 101B221-02 for 2½" gauges and 101B220-01 and 101B221-01 for 3½" gauges.



Positive Pressure Ranges –

1. Adjust pointer with a slotted screwdriver until it is in the center of the zero box. This is often all that is required it correct calibration issues.

2. Apply full scale pressure. If error exceeds 1% rotate the black span adjustment device with a #0 square drive bit. Clockwise increases span, counterclockwise decrease span.

3. Fully exhaust pressure and check that pointer still is still in the zero box. If not, repeat step 1 and 2

4. Once 0 and full scale are within tolerance, pressurize gauge to mid-scale.

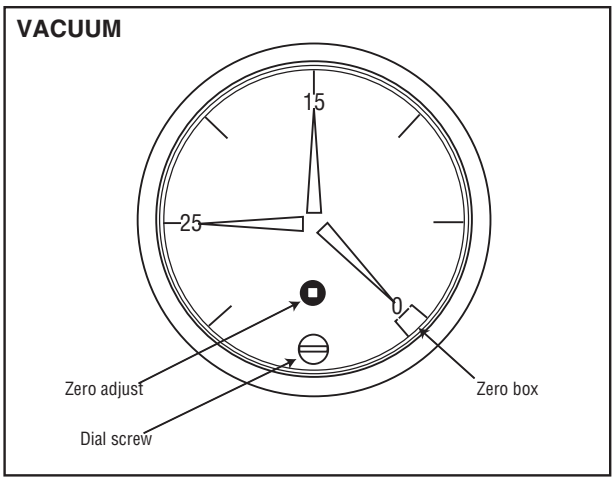
5. If gauge is within 1%, calibration is complete. If not loosen the dial screw and rotate dial left or right to adjust midpoint. Retighten dial screw.

6. If an adjustment was made in step 5, recheck the gauge at zero and full scale, adjust accordingly until zero, mid and full scale points are in tolerance.

Vacuum Range –

1. Adjust pointer with a slotted screwdriver until it is in the center of the zero box. This is often all that is required it correct calibration issues.

2. Apply 25 inches Hg vacuum. If the error exceeds 1% adjust pointer with a slotted screwdriver until gauge is within tolerance.



3. Vent to 0 pressure and check pointer position in the zero box. If error exceeds 1% rotate the black span adjustment device with a #0 square drive bit. Clockwise rotation moves pointer clockwise, counterclockwise rotation moves the pointer counterclockwise.

4. Repeat step 1 and 2 until 0 and 25 inches of Hg are within gauge tolerance.

5. Apply 15 inches Hg vacuum. If gauge is within 1%, calibration is complete. If not loosen the dial screw and rotate dial left or right to adjust midpoint. Retighten dial screw.

6. If an adjustment was made in step 4, recheck the gauge at zero and 25 inches of Hg vacuum, adjust accordingly until zero, 15 and 25 inches Hg are in tolerance.

7. Continue below.

Re-assemble window and ring to gauge:

a. If plastic window is used, push window back into front of gauge, ensure the o-ring does not roll out of window groove (lubricate if necessary). Align the tabs of the window with the tabs of the case front. Once window is in place, install ring and tighten with tools referenced above and shown on page 10.

b If safety glass is used, reinstall window, gasket, and ring. Ensure that the gasket is seated properly under all four tabs of the ring and does not wrinkle when ring is tightened.

Note: Tighten ring: Apply 120-200inlb of torque. Rotate ring clockwise to tighten. Warning: over tightening of safety glass may induce cracking.

Notes: See page 10 for any tools required to calibrate.

For models produced after September 2008 for 2½˝ version and December 2008 for 3½˝ version.
Back of gauge will have a date code sticker.

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TYPE 1279 & 1379 SOLID FRONT DURAGAUGE® PRESSURE GAUGE CONVERSION INSTRUCTIONS TO:

- **Convert A Standard Dry Gauge To A Liquid Filled Gauge**
- **Convert A Standard Dry Gauge To A Dry, Weatherproof IP66 Gauge**

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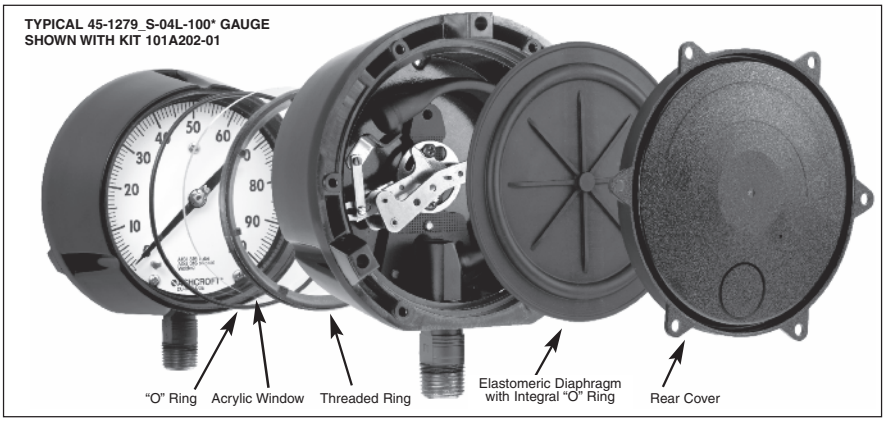

	1279		1379		
	4½˝ LOWER	4½˝ BACK	4½˝ LOWER	4½˝ BACK	6˝ LOWER & BACK
KIT PART NO.	101A202-01	101A203-01	1280	1283	1284
	QUANTITY INCLUDED				
ACRYLIC WINDOW	1	1	1	1	1
FRONT O-RING	1	1	1	1	1
DIAPHRAGM(1)	1	1	1	1	2(1-LC:1-BC)
REAR COVER	1	1	1	1	2(1-LC:1-BC)
COVER SCREWS	4	4	-	-	-
THROTTLE SCREWS	2	2	2	2	2
GARTER SPRING	–	1	1	1	1
FILL IDENTIFICATION	1	1	1	1	1
THREADED RING	–	–	1	1	1
TOP FILL PLUG	–	–	1	1	–

1. When Halocarbon fill is a requirement, rear case diaphragm bladder material is Viton instead of the standard Buna diaphragm bladder. Consult factory for part number.

TEMPERATURE LIMITS[1]				60 psi and Under Down Scale Zero Shift Required
	Ambient	Process	Storage	
Dry (IP66)	–20/200°F (–29/93°C)	–20/250°F(1) (–29/121°C)	–40/250°F (–40/121°C)	NONE
LF (glycerin)	20/150°F (7/66°C)	20/200°F (7/93°C)	0/150°F (–18/66°C)	NONE
(silicone)	–40/150°F (–40/66°C)	–40/200°F (–40/93°C)	–40/150°F (–40/66°C)	.12 psi
(halocarbon)	–40/150°F (–40/66°C)	–40/200°F (–40/93°C)	–40/150°F (–40/66°C)	.12 psi

Note: Other than discoloration of the dial and hardening of the gasketing that may occur as ambient or process temperatures exceeds 150°F, non-liquid-filled gauges with standard glass windows, can withstand continuous operating temperatures up to 250°F (121°C). Liquid-filled gauges can withstand 200°F (93°C) but glycerin fill and acrylic window will tend to yellow. Accuracy at temperatures above or below the reference ambient temperature of 68°F will be affected by approximately .4% per 25°F. Gauges with welded joints will withstand 750°F (450°F (232°C) with silver brazed joints) for short times without rupture, although other parts of the gauge will be destroyed and calibration will be lost. For continuous use and for process or ambient temperatures above 250°F (121°C), a diaphragm seal or capillary or siphon is recommended.
(1) Available for temperature below –20°F, see Production Information page ASH-PI-21B for details

1. Unscrew front threaded ring (turn CCW). Remove and discard glass window. For range spans 60 psi and under, shift pointer down scale by the amount shown in the table. With either the glass or plastic window, replace the O-ring with one furnished in the kit.
2. Remove protective paper from acrylic plastic window taking care not to scratch window. Assemble window in gauge.
3. Moisten face of threaded ring with silicone oil or silicone grease where ring bears up against window. Replace front threaded ring and tighten firmly hand tight. See instructions on reverse side for applying proper torque to ring to establish desired squeeze on O-ring seal. **(Fig. 4).**
It is important to hold gauge **rigidly,** otherwise ring lugs may be damaged during removal or assembly process.
4. From rear of gauge, remove and discard these parts: rear cover and cover gaskets from case.
Note: Disregard Step Nos. 5a and 5b if converting to hermetically sealed version.
When converting a 45-1379 with the top fill hole configuration, p/n 256A176-01 fill plug is required and must be ordered separately.
5. Filling Procedures:
a. Manual Filling Procedure: Place gauge face down on bench and **tip gauge** by blocking up front with a ⅜ inch block at the 12 o'clock dial position. Tipping of the gauge is necessary so fluid will flow into front cavity of the case. Pour in fill liquid to within about 1⁄16 inch of rear seal lip. When bubbles stop rising, front cavity is filled. Remove ⅜ inch block and pour in liquid until level is about 1⁄16 inch below rear sealing lip.
Note: An alternative method of filling is to fill the front dial cavity, adding the front window, etc., as in Step No. 3. Then fill the rear of the gauge. This method eliminates the need to tip the gauge.
b. Vacuum Pump Fill Procedure: (This procedure is recommended when filling a large number of gauges.) Place gauge face down and insert a ⅛ inch diameter tube, connected to a vacuum pump, through the 12 o'clock position hole in the rear, solid front portion of the case **(see Fig. 5).** Evacuate the air from the front dial cavity while pouring in the fill fluid through the case back. The vacuum will displace the air with fluid. When the dial cavity is solidly filled, remove the tubing and continue to pour the fill fluid to within 1⁄16 inch BELOW the O-ring channel lip.
Pre-measuring fill amount is not necessary with above methods. For reference, amount of fill is approximately 400 ml. or 14 fluid oz. (4½˝ GA.) and 455 ml. or 16 fluid oz. (6˝ GA.).
c. Note: The liquid fill level should be ⅜˝ (±⅛) as measured from the inside of the ring at the 12:00 o'clock position.
6. On lower connection gauges, assemble rear seal diaphragm to case.
For back connection gauges see instructions on reverse side. **(Fig. 2/4).**
7. For 1279:
Assemble rear cover and six self tapping screws in a criss-cross pattern and torque to 12 in lbs. (±2 in lbs.)
For 1379:
- Thread rear ring and torque to 200 in lbs
- Install stainless steel back cover using two screws. Torque screws to 14 in lbs. (±2 in lbs.)

8. Assemble throttle screw to threaded hole in socket.
Note: If system is monel (socket wrench flat stamped "PHS" or "PH") use monel throttle screw.
9. Check appropriate box on fill identification label, and peel off label back, and attach fill label to gauge case.
10. If gauge is to be repackaged:
a. Include enclosed instruction sheet inside carton.
b. Change type number on carton label to:
(1) Hermetically Sealed – 1279(*)SH.
(2) Liquid Filled – 1279(*)SL.
*Bourdon Tube System Code

Glycerin or silicone should not be used in applications involving Oxygen, Chlorine, Nitric Acid, Hydrogen Peroxide or other strong oxidizing agents, because of danger of spontaneous chemical reaction, ignition or explosion. Halocarbon should be specified. Products with this fill can be ordered from factory.

The use of fluids other than those listed in the table above (for example, Hydrocarbon-based oils) may result in leakage caused by a reaction between the fluid and the elastomeric seals. Consult the factory before filling with any other fluid.

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TYPE 1279 & 1379 SOLID FRONT DURAGAUGE®
PRESSURE GAUGE CONVERSION INSTRUCTIONS TO:

- **Convert A Standard Dry Gauge To A Liquid Filled Gauge**
- **Convert A Standard Dry Gauge To A Dry, Weatherproof IP66 Gauge**

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INSTRUCTIONS FOR USING CONE TOOL AND RING WRENCH

Garter Spring & Diaphragm Assembly (Back Connection Gauge Only)

A. Place cone tool over socket shank as shown.

B. Moisten lip of socket and outer O-ring surface with silicone oil or grease.

C. Place diaphragm with rib side facing upward over cone into case grove. Diaphragm O-ring must be completely in socket-shank grove.

D. Place garter spring over cone as shown and slide onto diaphragm in socket grove

E. Assemble rear cover with screws per step 7.

Front Ring Assembly (All Gauges)

A. Assemble ring to case by hand to start.

B. Place ring on wrench as shown

C. Use ½˝ drive extension and torque ring to 200 in. lb

Alternate Method

A. Tighten ring snugly by hand

B. Mark case and ring.

C. Turn ring another 100 to 120 degrees (slightly less than ½ turn) using the ring wrench and ½˝ drive socket wrench or place the blunt end of a wooden or plastic dowel against a ring lug and tap with a hammer.

BACK CONNECTION ASSEMBLED GAUGE

Fig. 2

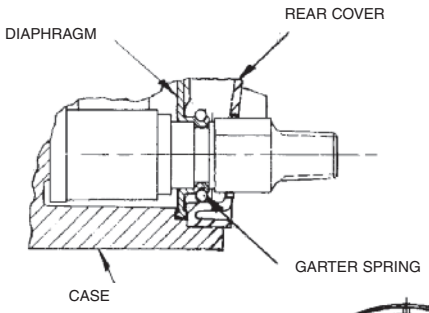


Fig. 3

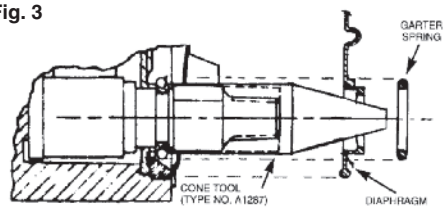
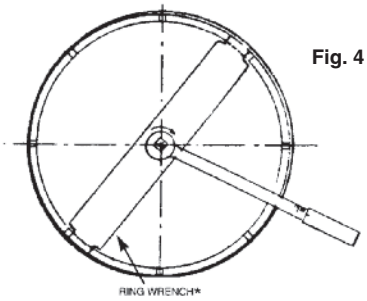


Fig. 4



INSTRUCTIONS FOR LIQUID FILLING ASHCROFT® TYPE 1279 AND 1379 SOLID FRONT DURAGAUGE® PRESSURE GAUGES USING A VACUUM PUMP

A. Insert a length of ⅛ ˝ diameter tubing through the 12 o'clock position hole in the rear, solid front portion of the case, as shown.

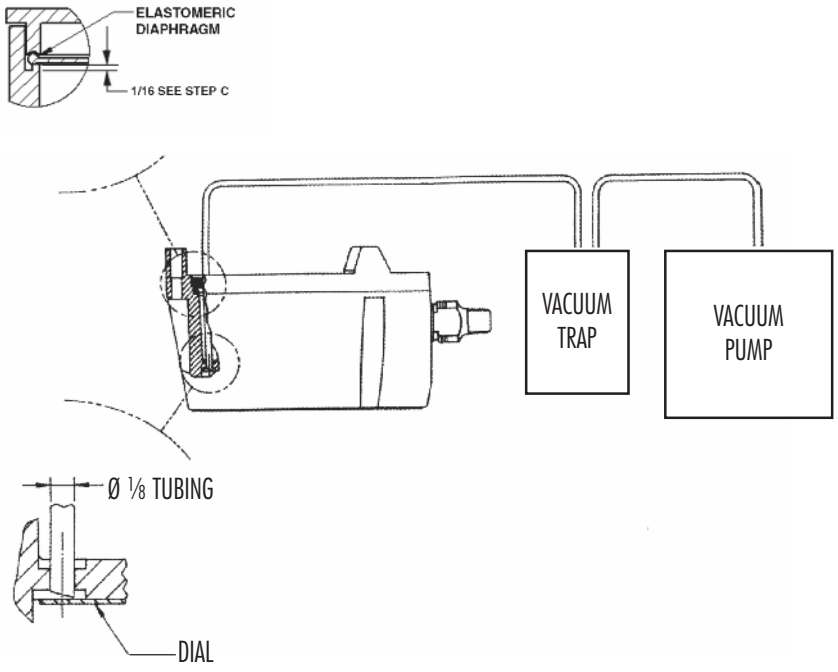
B. Evacuate the air from the front dial cavity while pouring in the fill fluid through the case back. The vacuum will displace the air with fluid.*

C. When the dial cavity is solidly filled, remove the tubing and continue to pour the fill fluid to within 1/16 ˝ below the o-ring channel lip, as shown.

D. When converting a 45-1379 with the top fill hole configuration, p/n 256A176-01 fill plug is required and must be ordered separately.

*To prevent breakage, reduce vacuum to 15 in. Hg for plain glass and safety glass.

Fig. 5



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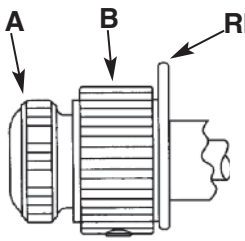
INSTRUCTIONS FOR USE OF EXTERNAL EASY ZERO™ ADJUST FEATURE*

Fig. 1



1. LOOSEN RING-LOCKING SCREW **A**.
2. OBTAIN REQUIRED ADJUSTMENT BY ROTATING KNOB **B** CLOCKWISE OR COUNTER-CLOCKWISE.
3. TIGHTEN SCREW **A** DOWN ON KNOB **B**.

*Applicable only for test gauge with hinged ring design.

ADDITIONAL CALIBRATION INSTRUCTIONS

1) "Standards shall have nominal errors no greater than ¼ of these permitted for the gauge being tested." *(Ref: ASME B40=100-1998)*
2) The instrument used as the calibration standard should have a maximum range no greater than 2x that of the gauge being tested. (i.e. Do not use a 400psi standard to test a 15psi gauge.)
3) "Known pressure shall be applied at each test point on increasing pressure (or vacuum) from one end to the other end of the scale. At each test point the gauge shall be . . .
lightly tapped, and then read . . ."
(*Ref: ASME B40.1 ¶ 6.2.4.1*)
4) To read gauge indication, move eye over red pointer tip at OD of printed dial until red reflection in mirror band is no longer visible, and then read the pointer position in reference to the dial.

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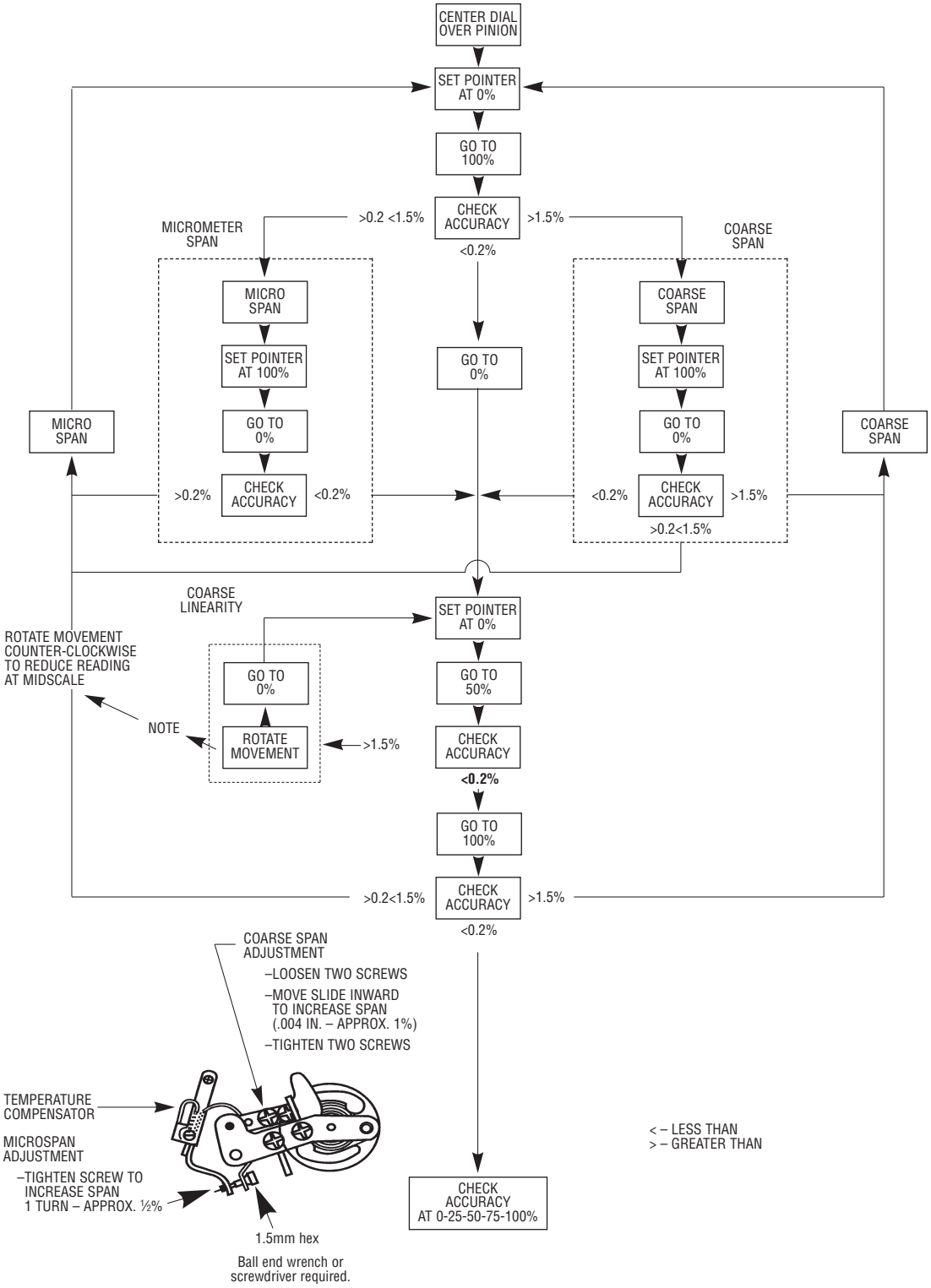
Installation and Maintenance Instructions for ASHCROFT® Type 1082 Test Gauge Calibration Procedure – Pressure Range

Fig. 2

THIS TEST GAUGE IS PROVIDED WITH A MICROSPAN™ ADJUSTMENT TO SIMPLIFY CALIBRATION. THE FLOW CHART BELOW OUTLINES THE RECOMMENDED CALIBRATION PROCEDURE



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I&M008-10098-5/02 (250-1353-L) Rev. 12/15

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INSTALLATION AND MAINTENANCE INSTRUCTIONS FOR ALL ASHCROFT® BIMETAL DIAL THERMOMETERS

ASHCROFT®

GENERAL

In removing the thermometer out of the packing box, handle it by the case or case outlet. Avoid handling it by the stem.

INSTALLATION OF THERMOMETERS

The thermometer should be mounted at any convenient location where it will be subjected to the average temperature variations to be indicated.

For an EVERYANGLE CONNECTION PLEASE REFER TO THE REVERSE SIDE OF THIS DOCUMENT before beginning the installation.

Avoid bending the stem as this will cause misalignment of the internal parts, resulting in undue frictional errors.

To tighten the thermometer to the apparatus, use a wrench applied to the hexagon head of the threaded connection located just outside of the case.

INSTALLATION

Locate the stem so that at least two inches will be subjected to the average temperature to be measured.

Exposing the stem to a temperature in excess of the highest dial reading should be avoided.

The thermometer is normally provided with a threaded connection. To tighten the thermometer to the apparatus or into the well, use an open-end wrench applied to the hexagon head of the threaded connection.Turn until reasonably tight, then tighten still further in the same manner as a pipe elbow or similar pipe fitting until the scale is in the desired position for reading. DO NOT TIGHTEN BY TURNING THE THERMOMETER CASE. Install the dry type thermometer so that the maximum case temperature is kept below 200°F at all times. Install the liquid filled type thermometer so that the maximum case temperature is kept below 150°F at all times.

When a thermometer is equipped with a well, the well should be installed onto the apparatus first. The stem of the thermometer should then be coated with a heat conducting medium (a mixture of glycerin and graphite or vaseline or any other heavy lubricant may be used), after which the thermometer stem is inserted, and tightened into the well.

CAUTION:
Thermowells should be used on all pressurized applications, to protect the thermometer from corrosion or physical damage, and to facilitate removal of the thermometer without disturbing the process.

TESTING

Ashcroft Bimetal Dial Thermometers are carefully calibrated at the factory and under most operating conditions will retain their accuracy indefinitely. However, as in the case of all instruments, it is well to make periodic checks for accuracy against known standards.

ADJUSTMENT

If it is necessary to make an adjustment to the thermometer proceed as follows:

On thermometers fitted with an "External Adjustment" – Use a small wrench, small screwdriver or a coin to turn the slotted hexagon head in the back of the case until the pointer indicates the proper temperature on the dial.

MAINTENANCE OF DIAL THERMOMETERS

Aside from occasional testing, little or no maintenance is required.

Be sure that the gasketed glass cover is on the case at all times, as moisture and dirt inside the case will eventually cause the thermometer to lose its accuracy. (See caution note below.)

If the thermometer is used for measuring the temperature of a material that may harden and build up an insulating layer on the stem, the thermometer should be removed from the apparatus occasionally, and the stem cleaned. Observe this precaution to ensure the sensitivity of the instrument.

CAUTION:
Bimetal Thermometers operating below freezing must have a perfectly tight case to prevent entrance of moisture which eventually will condense and freeze inside the stem. This condition shows up as a failure of the thermometer to read accurately below 32°F or 0°C. For this reason it is important to avoid damage to the glass front while the stem temperature is at freezing or below. All thermometers are hermetically sealed in a dry atmosphere at the factory and require no further maintenance.

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INSTALLATION AND MAINTENANCE INSTRUCTIONS FOR ASHCROFT® BIMETAL THERMOMETERS WITH EVERYANGLE™ CONN.

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This thermometer was designed to be positioned to face the direction of easiest reading.

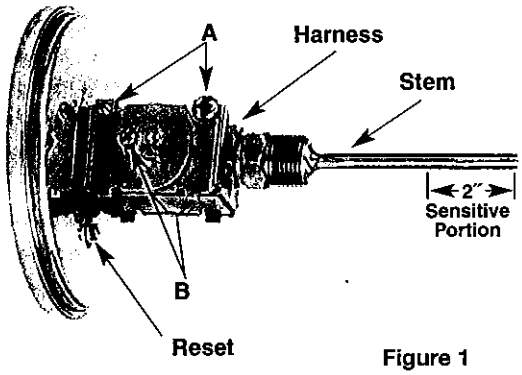

Figure 1

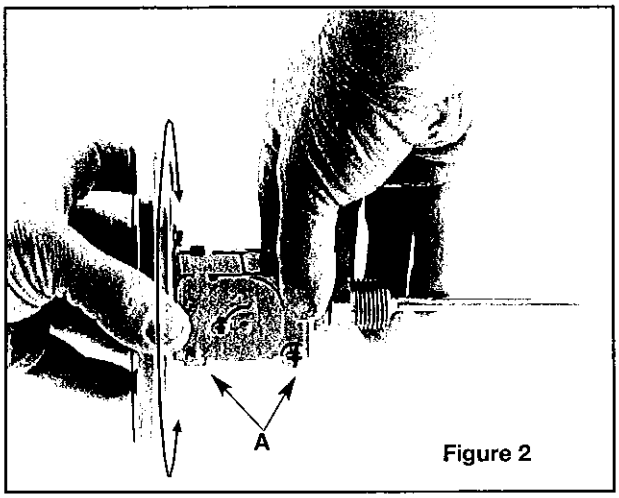

Figure 2

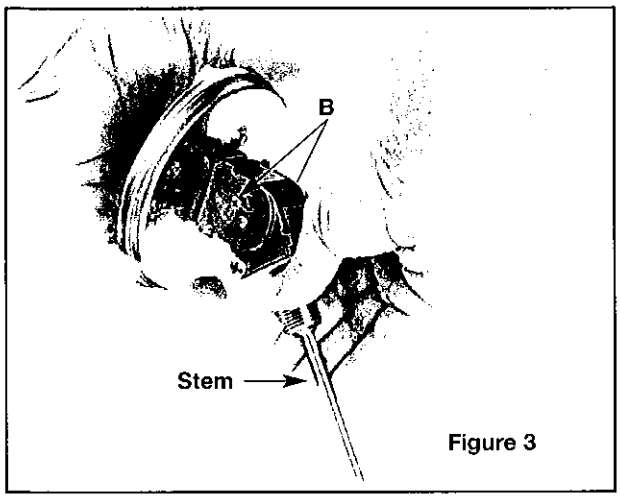

Figure 3

CAUTION: To assure longest life, the "EVERY- ANGLE" joint should be operated only when necessary during installation or removal of the thermometer.

POSITIONING THE STEM

Before installation, the stem should be set to the desired angle as follows:

Figure 1: Loosen the four screws labeled "A" and "B" in Figure 1, until the harness revolves freely without twisting the flexible housing.

Figure 2: While holding the case, revolve the harness clockwise or counterclockwise, as indicated by arrows in Figure 2, to place the harness in a position that will permit flexing the stem in the desired direction with respect to the case. Then lock the two screws labeled "A."

Figure 3: Flex the stem to the desired angle with respect to the face of the thermometer, as shown in Figure 3, then lock the two screws labeled "B."

INSTALLATION

The lower 2″ of the stem is the sensitive portion. Be sure this part of the stem is exposed to the temperature to be measured.

Tighten the thermometer to the apparatus or into the thermometer well, using an open-end wrench applied to the hexagon head of the connection bushing. Turn until reasonably tight, then tighten further (in the same manner as a pipe fitting) until the scale is in the desired position for reading.

DO NOT TIGHTEN BY TURNING THE THERMOMETER CASE OR THE HARNESS. INSTALL THE DRY TYPE EVERYANGLE THERMOMETER SO THAT THE MAXIMUM CASE TEMPERATURE IS KEPT BELOW 200°F. INSTALL THE LIQUID-FILLED TYPE EVERYANGLE THERMOMETER, SO THAT THE MAXIMUM CASE TEMPERATURE IS KEPT BELOW 150°F.

THERMOMETER WELLS

When the thermometer is equipped with a well, the well should first be removed from the thermometer and screwed into the apparatus.

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ASHCROFT®

Thermowells

75	W	0750	____	____	H	T	260	C	____	____	____	____
Size		U-Dimesion	Thread	Lagging	Shank	Type	Bore	Material	Cap & Chain	Facing	Rating	Special Lagging Length

Code	Inches
50	½
75	¾
10	1
12	1¼
15	1½
20	2
30	3
40	4

Code	Inches
0162	1⅝
0250	2½
0450	4½
0750	7½
1050	10½
1350	13½
1650	16½
1950	19½
2250	22½

Code	Inches
–	Without
L	With

Code	Type
T	NPT Thd.
W	Weld-in
F	Flanged
V	Van Stone
S	Socket Weld
M	Limited Space Threaded
G	Ground Joint
C	Sanitary

Code	Type
AA	Brass
B	Carbon Steel
C	AISI 304
S	AISI 316

Code	Rating #
150	150
300	300
600	600
1500	1500
2500	2500

Code	Internal Thread
–	½ NPSM

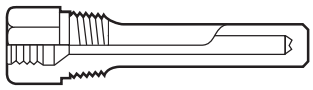
Code	Shank
H	Tapered
S	Straight
R	Stepped
B	Built-up

Code	Diameter
260	.260″
385	.385″

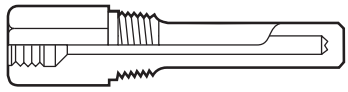
Code	Material
1	Brass
2	Stainless Steel

Code	Facing
F	Flat Face
R	Raised Face
J	Ring Joint
L	Lap Joint

Type: Straight (Uniform) Shank, Threaded
Bore Size: .385
Process Conn.: ½, ¾, 1 NPT, Wed-In
Materials: Brass, Carbon Steel
304 Stainless Steel, 316 Stainless Steel

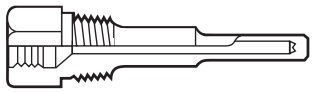


Standard Configuration

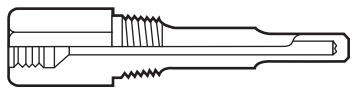


Lagging Configuration

Type: Stepped Shank, Threaded
Bore Size: .260
Process Conn.: ½, ¾, 1 NPT
Materials: Brass, Carbon Steel
304 Stainless Steel, 316 Stainless Steel

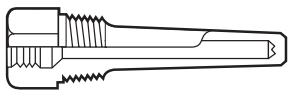


Standard Configuration

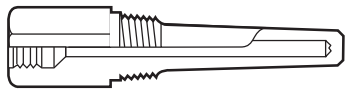


Lagging Configuration

Type: Tapered Shank, Threaded
Bore Size: .260, .385
Process Conn.: ½, ¾, 1 NPT
Materials: Brass, Carbon Steel
304 Stainless Steel, 316 Stainless Steel

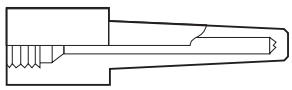


Standard Configuration

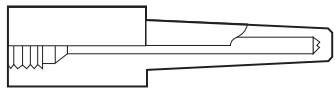


Lagging Configuration

Type: Socket Weld
Bore Size: .260, .385
Process Conn.: ¾″, 1″ Pipe Size
Materials: 304 Stainless Steel, 316 Stainless Steel, Carbon Steel

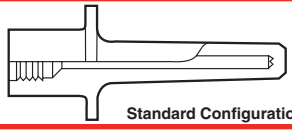


Standard Configuration



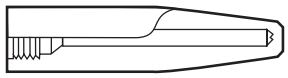
Lagging Configuration

Type: Van Stone
Bore Size: .260, .385
Process Conn.: 1,″ 1½″ Pipe Size
Materials: 304 Stainless Steel, 316 Stainless Steel



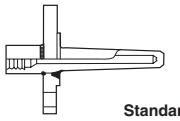
Standard Configuration

Type: Weld-in
Bore Size: .260, .385
Process Conn.: 1½″ Dia.
Materials: 304 Stainless Steel, 316 Stainless Steel



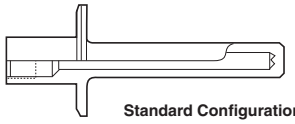
Standard Configuration

Type: Flanged
Bore Size: 260, .385
Process Conn.: 1″, 1½″, 2″ Pipe Size
Materials: 304 Stainless Steel, 316 Stainless Steel

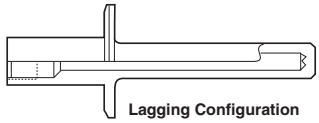


Standard Configuration

Type: Sanitary
Bore Size: .260, .385
Process Conn.: Tri-Clamp connection® 1″, 1½″, 2″
Materials: 304 Stainless Steel, 316 Stainless Steel



Standard Configuration



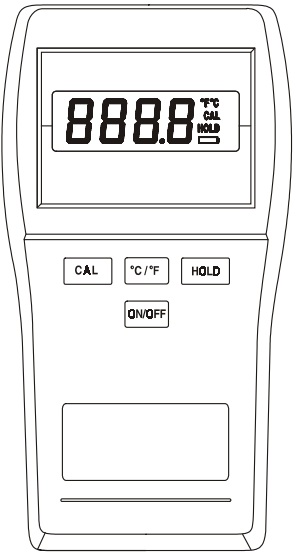
Lagging Configuration

Consult factory for guidance in product selection
Phone (203) 378-8281, Fax (203) 385-0499 or
visit our web site at www.ashcroft.com

OPERATING MANUAL

Thermocouple Thermometer Models

28-02700-J (Type J)
28-02700-K (Type K)
28-02700-T (Type T)



Pyro MATION, INC.
5211 Industrial Road
Fort Wayne, Indiana U.S.A. 46825

(260) 484-2580
(260) 482-6805 (Fax)

A-1299-0680
Edition 05

CERTIFICATE OF CONFORMANCE

This thermometer was calibrated using equipment traceable to the National Institute of Standards and Technology (NIST).

This instrument conforms to NIST monograph 175 revised to ITS-90.

The accuracy of the thermometer at the time of calibration was within specifications stated in the operating manual.

Model No.:_____

Serial Number:_____

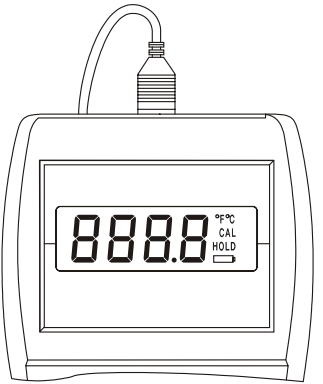
Date placed in service:_____

To purchase an NIST certificate of traceability with test data and test date for meter and probe, please contact your dealer or:

PYROMATION
5211 Industrial Road
Fort Wayne, Indiana U.S.A. 46825

260-484-2580

INTRODUCTION



This versatile hand-held instrument provides highly accurate temperature measurements. The instrument is designed for easy operation and includes the following features:

- Operator selection of Celsius or Fahrenheit scale
- Resolution of 0.1° from –99.9 to 299.9°
- Four-digit LCD
- Hold feature for temporarily retaining a reading
- Field calibration capability
- Low battery warning
- Built-in tilt stand for easy hands-free operation
- Two blade female ANSI mini-connector input
- Operates with a wide selection of probes

SAFETY PRECAUTIONS

⚠ WARNING *THIS INSTRUMENT IS DESIGNED TO ACCEPT LOW LEVEL SIGNALS SUPPLIED BY STANDARD THERMOCOUPLES. UNDER NO CIRCUMSTANCES SHOULD THE INPUT VOLTAGE EXCEED THE SPECIFIED 50V RMS.*

⚠ CAUTION *DO NOT USE OR STORE THIS INSTRUMENT IN MICROWAVE OVENS OR ANY ABNORMALLY HOT OR COLD AREAS.*

⚠ CAUTION *WEAK BATTERIES SHOULD NOT BE LEFT IN THE INSTRUMENT. DEAD BATTERIES CAN LEAK AND CAUSE DAMAGE TO UNIT.*

⚠ DANGER *VOLTAGES PRESENT AT THE THERMOCOUPLE MAY ALSO BE PRESENT AT THE BATTERY TERMINALS. ALWAYS DISCONNECT THE THERMOCOUPLE WHEN CHANGING BATTERIES.*

⚠ WARNING *TO PREVENT IGNITION OF A HAZARDOUS ATMOSPHERE, BATTERIES MUST ONLY BE CHANGED IN AN AREA KNOWN TO BE NON-HAZARDOUS.*

⚠ AVERTISSEMENT *AFIN DE PREVENIR L'INFLAMMATION D'ATMOSPHERES DANGEREUSES, NE CHANGER LES BATTERIES QUE DANS DES EMPLACEMENTS DESIGNES NON DANGEREUX.*

⚠ WARNING *TO PREVENT IGNITION OF A HAZARDOUS ATMOSPHERE BY ELECTROSTATIC DISCHARGE, CLEAN WITH DAMP CLOTH.*

SPECIFICATIONS

THERMOCOUPLE PROBES

Type	Temperature Range
Type J:	–200°C to 1000°C (–328°F to 1832°F)
Type K:	–250°C to 1372°C (–418°F to 2501°F)
Type T:	–250°C to 400°C (–418°F to 752°F)

Out of range display: - - - -

Resolution: 0.1°/1° autoranging, 0.1° from –99.9° to 299.9°, 1° outside this range.

Accuracy

> –99.9°: ±(0.2% of reading ±0.5°C)
±(0.2% of reading ±0.9°F)

< –99.9°: ±(0.25% of reading, ±1°C)
±(0.25% of reading ±2°F)

Display: 4-digit LCD with 0.5 in high numerals.

Display update rate: 0.6 sec per update.

Input: One thermocouple with ANSI connector.

Input Protection: 50V rms

Battery: Two AA, 1.5V alkaline ANSI-L40, IEC-LR6.

Battery Life: 750 hours continuous, typical.

Low battery indication

Battery Symbol on when 8 to 10 hours of battery life remains.
Battery symbol blinking: replace battery

Operating Conditions

Stated accuracy: 18°C to 28°C (64°F to 82°F)
Useful range: 0°C to 40°C (32°F to 104°F)
Storage: –40°C to 65°C (–40°F to 149°F)
Humidity (non-condensing): 10% to 90%

Dimensions

3 cm D x 8.4 cm W x 15.8 cm H
(1.2 in x 3.3 in x 6.2 in)

Weight with batteries: 227 grams (8 ounces)

Ingress protection: Meets IEC-529 IP-54 for dust and water-resistant enclosures.

Intrinsic safety

This product is energy limited for intrinsically safe operation in hydrogen atmospheres per Class I, Division 1, Groups A, B, C and D hazardous (classified) locations for UL per UL913 and CSA per C22.2 No. 0-M1982 and No. 157-M1987. Maximum surface temperature: 135°C (T4); UL file No. E182612 (1997).

Compliance: (For CE Mark)

EN61326-1/A1: 1998 (EU EMC Directive)

BATTERY INSTALLATION AND REPLACEMENT

⚠ CAUTION *WEAK BATTERIES SHOULD NOT BE LEFT IN THE INSTRUMENT. DEAD BATTERIES CAN LEAK AND CAUSE DAMAGE TO UNIT.*

⚠ DANGER *VOLTAGES PRESENT AT THE THERMOCOUPLE MAY ALSO BE PRESENT AT THE BATTERY TERMINALS. ALWAYS DISCONNECT THE THERMOCOUPLE WHEN CHANGING BATTERIES.*

⚠ WARNING *TO PREVENT IGNITION OF A HAZARDOUS ATMOSPHERE, BATTERIES MUST ONLY BE CHANGED IN AN AREA KNOWN TO BE NON-HAZARDOUS.*

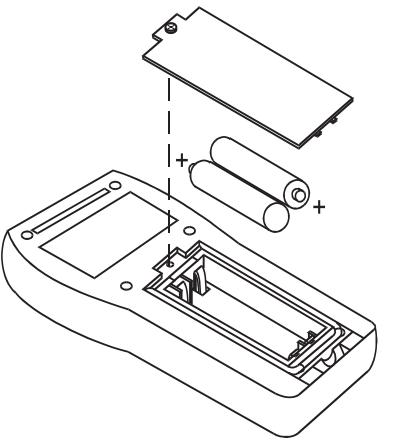
⚠ AVERTISSEMENT *AFIN DE PREVENIR L'INFLAMMATION D'ATMOSPHERES DANGEREUSES, NE CHANGER LES BATTERIES QUE DANS DES EMPLACEMENTS DESIGNES NON DANGEREUX.*

If battery indicator turns on, battery life is approximately 8 to 10 hours. The battery indicator will start blinking with less than 1 hour of life remaining.

AT THIS POINT, BATTERY MUST BE CHANGED. IF BATTERY VOLTAGE GOES TOO LOW, DISPLAY WILL GO BLANK.

See SPECIFICATIONS for battery type.

1. Before changing battery, turn instrument off and disconnect thermocouple.
2. Loosen screw and lift battery cover off back of case.
3. Remove the two AA batteries.
4. Insert two new batteries observing polarity.
5. Install cover and tighten screw.

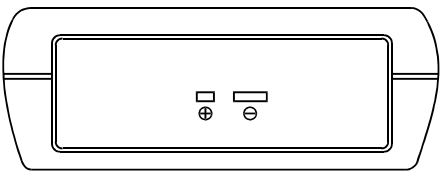


CONNECTING A THERMOCOUPLE

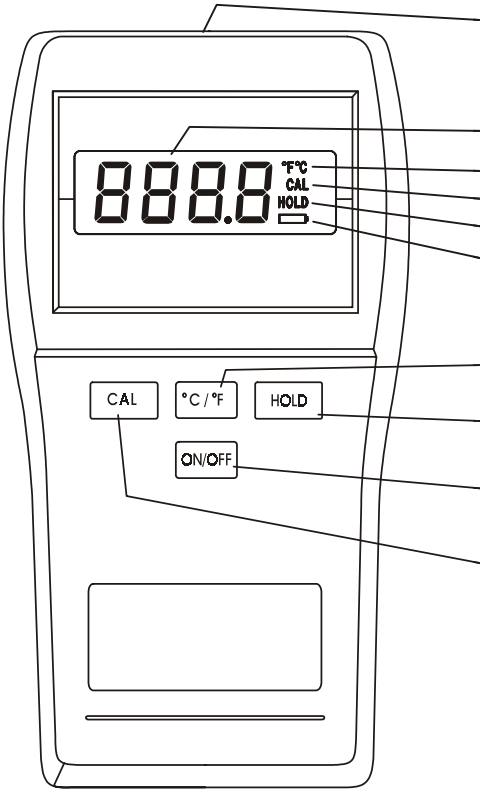
Use the correct thermocouple type for your instrument. Using an incorrect thermocouple type will result in erroneous readings. Thermocouples are color coded by type using the North American ANSI Color Code as follows:

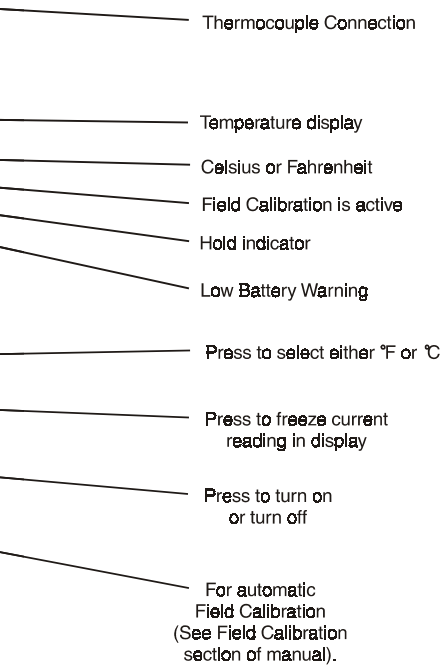
TYPE	COLOR
J	Black
K	Yellow
T	Blue

Thermocouple connectors have one wide blade and one narrow blade. *Do not force connector in backwards.* Connect thermocouple to receptacle at top of instrument as shown in the following illustration.



Thermocouple wiring polarity must be correct. If readings decrease as the temperature increases, the thermocouple wires may be reversed. The red wire is negative for thermocouple wires manufactured in North America.


888.8
°F°C
CAL
HOLD
CAL
°C / °F
HOLD
ON/OFF


Thermocouple Connection
Temperature display
Celsius or Fahrenheit
Field Calibration is active
Hold indicator
Low Battery Warning
Press to select either °F or °C
Press to freeze current reading in display
Press to turn on or turn off
For automatic Field Calibration (See Field Calibration section of manual).

OPERATION

Note: Be sure the thermocouple you are using matches the instrument setting indicated on the unit.

1. Press the **ON/OFF** key. The thermometer performs a self-test and all display digits and indicators, as shown below, should remain on for approximately two seconds.

2. If a thermocouple is not connected or if the thermocouple is defective, the display will indicate OPEn.

3. Select °C or °F by pressing the **°C/°F** key. Temperature scale can be switched at any time. The thermometer remembers the last selected scale the next time you turn the power on.

4. For optimum instrument accuracy, allow one minute for ambient temperature stabilization. If the unit has been stored at an extreme ambient condition, more time will be needed.

Thermocouples are sensitive at the tip or measuring junction. When taking temperature measurements, allow time for the reading to stabilize. Multiplying the time constant of the probe by 5 will give you the approximate time required.

Note that the readings will automatically change to 1° resolution below –99.9° or above 299.9°.

If desired, press the **HOLD** key to retain the reading on the display. Press **HOLD** key again for normal operation.

If the display shows "- - - -" the temperature reading is out of range of the instrument.

FIELD CALIBRATION

The thermometer is factory calibrated and does not require calibration before use. The CAL function allows single point calibration of the thermometer, at 0°C (32°F) to compensate for thermocouple offset error. It is not necessary to perform a field calibration to obtain specified meter accuracy. Use the field calibration feature to improve thermometer/probe accuracy or to compensate for thermocouple drift.

1. Follow steps 1 through 4 in **OPERATION** section.
2. Pack sensing end of probe in a container tightly packed with crushed ice and filled with distilled water. Allow temperature to stabilize.
3. Press and hold the **CAL** key for 5 seconds to enter the calibration mode, the CAL annunciator on the display starts blinking. Release the **CAL** key.
4. If the measured temperature is from –10°C to 10°C (14 to 50°F), when the temperature reading is stable, press the **CAL** key.

   The **CAL** indicator will stop blinking and the reading will be set to 0°C (32°F). The CAL indicator will remain turned on, indicating a field calibration is active.

If "Err" is displayed, either the displayed reading is outside the above limits or the batteries are weak.

CANCELING A FIELD CALIBRATION

1. Turn the thermometer off.
2. Hold the **CAL** key down while pressing the **ON/OFF** key.

The field calibration is canceled and the thermometer reverts to the default factory calibration. The CAL annunciator is now turned off.

FIELD CALIBRATION LOCKOUT AND RE-ENABLE

The calibration lockout feature, prevents any field calibration changes. The lockout remains in effect until a lockout re-enable has been performed. Use the following procedures to lockout or re-enable the field calibration operation.

Lockout Procedure

1. Turn the thermometer off.
2. Simultaneously press and hold the **CAL** and the **°C/°F** keys down and momentarily press the **ON/OFF** key. Continue to hold the **CAL** and **°C/°F** keys for at least 5 seconds.

Re-Enable Procedure

1. Turn the thermometer off.
2. Simultaneously press and hold the **HOLD** and the **CAL** keys down and momentarily press the **ON/OFF** key. Continue to hold the **HOLD** and **CAL** keys until the display blanks.

MAINTENANCE

Properly used, the thermometer should maintain calibration indefinitely and not require service other than occasional cleaning of the housing and changing of the batteries.

CLEANING

⚠ WARNING *TO PREVENT IGNITION OF A HAZARDOUS ATMOSPHERE BY ELECTROSTATIC DISCHARGE, CLEAN WITH DAMP CLOTH.*

Do not clean with abrasives or solvents. Use mild detergents, never immerse nor use excessive fluid.

BATTERIES

If there is no display when the thermometer is turned on, check condition of the two AA batteries. Also check that the battery terminals are clean and batteries are properly installed. If replacement is necessary, refer to the BATTERY INSTALLATION AND REPLACEMENT section for replacement procedure.

SERVICE

⚠ WARNING *SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY.*

⚠ AVERTISSEMENT *LA SUBSTITUTION DE COMPOSANTS PEUT COMPROMETTRE LA SECURITE INTRINSEQUE.*

There are no internal adjustments or user replaceable parts.

If "Err" followed by the numbers 1 through 9 is displayed (see example below) return unit for service. Note that "Err" alone may be displayed during improper field calibration.

Note: Serial number label is located inside battery compartment.

A-1925-32
Rev. E
Printed in U.S.A.
050798

WARRANTY

The Manufacturer warrants this product to be free from significant deviations from published specifications. If repair or adjustment is necessary within the warranty period, the problem will be corrected at no charge if it is not due to misuse or abuse on your part as determined by the Manufacturer. Repair costs outside the warranty period, or those resulting from product misuse or abuse, may be invoiced to you.

The warranty period for this product is noted on the Warranty Card.

PRODUCT RETURN

To limit charges and delays, contact the seller or Manufacturer for authorization and shipping instructions before returning the product, either within or outside of the warranty period. When returning the product, please state the reason for the return. For your protection, pack the product carefully and insure it against possible damage or loss. Any damages resulting from improper packaging are your responsibility.

TECHNICAL ASSISTANCE

If you have any questions about the use of this product, contact the Manufacturer or authorized seller.

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A-3477-57
Rev. E
Printed in U.S.A.
051000

120 Series Explosion-Proof Pressure and Differential Pressure Switches

Types
J120, J120K, H121, H121K, H122, H122K, H122P

UNITED ELECTRIC CONTROLS

Installation and Maintenance Instructions

Please read all instructional literature carefully and thoroughly before starting. Refer to the final page for the listing of Recommended Practices, Liabilities and Warranties.

GENERAL

MISUSE OF THIS PRODUCT MAY CAUSE EXPLOSION AND PERSONAL INJURY. THESE INSTRUCTIONS MUST BE THOROUGHLY READ AND UNDERSTOOD BEFORE UNIT IS INSTALLED.

THIS EQUIPMENT IS SUITABLE FOR USE IN CLASS I, DIVISION 1, GROUPS B, C AND D; CLASS II, DIVISION 1, GROUPS E, F AND G; CLASS III; OR NON-HAZARDOUS LOCATIONS ONLY. ENCLOSURE TYPE 4X, 7 & 9.

THIS EQUIPMENT IS ATEX CERTIFIED FOR EQUIPMENT CATEGORY 2. SUITABLE FOR APPROPRIATE USE IN GAS ZONE 1 & DUST ZONE 21 APPLICATIONS.

CE DEMKO 09 ATEX 0815573X
0539 IECEx UL 03.0001X

Ex II 2 G Ex d IIC T6 Gb
Ex II 2 D Ex tb IIIC T85°C Db IP66
-40°C ≤ TAMB. ≤ + 75°C

BEFORE INSTALLING, CHECK THE SENSOR MODEL SELECTED FOR COMPATIBILITY TO THE PROCESS MEDIA IN CONTACT WITH THE SENSOR AND WETTED PARTS.

PROOF PRESSURE* LIMITS STATED IN THE LITERATURE AND ON NAMEPLATES MUST NEVER BE EXCEEDED, EVEN BY SURGES IN THE SYSTEM. OCCASIONAL OPERATION OF UNIT UP TO MAXIMUM PRESSURE IS ACCEPTABLE (E.G., START-UP, TESTING). CONTINUOUS OPERATION SHOULD NOT EXCEED THE DESIGNATED OVER RANGE PRESSURE** OR WORKING PRESSURE RANGE***.

*Proof Pressure: The maximum pressure to which a pressure sensor may be occasionally subjected, which causes no permanent damage (e.g., start-up testing). The unit may require re-gapping. (See Part II- Adjustments)

**Over Range Pressure: The maximum pressure to which a pressure sensor may be continuously subjected without causing damage and maintaining set point repeatability.

***Working Pressure Range The pressure range within which two opposing sensors can be safely operated and still maintain set point repeatability.

THESE PRODUCTS DO NOT HAVE ANY FIELD REPLACEABLE PARTS. ANY SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 1.

TO PREVENT IGNITION OF HAZARDOUS ATMOSPHERES, DISCONNECT SUPPLY CIRCUITS BEFORE OPENING. KEEP COVER TIGHT WHILE CIRCUITS ALIVE.

The 120 Series pressure and differential pressure switches are actuated when a bellows, diaphragm or piston sensor responds to a pressure change. This response at a pre-determined set point(s) actuates a SPDT, DPDT or dual SPDT snap-acting microswitch(es), which convert the pressure signal into an electrical signal. Control set point(s) may be varied by turning the internal adjustment hex (J120 & J120K models) or the external knob and pointer(s) (H121, H121K, H122, H122K & H122P models, see picture above) according to the procedures outlined. (See Part II - Adjustments)

Please refer to product bulletin for product specifications. Product bulletins may be found at www.ueonline.com.

Date code format on nameplate is "YYWW" for year and week.

Part I -Installation

Tools Needed—Screwdriver/Adjustable Wrench to 1-1/2"

MOUNTING

THE CONNECTION OF THE DEVICE SHALL BE MADE BY CABLE ENTRIES OR A STOPPING BOX CERTIFIED IN TYPE OF EXPLOSION PROTECTION FLAMEPROOF ENCLOSURE 'd,' SUITABLE FOR THE CONDITIONS OF USE AND CORRECTLY INSTALLED.

TO PREVENT IGNITION, SEAL ALL CONDUIT RUNS WITHIN 18 INCHES OF ENCLOSURE.

ALWAYS HOLD A WRENCH ON THE PRESSURE HOUSING HEX WHEN MOUNTING UNIT. DO NOT TIGHTEN BY TURNING ENCLOSURE. THIS WILL DAMAGE SENSOR AND WEAKEN SOLDER OR WELDED JOINTS.

INSTALL UNITS WHERE SHOCK, VIBRATION AND TEMPERATURE FLUCTUATIONS ARE MINIMAL. MOUNT UNIT TO PREVENT MOISTURE FROM ENTERING THE ENCLOSURE. IT IS IMPERATIVE TO USE PROPERLY RATED EXPLOSION-PROOF SEALING FITTINGS FOR ELECTRICAL WIRE ENTRY. DO NOT MOUNT UNIT IN AMBIENT TEMPERATURES THAT EXCEED THE LIMITS ON THE NAMEPLATE FOR THE APPROPRIATE AREA.

J120 ENCLOSURES ARE PROVIDED WITH TWO 3/4" NPT ELECTRICAL CONDUIT OPENINGS, EITHER OF WHICH OR BOTH CAN BE USED DURING INSTALLATION. A 3/4" EXPLOSION PROOF PLUG* IS PROVIDED FOR PROPERLY SEALING THE UNUSED CONDUIT OPENING. THE EXPLOSION PROOF PLUG MUST BE PROPERLY SEALED DURING PRODUCT INSTALLATION.

*Plug is approved explosion proof with the product as a full assembly and does not carry individual markings.

Types J120, J120K, H121, H121K, H122, H122K, H122P

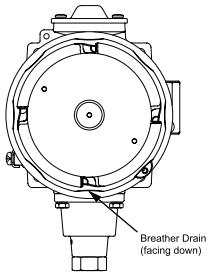


Figure 1a:
H121, H121K, H122, H122K, H122P

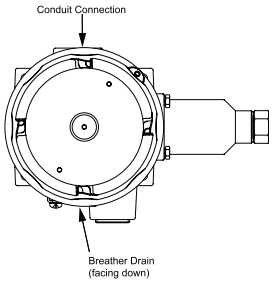


Figure 1b
J120, J120K

Mount controls vertically (pressure connection facing down, see Figure 1a) or horizontally (see Figure 1b). Control may be surface mounted via the four 1/4" screw holes on the enclosure or mounting bracket. It can also be mounted directly to a rigid pipe using the pressure connection.

Controls with Breather Drain (Option M450)

Type J120, J120K Models 455-559

Mount with breather drain facing down (See Figure 1b). The conduit connection must be "potted" for this type of installation.

Types H121, H122 & H122P, All Models

Mount in vertical position with pressure assembly and breather drain facing down (See Figure 1a).

Differential Pressure Types J120K, H121K, H122K
Opposed Sensor Models 36-39, (S)147(B)-(S)157(B), 367

"Opposed sensor" differential pressure switches should be mounted with their pressure connection in the horizontal position (See Figure 2). This will properly orient the 1/4" NPT venting conduit at the bottom of the middle compartment (standardly supplied with plastic plug).

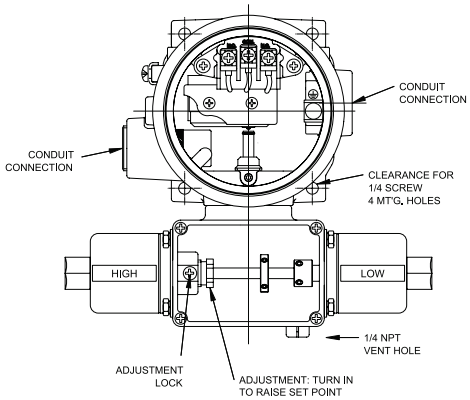


Figure 2
Opposed Sensor Models

On models supplied with an external manual reset button, be sure to leave sufficient finger space over the reset button for the operator to reset the control.

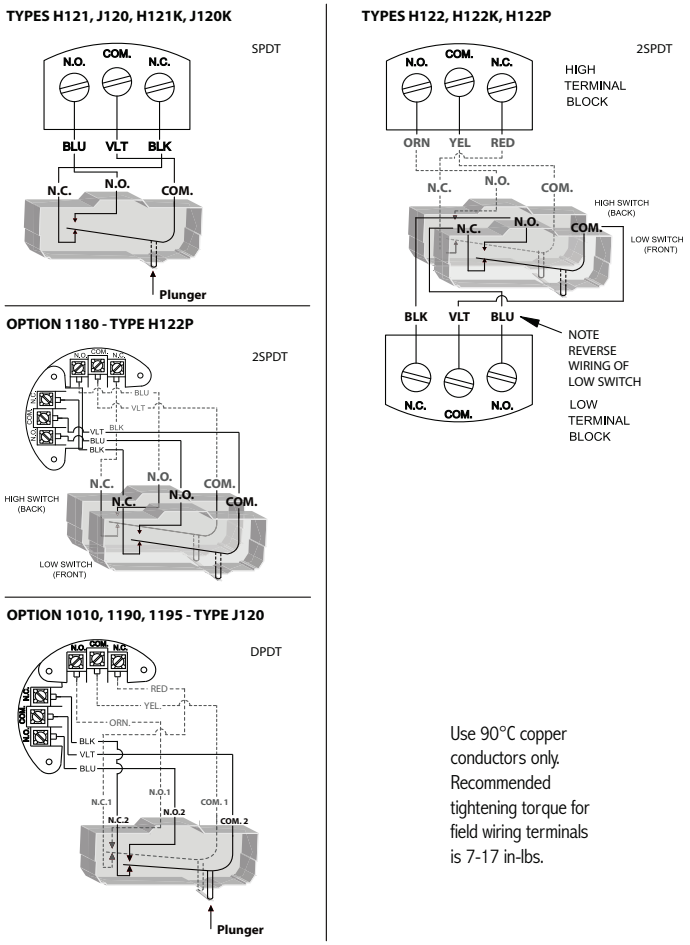


Figure 3

Use 90°C copper conductors only. Recommended tightening torque for field wiring terminals is 7-17 in-lbs.

WIRING

FIELD WIRING MUST BE RATED 90°C MINIMUM. FOR AMBIENT TEMPERATURES BELOW -10°C, USE SUITABLE FIELD WIRING.

DISCONNECT ALL SUPPLY CIRCUITS BEFORE WIRING UNIT. WIRE UNITS ACCORDING TO NATIONAL AND LOCAL ELECTRICAL CODES. MAXIMUM RECOMMENDED WIRE SIZE IS 14 AWG. THE RECOMMENDED TIGHTENING TORQUE FOR FIELD WIRING TERMINALS IS 7 TO 17 IN-LBS.

ELECTRICAL RATINGS STATED IN LITERATURE AND ON NAMEPLATES MUST NOT BE EXCEEDED—OVERLOAD ON A SWITCH CAN CAUSE FAILURE ON THE FIRST CYCLE.

TO PREVENT SEIZURE OF ENCLOSURE COVER, DO NOT REMOVE LUBRICANT. THREADS SHOULD ALSO BE FREE OF DIRT, ETC.

THE EXTERNAL GROUNDING TERMINAL IS NOT TO BE USED AS THE PRIMARY EQUIPMENT GROUNDING TERMINAL. THE INTERNAL GROUNDING TERMINAL SHALL BE USED AS THE PRIMARY EQUIPMENT GROUNDING MEANS AND THE EXTERNAL GROUNDING TERMINAL IS ONLY FOR A SUPPLEMENTAL (SECONDARY) GROUNDING CONNECTION WHERE LOCAL AUTHORITIES PERMIT OR REQUIRE SUCH A CONNECTION.

Remove cover and wire control (See Figure 3). Wire directly to the terminal block. An internal grounding terminal is located near the right-hand conduit opening. Replace cover and hand tighten to fully engage cover O-ring.

Part II - Adjustments

Tools Needed

Screwdriver
5/8" Open End Wrench
5/64" Allen Wrench

AFTER COMPLETING ADJUSTMENTS ON TYPE H121 AND H122 CONTROLS, BE SURE TO RE-INSTALL ADJUSTMENT COVER. DO NOT OVER TIGHTEN COVER SCREWS.

For set point adjustment and re-gapping (if necessary), connect control to a calibrated pressure source.

Types J120 (All) and J120K Models 455-559 (See Figure 4a)

Remove cover. Loosen phillips screw adjustment lock. Adjust set point by turning 5/8" hex adjustment screw clockwise (left) to raise set point, or counterclockwise (right) to lower set point. Secure adjustment screw by tightening adjustment lock.

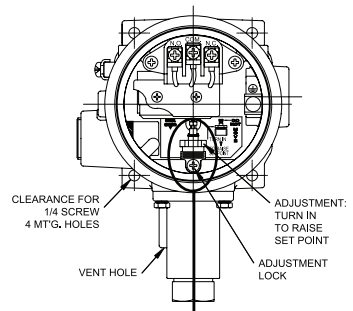


Figure 4a

J120K: Opposed Sensor, Models 36-39, 147-157, S147B, S157B, 367

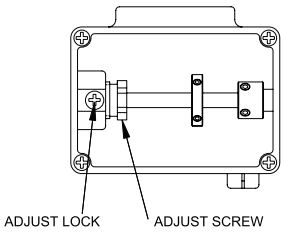
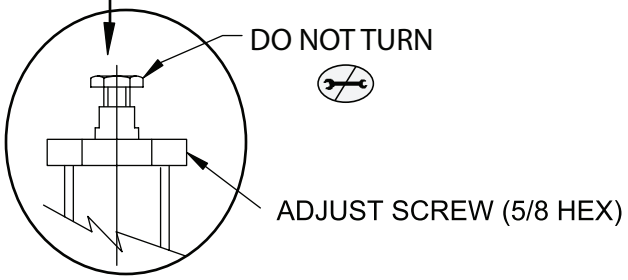


Figure 4b



Type J120K Models 36-39,147-S157B, & 367 (See Figure 4b)

Remove front cover and gasket from sensor assembly located below enclosure by unscrewing 4 phillips screws. Loosen phillips screw adjustment lock. Adjust set point by turning 5/8" hex screw clockwise (left) to increase setting or counterclockwise (right) to decrease setting. Adjusting screw should be locked by tightening adjustment lock.

Types H121, H121K

Adjust set point by turning external knob and pointer to desired setting on scale (see picture, page 1).

Types H122, H122K

Individual microswitches may be set together or separately by up to 100% of range. The front (Low) microswitch should never be set higher than the rear (High) microswitch. Turning external knobs will increase or decrease each switch setting independently (see picture, page 1).

Types H122P

Individual switches may be set together or separately by up to 60% of range. The front switch is set by turning the internal calibrating screw to the right for lower set point and turning to the left for higher set point. When not set together, the front switch should never be set higher than the rear switch. Turning the external knob will increase or decrease both switch settings simultaneously without disturbing their relationship (see picture, page 1).

Controls with Options

Types with Adjustable Deadband Switch (Select Models & Option 1519)

Models with option code 15622, 15834-15839, 15875 and types with option code 1519 incorporate a snap switch with integral adjustment wheel (see figure 5). Turing this wheel raises or lowers the pressure rise set point. The fall set point remains constant. To use the adjustable deadband switch:

1. Determine set point and deadband values. For example, a rising set point of 20 psi with a deadband value of 6 psi.
2. Set the falling set point at desired deadband value (determined by subtracting the deadband value from the desired set point) using the standard adjustment screw as outlined above. Using the example from step 1, 20 - 6 = 14, so you would set the fall set point at 14 psi. This is your constant.
3. Set your deadband by turning the adjustment wheel left to raise or right to lower the set point. Using the example from step 1, turn the wheel left or right until 20 psi is achieved. This is your set point.

Consult UE for additional information.

Type J120 and H121 with Option 1530, Manual Reset

This microswitch, when actuated, remains actuated until the pressure decreases and the reset button (located on the left side of the control) is manually depressed to reset the microswitch.

Option 1519 & Select Models

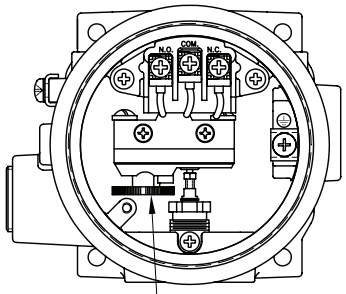


FIGURE 5

Option M210 Indicator for Differential Pressure Controls, Span Adjustment

(See Figure 6). To adjust indication for maximum accuracy at any desired set point, follow steps 1 thru 3 listed below:

1. Remove front window and gasket (four screws) to gain access to span adjustment.
2. Connect control to calibrated gauges and set required differential pressure.
3. Using a screwdriver, slowly turn the span adjustment to obtainrequired indication. Remount the front gasket and window.

NOTE: Spanning adjustment will not affect the mid-range indication. The adjustment is factory calibrated and sealed to indicate tampering.

DO NOT FORCE SPAN ADJUSTMENT, SINCE PERMANENT DEFORMATION OF THE LINKAGE MECHANISM MAY RESULT.

Option M210

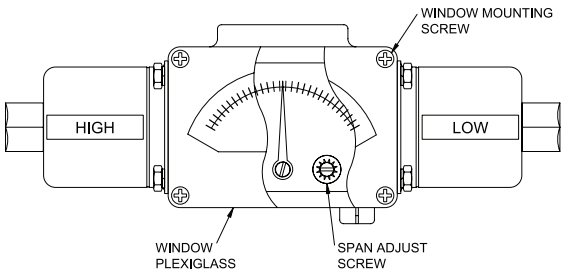


Figure 6

RE-GAPPING PROCEDURE

Tools Needed
5/8" Open End Wrench
3/16" Open End Wrench (2)

GAPPING IS FACTORY-SET AND CRITICAL TO THE FUNCTION OF THE SWITCH. THIS PROCEDURE SHOULD ONLY BE PERFORMED IF THE PLUNGER HAS ACCIDENTALLY BEEN ADJUSTED.

1. Loosen adjustment lock.
2. Turn 5/8" hex adjustment screw clockwise (left), to approximately midrange. This puts a load on the sensor and exposes the plunger flats. (See Figure 7).
3. Using a 3/16" wrench on the plunger flats and a 3/16" wrench on the plunger hex screw, turn hex counter-clockwise (right) from plunger until micro-switch actuates. If microswitch has already actuated, turn plunger hex screw clockwise (left) until microswitch deactuates.
4. Continue per following instructions, depending on model.

Models 171-174, 521-525, 531-535, and 540-548
Turn hex clockwise (left) an additional 1-1/2 flats from this point. This will provide a 5-9 mil gap.

Models 680, 701-705, 356-376, 612, 616, 270, 274
Turn hex clockwise (left) 3 flats from this point (approximately 1/2 turn). This will provide a 14-16 mil gap.

Models 183-189, 190-194, 483-489, 490-494,565-567
Turn hex clockwise (left) 1 flat from this point. This will provide a 4-7 mil gap.

CONTACT FACTORY FOR ASSISTANCE WITH MODELS

Re-Gapping Procedure for J120/J120K

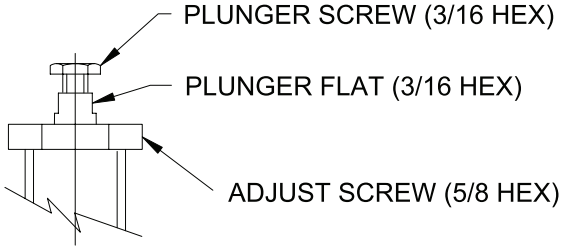


Figure 7

ZONE HAZARDOUS LOCATIONS FLAMEPROOF GAP AND JOINT DETAILS

120'S

Activation Plunger to adjustment screw hole gap joints: 1.140" min length by 0.0039" max annular gap

Plunger Guide to enclosure through threaded joints: minimum 8 ½ fully engaged threads

Cover to enclosure through threaded joints: minimum 7 ½ fully engaged threads

121'S & 122'S

Activation Plunger to enclosure through hole gap joints: 1.000" min length by 0.0030" max annular gap

Adjustment shaft to shaft through hole gap joints: 1.050" min. length by 0.0035" max. annular gap

Cover to enclosure through threaded joints: minimum 7 ½ fully engaged threads

MANUAL RESET OPTION 1530 (120'S,121'S)

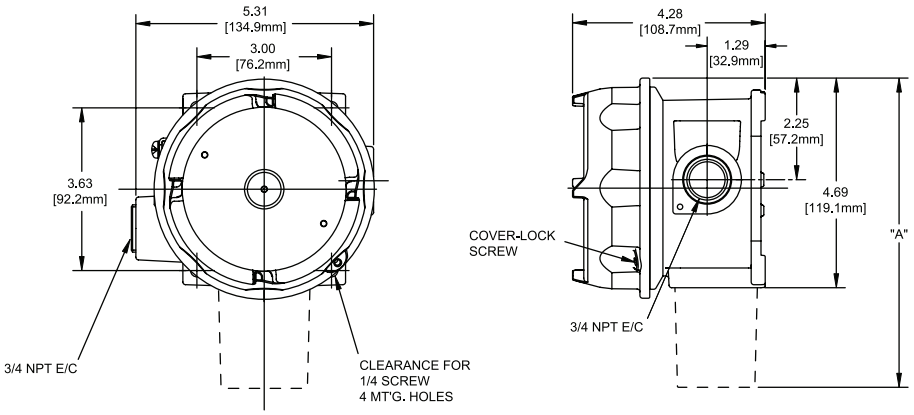
Reset pivot to pivot guide through hole gap joints: 1.118" min. length by 0.0036" max annular gap

Reset guide to enclosure through threaded joints: 8 fully engaged threads

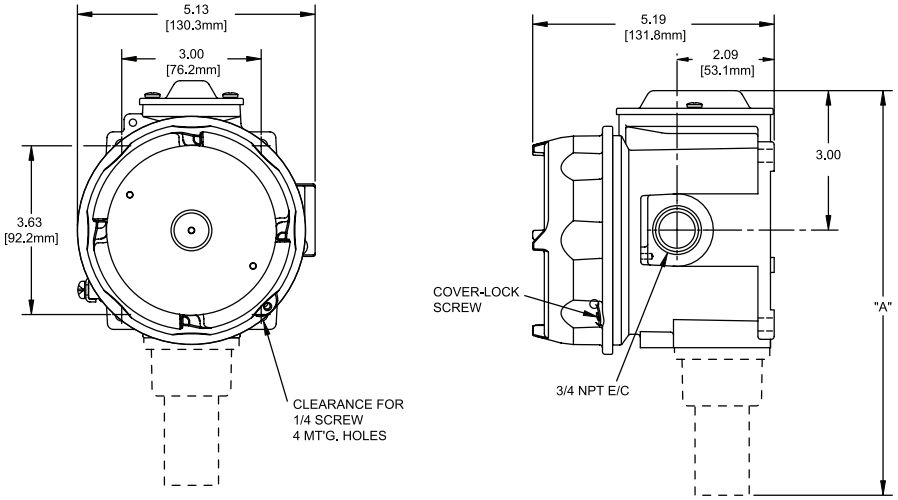
Dimensions

(Dimensional drawings for all models may be found at www.ueonline.com)

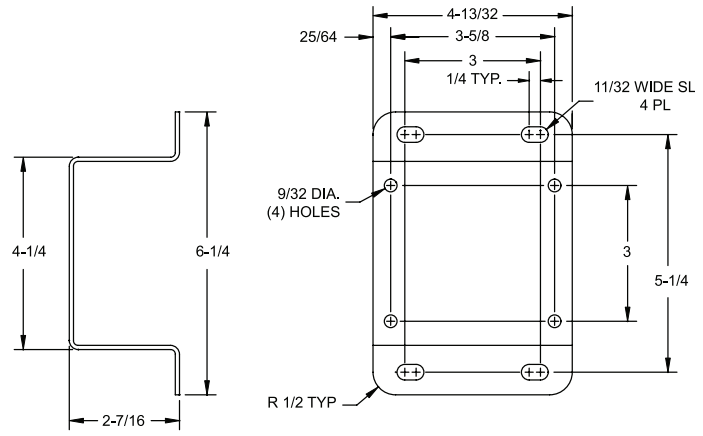
Internal Set Point Adjustment
Types J120, J120K



External Set Point Adjustment
Types H121, H122, H121K, H122K, H122P



Surface Mounting Hardware Kit
Part No. 6361-704 & Option M449



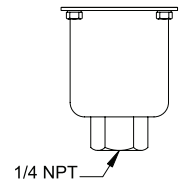
Types J120, J120K

Models	Dimension A Inches	mm	NPT
Pressure			
126-164	7.25	184.2	1/4
S126B-S164B	7.63	193.8	1/2
171-174	8.72	221.5	1/2
183-186, 483-486	8.41	213.6	1/2
188-189, 488-489	7.47	189.7	1/2
190-194, 490-494	7.44	189.0	1/2
270-274	8.13	206.5	1/4
358-376	8.09	205.5	1/4
450, 452	8.81	223.8	1/4
451, 453, 454	8.06	204.7	1/4
520-525	9.25	235.0	1/2
530-535	8.84	224.5	1/2
550, 552	8.81	223.8	1/4
551, 553-555	8.34	211.8	1/4
560-564	7.53	191.3	2" Sanitary
565-567	7.53	191.3	1-1/2" Sanitary
612, 616	7.88	200.2	1/4
680	8.13	206.5	1/4
701-705, 15622, 15834-15839	7.44	189.0	1/4
Differential Pressure			
36-39, 147-157, 367	7.59	192.8	1/4
S147B-S157B	7.59	192.8	1/2
455-457, 559	8.44	214.4	1/4
540-543	9.34	237.2	1/8
544-548	9.41	239.0	1/8

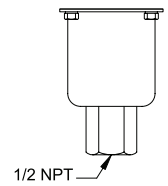
Types H121, H122, H121K, H122K, H122P

Models	Dimension A Inches	mm	NPT
Pressure			
126-164	8.09	205.5	1/4
S126B-S164B	8.50	215.9	1/2
270-274	7.88	200.2	1/4
358-376	7.81	194.4	1/4
450, 452	9.69	246.1	1/4
453, 454	8.94	227.1	1/4
550, 552	9.75	247.7	1/4
553-555	9.31	236.5	1/4
612, 614, 15875	8.75	222.3	1/4
701-705	8.31	211.1	1/4
Differential Pressure			
147-157	8.44	214.4	1/4
S147B-S157B	8.44	214.4	1/2
456-457, 559	9.31	236.5	1/4

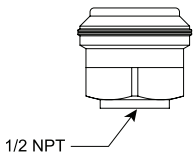
Pressure



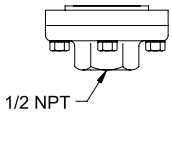
Models 126-164



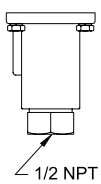
Models S126B-S164B



Models 171-174

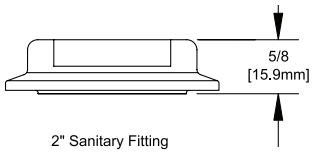


Models 183-186, 483-486

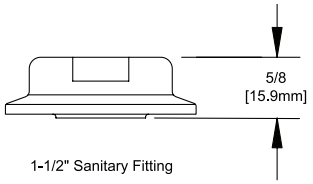


Models 188-194, 488-494

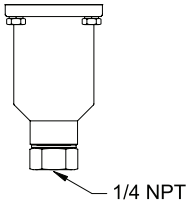
Pressure - continued



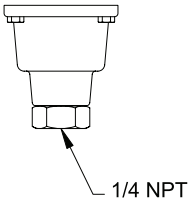
Models 560-564



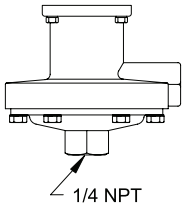
Models 565-567



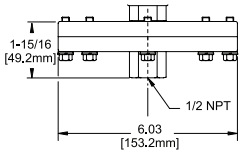
J120 Models
270-376, 680



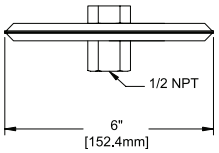
H121/H122 Models
270-376



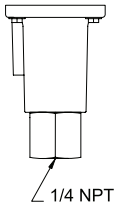
Models 450-454,
550-555



Models 520-525

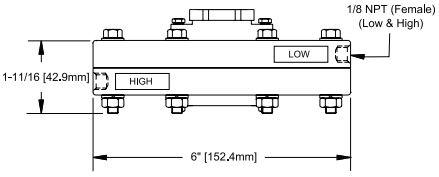


Models 530-535



Models 612-616, 701-705,
15622, 15834-15839, 15875

Differential Pressure



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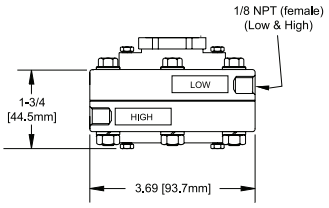
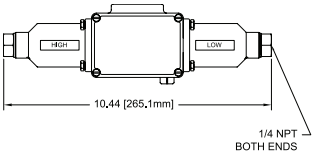
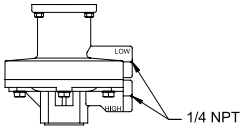


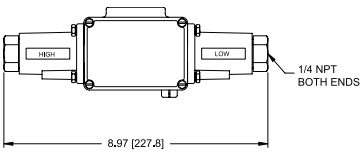
Models 544-548



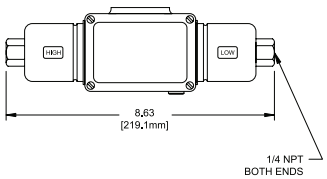
J120K Models 367



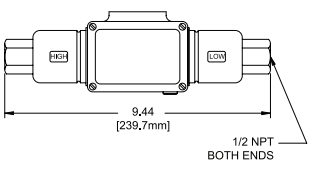
Models 455-457, 559



J120K Models 36-39



Models 147 & 157



Models S147B & S157B

RECOMMENDED PRACTICES AND WARNINGS

United Electric Controls Company recommends careful consideration of the following factors when specifying and installing UE pressure and temperature units. Before installing a unit, the Installation and Maintenance instructions provided with unit must be read and understood.

- To avoid damaging unit, proof pressure and maximum temperature limits stated in literature and on nameplates must never be exceeded, even by surges in the system. Operation of the unit up to maximum pressure or temperature is acceptable on a limited basis (e.g., start-up, testing) but continuous operation must be restricted to the designated adjustable range. Excessive cycling at maximum pressure or temperature limits could reduce sensor life.
- A back-up unit is necessary for applications where damage to a primary unit could endanger life, limb or property. A high or low limit switch is necessary for applications where a dangerous runaway condition could result.
- The adjustable range must be selected so that incorrect, inadvertent or malicious setting at any range point cannot result in an unsafe system condition.
- Install unit where shock, vibration and ambient temperature fluctuations will not damage unit or affect operation. Orient unit so that moisture does not enter the enclosure via the electrical connection. When appropriate, this entry point should be sealed to prevent moisture entry.
- Unit must not be altered or modified after shipment. Consult UE if modification is necessary.
- Monitor operation to observe warning signs of possible damage to unit, such as drift in set point or faulty display. Check unit immediately.
- Preventative maintenance and periodic testing is necessary for critical applications where damage could endanger property or personnel.
- For all applications, a factory set unit should be tested before use.
- Electrical ratings stated in literature and on nameplate must not be exceeded. Overload on a switch can cause damage, even on the first cycle. Wire unit according to local and national electrical codes, using wire size recommended in installation sheet.
- Do not mount unit in ambient temp. exceeding published limits.

LIMITED WARRANTY

Seller warrants that the product hereby purchased is, upon delivery, free from defects in material and workmanship and that any such product which is found to be defective in such workmanship or material will be repaired or replaced by Seller (Ex-works, Factory, Watertown, Massachusetts. INCOTERMS); provided, however, that this warranty applies only to equipment found to be so defective within a period of 24 months from the date of manufacture by the Seller. Seller shall not be obligated under this warranty for alleged defects which examination discloses are due to tampering, misuse, neglect, improper storage, and in any case where products are disassembled by anyone other than authorized Seller's representatives. EXCEPT FOR THE LIMITED WARRANTY OF REPAIR AND REPLACEMENT STATED ABOVE, SELLER DISCLAIMS ALL WARRANTIES WHATSOEVER WITH RESPECT TO THE PRODUCT, INCLUDING ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

LIMITATION OF SELLER'S LIABILITY

Seller's liability to Buyer for any loss or claim, including liability incurred in connection with (i) breach of any warranty whatsoever, expressed or implied, (ii) a breach of contract, (iii) a negligent act or acts (or negligent failure to act) committed by Seller, or (iv) an act for which strict liability will be inputted to seller, is limited to the "limited warranty" of repair and/or replacement as so stated in our warranty of product. In no event shall the Seller be liable for any special, indirect, consequential or other damages of a like general nature, including, without limitation, loss of profits or production, or loss or expenses of any nature incurred by the buyer or any third party.

UE specifications subject to change without notice.

UNITED ELECTRIC CONTROLS

180 Dexter Avenue, P.O. Box 9143
Watertown, MA 02471-9143 USA
Telephone: 617 926-1000 Fax: 617 926-2568
http://www.ueonline.com

CP121110K

EQUIPMENT MANUAL

Winnox (WX0850) v2.4 Horizontal Firing, Natural Gas Burner and SMJ Blower

SALES ORDER: 10S0221097

PURCHASE ORDER: V0363F Job 16-251

PREPARED FOR:

Heatec Incorporated

Chattanooga, TN 37410

BY

Honeywell
1665 ELMWOOD ROAD
ROCKFORD, ILLINOIS
61103-1299, USA

All drawings, burner and valvetrain data, and bulletins contained herein are proprietary to Honeywell and are not to be copied, reproduced, duplicated or disclosed to others, in whole or in part, without prior written consent of Honeywell.

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I. Eclipse Service Action Center

Phone: 815-637-7335

E-Mail: globalservice@eclipsenet.com

II. Project Information

Date: May 2, 2017

Sales Order Number: 10S0221097

Purchaser: Heatec Incorporated

Purchaser Order Number: V0363F Job 16-251

(Back)

III. BURNER DATA

Description: Winnox v2.4 (WX0850)

Capacity: 10.4 MMBtu/ hr.

Fuel Type: Natural Gas

Notes:

- Data Sheet

- Operating Instructions
- Product Brochure
- Spare Parts List
- Technical Information

(Back)

IV. Winnox (WX0850) Parts List:

PRJ101030776 Burner, Winnox, V2.4, (WX0850), Natural Gas, Horizontal Firing, Upright LH Piping, Pilot Ready, Hi Temp Alloy Tube
- **100205-22** Igniter, Self-Grounding, 590mm Long, 0.5 in. NPT
- **10047443** Valve, Check, 1 in., Union Insert (Check-All UVHBRVT.125SS)
- **10001490** Regulator, Ratio, 3 in. NPT, FRG730/6, 7 PSI max
- **101013594** Coupling, Flexible, 14mm Square Shaft x 12.7mm Hole, Pinned Connection, For Mounting Triac WE-500 to Integral BV
- **10348** Valve, Ball, Brass, 1 in. NPT, UL/ CSA/ FM Approved, Jomar 100-705
- **10897** Regulator, Pilot, 1 in. NPT, with Violet Spring 4-12 in. W.C.
- **500606** Valve, Orifice, Limiting, 1 in., NPT, ALO-4, Brass
- **501221** Valve, 112BV-B, Butterfly, Manual, 3 in., NPT, Full Port

(Back)

V. SMJ Blower

SMJ12.202769 1-202AA32X Blower, SMJ, Configured Product, v1.2

(Back)

VI. Orifice Plate

OMG130-J6A Orifice Meter, OMG, Threaded Flange, 3 in. Pipe, 1.963 in. Orifice Plate - Models X30/ X40, Gas Barb
- **10004480** Valve, Ball, Brass, Model T-82-M, 0.125 in. FNPT x 0.125 in. MNPT

(Back)

Datasheet 111-9
12/23/2014

Eclipse Winnox Burners

Model WX0850

Version 2

Parameter		Specifications	
Blower Type		**Packaged Blower** Nominal (60Hz)	**Remote Blower** Pressure at Air Inlet 1.5 psig (100 mbar)
Maximum Input, Btu/h (kW)[1] *For chamber pressures outside the given range or for varying chamber pressure conditions, contact Eclipse, Inc.*	Chamber Pressure "w.c. (mbar)		
	-5.0 (-12.5)	9,700,000 (2840)	13,600,000 (3985)
	-3.0 (-7.5)	9,200,000 (2694)	13,200,000 (3868)
	0.0	8,500,000 (2490)	12,500,000 (3660)
	1.0 (2.5)	8,200,000 (2416)	12,200,000 (3575)
	2.0 (5.0)	7,980,000 (2337)	12,000,000 (3516)
Minimum Input, Btu/h (kW) *For lower inputs, contact Eclipse, Inc.*	Natural Gas	500,000 (146)	500,000 (146)
	Propane, Butane	600,000 (175)	600,000 (175)
Main Gas Inlet Pressure, "w.c. (mbar)[2] *Fuel pressure at ratio regulator inlet*	Maximum	82 (207)	110 (273)
	Minimum	27.7 (69)	55.4 (138)
Maximum Chamber Temperature, °F (°C) *Maximum tube temperatures should be reduced 150°F (66°C) when using propane or butane.*		Standard combustion tube: 1300 (704) High temperature combustion tube: 1400 (760) Refractory plug: 1800 (982)[3]	
High Fire Visible Flame Length, inches (mm) *Measured from the outlet end of the combustor*	Alloy Tube	Flame is inside tube at all times.	
% Excess Air at High Fire		40% - 70%	
Piping		NPT or BSP/DN Flange connections available.	
Flame Detection		Flame rod or UV scanner.	
Fuels[4] *For any other mixed gas, contact Eclipse, Inc.*		Natural gas, Propane, Butane	
Blower Motor Power, Hp		15	-
Weight, lbs (kg)[5]		1435 (651)	1135 (515)
Approvals		АИ30	

[1] Maximum inputs for packaged blower versions are given for the standard combustion air blower without an inlet air filter.

[2] For proper performance, this pressure must be kept constant across the burner operating range.

[3] See page 3 of this datasheet and the "Refractory Plug" section of Installation Guide 111.

[4] See Design Guide 111 for more information about typical fuel composition and properties.

[5] All weights are approximate.

- All inputs are based on gross calorific values and standard conditions: one atmosphere, 70°F (21°C).
- All information is based on laboratory testing. Different chamber size and conditions will affect data.
- Eclipse reserves the right to change the construction and/or configurations of our products at any time without being obliged to adjust earlier supplies accordingly.

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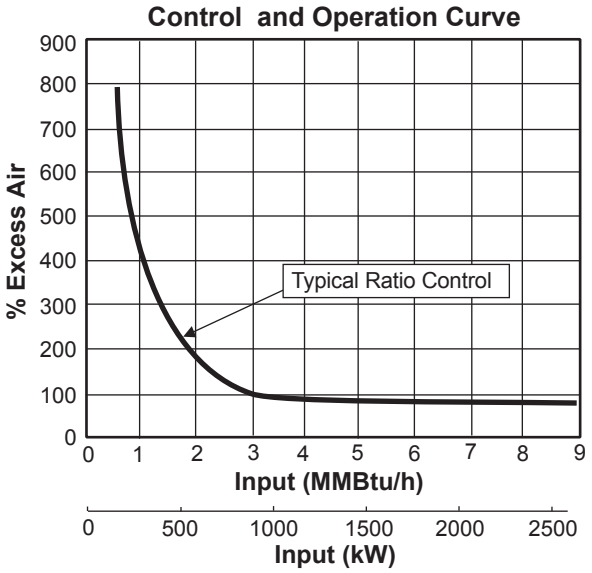
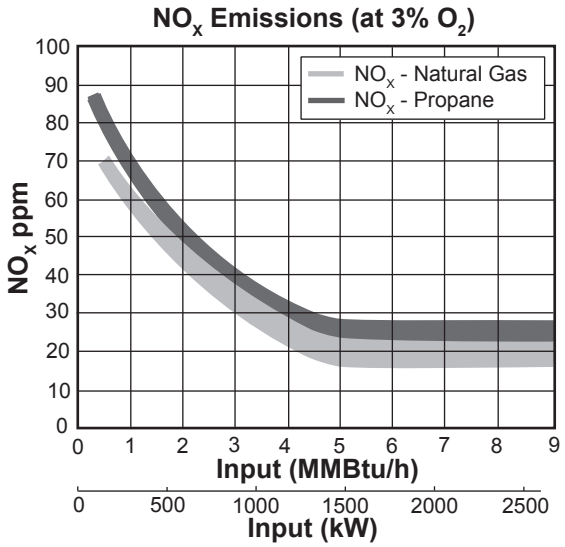
Performance Graphs





Fuel/Input Measurement

System design must include fuel flow measurement upstream of the burner. Eclipse recommends its 12-5 FOM (Fuel Orifice Meter) assembly number 302050-5 for natural gas. See Bulletin 930 for details.

Secondary By-Pass Fuel Setting:

Fuel	ΔP "w.c. (mbar)*
Natural Gas	4.0 (10.0)
Propane	4.0 (10.0)
Butane	4.0 (10.0)

*Measured between Tap “E” and the chamber @ low fire.

NOTE: Input at low fire changes with ratio regulator adjustment.

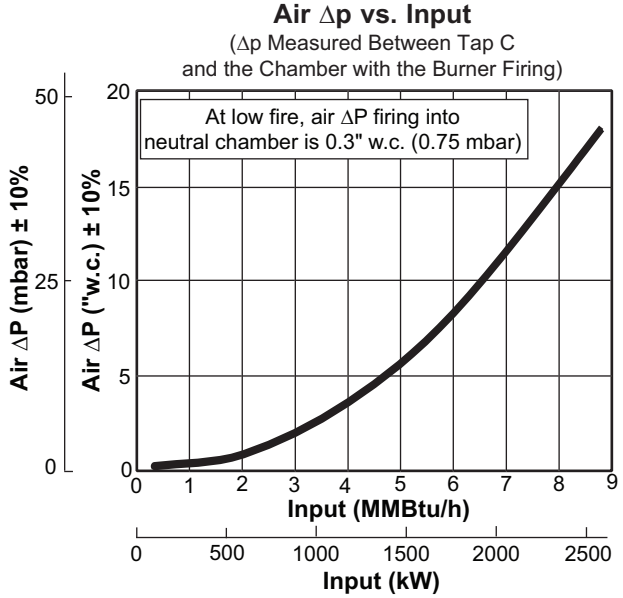
NO_x emission data is given for:

- Ambient combustion air (~70°F, 21°C)
- Less than 1000°F (540°C) firing chamber
- Minimal process air velocity
- Low fire input adjusted to 500,000 BTU/hr (88 kW)
- Neutral chamber pressure

Emissions are influenced by:

- Chamber conditions
- Fuel type
- Firing rate
- Ratio regulator adjustments
- Combustion air temperature
- Excess air

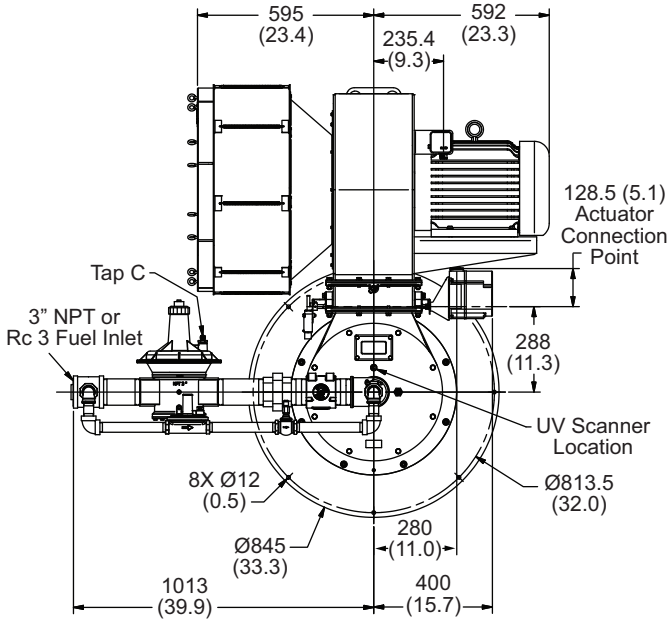
CO emission is largely influenced by chamber conditions. Contact your local Eclipse representative for an estimate of CO emission on your application.

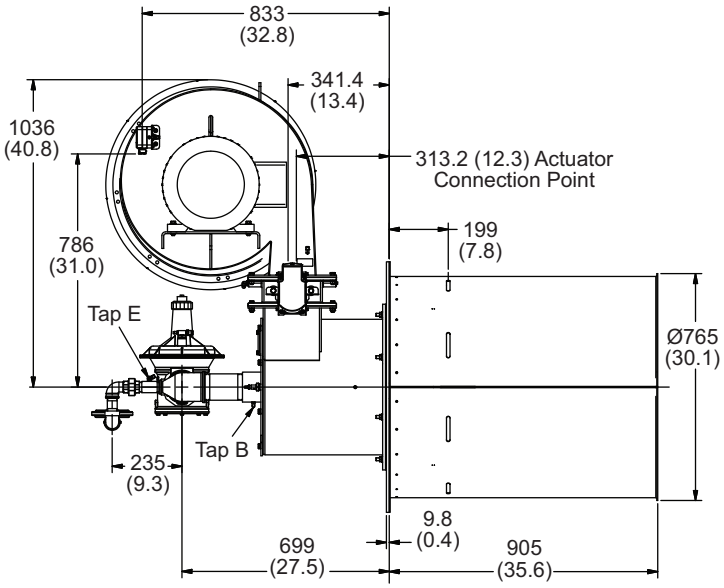


Dimensions and Specifications

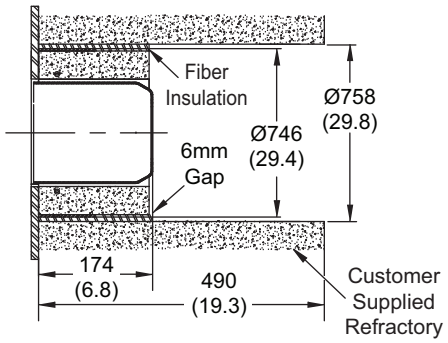
Dimensions in mm (inches)

Packaged Blower

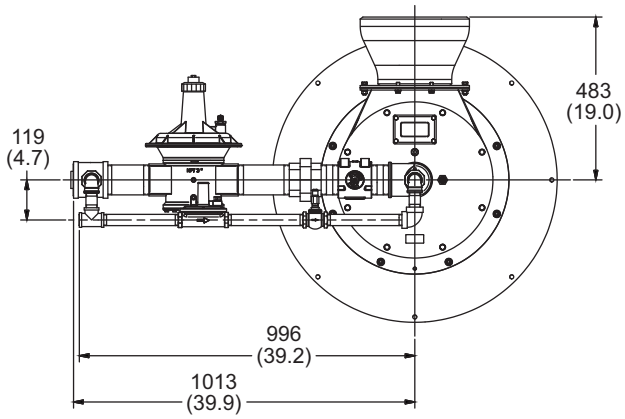


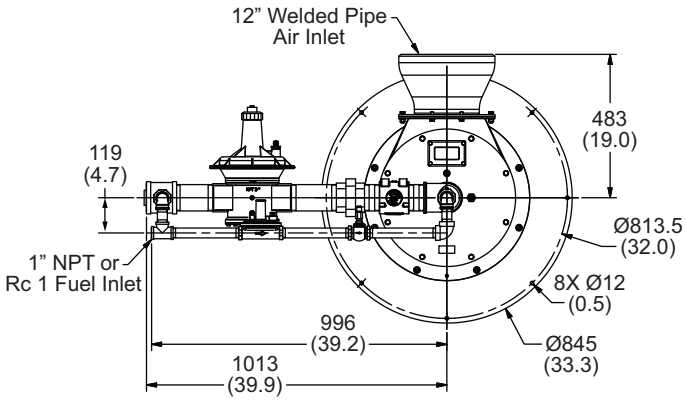


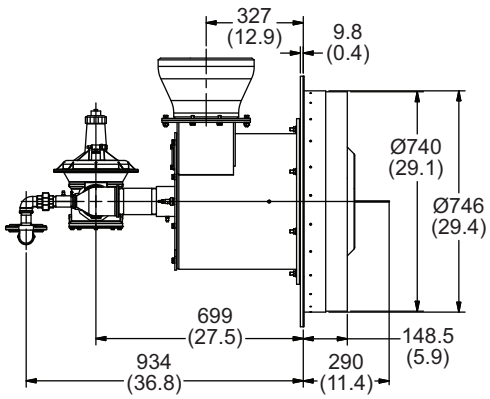
Refractory Plug



Remote Blower







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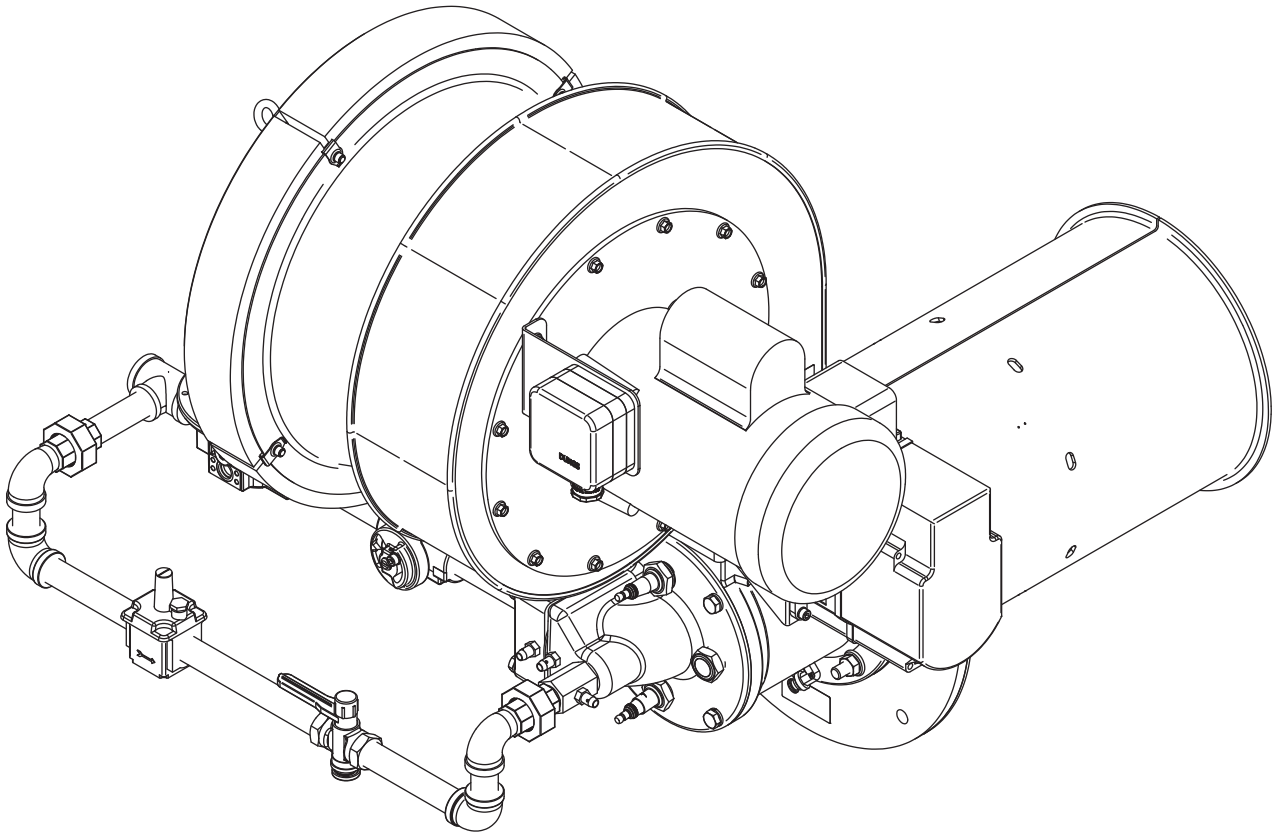
Installation Guide 111
12/2/2014

Eclipse Winnox Burners

WX Series

Version 2



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The material in this manual is believed adequate for the intended use of the product. If the product is used for purposes other than those specified herein, confirmation of validity and suitability must be obtained. Eclipse warrants that the product itself does not infringe upon any United States patents. No further warranty is expressed or implied.

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We have made every effort to make this manual as accurate and complete as possible. Should you find errors or omissions, please bring them to our attention so that we may correct them. In this way we hope to improve our product documentation for the benefit of our customers. Please send your corrections and comments to our Technical Documentation Specialist.

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Any operation expressly prohibited in this manual, any adjustment, or assembly procedures not recommended or authorized in these instructions shall void the warranty.

Document Conventions

There are several special symbols in this document. You must know their meaning and importance.

The explanation of these symbols follows below. Please read it thoroughly.

How To Get Help

If you need help, contact your local Eclipse representative. You can also contact Eclipse at:

1665 Elmwood Rd.
Rockford, Illinois 61103 U.S.A.
Phone: 815-877-3031
Fax: 815-877-3336
http://www.eclipsenet.com

Please have the information on the product label available when contacting the factory so we may better serve you.

ECLIPSE Innovative Thermal Solutions www.eclipsenet.com
Product Name
Item #
S/N
DD MMM YYYY

	This is the safety alert symbol. It is used to alert you to potential personal injurt hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.
	Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	Is used to address practices not related to personal injury.
NOTE	Indicates an important part of text. Read thoroughly.

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Introduction 1

Product Description

The Winnox is a nozzle-mix type, low-emissions burner designed for direct and indirect air heating, and oven applications up to 1800°F (980°C).

The burner package includes a combustion air blower and ratio regulator to fire over a wide gas turndown range at a controlled ratio.

The burner is designed for:

- low NO_X and CO emissions
- efficient ratio controlled combustion
- reliable burner operation
- simple burner adjustment
- direct spark ignition
- multiple fuel capability

The wide variety of options and configurations are available due to the modular design of the burner.

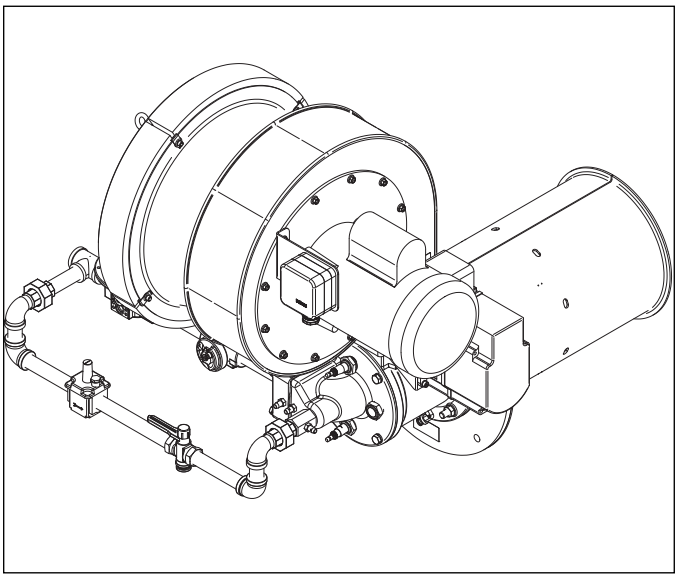


Figure 1.1 Winnox Burner

Audience

This manual has been written for people who are already familiar with all aspects of a nozzle-mix burner and its add-on components, also referred to as “the burner system”.

These aspects are:

- Design / Selection
- Use
- Maintenance

The audience is expected to have previous experience with this type of equipment.

Winnox Documents

Installation Guide No. 111

- This document

Datasheet, Series 111

- Available for individual WX models
- Required to complete design and selection

Design Guide No. 111

- Used with Datasheet to design burner system

Spare Parts List, Series 111

- Recommended replacement part information

Related Documents

- EFE 825 (Combustion Engineering Guide)
- Eclipse Bulletins and Info Guides: 684, 710, 732, 756, 760, 902, 930

Safety

2

Important notices which help provide safe burner operation will be found in this section. To avoid personal injury and damage to the property or facility, the following warnings must be observed. All involved personnel should read this entire manual carefully before attempting to start or operate this system. If any part of the information in this manual is not understood, contact Eclipse before continuing.

Safety Warnings

⚠ DANGER

- **The burners, described herein, are designed to mix fuel with air and burn the resulting mixture. All fuel burning devices are capable of producing fires and explosions if improperly applied, installed, adjusted, controlled or maintained.**
- **Do not bypass any safety feature; fire or explosion could result.**
- **Never try to light a burner if it shows signs of damage or malfunction.**

⚠ WARNING

- **The burner and duct sections are likely to have HOT surfaces. Always wear the appropriate protective equipment when approaching the burner.**
- **Eclipse products are designed to minimize the use of materials that contain crystalline silica. Examples of these chemicals are: respirable crystalline silica from bricks, cement or other masonry products and respirable refractory ceramic fibers from insulating blankets, boards, or gaskets. Despite these efforts, dust created by sanding, sawing, grinding, cutting and other construction activities could release crystalline silica. Crystalline silica is known to cause cancer, and health risks from the exposure to these chemicals vary depending on the frequency and length of exposure to these chemicals. To reduce the risk, limit exposure to these chemicals, work in a well-ventilated area and wear approved personal protective safety equipment for these chemicals.**

NOTICE

- **This manual provides information regarding the use of these burners for their specific design purpose. Do not deviate from any instructions or application limits described herein without written approval from Eclipse.**

Capabilities

Only qualified personnel, with sufficient mechanical aptitude and experience with combustion equipment, should adjust, maintain or troubleshoot any mechanical or electrical part of this system. Contact Eclipse for any needed commissioning assistance.

Operator Training

The best safety precaution is an alert and trained operator. Train new operators thoroughly and have them demonstrate an adequate understanding of the equipment and its operation. A regular retraining schedule should be administered to ensure operators maintain a high degree of proficiency. Contact Eclipse for any needed site-specific training.

Replacement Parts

Order replacement parts from Eclipse only. All Eclipse approved valves or switches should carry UL, FM, CSA, CGA and/or CE approval where applicable.

Installation 3

Introduction

In this chapter you will find information and instructions needed to install the burner and system components.

Handling & Storage

Handling

- Make sure that the area is clean.
- Protect the components from the weather, damage, dirt and moisture.
- Protect the components from excessive temperatures and humidity.
- Take care not to drop or damage components.

Storage

- Make sure that the components are clean and free of damage.
- Store the components in a cool, clean, dry room.
- After you have made sure that everything is present and in good condition, keep the components in the original package as long as possible.

Approval of Components

Limit Controls & Safety Equipment

All limit controls and safety equipment must comply with all applicable local codes and/or standards and must be listed for combustion safety by an independent testing agency. Typical application examples include:

- American: NFPA 86 with listing marks from UL, FM, CSA
- European: EN 746-2 with CE mark from TuV, Gastec, Advantica

Electrical Wiring

All the electrical wiring must comply with all applicable local codes and/or standards such as:

- NFPA Standard 70
- IEC60364
- CSA C22
- BS7671

Gas Piping

All the gas piping must comply with all applicable local codes and/or standards such as:

- NFPA Standard 54
- ANSI Z223
- EN 746-2

Where to Get the Standards:

The NFPA Standards are available from:
National Fire Protection Agency
Batterymarch Park
Quincy, MA 02269
www.nfpa.org

The ANSI Standards are available from:
American National Standard Institute
1430 Broadway
New York, NY 10018
www.ansi.org

The UL Standards are available from:
333 Pfingsten Road
Northbrook, IL 60062
www.ul.com

The FM Standards are available from:
1151 Boston-Providence Turnpike
PO Box 9102
Norwood, MA 02062
www.fmglobal.com/approvals

Information on the EN standards and where to get them is available from:
Comité Européen de Normalisation
Stassartstraat 36
B-1050 Brussels
Phone: +32-25196811
Fax: +32-25196819
www.cen.eu

Comité Européen de Normalisation Electronique
Stassartstraat 36
B-1050 Brussels
Phone: +32-25196871
Fax: +32-25196919
www.cenelec.org

Checklist Before Installation

Intake

To admit fresh combustion air from outdoors, provide an opening in the room of at least one square inch per 4,000 BTU/hr (1.17 kW). If there are corrosive fumes or materials in the air, then supply the burner with clean air from an uncontaminated area, or provide a sufficient air filtering system.

Exhaust

Do not allow exhaust fumes to accumulate in the work area. Provide some positive means for exhausting from the furnace and the building.

Access

Make sure that you install the burner in such a way that you can gain easy access for inspection and maintenance.

Environment

Make sure the local environment matches the original operating specifications. Check the following items:

- Voltage, frequency and stability of the electrical power
- Type and supply pressure of the fuel
- Availability of enough fresh, clean combustion air
- Humidity, altitude and temperature of air
- Presence of damaging corrosive gases in the air
- Prevent direct exposure to water

Installing the Flame Sensor

1. Install the flame sensor into the 1/2" NPT opening in the rear cover.
2. Make sure that you connect the flame sensor of a burner to the electrical circuit of that burner.

⚠ DANGER

- **Connecting the flame sensor of a burner to the electrical circuit of the wrong burner can result in a fire or explosion.**

There are two different types of flame sensors; UV scanner and flame rod.

UV Scanner

The UV scanner must be compatible to the flame monitoring control that is used. Refer to the manual of your selected control for proper selection of the scanner.

Flame Rod

NOTE: Only specific burner sizes with alloy or silicon carbide combustors can use a flame rod (see specific burner datasheets).

For detailed information on how to install and connect a flamerod, refer to Info Guide 832.

Installing the Spark Plug

Install the spark plug into the opening in the rear cover.

NOTE: Do ***not*** apply any grease to the threads of the spark plug or bad grounding of the spark plug may occur, resulting in a weak spark.

NOTICE

- **If flame monitoring controls other than those recommended in the Design Guide are used contact Eclipse to determine how the burner performance may be affected, adjustments may vary from Eclipse published values. Consult with the engineer who specified the alternate control for limitations.**

Burner Mounting

Chamber Opening

Provide an opening in the chamber wall at least 1/2" (12 mm) larger in diameter than the outside diameter of the combustor (1/4" - 6 mm per side). The combustor diameter can be found in the Winnox datasheet, series 111.

Provide an accessible pressure tap on the chamber wall to measure the pressure inside the firing chamber. The pressure tap should be located near the burner.

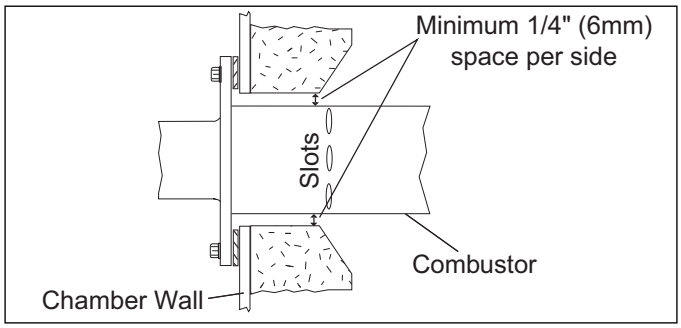


Figure 3.1. Chamber Opening

Mounting Pattern

Attach eight mounting bolts to the chamber wall. Position these bolts to match the clearance holes **(C)** on the burner mounting flange. Refer to Winnox datasheet, series 111.

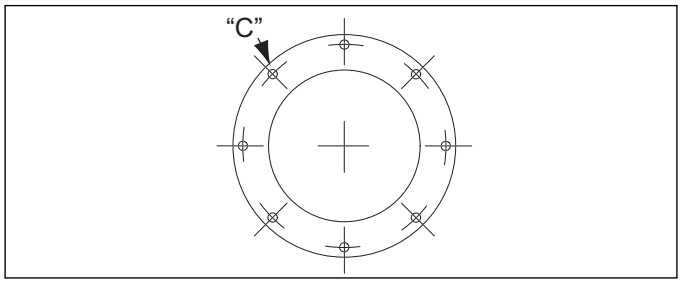


Figure 3.2. Mounting Pattern

Tube Shrouding Considerations

Applications in which there is process air flow perpendicular to and across the Winnox combustor greater than 1000 ft/min (5 m/s) may cause flame instability and/or high production of CO emissions. In these applications a shroud may be required to shield the combustor. Contact Eclipse for more information.

Chamber Wall

Make sure the chamber wall ❷ is strong enough to support the weight of the burner ❸. If necessary, reinforce the mounting area. See Figure 3.3.

NOTE: The slots in the combustor must not be covered with insulation. If necessary, taper the chamber insulation at a minimum of 45° to provide clearance for the combustor slots. Slot dimensions can be found in the Winnox datasheet, series 111.

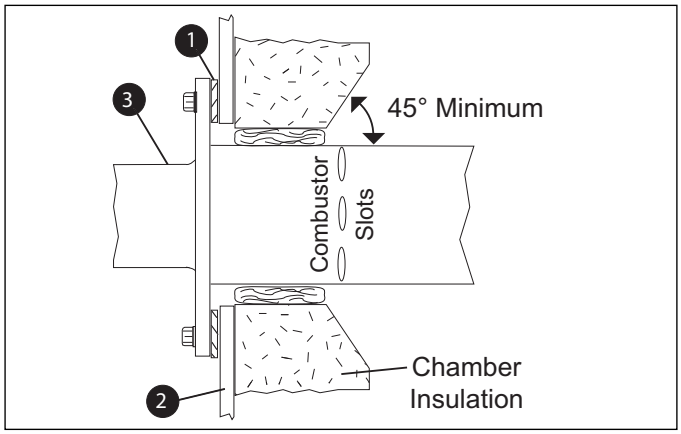


Figure 3.3. Chamber Wall

Burner Mounting

Mount the burner to the chamber wall using eight (8) customer supplied nuts and lock washers.

Alloy Combustion Tube

1. Be sure gasket ❶ is installed between burner ❸ and chamber wall ❷. See Figure 3.4.
2. Pack fiber insulation around the tube to a depth not beyond the combustor slot position, as shown in Figure 3.4.

⚠ CAUTION

- **Placing insulation over combustor slots will impede burner performance and decrease combustor life.**

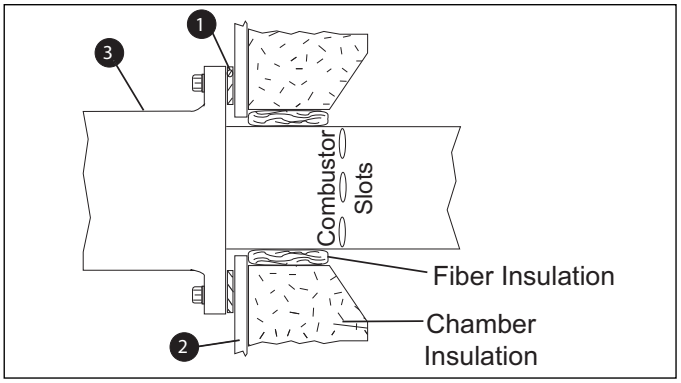


Figure 3.4. Alloy Combustion Tube

Refractory Plug

When using the refractory plug the customer must provide a refractory combustion tube. The customer is responsible for supplying all refractory materials for combustion tube field installation as follows:

1. Install the chosen refractory realizing it is essential that:
   - The combustion tube dimensions are held as given in the Winnox Datasheet series 111. See Figure 3.5.
   - The inside diameter of the combustion tube is concentric with the refractory plug.
2. Support refractory combustion tube according to the refractory supplier's recommendations. The alloy anchors should be coated with bitumastic whenever they are used.
3. Fiber insulation must be installed between the refractory plug and customer supplied refractory combustion tube.
4. After the burner and refractory have been installed, a proper curing schedule should be followed according to refractory supplier's recommendations.

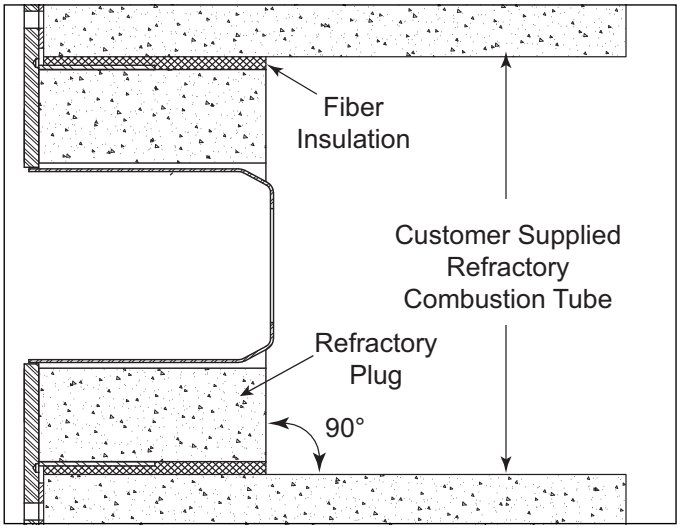


Figure 3.5. Refractory Plug

Gas Piping

Burner Piping

The burner is factory assembled and shipped as ordered.

NOTE: If it is necessary to redirect piping, remove **the outer four bolts only** ❶. Rotate the rear cover and replace bolts. When reassembling, be sure that:

- ratio regulator spring column ❷ is pointing up
- the bypass regulator spring column is pointing up
- arrow on the ratio regulator points in the direction of gas flow
- integral fuel orifice and o-rings ❸ are reinstalled
- the same straight run of pipe ❹ remains between the ratio regulator and the burner.

⚠ CAUTION

- **Do not attempt to redirect piping by removing the inner circle bolts ❺. Internal burner parts will be damaged.**

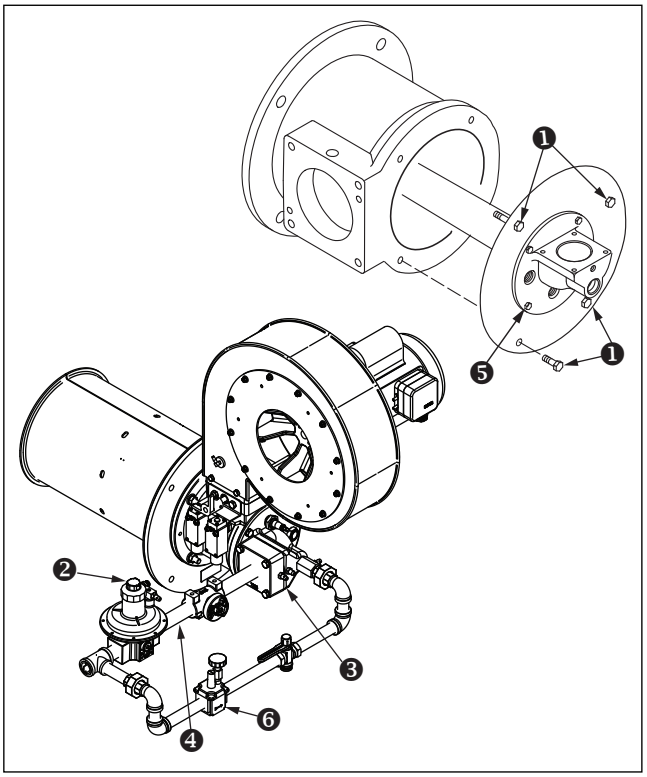


Figure 3.6. Burner Piping

⚠ CAUTION

- **Do not alter the bypass regulator. The NFPA requires that the bypass regulator ❻ be appropriately vented and protected.**
- **For applications in which the Winnox is operating indoors, a vent limiting device is installed in the bypass regulator.**
- **For applications in which the Winnox is operating outdoors, an insect/rain protector is installed in the bypass regulator.**

Supply Piping

Inlet pressure to the ratio regulator must stay within specified limits. Refer to the appropriate Winnox datasheet, series 111.

- Locate the valve train close to the burner. The gas must reach the burner during the fixed trial for ignition period.
- Sufficiently size the shut off valve in the valve train.
- Make sure piping is large enough to accommodate flow required to meet burner input.
- Minimize piping elbows.
- Install fuel flow measurement device ❶ upstream from the burner inlet.
- If necessary to maintain inlet pressures to the burner (see datasheet for your burner), install a gas pressure regulator ❷ upstream of the burner inlet and downstream of the valve train and fuel measurement device ❶.

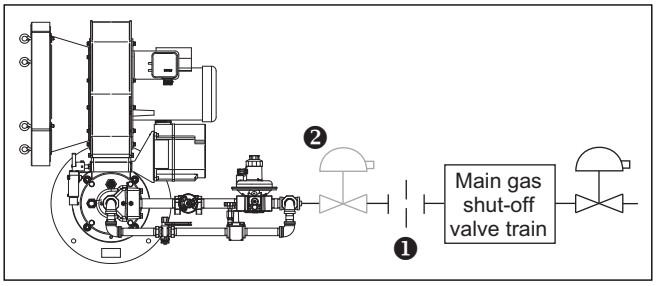


Figure 3.7. Supply Piping

Pipe Connections

Installation of a pipe union in the gas line is recommended to simplify burner removal.

Use of flexible pipe is optional.

NOTE: Flexible pipe causes higher pressure drops than standard pipe. Consider this when sizing your gas lines.

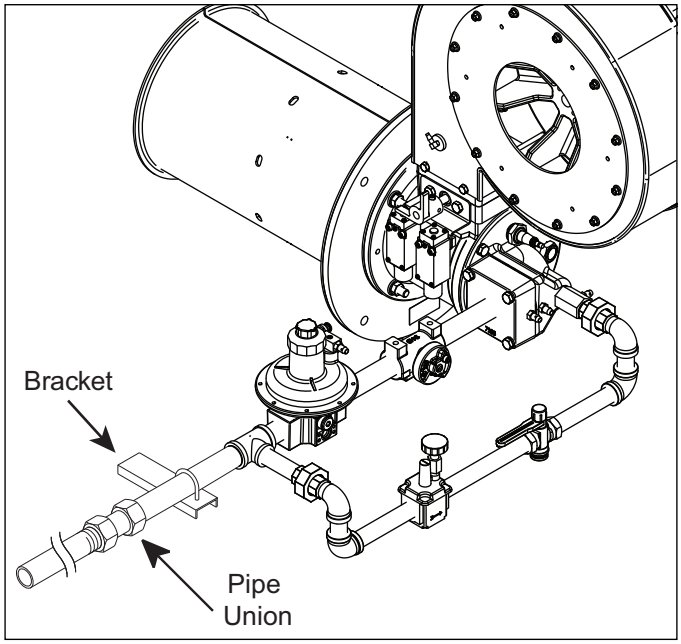


Figure 3.8. Pipe Connections

Piping Support

Use brackets or hangers to support the gas piping. If you have questions, consult your local gas company.

Control Motor

Install a control motor to modulate the air butterfly valve if not factory installed on the burner.

NOTE: Be sure the control motor shaft and air butterfly valve shaft are aligned properly.

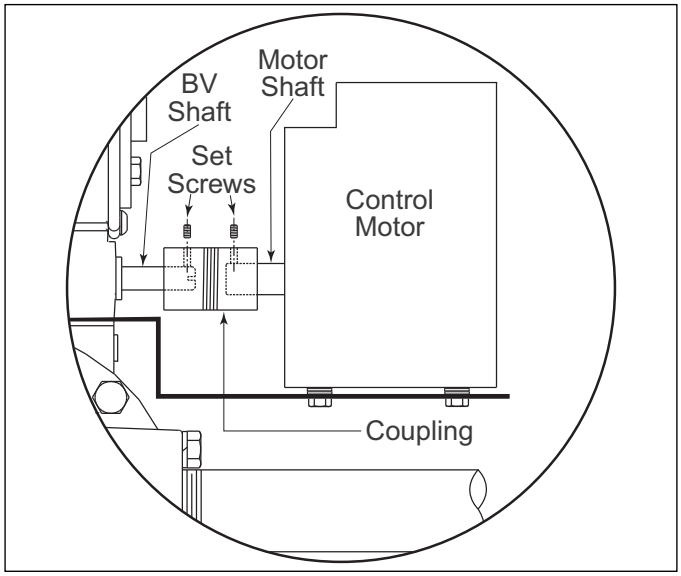


Figure 3.9. Control Motor

Checklist After Installation

To verify the system was properly installed, perform the following checks:

1. Be sure there are no leaks in the gas lines.
2. Be sure all the components contained in the flame monitoring and control systems are properly installed. This includes verifying that:
   - all the switches are installed in the correct locations.
   - all wiring, pressure, and impulse lines are properly connected.
3. Be sure all components of the spark ignition system are installed and functioning properly.
4. Be sure the blower rotates in the proper direction. If the rotation is incorrect, have a qualified electrician rewire the blower to rotate in the proper direction.
5. Be sure all valves are installed in the proper location and correctly oriented relative to the flow direction.

Remote Blower Air Pre-Mix Line Installation (WX0850 only)

When using a remote blower instead of the packaged blower on the WX0850, the low fire air pre-mix line must be installed to the combustion air line. 1/4" diameter braided hose is recommended, located as shown in figure 3.10.

NOTE: A 24" length of 1/4" diameter braided hose is included with the burner.

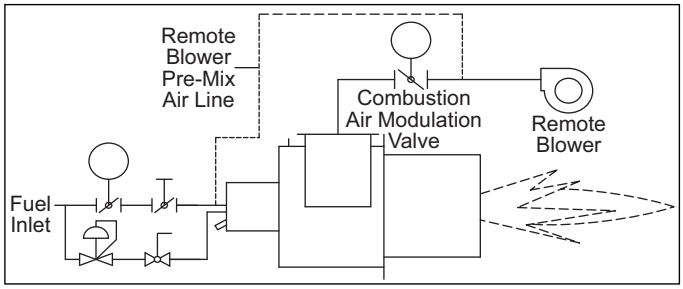


Figure 3.10.

Adjustment, Start & Stop

4

In this chapter, you will find instructions on how to adjust, start, and stop the burner system. Become familiar with burner control methods before attempting to make adjustments.

⚠ DANGER

- **The Winnox burners are designed to mix fuel with air and burn the resulting mixture. All fuel burning devices are capable of producing fires and explosions if improperly applied, installed, adjusted, controlled, or maintained.**
- **Do not bypass any safety feature; fire or explosion could result.**
- **Never try to light a burner if it shows signs of damage or malfunction.**

Step 1: Reset the System

1. Set the low gas pressure switch to 20% below the "Fuel Inlet Pressure" range as specified in the appropriate datasheet.
2. Set the high gas pressure switch to 20% above the "Main Gas Inlet Pressure" range as specified in the appropriate datasheet.
3. Close all the burner gas valves – manual and automatic.
4. Try to ignite the burner; be sure the flame monitoring system indicates a flame failure.
5. Activate the pressure switches and other limit interlocks. Be sure the switches fail as intended in the event of a power failure.

⚠ DANGER

- **If simulated limits or simulated flame failure do not shut down the fuel system within the required failure response time, immediately correct the problem before proceeding. Refer to the "Troubleshooting" chart in section 5.**

6. If the burner is firing into a duct or chamber with a circulating fan, start the fan to produce full process air flow past the burner.
7. Adjust main gas inlet pressure to the ratio regulator within the range specified in the appropriate datasheet.

⚠ WARNING

- **Gas inlet pressures must stay within the specified range. Pressure above the specified range can damage the ratio regulator.**
- **Pressure below the specified range can impair the ability of the ratio regulator to control the gas flow.**
- **Operating the system outside the specified range can cause excess fuel consumption and the possible accumulation of unburned fuel in the chamber.**
- **In extreme cases, this accumulation of unburned fuel may cause fires or explosions.**

8. Verify the actuator opens the air butterfly valve towards the back of the burner as shown in Figure 4.1. If it doesn't, refer to the actuator's literature for instructions on how to reverse the direction.

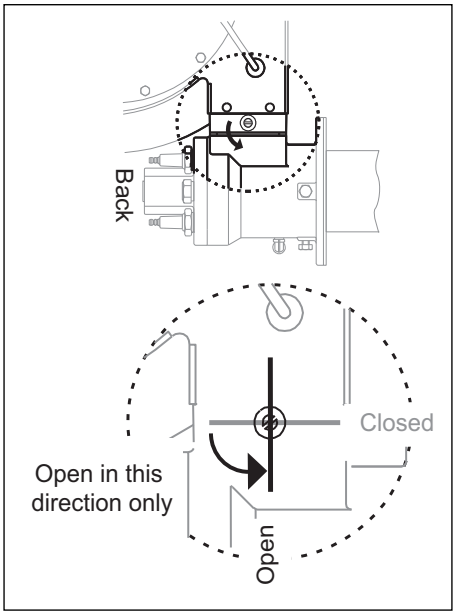


Figure 4.1. Air Butterfly Valve Open Direction

Step 2: Set Low Fire Air

1. Start combustion air blower.
2. Drive control motor to low fire position.
3. Measure the air differential pressure between **Tap C** and the combustion chamber.

NOTE: The pressure tap is in the open position when the screw inside the tap is unscrewed approximately 1/2 turn. Do not remove the screw. Be sure to tighten the pressure tap screw clockwise to the closed position after pressure measurements have been taken.

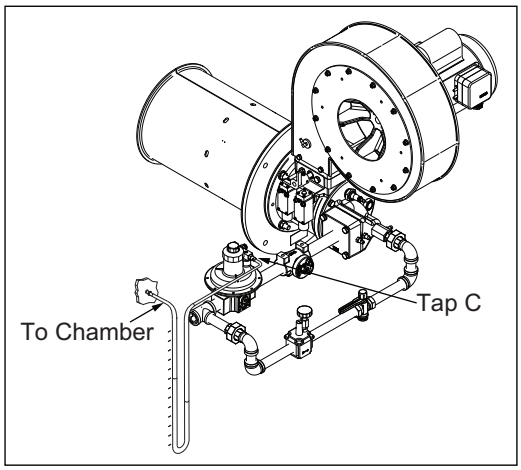


Figure 4.2. Air Differential Pressure

4. Set low fire air.
   a. Loosen the set screw ❶ on the burner side of coupling.
   There is a slot in the end of the butterfly valve shaft that is parallel to the air damper. This slot is used for visual indication of the butterfly valve position. The butterfly valve is closed when the shaft slot is perpendicular to the direction of air flow through the butterfly valve.
   b. Rotate the air butterfly valve shaft to a fully closed position. (Holes in the butterfly valve will supply low fire air.)
   c. When firing into a positive chamber pressure, rotate the air butterfly valve from the closed position in the direction of actuator travel to obtain a minimum 0.3" w.c. (0,8 mbar) air differential pressure.
   d. Hold the butterfly valve shaft firmly in place and tighten set screw ❶.

High fire air adjustment is not required if the burner is firing into a neutral pressure chamber and a 90° travel control motor is used. It may be necessary to limit control motor stroke to less than 90° if firing into a large negative chamber. Contact Eclipse for further information.

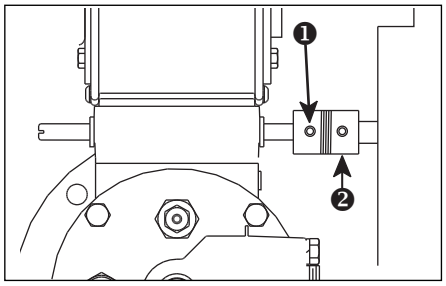


Figure 4.3. Air Butterfly Valve Adjustment

5. Verify high fire air:
   a. Drive control motor to high fire, full open.
   b. Compare the high fire air differential pressure between **Tap C** and the combustion chamber to the approximate datasheet chart "Air ∆p vs. Input". If high fire air is insufficient, refer to section 5, "Troubleshooting & Maintenance", in this document.
6. Return the control motor to the low fire position.
7. Close the pressure taps.

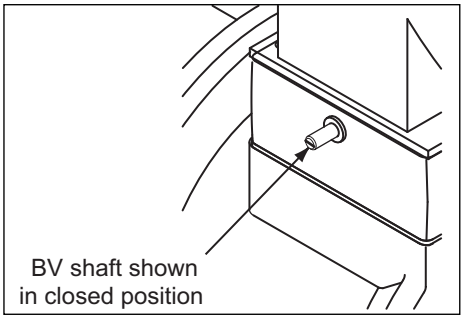


Figure 4.4. Air Butterfly Valve Shaft

Step 3: Ignite the Burner

Low Fire Start

WARNING

- **These procedures are written with the assumption the burner has a flame monitoring control system installed and operating. A proper purge cycle must be part of the system and purge timing should not be bypassed.**

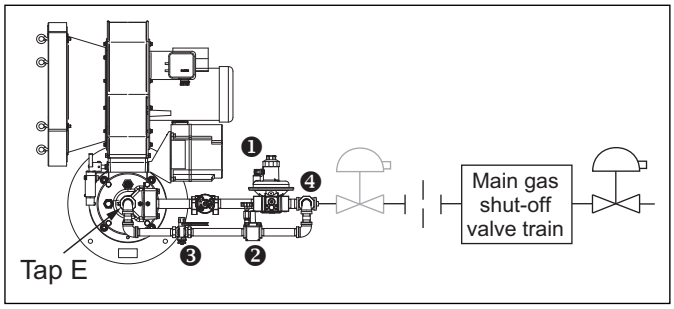


Figure 4.5. Low Fire Start

1. Drive control motor to low fire.
2. Be sure combustion air blower is running.
3. Turn bias adjusting screw ❶ on ratio regulator spring column three complete turns (360°) counter-clockwise (up) from the bottom.
4. Open main gas manual shut off valves.
5. With pressure taps open, connect the manometer between **Tap E** and the chamber.
6. Set system control to stay at low fire during and after ignition sequence.
7. Attempt to ignite burner.
8. During trial for ignition, adjust bypass pressure regulator ❷ and adjustable limiting orifice ❸ to achieve the appropriate ∆p between **Tap E** and the chamber as listed in the appropriate datasheet.

NOTE: If viewing the flame, it should be blue with flashes of yellow. The flame should be completely within the combustion tube. When firing propane or butane, a proper low fire flame may have sustained flashes of yellow.

9. If burner does not ignite.
   a. Shut off gas.
   b. When chamber temperature is below 250°F (121°C), shut off combustion air blower.
   c. Restart combustion air blower, drive through purge cycle and ignite the burner.
   d. Measure low fire gas pressure to the burner gas inlet ❹. Verify pressure at ❹ is within the range specified on the datasheet for your burner. range specified on the datasheet for your burner.
10. After ignition, verify low fire flame:
    a. Shut off gas.
    b. When chamber temperature is below 250°F (121°C), shut off combustion air blower.
    c. Restart combustion air blower and ignite burner.
    d. Measure low fire gas pressure to the burner gas inlet ❹.Verify pressure at ❹ is within the range specified on the datasheet for your burner.
    e. Verify repeatability of ignition and low fire flame signal.

NOTE: If the flame signal is too low, use the bypass regulator ❷ and/or the adjustable limiting orifice ❸ to increase the pressure at Tap E and provide better flame signal. However, this can have a negative impact on emissions and/or nozzle life.

11. Close all pressure taps.

Pilot Start Option

WARNING

- **These procedures are written with the assumption the burner has a flame monitoring control system installed and operating. A proper purge cycle must be part of the system and purge timing should not be bypassed.**

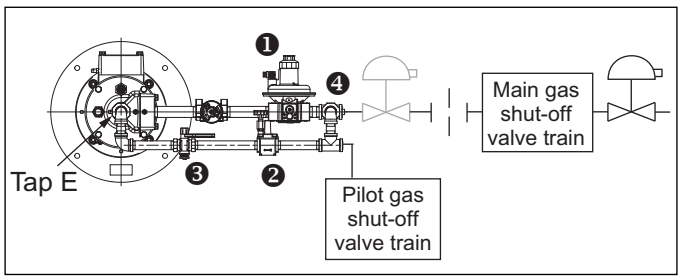


Figure 4.6. Low Fire Start with Pilot Start Option

1. Drive control motor to low fire.
2. Be sure combustion air blower is running.
3. Turn bias adjusting screw ❶ on ratio regulator spring column three complete turns (360°) counter-clockwise (up) from the bottom.
4. Open pilot gas manual shut off valve.

NOTE: Be sure main gas manual shut off valves are closed.

5. With pressure taps open, connect a manometer between **Tap E** and the chamber.
6. Set system control to stay at low fire during and after ignition sequence.
7. Attempt to ignite burner.
8. During trial for ignition, adjust bypass pressure regulator ❷ and adjustable limiting orifice ❸ to achieve the appropriate ∆p between **Tap E** and the chamber as listed in the appropriate datasheet.

NOTE: If viewing the flame, it should be blue with flashes of yellow. The flame should be completely within the combustion tube. When firing propane or butane, a proper low fire flame may have sustained flashes of yellow.

9. If burner does not ignite:
   a. Attempt to ignite the burner again to purge air from the gas piping.
   b. If burner still does not ignite, adjust bypass pressure regulator ❷ a half turn clockwise to increase gas flow.
   c. Repeat until burner ignites. If necessary, refer to Chapter 5, “Maintenance & Troubleshooting” in this manual.
10. After ignition, verify bypass flame:
   a. Shut off gas. When chamber temperature is below 250°F (121°C), shut off combustion air blower.
   b. Restart combustion air blower, drive through purge cycle, and ignite burner.
   c. Measure low fire gas pressure to the burner gas inlet ❹. Verify pressure at ❹ is within the range specified on the datasheet for your burner.
   d. Verify repeatability of ignition and low fire flame signal.
11. Close all pressure taps.

Step 4: Set Low Fire Gas

WARNING

- **This procedure is written with the assumption the burner has a flame monitoring control system installed and operating. A proper purge cycle must be part of the system and purge timing should not be bypassed.**

1. Verify bias adjusting screw ❶ on ratio regulator spring column is three full clockwise turns (360° x 3) up from the bottom. See Figure 4.7.
2. Set manual gas butterfly valve to 75% open. See Figure 4.8.

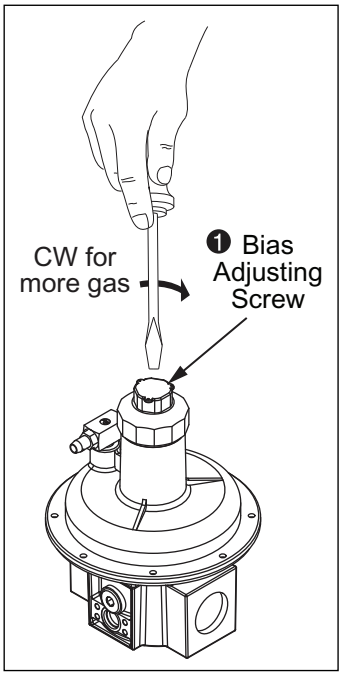


Figure 4.7. Ratio Regulator Adjustment

NOTE: To adjust manual butterfly valve:

a. Loosen set screw
b. Turn dial
c. Tighten set screw

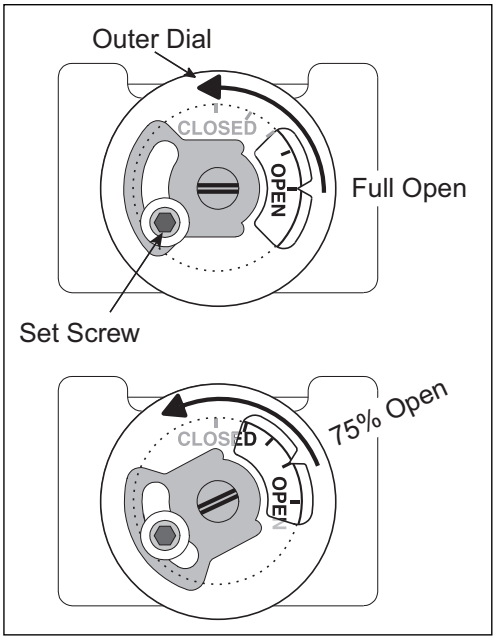


Figure 4.8. Manual Butterfly Valve Adjustment

3. Open all manual gas shut off valves.
4. Set system control to stay at low fire during and after ignition sequence.
5. With taps open, connect manometer between **Tap B** and the combustion chamber.
6. Ignite the burner.

NOTE: If viewing the flame, it should be blue with flashes of yellow. The flame should be completely within the combustion tube. When firing propane or butane, a proper low fire flame may have sustained flashes of yellow.

7. Verify low fire flame.
   a. Drive control motor from low fire and back. Verify low fire and stable flame signal are repeat-ed.
   b. Turn the burner off and repeat the ignition sequence. Verify low fire and stable flame signal are repeated.
8. Close all pressure taps.

Step 5: Set High Fire Gas

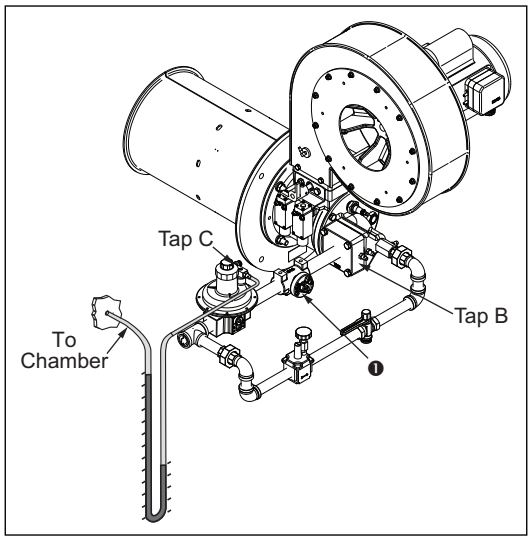


Figure 4.9. High Fire Gas Adjustment

1. Set manual gas butterfly valve to 75% open. See Figure 4.8.

NOTE: To adjust manual butterfly valve:

   a. Loosen set screw
   b. Turn dial
   c. Tighten set screw

2. With burner lit, drive control motor to high fire position.
3. Measure air loading line pressure from **Tap C** to the chamber.
4. Refer to the “Air ΔP vs. Input” graph on page 2 of the appropriate Eclipse Data Sheet. Find your measured high fire air ΔP “w.c. (mbar) on vertical axis at left and plot the intersection point it makes with performance curve in center of chart. Follow chart straight down from this intersection point to confirm the desired high fire burner input Btu/h (kW) charted on horizontal axis across the bottom.
5. Calculate the required gas flow scfh (Nm^3/h) for the desired high fire burner input Btu/h (kW).

Example: (500,000 Btu/h input) x (1 cuft Natural Gas/1000 Btu) = 500 cuft/h or scfh of Natural Gas.

6. Measure existing gas ΔP “w.c. (mbar) across customer supplied in-line fuel orifice meter, and using the manufacturer’s conversion flow chart for the fuel orifice meter, calculate* the existing gas flow scfh (Nm^3/h) through orifice.

(* = making the manufacturer’s prescribed corrections for Fuel Type, Temperature, and Elevation.)

7. If the required gas flow scfh (Nm^3/h) from step 5 does not correspond with the existing gas flow scfh (Nm^3/h) from step 6, adjust existing gas flow using manual butterfly valve (refer to step 1 for adjustment procedure) to match required gas flow for the desired high fire burner input.
8. If required gas flow cannot be achieved, refer to Chapter 5, “Maintenance and Troubleshooting”.

Step 6: Verify Settings

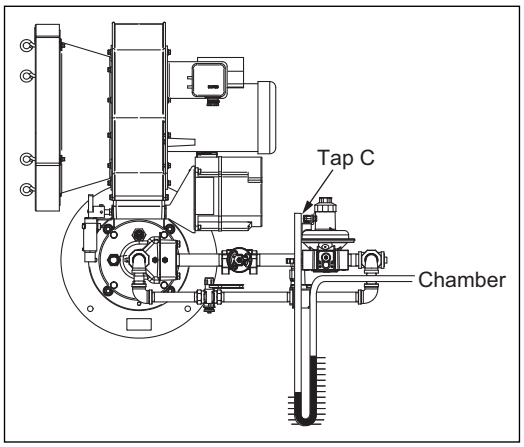


Figure 4.10. Verify Pressure Settings

1. With burner lit, drive control motor to high fire.
2. Wait for the chamber to reach normal operating conditions (e.g. chamber temperature, process flows, etc.).
3. Measure high fire fuel using fuel flow measurement device. Compare this to the rated high fire on datasheet.
4. Measure high fire air differential pressure between **Tap C** and the chamber. Compare this pressure to the **“**Air ∆p vs. Input**”** chart on the datasheet.
5. Drive the control motor to low fire and verify low fire flame signal and flame appearance (if viewing).
6. Cycle burner from high to low several times to check repeatability of settings.
7. Readjust burner if the settings do not repeat as expected. If necessary, refer to Chapter 5, “Maintenance & Troubleshooting”.
8. Use the Systems Schematics on Appendix page ii to record all setup data as an aid for future troubleshooting and setup operations.

CAUTION

- **Do not turn the combustion air blower off until the chamber temperature is below 250°F (121°C). This will prevent hot gases from back flowing into the burner and blower causing damage to the burner.**

9. Stop the burner.

Maintenance & Troubleshooting

5

This section is divided into two parts. The first part describes the maintenance procedures, and the second part helps you to identify problems that may occur and gives recommendations on how to solve these problems.

Preventative maintenance is the key to a reliable, safe and efficient system. The following are suggested guidelines for periodic maintenance. Burners in severe environments or operational conditions should be checked more frequently.

NOTE: The monthly and yearly lists are an average interval. If your environment is dirty, then the intervals may be shorter. Check with local authorities having jurisdiction on their recommended maintenance schedules.

⚠ CAUTION

- **Turn off the power to the burner and controls before proceeding with burner inspection.**

Monthly Checklist

1. Inspect flame-sensing devices for good condition and cleanliness.
2. Check for proper air/gas pressures. Refer to the Winnox datasheet, series 111.
3. Test all alarms for proper signals.
4. Check and clean igniter electrodes.
5. Check the air control valve for smooth, trouble free operation and adjustment.
6. Check for the proper operation of ventilating equipment.
7. Test interlock sequence of all safety equipment and manually make each interlock fail, noting that related equipment closes or stops as specified by the manufacturer. Test flame safeguard by manually shutting off gas to burner.
8. Test all manual fuel valves for operation.
9. Clean and/or replace the combustion air blower filter.
10. Inspect and clean the combustion air blower rotor.

Yearly Checklist

1. Test (leak test) safety shut-off valves for tightness of closure.
2. Test pressure switch settings by checking switch movements against pressure settings and compare these with the actual impulse pressure.
3. Visually check ignition cable and connectors.
4. Inspect impulse piping for leaks.
5. Be sure the following components are not damaged or distorted:
   - the burner nozzle
   - the igniter
   - the flame sensors
   - the combustion tube or block

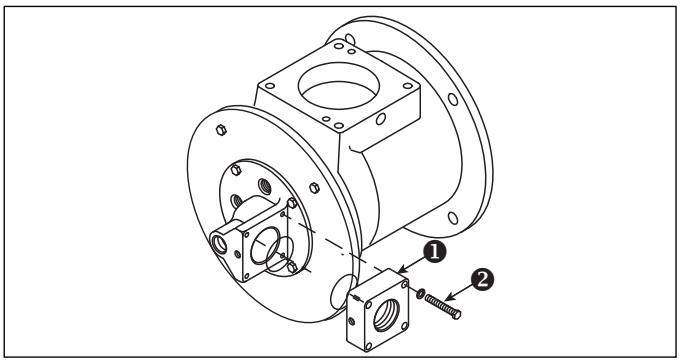


Figure 5.1 Component Inspection

The nozzle can be inspected without removing the burner from the chamber wall or entering the chamber. See Figure 5.1 and Figure 5.2. Perform the following:

a. Shut the burner off and manually close the main gas shut off cocks.
b. Allow the chamber temperature to cool down to 250°F (121°C).
c. Disconnect the gas piping at a union or the gas inlet flange ❶ provided on the burner.
d. Remove the four bolts ❷.

CAUTION

- **Do not attempt to remove the rear cover by removing the inner circle bolts ❺. Internal burner parts will be damaged.**

e. Remove bolts ❻.

f. Remove the rear cover / nozzle assembly ❸ from the burner housing ❹.

g. To reassemble, follow this sequence in the reverse order.

NOTE: The combustor can be inspected only by removing the burner from the chamber wall or entering the chamber.

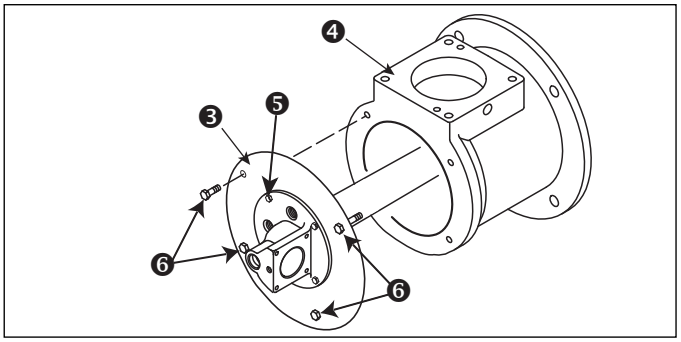


Figure 5.2 Nozzle Inspection

Recommended Spare Parts

To make sure that the downtime of the system is as short as possible in case of a failure, you should keep a stock of spare parts. Please refer to the Eclipse Product Information Center (EPIC) for a full listing of spare parts: http://www.eclipsenet.com/products

Troubleshooting

Problem	Possible Cause	Solution
Start-up sequence runs but burner does not light.	No ignition. There is no power to the ignition transformer.	Restore the power to the ignition transformer.
	No ignition. Open circuit between the ignition transformer and the igniter.	Repair or replace the wiring to the igniter.
	No ignition. The igniter needs cleaning.	Clean the igniter.
	No ignition. The igniter is not correctly grounded to the burner.	Clean the threads on the igniter and the burner. **NOTE:** Do not apply grease to the threads on the igniter.
	No ignition. Igniter insulator is broken. Igniter is grounding out.	Inspect the igniter. Replace if broken.
	Igniter grounds out, igniter is bent.	Inspect ignitor by removing nozzle and rear cover. Check if gaps exist, readjust if needed.
	Not enough gas. The gas pressure into the ratio regulator is too low.	Check the start-up setting. Measure the gas pressures and adjust where necessary.
	Not enough gas. The impulse line to the ratio regulator is leaking.	Repair any leaks.
	Not enough gas. The adjustable orifice valve is not open far enough.	Adjust bypass or low fire gas.
	Not enough gas. Start gas solenoid valve does not open.	Check the solenoid valve coil for proper operation. Replace it if necessary.
	Not enough gas. Gas valve does not open.	Check the wiring to the automatic gas shut-off valve. Check the output from the flame safeguard. Open manual gas cock.
	Not enough gas. Ratio regulator is incorrectly set.	Adjust the ratio regulator to the proper setting.
	No flame signal. Broken flamerod and/or dirty UV scanner lens.	Inspect and clean sensor. Replace if necessary.
	Too much gas. Gas butterfly valve too far open.	Check for proper setting.

Troubleshooting

Problem	Possible Cause	Solution
The low fire flame is weak or unstable.	Not enough gas flowing to the burner.	Adjust the ratio regulator or bypass fuel adjustable orifice valve to increase the gas flow.
	Not enough air.	Check for proper blower rotation. Check air filter for blockage. Compensate for chamber by opening the low fire air butterfly valve position.
The burner goes out when it cycles to high fire.	Not enough gas pressure into the ratio regulator.	Check the start-up settings. Measure the gas pressures and adjust them where necessary. Check for valve train pressure loss.
	Loading line to the ratio regulator is leaking.	Repair the leak in the loading line.
	Not enough gas flowing to the burner.	Adjust the ratio regulator to increase the gas flow.
	Fuel bypass line is not set correctly	Set fuel bypass pressure per datasheet. Additional minor adjustments to the fuel bypass ALO valve may be required to achieve a stable flame through the transition between low and high fire.
The burner is erratic and does not respond to adjustment.	Internal damage to the burner. Some parts inside the burner are loose, dirty or burned out.	Contact Eclipse for further information.
The burner is unstable or produces soot, smoke, or excessive carbon monoxide.	The air/gas ratio is out of adjustment.	Measure all the gas pressures and air pressures. Compare these pressures to the documented initial start-up settings and adjust them where necessary.
The burner cannot achieve full capacity.	Air filter is blocked.	Clean or replace the air filter.
	Gas pressure going into the ratio regulator is too low.	Adjust the gas pressure.
Cannot initiate a start sequence.	Air pressure switch has not made contact.	Check air pressure switch adjustment. Check air filter. Check blower rotation. Check outlet pressure from blower.
	High or low gas pressure switch has activated.	Check incoming gas pressure. Adjust gas pressure if necessary. Check pressure switch setting and operation.
	Malfunction of the flame safeguard system (e.g. shorted-out flame sensor or electrical noise in the sensor line).	Have a qualified electrician troubleshoot and correct the problem.
	No power to the control unit.	Have a qualified electrician troubleshoot and correct the problem.
	Main power is off.	Be sure the main power to the system is switched to the “On” position.

Appendix

Conversion Factors

Metric to English

From	To	Multiply By
actual cubic meter/h (am^3/h)	actual cubic foot/h (acfh)	35.31
normal cubic meter/h (Nm^3/h)	standard cubic foot /h (scfh)	38.04
degrees Celsius (°C)	degrees Fahrenheit (°F)	(°C x 9/5) + 32
kilogram (kg)	pound (lb)	2.205
kilowatt (kW)	Btu/h	3415
meter (m)	foot (ft)	3.281
millibar (mbar)	inches water column ("w.c.)	0.402
millibar (mbar)	pounds/sq in (psi)	14.5×10^{-3}
millimeter (mm)	inch (in)	3.94×10^{-2}
MJ/Nm^3	Btu/ft^3 (standard)	26.86

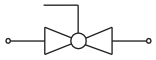
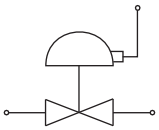
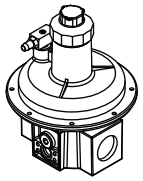
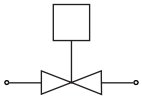
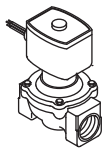
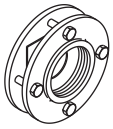
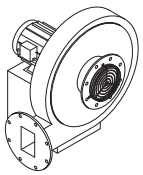
Metric to Metric

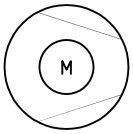
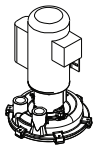
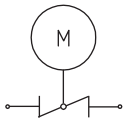
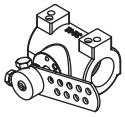
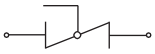
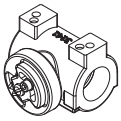
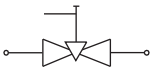
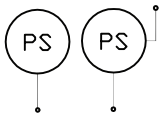
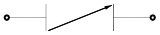
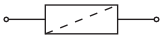
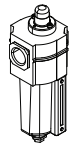
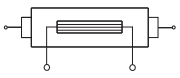
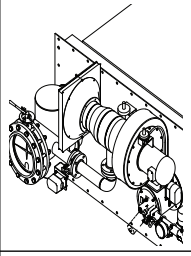
From	To	Multiply By
kiloPascals (kPa)	millibar (mbar)	10
meter (m)	millimeter (mm)	1000
millibar (mbar)	kiloPascals (kPa)	0.1
millimeter (mm)	meter (m)	0.001

English to Metric

From	To	Multiply By
actual cubic foot/h (acfh)	actual cubic meter/h (am^3/h)	2.832×10^{-2}
standard cubic foot /h (scfh)	normal cubic meter/h (Nm^3/h)	2.629×10^{-2}
degrees Fahrenheit (°F)	degrees Celsius (°C)	(°F - 32) x 5/9
pound (lb)	kilogram (kg)	0.454
Btu/h	kilowatt (kW)	0.293×10^{-3}
foot (ft)	meter (m)	0.3048
inches water column ("w.c.)	millibar (mbar)	2.489
pounds/sq in (psi)	millibar (mbar)	68.95
inch (in)	millimeter (mm)	25.4
Btu/ft^3 (standard)	MJ/Nm^3	37.2×10^{-3}

System Schematics

Symbol	Appearance	Name	Remarks	Bulletin/ Info Guide
		Gas Cock	Gas cocks are used to manually shut off the gas supply.	710
		Ratio Regulator	A ratio regulator is used to control the air/gas ratio. The ratio regulator is a sealed unit that adjusts the gas pressure in ratio with the air pressure. To do this, it measures the air pressure with a pressure sensing line, the impulse line. This impulse line is connected between the top of the ratio regulator and the burner body.	742
Main Gas Shut-Off Valve Train		Main Gas Shut-Off Valve Train	Eclipse strongly endorses NFPA as a minimum.	790/791
Pilot Gas Shut-Off Valve Train		Pilot Gas Valve Train	Eclipse strongly endorses NFPA as a minimum.	790/791
		Automatic Shut-Off Valve	Shut-off valves are used to automatically shut off the gas supply on a gas system or a burner.	760
		Orifice Meter	Orifice meters are used to measure flow.	930
		Combustion Air Blower	The combustion air blower provides the combustion air to the burner(s).	610

Symbol	Appearance	Name	Remarks	Bulletin/ Info Guide
		Hermetic Booster	Booster is used to increase gas pressure.	620
		Automatic Butterfly Valve	Automatic butterfly valves are typically used to set the output of the system.	720
		Manual Butterfly Valve	Manual butterfly valves are used to balance the air or gas flow at each burner.	720
		Adjustable Limiting Orifice	Adjustable limiting orifices are used for fine adjustment of gas flow.	728/730
		Pressure Switch	A switch activated by rise or fall in pressure. A manual reset version requires pushing a button to transfer the contacts when the pressure set point is satisfied.	840
		Pressure Gauge	A device to indicate pressure.	940
		Check Valve	A check valve permits flow only in one direction and is used to prevent back flow of gas.	780
		Strainer	A strainer traps sediment to prevent blockage of sensitive components downstream.	
		Flexible Connector	Flexible connectors isolate components from vibration, mechanical, and thermal stresses.	
		Heat Exchanger	Heat exchangers transfer heat from one medium to another.	500
		Pressure Taps	Pressure taps measure static pressure.	

Notes

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Installation Guide 111, 12/2/2014

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Bulletin 111C
2/10

ECLIPSE WINNOX BURNERS

Efficient and Simple, Winnox Burners Meet Tomorrow's Emissions Mandates Today

Designed to comply with the global emissions mandates of the 21st century, Winnox burners are also simple to set up and operate.

Ideal for air heating and oven applications, Winnox burners incorporate direct-spark ignition and a ratio regulator to fire efficiently over a wide gas turndown range at a controlled ratio.

- Patented nozzle design allows for intense mixing of air and fuel resulting in extremely low emissions.
- Ultra-low Nox, less than 20ppm in most applications.
- And...low CO. Virtually no CO emissions during normal operation.
- Short flame is completely contained within the firing tube due to intense swirl generated by the nozzle.

Ready for the world

Winnox burners combine advanced engineering with installation and operational features that are truly world class.

- Multi-fuel capability (natural gas, propane, butane).
- Simple, accurate burner control due to integral butterfly valve and ratio-regulator design.

Low Emission Air Heating Burners

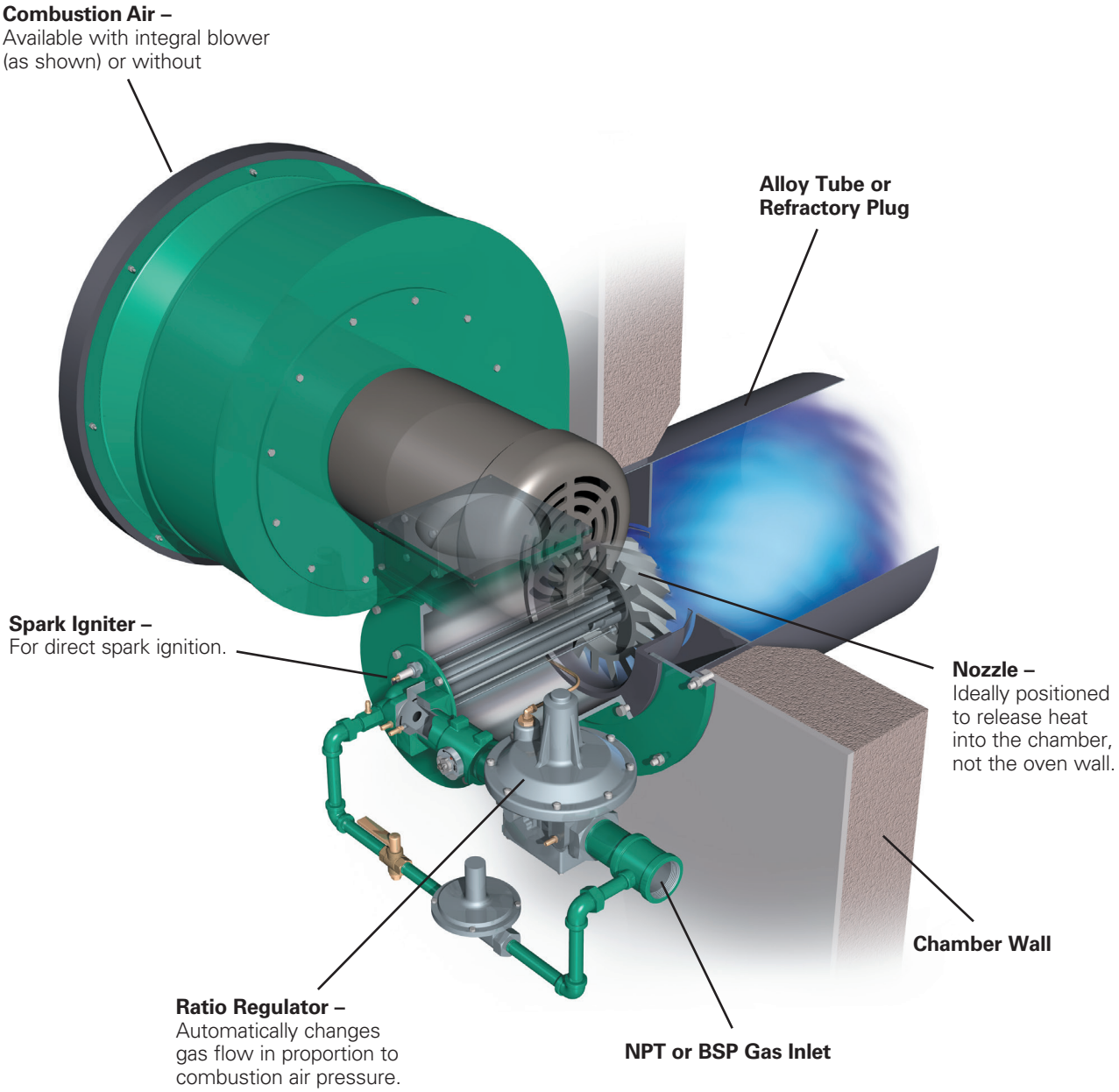
- Packaged convenience. Winnox burners are provided with blowers for ease of installation and at 50 Hz. or 60 Hz. for global application. They are also available with alloy tubes or a refractory combustor to meet the demands of customer requirements.
- Modular design means a variety of options and configurations are available, including NPT or BSP inlet pipe threads.

Consider the many user-preferred features of Winnox before investing in your next air heating burner.

ECLIPSE®
Innovative Thermal Solutions

Winnox Burners

Setting new standards for low emissions.



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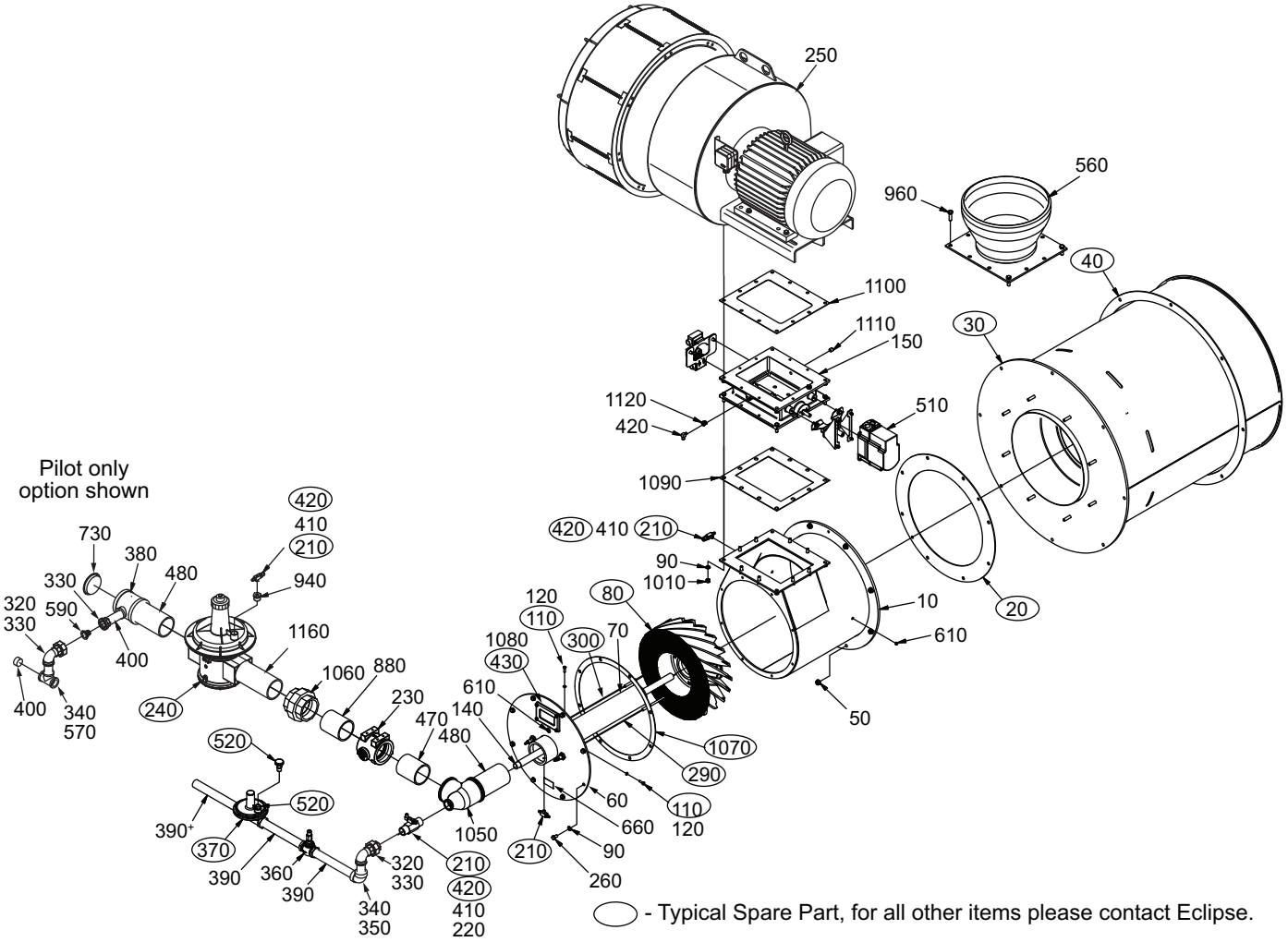
Litho in USA

Eclipse Winnox Burners

Spare Parts List 111-9
1/18/2013

Model WX0850
Version 2.4



- Typical Spare Part, for all other items please contact Eclipse.

Ref	Part Number	Description
1	15608	Filter Element (686 mm diameter)
2	10411	Filter Element (25 mm x 2235 mm x 254 mm)
20	25086	Burner Body to Combustor Mounting Gasket
30	10006681-1	Alloy Combustor for High Temp Operation
30	10006681-2	Alloy Combustor for Low Temp Operation
40	25088	Combustor to Furnace Mounting Gasket
80	101176	Nozzle for Natural Gas
80	10060803	Nozzle for Propane
210	13445	Pressure Tap

Ref	Part Number	Description
240	10056181	Ratio Regulator (3 inch NPT)
240	10058797	*Replacement Ratio Regulator Kit (3 inch NPT)
290	100205-22	Sparkrod (590 mm)
300	100050-8	Flame rod for Propane (568 mm)
300	100050-15	Flame rod for Natural Gas (590 mm)
370	10897	Bypass Regulator (1 inch NPT)
420	1494	Elbow Fitting for Braided Stainless Steel Air Pressure Switch Line

(Continued on next page)

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WX0850 Spare Parts List *(continued)*

Ref	Part Number	Description
420	B60022	Elbow Fitting for Stainless Steel Tube Impulse Line
420	19668	Elbow Fitting for Braided Stainless Steel Impulse Line
430	120072	Peepsight (38 mm x 76 mm)
440	36881	Stainless Steel Tubing Impulse Line (1220 mm) (not shown)
440	019869-03	Braided Stainless Steel Impulse Line (914 mm) (not shown)
450	015991-04	Braided Stainless Steel Air Pressure Switch Line (1220 mm) (not shown)
520	10028762	Vent Protector for Bypass Regulator (Outdoors)
520	19992	Vent Limiter for Bypass Regulator (Indoors)
1070	11880	Gasket for Rear Cover
N/S	10061993	Kit, Mounting, Actuator, Size 8, SQM5
N/S	10061986	Kit, Mounting, Actuator, Size 8, Honeywell

*For Winnox version 2.3 and earlier.

+Included as part of ratio regulator replacement kit.

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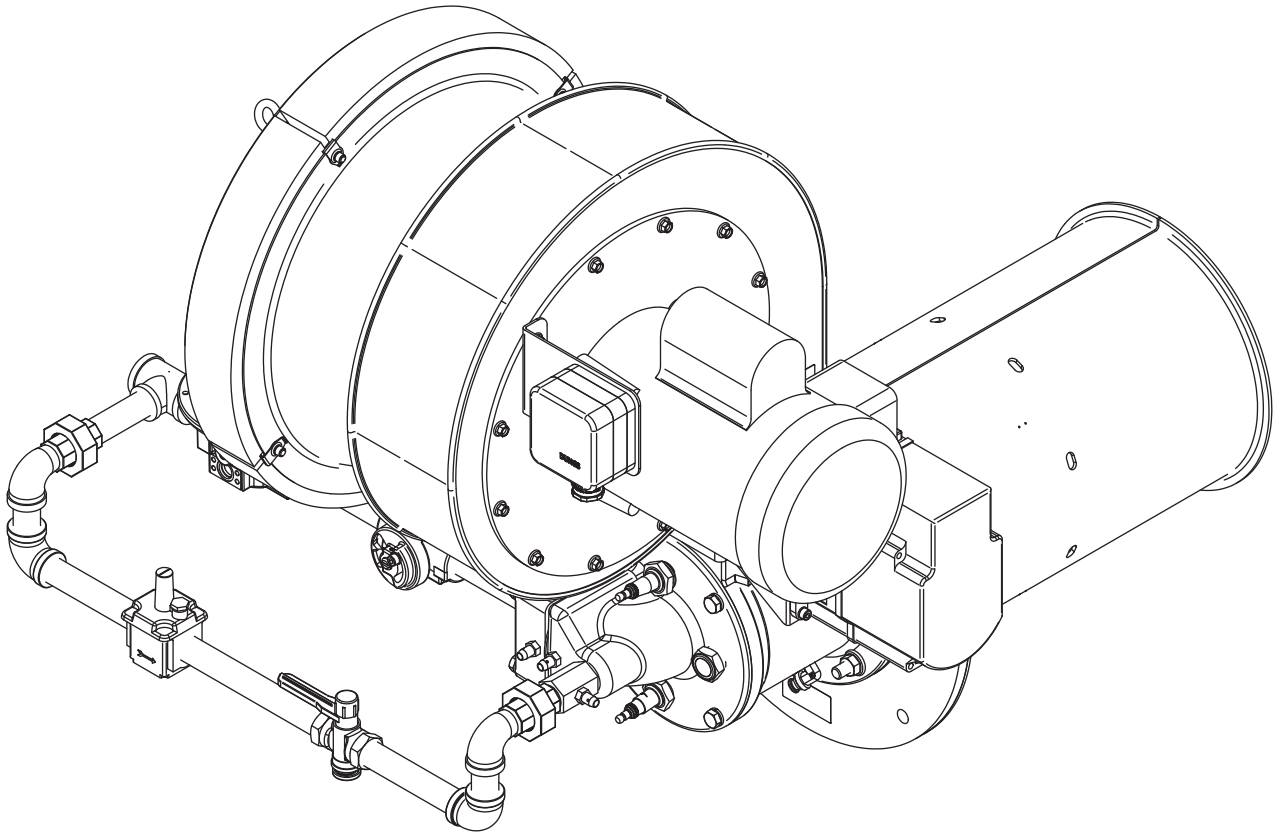
Design Guide 111
8/26/2011

Eclipse Winnox

Burners

WX Series

Version 2



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The material in this manual is believed adequate for the intended use of the product. If the product is used for purposes other than those specified herein, confirmation of validity and suitability must be obtained. Eclipse warrants that the product itself does not infringe upon any United States patents. No further warranty is expressed or implied.

Liability & Warranty

We have made every effort to make this manual as accurate and complete as possible. Should you find errors or omissions, please bring them to our attention so that we may correct them. In this way we hope to improve our product documentation for the benefit of our customers. Please send your corrections and comments to our Technical Documentation Specialist.

It must be understood that Eclipse's liability for its product, whether due to breach of warranty, negligence, strict liability, or otherwise is limited to the furnishing of replacement parts and Eclipse will not be liable for any other injury, loss, damage or expenses, whether direct or consequential, including but not limited to loss of use, income, or damage to material arising in connection with the sale, installation, use of, inability to use, or the repair or replacement of Eclipse's products.

Any operation expressly prohibited in this manual, any adjustment, or assembly procedures not recommended or authorized in these instructions shall void the warranty.

Document Conventions

There are several special symbols in this document. You must know their meaning and importance.

The explanation of these symbols follows below. Please read it thoroughly.

How To Get Help

If you need help, contact your local Eclipse representative. You can also contact Eclipse at:

1665 Elmwood Rd.
Rockford, Illinois 61103 U.S.A.
Phone: 815-877-3031
Fax: 815-877-3336
http://www.eclipsenet.com

Please have the information on the product label available when contacting the factory so we may better serve you.

ECLIPSE Innovative Thermal Solutions www.eclipsenet.com
Product Name
Item #
S/N
DD MMM YYYY

	This is the safety alert symbol. It is used to alert you to potential personal injurt hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.
	Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	Is used to address practices not related to personal injury.
NOTE	Indicates an important part of text. Read thoroughly.

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Introduction 1

Product Description

The Winnox is a nozzle-mix, low-emissions burner designed for direct and indirect air heating, as well as oven applications up to 1800°F (980°C).

The burner package includes a combustion air blower and ratio regulator to fire over a wide gas turndown range at a controlled ratio.

The burner is designed for:

- low NO_x and CO emissions
- efficient ratio controlled combustion
- reliable burner operation
- simple burner adjustment
- direct spark ignition
- multiple fuel capability

The wide variety of options and configurations are available due to the modular design of the burner.

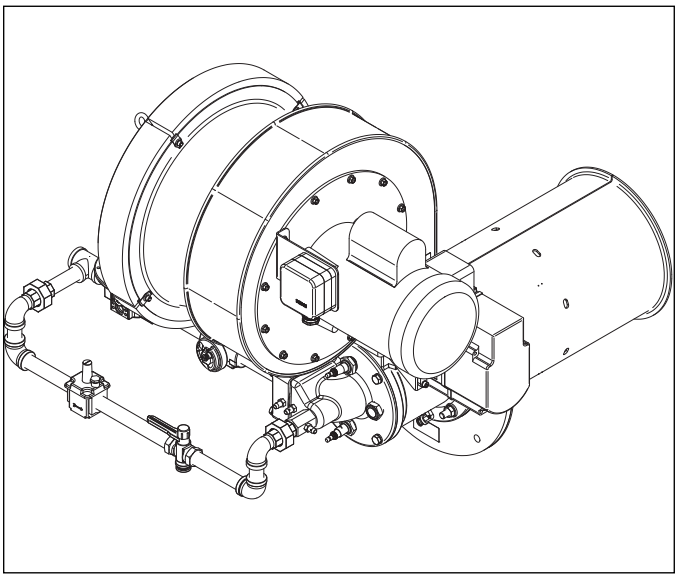


Figure 1.1 Winnox Burner

Audience

This manual has been written for people who are already familiar with all aspects of a nozzle-mix burner and its add-on components, also referred to as “the burner system”.

These aspects are:

- Design / Selection
- Use
- Maintenance

The audience is expected to have previous experience with this type of equipment.

Winnox Documents

Design Guide No. 111

- This document

Datasheet, Series 111

- Available for individual WX models
- Required to complete design and selection

Installation Guide No. 111

- Used with Datasheet to complete installation

Related Documents

- EFE 825 (Combustion Engineering Guide)
- Eclipse Bulletins and Info Guides: 684, 710, 732, 756, 760, 902, 930

Purpose

The purpose of this manual is to ensure the design of a safe, effective, and trouble-free combustion system.

Safety

2

Important notices which help provide safe burner operation will be found in this section. To avoid personal injury and damage to the property or facility, the following warnings must be observed. All involved personnel should read this entire manual carefully before attempting to start or operate this system. If any part of the information in this manual is not understood, contact Eclipse before continuing.

Safety Warnings

⚠ DANGER

- **The burners, described herein, are designed to mix fuel with air and burn the resulting mixture. All fuel burning devices are capable of producing fires and explosions if improperly applied, installed, adjusted, controlled or maintained.**
- **Do not bypass any safety feature; fire or explosion could result.**
- **Never try to light a burner if it shows signs of damage or malfunction.**

⚠ WARNING

- **The burner and duct sections are likely to have HOT surfaces. Always wear the appropriate protective equipment when approaching the burner.**
- **Eclipse products are designed to minimize the use of materials that contain crystalline silica. Examples of these chemicals are: respirable crystalline silica from bricks, cement or other masonry products and respirable refractory ceramic fibers from insulating blankets, boards, or gaskets. Despite these efforts, dust created by sanding, sawing, grinding, cutting and other construction activities could release crystalline silica. Crystalline silica is known to cause cancer, and health risks from the exposure to these chemicals vary depending on the frequency and length of exposure to these chemicals. To reduce the risk, limit exposure to these chemicals, work in a well-ventilated area and wear approved personal protective safety equipment for these chemicals.**

NOTICE

- **This manual provides information regarding the use of these burners for their specific design purpose. Do not deviate from any instructions or application limits described herein without written approval from Eclipse.**

Capabilities

Only qualified personnel, with sufficient mechanical aptitude and experience with combustion equipment, should adjust, maintain or troubleshoot any mechanical or electrical part of this system. Contact Eclipse for any needed commissioning assistance.

Operator Training

The best safety precaution is an alert and trained operator. Train new operators thoroughly and have them demonstrate an adequate understanding of the equipment and its operation. A regular retraining schedule should be administered to ensure operators maintain a high degree of proficiency. Contact Eclipse for any needed site-specific training.

Replacement Parts

Order replacement parts from Eclipse only. All Eclipse approved valves or switches should carry UL, FM, CSA, CGA and/or CE approval where applicable.

System Design 3

Design

The design process is divided into the following steps:

1. **Burner Option Selection Including:**
   - Burner Model / Size Selection
   - Firing Position
   - Burner Configuration
   - Fuel Type
   - Pilot Configuration
   - Combustor Type
   - Air Supply
   - Control Motor
   - Limit Switch
   - Loading Line Type
   - Air Pressure Switch
   - Pipe Connections
   - Flame Supervision
2. **Packaged Blower Option Selection Including:**
   - Power Supply Frequency
   - Pressure & Flow
   - Blower Motor Type
   - Blower Inlet
   - Blower Configuration
3. **Control Methodology Including:**
   - Burner Control
4. **Ignition System Including:**
   - Ignition Transformer
   - Trial for Ignition
   - Ignition Gas Piping
5. **Flame Monitoring Control System Including:**
   - Flame Sensor
   - Flame Monitoring Control
6. **Main Gas Shut-Off Valve Train Including:**
   - Component Selection
   - Fuel Flow Measurement
   - Valve Train Size
7. **Verify Chamber Design:**
   - Firing Chamber Dimensions
   - Flame Shielding

Step 1: Burner Option Selection

Step 1 describes how to select burner options to suit an application. Use the Winnox Price List and Datasheets, series 111 when following this selection process.

⚠ CAUTION

- **Consult EFE-825 Eclipse Engineering Guide or contact Eclipse if you have special conditions or questions.**

Burner Model / Size Selection

Consider the following when selecting the burner size:

- **Heat Input:** Calculate the required heat input to achieve the required heat balance. The burner air supply option selected will affect available heat output from the burner.
- **Power Supply Frequency:** Burner capacity will vary with power supply frequency (50 Hz or 60 Hz power).
- **Combustion Chamber Pressure:** Consider the effects that large or varying chamber pressures have on burner performance.
- **Altitude:** The maximum burner capacity is reduced by approximately 3% each 1000 feet (300 meters) above sea level.
- **Combustion Air Supply:** Combustion air should be fresh (20.9% O_2) and clean (without particles or corrosives).
- **Combustion Air Temperature:** Changes in air supply temperature can affect the burner capacity. The combustion air supply temperature should not exceed 250°F.
- **Fuel Type:** Variation in calorific value and density will affect burner performance. Nominal burner performance is based on fuel properties in Table 3.1.

Firing Position

- Vertical down firing
- Vertical up firing
- Horizontal firing

Burner Configuration

Select configuration. See Figure 3.1.

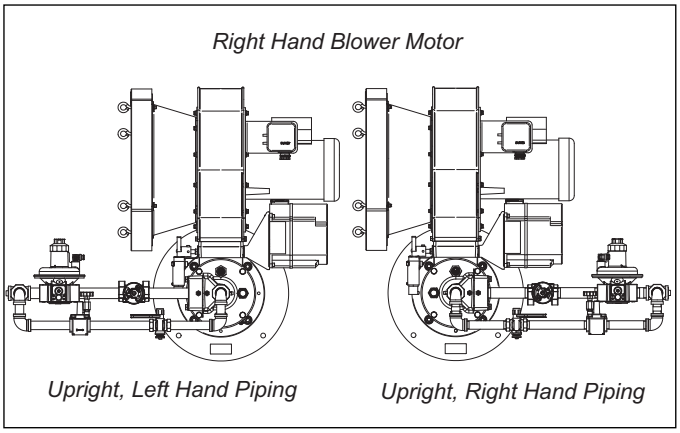


Figure 3.1 Burner Configuration & Motor Orientation Choice

Fuel Type

Table 3.1 Fuel Type

Fuel	Symbol	Gross Heating Value	Specific Gravity	WOBBE Index
Natural Gas	$CH_4$90%+	1000 BTU/ft^3 (40.1 MJ/m^3)	0.60	1290 BTU/ft^3
Propane	C_3H_8	2525 BTU/ft^3 (101.2 MJ/m^3)	1.55	2028 BTU/ft^3
Butane	C_4H_{10}	3330 BTU/ft^3 (133.7 MJ/m^3)	2.09	2303 BTU/ft^3
BTU/ft^3 @ standard conditions (MJ/m^3 @ normal conditions)				

If using an alternative fuel supply, contact Eclipse with an accurate breakdown of the fuel components.

Pilot Configuration

Winnox burners are equipped with a standard integral bypass pilot. No additional hookups are required to operate this pilot. All bypass regulators are supplied with a vent limiting orifice or a vent protector. For additional configurations contact Eclipse.

Combustor Type

Select a combustor type based on the application:

Table 3.2 Recommended Maximum Chamber Temp

Recommended Maximum Chamber Temperature °F (°C)			
Model	**Standard Alloy Tube**	**High Temp Alloy Tube**	**Refractory Plug**
100, 200	1300° (704°)	1550° (843°)	1800° (982°)
300, 400	1300° (704°)	1550° (843°)	1800° (982°)
500, 600	1300° (704°)	1550° (843°)	1800° (982°)
850	1100° (593°)	1400° (760°)	Not Available

Tube and plug temperatures should be reduced 150°F (65°C) when using propane or butane.

NOTE: When using a refractory plug, the customer must provide their own refractory combustion tube set up per Eclipse dimensions, see Datasheet series 111 and Installation Guide 111.

Air Supply

Select either a combustion air blower mounted directly to the burner body, or a pipe connection type for remote blower operation.

Control Motor

Select a control motor. Standard control motor options include various models, provided mounted to the burner. Winnox burners can be ordered with control motor bracket and mounting hardware only. Customer supplied control motors must conform to these specifications:

- rotation not to exceed 2 rpm
- minimum torque of 25 in-lb (2,8 Nm)
- 90° stroke
- continuous modulating or high/low modulating control
- reversible direction of rotation
- certain applications may require control motors with a limit switch or switches if:
  - the burner capacity is to be limited to fit an application
  - the chamber is to be fired with positive or negative pressure
  - the chamber pressure is outside the range -1" w.c. to +1" w.c. (-2,5 to 2,5 mbar)
  - there is a need to indicate a high and/or low fire air butterfly valve position

Limit Switch

Limit switches monitor the position of the integral air butterfly valve. Select high, low, high and low, or no limit switch option. Proper selection is based on preference, control system, and local code.

Loading Line Type

All Winnox burners have the option of plastic, flexible braided stainless steel or rigid stainless tubing loading line. Selection depends on application and environment.

Air Pressure Switch

The air pressure switch provides a signal to the monitoring system when there is not enough air pressure from the blower. If a switch is selected, it will be factory mounted.

⚠ WARNING

- **Eclipse supports the NFPA regulation requiring, as a minimum standard for main gas shut-off**

systems, the use of an air pressure switch in conjunction with other system components.

Pipe Connections

Select the gas pipe connection thread type. The piping, burner gas inlet, and fuel train components are threaded using the customer selected pipe thread option.

Flame Supervision

Select a flame rod or an ultraviolet (UV) scanner. Both are available on all Winnox burners. If a flame rod is selected, it will be factory mounted in the burner. If a UV scanner is selected, it must be ordered separately. See step 5 for additional information on flame supervision selection.

Step 2: Packaged Blower Option Selection

NOTE: Standard blower options are listed in Price List 111, additional blower options are available through Eclipse. Price and leadtime may vary.

Power Supply Frequency

Select the 50Hz or 60Hz option. The 50Hz blower motors have IEC frames and are CE marked. The 60Hz motors have NEMA frames.

Pressure & Flow

Eclipse integrated packaged blowers are designed to provide the required pressure and flow in standard conditions. For information regarding non-standard conditions, please refer to the appropriate datasheet series 111.

Blower Motor Type

Motor types include various options: voltages, single or three phase, TEFC or automotive duty enclosures.

Blower Inlet

When selecting an inlet, consider the following:

- amount and size of particles in the air
- sound requirements
- space limitations
- cleanliness requirements of the process

Blower Configuration

Right-hand blower motor is the standard blower configuration. If left-hand blower motor is required, contact factory. Refer to Figure 3.1.

Step 3: Control Methodology

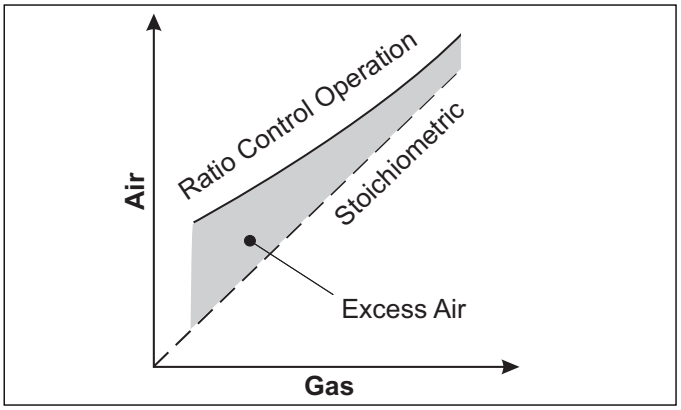


Figure 3.2 Air : Gas Flow

All standard Winnox burners are designed for:

- air : gas ratio controlled combustion
- 40 - 70% excess air at high fire
- higher excess air at low fire

Burner Control

Winnox burners come with a ratio regulator that maintains the air : gas ratio. An integral minimum fuel bypass line is used to maintain and control a reliable low fire input flow.

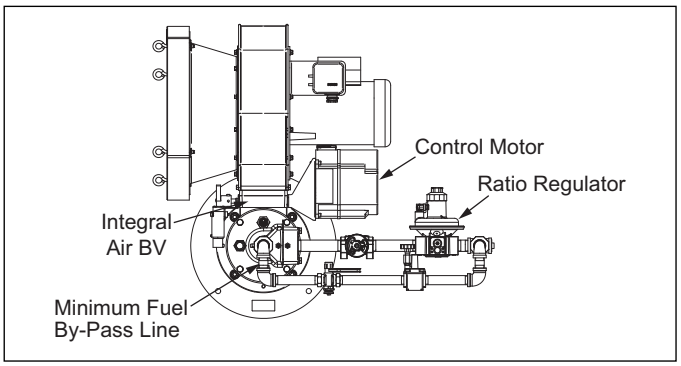


Figure 3.3 Basic Burner Components

- A control signal is sent from a process temperature controller (sold separately) to the control motor. (Contact Eclipse for further information on temperature controllers.)

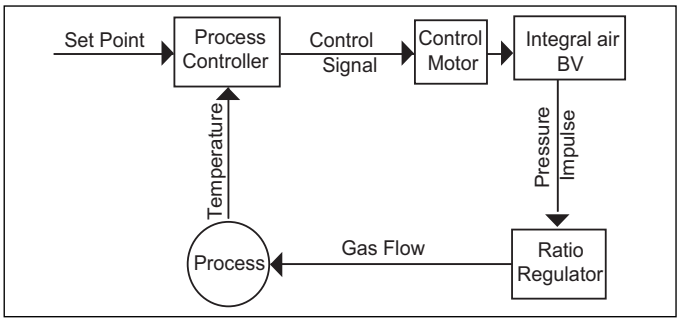


Figure 3.4 Basic Control Loop

- The control motor modulates the integral air butterfly valve which controls the combustion air flow.

- Air pressure in the burner body sends an impulse through the loading line to the ratio regulator.
- The ratio regulator controls the gas flow in proportion to the air flow.

WARNING

- **Do not use other control methods, such as, a fixed-air control, and do not alter the ratio regulator or burner piping without prior approval from Eclipse. See Installation Guide 111 "Adjustment, Start & Stop" section.**

Step 4: Ignition System

Ignition Transformer

For the ignition system, use a transformer with:

- secondary voltage 6,000 to 8,000 VAC
- minimum secondary current 0.02 amps continuous
- full wave output

DO NOT USE the following:

- twin outlet
- distributor type
- half wave output

Trial for Ignition

The burner may only be lit with low fire settings.

Most local safety codes and insurance requirements limit the maximum trial for ignition time (the time it takes for a burner to ignite). These requirements vary from one location to another; check your local codes and comply to the strictest codes applicable.

The time it takes for a burner to ignite depends on the following:

- the distance between the gas shut-off valve and the burner
- the air : gas ratio
- the gas flow conditions at start-up

Ignition Gas Piping

Winnox burners are capable of ignition with either low fire or bypass start gas.

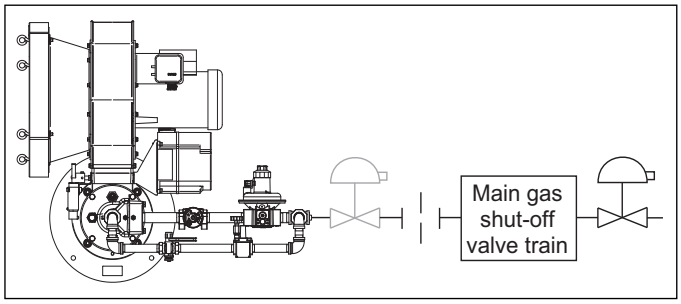


Figure 3.5 Low Fire Start

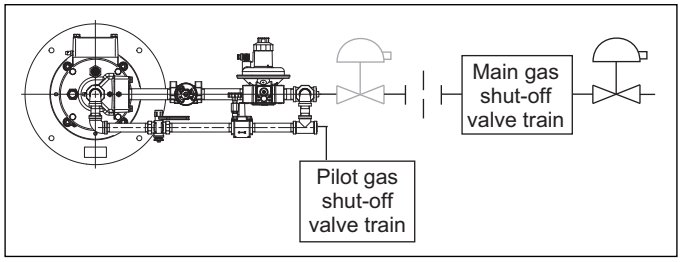


Figure 3.6 Pilot Start (Optional)

Piping for pilot start option needs to be sized to accommodate low fire gas flows as stated in Datasheet, series 111.

Step 5: Flame Monitoring Control System

The flame monitoring control system consists of two main components:

- Flame Sensor
- Flame Monitoring Control

Flame Sensor

Two types can be used on a Winnox Burner:

- Flame rod
- UV scanner

Flame rods are available for all Winnox burner sizes. Further information can be found in:

- Info Guide 832

A UV scanner can be used on all Winnox burner sizes. The UV scanner must be compatible to the flame monitoring control that is used. Refer to the manual of your selected control for proper selection of the scanner.

Flame Monitoring Control

The flame monitoring control processes the signal from the flame sensor and controls the start-up and shut-down sequences.

Eclipse recommends the following flame monitoring controls:

- Trilogy series T400; see Instruction Manual 830
- Veri-Flame series 5600: see Instruction Manual 818
- Bi-Flame series 6500: see Instruction Manual 826
- Multi-Flame series 6000; see Instruction Manual 820

If other controls are considered, contact Eclipse to determine how burner performance may be affected. Flame monitoring controls that have lower sensitivity flame detecting circuits may limit burner turndown and change the requirements for ignition. Flame monitoring controls that stop the spark as soon as a signal is detected may prevent establishment of flame, particularly when using UV scanners. The flame monitoring control must maintain the spark for a fixed time interval that is long enough for ignition.

DO NOT USE the following:

- Flame monitoring relays which interrupt the trial for ignition when the flame is detected
- Flame sensors which supply a weak signal
- Flame monitoring relays with low sensitivity

WARNING

- **A UV scanner can possibly detect another burner's flame if it is in the line of sight, and falsely indicate flame presence. Use a flame rod in this situation. This helps prevent accumulation of unburned fuel which, in extreme situations, could cause a fire or an explosion.**

Step 6: Main Gas Shut-Off Valve Train

Component Selection

Eclipse can help in the design of or provide a main gas shut-off valve train that satisfies the customer and complies with all local safety standards and codes set by the authorities within that jurisdiction. Contact Eclipse for further information.

NOTE: Eclipse supports NFPA regulations (two gas shut-off valves as a minimum standard for main gas shut-off systems).

Fuel Flow Measurement

Eclipse requires a fuel flow measurement device ❶ to ensure proper operation of the Winnox Burner. Eclipse recommendations can be found in the appropriate Winnox Datasheet, series 111.

Valve Train Size

Fuel pressure supplied to the ratio regulator inlet must be within the range specified on the Winnox Datasheet, series 111. The valve train should be sized sufficiently to provide the specified pressure. A second main gas pressure regulator ❷ immediately upstream from the burner gas inlet might be necessary to maintain inlet pressure to the burner.

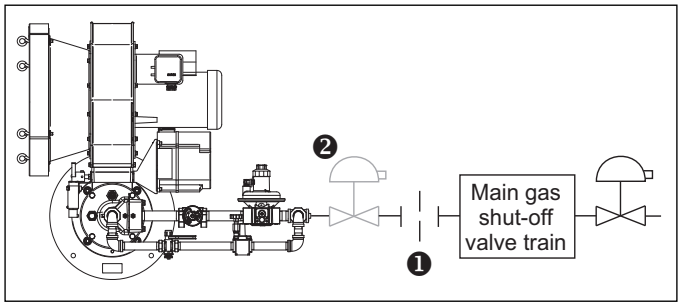


Figure 3.7 Low Fire Start

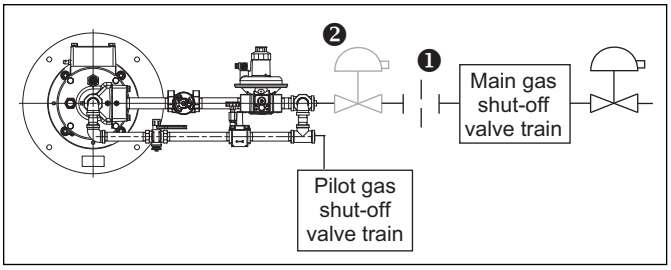


Figure 3.8 Pilot Start Option

WARNING

- **Do not operate Winnox burners with gas inlet pressure less than the minimum listed on the Winnox Datasheet. Lower gas inlet pressures may cause the ratio regulator to remain fully open at lower inputs as the burner transitions from low to high fire. This could result in the possible accumulation of unburned fuel in the burner which, in extreme situations, could cause a fire or an explosion.**

Step 7: Verify Chamber Design

Firing Chamber Dimensions

The Winnox is a low emissions burner that might require a larger firing chamber than a standard burner.

Chamber dimensions are a function of chamber temperature, process air volume and burner input. Contact your Eclipse representative to review your chamber design.

NOTE: See the Installation Guide for recommendations on wall and insulation construction when only installing the refractory plug.

Flame Shielding

In applications where process air may be flowing perpendicular over the combustor, a metal shroud should be installed around the combustor that is 20% larger than the combustor diameter and with a length that covers the combustor slots by 100 mm (4"). Slot dimensions can be found in Datasheet, series 111.

Appendix

Conversion Factors

Metric to English

From	To	Multiply By
actual cubic meter/h (am^3/h)	actual cubic foot/h (acfh)	35.31
normal cubic meter/h (Nm^3/h)	standard cubic foot /h (scfh)	38.04
degrees Celsius (°C)	degrees Fahrenheit (°F)	(°C x 9/5) + 32
kilogram (kg)	pound (lb)	2.205
kilowatt (kW)	Btu/h	3415
meter (m)	foot (ft)	3.281
millibar (mbar)	inches water column (“w.c.)	0.402
millibar (mbar)	pounds/sq in (psi)	14.5×10^{-3}
millimeter (mm)	inch (in)	3.94×10^{-2}
MJ/Nm^3	Btu/ft^3 (standard)	26.86

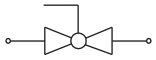
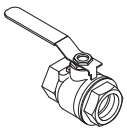
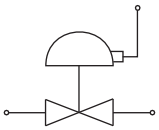
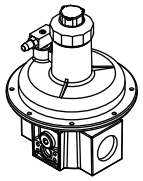
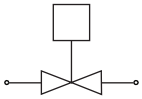
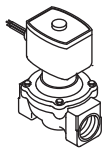
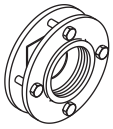
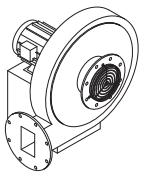
Metric to Metric

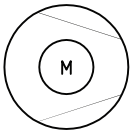
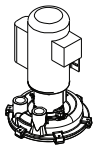
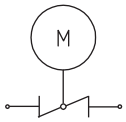
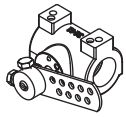
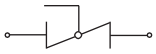
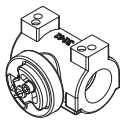
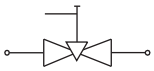
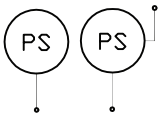
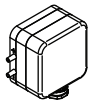
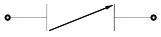
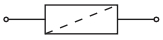
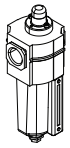
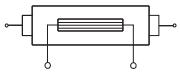
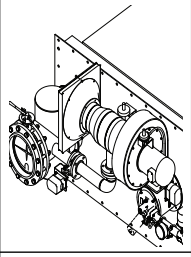
From	To	Multiply By
kiloPascals (kPa)	millibar (mbar)	10
meter (m)	millimeter (mm)	1000
millibar (mbar)	kiloPascals (kPa)	0.1
millimeter (mm)	meter (m)	0.001

English to Metric

From	To	Multiply By
actual cubic foot/h (acfh)	actual cubic meter/h (am^3/h)	2.832×10^{-2}
standard cubic foot /h (scfh)	normal cubic meter/h (Nm^3/h)	2.629×10^{-2}
degrees Fahrenheit (°F)	degrees Celsius (°C)	(°F - 32) x 5/9
pound (lb)	kilogram (kg)	0.454
Btu/h	kilowatt (kW)	0.293×10^{-3}
foot (ft)	meter (m)	0.3048
inches water column (“w.c.)	millibar (mbar)	2.489
pounds/sq in (psi)	millibar (mbar)	68.95
inch (in)	millimeter (mm)	25.4
Btu/ft^3 (standard)	MJ/Nm^3	37.2×10^{-3}

System Schematics

Symbol	Appearance	Name	Remarks	Bulletin/ Info Guide
		Gas Cock	Gas cocks are used to manually shut off the gas supply.	710
		Ratio Regulator	A ratio regulator is used to control the air/gas ratio. The ratio regulator is a sealed unit that adjusts the gas pressure in ratio with the air pressure. To do this, it measures the air pressure with a pressure sensing line, the impulse line. This impulse line is connected between the top of the ratio regulator and the burner body.	742
Main Gas Shut-Off Valve Train		Main Gas Shut-Off Valve Train	Eclipse strongly endorses NFPA as a minimum.	790/791
Pilot Gas Shut-Off Valve Train		Pilot Gas Valve Train	Eclipse strongly endorses NFPA as a minimum.	790/791
		Automatic Shut-Off Valve	Shut-off valves are used to automatically shut off the gas supply on a gas system or a burner.	760
		Orifice Meter	Orifice meters are used to measure flow.	930
		Combustion Air Blower	The combustion air blower provides the combustion air to the burner(s).	610

Symbol	Appearance	Name	Remarks	Bulletin/ Info Guide
		Hermetic Booster	Booster is used to increase gas pressure.	620
		Automatic Butterfly Valve	Automatic butterfly valves are typically used to set the output of the system.	720
		Manual Butterfly Valve	Manual butterfly valves are used to balance the air or gas flow at each burner.	720
		Adjustable Limiting Orifice	Adjustable limiting orifices are used for fine adjustment of gas flow.	728/730
		Pressure Switch	A switch activated by rise or fall in pressure. A manual reset version requires pushing a button to transfer the contacts when the pressure set point is satisfied.	840
		Pressure Gauge	A device to indicate pressure.	940
		Check Valve	A check valve permits flow only in one direction and is used to prevent back flow of gas.	780
		Strainer	A strainer traps sediment to prevent blockage of sensitive components downstream.	
		Flexible Connector	Flexible connectors isolate components from vibration, mechanical, and thermal stresses.	
		Heat Exchanger	Heat exchangers transfer heat from one medium to another.	500
		Pressure Taps	Pressure taps measure static pressure.	

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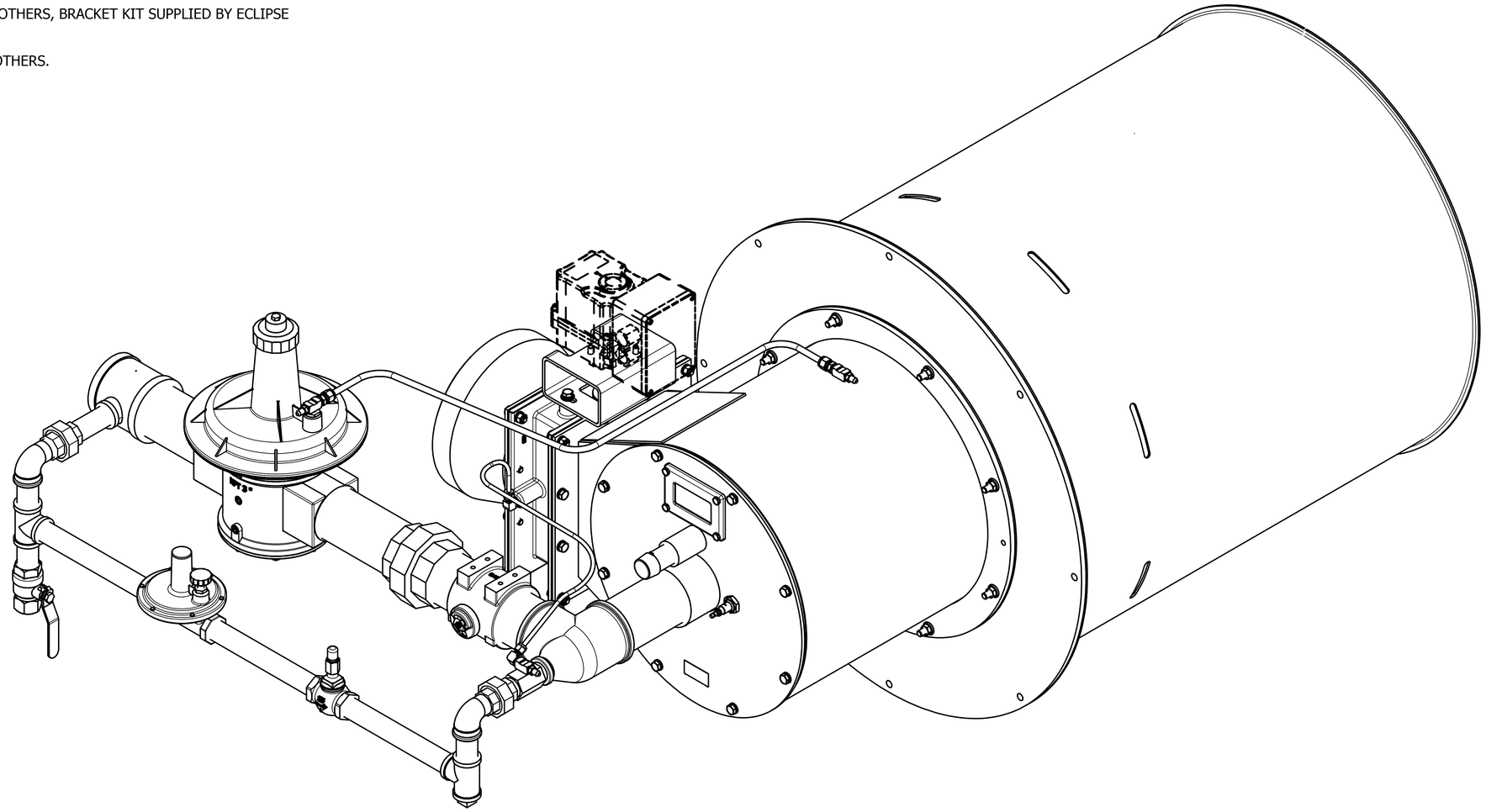
NOTES:

1. FUEL TYPE: NATURAL GAS
2. BURNER GROSS INPUT:
   MAXIMUM: 10.4 MMBTU/HR
   MINIMUM : 500,000 BTU/hr
3. FUEL INLET PRESSURE: 56-110" W.C.
4. AIR INLET PRESSURE: 40" W.C.
5. RECOMMENDED AIR PRESSURE SWITCH SETPOINT: 24" W.C.
6. ELECTRICAL POWER DESIGN REQUIREMENTS: N/A
7. ELECTRICAL ENCLOSURE RATING: N/A
8. AREA CLASSIFIACTION: NONE
9. DESIGN SITE CONDITIONS: 1300 FEET ASL, -20 TO 110˚F TEMP., 0.75" W.C. CHAMBER BACK PRESSURE
10. FOR ADDITIONAL INFORMATION REFER TO ECLIPSE DATA SHEET AND DOCUMENTATION.
11. ACTUATOR IS SUPPLIED AND INSTALLED BY OTHERS, BRACKET KIT SUPPLIED BY ECLIPSE FOR TRIAC WE-500.
12. UV SCANNER SUPPLIED AND INSTALLED BY OTHERS.



SHIPPING INFORMATION	
WEIGHT:	415 kg (915 lb)
LENGTH:	1911 mm [75.2 in]
WIDTH:	1438 mm [56.6 in]
HEIGHT:	845 mm [33.3 in]

REV	DESCRIPTION	DATE	APPROVED
B	Regulator: 10001490 Was 10056181	01/26/2016	MM/TSB
A	10S0186312	12/03/15	STM/GK

REVISION HISTORY

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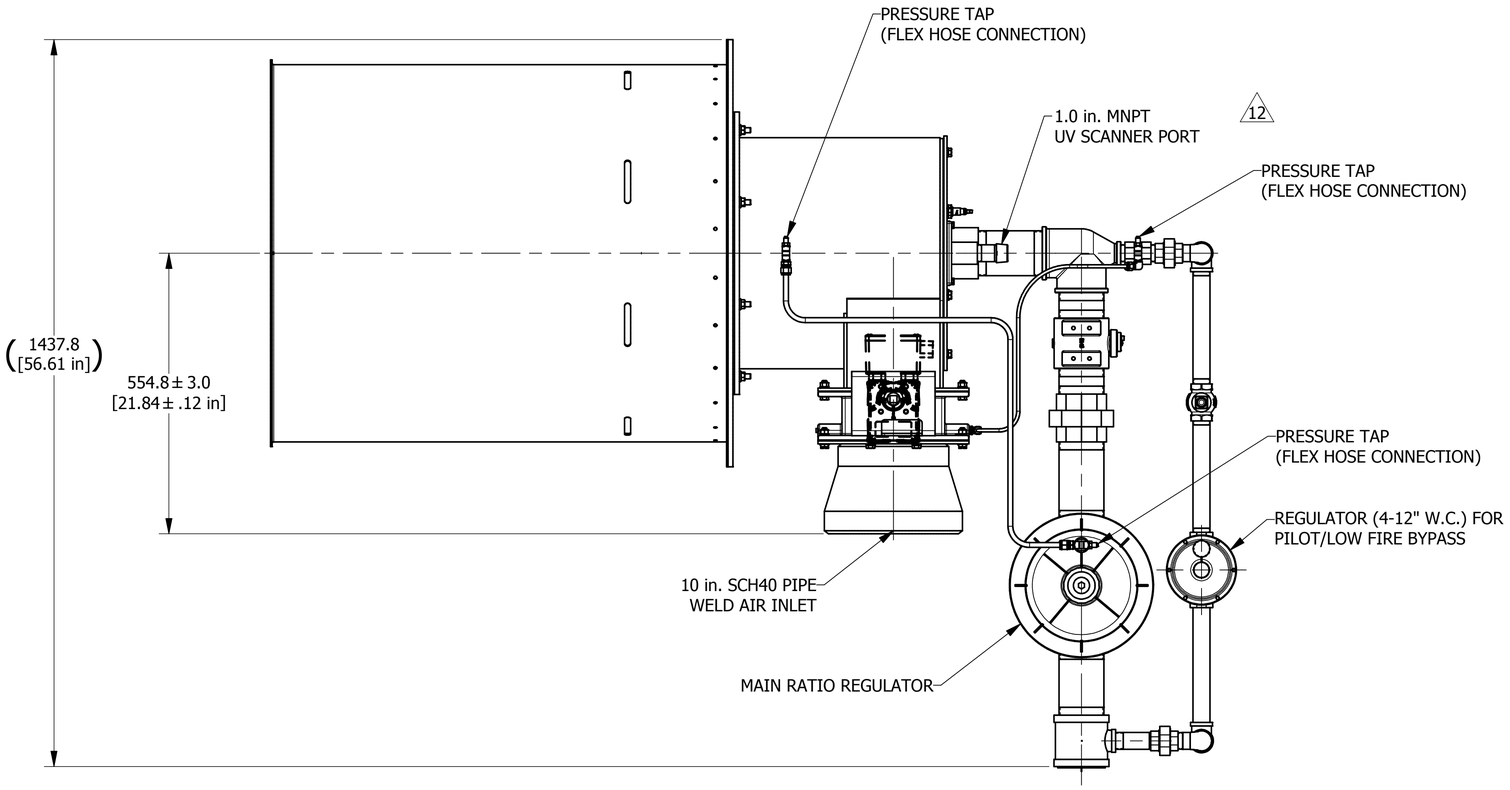
ECLIPSE®

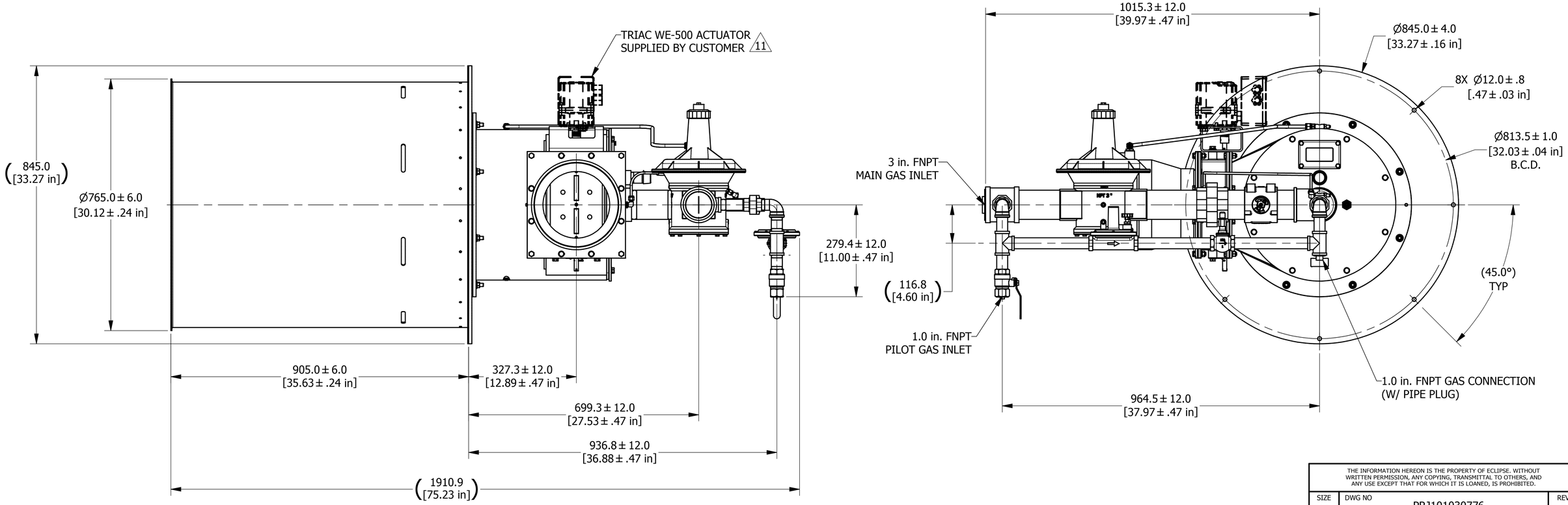
Burner, Winnox, Customer Level, V2.4, (WX0850), Natural Gas, Horizontal Firing,

THIRD ANGLE PROJECTION

SIZE A1 | DWG NO PRJ101030776

SCALE: NONE | REF: PRJ101019138 | UNITS: mm [in] | SHEET 1 OF 2





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SIZE	DWG NO	REV
A1	PRJ101030776	B

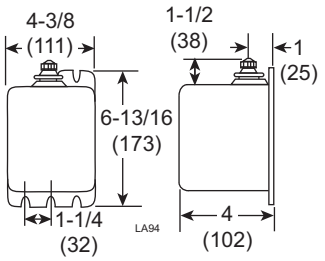
SCALE: NONE | UNITS: mm [in] | SHEET 2 OF 2

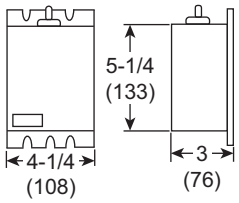
Bulletin 832
6/24/2011

Eclipse Flame Safety & Ignition Components

Ignition transformer with 20 mA secondary current. Single phase.

Part No.	Primary Voltage and Frequency	Secondary Voltage
12178	120 VAC / 60 Hz	6000 VAC
15171	240 VAC / 60 Hz	6000 VAC
20683	120 VAC / 50 Hz	6000 VAC
20684	220 VAC / 50 Hz	6000 VAC
20923	110 VAC / 50 Hz	5000 VAC
NOTE: For more ignition transformers see Data 841.		



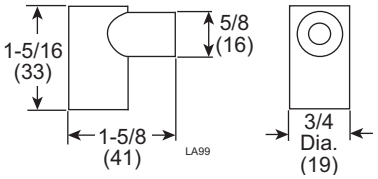


Part number 13551. Honeywell Q-624A-1014 solid state half wave spark generator. Primary: 120 VAC, 66VA secondary; 10,000 VAC.

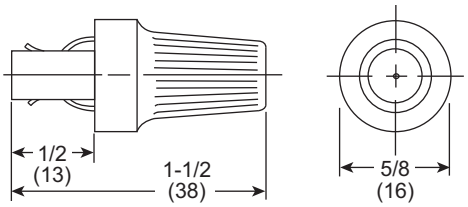
Part number 32756-50FT and 32756-100FT. High temperature ignition wire for maximum of 480°F (250°C).

Part number 35443-50Ft and 35443-100Ft. GTO-15 ignition cable for maximum ambient temperature of 220°F (105°C).

Part number 13564-4PC. Rajah 90° fitting with plastic insulator, connects to ignition cable. Snaps onto igniter or flamerod.



Part number 15996. Terminal, Rajah, straight fitting with half insulation over portion that connects to ignition cable. Snaps onto igniter or flamerod.



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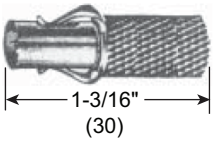
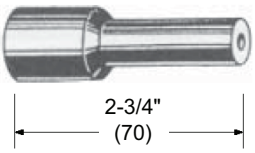
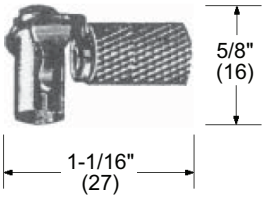
Part number 14202. Terminal, Rajah, straight, maximum 225°F (107°C), use with 14202-1 boot.



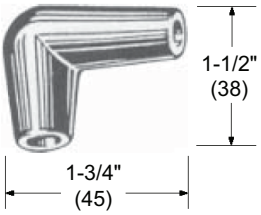
Part number 14202-1. Terminal Boot, straight, rubber, for use with 14202 terminal.



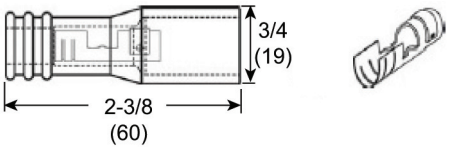
Part number 14204. Terminal, Rajah, right-angle, maximum 225°F (107°C), use with 14204-1 boot.



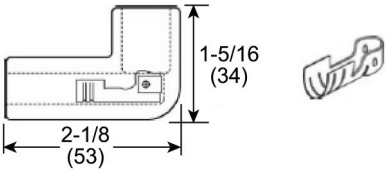
Part number 14204-1. Terminal Boot, right-angle, rubber, used with 14204 terminal.



Part number 10008547. Terminal, straight, ceramic, maximum 432°F (220°C).

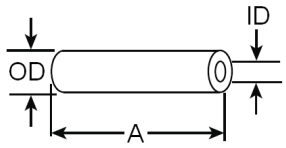


Part number 10008548. Terminal, right-angle, ceramic, maximum 432°F (220°C).



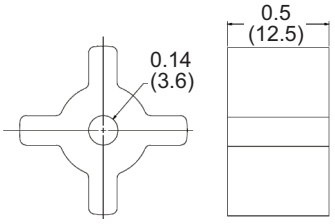
Insulator, ceramic to support electrode rods

Length A		ID		OD		
Inches	mm	Inches	mm	Inches	mm	Part No.
3"	76	0.130"	3.3	9/16"	14	12130
3"	76	0.140"	3.6	7/16"	11	20255

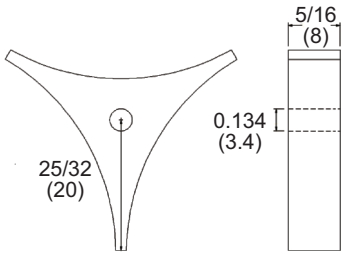


Insulator, ceramic, 1/2" long used to support 1/8" diameter rod inside pipe.

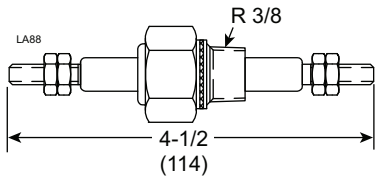
Pipe Size	Part No.
1/2 inch Sch 80	14462-1
3/4 inch Sch 40	14463
3/4 inch Sch 80	14463-1
1 inch Sch 80	14464-1



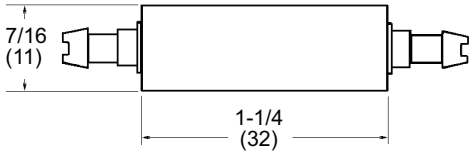
Part number 20403. Insulator, ceramic, used to support 1/8" diameter rod inside pipe diameter minimum of 1.625".



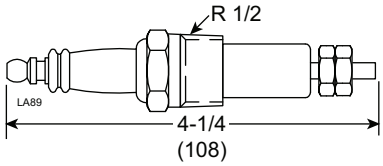
Part number 14320. 3/8" Feed-thru insulator; 4-1/2" lg.



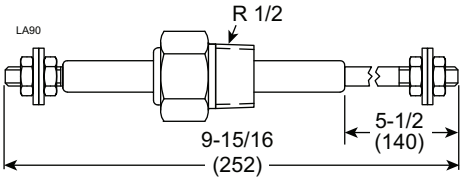
Part number 16219. Flame lead insulator with ignition studs.



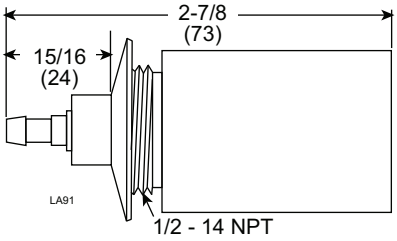
Part number 14319. 1/2" Feed-thru insulator; 4-1/4" lg.



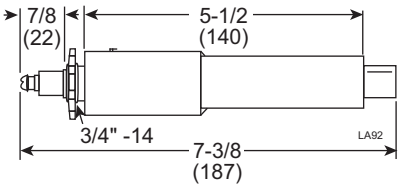
Part number 15908. 1/2" Feed-thru insulator; 9-15/16" lg. for 6-5/8" thick wall insulation.



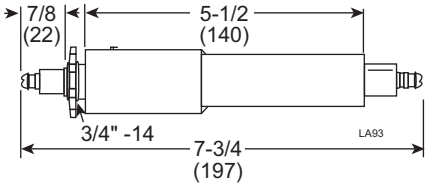
Part number 109031. Flame lead insulator; 1/2" conduit knock-out with ignition stud both ends.



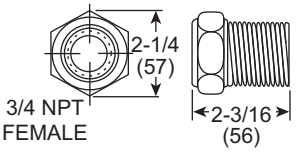
Part number 109345. Feed thru insulator 3/4-14 pipe thds.; 7-3/8" lg. for 5" thick insulation; ignition studs both ends.



Part number 109344. Feed thru insulator 3/4-14 pipe thds.; 7-3/4" lg. for 5" thick insulation; ignition studs both ends.

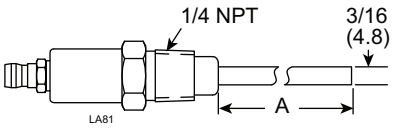


Part number 103401. Swivel adapter to position a flamerod in the flame.



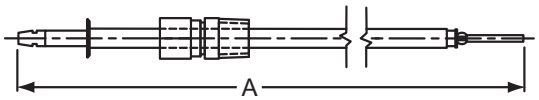
1/4" flamerod

Length A		
Inches	**mm**	**Part No.**
1-5/8"	41	13093-5
1-13/16"	46	13093-4
3"	76	13093-3
3-3/4"	95	13093-6
5-3/4"	146	13093
11-3/4"	298	13093-1
17-3/4"	451	13093-2



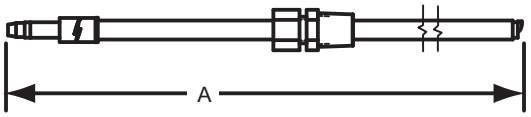
1/4" adjustable flamerod

Length A		
Inches	**mm**	**Part No.**
10-1/4"	260	100602-1
16-1/4"	413	100602-2
19-1/4"	489	100602-3
22-1/4"	565	100602-4
25-1/4"	641	100602-5
28-1/4"	717	100602-6
31-1/4"	794	100602-7
34-1/4"	870	100602-8
12.4"	315	100602-9
21-1/4"	540	100602-10
17-1/4"	438	100602-11
29-1/4"	743	100602-12
50-3/4"	1289	100602-13
45.91"	1166	100602-14
59"	1499	100602-15
24"	610	100621
43-1/2"	1105	100629



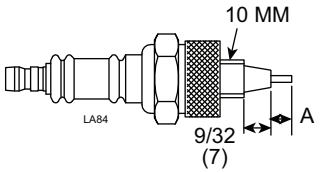
1/4" adjustable self grounding igniters

Length A		Part No.
Inches	mm	
5.9"	152	150000-44
7.0"	178	150000-41
8.8"	226	150000-26
11.1"	282	150000-28
11.8"	302	150000-31
12.9"	328	150000-32
13.8"	353	150000-33
14.8"	378	150000-27
15.9"	404	150000-29
16.8"	429	150000-36
17.9"	455	150000-1
18.8"	480	150000-2
19.8"	505	150000-3
20.9"	531	150000-4
21.8"	556	150000-5
22.9"	582	150000-6
23.1"	588	150000-45
23.8"	607	150000-7
24.8"	632	150000-8
25.9"	658	150000-9
26.8"	683	150000-10
27.9"	709	150000-11
28.8"	734	150000-12
29.8"	759	150000-13
30.9"	785	150000-14
31.8"	810	150000-15
32.9"	836	150000-16
33.8"	861	150000-17
34.8"	886	150000-18
35.9"	912	150000-19
36.8"	937	150000-20
37.9"	963	150000-21
38.8"	988	150000-22
39.8"	1013	150000-23
40.9"	1039	150000-24
41.8"	1064	150000-25
43.8"	1115	150000-38
45.9"	1166	150000-39
47.3"	1203	150000-46
49.8"	1267	150000-37
53.3"	1354	150000-42
54.8"	1394	150000-47
65.9"	1674	150000-40
77.9"	1981	150000-43

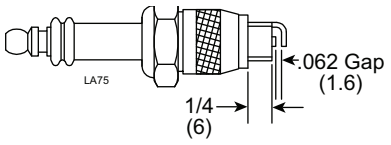


10mm igniter or flamerod.

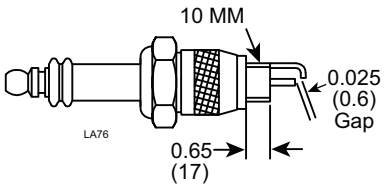
Length A		Part No.
Inches	mm	
1/2"	12	18461
2-1/2"	63	18460



Part number 16160. 10mm self grounding igniter.

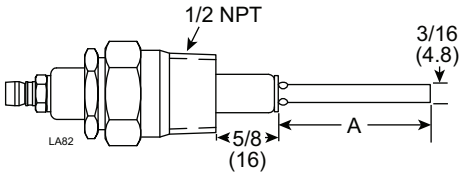


Part number 18458. 10mm self grounding igniter.



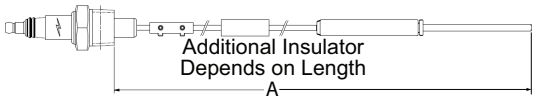
1/2" flamerod

Length A		Part No.
Inches	mm	
1-7/8"	48	13312-3
2-3/8"	60	13312-4
2-1/2"	64	13312-7
3"	76	13312-5
5"	127	13312-8
6"	152	13312
8.82"	224	10002219-3
9-3/4"	248	13312-10
9.98"	253	10002219-1
12"	304	13312-1
12"	305	10002219
24"	610	13312-2



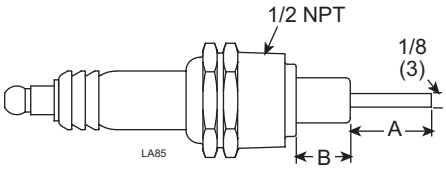
1/2" flamerod

Length A		Part No.
Inches	mm	
18.8"	478	100355-1
22.8"	580	100355-2
26.8"	682	100355-3
30.8"	784	100355-4
34.8"	886	100355-5
38.8"	988	100355-6
42.9"	1090	100355-7
46.9"	1192	100355-8
50.9"	1294	100355-9
54.9"	1396	100355-10



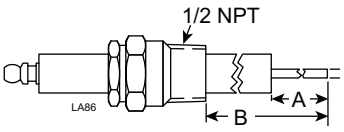
1/2" igniter or flamerod.

Length A		Length B		Part No.
Inches	mm	Inches	mm	
1/2"	12	1/2"	12	16946-6
3/4"	19	1/2"	12	16946-5
1-3/8"	34	1/2"	12	16946-3
1-13/16"	46	1/2"	12	16946-7
2"	50	1/2"	12	16946-9
2-1/2"	63	1/2"	12	16946-4
4-7/16"	112	1/2"	12	16946-2
5"	127	1/2"	12	16946-1
12"	304	1"	25	10002242
24"	609	1"	25	12978
38"	965	1"	25	12978-1



1/2" adjustable igniter or flamerod.

Length A		Length B		
Inches	mm	Inches	mm	Part No.
1"	25	5/8" to 4-1/4"	16 to 108	18193-1
2"	51	3-3/16" to 5-7/16"	81 to 138	20212
3"	76	2-5/8" to 6-1/4"	67 to 159	18193

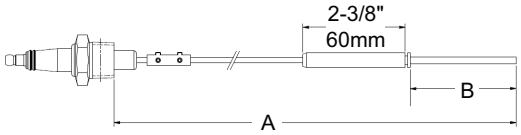


1/2" adjustable igniter or flamerod.

Length A		L1		L2		
Inches	mm	Inches	mm	Inches	mm	Part No.
11.4"	289	9.03"	229	8.06"	204	13837
19.12"	485	16.74"	425	15.79"	401	13581

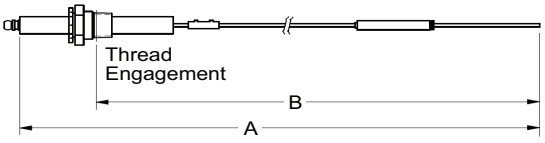
1/2" igniter or flamerod.

Length A		Length B		
Inches	mm	Inches	mm	Part No.
13-3/4"	349	4-3/4"	120	100050-1
15-7/8"	403	4-3/4"	120	100050-7
16-3/4"	425	4-3/4"	120	100050-2
18-15/16"	481	4-3/4"	120	100050-9
19-3/4"	501	4-3/4"	120	100050-3
21-1/16"	535	4-3/4"	120	100050-5
21-3/4"	552	4-3/4"	120	100050-13
21-15/16"	558	4-3/4"	120	100050-6
22-11/16"	577	4-3/4"	120	100050-11
24-1/16"	611	4-3/4"	120	100050-4
24-1/2"	622	4-3/4"	120	100050-14
24-11/16"	627	1"	25	100670-7
24-15/16"	634	4-3/4"	120	100050-12
25-3/16"	639	1"	25	100670-13
26"	660	4-3/4"	120	100050-10
26-11/16"	678	1"	25	100670-9
26-3/4"	680	4-3/4"	120	100050-8
27-7/16"	697	1"	25	100670-2
27-5/16"	702	4-3/4"	120	100050-15
27-15/16"	710	1"	25	100670-3
30-9/16"	777	1"	25	100670-8
31-3/8"	797	1"	25	100670-12
32-5/8"	828	1"	25	100670-10
32-15/16"	837	1"	25	100670-14
33-3/8"	847	1"	25	100670-1
33-7/8"	860	1"	25	100670-4
38-1/2"	978	1"	25	100670-11
39-1/4"	997	1"	25	100670-5
39-3/4"	1010	1"	25	100670-6

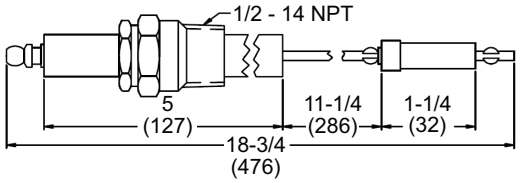


1/2" adjustable flamerod.

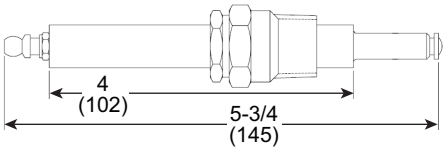
Length A		Length B		
Inches	mm	Inches	mm	Part No.
17	432	14	356	10014915-30
18	458	15	382	10014915-31
19	483	16	407	10014915-32
20	509	17	433	10014915-33
21	534	18	458	10014915-34
22	559	19	483	10014915-35
23	585	20	509	10014915-36
24	610	21	534	10014915-1
25	636	22	560	10014915-2
26	661	23	585	10014915-3
27	686	24	610	10014915-4
28	712	25	636	10014915-5
29	737	26	661	10014915-6
30	763	27	686	10014915-7
31	788	28	712	10014915-8
32	813	29	737	10014915-9
33	839	30	763	10014915-10
34	864	31	788	10014915-11
35	890	32	813	10014915-12
36	915	33	839	10014915-13
37	940	34	864	10014915-14
38	966	35	890	10014915-15



Part number 11941. 1/2" Adjustable igniter or flamerod.

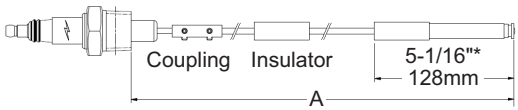


Part number 10034074. 1/2" adjustable igniter.



1/2" self grounding igniters.

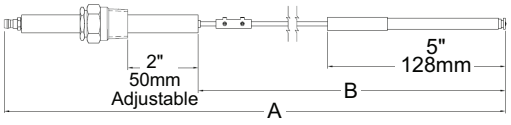
Length A				
Inches	**mm**	**Coupling**	**Insulator**	**Part No.**
11-15/16"	287	Yes	No	100173-1*
14-3/16"	361	Yes	No	100205-1
16-5/16"	415	Yes	No	100205-2
17"	432	Yes	No	100205-20
17-1/16"	434	Yes	No	100354-1
18-1/8"	461	No	No	10050564
18-11/16"	474	Yes	No	100205-18
19-5/16"	491	Yes	No	100205-3
19-3/4"	502	Yes	No	100205-21
20-3/4"	527	No	No	10050565
21-1/16"	536	Yes	No	100354-2
22-1/4"	565	Yes	No	100205-12
22-15/16"	582	Yes	No	100205-22
23-15/16"	608	Yes	No	100205-16
25-1/8"	638	Yes	No	100354-3
26-1/8"	664	No	No	10051949
26-3/4	680	Yes	No	100205-7
27-1/4"	693	Yes	No	100205-8
28-5/16"	720	Yes	No	100205-4
28-15/16"	735	Yes	No	100205-10
29-1/8"	740	Yes	Yes	100354-4
29-13/16"	758	Yes	No	100205-17
30-1/8"	766	Yes	No	100205-19
31-7/8"	809	Yes	No	100205-23
32-1/4"	819	Yes	No	100205-13
32-11/16"	830	Yes	No	100205-6
32-1/8"	842	Yes	Yes	100354-5
33-3/16"	843	Yes	No	100205-9
33-5/16"	847	Yes	No	100205-5
33-15/16"	862	Yes	No	100205-11
37-1/8	944	Yes	Yes	100354-6
38-9/16"	980	Yes	No	100205-14
39-1/16"	993	Yes	No	100205-15
41-3/16"	1046	Yes	Yes	100354-7
45-3/16"	1148	Yes	Yes	100354-8
49-3/16"	1250	Yes	Yes	100354-9
53-3/16"	1352	Yes	Yes	100354-10



*Except 100173-1, dimension is 2-13/16" (71mm)

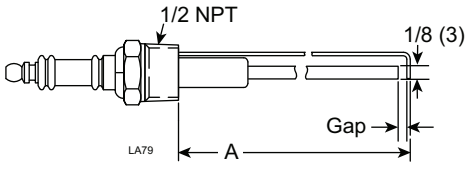
1/2" adjustable self grounding igniter.

Length A		Length B		
Inches	mm	Inches	mm	Part No.
19-1/2"	495	14"	356	100640-1
20-1/2"	521	15"	381	100640-2
21-1/2"	546	16"	406	100640-3
22-1/2"	572	17"	432	100640-4
23-1/2"	597	18"	457	100640-5
24-1/2"	622	19"	483	100640-6
25-1/2"	648	20"	508	100640-7
26-1/2"	673	21"	533	100640-8
27-1/2"	699	22"	559	100640-9
28-1/2"	724	23"	584	100640-10
29-1/2"	749	24"	610	100640-11
30-1/2"	775	25"	635	100640-12
31-1/2"	800	26"	660	100640-13
32-1/2"	826	27"	686	100640-14
33-1/2"	851	28"	711	100640-15
9-3/4"	248	4-1/4"	108	100640-16
38-1/2"	978	33"	838	100640-17
35-1/2"	902	30"	762	100640-18
12-1/2"	318	7"	178	100640-30
13-1/2"	343	8"	203	100640-31
14-1/2"	368	9"	229	100640-32
15-1/2"	394	10"	254	100640-33
16-1/2"	419	11"	279	100640-34
17-1/2"	445	12"	305	100640-35
18-1/2"	470	13"	330	100640-36



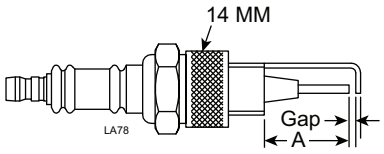
1/2" self grounding igniters.

Length A			
Inches	mm	Gap	Part No.
1.72	43	0.090	10089
2.21	56	0.125	11576
4-1/8"	104	0.125	12568
4.550"	115	0.125	17396
5-1/8"	130	0.063	17652



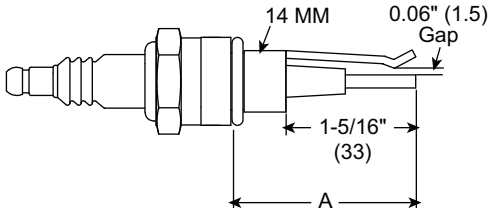
14mm self grounding igniters.

Length A		Gap		
Inches	mm	Inches	mm	Part No.
1"	25	.07"	1.7	17071
1-1/2"	38	.10"	2.5	16927
1-3/4"	45	.10"	2.5	10002322



14mm self grounding igniter.

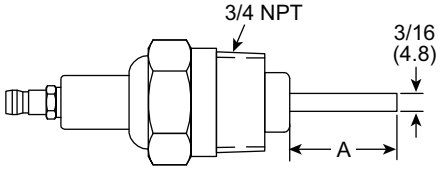
Length A		Gap		
Inches	mm	Inches	mm	Part No.
1-5/16"	29.5	0.06"	1.5	13047
1-5/16"	29.5	0.06"	1.5	13047-2*
1-5/8"	41.5	0.06"	1.5	13047-1
2-3/4"	70	0.06"	1.5	10019728
4"	101	0.06"	1.5	23045
4.33"	110	0.06"	1.5	10014597



* Terminal is not removable

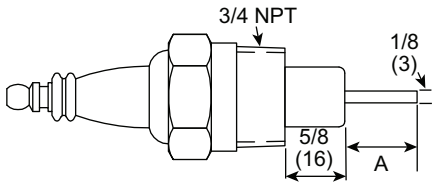
3/4" flamerod.

Length A		
Inches	mm	Part No.
6"	152	14265-1
12"	304	14265-2
18"	457	14265-3



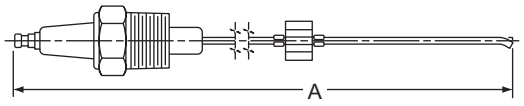
3/4" igniter or flamerod.

Length A		
Inches	mm	Part No.
2-3/8"	60	12392-4
6"	152	12392
12"	304	12392-3
26"	660	12392-1
54"	1371	12392-2



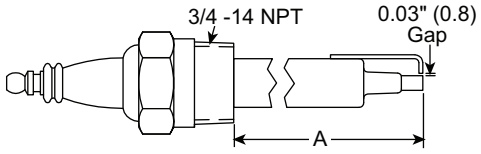
3/4" Igniter.

Length A		
Inches	mm	Part No.
24.33"	618	100216-1
28-1/8"	714	100224-1



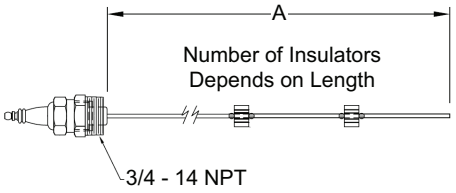
3/4" self grounding igniters with stainless steel sleeve.

Length A		
Inches	mm	Part No.
4-1/4"	107	13499
6"	152	13499-1
9"	228	13499-2



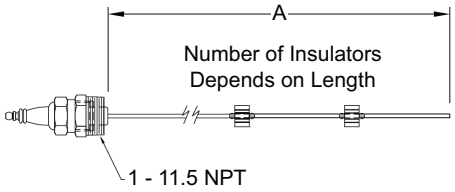
3/4" Igniter.

Length A		
Inches	mm	Part No.
12-1/2"	318	103162-1
18-1/2"	470	103162-2
24.48"	622	103162-3



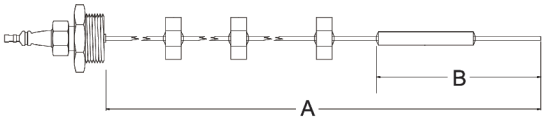
1" Igniter.

Length A		
Inches	**mm**	**Part No.**
13.3"	340	103162-4
19.3"	492	103162-5
25.4"	645	103162-6
37.4"	950	103162-7
15.9"	406	103162-8
41.4"	1054	103162-9
49.4"	1257	103162-10
61.4"	1562	103162-11



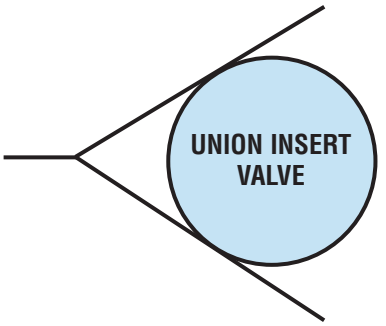
1-1/4" Igniter.

Length A		Length B		
Inches	**mm**	**Inches**	**mm**	**Part No.**
40-15/16"	1040	5-1/8"	130	900287
42-11/16"	1085	5-7/8"	150	900288
47-13/16"	1215	5-7/8"	150	900289



ECLIPSE®
Innovative Thermal Solutions
www.eclipsenet.com

See PED statement below

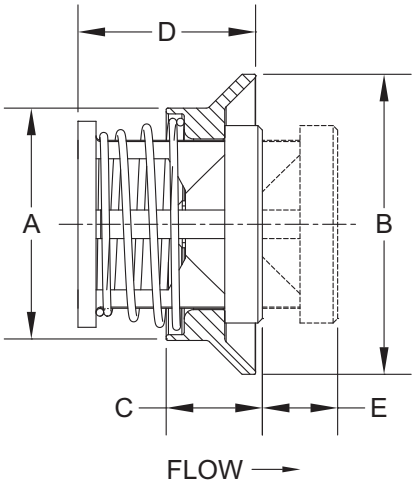


Union not included.

The **Union Insert (UV)** valve is the threaded pipe counterpart of the Flange Insert Valve. Designed to be inserted into most standard ground joint unions, it provides the simplest and most economical way to install a check valve in a threaded pipe system. A check valve may be installed anywhere in the system where there is a union. The valve works equally well in either a horizontal or vertical position with proper spring selection. Each Union Insert valve is furnished with a **metal tag,** which is quickly attached to the union when the valve is installed. This provides a **permanent visual notification** that the union contains a check valve.

NOTE: Bore of union must be equal to I.D. of schedule 40 pipe. Use ground joint unions with 45° seat only (union not included).

PED Conformance Statement: Due to the unique design of the Union Insert Valve, this series is not considered a pressure vessel but rather a gasket. According to PED Guideline 1/8, gaskets are not governed by the Pressure Equipment Directive. As a result, the UIV series is available for sale in the European Community and no CE Mark is required.



Nom. Pipe Size	Size Code	A	B	C	D	E ①	Orifice Diameter
1/2	D	0.587	0.937	0.42	0.78	0.41	0.348
3/4	F	0.794	1.125	0.40	0.81	0.44	0.464
1	H	1.087	1.437	0.45	1.09	0.56	0.593
1-1/4	I	1.365	1.750	0.56	1.19	0.70	0.890
1-1/2	J	1.598	2.000	0.60	1.32	0.80	1.135
2	K	2.005	2.500	0.67	1.57	0.92	1.385

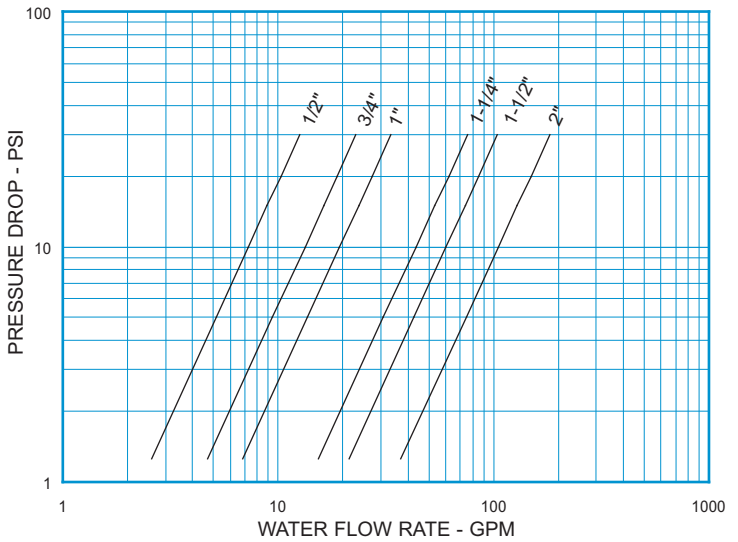
①**Maximum nominal dimension for a fully open valve with no spring.**

Body Material ②	Availability	Non-Shock Pressure-Temperature Rating
316 Stainless Steel (SS)	Standard	3000 PSIG @ 100°F (1500 PSIG for o-ring seats)
Carbon Steel (CS)		
Brass (BR)		
Alloy 20 (A2)	Semi-standard	
Alloy C-276 (HC)		
Monel ® (MO)		
Alloy B (HB)	Contact the factory for these or other materials	
Titanium (TI)		

②**See page 55 for material grade information.**

MADE IN USA CHECK-ALL VALVE MFG. CO. Phone: 515-224-2301 Fax: 515-224-2326

Union Insert Valve
For Water at 72°F



Note: All flow curves and Cv values presume the valves are fully open with 1/2 PSI cracking pressure springs. Consult the factory for more information.

STYLE UV (UIV) C_V VALUES & VALVE WEIGHTS		
C_V	SIZE	ALL MATL
2.3	1/2	0.5 oz.
4.2	3/4	0.8 oz.
6.1	1	1.6 oz.
13.8	1-1/4	2.8 oz.
19.0	1-1/2	4.3 oz.
33.3	2	7.8 oz.

See page 50 for Flow Formulae.
Valve weights are approximate.

HOW TO ORDER
CHECK-ALL STYLE UV (UIV)

BODY MATERIAL
ALLOY 20 = A2
BRASS = BR
CARBON STEEL = CS
ALLOY B = HB
ALLOY C-276 = HC
MONEL® = MO
316 SS = SS
TITANIUM = TI
See p. 4 for temperature ratings

SPRING CRACKING PRESSURES
Replace "X" with actual desired setting.
Must use decimal as a character.

(PSI)			FORMAT
.000	TO	.999	= .XXX
1.00	TO	9.99	= X.XX
10.0	TO	99.9	= XX.X
NO SPRING			= NOSPRG

STANDARD CRACKING PRESSURES① **.125 .500 1.50 3.50**
(Sizes D-J Only)

Note: Many other cracking pressures are available. Consult factory.

SPECIAL OPTIONS
T = FEP ENCAPSULATED SPRING
See p. 5 for temperature rating
Contact the factory for more options

U V

VALVE STYLE

SIZE
1/2 = D
3/4 = F
1 = H
1-1/4 = I
1-1/2 = J
2 = K

SEAT MATERIAL②
AFLAS® = AS
BUNA-N = BN
EPDM③ = EP
KALREZ® = KZ
"METAL-TO-METAL" = MT
NEOPRENE = NE
PTFE = TF
VITON® = VT
See p. 4 for temperature ratings

SPRING MATERIAL
316 SS = SS
ALLOY C-276 = HC
ALLOY B = HB
INCONEL® X-750 = IX
MONEL® = MO
17-7PH SS = PH
TITANIUM = TI
See p. 5 for temperature ratings

Listed above are the most common material selections. Please contact the factory for additional options.

①**.500 PSI is the only standard cracking pressure for spring materials other than Stainless Steel. Cracking pressure tolerance is +/- 15%. .125 PSI springs are not recommended for installations with flow vertical down.**
②**Seat materials other than "metal-to-metal" have a maximum pressure rating of 1500 PSI. "Metal-to-Metal" and PTFE seats are not resilient. See page 51 for allowable leakage rates.**
③**EP seats not recommended for use with Carbon Steel valves.**

Trademarks Used
AFLAS® Asahi Glass Company, Ltd
MONEL® Special Metals Family of Companies
INCONEL® Special Metals Family of Companies
VITON® E.I. du Pont de Nemours and Company
KALREZ® E.I. du Pont de Nemours and Company

Ratio Regulator
Zero Governor

FRG/6 Series

DUNGS®
Combustion Controls

CSA Certified
- ANSI Z21.18 / CSA 6.3
- CSA Requirement # 5.01
- Zero Governor and Gas/Air Regulator
- File # 157406

US and Canadian Models
- FRG 705/6
- FRG 707/6
- FRG 710/6
- FRG 712/6
- FRG 715/6
- FRG 720/6
- FRG 725/6
- FRG 730/6
- 1/2 in. NPT - 3 in. NPT

Commonwealth of Massachusetts Approved Product
- Approval code G3-0106-191
- Commerical / Industrial Gas Regulator

Codes and Standards
This product is intended for installations covered by but not limited to NFPA 86, ANSI Z83.4, ANSI Z83.18, ANSI Z21.13, UL 795, CSD-1, CSA B149.1, CSA B149.3 and CSA B149.6.

DUNGS is an ISO 9001 manufacturing facility.

Description
The FRG ratio regulator/zero governor has an adjustable setpoint spring and nonadjustable counterspring.
- Optional Low fire bypass for ½ in. NPT to 2 in. NPT models. Ideal for very flow or for high turndown applications.
- Steady, precise and instantaneous regulation of the outlet pressure.
- Connection for air impulse line.
- Inlet and outlet ¼ in. NPT test ports on each side.
- Factory installed vent limiter. Review applicable codes for vent line requirements.

Application (General)
The FRG is recommended for industrial and commercial heating applications. It is suitable for dry natural gas, propane, butane, air and inert gases. Suitable for up to 0.1 % by volume, dry H_2S.

Application (Ratio Regulator)
Holds a constant gas/air ratio during turndown by varying gas flow to the burner in proportion to combustion air flow. Adjustable ratio for excess gas or air operation.

Application (Zero Governor)
Controls fuel by reducing incoming gas pressure to zero or adjustable to slightly above or below atmospheric pressure.

FRG/6 Spring-loaded ratio regulator/zero governor with adjustable setpoint spring and defined counterspring. Internal sensing of output pressure; air impluse line connection is standard.

Specifications

Pipe thread (NPT)	1/2" 3/4" 1" 1 ¼" 1 ½" 2" 2 ½" 3"
Max. operating pressure	7 PSI (500 mbar) Factory Rating; 5 PSI (350mbar) CSA Certified
Max. body pressure	15 PSI (1000 mbar)
Optimal inlet pressure range	Ratio regulator = 3 to 82 in. W.C. (7 to 200 mbar) Zero Governor = 3 to 20 in. W.C. (7 to 50 mbar)
Output pressure range	Ratio regulator output = 0 to 60 in. W.C. (0 mbar to 150 mbar) Zero Governor output= -2 to 2 in. W.C. (-5 mbar to 5 mbar)
Materials in contact with gas	Housing: Aluminium Seals and diaphragms: NBR
Ambient temperature	+5°F to +160 °F for up to 7 PSI for regulating behavior (+/- 10% of setpoint). -40 °F to +160 °F: Diaphragms are suitable for the low temperature, but there may be out of range regulating behavior. CSA Certified for -40 °F to +160 °F for up to 5 PSI.
Installation position	Regulator dome vertically upright or horizontally.
Test ports / Pilot gas connections	¼ in. NPT on both sides of the inlet section and ¼ in. NPT on both sides of the outlet section. Taps/connections only on one side when low fire bypass is used.
Low fire Bypass (Optional)	Field mountable low fire bypass: ½ in. NPT to 2 in. NPT on either side of housing
Vent line connection / air impulse line connection / vent limiter	• The vent line connection/air impulse line connection is G ¼“ for FRG‘s up to 1“ NPT, and it is G ½“ for FRG‘s 1 ¼ to 3“ NPT. A G thread to NPT thread field mountable adapter is available. • For gas/air ratio applications at pressure ratio of approximately 1:1, use the existing connection as pressure connection for air impulse line / blower pressure, and at low fire, the air impulse line pressure shall be between 0.2 to 1.0 in WC. • The FRG/6 also has a factory installed vent limiting device, which limits the escape of gas to less than 0.5 CFH @ 5 PSI in case atmospheric diaphragm ruptures. Venting required unless otherwise accepted by the authority having jurisdication.
Hysterisis	+/- 10%

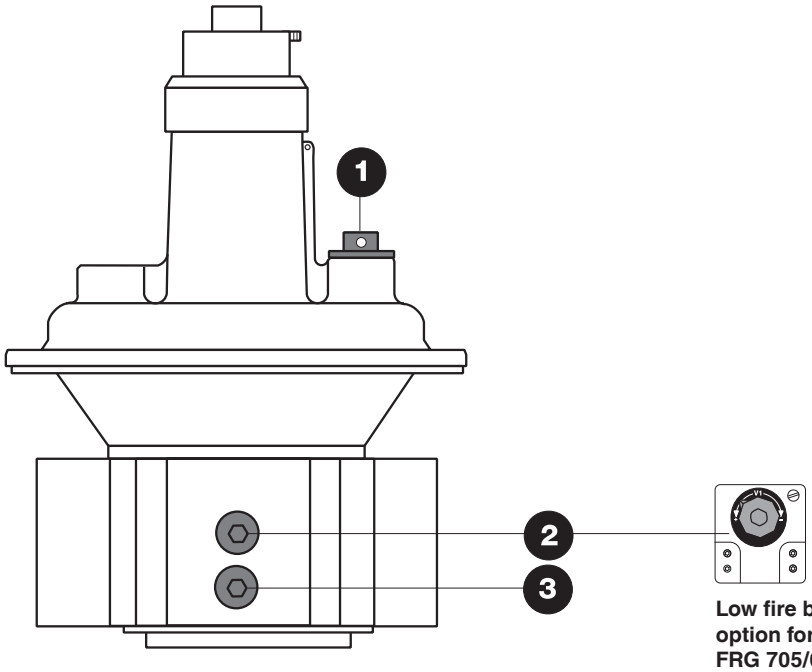
Pressure taps
Pulse and blower connection

1 Breathing plug/vent line conection for zero governor applications or connection for an air impulse line for ratio regulator applications.

2 Pressure connection in inlet section, both sides ¼ in. NPT.

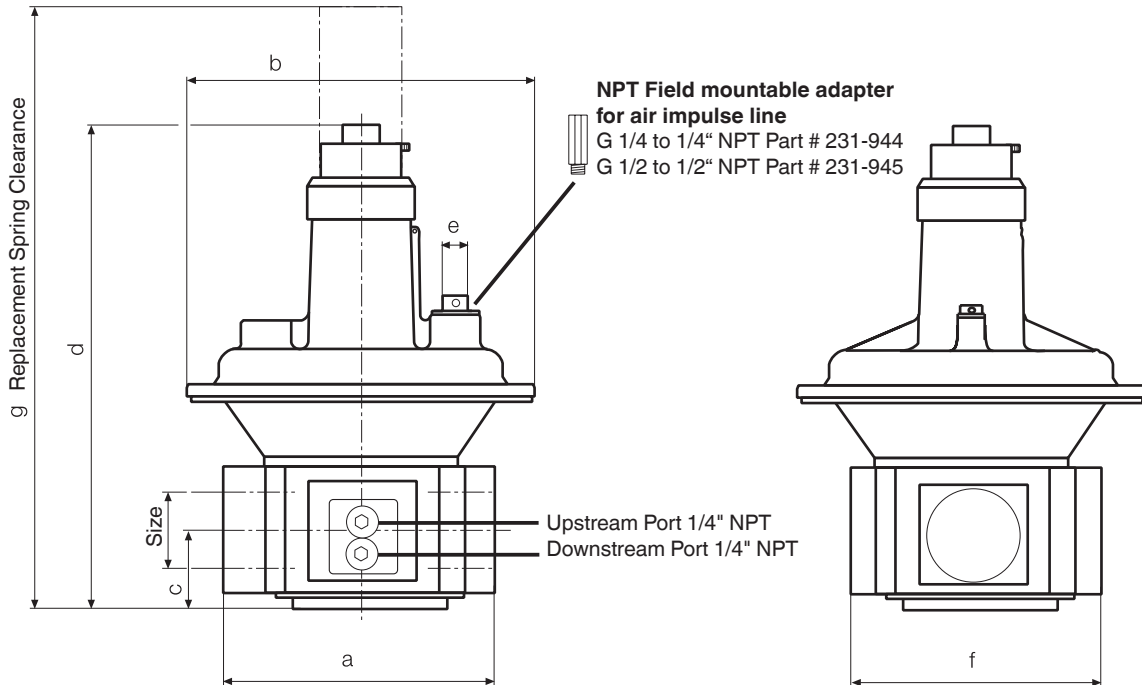
3 Pressure connection in outlet section, both sides ¼ in. NPT.

Low fire bypass option can be mounted on either side of valves (½" - 2").



Low fire bypass option for FRG 705/6 - 720/6. P/N 225-256

Dimensions inch (mm)



Type	Order No.	Pressure$_{max.}$ [PSI]	Size	Dimensions [inch] Dimensions [mm]						Weight [lbs] [kg]
				a	b	c	d	e	f	
FRG 705/6	226-458	7	NPT 1/2	**2.9** 75	**4.5** 115	**0.9** 24	**5.6** 143	G 1/4	**8.9** 225	**1.3** 0.6
FRG 707/6	226-459	7	NPT 3/4	**3.9** 100	**5.1** 130	**1.1** 28	**6.5** 165	G 1/4	**9.6** 245	**2.2** 1.0
FRG 710/6	226-460	7	NPT 1	**4.3** 110	**5.7** 145	**1.3** 6	**7.5** 190	G 1/4	**12.2** 310	**2.6** 1.2
FRG 712/6	226-461	7	NPT 1 1/4	**5.9** 150	**7.7** 195	**1.6** 40	**9.8** 250	G 1/2	**14.2** 365	**5.9** 2.7
FRG 715/6	226-462	7	NPT 1 1/2	**5.9** 150	**7.7** 195	**1.6** 40	**9.8** 250	G 1/2	**14.2** 365	**5.5** 2.5
FRG 720/6	226-463	7	NPT 2	**6.7** 170	**9.8** 250	**1.9** 47	**12.2** 310	G 1/2	**17.7** 450	**7.7** 3.5
FRG 725/6	226-464	7	NPT 2 1/2	**9.1** 230	**11.2** 285	**3.7** 95	**15.9** 405	G 1/2	**23.2** 590	**16.5** 7.5
FRG 730/6	226-465	7	NPT 3	**10.4** 265	**11.2** 285	**3.7** 95	**15.9** 405	G 1/2	**23.2** 590	**22.0** 10.0
Low fire bypass	225-256									

Replacement spring Size		Order No.
FRG 705/6	NPT 1/2	229-817
FRG 707/6	NPT 3/4	229-833
FRG 710/6	NPT 1	229-842
FRG 712/6	NPT 1 1/4	229-851
FRG 715/6	NPT 1 1/2	229-851
FRG 720/6	NPT 2	229-874
FRG 725/6	NPT 2 1/2	229-883
FRG 730/6	NPT 3	229-883

Functional description
The FRG/6 functions according to the principle between the force of:
- the adjustable setpoint spring
- the counterspring force
- the differential pressure at the working diaphragm based on zero atmosphere.
- the air impulse line pressure and
- the force due to weight of the moving parts

The counterspring acts against the setpoint spring and the weight due to force of the moving parts. Depending on the adjustment of the setpoint spring and the installation position, the force of the counterspring is compensated.

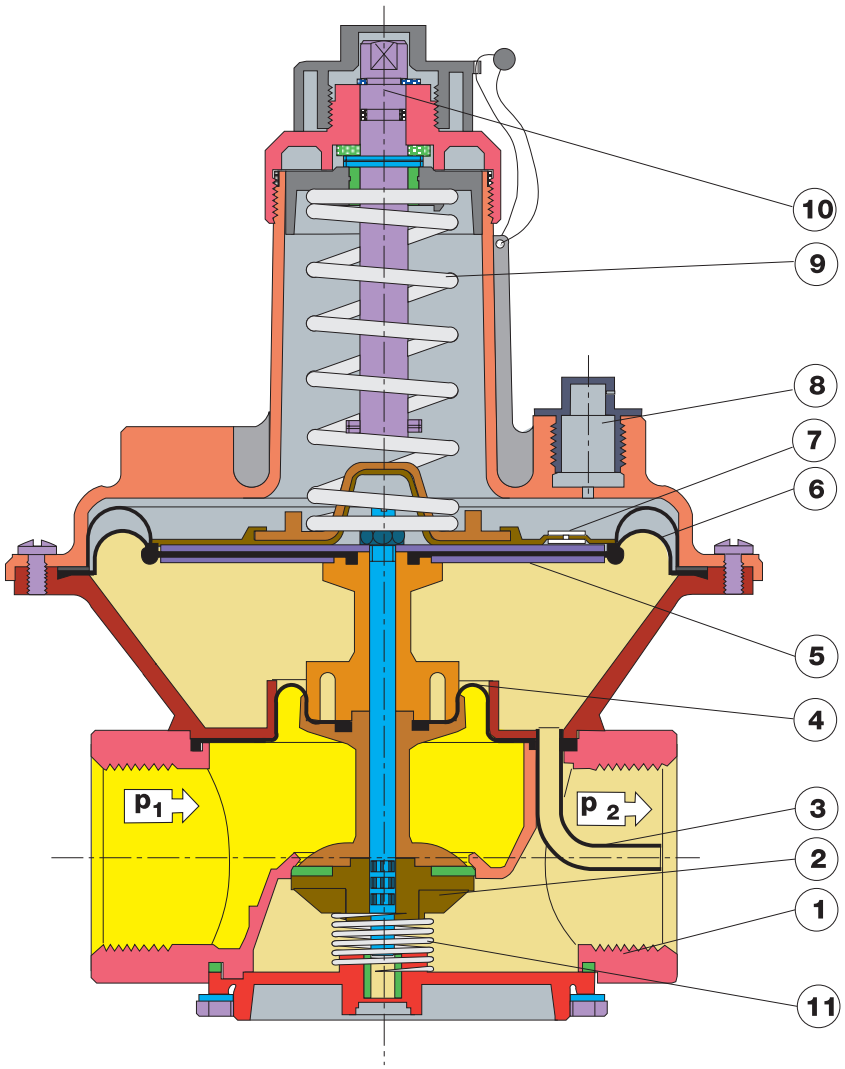
When used as a ratio regulator, adjusting the setpoint spring or biasing for excess air/excess gas should be performed at low fire. Outlet gas pressure from the FRG is directly proportional to the air impulse line pressure. I.e. increasing the air impulse line pressure increases the outlet gas pressure.

In zero governor applications biasing (adjustment of the setpoint spring) leads to negative or positive regulator output pressures. Excessive adjustment of the setpoint spring leads to positive regulator output pressures.

NOTE: Materials in contact with gas, air impulse and connection lines must be of durable, crack proof material that is resistant to thermal, chemical and mechanical loads.

⚠ Do not apply combustible gas, combustible gas air mixtures to the air impulse line. Only dry air shall be used.

FRG sectional drawing
Pressure regulator shown in closed position



1	Housing	5	Diaphragm disc.	9	Setpoint spring
2	Regulating disc.	6	Atmospheric diaphragm	10	Adjustment device
3	Internal impulse sensor	7	Vent limiter	11	Counterspring
4	Balancing diaphragm	8	Breathing plug / Air impulse line		

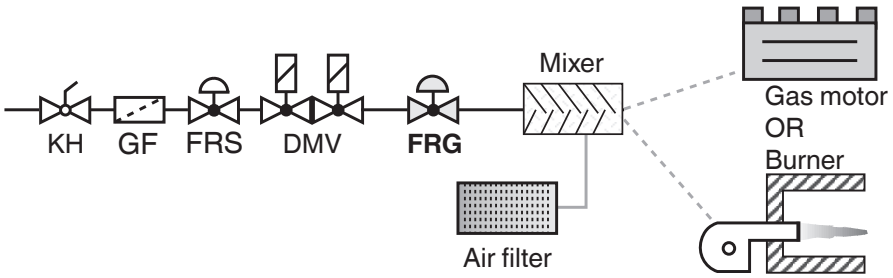
Application of zero governor (standard design)

The FRG regulates gas flow proportional to the vacuum signal, which can come from other equipment using negative pressure as the signal.

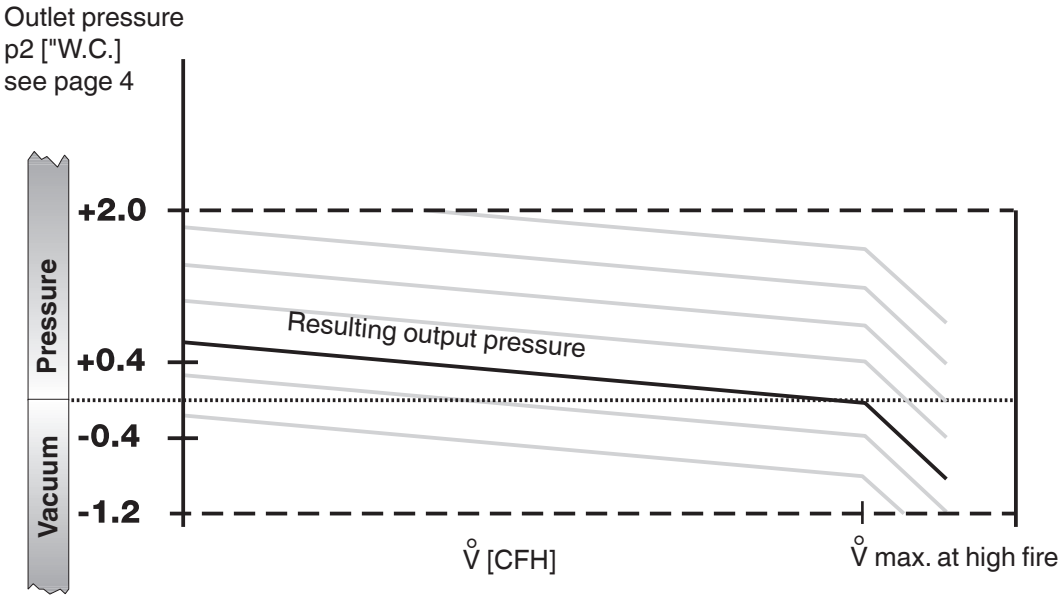
The zero governer is adjustable with the setpoint spring.

$\dot{V}_{min.} = \dot{V}_{max.} \times 0.1$

For $\dot{V}_{max}$ see flow diagram on page 8



Zero governor outlet pressure



The above illustration shows adjustability (fuel biasing) of the FRG when used as a zero governor. Refer to page 8 for sizing FRG at maximum flow rate.

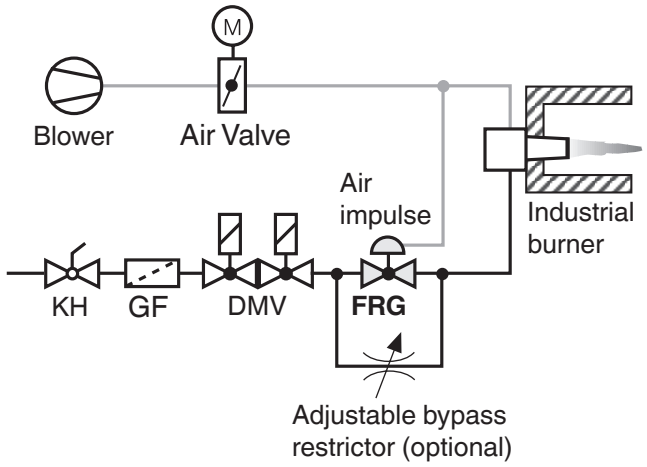
Application of ratio regulator (standard design)

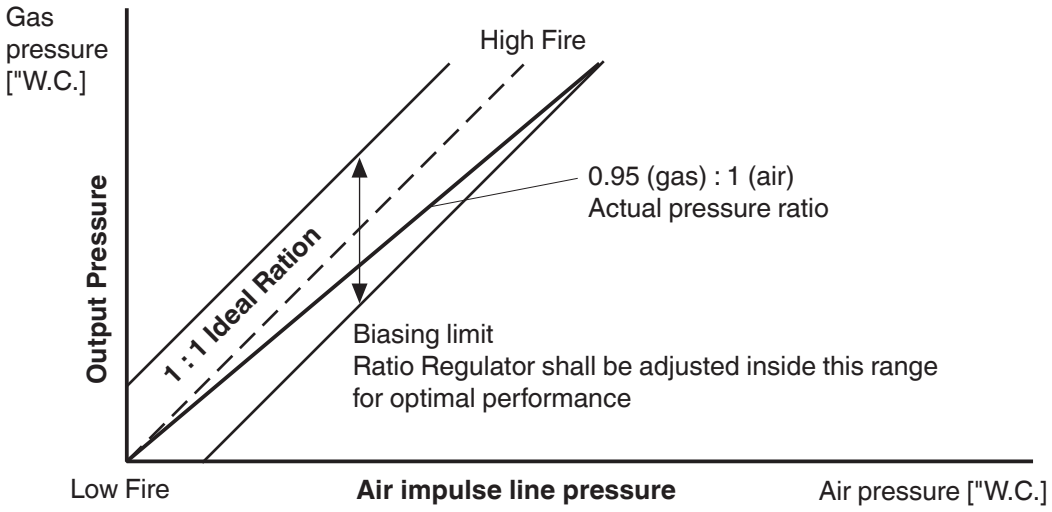
Used as a ratio regulator for gas-air ratio applications with fixed pressure ratio V = 1:1 on gas equipment based on air impulse line pressure.

Internal adjustable setpoint spring for bias control; bias adjustments to be made at low fire. Lower flow rates possible with low air impulse line pressure and optional low fire bypass restrictor (225-256). Available for FRG up to 2" NPT

$\dot{V}_{min.} = \dot{V}_{max.} \times 0.05$

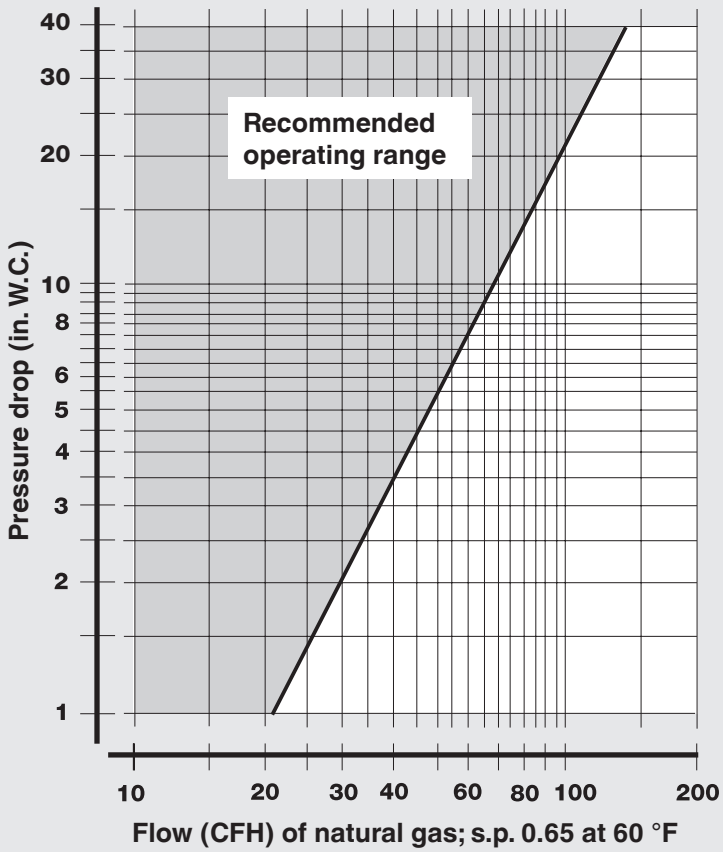
For $\dot{V}_{max}$ see flow diagram on page 8

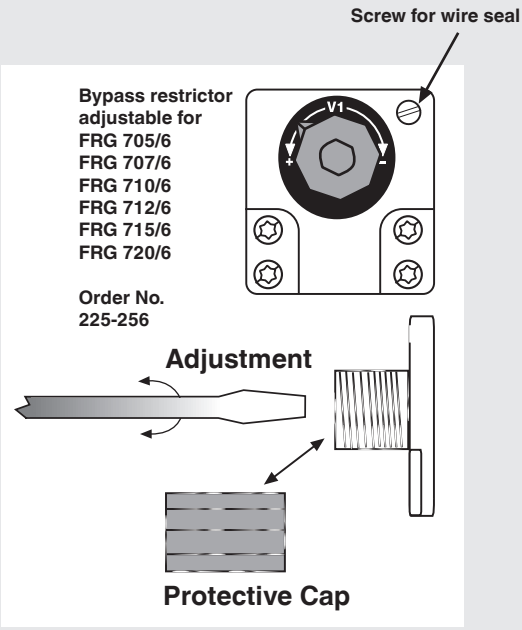




The above illustration shows that the air impulse line pressure equals the gas outlet pressure at low fire. However the air impulse line slightly exceeds the gas outlet pressure at high fire rate.

Flow diagram
Low fire bypass





Pressure drop for other gases
To determine the pressure drop when using a gas other than natural gas, use the flow formula below and f value located in the table below to determine the "corrected" flow rate in CFH through the valve for the other gas used. For example, when using propane, divide the volume (CFH) of propane required for the application by the calculated value f (f = 0.66 for propane). Use this "corrected" flow rate and the flow curve on the next page to determine pressure drop for propane.

Determining equivalent flow through valves using another gas

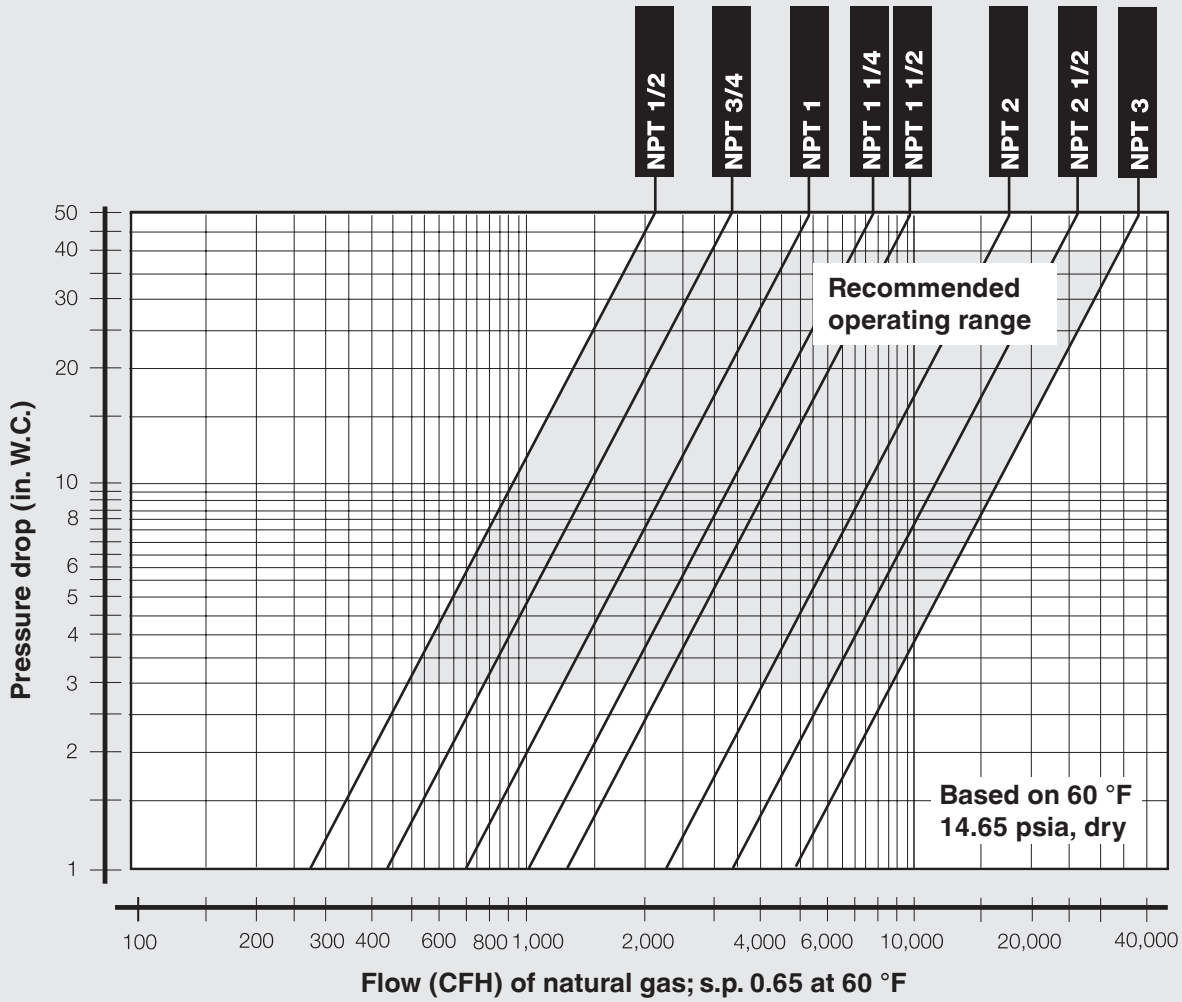
$$\dot{V}_{\text{gas used}} = \dot{V}_{\text{Natural gas}} \times f$$

$$f = \sqrt{\frac{\text{Density of Natural gas}}{\text{Density of gas used}}}$$

Type of gas	Density [kg/m³]	s.g.	f
Natural gas	0.81	0.65	1.00
Butane	2.39	1.95	0.58
Propane	1.86	1.50	0.66
Air	1.24	1.00	0.80

DUNGS®
Combustion Controls

Flow Curve (mechanically opened)
Shows maximum possible flow through FRG/6



⚠ A minimum of 3 in. W.C. Δp is required when sizing at maximum flow capacity for optimal control on high turndown applications (40 : 1). A 2 in. W.C. Δp can be applied for sizing if a lower turndrown (in the range of 10 : 1) is required. Sizing the FRG/6 using a 1 in. W.C. Δp or less is not recommended.

We reserve the right to make any changes in the interest of technical progress.

Karl Dungs Inc.
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Phone 763 582-1700
Fax 763 582-1799
e-mail info@karldungsusa.com
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D-73602 Schorndorf, Germany
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e-mail info@dungs.com
Internet http://www.dungs.com

Drawing No.:	Sales Sht. No.:	Rev.
10679	**1** of **1**	**B**
Weight (Calculated): .339 lb		

NOTES:

1 Restricted bore:

Maximum shaft penetration:
A2 bore- 15

2 Hubs and HELI-CAL FLEXURE are made from a single piece of material.

3 Backlash: None.
No lubrication required.

4 Permitted axial motion from free length: ± .010in

5 Working torque ratings are based upon continuous duty with noted misalignments applied separately and may be increased with improved alignment:

Non-ReversingTorques:
Up to 40 lbin

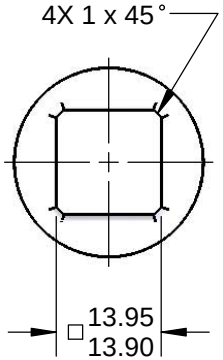
Reversing/Shock Torques:
Up to 20 lbin

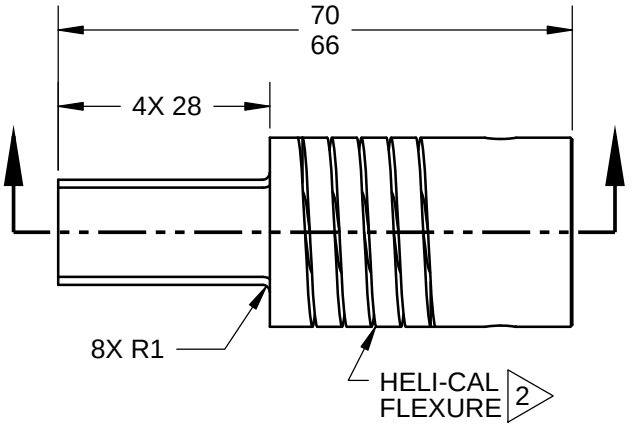
Momentary/Start Torques:
Up to 79 lbin

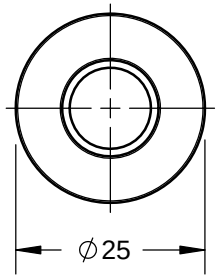
6 Permissible shaft misalignment:
Angular, up to 5 degrees.
Offset, up to .010in (FIM, .020in)

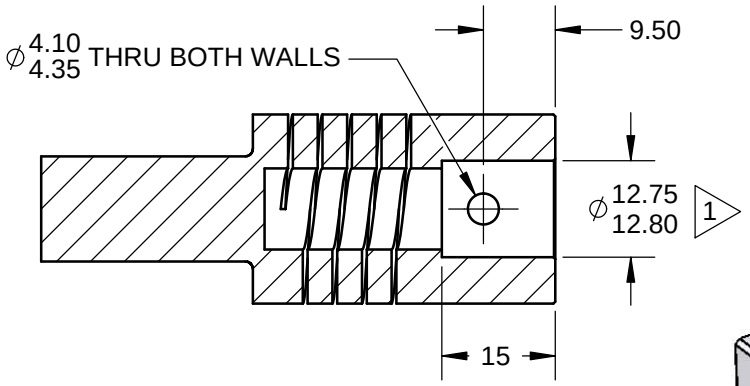
7 Include, but do not install, M4-0.7x25 STN cup point set screw

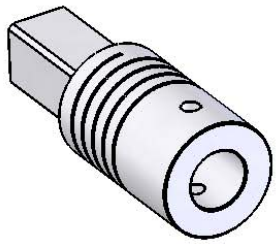
Recommended source of supply:
McMaster Carr P/N 92015A203











Description: **HELICAL FLEXIBLE SHAFT COUPLING**

Finish: **Natural** | Material: **17-4PH CRES HT**

Date	Ltr.	Revision	Drwn.	Chk.	App.
11-25-15	B	IAW ECR 15112300	MH	RV	EK
_	_	_	_	_	_
_	_	_	_	_	_

Drawn By/Date	Checked By/Date	Approved By/Date
HG/6-27-12	JAJ/6-27-12	EK/6-27-12

Unless Otherwise Specified
All Tolerances & Dimensions are in Inches

INCH	Angles	METRIC
X/XX= ± 1/64	± 2°	X= ± 0.5mm
.XX= ± .01		X.X= ± 0.25mm
.XXX= ± .005		X.XX= ± 0.15mm

All surface finish 63 roughness
Break all sharp corners .010 MAX
Interpret IAW ASME Y14.5 2009

DO NOT SCALE DRAWING | SCALE: 1:1

HELICAL PRODUCTS COMPANY
901 West McCoy Lane, P.O. BOX 1069
SANTA MARIA, CA. 93456 U.S.A.
PHONE (805) 928-3851 FSC13201

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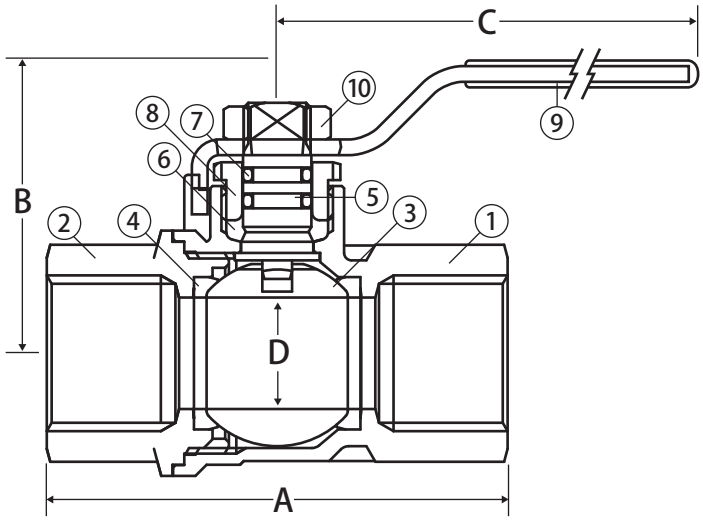
Brass Ball Valve

2 Piece • Full Port • Threaded Connections • 600 WOG

T-100NE

CRN# 0C16887.5469870YTN



Features

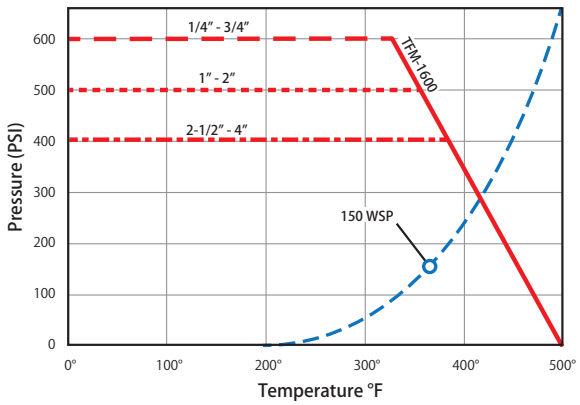
- Blow-out proof stem
- Triple sealing stem with 2 Viton® o-rings and Teflon® seal
- 100% leak tested
- Made in Italy
- Leakproof stem - Lifetime Warranty
- Accessories available on pages 223-226

Approvals

- UL Listed (1/4" - 2")
  - VQGU - Trim & drain
  - MHKZ - Manual valves
  - YQNZ - Compressed gas shut-off valves
  - YRBX - Flammable liquid shut-off valves
  - YRPV - Gas shut-off valves
  - YSDT - LP gas shut-off valves
  - SFJQ - Valves, refrigerant
- CSA Certified
  - ANSI Z21.15 (.5 PSIG) (1/4" - 3")
  - ASME B16.33 (125 PSIG) (1/2" - 2")
  - ASME B16.38 (125PSIG) (2-1/2" - 4")
  - CGA 3.16 (125 PSI) (1/4" - 4")
  - CGA 9.2 (1/4" - 3")
  - Delta C (3/8" - 3/4")
- FM Approval (1/4" - 2")
- MSS SP-110

Valve Seat Rating

1/4" - 3/4" 600 WOG, 1-2" 500 WOG, 2-1/2" - 4" 400 WOG - 150 WSP



Material Specifications

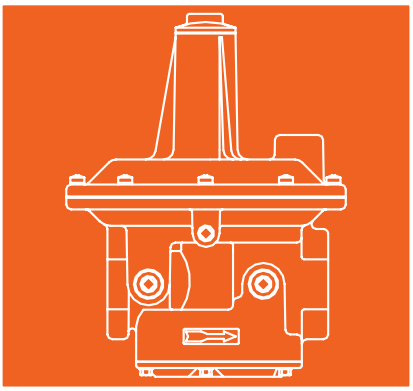
No.	Part	Materials
1	Body	Brass - CW617N
2	End Connection	Brass - CW617N
3	Ball	T.E.A. Coated Brass - CW617N
4	Seat (2)	Hostaflon® TFM 1600
5	Stem	Brass - CW614N
6	Packing	Hostaflon® TFM 1600
7	Stem O-ring (2)	Viton®
8	Packing Gland	Brass - CW614N
9	Handle	Steel - Geomet® Plated
10	Handle Nut	Steel - Geomet® Plated

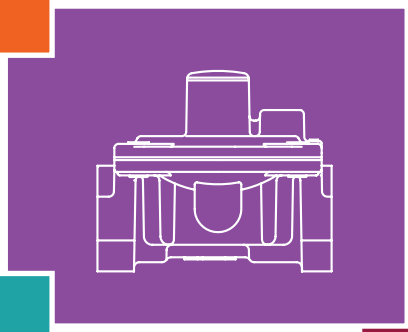
Dimensions

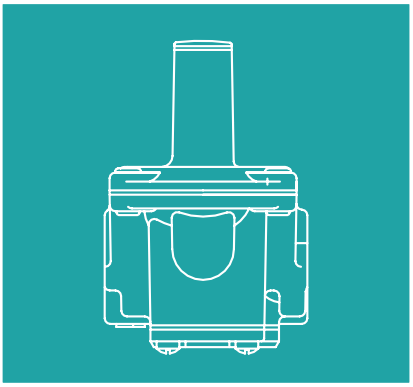
Part No.	Size	A	B	C	D	Cv
100-701	1/4"	1.86	1.41	2.95	0.39	7.66
100-702	3/8"	1.86	1.41	2.95	0.39	7.77
100-703	1/2"	2.45	1.53	2.95	0.59	16.82
100-704	3/4"	2.71	1.95	3.74	0.79	34.80
100-705	1"	3.30	2.40	4.75	0.97	52.20
100-706	1-1/4"	3.80	2.59	4.75	1.23	112.52
100-707	1-1/2"	4.16	3.22	6.00	1.49	174.00
100-708	2"	5.00	3.40	6.00	1.99	255.20
100-709	2 1/2"	6.06	4.60	8.00	2.46	350.32
100-710	3"	7.08	4.90	8.00	2.99	563.76
100-711	4"	8.57	5.90	9.88	4.00	879.28

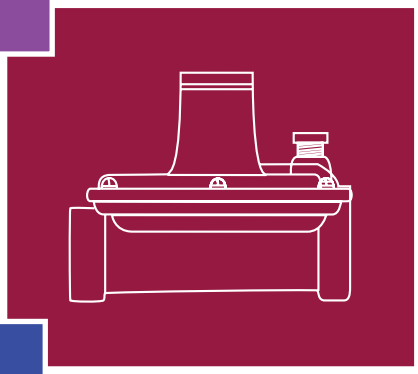
Note: Information subject to change without notice.

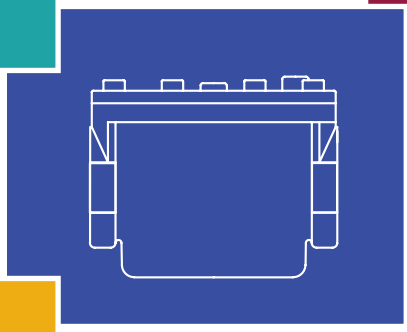
Gas Pressure Regulators
CATALOG

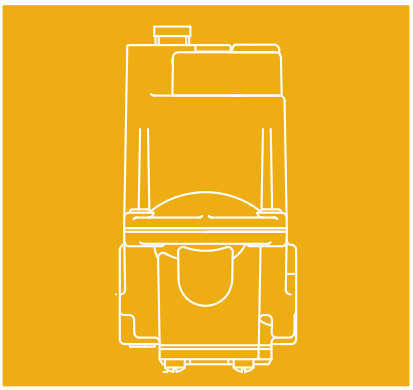












MAXITROL®

⚠ WARNING

Service and installation must be performed by a trained/experienced service technician.

All products used with combustible gas **must** be installed and used **strictly** in accordance with the instructions of the Original Equipment Manufacturer (OEM) and with all applicable government codes and regulations, e.g. plumbing, mechanical, and electrical codes and practices. Maxitrol products should be installed and operated in accordance with Maxitrol Safety Warning Instructions.

Maxitrol Company is NOT responsible for any errors or omissions in reliance by anyone of any information set forth in this catalog without additional reference to local requirements and applicable ordinances or codes.

Other worldwide approvals and certifications available upon inquiry.

C US

The Australian Gas Association

UA.TR.012-13

TP TГ02

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325 SERIES

Lever Acting Design

Maxitrol's 325 Series pounds to inches regulators are for use on residential, commercial, and industrial applications.
The 325 Series features a high leverage valve linkage assembly to deliver positive dead-end lock-up. The regulators are capable of precise control from full flow down to pilot flow.

325-3

NOTE: The 325-9 will be available 2Q2014.

Specifications

Pipe Sizes ..... 3/8″ to 2″ threaded connections with NPT or ISO7-1 threads.

Housing Material ..... 325-3, 325-5, 325-7A, 325-9: aluminum.

Mounting ..... Suitable for multi-positional mounting. If ball check vent limiting device is installed, mount in an upright position only.
NOTE: All Maxitrol gas pressure regulators should be installed and operated in accordance with Maxitrol Safety Warning Instructions (see GPR_MI_EN.ES or GPR_CSA_MI_EN.FR).

Certifications ..... 325-3, 325-5: ANSI Z21.18/CSA 6.3 Gas Appliance Pressure Regulators.

Gas Types ..... Suitable for natural, manufactured, mixed gases, liquefied petroleum gases, and LP gas-air mixtures.

Maximum Inlet Pressure ..... CSA Certified: 325-3, 325-5: 2 psi (13.8 kPa), 5 psi (34.5 kPa)
Maxitrol Tested: 325-3, 325-5, 325-7A, 325-9: 10 psi (69 kPa)
With Vent Limiter 12A09, 12A39, or 12A49 Installed:
325-3, 325-5, 325-7A, 325-9: 5 psi (34.5 kPa) - Natural, 2 psi (13.8 kPa) - LP

Emergency Exposure Limits .....65 psi (450 kPa) (inlet side only)

Maximum Individual Load ..... Largest single appliance served by the regulator: 325-3: 100,000 Btu/h;
325-5: 325,000 Btu/h; 325-7A: 1,250,000 Btu/h, 325-9: 2,250,000 Btu/h

Capacity .....Total load of multiple appliances combined: 325-3: 150,000 Btu/h;
325-5: 325,000 Btu/h; 325-7A: 1,250,000 Btu/h; 325-9: 2,250,000 Btu/h
NOTE: Capacities are used to determine the maximum multiple appliance load. The largest single appliance served by the regulator should not exceed the maximum individual load specified above.

Ambient Temperature Ranges .....-40 to 205°F (-40 to 96°C)

Minimum Regulation..... Suitable for pilot flow applications. Ⓟ (Circle P) (0.15 CFH NG), ▽P (Delta P) 0.50 CFH NG).

Imblue Technology™..... 325-3, 325-5, 325-7A, 325-9 models may be ordered with Imblue Technology™. Imblue Technology™ increases corrosion resistance and provides extra protection against the elements for regulators used in outdoor applications. Add suffix letter "B" to model number when ordering.

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Capacities: based on 1" w.c. pressure drop, from set point**

Capacities expressed in CFH (m^3/h) @ 0.64 sp gr gas

Model	Pipe Size	Outlet Pressure Set Point	CSA MAX CFH	Operating Inlet Pressure					
				0.5 psi (3.4 kPa)	0.75 psi (5.2 kPa)	1 psi (6.9 kPa)	2 psi (13.8 kPa)	5 psi (34.5 kPa)	10 psi (69.0 kPa)
325-3	3/8" x 3/8" 1/2" x 1/2"	4.0" w.c. (1.0 kPa)	150 (4.2)	160 (4.5)	190 (5.4)	220 (6.2)	220 (6.2)	300 (8.5)	320 (9.1)
		7.0" w.c. (1.7 kPa)	150 (4.2)	120 (3.4)	150 (4.2)	180 (5.1)	220 (6.2)	290 (8.2)	320 (9.1)
		10.0" w.c. (2.5 kPa)	150 (4.2)	100 (2.8)	120 (3.4)	150 (4.2)	220 (6.2)	280 (7.9)	320 (9.1)
325-5	1/2" x 1/2" 3/4" x 3/4" 1" x 1"	4.0" w.c. (1.0 kPa)	325 (9.2)	340 (9.6)	390 (11.0)	450 (12.7)	560 (15.9)	680 (19.3)	750 (21.2)
		7.0" w.c. (1.7 kPa)	325 (9.2)	260 (7.4)	360 (10.2)	410 (11.6)	530 (15.0)	680 (19.3)	750 (21.2)
		10.0" w.c. (2.5 kPa)	325 (9.2)	240 (6.8)	320 (9.1)	360 (10.2)	300 (8.5)	650 (18.4)	750 (21.2)
325-7A	1 1/4" x 1 1/4" 1 1/2" x 1 1/2"	4.0" w.c. (1.0 kPa)	—	850 (24.0)	1060 (30.0)	1190 (33.7)	1600 (45.3)	2090 (59.2)	2190 (62.0)
		7.0" w.c. (1.7 kPa)	—	780 (22.0)	950 (26.9)	1060 (30.0)	1500 (42.5)	1860 (52.7)	2060 (58.3)
		10.0" w.c. (2.5 kPa)	—	650 (18.4)	860 (24.4)	990 (28.0)	1300 (36.8)	1620 (45.9)	2060 (58.3)
325-9	1 1/2" x 1 1/2" 2" x 2"	4.0" w.c. (1.0 kPa)	—	1815 (51.4)	2075 (58.8)	2250 (63.7)	2660 (75.3)	3550 (100.5)	3750 (106.2)
		7.0" w.c. (1.7 kPa)	—	1430 (40.5)	1660 (47.0)	1960 (55.5)	2570 (72.8)	3420 (96.8)	3750 (106.2)
		10.0" w.c. (2.5 kPa)	—	1275 (36.1)	1450 (41.1)	1720 (48.7)	2160 (61.2)	3150 (89.2)	3750 (106.2)

NOTE: Maximum Individual Load: 325-3(B) is 100 CFH (2.8 m^3/h); 325-5(B) is 325 CFH (9.2 m^3/h); 325-7A(B) is 1250 CFH (35.4 m^3/h); 325-9(B) is 2250 CFH (63.7). Approval based on use as an appliance regulator. **Set points (in CFH): 325-3(B) = 50; 325-5(B) = 150; 325-7A(B) = 500; 325-9(B)=1000.

See pages 58-59 for Regulator Sizing Requirements and Examples.

Pressure Drop: 0.64 sp gr gas expressed in CFH (m^3/h) (for system pressure drop calculations)

Model	7.0" w.c. (1.7 kPa)	0.5 psi (3.4 kPa)	0.75 psi (5.2 kPa)	1 psi (6.9 kPa)	2 psi (13.8 kPa)
325-3	145 (4.0)	204 (5.8)	250 (7.0)	289 (8.2)	—
325-5	400 (11.3)	550 (15.6)	670 (19.0)	770 (21.8)	—
325-7A	815 (23.1)	1149 (32.5)	1405 (39.8)	1624 (46.0)	2305 (65.3)
325-9	1360 (38.5)	2113 (59.8)	2557 (72.4)	2949 (83.5)	4059 (114.8)

Spring Selection Chart: inches w.c. (kPa) unless noted

Model Number	CSA Certified				Standard Spring	Other Springs Available			
	2 psi (13.8 kPa)		5 psi (34.5 kPa)						
325-3	5 to 9 (1.25 to 2.25) Plated	7 to 11 (1.7 to 2.7) White	6 to 10 (1.5 to 2.5) Plated	7 to 11 (1.7 to 2.7) White	4 to 12 (1.0 to 3.0) Violet	2 to 6 (0.5 to 1.5) Plated	10 to 22 (2.5 to 5.5) Red	15 to 30 (3.7 to 7.5) Yellow	1 to 2 psi (6.9 to 13.9) Tagged
325-5	5 to 9 (1.25 to 2.25) Plated	7 to 11 (1.7 to 2.7) White	6 to 10 (1.5 to 2.5) Plated	7 to 11 (1.7 to 2.7) White	4 to 12 (1.0 to 3.0) Violet	2 to 6 (0.5 to 1.5) Plated	10 to 22 (2.5 to 5.5) Red	15 to 30 (3.7 to 7.5) Yellow	1 to 2 psi (6.9 to 13.9) Tagged
325-7A	—	—	—	—	4 to 12 (1.0 to 3.0) Violet	2 to 5 (0.5 to 1.5) Plated	10 to 22 (2.5 to 5.5) Red	15 to 30 (3.7 to 7.5) Yellow	20 to 42 (5.0 to 10.4) Black
325-9	—	—	—	—	4 to 12 (1.0 to 3.0) Violet	2 to 5 (0.5 to 1.5) Plated	10 to 22 (2.5 to 5.5) Red	15 to 30 (3.7 to 7.5) Yellow	20 to 42 (5.0 to 10.4) Black

NOTE: See pages 56-57 for complete Spring Selection Chart.

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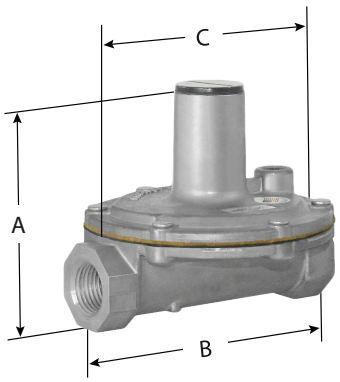
325 SERIES
Lever Acting Design

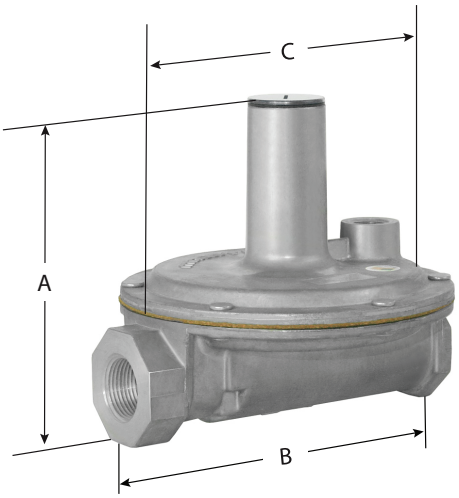
Dimensions

Model	Pipe Size	Vent Connection	Swing Radius	Dimensions		
				A	B	C
325-3	3/8″, 1/2″	1/8″ NPT	3″ (76 mm)	3.5″ (89 mm)	4.2″ (108 mm)	3.9″ (98 mm)
325-5	1/2″, 3/4″, 1″	3/8″ NPT	4.9″ (124 mm)	5.3″ (133 mm)	5.9″ (149 mm)	5.4″ (138 mm)
325-7A	1 1/4″, 1 1/2″	1/2″ NPT	6.1″ (156 mm)	7.3″ (184 mm)	8″ (203 mm)	7″ (178 mm)
325-9	1 1/2″, 2″	1/2″ NPT	7.8″ (198 mm)	9.4″ (239 mm)	10.8″ (274 mm)	9.1″ (231 mm)

NOTE: Dimensions are maximums and to be used only as an aid in designing clearance for the valve. Actual production dimensions may vary somewhat from those shown.



325-3



325-5

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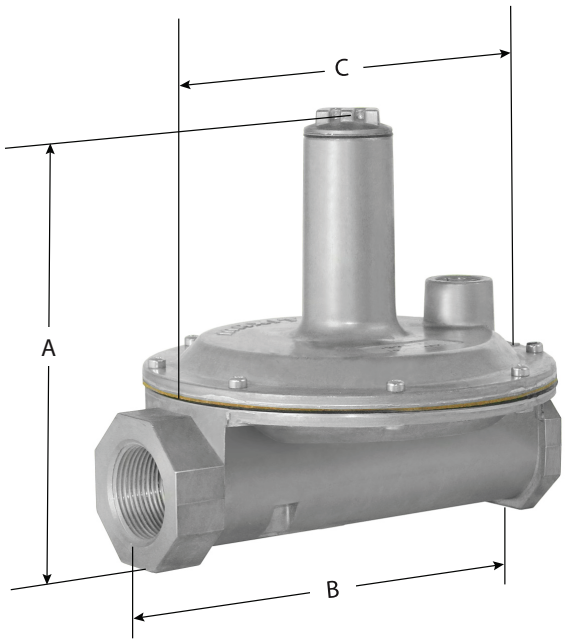
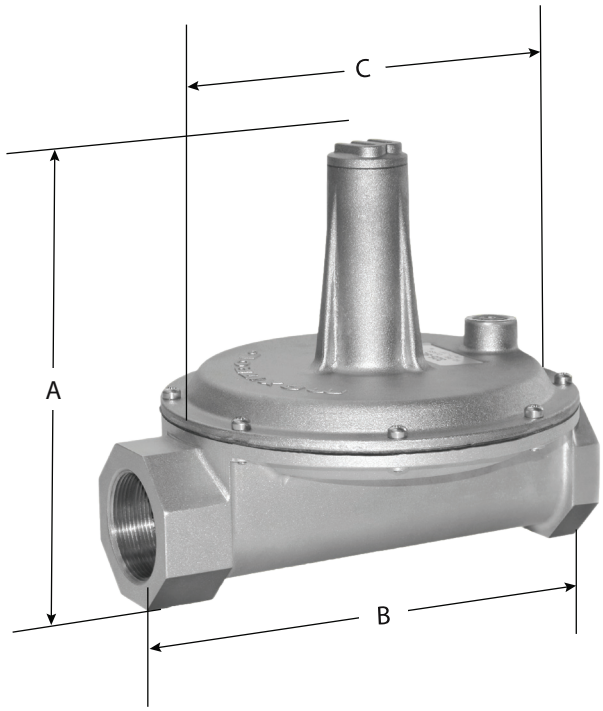
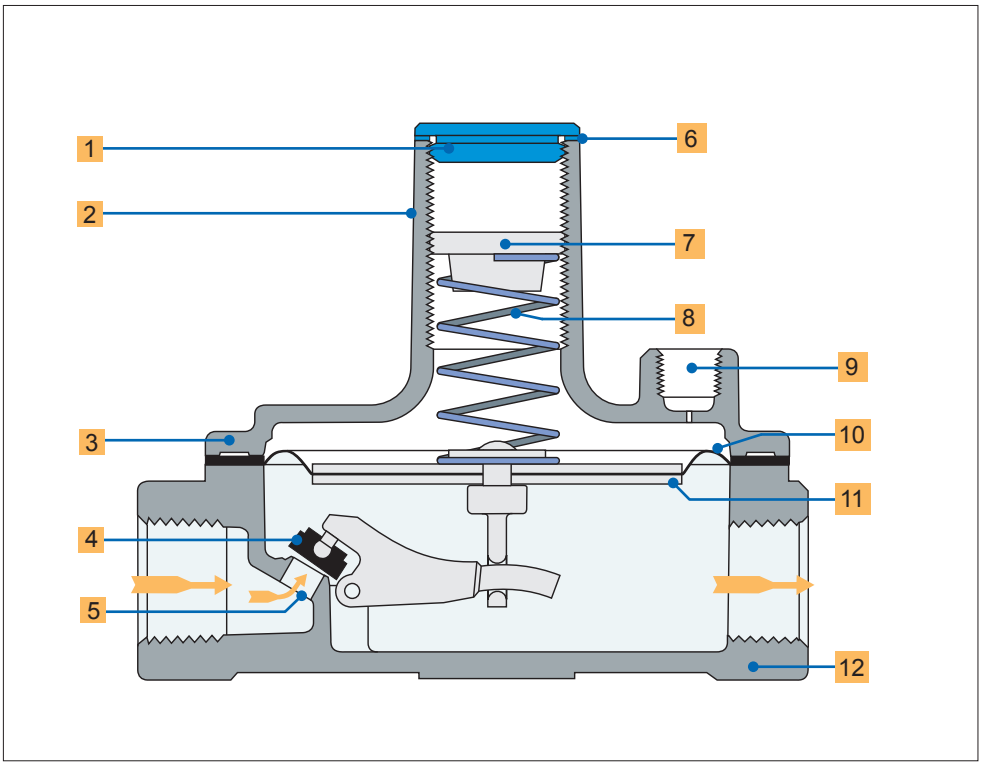


325-7A



325-9

Lever Acting Design



1	Seal Cap
2	Stack
3	Top Housing
4	Rubber Valve
5	Valve Seat
6	Seal Cap Gasket
7	Adjusting Screw
8	Spring
9	Vent Connection
10	Diaphragm
11	Diaphragm Plates
12	Bottom Housing

NOTE: Diagrams are graphical representations only and may differ from actual product.

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Southfield, MI 48037-2230

GPR_MS_EN_11.2013

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Bulletin 730
1/18/2013

Eclipse Adjustable Limiting Orifice Valves

Series ALO

Eclipse Adjustable Limiting Orifice Valves are recommended for installation in gas lines feeding nozzle mix burners as a means of gas flow adjustment for the desired air / gas ratio. The unique V-port design allows for extremely fine ratio adjustment.

Adjustable Limiting Orifice Valves are available in five sizes from 3/4" to 2". Capacities when using natural gas range from 213 cfh to 16,469 cfh depending on valve size and pressure drop taken (see Capacity Table). Maximum inlet pressure is 40 psi.

Valve adjustment is readily accomplished by removing the cap and turning the stem assembly clockwise for reduced flow and counterclockwise for increased flow. Once adjustment has been made, replace the cap to prevent tampering with the adjustment and to protect the threads of the packing nut.

"ALO" Valves are designed for use as limiting orifices and should not be used as a substitute for a normal shut off valve. They should be preceded in the gas line by a suitable manual shut off valve such as a lubricated plug cock. For a right angle version of the Adjustable Limiting Orifice Valve, series "ALO-R", see Bulletin 728. Contact Eclipse for applications below -20F (-28C).

Capacities

(CFH of 0.60 SG. Gas*)

Catalog Number	Pipe Size (inch)	Flow Coeff. (Cv) Full Open	Inches w.c. Drop**							PSIG Drop**				
			0.5	1.5	3.5	5.0	7.0	8.5	10.0	1.0	2.0	3.0	4.0	5.0
ALO-3	3/4	4.70	213	322	479	575	683	757	826	1396	1974	2418	2792	3122
ALO-4	1	6.54	203	345	468	574	682	756	823	1393	1970	2412	2786	3115
ALO-5	1-1/4	12.24	514	856	1277	1514	1808	1984	2160	3828	5413	6630	7656	8559
ALO-6	1-1/2	13.79	584	964	1427	1718	2027	2225	2442	4095	5791	7092	8189	9156
ALO-8	2"	24.81	1030	1675	2813	3052	3622	3981	4329	7365	10,416	12,757	14,731	16,469

*When using other than natural gas, apply multifactor to above capacities

Gas—Sp. Gr.	0.4	0.6	0.8	1.0	1.5	2.0
Multifactor	1.22	1.00	0.866	0.77	0.632	0.547

**Above capacities assume a secondary pressure of atmospheric to 1/2 psi. For other pressures use the following equations for gases or for liquids near the viscosity of water.

FOR GAS: $Q = 1360\, C_v \sqrt{\frac{(P_1-P_2)\, P_2}{GT}}$

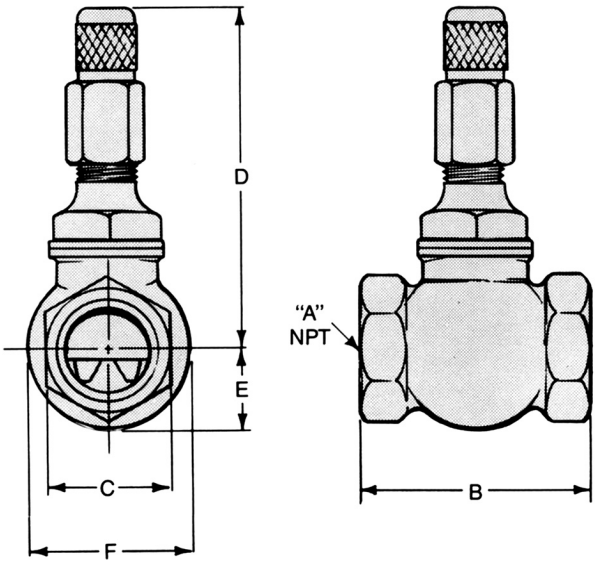
Q = SCFH
C_v = Flow Factor
P_1 = Inlet Pressure PSIA
P_2 = Outlet Pressure PSIA
G = Specific Gravity of gas
T = Flowing temperature absolute ° F.

FOR LIQUIDS: $Q = C_v \sqrt{\frac{\triangle P}{S.G.}}$

Q = Flow in G.P.M.
C_v = Flow factor
$\triangle P$ = Pressure differential
S.G. = Specific Gravity of liquid

ECLIPSE®
Innovative Thermal Solutions

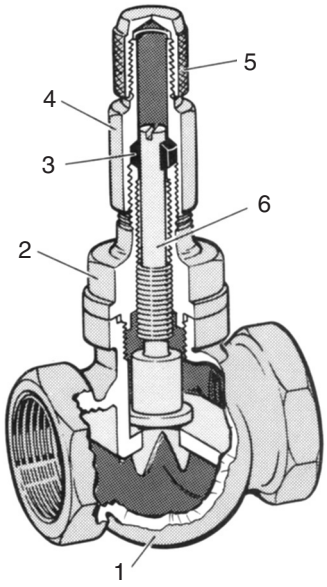
Dimensions



Catalog Number	Part Number	Dimensions					
		A	B	C	D	E	F
ALO-3	500605	3/4	2-17/32	1-3/8	3-15/16	7/8	1-3/4
ALO-4	500606	1	2-7/8	1-5/8	3-3/4	1-1/16	2-1/8
ALO-5	500607	1-1/4	3-5/8	2	4-5/8	1-1/4	2-1/2
ALO-6	500608	1-1/2	3-3/4	2-1/4	5	1-1/2	3
ALO-8	500609	2	4-1/4	2-3/4	5-7/8	1-7/8	3-3/4

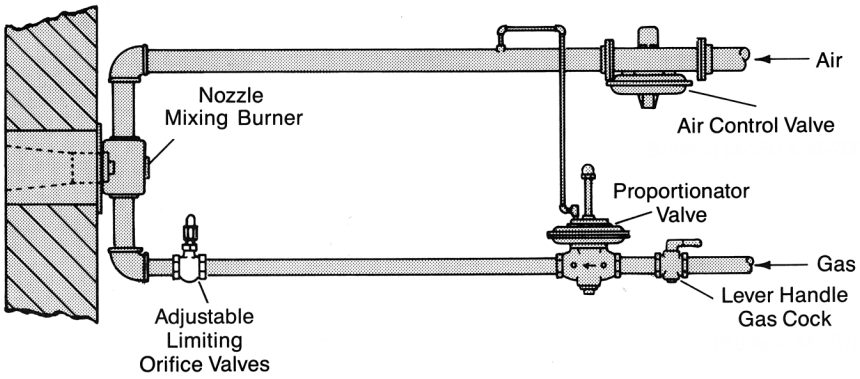
NOTE: All dimensions are in inches.

Parts List



Item No.	Description	No. Req'd.	Part Numbers				
			ALO-3	ALO-4	ALO-5	ALO-6	ALO-8
1	Body, Globe Valve	1	4395-11	4396-11	4397-11	4398-11	4399-11
2	Bonnet, Brass	1	4161-11	4162-11	4163-11	4164-11	4165-11
3	Packing	1	10004	10004	10006	10006	10014
4	Nut, Packing, Brass B-16 H.H.	1	19914	19914	19934	19934	19935
5	Cap, Brass B-16 H.H.	1	19938	19938	10000	10000	10000
6	Stem Assembly	1	500610	500611	500612	500613	500614

Typical Application



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Datasheet 720
9/13/2010

Eclipse Butterfly Valves

Full Port & Reduced Port

Version 2

Manual Control BV

Automatic Control BV

(Shown with Optional Crank Arm)

Product Description

Eclipse Butterfly Valves are designed to control air and gas flow to all types of combustion systems. They **should not** be used as tight shut-off valves.

Types Available

Valves are available for either manual or automatic control in pipe sizes 1/2" to 8". Full port, reduced port and high pressure drop constructions are available depending on pipe size and connection.

Thread Connections

The 1/2" through 4" valves are available with either NPT or Rc threads. The 6" and 8" valves are wafer type butterfly valves designed to be sandwiched between flanges on connecting pipes.

Disks

NPT Versions: Furnished with beveled or non-beveled disks, according to the selection table.

Rc Versions: Furnished with non-beveled disks.

Indication

All Eclipse butterfly valves feature an easy to read indicator plate and a slot on the end of the shaft to provide visual indication of the disk position.

Control

Manual butterfly valves 4" and smaller have an adjusting cover for setting disk position. A locking screw secures the cover at the desired setting.

Automatic control butterfly valves can be fitted with an optional crank arm or coupling. This allows integration with a variety of position control devices.

Manual wafer butterfly valves are adjusted by rotating a control arm which can be locked to the indicating plate after positioning.

Accessories

Eclipse stocks a selection of electric operators and mounting kits which can be ordered separately. The extended shaft length on the automatic butterfly valves allows the addition of either a second control arm for simultaneous automatic operation in dual valve applications, or a cam for a high/low fire microswitch arrangement.

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Main Specifications

Parameter	Specifications	
Maximum Operating Pressure	1/2" - 4" (15 - 100 mm)	5 psig (350 mbarg)
	6" - 8" (150 - 200 mm)	3 psig (210 mbarg)
Operating Temperature Range	NPT Version	-40 to 140°F (-40 to 60°C)
	Rc Version	32 to 140°F (0 to 60°C)
Materials of Construction	Body	Powder Coated Cast Iron
	Shaft	Zinc Plated Steel
	Disk	Carbon Steel
	Shaft Packing Seal	Nitrile Rubber (Buna-N)
Approvals	(UL) (only 1/2" thru 4" models)	
Typical Application	Control of air or gas flow in a combustion system	
Notes on European Applications	4" thread not acceptable for gas use. 3" thread is acceptable if pressure is limited to 100 mbar (1.5 psig)	
Approvals	АИ30	

NPT Model Selection

	Full Port Valves						Reduced Port Valves			
	Manual		Automatic				Manual		Automatic	
	Beveled Disk 75° Rotation		Beveled Disk 75° Rotation		Non-Beveled Disk 360° Rotation		Beveled Disk 75° Rotation		Beveled Disk 75° Rotation	
NPT Size	**Catalog Number**	**Item Code**	**Catalog Number**	**Item Code**	**Catalog Number**	**Item Code**	**Catalog Number**	**Item Code**	**Catalog Number**	**Item Code**
1/2"*	102BV-B	501238	2BV-AB	501239	--------	--------	--------	--------	--------	--------
3/4"	103BV-B	501215	3BV-AB	501223	3BV-A	501200	--------	--------	--------	--------
1"	104BV-B	501216	4BV-AB	501224	4BV-A	501201	104BV-RB	501208	4BV-ARB	501231
1-1/4"	105BV-B	501217	5BV-AB	501225	5BV-A	501202	105BV-RB	501209	5BV-ARB	501232
1-1/2"	106BV-B	501218	6BV-AB	501226	6BV-A	501203	106BV-RB	501210	6BV-ARB	501233
2"	108BV-B	501219	8BV-AB	501227	8BV-A	501204	108BV-RB	501211	8BV-ARB	501234
2-1/2"	110BV-B	501220	10BV-AB	501228	10BV-A	501205	110BV-RB	501212	10BV-ARB	501235
3"	112BV-B	501221	12BV-AB	501229	12BV-A	501206	112BV-RB	501213	12BV-ARB	501236
4"	116BV-B	501222	16BV-AB	501230	16BV-A	501207	116BV-RB	501214	16BV-ARB	501237
6" wafer	124BV-B	500915	24BV-AB	500998	--------	--------	124BV-RB	500690	24BV-ARB	500975
8" wafer	132BV-B	500913	32BV-AB	500999	--------	--------	132BV-RB	500691	32BV-ARB	500976

* See note below.

	High Pressure Drop Valves			
	Manual		Automatic	
	Non-Beveled Disk 90° Rotation		Non-Beveled Disk 360° Rotation	
NPT Size	**Catalog Number**	**Item Code**	**Catalog Number**	**Item Code**
1/2"*	402BV-HD	100129	402BV-AHD	100130
3/4"	403BV-HD	100133	403BV-AHD	100134
1"	404BV-HD	100119	404BV-AHD	100123

* See note below.

***NOTE:** Beveled disks physically stop against the body in the closed position. ALL 1/2" Butterfly Valves (NPT/Rc, Manual/Automatic, Beveled/Non-beveled) DO NOT have a mechanical stop limiting the travel to 75° rotation. The effective travel for flow control is 75° but the shaft will rotate 360°. The terms beveled and non-beveled do not apply to any of the 1/2" Butterfly Valves covered in this datasheet.

NOTE: Wafer Butterfly Valves are not threaded. For dimensional information, see page 7.

NPT Model Capacities

Multiply Capacity by the Factors Below for Gases Other than Air			
Gas - Sp. Gr.	**Natural - .6**	**Propane - 1.5**	**Butane - 2.0**
Multifactor	1.29	0.81	0.70

NPT Size	Flow Coefficient Cv-Full Open	Full Port								
		Capacity scfh air - "w.c. pressure drop								
		0.5	0.75	1	1.5	2	3	4	6	8
1/2"	5.5	173	212	244	299	345	422	487	595	685
3/4"	15.9	500	612	706	865	998	1,221	1,408	1,720	1,982
1"	29.7	933	1,143	1,319	1,615	1,864	2,280	2,630	3,213	3,702
1-1/4"	65.9	2,071	2,536	2,927	3,583	4,135	5,059	5,835	7,129	8,213
1-1/2"	111.0	3,489	4,272	4,931	6,036	6,965	8,521	9,828	12,009	13,834
2"	180.0	5,657	6,927	7,996	9,788	11,295	13,818	15,937	19,473	22,433
2-1/2"	322.0	10,121	12,391	14,304	17,509	20,206	24,719	28,510	34,836	40,131
3"	457.0	14,364	17,587	20,301	24,850	28,677	35,082	40,462	49,441	56,956
4"	819.0	25,741	31,517	36,383	44,534	51,394	62,871	72,513	88,604	102,072
6" wafer	2600.0	81,718	100,055	115,501	141,377	163,154	199,591	230,201	281,283	324,039
8" wafer	4200.0	132,007	161,628	186,578	228,379	263,557	322,417	371,864	454,380	523,448

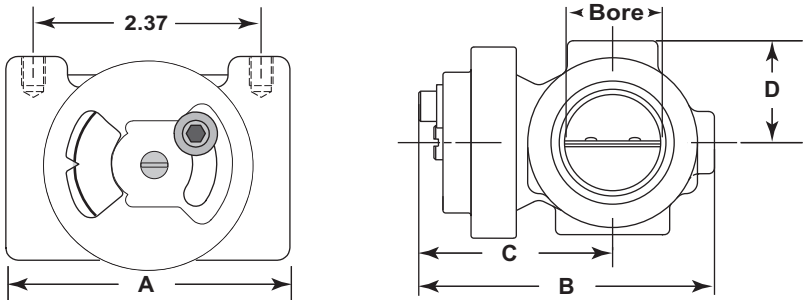
NPT Size	Flow Coefficient Cv-Full Open	Reduced Port								
		Capacity scfh air - "w.c. pressure drop								
		0.5	0.75	1	1.5	2	3	4	6	8
1"	14.1	443	543	626	767	885	1,082	1,248	1,525	1,757
1-1/4"	22.8	717	877	1,013	1,240	1,431	1,750	2,019	2,467	2,842
1-1/2"	31.4	987	1,208	1,395	1,707	1,970	2,410	2,780	3,397	3,913
2"	62.7	1,971	2,413	2,785	3,409	3,935	4,813	5,551	6,783	7,814
2-1/2"	87.9	2,763	3,383	3,905	4,780	5,516	6,748	7,783	9,510	10,955
3"	149.0	4,683	5,734	6,619	8,102	9,350	11,438	13,192	16,120	18,570
4"	244.0	7,669	9,390	10,839	13,268	15,311	18,731	21,604	26,397	30,410
6" wafer	553.0	17,381	21,281	24,566	30,070	34,702	42,452	48,962	59,827	68,921
8" wafer	721.5	22,677	27,765	32,051	39,232	45,275	55,387	63,881	78,056	89,921

NPT Size	Flow Coefficient Cv-Full Open	High Pressure Drop								
		Capacity scfh air - "w.c. pressure drop								
		0.5	0.75	1	1.5	2	3	4	6	8
1/2"	2.7	85	104	120	147	169	207	239	292	337
3/4"	3.2	101	123	142	174	201	246	283	346	399
1"	4.2	132	162	187	228	264	322	372	454	523

Dimensions, Manual Valves with NPT Threads

NPT Size	Full Port, Beveled Disk 75° Rotation: Catalog Number	Item Code	Bore Inches	Reduced Port, Beveled Disk 75° Rotation: Catalog Number	Item Code	Bore Inches	High Pressure Drop, 90° Rotation: Catalog Number	Item Code	Bore Inches	Dimensions, Inches: A	B	C	D
1/2"*	102BV-B	501238	0.61	-	-	-	402BV-HD	100129	0.44	3.00	3.05	2.05	1.19
3/4"	103BV-B	501215	0.87	-	-	-	403BV-HD	100133	0.55	3.00	3.07	2.07	1.06
1"	104BV-B	501216	1.10	104BV-RB	501208	0.87	404BV-HD	100119	2 x 0.44	2.87	3.33	2.14	1.31
1-1/4"	105BV-B	501217	3.12	105BV-RB	501209	1.02				3.12	3.58	2.26	1.50
1-1/2"	106BV-B	501218	1.46	106BV-RB	501210	1.18				3.12	3.82	2.38	1.63
2"	108BV-B	501219	2.13	108BV-RB	501211	1.53				3.12	4.45	2.70	1.94
2-1/2"	110BV-B	501220	2.64	110BV-RB	501212	1.77				3.87	5.09	3.09	2.25
3"	112BV-B	501221	3.23	112BV-RB	501213	2.24				3.87	5.58	3.33	2.50
4"	116BV-B	501222	4.17	116BV-RB	501214	2.80				5.00	6.65	3.84	3.06

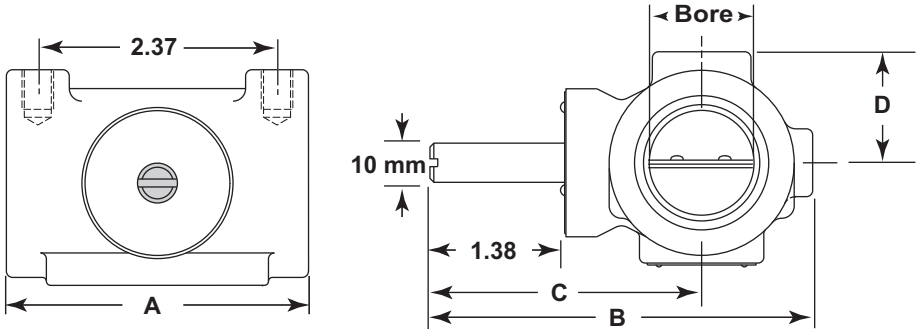
* See note below.



Dimensions, Automatic Valves with NPT Threads

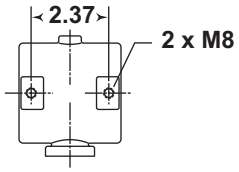
NPT Size	Full Port, Beveled Disk 75° Rotation: Catalog Number	Item Code	Non-Beveled Disk 360° Rotation: Catalog Number	Item Code	Bore Inches	Reduced Port, Beveled Disk 75° Rotation: Catalog Number	Item Code	Bore Inches	High Pressure Drop, 360° Rotation: Catalog Number	Item Code	Bore Inches	Dimensions, Inches: A	B	C	D
1/2"*	2BV-AB	501239	-	-	0.61	-	-	-	402BV-AHD	100130	0.44	3.00	3.66	2.66	1.19
3/4"	3BV-AB	501223	3BV-A	501200	0.87	-	-	-	403BV-AHD	100134	0.55	3.00	3.60	2.60	1.06
1"	4BV-AB	501224	4BV-A	501201	1.10	4BV-ARB	501231	0.87	404BV-AHD	100123	2 x 0.44	2.87	3.90	2.78	1.31
1-1/4"	5BV-AB	501225	5BV-A	501202	1.46	5BV-ARB	501232	1.02				3.12	4.22	2.90	1.50
1-1/2"	6BV-AB	501226	6BV-A	501203	1.65	6BV-ARB	501233	1.18				3.12	4.47	3.03	1.63
2"	8BV-AB	501227	8BV-A	501204	2.13	8BV-ARB	501234	1.54				3.12	5.09	3.34	1.94
2-1/2"	10BV-AB	501228	10BV-A	501205	2.64	10BV-ARB	501235	1.77				3.87	5.72	3.72	2.25
3"	12BV-AB	501229	12BV-A	501206	3.23	12BV-ARB	501236	2.24				3.87	6.22	3.97	2.50
4"	16BV-AB	501230	16BV-A	501207	4.17	16BV-ARB	501237	2.80				5.00	7.28	4.47	3.06

* See note below.

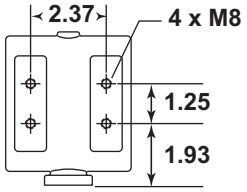


Actuator Bracket Mounting Holes

1/2" thru 2-1/2"



3" & 4"



***NOTE:** Beveled disks physically stop against the body in the closed position. ALL 1/2" Butterfly Valves (NPT/Rc, Manual/Automatic Beveled/Non-beveled) DO NOT have a mechanical stop limiting the travel to 75° rotation. The effective travel for flow control is 75° but the shaft will rotate 360°. The terms beveled and non-beveled do not apply to any of the 1/2" Butterfly Valves covered in this datasheet.

Rc Model Selection

Rc Size	Full Port Valves				Reduced Port Valves			
	Manual		Automatic		Manual		Automatic	
	Non-Beveled Disk 90° Rotation		Non-Beveled Disk 360° Rotation		Non-Beveled Disk 90° Rotation		Non-Beveled Disk 360° Rotation	
	Catalog No	Item Code	Catalog No	Item Code	Catalog No	Item Code	Catalog No	Item Code
1/2"*	102BVM	101103	2BVM-A	202081	--------	--------	--------	--------
3/4"	103BVM	101104	3BVM-A	101248	--------	--------	--------	--------
1"	104BVM	101105	4BVM-A	101249	104BVM-R	101255	4BVM-AR	101261
1-1/4"	--------	--------	--------	--------	--------	--------	--------	--------
1-1/2"	106BVM	101106	6BVM-A	101250	106BVM-R	101256	6BVM-AR	101262
2"	108BVM	101107	8BVM-A	101251	108BVM-R	101257	8BVM-AR	101263
2-1/2"	110BVM	101108	10BVM-A	101252	110BVM-R	101258	10BVM-AR	101264
3"	112BVM	101109	12BVM-A	101253	112BVM-R	101259	12BVM-AR	101265
4"	116BVM	101110	16BVM-A	101254	116BVM-R	101260	16BVM-AR	101266
6" wafer	**NOTE:** Selection information for these valves appears on page 2. Wafer BV Valves are not threaded and may be used with DN 150 and DN 200 flanged fittings. See dimensions on page 7.							
8" wafer								

* See note below.

Rc Size	High Pressure Drop Valves			
	Manual		Automatic	
	Non-Beveled Disk 90° Rotation		Non-Beveled Disk 360° Rotation	
	Catalog No	Item Code	Catalog No	Item Code
1/2"*	402BVM-HD	100131	402BVM-AHD	100132
3/4"	403BVM-HD	100135	403BVM-AHD	100136
1"	404BVM-HD	100120	404BVM-AHD	100100

* See note to the right.

***NOTE**: Beveled disks physically stop against the body in the closed position. ALL 1/2" Butterfly Valves (NPT/Rc, Manual/Automatic Beveled/Non-beveled) DO NOT have a mechanical stop limiting the travel to 75° rotation. The effective travel for flow control is 75° but the shaft will rotate 360°. The terms beveled and non-beveled do not apply to any of the 1/2" Butterfly Valves covered in this datasheet.

Rc Model Capacities

Multiply Capacity by the Factors Below for Gases Other than Air			
Gas - Sp. Gr.	Natural - .6	Propane - 1.5	Butane - 2.0
Multifactor	1.29	0.81	0.70

Rc Size	Flow Coefficient CV-Full Open	Full Port							
		Capacity nm^3/h air - mbar pressure drop							
		1	2	3	5	8	10	13	15
1/2"	4.7	4	6	7	9	12	13	15	16
3/4"	13.7	12	17	21	27	34	38	43	46
1"	25.5	22	32	39	50	63	70	80	86
1-1/2"	95.8	84	118	145	187	236	264	300	322
2"	155.0	136	192	234	302	382	427	486	521
2-1/2"	277.0	242	342	419	541	683	763	868	932
3"	393.0	344	486	595	767	969	1,082	1,232	1,322
4"	704.0	615	870	1,065	1,374	1,735	1,938	2,207	2,368
6" wafer	2251.0	1,968	2,782	3,405	4,392	5,548	6,197	7,056	7,572
8" wafer	3637.0	3,180	4,495	5,502	7,097	8,964	10,013	11,400	12,234

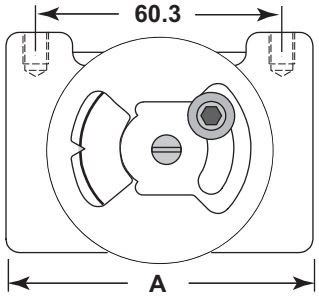
Rc Size	Flow Coefficient Kv-Full Open	Reduced Port							
		Capacity nm^3/h air - mbar pressure drop							
		1	2	3	5	8	10	13	15
1"	12.1	11	15	18	24	30	33	38	41
1-1/2"	27.0	24	33	41	53	67	74	85	91
2"	53.9	47	67	82	105	133	148	169	181
2-1/2"	75.9	66	94	115	148	187	209	238	255
3"	128.0	112	158	194	250	315	352	401	431
4"	210.0	184	260	318	410	518	578	658	706
6" wafer	479.0	419	592	725	935	1,181	1,319	1,501	1,611
8" wafer	625.0	546	772	946	1,220	1,540	1,721	1,959	2,102

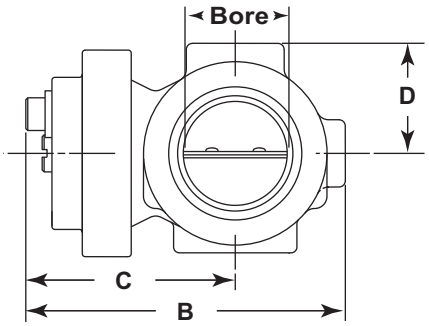
Rc Size	Flow Coefficient Kv-Full Open	High Pressure Drop							
		Capacity nm^3/h air - mbar pressure drop							
		1	2	3	5	8	10	13	15
1/2"	2.3	2.0	2.8	3.5	4.5	5.7	6.3	7.2	7.7
3/4"	2.8	2.4	3.5	4.2	5.5	6.9	7.7	8.8	9.4
1"	3.6	3.1	4.4	5.4	7.0	8.9	9.9	11.3	12.1

Dimensions, Manual Valves with Rc Threads

Rc Size	Full Port Non-Beveled Disk 90° Rotation			Reduced Port Non-Beveled Disk 90° Rotation			High Pressure Drop 90° Rotation			Dimensions, mm			
	Catalog Number	Item Code	Bore mm	Catalog Number	Item Code	Bore mm	Catalog Number	Item Code	Bore mm	A	B	C	D
1/2"*	102BVM	101103	15.5	-	-	-	402BVM-HD	100131	11.1	76.2	77.5	52.1	30.2
3/4"	103BVM	101104	22	-	-	-	403BVM-HD	100135	13.9	76.2	77.9	52.5	27.0
1"	104BVM	101105	28	104BVM-R	101255	22	404BVM-HD	100120	2 x 11.1	73.0	84.7	54.5	33.3
1-1/2"	106BVM	101106	42	106BVM-R	101256	30				79.4	97.0	60.5	41.3
2"	108BVM	101107	54	108BVM-R	101257	39				79.4	113.0	68.5	49.2
2-1/2"	110BVM	101108	67	110BVM-R	101258	45				98.4	129.2	78.5	57.2
3"	112BVM	101109	82	112BVM-R	101259	57				98.4	141.7	84.5	63.5
4"	116BVM	101110	106	116BVM-R	101260	71				127.0	168.9	97.5	77.8

* See note below.

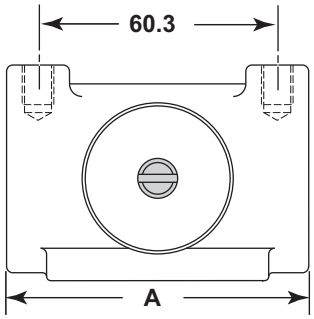


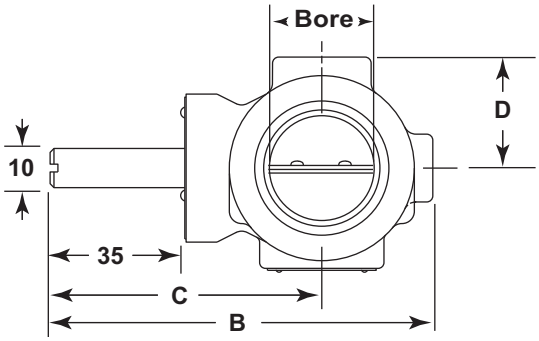


Dimensions, Automatic Valves with Rc Threads

Rc Size	Full Port Non-Beveled Disk 360° Rotation			Reduced Port Non-Beveled Disk 360° Rotation			High Pressure Drop 360° Rotation			Dimensions, mm			
	Catalog Number	Item Code	Bore mm	Catalog Number	Item Code	Bore mm	Catalog Number	Item Code	Bore mm	A	B	C	D
1/2"*	2BVM-A	202081	15.5	-	-	-	402BVM-AHD	100132	11.1	76.2	93.0	67.7	30.2
3/4"	3BVM-A	101248	22	-	-	-	403BVM-AHD	100136	13.9	76.2	91.3	65.9	27.0
1"	4BVM-A	101249	28	4BVM-AR	101261	22	404BVM-AHD	100100	2 x 11.1	73.0	99.2	70.6	33.3
1-1/2"	6BVM-A	101250	42	6BVM-AR	101262	30				79.4	113.5	77.0	41.3
2"	8BVM-A	101251	54	8BVM-AR	101263	39				79.4	129.4	84.9	49.2
2-1/2"	10BVM-A	101252	67	10BVM-AR	101264	45				98.4	145.3	94.5	57.2
3"	12BVM-A	101253	82	12BVM-AR	101265	57				98.4	158.0	100.8	63.5
4"	16BVM-A	101254	106	16BVM-AR	101266	71				127.0	184.9	113.5	77.8

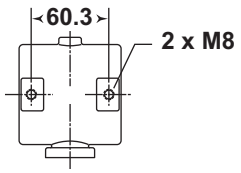
* See note below.



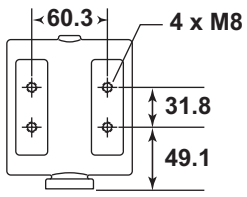


Actuator Bracket Mounting Holes

1/2" thru 2-1/2"



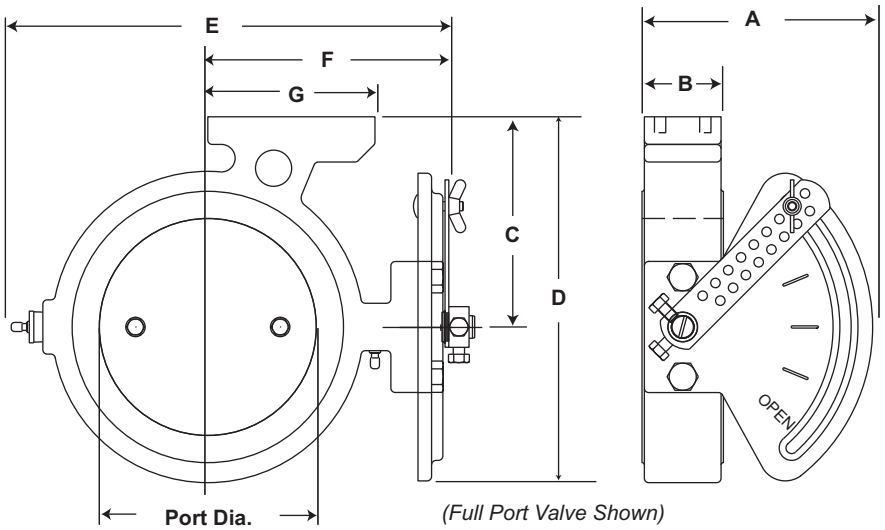
3" & 4"



***NOTE:** Beveled disks physically stop against the body in the closed position. ALL 1/2" Butterfly Valves (NPT/Rc, Manual/Automatic Beveled/Non-beveled) DO NOT have a mechanical stop limiting the travel to 75° rotation. The effective travel for flow control is 75° but the shaft will rotate 360°. The terms beveled and non-beveled do not apply to any of the 1/2" Butterfly Valves covered in this datasheet.

Dimensions, Wafer Type Valves

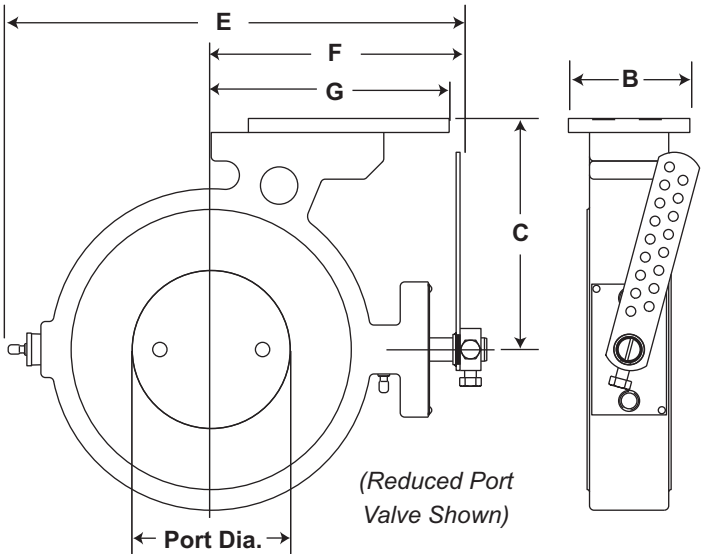
Manual Valves



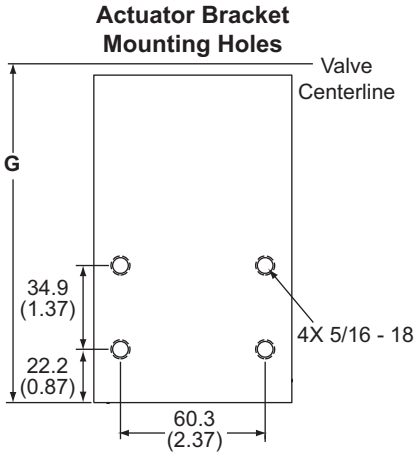
(Full Port Valve Shown)

Size	Catalog Number	Item Code	Dimensions mm (in)								
			A	B	C	D	E	F	G	Port Diameter	Approx. Weight
Full Port Manual											
6"	124BV-B	500915	162 (6.38)	57 (2.25)	148 (5.81)	257 (10.13)	289 (11.38)	97 (3.81)	117 (4.63)	152 (6.00)	13 (28
8"	132BV-B	500913	162 (6.38)	57 (2.25)	178 (7.00)	317 (12.47)	351 (13.81)	206 (8.13)	130 (5.13)	203 (8.00)	16 (36)
Reduced Port Manual											
6"	124BV-RB	500690	162 (6.38)	57 (2.25)	148 (5.81)	257 (10.13)	289 (11.38)	97 (3.81)	117 (4.63)	108 (4.25)	16 (35)
8"	132BV-RB	500691	162 (6.38)	57 (2.25)	178 (7.00)	317 (12.47)	351 (13.81)	206 (8.13)	130 (5.13)	130 (5.12)	23 (50)

Automatic Valves



(Reduced Port Valve Shown)



Size	Catalog Number	Item Code	Dimensions mm (in)								
			A	B	C	D	E	F	G	Port Diameter	Approx. Weight
Full Port Auto											
6"	24BV-AB	500998	162 (6.38)	83 (3.25)	157 (6.18)	257 (10.13)	289 (11.38)	97 (3.81)	162 (6.38)	152 (6.00)	13 (28)
8"	32BV-AB	500999	162 (6.38)	83 (3.25)	187 (7.38)	317 (12.47)	351 (13.83)	206 (8.13)	193 (7.60)	203 (8.00)	16 (36)
Reduced Port Auto											
6"	24BV-ARB	500975	162 (6.38)	83 (3.25)	157 (6.18)	257 (10.13)	289 (11.38)	97 (3.81)	162 (6.38)	108 (4.25)	16 (35)
8"	32BV-ARB	500976	162 (6.38)	83 (3.25)	187 (7.38)	317 (12.47)	351 (13.81)	206 (8.13)	193 (7.60)	130 (5.12)	23 (50)

Accessories for Automatic BV's

Control Motor Mounting Kits	Major Components				
Eclipse Trilogy T500 Actuator	**Kit Item Code**	**Bracket**	**Drive Pin**	**Coupling**	**Crank Arm**
1/2 inch thru 3/4 inch	10047900	10047436	10050816	00.4095056.40	Crank arms not required
1 inch	10047901	10047437	10050816	00.4095056.40	
1-1/4 inch	10047902	10047867	10050816	00.4095056.40	
1-1/2 inch	10047903	10047438	10050816	00.4095056.40	
2 inch	10047904	10047439	10050816	00.4095056.40	
2-1/2 inch	10047905	10047440	10050816	00.4095056.40	
3 inch	10047906	10047441	10050816	00.4095056.40	
4 inch	10047907	10047442	10050816	00.4095056.40	
For assembled T500 and valve, see catalog 725, BV-Pak.					
Eclipse PRA6 Rotary Actuator	**Kit Item Code**	**Bracket**	**Control Rod**	**Coupling**	**Crank Arm**
RH mount, 1/2 thru 4, ver. 2	100127	21695	Rod not required	21048	Crank arms not required
LH mount, 1/2 thru 4, ver. 2	100128	21696		21048	
Perpendicular mount, 1/2 thru 1-1/2, ver. 2	100190	21934		21048	
Perpendicular mount, 2 & 2-1/2, ver. 2	100191	21935		21048	
Perpendicular mount, 3 & 4, ver. 2	100192	21936		21048	

Siemens SQM5	**Kit Item Code**	**Bracket**	**Control Rod**	**Coupling, 10 mm**	**Coupling, 3/8 sq**	**Crank Arm**
1/2"	n/a	10009523	n/a	10040580	10034079	n/a
3/4"	n/a	10009537	n/a	10040580	10034079	n/a
1"	n/a	10009541	n/a	10040580	10034079	n/a
1-1/2"	n/a	10009600	n/a	10040580	10034079	n/a
2"	n/a	10009606	n/a	10040580	10034079	n/a
3"	n/a	10017267	n/a	10040580	10034079	n/a

EMP/EMA, Honeywell Mod IV	**Kit Item Code**	**Bracket**	**Control Rod**	**Coupling**	**Crank Arm**
1/2 thru 4 ver. 2	100099	13095	12730-1	14264	102265
1/2 thru 4 ver. 2, with 18093 crank arm	100099-1	13095	12730-1	14264	102265/18093
1/2 thru 4 ver. 2, automotive	100099-AUTO	13095	10024156-6	10017978	102265
1/2 thru 4 ver. 2,	10025305	13095	12730-1	14264	11652-6/18093
6 and 8 valves	500928-1	13095	12730-2	14264	500537
Honeywell M640 & M940	**Kit Item Code**	**Bracket**	**Control Rod**	**Coupling**	**Crank Arm**
1/2 thru 4 ver. 2	120079	13095 & 12758	12730-1	14264	102265

NOTES:

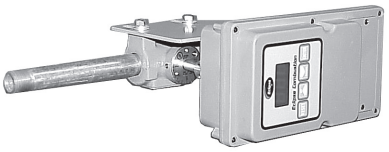
- Control Motor Mounting Kits contain brackets, couplings and miscellaneous screws and washers.
- The kits used with EMP/EMA and Honeywell valves also contain a control rod and crank arm.
- These mounting kits are designed to work in a majority of installations. Some applications may require special components.
- Items in the kit not listed are not available for individual sale.
- Contact the factory or your Eclipse representative for more detailed information.

Brackets for Eclipse T500 Actuator

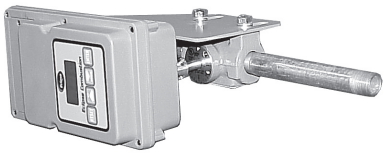
Bracket Item Code - see table above
Butterfly Valve with T500 actuator and bracket/coupling

T500 actuator can be mounted parallel or perpendicular to piping.

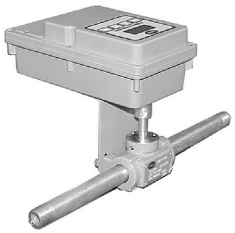
Accessories for Automatic BV's (continued)
Brackets for Eclipse PRA Rotary Actuator



Bracket Item Code 21695
Right hand mounting bracket for Eclipse Rotary Actuator



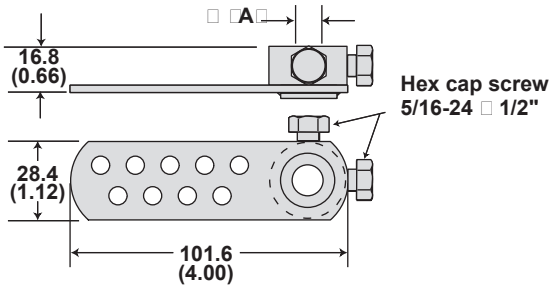
Bracket Item Code 21696
Left hand mounting bracket for Eclipse Rotary Actuator



Bracket Item Code 21934
for 1/2" to 1-1/2" valves
Bracket Item Code 21935
for 2" to 4" valves
Perpendicular mounting bracket for Eclipse Rotary Actuator

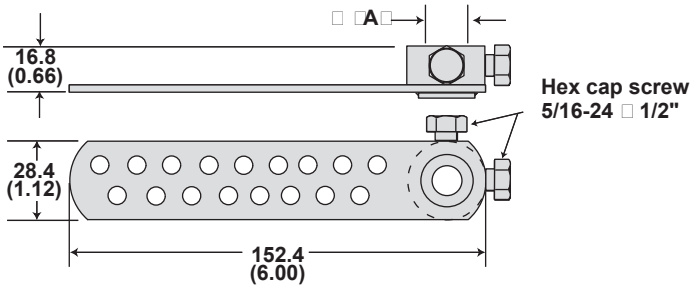
Crank Arms for General Use

Crank Arm Item Code	DIM □A□	
	mm	(in.)
500527	9.6	(0.380)
500535	12.8	(0.505)
500536	16.0	(0.630)



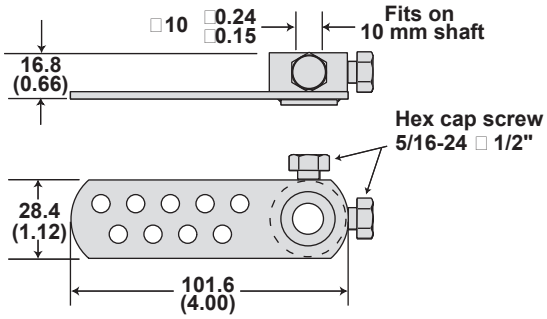
Materials: □inc plated carbon steel

Crank Arm Item Code	DIM □A□	
	mm	(in.)
500537	16.0	(0.630)
500538	9.6	(0.380)
500539	12.8	(0.505)



Materials: □inc plated carbon steel

Item Code 102265 **Dims: mm (in.)**



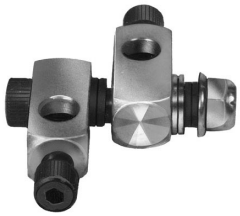
Materials: □inc plated carbon steel

Linkage control rods

Zinc plated cold rolled steel				Stainless steel			
Dia. Inches	Item Code	Length mm	Length in	Dia. Inches	Item Code	Length mm	Length in
5/16	12730	203	(8)	1/2	10175-1	305	(12)
	12730-1	254	(10)		10175-2	381	(15)
	12730-2	381	(15)		10175-3	457	(18)
	12730-3	610	(24)		10175-4	610	(24)
	12730-5	152	(6)		10175-5	762	(30)
					10175-6	914	(36)
					10175-7	1219	(48)
					10175-8	1524	(60)
					10175-9	1829	(72)

Swivel Connectors for 5/16" Diameter Control Rods

Item Code 500558 is a rotating swivel block connector assembly for joining control rod to control arm. It allows 360° rotation.



Item Code 500569 serves to connect two control rods to one control arm and also allows 360° rotation.

Item Code 14316 swivel connector allows 360° rotation. It provides a 20° flex from the swivel center line to accommodate an angular approach of a linkage control rod, but immediacy of response is less positive than Item Code 14264 (at right).

Item Code 14264 is a non-flexing swivel connector that allows 360° rotation around swivel center line. It provides a more positive positioning and immediacy of response than Item Code 14316 (at left).

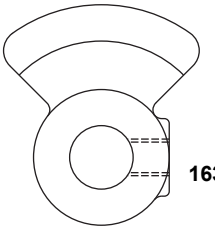
Swivel Connectors for 1/2" Diameter Control Rods

Item Code 500542 is a swivel block that rotates 360°.

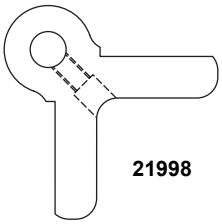
Item Code 500543 is a single ball swivel that rotates 360° while permitting an angular approach of rod toward control arm.

Item Code 500544 is a double ball swivel that connects two rods to one control arm. Allows angular approach of rod to arm, rotates 360°.

Cams for High/Low Fire Microswitch



1631/1632



21998

Item Code	Description
1631-1	3/8" Shaft
1631-3	10 mm Shaft
1631-2	1/2" Shaft
1632-1	5/8" Shaft
21998	10 mm Shaft

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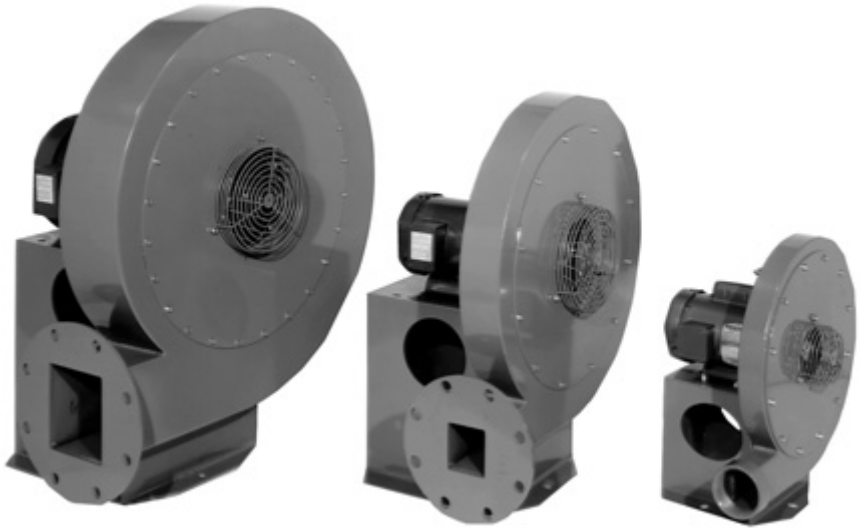
Eclipse SMJ Series
Turbo Blowers

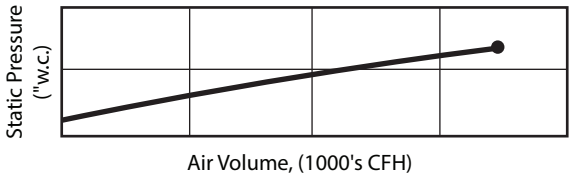
Data sheet Edition 10.15

Version 1



elster
Thermal Solutions

Performance curves are listed here for each of the blowers found in Bulletin 610.



The vertical axis of each curve shows static pressure in inches water column ("w.c.) corrected to an air inlet temperature of 70° F and a barometric pressure of 29.92" H.G.
The horizontal axis of each chart shows air volume in thousands of CFH.
For each motor horsepower, two operating points are marked:
Nominal rating for a TEFC motor or motor with 1.0 service factor:
and rating for an open motor or TEFC motor with service factor.

Curves are arranged numerically by blower catalog number.

Catalog number example:

4 Digit

SMJ 4610–1/3 &1/2

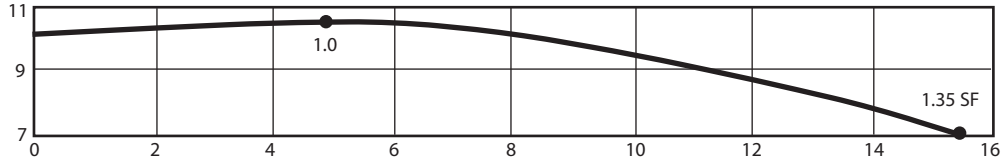
- Horsepower(s)
- Impeller diameter, 10"
- Inlet diameter, 6"
- Outlet size, 4"

6 Digit

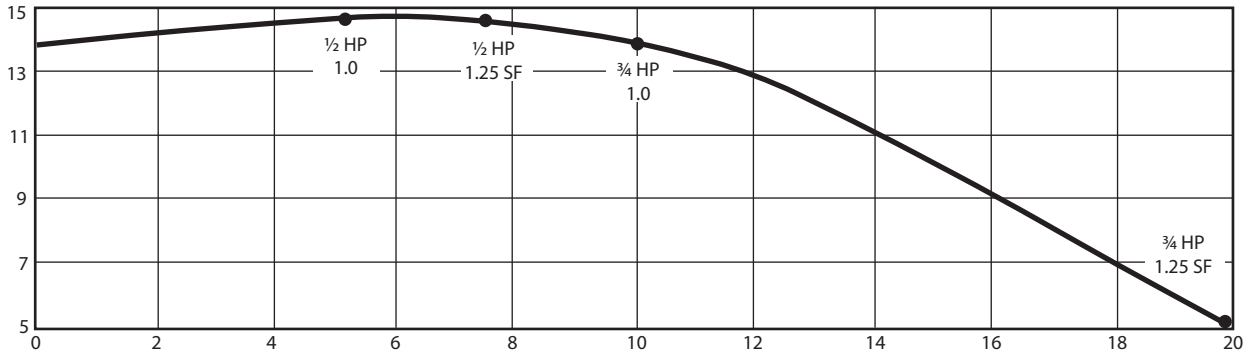
SMJ 101016–7-1/2

- Horsepower(s)
- Impeller diameter, 16"
- Inlet diameter, 10"
- Outlet size, 10"

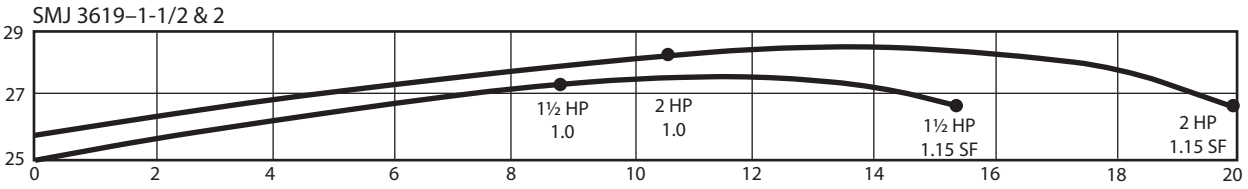
SMJ 3412–1/3



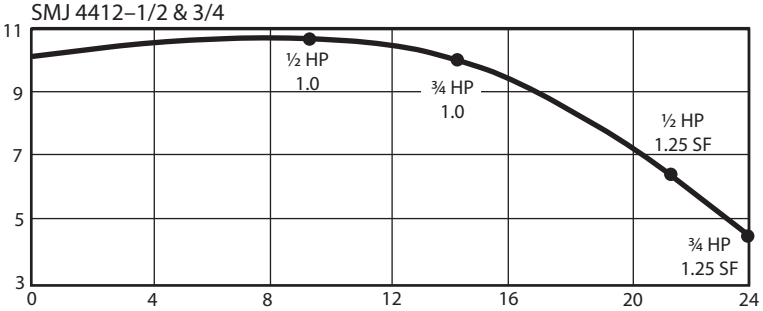
SMJ 3414–1/2 & 3/4



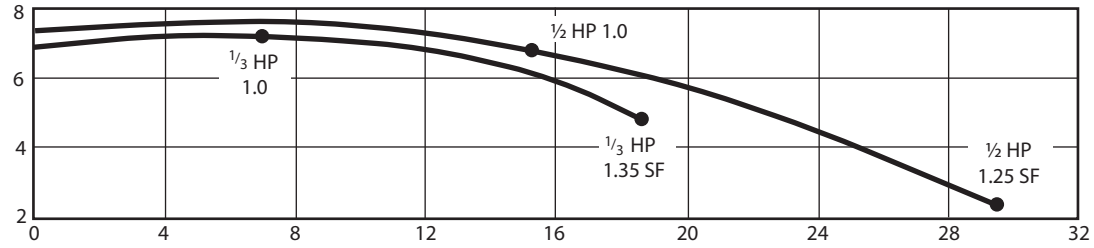
SMJ 3619–1-1/2 & 2



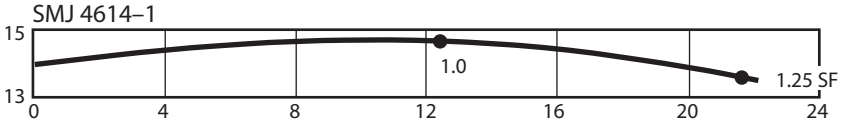
SMJ 4412–1/2 & 3/4



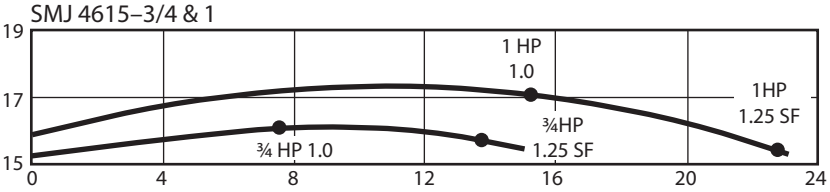
SMJ 4610–1/3 & 1/2



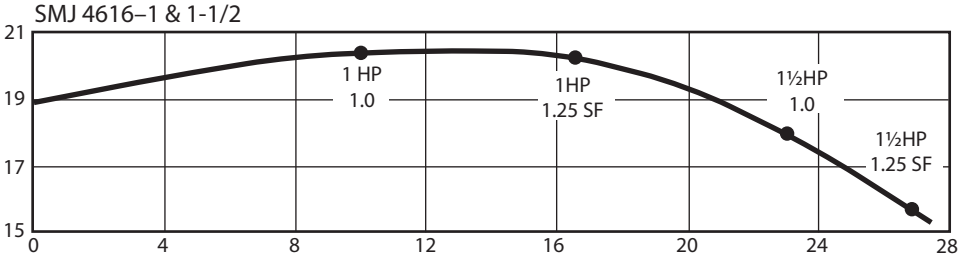
SMJ 4614–1



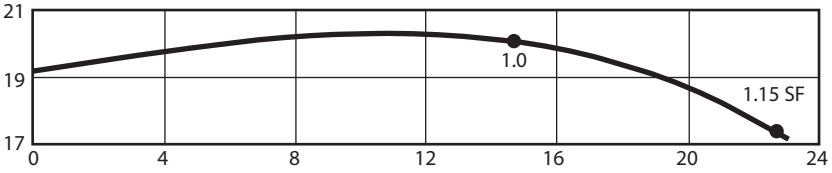
SMJ 4615–3/4 & 1



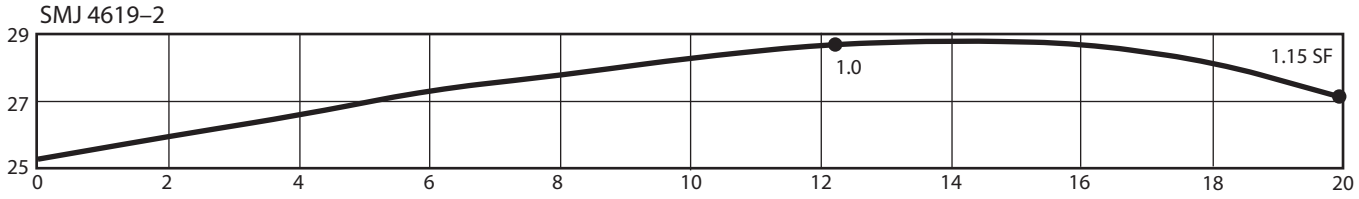
SMJ 4616–1 & 1-1/2



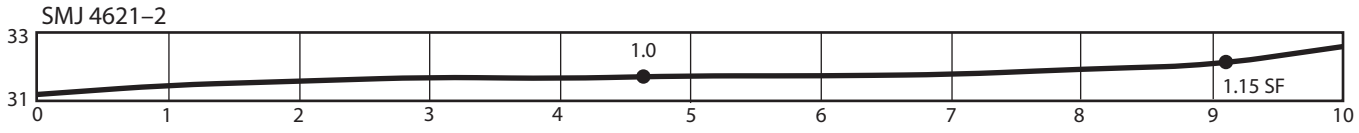
SMJ 4617–1-1/2



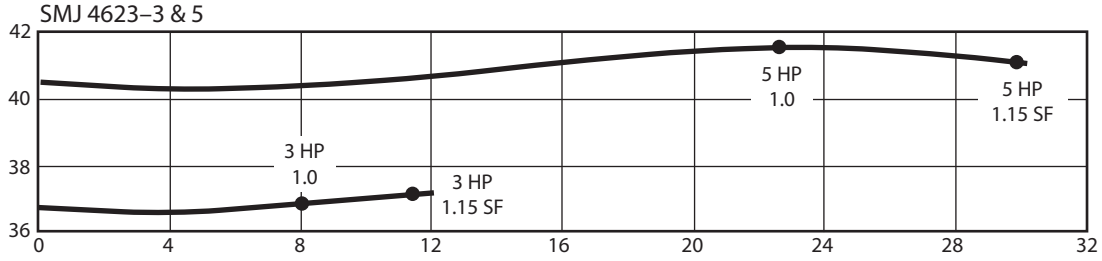
SMJ 4619–2



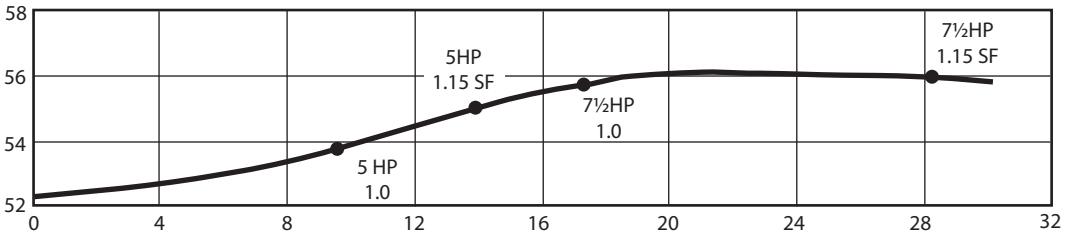
SMJ 4621–2



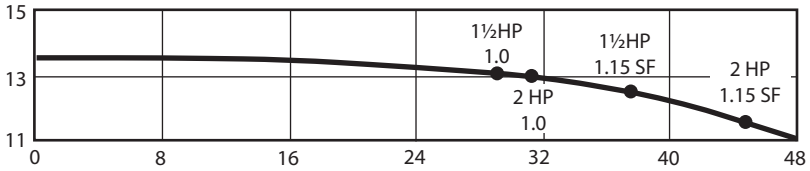
SMJ 4623–3 & 5



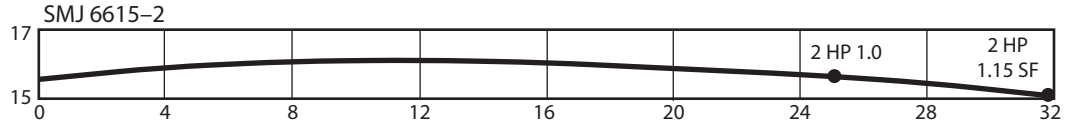
SMJ 4628–5 & 7-1/2



SMJ 6614–1-1/2 & 2

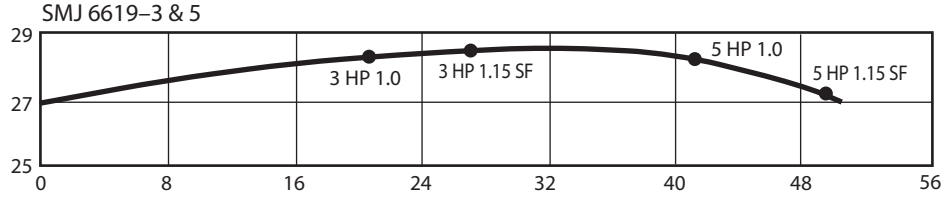


SMJ 6615–2

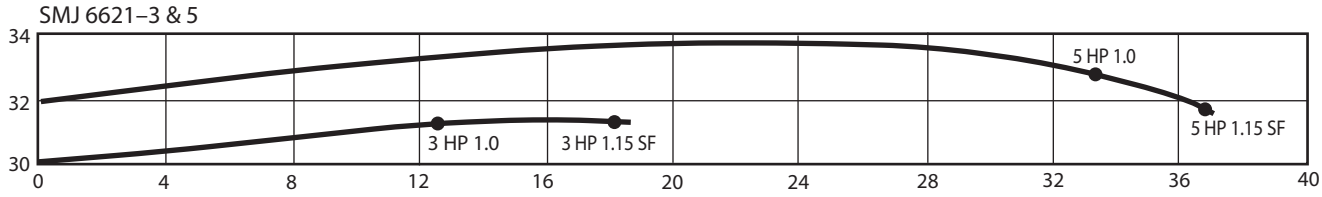


SMJ 6617–2 & 3

SMJ 6619–3 & 5



SMJ 6621–3 & 5



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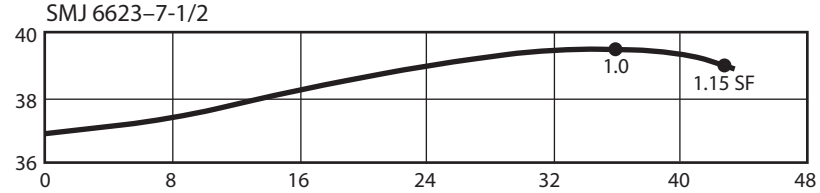
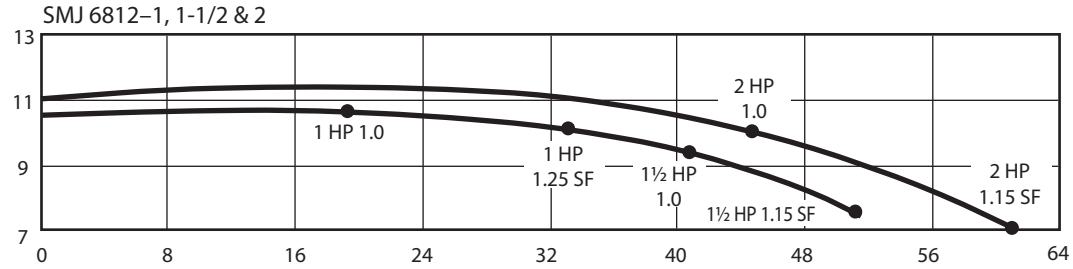
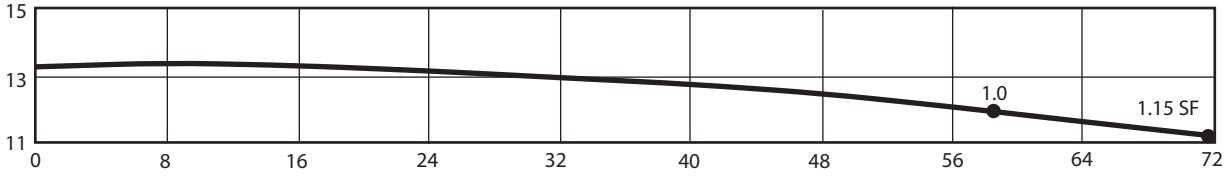


SMJ 6812–1, 1-1/2 & 2



SMJ 8813–3



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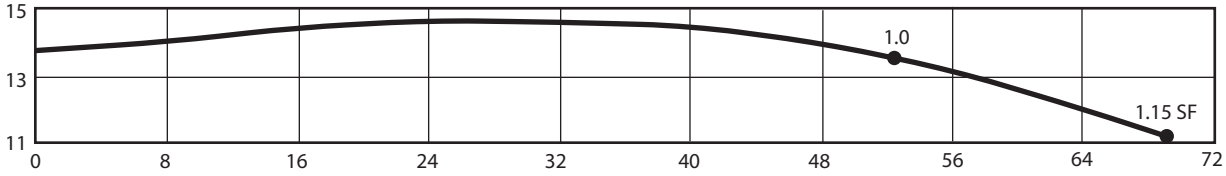
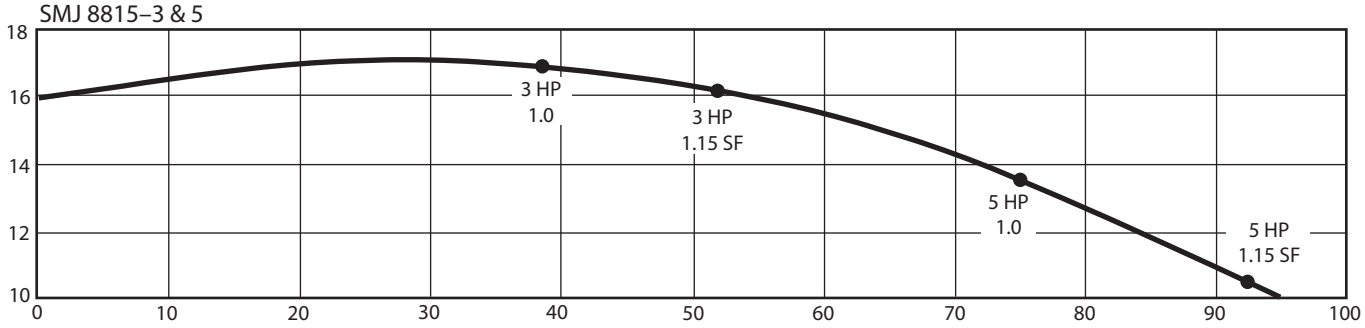


SMJ 8815–3 & 5



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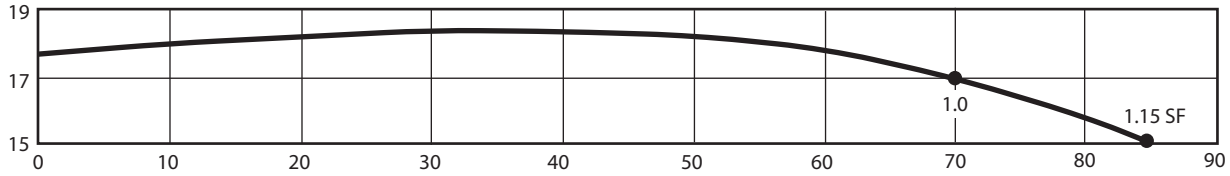
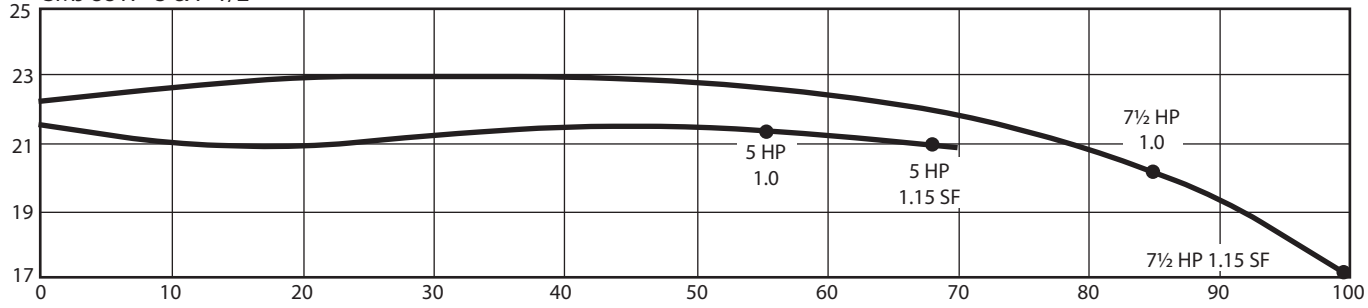
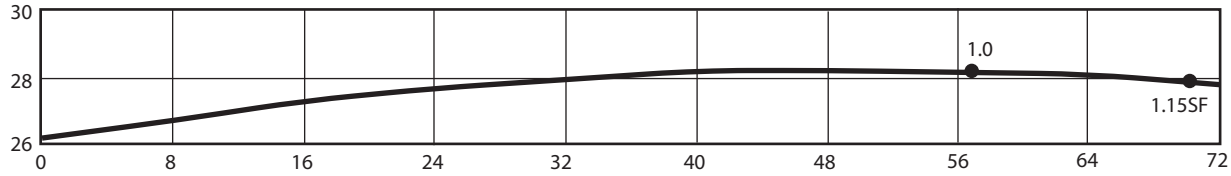


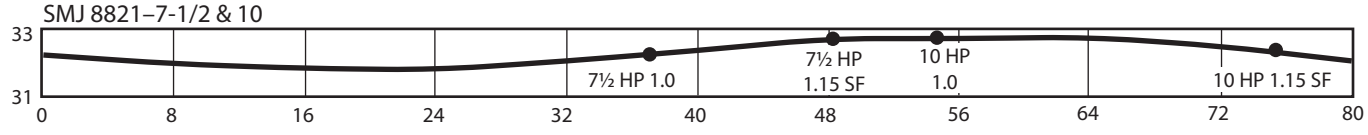
SMJ 8817–5 & 7-1/2



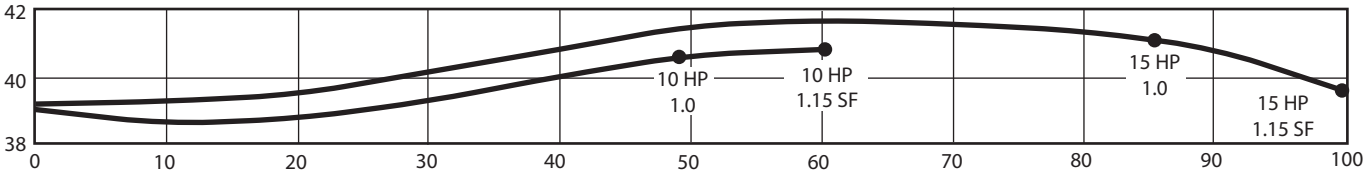
SMJ 8819–7-1/2



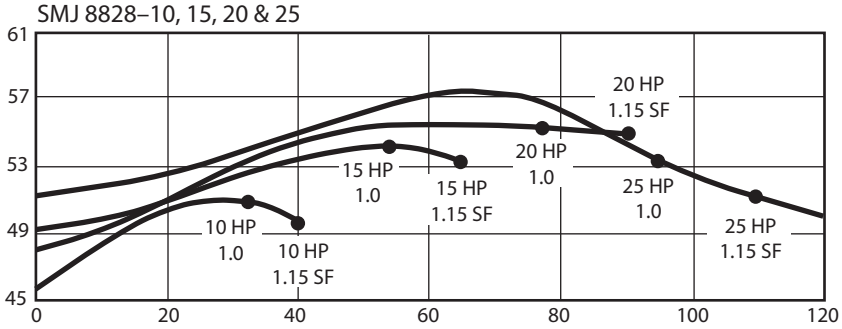
SMJ 8821–7-1/2 & 10



SMJ 8823–10 & 15



SMJ 8828–10, 15, 20 & 25



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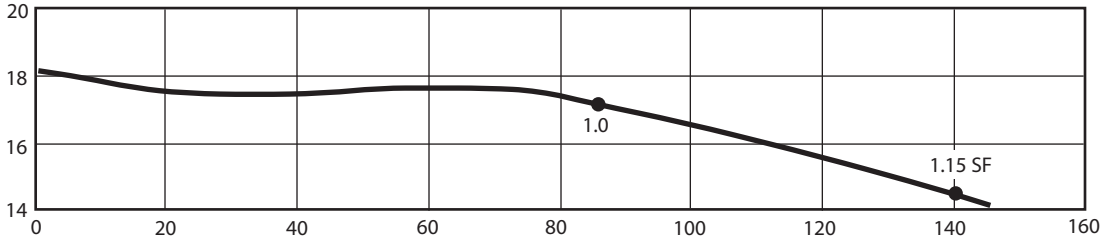
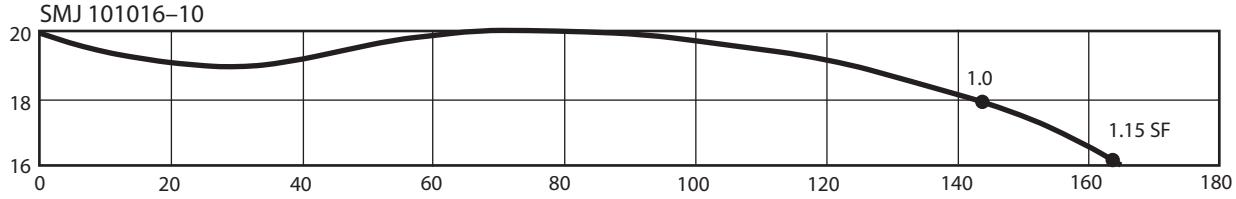


SMJ 101016–10



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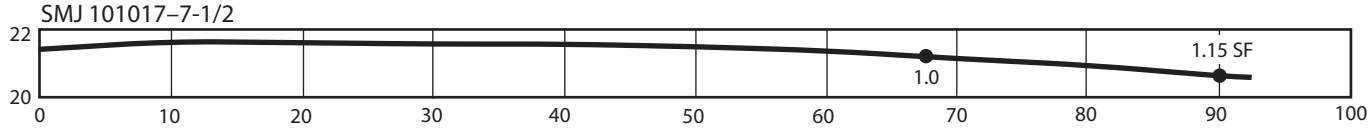

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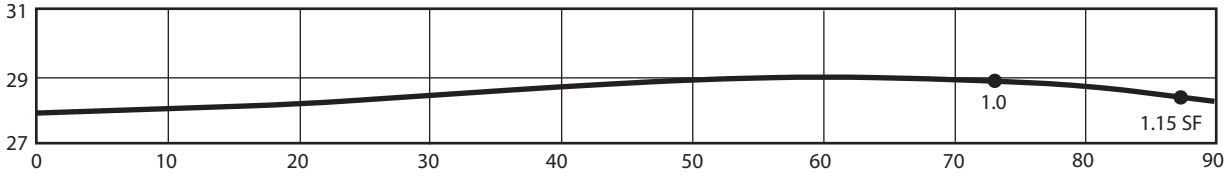
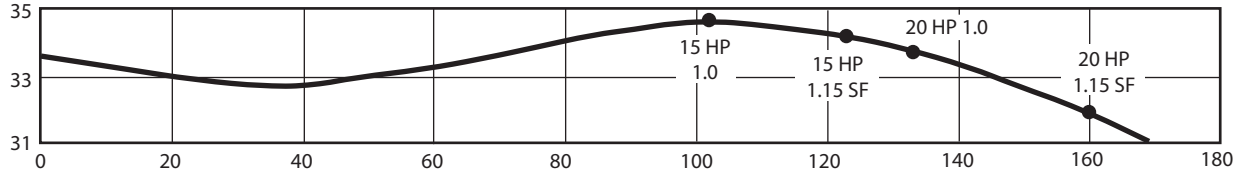
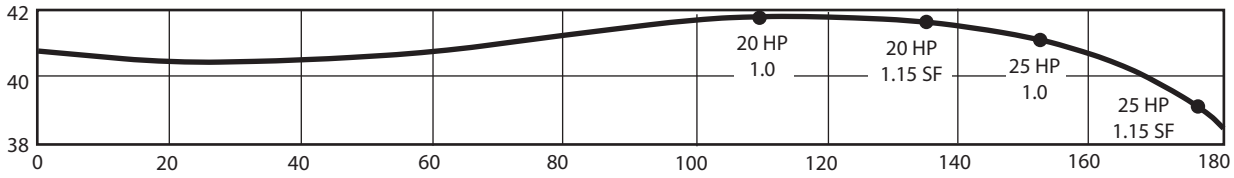


SMJ 101021–15 & 20



SMJ 101023–20 & 25



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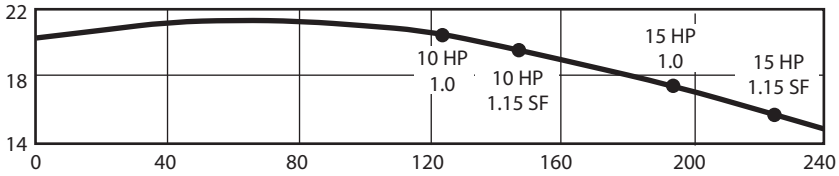

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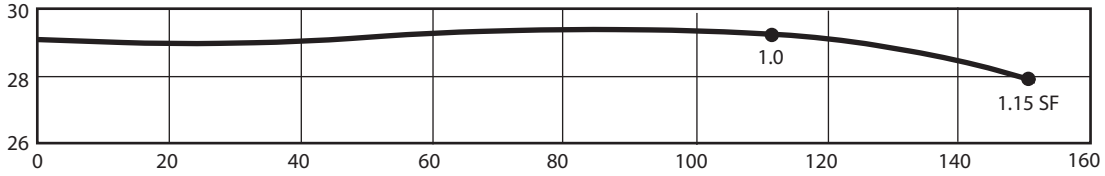

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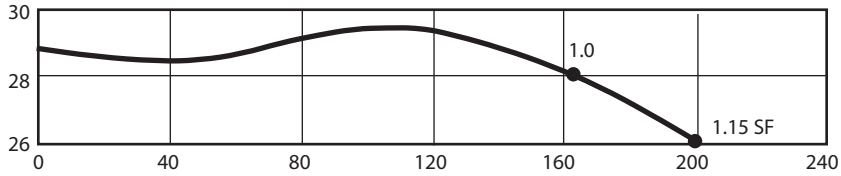

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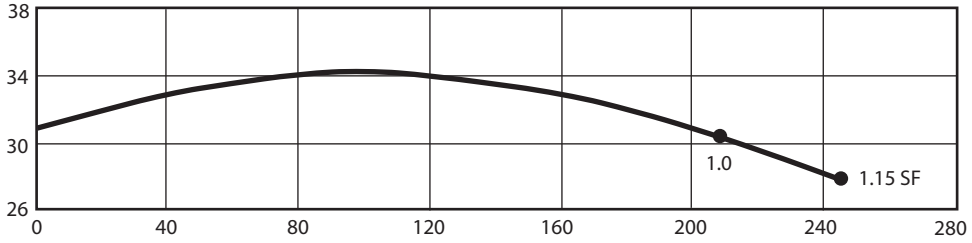

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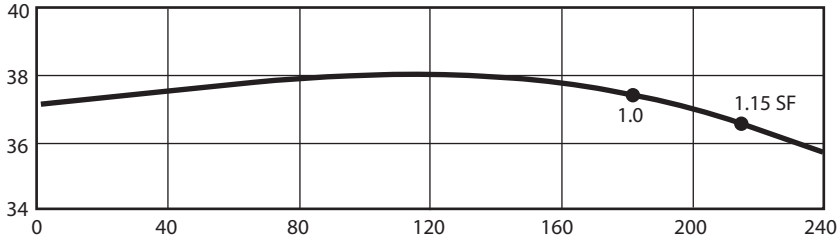

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OMG SERIES ORIFICE METERS

AIR & NATURAL GAS FLOW CAPACITY (SCFH)

100 – 200 Series Threaded / Weld-In
3/8" Through 1 ½" Pipe Size

Pipe Size	OMG Model Number	Orifice Bore Size	Air				Natural Gas			
			0.5" w.c.ΔP	1" w.c.ΔP	3" w.c.ΔP	5" w.c.ΔP	0.5" w.c.ΔP	1" w.c.ΔP	3" w.c.ΔP	5" w.c.ΔP
3/8"	103	0.197	24	33	57	73	30	43	73	94
		0.232	33	46	80	103	42	60	103	132
		0.266	44	62	107	137	57	80	137	177
		0.307	61	85	147	189	78	110	189	244
		0.350	84	118	203	261	108	152	262	336
1/2"	105	0.232	32	45	78	100	41	58	100	129
		0.266	42	60	103	133	55	77	133	171
		0.317	61	86	149	191	79	111	192	247
		0.368	85	120	206	265	109	154	266	342
		0.423	118	166	286	368	152	214	369	475
3/4"	107	0.273	44	62	107	137	57	80	137	177
		0.324	62	87	151	194	80	113	194	250
		0.379	86	121	208	268	110	156	269	346
		0.437	116	163	282	363	149	211	363	468
		0.508	162	228	394	507	208	294	508	654
		0.585	221	322	555	714	294	415	716	921
1"	110	0.324	61	86	149	192	79	111	192	247
		0.384	86	122	210	270	111	157	271	349
		0.452	120	170	293	378	155	219	378	487
		0.523	163	230	398	513	211	297	513	661
		0.613	231	326	562	724	297	420	725	935
		0.715	331	467	806	1039	427	602	1040	1340
1 ¼"	112	0.456	120	170	294	379	155	219	379	488
		0.533	165	233	403	520	213	301	520	671
		0.630	233	330	570	734	301	425	735	947
		0.735	324	457	790	1018	418	590	1020	1314
		0.850	447	632	1092	1407	577	815	1409	1816
		0.986	641	905	1564	2015	827	1168	2018	2600
1 ½"	115	0.533	164	232	400	516	212	299	517	666
		0.635	234	331	572	737	302	427	738	951
		0.744	325	459	794	1023	419	593	1024	1320
		0.867	450	636	1100	1417	581	821	1419	1829
		1.005	626	885	1530	1972	808	1142	1974	2544
		1.156	881	1245	2151	2771	1137	1607	2776	3576

Notes:
1. Orifice Bore Size Equals the Orifice Plate Inside Diameter. All Bore Sizes In Inches. Pipe Size Equals Schedule 40 Pipe.
2. Capacity Based On 60°F @ 1 psig Upstream Pressure. Natural Gas Specific Gravity At 0.60; Air Specific Gravity At 1.0.
3. 1__ Model Number Designates NPT Threaded Connection. 2__ Model Number Designates Weld-In Connection.
4. All Flow Rates At Standard Barometric Pressure: 29.92" Hg (Sea Level)
5. Design Capacity Is Based On 3" W.C.ΔP.

(OVER)

In accordance with Hauck's commitment to Total Quality Improvement, Hauck reserves the right to change the specifications of products without prior notice.

OMG SERIES ORIFICE METERS

AIR & NATURAL GAS FLOW CAPACITY (SCFH)

100 – 200 Series Threaded / Weld-In
2" Through 6" Pipe Size

Pipe Size	OMG Model Number	Orifice Bore Size	Air				Natural Gas			
			0.5" w.c.ΔP	**1" w.c.ΔP**	**3" w.c.ΔP**	**5" w.c.ΔP**	**0.5" w.c.ΔP**	**1" w.c.ΔP**	**3" w.c.ΔP**	**5" w.c.ΔP**
2"	120	0.640	238	335	577	743	307	432	744	958
		0.754	334	470	808	1039	430	605	1041	1339
		0.875	455	640	1100	1415	586	824	1417	1823
		1.034	650	914	1568	2016	836	1175	2019	2597
		1.203	911	1278	2192	2817	1170	1644	2822	3629
		1.375	1250	1753	3003	3858	1605	2253	3865	4967
2 ½"	125	0.754	330	465	800	1030	425	599	1031	1328
		0.890	464	652	1123	1445	597	840	1447	1863
		1.048	651	916	1576	2027	838	1180	2030	2613
		1.236	926	1302	2237	2877	1191	1676	2881	3707
		1.423	1266	1778	3053	3925	1628	2288	3932	5056
		1.625	1730	2428	4164	5353	2223	3123	5362	6894
3"	130/230	0.894	462	651	1122	1444	595	839	1446	1863
		1.056	649	914	1575	2027	836	1178	2030	2614
		1.252	923	1300	2237	2879	1188	1674	2884	3712
		1.452	1262	1776	3056	3932	1625	2287	2938	5068
		1.688	1753	2466	4238	5452	2256	3174	5460	7026
		1.963	2483	3489	5993	7706	3193	4491	7719	9929
4"	240	1.261	919	1295	2234	2877	1184	1670	2881	3710
		1.470	1258	1773	3056	3935	1621	2285	3941	5075
		1.722	1748	2462	4242	5461	2251	3173	5468	7041
		2.029	2479	3491	6009	7734	3192	4497	7746	9971
		2.345	3418	4810	8275	10648	4400	6195	10665	13725
		2.691	4731	6655	11440	14716	6088	8568	14741	18966
6"	260	1.735	1729	2439	4211	5425	2229	3146	5432	6998
		2.067	2470	3484	6011	7743	3184	4493	7754	9988
		2.437	3468	4890	8434	10863	4469	6305	10878	14011
		2.879	4924	6941	11965	15408	6344	8947	15429	19870
		3.314	6685	9420	16231	20897	8611	12140	20928	26946
		3.850	9423	13272	22856	29419	12135	17101	29466	37931
		4.388	13055	18381	31638	40712	16809	23679	40781	52484

Notes:

1. Orifice Bore Size Equals the Orifice Plate Inside Diameter. All Bore Sizes In Inches. Pipe Size Equals Schedule 40 Pipe.
2. Capacity Based On 60°F @ 1 psig Upstream Pressure. Natural Gas Specific Gravity At 0.60; Air Specific Gravity At 1.0.
3. 1__ Model Number Designates NPT Threaded Connection. 2__ Model Number Designates Weld-In Connection.
4. All Flow Rates At Standard Barometric Pressure: 29.92" Hg (Sea Level)
5. Design Capacity Is Based On 3" W.C.ΔP.

In accordance with Hauck's commitment to Total Quality Improvement, Hauck reserves the right to change the specifications of products without prior notice.

OMG SERIES ORIFICE METERS

AIR FLOW CAPACITY (SCFH)

2000 Series Weld – In
8" Through 16" Pipe Size

Pipe Size	OMG Model No.	Orifice Bore Size	Air Flow						
			0.5" w.c.ΔP	1" w.c.ΔP	3" w.c.ΔP	5" w.c.ΔP	6" w.c.ΔP	8" w.c.ΔP	10" w.c.ΔP
8"	2080	3.272	6247	8814	15209	19591	22441	24715	27586
		3.874	8921	12582	21702	27951	30588	35255	39348
		4.562	12772	18006	31044	39975	43744	50412	56260
		5.268	17891	25215	43452	55942	61210	70530	78701
		5.788	22737	32038	55193	71044	77729	89552	99915
10"	2100	4.095	9773	13791	23806	30670	33567	38695	43193
		4.944	14550	20527	35418	45623	49929	57551	64235
		5.770	20453	28846	49754	64078	70122	80817	90195
		6.514	27159	38295	66030	85025	93038	107215	119644
		7.241	35497	50041	86255	111049	121505	139999	156208
12"	2120	4.90	13975	19727	34061	43886	48033	55372	61810
		5.80	19934	28131	48557	62555	68462	78916	88087
		6.90	29179	41166	71029	91489	100122	115398	128795
		7.80	38839	54781	94492	121692	133166	153166	171265
		8.70	51176	72168	124444	160237	175332	202031	225432
14"	2140	5.70	18893	26673	46064	59354	64964	74892	83602
		6.80	27396	38668	66258	86009	94133	108511	121123
		8.00	39120	55202	95273	122728	134313	154813	172791
		9.10	52796	74486	128517	165526	181139	208761	232980
		10.10	68642	96825	167015	215075	235345	271197	302621
16"	2160	6.50	24550	34665	59874	77153	84446	97354	108678
		7.80	36040	50876	87849	113188	123881	142807	159408
		9.20	51776	73073	126139	162499	177841	204990	228799
		10.50	70505	99487	171686	221141	242004	278914	311276
		11.60	90725	127999	220835	284403	311213	358633	400196

Notes:
1. Orifice Bore Size Equals The Orifice Plate Inside Diameter. All Bore Sizes In Inches. Pipe Size Is A Nominal Pipe ID.
2. Capacity Based On 60°F @ 1 psig Upstream Pressure. Air Specific Gravity 1.0.
3. All Flow Rates At Standard Barometric Pressure 29.92" Hg (Sea Level)
4. Design Capacity Is Based On 3" W.C.ΔP.

In accordance with Hauck's commitment to Total Quality Improvement, Hauck reserves the right to change the specifications of products without prior notice.

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OMG SERIES ORIFICE METERS

AIR FLOW CAPACITY (SCFH)

2000 Series Weld – In
18" Through 28" Pipe Size

Pipe Size	OMG Model No.	Orifice Bore Size	Air Flow						
			0.5" w.c.ΔP	1" w.c.ΔP	3" w.c.ΔP	5" w.c.ΔP	6" w.c.ΔP	8" w.c.ΔP	10" w.c.ΔP
18"	2180	7.3	30947	43701	75491	97282	106479	122757	137037
		8.7	44758	63191	109131	140616	153903	177420	198048
		10.3	64773	91430	157854	203368	222573	256557	286362
		11.8	88932	125508	216631	279049	305381	351967	392813
		13.0	113553	160233	276502	356120	389700	449095	501154
20"	2200	8.2	39066	55170	95311	122826	134439	154993	173025
		9.7	55639	78562	135691	174845	191370	220615	246268
		11.5	80801	114066	196959	253758	277725	320137	357332
		13.1	109495	154548	266793	343682	376119	433507	483823
		14.4	138946	196092	338437	435913	477025	549746	613486
22"	2220	9.0	47037	66433	114778	147916	161903	186659	208377
		10.7	67703	95604	165141	212800	232913	268510	299736
		12.6	96855	136743	236144	304256	332997	383856	428461
		14.3	129987	183492	316802	408124	446651	514815	574580
		15.9	169696	239514	413428	532523	582754	671602	749477
24"	2240	9.8	55748	78740	136051	175337	191918	221266	247012
		11.6	79477	112238	193892	249856	273475	315276	351944
		13.8	116254	164144	283487	365266	399773	460837	514391
		15.7	157028	221682	382772	493124	539680	622046	694264
		17.4	203519	287280	495930	638812	699076	805668	899096
28"	2280	11.4	75388	106490	184022	237168	259599	299302	334134
		13.6	109262	154318	266618	343589	376073	433565	483996
		16.0	155929	220195	380353	490102	536413	6183645	690239
		18.2	210302	296938	512805	660689	723079	833464	930249
		20.2	273180	385674	665913	857829	938775	1081954	1207453

Notes:

1. Orifice Bore Size Equals The Orifice Plate Inside Diameter. All Bore Sizes In Inches. Pipe Size Is A Nominal Pipe ID.
2. Capacity Based On 60°F @ 1 psig Upstream Pressure Air Specific Gravity 1.0.
3. All Flow Rates At Standard Barometric Pressure: 29.92" Hg (Sea Level).
4. Design Capacity Is Based On 3" W.C.ΔP.

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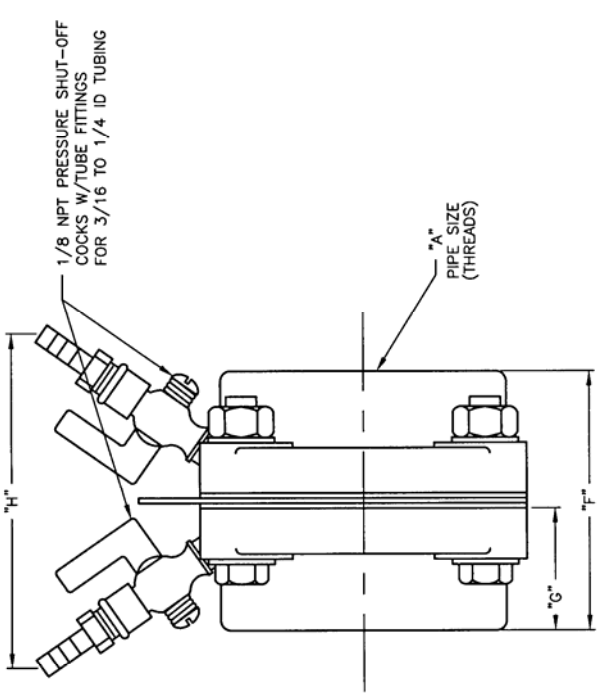
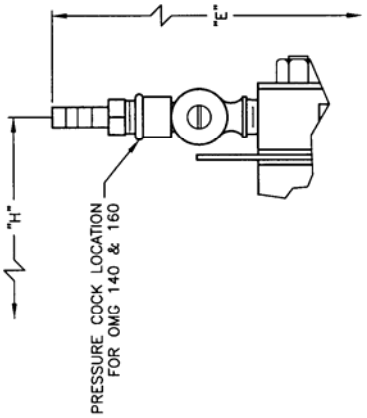
OMG SERIES ORIFICE METERS

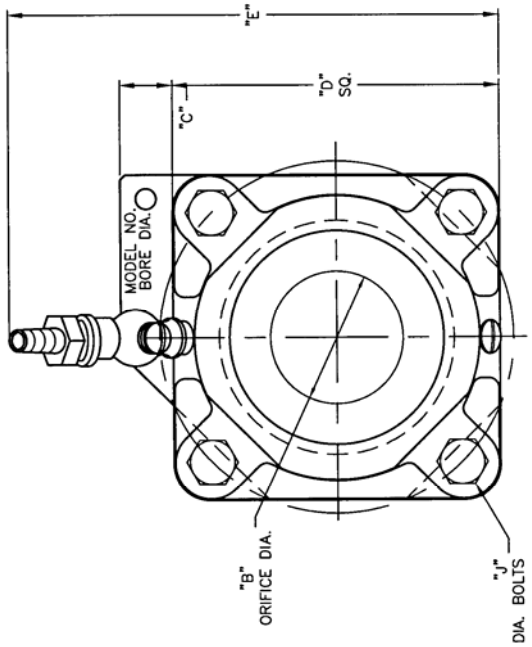
100 SERIES THREADED DESIGN





NOTE: 1. MIN. AND MAX. ORIFICE DIA. BASED ON BETA RATIO (ORIFICE DIA./SCH. 40 PIPE I.D.) RANGE OF 0.2–0.75; BETA RATIO OUTSIDE THIS RANGE IS NOT RECOMMENDED (CONSULT ENGINEERING).
2. USE ASME MFC–3M–1989 CORNER TAP EQUATIONS TO CALCULATE FLOW CAPACITIES.

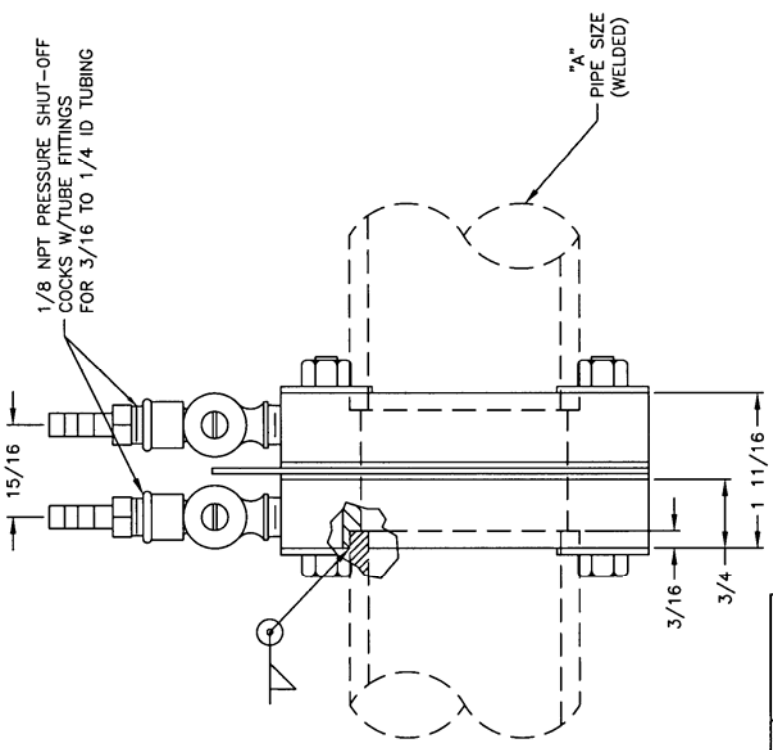
X1497
(NOT TO SCALE)

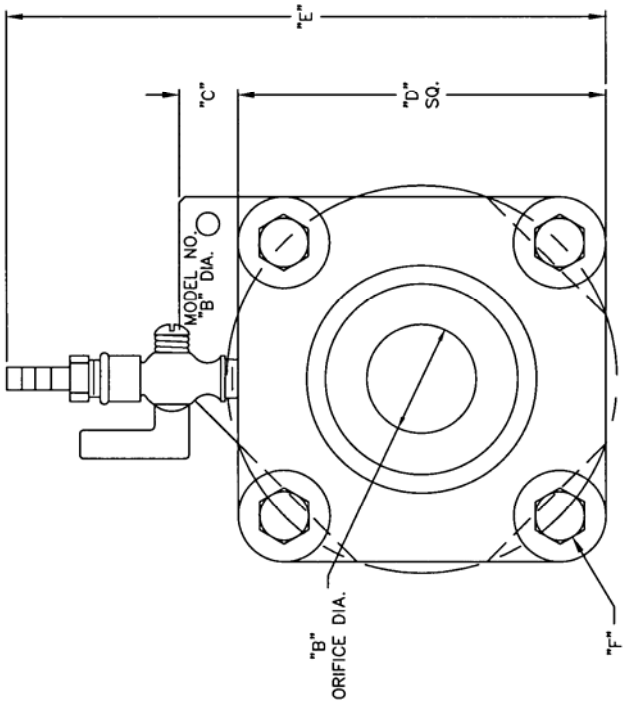


MODEL NUMBER	PIPE SIZE "A" NPT	ORIFICE "B" DIA. MIN.	ORIFICE "B" DIA. MAX.	"C"	"D"	"E"	"F"	"G"	"H"	"J"
OMG 103	3/8	0.099	0.370	9/16	2 7/16	4	2 7/16	1 1/8	5	5/16
OMG 105	1/2	0.124	0.467	9/16	2 7/16	4	2 7/16	1 1/8	5	5/16
OMG 107	3/4	0.165	0.618	9/16	2 7/16	3 15/16	2 7/16	1 1/8	5	5/16
OMG 110	1	0.210	0.787	9/16	2 7/16	4	2 7/16	1 1/8	4 7/8	5/16
OMG 112	1 1/4	0.276	1.035	5/8	3 1/8	4 11/16	2 13/16	1 5/16	5 3/16	3/8
OMG 115	1 1/2	0.322	1.208	5/8	3 1/8	4 3/4	2 13/16	1 5/16	5 1/16	3/8
OMG 120	2	0.413	1.550	3/4	4	5 9/16	2 15/16	1 3/8	5 5/16	3/8
OMG 125	2 1/2	0.494	1.852	3/4	4	5 15/16	3 3/16	1 1/2	4 1/16	3/8
OMG 130	3	0.614	2.301	7/8	5 1/2	7 1/16	4 3/16	2	5 11/16	3/8
OMG 140	4	0.805	3.020	7/8	5 1/2	8	4 7/16	2 1/8	15/16	3/8
OMG 160	6	1.213	4.549	1	8	10 1/2	4 3/16	2	1 11/16	1/2

In accordance with Hauck's commitment to Total Quality Improvement, Hauck reserves the right to change the specifications of products without prior notice.

DIMENSIONS
OMG 200 SERIES WELD-IN DESIGN





NOTES: 1. MIN. AND MAX. ORIFICE DIA. BASED ON BETA RATIO (ORIFICE DIA./SCH. 40 PIPE I.D.) RANGE OF 0.2–0.75.; BETA RATIO OUTSIDE THIS RANGE IS NOT RECOMMENDED (CONSULT ENGINEERING).
2. USE ASME MFC–3M–1989 CORNER TAP EQUATIONS TO CALCULATE FLOW CAPACITIES.

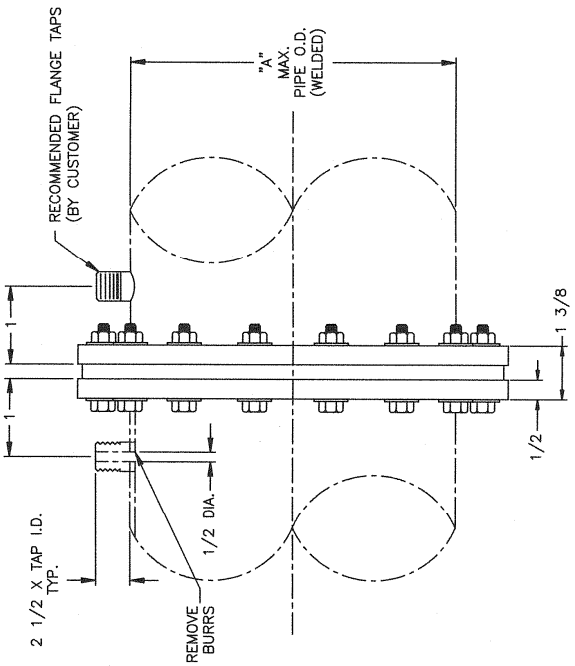
X1499
(NOT TO SCALE)

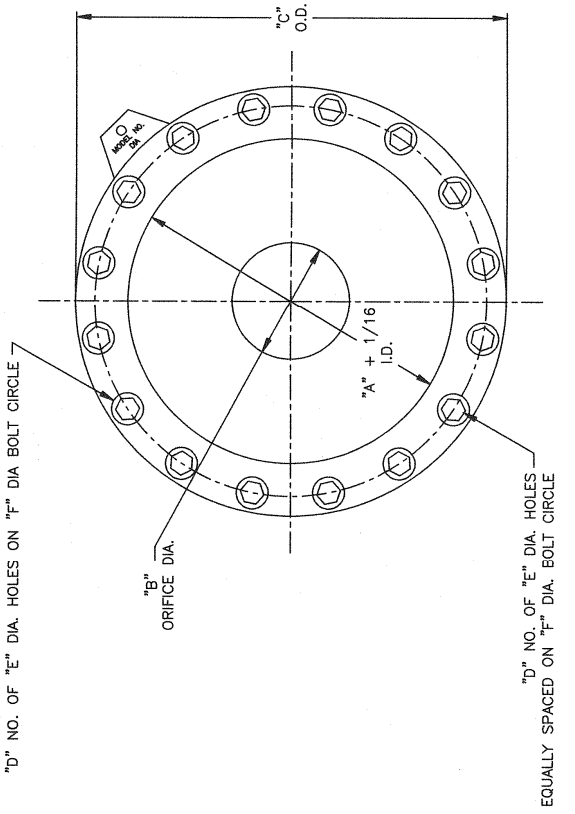
MODEL NUMBER	PIPE SIZE "A"	ORIFICE "B" DIA.		"C"	"D"	"E"	"F"
		MIN.	MAX.				
OMG 207	3/4	0.165	0.618	9/16	2 7/16	4 15/16	5/16
OMG 210	1	0.210	0.787	9/16	2 7/16	4 15/16	5/16
OMG 212	1 1/4	0.276	1.035	5/8	3 1/8	5 5/8	3/8
OMG 215	1 1/2	0.322	1.208	5/8	3 1/8	5 5/8	3/8
OMG 220	2	0.413	1.550	3/4	4	6 1/2	3/8
OMG 225	2 1/2	0.494	1.852	3/4	4	6 1/2	3/8
OMG 230	3	0.614	2.301	7/8	5 1/2	8	3/8
OMG 240	4	0.805	3.020	7/8	5 1/2	8	3/8
OMG 260	6	1.213	4.549	1	8	10 1/2	1/2

In accordance with Hauck's commitment to Total Quality Improvement, Hauck reserves the right to change the specifications of products without prior notice.

OMG SERIES ORIFICE METERS

2000 SERIES AIR ONLY WELD-IN DESIGN





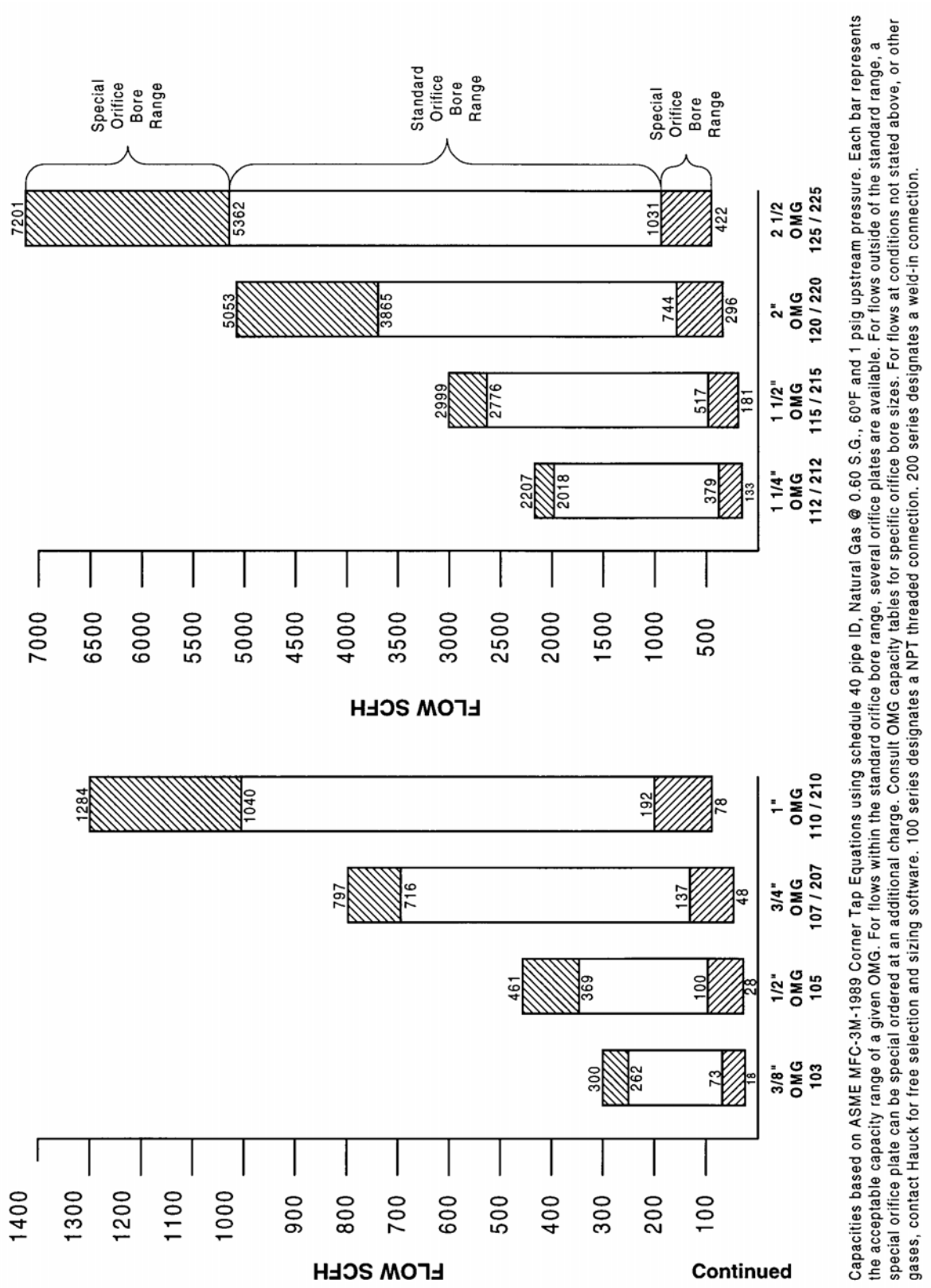
NOTES:
1. OMG 2000 SERIES DESIGNED FOR LOW PRESSURE AIR SERVICE ONLY.
2. MIN. AND MAX. ORIFICE DIA. BASED ON BETA RATIO (ORIFICE DIA./NOMINAL PIPE I.D.) RANGE OF 0.2–0.75; BETA RATIO OUTSIDE THIS RANGE IS NOT RECOMMENDED (CONSULT ENGINEERING).
3. USE ASME MFC–3M–1989 FLANGE TAP EQUATIONS TO CALCULATE FLOW CAPACITIES

X3305
(NOT TO SCALE)

MODEL NUMBER	NOMINAL PIPE I.D.	MAX. PIPE O.D. "A"	ORIFICE "B" DIA. MIN.	ORIFICE "B" DIA. MAX.	"C"	"D"	"E"	"F"
OMA 2080	8	8 1/4	1.600	6.000	11	8	19/32	10
OMA 2100	10	10 1/4	2.000	7.500	14	12	3/4	12 1/4
OMA 2120	12	12 1/4	2.400	9.000	16	12	3/4	14 1/4
OMA 2140	14	14 1/4	2.800	10.50	18	12	3/4	16 1/4
OMA 2160	16	16 1/4	3.200	12.00	21 1/4	16	3/4	19 1/4
OMA 2180	18	18 1/4	3.600	13.50	23 1/4	16	3/4	21 1/4
OMA 2200	20	20 1/4	4.000	15.00	25 1/4	20	3/4	23 3/8
OMA 2220	22	22 1/4	4.400	16.50	28 1/4	20	3/4	26
OMA 2240	24	24 1/4	4.800	18.00	30	20	3/4	27 3/4
OMA 2280	28	28 1/4	5.600	21.00	34	28	7/8	31 3/4

In accordance with Hauck's commitment to Total Quality Improvement, Hauck reserves the right to change the specifications of products without prior notice.

OMG SELECTION CHART
NATURAL GAS (SCFH) @ 3" W.C. ΔP



Continued

Capacities based on ASME MFC-3M-1989 Corner Tap Equations using schedule 40 pipe ID, Natural Gas @ 0.60 S.G., 60°F and 1 psig upstream pressure. Each bar represents the acceptable capacity range of a given OMG. For flows within the standard orifice bore range, several orifice plates are available. For flows outside of the standard range, a special orifice plate can be special ordered at an additional charge. Consult OMG capacity tables for specific orifice bore sizes. For flows at conditions not stated above, or other gases, contact Hauck for free selection and sizing software. 100 series designates a NPT threaded connection. 200 series designates a weld-in connection.

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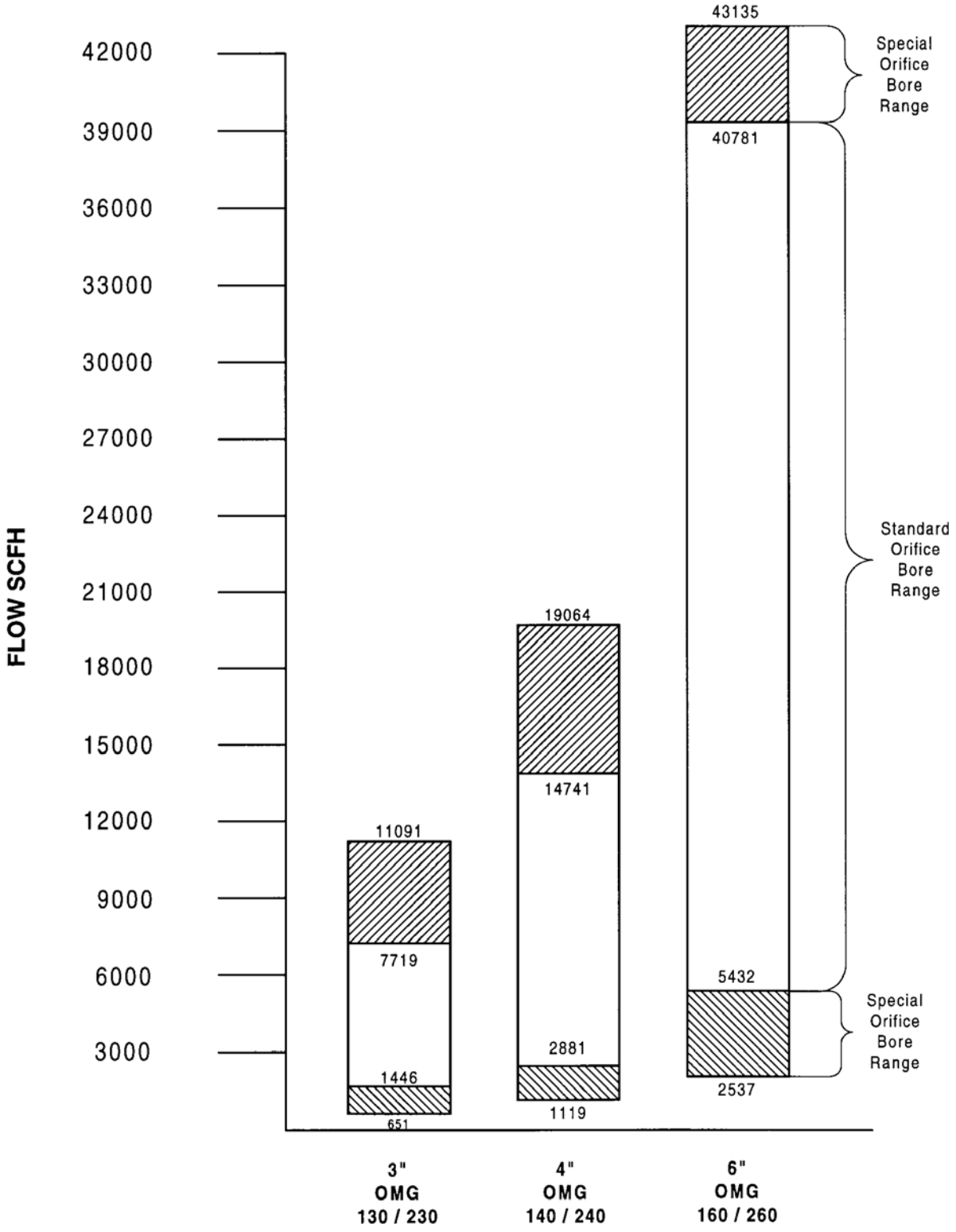
OMG SELECTION CHART
NATURAL GAS (SCFH) @ 3" W.C. ΔP



Capacities based on ASME MFC-3M-1989 Corner Tap Equations using schedule 40 pipe ID, Natural Gas @ 0.6 S.G., 60°F and 1 psig upstream pressure. Each bar represents the acceptable capacity range of a given OMG. For flows within the standard orifice bore range, several orifice plates are available. For flows outside of the standard range, a special orifice plate can be special ordered at an additional charge. Consult OMG capacity tables for specific orifice bore sizes. For flows at conditions not stated above, or other gases, contact Hauck for free selection and sizing software. 100 series designates a NPT threaded connection. 200 series designates a weld-in connection.

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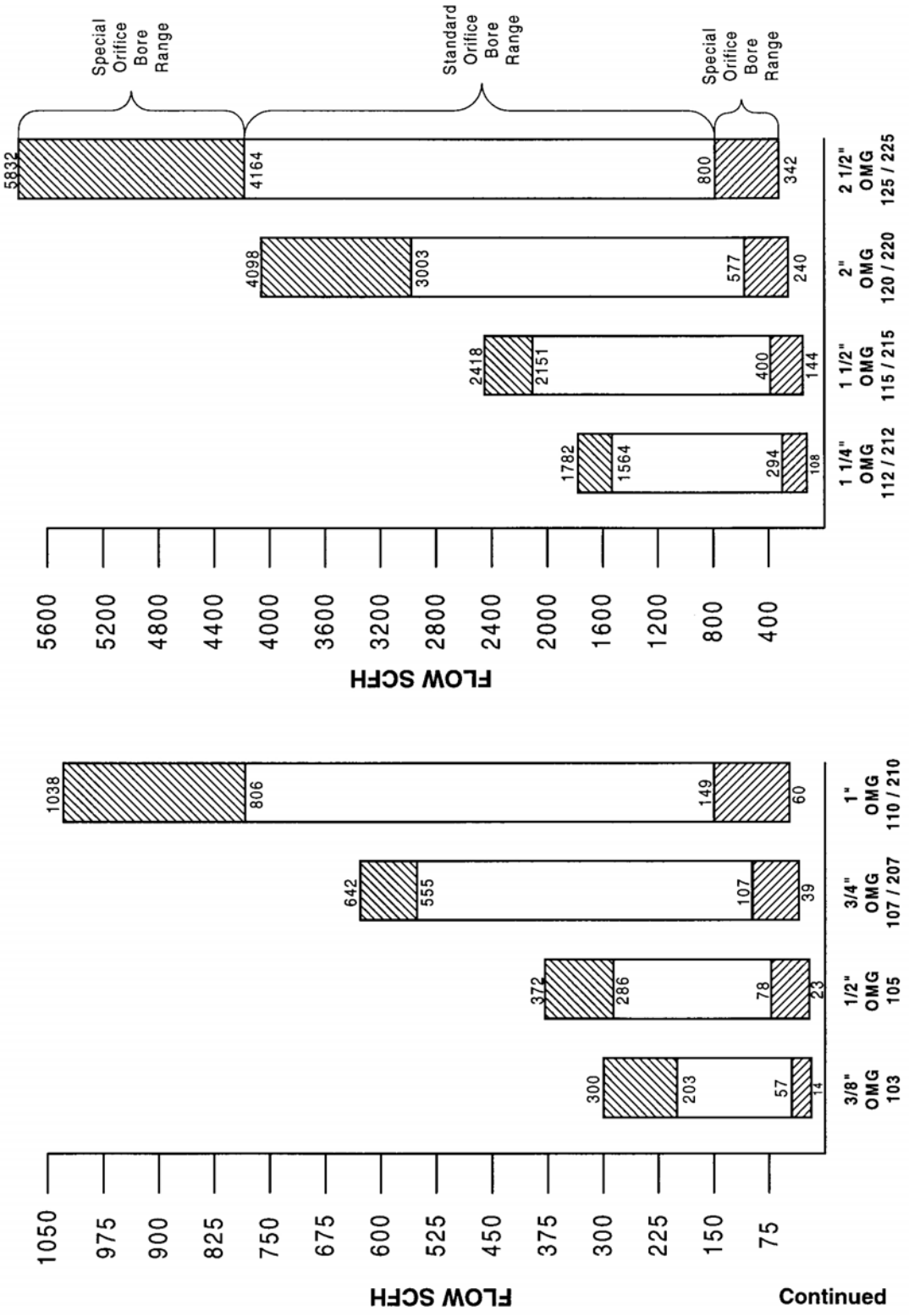
OMG SELECTION CHART
AIR (SCFH) @ 3" W.C. ΔP

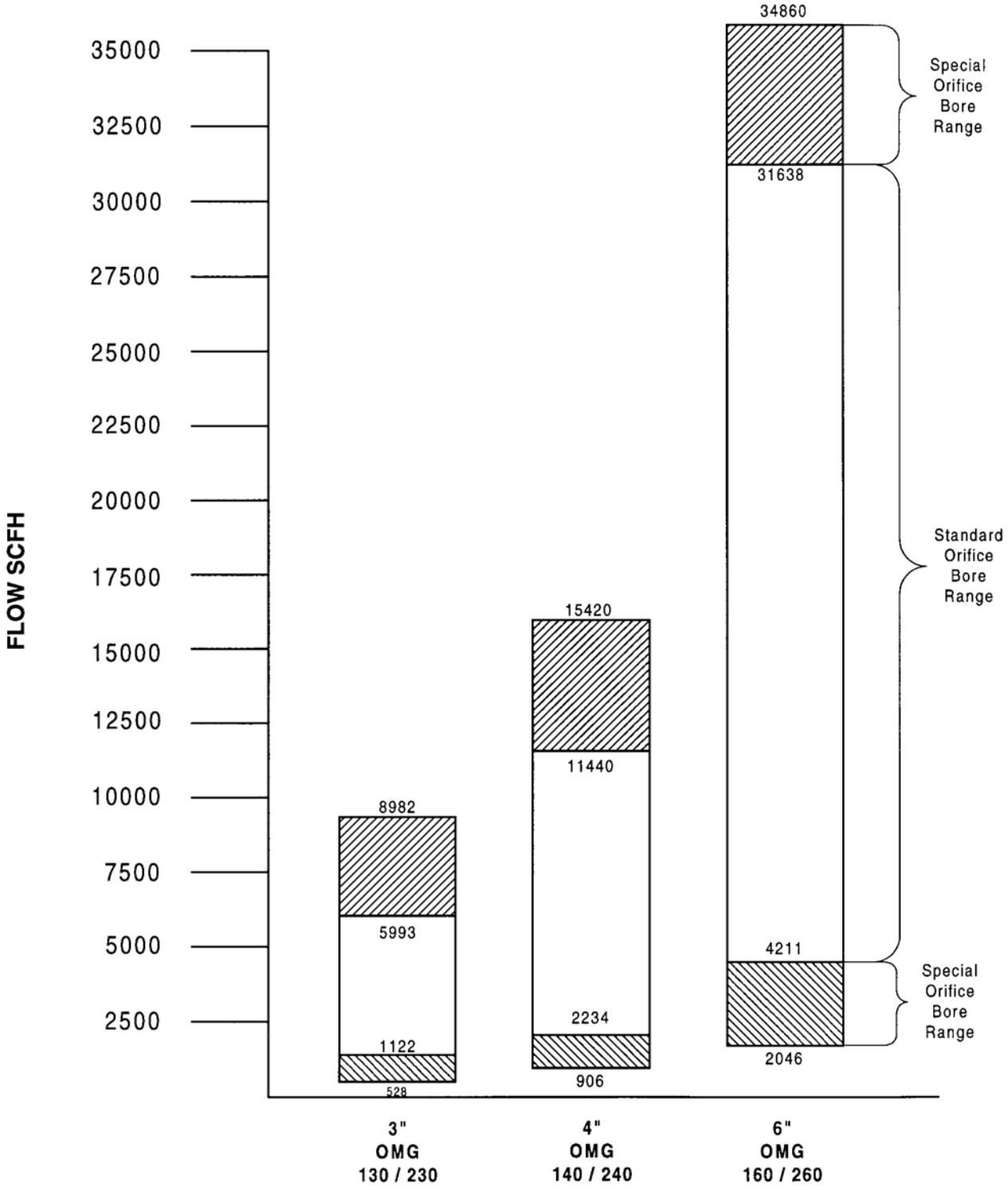


Capacities based on ASME MFC-3M-1989 Corner Tap Equations using schedule 40 pipe ID, Air @ 1.0 S.G., 60°F and 1 psig upstream pressure. Each bar represents the acceptable capacity range of a given OMG. For flows within the standard orifice bore range, several orifice plates are available. For flows outside of the standard range, a special orifice plate can be special ordered at an additional charge. Consult OMG capacity tables for specific orifice bore sizes. For flows at conditions not stated above, or other gases, contact Hauck for free selection and sizing software. 100 series designates a NPT threaded connection. 200 series designates a weld-in connection.

Continued

In accordance with Hauck's commitment to Total Quality Improvement, Hauck reserves the right to change the specifications of products without prior notice.

OMG SELECTION - AIR (SCFH) @ 3" W.C. ΔP



Capacities based on ASME MFC-3M-1989 Corner Tap Equations using schedule 40 pipe ID, Air @ 1.0 S.G., 60°F and 1 psig upstream pressure. Each bar represents the acceptable capacity range of a given OMG. For flows within the standard orifice bore range, several orifice plates are available. For flows outside of the standard range, a special orifice plate can be special ordered at an additional charge. Consult OMG capacity tables for specific orifice bore sizes. For flows at conditions not stated above, or other gases, contact Hauck for free selection and sizing software. 100 series designates a NPT threaded connection. 200 series designates a weld-in connection.

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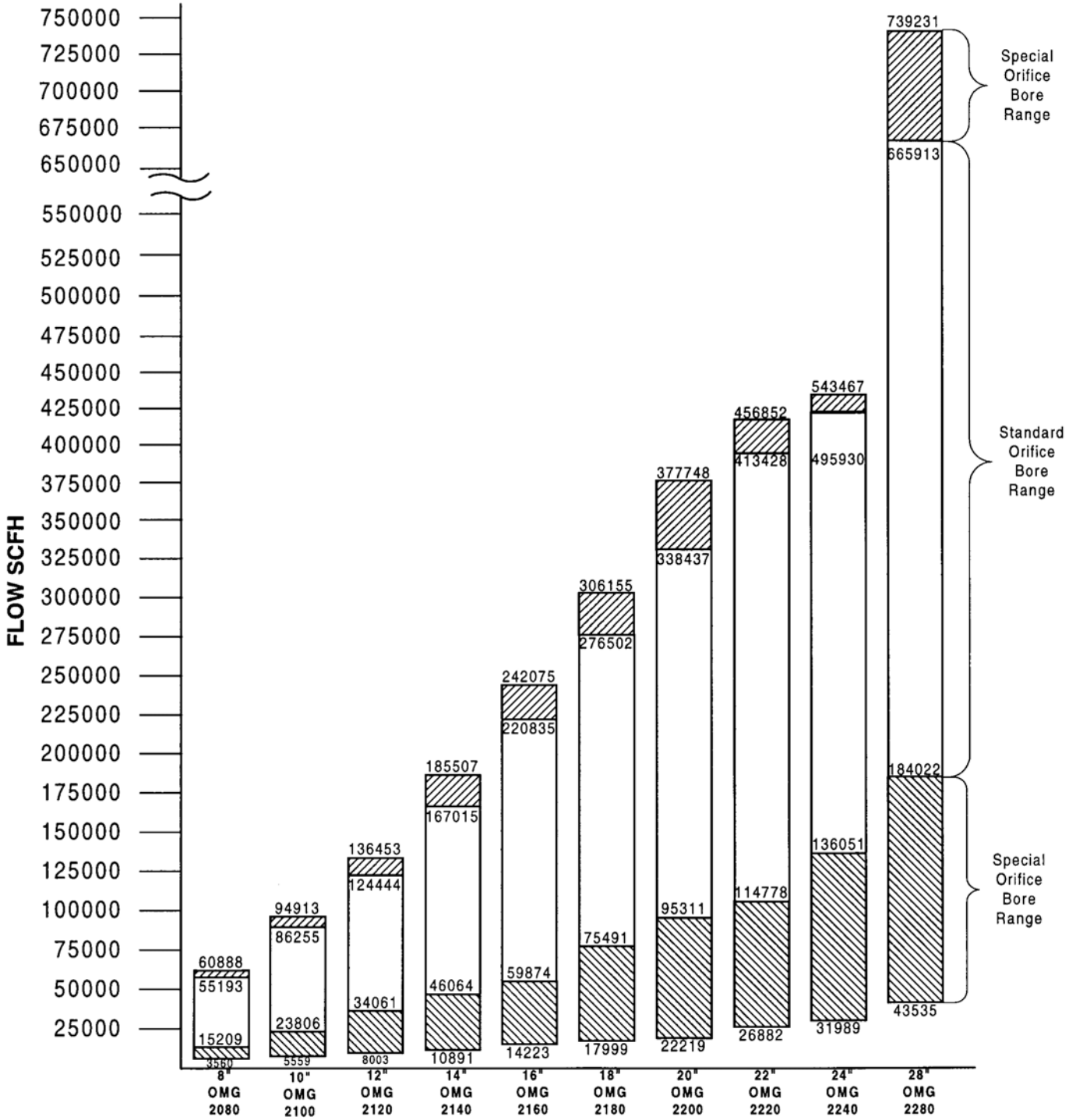
OMG SELECTION CHART
2000 SERIES – AIR SERVICE (SCFH) @ 3" W.C. ΔP



Capacities based on ASME MFC-3M-1989 Flange Tap Equations using schedule 40 pipe ID, Air @ 1.0 S.G., 60°F and 1 psig upstream pressure. Each bar represents the acceptable capacity range of a given OMG. For flows within the standard orifice bore range, several orifice plates are available. For flows outside of the standard range, a special orifice plate can be special ordered at an additional charge. Consult OMG capacity tables for specific orifice bore sizes. For flows at conditions not stated above, or other gases, contact Hauck for free selection and sizing software.

In accordance with Hauck's commitment to Total Quality Improvement, Hauck reserves the right to change the specifications of products without prior notice.

OMG SERIES ORIFICE METERS

CORRECTING FOR CONDITIONS OUTSIDE CATALOG PARAMETERS

The capacities listed in OMG-2 and OMG-2.1 are cataloged at 60°F and 1 psig upstream pressure (specific gravity for air at 1.0, natural gas 0.60). When these conditions are not present, corrections must be applied to the catalog flow rate.

Upstream Pressure

For an upstream pressure other than 1 psig, obtain the appropriate correction factor for upstream pressure, then determine the corrected flow as shown.

(1) $$C_{press} = \sqrt{\frac{p_2 + 14.7}{p_1 + 14.7}}$$

C_{press} = Upstream Pressure Correction Factor
p_1 = Cataloged Upstream Pressure (1 psig)
p_2 = Actual Upstream Pressure (psig)
(Note: 1psig = 27.7" W.C.)

Table 1

p_2(psig)	0.5	1.0	1.5	2.0	3.0	4.0	5.0	10.0
C_{press}	.98	1.0	1.01	1.03	1.06	1.09	1.12	1.25

Multiply the pressure correction factor, C_{press}, by the flow determined from the OMG capacity table to obtain the corrected flow. For example, an OMG 115 with a .744" orifice has a capacity of 1024 SCFH natural gas at 3" ΔP. For a 2 psig upstream pressure, the corrected flow will be 1024 SCFH X 1.03 = 1055 SCFH.

Specific Gravity

For a specific gravity other than 0.60 (natural gas) or 1.0 (air), use FORMULA 2 or TABLE 2 to obtain the appropriate specific gravity correction factor, then determine the corrected flow as shown.

(2) $$C_{s.g.} = \sqrt{\frac{s.g._1}{s.g._2}}$$

$C_{s.g.}$ = Specific Gravity Correction Factor
$s.g._1$ = Specific Gravity - Natural Gas (0.60)
$s.g._2$ = Specific Gravity - Actual Gas

Table 2

Gas	Coke Oven	Natural	Air	Propane	Butane
s.g.	0.40	0.60	1.0	1.52	2.01
$C_{s.g.}$	1.22	1.0	.77	.63	.55

Multiply the s.g. correction factor, $C_{s.g.}$, by the flow determined from the OMG capacity table to obtain the corrected flow. For example, an OMG 115 with a .744" orifice has a capacity of 1024 SCFH natural gas at 3" ΔP. For propane, the corrected flow will be 1024 SCFH X 0.63 = 645 SCFH.

Temperature

For a gas temperature other than 60°F, use FORMULA 3 or TABLE 3 to obtain the appropriate temperature correction factor, then determine the correct flow as shown.

(3) $$C_{temp} = \sqrt{\frac{\text{Abs Temp}_1}{\text{Abs Temp}_2}}$$

C_{temp} = Temperature Correction Factor
Abs $\text{Temp}_1 = t_1 + 460$
Abs $\text{Temp}_2 = t_2 + 460$
t_1 = Catalog Temperature (60ºF)
t_2 = Actual Temperature (ºF)

Table 3

Temp., °F	50	60	80	100	150	200	250
C_{temp}	1.01	1.0	.98	.96	.92	.88	.85

Multiply the temp. correction factor, C_{temp}, by the flow determined from the OMG capacity table to obtain the corrected flow. For example, an OMG 115 with a .744" orifice has a capacity of 1024 SCFH natural gas at 3" ΔP. For a natural gas temperature at 100°F, the corrected flow is 1024 SCFH X .96 = 983 SCFH.

Note: If more than one correction factor is necessary, simply multiply the cataloged flow by each of the correction factors. For all the correction factors shown above, the corrected flow will be 1024 SCFH X 1.03 X 0.63 X 0.96 = 638 SCFH.

Non Cataloged Differential Pressure And/Or Flow
To calculate differential pressure and/or flow not listed in the OMG Capacity Tables, use the Square Root Law, Formula 4 and 5 as shown below.

(4)

$$Q_2 = Q_1 \sqrt{\frac{p_2}{p_1}}$$

Q_2 = Unknown Flow (SCFH) @ p
Q_1 = Catalog Flow (SCFH) @ p_1
p_2 = Actual Pressure $\triangle$ p @ Q_2
p_1 = Catalog Pressure $\triangle$ p @ Q_1

For example, an OMG 115 with a .744" orifice has a flow capacity of 1024 SCFH natural gas at 3" w.c. Δp, 1 psig upstream pressure and 60°F. To determine the flow at 4.3" w.c. Δp, plug the known variables listed below into formula 4.

Q_2 = unknown
Q_1 = 1024 SCFH
p_2 = 4.3" w.c. Δp
p_1 = 3.0" w.c. Δp

Solving Formula 4, for Q_2, the natural gas flow is 1226 SCFH.

(5)

$$p_2 = p_1 \left(\frac{Q_2}{Q_1} \right)^2$$

p_2 = $\triangle$ p @ Q_2 ("w.c.)
p_1 = Catalog $\triangle$ p @ Q_1 ("w.c.)
Q_2 = Desired Flow @ p_2 (SCFH)
Q_1 = Catalog Flow @ p_1 (SCFH)

For example, an OMG 115 with a .744" orifice has a flow capacity of 1024 SCFH natural gas at 3" w.c. Δp , 1 psig upstream pressure and 60°F. To determine the Δp for a flow of 775 SCFH, plug the known variables listed below into formula 5.

p_2 = unknown
p_1 = 3" w.c. Δp
Q_2 = 775 SCFH
Q_1 = 1024 SCFH

Solving Formula 5 for p_2, the natural gas Δp is 1.71" w.c.

SAMPLE OMG SELECTION PROBLEM
Select an orifice meter to measure 925 cubic feet per hour natural gas at 3" w.c. pressure drop across the orifice meter. The meter shall be installed in 1 ½" threaded, scheduled 40 pipe. The specific gravity of the gas is 0.60 with an upstream pressure of 1 psig and temperature of 60°F.

Using the capacity table OMG-2, select natural gas and 1 ½ " pipe size. Next, select the 115 model number for threaded connections. Then, look in the 3" w.c. Δp column and find the flow that is closest to 925 cubic feet per hour. In this case, the closest available orifice bore is 0.744" which has a natural gas flow capacity of 1024 SCFH.

Select an OMG-115 with a 0.744" orifice.

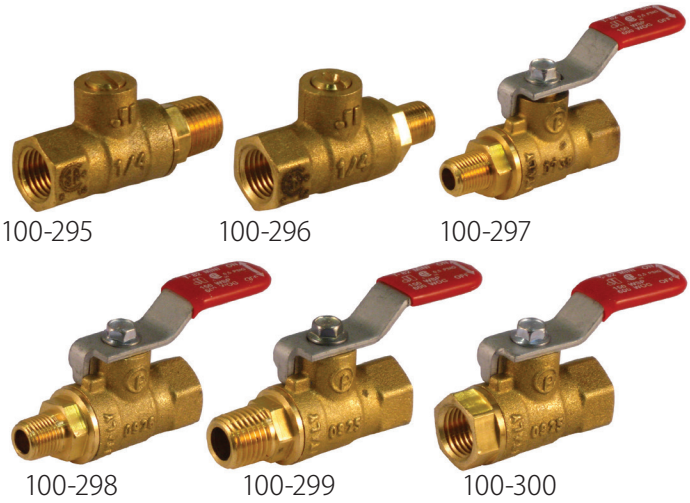
To calculate the actual Δp at 925 SCFH, use formula 5.

$$p_2 = 3\text{" w.c.} \left(\frac{925\ \text{SCFH}}{1024\ \text{SCFH}} \right)^2$$

$$p_2 = 2.45\text{" w.c.}$$

Brass Ball Valve

2 Piece • Full Port • Threaded Connection • Mini Valves • 600 WOG



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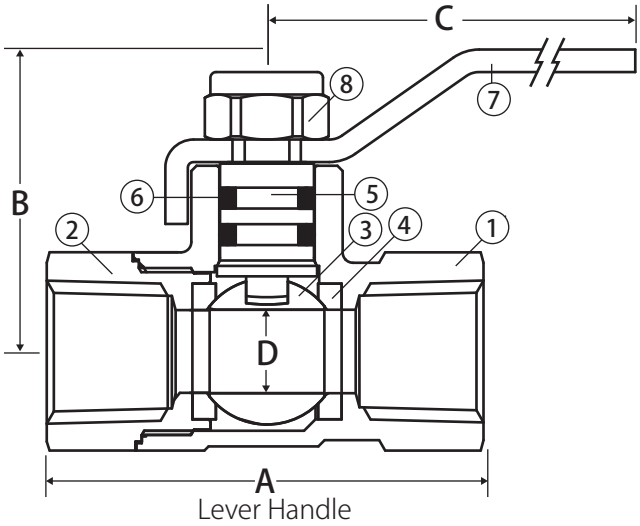
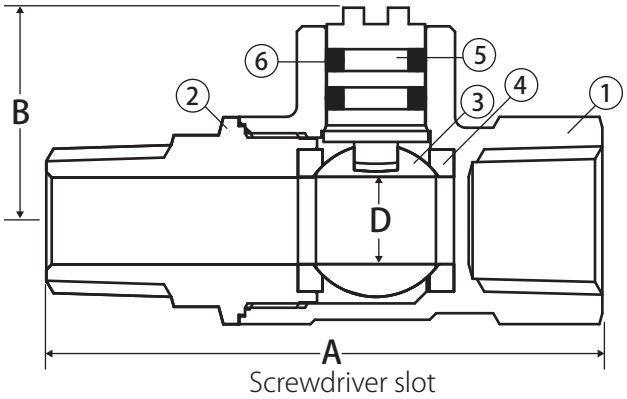
T-82-M



Lever Handle



Screwdriver slot

Features

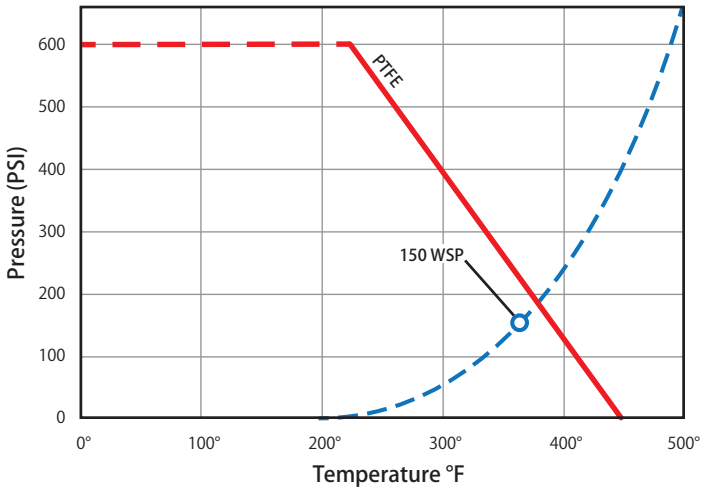
- Greater flow rate
- Blow-out proof stem
- 2 Viton® o-rings
- Large raised wrench flats
- 100% leak tested
- Made in Italy
- Leakproof stem - Lifetime Warranty

Approvals

- CSA Certified
  - ANSI Z21.15 (.5 PSIG) (1/4" - 2")
- MSS SP-110

Valve Seat Rating

600 WOG - 150 WSP



Material Specifications

No.	Part	Materials
1	Body	Brass - CW617N
2	End Connection	Brass - CW617N
3	Ball	Chrome Plated Brass - CW617N
4	Seat (2)	PTFE
5	Stem	Brass - CW614N
6	Stem O-ring (2)	Viton®
7	Handle*	Steel - Geomet® Plated
8	Handle screw*	Steel - Geomet® Plated

* Lever Handle Only

Dimensions

Part No.	Size	A	B	C	D
100-295	1/4"FIP x 1/4"MIP*	2.01	0.77	-	0.31
100-296	1/4"FIP x 1/8"MIP*	1.96	0.77	-	0.31
100-297	1/8" FIP x 1/8" MIP	1.96	1.14	1.69	0.31
100-298	1/4"FIP x 1/8"MIP	1.96	1.14	1.69	0.31
100-299	1/4" FIP x 1/4" MIP	2.01	1.14	1.69	0.31
100-300	1/4" FIP x 1/4" FIP	1.65	1.14	1.69	0.31

* Mini screwdriver slot handle

Note: Information subject to change without notice.

Jomar Valve • 7243 Miller Drive, Warren, MI 48092 • www.jomarvalve.com • phone: (586) 268-1220 • fax: (586) 979-8315

Allanson

Bringing Comfort to Indoor Environments

IGNITION TRANSFORMERS

AIR PURIFICATION

About Allanson

Allanson Environmental Electrics Group is a leading provider of innovative solutions to the heating and air conditioning industry for residential, industrial and commercial applications. As such, it combines best-in-class technology with proven engineering, design, and distribution services.

For over 80 years Allanson's Environmental Electrics have provided reliable quality products. Our product line ranges from transformers and electronic ignitors, to testing equipment and air purification systems. It also features the only universal ignitor in the industry – the OMNI®. We are committed to bringing comfort to indoor environments.

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OMNI® Universal Ignitor

2275-U

- The only universal ignitor
- Mounts onto any previously installed ignitor mounting plates
- Eliminates need for extra mounting plates
- Makes your service calls quick and easy
- Ships complete with required hardware

Model	Electrical Specifications
2270	12 Vdc, 14 kVrms Secondary, 22mA, Mid Point Ground
2275	120 Volt, 50/60 Hz, 17.5 kVpk Secondary, 45mA, Mid Point Ground
2280	230 Volt, 50/60 Hz, 17.5 kVpk Secondary, 45mA, Mid Point Ground

Service Kit

2275-KIT1 and **2275-KITCAN**
Electronic Ignition Transformer Service Kit

Includes:
- 2 OMNI® universal ignitors
- Selection of mounting plates
- Variety of contact terminals
- Tool box

	2275U OMNI®	2600 AERO	2601 BECKETT S	2502 WAYNE HI SPEED M/MH	2603 WAYNE E	2604 BECKETT A, AF, AFG	2605 CARLIN 99, 100, 101, Miser	2609 CARLIN 17.5 FR, 200, 201, 500, 501 CRD	54-766 CONTACT KIT	54-740 CONTACT KIT
2275-KIT1	2		1	1	1	1	1	1		1
2275-KITCAN	2	2				2	1		1	

*Contact Customer Service For Customized Kits

2275-456

Burner Manufacturer:
Aero
HV Terminal:
Zinc Plated Button
Hinge Location:
End Hinge

2275-589

Burner Manufacturer:
Grimsby
HV Terminal:
Cone Compression Spring
Hinge Location:
End Hinge

2275-605

Burner Manufacturer:
Beckett S
HV Terminal:
Large Spring Contact
Hinge Location:
End Hinge

2275-619

Burner Manufacturer:
Wayne HI Speed M/MH
HV Terminal:
Small Spring Contact
Hinge Location:
End Hinge

2275-620

Burner Manufacturer:
Wayne E
HV Terminal:
Zinc Plated Button
Hinge Location:
Side Hinge

2275-628G

Burner Manufacturer:
Beckett A, AF, AFG
HV Terminal:
Large Spring Contact
Hinge Location:
End Hinge
Includes:
Mounting Plate and Barrier Gaskets
Mounting Plate Clips

2275-629

Burner Manufacturer:
Carlin 17.5 FR, 200, 201, 500, 501 CRD
HV Terminal:
Finger Contact
Hinge Location:
Side Hinge

2275-630

Burner Manufacturer:
Carlin 99, 100, 101, Card Miser
HV Terminal:
Spring Clip Contact
Hinge Location:
End Hinge
Includes:
Mounting Plate Gasket

2275-633

Burner Manufacturer:
Carlin 601
HV Terminal:
Rajah Connector
Description:
Side Bracket Mounting
Includes:
2 Rajah Connector Caps

2275-637

Burner Manufacturer:
Wayne FH
HV Terminal:
Large Spring Contact
Hinge Location:
Side Hinge

2275-647

Burner Manufacturer:
Wayne HS
HV Terminal:
Small Spring Contact

2275-653

Burner Manufacturer:
Weil McLain, QB 180
HV Terminal:
1/4" Push On

2275-658

Burner Manufacturer:
Beckett AFII
HV Terminal:
High Voltage Cables with 1/4" Push On
Description:
Side Bracket Mounting

Model	Electrical Specifications
2270	12 Vdc, 14 kVrms Secondary, 22mA, Mid Point Ground
2275	120 Volt, 50/60 Hz, 17.5 kVpk Secondary, 45mA, Mid Point Ground
2280	230 Volt, 50/60 Hz, 17.5 kVpk Secondary, 45mA, Mid Point Ground

2721-068

HV Terminal: **Zinc Plated Button**
Hinge Location: **Side Hinge**

2721-069

Burner Manufacturer: **John Wood**
HV Terminal: **Large Spring Contact**
Hinge Location: **Side Hinge**

2721-252A

HV Terminal: **Zinc Plated Button**
Hinge Location: **Side Hinge**

2721-362A

HV Terminal: **Compression Cone Spring**

2721-368M

Burner Manufacturer: **Metro**
HV Terminal: **Zinc Plated Button**
Hinge Location: **End Hinge**

2721-409

Burner Manufacturer: **ABC Crane**
HV Terminal: **Zinc Plated Button**
Description: **Special Side Bracket**
Replaces: **Webster: 313-25AB73, France: LKR-2**

2721-411

Burner Manufacturer: **ABC**
HV Terminal: **Zinc Plated Button**
Hinge Location: **End Hinge**
Replaces: **Webster: 313-25AB59, France: 5LAY-20**

2721-448

Burner Manufacturer: **NU Way (Large Plate)**
HV Terminal: **Buss Bar Contact**
Hinge Location: **End Hinge**
Replaces: **Webster: 313-24AB80**

2721-452

Burner Manufacturer: **ABC D&LC**
HV Terminal: **Buss Bar Contact**
Hinge Location: **Side Hinge**
Replaces: **Webster: 313-26AB65, France: 5LAY-11**

2721-456

Burner Manufacturer: **Aero**
HV Terminal: **Zinc Plated Button**
Hinge Location: **End Hinge**
Replaces: **Webster: 313-24ABAER, France: 5LAY-56**

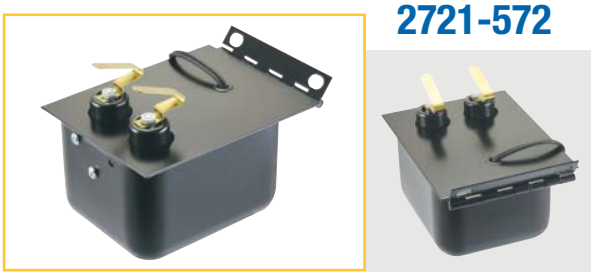
2721-457

Burner Manufacturer: **Acme Weatherall**
HV Terminal: **Zinc Plated Button**
Hinge Location: **Side Hinge**
Replaces: **Webster: 3-25AB-AH, France: LKE**

2721-558

Burner Manufacturer: **Conroy**
HV Terminal: **Compression Cone Spring**
Hinge Location: **Side Hinge**

2721-572



Burner Manufacturer: **NU Way (Small Plate)**
HV Terminal: **Buss Bar Contact**
Hinge Location: **End Hinge**
Replaces: **Webster: 313-24AB82**

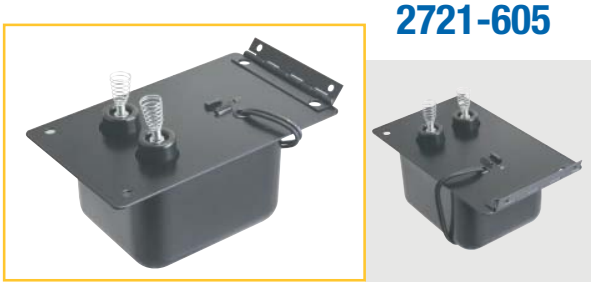
2721-576

HV Terminal: **Zinc Plated Button**
Hinge Location: **Special Side Hinge**

2721-589

Burner Manufacturer: **Grimsby**
HV Terminal: **Compression Cone Spring**
Hinge Location: **End Hinge**

2721-605



Burner Manufacturer: **Beckett S**
HV Terminal: **Large Spring Contact**
Hinge Location: **End Hinge**
Replaces: **Webster: 313-28AB92/313-28AB-BF, France: 5LAY-05**

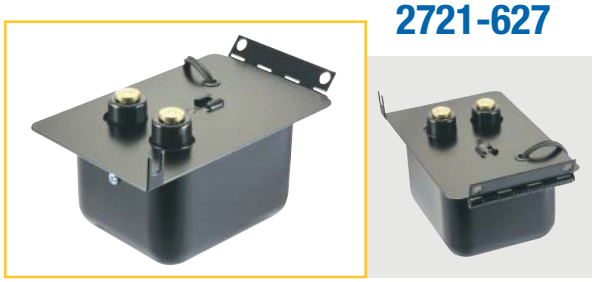
2721-619

Burner Manufacturer: **Wayne HI Speed M/MH**
HV Terminal: **Small Spring Contact**
Hinge Location: **End Hinge**
Replaces: **Webster: 313-28AB91, France: 5LAY-03**

2721-620

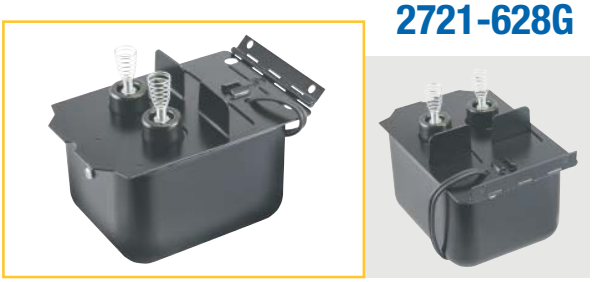
Burner Manufacturer: **Wayne E**
HV Terminal: **Zinc Plated Button**
Hinge Location: **Side Hinge**
Replaces: **Webster: 313-25AB78, France: 5LAY-30**

2721-627



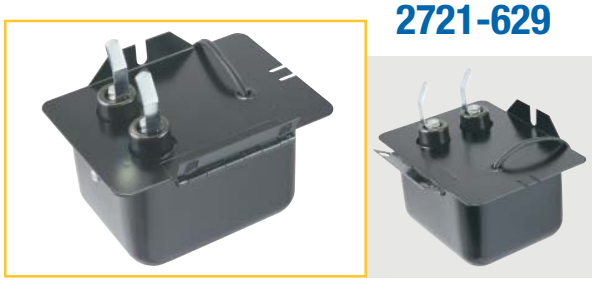
Burner Manufacturer: **Brock**
HV Terminal: **Zinc Plated Button**
Hinge Location: **End Hinge**
Replaces: **France: 5LAY-57**

2721-628G



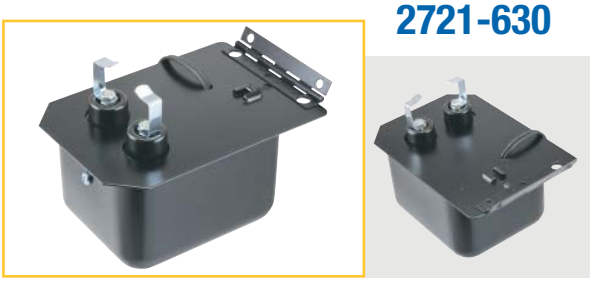
Burner Manufacturer: **Beckett A, AF, AFG**
HV Terminal: **Large Spring Contact**
Hinge Location: **End Hinge**
Includes: **Mounting Plate and Barrier Gaskets**
Mounting Plate Clips
Replaces: **Webster: 3-28AB-BAF, France: 5LAY-04**

2721-629



Burner Manufacturer: **Carlin 17.5 FR, 200, 201, 500, 501 CRD**
HV Terminal: **Finger Contact**
Hinge Location: **Side Hinge**
Replaces: **Webster: 313-24AB-81, France: 5LAY-16**

2721-630



Burner Manufacturer: **Carlin 99, 100, 101, Card Miser**
HV Terminal: **Spring Clip Contact**
Hinge Location: **End Hinge**
Includes: **Mounting Plate Gasket**
Replaces: **Webster: 313-28AB85, France: 5LAY-15**

2721-631A

Burner Manufacturer: **ABC Sunray**
HV Terminal: **Small Spring Contact**
Hinge Location: **Side Hinge**
Replaces: **Webster: 313-25AB86, France: 5LAY-12**

2721-637

Burner Manufacturer: **Wayne**
HV Terminal: **Zinc Plated Button**
Hinge Location: **Side Hinge**
Replaces: **Webster: 313-25AB49, France: 5LAY-21**

2721-647

Burner Manufacturer: **Wayne Blue Angle Eagle One**
HV Terminal: **Small Spring Contact**
Description: **Mounting Studs 8-32 x 3/8**
Replaces: **Webster: 313-28AB205W/313-28ABWHS, France: 5LAY-31**

2721-653

Burner Manufacturer: **Weil McLain QB180**
HV Terminal: **1/4" Push On**

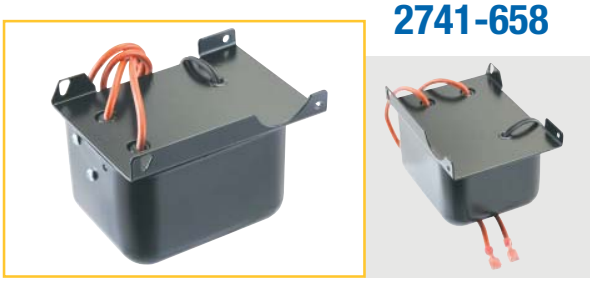
2721-654

Burner Manufacturer: **Clean Burn**
HV Terminal: **8-32 Threaded Post**
Hinge Location: **End Hinge**
Replaces: **France: 5LAY-59**

2721-668

Burner Manufacturer: **Wayne**
HV Terminal: **Large Spring Contact**
Description: **Same As 647 But Less Bolts**
Replaces: **Webster: 313-28AB205W/313-28ABWHS, France: 5LAY-31**

2741-658



Burner Manufacturer: **Beckett AFII**
HV Terminal: **High Voltage Cables with 1/4" Push On**
Description: **Side Bracket Mounting**
Replaces: **Webster: 3-32AB-BAF**

Model	Electrical Specifications
2721	120 Volt, 60 Hz, 10000 Volt Secondary, 23mA, Mid Point Ground, Small Can Series
2729	220 Volt, 50 Hz, 10000 Volt Secondary, 23mA, Mid Point Ground, Small Can Series
2730	120 Volt, 50 Hz, 10000 Volt Secondary, 23mA, Mid Point Ground, Small Can Series
2744	240 Volt, 60 Hz, 10000 Volt Secondary, 23mA, Mid Point Ground, Small Can Series

421-095

Burner Manufacturer: **York Shipley**
HV Terminal: **Buss Bar Clips**
Junction Box: **External**
Description: **Side Bracket Mounting**
Replaces: **Webster: 312-26ABE407, France: LGEW-1**

421-104E

Burner Manufacturer: **Aero, Metal Master, Sunray**
HV Terminal: **Buss Bar Clips**
Junction Box: **Internal**
Replaces: **Webster: 312-26AB022**

421-254A

Burner Manufacturer: **Barriere**
HV Terminal: **Zinc Plated Button**
Hinge Location: **Side Hinge**

421-331

Burner Manufacturer: **Lennox**
HV Terminal: **Zinc Plated Button**
Hinge Location: **End Hinge**
Replaces: **Webster: 313-25AB62**

421-340

Burner Manufacturer: **Armstrong/Esso**
HV Terminal: **Rajah Connector**
Junction Box: **External**
Replaces: **Webster: 312-25ABE1, France: LGPW-2**

421-430

Burner Manufacturer: **Ducane**
HV Terminal: **Zinc Plated Button**
Replaces: **Webster: 313-25AB90, France: 5LAY-06**

421-557

Burner Manufacturer: **Arco American Standard**
HV Terminal: **Buss Bar Clips**
Junction Box: **External**
Replaces: **Webster: 312-26ABE23,**
France: LGHW

421-655

Burner Manufacturer: **Power Flame**
HV Terminal: **Rajah Connector**
Junction Box: **Internal**
Description: **1/4-20 x 1" Mounting Studs**
For Ground Wire Model Add "G"
Replaces: **Webster: 312-25AB0418**

421-659

Burner Manufacturer: **Cleaver Brooks,**
Industrial Combustion
HV Terminal: **Rajah Connector**
Junction Box: **Internal**
Replaces: **Webster: 312-08A097/312-810169**

421-661

Burner Manufacturer: **Gordon Piatt**
HV Terminal: **Rajah Connector**
Replaces: **Webster: 313-25AB100**

421-663

Burner Manufacturer: **PVI Industries**
HV Terminal: **Thumb Screw**
Junction Box: **Internal**
Description: **1/4-20 x 1" Mounting Studs**

421-664

Burner Manufacturer: **Webster Engineering**
HV Terminal: **Thumb Screw**
Junction Box: **Internal**

Model	Electrical Specifications
421	120 Volt, 60 Hz, 10000 Volt Secondary, 23mA, Mid Point Ground, Large Can Series
444	240 Volt, 60 Hz, 10000 Volt Secondary, 23mA, Mid Point Ground, Large Can Series
911	240 Volt, 50 Hz, 10000 Volt Secondary, 23mA, Mid Point Ground, Large Can Series
912	120 Volt, 50 Hz, 10000 Volt Secondary, 23mA, Mid Point Ground, Large Can Series

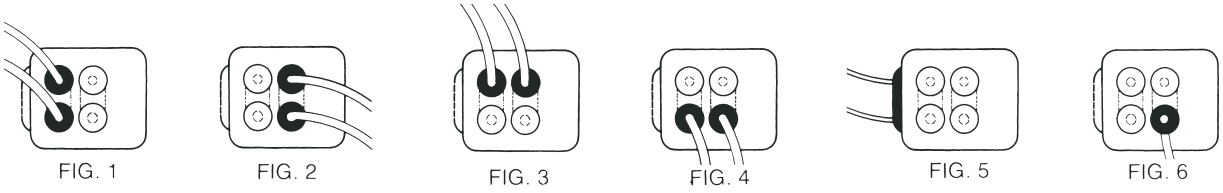
Universal Service Replacement Transformer

421-BT636

HV Terminal:
- Complete with required hardware
- Six position adaptability
- Includes mounting plate 2567-01

Junction Box: Internal

Replaces: Webster: 312-25AX0600, France: LAUV



Universal Service Replacement Transformer

421-BT384

HV Terminal:
- Complete with required hardware
- Five position adaptability

Junction Box: Internal

421-BT104

HV Terminal: **Thumb Screw**
Junction Box: **Internal**
Replaces: **Webster: 312-24AB0237, France: LGCV**

421-BT290

HV Terminal: **Thumb Screw**
Junction Box: **Internal**
Replaces: **Webster: 312-24AB0202, France: LGDV**

421-BT299

HV Terminal: **Rajah Connector**
Junction Box: **Internal**
Replaces: **Webster: 312-25A0202, France: LFBV**

421-BT332

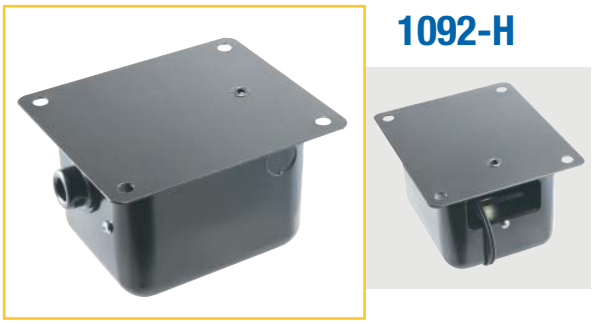
HV Terminal: **Rajah Connector**
Junction Box: **Internal**
Replaces: **Webster: 312-25AB0202, France: LGFV**

421-BT387

HV Terminal: **Thumb Screw**
Junction Box: **Internal**
Replaces: **Webster: 312-24A0202, France: LFAV**

Model	Electrical Specifications
421	120 Volt, 60 Hz, 10000 Volt Secondary, 23mA, Mid Point Ground, Large Can Series
444	240 Volt, 60 Hz, 10000 Volt Secondary, 23mA, Mid Point Ground, Large Can Series
911	240 Volt, 50 Hz, 10000 Volt Secondary, 23mA, Mid Point Ground, Large Can Series
912	120 Volt, 50 Hz, 10000 Volt Secondary, 23mA, Mid Point Ground, Large Can Series

1092-H



Burner Manufacturer: **Cleaver Brooks, Industrial Combustion**
HV Terminal: **Rajah Connector**
Junction Box: **Internal**
Replaces: **Webster: 612-8A021**

1092-PF

Burner Manufacturer: **Power Flame**
HV Terminal: **Thumb Screw**
Junction Box: **Internal**
Description: **1/4-20 x 1" Mounting Studs For Ground Wire Model Add "G"**
Replaces: **Webster: 612-6A056**

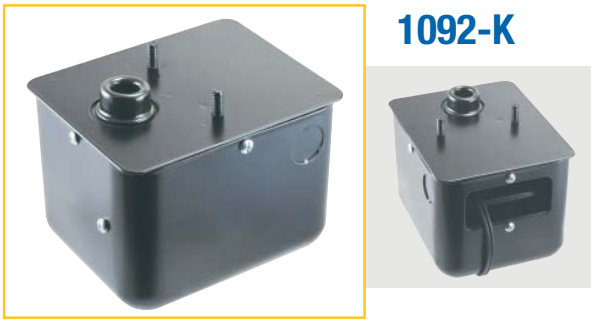
1092-S

Burner Manufacturer: **Gordon Piatt**
HV Terminal: **Thumb Screw**
Junction Box: **Internal**
Replaces: **Webster: 612-6A020/612-6A072**

1092-F

HV Terminal: **Thumb Screw**
Description: **Conduit Connection**
Replaces: **Webster: 612-6A7, France: 6EEGW-2**

1092-K



Burner Manufacturer: **Dunham-Bush, Iron Fireman**
HV Terminal: **Rajah Connector**
Junction Box: **Internal**
Description: **1/4-20x1" Mounting Studs**
Replaces: **Webster: 612-8AB017**

1092-N

Burner Manufacturer: **Ray Burner**
HV Terminal: **Thumb Screw**
Description: **Conduit Connection**
Replaces: **Webster: 613-6A10,**
France: 3RAFYR-14

1092-NA

Burner Manufacturer: **North American**
HV Terminal: **Rajah Connector**
Junction Box: **Internal**
Replaces: **Webster: 612-8A02**

1092-SG

Burner Manufacturer: **Webster**
HV Terminal: **Thumb Screw**
Junction Box: **Internal**
Description: **Primary with 3 wires, one ground**

Model	Electrical Specifications
1092	120 Volt, 50/60 Hz, 6000 Volt Secondary, 25/20mA, One End Ground
1112	240 Volt, 60 Hz, 6000 Volt Secondary, 20mA, One End Ground
1196	240 Volt, 50 Hz, 6000 Volt Secondary, 20mA, One End Ground

2714-359

Burner Manufacturer: **Cleaver Brooks, Industrial Combustion**
HV Terminal: **Rajah Connector**
Junction Box: **Internal**
Replaces: **Webster: 12-8A08, France: 2KAAVS-1**

2714-500

HV Terminal: **Rajah Connector**
Junction Box: **Internal**
Description: **1/4-20 x 1" Mounting Studs**

2714-633

Burner Manufacturer: **Carlin**
HV Terminal: **Rajah Connector**
Junction Box: **Internal**
Description: **Side Bracket Mounting**
Replaces: **Webster: 12-8AB7, France: 2KACVS-2**

2714-655

Burner Manufacturer: **Power Flame**
HV Terminal: **Rajah Connector**
Junction Box: **Internal**
Description: **1/4-20x1" Mounting Studs**
For Ground Wire Model Add "G"
Replaces: **Webster: 12-8AB11**

2714-656

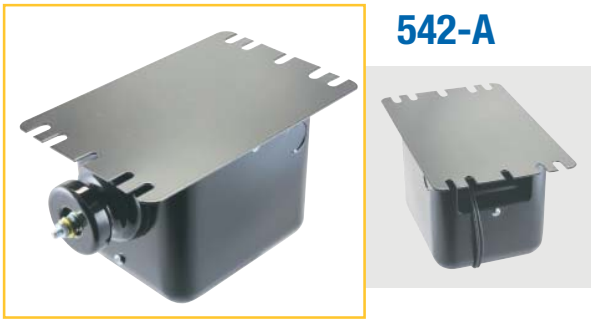
Burner Manufacturer: **Beckett**
HV Terminal: **Rajah Connector**
Description: **Conduit Connection**
Available in 220V-2742-656
Replaces: **Webster: 12-8AB16**

2714-662

Burner Manufacturer: **Gordon Piatt**
HV Terminal: **Rajah Connector**
Junction Box: **Internal**
Replaces: **Webster: 12-8AB02**

Model	Electrical Specifications
2714	120 Volt, 60 Hz, 12000 Volt Secondary, 23mA, Mid Point Ground
2742	220 Volt, 60 Hz, 12000 Volt Secondary, 23mA, Mid Point Ground

542-A



HV Terminal: **1/4-20 Stud**
Junction Box: **Internal**
Replaces: **Webster: 312-6A0456**

542-GP

Burner Manufacturer: **Gordon Piatt**
HV Terminal: **1/4-20 Stud**
Junction Box: **Internal**
Description: **For Ground Wire Model Add "G"**
Replaces: **Webster: 312-9A0456**

542-H

Burner Manufacturer: **Cleaver Brooks, Industrial Combustion**
HV Terminal: **1/4-20 Stud**
Junction Box: **Internal**

542-PF

Burner Manufacturer: **Power Flame**
HV Terminal: **1/4-20 Stud**
Junction Box: **Internal**
Description: **1/4-20x1" Mounting Studs For Ground Wire Model Add "G"**

Model	Electrical Specifications
542	120 Volt, 60 Hz, 10000 Volt Secondary, 23mA, One End Ground

2260-P

Description:
Center mounting, primary wire plug set with pigtails, 2 way mounting

2260-TP

Description:
Mounting tabs, primary plug set with pigtails, 3 way mounting

2260-TW

Description:
Mounting tabs with traditional bottom exit primary pigtails, 3 way mounting

2260-TWG

Description:
Mounting tabs with traditional bottom exit primary pigtails, 3 way mounting, 18" H.V. secondary cable

Model	Electrical Specifications
2260	120 Volt, 50/60 Hz, 15.6 kVpk Volt Secondary, 28mA, One End Ground
2265	230 Volt, 50/60 Hz, 15.6 kVpk Volt Secondary, 30mA, One End Ground

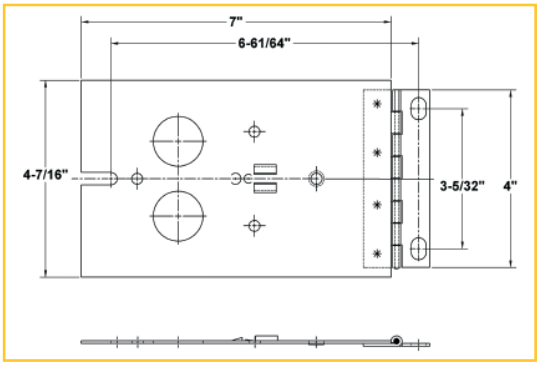
Chek-Mate™

SC-2100

- Safe and reliable
- Tests all manufacturer's 2 pole electronic ignitors and iron core transformers
- LED indicator notifies you if unit is functioning and producing enough spark to ignite the fuel oil
- Easy to use, lightweight and compact
- Makes service calls quick and easy

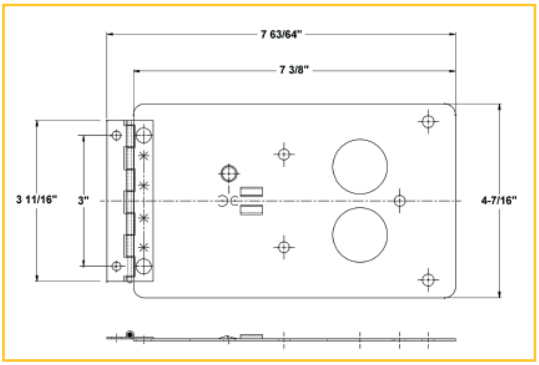
Electronic Oil Ignitor Mounting Plates

2600



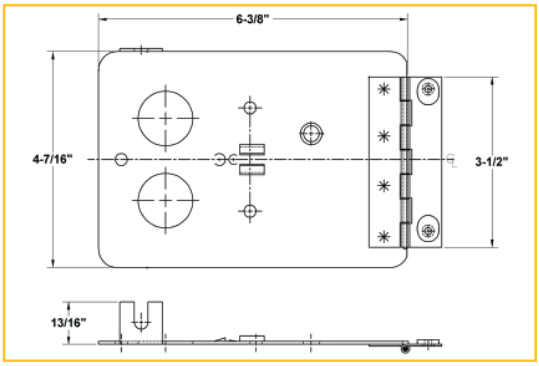
Burner Manufacturer: **Aero**

2601



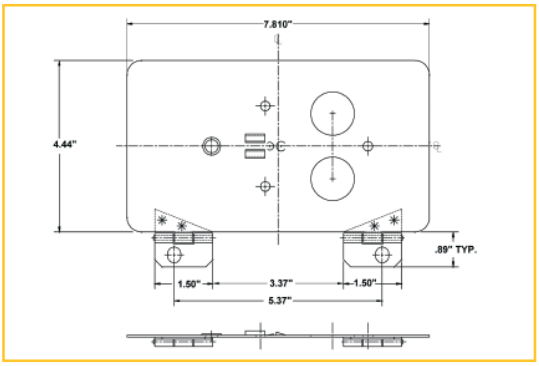
Burner Manufacturer: **Beckett S**

2602



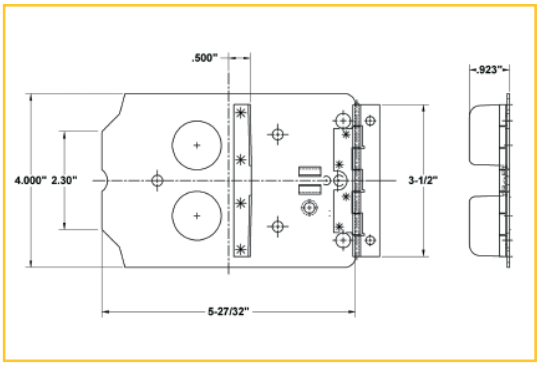
Burner Manufacturer: **Wayne HI Speed M/MH**

2603



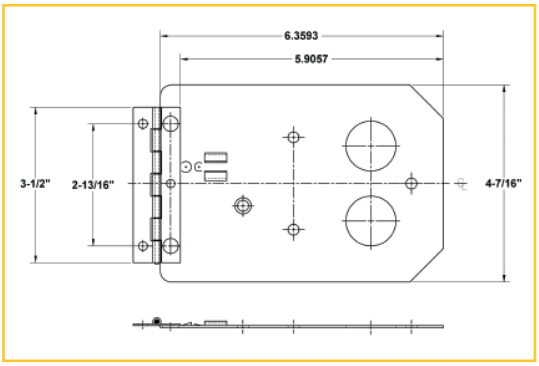
Burner Manufacturer: **Wayne E**

2604



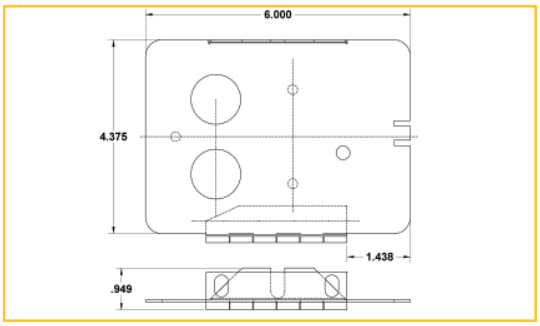
Burner Manufacturer: **Beckett A, AF, AFG**

2605



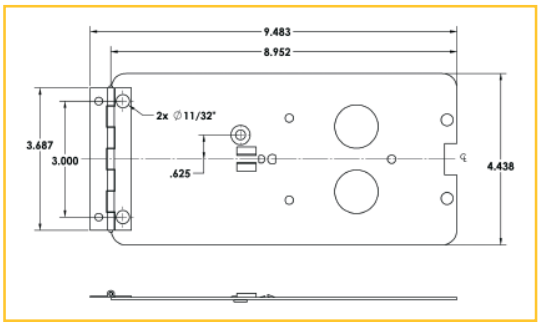
Burner Manufacturer:
Carlin 99, 100, 101, Card Miser

2609



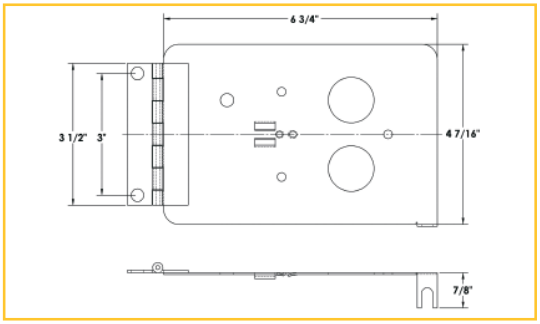
Burner Manufacturer:
Carlin 17.5 FR, 200, 201, 500, 501 CRD

2612



Burner Manufacturer: **Grimsby**

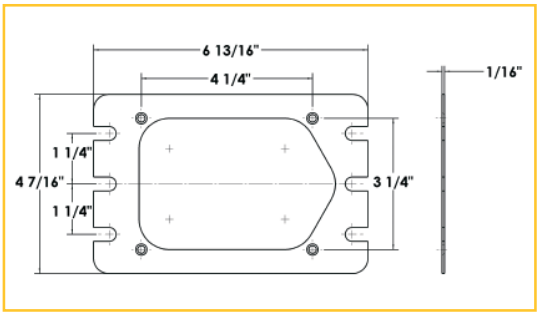
2614



Burner Manufacturer: **Brock**

Industrial Transformer Mounting Plates

2500



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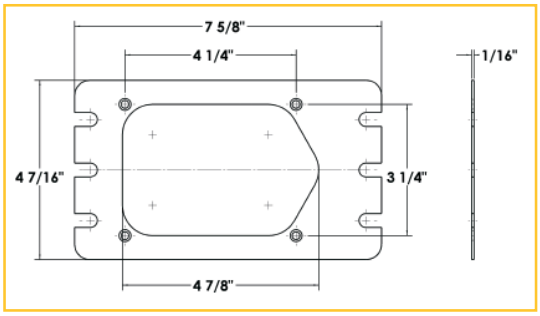

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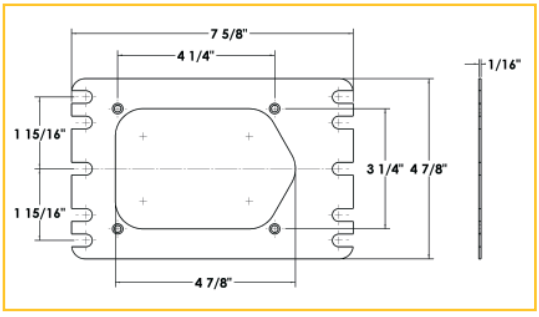

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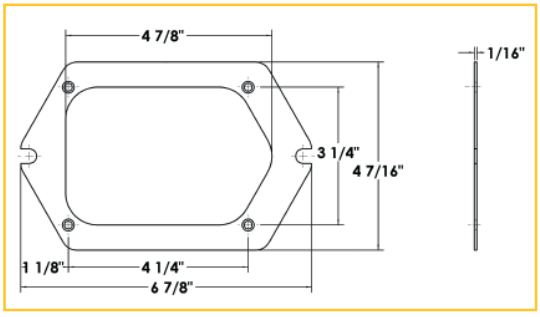


swordfish®
UVC AIR TREATMENT SYSTEM

Ultra Violet Air Treatment Systems

Swordfish® UVC Air Purification Systems provide healthy indoor air quality. They destroy airborne cold and flu-causing bacteria and viruses. In addition, they also help alleviate allergy and asthma symptoms. Swordfish purifies indoor air by deactivating micro-organisms, while other air purifiers merely filter and trap them. 3rd party facilities confirmed a kill rate of 99.99% of the airborne micro-organisms. Allanson's 80 years of designing and manufacturing power supplies enable us to provide optimal lamp performance.

Features and Benefits of Swordfish® UVC Technology:

- Most powerful germ killing light on the market
- Lamps do not produce ozone
- Lamp replacement notification
- Green product (energy efficient ballast)
- Easy and affordable maintenance
- Plug in to 120 (115) Volt outlets

Swordfish® UVC Whole Home Air Purification System

- Easy 15 min installation on the return air duct, or above the AC coil
- Compact and lightweight (1lb)
- 2" hole saw included
- Kills mold spores

UVA36WB

UVA36WLR

UVA18WLR

Swordfish® UVC Portable Air Purification System

- Reusable anti microbial filter captures micro-organisms
- Passing air is then exposed to the powerful UVC germ killing light
- 2 Speed whisper quiet fan

UVA1800RM

Swordfish® UVC Multi Packs

UVA36W-COMBO

Includes:
- 2 UVA36WB
- 1 UVA1800RM
- Literature
- Looping DVD
- Displayer

UVA36W-MULTI

Includes:
- 4 UVA36WB
- 2 UVA36WLR
- Literature
- Looping DVD
- Displayer

Type	Name	Description
UVA36WB	Swordfish® UVC Whole Home Air Purification System	For homes up to 3500 sq. ft.
UVA36WLR	36 Watt Replacement Lamp	Replacement for UVA36WB
UVA18WB	Swordfish® UVC Whole Home Air Purification System	For homes up to 1500 sq. ft.
UVA18WLR	18 Watt Replacement Lamp	Replacement for UVA18WB and UVA1800RM
UVA60WB	Swordfish® UVC Whole Home Air Purification System	For homes above 3500 sq. ft.
UVA60WLR	60 Watt Replacement Lamp	Replacement for UVA60WB
UVA1800RM	Swordfish® UVC Portable Air Purification System	Purifies rooms up to 200 sq. ft.
UVA36W-COMBO	Swordfish® UVC Combo Pack	Includes: 2 UVA36WB, 1 UVA1800RM, Literature, Looping DVD and Displayer
UVA36W-MULTI	Swordfish® UVC Multi Pack	Includes: 4 UVA36WB, 2 UVA36WLR, Literature, Looping DVD and Displayer

Kills germs that cause colds and flu

Purifies your indoor air

Alleviates allergy and asthma symptoms

Clean and fresh indoor air

Electronic Ignitor Contact Kit
54-740

Includes: Zinc Plated Buttons (2)
Small Spring Contacts (2)
Large Spring Contacts (2)
Spring Clip Contacts (2)

Electronic Ignitor Contact Kit
54-766

Includes: Zinc Plated Buttons (4)
Large Spring Contacts (4)
Spring Clip Contacts (2)

54-741

Zinc Plated Buttons
Description: Hardware Kit For Wayne/Aero
Quantity: 6 Sets

54-742

Large Spring Contact
Description: Hardware Kit For Beckett
Quantity: 6 Sets

54-743

Small Spring Contact
Description: Hardware Kit For Wayne
Quantity: 6 Sets

54-744

Spring Clip Contact
Description: Hardware Kit For Carlin
Quantity: 6 Sets

25-232

Screws - Type B Flat
Quantity: 4

25-409

Weld Bolts
1/4 - 20 x 1"
Description: Use on Service Replacement Transformers
Quantity: 2

29-204

Rajah Caps
Quantity: 2

29-276

Compression Cone Spring
Quantity: 2

29-294

Hollow Threaded Rajah Stud
Quantity: 2

29-295

Double Threaded Stud
Quantity: 2

GTO-18

High Voltage Cable
Description: Silicon cable; 18" long; 25KVDC 250^{0} C UR; 1/4 Female Rajah Connectors

NOTES:

Comments: Limited models of ignition transformers are available with solid filled potting - contact customer service for details.

Burner Manufacturer	Allanson	Dongan	France	Webster	Sid Harvey	Thermolok
10,000 Volt Secondary Mid Point Ground 120 Volt						
ABC	2721-411	XD-AB207	5LAY-20	313-25AB59	T-84	C-792
ABC/SUNRAY	2721-631A	XD-AB201	5LAY-12	313-25AB86	T-29-15B	TSR-10
ABC-CRANE	2721-409	A10-SV351	LKR-2	313-25AB73	T-86	C-793
ABC-D&LC	2721-452		5LAY-11	313-25AB65	T-34-B	
ACME/QUIET HEET	421-104	A10-SR12	LGNV		T-31N	C-53
ACME/WEATHERALL	2721-457		LKE	3-25AB-AH	T-82	
AERO	2721-456	XD-AR211	5LAY-56	3-24AB-AER	T-87	TA-10
AERO/SUNRAY	421-104E			312-26AB022	T-29-10B	
ARCO/AMER. STANDARD	421-557 (replaces 421-216)					
ARCO/AMER. STANDARD	421-557	A10-SP18	LGHW	312-26ABE23	T-183B	C-483
ARMSTRONG/ESSO	421-340		LGPW-2	312-25ABE1	T-80-3M	
BARRIERE	421-254A					
BECKETT A, AF, AFG	2721-628G	XD-BK103	5LAY-04	3-28AB-BAF	T-92	TB-10
BECKETT AFII	2741-658			3-32AB-BAF		
BECKETT S	2721-605	XD-BK204	5LAY-05	313-28AB92/ 313-28AB-BS	T-90	TB-11
BROCK	2721-627		5LAY-57			
CARLIN 99, 100 CRD	2721-630	XD-CR205	5LAY-15	313-28AB85	T-94	TC-10
CARLIN 200, 201, 500 CRD	2721-629	XD-CR206	5LAY-16	313-24AB81	T-95	TC-11
CLEAN BURN	2721-654		5LAY-59			
CLEAVER BROOKS	421-659			312-8AO97/ 312-810169		
CONROY	421-558					
DELCO P-200	2721-222A	A10-SQ182	LKP	313-24AB68	T-24N	
DUCANE	421-430	XD-DC212	5LAY-06	313-25AB90		
GORDON PIATT	421-661			313-25AB100		
GRIMSBY	2721-589					
INDUSTRIAL COMBUSTION	421-660			312-8AO169		
JOHN WOOD	2721-069					
LENNOX	421-331	A10-S32		313-25AB62	T-265	C-823
METAL MASTER	421-262	A10-S32	LGM		T-28B	C-544
METRO	2721-368M					
NU-WAY (LARGE PLATE)	2721-448			313-24AB80	T-120	C-794
NU-WAY (SMALL PLATE)	2721-572			313-24AB82	T-122	C-807
POWER FLAME	421-655			312-25AB0418		
PVI INDUSTRIES	421-663					
REZNOR	2721-628G (replaces 2721-667)					
SUNRAY	421-104E			312-26AB022	T-29-10B	C-733
WAYNE	2721-637		5LAY-21	313-25AB49	T-50	
WAYNE (BLUE ANGEL)	2721-647	XD-WN209	5LAY-31	313-28AB205W/ 313-28ABWHS		T-89-10
WAYNE E	2721-620	XD-WN208	5LAY-30	313-25AB78	T-88	C-799
WAYNE HI SPEED M/MH	2721-619	XD-WN202	5LAY-03	313-28AB91	T-93	TW-10
WEBSTER ENGINEERING	421-664					
YORK SHIPLEY	421-095		LGEW-1	312-26ABE407	T-25B	
12,000 Volt Secondary Mid Point Ground 120 Volt						
BECKETT	2714-656			12-8AB16		
CARLIN	2714-633	A12-SV10	2KACVS-2	12-8AB7	T-12	
CLEAVER BROOKS	2714-359	A12-SJ10	2KACVS-1	12-8AO8		
GORDON PIATT	2714-662			12-8AB02		
POWER FLAME	2714-655			12-8AB11		

Burner Manufacturer	Allanson	Dongan	France	Webster	Sid Harvey	Thermolok
10,000 Volt Secondary Mid Point Ground 120 Volt - Less Mounting Plate Replacement Type						
UNIVERSAL 6 WAY	421-BT636		LAUV	312-25AX0600	T1-15	T-628
UNIVERSAL 5 WAY	421-BT384			312-25AX0500		
	421-BT066					
	421-BT104	A10-SR10	LGCV	312-24AB0237	T-31N	
	421-BT276	A10-SW10	LGEV	312-25AB0237	T-17FM	C-551
	421-BT290	A10-SQ10	LGDV	312-24AB0202	T-17N	C-554
	421-BT299	A10-SJ10	LFBV	312-25A0202	T-21M	
	421-BT332	A10-SV10	LGFV	312-25AB0202	T-17M	C-555
	421-BT387	A10-SF10	LFAV	312-24A0202	T-21N	
INDUSTRIAL GAS TYPE IGNITION TRANSFORMERS - 6,000 Volt Secondary One End Ground, 120 Volt, 50/60 Hz						
CLEAVER BROOKS	1092-H			612-8A021		
GORDON PIATT	1092-S			612-6A020/ 612-6A072		
IRON FIREMAN, DUNHAM-BUSH	1092-K			612-8AB017		
BX CONNECTOR	1092-F	A06-SA6	6EEGW-2	612-6A7	T-246N	
NORTH AMERICAN	1092-NA			612-8A02		
POWER FLAME	1092-PF			612-6A056		
RAY BURNER	1092-N	A06-SD7	3RAFYR-14	613-6A10	T-193N	
WEBSTER (PRIMARY HAS 3 WIRES)	1092-SG					
INDUSTRIAL GAS/OIL TYPE IGNITION TRANSFORMERS 10,000 Volt Secondary One End Ground 120 Volt						
OIL APPLICATION	542-A	A10-LA22		312-6A0456		
CLEAVER BROOKS	542-H	A10-LN2X				
GORDON PIATT	542-GP			312-9A0456		
POWER FLAME	542-PF					

Burner Manufacturer	Allanson	Beckett	France	Carlin	Sid Harvey
OMNI® IGNITOR	2275U	< NO UNIVERSAL AVAILABLE >			T96I
AERO	2275-456	51828U	10SAY-56	41000-SO-AR	T87E
BECKETT A, AF, AFG	2275-628G	51771U	10SAY-04	41000-SO-BK1	T92E (1)
BECKETT AFII	2275-658	51805U	10SAYL-70		T97E
BECKETT S	2275-605	51824U	10SAY-05	41000-SO-BK2	T90E
CARLIN 17.5, 200, 201, 500, 501, CRD	2275-629	51840U	10SAY-16	41000-SO-SC	T95E
CARLIN 99, 100, 101, CRD	2275-630	51826U	10SAY-15	41000-SO-CAS	T94E
CARLIN 601 & UP	2275-633	51880U		41000-SO-LC	
WAYNE HI SPEED M/MH	2275-619	51825U	10SAY-03	41000-SO-WA3	T93E
WAYNE E	2275-620	51827U	10SAY-30	41000-SO-WA2	T88E
WAYNE HS	2275-647	51836U	10SAY-31	41000-SO-WA1	T89-10E
WEIL MCLAIN	2275-653	51837U	10SAY-32	41000-SO-WM	T86E
IGNITOR KIT	2275-KIT1	51835	10SAY-KIT	41000-SO-KIT	T97K

WARRANTY

Allanson agrees to correct any defects in material or workmanship which may develop in any oil burner or gas ignition transformer sold, when used under proper or normal conditions, during a period of 36 months, from the date of manufacture. Such correction may be by repair, replacement, or material credit at the company's discretion.

This warranty does not include shipping costs to and from the factory. This correction shall fulfill completely any and all obligations by Allanson intended or implied by this warranty. Allanson shall not be responsible for consequential damage or for labour involved in making replacement.

Allanson

Contact us:
Canada: 33 Cranfield Rd., Toronto, Ontario, M4B 3H2
Telephone 416.755.1191 Fax 877.278.0907
Toll Free 1.800.661.7251

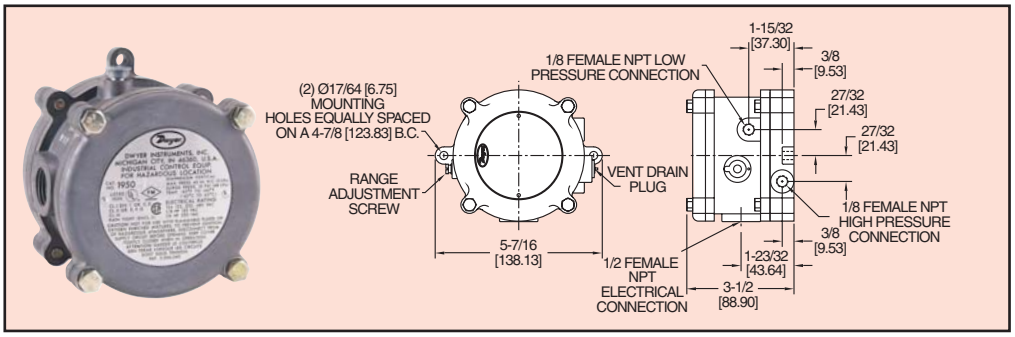
USA: 99 Adams Boulevard, East Farmingdale, New York, 11735
Telephone 631.293.3880 Fax 631.293.3470

Visit us:
www.allanson.com

Series 1950

Explosion-Proof Differential Pressure Switches

Compact, Low Cost, Explosion-proof and Weatherproof



Model 1950 Explosion-Proof Differential Pressure Switch combines the best features of the popular Dwyer series 1900 with an integral explosion-proof and weather-proof housing, making it an exceptional value for either application. It is CE, UL and CSA listed, FM approved for use in Class I, Div 1, Groups C and D, Class II Groups E, F, and G and Class III hazardous atmospheres (NEMA 7 & 9), Raintight (NEMA 3). Weatherproof features include a drain plug and O-ring seal in cover. Electrical connections are easily made by removing front cover. For convenience the set point adjustment screw is located on the outside of the housing. Twelve models offer set points from .03 to 20˝ w.c. (7.5 to 5 kPa) and from .5 to 50 psi (0.035 to 3.5 bar). The unit is very light and compact – about half the weight and bulk of other explosion-proof or weather-proof switches with separate enclosures.

SPECIFICATIONS

Service: Air and non-combustible, compatible gases.
Wetted Materials: Consult factory.
Temperature Limits: -40 to 140°F (-40 to 60°C); 0 to 140°F (-17.8 to 60°C) for 1950P-8, 15, 25, and 50. -30 to 130°F (-34.4 to 54.4°C) for 1950-02.
Pressure Limits:
Continuous: 1950's - 45˝ w.c. (0.11 bar); 1950P's - 35 psi (2.41 bar); 1950P-50 only - 70 psi (4.83 bar).
Surge: 1950's - 10 psi (0.69 bar), 1950P's - 50 psi (3.45 bar), 1950P-50 only - 90 psi (6.21 bar).
Enclosure Rating: IP64, NEMA 3, 7 and 9.
Switch Type: Single-pole double-throw (SPDT).
Electrical Rating: 15 A @, 125, 250, 480 VAC, 60 Hz. Resistive 1/8 HP @ 125 VAC, 1/4 HP @ 250 VAC, 60 Hz.
Electrical Connections: 3 screw type, common, normally open and normally closed.
Process Connections: 1/8˝ female NPT.
Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientations.
Set Point Adjustment: Screw type on top of housing.
Weight: 3.25 lb (1.5 kg); 1950-02 model, 4.4 lb (2 kg).
Agency Approvals: CE, UL, CSA, FM.

SERIES 1950 SWITCHES - MODELS, OPERATING RANGES AND DEAD BANDS

Model Number	Range, Inches W.C.	Approximate Dead Band at	
		Min. Set Point	Max. Set Point
1950-02-2S	.03 to .10	.025	.05
1950-00-2F	.07 to .15	.04	.05
1950-0-2F	.15 to .50	.10	.15
1950-1-2F	.4 to 1.6	.15	.20
1950-5-2F	1.4 to 5.5	.30	.40
1950-10-2F	3 to 11	.40	.50
1950-20-2F	4 to 20	.40	.60

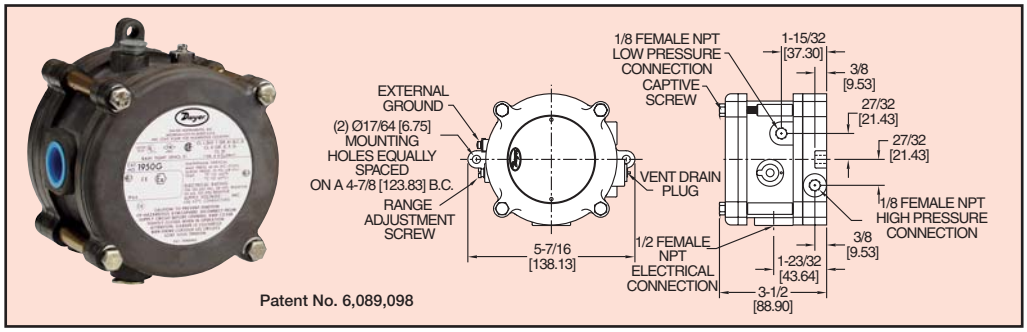
Model* Number	Range, PSID	Approximate Dead Band at	
		Min. Set Point	Max. Set Point
1950P-2-2F	0.5 to 2	.3	.3
1950P-8-2F	1.5 to 8	1.0	1.0
1950P-15-2F	3 to 15	.9	.9
1950P-25-2F	4 to 25	.7	.7
1950P-50-2F	15 to 50	1.0	1.5

CAUTION: For use only with air or compatible gases. Applications with hazardous atmospheres and a single positive pressure may require special venting.
*P=PSID range models

Series 1950G

Explosion-Proof Differential Pressure Switch

Explosion-Proof, Weatherproof, Compatible with Natural Gases



Patent No. 6,089,098

The Model 1950G Explosion-Proof Switch combines the best features of the popular Dwyer Series 1950 Pressure Switch with the benefit of natural gas compatibility. Units are rain-tight for outdoor installations, and are UL listed for use in Class I, Groups A, B, C, & D; Class II, Groups E, F, & G and Class III atmospheres, Directive 94/9/EC (ATEX) Compliant for CE Ex II 2 G EExd IIB & Hydrogen T6 and CSA & FM approved for Class I, Div 1, Groups B, C, D; Class II, Div 1, Groups E, F, G and Class III atmospheres. The 1950G is very compact, about half the weight and bulk of equivalent conventional explosion-proof switches.
Easy access to the SPDT relay and power supply terminals is provided by removing the top plate of the aluminum housing. A supply voltage of 24 VDC, 120 or 240 VAC is required. A captive screw allows the cover to swing aside while remaining attached to the unit. Adjustment to the set point of the switch can be made without disassembly of the housing.

SPECIFICATIONS

Service: Air and compatible combustible gases.
Wetted Materials: Contact Factory.
Temperature Limits: 0 to 140°F (-17 to 60°C). Note: Set point drift may occur with ambient temperature changes.
Pressure Limits: 45˝ w.c. (11.2 kPa) continuous; 10 psig (68.95 kPa) surge.
Enclosure Rating: IP64, NEMA 3, 7 and 9.
Switch Type: 1 Form C relay (SPDT).
Electrical Rating: 10A, 120/240 VAC, 28 VDC. Resistive 50mA, 125 VDC.
Power Requirements: 24 VDC ±10%. 120 or 240 VAC ±10% optional.
Electrical Connections: Internal terminal block.
Process Connections: 1/8˝ female NPT.
Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientations.
Set Point Adjustment: Screw type on top of housing.
Weight: 2 lb, 15.7 oz (1.35 kg).
Agency Approvals: CE, UL, CSA, FM, ATEX.

MODELS

Model Number[1]	Range, Inches W.C.	Approximate Dead Band at	
		Min. Set Point	Max. Set Point
1950G-00-B-24	.07 to .15	.04	.06
1950G-0-B-24	.15 to .50	.06	.11
1950G-1-B-24	.4 to 1.6	.11	.29
1950G-5-B-24	1.4 to 5.5	.4	.9
1950G-10-B-24	3 to 11	.9	1.8
1950G-20-B-24	4 to 20	1.2	3.0

[1]Note: For alternate supply voltages change 24 to 120 or 240. Example: 1950G-00-B-120.

TRIAC
VALVES & ACTUATORS

Division of A-T Controls Inc.
11363 Deerfield Road
Cincinnati, Ohio 45242
(513) 247-5465 Fax (513) 247-5462

INSTALLATION & MAINTENANCE MANUAL

WE-500 Series Electric Actuator
On / Off Control

Installation Instructions

Introduction

The WE-500 Series electric actuator is a rotary valve actuator with outputs of 500 in-lbs. It has been designed for NEMA 4, 4X and can come with an optional 4-20mA card for modulating service.

Storage

1. Keep conduit entries plugged.
2. Store in a dry enviroment.
3. Periodically cycle the actuator if possible.

Maintenance

WE-500 Series actuators contain a permanently lubricated precision cut, heat treated gear train for long, reliable cycle life. There is no need to change gear train grease.

Permanent split capacitor gearmotors have been equipped with thermal protectors. To guard the motor against overheating, the thermal protector opens the circuit to the motor and maintains this state until the temperature of the motor drops to a satisfactory level.

Installation

1. This section of the instruction sheet applies to the on-off units. For instructions on modulating units, please see IOM5004 (TMC2)
2. Manually open and close valve to ensure freeness of operation. Make sure valve and Triac actuator rotate in the same direction and are in the same position (i.e. valve closed, actuator closed). If not sure, electrically operate the actuator to determine its operating range. The Triac electric actuators are factory set for 90 degree operation.
3. Mount Triac actuator to valve with Triac provided mounting hardware to ensure proper alignment. (Note: Some valves have manual stops; remove if appropiate or set actuator to operate within those travel stops.
4. Care should be taken to align valve stem properly and Triac actuator output shaft. (Note: Misalignment will cause premature failure of assembly)
5. Connect power to terminal strip according to schematic diagram. The actuator should be wired and grounded in accordance with local and National Electrical Codes.
6. Before replacing cover, actuate valve and check to see if it opens and closes to preferred positions. If valve does not perform correctly, adjust cams to set actuator travel properly.
7. Drive actuator to desired open position. The cams are adjusted by simply losening the set screw and rotating cam to desired position. When open position is set, tighten the set screw to maintain position.
8. To adjust closed position, repeat step 7 with actuator in desired closed position.
9. Operate the unit several times and recheck position.

Note: Make sure the limit switches stop the actuator, not the mechanical stops.

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(513) 247-5465 Fax (513) 247-5462

Manual Override Operation

1. Manual override can be operated only when motor is de-energized

   Handwheel will turn as actuator operates.
2. No mechanical stops are available to stop the actuator at the full open and closed position during manual operation.
5. Reconnect the electric to actuator for automatic operation.
6. The manual override handwheel will turn during operation.

Trouble Shooting Guide

Problem:
- There is power to the unit, but it does not repond.

Solution:
- Check the nameplate to see that the correct voltage has been applied.
- Check the wiring to see that it is per the wiring schematic.
- Check the limit switches to see if they are in the normal operating position.

Problem:
- Power is getting to the motor, but it merely hums.

Solution:
- Check to see that the proper voltage is applied.
- Make sure all the connections are tight.
- Check to see that CW and CCW power connections are not powered at the same time.
- Make sure the limit switches stop the actuator, not the mechanical stops.

Problem:
- The actuator performs erratically.

Solution:
- Check the ambient temperature rating. The permanet split capacitor units are equipped with thermal cut-outs. Excessive temperatures and cycle frequencies may heat the motor up and the thermal cut-out turns off the motor.

Wiring Diagrams

- Caution: Electric operation of each actuator must be through an individual single pole control switch, in order to isolate the unused motor winding.
- Wiring diagrams show internal wiring connections and customer connections
- For additional voltages & control options please consult factory.

Installation & Maintenance Instructions

HYDRAMOTOR® PUSH-TYPE LINEAR ACTUATOR WITH GENERAL PURPOSE OR WATERTIGHT ENCLOSURE

SERIES

AH2E

⚠ WARNING

To prevent the possibility of death, serious injury or property damage, the Hydramotor® Actuator must be installed and serviced only by a qualified service technician avoiding the following hazards:

- **Electrical hazard. Turn off all electrical power to Hydramotor® Actuator.**
- **Risk of electric shock – More than one disconnect switch may be required to de-energize the device for servicing.**
- **Pressure hazard. Depressurize valve and vent hazardous or combustible fluid to a safe area before inspection or removal of the actuator or valve from service.**
- **Explosion, fire or toxic gas hazards. Extinguish all open flames and avoid any type of sparking or ignition during leakage testing.**

Service Notices

See separate V710 Gas Valve Installation and Maintenance Instructions for information on: Operation, Positioning, Mounting, Piping, Strainer or Filter Requirements, Flow Controls, Preventive Maintenance, and Cause of Improper Operation.

Do not install an actuator with General Purpose Enclosure in a location subject to weather, wash down, or other sources for water ingress. Use watertight enclosure for these locations.

DESCRIPTION

AH2E Hydramotors® are self-contained linear, push-type actuators which extend when powered and retract by spring force upon power interruption.

The AH actuator is typically used for control of gas-fired heating equipment, commonly to open and close a valve or both a valve and damper. AH2E actuators position V710 Series gas valve assemblies.

OPERATION

Application of electrical power simultaneously drives an electric pump and closes a normally-open dump valve, resulting in up to 250 pounds of force on the actuator stem. This extends the actuator stem and attached valve poppet, to open the valve and/or damper.

Upon reaching the fully extended position, a travel limit switch interrupts power to the electric motor while maintaining power to the dump valve, thus stabilizing hydraulic pressure to hold shaft position. Position indicators on both sides of the actuator show the actual position of the valve stem.

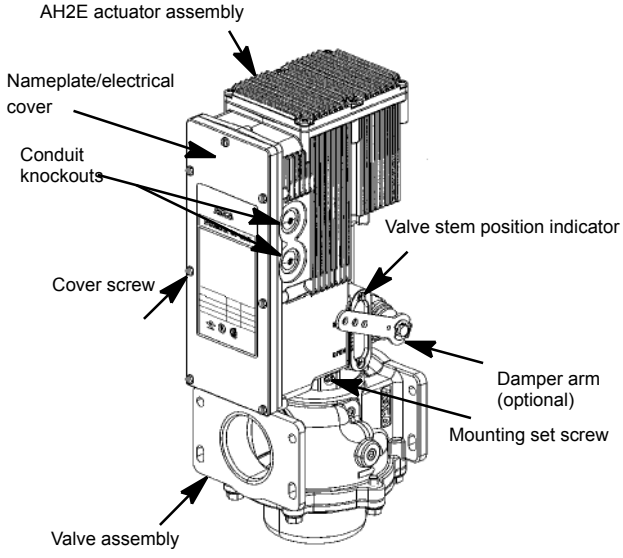
Upon power interruption, the dump valve opens releasing hydraulic pressure, and allowing the return spring to retract the stem and close the valve fully. Closing time is one second or less.

ACTUATOR / VALVE COMPATIBILITY

The AH2E series actuator is **designed for use with ASCO V710 series valves only** and is compatible with all ASCO V710 series valves.

OPTIONAL FEATURES

- **Damper Shaft Arm** Is factory-mounted on RH side. The arm is field-adjustable to 8 positions and can be switched to the LH side.
  - » **Damper Arm Rating:** Drives damper in one direction only. 20 lb maximum at 2.85 in. radius at 20°F to 150°F (-7°C to 65°C) and 10 lb maximum at -40°F to 20°F (-40°C to -7°C). Damper spring and linkage must provide sufficient return force.
  - » **Damper Arm Travel:** 2”
- **Auxiliary Switch** One or two integral SPDT switches, field adjustable to actuate at any position of stroke. This is not a safety switch.
- **Overtravel Proof-of-Closure Switch** A single factory set non-field adjustable SPDT switch to be used in conjunction with V710 Series Gas Valves with overtravel seal (V22 orV25 suffix in catalog number).



AH2E Actuator and V710 Valve Assembly
Figure 1

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Specifications

Force Output: 250 lbs

Stroke: 1 1/8" maximum

Electrical Characteristics:

Operating Voltage / Frequency	Current, in Amperes		
	Inrush	Opening	Holding
24/60	28	8.2	0.49
120/60*	5.6	2.1	0.09
240/60*	2.8	1.1	0.04

*Current increases by 20% for 50Hz operation.

Opening Time: Fast Opening: 6 to 14 seconds
Slow Opening: 14 to 26 seconds

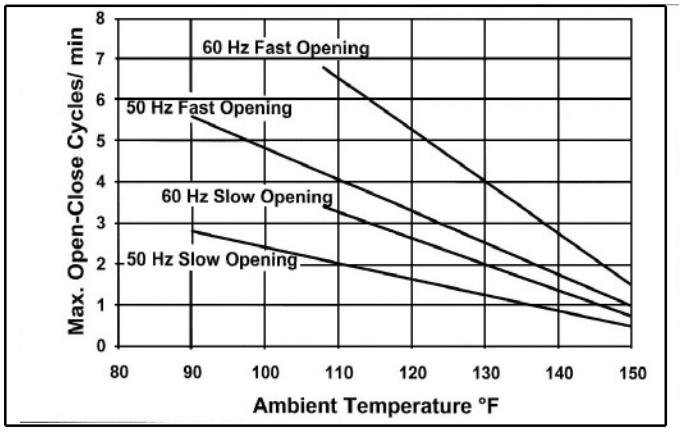
Note:

- Opening time doubles below -30°F (-34°C).
- 50Hz operation increases opening time by 20%.
- Opening time is not field adjustable.

Maximum Closing Time: One second

Ambient Temperature and Duty Cycle Limitations

The actuator may be operated in ambient temperature conditions from -40°F to 150° F (-40°C to 65°C). Actuator can be cycled open / close continuously below 108°F (42°C) for 60Hz and below 90°F (32°C) for 50 Hz. See chart below for limitations (open / close cycles) at elevated temperatures.



NOTICE

The AH2E actuator is fitted with a self-resetting thermal cutout device. If the recommended temperatures and duty cycles above are exceeded, the thermal cutout may trip causing the actuator to stop in its current position during valve opening. The valve closing time remains one second or less regardless of thermal cutout trip. Once the actuator cools,the cutout will self-reset and the actuator will resume operation. If the cutout trips repeatedly, verify that the application is within the ambient temperature and the duty cycle limits of the actuator. If the application is within the specified operating limits and the cutout continues to trip, replace actuator.

INSTALLATION

Positioning/Mounting

Follow the V710 Series Gas valve and/or damper manufacturer's instructions when installing the Hydramotor®.

1. AH2E actuators can be installed to operate in any position.
2. Check to ensure that the mounting gasket is in the proper position, clean and without damage. Position the actuator to operate the valve **(and damper if appropriate)**. Secure actuator with the three mounting set screws. Tighten set screws to 80 ± 5 in-lbs [9,0 ± 0,5 Nm] using a 5/32" hex key wrench. (See Figure 1)

Wiring (Refer to Figure 2)

⚠ WARNING: Electrical hazard. To prevent the possibility of death, serious injury or property damage, open all circuits before inspection, service or disassembly.

Wiring must comply with local codes and the National Electrical Code. Limit controls must conform with actuator rating (voltage, amperage, hertz). Wiring to meet NEC Class I, suitable for 90°C. Wire limit controls to the hot side of power supply.

1. Check the nameplate and confirm that the appropriate power is being supplied to the unit. Remove the front cover (with nameplate) and set aside to access electrical connections taking care not to damage the cover gasket if supplied. A diagram is located on the inside of the cover to aid in making electrical connections.
2. Remove the desired electrical knock out and install appropriate electrical fittings. Type4 fittings must be used with watertight units. Route wiring through the fitting. Take care not to scratch or otherwise damage the cover sealing surface when working on watertight enclosure.
3. Connect the power to terminals 1 and 2. The neutral wire, if applicable, should be connected to terminal 1. Connect the ground wire to the grounding screw provided on the housing next to the terminal strip.
4. Torque terminal screws: 8 to 12 in-lbs [0.9 to 1.3 Nm]. Torque ground screw: 20 to 25 in-lbs (2.3 to 2.8 Nm)
5. If a proof of closure or auxiliary switch is being used make those electrical connections. **Use the markings located on the insulators to determine normally open and normally closed terminals.** Torque electrical connection screws 8 to 12 in-lbs (0.9 to 1.3 Nm). Refer to auxiliary switch adjustment section on page 3 for instructions on adjusting switch. Proof of closure switches are set at the factory. **Do not adjust proof of closure switches.**
6. Install the cover. Be certain that the gasket (if applicable) and sealing surfaces are clean and there is no damage to the surfaces or gasket. Snug down all screws before tightening. Torque screws 20 to 25 in-lbs (2.3 to 2.8 Nm) evenly using a crisscross pattern starting in the middle and not in the corner.
7. If the damper arm is being used, connect linkage and adjust as needed for proper operation of the damper.

   Damper Arm Adjustment: To reposition the damper arm, remove the e-ring retainer and damper arm then reposition arm and reinstall e-ring. When repositioning arm onto the opposite side, remove e-rings on both sides and reposition and install on opposite sides. DO NOT remove the square damper shaft.
8. Operate actuator (with valve) through five cycles to verify proper operation of valve and damper/ linkage system prior to use.

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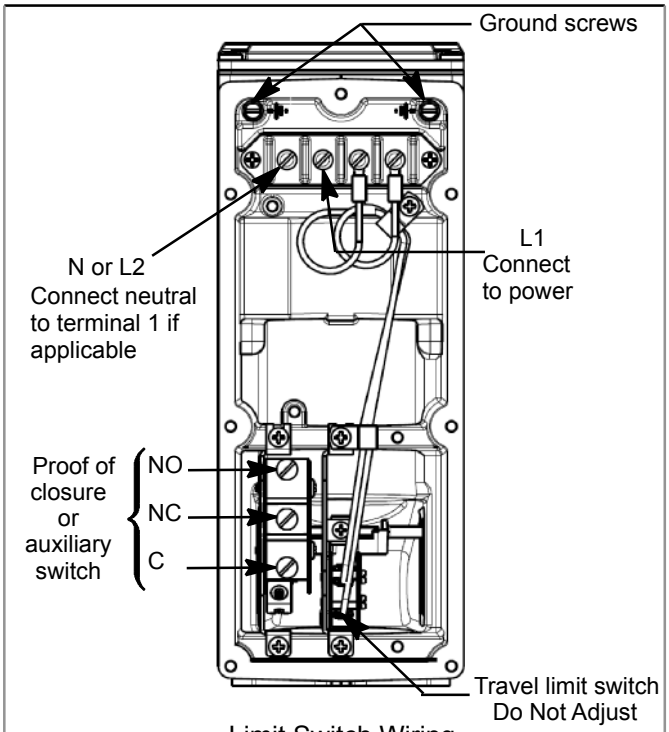


Limit Switch Wiring
Figure 2

Auxiliary and Overtravel Proof-of-Closure Switch Ratings

120VAC: 15 Amps, 1/3 HP
240VAC: 7.5 Amps, 1/2 HP

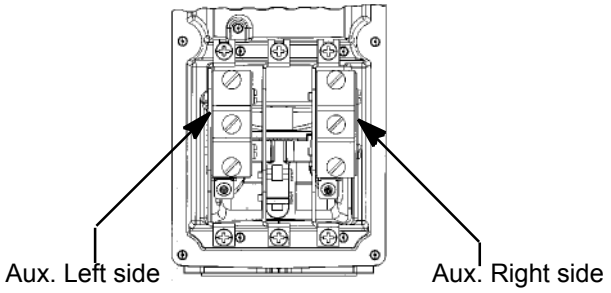
Total connected load of auxiliary and overtravel proof-of -closure switches not to exceed 1800VA.

CAUTION: Overtravel Proof-of-closure switch must only be used with V710 Series Gas Valves having an overtravel seal (V22 or V25 Suffix in catalog number).

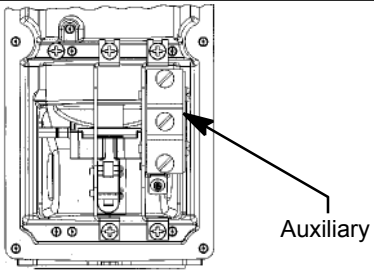
Overtravel Proof-of-Closure Switch

The optional valve overtravel proof-of-closure switch is set at the factory to provide both a mechanical and electrical means of proving valve closed position interlock to the primary control. **This switch is not to be field adjusted.**

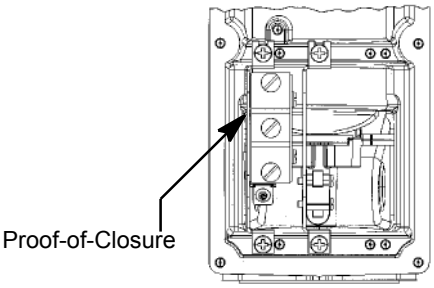
Optional Auxiliary and Overtravel Proof-of-Closure Switch Combinations (Partial Views)



Two Auxiliary Switches
Figure 3



Single Auxiliary Switch
Figure 4

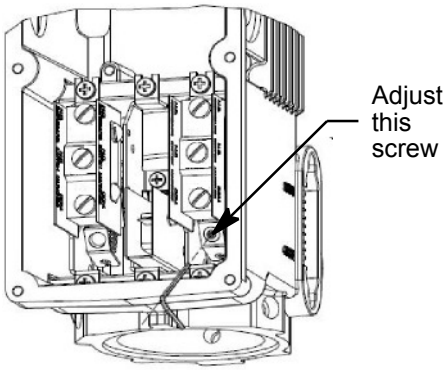


Proof-of-Closure Switch
Figure 5

Auxiliary Switch Adjustment (Refer to Figure 6)

Note: The Auxiliary switch is not a safety switch.

1. **Before removing the cover, review WARNING statements on page 1.** Remove cover screws and nameplate/electrical cover (with gasket if fitted). Take care not to damage the sealing surfaces and cover gasket if supplied.
2. Insert 1/16" Allen key into adjusting screw on auxiliary switch assembly.
3. Turn screw clockwise to move set point towards beginning of actuator stroke. Turn screw counterclockwise to move setpoint toward the end of the actuator stroke. (approximately 8.5 turns from 0 to 100% travel)
4. Cycle the actuator to verify the switch setting and readjust as required.
5. Install the cover. Be certain that the gasket (if applicable) and sealing surfaces are clean and without damage. Snug down all screws before tightening. Torque screws 20 to 25 in-lbs (2.3 to 2.8 Nm) evenly using a crisscross pattern starting in the middle.



Auxiliary Switch Adjustment
Figure 6

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MAINTENANCE

Before inspection, maintenance or rebuild, review WARNING statements on page 1. Maintenance should include annual inspection and cleaning. Use a mild cleaning fluid, not aggressive solvents to remove dirt and oil. Organize a maintenance schedule based on environment and frequency of use. Check for loose electrical and mechanical connections and replace damaged parts. Do not remove the top cover for maintenance. There are no serviceable parts contained inside the actuator housing.

Field Service Notice

Field service replacement kits are limited to the following:

1. Auxiliary Switch Replacement Kit 296804.
2. Proof of Closure Switch Replacement Kit 296806.
3. Travel Limit Switch Replacement Kit 296807.
4. Gasket and Screw Replacement Kit 296808.
   Kit contains:
   - Front cover gasket and screws
   - Window o-ring and screws
   - Mounting gasket and set screws.

To order, specify the kit or part number, as well as the actuator model number.

Auxiliary Switch Replacement (Refer to Figure 7)

Note: The Auxiliary switch is not a safety switch.

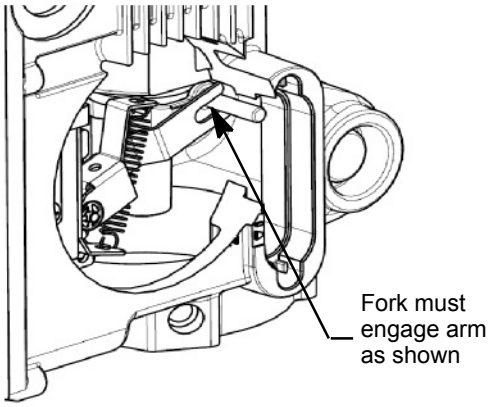
1. **Before removing the cover, review WARNING statements on page 1.** Remove the front cover (with nameplate) and set aside. Take care not to damage the cover gasket if supplied or sealing surfaces. A diagram is located on the inside of the cover to aid in making electrical connections.
2. Disconnect auxiliary switch wiring.
3. Remove two mounting screws and the auxiliary switch.
4. Install new auxiliary switch in the actuator making sure that the fork of the switch actuation lever engages the indicator arm as shown in Figure 8.
5. Torque mounting screws 20 to 25 in-lbs (2.3 to 2.8 Nm).
6. Reconnect switch wiring and torque terminal screws 8 to 12 in-lbs (0.9 to 1.3 Nm).
7. See instructions on page 3 for auxiliary switch adjustment, starting at Step 2.

Proof of Closure Switch Replacement

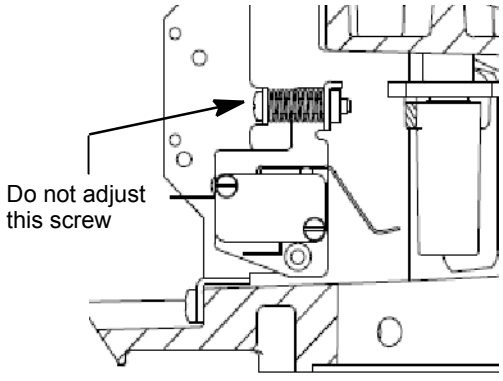
Same as auxiliary switch replacement except switch must NOT be adjusted.

Travel Limit Switch Replacement (Refer to Figure 8)

1. **Before removing the cover, review WARNING statements on page 1.** Remove the front cover (with nameplate) and set aside. Take care not to damage the cover gasket if supplied or sealing surfaces. A diagram is located on the inside of the cover to aid in making electrical connections.
2. Remove the two mounting screws.
3. Disconnect wiring from the travel limit switch taking care not to strain the wire connection at the terminal.
4. Install new travel limit switch. Torque mounting screws 20 to 25 in-lbs (2.3 to 2.8 Nm). Travel limit switches are set at the factory. DO NOT adjust.
5. Plug terminal connections to travel limit switch.
6. Install the cover. Be certain that the gasket (if applicable) and sealing surfaces are clean and without damage. Snug down all screws before tightening. Torque screws 20 to 25 in-lbs (2.3 to 2.8 Nm) evenly using a crisscross pattern starting at the middle.
7. Operate actuator (with valve) through five cycles to verify proper operation prior to use.



Auxiliary Switch
Figure 7



Limit Switch
Figure 8

Gasket replacement

The gaskets have an adhesive attachment. Use a nonmarring tool to peel off the old gasket. Remove backing from new gasket and stick on in the same location as the old gasket.

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Installation & Maintenance Instructions

2–WAY NORMALLY CLOSED GAS VALVES

3/4″, 1″, 1 1/4″, 1 1/2″, 2″, 2 1/2″ OR 3″ NPT — FUEL GAS SERVICE

SERIES B

V710

⚠ WARNING

To prevent the possibility of death, serious injury or property damage, the V710 Series B Gas Valve must be installed and serviced (tested) only by a qualified service technician avoiding the following hazards:

- **Electrical Hazard. Turn off all electrical power to Hydramotor® Actuator. More than one circuit may exist.**
- **Pressure Hazard. Depressurize valve and vent hazardous or combustible fluid to a safe area before inspection or removing the valve from service.**
- **Explosion/Fire Hazard. Extinguish all open flames and avoid any type of sparking or ignition when leakage testing.**

Service Notices

Except for actuator replacement or repair, V710 Series B Gas Valves are not repairable. When any performance problems are detected during routine inspection, replace valve immediately.

See separate AH Series Hydramotor® Actuator Installation and Maintenance Instructions for information on: Actuator Specifications, Installation, Positioning/Mounting, Wiring and Field Service of Actuator.

DESCRIPTION

V710 Series B Gas Valves are 2–way normally closed, soft–seated poppet–type valves for safety shutoff service on commercial or industrial gas burners. The V710 Series B was designed exclusively for use with AH Series E Hydramotor® Push–Type Actuators available in ON–OFF & LOW–HIGH–OFF positioning configurations.

The valves feature mounting flanges on the inlet and outlet of the valve. These flanges allow like valves to be mounted together in series without the use of an intermediate pipe nipple. This feature is intended for applications where two redundant valves are required by a governing body. The mounting of the two valves in series is accomplished with an optional connecting hardware kit. Please see additional instructions for the use of this kit in the Piping section of this I&M sheet.

The valves are equipped with aluminum seats and Nitrile seals. A quick–opening poppet is standard. Both overtravel seals and linear trim are available as options, i.e. ***Quick Opening With Overtravel Seal, Linear Opening or Linear Opening With Overtravel Seal.***

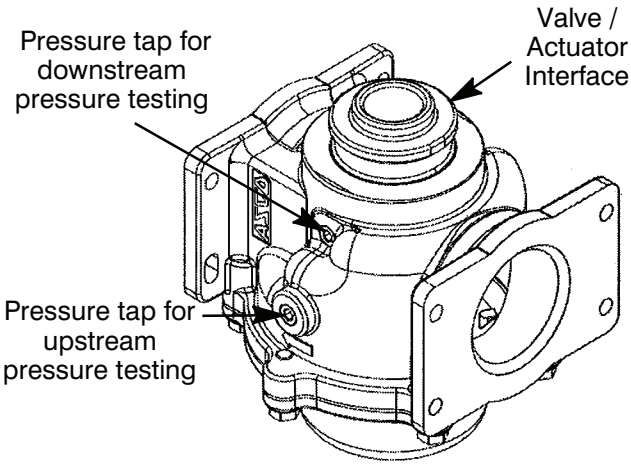
⚠ CAUTION: Use V710 Series B Gas Valves only with natural, mixed, manufactured or liquefied petroleum (propane) gases.

Provisions for Pressure and Seat Leakage Testing

V710 Series B valves are provided with four 1/8″ NPT tapped and plugged holes (pressure taps). Each side of the valve body is provided with upstream and downstream pressure taps for testing. The taps closest to the valve/actuator interface are downstream, while the taps closest to the bottom of the valve body are upstream. Leakage testing frequency shall be at least annually in accordance with NFPA–86 or original equipment manufacturer recommendations. For instructions, refer to section on ***Testing for Internal (Seat) Leakage*** and Figures 1 and 2.

View of valve assembly showing location of tapped and plugged holes for pressure and seat leakage testing

Pipe plugs are 1/8″ NPT
(use 3/16″ hex key wrench)



Note: Upstream and downstream pressure taps are on either side of valve body.

Figure 1. Provisions for pressure and seat leakage testing

OPERATION

V710 Series B is a normally closed, push–to–open valve which opens when the valve stem is depressed by an AH Actuator. An internal return spring closes the valve when its actuator is de–energized or removed. The actuator is retracted by its own internal return spring.

Maximum Operating Pressure Differentials:

3/4″, 1″, 1 1/4″ 1 1/2″, 2″, 2 1/2″ and 3″NPT – 15 psi

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INSTALLATION

Check nameplate for correct catalog number, pressure, and service. Check the catalog number against Table 1 to ensure that the valve meets the requirements of the application. Never apply incompatible fluids or exceed pressure rating of the valve.

V710 SERIES B

SIZE
- E = 3/4 ″
- F = 1 ″
- G = 1 1/4 ″
- H = 1 1/2 ″
- J = 2 ″
- K = 2 1/2 ″
- L = 3 ″
- M = 2″ High Flow

SERIES REVISION LETTER
- B = Revision B

BODY MATERIAL
- S = Aluminum Body

OPTIONS
- NONE = Quick opening (standard)
- V15 = Linear trim
- V22 = Quick opening plus overtravel seal
- V25 = Linear plus overtravel seal

V710GBSV15 (Typical Catalog Number)

Table 1. V710 Series B Product Codification

Temperature Limitations

Ambient and Fluid Temperature: –40F (–40°C) to 150°F (65°C).

Positioning

Valve body may be mounted in any position.

⚠ CAUTION: Valve/Actuator interface has a protective cap over the stem connection, do not remove protective cap until actuator is installed on valve body.

Piping

⚠ CAUTION: Piping must comply with applicable local and national codes and ordinances, including the National Fuel Gas Code ANSI Z223.1/NFPA No. 54.

Connect piping to valve according to markings on valve body. Apply pipe compound sparingly to male pipe threads only. If applied to valve threads, the compound may enter the valve and cause operational difficulty. Avoid pipe strain by properly supporting and aligning piping. When tightening the pipe, do not use valve or solenoid as a lever. Locate wrenches applied to valve piping as close as possible to connection point. Locate wrenches applied to valve body per Figure 1. Valve should be checked for external leakage at piping connections after installation. See ***Testing for External Leakage*** section.

These valves feature mounting flanges on the inlet and outlet of the valve for direct connection to one another or connection in a valve train with an optional Flange Adapter Kit. The optional Flange Adapter Kit may also be used in place of direct piping for easy maintenance and disassembly of the valve without breaking any NPT pipe connections. This feature may only be used with an optional ASCO connecting hardware kit containing approved hardware and seals. The use of hardware and seals that are not part of the kit will void your warranty. Please refer to Installation & Maintenance Instructions, I&M No. V9567 for kit part numbers and contact ASCO for availability.

⚠ WARNING: To prevent the possibility of death, serious injury or property damage, only use the optional ASCO connecting hardware kit for the direct connection of these valves to one another. Complete instructions and guidelines for piping the valves together are included in the kit.

⚠ WARNING: To prevent the possibility of death, serious injury or property damage, only use ASCO brand AH Hydramotor Actuators with the V710 series of valves. The use of actuators other then ASCO brand may cause a safety issue and will void your warranty.

⚠ CAUTION: To avoid damage to the valve body DO NOT OVERTIGHTEN PIPE CONNECTIONS. If PTFE tape, paste, spray, or similar lubricant is used, use extra care when tightening due to reduced friction.

⚠ CAUTION: To protect the valve, install a strainer or filter, suitable for the service involved, in the inlet side as close to the valve as possible. Clean periodically depending on service conditions. See ASCO Series 8600 and 8601 for strainers.

Testing for External Leakage

⚠ WARNING: Explosion/Fire Hazard. To prevent the possibility of death, serious injury or property damage from the possible release of combustible gas to the atmosphere, extinguish all open flames and avoid any type of sparking or ignition.

1. Block gas flow on downstream side of valve.
2. Apply pressure to valve within nameplate rating and energize solenoid.
3. Apply a soapy solution or a commercially available leak detecting solution to the pipe connections, and/or inlet/outlet flange adapter connections and check for bubbles. If the valve has been tested for seat leakage or disassembled and reassembled for inspecting, cleaning or rebuilding, apply the solution around the solenoid base sub–assembly, bonnet/body joint and pipe plugs.
4. If leakage exists. depressurize valve and turn off electrical power supply. Tighten connections and retest following the above steps.

MAINTENANCE

Preventive Maintenance

- Prepare and follow a routine inspection schedule based on the media, environment, and frequency of use. This should include periodic internal and external leakage checks.
- Keep the medium flowing through the valve as free from dirt and foreign material as possible. Depending on medium and service conditions, clean valve strainer, filter or drip leg as required to keep the valve free of contamination. In the extreme case, contamination will cause faulty valve operation and the valve may fail to open or close.
- While in service, the valve should be operated at least once a month to ensure proper opening and closing.

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Testing for Internal Seat Leakage (Refer to Figures 1&2)

⚠ WARNING: Explosion/Fire Hazard. To prevent the possibility of death, serious personal injury or property damage from the release of combustible gas to the atmosphere, extinguish all open flames and avoid any type of sparking or ignition.

⚠ CAUTION: Be sure valve can be tested without affecting other equipment.

1. Shut off both the upstream and downstream manual gas cocks. The downstream manual gas cock should remain closed throughout the entire test procedure.
2. Program the control system to operate valve through five cycles.
3. Open the upstream manual gas cock. Program the control system to energize and maintain the valve in the open (energized) position. Check all valve and piping connections for external leaks with rich soap and water solution or a commercially available leak detecting solution.
4. Shutoff the upstream manual gas cock and de–energize valve. Remove the plug from the leak test tap or downstream pressure tap in the valve body. Connect leak test equipment with the test petcock in the closed position, see Figure2.
5. Open the upstream manual gas cock. Program the control system to energize the valve to the full open position, then immediately de–energize it to seat the valve during operation.
6. Immerse the 1/4″ leak test tubing vertically into the plastic container of water to a depth of about 1/2″. Slowly open the test petcock. Bubbles may appear in the water as the pressure equalizes.
7. After the rate of bubbles coming through the water stabilizes, count the number of bubbles appearing in a 10 second period. The allowable leakage in 10 seconds for an orifice diameter of 1 inch (25.4 mm) or less is 6 bubbles (3 cc/min).

   For valves with an orifice diameter over 1 inch (25.4 mm) the allowable leakage rate is 6 bubbles (3 cc/min.) per inch (25.4 mm) of orifice diameter. If leakage exceeds this rate, replace valve.

NOTE: The leakage rate above recognizes that some wear and contamination from use can result in a slight amount of leakage. The allowable leakage rate is well within the leakage limits as recognized by applicable approval agencies.

8. Close the upstream manual gas cock and the test petcock. Then remove the test equipment. Apply a small amount of Loctite Corporation's PST® Pipe Sealant 567 (or equivalent) to the pipe plug threads. Reinstall pipe plug and torque to 12 ft–lbs (16.3 Nm).
9. Open the upstream manual gas cock. Program the control system to energize and maintain the valve in the open (energized) position. Check 1/4″ NPT pipe plug connection for external leaks with rich soap and water solution or a commercially available leak detecting solution.
10. De–energize the valve. Open the downstream manual gas cock.
11. Restore the system to normal operation.

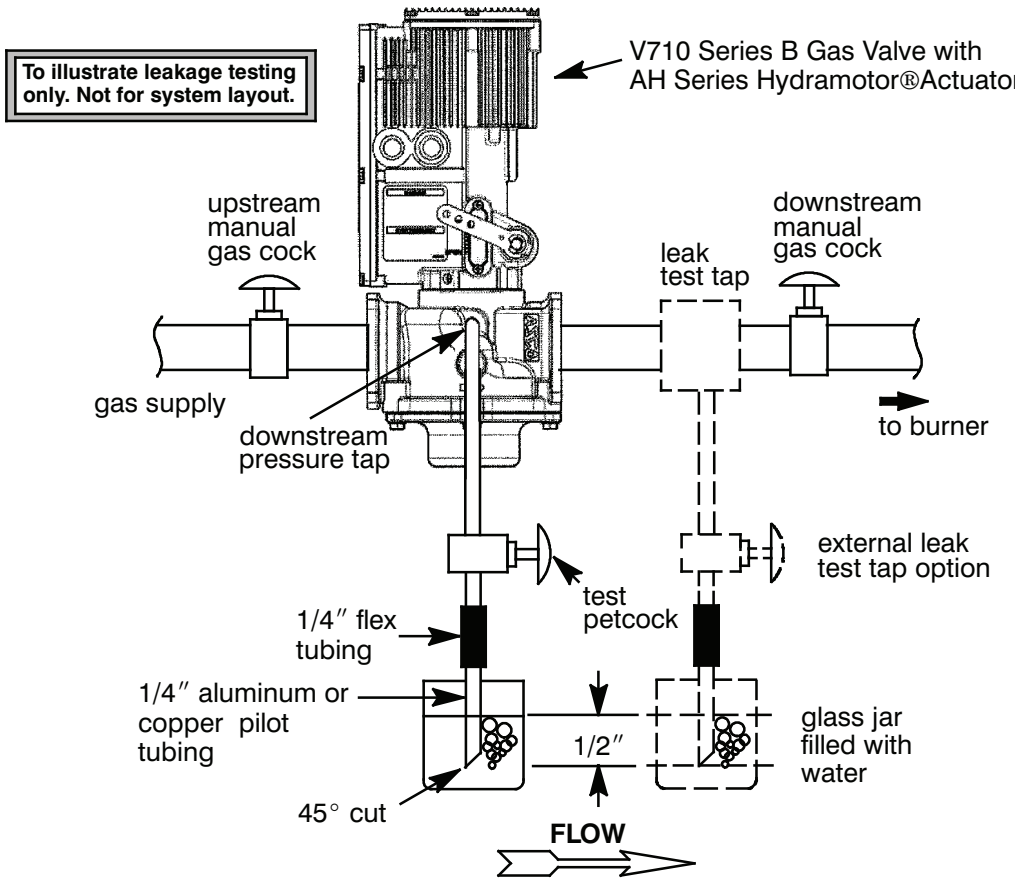

Figure 2. Testing for Internal Seat Leakage.

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Installation & Maintenance Instructions

2–WAY INTERNAL PILOT–OPERATED SOLENOID VALVES
NORMALLY OPEN OPERATION – 3/4", 1", 1–1/4", 1–1/2" OR 2" NPT
HIGH FLOW AIR OR FUEL GAS SERVICE

SERIES

8215

Form No.V5993R4

IMPORTANT: See separate solenoid installation and maintenance instructions for information on: Wiring, Solenoid Temperature, Causes of Improper Operation, and Coil Replacement.

DESCRIPTION

Series 8215 valves are 2–way normally open diaphragm type, solenoid valves designed for high flow air or fuel gas service. Valve bodies are made of rugged aluminum with trim and internal parts made of steel and stainless steel. Series 8215 valves may be provided with a general purpose or explosionproof solenoid enclosure.

OPERATION

Normally Open: Valve is open when solenoid is de–energized; closed when energized.

IMPORTANT: No minimum operating pressure differential required.

INSTALLATION

Check nameplate for correct catalog number, pressure, voltage, frequency, and service. Never apply incompatible fluids or exceed pressure rating of the valve. Installation and valve maintenance to be performed by qualified personnel.

Future Service Considerations

Provision should be made for performing seat leakage, external leakage, and operational tests on the valve with a nonhazardous, noncombustible fluid after disassembly and reassembly.

Temperature Limitations

For maximum valve ambient and fluid temperatures, refer to chart below. Check catalog number prefix on nameplate to determine maximum temperatures.

Construction	Coil Class	Catalog Number Prefix	Maximum Ambient Temp.°F	Maximum Fluid Temp.°F
AC Construction	A	None	104	104
	F	FT	125	125
	H	HT	140	140
DC Construction	B or H	None or HT	77	77

*DuPont Co. Registered Trademark

Positioning

Valves of AC construction with 3/4", 1", 1–1/4", or 1–1/2", NPT connections are designed to perform properly when mounted in any position. The 2" NPT valves of AC construction may be mounted with solenoid in any position from horizontal to vertical and upright. However, for optimum life and performance, the solenoid on all sizes should be mounted vertically and upright to reduce the possibility of foreign matter accumulating in the solenoid base sub–assembly area. **IMPORTANT: All valves of DC construction must be mounted with solenoid vertical and upright.**

Piping

Connect piping to valve according to markings on valve body. Apply pipe compound sparingly to male pipe threads only. If applied to valve threads the compound may enter the valve and cause operational difficulty. Avoid pipe strain by properly supporting and aligning piping. When tightening the pipe, do not use valve or solenoid as a lever. Locate wrenches applied to valve body or piping as close as possible to connection point.

CAUTION: To avoid damage to the valve body, DO NOT OVERTIGHTEN PIPE CONNECTIONS. If Teflon* tape, paste, spray or similar lubricant is used, use extra care when tightening due to reduced friction.

IMPORTANT: To protect the solenoid valve, install a strainer or filter, suitable for the service involved, in the inlet side as close to the valve as possible. Clean periodically depending on service conditions. See ASCO Series 8600, 8601 and 8602 for strainers.

MAINTENANCE

⚠ WARNING: To prevent the possibility of death, serious injury or property damage, turn off electrical power, depressurize valve, extinguish all open flames and avoid any type of sparking or ignition. Vent hazardous or combustible fluid to a safe area before servicing the valve.

NOTE: It is not necessary to remove the valve from the pipeline for repairs. See ***Service Note*** under ***Valve Disassembly and Reassembly***.

Cleaning

All solenoid valves should be cleaned periodically. The time between cleanings will vary depending on the medium and service conditions. In general, if the voltage to the coil is correct, sluggish valve operation, excessive noise or leakage will indicate that cleaning is required. In the extreme case, faulty valve operation will occur and the valve may fail to open or close. Clean valve strainer or filter when cleaning the valve.

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Preventive Maintenance

- Keep the medium flowing through the valve as free from dirt and foreign material as possible.
- Periodic exercise of the valve should be considered if ambient or fluid conditions are such that corrosion, elastomer degradation, fluid contamination build up or other conditions that could impede solenoid valve shifting are possible. In many cases, solenoid valves are periodically exercised during normal system use or as part of routine maintenance or surveillance activities and no additional exercise is necessary. The actual frequency of exercise necessary will depend on specific operating conditions. A successful operating history is the best indication of a proper interval between exercise cycles.
- Depending on the medium and service conditions, periodic inspection of internal valve parts for damage or excessive wear is recommended. Thoroughly clean all parts. If parts are worn or damaged, install a complete ASCO Rebuild Kit.

Causes of Improper Operation

1. **Incorrect Pressure:** Check valve pressure. Pressure to valve must be within range specified on nameplate.
2. **Excessive Leakage:** Disassemble valve (see Maintenance) and clean all parts. If parts are worn or damaged, install a complete ASCO Rebuild Kit.

Valve Disassembly and Reassembly

⚠ WARNING: To prevent the possibility of death, serious injury or property damage, turn off electrical power, depressurize valve, extinguish all open flames and avoid any type of sparking or ignition. Vent hazardous or combustible fluid to a safe area before servicing the valve.

—Service Note—

It is not necessary to remove the valve from the pipeline for inspecting, cleaning or rebuilding. However, for ease of valve reassembly (after maintenance), the solenoid valve should be temporarily in the upside−down position with the solenoid portion completely assembled. Electrical hookup to the solenoid is also required. This upside−down position allows easy alignment of parts through bottom cavity of the valve and a free hand to help in parts alignment. Therefore, it is recommended that whenever possible the valve be removed from the pipeline or inverted to the upside−down position, in the pipeline for reassembly. This is the preferred method and position for valve reassembly.

NOTE: Determine valve construction AC (Figure 1) or DC (Figure 2) and proceed as follows:

1. Remove solenoid enclosure, see separate installation and maintenance instructions.
2. For AC construction, unscrew solenoid base sub−assembly. Then remove spring retainer, core spring, core assembly and bonnet gasket. For DC Construction, unscrew solenoid base sub−assembly with special wrench adapter provided in ASCO Rebuild Kit. For wrench adapter kit only, order No.K218−949.

NOTE: An alternate type open end wrench, Order No. K168−146−1 is available for solenoid base sub−assembly removal or replacement.

3. Remove solenoid base sub−assembly, housing, core assembly (with core spring and rider rings attached) and bonnet gasket.
5. All parts are now accessible to clean or replace. If parts are worn or damaged, install a complete ASCO Rebuild kit.

Valve Reassembly

1. Reassemble using exploded views for identification and placement of parts.
2. Lubricate bonnet gasket and body gasket with a light coat of DOW CORNING® 111 Compound lubricant or an equivalent high grade grease.
3. Apply a light coat of RemGrit TFL 50 Dry Lubricant to:
   - Valve seat
   - Valve body flange where diaphragm assembly seats against valve body and body gasket.
   - Internal surface of valve bonnet where diaphragm assembly seats when valve is in the de−energized (open) position.
   - Seating surface of disc on diaphragm assembly.
4. Position bonnet gasket in valve body.
5. For AC construction, thread solenoid base sub−assembly into valve body. Torque solenoid base sub−assembly to 45 ± 5 ft−lbs (61,1 ± 6,8 Nm). For DC construction, position solenoid base sub− assembly into housing and then engage with valve body using special wrench adapter. Torque solenoid base sub−assembly to 30 ± 5 ft−lbs (40,7 ± 6,8 Nm).
6. Reassemble solenoid, see separate installation and maintenance instruction.
   NOTE: If possible position valve in upside−down position.
7. For AC construction, install core spring and spring retainer in core assembly.
8. Position core assembly through valve body and into the solenoid base sub−assembly.
9. Make a temporary electrical hookup to the solenoid. Then energize the solenoid. The core assembly will pull into the solenoid base sub−assembly.
   IMPORTANT: Solenoid should remain energized until valve is completely assembled and bonnet screws are tightened.

⚠ WARNING: If solenoid is accidentally de−energized before complete valve assembly, core assembly could disengage and fly outward. To prevent eye injury wear eye protection.

10. Install body gasket in valve body.
11. Install diaphragm assembly onto stem portion of core assembly and into valve body. Locate bleed hole in diaphragm assembly approximately 30° from valve inlet. Be sure all bonnet screw holes in diaphragm assembly are in alignment with holes in valve body.
12. Install diaphragm spring with wide end of spring facing valve bonnet.

13. Replace valve bonnet and bonnet screws, start all bonnet screws by hand. Torque bonnet screws in a crisscross manner to 100 ± 10 in−lbs (11,3, ± 1, 1 Nm). NOTE: For Catalog Numbers 8215A37 and 8215A38, torque screws to 70 ± 8 in−lbs (7,9 ± 0,9 Nm).
14. If necessary, make up piping and final electrical hookup.

⚠ WARNING: To prevent the possibility of death, serious injury or property damage, check valve for proper operation before returning to service. Also perform internal seat and external leakage tests with a nonhazardous, noncombustible fluid.

15. Restore line pressure and electrical power supply to valve.
16. After maintenance is completed, operate the valve a few times to be sure of proper operation. A metallic "click" signifies the solenoid is operating.

ORDERING INFORMATION FOR ASCO REBUILD KITS

Parts marked with an asterisk (*) in the exploded view are supplied in Rebuild Kits.

●When Ordering Rebuild Kits for ASCO valves, order the Rebuild Kit number stamped on the valve nameplate.+

+ If the number of the Rebuild Kit is not visible order them and specify your valve's Catalog Number and Serial Number.

Torque Chart		
Part Name	Torque Value	Torque Value Newton−Meters
Solenoid Base Sub−Assembly	45 ± 5 ft−lbs	61,1 ± 6,8
Bonnet Screws	100 ± 10 in−lbs	11,3 ± 1,1
Bonnet Screws (Catalog Nos. 8215A37 & 8215A38 only)	70 ± 8 in−lbs	7,9 ± 0,9

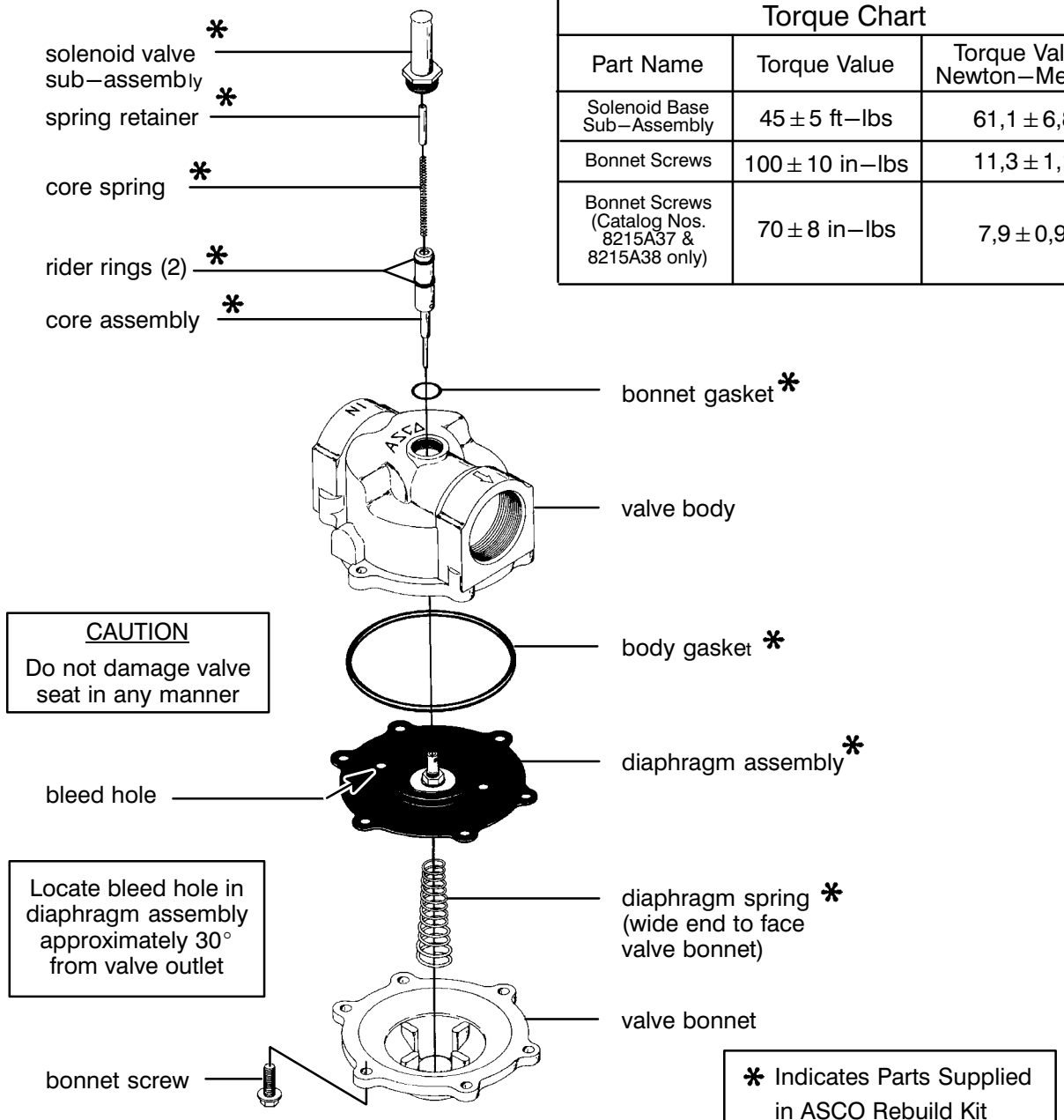

Figure 1. Series 8215 AC Construction

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Torque Chart		
Part Name	Torque Value	Torque Value Newton−Meters
Solenoid Base Sub−Assembly	30 ± 5 ft−lb	40,7 ± 6,8
Bonnet Screws	100 ± 10 in−lb	11,3 ± 1,1
Bonnet Screws (Catalog Nos. 8215A37 & 8215A38 only)	70 ± 8 in−lb	7,9 ± 0,9

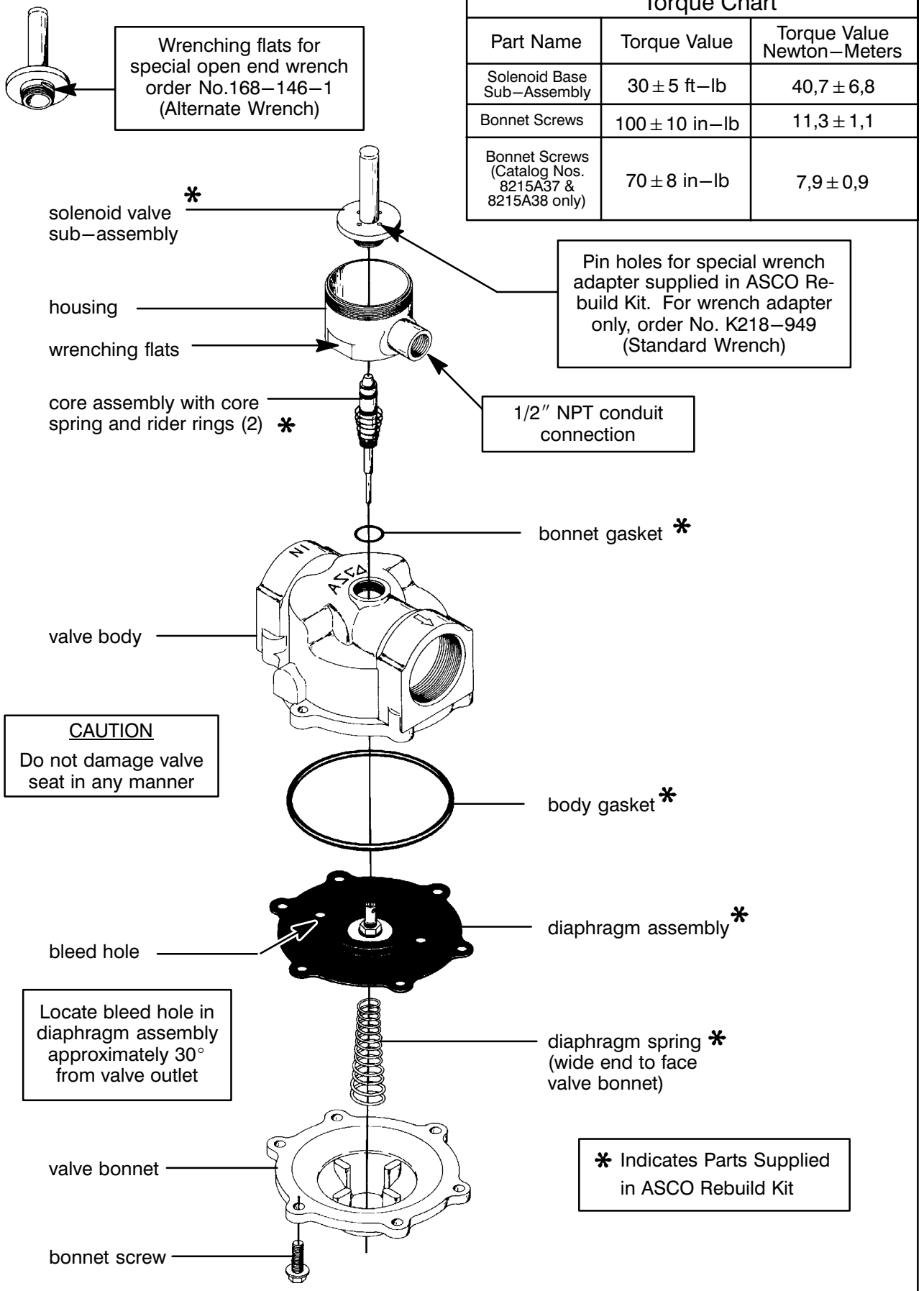


Figure 2. Series 8215 DC Construction

ASCO® 50 Hanover Road, Florham Park, New Jersey 07932 www.ascovalve.com

ASHCROFT®

Low Pressure Diaphragm Gauge
Series 1490, Grade A (2-1-2%)

- ***2½˝ and 3½˝ dial size***
- ***Glass-filled polysulfone case material***
- ***Beryllium copper diaphragm***
- ***Brass socket***
- ***Wetted materials of beryllium copper, brass, polysulfone and RTV silicone***

The Ashcroft® Type 1490 low pressure diaphragm gauge is designed to measure pressure from 10 in.H_2O to 15 psi, both positive and negative pressures. This gauge uses a very sensitive diaphragm capsule to measure low pressure and vacuum. The gauge is specifically designed for use whenever the pressure medium is a gas that is not corrosive to beryllium copper, brass, polysulfone and RTV silicone. Typical applications are, but not limited to, vacuum pumps, gas leak detectors, air compressors, air filters, gas burners, gas measurement, vacuum ovens, suction regulators and respirators.

SELECTION TABLE

DIAL SIZE		TYPE		WETTED MATERIAL		CONN. SIZE & TYPE		CONNECTION LOCATION		RANGES		OPTIONAL FEATURES	
Code	Desc.	Code	Description	Code	Description	Code	Description	Code	Description	Code	Description	Code	Description
25	2½˝	1490	Low Pressure Diaphragm Gauge	A	Beryllium Copper	01	1/8 NPT	L	Lower	10 IW	0 to 10˝H_2O	XAK	Autoclavable
35	3½˝				Brass Socket	02	1/4 NPT	B	Center Back			XAN	1% Opt. Accuracy
					Polysulfone	HD	1/8˝ Hose Barb(2)	T	Top		See Chart for	XDA	Dial Marking
					RTV Silicone	HE	3/16˝ Hose Barb(2)	D	3 O'Clock		Entire List of	XNH	Stain. Steel Tag
						HF	1/4˝ Hose Barb(2)	E	9 O'Clock		Ranges	XNN	Paper Tag
												XTU	Throttle Plug
												XUC(2)	U-clamp

(2) U-clamp furnished when hose barb specified **EXAMPLES: 25 1490A 02L 10 IW XNH**

STANDARD RANGES

Pressure	Figure Intervals	Minor Graduation
0/10 in. H_2O	1	0.1
0/15 in. H_2O	5	0.2
0/30 in. H_2O	5	0.5
0/60 in. H_2O	10	1
0/100 in. H_2O	10	1
0/160 in. H_2O	20	2
0/200 in. H_2O	20	2
0/300 in. H_2O	50	5
0/10 oz./in.^{2}	1	0.1
0/15 oz./in.^{2}	5	0.2
0/30 oz./in.^{2}	5	0.5
0/60 oz./in.^{2}	10	1
0/100 oz./in.^{2}	10	1
0/160 oz./in.^{2}	20	2
0/250 oz./in.^{2}	50	5
0/3 psi	0.5	0.05
0/5 psi	1	0.1
0/10 psi	1	0.1
0/15 psi	5	0.2

STANDARD RANGES (Cont.)

Vacuum	Figure Intervals	Minor Graduation
15/0 in.H_2O	5	0.2
30/0 in.H_2O	5	0.5
60/0 in.H_2O	10	1
100/0 in.H_2O	10	1
200/0 in.H_2O	20	2
15/0 oz./in.^{2}	5	0.2
30/0 oz./in.^{2}	5	0.5
60/0 oz./in.^{2}	10	1
100/0 oz./in.^{2}	10	1
Compound		
-30/30 in.H_2O	10	1
-30/30 in.oz./in.^{2}	10	1
-10/10 in.H_2O	2	0.2

Dual Scale

Range		Graduations			
		Inner Scale		Outer Scale	
Inner Scale	Outer Scale	Figure Intervals	Minor Grad.	Figure Intervals	Minor Grad.
0/9 oz./in.^{2}	0/15 in.H_2O	1	0.2	5	0.2
0/20 oz./in.^{2}	0/35 in.H_2O	5	0.5	5	0.5
0/35 oz./in.^{2}	0/60 in.H_2O	5	0.5	10	1
0/60 oz./in.^{2}	0/100 in.H_2O	10	1	10	1

Other ranges available on request. Consult factory.

STANDARD METRIC RANGES

Pressure	Figure Intervals	Minor Graduation
0/60 cm. H_2O	10	1
0/2.5 kPa	0.5	0.05
0/4.0 kPa	1	0.1
0/10 kPa	1	0.1
0/16 kPa	2	0.2
0/25 kPa	5	0.5
0/40 kPa	10	1
0/100 kPa	10	1
Vacuum		
2.5/0 kPa	0.5	0.05
4.0/0 kPa	1	0.1
10/0 kPa	1	0.1
16/0 kPa	2	0.2
25/0 kPa	5	0.5
40/0 kPa	10	1
100/0 kPa	10	1
Compound		
–10/60 cm H_2O	10	1
–10/80 cm H_2O	10	1
–20/40 cm H_2O	10	1
–10/100 cm H_2O	10	1
–10/120 cm H_2O	20	2

TO ORDER THESE LOW PRESSURE DIAPHRAGM GAUGES:

Select: **25** **1490** **A** **02L** **XXX** **10˝H_2O**

1. Dial size – 2½ (25), 3½ (35)
2. Case type
3. Tube and socket material
4. Connection size – ¼ (02), ⅛ (01)
5. Connection location – Lower (L), Back (B)
6. Optional features – see page 102
7. Standard pressure range – 10˝H_2O

Reference Bulletin DG-2 ***Consult factory for guidance in product selection***
Phone (203) 378-8281 FAX (203) 385-0499

DRESSER INSTRUMENT

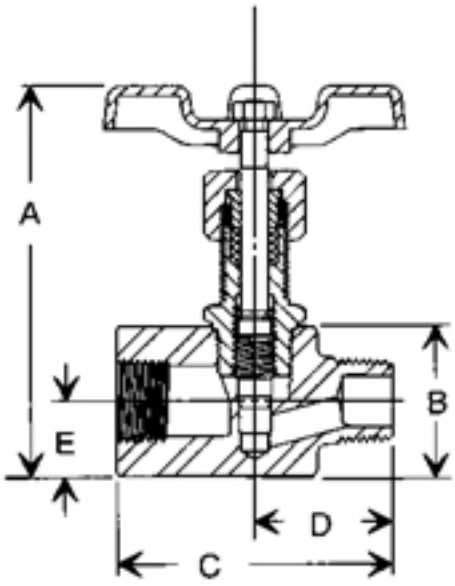
60 Series

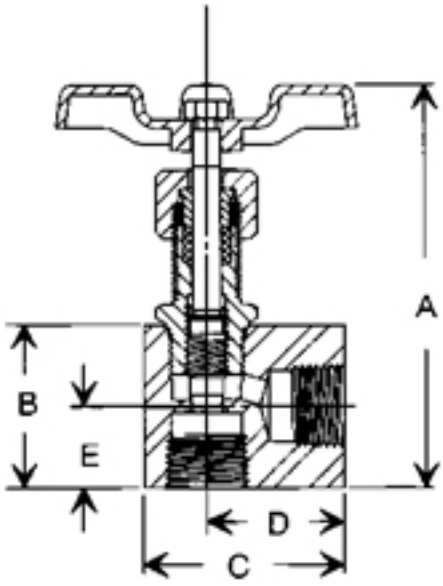
Bar Stock Needle Valves

Built from a variety of materials, these needle valves are rated to 10,000 psig for cold, non-shock service and temperatures to 550°F. Will back-seat when fully opened to relieve pressure on packing, eliminate stem blow out problems and prevent leakage.
Integral metal-to-metal seat and disc design; available with lock bonnet or ready for panel mounting. High-grade packing standard; carbon graphite packing standard; PTFE packing standard for 316 SS valves. Female x female NPT standard.

Features:

- 60-100: Carbon steel, F x F, M x F, 1/8" to 1"
- 60-400: 416 SS, F x F
- 60-700: 316 SS, F x F, M x F, 1/8" to 1"
- 60-900: Brass, F x F, 1/8" to 1/2"





FEMALE X FEMALE									
No.	**Size in./mm**	**Orifice**	A **Size in./mm**	B **Size in./mm**	C **Size in./mm**	D **Size in./mm**	E **Size in./mm**	**Cv**	**Weight Lbs/Kgs**
60-100/60-400/60-700	1/8	.125	3.81	1.37	2.25	1.12	.68	.43	123

	4	3.18	96.77	34.8	57.15	28.45	17.27		55.8
60-101/60-401/60-701	1/4 8	.187 4.75	3.81 96.77	1.37 34.8	2.25 57.15	1.12 28.45	.68 17.27	.43	123 55.8
60-102/60-402/60-702	3/8 10	.250 6.35	3.81 96.77	1.37 34.8	2.25 57.15	1.12 28.45	.68 17.27	.74	119 53.98
60-103/60-403/60-703	1/2 15	.312 7.93	3.81 96.77	1.50 38.1	2.75 69.85	1.37 34.8	.75 19.05	1.36	164 74.39
60-104/60-404/60-704	3/4 20	.437 11.1	5.43 137.92	1.93 49.02	3.18 80.77	1.59 40.39	.96 24.38	2.64	334 151.5
60-105/60-405/60-705	1 25	.562 14.28	6.00 15.24	2.12 53.85	3.62 91.95	1.81 45.97	1.06 26.92	3.60	424 192.33
60-900	1/8 4	.125 3.18	3.81 96.77	1.37 34.8	2.25 57.15	1.12 28.45	.68 17.27	.43	136 61.69
60-901	1/4 8	.187 4.75	3.81 96.77	1.37 34.8	2.25 57.15	1.12 28.45	.68 17.27	.43	136 61.69
60-902	3/8 10	.250 6.35	3.81 96.77	1.37 34.8	2.25 57.15	1.12 28.45	.68 17.27	.74	131 59.42
60-903	1/2 15	.312 7.93	3.81 96.77	1.50 38.1	2.75 69.85	1.37 34.8	.75 19.05	1.36	181 82.1
60-904	3/4 20	.437 11.1	5.43 137.92	1.93 49.02	3.18 80.77	1.59 40.39	.96 24.38	2.64	369 145.15
60-905	1 25	.562 14.28	6.00 152.4	2.12 53.85	3.62 91.95	1.81 45.97	1.06 26.92	3.60	469 226.8

60-111/60-711
MALE X FEMALE

No.	**Size in./mm**	**Orifice**	A **Size in./mm**	B **Size in./mm**	C **Size in./mm**	D **Size in./mm**	E **Size in./mm**	**Cv**	**Weight Lbs/Kgs**
60-111/60-711	1/4 8	.187 4.75	3.81 96.77	1.37 34.8	2.25 57.15	1.12 28.45	.68 17.27	.43	108 48.99
60-112/60-712	1/8 4	.250 6.35	3.81 96.77	1.37 34.8	2.25 57.15	1.12 28.45	.68 17.27	.74	104 47.17
60-113/60-713	1/2 15	.312 7.93	3.81 96.77	1.50 38.1	2.75 57.15	1.37 34.8	.75 19.05	1.36	141 63.96

ANGLE VALVES

No.	**Size in./mm**	**Orifice**	A **Size in./mm**	B **Size in./mm**	C **Size in./mm**	D **Size in./mm**	E **Size in./mm**	**Cv**	**Weight Lbs/Kgs**
60-200/60-500/60-800	1/8 4	.125 3.18	3.18 80.77	1.00 25.4	1.25 31.75	.81 20.57	.50 12.7	.39	60 27.22
60-201/60-501/60-801	1/4 8	.187 4.75	3.31 84.07	.87 22.1	1.50 38.1	1.03 26.16	.62 15.75	.43	80 36.29
60-202/60-502/60-802	3/8 10	.250 6.35	3.31 84.07	1.00 25.4	1.59 40.39	1.06 26.92	.62 15.75	.84	90 40.82
60-203/60-503/60-803	1/2 15	.312 7.93	3.31 84.07	1.50 38.1	2.00 50.8	1.37 34.8	.75 19.05	1.36	120 54.43

60-204/60-504/60-804	3/4 20	.437 11.1	4.50 114.3	1.50 38.1	2.50 63.5	1.62 41.15	1.00 25.4	2.64	320 145.15
60-205/60-505/60-805	1 25	.562 14.28	5.06 128.52	2.00 50.8	2.93 74.42	1.93 49.02	1.25 31.75	3.90	500 226.8

SOCKET WELD											
No.	**Size in./mm**	**Orifice**	A **Size in./mm**	B **Size in./mm**	C **Size in./mm**	D **Size in./mm**	E **Size in./mm**	F **Size in./mm**	G **Size in./mm**	**Cv**	**Weight Lbs/Kgs**
60-120/60-420/60-720	1/8 4	.125 3.18	3.81 96.77	1.37 34.8	2.25 57.15	1.12 28.45	.68 17.27	.424 10.77	.37 9.4	.43	123 55.8
60-121/60-421/60-721	1/4 8	.187 4.75	3.81 96.77	1.37 34.8	2.25 57.15	1.12 28.45	.68 17.27	.559 14.2	.37 9.4	.43	123 55.8
60-122/60-422/60-722	3/8 10	.250 6.35	3.81 96.77	1.37 34.8	2.25 .15.45	1.12 28.45	.68 17.27	.694 17.63	.37 9.4	.74	119 53.98
60-123/60-423/60-723	1/2 15	.312 7.93	3.81 96.77	1.50 38.1	2.75 69.85	1.37 4.8	.75 19.05	.859 21.82	.37 9.4	1.36	164 74.39
60-124/60-424/60-724	3/4 20	.437 137.92	5.43 137.92	1.93 49.02	3.18 80.77	1.59 40.39	.96 24.38	1.069 27.15	.50 12.7	2.64	334 151.5
60-125/60-425/60-725	1 50	.562 14.28	6.00 152.4	2.12 53.85	3.62 91.95	1.81 45.97	1.06 26.92	1.334 33.88	.50 12.7	3.60	424 192.33

133 Series Direct-Operated Regulators

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TYPES 133H, 133L, AND 133Z REGULATORS

TYPE 133HP REGULATOR

Figure 1. *133 Series Gas Regulators*

⚠ WARNING

Failure to follow these instructions or to properly install and maintain this equipment could result in an explosion and/or fire causing property damage and personal injury or death.

Fisher® regulators must be installed, operated, and maintained in accordance with federal, state, and local codes, rules and regulations, and Emerson Process Management Regulator Technologies, Inc. (Regulator Technologies) instructions.

If the regulator vents gas or a leak develops in the system, service to the unit may be required. Failure to correct trouble could result in a hazardous condition.

Call a gas service person to service the unit. Only a qualified person must install or service the regulator.

Introduction

Scope of the Manual

This manual provides specifications, installation, adjustment and maintenance instructions, and parts ordering information for the 133 Series regulators.

Only personnel qualified through training or experience should install, operate, and maintain this regulator. If there are any questions concerning these instructions, contact your local Sales Office before proceeding.

Product Description

The 133 Series direct-operated gas regulators, shown in Figure 1 are primarily designed for industrial and commercial applications supplying gas to furnaces, burners, and other appliances. The 133 Series

D100270X012

Specifications

The Specifications section lists the specifications for the Type 133 Series direct-operated regulators. Factory specification is stamped on the nameplate fastened on the regulator at the factory.

Available Constructions

Type 133H:
High pressure construction for outlet pressure range of 1.5 to 10 psig / 0.10 to 0.69 bar. The Type 133H can also use the 2 inches w.c. to 2 psig / 5 mbar to 0.14 bar springs of the Type 133L. The maximum operating inlet pressure is 60 psig / 4.1 bar with a maximum emergency inlet pressure of 125 psig / 8.6 bar.

Type 133HP:
Extra high pressure construction for outlet pressure range of 2 to 60 psig / 0.14 to 4.1 bar. The maximum operating and emergency inlet pressure rating is 150 psig / 10.3 bar.

Type 133L:
Low pressure construction for outlet pressure range of 2 inches w.c. to 2 psig / 5 mbar to 0.14 bar. The maximum operating inlet pressure is 60 psig / 4.1 bar with a maximum emergency inlet pressure of 125 psig / 8.6 bar.

Type 133Z:
Zero governor construction for outlet pressure range of -1 to 4 inches w.c. / -2 to 10 mbar. The maximum operating inlet pressure is 20 psig / 1.4 bar with a maximum emergency inlet pressure of 125 psig / 8.6 bar.

Body Size and End Connection Styles

BODY SIZE		BODY MATERIAL	
INCH	DN	Cast Iron Body	WCC Steel Body
2	50	NPT or CL125 FF Flanged	NPT or CL150 RF Flanged

Outlet Pressure Ranges
See Table 1

Maximum Inlet Pressures(1)
See Table 2

Maximum Outlet Pressures
See Table 2

Pressure Registration
External; downstream control line is required.

Temperature Capabilities(1)
-20 to 150°F / -29 to 66°C

Control Line Connection

Types 133H, 133L, and 133Z:
3/4 NPT (internal); connection will be positioned directly over body outlet (standard position) or 90 degrees right or left of standard position if specified.

Type 133HP:
1/4 NPT (internal) connection positioned directly over body outlet.

Vent Connection

Types 133H, 133L, and 133Z:
1 NPT (internal) with screen; standard position is in line with control line connection directly over body outlet. Vent will always be positioned over the control line connection.

Type 133HP:
1/2 NPT (internal) connection positioned directly over body inlet with a Fisher® Type Y602-7 vent assembly.

Approximate Weight

Types 133H, 133L, and 133Z NPT End Connections: 35 pounds / 16 kg

Types 133H, 133L, and 133Z Flanged End Connections: 40 pounds / 18 kg

Type 133HP NPT End Connections:
56.5 pounds / 26 kg

Type 133HP Flanged End Connections:
62.5 pounds / 28 kg

1. The pressure/temperature limits in this Instruction Manual or any applicable standard limitation should not be exceeded.

balancing system enables the regulator to provide accurate control gas pressure for maximum combustion efficiency despite varying inlet pressure conditions. The single port construction provides bubble-tight shutoff. An external downstream control line is required for the operation of the regulator. A restriction collar is available to reduce the flow capacity of the regulator.

Principle of Operation

Refer to the operational schematics in Figures 2 and 3. In the 133 Series, downstream pressure is registered under the diaphragm via the external control line and is used as the operating medium. Increased demand lowers the downstream pressure and allows the spring to move the diaphragm and stem assembly down, opening the valve disk, and supplying more gas to the

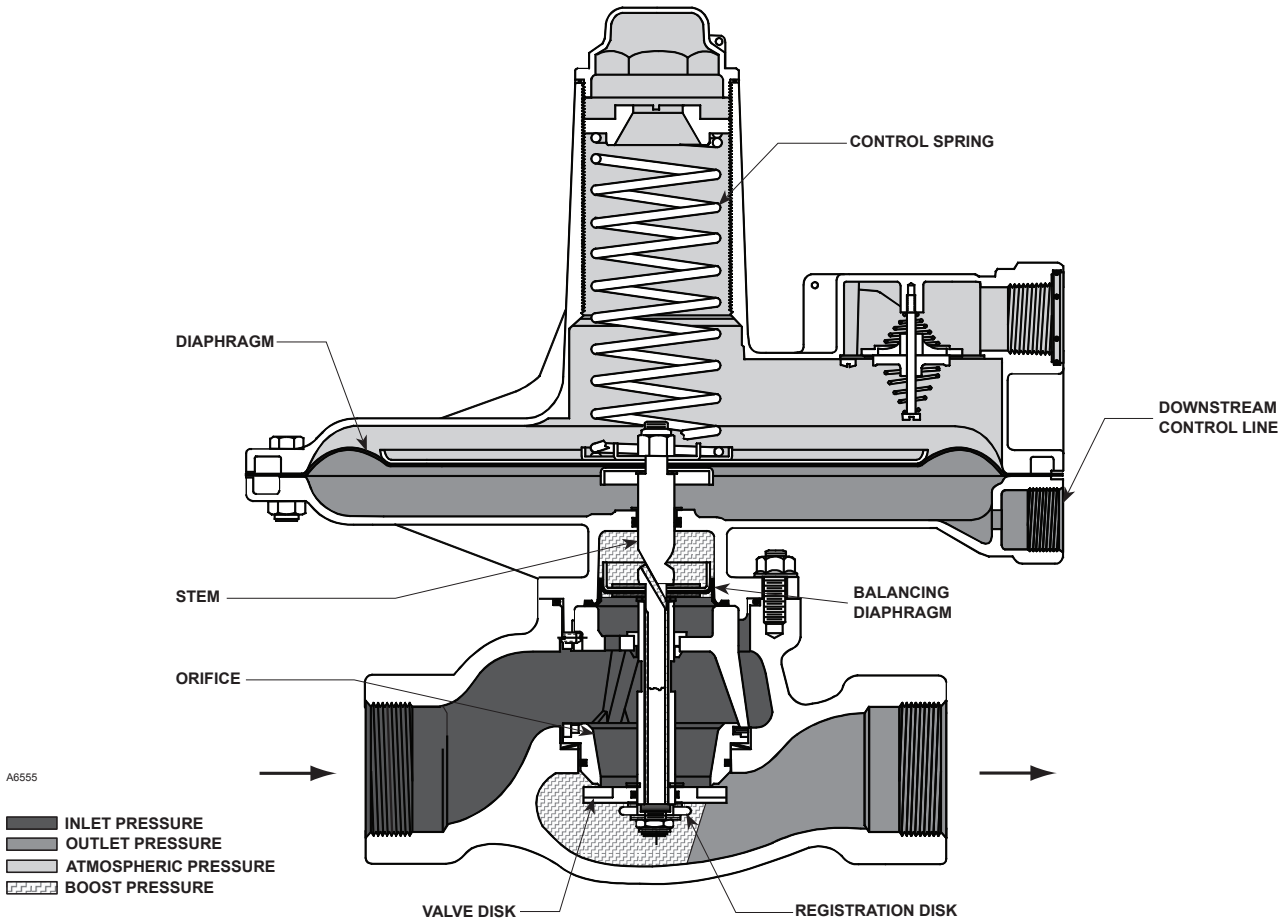

Figure 2. *Operational Schematic of Type 133L Regulator (Also Typical of Type 133H)*

downstream system. Decreased demand increases the downstream pressure and moves the diaphragm and stem assembly up, closing the valve disk, and decreasing the gas supply to the downstream system.

Boosting System

The 133 Series incorporates a balancing diaphragm and a boosting system. When the regulator is locked up, inlet pressure is registered on the top of the valve disk and on the bottom of the balancing diaphragm through registration holes in the top of the cage. Also, downstream pressure is registered on the bottom of the valve disk and on the top of the balancing diaphragm through a passage formed by grooves in the registration disk and an annular space between the stem and stem sleeve.

When the valve disk is open, gas flows from the inlet over the edge of the valve disk to the outlet. Under the valve disk near the registration disk, there is little gas flow. The gas pressure near the registration disk is higher than it is in the flow path where gas velocity tends to lower the pressure. The higher pressure near the disk is registered on the top of the balancing diaphragm through the registration disk and the annular space between the stem and stem sleeve.

This pressure registered on the top of the balancing diaphragm aids downward disk travel and compensates for spring and diaphragm effect. This improves regulator range ability and performance.

Installation

Before installing the 133 Series regulators, inspect it for shipping damage and be certain that the body and orifice are clean. Blow out the pipeline to remove pipe scale and other foreign material.

The regulator may be installed in any position as long as the flow through the body is the same as indicated by the flow direction arrow on the body and the vent opening is unobstructed and protected from the entrance of rain, ice, and other foreign material.

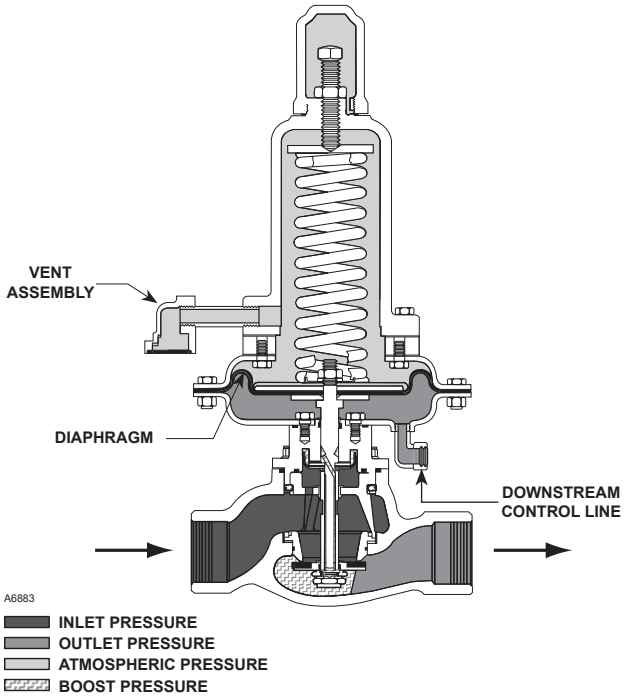

Figure 3. *Operational Schematic of Type 133HP*

If the regulator has threaded end connections, coat external threads with pipe compound. For flanged end connections, tighten the flange bolts evenly. Install a three valve bypass around the 133 Series if continuous operation is necessary.

The regulator must be protected from damage by vehicles and other outside sources.

Overpressure Protection

The 133 Series regulators have an outlet pressure rating that is lower than the inlet pressure rating. Some type of overpressure protection is needed if the actual inlet pressure exceeds the outlet pressure rating.

Maximum operating inlet pressure for the 133 Series regulators is given in Table 2. All models must be protected against inlet pressure above their listed maximum.

Regulator operation below these emergency pressure limitations does not preclude the possibility of damage from external sources or from debris in the gas line. The regulator should be inspected for damage after any overpressure condition.

Downstream Control Line

An external downstream control line must be installed before putting the 133 Series regulators in operation.

Without the control line, the regulator will remain wide-open. The downstream control line should be a pipe of at least 1/2 inch / 12.7 mm diameter; connect it to the downstream pipe line at least 5 to 10 pipe diameters from the regulator and in a straight section of pipe.

The external downstream control line connection on the Type 133HP is 1/4 NPT.

Vent

The 133 Series vent is screened to prevent insects or foreign material from entering. The Types 133H, 133L, and 133Z regulators have a 1 NPT (internal) connection and the Type 133HP has a 1/2 NPT internal connection. If a vent to the atmosphere is required for indoor installations, do the following:

- **For Types 133H, 133L, and 133Z** — remove the snap ring and screen (keys 8J and 8H, Figure 10, 11, or 12) and pipe the vent to the outside.
- **For Type 133HP** — remove the Type Y602-7 screened vent assembly and pipe nipple (keys 50 and 49, Figure 14) from the spring case (key 8) and pipe the vent to the outside.

The vent pipe should be as short as possible with minimum number of bends or elbows. The pipe should also have the largest practical diameter. Install a weather and bug resistant vent assembly on the outside end of the vent pipe.

For indoor installation that have been piped to the outside and for outdoor installations, the vent opening must be positioned so that water, ice, and other foreign material cannot enter the spring case. Use care not to place the vent opening below downspouts and eaves. The vent opening should be checked periodically to be sure that the opening has not been plugged with foreign material. On some installations it may be necessary to provide additional protection from the elements.

Startup

WARNING

If the downstream system is already pressured by another regulator or by a manual bypass, then extra precautions must be taken when placing the 133 Series in service. The outlet of the regulator must never be subjected to pressure higher than the inlet pressure, or the balancing diaphragm may be damaged.

Table 1. *133 Series Outlet Pressure Ranges, Control Springs*

TYPE	OUTLET PRESSURE RANGE		CONTROL SPRINGS					
			Part Number	Color Code	Free Length		Wire Diameter	
	psig	bar			Inch	mm	Inch	mm
133H[1]	1.5 to 3	0.10 to 0.21	1H975927032	Orange	6.91	176	0.250	6.35
	2 to 5	0.14 to 0.34	10A9440X012	Yellow	6.47	164	0.283	7.19
	5 to 10	0.34 to 0.69	1J146927142	Blue	6.19	157	0.375	9.52
133HP[1]	2 to 5	0.14 to 0.34	17B8632X012	Yellow	8.50	216	0.282	7.16
	4.5 to 10	0.31 to 0.69	17B8633X012	Orange	8.50	216	0.343	8.71
	6 to 20	0.41 to 1.4	10C1238X012	Silver	8.25	210	0.375	9.53
	16 to 30	1.1 to 2.1	10C1240X012	Red	8.25	210	0.438	11.1
	26 to 40	1.8 to 2.8	10C1241X012	Blue	8.25	210	0.500	12.7
	36 to 50	2.5 to 3.4	10C1242X012	Green	8.25	210	0.500	12.7
	45 to 60	3.1 to 4.1	10C1243X012	White	8.25	210	0.531	13.5
133L[1] and 133H[2]	2 to 4 inches w.c.	5 to 10 mbar	1D892527022	Brown	6.13	156	0.109	2.77
	3.5 to 6 inches w.c.	9 to 15 mbar	1D892627022	Red	7.53	191	0.112	2.85
	5 to 9 inches w.c.	12 to 22 mbar	1D892727012	Black	7.88	200	0.130	3.30
	8.5 to 18 inches w.c.	21 to 45 mbar	1D893227032	White	7.50	190	0.156	3.96
	14 to 28 inches w.c.	35 to 70 mbar	1D893327032	Green	7.25	184	0.182	4.62
	0.75 to 2	0.05 to 0.14	1H975827032	Blue	7.09	180	0.225	5.72
133Z[1]	-1 to 1 inch w.c.	-3 to 3 mbar	1K633427012 (Extension Spring)	Unpainted	2.00	50.8	0.075	1.91
	0 to 4 inches w.c.	0 to 10 mbar	1K633427012 (Extension Spring) and 1D892527022 (Compression Spring)	Unpainted Brown	2.00 6.13	50.8 156	0.075 0.109	1.91 2.77

1. Pressure ranges shown are correct if the regulator is installed with the actuator portion above the body portion. If the regulator is installed with the actuator portion below the body, the pressure ranges will be lowered by approximately 2 inches w.c. / 5 mbar for the Type 133L and by approximately 3 inches w.c. / 7 mbar for the Types 133H and 133Z.
2. If the 2 inches w.c. / 5 mbar to 2 psig / 0.14 bar springs (all 6 ranges) are used in the Type 133H, the pressure ranges will increase by approximately 1 inch w.c. / 2 mbar due to the weight of the Type 133H parts (assuming that the actuator is installed above the body).

Table 2. *Maximum Inlet and Outlet Pressures*

PRESSURES	TYPE NUMBER							
	133H		133HP		133L		133Z	
	psig	bar	psig	bar	psig	bar	psig	bar
Maximum Operating Inlet Pressure	60	4.1	150	10.5	60	4.1	20	1.4
Maximum Emergency Inlet Pressure	125	8.6			125	8.6	125	8.6
Maximum Operating Outlet Pressure[1]	10	0.69	Setpoint plus 40	Setpoint plus 2.8	2	0.14	4 inches w.c.	10 mbar
Maximum Outlet Pressure Over Outlet Pressure Setting	3	0.21			3	0.21	3	0.21
Maximum Emergency Outlet (Casing) Pressure	15	1.0	150	10.5	15	1.0	15	1.0

1. With highest spring range available only.

Also, the control line pressure must never exceed the set point dictated by the spring setting by more than 3 psig / 0.21 bar, or the valve seat or diaphragm plates can be damaged. The procedure used in putting the regulator in service must be planned accordingly. Pressure gauges should always be used to monitor downstream and control line pressures during startup.

If the downstream system is not pressured by another regulator or by manual bypass, use the following procedure:

1. Check to see that all appliances are turned off.
2. Slowly open the upstream shutoff valve.
3. Slowly open the downstream shutoff valve.
4. Check all connections for leaks.
5. Make final control spring adjustments according to the adjustment procedures.

Adjustment

To increase the pressure setting, remove the closing cap (key 9, Figures 10, 11, 12, and 14) and turn the adjusting screw (key 11) clockwise; to lower the setting, turn the adjusting screw counterclockwise. A pressure gauge should always be used when adjustments are being made. Do not adjust the spring to produce an outlet pressure setting above the limit

stamped on the nameplate (key 38, not shown), located on the casing flange. If the required pressure setting is not within the range of the spring in use, substitute with the correct spring. Ranges of available springs are shown in Table 1. When changing the spring, also change the nameplate, located on the casing flange, to indicate the outlet pressure range.

Shutdown

Isolate the regulator from the pressure system and release pressure from the outlet and the control line. Inlet pressure will then automatically be released as the regulator opens up in response to the lowered pressure on the diaphragm.

Maintenance

This section includes instructions for disassembly and replacement of parts. All key numbers refer to Figures 10, 11, 12, and 14, except where indicated.

WARNING

To avoid personal injury, property damage, or equipment damage caused by sudden release of pressure or explosion of accumulated gas, do not attempt any maintenance or disassembly without first isolating the regulator from system pressure and relieving all internal pressure from the equipment.

Do not loosen the diaphragm casing cap screws (keys 35 and 36) when the control spring (key 12) has spring force applied to it. Release the spring compression as described in step 7.

Due to normal wear that may occur in gas regulators, parts must be periodically inspected and replaced if necessary. The frequency of inspection, maintenance, and replacement of parts depend upon the severity of service conditions or requirements of local, state, and federal regulations.

Types 133H, 133L, and 133Z

Disassembly

1. Disconnect the downstream control line from the regulator and disconnect the remote vent pipe if one is used.

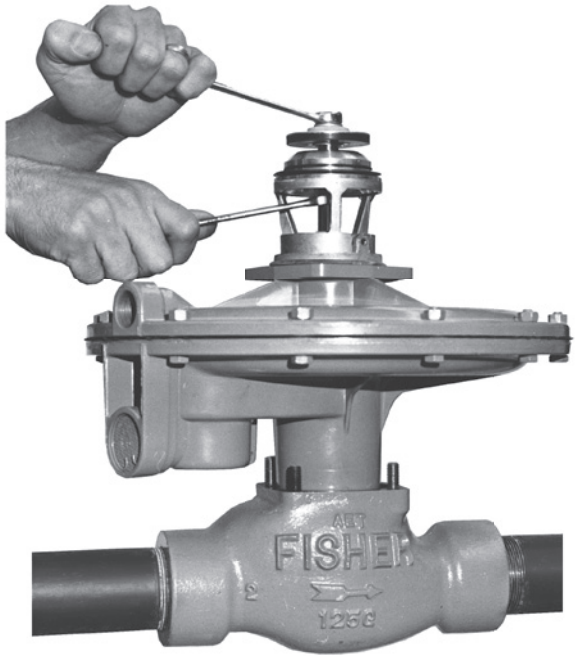

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Figure 4. *Spring Case Inserted in Body for Disassembly. Note Proper Method of Holding Stem and Sleeve When Loosening or Tightening Stem Nut.*

Note

Allowing a slight amount of compression to remain in the regulator spring (key 12) will facilitate disassembly of the trim parts.

2. Unscrew the four locknuts (key 34) and lift the actuator portion off the body (key 1). All of the trim parts will come out of the body with the actuator. Inspect the valve disk (key 28), orifice (key 2), and restriction collar (key 46, Figure 13), if used.
3. For further field disassembly and inspection, the actuator may be turned upside down and the spring case (key 8A) inserted into the body cavity (see Figure 4).

CAUTION

Use care in performing step 4 to guard against damage to the balancing diaphragm (key 22).

4. Insert a 1/2-inch / 13 mm open-end wrench between the legs of the cage (key 5) and place the wrench on the stem sleeve wrench flats. Hold this wrench while unscrewing the nut (key 31) to prevent stem and stem sleeve (keys 18 and 25)

Figure 5. *Inspecting Guide Bushing and Stem Seal O-ring*

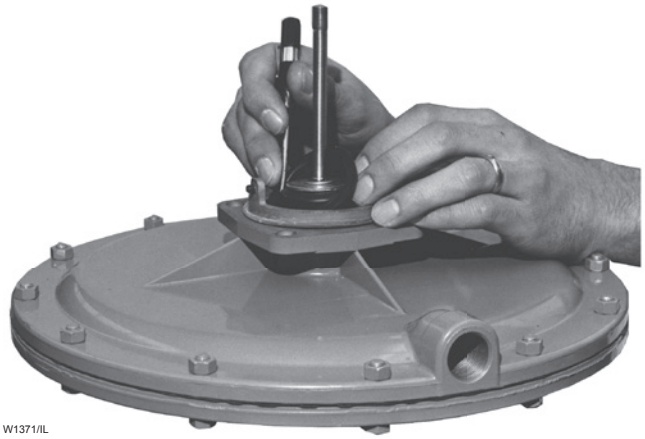


Figure 6. *Installing Balancing Diaphragm. The Side of Diaphragm Marked Piston Side Must Face Casing.*

rotation and diaphragm (key 15) and balancing diaphragm (key 22) damage due to twisting (see Figure 4).

5. Remove the washer, registration disk, and valve disk (keys 30, 29, and 28). To remove the restriction collar (key 46, Figure 13) (if used), loosen the set screw (key 47, Figure 13) and slip the E-ring (key 26, Figure 13) and collar off of the stem (key 18). Remove the orifice (key 2) by rotating it until the pins (key 5A) in the cage line up with the slots in the orifice; then, lift off the orifice. Replace the valve disk and orifice if necessary.

6. Loosen the set screws (key 39) in the cage (key 5) and remove the roll pin (key 27) from the stem (key 18). Remove the cage and stem sleeve (key 25), the sealing washer (key 17) under the balancing diaphragm (key 22), flat washers (key 23), balancing diaphragm, and balancing diaphragm plate (key 21). Replace sealing washer and balancing diaphragm if necessary.

WARNING

To avoid personal injury due to the sudden uncontrolled movement of parts, do not loosen the diaphragm casing cap screws (keys 35 and 36) when the control spring (key 12) has spring force applied to it.

Release the spring compression as described in step 7.

7. To inspect or replace the upper stem seal O-ring (key 19) or main diaphragm (key 15) on the Type 133L or 133H (Figure 10 or 11), remove the closing cap (key 9), and inspect the closing cap gasket (key 10). Release spring compression by slowly turning the adjusting screw (key 11) counterclockwise and remove the spring (key 12).

   For Type 133Z (Figure 12), remove the closing cap (key 9) and inspect the closing cap gasket (key 10). Release any spring compression by slowly turning the adjusting screw (key 11) counterclockwise. Lift the adjusting screw assembly (keys 11, 41, 42, 43, and 45) out of the spring case with pliers. Unhook the extension spring (key 44) from the spring retainer (key 42). Remove the compression spring (key 12) if one is used.

8. Unscrew the cap screws and nuts (keys 35 and 36) and remove the spring case (key 8A).

9. Pull out the diaphragm and stem as assembly; replace diaphragm (key 15) and sealing washer (key 17) if necessary. When removing or replacing the diaphragm, clamp the smallest diameter portion of the stem in a vise while turning the nut (key 20).

10. If necessary, replace the bearing (key 6) and the upper stem seal O-ring (key 19, Figure 5). Before reassembling, coat the O-ring with O-ring sealant and lubricant.

Reassembly

Reassemble in reverse order of the above steps. When reassembling, observe the following steps and cautions.

1. If the spring case was disassembled, reassemble it first. To ensure proper slack in the diaphragm (key 15) and to facilitate reassembly of the trim parts, tighten the casing cap screws and nuts (keys 35 and 36) finger-tight only. Then adjust the spring (key 12) to stroke the diaphragm assembly fully. Final tightening of the casing cap screws and nuts must be done alternately in equal increments to ensure a proper seal without crushing the diaphragm.
2. During reassembly, check all O-rings to be certain they are in good condition; replace if necessary. Lubricate the O-rings (keys 4, 19, and 32) with elastomer sealant and lubricant. Apply anti-seize compound liberally to the adjusting screw threads (key 11), as indicated in Figures 10 to 12.
3. When installing the balancing diaphragm (key 22), be certain the side marked PISTON SIDE is facing the spring case. Carefully tuck the slack diaphragm material into the space between the diaphragm plate (key 21) and the lower casing (key 7) until the diaphragm fits smoothly over the diaphragm plate without wrinkles and the bead fits snugly and evenly in the groove provided in the lower casing. This can be done with a small screwdriver, but be careful not to puncture the diaphragm (see Figure 6).
4. When replacing the cage (key 5), insert the set screws (key 39) only far enough to retain the cage. Do not tighten.
5. The registration disk (key 29) is marked for proper placement; be certain it is positioned correctly on the stem (key 18).

CAUTION

Always use the stem sleeve wrench flats when loosening or tightening the nuts (key 20 or 31) to prevent twisting of the main and balancing diaphragms (keys 15 and 22).

6. Be certain the Belleville spring washer (key 3) is in good condition and is in place before placing the actuator on the body (key 1).

Type 133HP

Disassembly

WARNING

To avoid personal injury, property damage, or equipment damage caused by sudden release of pressure or explosion of accumulated gas, do not attempt any maintenance or disassembly without first isolating the regulator from system pressure and relieving all internal pressure from the equipment.

Do not loosen the diaphragm casing cap screws (Figure 9, keys 35 and 36) when the control spring (key 12) has spring force applied to it. Release the spring compression as described in step 6.

This section includes instructions for disassembly and replacement of parts for the Type 133HP. All key numbers refer to Figures 7, 8, 9, and 14, except where indicated.

1. Disconnect the downstream control line from the regulator and disconnect the remote vent pipe if one is used.
2. Unscrew the four locknuts (key 34) and lift the actuator portion off the body (key 1). All of the trim parts will come out of the body with the actuator. Inspect the valve disk (key 28), orifice (key 2), and restriction collar (key 46), if used.

CAUTION

Use care in performing step 3 to guard against damage to the balancing diaphragm (key 22).

3. Insert a 1/2-inch / 13 mm open-end wrench between the legs of the cage (key 5) and place the wrench on the stem sleeve wrench flats. Hold this wrench while unscrewing the nut (key 31) to prevent stem and stem sleeve (keys 18 and 25) rotation and diaphragm (key 15) and balancing diaphragm (key 22) damage due to twisting.
4. Remove the washer, registration disk, and valve disk (keys 30, 29, and 28). To remove the restriction collar (key 46, Figure 13) (if used), loosen the set screw (key 47, Figure 13) and slip the E-ring (key 26, Figure 13) and collar off

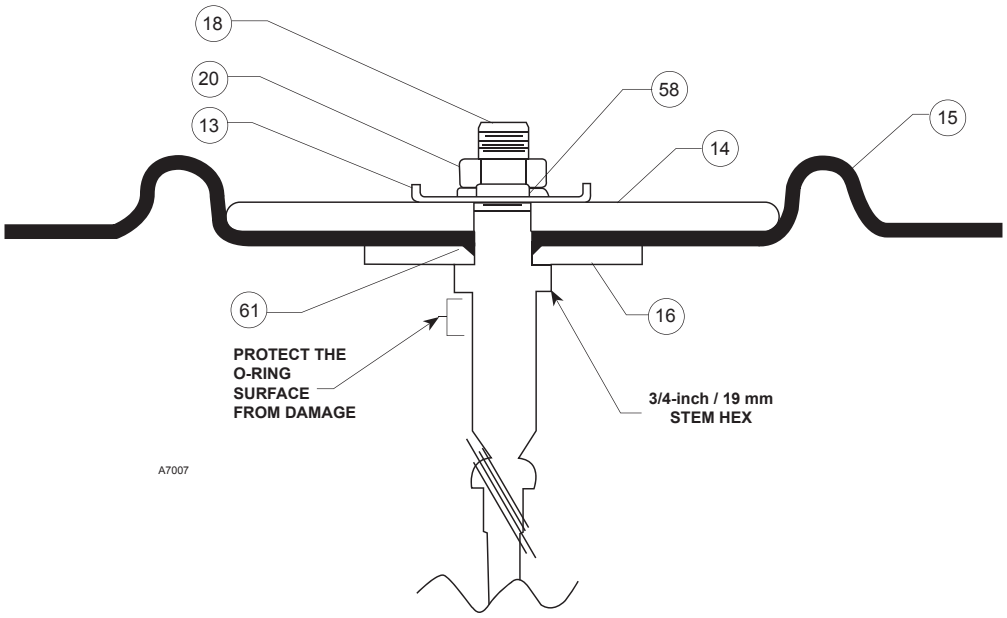


Figure 7. *Stem and Diaphragm Assembly*

the stem (key 18). Lift off the orifice (key 2) and replace the valve disk and orifice if necessary.

5. Loosen the set screws (key 39) in the cage (key 5) and remove the roll pin (key 27) from the stem (key 18). Remove the cage and stem sleeve (key 25), the sealing washer (key 17) under the balancing diaphragm (key 22), flat washers (key 23), balancing diaphragm, and balancing diaphragm plate (key 21). Replace the sealing washer and balancing diaphragm if necessary.

WARNING

- **To avoid personal injury due to the sudden uncontrolled movement of parts, do not loosen the diaphragm casing cap screws (keys 35 and 36) when the control spring (key 12) has spring force applied to it.**
- **Release the spring compression as described in step 6 below.**

6. To inspect or replace the upper stem seal O-ring (key 19) or main diaphragm (key 15), remove the closing cap (key 9), and inspect the closing cap gasket (key 10). Release the spring compression completely by loosening the hex nut (key 59) and turning the adjusting screw (key 11) counterclockwise.
7. Remove the six cap screws (key 62) from the spring case (key 8). Lift off the spring case, upper spring seat (key 41), and spring (key 12). Remove the diaphragm casing cap screws and hex nuts (keys 35 and 36), and lift off the upper diaphragm casing (key 52). Remove the cap screws (key 55) and mounting bracket (key 56). Inspect the two mounting bracket gaskets (key 57) and replace if necessary.
8. Remove the hex nut (key 20), lock washer (key 58), and spring seat (key 13) from the stem (key 18).
9. Remove the diaphragm plate (key 14), diaphragm (key 15), diaphragm washer O-ring (key 61), and sealing diaphragm plate (key 16). Replace the diaphragm and diaphragm washer O-ring if necessary.
10. Remove the cap screws (key 53) and lift the lower diaphragm casing (key 7) off the casing adaptor (key 60). If necessary, replace the bearing (key 6) and upper stem seal O-ring (key 19). Before reassembling, coat the O-ring with a O-ring sealant and lubricant.

Reassembly

When reassembling, observe the following steps and cautions. During reassembly, check all O-rings to be certain they are in good condition and replace if necessary. Coat O-rings (keys 4, 19, and 32) with Multi-Purpose Polytetrafluoroethylene (PTFE) lubricant or an equivalent elastomer sealant and lubricant.

All key numbers refer to Figures 7, 8, 9, and 14, except where indicated.

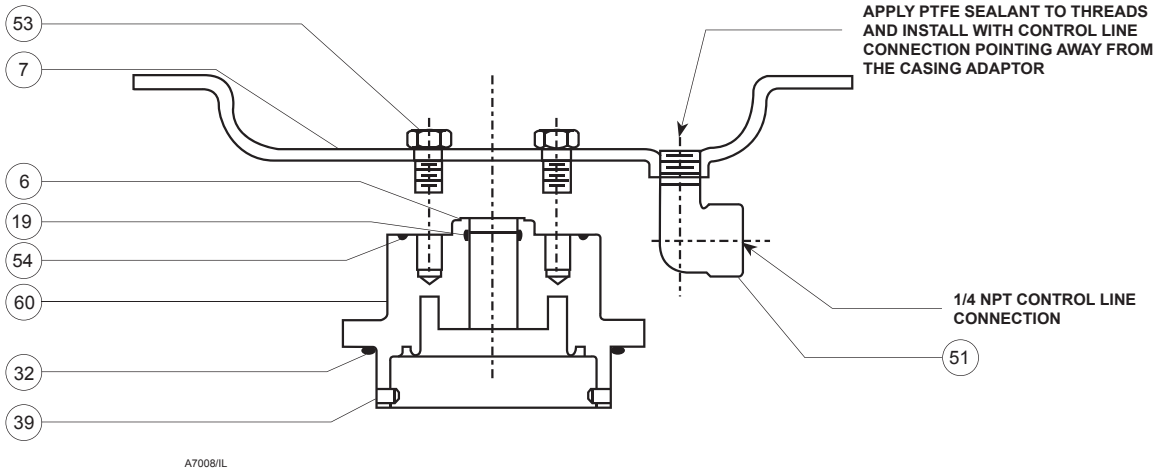


Figure 8. *Lower Casing and Casing Adaptor Assembly*

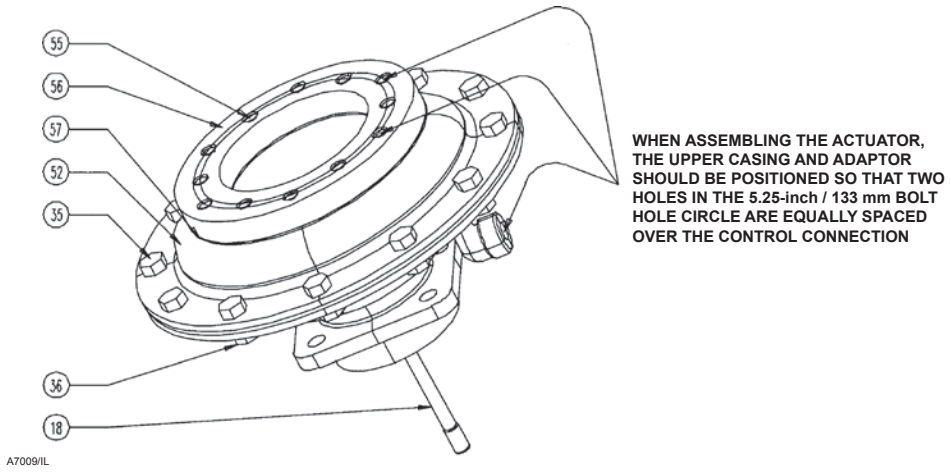


Figure 9. *Diaphragm Casing Assembly*

1. With the Type 133HP completely disassembled, start the reassembly by applying Multi-Purpose PTFE lubricant or an equivalent to the stem threads (key 18) and diaphragm washer O-ring (key 61). Place the sealing diaphragm plate (key 16) on the stem followed by the O-ring (key 61), diaphragm (key 15), diaphragm plate (key 14), spring seat (key 13), lock washer (key 58), and hex nut (key 20) as shown in Figure 7. To prevent diaphragm damage, torque the hex nut (key 20) to 25 to 30 foot-pounds / 34 to 41 N•m, while using 3/4-inch / 19 mm wrench flats on the stem.

2. If the street elbow (key 51) was removed, it must be reassembled before mounting the casing adaptor (key 60). Apply PTFE sealant or equivalent around the external threads of the street elbow and tighten to a torque of 20 to 35 foot-pounds / 27 to 47 N•m. Position the control line connection (street elbow) so that it points away from the casing adaptor.

3. Lubricate the O-rings (keys 19, 32, and 54) and install as shown in Figure 8. Install the casing adaptor (key 60) to the lower casing (key 7) and tighten the cap screws (key 53) to 20 to 30 foot-pounds / 27 to 41 N•m of torque.

4. Insert the stem bearing (key 6) and carefully insert the stem (key 18) into the lower casing (key 7) and casing adaptor (key 60) assembly.

5. Assemble the upper diaphragm casing (key 52), mounting plate adaptor (key 56), and mounting plate gasket (key 57) as shown in Figure 9. Tighten the cap screws (key 55) to 20 to 30 foot-pounds / 27 to 41 N•m of torque.

6. Assemble the upper and lower casings, noting that two of the holes in the 5-1/4-inch / 133 mm diameter

bolt circle in the mounting plate adaptor (key 56) must be spaced (aligned) an equal distance over the downstream control line connection. Install cap screws and hex nuts (keys 35 and 36) with a torque of 20 to 30 foot-pounds / 27 to 41 N•m.

7. Place the balancing plate washer (key 23), balancing diaphragm plate (key 21), balancing diaphragm (key 22) and a second balancing plate washer (key 23), onto the stem (key 18).

Note

When installing the balancing diaphragm (key 22), be certain the side marked PISTON SIDE is facing the spring case. Carefully tuck the slack diaphragm material into the space between the diaphragm plate (key 21) and lower casing (key 7) until the diaphragm fits smoothly over the diaphragm plate without wrinkles and the bead fits snugly and evenly in the groove provided in the lower casing. This can be done with a small screw screwdriver, but be careful not to puncture the diaphragm (see Figure 6).

8. Apply Multi-Purpose PTFE lubricant or equivalent to the sealing washer (key 17) and carefully slide over the threaded end of the stem (key 18).

9. Insert the guide bushing (key 24) into the cage (key 5), and slide the cage up onto the stem (key 18). Insert the set screws (key 39) only far enough to retain the cage. Do not tighten.

10. Lubricate and install the O-rings (keys 19 and 4) as indicated in Figure 14. Install the orifice (key 2) onto the cage (key 5). Install the Belleville spring washer (key 3) so that the concave face of the washer faces away from the orifice.

11. Install the E-ring (key 26) on the stem sleeve (key 25) and slide the stem sleeve over the stem (key 18) aligning the slotted end of the stem sleeve so that the roll pin (key 27) can be inserted through the cross-drilled hole in the end of the stem.

CAUTION

Always use the stem sleeve wrench flats when loosening or tightening the nuts (key 20 or 31) to prevent twisting of the main and balancing diaphragms (keys 15 and 22).

12. Install the valve disk (key 28), registration disk (key 29), washer (key 30) and hex nut (key 31) onto the stem. The registration disk (key 29) is marked for proper placement; be certain it is positioned correctly on the stem (key 18). Tighten the hex nut (key 31) using the 1/2-inch / 13 mm wrench flats on the stem sleeve.

13. Insert the valve trim assembly into the body and position the downstream control line connection (key 51) so it is pointing directly over the body outlet.

14. Screw the studs (key 33) into the body (key 1). Install and tighten the hex nuts (key 34) to 20 to 35 foot-pounds / 27 to 47 N•m of torque.

15. Apply anti-seize to the adjusting screw (key 11) and upper spring seat (key 41). Install the adjusting screw and hex jam nut (key 59) into the spring case (key 8). Position the control spring (key 12) and upper spring seat on the diaphragm plate (key 14) and lower spring seat (key 13).

16. Install the mounting plate gasket (key 57) and place the spring case on the mounting bracket (key 56). Install the cap screws (key 62) and torque to 20 to 30 foot-pounds / 27 to 41 N•m.

17. Screw in the pipe nipple (key 49) and vent (key 50). Install the closing cap gasket (key 10) and closing cap (key 9).

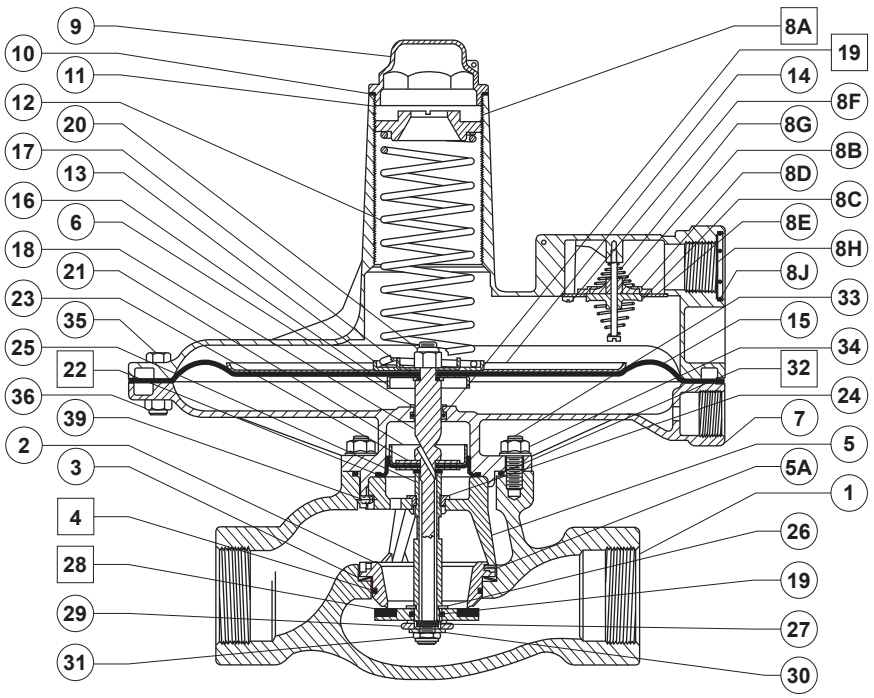
Parts Ordering

When corresponding with your local Sales Office about this equipment, be sure to include the type number and other information stamped on the nameplate.

When ordering replacement parts, reference the key number of each needed part and specify the eleven character part number as found in the following parts list.

Parts List

Key	Description	Part Number
	Parts kit for Types 133H, 133L, and 133Z (included are keys 2, 4, 6, 10, 15, 17, 19, 22, 24, 28, 32, and 40)	R133HX00012
1	Body	
	Cast iron	
	2 NPT	30A3044X012
	NPS 2 / DN 50, CL125 FF	30A3045X012
	WCC Steel	
	2 NPT	30B0855X012
	NPS 2 / DN 50, CL150 RF	30B0854X012



☐ **APPLY LUBRICANT (L) OR SEALANT (S)**(1)

1. Lubricant and sealant must be selected such that they meet the temperature requirements.

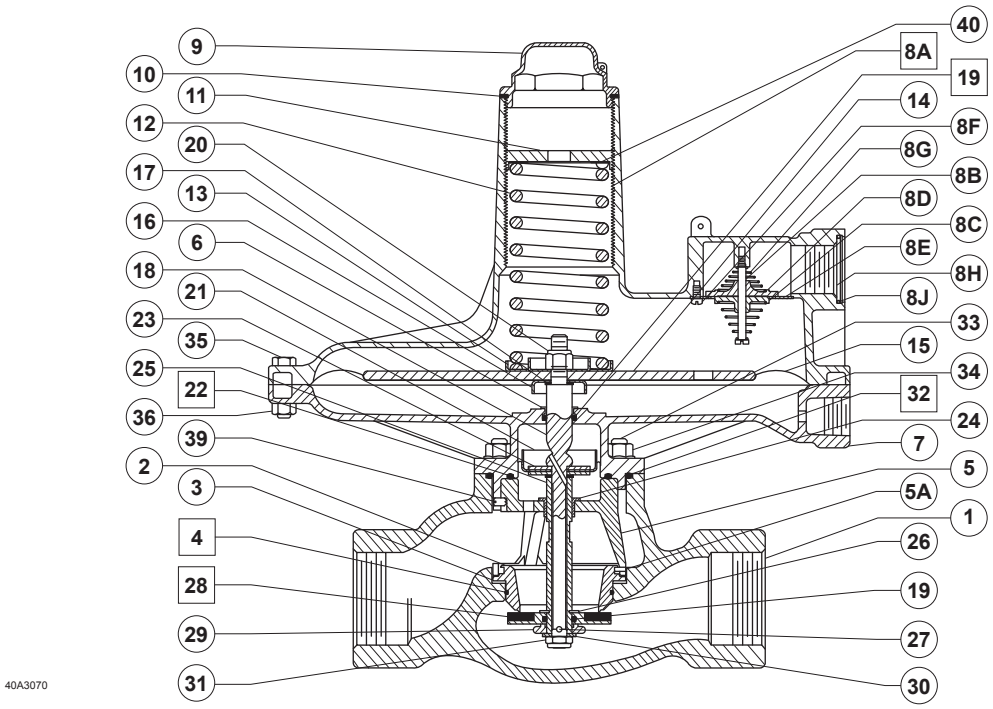
Figure 10. *Type 133L Assembly*

Key	Description	Part Number
2*	Orifice, Aluminum	20A3046X012
3	Belleville Spring Washer, 17-4PH Stainless steel	10A3047X012
4*	O-ring	
	Nitrile (NBR)	10A9339X012
	Fluorocarbon (FKM)	
	(for Types 133L and 133H only)	10A9339X022
5*	Cage/Pin Assembly, Aluminum/Steel	
	(including roll pins, key 5A)	20A3048X012
6*	Bearing, Nylon (PA)	10A3049X012
7	Lower Casing	
	Types 133H, 133L, and 133Z, Aluminum	40A3050X012
	Type 133HP, Steel	32B3499X012
8	Spring Case	
	Type 133HP, Cast iron	2H140619012
	Parts 8A through 8J are used on	
	Types 133H, 133L, and 133Z only	
8A	Spring Case, Aluminum	4L142308032
8B	Stabilizer Stem, 302 Stainless steel	1H976335022
8C	Lower Stabilizer, Nylon (PA)	1H976406992
8D	Upper Stabilizer, Polyethylene	1H976506992
8E	Orifice, Stainless steel	T13609T0012
8F	Screw, Steel (3 required)	1H976728982
8G	Spring, 302 Stainless steel (2 required)	1H976837022
8H	Screen, Stainless steel	1E564843122
8J	Snap Ring, 302 Stainless steel	1E564937022
9	Closing Cap	
	Types 133H, 133L, and 133Z, Aluminum	1L928308012
	Type 133HP, Cast iron	00288819012
10*	Closing Cap Gasket	
	Types 133H, 133L, and 133Z, Neoprene (CR)	1N446206992
	Type 133HP, Composition	1R742604022

Key	Description	Part Number
11	Adjusting Screw	
	Type 133H, Brass	1V9069X0012
	Type 133L, Aluminum	1L928608012
	Type 133Z, Brass	1K633714012
	Type 133HP, Steel	1H139731012
12	Spring Steel	
	Type 133H	
	Zinc-plated steel	
	1.5 to 3 psig / 0.10 to 0.21 bar, Orange	1H975927032
	2 to 5 psig / 0.14 to 0.34 bar, Yellow	10A9440X012
	17-7 PH Stainless steel	
	5 to 10 psig / 0.34 to 0.69, Blue	1J146927142
	Types 133L and 133H(1)	
	Zinc-plated steel	
	2 to 4 inches w.c. / 5 to 10 mbar, Brown	1D892527022
	3.5 to 6 inches w.c. / 9 to 15 mbar, Red	1D892627022
	Plated steel	
	5 to 9 inches w.c. / 12 to 22 mbar, Black	1D892727012
	8.5 to 18 inches w.c. / 21 to 45 mbar, White	1D893227032
	14 to 28 inches w.c. / 35 to 70 mbar, Green	1D893327032
	0.75 to 2 psig / 0.05 to 0.14 bar, Blue	1H975827032
	Type 133Z (Extension spring, key 44, also required)	
	Zinc-plated steel	
	-1 to 1 inch w.c. / -2 to 2 mbar, see key 44	
	0 to 4 inches w.c. / 0 to 10 mbar, Brown	1D892527022
	Type 133HP	
	17-7 PH Stainless steel	
	2 to 5 psig / 0.14 to 0.34 bar, Yellow	17B8632X012
	302 Stainless steel	
	4.5 to 10 psig / 0.31 to 0.69 bar, Orange	17B8633X012

* Recommended spare parts.

1. If the 2 inches w.c. to 2 psig / 5 mbar to 0.14 bar springs listed under Type 133L are used in the Type 133H, the pressure ranges will increase by approximately 1 inch w.c. / 2 mbar due to the weight of the Type 133H parts (assuming that the actuator is installed above the body).



☐ **APPLY LUBRICANT (L) OR SEALANT (S)**(1)

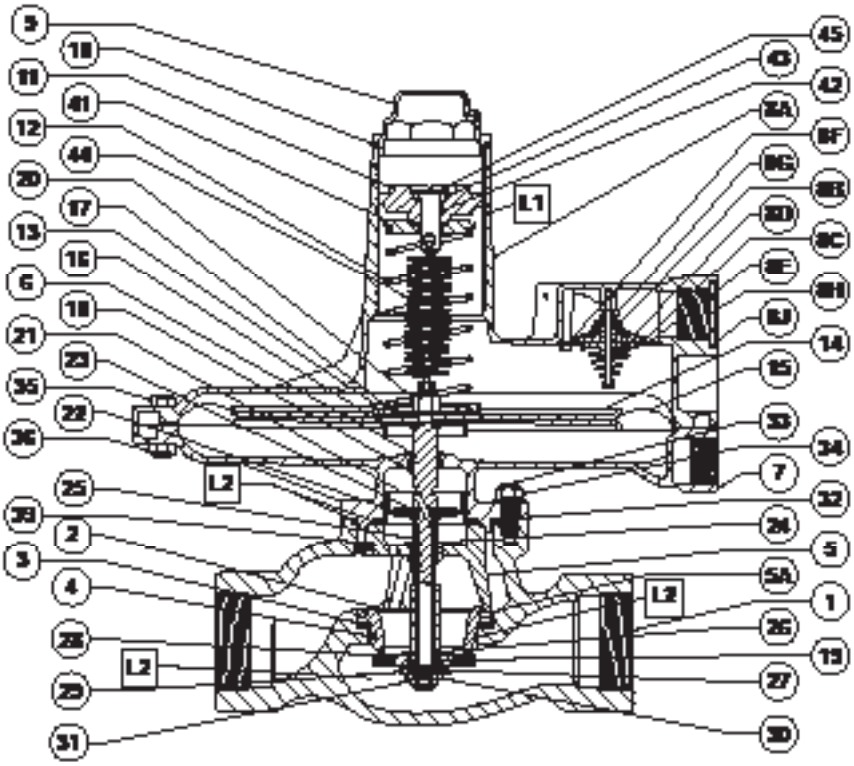
1. Lubricant and sealant must be selected such that they meet the temperature requirements.

Figure 11. *Type 133H Assembly*

Key	Description	Part Number
12	Spring Steel (continued)	
	Type 133HP (continued)	
	Steel	
	6 to 20 psig / 0.41 to 1.4 bar, Silver	10C1238X012
	16 to 30 psig / 1.1 to 2.1 bar, Red	10C1240X012
	26 to 40 psig / 1.8 to 2.8 bar, Blue	10C1241X012
	36 to 50 psig / 2.5 to 3.5 bar, Green	10C1242X012
	45 to 60 psig / 3.1 to 4.1 bar, White	10C1243X012
13	Spring Seat, Plated steel	
	Types 133H, 133L, and 133Z	10A3052X012
	Type 133HP	1P787724152
14	Diaphragm Plate, Steel	
	Type 133H (1 required)	1D555725012
	Type 133L (1 required)	1J881725072
	Type 133Z (2 required)	1J881725072
	Type 133HP (1 required)	22B3514X012
15*	Diaphragm, Nitrile (NBR) and Nylon (PA)	
	Types 133H, 133L, and 133Z	1N150802052
	Type 133HP	22B3514X012
	Fluorocarbon (FKM)	
	(for Types 133L and 133H only)	1N150802402
16	Sealing Diaphragm Plate, Zinc-plated steel	
	Types 133H, 133L, and 133Z	1D475725062
	Type 133HP	12B3517X012
17*	Sealing Washer, Zinc-plated steel	
	(2 required for Types 133L, 133H, and 133Z;	
	1 required for Type 133HP)	1F990428982
18	Stem, Stainless steel	
	Types 133H and 133L	20A3053X012
	Type 133Z	10A3069X012
	Type 133HP	37B3942X012
19*	O-ring	
	Nitrile (NBR)	
	(2 required for Types 133L, 133H,	
	and 133HP; 1 required for Type 133Z)	F1367806562
	Fluorocarbon (FKM)	
	(2 required for Types 133L and 133H only)	1E5914X0062
20	Hex Nut	
	Types 133H, 133L, and 133Z, Aluminum	1D5297X0012
	Type 133HP, Zinc-plated steel	1A413224122
21	Diaphragm Plate, Plated steel	10A3054X012
22*	Diaphragm	
	Nitrile (NBR) and Nylon (PA)	10A3055X012
	Fluorocarbon (FKM)	
	(for Types 133L and 133H only)	10A3055X022
23	Washer, Steel (2 required)	10A3056X012
24*	Guide Bushing, Nylon (PA)	10A3057X012
25	Stem Sleeve, 303 Stainless steel	10A3061X012
26	E-ring, Plated steel	1F599428982
27	Roll Pin, 420 Stainless steel	1E954028992
28*	Valve Disk Assembly	
	Aluminum / Neoprene (CR)	10A3058X012
	Aluminum / Fluorocarbon (FKM)	
	(for Types 133L and 133H only)	10A3058X032
29	Registration Disk, Nylon (PA)	10A3060X012
30	Washer, Zinc-plated steel	1H723125072
31	Hex Nut, Zinc-plated steel	1C121928982
32*	O-ring	
	Nitrile (NBR)	1J1079X0012
	Fluorocarbon (FKM)	
	(for Types 133L and 133H only)	1J1079X0022
33	Stud, Alloy steel (4 required)	10A3062X012

* Recommended spare parts.

1. If the 2 inches w.c. to 2 psig / 5 mbar to 0.14 bar springs listed under Type 133L are used in the Type 133H, the pressure ranges will increase by approximately 1 inch w.c. / 2 mbar due to the weight of the Type 133H parts (assuming that the actuator is installed above the body).



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☐ **APPLY LUBRICANT (L)[1]**
L1 = Anti-Seeze Compound
L2 = Silicone Grease
1. Lubricants must be selected such that they meet the temperature requirements.

Figure 12. *Type 133Z Assembly*

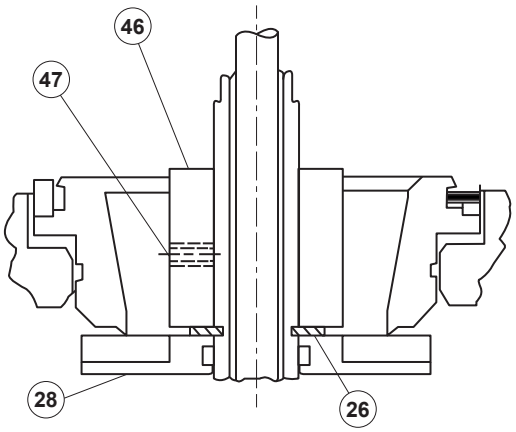
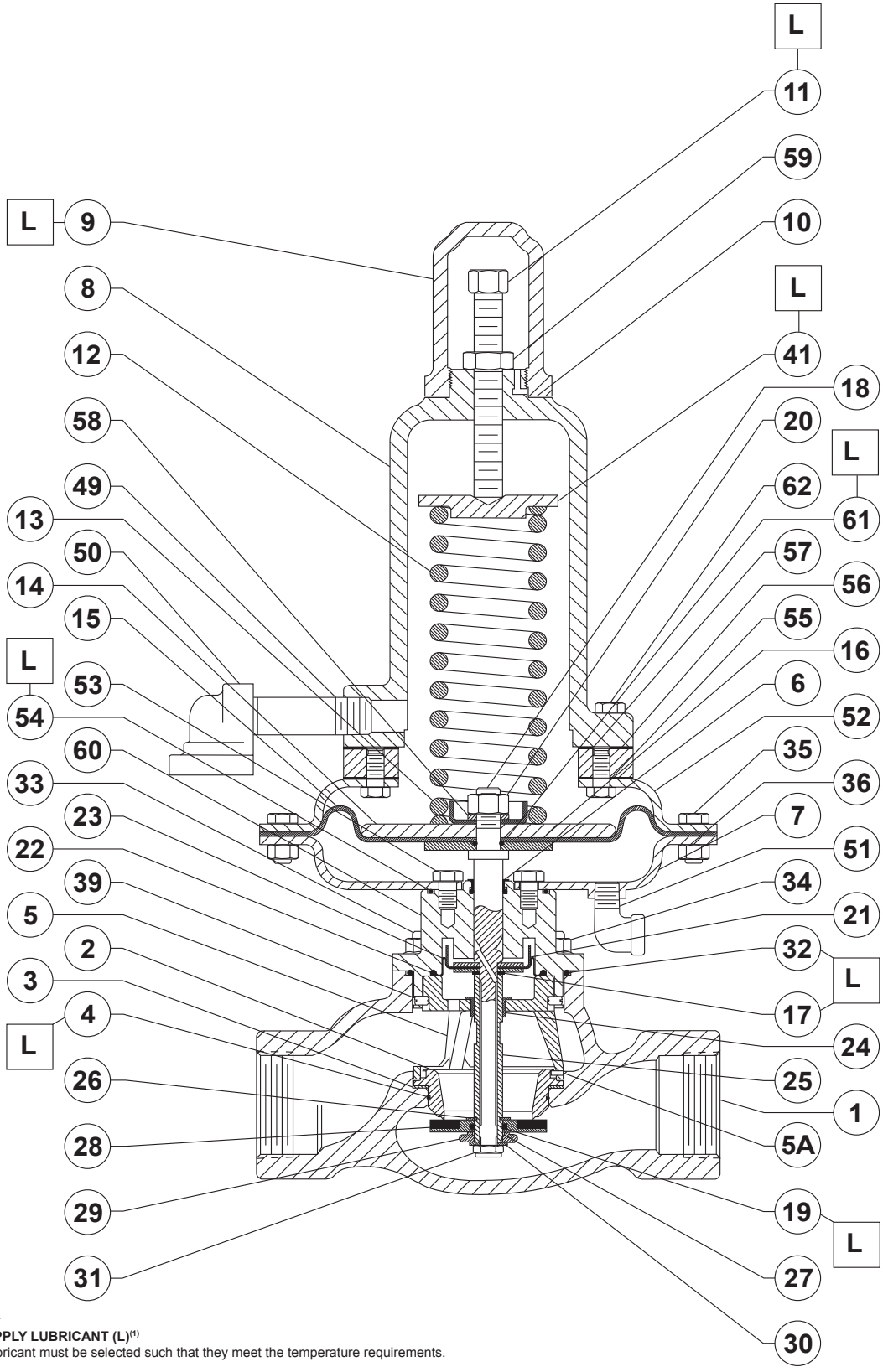


Figure 13. *Optional Restriction Collar Assembly*



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☐ **APPLY LUBRICANT (L)**[1]

1. Lubricant must be selected such that they meet the temperature requirements.

Figure 14. *Type 133HP Actuator Assembly*

Key	Description	Part Number
34	Locknut, Plated alloy steel (4 required)	10A3063X012
35	Cap Screw, Zinc-plated steel	
	Types 133H, 133L, and 133Z (12 required)	1B136324052
	Type 133HP (12 required)	1E760324052
36	Hex Nut, Zinc-plated steel	
	Types 133H, 133L, and 133Z (12 required)	1A309324122
	Type 133HP (12 required)	1A346524122
37	Nameplate (for Types 133L, 133H, and 133Z only) (not shown)	- - - - - - - - - -
38	Nameplate (for Types 133L, 133H, and 133Z only) (not shown)	- - - - - - - - - -
39	Set Screw, Alloy steel (2 required)	10A3051X012
40*	Thrust Washer, Nylon (PA)	
	Type 133H only	1V9661X0012
41	Upper Spring Seat	
	Type 133Z, Brass	1K633514012
	Type 133HP, Zinc-plated steel	1H140124092
42	Spring Retainer, Brass	
	Type 133Z only	1K633814012
43	Ball, 440C Stainless steel (10 required)	
	Type 133Z only	1B793546202
44	Extension Spring, Zinc-plated steel	
	Type 133Z only, Unpainted	1K633427012
45	Retaining Ring, Plated steel	
	Type 133Z only	10A3074X012
46	Restriction Collar, Aluminum	
	25% capacity	12A7404X012
	40% capacity	12A7402X012
	60% capacity	12A7403X012
47	Set Screw, Steel	1N830528992
50	Flow Arrow, 18-8 Stainless steel	- - - - - - - - - -
51	Drive Screw, 18-8 Stainless steel (2 required)	- - - - - - - - - -

Type 133HP only

Key	Description	Part Number
49	Pipe Nipple, Zinc-plated steel	1A473526012
50	Vent Assembly	Type Y602-7
51	Street Elbow, Malleable iron	1A913221992
52	Upper Diaphragm Casing, Steel	2F581125062
53	Cap Screw, Zinc-plated steel (4 required)	1D529824052
54*	Adaptor O-ring, Nitrile (NBR)	1F914106992
55	Cap Screw, Zinc-plated steel (6 required)	1A368424052
56	Mounting Bracket, Steel	1H140025032
57*	Mounting Bracket Gasket, Neoprene (CR) (2 required)	1H140404022
58	Lock Washer, Steel	1A487828992
59	Hex Jam Nut, Zinc-plated steel	1A319224122
60	Casing Adaptor, Steel	37B4486X012
61*	Diaphragm Washer O-ring, Nitrile (NBR)	1C782206992
62	Cap Screw, Zinc-plated steel (6 required)	1A341824052
63	Nameplate	- - - - - - - - - -
64	Drive Screw	1A368228982

*Recommended spare parts.

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289 Series Relief Valves

WARNING

Failure to follow these instructions or to properly install and maintain this equipment could result in an explosion and/or fire causing property damage and personal injury or death.

Fisher® relief valves must be installed, operated and maintained in accordance with federal, state, and local codes, rules and regulations, and manufacturer's instructions.

If a leak develops or if the outlet continually vents gas, service to the unit may be required. Failure to correct trouble could result in a hazardous condition. Only a qualified person must install or service the unit.

Call a gas service person to service the unit. Only a qualified person must install or service the regulator.

18702

2 NPT TYPE 289H

W18701

1 NPT TYPE 289H

Figure 1. *Type 289H Relief Valves*

Introduction

Scope of the Manual

This manual provides instructions for installation, maintenance, and parts ordering information for the 289 Series relief valves. Instructions for other equipment used with these relief valves can be found in separate instruction manuals.

Description

The 289 Series pressure relief valves (see Figure 1) are throttling relief valves used downstream of pressure regulators to protect the downstream system from overpressure. These relief valves can be used for natural gas, air, propane, or other noncorrosive, gas-flow service.

D100280X012

Specifications

Available Configurations

See Table 1

Body Sizes and Inlet Connections

Type 289L: 3/4 or 1 NPT

Types 289A and 289U: 1/4 NPT

Type 289H: 1 or 2 NPT

Type 289HH: 1 NPT

Maximum Allowable Relief (Inlet) Pressure(1) and Maximum Relief Set Pressure

See Table 1

Material Temperature Capabilities(1)

Nitrile (NBR) and Neoprene (CR):

-20 to 150°F / -29 to 66°C

Fluorocarbon (FKM)(2):

20 to 300°F / -7 to 149°C
Available with Types 289H and 289HH only

Pressure Setting Adjustment

Adjusting screw

Pressure Registration

Internal

Approximate Shipping Weights

Types 289A and 289U: 0.75 pounds / 0.3 kg

Type 289H:

1 NPT Size: 4 pounds / 2.0 kg

2 NPT Size: 15 pounds / 7.0 kg

Type 289HH: 4 pounds / 2.0 kg

Type 289L: 15 pounds / 7.0 kg

Additional Specifications

For construction materials, see Parts List

1. The pressure/temperature limits in this Instruction Manual and any applicable standard limitation should not be exceeded.
2. Bubble-tight shutoff cannot be attained at settings below 5 psig / 0.34 bar with Fluorocarbon (FKM) O-ring seat.

Principle of Operation

Refer to Figures 2 and 4. The 289 Series Relief valves are to be installed (between large service regulators such as S202G or S302G Series) so the outlet is piped downstream to relieve excess pressure to the atmosphere. As inlet pressure increases, the spring is compressed by the diaphragm, moving the disk away from the seat. When the valve is opening, high gas velocity through the orifice creates an area of relatively low pressure near the end of the pitot tube. This pitot tube effect forms a partial vacuum above the diaphragm (spring case area) which helps to open the valve further.

Installation

WARNING

Installing a 289 Series relief valve where its capabilities can be exceeded or where proper operation might be impaired may cause personal injury, property damage, or leakage due to bursting of pressure-containing parts or explosion of accumulated gas. To avoid such conditions, install a 289 Series relief valve where:

- **Service conditions are within the unit capabilities specified in the Specifications section, and**
- **The relief valve is protected from exposure to physical damage and/or corrosive substances.**

1. When installing a 289 Series relief valve, make sure that the installation of the system complies with applicable local, state, or federal codes or regulations.
2. Use qualified personnel when installing, operating, and maintaining a 289 Series relief valve. Before installation, make sure there is no damage to or foreign material in the relief valve and that all piping is clean and unobstructed.
3. For installation of Types 289H, 289HH, and 289L relief valves, the vent in the spring case must remain plugged or undrilled in order for the pitot tube to function properly.
4. The 289 Series relief valves may be installed in any orientation. However, when installing the relief valve at an outside location, adequate protection, such as

rain caps or elbow piping (see Figure 4), must be attached to the outlet to keep the relief valve from getting plugged or from collecting moisture, corrosive chemicals, or other foreign materials. If piping is to be attached to the valve outlet, the following parts (if they are connected to the valve outlet as shown in Figures 6 through 10) must first be removed: the screen (key 9), the snap ring (key 13), and the gasket (key 15). A typical installation of a 289 Series Relief Valve is shown in Figure 4.

WARNING

If using a 289 Series relief valve on hazardous or flammable gas service, personal injury and property damage could occur due to fire or explosion of vented gas that may have accumulated.

To prevent such injury or damage, provide piping or tubing to vent the gas to a safe, well-ventilated area. Also, when venting a hazardous gas, the piping or tubing should be located far enough away from any buildings or windows so to not create a further hazard, and the vent opening should be protected against anything that could clog it.

5. Apply pipe compound to the male pipeline threads only; do not apply pipe compound to the internal body threads. Then install the relief valve so that the flow through it will match the direction arrow or marking cast on the valve body.

When installing the molded diaphragm in the 289 Series Relief Valves, make sure the diaphragm convolutions is installed in the down position as shown in Figure 3.

Startup

Key numbers are shown in Figures 6 through 10. With proper installation completed and system equipment properly adjusted, close any vent valves, and slowly open the upstream shutoff valve while using pressure gauges to monitor pressure.

Note

To ensure proper operation of the pitot tube, if present, the spring case (key 2) must be tightly sealed. It is recommended that the gasket (key 15) be replaced whenever the closing cap

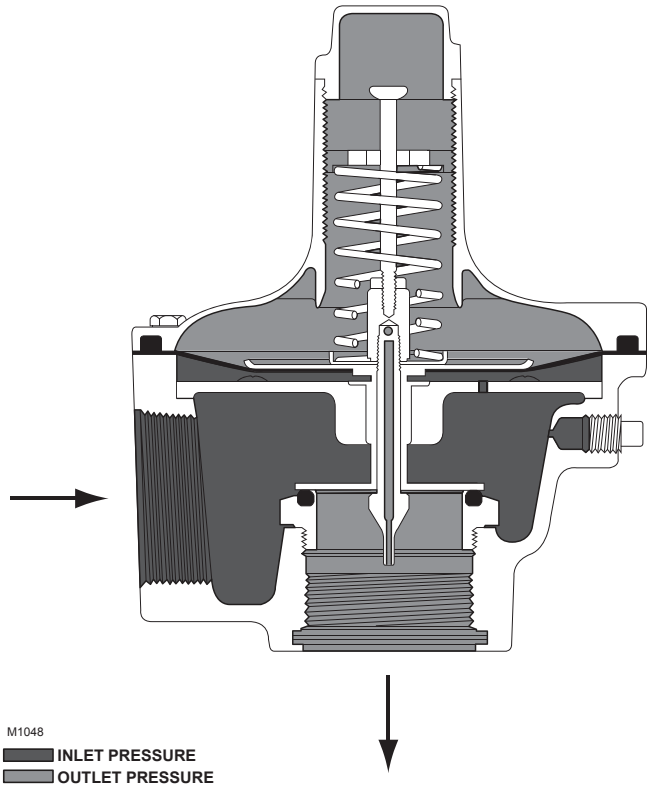

Figure 2. *2 NPT Type 289H Operational Schematic*

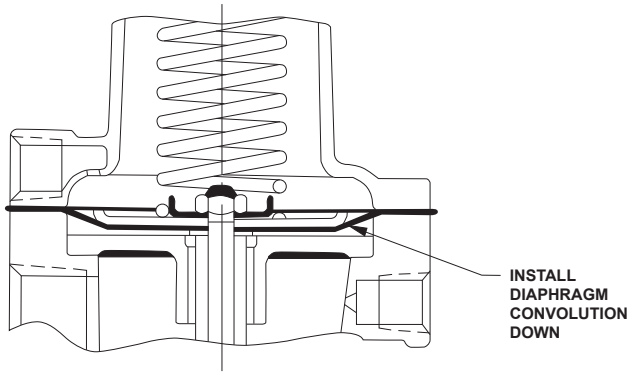

Figure 3. *Installation of Diaphragm*

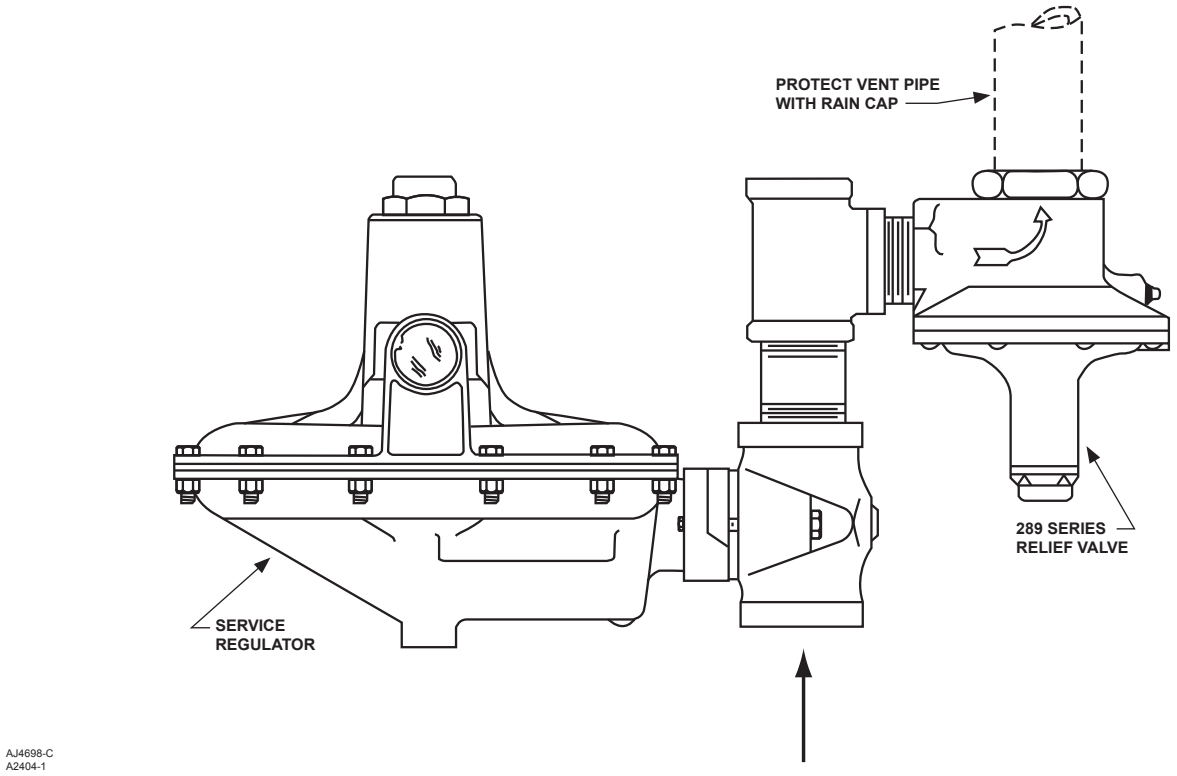

Figure 4. *Typical Installation*

(key 14) is removed. Antiseizing sealant should be applied to the adjusting screw (key 6) threads on valves without closing caps.

If set pressure adjustment is necessary, monitor the inlet pressure with a gauge during the adjustment procedure. Remove the closing cap (key 14), or loosen the hex nut (key 11), and turn the adjusting screw (key 6) clockwise to increase or counterclockwise to decrease the relief pressure setting.

For 2 NPT Type 289H relief valves, when changing from one spring range to another, it is recommended that a new spring case be used so that the travel stop drive screw will be positioned correctly for the corresponding spring range. Each spring range requires that the travel stop drive screw be positioned appropriately in the spring case to prevent setting the relief valve pressure too high. The location of the travel stop drive screw for each spring and spring range is shown in Figure 5.

Shutdown

Close the upstream shutoff valve, and release all pressure from the relief valve.

Maintenance

Relief valve parts are subject to normal wear and should be inspected periodically for maintenance. The frequency of inspection and replacement of parts depends upon the severity of service conditions.

This section contains information for inspection and maintenance of 289 Series relief valves. Maintenance procedures are presented for relief valve configurations of similar construction. Refer to the appropriate procedure and figure for the particular relief valve configuration when changing the control spring to one of a different range or when inspecting, cleaning, or replacing any other relief valve parts. The screen (key 9, Figures 6 through 9) and vent piping, if present, should be free of foreign material that might impair relief flow.

Note

The relief valve body (key 1, Figures 6 through 10) may remain in the pipeline during maintenance unless replacement of the valve body is necessary.

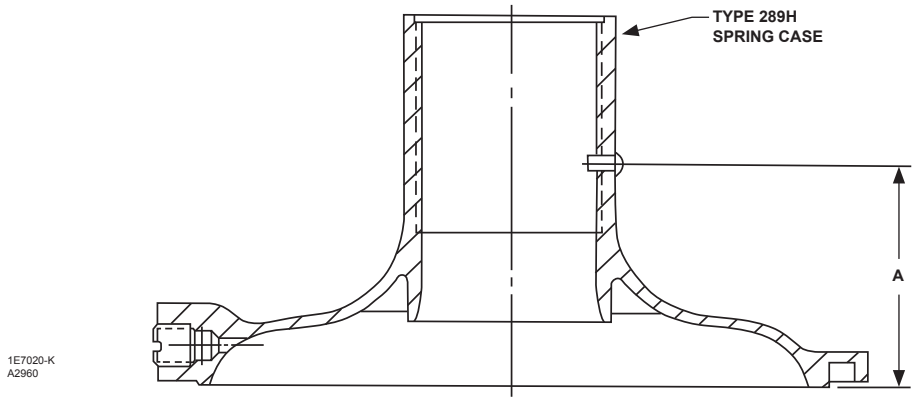

Figure 5. *Location of Travel Stop Drive Screw for 2 NPT Type 289H Relief Valve*

Table 1. *Maximum Allowable Relief (Inlet) Pressure*

AVAILABLE CONFIGURATION	BODY SIZE, NPT	SPRING PART NUMBER	COLOR CODE	SPRING RANGE (RELIEF PRESSURE SETTINGS)		MAXIMUM ALLOWABLE RELIEF (INLET) PRESSURE(1)	
				psig	bar	psig	bar
Type 289A	1/4	0Z056327022 1B268227022	Silver Silver	3 to 13 11 to 22	0.21 to 0.90 0.76 to 1.5	45	3.1
Type 289H	1	1F826927052 1D892327022 1D751527022 1D7455T0012	Pink Red Silver Green	1 to 4.5 4 to 15 10 to 20 15 to 50	0.07 to 0.31 0.28 to 1.0 0.69 to 1.4 1.0 to 3.5	100	6.9
	2	1B536527052 1B536627052 1B536827062 1B536927052	Dark blue Gray Dark green Red Stripe	7 to 18 inches w.c. 0.5 to 2.25 1.75 to 7 4 to 10	17 to 45 mbar 0.03 to 0.16 0.12 to 0.48 0.28 to 0.69	25	1.7
Type 289HH	1	1D7455T0012	Green	45 to 75	3.1 to 5.2	100	6.9
Type 289L	3/4 or 1	13A7917X012 13A7916X012	Silver Red Stripe	10 to 18 inches w.c. 12 to 40 inches w.c	25 to 45 mbar 30 to 99 mbar	7	0.48
Type 289U	1/4	0V060227022 0F058227022	Silver Silver	5 to 25 inches w.c. 20 inches w.c. to 3 psig	12 to 62 mbar 50 to 207 mbar	10	0.69

1. This value indicates the relief pressure setting plus pressure build-up.

Table 2. *Relief Set Pressure Ranges*

SPRING PART NUMBER	SPRING RANGE (RELIEF PRESSURE SETTING)		DIMENSION A	
	psig	bar	Inch	mm
1B536527052	7 to 18 inches w.c.	17 to 45 mbar	Drive screw not required	
1B536627052	0.5 to 2.25	0.03 to 0.16	1-17/32	39
1B536827062	1.75 to 7	0.12 to 0.48	2-5/32	55
1B536927052	4 to 10	0.28 to 0.69	2-5/16	59

WARNING

Avoid personal injury or property damage from sudden release of pressure or explosion of accumulated gas. Before starting disassembly:

- **Isolate the relief valve from line pressure, and**
- **Release trapped pressure from the valve body and pressure line.**

Type 289A

All key numbers are shown in Figure 6.

1. Loosen the hex nut (key 11), and unscrew the adjusting screw (key 6) to relieve spring compression.
2. Unscrew the machine screws (key 8), and remove the spring case (key 2), the spring seat (key 4), the spring (key 7), the diaphragm head (key 3), and the diaphragm (key 5).
3. Inspect the diaphragm and seating surfaces for damage or wear, and replace parts as necessary. To remove the orifice (key 10) unscrew it from the body.
4. Reinstall the orifice, the diaphragm, the diaphragm head, the spring, and the spring seat.
5. Reattach the spring case using the machine screws.
6. If a new spring with a different range is installed, stamp the spring case with the new spring range.
7. Adjust the spring compression according to the procedures outlined in the Startup section.

Type 289U

All key numbers are shown in Figure 7.

1. Loosen the hex nut (key 11), and unscrew the adjusting screw (key 6) to relieve spring compression.
2. Unscrew the machine screws (key 8), and remove the spring case (key 2), the spring seat (key 4), the spring (key 7), and the diaphragm assembly (key 5).
3. Inspect the diaphragm assembly and seating surfaces for damage or wear, and replace parts as necessary.
4. Reinstall the diaphragm assembly, the spring, and the spring seat.
5. Reattach the spring case using the machine screws.
6. If a new spring with a different range is installed, stamp the spring case with the new spring range.
7. Adjust the spring compression according to the procedures outlined in the Startup section.

Type 289L

All key numbers are shown in Figure 8.

1. Remove the closing cap (key 14) and the gasket (key 15), and then unscrew the adjusting screw (key 6) to relieve spring compression.
2. Unscrew the machine screws (key 8), and then remove the spring case (key 2), the spring (key 7), and the diaphragm assembly (key 5).
3. Inspect the diaphragm and seating surfaces for damage or wear, and replace parts as necessary. To remove the orifice (key 10), unscrew it from the body. Check the pitot tube in the diaphragm assembly for blockage, and remove any foreign material that might impair proper operation of the relief valve.
4. Reinstall the orifice, the diaphragm assembly, and the spring.
5. Reattach the spring case using the machine screws.
6. If a new spring with a different range is installed, stamp the closing cap with the new spring range.
7. Adjust the spring compression according to the procedures outlined in the Startup section, and then reinstall the closing cap and gasket.

Types 289HH and 1 NPT 289H

All key numbers are shown in Figure 9.

1. Loosen the hex nut (key 11), and then unscrew the adjusting screw (key 6) to relieve spring compression.
2. Unscrew the machine screws (key 8), and remove the spring case (key 2), the spring seat (key 4), and the spring (key 7).
3. Unscrew the hex nut (key 24), and remove the lower spring seat (key 17), the diaphragm head (key 3), and the diaphragm (key 5).
4. Unscrew the machine screws (key 29), and then remove the stem guide assembly (key 31) and attached parts from the valve body (key 1).
5. Slide the spacer (key 23) and the pitot tube (key 18) and attached parts from the valve body.
6. Remove the washer (key 27), the gasket (key 19), the spacer, the O-rings (key 30), the O-ring holder (key 21), the O-ring (key 20), and the O-ring washer (key 22) from the pitot tube.

7. Inspect the O-rings, the gaskets, the spacer, the orifice, and the seating surfaces for damage or wear, and replace parts as necessary.
8. Apply anti-seizing sealant to the adjusting screw threads, and to the end of the adjusting screw that contacts the spring seat.
9. Slide the O-ring washer, the O-rings (keys 30 and 20), the O-ring holder, the O-ring (key 30), the spacer, the stem guide assembly, the gasket, and the washer (key 27) onto the pitot tube.
10. Reinstall the stem guide assembly with attached parts into the valve body, and then attach this assembly with the machine screws (key 29).
11. Replace the diaphragm, the diaphragm head, and the lower spring seat, and then secure these parts with the hex nut (key 24).
12. Reinstall the spring and the spring seat, and then attach the spring case to the valve body using the machine screws (key 8).
13. If a new spring with a different range is installed, stamp the spring case with the new spring range.
14. Adjust the spring compression according to the procedures outlined in the Startup section.

2 NPT Type 289H

All key numbers are shown in Figure 10.

1. Remove the closing cap and the gasket (keys 14 and 15), and then unscrew the adjusting screw (key 6) to relieve spring compression.
2. Unscrew the machine screw (key 8), and remove the spring case (key 2), the washer (key 27), and the spring (key 7).
3. Unscrew the hex nut (key 24), unscrew the lifting stem (key 25), and then unscrew the hex nut (key 11).
4. Remove the lower spring seat (key 17), the diaphragm head (key 3), the diaphragm (key 5), the lower diaphragm head (key 26), and the gasket (key 19).
5. Unscrew the machine screws (key 29), and then remove the stem guide assembly (key 31) and attached parts.
6. Slide the spacer (key 23) and the pitot tube (key 18) and attached parts out of the stem guide assembly.
7. Remove the gaskets (key 19), the spacer (key 23), and the O-ring washer (key 22) from the pitot tube. Then remove the O-ring washer (key 22) and the orifice (key 10) from the valve body (key 1).
8. Inspect the O-rings, the gaskets, the spacer, the orifice, and the seating surfaces for damage or wear, and replace parts as necessary.
9. Apply anti-seizing sealant to the orifice threads, and then to the adjusting screw threads.
10. Reinstall the orifice and the O-ring (key 20) into the valve body.
11. Slide the gasket, the O-ring washer, the gasket, the spacer, the stem guide assembly, and the gasket onto the pitot tube.
12. Reinstall the stem guide assembly with attached parts into the valve body, and attach it with the machine screws (key 29).
13. Replace the lower diaphragm head, the diaphragm, the diaphragm head, and the lower spring seat; then secure these parts with the hex nut (key 11). Screw in the lifting stem, and lock it in place with the hex nut (key 24).
14. Reinstall the spring and the washer.

Note

For 2 NPT Type 289H relief valves, when changing from one spring range to another, use a new spring case to position the travel stop drive screw correctly for the corresponding spring range. Each spring range requires that the travel stop drive screw be positioned appropriately in the spring case to prevent setting the relief valve pressure too high. The location of the travel stop drive screw for each spring and spring range is shown in Figure 5.

15. Attach the spring case to the valve body using the machine screws (key 8).
16. If a new spring with a different range is installed, stamp the spring case with the new spring range.
17. Adjust the spring compression according to the procedures outlined in the Startup section. Then install the gasket and the closing cap.

Parts Ordering

When corresponding with your local Sales Office about this equipment, always reference the equipment serial number stamped on the spring case (key 2) or the closing cap (key 14). When ordering replacement parts, specify the complete 11-character part number of each required part as found in the following parts list.

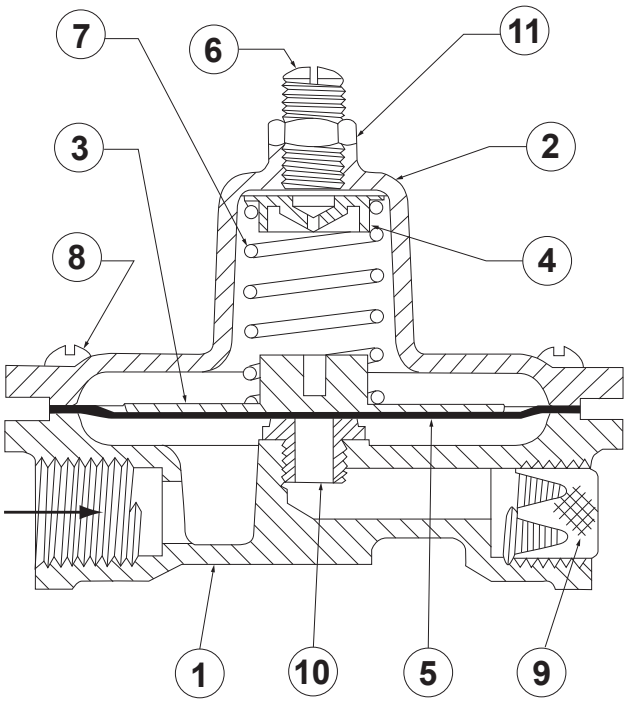

Figure 6. *Type 289A Relief Valve*

Parts List

Key	Description	Part Number
	Parts Kit (included are keys 5, 9, 15, 19, 20, 30, and 38). Screen is stainless steel and gaskets are composition and Neoprene (CR).	
	Type 289A (include keys 5 and 9 only)	
	Neoprene (CR) diaphragm	R289AX00012
	Type 289L (include keys 5, 9, and 15 only)	
	Nitrile (NBR) diaphragm and O-rings	
	3/4 NPT body	R289LX00012
	1 NPT body	R289LX00022
	Types 289H (1 NPT body) and 289HH	
	Nitrile (NBR) diaphragm and O-rings	R289HX00012
	Fluorocarbon (FKM) diaphragm and O-rings	R289HX00032
	Type 289H, 2 NPT body (include keys 5, 9, 15, 19, 20, and 38)	
	Nitrile (NBR) diaphragm and O-rings	R289HX00022
	Fluorocarbon (FKM) diaphragm and O-rings	R289HX00042
	Type 289U (include keys 5 and 9 only)	
	Nitrile (NBR) diaphragm	R289UX00012
1	Valve Body	
	Type 289A, Zinc	0Y071044022
	Type 289U, Zinc	0B043844012
	Types 289H (1 NPT body) and 289HH, Aluminum	3U888208012
	Type 289H (2 NPT body), Cast iron	31B1992X012
	Type 289L, Aluminum	
	3/4 NPT body	3L407008012
	1 NPT body	3L406908012
2	Spring Case/Spring Case Assembly	
	Type 289A, Zinc	0B061644022
	Types 289H (1 NPT body) and 289HH, Aluminum	1P901708012
	Type 289H (2 NPT body), Zinc/steel	1E7020X0012
	Type 289L, Aluminum	3L3338X0012
	Type 289U, Zinc	0B061644022
3	Diaphragm Head	
	Type 289A, Aluminum	0T022744022
	Type 289H, Zinc-plated steel	
	1 NPT body	1D666428982
	2 NPT body	0W020225072
	Type 289HH, Zinc-plated steel	1P901425062
4	Spring Seat	
	Type 289L, Zinc-plated steel	1L406525072
	Type 289A, Brass	0T022614012
	Type 289U, Zinc-plated steel	1B372544022
	Types 289H (1 NPT body) and 289HH, Zinc-plated steel	1D667125072
5*	Diaphragm/Diaphragm Assembly	
	Type 289A, Neoprene (CR)	1A505202102
	Types 289H (1 NPT body) and 289HH	
	Nitrile (NBR)	24B5622X012
	Fluorocarbon (FKM)	1E606602342
	Type 289H (2 NPT body)	
	Nitrile (NBR)	24B6447X012
	Fluorocarbon (FKM)	1D780002332
	Type 289L	
	Nitrile (NBR)[1], 3/4 and 1 NPT bodies, **(standard)**	AL4068X0062
	Type 289U[2], Nitrile (NBR)	18A2815X012

*Recommended Spare Parts

1. Assembly also includes an Aluminum pitot tube and brushing, a Zinc-plated steel spring seat and diaphragm head, and a Neoprene (CR) seat pad.
2. Assembly also includes a Zinc diaphragm head.

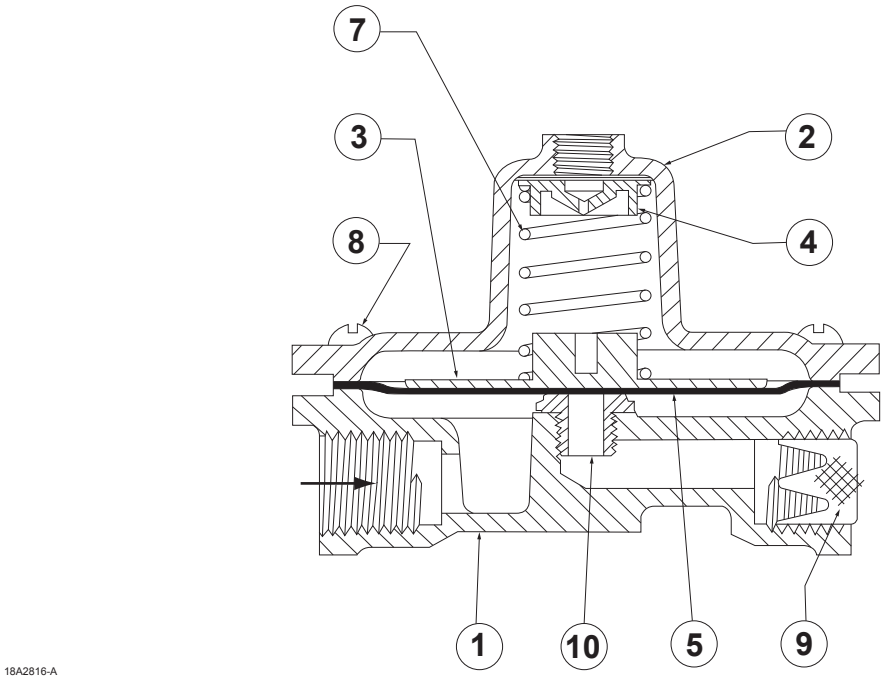

Figure 7. *Type 289U Relief Valve*

Key	Description	Part Number
6	Adjusting Screw	
	Type 289A, Brass	1A568414012
	Types 289H (1 NPT body) and 289HH, Zinc-plated steel	1D995448702
	Type 289H (2 NPT body), Zinc	1B537944012
	Type 289L, Delrin®	T1007106642
	Type 289U, Brass	0F058114012
7	Spring	See Table 1
8	Machine Screw, Plated steel	
	Type 289A (6 required)	1P474328982
	Types 289H and 289HH, 1 NPT body, (8 required)	1A391724052
	Type 289H, 2 NPT body (8 required)	1A407824052
	Type 289L (8 required)	T13305T0012
	Type 289U (6 required)	1A899028982
9	Screen, Stainless steel	
	Type 289L	
	3/4 NPT body	1B633538392
	1 NPT body	1E564843122
	Types 289A and 289U	0L078343062
	Types 289H and 289HH, 1 NPT body	1E564843122
	Type 289H, 2 NPT body	11B1994X012
10*	Orifice	
	Type 289A, Aluminum	0T022509012
	Type 289H (2 NPT body)	
	Brass	1E702613012
	Stainless steel	1E702635072
	Type 289L, Aluminum	1L406409012

Key	Description	Part Number
11	Hex Nut	
	Types 289A and 289U, Brass	1A505418992
	Types 289H (1 NPT body) and 289HH, Zinc-plated steel	1D667728982
	Type 289H (2 NPT body)	
	Zinc-plated steel	1D780124272
	Zinc	1A309324122
13	Snap Ring	
	Type 289L, Stainless steel	
	3/4 NPT body	1B633638992
	1 NPT body	1E564937022
	Types 289H and 289HH, 1 NPT body, Carbon-plated steel	13A9938X012
	Type 289H, 2 NPT body, Carbon steel	10B9241X012
14	Closing Cap	
	Type 289H, 2 NPT body, Zinc	1B541644012
	Type 289L	T1007206992
15*	Gasket, Neoprene (CR)	
	Types 289H and 289HH, 1 NPT body	13A9929X012
	Type 289H, 2 NPT body	1P753306992
	Type 289L	1E105606992
17	Lower Spring Seat, Zinc-plated steel	
	Types 289H and 289HH, 1 NPT body	1D666625072
	Type 289H, 2 NPT body	1D779925062
18	Pitot Tube	
	Types 289H and 289HH, 1 NPT body, Aluminum	1F826209012
	Type 289H, 2 NPT body	
	Brass	1E701914012
	Stainless steel	1E701935032

*Recommended Spare Parts

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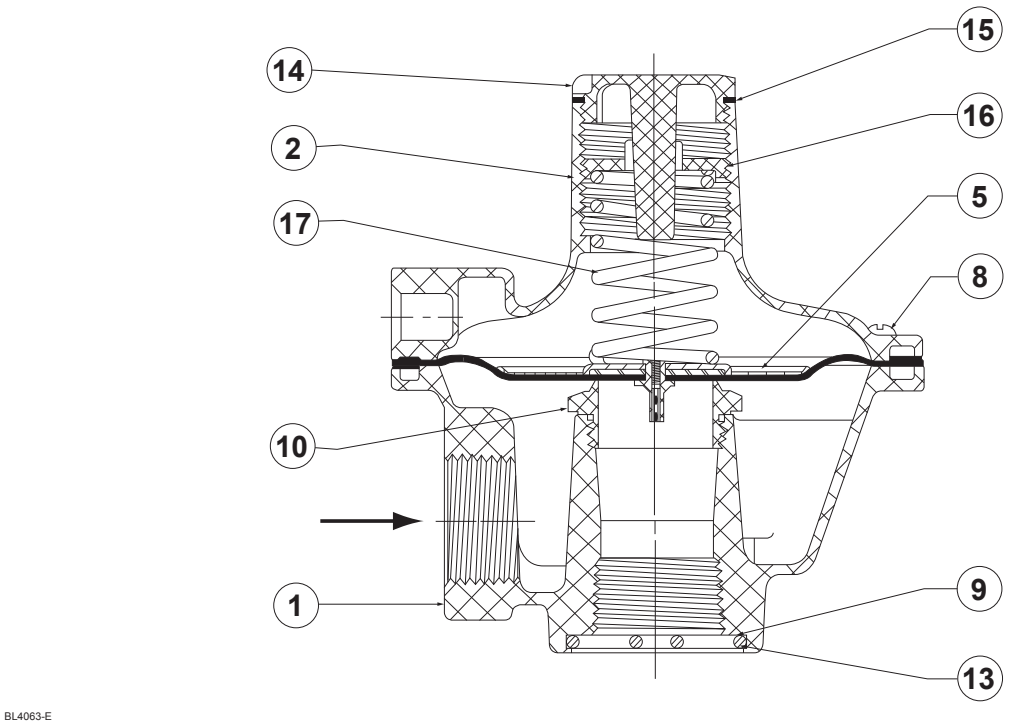

Figure 8. *Type 289L Relief Valve*

Key	Description	Part Number
19*	Gasket, Composition	
	Types 289H and 289HH, 1 NPT body (1 required)	1F826804022
	Type 289H, 2 NPT body (3 required)	1D779804022
20*	O-Ring	
	Type 289H, 1 NPT body	
	Nitrile (NBR)	1F269206992
	Fluorocarbon (FKM)	1F2692X0012
	Type 289H, 2 NPT body	
	Nitrile (NBR)	1P336106992
	Fluorocarbon (FKM)	1V664606382
	Type 289HH	
	Nitrile (NBR)	1F269206992
	Fluorocarbon (FKM)	1F2692X0012
21	O-Ring Holder, Aluminum	
	Types 289H and 289HH, 1 NPT body	1F826409012
22	O-Ring Washer	
	Types 289H and 289HH,	
	1 NPT body, Aluminum	1F826509012
	Type 289H, 2 NPT body, Stainless steel	1E702136072
23	Spacer	
	Types 289H and 289HH,	
	1 NPT body, Stainless steel	1F826335242
	Type 289H, 2 NPT body	
	Brass	1E702214172
	Stainless steel	1E702235162
24	Hex Nut, Plated steel	
	Types 289H and 289HH, 1 NPT body	1A499724122
	Type 289H, 2 NPT body	1B228228982

Key	Description	Part Number
25	Lifting Stem, Zinc-plated steel	
	Type 289H, 2 NPT body	1D780224092
26	Lower Diaphragm Head, Zinc-plated steel	
	Type 289H, 2 NPT body	1E703125072
27	Washer, Aluminum	
	Types 289H and 289HH, 1 NPT body	1F826709012
	Type 289H, 2 NPT body	1C680511032
28	Pipe Plug, Types 289H and 289HH, Carbon steel	T13718T0012
29	Machine Screw, Carbon-plated steel (not shown)	
	Types 289H and 289HH,	
	1 NPT body (2 required)	1H526928982
	Type 289H, 2 NPT body (4 required)	1F386528992
30*	O-Ring, Types 289H and 289HH,	
	1 NPT body (2 required)	
	Nitrile (NBR)	1D687506992
	Fluorocarbon (FKM)	1N430406382
31	Stem Guide Assembly	
	Types 289H and 289HH, 1 NPT body	
	Zinc/Brass	1F8272000A2
	Zinc/303 Stainless steel	1F8272X0012
	Type 289H, 2 NPT body	
	Cast iron/Brass	1E7028000A2
	Cast iron/303 Stainless steel	1E7028X00A2
32	Lifting Lever (not shown), Steel	
	Type 289H, 2 NPT body	0R061725092
34*	Diaphragm Protector (not shown),	
	Polytetrafluoroethylene (PTFE)	
	Types 289A	10A5116X012
38*	Gasket, Type 289H, 2 NPT body, Neoprene (CR)	11B1993X012

*Recommended Spare Parts

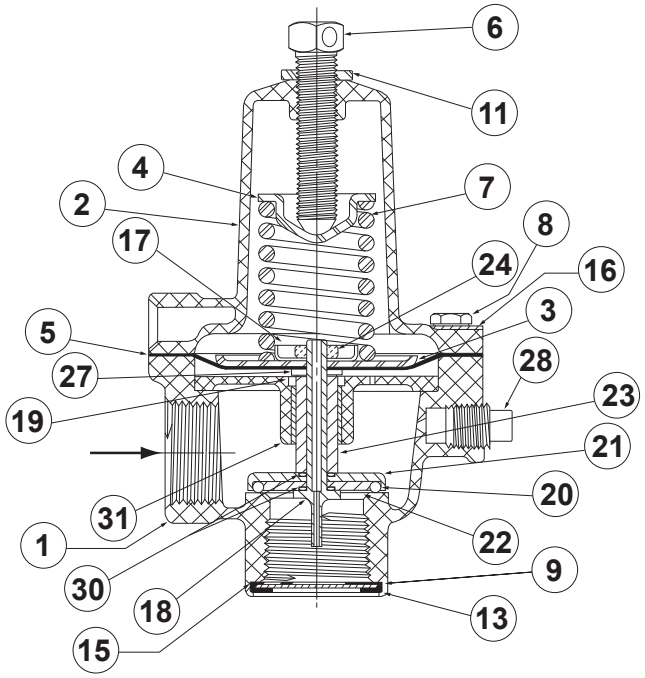

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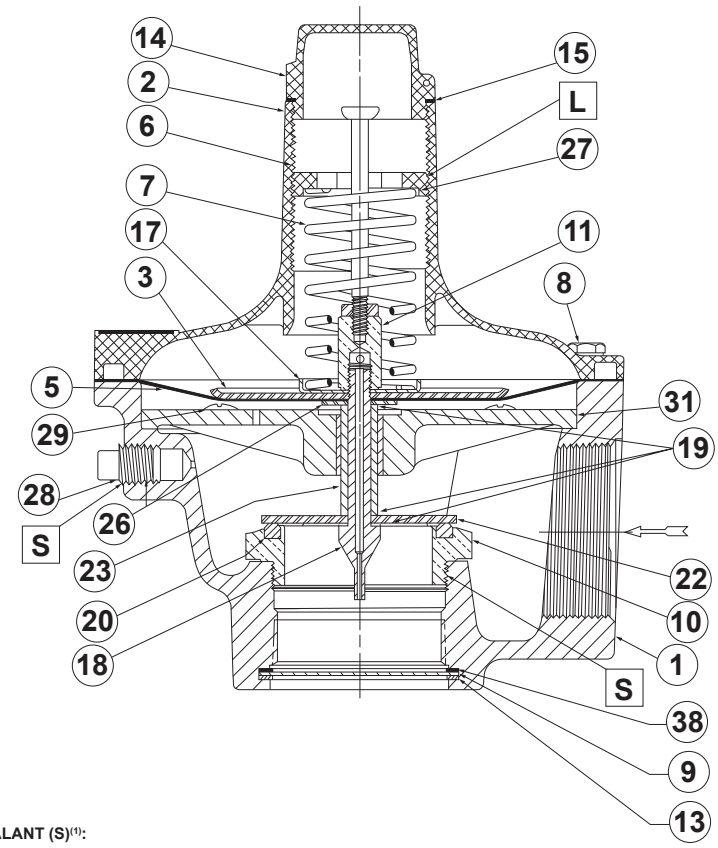
Figure 9. *Types 289HH and 1 NPT 289H Relief Valves*



BE7030-J

☐ **APPLY LUBRICANT (L) / SEALANT (S)[1]:**
L = ANTI-SEIZE COMPOUND
S = THREAD SEALANT

1. Lubricant and sealant must be selected such that they meet the temperature requirements.

Figure 10. *2 NPT Type 289H Relief Valve*

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Models: 581, 582

Cast Carbon Steel Screwed and Socket Weld End Y Strainers
Sizes: ¼" – 2" (6 – 50mm)

Pressure/Temperature - Non-Shock		
Model	**Material**	**Rating**
581, 582	Carbon Steel	1480psi @-20°F to 100°F 102.04 bar @ 37.8°C 1015psi @ 750°F 69.98 bar @ 389.89°C

581 screwed **Class 600**
582 socket weld **Class 600**

Model 581

Typical Service
- Used extensively to strain foreign matter from pipelines and provide economical protection for costly pumps, meters, valves, and other similar mechanical equipment.
- These are especially critical where weld debris is often present in the pipeline.
- Well suited for long service in high pressure and temperature applications.

Features
- Machined seats in both body and cap align and lock the screen in place to stop sediment bypass.
- Machined seats facilitate alignment and accurate reseating after servicing.

Construction
- Straight threaded, gasketed cap is used for easy disassembly and assembly. Many others use Loctite, rendering disassembly virtually impossible.
- Heavy duty, rugged bodies with extra heavy bore.

Self-Cleaning
- Self-cleaning is accomplished by opening the plug or valve connected to the blowoff outlet

Blowoff Outlets
- Outlets are NPT tapped
- Sizes of tapping specified on next page
- Not normally furnished with plug. Plug available, specify with order.
- Blind caps are also available, specify with order.

Capacity
- Generously proportioned bodies
- Open Area Ratio much greater than pipe size, ensuring low pressure drop

Screens

		STANDARD (WATER)		STEAM RECOMMENDATION	
MODEL	**SIZES**	**MATERIAL**	**OPENING**	**MATERIAL**	**OPENING**
581, 582	¼" – 2"	304SS	.062 perf	304SS	.033 perf

Materials

	581	582
Body	Carbon Steel ASTM A216 Gr. WCB	Carbon Steel ASTM A216 Gr. WCB
Screen	304 Stainless Steel ASTM A240	304 Stainless Steel ASTM A240
Gasket	Spiral Wound Graphite Filled	Spiral Wound Graphite Filled

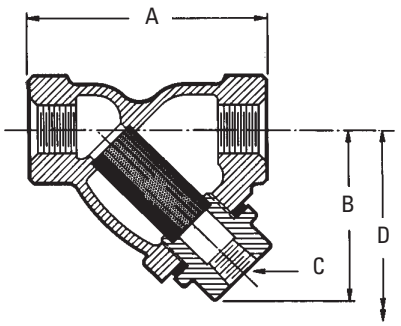
Pressure Drop
- See Pressure Drop Charts in Technical Data Section of the Mueller Steam Specialty Engineering binder.

Mueller Steam Specialty™

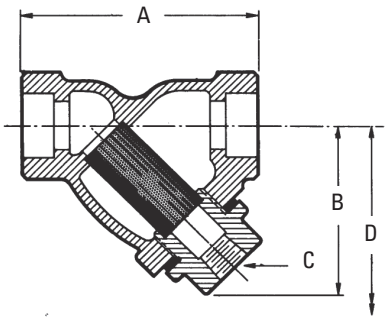
Dimensions and Weights

SIZE		DIMENSIONS								WEIGHT	
		A		B		C (NPT)		D Screen Removal			
in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	lbs.	kgs.
¼	6	2 15/16	76	2 3/8	60	¼	6	2½	64	2	.91
⅜	10	2 15/16	76	2 3/8	60	¼	6	2½	64	2	.91
½	15	2 15/16	76	2 3/8	60	¼	6	2½	64	2	.91
¾	20	3 11/16	95	2 13/16	72	⅜	10	3⅜	86	3	1.36
1	25	4 9/16	117	3⅛	130	⅜	10	4¾	121	5	2.27
1¼	32	4 15/16	127	4	102	¾	20	5¼	133	6.8	3.08
1½	40	5 9/16	143	4¾	121	¾	20	6	152	9.8	4.45
2	50	6 15/16	178	6	152	1	25	7⅝	194	15	6.8

Apply For Certified Drawings.



Model 581



Model 582

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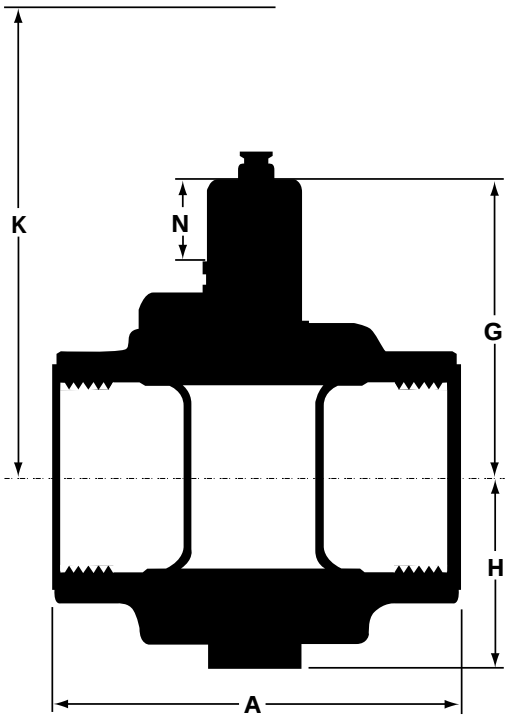
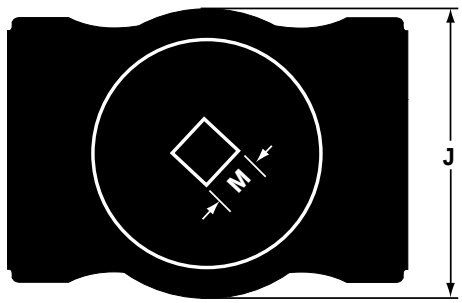


Fig.R-1430
Wrench-Operated

Materials of Construction

Body: ASTM A 126 Class B
Plug: ASTM A 126 Class B
Baseplate: ASTM A 126 Class B
Baseplate Spring: Stainless Steel 17-7
Sealant Screw: Commercial Steel
Double Ball Check Valve: Commercial Steel
Gasket: Glass Filled TFE



Upon Request

Dimensions -Regular Opening, Rectangular Port Valves R-1430

DESCRIPTION		BOTTOM ENTRY								
SIZE		1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4
A	End-to-end	3 7/8	3 7/8	3 7/8	5	5	5 3/4	6 3/4	7 1/2	9
H	Center of Port to Bottom of Valve	1 7/8	1 7/8	1 7/8	2 1/8	2 3/8	2 5/8	3 1/8	3 1/4	4 1/4
J	Extreme Width of Body	2 1/2	2 1/2	2 1/2	2 5/8	2 3/4	3 3/8	4 1/4	5	6 1/4
L	Diameter of Sealant Stick	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	5/8
	STEM DATA									
G	Center of Port to Top of Stem	3 5/8	3 5/8	3 5/8	3 5/8	3 5/8	3 7/8	5	5 1/4	6 5/8
K	Clearance to Remove Lubricant Screw	5 7/8	5 7/8	5 7/8	5 7/8	5 3/4	6 1/8	7 1/4	7 1/2	10 1/8
M	Width of Square of Stem	15/16	15/16	15/16	15/16	15/16	15/16	1 1/4	1 1/4	1 3/4
N	Height of Square of Stem	1 3/8	1 3/8	1 3/8	1 3/8	1 1/8	1 1/8	1 3/8	1 3/8	1 7/8
	Wrench	A	A	A	A	A	A	C	C	F
	Wt. (lb.)	4	4	4	5	6	9	15	21	40

R&M ENERGY SYSTEMS
A Unit of Robbins & Myers, Inc.

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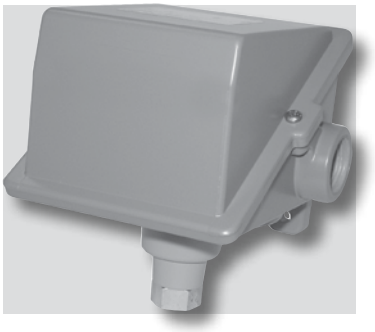


400 Series Pressure and Differential Pressure Switches

Types: H400, H402, H403, H400K, H402K, J400, J402, J403, J400K, J402K

UNITED ELECTRIC CONTROLS

Installation and Maintenance Instructions

Please read all instructional literature carefully and thoroughly before starting. Refer to the final page for the listing of Recommended Practices, Liabilities and Warranties.

GENERAL

BEFORE INSTALLING, CHECK THE SENSOR MODEL SELECTED FOR COMPATIBILITY TO THE PROCESS MEDIA IN CONTACT WITH THE SENSOR AND WETTED PARTS.

The 400 Series pressure and differential pressure switches are activated when a bellows, diaphragm or piston sensor responds to a pressure change. This response, at a pre-determined set point, actuates one, two or three snap-acting switch(es), converting the pressure signal into an electrical signal. Control set point may be varied by turning the internal knob and pointer (H types) or internal screw (J types). (See Adjustment -PART II)

PROOF PRESSURE* LIMITS STATED IN THE LITERATURE AND ON NAMEPLATES MUST NEVER BE EXCEEDED, EVEN BY SURGES IN THE SYSTEM. OCCASIONAL OPERATION OF UNIT UP TO PROOF PRESSURE IS ACCEPTABLE (E.G., START-UP, TESTING). CONTINUOUS OPERATION SHOULD NOT EXCEED THE DESIGNATED OVER RANGE** OR WORKING PRESSURE RANGE***.

*PROOF PRESSURE - THE MAXIMUM PRESSURE TO WHICH A PRESSURE SENSOR MAY BE OCCASIONALLY SUBJECTED, WHICH CAUSES NO PERMANENT DAMAGE (E.G., START-UP, TESTING). THE UNIT MAY REQUIRE RE-GAPPING.

**OVER RANGE PRESSURE - THE MAXIMUM PRESSURE TO WHICH A PRESSURE SENSOR MAY BE CONTINUOUSLY SUBJECTED WITHOUT CAUSING DAMAGE AND MAINTAINING SET POINT REPEATABILITY.

***WORKING PRESSURE RANGE - THE PRESSURE RANGE WITHIN WHICH TWO OPPOSING SENSORS CAN BE SAFELY OPERATED AND STILL MAINTAIN SET POINT REPEATABILITY.

THESE PRODUCTS DO NOT HAVE ANY FIELD REPLACEABLE PARTS.

Please refer to product bulletin for product specifications. Product bulletins may be found at www.ueonline.com

Part I - Installation

Tools Needed
Screwdriver
Hammer (for alternate wire knockouts)
Adjustable wrench

MOUNTING

ALWAYS LOCATE UNITS WHERE SHOCK, VIBRATION AND TEMPERATURE FLUCTUATIONS ARE MINIMAL. DO NOT MOUNT UNIT IN AMBIENT TEMPERATURES EXCEEDING PUBLISHED LIMITS.

UNIT MAY BE MOUNTED IN ANY POSITION PROVIDED THE ELECTRICAL CONDUIT IS NOT FACING UP. THE RECOMMENDED MOUNTING POSITION IS VERTICAL (PRESSURE CONNECTION FACING DOWN), SPECIFICALLY WHERE HEAVY CONDENSATION IS EXPECTED.

400 Series pressure controls can be mounted in any position, provided the electrical conduit is not facing up. The preferred mounting position is vertical (pressure connection down).

A 3/4" NPT E/C is provided on the right side of the enclosure in addition to the two (2) cast-in 7/8" diameter knockouts for 1/2" electrical conduit that are located on the left side and rear of the enclosure. These can easily be knocked out by placing the blade of a screwdriver in the groove and tapping sharply with a hammer.

Mount the unit via the (2) 1/4" screw clearance holes on the enclosure. See Dimensions. Units may also be mounted via the NPT pressure connection.

ALWAYS HOLD A WRENCH ON THE PRESSURE HOUSING HEX WHEN MOUNTING UNIT. DO NOT TIGHTEN BY TURNING ENCLOSURE. THIS WILL DAMAGE SENSOR AND WEAKEN SOLDER OR WELDED JOINTS.

On models supplied with an external manual reset button, be sure to leave sufficient finger space over the reset button for the operator to reset the control.

WIRING

DISCONNECT ALL SUPPLY CIRCUITS BEFORE WIRING UNIT. WIRE UNITS ACCORDING TO NATIONAL AND LOCAL ELECTRICAL CODES. MAXIMUM RECOMMENDED WIRE SIZE IS 14 AWG. THE RECOMMENDED TIGHTENING TORQUE FOR FIELD WIRING TERMINALS IS 7 TO 17 IN-LBS.

ELECTRICAL RATINGS STATED IN LITERATURE AND ON NAMEPLATE SHOULD NEVER BE EXCEEDED. OVERLOAD ON A SWITCH CAN CAUSE FAILURE ON THE FIRST CYCLE.

Connect conduit to the case and wire directly to the switch terminals according to local and national electrical codes. Bring the wires up to terminals from the rear of the case. (See fig. 1.) If manual reset switch or DPDT options are used, lead wires are supplied, color coded as follows:

	Manual Reset Option 1530 (for 400 & 400K)	Manual Reset Option 1530 (for 402 & 402K)	
	Switch 1	Switch 1	Switch 2
C	Violet	Violet	Yellow
NO	Blue	Blue	Orange
NC	Black	Black	Red

DPDT Option 1010 (for 400 & 400K)		
	Circuit 1	Circuit 2
C	Yellow	Violet
NO	Red	Blue
NC	Orange	Black

DPDT Option 1010 (for 402 & 402K)				
	Switch 1		Switch 2	
	Circuit 1	Circuit 2	Circuit 1	Circuit 2
C	White	Violet	Yellow	Blue
NO	**	**	**	**
NC	Black	Red	Orange	Brown

** On dual switch units (402 & 402K), the DPDT option is factory wired common and normally open per the color coding above. If normally closed wiring is desired, simply move the supplied wires from the normally open terminals to the normally closed terminals.

ALLOW ENOUGH SLACK SO AS NOT TO AFFECT SWITCH MOVEMENT WHEN MAKING SETTING ADJUSTMENTS AND ENSURE THAT THE WIRES ARE NOT TOUCHING THE COVER WHEN INSTALLED.

NOTE: For larger wire gauges, a one time shift may be experienced or expected due to space limitations within the enclosure. Verify set point after installation.

NOTE: The middle switch assembly is omitted for dual switch controllers. The outer switch assemblies are omitted for single switch controllers. Type "J" controls have internal screw adjustments and type "H" have cam assemblies for internal calibrated adjustments.

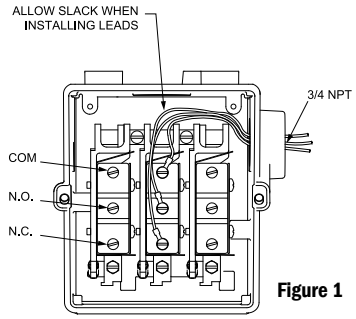


Figure 1

Special Instructions For Vacuum Ranges

On vacuum ranges, the C-NO circuit is closed at sea level conditions. Therefore, increasing vacuum will cause the C-NC circuit to close while decreasing vacuum will cause the C-NO circuit to close. Please make a note of this and wire/adjust the unit accordingly.

Part II - Adjustments (See Figure 2)

Tools Needed
Screwdriver

NOTE: For set point adjustments and re-calibration, connect control to a calibrated pressure gauge.

Type J400 & J400K

Remove cover. Switch has screw adjustments inside enclosure. Increase gauge pressure until switch transfers. To RAISE the pressure setting turn the screw clockwise (right). To LOWER the pressure setting turn the screw counter-clockwise (left). When making adjustments, do not exceed the proof pressure* rating on nameplate.

*Subjecting the switch to proof pressure may cause a shift in set point

Types J402, J403 & J402K

Remove cover, follow same procedure as paragraph above. Switches may be set together or apart, up to 100% of range (maximum separation on models 520-535 and 570-572 is defined in Table 1). On dual switch, either switch may be set high. On triple switch models, the third (middle) switch has no over-travel mechanism and must always be set to the highest pressure when switches are set apart. Altering the setting of one switch will usually have little effect on the other(s), however re-calibration may be desired at a critical pressure setting.

Table 1

Model & Range	Switch Separation (% of Range Span)
520, 530 (-300 to 0 VAC)	30%
521, 531 (-10 to 10 "wc)	50%
522, 532 (-50 to 50 "wc)	50%
523, 533 (0.5 to 5 "wc)	50%
524, 534 (2.5 to 50 "wc)	50%
525, 535 (10 to 250 "wc)	30%
570-572 (0 up to 100 psi)	30%

RE-CALIBRATION ADJUSTMENT

Special Instructions for Models 520-535 (see Figure 3)

When making set point adjustments, or re-calibrating the Models 520-535, Switch #2 should be set first, and to the highest pressure setting. Switch #1 should be set to a lower or equal setting than switch #2.

Switch #2 can be adjusted using a screwdriver to turn the slotted adjustment screw (see Figure 3) clockwise (to raise the pressure setting), or counter-clockwise (to lower the pressure setting). Once desired set point is achieved for switch #2, switch #1 can be set lower or equal to switch #2 set point, following the procedure outlined for switch #2. Maximum separation between switch #1 and #2 is defined in Table 1.

Types H400, H402, H403, H400K & H402K

Remove cover, switch has knob and pointer adjustment inside enclosure. Controls are factory calibrated for maximum accuracy at the dial midpoint. Switches may be set together or apart up to 100% of the range scale. On dual switch models either switch may be set high. On triple switch models, the third (middle) switch has no over-travel mechanism and must always be set to the highest pressure when the switches are set apart. Altering the setting of one switch will usually have little effect on the other(s), however re-calibration may be desired at a critical setting.

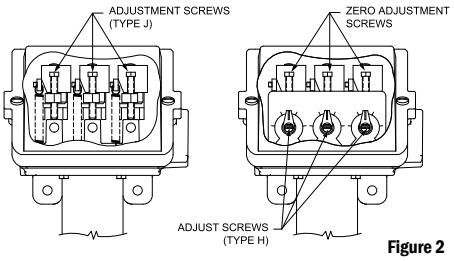


Figure 2

To re-calibrate, turn pointer to desired set point and add gauge pressure until switch transfers. If gauge pressure and set point pressure do not agree, turn zero adjust screw clockwise to raise and counter clockwise to lower pressure setting (See Figure 2).

Types with Manual Reset (Option 1530)

These optional models incorporate a snap switch that, when actuated, remains activated until pressure decreases and the reset button (located on top of the control) is manually depressed to the reset position.

Types with Adjustable Deadband Switch (Option 1520)

Models with option code 1520 incorporate a snap switch with integral adjustment wheel. Turing this wheel raises or lowers the pressure rise set point. The fall set point remains constant. To use the adjustable deadband switch:

1. Determine set point and deadband values. For example, a rising set point of 20 psi with a deadband value of 6 psi.
2. Set the falling set point at desired deadband value (determined by subtracting the deadband value from the desired set point) using the standard adjustment screw as outlined above. Using the example from step 1, 20 - 6 = 14, so you would set the fall set point at 14 psi. This is your constant.
3. Set your deadband by turning the adjustment wheel left to raise or right to lower the set point. Using the example from step 1, turn the wheel left or right until 20 psi is achieved. This is your set point.

Consult UE for additional information.

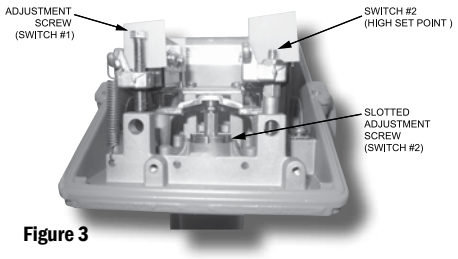


Figure 3

Types J400K & J402K with Option M210 (see Figure 4)

To adjust for maximum accuracy at any desired set point, follow steps 1 - 4:

Span Adjustment

1. Remove front window and gasket (four screws) to gain access to span adjustment.
2. Connect control to calibrated pressure source and set to required differential pressure.
3. Using a screwdriver, carefully turn span adjustment. (See Figure 4) to obtain required indication.
4. Reattach front gasket and window.

Option M210 - Differential Pressure Indication

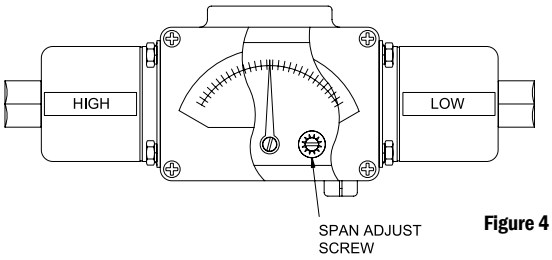
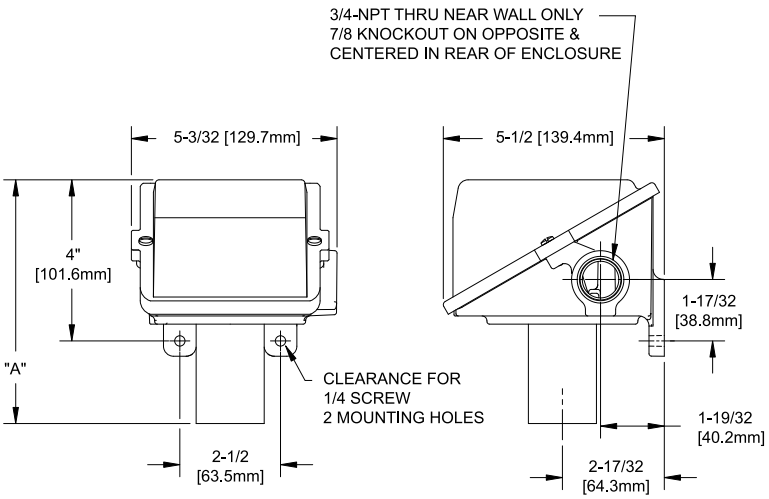


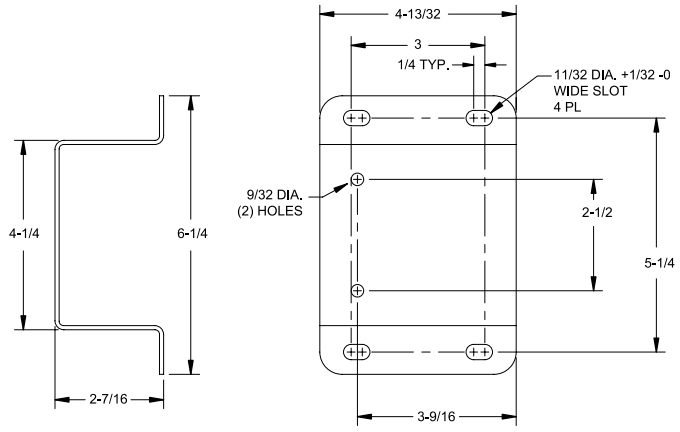
Figure 4

Dimensions

Dimensional drawings for all models may be found at www.ueonline.com



Surface Mounting Hardware Kit
Part Number 6361-704 & Option M449

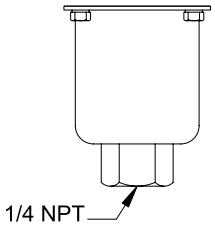


Dimension A

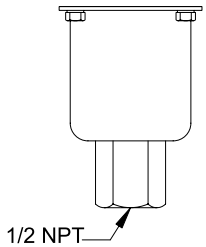
Models	Inches	mm	NPT
Pressure			
126-164	5.80	147.3	1/4
S126B-S164B	6.21	157.7	1/2
270-376	5.50	139.7	1/4
440-443, 449 451, 453, 454	4.28	108.7	1/4
448, 450, 452	5.03	127.8	1/4
520-525	8.25	209.6	1/2
530-535	8.13	206.5	1/2
551, 553-555	4.56	115.8	1/4
550, 552	5.03	127.8	1/4
570-572	4.56	115.8	1/4
610-614	6.31	160.3	1/4
Differential Pressure			
147-157	6.13	155.7	1/4
S147B-S157B	6.13	155.7	1/2
455-559	7.00	177.8	1/4
540-543	7.97	202.4	1/8
544-547	8.03	204.0	1/8

Pressure Sensors

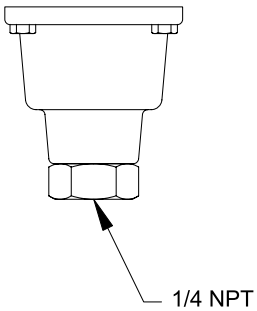
Models 126-164



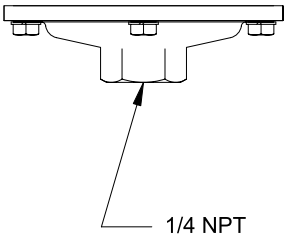
Models S126B-S164B



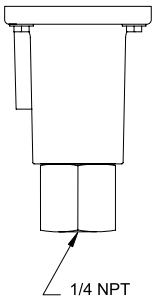
Models 270-376



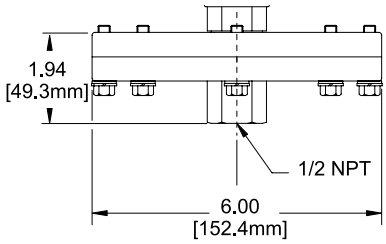
Models 440-454,
550-555, 570-572



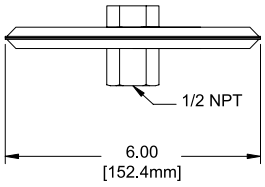
Models 610-614



Models 520-525

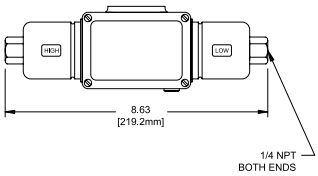


Models 530-535

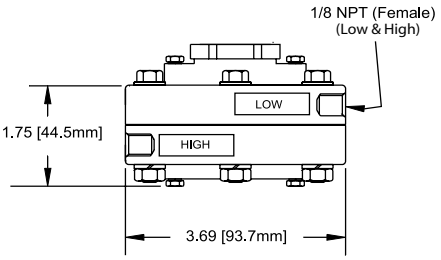


Differential Pressure Sensors

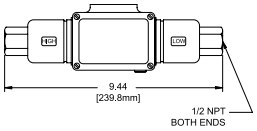
Models 147-157



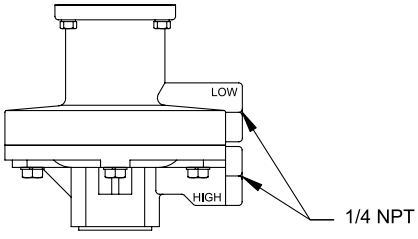
Models 544-547



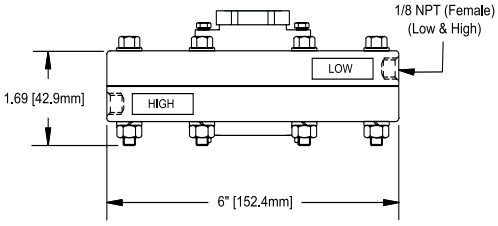
Models S147B-S157B



Models 455-559



Models 540-543



RECOMMENDED PRACTICES AND WARNINGS

United Electric Controls Company recommends careful consideration of the following factors when specifying and installing UE pressure and temperature units. Before installing a unit, the Installation and Maintenance instructions provided with unit must be read and understood.

- To avoid damaging unit, proof pressure and maximum temperature limits stated in literature and on nameplates must never be exceeded, even by surges in the system. Operation of the unit up to maximum pressure or temperature is acceptable on a limited basis (e.g., start-up, testing) but continuous operation must be restricted to the designated adjustable range. Excessive cycling at maximum pressure or temperature limits could reduce sensor life.
- A back-up unit is necessary for applications where damage to a primary unit could endanger life, limb or property. A high or low limit switch is necessary for applications where a dangerous runaway condition could result.
- The adjustable range must be selected so that incorrect, inadvertent or malicious setting at any range point cannot result in an unsafe system condition.
- Install unit where shock, vibration and ambient temperature fluctuations will not damage unit or affect operation. When applicable, orient unit so that moisture does not enter the enclosure via the electrical connection. When appropriate, this entry point should be sealed to prevent moisture entry.
- Unit must not be altered or modified after shipment. Consult UE if modification is necessary.
- Monitor operation to observe warning signs of possible damage to unit, such as drift in set point or faulty display. Check unit immediately.
- Preventative maintenance and periodic testing is necessary for critical applications where damage could endanger property or personnel.
- Electrical ratings stated in literature and on nameplate must not be exceeded. Overload on a switch can cause damage, even on the first cycle. Wire unit according to local and national electrical codes, using wire size recommended in installation sheet.
- Do not mount unit in ambient temp. exceeding published limits.

LIMITED WARRANTY

Seller warrants that the product hereby purchased is, upon delivery, free from defects in material and workmanship and that any such product which is found to be defective in such workmanship or material will be repaired or replaced by Seller (Ex-works, Factory, Watertown, Massachusetts. INCOTERMS); provided, however, that this warranty applies only to equipment found to be so defective within a period of 24 months from the date of manufacture by the Seller. Seller shall not be obligated under this warranty for alleged defects which examination discloses are due to tampering, misuse, neglect, improper storage, and in any case where products are disassembled by anyone other than authorized Seller's representatives. EXCEPT FOR THE LIMITED WARRANTY OF REPAIR AND REPLACEMENT STATED ABOVE, SELLER DISCLAIMS ALL WARRANTIES WHATSOEVER WITH RESPECT TO THE PRODUCT, INCLUDING ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

LIMITATION OF SELLER'S LIABILITY

Seller's liability to Buyer for any loss or claim, including liability incurred in connection with (i) breach of any warranty whatsoever, expressed or implied, (ii) a breach of contract, (iii) a negligent act or acts (or negligent failure to act) committed by Seller, or (iv) an act for which strict liability will be inputted to seller, is limited to the "limited warranty" of repair and/or replacement as so stated in our warranty of product. In no event shall the Seller be liable for any special, indirect, consequential or other damages of a like general nature, including, without limitation, loss of profits or production, or loss or expenses of any nature incurred by the buyer or any third party.

UE specifications subject to change without notice.

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CP121110K

Apollo 2 Piece Threaded Steel and Steel Alloy Ball Valves
Installation, Operation, & Maintenance Guide

Installation

Pre-Installation Inspection

Inspect the piping system prior to valve installation whenever possible, to ensure that it has been properly flushed and cleared of construction and fabrication debris. The seating surfaces in soft seated valves are particularly susceptible to weld slag and sand blasting grit. Pipe scale, metal chips and other foreign materials should be removed.

Just prior to installation, remove each valve from its packing and remove any end covers. Examine the flow bore for debris. All Apollo ball valves are shipped in the open position to prevent damage to the ball surface. Any grit or foreign matter must be removed. Scratched or dented balls must be replaced. Do not install a damaged valve.

Two piece threaded end Apollo Ball valves are bi-directional. They may be installed in vertical or horizontal pipe runs without regard to flow direction and without regard to stem orientation.

Note: Valves must be installed in piping systems that comply with the applicable portions of the ASME B31 standards. Special considerations must be taken with respect to pipe line expansions and contractions and the media expansion and contractions within the piping system.

Threaded End Valves

Pipe connections to be threaded into these valves should be accurately threaded, clean and free of foreign material or metal shavings. Apply pipe sealant compound or PTFE tape to the male pipeline threads only. Do not use sealant on the female threads as excess compound may be forced into the valve body. This could cause sticking of the ball or encourage the accumulation of dirt and

debris that could prevent positive valve shutoff. Two wrenches must be used when making up pipe joints to these valves. Apply one wrench on the valve end closest to the pipe joint being tightened and the other wrench to the pipe to prevent transmitting torque through the valve body joint. Typical pipe make-up is 1-1/2 turns after installing the pipe hand-tight.

Operation

Ball valves are intended to be on-off devices operating through 90° of stem rotation. The valve handle is marked showing proper rotation direction for "ON" and "OFF" positions. Rotation is clockwise for "OFF" (closed) and counterclockwise for "ON" (open).

The most common service failures not related to the installation and start-up processes are:

- Exceeding the operating temperature or pressure limits of the valve due to a process upset condition.
- A chemical attack on valve components due to either misapplication or changes in the service.

Violating temperature and pressure limits can result in immediate valve failure where chemical attack or corrosion generally occurs gradually.

Maintenance

Valve Adjustments

Normal stem packing wear can be compensated for by tightening the packing gland screw. (Wrench part number H371400 is available to ease this operation.) Tighten the packing gland screw clockwise in 1/8 turn increments until observed leakage stops. Do not exceed the values shown in Table 1. If all of the adjustments to the packing gland screw have been made, remove the handle nut, handle and packing gland screw and add one or two replacements bearings on top of the old packing. Reinstall the handle and handle nut.

Caution: Do not disassemble valve while under pressure nor with entrapped hazardous fluids therein.

Disassembly

1) Operate the valve fully opened to fully closed to assure there are no trapped fluids or pressure in the body cavity. Leave the valve in the closed position.
2) Remove the handle nut, handle and packing nut. Set aside for reuse.
3) Install pipe plugs in the body and retainer ports of NPT valves to prevent collapsing those areas.
4) Remove the retainer from the body. It may be necessary to heat the body joint above 450°F to breakdown the sealant used to secure the valve halves.
5) Remove the ball from the body cavity. Inspect the ball. If it is scarred, it is recommended that the whole valve be replaced, but replacement balls are available. Clean and set aside good balls for reuse.
6) Push the stem from the outside into the body cavity. Inspect the stem. If it is scarred or has damaged threads, replacements are available. Clean and set aside good stems for reuse.
7) Remove all seals and seats from the body and retainer then discard. Inspect the body and retainer for damage. If damaged, scrap the valve as replacements of these components are not offered.

Re-Assembly

1) Install stem bearing on to stem.
2) Fit stem into body from the retainer end and position the stem with the handle flats perpendicular to the flow axis.
3) Install stem packing over stem and fit into body recess.
4) Install packing gland screw into the threaded stem area.
5) Tighten the gland screw to manufacturing torque specifications, shown in Table 1.
6) Install the handle and handle retaining hardware.

7) Apply suitable light lubricant to seat and fit into the seat pocket of the body.
8) Install the ball in the closed position.
9) Apply suitable light lubricant to seat and fit into the seat pocket of the retainer.
10) Apply an adequate amount of thread locking compound (Loctite® 609, 648 or 680) to the retainer threads so that it covers no less than two complete threads opposite of the retainer shoulder.
11) With the ball in the closed position, thread the retainer into the body and torque to manufacturing specification to secure the body joint. Torque values are provided in Table 2.
12) Cycle the valve to the open position and verify proper operation and alignment of handle and/or mechanism.

Note: Valves in oxygen or other like services should be assembled with compatible thread sealant and lubricants.

Note: Always test valve and system before putting the system into service.

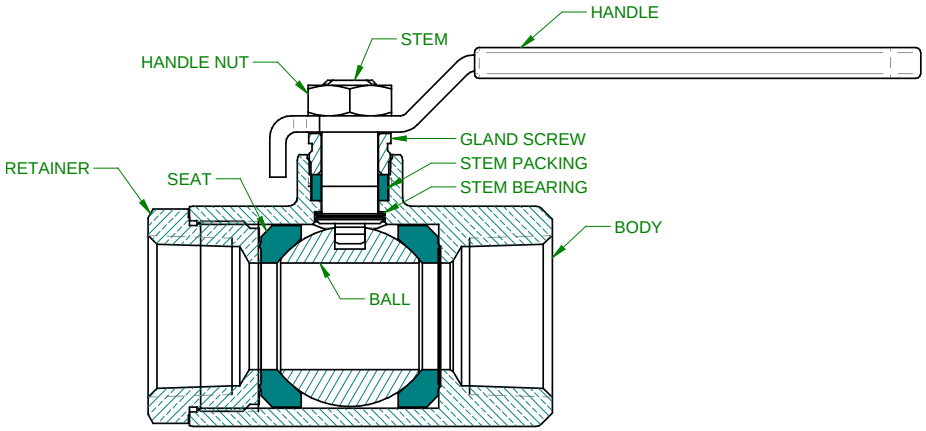
Table 1: Gland Nut Torque Requirements (ft-lbs.)

Valve Size	Gland Nut Torque
1/4" - 3/8"	12-18
1/2"	12-18
3/4"	20-25
1"	20-25
1-1/4"	61-100
1-1/2"	61-100
2"	61-100
2-1/2"	61-100
3"	61-100

Table 2: Retainer Torque Requirements, min. (ft-lbs.)

Valve Size	72, 73A, 74, 76, 89, 399, 489	7H, 76F	72-A
1/4" - 3/8"	25	15	-
1/2"	25	15	50
3/4"	25	20	100
1"	70	50	130
1-1/4"	110	95	230
1-1/2"	130	230	260
2"	200	230	450
2-1/2"	300	450	-
3"	960	1800	-

Parts Illustration



MET PRO CORPORATION **Dean Pump Division**

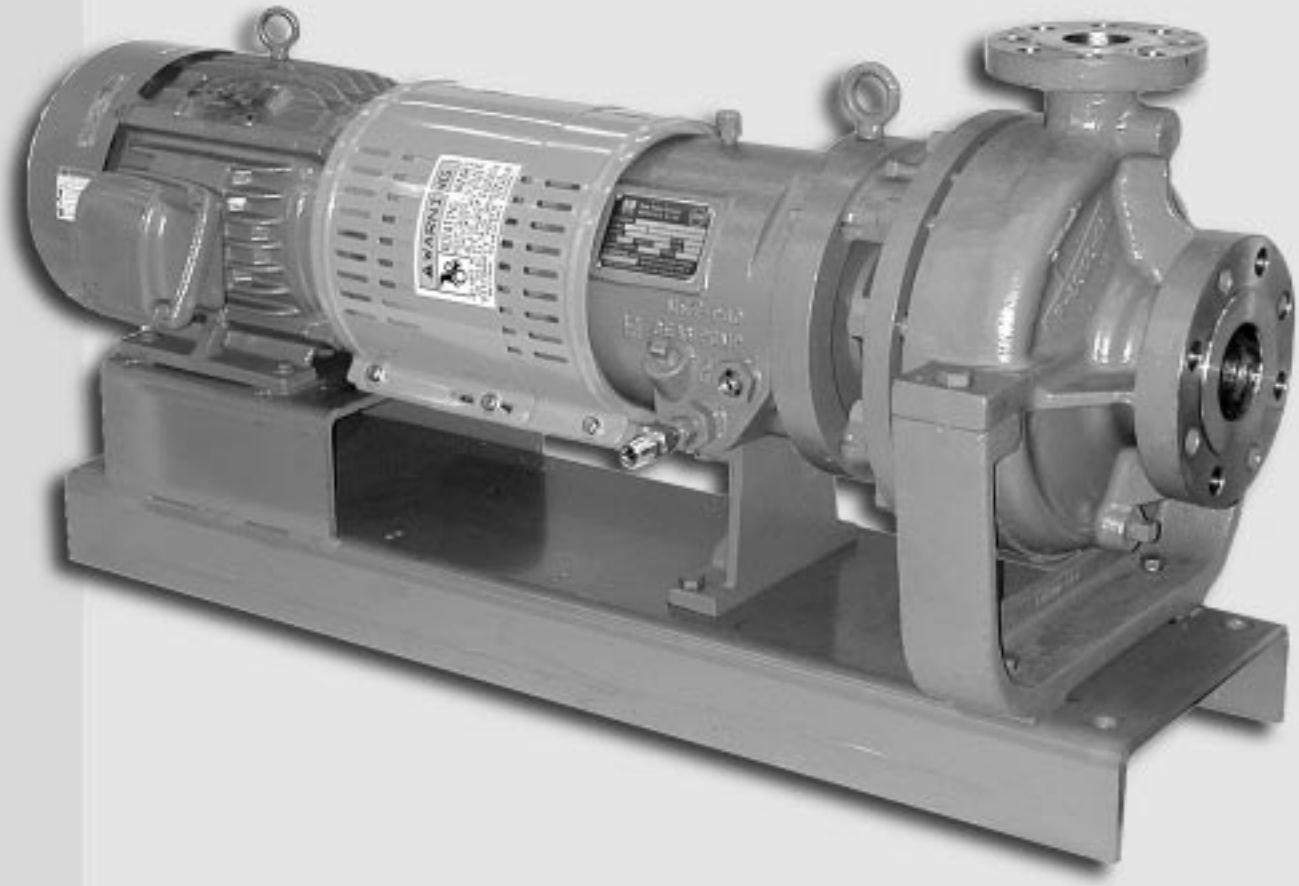
SERIES R400 & R4000

Horizontal Process Pumps

INSTALLATION

OPERATION

MAINTENANCE MANUAL



Instruction Manual MC 1.4.43

DO NOT INSTALL, OPERATE, OR SERVICE THIS PUMP BEFORE READING THE ENTIRE MANUAL

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PRODUCT INSPECTION AND TEST

The Products of Dean Pump Division are subject to thorough and rigorous quality control and inspection procedures throughout the whole of the manufacturing process to assure proper operation in full conformity with established performance standards. On completion of inspection, each unit is oiled, sealed against the entrance of dirt, and tagged with a signed certificate of inspection prior to shipment. Each pump when shipped is ready to perform the service for which it was designed with minimum maintenance and expense if properly installed and operated in accordance with the instructions furnished.

DEAN PRODUCT WARRANTY

We warrant to the purchaser from us of Dean Pump products and parts of our own manufacture (Dean Products) that the Dean Products are free under rated use and service from defects in design, material and workmanship for a period of one (1) year from the date of installation, but not to exceed eighteen (18) months from the date of shipment by us. This warranty does not cover (I) any loss or damage resulting from wear, corrosion, abrasion or deterioration due to normal use in rated service; (II) replacement of service items such as shaft packings and mechanical seals; (III) products or parts manufactured by others but furnished by us which, if defective, shall be repaired or replaced only to the extent of the original manufacturer's warranty; (IV) any loss or damage to or defects in any Dean Products resulting from the misuse or improper storage, installation, or operation thereof; or (V) any loss or damages to or defects in any Dean Products resulting from any alteration or modification thereof not expressly authorized and approved by us in writing. We shall not be liable, directly or indirectly, under any circumstances for consequential or incidental damages, including, but not limited, to: (I) any loss of business or profits; and (II) labor, material or other charges, claims, losses or damages incurred or suffered from, in connection with or in consequence of the working upon, alteration, or repair of any defective Dean Products by persons or firms other than us. Our liability for breach of warranty hereunder is limited solely to the repair in our factory or the replacement F.O.B. our factory, as the case may be, or any Dean Products which shall have been determined by us, after notice to us and inspection by us within the warranty period, to be so defective when shipped by us. THIS WARRANTY AND THE LIABILITY SET FORTH HEREIN ARE EXCLUSIVE AND IN LIEU OF ALL OTHER LIABILITIES AND WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSE.

WARNING

HAZARDOUS SITUATIONS MAY OCCUR UNLESS THIS EQUIPMENT IS APPLIED, INSTALLED, OPERATED, AND MAINTAINED BY THOROUGHLY QUALIFIED PERSONNEL IN STRICT ACCORDANCE WITH THE INSTRUCTION MANUAL AND ALL APPLICABLE DRAWINGS AND CODES.

Read the instruction manual completely before installing, filling, operating, or maintaining this equipment.

Obtain, read and heed the MSDS (Material Safety Data Sheet) for the fluids being handled before attempting to fill, operate or maintain this equipment. Obtain instructions from the Safety Engineer responsible for your facility before performing any work on the pumping equipment and systems.

Proper storage while not in use and proper installation and startup are essential for successful pump operation. Misuse or improper storage, installation or operation of pumps may result in serious loss or damage. Dean Pump Division is not responsible for any loss or damage resulting from causes beyond its control, and is not liable for charges for work performed or materials furnished to repair such loss or damage.

All installation, operation, and maintenance must be done by thoroughly qualified personnel in strict accordance with this manual and must comply with all local, state and Federal codes. Only Dean authorized service parts must be used in the repair of these pumps.

RECEIVING PUMP

When the pump is received from the transportation company it should be promptly inspected for damage and such damage noted on the bill of lading before it is signed. Claims for shipping damage must be filed against the carrier.

Care should be exercised in unloading and handling the pump.

STORAGE

Pumps must be properly covered and protected against moisture, dirt, and physical damage during storage prior to installation. If prolonged storage is anticipated, a heavy protective coating should be applied to bearings and all exposed machined surfaces. A rust preventative must be used to protect all steel or cast iron parts. Compression packing or mechanical seals should be removed and stored as well as protected separately.

Pumps must also be protected from moisture, dirt, and physical damage during and after installation while the system is being completed. Pumps "stored" on their foundations must be completely checked for proper installation prior to start-up.

Care in storage and installation will preserve the built in quality of each Dean Product.

MET PRO CORPORATION **Dean Pump Division**
6040 Guion Road P.O. Box 68172 Indianapolis, IN 46268-0172
Phone: (317) 293-2930 FAX: (317) 297-7028

STANDARD, HORIZONTAL, SINGLE STAGE, END SUCTION, ENCLOSED IMPELLER, CENTRIFUGAL PROCESS PUMPS TYPES R4140, R440, R450 AND R480

MECHANICAL DESIGN SPECIFICATIONS

Direction of Rotation (Viewed from Coupling End) . . . . . .CCW
Casing Thickness, Minimum . . . . . .5/16"
Corrosion Allowance . . . . . .1/8"
Impeller — Standard . . . . . .Single Plane Balanced
Optional Extra . . . . . Dynamically Balanced
Flanges — ASME/ANSI B16.5 Rating . . . . . .Class 300
Facing . . . . . .Standard Raised Face
Optional Extra . . . . . .Ring Type Joint
Finish . . . . . .125 Ra
Seal Chamber & Bearing Housing Jacket Pressure, Maximum . . . . . .125 psig
Suction Pressure, Maximum . . . .Max. Working Pressure Less Pump Developed Head

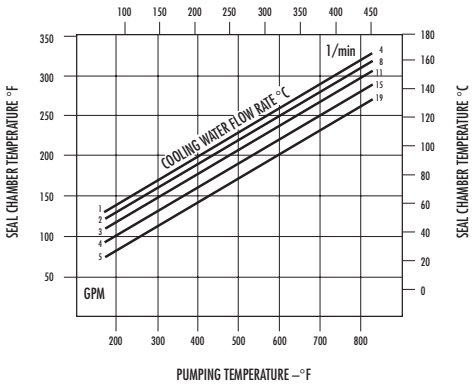
	R4140	R440	R450	R480
Horsepower Rating — Maximum				
@ 3500 rpm	100	200	250	–
@ 1750 rpm	40	100	125	300
@ 1160 rpm	25	–	75	200
Bearings, Type Ball Bearings, Oil Lubricated				
Thrust Bearing (Angular Contact Pair)	7309BG	7311BG	7312BG	7317BG
Radial Bearing	6309	6311	6312	6316
Seal Chamber Dimensions (Large Taper Bore)				
Length (Depth)	3"	3"	4 1/2"	4 7/8"
Inside Diameter (Bore Diameter)	3 1/2"	3 7/8"	4 1/4"	5"
Shaft Sleeve Diameter	1 3/4"	2 1/8"	2 1/4"	3"
Standard Bore (Stuffing Box) Dimensions				
Length (Depth)	3"	3"	3 7/8"	4 1/8"
Inside Diameter (Bore Diameter)	2 1/2"	2 7/8"	3 1/4"	4"
Shaft Sleeve Diameter	1 3/4"	2 1/8"	2 1/4"	3"
Lantern Gland Width	5/8"	5/8"	3/4"	1"
Lantern Gland to Open End of Stuffing Box	1 1/2"	1 1/2"	1 1/2"	2 3/8"
Packing Size, Square	3/8"	3/8"	1/2"	1/2"
Number of Rings with Lantern Ring	6	6	6	6
Spacing	3G3	3G3	3G3	3G3
Number of Rings Lantern Omitted	7	8	7	8
Pump Shaft Dimensions				
Span Between Bearings C_L to C_L	6"	5 3/16"	8"	10"
Span Between Radial Bearing C_L and Impeller C_L	8"	8 3/16"	10 3/4"	12 5/16"
Diameter at Coupling	1 1/8"	1 5/8"	1 5/8"	2 3/8"
Diameter Between Bearings	2 1/8"	2 1/2"	2 3/4"	4"
Diameter at Impeller	1 1/8"	1 1/4"	1 1/2"	2 1/4"
L^3/D^4				
Sleeved	101	44	78	36
Solid	55	27	26	23

MATERIAL CLASS	MAXIMUM WORKING PRESSURE	PUMPING TEMPERATURE MINIMUM	PUMPING TEMPERATURE MAXIMUM	HYDROSTATIC TEST PRESSURE R4140/R440	HYDROSTATIC TEST PRESSURE R450/R480
Carbon Steel (Class 40)†	500 psig @ 650°F	-20°F	800°F @ 340 psig	850 psig	750 psig
316SS (Class 50)	500 psig @ 100°F	-20°F	850°F @ 310 psig		

† Carbon Steel with Cast Iron trim. Also available with 316SS trim.

WARNING: Use the "Allowable Working Pressure VS. Pumping Temperature" chart (below, right) to determine the allowable working pressure at any allowable pumpage temperature for the material of construction selected.

Seal Chamber Temperature VS. Pumping Temperature
with respect to the GPM of cooling water flowing through the cooling jacket surrounding the seal chamber.



*GPM Flow Rate of Cooling Water Based on 70°F (21°C) Inlet Temp

Specifications are subject to change without notice

STANDARD MATERIALS OF CONSTRUCTION

Part No.	Part Name	Carbon Steel (Cl. 40)	316SS (Cl. 50)
3	Impeller	C.I. (1)	316 (3)
*4	Impeller Key	Steel (2)	316 (8)
5	Casing	Steel (6)	316 (3)
5A	Casing Drain Plug	Steel (2)	316 (8)
5C	Casing Stud Nut	Steel (5)	
5D	Casing Stud	Steel (4)	
*6	Casing Back Cover Ring	Iron (7)	316 (3)
6A	Casing Ring	Iron (7)	316 (3)
7	Cradle Spacer	D.I. (16)	
7A	Bull's Eye Oil Level Indicator (R4140)	—	
	Automatic Oiler (R440,R450 & R480)	—	
7G	Spacer to Bearing Housing Capscrew	Steel (2)	
9	Bearing Housing Foot	C.I. (1)	
*9F	Bearing Housing Foot, Jack Bolt R440 only	Steel (2)	
*9G	Bearing Housing Foot, Jack Bolt Nut R440 only	Steel (2)	
*10	Shaft Sleeve	316 (8)	
*10K	Shaft Sleeve Key	304 (9)	
*12	Impeller Bolt (Nut on R440)	Steel (2)	316 (8)
*12A	Impeller Washer	Steel (2)	316 (8)
*12B	Impeller Lock Washer	316 (8)	
*12C	Impeller Washer Pin	304 (9)	316 (8)
13	Seal Chamber Gland	316 (8)	
	Packing Gland	Steel (6)	316 (3)
14	Gland Stud	Steel (4)	304 (9)
15	Gland Nut	Steel (5)	304 (9)
*17	Lantern Ring	C.I. (1)	316 (3)
*18	Splash Collar – R440, R450 & R480 Only	C.I. (1)	
22	Casing Back Cover	Steel (6)	316 (3)
*22A	Back Cover to Cradle Cap Screw	Steel (2)	
*25	Radial Bearing	—	
*25A	Thrust Bearing	—	
*26	Bearing Housing	C.I. (1)	
*27	Seal Ring	C.I. (1)	
*28	Bearing End Cover	C.I. (1)	
*28A	Bearing End Cover Cap Screw	Steel (2)	
*29	Pump Shaft	Steel (10)	316 (8)
*31	Thrust Bearing Lock Nut	Steel (2)	
*31A	Thrust Bearing Lock Washer	Steel (2)	
*54	Throat Bushing	C.I. (1)	316 (8)
56	Casing Foot	C.I. (1)	
*56B	Casing Foot Dowel	Steel (2)	
*75B	Retaining Ring (All Except R480)	Steel (2)	
*76	Oil Seal—Front (All Except R4140)	Buna (14)	
	Labyrinth Seal—Front (R4140 Only)	Bronze & Viton ■	
*76A	Oil Seal—Rear (All Except R4140)	Buna (14)	
	Labyrinth Seal—Rear (R4140 Only)	Bronze & Viton ■	
77	Casing Gasket	Grafoil (11)	
*77B	End Cover Gasket (All Except R4140)	Manila (12)	
	End Cover Gasket (R4140 Only)	Buna (14)	
*77E	Oil Cooler Gasket (All Except R4140)	Fibre Sheet (13)	
*80	Bearing Housing Vent	—	
*87	Impeller Ring—Back (Optional)	Steel (2)	316 (3)
87A	Impeller Ring—Front (Optional)	Steel (2)	316 (3)
95A	Mechanical Seal Stationary	—	
95B	Mechanical Seal Rotary	—	
*109	Oil Cooler Assembly	SS Tubing with Steel Fins and Steel Fittings	

■ Registered Trademark of the E.I. DuPont Co.

* Denotes parts interchangeable in all pump sizes of same type.

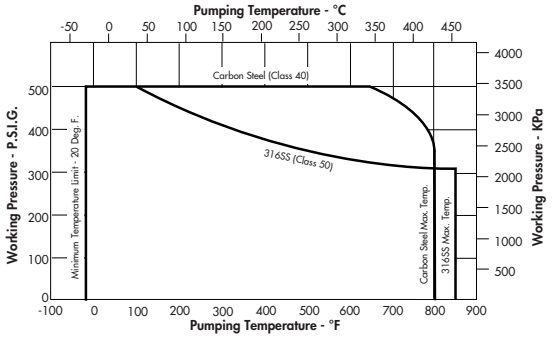
MATERIAL SPECIFICATIONS (REFER TO NUMBERS IN PARENTHESES)

(1) Cast Iron
(2) AISI 1020
(3) 316SS — ASTM #A744 Grade CF8M
(4) AISI 4140, ASTM #A193-B7 Steel
(5) ASTM #A194 Grade 2 Steel
(6) ASTM #A216 Grade WCB Cast Steel (-20 + 800°F)
(7) Hardened Iron
(8) AISI—316SS
(9) AISI—304SS
(10) Alloy Steel —125,000 TS. 100,000 YP
(11) Grafoil — Registered trademark of Union Carbide Corp.
(12) Manila Paper
(13) Fibre Sheet — Non-Asbestos Fibre
(14) Buna N Rubber
(15) Steel Finned, Stainless Steel Tube with Steel End Fittings
(16) Ductile Iron — ASTM-A536 Class 65-45-12

SEAL CHAMBER PRESSURE - R400 & R4000 SERIES PUMPS

**With Impeller Balance Holes—Seal Chamber Pressure Equals Pump Suction Pressure Plus .06 x Pump Developed Pressure in PSI
Without Impeller Balance Holes—Seal Chamber Pressure Equals Pump Suction Pressure Plus .75 x Pump Developed Pressure in PSI
Pumps are normally furnished with balance holes

R400 & R4000 Series Pumps – Allowable Working Pressure VS Pumping Temperature



INSTALLATION

Always wear the appropriate protective apparel when working on or around the pumping equipment. Safety glasses with side shields, heavy work gloves (use insulated work gloves when handling hot items), steel-toed shoes, hard hat, and any other protective gear as needed for protection. One example of other gear would be breathing apparatus when working near toxic materials. Use lifting devices, manufactured expressly for the purpose of lifting, to move the pumping machinery. Do not attempt to lift the assembly or its components manually. Use only devices with lifting capabilities in excess of the weight of the unit being lifted. Inspect straps, chains, hooks, etc. for damage and lifting capability before use. Lift only at the center of gravity.

Personal injury, death, and/or equipment damage could occur if good lifting practices are not used.

APPLICATION AND REAPPLICATION

At the time of installation, the equipment received should have already been selected for the service required. You must read the paperwork for the installation and check the serial number of the pump to assure that you are installing the correct pump into the service for which it was selected.

Many pumps look identical from the outside but can be made of different materials and/or be constructed differently inside. Personal injury, death, equipment damage, product (pumpage) damage, and/or product loss could occur if the incorrect pump is installed.

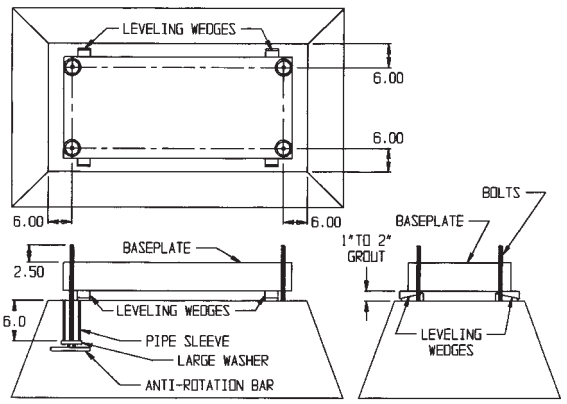
Do not transfer an existing pump to any other service conditions until you have thoroughly reviewed the pump construction, materials, sizing, sealing, pressure containing capability, head/capacity capability, and temperature capability with respect to the required service. Consult your Dean Pump sales engineer with all the service requirements and a full description of the existing pump (including the serial number), seal, and sub-systems so that we can assist you in a successful reapplication.

PUMP FOUNDATION

The pump foundation provides rigid support to the baseplate and maintains the alignment of the pumping unit. Baseplates are designed to rigidly support the pump and driver without vibration or distortion only when they are properly set, leveled, and secured to the foundation.

The purchaser may elect to mount the pump without grouting the baseplate. In any case the baseplate must be fully supported by the customer's mounting means to prevent vibration and distortion.

TYPICAL FOUNDATION LAYOUT



BASEPLATE MOUNTING AND ALIGNMENT

The sequence of mounting which must be observed for proper baseplate and pump mounting is:

1) Place baseplate, with pump and driver mounted thereon, on the pump foundation.
2) Use wedges under the baseplate edges, at each foundation bolt, to properly support and level the unit. Check this with a spirit level. Pull down the baseplate mounting bolt nuts tightly and recheck for level. Correct if necessary.
3) Align the driver to the pump (except for pumps with optional "C" face motor support). See ***"Pump and Driver Alignment"*** on page 4.
4) Grout the baseplate. ***Do not grout the baseplate to the foundation until the pump and driver are correctly aligned.*** Channel type baseplates are made with open ends to allow easy grouting and do not require grouting holes in the baseplate. Fabricated structural steel baseplates are provided with grouting holes. Fill the entire void under the baseplate with grout and firmly embed the baseplate edges.
5) Connect the suction and discharge piping without forcing the piping into position. See ***"Suction and Discharge Piping"*** on page 4. The pipe flanges must line up with the pump flanges ***"***freely***".***

   Install a ***"***new***"*** bolt, of the correct size per ASME/ANSI B16.5 and the correct material per ASME/ANSI B16.5, in every bolt hole. Tighten all bolts evenly. Use only new uncorroded fasteners.

WARNING:
Strain caused by "forcing", improper flange bolting, and/or misalignment may cause failure of the pumping unit, flanges, piping and/or fluid (pumpage) release which could cause personal injury, death, and/or damage to this and/or other equipment.

6) Recheck pump and driver alignment (except for pumps with optional "C" face motor support) to ensure that no distortion of the pump unit has been caused by piping strain. Correct piping if misalignment has occurred and again align pump and driver.
7) Connect all other (auxiliary) piping necessary for safe and successful operation of the equipment in the specific service conditions of the application. See ***"Pump Cooling Requirements"*** on page 6.

WARNING:
Make sure that all piping is installed into its correct connection. Installation of a pipe into an incorrect location could result in an explosion and personal injury or death as well as damage to this and/or other equipment. Install pressure relief valves in any cavities that could be subjected to pressures in excess of the allowable working pressure. Explosion, personal injury, death, and/or damage to this and/or other equipment may occur if pressure exceeds allowable.

One example of the above would be the cooling jacket around the seal chamber. If this chamber were full of water and someone would close both the inlet and outlet valves and then operate the pump at 500 degrees fahrenheit, the vapor pressure of the water, 665 PSIG, would far exceed the capacity of the jacket and possibly other parts. In this example, a relief valve must be installed between the pump and the outlet valve.

8) Recheck the alignment between the driver (motor, turbine, or engine) and pump shafts. Installation of piping

may have forced the pump out of alignment. If so, correct the piping to remove the distorting load, and realign the pump and driver.

9) The pump and driver alignment must again be checked (except for pumps with optional "C" face motor support) at the operating temperature and alignment corrected under the hot condition.

10) After about two weeks of normal pump operation the pump and driver alignment should again be checked (except for pumps with optional "C" face motor support) under the hot condition. If alignment is still correct, the driver feet may be doweled to the baseplate. If the alignment has changed, realign the unit and recheck after two weeks.

SUCTION AND DISCHARGE PIPING

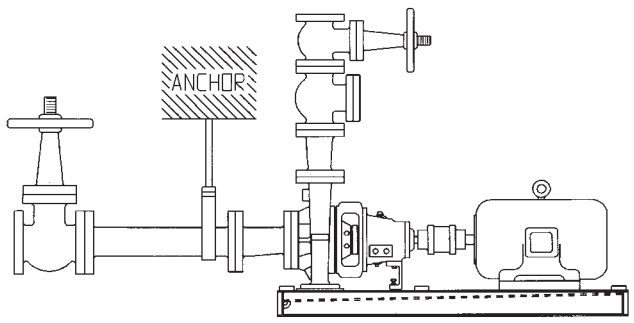
Suction and discharge nozzle sizes of Dean pumps are selected for proper performance of the pumping unit and are not intended to determine the suction and discharge pipe sizes. Pipe sizes must be determined by the user based on the system requirements.

Suction piping should have a minimum friction loss and thus should be as short and straight as possible with a pipe diameter as large as economically feasible for the flow rate handled. Suction piping should never be smaller in diameter than the suction nozzle size. When the suction piping is larger than the suction nozzle size an eccentric reducer is required at the suction flange and must be installed with the taper located on the underside to eliminate air or vapor pockets. The section of piping attached to the suction flange of the pump should be straight for a length of eight pipe diameters or more.

Discharge piping may be the same size as, larger, or smaller than the discharge nozzle as the system flow may demand.

In new installations or rebuilt systems, dirt, pipe scale, welding slag, and general construction debris may get into the piping. It is important to prevent this material from entering the pump and damaging pump parts, mechanical seal faces, or seal chamber packing. Mechanical seal parts are especially subject to damage even by very small particles. To prevent damage, a strainer or filter installed in the suction line is recommended. Commercially available strainers or filters as recommended by their manufacturers can do an excellent job. In addition, special filtering and mechanical seal flushing may be required. Consult your Dean representative. Suction line

TYPICAL PUMP PIPING



screens or strainers may usually be removed when, after several days of use, no dirt has been collected and the system is clean.

Remember that screens and filters in the suction line are restrictive devices which reduce the net positive suction head (NPSH) available to the pump and should be considered at the time the system is designed.

PUMP AND DRIVER ALIGNMENT

Proper running life of a pump and driver unit depends on the accuracy with which the axis of the driver shaft coincides with the axis of the pump shaft when the unit is running. Although pumps and drivers are check aligned at the factory, this is only to confirm that the unit can be aligned in the field and handling during shipment and installation will cause the alignment to change. ***The pump and driver alignment must always be checked and corrected (except for pumps with optional "C" face motor support) before the baseplate is grouted to the foundation and again before the pump is first started.*** If the baseplate mounting instructions have been carefully followed, no difficulties in making the alignment should be experienced. ***Failure to properly align the unit will result in vibration, short bearing life,*** and reduced mechanical seal or shaft packing life.

Pumps are not constructed to be used as pipe anchors. Both suction and discharge piping must be supported independently of the pumping unit and thermal expansion joints provided to guard against expansion loads on the pump. Pipes should be anchored between the expansion joint and the pump and as closely to the pump as possible. Failure to provide proper piping support and expansion joints may impose strains on the pumping unit which will result in serious misalignment. Maximum allowable piping loads are shown on page 5 in this manual.

No allowance for thermal expansion is made for motor driven units in mounting the driver. Allowance for turbine mounting should be in accordance with the turbine manufacturer's recommendations. ***Final alignment must always be checked and corrected at the operating temperatures of the pump and driver.***

Misalignment of the two shafts is of two kinds. The first of these is angular misalignment where the axis of one shaft is at an angle from the other. The other is offset alignment where the center of one shaft is offset from the center of the other shaft. These effects usually occur together so that both angular and offset misalignment are present.

Coincident alignment of the driver and pump shaft is measured at the faces of the coupling hubs. Because of the variety of coupling types furnished at customer's request, the procedure here given is general in nature but may be applied by simple adaption to most coupling types.

The first step is to remove the spacer from the coupling. To one of the remaining coupling hubs, firmly seated on the shaft, attach a dial indicator. Let the indicator button ride on the face of the other coupling hub and near the outside diameter. See illustration on page 5. Rotate the shaft on which the dial indicator is mounted, allowing the indicator button to move on the stationary coupling hub. The indicator dial movement will show the difference in distance between the two hubs. This indicates the amount of angular misalignment between the hubs and therefore the shaft axes. Good practice suggests alignment to within 0.002" T.I.R.

To check the offset alignment, mount the dial indicator as above except with the indicator button on an outside diameter of the stationary coupling hub. See illustration below. Rotate the shaft on which the dial indicator is mounted, allowing the indicator button to ride on the outside diameter of the stationary hub. The indicator dial movement will show the difference in the center locations of the two shafts. Good practice suggests alignment to within 0.002" T.I.R.

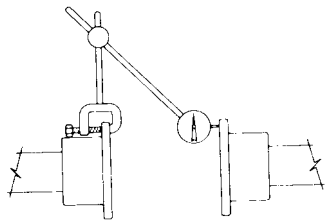
Angular and offset alignment is adjusted by placing thin metal shims under the driver mounting feet to bring the drive into exact alignment with the bolted down pump. ***If misalignment is of major proportions, the baseplate has been improperly installed on the foundation and must be releveled before proceeding with alignment.***

On the R440 series pumps, moderate alignment adjustments may be made by using the jack bolts provided on the bearing housing foot. Loosen the two bearing housing foot hold-down bolts and the jack bolt lock nuts. Adjustments of the jack bolts may then be made.

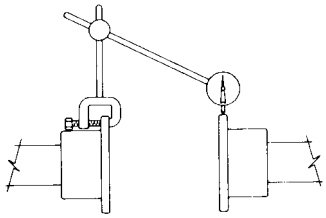
After each change, by shims or jack bolts, it is necessary to recheck both angular and offset alignment of the coupling. After the pump and driver are aligned, tighten all hold-down and jack bolt lock nuts and then recheck alignment.

Allowable error of shaft alignment is somewhat dependent on the coupling type. ***However, the closer the running alignment, the better the running life will be.***

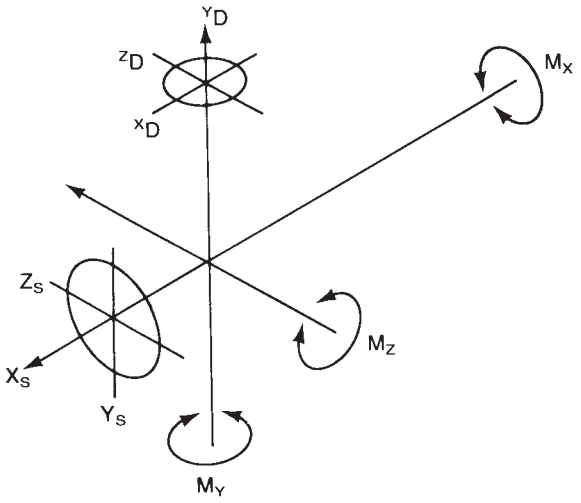
INDICATOR SETUP TO READ ANGULAR MISALIGNMENT



INDICATOR SETUP TO READ OFFSET MISALIGNMENT



ALLOWABLE PIPING LOADS R400 & R4000 SERIES PUMPS



MAXIMUM FORCES ON FLANGES
FOR SUCTION FLANGE

$\pm F_X \leq 200$ LBS./NOM.IN. $\leq 1.2W$
$\pm F_Y \leq 130$ LBS./NOM.IN. $\leq 0.6W$
$\pm F_Z \leq 160$ LBS./NOM.IN. $\leq 1.0W$
$F_r = (F_Y{}^2 + F_Z{}^2)^{1/2} \leq 2000$ LBS

FOR DISCHARGE FLANGE

$\pm F_X \leq 1.3W \leq 160$ LBS./NOM.IN.
$-F_Y$ (COMPRESSION) ≤ 200 LBS./NOM.IN. $\leq 1.2W$
$+F_Y$ (TENSION) ≤ 100 LBS./NOM.IN. $\leq 0.5W$
$\pm F_Z \leq 1.0W \leq 130$ LBS./NOM.IN.
$F_r = (F_X{}^2 + F_Z{}^2)^{1/2} \leq 2000$ LBS

WHERE

F = FORCE IN POUNDS
F_r = RESULTANT FORCE
W = WEIGHT OF PUMP ONLY, IN POUNDS

MAXIMUM MOMENTS APPLIED TO A PUMP ON A FULLY BOLTED AND GROUTED BASEPLATE. LOADS ARE TO BE APPLIED ONLY THROUGH THE SUCTION AND DISCHARGE FLANGES.

Pump Size	Pump Type	Wt. Lbs. Pump Only	M_X lb. ft.	M_Y lb. ft.	M_Z lb. ft.
1 x 3 x 8 1/2	R4140	210	690	340	725
1 1/2 x 3 x8 1/2	R4140	235	690	340	725
2 x 3 x 8 1/2	R4140	260	690	340	725
3 x 4 x 8 1/2	R4140	285	725	295	600
4 x 6 x 8 1/2	R4140	325	785	320	600
1 1/2 x 3 x 10	R4140	255	760	310	600
2 x 3 x 10	R4140	290	760	310	600
3 x 4 x 10	R4140	320	830	340	600
4 x 6 x 10	R4140	360	950	340	600
1 x 2 x 11 1/2	R4140	240	850	350	600
1 1/2 x 3 x 11 1/2	R4140	275	850	350	600
2 x 3 x 11 1/2	R4140	315	870	355	600
3 x 4 x 11 1/2	R4140	345	930	335	575
4 x 6 x 11 1/2	R4140	430	980	350	760
1 1/2 x 3 x 13 1/2	R4140/440	400	1015	365	525
2 x 3 x 13 1/2	R4140/440	414	1015	365	525
3 x 4 x 13 1/2	R4140/440	430	1045	375	630
4 x 6 x 10	R450	480	2300	1850	800
6 x 8 x 12 1/2	R450	560	2740	1490	800
2 x 4 x 15 1/2	R450	575	2530	1375	800
3 x 4 x 15 1/2	R450	587	2550	1385	800
4 x 6 x 15 1/2	R450	604	2740	1490	800
6 x 8 x 15 1/2	R480	919	3000	1615	1500
8 x 10 x 15 1/2	R480	942	3340	1810	1500

Maximum allowable forces and moments calculated from these force equations or the tabulated moment tables are those resulting in a maximum of .010 inch movement of the shaft measured at the shaft coupling when the pump is mounted on its baseplate and that baseplate is fully bolted to a properly designed foundation and is fully grouted in place. For a full discussion see API Standard 610, 5th Edition.

Data Sheet 1198

PUMP COOLING REQUIREMENTS

Pumps may be furnished with the following jackets or cooling coil:

1) Stuffing box
2) Mechanical seal gland (optional)
3) Casing pedestals (optional)
4) Bearing housing cooling coil (optional)

Cooling is recommended under the following conditions:

STUFFING BOX COOLING

1) With a mechanical seal when the application requires cooling.
2) With a mechanical seal when pumping liquids of 0.75 specific gravity, or less, when the pumping temperature permits further cooling.
3) With stuffing box packing, except Grafoil, at temperatures above 250°F.

MECHANICAL SEAL GLAND COOLING

When the mechanical seal application requires cooling of the seal faces. This depends on the liquid pumped and the pumping temperature.

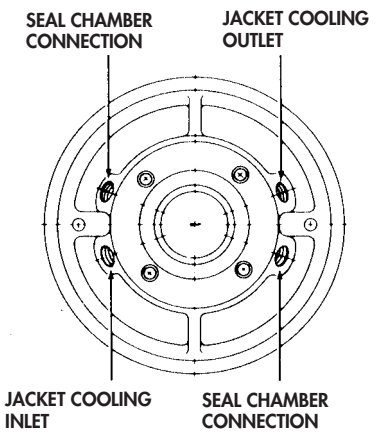
BEARING HOUSING COOLING

At pumping temperatures below 500°F, such cooling is rarely necessary. Excessive cooling of the bearing housing may lead to early bearing failure from moisture condensation and contamination of the oil.

CASING BACK COVER WITH JACKETED STUFFING BOX

AS VIEWED FROM THE MOTOR END OF THE PUMP, SHOWING THE PIPING CONNECTIONS.

WARNING: Improper connection of cooling and/or seal connection piping may be dangerous and may seriously damage pump and system.



WARNING—EXTREME HAZARD TO PERSONNEL: Improper connection of cooling water piping may result in the injection of cooling water into the pump stuffing box and into the pumpage. Depending on temperature this may cause a violent steam explosion in the pump, piping, or associated equipment with extreme hazard to personnel. It may also cause serious contamination of the pumpage and heavy corrosion of pump or equipment parts.

CASING PEDESTAL COOLING

Casing pedestal cooling is used to equalize and minimize thermal expansion of the pedestal pump supports.

COOLING WATER PIPING

The cooling water piping depends on what cooling coil or jackets are furnished and used. Jackets to be piped in series are, Casing Pedestal Cooling, Stuffing Box Cooling, and Bearing Housing Cooling, with the cooling water to flow in that sequence. Not all of these jackets will necessarily be used. All other jackets or cooling coil should be piped in parallel with separate flow to each. The customer must provide piping and a shut-off valve on each cooling inlet. The customer must also provide the outlet piping from each jacket or cooling coil, fitted with a pressure relief valve set at a maximum of 150 PSIG, and then a flow control valve. Pipe each outlet from the valve to it's own sight drain or through a suitable flow indicating device into the plant cooling water system.

In no case should the outlets be piped into the municipal water system.

COOLING WATER FLOW RATES

Stuffing box cooling, when used, has flow rates related to pumping temperature. See the chart below. The lower flow rates will lead to higher cooling water temperature and promote more rapid scaling within the jacket. Higher flow rates will do no harm.

Mechanical seal gland cooling flow should be adjusted to about 1/2 GPM.

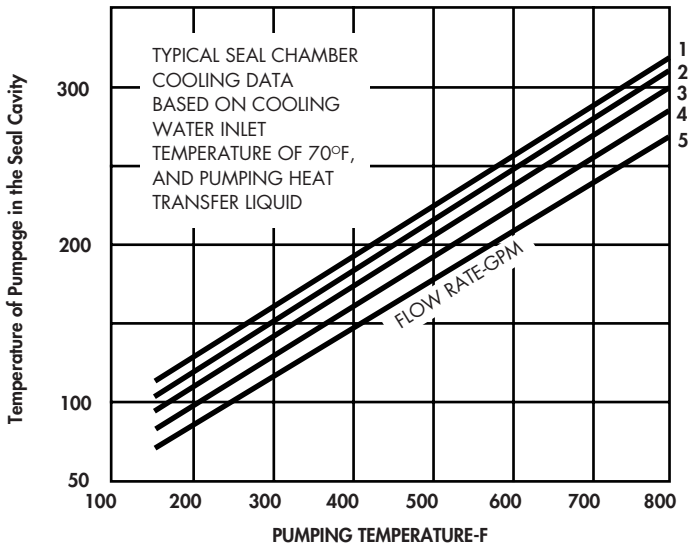
Bearing housing cooling flow rate, when not in series with the stuffing box cooling, should be adjusted to 1/2 GPM. This will maintain the oil temperature below 130°F at all pumping temperatures.

The pumps may be operated without bearing housing cooling if experience with the particular installation shows that the bearing temperature, without cooling, does not rise above 200°F.

As stated before, pumps operating at 500°F and lower, seldom require bearing housing cooling.

Casing pedestal cooling flow rates are equal to stuffing box cooling flow rates when piped in series. If piped separately, the flow need not be over 1/2 GPM.

WARNING—EXTREME HAZARD TO PERSONNEL: When cooling water is used to cool the stuffing box, gland, or bearing housing jackets, it is mandatory that the cooling water be allowed to flow at any time the pump is running. Closing the inlet and/or outlet valves under running conditions may result In the water In the jackets reaching high pressure which may lead to the rupture of a water jacket with extreme hazard to personnel.



PIPING CONNECTIONS FOR R4140 PUMPS

Connections (1) and (3) are cooling water inlets. Connections (2) and (4) are cooling water outlets. Do not control cooling water flow with a valve on connections (1) and/or (3). Connections (3) and (4) may be reversed, if so desired.

Openings (1) and (2) are stuffing box cooling jacket connections and are covered, at the manufacturing plant, with thread protectors, for shipment.

Openings (3) and (4) are bearing housing oil cooler connections and are covered, at the manufacturing plant, with thread protectors, for shipment.

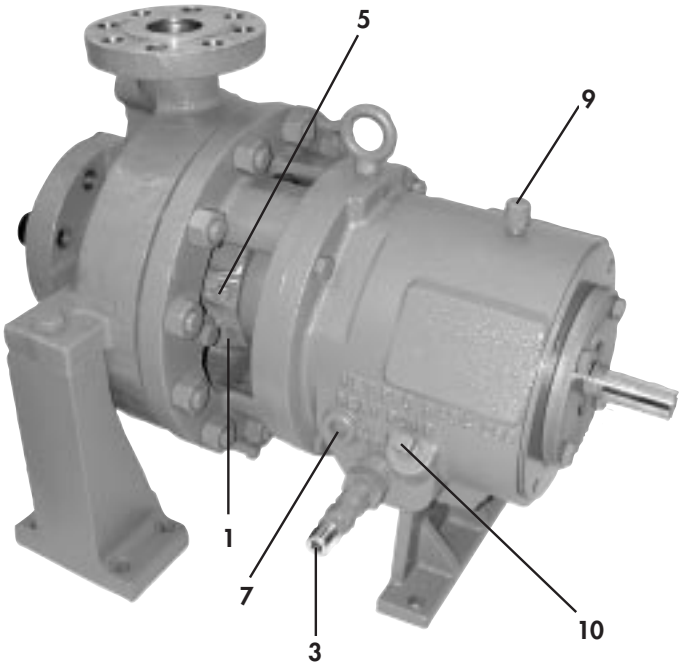
Openings (5) and (6) are connections into the center of the mechanical seal cavity (or to the lantern ring if the box is packed) and are sealed with standard, metal, threaded pipe plugs at the manufacturing plant.

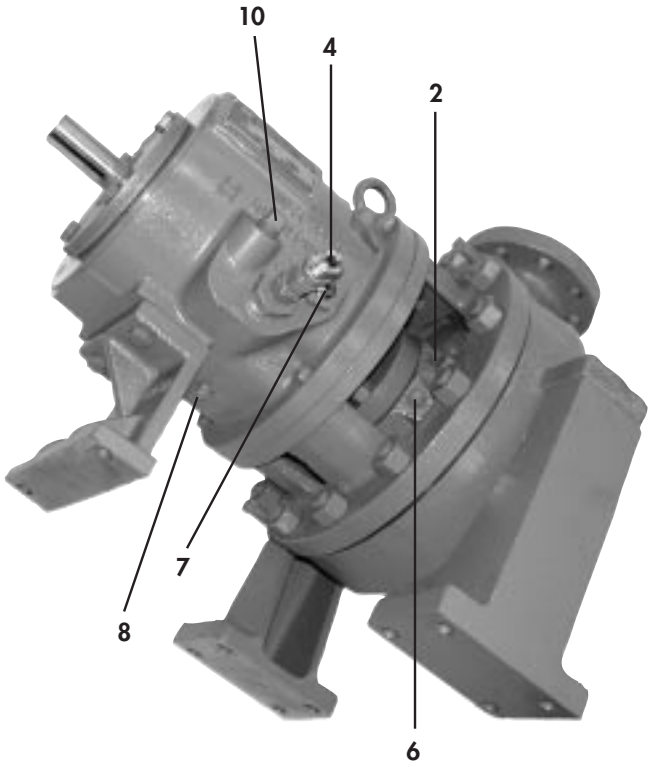
Connection (7) is for the "Bull's Eye" oil level indicator which is shipped installed on the side of the pump shown in the photo. There is a connection (7) on both sides of the pump. The "Bull's Eye" can be moved, in the field, if so desired, to the opposite side of the pump.

Connection (8) is the oil drain. This is plugged with a standard, metal, threaded pipe plug.

Connection (9) is the oil reservoir vent which is shipped installed.

Opening (10) is the oil fill connection. This connection is plugged with a standard, metal, threaded pipe plug. There is a connection (10) on both sides of the pump so that the oil reservoir may be conveniently filled from either side.





PIPING CONNECTIONS FOR R440, R450 AND R480 PUMPS

Connections (1) and (3) are cooling water inlets. Connections (2) and (4) are cooling water outlets. Do not control cooling water flow with a valve on connections (1) and/or (3).

Openings (1) and (2) are stuffing box cooling jacket connections and are covered, at the manufacturing plant, with thread protectors, for shipment.

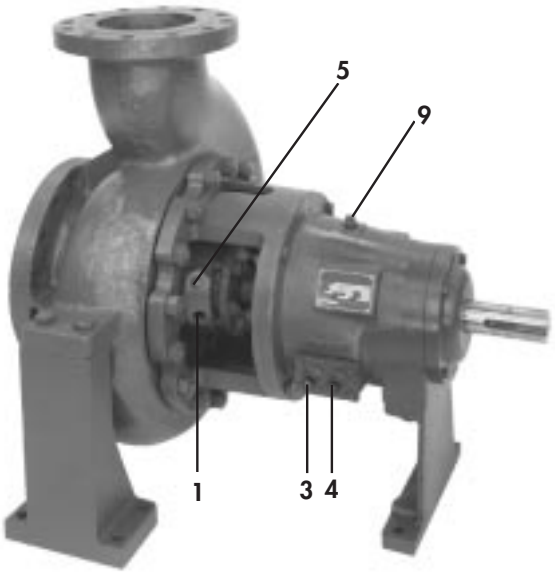
Openings (3) and (4) are bearing housing oil cooler connections and are covered, at the manufacturing plant, with thread protectors, for shipment.

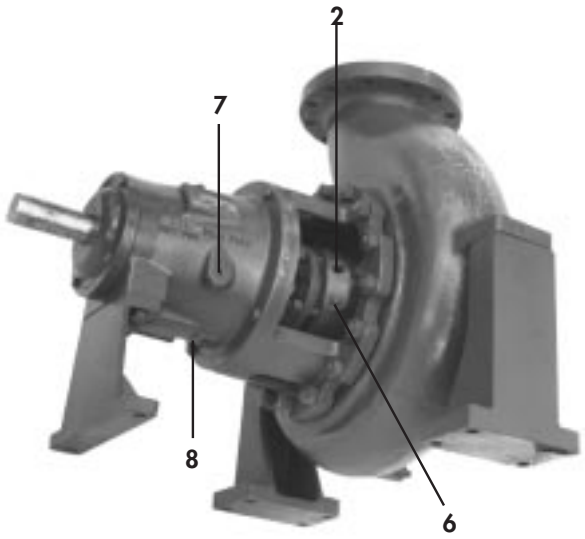
Openings (5) and (6) are connections into the center of the mechanical seal cavity (or to the lantern ring if the box is packed) and are sealed with standard, metal, threaded pipe plugs at the manufacturing plant.

Connection (7) is for the constant level oiler and is covered, at the manufacturing plant, with a threaded protector, for shipment.

Connection (8) is the oil drain. This is plugged with a standard, metal, threaded pipe plug.

Connection (9) is the oil reservoir vent cap which is shipped installed. The cap is not a standard cap, but has vent slots between the cap and the pipe nipple that it is mounted on.





PUMP LUBRICATION

Lubrication of the ball type bearings in Dean pumps is by oil contained in the sump of the bearing housing (26). The oil must be a good grade of rust and oxidation inhibited, non-foaming, industrial oil with a viscosity of approximately 500 SSU at 100°F. This will be an ISO 100 oil.

Failure to level the pump assembly when the entire unit is installed may adversely affect the oil level and reduce bearing life. Proper care should be taken to avoid this condition.

Model 4140

The Model 4140 is supplied with a "Bull's Eye" type oil level indicator, and fill openings on both sides of the bearing housing. Fill the sump through one of the 1/2" NPT tapped openings on the side of the bearing housing until the oil level reaches the center of the "Bull's Eye" level indicator. The oil must be maintained at this level during operation.

If the optional automatic oiler was supplied, it was packed separately for pump shipment to avoid damage. Install the oiler into the upper 1" NPT tapped hole (connection #7 on page 7) on either side of the bearing housing. Screw the oiler reservoir from the top of the "Bull"s Eye" housing, invert it, fill it with oil, and reinstall it into the housing. Thereafter, the oil level in the bearing housing remains constant as long as there is any oil in the reservoir cup. To maintain the oil level between oil changes, refill the oil cup when the cup nears empty.

Models R440, R450 and R480

The R440, R450, and R480 models are supplied with an adjustable, automatic oiler. This oiler is removed from the pump and packed separately for pump shipment to avoid damage. Install the oiler onto the 1/4" NPT pipe nipple (connection #7 above) on the side of the bearing housing.

Adjust the oiler height by loosening the three set screws in the outer sleeve, setting all the way down (0" for the dimension shown in the adjacent figure), and retightening the set screws.

The initial filling may be made through the 3/4" NPT tapped opening in the top of the bearing housing (26) by removing the vent assembly (80). Be careful to not overfill. Fill only until the oil appears in the very bottom of the constant level oiler housing when the reservoir cup is removed. Do not fill above this level. Replace the vent assembly (80) into the top of the bearing housing (26). Fill the reservoir cup and reinstall it. The oil will bubble slowly into the bearing housing until the proper level is attained. When the oil stops bubbling in, remove the reservoir cup, refill it, and reinstall it. Thereafter, the oil level in the bearing housing remains constant as long as there is any oil in the reservoir cup. To maintain the oil level between oil changes, refill the oil cup when the cup nears empty.

All Models

The oil should be drained and replaced at regular intervals, the intervals depending on the atmospheric conditions (dust, soot, corrosive vapors, humidity, temperature variations, etc.) prevailing at the pump installation site. The bearing housing should be flushed with a good solvent before the oil is replaced.

Pumps are shipped from the factory without oil in the bearing housing.

STARTING THE PUMP

It is important that a pump should never be subjected to thermal or pressure shock. The liquid should therefore be allowed to flow into the casing slowly. A centrifugal pump should never be started until all the parts are up to the temperature of the liquid to be pumped.

If the pump is equipped with cooling water piping this should be turned on before filling the pump.

FILLING

WARNING:
Before filling the pump with liquid, check to see that all possible leak locations are sealed. See that the point where the pump shaft enters the pressure containing cavity is sealed. Normally this sealing is accomplished with shaft packing or a mechanical face seal. See that all of the connections into the pressure containing cavity are sealed or connected to a related piping system that also has all possible leak paths sealed. Do not plug unused jacket cavities, as this could develop dangerous pressure build-up. Use a wrench on all bolted joints to apply torque to assure that all gaskets are sealed in a tight joint. Check to see that all threaded pipe connections are also tight enough to seal the Liquid pressure that will be applied when the system is started.

When the source of liquid supplied to the pump is below atmospheric pressure or located below the pump, the pump must be primed prior to start up. The priming may be accomplished in any of several ways, three of which are listed.

1) An exhauster may be connected to the discharge piping between the pump and the discharge shut-off valve. With the discharge shut-off valve closed and the suction valve open, the air can be exhausted from the pump and piping.
2) With a foot valve installed in the suction piping, the pump may be filled with liquid introduced somewhere above the pump in the discharge line. The seal chamber should be vented to allow complete filling. A foot valve may create extensive losses and should be taken into consideration in calculating the available NPSH.
3) A vacuum pump (preferably a wet vacuum pump) may be used for evacuating air from the pump and piping. The vacuum pump should be connected as is the exhauster covered in No. 1.

When the source of liquid supplied to the pump is above atmospheric pressure or above the pump centerline, the pump may be filled by venting through a bleed off line to atmosphere or back to the pump suction source.

It Is most Important to check the direction of rotation of the pump before allowing the pump to come up to speed. The pump was shipped with the coupling spacer not installed to allow alignment and motor rotation direction check. If, however, someone installed this spacer assembly, lock-out the power to the driver (motor, turbine, engine, etc.), and remove the spacer assembly at this time. If the pump was purchased with the "C" face motor support option, the coupling will not have a spacer assembly. To check rotation direction, push the starting button and instantly push the stop button. This will allow the motor to turn over a few revolutions and the direction of rotation to be observed. A direction of rotation arrow is shown on the front of the pump casing. If rotation is incorrect, change the wiring connections and recheck rotation. ***Operating the pump in reverse rotation may cause extensive damage.***

WARNING:
Lock-out the power to the driver (motor, turbine, engine, etc.)

Install the shaft coupling spacer (except for pumps with the optional "C" face motor support). Be sure that you install all the retaining devices and bolts and that they are tight. Read and comply with the coupling manufacturers instructions. Personal injury, death, and/or equipment damage could occur if the coupling spacer is not properly installed. Remove all debris and tools from the area near the shafts and the shaft coupling. Do this to assure that nothing is caught and thrown by the rotating parts when the pump is started. Bolt the coupling guard securely into place, checking to assure that it is not contacting any parts that will rotate when the pump is started.

OPERATING

WARNING:
Before starting the unit, see that all personnel are a safe distance away from all possible hazards, that all sub-systems are connected and operating, that all debris has been removed, that the shaft coupling guard is securely in place, and that the pump is full of liquid.

Do not operate this pump at shut-off (no flow) as an explosion may result. This can occur with any liquid, even "cold water". Personal injury, death, equipment damage, and/or loss of product (pumpage) is likely to occur. If your system is operated where it is possible for all outlets of the discharge from the pump to be closed while the pump is still operating, a modification of the system needs to be made to assure a continual flow of pumpage through the pump. NOTE: Some people have a belief that a bypass line from the discharge side of the pump to the suction side of the pump will relieve this problem, this is "NOT TRUE"; DO NOT ATTEMPT THIS.

WARNING:
Do not operate a pump at a low flow condition, unless provision has been made to prevent dangerous heat build up within the pump casing. The liquid in the pump will heat up and this may result in high pressure in the pump in a short time. Such pressure may result in a rupture of the pressure-containing parts and cause severe hazard to personnel and/or damage to the system.

A centrifugal pump should never be run without liquid In the casing. Extensive damage may result, particularly to the mechanical seal or compression packing. When the pump is equipped with a mechanical seal, vent the pump seal chamber through the seal connection to provide lubrication to the mechanical seal faces.

A centrifugal pump should be started with the suction valve open and the discharge valve opened a slight amount.

As soon as the pump is up to speed, the discharge valve must be opened slowly. A centrifugal pump cannot be operated with the discharge valve closed without heating up dangerously. During the first several minutes of operating watch the pump carefully for overheating, vibration, and other abnormal conditions. If trouble develops, stop pump at once and correct the problem.

PUMP START UP CHECK LIST

These points must be checked after pump installation and before starting up the pump.

1) Read instruction manual thoroughly and understand it.
2) Review pump order head sheet for the service rating of the pump and any special features.
3) Check all piping connections making certain that they are both tight and in the proper places. All piping includes seal, cooling, or heating piping.
4) Make sure that the baseplate has been properly installed.
5) Check the electrical or steam line connections to the driver.
6) Break the coupling by removing the coupling spacer (except for pumps with the optional "C" face motor support) and bump the motor starting button to check motor rotation. Operating the pump in reverse rotation may cause extensive damage. If driver rotation is correct, replace the coupling spacer. If not, connect the wiring for proper rotation and recheck.
7) Check coupling for proper alignment (except for pumps with the optional "C" face motor support). Realign if necessary.
8) If pump seal chamber is packed, check to be sure that gland stud nuts are pulled up only finger tight and that the gland is not cocked.
9) Rotate the pump shaft by hand to be sure there is no binding or rubbing within the pump or driver. Correct any difficulties at once.
10) Check to see that the pump is properly lubricated.
11) Remove all dirt, waste, tools, and construction debris from the area.
12) Check to see that the coupling guard is securely in place.

SPARE PARTS

To avoid prolonged down time and facilitate rapid repair of damaged pump parts, Dean recommends that the pump user maintain a minimum stock of spare parts. If the pump service is critical or the pump parts are of special materials, spare parts stock is even more important to the user. Such spares inventory may extend from a spare mechanical seal or seal parts through complete casing back-cover-impeller-bearing housing assemblies prepared for immediate insertion in the pump casing. Consult your Dean representative who will assist you in selecting your spares stock.

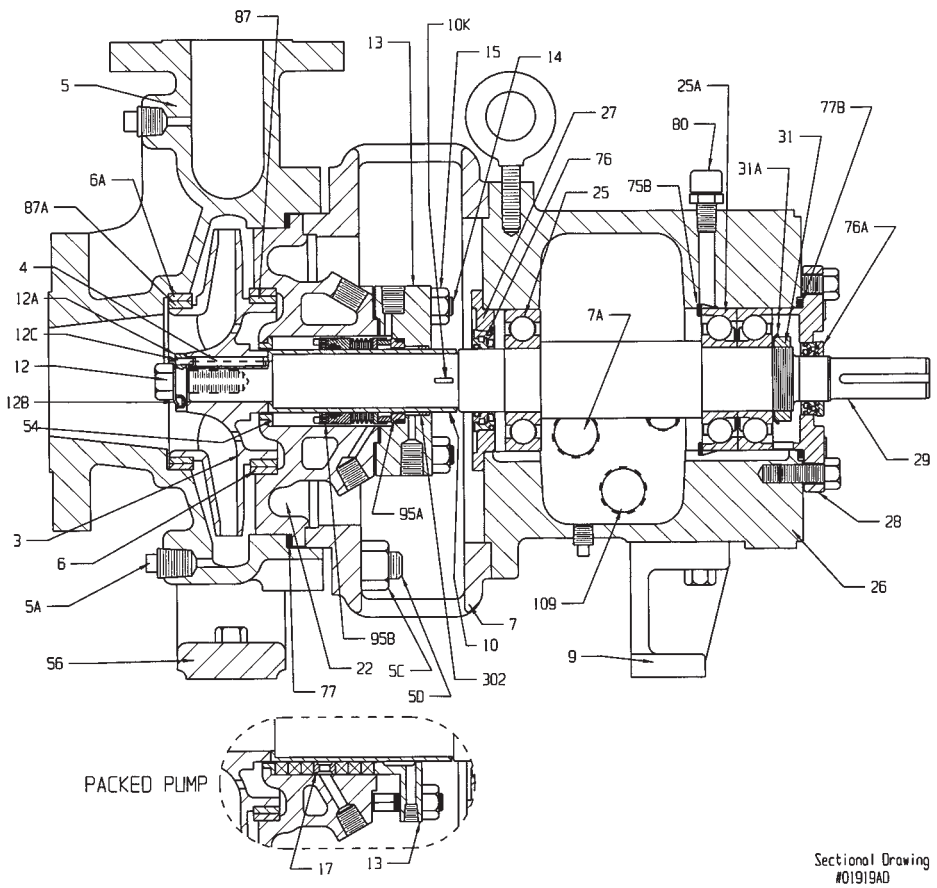
ORDERING SPARE PARTS

Spare part orders will be handled with a minimum delay if the following information is furnished by the customer with the order:

1) Give the pump serial number and size. These may be found on the pump name plate. The serial number is also stamped on the suction flange or the top edge of the bearing housing front flange.
2) Give the part name, part number, and material of part. These should agree with the standard parts list.
3) Give the quantity of each part required.
4) Give complete shipping instructions.

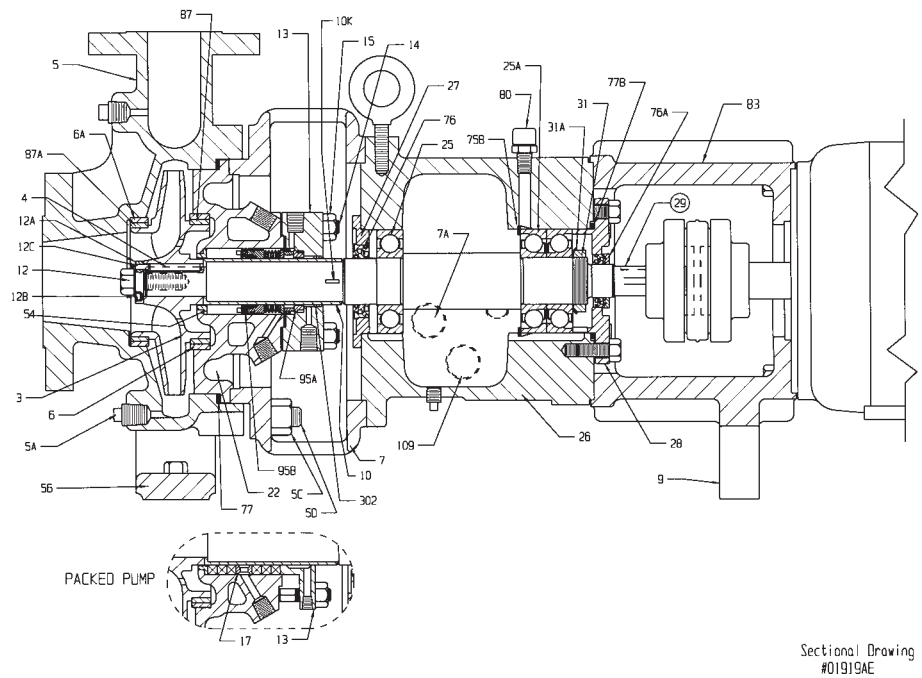
PUMP DESIGNATION CODE FOR R4140

Pump with Jacketed Seal Chamber and Bearing Housing Oil Cooler - R4144



Sectional Drawing #01919AD

Pump with Jacketed Seal Chamber and Optional "C" Face Motor Support - R4144



Sectional Drawing #01919AE

R4142 Pump with jacketed seal chamber
R4144 Pump with jacketed seal chamber and oil cooler
R4146 Pump with large taper bore seal chamber
R4147 Pump with jacketed seal chamber and jacketed casing
R4148 Pump with jacketed seal chamber, jacketed casing and oil cooler

Parts List	
Part No.	**Part Name**
3	Impeller
*4	Impeller Key
5	Casing
5A	Casing Drain Plug
5C	Casing Stud Nut
5D	Casing Stud
*6	Casing Back Cover Ring
6A	Casing Ring
7	Cradle Spacer
7A	Bull's Eye Oil Level Indicator
7G	Spacer to Bearing Housing Capscrew
9	Bearing Housing Foot
*10	Shaft Sleeve
*10K	Shaft Sleeve Key
*12	Impeller Bolt
*12A	Impeller Washer
*12B	Impeller Lock Washer
*12C	Impeller Washer Pin
13	Seal Chamber Gland
	Packing Gland
14	Gland Stud
15	Gland Nut
*17	Lantern Ring
22	Casing Back Cover
*22A	Back Cover to Cradle Cap Screw
*25	Radial Bearing
*25A	Thrust Bearing
*26	Bearing Housing
*27	Seal Ring
*28	Bearing End Cover
*29	Pump Shaft
*31	Thrust Bearing Lock Nut
*31A	Thrust Bearing Lock Washer
*54	Throat Bushing
56	Casing Foot
*56B	Casing Foot Dowel
*75B	Retaining Ring
*76	Labyrinth Seal—Front
*76A	Labyrinth Seal—Rear
77	Casing Gasket
*77B	End Cover Gasket
*80	Bearing Housing Vent
*87	Impeller Ring—Back (Optional)
87A	Impeller Ring—Front (Optional)
95A	Mechanical Seal Stationary
95B	Mechanical Seal Rotary
*109	Oil Cooler Assembly

* Denotes parts that are interchangeable in all R4140 series pumps.

R4140 DISASSEMBLY AND ASSEMBLY PROCEDURES

WARNING:
Work must be performed only by thoroughly trained and qualified personnel to assure quality repair and to reduce the possibilities of injury to personnel and/or damage to equipment. If you do not have personnel who are capable of safe quality repair of this equipment, we advise you to return the equipment to DEAN PUMP to be repaired.

When it is necessary to open the pump and/or the pumping system the fluid will be exposed to the atmosphere and personnel in the area. For the safety of all involved, the risk of exposure of personnel to the hazards of the pumpage can be reduced by flushing the entire system with a compatible, nontoxic, non-hazardous, stable Liquid before opening the pump or the system. In all cases, where the system is flushed or not, use the utmost care around the pumpage and the, pumping system.

Always wear the appropriate protective apparel when working on or around the pumping equipment. Safety glasses with side shields, heavy work gloves (use insulated work gloves when handling hot items), steel-toed shoes, hard hat, and any other protective gear as needed for protection. One example of other gear would be breathing apparatus when working near toxic materials.

Use only top quality tools.

a) Stop the pump. Turn off the power supply (electricity, steam, etc.) to the pump driver (motor, turbine, engine, etc.) and lock the switching device so that it can not be restarted. Tag the switching device so that no one will attempt to restart the unit.

b) Close the suction and discharge valves completely to isolate the pump from the system. Lock the valves in the closed position and tag them so that no one will attempt to open them.

c) Turn off, lock out, and tag all sub-systems and auxiliary equipment and auxiliary supply lines to isolate the pumping unit from any and all power, energy, and/or fluids.

WARNING:
Do not attempt to perform any work on the unit until you are confident that the pump and its contents have been stabilized at ambient temperature, and atmospheric pressure.

Put on protective wear to protect human tissue from attack by the fluids contained in the pump and any sub-systems, and from any vapors or fumes that could possibly be released from these fluids. This could mean breathing apparatus face shields, heavy long sleeve rubber gloves, rubber apron, hood, and possibly more, dependent, of course, on the properties of the fluids involved and the installed drain and vent piping arrangement. Personal injury and/or death can occur if adequate precautions are not taken with regard to the fluid, the installation and the possibilities of the release of fluid, vapors, and/or fumes.

d) Remove the coupling, guard(s).

e) If the pump and driver are independently mounted to a common baseplate (not connected to each other with a motor support (83)), remove the spacer section of the coupling. Remove the two bolts that fasten the bearing housing foot (9) to the baseplate. Go to step (j).

f) If the pump and driver (motor or turbine) are connected together by a "C" faced motor support (83), disconnect the power supply from the driver. Place wood block and wedges, under the rear feet of motor sizes 143TC through 215TC, or under the motor support (83) of motors sizes 254TC through 365TC. These blocks are to be positioned so as to support the weight of the motor and the motor support (83) when they are separated from the pump. Hook a lifting hoist to the lifting eye(s) of the motor and take the slack out of the cable or chain. Make sure that all of the components of the lifting apparatus are capable of lifting the weight.

g) For units with motor sizes 143TC trough 215TC, remove the two bolts that fasten the motor support (83) to the baseplate. For units with motor sizes 254TC through 365C, remove the two bolts that fasten the rear feet of the motor to the baseplate.

h) Remove the four bolts that fasten the motor support (83) to the back of the pump. Be careful to support the weight of the motor and motor support (83) as you are removing these bolts. Carefully move the motor and motor support (83) assembly horizontally and axially away from the pump, guiding the assembly to clear the pump coupling hub.

i) Remove the coupling elastomer from the coupling hub. The elastomer may be in either the pump hub or the motor hub.

j) Drain all the fluids from all the auxiliary sub-systems (lubrication, cooling, heating, seal barrier, etc.) that are connected to the pump. Drain each fluid into a separate container. Use caution required for each fluid after reading the MSDS (Material Safety Data Sheet) for each.

k) Flush each sub-system with a compatible, non-toxic, non-hazardous, stable liquid. Drain into individual containers for each fluid. Disconnect and remove all auxiliary piping.

l) Carefully bleed off any pressure remaining in the pump. Pressure remaining in the pump will be dependent upon the pressure in the system when the pump was stopped; the quality, type, and condition of the isolation valves; the thermal expansion values of the fluid and the pump material; and the change in the vapor pressure of the fluid between the temperature at the time the isolation valves were closed and the ambient temperature. Bleeding must be through a valved drain line piped to a closed container mounted lower than the pump. The container must be arranged with a relief passage to some point where pressure and fumes will not be harmful to personnel. The container must also have a level device so that determination can be made that sufficient fluid has been drained to empty the pump cavity and the volume of fluid that was contained in the run of suction and discharge pipe between the isolation valves and the pump. After the initial rush of fluid from the pump relieves the pressure, the drain valve can be opened further to speed the draining operation. When fluid quits running into the drain tank, gage the volume to see if it is sufficient to have fully drained the contents of the pump and the suction and discharge pipes between the isolation valves.

   If the system was constructed without any drain connections, it will be necessary to consult the designers of the system for safe draining procedures.

m) Now drain any small piping, that contains the fluid pumped, from all low points into the same container used to drain the pump. Do not drain any other fluids (different then the pumpage) into this container as they may not be compatible. Personal injury, death, and/or equipment damage could occur.

WARNING:
Even though it might appear that the cavity being drained has completely drained, be extremely careful about opening the system and/or opening the pump. If something solid in the pumpage moves to the vicinity of the drain connection, it could seal-off the drain and maintain pressure in the cavity thought to have been drained. It is also possible that the isolation valves are not sealing and therefore

allowing liquid to flow from the system into the pump. Personal injury, death and/or equipment damage may occur if great caution is not exercised.

n) Because of the above possibility, when you loosen the gasketed joint at the back of the casing (5), loosen the casing nuts (5C) only one full turn, and then use the jack screws in the flange of the cradle spacer (7) to break the gasket seal. If fluid and/or pressure remains in the pump it will spray out now. Use extreme caution, wearing protective gear, to avoid injury. Do not proceed with disassembly until leakage ceases completely. If leakage does not cease, the isolation valves may not be sealing. Note that if the pump was purchased without a drain, the pump will contain fluid which will flow out at the time the nuts are loosened and the gasket seal is broken.

WARNING:
When you open the pump, the fluid will be exposed to the atmosphere and personnel in the area. For the safety of all involved, the risk of exposure can be reduced by flushing the cavity that was just drained with a compatible, non-toxic, non-hazardous, stable liquid, before disassembling the pump.

o) Remove the casing nuts (5C) and using a mechanical lifting apparatus to support the weight, pull the rotating unit from the casing (5).

p) Flush the wetted parts, now exposed, with a compatible, non-toxic, non-hazardous, stable liquid.

q) Remove the gasket from the face of the casing (5) or the casing back cover (22) dependent on which one the gasket may have adhered to. The type of gasket and material of construction will vary with service requirements. Attack by prying and then, if necessary, layering off the old gasket with a sharp scraper, attempting to remove it in the largest possible pieces. Wear heavy leather, long sleeve work gloves when using the scraper. Be careful to not scar the gasket contact surfaces of the casing or the casing back cover. Wet the gasket before and during the scraping operation to reduce the possibility of fibers becoming airborne. Wear a respirator during this operation and until all debris has been disposed of in a plastic bag. Remove all of the gasket material down to clean metal surfaces on both parts that contacted the gasket. Place all of the gasket residue in a plastic bag, seal the bag and dispose.

r) The rotating assembly of the pump can now be moved to a more convenient location for further disassembly. Use mechanical lifting equipment to move assemblies and components.

DISASSEMBLY PROCEDURE
To further dismantle the pump, perform the following steps in the sequence shown:

WARNING:
Use only high quality tools.

Flush parts as disassembled to remove hazardous residue from the pumpage and/or sub-system fluids.

Wear protective equipment as advised at the beginning of this section.

Use mechanical lifting equipment to lift assemblies and components.

Do not apply heat to parts to assist in disassembly. Explosion could occur causing personal injury, death, and/or damage to equipment.

Do not attempt to drill, saw or otherwise cut parts to remove them. Explosion and/or fuming could occur causing personal injury, death, and/or equipment damage.

Do not hammer on any parts. Personal injury and/or damage to equipment may occur.

a) Remove gland stud nuts (15) and slide gland (13) away from seal chamber.

b) Remove packing from stuffing box if pump is packed. Use packing extractor.

c) Turn down the lip of the lockwasher (12B) which is turned up against one flat of the impeller bolt (12). Remove impeller bolt (12) (right hand thread). Remove impeller bolt lockwasher (12B) and impeller retaining washer (12A). Discard the lockwasher (12B). The impeller may now be removed from the shaft (29). Remove impeller key (4) from the shaft.

d) Remove the two capscrews securing the casing back cover (22) to the cradle spacer (7) and lift out the casing back cover. Do not remove the gland studs (14) from the casing back cover (22). If the gland studs (14) are damaged, or it is deemed necessary for any other reason to remove the gland studs (14), contact Dean Pump.

e) If the pump is equipped with a mechanical seal, loosen the set screws that retain the seal and remove the mechanical seal rotary (95B). Remove the mechanical seal stationary (95A) and gland(13). Remove the mechanical seal stationary (95A) from the gland (13).

f) Remove the four capscrews securing the cradle spacer (7) to the bearing housing (26) and remove the cradle spacer.

g) Remove the shaft sleeve (10) and shaft sleeve key (10K) from the shaft.

h) Remove pump half of coupling from shaft (29).

i) Remove the bearing housing oil cooler (109) before attempting to remove the pump shaft (29). Remove the 1/2" tube x 1/2" male pipe thread fitting from one end of the oiler cooler (109). Remove the tubing nut and tubing ferrule from the 1/2" tube x 1" male pipe thread fitting that is in the bearing housing (26) on the same side that you removed the first fitting. Unscrew the 1/2" tube x 1" male pipe thread fitting that is on the opposite side of the bearing housing (26) from the bearing housing and pull the oil cooler (109) out through the 1" NPT opening.

j) Remove the bearing end cover (28) and end cover gasket (77B) from the bearing housing (26). Remove the gasket (77B) from the end cover (28).

k) Push the pump shaft (29) towards the rear of bearing housing (26) until the thrust bearings (25A) are out of the back end of the bearing housing. Lift the shaft and reach in, with snap-ring pliers, to remove the snap ring (75B) from the bearing housing (26). Remove pump shaft and bearing assembly from the rear of the bearing housing.

l) Bend the tab of the lock nut washer (31A) out of the slot in the bearing lock nut (31). Remove bearing lock nut (31) and lock nut washer (31A) from the pump shaft (29). Use a hydraulic press to remove the bearings (25 and 25A) from the shaft. **Hammering bearings in any way, may result in serious damage to the pump shaft.** Remove snap ring (75B) from the pump shaft.

m) Press seal ring (27), labyrinth seal (76) assembly from bearing housing (26).

n) Press the front labyrinth seal (76) from seal ring (27).

o) Press rear labyrinth seal (76A) from bearing end cover (28).

p) If necessary, remove the casing ring (6A) by prying it out of the casing (5). If the ring is tack-welded into the casing, grind the

weld from between the ring and the casing before prying out the ring.

q) If necessary, remove the casing back cover ring (6) by prying it out of the casing back cover (22). If the ring is tack-welded into the casing back cover, grind the weld from between the ring and the casing back cover before prying out the ring.

r) If necessary, press the throat bushing (54) out of the casing back cover (22), using care to not damage the gland studs (14) nor the casing back cover (22).

s) I so desired, the bearing housing foot (9) can be removed from he bottom of the bearing housing (26).

t) Clean and inspect all parts.

REASSEMBLY PROCEDURE

WARNING:

Use only high quality tools.

Wear protective equipment as advised at the beginning of this section.

Use mechanical lifting equipment to lift assemblies and components.

Do not hammer on any parts. Personal injury and/or damage to equipment may occur.

Do not attempt to manufacture parts or modify Dean Pump parts in any manner. Death, personal injury, and/or damage to equipment may occur. One example of the above would be overboring the stuffing box or the seal chamber, which removes metal that is required to contain fluids. Removal of this metal reduces the pressure containing capability of the part and may create a leak path through the part. If the part separates two different fluids, mixing of the fluids could cause an explosion. Water leakage into a heat transfer liquid is one example of an explosive possibility.

Replace all gaskets, seals, bearings, and lubricants. Replace all parts that have worn, corroded, eroded, or otherwise deteriorated.

Use only Dean Pump Division of Met-Pro Corporation parts.

To reassemble the pump, perform the following steps:

a) Clean all parts thoroughly.

b) If needed, press a new throat bushing (54) carefully into the casing backcover (22).

c) If needed, press a new casing backcover ring (6) into the casing backcover (22).

d) If needed, press a new casing ring (6A) into the casing (5).

e) If the bearing housing foot (9) was removed, bolt it back to the bearing housing (26). Be sure that the dowel pins are in place between the foot (9) and the housing (26). Tighten the capscrews to 50 ft. lb.

f) If the bull's eye sight glass was removed, apply pipe sealant to the threads of a new bull's eye sight glass and tighten it into the side of the bearing housing (26). Torque to 50 ft. lb.

g) If the bearing housing vent (80) was removed, install a new vent (80), without thread sealant, into the top of the bearing housing (26). Tighten to 20 ft. lb.

h) Install new "O" rings onto the O.D. and into the I.D. of both the labyrinth seals (76 and 76A). Lubricate the "O" rings on the O.D. of both labyrinths.

i) Press the front labyrinth seal (76) into the seal ring (27).

j) Press the rear labyrinth seal (76A) into the bearing end cover (28). The "expulsion port" (the slot in the O.D.) of the labyrinth (76A) must be positioned at the bottom of the end cover. This will be inline with the machined "oil return" slot in the end cover (28).

k) Press the bearings (25 and 25A) onto the pump shaft (29). Press only on the inner races of the bearings. Do not press on the outer races. The thrust bearing is a matched pair of angular contact bearings and must be assembled "back to back". See the illustration on page 15. Be sure to place the snap ring (75B) over the shaft before pressing on the last bearing(s).

l) Place a new bearing lock washer (31A) onto the pump shaft (29). Tighten the bearing lock nut (31) against the lock washer, to 75 ft. lb., while holding the shaft (29) against rotation with a hook spanner wrench in the keyway. Another way to keep the shaft from turning is to place the coupling hub onto the shaft and hold it with a wrench. Bend one of the tabs of the lockwasher (31A) into the corresponding slot in the locknut (31).

m) Lubricate the O.D. of the bearings (25 and 25A) and the bores of the bearing housing (26). Slide the shaft (29) bearing (25 and 25A) assembly into the rear of the bearing housing (26). After the radial bearing (25) has passed through the rear bore of the housing, reach into the opening, with snap ring pliers, and place the retaining ring (75B) into the rear bore of the housing. Install the retaining ring with the opening in the ring at the bottom of the housing so that it is centered with the oil return groove in the housing. The ring does not have to be in it's groove. The bearing housing is machined with a long chamfer that allows the thrust bearing (25A) to push the ring into it's groove as the shaft assembly is pushed into the bearing housing. The shaft may now be fully inserted until the thrust bearing (25A) is firmly against the retaining ring (75B), and the retaining ring is firmly in it's groove.

n) Lubricate the end cover gasket (77B), which is an "O" ring. Place the end cover gasket (77B) onto the end cover (28). Lubricate the I.D. of the rear labyrinth seal (76A), which is in the end cover (28). Lubricate the area of the pump shaft (29), just behind the thrust bearing (25A), where the rear labyrinth seal (76A) will be mounted. Slide the bearing end cover (28), labyrinth seal (76A) assembly carefully over the end of the pump shaft (29). Be careful that the "O" ring in the I.D. of the labyrinth seal (76A) does not contact the keyway of the shaft (29) and become damaged. Placing a piece of plastic electrical tape over the keyway, before this assembly operation, will give a measure of protection. Rotate the end cover (28) so that the machined "oil return slot" is towards the bottom of the bearing housing (26). Seat the end cover fully into the bearing housing and tighten the end cover bolts to 25 ft. lb.

o) Re-install the bearing housing oil cooler (109) into the bearing housing (26). Install the oil cooler (109) into the open 1" NPT connection and carefully guide the end of the tubing through the tubing connector on the opposite side of the bearing housing (26). Apply pipe sealant to the 1" male pipe threads, and tighten the 1" tube connector into the bearing housing (26) with a torque of 50 ft. lb. The ferrules used in these tube connectors are plastic, to enable disassembly and re-assembly without damaging the cooling tube. When tightening these connectors, tighten to only 5 ft. lb.

p) Lubricate the I.D. of the front labyrinth seal (76), which is in the seal ring (27). Lubricate the area of the pump shaft (29), just in front of the radial bearing (25), where the front labyrinth seal (76) will be mounted. Slide the seal ring (27), labyrinth seal (76) assembly carefully over the end of the pump shaft (29). Be careful that the "O" ring in the I.D. of the labyrinth seal (76) does not contact the keyways of the shaft (29) and become damaged. Press the seal ring (27), labyrinth seal (76) assembly into the front of the bearing housing (26). The "expulsion port" (the slot in the O.D.) of

the labyrinth (76) must be positioned so that it is towards the bottom of the bearing housing (26)

q) Dean pumps are made with a lapped metal-to-metal joint between the shaft sleeve (10) hook and the locating shoulder on the shaft (29) to prevent liquid leakage under the shaft sleeve. The following instructions should be carefully observed when the shaft is reassembled to the shaft:

   1. Apply a small amount of 280 grit lapping compound (similar to automobile valve grinding compound) to the inside shoulder of the shaft sleeve hook.
   2. Slide the shaft sleeve (10) onto the shaft. Do not install the shaft sleeve key (10K).
   3. Rotate the shaft sleeve repeatedly by hand in its place on the shaft until the markings on both shaft and sleeve hook show that complete metal-to-metal contact has been made.
   4. Remove the shaft sleeve and flush all lapping compound from the sleeve and shaft. Reassemble the shaft sleeve on the shaft with the shaft sleeve key (10K) in place.

r) Assemble the cradle spacer (7) to the bearing housing (26). Tighten bolts to 50 ft. lb.

s) If the pump stuffing box is to be packed, slide the packing gland (13) over the shaft sleeve and back against the front labyrinth seal (76).

t) If the pump is equipped with a mechanical seal, assemble the seal parts on the shaft sleeve at this time. See separate mechanical seal installation instructions.

u) Slide the casing back cover (22) carefully into place and secure it to the cradle spacer with the two capscrews. Be especially careful not to damage mechanical seal parts. Tighten bolts to 30 ft. lb.

v) Place the impeller key (4) into the shaft (29) keyway and slide the impeller (3) into position on the shaft (29) Drive the impeller lockwasher dowel (12C) into the impeller washer (12A) until it is flush with the side of the washer that has a blind hole . Place the impeller bolt (12) through the impeller lock washer (12B) and then the impeller washer (12A) so that the protruding part of the impeller lock washer dowel (12C) is away from the head of the impeller bolt (12). Screw the impeller bolt (12) into the shaft (29) while guiding the protruding impeller lock washer dowel (12C) into the keyways of the impeller (3) and the shaft (29). Tighten the impeller bolt (12) to 60 ft. lb.

   Use a drive pin punch to bend the edge of the impeller lock washer (12B) into the blind hole in the impeller washer (12A). Use a chisel to bend the side of the impeller lock washer (12B) up against a flat of the impeller bolt, approximately 90° from the blind hole.

w) Replace the coupling key into the keyway at the coupling end of the pump shaft (29).

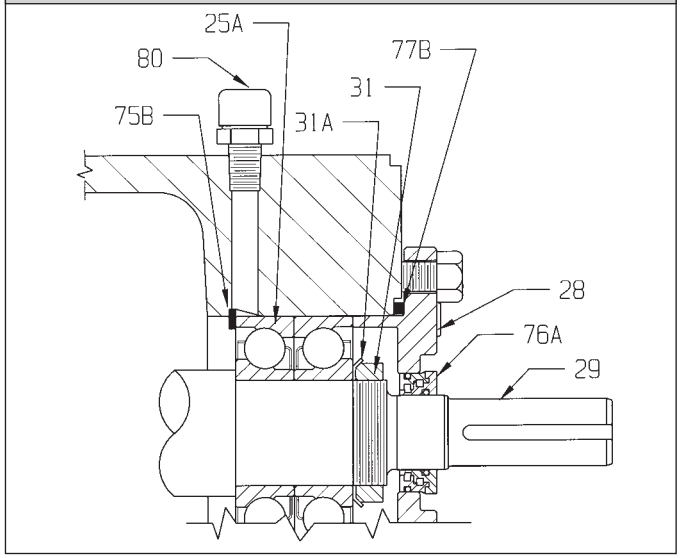
x) If the pump and driver are independently mounted to a common baseplate, place the pump coupling hub (including the four axial bolts) onto the pump shaft (29), flush with the end of the pump shaft, and tighten the set screws. Go to step (z).

y) If the pump and driver are connected by a "C" faced motor support, place the pump coupling hub onto the pump shaft (29), to the location noted below, and tighten the set screws.

   For use with motor sizes 143TC and 145TC, place pump hub to overhang pump shaft by 1/16".

   For use with motor sizes 182TC and 184TC, place pump hub so that the pump shaft protrudes 3/16".

Back-to-Back Thrust Bearings



   For use with motor sizes 213TC and 215TC, place pump hub to overhang pump shaft by 5/16".

   For use with motor sizes 254TC and 256TC, place pump hub flush with the end of the pump shaft.

   For use with motor sizes 284TSC and 286TSC, place pump hub to overhang pump shaft by 3/16".

   For use with motor sizes 324TSC, 326TSC, 364TSC and 365TSC, place pump hub flush with the end of the pump shaft.

z) If the pump shaft is to be sealed with packing, do so now. See "Installation and Maintenance of Shaft Compression Packing" section of this manual.

aa) Rotate the pump shaft by hand to be sure there is no internal rubbing or binding.

ab) The partial assembly can now be taken to the assembly site. Use proper lifting equipment and methods.

ac) Place a new casing gasket (77) into the casing (5). Unscrew the two casing jacket bolts in the flange of the cradle spacer (7) until neither protrudes from the flange towards the casing. Inspect the face of the casing, where the jack screws made contact during disassembly, and carefully remove any burrs with a file.

ad) Using a hoist to lift and position the partial pump assembly, install it into the pump casing (5). Be careful to align the assembly with the casing so that the impeller (3) slides freely into the close clearance of the casing ring (6A). Screw the casing stud nuts (5C) by hand into the casing studs (50) but do not tighten them yet.

ae) If the pump and driver are independently mounted to a common baseplate, go to step ap).

af) If the pump and driver are connected by a "C" faced motor support (83), place wood blocks and wedges under the bearing housing (26) to support the pump.

ag) Place the motor coupling hub onto the motor shaft to the location noted below, and tighten the set screws.

   On motor sizes 143TC and 145TC, place motor hub flush with the end of the motor shaft.

   On motor sizes 182TC and 184TC, place motor hub so that the motor shaft protrudes 1/4".

On motor sizes 213TC and 215TC, place motor hub to overhang motor shaft by 5/16".

On motor sizes 254TC and 256TC, place motor hub flush with the end of the motor shaft.

On motor sizes 284TSC and 286TSC, place motor hub to overhang motor shaft by 3/16".

On motor sizes 324TSC, 326TSC, 364TSC and 365TSC, place motor hub flush with the end of the motor shaft.

ah) On motor sizes 143TC, 145TC, 182TC and 184TC, bolt the spacer section to the motor hub.

ai) Place the coupling elastomer into the pump coupling hub.

aj) Lift the motor and motor support (83) assembly with a hoist, and position it so that the motor support pilots onto the end of the bearing housing (26) and so that the motor end of the coupling engages the coupling elastomer that is retained in the pump hub of the coupling. It may now be necessary to rotate the motor shaft slightly to allow the coupling components to engage. Install the bolts that retain the motor support (83) to the bearing housing (26). Hand tighten the bolts.

ak) Remove all blocks and wedges while maintaining support with a hoist. Gently and carefully lower the hoist enough to allow the weight to seat the supporting feet onto the baseplate. When the support feet make full contact with the base, lightly tighten the casing stud nuts (5C) and the bolts that retain the motor support (83) to the bearing housing (26).

al) Tighten the casing stud nuts (5C) evenly to 105 ft. lb.

am) Tighten the motor support (83) to bearing housing (26) bolts to 65 ft. lb.

an) Bolt the pump assembly to the baseplate, at the motor support foot (9) for motor sizes 143TC through 215TC, or at the rear two feet of the motor for motor frames 254TC through 365TSC.

ao) Rotate the pump shaft by hand to check for rubbing or binding. Go to step at).

ap) Gently allow the hoist to lower the pump assembly until the weight of the unit seats the bearing housing foot (9) firmly against the base plate. Tighten the casing stud nuts (5C) evenly to 105 ft. lb.

aq) Bolt the bearing housing foot (9) to the baseplate.

ar) Rotate the pump shaft by hand to check for rubbing or binding.

as) Align the pump and driver shafts. See "Pump and Driver Alignment". Reinstall the coupling spacer.

at) Reinstall the coupling guard(s).

au) Lubricate the pump according to the "Pump Lubrication" instructions.

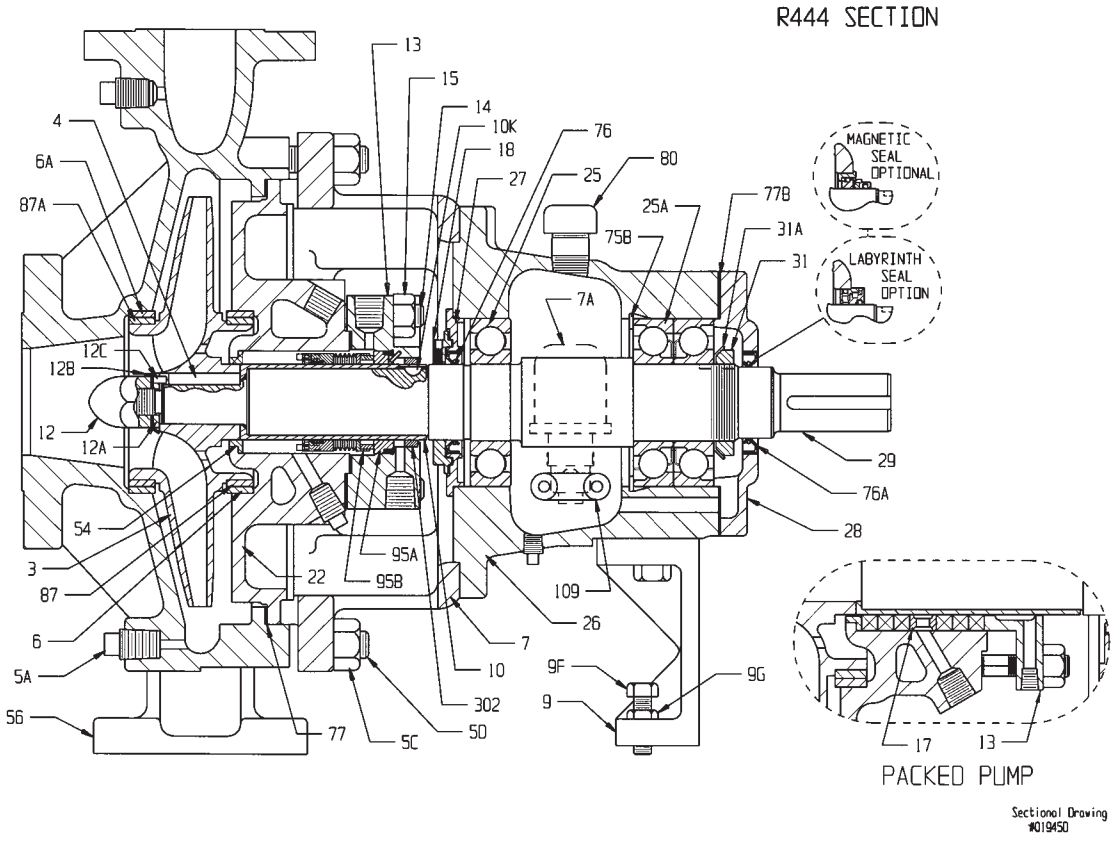
av) Reinstall any auxiliary piping and drain plugs that were removed during disassembly.

aw) Remove tools, old parts and debris from the area around the pump.

ax) Follow "Starting the Pump" instructions to restart the pump.

PUMP DESIGNATION CODE FOR R440, R450 AND R480

R440 Pump with Jacketed Seal Chamber and Bearing Housing Oil Cooler - R444



R444, R454or R484 Pump with jacketed seal chamber and oil cooler

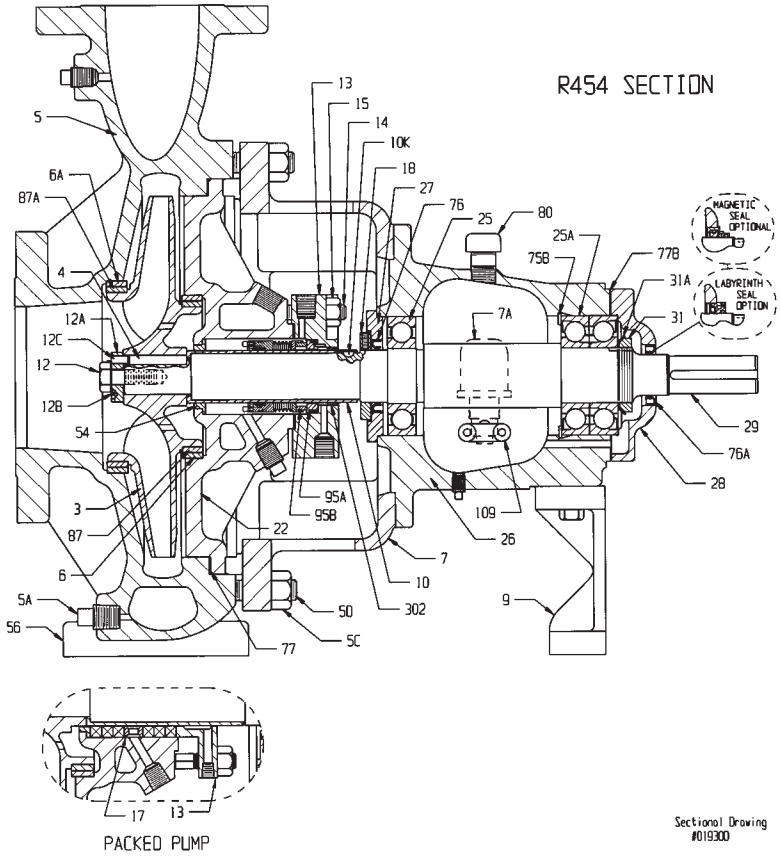
R446, R456or R486 Pump with large taper bore seal chamber and oil cooler

R448, R458or R488 Pump with jacketed seal chamber, jacketed casing and oil cooler

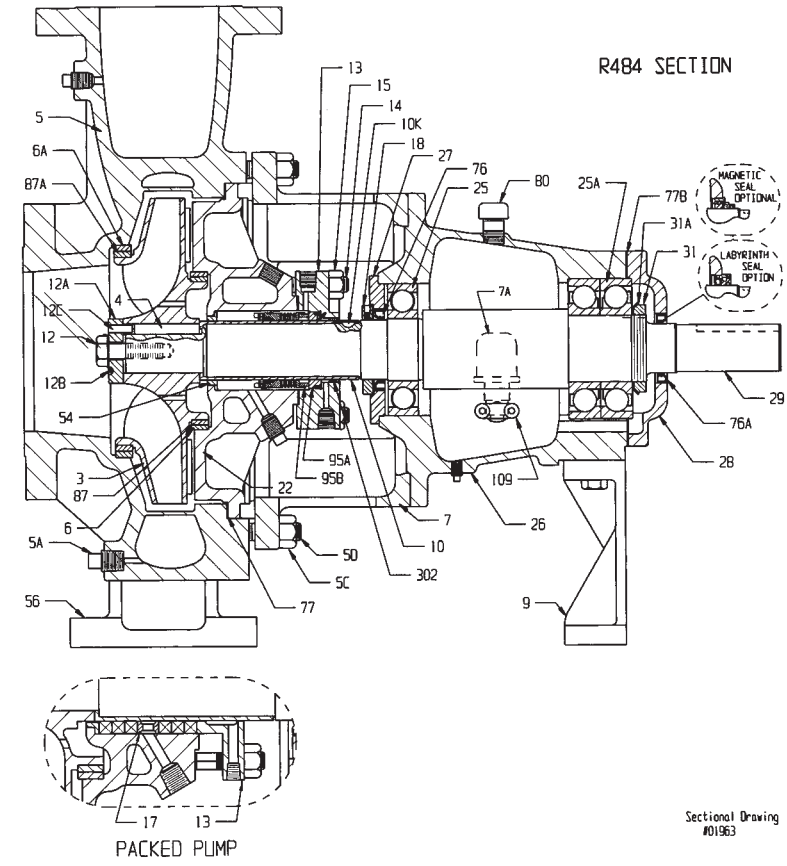
Parts List	
Part No.	**Part Name**
3	Impeller
*4	Impeller Key
5	Casing
5A	Casing Drain Plug
5C	Casing Stud Nut
5D	Casing Stud
*6	Casing Back Cover Ring
6A	Casing Ring
7	Cradle Spacer
7A	Automatic Oiler
7G	Spacer to Bearing Housing Capscrew
9	Bearing Housing Foot
*9F	Brg. Hsg. Foot Jack Bolt - R440 Only
*9G	Brg. Hsg. Foot Jack Bolt - R440 Only
*10	Shaft Sleeve
*10K	Shaft Sleeve Key
*12	Impeller Bolt (Nut on R440)
*12A	Impeller Washer
*12B	Impeller Lock Washer
*12C	Impeller Washer Pin
13	Seal Chamber Gland
	Packing Gland
14	Gland Stud
15	Gland Nut
*17	Lantern Ring
*18	Splash Collar
22	Casing Back Cover
*22A	Back Cover to Cradle Cap Screw
*25	Radial Bearing
*25A	Thrust Bearing
*26	Bearing Housing
*27	Seal Ring
*28	Bearing End Cover
*29	Pump Shaft
*31	Thrust Bearing Lock Nut
*31A	Thrust Bearing Lock Washer
*54	Throat Bushing
56	Casing Foot
*56B	Casing Foot Dowel
*75B	Retaining Ring (All except R480)
*76	Oil Seal—Front
*76A	Oil Seal—Rear
77	Casing Gasket
*77B	End Cover Gasket
*77E	Oil Cooler Gasket
*80	Bearing Housing Vent
*87	Impeller Ring—Back (Optional)
87A	Impeller Ring—Front (Optional)
95A	Mechanical Seal Stationary
95B	Mechanical Seal Rotary
*109	Oil Cooler Assembly

* Denotes parts that are interchangeable in all pumps of the same series.

R450 Pump with Jacketed Seal Chamber and Bearing Housing Oil Cooler - R454



R480 Pump with Jacketed Seal Chamber and Bearing Housing Oil Cooler - R484



R440, R450 and R480 DISASSEMBLY AND ASSEMBLY PROCEDURES

WARNING:
Work must be performed only by thoroughly trained and qualified personnel to assure quality repair and to reduce the possibilities of injury to personnel and/or damage to equipment. If you do not have personnel who are capable of safe quality repair of this equipment, we advise you to return the equipment to DEAN PUMP to be repaired.

When it is necessary to open the pump and/or the pumping system the fluid will be exposed to the atmosphere and personnel in the area. For the safety of all involved, the risk of exposure of personnel to the hazards of the pumpage can be reduced by flushing the entire system with a compatible, nontoxic, non-hazardous, stable Liquid before opening the pump or the system. In all cases, where the system is flushed or not, use the utmost care around the pumpage and the, pumping system.

Always wear the appropriate protective apparel when working on or around the pumping equipment. Safety glasses with side shields, heavy work gloves (use insulated work gloves when handling hot items), steel-toed shoes, hard hat, and any other protective gear as needed for protection. One example of other gear would be breathing apparatus when working near toxic materials.

Use only top quality tools.

a) Stop the pump. Turn off the power supply (electricity, steam, etc.) to the pump driver (motor, turbine, engine, etc.) and lock the switching device so that it can not be restarted. Tag the switching device so that no one will attempt to restart the unit.

b) Close the suction and discharge valves completely to isolate the pump from the system. Lock the valves in the closed position and tag them so that no one will attempt to open them.

c) Turn off, lock out, and tag all sub-systems and auxiliary equipment and auxiliary supply lines to isolate the pumping unit from any and all power, energy, and/or fluids.

WARNING:
Do not attempt to perform any work on the unit until you are confident that the pump and its contents have been stabilized at ambient temperature, and atmospheric pressure.

Put on protective wear to protect human tissue from attack by the fluids contained in the pump and any sub-systems, and from any vapors or fumes that could possibly be released from these fluids. This could mean breathing apparatus face shields, heavy long sleeve rubber gloves, rubber apron, hood, and possibly more, dependent, of course, on the properties of the fluids involved and the installed drain and vent piping arrangement. Personal injury and/or death can occur if adequate precautions are not taken with regard to the fluid, the installation and the possibilities of the release of fluid, vapors, and/or fumes.

d) Remove the coupling, guard. Remove the spacer section of the coupling. Remove the two bolts that fasten the bearing housing foot (9) to the baseplate.

e) Drain all the fluids from all the auxiliary sub-systems (lubrication, cooling, heating, seal barrier, etc.) that are connected to the pump. Drain each fluid into a separate container. Use caution required for each fluid after reading the MSDS (Material Safety Data Sheet) for each.

f) Flush each sub-system with a compatible, non-toxic, non-hazardous, stable liquid. Drain into individual containers for each fluid. Disconnect and remove all auxiliary piping.

g) Carefully bleed off any pressure remaining in the pump. Pressure remaining in the pump will be dependent upon the pressure in the system when the pump was stopped; the quality, type, and condition of the isolation valves; the thermal expansion values of the fluid and the pump material; and the change in the vapor pressure of the fluid between the temperature at the time the isolation valves were closed and the ambient temperature. Bleeding must be through a valved drain line piped to a closed container mounted lower than the pump. The container must be arranged with a relief passage to some point where pressure and fumes will not be harmful to personnel. The container must also have a level device so that determination can be made that sufficient fluid has been drained to empty the pump cavity and the volume of fluid that was contained in the run of suction and discharge pipe between the isolation valves and the pump. After the initial rush of fluid from the pump relieves the pressure, the drain valve can be opened further to speed the draining operation. When fluid quits running into the drain tank, gage the volume to see if it is sufficient to have fully drained the contents of the pump and the suction and discharge pipes between the isolation valves.

   If the system was constructed without any drain connections, it will be necessary to consult the designers of the system for safe draining procedures.

h) Now drain any small piping, that contains the fluid pumped, from all low points into the same container used to drain the pump. Do not drain any other fluids (different then the pumpage) into this container as they may not be compatible. Personal injury, death, and/or equipment damage could occur.

WARNING:
Even though it might appear that the cavity being drained has completely drained, be extremely careful about opening the system and/or opening the pump. If something solid in the pumpage moves to the vicinity of the drain connection, it could seal-off the drain and maintain pressure in the cavity thought to have been drained. It is also possible that the isolation valves are not sealing and therefore allowing liquid to flow from the system into the pump. Personal injury, death and/or equipment damage may occur if great caution is not exercised.

i) Because of the above possibility, when you loosen the gasketed joint at the back of the casing (5), loosen the casing nuts (5C) only one full turn, and then use the jack screws in the flange of the cradle spacer (7) to break the gasket seal. If fluid and/or pressure remains in the pump it will spray out now. Use extreme caution, wearing protective gear, to avoid injury. Do not proceed with disassembly until leakage ceases completely. If leakage does not cease, the isolation valves may not be sealing. Note that if the pump was purchased without a drain, the pump will contain fluid which will flow out at the time the nuts are loosened and the gasket seal is broken.

WARNING:
When you open the pump, the fluid will be exposed to the atmosphere and personnel in the area. For the safety of all involved, the risk of exposure can be reduced by flushing the cavity that was just drained with a compatible, non-toxic, non-hazardous, stable liquid, before disassembling the pump.

j) Remove the casing nuts (5C) and using a mechanical lifting apparatus to support the weight, pull the rotating unit from the casing (5).

k) Flush the wetted parts, now exposed, with a compatible, non-toxic, non-hazardous, stable liquid.

l) Remove the gasket from the face of the casing (5) or the casing back cover (22) dependent on which one the gasket may have

adhered to. The type of gasket and material of construction will vary with service requirements. Attack by prying and then, if necessary, layering off the old gasket with a sharp scraper, attempting to remove it in the largest possible pieces. Wear heavy leather, long sleeve work gloves when using the scraper. Be careful to not scar the gasket contact surfaces of the casing or the casing back cover. Wet the gasket before and during the scraping operation to reduce the possibility of fibers becoming airborne. Wear a respirator during this operation and until all debris has been disposed of in a plastic bag. Remove all of the gasket material down to clean metal surfaces on both parts that contacted the gasket. Place all of the gasket residue in a plastic bag, seal the bag and dispose.

m) The rotating assembly of the pump can now be moved to a more convenient location for further disassembly. Use mechanical lifting equipment to move assemblies and components.

DISASSEMBLY PROCEDURE

To further dismantle the pump, perform the following steps in the sequence shown:

WARNING:
Use only high quality tools.

Flush parts as disassembled to remove hazardous residue from the pumpage and/or sub-system fluids.

Wear protective equipment as advised at the beginning of this section.

Use mechanical lifting equipment to lift assemblies and components.

Do not apply heat to parts to assist in disassembly. Explosion could occur causing personal injury, death, and/or damage to equipment.

Do not attempt to drill, saw or otherwise cut parts to remove them. Explosion and/or fuming could occur causing personal injury, death, and/or equipment damage.

Do not hammer on any parts. Personal injury and/or damage to equipment may occur.

a) Remove gland stud nuts (15) and slide gland (13) away from seal chamber.

b) Remove packing from stuffing box if pump is packed. Use packing extractor.

c) Turn down the lip of the lockwasher (12B) which is turned up against one flat of the impeller bolt (12). Remove impeller bolt (12) (right hand thread). Remove impeller bolt lockwasher (12B) and impeller retaining washer (12A). Discard the lockwasher (12B). The impeller may now be removed from the shaft (29). Remove impeller key (4) from the shaft.

The R440 pumps are furnished with a threaded impeller end of the shaft. Remove impeller shaft nut (12) (left hand thread).

d) Remove the two capscrews securing the casing back cover (22) to the cradle spacer (7) and lift out the casing back cover. Do not remove the gland studs (14) from the casing back cover (22). If the gland studs (14) are damaged, or it is deemed necessary for any other reason to remove the gland studs (14), contact Dean Pump.

e) If the pump is equipped with a mechanical seal, loosen the set screws that retain the seal and remove the mechanical seal rotary (95B). Remove the mechanical seal stationary (95A) and gland(13). Remove the mechanical seal stationary (95A) from the gland (13).

f) Remove the four capscrews securing the cradle spacer (7) to the bearing housing (26) and remove the cradle spacer.

g) Remove the shaft sleeve (10) and shaft sleeve key (10K) from the shaft.

h) Loosen set screw in splash collar (18).

i) Remove pump half of spacer coupling from shaft (29).

j) Remove bearing end cover (28) and gaskets (77B) from bearing housing (26).

k) Remove the bearing housing cooling coil (109) before attempting to remove the shaft. Loosen and remove the four cooling coil retaining screws and pull the cooling coil (109) out of the side of the bearing housing (26). Remove the cooling coil gasket (77E).

l) Push shaft to rear of bearing housing. The splash collar (18) will be pushed off of the shaft when this is done. Lift the shaft and reach in and remove snap ring (75B) (not on R480) from bearing housing. Remove shaft and bearing assembly from rear of bearing housing.

m) Bend the tab of the lock nut washer (31A) out of the slot in the bearing lock nut (31). Remove bearing lock nut (31) and lock nut washer (31 A) from shaft. Press bearings (25 and 25A) from shaft. **Hammering bearings in any way may result in serious damage to the bearings and/or shaft.** Remove snap ring (75B) (not on R480) from shaft.

n) Press seal ring (27) from bearing housing (26).

o) Press shaft seal (76) from seal ring (27).

p) Press oil seal (76A) from bearing end cover (28).

q) If necessary, remove the casing ring (6A) by prying it out of the casing (5). If the ring is tack-welded into the casing, grind the weld from between the ring and the casing before prying out the ring.

r) If necessary, remove the casing back cover ring (6) by prying it out of the casing back cover (22). If the ring is tack-welded into the casing back cover, grind the weld from between the ring and the casing back cover before prying out the ring.

s) If necessary, press the throat bushing (54) out of the casing back cover (22), using care to not damage the gland studs (14) nor the casing back cover (22).

t) Clean and inspect all parts.

REASSEMBLY PROCEDURE

WARNING:
Use only high quality tools.

Wear protective equipment as advised at the beginning of this section.

Use mechanical lifting equipment to lift assemblies and components.

Do not hammer on any parts. Personal injury and/or damage to equipment may occur.

Do not attempt to manufacture parts or modify Dean Pump parts in any manner. Death, personal injury, and/or damage to equipment may occur. One example of the above would be overboring the stuffing box or the seal chamber, which removes metal that is required to contain fluids. Removal of this metal reduces the pressure containing capability of the part and may create a leak path through the part. If the part separates two different fluids, mixing of the fluids could cause an explosion. Water leakage into a heat transfer liquid is one example of an explosive possibility.

Replace all gaskets, seals, bearings, and lubricants. Replace all parts that have worn, corroded, eroded, or otherwise deteriorated.

Use only Dean Pump Division of Met-Pro Corporation parts.

To reassemble the pump, perform the following steps:

a) Clean all parts thoroughly.

b) If needed, press a new throat bushing (54) carefully into the casing backcover (22).

c) If needed, press a new casing backcover ring (6) into the casing backcover (22).

d) If needed, press a new casing ring (6A) into the casing (5).

e) Press the oil seal (76) into seal ring (27). Be sure that the lip of the seal faces away from the flanged side of the seal ring (towards the bearing housing).

f) Press bearings (25 and 25A) onto shaft. The thrust bearing (25A) is a matched pair of angular contact bearings and must be assembled back to back. See the illustration. Be sure to slide snap ring (75B) (not on R480) over shaft before pressing on the last bearings.

g) Replace bearing lock washer (31A) and bearing lock nut (31). Use a new lock washer.

h) Lubricate the O.D. of the bearings (25 and 25A) and the bores of the bearing housing (26). Slide the shaft (29) bearing (25 and 25A) assembly into the rear of the bearing housing (26). After the radial bearing (25) has passed through the rear bore of the housing, reach into the opening, with snap ring pliers, and place the retaining ring (75B) (not on R480) into the rear bore of the housing. The ring does not have to be in it's groove. The bearing housing is machined with a long chamfer that allows the thrust bearing (25A) to push the ring into it's groove as the shaft assembly is pushed into the bearing housing. The shaft may now be fully inserted until the thrust bearing (25A) is firmly against the retaining ring (75B) (not on R480), and the retaining ring is firmly in it's groove. On the R480 pump, the thrust bearing (25A) must seat firmly against the shoulder machined into the bearing housing.

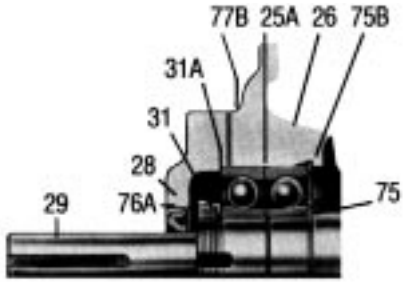
i) Bearing manufacturing tolerances are such that the combined width of the two outer races, when the bearings are assembled back to back, will exceed the depth of the bearing seat from the rear face of the bearing housing (26) to retainer snap ring (75B) (not on R480), plus the recess depth in the bearing end cover (28). Check this condition when the shaft and bearing assembly have been fitted snugly into the bearing housing against the retainer snap ring (75B) (not on R480) and the bearing end cover (28) is firmly in place. A gap exists between the rear face of the bearing housing and the flange of the bearing end cover. Measure this gap with a feeler gauge. End cover gaskets (77B) come in .005 inch and .011 inch thickness. Use a stack of end cover gaskets which exceeds your measurement by .002 inch to .007 inch. Press the oil seal (76A) into the bearing end cover (28) with the oil seal lip towards the flanged side of the end cover. Lubricate the oil seal (76A) and the pump shaft (29). Put the gaskets in place and bolt on the bearing end cover (28). Torque end cover bolts to 50 ft. lb.

j) Replace the bearing housing cooling coil after the shaft has been reinstalled. Use a new gasket and tighten the cooling coil cap screws snugly and evenly to avoid oil leakage. Torque cap screws to 20 ft. lb.

k) Lubricate oil seal (76) and pump shaft (29). Press the seal ring (27) assembled with the oil seal (76) into the front of the bearing housing (26).

l) Slide the splash collar (18) onto the shaft and gently into position until the outer rim of the splash collar is just slightly entered into the recess in the front of the seal ring (27). Tighten the set screw. Be sure that the splash collar does not rub in the recess.

THRUST BEARING ADJUSTMENT



m) Replace the pump half of the coupling on the shaft (29). The hub should be even with the end of the shaft:

n) Dean pumps are made with a lapped metal-to-metal joint between the shaft sleeve (10) hook and the locating shoulder on the shaft (29) to prevent liquid leakage under the shaft sleeve. The following instructions should be carefully observed when the shaft is reassembled to the shaft:

1. Apply a small amount of 280 grit lapping compound (similar to automobile valve grinding compound) to the inside shoulder of the shaft sleeve hook.
2. Slide the shaft sleeve (10) onto the shaft. Do not install the shaft sleeve key (10K).
3. Rotate the shaft sleeve repeatedly by hand in its place on the shaft until the markings on both shaft and sleeve hook show that complete metal-to-metal contact has been made.
4. Remove the shaft sleeve and flush all lapping compound from the sleeve and shaft. Reassemble the shaft sleeve on the shaft with the shaft sleeve key (10K) in place.

o) If the pump stuffing box is to be packed, slide the packing gland (13) over the shaft sleeve and back against the splash collar.

p) If the pump is equipped with a mechanical seal, assemble the seal parts on the shaft sleeve at this time. See separate mechanical seal installation instructions.

q) Assemble the cradle spacer (7) to the bearing housing (26). Tighten bolts to 50 ft. lb.

r) Slide the casing back cover (22) carefully into place and secure it to the cradle spacer with the two capscrews. Be especially careful not to damage mechanical seal parts. Tighten bolts to 30 ft. lb.

s) Place the impeller key (4) into the shaft (29) keyway and slide the impeller (3) into position on the shaft (29) Drive the impeller lockwasher dowel (12C) into the impeller washer (12A) until it is flush with the side of the washer that has a blind hole . Place the impeller bolt (12) through the impeller lock washer (12B) and then the impeller washer (12A) so that the protruding part of the impeller lock washer dowel (12C) is away from the head of the impeller bolt (12). Screw the impeller bolt (12) into the shaft (29) while guiding the protruding impeller lock washer dowel (12C) into the keyways of the impeller (3) and the shaft (29). Tighten the impeller bolt (12) to the torque value below .

R450	100 Ft. Lb.
R480	150 Ft. Lb.

Use a drive pin punch to bend the edge of the impeller lock washer (12B) into the blind hole in the impeller washer (12A).

Use a chisel to bend the side of the impeller lock washer (12B) up against a flat of the impeller bolt, approximately 90° from the blind hole.

The R440 pumps are furnished with a threaded impeller end of shaft and a nut instead of the impeller bolt described above. Assembly is like the above except the nut is a left hand thread. Tighten the nut to 120 ft. lb.

t) If the pump is fitted with compression packing, this packing may now be installed. See separate packing installation instructions.

u) Assemble the pump bearing housing and cradle assembly into the pump casing (5) after replacing the casing gasket (77). Be careful to align the assembly with the casing so that the impeller (3) slides freely into the close clearance of the casing ring (6A).

Tighten the casing stud nuts (5C) to 105 Ft.Lb. for 3/4" studs and 165 Ft.Lb. for 7/8" studs.

v) Rotate the pump shaft (29) by hand to be certain that there is no internal interference.

w) Bolt the pump to the baseplate. Rotate the pump shaft (29) by hand to be certain that there is no internal interference.

x) Reassemble the coupling parts, and realign the pump and driver. See separate instructions.

y) Replace the coupling guard and bolt it securely to the baseplate. Replace all auxiliary equipment .

z) Lubricate the pump according to lubricating instructions before operating.

INSTALLATION AND MAINTENANCE OF SHAFT COMPRESSION PACKING

The proper installation and maintenance of packing to seal a pump shaft is not difficult, but must be properly done to provide good packing and pump shaft sleeve life. Most packing must be allowed to leak. This leakage is the only lubrication for the packing and additionally provides cooling to remove part of the frictional heat built up between the shaft sleeve and the packing. Failure to allow sufficient leakage will result in short packing and shaft sleeve life and increased power consumption of the pumping unit. It is entirely possible to stall a centrifugal pump by clamping the packing gland down.

Most Dean pumps are shipped from the factory without packing in the stuffing box. Die molded packing specified for the service is shipped with the pump in a separately labeled carton. The pump-stuffing box must be properly packed before the pump is put into service.

The stuffing box may be packed either with or without a lantern ring (also known as a seal cage or lantern gland) as the service of the pump dictates. When the pump suction pressure is above 100 psig a lantern ring is not recommended.

PURPOSE OF LANTERN RING

Lantern rings are made of Teflon or suitable metal as the service demands. They are of split construction and may be easily installed or removed without disassembling the pump. A lantern ring is used in the stuffing box with packing for these reasons:

1) To permit the introduction of a sealing liquid into the stuffing box to prevent leakage of air into the pump through the packing when the pump suction pressure is less than atmospheric pressure. The sealing liquid may be from an internal seal connection or from an external source.

2) To permit introduction of grease, oil, or other suitable lubricant to the packing to provide lubrication or cooling

INTERNAL SEAL CONNECTION TO THE LANTERN RING

An internal seal connection is used to inject pumpage from the pump casing into the lantern ring through the lantern ring connection of the stuffing box to seal the pump against air leakage as noted above. It can be used only when the pumped liquid is clean and non-abrasive.

The pumped liquid introduced through the internal seal connection to the lantern ring will not seal the pump against air leakage through the packing when the pump is idle or on stand-by service.

EXTERNAL SEAL CONNECTION TO THE LANTERN RING

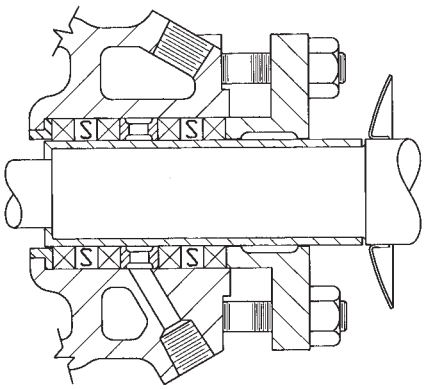
The sealing liquid introduced to the lantern ring may be from a source external to the pump. It must be introduced at a pressure above seal chamber pressure and must be non-corrosive, non-abrasive and 150°F or less in temperature. The connection is made to the lantern ring connections on the pump stuffing box.

The lantern ring connection on the pump stuffing box is also used to introduce grease, oil, or other suitable lubricants to the lantern ring.

LANTERN RING NOT USED

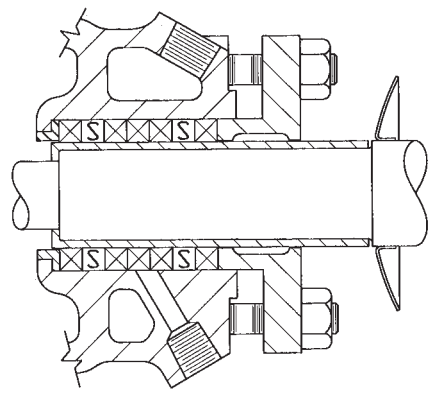
When the pump suction pressure is above atmospheric pressure or the stuffing box is pressure sealed (no impeller balance holes) and neither internal nor external liquid or lubricant is required to the packing, the lantern ring is not used and the seal chamber is packed full with rings of packing.

PACKED STUFFING BOX WITH LANTERN RING



S = When soft packing rings are furnished in a set with metallic rings, install the soft rings in the locations marked "S".

PACKED STUFFING BOX WITHOUT LANTERN RING



PACKING INSTALLATION

These instructions apply to the conventional woven, braided, folded, and wrapped packings. Packings of multifilament Teflon, braided carbon filament, compressed carbon sheet, and other special types or materials may require special installation techniques.

The way in which the packing is installed in the stuffing box is important to the good service life of the packing and the shaft sleeve. Incorrect installation will lead to excessive leakage and may cause higher power requirements.

The use of a packing tamper (split bushing) is recommended to properly seat the packing rings. Such a tool is easily made from wood or metal in the form of a hollow cylinder. The inside diameter must be slightly larger than the shaft sleeve and the outside slightly smaller than the stuffing box bore. Split the piece lengthwise to allow insertion in the stuffing box. More than one length of packing tamper may be necessary. Suit the lengths to the particular pump.

Packing rings furnished by Dean Pump Division are diemolded to fit the stuffing box. To place a ring on the shaft sleeve, open the ring at the split at a right angle to the plane of the ring. This will best retain the molded form and avoid distortion.Successive rings should be installed with the joints at 90° intervals.

Foil wrapped packings must be installed with the foil laps running in the direction of shaft sleeve rotation on the inside of the ring. Metallic packing should be lubricated, on the wearing face only, with a dry graphite lubricant before insertion.

Foil wrapped packing sets are furnished with soft rings of packing which are placed between the hard metallic rings in the locations shown in the diagrams. These rings help to furnish lubrication during the run-in period. Being soft, they are more sensitive to compression loads and care must be taken during the adjustment period.

Follow these steps:

1) With the packing gland slid back towards the bearing housing, or removed if it is a two piece gland, place a ring of packing on the shaft sleeve and enter it carefully into the stuffing box. Insert the halves of the packing tamper and push the packing ring to the bottom of the stuffing box. Slide the packing gland up against the end of the packing tamper with the gland studs indexed in the gland holes, put on the gland stud nuts and tighten them firmly and evenly to seat the packing ring.
2) Back off the gland, remove the packing tamper, and insert a second ring of packing, staggering the ring joint 90° from that in the first ring. Repeat the seating procedure above.
3) If a lantern ring is to be used, check the pump specifications to determine its position in relation to the number of rings between the bottom of the seal chamber and the lantern ring. Insert packing rings as above until the lantern ring position is reached and then install the lantern ring.
4) If no lantern ring is to be used, or after the lantern ring is put in place, continue to add packing rings, one at a time, staggering joints at 90° intervals, until the stuffing box is nearly full.
5) Put the packing gland in place and pull up the gland stud nuts firmly. Back the gland stud nuts off to finger tightness.
6) Rotate the pump shaft by hand to be sure it is not locked.
7) ***Final adjustment of the packing compression must be made with the pump running.*** Start and stop the pump several times to begin the running-in period. Allow sufficient leakage to assume good lubrication during the adjustment. Pull up the gland stud nuts 1/8 turn at a time. Allow a running in period between adjustments. Continue adjustment until the desired leakage control is reached. The minimum leakage rate depends on a number of things: liquid pumped, packing used, temperature, stuffing box pressure, and the condition of the pump. In any case, some leakage is necessary to both lubricate and cool the packing. Minimum rates may vary from a few drops per minute to as much as 1/2 pint per minute.
8) As the packing wears in service, the gland should be readjusted to maintain the minimum leakage.
9) After the gland has been taken up to full travel, an additional ring of packing may be placed in the stuffing box. When the gland has again been taken up to full travel the stuffing box should be repacked completely.

USUAL CAUSES OF PACKING FAILURE AND EXCESSIVE STUFFING BOX LEAKAGE

1) Packing has not been installed properly.
2) Packing used is not suitable for the temperature and pressure involved or may be subject to attack by liquid handled.
3) Inner rings are not thoroughly seated in the stuffing box so that outer rings are carrying all the load.
4) Dirt and foreign particles in stuffing box are causing rapid scoring of shaft sleeve.
5) Stuffing box cooling water not turned on.
6) Packing gland pulled up too tight.

When ordering additional packing sets, always refer to packing set number and to pump serial number.

INSTALLATION OF STANDARD MECHANICAL SEALS

Clean, careful, and correct installation of the mechanical seal is essential to successful mechanical seal operation. Cleanliness and accuracy of setting cannot be overemphasized.

For instructions on the pump disassembly and assembly, see above.

A correct mechanical seal drawing is furnished with each pump and the mechanical seal setting dimension is given on this drawing.

Use the setting for the specific pump type in which the installation is being made.

The pump is first assembled according to the applicable assembly instructions through the step of casing back cover installation.

The mechanical seal rotary unit must be properly located in relation to the face of the pump seal chamber in order to establish the proper seal spring tension and resultant proper force on the seal faces. An error in setting of more than several thousandths may well cause seal failure by excessive or insufficient seal face pressure.

INSTALLATION OF SINGLE INSIDE SEALS

To make the seal installation, with the pump partially assembled as noted above, scribe a mark on the shaft sleeve (10) exactly in line with the face of the pump seal chamber (Note 1). The impeller (3), and casing back cover (22) are now removed from the pump. If the mark causes roughness on the shaft sleeve remove the burr carefully

with crocus cloth. Any roughness on the shaft sleeve may damage the mechanical seal shaft packing when the seal is assembled.

Referring to the mechanical seal drawing, determine the proper "D" dimension for the seal and pump type. Measure carefully from the mark which you have made on the shaft sleeve and make a new mark on the shaft sleeve, towards the pump end, exactly to this dimension.

NOTE—Pumps using a single inside balanced seal (except metal bellows) are furnished with a short shaft sleeve. The mark is made on the shaft because the sleeve does not extend to this point. The second mark (setting mark) is made on the shaft sleeve and measured from the mark on the shaft.

If the mechanical seal insert (315) is of the clamped-in style, put the mechanical seal gland (300) on the pump shaft and slide it back towards the bearing housing (26). Put the gland gasket (325), the gland insert (315) and the seat gasket (326) on the shaft. Make sure that the lapped face of the seal insert is towards the seal chamber.

Flexibly mounted inserts are of two types, depending on the service of the pump. The insert may be of rectangular cross section grooved for an "O" ring or it may be of L-shaped cross-section used with a Teflon or Grafoil seat ring. Flexibly mounted inserts (315) frequently utilize a seat locking pin (375) pressed into the gland (300) to keep the insert from rotating. Check the condition of the pin (375) in the gland (300). If it needs replacing, pull the old pin out and press a new pin (375) in. Press the pin (375) into the gland (300) to the point where there is 1/32" of clearance between it and the bottom of the mating notch in the insert (315). Check this by installing the insert (315) into the gland (300) with out the seat ring (328). After checking the clearance, remove the insert (315) from the gland (300).

To position the "O" ring mounted insert, place the "O" ring (328) into the groove of the insert (315). Lubricate the "O" ring (328) and the inside of the mechanical seal gland (300). Slide the insert (315) into the seal gland (300) being careful not to damage the "O" ring (328). Make sure that the lapped face of the insert (315) faces toward the seal chamber and that the pin (375) enters the notch in the insert (315). Also be sure that the pin (375) does not touch the bottom of the notch in the insert (315).

To install the Teflon or Grafoil mounted insert, place the seat ring (328) carefully on to the insert (315). The seat ring (328) is chamfered on the outside diameter on one end, it is necessary to have this chamfer facing away from the insert (315). Lubricate the outside diameter of the seat ring (328) and the inside of the mechanical seal gland (300), if the seat ring (328) is Grafoil, use a round dowel (or similar object) and carefully smooth the chamfered edge. Carefully slide the insert (315), seat ring (328) assembly into position into the seal gland (300). Make sure that the pin (375) enters the notch in the insert (315). Also be sure that the pin (375) does not touch the bottom of the notch in the insert (315).

Put the mechanical seal gland (300) and insert (315) on the shaft (29) and slide it back towards the bearing housing (26). Be careful not to damage the insert or its mounting. Put the gland gasket (324) over the shaft and into the gland. Slide the seal rotary unit assembly carefully onto the shaft sleeve being particularly careful not to damage the seal shaft packing (345). Be sure that the shaft sleeve hook is firmly against the shoulder on the shaft. Set the rotary unit carefully to the setting mark you have made on the shaft sleeve and lock it tightly in place with the set screws. Recheck the setting. Slide the pump casing back cover (22) carefully into place, secure it with the two capscrews and then guide the seal gland insert and gaskets together with the gland carefully into position. Reassemble the pump.

Now tighten the gland stud nuts carefully and evenly to avoid cocking the gland, making sure that the gland insert and gaskets are in place. Tighten the gland stud nuts (15) evenly to; 20 Ft.Lb. for 1/2" studs, 40 Ft.Lb. for 5/8" studs, 65 Ft.Lb. for 3/4" studs, or 75 Ft.Lb. for 7/8" studs.

Before starting the pump, bleed the air from the seal chamber. The seal chamber must be full of liquid or the seal faces may be damaged by lack of lubrication when the pump is started.

Occasionally a seal may leak very slightly when the pump is first started. If the leakage continues more than a few minutes the pump should be shut down and the seal removed to discover the cause.

INSTALLATION OF SINGLE OUTSIDE UNBALANCED SEALS

If the seal rotary unit is scribed with a setting mark, the shaft marking procedure outlined below may be omitted.

The setting mark can be found on the outer shell of the rotary unit running circumferentially between the four round holes in the shell. Visible through each hole is the edge of the metal disc against which the seal springs bear. To set the seal with the proper spring pressure, first assemble the pump as noted below with the seal rotary unit slid back towards the bearing housing (26) and left loose until the entire bearing housing-impeller assembly is bolted in place in the pump casing. Then slide the seal rotary unit into place against the stationary insert and compress the springs until the metal disc visible through the holes is aligned with the setting mark scribed on the shell. Tighten the set screws and check through each hole to determine that the seal rotary unit is correctly compressed and not cocked.

If the seal rotary unit is not marked with a setting line, a setting mark must be made on the shaft sleeve. To make the seal installation, with the pump partially assembled as noted above, scribe a mark on the shaft sleeve (10) exactly in line with the face of the pump seal chamber. The impeller (3), and casing back cover (22) are now removed from the pump. If the mark causes roughness on the shaft sleeve remove the burr carefully with crocus cloth. Any roughness on the shaft sleeve may damage the mechanical seal shaft packing when the seal is assembled.

Referring to the mechanical seal drawing, determine the proper "D" dimension for the seal and pump type. Measure carefully from the mark which you have made on the shaft sleeve and make a new mark on the shaft sleeve, towards the bearing housing, exactly to this dimension. Remove the burr if necessary. This mark is the seal setting mark.

Put the mechanical, seal rotary unit on the shaft and slide it back towards the bearing housing (26). Assemble the seat gasket (326), the mechanical seal insert (315), and gland gasket (325) to the face of the seal chamber and, placing the gland (300) in position, pull down the gland stud nuts (15) evenly to; 20 Ft.Lb. for 1/2" studs, 40 Ft.Lb. for 5/8" studs, 65 Ft.Lb. for 3/4" studs, or 75 Ft.Lb. for 7/8" studs. Make sure that the lapped face of the seal insert is towards the rotary unit. Reassemble the pump. Now carefully slide the rotary unit and set it to the mark on the shaft sleeve and lock the rotary unit tightly in place with the set screws. Be careful not to cock the rotary unit.

Before starting the pump, bleed the air from the seal chamber. The seal chamber must be full of liquid or the seal faces may be damaged by lack of lubrication when the pump is started.

Occasionally a seal may leak very slightly when the pump is first started. If the leakage continues more than a few minutes the pump should be shut down and the seal removed to discover the cause.

INSTALLATION OF DOUBLE INSIDE UNBALANCED SEALS

To make the seal installation, with the pump partially assembled as noted above, scribe a mark on the shaft sleeve (10) exactly in line with the face of the pump seal chamber. The impeller (3) and casing back cover (22) are now removed from the pump. If this marking or subsequent marking causes roughness on the shaft sleeve remove the burr carefully with crocus cloth. Any roughness on the shaft sleeve may damage the mechanical seal shaft packing when the seal is assembled.

Referring to the mechanical seal drawing, determine the two "D" dimensions for the two rotary units. Be sure to determine those for the particular pump type. Measure carefully from the mark which you have made on the shaft sleeve and make two new marks on the shaft sleeve, towards the seal chamber, exactly to these dimensions.

Double seal stationary inserts are of two types depending on the service conditions of the pump. The inserts may be of rectangular cross section grooved for a "O" ring or the inserts may be of L-shaped cross-section used with a Teflon or Grafoil seat ring. This construction frequently utilizes seat locking pins (375) pressed into the throat bushing (54) and the gland (300) to keep the inserts from rotating. Check the condition of the pins (375) in the throat bushing (54) and the gland (300). If they need replacing, pull the old pins out and press new pins (375) in. Press the pins (375) into the throat bushing (54) and the gland (300) to the point where there is 1/32" of clearance between it and the bottom of the mating notch in the insert (315). Check this by installing the inserts (315) into the casing back cover (22) and the gland (300) without the seat rings (328). After checking the clearance, remove the inserts (315) from the casing back cover (22) and the gland (300).

To position the "O" ring mounted inserts, place the "O" rings (328) into the grooves of the inserts (315). Lubricate the "O" rings (328), the inside of the casing back cover (22), and the inside of the mechanical seal gland (300). Slide the inserts (315) into the casing back cover (22) and the seal gland (300) being careful to not damage the "O" rings (328). When installing the insert (315) into the casing back cover (22), be sure to slide it smoothly and continuously past the drilled holes in the bore of the seal chamber. Do not pause as the insert crosses these drilled holes. Make sure that the lapped faces of the inserts (315) face towards the seal rotary units and that the pins (375) enter the notches in the inserts (315). Also be sure that the pins (375) do not touch the bottom of the notches in the inserts (315).

To install the Teflon of Grafoil mounted inserts, place the seat rings (328) carefully on to the inserts (315). The seat rings (328) are chamfered on the outside diameter on one end, it is necessary to have this chamfer facing away from the insert (315). Lubricate the outside diameter of the seat rings (328), the inside of the casing back cover (22), and the inside of the mechanical seal gland (300), if the seat rings (328) are Grafoil, use a round dowel (or similar object) and carefully smooth the chamfered edge. Carefully slide the insert (315), seat ring (328) assemblies into position into the casing back cover (22) and the seal gland (300) being careful to not damage the seat rings (328). When installing the insert/seat assembly into the casing back cover (22), be sure to slide it smoothly and continuously past the drilled holes in the bore of the seal chamber. Do not pause as the insert crosses these drilled holes. Make sure that the lapped faces of the inserts (315) face toward the seal rotary units and that the pins (375) enter the notches in the inserts (315). Also be sure that the pins (375) do not touch the bottom of the notches in the inserts (315).

Put the mechanical seal gland (300), with insert installed, on the pump shaft sleeve (10) and slide it back towards the bearing housing (26). Put the seal gland gasket (324) over the sleeve (10) and into the gland (300). Slide one seal rotary unit on the sleeve (10) with the carbon face towards the bearing housing. Be careful not to damage the seal shaft packaging (345). Be sure that the shaft sleeve (10) hook is firmly against the shoulder on the shaft. Set the rotary unit carefully to its setting mark on the shaft sleeve (10) and lock it tightly in place with the set screws. Slide the second rotary unit onto the shaft sleeve (10) with the carbon face away from the bearing housing. Set it carefully to its setting mark and lock it tightly in place. Recheck both rotary settings and correct if necessary. Slide the pump casing back cover (22) very carefully in place over the seals and secure it with the two capscrews. Slide the gland gasket (324) and seal gland (300) into place and carefully tighten the gland stud nuts (15) evenly to; 20 Ft.Lb. for 1/2" studs, 40 Ft.Lb. for 5/8" studs, 65 Ft.Lb. for 3/4" studs, or 75 Ft.Lb. for 7/8" studs. Do not cock the gland. The pump may now be reassembled.

Double seals require a liquid in the seal chamber between the seal inserts to provide lubrication. This barrier liquid must be supplied at a pressure of 10 to 15 psi above seal chamber throat pressure to activate the inboard seal. Before starting the pump be sure that the seal chamber is full of this lubrication and that all supply lines for this liquid are in place and in operation.

Leakage from the outboard seal can be easily spotted. Leakage through the inboard seal can be detected only by the loss of the barrier (lubricating) liquid from between the seals. If leakage occurs, the pump must be disassembled and the cause of leakage determined.

CUSTOMER'S PLANT MAINTENANCE RECORD

Dean Pump Serial Number _____ Service _____

Plant Property Number _____ Location _____

Capacity _____ ; T.D.H. _____ ; Imp. Dia. _____ ; Temp. _____ ; RPM _____

Materials of Construction: Casing _____ ; Impeller _____ ; Shaft _____ ; Shaft Sleeve _____

Spare Parts in Plant Stock Room _____

_____

Interchangeable with Dean Serial Numbers _____

_____

_____

Dean Pump Division

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E-Mail: deanpump@met-pro.com Web Site: www.met-pro.com/dean.html

READ WARNINGS

HAZARDOUS SITUATIONS MAY OCCUR UNLESS THIS EQUIPMENT IS APPLIED, INSTALLED, OPERATED, AND MAINTAINED BY THOROUGHLY QUALIFIED PERSONNEL IN STRICT ACCORDANCE WITH THE INSTRUCTION MANUAL AND ALL APPLICABLE DRAWINGS AND CODES.

Read the instruction manual completely, before installing, filling, operating, or maintaining this equipment.

Obtain, read, and heed the MSDS (Material Safety Data Sheet) for the fluids being handled before attempting to fill, operate or maintain this equipment.

Obtain instructions from the Safety Engineer responsible for your facility before performing any work on the pumping equipment and systems.

APPLICATION AND REAPPLICATION - At the time of installation, the equipment received should have already been selected for the service required. You must read the paperwork for the installation and check serial number of the pump to assure that you are installing the correct pump into the service for which it was selected.

Many pumps look identical from the outside but can be made of different materials and/or be constructed differently inside. Personal injury, death, equipment damage, product (pumpage) damage, and/or product loss could occur if the incorrect pump is installed.

Do not transfer an existing pump to any other service conditions until you have thoroughly reviewed the pump construction, materials, sizing, sealing, pressure containing capability, head/capacity capability, and temperature capability with respect to the required service. Consult your DEAN PUMP sales engineer with all the service requirements and a full description of the existing pump (including the serial number), seal, and sub-systems so that we can assist you in a successful reapplication.

INSTALLATION - Always wear the appropriate protective apparel when working on or around the pumping equipment. Safety glasses with side shields, heavy work gloves (use insulated work gloves when handling hot items), steel toed shoes, hard hat, and any other protective gear as needed for protection. One example of other gear would be breathing apparatus when working near toxic materials.

Use lifting devices, manufactured expressly for the purpose of lifting, to move the pumping machinery. Do not attempt to lift the assembly or its components manually. Use only devices with lifting capabilities in excess of the weight of the unit being lifted. Inspect straps,chains, hooks, etc. for damage and lifting capability before use. Lift only at the center of gravity.

Personal injury, death, and/or equipment damage could occur if good lifting practices are not used.

Install the equipment on a properly designed and built foundation. Assure that the driver (motor, turbine,or engine) shaft is properly aligned to the pump shaft.

Connect the suction and discharge piping without forcing the piping into position. The pipe flanges must line up with the pump flanges "freely". Strain caused by "forcing" and/or misalignment may cause failure of the pumping unit, flanges, and/or the piping resulting in fluid (pumpage) release. This could cause personal injury, death and/or damage to this and/or other equipment.

Install a "new" bolt, of the correct size per ASME/ANSI B16.5 and the correct material per ASME/ANSI B16.5, in every bolt hole. Tighten all bolts evenly. Use only new uncorroded fasteners.

Improper flange bolting may cause failure of the pumping unit, flanges, piping, and/or fluid (pumpage) release which could cause personal injury, death, and/or damage to this and/or other equipment.

Connect all other (auxiliary) piping necessary for safe and successful operation of the equipment in the specific service conditions of the application. Make sure that all piping is installed into it's correct connection. Installation of a pipe into an incorrect location could result in an explosion and personal injury or death as well as damage to this and/or other equipment.

Install pressure relief valves in any cavities that could be subjected to pressures in excess of the allowable working pressure of that cavity. Explosion, personal injury, death, and/or damage to this and/or other equipment may occur if pressure exceeds allowable.

One example of the above would be the cooling jacket around the seal chamber. If this chamber were full of water and someone would close both the inlet and outlet valves and then operate the pump at 500°F, the vapor pressure of water, 665 PSIG, would far exceed the ability of the jacket and possibly other parts. In this example, a relief valve must be installed between the pump and the outlet valve.

Recheck the alignment between the driver (motor, turbine, or engine) and pump shafts. Installation of piping may have forced the pump out of alignment. If so, correct the piping to remove the distorting load.

Check to be certain that the shaft coupling spacer is not installed, and then gently bump the motor starter to check the rotational direction of the motor. If this is not in the direction of rotation required for the pump, make the necessary corrections.

Lock-out the power to the driver (motor, turbine, engine, etc.)

Install the shaft coupling spacer. Be sure that you install all the retaining devices and bolts and that they are tight. Read and comply with the coupling manufacturer's instructions. Personal injury, death, and/or equipment damage could occur if the coupling spacer is not properly installed. Remove all debris and tools from the area near the shafts and the shaft coupling. Do this to assure that nothing is caught and thrown by the rotating parts when the pump is started. Bolt the coupling guard securely into place, checking to assure that it is not contacting any parts that will rotate when the pump is started.

FILLING - Before filling the pump with liquid, check to see that all possible leak locations are sealed. See that the point where the pump shaft enters the pressure containing cavity is sealed. Normally this sealing is accomplished with shaft packing or a mechanical face seal. See that all of the connections into the pressure containing cavity are sealed or connected to a related piping system that also has all possible leak paths sealed. Do not plug unused jacket cavities, as this could develop dangerous pressure build-up. Use a wrench on all bolted joints to apply torque to assure that all gaskets are sealed in a tight joint. Check to see that all threaded pipe connections are also tight enough to seal the liquid pressure that will be applied when the system is started.

OPERATING - Before starting the unit, see that all personnel are a safe distance away from all possible hazards, that all sub-systems are connected and operating, that all debris has been removed, that the shaft coupling guard is securely in place, and that the pump is full of liquid.

Do not operate this pump at shut-off (no flow) as an explosion may result. This can occur with any liquid, even "cold water". Personal injury, death, equipment damage, and/or loss of product (pumpage) is likely to occur. If your system is operated where it is possible for all outlets for the discharge from the pump to be closed while the pump is still operating, a modification of the system needs to be made to assure a continual flow of pumpage through the pump. Note that some people have a belief that a bypass line from the discharge side of the pump to the suction side of the pump will relieve this problem, this is "NOT TRUE"; DO NOT ATTEMPT THIS.

MAINTENANCE, DISASSEMBLY AND REPAIR - Work must be performed only by thoroughly trained and qualified personnel to assure quality repair and to reduce the possibilities of injury to personnel and/or damage to equipment. If you do not have personnel who are capable of safe quality repair of this equipment, we advise you ti return the equipment to DEAN PUMP to be repaired.

When it is necessary to open the pump and/or the pumping system, the fluid will be exposed to the atmosphere and personnel in the area. For the safety of all involved, the risk of exposure of personnel to the hazards of the pumpage can be reduced by flushing the entire system with a compatible non-toxic, non-hazardous,stable liquid before opening the pump or the system. In all cases, where the system is flushed or not, use the utmost care around the pumpage and the pumping system.

Always wear the appropriate protective apparel when working on or around the pumping equipment. Safety glasses with side shields, heavy work gloves (use insulated work gloves when handling hot items), steel-toed shoes, hard hat, and any other protective gear as needed for protection. One example of other gear would be breathing apparatus when working near toxic materials.

Use only top quality tools.

Stop the pump. Turn off the power supply (electricity, steam, etc.) to the pump driver (motor, turbine, engine, etc.) and lock the switching device so that it cannot be restarted. Tag the switching device so that no one will attempt to restart the unit.

Close the suction and discharge valves completely to isolate the pump from the system. Lock the valves in the closed position and tag them so that no one will attempt to open them.

Turn off, lock out, and tag all sub-systems and auxiliary equipment and auxiliary supply lines to isolate the pumping unit from any and all power, energy, and/or fluids.

Do not attempt to perform any work on the unit until you are confident that the pump and its contents have been stabilized at ambient temperature, and atmospheric pressure.

Put on protective wear to protect human tissue from attack by the fluids contained in the pump and any sub-systems, and from any vapors or fumes that could possibly be released from these fluids. This could mean breathing apparatus, face shields, heavy long sleeve rubber gloves, rubber apron, hood, and possibly more, dependent of course on the properties of the fluids involved and the installed drain and vent piping arrangement. Personal injury and/or death can occur if adequate precautions are not taken with regard to the fluid, the installation, and the possibilities of the release of fluid, vapors, and/or fumes.

Remove the coupling guard. Remove the coupling spacer.

Drain all the fluids from the auxiliary sub-systems (lubrication, cooling, heating, seal barrier, etc.) that are connected to the pump. Drain each fluid into a separate container. Use caution required for each fluid after reading the MSDS (Material Safety Data Sheet) for each.

Flush each sub-system with a compatible, non-toxic, non-hazardous, stable liquid. Drain into individual containers for each fluid. Disconnect and remove all auxiliary piping.

Carefully bleed off any pressure remaining in the pump. Pressure remaining in the pump will be dependent upon the pressure in the system when the pump was stopped; the quality, type, and condition of the isolation valves; the thermal expansion valves of the fluid and the pump material; and the change in the vapor pressure of the fluid between the temperature at the time the isolation valves were closed and the ambient temperature. Bleeding must be through a valved drain line piped to a closed container mounted lower than the pump. The container must be arranged with a relief passage to some point where pressure and fumes will not be harmful to personnel. The container must also have a level device so that determination can be made that sufficient fluid has been drained to empty the pump cavity and the volume of fluid that was contained in the run of suction and discharge pipe between the isolation valves and the pump. After the initial rush of fluid from the pump relieves the pressure, the drain valve can be opened further to speed the draining operation. When fluid quits running into the drain tank, gauge the volume to see if it is sufficient to have fully drained the contents of the pump and the suction and discharge pipes between the isolation valves.

If the system was constructed without any drain connections, it will be necessary to consult the designers of the system for safe draining procedures.

Now drain any small piping, that contains the fluid pumped, from all low points, into the same container used to drain the pump. Do not drain any other fluids (different than the pumpage) into this container as they may not be compatible. Personal injury, death, and/or equipment damage could occur.

Even though it might appear that, the cavity being drained has completely drained, be extremely careful about opening the system and/or opening the pump. If something solid in the pumpage moves to the vicinity of the drain connection, it could seal-off the drain and maintain pressure in the cavity thought to have been drained. It is also possible that the isolation valves are not sealing and therefore allowing liquid to flow from the system into the pump. Personal injury, death, and/or equipment damage may occur if intense caution is not exercised.

Because of the above possibility, when you loosen the gasketed joint at the back of the casing (5), loosen the bolts or nuts only one full turn, and then use jack screws to break the gasket seal. If fluid and/or pressure remains in the pump, it will spray out now. Use extreme caution, wearing protective gear, to avoid injury. Do not proceed with disassembly until leakage ceases completely. If leakage does not cease, the isolation valves may not be sealing. Note that if the pump was purchased with out a drain, the pump will contain fluid which will flow out at the time the bolts are loosened and the gasket seal is broken.

When you open the pump, the fluid will be exposed to the atmosphere and personnel in the area. For the safety of all involved, the risk of exposure can be reduced by flushing the cavity that was just drained, with a compatible non-toxic, non-hazardous, stable liquid, before disassembling the pump.

Remove the casing nuts and using mechanical lifting apparatus to support the weight, pull the rotating unit from the casing.

Flush the wetted parts now exposed with compatible, non-toxic, non-hazardous, stable liquid.

Remove the gasket from the face of the casing (5) or the casing back cover (22) dependent on which one the gasket may have adhered to. The type of gasket and material of construction will vary with service requirements. Attack by prying and then, if necessary, layering off the old gasket with a sharp scraper, attempting to remove it in the largest possible pieces. Wear heavy leather, long sleeve work gloves when using the scraper. Wet the gasket before and during the scraping operation to reduce the possibility of fibers becoming airborne. Wear a respirator during this operation and until all debris has been disposed of in a plastic bag. Remove all of the gasket material down to clean metal surfaces on both parts that contacted the gasket. Place all of the gasket residue in a plastic bag, seal the bag and dispose of it in compliance with all government requirements.

The above procedure for removing the casing (5)/casing back cover (22) gasket must be used for the removal of any other gaskets in the pump (such as a mechanical seal gland gasket) or any associated piping and/or equipment.

The rotating assembly of the pump can now be moved to a more convenient location for further disassembly. Use only high quality tools. Flush parts as disassembled to removed hazardous residue from the pumpage and/or sub-system fluids.

Wear protective equipment as advised at the beginning of these warnings.

Use mechanical lifting equipment to lift assemblies and components.

Do not apply heat to parts to assist in disassembly. Explosion could occur causing personal injury, death, and/or damage to equipment.

Do not attempt to drill, saw, or otherwise cut parts to remove them. Explosion and/or fuming could occur causing personal injury, death, and/or equipment damage.

Do not hammer on any parts. Personal injury and/or damage to equipment may occur.

Do not attempt to manufacture parts or modify Dean Pump parts in any manner. Death, personal injury, and/or damage to equipment may occur.

One example of the above would be overboring the seal chamber, which removes metal that is required to contain fluids. Removal of this metal reduces the pressure containing capability of the part, and may create a leak path through the part. If the part separates two different fluids, mixing of the fluids could cause an explosion. Water leakage into a heat transfer liquid is one example of a explosive possibility.

Replace all gaskets, seals, bearings, and lubricants. Replace all parts that have worn, corroded, eroded, or otherwise deteriorated.

Use only Dean Pump Division of Met-Pro Corporation parts.

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DURABLA

Fluid Technology Inc.®

Installation & Maintenance Manual

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DURABLA® *Fluid Technology*

Durabla Fluid Technology specializes in spring assisted ***In-Line*** Check Valves that prevent **Water Hammer** and reverse flow and insure long life if **properly sized** for the flow not the line size. DFT® customizes the internal components for optimal performance without changing the line size.

DFT In-Line check valves do not rely on gravity or reverse fluid flow to close. Instead as the forward velocity of the fluid slows, the spring assist starts to close the disc.

Due to the spring assist and short travel distance of the disc, by the time forward velocity has decreased to zero, the valve disc has reached the seat and the valve is closed.

With reverse flow eliminated, the forces necessary to produce water hammer on both the upstream and downstream sides of the valve are substantially eliminated.

Durabla's objective is to solve and prevent check valve problems and failures in critical service applications. All valves are manufactured at our facility in Exton, PA.

Durabla is considered the control valve of check valves, the "Check Valve Doctor".

Our check valve sizing program insures you will know in advance what to expect from the check valve as opposed to after start up.

DFT In-Line check valves are used in all industries. They include chemical, food & beverage, mining, oil & gas, power, pulp & paper, refining and steel.

DFT In-Line check valves should provide trouble free service. Occasionally problems do arise or inspection is required. This manual provides information for inspection and repairs of your DFT check valves should the need arise. No special tools are needed.

Check Valve Assistance

Contact Durabla at **800-206-4013** for assistance, questions or the Authorized DFT repair facility in your area .

Durabla is available to review your check valve sizing requirements and assist in selecting the proper check valve.

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INSTALLATION PROCEDURES

All DURABLA® In-Line check valves can be installed in the line in any orientation. The operation of the DFT® check valve is not affected by the position of the valve itself. **The only requirement is that the flow arrow on the body casting must be pointed in the direction of the flow.** If the Durabla check valve is to be installed in an orientation with flow downward, that should be specified when ordering. A stronger spring may be required to compensate for the weight of the disc and any static head.

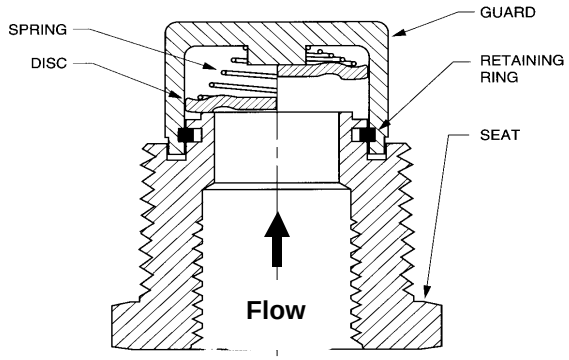
The operation of DFT In-Line check valves is not affected by its proximity to elbows, tees, control valves etc. However, installing Durabla In-Line check valves directly to the outlet of such devices can result in decreased life due to the turbulence caused by the fitting. Durabla recommends that all DFT In-Line check valves be installed a minimum of five pipe diameters downstream of any fitting that could cause turbulence.

Flange gaskets: ANSI non-metallic gaskets and spiral wound gaskets can be used with the DLC and Excalibur in all pressure classes. GLC, PDC and WLC units can use non-metallic gaskets for ANSI Class 150 and 300. Spiral wound gaskets can be used for all high pressure valves. An illustration of end flange gaskets is shown on the back cover.

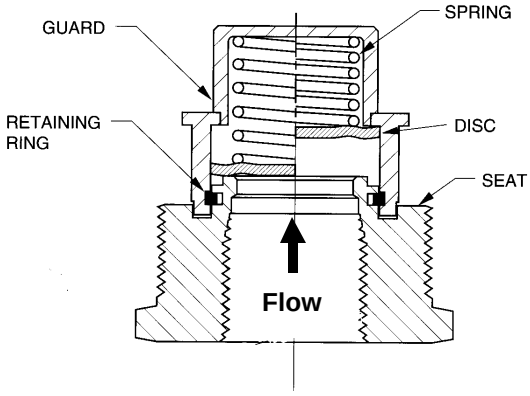
Check Valve Trouble Shooting Guide

Symptom	Cause	Solutions
Water hammer, loud noise, vibration, ruptured piping, equipment damage	Slow closing check valve	In-Line spring assisted check valve.
Stem wear (pointed stem), elongated seat guide, bushing wear	Low flow, pulsating flow, improper sizing	Custom sizing of the check valve internals. PDC for reciprocating air or gas mediums.
Excessive seat leakage (Greater than MSS-SP61)	Dirt, trash, foreign substance in the valve	Clean out the valve. Install strainers if it is a reoccurring problem. Install a soft seat if bubble tight shutoff is required.
Noise, clicking, tapping	Low flow, pulsating flow, improper sizing	Custom sizing of the check valve internals. PDC for reciprocating air or gas mediums.
Reverse flow	Slow closing check valve	In-Line spring assisted check valve.
Component breakage, valve failure	Reciprocating compressor	PDC for reciprocating air or gas mediums.
Missing internals	Valve not full open, pulsing flow, improper sizing	Custom sizing of the check valve internals. PDC for reciprocating air or gas mediums.

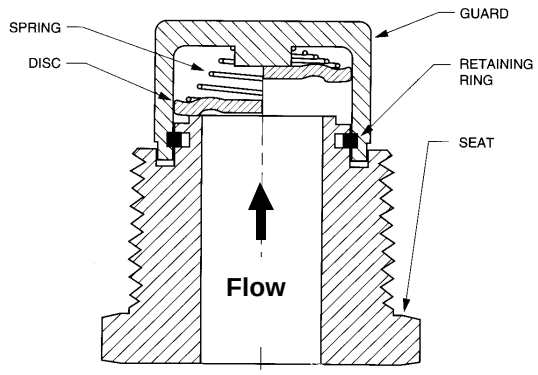
BASIC-CHECK® /RESTRICTOR CHECK/ VACUUM BREAKER MAINTENANCE PROCEDURES



Basic-Check



Restrictor Check



Vacuum Breaker

CAUTION: The Restrictor Check spring is under higher compression than the Basic-Check and Vacuum Breaker units. Use caution when the units are disassembled.

DIS-ASSEMBLY:

1) Draw together the ends of the retaining ring with pliers.

2) Lift the guard off the seat.

3) Seating surfaces may be cleaned using a soft cloth and appropriate solvent. Avoid scratching the seating surface.

RE-ASSEMBLY:

1) Place retaining ring in groove of seat.

2) Place spring, small end first, onto guard spring hub.

3) Position the disc over the spring and between the four guard legs. Be sure the valve disc is replaced with the “seat side” against the seat bushing.

4) While holding the disc and spring in the guard with one hand, compress the retaining ring with suitable pliers into the seat groove with the other, then position the disc/spring/guard over the seat with the notches in the guard legs aligned with the retaining ring and release the retaining ring, locking the guard onto the seat.

5) Lift the disc to work the valve a couple of times to check for free disc movement.

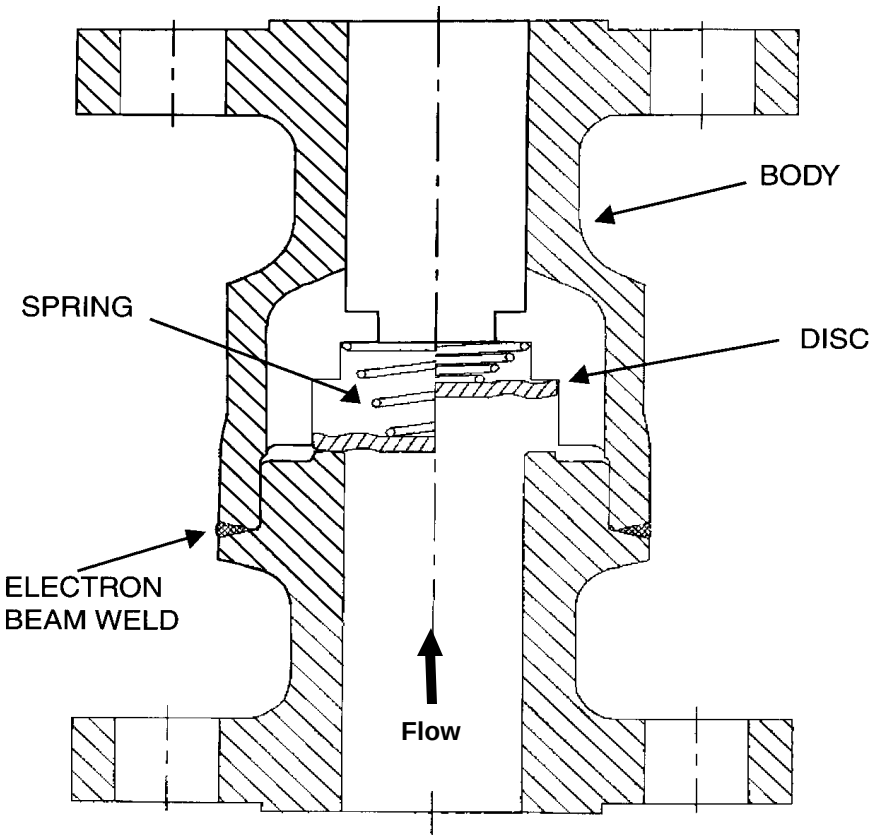
6) Re-install the valve.

Do not allow pipe thread sealants or tape to be forced into the valve operating area or to become lodged on the valve seating surface. Protect the valves from excessive heat from welding or brazing which may distort the seat bushing or damage the spring.

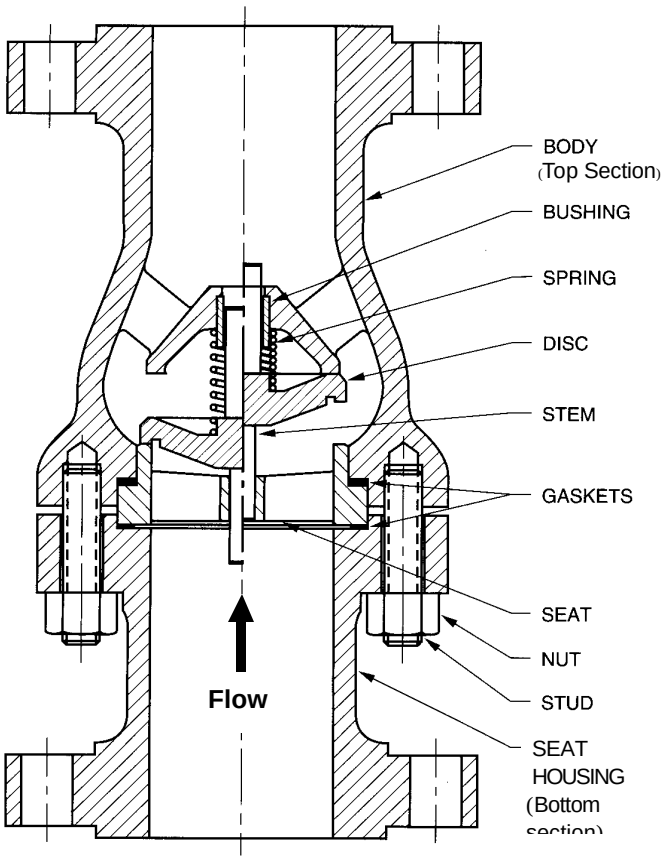
DLC® MAINTENANCE PROCEDURES

The DLC In-Line check valve has no user serviceable components inside. In operation, the valves are designed to be fully automatic. On start-up, the flow forces the disc open. Continuing flow holds the disc in an open position. Upon shut down, the spring returns the disc to the seat prior to flow reversal, preventing backflow.

WARNING: If the system fluid is hazardous, take appropriate precautions. Make sure to bleed off pressure from the line before removing the valve.



EXCALIBUR® MAINTENANCE PROCEDURES



DIS-ASSEMBLY:

1) Position the valve with the arrow on the side facing downward on the floor or bench.

2) Unscrew the nuts holding the two parts of the body together and lift the top section of the body from the bottom section.

3) Lift the seat ring from the bottom section of the body being careful not to damage the seating surface. Lift the disc/stem assembly from the body and remove the spring.

4) Inspection:

Inspect the seating surfaces, bushing and seat guide for wear. The seat and disc may be lapped with a suitable fine grade lapping compound. Remove any scale build up on the stem and guides. Replace the trim if total stem-to-bushing or seat guide clearance exceeds 1/16".

SOFT SEATING: For valves with an o-ring soft seat, inspect the o-ring and replace if cracked or excessively deformed.

5) Refacing:

A) METAL TO METAL SEATING A total of .03" metal per surface has been provided on the seat and disc to permit refacing when necessary. It is important that the facing remain perpendicular to the axis of the parts. The finish should be 32 Ra or better.

B) SOFT SEATING: The disc may be refaced as outlined above. The seat CAN NOT be refaced; if the o-ring groove is damaged, replace the trim. It is acceptable for the contact surface of the seat to have small scratches and/or pits, provided the groove is un-damaged.

6) Remove the old gasket material and clean gasket surfaces on both sides of the seat ring and on both body sections.

7) Soft Seat Replacement:

7) A) To replace the ring, pry it out of the groove using a thin piece of metal (a .005" thick feeler gage works well) taking care not to scratch the bottom of the o-ring groove.

B) Clean out the groove.

C) Lubricate a new o-ring with water soluble lubricant such as dishwashing detergent or suitable lubricant compatible with the process fluid.

D) To install the new o-ring, push one section of the o-ring into the groove with your thumb or a soft roller, then push the section 180° opposite from the first into the groove. Continue by pushing in the o-ring at points 90° to the original sections. Finally, push the rest of the ring into the groove.

E) Rub the o-ring in a circular motion in the groove with your thumb to even-out any bumps.

RE-ASSEMBLY:

1) Insert the spring into the spring retainer in the bottom body section.

2) Insert the disc/stem assembly into the disc guide of the bottom body section insuring that the seating surface faces upward.

3) Place a new gasket on the bottom body section.

4) Place the seat ring (seating surface downward) on the gasket.

5) Place a new gasket on top of the seat ring.

6) Place the top body section onto the bottom body section.

7) Hand tighten body bolts. With wrench, tighten bolts (as shown in Figure 1) gradually in three or four steps to the torque shown in Table 1.

8) Lift the disc to work the valve a couple of times to check for free disc movement.

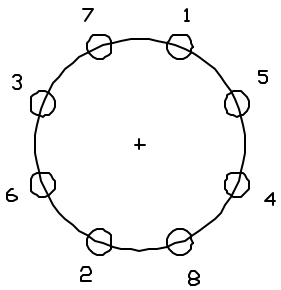
9) Re-install the valve in the line with the flow arrow on the body pointing in the direction of flow. (To insure correct operation of the gaskets, the body bolts should be re-torqued after start-up.)

TABLE 1: TORQUE VALUE RANGES

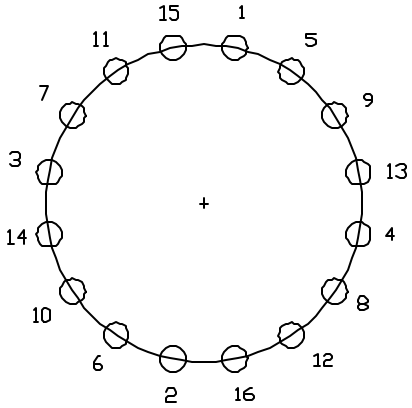
Bolt Size	Initial Torque (Ft. lbs.)	Bolt Size	Initial Torque (Ft. lbs.)
3/8”	15	1”	260
7/16”	20	1-1/8”	390
1/2”	35	1-1/4”	500
9/16”	50	1-3/8”	770
5/8”	60	1-1/2”	950
3/4”	110	1-5/6”	1300
7/8”	170		

NOTE: Torque values are based on new fasteners.

FIGURE 1: BOLT TORQUING SEQUENCE

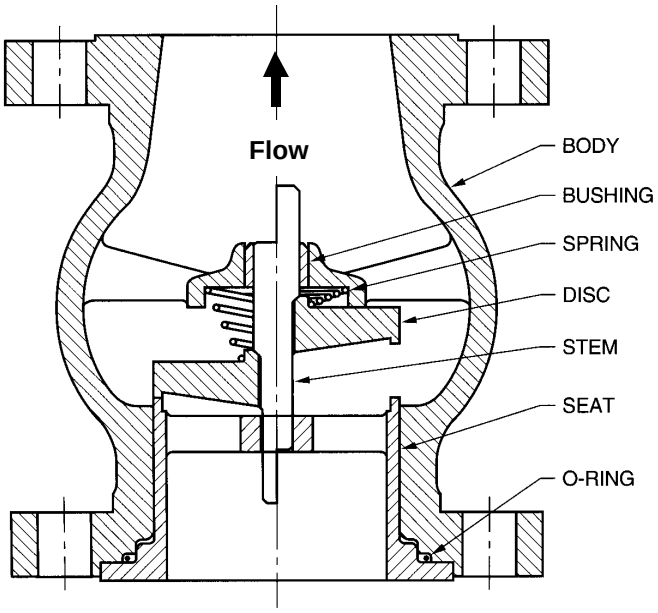


Small Valves



Large Valves

GLC® MAINTENANCE PROCEDURES



Caution: The upstream (seat) end of the valve should never be disconnected from the line if there is any chance that line pressure has not been completely relieved from the downstream end of the valve.

DIS-ASSEMBLY:

1) Remove the seat from the GLC.
There are three (3) different seat designs for the GLC:

A) DROP-IN SEAT:
- **1)** Remove the retaining screws.
- **2)** Pull the seat from the body.
- **3)** Remove the disc and spring.
- **4)** Press out guide bushing (interference fit).

B) THREADED SEAT:
- **1)** Unscrew the seat.
- **2)** Removed the disc/stem and spring.
- **3)** Press out the guide bushing (interference fit).

C) PUNCH-PRICKED SEAT:
- **1)** From the outlet end, drive the stem with a soft metal or plastic bar/rod. This will push the disc/stem and seat out the inlet end.
- **2)** Remove the spring, bushing, (and body seal o-ring on some units).

2) Inspection:

Inspect the seating surfaces, bushing and seat guide for wear. The seat and disc may be lapped with a suitable fine grade lapping compound. Remove any scale build up on the stem and guides. Replace the trim if total stem-to-bushing or seat guide clearance exceeds 1/16".

SOFT SEATING: For valves with an o-ring soft seat, inspect the o-ring and replace if cracked or excessively deformed.

3) Refacing:

A) METAL TO METAL SEATING:

A total of .03" metal per surface has been provided on the seat and disc to permit refacing when necessary. It is important that the facing remain perpendicular to the axis of the parts. The finish should be 32 Ra or better.

B) SOFT SEATING:

The disc may be refaced as outlined above. The seat CAN NOT be refaced; if the o-ring groove is damaged, replace the trim. It is acceptable for the contact surface of the seat to have small scratches and/or pits, provided the groove is un-damaged.

4) Soft Seat Replacement:

A) To replace the ring, pry it out of the groove using a thin piece of metal (a .005" thick feeler gage works well) taking care not to scratch the bottom of the o-ring groove.

B) Clean out the groove.

C) Lubricate a new o-ring with water soluble lubricant such as dishwashing detergent or suitable lubricant compatible with the process fluid.

D) To install the new o-ring, push one section of the o-ring into the groove with your thumb or a soft roller, then push the section 180° opposite from the first into the groove. Continue by pushing in the o-ring at points 90° to the original sections. Finally, push the rest of the ring into the groove.

E) Rub the o-ring in a circular motion in the groove with your thumb to even-out any bumps.

RE-ASSEMBLY:

1) Seat Installation

Install the seat into the valve body.

NOTE: There are three (3) different seat designs:

A) DROP-IN SEAT :

1) Press bushing into body.

2) Place spring, (large end first for conical springs) into the body.

3) Insert the disc/stem assembly.

4) Install the body o-ring (if required).

5) Lower the seat into the body and install the retaining screws.

B) THREADED SEAT :

1) Press bushing into the body.

2) Place spring, (large end first for conical springs) into the body.

3) Insert the disc/stem assembly.

4) Coating the seat threads with anti-seize compound is recommended. Then screw in seat until locked.

C) PUNCH-PRICKED SEAT :

1) Press bushing into body.

2) Place spring, (large end first for conical springs) into the body.

3) Insert the disc/stem assembly.

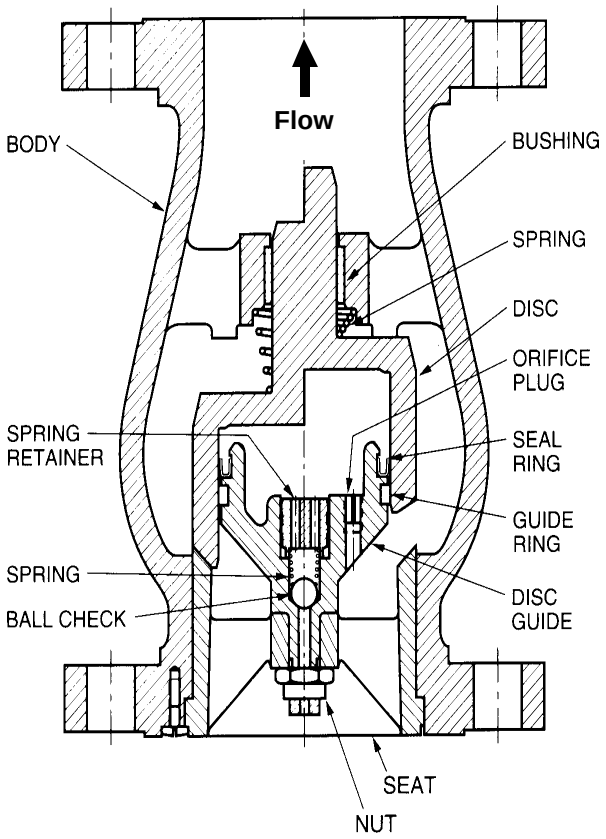
4) Install the body o-ring (If required).

5) Press in seat until bottomed. (If seat is not tight, remove and re-stake the O.D. of the seat with a sharp point punch at 3 or 4 places to create interference points, then press seat back into body.)

2) Lift the disc to work the valve a couple of times to check for free disc movement.

3) Re-install the valve in the line with the flow arrow on the body pointing in the direction of flow.

PDC^{Ò} MAINTENANCE PROCEDURES



US Patent #4,766,929 #4,693,270

DIS-ASSEMBLY:

1) Remove the seat from the PDC. There are two (2) different seat designs for the PDC:

A) DROP-IN SEAT:

1) Remove the retaining screws.
2) Push out the disc, disc guide and seat as an assembly.
3) Remove the o-ring (on some models).

B) PUNCH-PRICKED SEAT:

1) From the outlet end, drive the stem with a soft metal or plastic bar/rod. This will push the disc, disc guide and seat as an assembly out the inlet end.
2) Remove the o-ring (on some models).

2) Slide the Disc off the Disc Guide.

3) Remove guide ring and seal ring. Take care not to scratch the groove surfaces. It may be necessary to destroy the seal ring to remove.

4) Remove the **spring retainer**:

A) 2" through 8:
The retainer is threaded-in, then the threads are staked to lock them in.
1) Grind away the damaged threads where they are staked.
2) Stick two (2) 1/8" rods (or drill bits) in the two (2) holes.
3) With a large screwdriver wedged between the rods, unscrew the retainer.

B) 10" and larger
The retainer is dropped-in, then the edge of the bore is staked to lock it in.
1) Grind away the upset metal.
2) Push the check disc and retainer out.

5) Clean the Disc, Disc Guide and check ball (or the check disc on 10" and larger valves) with a suitable solvent.

6) Inspection:

A) Inspect the bore of the disc; replace if scored.
B) Inspect the Orifice in the Disc Guide; clean out if dirty or clogged.
C) Inspect the Bushing in the Body for excessive wear; if I.D. of Bushing is visibly out-of-round due to wear on one side or if stem-to-bushing or seat guide clearance exceeds 1/16" remove it by pressing it out.
D) Remove any scale build-up on stem and disc bore.

SOFT SEATING: For valves with an o-ring soft seat, inspect the o-ring and replace if cracked or excessively deformed.

7) Refacing:

A) METAL TO METAL SEATING:

A total of .03" metal per surface has been provided on the seat and disc to permit refacing when necessary. It is important that the facing remain concentric to the axis of the parts. The finish should be 32 Ra or better.

B) SOFT SEATING:

The disc may be refaced as outlined above. The seat CAN NOT be refaced; if the o-ring groove is damaged, replace the trim. It is acceptable for the contact surface of the seat to have small scratches and/or pits, provided the groove is un-damaged.

8) Soft Seat Replacement:

A) To replace the ring, pry it out of the groove using a thin piece of metal (a .005" thick feeler gage works well) taking care not to scratch the bottom of the o-ring groove.

B) Clean out the groove.

C) Lubricate a new o-ring with water soluble lubricant such as dishwashing detergent or suitable lubricant compatible with the process fluid.

D) To install the new o-ring, push one section of the o-ring into the groove with your thumb or a soft roller, then push the section 180º opposite from the first into the groove. Continue by pushing in the o-ring at points 90º to the original sections. Finally, push the rest of the ring into the groove.

E) Rub the o-ring in a circular motion in the groove with your thumb to even-out any bumps.

RE-ASSEMBLY:

1) Reinstall the check ball (or the check disc on 10" and larger valves), spring. and the spring retainer into the disc guide.

2) Stake the outside of the spring retainer at four (4) places to lock it in place.

3) Install new guide ring. Coat new seal ring with general purpose lithium grease and install on Disc Guide with the open side of the "U" facing up toward the compression chamber. The seal ring will fit tightly over the Disc Guide, so be careful not to distort it or damage its sealing edges.

4) Seat Installation

A) DROP-IN SEAT:

1) Press bushing into body.
2) Place spring, (large end first for conical springs) into the body.
3) Install the body o-ring (if required).
4) Apply a coating of grease to the seal ring and guide ring.
5) Lower the disc/disc guide/seat assembly into the body and install the retaining screws.

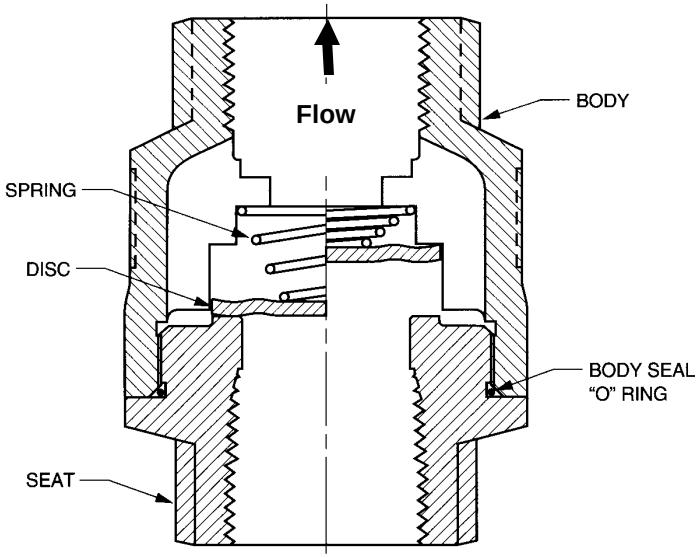
B) PUNCH-PRICKED SEAT:

1) Press bushing into body.
2) Place spring, (large end first for conical springs) into the body.
3) Install the body o-ring (If required).
4) Apply a coating of grease to the seal ring and guide ring.
5) Re-stake the O.D. of the seat with a sharp point punch at 3 or 4 places to create interference points, then press the disc/disc guide/seat assembly into the body.

5) Lift the disc to work the valve a couple of times to check for free disc movement. The valve should close in the horizontal orientation.

6) Re-install the valve in the line with the flow arrow on the body pointing in the direction of flow.

SCV MAINTENANCE PROCEDURES



WARNING:If the system fluid is hazardous, take appropriate precautions. Make sure to bleed off pressure from the line before removing the valve. Hold the valve by the Hex end nearest to the mating pipe and loosen. Again, do not hold the valve by the opposite end, as this may loosen the valve body joint.

DIS-ASSEMBLY:

1) Place the outlet Hex end of the valve in a vice or other suitable fixture.

2) Unscrew the seat from the body and remove the disc and spring.

3) Inspection:

Seating surfaces may be cleaned using a soft cloth and an appropriate solvent. Avoid scratching the seating surface. Check for scratches on the seating surfaces. If they can be felt with your fingernail, recondition or replace the disc and/or seat. Check the disc and guide ribs for signs of wear. If the total disc/rib clearance exceeds 1/16", replace the valve. Inspect the body o-ring for signs of cracking or ruptures. Replace it if necessary.

SOFT SEATING: For valves with an o-ring soft seat, inspect the o-ring and replace if cracked or excessively deformed.

4) Soft Seat Replacement:

A) To replace the ring, pry it out of the groove using a thin piece of metal (a .005" thick feeler gage works well) taking care not to scratch the bottom of the o-ring groove.

B) Clean out the groove.

C) Lubricate a new o-ring with water soluble lubricant such as dishwashing detergent.

D) To install the new o-ring, push one section of the o-ring into the groove with thumb or a soft roller, then push the section 180^0 opposite from the first into the groove. Continue by pushing in the o-ring at points 90^0 to the original sections. Finally push the rest of the ring into the groove.

E) Rub the o-ring in a circular motion in the groove with your thumb to even-out any bumps.

RE-ASSEMBLY:

1) Place the spring into the body, large end first, then the disc, “seat side” up.

2) Clean all the threads of the seat and coat with an anti-seize compound.

3) Install the new body o-ring in the thread undercut of the seat.

4) While holding the disc down in the body, and compressing the spring, screw the seat into the body.

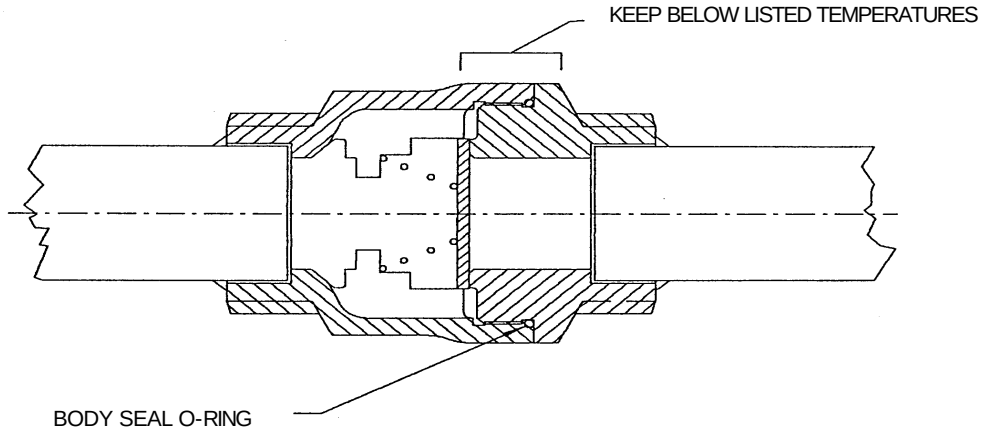
5) Tighten to 200 ft-lbs. for 1" and larger units, 100 ft-lbs. for 3/4" and 1/2" units and 50 ft-lbs. for 1/4".

6) Lift the disc to work the valve a couple of times to check for free disc movement.

7) Reinstall the valve in the line with the flow arrow on the body pointing in the direction of flow.

Caution: Do not allow any pipe thread sealants or tape to be forced into the valve operating area or become lodged on the valve sealing surfaces.

WELDING PRECAUTION FOR SOCKET WELD SCV CHECK VALVES

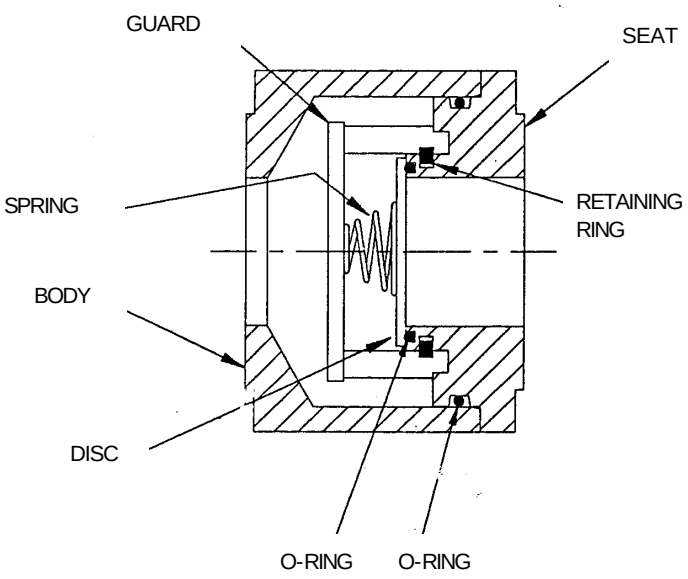


When welding the check valve into the line, avoid heating the marked body joint region above the temperatures listed below. Damage to the body seal (or optional soft seat) o-ring may result.

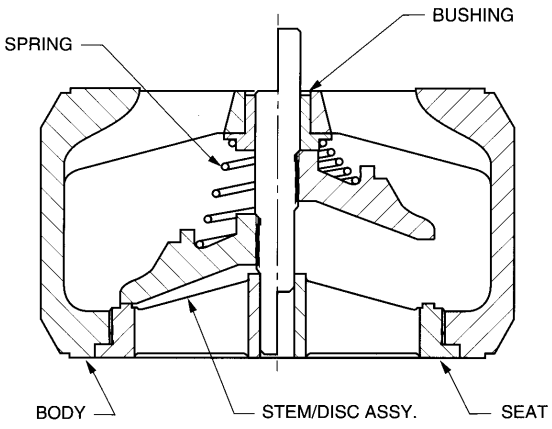
O-Ring Material	Max. Temperature
Buna-N (1)	275º F
Chemraz®	500º F
EPDM	300º F
Kalrez®	600º F
Teflon® Encapsulated Viton®	400º F
Viton®	400º F
Zelon (2)	470º F

Notes: 1. Standard O-ring for the 3600 CWP SCV.
2. Standard O-ring for the 750 CWP SCV.

WLC® MAINTENANCE PROCEDURES



1 and 1-1/2" WLC



2" and larger WLC

DIS-ASSEMBLY:

1) Remove the seat from the valve. There are three (3) different seat designs for the WLC:

A) 1-1/2" AND SMALLER:

1) Pull the seat from the body. The seat is only held in by the friction of the body o-ring seal. All internal parts will come out with the seat.

2) With a pair of pliers, squeeze the ends of the retaining ring together to release the guard and lift it off the seat.

3) Remove the disc and spring.

B) 2" AND LARGER WITH RAISED FACE:

1) Unscrew the seat (or remove the retaining set screws on cast iron units and lift out the seat).

2) The disc/stem, spring, and bushing can be easily removed by hand.

C) 2" AND LARGER WITH RTJ ENDS:

1) From the outlet end, drive the stem with a soft metal or plastic drift. This will push the disc/stem and seat out the inlet end.

2) Remove the spring, bushing and body seal o-ring.

2) Inspection:

Inspect the seating surfaces, bushing and seat guide (and guard on 1-1/2" and smaller) for wear. The seat and disc may be lapped with a suitable fine grade lapping compound. Remove any scale build up on the stem and guides. Replace the trim if total stem-to-bushing or seat guide clearance (or disc-to-guard leg on 1-1/2" and smaller units) exceeds 1/16".

SOFT SEATING: For valves with an o-ring soft seat, inspect the o-ring and replace if cracked or excessively deformed.

3) Refacing:

A) METAL TO METAL SEATING: A total of .03" metal per surface has been provided on the seat and disc to permit refacing when necessary. It is important that the facing remain perpendicular to the axis of the parts. The finish should be 32 Ra or better.

B) SOFT SEATING: The disc may be refaced as outlined above. The seat CAN NOT be refaced; if the o-ring groove is damaged, replace the trim. It is acceptable for the contact surface of the seat to have small scratches and/or pits, provided the groove is un-damaged.

4) Soft Seat Replacement:

A) To replace the ring, pry it out of the groove using a thin piece of metal (a .005" thick feeler gage works well) taking care not to scratch the bottom of the o-ring groove.

B) Clean out the groove. Lubricate a new o-ring with water soluble lubricant such as dishwashing detergent or suitable lubricant compatible with the process fluid.

C) To install the new o-ring, push one section of the o-ring into the groove with your thumb or a soft roller, then push the section 180^0 opposite from the first into the groove. Continue by pushing in the o-ring at points 90^0 to the original sections. Finally, push the rest of the ring into the groove.

D) Rub the o-ring in a circular motion in the groove with your thumb to even-out any bumps.

RE-ASSEMBLY:

1) Seat Installation

There are three (3) different seat designs for the WLC:

A) 1-1/2" AND SMALLER:

1) Place retaining ring in groove of seat.

2) Place spring, small end first, onto guard spring hub.

3) Position the disc over the spring and between the four guard legs.

4) While holding the disc and spring in the guard with one hand, compress the retaining ring with suitable pliers into the seat groove with the other, then position the disc/spring/guard over the seat with the notches in the guard legs aligned with the retaining ring and release the retaining ring, locking the guard onto the seat.

5) Lift the disc to work the valve a couple of times to check for free disc movement.

B) 2" AND LARGER WITH RAISED FACE:

1) Install the guide bushing.

2) Place the spring (small end for conical springs) on the guide bushing shoulder.

3) Insert the disc/stem assembly.

4) Coating the seat threads with anti-seize compound is recommended. Then screw in seat until locked. (Drop in the seat and re-install the retaining set screws for cast iron units.)

C) 2" AND LARGER WITH RTJ ENDS:

1) Install the guide bushing.

2) Place the small end of the spring on the guide bushing shoulder.

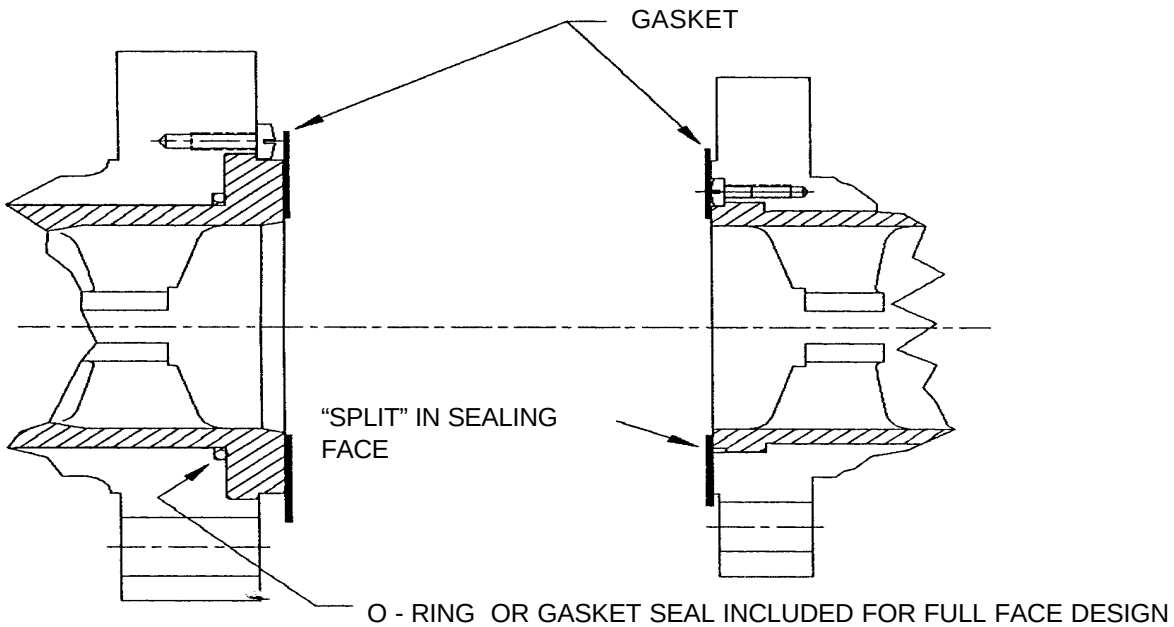
3) Insert the disc/stem assembly.

4) Install the body o-ring.

5) Press in seat until bottomed. (If seat is not tight, remove and re-stake the O.D. of the seat with a sharp point punch at 3 or 4 places to create interference points, then press seat back into body.)

2) Re-install the valve in the line with the flow arrow on the body pointing in the direction of flow.

END FLANGE GASKET ILLUSTRATION



FULL FACE SEAT
(3" ANSI 600 FLANGE SHOWN)

SPLIT FACE SEAT
(3" ANSI 150 FLANGE SHOWN)

Other Durabla Publications

Durabla Fluid Technology In-Line Check Valve Catalog/Product Selection Guide

Durabla Fluid Technology Application Guide

Durabla Fluid Technology Mining Trifold

Durabla Fluid Technology Oil & Gas Trifold

Durabla Fluid Technology Pulp & Paper Trifold

Durabla Fluid Technology SCV Trifold

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KUNKLE PRESSURE RELIEF VALVES

Installation and Operating Instructions

Pre-Installation Handling

This pressure relief valve is designed to protect equipment from overpressure. The valve should be handled with care, not subjected to heavy shock loads, and protected to prevent dirt from getting inside. It should be installed correctly. Failure to do so could result in property damage or serious injury to personnel.

Installation

1. Mount the valve in a vertical position so that the valve body is self draining. If a body drain port is provided, make sure it is open when required by the ASME code. Do not plug any bonnet vent openings. The inlet piping should be as short as possible, with no elbows, and equal to or greater than the size of the pressure relief valve inlet connection. This will help to limit the inlet pressure drop to 3% or less when the valve is relieving.

2. When discharge piping is connected to valve outlet, make sure it is self draining if a body drain port is not used. The valve should not be connected to any discharge pipe that contains pressure before the valve opens or to any pipe where the pressure build-up is greater than 10% of the set pressure when the valve is open and relieving.

   Discharge piping, other than a short tailpipe, must be supported. For steam service, a drip pan elbow or flexible connection between the valve and the pipe should be used to prevent excessive pipe stress, due to thermal expansion, from being imposed on the valve body.

3. For threaded valves, apply a small amount of pipe thread sealing compound to external threads only. Do not put any sealing compound on the first thread or on any internal threads. To do so may cause the sealing compound to enter the valve and cause seat leakage.

   Use the wrench flats provided to tighten the valve to the connecting pipe. Do not use the valve body or bonnet and do not over-tighten. To do so may cause valve leakage.

4. For flanged valves, use new gaskets and tighten the mounting studs evenly.

Operation

1. Maintain a system operating pressure at least 5 psig or 10% below the set pressure of the valve, whichever is greater. Operating too close to the valve set pressure will cause seat leakage and will shorten the time between valve maintenance.

2. Do not use the safety valve as a control valve to regulate system operating pressure. Excessive operation will cause the seat to leak and will require more frequent valve maintenance.

3. ASME Section I and VIII valves equipped with lift levers are designed to be operated only when the system pressure is 75% of set pressure or greater. ASME Section IV valves may be operated at any set pressure. When hand operating the valve, hold it open long enough to purge any foreign matter from the seat area. If a cable or wire is attached to the lift lever for remote actuation, make sure the direction of pull is the same as it would be if the lever were pulled directly by hand.

Maintenance

Maintenance should be performed on a regular basis. An initial inspection interval of 12 months is recommended. Depending on the service conditions and the condition of the e valve, the inspection interval may be decreased or increased. Use only Kunkle parts for repair. Depending o the local jurisdictional requirements where the valve is installed, repairs may have to be made by a repair facility holding a VR stamp

Kunkle
An Anderson, Greenwood Company
Phone: 828-669-55151281 Old US 70, Black Mountain, NC 28711 Fax: 828-669-0586

Models: 782*, 782-WE*

Cast Carbon & Alloy Steel Flanged & Butt Weld End Y Strainers
Sizes: ½"– 24" (15 – 600mm)

Pressure / Temperature – Non-Shock		
Model	**Material**	**Rating**
782, 782WE	Carbon Steel	740psi @ -20°F to 100°F 51.02 bar @ 37.78°C 300psi @ 850°F 20.86 bar @ 454.44°C
782, 782WE	Chrome-Moly	750psi @ -20°F to 100°F 51.71 bar @ 37.78°C 485psi @ 850°F 33.44 bar @ 454.44°C

782 **Class 300**
782-WE **Class 300**

Model 782

Model 782-WE

* The 782/782-WE supersede model 762/762-WE. Model 762/762-WE available upon request

Typical Service

- Used extensively to strain foreign matter from pipelines and provide economical protection for costly pumps, meters, valves, and other similar mechanical equipment.
- Especially important where weld debris is likely present in the pipeline.
- Well suited for long service in high pressure and temperature applications.

Features

- Machined seats in both body and cap align and lock the screen in place to stop sediment bypass. Machined seats facilitate alignment and accurate reseating after servicing.

Construction

- Designed for Class 300 specifications.
- Heavy gauge reinforced screens are used.
- IMPORTANT NOTE:
  - Model 782-WE ends are machined to match Schedule 40 pipe.
  - Other connections are available, consult factory.

Self-Cleaning

- Self-cleaning is accomplished by opening the plug or valve connected to the blowoff outlet.

Blowoff Outlets

- Blowoff outlets are NPT tapped at location C. See next page for NPT sizes.
- Blind covers are available, consult factory.

Capacity

- Generously proportioned bodies.
- Open Area Ratio much greater than pipe size, ensuring low pressure drop.
- Minimum of 4 to 1 Open Area Ratio.

Screens

		STANDARD (WATER)		STEAM RECOMMENDATION	
MODEL	**SIZES**	**MATERIAL**	**OPENING**	**MATERIAL**	**OPENING**
All	½" - 4"	304SS	.062 perf	304SS	.033 perf
All	5" - 12"	304SS	.062 perf	304SS	.045 perf
All	14" and Up	304SS	.125 perf	304SS	.062 perf

Materials

	782, 782-WE
Body	Carbon Steel, ASTM A216 Grade WCB
Cap	Carbon Steel, ASTM A216 Grade WCB
Gasket	316SS Tang Graphite

ALSO AVAILABLE:

Body/Cap: Carbon-Moly ASTM A217 Gr. W1, Chrome-Moly ASTM A217 Gr. WC6, Chrome-Moly ASTM A217 Gr. WC9

Mueller Steam Specialty™

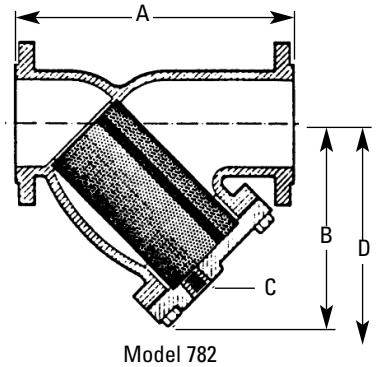
Pressure Drop

See Pressure Drop Charts in Technical Data Section of the Mueller Steam Specialty Engineering binder.

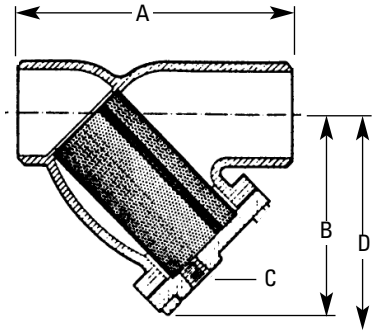
Dimensions and Weights

SIZE		DIMENSIONS								WEIGHT	
		A		B		C (NPT)		D Screen Removal			
in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	lbs.	kgs.
782											
½	15	6⅛	155	3½	89	⅜	10	5	130	5.5	2.5
¾	20	7¾	197	3¾	95	½	15	5	130	12.3	5.5
1	25	7⅞	200	3¾	95	½	15	5	130	13	5.9
1¼	32	7½	191	4¾	121	½	15	8	203	18.3	8.2
1½	40	8¼	194	4¾	121	½	15	8	203	18	8.1
2	50	8⅝	219	5¼	133	½	15	7	178	22	10
2½	65	10⅝	269	6½	165	1	25	9¾	248	32	14.5
3	80	12	305	7	178	1	25	10	254	49	22
4	100	14½	368	8¼	210	1½	40	12	305	90	40
5	125	19 5/16	491	13½	343	2	50	20	508	120	54.5
6	150	19 5/16	491	13½	343	2	50	20	508	175	79
8	200	23⅜	594	15¾	400	2	50	22¾	578	300	136
10	250	27⅜	695	18½	470	2	50	28	711	440	200
12	300	32	813	22¼	565	2	50	30	762	650	295
14	350	36	914	25	635	2	50	36½	927	1365	619
16	400	41 1/16	1056	26½	673	2	50	42	1067	1936	878
18	450	46	1168	34⅞	886	2	50	50⅞	1292	2576	1168
20	500	49½	1257	39	991	2	50	55⅜	1407	3111	1411
24	600	58⅜	1483	44⅛	1122	2	50	67¼	1708	5305	2406
782-WE											
½	15	6⅝	168	3½	89	⅜	10	5	130	3	1.3
¾	20	8 5/16	211	3¾	95	½	15	5	130	9	4
1	25	8 5/16	257	3¾	95	½	15	5	130	9	4
1¼	32	10⅛	260	5¼	133	½	15	8	203	12	5.4
1½	40	10¼	279	5¼	133	½	15	8	203	13	5.9
2	50	8⅝	219	5¼	133	½	15	7	178	10	4.5
2½	65	10⅝	269	6½	165	1	25	9¾	248	14	6.3
3	80	12	305	7	178	1	25	10	254	20	9
4	100	14½	368	8¼	210	1½	40	12	305	40	18
5	125	19 5/16	491	13½	343	2	50	20	508	90	40
6	150	19 5/16	491	13½	343	2	50	20	508	90	40
8	200	23⅜	594	15¾	400	2	50	22¾	578	168	76
10	250	27⅜	695	18½	470	2	50	28	711	250	113
12	300	32	813	22¼	565	2	50	30	762	440	200
14	350	36	914	25	635	2	50	36½	927	1033	468
16	400	41⅛	1056	26½	673	2	50	42	1067	1520	639
18	450	46	1168	34⅞	886	2	50	50⅞	1292	2060	934
20	500	49½	1257	39	991	2	50	55⅜	1407	2471	1120
24	600	58⅜	1483	44⅛	1122	2	50	67¼	1708	4500	2040

Apply For Certified Drawings.



Model 782



Model 782-WE

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Vogt Forged Steel Gate, Globe and Check Valves

FCD VVAIM2000-01

Installation, Operation and Maintenance Manual

FLOWSERVE®

Vogt Valves

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1 Recommended Spare Parts for Flowserve Vogt Valves

1.1 Packing and Gaskets

A high degree of standardization of Flowserve Vogt valves permits a small stock of replacement packing and gaskets to service your Vogt valves. The following matrix and part number tables provide the details for the purchasing of replacement gaskets for your Vogt bolted bonnet valves and packing for our popular class 150, 300, 600, 800, 1500, 1690, and 2680 gate, globe and angle valves.*

Packing Matrix

Pressure Class / **NPS** DN	½ 15	¾ 20	**1** 25	**1¼** 32	**1½** 40	**2** 50	**2½** 65	**3** 80	**4** 100
150 Conventional Port	B	B	C	D	D	E	F	F	G
300 Conventional Port	B	B	C	D	D	E	F	F	G
600 Conventional Port	B	B	C	D	D	E	F	F	G
800 Conventional Port	B*	B	C	D	D	E	F	F	—
1500 Conventional Port	J	J	D	E	E	F	—	—	—
600 and 800 Full Port	B	C	D	—	E	F	—	—	—
1500 Full Port	B	D	E	E	F	—	—	—	—
Class 800 LTD Class	C	C	D	—	F	F	—	—	—
Class 1690 LTD Class	C	C	E	—	G	G	—	—	—
Class 2680 LTD Class	C	E	E	—	G	G	—	—	—

**Also ¼ and ⅜ sizes.*

Packing Set Part Numbers

Matrix	Flexible Graphite		Fluoropolymer
	Packing Set PN**	Packing Cartridge PN***	Packing Set PN**
B	55163	55175	55276
C	55166	55176	55286
D	55167	55177	55287
E	55169	55178	55288
F	55170	—	55289
G	55171	—	55285
J	55165	55179	55294

**API 602/ASME B16.34 type valves—see valve description. For other valves consult your Flowserve distributor.*
***Order packing by Packing Set PN. Individual rings of complete set will be supplied.*
****One-piece or two-piece patented Packing Cartridge will be supplied when this PN is used.*

Gasket Matrix (Spiral-wound Type)

Pressure Class	NPS / DN	½ 15	¾ 20	1 25	1¼ 32	1½ 40	2 50	2½ 65	3 80	4 100
150 Conventional Port		A	A	B	C	C	D	E	E	F
300 Conventional Port		A	A	B	C	C	D	E	E	F
600 Conventional Port		A	A	B	C	C	D	E	E	F
800 Conventional Port		A*	A	B	C	C	D	E	E	—
1500 Conventional Port		A	A	B	C	C	D	—	—	—
600 & 800 Full Port		A	B	G	—	D	E	—	—	—
1500 Full Port		A	B	C	C	D	—	—	—	—

**Also ¼ and ⅜ sizes.*

Gasket Part Numbers

Gasket Matrix	Part Number	Spiral-Wound Gasket Description**
A	55002	304/Graphite-filled
	55003	316/Graphite-filled
	55004	316/fluoropolymer-filled
	55005	Monel/Graphite-filled
	55006	Monel/fluoropolymer-filled
B	55007	304/Graphite-filled
	55008	316/Graphite-filled
	55009	16/fluoropolymer-filled
	55010	Monel/Graphite-filled
	55011	Monel/fluoropolymer-filled
C	55025	304/Graphite-filled
	55026	316/Graphite-filled
	55027	316/fluoropolymer-filled
	55028	Monel/Graphite-filled
	55029	Monel/fluoropolymer-filled
D	55017	304/Graphite-filled
	55018	316/Graphite-filled
	55019	316/fluoropolymer-filled
	55020	Monel/Graphite-filled
	55021	Monel/fluoropolymer-filled
E	55030	304/Graphite-filled
	55031	316/Graphite-filled
	55032	316/fluoropolymer-filled
	55033	Monel/Graphite-filled
	55034	Monel/fluoropolymer-filled
F	55042	304/Graphite-filled
	55043	316/Graphite-filled
	55044	316/fluoropolymer-filled
	55045	Monel/Graphite-filled
	—	Monel/fluoropolymer-filled
G	55012	304/Graphite-filled
	55013	316/Graphite-filled
	55014	316/fluoropolymer-filled
	55015	Monel/Graphite-filled
	55016	Monel/fluoropolymer-filled

Usage Table

Gasket	Where Used
304/Graphite	A105, A182-F5, F9, F11 Cl 2, F22 Cl 3 Valves
316/Graphite	A182, F316 Valves
316/fluoropolymer	“T” Suffix Trimmed Valves
Monel/Graphite	MM & HF Acid Trimmed Valves
Monel/fluoropolymer	Chlorine Valves

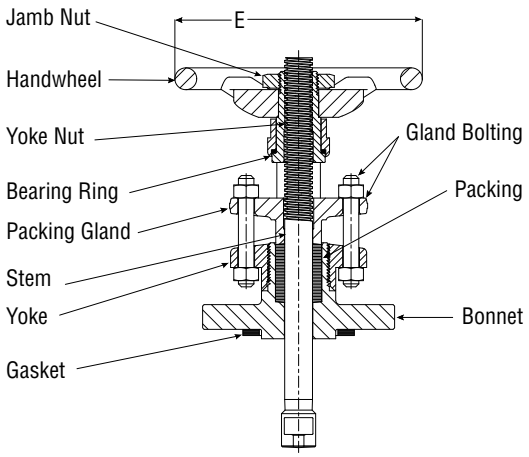
1.2 Bonnet Replacement Assemblies

Series 21000 – Vogt Valve Replacement Bonnet Subassemblies
Some valve end-users find it more expedient to replace the bonnet subassembly, complete with new packing, when repacking small-bore valves. To support this maintenance philosophy, Vogt valve users may purchaseA105 bonnet subassemblies for replacement on their Vogt valves by specifying the Series Number noted below. The removed bonnet assemblies, if not damaged and still serviceable, can be repacked in a valve repair shop environment and be used during a later valve repacking cycle.

- Repacking made easy
- Promotes quick change
- Completely packed and ready to install
- Supports valve repacking in valve shop environment
- High degree of standardization permits retrofitting of popular Vogt Class 150, 300,600, and 800, 13 Cr. trimmed, bolted bonnet valves.

The Replacement Bonnet Assembly Package can be easily installed on most existing in-line Compact Design Gate Valves in Classes 150,300, 600, and 800, of A105 bolted bonnet design with 13 Cr. trim. Specify the desired replacement Bonnet Assembly Package for the valve size and series you intend to repack by replacing the bonnet subassembly.

Figure 1 – Series 21000 – A105/13 CR Trim (Gasket Included)



Order by this number

Valve Size	Valve Series No.	Retrofit Bonnet Assembly Package Series No.	Handwheel Diameter E
½, ¾	353, 363, 373,12111, SW12111,12161, SW12161	21000 04	4.00
1	353, 363, 373,12111, SW12111,12161, SW12161	21000 06	4.75
1¼, 1½	353, 363, 373,12111, SW12111,12161, SW12161	21000 08	5.75
2	353, 363, 373,12111, SW12111, 12161, SW12161	21000 09	7.00

Consult Flowserve for Vogt's installation procedure covering instructions for proper field replacement of the series 21000 replacement bonnet subassemblies.

2 Valve Selection

2.1 Introduction

Flowserve Vogt Valves, is a world leader in the manufacture of forged steel, alloy steel, and stainless steel gate, globe and check valves. Since Vogt valves are used for a variety of applications and in various operating environments, it is reasonable to expect that the performance of a valve will reflect upon its selection and suitability for the specific service as well as proper installation and maintenance. As a long time member of the Manufacturers Standardization Society (MSS) of the Valve and Fitting Industry, Inc., Vogt engineers have participated in the development of MSS SP 92, *MSS Valve User Guide*. This guide was developed to recognize and offer recommendations to correct operating problems involving industrial valves that were not properly selected for the intended service, or were adversely affected by improper handling, installation, operation, or maintenance.

The purpose of this publication is to supply detailed information that relates specifically to selection, storage, installation, operation, and maintenance of Vogt gate, globe and check valves.

Flowserve Vogt Valves endorses the recommendations outlined in the following source as it pertains specifically to the selection, shipping, storage, installation, operation and maintenance of Vogt gate, globe and check valves:

MSS SP 92, Current Edition, MSS Valve User Guide*, available through Manufacturers Standardization Society of the Valve and Fittings Industry, Inc., 127 Park Street NE, Vienna, VA 22180-4602. Tel: 703-281-6613. Information in this Operation, Maintenance and Instruction Manual that was extracted from MSS SP 92, was done so with the permission of the MSS, and shall be denoted by footnote(1). Copies of the Standard Practice 92 are available from MSS by request.*

2.2 Gate Valve Limitations

- Do not use for flow regulation or throttling.
- Do not use if frequent manual operation is required.
- Do not use for slurries or fluids containing solids that can build up in valve cavities.
- When packed or gasketed with low melting point materials such as fluoropolymer the full shell pressure/temperature rating and fire-safe design are sacrificed.
- Locked-in volume when closed.

2.3 Globe Valve Limitations

- Do not use if full flow at minimal pressure drop is required.
- Do not use for slurries or fluids containing solids that can build up in valve cavities.
- When packed or gasketed with low melting point materials such as fluoropolymer the full shell pressure/temperature rating and fire-safe design are sacrificed.

2.4 Check Valve Limitations

- Must be installed to agree with flow arrow on body.
- Zero leakage of metal-to-metal check valves cannot be readily achieved without an elastomeric element in the seating arrangement.
- Sizing and pressure drop is critical to ensure full lift of valve piston.
- Use swing check valve design for “boiler feedwater” and other services where internal rusting may occur in service.
- Use spring-controlled lift check valve for compressor service.
- Size non-spring control lift check valves so that a minimum 2 psi pressure drop is achieved.
- Size swing check valve so that a minimum 0.5 psi drop is achieved.
- Use swing check valves when maximum flow at minimal pressure drop desired.
- Do not use for slurries or fluids containing solids that can build up in valve cavities.
- When gasketed with low melting point materials such as fluoropolymer the full shell pressure/temperature rating and fire-safe design are sacrificed.

2.5 Pressure/Temperature Rating

Proper selection of the pressure/temperature rating of the valve shall meet service requirements. If the valve application involves temperatures above 100°F (38°C), then the valve pressure rating at the service temperature must be verified to meet the requirements of the application.

If system testing will subject the valve to a pressure in excess of its working pressure rating, then the intended testing pressure and a statement explaining whether the test pressure is through the opened valve or a differential across the closed valve, should be included in the purchase specification.

Source Reference for Vogt valves pressure/temperature ratings
ASME B16.34 Valves, Flanged, Threaded, and Welded End
VVACT0000, Vogt Catalog.

2.6 Bending Strength

Piping systems are subject to mechanical constraints at fixed support points such as rigid nozzles, anchors, etc. Cold springing at assembly, system temperature changes, together with gravity, possible inertia loads, landslides, non-uniform subsidence in buried lines, etc., all potentially affect the bending moment at various points in the piping. [1]

Valves are also subjected to the bending moment occurring in the adjacent pipe that is in addition to the normal pressure loading. Bending loads can cause deformation in valve bodies that can be detrimental to valve performance. It is therefore a recommended design practice to avoid locating valves at points of large bending loads. [1]

Class 150, 300, 600 and 800 Vogt valves have bodies with a nozzle section modulus (I/C) greater than Schedule 80 pipe. Class 1500 Vogt valve bodies have I/C section modulus greater than that of Schedule 160 pipe. If the connecting pipe meets the above or has a lesser wall thickness, it is expected that the piping would be the weaker element when connected to a Vogt valve and exposed to a bending load. If the schedule pipe to be used with the Vogt valves are greater than the above (pipe has a heavier wall thickness), the purchase order shall denote this and Flowserve will provide an I/C section modulus calculation for the valve body/adjoining pipe to ensure the piping is the weaker element, or will advise customer otherwise.

[1] Paragraph extracted from MSS SP 92.

2.7 Fire Safety

Flowserve Vogt Valves all metal-seated gate, globe and check valves come standard with flexible graphite packing and gaskets and are of a fire-safe design. If these valves are supplied with low melting point packing, or gaskets, such as fluoropolymer or elastomeric seals for sealing, the fire-safe design and full shell pressure/temperature ratings are sacrificed.

The purchase order should indicate when the customer requires fire-safe designs.

2.8 Pressure Surge

Closure of a valve in a flowing fluid line causes the velocity of the fluid to be reduced to zero. If the fluid is a relatively incompressible liquid, the inertia of an upstream column produces a pressure surge at the valve whose magnitude is inversely proportional to the time required for closure. The surge pressure is also proportional to the length of the upstream fluid column and the fluid velocity prior to closure initiation. If the application involves a long upstream line, a long downstream line, high velocity, or rapid closure, singly or in any combination, the possibility of an unacceptable pressure surge should be investigated. (1)

Also to be considered are condensation-induced pressure surges which occur when a fluid velocity change is caused by rapid condensation or when a slug of water is accelerated by contact with steam. An example would be when condensate collects on one side of a closed valve that has steam on the other side, then opening the valve will cause collapsing steam voids, sharp pressure surges and acceleration of condensate slugs. Condensation-induced pressure waves can result in pressure pulses that are significantly higher than those produced by a sudden valve closure. In such events, non-shock rated gray iron valves installed in steel piping systems are particularly vulnerable to catastrophic failure. Traps are required to prevent condensate accumulation and "blow-off" valves located at the low point in the system are needed to ensure condensate drainage. Operation and maintenance personnel must be aware of the function of these devices in relationship to the "shut-off" valve operation and the necessity for their being in proper working order. (1)

(1) Paragraph extracted from MSS SP 92.

2.9 Throttling Service

Flow control (throttling) valves may be subject to extreme fluid turbulence that may create a high-energy conversion within the valve and associated piping system. High noise levels usually indicate this energy conversion, either by cavitation of liquids or by shock waves from gases.

Therefore, it is possible to damage the valve and piping system when the throttling of liquid flow results in severe and continuous cavitation conditions. Likewise, with gas flow under severe throttling conditions, shock waves can possibly result in damage to the system.

Vogt "flow control valves" should be used when the user requires true flow regulation. Flowserve Vogt Valves should be consulted on proper valve selection for throttling and/or flow control applications.

2.10 Temperature Changes

Forged steel expands and contracts with rising and falling temperatures, and in general, an increase in temperature results in a decrease of mechanical strength that is regained on return to a lower temperature. A temperature gradient in a steel part may impose significant thermal stresses or deformity with a possible negative effect on valve performance.

Frequent temperature cycling may result in development of thermal stress fatigue. Any one or a combination of the following increases this possibility:

An increase in temperature range, level, rate of change, an increase in the metal section thickness, or number of cycles.

Thermal cycling has been determined to increase the tendency for stem seal leakage.

2.11 Trapped Pressure

When a closed valve containing liquid is heated (e.g., from process condition, radiation or solar heating) the cavity pressure will increase due to volumetric expansion or vaporization of the liquid. Conversely, cooling an un-drained cavity below the freezing point may also result in volumetric expansion of the media. These types of expansion can result in extremely high pressures in the valve. [1]

A bonnet cavity relief can be added to Vogt gate valves when the user determines that the conditions for over-pressurization of the "locked-in bonnet cavity" exist. Globe and check valves do not have a "locked-in volume" when the valves are closed and are not subject to this trapped pressure.

[1] Paragraph extracted from MSS SP 92.

2.12 Material Compatibility

It is significant that forged valve materials and lubricants used in construction be chemically consistent or compatible with the connecting piping system components, line fluids, applications and the environment. Flowserve, or the system design engineers, should be consulted whenever there appears to be reason for such concern.

Flowserve Vogt Valves has construction procedures for valves used in various applications, one being "food service". These procedures ensure that valve materials, and lubrication used in manufacture are compatible with food standards. Flowserve should be consulted on proper valve selection when applications require special cleanliness, materials and/or lubricants.

2.13 Operating Effort

Vogt valves are designed to require a reasonable amount of physical effort applied to a handwheel to open or close at rated working pressure. Maximum handwheel torques at maximum pressure ratings are listed in Section 5 of this manual.

3 Shipping And Storage

3.1 Introduction

Flowserve recognizes the importance of maintaining the as-built condition of valves, and has prepared this section to call attention to important considerations in the handling of valves prior to installation.

Vogt forged steel valves are tested and shipped ready for installation. These valves are well-designed, fabricated under an ISO 9001 Quality Program, and inspected and tested to provide years of satisfactory service. Vogt valves can withstand a variety of damages caused by impact, shock or incursion of detrimental materials after installation. However, the intermediate period between the factory production tests and the installation in the end-user's pipeline may involve exposure to damage during shipping that may adversely affect the subsequent service performance of the valves.

Vogt valves are packaged to rigorous procedures, depending upon end-user specifications, and are padded and boxed for full protection during shipment to our customers.

Attention to the recommendations and cautions here will provide enhanced assurance of a satisfactory valve when installed.

3.2 Handling

Appropriate care in handling valves should be complementary to the degree of protection provided in preparation for transport. A basic consideration in handling valves should be to avoid damaging the protection provided for shipment. An obvious general rule is that valves should never be thrown or dropped. It is advisable to keep the valve(s) in the shipping containers until the valve is to be installed.

Vogt valves are carefully made from selected materials to give long, trouble-free service when properly installed in applications for which they were designed. Proper care and maintenance in the field can contribute significantly to maximum performance.

The care the valve receives between the time it is shipped by the manufacturer and installed in the piping system is important. During this period, the valve can be handled many times and can be kept in storage for long periods. Industrial valves are not delicate, but they are mechanical devices, which should be treated as such and handled with care.

Flowserve always provides valves with appropriate end covers to protect the end connections and to prevent foreign material from entering the valve. In addition, small valves are shipped in sealed cartons while larger valves are usually palletized. If at all practical, keep the valves in the cartons or on the pallets with end covers in place until ready to be installed. Storing the valves off the ground and indoors is always preferable. When stored outside, valves should be off the ground and protected by a weatherproof cover.

3.3 Storage – Short Term Recommendations

Following acceptance testing and inspection at the factory, Vogt products are moved to storage. During movement to storage, Vogt products are protected from rain and snow, stored in a building that is provided with uniform heating and cooling control, and outdoor storage is not permitted.

Store products away from exposure to the outside environment, airborne contaminants, acceleration forces, and physical damage.

Store products within a fire-resistant, weathertight, and well-ventilated building or equivalent enclosure. This area should be situated and constructed so that it is not be subject to flooding; the floor should be paved or equal, and well drained.

Place items on pallets or shoring to permit air circulation. This area should be provided with uniform heating and temperature control or its equivalent to prevent condensation and corrosion.

Do not remove valve end protectors unless necessary for inspection and installation.

3.4 Storage – Long Term Recommendations

Keep Vogt Valves products in the as-shipped pallets and/or boxes as long as practical. Do not remove valve end protectors unless necessary for inspection and installation.

Upon receipt, inspect pallet and/or boxes for handling damage and/or exposure to rain and/or ocean spray. Report damage to the transport agent.

Store the pallets and/or boxes for protection against the weather. Ideally products should be kept indoors with actual storage temperature always higher than the dew point.

The storage area should be a fire-resistant, tear-resistant, weathertight, and well-ventilated building or equivalent enclosure.

The storage area should be located and constructed so that it will not be subject to flooding. The floor should be paved or equal and well drained.

Place individual valves or other product separated from its shipment pallet and/or box on pallets or shoring to permit air circulation. Keep the valve flow ports sealed with the Vogt-supplied plugs and/or covers.

If outdoor storage is unavoidable, support products off the ground or pavement, protected by a watertight enclosure.

Weatherproof covering, when used for outdoor storage, should be a flame-resistant type of sheeting or tarpaulins. Place them so as to provide drainage and to ensure air circulation to minimize condensation. Tie them down to prevent moisture from entering laps and to protect the covering from wind damage.

Since Vogt Valves' packing and gaskets have an indefinite shelf life, valves may be removed from storage and installed without further preparation. This procedure shall be supplemented with valve motor and/or air cylinder manufacturer's storage recommendations for Vogt valves modified with motor or air cylinder valve actuators.

4 Installation

4.1 Introduction[1]

A most critical point in time in the life of an industrial valve is installation. The possibilities for degradation of the valve are numerous. Conversely, the exercise of proper care in this process will assure increased probability of trouble-free valve service.

This Section has been prepared in order to provide useful information, warnings and reminders, in a format that will be helpful to all concerned. A judicious selection of these pages, delivered to the installation site with the valve itself, will provide the opportunity for the person having the greatest need to know to be informed or reminded of what is most important at the time such information can be the most useful.

[1] Paragraph extracted from MSS SP 92.

4.2 Inspection

Prior to installation, the following inspections are recommended:

- Valve(s) and nameplates should be checked for proper identification to be sure the valve is the proper type and of a suitable pressure class.
- Check the handwheel jamb nut to ensure that it is tight. After installation, periodically check the nut to ensure tightness.
- Actuate the valve full-open to full-closed to check for possible damage from shipping and handling.
- It is extremely important to inspect the interior of both the valve and the adjoining pipe for cleanliness, because foreign material in the line is the major cause of seat leakage and seat damage.
- Make a point of noting any special warning tags or plates attached to or accompanying the valve and take any appropriate action.
- Verify any marking indicating flow direction. Make sure that the valve is installed in the proper flow orientation when a flow direction is indicated on the valve.

- Inspect end connections to be sure that pipe threads and flange faces are free from scratches, nicks, or dents.

  ⚠ **CAUTION:** Vogt valves are shipped with plastic threaded or welding end protectors. During inspection for installation, make sure these protectors have not been mishandled and displaced into the valve interior. If so they must be removed.

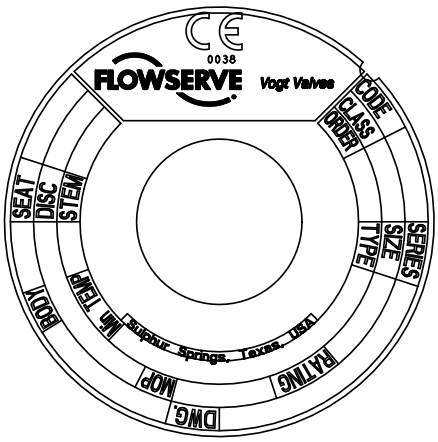
4.3 Valve Identification

All valves have a nameplate attached to the handwheel that include the series number, size, pressure class and material. The valve nameplate needs to be reviewed in conjunction with the installation, maintenance, and spare parts ordering instructions in this manual.

Valves Constructed Under The European Pressure Equipment Directive (PED)

A nameplate attached to the valve (as noted in the Illustration below) shall identify all Vogt PED Category III valves. This nameplate shall be placed on the valve at the factory. In addition to the nameplate, the Vogt PED valve will also have a lot tag to identify the date of manufacture. All nameplates for Category III valves shall have the **CE-mark** and shall also include the **Notified Body Number**.

Figure 2 – Vogt Valves PED Valve Nameplate



4.4 Threaded Valve – Pipe Assembly

Threaded pipe joints depend on a good fit between the external and internal pipe threads for tight sealing. Usually, a compatible soft or viscous material is used between the assembled threads to assist in ensuring a leak-free seal. The following installation practices are recommended:

a) Check the threads on both the valve and the mating pipe for correct thread form and cleanliness. Be alert for any indication of an impact that might have deformed the thread either out-of-round or by a local indentation. Be sure no chips or grit are present.

b) Note the internal length of the threads in the valve ends and the proximity of the valve internal seat to make sure the pipe end will not hit the seat when assembled. If there appears to be a possibility of a problem, carefully check the pipe end thread to make sure there is no extended straight portion beyond the standard tapered section.

c) Apply an appropriate thread tape or thread compound to the external pipe threads except when dry seal threading is specified. Avoid getting the thread tape or thread compound into the internal flow area.

d) Use care to align the threads at the point of assembly. Tapered pipe threads are inherently a loose fit at entry. Substantial wrenching force should not be applied until it is apparent that the threads are properly engaged.

e) Assemble the joint wrench-tight. The wrench on the valve should be on the valve end into which the pipe is being threaded.

   ⚠ **CAUTION:** Because there is no clear limit on the torque that may be developed in a tapered thread joint, it is possible to damage the valves or piping by applying excessive twisting forces through the body of the valve. If at all possible a wrench should be used on the same end of the valve to which the pipe is being threaded into. This way the torque load will not be applied throughout the valve body.

f) Repeat the process at the second valve end. Again, apply the wrench at end of the valve to which the pipe is being assembled.

4.5 Flanged Joint Assembly

Flanged joints depend on compressive deformation of the gasket material between the facing flange surfaces for tight sealing. The bolting must provide the mechanical force necessary to maintain the compressive stresses on the gasket, as well as resist the normal pressure forces tending to separate the joint. It should be recognized that with “brute force” alignment of misaligned flanges, sufficient bolting force may not be available to sustain the required gasket loading and to resist the load caused by the pressure separating force, resulting in a joint leakage problem. The following practices should be observed for satisfactory flange joint make-up:

a) Check the mating flange facings. Do not attempt to assemble the flanges if a condition is found which might cause leakage

(e.g., a deep radial groove cut by a retracting cutting tool or a dent across the face caused by mishandling), until the condition is corrected.

b) Check the bolting for proper size, length, and material. A carbon steel bolt on a high-temperature flange joint can result in early joint failure. High-strength material is always required for flange bolting on steel flanges Class 400 or higher. Such bolting is usually stamped "B-7" on the end, but other grades may be used in some cases. The proper matching of flanges, bolting and gaskets is important. Specific requirements of ASME B16.5 should be satisfied. Low-strength bolting may be used for lower-pressure flanges, Classes 150 and 300 for operating temperatures not exceeding 400°F (204°C), when using approved gasket materials. See ASME B16.5 for gasket specification.

c) Check the gasket materials. See ASME B16.5 for additional requirements for flange joints using low-strength bolting, (e.g., gray iron flanges or Class 150 steel flanges). Metal gaskets (flat, grooved, jacketed, corrugated, or spiral-wound), should not be used with these flanges.

d) Check the gaskets for freedom from defects or damage.

e) Use care to provide good alignment of the flanges being assembled. Use suitable lubricants on the bolt threads. Sequence the bolt tightening to make the initial contact of the flanges and gaskets as flat and parallel as possible. Tighten the bolts gradually and uniformly to avoid the tendency to twist one flange relative to the other. Use of a torque wrench is helpful to ensure correct and uniform final tightening of the flange bolting. Parallel alignment of flanges is especially important when assembling a valve into an existing system. It should be recognized that if the flanges are not parallel, then it would be necessary to bend something to make the flange joint tight. Simply forcing the flanges together with the bolting may bend the pipe or it may bend the valve. This is particularly true in large diameter piping. Such conditions should always be brought to the attention of someone capable of evaluating the bending condition and the corrective measures that need to be taken. The assembly of certain "short pattern" valves between mating flanges requires that the installation be checked for any possibility of interference between the moving parts of the valve and the adjacent pipe, fitting, or valve.

⚠ **CAUTION:** Torque wrenches should always be used to assure proper tightening of the flange bolting. If, in the tightening process, the torque on a given bolt has been increasing with each part turn and then is observed to remain unchanged or increase a much lesser amount with an additional part turn, that bolt is yielding. That bolt should be replaced and scrapped since it is no longer capable of maintaining the proper preload.

4.6 Weld Joint Assembly

Welded joints that are properly made provide a structural and metallurgical continuity between the pipe and the valve body. It is important that the joint should not constitute a "notch" or "weak link" in the pipe-valve-pipe assembly. Therefore, the weld fillet for socket weld joints must always have more cross sectional area than the pipe.

Butt weld joints require full-penetration welds and a weld thickness at least equal to that of the pipe. Welding a pipe of a high strength alloy to a valve with body material of lower mechanical strength requires that the weld taper to a compensating greater thickness at the valve end.

Sound welds are obviously important.

⚠ **CAUTION:** This guide is not a complete welding instruction. All welding should be in accordance with any Code or jurisdictional regulations applicable to the construction of the piping system. The welds must be made following approved welding procedures and be inspected as required by all applicable specifications. The following points are intended to be helpful as point-of-use reminders of important requirements of good welding practice:

a) Consult the manufacturer for the correct installation procedure of a metal-seated valve prior to pre-heating, welding and postweld heat treatment of a butt weld or socket weld valve. To avoid the possibility of arcing always attach the ground directly to the body.

b) Consult the manufacturer for the correct installation procedure before welding a soft-seated valve into a line. As a minimum, a soft-seated ball or plug valve should be in the full-open position prior to welding to prevent seat damage and/or weld splatter from adhering to the ball or plug. A means for venting the ball cavity is recommended to relieve any fluid pressure that might develop due to thermal effects.

c) Check materials marking on the pipe and valve to confirm that they are as specified.

d) Inspect the welding end surfaces for dimensions and cleanliness. Correct any condition that might interfere with assembly and satisfactory welding.

e) Check all backing rings that may be used to confirm that the ring material is compatible with the pipe and valve materials and that the individual rings fit and are clean.

f) Determine that all required welding parameters, including preheating and postweld heat treating, are in accordance with the approved welding procedure.

g) Inspect the "valve to pipe end" alignment and adjust as required.

h) Securely tack weld the mating parts when required if part of the approved procedure.

i) Complete the weld using the approved welding procedure.

j) Clean and inspect the finished weld.

k) Repair any defects using an approved weld repair procedure when necessary.

4.7 Recommendations for Field Welding of Small Carbon Steel Socket Weld Valves

1. **Evaluation of Code Requirements** Prior to welding, construction code requirements should be reviewed (ASME Section I, VIII, IX, B31.1, B31.3, etc.). Applicable code requirements may supersede these recommendations. In the absence of specific code requirements, the guidelines of ASME Section IX are recommended for qualification.

2. **Selection of Process** Based on the size of the valve and the skill of the welder, either the SMAW (stick) or GTAW (Tig) process is recommended. SMAW is generally preferred, although, GTAW offers more control (at the expense of speed) and may be preferred for ¾" and smaller valves.

3. **Selection of Weld Filler Metal** For SMAW, use 3/32" electrode on the first pass with 1/8" for subsequent passes. 1/8" and 5/32" electrodes may be used effectively on larger valves. E7018 electrodes are recommended, although E6010 may be preferred, particularly on the first pass, if joint cleanliness is less than desirable.

   Type ER70S-2 is preferred for GTAW. ER70S-3 and ER70S-6 may also be used. 3/32" size is recommended, although 1/16" and 1/8" may also be used successfully.

4. **Selecting the Welder** Most construction codes require a welder to qualify prior to making a production weld. Welder performance qualification provides some assurance that the production weld will be of good quality since the welder has proven, through testing, that he can make a good weld. Care should be taken in comparing the welder's qualification with the code requirements to assure that the welder has qualified with an appropriate test for the intended production weld.

5. **Joint Cleanliness** The area in-way-of welding should be cleaned to remove rust, scale, dirt, oil, and protective coatings. This should be done prior to fit-up or residue in the joint overlap will not be removed. Sanding, grinding, or wire brushing is usually adequate. Solvents may be necessary, if oil is to be removed.

6. **Fit-up (Socket Weld Valves)** In order to gauge fillet weld size after welding place a circumferential mark 1" from the engaging pipe end prior to welding. Bottom out the pipe engagement into the socket and pull it back approximately 1/16" to allow for weld shrinkage. Note the dimension from the mark to the valve pipe end.

   Tack welds should be contoured to allow for easy inclusion into the final weld.

7. **Welding Technique**

   a. Prior to welding, the valve should be lightly closed. Where possible, attach the electrical ground to the adjoining pipe on the same side of the valve as the weld being made. Do not attach the ground to the handwheel or upper structure of the valve or arcing across the valve seating surfaces could occur.

   b. Where possible, welding should be done in the flat or horizontal position. Where vertical welding is necessary, progression should be upward (vertical down welding is prone to lack-of-fusion).

   c. Welding parameters: The following welding parameters may be used as a guide.

Electrode	Current	Voltage	Shielding Gas
3/32" E6010	55-75 A	—	N/A
3/32" E7018	70-90 A	*	N/A
1/8" E7018	90-110 A	*	N/A
3/32" ER70S-2	75-100 A	13-14 V	100% Argon at 15-20 CFH

**Use as close and tight an arc as possible.*

   d. A minimum of two layers should be used for all socket welds. This will decrease the chance of leaking even if one pass contains a weld defect.

4.8 Recommendations for Field Welding of Small Alloy Steel Socket Weld Valves

1. **Evaluation of Code Requirements** Prior to welding, construction code requirements should be reviewed (ASME Section I, VIII, IX, B31.1, B31.3, etc.). Applicable code requirements may supersede these recommendations. In the absence of specific code requirements, the guidelines of ASME Section IX are recommended for qualification.

2. **Selection of Process** Based on the size of the valve and the skill of the welder, either the SMAW (stick) or GTAW (Tig) process is recommended. SMAW is generally preferred, although,

GTAW offers more control (at the expense of speed) and may be preferred for ¾" and smaller valves.

3. **Selection of Weld Filler Metal** For SMAW, use 3/32" electrode on the first pass with 1/8" for subsequent passes. 1/8" and 5/32" electrodes may be used effectively on larger valves. 3/32" is recommended for GTAW. 1/16" and 1/8" may also be used successfully. Based on the alloy type, the following filler metals are recommended:

Valve Material	SMAW Filler Material	GTAW Filler Material
A182 F5	E502-15 or 16 electrodes	ER502
A182 F11	E8018-B2	ER80S-B2
A182 F22	E9018-B3	ER90S-B3

Care should be taken to use only SMAW electrodes that have been kept essentially free of exposure to moisture. Exposure of coated electrodes to moisture can cause high levels of hydrogen in the weld which can result in delayed cracking, especially with hardenable alloys. Electrodes should be kept in heated electrode ovens operating at 250–300°F (120–150°C) when not being used. Limit atmospheric exposure to eight hours maximum without reheating. Electrodes may be used immediately following opening of the hermetically sealed containers in which they are normally supplied.

4. **Selecting the Welder** Most construction codes require a welder to qualify prior to making a production weld. Welder performance qualification provides some assurance that the production weld will be of good quality since the welder has proven, through testing, that he can make a good weld. Care should be taken in comparing the welder's qualification with the code requirements to assure that the welder has qualified with an appropriate test for the intended production weld.

5. **Joint Cleanliness** The area in-way-of welding should be cleaned to remove, dirt, oil, and protective coatings. This should be done prior to fit-up or residue in the joint overlap will not be removed. Sanding, grinding, or wire brushing is usually adequate. Solvents may be necessary, if oil is to be removed.

6. **Fit-up (Socket Weld Valves)** In order to gauge fillet weld size after welding, place a circumferential mark 1" from the engaging pipe end prior to welding. Bottom out the pipe engagement into the socket and pull it back approximately 1/16" to allow for weld shrinkage. Note the dimension from the mark to the valve pipe end.

   Tack welds should be contoured to allow for easy inclusion into the final weld.

7. **Welding Technique**

   a. Prior to welding, the valve should be lightly closed. Where possible, attach the electrical ground to the adjoining pipe on the same side of the valve as the weld being made. Do not attach the ground to the handwheel or upper structure of the valve or arcing across the valve seating surfaces could occur.

   b. Where possible, welding should be done in the flat or horizontal position. Where vertical welding is necessary, progression should be upward (vertical down welding is prone to lack-of-fusion).

   c. Preheat: A minimum preheat of 350°F (175°C) is recommended for alloy steels.

   d. Welding parameters: The following welding parameters may be used as a guide:

Electrode	Current	Voltage	Shielding Gas
SMAW			
3/32"	70-90 A	*	N/A
1/8"	90-110 A	*	N/A
GTAW			
3/32"	75-100 A	13-14 V	100% Argon at 15-20 CFH

**Use as close and tight an arc as possible.*

   e. A minimum of two layers should be used for all socket welds. This will decrease the chance of leaking even if one pass contains a weld defect.

   f. Postweld Heat Treatment: Due to controls on thickness and chemical composition, postweld heat treatment of Vogt F11 and F22 alloy steel valves is not normally required. Postweld heat treatment can reduce weld hardness and weld stresses. However, it is also possible to damage valve components at high temperatures. Refer to applicable governing codes to determine if postweld heat treatment is required. Contact Flowserve for further information if postweld heat treatment is required.

4.9 Recommendations for Field Welding of Small Stainless Steel Socket Weld Valves

1. **Evaluation of Code Requirements** Prior to welding, construction code requirements should be reviewed (ASME Section I, VIII, IX, ANSI B31.1, B31.3, etc.). Applicable code requirements may supersede these recommendations. In the absence of specific code requirements, the guidelines of ASME Section IX are recommended for qualification.

2. **Selection of Process** Based on the size of the valve and the skill of the welder, either the SMAW (stick) or GTAW (Tig) process is recommended. SMAW is generally preferred, although, GTAW offers more control (at the expense of speed) and may be preferred for ¾" and smaller valves.

3. **Selection of Weld Filler Metal** For SMAW, use 3/32" electrode on the first pass with 1/8" for subsequent passes. 1/8" and 5/32" electrodes may be used effectively on larger valves. E316L-16 electrodes are recommended.

   3/32" type ER316L is recommended for GTAW. 1/16" and 1/8" may also be used successfully.

4. **Selecting the Welder** Most construction codes require a welder to qualify prior to making a production weld. Welder performance qualification provides some assurance that the production weld will be of good quality since the welder has proven, through testing, that he can make a good weld. Care should be taken in comparing the welder's qualification with the code requirements to assure that the welder has qualified with an appropriate test for the intended production weld.

5. **Joint Cleanliness** The area in-way-of welding should be cleaned to remove, dirt, oil, and protective coatings. This should be done prior to fit-up or residue in the joint overlap will not be removed. Sanding, grinding, or wire brushing is usually adequate. Solvents may be necessary, if oil is to be removed.

6. **Fit-up (Socket Weld Valves)** In order to gauge fillet weld size after welding, place a circumferential mark 1" from the engaging pipe end prior to welding. Bottom out the pipe engagement into the socket and pull it back approximately 1/16" to allow for weld shrinkage. Note the dimension from the mark to the valve pipe end.

   Tack welds should be contoured to allow for easy inclusion into the final weld.

7. **Welding Technique**

   a. Prior to welding, the valve should be lightly closed. Where possible, attach the electrical ground to the adjoining pipe on the same side of the valve as the weld being made. Do not attach the ground to the handwheel or upper structure of the valve or arcing across the valve seating surfaces could occur.

   b. Where possible, welding should be done in the flat or horizontal position. Where vertical welding is necessary, progression should be upward (vertical down welding is prone to lack-of-fusion).

   c. Welding parameters: The following welding parameters may be used as a guide:

Electrode	Current	Voltage	Shielding Gas
3/32" E316L-16	70-90 A	*	N/A
1/8" E316L-16	90-110 A	*	N/A
3/32" ER316L	75-100 A	13-14 V	100% Argon at 15-20 CFH

**Use as close and tight an arc as possible.*

   d. A minimum of two layers should be used for all socket welds. This will decrease the chance of leaking even if one pass contains a weld defect.

4.10 Postweld Heat Treat (PWHT) Recommendations

The following recommendations are offered as they relate to the performance of postweld heat treatment on socket-welded or butt-welded valves during the installation stage.

Please note that ASME B31.1, B31.3, Section VIII and most other piping codes do not require PWHT of Vogt-designed ASTM A105, A182F11 class 2, F22 class 3 and F316/316l valves. Vogt F11 chemistry is restricted to meet the conditions for waiver of PWHT for this material in most ASME piping codes.

For assembled valves (seal-welded design*):

1. Lightly close the assembled valve.
2. Use only localized heating equipment.
3. Do not wrap or insulate total valve during PWHT.
4. Wrap the localized heating equipment around the welded joint and heat to the desired temperature for the desired length of time.
5. Furnace heating of the total valve assembly, as part of a piping subassembly, is completely unacceptable. As supplied valve trim part material conditions can be impacted by this requirement and the packing and gasket may be damaged or destroyed.

**Vogt seal-welded design valves cannot be disassembled without removal of the seal weld. A seal-weld valve design should not be used if the valve must be part of an assembly undergoing PWHT in a furnace. For this application, a bolted bonnet design valve should be used.*

For bolted bonnet valves (disassembly permitted):

1. Localized heating equipment is preferred for the PWHT of these valves as well and the PWHT can be done with the valve fully assembled per the instructions above.
2. When the total valve must be furnace heated as part of a piping subassembly to PWHT temperature, the following procedure is recommended:

A. Disassemble valve. Remove gate/disc, piston, gasket and bonnet assembly. The seat rings in gate valves cannot be removed and must be left in place.

B. For a gate valve, during disassembly the gate and body shall be marked to ensure that the same gate goes back into the same valve body in the same orientation as it was when it was removed. The gate shall not be rotated when reassembled.

C. Replace the bonnet gasket during assembly following PWHT.

D. The furnace for PWHT should be a controlled atmospheric type to ensure that heat treat scale does not develop that can adversely impact the gasket faces and/or threaded features of the valve.

3. Additionally, the above disassembly procedure may also be used with localized heating equipment, at the option of the heat treat provider.

   The above represents our best recommendation but does not constitute a guarantee that the valve will not suffer some damage as a result of PWHT.

The following table offers recommendations relating to valves installed in horizontal and vertical pipes.

Recommended Valve Orientation

Valve Type	Stem Orientation Horizontal Line [1]	Stem Orientation Vertical Line [2]
Gate	Any (except vertical down) Preferred vertical stem upright	Any Preferred stem horizontal
Gate valve [3] Motor/air-operated	Any (except vertical down) Preferred vertical stem upright	Any Preferred stem horizontal
Globe-T pattern	Any (except vertical down) Preferred vertical stem upright	Any Preferred stem horizontal
Globe-T pattern [3] Motor/air-operated	Any (except vertical down) Preferred vertical stem upright	Any Preferred stem horizontal
Globe-Y pattern	Any Preferred stem at ±50° to pipe run in upright position.	Any Preferred stem at ±50° to normal of pipe run
Globe-Y pattern [3] Motor/air-operated	Any Preferred stem at ±50° to pipe run in upright position.	Any Preferred stem at ±50° to normal of pipe run
Angle	Any (except vertical down) Preferred stem vertical upright	Any Preferred stem vertical upright
Angle [3] Motor/air-operated	Any (except vertical down) Preferred vertical stem upright	Any Preferred stem vertical upright
Ball or Piston lift check valve-T pattern (no spring) (includes stop check valve)	Preferred vertical Upright Rotation off top dead center ±40°	Not recommended
Ball or Piston lift check valve-T pattern (spring-controlled)	Preferred vertical upright Rotation off top dead center ±90°	Any
Piston lift check valve-Y pattern (spring-controlled)	Preferred vertical upright Rotation off top dead center ±90°	Any
Swing check valve	Preferred vertical upright Rotation off top dead center ±30°	Any, but upward vertical flow required
Stop check valves	Preferred vertical Upright Rotation from top dead center ±40°	Not recommended

General:

- *Gate, globe, angle, and spring-controlled check valve designs oriented with stem or body run vertical down orient the valve body cavities in such a matter that debris can be collected and not get flushed out. This may cause unreliable valve operation. A vertical stem down or body run down orientation is not recommended for fluid service that may include debris.*
- *Recommended orientation of motor/air-operated valves may be changed by the recommended orientation of the actuator.*

Notes:

[1] A ±5° variation off horizontal for the pipe would not change the recommendation except for swing check valves. This valve design will not close by gravity if the piping is off horizontal, which allows the swing check mechanism to swing away from the seat.

[2] A ±5° off variation vertical for vertical piping does not change the recommendations in the table.

[3] For small-bore socket welding and threaded valves equipped with a motor or air operator mounted in a horizontal plane, it is recommended that external supports be added to the piping arrangement to remove the load from the connecting socket welds or threads of the valve.

4.11 Testing and Adjustment

It is reasonable to assume that a valve that has been properly inspected and installed will be in good condition and ready to operate. However, the actual operability of a valve can only be proved by testing.

A first observation can be made by actuating the valve through an open-close-open or close-open-close cycle. If no obvious problems are observed, an actual test at pressure may then be applied while tightness and operability are checked.

It is common practice, after the installation of a piping system, to clean the system by blowing through the system with a gas or steam or flushing with a liquid to remove debris and/or internal protective films and coatings. It should be recognized that valve cavities may form a natural trap in a piping system and material not dissolved or carried out by the flushing fluid may settle in such cavities and adversely affect valve operation.

5 Operation and Maintenance

5.1 Introduction

An industrial valve, reasonably matched to a particular service application and properly installed in a piping system, can be expected to have a long service life with a minimum of attention. Unlike totally passive components such as pipe fittings, vessels, etc., valves are a special kind of "machinery" having moving and wearing parts. The satisfactory performance of these working parts depends on the long-term preservation of various highly finished surfaces. Therefore, it is important to give adequate attention to the specific requirements for proper operation and reasonable maintenance of all valves throughout their service life.

5.2 Operation – Manual Valves

Most valves are actuated manually by causing rotational movement of a handwheel, wrench, handle, etc. Care is required to assure that such movement is in the correct direction, is not too fast or too slow and is applied through the proper distance. The terminal positions, open and closed, have important functional significance. This is particularly true in the closed position where the internal closure element (disc, plug, gate, etc.) must be correctly positioned in relation to the seat to assure a positive seal.

Check the handwheel jamb nut to ensure that it is tight. After installation, periodically check the nut to ensure tightness.

Valves in which the closure element moves to and from the seat, such as in globe, angle, and wedge gate valves, depend to some degree on the mechanical force of the stem holding the closure element against the seat to make and maintain a tight shutoff. This is most important if the line pressure to be shut off acts on the closure element in a direction so as to push it off the seat. When globe valves are installed so that the line pressure then acts in the same direction as the stem force and also in wedge gate type valves, the line pressure then acts to increase the seating load, making valve stem loading less critical. However, substantial stem force will still be required at low line pressures. The stem force may even be more important at low line pressures than at high line pressures.

Globe valves (straight, angle or Y-pattern) and stop check valves with pressure under the disc, require sufficient stem loading to balance the line pressure and provide adequate net seat load. The higher the line pressure, the higher the required stem loading to achieve a leak-tight seal. Follow the manufacturer's recommendations on torque or handwheel rim force for seating of manually operated valves as well as impacting of impactor-type handles or handwheels.

⚠ **CAUTION:** The use of valve wrenches on handwheels may lead to valve damage or injury to operators.

Most valves in which the internal closure elements slide across the seat as in ball, plug, non-wedging gates, butterfly etc., do not rely on stem actuating force to provide tight shutoff. However, the correct position of the closure element in these types of valves is very important. In some cases, the effort required to move the closure element may increase substantially during final approach to the closed position, giving a false impression of having reached the required position. Failure to reach and stop at the full-closed position can result in leakage and consequent damage to the seal elements.

Thermal expansion and contraction can cause solid wedge gate valves to "lock up" if closed while hot. As the relatively cooler stem heats up to body temperature, and/or the body cools down toward the stem temperature, the stem expansion and/or body contraction will cause stem thrust to increase. If the thrust increases sufficiently, the wedge may be "locked" between the tapered seats.

Vogt valve stems are provided with a backseat arrangement, that is, a shoulder on the stem or on another part of the stem-disc assembly, that engages a corresponding seat shoulder on the inner side of the bonnet.

It has become generally recognized that the use of the stem backseat for stem sealing may mask an unsatisfactory condition of the stem packing. For this reason, the use of the backseat for normal operational stem sealing is not recommended. It is recommended that the valve be opened against the backseat as a means of determining that the full-open position has been reached, and the stem should then be backed off slightly from the backseat.

If circumstances necessitate use of the backseat for stem sealing to permit system operation until a shutdown will allow replacement of the stem packing, it should be recognized that backseats are usually much smaller than "mainseats" and care should be exercised to avoid applying excessive stem force in back seating. Impactors, gears, or similar features provided to assist in main seating valves should not be used for backseating.

⚠ **CAUTION:** Some users consider that backseats are provided for the purpose of repacking valves, which are under pressure. When the packing is removed in this situation, any leakage past the backseat escapes directly to the atmosphere and constitutes a potential safety hazard to personnel. The practice of repacking under pressure is not recommended. Further, if a valve is operated in the backseated position for any reason, exercise caution when moving the stem away from the backseat as the packing may have deteriorated while isolated from the line fluid and then leak when exposed to pressure.

Purchase specifications requiring restrictive maximum forces to be applied on levers or handwheel rims may also lead to damaging forces being applied to valves or actuators in actual practice as larger forces are sometimes applied in the field. Users should consider this fact in training of operating personnel.

5.3 Operation – Power Actuated Valves

Functionally, closure performance characteristics and backseating considerations are associated with all valve types regardless of the means of operation. Satisfactory valve performance with power actuation requires appropriate programming of the various requirements and constraints into the actuator controls. Therefore, the actuator should be adjusted to deliver an adequate opening, running and closing force to suit the anticipated service conditions. For the position-sensitive valve types, the close control should be position controlled by external stops or limit switches. Be sure to contact the actuator manufacturer's operation manual for more detailed information.

Data required for selection and adjustment of power actuators should be delineated clearly in purchase specifications for actuated valves. This data shall include but not necessarily be limited to:

a) Upstream pressure and differential pressure conditions at which both opening and closing shall be required. Specify direction if applicable. Additionally, specify if valve operation is required under high-flow "blow down" conditions.

b) Speed of operation required or the maximum time for opening and/or closing. Also, specify a minimum time if required due to fluid dynamics.

c) Electrical power supply available (AC or DC voltage, phase, frequency) for electrical power actuators or controls. Operating conditions for reduced voltages should also be considered.

d) Pneumatic pressure available for pneumatic actuators (cylinders or diaphragms). Also, specify fail-open, fail-closed, fail-as-is, or any special requirements.

e) Requirements for position indication signals.

Actuator selection and adjustments should normally be made by Flowserve based on published literature and/or technical advice of actuator manufacturer. Flowserve should be consulted when a manually operated valve must be retrofitted with a power actuator.

⚠ **CAUTION:** Some valve actuators, when sized to provide specified loading, may have much higher output at maximum switch or control settings and therefore be capable of damaging valves if misadjusted. Valve and actuator manufacturer instructions should be followed closely to prevent overloading valve stems, backseats and other structural parts. Successful operation of power-operated valves requires a diligent coordination of the skills and efforts of the valve specifier, Flowserve and the actuator manufacturer. Most applications are problem-free, but miscommunication can lead to unreliable operation at one extreme and possible valve or actuator damage at the other extreme.

5.4 Fluid Dynamics of Shutoff Valve Operation

A flowing fluid in a piping system has mass and velocity. Anything that causes a moving mass to change its velocity will experience a reacting inertia force in proportion to the magnitude of the mass and the rate of the imposed velocity change.

However, in the flow of gases the reacting inertia forces are inherently moderated by the compressibility of the fluid that permits the instantaneous velocity change to be effectively limited to the mass of fluid in the immediate vicinity. This, in addition to the self-cushioning capacity of the fluid column in the upstream pipe, effectively precludes any significant problem of pressure surge in rapidly closed valves in gaseous fluid piping.

In contrast, the inertia of the fluid column in a liquid pipeline is not so easily overcome. Its relative incompressibility provides no such cushion or proximity-limiting mechanism. The entire upstream fluid mass is required to be decelerated at once by the closing valve, and the resulting pressure surge may be of sufficient magnitude to cause structural damage.

An additional potential problem can occur downstream from the closing valve. This may be described as fluid column rupture and involves the inertia of the fluid column carrying it away from the closed valve with the proximate space being occupied by a bubble of the fluid vapor or, simply, a substantial vacuum. If there is sufficient backpressure in the line, the fluid column will reverse its velocity and close the void created by the fluid column rupture and cause another pressure surge when it reaches the valve.

It should be recognized that pressure surge intensity is roughly proportional to the length and velocity of the fluid column upstream of the closing valve and inversely proportional to the time taken to close the valve. Fluid column rupture and return surge intensity is proportional to the same condition on the other side of the valve in addition to the back pressure in that section of piping. Therefore, a slow closing is helpful in limiting the magnitude of the pressure surge phenomena.

In large, long distance liquid pipelines it is critically important to evaluate pressure surge possibilities and to establish limits on the speed of closure of the flow shutoff valves. In operating such valves or setting the speed of operation of power-actuated valves, design limits on speed of closure should be conscientiously observed.

Rapid closure of a valve in any flowing liquid pipeline can cause a substantial pressure surge that may manifest itself in a sharp “bang” or possibly a series of “bangs.” This is frequently referred to as water hammer. This phenomenon can occur in any flowing liquid line and is not limited to waterlines. Rapid closing of a shutoff valve in a flowing liquid line should be avoided especially during the last part of the stem travel.

5.5 Check Valves

Check valves are one-way valves that function to automatically stop a flow reversal in a flowing line. In most applications, the fastest possible closure is desirable. The speed of closure is understood in terms of the shortest possible time to achieve closure following the instant of flow reversal. It follows then, that the shorter that time interval can be made, the lower the velocity of the reverse flowing liquid will be.

The pressure surge resulting from a check valve closure is likely to be more severe than that in the case of the shutoff valve as the shutoff valve will usually provide a throttling action, while the check valve closure may be virtually instantaneous with little preliminary throttling.

A check valve closure can also cause downstream fluid column rupture just as in the case of shutoff valves. Furthermore, on fluid column reassembly, the pressure surge may be of sufficient magnitude to reopen the check valve, starting another sequence of closure, surge, etc. Under certain conditions a protracted succession of closure “hammers” may result.

The kinetic energy in flowing fluids present special problems regarding check valve performance. Quick closing is normally desirable,

but special features may be required for certain situations. Careful systems analysis may be required in complex applications.

While a rapid closure of a check valve is normally the best method of minimizing pressure surges due to flow reversal, some applications produce flow reversals that are too rapid to prevent excessive reverse velocity before the closure of a standard check valve could occur.

Such applications may require consideration of special valve features such as:

a) A spring or method of other loading to provide more rapid closing.

b) A dashpot or snubber to provide a slower, more controlled closure in order to reduce reverse flow velocity by a throttling action, as in a shutoff valve.

5.6 Noise

There are many different valve operating conditions that can result in noise. Such noise may be "normal" considering the nature of the fluid and the pressure, temperature and velocity of flow. There may be a "wind" noise in a flowing gas line. There may be clear or hoarse whistling sounds resulting from the shape of the flow passage, including the flow path through a valve. Cavitating conditions in a liquid line can cause a "white noise" that ranges from a whisper to a sound like rocks and gravel, to a deafening roar. There may also be mechanical noises as a result of movement of internal "things" acted on by the flowing fluid. Some of these noises may be relatively harmless insofar as system integrity and performance are concerned. Mechanical damage in lines with compressible fluid is generally limited to points of sonic or supersonic velocity, or where a vortex resonance with an internal component causes movement and wear or breakage.

Vortex resonance with an internal component may also cause problems in liquid service. In addition, noise may be evidence of cavitation, which has the potential for causing mechanical damage, including massive erosion of the metal walls of a valve or pipe walls and/or other internal components.

A full technical discussion of all sound-generating mechanisms is beyond the scope of this document. Nevertheless, it is recommended that an evaluation be made of any condition of remarkable noise in a piping system at least to the point of understanding its cause. If a valve is involved, a determination should be made as to whether the valve is the source or just happens to be the location of the noise. Usually, if the valve is the source, the noise can be "tuned" by slightly "throttling" the valve.

Mechanical or high-intensity fluid noise in the vicinity of a valve may be a warning of potentially serious trouble. Expert assistance should be obtained from system engineers or the valve manufacturer to determine the cause and evaluate possible need for action.

Noise emitted from a closed valve is a special case that may indicate seat leakage requiring repair. A whistling sound may indicate severe erosion of seating surfaces while "gurgling" or "popping" sounds may signify less severe leakage.

Consult Flowserve Vogt Valves when noise levels are desired for a Vogt valve. Flowserve will need pressure, temperature, flow rate, fluid details and pressure drop to determine the noise level.

5.7 Maintenance

Valves are properly considered to be a hybrid structure, a combination of a pressure vessel and operating machinery. Maintenance procedures therefore, must reflect the requirements of the occasional opening or closing of the "machinery" and the predominant operating condition of the valve where pressure is continuously applied and nothing is moving. The important performance parameters are pressure boundary integrity, actuating effort required and internal leak tightness. Maintenance should logically address the importance of preserving these performance parameters.

Valves that remain in one position for long periods of time may be hard to operate and/or not function as well as when originally installed. This reduction of operability can result from either a loss of effective lubricants, aging of packing, surface corrosion of moving parts, or an accumulation of deleterious solids. In some applications it may be desirable to schedule periodic partial or full cycle exercising of such valves.

Check valves require special consideration because they normally have no external stems, actuators, or packings that might indicate a pending operational problem. Complete internal failure may occur due to wear with no obvious advance warning. Preventive maintenance is recommended particularly where sudden check valve failure may require expensive plant or system shutdown.

Noise or vibration emitted at or near a closed check valve may be an indicator of leakage. Distinctive noises may also be produced from internal motion of the parts of check valves that are not fully open during forward flowing conditions. "Thumping" or "tapping" may indicate that the disc is impacting either on the seat or the full-open stop, or simply "rattling" in its guides. These types of conditions can lead to rapid wear and failure of the valve. Special non-intrusive diagnostics systems can be used to augment the evaluation of the noise. Periodic disassembly and internal inspection of selected

valves may be advisable, particularly where they are located close to upstream flow disturbances.

Stem seals may be a source of problems, particularly in valves that are frequently cycled or must operate at high pressures or temperatures. The stem seal must prevent or minimize leakage of line fluid between a movable stem and a stationary bonnet. While special mechanical arrangements, elastomers, or proprietary seals are used in some cases, the normal arrangement includes a cylindrical chamber in the bonnet surrounding the stem, with compression packing materials retained in the chamber by a gland and associated bolting.

Conventional compression packing requires that the gland bolting provide sufficient load to eliminate any communication porosity in the packing material and to compress it into intimate contact with the stem and bonnet. Clearances between the associated parts must be close enough to contain the packing material and minimize extrusion. Maintenance practices that increase clearances (e.g., machining of glands and/or bonnets to remove corrosion), may result in packing extrusion and leakage or “blowout”.

Pressure boundary integrity requires basically sound pressure-containing parts, a pressure-tight static seal at assembly joints and in most cases, an effective working seal between a moving stem and the valve body. Maintenance of pressure boundary parts and the static seal of assembly joints are not usually considered to be a problem. However, continuous monitoring is recommended to confirm that problems do not occur. The need for paint protection against corrosion of exposed piping should be obvious from normal observations of the system.

Wear and loss of packing material are normal expectations in frequently cycled valves. However, current packing materials and systems will minimize this deterioration particularly in new and well-maintained valves. Packing gland adjustment may be necessary from time to time but routine “repacking” should not be required in most valves that are otherwise well maintained. Packing replacement can usually be deferred until a time when other valve maintenance is required as long as the packing gland shows adequate room for further adjustment. The repacking of a backseated valve under pressure is not recommended.

Valve manufacturers and packing manufacturers should be consulted regarding the best design features and compression packing materials available to solve chronic packing problems. Ongoing developments in valve design and packing technology may offer improvements that can be implemented by retrofitting a valve with improved design, materials and installation procedures. For example, spacers may be used in the deep packing chambers common in old valves designed for use with old-style asbestos packings so that new packings/materials may be effectively installed.

Severe throttling service may cause the valve to be subjected to damage of the seating surfaces and other parts. Severe cavitation can cause gross damage of the internal parts, including the valve body and downstream piping. Good preventive maintenance procedures including periodic inspections may prevent serious failures that require expensive shutdowns. Methods of evaluation and solutions for maintenance problems are beyond the scope of this document. Flowserve should be consulted concerning design features and operating procedures for valves.

External valve mechanisms, actuators and accessories are generally readily accessible for inspection and maintenance. Reasonable protection should be provided to prevent mechanical damage and potentially degrading environmental exposure to such things as airborne grit, chemicals or moisture. Working surfaces such as stem threads, bearings, and gears should be lubricated on a reasonable schedule using the lubricants recommended or approved by the valve or actuator manufacturers.

Maintenance of valves must involve a good preventive maintenance program, particularly for check valves and valves in servere throttling service. Stem sealing problems may be alleviated by use of the newest technology in valve design, packing materials and installation procedures.

5.8 Valve Maintenance

Notice

This manual is intended as a maintenance guide for Flowserve Vogt Valves. Before working on any Vogt valves or related products, the reader should review and fully comply with this manual and its warnings and with the reader’s company safety procedures.

If anything in this manual is unclear, contact the Flowserve Customer Service Department for assistance.

Flowserve and its employees are in no way responsible for damage to property or for personal injury or death which may result through the use or misuse of any Vogt product, publication, audio or visual aid.

Warning

Vogt valves described in this manual may have been manufactured prior to September 1, 1986 and may have been equipped with gaskets that contained asbestos. When servicing, disassembling, or disposing of these products, avoid breathing the asbestos fibers or dust. Dispose of the material in accordance with local, state, and federal law.

Customer Service

If at any time you require assistance from Flowserve in the maintaining of your Vogt valves, feel free to call your Customer Service Representative, at the appropriate number listed on the back cover of this manual. Or write us at:

Flowserve Sulphur Springs Operations
1511 Jefferson Street
Sulphur Springs, Texas 75482 USA

Or Fax us at: (903) 439-3386

Field Service

Our Sales Representatives are the best in the business. They can provide you with technical information about your Vogt valves, and are available to visit your facility to conduct general maintenance seminars.

When You Call or Write

Be sure you provide the correct information and/or part numbers for your Vogt valves. Over the years there have been design changes due to our continuing effort make great valves even better. It is very important that we are provided the information necessary to correctly identify your valve.

The following information, located on the valve nameplate, is required to ensure the correct information and/or parts are provided for your valve:

1. The valve size and series number (including any prefixes or suffixes).
2. The valve drawing number listed on the valve nameplate.

Please note: In early 2002, our parent company changed, so the nameplates on Vogt valves will show one of three company names:

- Henry Vogt Machine Co, Louisville, KY, or
- Edward Vogt Valve, Inc, Jeffersonville, Indiana.
- Flowserve, Inc, Sulphur Springs, TX.

5.9 Routine Inspection and Maintenance

Once the right valve is properly installed, field maintenance is of a generally routine nature and can be readily performed by the user. The critical areas of a valve include the stem threads and those locations where leakage will most likely occur—the stem packing, the bonnet joint, the seat and the end connections. It is desirable that a maintenance program be established which will include periodic inspection of the noted critical areas. The most common location of a noticeable leak is at the stem seal. Leakage at the stem can usually be stopped by adjusting the packing. If leakage cannot be stopped by packing adjustment, repacking is indicated. However, backseating the valve and attempting to repack under pressure is hazardous and is not recommended. Rather than attempting to repack under pressure, it is preferable to use the backseat to control the stem leakage until a shutdown provides safe repacking conditions.

5.10 Major Field Repair

Maintenance involving rework or replacement of parts is considered major repair. When circumstances dictate field repair of Vogt valves, the following information is offered as an aid. It must be pointed out, however, that valves repaired in the field are no longer under "Product Warranty," and in no event is Flowserve liable for any incidental or consequential damages resulting from any cause whatsoever. There are no warranties of any kind whatsoever, express or implied, other than those stated in Flowserve's limited warranty provision.

5.11 Care and Maintenance of Vogt Forged Steel Valves

Preliminary Considerations for Valve Repair:

1. Use experienced, trained personnel.
2. Observe all standard safety precautions
3. If possible, remove valve from line so that work can be done in a clean, well-lighted area.
4. Use genuine Vogt replacement parts.
5. Use proper tools.
6. Pressure test valve before reinstalling. This is particularly essential on valves intended for critical service.

7. Remember that improper repairs can be hazardous.

Replacement Parts – How To Order

Genuine replacement parts are available for Vogt current standard valves and can usually be shipped from stock. All parts are made with the same careful inspection and laboratory control given original valves and parts. Orders for replacement parts should clearly identify the items required and should specify the correct name of the part, valve size and series number, drawing and revision number, material, etc. The drawing and revision number which appears on the identification disc attached to the handwheel is of particular value.

In the absence of an identification disc, series numbers may be found on the side of the valve body or drawing numbers may be found on the bonnet flange. The purchase date and/or purchase order number will further identify the parts and materials originally ordered, especially valves with custom-designed features.

The embossed number on each handwheel, having a prefix letter "V", is the pattern number of the handwheel and has no relation to the ordering of other valve parts. Prices for valve parts will be furnished on application.

Tools For Installing Replacement Parts

Wrenches are available (price on application) for the removal and replacement of renewable seats for globe, angle, and check valves. The wrenches are machined to an accurate finish to fit the spline broach on the inside diameter of the seat and are properly heat treated for strength and toughness.

Disassembly

Small valves of the union bonnet type or of the screw bonnet types are readily disassembled by unscrewing the union nut or the bonnet. In bolted bonnet valves, the nut should be removed from the bonnet stud bolts or hexagon head cap screws removed from the body. Tight bolt threads may be loosened by applying penetrating oil to the threads or by selectively heating the bolt at the point of thread engagement. On bonnet joints of the through-bolt type, the bolts may be cut between the body and bonnet flanges for removal.

Stems

Tight stems in valves of the O.S. and Y. type are caused by either dry, worn packing, or nonlubrication of yoke nut threads. Applying a few drops of oil to the stem threads and packing, and opening and closing the valve a few times, may loosen the stem. At the same time, make sure the packing gland bolting is pulled down evenly so the gland will not bind against the stem; however, care should be taken not to overcompress the packing.

A tight stem in an inside screw valve may also result from worn or overcompressed packing, or the stem bonnet threads may "freeze" from excessive service temperatures or from corrosive fluids in the valve. If the stem turns freely after all packing is removed, and if the surface of the stem in contact with the packing is in good condition, new packing is the remedy. If stem is still tight, turn valve to upright position, fill the stuffing box with penetrating oil, and let soak. If stem remains tight, a new bonnet and stem are required, or, if practical, an O.S. and Y. type valve could be substituted.

Bonnet Joints

On valves of the union bonnet type, repairs can be made without removing the valve from the line, provided there is enough wrench room for loosening and tightening the bonnet nut. Before loosening the bonnet nut, be sure valve is relieved of all pressure. A few hammer taps to the side of the bonnet nut or around the body neck of screw bonnet type valves will loosen nut or bonnet. Gasketed joints require smooth, clean surfaces on both the body and the bonnet gasket faces, and a new gasket is recommended for reassembly. On bolted bonnet valves in high-temperature service, and particularly where severe thermal cycling is involved, it is recommended that bolt torque be checked periodically. This recommendation applies to gland bolting as well.

Packing – General

Vogt valves have well-proportioned stuffing boxes filled with the best grade of packing available. Before repacking, be sure to have the right grade, type, and size of packing.

☠ **WARNING:** Repacking under pressure is hazardous and is not recommended. The backseat should be used as a temporary measure to control the stem leakage until a shutdown provides safe repacking conditions.

Partial disassembly of the valve is required if endless packing rings are to be placed in the valve. Split rings can be added without disassembly but is not the preferred method. Partial disassembly greatly facilitates the removal of old packing and the repacking with new packing.

Vogt makes maximum use of flexible graphite in the packing of its high temperature valves. This packing does not dry out and retains its compressibility. Valves packed with flexible graphite do not require full repacking except for severe blowing leaks, where erosion damage may have occurred to all rings of the flexible graphite packing. In this event all rings of packing shall be replaced. Otherwise, the maintenance of the valve packing can be maintained merely by the addition of one or two rings of flexible graphite without major valve disassembly.

Wipe all parts of the stuffing box, inside and out, before installing new packing. Vogt uses endless* and split ring type packing. If split ring type is used for replacement, take care to stagger the ring slits so that they are not in line. After putting in a few rings, tamp them well into place, using the packing gland as a tamping tool. Then add enough packing to fill the stuffing box. Pressure on the packing is applied by the packing nut or gland flange bolting, depending on valve design, which bears on a gland in the stuffing box. Gland bolting should be tightened evenly to obtain the proper packing compression for leak-free service. Upon reassembling the valve, a few

turns of the handwheel and a few drops of oil applied on the stem just above the packing will help work in the packing to the stem.

** Vogt has used a patented one-piece endless cylinder of packing in its factory-made valves for several years, and if this packing is to be replaced it will be necessary to remove the cylinder packing from the valve before repacking. If individual rings have been used, the individual rings can be removed as necessary. If complete valve disassembly is used during packing of a valve, the patented packing cylinder can be used for replacement. See Section 1 for Packing Cartridge PN.*

5.12 Detailed Packing Instructions

O.S. and Y. Bolted Bonnet Gate Valves (Typical Series 12111) (Partial Disassembly Required)

1. Loosen packing gland bolting and free up gland.
2. Remove bonnet bolts and bonnet subassembly.

   ⚠ **CAUTION:** Mark the gate and note orientation. The same gate and orientation shall be maintained upon replacement.

3. Spin handwheel until stem is removed from yoke nut thread.
4. Pull stem through packing. Rotating the stem during removal from the packing will aid in this process.
5. Remove packing gland and gland bolting.
6. Remove top ring of packing. This will be a braided graphite packing. Remove additional packing as required.
7. Add new rings of flexible graphite packing and one new top and bottom ring of braided packing as required.
8. Replace packing gland and snug up gland bolting evenly.
9. Insert new bonnet gasket. Insert gate/stem into body.
10. Place yoke bonnet subassembly back on stem and rotate handwheel to seat bonnet.
11. Replace bonnet bolts and torque bonnet bolts until bonnet joint becomes metal-to-metal. A .007" feeler gage may be used to gage joint. A bonnet/body joint that will accept a .007" feeler gage is not properly torqued and is not metal-to-metal. Additional torque should be applied.

    ⚠ **CAUTION:** During the torquing of the bonnet joint, the valve should be slightly open. This will prevent the bonnet bolt torque from driving the disc or gate into the valve seat and will ensure the bonnet joint will go metal-to-metal.

12. Tighten packing gland bolting evenly.
13. Open and close valve to ensure free operation.
14. Place valve back in service.

Alternate Method (No Major Disassembly Required)

1. Remove packing gland bolting and free up packing gland.
2. Remove top ring of packing. This will be a braided graphite packing. Prepare chamber to accept new ring or rings of packing.
3. Split a number of packing rings of flexible graphite as required and place individual ring in packing chamber using the gland to ram the packing into the chamber. Stagger packing ring's separations by 90° if more than one ring is required. Replace top ring of braided graphite packing as required. If total replacement of packing is necessary, a bottom ring of braided packing shall be used.
4. Tighten packing gland bolting evenly.
5. Open and close valve to ensure free operation.
6. Place valve back in service.

Packing

O.S. and Y. Bolted Bonnet Globe Valve (Typical Series 12141) (Partial Disassembly Required)

1. Loosen packing gland bolting and free up gland.
2. Remove bonnet bolts.
3. Remove handwheel nut and nameplate.
4. Spin handwheel until stem moves through yoke nut loosening and pushing off handwheel.
5. Remove yoke/bonnet subassembly, rotate stem and totally remove stem from yoke thread.
6. Pull stem through packing. Rotating the stem during removal from the packing will aid in this process.
7. Remove packing gland and gland bolting.
8. Remove top ring of packing. This will be a braided graphite packing. Remove additional packing as required.
9. Add new rings of flexible graphite packing and one new top and bottom ring of braided graphite packing as required.
10. Replace packing gland and snug up gland bolting evenly.
11. Place stem back into yoke/bonnet subassembly.

12. Rotate stem to engage yoke nut thread. Stem should be rotated until stem broach is visible and the handwheel can be placed on the stem. Replace nameplate and handwheel nut, tighten nut.
13. Insert new bonnet gasket.
14. Place yoke/bonnet subassembly on valve and replace bonnet bolting.
15. Replace bonnet bolts and torque bonnet bolts until bonnet joint becomes metal-tometal. A .007" feeler gage may be used to gage joint. A bonnet/body joint that will accept a .007" feeler gage is not properly torqued and is not metal-to-metal. Additional torque should be applied.

    ⚠ **CAUTION:** During the torquing of the bonnet joint, the valve should be slightly open. This will prevent the bonnet bolt torque from driving the disc into the valve seat and will ensure the bonnet joint will go metal-to-metal.

16. Tighten packing gland bolting evenly.
17. Open and close valve to ensure free operation.
18. Place valve back in service.

Alternate Method (No Major Disassembly Required)

1. Remove packing gland bolting and free up packing gland.
2. Remove top ring of packing. This will be a braided graphite packing. Prepare chamber to accept new ring or rings of packing.
3. Split a number of packing rings of flexible graphite as required and place individual rings in packing chamber using the gland to ram the packing into the chamber. Stagger packing ring's separations by 90° if more than one ring is required. Replace top ring of braided graphite packing as required. If total replacement of packing is necessary, a bottom ring of braided packing shall be used.
4. Tighten packing gland bolting evenly.
5. Open and close valve to ensure free operation.
6. Place valve back in service.

O.S. and Y. Welded Bonnet Gate Valves (Typical Series 2801) Preferred Method (Requires Disassembly of Yoke/Bonnet Subassembly)

1. Loosen packing gland bolting and free up gland.
2. Remove tack weld(s) at yoke/bonnet interface. A hammer and a sharp chisel should be utilized for this operation.
3. Remove yoke/handwheel assembly from yoke/bonnet subassembly.

    ⚠ **CAUTION:** The stem should be maintained in a near open position to ensure that the yoke/bonnet thread and the stem thread difference do not create a condition where the stem is locked against the backseat, making removal of the yoke impossible.

4. Remove top ring of packing. This will be a braided graphite packing. Remove additional packing as required.
5. Add new rings of flexible graphite packing and one new top ring of braided graphite packing as required. If total replacement of packing is necessary, a bottom ring of braided packing shall be used.
6. Replace yoke/handwheel assembly to bonnet subassembly.

    ⚠ **CAUTION:** When replacing yoke/handwheel assembly, the valve stem should be maintained in an open position to ensure the yoke thread advance does not drive the gate into the seats potentially making the yoke replacement impossible.

7. Tighten packing gland bolting evenly.
8. Tack weld yoke/bonnet subassembly at or near same location from which tack weld was removed. Tack weld in accordance with the manufacturer's recommended procedure.
9. Open and close valve to ensure free operation.
10. Place valve back in service.

Alternate Method (No Major Disassembly Required)

1. Remove packing gland bolting and free up packing gland.
2. Remove top ring of packing. This will be a braided graphite packing. Prepare chamber to accept new rings or rings of packing.
3. Split a number of packing rings of flexible graphite as required and place individual rings in packing chamber using the gland to ram the packing into the chamber. Stagger packing ring's separations by 90° if more than one ring is required. Replace top ring of braided graphite ring as required. If total replacement of packing is necessary, a bottom ring of braided packing shall be used.
4. Tighten packing gland bolting evenly.
5. Open and close valve to ensure free operation.
6. Place valve back in service.

O.S.and Y. Welded Bonnet Globe Valves (Typical Series 2821) Preferred Method (Requires Disassembly Of Yoke/ Bonnet Subassembly)

1. Loosen packing gland bolting and free up gland.
2. Remove handwheel nut, nameplate, and handwheel.
3. Remove tack weld(s) at yoke/bonnet subassembly. Remove yoke.

   ⚠ **CAUTION:** The stem should be maintained in a near closed position to ensure that the yoke/bonnet thread and the stem thread difference do not create a condition where the stem is locked against the backseat, making removal of the yoke impossible.

4. Remove top ring of packing. This will be a braided graphite packing. Remove additional packing as required.
5. Add new rings of flexible graphite packing and one new top ring of braided graphite packing as required. If total replacement of packing is necessary, a bottom ring of braided packing shall be used.
6. Replace the yoke to the bonnet.

   ⚠ **CAUTION:** When replacing the yoke the valve stem should be maintained in an open position to ensure the yoke thread advance does not drive the disc into the seat, potentially making the yoke replacement near impossible.

7. Tighten packing gland bolting evenly.
8. Tack weld yoke/bonnet subassembly at or near the same location from which the tack weld was removed. Tack weld in accordance with the manufacturer's recommended practice.
9. Replace handwheel, nameplate, and handwheel nut and tighten nut.
10. Open and close valve to ensure free operation.
11. Place valve back in service.

Alternate Method (No Major Disassembly Required)

1. Remove packing gland bolting and free up packing gland.
2. Remove top ring of packing. This will be a braided graphite packing. Prepare chamber to accept new rings or rings of packing.
3. Split a number of packing rings of flexible graphite as required and place individual rings in packing chamber using the gland to ram the packing into the chamber.

   Stagger packing ring's separations by 90° if more than one ring is required. Replace top ring of braided graphite packing as required. If total replacement of packing is necessary, a bottom ring of braided packing shall be used.

4. Tighten packing gland bolting evenly.
5. Open and close valve to ensure free operation.
6. Place valve back in service.

Inside Screw, Welded or Bolted Bonnet, Gate or Globe Valve (Typical Series 12161 and 12181)

1. Remove handwheel nut, nameplate, and handwheel.
2. Remove packing nut and packing gland.
3. Remove top ring of packing. This will be a braided graphite packing. Remove additional packing as required.
4. Add new rings of flexible graphite packing and one new top ring of braided graphite packing as required. If total replacement of packing is necessary, a bottom ring of braided packing shall be used.
5. Replace packing gland and packing nut.
6. Tighten packing nut.
7. Replace handwheel, nameplate, and handwheel nut and tighten nut.
8. Open and close valve to ensure free operation.
9. Place valve back into service.

5.13 Fluoropolymer Packing Instructions

For Vogt standard valves packed with Style C-VH packing, the detailed procedures above may be used as applicable. Fluoropolymer packing orientation shall be as outlined in Figure 3.

5.14 Vogt Valves Packed With Fluoropolymer for High-Pressure Applications – Standard

See solid assembly arrangement for method utilizing the C-VH packing rings. All fluoropolymer packing is used, even for the bottom ring. This is a standard fluoropolymer packing method and is designed to seal on internal pressure. See Figure 3.

5.15 For Vacuum Applications

The C-VH rings should be partially inverted for vacuum applications because leakage is from outside environment to inside of valve. Rings should be oriented per Figure 4.

5.16 For Combination Pressure/ Vacuum Applications

The C-VH rings should be oriented per Figure 5.

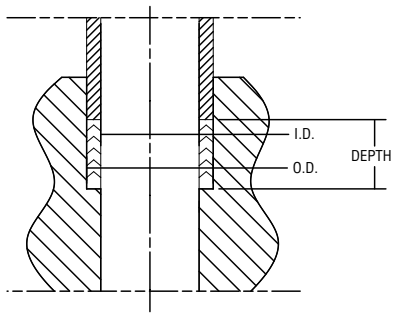
NOTE: In the event endless fluoropolymer rings are split, they may be cut at a 45° angle by the use of a razorblade. Install one ring at a time and stagger the splits in succeeding rings by 90°. Endless rings are preferred and this requires valves to be disassembled during repacking.

5.17 Style C-VH Rings for High-Pressure Service

This design incorporates a heavy wall and heel section necessary to withstand pressures up to 500 psi and greater.

C-VH rings are recommended for high-pressure applications such as hydraulic cylinders and pumps. See Figure 3.

Figure 3 – Stuffing Box: Standard and High Pressure Applications



Standard and High Pressure Applications

Stuffing Box Space					Number Of C-VH Rings		
Valve Size (in.)	**O.D. (in.)**	**I.D. (in.)**	**Depth (in.)**	**Cross Section (in^2)**	**Top Rings**	**Bottom Rings**	**Center Rings**
½	.62	.38	.62	.125	1	1	4
¾	.62	.38	.62	.125	1	1	4
1	.88	.50	1.12	.188	1	1	6
1¼	.94	.56	1.12	.188	1	1	6
1½	.94	.56	1.12	.188	1	1	6
2	1.12	.62	1.50	.250	1	1	6
3	1.25	.75	1.50	.250	1	1	6
4	1.38	.88	1.75	.250	1	1	7

Figure 4 – Stuffing Box: Vacuum Applications

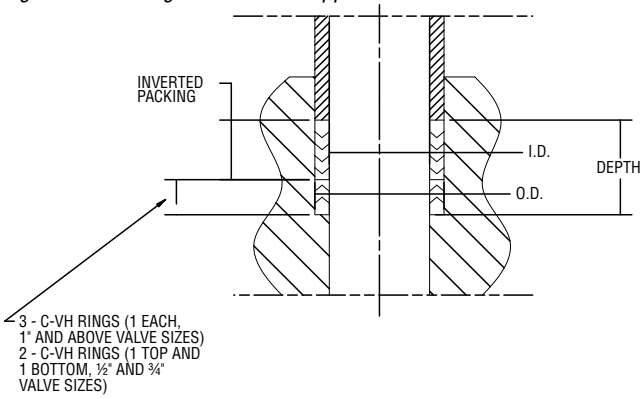
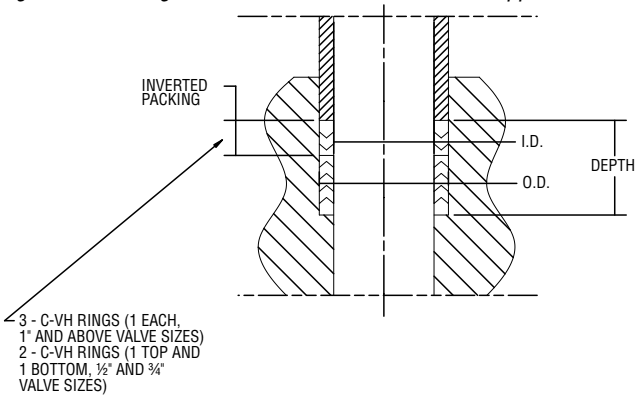


Figure 5 – Stuffing Box: Combined Pressure/Vacuum Applications



Combined Pressure/Vacuum Applications

Stuffing Box Space					Number Of C-VH Rings		
Valve Size (in.)	**O.D. (in.)**	**I.D. (in.)**	**Depth (in.)**	**Cross Section (in^2)**	**Top Rings**	**Bottom Rings**	**Center Rings**
½	.62	.38	.62	.125	2	2	2
¾	.62	.38	.62	.125	2	2	2
1	.88	.50	1.12	.188	2	2	4
1¼	.94	.56	1.12	.188	2	2	4
1½	.94	.56	1.12	.188	2	2	4
2	1.12	.62	1.50	.250	2	2	4
3	1.25	.75	1.50	.250	2	2	4
4	1.38	.88	1.75	.250	2	2	5

5.18 Disc and Seat

Leakage through the seat and disc is not always easy to detect, but when definitely known to exist, immediate repair is recommended since delay may permanently damage the disc, seat or both.

The internal repair of gate valves 2" and smaller is usually found to be uneconomical. However, if a gate valve is disassembled for inspection or cleaning, care should be taken when removing the wedge to note and mark its orientation with respect to the valve body so that when the wedge is reinserted in the valve, it will have precisely the same relationship to the seats that it had in the original assembly.

The seat threads in angle, globe, and check valve bodies should be carefully inspected to make sure they are in useable condition. When installing new seats by using proper seat tools, the seats should be screwed tightly into the valve body, then unscrewed and examined to make sure they are making continuous contact for tight seal.

If seating surfaces show galling, slight pitting, grooving, or indentations not deeper than 0.010", lapping will usually restore the surfaces sufficiently to permit tight closure. Defects deeper than 0.010" can seldom be corrected by lapping, but seating surfaces can be remachined or new parts installed. For relapping the seat and disc of Vogt globe, angle, or check valves, use a fine and a coarse grade emery base compound such as Clover Compound A and D. Apply a light coat of fine, or A, compound to the seating surface of the disc or one-piece stem, insert disc or one-piece stem into seat, and lap using an oscillating motion. Lap a few minutes and then wipe seating surfaces clean. This will clearly show the extent of damage. If severe damage is noted, use the coarse, or D, compound and lap until all defects are removed. Then finish with the fine, or A, compound. It is recommended that the face of the disc be “blued” to check for contact between seating surfaces after final lapping.

Globe and angle valves require a lapping guide fixture to maintain alignment during the lapping operation. A fixture as shown in Figure 6 may be made or, for O.S. and Y. valves, a valve bonnet with yoke nut removed may be used. For relapping loose disc globe valves, place a washer between the disc and head of the stem and retighten the disc nut, as shown in Figure 6.

Vogt piston check valves require an adapter to screw or mate into the piston for lapping the piston seating surface to the seat. The bore of the valve body serves as a guide for lapping, see Figure 7. Ball check valves are primarily used for fluids of high viscosity and the rolling action of the ball maintains seating surfaces in good condition until ball size or ball guide is worn and replacement parts are needed.

Figure 6

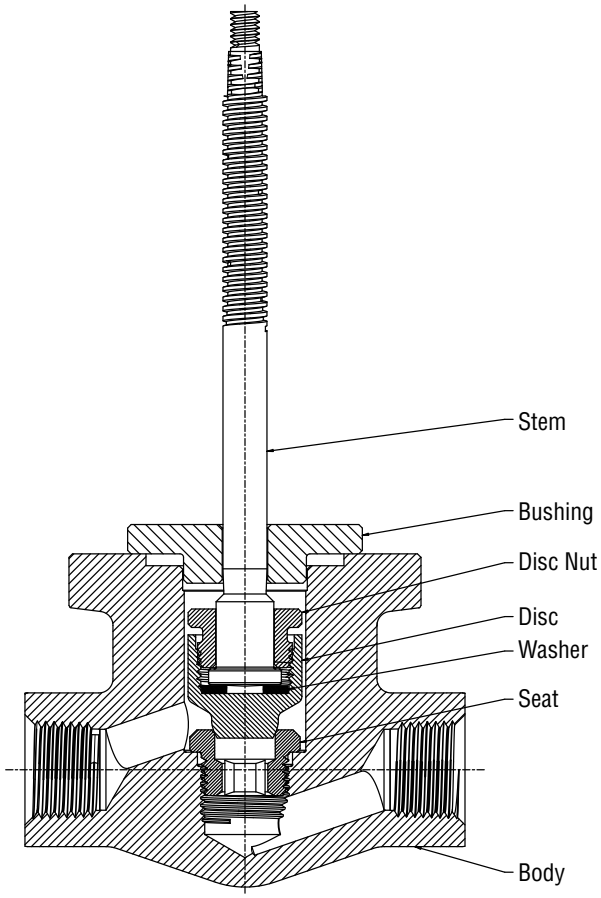
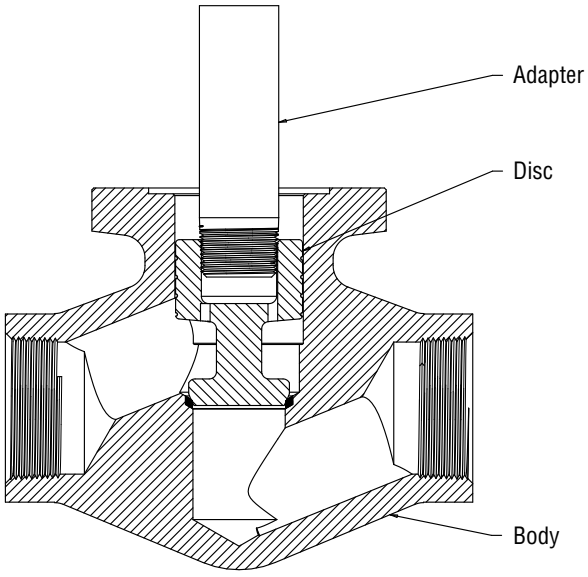


Figure 7



5.19 Gate Valve Maintenance

Bolted Bonnet Gate Valves

The repair of such valves can be accomplished as follows:

Recommended Spare Parts

1. Bonnet gasket—See Section 1 for part numbers. Listed or unlisted gaskets are available from Flowserve distribution on short notice.
2. Packing—See Section 1 for part numbers. Listed or unlisted gaskets are available from Flowserve distribution on short notice.

⚠ CAUTION

1. The system pressure shall be totally isolated and vented from the valve to ensure that the valve is at zero pressure while being repaired.

2. For small valves valve replacement may be the most economical way to facilitate repair.

Bonnet Gasket Leaker

1. Remove bonnet.
2. Clean and Inspect gasket recess and gasket surface on the bonnet. Erosion in the gasket seating area greater than 0.030" deep will require replacing the valve body and/or bonnet. A machining allowance of 0.030" is allowed to refurbish the gasket seating area of the bonnet and body.

   ⚠ **CAUTION:** Ensure that any metal removed from the bottom of the depth of the body gasket recess is duplicated by removing the same amount from the top of the body. This is required to ensure that the depth of the gasket recess (0.095–0.100") in the body is maintained.

   The bonnet gasket surface can be machined by up to 0.030" without any additional removal. Body/bonnet gasket surface metal removal will reduce the thickness of body/bonnet thickness.
3. Inspect the bonnet bolting to ensure it is proper and bolting is not damaged or stretched. If bolting is bad it shall be replaced. Bolting is available from Flowserve distribution on short notice.
4. If the gasket surface is not damaged and/or has been refurbished, replace the gasket with a gasket part number noted in the Recommended Spare Parts Table of Section 1. Gaskets are available from distribution on short notice.
5. Place the bonnet back on the valve and install the bonnet bolting. Torque the bonnet bolting in accordance with the torque requirements of Bonnet Torque Requirements of Section 1.
6. Test the valve and, if acceptable, place valve back in service.

Valve Seat Leaker

1. Remove the bonnet subassembly. Inspect body, seat rings, gate, and bonnet bolting.
2. If the gate is badly damaged it can be replaced. Since Vogt gate valves are selectively assembled with matching gates/seat rings a new gate may not correct a leaking valve. New gates are available from Flowserve distribution on short notice.
3. If the seat rings are damaged, a loose and leaking valve in service cannot be repaired without removal from the line. Special equipment will be required to replace the seat rings and replacement of the valve is recommended instead of seat replacement. In the event the user intends to repair the valve, call Flowserve distribution for seat ring part numbers and availability. Such parts are available on short notice.

Seal Welded Bonnet Gate Valves

The Vogt valves in this category include valves with threaded bonnets that, once assembled, are seal welded. They contain no gaskets. Replacement may be more economical than repair for these valves.

Bonnet Gasket Leaker

This would be a very unusual event, but if a seal weld leaks, it should be ground out while the valve is not under pressure, and a weld repair at the point of leakage shall be performed. See Section 4 for typical weld metal that can be used to weld repair carbon, alloy and stainless steel valves.

Valve Seat Leaker

Replacement instead of repair is recommended. Seat replacement will require removal of the valve form the service line. Special equipment will be required to replace seat rings. Call Flowserve for seat ring part numbers and availability. Such parts are available on short notice.

5.20 Globe Valve Maintenance

Bolted Bonnet Globe Valves

The repair of Vogt valves with spiral-wound gasket bonnet joints can be accomplished as follows:

Recommended Spare Parts

1. Bonnet gasket—See Section 1 for part number. Listed gaskets are available from Flowserve distribution on short notice.
2. Packing—See Section 1 for part number. Listed packing is available from Flowserve distribution on short notice.

⚠ CAUTION

1. The system pressure shall be totally isolated and vented from the valve to ensure that the valve is at zero pressure while being repaired.

2. For small valves valve replacement may be the most economical way to facilitate repair.

Bonnet Gasket Leaker

1. Remove bonnet subassembly. Four or eight bonnet bolts must be removed to remove the bonnet subassembly.

2. Clean and inspect gasket recess and gasket surface on the bonnet. Erosion in the gasket seating area greater than 0.030" deep will require the valve body and/or bonnet to be replaced. A machining allowance of 0.030" is allowed to refurbish the gasket seating area of the bonnet and/or body.

   ⚠ **CAUTION:** Ensure that any metal removed from the depth of the body gasket recess is duplicated by removing the same amount from the top of the body. This is required to ensure that the depth of the gasket recess (0.095–0.100") in the body is maintained.

   The bonnet gasket surface depth can be machined by up to 0.030" without damage to the valve. Bonnet gasket surface removal shall be across the full surface of the bonnet that contacts the gasket and body-mating surface when the valve is assembled. Body or bonnet gasket surface metal removal will reduce the thickness of body or bonnet thickness by a maximum acceptable 0.030".

3. Inspect the bonnet bolting to ensure it is proper and bolting is not damaged or stretched. If bolting is bad it shall be replaced. Bolting is available from Flowserve distribution on short notice.

4. If the gasket surface is not damaged and/or has been refurbished per the above machining process, replace the gasket with a gasket part number noted in the Recommended Spare Parts List of Section 1. Gaskets are available from Flowserve distribution on short notice.

5. Place the bonnet subassembly back on the valve and install the bonnet bolting. Torque the bonnet bolting in accordance with the torque requirements of Bonnet Torque Requirements of Section 5.

6. Test the valve and, if acceptable, place back in service.

Valve Seat Leaker

1. Remove the bonnet subassembly. Inspect body, disc, and bonnet bolting.

2. If the disc is badly damaged it can be replaced. Discs are available from Flowserve distribution on short notice.

3. Note any rust on the body and disc area. Internal rusting may cause the valve to close improperly.

4. Clean rust from valve.

5. Inspect the valve body seat. If the seat has imperfections deeper than 0.010", repair may not be economical and may be impossible. A replacement body is readily available from Flowserve distribution on short notice.

6. If the imperfections are less than 0.010", the valve seating surfaces can be brought back into like-new seating condition by lapping the disc to the body seat.

7. No special lapping tools are required. The bonnet subassembly can be modified to serve as a lapping tool. (See Figure 6, Section 5.) The packing shall be removed from the bonnet subassembly and the yoke nut shall also be removed and/or modified.

8. The disc/disc nut arrangement shall be assembled with an O-ring, or washer as noted in Figure 6, Section 5. This O-ring/washer fixes the disc to the stem and causes it to rotate when the stem is rotated.

9. The lapping process requires the disc to be rotated against the body seat with a lapping compound between the two parts. The rotation of the disc can be done manually or with a low speed air tool. Rotation of the piston with an air tool should be on the order of 40 rpm. Downward force should be limited to the weight of the tool.

10. For the lapping process, two grades of lapping compounds shall be used. The first lapping (rough) shall be done with the following grade of compound:

    Fel Pro
    Clover Sharpening Compound
    Silicon Carbide
    Water Soluble Gel
    120 grit Part No. 51846 E
    Coarse

    This compound removes a considerable amount of metal and should take 3–5 minutes to refurbish the seating surfaces. Discontinue when the disc and body have continuous lapping lines on the seating surfaces.

    The final lap shall be done with the following grade of compound:

    Clover Grade 1A
    320 Grit
    Very Fine

    This polishes the seating surface of the disc/body seating surface.

The final lap should be 3–5 minutes depending on the appearance of the lapping line on the piston. Since Vogt globe valves have a line contact, a continuous lapped line of width 0.040–0.050" is normal. The lapped body shall have a similar continuous line. The disc and body that have been lapped to each other shall be assembled together.

A normal appearance of a properly lapped valve would be as follows:

The disc would have a continuous black line when it is cleaned of the lapping compound. The lapping compound above is a water-soluble and can be cleaned with water. The black line represents the lapped surface.

The body should have a similar continuous black line as well of similar width. The lapping compound can be cleaned with water.

Once the body and disc have a continuous lapped line of contact, the O-ring shall be removed from the stem/disc/disc nut arrangement. The stem/disc/disc nut shall be reassembled. The disc/disc nut shall be staked per Figure 13, Section 5. This locks the disc nut to the disc. Once this is complete the valve can be reassembled, tested, and placed back in service.

Seal Welded Bonnet Globe Valves

The valves in this category include valves with threaded bonnets that, once assembled, are seal welded. They contain no gaskets. Valve replacement may be more economical than repair for these valves.

Bonnet Gasket Leaker

This would be a very unusual event, but if a seal weld leaks, it should be ground out while the valve is not under pressure, and a weld repair at the point of leakage shall be performed. See Section 4 for typical weld metal that can be used to weld repair carbon, alloy and stainless steel valves.

Valve Seat Leaker

1. Remove the seal weld by grinding and/or machining. This will require removal of the weld metal which will be ¼" thick at a minimum.
2. Once the seal weld is totally removed, use a pipe or strap wrench to remove the bonnet.
3. The lapping of the disc to body seat shall be per the previous procedure.
4. Reassemble the bonnet to the valve.
5. Test the valve. If acceptable, proceed with replacing the seal weld.
6. Test the valve for seal weld integrity and, if acceptable, place valve back in service.
7. Persistent leakage may be the result of “cracked hard facing” on the valve body seat. If so, the body and/or valve have to be replaced. Cracked hard facing cannot be repaired.

5.21 Check Valve Maintenance

Bolted Bonnet Piston Lift Check Valves

The repair of Vogt valves with spiral-wound gasket bonnet joints can be accomplished as follows:

Recommended Spare Parts

1. Bonnet gasket—See Section 1 for part number. Listed gaskets are available from Flowserve distribution on short notice.

⚠ CAUTION

1. The system pressure shall be totally isolated and vented from the valve to ensure the valve is at zero pressure while being repaired.

2. For small valves, replacement may be more economical than repair.

Bonnet Gasket Leaker

1. Remove bonnet subassembly. Four or eight bonnet bolts must be removed to remove the bonnet subassembly.
2. Clean and inspect gasket recess and gasket surface on the bonnet. Erosion in the gasket seating area greater than 0.030" deep will require the valve body and/or bonnet to be replaced. A machining allowance of 0.030" is allowed to refurbish the gasket seating area of the bonnet and/or body.

⚠ CAUTION: Ensure that any metal removed from the depth of the body gasket recess is duplicated by removing the same amount from the top of the body. This is required to ensure that the depth of the gasket recess (0.095–0.100") in the body is maintained.

The bonnet gasket surface depth can be machined by up to 0.030" without damage to the valve. Bonnet gasket surface removal shall be across the full surface of the bonnet that contacts the gasket and body-mating surface when the valve is assembled. Body or bonnet gasket surface metal removal will reduce the thickness of body or bonnet thickness by a maximum acceptable 0.030".

3. Inspect the bonnet bolting to ensure it is proper and bolting is not damaged or stretched. If bolting is bad it shall be replaced. Bolting is available from Flowserve distribution on short notice.

4. If the gasket surface is not damaged and/or has been refurbished per the above machining process, replace the gasket with a gasket part number noted in the Recommended Spare Parts List of Section 1. Gaskets are available from distribution on short notice.
5. Place the bonnet subassembly back on the valve and install the bonnet bolting. Torque the bonnet bolting in accordance with the torque requirements of Bonnet Torque Requirements of Section 5.
6. Test the valve and, if acceptable, place back in service.

Valve Seat Leaker

1. Remove the bonnet. Inspect body, bonnet, and bonnet bolting.
2. Note any rust on the body, piston or disc. Internal rusting may cause the valve to stick and close improperly.
3. Clean rust from valve.
4. Inspect the valve seat. If the seat has imperfections deeper than 0.010", repair may not be economical and may be impossible.
5. If the imperfections are less than 0.010" the valve seating surfaces can be brought back into like-new seating condition by lapping the piston/disc to the body seat.
6. Flowserve has a special lapping tool that will engage the piston and allow it to be rotated during the lapping process. Tool numbers are available from Flowserve.
7. The lapping process requires the piston/disc to be rotated against the body seat with a lapping compound between the two parts. The rotation of the piston can be done manually or with a low-speed air tool. Rotation of the piston with an air tool should be on the order of 40 rpm. Downward force should be limited to the weight of the tool.
8. For the lapping process two grades of lapping compounds shall be used. The first lapping shall be done with the following grade of compound:

    Fel Pro
    Clover Sharpening Compound
    Silicon Carbide
    Water Soluble Gel
    120 grit Part No. 51846 E
    Coarse

    This compound removes a considerable amount of metal and should take 3–5 minutes to refurbish the seating surfaces. Discontinue when the disc and body have continuous lapping lines on the seating surfaces.

    The final lap shall be done with the following grade of compound:

    Clover Grade 1A
    320 Grit
    Very Fine

The final lap should be 3–5 minutes depending on the appearance of the lapping line on the piston. Since Vogt check valves have a line contact, a continuous lapping line of width 0.040–0.050" is normal. The lapped body shall have a similar continuous line. The piston and body that have been lapped to each other shall be assembled together.

The normal appearance of a properly lapped valve would be as follows:

The disc would have a continuous black line when it is cleaned of the lapping compound. The lapping compound is water-soluble and can be cleaned with water. The black line represents the lapped surface.

The body should have a similar continuous black line as well, of similar width. The lapping compound can be cleaned with water. Once the body and piston have a continuous lapped line of contact, the valve can be reassembled, tested and placed back in service.

Bolted Bonnet Ball Check Valves

The previous procedures apply except that the lapping of the body seat shall be done with a Vogt piston normally used with the valve. This restores the seat in the valve body. The ball shall be inspected and replaced if it contains any nicks that would cause leakage.

Bolted Bonnet Swing Check Valves

Bonnet leakers shall be handled per the above. Call Flowserve for gasket part numbers. Seat leakers for removable seat valves shall be corrected as follows:

1. Remove the seats.
2. Lap the seats on a flat plate.
3. Remove the clapper and lap on a flat plate.
4. Reassemble the bonnet subassembly and valve body. Ensure that the clapper mechanism has the correct orientation to the seat. Rotate bonnet slightly to ensure that clapper and seat have good contact.
5. Reassemble, test and place back in service.

A persistent leakage may be the result of “cracked hard facing” on the valve body seat. If so, the body and/or valve have to be replaced. Cracked hard facing cannot be repaired.

Seal Welded Bonnet Piston Lift Check Valves

The valves in this category include those with threaded bonnets that, once assembled, are seal welded. They contain no gaskets.

Bonnet Gasket Leaker

This would be a very unusual event, but if a seal weld leaks, it should be ground out while the valve is not under pressure, and a weld repair at the point of leakage shall be performed. See Section 4 for typical weld metal that can be used to weld repair carbon, alloy and stainless steel valves.

Valve Seat Leaker

1. Remove the seal weld by grinding and/or machining.
2. Once the seal weld is removed, use a pipe or strap wrench to remove the bonnet.
3. Lapping of the disc to body seat shall be per the previous procedure.
4. Reassemble the bonnet to the valve.
5. Test the valve. If acceptable, proceed with replacing the seal weld.
6. Test the valve for seal weld integrity, and if acceptable, place valve back in service.

5.22 Vogt Motor-Operated Valve (MOV) Installation and Maintenance Instruction

References – Vogt MOV Installation And Maintenance Documents

1. VVAIM2000—Installation, Operation and Maintenance Manual for Vogt Valves. Shipped with each MOV valve.
2. Applicable valve actuator installation and maintenance manual, shipped with each Vogt MOV valve. Reference documents #1 and #2 are attached to the actuator.
3. Wiring diagram supplied with each Vogt MOV valve. Located within the instrument panel of the valve actuator.

Valve Identification

The following information shall be provided for the Vogt MOV valve when requesting information from Flowserve relating to the valve and/or actuator.

1. The valve has a nameplate on the actuator mounting flange that gives the details of the valve, such as pressure class, maximum delta pressure, and drawing number. The drawing number shall be used when making inquiry to Flowserve.
2. The actuator has a separate nameplate with details of the actuator. A serial number is normally supplied and this number shall be provided to Flowserve when making inquiry.

Vogt MOV Valve Installation

The installation of Vogt MOV valves shall be in accordance with the following procedures:

1. **General** The Vogt MOV valve has been assembled and performance-tested at the factory. All torque and limit switches have been set to operate the valve at a seat closure pressure of 110 percent of the design pressure for which the actuator was designed. The as-shipped Vogt MOV valve shall be installed and maintained in accordance with the above reference documents. The Vogt MOV valve is shipped complete with the reference document package for the appropriate valve actuator. These documents shall be used for the installation and maintenance of the Vogt MOV valve.
2. **Storage** The Vogt MOV valve shall be stored in accordance with the applicable Short Term and/or Long Term Storage procedures in this manual. Reference document #2 for any special storage requirement unique to the valve actuator. The valve stem opening in the valve actuator has been sealed at the factory. Other actuator wiring conduit openings in the actuator have not been disturbed by Flowserve.
3. **Welding** Vogt MOV socket and butt-welding end valves shall be installed using the applicable Recommended Installation Welding Procedures provided in this manual.
4. **WARNING** Any change in orientation of the actuator to the as-shipped valve mounting during field installation, including removal of the actuator from the valve, voids the actuator limit switch settings that were set during final performance testing at the factory. In the event the valve operator is removed from the valve, the actuator is rotated on the valve, or the bonnet assembly is rotated on the as-shipped valve, all actuator limit switches shall be reset to the actuator drawing limit switch development chart noted on Reference document #3. The procedures to set the limit switches on the actuator are detailed in Reference #2 document. Damage to valve and/or actuator can occur if limit switches are not properly set before installation.
5. **Bonnet Gasket/Gate Replacement** It is recommended that the bonnet gasket be replaced if any disassembly of the valve body/bonnet joint takes place. See Recommended Spare Parts for the proper gasket. For MOV gate valves that are selectively assembled by Flowserve, if the gate is removed from the MOV valve place it back in the same valve and in the same orientation as it was removed. Failure to follow this practice can lead to permanent seating damage of the gate valve.

6. **Water Entry** During installation, all the openings to the actuator shall be maintained to ensure that water does not enter into the actuator electrical control compartment. The valve actuator is most vulnerable to water entry during the electrical wiring stage when wiring conduit openings are left open and subject to rainfall. In the event water is unintentionally allowed to collect in the electrical compartment of the actuator the valve actuator manufacturer shall be contacted for maintenance instructions if not detailed in the maintenance instructions.

7. **Valve Or Actuator Field Replacement** In the event that the valve is replaced or the valve actuator interfaced with the Vogt MOV valve at the field job site, all torque and limit switches shall be set prior to operating. The torque and limit switch setting procedure is detailed in Reference #2. Unless otherwise specified, all Vogt as-shipped MOV valves are torque-seated on the shutoff seat and limit-seated on the backseat. Failure to do so can result in severe damage to valve and/or actuator.

8. **Wiring** The installation of the electrical wiring to the actuator shall be done in accordance with the Reference documents #2 and #3.

9. **Initial Electrical Operation** The actuator initial operation and setting of torque and limit switches disturbed during valve assembly installation shall be done in accordance with document #2. Unless otherwise specified, all Vogt as-shipped MOV valves are torque-seated on the shutoff seat and limit-seated on the backseat.

   ⚠ **CAUTION:** During the electrical start-up phase, "phase rotation" of the actuator (electrical motor) is most critical and, if the actuator rotation is incorrect, serious damage can occur to the valve. Reference document #2 has instructions on how to check and correct phase rotation.

10. **System Pressurization** Once the system is under pressure, the final setting on the actuator torque switches may need to be adjusted. During performance testing at Flowserve the closing torque switch is set to the lowest level to acceptably pass a seat test of 110 percent of the pressure for which the actuator was sized. When in operation, the torque switch may need to adjusted upward to ensure that the valve is fully closed under field conditions. Torque switch adjustment shall be performed in accordance with the instructions in Reference #2.

Vogt MOV Valve Maintenance

Recommended Spare Parts

1. Bonnet gasket—See Section 1 for part number. Listed gaskets are available from Flowserve distribution on short notice.
2. Packing—See Section 1 for part number. Listed packing is available from Flowserve distribution on short notice.
3. Actuator—See applicable Installation, Operation and Maintenance Manual supplied with each Vogt MOV valve or request a Recommended Spare Parts for Actuators when ordering.

⚠ **CAUTION:**

1. The system pressure shall be totally isolated and vented from the valve to ensure it is at zero pressure while being repaired.

2. Consult the reference document #2 for safety precautions when troubleshooting the actuator.

3. For small valves, valve replacement may be the most economical way to facilitate repair. Vogt Valves can replace the valve that will interface with the existing actuator. The valve nameplate gives the drawing number for the valve. Provide this to the authorized Vogt distributor for replacement.

Bonnet Leaker/Seat Leaker for Vogt MOV Gate, Globe or Angle Valve

1. See the applicable procedure for Gate, Globe or Angle valve detailed in this manual for repair of bonnet and/or seat leakers.
2. Stem breakage is common with MOV valves during the early stages of operation. To replace, remove the bonnet, remove the broken stem and insert a new stem. Make sure that the broken stem is removed from the stem nut in the valve actuator before replacing the new stem.
3. Replace the bonnet and torque bonnet bolts to the values noted in Section 5 for the appropriate bolting size.
4. Since the bonnet has been removed, the torque and limit switches will have to be reset on the actuator. See Reference document #2 for instructions.
5. After setting the switches, place valve back in operation.

Actuator Troubleshooting

1. The orientation of the valve may require that the Torque switch on the actuator be adjusted upon placement in service. The referenced document shall be consulted to increase/decrease the torque output of the actuator.

5.23 Vogt Air-Operated Valve (AOV) Installation and Maintenance Instruction

References – Vogt AOV Installation and Maintenance Documents

1. VVAIM2000 – Installation, Operation and Maintenance Manual for Vogt Valves. Shipped with each AOV valve.
2. Applicable valve actuator installation and maintenance manual, shipped with each Vogt AOV valve. Reference documents #1 and #2 are attached to the actuator.
3. Actuator accessories manuals. Examples—positioner, limit switch, solenoid valve, etc., manuals.

Valve Identification

The following information shall be provided for the Vogt AOV valve when requesting information from Flowserve relating to the valve and/or actuator.

1. The Vogt AOV valve has a nameplate on the actuator-mounting flange that gives the details of the valve, such as pressure class, maximum delta pressure, and drawing number. The drawing number shall be used when making inquiry to Flowserve.
2. The actuator has a separate nameplate with details of the actuator. A serial number is normally supplied and this number shall be provided to Flowserve when making inquiries.

Vogt AOV Valve Installation

The installation of Vogt AOV valves shall be in accordance with the following procedures:

1. **General** The Vogt AOV valve has been assembled and performance-tested at the factory. All applicable open and closed limit switches have been set to actuate during opening and closing of the valve. The Vogt AOV valve has been performance-tested at a seat closure pressure of 110 percent of the design pressure for which the actuator was designed. The as-shipped Vogt AOV valve shall be installed and maintained in accordance with the reference documents. The Vogt AOV valve is shipped complete with the reference document package for the appropriate valve actuator. These documents shall be used for the installation and maintenance of the Vogt AOV valve.
2. **Storage** The Vogt AOV valve shall be stored in accordance with the Short-Term and/or Long-Term Storage Procedures in this manual. Refer to the Reference document #2 for any special storage requirement unique to the valve actuator.
3. **Welding** Vogt AOV socket and butt-welding end valves shall be installed using the applicable Recommended Installation Welding Procedures provided in this manual.
4. ☠ **WARNING** Any change in orientation of the actuator to the as-shipped valve mounting during field installation, including removal of the actuator from the valve, voids the open and closed actuator limit switch settings that were set during final performance testing by Flowserve. In the event the valve operator is removed from the valve or the actuator is rotated on the as-shipped valve, reset the limit switch to actuate when the valve is fully open and fully closed. Removing the air actuator from the Vogt AOV also violates the valve stem/actuator coupling nut thread engagement and can cause the valve to not fully close. The stem/actuator coupling nut final assembled thread engagement geometry must be duplicated on reassembly of the actuator to the valve, otherwise the valve will not fully close when valve closure signal is given or the full thrust of the actuator on the stem may damage the stem or actuator coupling engagement threads.
5. **Valve Stem/Actuator Coupling Nut Adjustment** When the actuator is removed from the valve, the closure mechanism of the valve has been altered from the as-shipped condition. The valve stem and coupling nut are designed to permit the stem to be adjusted to ensure that the actuator actually preloads the stem and closure mechanism on closure to ensure the valve does not leak. In the event the actuator closes the valve but the valve continues to pass flow, the stem needs to be lengthened by adjusting the stem and/or the coupling nut in order to ensure that the actuator has placed enough preload on the closure mechanism, (spring force for fail-closed valves or air pressure for fail-open valves) to seat the valve against the design pressure.
6. **Bonnet Gasket/gate Replacement** It is recommended that the bonnet gasket be replaced if any disassembly of the valve body/bonnet joint takes place. See Section 1 for the proper gasket. For AOV gate valves, that are selectively assembled by Flowserve, if the gate is removed from the AOV valve, place it back on the same valve and in the same orientation as it was removed. Failure to follow this practice can lead to permanent seating damage of the gate valve.
7. **Valve Or Actuator Field Replacement** In the event that the valve is replaced or the valve actuator is interfaced with the Vogt MOV valve at the field job site, set the open and closed limit switches prior to operating. The open and close limit switch setting procedure is typically done as follows:
   a. Close Switch: Stroke the valve to the fully closed position by application of an air supply for “spring-to-open” actuators. With the air applied to the actuator, the close limit switch

actuator arm shall be adjusted to cause the close switch to trip in the closed position. For "spring-to-close" actuators, the air supply to actuator shall be vented and the spring allowed to close the valve. The close switch actuator arm shall be adjusted to cause the switch to trip.

b. Open Switch: Stroke the valve to the fully open position by application of an air supply for "spring-to-close" actuators. With the air applied to the actuator, the open limit switch actuator arm shall be adjusted to cause the open switch to trip in the fully open position. For "spring-to-open" actuators, the air supply to actuator shall be vented and the spring allowed to open the valve. The close switch actuator arm shall be adjusted to cause the switch to trip.

c. Final Cycling: Following the setting of the open and closed switches, the actuator shall be fully closed and opened to ensure the limit switches trip as required.

8. **System Pressurization** Once the system is under pressure, the stem/actuator coupling nut thread engagement may need further adjustment. During performance testing at Flowserve, the stem/coupling nut thread engagement is set to a level to acceptably pass a seat test of 110 percent of the pressure for which the actuator was sized. (See #5 above.)

9. **Supply Pressure**

   ⚠ **CAUTION:** The actuator nameplate contains a "Maximum Air Supply" that should be used. In the event the actuator is not supplied with a supply air regulator to make this adjustment, it is the responsibility of the end-user to provide an air supply regulator. Over-pressurization of the actuator can damage the unit, requiring major repair.

10. **Accessories** Accessories for the air actuators shall be supplied with the Installation, Operation and Maintenance Manual applicable to each unit.

Vogt AOV Valve Maintenance

Recommended Spare Parts

1. Bonnet gasket—See Section 1 for part number. Listed gaskets are available from Flowserve distribution on short notice.

2. Packing—See Section 1 for part number. Listed packing is available from Flowserve distribution on short notice.

3. Actuator—See applicable Installation, Operations and Maintenance Manual supplied with each Vogt AOV valve. It is recommended that *Recommended Spare Parts for Actuators* be requested when ordering a Vogt AOV valve.

⚠ **CAUTION:**

1. The system pressure shall be totally isolated and vented from the valve and supply pressure removed from the actuator when the valve is being repaired.

2. Consult Reference document #2 for safety precautions when troubleshooting the actuator.

3. For small valves, replacement may be more economical than repair. Vogt Valves can replace the valve with one that will interface with the existing actuator. The valve nameplate gives the drawing number for the valve. Provide this to the authorized Vogt distributor for replacement.

Bonnet Leaker/Seat Leaker for Vogt AOV Gate, Globe or Angle Valve

1. See the applicable procedure for Gate, Globe or Angle valve detailed in this manual for repair of bonnet and/or seat leaker.

2. Stem breakage is common with AOV valves during the early stages of operation. To replace the stem, it is recommended that the bonnet be removed and the old stem be replaced. Please note the length of the old stem and new stem and the thread engagement geometry of the valve stem and actuator coupling nut. Make sure that the broken stem is totally removed from the actuator coupling nut before replacing the new stem. If the stems are the same length, make every effort to duplicate the stem and actuator coupling nut engagement geometry noted before old stem was removed. This will ensure that the final stem/actuator coupling nut thread engagement adjustment will be kept to a minimum.

3. For an AOV gate valve, the gate orientation shall be noted and marked with the body to ensure that the same gate goes back into the same valve in the same orientation as it was when it was removed.

4. Replace the bonnet and torque bonnet bolts to the values noted in Section 5 for the appropriate bolting size.

5. After resetting the open and close switches, place valve back in operation.

Actuator Troubleshooting

The orientation of the valve may require that the stem/actuator coupling nut have an additional adjustment before the valve is placed back in service. If the valve is leaking across the closure seat, an adjustment is necessary for a "fail-closed" valve and/or an increase in supply pressure if the valve is a "fail-open" design.

For air actuator accessories, separate manuals may have to be consulted to properly troubleshoot any issues.

5.24 Vogt Valve Lubrication Points

Recommended Lubricant

Flowserve recommends a high-pressure and temperature lubricant such as Dow Corning Molykote™ G-N Paste or similar.

Gate Valves, O.S. and Y. Design (Figures 8-12)
There are two points to be lubricated for Vogt Gate Valves, the stem/yoke nut threads and the yoke nut/bearing ring area. Lubricate as follows:

1. For those Vogt Gate Valves with a single grease fitting (figure 9), note that lubricating through this fitting only reached one of the lubrication points, which is the yoke nut/ bearing ring area. The stem and yoke nut threads shall be lubricated as noted in (3) below.
2. For those valves with double grease fittings (figure 10) both lubrication points can be reached through these fittings. Both fittings must be used to lubricate the two points.
3. For those Vogt Gate Valves with no grease fitting (figure 8), lubricate the two reached points as follows:
   a) Open the valve to mid-stroke. Brush lubricant on the stem thread that protrudes through the handwheel and on the stem thread under the yoke. Fully open and close the valve. The stem/yoke thread is now lubricated.
   b) Open the valve slightly, this creates a clearance at the bearing ring area. Liberally brush lubricant on the bearing ring area. Close the valve. This distributes the lubricant to the bearing ring and the outside diameter area of the yoke nut.

   Note: The approach detailed in #3 can also be used for those Vogt Gate Valves with a single or double grease fitting, at the option of the end-user.

Globe/Angle Valves, O. S. and Y. Design (Figure 4)
With one exception, Vogt Globe Valves have one point of lubrication: the stem/yoke nut threads. The one exception is the Vogt Series 810, 811 and 822 valves, which shall be lubricated per the Gate Valve instruction #3 above. Lubricate globe valves as follows:

1. For those Vogt Globe Valves with a grease fitting (Figure 9), lubricate through the fitting.
2. For those Vogt Globe Valves with no grease fitting (Figure 8) open the valve to mid-stroke and brush lubricant on the stem thread both above and below the yoke nut. Fully opening and closing the valve will lubricate the stem threads.

Gate/Globe/Angle Valves, Inside Screw Stem (ISS) Design
These valves have no lubrication points. They shall be used in applications in which the service fluids lubricate the valve.

Check Valves, All Vogt Types
These valves have no lubrication points.

Motor-Operated Gate/Globe/Angle Valves
These valves are supplied with an actuator that includes a thrust base with mating stem nut. There is only one lubrication point, the stem thread/actuator stem nut. To lubricate the stem thread, proceed as follows:

Using the actuator, fully open the valve. Remove the plug from the top side of the actuator, and use a long brush inserted through the actuator opening to brush lubricant onto the valve stem threads. Stroke the valve closed. The stem thread is now lubricated. Replace the pipe plug back into the actuator opening.

Lubrication of the actuator shall be done in accordance with the maintenance provisions in the actuator manual.

Figure 8 – Gate Valve Top Works (no grease fitting)

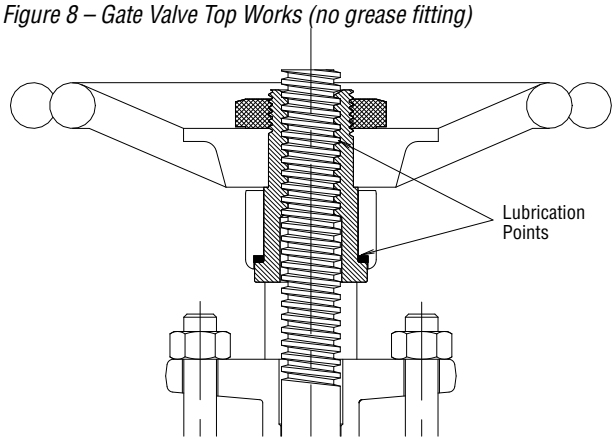


Figure 9 – Gate Valve Top Works (single grease fitting)

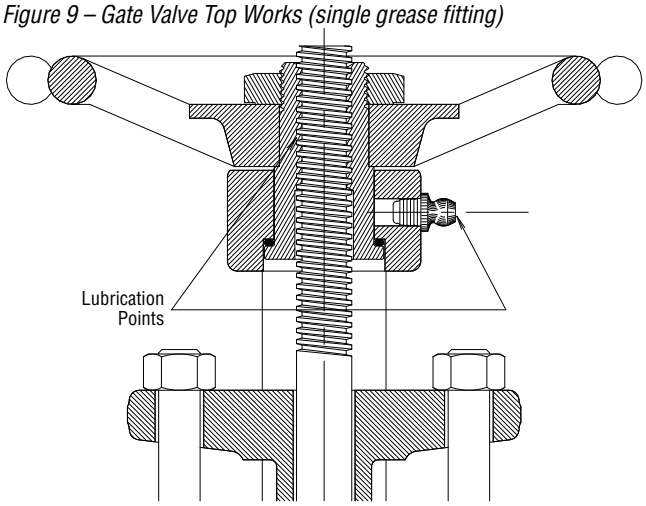


Figure 10 – API-600 Gate Valve Top Works (double grease fittings)

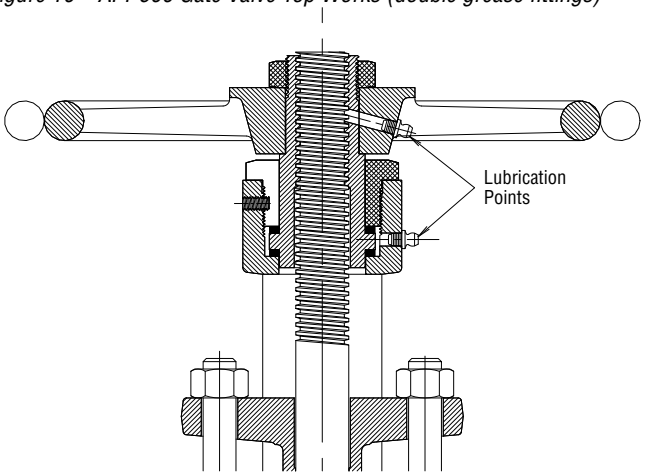


Figure 11 – Globe Valve Top Works (no grease fitting)

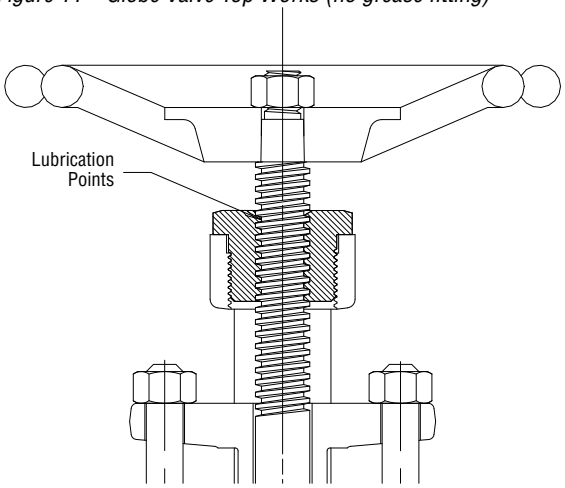


Figure 12 – Globe Valve (single grease fitting)

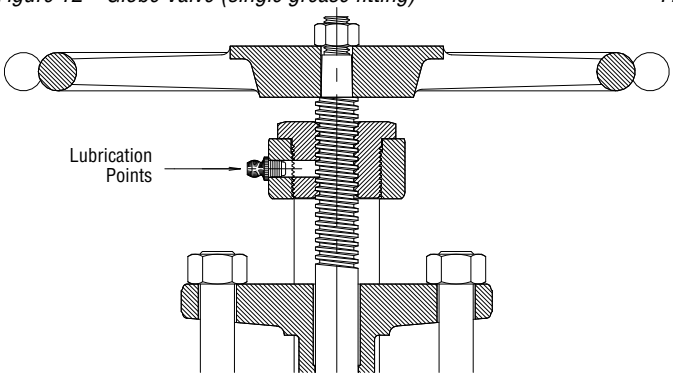
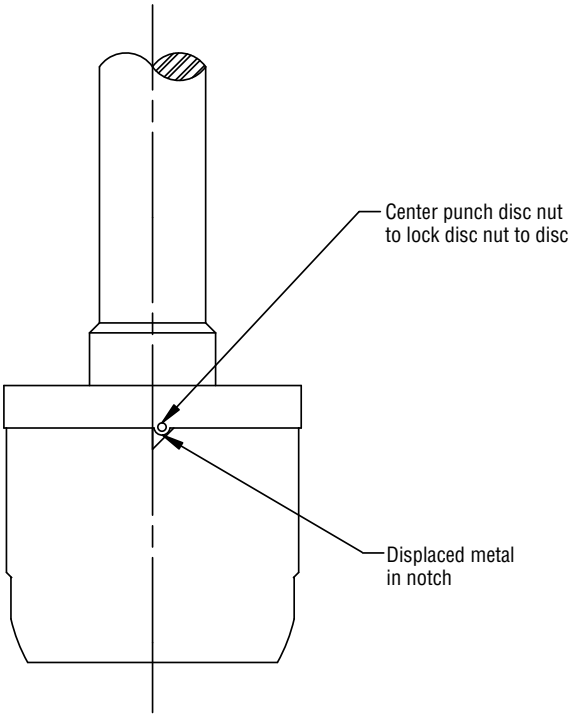


Figure 13 – Globe Valve Staked Disc



5.25 Engineering Information

Check Valve Cracking/Opening Pressures
(Vogt Valve Series 701, 15701, 573, 583, 593, etc.)

Size, NPS	Pressure (psi)
½	0.61
¾	0.61
1	0.52
1¼	0.57
1½	0.57
2	0.58

Maximum Packing Gland Bolting Torque (ft-lb)

Size, NPS	Class 150, 300, 600 & 800 Conventional Port	Class 600 & 800 Full Port	Class 1500	Class 1500 Full Port
½	1.8	1.8	4.2	4.2
¾	1.8	3.7	4.2	7.5
1	3.7	4.0	7.5	13.9
1¼	4.0	—	13.9	13.9
1½	4.0	7.5	13.9	15.9
2	7.5	8.5	15.9	—
2½	8.5	—	—	—
3	8.5	—	—	—
4	12.0	—	—	—

*Maximum Handwheel Closing Torques, Typical (ft-lb)**

Size, NPS	Class 800 Conventional Port Gate Valve	Class 800 Full Port Gate Valve	Class 1500 Conventional Port Gate Valve	Class 1500 Full Port Gate Valve	Class 2500 Full Port Gate Valve
¼"	8	—	—	—	—
⅜"	8	—	—	—	—
½"	15	15	25	25	30
¾"	15	20	25	35	75
1"	20	40	35	55	75
1¼"	50	50	75	75	—
1½"	50	70	75	115	175
2"	70	100	115	—	175

**Torque based on valve pressure rating at 100°F.*

*Maximum Handwheel Closing Torques, Typical (ft-lb)**

Size, NPS	Class 800 Conventional Port Globe Valve	Class 800 Full Port Globe Valve	Class 1500 Conventional Port Globe Valve	Class 1690 Conventional Port Globe Valve [1]	Class 2680 Full Port Globe Valve [1]
½"	15	15	25	25	30
¾"	15	30	25	25	75
1"	30	40	35	40	75
1¼"	—	—	60	—	—
1½"	40	75	60	125	175
2"	75	125	100	125	175

**Torque based on valve pressure rating at 100°F.*

[1] The NPS 1.5 and 2 have hammer blow-type handwheels.

Recommended Maximum Bonnet Bolt Torques (Dry, Unlubricated Values)

Bolt Diameter	Torque (ft-lb) B7 & B16	Torque (ft-lb) B8M
5/16"	25	22
3/8"	40	36
7/16"	50	45
½"	85	75
9/16"	144	130
5/8"	125	115
¾"	175	156
7/8"	530	480
1"	795	710

Note: Reduce above values by 25 percent to 30 percent if any type of lubrication is used on bolting.

Flowserve Corporation has established industry leadership in the design and manufacture of its products. When properly selected, this Flowserve product is designed to perform its intended function safely during its useful life. However, the purchaser or user of Flowserve products should be aware that Flowserve products might be used in numerous applications under a wide variety of industrial service conditions. Although Flowserve can (and often does) provide general guidelines, it cannot provide specific data and warnings for all possible applications. The purchaser/user must therefore assume the ultimate responsibility for the proper sizing and selection, installation, operation, and maintenance of Flowserve products. The purchaser/user should read and understand the Installation Operation Maintenance (IOM) instructions included with the product, and train its employees and contractors in the safe use of Flowserve products in connection with the specific application.

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Fax: 903-439-3386

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Apollo® 73-100 Series
Carbon Steel Ball Valve

Threaded, 1/4" to 1" 2000 psig WOG, 1-1/4" to 2" 1500 psig WOG. Cold Non-Shock. 150 psig Saturated Steam.
Vacuum Service to 29 inches Hg.
Federal Specification: WW-V-35C, Type: II, Composition: CS, Style: 3.

FEATURES

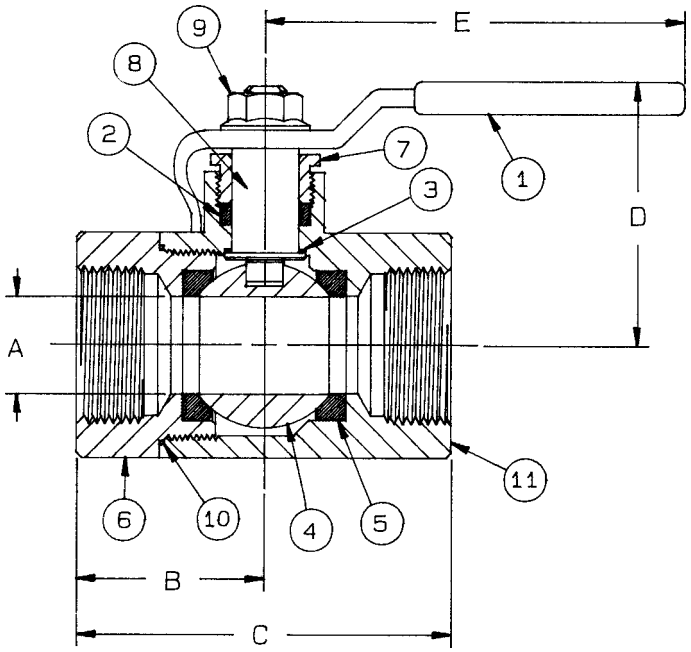
- Barstock design
- RPTFE seats and stuffing box ring
- Fire safe design when ordered with graphite packing
- Adjustable packing gland
- Blow-out-proof stem design
- Nitride corrosion protection

STANDARD MATERIAL LIST

1. Lever and grip	Steel, zinc plated w/vinyl	7. Gland nut	A108-CS
2. Stem packing	RPTFE	8. Stem	A108-CS
3. Stem bearing	RPTFE	9. Lever nut	Steel, zinc plated
4. Ball	A108-CS chrome plated	10. Body seal (1-1/4" to 2")	PTFE
5. Seat (2)	RPTFE		
6. Retainer	A108-CS	11. Body	A108-CS

VARIATIONS AVAILABLE:

73-140 Series (316 SS Ball & Stem)
73-160 Series (NACE Trim)



OPTIONS AVAILABLE:

(SUFFIX)	OPTION	SIZES
-02-	Static Grounded	1/4" to 2"
-03-	1-1/4" Stem Extension	1/4" to 2"
-04-	2-1/4" Stem Extension	1/4" to 2"
-06-	2000 psig WOG	1-1/4" to 2"
-07-	Tee Handle	1/4" to 1-1/2"
-08-	90° Reversed Stem	1/4" to 2"
-10-	SS Lever & Nut	1/4" to 2"
-14-	Vented Ball (see page J-2)	1/4" to 2"
-15-	Round Handle	1/4" to 1-1/2"
-19-	Lock Plate	1/4" to 2"
-24-	Graphite Stem Packing	1/4" to 2"
-44-	Seal Welded	1/4" to 2"
-45-	Less Lever & Nut	1/4" to 2"
-56-	Multifill Seats	1/4" to 2"
-60-	Static Grounded Ball & Stem	1/4" to 2"
-64-	250 Lb. Steam Trim	1/4" to 2"
-P01-	BSPP (Parallel) Thread Connection	1/4" to 2"
-T01-	BSPT (Tapered) Thread Connection	1/4" to 2"

CARBON STEEL BALL VALVE

NUMBER	SIZE	A	B	C	D	E	Wt.
73-101-01	1/4"	.37	1.03	2.06	1.75	3.87	.66
73-102-01	3/8"	.37	1.03	2.06	1.75	3.87	.63
73-103-01	1/2"	.50	1.12	2.25	1.81	3.87	.75
73-104-01	3/4"	.68	1.50	3.00	2.12	4.87	1.58
73-105-01	1"	.87	1.68	3.37	2.25	4.87	2.07
73-106-01	1-1/4"	1.00	2.00	4.00	2.62	5.50	3.74
73-107-01	1-1/2"	1.25	2.18	4.37	2.87	5.50	5.31
73-108-01	2"	1.50	2.75	5.50	3.06	8.00	8.03

For Pressure/Temperature Ratings, Refer to Page N-15, Graph No. 13 (1/4" to 1")
Refer to Page N-14, Graph No. 11 (1-1/4" to 2")

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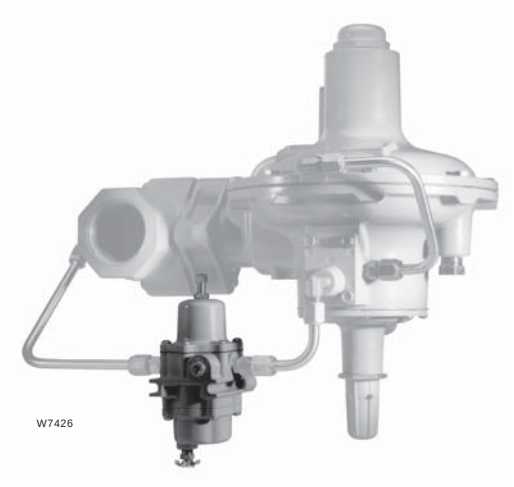
02/99

67CF Series Filter Regulators

- ☆ Compact and Light Weight
- ☆ Designed for Digital Instrumentation
- ☆ No Air Loss
- ☆ Easy Maintenance



W7426

A 67CF Series regulator used as a pilot supply regulator for the Type 299 pressure regulator

W7412

A 67CF Series filter regulator shown with optional pressure gauge

W7423_1

A 67CF Series regulator used as a supply regulator for digital instrumentation

- ☆ High Performance
- ☆ Integral Filter
- ☆ Internal Relief Valve
- ☆ Rugged Construction

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EMERSON™ Process Management

D102656X012

Introduction

The 67CF Series regulators are typically used to provide constantly controlled, reduced pressures to pneumatic and electropneumatic controllers and other instruments. These direct-operated regulators are suitable for most air or gas applications. Other applications include providing reduced pressures to air chucks, air jets, and spray guns.

Features

- **Compact**—The 67CF Series regulators are engineered for outstanding performance in a compact, light-weight package.
- **Internal Relief**—The Type 67CFR has an internal relief valve with a soft seat for reliable shutoff with no discernible leakage.
- **Panel Mounting**—Panel mount construction includes spring case with 1/4-inch NPT vent, handwheel adjusting screw, and mounting nut.
- **Instrument Supply Regulator**—Provides a clean air supply to a variety of pneumatic and electropneumatic instrumentation.
- **Digital Instrument Supply Regulator**—Designed for the accuracy, repeatability, and hysteresis demands of digital instrumentation.
- **Pilot Supply Regulator**—Improves the accuracy of two-path control regulators by reducing inlet sensitivity caused by fluctuating inlet pressures.
- **Pressure Loading Regulator**—Provides high accuracy and improved performance in dirty steam service by eliminating the need for a pilot regulator (see figure 2).
- **Sour Gas Service Capability**—NACE (MR0175) compliant construction available.
- **Integral Filter**—An integral filter ensures clean downstream air supply.
- **Ease of Maintenance**—No special tools are required to perform maintenance, and all maintenance can be performed with the regulator in the line. Filter elements are easily replaced. The one-piece valve plug cartridge allows easy inspection and replacement.

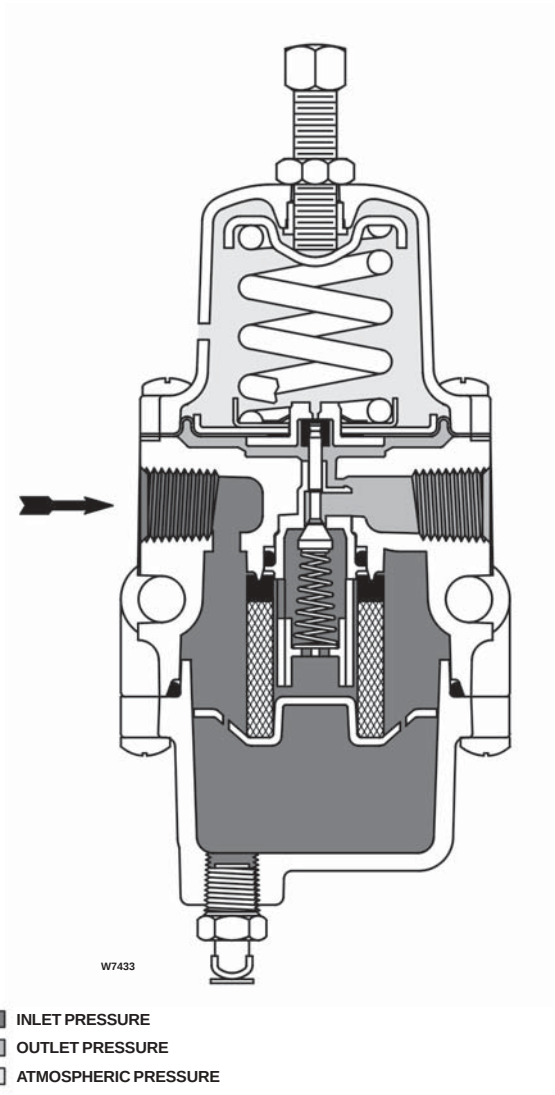


Figure 2. *67CF Series Regulator Operational Schematic*

- **Rugged Construction**—The 67CF Series regulators are engineered for longer service life with minimal maintenance requirements.
- **Second Outlet**—Body side outlet for pressure gauge or other uses.
- **Powder Paint Coating**—Fisher products are powder paint coated, offering impact, abrasion, and corrosion resistance.
- **Corrosion Resistant Fasteners**—Adjusting screw and screws are double zinc-chromated for enhanced corrosion resistance.
- **Full Usable Capacity**—Fisher regulators are laboratory tested. 100 percent of the published capacities can be used with confidence.

Specifications

Body Size, Inlet and Outlets Connection Style
1/4-inch NPT screwed

Maximum Inlet Pressure (Body Rating)(1)
250 psig (17,2 bar)

Outlet Pressure Ranges

OUTLET PRESSURE RANGES, PSIG (bar)	CONTROL SPRING DATA		
	Part Number	Color	Wire Diameter, Inch (mm)
0 to 20 (0 to 1,4)	T14130T0012	green stripe	0.135 (3,43)
0 to 35 (0 to 2,4)	T14059T0012	silver	0.156 (3,96)
0 to 60 (0 to 4,1)	T14058T0012	blue stripe	0.170 (4,32)
0 to 125 (0 to 8,6)	T14060T0012	red stripe	0.207 (5,26)

Maximum Emergency Outlet Pressure(1)
50 psi (3,4 bar) over outlet pressure setting

Capacities
See table 1

Wide-Open Flow Coefficients
Main Valve: C_g: 11.7; C_v: 0.36; C_1: 32.2
Internal Relief Valve: C_g: 1.45; C_v: 0.045; C_1: 32.8

Pressure Registration
Internal

Accuracy
Inlet Sensitivity: Less than 0.2 psig (0,014 bar) change in outlet pressure for every 25 psig (1,72 bar) change in inlet pressure
Repeatability: 0.1 psig (0,0069 bar)(2)
Air Consumption: testing repeatedly shows no discernible leakage

Type 67CFR Internal Relief Performance
Low capacity for minor seat leakage only; other overpressure protection must be provided if inlet pressure can exceed the maximum pressure rating of downstream equipment or exceeds maximum outlet pressure rating of the Type 67CFR

Filter Capabilities
Free Area: 12 times pipe area
Micron Rating:
Cellulose Element: 40 microns
Glass Fiber Element: 10 microns
Stainless Steel Element: 40 microns

Regulator Temperature Capabilities
With Nitrile (NBR):
-40° to 180°F (-40° to 82°C)
With Fluoroelastomer (FKM):
0° to 300°F (-18° to 149°C)
With Silicone (VMQ)(3):
-60° to 180°F (-51° to 82°C)

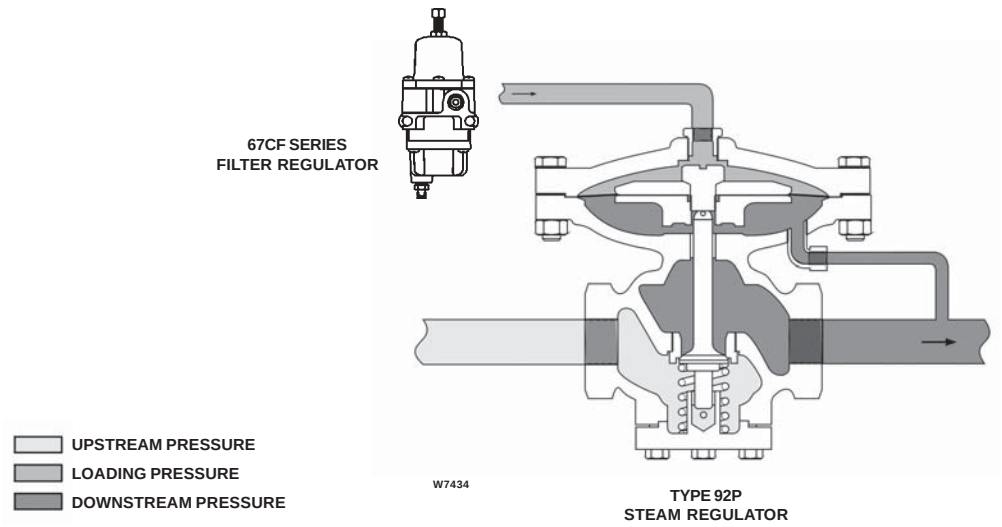
Drain Valve and Spring Case Vent Location
Aligned with inlet standard, other positions optional

Approximate Unit Weight
1 pound (0,5 kg)

Construction Materials
Body, Spring Case and Dripwell: Aluminum (ASTM B85/Alloy 380)
Pusher Post: Polyester resin
Upper Spring Seat: Zinc-plated steel
Diaphragm Plate: Zinc-plated steel
Adjusting Screw: Zinc-plated steel
Filter Retainer: Zinc-plated steel
Valve Plug: Brass stem with nitrile (NBR) plug (standard); aluminum stem with nitrile (NBR) or fluoroelastomer (FKM) plug; or stainless steel stem with nitrile (NBR) or fluoroelastomer (FKM) plug (optional)
Soft Seat: Nitrile (NBR) (standard), or fluoro-elastomer (FKM) (optional)
Diaphragm and O-Rings: Nitrile (NBR) (standard), fluoroelastomer (FKM), or silicone (VMQ) (optional)
Control Spring: Plated steel (standard) or Inconel (for 67CFR NACE)
Valve Spring: Stainless stee (standard) or Inconel (NACE)
Drain Valve: Brass (standard), aluminum, or stainless steel (optional)
Filter Element: Cellulose (standard), glass fiber, or stainless steel (optional)

Options
- Handwheel adjusting screw
- NACE construction
- Ammonia service construction
- Panel mount (includes spring case with 1/4-inch vent, handwheel, and panel mounting nut)
- Closing cap (available on spring case with 1/4-inch NPT vent)
- Aluminum or stainless steel drain valve
- Fluoroelastomer (FKM) elastomers for high temperatures and/or corrosive chemicals
- Silicone (VMQ) elastomers for cold temperatures
- Triple scale outlet pressure gauge (brass or stainless steel)
- Stainless steel stem on the valve plug
- Fixed bleed restriction mounted in the side outlet
- Tire valve in second outlet
- Pipe plug in second outlet

1. The pressure/temperature limits in this bulletin and any applicable standard or code limitation should not be exceeded.
2. Repeatability is the measure of the regulator's ability to return to setpoint consistently when traveling from steady state to transient to steady state.
3. Silicone is not compatible with hydrocarbon gas.



A 67CF SERIES PRESSURE LOADING REGULATOR USED WITH THE TYPE 92P STEAM REGULATOR ELIMINATES THE NEED FOR A PILOT REGULATOR. THIS PROVIDES HIGH ACCURACY AND IMPROVED PERFORMANCE IN DIRTY STEAM SERVICE.

Figure 3. *67CF Series Regulator Used to Pressure Load a 92P Steam Regulator*

Capacity Information

Table 1 shows the air regulating capacities of the 67CF Series regulators at selected inlet pressures and outlet pressure settings. Flows are shown in scfh (at 60°F and 14.7 psia) and in m³/h(n) (at 0°C and 1,01325 bar) of air.

Note

The 67CF Series regulators may be sized for 100% flow using capacities as shown in table 1. It is not necessary to reduce published capacities.

To determine the equivalent capacities for other gases, multiply the table capacity by the following appropriate conversion factor: 1.29 for 0.6 specific gravity natural gas, 0.810 for propane, 0.707 for butane, or 1.018 for nitrogen. For gases of other specific gravities, divide the table capacities by the square root of the appropriate specific gravity.

To find wide-open flow capacities for relief sizing at any inlet pressure, perform one of the following procedures. Then, if necessary, convert using the factors provided above.

For critical pressure drops (absolute outlet pressure equal to or less than one-half of absolute inlet pressure), use the following formula:

$$Q = (P_1)(C_g)$$

where,

Q = gas flow rate, scfh
P_1 = absolute inlet pressure, psia (P_1 gauge + 14.7)

For pressure drops lower than critical (absolute outlet pressure greater than one-half of absolute inlet pressure), use the following formula:

$$Q = \sqrt{\frac{520}{GT}}\, C_g P_1 \mathrm{SIN}\left(\frac{3417}{C_1}\sqrt{\frac{\Delta P}{P_1}}\right)\mathrm{DEG}$$

where,

Q = gas flow rate, scfh
G = specific gravity of the gas
T = absolute temperature of gas at inlet, °Rankine
C_g = gas sizing coefficient
P_1 = absolute inlet pressure, psia
C_1 = flow coefficient ($C_g \div C_v$)
ΔP = pressure drop across the regulator, psi

Then, if capacity is desired in normal cubic meters per hour (at 0°C and 1,01325 bar), multiply scfh by 0.0268.

Table 1. *Capacities*

OUTLET PRESSURE RANGE, SPRING PART NUMBER AND COLOR, PSIG (bar)	OUTLET PRESSURE, PSIG (bar)	INLET PRESSURE, PSIG (bar)	CAPACITIES IN SCFH ($m^3/h(n)$) OF AIR	
			10% Droop	20% Droop
0 to 35 (0 to 2,4) T14059T0012 Silver	15 (1,0)	50 (3,4) 75 (5,2) 100 (6,9) 150 (10,3) 250 (17,2)	250 (6,7) 300 (8,0) 330 (8,8) 400 (10,7) 450 (12,1)	430 (11,5) 690 (18,5) 1150 (30,8) 1600 (42,9) 1800 (48,2)
	20 (1,4)	50 (3,4) 75 (5,2) 100 (6,9) 150 (10,3) 250 (17,2)	350 (9,4) 530 (14,2) 750 (20,1) 1850 (49,6) 2800 (75,0)	500 (13,4) 820 (22,0) 1300 (34,8) 1850 (49,6) 3000 (80,4)
	35 (2,4)	50 (3,4) 75 (5,2) 100 (6,9) 150 (10,3) 250 (17,2)	400 (10,7) 600 (16,1) 840 (22,5) 1850 (49,6) 3000 (80,4)	620 (16,6) 980 (26,3) 1300 (34,8) 1850 (49,6) 3000 (80,4)
0 to 60 (0 to 4,1) T14058T0012 Blue stripe	35 (2,4)	50 (3,4) 75 (5,2) 100 (6,9) 150 (10,3) 250 (17,2)	370 (9,9) 540 (14,5) 760 (20,4) 1360 (36,4) 3000 (80,4)	560 (15,0) 940 (25,2) 1300 (34,8) 1850 (49,6) 3000 (80,4)
	60 (4,1)	75 (5,2) 100 (6,9) 150 (10,3) 250 (17,2)	570 (15,3) 830 (22,2) 1450 (38,9) 2900 (77,7)	830 (22,2) 1220 (32,7) 1850 (49,6) 3000 (80,4)
0 to 125 (0 to 8,6) T14060T0012 Red stripe	80 (5,5)	100 (6,9) 150 (10,3) 250 (17,2)	600 (16,1) 880 (23,6) 1400 (37,5)	870 (23,3) 1320 (35,4) 2500 (67)
	125 (8,6)	150 (10,3) 250 (17,2)	960 25,7() 1700 (45,6)	1400 (37,5) 2580 (69,1)

Overpressure Protection

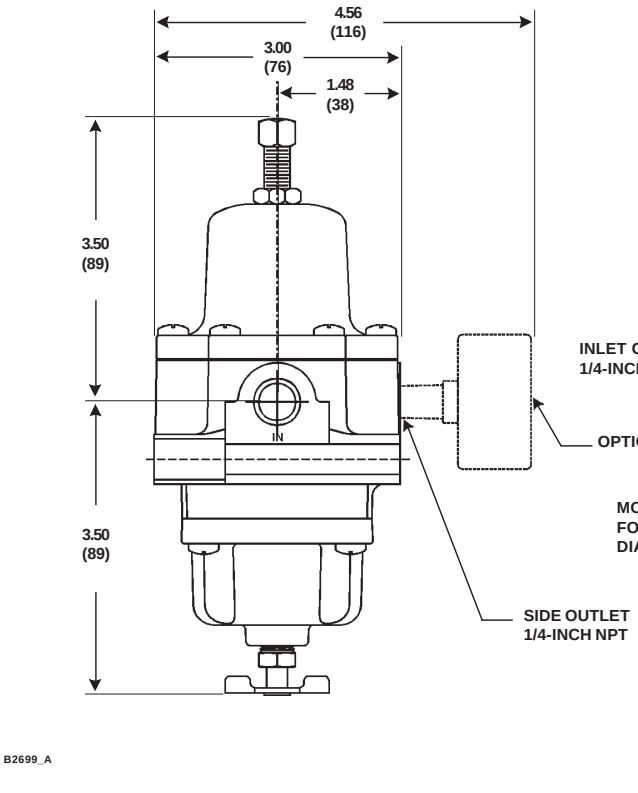
The 67CF Series regulators have maximum outlet pressure ratings that are lower than their maximum inlet pressure ratings. A pressure relieving or pressure limiting device is needed if inlet pressure can exceed the maximum outlet pressure rating.

Refer to the Capacity Information section and the relief sizing coefficient in the specifications table to determine the required relief valve capacity.

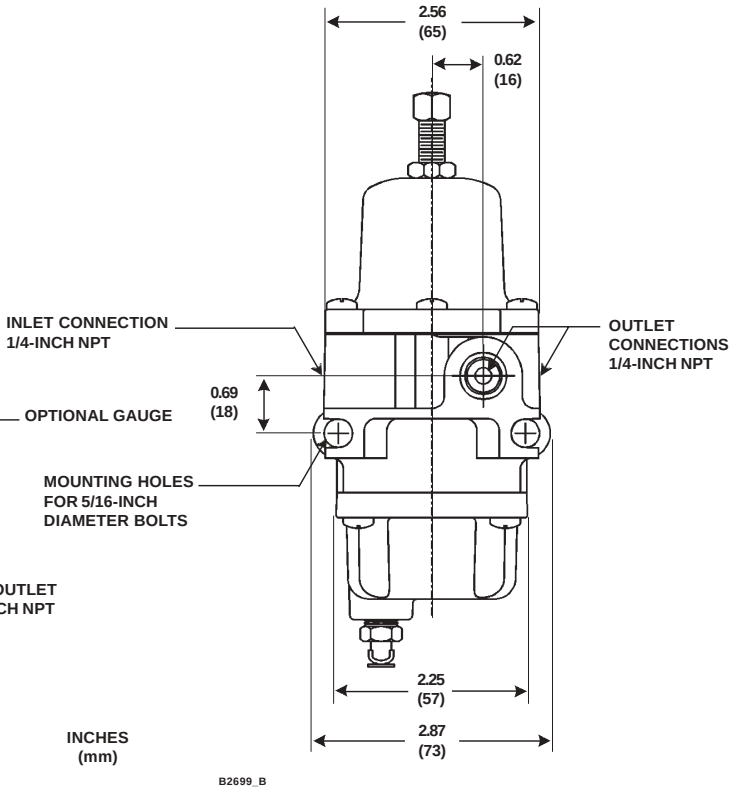
The Type 67CFR regulator has a low capacity internal relief valve for minor seat leakage only. Other overpressure protection must be provided if the maximum inlet pressure can exceed the maximum pressure rating of the downstream equipment or exceeds maximum outlet pressure rating of the Type 67CFR regulator.

Ordering Information

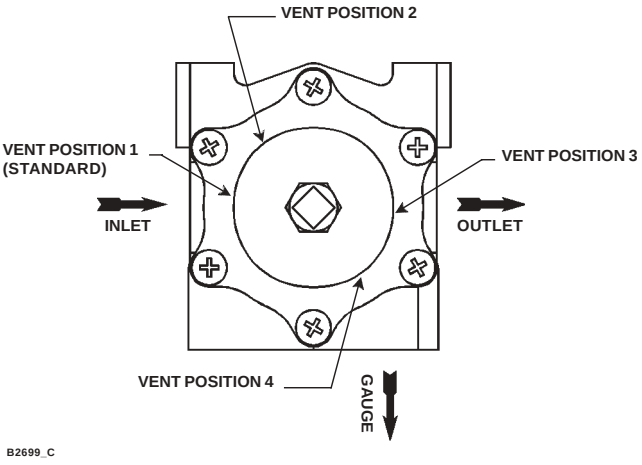
When ordering, complete the Ordering Guide on page 8. Refer to the Specifications on page 2. Review the description to the right of each specification and the information in each referenced table or figure. Specify your choice whenever a selection is offered.



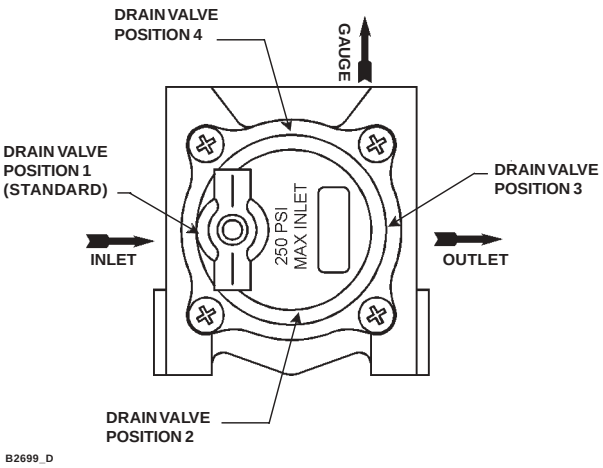
DIMENSIONS
FOR GAUGE OPTION



STANDARD DIMENSIONS

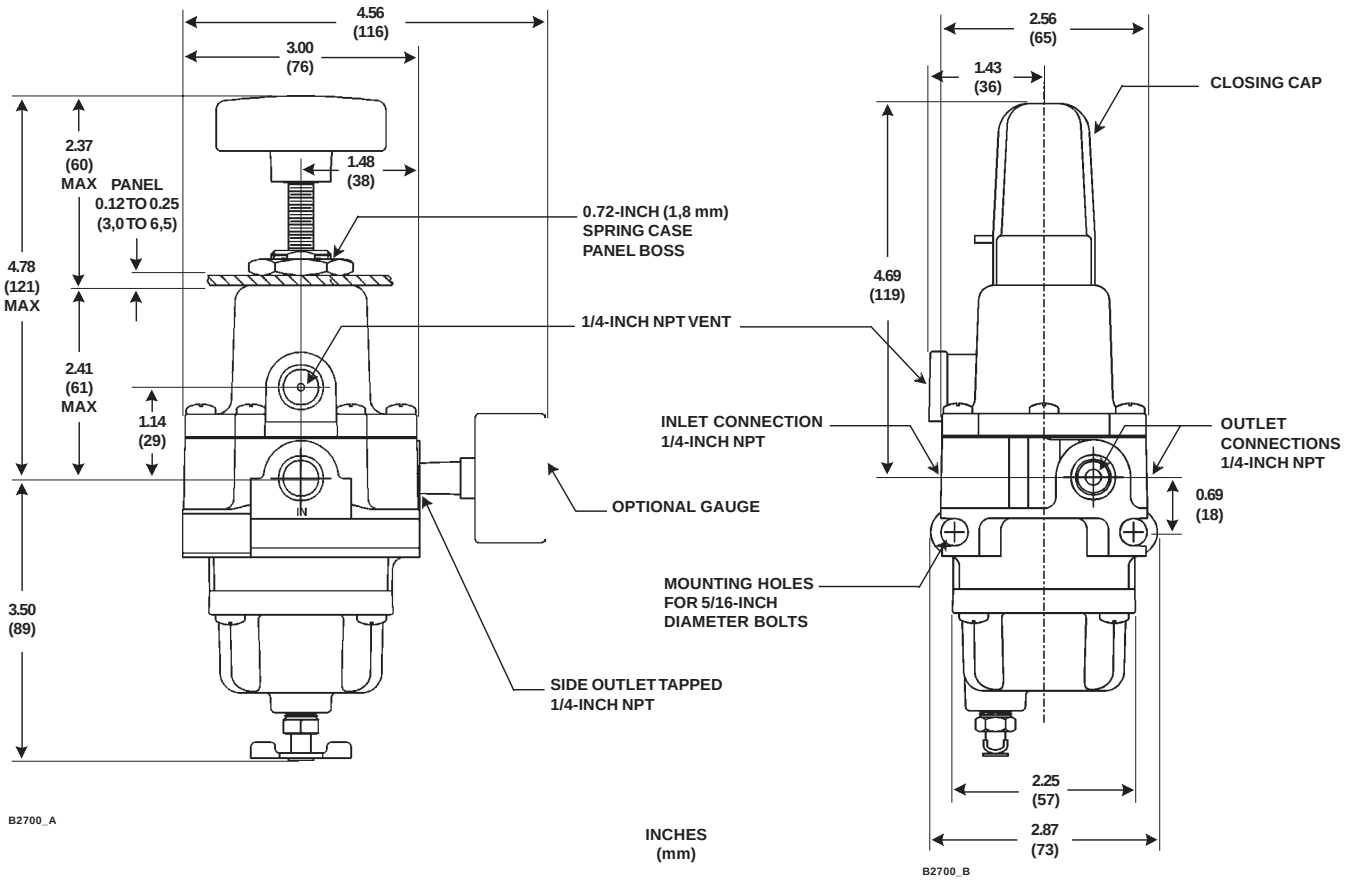


VENT POSITIONS



DRAIN VALVE POSITIONS

Figure 4. *Dimensions*



DIMENSIONS FOR PANEL MOUNT OPTION WITH HAND WHEEL AND 1/4-INCH SPRING CASE VENT

DIMENSIONS FOR CLOSING CAP OPTION WITH 1/4-INCH SPRING CASE VENT

Figure 4. *Dimensions (continued)*

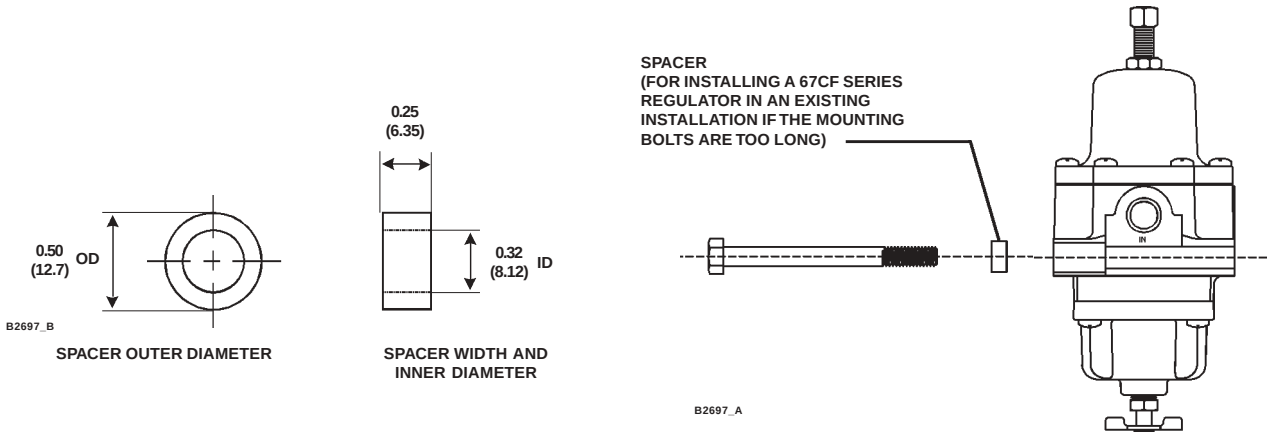


Figure 5. *Spacer Dimensions and Installation Schematic*

Ordering Guide

Type (Select One)
- ☐ Type 67CF (without internal relief)***
- ☐ Type 67CFR (with internal relief)***

Quantity (Specify)

_____

Spring Case Style (Select One)
- ☐ Standard with drilled hole vent***
- ☐ Handwheel adjusting screw***
- ☐ Panel mount (includes 1/4-inch spring case vent, handwheel adjusting screw, and mounting nut)***
- ☐ Closing cap and 1/4-inch NPT spring case vent***

Outlet Pressure Range (Select One)
- ☐ 0 to 20 psig (0 to 1,4 bar) (not available for NACE)***
- ☐ 0 to 35 psig (0 to 2,4 bar)***
- ☐ 0 to 60 psig (0 to 4,1 bar)***
- ☐ 0 to 125 psig (0 to 8,6 bar)***

Diaphragm, O-Rings, and Valve Plug (Select One)
- ☐ Nitrile (NBR) (standard)***
- ☐ Fluoroelastomer (FKM)**
- ☐ Silicone (VMQ) diaphragm, O-rings, and nitrile valve plug*

Filter Material (Select One)
- ☐ Cellulose (40 microns) (standard)***
- ☐ Glass (10 microns)***
- ☐ Stainless steel (40 microns)***

Drain Valve (Select One)
- ☐ Brass (standard)***
- ☐ Aluminum***
- ☐ Stainless steel***

Drain Valve Location (Select One)
- ☐ Position 1 - Aligned with inlet (standard)***
- ☐ Position 2
- ☐ Position 3
- ☐ Position 4

Spring Case Vent Location (Select One)
- ☐ Position 1 - Aligned with inlet (standard)***
- ☐ Position 2
- ☐ Position 3
- ☐ Position 4

Second Outlet (Select One)
- ☐ Open (standard)***
- ☐ Plugged with pipe plug***
- ☐ Tire Valve***
- ☐ Pressure Gauge (see below)

Triple Scale Pressure Gauge (Optional)

Brass Gauge
- ☐ 0 to 30 psig/0 to 0.2 MPa/0 to 2 bar***
- ☐ 0 to 60 psig/0 to 0.4 MPa/0 to 4 bar***
- ☐ 0 to 160 psig/0 to 1.1 MPa/0 to 11 bar***

Stainless Steel Gauge
- ☐ 0 to 30 psig/0 to 0.2 MPa/0 to 2 bar***
- ☐ 0 to 60 psig/0 to 0.4 MPa/0 to 4 bar***
- ☐ 0 to 160 psig/0 to 1.1 MPa/0 to 11 bar***

NACE (MR0175) Construction (Optional)
- ☐ Yes**

Ammonia Service Construction (Optional)
- ☐ Yes**

Replacement Parts Kit (Optional)
- ☐ Yes, send one replacement parts kit to match this order.

Fisher Regulators Quick Order Guide	
* * *	Standard - Readily Available for Shipment
* *	Non-Standard - Allow Additional Time for Shipment
*	Special Order, Constructed from Non-Stocked Parts. Consult Your Fisher Sales Representative for Availability.
Availability of the product being ordered is determined by the component with the longest shipping time for the requested construction.	

Specification Worksheet

Application (Please designate units):

Specific Use _____

Line Size _____

Gas Type and Specific Gravity _____

Gas Temperature _____

Does the Application Require Overpressure Protection?

☐ No ☐ Yes, if so, which is preferred:

☐ Relief Valve ☐ Monitor Regulator ☐ Shutoff Device

Is overpressure protection equipment selection assistance desired? _____

Pressure (Please designate units):

Maximum Inlet Pressure (P_{1max}) _____

Minimum Inlet Pressure (P_{1min}) _____

Downstream Pressure Setting(s) (P_2) _____

Maximum Flow (Q_{max}) _____

Performance Required:

Accuracy Requirements? _____

Need for Extremely Fast Response? _____

Other Requirements: _____

_____

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Types 98L and 98H Backpressure Regulators and Relief Valves

W6155

TYPE 98H OR 98HM

W6156

TYPE 98L

Figure 1. *Types 98L and 98H Backpressure Regulators and Relief Valves*

WARNING

Failure to follow these instructions or to properly install and maintain this equipment could result in an explosion, fire and/or chemical contamination causing property damage and personal injury or death.

Fisher® backpressure regulators and relief valves must be installed, operated, and maintained in accordance with federal, state, and local codes, rules, and regulations, and Emerson Process Management Regulator Technologies, Inc. instructions.

If a leak develops or if the outlet continually vents gas, service to the unit may be required. Failure to correct trouble could result in a hazardous condition. Only a qualified person must install or service the unit.

Installation, operation, and maintenance procedures performed by unqualified personnel may result in improper adjustment and unsafe operation. Either condition may result in equipment damage or personal injury. Use qualified personnel when installing, operating, and maintaining the Types 98L and 98H backpressure regulators and relief valves.

Introduction

Scope of the Manual

This manual provides instructions for the installation, adjustment, maintenance, and parts ordering information of Types 98L and 98H Backpressure Regulators and Relief Valves. Instructions and parts lists for other equipment mentioned in this instruction manual are found in separate manuals.

Description

Types 98L and 98H are direct-operated, spring-loaded backpressure regulators or relief valves. Typical applications include use in wash tanks, small heaters, fuel and oil lines, air supply systems, test fixtures, and sterilizers. Relief pressure ranges are 2 to 38 psig /

D100258X012

Specifications

Available Constructions

Type 98L: Direct-operated low-pressure backpressure regulator/relief valve with internal pressure registration and standard adjusting screw for 2 to 38 psig / 0,14 to 2,6 bar set pressure range

Type 98H: Direct-operated high-pressure backpressure regulator/relief valve with internal pressure registration and standard adjusting screw for 5 to 200 psig / 0,34 to 13,8 bar set pressure range

Type 98HM: Direct-operated high-pressure backpressure regulator/relief valve with external pressure registration and standard adjusting screw for 5 to 275 psig / 0,34 to 19,0 bar set pressure range

Body Sizes and End Connection Styles

TYPE	BODY MATERIAL	
	Cast Iron	WCC Steel, CF8M Stainless steel
98L	1/4, 1/2, 3/4, 1 NPT	1/4 through 1 NPT, NPS 1/2 through 1 / DN 15 through 25, SWE, CL150 RF, CL300 RF, PN16/25/40 RF
98H	1/4, 1/2, 3/4, 1, 1-1/2, 2 NPT	1/4 through 2 NPT, NPS 1/2 through 2 / DN 15 through 50, SWE, CL150 RF, CL300 RF, PN 16/25/40 RF
98HM	- - - -	1/2, 3/4, 1, 1-1/2, 2 NPT

Maximum Cold Working Pressures of Body Size and Materials[1][2]

REGULATOR	BODY SIZE	BODY AND SPRING CASE MATERIALS	MAXIMUM INLET PRESSURE[3]	
			psig	bar
Type 98L	All Sizes	Cast Iron	60	4,1
		Steel	125	8,6
		Stainless Steel	125	8,6
Type 98H	All Sizes	Cast Iron	300	20,7
		Steel	300	20,7
		Stainless Steel	300	20,7
Type 98HM	All Sizes	Steel	300	20,7
		Stainless Steel	300	20,7

Flow Coefficient

C_1: 35

IEC Sizing Coefficients

BODY SIZE		X_T	F_D	F_L	K_m
NPS	DN				
1/4	- - - -	0.78	0.50	0.91	0.83
1/2	15			0.83	0.69
3/4 and 1	20 and 25			0.88	0.77
1-1/2 and 2	40 and 50			0.92	0.85

Relief Pressure Ranges

See Tables 1 and 2

Shutoff Classification Per ANSI/FCI 70-3-2004

Metal Seats: Class IV

Polytetrafluoroethylene (PTFE): Class IV

Elastomer Seats: Class VI

Temperature Capabilities for Elastomer Parts[1][4]

MATERIAL	TEMPERATURE RANGE
Nitrile (NBR)	-40° to 180°F / -40° to 82°C
Neoprene (CR)	-40° to 180°F / -40° to 82°C
Fluorocarbon (FKM)[5]	0° to 300°F / -18° to 149°C Limited to 200°F / 93°C for hot water
Ethylenepropylene (EPDM)[5]	-40° to 275°F / -40° to 135°C
Perfluoroelastomer (FFKM)[5]	0° to 425°F / -18° to 218°C
PTFE Diaphragm protector	-40° to 400°F / -40° to 207°C

Temperature Capabilities for Metal Parts[1][4]

MATERIAL	TEMPERATURE RANGE
Cast iron[6]	-40° to 406°F / -40 to 207°C
WCC Steel	-20° to 450°F / -29° to 232°C
CF8M Stainless steel	-40° to 450°F / -40° to 232°C

Type 98HM Sensing Line Connection

NPS 1/2, 1-1/2, or 2 / DN 15, 40, or 50 Body: 1/8 NPT

NPS 3/4 or 1 / DN 20 or 25 Body: 1/4 NPT

Pressure Registration

Types 98L and 98H: Internal

Type 98HM: External

Options

- Handwheel or tee handle for Types 98L and 98H
- Tapped spring case vent for Types 98L, 98H, and 98HM
- Seal washer to permit spring case pressure loading for Types 98L, 98H, and 98HM

Approximate Weights

Type 98L

NPS 1/4 Body: 6 pounds / 3 kg

NPS 1/2 / DN 15 Body: 13 pounds / 6 kg

NPS 3/4 / DN 20 Body: 30 pounds / 14 kg

NPS 1 / DN 25 Body: 30 pounds / 14 kg

Type 98H

NPS 1/4 Body: 7 pounds / 4 kg

NPS 1/2 / DN 15 Body: 7 pounds / 2 kg

NPS 3/4 / DN 20 Body: 16 pounds / 7 kg

NPS 1 / DN 25 Body: 16 pounds / 7 kg

NPS 1-1/2 / DN 40 Body: 55 pounds / 25 kg

NPS 2 / DN 50 Body: 55 pounds / 25 kg

Type 98HM

NPS 1/2 / DN 15 Body: 8 pounds / 4 kg

NPS 3/4 or 1 / DN 20 or 25 Body: 20 pounds / 9 kg

NPS 1-1/2 or 2 / DN 40 or 50 Body: 73 pounds / 33 kg

1. The pressure/temperature limits in this instruction manual or any applicable standard limitation should not be exceeded.
2. Temperature and/or the body end connection may decrease these maximum pressures.
3. Maximum inlet pressure equals set pressure plus buildup.
4. Pressure and/or the body end connection may decrease these maximum temperatures.
5. Not for use on steam service.
6. Not available for Type 98HM.

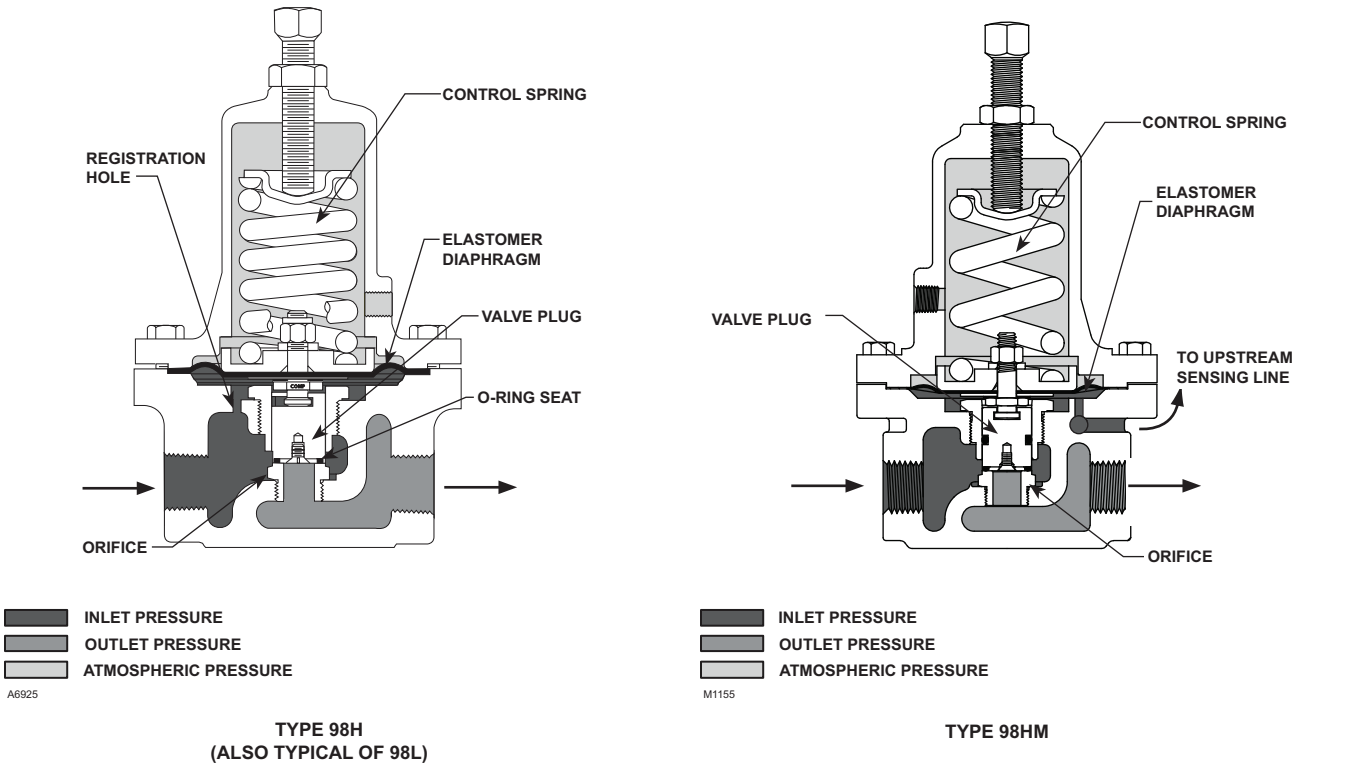


Figure 2. *98 Series Operational Schematics*

0,14 to 2,6 bar, in four ranges, for Type 98L and 15 to 200 psig / 1,0 to 13,8 bar, in four ranges for each sizes, for Type 98H. Type 98L is available on body sizes NPS 1/4, 1/2, 3/4, and 1 / DN 15, 20, and 25 and Type 98H on body sizes NPS 1/4, 1/2, 3/4, 1, 1-1/2, and 2 / DN 15, 20, 25, 40, and 50.

The Type 98HM can be used for backpressure or relief applications in liquid, gas, or steam service. The Type 98HM features a sensing line connection for sensing pressure externally from the regulator. The Type 98HM is a direct-operated, spring-to-close regulator and requires no external power to operate. A seal washer for the set screw can be included when applications require pressure loading of the spring case (not available on NPS 1-1/2 and 2 / DN 40 and 50 bodies).

Note

Using a Type 98HM as a relief valve does not exclude the installation of an ASME certified full flow relief valve as specified by local codes and regulations or system design.

Principle of Operation

Relief or backpressure valves respond to changes in upstream pressure. Pressure changes register under the diaphragm (see Figure 2) through a registration hole in the valve body (through upstream sensing line connection for Type 98HM). When the pressure increases beyond the spring setting, the diaphragm pressure overcomes the spring compression. This causes the valve plug to move away from the orifice. The flow line through the valve is open and excess pressure is vented. When upstream pressure drops back to normal, the valve resumes its closed position.

Installation

WARNING

Personal injury or system damage may result if this relief valve/backpressure regulator is installed where service conditions could exceed the limits given on the Specifications section

Table 1. *Types 98L and 98H Relief Set Pressure Ranges*

BODY SIZES		TYPE 98L RELIEF SET PRESSURE RANGE(1)		TYPE 98H RELIEF SET PRESSURE RANGE(1)		SPRING COLOR	SPRING PART NUMBER	SPRING WIRE DIAMETER		SPRING FREE LENGTH	
NPS	DN	psig	bar	psig	bar			Inches	mm	Inches	mm
1/4	- - - -	2 to 7	0,14 to 0,48	15 to 35	1,0 to 2,4	Yellow	1E392527022	0.148	3,76	2.00	50,8
		6 to 14	0,41 to 0,97	25 to 75	1,7 to 5,2	Green	1E392627012	0.170	4,32	2.00	50,8
		12 to 25	0,83 to 1,7	70 to 140	4,8 to 9,6	Red	1E392727142	0.207	5,26	1.93	49,0
		20 to 38	1,4 to 2,6	130 to 200	9,0 to 13,8	Blue	1L346127142	0.225	5,72	2.08	52,8
1/2	15	2 to 7	0,14 to 0,48	15 to 35	1,0 to 2,4	Yellow	1E395627022	0.207	5,26	2.50	63,5
		6 to 14	0,41 to 0,97	25 to 75	1,7 to 5,2	Green	1D7455T0012	0.234	5,94	1.02	25,9
		12 to 25	0,83 to 1,7	70 to 140	4,8 to 9,6	Red	1E395727192	0.281	7,14	2.44	62,0
		20 to 38	1,4 to 2,6	130 to 200	9,0 to 13,8	Blue	1L380027142	0.331	8,41	2.25	57,2
3/4 and 1	20 and 25	2 to 7	0,14 to 0,48	15 to 35	1,0 to 2,4	Yellow	1E398927022	0.306	7,77	4.00	102
		6 to 14	0,41 to 0,97	25 to 75	1,7 to 5,2	Green	1E399027142	0.343	8,71	4.00	102
		12 to 25	0,83 to 1,7	70 to 140	4,8 to 9,6	Red	1E399127162	0.406	10,3	4.00	102
		20 to 38	1,4 to 2,6	130 to 200	9,0 to 13,8	Blue	1L380127082	0.468	11,9	3.75	95,3
1-1/2 and 2	40 and 50	- - - -	- - - -	5 to 35	0,3 to 2,4	Dark Gray	1E792327092	0.468	11,9	6.56	167
		- - - -	- - - -	20 to 65	1,4 to 4,5	Light Blue	1E795327082	0.531	13,5	6.56	167
		- - - -	- - - -	50 to 100	3,5 to 6,9	Light Gray	1E795427082	0.562	14,2	6.56	167
		- - - -	- - - -	80 to 170	5,5 to 11,7	Black	1P788827082	0.625	15,9	6.56	167

1. All springs may be backed off to 0 psig / 0 bar. However, highest capacities and best performances are obtained by using these springs in their recommended ranges.

Table 2. *Type 98HM Relief Set Pressure Ranges*

SPRING MATERIAL	BODY SIZES		SPRING RANGE(1)		SPRING COLOR	SPRING PART NUMBER	SPRING WIRE DIAMETER		SPRING FREE LENGTH	
	NPS	DN	psig	bar			Inches	mm	Inches	mm
Steel	1/2	15	15 to 35	1,0 to 2,4	Yellow	1E395627022	0.207	5,26	2.50	63,5
			25 to 75	1,7 to 5,2	Green	1D7455T0012	0.234	5,94	2.62	66,5
			70 to 140	4,8 to 9,6	Red	1E395727192	0.281	7,14	2.44	62,0
			130 to 200	9,0 to 13,8	Blue	1L380027142	0.331	8,41	2.25	57,2
	3/4 and 1	20 and 25	15 to 35	1,0 to 2,4	Yellow	1E398927022	0.306	7,77	4.00	102
			25 to 75	1,7 to 5,2	Green	1E399027142	0.343	8,71	4.00	102
			70 to 140	4,8 to 9,6	Red	1E399127162	0.406	10,3	4.00	102
			130 to 200	9,0 to 13,8	Blue	1L380127082	0.468	11,9	3.75	95,3
	1-1/2 and 2	40 and 50	5 to 35	0,34 to 2,4	Dark Gray	1E792327092	0.469	11,9	6.50	165
			20 to 65	1,4 to 4,5	Light Blue	1E795327082	0.531	13,5	6.50	165
			50 to 100	3,5 to 6,9	Light Gray	1E795427082	0.563	14,3	6.50	165
			80 to 170	5,5 to 11,7	Black	1P788827082	0.656	16,7	6.50	165
Stainless Steel	1/2	15	15 to 100	1,0 to 6,9	Unpainted	14B9943X012	0.282	7,16	2.50	63,5
			100 to 275	6,9 to 19,0	Unpainted	14B9942X022	0.375	9,53	2.50	63,5
	3/4 and 1	20 and 25	15 to 100	1,0 to 6,9	Unpainted	14B9944X022	0.432	11,0	4.03	102
			100 to 275	6,9 to 19,0	Unpainted	14B9945X022	0.562	14,2	4.03	102

1. All springs may be backed off to 0 psig / 0 bar. However, highest capacities and best performances are obtained by using these springs in their recommended ranges.

Table 3. *Torque Specifications*

BODY SIZES		SPRING CASE		ORIFICE	
NPS	DN	FOOT-POUNDS	N•m	FOOT-POUNDS	N•m
1/4	- - - -	4.5 to 5.0	6,1 to 6,8	8 to 12	11 to 16
1/2	15	10 to 13	14 to 18	29 to 35	39 to 47
3/4, 1	20, 25	24 to 30	33 to 41	33 to 42	45 to 57
1-1/2, 2	40, 50	40 to 50	54 to 68	140 to 170	190 to 230

or regulator nameplate. Installations should be adequately protected from physical damage.

Overpressuring any portion of this equipment may cause equipment damage, leaks in the relief valve/ backpressure regulator, or personal injury due to bursting of pressure-containing parts. System operation within the limits shown in the Specifications section (page 2) does not eliminate the possibility of damage from external sources or debris in the pipeline. The relief valve/backpressure regulator should be inspected for damage regularly and after any overpressure condition.

Unbox and inspect the valve. Remove pipe scale and other foreign material from the connecting pipeline. Apply a suitable pipe compound to the external threads. The relief valve can be installed in any position as long as the flow is in the direction indicated by the arrow cast on the body.

Overpressure Protection

WARNING

Overpressuring any portion of this equipment may result in equipment damage, leaks in the relief valve / backpressure regulator, or personal injury due to bursting of pressure-containing parts. The system should be inspected after any overpressure condition.

Relief or backpressure ranges are from 2 to 200 psig / 0,14 to 13,8 bar. The individual spring range of your relief valve is stamped on the nameplate.

Maximum inlet pressures depend upon body materials and temperatures. See the Specifications section for the maximum inlet pressure of the valve. The valve should be inspected for damage after any overpressure condition.

Vents

WARNING

If using a Type 98L, 98H, or 98HM Backpressure Regulator or Relief Valve on hazardous or flammable gas service, personal injury and property damage could occur due to fire or explosion of vented gas that may have accumulated.

To prevent such injury or damage, provide piping or tubing to vent the gas to a safe, well-ventilated area. Also, when venting a hazardous gas, the piping or tubing should be located far enough away from any buildings or windows so to not create a further hazard, and the vent opening should be protected against anything that could clog it.

If remote venting is necessary, an optional tapped vent in the spring case is available. Install remote vent lines in the spring case and outlet openings. The vent lines must have the largest practical diameter and be as short as possible with a minimum number of bends or elbows.

Startup

Key numbers are shown in Figures 3 through 5. With proper installation completed and system equipment properly adjusted, close any vent valves, and slowly open the upstream shutoff valve while using pressure gauges to monitor pressure.

If set pressure adjustment is necessary, monitor the inlet pressure with a gauge during the adjustment procedure.

Adjustment

Each unit is factory set for the pressure specified on your order. The allowable spring range is stamped on the nameplate. If a pressure setting beyond the indicated range is required, replace with the appropriate spring. Be sure to label the valve to indicate the new pressure range.

Always use a pressure gauge to monitor pressure when making adjustments.

All regulator springs can be backed off to 0 psig / 0 bar. Recommended set pressure ranges available, maximum inlet pressures and temperatures, and color codes of the respective springs are shown in the Specifications section and Tables 1 and 2.

Loosen the jam nut (key 17). To increase the setting, turn the adjusting screw (key 15) clockwise. Turn the adjusting screw counterclockwise to decrease the setting. Tighten the jam nut.

Shutdown

Close the upstream shutoff valve, and release all pressure from the backpressure regulator/relief valve.

Maintenance

WARNING

To avoid personal injury and equipment damage, isolate the valve from all pressure. Cautiously release pressure from the valve before attempting disassembly.

Due to normal wear and damage that may occur from external sources, relief valve parts such as the O-rings, gaskets, diaphragm, orifice, and valve plug should be inspected periodically and replaced as necessary. The frequency of inspection and replacement depends upon the severity of service conditions or the requirements of state and federal laws.

Instructions are given below for disassembly of the Types 98L and 98H backpressure regulators/relief valves. These valves do not have to be removed from the pipeline to inspect internal parts. Suitable lubricants are indicated on the assembly drawings. Apply the lubricants as the relief valve is being

reassembled. Refer to Figures 3, 4, and 5 while servicing the relief valve.

CAUTION

Metal diaphragms have thin sharp edges. To avoid hand cuts, use caution when handling the diaphragm and particularly the diaphragm edge.

Type 98 relief valves contain or may contain a thin metal diaphragm. Use care when handling the metal diaphragms to prevent hand injuries or damage to the diaphragm.

1. Relieve the spring tension by loosening the jam nut (key 17) and turning the adjusting screw (key 15) counterclockwise. Remove the cap screws (key 16). Lift off the spring case (key 2), upper spring seat (key 9), and spring (key 11).
2. Lift out the diaphragm unit which includes the pusher post (key 6), lower spring seat (key 8), diaphragm head (key 25, Type 98L), washer (key 7), valve plug (key 4), and diaphragm (key 12).

   There will be two diaphragms if the diaphragm material is metal or fluorocarbon (FKM) except for Type 98L, NPS 1/4, 2 to 7 psi / 0,14 to 0,48 bar range which uses only one metal diaphragm.

   For Type 98HM, two diaphragms are also required if material used is Ethylenepropylene (EPDM) except for NPS 3/4 or 1 / DN 20 or 25 which uses only one Ethylenepropylene (EPDM) diaphragm.

   Refer to Figures 3, 4, and 5 for the diaphragm and gasket assembly.
3. Check the orifice (key 3). If it needs replacing or repairing, unscrew the valve plug guide (key 5) and then the orifice. The valve plug can be removed by sliding it off of the pusher post (key 6).

Note

If damage to elastomer or metal seating surfaces is severe, replace the orifice (key 3) and valve plug O-ring (key 22) with new parts. However, by following the lapping procedure below, it is possible to repair metal seating surfaces if they are only slightly worn or scratched.

4. Lapping procedure:
   a. Place a small amount of 500-grit silicon carbide or aluminum oxide lapping compound on a flat surface such as a piece of heavy plate glass.
   b. Take the valve plug (key 4) or orifice (key 3) and move it in a figure 8 motion on the lapping compound. Do not allow the part to tip or rock since this would round the corners.
   c. Repeat step b for each part, using an 800-grit or 1000-grit silicon carbide or aluminum oxide lapping compound.
   d. Wash away all traces of the lapping compound. To help prevent scratching the seating surfaces, a light coat of oil may be applied before returning the valve plug and orifice to the body (key 1). See Table 3 for torque specifications.
5. Return the orifice and valve plug guide (key 5) to the body.
6. Place a small amout of sealant on the threads before installing the valve plug guide and the orifice. See Table 3 for torque specifications.
7. To replace the valve plug O-ring (key 22), remove the screw (key 24) and O-ring retainer (key 21) from the plug. Remove and replace the O-ring.
8. Separate the remainder of the diaphragm unit parts. Take the locknut (key 26) off of the pusher post (key 6). Slide off the lock washer (key 23), lower spring seat, diaphragm head (Type 98L), diaphragm, washer (key 7), and gasket (key 10).
9. Slip the plug (key 4) onto the pusher post. Place a gasket (key 10) on the shaft of the pusher post (key 6) over the threaded portion until it rests on the base of the post. If elastomer diaphragm is used, place a metal washer (key 7) on top of the gasket. For Type 98H, NPS 1-1/2 to 2 / DN 40 to 50) with metal diaphragm, place another gasket on the shaft of the pusher post until it rests on the bottom diaphragm head (key 25), see Figure 4. Refer to Figures 3 to 5.

Note

If a metal diaphragm is to be replaced by an elastomer diaphragm or an elastomer diaphragm by a metal diaphragm, a new pusher post is required. Each diaphragm material requires a different pusher post length and make sure the proper number of metal or elastomer diaphragm that will be used is followed. Refer to the Parts List section for the correct number of diaphragm to be used.

10. For the metal diaphragms, replace the large diaphragm gasket (key 19) on the surface of the body (key 1) that will support the diaphragms. There will be two diaphragms used per regulator,

except for Type 98L, NPS 1/4 with 2 to 7 psi / 0,14 to 0,48 bar set pressure range which uses only one metal diaphragm. The raised surfaces of the metal diaphragms should be placed in the unit so that they are facing toward the assembler (toward the spring) except only when one diaphragm is being used then the raised surface should be facing down (towards the body). See Figures 3 to 5 as references.

11. Slip the lower spring seat (key 8) and lock washer (key 23) back onto the pusher post. Screw on the locknut (key 26) and return the diaphragm unit to the body (key 1).
12. Set the spring (key 11) in the lower spring seat and place the upper spring seat (key 9) on the spring.
13. Put the spring case (key 2) over the spring and onto the body. Tighten the cap screws (key 16) finger tight only.
14. To ensure proper slack in the diaphragm, apply some spring compression by turning the adjusting screw clockwise. Finish tightening the cap screws.

Parts Ordering

When corresponding with your local Sales Office about this equipment, always reference the equipment serial number stamped on the nameplate.

When ordering replacement parts, specify the complete 11-character part number of each required part as found in the following parts list. Separate kits containing all recommended spare parts are available.

Parts List

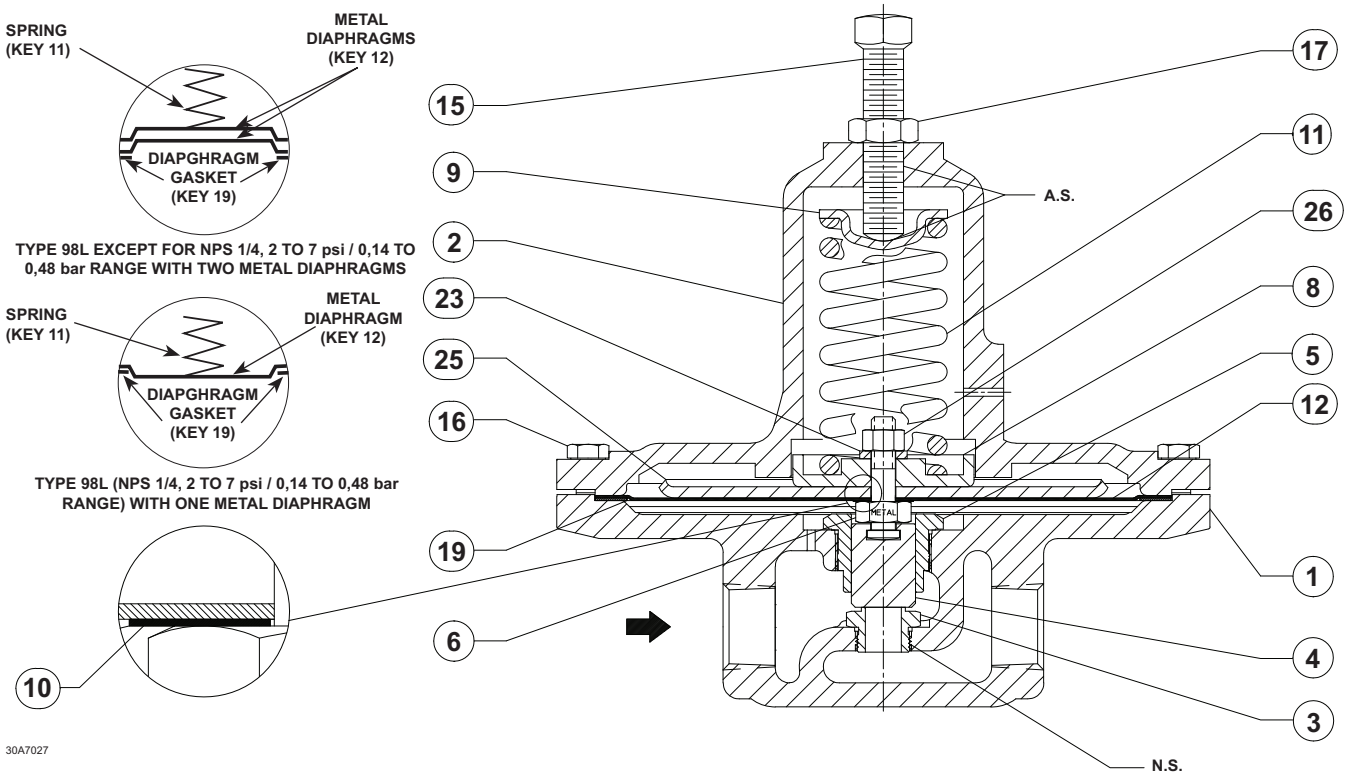
Note

In this parts list, parts marked NACE are intended for corrosion-resistant service as detailed in the NACE International standard MR0175-2003.

Types 98L, 98H, and 98HM (Figures 3, 4, and 5)

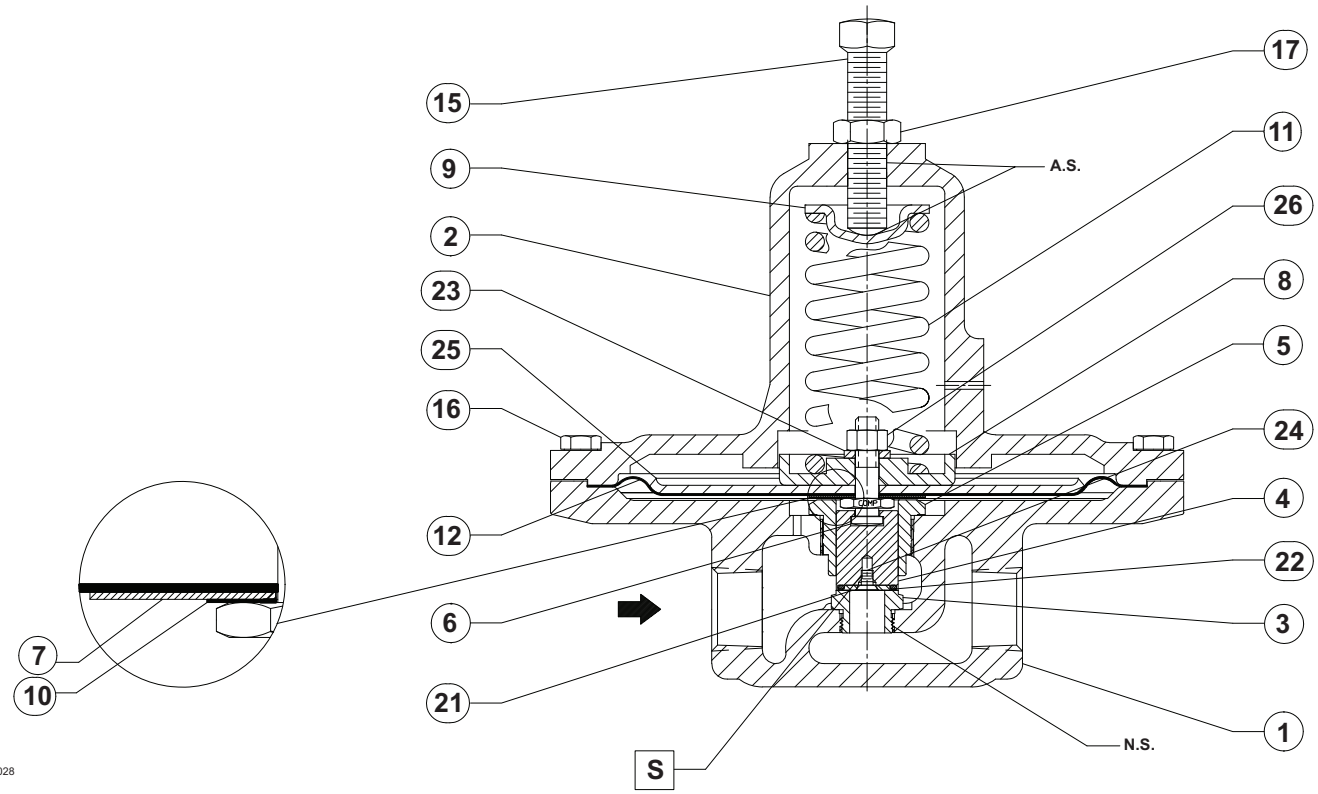
Key	Description	Part Number
	Type 98L	
	Parts Kits	
	Elastomer Trim	
	(include keys 3, 4, 10, 12, 21, 22, and 24)	
	NPS 1/4	R98LX000012
	NPS 1/2 / DN 15 body	R98LX000022
	NPS 3/4 and 1 / DN 20 and 25 bodies	R98LX000032
	Metal Trim (include keys 3, 4, 10, 12, and 19)	
	NPS 1/4	R98LX000042
	NPS 1/2 / DN 15 body	R98LX000052
	NPS 3/4 and 1 / DN 20 and 25 bodies	R98LX000062
	Type 98H	
	Parts kit	
	Elastomer Trim (include keys 3, 4, 10, 12, 14 (for NPS 1-1/2 and 2 / DN 40 and 50 only), 21, 22, and 24)	
	NPS 1/4 body	R98HX000012
	NPS 1/2 / DN 15 body	R98HX000022
	NPS 3/4 and 1 / DN 20 and 25 bodies	R98HX000032
	NPS 1-1/2 and 2 / DN 40 and 50 bodies	R98HX000072
	Metal Trim (include keys 3, 4, 10, 12, and 19)	
	NPS 1/4 body	R98HX000042
	NPS 1/2 / DN 15 body	R98HX000052
	NPS 3/4 and 1 / DN 20 and 25 bodies	R98HX000062
	NPS 1-1/2 and 2 / DN 40 and 50 bodies	R98HX000082
	Type 98HM	
	Parts Kits (include keys 3, 4, 10, 12, 19, 21, 22, 24, and 53)	
	416 Stainless steel trim	
	With Fluorocarbon (FKM) O-rings	R98HMX00012
	With Ethylenepropylene (EPDM) O-rings	R98HMXEPR12
	316 Stainless steel	
	With Fluorocarbon (FKM) O-rings	R98HMX00022
	With Ethylenepropylene (EPDM) O-rings	R98HMXEPR22
1	Body	See following table
2	Spring Case	
	Type 98H	
	Cast iron	
	Standard	
	NPS 1/4 body	2E391219012
	NPS 1/2 / DN 15 body	2J496219012
	NPS 3/4 and 1 / DN 20 and 25 bodies	3E397819012
	NPS 1-1/2 and 2 / DN 40 and 50 bodies	- - - - - - - - - - -
	Tapped	
	NPS 1/4 body	2L442919012
	NPS 1/2 / DN 15 body	- - - - - - - - - - -
	NPS 3/4 and 1 / DN 20 and 25 bodies	3L460819012
	NPS 1-1/2 and 2 / DN 40 and 50 bodies	4P784019012
	Steel	
	Standard	
	NPS 1/4 body	2J127522012
	NPS 1/2 / DN 15 body	2L416322012
	NPS 3/4 and 1 / DN 20 and 25 bodies	3E408722012
	NPS 1-1/2 and 2 / DN 40 and 50 bodies	- - - - - - - - - - -
	Tapped	
	NPS 1/4 body	2L443022012
	NPS 1/2 / DN 15 body	2L442022012
	NPS 3/4 and 1 / DN 20 and 25 bodies	3L460722012
	NPS 1-1/2 and 2 / DN 40 and 50 bodies	3P790422012
	316 Stainless steel	
	Standard	
	NPS 1/4 body	2J1275X0012
	NPS 1/2 / DN 15 body	2L416333092
	NPS 3/4 and 1 / DN 20 and 25 bodies	3E4087X0012
	NPS 1-1/2 and 2 / DN 40 and 50 bodies	- - - - - - - - - - -
	Tapped	
	NPS 1/4 body	2L4430X0012
	NPS 1/2 / DN 15 body	2L4420X0012
	NPS 3/4 and 1 / DN 20 and 25 bodies	3L4607X0022
	NPS 1-1/2 and 2 / DN 40 and 50 bodies	3P7904X0012
	Type 98L	
	Cast iron	
	Standard	
	NPS 1/4 body	2E391319012
	NPS 1/2 / DN 15 body	3J496319012
	NPS 3/4 and 1 / DN 20 and 25 bodies	4E397919012

*Recommended spare part.



A.S - APPLY ANTI-SEIZE COMPOUND
N.S - APPLY NEVER-SEEZ®

TYPE 98L ASSEMBLY WITH METAL DIAPHRAGM

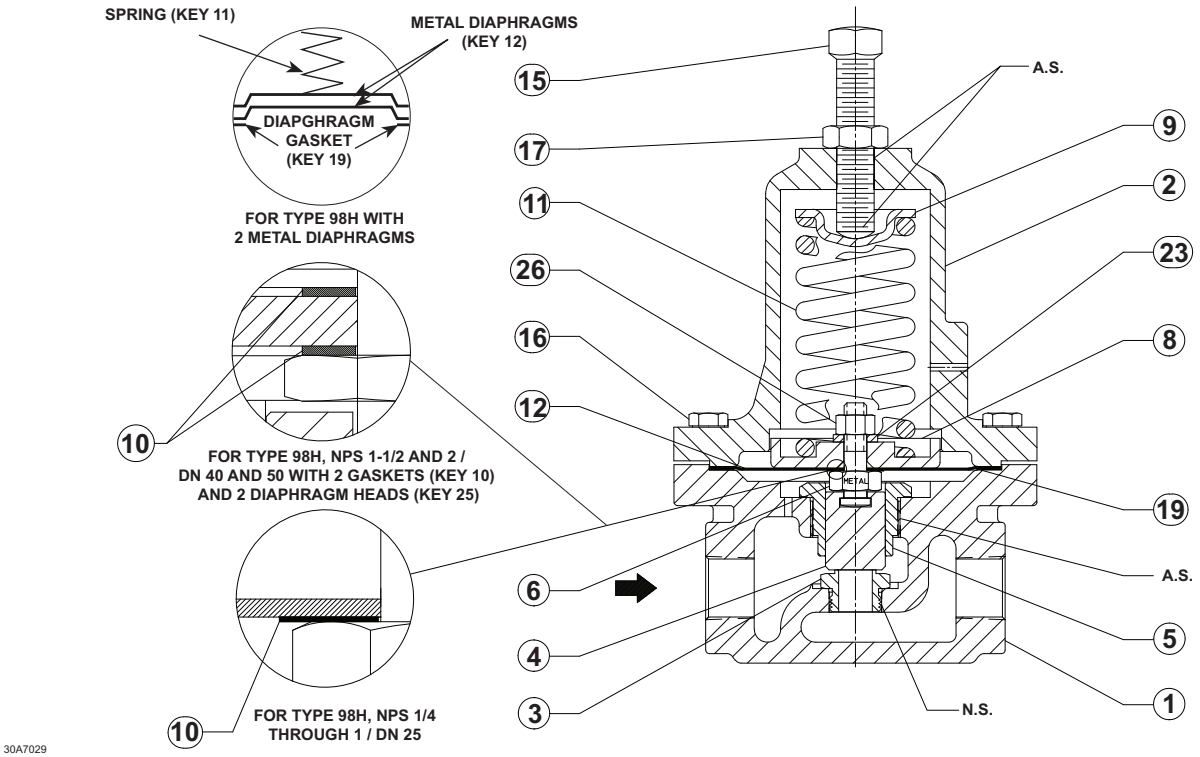


A.S - APPLY ANTI-SEIZE COMPOUND
N.S - APPLY NEVER-SEEZ®
□ - APPLY PIPE THREAD SEALANT (S)

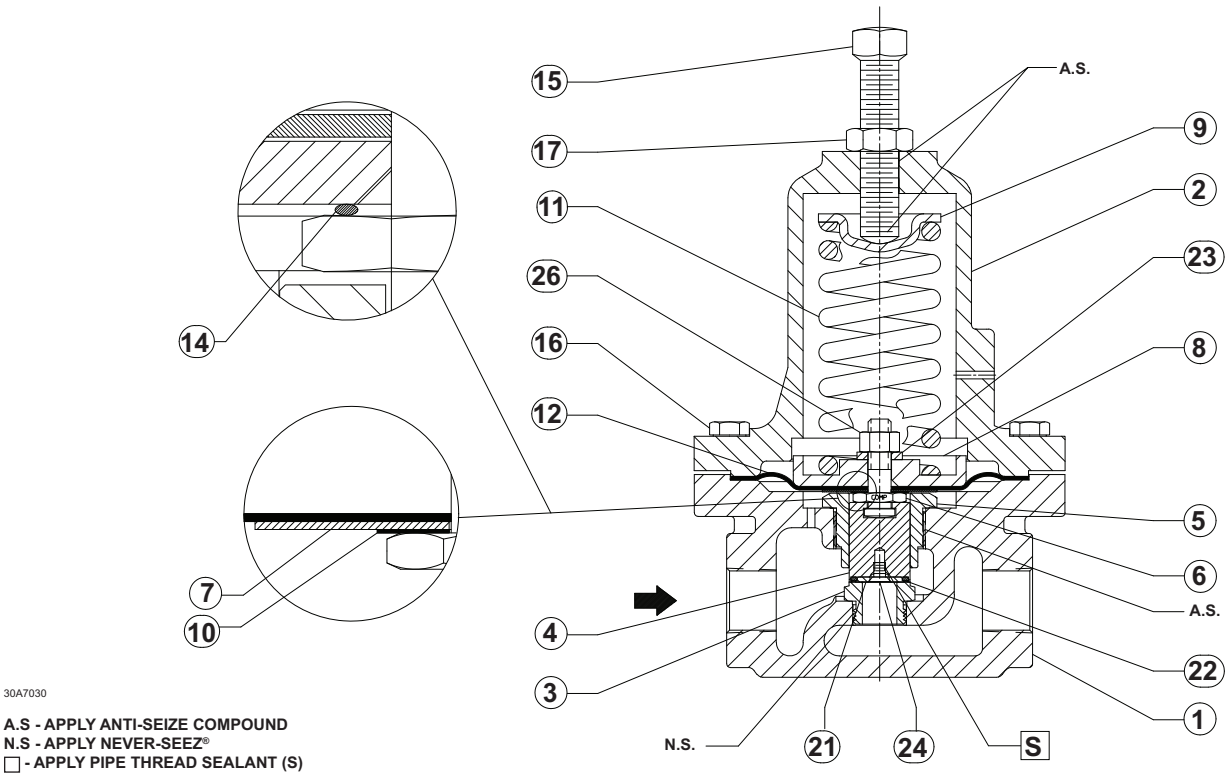
TYPE 98L ASSEMBLY WITH ELASTOMER DIAPHRAGM

Never-Seez® is a trademark of Bostik, Inc.

Figure 3. *Type 98L Relief Valve Assemblies*

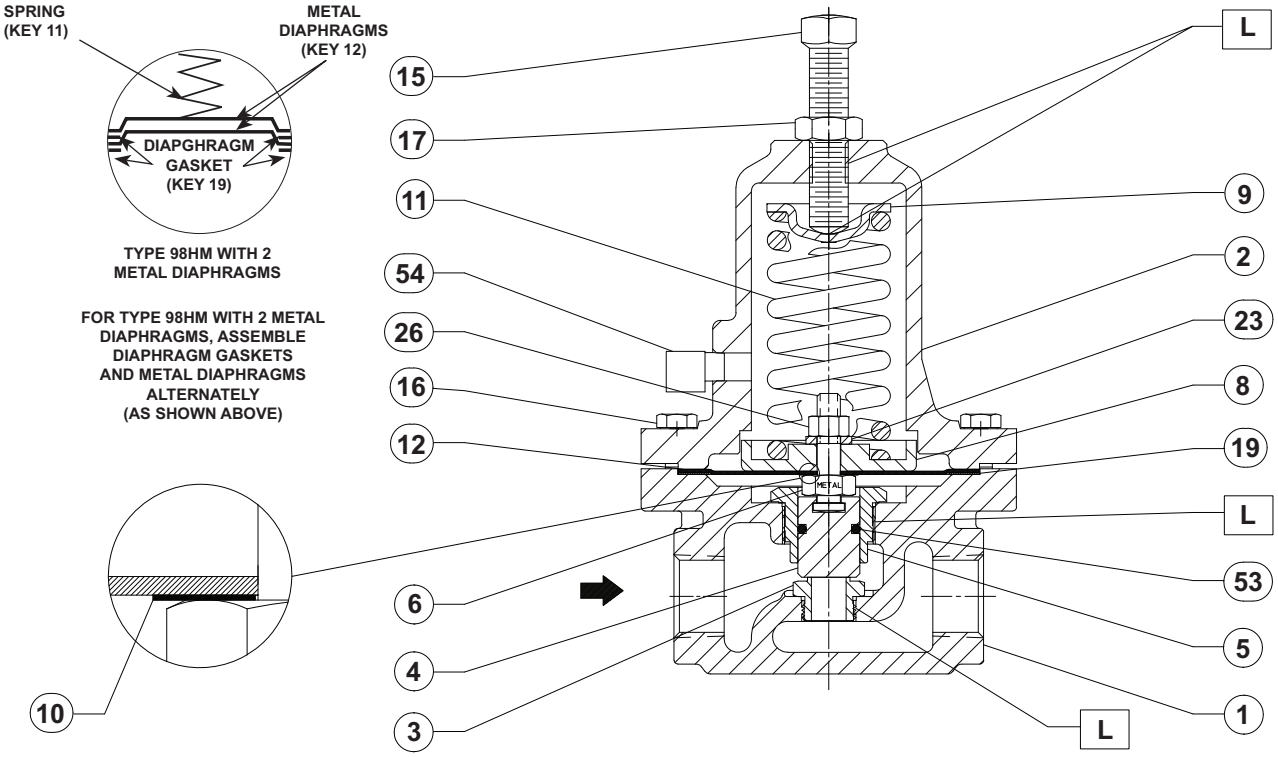


TYPE 98H ASSEMBLY WITH METAL DIAPHRAGM

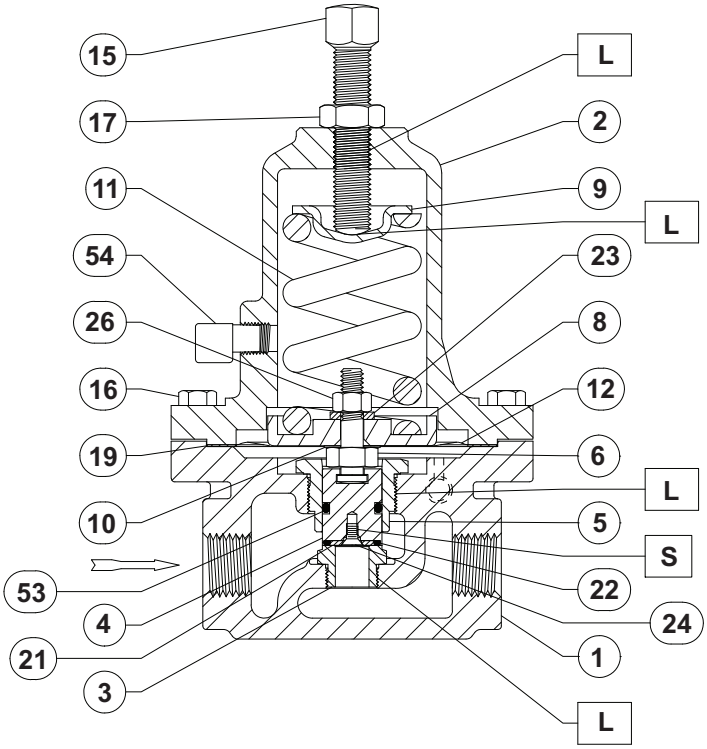


TYPE 98H ASSEMBLY WITH ELASTOMER DIAPHRAGM

Figure 4. *Type 98H Relief Valve Assemblies*



TYPE 98HM ASSEMBLY WITH METAL SEAT AND DIAPHRAGM



TYPE 98HM ASSEMBLY WITH ELASTOMER SEAT AND METAL DIAPHRAGM

Figure 5. *Type 98HM Relief Valve Assemblies*

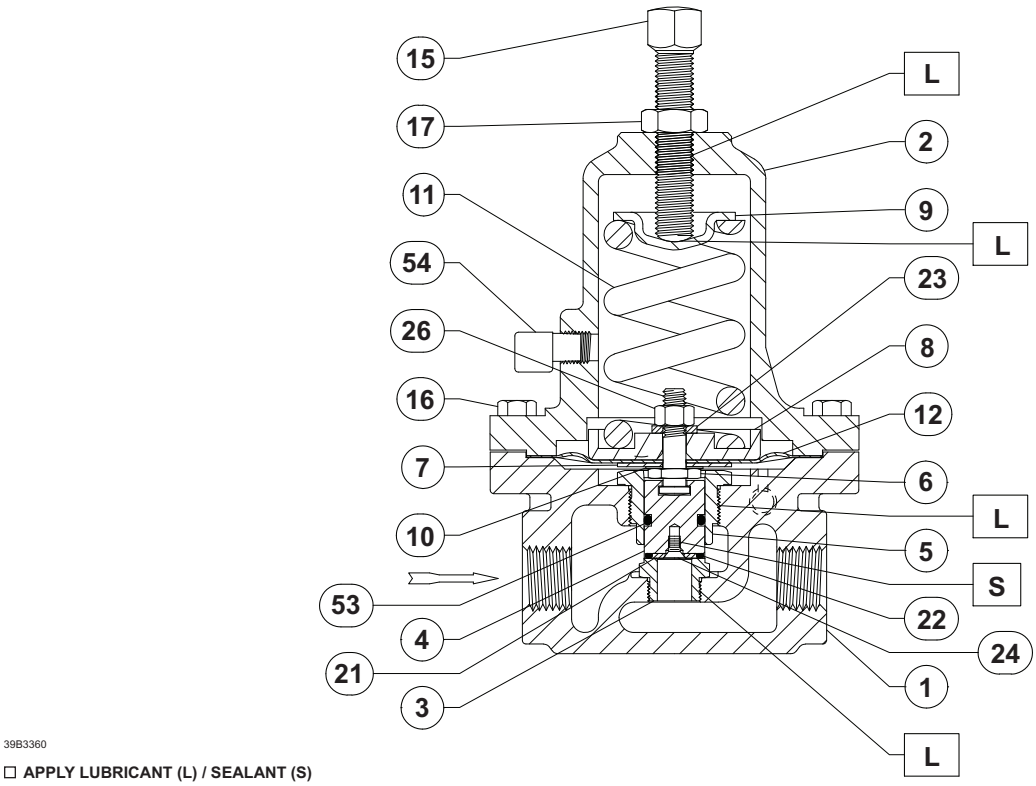


Figure 5. *Type 98HM Relief Valve Assemblies (continued)*

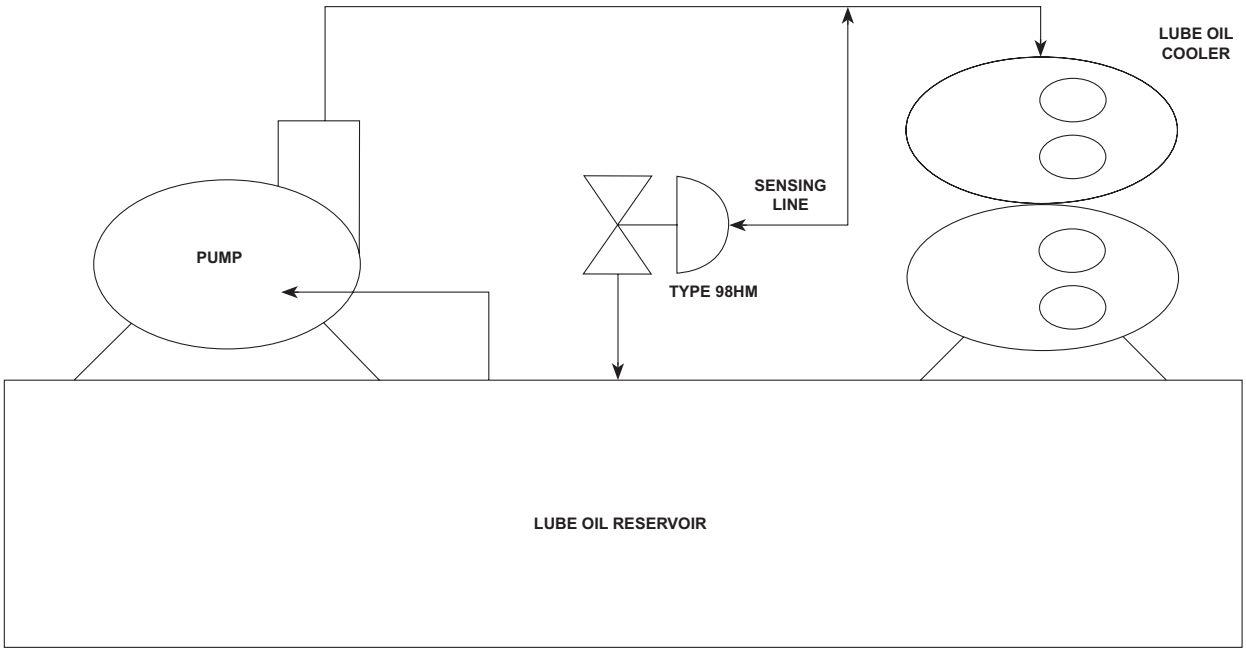


Figure 6. *Type 98HM Used in a Typical Bypass Application*

Key	Description	Part Number
2	Spring Case (continued)	
	Type 98L (continued)	Tapped
	NPS 1/4 body	- - - - - - - - - -
	NPS 1/2 / DN 15 body	3L442119012
	NPS 3/4 and 1 / DN 20 and 25 bodies	4L461019012
	Steel	
	Standard	
	NPS 1/4 body	2J127922012
	NPS 1/2 / DN 15 body	3L416122012
	NPS 3/4 and 1 / DN 20 and 25 bodies	4E592922012
	Tapped	
	NPS 1/4 body	- - - - - - - - - -
	NPS 1/2 / DN 15 body	3L442222012
	NPS 3/4 and 1 / DN 20 and 25 bodies	4L460922012
	316 Stainless steel	
	Standard	
	NPS 1/4 body	2J1279X0022
	NPS 1/2 / DN 15 body	3L4161X0022
	NPS 3/4 and 1 / DN 20 and 25 bodies	4E592933092
	Tapped	
	NPS 1/4 body	2L4428X0012
	NPS 1/2 / DN 15 body	3L4422X0012
	NPS 3/4 and 1 / DN 20 and 25 bodies	4L4609X0032
	Type 98HM	
	Steel	
	NPS 1/2 / DN 15 body	2L442022012
	NPS 3/4 and 1 / DN 20 and 25 bodies	3L460722012
	NPS 1-1/2 and 2 / DN 40 and 50 bodies	3P790422012
	Stainless Steel	
	NPS 1/2 / DN 15 body	2L4420X0012
	NPS 3/4 and 1 / DN 20 and 25 bodies	3L4607X0022
	NPS 1-1/2 and 2 / DN 40 and 50 bodies	3P7904X0012
3*	Orifice	See following table
4*	Valve Plug	See following table
5	Valve Plug Guide	
	Types 98L and 98H	
	416 Stainless steel	
	NPS 1/4 body	1L345835132
	NPS 1/2 / DN 15 body	1L341635132
	NPS 3/4 and 1 / DN 20 and 25 bodies	1L342935132
	NPS 1-1/2 and 2 / DN 40 and 50 bodies	1P788535132
	316 Stainless steel	
	NPS 1/4 body, NACE	1L345835072
	NPS 1/2 / DN 15 body, NACE	1L3416X0102
	NPS 3/4 and 1 / DN 20 and 25 bodies, NACE	1L342935072
	NPS 1-1/2 and 2 / DN 40 and 50 bodies, NACE	1P788535072
	Type 98HM	
	NPS 1/2 / DN 15 body	
	Metal Seat and Metal Diaphragm	
	416 Stainless steel	1L341635132
	316 Stainless steel	1L3416X0102
	Elastomer Seat and Metal Diaphragm	
	416 Stainless steel	1L341635132
	316 Stainless steel	1L3416X0102
	Elastomer Seat and Elastomer Diaphragm	
	416 Stainless steel	1L341635032
	316 Stainless steel	1L3416X0102
	NPS 3/4 and 1 / DN 20 and 25 bodies	
	416 Stainless steel	18B5256X012
	316 Stainless steel	18B5256X022
	NPS 1-1/2 and 2 / DN 40 and 50 bodies	
	416 Stainless steel	18B3529X012
	316 Stainless steel	18B3529X022
6	Pusher Post	See following table
7	Washer (Elastomer diaphragm only)	
	416 Stainless steel trim	
	NPS 1/4 body	1L344736012
	NPS 1/2 / DN 15 body	1L339836012
	NPS 3/4 and 1 / DN 20 and 25 bodies	1L342836012

Key	Description	Part Number
7	Washer (Elastomer diaphragm only) (continued)	
	316 Stainless steel trim	
	NPS 1/4 body, Standard	1L344736142
	NPS 1/4 body, NACE	1L3447X0012
	NPS 1/2 / DN 15 body, Standard	1L339835072
	NPS 1/2 / DN 15 body, NACE	1L339840032
	NPS 3/4 and 1 / DN 20 and 25 bodies, Standard	1L342836142
	NPS 3/4 and 1 / DN 20 and 25 bodies, NACE	1L3428X0022
8	Lower Spring Seat	
	NPS 1/4 body, Aluminum	1L344609012
	NPS 1/2 / DN 15 body, Aluminum	1L339708012
	NPS 1/2 / DN 15 body, Plated Steel	
	(For Type 98HM only with SST Spring)	17B4480X012
	NPS 3/4 and 1 / DN 20 and 25 bodies, Aluminum	1L342708012
	NPS 3/4 and 1 / DN 20 and 25 bodies, Plated Steel	
	(For Type 98HM only with SST Spring)	17B3088X022
	NPS 1-1/2 and 2 / DN 40 and 50 bodies,	
	Steel plated	1P787724152
9	Upper Spring Seat, Steel plated	
	NPS 1/4 body	1B798525062
	NPS 1/2 / DN 15 body	1D667125072
	NPS 1/2 / DN 15 body	
	(For Type 98HM only with SST Spring)	14B9951X012
	NPS 3/4 and 1 / DN 20 and 25 bodies	1E398725072
	NPS 3/4 and 1 / DN 20 and 25 bodies	
	(For Type 98HM only with SST Spring)	14B9952X012
	NPS 1-1/2 and 2 / DN 40 and 50 bodies	1P787624092
10*	Gasket	
	Types 95L and 95H, Composition	
	NPS 1/4 body	1L344804022
	NPS 1/2 / DN 15 body	1L341104022
	NPS 3/4 and 1 / DN 20 and 25 bodies	1L343404022
	NPS 1-1/2 and 2 / DN 40 and 50 bodies	
	(2 required, for Type 98H only)	1P788004022
	Type 98HM	
	Graphite	
	NPS 1/2 / DN 15 body	1L3411X0012
	NPS 3/4 and 1 / DN 20 and 25 bodies	1L3434X0032
	Composition	
	NPS 1/2 / DN 15 body	1L341104022
	NPS 3/4 and 1 / DN 20 and 25 bodies	1L343404022
	NPS 1-1/2 and 2 / DN 40 and 50	1P788004022
11	Relief Valve Spring	See Tables 1 and 2
12*	Diaphragm	See following table
13	Nameplate, (not shown)	- - - - - - - - - -
14*	O-Ring, Type 98H only, NPS 1-1/2 and 2 /	
	DN 40 and 50 bodies, Elastomer seat only	
	Nitrile (NBR)	1C782206992
	Fluorocarbon (FKM)	1K756106382
	Fluorocarbon, NACE	1K756135072
15	Adjusting Screw, Steel plated	
	NPS 1/4 body, **(standard)**	1C216032992
	NPS 1/2 / DN 15 body, **(standard)**	1D995448702
	NPS 1/2 / DN 15 body, For Handwheel	1J496428982
	NPS 1/2 / DN 15 body, Type 98HM only (SST Spring)	1D9954X0032
	NPS 3/4 and 1 / DN 20 and 25 bodies, **(standard)**	1A330828982
	NPS 3/4 and 1 / DN 20 and 25 bodies,	
	Type 98HM only (SST Spring)	1A3308X0092
	NPS 1-1/2 and 2 / DN 40 and 50 bodies, **(standard)**	1A680128992
16	Cap Screw	
	Zinc-plated steel	
	Type 98L	
	NPS 1/4 body (10 required)	1A407824052
	NPS 1/2 / DN 15 body (10 required)	1A381624052
	NPS 3/4 and 1 / DN 20 and 25 bodies (12 required)	1A336924052
	Types 98H and 98HM	
	NPS 1/4 body	
	(not available to Type 98HM) (6 required)	1A391724052
	NPS 1/2 / DN 15 body (8 required)	1A352624052
	NPS 3/4 and 1 / DN 20 and 25 bodies (8 required)	1A341824052
	NPS 1-1/2 and 2 / DN 40 and 50 bodies	
	(8 required)	1K568428982

*Recommended spare part.

Key	Description	Part Number
16	Cap Screw (continued)	
	Stainless alloy	
	Type 98L	
	NPS 1/4 body (10 required)	1A4078X0102
	NPS 1/2 / DN 15 body (10 required)	1A3816X0152
	NPS 3/4 and 1 / DN 20 and 25 bodies (12 required)	1A3369X0112
	Type 98H	
	NPS 1/4 body (6 required)	1A3917X0062
	NPS 1/2 / DN 15 body (8 required)	1A3526X0142
	NPS 3/4 and 1 / DN 20 and 25 bodies (8 required)	1A3418X0332
	NPS 1-1/2 and 2 / DN 40 and 50 bodies (8 required)	1K5684X0032
	Type 98HM	
	For Steel Springs	
	NPS 1/2 / DN 15 body (8 required)	1A352624052
	NPS 3/4 and 1 / DN 20 and 25 (8 required) bodies	1A341824052
	NPS 1-1/2 and 2 / DN 40 and 50 (8 required) bodies	1K568428982
	For Stainless Springs	
	NPS 1/2 / DN 15 body (8 required)	1A3526X0142
	NPS 3/4 and 1 / DN 20 and 25 (8 required) bodies	1A3418X0332
17	Jam Nut, Zinc-plated steel	
	NPS 1/4 body	1A352224122
	NPS 1/2 / DN 15 body	1A353724122
	NPS 1/2 / DN 15 body, (For Type 98HM only with SST Spring)	T1208635442
	NPS 3/4 and 1 / DN 20 and 25 bodies	1A319224122
	NPS 3/4 and 1 / DN 20 and 25 bodies, (For Type 98HM only with SST Spring)	1A3192K0012
	NPS 1-1/2 and 2 / DN 40 and 50 bodies	1A368124112
18	Drive Screw (not shown) (2 required)	1A368228982
19*	Diaphragm Gasket, Composition (use with 302 Stainless steel diaphragm)	
	Type 98H	
	NPS 1/4 body	1E393104022
	NPS 1/2 / DN 15 body	1E396104022
	NPS 3/4 and 1 / DN 20 and 25 bodies	1E399304022
	NPS 1-1/2 and 2 / DN 40 and 50 bodies	1P787904022
	Type 98L	
	NPS 1/4 body	1E394004022
	NPS 1/2 / DN 15 body	1E397004022
	NPS 3/4 and 1 / DN 20 and 25 bodies	1E390404022

Key	Description	Part Number
19*	Diaphragm Gasket, Composition (continued)	
	Type 98HM	
	Composition (2 required)	
	NPS 1/2 / DN 15 body	1E396104022
	NPS 3/4 and 1 / DN 20 and 25 bodies	1E399304022
	NPS 1-1/2 and 2 / DN 40 and 50 bodies	1P787904022
	Graphite (2 required)	
	NPS 1/2 / DN 15 body	1E3961X0012
	NPS 3/4 and 1 / DN 20 and 25 bodies	1E3993X0012
20	Diaphragm Protector, PTFE (not shown)	
	Type 98L	
	NPS 1/4 body	11A5132X012
	NPS 1/2 / DN 15 body	11A5133X012
	NPS 3/4 and 1 / DN 20 and 25 bodies	11A5134X012
	Type 98H	
	NPS 1/4 body	11A5135X012
	NPS 1/2 / DN 15 body	11A5136X012
	NPS 3/4 and 1 / DN 20 and 25 bodies	11A5137X012
	NPS 1-1/2 to 2 / DN 40 and 50 bodies	11A5527X012
	Type 98HM	
	NPS 1/2 / DN 15 body	11A5136X012
	NPS 3/4 and 1 / DN 20 and 25 bodies	11A5137X012
21	O-Ring Retainer (Elastomer seat only)	
	NPS 1/4 body	
	416 Stainless steel	1L346035132
	316 Stainless steel, NACE	1L346035072
	NPS 1/2 (DN 15) body	
	416 Stainless steel	1L341535232
	316 Stainless steel, NACE	1L341535072
	NPS 3/4 and 1 (DN 20 and 25) bodies	
	416 Stainless steel	1L343035132
	316 Stainless steel, NACE	1L343035072
	NPS 1-1/2 and 2 (DN 40 and 50) bodies	
	416 Stainless steel	1P787535132
	316 Stainless steel, NACE	1P787535072
22*	O-Ring	
	Types 98L and 98H, Elastomer seat only	
	NPS 1/4 body	
	Nitrile (NBR)	1C853806992
	Fluorocarbon (FKM)	1C8538X0052
	NPS 1/2 / DN 15 body	
	Nitrile (NBR)	1D288806992
	Fluorocarbon (FKM)	1N530106382
	Ethylenepropylene (EPDM)	1D2888X0042
	NPS 3/4 and 1 / DN 20 and 25 bodies	
	Nitrile (NBR)	1C782106992
	Fluorocarbon (FKM)	1C7821X0072

Key 1 Types 98L and 98H Regulator Body, NPT

BODY SIZE		TYPE 98H			TYPE 98L		
NPS	DN	Cast Iron	Steel	316 Stainless steel	Cast Iron	Steel	316 Stainless steel
1/4	- - - -	1L346419012	1L372122012	1L372133092	1L346519012	1L372322012	1L372333092
1/2	15	2L339519012	2L368722012	2L368733092	2L339219012	2L368922012	2L368933092
3/4	20	2L342519012	2L373422012	2L373433092	2L341919012	2L318222012	2L318233092
1	25	2L342619012	2L373522012	2L373533092	2L342019012	2L318322012	2L318333092
1-1/2	40	3P786819012	3P786822012	3P786833092	- - - -	- - - -	- - - -
2	50	3P786719012	3P786722012	3P786733092	- - - -	- - - -	- - - -

Key 1 Type 98HM Regulator Body, NPT

BODY SIZE		TYPE 98HM	
NPS	DN	Steel	316 Stainless Steel
1/2	15	37B3472X012	37B3472X022
3/4	20	48B5252X012	48B5252X022
1	25	48B6241X012	48B6241X022
1-1/2	40	38B3526X012	38B3526X022
2	50	38B3526X032	38B3526X042

*Recommended spare part.

Key 1 Types 98L and 98H Regulator Body, CL150 and CL300 RF Flanges

BODY SIZE		TYPE 98H BODY MATERIAL				TYPE 98L BODY MATERIAL			
		Steel		Stainless Steel		Steel		Stainless Steel	
NPS	DN	CL150 RF	CL300 RF	CL150 RF	CL300 RF	CL150 RF	CL300 RF	CL150 RF	CL300 RF
1/2	15	1V5178X0012	20A4987X0A2	1V5178X0022	20A4987X012	25A9930X022	20A4701X012	25A9930X012	20A4701X022
3/4	20	15A6098X022	23B9543X022	15A6098X012	23B9543X012	2V4264X0022	14B2317X012	2V4264X0012	14B2317X022
1	25	2V3805X0012	2U8048X0012	2V3805X00B2	2U8048X0022	2V3641X0022	2U8047X0012	2V3641X0012	2U8047X0062
1-1/2	40	21B0804X012	1V4541X0012	21B0804X022	1V4541X0022	- - - -	- - - -	- - - -	- - - -
2	50	10A0192X012	10A4986X012	10A0192X022	10A4986X052	- - - -	- - - -	- - - -	- - - -

Key 1 Types 98L and 98H Regulator Body, Socket Weld

BODY SIZE		TYPE 98H BODY MATERIAL		TYPE 98L BODY MATERIAL	
NPS	DN	Steel	Stainless Steel	Steel	Stainless Steel
1/2	15	2L9673X0022	2L9673X0012	2U8059X0012	2U8059X0022
3/4	20	2N443922012	2N4439X0012	2N4463X0012	2N4463X0022
1	25	2N414422012	2N4144X0012	2N445222012	2N4452X0012
1-1/2	40	3V4542X0012	3V4542X0022	- - - -	- - - -
2	50	30A0191X012	30A0191X032	- - - -	- - - -

Key 1 Types 98L and 98H Regulator Body, PN 16/25/40 RF Flanged Bodies

BODY SIZE		TYPE 98H BODY MATERIAL		TYPE 98L BODY MATERIAL	
NPS	DN	Steel	316 Stainless Steel	Steel	316 Stainless Steel
1/2	15	14B2236X012	14B2236X022	24B1959X012	24B1959X022
3/4	20	14B2236X032	14B2236X042	14B2237X012	14B2237X022
1	25	14B2236X052	14B2236X062	14B2237X032	14B2237X042
1-1/2	40	14B2236X072	14B2236X082	- - - -	- - - -
2	50	14B1513X012	14B1513X022	- - - -	- - - -

Key 3 Orifice*

BODY SIZES		METAL TO METAL SEAT		ELASTOMER SEAT		
				Standard Applications		NACE Applications
NPS	DN	416 Stainless Steel	316 Stainless Steel	416 Stainless Steel	316 Stainless Steel	
1/4	- - - -	1E391646172	1E391635072	1L345935132	1L345935072	1L345935072
1/2	15	1E395046172	1E395035072	1L341735132	1L341735072	1L341735072
3/4, 1	20, 25	1E398046172	1E398035072	1L343135132	1L343135072	1L343135072
1-1/2, 2	40, 50	2P787046172	2P787035072	1P787135132	1P787135072	1P787135072

Key 4 Types 98L and 98H Valve Plug*

BODY SIZES		METAL TO METAL SEAT		ELASTOMER SEAT		
				Standard Applications		NACE Applications
NPS	DN	416 Stainless Steel	316 Stainless Steel	416 Stainless Steel	316 Stainless Steel	
1/4	- - - -	1L345246172	1L345235072	1L345135132	1L345135072	1L345135072
1/2	15	1L344146172	1L344135162	1L344335132	1L344335072	1L344335072
3/4, 1	20, 25	1L343746172	1L343735162	1L343635132	1L343635072	1L343635072
1-1/2, 2	40, 50	1P787246172	1P787235072	1P787346172	1P787335072	1P787335072

*Recommended spare part.

Key 4 Type 98HM Valve Plug*

BODY SIZES		METAL SEAT AND METAL DIAPHRAGM		ELASTOMER SEAT AND METAL DIAPHRAGM		ELASTOMER SEAT AND ELASTOMER DIAPHRAGM	
NPS	DN	416 Stainless steel	316 Stainless steel	416 Stainless steel	316 Stainless steel	416 Stainless steel	316 Stainless steel
1/2	15	17B3475X012	17B3475X022	17B3474X032	17B3474X012	17B3474X032	17B3474X012
3/4, 1	20, 25	18B5255X012	18B5255X022	18B5254X012	18B5254X022	18B5254X012	18B5254X022
1/2, 2	40, 50	18B3528X012	18B3528X022	18B3530X012	18B3530X022	18B3530X012	18B3530X022

Key 6 Pusher Post

BODY SIZES		METAL TO METAL SEAT		ELASTOMER SEAT		
				Standard Applications		NACE Applications
NPS	DN	416 Stainless Steel	316 Stainless Steel	416 Stainless Steel	316 Stainless Steel	
1/4 1/2	- - - - 15	1L345735132 1L344535132	1L345735072 1L344535072	1L345635132 1L344235132	1L345635072 1L344235072	1L345635072 1L344235072
3/4, 1 1-1/2, 2	20, 25 40, 50	1L343935132 1P788335132	1L343935072 1P788335072	1L343835132 1P788435132	1L343835072 1P788435072	1L343835072 1P788435072

Key 12 Diaphragm*

TYPES	BODY SIZES		DIAPHRAGM MATERIAL				
	NPS	DN	Neoprene (CR)	Neoprene (CR) with PTFE Protector	Fluorocarbon (FKM) (2 required)	Ethylenepropylene (EPDM)(3)	302 Stainless Steel (2 required)
98L	1/4 1/2 3/4, 1	- - - - 15 20, 25	1L345302112 1L341302112 1L342302112	- - - - - - - - - - - -	1L345302402 1L341302402 1L342302402	- - - - - - - - - - - -	1L345436012(4) 1L341436012 1L342236012
98H	1/4	- - - -	1L344902112	1K344902112	1L344902402	- - - -	1L345036012
98H and 98HM	1/2	15	1L341202112	- - - -	1L341202402	1L3412X0032(1)	1L339936012
	3/4, 1 1-1/2, 2	20, 25 40, 50	1L343302112 1P788102192	- - - - - - - -	1L3433X0032 11A1347X012	1L3433X0062 1P7881X0022(2)	1L343236012 1P787836012

1. 1 required for Type 98H and 2 for Type 98HM.
2. 2 required.
3. Available to NPS 1/2 / DN 15 Type 98H and all sizes Type 98HM. Please consult your local Sales Office for Ethylenepropylene (EPDM) option on other sizes.
4. Only 1 metal diaphragm is required for Type 98L, NPS 1/4, 2 to 7 psi / 0,14 to 0,48 bar; 2 metal diaphragms for other ranges.

Key	Description	Part Number
22*	O-Ring	
	Type 98HM, Elastomer Seat Only	
	NPS 1/2 / DN 15 body	
	Nitrile (NBR)	1D288806992
	Fluorocarbon (FKM)	1N530106382
	Ethylenepropylene (EPDM)	1N5301X0022
	Perfluoroelastomer (FFKM)	1N5301X0012
	Type 98HM, Elastomer Seat Only	
	NPS 3/4 and 1 / DN 20 and 25 bodies	
	Nitrile (NBR)	1C7821X0062
	Fluorocarbon (FKM)	1C7821X0072
	Ethylenepropylene (EPDM)	1C7821X0032
	Perfluoroelastomer (FFKM)	1C7821X0052
	NPS 1-1/2 and 2 / DN 40 and 50 bodies	
	Nitrile (NBR)	1P787403202
	Fluorocarbon (FKM)	1P787406382
	Ethylenepropylene (EPDM)	1P7874X0032
	Perfluoroelastomer (FFKM)	1P7874X0022
22	L-Ring, Type 98H only, Elastomer seat only,	
	NPS 1-1/2 and 2 / DN 40 and 50 bodies	
	Nitrile (NBR)	1P787403202
	Fluorocarbon (FKM)	1P787406382
23	Lock Washer, Steel	
	NPS 1/4 and 1/2 / DN 15 bodies	1C225628982
	NPS 3/4 and 1 / DN 20 and 25 bodies	1H624328992
	NPS 1-1/2 and 2 / DN 40 and 50 bodies	1A487828992
24	Machine Screw, Stainless steel,	
	Elastomer seat only	
	NPS 1/4 body, NACE	1L346238992
	NPS 1/2 / DN 15 body, NACE	1J4159X0012
	NPS 3/4 and 1 / DN 20 and 25 bodies	1L343538992
	NPS 3/4 and 1 / DN 20 and 25 bodies, NACE	1L3435X0012
	NPS 1-1/2 and 2 / DN 40 and 50 bodies, NACE	1P788638992
25	Diaphragm Head	
	Type 98L, Steel plated	
	NPS 1/4 body	1L345525072
	NPS 1/2 / DN 15 body	1L339625072
	NPS 3/4 and 1 / DN 20 and 25 bodies	1L342125072
	Type 98H, NPS 1-1/2 and 2 / DN 40 and 50 bodies	
	Metal Seat with	
	416 Stainless steel Trim,	
	Steel/316 Stainless steel	
	(1 of each required)	1P788225012/1P788235072
	316 Stainless steel Trim,	
	316 Stainless steel (2 required)	1P788235072
	Steel/316 Stainless steel	
	(1 of each required)	1P788225012/1P788235072
	Elastomer Seat with	
	416 Stainless steel Trim, Steel (2 required)	1P788225012
	316 Stainless steel Trim,	
	316 Stainless steel (2 required)	1P788235072
	Type 98HM, NPS 1-1/2 and 2 /	
	DN 40 and 50 bodies (2 required)	1P788235072

*Recommended spare part.

Key	Description	Part Number
26	Locknut, Steel plated	
	NPS 1/4 and 1/2 / DN 15 bodies	1L872324122
	NPS 3/4 and 1 / DN 20 and 25 bodies	1L872224122
	NPS 1-1/2 and 2 / DN 40 and 50 bodies	1P788724122
27	Tee Handle Assembly (not shown),	
	Types 98L and 98H only	
	NPS 1/4	1F2236000A2
	NPS 3/4 and 1 / DN 20 and 25	1F2238000A2
28	Handwheel (not shown), Zinc, NPS 1/2 / DN 15	
	Types 98L and 98H bodies only	1J496144012
29	Machine Screw (not shown), Steel plated,	
	NPS 1/2 / DN 15 body (with handwheel only)	16A5763X012
30	Lockwasher (not shown), Steel,	
	NPS 1/2 / DN 15 body (with handwheel only)	1A352332992
45*	O-Ring (not shown)	
	Types 98L and 98H	
	(with sealed adjusting screw only)	1E547706992
50	Sealing Washer (not shown)	
	Types 98L and 98H	
	NPS 1/2 / DN 15	1V205699012
	NPS 3/4 and 1 / DN 20 and 25	11A9681X012
	Type 98HM	
	NPS 1/2 / DN 15	1V2056X0022
	NPS 3/4 and 1 / DN 20 and 25	11A9681X022

Key	Description	Part Number
51	NACE Tag (not shown)	----------
52	Tag Wire (not shown), NACE	----------
53	O-Ring (for Type 98HM only)	
	Nitrile (NBR)	
	(not available with Metal Diaphragms)	
	NPS 1/2 / DN 15 body	1H292406992
	NPS 3/4 and 1 / DN 20 and 25 bodies	1D2375X0022
	NPS 1-1/2 and 2 / DN 40 and 50 bodies	1D262006992
	Ethylenepropylene (EPDM)	
	NPS 1/2 / DN 15 body	1V8029X0012
	NPS 3/4 and 1 / DN 20 and 25 bodies	1D2375X0042
	NPS 1-1/2 and 2 / DN 40 and 50 bodies	1D2620X0052
53	O-Ring (for Type 98HM only) (continued)	
	Fluorocarbon (FKM)	
	NPS 1/2 / DN 15 body	1R620106382
	NPS 3/4 and 1 / DN 20 and 25 bodies	1D237506382
	NPS 1-1/2 and 2 / DN 40 and 50 bodies	1D2620X0032
	Perfluoroelastomer (FFKM)	
	(not available with Composition Diaphragms)	
	NPS 1/2 / DN 15 body	1V8029X0022
	NPS 3/4 and 1 / DN 20 and 25 bodies	1D2375X0052
	NPS 1-1/2 and 2 / DN 40 and 50 bodies	1D2620X0082
54	Type Y602-12 (shown in the 98HM Series assemblies)	27A5516X012

*Recommended spare part.

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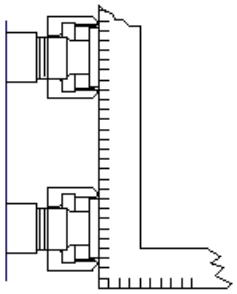
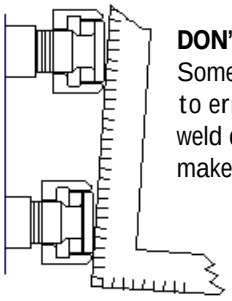
MODEL 15A GAGE VALVES

APPLICATION—
Pressure Rating: 3000 PSI @ -20°F to 100F 2850 PSI @ 300°F 2625 PSI @ 500°F

INSTALLATION—

DO Plumb tailpieces to avoid mis-alignment.

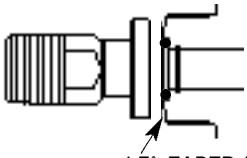




DON'T Create additional misalignment. Some misalignment is usually present due to errors in concentricity of pipe threads, weld distortion in couplings, etc. Don't make it worse!

DO Make up unions tight. Use at least an 18" wrench. Union is designed to crush solid metal along a high ridge, creating a "line" seal between the taper and the flat surfaces.

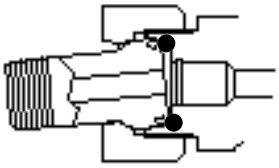
Union will seal pressure without need for O-ring if alignment is good enough and if the installation torque has been efficiently transmitted into tightening the joint.

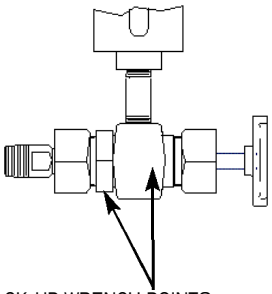


1.5° TAPER (Union Nut omitted for clarity)

However, if there is significant misalignment in the piping arrangement then some of the "umpf" experienced during make-up has been diverted into deflecting the piping. This causes resistance to further turning of the nut and may leave insufficient tightness in the metal to metal seat of the union for sealing. In this case the O-ring will finish the job. The joint needs to be tight enough (close enough) to close the extrusion gap for O-ring to maintain its seal.

More severe MISALIGNMENT can lead to leaks at the union or broken pipe nipples or broken tailpieces. If you are experiencing these difficulties ask for Inferno SPHERICAL UNIONS available as a separate male x male union or built into the valve itself.



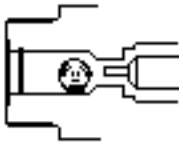


BACK-UP WRENCH POINTS

DO Make up unions using a BACK-UP WRENCH on the valve body.

Failure to use back-up wrench causes excessive stress on the connecting nipple and can lead to breakage of nipple or harmful twisting to sight glass.

OPERATION—
BALL CHECKS...
Open valves full open during operation to assure safety action of ball check in case of glass or gasket failure. Stem must be open more than 1-1/2 turns before ball is allowed to back seat. Extension on end of stem will deny ball a seating position until valve is opened sufficiently. At this point the extension of the stem retreats enough to allow ball to check closed in event of sudden loss of pressure in the sight glass.



Ball checks are designed to limit flow from vessel in case of accidental glass or gasket failure. They can be of great help in limiting the blow-out effect of pressure acting on a shattered glass. But— they are not intended to provide a perfect seal. Dirt, trash and corrosion in the ball check cavity and back seat area will limit the tightness of the emergency shut-off. In such cases there may be some degree of leakage past the ball checks.

Ball check will not activate in case of seepage caused by a leaky gasket. Ball check may not activate at all if cavity is packed with

Ball checks cont'd...

corrosion. Ball check requires pressure in the vessel to activate. About 7" head of water is sufficient pressure to check the ball in water service with a full flow leak. More pressure is required to check with a choked off leak. Performance in other fluids will vary. Ball check may not activate in extremely viscous fluids.

If in doubt as to whether ball checks are present in an existing installation or whether or not they are working properly you can test as follows: Close off the upper gage valve. Leave the lower valve open. Open a drain valve rapidly and listen for the ball to make an audible "click". Now repeat process reversing the upper and lower valve position.

Restore fluid level in sight glass by closing drain and then moving both valves into the cracked open position. Cracking the valves open will cause the stem extension to unseat the ball and allow it to drop back into its normal resting place.

If sight glass fails and balls are activated then manually close both valves. Be aware that a small amount of fluid will escape as the balls are dislodged and before stem has a chance to fully close. Take necessary precaution.

BLOW-DOWN... **DON'T** blow down sight glass with valves open. High velocity flow will cut seat and lead to failure of valve to close without leakage. This problem is especially common in steam and hot water applications. However if it is not convenient to blow-down the hot water sight glass with valves in the closed position then **DO** install a second valve (ball or gate) to insure that a tight shut-off can be made for maintenance purposes during normal plant operation. A double block system may be required if you experience cutting in the seat area.

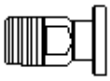
Shut off upper and lower valves first, then blow down sight glass through the lower valve's drain connection, or through an additional outlet at the bottom of the sight glass. Restore fluid level in sight glass by closing vent and drain and then cracking open the upper and lower valves. Cracking the valves open prevents nuisance ball checking. After level has been reestablished open the valves full open. In the full open position the ball is able to check autmatically in case of glass failure. In cracked position it will not check.

SHUTDOWNS... It is usually best to leave valves in normal full open position as the system is de-pressurized. This prevents excessive thermal stress on the sight glass and valves and prevents trapping high pressure fluid. During START-UP pressure and temperature are allowed to equalize slowly in the sight glass.

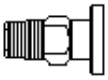
SPARE PARTS FORMODEL 15A—

O-ring, Viton™, Size 2-116 (90 durometer)
P/N 4761

3/4" NPT Tailpiece, Steel
P/N 4613



1/2" NPT
Tailpiece, Steel
P/N 4612



Union Nut, Steel
P/N 3882

Stem Packing,
Teflon™
standard, to 500°F
P/N 4347

Optional Materials

O-Ring, EPDM E0962-90, Size 2-116, for hot water & steam
P/N 4938

O-Ring, Parofluor Ultra, Size 2-116, for hot water & steam to 525F
P/N 6965

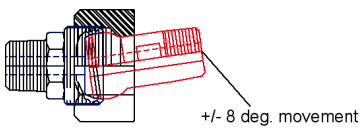
Stem Packing, Grafoil™, over 500°F
P/N 3509

New Item

Spherical Union- Corrects for angular misalignment in piping.. reduces all piping strain.Re-usable joint seals gas-tight multiple times.
Best when used with Close Hook-up (CH) level gages having side or back outlets. Position the spherical union between the side or back outlets of the "CH" level gage and the gage valve. If C-C does not match, rotate the vessel connection of the valves until the ball will fit into socket. By allowing the valves to rotate non-parallel to each other the spherical union will correct a relatively large C-C difference between assembly and vessel. Purpose of spherical joint between gage and valve is to eliminate piping strain.

May also be used with CH level gage without valves for direct connection to vessel or piping Should be used in conjunction with a plain, flat, "Floating Union" in a matched set. In this way angular misalignment and C-C difference may be overcome.

Available in Steel and Stainless, Std. O-Ring is Viton
1/2" x 1/2"
3/4" x 3/4"
1/2" x 3/4"



COMMENTS AND SUGGESTIONS WELCOME

INFERNO MFG. CORP. SHREVEPORT, LOUISIANA www.infernomfg.com
TEL: 318-221-8454 FAX: 318-222-4106 email: inferno@infernomfg.com

B. Locate the pressure gasket in the body recess. The gasket should be flat on the surface without lapping up on the sides of the recess.

Use pressure gasket thickness as follows:
Column Gages: 1/32" thick
Exception: 1/16" thick for TFE
Weld Pad Gages: 1/16" thick

C. Glass should be centrally located on the body and cover seats.

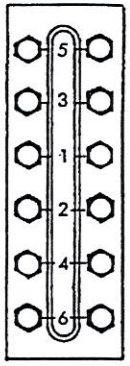
Glass should be taped at both ends, as shown in sketch, to help prevent the glass from making contact with the metal. Masking tape or some other soft tape is suitable for this purpose.

D. Install bolts and nuts. The bolt and nut threads should be cleaned and lubricated before installing. Molybenum disulfide lubricant is a good lubricant for this application. If threads show evidence of galling or corrosion the bolts and nuts should be replaced. Tighten all nuts finger-tight then tighten in sequence shown in Figure 3, in five (5) pound increments. Use torque wrench to obtain correct torque values. This procedure prevents excessive stresses from building up on the glass.

NOTE: The following torques are for our standard gages; lead lined, special shields or gaskets may require lower torque. If information has not been supplied with the gage, contact factory.

RECOMMENDED TORQUES

GAGE MODEL	TORQUE (FT-LBS)
R100, RA, RDM	30 w Grafoil
T100, TA, TDM	30 w Grafoil
T200, TDH	30 w Grafoil
R200 , RDH	42 w Grafoil
R13BC, R14BC etc	30 w Grafoil
A-TL-B	90
B-TE-D	110
TXT-11	35
19-14X (Bullseye)	Hand Tight
SFI (Sight Feed)	Hand Tight
WELD PAD GAGES	
RWA	20
TWA	20



CAUTION: Bolts or nuts should not be tightened unless the gage is isolated from the vessel and the gage is vented to the atmosphere.

We recommend a hydrostatic test on the gage assembly at 1.3 to 1.5 times the operating pressure whenever possible, especially in high pressure applications.

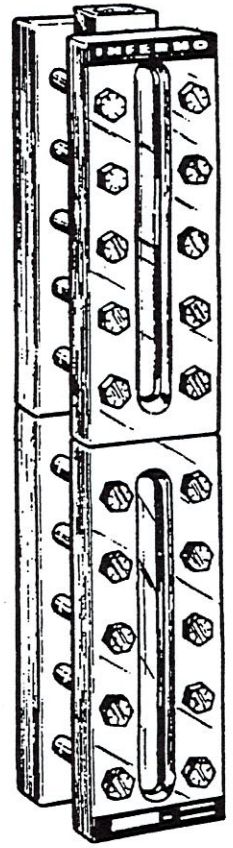
FIGURE 3

inferno MANUFACTURING CORPORATION

INSTALLATION, OPERATIONS, AND MAINTENANCE of INFERNO LIQUID LEVEL FLAT GAGES

Inferno liquid level gages are designed and constructed to give satisfactory performance under a wide range of environmental and operating conditions.

Assuming the correct design and materials were specified at the time of purchase for the particular application, satisfactory service is dependent on reasonable care in the installation, operation, and maintenance of the gage assemblies.



INSTALLATION

Before installing the gage the following items should be considered.

A. Avoid piping strains.

1. Connect and mount the gage to insure the gage does not support the piping or that misalignments do not exist in the piping to the gage.

2. Make sure adequate provisions such as expansion loops or long piping runs between the gage and vessel exist when large differentials in temperature between the gage and vessel are present. Severe mechanical loads can be imposed on the gage or piping due to the thermal expansion.
3. Support brackets should be provided for gages over 100 pounds in weight, especially so if the gages are subjected to vibration or shock environmental conditions, to prevent damage to the gage, valves, or piping.

B. Provide shutoff valves between the gage and vessel. In case of an accident where the glass fails or a gasket blows a shutoff valve will reduce the loss of fluid.

Also, a shutoff valve will allow removing or servicing the gage without draining the vessel. We recommend using gage valves with ball checks, which provide manual operation and quick automatic shutoff if a gage glass or gasket failure should occur.

C. Additional safety features. For high pressure applications or severe environmental conditions additional protection for the operator can be provided by using a mirror mounted on the gage to permit the operator to view the fluid column from the side.

OPERATION

STARTING UP — When a large differential in temperature exists between the gage and vessel fluid, raise or lower the gage temperature slowly by cracking the gage valves all the way until the gage is either fully warmed up or cooled down. The glass used in Inferno gages are tempered glass which can stand large temperature shocks but the amount is limited by factors such as stresses imposed during installation which reduces the glass resistance to thermal shocks.

CAUTION: If a leak develops, do not torque nuts while gage is under pressure. Also if torquing to the specified torque does not eliminate the leak, disassemble the gage and follow the maintenance procedure.

SHUTTING DOWN — It is better to shut down with the gage valves open. This allows the gage pressure and temperature to be reduced slowly with the system. If the gage valves are closed off the gage should be vented to the atmosphere to prevent pressure build-up in the gage, especially when the gage is cold.

MAINTENANCE

Proper tools and equipment are important in making the maintenance job easier and for the best results.

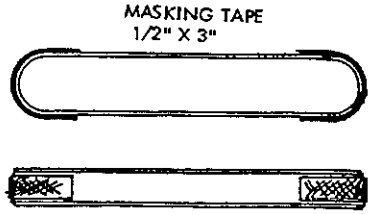
Below is a list of equipment that can be readily purchased and kept in a kit to make the job easier.

1. Socket head wrench for bolt heads.
2. Socket head torque wrench for torquing nuts.
3. Open end or cresent wrench for torquing reflex gage set screws.
4. Assortment of sockets depending on gage bolt sizes for use with socket wrenches.
5. Scraper for preparing gasket surfaces on gage body and clamps. Use soft materials such as brass to prevent making burrs. Bolt lubricant – molybdenum disulfide lubricant.
6. Soft tape. Such as 1/2" masking tape for ends of glass to prevent glass to metal contact when installed in the gage. (See figure 1)

Alternative: Use #32 Rubber Band, P/N 10952

DISASSEMBLY

Loosen bolts in opposite sequence from that shown in sketch for tightening bolts (opposite ends toward center). It is preferable to loosen the bolts a small amount at a time in sequence instead of loosening a bolt completely when the other bolts are fully torqued.



TAPED SIGHT GLASSES
FIGURE 1

Whenever possible the gage should be removed from service to a bench so the gage can be worked on in a horizontal position.

REASSEMBLY

See sketches in Figure 2 of the different type gages to see basic arrangements, for the reflex and transparent gages.

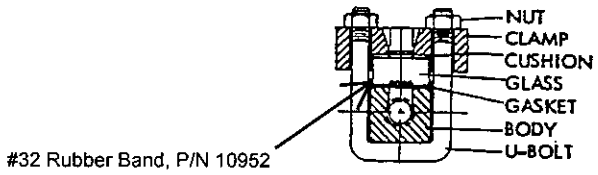
Used pressure gaskets or cushion gaskets should not be used even when they appear to be in good condition. Used glasses may appear to be in good shape but as a general rule are not as reliable as new glasses. The replacement glass should be free of scratches or chips that may cause local stress concentration.

The glasses used in Inferno gages have a low coefficient of expansion, resistant to thermal shock and resistance to bending loads. Nevertheless, care should be taken to prevent loads on the glass which will cause bending or stress in the glass.

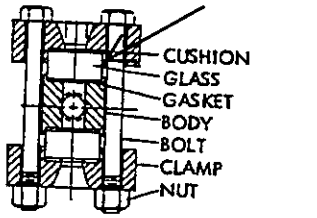
The following is a list of items that should be observed to ensure satisfactory service.

A. The gasket surface on the gage body and covers should be flat to provide a flat surface for mounting the sight glass.

A soft scraper should be used to remove the old gasket. All burrs and gasket material or other residue should be removed from the surfaces. Gouged or scarred seats should be refinished by milling. If the seats show evidence of corrosion, pitting or cracking, a careful investigation should be made to determine whether the part should be used and whether the material selection is suitable for the application.



U-BOLT TYPE REFLEX



TRANSPARENT

FIGURE 2

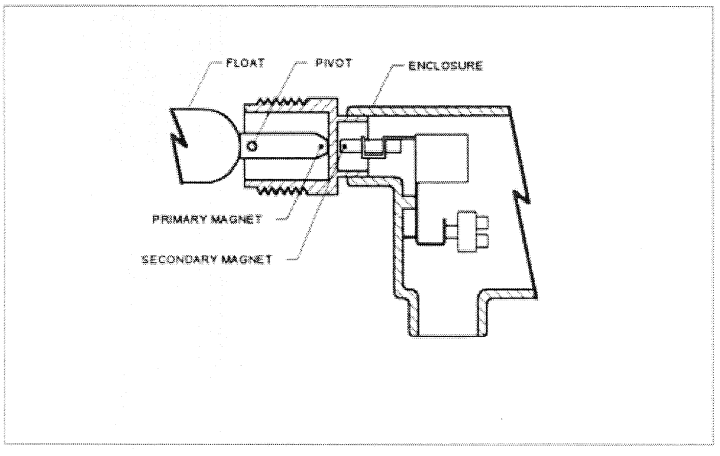
MAGNE-SONICS MLS Horizontal Mount Magnetic Level Switch

FEATURES

- Magnetic Snap-Action
- All SST Wetted Parts
- SPDT 5A Contacts
- Integral Conduit Box
- Magnetic Latching
- Class I, Div. 1, Grp. C&D Enclosure
- CSA Approved

OPERATION

Operation is achieved using the time proven principle of repelling magnetic forces.



One permanent magnet forms part of a float assembly which rises and falls with changing liquid level. A second permanent magnet is positioned within the switch head so that the adjacent poles of the two magnets repel each other through a non-magnetic diaphragm. A change in liquid level moves the float through its permissible range of travel causing the float magnet to pivot and repel the switch magnet. The resulting snap action of the repelling magnets actuates the switch.

TYPICAL APPLICATIONS

Petroleum Processing

Fuels, lubricating oils, hydraulic fluids, separators, treaters, crude oil, fuel-water interfaces.

Chemical Processing

Acids, alkalis, ammonia, paints, lacquer, peroxides, alcohols, printing inks, freon.

Food Processing

Beverages, fruit juices, cooking oils.

Pharmaceutical and Cosmetic

Liquids, emulsions, lotions, solutions.

Marine Operations

Fuel oil, hydraulic fluid, bilge level alarms, sea water, coolant, condensate levels, cargo levels.

Reactor Operation

Level control, alarm signalling.

Cryogenic Liquids

Liquid methane, nitrogen, carbon dioxide, oxygen.

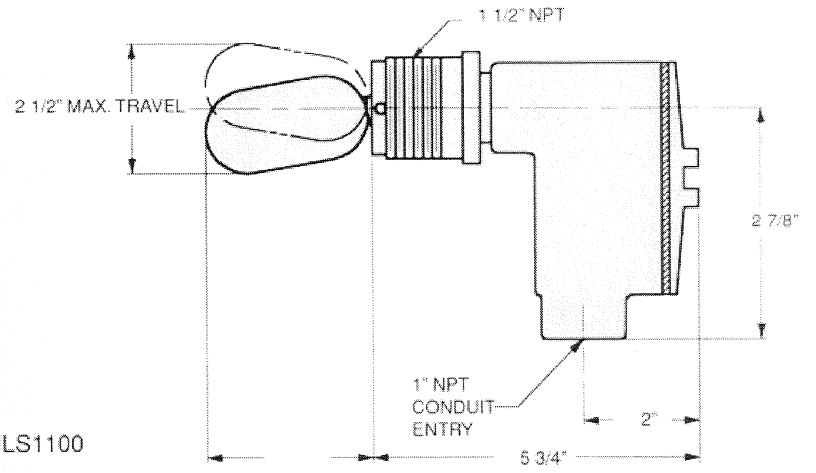
Water Industry

Flood control, reservoir levels.

General

Leak detection, overflow alarm, low level alarm in evaporators.

DIMENSIONS AND SPECIFICATIONS



TYPICAL MLS1100

Pressure Rating	Min. S.G.	Ambient Max. Temp.	Differential @ Min. S.G.	Enclosure Rating	Electrical Components
1500 PSIG	0.50	250°F/139°C	Nominal 1"	CL1 Grp C&D	U.L. & CSA

MODEL SELECTION GUIDE

MLS — Magnetic Level Switch

Code	Body Material	Trim Material
1	T-303 SST	T-316 SST
2	T-316 SST	T-316 SST

Code	Switch Form and Function	Max Temp.	Switch Rating
1	SPDT Standard Switch	450°F	5A @ 120 VAC
2	DPDT Standard Switch	450°F	5A @ 120 VAC
3	SPDT High AMP Rating	250°F	11A @ 120 VAC
4	DPDT High AMP Rating	250°F	11A @ 120 VAC
5	SPDT High Temperature	750°F	5A @ 120 VAC
6	DPDT High Temperature	750°F	5A @ 120 VAC
7	SPDT Hermetically Sealed	400°F	2A @ 120 VAC
8	DPDT Hermetically Sealed	400°F	2A @ 120 VAC

Code	Connection	Pressure Rating	Min. S.G.
0	1 1/2" NPT (Standard Model)	1500 PSIG@100°F	0.50
1	2 1/2" 150# RF Flange	285 PSIG@100°F	0.50
2	2 1/2" 300# RF Flange	740 PSIG@100°F	0.50
3	2 1/2" 600# RF Flange	1480 PSIG@100°F	0.50
4	3" 150# RF Flange	285 PSIG@100°F	0.50
5	3" 300# RF Flange	740 PSIG@100°F	0.50
6	3" 600# RF Flange	1480 PSIG@100°F	0.50
7	2" NPT	450 PSIG@100°F	0.40

Code	Flange Material
0	All NPT models use this code
1	A105 C.S.
2	A182 T304 SST
3	A182 T316 SST

MLS	1	1	0	0	**TYPICAL MODEL**

RETURN

Quality...Reliability...Service

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Fax: (713) 785-1826

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Strongsville, OH 44136 U.S.A.
Telephone: (440) 572-1500
Fax: (440) 238-8828

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Data 841
4/22/2010

Eclipse Ignition Transformer

- Safer, more durable insulation
- Excellent mechanical properties
- Superior electronics
- High temperature rating
- Effective heat dissipation
- Compact design
- Light weight
- Durable sealed construction suitable for outdoors when used with cable assembly
- Reliable operation
- 100% final tested

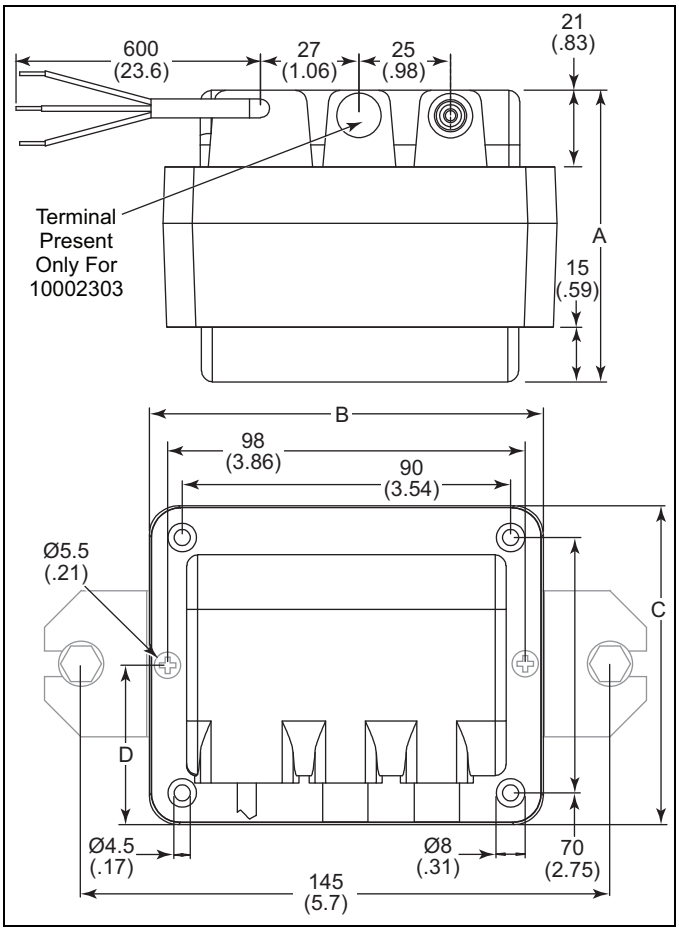
Ignition Transformer with Bracket Kit and Ignition Cable (See page 2, Accessories)

Parameter	22967	10002303	10002304	10005352	10012234
Primary Supply Voltage, VAC	120	120	120	220 - 240	110 - 120
Frequency, Hz	60	60	60	50 - 60	50 - 60
Primary Current, A	1.6	3.5	1.5	0.4	1.5
Power, VA	192	420	180	92	165
Secondary Voltage RMS [±10%], VAC	7000	2 x 5000	6000	6000	6000
Secondary Current RMS [±10%], mA	23	35	23	10	23
Secondary Ground Termination	End Pole	Center Tap	End Pole	End Pole	End Pole
Service Duty,% on time / 4 minutes	25%	25%	100%	100%	100%
Approvals	CE, UL (USA and Canada)	CE, UL (USA and Canada)	CE, UL (USA and Canada)	CE	CE
Weight, kg (lbs)	1.9 (4.2)	2.8 (6.2)	2.8 (6.2)	1.9 (4.2)	2.8 (6.2)
Surface Material	Araldite Epoxy Resin				
Ambient Temperature	90°C (194°F) Maximum -40°C (-40°F) Minimum				

CE Standards: EN 61558/2/3, VDE 0550, SEV BA9, 73/23/EEC Low Voltage Directive, and meets 89/336/EEC Electromagnetic compatibility, emission standards EN 50081-1 and EN 55014-1/A2 when used with suppression wire and filter PN 10005353. Underwriters Laboratories listed as a recognized component, cURus, for the Canadian and US markets.

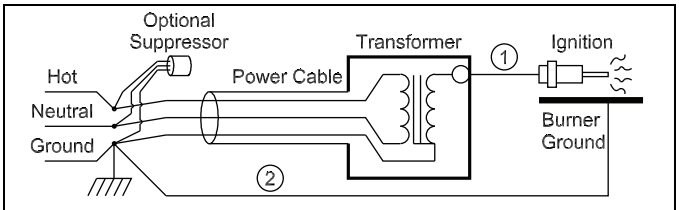
ECLIPSE®
Innovative Thermal Solutions

Dimensions mm (inches)



Part Number	Dimensions mm (inches)			
	A	B	C	D
22697	65 (2.56)	106 (4.17)	86 (3.38)	43 (1.69)
10002303	80 (3.15)	108 (4.25)	87.4 (3.44)	43.7 (1.72)
10002304	80 (3.15)	108 (4.25)	87.4 (3.44)	43.7 (1.72)
10005352	65 (2.56)	106 (4.17)	86 (3.38)	43 (1.69)
10012234	80 (3.15)	108 (4.25)	87.4 (3.44)	43.7 (1.72)

Wiring



Power Supply	Transformer	Suppressor
Hot (110-120 / 220-240 V)	Black or Brown	Black
Neutral (0 V)	White or Blue	Black
Ground (0 V)	Green-Yellow	White

NOTES:
1. Keep as short as possible and keep away from other wiring.
2. Insure good conductance and short path from burner ground to the transformer ground wire.

Accessories

Part No.	Description	
20580	Kit, Bracket, Ignition Transformer, 40mm x 40mm. Consisting of: (2) Galvanized Brackets, (2) 5M x 50mm Screws, (2) 5M x 4mm Nuts	
10013387	Cable, Ignition, 300mm Long (11.8"), Complete Cable Assembly, 7mm Dia. Suppression Wire Rated 20KV, 4mm Dia. Straight Terminal Connector w/ Cap, 6.3mm Dia. Right Angle Terminal Connector w/ Cover, -50°C (-58°F) to 180°C (356°F)	
20581	Cable, Ignition, 1M Long (39.4"), Complete Cable Assembly, 7mm Dia. Suppression Wire Rated 20KV, 4mm Dia. Straight Terminal Connector w/ Cap, 6.3mm Dia. Right Angle Terminal Connector w/ Cover, -50°C (-58°F) to 180°C (356°F)	
20603	Cable, Ignition, 3M Long (9.8'), Complete Cable Assembly, 7mm Dia. Suppression Wire Rated 20KV, 4mm Dia. Straight Terminal Connector w/ Cap, 6.3mm Dia. Right Angle Terminal Connector w/ Cover, -50°C (-58°F) to 180°C (356°F)	
10005353	Suppressor, Emi Disturbance Suppression Filter for Ignition Transformer Primary	
10005354-10FT 10005354-100FT	Wire, Ignition, Emi-Suppression, -50 to 180°C, 7mm Dia., Breakdown Voltage 20kV, Iso-Spec 3808/1 Clause 5.2.3 10 ft or 100 ft coils	
10002352-4PC	Connector, Wire, 90° with Spring, for Spark Electrode, 6.3mm Dia., for 4.7-5.2-7mm Dia. Cable, Package of 4	
10002353-4PC	Cap, Terminal, Wire, 90°, Rubber, for Spark Electrode, for 4.7-5.2-7mm Dia. Cable, Package of 4, use with PN 10002352-4PC	
10002349-10PC	Connector, Wire, Straight, Output for Ignition Transformer, Phosphor Bronze, 4mm Dia., for 4.7mm Dia. Cable (32756-50ft, 32756-100ft) Package of 10	
10002351-10PC	Connector, Wire, Straight, Output for Ignition Transformer, Phosphor Bronze, 4mm Dia., for 7mm Dia. Cable (10005354-10ft, 10005354-100ft, 35443-50ft, 35443-100ft) Package of 10	
10002354-4PC	Cap, Terminal, Wire, Straight, Rubber, L=35mm, Output for Ignition Transformer, for 4.7- 5.2-7mm Dia. Cable, Package of 4, use with PN 10002349-10PC or 10002351-10PC	

ECLIPSE®
Innovative Thermal Solutions
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MODEL 350WB

INSTALLATION INSTRUCTIONS FOR VIBRATONE HORN MODEL 350WB

MODELO 350WB

INSTRUCCIONES DE INSTALACION PARA LA BOCINA VIBRATONE MODELO 350WB

MODELE 350WB

INSTRUCTIONS D'INSTALLATION POUR LE KLAXON VIBRATONE, MODELE 350WB

Address all communications and shipments to:
Dirija todos la correspondencia y envíos a:
Adressez toutes les communiations et expéditions à:

FEDERAL SIGNAL CORPORATION
Electrical Products Division
2645 Federal Signal Drive
University Park, IL 60466-3195

INSTALLATION INSTRUCTIONS FOR VIBRATONE HORN MODEL 350WB

SAFETY MESSAGE TO INSTALLERS

NOTE

INSTALLATION, MAINTENANCE AND DISPOSAL OF THIS PRODUCT MUST BE CARRIED OUT IN ACCORDANCE WITH NATIONAL CODES AND STANDARDS.

It is important to follow all instructions shipped with this product. This device is to be installed by a trained electrician who is thoroughly familiar with and will follow all applicable national and local codes in the country of use.

The selection of the mounting location for the device, its controls and the routing of the wiring is to be accomplished under the direction of the Facilities Engineer and the Safety Engineer. In addition, listed below are some other important safety instructions and precautions you should follow:

- Read and understand all instructions before installing or operating this equipment.
- Do not connect this unit to the system when power is on.
- Optimum sound distribution will be severely reduced if any objects are in front of the speaker. You should ensure that the front of the speaker is clear of any obstructions.
- All effective warning horns produce loud sounds which may cause, in certain situations, permanent hearing loss. The device should be installed far enough away from potential listeners to limit their exposure while still maintaining its effectiveness. National Noise Standards, such as The OSHA Code of Federal Regulations 1910.95 in the United States, provide guidelines which may be used regarding permissible noise exposure levels.
- After installation, ensure that all mounting screws have been tightened.
- Establish a procedure to routinely check the sound system for proper activation and operation.
- Provide a copy of these instructions to the Safety Engineer, operator(s) and maintenance personnel.
- File these instructions in a safe place and refer to them when maintaining and/or reinstalling the device.

Failure to follow all safety precautions and instructions may result in property damage, serious injury, or death to you or others.

A. Introduction.

In all installations, it is recommended that the electrical wiring to the installation site be completed before the horn is mounted. Installations are subject to national and local electrical and fire codes and standards.

B. Installation.

WARNING

Do not connect wires when power is on.

The 350WB is gasketed and has two 3/4-14 NPT and one 1/2-14 NPT tapped openings to accommodate supply connections.

1. Use the rear enclosure of the 350WB as a template and mark the location of the mounting ears on the mounting surface. Secure the 350WB to the mounting surface with user-supplied fasteners suitable for the mounting surface.

2. See figure 1. Remove and retain the four screws which secure the horn to the rear enclosure. Remove the horn from the rear enclosure.
3. Attach the supply wires to the terminal block as shown in figures 2 and 3. The terminal block is capable of accepting both solid and stranded wire within the range of 10 AWG (5.27 mm sq.) to 20 AWG (0.52 mm sq.). When using stranded wire, ensure that the strands of the wire are twisted together prior to inserting them into the terminal block.
4. Reassemble the horn to the rear enclosure using the previously removed screws.
5. For Model 350WB-120VAK only:

   a. Volume adjustment set screw is already installed in horn.

   b. For additional information, see instruction sheet 8435A536.

SAFETY MESSAGE TO MAINTENANCE PERSONNEL

- Read and understand all instructions before performing any maintenance to this unit.
- To reduce the risk of electrical shock or ignition of hazardous atmospheres, do not perform maintenance/service on this device when circuits are energized.
- Optimum sound distribution will be reduced if the speaker becomes clogged with a foreign substance. Periodic checks should be performed to ensure foreign substances are not packed into the speaker.
- Any maintenance to the warning system must be performed by a trained electrician in accordance with all applicable national and local codes and standards in the country of use.
- Never alter the unit in any manner. Safety in hazardous locations may be endangered if additional openings or alterations are made in units specifically designed for use in these locations.
- The nameplate, which may contain cautionary or other information of importance to maintenance personnel, should not be obscured if the exterior of housings are painted.

Failure to follow all safety precautions and instructions may result in property damage, serious injury, or death to you or others.

C. Audibility and Electrical Ratings..

VOLTAGE	CURRENT (AMPS)	Hz	dB*	dB**
120	0.18/0.22	50/60	100	94
230-240	0.09	50/60	100	94

* MEASURED ON-AXIS AT TEN FEET/3 METERS IN AN ANECHOIC CHAMBER.

INSTRUCCIONES DE INSTALACION PARA LA BOCINA VIBRATONE

MODELO 350WB

MENSAJE DE SEGURIDAD PARA LOS INSTALADORES

NOTA

LA INSTALACIÓN, MANTENIMIENTO Y DESECHO DEL PRODUCTO DEBE REALIZARSE SEGÚN LO ESTABLECIDO EN LOS REGLAMENTOS Y NORMATIVAS NACIONALES

Es importante seguir todas las instrucciones remitidas con el producto. El dispositivo debe ser instalado por un electricista cualificado que aplicará los reglamentos nacionales y locales vigentes en el país de uso.

La elección del lugar de instalación del dispositivo, de los controles y del cableado se realizará bajo la dirección del Ingeniero de Instalaciones y del Ingeniero de Seguridad. A continuación se indican otras instrucciones de seguridad y medidas de precaución importantes que deben cumplirse:

- Lea y comprenda todas las instrucciones antes de instalar o poner en funcionamiento este equipo.
- No conecte la unidad al sistema cuando la alimentación esté activada.
- Si hay objetos situados delante de los altavoces, se verá gravemente reducida la distribución óptima del sonido. Debe comprobar que no hay objetos que obstruyan la parte frontal de los altavoces.
- Todas las sirenas de advertencia eficaces producen sonidos fuertes que pueden causar, en ciertas situaciones, pérdida permanente de la audición. Este dispositivo se debe instalar suficientemente alejado de cualquier escucha potencial para limitar su exposición mientras continúa manteniendo su eficacia. Las Normas nacionales sobre ruido, como por ejemplo el Código OSHA de regulaciones federales, 1910.95 en los Estados Unidos, ofrece una guía que se puede utilizar para informarse sobre los niveles de exposición al ruido que son permisibles.
- Después de la instalación, asegúrese de que todos los tornillos de montaje estén ajustados.
- Establezca un procedimiento de comprobación rutinaria del sistema de sonido para que la conexión y el funcionamiento sean correctos.
- Proporcione una copia de estas instrucciones al Ingeniero de Seguridad, al(a los) operador(es) y al personal de mantenimiento.
- Conserve estas instrucciones en un lugar seguro y consúltelas para el mantenimiento y/o

reinstalación del dispositivo.

El incumplimiento de todas las precauciones e instrucciones de seguridad, puede producir daños materiales o ser causa para usted u otras personas de lesiones graves o de muerte.

A. Introduccion.

En todas las instalaciones, se recomienda completar el cableado eléctrico hasta el lugar de instalación antes demontar la bocina. Las instalaciones deben someterse a los reglamentos y normativas nacionales y locales en materia de electricidad e incendios.

B. Instalacion.

ADVERTENCIA

No conecte los cables cuando la alimentación está activada.

El Modelo 350WB está guarnecido con empaquetadura metálica y está dotado de dos aberturas derivadas 3/4-14 NPT y una abertura derivada 1/2-14NPT para acomodar las tomas de conexión.

1. Utilice la caja posterior del Modelo 350WB como plantilla y marque la localización de los bordes en la superficie de montaje. Fije el 350WB a la superficie de montaje con los remaches proporcionados al usuario adecuados para la superficie de montaje.
2. Vea el diagrama 1. Retire y conserve los cuatro tornillos que fijan la bocina a la caja posterior. Retire la bocina de la caja posterior.
3. Conecte los cables de suministro al bloque terminal tal como muestran los diagramas 2 y 3. El bloque terminal admite cables de un hilo y cables trenzados desde 10 AWG (5,27 mm2) hasta 20 AWG (0,52 mm2). Si se utilizan cables trenzados, compruebe que los hilos del cable están trenzados antes de introducirlos en el bloque terminal.
4. Vuelva a instalar la bocina en la caja posterior utilizando los tornillos retirados.
5. Para el modelo 350WB-120VAK solamente:

   a. El tornillo de presión del ajuste del volumen ya está instalado en la bocina.

   b. Para información adicional, vea la hoja de instrucción 8435A536.

MENSAJE DE SEGURIDAD PARA EL PERSONAL DE MANTENIMIENTO

- Lea y comprenda las instrucciones antes de realizar el mantenimiento de la unidad.
- Para reducir el riesgo de descarga eléctrica o de ignición en ambientes peligrosos, no realice el mantenimiento del mecanismo cuando los circuitos estén activos.
- Si el altavoz está obstruido por elementos extraños, se verá reducida la distribución óptima del sonido. Deben realizarse comprobaciones periódicas para asegurar que el altavoz no contiene sustancias extrañas en su interior.
- El mantenimiento del sistema de aviso debe ser realizado por un electricista cualificado según los reglamentos y normativas nacionales y locales vigentes en el país de uso.
- Nunca modifique la unidad de modo alguno. Si se realizan aberturas o modificaciones adicionales a las unidades específicamente diseñadas para ser utilizadas en lugares peligrosos, puede reducirse el nivel de seguridad en estos lugares.
- La chapa de identificación, que puede contener medidas de precaución u otra información de importancia para el personal de mantenimiento, no debe taparse en el caso de pintar la carcasa exterior.

El incumplimiento de todas las precauciones e instrucciones de seguridad, puede producir daños materiales o ser causa para usted u otras personas de lesiones graves o de muerte.

C. Clasificaciones eléctricas y de audibilidad.

VOLTAJE	CORRIENTE (AMPS)	Hz	dB*	dB**
120	0.18/0.22	50/60	100	94
230-240	0.09	50/60	100	94

INSTRUCTIONS D'INSTALLATION POUR LE KLAXON VIBRATONE, MODELE 350WB

MESSAGE DE SECURITE AUX INSTALLATEURS

NOTA

L'INSTALLATION, L'ENTRETIEN ET LA MISE AU REBUT DE CE PRODUIT DOIVENT ETRE FAITS CONFORMEMENT AUX CODES ET NORMES NATIONAUX.

Il est important de suivre toutes les instructions expédiées avec ce produit. Ce dispositif doit être installé par un électricien professionnel qui est complètement au courant du Code Electrique National et respectera les recommandations NEC ainsi que les codes locaux du pays d'utilisation.

Le choix de l'endroit de montage du dispositif, de ses commandes et du passage des câbles doit être effectué sous la direction de l'ingénieur des services électriques et de l'ingénieur de sécurité. De plus, sont énumérées ci-dessous quelques autres instructions et précautions de sécurité importantes que vous devez suivre:

- Lire et comprendre toutes les instructions avant d'installer ou d'utiliser ce matériel.
- Ne connectez pas cet appareil au système si la tension est présente.
- Une répartition optimale du son sera gravement réduite si des objets se trouvent devant le haut-parleur. Vous devez vous assurer que l'avant du haut-parleur est dégagé de tout obstacle.
- Tous les avertisseurs efficaces produisent des sons forts qui pourraient causer, dans certaines situations, des pertes auditives permanentes. Le dispositif doit être installé assez loin des auditeurs possibles pour limiter leur exposition tout en conservant l'efficacité du dispositif. Les normes de bruit nationales, telles que le OSHA Code of Federal Regulations 1910.95 aux États-Unis, offrent des directives que vous pouvez utiliser en matière de niveaux d'exposition au bruit acceptables.
- Après l'installation, assurez-vous que toutes les vis de montage ont été bien resserrées.
- Etablissez une procédure pour vérifier régulièrement le système sonore concernant son actionnement et son fonctionnement.
- Fournissez une copie de ces instructions à l'ingénieur de sécurité, aux opérateurs et au personnel d'entretien.
- Classez ces instructions dans un endroit sûr et référez-vous à elles lorsque vous entretenez ou réinstallez le dispositif.

Si on ne respecte pas ces précautions de sécurité, il peut en résulter des dommages aux biens, des blessures graves ou mortelles pour vous ou d'autres.

A. Introduction.

Dans toutes les installations, il est recommandé de terminer le câblage électrique jusqu'à l'endroit de l'installation avant de monter le klaxon. Les installations sont soumises aux codes et normes nationaux et locaux électriques et contre les incendies.

B. Installation.

AVERTISSEMENT

Ne branchez pas les fils si le courant est présent.

Le 350WB est équipé de joints et est muni de deux ouvertures taraudées de 3/4-14 NPT et un 1/2-14 NPT pour recevoir les branchements d'alimentation.

1. Utilisez l'enceinte arrière du 350WB comme gabarit et marquez l'emplacement des oreilles de montage sur la surface de montage. Fixez le 350WB à la surface de montage avec des fixations fournies par l'utilisateur, convenant à la surface de montage.
2. Voir la Figure 1. Retirez et gardez les quatre vis qui fixent le klaxon à l'enceinte arrière. Retirez leklaxon de l'enceinte arrière.
3. Attachez les fils d'alimentation à la barre à bornes comme indiqué sur les figures 2 et 3. La barre à bornes est capable d'accepter des câbles pleins et torsadés dans la gamme 10 AWG (0,27 mm) à 20 AWG (0,52 mm). Si on utilise du fil torsadé, il faut s'assurer que les brins de fil sont torsadés ensemble avant de les insérer dans la barre à bornes.
4. Remonter le klaxon sur l'enceinte arrière à l'aide des vis précédemment retirées.
5. Pour le Modèle 350WB-120VAK uniquement :

   a. La vis de réglage du volume est déjà installée dans le pavillon.

   b. Pour toute information complémentaire, voir la page d'instructions 8435A536.

MESSAGE DE SECURITE AU PERSONNEL D'ENTRETIEN

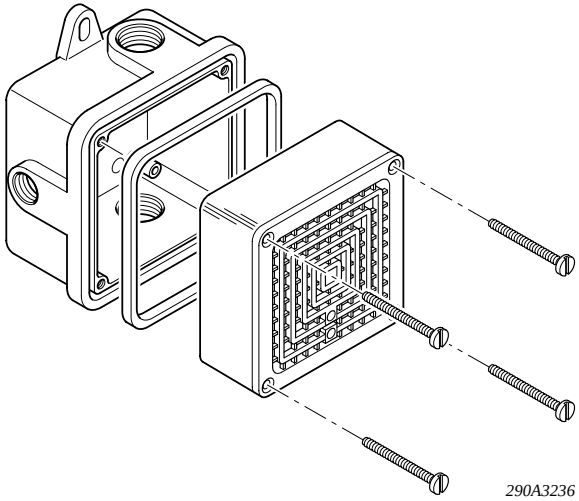
- Lire et comprendre toutes les instructions avant d'effectuer de l'entretien sur cet appareil.
- Pour réduire le risque de choc électrique ou d'allumage en atmosphères dangereuses, ne faites pas d'entretien ou de service sur cet appareil si les circuits sont sous tension.
- Une répartition optimale du son sera gravement réduite si des objets se trouvent devant le haut-parleur. Des vérifications périodiques doivent être effectuées pour assurer qu'aucune matière étrangère n'est présente dans le haut-parleur.
- Tout entretien de l'appareil DOIT être effectué par un électricien professionnel conformément à tous les codes nationaux et locaux et aux normes applicables dans le pays d'utilisation.
- Ne jamais modifier l'unité de quelle que manière que ce soit. La sécurité dans des lieux dangereux peut être mise en cause si des ouvertures supplémentaires ou d'autres modifications sont faites dans des unités spécifiquement conçues pour utiliser dans ces endroits.
- La plaque de caractéristiques, qui peut contenir des informations d'avertissement ou autre, importantes pour le personnel d'entretien, ne doit pas être cachée si l'extérieur du carter utilisé dans des endroits dangereux est peint.

Si on ne respecte pas ces précautions de sécurité, il peut en résulter des dommages aux biens, des blessures graves ou mortelles pour vous ou d'autres.

C. Audibilité et régime nominal électrique.

TENSION	COURANT (A)	Hz	dB*	dB**
120	0.18/0.22	50/60	100	94
230-240	0.09	50/60	100	94

1



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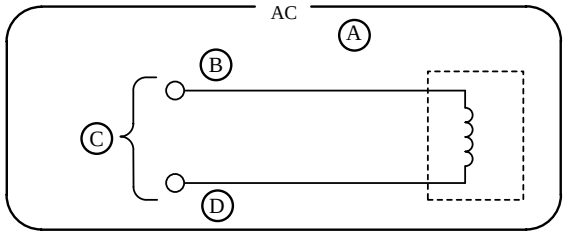
2



290A3235B

English

A. Standard AC horn wiring
B. L, phase
C. AC input power
D. N, neutral

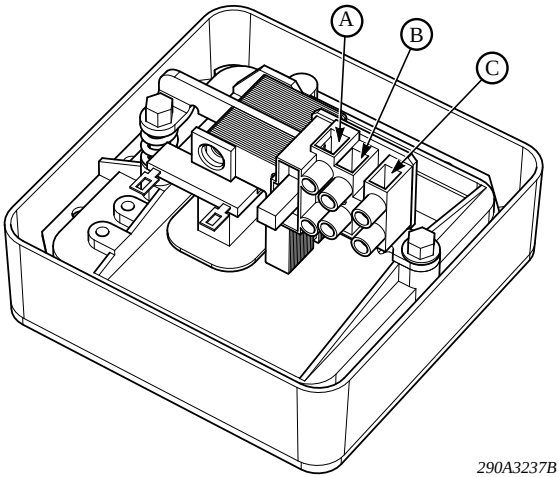
Español

A. Cableado estandar CA la bocina
B. L, fase
C. Potencia de entrada CA
D. N, neutral

Français

A. Cablage standard du klaxon en courant alternatif
B. L, phase
C. Alimentation en courant alternatif
D. N, neutre

3



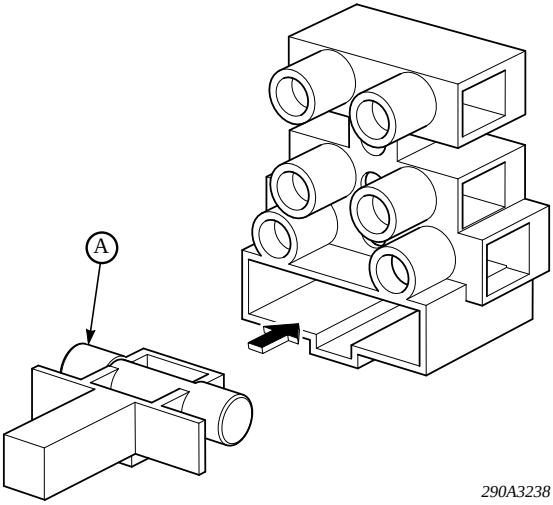
290A3237B

English
A. Phase, L
B. Ground
C, Neutral, N

Español
A. Fase, L
B. Tierra
C. Neutral, N

Français
A. Phase, L
B. Terre
C. Neutre, N

4



290A3238

English
A. 1 AMP 5 x 20mm fuse

Español
A. Fusible 1 AMP 5 x 20mm

Français
Fusible 5 x 20mm, 1A

2561369F
REV. F Printed 1/05
Printed in U.S.A.

NOTE: AGENCY CONTROLLED DOCUMENT NO MODIFICATIONS PERMITTED WITHOUT THE APPROVAL OF FEDERAL SIGNAL AGENCY ENGINEERING

Vibratone® Horns

Models 350 and 450

DESIGNED FOR ROUTINE SIGNALING

- Effective range of 200 feet (61m)
- Reproduces coded or sustained tones
- Model 350 – 12, 24, 120 and 240VAC and produces 100dB @ 10' (110dB @ 1m)
- Model 450 – 12, 24, 125 and 250VDC and produces 99dB @ 10' (109dB @ 1m)
- UL Listed, cUL Listed, CSA Certified, FM Approved
- NEMA 4 with panel mount gasket; NEMA 4X, IP55 with weatherproof backbox (WB)

The Models 350 (AC current) and 450 (DC current) Vibratone® horns produce sound by the electro-mechanical vibration of a diaphragm. The horn mechanism with diaphragm is attached to the grille. Indoor or outdoor use depends on the back box used. Both models may be fitted with a single projector (Model PR) or a double projector (Model PR2).

Model 350 is available in 12, 24, 120 or 240VAC for 50/60Hz. Its sound output level is 100dB nominal at ten feet (110dB @ 1 meter); the 12VAC model is rated for 94dB at ten feet (104dB @ 1 meter).

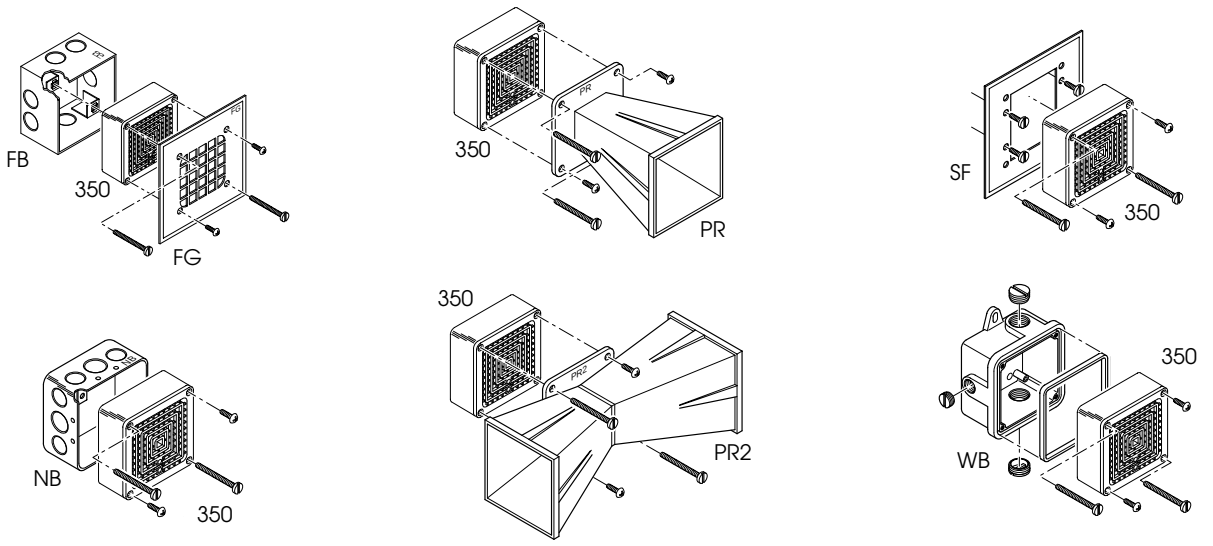
Model 450 is available in 12, 24, 125 and 250VDC – the 250VDC model is excellent for coding and alarm usage. The 24VDC, 125VDC and 250VDC versions are rated at 99dB at ten feet (109dB @ 1m); the 12VDC version is rated at 93dB at 10' (103dB @ 1m).

These Federal Signal horns accommodate surface, flush or semi-flush mounting on walls, panels, in cabinets, or on 4-inch square outlet boxes (not included with signal). **For NEMA Type 4 applications,** an optional gasket kit is available for surface or flush panel mounting. The 350 and 450 models are made of die-cast zinc with gray enamel finish. Both outer housings measure 4" x 4" x 2½" and resist vandalism without reducing sound output. Model 350 has a stainless steel diaphragm; Model 450 has an aluminum alloy diaphragm and heavy-duty contacts. Both are UL and cUL Listed (Underwriters Laboratories), CSA (Canadian Standards Association) Certified and FM Approved. When used with the weatherproof back box (Model WB), these horns also meet NEMA 4X requirements.

Capable of reproducing coded blasts or sustained tones, Federal Signal's Vibratone horns are excellent for general alarm, start/dismissal, coded paging and process control signaling in areas where their sound output exceeds ambient noise levels. Compact size and a variety of installation options make them ideal for institutional use.

Model	Voltage	Operating Current	Decibels @ 10'	1m
350	12VAC 50/60Hz	0.90 amps	94	104
350	24VAC 50/60Hz	0.90 amps	100	110
350	120VAC 50/60Hz	0.18 amps	100	110
350	240VAC 50/60Hz	0.09 amps	100	110
450	12VDC	0.13 amps	93	103
450	12VDC	0.50 amps	99	109
450	24VDC	0.25 amps	99	109
450	125VDC	0.05 amps	99	109
450	250VDC	0.03 amps	99	109

VIBRATONE® HORNS (350/450)



OPTIONS

FB	Wall box for flush mounting the Vibratone® horn in stud, 4" block, or other shallow wall construction; 4 3/8" square box; 2 7/8" deep; shipping weight 2 lbs. (0.91 kg)
FBL	Same as FB, but 3 5/8" deep for 6" x 8" concrete block, cinder block or other deep wall construction; shipping wt. 3 lbs. (1.36 kg)
FG	Flush grille which attaches to the basic unit and serves as the cover of the plastered-in FB flush box; 6" H x 6" W x 1/8" D; shipping wt. 1 lb. (0.45 kg)
K8435666A	Optional Panel Mounting Gasket Kit includes a gasket and hardware for surface or flush mounting the horn for NEMA Type 4 applications.
NB	4" square box with 1/2" & 3/4" knockouts for interior mountings; 1 1/2" deep; shipping weight 1 lb. (0.45 kg)
PR	Projector which concentrates sound into a basic area when attached to the basic model 350/450 units; 4" H x 4" W x 6" D; shipping weight 1 lb. (0.45 kg)
PR2	Double projector directs sounds to both sides when attached to the basic model 350/450 units; ideal for use in hallways; 4" H x 11 1/2" W x 4" D; shipping weight 2 lbs. (0,91 kg)
SF	Stamped surface plate used for installations on plastered-in 4" outlet switch boxes for semi-flush mountings; 6"H x 6" W x 1/2" D; shipping weight 1 lb. (0.45 kg)
WB	Cast aluminum neoprene-gasketed weatherproof housing for outside use, complete with mounting lugs; tapped for 1/2" conduit; 4 3/8" square box; 2" deep mounting lugs on 4 1/2" centers; shipping weight 1 lb. (0.45 kg)

SPECIFICATIONS

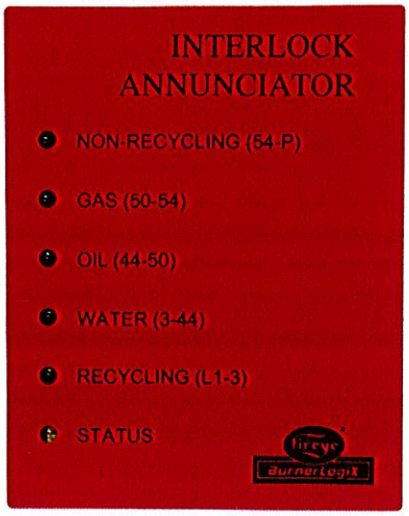
Operating Temp.:	-65°F to 150°F	-54°C to 66°C
Net Weight:	1.4 lbs.	0.6 kg
Shipping Weight:	1.5 lbs.	0.7 kg
Height:	4.0"	102 mm
Width:	4.0"	102 mm
Depth:	2.5"	64 mm

HOW TO ORDER

- Specify model and voltage
- Specify options from list

REPLACEMENT PARTS

Description	***Part Number***
Panel Mount Gasket Kit	K8435666A
Coil (120VAC only)	KFC1516C



FIREYE® YZ300 and YZ320 INTERLOCK ANNUNCIATOR

For use with the Fireye BurnerLogix™ Control

CE c UL US LISTED FM APPROVED

DESCRIPTION

The FIREYE YZ300 (YZ320) Interlock Annunciator Module provides increased interlock supervision capability of the BurnerLogix System. The Interlock Annunciator Module connects to any YB110 (YB230) or ZB110 (ZB230) BurnerLogix chassis/amplifier by means of a cable, (P/N ED580-2, ED580-4, ED580-8).

By wiring any of twenty interlock switches into the Interlock Annunciator Module, the BurnerLogix display automatically acts as a "first-out" annunciator for these interlocks. In addition, a fuel selection circuit providing full annunciation even if two fuels are fired simultaneously is standard. The YZ300 (YZ320) is shipped with default messages associated with each set of terminals. The user has the ability to modify these lockout messages in one of two ways:

1. Use the BLV512 or BLL510 display module to select a lockout alarm message for the individual terminals of the YZ300 (YZ320) from a library of available messages. Refer to Bulletins BL-1001 and/or BLZ-1001 for information regarding the operation of these controls.
2. Program a customized message (up to 40 characters in length) for the individual terminals of the YZ300 (YZ320) using a compatible PC with the Windows based YZ300P Programming software, available from Fireye and the appropriate hardware. Note: The YZ300 (YZ320) Interlock Annunciator does not need to be connected to a BurnerLogix system to be custom programmed.

Note: *Proper operation of the YZ300 (YZ320) requires a BurnerLogix YB110 (YB230) with an Engineering code of 3 or later or any ZB110 (ZB230) chassis/amplifier (Engineering codes are found after the date code, e.g. 0636-03).*

The Interlock Annunciator Module does not interfere with the normal operation of the BurnerLogix System. It expands the message and diagnostic capability.

The wiring bases for the YZ300 (YZ320) measure 4 in. wide by 7 in. tall, consuming a minimum amount of cabinet space. The wiring bases contain a 24 position terminal block, each position clearly numbered and each terminal utilizing a clamping mechanism to assure a good mechanical connection.

The YZ300 (YZ320) Interlock Annunciator module provides operational information and reduces troubleshooting time and expense. It expands the standard display messages of the BurnerLogix to identify the specific limit in the operating control circuit (L1-3) or running interlock circuit (3-P) which caused the burner shutdown or lockout. For a detailed description of the BurnerLogix System, see Bulletins BL-1001 or BLZ-1001.

APPROVALS

Underwriters Laboratories Inc.:
MCCZ File MP1537
Controls, Primary Safety - Listed
MCCZ2 File MP1537
Controls, Primary Safety - Component
MCCZ7 File MP1537
Controls, Primary Safety Certified for Canada
MCCZ8 File MP1537
Controls, Primary Safety Certified for Canada - Component

Factory Mutual: Approved
Acceptable by: Industrial Risk Insurers (I.R.I.)
CE:

Gas Appliances

Gas Appliance Directive:	90/396/EEC
Low Voltage Directive:	73/23/EEC
EMC Directive:	89/336/EEC
GASTEC:	0063BT1754 (EN298, 2003; EN230, 2005)

Table 1: Agency Approvals

BurnerLogix Chassis/Flame Amp. Module	FM APPROVED	c UL us LISTED	c TÜV us	CE	DIN DVGW	DIN CERTIFIED
YZ300	X	X	X	X		
YZ320				X		

X = CERTIFICATION IN HAND

SPECIFICATIONS

Supply Voltage: YZ300 - 120VAC (+ 10% - 15%), 50 / 60 Hz
YZ320 - 230VAC (+ 10% - 15%), 50 / 60 Hz

Power Consumption: 10 VA

Protection Category: NEMA1 (IP01)

Ambient Temperature Levels: -40F to +140F (-40C to +60C)

Response Time: 66 milliseconds Purge / 32 milliseconds Run

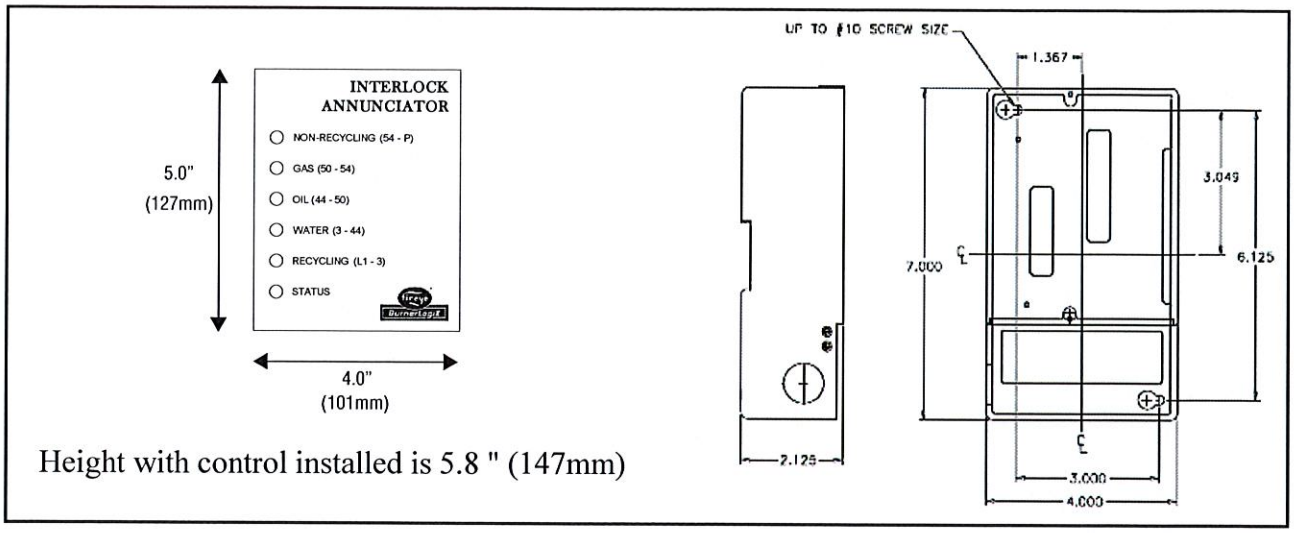
Weight: 1.1 lb. (0.5 kg)

Humidity: 85% R.H. non-condensing

Cable Length: 8 feet maximum

WARNING: This equipment is a Class B digital apparatus which complies with the Radio Interference Regulations, CRC c.1374.

FIGURE 1. DIMENSIONS



Height with control installed is 5.8 " (147mm)

The location should be free from excessive vibration and within the ambient temperature rating.

ORDERING INFORMATION

Part Number	Description
YZ300	Interlock Annunciator Module used with the YB110 or ZB110 BurnerLogix chassis/amplifier, 120 VAC, +10%, -15%, 50/60 Hz
YZ320	Interlock Annunciator Module used with the YB230 or ZB230 BurnerLogix chassis/amplifier, 230 VAC, +10%, -15%, 50/60 Hz
60-2872-1	Wiring base, terminal blocks, closed with knockouts
60-2874-1	Wiring base, terminal blocks, open end
ED580-2, -4, -8	YB110 or ZB110 to YZ300 interconnection cable in 2', 4' and 8' lengths
YZ300P	Windows based software for programming custom messages. Download from www.fireye.net/ftpfiles/YZ300P
EC485	RS232 to RS485 converter with power supply. Required to customize YZ300 messages
UC485	USB to RS485 converter with USB cable. Required to customize YZ300 messages
ED512-2, 4, -8	Cable with RJ12 connectors on each end. Required to customize YZ300 lockout alarm messages

OPERATION

The YZ300 (YZ320) Interlock Annunciator Module is designed to expand the capability of the BurnerLogix System by allowing the operator to individually track the operation of four (4) recycling interlocks and sixteen (16) running interlocks (non-recycling). The recycling interlocks are wired between the L1-3 terminals on the BurnerLogix wiring base and the non-recycling interlocks are in the 3-P circuit.

Referring to the wiring diagram, Figure 2 on page 8, the operating control and auxiliary limits 1, 2 and 3 will act as an operating control to recycle the burner. Whenever any of the auxiliary limits are open and the other limits are closed, the message on the display of the BurnerLogix control will indicate:

STANDBY

L1-3 AUX #1(or #2, or #3) OPEN (or the appropriate modified message)

Similarly, the interlocks in the 3-P circuit will change the standard running interlock message on the display from: LOCKOUT 3-P INTLK OPEN to one which will individually identify the sixteen (16) interlocks now being monitored by the YZ300 (YZ320), such as, LOCKOUT LOW OIL TEMPERATURE (or the appropriate modified message). The interlock switch chosen will be selected on a

"first out" basis. The first switch which opens in the string to cause the condition will be displayed. The 3-P circuit is immediately monitored after a burner start-up.

When a "lockout" condition is manually reset, the display on the BurnerLogix and the Interlock Annunciator Module is ready to begin a new burner sequence. Note the section *Lockouts* in the Bulletin BL-1001 or BLZ-1001.

Whenever more than one interlock switch in the L1-3 circuit is open on a start-up, the open interlock switch wired in the sequence closest to the L1 terminal will be displayed. Whenever more than one interlock switch in the 3-P circuit is open on a startup, the open interlock switch closest to terminal 3 will be displayed.

CAUTION: The YZ300 (YZ320) messages are stored within the Interlock Annunciator Module. The YZ300 (YZ320) messages shown in Table 2 on page 5, and on the wiring diagram, Figure 2 on page 8, represent the default messages that are shipped with each Interlock Annunciator module. Unless these default messages are modified via the BLL510 or BLV512 display module or customized via a PC (Refer to CUSTOMIZING YZ300 (YZ320) MESSAGES in this bulletin), the YZ300 (YZ320) must be wired EXACTLY AS SHOWN, in the sequence as shown in the wiring diagram, Figure 2 on page 8, to ensure proper operation.

The YZ300 (YZ320) must be connected to the BurnerLogix control to provide access to the additional lockout messages associated with the YZ300 (YZ320) Expansion Module.

In operation, the 3 to P and L1 to 3 circuits are checked each half cycle by separate photo optical couplers in the BurnerLogix system to determine if any interlock is open. Upon detecting an open interlock, the BurnerLogix control initiates a LOCKOUT or HOLD message, then requests information from the YZ300 (YZ320) to determine which interlock corresponding to terminals 43 through 59 and L1 through 42 (on YZ300 [YZ320]) to determine which of the interlocks closest to terminal 3 (3-P circuit) or closest to terminal L1 (L1-3 circuit) is open. The BurnerLogix then selects the corresponding message from the stored message list and displays it. The YZ300 (YZ320) messages then become a part of the historical data which is stored in the BurnerLogix system memory.

Any interlock in the 3-P or in the L1-3 circuit that opens for at least 33-50 ms while the burner is ON, or for at least 66 ms while the unit is in PURGE will cause the YZ300 (YZ320) and the BurnerLogix control to respond with the proper message. Interlock contacts that temporarily open for shorter time periods will be ignored. Refer to Figure 2 on page 8 for DEFAULT MESSAGES.

SPECIAL NOTES ON OPERATION

After the start of PTFI, if any recycle (L1-3) or running interlock (3-P) limit opens, the BurnerLogix control will display a POST PURGE message for 15 (or selected post purge time) seconds before displaying the appropriate message. The appropriate LED located on the face of the YZ300 (YZ320) will flash to indicate in what section of the circuit the interlock is open.

On recycle type programmers (e.g. YP200 or YP300 set for recycle operation), if a running interlock (3-P) limit opens, the control will shutdown, perform a post purge and then try to restart. The control will hold for ten (10) minutes during purge waiting for the limit to close. If a second running interlock opens during this "hold" period, the message may change to reflect the new interlock.

If the operating control limit or auxiliary limit #1, #2 or #3 opens during a firing cycle, the control will initiate a 15 second post purge and then go to standby and display the message pertaining to the interlock that opened. The BurnerLogix will wait for all interlocks in the L1-3 circuit to close to begin a new cycle.

If multiple interlocks in the 3-P circuit are opened during the start of a burner cycle, the first interlock in the following sequence will be displayed.

LED INDICATORS

The YZ300 (YZ320) contains 6 LED's that provide information that can be useful in determining the current state of the interlocks wired between terminals L1 and P of the BurnerLogix control.

STATUS – indicates red when the ED580 connection to the BurnerLogix is interrupted, green when connection is established.

RECYCLING – illuminates steady when all interlocks between terminal L1 and 3 are closed and powered. Blinks if any interlock is open.

WATER – illuminates steady when Low Water and High Water are closed and powered, blinks if any is open.

OIL – illuminates steady if all oil interlocks between terminals 44 and 55 are closed and powered and oil is an active fuel, blinks if any oil interlock is open.

GAS – illuminates steady if all gas interlocks between terminals 50 and 54 are closed and powered and gas is an active fuel, blinks if any gas interlock is open.

NON-RECYCLING - illuminates steady when all interlocks between terminals 54 and P are closed and powered, blinks if any interlock is open.

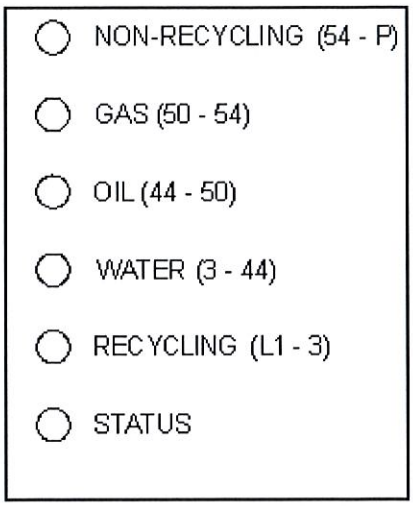


Table 2: YZ300 (YZ320) DEFAULT MESSAGES

OIL MODE		GAS MODE	
Terminal	Message	Terminal	Message
Recycling Limits			
L1-40	Op Control Open	L1-40	Op Control Open
40-41	L1-3 Aux#1 Open	40-41	L1-3 Aux#1 Open
41-42	L1-3 Aux#2 Open	41-42	L1-3 Aux#2 Open
42-3	L1-3 Aux#3 Open	42-3	L1-3 Aux#3 Open
Non-Recycling Limits			
3-43	High Water	3-43	High Water
43-44	Low Water	43-44	Low Water
For OIL select, connect terminal 49 to 53		**For GAS select, connect terminal 45 to 49**	
45-46	High Oil Temperature	50-51	Low Gas Pressure
46-47	Low Oil Temperature	51-52	High Gas Pressure
47-48	Low Oil Pressure	52-53	Aux Gas
48-49	Low Atomizing Media		
54-55	High Pressure	54-55	High Pressure
55-56	High Temperature	55-56	High Temperature
56-57	Aux #4 Open	56-57	Aux #4 Open
57-58	Aux #5 Open	57-58	Aux #5 Open
58-59	Aux #6 Open	58-59	Aux #6 Open
59-60	Aux #7 Open	59-60	Aux #7 Open
60-P	Air Flow Open	60-P	Air Flow Open

INSTALLATION AND WIRING

Wiring Base

Install the wiring base where the relative humidity never reaches the saturation point. The YZ300 (YZ320) Interlock Annunciation system is designed to operate in a maximum 90% relative humidity continuous, non-condensing environment. Do not install the YZ300 (YZ320) where it can be subjected to vibration in excess of 0.5G continuous maximum vibration. The BurnerLogix system is not a weather tight enclosure. The standard vertical position is recommended. Allow at least one inch clearance around the control for service and installation.

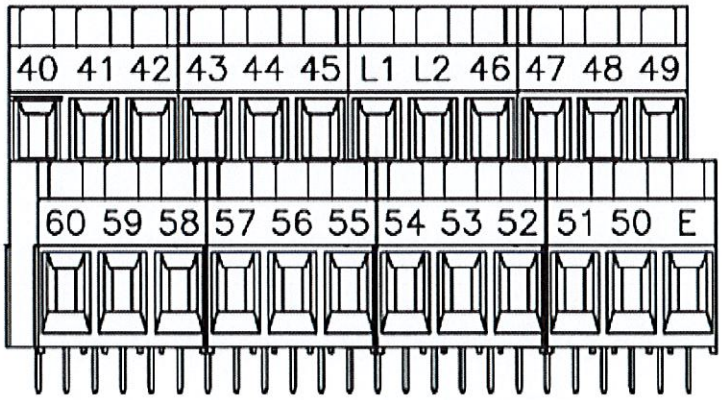
1. Wiring must comply with all applicable codes, ordinances and regulations.
2. **Wiring must comply with NEC Class 1 (Line Voltage) wiring.**
3. Limits and interlocks must be rated to simultaneously carry and break current to the ignition transformer, pilot valve and main fuel valve(s).
4. Maximum wire lengths:
   a. The maximum lead wire length is 200 ft. (61 meters) to terminal inputs (Operating limits, interlocks, valves, etc.).
   b. Modbus communications: The maximum cable length of wire is 3300 feet (1000 meters) for RS-485.

A good ground system should be provided to minimize the effects of AC quality problems. A properly designed ground system meeting all the safety requirements will ensure that any AC voltage quality problems, such as spikes, surges and impulses have a low impedance path to ground. A low impedance path to ground is required to ensure that large currents involved with any surge voltages will follow the desired path in preferences to alternative paths, where extensive damage may occur to equipment.

WARNING: Controls require safety limits utilizing isolated mechanical contacts. Electronic limit switches may cause erratic operation and should be avoided.

Wiring bases 60-2872-1 and 60-2874-1 each contain a 24 position terminal block. Each terminal can accept either 2 type 16 AWG wires or a single type 14 AWG wire. Each terminal is a clamp type terminal that provides sufficient pressure against the wire.

For any interlock of the YZ300 (YZ320) that is not used, a jumper must be placed between those two terminals. For example, if AUX LIMIT #7 is not used, a jumper must be placed from terminal 59 to terminal 60.



The fuel select switch connects to terminals 45, 49 and 53.

Terminals 44 & 45, 49 & 50 and 53 & 54 are internally connected.

Important: If a particular interlock is not used, a jumper must be installed on the terminals of the Interlock Annunciator Module wiring base which corresponds to that unused interlock. For example: if the system has no high temperature switch and no need for auxiliary limits 5 and 6, a jumper should be placed between terminals 55 and 56, 57 and 58, 58 and 59.

Important: When a single fuel burner is used, a fuel selector switch is not necessary. However, the fuel selection terminals for the unused fuel type must be jumped out.

For gas only: connect terminal 45 to 49

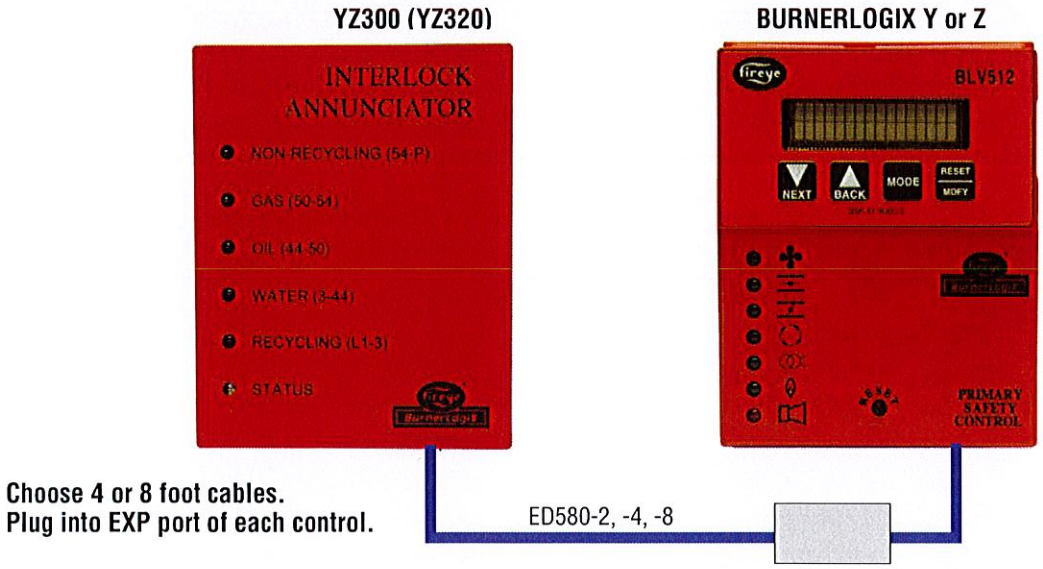
For oil only: connect terminal 49 to 53

When the fuel selector switch is in the GAS position, the 4 oil interlocks are ignored by The Burner-Logix Control. When the switch is in the OIL position, the 3 gas interlocks are ignored.

CAUTION: All YZ300 (YZ320) wiring should not interfere with the safety function or operation of any of the interlocks. Check each interlock for proper operation after wiring

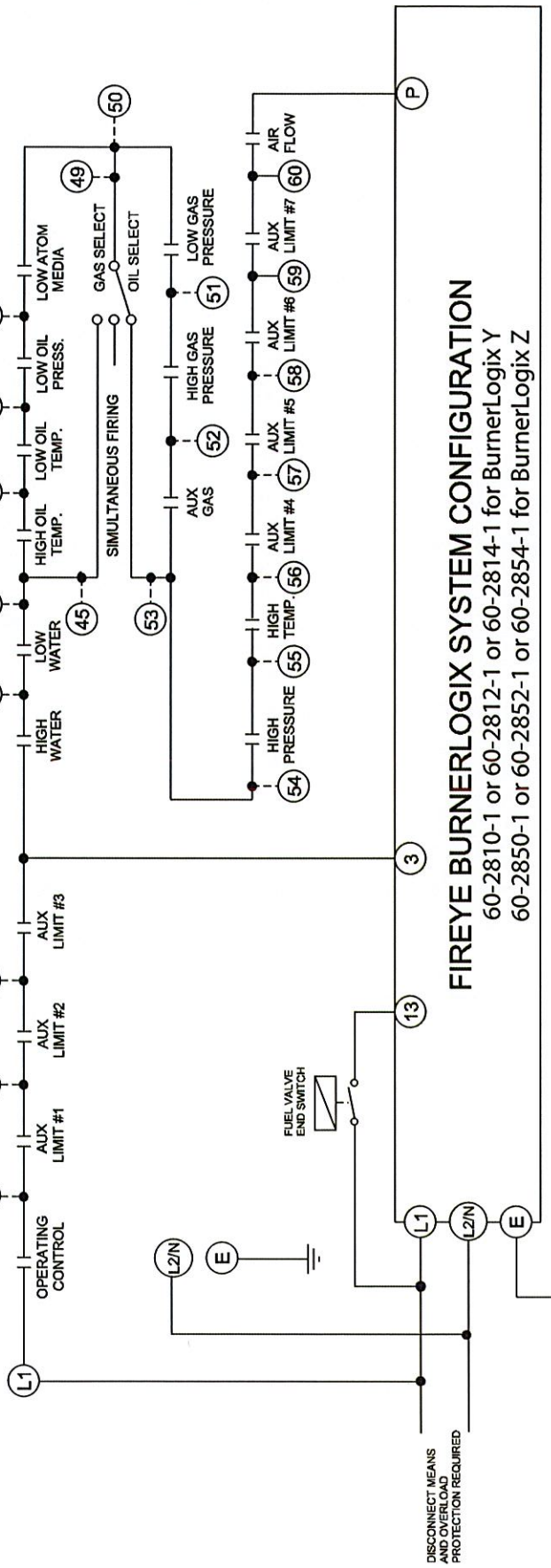
INTERCONNECTING YZ300 (YZ320) TO BURNERLOGIX

Remove the RJ485 plug from the EXP port located on the underside of the BurnerLogix control. Plug end of ED580 cable with ferrite core into EXP port of the BurnerLogix control. Plug the other end of the ED580 cable into the EXP port located on the underside of the YZ300 (YZ320) Interlock Annunciator.



While power is on and the interconnection between the YZ300 (YZ320) and BurnerLogix has been established, if either the ED580 cable is unplugged or the YZ300 (YZ320) ceases to communicate with the BurnerLogix control for 3 consecutive minutes, the BurnerLogix (Y or Z) will move to lockout with a CHECK EXP MODULE message. Resetting the control with the ED580 cable unplugged will resume normal operation

FIGURE 2. WIRING DIAGRAM FOR DEFAULT MESSAGES



Note: Terminals 44 & 45, 49 & 50 and 53 & 54 are internally connected.

Note: All existing wiring on terminals not shown will be undisturbed when the YZ300 (YZ320) is installed.

For any interlock of the YZ300 (YZ320) that is not used, a jumper must be placed between those two terminals. For example, if AUX LIMIT #7 is not used, a jumper must be placed from terminal 59 to terminal 60.

Remove all power from the BurnerLogix control and the YZ300 (YZ320) before wiring.

YZ300 (YZ320) MESSAGE SELECT

The sub-menu "YZEM MSG SELECT" will allow the user to modify the recycle and non-recycle messages associated with the operation of the YZ300 (YZ320) Interlock Annunciator Module and BurnerLogix. The use of the default messages requires the system to be wired as shown in the wiring diagram. For example, the low water cutoff had to be wired between terminals 43 and 44 of the YZ300 (YZ320). The YZEM MSG SELECT option now allows the user to select from a library of messages and program each interlock terminal as required. The messages associated with the YZ300 (YZ320) are divided into four (4) groups: **Recycle, Non-recycle, Gas Select, and Oil Select.**

The **Recycle** group pertains to the limits that are connected between terminals L1 and 3 of the BurnerLogix. These are terminals L1-40, 40-41, 41-42, and 42-3.

The **Non-Recycle** group pertains to the limits that are connected between terminals 3 and P of the BurnerLogix. These are terminals 3-43, 43-44, 54-55, 55-56, 56-57, 57-58, 58-59, 59-60 and 60-P.

The **Gas Select** group pertains to the terminals associated with the gas interlocks of the YZ300 (YZ320). These are terminals 50-51, 51-52, and 52-53.

The **Oil Select** group pertains to the terminals associated with the oil interlocks of the YZ300 (YZ320). These are terminals 45-46, 46-47, 47-48, and 48-49.

The lockout messages associated with the above terminals can be modified via either the BLL510 or BLV512 displays.

The selection of available messages are dependent on each group. For example, the message "Low Oil Pressure" is a selection only for the Oil Select group. The default message for a particular interlock is the standard message for those terminals. For example, the default message for terminals 40-41 is "L1-3 AUX #1 OPEN."

TO MODIFY THE YZ300 (YZ320) MESSAGES

All four keys: NEXT, BACK, MODE, and RESET/MDFY are used to used to enter or exit the sub-menu associated with the YZ300 (YZ320) messages. The NEXT or BACK keys are used to scroll through the various terminals and selectable messages. The RESET/MDFY key is used to modify and save a new message for each of the YZ300 (YZ320) Interlock Annunciator terminals.

Library messages cannot override custom programmed messages.

To modify the YZ300 (YZ320) messages:

Press the NEXT or BACK key until the BLL510 or BLV512 displays:

YZEM MSG SELECT>

Press the MODE key to enter the sub-menu and the screen displays:

TRM #40-41 MDFY

L1-3 AUX#1 OPEN or previously selected message.

Press the NEXT key and the screen displays:

TRM #41-42 MDFY

L1-3 AUX#2 OPEN or previously selected message.

To change the message, press and hold the RESET/MDFY key for one (1) second. When the RESET/MDFY key is released, the screen displays:

TRM #41-42 SAVE

L1-3 AUX#2 OPEN

Press the NEXT or BACK key to display the available messages for the particular group being modified. See attached List of available messages for each group.

When the messages displayed is appropriate for the terminals, press and hold the RESET/MDFY key for one (1) second. When the RESET/MDFY key is released, the screen displays:

TRM #41-42 MDFY

LOW WATER

Press the MODE key to exit the YZ300 (YZ320) Message Sub-menu.

AVAILABLE YZ300 (YZ320) MESSAGES

The following messages are available for each of the four YZ300 (YZ320) terminal groups:

GROUP 1 — RECYCLE
OP CNTL OPEN
DAMPER POSITION END SWITCH OPEN
COMBUSTION AIR END SWITCH OPEN
LOW WATER
HIGH GAS PRESSURE
LOW GAS PRESSURE
HIGH WATER
BLOWER MOTOR INTLK
HIGH STACK TEMPERATURE
CONTROL PANEL SWITCH OPEN

GROUP 2 — OIL SELECT
LOW OIL PRESSURE
HIGH OIL PRESSURE
LOW OIL TEMPERATURE
HIGH OIL TEMPERATURE
LOW ATOMIZING MEDIA

GROUP 3 — GAS SELECT
HIGH GAS PRESSURE
LOW GAS PRESSURE
AUX GAS

GROUP 4 — NON-RECYCLE
SAFETY INLK OPEN
HIGH WATER
LOW WATER
HIGH PRESSURE
BLOWER MOTOR INTLK
ID FAN INTLK
FD FAN INTLK
HIGH TEMPERATURE
AIR FLOW OPEN
OIL GUN END SWITCH OPEN
HIGH STACK TEMPERATURE

USER PROGRAMMED YZ300 (YZ320) MESSAGES

In addition to selecting the hold or lockout alarm messages for the YZ300 (YZ320) Interlock Annunciator Module from the menu selection via the BLL510 or BLV512 display, the user can also program any message (up to 40 characters in length) for the individual terminals of the YZ300 (YZ320). Fireye provides a Windows based program YZ300P to facilitate this process.

The YZ300 (YZ320) Interlock Annunciator need NOT be connected to the BurnerLogix in order to program customized messages.

The following equipment is required:

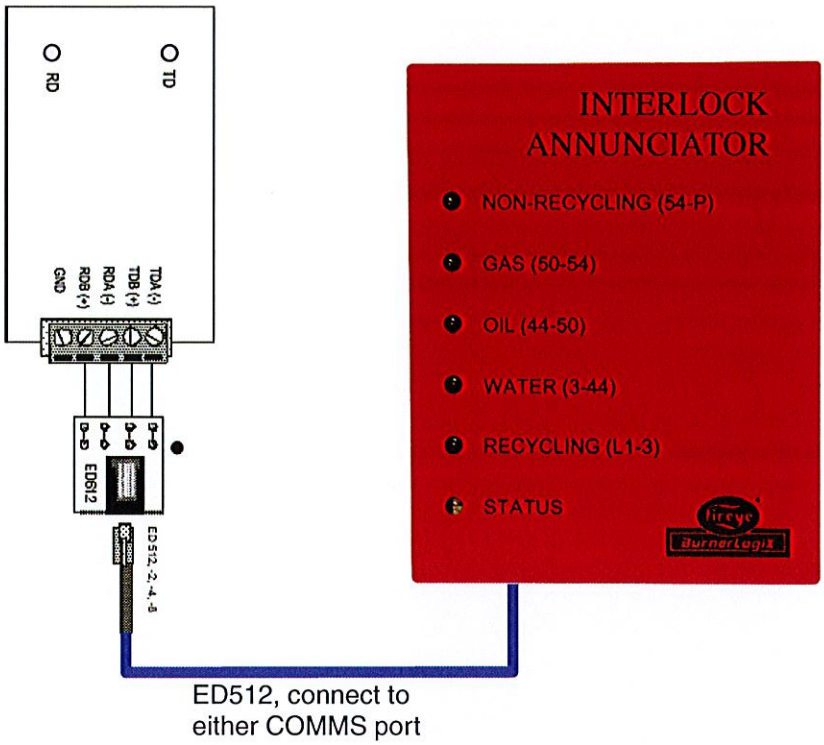
- A computer running Windows.
- A copy of YZ300P software provided by Fireye.
- An RS232 to RS485 converter, serial port required (P/N EC485 or IC485 - includes necessary power supply) or USB to RS485 converter (P/N UC485).
- An ED512-2, -4, or -8 cable

Setup

1. Connect the EC485 (or equivalent) to the serial COM or USB (or equivalent) port of the PC.

2. Connect the RJ12 female connector (provided with the EC485, IC485 or UC485 (preferred)) to terminals TD(A), TD(B), RD(A) and RD(B) on the UC485. The pins on the RJ12 connector should line up with the terminals on the converter.

UC485 or equivalent
see UC-4851 for setup & configuration.



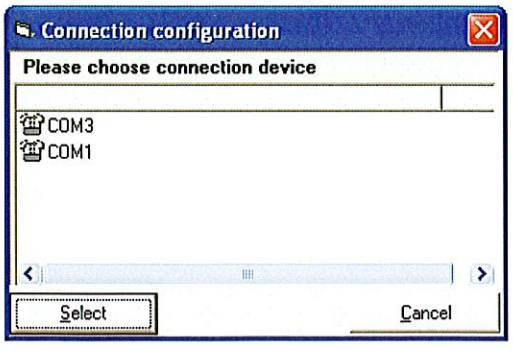
ED512, connect to either COMMS port

3. Plug one end of the ED512-2, -4 or -8 cable into the RJ12 jack on the UC485 and the other end into either of the RJ12 jacks located on the underside of the YZ300 (YZ320) Interlock Annunciator.
4. The YZ300 (YZ320) must be powered and if not connected to the BurnerLogix, the default address is set to 1 and the baud rate is 9600,N,8,1.

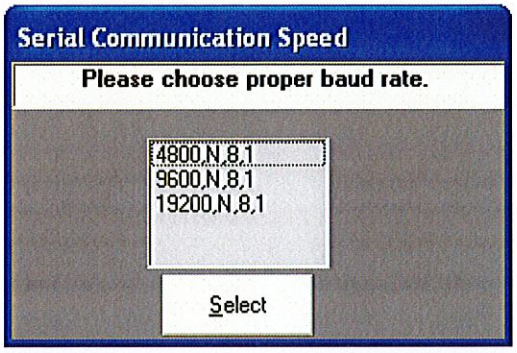
If the COMMS of the BurnerLogix and YZ300 (YZ320) are connected together, the YZ300 (YZ320) assumes the address and baud rate of the BurnerLogix control. Check PROGRAM SETUP sub-menu for the current settings.

RUNNING THE YZ300P SOFTWARE

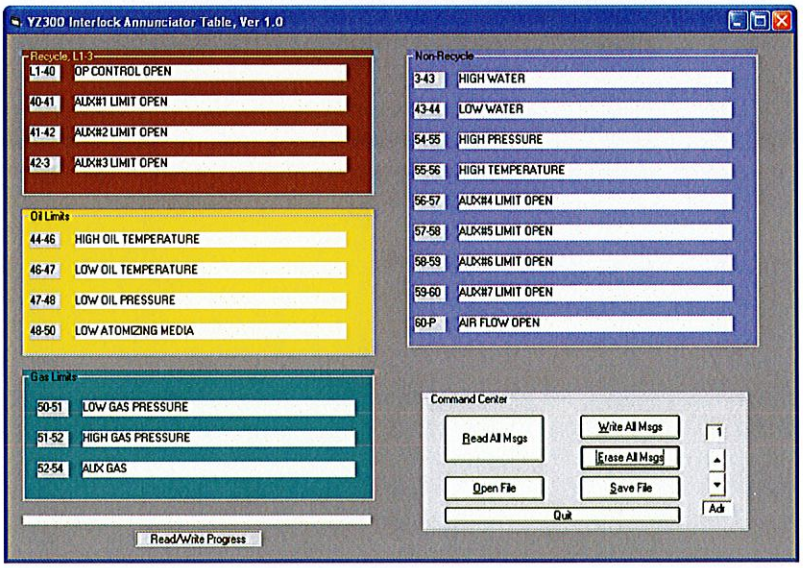
1. Run the YZ300P software on the PC. After the introductory and obligatory splash screen, a list of available COM ports will be displayed. Use the TAB and arrow keys or mouse to select the proper port.



2. A list of available communication baud rates will appear. Use the TAB and arrow keys or mouse to make the proper selection Press Select to continue.



3. Assuming the selected COM port is available the following screen appears.



USING THE YZ300P SOFTWARE

Initially, the YZ300P displays the default messages of the YZ300 (YZ320) Interlock Annunciator. The Command Center allows the user to Read, Write and Erase all stored messages, Open and Save the message file and select the communication address. Pressing the Quit bar will terminate the program.

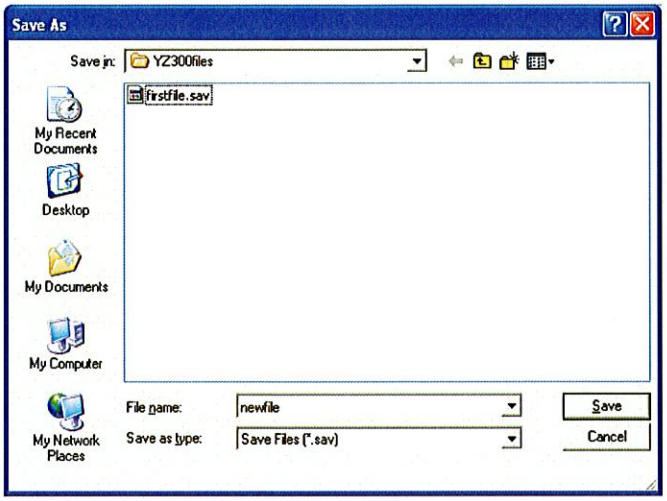
- **Read** - the YZ300P will read all messages currently stored in the YZ300 (YZ320) and display the custom message in the appropriate location. If no message is stored, the default message will be displayed. (Library selected messages will not be displayed on the YZ300P).
- **Write** - the YZ300P will upload or write all messages to the YZ300 (YZ320). If the message displayed on the YZ300P screen is a default message then no writing of that message location will take place.
- **Erase** - the YZ300P will send an erase message command to each message location in the YZ300 (YZ320) and restore that message location to the factory default condition, no message stored.

> During the Read, Write and Erase operations, the progress bar located on the YZ300P screen will move left to right indicating the status of the selected operation.

- **Save** - the YZ300P allows the current message file to be stored for later recall and re-programming of other YZ300 (YZ320) Interlock Annunciators. Clicking Save will open a dialog box allowing the user to store the current message file using any descriptive name. The user must select or create the appropriate folder location to store the file. Typically, the YZ300P wants

saved files to have the '.sav' extension. If no file extension is specified, the YZ300P will append each saved file with the '.sav' extension automatically. Click on Save after the file name is specified.

Save File Dialog Box

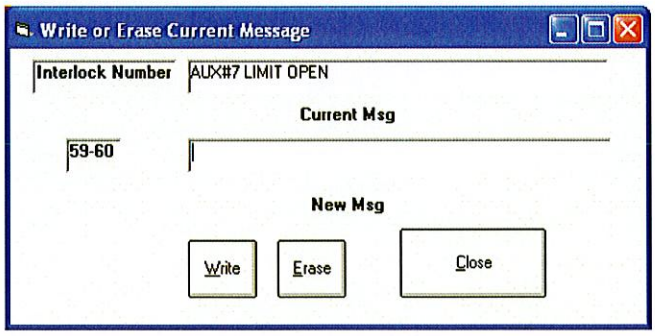


- **Open** - The YZ300P allows the user to open an existing file that can be used to upload to a new YZ300 (YZ320). Clicking Open will open a dialog box showing all files with the '.sav' extension in the folder displayed. Click on the desired file and then Open. The file will be read into the program and the screen will be populated with the messages from the file. Clicking on Write will upload these messages to the connected YZ300 (YZ320). This is especially helpful when customizing messages in multiple devices or replacing a unit currently installed.

CUSTOMIZING OR ERASING A MESSAGE

To customize or erase a message, on the YZ300P screen, click on the particular message and the following dialog box will appear.

Write or Erase Message Dialog Box



The current message pertaining to that interlock location is displayed and a text box is available to enter in the new message. The new message cannot exceed 40 characters in length and also the new message is not case sensitive. When complete, click on the Write button to send the message to the YZ300 (YZ320). A confirmation will appear indicating if the message transfer was successful. This same dialog box can be used to also erase the message in the current location and return the message to factory default or no message stored. When complete, click on Close to return to the YZ300P screen. The new message for the selected interlock will appear in the selected location. The file can then be saved for later use.

NOTICE

When Fireye products are combined with equipment manufactured by others and/or integrated into systems designed or manufactured by others, the Fireye warranty, as stated in its General Terms and Conditions of Sale, pertains only to the Fireye products and not to any other equipment or to the combined system or its overall performance.

WARRANTIES

FIREYE guarantees for *one year from the date of installation or 18 months from date of manufacture* of its products to replace, or, at its option, to repair any product or part thereof (except lamps and photocells) which is found defective in material or workmanship or which otherwise fails to conform to the description of the product on the face of its sales order. **THE FOREGOING IS IN LIEU OF ALL OTHER WARRANTIES AND FIREYE MAKES NO WARRANTY OF MERCHANTABILITY OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED.** Except as specifically stated in these general terms and conditions of sale, remedies with respect to any product or part number manufactured or sold by Fireye shall be limited exclusively to the right to replacement or repair as above provided. In no event shall Fireye be liable for consequential or special damages of any nature that may arise in connection with such product or part.

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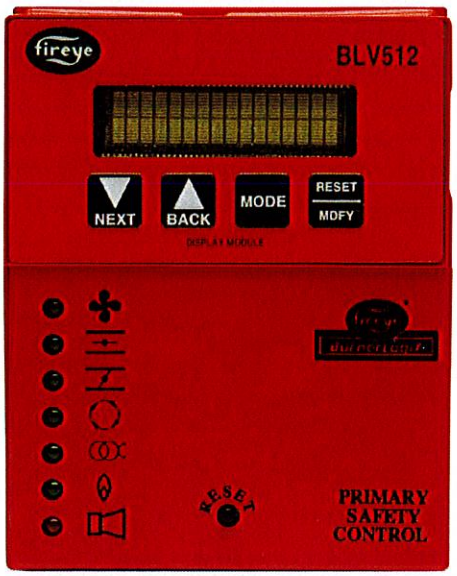
www.fireye.com

YZEM-3001
APRIL 3, 2013
Supersedes September 16, 2011



YB110/YB230 FIREYE® BurnerLogiX™

MICROPROCESSOR-BASED INTEGRATED BURNER MANAGEMENT CONTROL

CE c UL US LISTED FM APPROVED

DESCRIPTION

The Fireye® BurnerLogix™ System is a microprocessor based burner management control system designed to provide the proper burner sequencing, ignition and flame monitoring protection on automatically ignited oil, gas, and combination fuel burners. In conjunction with limit and operating controls, it programs the burner/blower motor, ignition and fuel valves to provide for proper and safe burner operation. Through SMART LED'S, the control provides current operating status and lockout information in the event of a safety shutdown. Optional VFD and LCD displays are available that may be either plugged in or mounted remotely to give full language descriptors of current status and diagnostic lockout information. Refer to BurnerLogix PROGRAMMER SELECTION later in this document for the various combinations of programmer and display modules.

A complete BurnerLogix system includes the YB110 (YB230) chassis equipped with the type of flame amplifier required for the application, appropriate flame detector, plug-in programmer module, wiring base and optional alpha-numeric display. Interchangeable programmer modules allow for complete versatility in selection of function, timing and flame failure response times.

The optional alpha-numeric display is made up of 2 lines by 16 characters per line and is available in either vacuum fluorescent or liquid crystal formats. The advantage of VFD is high brightness and extended temperature range to –40°F. Both displays contain a fully functional keypad allowing the user to easily scroll through the various menus to view the current operating status, review programmer configuration, and lockout history. When mounted remotely, the displays provide NEMA 4x(IP66) protection. An advantage of the BurnerLogix control family is the ability to set many of the operating parameters associated with proper and reliable burner operation allowing inventory of various programmer types to be kept to a minimum.

The YB110 (YB230) is a chassis/flame amplifier module complete with mounting screws and blank display module. The display module (BLV512 or BLL510), if required, must be ordered separately. Interchangeable YP programmer modules allow for complete versatility in selection of control function, timing, and flame scanning means. Functions such as pre-purge time, recycling or non-recycling interlocks, high fire proving interlock, and trial for ignition timing of the pilot and main flame are determined by the programmer module. The BurnerLogix system can be used with ultra-violet, auto-check infrared, flame rod, self-check ultra-violet flame scanners or direct coupled integrated scanners by choosing the proper chassis/flame amplifier module.

Wiring bases for the BurnerLogix control are available pre-wired with 4 foot lead wires color coded and marked for easy installation or with an integral terminal block capable of a accepting up to 2 X 14 AWG wires. The wiring base terminal block is available with knockouts for conduit or open ended for cabinet mounting. The pigtail wiring base is 4" X 5" and the terminal block wiring base is 4" X 7".

Additional functions of the BurnerLogix system include:

- A non-volatile memory which allows the control to remember its history and present position even when power is interrupted.
- A consistent flame signal read-out via display module or 4-20 mA output.
- Read-out of main fuel operational hours and complete cycles via display module.
- Modbus communications via RS485 multi-drop link.
- Proof of fuel valve closure during off cycle.
- Burn-in time of program parameters occurs after 8 hours of main valve on time.
- A run/check switch which allows the operator to stop the program sequence in any of four different positions (Purge, PTFI, MTFI or Auto).
- Remote Display mounting with NEMA 4 protection.
- Remote Reset.
- Programmable communication baud rate allows for DCS compatibility.
- Keypad selectable language readout.
- Revert to pilot can increase burner turn down.
- Additional terminals provided for applications requiring additional inputs and outputs.

WARNING: This equipment is a Class B digital apparatus which complies with the Radio Interference Regulations, CRC c.1374.

CAUTION: While programmers are mechanically interchangeable in that they mate with a common chassis/amplifier module, you should select the correct model for your application. Inappropriate application of a control could result in an unsafe condition hazardous to life and property. Selection of a control for a particular application should be made by a competent professional, such as a boiler/burner service technician licensed by a state or other government agency.

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BURNERLOGIX SPECIFICATIONS

Supply Voltage:

YB110 120 VAC (+10%, -15%) 50/60 Hz

YB230 230 VAC (+10%, -15%) 50/60 Hz

Power Consumption:

25 VA

Temperature Rating:

-40°C (-40°F) to +60°C (140°F)

Protection Category:

YB110 (YB230) control NEMA 1 (IP01)

Display, remote mounted NEMA 4X (IP66)

Unit Dimensions:

Wiring base 60-2810-1 - 4.0" (101 mm) W x 5.0" (127mm) H

Wiring base 60-2812-1, 60-2814-1 - 4.0" (101 mm) W x 7.0" (178 mm) H

Shipping Weight:

YB110 (YB230) Approx. 3.2 lbs. (1.45kg)

OPERATING TEMPERATURE LIMITS

CONTROL	MAXIMUM		MINIMUM	
YB110, YB230	140°F	60°C	-40°F	-40°C
YP Programmers	140°F	60°C	-40°F	-40°C
BLV512, VFD Display	140°F	60°C	-40°F	-40°C
BLL510, LCD Display	140°F	60°C	-4°F	-20°C
Scanner UV1A, UV2, UV8A, UV90, 45UV3	200°F	93°C	-40°F	-40°C
45UV5-1005, 45UV5-1105 45UV5-1007, 45UV5-1009 55UV5-1007, 55UV5-1009	200°F	93°C	-40°F	-40°C
48PT2	140°F	60°C	-40°F	-40°C
Flame Rod (Tip 2460°F)	1500°F	816°C	-40°F	-40°C
Humidity: 90% R.H. (Non-condensing)				
Phoenix 85 Series	150°F	65°C	-40°F	-40°C
InSight 95 Series	150°F	65°C	-40°F	-40°C

LOAD RATINGS:

Terminal	Typical Load	A. Maximum Rating @120V-50/60 Hz	B. Maximum Rating @230V-50/60 Hz	C. Alternate Rating
M	Burner/Blower Motor	9.8 F.L.A. * 58 L.R.A.	4.0 F.L.A. * 20 L.R.A.	240 VA Pilot Duty (Motor Starter Coil)
10-11-12-X	Modulator	125 VA Pilot Duty		
A	Alarm	50 VA Pilot Duty		
Terminal ratings may be selected from either column A or C for 120 VAC or from either column B or C for 30 VAC: (select the rating from the column which best applies to the connected load on that terminal). * F.L.A. = full load amps; L.R.A = locked rotor amps				

Combination of fuel and igniter terminals

Combination No.	Pilot Fuel Trm 6	Main Trm 7	Ignition Trm 5	Delayed Valve Trm W
1	C	E	No Load	No Load
2	B	E	No Load	No Load
3	No Load	E	No Load	B
4	E	E	A	No Load
5	No Load	E	A	E
6	D	E	A	No Load
7	D	D	A	D
8	No Load	D	A	No Load

Composition of each combination

A	B	C	D	E
4.5A Ignition @120 VAC	50 VA Pilot Duty plus 4.5A ignition@ 120 VAC	180 VA Ignition plus motor valves with: 660 VA inrush, 360 VA open, 250 VA hold.	2A Pilot Duty @120 VAC	65 VA Pilot Duty plus Motor valves with: 3850 VA inrush, 700 VA open 250 VA hold.
2.2A Ignition @230 VAC	50 VA Pilot Duty plus 2.2A ignition @230 VAC		1A Pilot Duty @230 VAC	

Maximum connected load not to exceed 2000 VA

ELECTRICAL RATINGS

VA ratings (not specified as pilot duty) permit the connection of transformers and similar devices whose inrush current is approximately the same as their running current.

VA Pilot Duty ratings permit the connection of relays, solenoid valves, lamps, etc. whose total operating load does not exceed the published rating and whose total inrush current does not exceed 10 times the rating.

Running and locked rotor ratings are intended for motors. VA and VA Pilot Duty loads may be added to a motor load provided the total load does not exceed the published rating.

CAUTION: Published load ratings assume that no contact be required to handle inrush current more often than once in 15 seconds. The use of control switches, solenoid, relays, etc. which chatter will lead to premature failure. It is important to run through a test operation (with fuel shut off) following the tripping of a circuit breaker, a blown fuse, or any known instance of chattering of any external current consuming devices.

APPROVALS

Underwriters Laboratories Inc.:

MCCZ File MP1537
Controls, Primary Safety - Listed
MCCZ2 File MP1537
Controls, Primary Safety - Component
MCCZ7 File MP1537
Controls, Primary Safety Certified for Canada
MCCZ8 File MP1537
Controls, Primary Safety Certified for Canada - Component

Factory Mutual:	Approved	
Acceptable by:	Industrial Risk Insurers (I.R.I.)	
CE:		
	Gas Appliances	
	Gas Appliance Directive:	90/396/EEC
	Low Voltage Directive:	73/23/EEC
	EMC Directive:	89/336/EEC
	GASTEC:	0063BT1754 (EN298, 2003; EN230, 2005)
DVGW:	Reg. No.	NG-2510BT0347
DIN-CERTCO:	Reg. No.	5F233/08

WARNING: This equipment generates and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user, at his own expense, will be required to take whatever measures which may be required to correct the interference.

PART NUMBERS AND APPROVALS

Table 1: Agency Approvals

BurnerLogix Chassis/Flame Amp. Module	FM APPROVED	c UL us LISTED	c CSA us	CE	DIN DVGW	DIN EPRAN
YB110UV	X	X	X	X	X	X
YB110UVSC	X	X	X	X	X	X
YB110IR	X	X	X	X	X	X
YB110IR2	X	X	X	X	X	X
YB110FR	X	X	X	X	X	X
YB110DC	X	X	X	X	X	X
YB230UV	X			X	X	X
YB230UVSC	X			X	X	X
YB230IR	X			X	X	X
YB230IR2	X			X	X	X
YB230FR	X			X	X	X
YB230DC	X			X	X	X
BurnerLogix Programmer Module						
YP100	X	X	X			
YP102	X	X	X			
YP138	X	X	X			
YP118	X	X	X			
YP183	X	X	X			
YP200	X	X	X			
YP202	X	X	X			
YP300	X	X	X			
YP302	X	X	X			
YP113	X	X	X	X	X	X
YP115	X	X	X	X	X	X
BurnerLogix Displays						
BLV512	X	X	X	X	X	X
BLL510	X	X	X	X	X	X
BurnerLogix Wiring Bases						
60-2810-1	X	X		X	X	X
60-2812-1	X		X	X	X	X
60-2814-1	X		X	X	X	X

X = CERTIFICATION IN HAND

WARNING: This equipment generates and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user, at his own expense, will be required to take whatever measures which may be required to correct the interference.

APPLICABLE BULLETINS

Programmers, Non-recycle Operation	YP-1001
Programmers, Recycle Operation	
Programmers, Non-modulating	
Displays	BD-5001
Wiring base installation, 60-2810-1	133-676
Wiring base installation, 60-2812-1	133-677
Wiring base installation, 60-2814-1	133-677

ORDERING INFORMATION

BurnerLogix Chassis/Flame Amplifier Module	
YB110UV	120 VAC input with UV non self-check amplifier
YB110UVSC	120 VAC input with UV self-check amplifier
YB110IR	120 VAC input with IR auto-check amplifier
YB110IR2	120 VAC input with IR auto-check amplifier (special application only -consult factory)
YB110FR	120 VAC input with flame rectification amplifier
YB110DC	120 VAC input with direct coupled amplifier
YB230UV	230 VAC input with UV non self-check amplifier
YB230UVSC	230 VAC input with UV self-check amplifier
YB230IR	230 VAC input with IR auto-check amplifier
YB230IR2	230 VAC input with IR auto check (special application only-consult factory)
YB230FR	230VAC input with flame rectification amplifier
YB230DC	230VAC input with direct coupled amplifier

BurnerLogix Programmer Modules	
YP100	Keypad selectable parameters, non-recycle operation, modulation, open damper proving, 4 second FFRT
YP102	Keypad selectable parameters, non-recycle operation, modulation, open damper proving, 2 second FFRT
YP138	Keypad selectable parameters, non-recycle operation, modulation, open damper proving, indefinite pilot hold, revert to pilot from auto, 4 second FFRT
YP118	Keypad selectable parameters, non-recycle operation, modulation, open damper proving, indefinite pilot hold, revert to pilot from auto, 1 second FFRT
YP183	Same as YP138, terminal W used for purge complete, no voltage on 21 to move to pilot, no voltage on 16 to move to main.
YP200	Keypad selectable parameters, recycle operation, modulation, 4 second FFRT

BurnerLogix Programmer Modules	
YP202	Keypad selectable parameters, recycle operation, modulation, 2 second FFRT
YP300	Keypad selectable parameters, recycle operation, low fire start, early spark termination, 4 second FFRT
YP302	Keypad selectable parameters, recycle operation, low fire start, early spark termination, 2 second FFRT
YP113	Keypad selectable parameters, non-recycle operation, modulation, open damper proving, 1 second FFRT
YP115	Keypad selectable parameters, non-recycle operation, modulation, open damper proving, 1 second FFRT

Note: All programmers: when used with the YB110DC or YB230DC, the FFRT is 0.2 seconds

BurnerLogix Displays	
BLV512	Display, 2 line X 16 characters, VFD, with cable, NEMA 4
BLL510	Display, 2 line X 16 characters, LCD, with cable, NEMA 4

BurnerLogix wiring bases	
60-2810-1	Pigtail wires, 4 foot long, 4"W x 5"H
60-2812-1	Closed base with terminal block and knockouts, 4"W x 7"H
60-2814-1	Open base with terminal block. 4"W x 7"H

BurnerLogix Accessories	
129-178-4	Kit, remote mounting, BurnerLogix display, 4 ft. cable, provides NEMA 4 protection
129-178-8	Kit, remote mounting, BurnerLogix display, 8 ft. cable, provides NEMA 4 protection
BLD500	Blank display module, included with YB module
IT1000	Alarm annunciation system using wireless technology
PPC6000	Parallel Positioning System
61-5745-3	Shutter drive assembly for redundant self-check scanners

SCANNER SELECTION

FIREYE P/N	DESCRIPTION	USE WITH CHASSIS	BULLETIN
48PT2-1003	Infrared 1/2" straight mount 96"(2438mm) TC-ER cable	YB110IR YB230IR YB110IR2 YB230IR2	SC-103
48PT2-9003	Infrared 1/2" straight mount 96" (2438mm) TC-ER cable		
48PT2-1007	Infrared 1/2" straight mount 48" (1219mm) TC-ER cable		
48PT2-9007	Infrared 1/2" 90° angle mount 48" (1219mm) TC-ER cable		
4-263-1	Replacement photo detector		
UV1A3	UV 1/2" straight 36" (915mm) TC-ER cable	YB110UV YB230UV	SC-102
UV1A6	UV 1/2" straight 72" (1830mm) TC-ER cable		
UV8A	UV 1/2" 90° head 72" (1830mm) no armor flex		
UV2	UV 3/8" straight 36"(915mm) TC-ER cable		
UV2A6	UV 3/8" straight 72" (1830mm) TC-ER cable		
45UV3-1050	UV 3/4" cast aluminum housing 96" (2438mm) unshielded leads		
UV90-3	UV 90° lateral view with 36" (915mm) flex conduit		
UV90-6	UV 90° lateral view with 72" (1830mm) flex conduit		
UV90-9	UV 90° lateral view with 108" (2745mm) flex conduit		
45UV5-1007	Self-check UV 1" BSP threads, 102-264VAC	YB110UVSC YB230UVSC	SC-101
45UV5-1009	Self-check UV 1" NPT threads, 102-264VAC		
4-314-1	Replacement UV tube		
69ND1-1000K4	Flame rod, 12", 1/2" mount	YB110FR YB230FR	SC-103
69ND1-1000K6	Flame rod, 18", 1/2" mount		
69ND1-1000K8	Flame rod, 24", 1/2" mount		

SCANNER SELECTION

FIREYE P/N	DESCRIPTION	USE WITH CHASSIS	BULLETIN
45UV5-1005	Self-check UV 1" NPT threads, 61-5745-3 required	YB110UVSC	133-645
45UV5-1105	Self-check UV 1" BSP threads, 61-5745-3 required	YB230UVSC	
55UV5-1007	Self-check UV 1" BSP, 102-264VAC, Suitable for hazardous locations.	YB110UVSC	SC-106
55UV5-1009	Self-check UV 1" NPT, 102-264VAC, Suitable for hazardous locations.	YB230UVSC	
PHOENIX			
85UVF4-1QDWR	Phoenix Integrated Scanner, 4 sec FFRT – Ultra-violet with 8-pin electrical quick disconnect. FM, UL_CUS approved.	YB110DC YB230DC	CU-114
85UVF4-2QDWR	Fiber optic version of standard Phoenix Integrated Scanner, 4 sec FFRT – Ultra-violet with 8-pin electrical quick disconnect. FM, UL_CUS approved.		
85IRF4-1QDWR	Phoenix Integrated Scanner, 4 sec FFRT – Infrared with 8-pin electrical quick disconnect.. FM, UL_CUS approved.		
85IRF4-2QDWR	Fiber optic version of standard Phoenix Integrated Scanner, 4 sec FFRT – Infrared with 8-pin electrical quick disconnect. FM, UL_CUS approved.		
35-318-1	Mounting flange for Phoenix, 1" NPT		
35-318-2	Mounting flange for Phoenix, 1" BSP		
59-546-3	8-Conductor 3-meter (9 ft. 10 in.) cable assembly with 8-pin female connector.		
59-546-6	8-Conductor 6-meter (19 ft. 8 in.) cable assembly with 8-pin female connector.		
59-546-9	8-Conductor 9-meter (29 ft. 3 in.) cable assembly with 8-pin female connector.		
59-546-12	8-Conductor 12-meter (39 ft. 4 in.) cable assembly with 8-pin female connector.		
59-546-15	8-Conductor 15-meter (49 ft. 2 in.) cable assembly with 8-pin female connector.		
59-546-30	8-Conductor 30-meter (98 ft. 5 in.) cable assembly with 8-pin female connector.		
59-546-45	8-Conductor 45-meter (147 ft. 7 in.) cable assembly with 8-pin female connector.		
59-546-60	8-Conductor 60-meter (196 ft. 10 in.) cable assembly with 8-pin female connector.		
59-546-90	8-Conductor 90-meter (295 ft. 3 in.) cable assembly with 8-pin female connector.		
INSIGHT			
95IRS2-1, 2	Enhanced Model InSight Scanner – Infrared with quick disconnect, FM, UL_CUS approved.	YB110DC YB230DC	CU-95
95UVS2-1, 2, 3	Enhanced Model InSight Scanner – Ultra-violet with quick disconnect, FM, UL_CUS approved.		
95DSS2-1	Enhanced Model InSight Scanner – Dual detector with quick disconnect, FM, UL_CUS approved.		
60-2692	1" NPT mounting flange for InSight Scanner, includes heat insulator 35-127-1.		
60-2693	1" BSP mounting flange for InSight Scanner, includes heat insulator 35-127-3.		
59-497-020-WR	12-Conductor cable with straight connector (129-164), 20 feet(6 meter)		
59-497-020C-WR	12-Conductor cable with straight connector (129-164C) and flex conduit adapter, 20 feet(6 meter)		
59-497-020R-WR	12-Conductor cable with right angle connector (129-164R), 20 feet(6 meter)		
59-497-020RC-WR	12-Conductor cable with right angle connector (129-164RC) and flex conduit adapter, 20 feet(6 meter)		
POWER SUPPLIES			
60-2685-2	Power Supply, 24 VDC, 2.1A, 120/240 VAC, 50/60Hz		CU-100
60-2685-4	Power Supply, 24 VDC, 4.2A, 120/240 VAC, 50/60Hz		

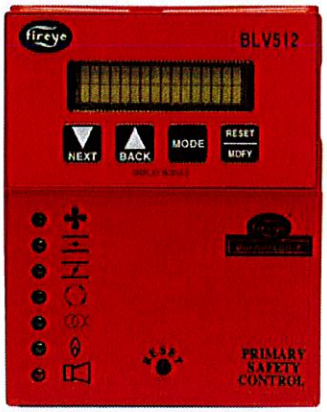
NOTE: The Phoenix QDWR models with electrical quick-disconnect have replaced the original WR models equipped with ten feet of captive cable. The QDWR models (with 59-546-X cables) are also suitable for use in Class I Division 2 hazardous areas, thereby eliminating the need for the "EXWR" models.

BURNERLOGIX Ordering Information

CHASSIS/AMPLIFIER

120 VAC, 50/60 Hz
YB110UV
YB110UVSC
YB110IR
YB110FR
YB110DC

230 VAC, 50/60 Hz
YB230UV
YB230 UVSC
YB230IR

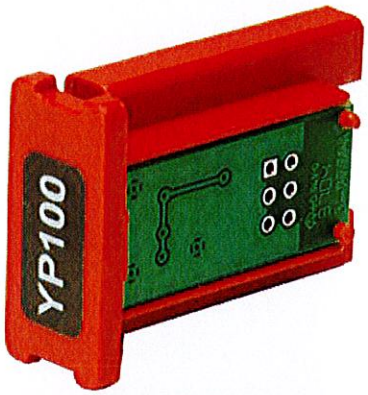


FRONT VIEW
(WITH OPTIONAL DISPLAY INSTALLED)

SIDE VIEW
(WITH OPTIONAL PROGRAMMER AND DISPLAY INSTALLED)

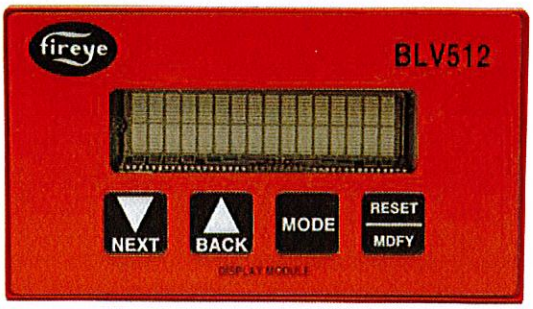
PROGRAMMER MODULE

YP100
YP102
YP200
YP202
YP300
YP302
YP113
YP138
YP118



DISPLAY MODULE

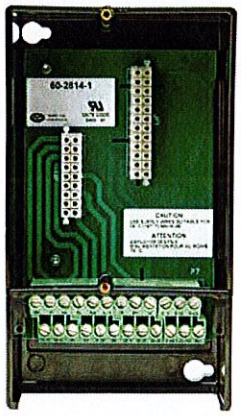
BLV512 - VACUUM FLUORESCENT
BLL510 - LIQUID CRYSTAL



WIRING BASE

60-2814-1
OPEN BOTTOM
CABINET MOUNT

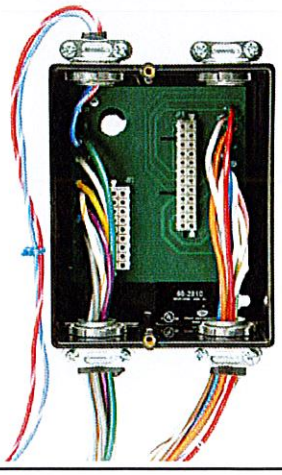
60-2812-1
CLOSED BOTTOM
CONDUIT KNOCKOUT



60-2814-1 SHOWN

WIRING BASE

60-2810-1
PRE-WIRED
4 FOOT
COLOR CODED

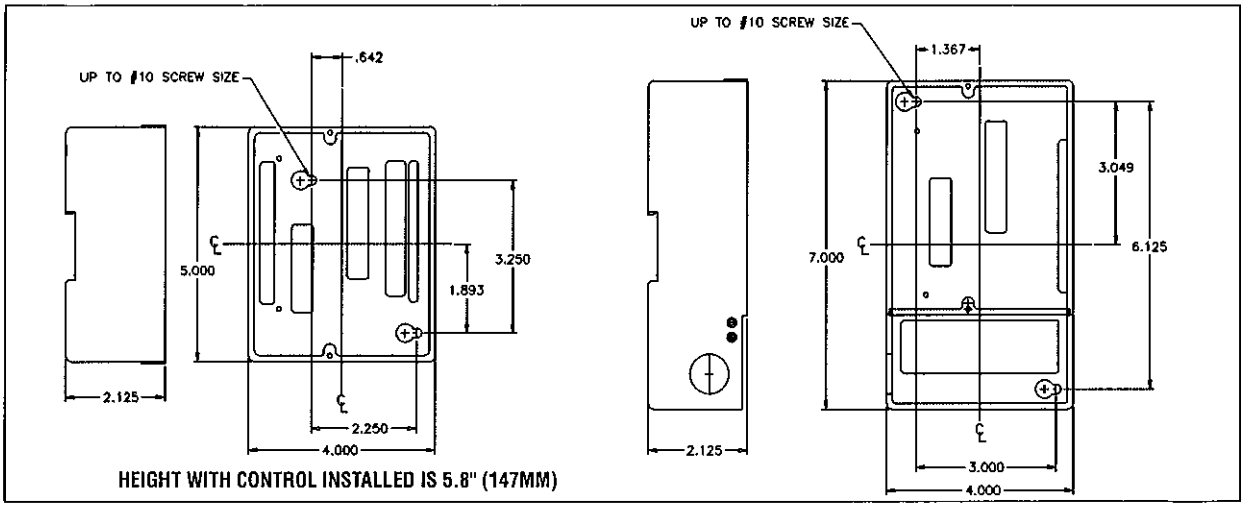


INSTALLATION PROCEDURE

WIRING BASE

Select either the pre-wired wiring base (60-2810-1) or terminal block style (60-2812-1, 60-2814-1). Either wiring base type can be mounted on a din rail or directly mounted to the cabinet back plate. Refer to Figure 1 for mounting dimensions.

FIGURE 1.



The location should be free from excessive vibration and within the ambient temperature rating.

PRE-WIRED WIRING BASE, P/N 60-2810-1 (shown for 120 VAC)

Terminal No.	Wire Color	Type	Description	Rating
L1 (Hot)	Black		Line voltage supply	120 VAC (+10%,-15%), 50/60 Hz
L2 (Neutral)	White		Line voltage common	
EARTH	Green	Ground		
S1	Red/Wht		Scanner Input	300 VAC, 3 mA (UV models only)
S2	Blu/Wht		Scanner Input	300 VAC, 3 mA (UV models only)
A	Red	Output	Alarm	120 VAC, 1 A pilot duty
M	Brown	Output	Combustion Blower	120 VAC, 9.8 FLA, 58.8 LRA
3	Yellow	Input	Operating Control	120 VAC, 1 mA
13	Orange	Input	Fuel Valve End Switch, Pre-Ignition Interlock	120 VAC, 1 mA
P	Gray	Input	Running Interlock	120 VAC, 1 mA
D	Wht/Brn	Input	Low Fire Start Switch	120 VAC, 1 mA
8	Wht/Gry	Input	Open Damper Proving Switch	120 VAC, 1 mA
W	Wht/Orn	Output	Delayed Main Valve	See Load Ratings
5	LT Blue	Output	Ignition / Pilot Valve	See Load Ratings
6	Tan	Output	Pilot Valve	See Load Ratings
7	Violet	Output	Main Fuel Valve	See Load Ratings
16	DK Blue	Input	Pilot Valve Hold	120 VAC, 1 mA
21	Pink	Input	Start Input	120 VAC, 1 mA
10	Wht/Red	Output	Modulator Common	120 VAC 75 VA
12	Wht/Yel	Output	Modulator Low Fire	120 VAC 75 VA
X	Wht/Blue	Output	Modulator High Fire	120 VAC 75 VA
11	Wht/Grn	Output	Modulator Auto	120 VAC 75 VA
22	Wht/Vio	Input	Remote Reset	120 VAC, 1 mA
23	Brn/Wht	Input	Spare 2	120 VAC, 1 mA

INSTALLATION PROCEDURE

WIRING BASE

Install the wiring base where the relative humidity never reaches the saturation point. The BurnerLogix system is designed to operate in a maximum 90% relative humidity continuous, non-condensing environment. Do not install the BurnerLogix system where it can be subjected to vibration in excess of 0.5G continuous maximum vibration. The BurnerLogix system is not a weather tight enclosure. The standard vertical position is recommended. Allow at least one inch clearance around the control for service and installation.

1. Wiring must comply with all applicable codes, ordinances and regulations.
2. **Wiring must comply with NEC Class 1 (Line Voltage) wiring.**
3. Torque rating on terminal block screws is 4.4 in/lbs to 5.3 in/lbs.
4. Limits and interlocks must be rated to simultaneously carry and break current to the ignition transformer, pilot valve and main fuel valve(s).
5. Recommended wire routing of lead wires:
   a. Do not run high voltage ignition transformer wires in the same conduit with any other wires.
   b. Do not route flame detector lead wires in conduit with line voltage circuits. Use separate conduit where necessary.
6. Maximum wire lengths:
   a. The maximum lead wire length is 200 ft. (61 meters) to terminal inputs (Operating limits, interlocks, valves, etc.).
   b. Flame Detector lead wires: see section on flame scanners
   c. Remote reset: The maximum length of wire is 500 feet (152 meters) to a normally open remote reset push-button, but should remain within sight and sound of the burner.
   d. Modbus communications: The maximum cable length of wire is 3300 feet (1000 meters) for RS-485.

A good ground system should be provided to minimize the effects of AC quality problems. A properly designed ground system meeting all the safety requirements will ensure that any AC voltage quality problems, such as spikes, surges and impulses have a low impedance path to ground. A low impedance path to ground is required to ensure that large currents involved with any surge voltages will follow the desired path in preferences to alternative paths, where extensive damage may occur to equipment.

WARNING: Controls require safety limits utilizing isolated mechanical contacts. Electronic limit switches may cause erratic operation and should be avoided.

BEFORE INSTALLING THE BURNERLOGIX CONTROL

CAUTION: Ensure that electric power is turned off. Refer to SN-100 for recommended grounding techniques.

Be aware that power to some interlocks (operating controls, air flow switches, modulating circuits, etc.) may be derived from sources other than what is controlling the BurnerLogix.

INSTALLING THE YP PROGRAMMER MODULE

The YP programmer module plugs into the side of the YB110 (YB230) chassis module and can only be installed in one direction. DO NOT ATTEMPT TO FORCE THE YP PROGRAMMER INTO THE CHASSIS. Referring to the illustration on the right, align the holes in the YP programmer housing with the posts located within the YB chassis. Push the YP module into the chassis until the YP module is flush with the YB housing.

If it is necessary to remove the YP programmer module from the YB chassis, 2 slots are provided on the top and bottom of the YP housing. A small screwdriver can be used to 'pop' the programmer from the chassis.

For installations requiring CE certification:

After installation, the equipment should be protected from general access by means of a cabinet which is only accessible with a key or special tool and therefore a clear responsibility who replaced the fuse. If the fuse is blown during installation or operation, the control must be sent to the manufacturer to check.

ELECTRICAL CHECKOUT

If either a ground or a short circuit is detected, it must be eliminated before the control is plugged into the wiring base and power turned on.

Test the electrical field wiring for short circuits and grounds. The recommended method requires the use of an ohmmeter set on its lowest resistance scale.

7. Touch the meter probes together and calibrate accurately to ensure a reliable test.
8. Disconnect the neutral wire (L2) from the control system at the power source. Clip one meter test lead to the grounded green wire or to terminal E and with the other probe touch each other terminal. At no time should the meters show continuity or read 0 ohms.
9. Reconnect the neutral wire (L2) at the power source. Remove the test probe from the grounded terminal and reconnect it to Terminal L2 in the wiring base. With the other probe, touch each other terminal. It is normal to obtain a resistance reading on the meter at some terminals during this test as there are resistive loads (coils, transformers, lamps, etc.) connected whose normal DC resistance may be less than 5 ohms. However, at no time should the test meter read zero ohms.

⚠ **CAUTION: Restore power for the following test.**

10. With BurnerLogix installed, measure voltage from L2 to all other terminals. Reading should be zero on all terminals except Ll.

INSTALL BURNERLOGIX INTO WIRING BASE

The BurnerLogix YB chassis/amplifier module contains 2 screws permanently retained into the top and bottom of the housing. The wiring base contains two brass inserts with recessed threads to ease the installation. Line up the printed circuit board spacer located in the YB chassis/amplifier module with the alignment tabs located in the wiring base. Firmly push the YB model into the wiring base to assure the connectors mate properly. Tighten the screws into the brass inserts until snug.

BurnerLogiX PROGRAMMER SELECTION

All programmers for the BurnerLogiX Series are designated with the prefix "YP". The functional operation, flame failure response time, purge timings, firing rate motor circuit, trial for ignition timings, recycling function and display messages are determined by the programmer.

A chart of the most common programmers is found below.

Take note of the programming sequence chart for each programming module for the proper explanation of prepurge timings.

WARNING: THE INAPPROPRIATE SELECTION OR APPLICATION OF A PROGRAMMER MODULE COULD RESULT IN AN UNSAFE CONDITION HAZARDOUS TO LIFE AND PROPERTY. The various programmer modules are interchangeable because they plug into a common YB chassis. Many parameters are configurable through the keypad display. Care should be taken to insure the proper parameters are set. Refer to the appropriate programmer bulletin for appropriate settings. Selection of the programmer module and setting the various parameters for a particular application should be made by a competent professional, such as a Boiler/Burner technician licensed by a state or government agency, engineering personnel of the burner, boiler or furnace manufacturer (OEM) or in the performance of duties based on the information from the OEM.

FIREYE PART NUMBER	Pre-purge Programming (Seconds)	Proven High Fire Interlock (M-8)	Proven Low Fire Interlock (M-D)	Terminal 6, Interrupted or Intermittent	Early Spark Termination	PTFI (5/6)	MTFI (5/6)	Running Interlock (3-P)	* Flame Fail Time (Seconds)	Firing Rate Motor
SETTINGS SHOWN ARE FACTORY DEFAULT										
YP100	30	YES	YES	INTRP	NO	10/10	10/15	Non-recycle	4	YES
YP102	30	YES	YES	INTRP	NO	10/10	10/15	Non-recycle	2	YES
YP138	30	YES	YES	INTRP	NO	10/10	10/15	Non-recycle	4	YES
YP118	30	YES	YES	INTRP	NO	10/10	10/15	Non-recycle	1	YES
YP183	30	YES	YES	INTRP	NO	10/10	10/15	Non-recycle	4	YES
YP113	30	YES	YES	INTRP	NO	5/5	3/5	Non-recycle	1	YES
YP115	30	YES	YES	INTRP	NO	5/5	3/5	Non-recycle	1	YES
YP200	30	NO	YES	INTRP	NO	10/10	10/15	Recycle	4	YES
YP202	30	NO	YES	INTRP	NO	10/10	10/15	Recycle	2	YES
YP300	30	NO	YES	INTMT	YES	10/10	10/ intmt	Recycle	4	NO
YP302	30	NO	YES	INTMT	YES	10/10	10/ intmt	Recycle	2	NO

**FFRT with YB110DC or YB230DC is 0.2 seconds*

PTFI*MTFI TIMINGS

The BurnerLogix system provides keypad selectable timings for both PTFI and MTFI. The selections offered can provide 5 or 10 second timing for terminal 5 and 6 or a shortened time for terminal 5, allowing for early spark termination. BurnerLogix also provides selectable interrupted or intermittent operation for terminal 6.

The selections provided for PTFI*MTFI timings are:

Table 2:

SELECTION	PTFI		MTFI		COMMENT
	Term 5	Term 6	Term 5	Term 6	
10/10*10/15	10	10	10	15	
5/5*0/10	5	5	0	10	NO SPARK DURING MTFI
5/5*0/5	5	5	0	5	NO SPARK DURING MTFI
5/5*10/15	5	5	10	15	SHORTENED PTFI
5/5*10/10	5	5	10	10	SHORTENED PTFI
5/10*0/15	5	10	0	15	EARLY SPARK TERMINATION
5/10*0/10	5	10	0	10	EARLY SPARK TERMINATION
10/10*0/10	10	10	0	10	NO SPARK DURING MTFI
10/10*0/5	10	10	0	5	NO SPARK DURING MTFI
10/10*10/10	10	10	10	10	

LED INDICATOR LIGHTS

The BurnerLogix YB control module has seven (7) LED indicator lights to annunciate the operating status of the control, as well as provide the reason for the last lockout condition. The "Open Damper" and "Close Damper" LED's provide easy set-up of the modulating motor end switches. Each LED has a graphic symbol to describe its function (see Table 3).

Table 3:

	FAN	Lights when the blower motor is energized (terminal M) and flashes when the RUN/CHECK switch is in the "CHECK" position during Purge, PTFI, MTFI and AUTO.
	OPEN DAMPER	Will blink when the modulator motor is being driven to the high fire position. (circuit 10-X made). Once the high purge switch closes (M-8), this LED will light constant. This LED provides the status of the high fire purge interlock circuit (M-8). This LED lights anytime the M-8 circuit closes during Prepurge, PTFI, MTFI, Post Purge.
	CLOSE DAMPER	Will blink when the modulator motor is being driven to the low fire position (circuit 10-12 made). Once the low fire switch closes (M-D), this LED will light constant. This LED provides the status of the low fire start interlock circuit (M-D). This LED lights anytime the M-D circuit closes during Pre-purge, PTFI, MTFI, post purge.
	AUTO	Will light when the control releases to automatic modulating control (circuit 10-11 made).
	IGNITION	Will blink during Pilot Trial For Ignition (PTFI). Will light constant during Main Trial For Ignition (MTFI).
	FLAME	Will light whenever flame is detected by the flame scanner.
	ALARM	In the event of a lockout condition, the Alarm LED will blink, the remaining LED's will light up to indicate the lockout condition. See "Safety Lockout Codes."

REPLACEABLE FUSE

The following applies only to the YB110 controls operating at 120 VAC, 50/60 Hz:

The chassis/amplifier modules are designed with a field replaceable fuse to protect Terminals 5, 6, 7 and W against short circuit loads or mis-wiring. In the event the fuse becomes OPEN, the display will indicate CHECK FUSE or the CLOSE DAMPER, AUTO and IGN LED's will light. An OPEN or blown fuse is a result of an over current condition on Terminals 5, 6, 7, or W. The over current condition causing the fuse to OPEN must be resolved before another attempt to apply power.

For installations requiring CE certification:

Only Fireye or a Fireye trained technician is allowed to replace the fuse.

All other installations:

The fuse is located on the printed circuit board containing the relays. To replace the fuse, remove power from the system and remove the control from its wiring base. Using an appropriate tool, remove the defective fuse and discard. Install a Fireye replacement fuse (P/N 23-197). Re-install the BurnerLogix control in accordance with the installation procedure detailed in a previous section.

The YB230 control contains a non-replaceable fuse and must be returned to the manufacturer for repair or replacement.

DESCRIPTION OF FUNCTIONS OF OPERATING CONTROLS

1. **Operating Controls:** Generally pressure or temperature activated, the operating control closes, causing the burner start-up sequence to begin. When the operating control opens, the burner shuts off. The operating control is connected in the L1-3 circuit on the wiring base.
2. **Limit Switches:** These are generally pressure, water level or temperature activated
   a. Recycle — when it is desired to stop the burner when the limit switch opens and restart it when the limit switch recloses, they are connected between Terminals L1 and 3.
   b. Non-Recycle —when it is necessary to stop the burner when the limit switch opens and prevent it from starting until both the limit switch recloses and the manual reset is activated, they are connected between terminals 3 and P.
3. **Fuel Valve End Switch Interlock**: This is generally an integral switch mounted on the main fuel valve and activated by the valve stem. It is connected between Terminal L1 & 13. The fuel valve end switch interlock prevents a burner start-up if the valve stem is not in the "valve closed" position. This interlock must remain closed while in STANDBY and until the start of PTFI.
4. **Purge Interlock:** Generally a firing rate motor linkage position switch or a differential air-pressure switch, that proves a maximum purge air flow rate. It is connected between Terminals M and 8. The purge interlock proves that the air damper is fully open and purge air flow rate is at maximum during the purge.
5. **Running Interlocks:** These generally are air flow switches, high and low fuel pressure switches, oil temperature switches, atomizing media pressure switches, and excess smoke density controls. These interlocks prove proper conditions for normal operation of the burner. They are wired in series and connected between Terminals 3 and P.
6. **Low Fire Start Interlock:** Generally a firing rate motor linkage position switch or a damper position switch, will prove both the linkage and dampers are in their proper positions to begin burner light off. This switch is connected between Terminals M and D.

SETTING PROGRAMMER PARAMETERS

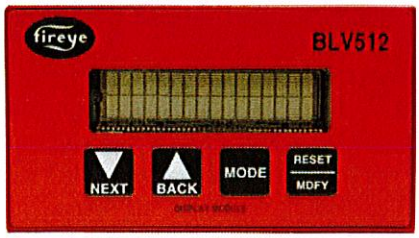
In order to change the factory default parameters stored in the programmer module an optional keypad/display (BLV512 or BLL510) is required. All configurable parameters are stored within the PROGRAM SETUP sub-menu. The keypad/display module provides tactile feedback keys that are used to access the sub-menus inherent in the BurnerLogix system.

All programmed settings become permanent after 8 hours of main burner (Terminal 7) on time.

The BurnerLogix display consists of 2 lines having 16 characters per line. The default displayed item is the current operating status. This would include the current point in the burner sequence followed by the parameter pertaining to that point in the sequence, such as time or the flame signal level. The bottom line is used to display the current operating status. The BurnerLogix display also provides the historical information stored in the control's memory such as burner hours, cycles, lockouts and system hours. The remainder of the display items are menus with sub-menus indicated by a right facing arrow. The sub-menus indicate the current value of the selected item and in some cases can be modified to suit the application.

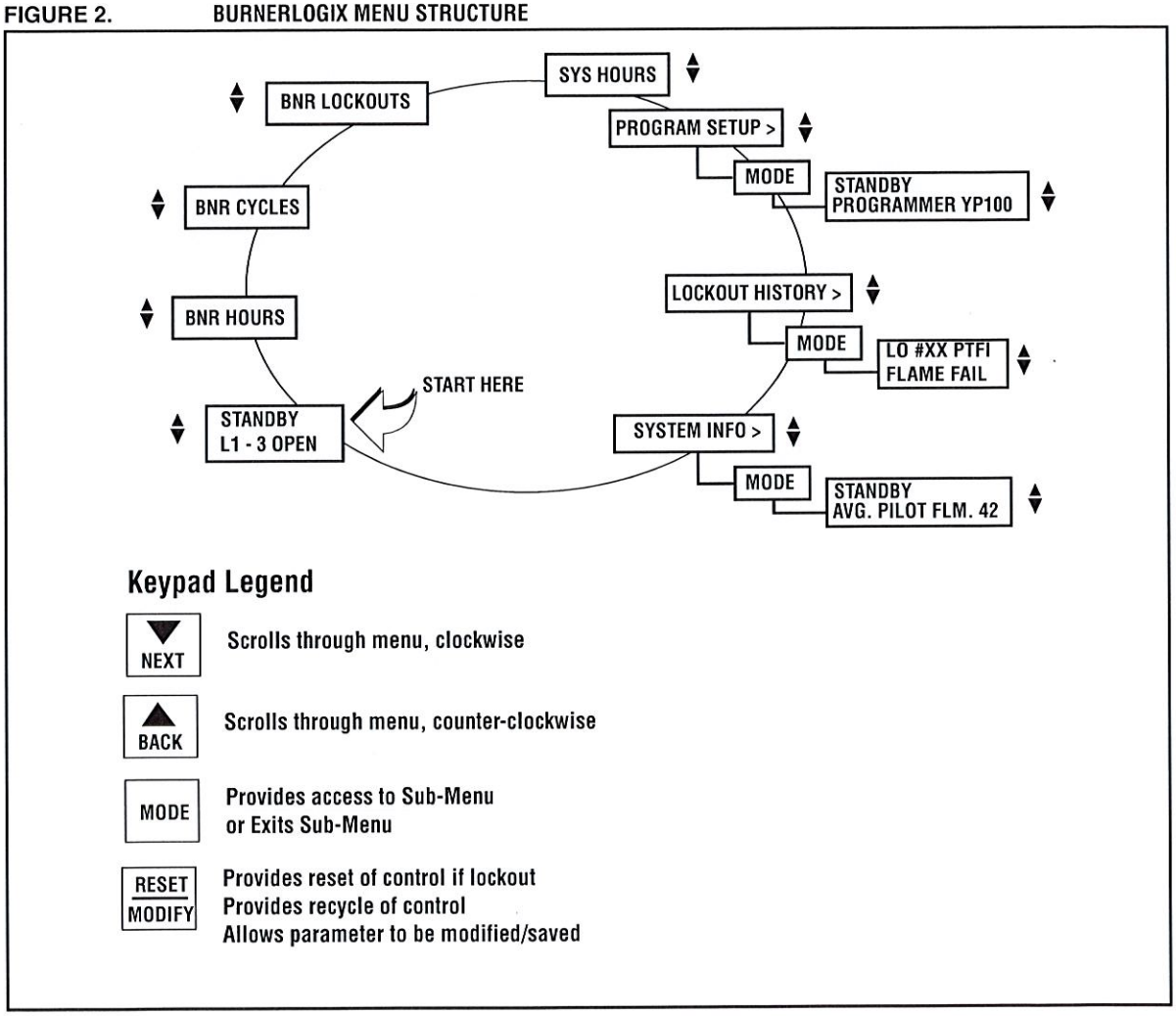
STANDBY
PROGRAM SETUP >

KEYPAD DESCRIPTION



The NEXT key is used to scroll down through the various menus and is also used to increment the value when in the modify mode. The BACK key is used to scroll up through the menus and is also used to decrement the value when in the modify mode. The MODE key is used to enter a sub-menu when the displayed item indicates a sub-menu with a right facing arrow and also to exit the sub-menu and move on to the next main menu item. The RESET/MDFY key is used to reset the BurnerLogix from a lockout condition, force a recycle of the programmer, indicate to the system the value displayed is to be modified or when done with the modification.

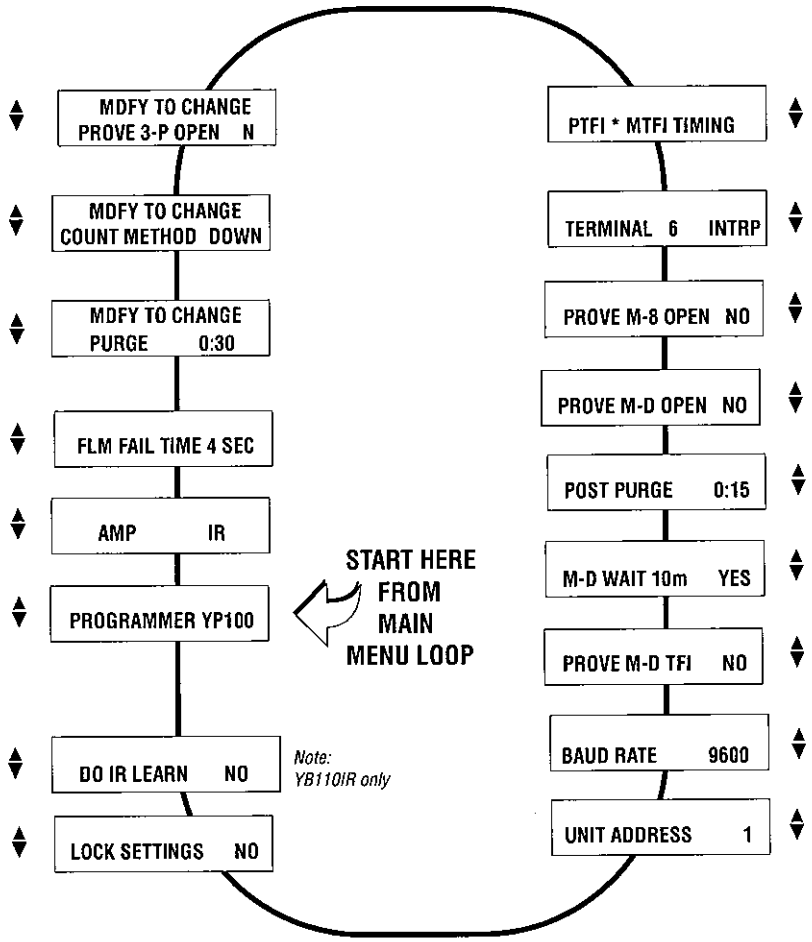
FIGURE 2. BURNERLOGIX MENU STRUCTURE



PROGRAM SET UP SUB-MENU

The sub-menu "PROGRAM SETUP" allows the user to review the various operational settings of the programmer module (e.g. programmer type, purge timing, etc.) and some instances modify the operational parameters to suit the application requirement. The MODE key is used to enter and exit the sub-menu and the NEXT and BACK keys are used to scroll through the menu as well as change the operational parameter.

PRESS [MODE] KEY FROM MAIN MENU LOOP



PRESS [MODE] KEY AT ANYTIME TO EXIT SUB-MENU

Modifiable parameters located in PROGRAM SETUP MENU

Parameter	Factory Default	Range	Description
Purge time	00:30s	0:30s – 60:00m, 15 second increments. 0:10s-60:00m, YP113 0:00s-60:00m, YP115 (0:00s - 60:00m in YP3XX)	Applies to open damper purge time in YP1XX and YP2XX programmers and low fire start time in YP3XX programmers
Count method	DOWN	UP, DOWN	Time counts UP to final value or DOWN to zero from starting value. This setting will apply to all timer values.
Prove 3-P open at start	NO	YES, NO	Prevents jumped terminals. Requires the 3-P circuit to be open at the start of a cycle.
PTFI*MTFI timing	10/10*10/15 YP113 = 5/5*3/5	See chart on page 15	Applies to terminals 5 and 6 operation during PTFI and MTFI.
Terminal 6 interrupted or intermittent	INTRP	INTRP, INTMT	Provide interrupted or intermittent operation on terminal 6.
Prove M-8 open	NO	YES, NO	If YES, M-8 must be open at start of open damper purge period. (YP1XX Series only).
Prove M-D open	NO	YES, NO	If YES, M-D must be open at end of open damper purge period. Does not apply to YP3XX Series.
Post purge	0:15	0:15s - 4:00m, 5 second increments.	Selects Post Purge time
3-P Recycle	YES	YES, NO	Applies to YP3XX series only. Allows non-recycle operation of 3-P circuit.
M-D WAIT 10m	YES	YES, NO	Select YES for lockout on M-D open for 10 minutes. Select NO for indefinite wait for M-D to close. This wait time applies prior to pilot trial for ignition.
PROVE M-D TFI	NO	YES, NO	Select YES to force lockout on M-D opening during PTFI and MTFI
Baud rate	9600	4800, 9600, 19200, 38400	Sets communication baud rate
Unit address	00	00-31	Multi-drop requires unique addressing. Lowest address allowed for modbus is 01
Lock Settings	NO	YES, NO	Parameters can be stored to memory before automatic 8 hour store.
DO IR LEARN	NO	YES, NO	Select YES to activate IR LEARN process. See IR operation.

Shaded parameters not affected by 8 hour burn-in or LOCK SETTINGS.

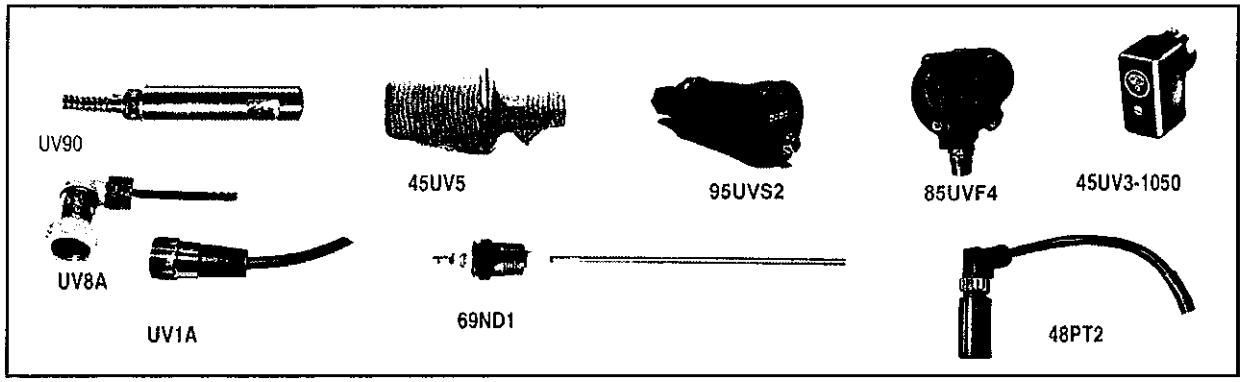
TO VIEW AND MODIFY A PROGRAMMABLE PARAMETER:

Use the NEXT or BACK key to scroll to PROGRAM SETUP. Press the MODE key to enter the sub-menu showing all program setup parameters. Pressing the MODE key while in the sub-menu will exit the sub-menu, and the next main menu item will be displayed. While in the sub-menu, pressing the NEXT key will scroll forward through the sub-menu. Pressing the BACK key will scroll backward through the sub-menu. When a modifiable parameter is displayed, the top line will indicate MDFY TO CHANGE while the bottom line will indicate the current item and its current value. Pressing the RESET/MDFY key will allow the displayed parameter to be modified. The item to be modified will move to the top line while its value will remain on the bottom line. At an infrequent rate, the top line will indicate MDFY TO SAVE. Use the NEXT or BACK keys to select the value to suit the application and when done, press the RESET/MDFY to save the value to memory.

All programmed settings become permanent if the BurnerLogix system has been powered continuously and 8 hours of main burner (terminal 7) on time has been accumulated. If the AC power is removed prior to accumulating 8 hours of main burner on time, the system burn-in time clock will be reset to zero. It is not necessary for the main burner on time to be continuous. The BurnerLogix accumulates burner on time in seconds. If necessary, the programmed settings can be made to become permanent anytime before the required 8 hours of main burner on time through the use of the optional keypad and the LOCK SETTINGS option under the PROGRAM SETUP sub menu.

Refer to SYSTEM INFO Sub Menu, page 33, for language selection.

FLAME SCANNERS

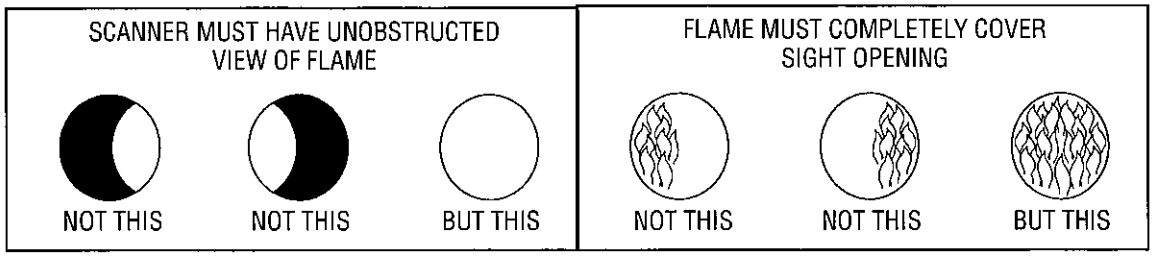


CAUTION: The UV1A, UV2, UV8A, UV90 and 45UV3 flame scanners and associated amplifier module are non-self checking UV systems and should be applied only to burners that cycle often (e.g.: a minimum of once per 12 hours) in order for the safety checking circuit to be exercised. If component checking is required during burner operation for constantly fired burners, utilize the self-checking ultra-violet flame scanners (45UV5, 55UV5) with associated amplifier modules (YB110UVSC), the infrared flame scanner (48PT2) with associated Auto Check amplifier (YB110IR), or integrated scanners (Phoenix or InSight with associated amplifier (YB110DC).

INSTALLATION - UV SCANNERS

Where possible, obtain the burner manufacturer's instructions for mounting the scanner. This information is available for most standard burners. The scanner mounting should comply with the following general instructions:

1. Position the UV1A, UV2 scanner within 30 inches of the flame to be monitored; the 45UV5 within 72 inches, closer if possible.
2. Select a scanner location that will remain within the ambient temperature limits of the UV Scanner. If cooling is required, use an insulating coupling (Fireye #35-69 for UV1A, UV2 Scanners, #35-127-1 for 45UV5) to reduce conducted heat.
3. The UV1A, UV2, 45UV5 Scanners are designed to seal off the sight pipe up to 1 PSI pressure. Higher furnace pressures should be sealed off. To seal off positive furnace pressure up to 100 PSI for UV1A, UV2 Scanners, install a quartz window coupling (#60-1257) For 45UV5 Scanners, use #60-1100 coupling. Add cooling air to reduce the scanner sight pipe temperature.
4. Install the scanner on a standard NPT pipe (UV1A: 1/2", UV2: 3/8", 45UV5: 1") whose position is rigidly fixed. If the scanner mounting pipe sights through the refractory, do not extend it more than halfway through. Swivel flanges are available if desired (#60-302 for UV1A, UV2 Scanners, #60-1664-3 for 45UV5). The sight pipe must permit an unobstructed view of the pilot and/or main flame, and both pilot and main flames must completely cover the scanner field of view

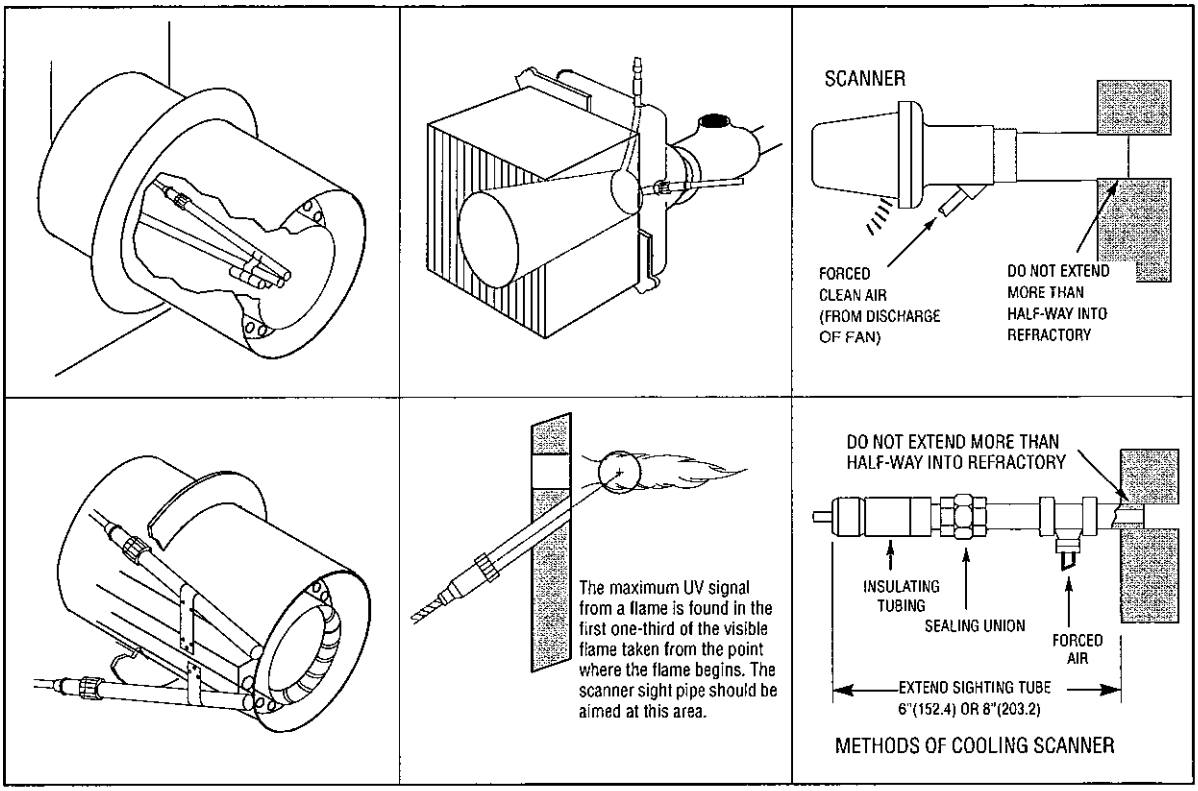


5. Smoke or unburned combustion gases absorb ultra-violet energy. On installations with negative pressure combustion chambers, a small hole drilled in the UV1A, UV2 sight pipe will assist in

keeping the pipe clean and free from smoke. For positive pressure furnaces, provide clean air to pressurize the sight pipe, if necessary.

6. Two UV1A or UV2 Scanners may be installed on the burner if it is necessary to view two areas to obtain reliable detection of the flame. They should be wired in parallel. Only one repetitive selfchecking 45UV5 Scanner may be installed on a burner.
7. To increase scanner sensitivity with UV1A, UV2 Scanners, a quartz lens permits location of the scanner at twice the normal distance. Use l/2" x 1 l/2" pipe nipple between UV1A Scanner and the coupling. Use 3/8" pipe nipple and a l/2" x 3/8" bushing on UV2 installations.
8. Request the assistance of any Fireye field office for recommendations of a proper scanner installation on a non-standard application.

TYPICAL SCANNER INSTALLATIONS



OPERATION — 45UV5 & 55UV5 SELF-CHECKING UV SCANNER

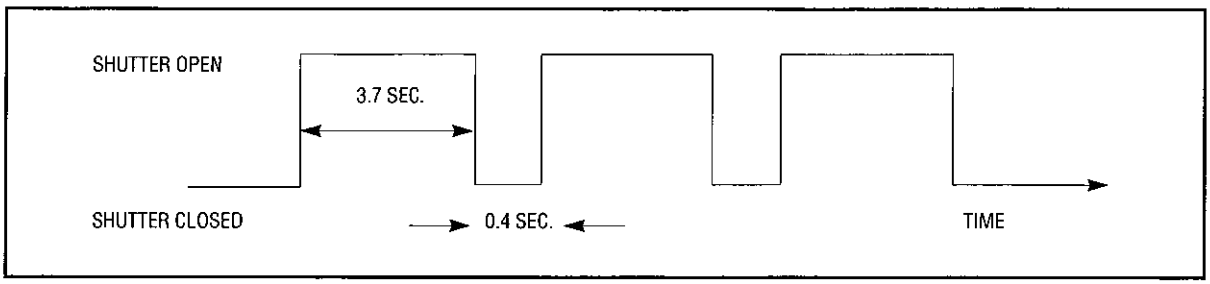
Self-checking ultra-violet scanners should be used in applications where burner firing operation is continuous or where the burner is on for long periods of time without recycling and UV detection is the best alternative. In addition, ultra-violet self-checking systems are mandatory in some locations.

The operation of this type of system consists of maintaining the flame scanning capability at all times while also proving that the ultra-violet tube is firing properly. This is done periodically by mechanically closing off the sight of the UV tube and checking to make sure that the flame signal goes away.

A shutter assembly in the 45UV5 scanner performs this function. The diagram below explains the process further.

If the shutter assembly in the scanner fails, the tube is faulty, or there is insufficient power to the scanner, the BurnerLogix will LOCKOUT and display the following message LOCKOUT CHECK SCANNER. The ultra-violet tube is replaceable (P/N 4-314-1).

A lockout will result if a minimum signal is detected for three consecutive shutter closed periods.



WIRING - UV SCANNERS

To connect the scanner to the control, the UV1A Scanner is supplied with 36" or 72" of flexible cable. The 45UV5 is supplied with four 72 lead wires. Install them in a suitable length of flexible armor cable and connect it to the control. A conduit connector is supplied with the scanner. Connect black wires (shutter) to terminals L1, L2; red wires (UV tube) to terminals S1, S2.

If it is necessary to extend the scanner wiring, the following instructions apply:

Scanner wires should be installed in a separate conduit. The wires from several scanners may be installed in a common conduit.

1. Selection of Wire

   a. Wiring: For extended scanner wiring up to 500 feet, and for shorter lengths to reduce signal loss, use a shielded wire (Belden 8254-RG62 coaxial cable, or equal) for each scanner wire of UV1A, UV2 and each red wire of the 45UV5. The ends of the shielding must be taped and not grounded.

   b. Asbestos insulated wire should be avoided.

   c. Multiconductor cable is not recommended without prior factory approval.

2. High voltage ignition wiring should not be installed in the same conduit with flame detector wires.

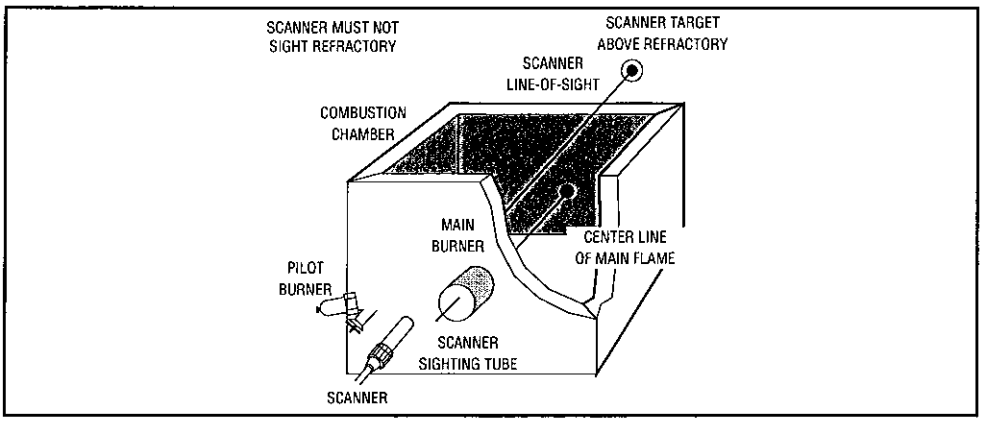
INSTALLATION—INFRARED SCANNER TYPE 48PT2

Where possible, obtain the burner manufacturer's instructions for mounting the scanner, otherwise proceed as follows:

A single scanner is used to detect both pilot and main flames. The sight pipe on which the scanner mounts must be aimed so that the scanner sights a point at the intersection of main and pilot flames.

Proper scanner positioning must assure the following:

1. Reliable pilot flame signal.
2. Reliable main flame signal.
3. A pilot flame too short or in the wrong position to ignite the main flame reliably, must not be detected.
4. Scanner must have an unobstructed view of flame being monitored.
5. Flame being monitored must completely cover the scanner field of view.
6. To avoid nuisance shutdowns, it is important to avoid sighting hot refractory and to keep scanner temperature below 140° F (60°C).
7. When the proper position has been established, drill a hole through the furnace wall and install a 4" to 8" length of threaded 1/2" black iron pipe on which to mount the 48PT2 scanner.
8. When satisfactory sighting position has been confirmed by operating tests, the sight tube should be firmly welded in place.



WIRING

Attach the cable supplied with the scanner to a junction box. Splice the cable wires to a pair of wires not smaller than #18. Install the complete run in a separate conduit to the control. Continuous conduit bonding between scanner and the control is mandatory! Scanner may be located up to 100 feet from control. Do not pass scanner wiring through any junction box containing other wires. Do not run other wires through scanner conduit. Asbestos insulated wire should be avoided.

9. To avoid nuisance shutdowns, it is important to avoid sighting hot refractory and to keep scanner temperature low below 140° F (60°C).
10. When the proper position has been established, drill a hole through the furnace wall and install a 4" to 8" length of threaded 1/2" black iron pipe on which to mount the 48PT2 scanner.
11. When satisfactory sighting position has been confirmed by operating tests, the sight tube should be firmly welded in place.

OPERATION - IR LEARN

The BurnerLogix IR learn adapts the operation of the amplifier to the actual burner environment. 'Out of the box', the BurnerLogix IR system is shipped with its sensitivity and thresholds set to detect most firing conditions and does not require learning. The purpose of the LEARN process is to maximize reliable flame detection over a wide range of conditions. The learn process sets the optimum values for the flame on and flame off thresholds during pilot trial for ignition and the main firing period separately. The LEARN process allows the BurnerLogix system to better differentiate between real and simulated flame conditions. Simulated flame can be caused by burner throat modulation, radiation from the refractory tiles, or steam atomization. The result of this technique of flame detection assures a positive flame out response for usual or adverse conditions. Although it is not necessary to perform an IR LEARN, it is suggested this be done as part of the installation process or when the 48PT2 scanner is changed.

The type of burner and fuel will affect the amplitude and radiation characteristics of the flame. Gaseous flames tend to have low amplitude and radiation whereas oil flames have a high amplitude and radiation. On burners having the option to fire both gaseous and oil fuels, it is recommended the LEARN process be performed on the condition that has the lowest signal level. Normally this condition is gas at low fire.

The LEARN process in the BurnerLogix system is initiated through the keypad display module. The menu item is located under the PROGRAM SETUP menu and is called DO IR LEARN. Refer to the section titled **'SETTING PROGRAMMER PARAMETERS'** for information on setting operational values. Since the default value is NO, the user must modify this value to YES.

MDFY TO CHANGE
DO IR LEARN YES

The LEARN process is not subject to the 8 hour burn-in and therefore will always be available. If the LEARN process is activated at STANDBY, the LEARN process will involve both pilot and main flame. If the LEARN process is activated during the main firing period (AUTO) the LEARN process will only involve the main flame learn. During this LEARN process in AUTO, the thresholds for pilot flame are not affected. It is necessary to have separate learns to adjust for the characteristics of the flame changing conditions due to changes in background conditions after a long firing period.

Once a LEARN process is activated, it cannot be undone. Also, if a LEARN cannot be completed in the subsequent burner cycle due to burner interruptions or a flame fail, the LEARN process will continue to remain active. During PTFI, the LEARN process takes place during the last 3 seconds of the pilot period and is indicated on the display:

PTFI 80
LEARNING FLAME

During AUTO the LEARN process takes place during the first 3 seconds of AUTO and is indicated on the display

HOLD 80
LEARNING FLAME

After the LEARN process is completed the flame signal displayed value is normalized to a value of 32.

AUTO 32
FLAME SIGNAL

Therefore during the next pilot trail for ignition period the expected value of flame signal should be 32.

PTFI 32
FLAME SIGNAL

Any increases or decreases in amplitude or radiation may cause the displayed value to increase or decrease. Should the displayed value continue to decrease, possibly due to changing conditions in the boiler such as a bright background causing a reduction in scanner sensitivity, it is suggested to activate a new DO IR LEARN during AUTO. Without shutting the burner off, scroll to PROGRAM SETUP and in that sub-menu, modify DO IR LEARN to YES. The LEARN function will be activated immediately. [Note: The display will continue to indicate YES even though the LEARN process is complete. Pressing the up arrow and then down arrow will indicate the updated state of DO IR LEARN.]

An abrupt change in the background radiation (brightness) may be an indication that the firing characteristics of the fuel have changed. In oil fired units this may be caused by a sudden interruption in the oil delivery. The BurnerLogix utilizes this information to make a decision to keep the burner on line or force a shut down. A lockout will happen if the background radiation (brightness) changes downward by 20% in and stays at this level for 1 FFRT. Also, if the detected flame signal average falls below 20% of the Learned On value, the burner will also be shut down.

Keeping the Scanner Cool

The Infrared Scanner (Temperature Limit 140° F) should never get too hot to grasp comfortably in the hand. Keep the scanner cool by one or more of the following methods.

1. Use 6" to 8" length of pipe between scanner and hot furnace front plate.
2. Use insulating tube (P/N 35-69) on the end of the iron pipe.
3. Force air into sighting tube. Use Fireye Sealing Union (P/N 60-801).
4. Make sure sighting tube does not extend more than halfway into refractory wall.

INSTALLATION - 69ND1 FLAME ROD

The 69NDl flame rod proves a gas pilot flame and/or main gas flame. It is a spark plug type unit consisting of 1/2' "NPT" mount, a KANTHAL flame rod, a glazed porcelain insulating rod holder and a spark plug connector for making electrical connections. The 69ND1 is available in 12", 18" or 24" lengths.

The flame rod may be located to monitor only the gas pilot flame or both the gas pilot and main gas flames. It is mounted on a l/2" "NPT" coupling.

The following instructions should be observed:

1. Keep flame rod as short as possible.
2. Keep flame rod at least 1/2" from any refractory.
3. Flame rod should enter the pilot flame from the side so as to safely prove an adequate pilot flame under all draft conditions.
4. If the flame is nonluminous (air and gas mixed before burning), the electrode tip should extend at least 1/2" into the flame, but not more than halfway through.
5. If the flame is partly luminous, the electrode tip should extend only to the edge of the flame. It is not necessary to maintain uninterrupted contact with the flame.
6. It is preferable to angle the rod downward to minimize the effect of sagging and to prevent it from coming in contact with any object.
7. An adequate grounding surface for the flame must be provided. The grounding surface in actual contact with the flame must be at least 4 times greater that the area of the portion of the flame rod in contact with the flame. It is essential to adjust the flame rod and ground area ratio to provide a maximum, signal reading.

Note: Interference from the ignition spark can alter the true signal reading by adding to, or subtracting from it. This trend sometimes may be reversed by interchanging the primary wires (line voltage) to the ignition transformer. This interference can also be reduced by the addition of grounded shielding between the flame rod and ignition spark.

INSTALLATION - 85 SERIES PHOENIX SCANNER

Fireye Phoenix 85UVF self-checking scanners are used to detect 295 to 340 nanometers wavelength ultraviolet emissions.

Fireye Phoenix 85IRF self checking scanners are used to detect 830 to 1100 nanometers wavelength infrared emissions.

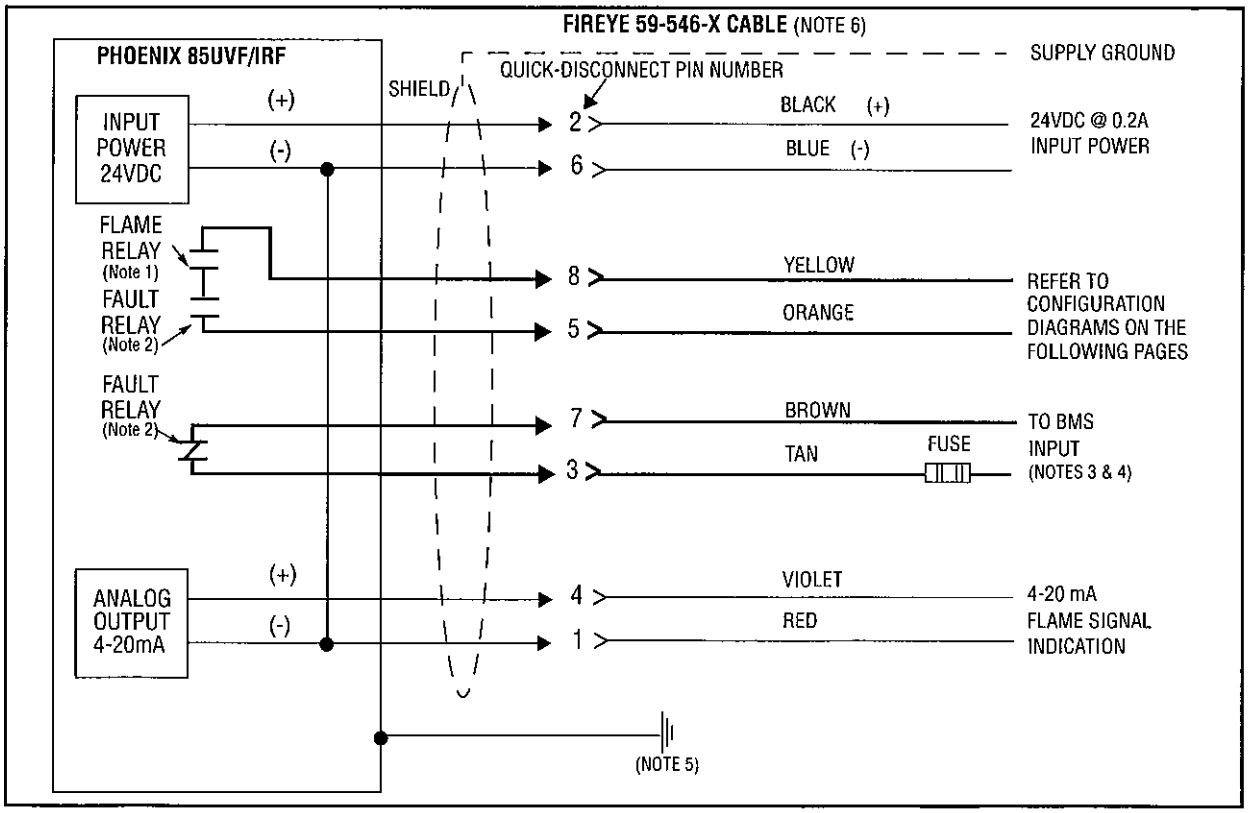
Fireye Phoenix scanners are suited for application to duct burners, industrial gas/oil burners, refinery applications, ignition systems and Low NOx detection and for continuous or non-continuous burner operation.

NOTE: Because the sensors in the Phoenix are solid state devices they can perform well with many different fuels. For example UV is typically used on gaseous fuels but can also be applied to oils and heavy oils. To be 100% sure of correct application a test should be performed. Phoenix scanners ARE NOT recommended for use on small pilot flames or obstructed sighting.

Operator interface to the Phoenix scanner is via a pushbutton keypad and informative LEDs. These provide continuous indication of flame signal, flame relay status, scanner status as well as selected mode of operation. Simplified keystroke routines are used for setup and this can be completed in seconds. For remote interface, outputs are provided for flame switch, fault relay and 4 to 20mA flame strength.

The installer must assure the combined flame failure response (FFRT) time of the Phoenix and BurnerLogix is within the guidelines of the local codes. Refer to bulletin CU-114 for detailed information.

PHOENIX WIRING DIAGRAM



Notes:

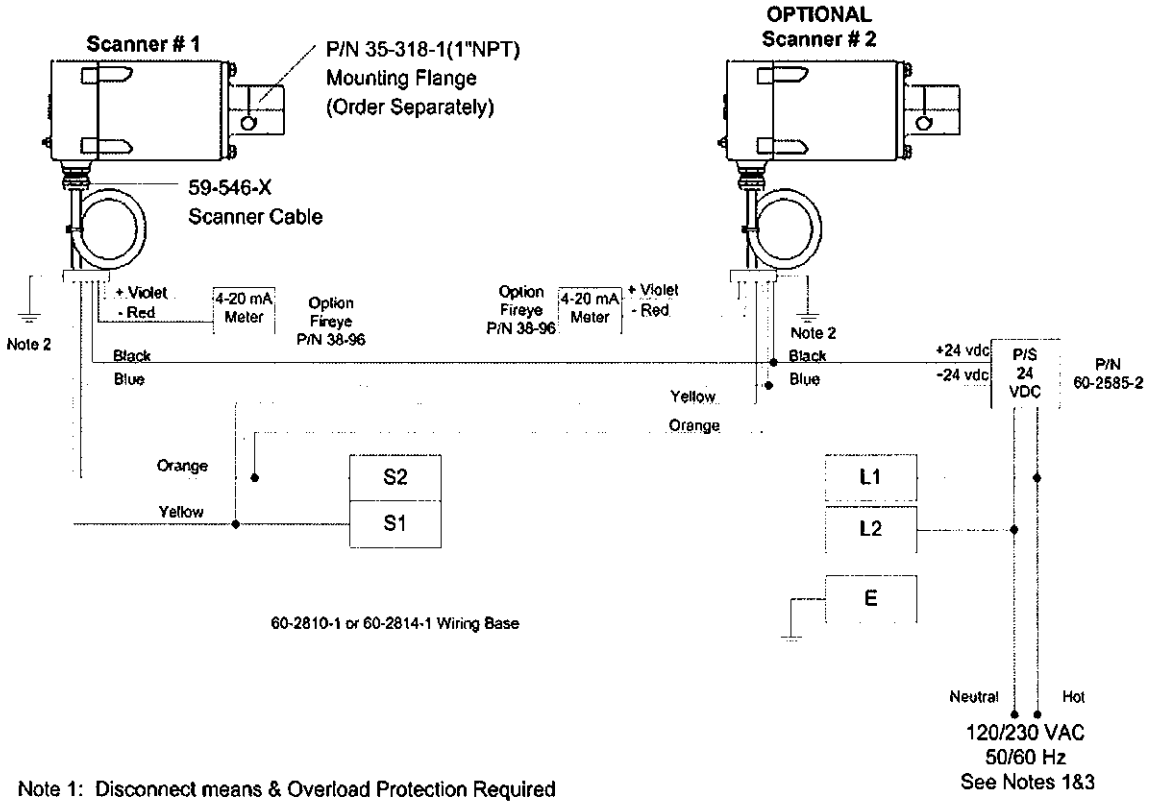
1. Flame relay contacts are shown in the de-energized (no flame condition).
2. Fault relay contacts are shown in de-energized (fault) condition.

3. BMS = Burner Management System (by others). Do not use Red as 24 volt ground.
4. External 2.0 Amp fuses recommended.
5. A safety ground screw is provided on the scanner end plate. An external ground wire must be installed if line voltage is applied to the relay contacts.

Table 4: PHOENIX SCANNER CABLE COLOR CODE

NEW 59-546 CABLE COLOR CODE (Connector Pin No.)	FUNCTION	OLD 59-497 CAPTIVE-CABLE COLOR CODE *For reference only*
(2) Black	24 vdc Input (+)	Black / Red
(6) Blue	24 vdc Input (-)	White / Blue
(8) Yellow	Flame Relay Contact (n.o.)	White / Red
(5) Orange	Flame Relay Contact (n.o.)	White / Black
(7) Brown	Fault Relay Contact (n.c.)	Red
(3) Tan	Fault Relay Contact (n.c.)	Pink
(4) Violet	4-20 ma Analog Output (+)	Violet
(1) Red	4-20 ma Analog Output (-)	Grey / Red
Shield Drain Wire	Earth Ground	*Shield Drain Wire*

BURNERLOGIX YB110DC/YB230DC WITH 85UVF4-1QDWR SCANNER



Note 1: Disconnect means & Overload Protection Required
Note 2: Scanner shield must be connected to earth ground.
Note 3: 24 VDC supply must be powered from same mains supply as YB110/YB230

INSTALLATION - 95 SERIES INSIGHT SCANNERS

Type 95IR contains an infrared flame sensor, responding to infrared radiation from 700 to 1700 nanometers wavelength. This sensor is best suited to coal and oil applications.

Type 95UV contains an ultraviolet flame sensor, responding to ultraviolet radiation from 295 to 320 nanometers wavelength. This sensor is best suited to gas applications.

Type 95DS (Dual sensor) contains both the infrared and ultraviolet flame sensors described above. This sensor is best suited to multi-fuel applications.

The InSight scanners measure the amplitude of the modulations (the flame "flicker") that occur within the targeted flame. During the scanner set-up procedure, the modulation frequency that yields the best flame ON/OFF discrimination is selected. The appropriate modulation frequency and sensor gain is either manually selected (S1 models), or automatically selected with manual override capability (S2 models).

The InSight 95IR, 95UV, and 95DS scanners are each available in two models differentiated by feature levels.

The Standard Model S1 has three choices of modulation frequency, adjustable sensor gain, adjustable flame relay ON/OFF thresholds, 4-20 mA analog signal strength output, fault relay, and two selectable programmable files to store setpoints (for two different fuels or firing rates).

The Expanded Model S2 adds automatic programming (AutoTune) with manual override capability, 21 choices of flame flicker frequency, a total of four selectable programmable files to store setpoints, plus adds remote communication capability via Fireye Windows 95/98/NT user software.

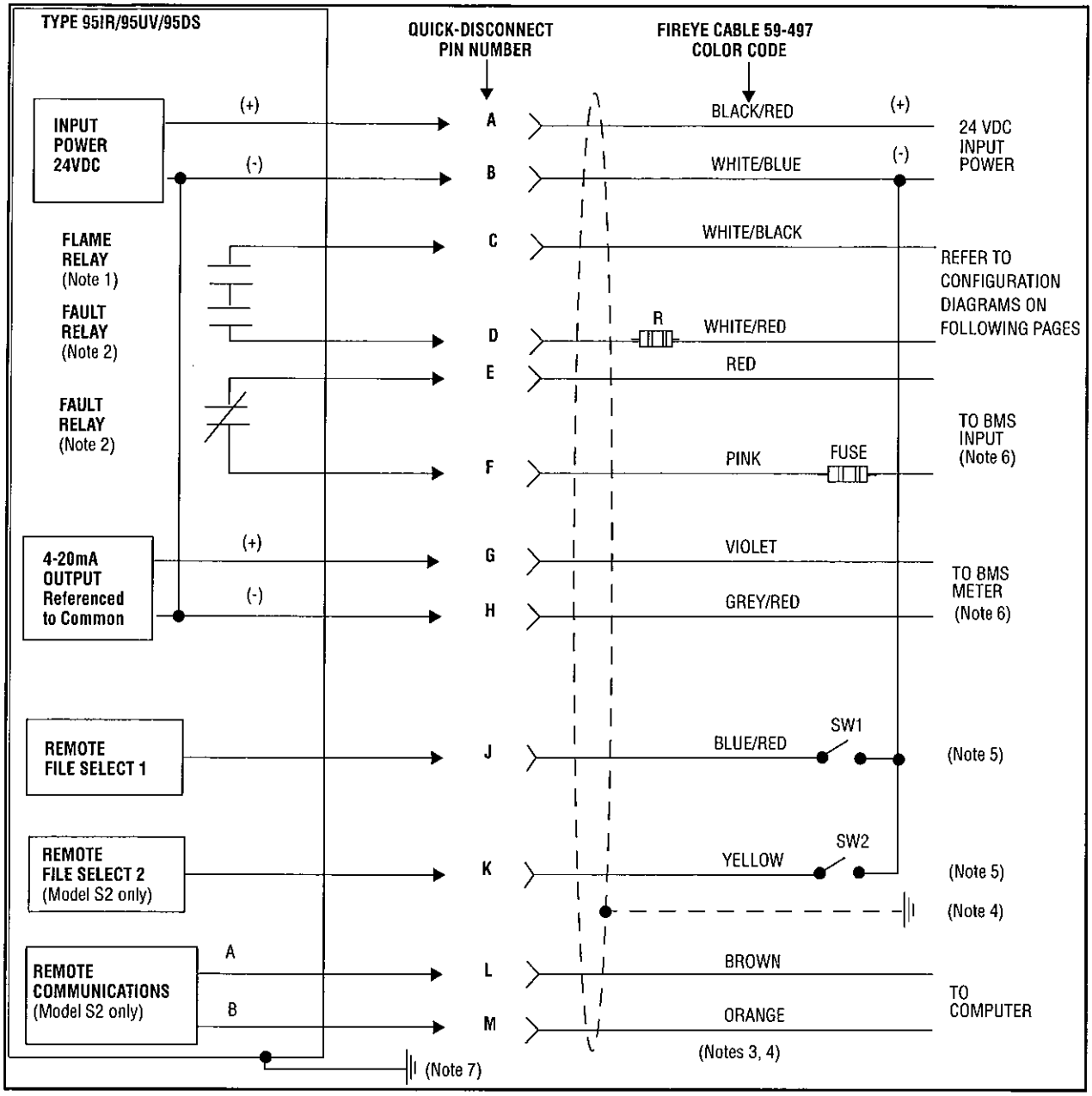
All FIREYE InSight scanner models are powered by 24 Vdc and contain electronic self-checking (no mechanical shutter required). The scanners contain an eight character alpha-numeric LED display and a four (4) push-button keypad to enable the user to view operating parameters and select setpoints.

The Standard Model S1 is best suited to the many applications that do not require the level of sophistication, or the remote communications capability of the Expanded Model S2 (e.g. single burner boilers and furnaces, duct burners, etc.)

The Expanded Model S2 is best suited to the applications that require the highest level of sophistication and flexibility (addition choices of modulation frequencies, and the time-saving AutoTune function), and remote communications capability (e.g. larger multi-burner boilers and furnaces).

Because of the shorted cable detect algorithm built into the BurnerLogix, it is imperative the proper cable be used when employing Insight scanners.

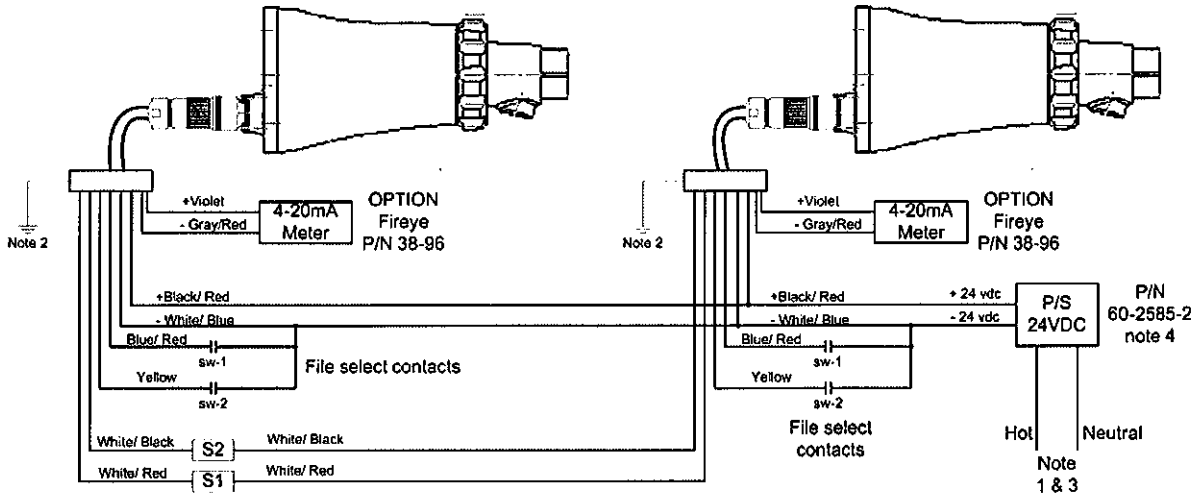
INSIGHT WIRING DIAGRAM



Notes:

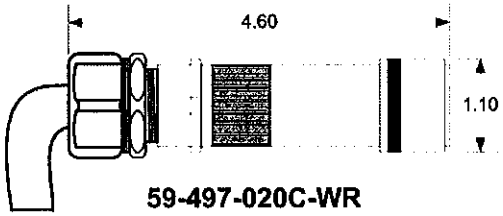
1. Flame relay contacts are shown in de-energized (no flame) condition.
2. Fault relay contacts are shown in de-energized (fault) condition.
3. Brown and orange wires are a twisted pair.
4. Connect cable shield to earth ground at power source.
5. With Remote File Select programmed as "LINE", external switches SW1/SW2 (not furnished) will select between two (S1 Models) or four (S2 Models) internal memory files, when connected to 24Vdc (-) supply.
6. External 2.0 Amp fuses recommended.
7. A ground screw is provided on the scanner end plate. An external ground wire must be installed if line voltage is applied to the relay contacts.

BurnerLogix YB110DC/YB230DC & INSIGHT scanner with 59-497-020xx-WR CABLE

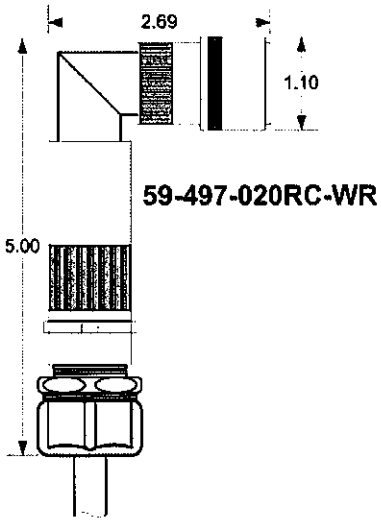


On 60-2814-1 wiring base

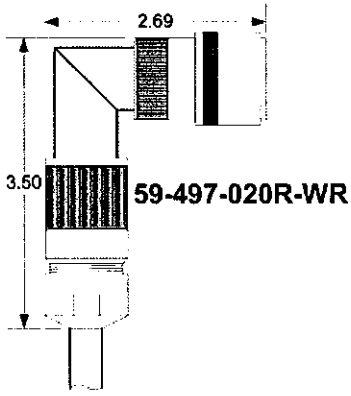
Note 1: Disconnect means & overload protection required
Note 2: Scanner shield must be connected to earth ground
Note 3: 24 VDC supply must be powered from same main supply as YB110/YB230



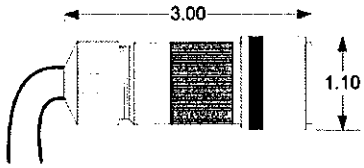
59-497-020C-WR



59-497-020RC-WR



59-497-020R-WR



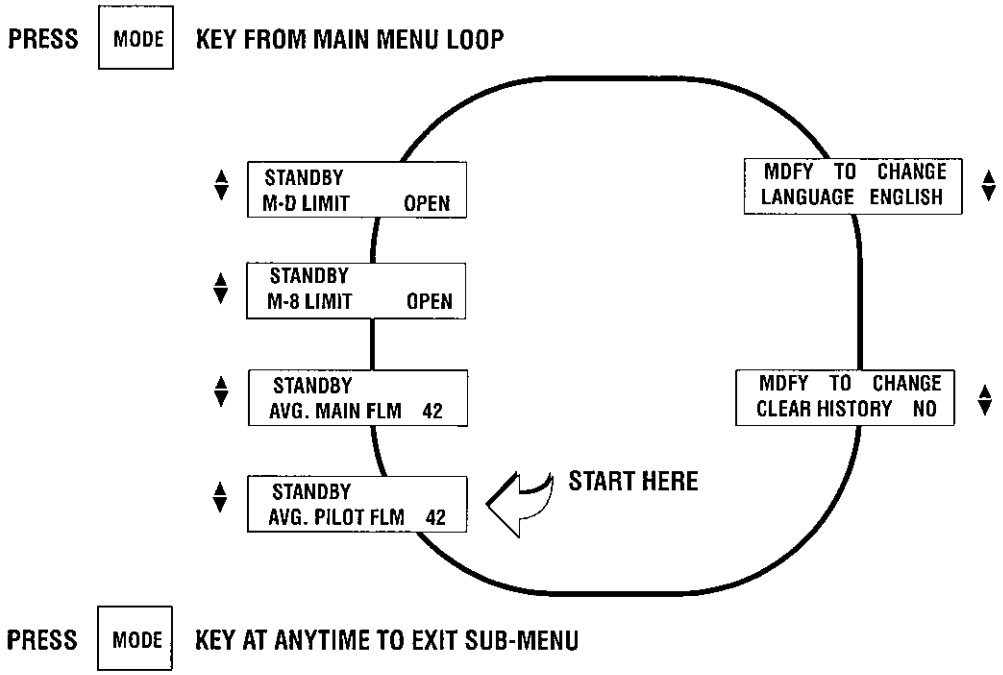
59-497-020-WR

SYSTEM INFO SUB-MENU

The sub-menu "SYSTEM INFO" allows the user to review information pertaining to the operation of the control (e.g. average main flame signal strength, status of the high fire and low fire end switches, etc.). This information can be very helpful when setting the damper linkages on the firing rate motor. The user may also clear the internal burner history (burner hours, cycles and system hours), number of lockouts and stored lockout information.

Language choices of English, French, Spanish, Dutch German and Swedish are available.

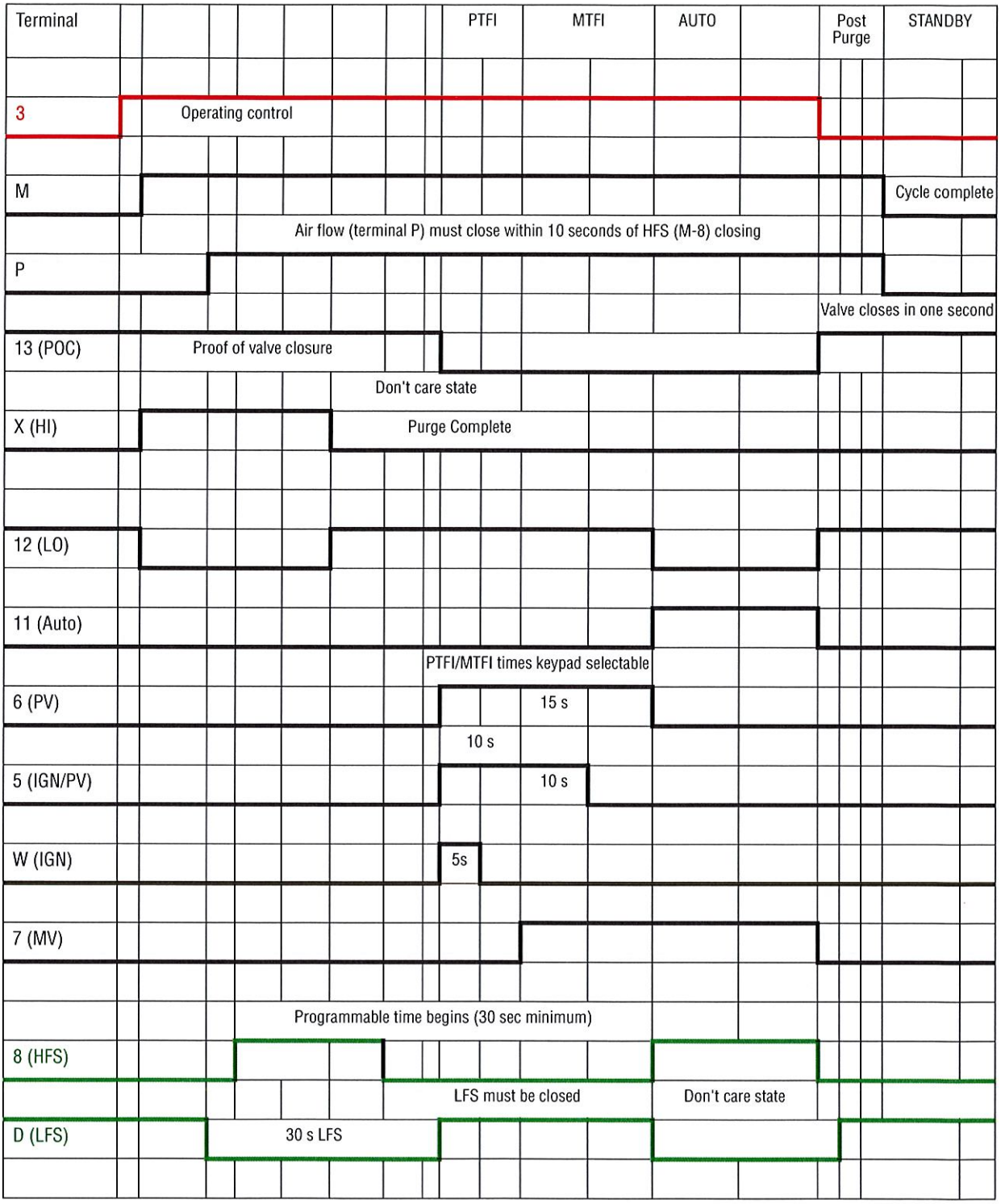
The MODE key is used to enter and exit the "SYSTEM INFO" sub-menu, and the NEXT and BACK keys are used to advance through the sub-menu.



SYSTEM OPERATION

The programmer module determines the functional operation of the Burnerlogix control (e.g. purge timing, trial for ignition timings, recycle or non-recycle operation, etc.). For purposes of illustration, we will be looking at the YP100 Programmer functions and messages associated with the BLL510 display module in this bulletin. **Because the messages change depending upon which YP style programmer is being used, it is necessary to check the bulletin covering the specific programmer for exact details.** Refer to the suggestions shown in this bulletin before proceeding to power the Fireye YB110 (YB230) BurnerLogix system. Items such as scanner installation, short circuit tests and safety information should be carefully reviewed.

YP100 OPERATING SEQUENCE



START-UP (NORMAL CYCLE)

Note: For direct spark ignited oil burners, substitute the words Main-Oil Valve for Pilot Valve.

1. Constant 120 VAC should be available to the LI-L2 terminals only on the wiring base.
2. The operating control circuits (LI-3) will close, signaling the burner to start its firing sequence. Terminal 13, fuel valve end switch must be closed.
3. The burner/blower motor (terminal M) circuit is energized. The running interlock (limit) circuit (3-P) will close (e.g. all limits, interlocks, etc. are proven).
4. The firing rate motor (Modulator Motor) is driven toward the high purge open damper position (10-X circuit made).
5. When the firing rate motor reaches its open damper position, the Hi Purge switch closes (M-8) and the prepurge interval of 30* seconds is initiated.
   Assuming countdown method, the BLV512 will display:

   PREPRG 00:25
   HIGH FIRE PURGE

   If the M-8 circuit does not close, the program will hold in this position for ten minutes waiting for it to close. If it does not, the control will lockout. If the M-8 circuit is closed at the start of a cycle, the top line of a display will switch to PURGE 20 seconds.

   PURGE 00:19
   HIGH FIRE PURGE

If the M-8 circuit is not closed at the beginning of a cycle, the top line of a display will switch to PURGE 10 seconds.

PURGE 00:10
HIGH FIRE PURGE

6. When the prepurge is completed, the firing rate motor is driven toward the low purge damper position (10-12 circuit made). The BLV512 will display:

   PURGE 00:24
   LOW FIRE PURGE

7. Following the minimum 30 second delay (10 second delay on YP113) to permit the firing rate motor to get to the low fire position, the control will wait for the low fire switch (M-D) to close. When it closes, the trial for ignition sequence will start. If after ten minutes, the M-D circuit is not closed, the control will lockout unless selected to wait indefinitely.
8. The trial for ignition period begins with Terminals 5, 6 and W being energized simultaneously. This is known as PTFI (Pilot Trial for Ignition). The BLV512 will display:

   PTFI 00:02
   IGNITION TIMING

Unless otherwise selected this period is ten seconds in duration. Terminal W will de-energize after 5 seconds. Refer to PTFI*MTFI TIMINGS to determine times selected or timings appropriate for the application. The test meter jacks on the YB110 (YB230) will provide an indication of the flame signal strength. The flame signal readout is also available on the alpha-numeric display.

	TEST JACKS	DISPLAY
MINIMUM ACCEPTABLE	6mA	6-16
NORMAL	7.5 -20mA	20-80

PTFI 20
FLAME SIGNAL

9. With flame proven at the end of PTFI, the main flame trial for ignition (MTFI) period begins. Terminal 7 is energized. The BLV512 will display:

MTFI 35
FLAME SIGNAL

Terminal 5 is de-energized 10 seconds later and Terminal 6 is de-energized after another 5 seconds.

10. The firing rate motor is now sent to the automatic modulation position (10-11 circuit made) and is under the command of the proportional controller. The BLV512 will display:

AUTO 40
FLAME SIGNAL

Normal Shutdown

1. When the operating control circuit (L1-3) opens, the main fuel valve is de-energized. The firing rate motor is driven to the low purge position (10-12 circuit made).
2. Following a 15 second post purge, the burner/blower motor is de-energized.

POST PURGE 0:05
CYCLE COMPLETE

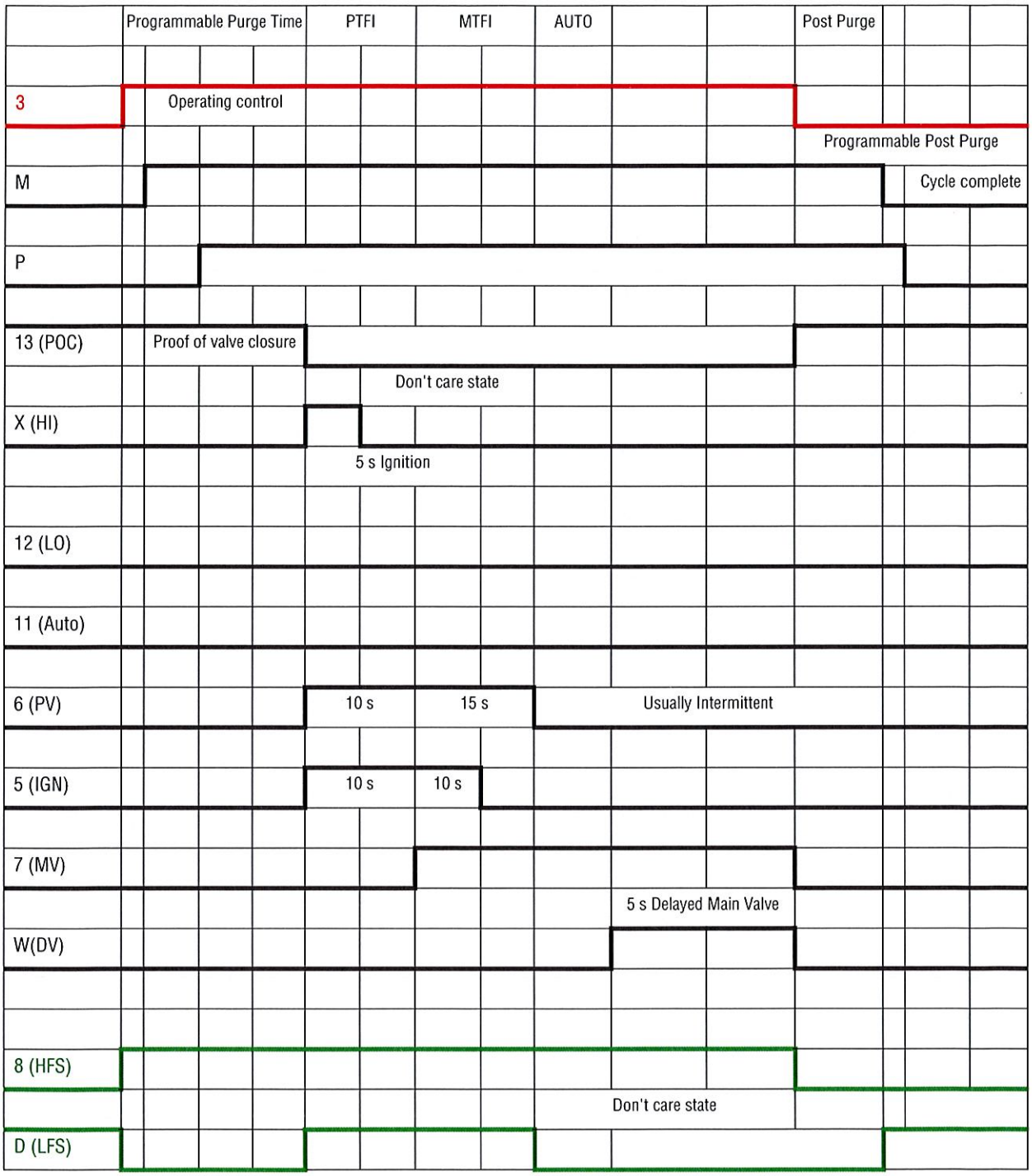
3. The burner is now off and the BLV512 will display

STANDBY
L1-3 OPEN

YP200 OPERATING SEQUENCE

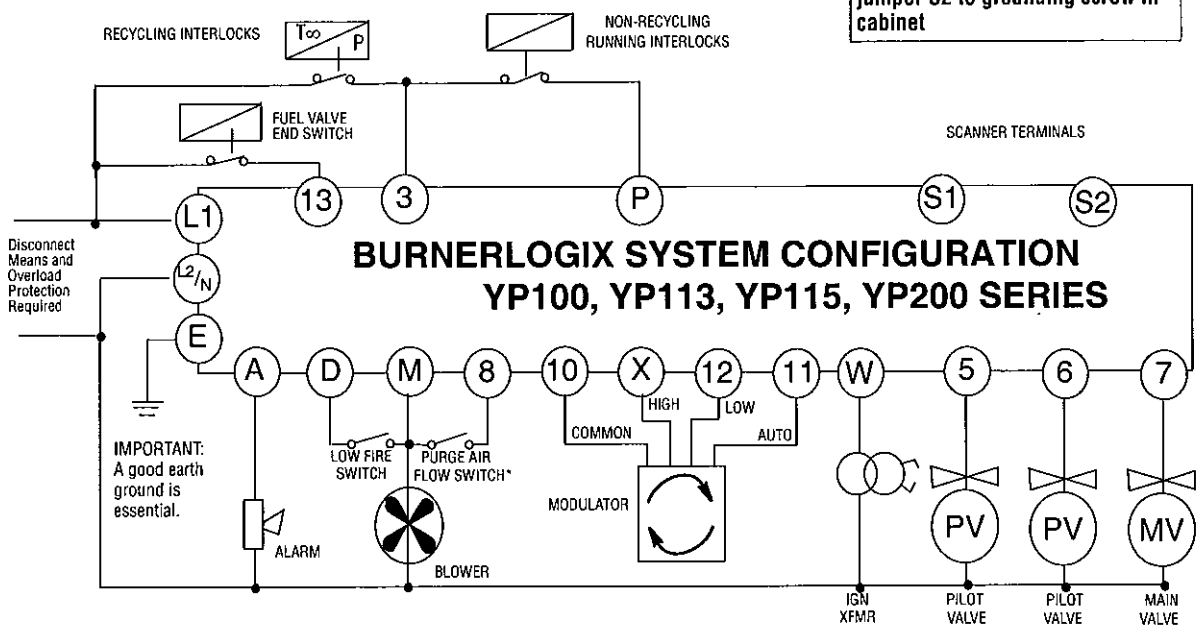
	OPEN DAMPER PURGE (begins after terminal M energized or cycle start)	PTFI	MTFI	AUTO	Post Purge
3	Operating control				
M					Cycle complete
P	Air Flow (terminal P) must close within 20 seconds of cycle start				
13 (POC)	Proof of valve closure				
X (HI)	Programmable time begins (30 sec minimum)		Don't care state		
12 (LO)					
11 (Auto)					
6 (PV)		10 s	15 s		
5 (IGN)		10 s	10 s		
7 (MV)					
8 (HFS)	Ignore M-8 Input			Don't care state	
D (LFS)	30 s				

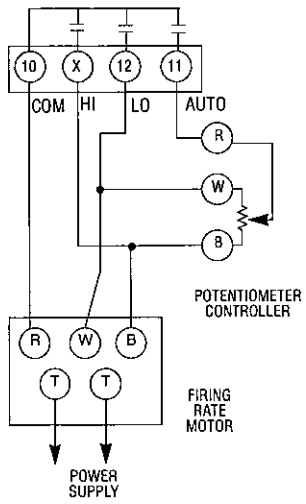
YP300 OPERATING SEQUENCE



SUGGESTED WIRING DIAGRAM FOR YP100/YP200 PROGRAMMERS

Note: When Flame Rod is used jumper S2 to grounding screw in cabinet

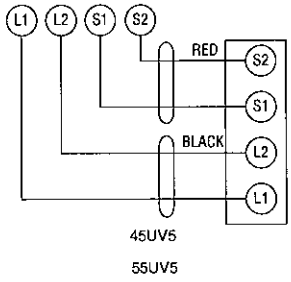




1. Purge air switch from M to 8 not required for YP200.
2. YP200 programmer recycles on 3-P open.
3. Terminal 6 selectable interrupted/intermittent pilot.
4. Terminal W active first 5 seconds of PTFI (YP100 Series only).
5. See chart on Table 2 for selectable timings (YP100, YP200 only).

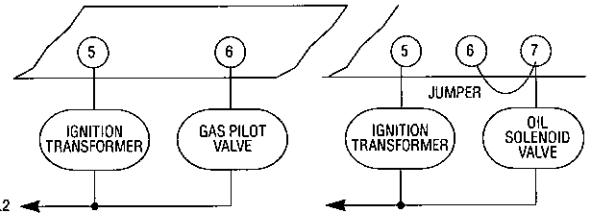
Connect terminal E to grounded bonding screw in cabinet.

All wiring must comply with NEC Class 1 (Line Voltage) wiring.



Caution: All safety limit switches should be approved as limit controls and should be wired directly in the circuit of the Flame Safeguard control. The use of electronic switches to close interlock circuits may cause erratic operation.

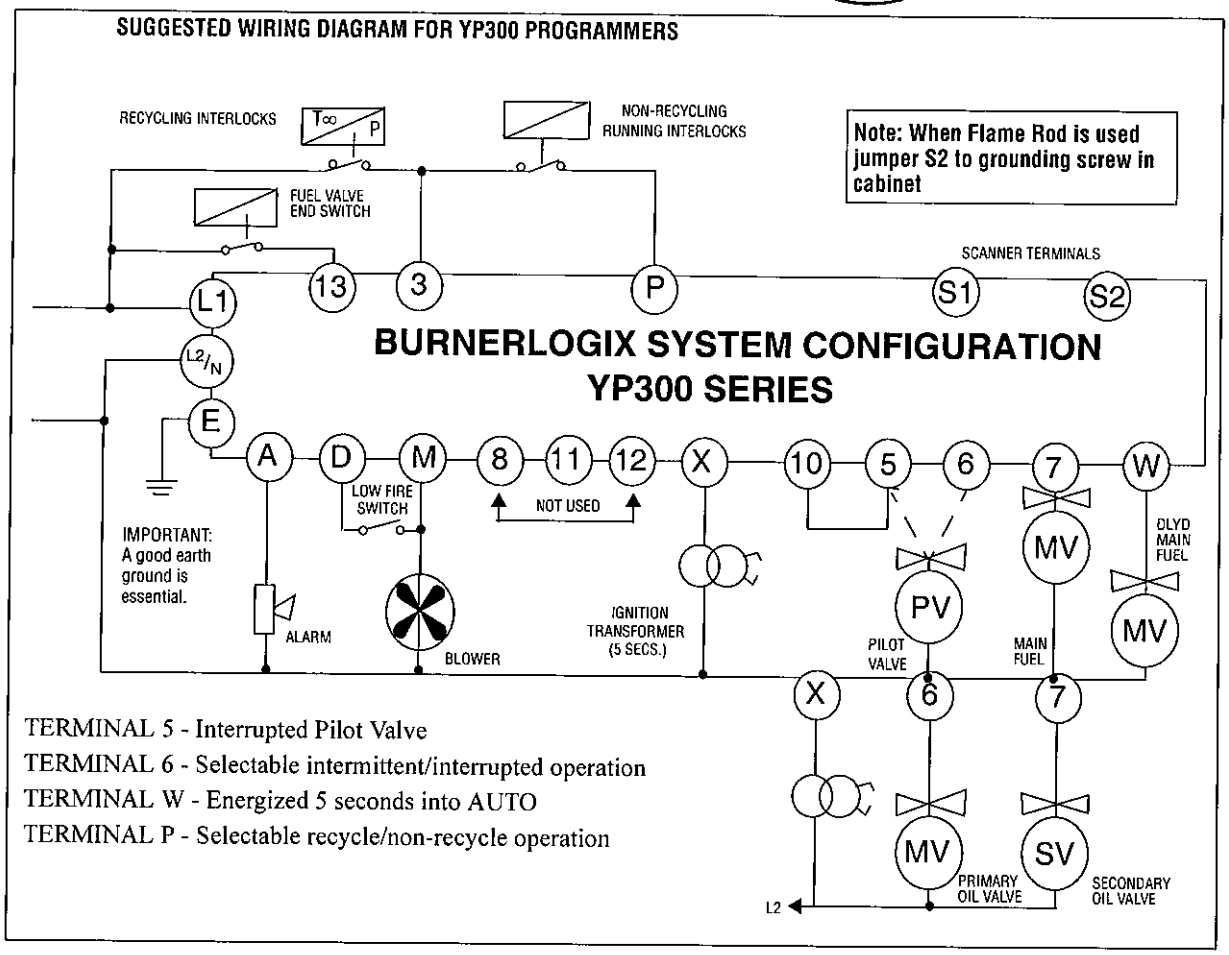
TYPICAL WIRING ARRANGEMENT FOR PILOT IGNITER
(Applies to YP100 and YP 200 only)



WIRING ARRANGEMENT FOR IGNITION TRANSFORMER & GAS PILOT VALVE FOR SPARK CUTOFF FEATURE

SET PTFI*MTFI SETTINGS APPROPRIATELY

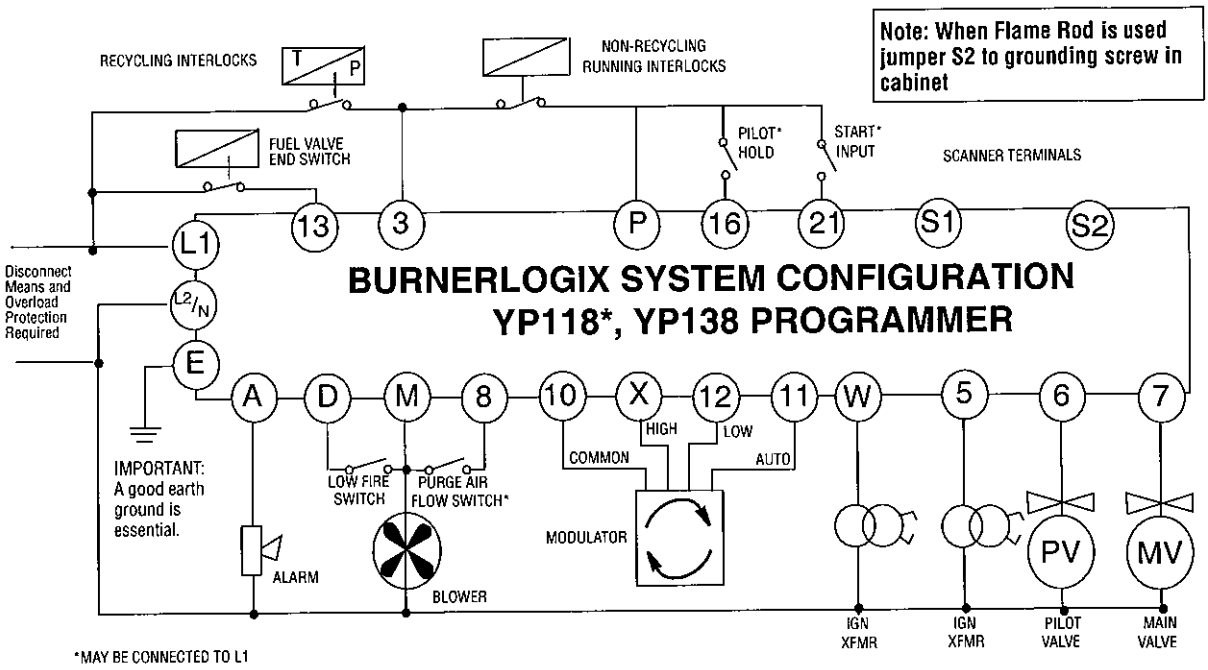
WIRING ARRANGEMENT FOR SPARK IGNITED OIL BURNER



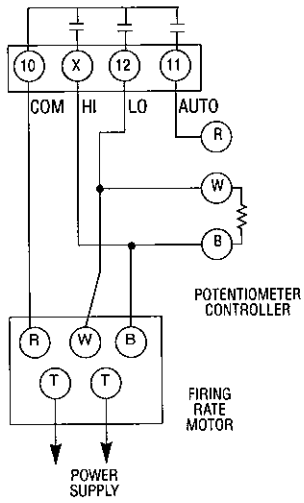
YP118, YP138 PROGRAMMER

The YP118 and YP138 programmers offer burner operation similar to the YP100 programmer but with extended functions that might enhance burner operation such as increased turndown. The YP138 programmer makes use of additional inputs on terminals 16 and 21. Both terminals 16 (PILOT HOLD) and 21 (START INPUT) are line voltage inputs.

SUGGESTED WIRING DIAGRAM FOR YP138 PROGRAMMER



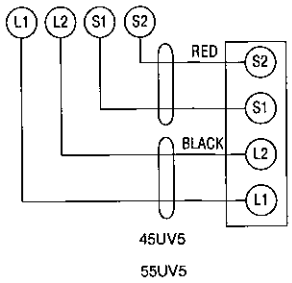
*MAY BE CONNECTED TO L1



1. Terminal 6 selectable interrupted/intermittent pilot.
2. Terminal W active first 5 seconds of PTFI.
3. See chart on Table 2 for selectable timings.

Connect terminal E to grounded bonding screw in cabinet.

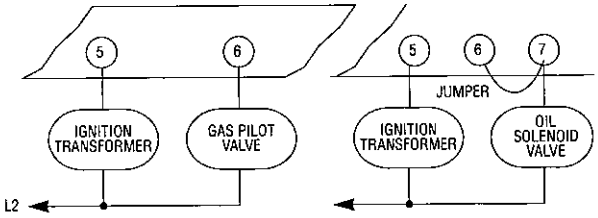
All wiring must comply with NEC Class 1 (Line Voltage) wiring.



Caution: All safety limit switches should be approved as limit controls and should be wired directly in the circuit of the Flame Safeguard control. The use of electronic switches to close interlock circuits may cause erratic operation.

*Use YP118 programmer if 1 second FFRT required

TYPICAL WIRING ARRANGEMENT FOR PILOT IGNITER



WIRING ARRANGEMENT FOR IGNITION TRANSFORMER & GAS PILOT VALVE FOR SPARK CUTOFF FEATURE

WIRING ARRANGEMENT FOR SPARK IGNITED OIL BURNER

SET PTFI*MTFI SETTINGS APPROPRIATELY

Terminal 21 is used to hold the system indefinitely at the end of low fire start and when opened will initiate pilot trial for ignition. Assuming the count method is set for down, at the end of a low fire start period the display will indicate:

HOLD 00:00
T21 INPUT

During the AUTO or RUN position, terminal 21 can be used to force the firing motor to the low fire position. In this state the display will indicate:

HOLD T21 42 top line indicates hold mode with flame signal
LOW FIRE SIGNAL

Terminal 16 is used to hold the system in a pilot proving state following the pilot trial for ignition period. After pilot trial for ignition, as determined by the PTFI*MTFI TIMING selection, terminal 5 will be de-energized and terminal 6 will remain energized. During this state the system is in a flame proven state and the display will indicate:

PILOT 42 flame signal displayed
T16 INPUT pilot hold period

Once terminal 16 is released or de-activated, the system then proceeds in the MTFI period in accordance with the PTFI*MTFI TIMINGS selection. If selected to be on, terminal 5 with the ignitor will become energized during MTFI.

Terminal 16 is also used to revert the system back to the pilot proving mode from the AUTO or RUN mode. During AUTO, an active state on terminal 16 initiates the steps to revert back to pilot mode. On detection of terminal 16, the firing rate motor is commanded to the low fire position and the system waits for the low fire start switch (M-D) to close. While in this wait mode the display indicates:

HOLD T16 42 while in AUTO, Terminal 16 closes
M-D LIMIT OPEN wait for low fire interlock to close

Once the low fire start switch is detected as closed, terminal 6 is energized to open the pilot valve. A 20 second time delay is then imposed with both the main valve (7) and pilot valve (6) energized. The display will indicate:

HOLD T16 42 while in AUTO, M-D detected closed
M-D LOW LIMIT wait 20 seconds in this state

At the end of the 20 seconds, the main valve (7) is de-energized and the ignition terminal (5) is energized for the time specified in PTFI*MTFI TIMINGS. Terminal W is energized for 5 seconds. The display will indicate:

PTFI 42 flame signal displayed
FLAME SIGNAL

Unlike PTFI, this period is a flame proven state and if flame signal is lost for one FFRT, the system will shutdown and lockout. At the end of the selected PTFI time, terminal 5 is de-energized and the system proceeds to the pilot proving period with terminal 6 energized and flame being proven. The display will indicate:

PILOT 42 flame signal displayed
T16 INPUT pilot hold period

Once terminal 16 is de-energized, the system proceeds into the MTFI period with terminal 7 (main valve energized). If selected to be on, terminal 5 with the ignitor will become energized during MTFI in accordance with the PTFI*MTFI TIMINGS selection. At the conclusion of the MTFI period and as selected by PTFI*MTFI TIMINGS selection and terminal 6 as interrupted/intermittent, terminals 5 and 6 assume their respective states.

Notes on operation:

While in AUTO or RUN mode, once the action initiated by T16 begins, it cannot be reversed by opening T16. At the conclusion of PTFI, if T16 is open, the control will advance through MTFI to AUTO.

If START INPUT (T21) and PILOT HOLD (T16) are both active in AUTO, T16 has priority and revert to pilot will be initiated.

The user shall contact the burner manufacturer to determine if the pilot assembly is rated for intermittent operation.

LOCKOUTS

When a safety shutdown occurs, the control will indicate through the LED's the reason for the lockout and if equipped will display a lockout message and when in the cycle the lockout occurred. The alarm circuit (Terminal "A") will be energized. The non-volatile memory will remember the status of the control even if a power failure occurs. By momentarily depressing and releasing the reset button on the control or the display keypad, the control can be reset. The button must be held down for one second and then released. Very little force is required to do this. Do not press hard.

SAFETY SHUTDOWN

1. If the running interlock circuit (3-P) does not close, the control will lockout and the blower motor will be de-energized.

PROVING 3-P CLOSED

On cycle start the BurnerLogix proves the 3-P running interlock circuit closed in the following manner:

1. At cycle start (L1-3 closes), if the M-8 damper switch is closed, the pre-purge period begins and the BurnerLogix will wait up to 20 seconds for the 3-P circuit to close.

2. At cycle start (L1-3 closes), if the M-8 damper switch is open, the BurnerLogix will wait up to 10 seconds for the 3-P circuit to close after the M-8 circuit closes. Pre-purge timing begins after the M-8 closes circuit closes.

2. If the fuel valve end switch or proof of closure switch connected to Terminal 13 opens during standby or purge, the control will lockout.
3. If the running interlock circuit (3-P) opens during a start-up or firing period, all fuel valves will be de-energized and the control will lockout.
4. If the proven high fire circuit (M-8) has not closed after a ten (10) minute "Hold" period at the start of prepurge, the control will lockout.
5. If the low fire start circuit (M-D) has not closed after a ten (10) minute "Hold" period at the end of prepurge, the control will lockout.
6. a.) If PROVE 3-P OPEN is selected as YES, and the 3-P circuit is closed at the start of the operating cycle, the control will hold for thirty (30) seconds waiting for the 3-P circuit to open. If, after thirty (30) seconds, the 3-P circuit does not open, the control will lockout.
   b.) If PROVE M-8 OPEN is selected as YES, and the M-8 circuit is closed at the start of a cycle, the control will hold for thirty (30) seconds for it to open. If, after thirty (30) seconds, the M-8 is still closed, the control will lockout.
   c.) If PROVE M-D OPEN is selected as YES, and the M-D switch is closed at the end the high fire purge cycle, the control will hold for thirty (30) seconds for it to open. If, after thirty (30) seconds, the M-D is still closed, the control will lockout.
   d.) If PROVE M-D TFI is selected as YES, the low fire start switch located between terminals M-D must be closed during PTFI and MTFI.
7. If pilot flame is not detected after the pilot trial for ignition period, the pilot valve and ignition transformer will be de-energized and the control will lockout on safety.
8. If main flame is not detected during the main flame trial for ignition period for one FFRT, all fuel valves will be de-energized and the control will lockout on safety.
9. If the main flame fails during a firing cycle, all fuel valves will be de-energized within 1 FFRT and the control will lockout on safety.
10. If flame is detected when the operating control (L1-3) is open, the control will wait sixty (60) seconds and then lockout if flame is still present. If the operating control closes and flame is detected during purge, the control will drop back to Standby position and de-energize the blower motor (Term M). If the flame signal goes away within sixty (60) seconds, the control will proceed with a normal start-up. If flame signal is still present after sixty (60) seconds, the control will lockout.
11. If the fuel valve end switch connected to Terminal 13 is not closed after 5 seconds into post purge, the control will lockout on safety.

DIAGNOSTIC MESSAGES

MESSAGE	POSSIBLE CAUSE	SOLUTION
CHECK PROGRAMMER	No programmer module plugged into YB chassis/amplifier module	Remove power, insert programmer, press reset to clear fault
	Defective programmer module	Remove power, replace programmer module
CHECK CHASSIS	Relay feedback error caused by bad wiring	Check all wiring, Re-inspect routing of all wires
	Programmer module inserted while power is applied	Cycle power, reset control
	Defective opto-coupler on the YB chassis/amplifier	Replace YB module
CHECK WIRING	Voltage is detected on terminals at improper time	Check system wiring. Measure voltages on input/output terminals
CHECK SCANNER	Flame signal detected during shutter close time in 45UV5 or 55UV5 scanner	Check power on shutter terminals and/or replace shutter in scanner.
	Runaway UV tube	Replace UV tube, part number 4-314-1
CHECK EXPANSION MODULE	Internal diagnostics within expansion module has detected a problem and ceased communications with BurnerLogix control for 3 minutes.	Check that ED580 cable from expansion module to BurnerLogix is plugged in or not damaged, check routing of cable within burner cabinet or check L1-L2 connections to expansion module. Reset control and check STATUS LED on expansion module. Replace YZ300 or YZ320 expansion module or YB110 (YB230) chassis/amplifier module.
	Defective or unplugged ED580 cable.	Assure cable is fully inserted in both BurnerLogix control and Expansion module. Check for damage to cable or connectors.
WAITING FOR DATA	Communications to/from display	Indicates the display is not communicating properly with chassis. Check that the YP programmer is properly inserted. Check that the cable is not defective and is properly inserted into the connectors. In rare instances due to ongoing enhancements to the BurnerLogix family, the display and chassis may not be compatible. Check the date code and engineering code of both sets.

RESETTING THE CONTROL

The BurnerLogix systems contain three methods of reset, by push-button located on the YB chassis/amplifier module, by keypad push-button located on the optional keypad/display module, and by a user installed normally open push-button connected from line voltage (L1) to Terminal 22. Terminal 22 is a line voltage isolated input. Depressing and releasing the reset button is required.

Notes:

1. Manual Reset is required following any non-volatile lockout.
2. Depressing and releasing the reset button during a cycle will cause the control to shut the burner down and recycle.
3. The YP113 and YP115 programmers limit the amount of reset attempts to 5 tries. This internal counter gets reset to 0 when the control reaches the AUTO state and on every application of power.

LOCKOUT CODES

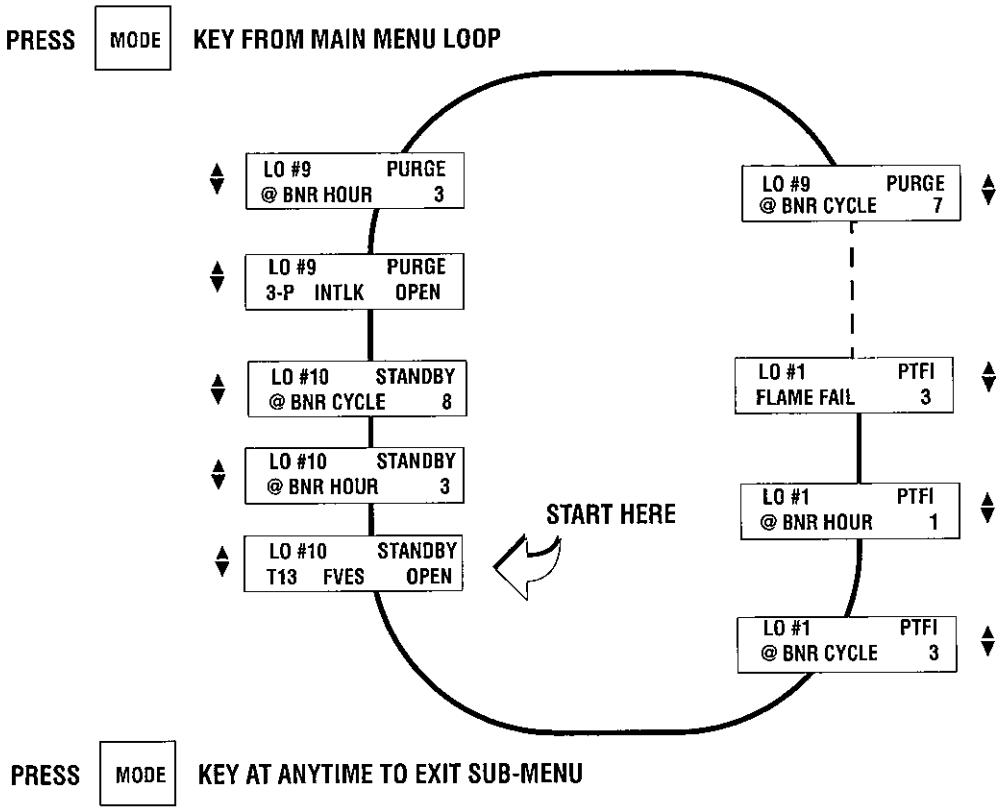
During an alarm condition, the Alarm LED is made to flash at approximately a twice per second rate. The remaining LED's are illuminated as a coded sequence identifying the reason for the lockout. This remains true if power is removed and then restored in a locked out condition.

Table 5:

LED DISPLAY READOUT ● = ON							
LOCKOUT MESSAGE	FAN	OPEN DAMPER	CLOSE DAMPER	AUTO	IGN	FLAME	
T13 FUEL VALVE END SWITCH OPEN					●	●	
M-D LOW FIRE START OPEN				●		●	
M-D LOW FIRE START OPEN - PTFI	●			●		●	
M-D LOW FIRE START OPEN - MTFI	●	●		●		●	
M-D CLOSED			●		●		
M-8 CLOSED			●			●	
M-8 HIGH PURGE CIRCUIT OPEN				●			
FALSE FLAME-STANDBY				●	●		
FLAME FAIL PTFI	●			●	●	●	
FLAME FAIL - MTFI	●	●		●	●	●	
FLAME FAIL AUTO				●	●	●	
3-P RUN INTLK OPEN - PREPURGE	●		●			●	
3-P RUN INTLK OPEN - PURGE	●		●		●		
3-P RUN INTLK OPEN-PTFI	●		●				
3-P RUN INTLK OPEN-MTFI	●	●	●				
3-P RUN INTLK CLOSED-STANDBY						●	
3-P RUN INTLK OPEN-AUTO			●				
FUEL VALVE STATE CHANGE					●		
CHECK FUSE			●	●	●		
CHECK WIRING			●	●		●	
CHECK SCANNER			●		●	●	
CHECK PROGRAMMER			●	●			
CHECK CHASSIS		●					
CHECK EXPANSION MODULE			●	●	●	●	

LOCKOUT HISTORY SUB-MENU

The sub-menu "LOCKOUT HISTORY" will display the last ten (10) lockouts, along with the burner cycle and burner hour when the lockout occurred. When the MODE key is pressed, the screen will display the most recent lockout condition and the number of that lockout (e.g. LO #10 represents the 10th lockout of that control). The NEXT key will display the Burner Hour, followed by the Burner Cycle when the lockout occurred. The NEXT key will advance to the next lockout, and repeat the sequence listed above. The BACK key can be used to scroll back up through the sub-menu items. The MODE key will exit the sub-menu.



COMMUNICATIONS

The protocol to be used is Modbus RTU. This is implemented by the master (PC, PLC, etc.) issuing a poll to the slave (BurnerLogix) and the slave responding with the appropriate message.

A typical format of a poll request is as follows:

MESSAGE FORMAT

DST	FNC	ADR HI	ADR LO	DAT HI	DAT LO	CRC LO	CRC HI

DST refers to the logical address of the slave.

FNC is the function being requested. FNC 03 is a read request.

ADR is the message number or register number of the data being requested.

For the BurnerLogix all registers are mapped as HOLDING REGISTERS, FNC 03. Register addresses begin at 40001 but is interpreted as address 00.

DAT is the number of words being requested. A word is an integer consisting of 2 bytes.

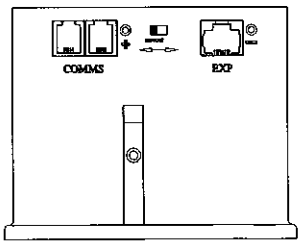
The normal response from a slave is as follows:

DST	FNC	DBC	DATA.... Hi/Lo	CRC LO	CRC HI

DBC is the data byte count being returned. It must be two times the DAT number from the poll request.

DATA is the data returned and is always a series of 2 byte integers. If 4 words were requested then DBC would be 8 and there would be 8 data bytes or 4 data words containing the requested data.

The format of the data is N,8,1 meaning no parity, and 1 stop bit. Baud rate is selectable through the keypad / display. As shipped the baud rate is 9600.



Communication to the BurnerLogix control is made through either of the RJ-12 jacks located on the underside of the control (note figure on right). The jacks are internally wired in parallel to ease multi-dropping of BurnerLogix controls. The physical method for communications is RS485, half duplex. For each of the RJ-12 connections, the outside contacts are connected together and are designated as "A" or "+" while the inside contacts are connected together and are designated as "B" or "-". Fireye supplies the ED512 cables in various lengths with RJ-12 plugs on each end. Refer to bulletin E-8002 for additional information.

See page 49 for a table of currently available messages provided by the BurnerLogix programmers, followed by a description where necessary

MODBUS MESSAGE TABLE

HOLDING REGISTER	MESSAGE ADDRESS	WORD REQUESTED	WORD RESPONSE	VALUE
40001	00	1	STATUS	83 (053H) = RUN; 202 (0CAH) = LOCKOUT
40002	01	1	MSGN	Current message being displayed (see Table 8)
40003	02	1	GSTAT	Defines Timer Type
40004	03	1	TIMER	Time in seconds
40005	04	1	FLAME	Flame Signal
40006	05	1	LOGSTAT	Current logic module, PURGE, PTFI, AUTO (see Table 7)
40007	06	1	INPUTS	Input limits state
40008	07	1	OUTPUTS	Output relays state
40009	08	2	SYSMINS	System on minutes
40011	10	2	BNRMINS	Burner on minutes
40013	12	2	CYCLES	Completed Burner Cycles
40015	14	1	LOCKOUT COUNT	Stored Lockout Count
40016	15	6	LOCKOUT HISTORY Most Recent Lockout Data	Beginning of Last 10 Lockouts
40022	21	6	2nd Most Recent Lockout Data	Returns complete lockout description of stored lockout history. Includes lockout message (1), lockout module (1), @ burner hours (2), and @ burner cycles (2)s
40028	27	6	3rd Most Recent Lockout Data	
40034	33	6	4th Most Recent Lockout Data	
40040	39	6	5th Most Recent Lockout Data	
40046	45	6	6th Most Recent Lockout Data	
40052	51	6	7th Most Recent Lockout Data	
40058	57	6	8th Most Recent Lockout Data	
40064	63	6	9th Most Recent Lockout Data	
40070	69	6	10th Most Recent Lockout Data	
40076 • • • 40079	75 • • • 78	4		
40080 • • • 40090	79 • • • 89	11	N/A	Reserved for Fireye use
INTERLOCK ANNUNCIATOR				
40901	900	1 - 3	YZ300 Expansion Module registers (see Table 6)	Returns lower, middle and upper interlock annunciator (YZ300) registers.
40902	901	1 - 2		Returns middle and upper interlock annunciator (YZ300) registers.
40903	902	1		Returns upper interlock annunciator (YZ300) register.

It is suggested that polling intervals not be less than 200 mSec per request. Requesting data such as burner minutes, system minutes and burner cycles should be kept at a minimum due to the amount of processing time required to gather that data.

The MSGN being transmitted is a numerical value and must be interpreted by the communicating device, which actually is an advantage since this can be made to be whatever message text the end user wants. In other words, it allows for programming custom messages without actually changing the message in the programmer. Refer to Table 8, for message information.

The BurnerLogix stores its burner on time (7 powered) and system on time (L1 powered) in minutes. For display purposes, the programmer converts this to hours. The information being supplied by Modbus will be the actual time in minutes and it is up to the communicating device to do the conversion. Since the maximum value stored in the BurnerLogix is 9,999,999 minutes, the maximum value in hex therefore is 98967FH and comprises two data words. The maximum cycle count is 999,999 decimal or F423FH, still two data words.

*To convert, multiply high word by 10000H (65536), add to this high byte of low word multiplied by 100H (256) and add to this the low byte of low word. Example: (98H*10000H) + (96H*100H) + 7FH = 98967FH = 9,999,999 minutes.*

As an example, the System on Minutes data is transmitted from the BurnerLogix to the interface as high word / low word as shown below: The same applies to Burner On Minutes and Burner Cycles.

ADDRESS 8		ADDRESS 9	
HIGH WORD		LOW WORD	
HIGH BYTE	LOW BYTE	HIGH BYTE	LOW BYTE
0	98H	96H	7FH

All values are represented in a HEX or base 16 format.

GSTAT determines the type of value TIMER represents. TIMER can be a running timer such as is used in purge, a flame signal or meaningless. Only the lower nibble of GSTAT has any value. If this value is 0 then the TIMER value has no meaning. The value in TIMER is a background minute timer in the BurnerLogix and should be ignored. If GSTAT is between 4 and 7, the TIMER represents the current value flame signal. If GSTAT is a 1, 2, or 3 then TIMER represents a running timer value.

The format of the data is 8 data bits, no parity and 1 stop bit. Due to the RS485 format, the communication format is considered half-duplex. That is, only one user is permitted on the communication lines at a time.

The information contained in INPUTS and OUTPUTS represents the status of the interlocks and output relays respectively. For the INPUTS, a 1 in the interlock position defines the interlock as being on or active where a 1 in any bit position in the OUTPUT register signifies the relay as being energized.

INPUTS (40007)

Bit 15							Bit 8
AC Line	Term D	Term 16	Term 13	Term 21	Term 22	Term 23	Term 8
Ref	Low Fire Start	Pilot Hold	FVES POC	Start Input	Remote Reset	Spare	Purge Damper

Bit 7							Bit 0
Term P	Term 3	Term M	Term 5	Term 6	Term W	Term 7	KS
Run Interlock	Op Cntrl	Blower	Ignition	Pilot Valve	Delayed Valve	Main Valve	Safety Relay

A '1' in the opto-coupler position indicates the opto-coupler is on or interlock closed.

OUTPUTS (40008)

Bit 15				Bit 11			Bit 8
				Term A	Term11	Term X	Term 12
				Alarm	Auto	High Fire	Low Fire

Bit 7				Bit 3			Bit 0
	IS	Term W	Term 7	Term M	Term 6	Term 5	
	Internal Safety	Delayed Valve	Main Valve	Blower	Pilot Valve	Ignition	

Note: A "1" in any bit position indicates the output or terminal is on or active.

Table 6:

YZ300 LOWER (40901) – REFER TO BULLETIN YZEM-3001

Bit 7							Bit 0
Term 47	Term 46	Term 44*	Term 43	Term 3	Term 42	Term 41	Term 40
Low Oil Temp	High Oil Temp	Low Water	High Water	Aux #3	Aux #2	Aux #1	Op Control

* Terminals 44 and 45 are internally connected

YZ300 MIDDLE (40902) – REFER TO BULLETIN YZEM-3001

Bit 7							Bit 0
Term 57	Term 56	Term 55	Term 54*	Term 52	Term 51	Term 49*	Term 48
Aux #4	High Temp	High Pres-sure	Aux Gas	High Gas Pressure	Low Gas Pressure	Low Atomizing Media	Low Oil Pressure

* Terminals 49 and 50 are internally connected

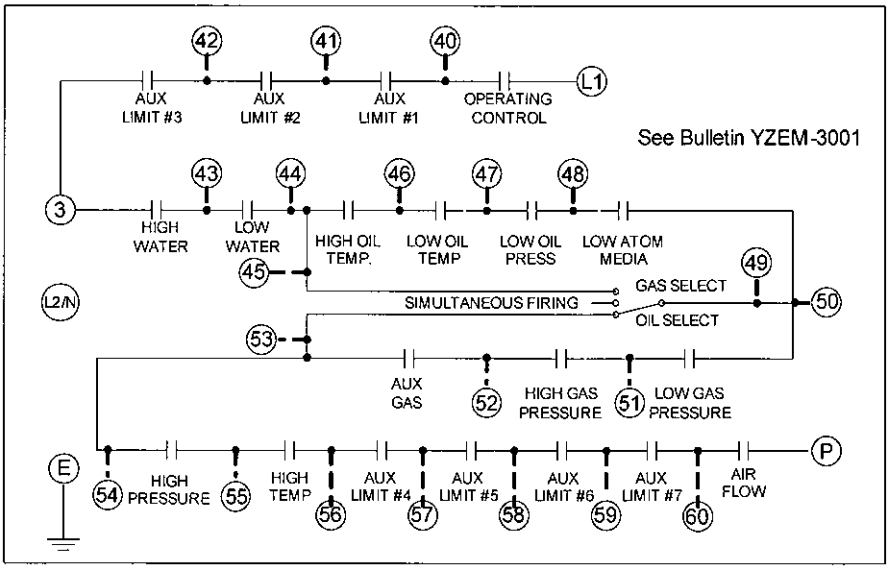
* Terminals 53 and 54 are internally connected

YZ300 UPPER (40903) – REFER TO BULLETIN YZEM-3001

Bit 7							Bit 0
				Term P	Term 60	Term 59	Term 58
Unused	Unused	Unused	Unused	Air Flow	Aux #7	Aux #6	Aux #5

* Unused Bits 4-7 will always return 0

Default wiring for YZ300 Interlock Annunciator



EXPLANATION OF LOGSTAT

LOGSTAT is an indication of what logic module the control is currently operating in during its cycle and is used for diagnostic purposes only. If a lockout occurs the current value of LOGSTAT is stored as part of the lockout information. The message displayed corresponds to the current logic module.

Table 7:

LOGIC DISPATCHER			
VALUE		MODULE	FUNCTION
DEC	HEX		
1	01H	STANDBY	Idle state
2	02H	BLOWER ON	1/2 second period after operating control closes when blower motor is energized
3	03H	PURGE	Open Damper Purge or waiting for air flow and/or high fire switch to close
4	04H	PURGE	Low Fire Purge
5	05H	PTFI	Pilot Trial for Ignition
6	06H	PTFI	Pilot Trial for Ignition for YP3XX programmers
7	07H	PTFI	If PTFI is greater than 5 seconds and early spark termination is not needed
8	08H	PTFI	If PTFI is greater than 5 seconds and early spark termination is needed
9	09H	PILOT	Pilot Hold, YP138 only
10	0AH	MTFI	Main Trial for Ignition
11	0BH	MTFI	Main Trial for Ignition with terminal 5 de-energized
12	0CH	AUTO	Delayed valve on
13	0DH	AUTO	AUTO
14	0EH	AUTO	On YP138 programmer, hold for 20 seconds with terminals 6 and 7 energized
15	0FH	AUTO	On YP138 programmer, when terminal 21 first energized, wait for M-D to close
16	10H	POSTPURGE	Post Purge
17	11H	POSTPURGE	Post Purge period if flame fail lockout
18	12H	POSTPURGE	Idle state if unit is in lockout

Logstat represents the current software module the BurnerLogix is currently executing.

The BurnerLogix outputs the current displayed message as well as the historical lockout messages as numbers. The table below correlates the message number with the actual displayed text message.

Table 8:

DEC	HEX		BURNERLOGIX MESSAGES
1	1	H	T16 M-D LIMIT OPEN - AUTO
2	2	H	HOLD FALSE FLAME- STANDBY
3	3	R	LOW FIRE PURGE
4	4	H	HOLD M-8 LIMIT OPEN- PURGE
5	5	H	See Interlock Annunciation Message Table
6	6	H	T16 M-D LOW LIMIT - AUTO
7	7	L	LOCKOUT FLAME FAIL - PTFI
8	8	H	T16 INPUT
9	9	H	HOLD M-D LIMIT OPEN
10	A	R	IGNITION TIMING - PTFI
11	B	C	CHECK FLAME SIGNAL - MTFI
12	C	R	FLAME SIGNAL - AUTO
13	D	R	CYCLE COMPLETE - POST PURGE
14	E	R	L1-3 OPEN
15	F	H	T21 INPUT
16	10	L	LOCKOUT M-D LIMIT OPEN - PTFI
17	11	L	LOCKOUT M-8 LIMIT OPEN
18	12	L	LOCKOUT M-D LIMIT OPEN
19	13	L	LOCKOUT FLAME FAIL - MTFI
20	14	L	LOCKOUT FALSE FLAME
21	15	L	LOCKOUT 3-P INTLK OPEN (PURGE)
22	16	L	LOCKOUT 3-P INTLK CLOSED
23	17	H	HOLD 3-P INTLK CLOSED - STANDBY
24	18	H	HIGH FIRE PURGE
25	19	L	LOCKOUT M-D LIMIT OPEN - MTFI
26	1A	L	LOCKOUT 3-P INTLK OPEN -AUTO
27	1B	L	LOCKOUT 3-P INTLK OPEN - MTFI
28	1C	L	LOCKOUT 3-P INTLK OPEN - PTFI
29	1D	L	LOCKOUT T13 FVES OPEN
30	1E	L	LOCKOUT 3-P INTLK OPEN - PREPURGE
31	1F	C	CHECK FLAME SIGNAL - PTFI
32	20	C	CHECK M-8 HI LIMIT (HI FIRE PURGE)
33	21	C	CHECK M-D LOW LIMIT (LO FIRE START)
34	22	R	FLAME SIGNAL- PTFI
35	23	C-H	HOLD T21 or CHECK LOW FIRE SIGNAL - AUTO
36	24	R	FLAME SIGNAL - MTFI
37	25	L	LOCKOUT FLAME FAIL (AUTO)
38	26	H	HOLD 3-P INTLK OPEN - PREPURGE
39	27	L	LOCKOUT FUEL VALVE STATE CHANGE
104	68	R	LEARNING FLAME (PTFI and AUTO)
SYSTEM DIAGNOSTIC MESSAGES			
54	36	L	LOCKOUT CHECK CHASSIS
55	37	L	LOCKOUT CHECK PROGRAMMER
56	38	L	See Interlock Annunciation Message Table
57	39	L	LOCKOUT CHECK EXPANSION MODULE
58	3A	L	LOCKOUT CHECK WIRING

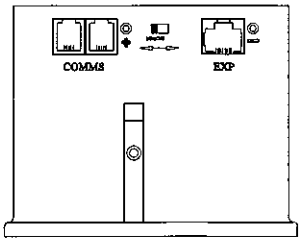
DEC	HEX		BURNERLOGIX MESSAGES
59	3B	L	LOCKOUT CHECK FUSE
76	4C	L	LOCKOUT CHECK SCANNER
PURGE INTERLOCK RELATED MESSAGES			
77	4D	H	HOLD M-8 LIMIT CLOSED
78	4E	L	LOCKOUT M-8 LIMIT CLOSED
79	4F	H	HOLD M-D LIMIT CLOSED
80	50	L	LOCKOUT M-D LIMIT CLOSED
81	51		Reserved for future use
82	52		Reserved for future use
83	53	L	LOCKOUT FLAME FAIL - PILOT
84	54	L	LOCKOUT 3-P INTLK OPEN - PILOT
85	55	L	LOCKOUT M-D LIMIT OPEN - PILOT
86	56	L	LOCKOUT T13 FVES OPEN - PILOT
87	57	L	LOCKOUT T13 FVES OPEN - POST PURGE

INTERLOCK ANNUNCIATOR				
DEC	HEX	STATE	TERMINAL	YZ300 INTERLOCK ANNUNCIATOR LOCKOUT MESSAGES
41	29	L	3-43	HIGH WATER
42	2A	L	43-44	LOW WATER
43	2B	L	51-52	HIGH GAS PRESSURE
44	2C	L	50-51	LOW GAS PRESSURE
92	5C	L	52-54	AUX GAS
45	2D	L	47-48	LOW OIL PRESSURE
56	38	L	44-46	HIGH OIL TEMPERATURE
46	2E	L	46-47	LOW OIL TEMPERATURE
47	2F	L	48-50	LOW ATOMIZING MEDIA
48	30	L	54-55	HIGH PRESSURE
49	31	L	55-56	HIGH TEMPERATURE
50	32	L	56-57	AUX #4 OPEN
51	33	L	57-58	AUX #5 OPEN
52	34	L	58-59	AUX #6 OPEN
53	35	L	59-60	AUX #7 OPEN
40	28	L	60-P	AIR FLOW OPEN
DEC	HEX	STATE	TERMINAL	YZ300 INTERLOCK ANNUNCIATOR HOLD MESSAGES
94	5E	H	L1-40	OP CONTROL OPEN
60	3C	H	40-41	L1-3 AUX #1 OPEN
61	3D	H	41-42	L1-3 AUX #2 OPEN
62	3E	H	42-3	L1-3 AUX #3 OPEN
63	3F	H-C	3-43	HIGH WATER
64	40	H-C	43-44	LOW WATER
65	41	H-C	51-52	HIGH GAS PRESSURE
66	42	H-C	50-51	LOW GAS PRESSURE
95	5F	H-C	52-54	AUX GAS
67	43	H-C	47-48	LOW OIL PRESSURE
96	60	H-C	44-46	HIGH OIL TEMPERATURE
68	44	H-C	46-47	LOW OIL TEMPERATURE
69	45	H-C	48-50	LOW ATOMIZING MEDIA
70	46	H-C	54-55	HIGH PRESSURE
71	47	H-C	55-56	HIGH TEMPERATURE
72	48	H-C	56-57	AUX #4 OPEN
73	49	H-C	57-58	AUX #5 OPEN
74	4A	H-C	58-58	AUX #6 OPEN
75	4B	H-C	59-60	AUX #7 OPEN
5	5	H-C	60-P	AIR FLOW OPEN

R = RUN H = HOLD L = LOCKOUT C = CHECK

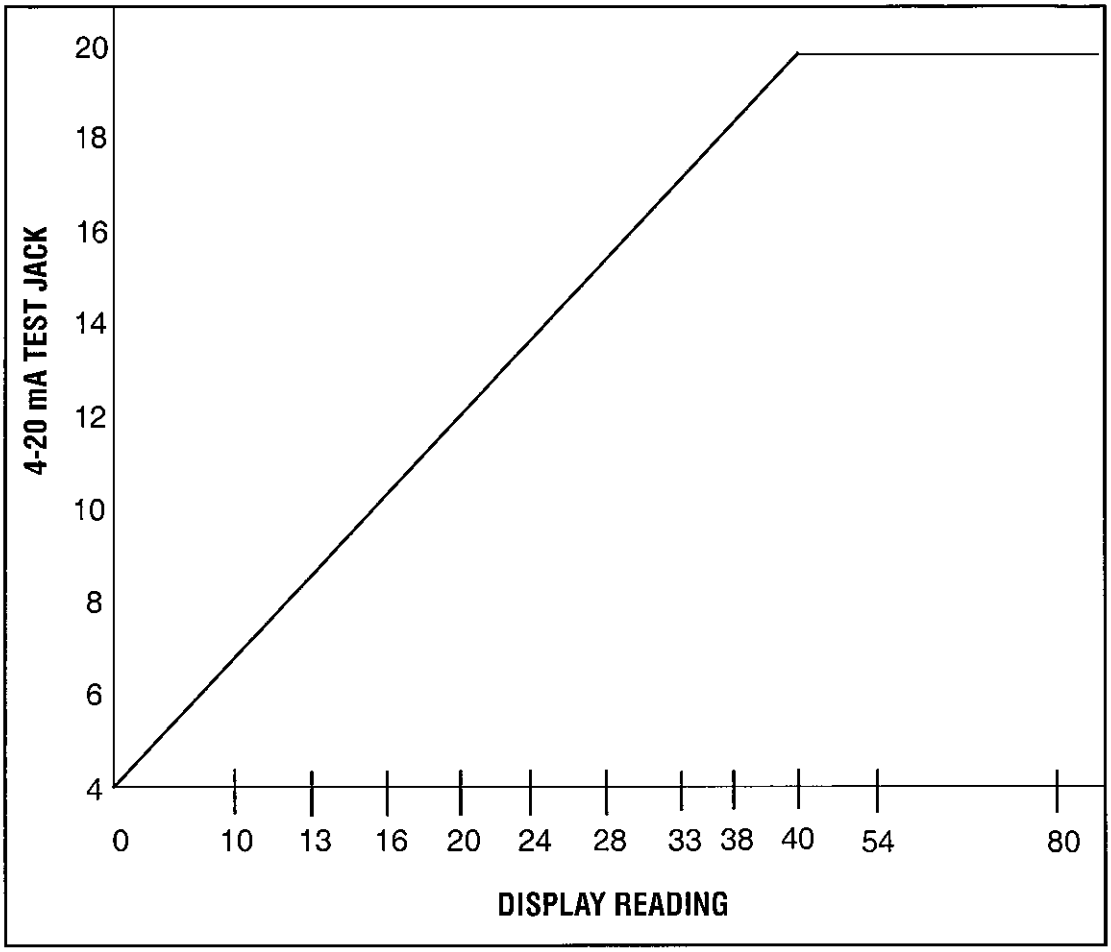
OPERATIONAL FEATURES

4-20 mA TEST JACKS

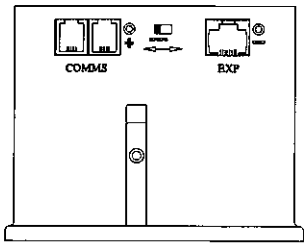


For all amplifier types, the BurnerLogix provides 4-20 mA test jacks to represent the flame signal strength. The test jacks are located on the underside of the YB module (pictured at right). The '+' jack is located next to COMMS port jack and the '–' jack is located next to the EXP port. Use caution so as NOT to plug the '–' jack into the EXP port. The test jacks accept standard plugs having a diameter of 0.078" (2mm). The maximum input impedance allowed is 100 ohms. The chart below correlates the test jack current to the numerical value shown on the display.

FIGURE 3.



CHECK-RUN SWITCH



The Check-Run switch is located on the underside of the YB Chassis Module (note drawing on right) and can be used to stop the control in its firing sequence at any time in the burner sequence. It is designed to aid in set-up, start-up and check-out of the burner and its associated interlocks.

Following are the modes of operation:

1. When power is applied to the control (Ll-L2) and the operating control circuit is closed (L1-3), the purge period begins and the firing rate motor is sent to the Hi Purge position. If the Check-Run Switch is moved to the Check position before the open damper 30 second purge period ends, the control will display:

   CHECK 00:24
   HIGH FIRE PURGE

The control will hold in this position indefinitely to allow the operator to make interlock switch and linkage adjustments. To continue in the cycle, move the Check-Run switch to Run to allow the control to advance.

2. If the Check-Run switch is moved to the Check position after the open damper purge period, but before low fire start period ends, the control will display:

   CHECK 00:24
   LOW FIRE PURGE

The control will hold in this position indefinitely to allow the operator to make interlock switch and linkage adjustments. To continue the cycle, moving the Check-Run Switch to Run will allow the control to advance.

3. During the PTFI period, switching to the Check position will stop the program in the PTFI period, allowing for pilot and/or scanner alignment adjustments to be made. The control will display:

   CHECK 35
   FLAME SIGNAL

It will hold in this position indefinitely as long as the flame signal strength is above the threshold of 10. If it drops below 10 for thirty (30) consecutive seconds, lockout will occur and the message on the display will read Flame Fail PTFI.

4. During the MTFI period, switching to the Check position will stop the program in the MTFI period. At this point it may be useful to inspect the position of the main flame at the burner head. Depending on where the switch is placed in check and depending on the selection of PTFI*MTFI TIMING, terminals 5, 6 and 7 could be energized simultaneously. The control will display:

   CHECK 35
   FLAME SIGNAL

   If the unit is left in Check for longer than 2 minutes, the control will automatically advance to AUTO.

5. Switching from run to check during the burner on period will drive the modulator circuit to low fire (10-12 Closes). This allows for low fire fuel-air adjustments and holding the burner at low fire. Consult your boiler/burner instructions for low fire hold firing recommendations. The control will display:

   CHECK 35
   LOW FIRE SIGNAL

OPERATIONAL TEST

WARNING: Before testing the control operation on the boiler, close the manual main shut-off fuel valve. Failure to do this may cause injury or property damage.

Close the manual main shut-off fuel valve.

1. Recheck all limit circuit wiring for proper operation and correct connection.
2. Confirm that the automatic main fuel valves are wired to terminal "7."
3. Power the control and electronically check the proper sequence of operation according to the Operation section on page 34 of this bulletin.
4. After assuring yourself that all interlocks and valves are properly wired and that the sequence of operation is correct, open the manual main shut-off fuel valve and proceed cautiously through the boiler light off process. Check all safety interlocks for proper shut down of the boiler.

When the installation and all burner adjustments are completed, the entire burner control system should be tested in accordance with the burner manufacturer's instructions. The procedure should verify the correct operation of:

1. Each operating control (temperature, pressure, etc.).
2. Each limit switch (temperature, pressure, low water cutoff, etc.).
3. Each interlock switch (airflow switch, high and low fuel pressure or temperature switches, purge and low fire start switches, fuel valve proof of closure interlock, etc.).
4. Pilot flame failure response and lockout.
5. Main flame failure response and lockout.
6. Tight shut off of all fuel valves.

CAUTION: LIVE VOLTAGE IS NECESSARY TO PERFORM THIS TEST.

Voltage Test

A Voltage Check is necessary to identify a potential problem with the supply to the control. This could be caused by an improperly sized or faulty transformer, faulty load coils or low entry voltage. Follow this procedure:

1. Monitor the L1-L2 supply throughout a complete burner cycle. The acceptable voltage range is 102V-132V. At no time during the cycle should the voltage dip below the minimum level.
2. Check other load terminal (M/L2, 5/L2, 6/L2, 7/L2) for voltage at improper times or improper values.

TEST CHECKOUT PROCEDURES

Normal Pilot Flame Test

CAUTION: Before making a pilot flame test, manually shut off the fuel supply to the main burner.

1. At the start of PTFI, place the RUN/CHK switch in the CHK position.
2. Observe the pilot flame signal on the display. If the average signal is below the minimum of 10, readjust the pilot flame or realign the flame detector.
3. During the pilot flame test, if flame is not detected for a continuous 30 seconds, the control will lockout. To re-establish the pilot flame trial for ignition (PTFI), manual reset of the lockout switch is required, and a complete prepurge accomplished.

4. When UV flame detection is used, a test is required to verify that UV radiation from the ignition spark is not being detected. To accomplish this, manually shut off both pilot and main fuels. Initiate a normal start-up, and when the PTFI display comes on, observe the display which should read no signal more than 4. If more than 4 is observed, realign the UV scanner, and/or shield the spark from the scanner's view.
5. With all methods of flame detection, check pilot flame failure response by manually shutting off the pilot fuel and then initiate a normal start-up. With no pilot flame present, the control will de-energize the pilot assembly at the end of the trial for ignition interval, and the control will lock-out. Also check to verify that the ignition spark does not cause an electrical interference on infrared or flame rod applications.

Main Flame Test

Note: This test requires an interrupted pilot (a pilot that shuts off after main flame has been established).

1. Proceed through a normal startup. After the pilot flame is shut off, observe the reading on the display. If the signal reading is low, readjust main flame or realign detector.
2. Check main flame failure protection by manually shutting off the main fuel supply. Within 4 seconds after main flame goes out, the fuel valve will be de-energized. The alarm circuit will be energized following safety lockout.

Minimum Pilot Test

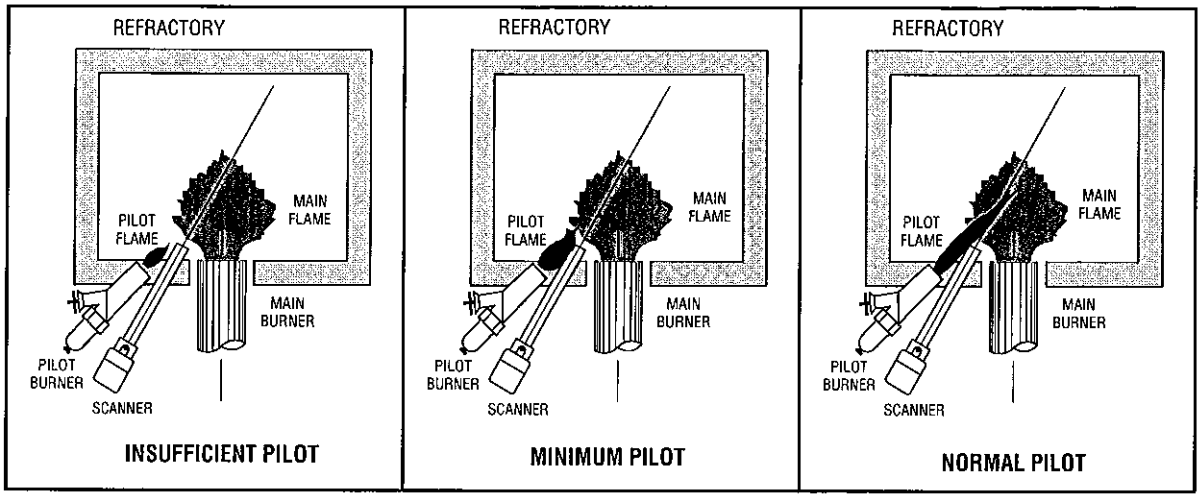
CAUTION: The minimum pilot test must be accomplished by a trained and qualified burner technician

This test assures that the flame detector will not detect a pilot flame too small to reliably light off the main flame. The test should be made on every new installation and following any repositioning or replacement of the flame detector. This procedure should not be used on a direct spark ignited burner.

1. Turn off the main fuel supply manually.
2. At the start of PTFI, place the Check-run switch in the check position.
3. Reduce the fuel supply to the pilot until the display reads below 10.
4. Slowly increase the fuel to the pilot until the display reads 10. This is minimum pilot flame that the flame detector will reliably detect.
5. Place the Check-run switch in the Run position. When the main fuel safety shut-off valve is energized, slowly open the manual main fuel valve.
6. Observe the light-off of the main flame. It must be smooth and normal.

CAUTION: If the main flame does not ignite immediately, shut off the main fuel. Realign the detector to require larger minimum pilot flame

7. Repeat the test until a reliable and smooth light-off occurs with the minimum pilot.
8. After this test is completed, increase the fuel to the pilot to its normal setting.



Scanner Wiring

Care should be taken to see that ignitor cables and scanner cables are routed away from one another on all installations. These cables, when crossed or run together, may interfere with the proper operation of the flame safeguard control.

If you are experiencing erratic operation or inappropriate characters on the display during the trial for ignition period, the cause is likely to be ignitor noise. Check for worn ignitor cable insulation, broken or cut insulation or loose connectors at the electrode and transformers

SUGGESTED GROUNDING RULES

The BurnerLogix system, being microprocessor based, requires a ground system that provides a zero-voltage reference. The voltage measured from L2 to all other terminals except L1 should be 0 volts.

1. The most effective ground is to run the ground wire in the same raceway as the hot and neutral from the main distribution service panel (not intermediate sub-panels) to the burner control panel and insure that this ground wire is well bonded to the control panel.
2. The wiring base of the BurnerLogix must have earth ground providing a connection between the sub-base and the control panel or the burner.
3. The earth ground wire must be capable of conducting the current to blow the 20A fuse in event of an internal short circuit. A number 14 AWG copper conductor is adequate, wide straps or brackets are preferred rather than lead wires.
4. The ground path needs to be low impedance (less than 1 ohm) to the equipment frame which in turn needs a low impedance to earth ground. For a ground path to be low impedance at RF frequencies, the connection must be made with minimum length conductors having maximum surface areas.
5. All connections should be free of nonconductive coatings and protected against rust.
6. Utilizing conduit as a means of providing a ground must be avoided.
7. Installing ground rods at the burner control panel defeats the purpose of a single point ground as described above and could also present a safety hazard.

INSTALLATION

Do not run high voltage ignition transformer wires in the same conduit with flame detection wiring. Do not run scanner wires in a conduit with line voltage circuits. Ensure the frame of the ignition transformer is securely connected to control panel frame or preferably the burner frame.

The BurnerLogix chassis (YB110/YB230) contains a transient suppressing device connected internally across hot and neutral and to earth ground, terminal E. For this to be effective terminal E or the green wire in the pig-tail wiring base must be grounded well.

REMOTE DISPLAY

To locate the display remotely from the BurnerLogix control, mounting kits are available. These are Fireye part numbers 129-178-4 or 129-178-8. Each kit contains a gasket, hardware to mount the display and a 4 or 8 foot cable.

Care must be taken not to route the ED580 cable in close proximity to any starter motor contactors located in the control panel or across any high voltage ignition wires. Refer to Fireye bulletin E-8002 for proper installation.

COMMUNICATIONS

When interfacing Fireye controls to a communication system, be it a PLC or other microprocessor based device, ferrite cores should also be utilized. Proper twisted shielded pair cable must be utilized. In a multi-drop system, the shields should be tied together within a cabinet and not to any ground point. The shield at the source end of the cable of the multi-drop connection can then be terminated to ground. Source end is defined as the originating end of the communication system

Care must be taken not to route communication cables in close proximity to any starter motor contactors located in the control panel or across any high voltage ignition wires. Refer to Fireye bulletin E-8002 for proper installation.

SCANNERS

The armored cable supplied with the Ultra-Violet and Infrared scanners should be connected to equipment by means of a good mechanical connection such as a conduit fitting. It may be necessary to utilize heat insulator (P/N 35-69) to isolate the sensing end of the scanner from boiler ground. Care must be taken not to route the scanner cable across the high voltage ignition cable. The high energy ignition cable should be checked periodically for cracking, connections and aging.

In applications using flame rod units, it may be beneficial to route a separate return wire from the S2 terminal to the flame rod assembly. This will minimize the effects of transient currents flowing into the BurnerLogix.

In all cases, scanner wires should be routed in separate conduit and not joined with any high voltage AC or ignition cables.

MAINTENANCE

Periodically, the spark electrode should be inspected for proper gapping and cracked ceramics. At ignition time, the high energy from the ignition transformer will attempt to conduct to the point of least resistance and with an improper spark gap, where the conduction takes place will no longer be controlled.

The VA rating of the control transformer must be sized to handle the inrush currents of the pilot solenoid and ignition transformer at PTFI and then the inrush currents of the main fuel valve assembly at MTFI time.

Inspect neatness of wiring in junction boxes and cabinets. It is best to have connections short and direct and also not having wires bunched up and tied off. Also, connections should be periodically inspected for tightness and corrosion

Type 48PT2 Infrared and Type UV1A, UV2, 45UV5 Ultra-violet Scanners

The viewing area of the scanner must be kept clean. Even a small amount of contamination will reduce the flame signal reaching the detector by a measurable amount. Wipe the viewing area routinely using a soft cloth dampened with concentrated detergent.

— Type 48PT2 Scanners include a replaceable #4-263-1 Firetron cell.

— Type 45UV5 Scanners include a replaceable #4-314-1 UV tube.

Type 69ND1 Flame Rod

The flame rod and its insulator should be kept clean by washing routinely with soap and water. Rods should be routinely replaced as they oxidize.

Flame Signal Strength

Routine observation of the flame signal strength will forewarn any deterioration in the capability of the flame detector or its application.

Contacts

There are no accessible contacts in the BurnerLogix. Where contacts are used, their design assures long trouble-free life when the load circuits are maintained within the published load ratings.

Humidity

In areas of high humidity, the control chassis should be removed and placed in a dry atmosphere when the system is expected to be out of service for an extended period.

Periodic Safety Check

It is recommended that a procedure be established to test the complete flame safeguard system at least once a month,. This test should verify the proper operation of all limit switches and safety interlocks as well as flame failure protection and fuel safety shutoff valve tightness.

Rotation

It is recommended that control and scanner units purchased as spares be installed periodically to ensure proper operation.

NOTICE

When Fireye products are combined with equipment manufactured by others and/or integrated into systems designed or manufactured by others, the Fireye warranty, as stated in its General Terms and Conditions of Sale, pertains only to the Fireye products and not to any other equipment or to the combined system or its overall performance.

WARRANTIES

FIREYE guarantees for *one year from the date of installation or 18 months from date of manufacture* of its products to replace, or, at its option, to repair any product or part thereof (except lamps and photocells) which is found defective in material or workmanship or which otherwise fails to conform to the description of the product on the face of its sales order. **THE FOREGOING IS IN LIEU OF ALL OTHER WARRANTIES AND FIREYE MAKES NO WARRANTY OF MERCHANTABILITY OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED.** Except as specifically stated in these general terms and conditions of sale, remedies with respect to any product or part number manufactured or sold by Fireye shall be limited exclusively to the right to replacement or repair as above provided. In no event shall Fireye be liable for consequential or special damages of any nature that may arise in connection with such product or part.

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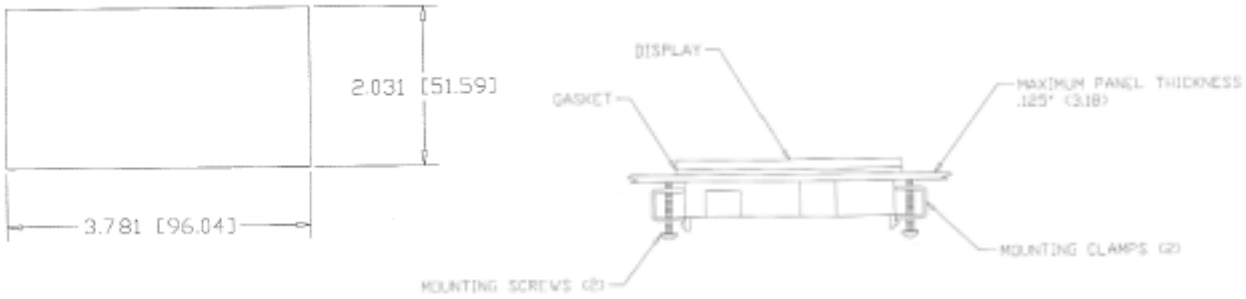
INSTALLATION SHEET 133-675

REMOTE MOUNT THE BURNERLOGIX TYPE BLL510 & BLV512 DISPLAYS USING

129-178 MOUNTING KIT FOR NEMA 4 COMPLIANCE

Properly installed, the BLL510 and BLV512 displays can be remote mounted onto a cabinet or other appropriate enclosure to be in accordance with NEMA 4 requirements.

Refer to Figure 1 below to facilitate mounting.

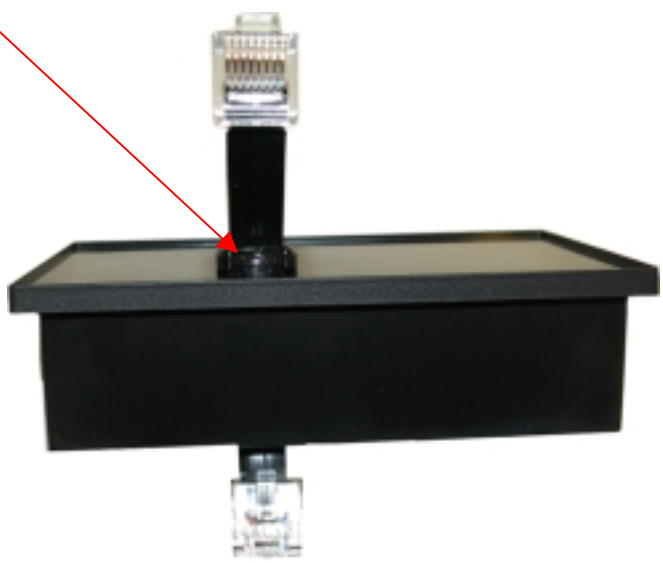


To install the BLL510 or BLV512 display module using the remote mounting kit (129-178-4 and -8):

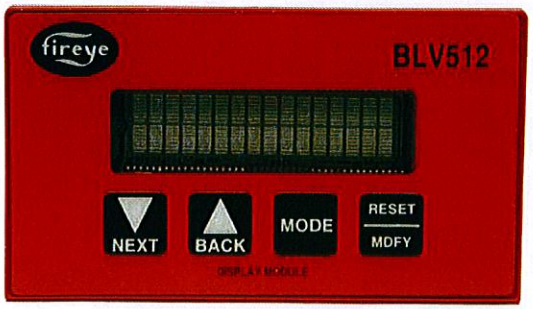
1. Cut an opening in the front panel face per the dimensions shown in the figure.
2. Slide the gasket over the rear side of the display (BLL510 or BLV512).
3. Insert the display and gasket through the panel opening.
4. Insert a screw into each of the mounting clamps and tighten a few threads to hold the screw in place.
5. Attach the mounting clamps into the openings located on the sides of the display housing.
6. **Tighten screws against rear of panel to a torque of 2-4 in/lbs.**

(see next page)

7. Insert the 4 foot cable (129-178-4) or 8 foot cable (129-178-8) into the RJ45 style connectors on both the BLL510/BLV512 display and the BurnerLogiX YB control chassis.
8. Remove the blank display housing from the YB control chassis.
9. Remove the hole plug from the blank display housing.
10. Feed one end of the supplied cable through the hole in the blank display housing. A length of 2" to 2 ½" of cable, measured from the inside wall of the blank cover, is required. Use the supplied strain relief bushing to secure the cable to the blank display housing on the control chassis. The bushing can be installed by squeezing the clamp over the cable with a pair of pliers and inserting it into the hole through the front.



11. Insert the RJ45 plug into the RJ45 connector located on the YB control chassis and then follow through in an upward angular motion with the blank display housing until it clicks into the YB control chassis.
12. Plug the other end of the cable into the RJ45 style connector located on the BLL510/BLV512 display module.



BLV512
BLL510
DISPLAY MODULES FOR USE WITH THE FIREYE® BurnerLogiX™ CONTROL SYSTEM

c UL US LISTED FM APPROVED

DESCRIPTION

The BurnerLogix system offers optional vacuum fluorescent (VFD) and liquid crystal (LCD) displays that may be either plugged in or mounted remotely to give full language descriptors of current status and diagnostic lockout information.

In order to change the factory default parameters stored in the programmer module an optional keypad/display (BLV512 or BLL510) is required. All configurable parameters are stored within the PROGRAM SETUP sub-menu. The keypad/display module provides tactile feedback keys that are used to access the sub-menus inherent in the BurnerLogix system.

The optional alpha-numeric display is made up of 2 lines by 16 characters per line and is available in either vacuum fluorescent or liquid crystal formats. The advantage of VFD is high brightness and extended temperature range to -40°F. Both displays contain a fully functional keypad allowing the user to easily scroll through the various menus to view the current operating status, review programmer configuration, and lockout history.

When mounted remotely using kits 129-178-4 or 129-178-8, each display meets NEMA 4X requirements. Refer to instruction sheet 133-675 for details.

INSTALLATION PROCEDURE

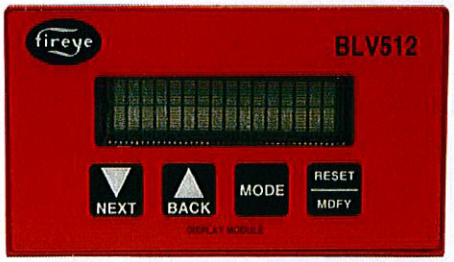
The display module is held into the BurnerLogix chassis/amplifier by mounting tabs designed into the display housing.

Using the thumb and index finger, grasp the left and right edges of the blank display module and pull forward until removed. Insert one end of the supplied 4 inch display cable into the jack located in the back of the display module. Plug the other end of the cable into the jack located inside the chassis/amplifier module.

Using the thumb and index finger, grasp the left and right edges of the blank display module and insert it into the compartment of the chassis/amplifier module. Push the unit into the unit until a positive click is realized.

Refer to bulletin BL-1001 for complete information

Keypad Description



The NEXT key is used to scroll down through the various menus and is also used to increment the value when in the modify mode. The BACK key is used to scroll up through the menus and is also used to decrement the value when in the modify mode. The MODE key is used to enter a sub-menu when the displayed item indicates a sub-menu with a right facing arrow and also to exit the sub-menu and move on to the next main menu item. The RESET/MDFY key is used to reset the BurnerLogiX from a lockout condition, force a recycle of the programmer, indicate to the system the value displayed is to be modified or when done with the modification.

List of display of main menu items in BurnerLogiX:

L1-3 OPEN	current operating status
BNR HOURS	total hours terminal 7 (main fuel) is energized
BNR CYCLES	total burner cycles
BNR LOCKOUTS	total system lockouts
SYS HOURS	total hours installed
PROGRAM SETUP >	review and set program parameters
LOCKOUT HISTORY >	last 10 lockouts with burner hour and cycle time stamp.
SYSTEM INFO >	view flame signal averages, M-D and M-8 status, select language, clear history feature.

TO VIEW AND MODIFY A PROGRAMMABLE PARAMETER:

On display module BLV512 or BLL510, use the NEXT or BACK key to scroll to PROGRAM SETUP. Press the MODE key to enter the submenu showing all program setup parameters. Pressing the MODE key while in the sub-menu will exit the sub-menu, and the next main menu item will be displayed. While in the sub-menu, pressing the NEXT key will scroll forward through the sub-menu. Pressing the BACK key will scroll backward through the sub-menu. When a modifiable parameter is displayed, pressing the RESET/MDFY key will allow the displayed parameter to be modified. Use the NEXT or BACK keys to select the value to suit the application and when done, press the RESET/MDFY to save the value to memory.

NOTICE

When Fireye products are combined with equipment manufactured by others and/or integrated into systems designed or manufactured by others, the Fireye warranty, as stated in its General Terms and Conditions of Sale, pertains only to the Fireye products and not to any other equipment or to the combined system or its overall performance.

WARRANTIES

FIREYE guarantees for *one year from the date of installation or 18 months from date of manufacture* of its products to replace, or, at its option, to repair any product or part thereof (except lamps, electronic tubes and photocells) which is found defective in material or workmanship or which otherwise fails to conform to the description of the product on the face of its sales order. **THE FOREGOING IS IN LIEU OF ALL OTHER WARRANTIES AND FIREYE MAKES NO WARRANTY OF MERCHANTABILITY OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED.** Except as specifically stated in these general terms and conditions of sale, remedies with respect to any product or part number manufactured or sold by Fireye shall be limited exclusively to the right to replacement or repair as above provided. In no event shall Fireye be liable for consequential or special damages of any nature that may arise in connection with such product or part.

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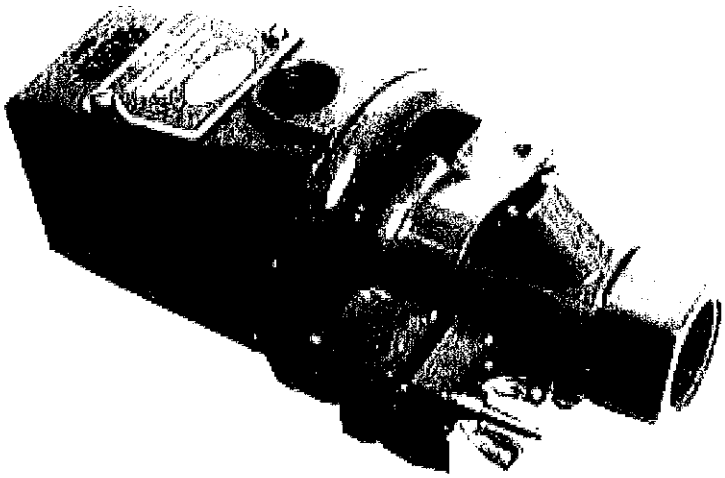


45UV5 SCANNER MODELS: 1000, 1010, 1101, 1103

(including EX and CEX Models)

FM APPROVED

This bulletin is directed to the licensed boiler service technicians and professional combustion engineers who are experienced in the installation and operation of Fireye flame safeguard controls. Persons not experienced with Fireye flame safety products should contact the nearest Fireye representative, or a qualified service group for assistance. IMPROPER INSTALLATION OF THESE PRODUCTS MAY BE HAZARDOUS TO LIFE AND PROPERTY.

DESCRIPTION

Fireye Type 45UV5 scanners are self-checking, flame sensing devices. When powered by a compatible, self-checking Fireye control, the scanners detect the presence or absence of flames which emit ultraviolet radiation (UV). Typical fossil fuels which emit UV include natural gas, propane, methane, butane, kerosene, light petroleum distillates and diesel fuels. For burners firing steam-atomized oil or pulverized coal, Fireye recommends the use of infrared (IR) scanners. Fireye offers a complete line of infrared scanners best suited for these applications.

APPLICATION

When used with a Fireye amplifier, the 45UV5 scanner provides flame failure protection on single and multi-burner industrial applications such as electric utility boilers, power boilers and large furnaces or incinerators. The 45UV5 scanner monitors the flame(s) of only one burner. The pilot and main flames may be monitored individually (2 scanners) or in combination (1 scanner). When properly sighted, the scanner should discriminate between the burner being monitored and all other burners and any background flames.

Note: Scanner response is dependent on burner configuration as well as the turbulence and spectral characteristics of the flames. Application assistance is available on request.

PRINCIPLES OF OPERATION

The 45UV5 scanner employs a detector which is a sealed, gas filled, ultraviolet-transmitting special glass envelope containing two electrodes connected to an AC voltage source. The detector responds only to a portion of the ultraviolet spectrum from common flames.

When ultraviolet radiation of sufficient energy (at wavelengths shorter than those in sunlight at the earth's surface) falls upon the electrodes, electrons are released and the inter-electrode gas becomes conductive. This results in an electric current flow from one electrode to the other.

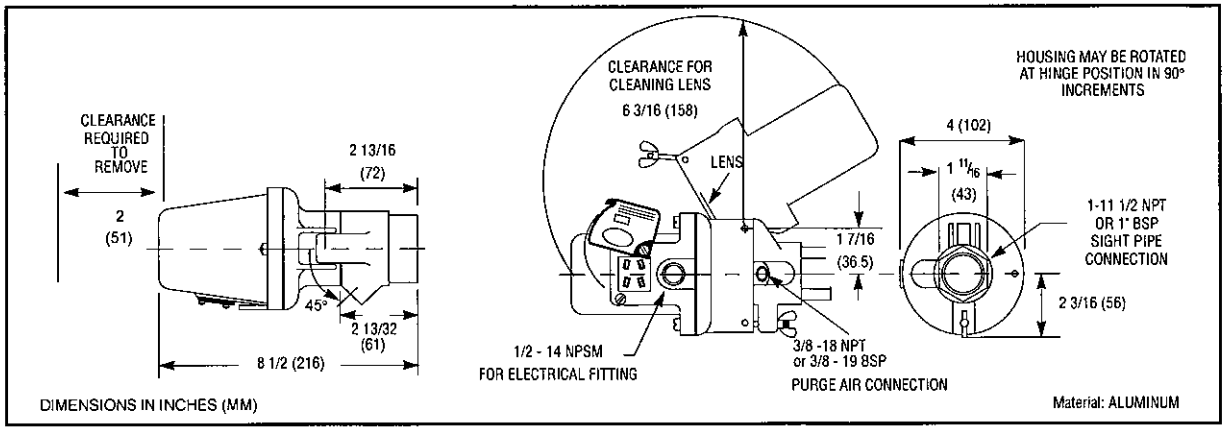
The current flow in the detector starts and ends abruptly and is known as an "avalanche." A very intense source of UV radiation will produce several thousand avalanches or pulses per second. Less radiation will produce fewer pulses per second. Upon total loss of flame, the detector output ceases except for very infrequent single pulses caused by cosmic rays. The circuitry does not respond to these infrequent pulses. Thus, the presence or absence of pulses is an indication of the presence or absence of flame; the frequency of the pulses is a measure of flame intensity. Pulses generated by the scanner are transmitted to a compatible Fireye control via scanner wiring.

FEATURES

The UV tube, quartz lens, power transformer and related electronic components are contained in an aluminum enclosure which is sealed with high temperature oil-resistant gaskets. The quartz lens is a planoconvex type which increases the scanner's sensitivity up to 400 percent. A hinged mount is provided to permit easy access for cleaning the lens. A double screw-and-keyhole slot arrangement permits quick removal of the housing from its mount. The scanner has a 1" fitting for mounting to a threaded sight pipe and a 3/8" threaded connection for purge air.

Also included in the Type 45UV5 scanner is an electromagnetic shutter that permits a self-checking circuit within an associated Fireye control to verify that the scanner and signal circuits are producing valid flame presence or absence information. During the shutter closed period the detector's optical path is blocked from flame radiation. While the shutter is open, flame presence or absence is detected. The resultant scanner output, while flame is detected, is a continuous, periodically interrupted pulsed flame signal. This is a prerequisite for energizing the associated Fireye control's flame relay.

FIGURE 1. 45UV5 SCANNER DIMENSIONS



SPECIFICATIONS

Mounting

Models are provided with 1" female thread mounting, either US NPT or British Whitworth according to model (see table below).

Housing, Including Mounting Flange

Material: Die Cast Aluminum

Design: Hinged Mounting Flange, with air fitting to be permanently installed, carries two 1/4 - 20 screws which may be loosened for quick removal of the scanner housing, such as for lens cleaning.

Weight: 3.75 lbs. (1.7kg)

Electrical

Power Requirement: 4 VA AC from associated Fireye control (see note below).

Frequency: Frequency of scanner must match frequency of Fireye control and power line supply (See Table 1).

Connection: 1/2 inch 14 NPSM tapping.

Temperature Range: Maximum operating: 200° F (93° C)
Minimum operating: -40° F (-40° C)

Optical Range: 190 to 250 nanometers. No response to infrared radiation or visible light.

Purge Air

Source: Clean ambient

Volume Required: 4 SCFM (113 L/min. @ 4" water column above furnace pressure minimum) at 3/8 inch threaded housing inlet or 4 SCFM at 1 inch wye fitting in scanner sight pipe. Temperatures near the upper limit of the scanner operating range and/or use with dirty fuels may require up to 15 SCFM (425 L/min.).

Table 1:

MODEL 45UV5	FREQUENCY HZ	MOUNTING THREADS	FM	CSA	DIN	APAVE
1000	60	NPT	✓	✓		✓
1010	60	BSP	✓			
1101	50	BSP	✓		✓	
1103	50	NPT				

Specifications subject to change without notice.

IMPORTANT NOTE: The AC power source must be sinusoidal for proper scanner operation. The application of any waveform other than a sine wave (e.g. square wave) will damage the 45UV5 scanner.

Optional Mounting Configurations for Hazardous Areas

FIGURE 2. 45UV5 SCANNER IN NEC/NEMA HAZARDOUS AREA HOUSING

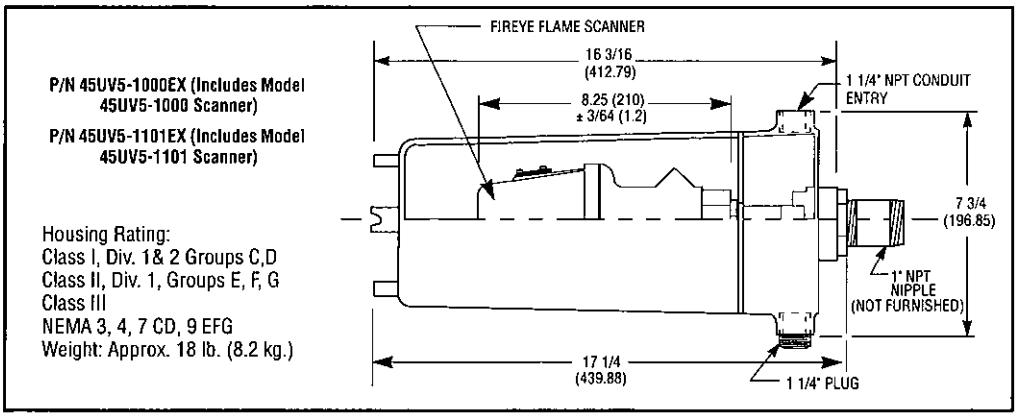
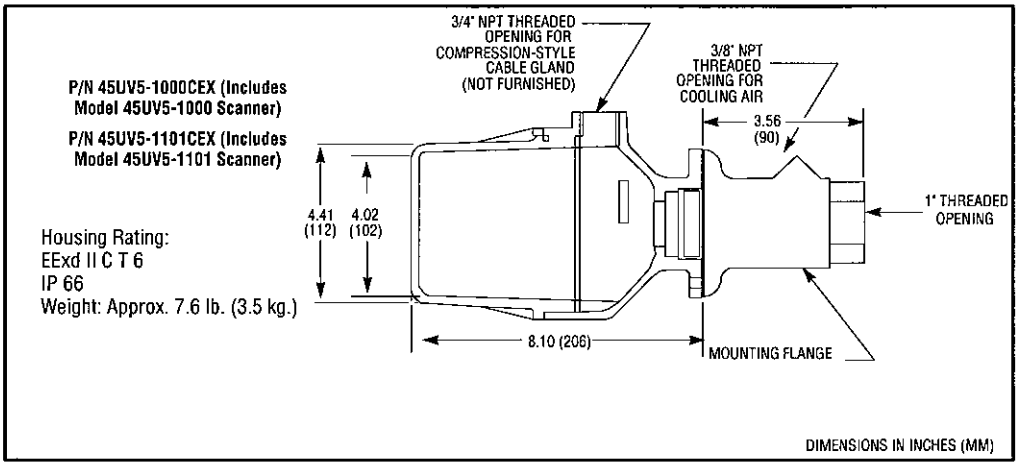


FIGURE 3. 45UV5 SCANNER IN CENELEC HAZARDOUS AREA HOUSING



INSTALLATION

1. The best scanner sighting results are obtained when the scanner is aimed so that the scanner (viewing) center line intersects the burner center line at a slight angle, as shown in Figure 4. The area of maximum ultraviolet radiation is near the base of the flame envelope. If only one scanner is used per burner, the intersection should be made so the line of sight or viewing angle can also see the igniter flame. Consideration must be given to burner air rotation (burners have clockwise or counterclockwise air rotation). Figure 5 illustrates how scanner location is influenced by the igniter position and air circulation. Physical obstructions such as air register blades should not fall within the scanner's line of sight.

FIGURE 4. SINGLE BURNER SCANNER SIGHTING

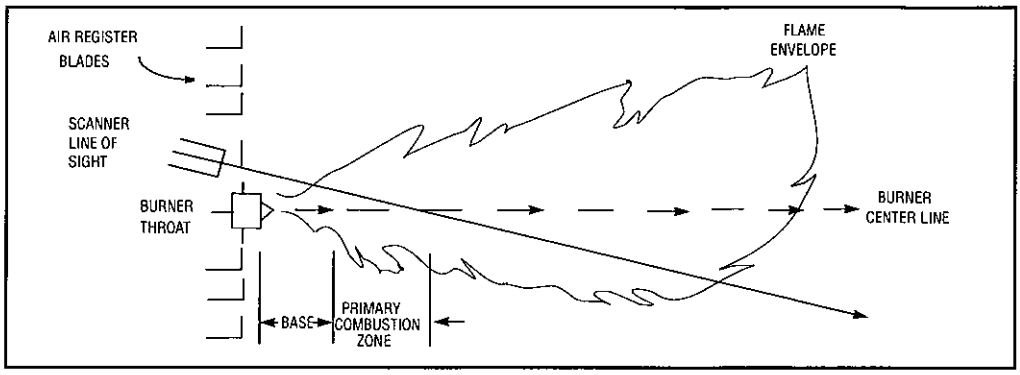
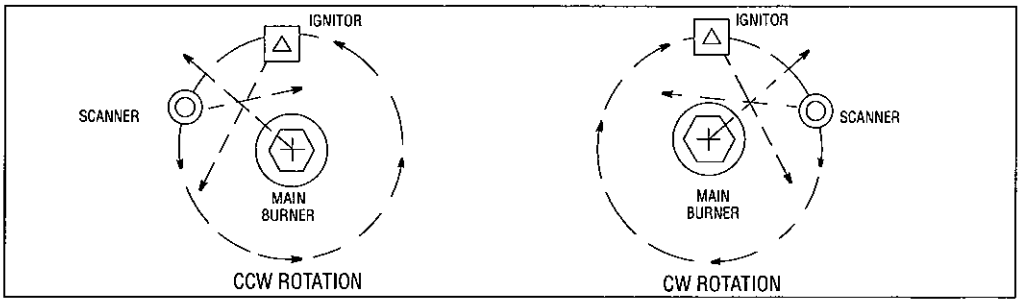


FIGURE 5. SCANNER LOCATION VS. SECONDARY AIR ROTATION



2. An acceptable scanner location must ensure the following:
   - — Reliable igniter flame detection.
   - — Reliable main flame detection.
   - — Rejection of igniter flame too short or in the wrong position to ignite the main flame reliably.

Note: Reliable signals must be obtained at all air flows, furnace loads (ranges of fuel firing) and desirable fuel air ratios.

3. If combustion air enters the furnace with a rotational movement of sufficient velocity to deflect igniter flame in the direction of rotation, position the scanner 0 to 30 degrees downstream of the igniter and near the periphery of the throat where the ultraviolet radiation is at a maximum. (see figures 4 and 5).
4. Having determined an approximate location for the sight tube, cut a clearance hole for a 2 inch pipe through the burner plate. If register vanes interfere with the desired line-of-sight, the interfering vane(s) should be trimmed to assure an unobstructed viewing path at all firing levels.
5. Mount scanner sight pipe by either:
   - — Centering a swivel mount, P/N 60-1664-3 (NPT) or 60-1664-4 (BSP) over the hole and installing the sight pipe on the swivel mount, or
   - — Inserting the end of the sight pipe into the hole, aligning the pipe to the desired viewing angle and tack welding. Welding must be adequate to temporarily support the weight of the installed scanner. The sight pipe should be arranged to slant downward so that dirt and dust will not collect in it.
6. When a satisfactory sighting position has been confirmed by an operating test, (see section on alignment), the sight pipe should either be firmly welded in place or, if the swivel mount is used, the ball position should be secured by tightening the three hex head cap screws located on the swivel mount ring. In certain older style swivel mounts, tack welding may be required.

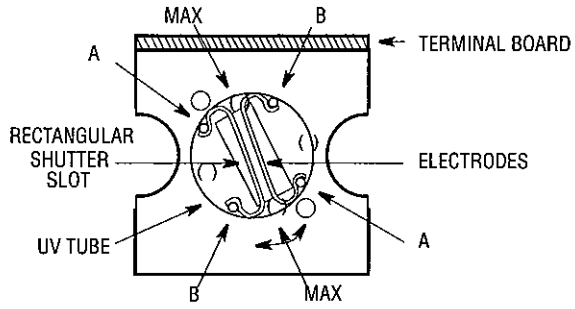
FIGURE 6. **FLAME MUST COMPLETELY COVER SIGHT OPENING**

7. The scanner viewing window must be kept free of contaminants (oil, ash, soot, dirt) and the scanner temperature must not exceed the maximum rating. Both requirements will be satisfied by continuous injection of air at either the 3/8" housing inlet or at a 1" wye ahead of the swivel mount, as shown in Figures 8, 9, and 10.

   Purge air may be supplied through the 3/8" or 1" wye connection. Normally only one of the two connections is provided with purge air and the other connection is plugged. When a Fireye sealing union is used as shown in Figure 8, the 1" wye connection is used for the purge air (plug 3/8" opening).

   Under normal conditions, with clean burning fuels and moderate ambient temperature conditions, purge air flow of approximately 4 SCFM (113 L/min.) @ 4" water column above furnace pressure is generally adequate. Up to 15 SCFM (425 L/min.) may be required for fuels that may produce high levels of flash or soot or for hot environments to maintain scanner internal temperature within specification.

FIGURE 7. **UV TUBE POSITION**



Note: To change UV Tube position, pull tube out and rotate to desired position. Then insert.

8. Excessive flame signal can affect flame discrimination and prevent the control connected to the scanner from performing properly. Weak signals may cause unnecessary burner shutdown or alarms. To change the signal level of the tube, remove the UV tube, rotate it, and replace it in the eight pin (octal) socket.

   The tube has four different significant positions as shown in Figure 7. When the electrodes are almost perpendicular to the Terminal Board and approximately parallel to the shutter slot, the detector tube will generate maximum signal. This is the "Maximum Position" shown in Figure 7. When the electrodes are 90° from the maximum position, minimum signal will be generated. The intermediate positions, "A and B" (as indicated in Figure 7) will yield intermediate signals. Position "A" will yield a slightly higher signal than the intermediate position "B" since more electrode will be exposed to the radiation entering the shutter slot. To adjust the signal intensity further, use the appropriate sensitivity adjustment in the control unit selected for use with this scanner. Refer to the appropriate control bulletin for further information. **The detector is positioned in the maximum signal orientation at the factory.**

If the tube position is changed in the field, and the scanner is later replaced, verify that the signal strength is not excessive.

9. The scanner sight pipe should be as large as is practical. Ideally, the sight pipe should increase one inch in diameter (ID) for every foot in length. Under most circumstances, a sight pipe diameter increase of one inch should be adequate for an increase in length of three feet (1m). When applying the scanner to long sight tubes (more than three feet), minimize the use of one inch pipe. Avoid using pipe less than one inch (ID), and avoid using stainless steel sight pipes.

10. Temperature in the scanner housing should not exceed 200°F.

11. Where separate scanners are used to monitor main and igniter flames, the main flame scanner should be sighted to not detect the igniter flame. If it *does* detect the igniter flame, re-aim the main flame scanner.

PIPING ARRANGEMENTS

FIGURE 8.

	PART NUMBER	
A. SWIVEL MOUNT	60-1664-3 60-1664-4	(NPT) (BSP)
B. 1" WYE	35-200 35-239	(NPT) (BSP)
C. HEAT INSULATING NIPPLE	36-127-1 35-127-3	(NPT) (BSP)
D. 3/8" PLUG	35-202	

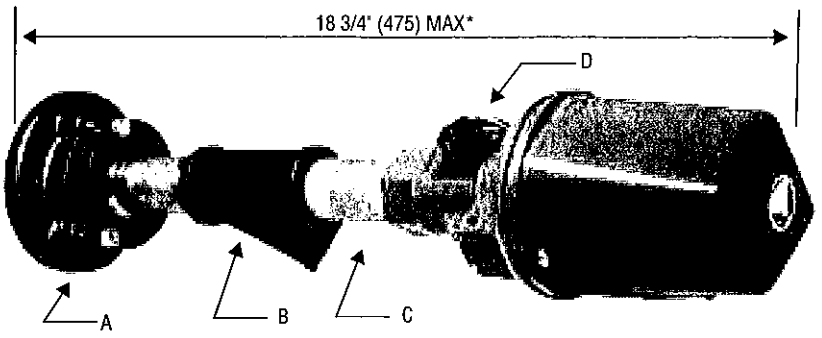
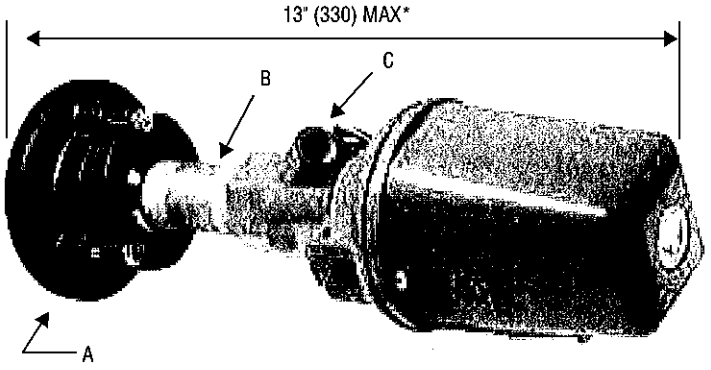


FIGURE 9.

	PART NUMBER	
A. SWIVEL MOUNT	60-1664-3 60-1664-4	(NPT) (BSP)
B. HEAT INSULATING NIPPLE	35-127-1 35-127-3	(NPT) (BSP)
C. 3/8" THREADED OPENING		



ALIGNMENT AND ADJUSTMENTS

Before installing or adjusting scanners, thoroughly plan the scanning objectives in reference to the boiler/furnace mode of operation.

The following procedures are recommended to ensure optimum flame detection and discrimination. Flame discrimination is the ability to see the flame of only one burner or one igniter with other burners or igniters operating nearby.

These procedures should be used whenever parts are replaced, when the scanner has been moved, when the flame shape is altered (additional fuels, new burners, burner/register modifications) as well as on all new installations. Signal readings referred to in this procedure are as displayed on a 0-3 VDC Fireye flame signal meter. (P/N 38-54, 38-55, 38-56, 38-62). [1, 2]

[1] If using analog bargraph meter (P/N 38-88), the flame will be properly sighted when there are 5-8 LEDs illuminated.

[2] When used with the 25SU3-2000 series amplifiers and appropriate power supply, the required flame signal strength (in terms of "pulses-per-second," will be determined by the "Flame-On" and "Flame-Off" thresholds programmed into the amplifier. Refer to bulletin CU-34 for additional information.

Igniter Flame Scanner

1. Apply power to scanner and associated control.
2. Start Igniter.
3. Adjust scanner sighting to detect igniter flame in the manner shown in Figure 4.
4. When flame is properly sighted and the control sensitivity properly adjusted (see Caution below) the signal meter should register between 4 and 16. If readings fluctuate widely, readjust scanner sighting until highest steadiest reading is obtained.
5. When the proper signal reading has been obtained, make sure that the scanner and the associated control do not respond to the ignition spark. This is accomplished by cutting off the fuel to the igniter and attempting to start the igniter using the spark igniter. If the system responds to the spark, the sighting should be realigned.

CAUTION: Do not increase sensitivity any more than necessary to provide proper detection of the minimum igniter flame. Minimum igniter flame is the minimum flame required to ignite the main burner reliably. Be sure to test for reliable signals under maximum air flow conditions when the igniter flame may be deflected outside the line of sight. If this occurs, resighting is required.

Main Flame Scanner

1. Apply power to scanner and control.
2. Start igniter.
3. Adjust scanner sighting so that ignition spark and igniter flame are not detected. Test should be conducted with **maximum** igniter flame and with both minimum and maximum air flow.

Note: This step may not be practical with Class 1 igniters, but may be desirable with Class 3.

4. Start main burner.
5. Adjust scanner sighting to detect main burner flame. When sighting is correct (see Figure 6), the signal should read between 4 and 32 on a Flame Signal Meter, Fireye P/N 38-54 or 38-55, without extreme fluctuations in the signal reading.
6. When proper signal is established, manually close off the main burner fuel supply. When burner flame becomes unstable or is extinguished, the associated Fireye control should register a "No Flame" condition.
7. Start an adjacent burner and vary its firing rate under normal air flow conditions. Make certain that the main flame scanner on the burner *not in service* does not respond to the adjacent burner.

FIGURE 10.

SCANNER WITH COVER REMOVED TO REPLACE TUBE OR CHANGE SLOT POSITION OF 4-320-1 TUBE

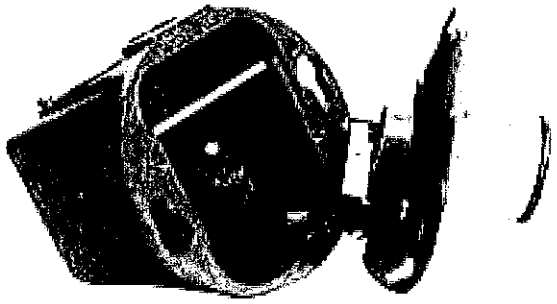


FIGURE 11.

A. Tube 4-320-1
B. Shutter 61-2914
C. Shutter and lens61-2913
D. Gasket 29-248
E. Lens Holder 82-95
F. Lens Retainer 16-103
G. Lens Assembly 61-2275-2

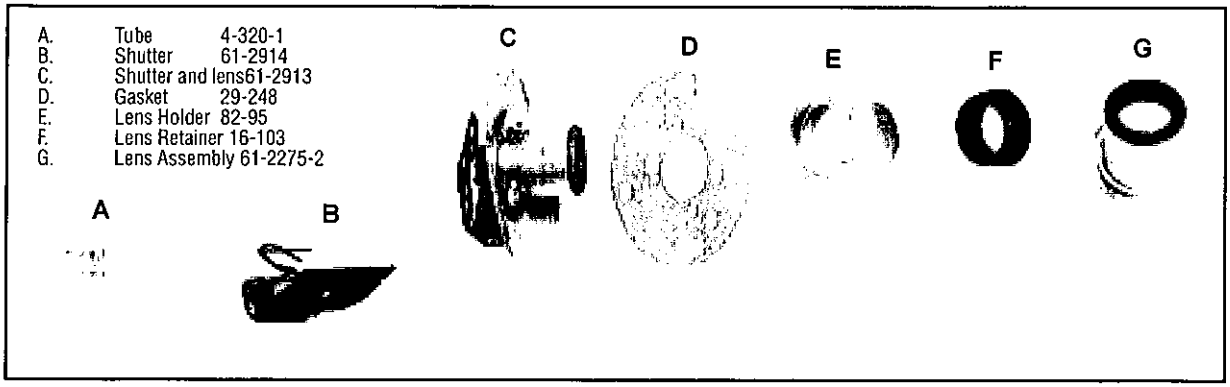


FIGURE 12.

A-I. Orifices: 0.062" - 0.5" DIA
J. Orifice Retainer 34-181
K. Heat Insulating Nipple 35-127-1 (NPT)
Heat Insulating Nipple 35-127-3 (BSP)
L. Quartz Scanner Lens 46-38
M. Sealing Quartz Window 92-48
N. Diode 101-78

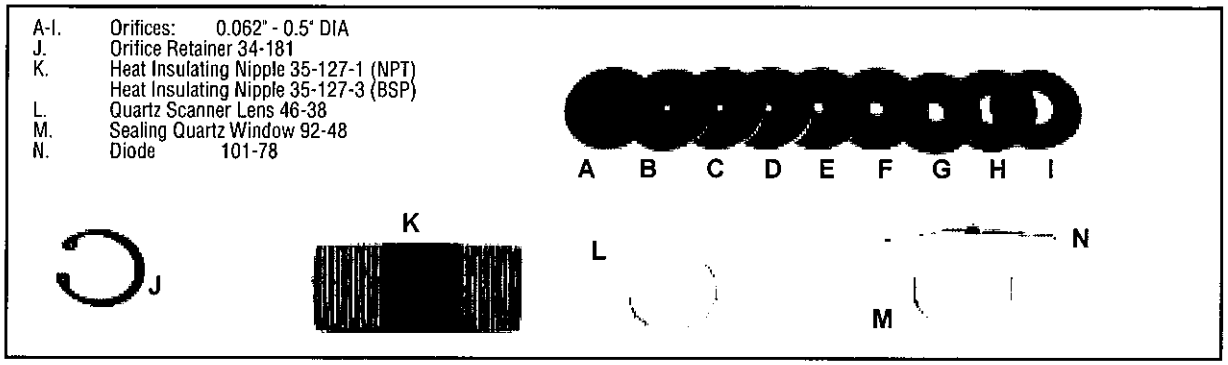
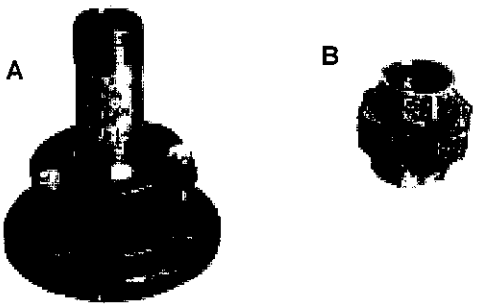


FIGURE 13.

A. Swivel Mount 60-1664-3 (NPT)
Swivel Mount 60-1664-4 (BSP)
B. Sealing Union with Quartz Window 60-1199 (NPT)



ACCESSORIES

Swivel Mount

The scanner swivel mount (P/N 60-1664-3, -4) is used to adjust the scanner sighting angle after the scanner has been installed. The swivel mount is used as indicated in Figures 8 and 9.

Orifices

The orifice is used to restrict field of view (target area), reduce air flow, maintain air block, and increase discrimination between flame and background radiation. The orifice is secured within the ball of a swivel mount with an orifice retainer or the orifice can be placed within a 1 inch union (not provided).

The scanner should ideally sight a target area of 4 to 25 square inches (25-250cm^2) of the flame front. The flame front is a plane within the combustion space separating the region of unburned fuel from the burning fuel. For example, if a 1/2 inch diameter orifice is placed within a mounting swivel one foot from the scanner lens, and the swivel mount is located on the surface of a 4 foot deep windbox, and if the range of stable flame is 5 feet beyond the windbox, the flame front target area is 19.6 square inches as shown in Figure 15.

ORIFICES

Figure	Qty.	Part Number	Description
12	1	53-121	Orifice Kit: Contains following items:
12A	1	53-121-2	Orifice: Diameter = 0.062"
12B	1	53-121-3	Orifice: Diameter = 0.078"
12C	1	53-121-4	Orifice: Diameter = 0.093"
12D	1	53-121-5	Orifice: Diameter = 0.109"
12E	1	53-121-6	Orifice: Diameter = 0.125"
12F	1	53-121-7	Orifice: Diameter = 0.187"
12G	1	53-121-8	Orifice: Diameter = 0.250"
12H	1	53-121-9	Orifice: Diameter = 0.375"
12I	1	53-121-10	Orifice: Diameter = 0.500"
12J	2	34-181	Orifice Retainer

FIGURE 14. ORIFICE LOCATION

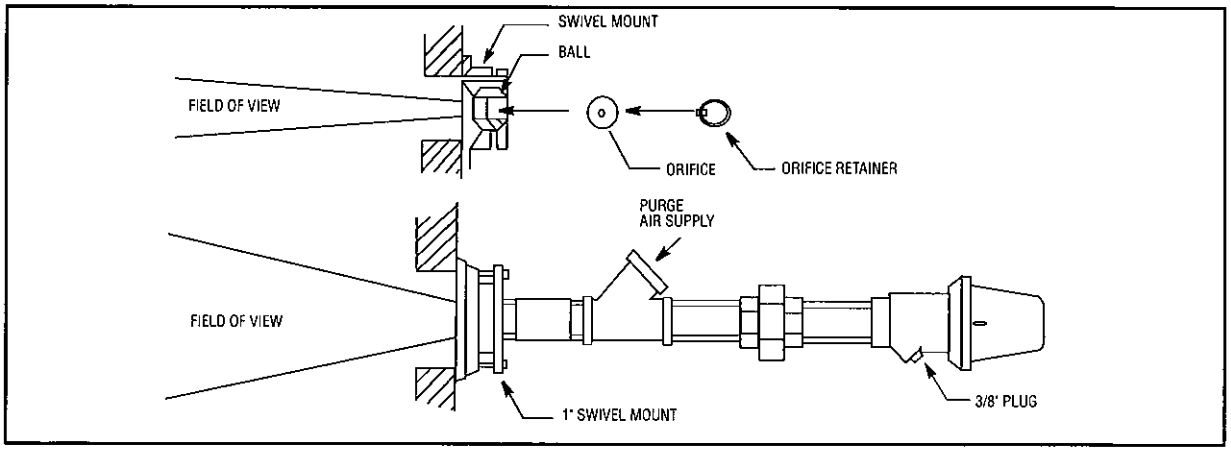
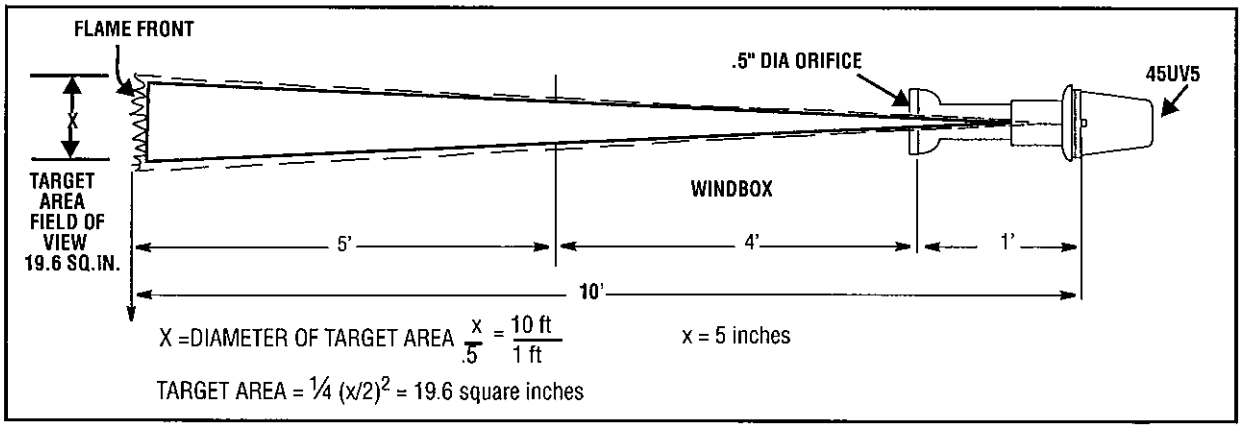


FIGURE 15. Scanner with Orifice



Note: There is an inverse relationship between discrimination and sensitivity.

Heat Insulating Nipple

The heat insulating nipple (P/N 35-127-1, -3) is used to prevent heat transfer from the hot sight pipe to the scanner head.

Sealing Union with Quartz Window

The sealing union, PN 60-1199 is used whenever a coupling or seal is required for scanner piping. The quartz window blocks furnace pressure, heat, gases and soot from coming in contact with the scanner and contaminating the lens. The size is one inch U.S. standard taper pipe thread (Schedule 40, 1" NPT). When the sealing union is used, a 1" wye fitting must by used downstream from it for connection of a purge air supply (plug 3/8" opening).

Electrical Accessories

The diode (101-78) is used whenever a solid state scanner (45RM1, 45RM2, 45RM4, 45FS1,or 45UVFS1) is operated with a Type 45UV5 scanner. Refer to the "Control and Scanner Wiring" section, for further information. Fireye scanner cable Part No. 59-470 (4 conductors 18 AWG, 2 conductors 22 AWG, common shield) or Part No. 59-471 (4 conductors 18 AWG, 4 conductors 22 AWG, common shield) is used for wiring connections between the scanner(s) and the control terminals. Each wire is color coded for connection as follows:

BLACK	"L" or AC hot terminal.
RED	"1" or shutter terminal.
WHITE	"C" or common terminal.
GREEN	"14" or flame signal terminal.
SHIELD	Connect the shield to terminal C at the control end only. The shield at the scanner end should be left disconnected.
BLUE	Not Used.
YELLOW	Not Used.
BROWN	(59-471 only) Not Used.
ORANGE	(59-471 only) Not Used.

Note: If the application requires only model 45UV5 scanners, specify Fireye Part Number 59-470 cable. Clip and tape the blue and yellow wires.

MAINTENANCE

CAUTION: Disconnect or shut off electric power when working on scanner.

1. The Fireye (25SU3 or 25SU5) control and scanner should be powered at all times (except for repair, cleaning or replacement) to reduce any harmful effects of atmospheric humidity.
2. The scanner and sight pipe must be kept clean to prevent overheating and assure optical qualities.
3. When replacing or cleaning the UV tube, note the position of the tube electrodes in relation to the rectangular slot in the shutter assembly. Replace tube in the same slot location.
4. Clean the quartz lens with glass detergent or glass cleaning agents which contain no abrasives. After cleaning remove all cleaning films with a soft lint-free cloth.
5. Use original Fireye repair parts to maintain optimum operation

RECOMMENDED SPARE PARTS		
FIGURE	PART NUMBER	DESCRIPTION
11A	4-320-1	UV TUBE
11B	61-2914	SHUTTER ASSEMBLY
11C	61-2913	SHUTTER ASSEMBLY WITH LENS
11D	29-248	FLANGE GASKET
11E	82-95	LENS HOLDER
11F	16-103	RETAINER RING/GROMMET
12L	46-38	LENS
12M	92-48	QUARTZ WINDOW (Part of Sealing Union 60-1199)

Fireye original equipment factory replacement parts are available at various sub-assembly levels. For example, the shutter assembly (Part Number 61-2913) contains five parts which can be inserted as a unit.

CONTROL AND SCANNER WIRING

All wiring to the scanner should be rated at 600 volts and 90° C. For runs less than 1000 feet Fireye recommends the use of scanner cable Part No. 59-470 (4 conductors 18 AWG, 2 conductors 22 AWG, common shield) or Part No. 59-471 (4 conductors 18 AWG, 4 conductors 22 AWG, common shield). For runs in excess of 1000 feet, consult the factory. For ease of installation and occasional service, the wires should be routed to the screw terminals in the scanner via a flexible conduit per the following groups. Always refer to the appropriate flame safeguard control bulletin.

Group I Fireye Controls

A blocking diode, Fireye Part Number 101-78, must be used when a solid state type scanner is used in parallel with a UV scanner. Connect the diode in series with the lead from terminal 14 in the UV scanner as shown in Figures 16 and 20. This is to avoid damaging the solid state scanner. If the application requires that only one scanner be in use at any time, the other unit can be removed from operation by breaking the power lead (LA or LB).

Group II Fireye Controls

If the intended use requires that the amplifier input signal come from one of two or more scanners, the power and shutter drive signals should be switched between scanners using a single relay "S" or selector switch. This permits the operation of one scanner at a time. As with Group I amplifiers, the blocking diode is necessary when using the solid state scanner with a UV unit (see Figure 17).

Group III Fireye Controls (non-self-checking type)

With these amplifiers, terminal 1 on the scanner, the self-checking shutter connection, is not used. If more than one scanner is used, power for additional units can be obtained from terminal 1 of the amplifier through a special 0.33 μF capacitor (Part No. 7-1143) and 1 meg ohm, 1/4 watt resistor. With the connections as shown, the unwanted scanner can be turned off by breaking the power lead at LA or 1A. As with Group I and II amplifiers, the diode must be used when a solid state scanner is used with a UV unit. (see Figure 18).

Group IV Amplifiers (25SU3-5170 Series)

A blocking diode is not required when a solid state scanner is used with a UV unit (See Figure 19).

Notes:

1. Connect the scanner cable shield to terminal C at the control end only; the shield at the scanner end should be left disconnected.
   - — Strip six inches of insulation from scanner end of cable.
   - — Cut off the six inches of cable shield that is visible.
   - — Tape the cable's insulation where it terminates so the cable shield is not visible.
2. Flame amplifier rack, Part Number 60-1706 has a blocking diode between terminals 14A and 14D.

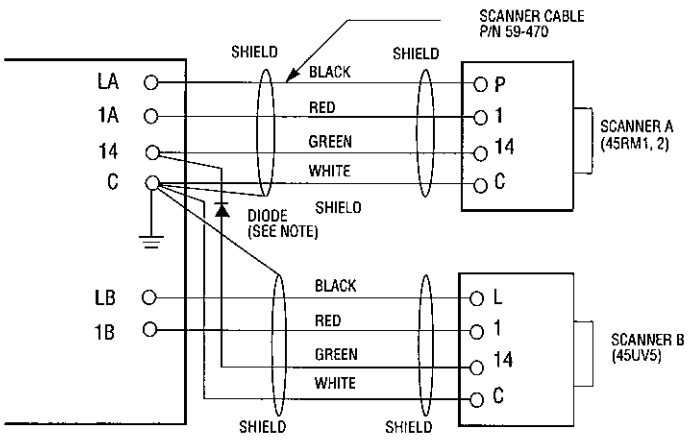
Group V Amplifiers (5000 Series)

A blocking diode, Fireye part number 101-78, must be used when a solid state scanner is used in parallel with a UV scanner. Connect the diode in series with the lead from terminal 14 in the UV scanner as shown in figures 20 and 21.

Group VI Amplifiers (2000 Series)

A blocking diode is not required when a solid state scanner is used with a UV unit (See Figure 22).

FIGURE 16. GROUP I CONNECTIONS



NOTES:

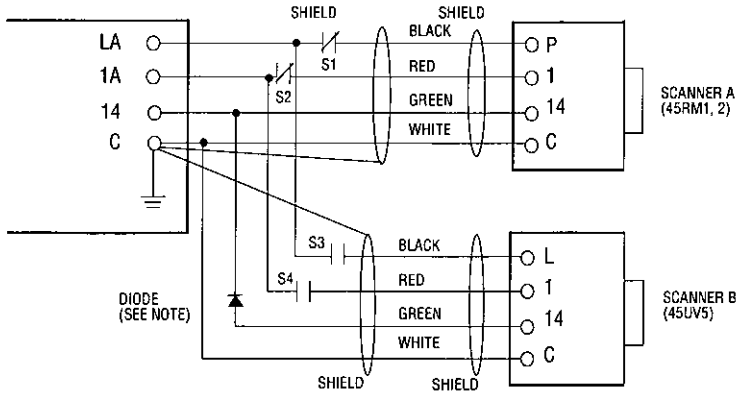
1. DIODE - PART NUMBER 101-78, CONNECT AS SHOWN IN SIGNAL LEAD (14) OF UV SCANNER WHEN USING WITH 8GC SCANNER. IF TWO UV SCANNERS ARE USED, ONE AT LOCATION A AND ONE AT LOCATION B, THE DIODE INDICATED IS NOT REQUIRED.
2. FLAME AMPLIFIER RACK P/N 60-1706 HAS A BLOCKING DIODE BETWEEN TERMINALS 14A AND 14D.
3. IF THE APPLICATION REQUIRES THAT ONLY ONE SCANNER BE IN USE AT ANY TIME, THE OTHER UNIT CAN BE REMOVED FROM THE OPERATION BY BREAKING THE POWER LEAD (LA OR LB).

Group I

Self-checking units capable of operation with one or two scanners. (One 45UV5 and one solid state 45RM1 or 45RM2 scanner may be used as shown in the figures in this document. If two 45UV5 scanners are used, one at location A and one at location B, the diode indicated is not required. If only one scanner is used, connect the scanner as shown at scanner A position.)

25SU3 Models 4163(T), 4164(T), 4167(T), 4168(T), 4169(T), 4170, 4171.

FIGURE 17. GROUP II CONNECTIONS



NOTE:

DIODE PART NO. 101-78. CONNECT AS SHOWN IN SIGNAL LEAD (14) OF U.V. SCANNER WHEN USING WITH SOLID STATE SCANNER.

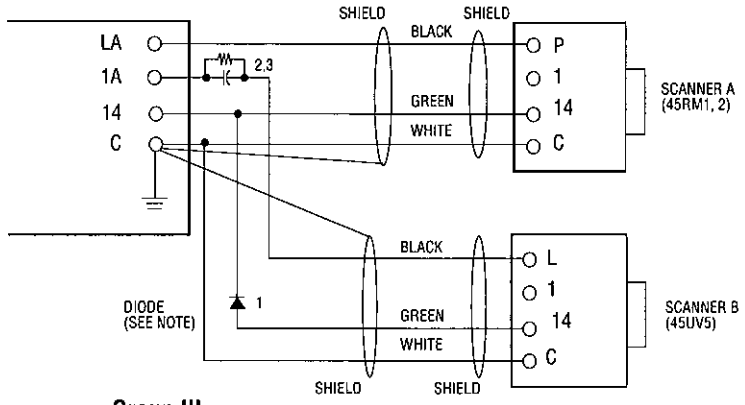
Group II

Self-checking units capable of operation with one scanner.

25SU3 Models: 4157, 4158, 4162, 4165, 4166 (or 5166, 5168 using 60-2206-2 adapter plate).

25SU5 Models: 4011, 4012, 4117 (or 5011, 5012, 5013 using 60-2206-1 adapter plate).

FIGURE 18. GROUP III CONNECTIONS



NOTES

1. DIODE - PART NUMBER 101-78. CONNECT AS SHOWN IN SIGNAL LEAD (14) OF UV SCANNER WHEN USING WITH SOLID STATE SCANNER.
2. CAPACITOR - PART NUMBER 7-1143. CONNECT AS SHOWN TO POWER SECOND SCANNER FROM ONE AMPLIFIER.
3. RESISTOR - 1 MEG OHM, 1/4 WATT

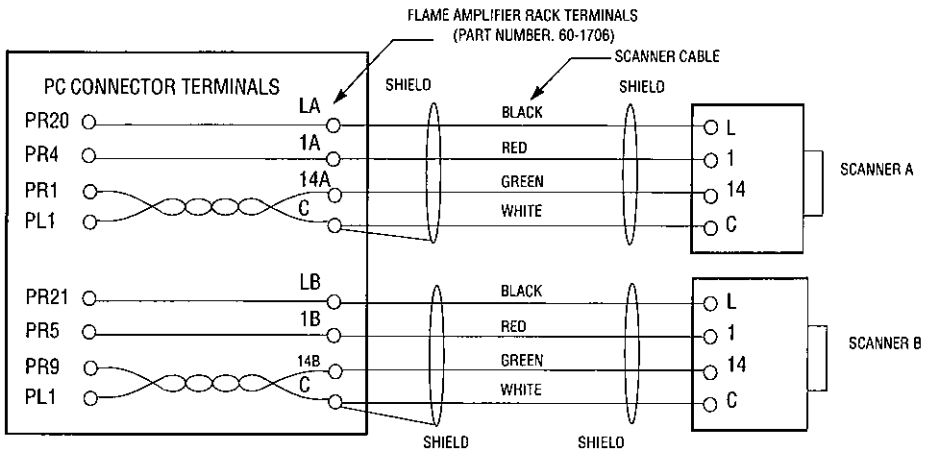
Group III

Non-self-checking units capable of operation with one or more scanners: One 45UV5 and one solid state 45RM1 or 45RM2 scanner may be used as shown in the figures. If two 45UV5 scanners are used, one at location A and one at location B, the diode indicated is not required. If only one scanner is used, connect the scanner as shown at scanner position A.

25SU3 Models: 1157(T), 1158(T), 1160, 1161, 1162, 1166.

25SU5 Models: 1011, 1111(T), 1112(T), 1117.

FIGURE 19. GROUP IV CONNECTIONS



Group IV

Self-checking units capable of operation with one or two scanners.

25SU3 Models: 5170, 5171, 5172, 5173.

FIGURE 20. BLOCKING DIODE CONNECTIONS

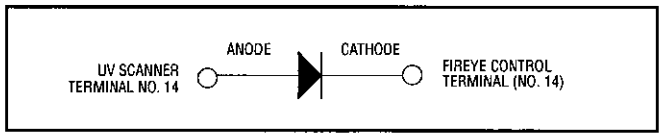
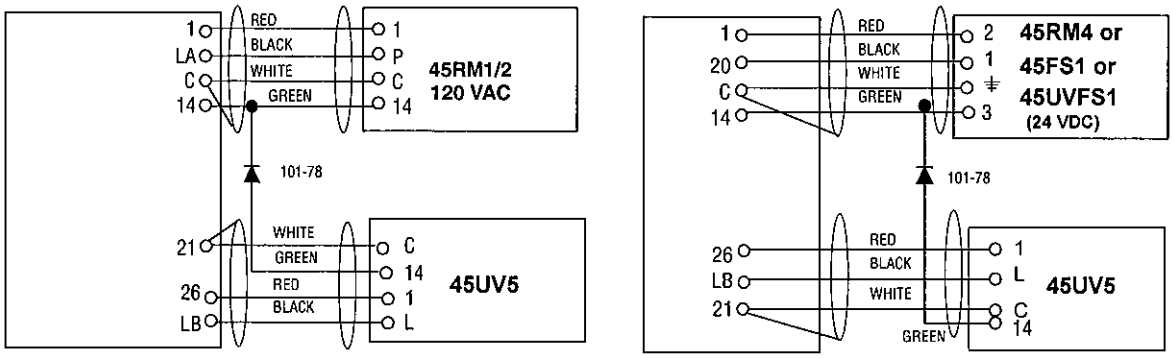


FIGURE 21. GROUP V CONNECTIONS



Group V

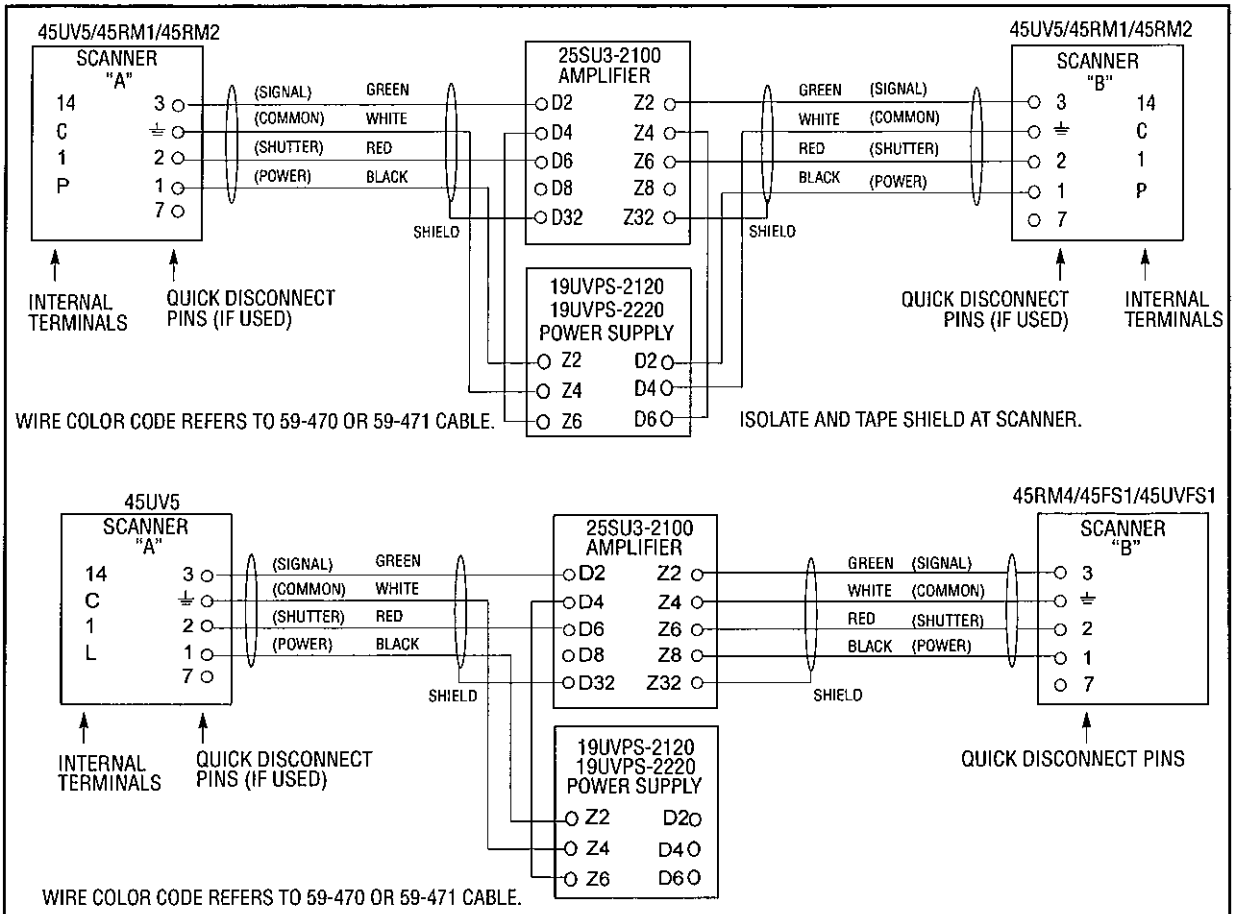
Self-checking units capable of operation with one or two scanners. If two models 45UV5 scanners are used the diode is not required.

Connect scanner cable shield(s) to wiring base terminal C. The shield at the 45UV5, 45RM1, or 45RM2 scanner end is left disconnected. The shield at the 45RM4, 45FS1, or 45UVFS1 scanner end is tied to the scanner cable quick-disconnect.

25SU3 Models: 5166, 5168 (wiring base 60-2206-2)

25SU5 Models: 5011,5012, 5013 (wiring base 60-2206-1)

FIGURE 22. GROUP VI CONNECTIONS



Group VI

Self-checking units capable of operation with one or two scanners. Connect scanner cable shield(s) to 25SU3 terminal D32 or Z32. The shield at the 45UV5, 45RM1, or 45RM2 scanner end is left disconnected. The shield at the 45RM4, 45FS1, or 45UVFS1 scanner ends is tied to the scanner cable quick-disconnect.

If only one scanner is used, connect as scanner "A".

Wire color code refers to 59-470 or 59-471 cable. Cable 59-221 (OBSOLETE) had the same color code, but only the green wire was shielded.

45UV5 SCANNER COMPATIBILITY CHART

FIREYE CONTROL		45UV5 MODEL		FIREYE CONTROL		45UV5 MODEL	
TYPE	MODEL	1000, 1010 (60 HZ)	1101, 1103 (50 HZ)	TYPE	MODEL	1000, 1010 (60 HZ)	1101, 1103 (50 HZ)
25SU3	1157(T)	X	X	25SU3	4171	X	X
	1158(T)		X		5166	X	X
	1160	X	X		5168	X	X
	1161		X		5170	X	X
	1162	X	X		5171	X	X
	Series 2000	X	X		5172	X	X
	1166		X		5173	X	X
	4157	X	X		SYSTEM 126	X	X
	4158		X				
	4162	X	X	25SU5	1011	X	
	4163(T)	X	X		1111(T)	X	X
	4164(T)		X		1112(T)		X
	4165		X		1117		X
	4166	X	X		4011	X	X
	4167(T)	X	X		4012		X
	4168(T)	X	X		4117	X	X
	4169T	NOTE 2	NOTE 2		5011	X	X
	4170	X	X		5012	X	X

NOTE 1: Scanner and control frequency must be compatible with frequency of power line.
NOTE 2: For 25SU3 Model 4169T code 17 and earlier, use 45UV5 Model 1101 or 1103 (50HZ).For 25SU3 Model 4169T code 18 and later use 45UV5 Model 1000 or 1010 (60HZ).
NOTE 3: With 25SU3-2000 series controls, the 120 VAC to the scanner must be provided by a separate Fireye power supply, or modernization adapter.
NOTE 4: The AC power source must be sinusoidal for proper scanner operation. The application of any waveform other than a sine wave (e.g. square wave) will damage the 45UV5 scanner.

TROUBLESHOOTING

The following steps should be performed if flame is not detected:
NOTE: Wear protective filtered lenses when viewing flame.

1. Check scanner wiring for breaks and proper connections.
2. Look down the sight pipe.
   — Scanner should have an unrestricted view for all firing conditions.
   — The flame's primary combustion zone (first 1/3 of flame) should be within the scanner's field of view for all firing loads.
3. Clean the scanner lens with a glass detergent or glass cleaning agent which contains no abrasives. After cleaning remove all cleaning films with a soft lint-free cloth. (Some cleaning films may reduce or filter UV).
4. Measure voltage across scanner terminals.
   — Between terminals 14 and C there should be 70 VAC pulses of 6 microseconds (use oscilloscope).Between terminals L and C there should be 200 to 250 VAC for units manufactured before 1994. For later units, there should be 130 to 150 VAC.
5. Scanner operation can be checked by aiming the scanner at a source of ultra-violet radiation, (lighter or propane torch). The meter on the associated control should indicate flame.
6. Check to see that an external selector switch is connected to the associated control's sensitivity/ threshold select or scanner enable terminals.
7. Reposition scanner so it is properly aligned for best flame signal.
8. If the scanner still does not indicate the presence of flame (DC voltage on Flame Signal Meter) replace the UV tube and repeat steps 4 through 7.

NOTICE

When Fireye products are combined with equipment manufactured by others and/or integrated into systems designed or manufactured by others, the Fireye warranty, as stated in its General Terms and Conditions of Sale, pertains only to the Fireye products and not to any other equipment or to the combined system or its overall performance.

WARRANTIES

FIREYE guarantees for *one year from the date of installation or 18 months from date of manufacture* of its products to replace, or, at its option, to repair any product or part thereof (except lamps, electronic tubes and photocells) which is found defective in material or workmanship or which otherwise fails to conform to the description of the product on the face of its sales order. **THE FOREGOING IS IN LIEU OF ALL OTHER WARRANTIES AND FIREYE MAKES NO WARRANTY OF MERCHANTABILITY OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED.** Except as specifically stated in these general terms and conditions of sale, remedies with respect to any product or part number manufactured or sold by Fireye shall be limited exclusively to the right to replacement or repair as above provided. In no event shall Fireye be liable for consequential or special damages of any nature that may arise in connection with such product or part.

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CU-22
AUGUST 12, 2005
Supersedes June 2003

A Kidde Company

FLAME-MONITOR™ SYSTEM ACCESSORIES

129-145 Remote Display Mounting Kit
ED610 Multi-port Cable Connector and Terminal Strip
ED580 Remote Display Cables
ED512 Remote Mounting Cables
ED150 Remote Reset Cables

129-145 REMOTE MOUNTING KIT

The 129-145-1, -2 and -3 mounting kits provide an easy, efficient method to panel mount the ED510 display module. Each kit contains a mounting plate, gasket, two (2) 8-32 x 1 1/4" mounting screws, and connection cable: ED580-4 (4 foot cable) with the 129-145-1, ED580-8 (8 foot cable) with the 129-145-2, and ED580-2 (2 foot cable) with the 129-145-3.

ED610 MULTI-PORT CABLE CONNECTOR WITH TERMINAL STRIP

The ED610 is a multi-port adapter with two RJ45 and one RJ12 telephone jack connectors and a 10-connector terminal strip. It facilitates remote cable connections between the E110 control, ED510 Display Module, and the E500 Communication Interface. The ED610 is mounted on a flat surface with two screws and is recommended where cable runs greater than eight (8) feet are required.

ED580 REMOTE DISPLAY CABLES

The ED580 remote display cable is a cable in varying lengths (2', 4', and 8') with an RJ45 connector on each end of the cable. The ED580 is used to mount the ED510 display module remote from the Flame-Monitor control (with EP programmers, Engineering code 28 or later or EPD programmers, Engineering code 02 or later).

ED512 REMOTE MOUNTING CABLES

The ED512 remote mount cable is a cable in varying lengths (2', 4', and 8') with an RJ12 connector on each end of the cable. The ED512 is used with the ED610 multi-port connector for connecting the Flame-Monitor control (with EP programmers, Engineering code 28 or later or EPD programmers) to the E500 Communication Interface. The ED512 cables are also used to customize E300 messages. Refer to bulletins E-3001 and EC-3451.

ED150 REMOTE RESET CABLES

The Remote Reset Cables are 10 conductor flat ribbon cables with a connector on one end and with two stripped and tinned conductors on the opposite end. Maximum length available is 25 feet (7.62m). A momentary contact switch connected to the stripped end of the cable will allow for remote reset of the FLAME-MONITOR.

See CAUTION on Page 3.

ORDERING INFORMATION

PART NUMBER	DESCRIPTION
129-145-1	Remote mounting kit (includes ED580-4)
129-145-2	Remote mounting kit (includes ED580-8)
129-145-3	Remote mounting kit (includes ED580-2)
ED610	Multi-port connector with terminal strip and phone jacks.
ED512-2	2 foot cable with RJ12 connectors for connection to E500.
ED512-4	4 foot cable with RJ12 connectors for connection to E500.
ED512-8	8 foot cable with RJ12 connectors for connection to E500.
ED580-2	2 foot cable with RJ45 connectors for remote display.
ED580-4	4 foot cable with RJ45 connectors for remote display.
ED580-8	8 foot cable with RJ45 connectors for remote display.
ED150-3	3 foot remote reset cable
ED150-6	6 foot remote reset cable
ED150-15	15 foot remote reset cable
ED150-25	25 foot remote reset cable
EC485	RS485 to RS232 Converter with optional RJ12 connector and power supply

REMOTE MOUNT THE ED510 DISPLAY USING 129-145 MOUNTING KIT

See Figure 1. The 129-145-1, -2, or -3 is used to panel mount the ED510 display.

To install the ED510 display module using the remote mounting kit (129-145-1, -2 and -3):

1. Cut an opening in the front panel face 3.62 inches square (92.0 mm). The width of the panel face cannot exceed 5/64."
2. Slide the gasket over the rear side of the display.
3. Insert the ED510 display and gasket through the panel opening.
4. Insert the mounting plate over the rear side of the display. Slide the two (2) mounting tabs on the mounting plate over the slots on the ED510 display. Then move the mounting plate until the tab on top of the ED510 display snaps into position under the opening on the mounting plate.

NOTE: *Align the mounting plate so when the mounting screws are installed and tightened, the threaded inserts are not pushed out of the mounting plate.*

The mounting plate has a 1/2" circular opening to allow access to the contrast adjustment potentiometer on the rear of the ED510 display.

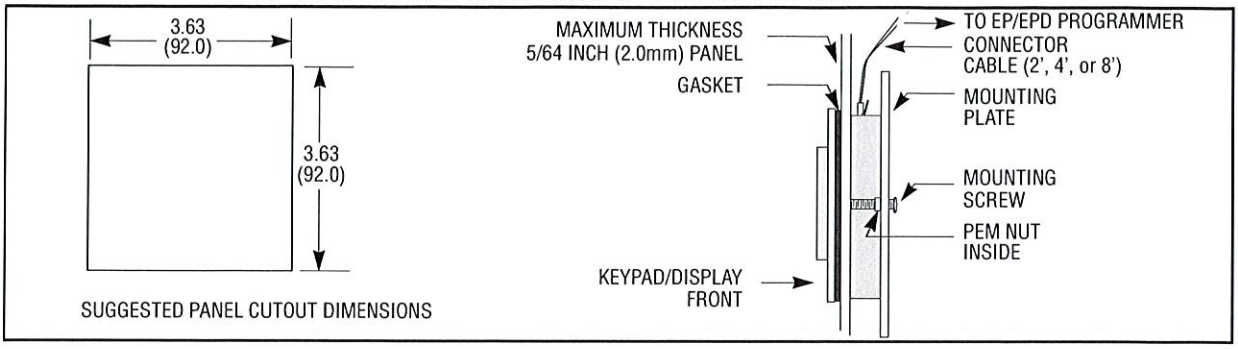
5. Insert the mounting screws into the threaded inserts and tighten.
6. Insert the 2 foot cable (129-145-3), 4 foot cable (129-145-1) or 8 foot cable (129-145-2) into the RJ45 style connectors on both the ED510 display and the EP Programmer Module (Engineering code 28 or later). A ferrite core is provided on the ED580 cable to improve the electrical noise immunity of the FLAME-MONITOR system.**The connector nearest to the ferrite core must be plugged into the EP Programmer.**

TO ENSURE THE SYSTEM IS PROPERLY GROUNDED:

1. Connect the back plane of the mounting cabinet to a proper earth ground.
2. Ground the FLAME-MONITOR wiring base to the mounting cabinet by using mounting screws with star washers to ensure proper electrical contact.
3. Connect the green grounding screw on the wiring base to a proper earth ground.
   NOTE: A PROPER EARTH GROUND CONSISTS OF A METAL ROD DRIVEN INTO THE GROUND AT A LOCATION NEAR THE ELECTRICAL DISTRIBUTION PANEL PROVIDING POWER TO THE FLAME-MONITOR CONTROL SYSTEM. REFER TO SN-100.

Refer to the ED610 to remote mount the display greater than 8 feet away from the control.

FIGURE 1. INSTALLATION AND MOUNTING DIAGRAM OF ED510 WITH 129-145



WIRING CONNECTIONS FOR ED610 AND ED510 REMOTE DISPLAY

See Figure 2. Use the ED610 multi-port connector to remote mount the ED510 display greater than eight (8) feet away from the Flame-Monitor control. An eight (8) conductor, 18 gage, low capacitance, overall shielded cable (Belden 9554 or equivalent) must be used between the ED610 at the burner site and the ED610 at the remote site. An ED580 cable is required between the ED510 display module and the ED610 connector as well as the ED610 connector and FLAME-MONITOR control. A ferrite core is provided on the ED580 cable to improve the electrical noise immunity of the FLAME-MONITOR system.**The connector nearest to the ferrite core must be plugged into the EP Programmer.**

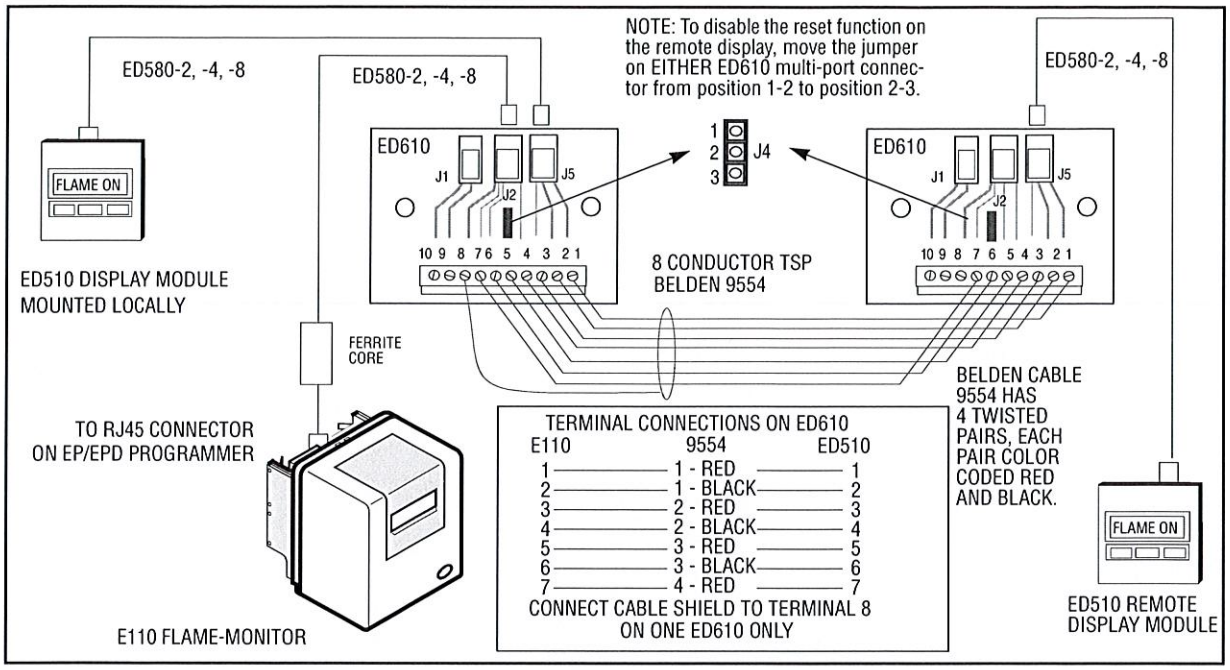
MAKE SURE THE FLAME-MONITOR SYSTEM IS PROPERLY GROUNDED. REFER TO THE WARNING BOX ON PAGE 2 TO ENSURE THE SYSTEM IS PROPERLY GROUNDED.

The position of the ferrite core is not critical on the ED580 cable connected between the ED510 display and ED610 adapter. The Flame-Monitor control will drive two (2) ED510 display modules.

The Belden cable 9554 has 4 twisted pairs with an overall shield. Conductor pairs are color coded red and black and numbered at one (1) inch intervals (e.g. 1-black, 2-red). Maximum cable distance of the ED510 from the Flame-Monitor control is 700 feet. Do not ground shield at both ED610's.

CAUTION: When the remote display or the remote reset is installed, make sure that the remote location is within sight and sound of the fired equipment. Safety procedures require that the operator be at the burner to reset the safety controls in order that any unsafe conditions can be discovered and corrected prior to resetting the safety controls or devices. Fireye does not recommend remote reset locations beyond sight and sound of the burner.

FIGURE 2. **Wiring Connections for ED610 and ED510 Remote Display**



WIRING FOR E500 COMMUNICATION INTERFACE

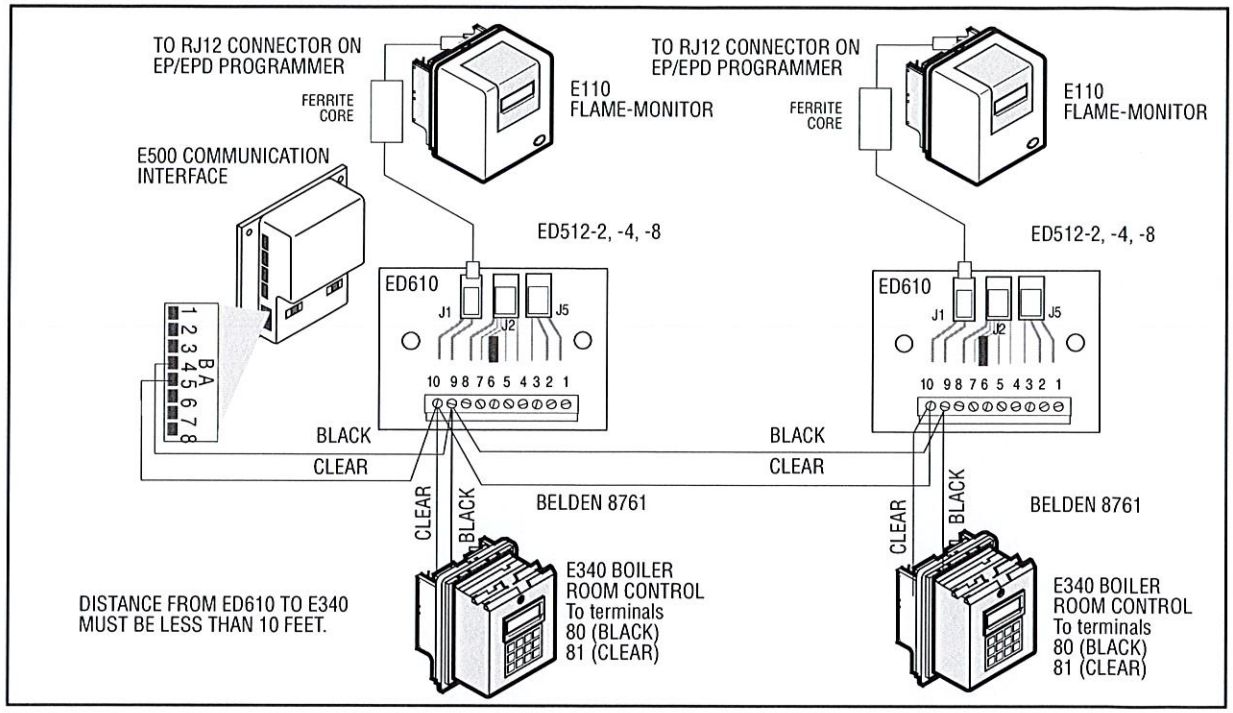
See Figure 3. Use an ED610 multi-port connector for each Flame-Monitor or E340 Boiler Control unit connected in a multi-drop wiring configuration to the E500 Communication Interface. A two (2) conductor, 22 gage, low capacitance shielded cable (Belden 8761 or equivalent) must be used between the E500 Communication Interface and each ED610 multi-port connector and E340 Boiler Control. An ED512 cable is required between the ED610 and the Flame-Monitor. A ferrite core is provided on the ED512 cable to improve the electrical noise immunity of the FLAME-MONITOR system.**The connector nearest to the ferrite core must be plugged into the EP Programmer.**

MAKE SURE THE FLAME-MONITOR SYSTEM IS PROPERLY GROUNDED. REFER TO THE WARNING BOX ON PAGE 2 TO ENSURE THE SYSTEM IS PROPERLY GROUNDED.

Ground the shield at one end only of each individual wiring run. Total maximum cable distances shall not exceed 4,000 feet.

NOTE: *Cable should be routed within the cabinet so that it doesn't come in close proximity with ignition wires, high energy contactors or solenoids.*

FIGURE 3. **Wiring for E500 Communication Interface**



BELDEN 8761	TERMINAL CONNECTIONS		
	E500	ED610	E340
BLACK	4 (B)	9	80
CLEAR	5 (A)	10	81

WIRING FOR E110'SFOR MODBUS PROTOCOL

See Figure 4. Use an ED610 multi-port connector for each Flame-Monitor unit connected in a multi-drop wiring configuration. A two (2) conductor, 22 gage, low capacitance shielded cable (Belden 8761 or equivalent) must be used between each ED610 multi-port connector. An ED512 cable is required between the ED610 and the Flame-Monitor. A ferrite core is provided on the ED512 cable to improve the electrical noise immunity of the FLAME-MONITOR system.**The connector nearest to the ferrite core must be plugged into the EP Programmer.**

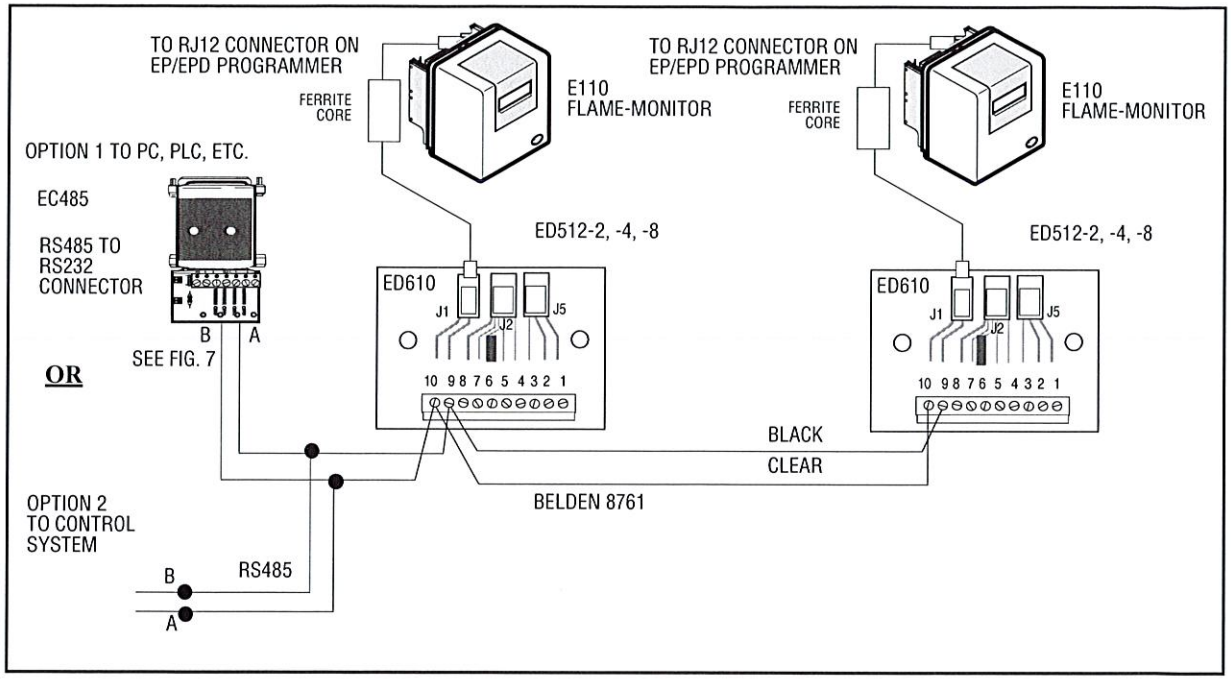
Each Flame Monitor must be assigned its own unique address. Refer to bulletin E-1101 for specific information. The baud rate of each Flame Monitor is fixed at 4800 bits per second. Modbus is available on all EP programmers having an engineering code of 38 or greater and EPD programmers having and engineering code of 4 or greater.

MAKE SURE THE FLAME-MONITOR SYSTEM IS PROPERLY GROUNDED. REFER TO THE WARNING BOX ON PAGE 2 TO ENSURE THE SYSTEM IS PROPERLY GROUNDED.

Ground the shield at one end only of each individual wiring run. Total maximum cable distances shall not exceed 4,000 feet.

NOTE: *Cable should be routed within the cabinet so that it doesn't come in close proximity with ignition wires, high energy contactors or solenoids.*

FIGURE 4. **Wiring for Modbus Protocol**



WIRING FOR REMOTE RESET

A remote reset button can be added when using the ED610 multi-port connector. Wire a normally open momentary push button across terminals 8 & 4 on the ED610. Jumper J4 must be in position 1-2. Refer to Figure 6.

REFER TO "CAUTION" FOR REMOTE RESET ON PAGE 3.

FIGURE 5. **ED610 DIMENSIONS**

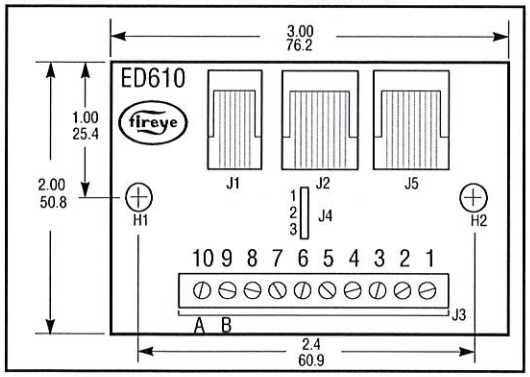
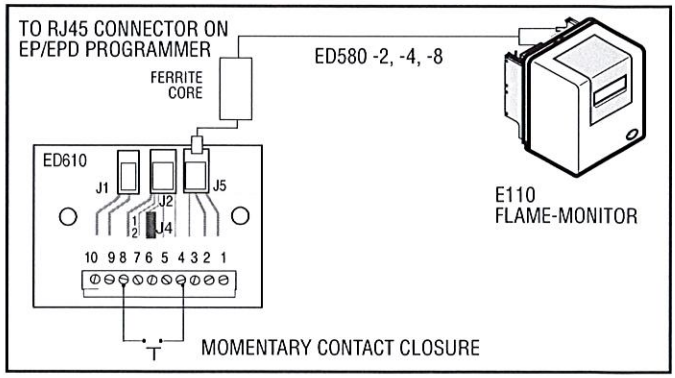


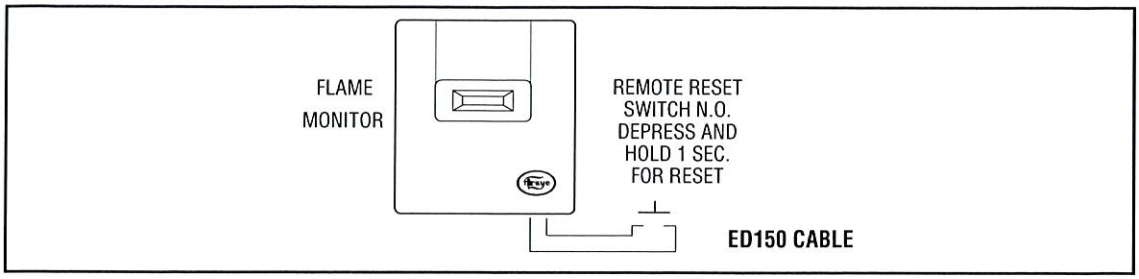
FIGURE 6: **WIRING FOR REMOTE RESET**



The ED611 multi-port connector provides for remote reset at the terminal block, but inhibits the lockout reset capability at the ED510. This is useful for applications that may want to use a key lock switch in lieu of the reset button located on the ED510 display. Connect the E110 and ED510 as shown using the ED580 cables. Wire a normally open momentary push button switch across terminals 8 & 4. Jumper J4 on the ED611 must be in position 1 to 2. Refer to Figure 8.

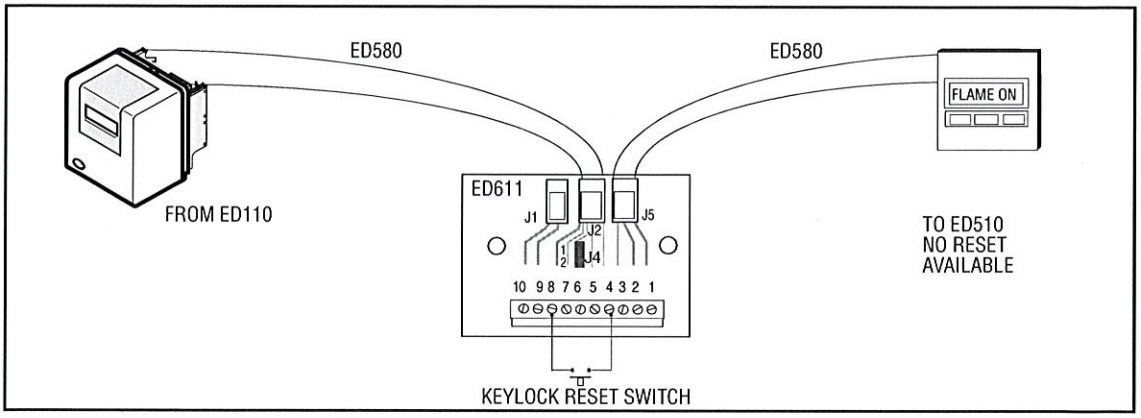
REFER TO "CAUTION" FOR REMOTE RESET ON PAGE 3.

FIGURE 7: REMOTE RESET CONNECTION



REFER TO "CAUTION" FOR REMOTE RESET ON PAGE 3.

FIGURE 8: WIRING FOR REMOTE RESET



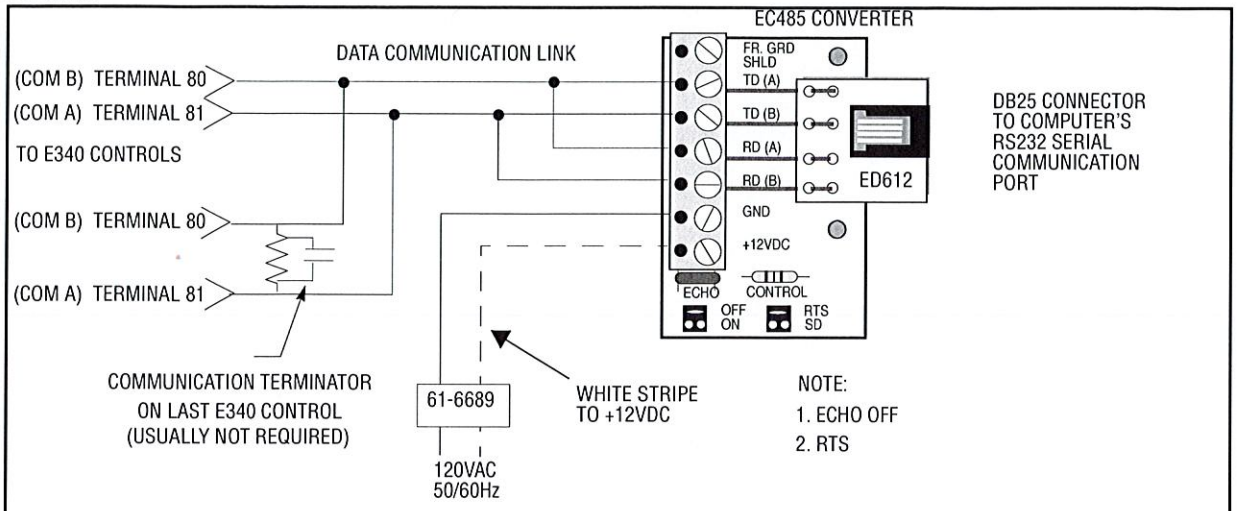
COMMUNICATING WITH THE E340 BOILER CONTROL

The E340 Boiler Control also communicates over an RS485 communication data link. The data link uses a single, twisted shielded pair wire (Belden 8761) with the E340 controls wired in a multi-drop (e.g. daisy-chain) wiring configuration. The Fireye communication software program (P/N E720) running on an IBM compatible PC is required for communication with the E340 controls.

Fireye recommends using the E500 Communication interface when communicating with the E340 controls, since the E500 provides communication with the Flame-Monitor™ flame safeguard controls as well. However, the EC485 converter can be used to communicate only with the E340 controls.

Wire the EC485 converter to the E340 controls in the following manner:

FIGURE 9:



Note: The two jumpers on the 485CON converter should be set to "RTS" and "Echo Off."
Note: TD (A) and RD (A) on EC485 converter connected to Terminal 80 (COM B) of E340 control.
TD (B) and RD (B) on EC485 converter connected to Terminal 81 (COM A) of E340 control.

For complete details on wiring and communicating with the E340 controls refer to bulletin BW-1000 (BoilerWorx™ Communication Software Program).

NOTICE

When Fireye products are combined with equipment manufactured by others and/or integrated into systems designed or manufactured by others, the Fireye warranty, as stated in its General Terms and Conditions of Sale, pertains only to the Fireye products and not to any other equipment or to the combined system or its overall performance.

WARRANTIES

FIREYE guarantees for *one year from the date of installation or 18 months from date of manufacture* of its products to replace, or, at its option, to repair any product or part thereof (except lamps, electronic tubes and photocells) which is found defective in material or workmanship or which otherwise fails to conform to the description of the product on the face of its sales order. **THE FOREGOING IS IN LIEU OF ALL OTHER WARRANTIES AND FIREYE MAKES NO WARRANTY OF MERCHANTABILITY OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED.** Except as specifically stated in these general terms and conditions of sale, remedies with respect to any product or part number manufactured or sold by Fireye shall be limited exclusively to the right to replacement or repair as above provided. In no event shall Fireye be liable for consequential or special damages of any nature which may arise in connection with such product or part.

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E-8002
APRIL 3, 2013
Supersedes June 8, 2006

YP100, YP102, YP113
YP115,YP118, YP138
YP183,YP200, YP202
YP300, YP302

PROGRAMMER MODULES FOR USE WITH THE FIREYE®

BurnerLogix™ CONTROL SYSTEM

CE c UL US LISTED FM APPROVED

DESCRIPTION

The Fireye YP100, YP102, YP113, YP115, YP118, YP183, YP200, YP300, YP302 and YP138 Programmer Modules are used with the Fireye BurnerLogix control. The operational characteristics of the control are determined by the selection of the programmer module (e.g. modulation, recycle, non-recycle, fixed firing, flame failure response time, etc.). The programmer module incorporates a plug-in design for easy installation.

A complete BurnerLogix system includes the YB110 (YB230) or ZB110 (ZB230) chassis equipped with the type of flame amplifier required for the application, appropriate flame detector, plug-in programmer module, wiring base and optional alpha-numeric display. Interchangeable programmer modules allow for complete versatility in selection of function, timing and flame failure response times

.

WARNING: THE INAPPROPRIATE SELECTION OR APPLICATION OF A PROGRAMMER MODULE COULD RESULT IN AN UNSAFE CONDITION HAZARDOUS TO LIFE AND PROPERTY. The various programmer modules are interchangeable because they plug into a common YB chassis. Many parameters are configurable through the keypad display. Care should be taken to insure the proper parameters are set. Refer to bulletin BL-1001 or BLZ-1001 for a complete description of the BurnerLogix system. Selection of the programmer module and setting the various parameters for a particular application should be made by a competent professional, such as a Boiler/Burner technician licensed by a state or government agency, engineering personnel of the burner, boiler or furnace manufacturer (OEM) or in the performance of duties based on the information from the OEM.

PROGRAMMER MODULE SELECTION

YP100	Keypad selectable parameters, non-recycle operation, modulation, open damper proving, 4 second FFRT
YP102	Keypad selectable parameters, non-recycle operation, modulation, open damper proving, 2 second FFRT
YP138	Keypad selectable parameters, non-recycle operation, modulation, open damper proving, indefinite pilot hold, revert to pilot from auto, 4 second FFRT
YP118	Keypad selectable parameters, non-recycle operation, modulation, open damper proving, indefinite pilot hold, revert to pilot from auto, 1 second FFRT
YP183	Same as YP138, terminal W used for purge complete, no voltage on 21 to move to pilot, no voltage on 16 to move to main.
YP200	Keypad selectable parameters, recycle operation, modulation, 4 second FFRT
YP202	Keypad selectable parameters, recycle operation, modulation, 2 second FFRT
YP300	Keypad selectable parameters, recycle operation, low fire start, early spark termination, 4 second FFRT
YP302	Keypad selectable parameters, recycle operation, low fire start, early spark termination, 2 second FFRT
YP113	Keypad selectable parameters, non-recycle operation, modulation, open damper proving, 1 second FFRT
YP115	Keypad selectable parameters, non-recycle operation, modulation, open damper proving, 1 second FFRT

CAUTION: Ensure that electric power is turned off.

Be aware that power to some interlocks (operating controls, air flow switches, modulating circuits, etc.) may be derived from sources other than what is controlling the BurnerLogix.

INSTALLING THE YP PROGRAMMER MODULE

The YP programmer module plugs into the side of the YB110 (YB230) or ZB110 (ZB230) chassis modules and can only be installed in one direction. DO NOT ATTEMPT TO FORCE THE YP PROGRAMMER INTO THE CHASSIS. Referring to the illustration on the right, align the holes in the YP programmer housing with the posts located within the YB chassis. Push the YP module into the chassis until the YP module is flush with the YB housing.

If it is necessary to remove the YP programmer module from the YB chassis, 2 slots are provided on the top and bottom of the YP housing. A small screwdriver can be used to 'pop' the programmer from the chassis.

WARNING: Selection of this control for a particular application should be made by a competent professional, licensed by a state or other government agency. Inappropriate application of this product could result in an unsafe condition hazardous to life and property. Installation should not be considered complete until pilot turndown and other appropriate performance tests have been successfully completed.

FIREYE PART NUMBER	Pre-purge Programming (Seconds)	Proven High Fire Interlock (M-8)	Proven Low Fire Interlock (M-D)	Terminal 6, Interrupted or Intermittent	Early Spark Termination	PTFI (5/6)	MTFI (5/6)	Running Interlock (3-P)	Flame Fail Time (Seconds)	Firing Rate Motor
SETTINGS SHOWN ARE FACTORY DEFAULT										
YP100	30	YES	YES	INTRP	NO	10/10	10/15	Non-recycle	4	YES
YP102	30	YES	YES	INTRP	NO	10/10	10/15	Non-recycle	2	YES

FIREYE PART NUMBER	Pre-purge Programming (Seconds)	Proven High Fire Interlock (M-8)	Proven Low Fire Interlock (M-D)	Terminal 6, Interrupted or Intermittent	Early Spark Termination	PTFI (5/6)	MTFI (5/6)	Running Interlock (3-P)	Flame Fail Time (Seconds)	Firing Rate Motor
YP138	30	YES	YES	INTRP	NO	10/10	10/15	Non-recycle	4	YES
YP118	30	YES	YES	INTRP	NO	10/10	10/15	Non-recycle	1	YES
YP183	30	YES	YES	INTRP	NO	10/10	10/15	Non-recycle	4	YES
YP113	30	YES	YES	INTRP	NO	5/5	3/5	Non-recycle	1	YES
YP115	30	YES	YES	INTRP	NO	5/5	3/5	Non-recycle	1	YES
YP200	30	NO	YES	INTRP	NO	10/10	10/15	Recycle	4	YES
YP202	30	NO	YES	INTRP	NO	10/10	10/15	Recycle	2	YES
YP300	30	NO	YES	INTMT	YES	10/10	10/ intmt	Recycle	4	NO
YP302	30	NO	YES	INTMT	YES	10/10	10/ intmt	Recycle	2	NO

PTFI*MTFI TIMINGS

The BurnerLogix system provides keypad selectable timings for both PTFI and MTFI. The selections offered can provide 5 or 10 second timing for terminal 5 and 6 or a shortened time for terminal 5, allowing for early spark termination. BurnerLogix also provides selectable interrupted or intermittent operation for terminal 6.

The selections provided for PTFI*MTFI timings are:

Table 2:

SELECTION	PTFI		MTFI		COMMENT
	Term 5	Term 6	Term 5	Term 6	
10/10*10/15	10	10	10	15	
5/5*0/10	5	5	0	10	NO SPARK DURING MTFI
5/5*0/5	5	5	0	5	NO SPARK DURING MTFI
5/5*10/15	5	5	10	15	SHORTENED PTFI
5/5*10/10	5	5	10	10	
5/10*0/15	5	10	0	15	EARLY SPARK TERMINATION
5/10*0/10	5	10	0	10	EARLY SPARK TERMINATION
10/10*0/10	10	10	0	10	NO SPARK DURING MTFI
10/10*0/5	10	10	0	5	NO SPARK DURING MTFI
10/10*10/10	10	10	10	10	

SETTING PROGRAMMER PARAMETERS

In order to change the factory default parameters stored in the programmer module an optional keypad/ display (BLV512 or BLL510) is required. All configurable parameters are stored within the PROGRAM SETUP sub-menu. The keypad/display module provides tactile feedback keys that are used to access the sub-menus inherent in the BurnerLogix system.

Modifiable parameters located in PROGRAM SETUP sub menu

Parameter	Factory Default	Range	Description
Purge time	00:30s	0:30s – 60:00m, 15 second increments. 0:10s-60:00m, YP113 0:00s-60:00m, YP115 (0:00s - 60:00m in YP3XX)	Applies to open damper purge time in YP1XX and YP2XX programmers and to low fire start time in YP3XX programmers
Count method	DOWN	UP, DOWN	Time counts UP to final value or DOWN to zero from starting value. This setting will apply to all timer values.
Prove 3-P open at start	NO	YES, NO	Prevents jumped terminals. Requires the 3-P circuit to be open at the start of a cycle.
PTFI*MTFI timing	10/10*10/15 YP113 = 5/5*3/5	**See Table 2**	Applies to terminals 5 and 6 operation during PTFI and MTFI.
Terminal 6 interrupted or intermittent	INTRP	INTRP, INTMT	Provide interrupted or intermittent operation on terminal 6.
Prove M-8 open	NO	YES, NO	If YES, M-8 must be open at start of open damper purge period. (YP1XX Series only).
Prove M-D open	NO	YES, NO	If YES, M-D must be open at end of open damper purge period. Does not apply to YP3XX Series.
Post purge	0:15	0:15s - 4:00m*, 5 second increments.	Selects Post Purge time * code 8 or above display required
3-P Recycle	YES	YES, NO	Applies to YP3XX series only. Allows non-recycle operation of 3-P circuit.
M-D WAIT 10m	YES	YES, NO	Select YES for lockout on M-D open for 10 minutes. Select NO for indefinite wait for M-D to close. This wait time applies prior to pilot trial for ignition.
PROVE M-D TFI	NO	YES, NO	Select YES to force lockout on M-D opening during PTFI and MTFI
Baud rate	9600	4800, 9600, 19200, 38400*	Sets communication baud rate, * code 8 or above display required
Unit address	00	00-31	Multi-drop requires unique addressing. Lowest address allowed for modbus is 01
Lock Settings	NO	YES, NO	Parameters can be stored to memory before automatic 8 hour store.

Note:Shaded parameters not affected by 8 hour burn-in or LOCK SETTINGS.

TO VIEW AND MODIFY A PROGRAMMABLE PARAMETER:

On display module BLV512 or BLL510, use the NEXT or BACK key to scroll to PROGRAM SETUP. Press the MODE key to enter the submenu showing all program setup parameters. Pressing the MODE key while in the sub-menu will exit the sub-menu, and the next main menu item will be displayed. While in the sub-menu, pressing the NEXT key will scroll forward through the sub-menu. Pressing the BACK key will scroll backward through the sub-menu. When a modifiable parameter is displayed, pressing the RESET/MDFY key will allow the displayed parameter to be modified. Use the NEXT or BACK keys to select the value to suit the application and when done, press the RESET/MDFY to save the value to memory.

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All programmed settings become permanent if the BurnerLogix system has been powered continuously and 8 hours of main burner (terminal 7) on time has been accumulated. If the AC power is removed prior to accumulating 8 hours of main burner on time, the system burn-in time clock will be reset to zero. It is not necessary for the main burner on time to be continuous. The BurnerLogix accumulates burner on time in seconds. For example, assume power has been applied for 10 hours and the main burner has been on for 4 hours. If the AC power is removed and then restored the accumulated main burner on time will be reset to 0. If necessary, the programmed settings can be made to become permanent anytime before the required 8 hours of main burner on time through the use of the optional keypad and the LOCK SETTINGS option under the PROGRAM SETUP sub menu.

Refer to Bulletin BL-1001 or BLZ-1001 for complete information

NOTICE

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WARRANTIES

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FIREYE®
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YP-1001
APRIL 3, 2013
Supersedes April 8, 2010

FIREYE Inc.
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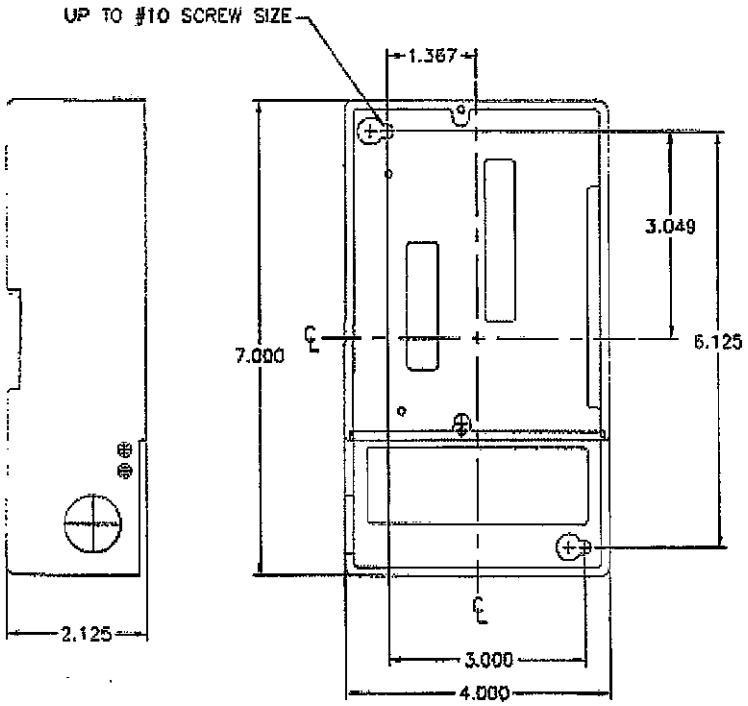
INSTALLATION INSTRUCTIONS 133-677
TERMINAL BLOCK WIRING BASE
Used with BurnerLogix Y type only
FLAME SAFEGUARD and BOILER CONTROL

Wiring base part number **60-2812-1** offers a closed wiring compartment suitable for mounting outside of a cabinet. Knockouts are located along the bottom surface of the wiring base. Wiring base **60-2814-1** offers an open wiring base accessible from the bottom and suitable for mounting inside a cabinet. Both wiring base styles contain a terminal block inside the wiring compartment and is located outside of the control mounting area. Torque rating on terminal block screws is 4.4 in/lbs to 5.3 in/lbs. Access to the compartment is gained by loosening and NOT removing the screws used to secure the housing compartment cover. The terminal block allows easy troubleshooting access to all BurnerLogix control terminals without the need to remove the control from the base. As shipped, all knockouts on the **60-2812-1** are in place and can be easily removed with either a screwdriver, used as a chisel or a blunt force of greater than 10 lbs. The wiring base can be mounted using either a din rail or direct mounted to a back plate using up to #10-32 screws. The mounting location for the din rail is along the horizontal center line.



The mounting information is detailed as follows:

Ensure that electric power is turned off!

WARNING: Installer must be trained and qualified. Follow the burner manufacturer's instructions. Controls require safety limits utilizing isolated mechanical contacts. Electronic limit switches may cause erratic operation and should be avoided.

CAUTION: Refer to SN-100 for recommended grounding techniques. Be aware that power to some interlocks (operating controls, air flow switches, modulating circuits, etc.) may be derived from sources other than what is controlling the BurnerLogiX.

Terminal No.	Wire Color	Type	Description	Rating
L1 (Hot)	Black		Line voltage supply	120 VAC (+10%,-15%), 50/60 Hz
L2 (Neutral)	White		Line voltage common	
EARTH	Green	Ground		
S1	Red/Wht		Scanner Input	300 VAC, 3 mA
S2	Blu/Wht		Scanner Input	300 VAC, 3 mA
A	Red	Output	Alarm	120 VAC, 1 A pilot duty
M	Brown	Output	Combustion Blower	120 VAC, 9.8 FLA, 58.8 LRA
3	Yellow	Input	Operating Control	120 VAC, 1 mA
13	Orange	Input	Fuel Valve End Switch, Pre-Ignition Interlock	120 VAC, 1 mA
P	Gray	Input	Running Interlock	120 VAC, 1 mA
D	Wht/Brn	Input	Low Fire Start Switch	120 VAC, 1 mA
8	Wht/Gry	Input	Open Damper Proving Switch	120 VAC, 1 mA
W	Wht/Orn	Output	Delayed Main Valve	See Table
5	LT Blue	Output	Ignition / Pilot Valve	See Table
6	Tan	Output	Pilot Valve	See Table
7	Violet	Output	Main Fuel Valve	See Table
16	DK Blue	Input	Pilot Valve Hold	120 VAC, 1 mA
21	Pink	Input	Start Input	120 VAC, 1 mA
10	Wht/Red	Output	Modulator Common	120 VAC 75 VA
12	Wht/Yel	Output	Modulator Low Fire	120 VAC 75 VA
X	Wht/Blue	Output	Modulator High Fire	120 VAC 75 VA
11	Wht/Grn	Output	Modulator Auto	120 VAC 75 VA
22	Wht/Vio	Input	Remote Reset	120 VAC, 1 mA
23	Brn/Wht	Input	Spare 2	120 VAC, 1 mA

Combination No.	Pilot	Main	Ignition	Delayed Valve
1	C	E	No Load	No Load
2	B	E	No Load	No Load
3	No Load	E	No Load	B
4	E	E	A	No Load
5	No Load	E	A	E
6	D	E	A	No Load
7	D	D	A	D
8	No Load	D	A	No Load

Composition of each Combination

A	B	C	D	E
4.5 A Ignition	50 VA Pilot Duty plus 4.5 A Ignition	180 VA Ignition plus motor valves with: 660 VA inrush, 360 VA open, 250 VA hold.	2 A Pilot Duty	65 VA Pilot Duty plus motor valves with: 3850 VA inrush 700 VA open, 250 VA hold

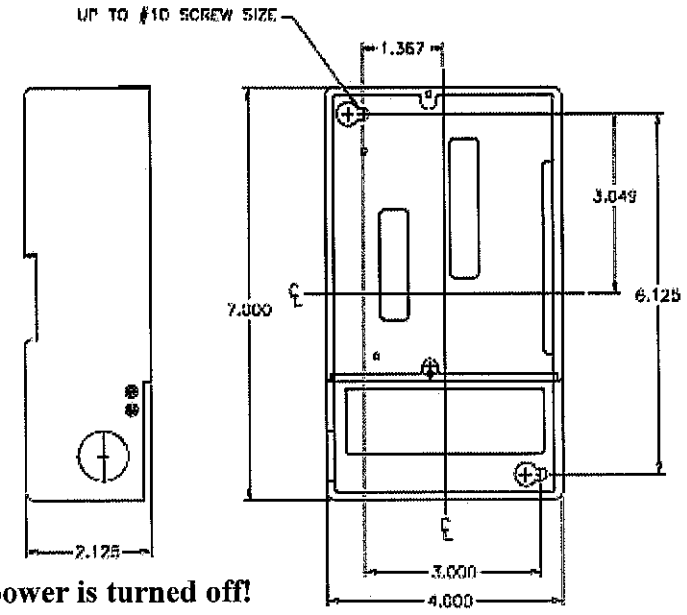
MAXIMUM CONNECTED LOAD NOT TO EXCEED 2000 VA

INSTALLATION INSTRUCTIONS
133-707

Terminal Block Wiring Base Used with BurnerLogix YZ300 Interlock Annunciator

INSTALLATION INSTRUCTIONS

Wiring base part number 60-2872-1 offers a closed wiring compartment suitable for mounting outside of a cabinet. Knockouts are located along the bottom surface of the wiring base. Wiring base 60-2874-1 offers an open wiring base accessible from the bottom and suitable for mounting inside a cabinet. Both wiring base styles contain a terminal block inside the wiring compartment and are located outside of the control mounting area. Torque rating on terminal block screws is 4.4 in/lbs to 5.3 in/lbs. Access to the compartment is gained by loosening and NOT removing the screws used to secure the housing compartment cover. The terminal block allows easy troubleshooting access to all YZ300 Interlock Annunciator terminals without the need to remove the control from the base. As shipped, all knockouts on the 60-2872-1 are in place and can be easily removed with either a screwdriver (used as a chisel) or a blunt force of greater than 10 lbs. The wiring base can be mounted using either a din rail or direct mounted to a back plate using up to #10-32 screws. The mounting location for the din rail is along the horizontal center line. The mounting information is detailed as follows:

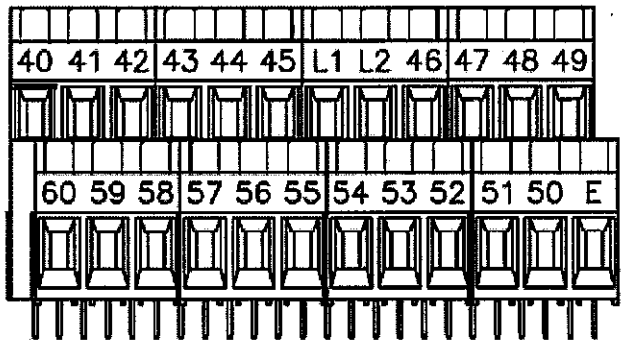


Ensure that electrical power is turned off!

WARNING: Installer must be trained and qualified. Follow the burner manufacturer's instructions. Controls require safety limits utilizing isolated mechanical contacts. Electronic limit switches may cause erratic operation and should be avoided.

CAUTION: Refer to SN-100 for recommended grounding techniques. Be aware that power to some interlocks (operating controls, air flow switches, modulating circuits, etc.) may be derived from sources other than what is controlling the BurnerLogix

Wiring bases 60-2872-1 and 60-2874-1 each contain a 24 position terminal block. Each terminal can accept either 2 type 16 AWG wires or a single type 14 AWG wire. Each terminal is a clamp type terminal that provides sufficient pressure against the wire. For any interlock of the YZ300 that is not used, a jumper must be placed between those two terminals. For example, if AUX LIMIT #7 is not used, a jumper must be placed from terminal 59 to terminal 60.



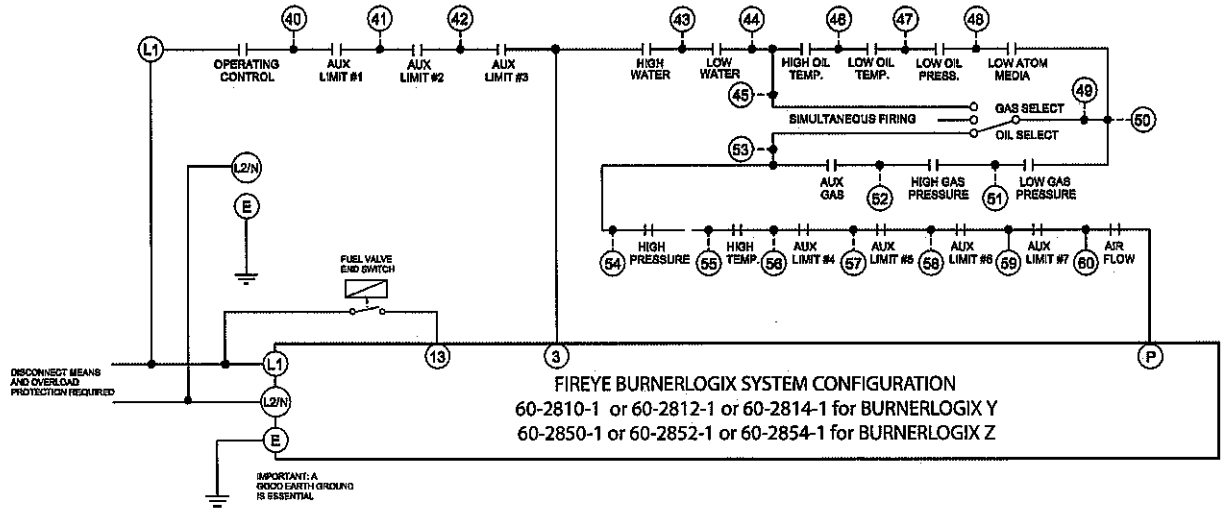
The fuel select switch connects to terminals 45, 49 and 53.

Important: If a particular interlock is not used, a jumper must be installed on the terminals of the Interlock Annunciator Module wiring base which corresponds to that unused interlock. For example: if the system has no high temperature switch and no need for auxiliary limits 5 and 6, a jumper should be placed between terminals 55 and 56, 57 and 58, 58 and 59.

Important: When a single fuel burner is used, a fuel selector switch is not necessary. However, the fuel selection terminals for the unused fuel type must be jumped out.

For gas only: connect terminal 45 to 49
For oil only: connect terminal 49 to 53

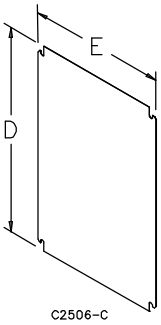
When the fuel selector switch is in the GAS position, the 4 oil interlocks are ignored by the BurnerLogix Control. When the switch is in the OIL position, the 3 gas interlocks are ignored.



Refer to bulletin YZEM-3001 for operational detail.

Note: All existing wiring on terminals not shown will be undisturbed when the YZ300 is installed.

CONCEPT® Panels



Panels for CONCEPT enclosures are 14 or 12 gauge steel. They are painted white or have a conductive finish.

Catalog Number Painted	Catalog Number Conductive	Panel Size D x E (in.)	Panel Size D x E (mm)	Gauge
CP1212	CP1212G	10.20 x 10.20	259 x 259	14
CP1612	CP1612G	14.20 x 10.20	361 x 259	14
CP1616	CP1616G	14.20 x 14.20	361 x 361	12
CP2016	CP2016G	18.20 x 14.20	462 x 361	12
CP2416	CP2416G	22.20 x 14.20	564 x 361	12
CP2020	CP2020G	18.20 x 18.20	462 x 462	12
CP2420	CP2420G	22.20 x 18.20	564 x 462	12
CP3020	CP3020G	28.20 x 18.20	716 x 462	12
CP2424	CP2424G	22.20 x 22.20	564 x 564	12
CP3024	CP3024G	28.20 x 22.20	716 x 564	12
CP3624	CP3624G	34.20 x 22.20	869 x 564	12
CP4824	CP4824G	46.20 x 22.20	1173 x 564	12
CP3030	CP3030G	28.20 x 28.20	716 x 716	12
CP3630	CP3630G	34.20 x 28.20	869 x 716	12
CP4230	CP4230G	40.20 x 28.20	1021 x 716	12
CP3636	CP3636G	34.20 x 34.20	869 x 869	12
CP4236	CP4236G	40.20 x 34.20	1021 x 869	12
CP4836	CP4836G	46.20 x 34.20	1173 x 869	12
CP6036	CP6036G	58.20 x 34.20	1478 x 869	12
CP2442	CP2442G	22.20 x 40.20	564 x 1021	12
CP3048	CP3048G	28.20 x 46.20	716 x 1173	12
CP3060	CP3060G	28.20 x 58.20	716 x 1478	12

CONCEPT® Swing-Out Panels

CSPB panels

CSP panels

Panels swing clear from front of the enclosure to provide access to mounted internal equipment. For CSPB panels, maximum swing is 94 degrees. For CSP panels, maximum panel swing is 106 degrees. Distance from panel surface to door when in the latched position is 1.71 in. (43mm) for solid doors and 1.45 in. (37mm) for window doors. Kits include panel, brackets, and hardware to mount to the front flange.

NOTE: Swing-out panels also can be mounted on front-to-back adjustable rails with adapter CSPBADB.

CSP Catalog Number	Fits Enclosure Size A x B (in.)	Fits Enclosure Size A x B (mm)	Panel Size D x E (in.)	Panel Size D x E (mm)
CSP1212	12.00 x 12.00	305 x 305	9.78 x 9.84	248 x 250
CSP1612	16.00 x 12.00	406 x 305	13.78 x 9.84	350 x 250
CSP1616	16.00 x 16.00	406 x 406	13.78 x 13.84	350 x 352
CSP1620	16.00 x 20.00	406 x 508	13.78 x 17.84	350 x 453
CSP2016	20.00 x 16.00	508 x 406	17.78 x 13.84	452 x 352
CSP2020	20.00 x 20.00	508 x 508	17.78 x 17.84	452 x 453
CSP2024	20.00 x 24.00	508 x 610	17.78 x 21.84	452 x 555
CSP2416	24.00 x 16.00	610 x 406	21.78 x 13.84	553 x 352
CSP2420	24.00 x 20.00	610 x 508	21.78 x 17.84	553 x 453
CSP2424	24.00 x 24.00	610 x 610	21.78 x 21.84	553 x 555
CSP3020	30.00 x 20.00	762 x 508	27.78 x 17.84	706 x 453
CSP3024	30.00 x 24.00	762 x 610	27.78 x 21.84	706 x 555
CSP3030	30.00 x 30.00	762 x 762	27.78 x 27.84	706 x 707
CSP3624	36.00 x 24.00	914 x 610	33.78 x 21.84	858 x 555
CSP3630	36.00 x 30.00	914 x 762	33.78 x 27.84	858 x 707
CSP3636	36.00 x 36.00	914 x 914	33.78 x 33.84	858 x 860

CSPB Catalog Number	Fits Enclosure Size A x B (in.)	Fits Enclosure Size A x B (mm)	Panel Size D x E (in.)	Panel Size D x E (mm)
CSPB1212	12.00 x 12.00	305 x 305	9.72 x 9.75	247 x 248
CSPB1612	16.00 x 12.00	406 x 305	13.72 x 9.75	349 x 248
CSPB1616	16.00 x 16.00	406 x 406	13.72 x 13.75	349 x 349
CSPB1620	16.00 x 20.00	406 x 508	13.72 x 17.75	349 x 451
CSPB2016	20.00 x 16.00	508 x 406	17.72 x 13.75	450 x 349
CSPB2020	20.00 x 20.00	508 x 508	17.72 x 17.75	450 x 451
CSPB2024	20.00 x 24.00	508 x 610	17.72 x 21.75	450 x 553
CSPB2416	24.00 x 16.00	610 x 406	21.72 x 13.73	552 x 349
CSPB2420	24.00 x 20.00	610 x 508	21.72 x 17.75	552 x 452
CSPB2424	24.00 x 24.00	610 x 610	21.72 x 21.75	552 x 553
CSPB2430	24.00 x 30.00	610 x 762	21.72 x 27.75	552 x 705
CSPB3020	30.00 x 20.00	762 x 508	27.72 x 17.75	704 x 451
CSPB3024	30.00 x 24.00	762 x 610	27.72 x 21.75	704 x 553
CSPB3030	30.00 x 30.00	762 x 762	27.72 x 27.75	704 x 705
CSPB3624	36.00 x 24.00	914 x 610	33.72 x 21.75	857 x 553
CSPB3630	36.00 x 30.00	914 x 762	33.72 x 27.75	857 x 705
CSPB3636	36.00 x 36.00	914 x 914	33.72 x 33.75	857 x 857
CSPB4236	42.00 x 36.00	1067 x 914	39.72 x 33.75	1009 x 857
CSPB4824	48.00 x 24.00	1219 x 610	45.72 x 21.75	1161 x 553
CSPB4836	48.00 x 36.00	1219 x 914	45.72 x 33.75	1161 x 857
CSPB6036	60.00 x 36.00	1542 x 914	57.72 x 33.75	1466 x 857

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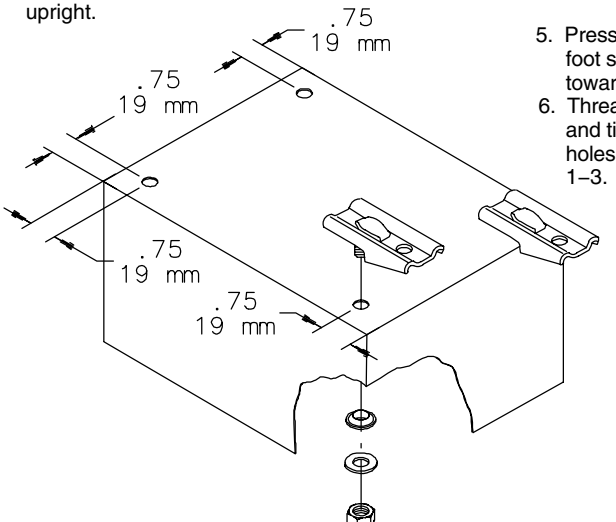
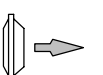
Mounting Feet

1. Locate mounting foot stud location using the dimensions given. (when holes are not provided)
2. Use center punch to mark hole centers, and drill four .5 inch (13 mm) diameter holes.
3. Deburr holes.
4. Insert mounting foot studs into drilled holes and turn enclosure upright.



5. Press sealing washer onto mounting foot stud with the tapered cone towards the hole and add flat washer.
6. Thread nut onto mounting foot stud and tighten to 200 in–lbs. Note: If holes are pre–punched, omit steps 1–3.



Sealing Washer Detail

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CONCEPT® Stainless Steel Type 4X Wall-Mounted Enclosures

Application

The CONCEPT stainless steel enclosure, with its streamlined design and Type 4X rating, is a perfect fit for mounting electrical or high-tech electronic equipment in a variety of indoor and outdoor settings. It is typically used in the following areas where corrosion-resistant protection is needed: food processing plants, pharmaceutical manufacturing facilities, petrochemical plants, pulp and paper processing, and water treatment facilities.

Construction

- Manufactured from 16 or 14 gauge Type 304 or 316L stainless steel
- Seams continuously welded and ground smooth
- Minimum-width body flange provides maximum door opening
- Body flange trough excludes liquids and contaminants
- Panel mounting studs fit optional CONCEPT panels and other accessories
- Mounting holes in back of body for direct mounting or for optional external mounting brackets
- Type 304 stainless steel hidden hinges promote clean aesthetic appearance
- Standard full-access door opening
- Doors are interchangeable and easily removable by pulling captive hinge pins
- Provision on door (except window door style) for thermoplastic data pocket
- Provision on door (except window door style) for optional doorstop kit
- Quarter-turn latches (or a 3-point latch system on larger enclosures) furnished with flush slotted insert. Optional handles or inserts are available.
- Seamless foam-in-place gasket provides oiltight and dusttight seal against contaminants
- Self-grounding latch system with double seal provides maximum protection against leakage
- Bonding provision on door. Grounding stud on body.
- Furnished hardware kit consists of panel-mounting nuts, panel-grounding hardware, and sealing washers for wall-mounting holes
- Installation instructions for enclosure and accessories are provided

Finish

Enclosures are unpainted. Door and body have smooth #4 brushed finish. Optional mild steel panels are painted white. Optional conductive panels are available.

Industry Standards

Mounting brackets required to meet UL/CSA external mounting requirements.

UL 508A, File No. E61997: Type 3R, 4, 4X, and 12
NEMA/EEMAC Type 3R, 4, 4X, 12, and 13
CSA File No. 42186: Type 4, 4X, and 12
VDE IP66
IEC 60529, IP66

Meets Type 3RX requirements

Patents

This product covered by the following patents:

US 360,345
DE 9405854.7
US 5,509,703
US 5,666,695

Other patents pending.

Accessories

Corrosion Inhibitors
Data Pocket
DIN3 Rails
Door Stop Kit
Lighting Kits
Mounting Brackets
Panels
Panels, NEMA
Terminal Block Kit Assembly
Thermal Accessories

Data Pockets for Solid Door Enclosures

- No pocket when enclosure B dimension = 12.00 in. (305mm)
- Small pocket when enclosure A dimension <30.00 in. (762mm) and B dimension is between 12 in. (305mm) and 20.00 in. (508mm)
- Large pocket when enclosure A dimension >30.00 in. (762mm) and B dimension is >20.00 in. (508mm)

Modification Services Program

You can customize this product to your unique requirements by specifying from these options:

- Enclosure height, width, depth
- Holes and cutouts in body, doors, subpanels
- Tapped holes in subpanels
- Fasteners, mounting channel in enclosure and subpanel
- Mounting (adds and deletes)
- Doors
- Subpanels
- Thermal management (louvers, fans, filters)
- Windows
- Standard accessories
- Drip shield

To order, contact your local Hoffman sales representative.

NOTE: For information about modifications outside the scope of the Modification Services program, contact your Hoffman sales representative.

Subject to change without notice
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CONCEPT® Stainless Steel Type 4X Wall-Mounted Enclosures

Standard Sizes CONCEPT® Stainless Steel Single-Door Wall-Mount Enclosures

Catalog Number	A x B x C in. (mm)	Stainless Steel Type	Door Ga.	Body Ga.	CONCEPT Panel Catalog Number	Conductive Panel Catalog Number	Panel Size D x E (in.)	Panel Size D x E (mm)	Mounting G x H (in.)	Mounting G x H (mm)	Latch (qty)	Latch (style)	J (in.)	J (mm)
CSD12126SS	12.00 x 12.00 x 6.00 (305 x 305 x 152)	304	16	16	CP1212	CP1212G	10.20 x 10.20	259 x 259	10.50 x 10.50	267 x 267	1	1/4-turn	6.00	152
CSD12126SS6	12.00 x 12.00 x 6.00 (305 x 305 x 152)	316L	16	16	CP1212	CP1212G	10.20 x 10.20	259 x 259	10.50 x 10.50	267 x 267	1	1/4-turn	6.00	152
CSD16126SS	16.00 x 12.00 x 6.00 (406 x 305 x 152)	304	16	16	CP1612	CP1612G	14.20 x 10.20	361 x 259	14.50 x 10.50	368 x 267	1	1/4-turn	8.00	203
CSD16126SS6	16.00 x 12.00 x 6.00 (406 x 305 x 152)	316L	16	16	CP1612	CP1612G	14.20 x 10.20	361 x 259	14.50 x 10.50	368 x 267	1	1/4-turn	8.00	203
CSD16166SS	16.00 x 16.00 x 6.00 (406 x 406 x 152)	304	16	16	CP1616	CP1616G	14.20 x 14.20	361 x 361	14.50 x 14.50	368 x 368	1	1/4-turn	8.00	203
CSD16166SS6	16.00 x 16.00 x 6.00 (406 x 406 x 152)	316L	16	16	CP1616	CP1616G	14.20 x 14.20	361 x 361	14.50 x 14.50	368 x 368	1	1/4-turn	8.00	203
CSD20166SS	20.00 x 16.00 x 6.00 (508 x 406 x 152)	304	16	16	CP2016	CP2016G	18.20 x 14.50	462 x 361	18.50 x 14.50	470 x 368	1	1/4-turn	10.00	254
CSD20166SS6	20.00 x 16.00 x 6.00 (508 x 406 x 152)	316L	16	16	CP2016	CP2016G	18.20 x 14.50	462 x 361	18.50 x 14.50	470 x 368	1	1/4-turn	10.00	254
CSD20206SS	20.00 x 20.00 x 6.00 (508 x 508 x 152)	304	16	16	CP2020	CP2020G	18.20 x 18.20	462 x 462	18.50 x 18.50	470 x 470	1	1/4-turn	10.00	254
CSD20206SS6	20.00 x 20.00 x 6.00 (508 x 508 x 152)	316L	16	16	CP2020	CP2020G	18.20 x 18.20	462 x 462	18.50 x 18.50	470 x 470	1	1/4-turn	10.00	254
CSD16128SS	16.00 x 12.00 x 8.00 (406 x 305 x 203)	304	16	16	CP1612	CP1612G	14.20 x 10.20	361 x 259	14.50 x 10.50	368 x 267	1	1/4-turn	8.00	203
CSD16128SS6	16.00 x 12.00 x 8.00 (406 x 305 x 203)	316L	16	16	CP1612	CP1612G	14.20 x 10.20	361 x 259	14.50 x 10.50	368 x 267	1	1/4-turn	8.00	203
CSD16168SS	16.00 x 16.00 x 8.00 (406 x 406 x 203)	304	16	16	CP1616	CP1616G	14.20 x 14.20	361 x 361	14.50 x 14.50	368 x 368	1	1/4-turn	8.00	203
CSD16168SS6	16.00 x 16.00 x 8.00 (406 x 406 x 203)	316L	16	16	CP1616	CP1616G	14.20 x 14.20	361 x 361	14.50 x 14.50	368 x 368	1	1/4-turn	8.00	203
CSD16208SS	16.00 x 20.00 x 8.00 (406 x 508 x 203)	304	16	16	CP2016	CP2016G	18.20 x 14.20	462 x 361	14.50 x 18.50	368 x 470	1	1/4-turn	8.00	203
CSD16208SS6	16.00 x 20.00 x 8.00 (406 x 508 x 203)	316L	16	16	CP2016	CP2016G	18.20 x 14.20	462 x 361	14.50 x 18.50	368 x 470	1	1/4-turn	8.00	203
CSD20168SS	20.00 x 16.00 x 8.00 (508 x 406 x 203)	304	16	16	CP2016	CP2016G	18.20 x 14.20	462 x 361	18.50 x 14.50	470 x 368	1	1/4-turn	10.00	254
CSD20168SS6	20.00 x 16.00 x 8.00 (508 x 406 x 203)	316L	16	16	CP2016	CP2016G	18.20 x 14.20	462 x 361	18.50 x 14.50	470 x 368	1	1/4-turn	10.00	254
CSD20208SS	20.00 x 20.00 x 8.00 (508 x 508 x 203)	304	16	16	CP2020	CP2020G	18.20 x 18.20	462 x 462	18.50 x 18.50	470 x 470	1	1/4-turn	10.00	254
CSD20208SS6	20.00 x 20.00 x 8.00 (508 x 508 x 203)	316L	16	16	CP2020	CP2020G	18.20 x 18.20	462 x 462	18.50 x 18.50	470 x 470	1	1/4-turn	10.00	254
CSD24168SS	24.00 x 16.00 x 8.00 (610 x 406 x 203)	304	16	16	CP2416	CP2416G	22.20 x 14.20	564 x 361	22.50 x 14.50	572 x 368	1	1/4-turn	12.00	305
CSD24168SS6	24.00 x 16.00 x 8.00 (610 x 406 x 203)	316L	16	16	CP2416	CP2416G	22.20 x 14.20	564 x 361	22.50 x 14.50	572 x 368	1	1/4-turn	12.00	305
CSD24208SS	24.00 x 20.00 x 8.00 (610 x 508 x 203)	304	16	16	CP2420	CP2420G	22.20 x 18.20	564 x 462	22.50 x 18.50	572 x 470	1	1/4-turn	12.00	305
CSD24208SS6	24.00 x 20.00 x 8.00 (610 x 508 x 203)	316L	16	16	CP2420	CP2420G	22.20 x 18.20	564 x 462	22.50 x 18.50	572 x 470	1	1/4-turn	12.00	305
CSD24248SS	24.00 x 24.00 x 8.00 (610 x 610 x 203)	304	14	16	CP2424	CP2424	22.20 x 22.20	564 x 564	22.50 x 22.50	572 x 572	2	1/4-turn	5.00	127
CSD24248SS6	24.00 x 24.00 x 8.00 (610 x 610 x 203)	316L	14	16	CP2424	CP2424G	22.20 x 22.20	564 x 564	22.50 x 22.50	572 x 572	2	1/4-turn	5.00	127
CSD30248SS	30.00 x 24.00 x 8.00 (762 x 610 x 203)	304	14	16	CP3024	CP3024G	28.20 x 22.20	716 x 564	28.50 x 22.50	724 x 572	2	1/4-turn	5.00	127
CSD30248SS6	30.00 x 24.00 x 8.00 (762 x 610 x 203)	316L	14	16	CP3024	CP3024G	28.20 x 22.20	716 x 564	28.50 x 22.50	724 x 572	2	1/4-turn	5.00	127
CSD30308SS	30.00 x 30.00 x 8.00 (762 x 762 x 203)	304	14	14	CP3030	CP3030G	28.20 x 28.20	716 x 716	28.50 x 28.50	724 x 724	2	1/4-turn	5.00	127
CSD30308SS6	30.00 x 30.00 x 8.00 (762 x 762 x 203)	316L	14	14	CP3030	CP3030G	28.20 x 28.20	716 x 716	28.50 x 28.50	724 x 724	2	1/4-turn	5.00	127
CSD36248SS	36.00 x 24.00 x 8.00 (914 x 610 x 203)	304	14	16	CP3624	CP3624G	34.20 x 22.20	869 x 564	34.50 x 22.50	876 x 572	2	1/4-turn	5.00	127
CSD36248SS6	36.00 x 24.00 x 8.00 (914 x 610 x 203)	316L	14	16	CP3624	CP3624G	34.20 x 22.20	869 x 564	34.50 x 22.50	876 x 572	2	1/4-turn	5.00	127
CSD36308SS	36.00 x 30.00 x 8.00 (914 x 762 x 203)	304	14	14	CP3630	CP3630G	34.20 x 28.20	869 x 716	34.50 x 28.50	876 x 724	2	1/4-turn	5.00	127
CSD36308SS6	36.00 x 30.00 x 8.00 (914 x 762 x 203)	316L	14	14	CP3630	CP3630G	34.20 x 28.20	869 x 716	34.50 x 28.50	876 x 724	2	1/4-turn	5.00	127

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CONCEPT® Stainless Steel Type 4X Wall-Mounted Enclosures

Standard Sizes CONCEPT® Stainless Steel Single-Door Wall-Mount Enclosures (Cont.)

Catalog Number	A x B x C in. (mm)	Stain-less Steel Type	Door Ga.	Body Ga.	CONCEPT Panel Catalog Number	Conductive Panel Catalog Number	Panel Size D x E (in.)	Panel Size D x E (mm)	Mounting G x H (in.)	Mounting G x H (mm)	Latch (qty)	Latch (style)	J (in.)	J (mm)
CSD161210SS	16.00 x 12.00 x 10.00 (406 x 305 x 254)	304	16	16	CP1612	CP1612G	14.20 x 10.20	361 x 259	14.50 x 10.50	368 x 267	1	1/4-turn	8.00	203
CSD161210SS6	16.00 x 12.00 x 10.00 (406 x 305 x 254)	316L	16	16	CP1612	CP1612G	14.20 x 10.20	361 x 259	14.50 x 10.50	368 x 267	1	1/4-turn	8.00	203
CSD161610SS	16.00 x 16.00 x 10.00 (406 x 406 x 254)	304	16	16	CP1616	CP1616G	14.20 x 14.20	361 x 361	14.50 x 14.50	368 x 368	1	1/4-turn	8.00	203
CSD161610SS6	16.0 x 16.00 x 10.00 (406 x 406 x 254)	316L	16	16	CP1616	CP1616G	14.20 x 14.20	361 x 361	14.50 x 14.50	368 x 368	1	1/4-turn	8.00	203
CSD162010SS	16.00 x 20.00 x 10.00 (406 x 508 x 254)	304	16	16	CP2016	CP2016G	18.20 x 14.20	462 x 361	14.50 x 18.50	368 x 470	1	1/4-turn	8.00	203
CSD162010SS6	16.00 x 20.00 x 10.00 (406 x 508 x 254)	316L	16	16	CP2016	CP2016G	18.20 x 14.20	462 x 361	14.50 x 18.50	368 x 470	1	1/4-turn	8.00	203
CSD201610SS	20.00 x 16.00 x 10.00 (508 x 406 x 254)	304	16	16	CP2016	CP2016G	18.20 x 14.20	462 x 361	18.50 x 14.50	470 x 368	1	1/4-turn	10.00	254
CSD201610SS6	20.00 x 16.00 x 10.00 (508 x 406 x 254)	316L	16	16	CP2016	CP2016G	18.20 x 14.20	462 x 361	18.50 x 14.50	470 x 368	1	1/4-turn	10.00	254
CSD202010SS	20.00 x 20.00 x 10.00 (508 x 508 x 254)	304	16	16	CP2020	CP2020G	18.20 x 18.20	462 x 462	18.50 x 18.50	470 x 470	1	1/4-turn	10.00	254
CSD202010SS6	20.00 x 20.00 x 10.00 (508 x 508 x 254)	316L	16	16	CP2020	CP2020G	18.20 x 18.20	462 x 462	18.50 x 18.50	470 x 470	1	1/4-turn	10.00	254
CSD202410SS	20.00 x 24.00 x 10.00 (508 x 610 x 254)	304	16	16	CP2420	CP2420G	22.20 x 18.20	464 x 462	18.50 x 22.50	470 x 572	1	1/4-turn	10.00	254
CSD202410SS6	20.00 x 24.00 x 10.00 (508 x 610 x 254)	316L	16	16	CP2420	CP2420G	22.20 x 18.20	464 x 462	18.50 x 22.50	470 x 572	1	1/4-turn	10.00	254
CSD241610SS	24.00 x 16.00 x 10.00 (610 x 406 x 254)	304	16	16	CP2416	CP2416G	22.20 x 14.20	564 x 361	22.50 x 14.50	572 x 368	1	1/4-turn	12.00	305
CSD241610SS6	24.00 x 16.00 x 10.00 (610 x 406 x 254)	316L	16	16	CP2416	CP2416G	22.20 x 14.20	564 x 361	22.50 x 14.50	572 x 368	1	1/4-turn	12.00	305
CSD242010SS	24.00 x 20.00 x 10.00 (610 x 508 x 254)	304	16	16	CP2420	CP2420G	22.20 x 18.20	564 x 462	22.50 x 18.50	572 x 470	1	1/4-turn	12.00	305
CSD242010SS6	24.00 x 20.00 x 10.00 (610 x 508 x 254)	316L	16	16	CP2420	CP2420G	22.20 x 18.20	564 x 462	22.50 x 18.50	572 x 470	1	1/4-turn	12.00	305
CSD242410SS	24.00 x 24.00 x 10.00 (610 x 610 x 254)	304	14	16	CP2424	CP2424G	22.20 x 22.20	564 x 564	22.50 x 22.50	572 x 572	2	1/4-turn	5.00	127
CSD242410SS6	24.00 x 24.00 x 10.00 (610 x 610 x 254)	316L	14	16	CP2424	CP2424	22.20 x 22.20	564 x 564	22.50 x 22.50	572 x 572	2	1/4-turn	5.00	127
CSD243010SS	24.00 x 30.00 x 10.00 (610 x 762 x 254)	304	14	16	CP3024	CP3024G	28.20 x 22.20	716 x 564	22.50 x 28.50	572 x 724	2	1/4-turn	5.00	127
CSD243010SS6	24.00 x 30.00 x 10.00 (610 x 762 x 254)	316L	14	16	CP3024	CP3024G	28.20 x 22.20	716 x 564	22.50 x 28.50	572 x 724	2	1/4-turn	5.00	127
CSD302010SS	30.00 x 20.00 x 10.00 (762 x 508 x 254)	304	14	16	CP3020	CP3020G	28.20 x 18.20	716 x 462	28.50 x 18.50	724 x 470	2	1/4-turn	5.00	127
CSD302010SS6	30.00 x 20.00 x 10.00 (762 x 508 x 254)	316L	14	16	CP3020	CP3020G	28.20 x 18.20	716 x 462	28.50 x 18.50	724 x 470	2	1/4-turn	5.00	127
CSD302410SS	30.00 x 24.00 x 10.00 (762 x 610 x 254)	304	14	16	CP3024	CP3024G	28.20 x 22.20	716 x 564	28.50 x 22.50	724 x 572	2	1/4-turn	5.00	127
CSD302410SS6	30.00 x 24.00 x 10.00 (762 x 610 x 254)	316L	14	16	CP3024	CP3024G	28.20 x 22.20	716 x 564	28.50 x 22.50	724 x 572	2	1/4-turn	5.00	127
CSD303010SS	30.00 x 30.00 x 10.00 (762 x 762 x 254)	304	14	14	CP3030	CP3030G	28.20 x 28.20	716 x 716	28.50 x 28.50	724 x 724	2	1/4-turn	5.00	127
CSD303010SS6	30.00 x 30.00 x 10.00 (762 x 762 x 254)	316L	14	14	CP3030	CP3030G	28.20 x 28.20	716 x 716	28.50 x 28.50	724 x 724	2	1/4-turn	5.00	127
CSD362410SS	36.00 x 24.00 x 10.00 (914 x 610 x 254)	304	14	16	CP3624	CP3624G	34.20 x 22.20	869 x 564	34.50 x 22.50	876 x 572	2	1/4-turn	5.00	127
CSD362410SS6	36.00 x 24.00 x 10.00 (914 x 610 x 254)	316L	14	16	CP3624	CP3624G	34.20 x 22.20	869 x 564	34.50 x 22.50	876 x 572	2	1/4-turn	5.00	127
CSD363010SS	36.00 x 30.00 x 10.00 (914 x 762 x 254)	304	14	14	CP3630	CP3630G	34.20 x 28.20	869 x 716	34.50 x 28.50	876 x 724	2	1/4-turn	5.00	127
CSD363010SS6	36.00 x 30.00 x 10.00 (914 x 762 x 254)	316L	14	14	CP3630	CP3630G	34.20 x 28.20	869 x 716	34.50 x 28.50	876 x 724	2	1/4-turn	5.00	127
CSD482410SS	48.00 x 24.00 x 10.00 (1220 x 610 x 254)	304	14	14	CP4824	CP4824G	46.20 x 22.20	1173 x 564	46.50 x 22.50	1181 x 572	1	3-point	24.00	610
CSD482410SS6	48.00 x 24.00 x 10.00 (1220 x 610 x 254)	316L	14	14	CP4824	CP4824G	46.20 x 22.20	1173 x 564	46.50 x 22.50	1181 x 572	1	3-point	24.00	610

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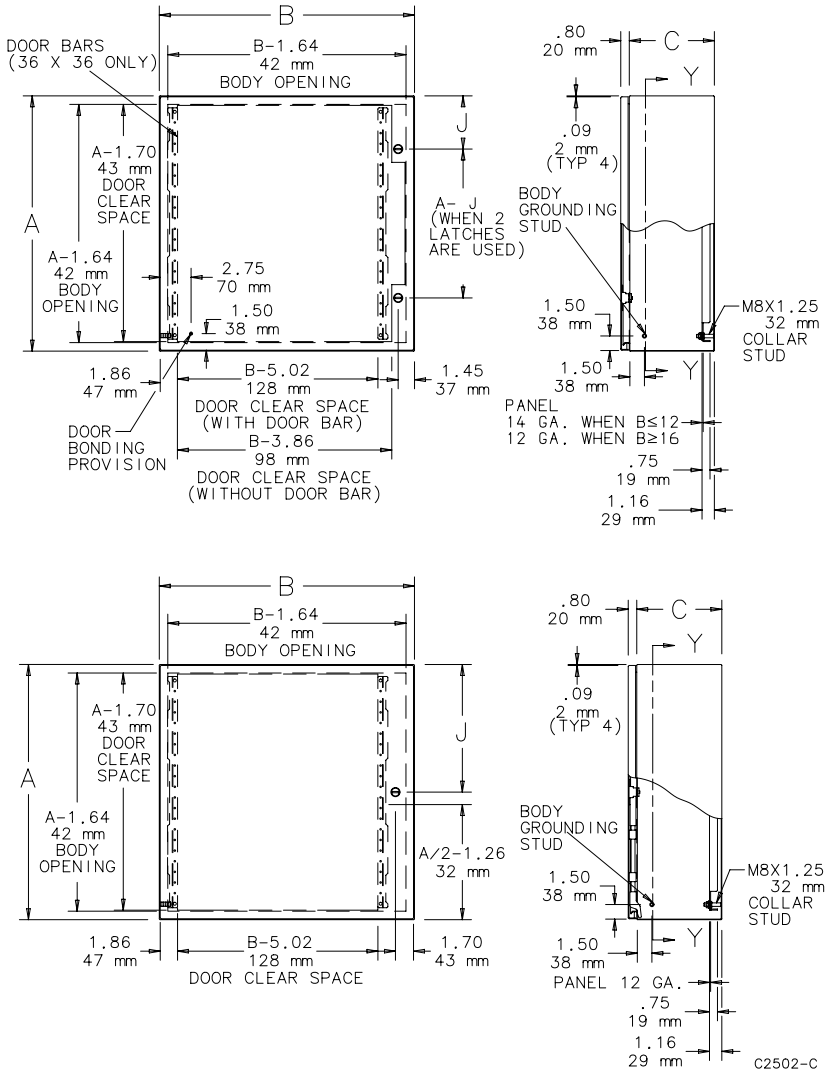
CONCEPT® Stainless Steel Type 4X Wall-Mounted Enclosures

Standard Sizes CONCEPT® Stainless Steel Single-Door Wall-Mount Enclosures (Cont.)

Catalog Number	A x B x C in. (mm)	Stainless Steel Type	Door Ga.	Body Ga.	CONCEPT Panel Catalog Number	Conductive Panel Catalog Number	Panel Size D x E (in.)	Panel Size D x E (mm)	Mounting G x H (in.)	Mounting G x H (mm)	Latch (qty)	Latch (style)	J (in.)	J (mm)
CSD202012SS	20.00 x 20.00 x 12.00 (508 x 508 x 305)	304	14	14	CP2020	CP2020G	18.20 x 18.20	462 x 462	18.50 x 18.50	470 x 470	1	1/4-turn	10.00	254
CSD202012SS6	20.00 x 20.00 x 12.00 (508 x 508 x 305)	316L	14	14	CP2020	CP2020G	18.20 x 18.20	462 x 462	18.50 x 18.50	470 x 470	1	1/4-turn	10.00	254
CSD242412SS	24.00 x 24.00 x 12.00 (610 x 610 x 305)	304	14	14	CP2424	CP2424G	22.20 x 22.20	564 x 564	22.50 x 22.50	572 x 572	2	1/4-turn	5.00	127
CSD242412SS6	24.00 x 24.00 x 12.00 (610 x 610 x 305)	316L	14	14	CP2424	CP2424G	22.20 x 22.20	564 x 564	22.50 x 22.50	572 x 572	2	1/4-turn	5.00	127
CSD302412SS	30.00 x 24.00 x 12.00 (762 x 610 x 305)	304	14	14	CP3024	CP3024G	28.20 x 22.20	716 x 564	28.50 x 22.50	724 x 572	2	1/4-turn	5.00	127
CSD302412SS6	30.00 x 24.00 x 12.00 (762 x 610 x 305)	316L	14	14	CP3024	CP3024G	28.20 x 22.20	716 x 564	28.50 x 22.50	724 x 572	2	1/4-turn	5.00	127
CSD362412SS	36.00 x 24.00 x 12.00 (914 x 610 x 305)	304	14	14	CP3624	CP3624G	34.20 x 22.20	869 x 564	34.50 x 22.50	876 x 572	2	1/4-turn	5.00	127
CSD362412SS6	36.00 x 24.00 x 12.00 (914 x 610 x 305)	316L	14	14	CP3624	CP3624G	34.20 x 22.20	869 x 564	34.50 x 22.50	876 x 572	2	1/4-turn	5.00	127
CSD363012SS	36.00 x 30.00 x 12.00 (914 x 762 x 305)	304	14	14	CP3630	CP3630G	34.20 x 28.20	869 x 716	34.50 x 28.50	876 x 724	2	1/4-turn	5.00	127
CSD363012SS6	36.00 x 30.00 x 12.00 (914 x 762 x 305)	316L	14	14	CP3630	CP3630G	34.20 x 28.20	869 x 716	34.50 x 28.50	876 x 724	2	1/4-turn	5.00	127

Purchase panels separately.
Optional NEMA style steel and stainless steel panels require conversion kit catalog number CCPM4.



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CONCEPT® Stainless Steel Type 4X Wall-Mounted Enclosures

Standard Sizes CONCEPT® Stainless Steel Single-Door Wall-Mounted Enclosures with Windows

Type 304 Catalog Number	Door Ga.	Body Ga.	A x B x C in. (mm)	CONCEPT Panel Catalog Number	Conductive Panel Catalog Number	Panel Size D x E (in.)	Panel Size D x E (mm)	Mtg. G x H (in.)	Mtg. G x H (mm)	Window Size M x N (in.)	Window Size M x N (mm)	Latch qty	Latch style	J in. (mm)
CSD12126WSS	16	16	12.00 x 12.00 x 6.00 (305 x 305 x 152)	**CP1212**	**CP1212G**	10.20 x 10.20	259 x 259	10.50 x 10.50	267 x 267	8.74 x 7.10	222 x 180	1	1/4-turn	6.00 (152)
CSD16126WSS	16	16	16.00 x 12.00 x 6.00 (406 x 305 x 152)	**CP1612**	**CP1612G**	14.20 x 10.20	361 x 259	14.50 x 10.50	368 x 267	12.74 x 7.10	324 x 180	1	1/4-turn	8.00 (203)
CSD20166WSS	16	16	20.00 x 16.00 x 6.00 (508 x 406 x 152)	**CP2016**	**CP2016G**	18.20 x 14.20	462 x 361	18.50 x 14.50	470 x 368	16.74 x 11.10	425 x 282	1	1/4-turn	10.00 (254)
CSD20206WSS	16	16	20.00 x 20.00 x 6.00 (508 x 508 x 152)	**CP2020**	**CP2020G**	18.20 x 18.20	462 x 462	18.50 x 18.50	470 x 470	16.74 x 15.10	425 x 384	1	1/4-turn	10.00 (254)
CSD20168WSS	16	16	20.00 x 16.00 x 8.00 (508 x 406 x 203)	**CP2016**	**CP2016G**	18.20 x 14.20	462 x 361	18.50 x 14.50	470 x 368	16.74 x 11.10	425 x 282	1	1/4-turn	10.00 (254)
CSD20208WSS	16	16	20.00 x 20.00 x 8.00 (508 x 508 x 203)	**CP2020**	**CP2020G**	18.20 x 18.20	462 x 462	18.50 x 18.50	470 x 470	16.74 x 15.10	425 x 384	1	1/4-turn	10.00 (254)
CSD24208WSS	16	16	24.00 x 20.00 x 8.00 (610 x 508 x 203)	**CP2420**	**CP2420G**	22.20 x 18.20	564 x 462	22.50 x 18.50	572 x 470	20.74 x 15.10	527 x 384	1	1/4-turn	12.00 (305)
CSD24248WSS	14	16	24.00 x 24.00 x 8.00 (610 x 610 x 203)	**CP2424**	**CP2424G**	22.20 x 22.20	564 x 564	22.50 x 22.50	572 x 572	20.74 x 17.68	527 x 449	2	1/4-turn	5.00 (127)
CSD30248WSS	14	16	30.00 x 24.00 x 8.00 (762 x 610 x 203)	**CP3024**	**CP3024G**	28.20 x 22.20	716 x 564	28.50 x 22.50	724 x 572	26.74 x 17.68	679 x 449	2	1/4-turn	5.00 (127)
CSD161210WSS	16	16	16.00 x 12.00 x 10.00 (406 x 305 x 203)	**CP1612**	**CP1612G**	14.20 x 10.20	361 x 259	14.50 x 10.50	368 x 267	12.74 x 7.10	324 x 180	1	1/4-turn	8.00 (203)
CSD201610WSS	16	16	20.00 x 16.00 x 10.00 (508 x 406 x 203)	**CP2016**	**CP2016G**	18.20 x 14.20	462 x 361	18.50 x 14.50	470 x 368	16.74 x 11.10	425 x 282	1	1/4-turn	10.00 (254)
CSD202010WSS	16	16	20.00 x 20.00 x 10.00 (508 x 508 x 203)	**CP2020**	**CP2020G**	18.20 x 18.20	462 x 462	18.50 x 18.50	470 x 470	16.74 x 15.10	425 x 384	1	1/4-turn	10.00 (254)
CSD242010WSS	16	16	24.00 x 20.00 x 10.00 (610 x 508 x 203)	**CP2420**	**CP2420G**	22.20 x 18.20	564 x 462	22.50 x 18.50	572 x 470	20.74 x 15.10	527 x 384	1	1/4-turn	12.00 (305)
CSD242410WSS	14	16	24.00 x 24.00 x 10.00 (610 x 610 x 203)	**CP2424**	**CP2424G**	22.20 x 22.20	564 x 564	22.50 x 22.50	572 x 572	20.74 x 17.68	527 x 449	2	1/4-turn	5.00 (127)
CSD302410WSS	14	16	30.00 x 24.00 x 10.00 (762 x 610 x 203)	**CP3024**	**CP3024G**	28.20 x 22.20	716 x 564	28.50 x 22.50	724 x 572	26.74 x 17.68	679 x 449	2	1/4-turn	5.00 (127)
CSD202012WSS	14	16	20.00 x 20.00 x 12.00 (508 x 508 x 305)	**CP2020**	**CP2020G**	18.20 x 18.20	462 x 462	18.50 x 18.50	470 x 470	16.74 x 15.10	425 x 384	1	1/4-turn	10.00 (254)
CSD302412WSS	14	16	30.00 x 24.00 x 12.00 (762 x 610 x 305)	**CP3024**	**CP3024G**	28.20 x 22.20	716 x 564	28.50 x 22.50	724 x 572	26.74 x 17.68	679 x 449	2	1/4-turn	5.00 (127)

Purchase panels separately.
Optional NEMA style steel and stainless steel panels require conversion kit catalog number CCPM4.

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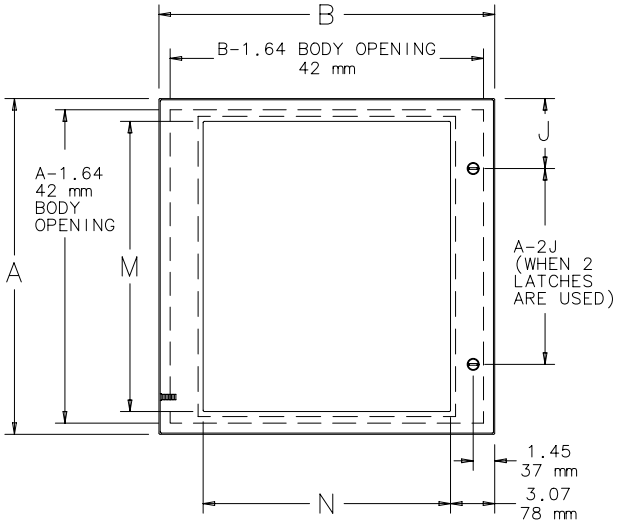
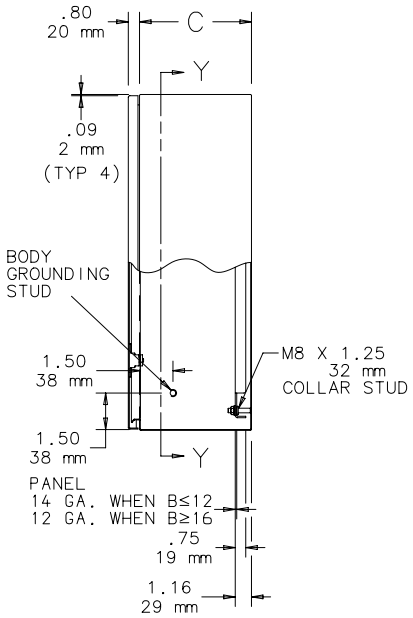
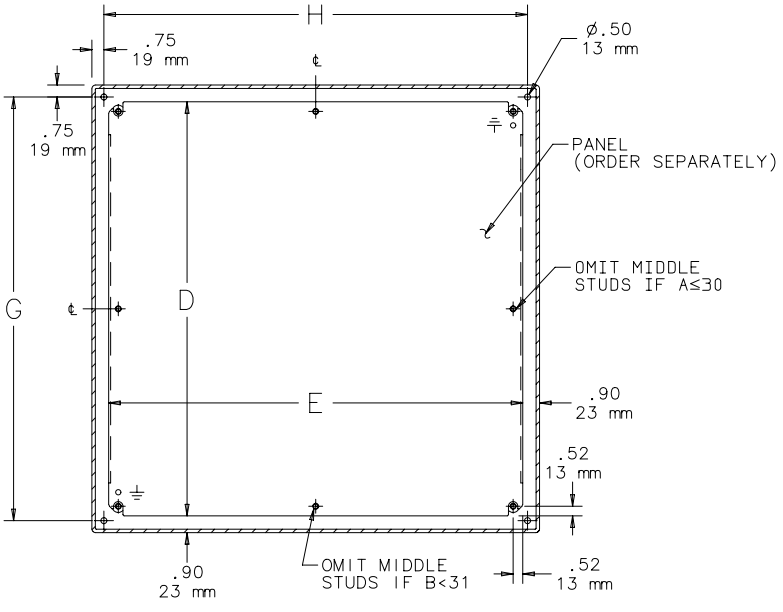
CONCEPT® Stainless Steel Type 4X Wall-Mounted Enclosures

CONCEPT® Stainless Steel Single-Door Wall-Mount Enclosures with Windows



Window Door Enclosure with Quarter-turn Latches





SECTION Y-Y
(WITH PANEL INSTALLED)

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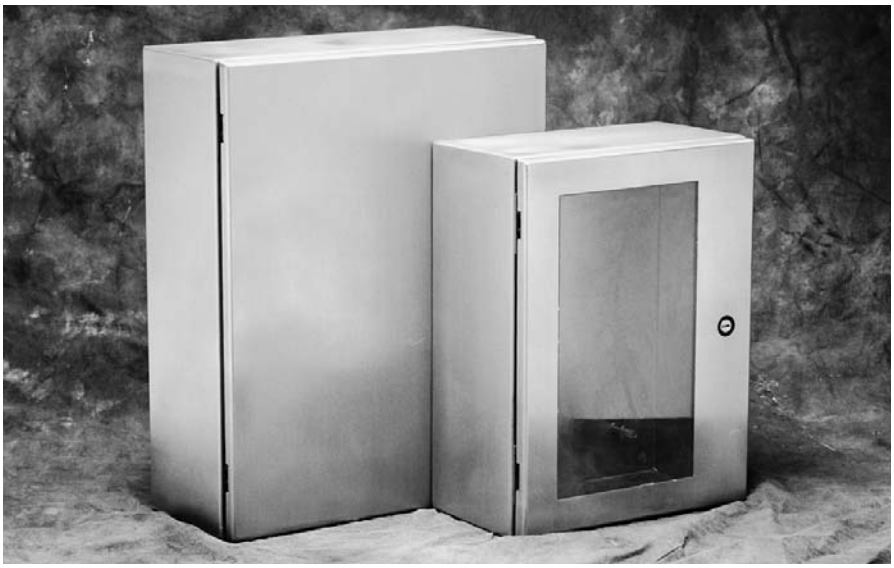
A Pentair Company

CONCEPT® Stainless Steel Wall-Mount Enclosures



Application

The CONCEPT® stainless steel enclosure, with its streamlined design and Type 4X rating, is a perfect fit for mounting electrical or high-tech electronic equipment in a variety of indoor and outdoor settings. It is typically used in the following areas where corrosion-resistant protection is needed: food processing plants, pharmaceutical manufacturing facilities, petrochemical plants, pulp and paper processing, and water treatment facilities.

See Chapter 11, EMC Enclosures, for information on a related EMC-shielded product.

Patents:
Combined Handle and Lock Unit
360,345 (U.S.)
DEM 9405854.7 (Germany)
Enclosure Latch 5,509,703 (U.S.)
Hinge System 5,666,695 (U..S.)

Other patents pending.

Construction

- Manufactured from 16 or 14 gauge Type 304 or Type 316L stainless steel
- Seams continuously welded and ground smooth
- Minimum width body flange provides maximum door opening
- Body flange trough excludes liquids and contaminants
- Panel mounting studs fit optional CONCEPT® panels and other accessories
- Mounting holes in back of body for direct mounting or for optional external mounting brackets
- Type 304 stainless steel hidden hinges promote clean aesthetic appearance
- Standard full access door opening
- Doors are interchangeable and easily removable by pulling captive hinge pins
- For extra rigidity, door bars furnished on doors 36.00 x 36.00 in.(914mm) and larger
- Provision on door (except window door style) for thermoplastic data pocket
- Provision on door (except window door style) for optional doorstop kit
- Quarter-turn latches (or a 3-point latch system on larger enclosures) furnished with flush slotted insert. Optional handles or inserts are available.
- Window door enclosures have a clear polycarbonate window mounted flush with door surface
- Seamless foam-in-place gasket provides oil-tight and dust-tight seal against contaminants
- Self-grounding latch system with double seal provides maximum protection against leakage
- Integral body grounding stud
- Furnished hardware kit consists of panel mounting nuts, panel grounding hardware, and sealing washers for wall-mounting holes
- Installation instructions for enclosure and accessories are provided

Finish

Enclosures are unpainted. Door and body have smooth #4 brushed finish.

- Optional CONCEPT® panels are white painted or zinc-plated.
- Optional NEMA panels are white painted, zinc-plated, aluminum, or stainless steel.

Industry Standards

Mounting brackets required to meet UL/CSA external mounting requirements.

UL 508A, 508, File No. E61997: Type 3R, Type 4, Type 4X, and Type 12
NEMA/EEMAC Type 3R, Type 4, Type 4X, Type 12, and Type 13
CSA File No. LR42186: Type 4, Type 4X, and Type 12
VDE IP66
IEC 60529, IP66
Meets Type 3RX requirements

Accessories

See Chapter 12, General Accessories.

Corrosion Inhibitors
Data Pocket (except window door style)
DIN3 Rails
Door Stop Kit (except window door style)
Lighting Kits
Mounting Brackets
Panels (see table)
Panels, NEMA
Terminal Block Kit Assembly
Thermal Accessories

Modification Services Program

You can customize this product to your unique requirements by specifying from these options:

- Enclosure height, width, depth
- Holes and cutouts in body, doors, subpanels
- Tapped holes in subpanels
- Fasteners, mounting channel in enclosure and subpanel
- Mounting (adds and deletes)
- Doors
- Subpanels
- Thermal management (louvers, fans, filters)
- Windows
- Standard accessories
- Drip shield

For details, see Modification Services at hoffmanonline.com.
To order, contact your local Hoffman sales representative.

NOTE: For information about modifications outside the scope of the Modification Services program, contact your Hoffman sales representative.

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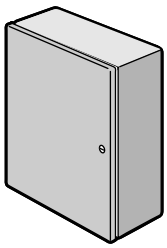
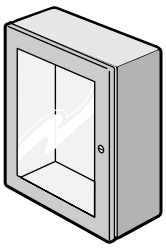
The CONCEPT® Enclosure Group Accessory Selection Guide

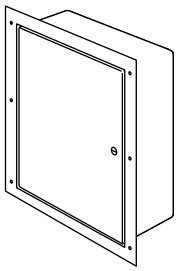
See Chapter 12, General Accessories: CONCEPT® Enclosure Accessories



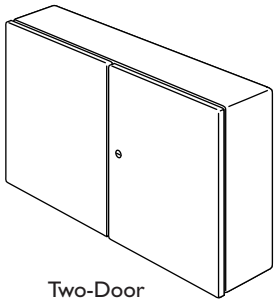
Steel or **Stainless Steel Enclosures**



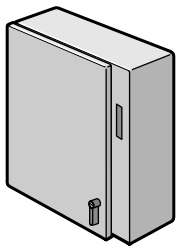
Steel or **Stainless Steel Window-Door Enclosures**



Flush Mount Enclosures

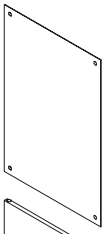


Two-Door Enclosures

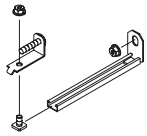


Steel or **Stainless Steel Disconnect Enclosures**

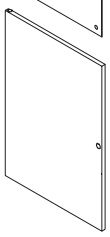
Internal Accessories



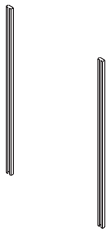
Steel Panel



Adjustable Depth Mounting Kit



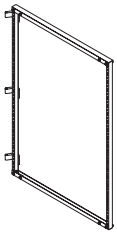
Swing-Out Panel



Mounting Channels

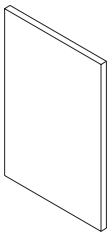
Panel Conversion Kit

DIN3 Rail Kit

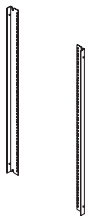


Swing-Out Rack Frame

Grid Straps

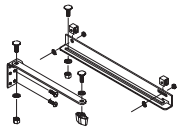


Dead Front Kit



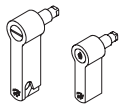
Rack Mounting Angles

Door Accessories

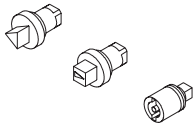


Door Stop Kit

Data Pocket

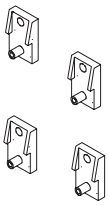


Handles and Latches

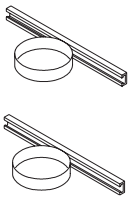


Key Inserts

External Accessories



Mounting Bracket Kit



Pole Mounting Kit

Stainless steel strap with galvanized unistrut.

11C59754

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CONCEPT® Stainless Steel Wall-Mount Enclosures

Standard Sizes CONCEPT® Stainless Steel Single-Door Wall-Mount Enclosures

Type 304 Catalog Number	Type 316L Catalog Number	Door Gauge	Body Gauge	Enclosure Size A x B x C	* CONCEPT® Panel Catalog Number	Panel Size D x E	Mounting G x H	Latches qty	style	J
CSD12126SS	CSD12126SS6	16	16	12.00 x 12.00 x 6.00 (305 x 305 x 152)	CP1212	10.20 x 10.20 (259 x 259)	10.50 x 10.50 (267 x 267)	1	Quarter-turn	6.00 (152)
CSD16126SS	CSD16126SS6	16	16	16.00 x 12.00 x 6.00 (406 x 305 x 152)	CP1612	14.20 x 10.20 (361 x 259)	14.50 x 10.50 (368 x 267)	1	Quarter-turn	8.00 (203)
CSD16166SS	CSD16166SS6	16	16	16.00 x 16.00 x 6.00 (406 x 406 x 152)	CP1616	14.20 x 14.20 (361 x 361)	14.50 x 14.50 (368 x 368)	1	Quarter-turn	8.00 (203)
CSD20166SS	CSD20166SS6	16	16	20.00 x 16.00 x 6.00 (508 x 406 x 152)	CP2016	18.20 x 14.50 (462 x 361)	18.50 x 14.50 (470 x 368)	1	Quarter-turn	10.00 (254)
CSD20206SS	CSD20206SS6	16	16	20.00 x 20.00 x 6.00 (508 x 508 x 152)	CP2020	18.20 x 18.20 (462 x 462)	18.50 x 18.50 (470 x 470)	1	Quarter-turn	10.00 (254)
CSD16128SS	CSD16128SS6	16	16	16.00 x 12.00 x 8.00 (406 x 305 x 203)	CP1612	14.20 x 10.20 (361 x 259)	14.50 x 10.50 (368 x 267)	1	Quarter-turn	8.00 (203)
CSD16168SS	CSD16168SS6	16	16	16.00 x 16.00 x 8.00 (406 x 406 x 203)	CP1616	14.20 x 14.20 (361 x 361)	14.50 x 14.50 (368 x 368)	1	Quarter-turn	8.00 (203)
CSD16208SS	CSD16208SS6	16	16	16.00 x 20.00 x 8.00 (406 x 508 x 203)	CP2016	18.20 x 14.20 (462 x 361)	14.50 x 18.50 (368 x 470)	1	Quarter-turn	8.00 (203)
CSD20168SS	CSD20168SS6	16	16	20.00 x 16.00 x 8.00 (508 x 406 x 203)	CP2016	18.20 x 14.20 (462 x 361)	18.50 x 14.50 (470 x 368)	1	Quarter-turn	10.00 (254)
CSD20208SS	CSD20208SS6	16	16	20.00 x 20.00 x 8.00 (508 x 508 x 203)	CP2020	18.20 x 18.20 (462 x 462)	18.50 x 18.50 (470 x 470)	1	Quarter-turn	10.00 (254)
CSD24168SS	CSD24168SS6	16	16	24.00 x 16.00 x 8.00 (610 x 406 x 203)	CP2416	22.20 x 14.20 (564 x 361)	22.50 x 14.50 (572 x 368)	1	Quarter-turn	12.00 (305)
CSD24208SS	CSD24208SS6	16	16	24.00 x 20.00 x 8.00 (610 x 508 x 203)	CP2420	22.20 x 18.20 (564 x 462)	22.50 x 18.50 (572 x 470)	1	Quarter-turn	12.00 (305)
CSD24248SS	CSD24248SS6	14	16	24.00 x 24.00 x 8.00 (610 x 610 x 203)	CP2424	22.20 x 22.20 (564 x 564)	22.50 x 22.50 (572 x 572)	2	Quarter-turn	5.00 (127)
CSD30248SS	CSD30248SS6	14	16	30.00 x 24.00 x 8.00 (762 x 610 x 8.00)	CP3024	28.20 x 22.20 (716 x 564)	28.50 x 22.50 (724 x 572)	2	Quarter-turn	5.00 (127)
CSD30308SS	CSD30308SS6	14	14	30.00 x 30.00 x 8.00 (762 x 762 x 203)	CP3030	28.20 x 28.20 (716 x 716)	28.50 x 28.50 (724 x 724)	2	Quarter-turn	5.00 (127)
CSD36248SS	CSD36248SS6	14	16	36.00 x 24.00 x 8.00 (914 x 610 x 203)	CP3624	34.20 x 22.20 (869 x 564)	34.50 x 22.50 (876 x 572)	2	Quarter-turn	5.00 (127)
CSD36308SS	CSD36308SS6	14	14	36.00 x 30.00 x 8.00 (914 x 762 x 203)	CP3630	34.20 x 28.20 (869 x 716)	34.50 x 28.50 (876 x 724)	2	Quarter-turn	5.00 (127)
CSD161210SS	CSD161210SS6	16	16	16.00 x 12.00 x 10.00 (406 x 305 x 254)	CP1612	14.20 x 10.20 (361 x 259)	14.50 x 10.50 (368 x 267)	1	Quarter-turn	8.00 (203)
CSD161610SS	CSD161610SS6	16	16	16.00 x 16.00 x 10.00 (406 x 406 x 254)	CP1616	14.20 x 14.20 (361 x 361)	14.50 x 14.50 (368 x 368)	1	Quarter-turn	8.00 (203)
CSD162010SS	CSD162010SS6	16	16	16.00 x 20.00 x 10.00 (406 x 508 x 254)	CP2016	18.20 x 14.20 (462 x 361)	14.50 x 18.50 (368 x 470)	1	Quarter-turn	8.00 (203)
CSD201610SS	CSD201610SS6	16	16	20.00 x 16.00 x 10.00 (508 x 406 x 254)	CP2016	18.20 x 14.20 (462 x 361)	18.50 x 14.50 470 x 368)	1	Quarter-turn	10.00 (254)
CSD202010SS	CSD202010SS6	16	16	20.00 x 20.00 x 10.00 (508 x 508 x 254)	CP2020	18.20 x 18.20 (462 x 462)	18.50 x 18.50 (470 x 470)	1	Quarter-turn	10.00 (254)
CSD202410SS	CSD202410SS6	16	16	20.00 x 24.00 x 10.00 (508 x 610 x 254)	CP2420	22.20 x 18.20 (564 x 462)	18.50 x 22.50 (470 x 572)	1	Quarter-turn	10.00 (254)
CSD241610SS	CSD241610SS6	16	16	24.00 x 16.00 x 10.00 (610 x 406 x 254)	CP2416	22.20 x 14.20 (564 x 361)	22.50 x 14.50 (572 x 368)	1	Quarter-turn	12.00 (305)
CSD242010SS	CSD242010SS6	16	16	24.00 x 20.00 x 10.00 (610 x 508 x 254)	CP2420	22.20 x 18.20 (564 x 462)	22.50 x 18.50 (572 x 470)	1	Quarter-turn	12.00 (305)
CSD242410SS	CSD242410SS6	14	16	24.00 x 24.00 x 10.00 (610 x 610 x 254)	CP2424	22.20 x 22.20 (564 x 564)	22.50 x 22.50 (572 x 572)	2	Quarter-turn	5.00 (127)
CSD243010SS	CSD243010SS6	14	16	24.00 x 30.00 x 10.00 (610 x 762 x 254)	CP3024	28.20 x 22.20 (716 x 564)	22.50 x 28.50 (572 x 724)	2	Quarter-turn	5.00 (127)
CSD302010SS	CSD302010SS6	14	16	30.00 x 20.00 x 10.00 (762 x 508 x 254)	CP3020	28.20 x 18.20 (716 x 462)	28.50 x 18.50 (724 x 470)	2	Quarter-turn	5.00 (127)
CSD302410SS	CSD302410SS6	14	16	30.00 x 24.00 x 10.00 (762 x 610 x 254)	CP3024	28.20 x 22.20 (716 x 564)	28.50 x 22.50 (724 x 572)	2	Quarter-turn	5.00 (127)
CSD303010SS	CSD303010SS6	14	14	30.00 x 30.00 x 10.00 (762 x 762 x 254)	CP3030	28.20 x 28.20 (716 x 716)	28.50 x 28.50 (724 x 724)	2	Quarter-turn	5.00 (127)
CSD362410SS	CSD362410SS6	14	16	36.00 x 24.00 x 10.00 (914 x 610 x 254)	CP3624	34.20 x 22.20 (869 x 564)	34.50 x 22.50 (876 x 572)	2	Quarter-turn	5.00 (127)
CSD363010SS	CSD363010SS6	14	14	36.00 x 30.00 x 10.00 (914 x 762 x 254)	CP3630	34.20 x 28.20 (869 x 716)	34.50 x 28.50 (876 x 724)	2	Quarter-turn	5.00 (127)
CSD363610SS	CSD363610SS6	14	14	36.00 x 36.00 x 10.00 (914 x 914 x 254)	CP3636	34.20 x 34.20 (869 x 869)	34.50 x 34.50 (876 x 876)	2	Quarter-turn	5.00 (127
CSD423610SS	CSD423610SS6	14	14	42.00 x 36.00 x 10.00 (1067 x 762 x 254)	CP4236	40.20 x 34.20 (1021 x 869)	40.50 x 34.50 (1029 x 876)	1	3-point.	21.00 (533)

Continued on next page

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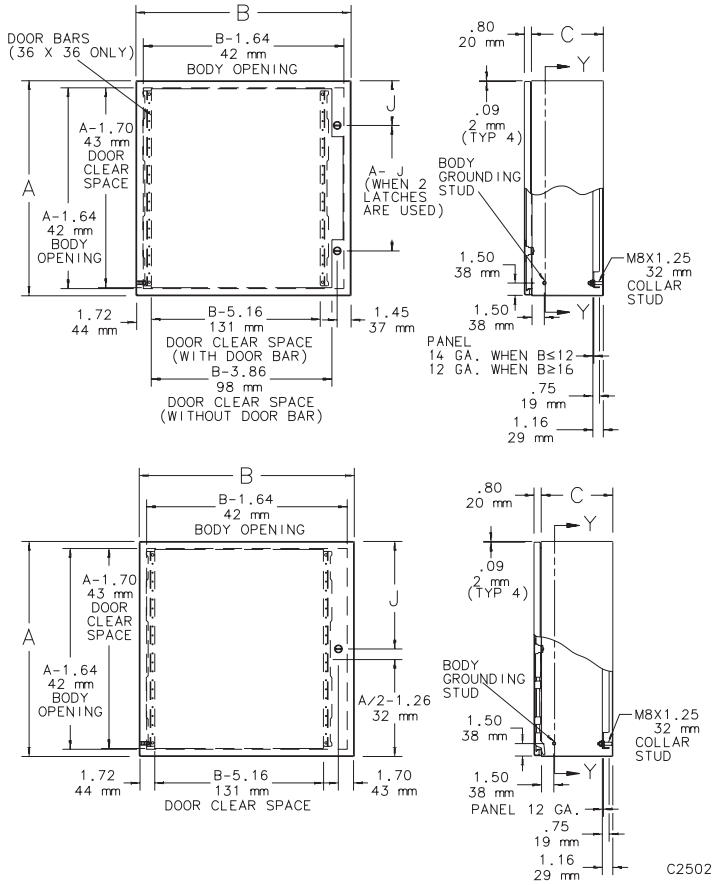
CONCEPT® Stainless Steel Single-Door Wall-Mount Enclosures



Single-Door Enclosure with Quarter-turn Latching

Data Pockets for Solid Door Enclosures		
Enclosure Size A	B	Pocket
Any	12.00 (305)	None
<30.00 (762)	>12 and <20.00 (305) (508)	Small
>30.00 (762)	>20.00 (508)	Large

Single-Door Enclosure with 3-Point Latching

For Section Y-Y see page 6.25.

Standard Sizes CONCEPT® Stainless Steel Single-Door Wall-Mount Enclosures (Cont.)

Type 304 Catalog Number	Type 316L Catalog Number	Door Gauge	Body Gauge	Enclosure Size A x B x C	* CONCEPT® Panel Catalog Number	Panel Size D x E	Mounting G x H	Latches qty	Latches style	J
CSD482410SS	CSD482410SS6	14	14	48.00 x 24.00 x 10.00 (1219 x 610 x 254)	CP4824	46.20 x 22.20 (1173 x 564)	46.50 x 22.50 (1181 x 572)	1	3-point	24.00 (610)
CSD483610SS	CSD483610SS6	14	14	48.00 x 36.00 x 10.00 (1219 x 762 x 254)	CP4836	46.20 x 34.20 (1173 x 869)	46.50 x 34.50 (1181 x 876)	1	3-point	24.00 (610)
CSD603610SS	CSD603610SS6	14	14	60.00 x 36.00 x 10.00 (1524 x 914 x 254)	CP6036	58.20 x 34.20 (1478 x 869)	58.50 x 34.50 (1486 x 876)	1	3-point	30.00 (762)
CSD202012SS	CSD202012SS6	14	14	20.00 x 20.00 x 12.00 (508 x 508 x 305)	CP2020	18.20 x 18.20 (462 x 462)	18.50 x 18.50 (470 x 470)	1	Quarter-turn	10.00 (254)
CSD242412SS	CSD242412SS6	14	14	24.00 x 24.00 x 12.00 (610 x 610 x 305)	CP2424	22.20 x 22.20 (564 x 564)	22.50 x 22.50 (572 x 572)	2	Quarter-turn	5.00 (127)
CSD302412SS	CSD302412SS6	14	14	30.00 x 24.00 x 12.00 (762 x 610 x 305)	CP3024	28.20 x 22.20 (716 x 564)	28.50 x 22.50 (724 x 572)	2	Quarter-turn	5.00 (127)
CSD362412SS	CSD362412SS6	14	14	36.00 x 24.00 x 12.00 (914 x 610 x 305)	CP3624	34.20 x 22.20 (869 x 564)	34.50 x 22.50 (876 x 572)	2	Quarter-turn	5.00 (127)
CSD363012SS	CSD363012SS6	14	14	36.00 x 30.00 x 12.00 (914 x 762 x 305)	CP3630	34.20 x 28.20 (869 x 716)	34.50 x 28.50 (876 x 724)	2	Quarter-turn	5.00 (127)
CSD363612SS	CSD363612SS6	14	14	36.00 x 36.00 x 12.00 (914 x 914 x 305)	CP3636	34.20 x 34.20 (869 x 869)	34.50 x 34.50 (876 x 876)	2	Quarter-turn	5.00 (127)
CSD423612SS	CSD423612SS6	14	14	42.00 x 36.00 x 12.00 (1067 x 914 x 305)	CP4236	40.20 x 34.20 (1021 x 869)	40.50 x 34.50 (1029 x 876)	1	3-point	21.00 (533)
CSD483612SS	CSD483612SS6	14	14	48.00 x 36.00 x 12.00 (1219 x 914 x 305)	CP4836	46.20 x 34.20 (1173 x 869)	46.50 x 34.50 (1181 x 876)	1	3-point	24.00 (610)
CSD603612SS	CSD603612SS6	14	14	60.00 x 36.00 x 12.00 (1524 x 914 x 305)	CP6036	58.20 x 34.20 (869 x 462)	58.50 x 34.50 (1486 x 876)	1	3-point	30.00 (762)

Millimeter dimensions ( ) are for reference only; do not convert metric dimensions to inch.

* Panels must be ordered separately. Optional zinc-plated CONCEPT® panels available for most sizes. Optional NEMA size steel and stainless steel panels require conversion kit catalog number CCPM4 (see Chapter 12, General Accessories).

NOTE: Panels have a formed flange along any side that is longer than 22.20 in. (564mm). CP2420 and CP2424 have a flange on all four sides.

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CONCEPT® Stainless Steel Wall-Mount Enclosures

Standard Sizes CONCEPT® Stainless Steel Single-Door Wall-Mount Enclosures with Windows

Type 304 Catalog Number	Door Gauge	Body Gauge	Enclosure Size A x B x C	*CONCEPT® Panel Catalog Number	Panel Size D x E	Mounting G x H	Window Size M x N	Latches qty	style	J
CSD12126WSS	16	16	12.00 x 12.00 x 6.00 (305 x 305 x 152)	**CP1212**	10.20 x 10.20 (259 x 259)	10.50 x 10.50 (267 x 267)	8.74 x 7.10 (222 x 180)	1	Quarter-turn	6.00 (152)
CSD16126WSS	16	16	16.00 x 12.00 x 6.00 (406 x 305 x 152)	**CP1612**	14.20 x 10.20 (361 x 259)	14.50 x 10.50 (368 x 267)	12.74 x 7.10 (324 x 180)	1	Quarter-turn	8.00 (203)
CSD20166WSS	16	16	20.00 x 16.00 x 6.00 (508 x 406 x 152)	**CP2016**	18.20 x 14.20 (462 x 361)	18.50 x 14.50 (470 x 368)	16.74 x 11.10 (425 x 282)	1	Quarter-turn	10.00 (254)
CSD20206WSS	16	16	20.00 x 20.00 x 6.00 (508 x 508 x 152)	**CP2020**	18.20 x 18.20 (462 x 462)	18.50 x 18.50 (470 x 470)	16.74 x 15.10 (425 x 384)	1	Quarter-turn	10.00 (254)
CSD20168WSS	16	16	20.00 x 16.00 x 8.00 (508 x 406 x 203)	**CP2016**	18.20 x 14.20 (462 x 361)	18.50 x 14.50 (470 x 368)	16.74 x 11.10 (425 x 282)	1	Quarter-turn	10.00 (254)
CSD20208WSS	16	16	20.00 x 20.00 x 8.00 (508 x 508 x 203)	**CP2020**	18.20 x 18.20 (462 x 462)	18.50 x 18.50 (470 x 470)	16.74 x 15.10 (425 x 384)	1	Quarter-turn	10.00 (254)
CSD24208WSS	16	16	24.00 x 20.00 x 8.00 (610 x 508 x 203)	**CP2420**	22.20 x 18.20 (564 x 462)	22.50 x 18.50 (572 x 470)	20.74 x 15.10 (527 x 384)	1	Quarter-turn	12.00 (305)
CSD24248WSS	14	16	24.00 x 24.00 x 8.00 (610 x 610 x 203)	**CP2424**	22.20 x 22.20 (564 x 564)	22.50 x 22.50 (572 x 572)	20.74 x 17.68 (527 x 449)	2	Quarter-turn	5.00 (127)
CSD30248WSS	14	16	30.00 x 24.00 x 8.00 (762 x 610 x 203)	**CP3024**	28.20 x 22.20 (716 x 564)	28.50 x 22.50 (724 x 572)	26.74 x 17.68 (679 x 449)	2	Quarter-turn	5.00 (127)
CSD161210WSS	16	16	16.00 x 12.00 x 10.00 (406 x 305 x 203)	**CP1612**	14.20 x 10.20 (361 x 259)	14.50 x 10.50 (368 x 267)	12.74 x 7.10 (324 x 180)	1	Quarter-turn	8.00 (203)
CSD201610WSS	16	16	20.00 x 16.00 x 10.00 (508 x 406 x 203)	**CP2016**	18.20 x 14.20 (462 x 361)	18.50 x 14.50 (470 x 368)	16.74 x 11.10 (425 x 282)	1	Quarter-turn	10.00 (254)
CSD202010WSS	16	16	20.00 x 20.00 x 10.00 (508 x 508 x 203)	**CP2020**	18.20 x 18.20 (462 x 462)	18.50 x 18.50 (470 x 470)	16.74 x 15.10 (425 x 384)	1	Quarter-turn	10.00 (254)
CSD242010WSS	16	16	24.00 x 20.00 x 10.00 (610 x 508 x 203)	**CP2420**	22.20 x 18.20 (564 x 462)	22.50 x 18.50 (572 x 470)	20.74 x 15.10 (527 x 384)	1	Quarter-turn	12.00 (305)
CSD242410WSS	14	16	24.00 x 24.00 x 10.00 (610 x 610 x 203)	**CP2424**	22.20 x 22.20 (564 x 564)	22.50 x 22.50 (572 x 572)	20.74 x 17.68 (527 x 449)	2	Quarter-turn	5.00 (127)
CSD302410WSS	14	16	30.00 x 24.00 x 10.00 (762 x 610 x 203)	**CP3024**	28.20 x 22.20 (716 x 564)	28.50 x 22.50 (724 x 572)	26.74 x 17.68 (679 x 449)	2	Quarter-turn	5.00 (127)
CSD202012WSS	14	16	20.00 x 20.00 x 12.00 (508 x 508 x 305)	**CP2020**	18.20 x 18.20 (462 x 462)	18.50 x 18.50 (470 x 470)	16.74 x 15.10 (425 x 384)	1	Quarter-turn	10.00 (254)
CSD302412WSS	14	16	30.00 x 24.00 x 12.00 (762 x 610 x 305)	**CP3024**	28.20 x 22.20 (716 x 564)	28.50 x 22.50 (724 x 572)	26.74 x 17.68 (679 x 449)	2	Quarter-turn	5.00 (127)

Millimeter dimensions ( ) are for reference only; do not convert metric to inch.

* Panels must be ordered separately. Optional zinc-plated CONCEPT® panels available for most sizes. Optional NEMA size steel and stainless steel panels require conversion kit catalog number CCPM4 (see Chapter 12, General Accessories).

NOTE: Panels have a formed flange along any side that is longer than 22.20 in. (564mm). CP2420 and CP2424 have a flange on all four sides.

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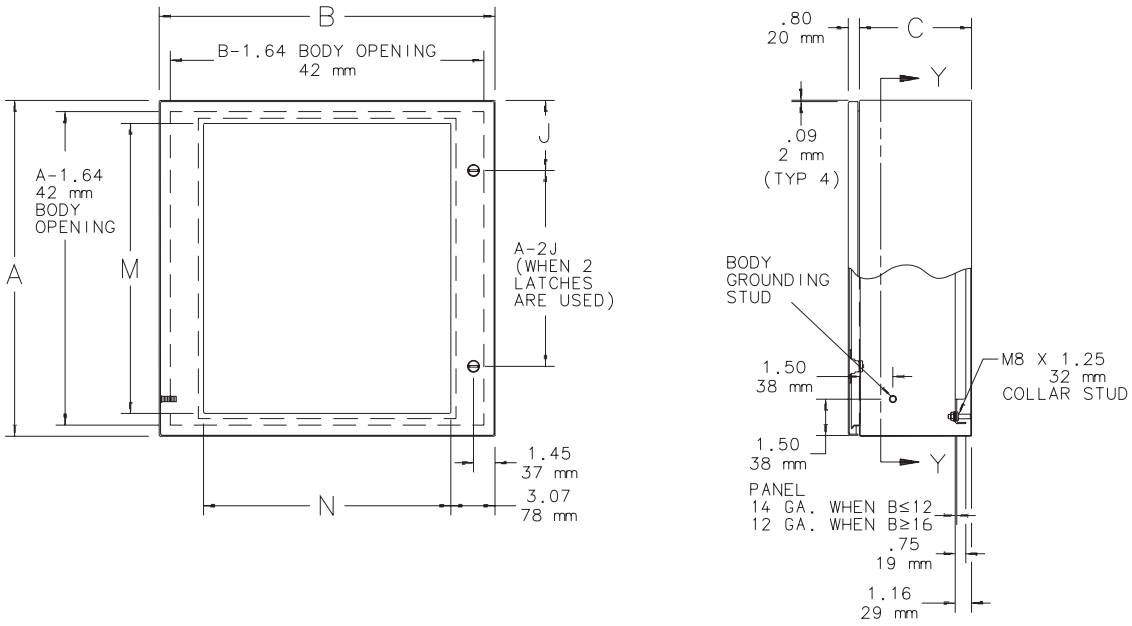
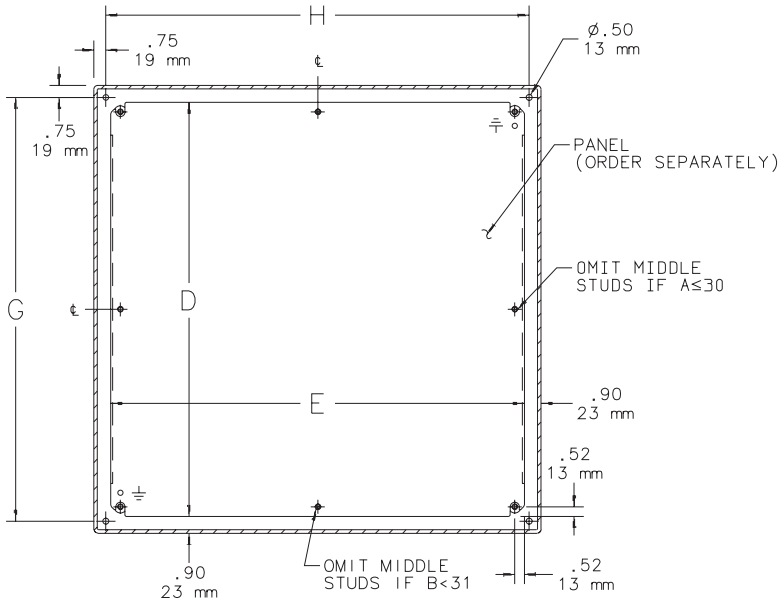
CONCEPT® Stainless Steel Single-Door Wall-Mount Enclosures with Windows



Window Door Enclosure with Quarter-turn Latching



SECTION Y-Y
(WITH CONCEPT® PANEL INSTALLED)

C2503

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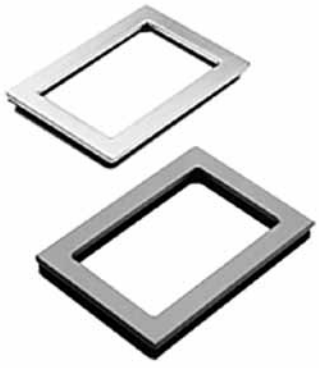
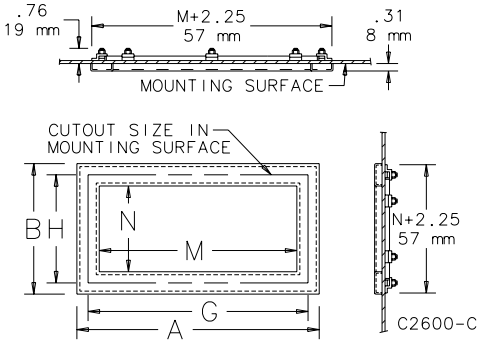
Window Kits

Steel and Stainless Steel Window Kits



Steel Window Kits are designed to be used on Type 4 and 12 enclosures. Stainless Steel Window Kits are suitable for Type 4, 4X, 12 and 13 enclosures in indoor or outdoor applications where corrosion is a problem. These kits are easily installed by making a cutout in the enclosure and attaching the window and frame in place. Frames are made from heavy-gauge steel with an ANSI 61 gray polyester powder finish over phosphatized surfaces or from heavy-gauge Type 304 stainless steel with a brushed finish. The window is .25-in. (6-mm) acrylic for steel kits or .25-in. (6-mm) polycarbonate material for stainless steel kits. Oil-resistant gasketing ensures a water-tight seal around the perimeter of the window and frame. All mounting hardware is furnished. Custom sizes, materials and finishes can be provided on special order. Consult factory for information.

Bulletin: A80SW, A80W



Industry Standards

UL 508A Component Recognized; Type 4, 4X (stainless steel version only), 12, 13; File No. E61997

CSA Type 4, 4X (stainless steel version only), 12,13; File No. 42186
NEMA/EEMAC 4, 4X (stainless steel version only), 12, 13
IEC 60529, IP66

Catalog Number	AxB in.	AxB mm	Material	Window Size M x N (in.)	Window Size M x N (mm)	Required Cutout Size G x H (in.)	Required Cutout Size G x H (mm)
APWK53NF	7.50 x 5.50	191 x 140	Steel	5.00 x 3.00	127 x 76	6.69 x 4.69	170 x 119
APWK53NFSS	7.50 x 5.50	191 x 140	Stainless Steel	5.00 x 3.00	127 x 76	6.69 x 4.69	170 x 119
APWK95NF	11.50 x 8.00	292 x 203	Steel	9.00 x 5.50	229 x 140	10.69 x 7.19	272 x 183
APWK95NFSS	11.50 x 8.00	292 x 203	Stainless Steel	9.00 x 5.50	229 x 140	10.69 x 7.19	272 x 183
APWK711NFSS	13.50 x 9.50	343 x 241	Stainless Steel	11.00 x 7.00	279 x 178	12.69 x 8.69	392 x 211
APWK133NF	15.50 x 5.50	394 x 140	Steel	13.00 x 3.00	330 x 76	14.69 x 4.69	373 x 119
APWK138NF	15.50 x 10.50	394 x 267	Steel	13.00 x 8.00	330 x 203	14.69 x 9.69	373 x 246
APWK138NFSS	15.50 x 10.50	394 x 267	Stainless Steel	13.00 x 8.00	330 x 203	14.69 x 9.69	373 x 246
APWK715NFSS	17.50 x 9.50	343 x 445	Stainless Steel	15.00 x 7.00	381 x 178	16.69 x 8.69	424 x 211
APWK175NF	19.50 x 8.00	495 x 203	Steel	17.00 x 5.50	432 x 140	18.69 x 7.19	475 x 183
APWK1711NF	19.50 x 13.50	495 x 343	Steel	17.00 x 11.00	432 x 279	18.69 x 12.69	475 x 322
APWK1711NFSS	19.50 x 13.50	495 x 343	Stainless Steel	17.00 x 11.00	432 x 279	18.69 x 12.69	475 x 322
APWK720NFSS	22.50 x 9.50	572 x 241	Stainless Steel	20.00 x 7.00	508 x 178	21.69 x 8.69	551 x 221
APWK2315NF	25.50 x 17.50	648 x 445	Steel	23.00 x 15.00	584 x 381	24.69 x 16.69	627 x 424
APWK2315NFSS	25.50 x 17.50	648 x 445	Stainless Steel	23.00 x 15.00	584 x 381	24.69 x 16.69	627 x 424
APWK724NFSS	26.50 x 9.50	673 x 241	Stainless Steel	24.00 x 7.00	610 x 178	25.69 x 8.69	653 x 221
APWK729NFSS	31.50 x 9.50	800 x 241	Stainless Steel	29.00 x 7.00	737 x 178	30.69 x 8.69	780 x 221
APWK2919NF	31.50 x 21.50	800 x 546	Steel	29.00 x 19.00	737 x 483	30.69 x 20.69	780 x 526
APWK2919NFSS	31.50 x 21.50	800 x 546	Stainless Steel	29.00 x 19.00	737 x 483	30.69 x 20.69	780 x 526
APWK3523NF	37.50 x 25.50	953 x 445	Steel	35.00 x 23.00	889 x 584	36.69 x 24.69	932 x 627

When determining if a window kit will fit in a door or cover, be sure to allow for gaskets, data pockets, door handles, latch rods and other parts attached to the door or cover.

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Frameless Window Kit

Window Kits

Designed for use on many Type 12 and 13 enclosures. These kits are for indoor use in a temperature range of 55 F to 125 F (13 C to 52 C). For more severe conditions use Steel or Stainless Steel Window Kits. The window is scratch-resistant .12-in. (3-mm) polycarbonate. Special high-strength, double-sided tape is supplied as well as screw fasteners. Windows can be cut to smaller sizes. Allow .50-in. (13-mm) overlap on each side of window for tape.

Bulletin: A80W

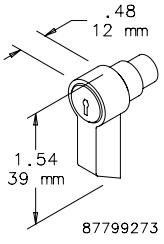
Catalog Number	Window Size in./mm	Maximum Cutout Size in./mm
APWKE52	5.50 x 3.00	4.50 x 2.00
	140 x 76	114 x 51
APWKE96	9.62 x 7.19	8.62 x 6.19
	244 x 183	219 x 157
APWKE133	13.88 x 3.88	12.88 x 2.88
	353 x 99	327 x 73

Wing Knobs for CONCEPT® Window Kits

Knobs are optional latching for hinged windows and hinged bezels. Knobs are black and available in locking and nonlocking versions. Keylocking knob maintains Type 12 rating only.

Bulletin: C2

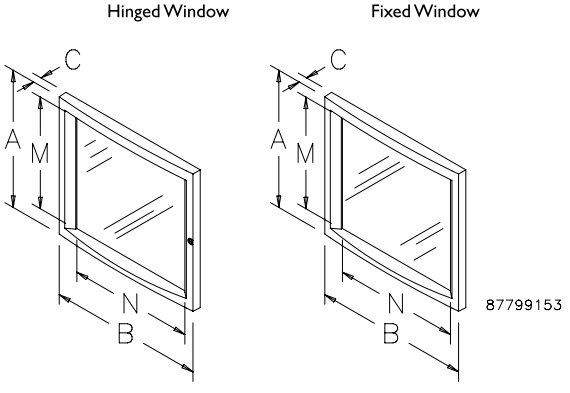
Catalog Number	Description
CWKL	Wing Knob, locking
CWKN	Wing Knob, nonlocking



CONCEPT® Fixed and Hinged Window Kits

Aesthetic die-cast aluminum frame has .188-in. (5-mm) thick, clear polycarbonate window. Pre-assembled kit is secured to front opening of enclosure by four mounting screws. Furnished window frame caps conceal mounting screws. Hinged window kit is hinged on left side and has a single-point slotted latch (optional locking or non-locking wing knob latch is also available). Textured finish, ANSI 61 gray or RAL 7035 light gray.

Bulletin: C2



Catalog Number	AxBxC in.	AxBxC mm	Finish	Description	Window Size M x N (mm)	Window Size M x N (in.)
CWF3136	12.20 x 14.17 x 1.26	310 x 360 x 32	ANSI 61	Fixed window kit	253 x 276	9.96 x 10.86
CWF3136LG	12.20 x 14.17 x 1.26	310 x 360 x 32	RAL 7035	Fixed window kit	253 x 276	9.96 x 10.86
CWH3136	12.20 x 14.17 x 1.34	310 x 360 x 34	ANSI 61	Hinged window kit	253 x 276	9.96 x 10.86
CWH3136LG	12.20 x 14.17 x 1.34	310 x 360 x 34	RAL 7035	Hinged window kit	253 x 276	9.96 x 10.86
CWF4045	15.75 x 17.72 x 1.30	400 x 450 x 33	ANSI 61	Fixed window kit	343 x 366	13.50 x 14.40
CWF4045LG	15.75 x 17.72 x 1.30	400 x 450 x 33	RAL 7035	Fixed window kit	343 x 366	13.50 x 14.40
CWH4045	15.75 x 17.72 x 1.38	400 x 450 x 35	ANSI 61	Hinged window kit	343 x 366	13.50 x 14.40
CWH4045LG	15.75 x 17.72 x 1.38	400 x 450 x 35	RAL 7035	Hinged window kit	343 x 366	13.50 x 14.40
CWF5557	21.65 x 22.44 x 1.42	550 x 570 x 36	ANSI 61	Fixed window kit	493 x 486	19.40 x 19.13
CWF5557LG	21.65 x 22.44 x 1.42	550 x 570 x 36	RAL 7035	Fixed window kit	493 x 486	19.40 x 19.13
CWH5557	21.65 x 22.44 x 1.50	550 x 570 x 38	ANSI 61	Hinged window kit	493 x 486	19.40 x 19.13

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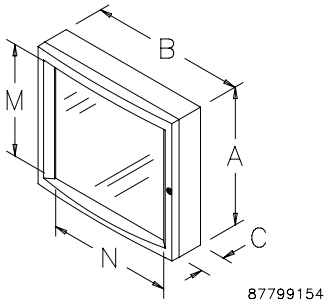
Window Kits

CONCEPT® Deep Hinged Window Kit

Kit is hinged on left side and has a single-point slotted latch (optional locking or non-locking wing knob latch is also available). Aesthetic die-cast aluminum frame has .188-in. (5-mm) thick, clear polycarbonate window. Two-inch space between enclosure front opening and window surface accommodates switches, lights, meters and other components. This kit can be used as an accessory window kit on larger standard Hoffman enclosure doors. Textured finish, ANSI 61 gray or RAL 7035 light gray.

Bulletin: C2

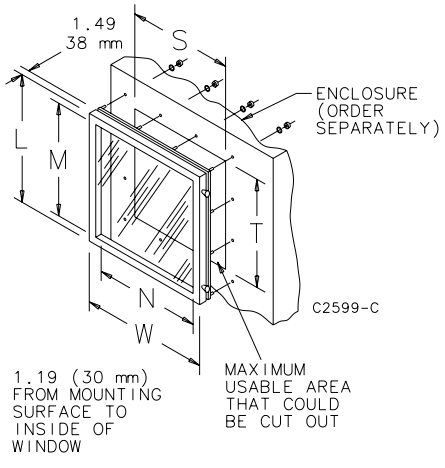


Catalog Number	AxBxC in.	AxBxC mm	Finish	Window Size M x N (mm)	Window Size M x N (in.)
CWHD3136	12.20 x 14.17 x 3.31	310 x 360 x 84	ANSI 61	253 x 276	9.96 x 10.86
CWHD3136LG	12.20 x 14.17 x 3.31	310 x 360 x 84	RAL 7035	253 x 276	9.96 x 10.86
CWHD4045	15.75 x 17.72 x 3.39	400 x 450 x 86	ANSI 61	343 x 366	13.50 x 14.40
CWHD4045LG	15.75 x 17.72 x 3.39	400 x 450 x 86	RAL 7035	343 x 366	13.50 x 14.40
CWHD5557	21.65 x 22.44 x 3.50	550 x 570 x 89	ANSI 61	493 x 486	19.40 x 19.13

Type 12 Hinged Window Kit

For use as a viewing window where access to components mounted behind the window is required. Window is .25-in. (6-mm) clear acrylic. Easily mounted by drilling the appropriate mounting holes. All mounting hardware is provided. Continuous gaskets on all openings maintain UL Type 12 integrity. Finish is ANSI 61 gray polyester powder paint.

Bulletin: A80W



Industry Standards

UL 508A Component Recognized; Type 12; File No. E61997

CSA Type 12; File No. 42186
NEMA/EEMAC Type 12
IEC 60529, IP55

Catalog Number	Window Size M x N in./mm	Overall L x W in./mm	S in./mm	T in./mm
APWK1212H	10.28 x 10.28	12.00 x 12.00	10.44	10.44
	261 x 261	305 x 305	265	265
APWK1612H	14.28 x 10.28	16.00 x 12.00	10.44	14.44
	363 x 261	406 x 305	265	367
APWK2016H	18.28 x 14.28	20.00 x 16.00	14.44	18.44
	464 x 363	508 x 406	367	468
APWK2020H	18.28 x 18.28	20.00 x 20.00	18.44	18.44
	464 x 464	508 x 508	468	468
APWK2420H	22.28 x 18.28	24.00 x 20.00	18.44	22.44
	566 x 464	610 x 508	468	570
APWK3024H	28.28 x 22.28	30.00 x 24.00	22.44	28.44
	718 x 566	762 x 610	570	722

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Type 4 and 4X Deep-Hinged Window Kits

Industry Standards

Stainless Steel

UL 508A Listed; Type 3R, 4, 4X, 12; File No. E61997
cUL Listed per CSA C22.2, No. 94; Type 3R, 4, 4X, 12; File No. E61997

NEMA/EEMAC Type 3R, 4, 4X, 12
IEC 60529, IP66

Mild Steel

UL 508A Listed; Type 4, 12; File No. E61997
cUL Listed per CSA C22.2 No. 94; Type 4, 12; File No. E61997

NEMA/EEMAC Type 4, 12

Application

Deep-hinged window kits provide protection, visibility and easy access to equipment and components installed behind the viewing area. Window kits are conveniently sized to allow direct mounting in the usable door area of Hoffman NEMA and CONCEPT® wall-mount enclosures, as well as any Hoffman enclosure with a suitably sized mounting surface. Deep-hinged window kits provide protection, visibility and easy access to equipment and components installed behind the viewing area. These kits have an aesthetic appearance, quarter-turn latching for easy access, .25-in. (6-mm) thick, clear polycarbonate material for viewing, 2.5-in. (64-mm) depth to allow for deep controls and a built-in gasket compression stop to facilitate flush mounting. Each kit comes with a mounting template and hardware to allow for easy installation and can be mounted either left or right hinged.

Specifications

- Manufactured from Type 316L stainless steel or painted mild steel
- Quarter-turn latches for quick access
- 0.25-in. (6-mm) thick, clear polycarbonate windows for easy viewing
- 2.5-in. (64-mm) deep to allow for deep controls
- Built-in gasket compression stop on back of window kit facilitates flush mounting
- Designed for either left or right hinging
- Includes mounting template and mounting hardware
- Easy-to-remove clip-style hinge pin

Window Kits

Finish

- Stainless steel: Enclosures are unpainted; door and body have a smooth #4 brushed finish
- Mild steel: ANSI 61 gray polyester powder paint inside and out

Accessories

Touch-up Paint (ATPPY61)

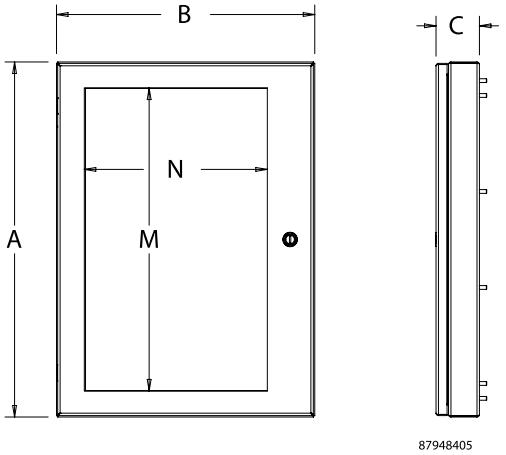
Options

Optional Handles
CWHNL - Nonlocking
CWHK - Keylocking
CWHPTO - Padlocking

Bulletin: A80SW, A80W

Standard Product

Catalog Number	AxBxC in./mm	Material	Window Size M x N in./mm
AWDH1418N4	12.19 x 14.56 x 2.73 310 x 370 x 69	Steel	8.93 x 9.86 227 x 250
AWDH1418N4SS	12.19 x 14.56 x 2.73 310 x 370 x 69	316L Stainless steel	8.93 x 9.86 227 x 250
AWDH1612N4	14.19 x 8.14 x 2.73 360 x 207 x 69	Steel	10.91 x 3.39 277 x 66
AWDH1612N4SS	14.19 x 8.14 x 2.73 360 x 207 x 69	316L Stainless steel	10.91 x 3.39 277 x 66
AWDH2016N4	18.19 x 12.14 x 2.73 462 x 308 x 69	Steel	15.60 x 8.08 396 x 205
AWDH2016N4SS	18.19 x 12.14 x 2.73 462 x 308 x 69	316L Stainless steel	15.60 x 8.08 396 x 205
AWDH2416N4	22.19 x 12.14 x 2.73 563 x 308 x 69	Steel	19.60 x 8.08 498 x 205
AWDH2416N4SS	22.19 x 12.14 x 2.73 563 x 308 x 69	316L Stainless steel	19.60 x 8.08 498 x 205
AWDH2420N4	22.19 x 16.14 x 2.73 563 x 410 x 69	Steel	19.60 x 12.08 498 x 307
AWDH2420N4SS	22.19 x 16.14 x 2.73 563 x 410 x 69	316L Stainless steel	19.60 x 12.08 498 x 307
AWDH2430N4	22.19 x 26.14 x 2.73 563 x 664 x 69	Steel	19.60 x 20.89 498 x 531
AWDH2430N4SS	22.19 x 26.14 x 2.73 563 x 664 x 69	316L Stainless steel	19.60 x 20.89 498 x 531
AWDH3024N4	28.19 x 20.14 x 2.73 716 x 512 x 69	Steel	25.60 x 14.89 650 x 378
AWDH3024N4SS	28.19 x 20.14 x 2.73 716 x 512 x 69	316L Stainless steel	25.60 x 14.89 650 x 378
AWDH3624N4	34.19 x 20.14 x 2.73 868 x 512 x 69	Steel	31.60 x 14.89 803 x 378
AWDH3624N4SS	34.19 x 20.14 x 2.73 868 x 512 x 69	316L Stainless steel	31.60 x 14.89 803 x 378



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3TG10 contactors 4-pole, 4 kW

Overview

Version

The 3TG10 power relays/miniature contactors with 4 main contacts are available with screw terminals or 6.3 mm × 0.8 mm flat connectors. The versions with screw terminals are climate-proof and finger-safe according to EN 61140.

The 3TG10 miniature contactors are characterized by their width of only 36 mm.

Surge suppression

The 3TG10 power relays/miniature contactors have an integrated protective circuit against opening surges.

Application

Because they are hum-free they are suitable for use in household appliances and distribution boards in office and residential areas. They can also be used for applications where there is little space such as air conditioners, heating systems, pumps and fans, i. e. for simple electrical controls.

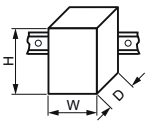
AC and DC operation

EN 60947-1, EN 60947-4-1, EN 60947-5-1

Overload and short-circuit protection

The 3UA7 overload relay can be used for overload protection. This applies to mounting onto contactors and to stand-alone installation.

Technical specifications

Type				**3TG10**
Dimensions (W x H x D)			mm	36 x 56 x 56
• With 3UA7 overload relay mounted below			mm	45 x 100 x 62
General data				
Endurance				
• Mechanical		Operating cycles		3 million
• Electrical				
- AC-1 at I_e		Operating cycles		0.1 million
- AC-3 at I_e		Operating cycles		0.4 million
Rated insulation voltage U_i (pollution degree 3)			V	400
Rated impulse withstand voltage U_{imp}			kV	4
Protective separation Between the coil and the contacts acc. to EN 60947-1, Appendix N			V AC	Up to 300
Permissible ambient temperature				
• During operation[1]			°C	-25 ... + 55
• During storage			°C	-50 ... + 80
Degree of protection acc. to IEC 60947-1 and EN 60529				IP00, drive system IP20
Control circuit				
Power consumption of the solenoid coils (when coil is cold and 1.0 x U_s)				
• AC operation, 45 ... 450 Hz			VA	4.4
- P.f.				0.9 (hum-free)
• DC operation			W	4
Coil operating range				0.85 ... 1.1 x U_s
Short-circuit protection				
Fuse links operational class gG Type LV HRC 3NA, DIAZED 5SB, NEOZED 5SE acc. to EN 60947-4-1				
• Type of coordination "1"			A	25
• Type of coordination "2"			A	10
Miniature circuit breakers, C characteristic			A	10
AC capacity				
Utilization category AC-1, switching resistive loads				
Rated operational current I_e up to 400 V at 55 °C[1]			A	20 for screw terminals, 16 for flat connector
Rated power U_e for AC loads with p.f. = 1, 230/220 V				
• For screw terminals			kW	7.5 (13 at 400 V)
• For flat connector			kW	6 (10 at 400 V)
Minimum conductor cross-section for load with I_e			mm^2	2.5
Utilization categories AC-2 and AC-3 **Operational current for AC-3 at 400 V rated value**			A	8.4
Rated power for slipring or squirrel-cage motors with 50 and 60 Hz and at 400 V			kW	4
Utilization category AC-5a (permissible nominal impedance: ≥ 0.5 Ω) **Switching of gas discharge lamps** Per main current path at 230 V, 50 Hz Rated power/rated operational current per lamp				
• Uncorrected	18 W	0.37 A		43
	36 W	0.43 A		37
	58 W	0.67 A		24
• DUO switching	18 W	2 x 0.11 A		2 x 81
	36 W	2 x 0.21 A		2 x 42
	58 W	2 x 0.32 A		2 x 28

[1] If the three main current paths carry a load of 20 A, the following applies if I > 10 A in the fourth conducting path: Permissible ambient temperature 40 °C.

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3TG10 contactors 4-pole, 4 kW

Type						3TG10
AC capacity						
Switching gas discharge lamps with correction, ECG Per main current path 230 V, 50 Hz Rated power per lamp/capacitance/ rated operational current per lamp						
• Shunt compensation	L18 W	4.5 µF	0.11 A		Unit(s)	15
	L36 W	4.5 µF	0.21 A		Unit(s)	15
	L58 W	7 µF	0.32 A		Unit(s)	10
• With ECG (single lamp)	L18 W	6.8 µF	0.10 A		Unit(s)	39
	L36 W	6.8 µF	0.18 A		Unit(s)	39
	L58 W	10 µF	0.27 A		Unit(s)	26
• With ECG (two lamps)	L18 W	10 µF	0.18 A		Unit(s)	2 x 26
	L36 W	10 µF	0.35 A		Unit(s)	2 x 26
	L58 W	22 µF	0.52 A		Unit(s)	2 x 12
Utilization category AC-5b, switching incandescent lamps Per main current path at 230 V, 50 Hz					kW	1.6
Load rating with DC						
Utilization category DC-1, switching resistive load (*L/R* ≤ 15 ms) • Rated operational currents I_e						
- 1 conducting path				Up to 24 V	A	16
				60 V	A	6
				110 V	A	2
				220 V/240 V	A	0.8
- 2 conducting paths in series				Up to 24 V	A	16
				60 V	A	16
				110 V	A	6
				220 V/240 V	A	1.6
- 3 conducting paths in series				Up to 24 V	A	18
				60 V	A	18
				110 V	A	16
				220 V/240 V	A	6
- 4 conducting paths in series				Up to 24 V	A	20
				60 V	A	20
				110 V	A	20
				220 V/240 V	A	20
Utilization category DC-3 and DC-5 **Shunt-wound and series-wound motors (*L/R* ≤ 15 ms)** • Rated operational currents I_e						
- 1 conducting path				Up to 24 V	A	10
				60 V	A	0.5
				110 V	A	0.15
				220 V/240 V	A	0
- 2 conducting paths in series				Up to 24 V	A	16
				60 V	A	5
				110 V	A	0.35
				220 V/240 V	A	0
- 3 conducting paths in series				Up to 24 V	A	16
				60 V	A	16
				110 V	A	10
				220 V/240 V	A	1.75
- 4 conducting paths in series				Up to 24 V	A	18
				60 V	A	16
				110 V	A	10
				220 V/240 V	A	2
Conductor cross-sections						
						Screw terminals
Terminal screws						M3
• Finely stranded with end sleeve (DIN 46228 Form A/D/C)					mm^2	2 x (0.75 ... 2.5)
• Solid					mm^2	2 x (1 ... 2.5), 1 x 4
Permissible opening tool (screwdriver)						3.0 mm x 0.5 mm (3RA29 08-1A) or Pozidriv 2
						Flat connectors
• Finely stranded 6.3 mm plug-in sleeve acc. to DIN 46245/46247						
- 6.3 ... 1					mm^2	0.5 ... 1
- 6.3 ... 2.5					mm^2	1 ... 2.5
CSA and UL rating (screw terminals)						
Rated insulation voltage				AC	V	600
Uninterrupted current	Open and enclosed				A	20
Maximum horsepower ratings (CSA and UL approved values), rated power for induction motors with 60 Hz						Single-phase/Three-phase
				At 115 V	hp	0.5/ --
				200 V	hp	1/ 3
				230 V	hp	1.5/ 3
				460 ... 600 V	hp	0/ 5

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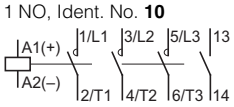
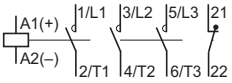
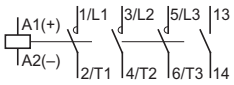
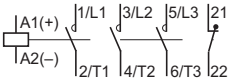
3TG10 contactors 4-pole, 4 kW

Selection and ordering data

For screw and snap-on mounting onto TH 35 standard mounting rail

Rated data Utilization category AC-1 Switching of resistive loads at 55 °C: Operational current I_e up to 400 V	AC-1: Power of AC loads at 50 Hz and 400 V	AC-2 and AC-3: Operational current I_e up to 400 V[1]	AC-2 and AC-3: Power of AC loads at 50 Hz and 400 V	Main contacts: Version NO	NC	Rated control supply voltage U_s	DT	Order No.	Price per PU	PU (UNIT, SET, M)	PS*	PG
A	kW	A	kW			V						
4-pole · Hum-free · With screw terminals												
Terminal designations according to EN 50012												
1 NO, Ident. No. **10**								1 NC, Ident. No. **01E**				
												
AC operation, 45 ... 450 Hz								**Screw terminals**				
20	13	8.4	4	4	--	24 AC	▶	**3TG10 10-0AC2**		1	1 unit	101
						110 AC	▶	**3TG10 10-0AG2**		1	1 unit	101
						230 AC	▶	**3TG10 10-0AL2**		1	1 unit	101
				3	1	24 AC	▶	**3TG10 01-0AC2**		1	1 unit	101
						110 AC	▶	**3TG10 01-0AG2**		1	1 unit	101
						230 AC	▶	**3TG10 01-0AL2**		1	1 unit	101
DC operation												
20	13	8.4	4	4	--	24 DC	▶	**3TG10 10-0BB4**		1	1 unit	101
				3	1	24 DC	▶	**3TG10 01-0BB4**		1	1 unit	101
3TG10 ..-0...												
4-pole · Hum-free · With flat connectors 6.3 mm x 0.8 mm												
Terminal designations according to EN 50012												
1 NO, Ident. No. **10**								1 NC, Ident. No. **01E**				
												
AC operation, 45 ... 450 Hz								**Flat connectors**				
16	10	8.4	4	4	--	24 AC	▶	**3TG10 10-1AC2**		1	1 unit	101
						110 AC	D	**3TG10 10-1AG2**		1	1 unit	101
						230 AC	▶	**3TG10 10-1AL2**		1	1 unit	101
				3	1	24 AC	D	**3TG10 01-1AC2**		1	1 unit	101
						110 AC	D	**3TG10 01-1AG2**		1	1 unit	101
						230 AC	▶	**3TG10 01-1AL2**		1	1 unit	101
DC operation												
16	10	8.4	4	4	--	24 DC	C	**3TG10 10-1BB4**		1	1 unit	101
		8.4	4	3	1	24 DC	D	**3TG10 01-1BB4**		1	1 unit	101
3TG10 ..-1...												

Accessories

Max. rated operational currents I_e/AC-1 (at 55 °C) of the contactors: Type	Max. conductor cross-sections mm²	DT	Order No.	Price per PU	PU (UNIT, SET, M)	PS*	PG
Links for paralleling (star jumpers)							
3-pole, without connection terminals[1) 2)]							
16 star jumpers can be reduced by one pole	--	▶	**3RT19 16-4BA31**		1	1 unit	101
3-pole, with connection terminals[1)3)]							
40	25	▶	**3RT19 16-4BB31**		1	1 unit	101
4-pole, with connection terminals[1)4)]							
40	25	C	**3RT19 16-4BB41**		1	1 unit	101

1) The links for paralleling can be reduced by one pole. The rated operational currents apply to each pole. The links for paralleling are insulated.

2) Replacement for 3TX4 490-2C.

3) Replacement for 3TX4 490-2A.

4) Replacement for 3TX4 490-2B.

*** You can order this quantity or a multiple thereof.**
Illustrations are approximate

SIEMENS

Devices: ED Frame Types ED2, ED2Y, ED4, HED4, HED6, HHED6 and HCED6 Circuit Breakers, Type ED6 ETI Motor Circuit Interrupters, Types ED2, ED4, ED6, HHED6 and HCED6 Molded Case Switches.

Siemens Energy & Automation, Inc.
Bellefontaine, OH 43311 U.S.A.

Pc. No. 75822B00

Installation Instructions

⚠ DANGER

Hazardous Voltage.
Will cause death or serious injury.

Turn off and lock out all power before installing or servicing.

⚠ SAFETY INSTRUCTIONS

NOTE: This instruction outlines the recommended installation procedure.

1. General Product Information

The ED frame circuit breaker line includes Types ED2, ED2Y, ED4, ED6, HED4, HED6, HHED6 and HCED6 Circuit Breakers; Type ED6 ETI Motor Circuit Interrupters; and Types ED2, ED4, ED6, HHED6 and HCED6 Molded Case Switches. These devices are rated 15A. to 125A. continuous current and are available for use at operating voltages up to 600 V.A.C., 50/60 Hz.; 240 V.A.C., 400 Hz.; and 250 V.D.C. (Type ED2 and ED2Y Circuit Breakers and Molded Case Switches are rated 100 A. maximum. Type HHED6 and HCED6 Circuit Breakers and Molded Case Switches are rated for A.C. 50/60 Hz. current only.)

NOTE: Molded Case Switches are available as 100 A. and 125 A. ratings only, and are not provided with a “Push-to-Trip” button. In addition, Type ED6 ETI Motor Circuit Interrupters are available with ratings down to 1 A.

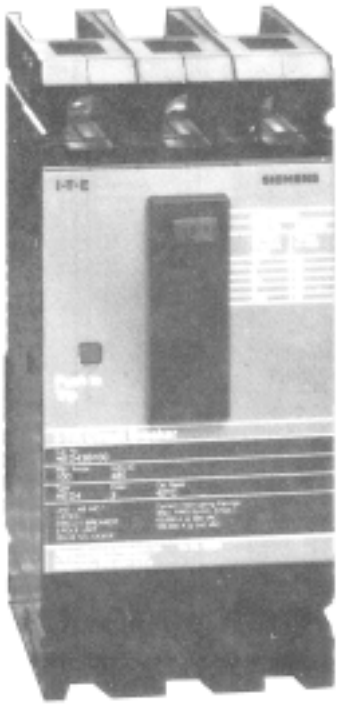
For this publication, the term Circuit Breaker also includes Molded Case Switches and Motor Circuit Interrupters.

2. Installation

ED-frame circuit breakers are for use in individual enclosures, panelboards, switch boards or other approved equipment.

The installation procedure consists of inspecting, attaching required accessories, mounting the circuit breaker, and connecting and torquing the line and load wire connectors.

Mounting hardware and wire connectors (where



ED-Frame Circuit Breaker and Molded Case Switch

Fig. 1

Installation (con’t)

required) are available as separate catalog items.

NOTE: Accessory installation must be completed before the circuit breaker is mounted and connected. (See installation instructions supplied with accessory before proceeding).

NOTE: Accessories manufactured by Siemens Energy and Automation, Inc. that are suitable for use with Circuit Breaker Types ED2, ED2Y, ED4, ED6, HED4 and HED6 are also suitable and may be used with Types HHED6 and HCED6.

A. Turn off and lock out all power before installing or servicing.

B. Make sure that the circuit breaker is suitable for the installation by comparing nameplate ratings with system requirements. Inspect the circuit breaker for completeness and check for any damage before mounting.

C. The circuit breaker must be in the “Tripped” or “OFF” position prior to mounting.

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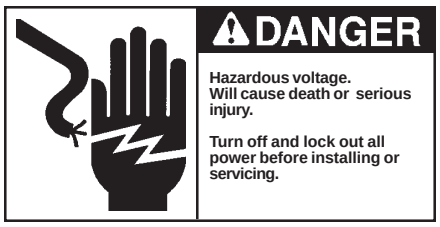

Installation Instructions

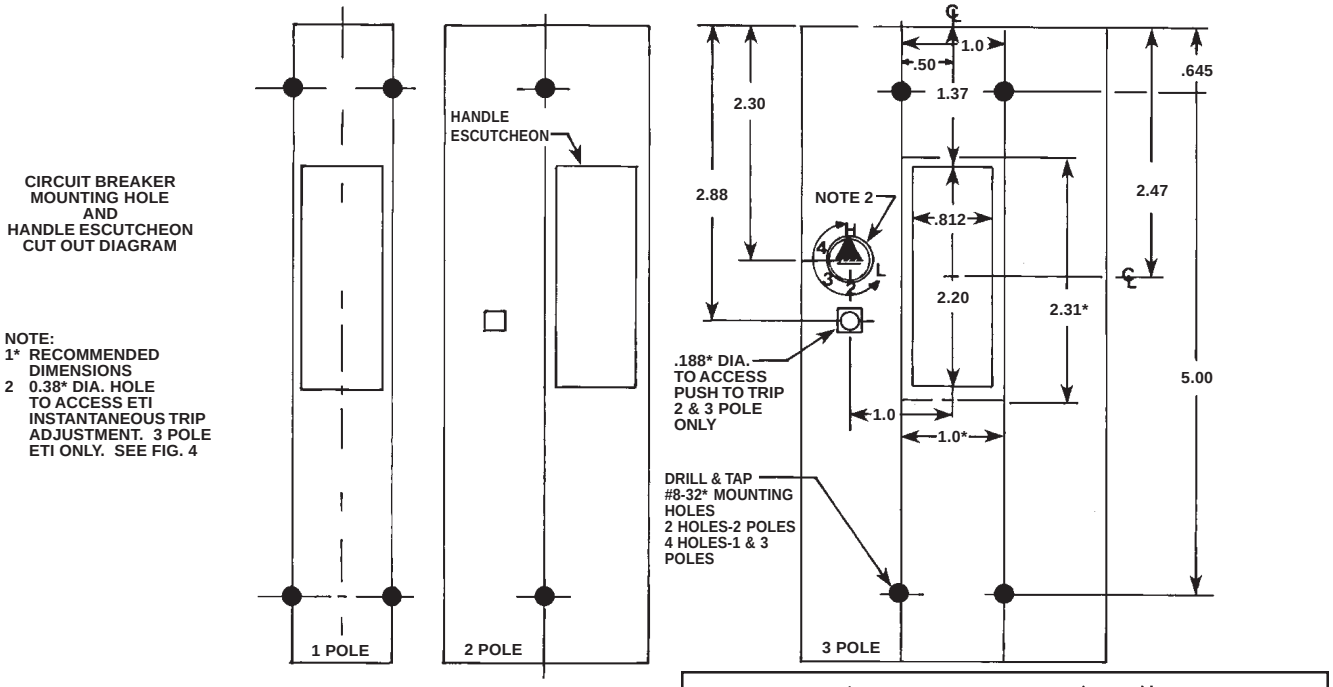

Fig. 2

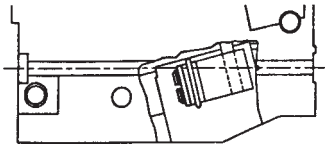

Fig. 3

Wiring Lug Installation
for Circuit Breaker Types HHED6 and HCED6
Load terminal and wiring lug are positioned at an angle

D. To mount the circuit breaker, perform the following steps:

1. For individual enclosures, panelboards and switchboards manufactured by Siemens Energy and Automation, Inc., follow the instructions provided with this equipment.
2. For those applications where mounting is on a flat surface of the customers equipment, drill and tap mounting bolt holes according to the drilling plan in Fig. 2. For handle escutcheon cut out plans refer to Fig. 2.

NOTE: For mounting single pole breakers, the use of a back mounting plate (Catalog Number E2BMB) is required.

3. If circuit breaker contains accessories, make sure terminals can be connected when the circuit breaker is mounted.
4. Position circuit breaker on mounting surface.
5. Install mounting screws and washers from kit Catalog Number MSE6. Torque mounting hardware to 12-15 in-lbs.
6. After mounting the circuit breaker, line and load terminals and accessory terminals should be connected. Install wire connectors with correct torque requirements. Torque values for line and load connectors are provided on the circuit breaker nameplate. Insure that wire and wire connectors are fully engaged on terminals and that connectors are flush with end of terminal.

   NOTE: When aluminum conductors are used, the application of a suitable joint compound is recommended to reduce the possibility of terminal overheating.

   NOTE: Circuit Breaker Types HHED6 and HCED6 have load terminals that can rotate between two positions. When installing wire connectors, the load terminal must be positioned at an angle as shown in Fig. 3.
7. After the circuit breaker is installed, check all mounting hardware for secureness.

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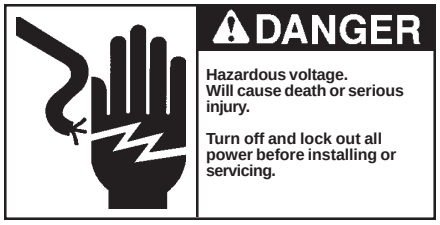


Installation Instructions

3. Manual Operation

Manual operation of the circuit breaker is controlled by the circuit breaker handle and the PUSH-TO-TRIP button. The circuit breaker handle has three indicating positions, two of which are molded into the handle to indicate ON and OFF. The third position indicates a TRIP position and is between the ON and OFF position. (See Fig. 4)

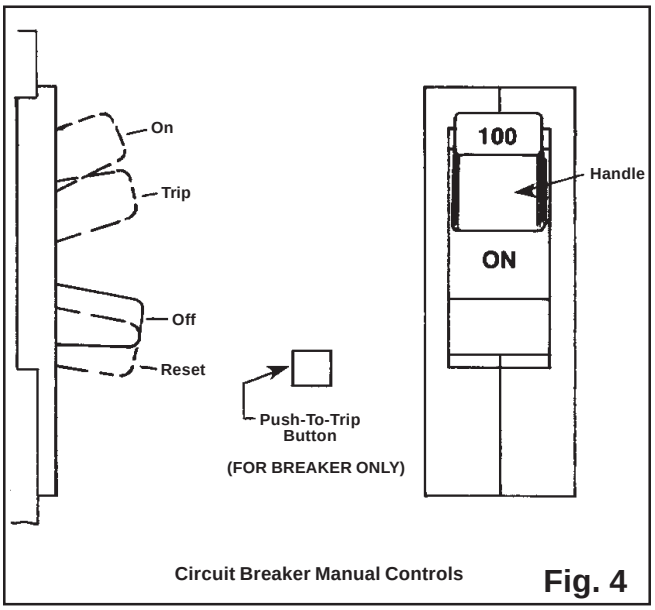
A. Circuit Breaker Reset

After tripping, the circuit breaker is reset by moving the circuit breaker handle to the reset position and then moving the handle to the ON position.

NOTE: In the event of a thermal trip, the circuit breaker cannot be reset until the thermal element cools.

B. PUSH-TO-TRIP Button

The PUSH-TO-TRIP button checks the tripping function and is used to manually exercise the operating mechanism. (PUSH-TO-TRIP button not provided on switch)



Circuit Breaker Manual Controls **Fig. 4**

4. Inspection and Field Testing

ED-frame circuit breakers are designed to provide years of maintanance free service. The following procedure outlines how to inspect and test a circuit breaker in service.

Inspection and Maintenance

Circuit breakers in service should be inspected periodically. The inspection should include the following steps:

A. Turn off and lock out power before inspecting or servicing. Special attention should be paid to reverse feed applications to ensure no voltage is present.

B. Remove dust, soot, grease or moisture from the surface of the circuit breaker using a lint free cloth brush or vacuum cleaner. DO NOT blow debris into the circuit breakers. If contamination is found, eliminate the source of the problem.

NOTE: Do not spray or allow any petroleum based chemicals, solvents or paints to contact the inside or outside of breaker or electrical connections.

C. Switch the circuit breaker to the ON and OFF positions several times to be sure the mechanical linkages are free and do not bind. If mechanical linkages are not free, replace the circuit breaker.

D. Press the PUSH-TO-TRIP button to mechanically trip the circuit breaker. Trip, reset, and switch the breaker on several times. If the circuit breaker cannot be turned on replace the circuit breaker.

E. Check circuit breaker housing and handle for cracks, chipping and discoloration. Circuit breakers should be replaced if cracks or severe discoloration is found.

F. Check terminals and wire connectors for looseness or signs of overheating. Overheating will show as discoloration, melting or blistering of conductor insulation, or as pitting or melting of conductor surfaces due to arcing. If there is no evidence of overheating or looseness, do not disturb or tighten the connections. If there is evidence of overheating, terminations should be replaced. Before re-energizing the circuit breaker, all wire connectors and cable should be refurbished to the original installed condition.

IMPORTANT: Refer to instructions on page 2, Item 6.

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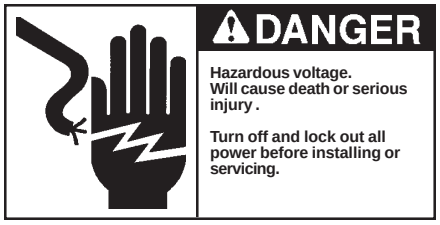

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Installation Instructions

G. Check circuit breaker mounting hardware. Tighen if necessary.

H. Check area where circuit breaker is installed for any safety hazards, including personal safety and fire hazards. Exposure to certain types of chemicals can cause deterioration of electrical connections.

Field Testing

Any field testing should be conducted in accordance with NEMA Standards Publication AB2.

5. Adjustment procedures for ETI Motor Circuit Interrupter.

A. Determine the Motor Full Load Amperes from the motor nameplate or table 430-150 of N.E.C. (1990).

B. Use Table 1 for suggested device catalog number and adjustment setting.

C. Adjust the instantaneous button by rotating to the desired setting determined above (Ref. Fig. 5).

ETI instantaneous-trip circuit breakers are recommended for use in combination motor starters to provide selective short-circuit protection for the motor branch circuit. The adjustable instantaneous-trip feature of the ETI circuit breaker provides for a trip setting slightly above the peak motor-inrush current. With this setting, no delay is introduced in opening the circuit when a fault occurs. This circuit breaker has no time-delay trip element. Therefore it must be used in conjunction with, and immediately ahead of, the motor-running overcurrent protective device.

The recommended ETI instantaneous only circuit breakers listed in Table 1 have continuous-current ratings of at least 115% of motor full-load currents. The trip-setting positions are approximately 11 times motor full-load currents. The suggested trip settings, and in some cases, the allowable maximum setting of 1300% of motor full load current may not be sufficient to get “energy efficient” motors on line.

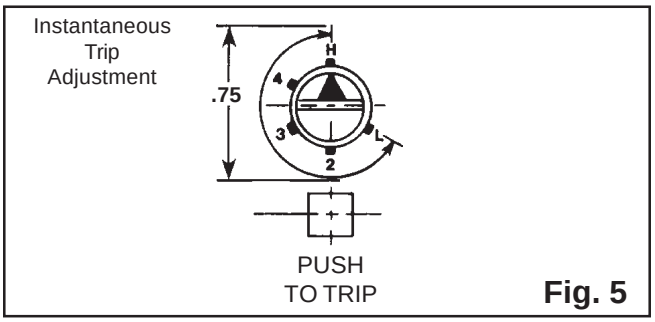

Fig. 5

(When Breaker is Mounted Immediately Ahead of Motor Starter)

3 Phase Induction Type Motors (ETI circuit breakers for branch circuit use with alternating-current combination, full voltage motor starters).

TABLE 1

Motor Full Load Amperes	Catalog Number	ETI Trip Setting	
		Adjustment	Amperes
.20- .33	ED63A001	Low	2.6
.34- .45		2	4.5
.46- .56		3	6
.57- .68		4	7.5
.69- .81		High	9
.53- .83	ED63A002	Low	7
.84- 1.14		2	11
1.15- 1.45		3	15
1.46- 1.68		4	19
1.69- 2.00		High	22
.76- 1.29	ED63A003	Low	10
1.30- 1.75		2	17
1.76- 2.29		3	23
2.30- 2.68		4	30
2.69- 3.18		High	35
1.23- 1.99	ED63A005	Low	16
2.00- 2.75		2	26
2.76- 3.52		3	36
3.53- 4.14		4	46
4.15- 4.90		High	54
2.30- 3.83	ED63A010	Low	30
3.84- 5.37		2	50
5.38- 6.52		3	70
6.53- 7.68		4	85
7.69- 9.10		High	100
4.23- 6.91	ED63A025	Low	55
6.92- 9.61		2	90
9.62- 11.91		3	125
11.92- 13.83		4	155
13.84- 16.40		High	180
6.15- 10.37	ED63A030	Low	80
10.38- 14.22		2	135
14.23- 18.06		3	185
18.07- 20.75		4	235
20.76- 24.50		High	270
8.84- 14.22	ED63A040	Low	115
14.23- 19.60		2	185
19.61- 24.99		3	255
25.00- 28.83		4	325
28.84- 34.00		High	375
13.84- 23.06	ED63A050	Low	180
23.07- 31.52		2	300
31.53- 39.99		3	410
40.00- 46.14		4	520
46.15- 54.50		High	600
24.23- 41.52	ED63A100	Low	315
41.53- 56.91		2	540
56.92- 68.45		3	740
68.46- 76.91		4	890
76.92- 90.90		High	1000
38.46- 55.37	ED63A125	Low	500
55.38- 70.75		2	720
70.76- 84.60		3	920
84.61- 96.14		4	1100
96.15- 113.60		High	1250

Manufactured Under One or More of the Following
U.S. Patents: 4,594,567; 4,595,896; 4,675,640; 4,680,564.

SIEMENS

Item: Rotary Handle Operator

For Use With: Circuit Breakers Motor Interrupters and Molded Case Switches.

Siemens Energy & Automation, Inc.
Bellefontaine, Ohio 43311 U.S.A.

Pc. No. 745166A04

Installation Instructions

⚠ DANGER

Hazardous voltage.
Will cause death or severe injury.

Turn off and lock out power supplying device before installing.

⚠ SAFETY INSTRUCTIONS

These instructions outline the recommended installation procedure. When properly installed, the Rotary Handle Operator provides single point latching of the enclosure door. For maximum protection against unauthorized entry into the enclosure, additional latching means should be provided.

The rotary handle operator provides through-the-door operation of enclosure mounted circuit breakers. A complete operator consists of (1) handle, (1) breaker operator, and (1) shaft. The term Circuit Breaker used in these instructions also includes motor circuit interrupters and molded case switches.

FEATURES

— Handle can be padlocked in OFF position with up to thee 5/16 padlocks.

— Breaker operator can be padlocked in OFF position.

— Handle is vertical when breaker is ON and horizontal when breaker is OFF.

— Interlocks with enclosure door.

All dimensions are in inches.

Cat. No.	**Used With:**
RHOH Handle	1, 3, 3R, 12 & 13 enclosures
RHOH4 Handle	4 & 4X enclosures
RHOEBO Breaker Operator	E, ED & EF Frame Circuit Breaker (Three Pole Only) Types E2-A, (H)E4-A, (H)E6-A, (ETI), ED2(Y), (H)ED4, (H)ED6, (ETI), CED6(ETI), EFC,EFF
RHOFBO Breaker Operator	F, FD & FF Frame Circuit Breakers Types (H)F6, FJ6, FXD6(ETI), (H)FD6, CFD6, CLF, SFD6, SHFD6, FFC, FFF
RHOJBO Breaker Operator	JD, LD, JF & LF Frame Circuit Breakers Types JXD2(-A), JXD6(-A), HJXD6(-A), HHJXD6, CJD6(-A), LXD6(-A), HLXD6(-A), HHLXD6, CLD6(-A), JXD6(-A) ETI, CJD6 (-A) ETI, LXD6(-A) ETI, CLD6 (-A) ETI, SJD6(-A), SHJD6(-A), SCJD6(-A), SLD6(-A), SHLD6 (-A), SCLD6(-A), JFC, JFF, LFC, LFF
RHOLMBO Breaker Operator	LMD & LMF Frame Circuit Breakers Types LMXD, HLMXD, LMFC & LMFF
RHOSSD Shaft	Standard Depth
RHOSVD Shaft	Variable Depth
RHOSXD Shaft	Extra Depth

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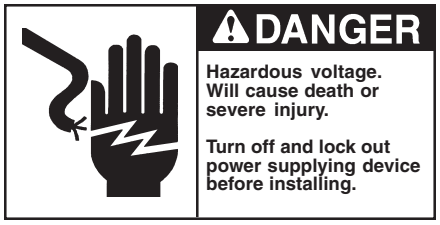

Installation Instructions

1. PREPARE MOUNTING SURFACES

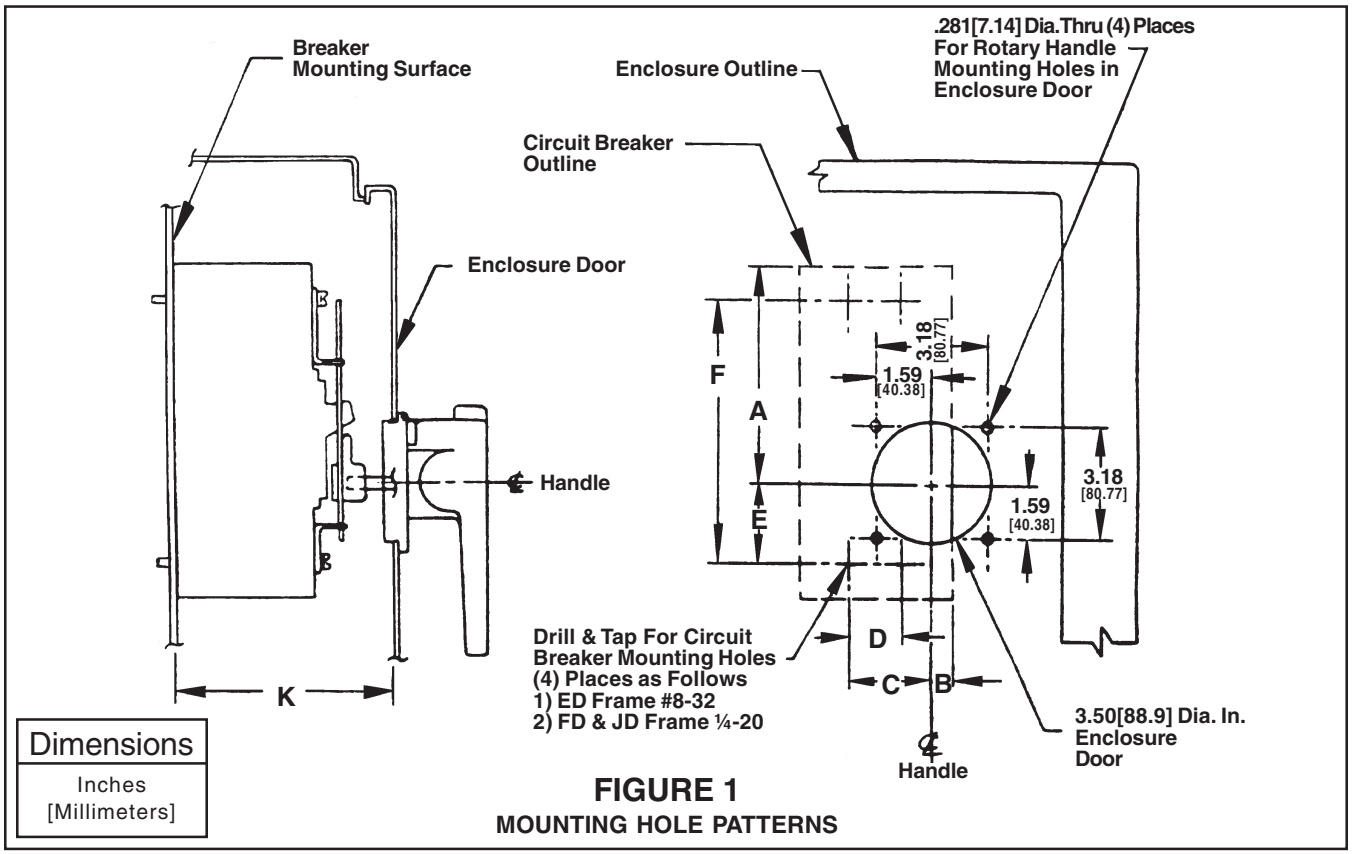

FIGURE 1
MOUNTING HOLE PATTERNS

Cat. No.	RHOSSD	RHOSVD	RHOSXD
K Dim.	**Min.**	**Max.**	**Max.**
ED & EF Frame	5.81 [147.6]	16.12 [409.4]	19.62 498.3]
FD & FF Frame	6.26 [159.0]	16.57 [420.9]	20.00 [508.0]
JD, JF, LD, LF Frame	6.59 [167.4]	16.90 [429.2]	20.40 [518.1]
LMD & LMF Frame	7.09 [180.0]	17.40 [441.9]	20.90 [530.8]

TABLE 1

Cat. No. RHOSSD standard depth shaft used for minimum depth enclosures.

Cat. No. RHOSVD variable depth shaft cut to length described in figure 4.

Cat. No. RHOSXD extra depth shaft cut to length described in figure 4.

	A	B	C	D	E	F
ED & EF FRAME	3.84 [97.5]	.69 [17.9]	1.31 [33.3]	1.00 [25.4]	1.81 [45.9]	5.00 [127.0]
FD & FF FRAME	6.19 [157.2]	.62 [15.7]	2.38 [60.4]	1.50 [38.1]	2.31 [58.6]	7.50 [190.5]
JD, JF, LD & LF FRAME	7.00 [177.8]	2.12 [53.8]	2.88 [73.1]	2.50 [63.5]	3.37 [85.6]	9.75 [247.6]
LMD & LMF FRAME	9.50 [241.3]	2.12 [53.8]	2.88 [73.1]	2.50 [63.5]	3.37 [85.6]	9.75 [247.6]

TABLE 2

Place circuit breaker mounting holes in breaker mounting surface and handle mounting holes in enclosure door as shown in figure 1 and table 2.

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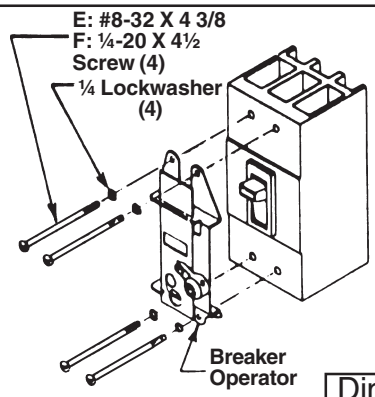
Installation Instructions

2. INSTALL BREAKER AND BREAKER OPERATOR

ED, EF, FD & FF FRAMES (see figure 2)

Attach circuit breaker and breaker operator to the enclosure panel using the four mounting screws and lockwashers as shown. Tighten to 20 In-Lbs.[2.26 N/m] for the E Frame and 75 In-Lbs.[8.47 N/m] for the F Frame.



Dimensions
Inches
[Millimeters]

FIGURE 2
ED EF, FD &FF FRAMES

JD, JF, LD, LF & LMD FRAMES (see figure 3)

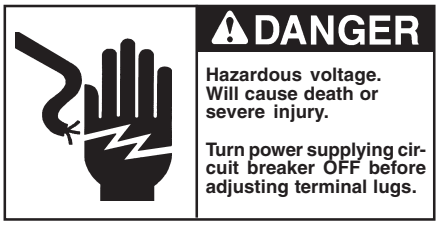
a. Remove the two terminal shields from the circuit breaker and punch or drill out the two .53[13.5] diameter knockouts.

Note: Cut slots in terminal shields as shown to allow access to terminal lugs after installation of breaker operator without prior removal of mechanism.

CAUTION: REPLACE THE TERMINAL SHIELDS.

b. Mount circuit breaker to enclosure panel using the four breaker mounting screws as shown. Tighten to 75 In-Lbs.[8.47 N/m].

c. Insert spacers into the four circuit breaker mounting holes and attach the breaker operator using the four mounting screws and lockwashers as shown. Tighten to 75 In-Lbs.[8.47 N/m].



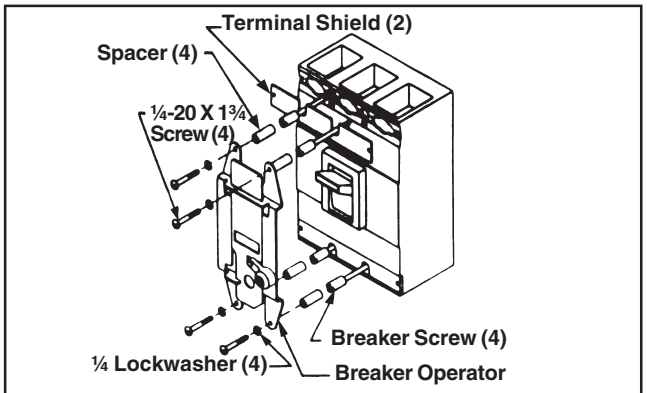


FIGURE 3
JD, LD & LMD FRAMES

3. INSTALL SHAFT

Shaft Length "L" For Variable Depth Operators

ED & EF Frame	L = K - 3.16[80.2]
FD & FF Frame	L = K - 3.61[91.7]
JD, LD, JF & LF Frames	L = K - 3.94[100.0]
LMD & LMF Frame	L = K - 4.44[112.7]

Attach the shaft to the operating arm of the breaker operator and tighten set screw to 70 In-Lbs.[7.90 N/m] min. Note proper orientation of the "wings" (shown in off position) at the end of the shaft when breaker is in OFF position as shown in figure 4.

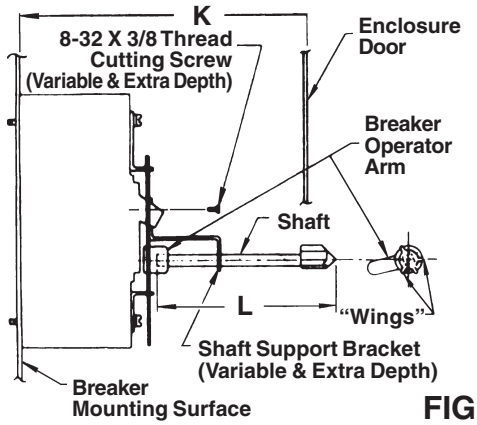


FIGURE 4
SHAFT

Note: It is recommended that the shaft support bracket be installed if enclosure depth exceeds 10 inches. Attach as shown in figure 4. Tighten to 45 In-Lbs.[5.08 N/m]. [On catalog number RHOEBO mounting hole for shaft support is under label.]

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Installation Instructions

4. INSTALL HANDLE

Attach the handle and gasket to the enclosure door and secure with the four bolts, lockwashers and nuts as shown in figure 5. Tighten to 75 In-Lbs.[8.47 N/m]

Check that when the enclosure door is closed, the handle interlocks with the shaft in all handle positions except RESET/OPEN. To open the enclosure door when the breaker is in the ON position, rotate the screw slot on the handle plate counterclockwise. Verify operation and recheck instructions if necessary.

To lock handle in OFF position, pull the lock plate from the handle into the grooves on the handle plate located at the interlock defeater screw and insert padlocks.

The unit can be modified to lock in the ON position by cutting slots in the boss located beneath the letters ON. Note score lines on the inside diameter below the letters ON indicating slot locations.

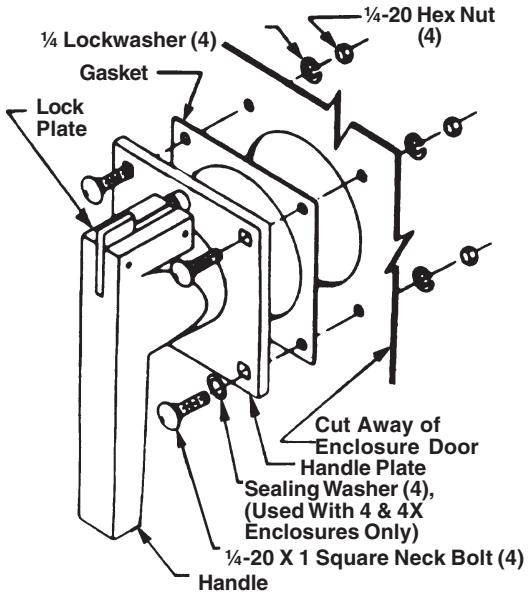


FIGURE 5
HANDLE

Operation Guide

IM 05P01D31-11EN **Installation and Wiring**

YOKOGAWA ◆
Yokogawa Electric Corporation

1st Edition : Jan. 2010

This operation guide describes installation, wiring, and other tasks required to make the controller ready for operation.

Contents

1. Safety Precautions
2. Model and Suffix Codes
3. How to Install
4. Hardware Specifications
5. How to Connect Wires
6. Terminal Wiring Diagrams

Introduction

Thank you for purchasing the UT35A/UT32A Digital Indicating Controller.
This operation guide describes the basic operations of the UT35A/UT32A. The guide should be provided to the end user of this product.
Be sure to read this operation guide before using the product in order to ensure correct operation.
For details of each function, refer to the electronic manual. Before using the product, refer to the table of Model and Suffix Codes to make sure that the delivered product is consistent with the model and suffix codes you ordered. Also make sure that the following items are included in the package.

- Digital Indicating Controller (the model you ordered) x1
- Set of Brackets x1
- Unit Label (L4502VZ) x1
- Tag Label (L4502VE) x1
- Operation Guide (this document) ..... x6 (A3 size)
  (Installation and Wiring, Initial Settings, Operations, and Parameters)

●Target Readers
This guide is intended for the following personnel;
- Engineers responsible for installation, wiring, and maintenance of the equipment.
- Personnel responsible for normal daily operation of the equipment.

1. Safety Precautions

The following symbol is used on the instrument. It indicates the possibility of injury to the user or damage to the instrument, and signifies that the user must refer to the user's manual for special instructions. The same symbol is used in the user's manual on pages that the user needs to refer to, together with the term "WARNING" or "CAUTION."

WARNING

Calls attention to actions or conditions that could cause serious or fatal injury to the user, and indicates precautions that should be taken to prevent such occurrences.

CAUTION

Calls attention to actions or conditions that could cause injury to the user or damage to the instrument or property and indicates precautions that should be taken to prevent such occurrences.

~ AC

≂ AC/DC

⧈ The equipment wholly protected by double insulation or reinforced insulation.

⏚ Functional grounding terminals
(Do not use this terminal as a protective grounding terminal).

Note

Identifies important information required to operate the instrument.

■ Warning and Disclaimer

(1) YOKOGAWA makes no warranties regarding the product except those stated in the WARRANTY that is provided separately.
(2) The product is provided on an "as is" basis. YOKOGAWA assumes no liability to any person or entity for any loss or damage, direct or indirect, arising from the use of the product or from any unpredictable defect of the product.
(3) Be sure to use the spare parts approved by YOKOGAWA when replacing parts or consumables.
(4) This product is not designed or manufactured to be used in critical applications that directly affect or threaten human lives. Such applications include nuclear power equipment, devices using radioactivity, railway facilities, aviation equipment, air navigation facilities, aviation facilities, and medical equipment. If so used, it is the user's responsibility to include in the system additional equipment and devices that ensure personnel safety.
(5) Modification of the product is strictly prohibited.

WARNING

- **Power Supply**
  Ensure that the instrument's supply voltage matches the voltage of the power supply before turning ON the power.
- **Do Not Use in an Explosive Atmosphere**
  Do not operate the instrument in locations with combustible or explosive gases or steam. Operation in such environments constitutes an extreme safety hazard. Use of the instrument in environments with high concentrations of corrosive gas (H_2S, SO_x, etc.) for extended periods of time may cause a failure.
- **Do Not Remove Internal Unit**
  The internal unit should not be removed by anyone other than YOKOGAWA's service personnel. There are dangerous high voltage parts inside. Additionally, do not replace the fuse by yourself.
- **Damage to the Protective Construction**
  Operation of the instrument in a manner not specified in the user's manual may damage its protective construction.

CAUTION

This instrument is an EMC class A product. In a domestic environment this product may cause radio interference in which case the user needs to take adequate measures.

2. Model and Suffix Codes

■ UT35A

[Style:S1]

Model	Suffix code					Optional suffix code	Description
UT35A							Digital Indicating Controller (provided with retransmission output or 15 V DC loop power supply, 2 DIs, and 3 DOs) (Power supply: 100-240 V AC)
Type 1: Basic control	-0						Standard type
	-1						Position proportional type
	-2						Heating/cooling type
Type 2: Functions		0					None
		1					2 additional DIs, 2 additional DOs
		2					5 additional DIs, 5 additional DOs
Type 3: Open networks			0				None
			1				RS-485 communication (Max.38.4 kbps, 2-wire/4-wire)
			2				Ethernet communication (with serial gateway function)
			4				PROFIBUS-DP communication
Display language (*1)				-10			English
				-20			German
				-30			French
				-40			Spanish
Fixed code					-00		Always "-00"
Optional suffix codes						/LP	24 V DC loop power supply (*2)
						/HA	Heater break alarm (*3)
						/DC	Power supply 24 V AC/DC
						/CT	Coating (*4)

*1: English, German, French, and Spanish can be displayed as the guide display.
*2: The /LP option can be specified in the combination of Type 2 code (any of "0" or "1") and Type 3 code (any of "0" or "1".)
*3: The /HA option can be specified when the Type 1 code is "-0" or "-2".
*4: When the /CT option is specified, the UT35A does not conform to the safety standards (UL and CSA) and CE marking.

■ UT32A

[Style:S1]

Model	Suffix code					Optional suffix code	Description
UT32A							Digital Indicating Controller (provided with retransmission output or 15 V DC loop power supply, 2 DIs, and 3 DOs) (Power supply: 100-240 V AC)
Type 1: Basic control	-0						Standard type
	-1						Position proportional type
	-2						Heating/cooling type
Type 2: Functions		0					None
		1					RS-485 communication (Max. 38.4 kbps, 2-wire/4-wire)
		2					2 additional DIs and 2 additonal DOs
Type 3: Open networks			0				None
Display language (*1)				-10			English
				-20			German
				-30			French
				-40			Spanish
Fixed code					00		Always "-00"
Optional suffix codes						/LP	24 V DC loop power supply (*2)
						/HA	Heater break alarm (*3)
						/DC	Power supply 24 V AC/DC
						/CT	Coating (*4)

*1: English, German, French, and Spanish can be displayed as the guide display.
*2: The /LP option can be specified in the combination of Type 1 code (any of "-0" or "-1") and Type 2 code (any of "0" or "1.") Additionally, when the Type 2 code is "1", the RS-485 communication is 2-wire system.
*3: The /HA option can be specified when the Type 1 code is "-0" or "-2."
*4: When the /CT option is specified, the UT32A does not conform to the safety standards (UL and CSA) and CE marking.

■ Accessories (sold separately)

The following is an accessory sold separately.

- LL50A Parameter Setting Software

Model	Suffix code	Description
LL50A	-00	Parameter Setting Software

- Terminal Cover
  For UT35A: Model UTAP001; For UT32A: Model UTAP002
- User's Manual (A4 size)
  Note: User's Manual can be downloaded from a website.
- User's Manual (CD-ROM), Model: UTAP003
  Note: Contains all manuals.

■ Waste Electrical and Electronic Equipment (WEEE), Directive 2002/96/EC

This is an explanation of how to dispose of this product based on Waste Electrical and Electronic Equipment (WEEE), Directive 2002/96/EC. This directive is only valid in the EU.

Marking

This product complies with the WEEE Directive (2002/96/EC) marking requirement.
This marking indicates that you must not discard this electrical/electronic product in domestic household waste.

Product Category

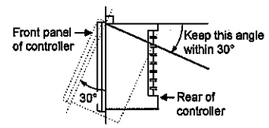
With reference to the equipment types in the WEEE directive Annex 1, this product is classified as a "Monitoring and Control instrumentation" product. Do not dispose in domestic household waste. When disposing products in the EU, contact your local Yokogawa Europe B.V. office.

3. How to Install

■ Installation Location

The instrument should be installed in indoor locations meeting the following conditions:

- **Instrumented panel**
  This instrument is designed to be mounted in an instrumented panel. Mount the instrument in a location where its terminals will not inadvertently be touched.
- **Well ventilated locations**
  Mount the instrument in well ventilated locations to prevent the instrument's internal temperature from rising.
  However, make sure that the terminal portions are not exposed to wind. Exposure to wind may cause the temperature sensor accuracy to deteriorate. To mount multiple indicating controllers, see the external dimensions/panel cutout dimensions which follow. If mounting other instruments adjacent to the instrument, comply with these panel cutout dimensions to provide sufficient clearance between the instruments.
- **Locations with little mechanical vibration**
  Install the instrument in a location subject to little mechanical vibration.
- **Horizontal location**
  Mount the instrument horizontally and ensure that it is level, with no inclination to the right or left.

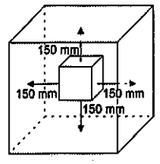


Note

If the instrument is moved from a location with low temperature and low humidity to a place with high temperature and high humidity, or if the temperature changes rapidly, condensation will result. Moreover, in the case of thermocouple inputs, measurement errors will result. To avoid such a situation, leave the instrument in the new environment under ambient conditions for more than 1 hour prior to using it.

Do not mount the instrument in the following locations:

- **Outdoors**
- **Locations subject to direct sunlight or close to a heater**
  Install the instrument in a location with stable temperatures that remain close to an average temperature of 23°C. Do not mount it in locations subject to direct sunlight or close to a heater. Doing so adversely affects the instrument.
- **Locations with substantial amounts of oily fumes, steam, moisture, dust, or corrosive gases**
  The presence of oily fumes, steam, moisture, dust, or corrosive gases adversely affects the instrument. Do not mount the instrument in locations subject to any of these substances.
- **Areas near electromagnetic field generating sources**
  Do not place magnets or tools that generate magnetism near the instrument. If the instrument is used in locations close to a strong electromagnetic field generating source, the magnetic field may cause measurement errors.
- **Locations where the display is difficult to see**
  The instrument uses an LCD for the display unit, and this can be difficult to see from extremely oblique angles. Mount the instrument in a location where it can be seen as much as possible from the front.
- **Areas close to flammable articles**
  Absolutely do not place the instrument directly on flammable surfaces. If such a circumstance is unavoidable and the instrument must be placed close to a flammable item, provide a shield for it made of 1.43 mm thick plated steel or 1.6 mm thick unplated steel with a space of at least 150 mm between it and the instrument on the top, bottom, and sides.



- **Areas subject to being splashed with water**

WARNING

Be sure to turn OFF the power supply to the controller before installing it on the panel to avoid an electric shock.

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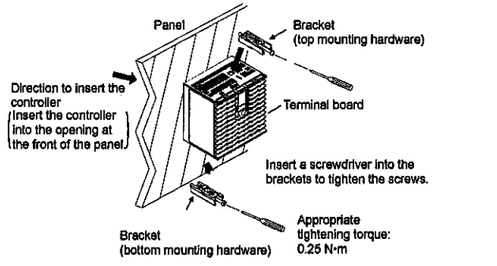
■ Mounting the Instrument Main Unit

Provide an instrumented panel steel sheet of 1 to 10 mm thickness.
After opening the mounting hole on the panel, follow the procedures below to install the controller:

1) Insert the controller into the opening from the front of the panel so that the terminal board on the rear is at the far side.
2) Set the brackets in place on the top and bottom of the controller as shown in the figure below, then tighten the screws of the brackets. Take care not to overtighten them.



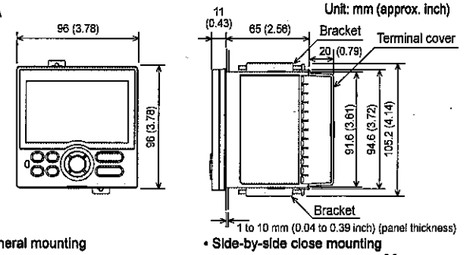
CAUTION

- **Tighten the screws with appropriate tightening torque within 0.25 N·m. Otherwise it may cause the case deformation or the bracket damage.**
- **Make sure that foreign materials do not enter the inside of the instrument through the case's slit holes.**

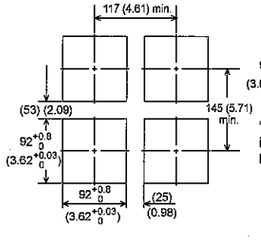
■ External Dimensions and Panel Cutout Dimensions

UT35A

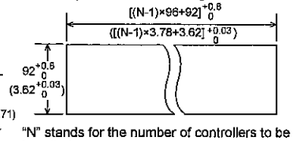
Unit: mm (approx. inch)



• General mounting



• Side-by-side close mounting

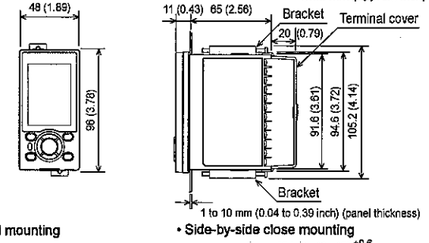


"N" stands for the number of controllers to be installed.
However, the measured value applies if N≥5.

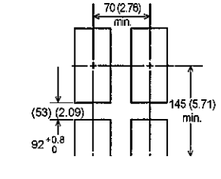
Normal tolerance:
±(value of JIS B 0401-1998 tolerance class IT18)/2

UT32A

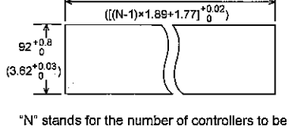
Unit: mm (approx. inch)



• General mounting



• Side-by-side close mounting

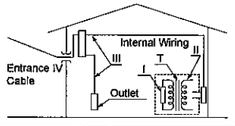


"N" stands for the number of controllers to be installed.

4. Hardware Specifications

WARNING

This instrument is for Measurement Category I (CAT.I). Do not use it for measurements in locations falling under Measurement Categories II, III, and IV.



Category	Measurement category	Description	Remarks
I	CAT.I	For measurements performed on circuits not directly connected to MAINS.	-
II	CAT.II	For measurements performed on circuits directly connected to the low-voltage installation.	Appliances, portable equipments, etc.
III	CAT.III	For measurements performed in the building installation.	Distribution board, circuit breaker, etc.
IV	CAT.IV	For measurements performed at the source of the low-voltage installation.	Overhead wire, cable systems, etc.

■ Input Specifications

•Universal Input (Equipped as standard)

- Number of inputs: 1
- Input type, instrument range, and measurement accuracy: See the table below,

Input Type		Instrument Range °C	Instrument Range °F	Accuracy
Thermocouple	K	-270.0 to 1370.0°C	-450.0 to 2500.0°F	±0.1% of instrument range ±1 digit for 0°C or more ±0.2% of instrument range ±1 digit for less than 0°C
		-270.0 to 1000.0°C	-450.0 to 2300.0°F	
		-200.0 to 500.0°C	-200.0 to 1000.0°F	
	J	-200.0 to 1200.0°C	-300.0 to 2300.0°F	±2% of instrument range ±1 digit for less than -200.0°C of thermocouple K ±1% of instrument range ±1 digit for less than -200.0°C of thermocouple T
	T	-270.0 to 400.0°C	-450.0 to 750.0°F	
		0.0 to 400.0°C	-200.0 to 750.0°F	
	B	0.0 to 1800.0°C	32 to 3300°F	±0.15% of instrument range ±1 digit for 400°C or more ±5% of instrument range ±1 digit for less than 400°C
	S	0.0 to 1700.0°C	32 to 3100°F	±0.15% of instrument range ±1 digit
	R	0.0 to 1700.0°C	32 to 3100°F	
	N	-200.0 to 1300.0°C	-300.0 to 2400.0°F	±0.1% of instrument range ±1 digit ±0.25% of instrument range ±1 digit for less than 0°C
	E	-270.0 to 1000.0°C	-450.0 to 1800.0°F	±0.1% of instrument range ±1 digit for 0°C or more
	L	-200.0 to 900.0°C	-300.0 to 1600.0°F	
	U	-200.0 to 400.0°C	-300.0 to 750.0°F	±0.2% of instrument range ±1 digit for less than 0°C ±1.5% of instrument range ±1 digit for less than -200.0°C of thermocouple E.
		0.0 to 400.0°C	-200.0 to 1000.0°F	
	W	0.0 to 2300.0°C	32 to 4200°F	±0.2% of instrument range ±1 digit (Note 2)
	Platinel 2	0.0 to 1390.0°C	32.0 to 2500.0°F	±0.1% of instrument range ±1 digit
	PR20-40	0.0 to 1900.0°C	32 to 3400°F	±0.5% of instrument range ±1 digit for 800°C or more Accuracy is not guaranteed for less than 800°C.
	W97Re3-W75Re25	0.0 to 2000.0°C	32 to 3600°F	±0.2% of instrument range ±1 digit
RTD	JPt100	-200.0 to 500.0°C	-300.0 to 1000.0°F	±0.1% of instrument range ±1 digit (Note 1)
		-150.00 to 150.00°C	-200.0 to 300.0°F	±0.1% of instrument range ±1 digit
	Pt100	-200.0 to 850.0°C	-300.0 to 1560.0°F	±0.1% of instrument range ±1 digit (Note 1)
		-200.0 to 500.0°C	-300.0 to 1000.0°F	
		-150.00 to 150.00°C	-200.0 to 300.0°F	±0.1% of instrument range ±1 digit
Standard signal		0.400 to 2.000 V		±0.1% of instrument range ±1 digit
		1.000 to 5.000 V		
		4.00 to 20.00 mA		
DC voltage/current		0.000 to 2.000 V		
		0.00 to 10.00 V		
		0.00 to 20.00 mA		
		-10.00 to 20.00 mV		
		0.0 to 100.0 mV		

The accuracy is that in the standard operating conditions: 23±2°C, 55±10%RH, and power frequency at 50/60 Hz.
Note 1: ±0.3°C ±1 digit in the range between 0 and 100°C, ±0.5°C ±1 digit in the range between -100 and 200°C.
Note 2: W: W-5% Re/W-26% Re(Hoskins Mfg.Co.). ASTM E988

- Input sampling (control) period: 200 ms
- Burnout detection:
  Functions at TC, RTD, and standard signal.
  Upscale, downscale, and off can be specified.
  For standard signal, burnout is determined to have occurred if it is 0.1 V or 0.4 mA or less.
- Input bias current: 0.05 μA (for TC or RTD)
- Measured current (RTD): About 0.16 mA
- Input resistance:
  TC or mV input: 1 MΩ or more
- Allowable signal source resistance:
  TC or mV input: 250 Ω or less
  Effects of signal source resistance: 0.1 μV/Ω or less
  DC voltage input: 2 kΩ or less
  Effects of signal source resistance: About 0.01%/100 Ω
- Allowable wiring resistance:
  RTD input: Max. 150 Ω/wire (The conductor resistance between the three wires shall be equal.)
  Wiring resistance effect: ±0.1°C/10 Ω
- Allowable input voltage/current:
  TC, mV, mA and RTD input: ±10 V DC
  V input: ±20 V DC
  mA input: ±40 mA
- Noise rejection ratio:
  Normal mode: 40 dB or more (at 50/60 Hz)
  Common mode: 120 dB or more (at 50/60 Hz)
  For 100-240 V AC, the power frequency can be set manually. Automatic detection is also available.
  For 24 V AC/DC, the power frequency can be set manually.
- Reference junction compensation error:
  ±1.0°C (15 to 35°C)
  ±1.5°C (-10 to 15°C and 35 to 50°C)
- Applicable standards: JIS/IEC/DIN (ITS-90) for TC and RTD

■ Analog Output Specifications

- Number of outputs:
  Control output: 1
  Cooling-side control output of Heating/cooling type (Retransmission output terminal): 1
- Output type: Current output or voltage pulse output
- Current output: 4 to 20 mA DC or 0 to 20 mA DC/load resistance of 600 Ω or less
- Current output accuracy: ±0.1% of span (±5% of span for 1 mA or less)
  The accuracy is that in the standard operating conditions: 23±2°C, 55±10%RH, and power frequency at 50/60 Hz.
- Voltage pulse output:
  Use: Time proportional output
  On-voltage: 12 V or more/load resistance of 600 Ω or more
  Off-voltage: 0.1 V DC or less
  Time resolution: 10 ms or 0.1% of output, whichever is larger

■ Step Response Time Specifications

Within 1 s (63% of analog output response time when a step change of 10 to 90% of input span is applied)

■ Relay Contact Output Specifications

- Contact type and number of outputs:
  Control output: contact point 1c; 1 point
  Heating/cooling type: contact point 1a; 2 points for both heating and cooling sides
  Alarm output: contact point 1a; 3 points (common is independent)
- Contact rating:
  Contact point 1c (control output): 250 V AC, 3 A or 30 V DC, 3A (resistance load)
  Contact point 1a (control output): 240 V AC, 3A or 30 V DC, 3A (resistance load)
  Contact point 1a (alarm output): 240 V AC, 1A or 30 V DC, 1 A (resistance load)
- Use: Time proportional output, alarm output, FAIL output, etc.
- Time resolution of control output: 10 ms or 0.1% of output, whichever is larger

Note: This cannot be used for a small load of 10 mA or less.

■ Position Proportional Output Specifications

- Position signal input:
  Slide resistance: 100 Ω to 2.5 kΩ of total resistance
  100% side and slide line: with disconnection detection
  0% side: without disconnection detection
  Current input: 4 to 20 mA (with disconnection detection)
- Sampling period: 50 ms
- Measurement resolution: 0.1% of input span
- Position proportional relay output:
  UT35A: contact point 1a; 2 points, 250 V AC, 3 A or 30 V DC, 3 A (resistance load)
  UT32A: contact point 1a; 2 points, 240 V AC, 3 A or 30 V DC, 3 A (resistance load)

Note: This cannot be used for a small load of 10 mA or less.

■ Retransmission Output Specifications

- Number of outputs: Retransmission output; 1, shared with 15 V DC loop power supply or Cooling-side control output.
- Current output: 4 to 20 mA DC or 0 to 20 mA DC/ load resistance of 600 Ω or less
- Current output accuracy: ±0.1% of span (±5% of span for 1 mA or less)
  The accuracy is that in the standard operating conditions: 23±2°C, 55±10%RH, and power frequency at 50/60 Hz.

■ 15 V DC Loop Power Supply Specifications

(Shared with retransmission output or Cooling-side control output.)

- Power supply: 14.5 to 18.0 V DC
- Maximum supply current: About 21 mA (with short-circuit current limiting circuit)

■ Contact Input Specifications

- Number of inputs: See the table of Model and Suffix Codes.
- Input type: No-voltage contact input or transistor contact input
- Input contact rating: 12 V DC, 10 mA or more
  Use a contact with a minimum on-current of 1 mA or more.
- ON/OFF detection:
  No-voltage contact input:
  Contact resistance of 1 kΩ or less is determined as "ON" and contact resistance of 50 kΩ or more as "OFF."
  Transistor contact input:
  Input voltage of 2 V or less is determined as "ON" and leakage current must not exceed 100 μA when "OFF."
- Minimum status detection hold time: Control period +50 ms
- Use: SP switch, operation mode switch, and event input

■ Transistor Contact Output Specifications

- Number of outputs: See the table of Model and Suffix Codes.
- Output type: Open collector (SINK current)
- Output contact rating: Max. 24 V DC, 50 mA
- Output time resolution: 200 ms

■ Heater Break Alarm Specifications

- Number of inputs: 2
- Number of outputs: 2 (transistor contact output)
- Use: Measures the heater current using an external current transformer (CT) and generates a heater break alarm when the measured value is less than the break detection value.
- Current transformer input resistance: About 9.4 Ω
- Current transformer input range: 0.0 to 0.1 Arms (0.12 Arms or more cannot be applied.)
- Heater current setting range: OFF, 0.1 to 300.0 Arms
  Heater current measured value display range: 0.0 to 360.0 Arms
  Note: The CT ratio can be set. CT ratio setting range: 1 to 3300
- Recommended CT: CT from U.R.D., Ltd.
  CTL-6-S-H: CT ratio 800, measurable current range: 0.1 to 80.0 Arms
  CTL-12L-30: CT ratio 3000, measurable current range: 0.1 to 180.0 Arms
- Heater current measurement period: 200 ms
- Heater current measurement accuracy: ±5% of current transformer input range span ± 1digit (CT error is not included.)
- Heater current detection resolution: Within 1/250 of current transformer input range span
- Break detection On-time: Min. 0.2 second (for time proportional output)

■ 24 V DC Loop Power Supply Specifications

- Use: Power is supplied to a 2-wire transmitter.
- Power supply: 21.6 to 28.0 V DC
- Rated current: 4 to 20 mA DC
- Maximum supply current: About 30 mA (with short-circuit current limiting circuit.)

Installation category: CAT. II Pollution degree: 2
Measurement category: I (CAT. I)
Rated measurement input voltage: Max. 10 V DC
Rated transient overvoltage: 1500 V (Note)

Note: This is a reference safety standard value for Measurement Category I of IEC/EN/CSA/UL61010-1. This value is not necessarily a guarantee of instrument performance.

- EMC Conformity standards:
  CE marking
  EN61326-1 Class A, Table 2 (For use in industrial locations)
  EN61326-2-3
  EN 55011 Class A, Group1
  EN 61000-3-2 Class A
  EN 61000-3-3
  C-tick mark
  EN 55011 Class A, Group1
  The instrument continues to operate at a measurement accuracy of within ±20% of the range during testing.

■ Construction, Installation, and Wiring

- Dust-proof and drip-proof: IP56 (for front panel) (Not available for side-by-side close mounting.)
- Material: Polycarbonate (Flame retardancy: UL94V-0)
- Case color: Light gray
- Weight: 0.5 kg or less
- External dimensions (mm):
  UT35A: 96 (W) × 96 (H) × 65 (depth from the panel face)
  UT32A: 48 (W) × 96 (H) × 65 (depth from the panel face)
  (Depth except the projection on the rear panel)
- Installation: Direct panel mounting; mounting bracket, one each for upper and lower mounting
- Panel cutout dimensions (mm):
  UT35A: $92^{+0.8/0}$ (W) × $92^{+0.8/0}$ (H)
  UT32A: $45^{+0.6/0}$ (W) × $92^{+0.8/0}$ (H)
- Mounting attitude: Up to 30 degrees above the horizontal. No downward tilting allowed.
- Wiring: M3 screw terminal with square washer (for signal wiring and power wiring)

■ Power Supply Specifications and Isolation

- Power supply:
  Rated voltage: 100-240 V AC (+10%/-15%), 50/60 Hz
  24 V AC/DC (+10%/-15%) (for /DC option)
- Power consumption: UT35A: 18 VA (DC:9 VA, AC: 14 VA if /DC option is specified)
  UT32A: 15 VA (DC:7 VA, AC: 11 VA if /DC option is specified)
- Data backup: Nonvolatile memory
- Power holdup time: 20 ms (for 100 V AC drive)
- Withstanding voltage
  Between primary terminals and secondary terminals: 2300 V AC for 1 minute
  Between primary terminals: 1500 V AC for 1 minute
  Between secondary terminals: 500 V AC for 1 minute
  (Primary terminals: Power* and relay output terminals; Secondary terminals: Analog I/O signal terminals, contact input terminals, communication terminals and functional grounding terminals.)
  *: Power terminals for 24V AC/DC models are the secondary terminals.
- Insulation resistance: Between power supply terminals and a grounding terminal 20 MΩ or more at 500 V DC
- Isolation specifications

PV (universal) input terminals	Internal circuits	Power supply
Control, retransmission (analog) output terminals (not isolated between the analog output terminals) Valve position (feedback) input terminals		
Control relay (contact point c/contact point a x 2) output terminals		
Alarm-1 relay (contact point a) output terminals		
Alarm-2 relay (contact point a) output terminals		
Alarm-3 relay (contact point a) output terminals		
Position proportional relay output terminals		
Contact input terminals (all) RS-485 communication terminals (2 ports)		
24 V DC loop power supply terminals		
Contact output (transistor) terminals		
Ethernet communication terminal		
PROFIBUS-DP communication terminal		
Current transformer input terminals		

The circuits divided by lines are insulated mutually.

- Ambient temperature: -10 to 50ºC (-10 to 40ºC for side-by-side close mounting)
- Ambient humidity: 20 to 90% RH (no condensation allowed)
- Magnetic field: 400 A/m or less
- Continuous vibration at 5 to 9 Hz: Half amplitude of 1.5 mm or less, 1oct/min for 90 minutes each in the three axis directions
  Continuous vibration at 9 to 150 Hz: 4.9 m/s^2 or less, 1oct/min for 90 minutes each in the three axis directions
- Short-period vibration: 14.7 m/s^2, 15 seconds or less
- Shock: 98 m/s^2 or less, 11 ms
- Altitude: 2000 m or less above sea level
- Warm-up time: 30 minutes or more after the power is turned on
- Startup time: Within 10 seconds
  *: The LCD (a liquid crystal display) is used for a display portion of this product. The LCD has a characteristic that the display action becomes late at the low temperature. However, the control fuction is not affected.

Transportation and Storage Conditions:

- Temperature: -25 to 70ºC
- Temperature change rate: 20ºC/h or less
- Humidity: 5 to 95% RH (no condensation allowed)

Effects of Operating Conditions

- Effect of ambient temperature:
  Voltage or TC input: ±1 µV/ºC or ±0.01% of F.S./ºC, whichever is larger
  Current input: ±0.01% of F.S./ºC
  RTD input: ±0.05ºC/ºC (ambient temperature) or less
  Analog output: ±0.02% of F.S./ºC or less
- Effect of power supply voltage fluctuation
  Analog input: ±0.05% of F.S. or less
  Analog output: ±0.05% of F.S. or less
  (Each within rated voltage range)

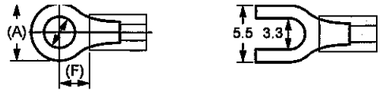
5. How to Connect Wires

WARNING

- **Wiring work must be carried out by a person with basic electrical knowledge and practical experience.**
- **Be sure to turn OFF the power supply to the controller before wiring to avoid an electric shock. Use a tester or similar device to ensure that no power is being supplied to a cable to be connected.**
- **As a safety measure, always install a circuit breaker (an IEC 60947-compatible product, 5 A, 100 V or 220 V AC) in an easily accessible location near the instrument. Moreover, provide indication that the switch is a device for turning off the power to the instrument.**
- **Install the power cable keeping a distance of more than 1 cm from other signal wires.**
- **The power cable is required to meet the IEC standards concerned or the requirements of the area in which the instrument is being installed.**
- **Wiring should be installed to conform to NEC (National Electrical Code: ANSI/NFPA-70) or the wiring construction standards in countries or regions where wiring will be installed.**
- **For control relay output, alarm relay output, and power terminal connections, use heat-resistant cables.**

CAUTION

- **Provide electricity from a single-phase power supply. If the power is noisy, install an isolation transformer on the primary side, and use a line filter on the secondary side. When measures against noise are taken, do not install the primary and secondary power cables close to each other.**
- **If there is a risk of external lightning surges, use a lightning arrester etc.**
- **For TC input, use shielded compensating lead wires for wiring. For RTD input, use shielded wires that have low conductor resistance and cause no significant differences in resistance between the three wires.**
- **Since the control output relay has a life span (resistance load of 100,000 times), use the auxiliary relay to perform ON/OFF control.**
- **The use of inductance (L) loads such as auxiliary relays, motors and solenoid valves causes malfunction or relay failure; always insert a CR filter for use with alternating current or a diode for use with direct current, as a spark-removal surge suppression circuit, into the line in parallel with the load.**
- **After completing the wiring, the terminal cover is recommended to use for the instrument.**



Recommended tightening torque: 0.6 N·m
Applicable wire size: Power supply wiring 1.25 mm^2 or more

Applicable terminal lug	Applicable wire size mm^2 (AWG#)	(φ d)	(A)	(F)
M3	0.25 to 1.65 (22 to 16)	3.3	5.5	4.2

• Cable Specifications and Recommended Cables

Purpose	Name and Manufacturer
Power supply, relay contact outputs	600 V Grade heat-resistant PVC insulated wires, JIS C 3317(HIV), 0.9 to 2.0 mm^2
Thermocouple	Shielded compensating lead wires, JIS C 1610
RTD	Shielded wires (three/four conductors), UL2482 (Hitachi Cable)
Other signals (other than contact input/output)	Shielded wires
Other signals (contact input/output)	Unshielded wires
RS-485 communication	Shielded wires
Ethernet communication	100 BASE-TX (CAT-5)/10 BASE-T
PROFIBUS-DP communication	Dedicated cable for PROFIBUS-DP (Shielded two-wires)

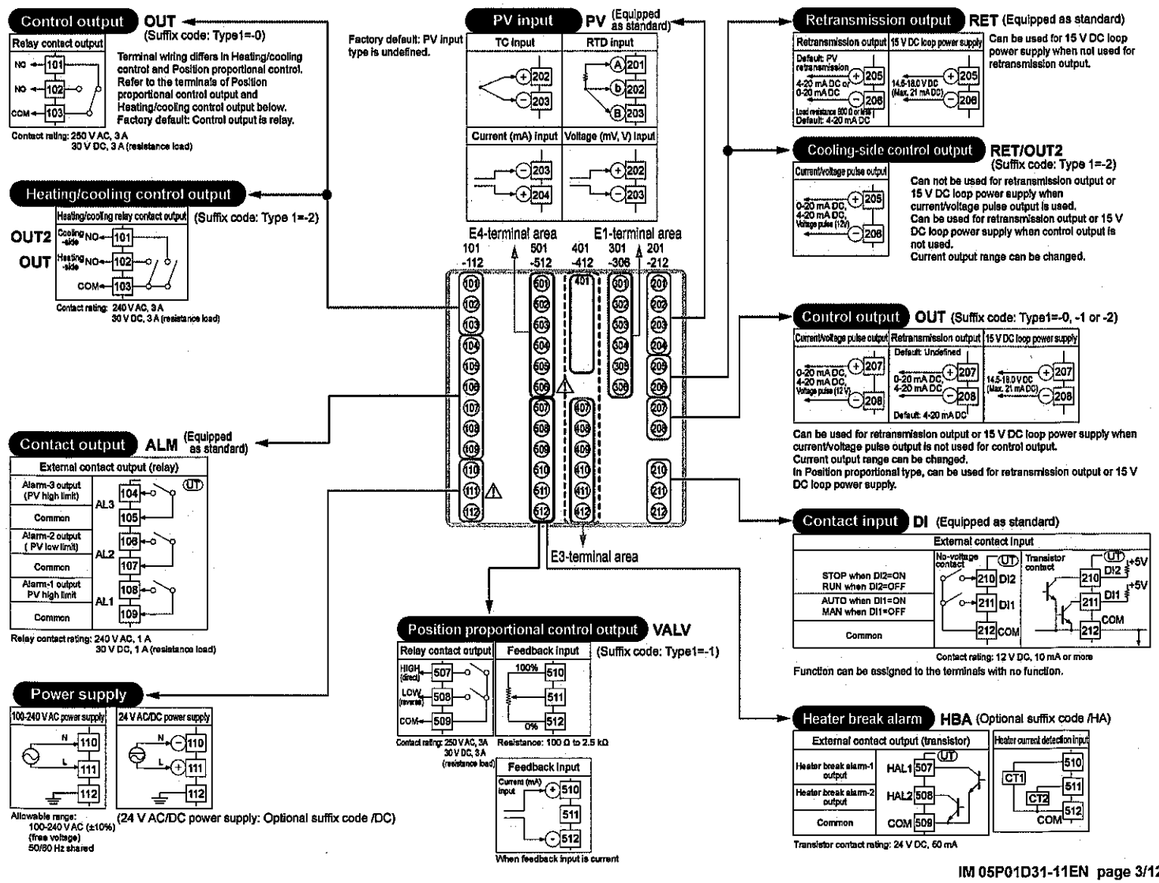
PROFIBUS-DP Connector (wiring side) (Part number: A1987JT)
Recommended tightening torque: 0.5 to 0.6 N·m

6. Terminal Wiring Diagrams

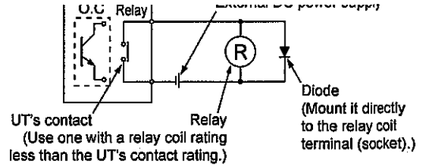
CAUTION

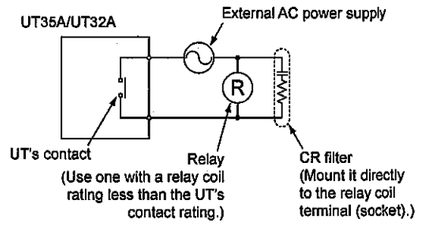
- **Do not use an unassigned terminal as the relay terminal.**
- **Do not use a 100-240 V AC power supply for the 24 V AC/DC model; otherwise, the instrument will malfunction.**

■ UT35A

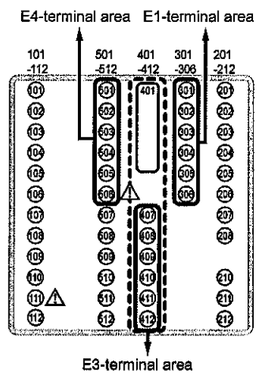


AC Relay Wiring





■ UT35A (Continued from page 3)



301-306 E1-Terminal Area

Contact input DI (Suffix code: Type 2=2)

External contact input

Common		No-voltage contact	301	COM
Factory default: No function	DI11		302	DI11
Factory default: No function	DI12		303	DI12
Factory default: No function	DI13	Transistor contact	304	DI13
Factory default: No function	DI14		305	DI14
Factory default: No function	DI15		306	DI15

Contact rating: 12 V DC, 10 mA or more

Function can be assigned to the terminals with no function.

Contact input / Contact output DI/DO (Suffix code: Type 2=1)

External contact input

Common		No-voltage contact	301	COM
Factory default: No function	DI11		302	DI11
Factory default: No function	DI12	Transistor contact	303	DI12

Contact rating: 12 V DC, 10 mA or more

External contact output

Factory default: No function	DO12	304
Factory default: No function	DO11	305
Common	COM	306

Function can be assigned to the terminals with no function.

Transistor contact rating: 24 V DC, 50 mA

401-412 E3-Terminal Area

RS-485 communication RS485

RS-485

SDB(+)	407	(Suffix code: Type 3=1)
SDA(-)	408	
SG	409	
RDB(+)	410	
RDA(-)	411	

Ethernet communication (with gateway function) ETHR (Suffix code: Type 3=2)

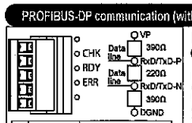
10BASE-T/100BASE-TX RJ45 connector

Upper side LED (baud rate)	
Color	Amber
Lit	100M bps
Unit	10M bps
Lower side LED (link activity)	
Color	Green
Lit	Linked
Blink	Active
Unit	Link failure

RS-485

RSB(+)	407	
RSA(-)	408	
SG	409	

PROFIBUS-DP communication (with Modbus master) PROF (Suffix code: Type 3=4)



If the UT is located at the end of a segment for the PROFIBUS communication wiring, terminating resistors are separately needed. These are to be prepared by users. (390 Ω: 2 pcs, 220 Ω: 1 pc., or an active terminator.)

Pin	Signal name	Description
1	VP	+5V bus power
2	RxD/TxD-P	Data signal (positive data receive/transmit)
3	RxD/TxD-N	Data signal (negative data receive/transmit)
4	DGND	Signal ground
5	SHIELD	Shield ground

LED	Lit	Unit
CHK (red)	User profile error	Normal
RDY (green)	Normal communicating successfully	No electricity, or communication failure
ERR (red)	Not connected, or communication failure (flashing)	Normal

RS-485

RSB(+)	407	
RSA(-)	408	
SG	409	

501-506 E4-Terminal Area

Contact output DO (Suffix code: Type 2=2)

External contact output

Factory default: No function	DO45	501
Factory default: No function	DO44	502
Factory default: No function	DO43	503
Factory default: No function	DO42	504
Factory default: No function	DO41	505
Common	COM	506

Function can be assigned to the terminals with no function.

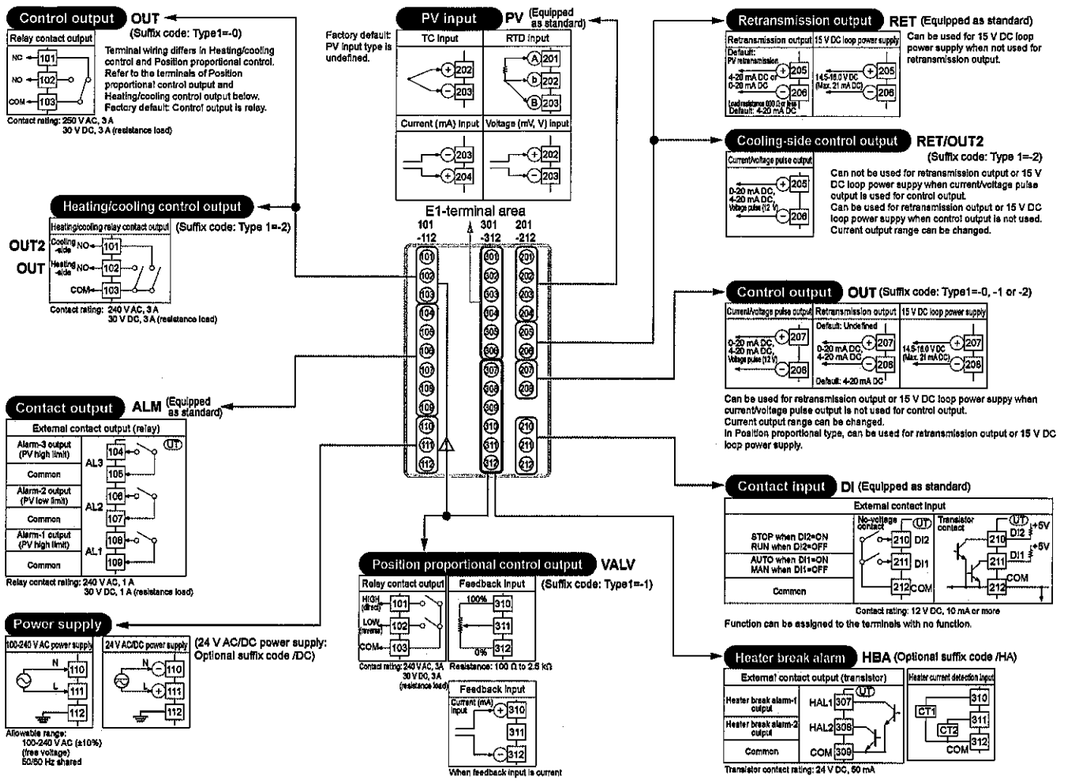
Transistor contact rating: 24 V DC, 50 mA

24 V DC loop power supply LPS24 (Optional suffix code /LP)

24 V DC loop power supply

21.6-28.0 V DC (Max. 30 mA DC)	505
	506

■ UT32A



301-306 E1-Terminal Area

RS-485 communication RS485 (Suffix code: Type 2=1)

RS-485

SDB(+)	301	
SDA(-)	302	
SG	303	
RDB(+)	304	
RDA(-)	305	

24 V DC loop power supply LPS24 (Suffix code: Type 2=0 and optional suffix code /LP)

24 V DC loop power supply

21.6-28.0 V DC (Max. 30 mA DC)	305
	306

Contact input / Contact output DI/DO (Suffix code: Type 2=2)

External contact input

Common		No-voltage contact	301	COM
Factory default: No function	DI11		302	DI11
Factory default: No function	DI12	Transistor contact	303	DI12

Contact rating: 12 V DC, 10 mA or more

External contact output

Factory default: No function	DO12	304
Factory default: No function	DO11	305
Common	COM	306

Function can be assigned to the terminals with no function.

Transistor contact rating: 24 V DC, 50 mA

RS-485 communication/24 V DC loop power supply RS485/LPS24 (Suffix code: Type 2=1 and optional suffix code /LP)

RS-485

RSB(+)	301
RSA(-)	302
SG	303

24 V DC loop power supply

21.6-28.0 V DC (Max. 30 mA DC)	305
	306

Operation Guide

Initial Settings

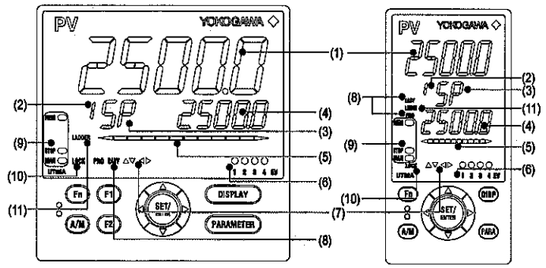
YOKOGAWA ◆
Yokogawa Electric Corporation

**This operation guide describes basic settings and operations of the UT35A/UT32A.
For details of each function, see the electronic manual.
The scrolling guide is displayed on PV display in the Parameter Setting Display.
This guide can be turned on/off with the Fn key.**

Contents

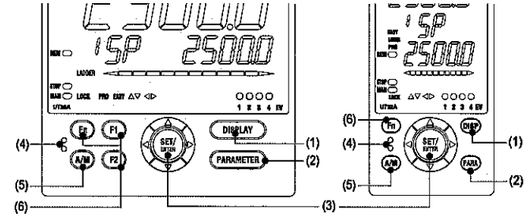
1. Names and Functions of Display Parts
2. Setup Procedure
3. Quick Setting Function (Setting of Input and Output)
4. Adjusting Valve Position Automatically (for a Position Proportional Type Controller Only)
5. Setting Alarm Type
6. Setting Alarm Setpoint

1. Names and Functions of Display Parts



(2) + (3) + (4) : Setpoint display

No. in figure	Name	Description
(1)	PV display (white or red)	Displays PV. Displays an error code if an error occurs. Displays the scrolling guide in the Menu Display and Parameter Setting Display when the guide display ON/OFF is set to ON.
(2)	Group display (green)	Displays a group number (1 to 4 or R) and terminal area (E1 to E4). 1 to 4 represent SP numbers in the Operation Display. R and E1 to E4 are displayed in the Parameter Setting Display.
(3)	Symbol display (orange)	Displays a parameter symbol.
(4)	Data display (orange)	Displays a parameter setpoint and menu symbol.
(5)	Bar-graph display (orange)	Displays control output value (OUT) and measured input value (PV). The data to be displayed can be set by the parameter. Initial value: Deviation, Heating-side control output (in Heating/cooling control)
(6)	Event indicator (orange)	Lit when the alarms 1 to 4 occur. Event displays other than alarms can be set by the parameter.
(7)	Key navigation indicator (green)	Lit or blinks when the Up/Down or Left/Right arrow key operation is possible.
(8)	Parameter display level indicator (green)	Displays the setting conditions of the parameter display level function. Parameter display level: EASY: Lit / PRO: Lit (Easy setting mode) Parameter display level: EASY: Unlit / PRO: Unlit (Standard setting mode) Parameter display level: EASY: Unlit / PRO: Lit (Professional setting mode)
(9)	Status indicator (green and red)	Displays the operating conditions and control status. REM: Lit when in remote mode (REM). STOP: Lit when in stop mode (STOP). MAN: Lit when in manual mode (MAN). Blinks during auto-tuning.
(10)	Security indicator (red)	Lit if a password is set. The setup parameter settings are locked.
(11)	Ladder operation indicator (green)	Lit while the ladder operation is executed.

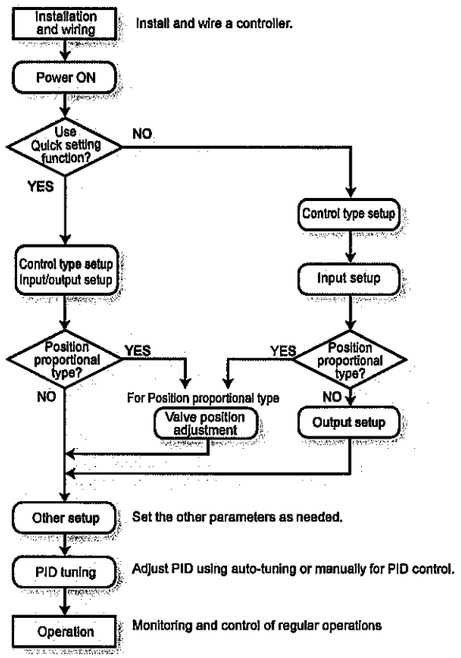


No. in figure	Name	Description
(1)	UT35A: DISPLAY key UT32A: DISP key	Used to switch the Operation Displays. Press the key in the Operation Display to switch the provided Operation Displays. Press the key in the Menu Display or Parameter Setting Display to return to the Operation Display.
(2)	UT35A: PARAMETER key UT32A: PARA key	Hold down the key for 3 seconds to move to the Operation Parameter Setting Display. Hold down the key and the Left arrow key simultaneously for 3 seconds to move to the Setup Parameter Setting Display. Press the key in the Parameter Setting Display to return to the Menu Display. Press the key once to cancel the parameter setting (setpoint is blinking).
(3)	SET/ENTER key Up/Down/Left/Right arrow keys	SET/ENTER key Press the key in the Menu Display to move to the Parameter Setting Display of the Menu. Press the key in the Parameter Setting Display to transfer to the parameter setting mode (setpoint is blinking), and the parameter can be changed. Press the key during parameter setting mode to register the setpoint. Up/Down/Left/Right arrow keys Press the Left/Right arrow keys in the Menu Display to switch the Displays. Press the Up/Down/Left/Right arrow keys in the Parameter Setting Display to switch the Displays. Press the Up/Down arrow keys during parameter setting mode (setpoint is blinking) to change a setpoint. Press the Left/Right arrow keys during parameter setting mode (setpoint is blinking) to move between digits according to the parameter.
(4)	Light-loader interface	It is the communication interface for the adapter cable used when setting and storing parameters from a PC. The LL50A Parameter Setting Software (sold separately) is required.
(5)	A/M key	Used to switch between AUTO and MAN modes. The setting is switched between AUTO and MAN each time the key is pressed.
(6)	User function keys	The UT35A has F1, F2, and Fn keys. The UT32A has only the Fn key. The user can assign a function to the key. The function is set by the parameter.

Note: The communication connector (maintenance port) for LL50A Parameter Setting Software is on the top of the unit.

2. Setup Procedure

The following flowchart shows the setup procedure for UT35A/UT32A.



ler.
Turn on the controller to start the Quick setting function.
This function allows you to easily set the control type, input, and output, and quickly start the control action.
The items (parameters) to be set by Quick setting function are as follows.
(1) Control type (PID control, Heating/cooling control, etc.)
(2) Input function (PV input type, range, scale (at voltage input), etc.)
(3) Output function (control output type and cycle time)

After turning on the controller, first decide whether or not to use the Quick setting function.

Operation in Initial Display

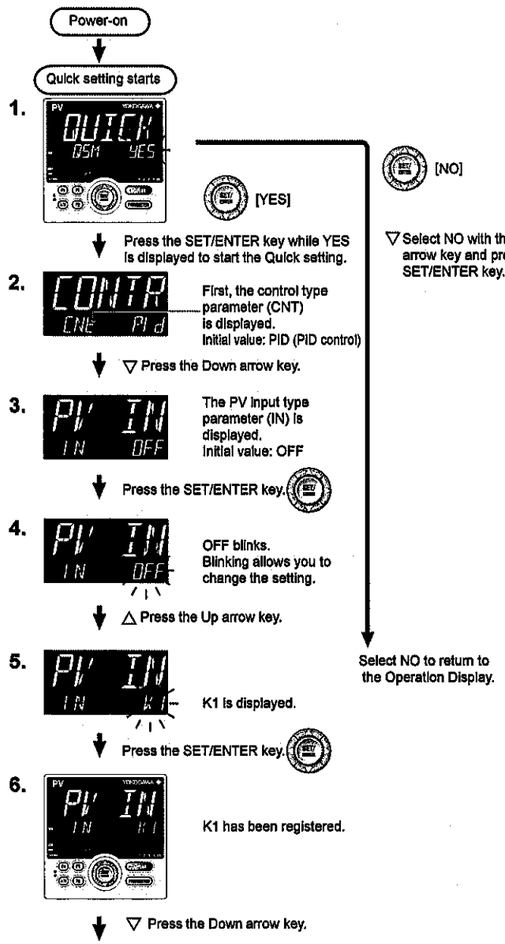
- Press the SET/ENTER key while YES is displayed to start the Quick setting function.
- If you change YES to NO and press the SET/ENTER key, Operation Display will appear without starting the Quick setting function.

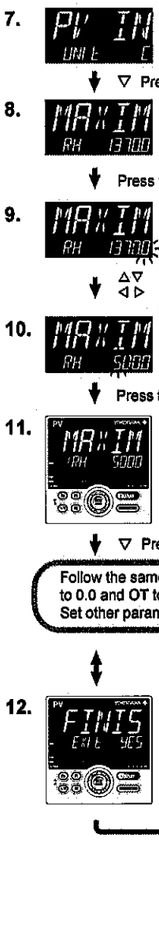
Operation for Setting

- To select the parameter setting displayed as the initial value, press the Down arrow key to move to the next parameter.

■ Flow of Quick Setting Function

In Quick setting mode, the parameter guide appears on PV display.
This guide can be turned on/off with the Fn key.





■ Making Settings Using Quick Setting Function

Example: Setting to PID control, thermocouple type K (range of 0.0 to 500.0°C), and current control output

For the detailed procedure and switching of displays, see "Flow of Quick Setting Function" below. For the parameters to set, see the next page.

(1) Press the SET/ENTER key while YES for QSM (Quick setting mode) is displayed.
(2) Set the control type parameter (CNT) to PID (PID control).
(3) Set the PV input type parameter (IN) to K1 (-270.0 to 1370.0 °C).
(4) Set the PV input unit parameter (UNIT) to C (Degree Celsius).
(5) Set the maximum value of PV input range parameter (RH) to 500.0.
(6) Set the minimum value of PV input range parameter (RL) to 0.0.
(7) Set the output type selection parameter (OT) to OUT terminals (current=00.02).
(8) Finally, EXIT is displayed. Change NO to YES and press the SET/ENTER key to complete the setup. Operation Display appears.

■ Parameters to be set

Control Type

Parameter Symbol	Name of Parameter	Setting Range
CNT	Control type	PID: PID control ONOF: ON/OFF control (1 point of hysteresis) ONOF2: ON/OFF control (2 points of hysteresis) 2P2L: Two-position two-level control H/C: Heating/cooling control

Note: Some setpoints may not be displayed depending on the model and suffix codes.

Input Function

Parameter Symbol	Name of Parameter	Setting Range
IN	PV input type	OFF: Disable K1: -270.0 to 1370.0 °C / -450.0 to 2500.0 °F K2: -270.0 to 1000.0 °C / -450.0 to 2300.0 °F K3: -200.0 to 500.0 °C / -200.0 to 1000.0 °F J: -200.0 to 1200.0 °C / -300.0 to 2300.0 °F T1: -270.0 to 400.0 °C / -450.0 to 750.0 °F T2: 0.0 to 400.0 °C / -200.0 to 750.0 °F B: 0.0 to 1800.0 °C / 32 to 3300 °F S: 0.0 to 1700.0 °C / 32 to 3100 °F R: 0.0 to 1700.0 °C / 32 to 3100 °F N: -200.0 to 1300.0 °C / -300.0 to 2400.0 °F E: -270.0 to 1000.0 °C / -450.0 to 1800.0 °F L: -200.0 to 900.0 °C / -300.0 to 1600.0 °F U1: -200.0 to 400.0 °C / -300.0 to 750.0 °F U2: 0.0 to 400.0 °C / -200.0 to 1000.0 °F W: 0.0 to 2300.0 °C / 32 to 4200 °F PL2: 0.0 to 1390.0 °C / 32.0 to 2500.0 °F P2040: 0.0 to 1900.0 °C / 32 to 3400 °F WRE: 0.0 to 2000.0 °C / 32 to 3600 °F JPT1: -200.0 to 500.0 °C / -300.0 to 1000.0 °F JPT2: -150.00 to 150.00 °C / -200.0 to 300.0 °F PT1: -200.0 to 850.0 °C / -300.0 to 1560.0 °F PT2: -200.0 to 500.0 °C / -300.0 to 1000.0 °F PT3: -150.00 to 150.00 °C / -200.0 to 300.0 °F 0.4-2V: 0.400 to 2.000 V 1-5V: 1.000 to 5.000 V 4-20: 4.00 to 20.00 mA 0-2V: 0.000 to 2.000 V 0-10V: 0.00 to 10.00 V 0-20: 0.00 to 20.00 mA -1020: -10.00 to 20.00 mV 0-100: 0.0 to 100.0 mV
UNIT	PV input unit	-: No unit, C: Degree Celsius -: No unit, - -: No unit, - - -: No unit, F: Degree Fahrenheit
RH	Maximum value of PV input range	Depends on the input type. - For temperature input - Set the temperature range that is actually controlled. (RL<RH) - For voltage / current input - Set the range of a voltage / current signal that is applied. The scale across which the voltage / current signal is actually controlled should be set using the maximum value of input scale (SH) and minimum value of input scale (SL). (Input is always 0% when RL = RH.)
RL	Minimn value of PV input range	
SDP	PV input scale decimal point position	0: No decimal place 3: Three decimal places 1: One decimal place 4: Four decimal places 2: Two decimal places
SH	Maximum value of PV input scale	-19999 to 30000, (SL<SH), | SH - SL | ≤ 30000
SL	Minimum value of PV input scale	

Note 1: SDP, SH, and SL are displayed only for voltage/current input.
Note 2: W: W-5%Re/W-26%Re (Hoskins Mfg.Co.), ASTM E998

Output Function

Parameter Symbol	Name of Parameter	Setting Range	
OT	Output type selection Upper two digits / Lower two digits	Control output or Heating-side control output (Lower two digits) 00: OFF 01: OUT terminals (voltage pulse) 02: OUT terminals (current) 03: OUT terminals (relay) 06: OUT2 terminals (relay) 07: RET/OUT2 terminals (voltage pulse) 08: RET/OUT2 terminals (current)	Cooling-side control output (Upper two digits) 00: OFF 01: OUT terminals (voltage pulse) 02: OUT terminals (current) 03: OUT terminals (relay) 06: OUT2 terminals (relay) 07: RET/OUT2 terminals (voltage pulse) 08: RET/OUT2 terminals (current)
CT	Control output cycle time Heating-side control output cycle time (in Heating/cooling control)	0.5 to 1000.0 s	
CTc	Cooling-side control output cycle time (in Heating/cooling control)		

4. Adjusting Valve Position Automatically (for a Position Proportional Type Controller Only)

The following operating procedure describes how to input feedback signals from the control valve and adjust the fully-open and fully-closed positions of the control valve automatically. The fully-open and fully-closed positions of the valve can be adjusted automatically by inputting feedback signals from the valve. To adjust the valve position, you need to carry out the connection and bring the controller into manual mode. For the connection, see "6. Terminal Wiring Diagrams" in "Installation and

1. MAN is lit — Show the Operation Display.
   Hold down the keys for 3 seconds.
   * When a password is set, PASS is displayed. If the correct password is not entered, setup parameters cannot be changed.
2. SEt.MCtL — CTL menu is displayed.
   ▷ Press the Right arrow key until OUT menu appears.
3. SEt.MOUt — OUT menu is displayed.
   Press the SET/ENTER key.
4. VAt OFF — The parameter V.AT (automatic valve position adjustment) is displayed.
   Press the SET/ENTER key.
5. VAt OFF — OFF blinks.
   △ Press the Up arrow key.
6. VAt ON — ON is displayed. Blinks during the change.
   Press the SET/ENTER key.
7. VAt ON — ON has been registered and the automatic adjustment of the valve position starts. V.AT blinks during the automatic adjustment. After the adjustment is completed, press the DISPLAY key or DISP key once to return to the Operation Display.

- When the adjustment is completed normally, the indication automatically returns to OFF.
- When VAT.E appears on PV display, it indicates an error. Check the wiring for feedback input and perform the automatic adjustment again. To perform a valve adjustment manually, see User's Manual.

5. Setting Alarm Type

The following operating procedure shows an example of changing the alarm-1 type (factory default: PV high limit alarm) to PV low limit alarm.

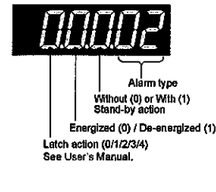
1. Show the Operation Display.
   Hold down the key for 3 seconds.
2. OPEM.MODE — MODE menu is displayed.
   ▷ Press the Right arrow key until ALRM menu appears.
3. OPEM.ALRM — ALRM menu is displayed.
   Press the SET/ENTER key.
4. AL1 00001 — The parameter AL1 (alarm-1 type) is displayed.
5. AL1 00001 — The last digit of the setpoint blinks.
   △▽ Change the setpoint using the Up/Down arrow keys to increase and decrease the value and ◁ ▷ the Left/Right arrow keys to move between digits.
   Press the SET/ENTER key.
6. AL1 00002 — The alarm-1 type setpoint 02 (PV low limit) is registered. After the setup is completed, press the DISPLAY key or DISP key once to return to the Operation Display.

Symbol: Stand-by action; Energized/De-energized; Latch action

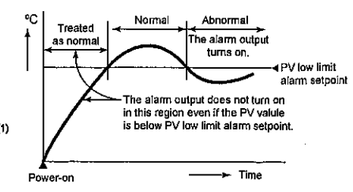
- To change the alarm type, change the last 2 digits of the 5-digit value.
- Stand-by action and excitation are turned on or off by selecting 1 or 0. (See "Setting Display of Alarm Type.")
- For the latch action, see User's Manual.

Alarm Type (Alarm Setpoint)	Alarm Action (Energized)	Alarm Action (De-energized)
No alarm (00)	-	-
PV high limit (01) Analog input PV high limit (19)	Hysteresis; Open (unlit); Closed (lit); PV; Alarm setpoint	Hysteresis; Closed (unlit); Open (lit); PV; Alarm setpoint
PV low limit (02) Analog input PV low limit (20)	Hysteresis; Closed (lit); Open (unlit); Alarm setpoint; PV	Hysteresis; Open (lit); Closed (unlit); Alarm setpoint; PV
SP high limit (03) Target SP high limit (09)	Hysteresis; Open (unlit); Closed (lit); SP or Target SP; Alarm setpoint	Hysteresis; Closed (unlit); Open (lit); SP or Target SP; Alarm setpoint
SP low limit (04) Target SP low limit (10)	Hysteresis; Closed (lit); Open (unlit); Alarm setpoint; SP or Target SP	Hysteresis; Open (lit); Closed (unlit); Alarm setpoint; SP or Target SP
Deviation high limit (05) Target SP deviation high limit (11)	Hysteresis; Open (unlit); Closed (lit); PV; Deviation setpoint; SP or Target SP ⊕	Hysteresis; Closed (unlit); Open (lit); PV; Deviation setpoint; SP or Target SP ⊕
Deviation low limit (06) Target SP deviation low limit (12)	Hysteresis; Closed (lit); Open (unlit); Deviation setpoint; PV; ⊖ SP or Target SP	Hysteresis; Open (lit); Closed (unlit); Deviation setpoint; PV; ⊖ SP or Target SP
Deviation high and low limits (07) Target SP deviation high and low limits (13)	Hysteresis Hysteresis; Closed (lit); Open (unlit); Closed (lit); Deviation setpoint; PV; SP or Target SP	Hysteresis Hysteresis; Open (lit); Closed (unlit); Open (lit); Deviation setpoint; PV; SP or Target SP
Deviation within high and low limits (08) Target SP deviation within high and low limits (14)	Hysteresis Hysteresis; Open (unlit); Closed (lit); Open (unlit); Deviation setpoint; PV; SP or Target SP	Hysteresis Hysteresis; Closed (unlit); Open (lit); Closed (unlit); Deviation setpoint; PV; SP or Target SP
Control output high limit (15) Cooling-side control output high limit (17)	Hysteresis; Open (unlit); Closed (lit); Output; Alarm setpoint	Hysteresis; Closed (unlit); Open (lit); Output; Alarm setpoint
Control output low limit (16) Cooling-side control output low limit (18)	Hysteresis; Closed (lit); Open (unlit); Alarm setpoint; Output	Hysteresis; Open (lit); Closed (unlit); Alarm setpoint; Output
Feedback input high limit (27)	Fault diagnosis alarm (30) Burnout of PV input, ADC failure, RJC error.	
Feedback input low limit (28)	FAIL (31) For the factory default, the contact output is turned ON in normal operation, OFF at the time of FAIL. Control output: OFF or 0%, Alarm output: OFF	
PV velocity (29)		

Setting Display of Alarm Type



Stand-by Action



6. Setting Alarm Setpoint

The following operating procedure shows an example of setting the alarm-1 setpoint of group 1 to 180.0.
Before setting the alarm setpoint, check the alarm type.
To change the alarm type, see "5. Setting Alarm Type."

1. Show the Operation Display.
2. Display MODE menu with the same procedure as described in Setting Alarm Type.
   ▷ Press the Right arrow key.
3. OPEM.SP — SP menu is displayed.
   Press the SET/ENTER key.
   ▽ Press the Down arrow key until A1 appears.
4. A1 1500 — The parameter A1 is displayed. A1 to A4 represent the alarm-1 to -4 setpoints.
   Group

Each parameter and group can be changed in the Parameter Setting Displays of alarms using arrow keys.
△▽ Up/Down arrow keys: parameters
◁ ▷ Left/Right arrow keys: groups

Display the parameter and group that need to be changed.
Press the SET/ENTER key.

5. A1 1500 — Blinks during the change.
   △▽ Change the setpoint using the Up/Down arrow keys to increase and decrease the value and ◁ ▷ the Left/Right arrow keys to move between digits.
   Press the SET/ENTER key.
6. A1 1800 — The setpoint has been registered. After the setup is completed, press the DISPLAY key or DISP key once to return to the Operation Display.

Operations

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This operation guide describes key entries for operating the UT35A/UT32A.
Although the display of UT35A is used in this guide, UT32A can be operated similarly.
For operations using external contact inputs, see "DI" of "6. Terminal Wiring Diagrams" in "Installation and Wiring."
If you cannot remember how to carry out an operation during setting, press the DISPLAY key or DISP key once. This brings you to the display (Operation Display) that appears at power-on.
The scrolling guide is displayed on PV display in the Parameter Setting Display.
This guide can be turned on/off with the Fn key.

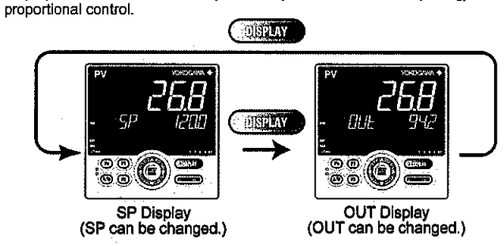
Contents

1. Monitoring-purpose Operation Displays Available during Operation
2. Setting Target Setpoint (SP)
3. Performing/Canceling Auto-tuning
4. Selecting Target Setpoint Numbers (SPNO.)
5. Switching between AUTO and MAN
6. Switching between RUN and STOP
7. Switching between REM (Remote) and LCL (Local)
8. Manipulating Control Output in Manual Mode
9. Troubleshooting

1. Monitoring-purpose Operation Displays Available during Operation

■ Operation Display Switching Diagram for Standard and Position Proportional Types

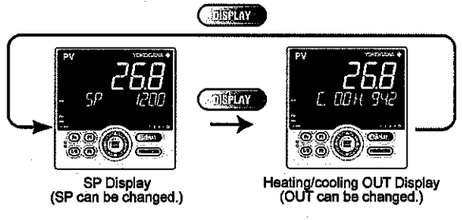
- **SP Display**
  Displays the measured input value on PV display.
  Displays the target setpoint (SP) on Setpoint display (SP can be changed).
- **OUT Display**
  Displays the measured input value on PV display.
  Displays the control output value (OUT) on Setpoint display (OUT can be changed in manual mode).
  Displays the valve's feedback input value (at 0 to 100% valve opening) in Position proportional control.



SP Display (SP can be changed.) — OUT Display (OUT can be changed.)

■ Operation Display Switching Diagram for Heating/Cooling Type

- **SP Display**
  Displays the measured input value on PV display.
  Displays the target setpoint (SP) on Setpoint display (SP can be changed).
- **OUT Display**
  Displays the measured input value on PV display.
  Displays the control output values (C.H.) of heating and cooling sides on Setpoint display (C.H. can be changed in manual mode).



SP Display (SP can be changed.) — Heating/cooling OUT Display (OUT can be changed.)

After showing the OUT Display, press the DISPLAY key or DISP key to show the following displays conditionally.
For details, see User's Manual.

Standard, Position Proportional, and Heating/Cooling Types

- SELECT Displays 1 to 5 (which appear when registered)
- Analog Input Display (display only) (factory default: non-display)
- Position Proportional Computation Output Display (display only) (factory default: non-display)
- PID Number Display (display only) (factory default: non-display)
- Heater Break Alarm-1 Current Display (display only) (for heater break alarm option only)
- Heater Break Alarm-2 Current Display (display only) (for heater break alarm option only)

1. Show the SP Display (Operation Display). (This is an example of setting the target setpoint to 150.0).

2. Press the SET/ENTER key to start the last digit of the setpoint blinking. Blinking allows you to change the value.

3. ◁▷ To set the setpoint, use the △▽ Left/Right arrow keys to move between digits and the Up/Down arrow keys to increase and decrease the value.

4. When the required value is displayed, press the SET/ENTER key to register the setpoint.

3. Performing/Canceling Auto-tuning

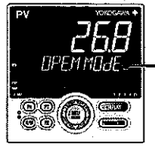
Auto-tuning should be performed after setting a target setpoint.
Make sure that the controller is in automatic mode (AUTO) and in run mode (RUN) before auto-tuning. For setting to AUTO, see "5. Switching between AUTO and MAN," and for setting to RUN, see "6. Switching between RUN and STOP."
If the setpoint is known in advance or auto-tuning does not find any appropriate PID constants, set the PID manually. For setting the PID manually, see User's Manual.

CAUTION

Do not perform auto-tuning for the following processes.
Tune PID manually.
- **Processes with fast response such as flow rate control and pressure control.**
- **Processes which do not allow the output to be turned on and off even temporarily.**
- **Processes which prohibit severe output changes at control valves (or other actuators).**
- **Processes in which product quality can be adversely affected if PV values fluctuate beyond their allowable ranges.**

1. Show the Operation Display.

2. Hold down the PARAMETER key or PARA key for 3 seconds to display MODE menu.



Press the SET/ENTER key.

3. In cases where the communication is specified, the parameter R.L (REMOTE/LOCAL switch) is displayed.

▽ Press the Down arrow key until the parameter AT appears.

4. The parameter AT (auto-tuning switch) is displayed.

Press the SET/ENTER key.

△▽ Press the Up/Down arrow keys to display the required setpoint.

6. Blinks during the change.

The setting range is 1 to 4 (represent group numbers) or R.
To perform auto-tuning for the PID of group 1, set the parameter AT to 1.

Press the SET/ENTER key.

7. The setpoint has been registered.
This starts auto-tuning.
The limiter can be set to the output during auto-tuning.
For details, see User's Manual.

During auto-tuning,
- The MAN lamp blinks.
- The OUT symbol appears.
- The output values at 100.0% and 0% appear alternately.

8. The MAN lamp goes off, which means that the auto-tuning completed normally.

4. Selecting Target Setpoint Numbers (SPNO.)

The following operating procedure shows an example of changing the target setpoint number (SPNO.) from 1 to 2. Each SP has its PID group. The PID group set for the parameter PIDN (PID number selection) is used.

1. Show the Operation Display.

2. Hold down the PARAMETER key or PARA key for 3 seconds to display MODE menu.

Press the SET/ENTER key.

3. In cases where the communication is specified, the parameter R.L (REMOTE/LOCAL switch) is displayed.

▽ Press the Down arrow key until the parameter SPNO. appears.

4. The parameter SPNO. (SP number selection) is displayed.

Press the SET/ENTER key.

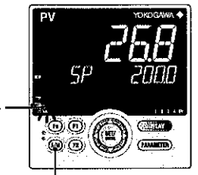
5. △▽ Change the setpoint using the Up/Down arrow keys.
Blinks during the change.

Press the SET/ENTER key.

6. The setpoint has been registered.
Press the DISPLAY key or DISP key once to return to the Operation Display.

7. SPNO. has been changed to 2.

(2) Contact input, (3) Communication, and (4) User function key.
The figure below shows a direct operation using the A/M key.
When AUTO and MAN switching function is assigned to the contact input, and the contact input is ON, the switching by key operation cannot be performed.
For details, see User's Manual.



MAN lamp is lit in MAN mode.
Each time you press the A/M key, AUTO and MAN is switched alternately.

When AUTO is switched into MAN, the control output value in AUTO mode is held.
The controller can be operated manually from the hold value.
If the manual preset output is set (MPON parameter ≠ OFF), the controller can be operated manually from the arbitrary output value (MPO1 to MPO5 parameters).

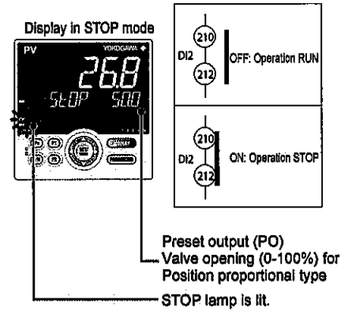
6. Switching between RUN and STOP

RUN and STOP switching can be performed using any of the following: (1) Contact input, (2) Parameter, (3) Communication, and (4) User function key.
The following shows an example of switching using the contact input.
(The switching function is assigned to DI2 contact for the factory default.)
For details of other switching methods and the display appearing when the operation is started, see User's Manual.
When the controller is stopped, input and outputs are as follows:

PV input	Displays the PV value.
Control output	Displays the preset output value. The preset output value is set for each PID group.
Alarm output	Turns the output on in case of an alarm.

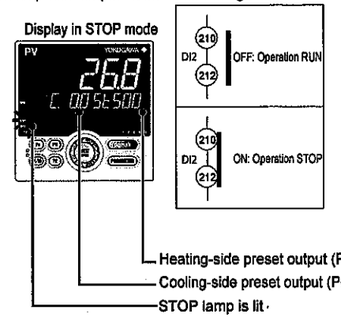
Display in STOP mode

"STOP" is displayed on Symbol display and "preset output value" is displayed on Data display.



Display in STOP mode in Heating/cooling control

"Cooling-side preset output value" is displayed on the left side of the "ST" symbol, and "Heating-side preset output value" is on the right side.



7. Switching between REM (Remote) and LCL (Local)

Remote and local switching can be performed using any of the following:
(1) Contact input, (2) Parameter, (3) Communication, and (4) User function key.

LCL (Local)

Control is performed using the target setpoint set on the controller.

REM (Remote)

Control is performed using a setpoint via communication for the target setpoint. The following shows an example of switching from local to remote using the parameter. (Only in cases where the communication is specified.)
For details of other switching methods, see User's Manual.

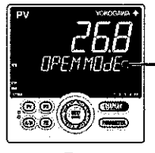
- The PID group for the local SP number is used as PID in remote mode.

NOTE

When the contact input is ON, operation cannot be performed using the parameter, communication, or key. When the contact input is OFF and the setting is switched using the parameter, communication, or key, the last switching operation is performed.

1. Show the Operation Display.

2.



PARAMETER
Hold down the PARAMETER key or PARA key for 3 seconds to display MODE menu.

Press the SET/ENTER key.

3.

The parameter R.L (REMOTE/LOCAL switch) is displayed.

Press the SET/ENTER key.

4.

△▽Change the operation mode using the Up/Down arrow keys. Blinks during the change.

Press the SET/ENTER key.

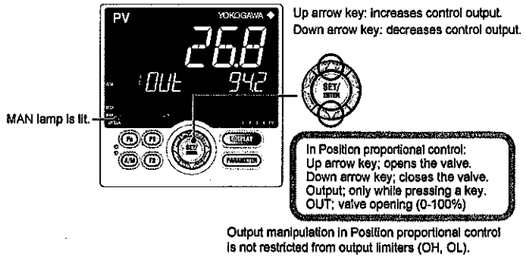
5.

The REM lamp is lit.

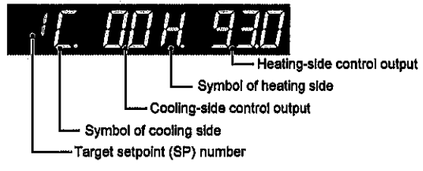
8. Manipulating Control Output in Manual Mode

NOTE

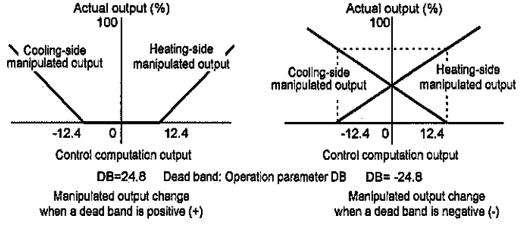
In manual mode, control output is manipulated by operating the keys (the value is changed using the Up/Down arrow keys, then outputted as it is).
Even if the SET/ENTER key is not pressed, the control output value changes according to the displayed value.
In stop mode (when the STOP lamp is lit), control output cannot be manipulated.



Manual operation in Heating/cooling control



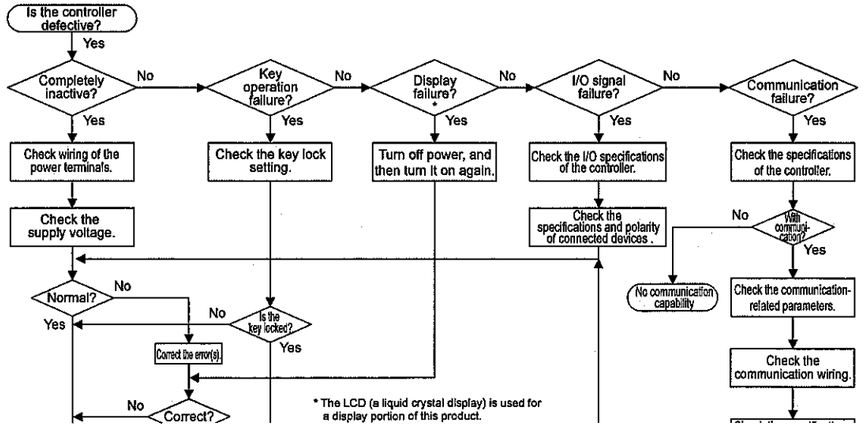
Up arrow key: concurrently decreases cooling-side control output and increases heating-side control output.
Down arrow key: concurrently increases cooling-side control output and decreases heating-side control output.
(Either none of the heating-side and cooling-side outputs are presented, or both of them are presented according to the dead band setting.)



9. Troubleshooting

■ Troubleshooting Flow

If the Operation Display does not appear after turning on the controller's power, check the procedures in the following flowchart.
If a problem appears to be complicated, contact our sales representatives.



■ Remedies if Power Failure Occurs during Operations

- Instantaneous power failure within 20 ms.
  A power failure is not detected. Normal operation continues.
- Power failure for less than about 5 seconds, or for about 5 seconds or more.
  Affects the "settings" and "operation status."
  For details, see User's Manual.

NOTE

Write down the settings of parameters for a repair request.

■ Errors at Power On

The errors shown below may occur in the fault diagnosis when the power is turned on. (For details of Setpoint display and input/output action when each error occurs, see User's Manual.

PV display (Operation Display)	Setpoint display (Operation Display)	Status indicator (Operation Display)	Parameter that displays error details	Error description	Cause and diagnosis	Remedy
Indication off	Indication off	—	—	Faulty MCU RAM / MCU ROM	MCU RAM / MCU ROM are failed.	Faulty. Contact us for repair.
ERR	SYS - - - - -	—	—	System data error	System data is corrupted.	Faulty. Contact us for repair.
	PAR 0004 (for user default value error only)		Setup parameter (PA.ER)	User (parameter) default value error	User parameter is corrupted. Initialized to factory default value.	Check and reconfigure the initialized setting parameters. Error indication is erased when the power is turned on again.
	PAR 0010 (for setup parameter error only)			Setup parameter error	Setup parameter data is corrupted. Initialized to user default value.	
	PAR 0020 (for operation parameter error only)			Operation parameter error	Operation parameter data is corrupted. Initialized to user default value.	
	SLOT 0015 (0015: Error occurs to all hardware of E1 to E4-terminal areas.)		Setup parameter (OP.ER)	Nonresponding hardware of extended function (E1 to E4-terminal areas)	Inconsistence of system data and hardware of extended function. Nonresponding communication between hardware of extended function (E1 to E4-terminal areas).	Faulty. Contact us for repair.
Normal indication	Normal indication	Rightmost decimal point on PV display blinks.	Setup parameter (PA.ER)	Calibration value error	Initialized to calibrated default value because of corrupted factory default value.	Faulty. Contact us for repair.
		Rightmost decimal point on Symbol display blinks.		Faulty FRAM	Data writing (storing) to FRAM is impossible.	
Normal indication	Normal indication	LADDER lamp blinks	Setup parameter (LA.ER)	Corrupted ladder program	Ladder program is corrupted. Operates without ladder program.	Download the ladder program again.
Normal indication	0.000 00000 (Decimal point on the left of the Symbol display blinks)	—	Setup parameter (OP.ER)	User profile error (PROFIBUS-DP communication)	User profile is corrupted.	Download the user profile again.

■ Errors during Operation

The errors shown below may occur during operation. (For input/output action when each error occurs, see User's Manual.

PV display (Operation Display)	Setpoint display (Operation Display)	Status indicator (Operation Display)	Parameter that displays error details	Error description	Cause and diagnosis	Remedy
AD.ERR	Normal indication (Note)	—	Setup parameter (AD1.E)	Analog input terminal ADC error +PV input	Analog input terminal AD value error	Faulty. Contact us for repair.
RJC.E (Displays RJC. E and PV alternately.)	Normal indication (Note)	—	Setup parameter (AD1.E)	Universal input terminal RJC error +PV input	Universal input terminal RJC error	Faulty. Contact us for repair. Set the parameter RJC to OFF to erase error indication.
B.OUT	Normal indication (Note)	—	Setup parameter (AD1.E)	Analog input terminal burnout error +PV input	Analog input terminal sensor burnout	Check wiring and sensor. Error indication is erased in normal operation.
			Setup parameter (PV1.E)	PV input burnout error	Burnout of analog input connected to PV	Check wiring and sensor of connected analog input terminals. Error indication is erased in normal operation.
OVER -OVER	Normal indication	—	Setup parameter (PV1.E)	PV input over-scale PV input under-scale (PV values out of -5 to 105%)	PV input is out of -5 to 105%. Also occurs when the data out of range which is the ladder calculation result is input.	Check analog input value or ladder program.
Normal indication	OUT - - - - -	—	Setup parameter (AD2.E)	Feedback input resistor/current burnout	Feedback input burnout	Check wiring of feedback input resistor/current. Error indication is erased in normal operation.
Normal indication	Normal indication	LADDER lamp blinks	Setup parameter (LA.ER)	Ladder calculation overflow	Floating point computation for ladder calculation is infinite.	Check the ladder program.
				Load factor over 100%	Computation does not end within the control period (load factor is 100% or more).	Change the control period or reduce the number of steps for the ladder program.
				Load factor over 200% (Forced end)	Computation does not end within the control period (load factor is 200% or more).	Change the control period or reduce the number of steps for the ladder program.
				Ladder program error	Ladder program is corrupted.	Download the ladder program again. If the error indication is still not erased, there is a fault. Contact us for repair.
	0.000 00000 (Decimal point on the left of the Symbol display blinks)	—	Setup parameter (OP.ER)	Peer-to-peer communication error	Peer-to-peer communication error	Check that the target devices are connected correctly. Recovery at normal receipt.
AT.E	Normal indication	—	Setup parameter (PV1.E)	Auto-tuning time-out	Auto-tuning does not end even when 24 hours have elapsed after the start of tuning.	Check the process. Hold down any key to erase the error indication
VAT.E	Normal indication	—	Setup parameter (AD2.E)	Valve position automatic adjustment error	Fully-closed valve position is equal to or larger than the fully-open valve position after automatic valve position adjustment is performed.	Check wiring and valve. Hold down any key to erase the error indication.
Normal indication	0.000 00000 (Decimal point on the left of the Symbol display blinks)	—	Setup parameter (OP.ER)	Communication error (RS-485 communication)	Framing parity error Buffer overflow Inter-character time-out Checksum error (PC link communication with checksum) CRC check error (Modbus/RTU) LRC check error (Modbus/ASCII)	Check the communication parameters. Recovery at normal receipt. Hold down any key to stop blinking.
Normal indication	0.000 00000 (Decimal point on the left of the Symbol display blinks)	—	Setup parameter (OP.ER)	Communication error (coordinated operation)	Inconsistence of loop between coordinated master and slaves	Check the communication parameters. Recovery at normal receipt. Change from remote to local mode to stop blinking. When the mode is changed from remote to local, SP tracking does not work even if it is set to ON.
					Communication from coordinated master is interrupted for 2 seconds.	
Normal indication	0.000 00000 (Decimal point on the left of the Symbol display blinks)	—	Setup parameter (OP.ER)	User profile error (PROFIBUS-DP communication)	User profile is corrupted.	Download the user profile again.
Normal indication	Normal indication	Rightmost decimal point on Symbol display blinks.	Setup parameter (PA.ER)	Faulty FRAM	Writing (storing) data to FRAM is impossible.	Faulty. Contact us for repair.
Undefined	Undefined	—	—	Faulty MCU / DCU (ROM / RAM error, corrupted)	MCU / DCU is corrupted.	Faulty. Contact us for repair.

Note: When an error occurs in input shown in Analog input display (Operation display)shows the same symbol as the PV display.

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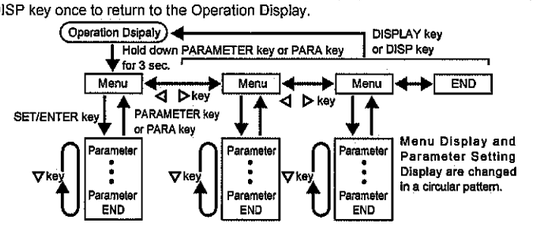
This operation guide describes the functions of parameters briefly. The parameter symbols listed are in the order shown on the display in each group of menu symbols. In addition, each parameter table has a "User Setting" column, where you can record your setpoints when setting them in the controller. The scrolling guide is displayed on PV display in the Parameter Setting Display. This guide can be turned on/off with the Fn key.

Operation Parameters

Hold down the PARAMETER key or PARA key for 3 seconds to move from the Operation Display to the Operation Parameter Setting Display. Press the DISPLAY key or DISP key once to return to the Operation Display.



The parameter groups can be switched using ◁, ▷keys.

Move to the Setup Parameter Setting Display:
Hold down the PARAMETER key or PARA key and the Left arrow key simultaneously for 3 sec.

Operation for Setting

- To select the parameter setting displayed as the initial value, press the Down arrow key to move to the next parameter.
- To change and set the parameter setting, press the SET/ENTER key to start the setpoint blinking. The blinking state allows you to make changes (setting mode). Use the Up/Down/Left/Right arrow keys to change the setpoint. Press the SET/ENTER key to register the setting.

Note that there are some parameters which are not displayed depending on the model and suffix codes, control type (CNT), etc.

■ Operation Mode

Menu symbol: MOdE (MODE)

Parameter symbol	Name of Parameter	Setting Range	Initial value	User setting	Display level
SR (S.R)	STOP/RUN switch	STOP: Stop mode RUN: Run mode Preset output (PO) is generated in STOP mode. Default: Not displayed. STOP/RUN switch is assigned to contact input.	RUN		EASY
RL (R.L)	REMOTE/LOCAL switch	LCL: Local mode REM: Remote mode (Displayed only in cases where the communication is specified.)	LCL		
At (AT)	AUTO-tuning switch	OFF: Disable 1 to 4: Perform auto-tuning. Tuning result is stored in the specified numbered PID. R: Tuning result is stored in the PID for reference deviation.	OFF		
SPNO (SPNO.)	SP number selection	1 to 4 (Depends on the setup parameter SPGR. setting.)	1		
PId (PID)	PID number	The PID group number being selected is displayed. 1 to 4, R: PID group for reference deviation	1		

■ SELECT Parameter

Menu symbol: CS (CS)

Parameter symbol	Name of Parameter	Setting Range	Initial value	User setting	Display level
Registered parameter symbol	SELECT parameter 10 to 19	Setting range of a registered parameter. For details, see User's Manual.	0	Table below	EASY

Parameter	n=10	n=11	n=12	n=13	n=14	n=15	n=16	n=17	n=18	n=19
CSn										

For the registration of SELECT parameters, see User's Manual.

Parameter symbol	Name of Parameter	Setting Range	Initial value	User setting	Display level
SP (SP)	Target setpoint	0.0 to 100.0% of PV input range (EU) (Setting range: SPL to SPH)	SPL	Table below	EASY
SUb (SUB)	Sub-target setpoint (in Two-position two-level control)	Set the offset from SP. -100.0 to 100.0% of PV input range span (EUS)	0.0 % of PV input range span		
PI dN (PIDN)	PID number selection	Set a PID group number to use. 1 to 4 (Depends on the setup parameter PIDG. setting.)	1 to 4		
A1 to A4 (A1 to A4)	Alarm-1 to -4 setpoint	Set a display value of setpoint of PV alarm, SP alarm, deviation alarm, output alarm, or velocity alarm. -19999 to 30000 (Set a value within the input range.) Decimal point position depends on the input type	0		

For the parameter SP (target setpoint), 4 groups are displayed for the factory default. The number of groups can be changed by the setup parameter SPGR. (number of SP groups). For the alarm setpoint parameter, alarm-1 to -4 are displayed for the factory default. The number of alarms can be changed using the setup parameter ALNO. (number of alarms). To change the number of SP groups or alarms, see User's Manual.

Use the following table to record SP and alarm setpoints.

Parameter	n=1	n=2	n=3	n=4
SP				
SUB				
PIDN				
A1				
A2				
A3				
A4				

n: group number

■ SP-related Setting Parameter

Menu symbol: SPS (SPS)

Parameter symbol	Name of Parameter	Setting Range	Initial value	User setting	Display level
rt (RT)	Remote input ratio	SP = Remote input x RT + Remote input bias 0.001 to 9.999	1.000		STD
rbS (RBS)	Remote input bias	-100.0 to 100.0% of PV input range span (EUS)	0.0 % of PV input range span		
UPR (UPR)	SP ramp-up rate	Used to prevent SP from changing suddenly. Set a ramp-up rate or ramp-down rate per hour or minute. Set a time unit using the parameter TMU. OFF, 0.0 + 1 digit to 100.0% of PV input range span (EUS)	OFF		EASY
dNR (DNR)	SP ramp-down rate		OFF		
tMU (TMU)	SP ramp-rate time unit	HOUR: Ramp-up rate or ramp-down rate per hour MIN: Ramp-up rate or ramp-down rate per minute	HOUR		
SPt (SPT)	SP tracking selection	Tracking is performed when the mode changes from Remote to Local. (The local setpoint keeps track of the remote setpoint.) OFF, ON	ON		STD
PVt (PVT)	PV tracking selection	Causes the setpoint to keep track of the PV so the setpoint automatically reverts to its original value at a preset rate of change. The UPR, DNR, and TMU are used in combination. Operating conditions: 1) MAN → AUTO, 2) STOP → AUTO, 3) Power-on, 4) SP number change, 5) SP change OFF, ON	OFF		

Parameter symbol	Name of Parameter	Setting Range	Initial value	User setting	Display level
AL 1 to AL4 (AL1 to AL4)	Alarm-1 to 4 type Example: Alarm-1 AL 1 00000 1 Latch action Energized/ De-energize Stand-by action Alarm type	Set a 5-digit value in the following order. [Alarm type: 2 digits (see below)] + [Without (0) or With (1) Stand-by action] + [Energized (0) or De-energized (1)] + [Latch action (0/1/2/3/4)] For latch action, see User's Manual. Alarm type: 2 digits 00: Disable 01: PV high limit 02: PV low limit 03: SP high limit 04: SP low limit 05: Deviation high limit 06: Deviation low limit 07: Deviation high and low limits 08: Deviation within high and low limits 09: Target SP high limit 10: Target SP low limit 11: Target SP deviation high limit 12: Target SP deviation low limit 13: Target SP deviation high and low limits 14: Target SP deviation within high and low limits 15: OUT high limit 16: OUT low limit 17: Cooling-side OUT high limit 18: Cooling-side OUT low limit 19: Analog input PV high limit 20: Analog input PV low limit 27: Feedback input high limit 28: Feedback input low limit 29: PV velocity 30: Fault diagnosis 31: FAIL	AL1, AL3: PV high limit (01) Without Stand-by action (0) Energized (0) Latch action (0) AL2, AL4: PV low limit (02) Without Stand-by action (0) Energized (0) Latch action (0)	Table below	EASY
Vt 1 to Vt4 (VT1 to VT4)	PV velocity alarm time setpoint 1 to 4	0.01 to 99.59 (minute.second)	1.00		
HY 1 to HY4 (HY1 to HY4)	Alarm-1 to -4 hysteresis	Set a display value of setpoint of hysteresis. -19999 to 30000 (Set a value within the input range.) Decimal point position depends on the input type.	10		
dYN 1 to dYN4 (DYN1 to DYN4)	Alarm-1 to -4 On-delay timer	An alarm output is ON when the delay timer expires after the alarm setpoint is reached. 0.00 to 99.59 (minute.second)	0.00		STD
AMd (AMD)	Alarm mode	0: Always active 1: Not active in STOP mode 2: Not active in STOP or MAN mode	0		

For the alarm function setting parameter, 4 groups are displayed for the factory default. The number of groups can be changed by the setup parameter ALNO. (number of alarms). To change the number of alarms, see User's Manual.

Parameter	n=1	n=2	n=3	n=4
ALn				
VTn				
HYn				
DYNn				

n: group number

■ PV-related Setting Parameter

Menu symbol: PVS (PVS)

Parameter symbol	Name of Parameter	Setting Range	Initial value	User setting	Display level
bS (BS)	PV input bias	-100.0 to 100.0% of PV input range span (EUS)	0.0 % of PV input range span		EASY
FL (FL)	PV input filter	OFF, 1 to 120 s	OFF		

Parameter symbol	Name of Parameter	Setting Range	Initial value	User setting	Display level
P (P)	Proportional band Heating-side proportional band (in Heating/cooling control)	0.0 to 999.9% When 0.0% is set, it operates as 0.1%. Heating-side ON/OFF control applies when 0.0% in Heating/cooling control	5.0%		EASY
I (I)	Integral time Heating-side integral time (in Heating/cooling control)	OFF: Disable 1 to 6000 s	240 s		
d (D)	Derivative time Heating-side derivative time (in Heating/cooling control)	OFF: Disable 1 to 6000 s	60 s		
OH (OH)	Control output high limit Heating-side control output high limit (in Heating/cooling control)	-4.9 to 105.0%, (OL<OH) In Heating/cooling control: 0.1 to 105.0% (OL<OH)	100.0%		
OL (OL)	Control output low limit Heating-side control output low limit (in Heating/cooling control)	-5.0 to 104.9%, (OL<OH), SD: Tight shut In Heating/cooling control: 0.0 to 104.9% (OL<OH)	0.0%		
MR (MR)	Manual reset	Enabled when integral time is OFF. The manual reset value equals the output value when PV = SP. -5.0 to 105.0%	50.0%		
HYS (HYS)	Hysteresis (in ON/OFF control, Position proportional control, or Two-position two-level control) Heating-side ON/OFF control hysteresis (in Heating/cooling control)	In ON/OFF control or Two-position two-level control: 0.0 to 100.0% of PV input range span (EUS) In Heating/cooling control or Position proportional control: 0.0 to 100.0%	In ON/OFF control or Two-position two-level control: 0.5 % of PV input range span In Heating/ cooling control or Position proportional control: 0.5 %		
SUHY (SU.HY)	Sub-hysteresis (in Two-position two-level control)	0.0 to 100.0% of PV input range span (EUS)	0.5 % of PV input range span		
HYUP (HY.UP)	Upper-side hysteresis (in ON/OFF control)		0.5 % of PV input range span		
HYLO (HY.LO)	Lower-side hysteresis (in ON/OFF control)		0.5 % of PV input range span		
dR (DR)	Direct/reverse action switch	RVS: Reverse action DIR: Direct action	RVS		STD
SUdR (SU.DR)	Sub-direct/reverse action switch (in Two-position two-level control)		DIR		
Pc (Pc)	Cooling-side proportional band	0.0 to 999.9% (Cooling-side ON/OFF control applies when 0.0% in Heating/cooling control)	5.0%		EASY
I c (Ic)	Cooling-side integral time	OFF: Disable 1 to 6000 s	240 s		
dc (Dc)	Cooling-side derivative time	OFF: Disable 1 to 6000 s	60 s		
OHc (OHc)	Cooling-side control output high limit	0.1 to 105.0%, (OLc<OHc)	100.0%		
OLc (OLc)	Cooling-side control output low limit	0.0 to 104.9%, (OLc<OHc)	0.0%		
HYSc (HYSc)	Cooling-side ON/OFF control hysteresis	0.0 to 100.0%	0.5%		
db (DB)	Output dead band (in Heating/cooling control or Position proportional control)	In Heating/cooling control: -100.0 to 50.0% In Position proportional control: 1.0 to 10.0%	3.0%		
PO (PO)	Preset output Heating-side preset output (in Heating/cooling control)	In STOP mode, fixed control output can be generated. In Position proportional control, Valve opening can be set; -5.0 to 105.0%	0.0%		
SUPO (SU.PO)	Sub-preset output (in Two-position two-level control)	In STOP mode, fixed sub-control output can be generated. 0%, 100%	0%		
POc (POc)	Cooling-side preset output	In STOP mode, cooling-side fixed control output can be generated. -5.0 to 105.0%	0.0%		

For the PID setting parameter, 4 groups are displayed for the factory default.
The number of groups can be changed by the setup parameter PIDG. (number of PID groups). To change the number of PID groups, see User's Manual.

If you are using two or more groups of PID parameters, use the following table to record their setting values.

Parameter	n=2	n=3	n=4	R
P				
I				
D				
OH				
OL				
MR				
HYS				
SU.HY				
HY.UP				
HY.LO				
DR				
SU.DR				
Pc				
Ic				
Dc				
OHc				
OLc				
HYSc				
DB				
PO				
SU.PO				
POc				

n: group number

■ Tuning Parameter

Menu symbol: TUNE (TUNE)

Parameter symbol	Name of Parameter	Setting Range	Initial value	User setting	Display level
SC (SC)	Super function	OFF: Disable 1: Overshoot suppressing function (normal mode) 2: Hunting suppressing function (stable mode) Enables to answer the wider characteristic changes compared with response mode. 3: Hunting suppressing function (response mode) Enables quick follow-up and short converging time of PV for the changed SP. 4: Overshoot suppressing function (strong suppressing mode) Note: Setpoints 2 and 3 must be used in PID control or PI control. Disabled in the following controls: 1) ON/OFF control, 2) PD control, 3) P control, 4) Heating/cooling control. Do not use the function for the control processes with response such as flow or pressure control.	OFF		EASY
AT.TY (AT.TY)	Auto-tuning type	0: Normal 1: Stability	0		STD
AR (AR)	Anti-reset windup (excess integration prevention)	AUTO, 50.0 to 200.0%	AUTO		
OPR (OPR)	Output velocity limiter	OFF: Disable 0.1 to 100.0%/s	OFF		
MPON (MPON)	Manual preset output number selection	Select the output used in MAN mode when switched from AUTO to MAN mode. OFF: Hold the control output in AUTO mode (bumpless) 1: Use manual preset output 1 (output bump) 2: Use manual preset output 2 (output bump) 3: Use manual preset output 3 (output bump) 4: Use manual preset output 4 (output bump) 5: Use manual preset output 5 (output bump)	OFF		
MP01 to MP05 (MPO1 to MPO5)	Manual preset output 1 to 5	-5.0 to 105.0% However, output is limited to the output high limit and low limit.	0.0%	Table below	

Use the following table to record the manual preset output setting value.

Parameter	n=1	n=2	n=3	n=4	n=5
MPOn					

■ Zone Control Parameter

Menu symbol: ZONE (ZONE)

Parameter symbol	Name of Parameter	Setting Range	Initial value	User setting	Display level
RP1 to RP3 (RP1 to RP3)	Reference point 1 to 3	Set reference points at which switching is carried out between groups of PID constants according to the given temperature zone. 0.0 to 100.0% of PV input range (EU) (RP1 ≤ RP2 ≤ RP3)	100.0% of PV input range	Table below	STD
RHY (RHY)	Zone PID switching hysteresis	Hysteresis can be set for switching at a reference point. 0.0 to 10.0% of PV input range span (EUS)	0.5 % of PV input range span		
RDV (RDV)	Reference deviation	Set a deviation from SP. The PID for reference deviation is used if there is a larger deviation than the preset reference deviation. OFF: Disable 0.0 + 1 digit to 100.0% of PV input range span (EUS)	OFF		

For Zone control, set the setup parameter ZON (zone PID selection) to Zone PID selection.

Use the following table to record the reference point setting value.

Parameter	n=1	n=2	n=3
RPn			

■ P Parameter (for Ladder Program)

Menu symbol: PPAR (PPAR)

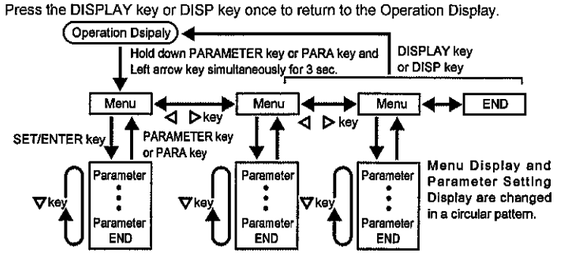
Parameter symbol	Name of Parameter	Setting Range	Initial value	User setting	Display level
P01 to P10 (P01 to P10)	P01 to P10 parameter	-19999 to 30000 (Set a decimal point position using LL50A Parameter Setting Software.)	0	Table below	STD

Parameter	n=01	n=02	n=03	n=04	n=05	n=06	n=07	n=08	n=09	n=10
Pn										

Setup Parameters

Hold down the PARAMETER key or PARA key and Left arrow key simultaneously for 3 seconds to move from the Operation Display or Operation Parameter Setting Display to the Setup Parameter Setting Display.

Press the DISPLAY key or DISP key once to return to the Operation Display.



Operation for Setting

- To select the parameter setting displayed as the initial value, press the Down arrow key to move to the next parameter.
- To change and set the parameter setting, press the SET/ENTER key to start the set-point blinking. The blinking state allows you to make changes (setting mode). Use the Up/Down/Left/Right arrow keys to change the setpoint. Press the SET/ENTER key to register the setting.

Note that there are some parameters which are not displayed depending on the Model and Suffix codes, control type (CNT), etc.

■ Control Function Setting Parameter

Menu symbol: CTL (CTL)

Parameter symbol	Name of Parameter	Setting Range	Initial value	User setting	Display level
CNT (CNT)	Control type	PID: PID control ONOF: ON/OFF control (1 point of hysteresis) ONOF2: ON/OFF control (2 points of hysteresis) 2P2L: Two-position two-level control H/C: Heating/cooling control	PID		EASY
SPGR (SPGR.)	Number of SP groups	Set a number of SP groups to use. 1 to 4	4		STD
ZON (ZON)	Zone PID selection	If set to "SP group number selection," allows PID constants to be selected for each SP group. If set to "Zone PID selection," automatically selects PID constants according to the range set in the Reference point. 0: SP group number selection 1 1: Zone PID selection (selection by PV) 2: Zone PID selection (selection by target SP) 3: SP group number selection 2 4: Zone PID selection (selection by SP)	0		
PIDG (PIDG.)	Number of PID groups	Set a number of PID groups to use. 1 to 4	4		

■ PV Input Setting Parameter

Menu symbol: PV (PV)

Parameter symbol	Name of Parameter	Setting Range	Initial value	User setting	Display level
IN (IN)	PV input type	OFF: Disable K1: -270.0 to 1370.0 °C / -450.0 to 2500.0 °F K2: -270.0 to 1000.0 °C / -450.0 to 2300.0 °F K3: -200.0 to 500.0 °C / -200.0 to 1000.0 °F J: -200.0 to 1200.0 °C / -300.0 to 2300.0 °F T1: -270.0 to 400.0 °C / -450.0 to 750.0 °F T2: 0.0 to 400.0 °C / -200.0 to 750.0 °F B: 0.0 to 1800.0 °C / 32 to 3300 °F S: 0.0 to 1700.0 °C / 32 to 3100 °F R: 0.0 to 1700.0 °C / 32 to 3100 °F N: -200.0 to 1300.0 °C / -300.0 to 2400.0 °F E: -270.0 to 1000.0 °C / -450.0 to 1800.0 °F L: -200.0 to 900.0 °C / -300.0 to 1600.0 °F U1: -200.0 to 400.0 °C / -300.0 to 750.0 °F U2: 0.0 to 400.0 °C / -200.0 to 1000.0 °F W: 0.0 to 2300.0 °C / 32 to 4200 °F PL2: 0.0 to 1390.0 °C / 32.0 to 2500.0 °F P2040: 0.0 to 1900.0 °C / 32 to 3400 °F WRE: 0.0 to 2000.0 °C / 32 to 3600 °F JPT1: -200.0 to 500.0 °C / -300.0 to 1000.0 °F JPT2: -150.0 to 150.0 °C / -200.0 to 300.0 °F PT1: -200.0 to 850.0 °C / -300.0 to 1560.0 °F PT2: -200.0 to 500.0 °C / -300.0 to 1000.0 °F PT3: -150.00 to 150.00 °C / -200.0 to 300.0 °F 0.4-2V: 0.400 to 2.000 V 1-5V: 1.000 to 5.000 V 4-20: 4.00 to 20.00 mA 0-2V: 0.000 to 2.000 V 0-10V: 0.00 to 10.00 V 0-20 : 0.00 to 20.00 mA -1020: -10.00 to 20.00 mV 0-100: 0.0 to 100.0 mV	OFF		EASY
UNIT (UNIT)	PV input unit	-: No unit, C: Degree Celsius -: No unit, - -: No unit, - - -: No unit, F: Degree Fahrenheit	C		
RH (RH)	Maximum value of PV input range	Depends on the input type. - For temperature input - Set the temperature range that is actually controlled. (RL<RH) - For voltage / current input - Set the range of a voltage / current signal that is applied. The scale across which the voltage / current signal is actually controlled should be set using the maximum value of input scale (SH) and minimum value of input scale (SL). (Input is always 0% when RL = RH.)	Depends on the input type		
RL (RL)	Minimum value of PV input range		Depends on the input type		
SDP (SDP)	PV input scale decimal point position	0: No decimal place 1: One decimal place 2: Two decimal places 3: Three decimal places 4: Four decimal places	Depends on the input type		
SH (SH)	Maximum value of PV input scale	-19999 to 30000, (SL<SH), | SH - SL | ≤ 30000	Depends on the input type		
SL (SL)	Minimum value of PV input scale		Depends on the input type		
BSL (BSL)	PV input burnout action	OFF: Disable UP: Upscale DOWN: Downscale	Depends on the input type		STD

W: W-5% Re/W-26% Re(Hoskins Mfg.Co.). ASTM E988, WRE: W97Re3-W75Re25

■ Input Range, SP Limiter Setting Parameter

Menu symbol: MPV (MPV)

Parameter symbol	Name of Parameter	Setting Range	Initial value	User setting	Display level
PUNI (P.UNI)	Control PV input unit	-: No unit C: Degree Celsius -: No unit - -: No unit - - -: No unit F: Degree Fahrenheit	Same as PV input unit		STD
PDP (P.DP)	Control PV input decimal point position	0: No decimal place 1: One decimal place 2: Two decimal places 3: Three decimal places 4: Four decimal places	1		
PRH (P.RH)	Maximum value of control PV input range	-19999 to 30000, (P.RL<P.RH), | P.RH - P.RL | ≤ 30000	Depends on the input type		
PRL (P.RL)	Minimum value of control PV input range		Depends on the input type		
SPH (SPH)	SP high limit	0.0 to 100.0% of PV input range (EU), (SPL<SPH)	100.0 % of PV input range		
SPL (SPL)	SP low limit		0.0 % of PV input range		

Parameter symbol	Name of Parameter	Setting Range	Initial value	User setting	Display level
Ot (OT)	Output type selection Ot 0001 Upper two digits / Lower two digits	Control output or Heating-side control output (Lower two digits) 00: OFF 01: OUT terminals (voltage pulse) 02: OUT terminals (current) 03: OUT terminals (relay) 06: OUT2 terminals (relay) 07: RET/OUT2 terminals (voltage pulse) 08: RET/OUT2 terminals (current) Cooling-side control output (Upper two digits) 00: OFF 01: OUT terminals (voltage pulse) 02: OUT terminals (current) 03: OUT terminals (relay) 06: OUT2 terminals (relay) 07: RET/OUT2 terminals (voltage pulse) 08: RET/OUT2 terminals (current)	Standard type: 00.03 Heating /cooling type: 06.03		EASY
Ct (CT)	Control output cycle time Heating-side control output cycle time (in Heating/cooling control)	0.5 to 1000.0 s	30.0 s		
Ctc (CTc)	Cooling-side control output cycle time		30.0 s		
VAt (V.AT)	Automatic valve position adjustment	OFF: Stop automatic adjustment ON: Start automatic adjustment	OFF		
VRS (V.RS)	Valve position setting reset	Setting V.RS to ON resets the valve adjustment settings and causes the indication "V.RS" to blink.	OFF		
VL (V.L)	Fully-closed valve position setting	Pressing the SET/ENTER key with valve position set to the fully-closed position by Down arrow key causes the adjusted value to be stored. When V.L adjustment is complete, V.L stops blinking.	-		
VH (V.H)	Fully-opened valve position setting	Pressing the SET/ENTER key with valve position set to the fully-opened position by Up arrow key causes the adjusted value to be stored. When V.H adjustment is complete, V.H stops blinking	-		
tRt (TR.T)	Valve traveling time	5 to 300 s	60 s		STD
VMOd (V.MOD)	Valve adjusting mode	0: Valve position feedback type 1: Valve position feedback type (moves to the estimating type if a feedback input error or break occurs.) 2: Valve position estimating type	0		
rtS (RTS)	Retransmission output type of RET	OFF: Disable PV1: PV SP1: SP OUT1: OUT (Valve opening: 0 to 100 % in Position proportional control) LPS: 15 V DC loop power supply TSP1: Target SP HOUT1: Heating-side OUT COUT1: Cooling-side OUT MV1: Position proportional output (internal computed value) PV: PV terminals analog input	PV1		EASY
rtH (RTH)	Maximum value of retransmission output scale of RET	When RTS = PV1, SP1, TSP1, PV RTL + 1 digit to 30000 -19999 to RTH - 1 digit Decimal point position: When RTS=PV1, SP1, or TSP1, decimal point position is same as that of PV input. When RTS=PV, decimal point position is same as that of PV input scale.	100 % of PV input range		STD
rtL (RTL)	Minimum value of retransmission output scale of RET		0 % of PV input range		
O1rS (O1RS)	Retransmission output type of OUT current output	Same as RTS	OFF		
O1rH (O1RH)	Maximum value of retransmission output scale of OUT current output	When O1RS = PV1, SP1, TSP1, PV, O1RL + 1 digit to 30000 -19999 to O1RH - 1 digit Decimal point position: When O1RS=PV1, SP1, or TSP1, decimal point position is same as that of PV input. When O1RS =PV, decimal point position is same as that of PV input scale.	-		
O1rL (O1RL)	Minimum value of retransmission output scale of OUT current output		-		
OUA (OU.A)	OUT current output range	4-20: 4 to 20 mA 0-20: 0 to 20 mA 20-4: 20 to 4 mA 20-0: 20 to 0 mA	4-20		
rEtA (RET.A)	RET current output range		4-20		

Parameter symbol	Name of Parameter	Setting Range	Initial value	User setting	Display level
Hb1S (HB1.S)	Heater break alarm-1 function selection	0: Heater current measurement 1: Heater break alarm (Heating-side) 2: Cooling-side heater break alarm	1		EASY
Hb2S (HB2.S)	Heater break alarm-2 function selection		1		
Hb1 (HB1)	Heater break alarm-1 current setpoint	OFF, 0.1 to 300.0 Arms	OFF		
Hb2 (HB2)	Heater break alarm-2 current setpoint		OFF		
Ct1t (CT1.T)	CT1 coil winding number ratio	1 to 3300	800		
Ct2t (CT2.T)	CT2 coil winding number ratio		800		
HdN1 (HDN1)	Heater break alarm-1 On-delay timer	0.00 to 99.59 (m.s)	0.00		STD
HdN2 (HDN2)	Heater break alarm-2 On-delay timer		0.00		

In cases where the current transformers manufactured by U.R.D. Co., Ltd are used, set the following value for the coil winding number ratio.
CTL-6-S-H: 800
CTL-12L-30: 3000

■ RS-485 Communication Setting Parameter (UT35A: E3-terminal Area, UT32A: E1-terminal Area)

Menu symbol: R485 (R485)

Parameter symbol	Name of Parameter	Setting Range	Initial value	User setting	Display level
PSL (PSL)	Protocol selection	PCL: PC link communication PCLSM: PC link communication (with checksum) LADR: Ladder communication CO-M: Coordinated master station CO-S: Coordinated slave station MBASC: Modbus (ASCII) MBRTU: Modbus (RTU) CO-S1: Coordinated slave station (Loop-1 mode) CO-S2: Coordinated slave station (Loop-2 mode) P-P: Peer-to-peer communication	MBRTU		EASY
bPS (BPS)	Baud rate	600: 600 bps 1200: 1200 bps 2400: 2400 bps 4800: 4800 bps 9600: 9600 bps 19200: 19.2k bps 38400: 38.4k bps	19200		
PRI (PRI)	Parity	NONE: None EVEN: Even ODD: Odd	EVEN		
StP (STP)	Stop bit	1: 1 bit, 2: 2 bits	1		
dLN (DLN)	Data length	7: 7 bits, 8: 8 bits	8		
Adr (ADR)	Address	1 to 99	1		

Parameter symbol	Name of Parameter	Setting Range	Initial value	User setting	Display level
HSR (HSR)	High-speed response mode	OFF, 1 to 8	1		EASY
bPS (BPS)	Baud rate	9600: 9600 bps 19200: 19.2k bps 38400: 38.4k bps	38400		
PRI (PRI)	Parity	NONE: None EVEN: Even ODD: Odd	EVEN		
IP1 to IP4 (IP1 toIP4)	IP address 1 to 4	0 to 255 Initial value: (IP1).(IP2).(IP3).(IP4) = (192).(168).(1).(1)	See left	Table below	
SM1 to SM4 (SM1 to SM4)	Subnet mask 1 to 4	0 to 255 Initial value: (SM1).(SM2).(SM3).(SM4) = (255).(255).(255).(0)	See left	Table below	
dG1 to dG4 (DG1 to DG4)	Default gateway 1 to 4	0 to 255 Initial value: (DG1).(DG2).(DG3).(DG4) = (0).(0).(0).(0)	See left	Table below	
PRt (PRT)	Port number	502, 1024 to 65535	502		
IPAR (IPAR)	IP access restriction	OFF: Disable, ON: Enable	OFF		
IP1 to IP4, 2IP1 to 2IP4 (1.IP1 to 1.IP4, 2.IP1 to 2.IP4)	Permitted IP address 1-1 to 1-4 Permitted IP address 2-1 to 2-4	0 to 255 Initial value: (1.IP1).(1.IP2).(1.IP3).(1.IP4) = (255).(255).(255).(255) (2.IP1).(2.IP2).(2.IP3).(2.IP4) = (255).(255).(255).(255)	See left	Table below	
ESW (ESW)	Ethernet setting switch	Setting this parameter to "ON" enables the Ethernet communication parameter settings. OFF, ON	OFF		

Use the following table to record Ethernet communication setting value.

Parameter	n=1	n=2	n=3	n=4
IPn				
SMn				
DGn				
1.IPn				
2.IPn				

■ PROFIBUS-DP Communication Setting Parameter (E3-terminal Area)

Menu symbol: PROF (PROF)

Parameter symbol	Name of Parameter	Setting Range	Initial value	User setting	Display level
bR (BR)	Baud rate	9.6K: 9.6k bps 19.2K: 19.2k bps 93.75K: 93.75k bps 187.5K: 187.5k bps 0.5M: 0.5M bps 1.5M: 1.5M bps 3M: 3M bps 6M: 6M bps 12M: 12M bps AUTO 45.45K: 45.45k bps	AUTO		EASY
Adr (ADR)	Address	0 to 125	3		
bPS (BPS)	Baud rate	9600: 9600 bps 19200: 19.2k bps 38400: 38.4k bps	38400		
FILE (FILE)	Profile number	0 to 3	0		

Parameter symbol	Name of Parameter	Setting Range	Initial value	User setting	Display level
F1 (F1)	User function key-1 action setting	OFF: Disable A/M: AUTO/MAN switch R/L1: REM/LCL switch S/R: STOP/RUN switch AUTO: Switch to AUTO MAN: Switch to MAN REM1: Switch to REM LCL1: Switch to LCL STOP: Switch to STOP RUN: Switch to RUN AT: Auto-tuning LTUP: LCD brightness UP LTDN: LCD brightness DOWN BRI: Adjust LCD brightness LCD: LCD backlight ON/OFF switch LAT: Latch release PID: PID tuning switch	OFF		EASY
F2 (F2)	User function key-2 action setting		OFF		
FN (Fn)	User function key-n action setting		PID		

■ Display Function Setting Parameter

Menu symbol: diSP (DISP)

Parameter symbol	Name of Parameter	Setting Range	Initial value	User setting	Display level
PCMd (PCMD)	Active color PV display switch	0: Fixed in white 1: Fixed in red 2: Link to alarm 1 (Alarm OFF: white, Alarm ON: red) 3: Link to alarm 1 (Alarm OFF: red, Alarm ON: white) 4: Link to alarm 1 or 2 (Alarm OFF: white, Alarm ON: red) 5: Link to alarm 1 or 2 (Alarm OFF: red, Alarm ON: white) 6: PV limit (Within range: white, Out of range: red) 7: PV limit (Within range: red, Out of range: white) 8: SP deviation (Within deviation: white, Out of deviation: red) 9: SP deviation (Within deviation: red, Out of deviation: white)	0		EASY
PCH (PCH)	PV color change high limit	Set a display value when in PV limit or SP deviation. -19999 to 30000 (Set a value within the input range.) Decimal point position depends on the input type.	0		
PCL (PCL)	PV color change low limit		0		
bAR1 (BAR1)	Bar-graph display registration	0: Disable 1:OUT, Heating-side OUT, Internal value in Position proportional control 2: Cooling-side OUT 3: PV 4: SP 5: Deviation 6 to 16: Disable 17: Feedback input (valve opening) 18: PV terminals analog input	5 (Heating /cooling type: 1)		STD
bdV (BDV)	Bar-graph deviation display band	0.0 to 100.0% of PV input range span (EUS)	10.0 % of PV input range span		
GUId (GUID)	Guide display ON/OFF	OFF: Nondisplay, ON: Display	ON		EASY
ECO (ECO)	Economy mode	OFF: Disable 1: Economy mode ON (All indications except PV display OFF) 2: Economy mode ON (All indications OFF) 3: Brightness 10 % (whole indication)	OFF		
bRI (BRI)	Brightness	(Dark) 1 to 5 (Bright)	3		
MLSd (MLSD)	Least significant digital mask of PV display	OFF: With least significant digit ON: Without least significant digit	OFF		STD

■ SELECT Display Setting Parameter

Menu symbol: CSEL (CSEL)

Parameter symbol	Name of Parameter	Setting Range	Initial value	User setting	Display level
CS1 to CS5 (CS1 to CS5)	SELECT Display-1 to -5 registration	Register the operation parameter (except the Operaiton Mode) that is frequently modified to display it in the Operation Display. OFF, 2301 to 5000 For the setting range, see User's Manual.	OFF		STD

Use the following table to record SELECT Dsipaly setting value.

Parameter	n=1	n=2	n=3	n=4	n=5
CSn					

■ Key Lock Setting Parameter

Menu symbol: KLOC (KLOC)

Parameter symbol	Name of Parameter	Setting Range	Initial value	User setting	Display level
COMW (COM.W)	Communication write enable/disable	OFF: Enable, ON: Disable	OFF		STD
dATA (DATA)	Front panel parameter data (▼,▲) key lock	OFF: Unlock, ON: Lock	OFF		
A/M (A/M)	Front panel A/M key lock		OFF		

■ DI Function Registration Parameter

Menu symbol: dI.SL (DI.SL)

Parameter symbol	Name of Parameter	Setting Range	Initial value	User setting	Display level
A/M (A/M)	AUTO/MAN switch	Set an I relay number of contact input. Set "OFF" to disable the function. Standard terminals DI1: 5025, DI2: 5026 E1-terminal area DI11: 5041, DI12: 5042, DI13: 5043, DI14: 5044, DI15: 5045	5025		STD
R/L (R/L)	REMOTE/LOCAL switch		OFF		
S/R (S/R)	STOP/RUN switch		5026		
AUTO (AUTO)	Switch to AUTO		OFF		
MAN (MAN)	Switch to MAN		OFF		
REM (REM)	Switch to REMOTE		OFF		
LCL (LCL)	Switch to LOCAL		OFF		
AT (AT)	Auto-tuning START/STOP switch		OFF		
LAT (LAT)	Latch release		OFF		
LCD (LCD)	LCD backlight ON/OFF switch		OFF		

■ DI Function Numbering Parameter

Menu symbol: dI.NU (DI.NU)

Parameter symbol	Name of Parameter	Setting Range	Initial value	User setting	Display level
SPB0 (SP.B0)	Bit-0 of SP number	Set an I relay number of contact input. Set "OFF" to disable the function. Standard terminals DI1: 5025, DI2: 5026 E1-terminal area DI11: 5041, DI12: 5042, DI13: 5043, DI14: 5044, DI15: 5045	OFF		EASY
SPB1 (SP.B1)	Bit-1 of SP number		OFF		
SPB2 (SP.B2)	Bit-2 of SP number		OFF		
PNB0 (PN.B0)	Bit-0 of PID number		OFF		STD
PNB1 (PN.B1)	Bit-1 of PID number		OFF		
PNB2 (PN.B2)	Bit-2 of PID number		OFF		
MPB0 (MP.B0)	Bit-0 of manual preset output number		OFF		
MPB1 (MP.B1)	Bit-1 of manual preset output number		OFF		
MPB2 (MP.B2)	Bit-2 of manual preset output number		OFF		

■ AL1-AL3 Function Registration Parameter

Menu symbol: ALM (ALM)

Parameter symbol	Name of Parameter	Setting Range	Initial value	User setting	Display level
AL1S (AL1.S)	AL1 function selection	Set an I relay number. For the items other than below, see User's Manual. Ex.) Set the number 4353 for AL1.S to use the alarm 1. Set "OFF" to disable the function. No function: OFF Alarm 1: 4353 Alarm 2: 4354 Alarm 3: 4355 Alarm 4: 4357 AUTO (ON) / MAN (OFF) status: 4193 REM (ON) / LCL (OFF) status: 4194 STOP (ON) / RUN (OFF) status: 4195 FAIL (Normally ON) output: 4256	4353		STD
AL2S (AL2.S)	AL2 function selection		4354		
AL3S (AL3.S)	AL3 function selection		4355		
OR1S (OR.S)	OUT relay function selection		OFF		
OR2S	OUT2 relay function		OFF		

■ DO Setting Parameter (E1/E4-terminal Area)

Menu symbol: dO (DO)

Parameter symbol	Name of Parameter	Setting Range	Initial value	User setting	Display level
DO1S (DO1.S)	DO11/DO41 function selection	Same as AL1.S Set "OFF" to disable the function	OFF	Table below	STD
DO2S (DO2.S)	DO12/DO42 function selection		OFF		
DO3S (DO3.S)	DO43 function selection		OFF		
DO4S (DO4.S)	DO44 function selection		OFF		
DO5S (DO5.S)	DO45 function selection		OFF		

Use the following table to record DO setting value.

Parameter	E1-terminal Area	E4-terminal Area
DO1.S		
DO2.S		
DO3.S		
DO4.S		
DO5.S		

■ System Setting Parameter

Menu symbol: SYS (SYS)

Parameter symbol	Name of Parameter	Setting Range	Initial value	User setting	Display level
RMD (R.MD)	Restart mode	Set how the controller should recover from a power failure of 5 seconds or more. CONT: Continue action set before power failure. MAN: Start from MAN. AUTO: Start from AUTO.	CONT		STD
RTM (R.TM)	Restart timer	Set time between power on and the instant where controller starts computation. 0 to 10 s	0		
EPO (EPO)	Input error preset output	Set preset output value when the input burnout or ADC error occurs. Manual output is prioritized when the input burnout occurs in MAN. 0: Preset output 1: 0% output 2: 100% output	0		
FREQ (FREQ)	Power frequency	AUTO, 60: 60 Hz, 50: 50 Hz	AUTO		EASY
QSM (QSM)	Quick setting mode	OFF: Disable ON: Enable	ON		
LANG (LANG)	Guide display language	ENG: English FRA: French GER: German SPA: Spanish	Depends on the model and suffix codes		
PASS (PASS)	Password setting	0 (No password) to 65535 Setting "0" means "without password protection."	0		

■ Error and Version Confirmation Parameter (for display only)

Menu symbol: VER (VER)

Parameter symbol	Name of Parameter	Status recording	Display level
PAER (PA.ER)	Parameter error status		EASY
OPER (OP.ER)	Option error status		
AD1E (AD1.E)	A/D converter error status 1		
AD2E (AD2.E)	A/D converter error status 2		
PV1E (PV1.E)	PV input error status		
LAER (LA.ER)	Ladder error status		
MCU (MCU)	MCU version		
DCU (DCU)	DCU version		
ECU1 (ECU1)	ECU-1 version (E1-terminal area)		
ECU3 (ECU3)	ECU-3 version (E3-terminal area)		
ECU4 (ECU4)	ECU-4 version (E4-terminal area)		
PARA (PARA)	Parameter version		
HVER (H.VER)	Product version		
SER1 (SER1)	Serial number 1		
SER2 (SER2)	Serial number 2		
MAC1 (MAC1)	MAC address 1 (E3-terminal area)		
MAC2 (MAC2)	MAC address 2 (E3-terminal area)		
MAC3 (MAC3)	MAC address 3 (E3-terminal area)		

■ Parameter Display Level Parameter

Menu symbol: LVL (LVL)

Parameter symbol	Name of Parameter	Setting Range	Initial value	User setting	Display level
LEVL (LEVL)	Parameter display level	EASY: Easy setting mode STD: Standard setting mode PRO: Professional setting mode	STD		EASY

* For Professional setting mode, see User's Manual.

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User's
Manual

UTAdvanced.

UT35A-L
Digital Indicating Controller
(Limit Control Type)
User's Manual

IM 05P04D41-01EN

vigilantplant.®

YOKOGAWA ◆
Yokogawa Electric Corporation

IM 05P04D41-01EN
1st Edition

Product Registration

Thank you for purchasing YOKOGAWA products.

YOKOGAWA provides registered users with a variety of information and services. Please allow us to serve you best by completing the product registration form accessible from our homepage.

http://www.yokogawa.com/ns/reg/

Introduction

Thank you for purchasing the UT35A-L digital indicating controller (hereinafter referred to as UT35A-L).
This manual describes how to use UT35A-L functions other than UT35A-L's communication function. Please read through this user's manual carefully before using the product.

- **Printed manual**

Manual Name	Manual Number	Description
UT35A-L Operation Guide	IM 05P04D41-11EN	This manual describes the basic operation method.

- **Electronic manuals**

Manual Name	Manual Number	Description
UT35A-L Operation Guide	IM 05P04D41-11EN	This is identical to the printed manual.
UT35A-L User's Manual	IM 05P04D41-01EN	This manual. It describes the usage of all functions except the communication functions.
UTAdvanced Series Communication Interface (RS-485, Ethernet) User's Manual	IM 05P07A01-01EN	This manual describes how to use UT35A/UT32A in Ethernet and serial communications. For communication wiring, see the Operation Guide or User's Manual.
LL50A Parameter Setting Software Installation Manual	IM 05P05A01-01EN	This manual describes how to install and uninstall the LL50A.
LL50A Parameter Setting Software User's Manual	IM 05P05A01-02EN	This manual describes how to use the LL50A, ladder sequence function, peer-to-peer communication, and network profile creating function.

* User's Manual can be downloaded from a website.

Target Readers

This guide is intended for the following personnel;

- Engineers responsible for installation, wiring, and maintenance of the equipment.
- Personnel responsible for normal daily operation of the equipment.

Notice

- The contents of this manual are subject to change without notice as a result of continuing improvements to the instrument's performance and functions.
- Every effort has been made to ensure accuracy in the preparation of this manual. Should any errors or omissions come to your attention, however, please inform Yokogawa Electric's sales office or sales representative.
- Under no circumstances may the contents of this manual, in part or in whole, be transcribed or copied without our permission.

1st Edition : July 2011 (YK)
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Trademarks

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Safety Precautions

This instrument is a product of Installation Category II of IEC/EN/CSA/UL61010-1 Safety Standards and Class A of EN61326-1, EN55011 (EMC Standards).

CAUTION

This instrument is an EMC class A product. In a domestic environment, this product may cause radio interference in which case the user needs to take adequate measures.

The instrument is a product rated Measurement Category I (CAT.I).

* Measurement Category I (CAT.I)

This category applies to electric equipment that measures a circuit connected to a low-voltage facility and receives power from stationary equipment such as electric switchboards.

To use the instrument properly and safely, observe the safety precautions described in this user's manual when operating it. Use of the instrument in a manner not prescribed herein may compromise protection features inherent in the device. We assume no liability for or warranty on a fault caused by users' failure to observe these instructions.

This instrument is designed to be used within the scope of Measurement Category I (CAT. I) and is dedicated for indoor use.

Notes on the User's Manual

- This user's manual should be readily accessible to the end users so it can be referred to easily. It should be kept in a safe place.
- Read the information contained in this manual thoroughly before operating the product.
- The purpose of this user's manual is not to warrant that the product is well suited to any particular purpose, but rather to describe the functional details of the product.

Safety, Protection, and Modification of the Product

The following symbols are used in the product and user's manuals to indicate safety precautions:

"Handle with Care" (This symbol is attached to the part(s) of the product to indicate that the user's manual should be referred to in order to protect the operator and the instrument from harm.)

AC

AC/DC

The equipment wholly protected by double insulation or reinforced insulation.

Functional grounding terminal (Do not use this terminal as a protective grounding terminal.)

- In order to protect the system controlled by this product and the product itself, and to ensure safe operation, observe the safety precautions described in this user's manual. Use of the instrument in a manner not prescribed herein may compromise the product's functions and the protection features inherent in the device. We assume no liability for safety, or responsibility for the product's quality, performance or functionality should users fail to observe these instructions when operating the product.
- Installation of protection and/or safety circuits with respect to a lightning protector; protective equipment for the system controlled by the product and the product itself; foolproof or failsafe design of a process or line using the system controlled by the product or the product itself; and/or the design and installation of other protective and safety circuits are to be appropriately implemented as the customer deems necessary.
- Be sure to use the spare parts approved by YOKOGAWA when replacing parts or consumables.
- This product is not designed or manufactured to be used in critical applications that directly affect or threaten human lives. Such applications include nuclear power equipment, devices using radioactivity, railway facilities, aviation equipment, air navigation facilities, aviation facilities, and medical equipment. If so used, it is the user's responsibility to include in the system additional equipment and devices that ensure personnel safety.
- Modification of the product is strictly prohibited.
- This product is intended to be handled by skilled/trained personnel for electric devices.
- This product is UL Recognized Component. In order to comply with UL standards, end-products are necessary to be designed by those who have knowledge of the requirements.

WARNING

- Power Supply
  Ensure that the instrument's supply voltage matches the voltage of the power supply before turning ON the power.
- Do Not Use in an Explosive Atmosphere
  Do not operate the instrument in locations with combustible or explosive gases or steam. Operation in such environments constitutes an extreme safety hazard. Use of the instrument in environments with high concentrations of corrosive gas (H_2S, SO_X, etc.) for extended periods of time may cause a failure.
- Do Not Remove Internal Unit
  The internal unit should not be removed by anyone other than YOKOGAWA's service personnel. There are dangerous high voltage parts inside. Additionally, do not replace the fuse by yourself.
- Damage to the Protective Construction
  Operation of the instrument in a manner not specified in this user's manual may damage its protective construction.

Warning and Disclaimer

- YOKOGAWA makes no warranties regarding the product except those stated in the WARRANTY that is provided separately.
- The product is provided on an "as is" basis. YOKOGAWA assumes no liability to any person or entity for any loss or damage, direct or indirect, arising from the use of the product or from any unpredictable defect of the product.

Notes on Software

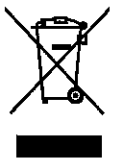
- YOKOGAWA makes no warranties, either expressed or implied, with respect to the software's merchantability or suitability for any particular purpose, except as specified in the terms of the separately provided warranty.
- This software may be used on one specific machine only.
- To use the software on another machine, the software must be purchased again separately.
- It is strictly prohibited to reproduce the product except for backup purposes.
- Store the software CD-ROM (the original medium) in a safe place.
- All reverse-engineering operations, such as reverse compilation or the reverse assembly of the product are strictly prohibited.
- No part of the product's software may be transferred, converted, or sublet for use by any third party, without prior written consent from YOKOGAWA.

Handling Precautions for the Main Unit

- The instrument comprises many plastic components. To clean it, wipe it with a soft, dry cloth. Do not use organic solvents such as benzene or thinner for cleaning, as discoloration or deformation may result.
- Keep electrically charged objects away from the signal terminals. Not doing so may cause the instrument to fail.
- Do not apply volatile chemicals to the display area, operation keys, etc. Do not leave the instrument in contact with rubber or PVC products for extended periods. Doing so may result in failure.
- If the equipment emits smoke or abnormal smells or makes unusual noises, turn OFF the instrument's power immediately and unplug the device. In such an event, contact your sales representative.

Waste Electrical and Electronic Equipment (WEEE), Directive 2002/96/EC

This is an explanation of how to dispose of this product based on Waste Electrical and Electronic Equipment (WEEE), Directive 2002/96/EC. This directive is only valid in the EU.



Marking

This product complies with the WEEE Directive (2002/96/EC) marking requirement. This marking indicates that you must not discard this electrical/electronic product in domestic household waste.

Product Category

With reference to the equipment types in the WEEE directive Annex 1, this product is classified as a "Monitoring and Control instrumentation" product.
Do not dispose in domestic household waste. When disposing products in the EU, contact your local Yokogawa Europe B.V. office.

Checking the Contents of the Package

Unpack the box and check the contents before using the product. If the product is different from that which you have ordered, if any parts or accessories are missing, or if the product appears to be damaged, contact your sales representative.

UT35A-L Main Unit

The UT35A-L main units have nameplates affixed to the side of the case.
Check the model and suffix codes inscribed on the nameplate to confirm that the product received is that which was ordered.

No. (Instrument number)

When contacting your sales representative, inform them of this number, too.

Note

The last digit of the display code (-x0) has been changed into the case color code.

Model and Suffix Codes of UT35A-L

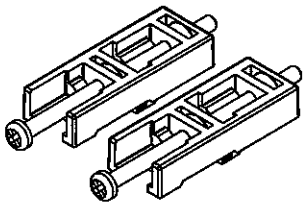
[Style:S6]

Model	Suffix code						Optional suffix code	Description
UT35A								Digital Indicating Controller (provided with retransmission output, 2 DIs, and 3 DOs) (Power supply: 100-240 V AC)
Type 1: Basic control	-L							Limit control type
Type 2: Functions		0						Always "0"
Type 3: Open networks			0					None
			1					RS-485 communication (Max.38.4 kbps, 2-wire/4-wire)
			2					Ethernet communication (with serial gateway function)
Display language				-1				English
Case color					0			White (Light gray)
					1			Black (Light charcoal gray)
Fixed code						-00		Always "-00"
							/DC	Power supply 24 V AC/DC

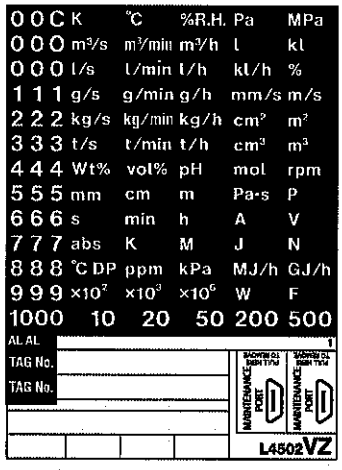
Accessories

The product is provided with the following accessories according to the model and suffix codes. Check that none of them are missing or damaged.

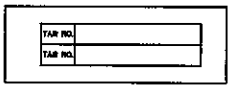
1



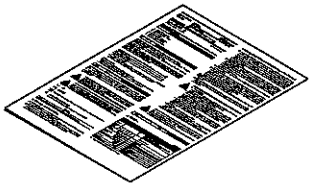
2



3



4



No.	Product Name	Quantity	Remark
1	Brackets	2	Part number: L4502TP (For fixing the upper and lower parts)
2	Unit label	1	Part number: L4502VZ
3	Tag label	1	Part number: L4502VE (Only when ordered.)
4	Operation Guide	1	A3 size, x 5 (Standard model only)

Accessory (sold separately)

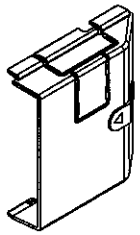
The following lists an accessory sold separately.

• LL50A Parameter Setting Software

Model	Suffix code	Description
LL50A	-00	Parameter Setting Software

• Terminal cover

Model: UTAP001



• Brackets

Part number L4502TP (2 pieces for fixing the upper and lower parts)

• User's Manual (A4 size)

* User's Manual can be downloaded from a website.

• User's Manual (CD-ROM), Model: UTAP003

* Contains all manuals.

Symbols Used in This Manual

This symbol is used on the instrument. It indicates the possibility of injury to the user or damage to the instrument, and signifies that the user must refer to the user's manual for special instructions. The same symbol is used in the user's manual on pages that the user needs to refer to, together with the term "WARNING" or "CAUTION."

WARNING

Calls attention to actions or conditions that could cause serious or fatal injury to the user, and indicates precautions that should be taken to prevent such occurrences.

CAUTION

Calls attention to actions or conditions that could cause injury to the user or damage to the instrument or property and indicates precautions that should be taken to prevent such occurrences.

Note

Identifies important information required to operate the instrument.

▶

Indicates related operations or explanations for the user's reference.

[ ]

Indicates a character string displayed on the display.

Setting Display

Indicates a setting display and describes the keystrokes required to display the relevant setting display.

Setting Details

Provides the descriptions of settings.

Description

Describes restrictions etc. regarding a relevant operation.

How to Use This Manual

This user's manual is organized into Chapters 1 to 19 as shown below.

Chapter	Title and Description
1	**Introduction to Functions** Describes the main functions of the UT35A-L.
2	**UT35A-L Operating Procedures** Describes the flow from unpacking to regular operations.
3	**Part Names** Describes part names and functions on the front panel.
4	**Basic Operation** Describes basic operation of the UT35A-L.
5	**Quick Setting Function** Describes the minimum necessary settings for operation.
6	**Monitoring and Control of Regular Operations** Describes monitoring displays of regular operations and operation.
7	**Input (PV) Functions** Describes PV input.
8	**Function Block Diagram** Provides function block diagrams.
9	**Auxiliary Control Functions** Describes auxiliary control functions
10	**Retransmission Output Functions** Describes output functions.
11	**Alarm Functions** Describes alarm output and status output.
12	**Contact Input Functions** Describes contact input functions.
13	**Display, Key, and Security Functions** Describes display, user function key and security functions.
14	**Parameter Initialization** Describes the initialization to factory default values and to user default values.
15	**Power Failure Recovery Processing / Power Frequency Setting / Other Settings** Describes operations performed after momentary power interruption and power failures.
16	**Troubleshooting, Maintenance, and Inspections** Describes troubleshooting, maintenance, periodic inspections, and disposal.
17	**Installation and Wiring** Describes installation and wiring.
18	**Parameters** Provides parameter maps.
19	**Specifications** Provides the UT35A-L specifications.

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Appendix Input and Output Table

Appendix 1 Input and Output Table.....App-1

Revision Information

1.1 Quick Setting Function

The Quick setting function is a function to easily set the basic function of the controller.

Buy and Unpacking

Check the contents.

Installation and Wiring

Installation and Wiring: Chapter 17
Install and wire a controller, and then turn on the power.

Setup

Q: What should I do to perform operate immediately? First, I want to set the input and output.

A: Use the Quick setting function to perform the setup easily.
Quick setting function: Chapter 5

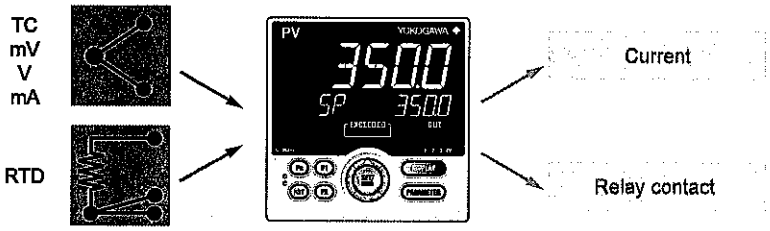
Operation

1.2 Input/Output Functions

PV Input (equipped as standard)

PV input is a universal input to arbitrarily set the type and range for the thermocouple (TC), resistance-temperature detector (RTD), and DC voltage/current.

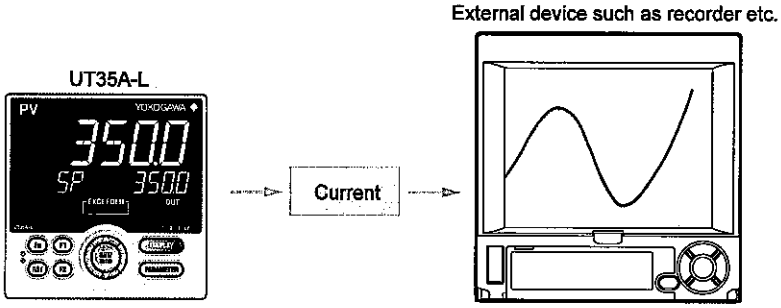
► Chapter 7 Input (PV) Functions



Retransmission Output

Retransmission output outputs a PV input value (PV), target setpoint (SP), and the like as an analog signal to, for example, the recorder.

► Chapter 10 Retransmission Output Functions



Contact Input

Two contact inputs are incorporated in UT35A-L.

► Chapter 12 Contact Input Functions

Contact Output

Three contact outputs are incorporated in UT35A-L. Contact output can output events such as alarms.

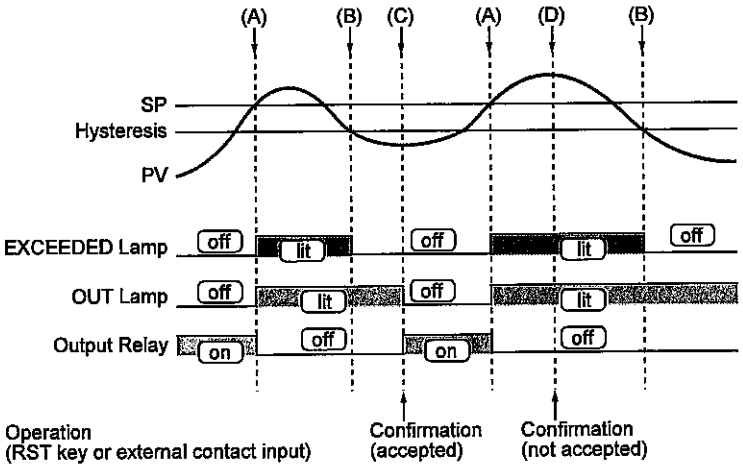
For details, see the table of Model and Suffix Codes.

► Chapter 11 Alarm Functions

1.3 Limit Control Functions

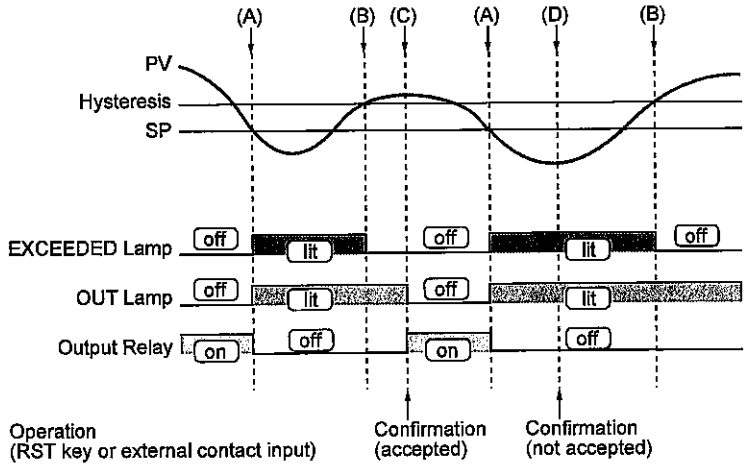
In Case of High Limit Control

When PV exceeds a setpoint (SP), "EXCEEDED" lamp lights, and "OUT" lamp turns ON (point A). The limit control output relay is de-energized then.
"EXCEEDED" lamp turns off when PV goes into normal condition, while "OUT" lamp stays on as it is (point B). "OUT" lamp turns off when a confirming operation is done by an operator (point C). The way to confirm is pushing the "RST" key (or by an exeternal contact, according to the setting of setup parameter CNF). The confirming operation is not accepted during PV exceeds SP (point D). State of output relay is deenergized whenever "OUT" lamp is on. (NC terminal: CLOSE, NO terminal: OPEN)



In Case of Low Limit Control

When PV exceeds a setpoint (SP), "EXCEEDED" lamp lights, and "OUT" lamp turns ON (point A). The limit control output relay is de-energized then.
"EXCEEDED" lamp turns off when PV goes into normal condition, while "OUT" lamp stays on as it is (point B). "OUT" lamp turns off when a confirming operation is done by an operator (point C). The way to confirm is pushing the "RST" key (or by an exeternal contact, according to the setting of setup parameter CNF). The confirming operation is not accepted during PV exceeds SP (point D). State of output relay is deenergized whenever "OUT" lamp is on. (NC terminal: CLOSE, NO terminal: OPEN)



Power on Status

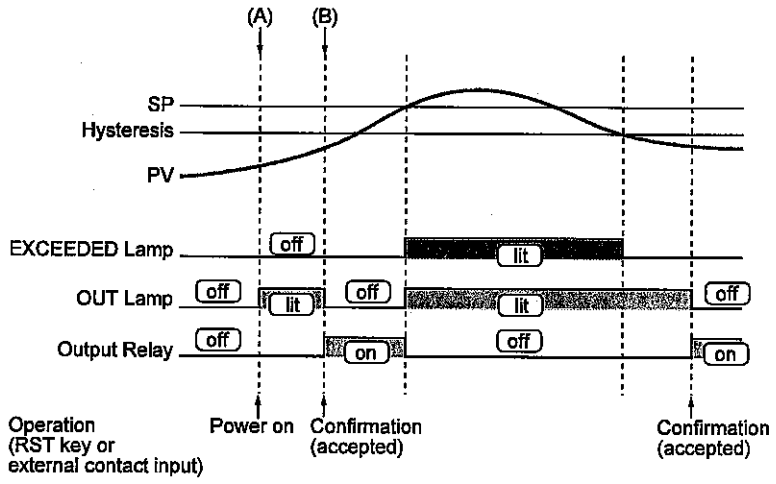
The state of output relay at power-on can be set by a setup parameter restart mode R.MD.
Restart mode R.MD:

0: Limit output relay is de-energized at power on.
1: Limit output relay is energized at power on.

When parameter R.MD is set to 0.

The limit output relay is always de-energized at power on, even if PV doesn't exceed SP (point A). (NC terminal: CLOSE, NO terminal: OPEN). "OUT" lamp is lit. After the confirmation, state of output relay is energized (NC terminal: OPEN, NO terminal: CLOSE) and "OUT" lamp turns off, if the PV doesn't exceed SP (point B).

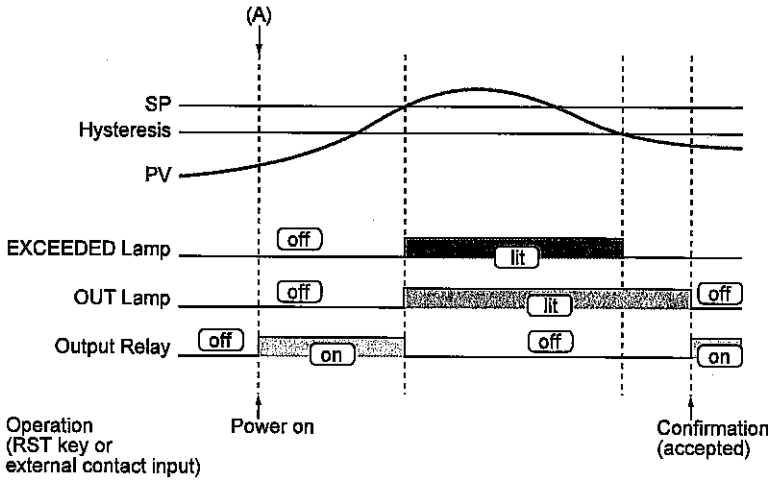
In Case of High Limit Control



When parameter R.MD is set to 1.

The limit output relay is always energized at power on (point A) (NC terminal: OPEN, NO terminal: CLOSE) and "OUT" lamp is off, except when PV exceeds SP at power on.

In Case of High Limit Control



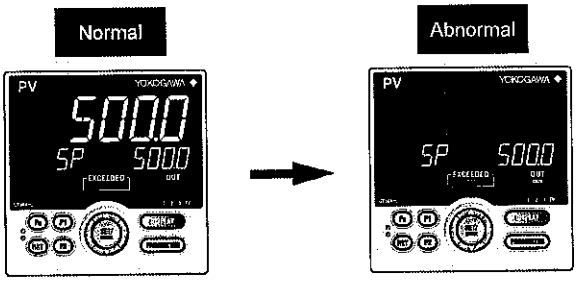
1.4 Display and Key Functions

Employing a 14-segment, active color LCD greatly increases the monitoring and operating capabilities.

Active Color PV Display (display color change)

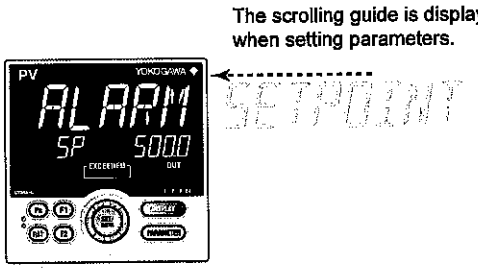
The active color PV display function changes the PV display color (red or white) when abnormality occurs in PV etc.

► 13.1.1 Setting Active Color PV Display Function



Guide Display

The guide is displayed on PV display when setting parameters. This guide can be turned on/off with the Fn key.



Parameter Display Level

To intended use of the operator, the display level of the parameter can be set.

► Chapter 18 Parameters

User Function Keys

The UT35A-L has user function keys (F1, F2, and Fn).
Assign a function to a user function key to use it as an exclusive key.

► 13.2 Assigning Function to User Function Key

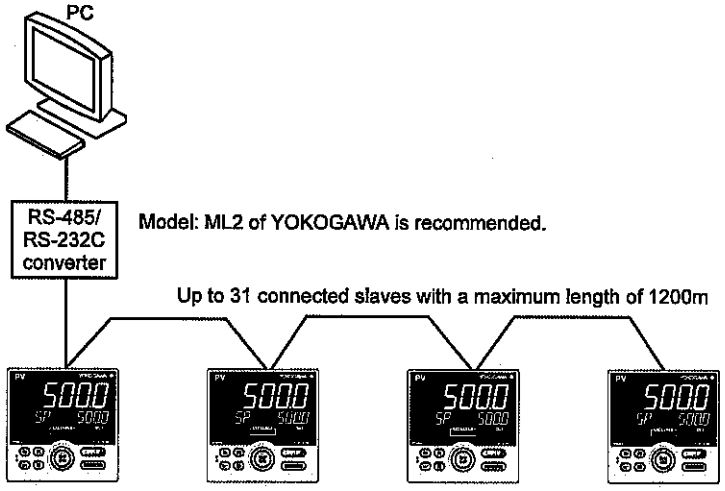
1.5 Communication Functions

The UT35A-L can use RS-485 communication and Ethernet communication specifying the suffix code and optional suffix code for each communication.

► UTAdvanced Series Communication Interface (RS-485, Ethernet) User's Manual

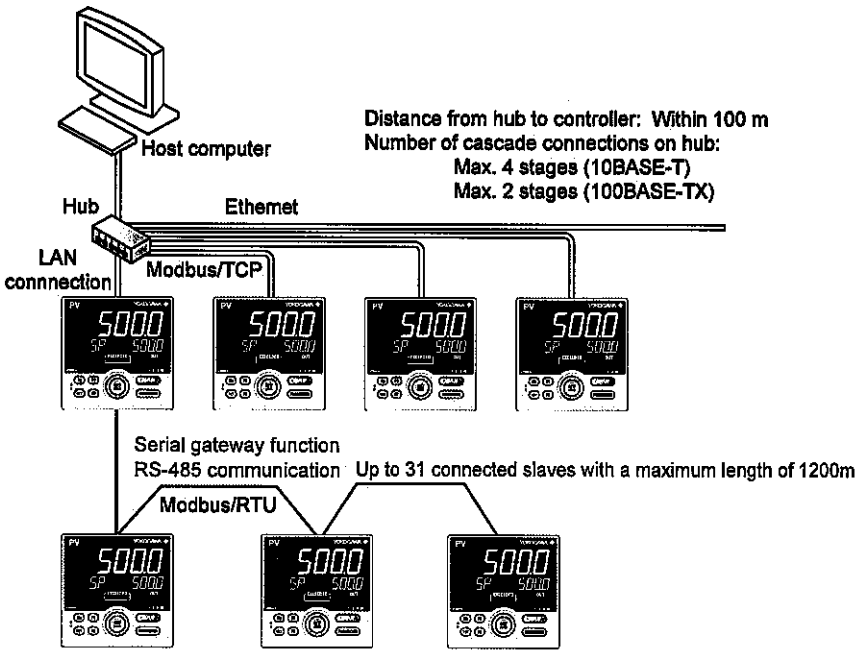
RS-485 Communication (Modbus communication, PC link communication, and Ladder communication)

The UT35A-L can communicate with PCs, PLCs, touch panels, and other devices.



Ethernet Communication (Modbus/TCP)

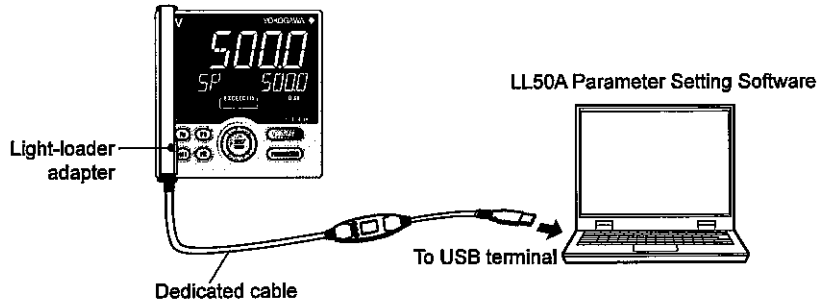
The UT35A-L can be connected to IEEE802.3-compliant network (10BASE-T/100BASE-TX). A serial gateway function can increase the number of connected controllers.



Light-loader Communication

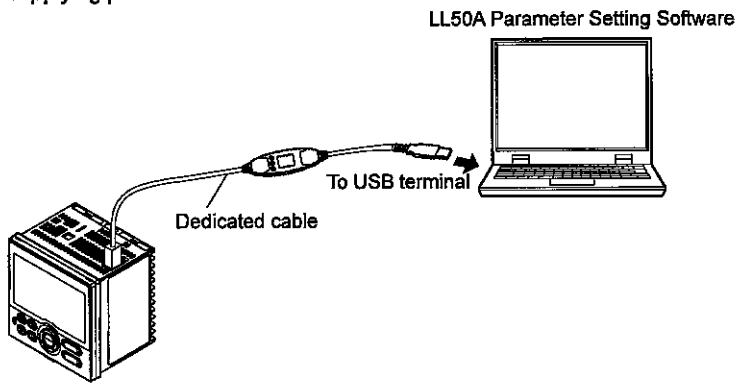
Use the LL50A to set parameters. Attach the adapter to the front of the controller to communicate.

► Light-loader function: LL50A Parameter Setting Software User's Manual



Maintenance Port Communication (Power supply is not required for the UT35A-L)

Maintenance port is used to connect with the dedicated cable when using LL50A Parameter Setting Software (sold separately). The parameters can be set without supplying power to the UT35A-L.



CAUTION

When using the maintenance port, do not supply power to the controller. Otherwise, the controller does not work normally.
If power is supplied to the controller while the cable is connected, or the cable is connected to the controller already turned on, unplug the cable and turn on the controller again. The controller returns to the normal condition.

1.6 Definition of Main Symbols and Terms

Main Symbol

PV: Measured input value
SP: Target setpoint
OUT: Limit control output

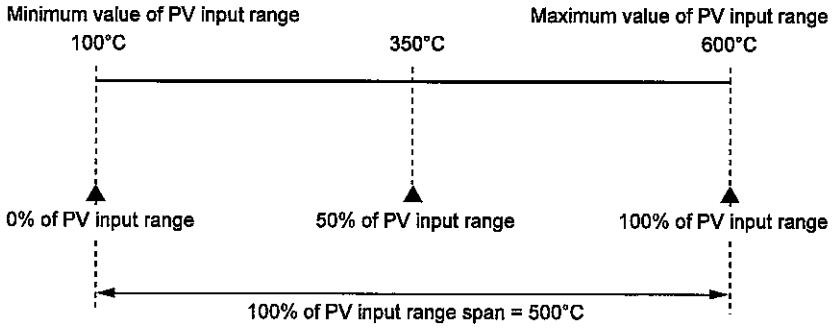
E3: Terminal areas
► 17.4 Wiring

Engineering Units

Input range (scale): the PV range low limit is set to 0%, and the high limit is set to 100% for conversion.
Input range (scale) span: the PV range span is set to 100% for conversion.

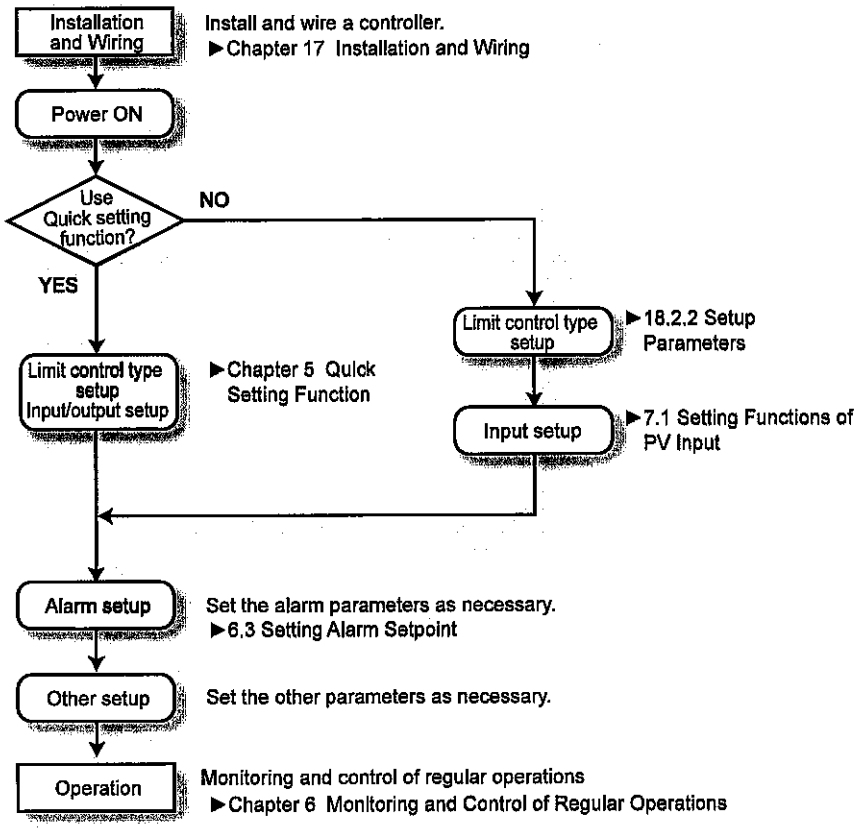
In this manual, the parameter setting range is described as the "input range" and "input range span." This means that engineering units are required to be set. Set a temperature for temperature input.

The following describes a conversion example.
When the PV input range is 100 to 600°C, 0% of the PV range is equivalent to 100°C, 50% of the PV range is equivalent to 350°C, and 100% of the PV range is equivalent to 600°C.
100% of the PV range span is equivalent to 500°C.
20% of the PV range span is equivalent to 100°C.



The above applies to the scale for voltage and current input.

2.1 UT35A-L Operating Procedures



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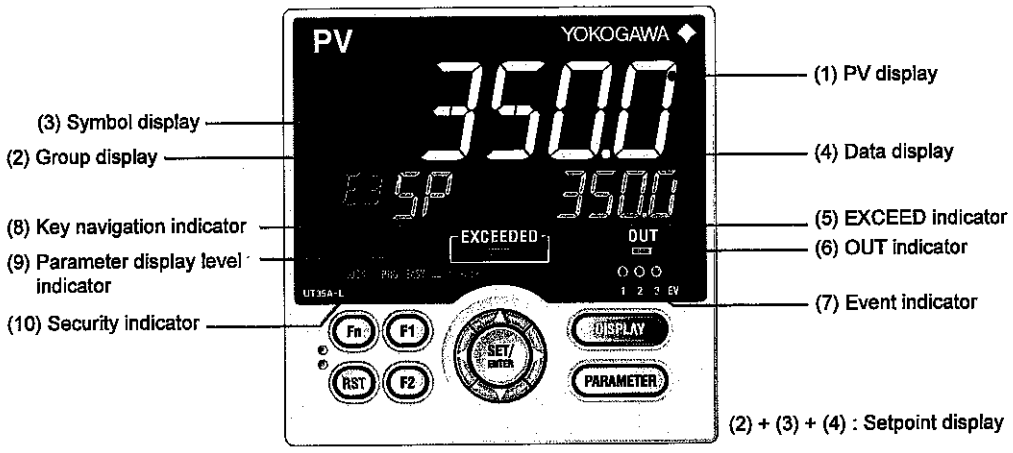
3.1 Names and Functions of Display Parts

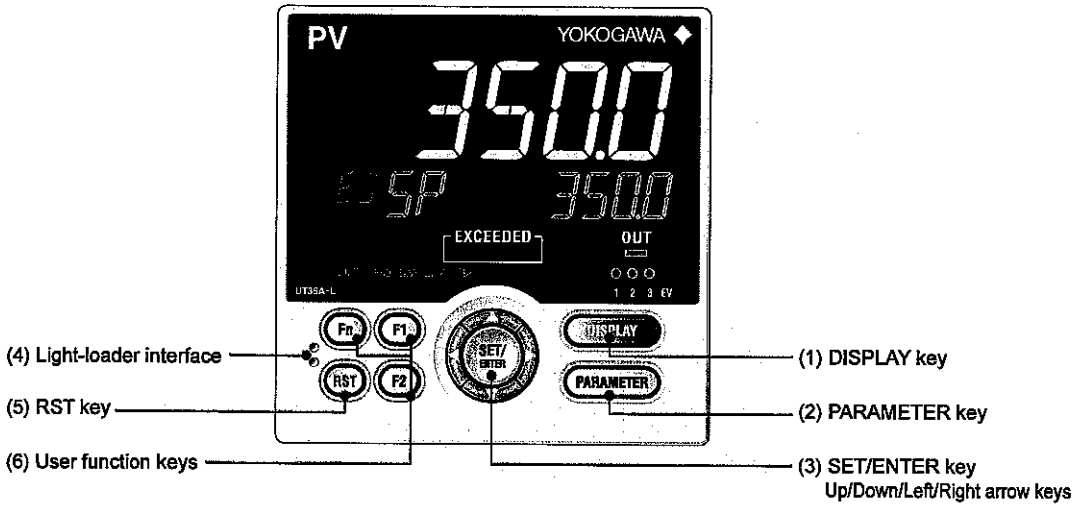


No. In figure	Name	Description
(1)	**PV display (white or red)**	Displays PV. Displays an error code if an error occurs. Displays the scrolling guide in the Menu Display and Parameter Setting Display when the guide display ON/OFF is set to ON.
(2)	**Group display (green)**	Displays terminal area (E3). E3 is displayed in the Parameter Setting Display.
(3)	**Symbol display (orange)**	Displays a parameter symbol.
(4)	**Data display (orange)**	Displays a parameter setpoint and menu symbol.
(5)	**EXCEED indicator (red)**	Light to indicate the exceeded status of PV. Lights while PV exceeds SP.
(6)	**OUT indicator (orange)**	Light to indicate the output status. Lights while the relay output is OFF.
(7)	**Event indicator (orange)**	Lit when the alarms 1 to 3 occur. Event displays other than alarms can be set by the parameter.
(8)	**Key navigation indicator (green)**	Lit or blinks when the Up/Down or Left/Right arrow key operation is possible.
(9)	**Parameter display level indicator (green)**	Displays the setting conditions of the parameter display level function.

Parameter display level	EASY	PRO
Easy setting mode	Lit	Unlit
Standard setting mode	Unlit	Unlit
Professional setting mode	Unlit	Lit

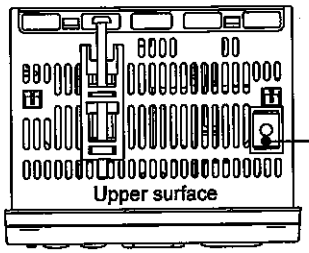
(10)	**Security indicator (red)**	Lit if a password is set. The setup parameter settings are locked.

3.2 Names and Functions of Keys



No. in figure	Name	Description
(1)	**DISPLAY key**	Used to switch the Operation Displays. Press the key in the Operation Display to switch the provided Operation Displays. Press the key in the Menu Display or Parameter Setting Display to return to the Operation Display.
(2)	**PARAMETER key**	Hold down the key for 3 seconds to move to the Operation Parameter Setting Display. Hold down the key and the Left arrow key simultaneously for 3 seconds to move to the Setup Parameter Setting Display. Press the key in the Parameter Setting Display to return to the Menu Display. Press the key once to cancel the parameter setting (setpoint is blinking).
(3)	**SET/ENTER key** **Up/Down/ Left/Right arrow keys**	**SET/ENTER key** Press the key in the Menu Display to move to the Parameter Setting Display of the Menu. Press the key in the Parameter Setting Display to transfer to the parameter setting mode (setpoint is blinking), and the parameter can be changed. Press the key during parameter setting mode to register the setpoint. **Up/Down/Left/Right arrow keys** Press the Left/Right arrow keys in the Menu Display to switch the Displays. Press the Up/Down/Left/Right arrow keys in the Parameter Setting Display to switch the Displays. Press the Up/Down arrow keys during parameter setting mode (setpoint is blinking) to change a setpoint. Press the Left/Right arrow keys during parameter setting mode (setpoint is blinking) to move between digits according to the parameter.
(4)	**Light-loader interface**	It is the communication interface to the adapter cable when setting and storing parameters via PC. The LL50A Parameter Setting Software (sold separately) is required.
(5)	**RST key**	Used to confirm and reset the limit output and related parameters.
(6)	**User function keys**	The user can assign a function to the key. The function is set by the parameter.

Maintenance Port (Power supply is not required for the UT35A-L).
The maintenance port is used to connect with the dedicated cable when using LL50A Parameter Setting Software (sold separately). The parameters can be set without supplying power to the UT35A-L.



UT35A-L

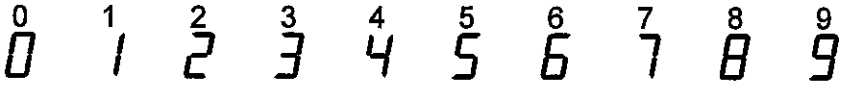
CAUTION

When using the maintenance port, do not supply power to the controller. Otherwise, the controller does not work normally.
If power is supplied to the controller while the cable is connected, or the cable is connected to the controller already turned on, unplug the cable and turn on the controller again. The controller returns to the normal condition.

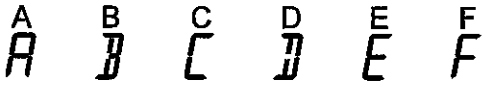
3.3 List of Display Symbols

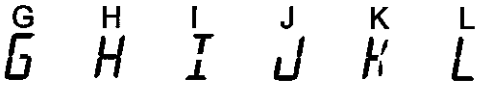
The following shows the parameter symbols, menu symbols, alphanumeric of guide, and symbols which are displayed on the UT35A-L.

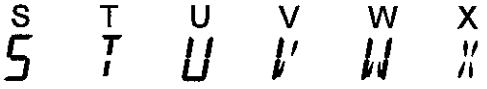
Figure (common to all display area)

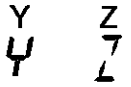


PV display (14 segments): Alphabet

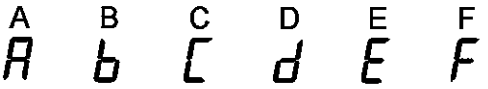




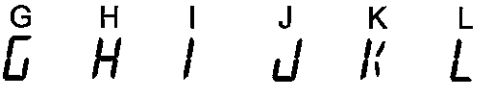


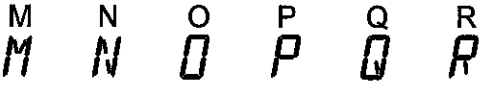


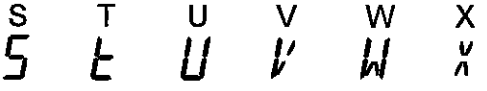
Symbol display and Data display (11 segments): Alphabet

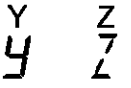


c (lower-case)









Group display (7 segments): Alphabet

A	B	C	D	E	F

G	H	I	J	K	L

M	N	O	P	Q	R

S	T	U	V	W	X
					None

Y	Z

PV display (14 segments): Symbol

Space	-	/	‘	,

3.4 Brief Description of Setting Details (Parameters)

This manual describes the Setting Details as follows in addition to the functional Description.

Setting Details

(Display Example)

Parameter symbol	Name	Display level	Setting range	Menu symbol
A1 to A3	Alarm-1 to -3 setpoint	EASY	Set a display value of setpoint of PV alarm, SP alarm, deviation alarm, or velocity alarm. -19999 to 30000 (Set a value within the input range.) Decimal point position depends on the input type	SP Ope

(1) Parameter symbol: Symbol displayed on Symbol display on the front panel.

(2) Name: Parameter name

(3) Display level: Indicates the parameter display level.

(4) Setting range: Parameter setting range

(5) Menu symbol: Indicates the menu to which the parameter belongs.
Ope: Operation parameter
Set: Setup parameter

Parameter Display Level

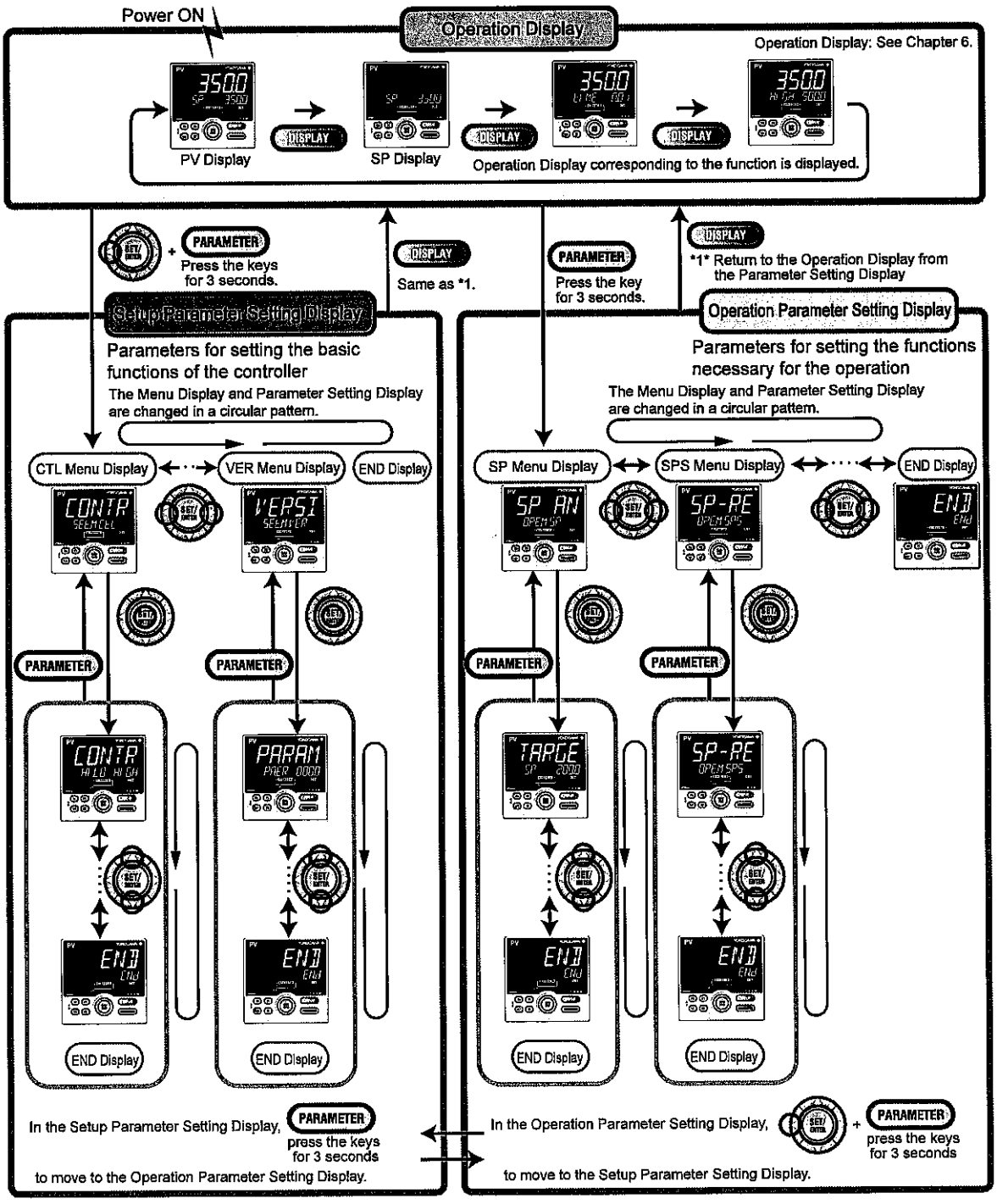
Display level		Description
EASY	Easy setting mode: The minimum necessary parameters are displayed.	Corresponding parameters are displayed in all modes.
STD	Standard setting mode: The wider range of parameters than those shown in Easy setting mode are displayed.	Corresponding parameters are displayed only in Standard setting mode and Professional setting mode. Parameter display level indicators "EASY" and "PRO" are unlit in Standard setting mode. *: "STD" is the symbol used in this manual only.
PRO	Professional setting mode: All parameters are displayed.	Corresponding parameters are displayed only in Professional setting mode.

Note

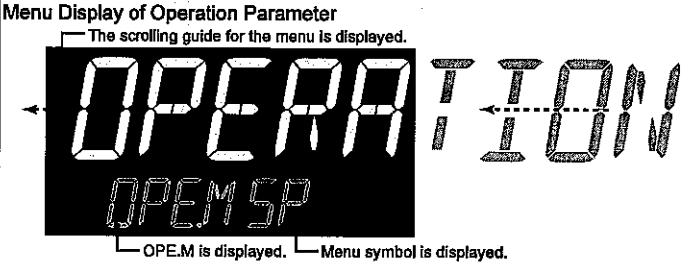
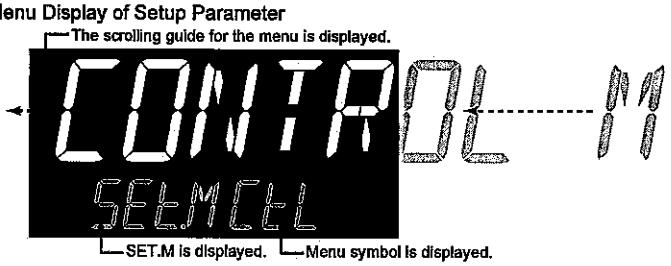
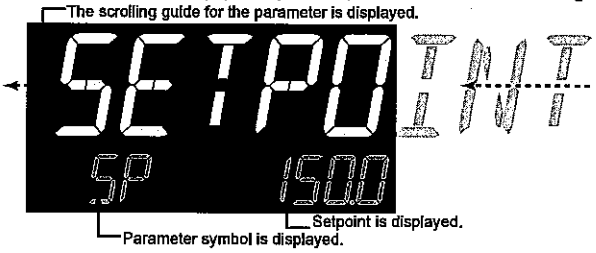
For more intelligible display operation of parameters and the references, see Chapter 18, "Parameter Map."

4.1 Overview of Display Switch and Operation Keys

The following shows the transition of Operation Display, Operation Parameter Setting Display, and Setup Parameter Setting Display.
The "Operation Parameter Setting Display" has the parameters for setting the functions necessary for the operation.
The "Setup Parameter Setting Display" has the parameters for setting the basic functions of the controller.

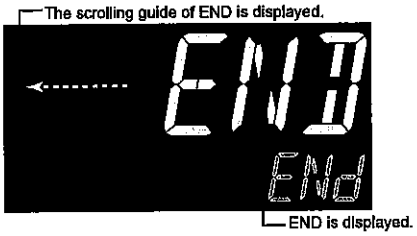


The display pattern of the UT35A-L is as follows; the Menu Display and Parameter Setting Display.
For the Operation Display, see Chapter 6, "Monitoring and Control of Regular Operations."

Display	Description
Menu Display	The Menu Display is segmented by the function and optional terminal position. The scrolling guide for the menu is displayed on PV display. The guide display can be turned on/off with the Fn key. Menu Display of Operation Parameter  Menu Display of Setup Parameter 
Parameter Setting Display	The following is the Display for displaying and setting a parameter. The parameters have three types of display levels; Easy setting mode, Standard setting mode, and Professional setting mode. The parameters to be displayed can be limited according to the setting of the parameter display level. The scrolling guide for the parameter is displayed on PV display. The guide display can be turned on/off with the Fn key. Parameter Setting Display (Example of Operation Parameter Setting Display) 

Display Shown at the End (the Lowest Level) of the Parameter Setting Display

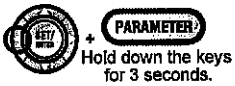
As shown in the figure below, the END Display is shown to indicate the end of the Menu Display and Parameter Setting Display. There are no setting items.



Basic Key Operation Sequence

- **To move to the Setup Parameter Setting Display**

Hold down the PARAMETER (or PARA) key and the Left arrow key simultaneously for 3 seconds.



- **To move to the Operation Parameter Setting Display**

Hold down the PARAMETER (or PARA) key for 3 seconds.

- **To move to the Operation Display**

Press the DISPLAY (or DISP) key once.

4.2 How to Set Parameters

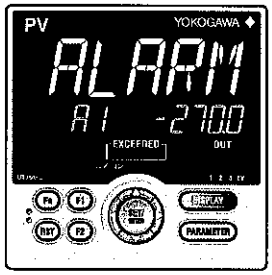
The following operating procedure describes an example of setting alarm setpoint (A1).

Operation

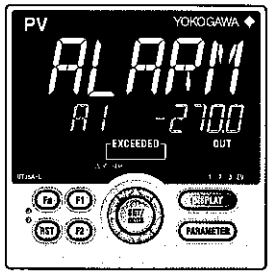
1. Hold down the **PARAMETER** key for 3 seconds in the Operation Display to call up the **[SP]** Menu Display.

2. Press the **SET/ENTER** key to display the **[SP]** Parameter Setting Display.

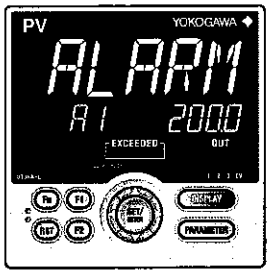
3. Press the **Down arrow** key to display the **[A1]** Parameter Setting Display.



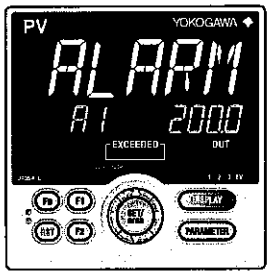
4. Press the **SET/ENTER** key to blink the setpoint.



5. Press the **Up** or **Down arrow** key to change the setpoint.
(Change the setpoint using the Up/Down arrow keys to increase and decrease the value and the Left/Right arrow keys to move between digits.)



6. Press the **SET/ENTER** key to register the setpoint (the setpoint stops blinking).



7. Press the **PARAMETER** key once to return to the Menu Display. Press the **DISPLAY** key once to return to the Operation Display.

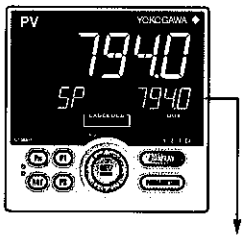
This completes the setting procedure.

How to Cancel Parameter Setting

To cancel parameter setting when a parameter is being set (setpoint is blinking), press the **PARAMETER** key once.

How to Set Parameter Setpoint

Numeric Value Setting



1. Display the Parameter Setting Display.

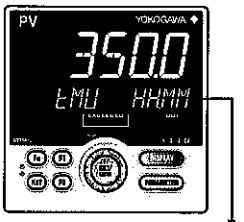
2. Press the SET/ENTER key to move to the setting mode (the setpoint blinks).

3. Press the Left arrow key to move one digit to the left. (Press the Right arrow key to move one digit to the right.)

4. Press the Up or Down arrow key to change the setpoint. Press the Up arrow key when 9 is displayed to move one digit to the left. Press the Down arrow key when 0 is displayed to move one digit to the right.

5. Press the SET/ENTER key to register the setpoint.

Selection Data Setting



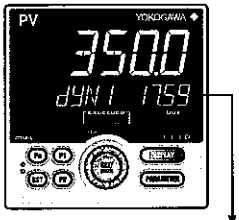
1. Display the Parameter Setting Display.

2. Press the SET/ENTER key to move to the setting mode (the setpoint blinks).

3. Press the Up arrow key to change the setpoint (press the Down arrow key to change the setpoint).

4. Press the SET/ENTER key to register the setpoint.

Time (minute.second) Setting



Example of 17 minutes 59 seconds

1. Display the Parameter Setting Display.

2. Press the SET/ENTER key to move to the setting mode (the setpoint blinks).

3. Press the Left arrow key to move one digit to the left. (press the Right arrow key to move one digit to the right.)

4. Press the Up or Down arrow key to change the setpoint. Press the Up arrow key when 5 is displayed to move one digit to the left. Press the Down arrow key when 0 is displayed to move one digit to the right.

5. Press the SET/ENTER key to register the setpoint.

Blank Page

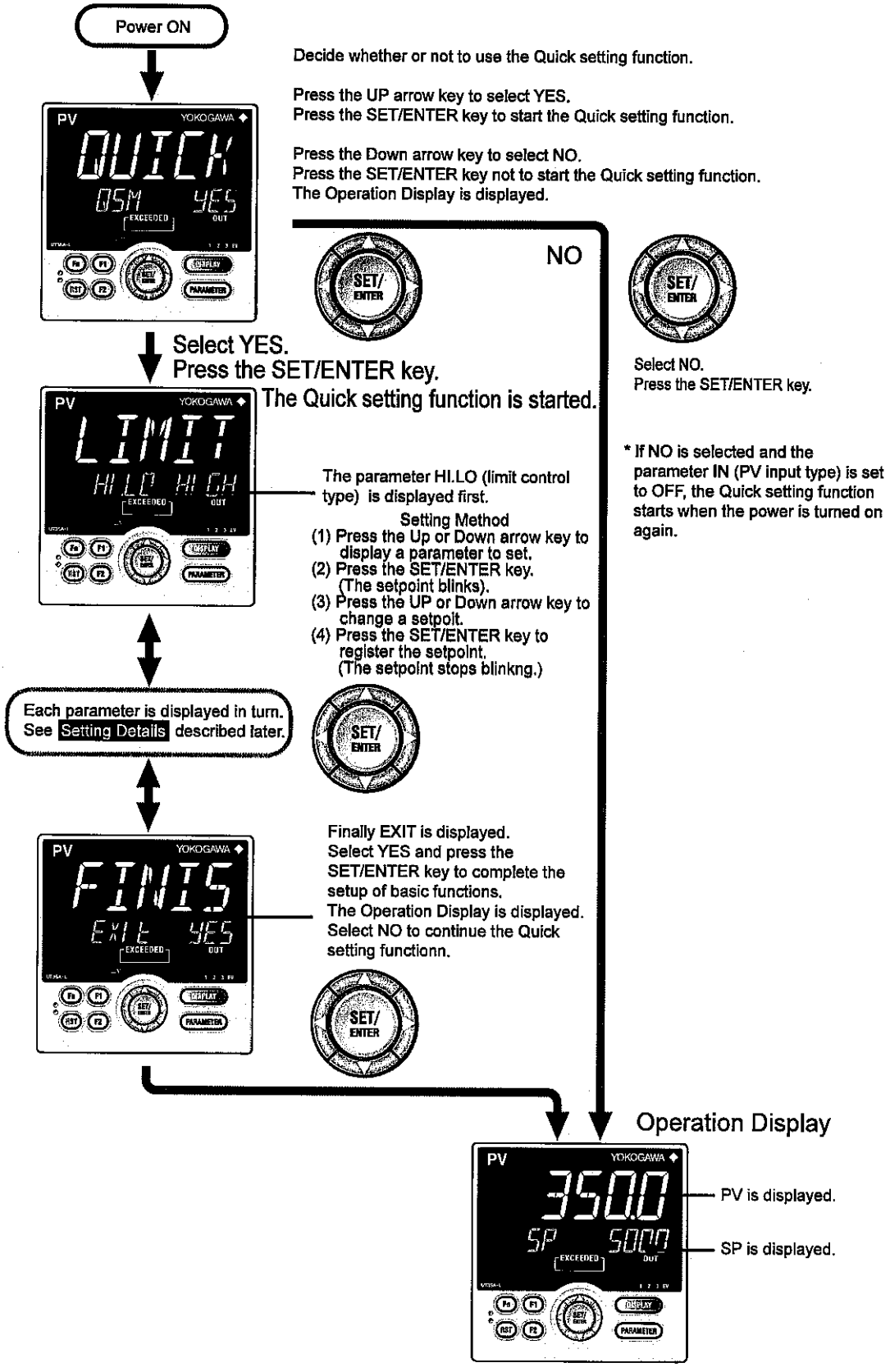
5.1 Setting Using Quick Setting Function

Description

The Quick setting function is a function to easily set the basic function of the controller.
The Quick setting function starts when the power is turned on after wiring.

The following lists the items to set using the Quick setting function.
(1) Limit control type (High or low)
(2) Input function (PV input, range, scale (at voltage/current input), etc.)

Flowchart of Quick Setting Function



Setting Example

Set the following parameters to set to high limit control and thermocouple Type K (range: 0.0 to 500.0°F). No need to change the parameters other than the following parameters.

Set QSM = YES to enter the quick setting mode.

(1) Set HI.LO = HIGH.
(2) Set IN = K1.
(3) Set UNIT = F.
(4) Set RH = 500.0.
(5) Set RL = 0.0.

Set EXIT = YES to quit the quick setting mode.
The Operation Display is shown.

Setting Details

Control Type

Parameter symbol	Name	Display level	Setting range	Menu symbol
HI.LO	Limit control type	EASY	LOW: Low limit control HIGH: High limit control	CTL Set

Input Function

Parameter symbol	Name	Display level	Setting range	Menu symbol
IN	PV input type	EASY	OFF: Disable K1: -270.0 to 1370.0 °C / -450.0 to 2500.0 °F K2: -270.0 to 1000.0 °C / -450.0 to 2300.0 °F K3: -200.0 to 500.0 °C / -200.0 to 1000.0 °F J: -200.0 to 1200.0 °C / -300.0 to 2300.0 °F T1: -270.0 to 400.0 °C / -450.0 to 750.0 °F T2: 0.0 to 400.0 °C / -200.0 to 750.0 °F B: 0.0 to 1800.0 °C / 32 to 3300 °F S: 0.0 to 1700.0 °C / 32 to 3100 °F R: 0.0 to 1700.0 °C / 32 to 3100 °F N: -200.0 to 1300.0 °C / -300.0 to 2400.0 °F E: -270.0 to 1000.0 °C / -450.0 to 1800.0 °F L: -200.0 to 900.0 °C / -300.0 to 1600.0 °F U1: -200.0 to 400.0 °C / -300.0 to 750.0 °F U2: 0.0 to 400.0 °C / -200.0 to 1000.0 °F W: 0.0 to 2300.0 °C / 32 to 4200 °F PL2: 0.0 to 1390.0 °C / 32.0 to 2500.0 °F P2040: 0.0 to 1900.0 °C / 32 to 3400 °F WRE: 0.0 to 2000.0 °C / 32 to 3600 °F JPT1: -200.0 to 500.0 °C / -300.0 to 1000.0 °F JPT2: -150.0 to 150.0 °C / -200.0 to 300.0 °F PT1: -200.0 to 850.0 °C / -300.0 to 1560.0 °F PT2: -200.0 to 500.0 °C / -300.0 to 1000.0 °F PT3: -150.00 to 150.00 °C / -200.0 to 300.0 °F 0.4-2V: 0.400 to 2.000 V 1-5V: 1.000 to 5.000 V 4-20: 4.00 to 20.00 mA 0-2V: 0.000 to 2.000 V 0-10V: 0.00 to 10.00 V 0-20 : 0.00 to 20.00 mA -1020: -10.00 to 20.00 mV 0-100: 0.0 to 100.0 mV	PV Set
UNIT	PV input unit	EASY	-: No unit C: Degree Celsius -: No unit - -: No unit - - -: No unit F: Degree Fahrenheit	
RH	Maximum value of PV input range	EASY	Depends on the input type. - For temperature input - Set the temperature range that is actually controlled. (RL<RH) - For voltage / current input - Set the range of a voltage / current signal that is applied. The scale across which the voltage / current signal is actually controlled should be set using the maximum value of input scale (SH) and minimum value of input scale (SL). (Input is always 0% when RL=RH.)	
RL	Minimum value of PV input range	EASY		

Note1: W:W-5% Re/W-26% Re(Hoskins Mfg. Co.). ASTM E988
WRE: W97Re3-W75Re25

Input Function (Continued)

Parameter symbol	Name	Display level	Setting range	Menu symbol
SDP	PV input scale decimal point position	EASY	0: No decimal place 1: One decimal place 2: Two decimal places 3: Three decimal places 4: Four decimal places	PV Set
SH	Maximum value of PV input scale	EASY	-19999 to 30000, (SL<SH), | SH - SL | ≤ 30000	
SL	Minimum value of PV input scale	EASY		

► Input setting: 7.1 Setting Functions of PV Input

5.2 Restarting Quick Setting Function

Once functions have been built using the Quick setting function, the Quick setting function does not start even when the power is turned on. The following methods can be used to restart the Quick setting function.

- Set the parameter QSM (Quick setting mode) to ON and turn on the power again.
- Set the parameter IN (PV input type) to OFF and turn on the power again.

CAUTION

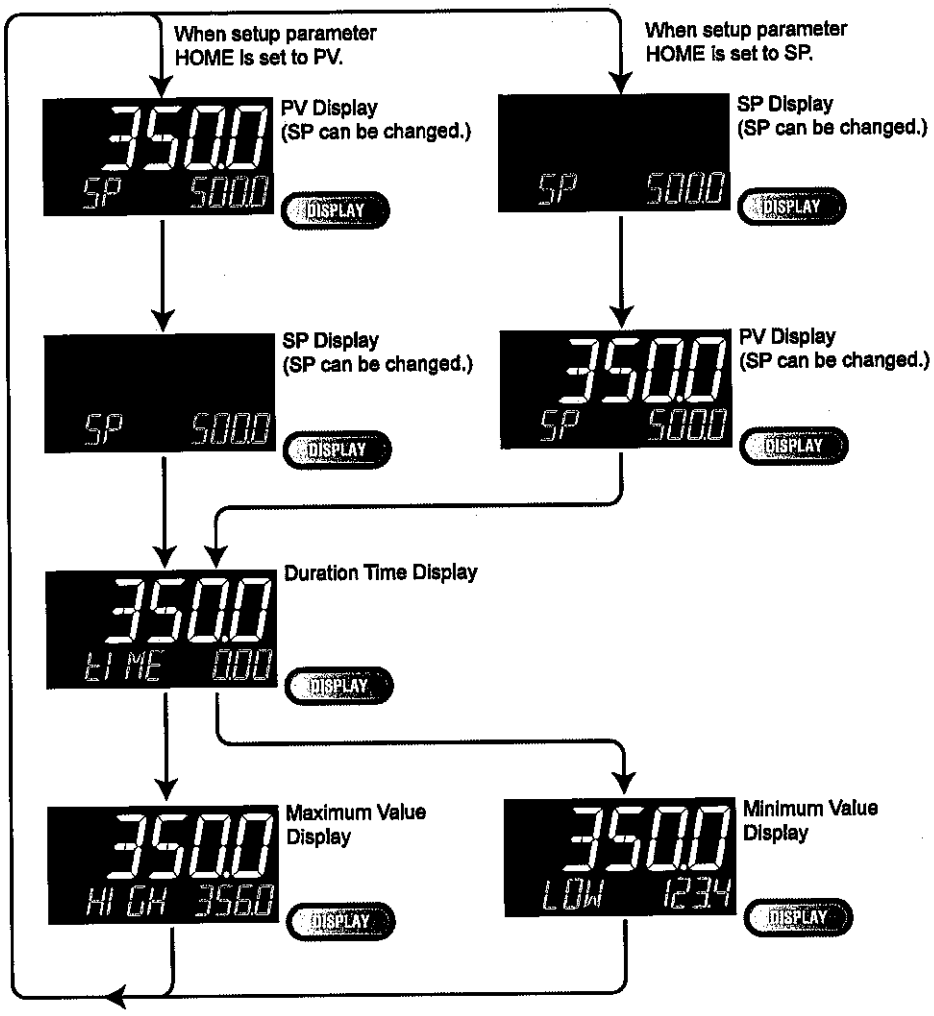
The parameters related to the range or scale are initialized if the PV input type is changed.

Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
IN	PV input type	EASY	OFF: Disable	PV Set
QSM	Quick setting mode	EASY	OFF: Disable ON: Enable	SYS Set

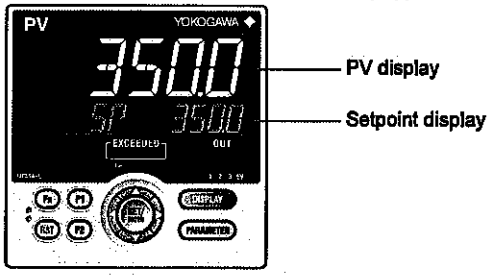
6.1 Monitoring and Control of Operation Displays

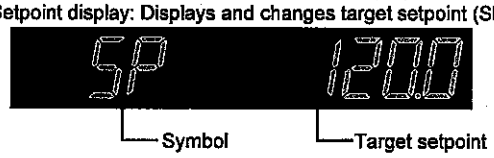
6.1.1 Operation Display Transitions.



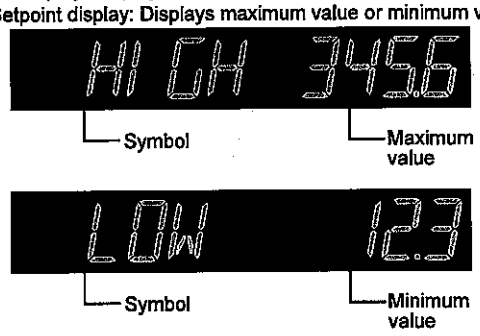
Details of the Operation Display

The following is the Operation Display types and each display and operation description.



Operation Display	Display and operation description
SP Display	PV display: Displays measured input value (PV). Setpoint display: Displays and changes target setpoint (SP).  **[SP Change Operation]** (1) Press the SET/ENTER key to move to the setting mode (the setpoint blinks). (2) Use the Left or Right arrow key to move between digits (the setpoint blinks). (3) Use the UP or Down arrow key to change the value (the setpoint blinks). (4) Press the SET/ENTER key to register the setpoint. (the setpoint stops blinking). * Only Up or Down arrow key operation is also possible.
Duration Time Display	PV display: Displays measured input value (PV). Setpoint display: Displays duration time. The time while PV exceeds SP is counted and stored in the memory. It is displayed in the "TIME" display in the confirmation display. Display time range: 0.00 to 99.59 Unit of time is be either "hour.minute" or "minute.second", and can be set by operation parameter TMU.

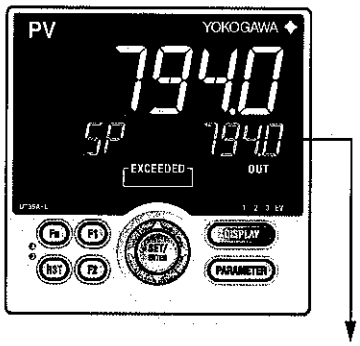
(Continued)

Operation Display	Display and operation description
Maximum/ Minimum Value Display	PV display: Displays measured input value (PV). Setpoint display: Displays maximum value or minimum value.  The maximum value or minimum value of PV is stored in the memory and display in the "HIGH" or "LOW" display in the confirmation display. When the control type is specified as high limit control, the maximum value is displayed in the "HIGH" display, and control type is specified as low limit control, the minimum value is displayed in the "LOW" display. When the PV exceeds SP and then returns to the normal status, Maximum / Minimum Value is retained as it is , but when PV exceeds SP again, it is automatically reset and starts taking new value for its minimum / maximum value.

6.2 Setting Target Setpoint

Operation in the Operation Display

Operation



1. Bring the SP Display into view.

2. Press the SET/ENTER key to move to the setting mode (the setpoint blinks).

3. Press the Left arrow key to move one digit to the left. (Press the Right arrow key to move one digit to the right.)

4. Press the Up or Down arrow key to change a setpoint. Press the Up arrow key when 9 is displayed to move one digit to the left. Press the Down arrow key when 0 is displayed to move one digit to the right.

5. Press the SET/ENTER key to register the setpoint. Control with the new setpoint.

Operation in Parameter Setting Display

Setting Display

Parameter Setting Display

Operation Display > **PARAMETER** key for **3 seconds** (to **[SP]** Menu Display) > **SET/ENTER** key (The setting parameter is displayed.)

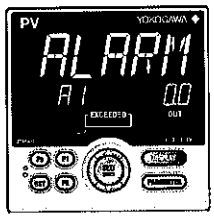
Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
SP	Target setpoint	EASY	0.0 to 100.0% of PV input range (EU) (Setting range: SPL to SPH)	SP Ope

6.3 Setting Alarm Setpoint

Setting Display

Parameter Setting Display



Operation Display > **PARAMETER** key for **3 seconds** (to **[SP]** Menu Display) > **SET/ENTER** key (The setting parameter is displayed.) > **Down arrow** key (The setting parameter is displayed.)

In the setting Display for the alarm parameters, Displays can be arbitrarily switched using the Up, Down, Left or Right arrow key. Pressing the Left or Right arrow key changes the group. (The group number is displayed on Group display.)

Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
A1 to A3	Alarm-1 to -3 setpoint	EASY	Set a display value of setpoint of PV alarm, SP alarm, deviation alarm, or velocity alarm. -19999 to 30000 (Set a value within the input range.) Decimal point position depends on the input type	SP Ope

Description

Each alarm type has three alarm setpoints.

Alarm-related parameter	Number of settings
Alarm type	3 (number of settings)
PV velocity alarm time setpoint	3 (number of settings)
Alarm hysteresis	3 (number of settings)
Alarm delay timer	3 (number of settings)
Alarm setpoint	3 (number of settings)

► Alarm type: Chapter 11 Alarm Functions

6.4 Releasing On-State (Latch) of Alarm Output

Description

Alarm latch can be released by any of the following.

(1) User function key
(2) Communication
(3) Contact input

For the switching operation by using the above, the last switching operation is performed.

Releasing the alarm latch function releases all of the latched alarm outputs.
By factory default, the function is not assigned to the user function key and contact input.
Assign and use the function in accordance with the reference sections below.

- ▶ Release by user function key: 13.2 Assigning Function to User Function Key
- ▶ Release by contact input: 12.1 Setting Contact Input Function
- ▶ Release via communication: UTAdvanced Series Communication Interface User's Manual

7.1 Setting Functions of PV Input

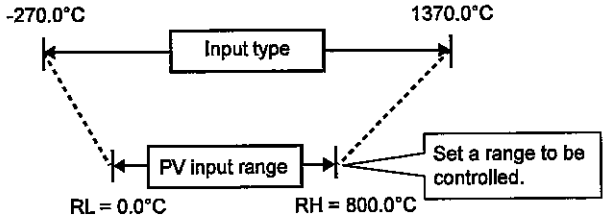
7.1.1 Setting Input Type, Unit, Range, Scale, and Decimal Point Position

Description

The figure below describes the case of PV input.

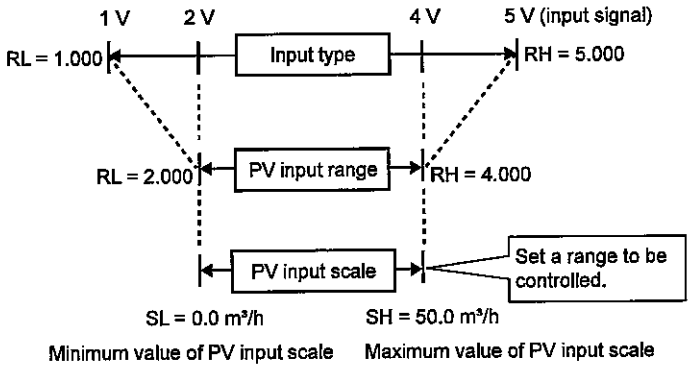
Example of Temperature Input

The figure below is an example of setting Type K thermocouple and a measurement range of 0.0 to 800.0 °C.



Example of Voltage and Current Inputs

The figure below is an example of setting 2-4 V DC and a scale of 0.0 to 50.0 m³/h.



When using 1-5 V DC signal as is, set RH = 5.000 V, RL = 1.000 V, SDP=1, and SH = 50.0, and SL=0.0.

Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
IN	PV input type	EASY	OFF: Disable K1: -270.0 to 1370.0 °C / -450.0 to 2500.0 °F K2: -270.0 to 1000.0 °C / -450.0 to 2300.0 °F K3: -200.0 to 500.0 °C / -200.0 to 1000.0 °F J: -200.0 to 1200.0 °C / -300.0 to 2300.0 °F T1: -270.0 to 400.0 °C / -450.0 to 750.0 °F T2: 0.0 to 400.0 °C / -200.0 to 750.0 °F B: 0.0 to 1800.0 °C / 32 to 3300 °F S: 0.0 to 1700.0 °C / 32 to 3100 °F R: 0.0 to 1700.0 °C / 32 to 3100 °F N: -200.0 to 1300.0 °C / -300.0 to 2400.0 °F E: -270.0 to 1000.0 °C / -450.0 to 1800.0 °F L: -200.0 to 900.0 °C / -300.0 to 1600.0 °F U1: -200.0 to 400.0 °C / -300.0 to 750.0 °F U2: 0.0 to 400.0 °C / -200.0 to 1000.0 °F W: 0.0 to 2300.0 °C / 32 to 4200 °F (Note1) PL2: 0.0 to 1390.0 °C / 32.0 to 2500.0 °F P2040: 0.0 to 1900.0 °C / 32 to 3400 °F WRE: 0.0 to 2000.0 °C / 32 to 3600 °F JPT1: -200.0 to 500.0 °C / -300.0 to 1000.0 °F JPT2: -150.0 to 150.0 °C / -200.0 to 300.0 °F PT1: -200.0 to 850.0 °C / -300.0 to 1560.0 °F PT2: -200.0 to 500.0 °C / -300.0 to 1000.0 °F PT3: -150.00 to 150.00 °C / -200.0 to 300.0 °F 0.4-2V: 0.400 to 2.000 V 1-5V: 1.000 to 5.000 V 4-20: 4.00 to 20.00 mA 0-2V: 0.000 to 2.000 V 0-10V: 0.00 to 10.00 V 0-20 : 0.00 to 20.00 mA -1020: -10.00 to 20.00 mV 0-100: 0.0 to 100.0 mV	PV Set
UNIT	PV input unit	EASY	-: No unit C: Degree Celsius -: No unit - -: No unit - - -: No unit F: Degree Fahrenheit	PV Set
RH (Physical quantity)	Maximum value of PV input range	EASY	Depends on the input type. - For temperature input - Set the temperature range that is actually controlled. (RL<RH) - For voltage / current input - Set the range of a voltage / current signal that is applied. The scale across which the voltage / current signal is actually controlled should be set using the maximum value of input scale (SH) and minimum value of input scale (SL). (Input is always 0% when RL = RH.)	PV Set
RL (Physical quantity)	Minimum value of PV input range	EASY	Same as RH	PV Set

Note1: W: W-5% Re/W-26% Re(Hoskins Mfg. Co.). ASTM E988
WRE: W97Re3-W75Re25

(Continued)

Parameter symbol	Name	Display level	Setting range	Menu symbol
SDP (Scaling)	PV input scale decimal point position	EASY	0: No decimal place 1: One decimal place 2: Two decimal places 3: Three decimal places 4: Four decimal places	PV Set
SH (Scaling)	Maximum value of PV input scale	EASY	-19999 to 30000, (SL<SH), | SH - SL | ≤ 30000	PV Set
SL (Scaling)	Minimum value of PV input scale	EASY	-19999 to 30000, (SL<SH), | SH - SL | ≤ 30000	PV Set

When changing the PV decimal point position or the digit of the indicated value, can be set by the following parameters.

Example: PV input type= K1 (-270.0 to 1370.0°C), the digit is without decimal point for "0 to 1000°C".

P.UNI=C

P.DP=0

P.RH=1000

P.RL=0

Parameter symbol	Name	Display level	Setting range	Menu symbol
P.UNI	Control PV input unit	STD	-: No unit C: Degree Celsius -: No unit - -: No unit - - -: No unit F: Degree Fahrenheit	MPV Set
P.DP	Control PV input decimal point position		0: No decimal place 1: One decimal place 2: Two decimal places 3: Three decimal places 4: Four decimal places	
P.RH	Maximum value of control PV input range		-19999 to 30000, (P.RL<P.RH), | P.RH - P.RL | ≤ 30000	
P.RL	Minimum value of control PV input range			

7.1.2 Setting Burnout Detection for Input

Description

The input value when input burnout occurs can be determined.
The input value is 105.0% of the input range when the upscale is set, and -5.0% of the input range when the downscale is set.
Burnout detection is activated for TC, RTD, and standard signal (0.4–2 V or 1–5 V).
For standard signal, burnout is determined to have occurred if it is 0.1 V or less for the range of 0.4–2 V and 1–5V, or if it is 0.4 mA or less for the range of 4–20 mA.

Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
BSL	PV input burnout action	STD	OFF: Disable UP: Upscale DOWN: Downscale	PV Set

7.1.3 Setting Reference Junction Compensation (RJC) or External Reference Junction Compensation (ERJC)

Description

Reference Junction Compensation (RJC)

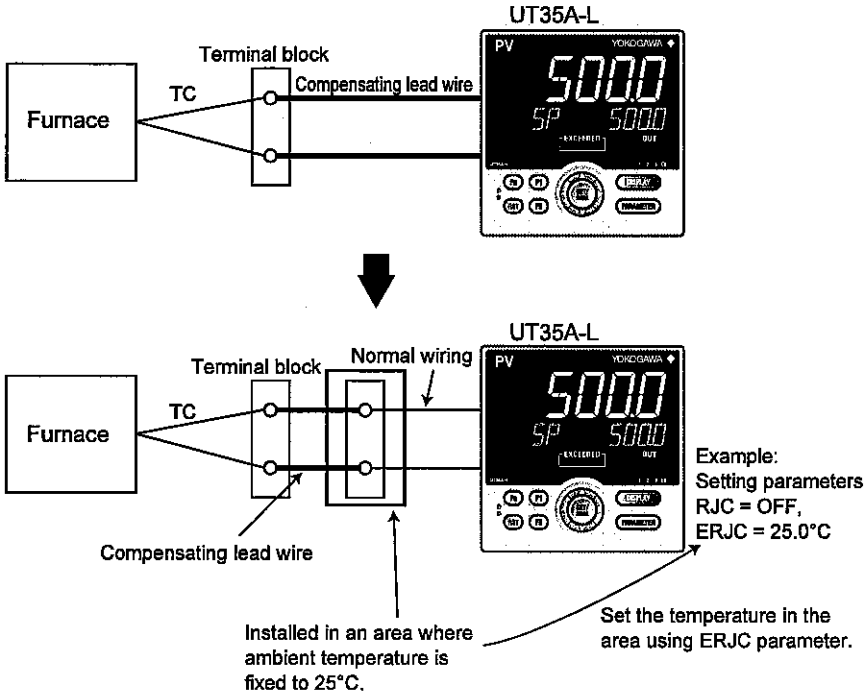
When TC input is selected, presence/absence of input reference junction compensation can be set.

Usually input values are compensated with the RJC function provided for the controller. However, if it is necessary to rigorously compensate the values with a device other than the function of the controller, for example with a zero-compensator, the RJC function of the controller can be turned off.

External Reference Junction Compensation (ERJC)

For TC input, a temperature compensation value for external device can be set.

The external RJC can be used only when RJC = OFF.



Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
RJC	PV input reference junction compensation	PRO	OFF: RJC OFF ON: RJC ON	PV Set
ERJC	PV input external RJC setpoint	PRO	-10.0 to 60.0°C or 14.0 to 140.0°F	PV Set

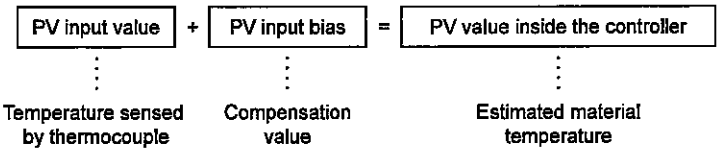
7.1.4 Correcting Input Value

Setting Bias and Filter

Description

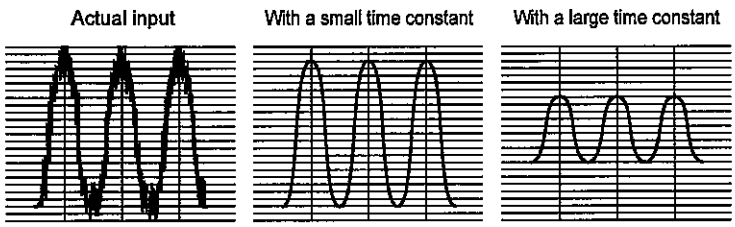
PV Input Bias

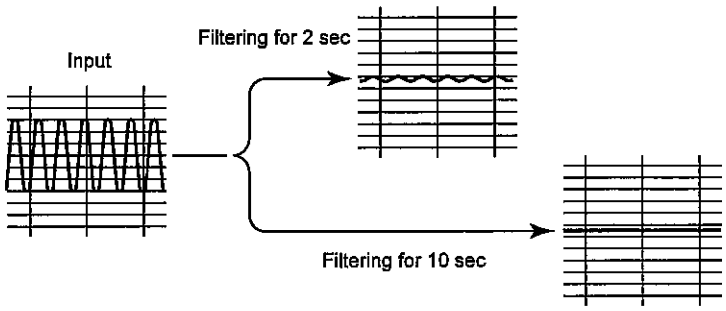
The PV input bias allows bias to be summed with input to develop a measured value for display and control use inside the controller.
This function can also be used for fine adjustment to compensate for small inter-instrument differences in measurement reading that can occur even if all are within the specified instrument accuracies.
PV input bias is used for normal operation.



PV Input Filter

If input noise or variations cause the low-order display digits to fluctuate so that the displayed value is difficult to read, a digital filter can be inserted to smooth operation.
This filter provides a first-order lag calculation, which can remove more noise the larger the time constant becomes. However, an excessively large time constant will distort the waveform.
PV input filter is used for normal operation.





Analog Input Bias

Analog input bias is used to correct sensor-input characteristics, compensating lead wire errors, and so on.

Analog Input Filter

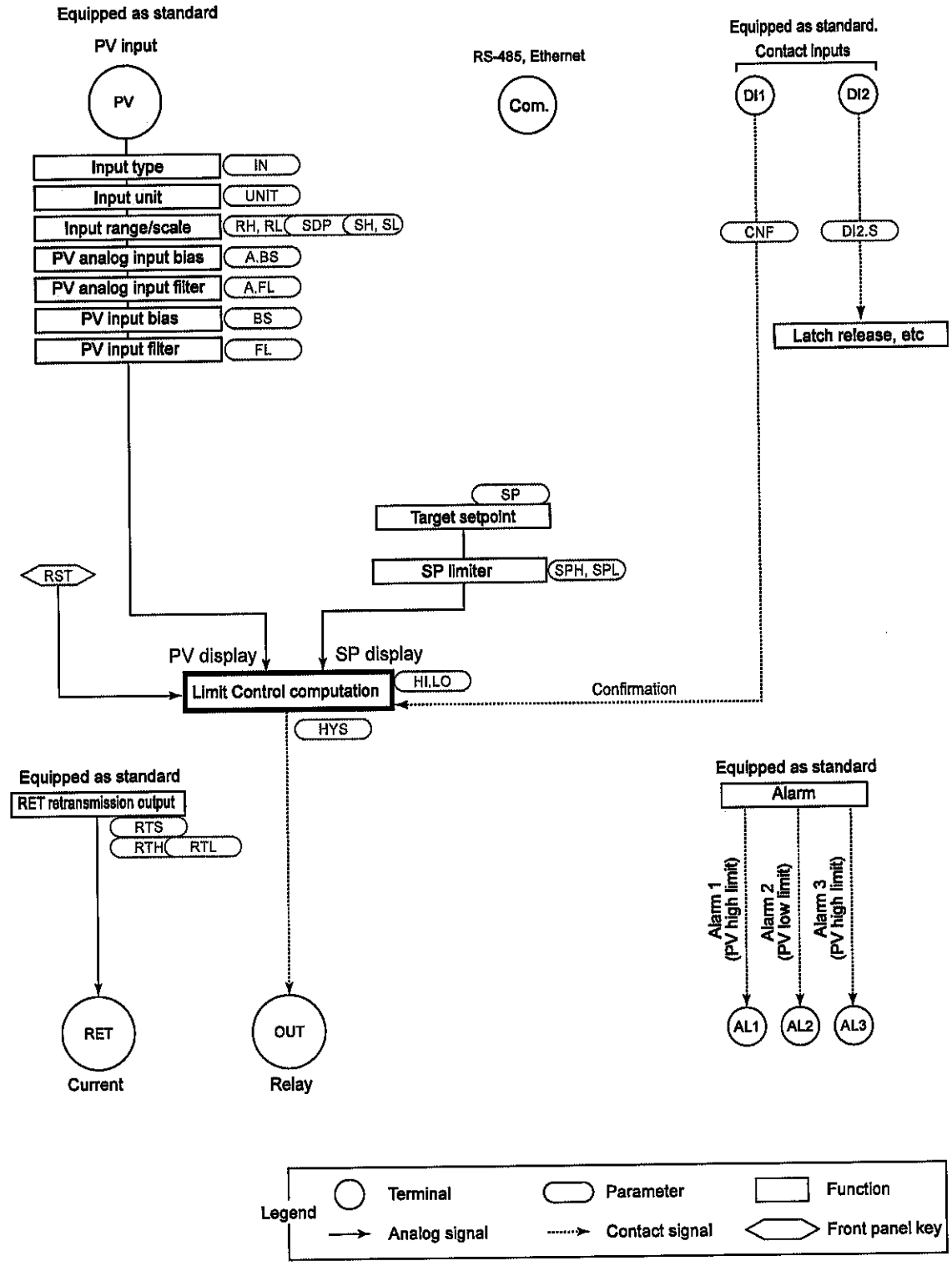
The analog input filter is used to remove noise from an input signal. This filter provides a first-order lag calculation, which can remove more noise the larger the time constant becomes. However, an excessively large time constant will distort the waveform.

Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
BS	PV input bias	EASY	-100.0 to 100.0% of PV input range span (EUS)	PVS Ope
FL	PV input filter	EASY	OFF, 1 to 120 s	

Parameter symbol	Name	Display level	Setting range	Menu symbol
A.BS	PV analog input bias	STD	-100.0 to 100.0% of each input range span (EUS)	PV Set
A.FL	PV analog input filter	STD	OFF, 1 to 120 s	PV Set

8.1 Function Block Diagram



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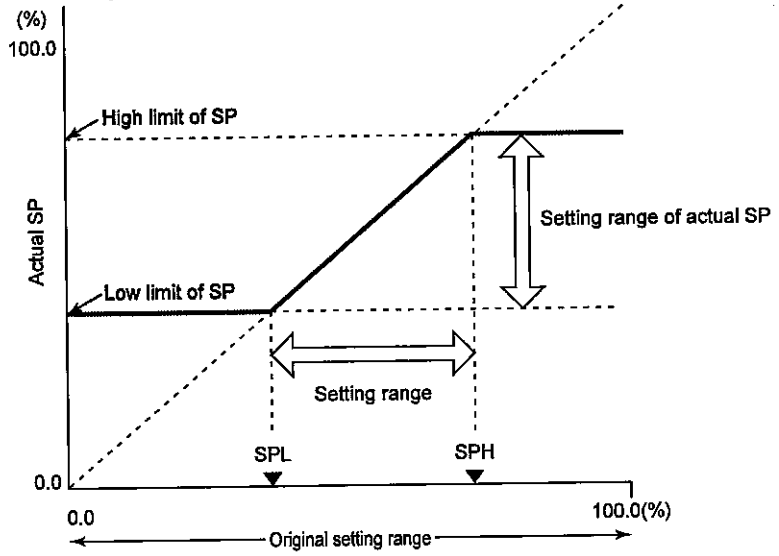
9.1 Setting SP Limiter

Description

The SP high and low limits can be set to restrict the SP to the range between those limits. They works to the SP of all SP groups.



Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
SPH	SP high limit	STD	0.0 to 100.0% of PV input range (EU), (SPL<SPH)	MPV Set
SPL	SP low limit	STD		

9.2 Setting Controller Action at Power ON (Restart Mode)

Description

The state of output relay at power-on can be set by a setup parameter restart mode R.MD. For details, see Chapter 15, "Power Failure Recovery Processing."

Setting Details

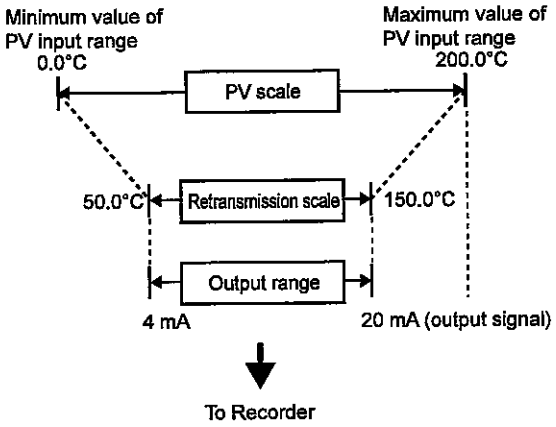
Parameter symbol	Name	Display level	Setting range	Menu symbol
R.MD	Restart Mode	STD	0: Limit output is ON at power on in any cases. 1: Limit output is OFF at power on when PV doesn't exceed SP.	SYS Set

10.1 Setting Retransmission Output Terminal, Type, and Scales

Description

The retransmission output can be used when the control output is not assigned to the analog output terminal. Confirm the output type selection (OT) before setting the retransmission output. The range can be changed.

► Current output range: 10.2 Changing Current Output Range



Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
RTS	Retransmission out type of RET	EASY	OFF: Disable PV1: PV SP1: SP	OUT Set
RTH	Maximum value of retransmission output scale of RET	STD	When RTS = PV1, SP1 RTL + 1 digit to 30000 -19999 to RTH - 1 digit Decimal point position: When RTS=PV1 or SP1, decimal point position is same as that of PV input.	
RTL	Minimum value of retransmission output scale of RET	STD		

Parameters and Corresponding Terminals

RTS, RTH, RTL	RET terminal

10.2 Changing Current Output Range

Description

The analog output type can be selected from among 4 to 20, 0 to 20, 20 to 4, or 20 to 0 mA.

Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
RET.A	RET current output range	STD	4-20: 4 to 20 mA, 0-20: 0 to 20 mA, 20-4: 20 to 4 mA, 20-0: 20 to 0 mA	OUT Set

Parameters and Corresponding Terminals

RET.A	RET terminal

11.1 Setting Alarm Type

Description

The alarm-related parameters consist of the alarm type (type, stand-by action, energized/de-energized, and latch function), PV velocity alarm time setpoint, alarm hysteresis, alarm (On-/Off-) delay timer, and alarm setpoint.

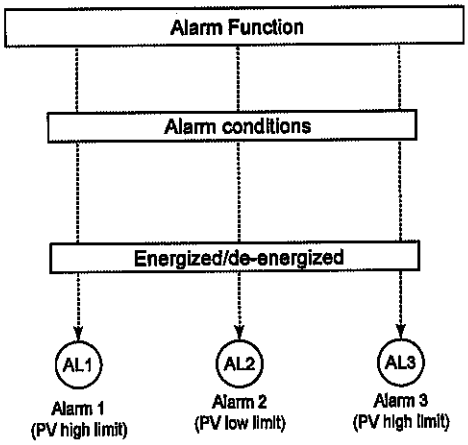
Alarm-related parameter	Number of settings
Alarm type	3 (number of settings)
PV velocity alarm time setpoint	3 (number of settings)
Alarm hysteresis	3 (number of settings)
Alarm (on-/off-) delay timer	3 (number of settings)
Alarm setpoint	3 (number of settings)

- ▶ Alarm hysteresis: 11.2 Setting Hysteresis to Alarm Operation
- ▶ Alarm delay timer: 11.3 Delaying Alarm Output (Alarm Delay Timer)
- ▶ Alarm setpoint: 6.3 Setting Alarm Setpoint

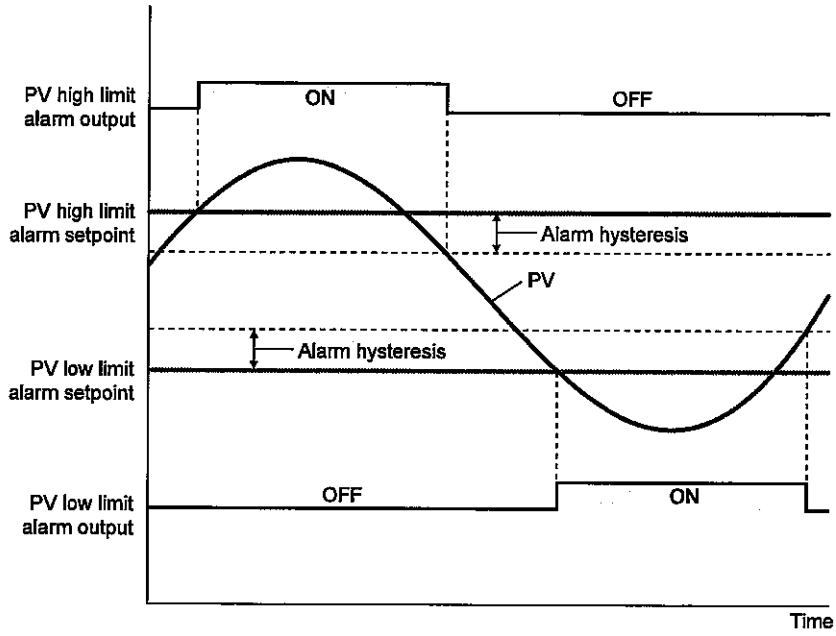
Factory default: Only three groups of alarm-related parameters are displayed.

- ▶ Terminal function: 17.4.5 Contact Output Wiring

To read the conditions of alarms, outputs, or latches via communication, see Communication Interface User's Manual.

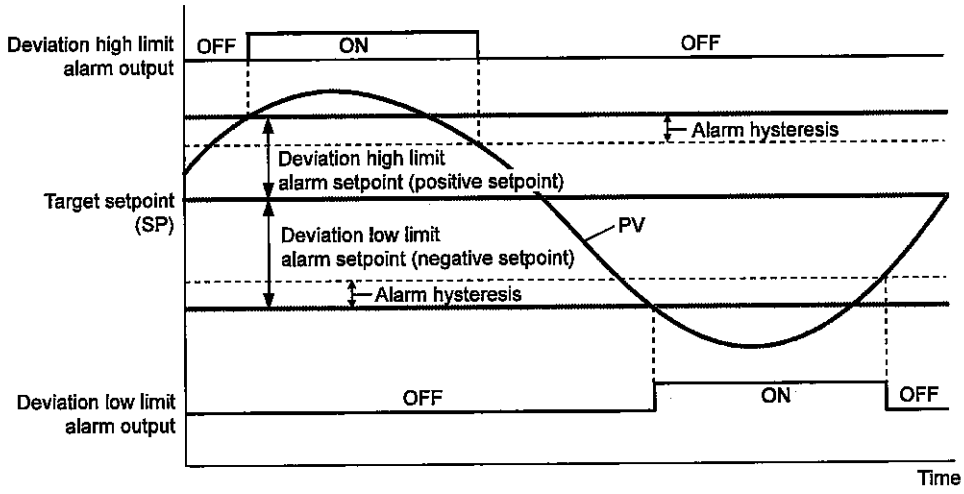


PV High Limit Alarm and PV Low Limit Alarm



Contact type in the figure above: Energized when an event occurs (factory default).

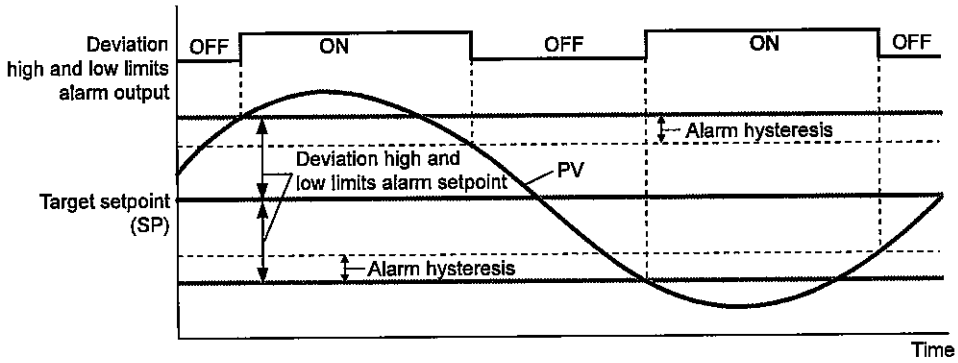
Deviation High Limit Alarm and Deviation Low Limit Alarm



Contact type in the figure above: Energized when an event occurs (factory default).

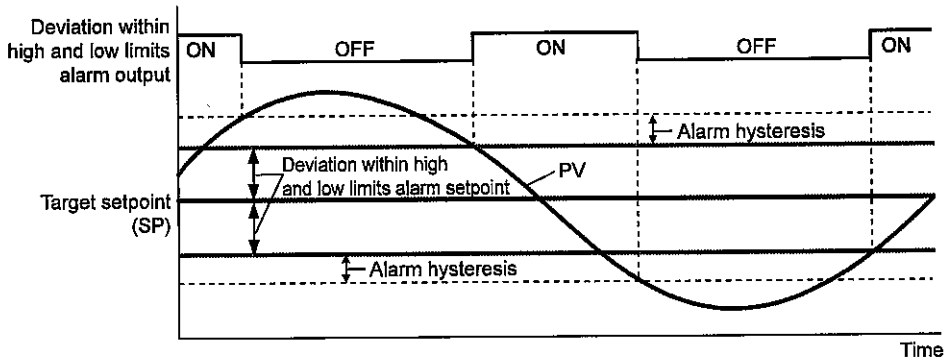
When a negative setpoint is set for the deviation high limit alarm setpoint, the deviation setpoint will be lower than the SP.
Moreover, when a positive setpoint is set for the deviation low limit alarm setpoint, the deviation setpoint will be higher than the SP.

Deviation High and Low Limits Alarm



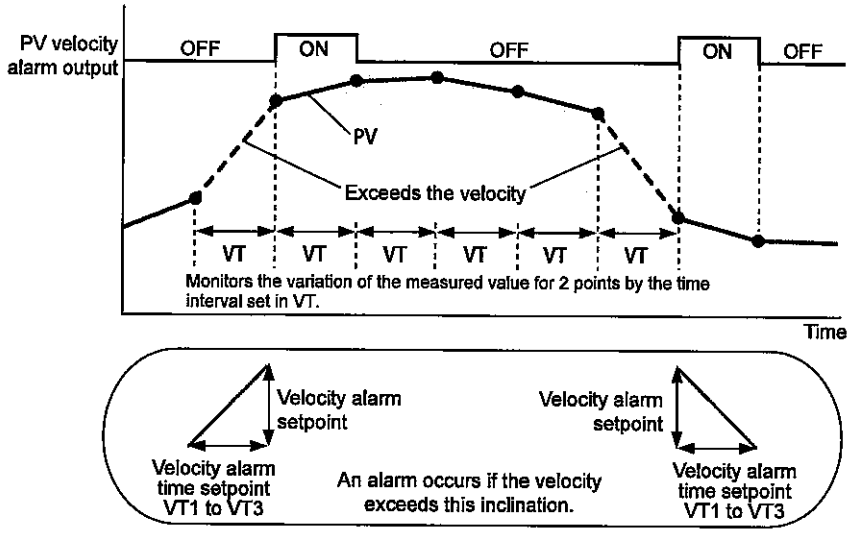
Contact type in the figure above: Energized when an event occurs (factory default).

Deviation within High and Low Limits Alarm



Contact type in the figure above: Energized when an event occurs (factory default).

PV Velocity Alarm



Contact type in the figure above: Energized when an event occurs (factory default).

The PV velocity alarm function does not work the alarm hysteresis, the stand-by action and the alarm delay timer functions.

Fault diagnosis Alarm

The function outputs an alarm signal in the following cases.
The corresponding event (EV) lamp is lit and the contact output turns on (when the contact type is energized).

- Burnout of PV input
- ADC failure of PV input
- Reference junction compensation (RJC) error of PV input

The fault diagnosis alarm does not work the stand-by action functions.

FAIL output

When the FAIL condition is caused (faulty MCU or system data error), DO (alarm output) turned off regardless of contact type.
The FAIL output does not work the alarm latch, the energized/de-energized and the stand-by action functions.

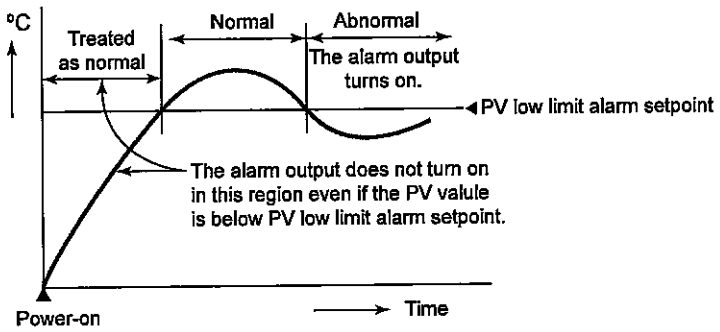
Stand-by Action

The stand-by action is a function for ignoring the alarm condition and keeps the alarm off until the alarm condition is removed. Once the alarm condition is removed, the stand-by action is cancelled.

It is effective in the following cases where;

- The power is turned on
- SP is changed
- The alarm type is changed
- Forced stand-by via communication

The following shows the behavior of an alarm with the stand-by action at power ON.



Alarm Latch Function

The alarm latch function is a function for keeping the alarm output (keeping the alarm output on) after entering the alarm condition (alarm output is turned on) until an order to release the alarm latch is received.

The alarm latch function has the following four types of action.

Latch 1

Cancels the alarm output when an order to release the alarm latch is received. (Alarm output OFF.)
However, an order to release the alarm latch is ignored if the order is received during alarm condition.

Latch 2

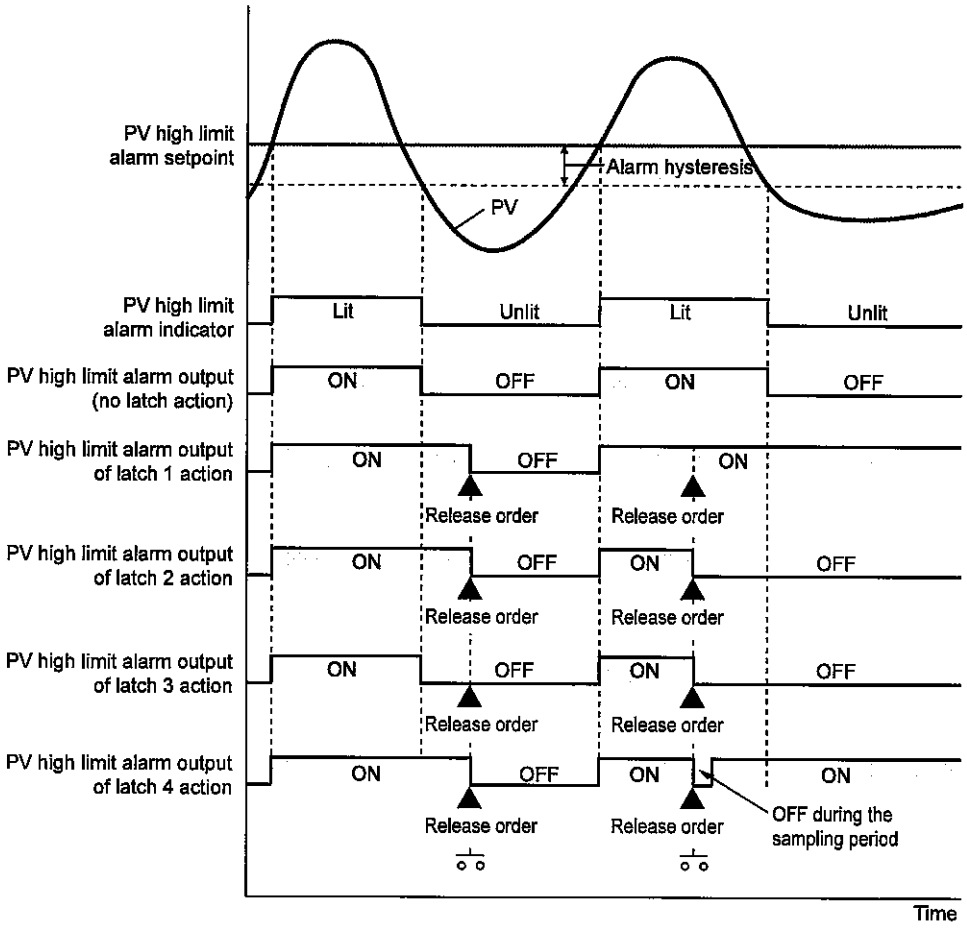
Always forces cancelling of the alarm output when an order to release the alarm latch is received. (Alarm output OFF)

Latch 3

Cancels the alarm output when an order to release the alarm latch is received or when the alarm condition is removed. (Alarm output OFF.)

Latch 4

Cancels the alarm output when an order to release the alarm latch is received. (Alarm output OFF.)
However, cancels the alarm output for the duration of the sampling period (control period) if an order to release the alarm latch is received during alarm condition. (Alarm output OFF)

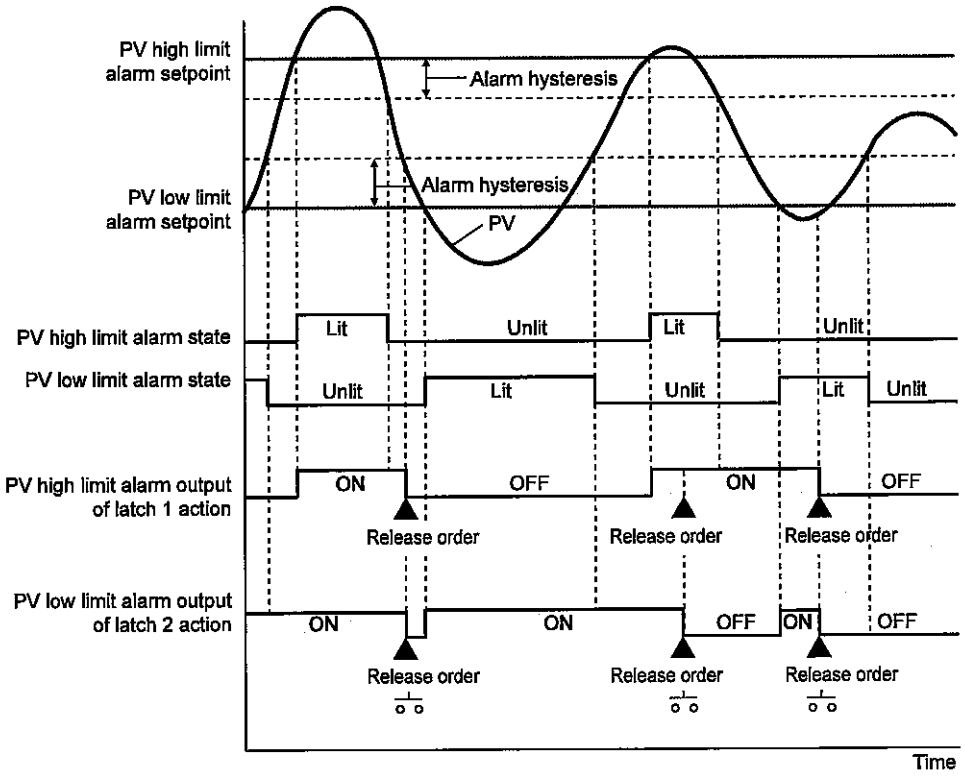


Contact type in the figure above: Energized when an event occurs (factory default).

Release of Alarm Latch

The alarm latch function can be cancelled by the user function key or by contact input. Cancelling the alarm latch function cancels all latched alarm outputs.

- ▶ Release by user function key: 13.2 Assigning Function to User Function Key
- ▶ Release by contact input: 12.1.1 Setting Contact Input Function
- ▶ Release via communication: UTAdvanced Series Communication Interface User's Manual



Contact type in the figure above: Energized when an event occurs (factory default).

Operation of Alarm Output and Display Lamp (EV)

The contact output and display lamp (EV) are usually output and displayed according to the setpoint of the alarm type. However, the alarm conditions (operations) of the normal action, and latch action can be assigned to the contact output and display lamp (EV), regardless of the setpoint of the alarm type. (Two operations can be assigned simultaneously.)

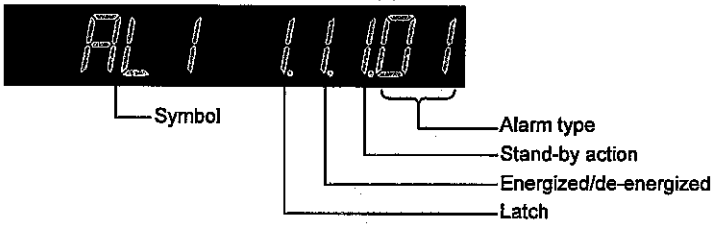
- ▶ Display lamp action: 13.1 Setting Display Functions

Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
AL1 to AL3	Alarm-1 to -3 type	EASY	See the table below.	ALRM Ope
VT1 to VT3	PV velocity alarm time setpoint 1 to 3	EASY	00.01 to 99.59 (minute.second)	

Note1: The initial values of the parmeters AL1 to AL3 and VT1 to VT3 are "3".

The following shows the example of setting PV high limit (01), With stand-by action (1), De-energized (1), and Latch 1 action (1).



Name	Latch action (Note 1)	Energized (0) / de-energized (1)	Stand-by action Without (0) / with (1)	Alarm type
Disable	- (Note 2)	- (Note 2)	- (Note 2)	00
PV high limit	0 / 1 / 2 / 3 / 4	0 / 1	0 / 1	01
PV low limit	0 / 1 / 2 / 3 / 4	0 / 1	0 / 1	02
Deviation high limit	0 / 1 / 2 / 3 / 4	0 / 1	0 / 1	05
Deviation low limit	0 / 1 / 2 / 3 / 4	0 / 1	0 / 1	06
Deviation high and low limits	0 / 1 / 2 / 3 / 4	0 / 1	0 / 1	07
Deviation within high and low limits	0 / 1 / 2 / 3 / 4	0 / 1	0 / 1	08
PV velocity	0 / 1 / 2 / 3 / 4	0 / 1	- (Note 2)	29
Fault diagnosis	0 / 1 / 2 / 3 / 4	0 / 1	- (Note 2)	30
FAIL	- (Note 2)	- (Note 2)	- (Note 2)	31

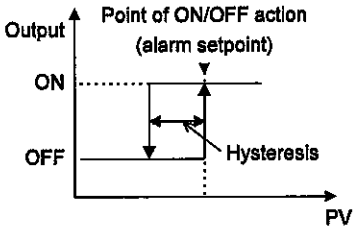
Note 1: 0: No latch function, 1: Latch 1, 2: Latch 2, 3: Latch 3, 4: Latch 4
Note 2: -: Alarm function doesn't work even if any value is set.

11.2 Setting Hysteresis to Alarm Operation

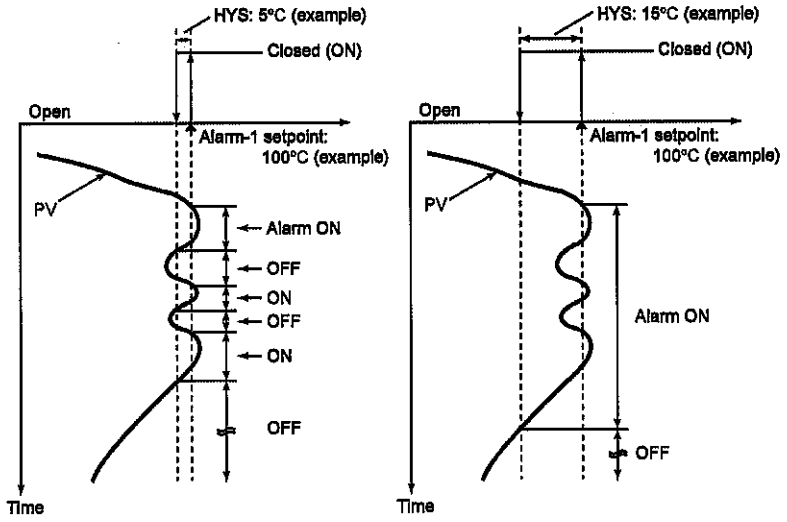
Description

If the On/Off switch of the alarm output is too busy, you can alleviate the busyness by increasing the alarm hysteresis.

Hysteresis for PV High Limit Alarm



When Setting Hysteresis of 5°C and 15°C for PV High Limit Alarm



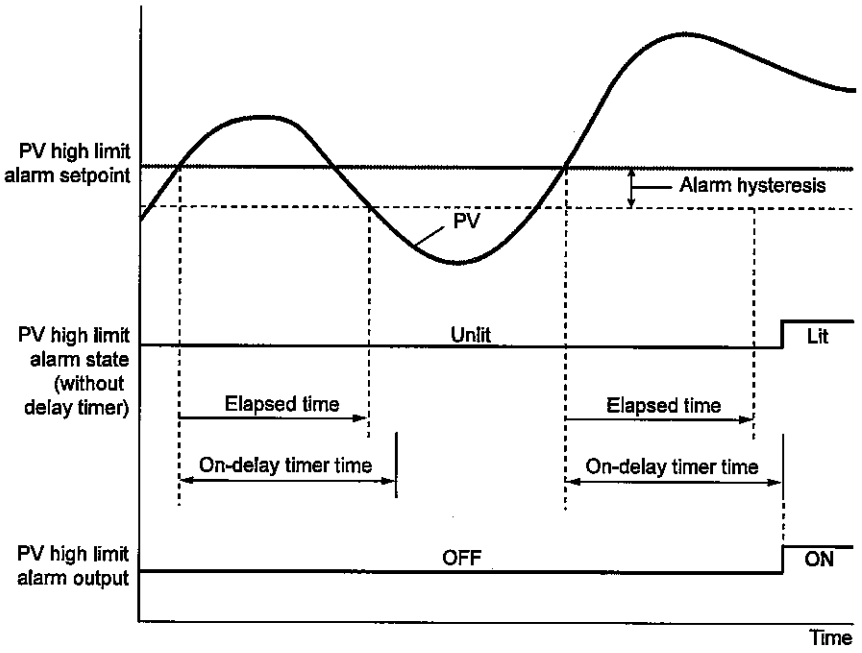
Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
HY1 to HY3	Alarm-1 to -3 hysteresis	EASY	Sets the hysteresis setpoint as a display value. -19999 to 30000 (set it within the input range) The decimal point position depends on the input type.	ALRM

11.3 Delaying Alarm Output (Alarm Delay Timer)

Description

The alarm on-delay timer is a function for turning on the alarm when the alarm condition occurs, and the timer starts and the set time elapses.
The timer is reset if the alarm condition is removed while the timer is running. No alarm is generated.
The figure below shows the example of the On-delay timer



Contact type in the figure above: Energized when an event occurs (factory default).

The alarm Off-delay timer is a function for turning off the alarm when the alarm condition is removed (normal condition), and the timer starts and the set time elapses.
The timer is reset if the alarm condition occurs again while the timer is running. The alarm is not cancelled.

Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
DYN1 to DYN3	Alarm-1 to -3 On-delay timer	STD	0.00 to 99.59 (minute.second)	ALRM Ope
DYF1 to DYF3	Alarm-1 to -3 Off-delay timer	PRO		

12.1 Setting Contact Input Function

12.1.1 Setting Contact Input Function

Description

The contact input (DI2) function works by setting the DI2.S parameter to functions such as the operation mode.

Latch Release (LAT)

Latch can be released using contact input. (Switch by the rising edge)

Contact status	Operation	Remark
OFF→ON	Releases the latch	–
ON→OFF	Maintains the current operation status	–

Releasing the latch function releases all latched contact (alarm) outputs.

LCD Backlight ON/OFF Switch (LCD)

LCD backlight ON/OFF can be switched using contact input. (Switch by the rising edge and the falling edge)

Contact status	Operation	Remark
OFF→ON	Turns off the LCD backlight	–
ON→OFF	Turns on the LCD backlight	–

Message Display Interruption 1 to 4 (MG 1 to 4)

The message set using LL50A Parameter Setting Software can be interrupt-displayed on PV display using contact input. The messages are limited to 20 alphanumeric characters. A maximum of four displays can be registered. (Switch by the rising edge)

► Message: LL50A Parameter Setting Software User's Manual

Contact status	Operation	Remark
OFF→ON	Interrupt-displays the message	Pressing the DISPLAY key erases the message.
ON→OFF	Displays the current PV	–

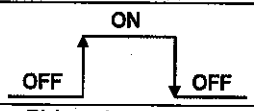
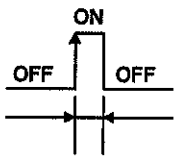
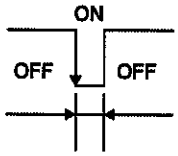
PV Red/white Switch (PVRW)

PV color can be switched using contact input. (Status switch)

Contact status	Operation	Remark
ON	Red color	–
OFF	White color	–

Set "10" to the parameter PCMD.

Contact Action

Type	Operation	Description
Status		Receiving a contact input signal changes the status to the specified operation, and a release changes the status back to the original action.
Rising edge	Rising edge  Detection time: 250 ms	Receiving an OFF-to-ON contact input signal changes the status to the specified operation. The minimum detection time is 250 ms.
Falling edge	Falling edge  Detection time: 250 ms	Receiving an ON-to-OFF contact input signal changes the status to the specified operation. The minimum detection time is 250 ms.

Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
DI2.S	DI2 function switch	STD	DI2 function selection OFF: No function LAT: Latch release LCD: LCD backlight ON/OFF switch PVPW: PV red/white switch MG1: Message display interruption 1 MG2: Message display interruption 2 MG3: Message display interruption 3 MG4: Message display interruption 4	DI.SL Set

13.1 Setting Display Functions

13.1.1 Setting Active Color PV Display Function

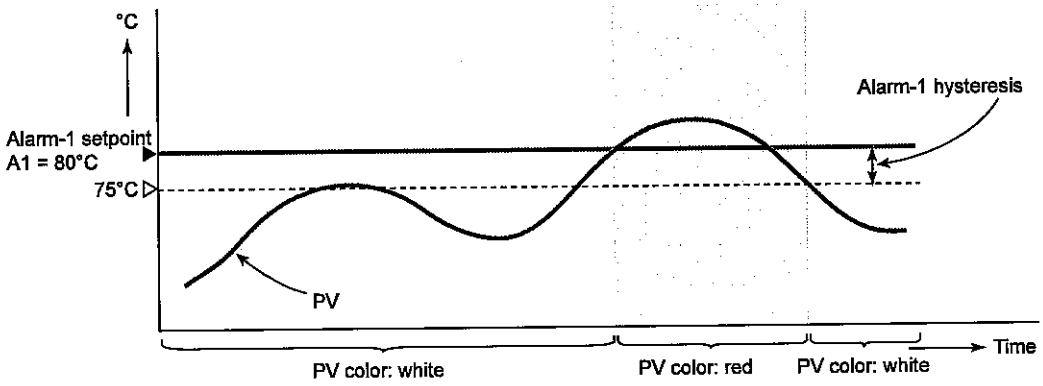
The active color PV display function changes the PV display color when an event occurs.

Description

Link to Alarm

The PV display color changes by linking to the alarm 1 or alarm 2.

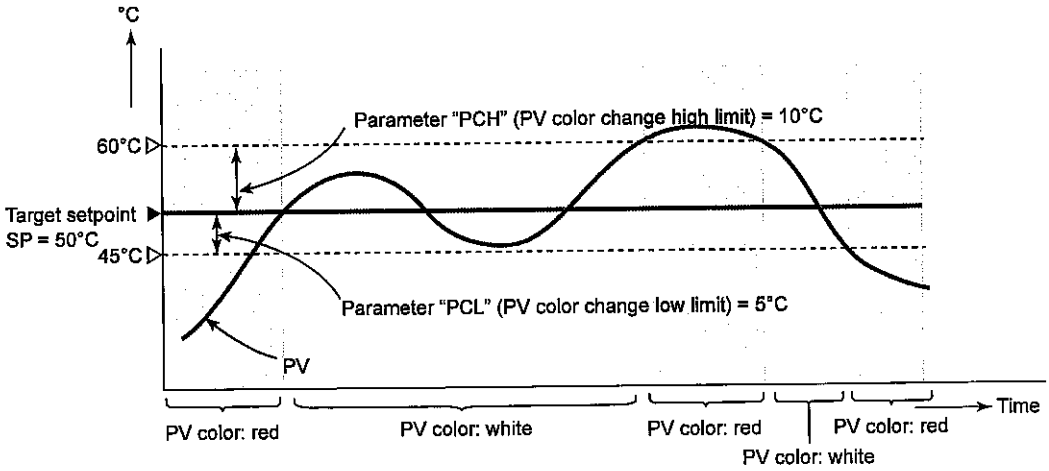
The following is an example of operation linking to alarm 1.
Set the alarm-1 type to "PV high limit alarm" and alarm-1 setpoint to "80°C."
When the active color PV display switch is set to"2," PV display color changes from white to red if PV exceeds the alarm-1 setpoint.
The red-to-white switching action can be set.



Change by Deviation

The PV display color changes by deviation (PV – SP).

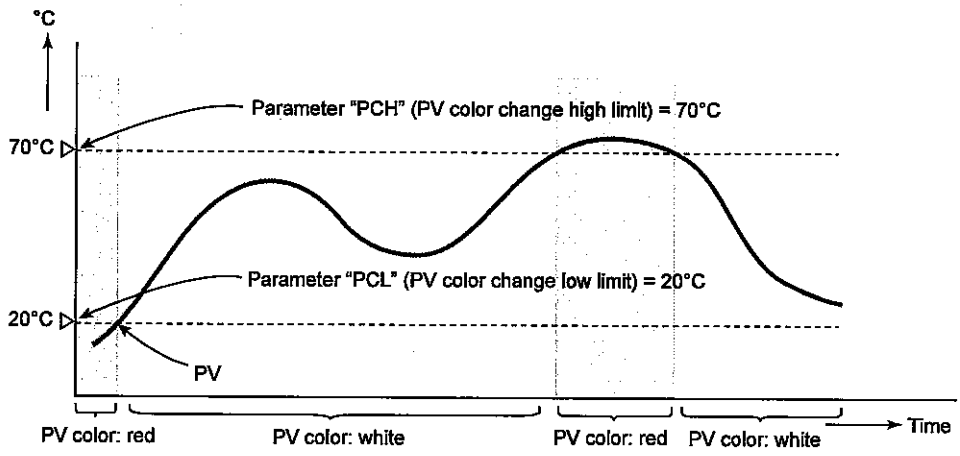
Set the PV color change high limit to "10°C" and the PV color change low limit to "5°C" as deviation band for the current target setpoint "50°C." PV display color changes from white to red if PV is out of the deviation.
The red-to-white switching action can be set. There is no hysteresis.



Link to PV

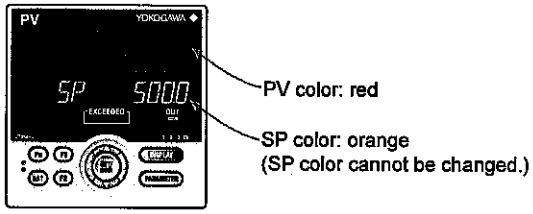
The PV display color changes by linking to PV.

Set the PV color change high limit to "70°C" and the PV color change low limit to "20°C."
PV display color changes from white to red if PV is out of the range.
The red-to-white switching action can be set. There is no hysteresis.



Use in Fixed Color

PV display color can be fixed in red. It can also be fixed in white.



Link to DI

The PV display color changes by linking to DI (ON/OFF).

The following is an example for changing the display color by a state of DI2.
Set the parameter PCMD=10, and DI2.S=PVRW.
PV display color is red when DI2=ON, and is white when DI2=OFF.

PVRW: PV red/white switch (Menu: DI.SL)

Setting Details

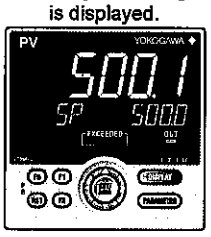
Parameter symbol	Name	Display level	Setting range	Menu symbol
PCMD	Active color PV display switch	EASY	0: Fixed in white 1: Fixed in red 2: Link to alarm 1 (Alarm OFF: white, Alarm ON: red) 3: Link to alarm 1 (Alarm OFF: red, Alarm ON: white) 4: Link to alarm 1 or 2 (Alarm OFF: white, Alarm ON: red) 5: Link to alarm 1 or 2 (Alarm OFF: red, Alarm ON: white) 6: PV limit (Within range: white, Out of range: red) 7: PV limit (Within range: red, Out of range: white) 8: SP deviation (Within deviation: white, Out of deviation: red) 9: SP deviation (Within deviation: red, Out of deviation: white) 10: Link to DI2 (ON: red, OFF: white) (*) 11: Link to EXCEEDED lamp (Unlit: hite, lit: red) 12: Link to OUT lamp (Unlit: white, lit: red) *: Set the parameter DI2.S = PVRW	DISP Set
PCH	PV color change high limit	EASY	Set a display value when in PV limit or SP deviation. -19999 to 30000 (Set a value within the input range.) Decimal point position depends on the input type.	
PCL	PV color change low limit	EASY		

13.1.2 Masking Least Significant Digit of PV Display

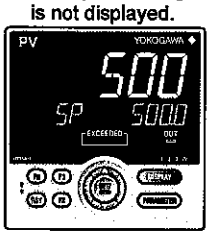
Description

With and without least significant digit of the PV in the Operation Display can be set. When without least significant digit is set, the value of the least significant digit is truncated and not displayed.
The internal value is not changed depending on whether with or without least significant digit (the value is for display only). This parameter does not function for the PV without decimal point.

Least significant digit is displayed.



Least significant digit is not displayed.



The following shows the example of with and without least significant digit

PV display	
With least significant digit	**Without least significant digit**
1.4999	1.499
1.5000	1.500
1.9999	1.999
2.0000	2.000
3000.0	3000
3000.9	3000
3001.0	3001

Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
MLSD	Least significant digital mask of PV display	STD	OFF: With least significant digit ON: Without least significant digit	DISP Set

13.1.3 Setting Economy Mode

Description

The LCD backlight ON/OFF can be set in the following methods.
Setting the LCD backlight to OFF saves energy.

User Function Keys

The LCD backlight ON/OFF switch can be assigned to the user function key.

▶ User function key: 13.2 Assigning Function to User Function Key

Backlight OFF timer

The backlight OFF timer sets the economy mode parameter to ON.
If no keys are pressed for 30 minutes, the LCD backlight goes off automatically.
The backlight OFF can be set to turn off the backlight for the whole display or a display other than the PV display.
To turn on the LCD backlight, press any key.

Contact Input

The LCD backlight ON/OFF switch can be assigned to the contact input

▶ Contact input: 12.1 Setting Contact Input Function

In the following cases, the LCD backlight does not go off.

- When an alarm occurs.
- When an error at power-on or a hardware malfunction error occurs.
- When EXCEED lamp and OUT lamp turn on.

Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
ECO	Economy mode	STD	OFF: Disable 1: Economy mode ON (All indications except PV display OFF) 2: Economy mode ON (All indications OFF) 3: Brightness 10 % (all indications)	DISP Set

13.1.4 Selecting the Initial Operation Display that Appears at Power ON

Description

The initial Operation Display that appears when the power is turned on can be set.

Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
HOME	Home Operation Display setting	PRO	PV: PV Display SP: SP Display	DISP Set

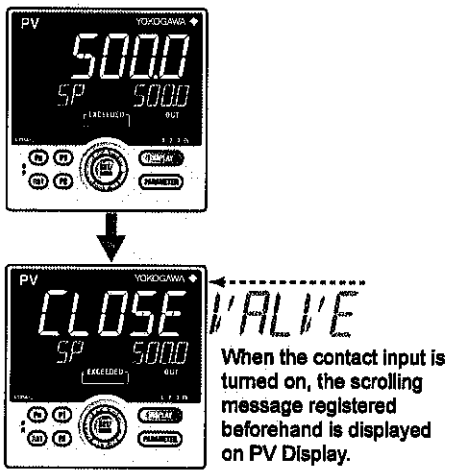
13.1.5 Setting Message Function

Description

Using the message function and turning the contact input on/off, the message registered beforehand can be displayed on PV display by interrupt.
The message is registered using LL50A Parameter Setting Software.
The messages are limited to 20 alphanumeric characters. A maximum of four messages can be registered.
If a number of messages occur simultaneously, the priority is as follows:
(high) MG1>MG2>MG3>MG4 (low)

- ► Message registration: LL50A Parameter Setting Software User's Manual
- ► Registration of contact input: 12.1.1 Setting Contact Input Function
- ► Registration symbols: 3.3 List of Display Symbols

Operation Display



When the contact input is turned on, the scrolling message registered beforehand is displayed on PV Display.

13.1.6 Changing Guide Scroll Speed

Description

The scroll speed can be changed when the guide for the parameter or menu is displayed.

Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
SPD	Scroll speed	PRO	(Slow) 1 to 8 (Quick)	DISP Set

13.1.7 Turning Guide Display ON/OFF

Description

The guide display that appears when the parameter or the menu is displayed can be switched.
The guide display can be turned on and off by the Fn key in the Menu Display and Parameter Setting Display.

Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
GUID	Guide display ON/OFF	STD	OFF: Nondisplay ON: Display	DISP Set

13.1.8 Setting Automatic Return to Operation Display

Description

The Display will automatically revert to the Operation Display if no keys are pressed for 5 minutes in Menu Display or Parameter Setting Display.

Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
OP.JP	Automatic return to Operation Display	PRO	ON: Automatically returned to the Operation Display. OFF: Not automatically returned to the Operation Display.	DISP Set

13.1.9 Setting Brightness and Contrast Adjustment of LCD and Display Update Cycle

Description

The brightness and contrast can be adjusted.
The LCD has a characteristic that the display action becomes late at the low temperature. This can be solved by adjusting the display update cycle (D.CYC).

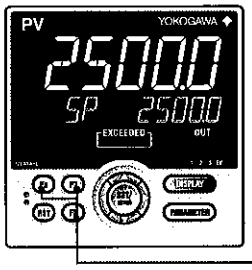
Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
BRI	Brightness	EASY	(Dark) 1 to 5 (Bright)	DISP Set
B.PVW	White brightness adjustment of PV display	PRO	Adjusts the white brightness of PV display. (Dark) -4 to 4 (Bright)	
B.PVR	Red brightness adjustment of PV display	PRO	Adjusts the red brightness of PV display. (Dark) -4 to 4 (Bright)	
B.SP	Brightness adjustment of Setpoint display	PRO	Adjusts the brightness of SP display. (Dark) -4 to 4 (Bright)	
B.BAR	Brightness adjustment of Bar-graph display	PRO	Adjusts the brightness of EXCEED lamp and OUT lamp. (Dark) -4 to 4 (Bright)	
B.STS	Brightness adjustment of Status indicator	PRO	Adjusts the brightness of Status indicator. (Dark) -4 to 4 (Bright)	
D.CYC	Display update cycle	PRO	1: 100 ms 2: 200 ms 3: 500 ms 4: 1 s 5: 2 s	

13.2 Assigning Function to User Function Key

Description

The UT35A-L has three user function keys on the front panel.
Various functions can be assigned to the user function key. Press the user function key to perform the assigned function.
The User function key is available only on the Operation Display.
The assigned function does not work on the Parameter Setting Display. However, the Fn key can be used to turn on/off the guide display.



User function keys

Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
F1 to Fn	User function key action setting	EASY	See the table below	KEY Set

Setpoint	Function	Action	Availability (Note 1)		
			F1	F2	Fn
OFF	Unassigned	–	√	√	√
LTUP	LCD brightness UP	The current brightness gradually increases every time the function key is pressed.	√	√	√
LTDN	LCD brightness DOWN	The current brightness gradually decreases every time the function key is pressed.	√	√	√
BRI	Adjust LCD brightness	The current brightness gradually increases every time the function key is pressed. Pressing the function key after reaching the maximum brightness changes to the minimum brightness. Thereafter, minimum brightness→maximum brightness→maximum brightness is repeated.	√	√	√
LCD	LCD Backlight ON/OFF switch	The LCD backlight turns on and off every time the user function key is pressed.	√	√	√
LAT	Latch release	Latch 1 to latch 3 are released every time the user function key is pressed.	√	√	√

Note 1: √ indicates available, – indicates unavailable, and √√ indicates initial value.

Status of user function key

The status of the user function key can be identified by communication.
"1" can be read while the user function key is held down, and "0" can be read when the user function key is released. (Initial value: 0)
► Reading via communication: UTAdvanced Series Communication Interface User's Manual

Fn key operation in the Parameter Setting Display

In the Menu Display and Parameter Setting Display, the guide is displayed on PV display. At this time, use the Fn key to turn on and off the guide display on PV display. A measured input value (PV) is displayed in the ON state.

13.3 Setting Security Functions

13.3.1 Setting a Password

Description

The password function can prevent inadvertent changes to the parameter settings.
If a password is set, the checking is required when moving to the Setup Parameter Setting Display. When the password is verified, can be changed to the Setup Parameter Setting Display. The parameters in the following menus can be set only when the password is verified.
CTL, PV, MPV, OUT, R485, ETHR, KEY, DISP, KLOC, MLOC, DI.SL, I/O, SYS, INIT, VER, and LVL.

Always remember your password when using the password function.

Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
PASS	Password setting	EASY	0 (No password) to 65535	SYS Set

13.3.2 Setting Parameter Display Level

Description

Parameter display level can be set according to the setting level.
► Parameter display level: Chapter 18 Parameters

Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
LEVL	Parameter display level	EASY	EASY: Easy setting mode STD: Standard setting mode PRO: Professional setting mode	LVL Set

13.3.3 Locking (Hiding) Parameter Menu Display

Description

The parameter menu display lock function hides the following Parameter Menu Displays.

Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
CTL	[CTL] menu lock	PRO	OFF: Display ON: Nondisplay	MLOC Set
PV	[PV] menu lock	PRO		
MPV	[MPV] menu lock	PRO		
OUT	[OUT] menu lock	PRO		
R485	[R485] menu lock	PRO		
ETHR	[ETHR] menu lock	PRO		
KEY	[KEY] menu lock	PRO		
DISP	[DISP] menu lock	PRO		
KLOC	[KLOC] menu lock	PRO		
DI.SL	[DI.SL] menu lock	PRO		
I/O	[I/O] menu lock	PRO		
SYS	[SYS] menu lock	PRO		
INIT	[INIT] menu lock	PRO		
VER	[VER] menu lock	PRO		
LVL	[LVL] menu lock	PRO		
SP	[SP] menu lock	PRO		
SPS	[SPS] menu lock	PRO		
ALRM	[ALRM] menu lock	PRO		
PVS	[PVS] menu lock	PRO		

13.3.4 Key Lock

Description

The key lock function locks the key on the front panel to prohibit key operation.
It can prohibit the operation mode switch or parameter setting change.

Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
DATA	Front panel parameter data key lock	STD	OFF: Unlock ON: Lock	KLOCK Set

13.3.5 Prohibiting Writing via Communication

Description

Writing data to each register via all communication methods can be permitted or prohibited. However, writing data via light-loader (front) or maintenance port (upper) is possible using LL50A Parameter Setting Software.

Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
COM.W	Communication write enable/ disable	STD	OFF: Enable ON: Disable	KLOC Set

Displayed only in cases where the communication is specified.

13.4 Confirmation of Key and I/O Condition and Version

13.4.1 Confirmation of Key and I/O Condition

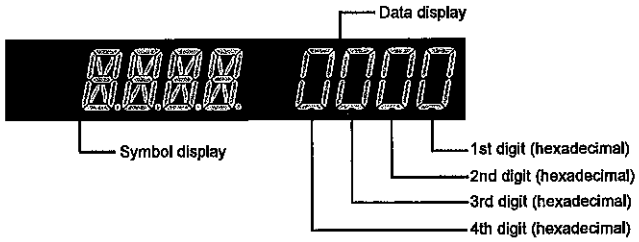
Description

Can be confirm the Key and I/O condition.

Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
KEY	Key status	PRO	Read only.	I/O Set
X000	DI1-DI2 status (equipped as standard)	PRO		
Y000	AL1-AL3 status (equipped as standard)	PRO		

Key confirmation parameters are displayed in hexadecimal.
When the error occurs, "1" is set on the bit of corresponding error , and the bit data is displayed in hexadecimal.



Parameter KEY

Displayed digit	bit	Description
1st digit	0	PARAMETER (or PARA) key (0: OFF, 1: ON)
	1	DISPLAY (or DISP) key (0: OFF, 1: ON)
	2	RIGHT arrow key (0: OFF, 1: ON)
	3	DOWN arrow key (0: OFF 1: ON)
2nd digit	4	SET/ENTER key (0: OFF, 1: ON)
	5	UP arrow key (0: OFF, 1: ON)
	6	LEFT arrow key (0: OFF, 1: ON)
	7	F2 key (0: OFF, 1: ON)
3rd digit	8	F1 key (0: OFF, 1: ON)
	9	RST key (0: OFF, 1: ON)
	10	Fn key (0: OFF, 1: ON)
	11	–
4th digit	12	–
	13	–
	14	–
	15	–

Parameter X000

Displayed digit	bit	Description
1st digit	0	DI1 status (0: OFF, 1: ON)
	1	DI2 status (0: OFF, 1: ON)
	2	–
	3	–
2nd digit	4	–
	5	–
	6	–
	7	–
3rd digit	8	–
	9	–
	10	–
	11	–
4th digit	12	–
	13	–
	14	–
	15	–

Parameter Y000

Displayed digit	bit	Description
1st digit	0	AL1 status (0: OFF, 1: ON)
	1	AL2 status (0: OFF, 1: ON)
	2	AL3 status (0: OFF, 1: ON)
	3	–
2nd digit	4	–
	5	–
	6	–
	7	–
3rd digit	8	–
	9	–
	10	–
	11	–
4th digit	12	–
	13	–
	14	–
	15	–

13.4.2 Confirmation of Version

Description

Can be confirm the version of the controller.

Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
MCU	MCU version	EASY	Read only.	VER Set
DCU	DCU version	EASY		
ECU3	ECU-3 version	EASY		
PARA	Parameter version	EASY		
H.VER	Product version	EASY		
SER1	Serial number 1	EASY		
SER2	Serial number 2	EASY		
MAC1	MAC address 1	EASY		
MAC2	MAC address 2	EASY		
MAC3	MAC address 3	EASY		

Blank Page

14.1 Initializing Parameter Settings to Factory Default Values

Description

Parameter settings can be initialized to the factory default values.
Use the key or LL50A Parameter Setting Software to execute it.

Note

The user setting values (defaults) are not initialized even if the parameter setting values are initialized to the factory default values.

Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
F.DEF	Initialization to factory default value	PRO	-12345: Initialization, automatically returned to "0" after initialization.	INIT Set

14.2 Registering and Initializing User Default Values

14.2.1 Registering as User Setting (Default) Values

Description

The user default values can be registered as parameter default values.
Use the LL50A Parameter Setting Software to register user setting (default) values.

CAUTION

Before registering the user default value, make sure that the user setting value is set to the parameter.

14.2.2 Initializing to User Setting (Default) Values

Description

Parameter settings can be initialized to the user setting (default) values.
Use the LL50A Parameter Setting Software to execute it.

Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
U.DEF	Initialization to user default value	PRO	12345: Initialization, automatically returned to "0" after initialization.	INIT Set

15.1 Remedies if Power Failure Occurs during Operations

Description

All functions of the controller cannot be operated for about 10 seconds after recovery. However, the case of instantaneous power failure is excepted.

- 100–240 V AC: Instantaneous power failure of 20 ms or less
- 24 V AC/DC: Instantaneous power failure of 1 ms

A power failure is not detected. Normal operation continues.

The following shows effects caused in "settings" and "operation status."

Alarm action	Does not continue. Alarm with stand-by function will enter stand-by status. Alarm latch will be initialized.
Setting parameter	Set contents of each parameter are retained.

Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
R.MD	Restart mode	EASY	0: Limit output relay is de-energized at power on. 1: Limit output relay is energized at power on.	SYS Set

15.2 Power Frequency Setting

Description

The power frequency can be set by automatic detection or manually.
However, when the /DC option is specified, only manual setting is available. Set the range to the commercial frequency of the installation location.

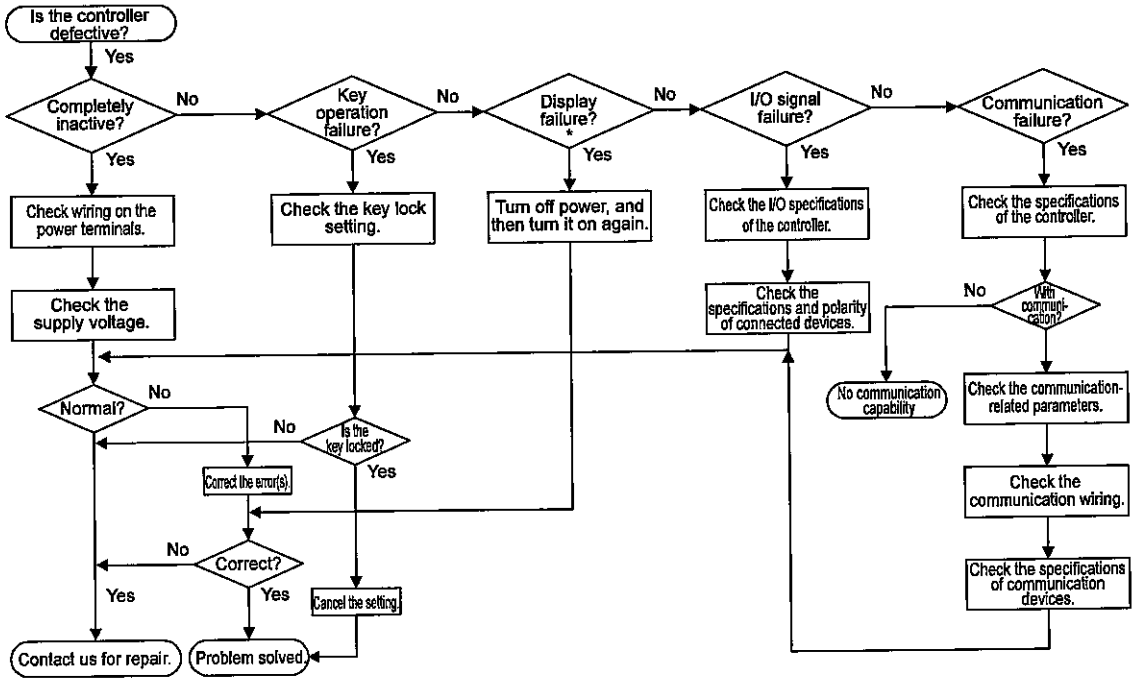
Setting Details

Parameter symbol	Name	Display level	Setting range	Menu symbol
FREQ	Power frequency	EASY	AUTO 60: 60 Hz 50: 50 Hz	SYS Set

16.1 Troubleshooting

16.1.1 Troubleshooting Flowchart

If the Operation Display does not appear after turning on the controller's power, follow the measures in the procedure below.
If a problem appears complicated, contact our sales representative.



*: The LCD (a liquid crystal display) is used for a display portion of this product. The LCD has a characteristic that the display action becomes late at the low temperature. Additionally, the luminance and contrast degradation are caused due to aged deterioration. However, the control function is not affected.

16.1.2 Errors at Power On

The errors shown below may occur in the fault diagnosis when the power is turned on.

PV display (Operation Display)	Setpint display (Operation Display)	Status indicator (Operation Display)	Parameter that displays error details	Error description	Cause and diagnosis	Remedy
Indication off	Indication off	–	–	Faulty MCU RAM / MCU ROM	MCU RAM / MCU ROM are failed.	Faulty. Contact us for repair.
ERR	SYS ——	–	–	System data error	System data is corrupted.	Faulty. Contact us for repair.
	PAR 0004 (for user default value error only)		Setup parameter (PA.ER)	User (parameter) default value error	User parameter is corrupted. Initialized to factory default value.	Check and reconfigure the initialized parameters. Error indication is erased when the power is turned on again.
	PAR 0010 (for setup parameter error only)			Setup parameter error	Setup parameter data is corrupted. Initialized to factory default value.	
	PAR 0020 (for operation parameter error only)			Operation parameter error	Operation parameter data is corrupted. Initialized to user default value.	
	SLOT 0004 (0004: Error occurs to all hardware of E3-terminal areas.)		Setup parameter (OP.ER)	Non responding hardware of extended function (E3-terminal areas)	Inconsistence of system data and hardware of extended function. Non responding communication between hardware of extended function (E3-terminal areas).	Faulty. Contact us for repair.
Normal indication	Normal indication	Rightmost decimal point on PV display blinks.	Setup parameter (PA.ER)	Calibration value error	Initialized to calibrated default value because of corrupted factory default value.	Faulty. Contact us for repair.
		Right most decimal point on Symbol display blinks.		Faulty FRAM	Writing (storing) data to FRAM is impossible.	

16.1.3 Errors during Operation

The errors shown below may occur during operation.

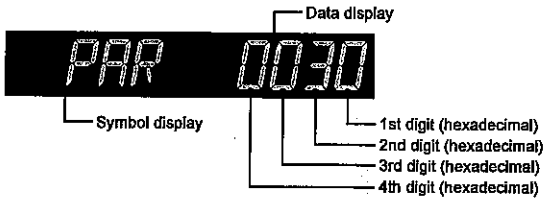
PV display (Operation Display)	Setpoint display (Operation Display)	Status Indicator (Operation Display)	Parameter that displays error details	Error description	Cause and diagnosis	Remedy
AD.ERR	Normal indication (Note)	–	Setup parameter (AD1.E)	Analog input terminal ADC error • PV input	Analog input terminal AD value error	Faulty Contact us for repair.
RJC.E (Displays RJC.E and PV alternately.)	Normal indication (Note)	–	Setup parameter (AD1.E)	Universal input terminal RJC error • PV input	Universal input terminal RJC error	Faulty Contact us for repair. Set the parameter RJC to OFF to erase error indication.
B.OUT	Normal indication (Note)	–	Setup parameter (AD1.E)	Analog input terminal burnout error • PV input	Analog input terminal sensor burnout	Check wiring and sensor. Error indication is erased in normal operation.
			Setup parameter (PV1.E)	PV input burnout error)	Burnout of analog input connected to PV	Check wiring and sensor of connected analog input terminal. Error indication is erased in normal operation.
OVER -OVER	Normal indication	–	Setup parameter (PV1.E)	PV input over-scale PV input under-scale (PV values out of -5 to 105%)	PV input is out of -5 to 105%.	Check analog input value.
Normal indication	0.000 00000 (Decimal point on the left of the Symbol display blinks)	–	Setup parameter (OP.ER)	Communication error (RS-485 communication)	Framing parity error Buffer overflow Inter-character time-out Checksum error (PC link communication with checksum) CRC check error (Modbus/RTU) LRC check error (Modbus/ASCII)	Check the communication parameters. Recovery at normal receipt. Hold down any key to stop blinking.
Undefined	Undefined	–	–	Faulty MCU	MCU is corrupted.	Faulty Contact us for repair.
Undefined	Undefined	–	–	Faulty DCU (ROM/RAM error, corrupted)	DCU is corrupted.	Faulty Contact us for repair.

Note: When an error occurs in input shown in Analog input display (Operation display).
Setpoint display shows the same symbol as the PV display.

Hexadecimal Display on Setpoint Display (Operation Display)

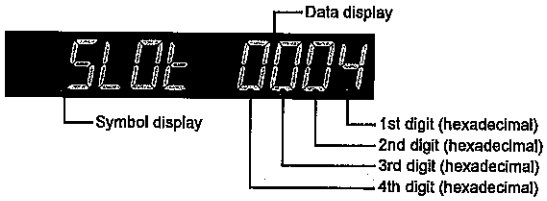
Some error codes are displayed in hexadecimal.
When the error occurs, "1" is set on the bit of corresponding error, and the bit data is displayed in hexadecimal.

If the setup parameter error or the operation parameter errors occur, it is displayed as follows:



Displayed digit	bit	Description
1st digit	0	System data error
	1	Calibration value error
	2	User (parameter) default value error
	3	–
2nd digit	4	Setup parameter error
	5	Operation parameter error
	6	–
	7	–
3rd digit	8	Faulty FRAM
	9	–
	10	Control parameter error
	11	–
4th digit	12	–
	13	–
	14	–
	15	–

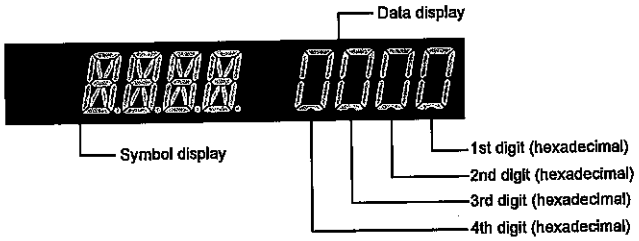
If the hardware in E3-terminal area does not respond, it is displayed as follows:



Displayed digit	bit	Description
1st digit	0	–
	1	–
	2	Non responding hardware in E3-terminal area
	3	–
2nd digit	4	–
	5	–
	6	–
	7	–
3rd digit	8	–
	9	–
	10	Communication error in E3-terminal area
	11	–
4th digit	12	–
	13	–
	14	–
	15	–

Hexadecimal Display of the Parameter which Shows the Error Details

Error confirmation parameters are displayed in hexadecimal.
When the error occurs, "1" is set on the bit of corresponding error.



Parameter PA.ER

Displayed digit	bit	Description
1st digit	0	System data error
	1	Calibration value error
	2	User (parameter) default value error
	3	–
2nd digit	4	Setup parameter error
	5	Operation parameter error
	6	–
	7	–
3rd digit	8	Faulty FRAM
	9	–
	10	Control parameter error
	11	–
4th digit	12	–
	13	–
	14	–
	15	–

Parameter OP.ER

Displayed digit	bit	Description
1st digit	0	–
	1	–
	2	Non responding hardware in E3-terminal area
	3	–
2nd digit	4	–
	5	–
	6	–
	7	–
3rd digit	8	–
	9	–
	10	Communication error in E3-terminal area
	11	–
4th digit	12	–
	13	–
	14	–
	15	–

Parameter AD1.E

Displayed digit	bit	Description
1st digit	0	ADC error of PV input
	1	–
	2	–
	3	–
2nd digit	4	–
	5	RJC error of PV input
	6	–
	7	–
3rd digit	8	PV input burnout error
	9	–
	10	–
	11	–
4th digit	12	–
	13	–
	14	–
	15	–

Parameter PV1.E

Displayed digit	bit	Description
1st digit	0	PV input burnout error
	1	–
	2	–
	3	–
2nd digit	4	PV input over-scale
	5	PV input under-scale
	6	–
	7	–
3rd digit	8	–
	9	–
	10	–
	11	–
4th digit	12	–
	13	–
	14	–
	15	–

16.2 Maintenance

16.2.1 Cleaning

The front panel and operation keys should be gently wiped with a cloth soaked with water and squeezed firmly.

CAUTION

In order to prevent LCD from static electricity damage, do not wipe with dry cloth.
(When LCD is electrified, it returns to normal in several minutes.)
Do not use alcohol, benzene, or any other solvents.

16.2.2 Packaging when Shipping the Product for Repair

Should the instrument break down and need to be shipped to our sales representative for repair, handle it as noted below:

CAUTION

Write down the settings of parameters for a repair request.

WARNING

Prior to shipping the instrument, put it into an antistatic bag and repackage it using the original internal packaging materials and packaging container.

16.2.3 Replacing Parts

Do not replace any parts inside the unit.

16.3 Periodic Maintenance

Check the operating condition periodically to use this instrument with good condition.

16.4 Disposal

When disposing of this instrument, arrange for appropriate disposal as industrial waste according to the rules of a country, the area, or a local government.

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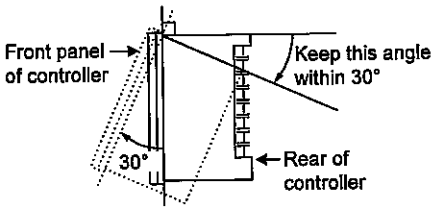
17.1 Installation Location

The instrument should be installed in indoor locations meeting the following conditions:

- Instrumented panel
  This instrument is designed to be mounted in an instrumented panel. Mount the instrument in a location where its terminals will not inadvertently be touched.
- Well ventilated locations
  Mount the instrument in well ventilated locations to prevent the instrument's internal temperature from rising. However, make sure that the terminal portions are not exposed to wind. Exposure to wind may cause the temperature sensor accuracy to deteriorate. To mount multiple indicating controllers, see the external dimensions/ panel cutout dimensions which follow. If mounting other instruments adjacent to the instrument, comply with these panel cutout dimensions to provide sufficient clearance between the instruments.
- Locations with little mechanical vibration
  Install the instrument in a location subject to little mechanical vibration.
- Horizontal location
  Mount the instrument horizontally and ensure that it is level, with no inclination to the right or left.

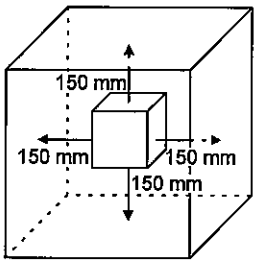


Note

If the instrument is moved from a location with low temperature and low humidity to a place with high temperature and high humidity, or if the temperature changes rapidly, condensation will result. Moreover, in the case of thermocouple inputs, measurement errors will result. To avoid such a situation, leave the instrument in the new environment under ambient conditions for more than 1 hour prior to using it.

Do not mount the instrument in the following locations:

- Outdoors
- Locations subject to direct sunlight, ultrared rays, ultraviolet rays, or close to a heater
  Install the instrument in a location with stable temperatures that remain close to an average temperature of 23°C. Do not mount it in locations subject to direct sunlight or close to a heater. Doing so adversely affects the instrument and LCD.
- Locations with substantial amounts of oily fumes, steam, moisture, dust, or corrosive gases
  The presence of oily fumes, steam, moisture, dust, or corrosive gases adversely affects the instrument. Do not mount the instrument in locations subject to any of these substances.
- Areas near electromagnetic field generating sources
  Do not place magnets or tools that generate magnetism near the instrument. If the instrument is used in locations close to a strong electromagnetic field generating source, the magnetic field may cause measurement errors.
- Locations where the display is difficult to see
  The instrument uses an LCD for the display unit, and this can be difficult to see from extremely oblique angles. Mount the instrument in a location where it can be seen as much as possible from the front.
- Areas close to flammable articles
  Absolutely do not place the instrument directly on flammable surfaces. If such a circumstance is unavoidable and the instrument must be placed close to a flammable item, provide a shield for it made of 1.43 mm thick plated steel or 1.6 mm thick unplated steel with a space of at least 150 mm between it and the instrument on the top, bottom and sides.



- Areas subject to being splashed with water

17.2 Mounting Method

WARNING

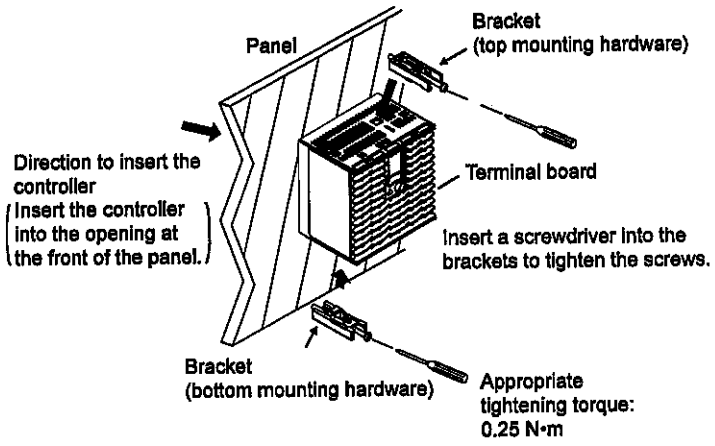
Be sure to turn OFF the power supply to the controller before installing it on the panel to avoid an electric shock.

Mounting the Instrument Main Unit

Provide an instrumented panel steel sheet of 1 to 10 mm thickness.

After opening the mounting hole on the panel, follow the procedures below to install the controller:

1. Insert the controller into the opening from the front of the panel so that the terminal board on the rear is at the far side.
2. Set the brackets in place on the top and bottom of the controller as shown in the figure below, then tighten the screws of the brackets. Take care not to overtighten them.



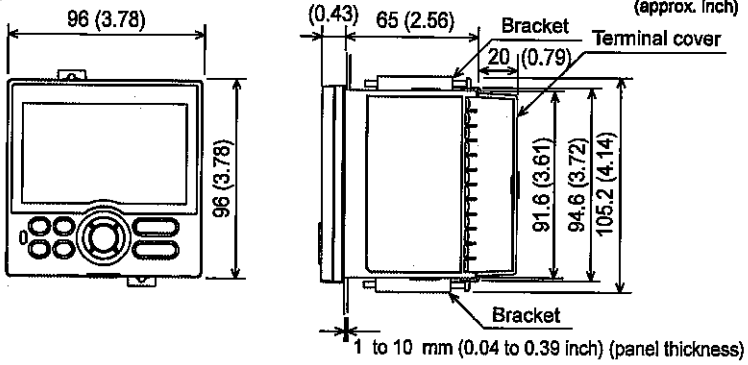
To uninstall the controller, perform the procedure in the reverse order.

CAUTION

1) Tighten the screws with appropriate tightening torque within 0.25 N•m. Otherwise it may cause the case deformation or the bracket damage.
2) Make sure that foreign materials do not enter the inside of the instrument through the case's slit holes.

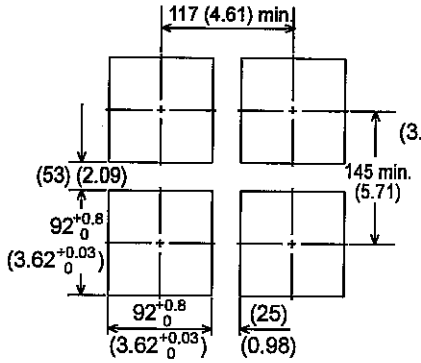
17.3 External Dimensions and Panel Cutout Dimensions

UT35A-L

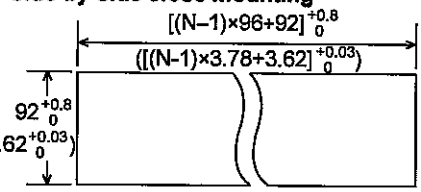


Unit: mm
(approx. inch)

General mounting



Side-by-side close mounting



"N" stands for the number of controllers to be installed.
However, the measured value applies if N≥5.

Normal tolerance:
±(value of JIS B 0401-1998 tolerance class IT18)/2

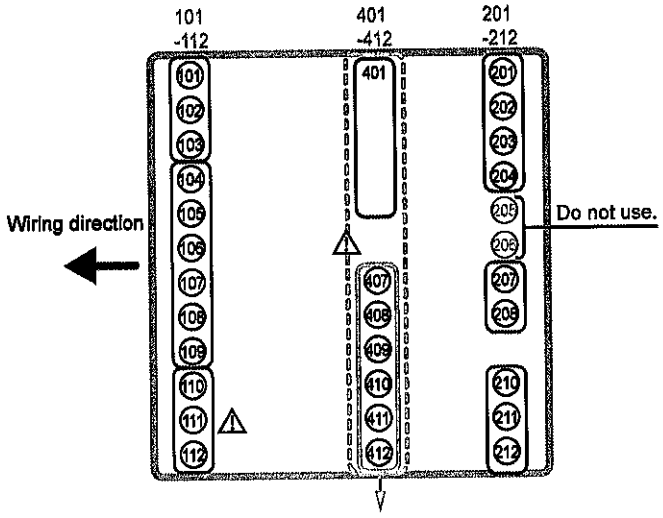
17.4 Wiring

17.4.1 Important Information on Wiring

WARNING

1) Be sure to turn OFF the power supply to the controller before wiring to avoid an electric shock. Use a tester or similar device to ensure that no power is being supplied to a cable to be connected.
2) Wiring work must be carried out by a person with basic electrical knowledge and practical experience.

UT35A-L Terminal Block Diagram



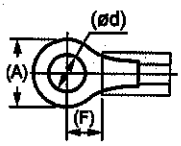
CAUTION

- When connecting two or more crimp-on terminal lugs to the single terminal block, bend the crimp-on terminal lugs before tightening the screw.
- Note that the wiring of two or more crimp-on terminal lugs to the single high-voltage terminal of the power supply and relay, etc. does not comply with the safety standard.

CAUTION

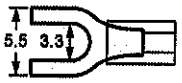
Do not use an unassigned terminal as the relay terminal.

Recommended Crimp-on Terminal Lugs



Recommended tightening torque: 0.6 N·m
Applicable wire size: Power supply wiring 1.25 mm^2 or more

Applicable terminal lug	Applicable wire size mm^2 (AWG#)	(ød)	(A)	(F)
M3	0.25 to 1.65 (22 to 16)	3.3	5.5	4.2



Cable Specifications

Purpose	Name and Manufacturer
Power supply, relay contact output	600 V Grade heat-resistant PVC insulated wires, JIS C 3317(HIV), 0.9 to 2.0 mm^2
Thermocouple	Shielded compensating lead wire JISC1610
RTD	Shielded wire (three/four conductors) UL2482 (Hitachi Cable)
Other signals (other than contact input/output)	Shielded wires
Other signals (contact input/output)	Non shielded wires
RS485 communication	Shielded wires
Ethernet communication	100 BASE-TX (CAT-5) / 10 BASE-T

Recommended tightening torque: 0.5 to 0.6 N·m

Note

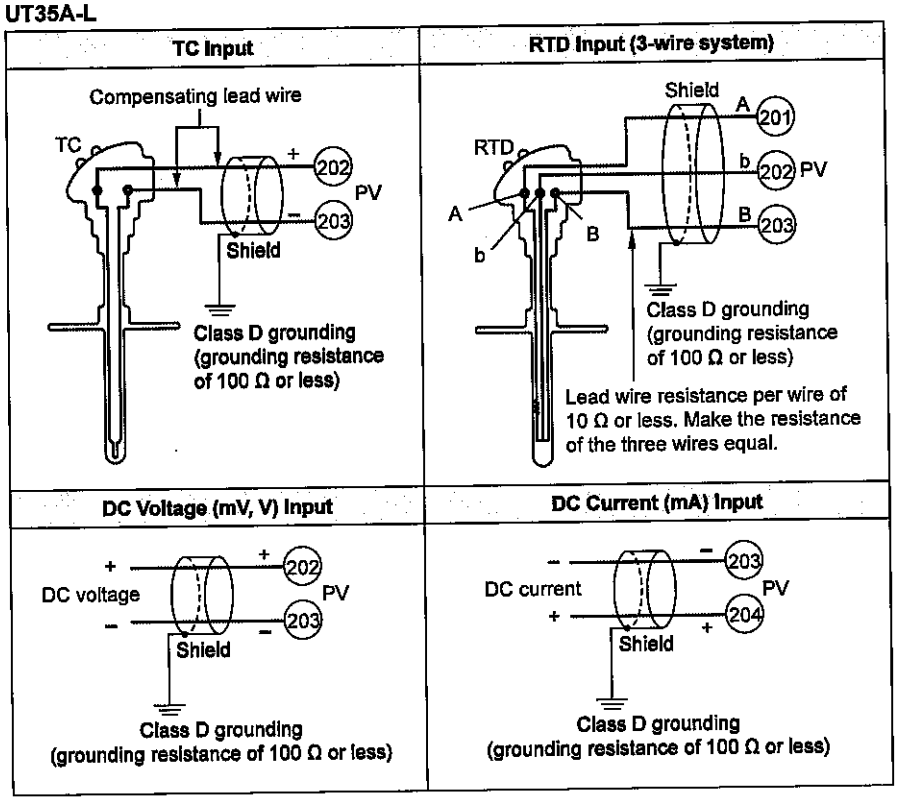
Communication wires of cross-sectional area less than or equal to 0.34 mm^2 may not be secured firmly to the terminals.
Check that the wire is firmly connected to the terminal by folding the conductor of the wire connected to the climp-on lug.
Recommended length of the stripped wire: 7 mm

17.4.2 PV Input Wiring

CAUTION

1) Be careful of polarity when wiring inputs. Reversed polarity can damage the UT.
2) Keep the PV input signal line as far away as possible from the power supply circuit and ground circuit.
3) For TC input, use shielded compensating lead wires for wiring. For RTD input, use shielded wires that have low conductor resistance and cause no significant differences in resistance between the three wires.
4) If there is a risk of external lightning surges, use a lightning arrester etc.

UT35A-L



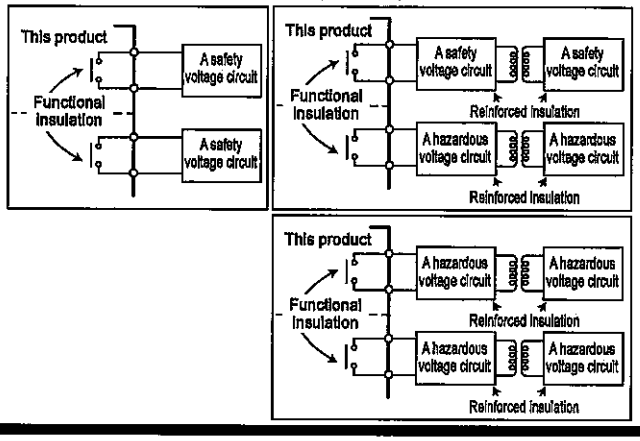
Use

PV input is used for PV input.

17.4.3 Limit Control Output (Relay) Wiring

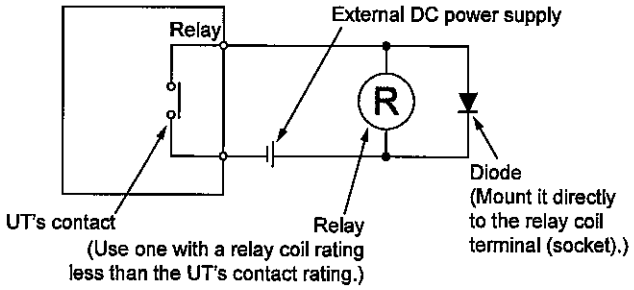
CAUTION

1) The use of inductance (L) loads such as auxiliary relays, motors and solenoid valves causes malfunction or relay failure; always insert a CR filter for use with alternating current or a diode for use with direct current, as a spark-removal surge suppression circuit, into the line in parallel with the load.
2) If there is a risk of external lightning surges, use a lightning arrester etc.
3) Relays cannot be used for a small load of 10 mA or less.
4) Since the insulation provided to each relay output terminal is Functional insulation, provide Reinforced insulation to the external of the device as necessary. (Refer to the drawing below.)



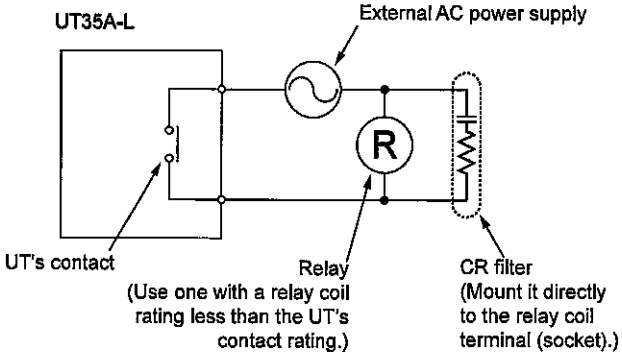
DC Relay Wiring

UT35A-L



AC Relay Wiring

UT35A-L



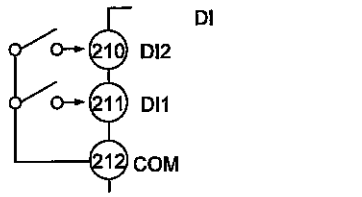
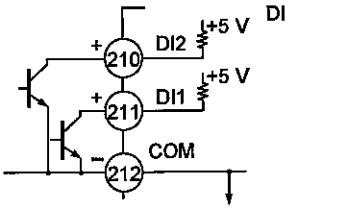
17.4.4 Contact Input Wiring

CAUTION

1) Use a no-voltage contact (relay contact etc.) for external contacts.
2) Use a no-voltage contact which has ample switching capacity for the terminal's OFF voltage (approx. 5V) and ON current (approx 1mA).
3) When using a transistor contact, the voltage at both terminals must be 2 V or less when the contact is ON and the leakage current must be 100 µA or less when it is OFF.
4) If there is a risk of external lightning surges, use a lightning arrester etc.

UT35A-L

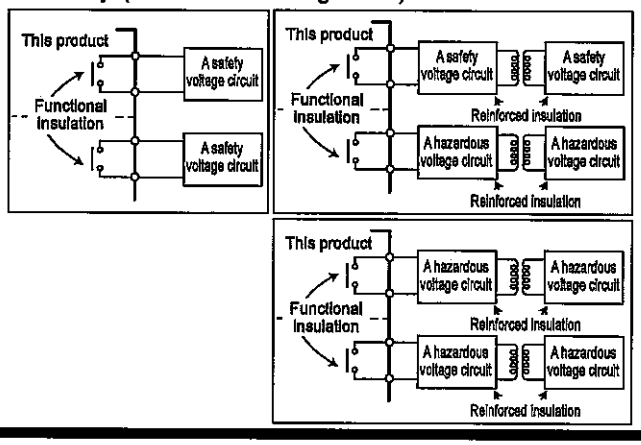
Contact Input Equipped as Standard

No-voltage contact	Transistor contact
 Contact rating: 12 V DC, 10 mA or more	 Contact rating: 12 V DC, 10 mA or more

17.4.5 Contact Output Wiring

CAUTION

1) Use an auxiliary relay for load-switching if the contact rating is exceeded.
2) Connect a bleeder resistor when a small current is used, so that a current exceeding 10 mA can be supplied.
3) The output relay has a limited service life. Be sure to connect a CR filter (for AC) or diode (for DC) to the load.
4) If there is a risk of external lightning surges, use a lightning arrester etc.
5) Since the insulation provided to each relay output terminal is Functional insulation, provide Reinforced insulation to the external of the device as necessary. (Refer to the drawing below.)

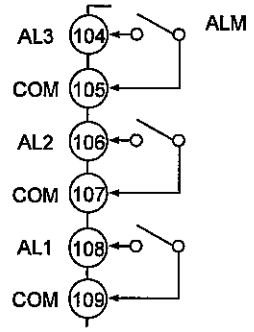


► When using auxiliary relay: 17.4.3 Limit Control Output (Relay) Wiring

UT35A-L

Contact Output Equipped as Standard

Relay contact



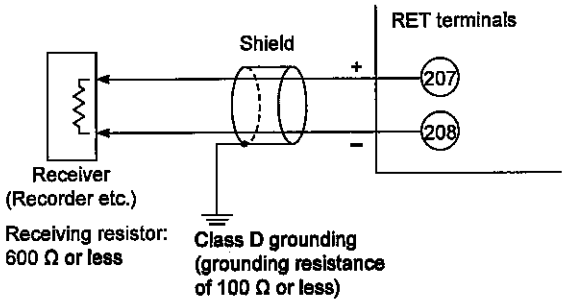
Contact rating: 240 V AC, 1 A
30 V DC, 1 A (resistance load)

The following table shows the initial status.

AL1 terminal	AL2 terminal	AL3 terminal
Alarm 1 (PV high limit)	Alarm 2 (PV low limit)	Alarm 3 (PV high limit)

17.4.6 Retransmission Output Wiring

The current output range can be changed.



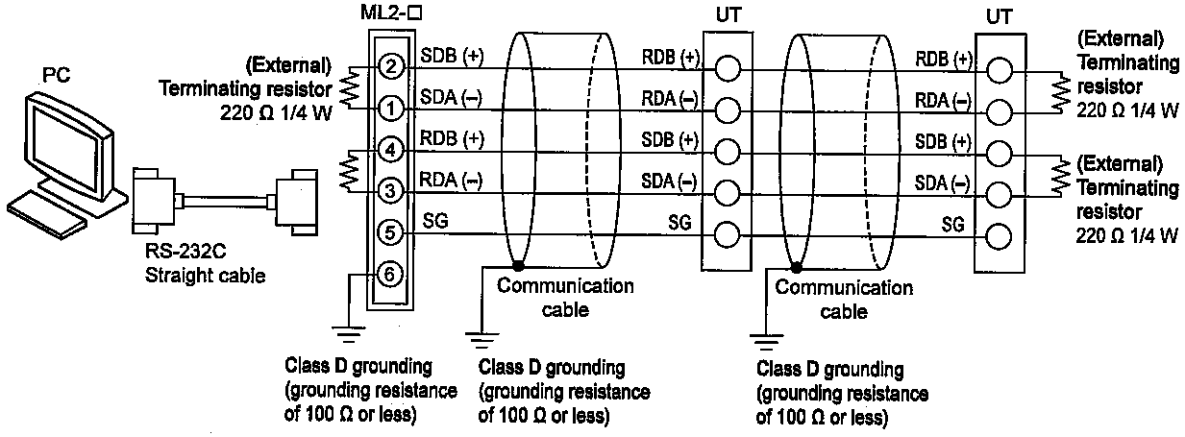
17.4.7 RS-485 Communication Interface Wiring

Wire as follows for Modbus communication, PC link communication, or ladder communication.

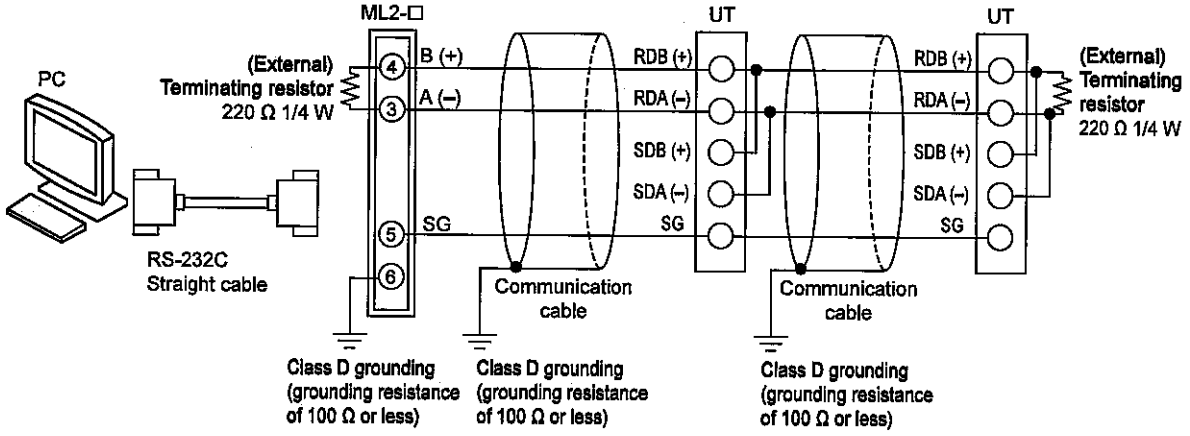
Always connect a terminating resistor to the station at the end of the communication line.

► Details of communication parameter settings and communication functions: UTAdvanced Series Communication Interface (RS-485, Ethernet) User's Manual

4-wire Wiring



2-wire Wiring of 4-wire Terminal



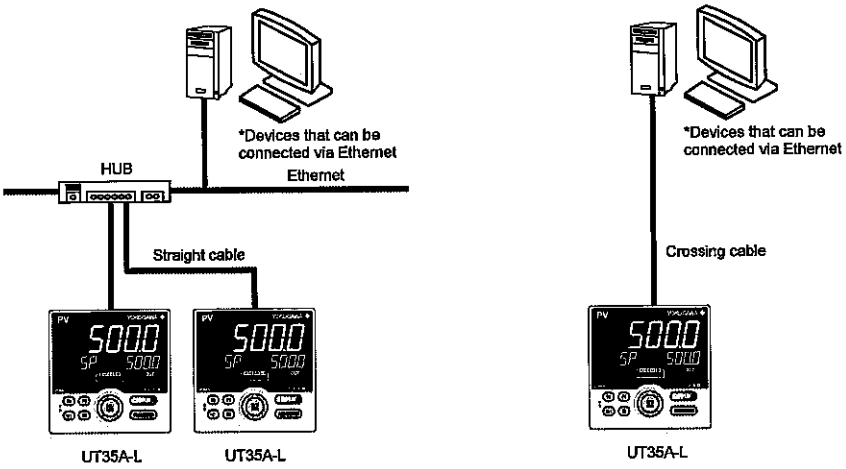
UT35A-L

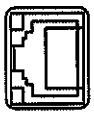
Terminal symbol above	UT35A-L (For Standard model) Suffix code: Type 3 = "1"
RDB (+)	410
RDA (–)	411
SDB (+)	407
SDA (–)	408
SG	409

Note

ML2-x indicates a converter of YOKOGAWA. Other than this, RS232C/RS485 converters can also be used. If another converter is to be used, check the electrical specifications of the converter before using it.

17.4.8 Ethernet Communication Interface Wiring





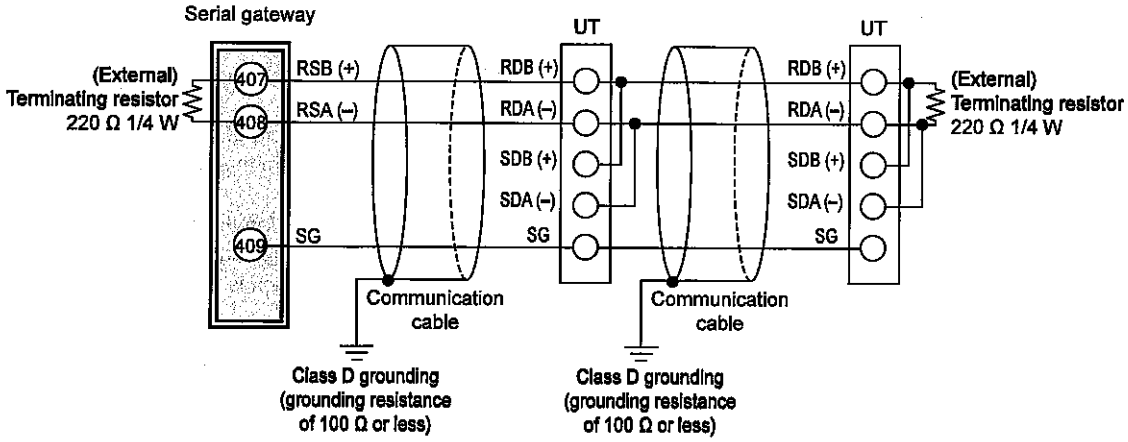
Upper side LED (baud rate)		Lower side LED (link activity)	
Color	Amber	Color	Green
Lit	100M bps	Lit	Linked
Unlit	10M bps	Blink	Active
		Unlit	Link failure

CAUTION

Be sure to connect a lightning arrester for Ethernet (100BASE-TX/10BASE-T) in an environment where a surge voltage may be induced by a lightning discharge.

RS-485 communication wiring for the serial gateway function is as follows.

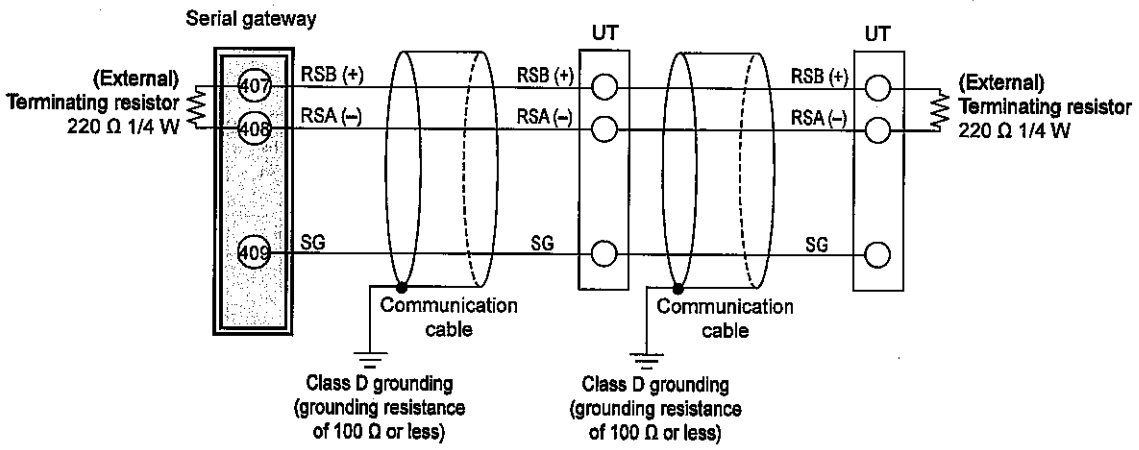
2-wire Wiring of 4-wire Terminal



Slave terminals

Terminal symbol above	UT35A-L (For Standard model) Suffix code: Type 3 = "1" (For Detailed model) Optional suffix code: /CH3
RDB (+)	410
RDA (–)	411
SDB (+)	407
SDA (–)	408
SG	409

2-wire Wiring



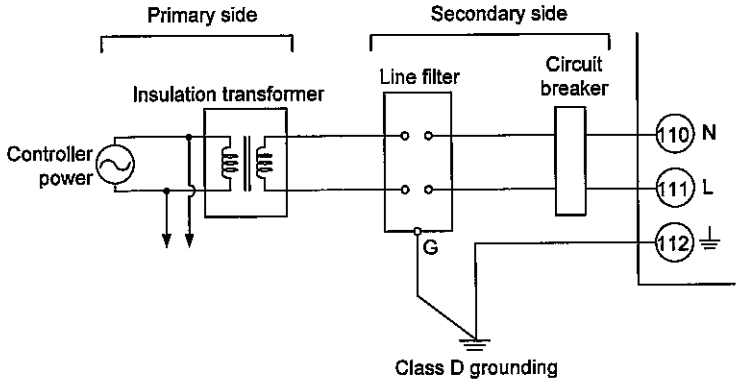
17.4.9 Power Supply Wiring

WARNING

1) Wiring work must be carried out by a person with basic electrical knowledge and practical experience.
2) Be sure to turn OFF the power supply to the controller before wiring to avoid an electric shock. Use a tester or similar device to ensure that no power is being supplied to a cable to be connected.
3) As a safety measure, always install a circuit breaker (an IEC 60947-compatible product, 5 A, 100 V or 220 V AC) in an easily accessible location near the instrument. Moreover, provide indication that the switch is a device for turning off the power to the instrument.
4) Install the power cable keeping a distance of more than 1 cm from other signal wires.
5) The power cable is required to meet the IEC standards concerned or the requirements of the area in which the instrument is being installed.
6) Wiring should be installed to conform to NEC (National Electrical Code: ANSI/ NFPA-70) or the wiring construction standards in countries or regions where wiring will be installed.
7) Be sure to use a heat-resistant cable for control output, alarm output, and power wiring.

CAUTION

1) Provide electricity from a single-phase power supply. If the power is noisy, install an isolation transformer on the primary side, and use a line filter on the secondary side. When measures against noise are taken, do not install the primary and secondary power cables close to each other.
2) If there is a risk of external lightning surges, use a lightning arrester etc.

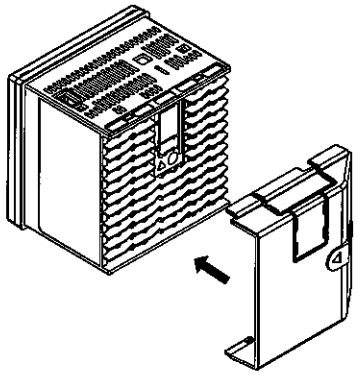


17.5 Attaching and Detaching Terminal Cover

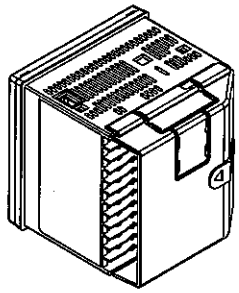
After completing the wiring, the terminal cover is recommended to use for the instrument.

Attaching Method

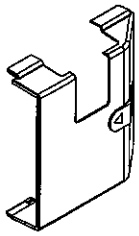
(1) Attach the terminal cover to the rear panel of the main unit horizontally.



(2) The following figure is a mounting image.

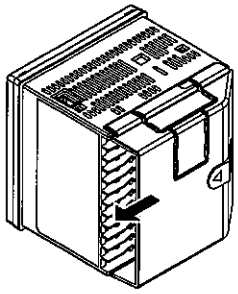


When Ethernet communication is specified, cut and use a terminal cover as follows.
Cut the cover carefully using nippers etc. so that sharp edge does not remain.



Detaching Method

(1) Slide the terminal cover to the direction of the printed arrow.



18.1 Parameter Map

Brief Description of Parameter Map

Group Display

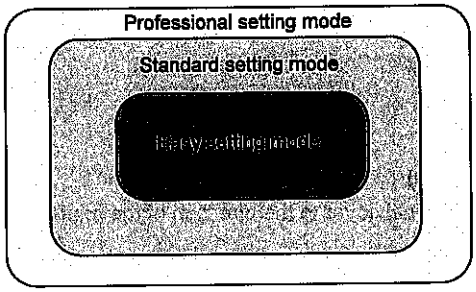
"E3" appearing in the parameter map are displayed on Group display (7 segments, 2 digits) while the menu or parameter is displayed.

E3: indicates the parameter in E3-terminal area

Parameter Display Level

The marks below appearing next to the menu symbol and parameter symbol in the parameter map indicate the display/non-display level.

Mark	Display	Display level	Description
None	EASY	Easy setting mode: Displays the minimum parameters.	Corresponding parameters are displayed in all modes.
Ⓢ	STD	Standard setting mode: Displays a wider range of parameters than displayed in the Easy setting mode.	Corresponding parameters are displayed only in Standard setting mode and Professional setting mode. Parameter display level indicators "EASY" and "PRO" are unlit in Standard setting mode. *: "STD" is the symbol used in this manual only.
Ⓟ	PRO	Professional setting mode: Displays all parameters.	Corresponding parameters are displayed only in Professional setting mode.



► Display level: 13.3.2 Setting Parameter Display Level

Function of Each Menu

The parameters in the menu of the following table indicate the parameters to set the functions necessary for operation.

Menu symbol	Function
SP	SP and alarm setpoint
SPS	SP-related function
ALRM	Alarm function
PVS	PV-related function

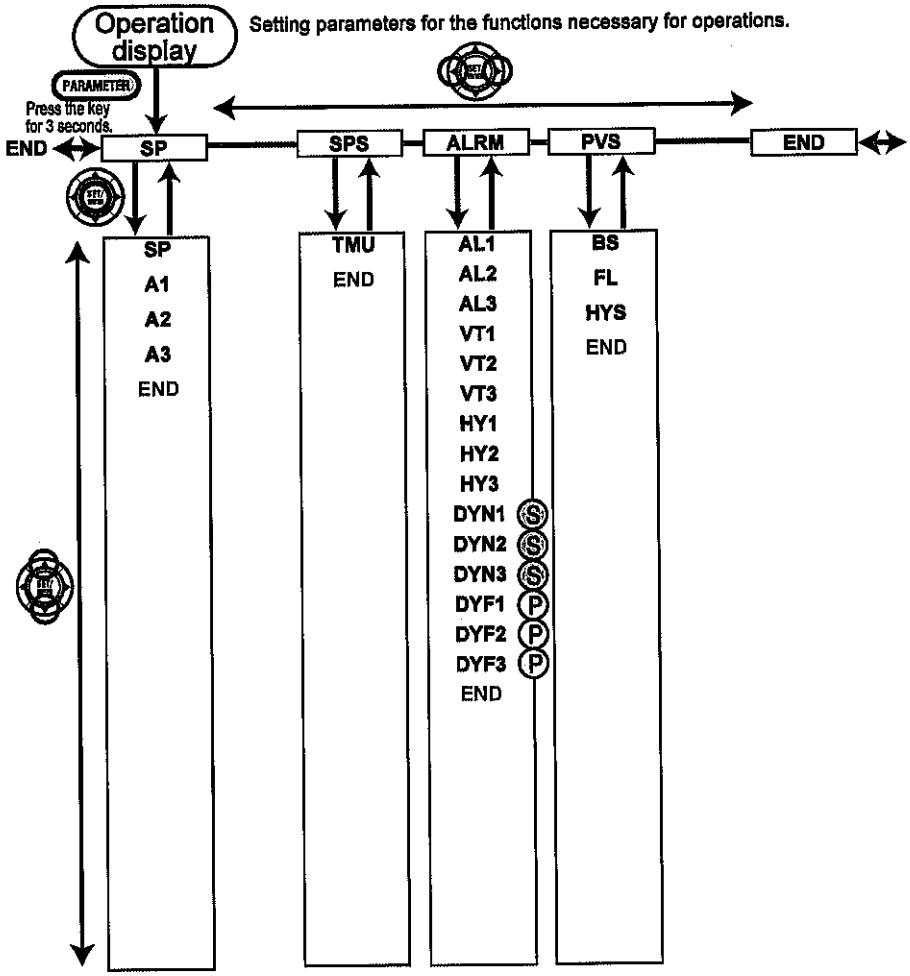
The parameters in the menu of the following table indicate the parameters to set the basic functions of the controller. The symbol in parentheses are shown on Group display.

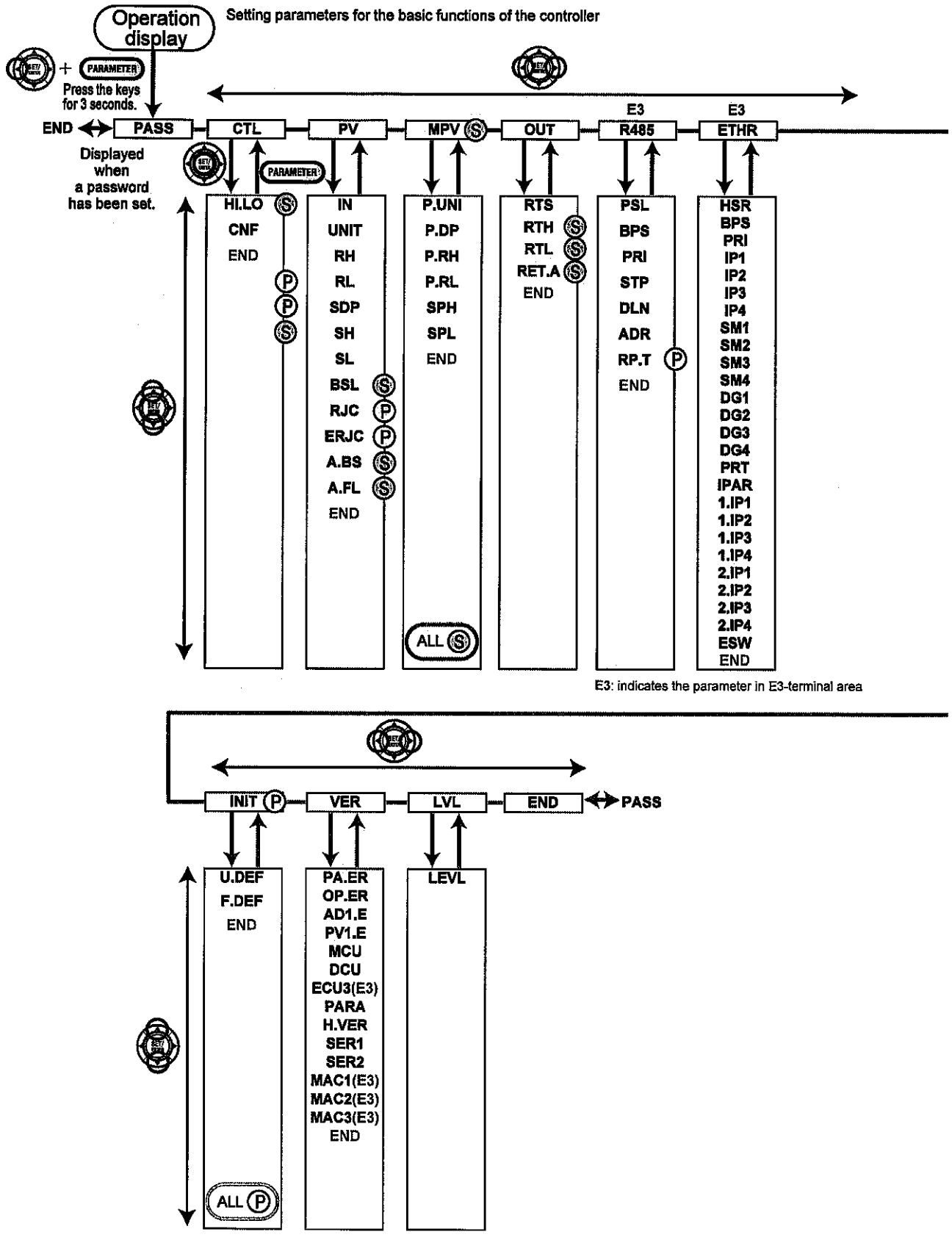
Menu symbol	Functions
PASS	Password setting (Displayed only when the password has been sent.)

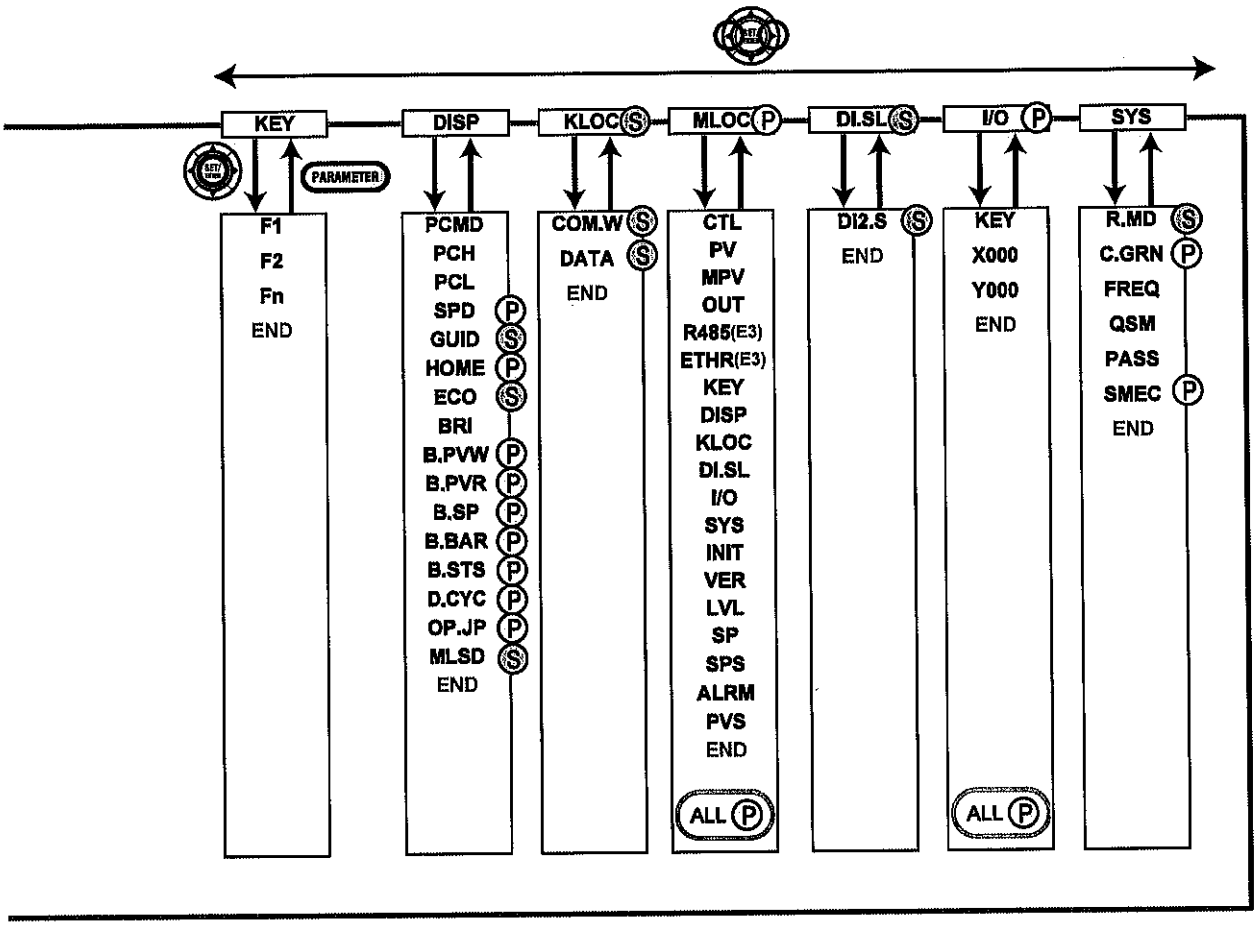
Menu symbol	Functions
CTL	Limit control type, the way of confirming operation
PV	PV input type, range, scale, etc
MPV	Input range, SP limiters
OUT	Retransmission output
R485 (E3)	RS-485 communication (E3-terminal area)
ETHR (E3)	Ethernet communication, gateway setting, IP access restriction, etc. (E3-terminal area)
KEY	Function of User function key
DISP	Display functions
KLOC	Key lock
MLOC	Parameter menu lock
DI.SL	Contact input function
I/O	Input / output data display
SYS	Action setting when recovering from a power failure, password setting, etc
INIT	Initialization of parameter
VER	Error status, version, MAC address, etc
LVL	Parameter display level

Note

Some parameters are not displayed according to the setting such as input and output.


Operation display
Setting parameters for the functions necessary for operations.
PARAMETER
Press the key for 3 seconds.
END
SP
SPS
ALRM
PVS
END
SP
A1
A2
A3
END
TMU
END
AL1
AL2
AL3
VT1
VT2
VT3
HY1
HY2
HY3
DYN1
DYN2
DYN3
DYF1
DYF2
DYF3
END
BS
FL
HYS
END


Operation display
Setting parameters for the basic functions of the controller
+ PARAMETER
Press the keys for 3 seconds.
END
PASS
CTL
PV
MPV
OUT
E3 R485
E3 ETHR
Displayed when a password has been set.
PARAMETER
HI.LO
CNF
END
IN
UNIT
RH
RL
SDP
SH
SL
BSL
RJC
ERJC
A.BS
A.FL
END
P.UNI
P.DP
P.RH
P.RL
SPH
SPL
END
ALL
RTS
RTH
RTL
RET.A
END
PSL
BPS
PRI
STP
DLN
ADR
RP.T
END
HSR
BPS
PRI
IP1
IP2
IP3
IP4
SM1
SM2
SM3
SM4
DG1
DG2
DG3
DG4
PRT
IPAR
1.IP1
1.IP2
1.IP3
1.IP4
2.IP1
2.IP2
2.IP3
2.IP4
ESW
END
E3: indicates the parameter in E3-terminal area
INIT
VER
LVL
END
PASS
U.DEF
F.DEF
END
ALL
PA.ER
OP.ER
AD1.E
PV1.E
MCU
DCU
ECU3(E3)
PARA
H.VER
SER1
SER2
MAC1(E3)
MAC2(E3)
MAC3(E3)
END
LEVL


KEY
DISP
KLOC (S)
MLOC (P)
DI.SL (S)
I/O (P)
SYS
PARAMETER
F1
F2
Fn
END
PCMD
PCH
PCL
SPD (P)
GUID (S)
HOME (P)
ECO (S)
BRI
B.PVW (P)
B.PVR (P)
B.SP (P)
B.BAR (P)
B.STS (P)
D.CYC (P)
OP.JP (P)
MLSD (S)
END
COM.W (S)
DATA (S)
END
CTL
PV
MPV
OUT
R485(E3)
ETHR(E3)
KEY
DISP
KLOC
DI.SL
I/O
SYS
INIT
VER
LVL
SP
SPS
ALRM
PVS
END
ALL (P)
DI2.S (S)
END
KEY
X000
Y000
END
ALL (P)
R.MD (S)
C.GRN (P)
FREQ
QSM
PASS
SMEC (P)
END

18.2 List of Parameters

18.2.1 Operation Parameters

SP and Alarm Setpoint Setting Menu (Menu: SP)

Parameter symbol	Name	Display level	Setting range	Initial value
SP	Target setpoint	EASY	0.0 to 100.0% of PV input range (EU) (Setting range: SPL to SPH)	SPH
A1 to A3	Alarm-1 to -3 setpoint	EASY	Set a display value of setpoint of PV alarm, deviation alarm, or velocity alarm. -19999 to 30000 (Set a value within the input range.) Decimal point position depends on the input type.	0

SP-related Setting Menu (Menu: SPS)

Parameter symbol	Name	Display level	Setting range	Initial value
TMU	Time unit for duration time	EASY	HH.MM: Hour and minute MM.SS: Minute and second	HH.MM

Alarm Function Setting Menu (Menu: ALRM)

Parameter symbol	Name	Display level	Setting range	Initial value
AL1 to AL3	Alarm-1 to -3 type	EASY	Set a 5-digit value in the following order. [Alarm type: 2 digits (see below)] + [Without (0) or With (1) Stand-by action] + [Energized (0) or De-energized (1)] + [Latch action (0/1/2/3/4)] For latch action, see chapter 11. Alarm type: 2 digits 00: Disable 01: PV high limit 02: PV low limit 05: Deviation high limit 06: Deviation low limit 07: Deviation high and low limits 08: Deviation within high and low limits 29: PV velocity 30: Fault diagnosis 31: FAIL	AL1, AL3: PV high limit (01) Without Stand-by action (0) Energized (0) Latch action (0) AL2: PV low limit (02) Without Stand-by action (0) Energized (0) Latch action (0)
VT1 to VT3	PV velocity alarm time setpoint 1 to 3	EASY	0.01 to 99.59 (minute.second)	1.00
HY1 to HY3	Alarm-1 to -3 hysteresis	EASY	Set a display value of setpoint of hysteresis. -19999 to 30000 (Set a value within the input range.) Decimal point position depends on the input type. When the decimal point position for the input type is set to "1", the initial value of the hysteresis is "1.0".	10
DYN1 to DYN3	Alarm-1 to -3 On-delay timer	STD	0.00 to 99.59 (minute.second)	0.00
DYF1 to DYF3	Alarm-1 to -3 Off-delay timer	PRO		0.00

PV-related Setting Menu (Menu: PVS)

Parameter symbol	Name	Display level	Setting range	Initial value
BS	PV input bias	EASY	-100.0 to 100.0% of PV input range span (EUS)	0.0 % of PV input range span
FL	PV input filter	EASY	OFF, 1 to 120 s	OFF
HYS	Limit control output hysteresis	EASY	0.0 to 100.0% of PV input range span (EUS)	0.5% of PV input range span

18.2.2 Setup Parameters

Control Function Setting Menu (Menu: CTL)

Parameter symbol	Name	Display level	Setting range	Initial value
HI.LO	Limit control type	EASY	LOW: Low limit control HIGH: High limit control	HIGH
CNF	The way of confirming operation	EASY	KEY: By key operation DI: By DI	KEY

PV Input Setting Menu (Menu: PV)

Parameter symbol	Name	Display level	Setting range	Initial value
IN	PV input type	EASY	OFF: Disable K1: -270.0 to 1370.0 (°C) / -450.0 to 2500.0 (°F) K2: -270.0 to 1000.0 (°C) / -450.0 to 2300.0 (°F) K3: -200.0 to 500.0 (°C) / -200.0 to 1000.0 (°F) J: -200.0 to 1200.0 (°C) / -300.0 to 2300.0 (°F) T1: -270.0 to 400.0 (°C) / -450.0 to 750.0 (°F) T2: 0.0 to 400.0 (°C) / -200.0 to 750.0 (°F) B: 0.0 to 1800.0 (°C) / 32 to 3300 (°F) S: 0.0 to 1700.0 (°C) / 32 to 3100 (°F) R: 0.0 to 1700.0 (°C) / 32 to 3100 (°F) N: -200.0 to 1300.0 (°C) / -300.0 to 2400.0 (°F) E: -270.0 to 1000.0 (°C) / -450.0 to 1800.0 (°F) L: -200.0 to 900.0 (°C) / -300.0 to 1600.0 (°F) U1: -200.0 to 400.0 (°C) / -300.0 to 750.0 (°F) U2: 0.0 to 400.0 (°C) / -200.0 to 1000.0 (°F) W: 0.0 to 2300.0 (°C) / 32 to 4200 (°F) PL2: 0.0 to 1390.0 (°C) / 32.0 to 2500.0 (°F) P2040: 0.0 to 1900.0 (°C) / 32 to 3400 (°F) WRE: 0.0 to 2000.0 (°C) / 32 to 3600 (°F) JPT1: -200.0 to 500.0 (°C) / -300.0 to 1000.0 (°F) JPT2: -150.00 to 150.00 (°C) / -200.0 to 300.0 (°F) PT1: -200.0 to 850.0 (°C) / -300.0 to 1560.0 (°F) PT2: -200.0 to 500.0 (°C) / -300.0 to 1000.0 (°F) PT3: -150.00 to 150.00 (°C) / -200.0 to 300.0 (°F) 0.4-2V: 0.400 to 2.000 V 1-5V: 1.000 to 5.000 V 4-20: 4.00 to 20.00 mA 0-2V: 0.000 to 2.000 V 0-10V: 0.00 to 10.00 V 0-20: 0.00 to 20.00 mA -1020: -10.00 to 20.00 mV 0-100: 0.0 to 100.0 mV Note: W: W-5% Re/W-26% Re (Hoskins Mfg. Co.), ASTM E988 WRE: W97Re3-W75Re25	OFF
UNIT	PV input unit	EASY	-: No unit C: Degree Celsius -: No unit —: No unit —: No unit F: Degree Fahrenheit	C
RH	Maximum value of PV input range	EASY	Depends on the input type. - For temperature input - Set the temperature range that is actually controlled. (RL<RH) - For voltage / current input - Set the range of a voltage / current signal that is applied. The scale across which the voltage / current signal is actually controlled should be set using the maximum value of input scale (SH) and minimum value of input scale (SL). (Input is always 0% when RL = RH.)	Depends on the input type
RL	Minimum value of PV input range	EASY		Depends on the input type

PV Input Setting Menu (Menu: PV) (Continued from previous page)

Parameter symbol	Name	Display level	Setting range	Initial value
SDP	PV input scale decimal point position	EASY	0: No decimal place 1: One decimal place 2: Two decimal places 3: Three decimal places 4: Four decimal places	Depends on the input type
SH	Maximum value of PV input scale	EASY	-19999 to 30000, (SL<SH), | SH - SL | ≤ 30000	Depends on the input type
SL	Minimum value of PV input scale	EASY		Depends on the input type
BSL	PV input burnout action	STD	OFF: Disable UP: Upscale DOWN: Downscale	Depends on the input type
RJC	PV input reference junction compensation	PRO	OFF: RJC OFF ON: RJC ON	ON
ERJC	PV input external RJC setpoint	PRO	-10.0 to 60.0 (°C) or 14.0 to 140.0 (°F)	0.0
A.BS	PV analog input bias	STD	-100.0 to 100.0% of PV input range span (EUS)	0.0 % of PV input range span
A.FL	PV analog input filter	STD	OFF, 1 to 120 s	OFF

Input Range / SP Limiter Setting Menu (Menu: MPV)

Parameter symbol	Name	Display level	Setting range	Initial value
P.UNI	Control PV input unit	STD	-: No unit C: Degree Celsius -: No unit --: No unit —: No unit F: Degree Fahrenheit	Same as PV input unit
P.DP	Control PV input decimal point position	STD	0: No decimal place 1: One decimal place 2: Two decimal places 3: Three decimal places 4: Four decimal places	1
P.RH	Maximum value of control PV input range	STD	-19999 to 30000, (P.RL<P.RH), | P.RH - P.RL | ≤ 30000	Depends on the input type
P.RL	Minimum value of control PV input range	STD		Depends on the input type
SPH	SP high limit	STD	0.0 to 100.0% of PV input range (EU), (SPL<SPH)	100.0 % of PV input range
SPL	SP low limit	STD		0.0 % of PV input range

Output Setting Menu (Menu: OUT)

Parameter symbol	Name	Display level	Setting range	Initial value
RTS	Retransmission output type of RET	EASY	OFF: Disable PV1: PV SP1: SP	PV1
RTH	Maximum value of retransmission output scale of RET	STD	When RTS = PV1, SP1 RTL + 1 digit to 30000 -19999 to RTH - 1 digit Decimal point position: When RTS=PV1 or SP1 decimal point position is same as that of PV input. When RTS=PV, decimal point position is same as that of PV input scale.	100 % of PV input range
RTL	Minimum value of retransmission output scale of RET	STD		0 % of PV input range
RET.A	RET current output range	STD	4-20: 4 to 20 mA 0-20: 0 to 20 mA 20-4: 20 to 4 mA 20-0: 20 to 0 mA	4-20

RS-485 Communication Setting Menu (Menu: R485) (E3 terminal area)

Parameter symbol	Name	Display level	Setting range	Initial value
PSL	Protocol selection	EASY	PCL: PC link communication PCLSM: PC link communication (with checksum) LADR: Ladder communication MBASC: Modbus (ASCII) MBRTU: Modbus (RTU)	MBRTU
BPS	Baud rate	EASY	600: 600 bps 1200: 1200 bps 2400: 2400 bps 4800: 4800 bps 9600: 9600 bps 19200: 19.2k bps 38400: 38.4k bps	19200
PRI	Parity	EASY	NONE: None EVEN: Even ODD: Odd	EVEN
STP	Stop bit	EASY	1: 1 bit, 2: 2 bits	1
DLN	Data length	EASY	7: 7 bits, 8: 8 bits	8
ADR	Address	EASY	1 to 99	1
RP.T	Minimum response time	PRO	0 to 10 (x10ms)	0

When each parameter is displayed, the terminal area (E3) is displayed on Group display.
• Parameter: PSL, BPS, STP, DLN, ADR, RP.T

Ethernet Communication Setting Menu (Menu: ETHR) (E3 terminal area)

Parameter symbol	Name	Display level	Setting range	Initial value
HSR	High-speed response mode	EASY	OFF, 1 to 8	1
BPS	Baud rate	EASY	9600: 9600 bps 19200: 19.2k bps 38400: 38.4k bps	38400
PRI	Parity	EASY	NONE: None EVEN: Even ODD: Odd	EVEN
IP1 to IP4	IP address 1 to 4	EASY	0 to 255 Initial value: 192.168.1.1	See left
SM1 to SM4	Subnet mask 1 to 4	EASY	0 to 255 Initial value: 255.255.255.0	See left
DG1 to DG4	Default gateway 1 to 4	EASY	0 to 255 Initial value: 0.0.0.0	See left
PRT	Port number	EASY	502, 1024 to 65535	502
IPAR	IP access restriction	EASY	OFF: Disable, ON: Enable	OFF
1.IP1 to 1.IP4	Permitted IP address 1-1 to 1-4	EASY	0 to 255 Initial value: 255.255.255.255	See left
2.IP1 to 2.IP4	Permitted IP address 2-1 to 2-4	EASY	0 to 255 Initial value: 255.255.255.255	See left
ESW	Ethernet setting switch	EASY	OFF, ON Setting this parameter to "ON" enables the Ethernet communication parameter settings. * The parameter ESW automatically returns to "OFF" after "ON" is set.	OFF

When each parameter is displayed, the terminal area (E3) is displayed on Group display.

Key Action Setting Menu (Menu: KEY)

Parameter symbol	Name	Display level	Setting range	Initial value
F1 to F2	User function key-1, -2 action setting	EASY	OFF: Disable LTUP: LCD brightness UP LTDN: LCD brightness DOWN BRI: Adjust LCD brightness LCD: LCD backlight ON/OFF switch LAT: Latch release	OFF
Fn	User function key-n action setting	EASY		

Display Function Setting Menu (Menu: DISP)

Parameter symbol	Name	Display level	Setting range	Initial value
PCMD	Active color PV display switch	EASY	0: Fixed in white 1: Fixed in red 2: Link to alarm 1 (Alarm OFF: white, Alarm ON: red) 3: Link to alarm 1 (Alarm OFF: red, Alarm ON: white) 4: Link to alarm 1 or 2 (Alarm OFF: white, Alarm ON: red) 5: Link to alarm 1 or 2 (Alarm OFF: red, Alarm ON: white) 6: PV limit (Within range: white, Out of range: red) 7: PV limit (Within range: red, Out of range: white) 8: SP deviation (Within deviation: white, Out of deviation: red) 9: SP deviation (Within deviation: red, Out of deviation: white) 10: Link to DI2 (ON: red, OFF: white) (*) 11: Link to EXCEEDED lamp (Unlit: white, lit: red) 12: Link to OUT lamp (Unlit: white, lit: red) *: Set the parameter DI2.S=PVRW	0
PCH	PV color change high limit	EASY	Set a display value when in PV limit or SP deviation. -19999 to 30000 (Set a value within the input range.) Decimal point position depends on the input type.	0
PCL	PV color change low limit	EASY		0
SPD	Scroll speed	PRO	(Slow) 1 to 8 (Quick)	4

Display Function Setting Menu (Menu: DISP) (Continued from previous page)

Parameter symbol	Name	Display level	Setting range	Initial value
GUID	Guide display ON/OFF	STD	OFF: Nondisplay ON: Display	ON
HOME	Home Operation Display setting	PRO	PV: PV Display SP: SP Display	SP
ECO	Economy mode	STD	OFF: Disable 1: Economy mode ON (All indications except PV display OFF) 2: Economy mode ON (All indications OFF) 3: Brightness 10 % (All indications)	OFF
BRI	Brightness	EASY	(Dark) 1 to 5 (Bright)	3
B.PVW	White brightness adjustment of PV display	PRO	Adjusts the white brightness of PV display. (Dark) -4 to 4 (Bright)	0
B.PVR	Red brightness adjustment of PV display	PRO	Adjusts the red brightness of PV display. (Dark) -4 to 4 (Bright)	0
B.SP	Brightness adjustment of Setpoint display	PRO	Adjusts the brightness of SP display. (Dark) -4 to 4 (Bright)	0
B.BAR	Brightness adjustment of Bar-graph display	PRO	Adjusts the brightness of EXCEED lamp and OUT lamp. (Dark) -4 to 4 (Bright)	0
B.STS	Brightness adjustment of Status indicator	PRO	Adjusts the brightness of Status indicator. (Dark) -4 to 4 (Bright)	0
D.CYC	Display update cycle	PRO	1: 100 ms 2: 200 ms 3: 500 ms 4: 1 s 5: 2 s	2
OP.JP	Autoreturn to operation display	PRO	Automatically returned to the Operation Display when there has been no keystroke operation for 5 minutes. OFF, ON	ON
MLSD	Least significant digital mask of PV display	STD	OFF: With least significant digit ON: Without least significant digit	OFF

Key Lock Setting Menu (Menu: KLOC)

Parameter symbol	Name	Display level	Setting range	Initial value
COM.W	Communication write enable/ disable	STD	OFF: Enable, ON: Disable	OFF
DATA	Front panel parameter data key lock	STD	OFF: Unlock ON: Lock	OFF

Menu Lock Setting Menu (Menu: MLOC)

Parameter symbol	Name	Display level	Setting range	Initial value
CTL	[CTL] menu lock	PRO	OFF: Display ON: Nondisplay	OFF
PV	[PV] menu lock	PRO		
MPV	[MPV] menu lock	PRO		
OUT	[OUT] menu lock	PRO		
R485	[R485] menu lock	PRO		
ETHR	[ETHR] menu lock	PRO		
KEY	[KEY] menu lock	PRO		
DISP	[DISP] menu lock	PRO		
KLOC	[KLOC] menu lock	PRO		
DI.SL	[DI.SL] menu lock	PRO		
I/O	[I/O] menu lock	PRO		
SYS	[SYS] menu lock	PRO		
INIT	[INIT] menu lock	PRO		
VER	[VER] menu lock	PRO		
LVL	[LVL] menu lock	PRO		
MODE	[MODE] menu lock	PRO	OFF: Display ON: Nondisplay	OFF
SP	[SP] menu lock	PRO		
SPS	[SPS] menu lock	PRO		
ALRM	[ALRM] menu lock	PRO		
PVS	[PVS] menu lock	PRO		

When each parameter is displayed, the terminal area (E3) is displayed on Group display.
• Parameter: R485, ETHR

DI Function Registration Menu (Menu: DI.SL)

Parameter symbol	Name	Display level	Setting range	Initial value
DI2.S	DI2 function selection	STD	OFF: No function LAT: Latch release LCD: LCD backlight ON/OFF switch PVRW: PV red/white switch (*) MG1: Message display interruption 1 MG2: Message display interruption 2 MG3: Message display interruption 3 MG4: Message display interruption 4 *: Set the parameter PCMD=10.	OFF

I/O Display Menu (Menu: I/O)

Parameter symbol	Name	Display level	Read only
KEY	Key status	PRO	See 13.4.1 Confirmation of Key and I/O Condition.
X000	DI1-DI2 status (equipped as standard)	PRO	
Y000	AL1-AL3 status (equipped as standard)	PRO	

System Setting Menu (Menu: SYS)

Parameter symbol	Name	Display level	Setting range	Initial value
R.MD	Restart mode	STD	0: Limit output is ON at power on in any cases. 1: Limit output is OFF at power on when PV doesn't exceed SP.	0
C.GRN	Response as GREEN Series	PRO	OFF: Works as UTAdvanced Series in communication of device information response or broadcasting. ON: Works as GREEN Series in communication of device information response or broadcasting.	OFF
FREQ	Power frequency	EASY	AUTO, 60: 60 Hz, 50: 50 Hz	AUTO
QSM	Quick setting mode	EASY	OFF: Disable ON: Enable	ON
PASS	Password setting	EASY	0 (No password) to 65535	0
SMEC	Sampling period error counter	PRO	0 to 65535 (display only)	0 when power is turned on.

Initialization Menu (Menu: INIT)

Parameter symbol	Name	Display level	Setting range	Initial value
U.DEF	Initialization to user default value	PRO	12345: Initialization, automatically returned to "0" after initialization.	0
F.DEF	Initialization to factory default value	PRO	-12345: Initialization, automatically returned to "0" after initialization.	0

Error and Version Confirmation Menu (Menu: VER)

Parameter symbol	Name	Display level	Read only
PA.ER	Parameter error status	EASY	See 16.1 Troubleshooting.
AD1.E	A/D converter error status 1	EASY	
PV1.E	PV input error status	EASY	
MCU	MCU version	EASY	See 13.4.2 Confirmation of Version.
DCU	DCU version	EASY	
ECU3	ECU-3 version	EASY	
PARA	Parameter version	EASY	
H.VER	Product version	EASY	
SER1	Serial number 1	EASY	
SER2	Serial number 2	EASY	
MAC1	MAC address 1	EASY	
MAC2	MAC address 2	EASY	
MAC3	MAC address 3	EASY	

When the following parameters are displayed, the terminal area (E3) is displayed on Group display.
• Parameter: ECU3, MAC1, MAC2 and MAC3

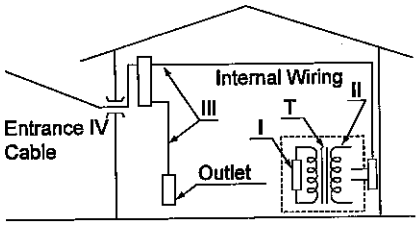
Parameter Display Level Menu (Menu: LVL)

Parameter symbol	Name	Display level	Setting range	Initial value
LEVL	Parameter display level	EASY	EASY: Easy setting mode STD: Standard setting mode PRO: Professional setting mode	STD

19.1 Hardware Specifications

WARNING

This instrument is for Measurement Category I (CAT.I). Do not use it for measurements in locations falling under Measurement Categories II, III, and IV.



Category	Measurement category	Description	Remarks
I	CAT.I	For measurements performed on circuits not directly connected to MAINS.	-
II	CAT.II	For measurements performed on circuits directly connected to the low-voltage installation.	Appliances, portable equipments, etc.
III	CAT.III	For measurements performed in the building installation.	Distribution board, circuit breaker, etc.
IV	CAT.IV	For measurements performed at the source of the low-voltage installation.	Overhead wire, cable systems, etc.

19.1.1 Input Specifications

Universal Input

- Number of inputs: 1
- Input type, instrument range, and measurement accuracy: See the table below.

Input Type		Instrument Range (°C)	Instrument Range (°F)	Accuracy
Thermo-couple	K	-270.0 to 1370.0°C	-450.0 to 2500.0°F	±0.1% of instrument range ±1 digit for 0°C or more ±0.2% of instrument range ±1 digit for less than 0°C ±2% of instrument range ±1 digit for less than -200.0°C of thermocouple K ±1% of instrument range ±1 digit for less than -200.0°C of thermocouple T
		-270.0 to 1000.0°C	-450.0 to 2300.0°F	
		-270.0 to 500.0°C	-200.0 to 1000.0°F	
	J	-200.0 to 1200.0°C	-300.0 to 2300.0°F	
	T	-270.0 to 400.0°C	-450.0 to 750.0°F	
		0.0 to 400.0°C	-200.0 to 750.0°F	
	B	0.0 to 1800.0°C	32 to 3300°F	±0.15% of instrument range ±1 digit for 400°C or more ±5% of instrument range ±1 digit for less than 400°C
	S	0.0 to 1700.0°C	32 to 3100°F	±0.15% of instrument range ±1 digit
	R	0.0 to 1700.0°C	32 to 3100°F	
	N	-200.0 to 1300.0°C	-300.0 to 2400.0°F	±0.1% of instrument range ±1 digit ±0.25% of instrument range ±1 digit for less than 0°C
	E	-270.0 to 1000.0°C	-450.0 to 1800.0°F	±0.1% of instrument range ±1 digit for 0°C or more ±0.2% of instrument range ±1 digit for less than 0°C ±1.5% of instrument range ±1 digit for less than -200.0°C of thermocouple E.
	L	-200.0 to 900.0°C	-300.0 to 1600.0°F	
	U	-200.0 to 400.0°C	-300.0 to 750.0°F	
		0.0 to 400.0°C	-200.0 to 1000.0°F	
	W	0.0 to 2300.0°C	32 to 4200°F	±0.2% of instrument range ±1 digit (Note 2)
	Platinel 2	0.0 to 1390.0°C	32.0 to 2500.0°F	±0.1% of instrument range ±1 digit
	PR20-40	0.0 to 1900.0°C	32 to 3400°F	±0.5% of instrument range ±1 digit for 800°C or more Accuracy is not guaranteed for less than 800°C.
	W97Re3-W75Re25	0.0 to 2000.0°C	32 to 3600°F	±0.2% of instrument range ±1 digit
RTD	JPt100	-200.0 to 500.0°C	-300.0 to 1000.0°F	±0.1% of instrument range ±1 digit (Note 1)
		-150.00 to 150.00°C	-200.0 to 300.0°F	±0.1% of instrument range ±1 digit
	Pt100	-200.0 to 850.0°C	-300.0 to 1560.0°F	±0.1% of instrument range ±1 digit (Note 1)
		-200.0 to 500.0°C	-300.0 to 1000.0°F	
		-150.00 to 150.00°C	-200.0 to 300.0°F	±0.1% of instrument range ±1 digit
Standard signal		0.400 to 2.000 V		±0.1% of instrument range ±1 digit
		1.000 to 5.000 V		
		4.00 to 20.00 mA		
DC voltage/current		0.000 to 2.000 V		
		0.00 to 10.00 V		
		0.00 to 20.00 mA		
		-10.00 to 20.00 mV		
		0.0 to 100.0 mV		

The accuracy is that in the standard operating conditions: 23±2°C, 55±10%RH, and power frequency at 50/60 Hz.

Note 1: ±0.3°C ±1 digit in the range between 0 and 100°C, ±0.5°C ±1 digit in the range between -100 and 200°C.

Note 2: W: W-5% Re/W-26% Re(Hoskins Mfg.Co.). ASTM E988

- Burnout detection:
  Functions at TC, RTD, and standard signal
  Upscale, downscale, and off can be specified.
  For standard signal, burnout is determined to have occurred if it is 0.1 V or 0.4 mA or less.
- Input bias current: 0.05 µA (for TC or RTD)
- Measurement current (RTD): About 0.16 mA
- Input resistance:
  TC or mV input: 1 MΩ or more
  V input: About 1 MΩ
  mA input: About 250 Ω
- Allowable signal source resistance:
  TC or mV input: 250 Ω or less
  Effects of signal source resistance: 0.1 µV/Ω or less
  DC voltage input: 2 kΩ or less
  Effects of signal source resistance: About 0.01%/100 Ω
- Allowable wiring resistance:
  RTD input: Max. 150 Ω/wire (The conductor resistance between the three wires shall be equal.)
  Wiring resistance effect: ±0.1°C/10 Ω
- Allowable input voltage/current:
  TC, mV, mA or RTD input: ±10 V DC
  V input: ±20 V DC
  mA input: ±40 mA
- Noise rejection ratio:
  Normal mode: 40 dB or more (50/60 Hz)
  Common mode: 120 dB or more (50/60 Hz)
  For 100-240 V AC, the power frequency can be set manually. Automatic detection is also available.
  For 24 V AC/DC, the power frequency can be set manually.
- Reference junction compensation error:
  ±1.0°C (15 to 35°C)
  ±1.5°C (-10 to 15°C, 35 to 50°C)
- Applicable standards: JIS/IEC/DIN (ITS-90) for TC and RTD

19.1.2 Step Response Time Specifications

Within 1 s
(63% of analog output response time when a step change of 10 to 90% of input span is applied)

19.1.3 Relay Contact Output Specifications

- Contact type and number of outputs:
  Control output: contact point 1c; 1 point
  Alarm output: contact point 1a; 3 points (common is independent)
- Contact rating:
  Contact point 1c (control output): 250 V AC, 3 A or 30 V DC, 3A (resistance load)
  Contact point 1a (alarm output): 240 V AC, 1A or 30 V DC, 1 A (resistance load)
- Use: Alarm output, FAIL output, etc.
- Time resolution of control output: 10 ms or 0.1% of output, whichever is larger

Note: Cannot be used for a small load of 10 mA or less.

19.1.4 Retransmission Output Specifications

- Number of outputs: Retransmission output; 1
- Current output: 4 to 20 mA DC or 0 to 20 mA DC/ load resistance of 600 Ω or less
- Current output accuracy: ±0.1% of span (±5% of span for 1 mA or less.)
  The accuracy is that in the standard operating conditions: 23±2°C, 55±10%RH, and power frequency at 50/60 Hz.

19.1.5 Contact Input Specifications

- Number of inputs: 2 points
- Input type: No-voltage contact input or transistor contact input
- Input contact rating: 12 V DC, 10 mA or more
  Use a contact of a minimum on-current of 1 mA or more
- ON/OFF detection:
  No-voltage contact input:
  Contact resistance of 1 kΩ or less is determined as "ON" and contact resistance of 50 kΩ or more as "OFF."
  Transistor contact input:
  Input voltage of 2 V or less is determined as "ON" and leakage current must not exceed 100 µA when "OFF."
- Minimum status detection hold time: 250 ms
- Use: Confirmation operation, etc.

19.1.6 Safety and EMC Standards

- Safety: Compliant with IEC/EN61010-1 (CE), approved by CAN/CSA C22.2 No.61010-1 (CSA), approved by UL61010-1.
  Certified for FM-3810 and FM-3545.
  Installation category: CAT. II Pollution degree: 2
  Measurement category: I (CAT. I)
  Rated measurement input voltage: Max. 10 V DC
  Rated transient overvoltage: 1500 V (Note)

Note: This is a reference safety standard value for Measurement Category I of IEC/EN/CSA/UL61010-1. This value is not necessarily a guarantee of instrument performance.

- EMC Conformity standards:
  CE marking
  EN61326-1 Class A, Table 2 (For use in industrial locations)
  EN61326-2-3
  EN 55011 Class A, Group1
  EN 61000-3-2 Class A
  EN 61000-3-3
  C-tick mark
  EN 55011 Class A, Group1

The instrument continues to operate at a measurement accuracy of within ±20% of the range during testing

19.1.7 Construction, Installation, and Wiring

- Dust-proof and drip-proof: IP66 (for front panel) (Not available for side-by-side close mounting.)
- Material: Polycarbonate (Flame retardancy: UL94V-0)
- Case color: White (Light gray) or black (Light charcoal gray)
- Weight: 0.5 kg or less
- External dimensions (mm): 96 (W) × 96 (H) × 65 (depth from the panel face)
  (Depth except the projection on the rear panel)
- Installation: Direct panel mounting; mounting bracket, one each for upper and lower mounting
- Panel cutout dimensions (mm): $92^{+0.8/0}$ (W) × $92^{+0.8/0}$ (H)
- Mounting attitude: Up to 30 degrees above the horizontal. No downward titling allowed.
- Wiring: M3 screw terminal with square washer (for signal wiring and power wiring)

19.1.8 Power Supply Specifications and Isolation

- Power supply:
  Rated voltage: 100 – 240 V AC (+10%/-15%), 50/60 Hz
  24 V AC/DC (+10%/-15%) (for /DC option)
- Power consumption: 18 VA (DC:9 VA, AC: 14 VA if /DC option is specified)
- Data backup: Nonvolatile memory
- Power holdup time: 20 ms (for 100 V AC drive)
- Withstanding voltage
  - Between primary terminals and secondary terminals: 2300 V AC for 1 minute
  - Between primary terminals: 1500 V AC for 1 minute
  - Between secondary terminals: 500 V AC for 1 minute
    (Primary terminals: Power (*) and relay output terminals; Secondary terminals: Analog I/O signal terminals, contact input terminals, communication terminals, and functional grounding terminals.)
  (*): Power terminals for 24V AC/DC models are the secondary terminals.
- Insulation resistance
  Between power supply terminals and a grounding terminal: 20 MΩ or more at 500 V DC

- Isolation specifications

PV (universal) input terminals	Internal circuits	Power supply
Retransmission (analog) output terminals		
Control relay (contact point c)		
Alarm-1 relay (contact point a) output terminals		
Alarm-2 relay (contact point a) output terminals		
Alarm-3 relay (contact point a) output terminals		
Contact input terminals RS-485 communication terminals		
Ethernet communication terminal		

The circuits divided by lines are insulated multually.

19.1.9 Environmental Conditions

Normal Operating Conditions

- Ambient temperature: -10 to 50°C (-10 to 40°C for side-by-side close mounting)
- Ambient humidity: 20 to 90% RH (no condensation allowed)
- Magnetic field: 400 A/m or less
- Continuous vibration at 5 to 9 Hz: Half amplitude of 1.5 mm or less, 1oct/min for 90 minutes each in the three axis directions
  Continuous vibration at 9 to 150 Hz: 4.9 m/s^2 or less, 1oct/min for 90 minutes each in the three axis directions
- Short-period vibration: 14.7 m/s^2, 15 seconds or less
- Shock: 98 m/s^2 or less, 11 ms
- Altitude: 2000 m or less above sea level
- Warm-up time: 30 minutes or more after the power is turned on
- Startup time: Within 10 seconds

*: The LCD (a liquid crystal display) is used for a display portion of this product.
The LCD has a characteristic that the display action becomes late at the low temperature. However, the control fuction is not affected.

Transportation and Storage Conditions

- Temperature: -25 to 70°C
- Temperature change rate: 20°C/h or less
- Humidity: 5 to 95% RH (no condensation allowed)

Effects of Operating Conditions

- Effect of ambient temperature:
  Voltage or TC input: ±1 μV/°C or ±0.01% of F.S./°C, whichever is larger
  Current input: ±0.01% of F.S./°C
  RTD input: ±0.05°C/°C (ambient temperature) or less
  Analog output: ±0.02% of F.S./°C or less
- Effect of power supply voltage fluctuation
  Analog input: ±0.05% of F.S. or less
  Analog output: ±0.05% of F.S. or less
  (Each within rated voltage range)

Appendix 1 Input and Output Table

UT35A Model and Suffix Codes

Model	Suffix code					Optional suffix code	INPUT	OUT	DI		DO			
							PV	RET	DI1	DI2	AL1	AL2	AL3	OUT
UT35A	-x	x	x	-xx	-00	/x	●	●	●	●	●	●	●	●
Type 1: Basic control	-L													
Type 2: Functions	0													
Type 3: Open networks	x													
Display language/Case color	-xx													
Fixed code	-00													
Optional suffix codes	/x													

●: Equipped

Description of symbol

PV: Measured input
RET: Retransmission output
DI1 to DI2: Contact input
AL1 to AL3: Alarm output
OUT: Limit control output

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Revision Information

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