CHD SERIES
HEATED REGENERATIVE DRYER
MODELS 550 THROUGH 4900

OPERATORS/
INSTRUCTION MANUAL

Before installation or starting the dryer for the first time, this manual should be studied carefully to obtain a clear knowledge of the unit and of the duties to be performed while operating and maintaining the unit.

RETAIN THIS MANUAL WITH UNIT.
This Technical manual contains IMPORTANT SAFETY DATA and should be kept with the air dryer at all times.

Form No: X-854 Rev.: F
November, 2000

INGERSOLL-RAND COMPANY
HEATED REGENERATIVE DRYER WARRANTY

Warranty

Ingersoll-Rand warrants that this product shall, when properly installed, operated, applied and maintained in accordance with procedures and recommendations outlined in owner's manuals published by Ingersoll-Rand, be free from defect in materials and workmanship for a period of one year from the date of installation, or eighteen (18) months from the date of shipment from the factory, whichever occurs first, provided such defect is discovered and brought to Ingersoll-Rand's attention within the aforesaid warranty period.

During the warranty period, Ingersoll-Rand will repair or replace any product or part determined by Ingersoll-Rand to be defective within such warranty period, provided such defect occurred in normal service and not as a result of misuse, abuse, neglect or accident. Repair or replacement shall be made at the factory or the installation site, as elected by Ingersoll-Rand. Any service performed on the product by anyone other than Ingersoll-Rand, must first be authorized by Ingersoll-Rand. Unauthorized service voids the warranty, and any resulting charge or subsequent claim will not be paid by Ingersoll-Rand.

Ingersoll-Rand products repaired or replaced under warranty shall be warranted for the unexpired portion of the warranty applying to the original product.

THE LIMITED WARRANTY AND LIMITED REMEDY PROVIDED HEREIN ARE IN LIEU OF ANY OTHER EXPRESS OR IMPLIED WARRANTY OR REMEDY, INCLUDING ANY IMPLIED WARRANTY OR MERCHANTABILITY AND WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE. INGERSOLL-RAND MAKES NO WARRANTY, EXPRESS OR IMPLIED, OF ANY NATURE WHATSOEVER WITH RESPECT TO THIS PRODUCT OR THE USE THEREOF EXCEPT AS IS SPECIFICALLY SET FORTH HEREIN. INGERSOLL-RAND SHALL IN NO EVENT BE LIABLE FOR INDIRECT, SPECIAL, INCIDENTAL, CONSEQUENTIAL OR PENAL DAMAGES, OR FOR ANY OTHER DAMAGES EXCEPT AS PROVIDED IN THIS LIMITED REMEDY. IN ANY EVENT, INGERSOLL-RAND'S MAXIMUM MONETARY LIABILITY HEREUNDER SHALL BE LIMITED TO THE PURCHASE PRICE PAID FOR THAT PART OF THE PRODUCT WHICH IS FOUND TO BE DEFECTIVE WITHIN THE WARRANTY PERIOD.

This unit was purchased from

_____

_____

_____

Ingersoll-Rand Company reserves the right to make changes or add improvements without notices and without incurring any obligation to make such changes or add such improvements to products sold previously.

No. of units on order: _____

Customer Order No.: _____

Ingersoll-Rand Co. Order No.: _____

For ready reference:
Record the serial number and model number of your unit here.

Serial Number: _____

Model Number: _____

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INTRODUCTION

CHD Series Heated Regenerative Dryers use non-consumable desiccants to remove moisture from compressed air to achieve pressure dew points as low as -55°F (-48°C). This fully automatic dryer alternately cycles a continuous flow of compressed process air through two desiccant vessels, where the air's entrained vaporous moisture content is adsorbed. One desiccant vessel is always on-line in a Drying Cycle throughout normal dryer operation. The opposite, off-line desiccant vessel is in a Regeneration Cycle for removal of the desiccant's previously adsorbed moisture content in a pressurized condition. The drying cycle is controlled by a microprocessor.

To ensure continuing good dryer performance and safe operation, everyone who installs, uses or maintains the dryer must read and carefully follow the instructions in this manual. Throughout the manual, the word dryer is used to refer to CHD Series Heated Regenerative Dryers.

SAFETY

CHD Series dryers are designed and built with safety as a prime consideration with industry accepted safety factors having been used in the design. Each dryer has been inspected and tested for safety and operation. All desiccant vessels have been hydrostatically tested at 1½ times the design pressure in accordance with ASME code requirements. Safety relief valves are standard and are provided with each dryer.

WARNING

The following safety rules must be observed to ensure safe dryer operation. Failure to follow these rules may void the warranty or result in dryer damage or personal injury.

1. Never install or try to repair any dryer that has been damaged in shipment. See the Receiving and Inspection instructions in this manual for appropriate action.
2. Never operate the dryer at pressures or temperatures above the maximum conditions shown on the data plate.
3. Always supply electrical power that is within the allowable voltage range shown on the data plate.
4. Never dismantle or work on any component of the dryer or compressed air system under pressure. Vent internal air pressure to the atmosphere before servicing.
5. Never perform electrical service on the dryer unless the main power supply has been disconnected. Parts of the control circuit may remain energized when the power switch is turned off.
6. Vessel surface may be in excess of 150°F during normal operation. Purchaser to provide any personnel protection required.
7. Use only genuine replacement parts from the manufacturer. The manufacturer is not liable for hazards caused by the use of unauthorized parts.

Safety instructions in this manual are bold-faced for emphasis. The signal words DANGER, WARNING and CAUTION are used to indicate hazard seriousness levels as follows:

DANGER—Used to indicate the presence of an immediate hazard which WILL cause severe personal injury, death, or substantial property damage if the warning is ignored.

WARNING—Used to indicate the presence of a hazard or unsafe practice which COULD cause severe personal injury, death, or substantial property damage if the warning is ignored.

CAUTION—Used to indicate the presence of a hazard or unsafe practice which WILL or CAN cause minor personal injury or property damage if the warning is ignored.

The dryer data plate (Figure 1) contains critical safety and identification information. If the data plate is missing or defaced, contact your local distributor for a replacement.

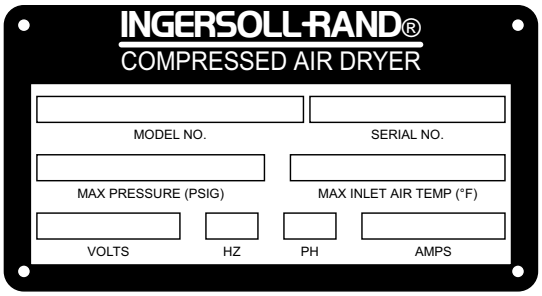

Figure 1
DRYER DATA PLATE

INSTALLATION

RECEIVING AND INSPECTION

Equipment must be thoroughly inspected immediately upon receipt for possible damage incurred during shipment. Since the dryer is shipped F.O.B. Ocala, Florida, the carrier is legally responsible for damage incurred during shipment. Shipping damage is not covered by the dryer warranty.

Any indication of careless handling by the carrier should be noted on the delivery receipt. Obtaining the delivery man's signed agreement to any noted damages will facilitate any future insurance claims.

If concealed loss or damage is discovered, notify the carrier at once and request an inspection. The carrier will make an

inspection and grant a concealed damage notation. The carrier will not consider any claim for loss or damage unless an inspection has been made. If you give the carrier a clear receipt for goods that have been damaged or been lost in transit, you do so at your own risk and expense.

HANDLING

The dryer is designed to be moved by means of lifting eyes supplied on the desiccant vessels. Use appropriate, load-rated lifting equipment and observe safe lifting procedures during all moves. The dryer should be carefully unloaded as close as possible to the final installation site to minimize chances of equipment damage.

LOCATION AND CLEARANCE

Install the dryer on a solid, level foundation. Utilizing the base-plate mounting holes provided, anchor the dryer to the floor with four ½ inch diameter bolts with a minimum 4 inch thread engagement. Allow a minimum of 4 feet clearance for servicing of all components. Above each dryer chamber fill port, allow an overhead clearance of not less than two (2) feet for desiccant installation. Provide suitable protective barriers to reduce the possibility of accidental damage if the dryer is located in an open area or in close proximity to heavy vehicular and pedestrian traffic.

PIPING AND CONNECTIONS

All external piping must be supplied by the user unless otherwise specified. Piping must be rated for the maximum operating pressure and temperature given on the dryer nameplate, and must conform to applicable codes. Support all piping. Do not allow the weight of the piping to stress the dryer connections.

CAUTION
User supplied piping must not exert forces or moments on the dryer or compressor connections.

All inlet and outlet piping MUST be of the same size as the dryer inlet connection or larger. Undersized or incorrectly installed piping and/or piping components will increase pressure drop and reduce capacity. Refer to the Dimension and Connection drawing which accompanies this manual for the correct inlet and outlet connection sizes.

Inlet and outlet manual shut off valves are recommended so the dryer can be easily isolated and depressurized for servicing. Bypass piping may be installed around the dryer to allow for uninterrupted air flow during servicing. If the downstream application cannot tolerate unprocessed air for short periods, install a second dryer in the bypass line.

CAUTION
Do not hydrostatically test the piping with the dryer installed in the air system. Hydrostatic testing will damage the dryer's desiccant charge.

DESICCANT

CHD Series dryers use activated alumina as the desiccant in the dryer vessels.

For Dryer Models 550CHD and 940CHD desiccant is installed prior to shipment unless otherwise specified by customer. Tapping on each vessel with a soft-face mallet will yield a deadened sound if desiccant has been installed. If a hollow sound is noted, the vessels are empty and require installation of desiccant before the dryer is put into service.

For Dryer Models 1300CHD through 4900CHD, desiccant is not normally installed prior to shipment, and must be added to the dryer vessels before the dryer is put into service.

DANGER
SHOCK HAZARD
A static electric charge can build up when pouring desiccant or dry powders. Proper grounding should be observed when pouring from a container (bag, drum, etc.)

CAUTION
Pouring desiccant creates a fine dust; safety goggles, gloves and dust mask should be worn by personnel installing desiccant. Refer to the Material Safety Data Sheet (MSDS) for more complete information.

CAUTION
Do not tamp, ram or pneumatically convey desiccant in vessels. Tamping damages desiccant and causes dusting.

To add desiccant:

1. Remove desiccant fill port closure installed in the top of each desiccant vessel.

   Note: Larger vessels (models 1300CHD through 4900CHD) have retaining screens that must be removed before desiccant installation.

2. Refer to Table 1 for quantity of desiccant and tabular support required for each vessel.

   When using Table 1 you will find the desiccant quantities listed in layers. Each layer will vary in depth. Layer 1 must be installed first at the bottom of the vessel followed by layer number 2 etc., until the complete charge of desiccant has been installed.

Note: A desiccant spreader is provided to level each layer of desiccant after it has been installed.

Table 1
DESICCANT REQUIREMENTS PER CHAMBER

Model \ Layer	1	2
550	300# 3/16" Bead	——
940	450# 3/16" Bead	——
1300	620# 3/16" Bead	——
1600	768# 3/16" Bead	——
2000	1050# 3/16" Bead	——
2500	1234# 3/16" Bead	——
3600	330# 1/2" Bead	1711# 3/16" Bead
4900	630# 1/2" Bead	2585# 3/16" Bead

3. Utilizing an appropriately sized funnel (with nozzle long enough to extend below manifolds on models 1300 through 4900), fill each desiccant vessel as follows:

   a) Install the specified quantity of tabular support (1/2" bead) in each vessel.

   b) Level the tabular support layer and each subsequent layer of desiccant as added to each chamber.

   c) Finish filling each chamber with desiccant (3/16" bead) until all desiccant has been installed. LIGHT tapping on chamber sides with a soft-face mallet should yield additional free space to allow installation of all desiccant required. **DO NOT TAMP OR RAM DESICCANT.**

   Note: Do not be alarmed if the specified quantity of desiccant cannot be installed in each chamber. Desiccant levels will settle after two to three weeks of normal operation. Following this 'settling' period, desiccant should be added as necessary to bring the levels up to the bottom of each chamber's retaining screen (when installed).

4. Clean fill port closure. Reinstall the desiccant fill port closure for each desiccant vessel. Torque flanged fill port (models 1300CHD through 4900CHD) bolts per following.

   5/8" Bolts — 55 ft-lbs.
   3/4" Bolts — 80 ft-lbs.

Note: Larger vessels (models 1300CHD through 4900CHD) have retaining screens that must be reinstalled before desiccant installation.

ELECTRICAL CONNECTIONS

The dryer is prewired, ready for use. Connect the dryer to the power supply specified on the data plate. Using the conduit connection ports provided, connect the electrical input and ground leads to the power input terminal blocks. Make connections in accordance with the lead connection inscriptions (GND, H, N). CONNECT GROUND LEAD (GND) FIRST.

CAUTION
Do not make any additional wiring connections to terminals GND, H and N on the power input terminal blocks.

INSTRUMENTATION

The CHD dryer is equipped with a microprocessor system that controls the operation of all dryer functions. The controller is programmed to operate the dryer on a four hour cycle. The controller keeps the drying vessel on line for two hours while simultaneously regenerating the off-line vessel. Standard and optional indicators on the controller help in monitoring dryer operation and performance.

Dryer sequence indicators include:

- Power On
- Left Tower Drying
- Right Tower Drying
- Heating

Valve Switching Failure Alarm (Optional)

This alarm is triggered by the failure of a valve position indicator switch to sense the switching of a switching valve from its occupied position to its alternate position.

Should the alarm conditions correct themselves after the alarm has activated, the alarm will reset itself and the dryer will return to normal operation.

High Humidity Warning (Optional)

A moisture sensor in the dryer outlet manifold monitors the relative humidity of the outlet air. The sensor triggers an alarm, labeled HIGH HUMIDITY WARNING, if the relative humidity of the outlet air exceeds the factory setting before regeneration is complete. A calibrated set-plug adjustment bulb is included for use in calibrating the high humidity alarm. Refer to the maintenance section of this manual for field adjustment instructions.

AIRSaver Control (Optional)

The optional AIRSaver control matches purge air and heater usage to actual dryer load. The control monitors the dew point of the outlet air and adjusts the dryer cycle according to the dew point achieved and the dew point specified. It includes a panel mounted digital dew point display and high dew point alarm contacts.

NOTE: Prior to shipment from the factory, the AIRSaver Probe is removed from the dryer, repacked with desiccant in its original container, and placed in the dryer control box.

Before starting the dryer, the AIRSaver Probe must be reinstalled in the following manner.

1. Connect the probe to the analyzer via the cable supplied.
2. Locate the Flow Cell Block located near the dryer control box.
3. Mount the probe into the Flow Cell Block. Tighten the compression fitting by first hand-tightening the nut. Using a wrench, tighten the nut one and one-quarter turn.

Dew Point Monitor (Optional)

The monitor continuously displays outlet pressure dew point. (Consult the owner's manual supplied with the monitor for more information.)

Remote Alarm Contacts

Contacts available for remote alarm indication are connected to a terminal strip in the electrical enclosure. Refer to the electrical schematic for terminal identification.

Color Moisture Indicator (Optional)

An indicator utilizing specially treated "silica gel" which changes color to alert personnel of a moisture problem requiring corrective action. The indicator is blue when dry, but gradually changes to pink in color whenever a "wet" gas sample is received.

Vessel Temperature Gauges

A gauge is mounted on each desiccant vessel to indicate the temperature inside the vessel.

Vessel Pressure Gauges

A gauge is mounted on outlet piping of each desiccant vessel to indicate the pressure inside the vessel.

OPERATION

HOW IT WORKS

Hot, compressed air from the air compressor enters the regenerating vessel. The desiccant in the regenerating vessel is regenerated by the hot compressed air. The hot air along with water vapor from the desiccant, exits the regenerating vessel and flows into an aftercooler.

Upon completion of regeneration, the bypass valve opens around the regeneration chamber. The cooled air and condensed water flows into the moisture separator. The condensed water is separated from the cool air and is drained from the moisture separator. The cooled air returns to the drying vessel to be dried to the desired dew point. The dried air exits the dryer for use.

START-UP

Once the CHD Series dryer has been installed according to instructions, it is ready to be operated. The system is fully automatic and does not require any auxiliary controls. It is designed to run continuously.

To start the dryer:

WARNING

Compressed air can be dangerous unless safety precautions are observed in the use of compressed air and compressed air equipment. Completely vent the internal air pressure to the atmosphere before disassembling any subassemblies or components and before doing any work on compressed air equipment. To vent internal air pressure, follow the shutdown instructions.

Do not start dryer with compressed air flow through the dryer. Open dryer bypass valve (customer supplied) and close dryer shut off valves (customer supplied) before beginning start-up procedure.

1. Remove the pilot air filter bowl. Verify that the pilot air filter cartridge is installed. Replace filter bowl ensuring that the o-ring is properly seated.
2. Close the pilot air filter bleed valve and any manual vent or drain valves installed in separator assembly.
3. Inspect for, and remove pipe plug or cap from separator assembly's automatic drain valve which may have been installed in drain port for shipping purposes.
4. Ensure that all associated pipe and tubing connections, flanges, unions, plugs, mounting bolts, etc., have been checked tight and/or properly secured.

5. Open the pilot air service valve, located upstream of the pilot air filter.

6. Supply pressure to dryer by slowly opening the customer supplied inlet shut off valve. Both desiccant vessels will begin to rise to system pressure.

7. Set Pilot Air Pressure Regulator to 100 PSIG.

8. The Color Change Moisture Indicator's bleed valve is installed directly in the back of the indicator's body. Close the indicator's bleed valve and fully open the moisture indicator's supply valve (if system so equipped).

9. Check and correct all connections for leaks.

10. Once both desiccant vessels are at system pressure, SLOWLY open customer supplied outlet shut off valve to let process air flow downstream.

11. Close dryer bypass valve (if system so equipped).

12. Open and adjust Moisture Indicator's bleed valve until a very slight, continuous air bleed is felt exhausting from the bleed valve's exhaust port. Ensure that the granular indicator's crystal remain motionless after final adjustment (if system so equipped).

13. Perform system "First Start".
    a) Press and hold the Alarm Reset button.
    b) Energize the dryer's electrical supply.
    c) Hold the Alarm Reset button until the front panel LED's flash.
    d) The dryer will start in Right Chamber Drying.

    During all sequences, verify operation.

    Note: It is not necessary to perform a "First Start" each time. Perform step "b" **only** to start the dryer without a "First Start".

MAINTENANCE

SHUTDOWN

If the dryer or air system is shut down, desiccant life can be prolonged by venting the dryer internal pressure to the atmosphere.

DANGER
EXPLOSION HAZARD
Ensure that the dryer is valve isolated, and fully depressurized before attempting to remove or disassemble any component or subassembly. Failure to do so may result in serious personal injury and/or equipment damage.

To shut down the dryer:

1. De-energize the dryer's electrical supply. When the dryer's power supply is de-energized, the desiccant vessel last on-line will remain on-line.

2. Open customer supplied bypass valve (if installed).

3. Close the customer supplied inlet and outlet shut-off valves.

WARNING
Inlet and outlet shut-off valves must be closed to prevent moisture overloading of desiccant beds, due to continuous flow without regeneration.

4. Close Pilot Air Service Valve.

5. Open Chamber Blow Down Valves, Pilot Air Filter's Bleed Valve and Moisture Indicator Supply Valve (if installed) to vent the dryer internal air pressure.

6. Depressurization is complete when all dryer pressure gauges indicate 0 PSIG.

Restart the dryer according to the start-up instructions.

If electrical maintenance must be performed on the dryer, electrical power must be locked out and tagged in accordance with OSHA requirements.

DANGER
SHOCK HAZARD
Portions of the electrical control circuit remain energized when the power switch is turned OFF. Disconnect the main power supply to the dryer before performing maintenance on the electrical system.

Before performing electrical maintenance:

1. De-energize the dryer's electrical supply after completion of switch over.

2. Disconnect the main power supply.

MAINTENANCE SCHEDULE

The following periodic checks should be made to monitor dryer operation. These inspections will help schedule servicing to ensure continuing good dryer performance and safe operation.

CAUTION
Contact your local Ingersoll Rand distributor before performing any work on the solid state controls. Attempting to service circuit boards or components may result in equipment damage and will void warranty.

WARNING

To avoid serious injury and/or equipment damage, ensure that the dryer is de-energized, valve-isolated and depressurized before dismantling any part of the dryer or compressed air system.

DAILY MAINTENANCE

1. Check operation of the separator's automatic drain valve. If no condensate discharges from drain valve, follow Shutdown procedure, then dismantle and clean, repair or replace valve as required.

WEEKLY MAINTENANCE

1. Check the following operating conditions:
   a) Inlet and Outlet Pressure
   b) Inlet Flow Rate
   c) Inlet Temperature

2. Check the Color Change Moisture Indicator (if installed) for a BLUE (dry) indication. If the indicator is PINK (wet) in color, refer to the Field Service Guide at the back of this manual, and conduct checks listed for the Color Change Moisture Indicator.

3. Check the dryer's indicator panel for the presence of any illuminated alarm indicator's. If an alarm indicator is illuminated, see explanation in INDICATORS Section for diagnosis and refer to the Field Service Guide for remedy.

4. Check for leaks at all flanged connections on the dryer. Flanged connections should be retightened following several heat cycles to ensure the gasket seal. Failure to retighten flanges could lead to leaking and premature failure of the gaskets.

MONTHLY MAINTENANCE

1. Check differential pressure drop across dryer. Refer to Field Service Guide if the differential pressure is excessive.

2. Check the dry air outlet dew point.

6-MONTH MAINTENANCE

Depressurize dryer according to Shutdown procedure of this manual. Check for the following and correct:

1. Inspect and/or replace the pilot air filter cartridge if the used cartridge appears clogged, dirty or excessively corroded.

2. Inspect any filter cartridge (if installed) for clogging, excessive corrosion, cracked or damaged seals or high pressure drop. Replace cartridge(s) if necessary.

YEARLY MAINTENANCE

Inspect desiccant in drying vessels. Depressurize dryer according to Shutdown procedure of this manual. Check for the following and correct as indicated:

1. Broken Desiccant (excessive dusting)
   Desiccant dusting may be caused by air flow surges, excessive air flow or pulsating air pressure. Check and correct these conditions, then replace desiccant.

RETURNS TO MANUFACTURER

If the dryer or a component of the dryer must be returned to the manufacturer, first call your local Ingersoll Rand distributor for a return authorization number and a shipping address. Your distributor will inform you whether the dryer or only the component must be returned.

DESICCANT REPLACEMENT

Periodic desiccant replacement is necessary to maintain dryer performance. The frequency of desiccant replacement is dependent on the operating conditions present. A rising dew point at the dryer outlet is an indication that new desiccant is needed

DANGER
EXPLOSION HAZARD

Ensure that the dryer is valve isolated, and fully depressurized before attempting to remove or disassemble any component or subassembly. Failure to do so may result in serious personal injury and/or equipment damage.

DANGER
SHOCK HAZARD

Portions of the electrical control circuit remain energized when the power switch is turned OFF. Disconnect the main power supply to the dryer before performing maintenance on the electrical system.

WARNING

Used desiccant material must be handled with special care. Desiccant is an adsorbent material. Used desiccant may contain chemicals and/or gases that are hazardous, toxic and/or flammable. It is recommended that all used desiccant be analyzed to determine content before disposal. Exercise proper care and procedures during handling and storage of used materials. All containers must be properly labelled and disposed of in accordance with local, state, and federal regulations.

CAUTION

Pouring desiccant creates a fine dust; safety goggles, gloves and dust mask should be worn by personnel installing desiccant. Refer to the Material Safety Data Sheet (MSDS) for more complete information.

CAUTION

Do not tamp, ram or pneumatically convey desiccant in vessels. Tamping damages desiccant and causes dusting.

1. Remove the desiccant fill port closure installed in the top of each desiccant vessel.

   Note: Larger vessels (models 1300CHD through 4900CHD) have retaining screens that must be removed before desiccant installation.

2. Place a container suitable for receiving the spent desiccant under the desiccant vessels desiccant drain port.

3. Remove the desiccant drain port closure from the bottom of each desiccant vessel. Desiccant will begin draining when desiccant drain port closure is removed.

4. Use a flashlight to inspect each vessel through its respective ports to ensure that all desiccant has been drained. LIGHT tapping on the vessel side with a soft-faced mallet will remove any desiccant that may have remained in each desiccant vessel.

5. Reinstall the desiccant drain port closure for each desiccant vessel. Torque flanged drain port (models 1300CHD through 4900CHD) bolts per following.

   5/8" Bolts — 55 ft-lbs.
   3/4" Bolts — 80 ft-lbs.

6. Refer to Table 1 for the quantity of tabular support and/or desiccant required for each desiccant vessel.

   When using Table 1 you will find the desiccant quantities listed in layers. Each layer will vary in depth. Layer 1 must be installed first at the bottom of the vessel followed by layer number 2 etc., until the complete charge of desiccant has been installed.

   Note: A desiccant spreader is provided to level each layer of desiccant after it has been installed.

7. Utilizing an appropriately sized funnel (with nozzle long enough to extend below manifolds on models 1300 through 4900), fill each desiccant vessel as follows:

   a) Install the specified quantity of tabular support in layer one of each vessel.

   b) Level layer 1 and each subsequent layer of desiccant as added to each vessel.

   c) Finish filling each vessel with desiccant until all desiccant has been installed. LIGHT tapping on vessel sides with a soft-face mallet should yield additional free space to allow installation of all desiccant required.

   Note: Do not be alarmed if the specified quantity of desiccant cannot be installed in each chamber. Desiccant levels will settle after two to three weeks of normal operation. Following this 'settling' period, desiccant should be added as necessary to bring the levels up to the bottom of each chamber's retaining screen (when installed).

8. Clean fill port closure. Reinstall fill port closure in each desiccant vessel. Torque flanged fill port (models 1300CHD through 4900CHD) bolts per following.

   5/8" Bolts — 55 ft-lbs.
   3/4" Bolts — 80 ft-lbs.

   Note: Larger vessels (models 1300CHD through 4900CHD) have retaining screens that must be reinstalled before desiccant installation.

COLOR CHANGE MOISTURE INDICATOR (Optional) DESICCANT REPLACEMENT

As illustrated on the following page, the air sample supplied from the dryer outlet enters the moisture indicator's inlet connection ①, and circulates through a desiccant filled sight dome ②. The granular indicator ③, is a specially treated "silica gel" which gradually changes from blue to pink in color whenever a "wet" air sample is received. This change alerts personnel of a moisture problem requiring corrective action. The color will return to blue when dry air is once again supplied through a porous disc ④ and vents to atmosphere through an adjustable bleed valve ⑤.

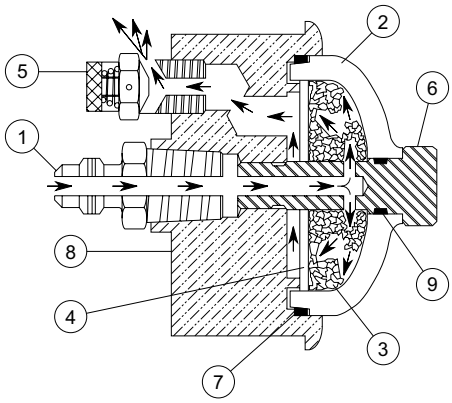

Figure 4
MOISTURE INDICATOR

CAUTION

Dryer shutdown is not necessary to perform the following procedure and can be accomplished without removing the entire assembly from the gauge panel.

1. Close the Moisture Indicator Supply Valve, and ensure that the moisture indicator has fully depressurized through bleed valve ⑤ before proceeding to next step.

DANGER
To avoid serious injury and/or equipment damage, ensure that the moisture indicator is fully depressurized before attempting disassembly.

2. Remove sight dome assembly (items ②, ③, ④, ⑥ and ⑨) from body ⑧ by turning screw ⑥ counter-clockwise.

3. Remove screw ⑥ from sight dome ② by exerting pressure on screw's threaded end. Drain granular indicator.

4. Remove porous disc ④ and clean sight dome.

CAUTION
The sight dome ② is an acrylic plastic. Do not clean with any type of solvent.

5. Replace O-ring ⑨, reinstall screw ⑥ in sight dome ②.

6. Carefully pour new granular indicator ③ into sight dome. Slide porous disc ④ into place.

7. Replace O-ring ⑦ and reinstall sight dome assembly (items ②, ③, ④, ⑥ and ⑨) in body ⑧.

8. Fully open moisture indicator's gas supply valve.

9. Adjust bleed valve ⑤ until only a very slight constant gas bleed is felt exhausting from valve's bleed port. Ensure that granular indicator remains motionless after final adjustment.

High Humidity Alarm Field Adjustment

To set the high-humidity alarm:

1. Turn power switch OFF.

DANGER
SHOCK HAZARD
Portions of the electrical control circuit remain energized when the power switch is turned OFF. Disconnect the main power supply to the dryer before performing maintenance on the electrical system.

2. Open the door of the electrical control box.

3. Locate the high-humidity circuit board (refer to Figure 5).

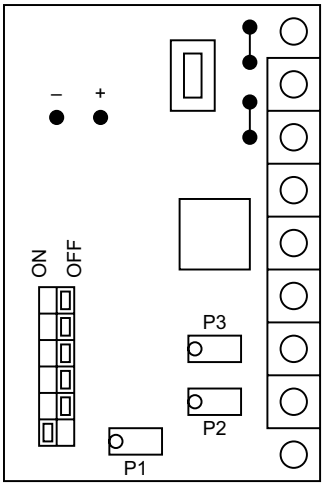

Figure 5
HIGH-HUMIDITY ALARM CIRCUIT BOARD
POTENTIOMETERS P1, P2 AND P3

4. A calibrated set plug (refer to Figure 6) is shipped loose inside the electrical box. The set plug is used to select the setting at which the high-humidity alarm sounds. To insert the set plug, unplug the flat brown 2-wire ribbon cable in the electrical box. Insert the set plug into the ribbon cable socket.

5. Turn the power switch to ON.

6. With a small slotted screwdriver, adjust P1 on the high-humidity circuit board (Figure 5) clockwise and counter-clockwise. Find the adjustment point where the contacts open and close. Leave adjustment where the contacts just close.

NOTE: DO NOT ADJUST POTENTIOMETERS P2 AND P3.

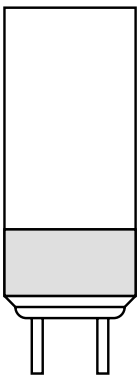

Figure 6
SET PLUG

7. Put a drop of lacquer or nail polish on potentiometer P1 to prevent vibrations from altering the setting.

8. Turn the power switch to OFF.

9. Remove the set plug and reinsert the ribbon cable. The high humidity alarm is now set.

To put the dryer back into service, follow the start-up instructions.

Temperature Switch Field Adjustment

> ***DANGER***
> ***EXPLOSION HAZARD***
> ***Ensure that the dryer is de-energized, valve isolated, and fully depressurized before attempting to remove or disassemble any dryer component or subassembly. Failure to do so may result in serious personal injury and/or equipment damage.***

1. To adjust temperature switch:

   When a desiccant chamber does not reach a satisfactory temperature (usually 180°F to 200°F) at the end of its heating period, move the temperature switch adjusting screw 1/4 turn in the proper direction. Then allow the chamber to go completely through another heating period and note its temperature. If necessary, make further adjustments 1/4 turn at a time, until a satisfactory temperature is reached.

   To raise setting — turn counterclockwise.
   To lower setting — turn clockwise.

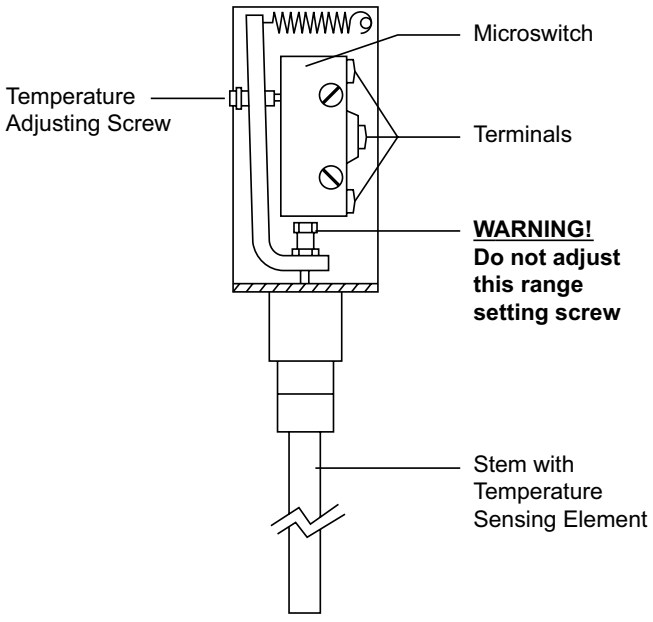

Figure 7
TEMPERATURE SWITCH

FIELD SERVICE GUIDE

WARNING

Compressed air can be dangerous unless safety precautions are observed in the use of compressed air and compressed air equipment. Completely vent the internal air pressure to the atmosphere before diassembling any subassemblies or components and before doing any work on compressed air equipment. To vent internal air pressure, follow the shutdown instructions.

PROBLEM	POSSIBLE CAUSE	REMEDY
Dew Point too high or too low.	Inlet moisture content is above the design moisture content.	Check the system inlet moisture content and correct if necessary.
	Inlet flow rate (in SCFM) is above the dryer's design flow rate.	Verify actual flow rate (in SCFM) through dryer. Reduce flow rate if operating above design flow rate.
	Inlet flow rate (in SCFM) is less than the design flow rate.	Verify actual flow rate. Increase flow rate if operating below 10 to 15% of the design flow rate.
	Desiccant is badly broken.	**Shutdown and Depressurize Dryer.** Inspect desiccant through fill ports and replace if badly broken or fouled.
	Union or other piping/component leaks at dryer outlet manifold or downstream of dryer outlet.	Soap test dryer outlet manifold and piping downstream of dryer. Repair ALL leaks.
Color Change Moisture Indicator has changed from BLUE (dry) to PINK (wet) indication.	Moisture Indicator's bleed valve is closed.	Open bleed valve installed in moisture indicator body until a SLIGHT continuous air bleed is felt exhausting from bleed valve's exhaust port. Granular indicator MUST remain motionless after final adjustment.
	Moisture Indicator's supply valve is closed.	Fully open moisture indicator supply valve. Adjust indicator's bleed valve as instructed in previous step.
	Moisture indicator is internally clogged, preventing air from exiting through indicator's bleed valve.	Refer to Color Change Moisture Indicator Recharging Procedure section for disassembly instructions. Clean or replace components as necessary.
	Sample tubing to Moisture Indicator is leaking permitting "wet" atmospheric air to enter tubing and contaminate dry air sample.	Perform a soap bubble leak test indicator's tubing and fittings. Tighten or repair.
	If after previous items have been checked and the Moisture Indicator fails to return to blue within 3 to 5 hours, a dew point problem may exist.	Refer to "Dew Point too high or too low" section of this Field Service Guide. Determine cause and correct.
Excessive pressure drop across dryer.	Badly broken, dusted or fouled desiccant.	**Shutdown and Depressurize.** Inspect desiccant through fill ports. Replace if badly broken, dusted or fouled.
	Inlet flow rate (scfm) exceeds the dryer's design flow rate.	Reduce inlet flow rate as necessary to meet dryer's design flow rate.
	Desiccant retaining screens are clogged or fouled. **Note:** Desiccant retaining screens for models 550CHD and 940CHD are located at the flange connections at the top and bottom of the vessel with the manifolds. **Note:** Desiccant retaining screens for models 1300CHD through 4900CHD are located in the vessel nozzle assemblies at the top and bottom of the vessel.	**Shutdown and Depressurize.** Remove desiccant retaining screens from the top and bottom of each vessel and clean if fouling is noted. Investigate and correct source of fouling. **Note:** Desiccant must first be removed before removal of a desiccant retaining screen located at the bottom of the vessel. Desiccant may be reinstalled if not fouled or badly broken.

PROBLEM	POSSIBLE CAUSE	REMEDY
Loss of power to operating status and alarm indicators.	Loss of power supply to dryer's customer supplied electrical disconnect switch or breaker.	Check disconnect switch or breaker is closed. If tripped breaker or blown fuse. Investigate and remedy cause.
	Control system's power fuse is blown.	**De-energize dryer power supply.** Replace fuse if blown. Investigate and remedy cause.
	Loose connections at power input.	**De-energize dryer power supply.** Check power supply input wiring connections.
	Damaged solid state components and/or circuit boards.	Contact local Ingersoll Rand distributor for assistance.
Valve Switching Failure Alarm	A Switching Valve has failed to switch position due to the associated solenoid valve's failure to energize.	Check pneumatic output indicators (red or yellow) on solenoid valves to determine whether energized. up position - energized (pneumatic output present) down position - de-energized If de-energized, trip manual override (slotted screw) located on top of solenoid valve to determine if functioning. Replace if not functioning. **IMPORTANT:** Refer to Flow Schematic Drawing before manually overriding solenoid valves to prevent accidently closing valves, resulting in stoppage of air flow.
	A Switching Valve has failed to switch position due to fouled or worn valve internals.	Check for pilot air at Switching Valve's pilot air tubing connections. If pilot air pressure is present,**Shutdown and Depressurize Dryer.** Repair or replace valve.
	Valve position limit switch failure.	Check the appropriate terminal blocks prior to the limit switches and make certain that the required input signals are present. There are two limit switches per Switching Valve. The top limit switch on each valve, identified by LS1, actuates when the Switching Valve is "CLOSED". The lower limit switch on each valve, Identified by LS2, actuates when the Switching Valve is "OPENED". Check limit switch actuation. Adjust cam if required.
HIGH HUMIDITY or AirSaver Sensor Failure.	Excessive moisture or temperature on sensor.	Check tubing or sensor isolation valve. If problem persists, a dew point problem may exist.

APPENDIX A: Replacement Parts

REPLACEMENT PARTS: MODEL# CHD 550

VALVE AND REPAIR KITS

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
38485009	VALVE, BTFL&A	3IN, CS, CLS150, PNEU ACTR	—	9
38485017	KIT, REPAIR	3IN, SEAT KIT, BTFL&A, HI-TEMP	2	—
38485025	KIT, REPAIR	R1 POWERRAC CYLINDER KIT	2	—
37969185	KIT, PACKING	R1 POWERRAC ACTUATOR	2	—
38485003	VALVE, RELIEF	160 PSIG, CS, 1/2X1, MPTXFPT	—	2

GAUGES AND INSTRUMENTATION

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
37963972	GAUGE, PRESS	2-1/2IN, BRZ, 0-200PSIG, LOMTD	1	2
37965043	GAUGE, TEMP	3IN, 50-500F, 1/2MPT, LOMTD	—	1
37965035	GAUGE, TEMP	3IN, 50-500F, 1/2MPT, LOMTD	—	1
37965050	GAUGE, TEMP	3IN, 50-500F, 1/2MPT, LOMTD	—	3
37988953	ASSY, FILTER	IR30P FILTR W/IDE1026A BRKT	—	1
37976891	IND, MOISTURE	IR DEWPOINTER (AIR SAVER)	—	1
37977014	HSG, SENSOR	FOR DEWPOINTER SENSORS	—	1

ELECTRICAL

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
37994225	IC, PROGRAMD	MEC/EXP, CHD, I.R., VERSION 1.0C	—	1
37964905	ASSY, PCB	MEC EXP, STD (LEDS=GGGGGRRR)	—	1
37964913	ASSY, CABLE	30 COND, MEC-EXP, FEMALE, FLAT	—	1
37963139	ASSY, PCB	MEC CPU/C, N4, NO CHIP, IR	—	1
37979028	SUPPLY, POWER	24VDC, 1.4A, 85-132V, 50/60HZ	—	1
37994233	ASSY, VLV OPR	4WAY(5) DBL ACTUATED, POLYAM	—	1
37964947	ASSY, PCB	I/O MODULE, 4-POSITION	—	1
37964954	MODULE, I/O	INDUSTRY STND #OAC-24	—	2
37963121	FUSE, ELEC	3A, 250V, 13/32X1-1/2LG	1	1
37964996	SW, PUSHBUTN	MOMENT, 1NO-1NC, NEMA4(IP65)	—	1
37964798	SW, TEMP	N4, DIFF EXP, 200F	1	1
37992880	SW, SELECTOR	2-POS, N4, MAINTAIN, 1NO, BLK	1	1

DESICCANT AND FILTER ELEMENTS

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
39182415	CRTG, FILTER	MODEL 6-IR30PDE	1	1
37975190	DSCC, PKGD	3/16” BEAD, 150# DRI-PAC	4	4

NOTES:

1. CODE 1 COLUMN INDICATES SPARES RECOMMENDED FOR STOCKING AND MAINTENANCE.
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3. ALL PRICES F.O.B. OCALA, FLORIDA: DOMESTIC PACKED: SUBJECT TO CHANGE WITHOUT NOTICE.
4. THE DRYER MODEL AND S.O.# MUST BE SPECIFIED WHEN ORDERING SPARE PARTS.

REPLACEMENT PARTS: MODEL# CHD 940

VALVE AND REPAIR KITS

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
38485009	VALVE, BTFL&A	3IN, CS, CLS150, PNEU ACTR	—	9
38485017	KIT, REPAIR	3IN, SEAT KIT, BTFL&A, HI-TEMP	2	—
38485025	KIT, REPAIR	R1 POWERRAC CYLINDER KIT	2	—
38485003	VALVE, RELIEF	160 PSIG, CS, 1/2X1, MPTXFPT	—	2

GAUGES AND INSTRUMENTATION

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
37963972	GAUGE, PRESS	2-1/2IN, BRZ, 0-200PSIG, LOMTD	1	2
37965043	GAUGE, TEMP	3IN, 50-500F, 1/2MPT, LOMTD	—	1
37965035	GAUGE, TEMP	3IN, 50-500F, 1/2MPT, LOMTD	—	1
37965050	GAUGE, TEMP	3IN, 50-500F, 1/2MPT, LOMTD	—	3
37988953	ASSY, FILTER	IR30P FILTR W/IDE1026A BRKT	—	1
37979804	SENSOR, HMD	XR18110 (-85F TO +68F)	—	1
37977014	HSG, SENSOR	FOR IR XENTAUR SENSORS	—	1

ELECTRICAL

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
37979804	IC, PROGRAMD	MEC/EXP, CHD, V2.0, AIRSAVER	—	1
37964905	ASSY, PCB	MEC EXP, STD (LEDS=GGGGGRRR)	—	1
37964913	ASSY, CABLE	30 COND, MEC-EXP, FEMALE, FLAT	—	1
37963139	ASSY, PCB	MEC CPU/C, N4, NO CHIP, IR	—	1
37979028	SUPPLY, POWER	24VDC, 1.4A, 85-132V, 50/60HZ	—	1
38484994	ASSY, VLV OPR	4WAY(5), (1)NO, (2)NC, POLYAM	—	1
37964947	ASSY, PCB	I/O MODULE, 4-POSITION	—	1
37964954	MODULE, I/O	INDUSTRY STND #OAC-24	—	2
37963121	FUSE, ELEC	3A, 250V, 13/32X1-1/2LG	1	1
37964996	SW, PUSHBUTN	MOMENT, 1NO-1NC, NEMA4(IP65)	—	1
37964798	SW, TEMP	N4, DIFF EXP, 200F	1	1

DESICCANT AND FILTER ELEMENTS

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
39182415	CRTG, FILTER	MODEL 6-IR30PDE	1	1
37975190	DSCC, PKGD	3/16” BEAD, 150# DRI-PAC	—	6

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REPLACEMENT PARTS: MODEL# CHD 1300

VALVE AND REPAIR KITS

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
38485009	VALVE, BTFL&A	3IN, CS, CLS150, PNEU ACTR	—	9
38485017	KIT, REPAIR	3IN, SEAT KIT, BTFL&A, HI-TEMP	1	—
38485025	KIT, REPAIR	R1 POWERRAC CYLINDER KIT	1	—
38485003	VALVE, RELIEF	160 PSIG, CS, 1/2X1, MPTXFPT	—	2
37965894	VALVE, RELIEF	125 PSIG, .250X., BRS	—	1

GAUGES AND INSTRUMENTATION

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
37963972	GAUGE, PRESS	2-1/2IN, BRZ, 0-200PSIG, LOMTD	1	2
37965043	GAUGE, TEMP	3IN, 50-500F, 1/2MPT, LOMTD	—	1
37965035	GAUGE, TEMP	3IN, 50-500F, 1/2MPT, LOMTD	—	1
37965050	GAUGE, TEMP	3IN, 50-500F, 1/2MPT, LOMTD	—	3
37988953	ASSY, FILTER	IR30P FILTR W/IDE1026A BRKT	—	1
37965886	RGLTR, PRESS	1/4IN, FPT, 12-250PSI ADJ, 300PSI	—	1

ELECTRICAL

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
37994225	IC, PROGRAMD	MEC/EXP, CHD, I.R., VERSION 1.0C	—	1
37964905	ASSY, PCB	MEC EXP, STD (LEDS=GGGGGRRR)	—	1
37964913	ASSY, CABLE	30 COND, MEC-EXP, FEMALE, FLAT	—	1
37963139	ASSY, PCB	MEC CPU/C, N4, NO CHIP, IR	—	1
37979028	SUPPLY, POWER	24VDC, 1.4A, 85-132V, 50/60HZ	—	1
37994233	ASSY, VLV OPR	4WAY(5) DBL ACTUATED, POLYAM	—	1
37964947	ASSY, PCB	I/O MODULE, 4-POSITION	—	1
37964954	MODULE, I/O	INDUSTRY STND #OAC-24	—	2
37963121	FUSE, ELEC	3A, 250V, 13/32X1-1/2LG	1	1
37964996	SW, PUSHBUTN	MOMENT, 1NO-1NC, NEMA4(IP65)	—	1
37964798	SW, TEMP	N4, DIFF EXP, 200F	1	1

DESICCANT AND FILTER ELEMENTS

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
39177431	CRTG, FILTER	MODEL 6IR30PE	1	1
37975190	DSCC, PKGD	3/16” BEAD, 150# DRI-PAC	—	6
37975182	DSCC, PKGD	3/16” BEAD, 34# DRI-PAC	—	10

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REPLACEMENT PARTS: MODEL# CHD 1600

VALVE AND REPAIR KITS

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
37988904	VALVE, BTFL&A	4IN, CS, CLS150, PNEU ACTR	—	9
37969185	KIT, REPAIR	R-K FOR R1 POWERRAC ACTUATOR	1	—
38485025	KIT, REPAIR	CYLINDER KIT, BTFL&A	1	—
37994241	VALVE, RELIEF	160 PSIG, .500X1.000, CS	—	2

GAUGES AND INSTRUMENTATION

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
37963972	GAUGE, PRESS	2-1/2IN, BRZ, 0-200PSIG, LOMTD	1	2
37965043	GAUGE, TEMP	3IN, 50-500F, 1/2MPT, LOMTD	—	1
37965035	GAUGE, TEMP	3IN, 50-500F, 1/2MPT, LOMTD	—	1
37965050	GAUGE, TEMP	3IN, 50-500F, 1/2MPT, LOMTD	—	3
37988953	ASSY, FILTER	IR30P FILTR W/IDE1026A BRKT	—	1
37979804	SENSOR, HMD	XR18110 (-85F TO +68F)	—	1
37977014	HSG, SENSOR	FOR IR XENTAUR SENSORS	—	1

ELECTRICAL

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
37994225	IC, PROGRAMD	MEC/EXP, CHD, I.R., VERSION 1.0C	—	1
37964905	ASSY, PCB	MEC EXP, STD (LEDS=GGGGGRRR)	—	1
37964913	ASSY, CABLE	30 COND, MEC-EXP, FEMALE, FLAT	—	1
37963139	ASSY, PCB	MEC CPU/C, N4, NO CHIP, IR	—	1
37979028	SUPPLY, POWER	24VDC, 1.4A, 85-132V, 50/60HZ	—	1
37994233	ASSY, VLV OPR	4WAY(5) DBL ACTUATED, POLYAM	—	1
37964947	ASSY, PCB	I/O MODULE, 4-POSITION	—	1
37964954	MODULE, I/O	INDUSTRY STND #OAC-24	—	2
37963121	FUSE, ELEC	3A, 250V, 13/32X1-1/2LG	1	1
37964996	SW, PUSHBUTN	MOMENT, 1NO-1NC, NEMA4(IP65)	—	1
37964798	SW, TEMP	N4, DIFF EXP, 200F	1	1

DESICCANT AND FILTER ELEMENTS

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
39182415	CRTG, FILTER	MODEL 6-IR30PDE	1	1
37975208	DSCC, PKGD	3/16” BEAD, 350# DRI-PAC	—	4
37975182	DSCC, PKGD	3/16” BEAD, 34# DRI-PAC	—	4

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REPLACEMENT PARTS: MODEL# CHD 2000

VALVE AND REPAIR KITS

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
37988904	VALVE, BTFL&A	4IN, CS, CLS150, PNEU ACTR	—	9
37969185	KIT, REPAIR	R-K FOR R1 POWERRAC ACTUATOR	1	—
38485025	KIT, REPAIR	CYLINDER KIT, BTFL&A	1	—
37994241	VALVE, RELIEF	160 PSIG, .500X1.000, CS	—	2

GAUGES AND INSTRUMENTATION

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
37963972	GAUGE, PRESS	2-1/2IN, BRZ, 0-200PSIG, LOMTD	1	2
37965043	GAUGE, TEMP	3IN, 50-500F, 1/2MPT, LOMTD	—	1
37965035	GAUGE, TEMP	3IN, 50-500F, 1/2MPT, LOMTD	—	1
37965050	GAUGE, TEMP	3IN, 50-500F, 1/2MPT, LOMTD	—	3
37988953	ASSY, FILTER	IR30P FILTR W/IDE1026A BRKT	—	1
37979804	SENSOR, HMD	MOISTURE PROBE	—	1
37977014	HSG, SENSOR	FLOW CELL	—	1

ELECTRICAL

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
37994225	IC, PROGRAMD	MEC/EXP, CHD, I.R., VERSION 1.0C	—	1
37964905	ASSY, PCB	MEC EXP, STD (LEDS=GGGGGRRR)	—	1
37964913	ASSY, CABLE	30 COND, MEC-EXP, FEMALE, FLAT	—	1
37963139	ASSY, PCB	MEC CPU/C, N4, NO CHIP, IR	—	1
37979028	SUPPLY, POWER	24VDC, 1.4A, 85-132V, 50/60HZ	—	1
37994233	ASSY, VLV OPR	4WAY(5) DBL ACTUATED, POLYAM	—	1
37964947	ASSY, PCB	I/O MODULE, 4-POSITION	—	1
37964954	MODULE, I/O	INDUSTRY STND #OAC-24	—	2
37963121	FUSE, ELEC	3A, 250V, 13/32X1-1/2LG	1	1
37964996	SW, PUSHBUTN	MOMENT, 1NO-1NC, NEMA4(IP65)	—	1
37964798	SW, TEMP	N4, DIFF EXP, 200F	1	1
37992880	SW, SELECTOR	2-POS, N4, MAINTAIN, 1-NO, BLK	1	1

DESICCANT AND FILTER ELEMENTS

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
39182415	CRTG, FILTER	MODEL 6-IR30PDE	1	1
37975208	DSCC, PKGD	3/16” BEAD, 350# DRI-PAC	6	6
37975190	DSCC, PKGD	3/16” BEAD, 150# DRI-PAC	2	2
37975182	DSCC, PKGD	3/16” BEAD, 34# DRI-PAC	2	2

NOTES:

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REPLACEMENT PARTS: MODEL# CHD 2500

VALVE AND REPAIR KITS

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
37993367	VALVE, BTFL&A	6IN, CS, CLS150, PNEU ACTR	—	9
37990785	KIT, REPAIR	ACTUATOR LIMIT SWITCHES	2	—
37969193	KIT, REPAIR	R1 POWERRAC CYLINDER KIT	2	—
37969185	KIT, PACKING	CYLINDER KIT, BTFL&A	1	—
38485003	VALVE, RELIEF	160 PSIG, CS, 1/2X1, MPTXFPT	—	2

GAUGES AND INSTRUMENTATION

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
37963972	GAUGE, PRESS	2-1/2IN, BRZ, 0-200PSIG, LOMTD	1	2
37965043	GAUGE, TEMP	3IN, 50-500F, 1/2MPT, LOMTD	—	1
37965035	GAUGE, TEMP	3IN, 50-500F, 1/2MPT, LOMTD	—	1
37965050	GAUGE, TEMP	3IN, 50-500F, 1/2MPT, LOMTD	—	3
37988953	ASSY, FILTER	IR30P FILTR W/IDE1026A BRKT	—	1
37979804	SENSOR, HMD	MOISTURE PROBE	—	1
37977014	HSG, SENSOR	FLOW CELL	—	1

ELECTRICAL

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
37994225	IC, PROGRAMD	MEC/EXP, CHD, I.R., VERSION 1.0C	—	1
37964905	ASSY, PCB	MEC EXP, STD (LEDS=GGGGGRRR)	—	1
37964913	ASSY, CABLE	30 COND, MEC-EXP, FEMALE, FLAT	—	1
37963139	ASSY, PCB	MEC CPU/C, N4, NO CHIP, IR	—	1
37979028	SUPPLY, POWER	24VDC, 1.4A, 85-132V, 50/60HZ	—	1
37994233	ASSY, VLV OPR	4WAY(5) DBL ACTUATED, POLYAM	—	1
37964947	ASSY, PCB	I/O MODULE, 4-POSITION	—	1
37964954	MODULE, I/O	INDUSTRY STND #OAC-24	—	2
37963121	FUSE, ELEC	3A, 250V, 13/32X1-1/2LG	1	1
37964996	SW, PUSHBUTN	MOMENT, 1NO-1NC, NEMA4(IP65)	—	1
37964798	SW, TEMP	N4, DIFF EXP, 200F	1	1
37992880	SW, SELECTOR	2-POS, N4, MAINTAIN, 1-NO, BLK	1	1

DESICCANT AND FILTER ELEMENTS

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
39182415	CRTG, FILTER	MODEL 6-IR30PDE	1	1
37975208	DSCC, PKGD	3/16” BEAD, 350# DRI-PAC	6	6
37975190	DSCC, PKGD	3/16” BEAD, 150# DRI-PAC	2	2
37975182	DSCC, PKGD	3/16” BEAD, 34# DRI-PAC	2	2

NOTES:

1. CODE 1 COLUMN INDICATES SPARES RECOMMENDED FOR STOCKING AND MAINTENANCE.
2. CODE 2 IS A TOTAL QUANTITY OF PARTS FOR ONE DRYER.
3. ALL PRICES F.O.B. OCALA, FLORIDA: DOMESTIC PACKED: SUBJECT TO CHANGE WITHOUT NOTICE.
4. THE DRYER MODEL AND S.O.# MUST BE SPECIFIED WHEN ORDERING SPARE PARTS.

REPLACEMENT PARTS: MODEL# CHD 3600

VALVE AND REPAIR KITS

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
37993367	VALVE, BTFL&A	6IN, CS, CLS150, PNEU ACTR	—	9
37991957	KIT, PACKING	6” SEAT KIT, BTFLY&ACT	1	—
37963089	KIT, REPAIR	CYLINDER KIT, BTFLY&ACT	1	—
37963097	KIT, REPAIR	ACTUATOR LIMIT SWITCHES	2	—
38485003	VALVE, RELIEF	160 PSIG, CS, 1/2X1, MPTXFPT	—	2

GAUGES AND INSTRUMENTATION

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
37963972	GAUGE, PRESS	2-1/2IN, BRZ, 0-200PSIG, LOMTD	1	2
37965043	GAUGE, TEMP	3IN, 50-500F, 1/2MPT, LOMTD	—	1
37965035	GAUGE, TEMP	3IN, 50-500F, 1/2MPT, LOMTD	—	2
37965050	GAUGE, TEMP	3IN, 50-500F, 1/2MPT, LOMTD	—	2
37988953	ASSY, FILTER	IR30P FILTR W/IDE1026A BRKT	—	1
37965142	SENSOR, HMD	MOISTURE PROBE	—	1
37965159	SENSOR, HMD	DIGITAL MOISTURE ANALYZER	—	1
37965167	SENSOR, HMD	FLOW SENSOR	—	1

ELECTRICAL

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
37994225	IC, PROGRAMD	MEC/EXP, CHD, I.R., VERSION 1.0C	—	1
37964905	ASSY, PCB	MEC EXP, STD (LEDS=GGGGGRRR)	—	1
37964913	ASSY, CABLE	30 COND, MEC-EXP, FEMALE, FLAT	—	1
37963139	ASSY, PCB	MEC CPU/C, N4, NO CHIP, IR	—	1
37979028	SUPPLY, POWER	24VDC, 1.4A, 85-132V, 50/60HZ	—	1
37994233	ASSY, VLV OPR	4WAY(5) DBL ACTUATED, POLYAM	—	1
37964947	ASSY, PCB	I/O MODULE, 4-POSITION	—	1
37964954	MODULE, I/O	INDUSTRY STND #OAC-24	—	2
37963121	FUSE, ELEC	3A, 250V, 13/32X1-1/2LG	1	1
37964996	SW, PUSHBUTN	MOMENT, 1NO-1NC, NEMA4(IP65)	—	1
37964798	SW, TEMP	N4, DIFF EXP, 200F	1	1
37992880	SW, SELECTOR	2-POS, N4, MAINTAIN, 1-NO, BLK	1	1

DESICCANT AND FILTER ELEMENTS

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
39182415	CRTG, FILTER	MODEL 6-IR30PDE	1	1
37966132	DSCC, PKGD	1/2” BEAD, 270# DRI-PAC	2	2
37966140	DSCC, PKGD	1/2” BEAD, 60# DRI-PAC	4	4
37975208	DSCC, PKGD	3/16” BEAD, 350# DRI-PAC	10	10

NOTES:

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4. THE DRYER MODEL AND S.O.# MUST BE SPECIFIED WHEN ORDERING SPARE PARTS.

REPLACEMENT PARTS: MODEL# CHD 4900

VALVE AND REPAIR KITS

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
37993367	VALVE, BTFL&A	4IN, CS, CLS150, PNEU ACTR	—	9
37990785	KIT, REPAIR	ACTUATOR LIMIT SWITCHES	2	—
37969193	KIT, REPAIR	R1 POWERRAC CYLINDER KIT	2	—
37969185	KIT, PACKING	CYLINDER KIT, BTFL&A	1	—
38485003	VALVE, RELIEF	160 PSIG, CS, 1/2X1, MPTXFPT	—	2

GAUGES AND INSTRUMENTATION

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
37963972	GAUGE, PRESS	2-1/2IN, BRZ, 0-200PSIG, LOMTD	1	2
37965043	GAUGE, TEMP	3IN, 50-500F, 1/2MPT, LOMTD	—	1
37965035	GAUGE, TEMP	3IN, 50-500F, 1/2MPT, LOMTD	—	1
37965050	GAUGE, TEMP	3IN, 50-500F, 1/2MPT, LOMTD	—	3
37988953	ASSY, FILTER	IR30P FILTR W/IDE1026A BRKT	—	1
37979804	SENSOR, HMD	MOISTURE PROBE	—	1
37977014	HSG, SENSOR	FLOW CELL	—	1

ELECTRICAL

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
37994225	IC, PROGRAMD	MEC/EXP, CHD, I.R., VERSION 1.0C	—	1
37964905	ASSY, PCB	MEC EXP, STD (LEDS=GGGGGRRR)	—	1
37964913	ASSY, CABLE	30 COND, MEC-EXP, FEMALE, FLAT	—	1
37963139	ASSY, PCB	MEC CPU/C, N4, NO CHIP, IR	—	1
37979028	SUPPLY, POWER	24VDC, 1.4A, 85-132V, 50/60HZ	—	1
37994233	ASSY, VLV OPR	4WAY(5) DBL ACTUATED, POLYAM	—	1
37964947	ASSY, PCB	I/O MODULE, 4-POSITION	—	1
37964954	MODULE, I/O	INDUSTRY STND #OAC-24	—	2
37963121	FUSE, ELEC	3A, 250V, 13/32X1-1/2LG	1	1
37964996	SW, PUSHBUTN	MOMENT, 1NO-1NC, NEMA4(IP65)	—	1
37964798	SW, TEMP	N4, DIFF EXP, 200F	1	1
37992880	SW, SELECTOR	2-POS, N4, MAINTAIN, 1-NO, BLK	1	1

DESICCANT AND FILTER ELEMENTS

CCN#	NAME	DESCRIPTION	CODE 1	CODE 2
39182415	CRTG, FILTER	MODEL 6-IR30PDE	1	1
37975216	DSCC, PKGD	3/16” BEAD, 2000# DRI-PAC	2	2
37975208	DSCC, PKGD	3/16” BEAD, 350# DRI-PAC	2	2
37975190	DSCC, PKGD	3/16” BEAD, 150# DRI-PAC	2	2
37975182	DSCC, PKGD	3/16” BEAD, 34# DRI-PAC	4	4
37975174	DSCC, PKGD	3/16” BEAD, 17# DRI-PAC	2	2
37966132	DSCC, PKGD	1/2” BEAD, 270# DRI-PAC	2	2
37966140	DSCC, PKGD	1/2” BEAD, 60# DRI-PAC	2	2

NOTES:

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APPENDIX B: Sub-Vendor Information

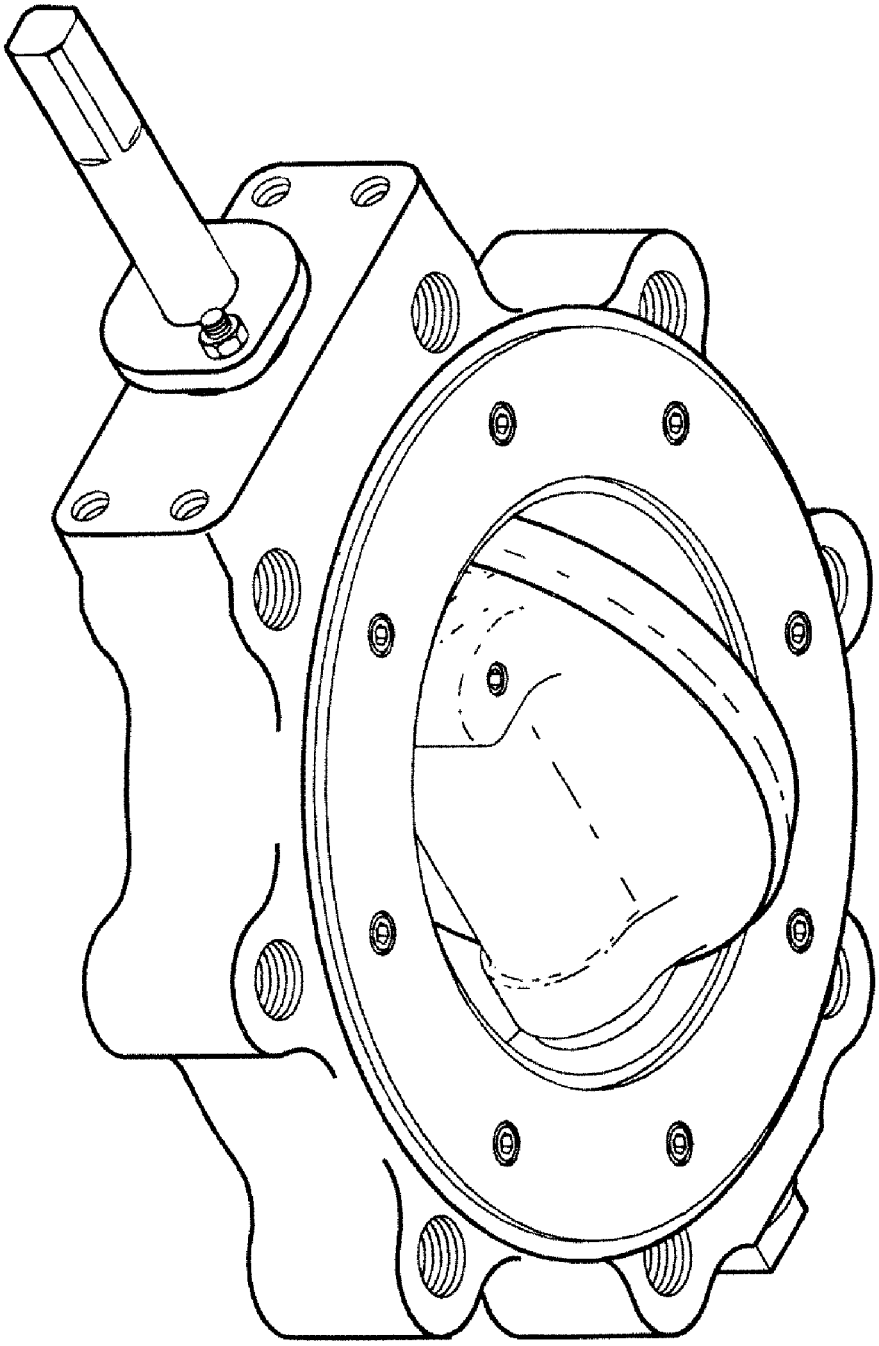
- Switching Valve User Manuals
  - DeZURIK: Instruction for BHP Butterfly Valves
  - DeZURIK: Instructions for R1 & R2 POWERRAC™ Actuator

- AIRSAVER Option:
  - XDT DewPoint Transmitter Operating Manual

- MATERIAL SAFETY DATA SHEETS
  - DRIOUT Desiccant
  - DRIOUT Bed Support

DeZURiK®

BHP BUTTERFLY VALVES



Instruction D–10322
September 1998

USE OF THESE INSTRUCTIONS

This document should be made available to personnel responsible for the installation, operation, and maintenance of DeZURIK BHP Butterfly Valves. Refer to the data plate attached to the valve, and also to the applicable product bulletin for information regarding materials of construction and product limitations.

Instructions for this equipment consist of a separate document for each of the following system components:

- The basic valve, without the actuator
- The valve actuator
- Accessories if any, such as positioners, pilot valves, and limit switches

Each of the above components also has an Assembly drawing that is referenced on the Installation drawing.

SAFETY MESSAGES

Safety messages in these Instructions and on label(s) on the valve are flagged with one of the words CAUTION, WARNING, or DANGER. The messages must be carefully read and followed to avoid personal injury and/or equipment damage.

After installation, if a safety label on the valve becomes difficult to see or read, or if a label has been removed, please contact DeZURIK for replacement label(s). Include the 7-digit part number from the data plate on the valve, the quantity of valves, and an appropriate name and mailing address.

INSPECTION

This equipment has been properly packaged and protected for shipment. However, the possibility exists for damage in transit, due to improper handling. Upon arrival at the final destination, the equipment should be carefully inspected for damage. If damage exists, a damage claim should be filed immediately with the carrier.

STORAGE

Units should be stored in a clean, cool and dry location, and should be protected from dirt, chips, dust, and other contaminants. It is recommended that BHP Butterfly Valves be stored with the disc horizontal and fully closed, and with the disc protectors in place. For long term storage, the seating and packing gland areas should be protected from direct sunlight.

If outdoor storage is necessary, the equipment should be wrapped in plastic and stored high enough so that it will not be immersed in water or buried in snow. The temporary plastic plugs in electrical and pneumatic openings should be replaced with metal pipe plugs.

REPLACEMENT PARTS

Replacement parts may be ordered from the local DeZURIK sales representative, or directly from DeZURIK, as listed on the back cover.

Recommended spare parts are listed on the Assembly drawings. It is recommended that one set of parts be inventoried for each valve size and type.

When ordering parts, include the valve size and the 7-digit part number from the valve data plate. Also include the Assembly drawing number, the name of the part, and the balloon number and quantity shown on the Assembly drawing.

DeZURIK SERVICE

DeZURIK service personnel are available for start-up and repair of DeZURIK products. Also, DeZURIK provides customized training programs for customers. Contact a DeZURIK sales representative for more information, or visit our web site at: www.dezurik.com

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DESCRIPTION The DeZURIK BHP Butterfly Valve is designed for on-off and throttling applications in the chemical, power, paper, air conditioning, petroleum, and refining industries. A choice of body styles, ratings, seat styles, materials, actuators, and accessories is available in valve sizes from 2" through 48". Pressure and temperature ratings are shown on the valve data plate.

INSTALLATION Refer to the valve Installation Drawing for dimensional information.

CAUTION

Failure to lift the valve properly may cause damage. Do not fasten lifting devices to the actuator or disc, or through the seat opening in the body. Lift the valve with slings fastened around the valve body, or attach them to bolts or rods run through holes for the pipeline flanges.

1. If the valve does not have an attached actuator, mount the actuator on the valve.
   a. For a DeZURIK actuator, refer to the Actuator Instructions.
   b. For an actuator other than DeZURIK, the dimensional requirements for the actuator interface are shown on the Installation Drawing for the valve.
2. Remove all foreign material such as weld spatter, oil, grease, and dirt from the valve, flanges, and pipeline.
3. Open the valve, and clean the seat and the sealing edge of the disc.

CAUTION

Excessive dynamic torque can harm the valve if it is not properly located. Install the valve at least 8 pipe diameters downstream from the nearest pump or elbow.

4. Install the valve so that the seat side will be on the higher pressure side when the valve is closed—the seat side of the valve is marked “seat”.

   Note: Pipeline flow may be in either direction through the valve. If possible, install the valve with the shaft horizontal to provide a self-cleaning action on the seat.

5. For 2" through 24" Class 150 and Class 300 valves, use mating flanges that comply with the same class of ASME/ANSI B16.5. For larger sizes, use flanges that comply with the Class 150, Series A requirements of ASME B16.47.

   Note: Valves with an undrilled seat retainer are not suitable for dead-end service without a downstream flange.

6. Use self-centering flat ring flange gaskets.

INSTALLATION (CONTINUED)

7. Place the valve in the pipeline with the valve closed.

   Note: Handle the valve carefully so that the flange gasket sealing surfaces do not get scratched or damaged.

8. Ensure that the valve, the pipeline, and the mating connections are concentric before tightening the pipeline bolts.

9. Tighten the bolts evenly, in a crisscross pattern.

OPERATION

Clockwise rotation of the valve shaft closes the disc into the seat.

The valve is fully open when the disc is 90 degrees counterclockwise from the closed position. The valve is fully closed when the flat side of the disc is parallel with the flange sealing surface on the body.

On sizes 5" and larger, the closed disc must not contact the stop lug in the body.

An indicator line on the top of the valve shaft corresponds to the flat (or concave) side of the disc. The line may be used to determine the approximate position of the disc when the disc is not visible.

The valve actuator is connected to the valve shaft, and positions the disc at the open, closed, or intermediate positions. The adjustable open and closed position stops in the valve actuator are set to match the open and closed positions of the valve.

Note: Refer to the Actuator Instructions for actuator stop adjustment information.

LUBRICATION

The valve is lubricated at the factory, and does not require routine lubrication. Refer to the Actuator Instructions for actuator lubrication requirements.

PACKING ADJUSTMENT

The shaft seal consists of packing that is contained and compressed by the packing gland. If packing leakage occurs, tighten the two adjustment nuts (A15) on top of the packing gland (A12), refer to the appropriate section. Tighten the nuts evenly and gently, just enough to stop the leakage. Overtightening will cause excessive valve operating torque, and will decrease the life of the packing.

If leakage cannot be stopped by tightening the packing, replace the packing. See "Packing Replacement" below.

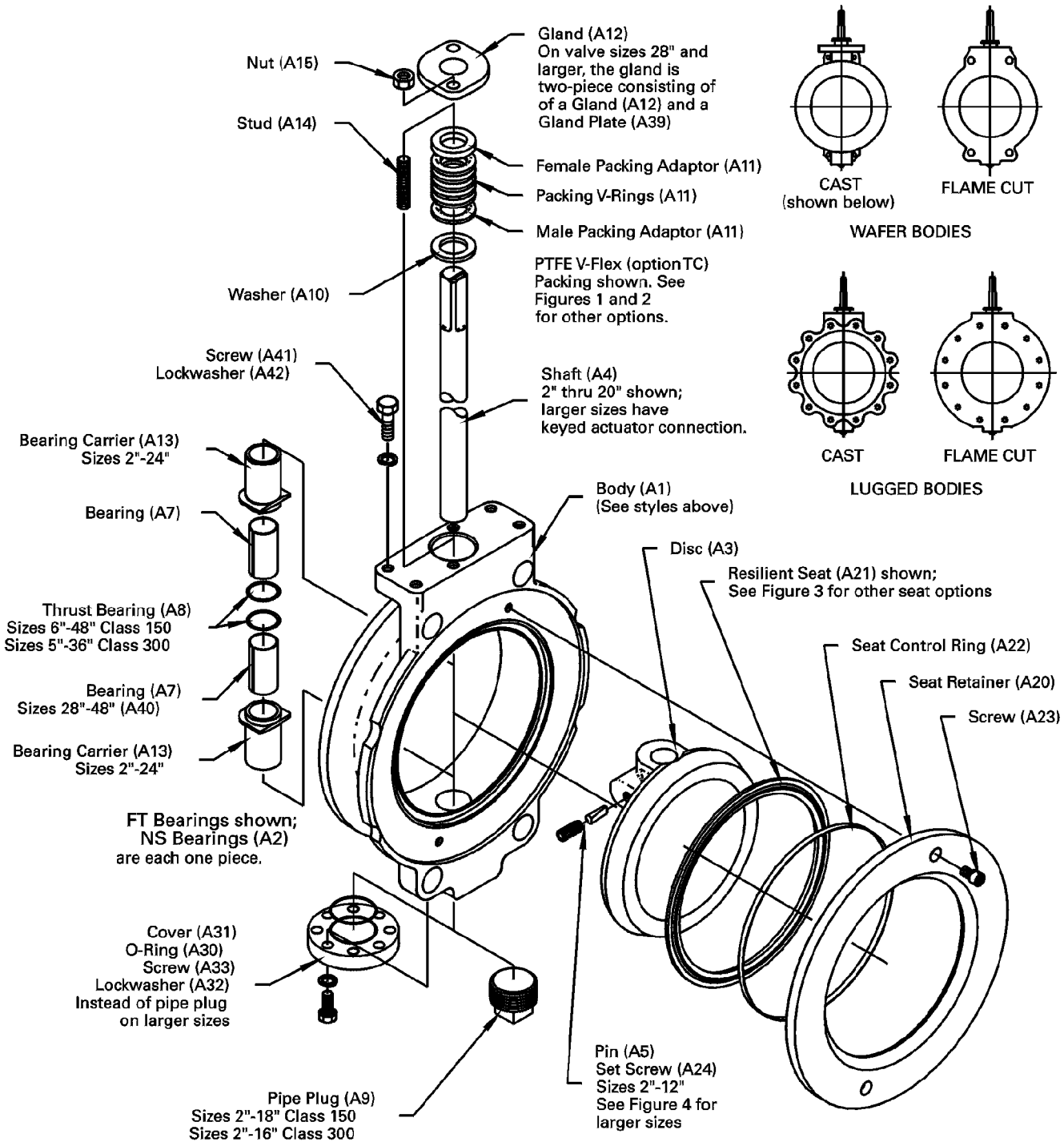


Figure 1—Component Identification

PACKING REPLACEMENT

Several packing options are available. Follow the steps below to replace the packing. See Figure 1 for component identification.

⚠ WARNING

Pipeline pressure can propel the loose packing and packing gland, and can cause personal injury or equipment damage. Relieve the pressure in the pipeline before removing the packing gland.

1. Relieve the pressure in the pipeline, and drain the pipeline.

⚠ WARNING

Moving parts from accidental operation of powered actuator can cause personal injury or equipment damage. Disconnect and lock out power to actuator before servicing.

2. If the actuator is powered, disconnect and lock out the pneumatic, hydraulic, or electrical power to prevent accidental operation of the actuator.
3. Remove the actuator as described in the Actuator Instructions, and remove the actuator bracket from the valve.
4. Remove the two gland nuts (A15) and remove the gland (A12). Live-loaded packing options include a flat washer (A37) and several spring washers (A36) under each gland nut. On valve sizes 28" and larger, the gland consists of a two-piece gland (A12) and gland plate (A39).
5. Remove all of the packing (A11). If the valve has the dual packing option, remove the secondary packing chamber (A17) the gasket (A16), and the secondary packing (A26).
6. Remove all packing fragments, dirt, and other contaminants from all packing sealing surfaces.
7. Follow the procedure for the applicable packing option:
   - PTFE V-Flex Packing Option TC—See page 6.
   - Carbon Graphite Packing Option G1—See page 8.
   - Graphoil Live-Loaded Packing Option G2L—See page 9.
   - PTFE V-Flex Live-Loaded Packing Option TCL—See page 7.
   - PTFE V-Flex Dual-Seal Live-Loaded Packing Option TCDL—See page 5.
   - Graphoil Dual Seal Packing Option G2D—See page 10.
   - Graphoil Dual Seal Live-Loaded Packing Option G2DL—See page 11.
   - Carbon Graphite Packing Option G1—See page 8.

PACKING REPLACEMENT (CONTINUED)

PTFE V-Flex Dual-Seal Live-Loaded Packing Option TCDL

The new primary packing (A11) and the new secondary packing (A11) each consist of one bottom end ring, three or more chevron rings, and one top end ring.
A quantity of new spring washers (A36) is required as shown in Table A (page 13) for Class 150 valves, and in Table B (page 14) for Class 300 valves.

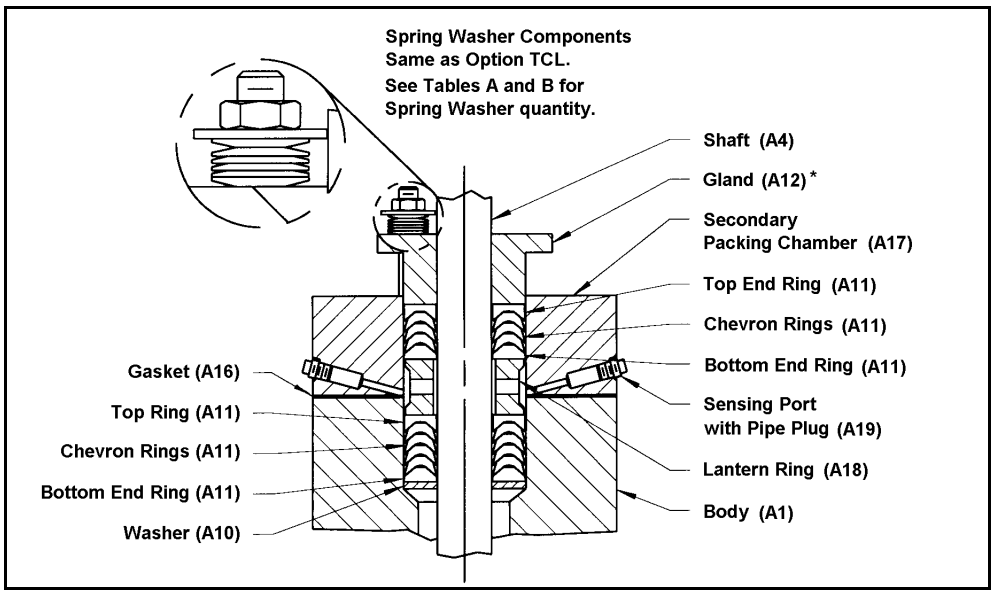


Figure 2—Packing Option TCDL

a. Place the primary (lower) set of packing in the body, one ring at a time, in the configuration shown in Figure 2. Do not lubricate. Start each chevron ring into the packing chamber at a slight angle, and push each ring carefully into position so that the sealing lips do not bend over.

b. Place the new gasket (A16), the secondary packing chamber (A17), and the lantern ring (A18) in the configuration shown in Figure 2.

c. Place the secondary (upper) set of packing in the secondary packing chamber (A17), one ring at a time, as shown in Figure 2—do not lubricate.

d. Start each chevron ring into the packing chamber at a slight angle, and push each ring carefully into position so that the sealing lips do not bend over.

e. Lubricate the threads of the two studs (A14) and the threads and contact faces of the two gland nuts (A15) with Never-Seez.

f. Replace the gland (A12), the new spring washers (A36), the two flat washers (A37), and the two gland nuts (A15). Arrange the spring washers in the configuration shown in Figure 8 on page 9, with the top and bottom washers in series, and the remaining washers in parallel. Do not tighten the nuts.

g. Mount the actuator bracket and the secondary packing chamber to the body with the same screws, and tighten the screws as shown in Table C (page 15).

h. Tighten the gland nuts (A15) finger tight, and torque the nuts evenly to the value in Table A (page 13) for Class 150 valves, and in Table page 14 (page 14) for Class 300 valves.

i. Continue with step 8 on page 12.

PACKING REPLACEMENT (CONTINUED)

PTFE V-Flex Packing Option TC

The new packing (A11) consists of one bottom end ring, three or more chevron rings, and one top end ring.

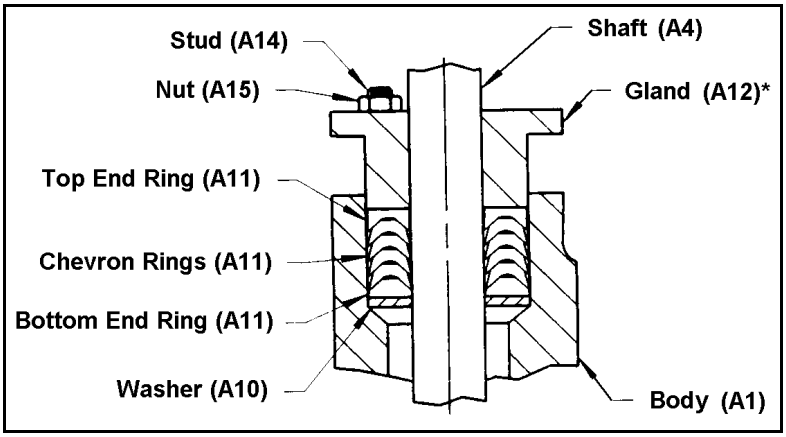


Figure 3—Packing Option: TC

a. Place the packing in the body, one ring at a time, in the configuration shown in Figure 3. Do not lubricate.

b. Start each chevron ring into the packing chamber at a slight angle, and push each ring carefully into position so that the sealing lips do not bend over.

c. Replace the gland (A12) and the two gland nuts (A15). Tighten the nuts finger tight, plus ½ turn.

d. Continue with step 8 on page 12.

PTFE Dual Seal with Mechanical Spring Packing Option TMD

The new primary packing (A11) consists of one spring-loaded bottom end ring, three or more chevron rings, and one top end ring, all between two anti-extrusion washers (A34); the new secondary packing (A26) consists of one bottom end ring, three or more chevron rings, and one top end ring, all between two anti-extrusion washers (A34).

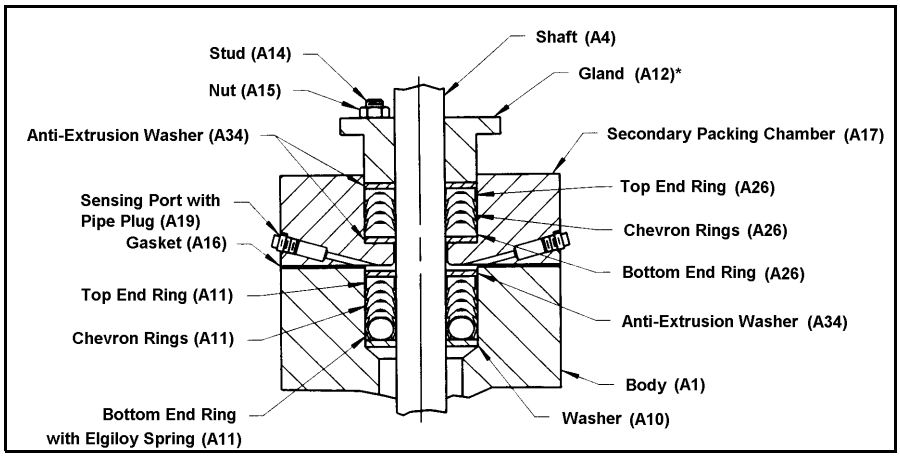


Figure 4—Packing Option TMD

a. Place the primary (lower) set of new packing (A11) and anti-extrusion washers (A34) in the body, one ring at a time, as shown in Figure 4—do not lubricate.

PACKING REPLACEMENT (CONTINUED)

b. Place the new gasket (A16), the secondary packing chamber (A17), and the new secondary packing, one ring at a time, in the configuration shown in Figure 8 on page 9—do not lubricate. Start each chevron ring into the packing chamber at a slight angle, and push each ring carefully into position so that the sealing lips do not bend over.Place the gland (A12) and the two gland nuts (A15) in position as shown—Do not tighten the nuts.

c. Mount the actuator bracket and the secondary packing chamber to the body with the same screws, and tighten the screws as shown in Table C on page 15.

d. Tighten the gland nuts (A15) finger tight, plus ½ turn.

e. Continue with step 8 on page 12.

PTFE V-Flex Live-Loaded Packing Option TCL

The new packing (A11) consists of one bottom end ring, three or more chevron rings, and one top end ring. A quantity of new spring washers (A36) is required as shown in Table A (page 13) for Class 150 valves, and in Table B (page 14) for Class 300 valves.

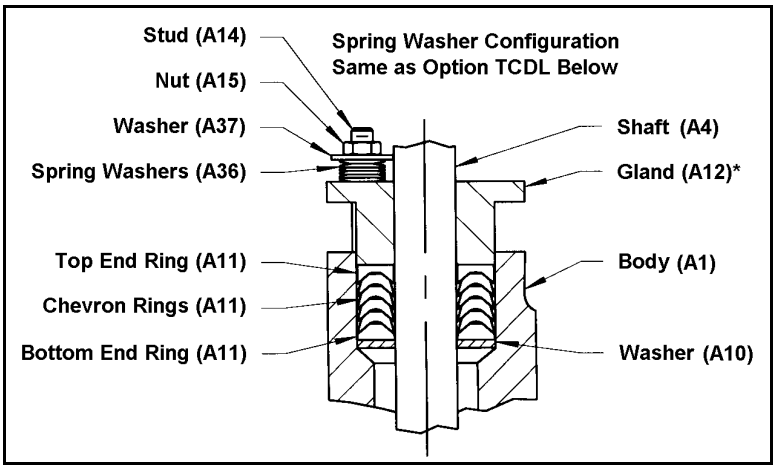


Figure 5—PTFE V-Flex Live-Loaded Packing Option TCL

a. Place the packing in the body, one ring at a time, in the configuration shown in Figure 5. Do not lubricate. Start each chevron ring into the packing chamber at a slight angle, and push each ring carefully into position so that the sealing lips do not bend over.

b. Lubricate the following surfaces with Never-Seez:

- The threads of the two studs (A14)
- The threads and contact faces of the two gland nuts (A15)

c. Replace the gland (A12), the new spring washers (A36), the two flat washers (A37), and the two gland nuts (A15). Arrange the spring washers in the configuration shown in Figure 8 on page 9, with the top and bottom washers in series, and the remaining washers in parallel. Tighten the nuts finger tight, and torque the nuts evenly to the value in Table A (page 13) for Class 150 valves, and in Table B (page 14) for Class 300 valves.

d. Continue with step 8 on page 12.

PACKING REPLACEMENT (CONTINUED)

Carbon Graphite Packing Option G1

The new packing (A11) consists of one Graphoil ring and two carbon rings.

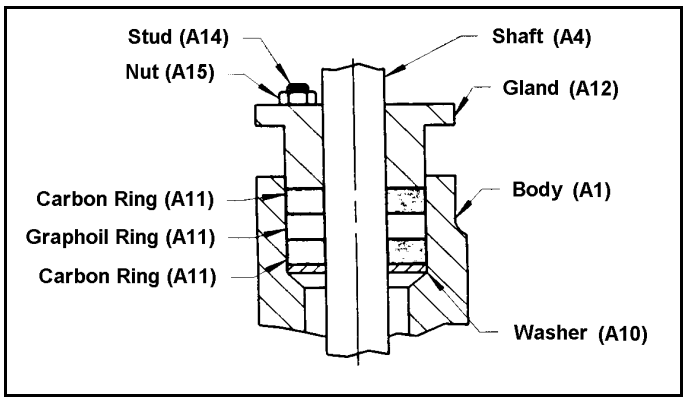


Figure 6—Packing Option G1

a. Place the packing in the body, one ring at a time, in the configuration shown in Figure 6. Do not lubricate.

b. Replace the gland (A12) and the two gland nuts (A15).

c. Tighten the nuts finger tight, plus ½ turn.

d. Continue with step 8 on page 12.

Graphoil Packing Option G2

The new packing consists of three or more Graphoil rings (A11) between two anti-extrusion washers (A34).

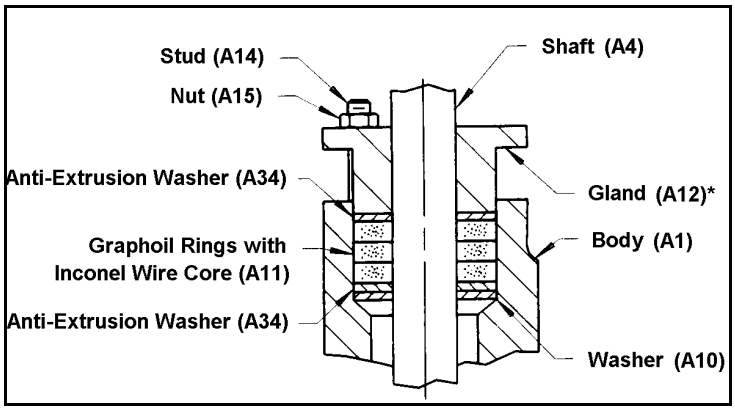


Figure 7—Packing Option G2

a. Lubricate the inside and outside diameters of each new packing ring with Krytox 240 AC lubricant.

b. Place the new packing and anti-extrusion washers in the body, one ring at a time, in the configuration shown in Figure 7.

c. Replace the gland (A12) and the two gland nuts (A15). Tighten the nuts finger tight, plus ½ turn.

d. Continue with step 8 on page 12.

PACKING REPLACEMENT (CONTINUED)

Graphoil Live-Loaded Packing Option G2L

The new packing (A11) consists of three or more Graphoil rings between two anti-extrusion washers (A34). A quantity of new spring washers (A36) is required as shown in Table A (page 13) for Class 150 valves, and in Table B (page 14) for Class 300 valves.

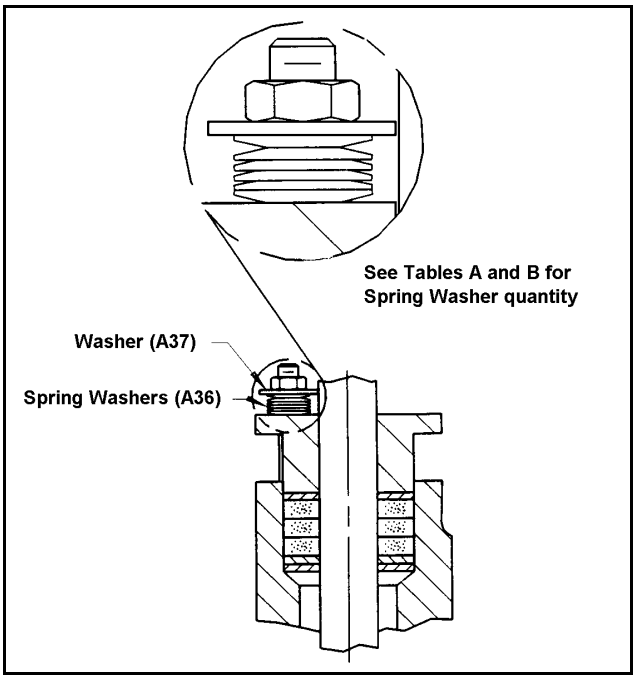


Figure 8—Packing Option G2L

a. Lubricate the following surfaces with Krytox 240 AC lubricant:

- The inside and outside of each new packing ring
- The threads of the two studs (A14)
- The threads and contact faces of the two gland nuts (A15).

b. Place the new packing (A11) and anti-extrusion washers (A34) in the body, one ring at a time, in the configuration shown in Figure 8.

c. Replace the gland (A12), the new spring washers (A36), the two flat washers (A37), and the two gland nuts (A15).

d. Arrange the spring washers in the configuration shown in Figure 8, with the top and bottom washers in series, and the remaining washers in parallel.

e. Tighten the nuts finger tight, and torque the nuts evenly to the value in Table A (page 13) for Class 150 valves, and in Table B (page 14) for Class 300 valves.

PACKING REPLACEMENT (CONTINUED)

Graphoil Dual Seal Packing Option G2D

The new primary packing (A11) consists of three or more Graphoil rings between two anti-extrusion washers (A34); the new secondary packing (A26) consists of two Graphoil rings between two anti-extrusion washers (A34).

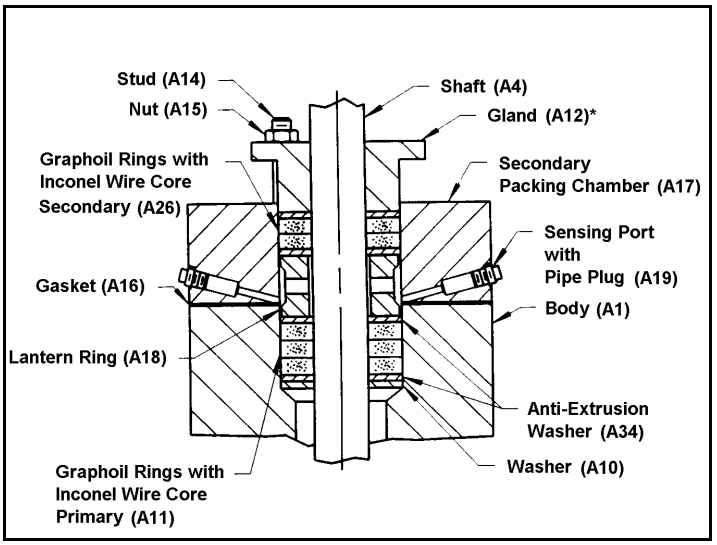


Figure 9—Packing Option G2D

a. Lubricate the inside and outside diameters of each new packing ring with Krytox 240 AC lubricant.

b. Place the primary (lower) set of new packing (A11) and anti-extrusion washers (A34) in the body, one ring at a time, as shown in Figure 9.

c. Remove the two gland studs (A14) from the secondary packing chamber (A17), and temporarily place the studs in the threaded holes in the body.

d. Place the gland (A12) and nuts (A15) on the studs, and turn the nuts evenly until the gland has moved about 25% of the distance from the bottom of the gland to the top of the body.

e. Remove the nuts, the gland, and the studs, and replace the studs in the secondary packing chamber.

f. Place the following components in the configuration shown in Figure 9:

- The new gasket (A16)
- The secondary packing chamber (A17)
- The lantern ring (A18), the two new packing rings (A26)
- One ring at a time (lubricated)
- Anti-extrusion washers (A34)
- The gland (A12), and the gland nuts (A15)—Do not tighten the nuts.

g. Mount the actuator bracket and the secondary packing chamber to the body with the same screws, and tighten the screws as shown in Table C (page 15).

h. Tighten the gland nuts (A15) finger tight, plus ½ turn.

i. Continue with step 8 on page 12.

PACKING REPLACEMENT (CONTINUED)

Graphoil Dual Seal Live-Loaded Packing Option G2DL

Components are the same as option G2D. In addition, a quantity of new spring washers (A36) is required as shown in Table A (page 13) for Class 150 valves, and in Table B (page 14) for Class 300 valves.

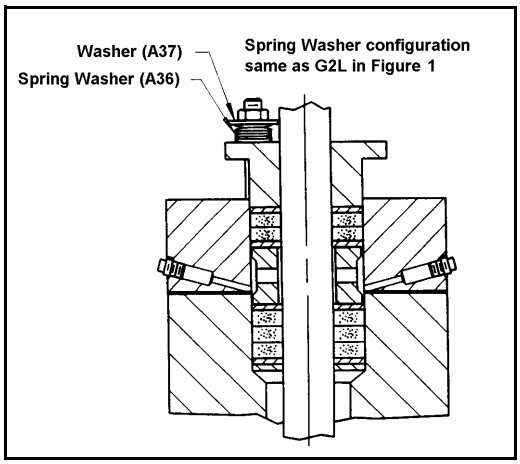


Figure 10—Graphoil Dual Seal Live-Loaded Packing Option G2DL

a. Lubricate the inside and outside diameters of each new packing ring with Krytox 240 AC lubricant. Place the primary (lower) set of new packing (A11) and anti-extrusion washers (A34) in the body, one ring at a time, in the configuration shown in Figure 10.

b. Remove the two gland studs (A14) from the secondary packing chamber (A17), and temporarily place the studs in the threaded holes in the body. Place the gland (A12) and nuts (A15) on the studs, and turn the nuts evenly until the gland has moved about 25% of the distance from the bottom of the gland to the top of the body.

c. Remove the nuts, the gland, and the studs, and replace the studs in the secondary packing chamber.

d. Place the following components in the configuration shown in Figure 10:

- The new gasket (A16),
- The secondary packing chamber (A17),
- The lantern ring (A18), the two new packing rings (A26), one ring at a time (Lubricated)
- Anti-extrusion washers (A34)
- The gland (A12), and the gland nuts (A15), and the new spring washers (A36)
- The two flat washers (A37) in the configuration shown in Figure 8 on page 9, with the top and bottom washers in series, and the remaining washers in parallel—do not tighten the nuts.

e. Lubricate the threads of the two studs (A14), and the threads and contact faces of the two gland nuts (A15)

f. Mount the actuator bracket and the secondary packing chamber to the body with the same screws, and tighten the screws as shown in Table C (page 15).

g. Tighten the gland nuts (A15) finger tight, plus ½ turn.

h. Torque the nuts evenly to the value in Table A (page 13) for Class 150 valves, or in Table B (page 14) for Class 300 valves.

i. Continue with step 8 on page 12.

PACKING REPLACEMENT (CONTINUED)

8. If the valve has single packing, re-mount the actuator bracket on the valve, and tighten the screws as shown in Table A (page 13).
9. Re-mount the actuator on the valve, as described in the Actuator Instructions.
10. If the actuator is a powered actuator, reconnect power and other connections.
11. Actuate the valve. If necessary, adjust the open and closed position stops as described in the *Operation section.*
12. Pressurize the valve. If the packing leaks, tighten the gland nuts evenly and slowly, just enough to stop the leak.
13. If the valve has dual packing, remove the pipe plug from one of the sensing ports in the secondary packing chamber.
    - If leakage occurs through the sensing port on packing options G2D or G2DL, tighten the gland nuts evenly and slowly, just enough to stop the leakage, and replace the pipe plug.
    - If leakage occurs through the sensing port on packing option TMD, repeat the steps in this section, starting with step 1, and replace the TMD packing components located in the body, below the secondary packing chamber.

TORQUE SPECIFICATION

Table A: Class 150 Valves—Gland Nut Torques and Spring Washer Quantities for Live-Loaded Packing

Valve Size	Gland Nut Torque, Inch Pounds	Spring Washers (17-7PH Stainless Steel)				
		Quantity Each Gland Stud	Dimensions (Ref)			
			Outside Diameter	Inside Diameter	Material Thickness	Overall Height
2	4 ± 0.5	5	0.551	0.283	0.014	0.032
2½	5 ± 0.5					
3	6 ± 0.5					
4	6 ± 0.5	6				
5	11 ± 0.5	8	0.551	0.283	0.014	0.032
6	16 ± 1	5	0.709	0.323	0.020	0.043
8	19 ± 1	6				
10	23 ± 1	7	0.709	0.323	0.020	0.043
12	43 ± 2	4	0.787	0.402	0.035	0.057
14	43 ± 2					
16	45 ± 2					
18	59 ± 2	6	0.984	0.480	0.028	0.063
20	70 ± 2	5	0.984	0.480	0.035	0.063
24	105 ± 2	6	1.100	0.559	0.032	0.075
30	156 ± 3	6	1.100	0.559	0.039	0.071
36	185 ± 3	4	1.100	0.559	0.049	0.083

TORQUE SPECIFICATION (CONTINUED)

Table B: Class 300 Valves—Gland Nut Torques and Spring Washer Quantities for Live-Loaded Packing

Valve Size	Gland Nut Torque, Inch Pounds	Spring Washers (17-7PH Stainless Steel)				
		Quantity Each Gland Stud	Dimensions (Ref)			
			Outside Diameter	Inside Diameter	Material Thickness	Overall Height
2	13 ± 0.5	9	0.551	0.283	0.014	0.032
2½	14 ± 0.5	10				
3	16 ± 1	6	0.551	0.283	0.020	0.035
4	28 ± 1	8				
5	40 ± 1	7	0.630	0.323	0.024	0.041
6	49 ± 2	8				
8	59 ± 2	4	0.630	0.323	0.035	0.049
10	110 ± 3	8	0.984	0.480	0.035	0.063
12	126 ± 3	8				
14	152 ± 3	7	1.100	0.480	0.039	0.077
16	163 ± 3	7	1.240	0.480	0.039	0.083
18	181 ± 3	8				
20	274 ± 4	7	1.340	0.563	0.049	0.095
24	382 ± 4	7	1.240	0.642	0.049	0.085

TORQUE SPECIFICATION (CONTINUED)

Table C: Fastener Torques Actuator Bracket–to–Valve

Valve		Fastener		
Class	**Size**	**Size (Ref)**	**Grade (Ref)**	**Torque, Foot Pounds**
150	2 thru 4	1/4-20	8	13 ± 1
	5 thru 8	5/16-18	8	27 ± 4
	10	3/8-16	8	50 ± 7
	12 thru 16	1/2-13	8	125 ± 17
	18 and 20	5/8-11	8	250 ± 40
	24 thru 36	5/8-11	5	180 ± 20
	42 and 48	3/4-10	5	330 ± 40
300	2 thru 3	1/4-20	8	13 ± 1
	4 thru 6	5/16-18	8	27 ± 4
	8	3/8-16	8	50 ± 7
	10 and 12	1/2-13	8	125 ± 17
	14	5/8-11	8	250 ± 40
	16 thru 24	5/8-11	5	180 ± 20
	30 and 36	3/4-10	5	330 ± 40

SEAT REPLACEMENT

Follow the steps below to replace the used seat with a new seat.

WARNING

Pipeline pressure can propel the loose flange bolts and flanges, and can cause personal injury or equipment damage. Relieve the pressure in the pipeline before removing flange bolts and flanges.

1. Relieve pressure in the pipeline, and drain the pipeline.
2. Close the valve.

WARNING

Moving parts from accidental operation of powered actuator can cause personal injury or equipment damage. Disconnect and lock out power to actuator before servicing.

3. If the actuator is powered, disconnect and lock out the pneumatic, hydraulic, or electrical power to prevent accidental operation of the actuator.
4. Support the valve, remove the flange bolts, and remove the valve from the pipeline. Refer to the lifting requirements in the Installation section. Place the valve in a horizontal position, with the seat side up.
5. Refer to Figure 1—page 3—for component identification. Remove the seat retainer screws (A23), the seat retainer (A20), and all of the seat components. The seat retainer on valve sizes 14" and larger has two tapped holes. Screws may be used in the holes to release the seat retainer from the body.
6. Clean the seat cavity in the body and the seat cavity in the seat retainer. Remove all seat fragments, dirt, and other contaminants.
7. Close the valve.
8. Refer to the appropriate seat option:
   - Resilient Seat Options TT, TI, RT, and RI—See page 17.
   - Fyre-Block Seat Options RTS2 and TTS2—See page 18.
   - Metal Seat Options S2 and S2L—See page 17.
   - Intelli-Seal™ Seat Options IS1 & IS2—See page 18.

SEAT REPLACEMENT (CONTINUED)

Resilient Seat Options TT, TI, RT, and RI

a. Place the seat control ring (A22) in the groove in the new seat (A21), and center the seat on the closed disc.

b. On valve sizes 5" through 10" only, a seat retainer gasket (A6) is required. Center the gasket in position on the body.

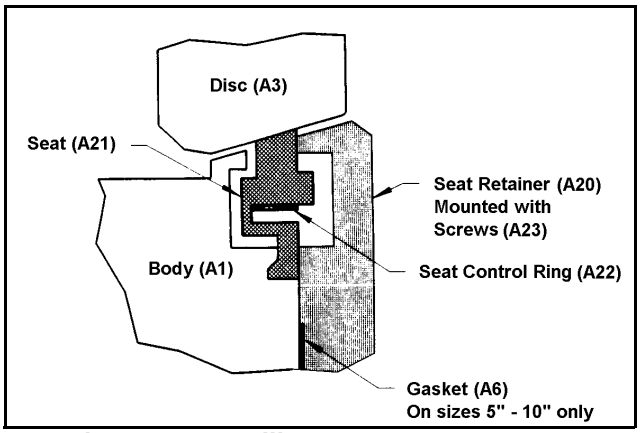


Figure 11—Resilient Seat Option TT, TI, RT, and RI

c. Apply a rust inhibitor such as Never Seez to the threads of the seat retainer screws (A23). Mount the seat retainer (A20) to the body with the seat retainer screws, and tighten the screws as shown in Table D (page 19).

d. Continue with step 9 on page 19.

Metal Seat Options S2 and S2L

a. If the valve actuator connection is clamped to the valve shaft, loosen the connection so that the valve shaft is free to move axially.

b. Loosen the packing gland nuts (A15).

c. Place the seat support ring (A29) in the body. Center the Gasket (A27) and the metal seat (A28) on the closed disc.

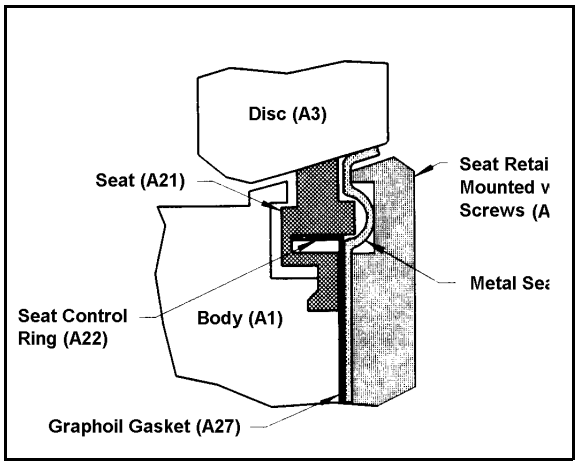


Figure 12—Metal Seat Option S2 and S2L

d. Apply a rust inhibitor such as Never Seez to the threads of the seat retainer screws (A23). With all components centered, mount the seat retainer (A20) to the body with the seat retainer screws. Tighten the screws as shown in Table D (page 19).

e. If the valve actuator connection was loosened in step a, tighten the connection.

f. Adjust the packing gland nuts (A15) as described in the *Packing Adjustment section.* If the packing is live-loaded, tighten the nuts as shown in Table A (page 13) for Class 150 valves, or in Table B (page 14) for Class 300 valves.

g. Continue with step 9 on page 19.

SEAT REPLACEMENT (CONTINUED)

Fyre-Block Seat Options RTS2 and TTS2

a. If the valve actuator connection is clamped to the valve shaft, loosen the connection so that the valve shaft is free to move axially.

b. Loosen the packing gland nuts (A15).

c. Place the seat control ring (A22) in the groove in the new PTFE seat (A21).

d. Center the PTFE seat (A21), the gasket (A27), and the metal seat (A28) on the closed disc.

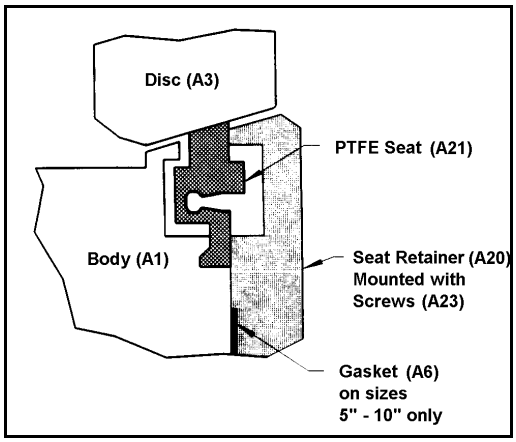


Figure 13—Fyre Block Seat Options RTS2 and TTS2

e. Apply a rust inhibitor such as Never Seez to the threads of the seat retainer screws (A23). With all components centered, mount the seat retainer (A20) to the body with the seat retainer screws. Tighten the screws as shown in Table D (page 19).

f. If the valve actuator connection was loosened in step *a,* tighten the connection.

g. Adjust the packing gland nuts (A15) as described in the Intelli-Seal™ Seat Options IS1 & IS2—See page 18. If the packing is live-loaded, tighten the nuts as shown in Table A (page 13) for Class 150 valves, or in Table B (page 14) for Class 300 valves.

h. Continue with step 9 on page 19.

Intelli-Seal™ Seat Options IS1 & IS2

a. If the valve actuator connection is clamped to the valve shaft, loosen the connection so that the valve shaft is free to move axially.

b. Loosen the packing gland nuts (A15).

c. Apply a light coat of ZEP45 Lubricant to the sealing surface of seat and disc.

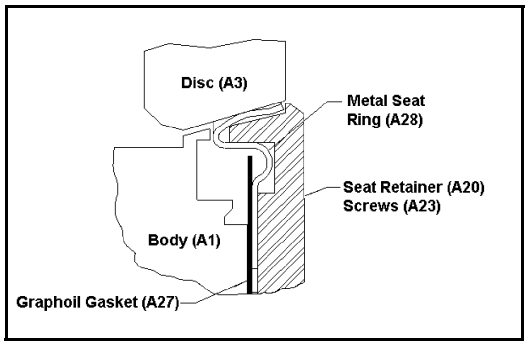


Figure 14—Intelli-Seal™ Seat Option IS1 & IS2

d. Center the Gasket (A27) and the metal seat (A28) on the closed disc.

e. Apply a rust inhibitor such as Never Seez to the threads of the seat retainer screws (A23). With all components centered, mount the seat retainer (A20) to the body with the seat retainer screws.

f. Tighten the screws as shown in Table C (page 15).

SEAT REPLACEMENT (CONTINUED)

g. If the valve actuator connection was loosened in step a, tighten the connection.

h. Adjust the packing gland nuts (A15) as described in the Packing Adjustment section.

i. If the packing is live-loaded, tighten the nuts as shown in Table A (page 13) for Class 150, PN 10, PN 16, and JIS 10 valves, and in Table B (page 14) for Class 300, PN 25, PN 40, and JIS 20 valves.

j. Continue with step 9.

9. Install the valve in the pipeline as described in the Installation section.

9. If the actuator is a powered actuator, reconnect the power and other connections.

10. Pressurize the valve.

11. If packing leaks, tighten the gland nuts evenly and slowly – just enough to stop the leakage.

Table D: Seat Retainer Screw Torques—Stainless Steel, Lubricated

Screw Size	Torque, inch pounds
8-32	4 ± ½
1/4-20	15 ± 2
5/16-18	34 ± 4
3/8-16	58 ± 6

VALVE DISASSEMBLY

Bearing liners, used with the FT bearing option, and one-piece bearings, used with the NS bearing option, may be replaced by following the steps below.

Other internal valve components such as the disc and the shaft may also be replaced. Refer to Figure 1— page 3— for component identification.

⚠ WARNING

Pipeline pressure can propel the loose flange bolts and flanges, and can cause personal injury or equipment damage. Relieve the pressure in the pipeline before removing flange bolts and flanges.

1. Relieve the pressure in the pipeline, drain the pipeline, and close the valve.

⚠ WARNING

Moving parts from accidental operation of powered actuator can cause personal injury or equipment damage. Disconnect and lock out power to actuator before servicing.

2. If the actuator is powered, disconnect and lock out the pneumatic, hydraulic, or electrical power to prevent accidental operation of the actuator.
3. Support the valve, remove the flange bolts, and remove the valve from the pipeline. Refer to the lifting requirements in the Installation section.
4. Remove the actuator as described in the Actuator Instructions, and remove the actuator bracket from the valve.
5. Remove the two gland nuts (A15) and remove the gland (A12).

   Note: Live-loaded packing options include a flat washer (A37) and several spring washers (A36) under each gland nut.
   On valve sizes 28" and larger, the gland consists of a two-piece gland (A12) and gland plate (A39).
6. Remove all of the packing (A11).
7. If the valve has the dual-packing option, remove the secondary packing chamber (A17) and the gasket (A16), and remove all of the secondary packing—do not reuse removed packing.
8. Remove all packing fragments, dirt, and other contaminants from all packing sealing surfaces.

VALVE DISASSEMBLY (CONTINUED)

9. Remove the seat retainer screws (A23), the seat retainer (A20), and all of the seat components.

   Note: The seat retainer on valve sizes 14" and larger has two tapped holes. Screws may be used in the holes to release the seat retainer from the body.

10. On Class 150 valve sizes 2" through 18" and Class 300 valve sizes 2" through 16", remove the pipe plug (A9) from the bottom of the body.
11. On larger sizes, remove the cover screws (A33), lockwashers (A32), cover (A31), and seal (A30) from the bottom of the body.
12. Remove the disc pin:
    - On valve sizes 2" through 12", remove the disc pin set screw (A24), and drive the disc pin (A5) from the disc with a small punch. (See Figure 14—"Disc Pin Assembly" on page 25.) Do not damage the shaft with the punch.
    - On larger sizes, remove the two disc pins (A5) with a large screw driver.
13. Place the valve in a horizontal position with the seat side down.
14. While supporting the disc (A3), carefully pull the shaft (A4) from the body, and remove the disc.

BEARING REPLACEMENT

On valve sizes 2" through 24", the FT bearing option consists of two bearing carriers (A13), each with a replaceable bearing liner (A7). Class 150 valve sizes 6" and larger, and Class 300 valve sizes 5" and larger also include a thrust bearing (A8). See Figure 14—"Disc Pin Assembly" on page 25.

1. Remove the liners towards the flanged end of carrier, and clean the carriers.
2. Place a new liner in each carrier from the flanged end.

   Note: To increase life, position the split in liner towards the side of the body rather than parallel with the pipeline.

On valve sizes 28" and larger, the FT bearing option includes the two thrust bearing (A8), but does not include the two bearing carriers (A13). The upper bearing (A7) and the lower bearing (A40) are located in the shaft bore.

1. Remove the used bearings from the body, and clean all contaminants from the bearing locations.
2. Place a new bearing at the same two locations in the body.

   Note: For increased life, position the split in the liner towards the side of the body rather than parallel with the pipeline.

The NS bearing option consists of two one-piece bearings (A2) pressed into the body.

1. Drive the used bearings out of the body.
2. Press the new bearings into position in the body.

REASSEMBLY

1. With the valve horizontal and the seat side down, align the shaft hole in the disc (A3) with the assembled bearing components in the body.
2. Then insert the bottom end of the shaft (the end without an actuator connection) into the top of the body, and push the shaft into position.

3. Rotate the shaft so that the line on the top end of the shaft is towards and parallel with the flat (or concave) side of the disc.

Table E: Shaft Axial Adjustment Dimension from Top–of–Body to Top–of–Shaft, inches ± 0.03

Valve Size	Class 150	Class 300
2” thru 3”	3.75	3.75
4”	3.75	4.25
5”and 6”	4.25	4.25
8”	4.25	4.63
10”	4.63	4.75
12”	4.75	4.75

On valve sizes 2" through 12"

a. On valve sizes 2" through 12", slide the shaft so that the top end of the shaft protrudes from the body to the dimension in Table E.

b. Place the disc pin (A5) in the hole in the disc (A3) as shown in Figure 14 on page 25, and tap the end of the pin lightly to seat the pin against the flat on the shaft (A4). A new set screw (A24) is required.

c. Apply Loctite 271 to the set screw threads.

d. Turn the set screw into the end of the pin, and tighten the set screw as shown in Table F.

e. As shown in Figure 14 on page 25, stake the end of the set screw threads once with a pointed punch to secure the set screw in position.

On valve sizes 14" and larger,

a. Slide the shaft so that the disc pin slots in the shaft are aligned with the disc pin holes in the disc.

b. Apply a rust inhibitor such as Never Seez to the threads of the disc pins (A5).

c. Use two new pins, and turn the pins into the threaded holes in the disc (A3), and against the slots in the shaft (A4) as shown in Figure 14 on page 25.

d. Adjust the pins so that both pins protrude the same distance above the disc surface, and tighten the pins as shown in Table F.

e. As shown in Figure 14, stake the screw threads on each disc pin once with a pointed punch to secure the pins in position.

4. Replace the seat and the seat retainer as described in steps 6, 7, and 8 in the "Seat Replacement" section on page 16.

REASSEMBLY (CONTINUED)

5. Replace the packing, the packing gland, and the gland adjustment nuts as described in steps 6 and 7 of the Packing Replacement section.
6. On Class 150 valve sizes 2"—18" and Class 300 valve sizes 2"—16":
   a. Replace and tighten the pipe plug (A9) in the bottom of the body.
   b. With the S2 metal seat, seal the threads of the pipe plug with Sepco SG630805AN-25 UCAR Graphoil Tape; with other seats, use PTFE tape. Wind the tape three turns counterclockwise, as viewed from the threaded end, and spiral the tape approximately one thread for each turn.
7. On larger sizes:
   a. Mount the cover (A31) and seal (A30) to the bottom of the body with the cover screws (A33).
   b. Lubricate the threads of the screw with a rust inhibitor such as Never Seez.
   c. Tighten the screws as follows: 1/2-13 screws to 38 ± 5 foot pounds, 5/8-11 screws to 77 ± 10 foot pounds, and 3/4-10 screws to 140 ± 18 foot pounds.
8. Mount the actuator bracket on the valve, and tighten the screws as shown in Table A on page 13.
9. Re-mount the actuator on the valve, as described in the Actuator Instructions.
10. Actuate the valve. If necessary, adjust the open and closed position stops as described in the Operation section.
11. Install the valve in the pipeline as described in the Installation section.
12. If the actuator is a powered actuator, reconnect the power and other connections.
13. Pressurize the valve.
14. If packing leakage occurs, tighten the gland nuts evenly and slowly – just enough to stop the leakage.

Table F: Disc Pin Torques

Fastener Type	Fastener Size	Torque, foot pounds
2” thru 12” Disc Pin Set Screw (A24)	1/4-20	6 ± 1
	5/16-18	11 ± 1
	3/8-16	14 ± 2
	1/2-13	23 ± 3
	5/8-11	28 ± 4
14” thru 48” Disc Pin (A5)	3/4-10	140 ± 18
	7/8-9	230 ± 30
	1-8	350 ± 40
	1 1/8-7	490 ± 60
	1 1/4-7	760 ± 100
	1 3/4-5	2100 ± 300
	2-8	3100 ± 400

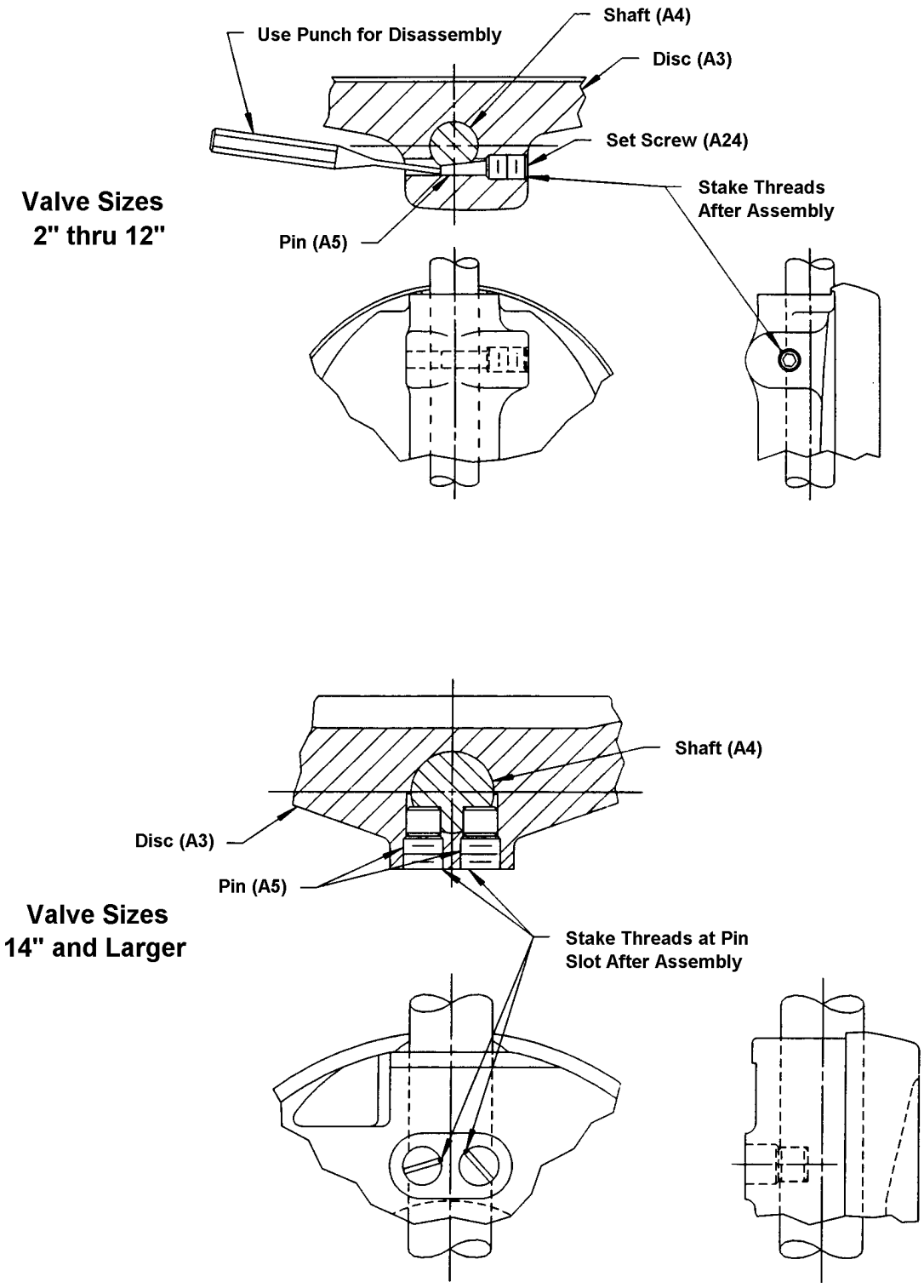


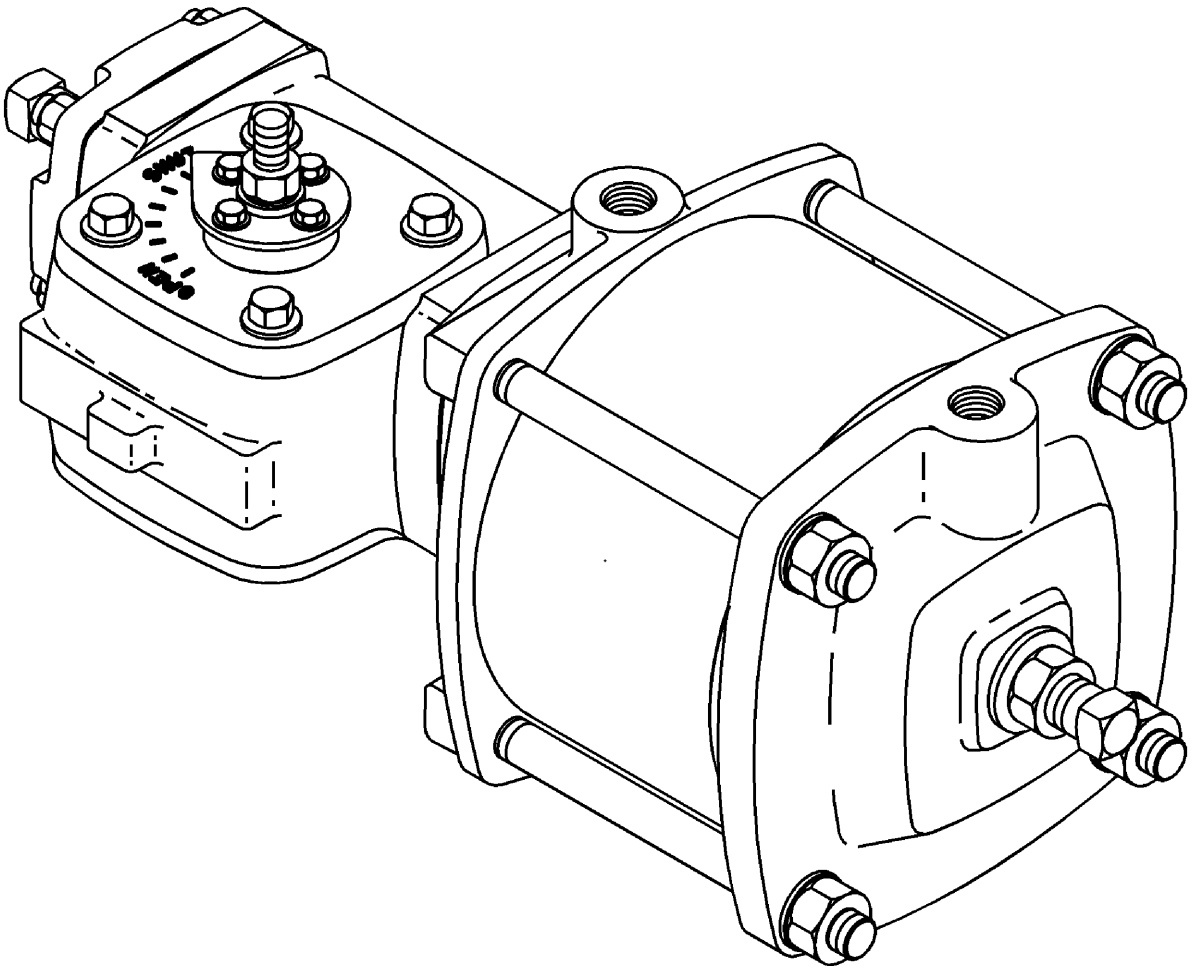
Figure 15—Disc Pin Assembly

TROUBLESHOOTING

Condition	Possible Cause	Corrective Action
Packing Leaks	Packing is loose.	Adjust packing. See page 2.
	Packing is worn.	Replace packing. See page 3.
Valve leaks when closed.	Closed position stop is set incorrectly.	Adjust closed stop. See “Operation” on page 2.
	Seat is worn or damaged.	Replace seat. See page 3.
	Sealing edge of disc is worn or damaged.	Replace disc. See “Valve Disassembly and Reassembly” on page 18.
Valve body leaks from seat retainer area.	Pipeline flange bolting is loose.	Tighten pipeline flange bolts.
	Pipeline flanges are misaligned.	Align pipeline flanges. See "Installation" on page 1.
	Pipeline flange gasket or seat retainer gasket is worn.	Replace gasket(s).
Valve does not fully close.	Object is wedged between disc and seat.	Open valve, and allow flushing action to remove object.
	Closed position stop is not adjusted correctly.	Adjust closed stop. See "Operation" on page 2.
	Disc-to-shaft connection has failed.	Replace disc pins and/or shaft. See “Valve Disassembly and Reassembly” on page 18.
Valve does not fully open.	Open position stop is not adjusted correctly.	Adjust open stop. See "Operation" on page 2.
	Disc-to-shaft connection has failed.	Replace disc pins and/or shaft. See “Valve Disassembly and Reassembly” on page 18.
Opening or closing torque is excessive.	Bearings, shaft, disc, and/or seat are dirty or worn.	Clean/replace dirty or worn components. See “Valve Disassembly and Reassembly” on page 18.
	Shaft is bent.	Replace shaft. See page 18.

DeZURiK®

R1 and R2 PowerRac™ Actuator



Instruction D–10268
January 1999

INSTRUCTIONS

These instructions provide installation, operation, and maintenance information for DeZURIK R1 AND R2 POWERRAC™ Actuators. They include procedures which, when carefully followed, help to ensure satisfactory performance of these actuators. All warnings and cautions included in these instructions must be followed to avoid personal injury and equipment damage.

These instructions are intended for use by personnel who are responsible for installation, operation or maintenance of R1 and R2 POWERRAC™ actuators.

SAFETY MESSAGES

Safety messages in these instructions and on the label(s) on the product are flagged with one of the words Caution, Warning or Danger. These messages must be carefully read and followed to avoid personal injury and/or equipment damage.

After installation, if a safety label on the actuators becomes difficult to see or read, or if a label has been removed, please contact DeZURIK for replacement label(s).

INSPECTION

This unit has been packaged to provide ample protection during shipment. However, if the unit is mishandled in transit, it could sustain damage. Upon arrival at its final destination, the unit should be carefully inspected for damage.

If damage exists, a damage claim should be filed immediately with the carrier.

PARTS

Recommended spare parts are listed on the Assembly Drawing. These parts should be stocked to minimize downtime.

Replacement parts may be ordered from the local DeZURIK sales representative, or directly from DeZURIK, as listed on the back cover. When ordering parts, include the 7-digit part number, the Assembly Drawing number, the name of the part, and the balloon number and quantity shown on the Assembly Drawing.

DeZURIK SERVICE

DeZURIK service personnel are available for start-up and repair of DeZURIK products. DeZURIK also offers customized training programs and consultation services for customers.

Contact a DeZURIK sales representative or visit our website at www.dezurik.com for more information.

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DESCRIPTION

The DeZURIK R1 and R2 PowerRac™ actuators are quarter-turn, enclosed rack and gear cylinder actuators. The R1 and R2 PowerRac™ actuator are used for on-off or modulating control on valves that have a square or double-D shaft connection.

The R number designates the radius of the actuator gear. A choice of cylinder diameters is offered—4 and 6" (100 mm and 150 mm) on the R1 actuator, and 6 and 8" (150 mm and 200 mm) on the R2 actuator.

The R1 and R2 PowerRac™ actuator are available as double-acting actuators or as a spring-return actuators, either spring-to-open or spring-to-close. The spring action may be reversed by ordering the alternate spring-return cylinder assembly, and exchanging the positions of the two cylinders. The cylinder mounting interface is the same for all PowerRac™ actuators.

A lockable model of The DeZURIK PowerRac™ actuator is also available. Operation of the lockable model is described on page 19.

These instructions include information for all three actuator configurations, and for changing from one to another. See Figure 1 to identify the applicable configuration; refer to Figures 2 through 4 to identify the components within each configuration.

INSTALLATION

Pneumatic connections are required as shown in Figure 1, and as described below.

All cylinder port connections are ¼" NPT.

Double-Acting Actuator

The double-acting actuator requires two pneumatic connections—one to each port on opposite ends of the cylinder. Air to the connection closest to the actuator drives the actuator clockwise, towards the “shut” position on the dial; air to the connection farthest from the actuator drives the actuator counterclockwise, towards the “open” position on the dial.

Spring-Return Actuator

The spring-return actuator requires one pneumatic connection—to the fitting on the tubing that connects the two cylinders. With a spring-to-open spring cartridge, air to the connection drives the actuator clockwise, towards the “shut” position on the dial; with a spring-to-close spring cartridge, air to the connection drives the actuator counterclockwise, towards the “open” position on the dial.

As the spring-return actuator is cycled, air is alternately exhausted and drawn in through two breathers—one on each cylinder as shown in Figure 1. The breathers must be protected from water because water inside of the actuator will cause sticking and premature wear of the internal components. If the actuator is located outdoors or in an area that will be hosed down, the breathers must be oriented vertically. The “umbrella” top of the breathers will then prevent water from being drawn in through the breathers. In locations that are submerged or subject to flooding, the breathers must be removed and remotely piped to a protected location.

INSTALLATION
(CONTINUED)

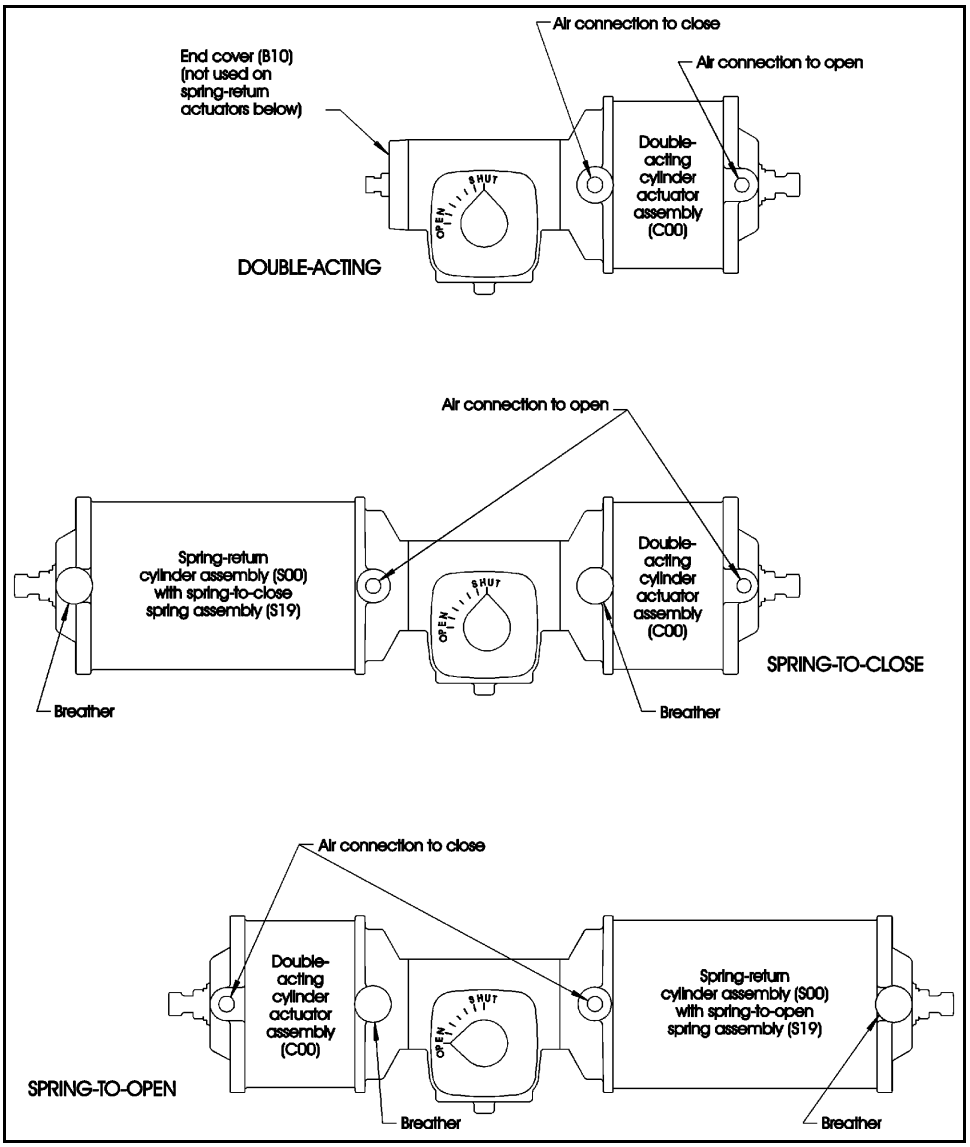


Figure 1—R1 and R2 PowerRac™ Configurations

OPERATION

The R1 and R2 PowerRac™ actuator is powered pneumatically, and rotates 90° between the open and closed positions, in the direction as described above.

The double-acting cylinder is sized for 60 psi or 80 psi (415 kPa or 550 kPa), and the spring-return cylinder is sized for a 60 psi (415 kPa) spring only.

All cylinders are limited to 100 psi (690 kPa) maximum.

LUBRICATION

The actuator is lubricated at the factory, and does not require routine lubrication.

If the actuator is disassembled, lubrication is required. See the applicable actuator reassembly section.

POSITION STOPS

The adjustable open and closed position stops prevent the actuator from rotating beyond the open and closed positions of the valve.

Double Acting Actuator

The closed position stop is located in the cylinder cap, and the open position stop is located in the actuator end cover.

Spring-Return Actuators

With a spring-to-open spring cartridge, the closed position stop is located in the spring cylinder (the longer cylinder), and the open position stop is located in the other (shorter) cylinder.

With a spring-to-close spring cartridge, the open position stop is located in the spring cylinder (the longer cylinder), and the closed position stop is located in the other (shorter) cylinder.

Adjustments

If the actuator is factory-mounted on the valve, the stops are preset, and do not require further adjustment. If the actuator is not factory-mounted on the valve, or if the actuator is removed and/or disassembled, the stops will require adjustment as described below. Refer to the Valve Instructions for closed-position information, and adjust the stops after the actuator is mounted on the valve.

The adjustable stops are square head screws, secured with jam nuts, and located in the extreme ends of the actuator as shown in Figures 1 through 4.

To adjust either stop:

1. Loosen the jam nut, and turn the screw counterclockwise to increase the stroke, or clockwise to decrease the stroke.
2. After the stop is adjusted to the desired position, hold the screw from turning, and tighten the jam nut to the torque value shown in Table A.

Table A: Jam Nut Torques, Position Stops

Jam Nut	Carbon Steel		Stainless Steel	
	Foot Pounds	Newton Meters	Foot Pounds	Newton Meters
1/2” Nut on 4” Cylinder Cap	63 ± 8	85 ± 11	38 ± 5	52 ± 7
5/8” Nut on 6” Cylinder Cap	130 ± 20	176 ± 27	77 ± 10	104 ± 14
3/4” Nut on 8”” Cylinder Cap	230 ± 30	312 ± 41	140 ± 18	190 ± 24
5/8” Nut on End Cover	130 ± 20	176 ± 27	77 ± 10	104 ± 14

REMOVING ACTUATOR

Refer toFigure 2 for component identification.

WARNING

Flow in the pipeline with the actuator removed can allow the valve to slam closed and cause personal injury and/or damage to the flow system. Shut down the flow in the pipeline before removing the actuator from the valve.

1. Shut down the flow in the pipeline.

WARNING

Moving parts from unexpected operation of a powered actuator can cause personal injury or equipment damage. Disconnect and lock out power to the actuator before servicing.

2. Disconnect and lockout the pneumatic power to the actuator to prevent accidental operation of the actuator.
3. Release the collet assembly (B9) from the valve shaft by loosening the jam nut (B9D) and the hex socket set screw (B9A) that extends through the pointer (B9F) on top of the actuator.
4. Remove the four mounting screws (B26) that fasten the actuator to the valve.
5. Remove the actuator from the valve by lifting the actuator from the valve shaft.

ACTUATOR DISASSEMBLY

Refer to Figures 2, 3 and 4 for component identification.

1. Remove the four pointer screws (B9G), and remove the collet assembly (B9), together with the pointer (B9F) from the actuator.
2. Remove the four top cover screws (B15) and remove the top cover (B11).
3. Remove the top cover gasket (B13) and the O-ring (B10).
4. Remove the gear (B8).
5. Remove the four cylinder assembly nuts (B20) and lockwashers (B19), and remove the cylinder assembly (C00) and gasket (B16).
6. Remove the rack screw (B7), the lockwasher (B6), and separate the rack (B5) from the piston rod (C4).
7. Remove the rack bearing (B3) from the pin (B4).
8. If the actuator is double-acting, remove the four end cover nuts (B20) the lockwashers (B19), the end cover (B17) and gasket (B16).
9. If the actuator is spring-return, remove the four cylinder assembly nuts (B20) lockwashers (B19), the spring-return cylinder assembly (S00) and the gasket (B16).

ACTUATOR DISASSEMBLY (CONTINUED)

See Figure 1 for orientation of cylinder assembly(ies) and/or end cover on double-acting and spring-return actuator configurations.

* Square Collet Coupling components

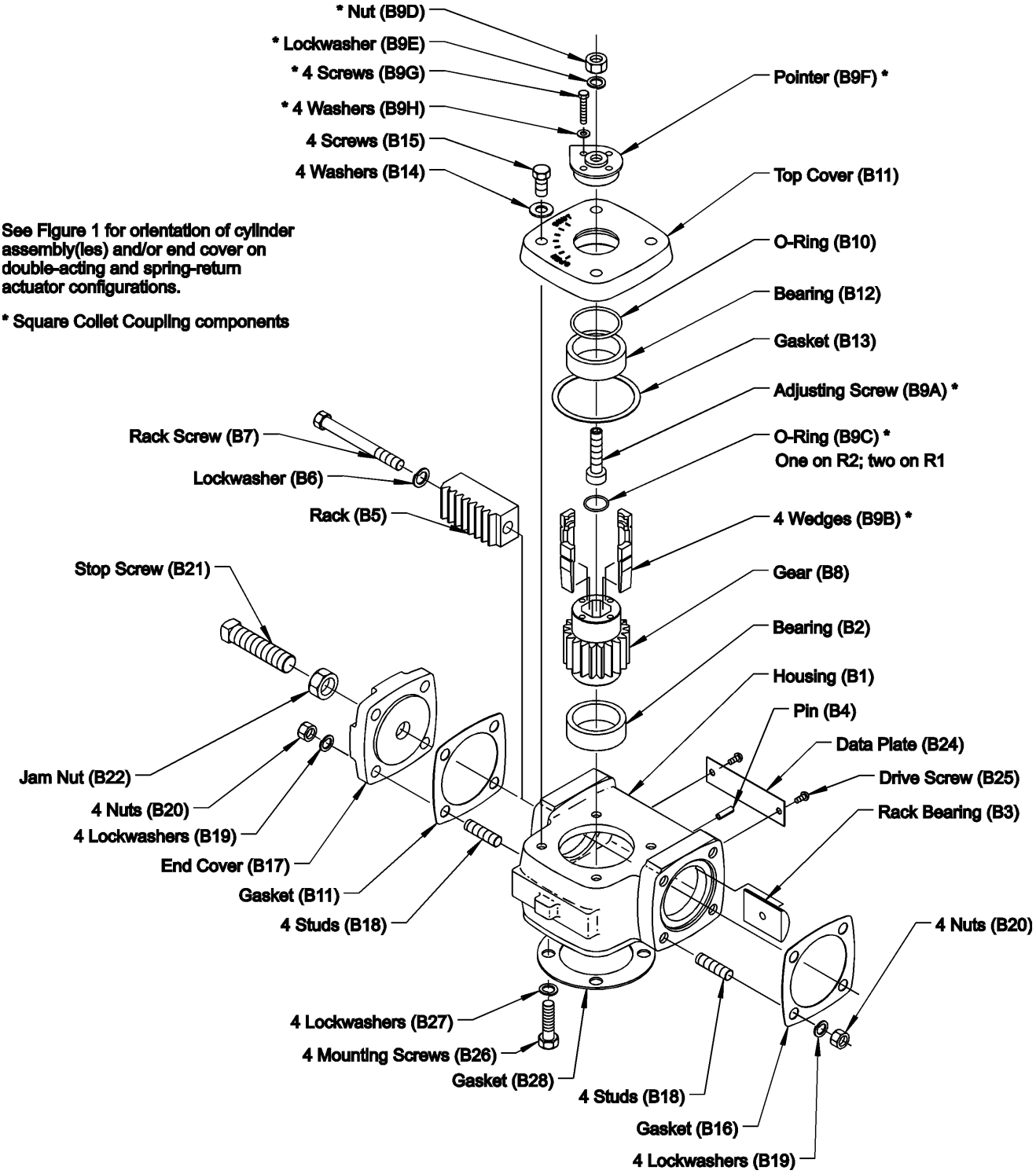


Figure 2—Actuator Assembly, Less Cylinders

DOUBLE-ACTING CYLINDER DISASSEMBLY

Refer to Figure 3 for component identification.

1. Remove the tie rod nuts (C15) and washers (C13) from the tie rods (C12).
2. Remove the cylinder cap (C11).
3. Push the piston rod (C4) through the cylinder head (C1), and remove the piston (C7) and piston rod (C4).
4. Remove the piston nut (C10), the piston (C7), and the O-ring (C14) from the piston rod (C4).
5. Remove the cylinder tube (C6) from the cylinder head (C1).
6. Remove the piston seal (C9) and the O-ring (C8) from the piston (C7).
7. Remove the piston rod seal (C3) from the cylinder head (C1).
8. Remove the two cylinder tube O-rings (C5) from the cylinder head (C1) and from the cylinder cap (C11).

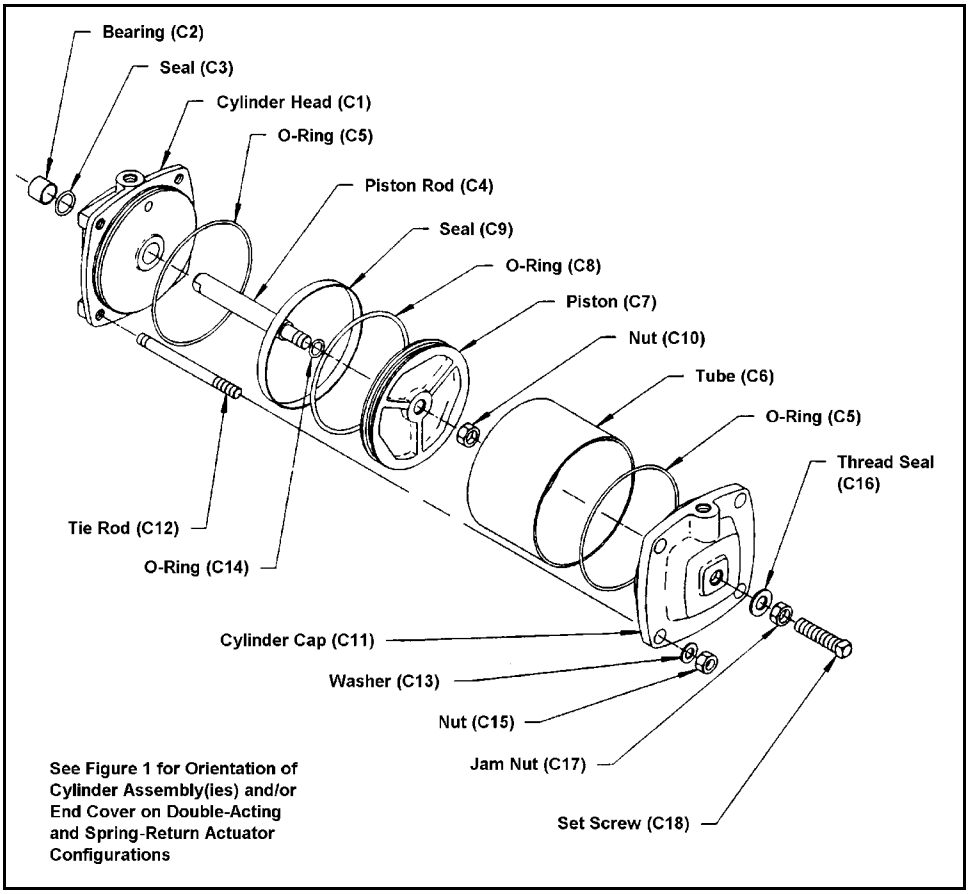


Figure 3—Double-Acting Cylinder Assembly

SPRING-RETURN CYLINDER DISASSEMBLY

Refer to Figure 4 for component identification.

DANGER

The spring assembly (S19) contains a compressed spring that can cause death or personal injury if the cylinder tie rod nuts are removed while the spring force is on the tie rod nuts. DO NOT REMOVE THE CYLINDER TIE ROD NUTS UNLESS THE SPRING FORCE DECREASES TO ZERO!

1. Loosen the tie rod nuts (S15) on the tie rods (S12).

   Note: Force from the spring assembly will be felt during the first few turns of the nuts. As the cylinder tie rod nuts are loosened, the force from the spring assembly must decrease to zero before the nuts can be removed from the tie rods. The nuts and washers (S13) may be removed safely after the force from the spring assembly decreases to zero. **If the spring force does not decrease to zero, re-tighten the nuts and contact the factory.**

2. Remove the cylinder cap (S11).
3. Push the piston rod (S4) through the cylinder head (S1) so that the spring assembly (S19) is accessible.

DANGER

The spring assembly (S19) contains a compressed spring that can cause death or personal injury if the assembly is taken apart.
DO NOT DISASSEMBLE THE SPRING ASSEMBLY!

4. Remove the spring assembly (S19) carefully from the cylinder tube (S6).

   Note: Do not damage the cylinder wall with the spring assembly during this step. **Do not disassemble the spring assembly!**

5. Remove the cylinder tube (S6), the piston (S7) and the piston rod (S4) from the cylinder head (S1).
6. Remove the piston (S7) and the piston rod (S4) from the cylinder tube (S6).
7. Remove the piston nut (S10), the piston (S7) and the O-ring (S14) from the piston rod (S4).
8. Remove the piston seal (S9) and the O-ring (S8) from the piston (S7).
9. Remove the piston rod seal (S3) from the cylinder head (S1).
10. Remove the two cylinder tube O-rings (S5) from the cylinder head (S1) and from the cylinder cap (S11).

SPRING-RETURN CYLINDER REASSEMBLY

Clean and inspect all parts before reassembly. Refer to Figure 4 for component identification. See Figure 1 for orientation of cylinder assembly and end cover on spring-to-open and spring-to-close actuator configurations.

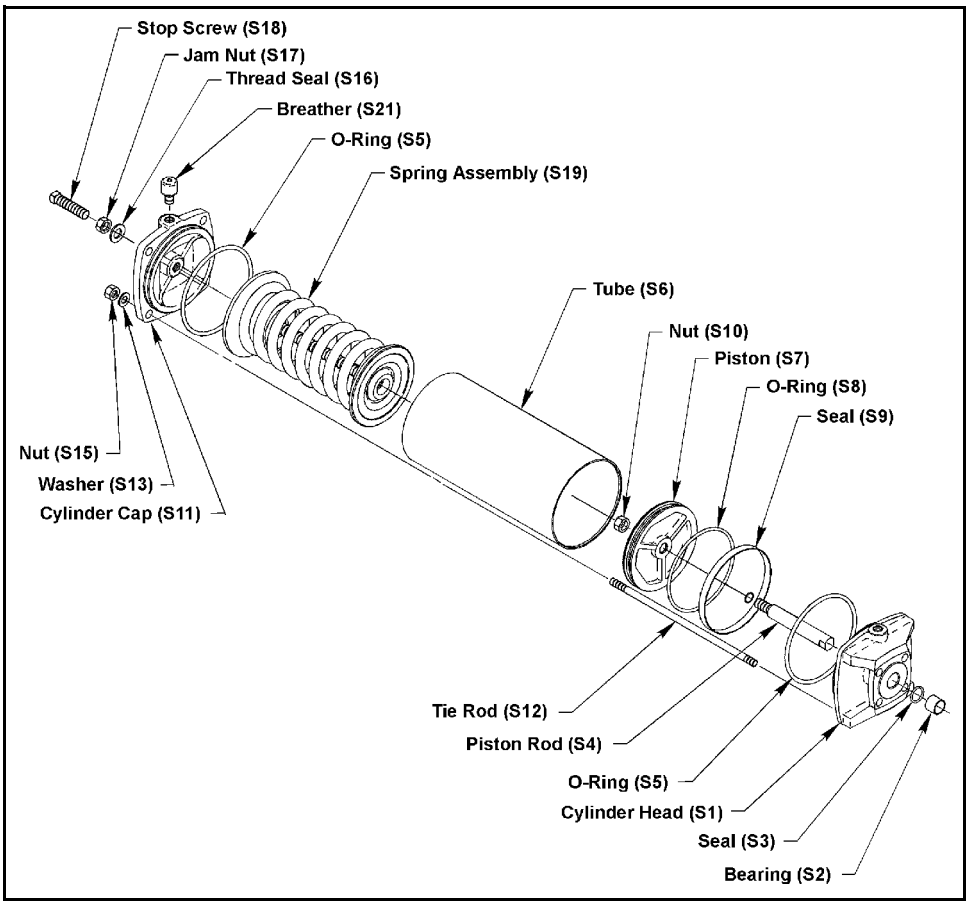


Figure 4—Cylinder Assembly

1. Replace worn parts, especially sealing components such as O-rings, other seals, and the cylinder tube.
2. Lubricate O-rings, other seals, and the cylinder tube walls with Dow Corning Molykote 44 grease, or equivalent.
3. With the O-ring and groove toward the piston rod, place the O-ring (S14), the piston (S7), and the nut (S10) on the piston rod (S4).
4. Tighten the nut to 45 ± 5 foot pounds (61 ± 7 Nm).
5. Place the O-ring (S8) in the smaller groove of the piston (S7). Place the piston seal (S9) in the larger groove of the piston as far around the circumference as possible without stretching the seal. Angle the remaining portion of the seal, and carefully slip it over the edge of the piston and into the groove.
6. Place the piston rod seal (S3) in the cylinder head (S1).
7. Push the piston rod (S4) through the cylinder head (S1) so that the piston (S7) is against the cylinder head.

SPRING-RETURN CYLINDER REASSEMBLY (CONTINUED)

8. Place the two cylinder tube O-rings (S5) in the groove in the cylinder head (S1) and in the groove in the cylinder cap (S11).
9. Using care to avoid damage to the piston seal (S9), replace the cylinder tube following the appropriate steps for the size:
   a. If the cylinder tube (S6) diameter is 6 or 8" (150 mm), place the cylinder tube over the piston (S7) at about a 45° angle. Carefully square the cylinder tube into alignment with the piston, and push the cylinder tube into position on the cylinder head (S1).
   b. If the cylinder tube diameter is 4" (100 mm), push the cylinder tube on straight, without the angle.
10. Note the end of the spring assembly (S19) that has a $1^{1}/_{8}$" (29 mm) diameter machined hole. With the hole toward the piston (S7), carefully insert the spring assembly into the cylinder tube (S6) so that the hole fits over the piston nut (S10). Do not damage the cylinder wall with the spring assembly during this step.
11. Align the holes in the cylinder cap (S11) with the tie rods (S12) and insert the cylinder cap into the cylinder tube (S6). Place the tie rod nuts (S15) and washers (S13) on the tie rods. If the cylinder tube diameter is 4" (100 mm), tighten the nuts (5/16") to 12 ± 2 foot pounds (16 ± 3 Nm); if the cylinder tube diameter is 6" (150 mm), tighten the nuts (1/2") to 16 ± 2 foot pounds (22 ± 3 Nm).

DOUBLE-ACTING CYLINDER REASSEMBLY

Clean and inspect all parts before reassembly.

Refer to Figure 3 for component identification.

1. Replace worn parts, especially sealing components such as O-rings, other seals, and the cylinder tube.
2. Lubricate O-rings, other seals, and the cylinder tube walls with Dow Corning Molykote 44 grease, or equivalent.
3. With the O-ring and groove toward the piston rod, place the O-ring (S14), the piston (S7), and the nut (S10) on the piston rod (S4).
4. Tighten the nut to 45 ± 5 foot pounds (61 ± 7 Nm).
5. Place the O-ring (S8) in the smaller groove of the piston (S7). Place the piston seal (S9) in the larger groove of the piston as far around the circumference as possible without stretching the seal. Angle the remaining portion of the seal, and carefully slip it over the edge of the piston and into the groove.
6. Place the piston rod seal (S3) in the cylinder head (S1).
7. Push the piston rod (S4) through the cylinder head (S1) so that the piston (S7) is against the cylinder head.
8. Place the two cylinder tube O-rings (S5) in the groove in the cylinder head (S1) and in the groove in the cylinder cap (S11).

DOUBLE-ACTING CYLINDER REASSEMBLY (CONTINUED)

9. Using care to avoid damage to the piston seal (S9), replace the cylinder tube following the appropriate steps for the size:
   a. If the cylinder tube (S6) diameter is 6 or8" (150 mm), place the cylinder tube over the piston (S7) at about a 45° angle. Carefully square the cylinder tube into alignment with the piston, and push the cylinder tube into position on the cylinder head (S1).
   b. If the cylinder tube diameter is 4" (100 mm), push the cylinder tube on straight, without the angle.
10. Align the holes in the cylinder cap (S11) with the tie rods (S12) and insert the cylinder cap into the cylinder tube (S6). Place the tie rod nuts (S15) and washers (S13) on the tie rods. If the cylinder tube diameter is 4" (100 mm), tighten the nuts (5/16") to 12 ± 2 foot pounds (16 ± 3 Nm); if the cylinder tube diameter is 6" (150 mm), tighten the nuts (1/2") to 16 ± 2 foot pounds (22 ± 3 Nm).

DOUBLE-ACTING ACTUATOR REASSEMBLY

Clean and inspect all parts before reassembly.

Refer to Figure 3 for component identification.

1. Replace worn parts, especially sealing components such as O-rings and gaskets.
2. Lubricate the following surfaces with a medium aluminum complex based grease such as Keystone Zeniplex-1:
   - The flat side of the rack bearing (B3)
   - Both bearing hubs of the gear (B8)
   - The top cover O-ring (B10) and the groove in the top cover (B11)
   - Both sides of the four wedges in the collet assembly (B9), and the mating four surfaces inside of the gear (B8)
   - The teeth in the rack (B5) and in the gear (B8)
3. Place the rack bearing (B3) on the pin (B4).

   Note: A dab of grease on the curved side of the bearing will help hold it in place.
4. Note the witness mark(s) on the teeth near one end of the rack (B5). Assemble the end of the rack opposite the witness marks to the end of the double-acting piston rod (C4) with the rack screw (B7) and lockwasher (B6). Do not tighten the screw until step number 10.
5. With the pneumatic connections facing upwards (towards the top of the actuator), mount the cylinder assembly (C00) and the gasket (B16) to the housing (B1). Use the four studs (B18) on the left-hand side of the housing, as viewed when facing the data plate (B24) on the housing. Place the nuts (B20) and lockwashers (B19) on the studs. Tighten the nuts to 26 ± 3 foot pounds (35 ± 4 Nm) if carbon steel, or to 15 ± 2 foot pounds (20 ± 3 Nm) if stainless steel.

DOUBLE-ACTING ACTUATOR REASSEMBLY (CONTINUED)

6. With the four tapped holes facing upwards, place the gear (B8) into the housing bearing (B2), and engage the gear teeth with the rack (B5) following the procedure applicable to your configuration:

   - **R1 Actuator on a Square valve shaft**
     One tooth on the rack is marked with a raised dot that must mesh between two teeth with similar dots on the R1 gear, as shown in Figure 5.
   - **R2 Actuator on a Square valve shaft**
     One tooth on the gear is marked with a raised dot that must mesh between two teeth with similar dots on the R2 rack, as shown in Figure 5.
   - **R1 Actuator on a Double-D valve shaft**
     One tooth on the rack is marked with a raised dot that must mesh between one of two pair of teeth with similar dots on the R1 gear. The correct pair of teeth to use is shown in Figure 5, as determined by the desired actuator mounting position on the valve. The optional mounting positions are shown on the Valve Installation Drawing.
   - **R2 Actuator on a Double-D valve shaft**
     Two non-adjacent teeth on the gear are marked with a raised dot. One of the marked gear teeth must mesh between the two adjacent teeth with similar dots on the R2 rack. The correct gear tooth to use is shown in Figure 5, as determined by the desired actuator mounting position on the valve. The optional mounting positions are shown on the Valve Installation Drawing.

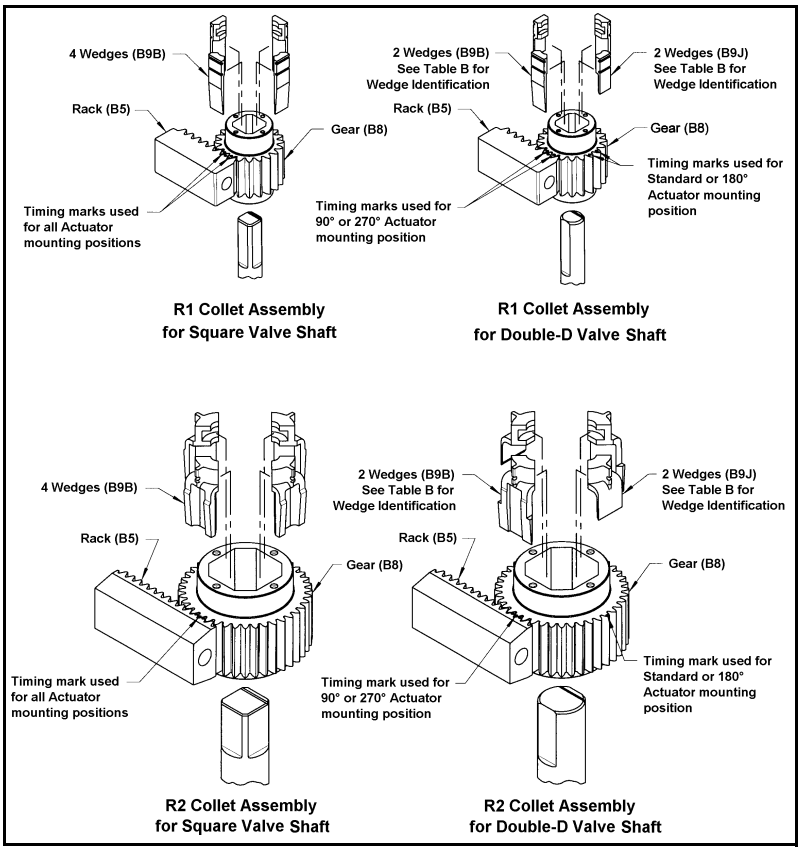


Figure 5—Collet Assembly and Gear Alignment

DOUBLE-ACTING ACTUATOR REASSEMBLY (CONTINUED)

7. Place the O-ring (B10) in the groove of the top cover (B11).
8. Mount the top cover (B11) and gasket (B13) to the housing (B1) with the four screws (B15) and washers (B14). Tighten the nuts to 26 ± 3 foot pounds (35 ± 4 Nm) if carbon steel, or to 15 ± 2 foot pounds (20 ± 3 Nm) if stainless steel.
9. Place the actuator in the open position (with the piston rod C4 extended into the actuator) before the next step.
10. Tighten the rack screw (B7):
    - On the R1 model, tighten the screw (3/8") to 35 ± 5 foot pounds (47 ± 7 Nm)
    - On the R2 model, tighten screw (1/2") to 89 ± 12 foot pounds (121 ± 16 Nm).
11. Turn the jam nut (B22) onto the stop screw (B21), and turn the stop screw into the center hole in the end cover (B17) until the end of the stop screw protrudes about 1/4" (6 mm) through the end cover. Turn the jam nut finger tight.
12. Mount the end cover (B17) and the gasket (B16) to the housing studs (B18) with the four nuts (B20) and lockwashers (B19). Tighten the nuts to 26 ± 3 foot pounds (35 ± 4 Nm) if carbon steel, or to 15 ± 2 foot pounds (20 ± 3 Nm) if stainless steel.
13. Turn the adjusting screw (B9A) in the collet assembly (B9) so that the four wedges are about 1/32" (0.8 mm) from the bottom of the pointer (B9F).
14. With the actuator in the open or closed position, place the collet assembly (B9) into the opening in the gear (B8), and align the pointer (B9F) with the corresponding position on the top cover (B11). Mount the pointer (B9F) to the gear with the four screws (B9G) and washers (B9H). On the R1 model, tighten the screws (#10-24) to 18 ± 2 inch pounds (2.0 ± 0.2 Nm); on the R2 model, tighten the screws (5/16") to 8 ± 1 foot pounds (11 ± 1 Nm).

Table B: Wedge Identification Numbers for Double-D Valve Shafts

Actuator Size	Dimension Across Shaft Flat, Nominal		Shaft Diameter, Nominal		Wedge Identification Number	
	inches	mm	inches	mm	For Two Wedges (B9B) on Shaft Flats	For Two Wedges (B9J) on Shaft Diameter
R1	0.353	9.00	0.434	11.02	6	5
	0.393	10.00	0.496	12.60	5	4
	0.471	12.00	0.621	15.77	4	3
	0.629	16.00	0.746	18.95	3	2
R2	0.629	16.00	0.746	18.95	13	12
	0.944	24.00	1.120	28.45	10	11
	1.259	32.00	1.495	37.97	9	7

SPRING RETURN ACTUATOR REASSEMBLY

Refer to Figure 4 for component identification.

1. Replace worn parts, especially sealing components such as O-rings and gaskets.
2. Lubricate the following surfaces with a medium aluminum complex based grease such as Keystone Zeniplex-1:
   - The flat side of the rack bearing (B3)
   - Both bearing hubs of the gear (B8)
   - The top cover O-ring (B10) and the groove in the top cover (B11)
   - Both sides of the four wedges in the collet assembly (B9), and the mating four surfaces inside of the gear (B8)
   - The teeth in the rack (B5) and in the gear (B8)
3. Place the rack bearing (B3) on the pin (B4).

   Note: A dab of grease on the curved side of the bearing will help hold it in place.
4. Note the witness mark(s) on the teeth near one end of the rack (B5). Assemble the end of the rack opposite the witness marks to the end of the double-acting piston rod (C4) with the rack screw (B7) and lockwasher (B6). Do not tighten the screw until step number 10.
5. With the pneumatic connections facing upwards (towards the top of the actuator), mount the cylinder assembly (C00) and the gasket (B16) to the housing (B1). Using the four studs (B18) on the side of the housing, place the nuts (B20) and lockwashers (B19) on the studs. Tighten the nuts to 26 ± 3 foot pounds (35 ± 4 Nm) if carbon steel, or to 15 ± 2 foot pounds (20 ± 3 Nm) if stainless steel.

   Note: The cylinder assembly (C00) is mounted on the left-hand side of the housing for spring-to-close {as viewed when facing the data plate (B24) on the housing} and on the right-hand side for spring-to-open.
6. With the four tapped holes facing upwards, place gear (B8) into the housing bearing (B2), and engage the gear teeth with the rack (B5) according to configuration:
   - **R1 Actuator on a Square valve shaft**
     One tooth on the rack is marked with a raised dot that must mesh between two teeth with similar dots on the R1 gear, as shown in Figure 6.
   - **R2 Actuator on a Square valve shaft**
     One tooth on the gear is marked with a raised dot that must mesh between two teeth with similar dots on the R2 rack, as shown in Figure 6.
   - **R1 Actuator on a Double-D valve shaft**
     One tooth on the rack is marked with a raised dot that must mesh between one of two pair of teeth with similar dots on the R1 gear. The correct pair of teeth to use is shown in Figure 6, as determined by the desired actuator mounting position on the valve. The optional mounting positions are shown on the Valve Installation Drawing.
   - **R2 Actuator on a Double-D valve shaft**
     Two non-adjacent teeth on the gear are marked with a raised dot. One of the marked gear teeth must mesh between the two adjacent teeth with similar dots on the R2 rack. The correct gear tooth to use is shown in Figure 6, as determined by the desired actuator mounting position on the valve. The optional mounting positions are shown on the Valve Installation Drawing.

SPRING RETURN ACTUATOR REASSEMBLY (CONTINUED)

7. Place the O-ring (B10) in the groove of the top cover (B11).

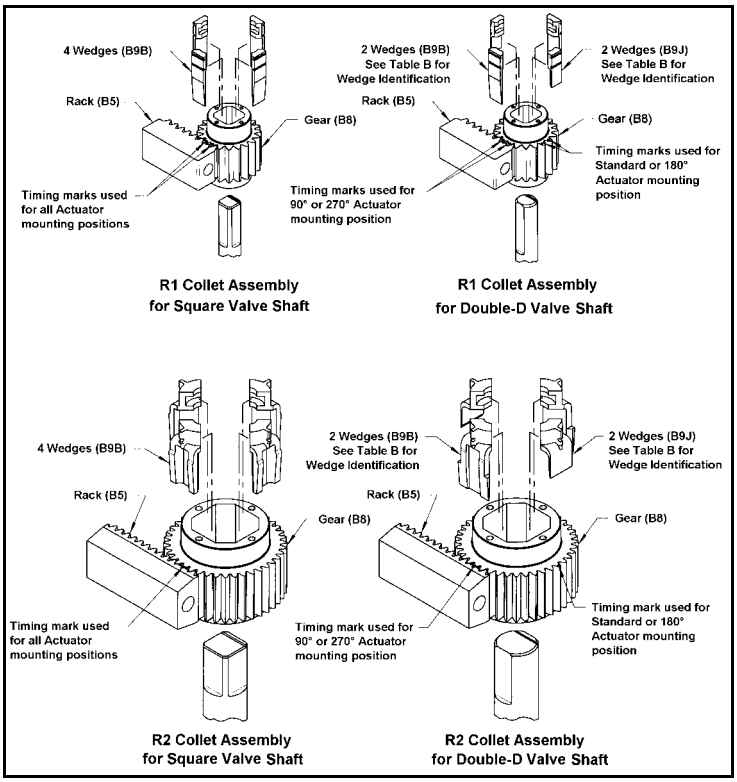


Figure 6—Collet Assembly and Gear Alignment

8. Mount the top cover (B11) and gasket (B13) to the housing (B1) with the four screws (B15) and washers (B14). Tighten the nuts to 26 ± 3 foot pounds (35 ± 4 Nm) if carbon steel, or to 15 ± 2 foot pounds (20 ± 3 Nm) if stainless steel.
9. Place the actuator open position for a spring-to-close actuator or the closed position for a spring-to-open actuator.
10. Tighten the rack screw (B7) as described in step 8.
11. Turn the jam nut (B22) onto the stop screw (B21), and turn the stop screw into the center hole in the end cover (B17) until the end of the stop screw protrudes about 1/4" (6 mm) through the end cover. Turn the jam nut finger tight.
12. Mount the spring-return cylinder (S00) and the gasket (B16) to the housing studs (B18) with the four nuts (B20) and lockwashers (B19). Tighten the nuts to 26 ± 3 foot pounds (35 ± 4 Nm) if carbon steel, or to 15 ± 2 foot pounds (20 ± 3 Nm) if stainless steel.
13. Turn the adjusting screw (B9A) in the collet assembly (B9) so that the four wedges are about 1/32" (0.8 mm) from the bottom of the pointer (B9F).
14. With the actuator in the open or closed position, place the collet assembly (B9) into the opening in the gear (B8), and align the pointer (B9F) with the corresponding position on the top cover (B11). Mount the pointer (B9F) to the gear with the four screws (B9G) and washers (B9H). On the R1 model, tighten the screws (#10-24) to 18 ± 2 inch pounds (2.0 ± 0.2 Nm); on the R2 model, tighten the screws (5/16") to 8 ± 1 foot pounds (11 ± 1 Nm).

MOUNTING ACTUATOR

Refer to Figure 2 for component identification.

1. Determine which of the four actuator-to-valve mounting positions is desired, as shown on the Valve Installation Drawing.
2. Match the open or closed position of the valve with the open or closed position of the actuator.
3. Note the position of the word “open” on the top cover (B11).
4. Position the cover on the housing (B1) so that dial hash mark for “open” will be parallel with the pipeline when the valve is installed.

   Note: One or more of the steps below may be required, depending upon the mounting position selected, the type of valve shaft, and the positions of the valve, actuator, and actuator cover.

   a. Rotate the valve shaft.
   b. Stroke the actuator.
   c. Select a different actuator-to-valve mounting position.
   d. Remove and re-index the actuator cover:
      Remove the four cover screws (B15), rotate the cover, and replace the four cover screws (B15) and washers (B14). Tighten the screws to 15 ± 2 foot pounds (20 ± 3 Nm).
   e. If the valve has a double-D shaft connection, the actuator may be mounted in the standard or 180° position with a given gear-timing configuration, or may be mounted in the 90° or 270° position with an alternative gear-timing configuration. To change to the other configuration, remove the cover screws (B15), the cover (B11), and the gear (B8). Then re-time the gear and replace the cover as described in steps 6 and 7 in the *“Double-Acting Actuator Reassembly”* section.
5. If the actuator does not include the collet assembly (B9), grease the assembly as described in the *“Double-Acting Actuator Reassembly”* section and install the assembly as explained in steps 13 and 14 in the same section.
6. Place the gasket (B28) between the actuator and the valve, engage the actuator with the valve shaft in the desired mounting position, and slide the actuator onto the valve shaft.

   Note: Certain high-temperature valves include and require a high-temperature gasket. If the valve includes a gasket, use the gasket included with the valve rather than the gasket included with the actuator.
7. Assemble the four actuator mounting screws (B26) with lockwashers (B27) up through the mounting holes in the top of the valve (or the actuator adaptor on the valve), through the gasket (B28), and into the threaded holes in the bottom of the actuator. Tighten the screws finger tight—so that the valve and actuator mounting surfaces are in contact, but are free to slide and self-center during the next step.

MOUNTING ACTUATOR (CONTINUED)

8. Tighten the adjusting screw (B9A) in the collet assembly (B9):
   - For the R1 actuator, tighten the screw to 16 ± 2 foot pounds (22 ± 3 Nm) if 3/8", or tighten to 22 ± 2 foot pounds (30 ± 3 Nm) if 1/2"
   - For the R2 actuator, tighten screw (1/2") to 40 ± 3 foot pounds (54 ± 4 Nm)
9. Tighten the four actuator mounting screws (B26):
   - For the R1 actuator, tighten the screws to 26 ± 3 foot pounds (35 ± 4 Nm) if carbon steel, or to 15 ± 2 foot pounds (20 ± 3 Nm) if stainless steel
   - For the R2 actuator, tighten the screws to 83 ± 10 foot pounds (113 ± 14 Nm) if carbon steel, or to 38 ± 5 foot pounds (52 ± 7 Nm) if stainless steel
10. Loosen the adjusting screw (B9A) in the collet assembly (B9).
11. Re-tighten the four actuator mounting screws (B26) as described in step 6 above.
12. Tap the adjusting screw with a rubber mallet so that the gear (B8) bottoms out against the lower housing bearing (B2).
13. Begin to tighten the adjusting screw (B9A); as the adjusting screw becomes snug, repeat step 12. Finish tightening as described in step 8.
14. Tighten the adjusting screw jam nut (B9D):
    - For the R1 actuator, tighten the screw to 16 ± 2 foot pounds (22 ± 3 Nm) if 3/8", or tighten to 22 ± 2 foot pounds (30 ± 3 Nm) if 1/2"
    - For the R2 actuator, tighten screw (1/2") to 40 ± 3 foot pounds (54 ± 4 Nm).
15. Adjust the open and closed position stops as explained in the "*Open and Closed Position Stops*" section.
16. Operate the actuator and valve three full cycles to demonstrate that the unit operates smoothly in both directions. Do not exceed 100 psi (690 kPa) in cylinder(s).

CHANGING FROM DOUBLE-ACTING TO SPRING-RETURN SPRING-TO-CLOSE

1. Relieve the cylinder pressure, if any, to the actuator.
2. If an actuator accessory will be mounted on the actuator, refer to the Accessory Kit Instructions for cylinder orientation requirements. Certain actuator accessories require the cylinder ports to be rotated 180° to provide piping clearance.
3. Remove the end cover (B17) and gasket (B16) by removing the four nuts (B20) and lockwashers (B19). The end cover, including the stop screw (B21) and jam nut (B22), are not required on a spring-return actuator.
4. Loosen the jam nut (C17) and back out the stop screw (C18) on the double-acting cylinder assembly (C00).
5. Mount the spring-return cylinder assembly (S00) and gasket (B16) to the studs from which the end cover was removed. Use the same four nuts (B20) and lockwashers (B19). Tighten the nuts to 26 ± 3 foot pounds (35 ± 4 Nm) if carbon steel, or to 15 ± 2 foot pounds (20 ± 3 Nm) if stainless steel.
6. If actuator sizing requires a larger (or smaller) double-acting cylinder, replace the double-acting cylinder by following the steps below; however the locations of the two cylinders with respect to the actuator must remain unchanged.
7. Adjust the open and closed position stops as explained in the "*Open and Closed Position Stops*" section.

CHANGING FROM DOUBLE-ACTING TO SPRING-RETURN SPRING-TO-OPEN

1. If the actuator is on a valve, remove the actuator from the valve as described in the *"Removing Actuator"* section.
2. If an actuator accessory will be mounted on the actuator, refer to the Accessory Kit Instructions for cylinder orientation requirements. Certain actuator accessories require the cylinder ports to be rotated 180° to provide piping clearance.
3. Remove the four pointer screws (B9G), and remove the collet assembly (B9) from the actuator.
4. Remove the four top cover screws (B15), and remove the top cover (B11) and gear (B8).
5. Remove the four cylinder assembly nuts (B20) and lockwashers (B19), and remove the cylinder assembly (C00).
6. Remove the end cover (B17) and gasket (B16) by removing the four nuts (B20) and lockwashers (B22). The end cover, including the stop screw (B21) and jam nut (B22), may be discarded.
7. Loosen the rack screw (B7), but do not remove the rack screw and rack (B5) from the piston rod (C4). Rotate the rack 180° on the rack screw.
8. Ensure that the rack bearing (B3) has stayed in position on the pin (B4). A dab of grease on the curved side of the rack bearing will help to hold it in place if necessary.
9. Mount the double-acting cylinder assembly and gasket (B16) to the studs from which the end cover was removed. Place the nuts (B20) and lockwashers (B19) on the studs. Tighten the nuts to 26 ± 3 foot pounds (35 ± 4 Nm) if carbon steel, or to 15 ± 2 foot pounds (20 ± 3 Nm) if stainless steel. Replace the gear (B8), and engage the teeth with the rack (B5) as follows:

   - **R1 actuator on a Square valve shaft**
     One tooth on the rack is marked with a raised dot that must mesh between two teeth with similar dots on the R1 gear, as shown in Figure 5.
   - **R2 Actuator on a Square valve shaft**
     One tooth on the gear is marked with a raised dot that must mesh between two teeth with similar dots on the R2 rack, as shown in Figure 5.
   - **R1 Actuator on a Double-D valve shaft**
     One tooth on the rack is marked with a raised dot that must mesh between one of two pair of teeth with similar dots on the R1 gear. The correct pair of teeth to use is shown in Figure 5, as determined by the desired actuator mounting position on the valve. The optional mounting positions are shown on the Valve Installation Drawing.
   - **R2 Actuator on a Double-D valve shaft**
     Two non-adjacent teeth on the gear are marked with a raised dot. One of the marked gear teeth must mesh between the two adjacent teeth with similar dots on the R2 rack. The correct gear tooth to use is shown in Figure 5, as determined by the desired actuator mounting position on the valve. The optional mounting positions are shown on the Valve Installation Drawing.

CHANGING FROM DOUBLE-ACTING TO SPRING-RETURN SPRING-TO-OPEN (CONTINUED)

10. Mount the top cover (B11) and gasket (B13) to the housing (B1) with the four screws (B15) and washers (B14). Tighten the nuts to 26 ± 3 foot pounds (35 ± 4 Nm) if carbon steel, or to 15 ± 2 foot pounds (20 ± 3 Nm) if stainless steel.
11. Place the actuator in the open position (with the rack B5 extended into the actuator) before the next step.
12. Tighten the rack screw (B7). On the R1 actuator, tighten the screw (3/8") to 35 ± 5 foot pounds (47 ± 7 Nm); on the R2 actuator, tighten the screw (1/2") to 89 ± 12 foot pounds (121 ± 16 Nm).
13. Loosen the jam nut (C17) and back out the stop screw (C18) on the double-acting cylinder assembly (C00).
14. Mount the spring-return cylinder assembly (S00) and gasket (B16) to the same studs from which the double-acting cylinder assembly was removed. Place the nuts (B20) and lockwashers (B19) on the studs. Tighten the nuts to 26 ± 3 foot pounds (35 ± 4 Nm) if carbon steel, or to 15 ± 2 foot pounds (20 ± 3 Nm) if stainless steel.
15. Mount the collet assembly (B9) with the four screws (B9G) and washers (B9H). On the R1 actuator, tighten the screws (#10-24) to 18 ± 2 inch pounds (2.0 ± 0.2 Nm); on the R2 actuator, tighten the screws (5/16") to 8 ± 1 foot pounds (11 ± 1 Nm).
16. Replace the actuator on the valve as described in the *"Mounting Actuator"* section.

CHANGING FROM SPRING-RETURN SPRING-TO-CLOSE TO DOUBLE-ACTING

1. Relieve the cylinder pressure, if any, to the actuator.
2. Remove the four cylinder assembly nuts (B20) and lockwashers (B19), and remove the spring-return cylinder assembly (S00) and gasket (B16).
3. Mount the new end cover (B17) and gasket (B16) to the studs from which the cylinder assembly was removed. Use the same four nuts (B20) and lockwashers (B19). Tighten the nuts to 26 ± 3 foot pounds (35 ± 4 Nm) if carbon steel, or to 15 ± 2 foot pounds (20 ± 3 Nm) if stainless steel.
4. If actuator sizing requires a different sized cylinder, replace the double-acting cylinder by following the steps in the next section.

CHANGING FROM SPRING-RETURN SPRING-TO-OPEN TO DOUBLE-ACTING

1. If the actuator is on a valve, remove the actuator from the valve as described in the *"Removing Actuator"* section.
2. Disassemble the actuator as described in the *"Actuator Disassembly"* section.
3. Assemble the actuator as described in the *"Double-Acting Actuator Reassembly"* section.
4. Replace the actuator on the valve as described in the *"Mounting Actuator"* section.

REVERSING SPRING ACTION

The spring action is not reversible with existing parts.

The spring action of a spring-return actuator may be reversed from spring-to-open to spring-to-close—or vice versa—as described below; however, a new cylinder assembly with the opposite action is required. Cylinder assemblies with opposite action are not interchangeable; thus a spring-to-close cylinder may not be used for spring-to-open, and a spring-to-open cylinder may not be used for spring-to-close.

1. If the actuator is on a valve, remove the actuator from the valve as described in the *"Removing Actuator"* section.
2. Disassemble the actuator as described in the *"Actuator Disassembly"* section.
3. Assemble the actuator as described in the *"Spring-Return Cylinder Reassembly"* section, except: (a) Reverse the locations of the two cylinder assemblies, and (b) Use the appropriate (spring-to-open or spring-to-close) spring assembly.
4. Replace the actuator on the valve as described in the *"Mounting Actuator"* section.

CHANGING MOUNTING POSITION

The actuator may be mounted in any of four positions on the valve.

The mounting position may be changed as follows:

1. Remove the actuator from the valve as described in the *"Removing Actuator"* section.
2. Replace actuator on the valve as described in the *"Mounting Actuator"* section.

LOCKABLE MODEL

The double-acting and spring-return DeZURIK PowerRacTM R1 and R2 Actuators are each available as a lockable model that allows the actuator to be locked in either the open or closed position. The lockable model is identified by PRL in the catalog characteristic.

As shown in Figure 7, the lockable model has a notched gear (B8) and an enlarged housing (B1) that includes two lock screws (B64) and two jam nuts (B65). A lockout cover assembly (B60) is also included.

CAUTION

The two lock screws (B64) must be in either the unlocked or the locked position as described in the following sections. The gear (B8) will be damaged if either of the stop screws is placed in an intermediate position between the unlocked and locked positions.

Unlocked Condition

Under normal unlocked running conditions, both of the lock screws are backed out of the housing to allow the gear to rotate freely in either direction. To be fully disengaged, the distance from the housing to the end of each lock screw must be at least 2¼" (57 mm) on the R1 actuator, and at least 3" (76 mm) on the R2 Actuator. To hold the lock screws in position, the jam nuts are tightened to 38 ± 5 foot pounds (52 ± 7 Nm) on the R1 Actuator, and to 77 ± 10 foot pounds (104 ± 14 Nm) on the R2 actuator.

LOCKABLE MODEL (CONTINUED)

Locked Closed Position

Follow the steps below to change the unit from the unlocked condition to the locked closed position. Refer to Figure 7 for component identification. Before proceeding, the open and closed position stops must be correctly adjusted as described in the Open and Closed Stops section.

1. Operate the actuator to the fully closed (clockwise) position.

⚠ WARNING

Adjust only the left-side lock screw to lock the actuator in the closed position. Adjusting the wrong screw does not lock the actuator, and can result in personal injury or equipment damage.

2. Loosen the jam nut (B65) on the **left** side lock screw (B64), as viewed when facing the top of the heads of the lock screws. Hold the lock screw from turning, and turn the jam nut several turns counterclockwise, to the head of the lock screw.
3. Turn the **left** side lock screw clockwise several turns until resistance is felt from the lock screw contacting the notch in the gear (B8). Tighten the lock screw to 5 to 10 foot pounds (7 to 14 Nm) to assure that the lock screw is contacting the gear.
4. Turn the **left** side jam nut clockwise against the actuator housing. While holding the lock screw from turning, tighten the jam nut to 38 ± 5 foot pounds (52 ± 7) on the R1 Actuator, and to 77 ± 10 foot pounds (104 ± 14 Nm) on the R2 Actuator.
5. Place and lock the lockout cover assembly (B60) on head of the **left** side lock screw.

Locked Open Position

Follow the steps below to change the unit from the unlocked condition to the locked open position. Refer to Figure 7 for component identification. Before proceeding, the open and closed position stops must be correctly adjusted as described in the Open and Closed Stops section.

1. Operate the actuator to the fully open (counterclockwise) position.

⚠ WARNING

Adjust only the right-side lock screw to lock the actuator in the open position. Adjusting the wrong screw does not lock the actuator, and can result in personal injury or equipment damage.

2. Loosen the jam nut (B65) on the **right** side lock screw (B64), as viewed when facing the top of the heads of the lock screws. Hold the lock screw from turning, and turn the jam nut several turns counterclockwise, to the head of the lock screw.

LOCKABLE MODEL (CONTINUED)

3. Turn the **right** side lock screw clockwise several turns until resistance is felt from the lock screw contacting the notch in the gear (B8). Tighten the lock screw to 5 to 10 foot pounds to assure that the lock screw is contacting the gear.
4. Turn the **right** side jam nut clockwise against actuator housing. While holding the lock screw from turning, tighten the jam nut to 38 ± 5 foot pounds (52 ± 7 Nm) on the R1 Actuator, and to 77 ± 10 foot pounds (104 ± 14 Nm) on the R2 Actuator.
5. Place & lock the lockout cover assembly (B60) on head of the **right** side lock-screw.

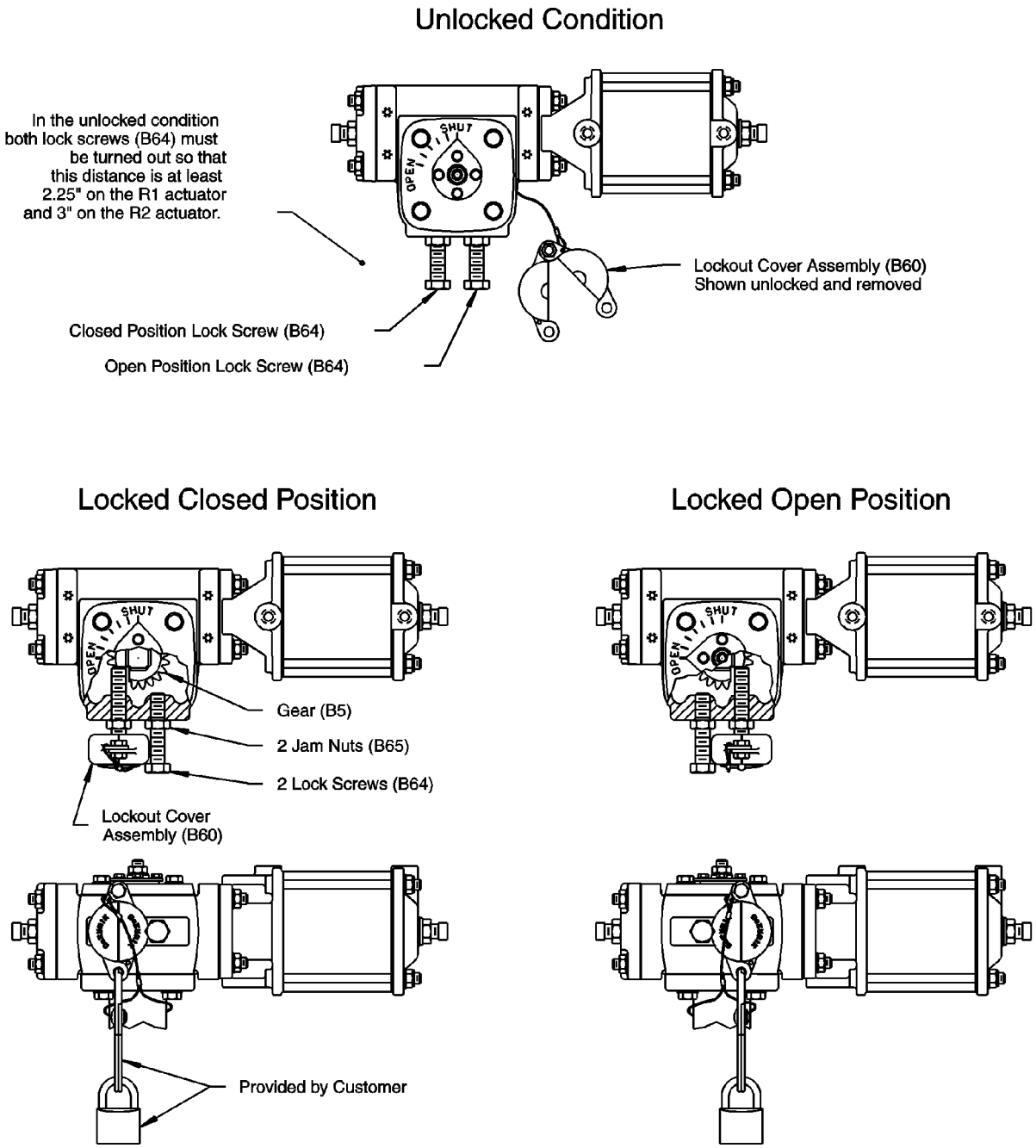


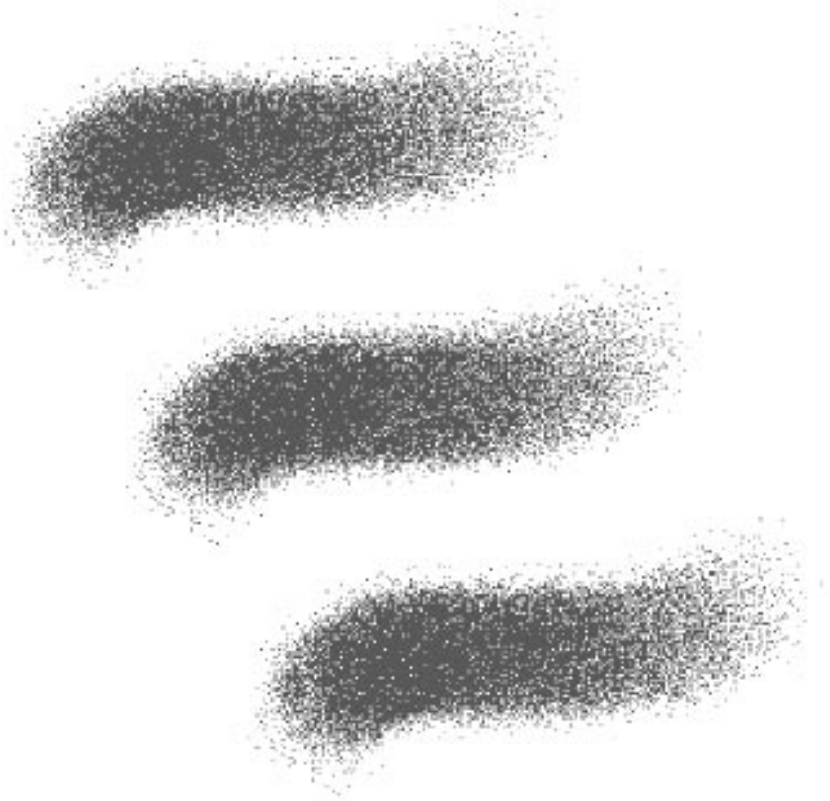
Figure 7—Lockable Model Component Identification

TROUBLESHOOTING

Condition	Possible Cause	Corrective Action
Actuator closes to wrong position	Closed position stop is set incorrectly.	Adjust closed position stop. See page 3.
Actuator opens to wrong position	Open position stop is set incorrectly.	Adjust open position stop.
Actuator will not fully operate valve	Cylinder pressure is low.	Increase cylinder pressure. Do not exceed 100 psi.
	Actuator is not sized correctly.	Use larger actuator
	Piston seal in cylinder is leaking.	Replace piston seal(s)
	Cylinder has wrong spring assembly.	Use spring assembly with opposite action
	Obstruction in valve is preventing closure.	Remove obstruction
	Lockable Model is locked.	Place in unlocked condition. See LOCKABLE MODEL.
Double-acting actuator rotates wrong direction	Air connections to cylinder are incorrect.	Reverse air connections to cylinder.
Valve fails in wrong direction with spring-return actuator	Actuator is assembled incorrectly.	Exchange locations of spring-return and double-acting cylinders.

User's Manual

Dewpoint Transmitter Series XDT



Xentaur

When calling for technical support.....
..... please have your serial numbers ready.
The Sensor and Instrument Serial Numbers are on the rear of the instrument, also see section 5.2.

Sensor Serial No.: _____
Instrument Serial No.: _____

Your Representative is:

Check the Internet for updates; The latest revision of this manual is available in Adobe Acrobat format at: http://www.xentaur.com

Rev.1 Document No. XDT.01.D.0000
12/30/97

The customer agrees that in accepting and using this instrument Xentuar Corporation's liability arising from or in any way connected with this instrument shall be limited exclusively to performing a new calibration or replacement or repair of the instrument or sensor, at Xentaur's sole option. In no event shall Xentaur be liable for any incidental, consequential or special damages of any kind or nature whatsoever, including but not limited to lost profits arising from or in any way connected with this instrument or items hereunder, whether alleged to arise from breach of contract, express or implied warranty, or in tort, including without limitation, negligence, failure to warn or strict liability.

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1 Precautions

Please read these notes carefully, before unpacking and using this equipment.

1.1 Precautions using the sensor

- For reasons explained later in this manual *(section 4.2.3)*, do not expose the sensor to room air longer than necessary (1 - 2 minutes). Thus, do not open the sensor packing before you are ready to install the sensor.
- The sensor packing contains desiccant to keep the sensor dry during shipping and to avoid damage due to condensation. Close the packing immediately after removing the sensor to avoid degradation of the desiccant.
- Do not throw away the sensor packing, you may use it again to transport the sensor between locations, to store it between uses or to ship it back to the factory for certification. The container can be attached to the sensor cable, by trapping the cable with the strap that holds the lid.
- Do not expose the sensor to corrosive gases such as gases containing chlorine, ammonia or HCl. (SO2 can be monitored when the moisture content is low).
- Except for the XTR65W sensor:
  1. Do not expose the sensor to liquid water, as it may get damaged.
  2. Do not breathe directly onto the sensor, as condensation may form which could damage the sensor element.
- Do not remove the porous metal filter guard from the sensor element, as this will damage the sensor and void your factory warranty.

1.2 Precautions using the electronics

- Do not install the unit near heat sources such as radiators or air ducts.
- Do not install the unit in places subject to extreme mechanical vibration or shock. If this is not avoidable, use resilient mounting. If in doubt, call your representative.

1.3 Electromagnetic Interference Considerations

- In order to provide an acceptable noise environment for the XDT or any other digital equipment in the proximity of inductive loads, it is recommended that there be varistors placed across the inductors to keep down the high voltage spikes during transitions.
- Any circuitry which is activated by relay contacts should account for the contact bounce, one simple debouncing method is placing a capacitor across the relay contacts.
- AC power wiring should be routed as far away from the XDT as practical, and under no circumstances should AC power wires run across the top or bottom of the XDT. In addition, relay switched leads should exit at right angles to the XDT board.
- Note that the XDT signal ground is connected to frame (AC power) ground. The sensor ground is isolated from the signal and frame grounds, however it is shunted with a 1MΩ resistor and a 0.1µf capacitor, this prevents electrostatic buildup and noise pickup.

2 Overview

The XDT is a dewpoint transmitter for continuous on-line measurement of dewpoint in gaseous streams.

2.1 Enclosure

The instrument is available in three configurations:

- Polycarbonate enclosure which meets NEMA 1, 2, 3, 12, 13, 4, and 4X specifications (IP65). The dimensions are 4.72" (120 mm) high by 6.29" (160 mm) wide by 3.54" (90 mm) deep. All connections are made through three watertight fittings located on the bottom of the enclosure. Wall or panel mounting is accomplished through four screw holes on the back of the instrument enclosure.
- DIN 43700 enclosure. The dimensions are 144mm x 72mm x 75mm. Connections are made through a pluggable screw terminal block.
- OEM stand alone board, suitable for mounting in existing enclosures. The board can be broken into two parts and sandwiched to accommodate space constraints. Connections are made through a pluggable screw terminal block.

2.2 Electronics

The electronics feature a custom LCD display with backlight showing the measurements in °C, °F, ppm, and for natural gas in lbs of H2O/million cft or g/m3. The instrument can be optionally equipped with two individual software adjustable alarms, isolated 0 - 24 mA or 4 - 20 mA current loop output, and RS-232C computer interface.

2.3 High Capacitance Aluminum Oxide Sensors

The instrument is designed to work with high capacitance aluminum oxide sensors. These sensors typically change their capacitance (from dry to wet) from a few nanofarads to approximately 200 nanofarads, depending on the sensor type. The capacitance change from dry to wet is close to linear to the dewpoint change in the measured gas. While curve corrections specific to individual sensors can improve the accuracy of the results, in most applications the general curve correction implemented in the XDT is sufficient.

2.4 Room Air Calibration (Autocal)

High capacitance aluminum oxide sensors saturate at a factory designed moisture level. Once this moisture level is reached, their capacitance does not further increase with increasing moisture. For some of the available sensor types this factory designed saturation level (DSL) is kept below the dewpoint which is usually found in room air, these sensors can be calibrated by exposing them to room air and adjusting the instrument reading to the saturation dewpoint for the selected sensor range. For sensors with higher ranges the DSL may be above +20°C, thus calibration can be achieved using a micro-climate *see 4.2.3*. These calibration procedures are performed by the instrument automatically.

2.5 User Interface

The instrument's user interface consists of four push buttons, a three and a half (3.5) digit custom digital display, and audible indicator (beeper).

2.6 Theory of Operation

3 Installation

3.1 Sensor Installation

The high capacitance aluminum oxide sensors can be installed either directly in the line to be sampled (in-situ), or in a slip stream of a sample system (extractive).

3.1.1 In-situ Installation

In-situ installation is not recommended for the following reasons:

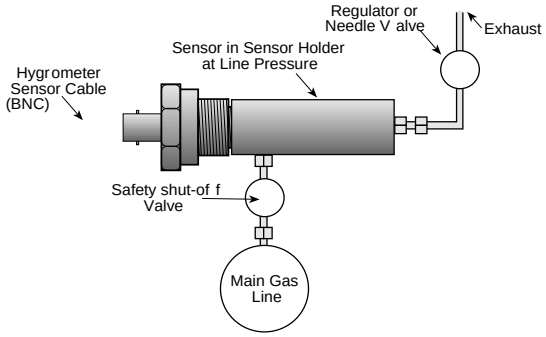
- Sample conditioning is almost always necessary to avoid exposure of the sensor to liquid water and other contaminants, such as hydrocarbons which may damage the sensor over time.
- Variations in line pressure affect the reading of the sensor because dewpoint varies with pressure.
- If the gas line is under pressure, it is more likely that water condensation occurs which may damage the sensor.
- Under a pressurized system removal of the sensor without the installation of isolation valves can be dangerous.

If in-situ installation is required, make sure to install the sensor at the upper surface of the gas line to minimize its exposure to liquid water, should condensation occur, the XTR65W sensor is best suited for these applications.

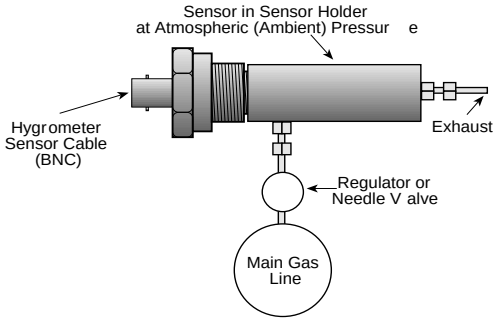
3.1.2 Extractive Installation

For extractive installations we recommend our sample system DSS-. However, the following diagrams show you how to configure a simple system yourself.

A) Sensor measures at line pressure



B) Sensor operates at ambient pressure



It is generally recommended to measure at ambient pressure for the following reasons:

- The readings will not be affected by variations in line pressure.
- The risk of exposing the sensor to liquid water is significantly reduced.
- ppm readings are computed for a pressure of one atmosphere (1 bar); and have to be corrected using software in the XDT, or a pressure nomograph, or calculator if the sensor is measuring at different pressures.

If readings at line pressure are necessary, it is recommended to measure at ambient pressure and to use the instrument's pressure compensation feature to calculate the dewpoint at line pressure. See section 4.2.1.

Please make sure that:

- The sample is taken from the upper surface of the main gas line. This avoids problems with contamination.
- For dewpoints below -40°F, use stainless steel tubing only. Copper tubing is acceptable for dewpoints above -40°F. Do not use plastic, rubber or tygon tubing under any circumstances, as measurements would be incorrect and/or response time slow due to water retention inside these materials.
- Try to run pipes to the sensor upwards, so that contaminant's tend to fall back into the main line.
- Keep the length of the sample line to the sensor as short as possible.
- Use small diameter pipes (1/8" OD).
- Use sufficient flow rates (e.g. 1 l/min with 6 feet of 1/8" piping is adequate).
- Do not install upstream of the sensor any devices, such as other measuring systems, flowmeters etc. which are not absolutely necessary as these are potential leak sources.
- Installation of a coalescing filter ahead of the sensor is desirable to prevent any liquid contamination of the sensor.
- If filters are used upstream of the sensor, make sure these contain non-hygroscopic filter materials only.
- If pressure regulators, shut off valves etc. are used upstream of the sensor, make sure these do not contain rubber or other hygroscopic materials.

3.2 Enclosure Installation

3.2.1 NEMA (IP65) Enclosure Installation

The instrument enclosure can be installed as a wall or panel mount through four screw holes on the back of the instrument enclosure. Open the instrument cover for access to these screw holes. They are located at the corners of the enclosure and outside of the NEMA seal. Do not drill other mounting holes, as you may compromise the seal.
*Refer to Appendix B for all dimensions.

3.2.2 DIN43700 Box Installation

The Din box can be installed in a panel cutout of 137mm x 67mm, refer to Appendix B for all dimensions. The box may be secured with the provided snap-on brackets.

3.2.3 OEM Board Installation

If the circuit board is mounted in a user supplied enclosure, be sure to use insulating washers when fastening the board to standoffs. Refer to Appendix C for mounting hole dimensions and required mounting dimensions.

3.2.4 Remote Display Installation

The remote display (optional) is mounted into a panel cutout of 2.595” x 1” using a bezel. *See Appendix C*. Note that it is necessary to use insulating washers under the nut that holds the remote display board.

3.3 Electrical Connections

All connections are made via pluggable screw type terminal strips. Cable access to the NEMA enclosure is through three watertight cable grips located at the bottom of the instrument. To install the cables, loosen the nut, feed the cable through the grips and tighten the nut again. The two cable grips located on the sides are for the power and sensor cables and are designed for cables with diameters 0.196” to 0.315”. The cable grip located in the center and closer to the face of the instrument is for the alarm relay wires and designed for cable diameters 0.275” to 0.393”.

3.3.1 Power Supply Connection

The power input is on terminal strip P1 located at the bottom of the board. The terminals are labeled “ACH” or “AC LIVE”, “ACN” or “AC NEUTRAL”, and “ACG” or “AC GROUND” and are set up to operate in the range of 85 VAC to 265 VAC, 47 to 440 HZ. The input supply is fused through fuse F1 which is rated at 250mA 250V. This fuse is located on the component side of the board about half an inch up from the terminal strip P1.

3.3.2 Sensor Connection

The sensor input is on terminal strip P1. The terminals are labeled “SIGNAL-IN” or “C” for the center core of the coaxial sensor cable, and “SIGNAL GND” or “B” for the outside braid of the cable. Factory supplied coaxial cables have a BNC connector at one end to mate to the sensor, and pigtails at the other end to be placed in the screw terminals of P1, the black pigtail is the braid and should be connected to the terminal marked “SIGNAL-GND” or “B”. The coaxial cable can be as much as 3,000 ft. long, however if the cable is changed for a longer or shorter one the unit must be compensated for the new cable see section 4.3. The instrument is properly compensated for the cable supplied from the factory. Consult your representative for obtaining the proper cable.

3.3.3 Wiring the Alarm Contacts.

The alarm contacts are located on the terminal strip P1. The terminal strips are marked to indicate wipers and normally open and normally closed contacts, of the two independent relays 1 & 2 corresponding to the HI and LO alarms. Also see section 1.3 for EMI considerations. Keep in mind that the relay polarity is programmable thus wiring should be designed to provide a fail safe operation in case of power failure. See section 4.2.2. Also note that while viewing the dewpoint, the display will flash HI and/or LO as neces-

sary to indicate that the corresponding alarm relay is de-energized.

3.3.4 Interfacing to the Current Loop Output

The current loop signal is provided on the P1 connector, when connecting please observe the polarity indications. The positive terminal is on pin #7 it is labeled “A.OUT” and the negative is on pin #8 it is labeled “A.GND”. The ground of the current loop output is connected to the frame (AC power) ground but it is isolated from the sensor ground, see section 1.3.

The current loop is capable of driving loads from 0Ω to 500Ω and may be configured as 0-24mA or as 4-20mA. The output is linearly proportional to the selected engineering units. The output may be scaled such that it spans only a portion of the full range of the sensor, this feature may be useful in cases where a higher resolution output is required over a narrow dewpoint range, or vise versa. To verify or change the current loop configuration and scaling follow the instructions in the set-up mode section 4.3.

The current output is computed by the microprocessor as follows:

If the 4-20mA range is selected then:

$$O = \frac{(R - L)}{(H - L)} \times 16 + 4$$

Where:

O=output current in mA.
R= value of Reading shown on display in selected engineering units.
L= value of Low Limit of Output Scaling converted to selected engineering units.
H= value of High Limit of Output Scaling converted to selected engineering units.

See section 4.3 to select values for L & H. Their factory defaults are the upper and lower range of the sensor i.e. for XTR-100 L= -100°C and H= +20°C. The values for L & H are set up always in °C, however the microprocessor converts them to the currently selected units. Note that because R, L and H are all in the same engineering units the output current is proportional to the selected engineering units. The current is linearly proportional to dewpoint, if the selected units are °C or °F, however if the selected units are Lbs, ppm or G/M^3 then the current is approximately logarithmically proportional to dewpoint see Appendix D.

After hooking up the current loop output, it can be forced to its low, mid and high points by following the instructions in section 4.3. This procedure may be helpful in testing the connection and setting-up the termination equipment.

3.3.5 Interfacing to the RS-232C

The RS-232C interface is provided on the P1 connector. The configuration is 9600 baud, Even Parity, 8 Bits, 1 Stop, all received characters are echoed. The ground of the RS-232C interface is connected to the frame (AC power) ground however it is isolated from the sensor ground, see section 1.3.

To connect the instrument to a Personal Computer a 3 conductor cable is required; with wires to be placed in the screw terminals of the XDT at one end, and with either a DB9 or DB25 female connector at the other end:

Signal Name	XDT P1 pin	DB9 pin	or DB25 pin
Transmit Data	9 TXD or Tx	2	3
Receive Data	10 RXD or Rx	3	2
Signal Ground	11 GND	5	7
RTS	n.c.	7	7
CTS	n.c.	8	5
DTR	n.c.	4	20
DSR	n.c.	6	6

Note that some Personal Computer Programs may require that RTS & CTS and/or DTR & DSR are jumpered for proper operation. This jumpering may be accomplished at the DB9 or DB25 connector.

CAUTION: Connecting the RS-232C interface on instruments which do nat have the option installed, will damage the instrument.

Refer to section 4.4 for details on the protocol used on the RS-232C interface.

4 Operating the Instrument

4.1 Starting up

The instrument is ready for use as soon as the sensor coaxial cable is installed and the power is hooked up. When power is applied the instrument will initialize its program and for a moment display the selected sensor type, then it will enter the operating state.

4.1.1 Display Conventions

1. To display characters with the 7 segment numeric display, the following pseudo-alphanumerics are used:
   Numbers:

0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
0	1	2	3	4	5	6	7	8	9

   Letters:

A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**L**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**	**U**	**X**	**Y**	**Z**
A	b	C	d	E	F	G	H	I	J	L	n	o	P	9	r	S	t	U	X	Y	Z

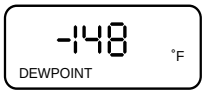
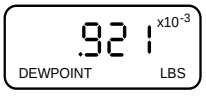
   Symbols:

?	**-**	**.**
?	-	.

2. The instrument will indicate whether a particular mode lets you change a parameter by showing the word “SET” in the upper left corner of the display. Be careful not to change any parameter inadvertently.
3. °C°F appear simultaneously, to indicate the sensors’ attenuation in decibels.
4. Values higher than ±1999 or lower than ±0.01 are displayed in powers of $10^{\pm 3}$. Either a “10^{3}” or “10^{-3}” will appear above and to the right of the displayed value, if this is required, and the value will be rounded off to 3½ digits. Examples follow:

actual value	+20°C	+68°F	23612 ppmV	1104.2 lbs H_20/mmSCF	17.688 grams H_20/meters^3
					

---

actual value	-100°C	-148°F	0.013849 ppmV	0.00092115 lbs H_20/mmSCF	0.00001475 grams H_20/meters^3
					

4.1.2 Push Buttons

Depending on the instrument configuration, it may be necessary to remove the front cover of the enclosure to obtain access to the push buttons located on the display board. The push buttons or keys have a tactile feel, however to provide additional feed back to the user they also produce a beep when depressed. If a button is held down for a prolonged time then a beep with a different tone is produced signifying a long press, this may be useful for accelerated incrementing or decrementing of numeric values.
In general the Mode button navigates through the different user options “Modes”; the UP and DOWN buttons modify the units, values or choices in the selected mode; and the Pressure Correct button is used to either abort out of a mode or to activate the pressure correction functions of the instrument. Refer to the flow diagrams in Appendix A for detailed overview of button functionality.

4.2 Operating State

Upon power up, the unit performs certain initialization tests (see section 6.1), and enters the ‘Operating State’, in the Viewing Dewpoint mode. Depressing the ‘Mode’ button will change modes in the following order: Viewing Dewpoint ➜ Alarms Setup ➜ Start Autocal ➜ Viewing Serial Number ➜ (back to) Viewing Dewpoint. The unit will return to Viewing Dewpoint mode if no buttons are pressed for 30 seconds, unless it is performing Autocal.

4.2.1 Viewing Dewpoint Mode

In this mode the user can view the dewpoint, signified by the presence of the ‘DEW-POINT’ legend on the lower left of the display. The available engineering units in which to view the moisture content are °C, °F, PPM, LBS and G/M^3; the up and down buttons scroll back and forth through these units in respective order. The °C and °F are dewpoint readings. The PPM is parts per million by volume computed at the sensor pressure (more about pressure later). The LBS and G/M^3 are pounds of water per million standard cubic feet and grams of water per standard cubic meters, both in Natural Gas, they are computed according to data derived by IGT Research Bulletin 8, taking into account sensor pressure.
A short press of the ‘pressure correct’ button toggles the unit in and out of pressure correct mode. When there is no pressure correction applied, the PSI legend does not appear. The PSI legend flashes at the bottom of the display, when there is pressure correction in the computation of the displayed values.
Pressure correction is used in the context that the values displayed signify the moisture content at some pressure (we refer to this as the ‘Gas Pressure’) different than the pressure at the sensor. Note that PPM, LBS and G/M^3 readings are by definition unaffected by pressure correction because only the pressure at the sensor affects their value. While °C and °F are affected by pressure correction by reporting what the dewpoint would be at the Gas Pressure when the dewpoint is what is measured at the pressure at the sensor. However, this also implies that whether pressure correction is applied or not the PPM, LBS and G/M^3 readings are affected by the setting of the sensor pressure.
Sensor pressure is used in the context that this is the pressure inside the sampling chamber when performing the measurement.

Gas pressure is used in the context that this is the pressure to be used in computing what the dewpoint would be at a pressure different than the one in the sampling chamber.
A long press of the Pressure Correct button, while in the pressure correct mode (flashing PSI legend), changes the unit to the View/Set Sensor Pressure sub-state. The display has the ‘SET’ and ‘PSI’ legends on and alternately shows SEn and the currently set value for the sensor pressure. The up and down buttons allow the user to modify the sensor pressure, while a short press of the pressure correct button toggles the Sensor Pressure setting between whatever value is on the display and 14.7 psi ---- this is a quick way to go back to atmospheric settings. A long press of the pressure correct button changes the unit back to the Viewing Dewpoint Mode. Pressing the ‘Mode’ button changes the unit to the View/Set Gas Pressure sub-state. The display has the ‘SET’ and ‘PSI’ legends on and alternately shows GAS and the currently set value for the gas pressure. The up, down and pressure correct buttons operate in the same manner as in the Sensor Pressure sub-state. Pressing the ‘Mode’ button changes the unit back to View/Set Sensor Pressure sub-state, and so forth.
Note: The instruments are shipped from the factory in the locked mode and must be unlocked before this procedure can take place (see section 4.3 #7 to unlock).
The factory default settings are: 14.7psi for both sensor and gas pressure and pressure correction disabled.
When Pressure correction is disabled all dewpoints are computed by assuming that both Sensor and Gas Pressures are 14.7psi.

4.2.2 Setting the Alarms

There are two independent alarms, they are named HI and LO alarms. Each alarm can activate a single pole double throw relay rated at 10A 250VAC or 30VDC per contact. The alarms can be set with a trip-point at any dewpoint within the range of the selected sensor.
There is also a selectable hysteresis (which has a minimum value of approximately ±0.5°C) to drive systems such as regenerative dryer purge valves in "dewpoint demand mode". The polarity of the alarm is also selectable, thus one may choose whether the relay energizes above or below the trip point, to allow fail safe design in case of XDT power loss, or in case of any other errors or failures which will cause the relays to deenergize.
When an alarm relay is deenergized the corresponding HI and/or LO indicator flashes on the display while viewing the dewpoint.

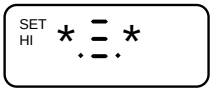
The behavior of the alarm when a sensor failure (e.g. open or short) is detected is also programmable. The options upon sensor failure are:

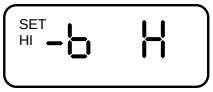
1. Fail High - put the alarm in a state as if the dewpoint is high, e.g. A.E.H
2. Fail Low - put the alarm in a state as if the dewpoint is low, e.g. A.E.L
3. Fail Flashing - Energize/Deenergize the relay alternating once every 2 seconds, e.g. A.E.F
4. No Special Handling - if sensor is open the alarm is in a low dewpoint state; if the sensor is shorted, the alarm is in a high dewpoint state, e.g. A.E.n

Setting or checking the alarms is illustrated with the following example:

EXAMPLE 1 - Set the 'HI' alarm to de-energize the relay when the dewpoint exceeds -75°C with minimal hysteresis (±0.5°C), and faults such as sensor failure cause relays to react as if there is high dewpoint i.e. if sensor cable breaks the relay de-energizes.

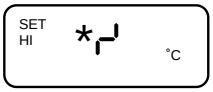
When following these instructions, it may be helpful to refer to Appendix A.

1. Make sure that the instrument is not in the Locked mode, *see section 4.3*.
2. While in the viewing 'Dewpoint Mode' push the UP or DOWN buttons until the °C indicator appears.
3. Push the MODE button until the display shows: 

   the asterisks '*****' take the place of characters that may appear depending on previous settings; the '**SET**' indicator means that changes can be made; the '**HI**' indicator means that we are changing the HI Alarm, (alarm #1).
   Note that if the instrument does not have the alarm options installed this MODE (User Option) will not appear.
4. Push the UP or DOWN buttons until the display shows: 

   the -b means energize below or de-energize above set dewpoint, the H means faults look like high dewpoint. If the display shows LoC, the alarm changes are locked out, repeat step 1.
5. Push the MODE button. The display will show: 

   the '**DEWPOINT**' indicator means that we are changing the alarm trigger dewpoint
6. Push the UP or DOWN buttons until the display shows: 

7. Push the MODE button. The display will show: 

   the r indicates that we are changing the histerisis of the alarm.
8. Push the UP or DOWN buttons until the display shows: 

9. Push the MODE button until the instrument goes to the dewpoint display mode.
10. If it is desired to prevent inadvertent alarm settings changes by unauthorized people, activate the Lockout, *see section 4.3*.

The instrument will retain the alarm settings even if the power is turned off.

4.2.3 Automatic Calibration Mode

The instrument is calibrated at the factory with the sensor it is shipped with and does not need to be recalibrated prior to installation.

Instrument calibration is recommended in approximately 12 month intervals, the XTR65W sensor should be recalibrated after prolonged exposure to liquid water. Simply follow steps 1 - 7 of the procedure below, removing the sensor from the sample gas stream. Make sure the gas stream is depressurized before removing the sensor to avoid injury.

It is recommended to keep the sensor exposure to room air as short as possible to avoid super saturation of the sensor. While super saturation is not damaging to the sensor, it will prolong the initial dry-down time after you install the sensor in the sample stream. Therefore, remove the sensor from the packaging container only after you are ready to proceed with the calibration procedure and install the sensor in the sample stream immediately after the calibration procedure is completed. If you are not ready to use the sensor right away after calibration, put the sensor back in the shipping container for dry storage.

The instrument must be calibrated with the sensor it will be used with. The calibration procedure takes advantage of the designed saturation level (DSL) feature of the sensor and is executed by the instrument computer, by performing the following steps:

1. Depending on the instrument configuration, it may be necessary to remove the front cover of the enclosure to obtain access to the control buttons located on the display board.
2. Push the "MODE" key a few times until the display show's CAL.
3. Press the "UP" button. The display will show CnF, prompting you to confirm that you want to start the calibration procedure. You can abort the calibration procedure by pressing the MODE key.
4. Remove the sensor from its packaging container so that the porous metal filter is visible and the sensor is exposed to in-hand micro-climate. Connect the sensor to the coaxial cable. Close the packaging container as soon as you have removed the sensor to avoid degradation of the desiccant inside of the container. You may want to re-use the container at a later date.
5. Push the "UP" button again to confirm that you want to start the calibration procedure. The display will flash AC for 60 seconds, while the sensor is saturating. Make sure you keep the sensor exposed to in-hand micro-climate until the display shows End.
6. After 60 seconds, the display will flash the selected sensor type (see "*Selecting a sensor type*") and then the instrument will calculate the slope and offset of the sensor curve while displaying the calculations and then will display End for a few seconds, after which the instrument will automatically go into measuring mode. The sensor calibration is completed. (The display may flash SAt, indicating that the sensor has super-saturated. As soon as the sensor is exposed to an atmosphere with a dewpoint lower than the saturation dewpoint, the display will indicate the dewpoint measured by the sensor.) The display may show alternating SEn and 2Lo as an indication that the measured capacitance is too low to be from a

saturated sensor, in this case check sensor cable and connector, and repeat the autocal procedure.

7. Install the sensor in the sample cell or adapter fitting or put it back into the packaging container for later use.

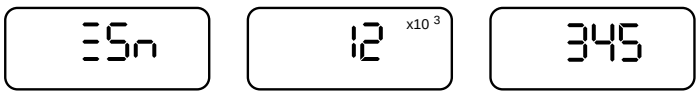
The instrument will retain the calibration even if the power is turned off.

Under certain conditions, an over (super) saturated sensor may need to be completely dried out before either auto calibration or manual calibration is performed. Symptoms of these conditions are a sensor that will not go through the automatic calibration function to the End display, or a sensor that will not dry down after calibration. To dry, install sensor in either a known dry gas stream i.e. instrument quality air or dry nitrogen, or place sensor in a dry can or bottle of desiccant and seal the container from outside air (the shipping container is designed for this purpose). After a minimum dry out period of 24 hours, proceed with the calibration procedure of your choice.

Wetter range sensors can be calibrated using micro climates. Please contact your representative if you have any questions about how to create such micro climates.
A perfectly acceptable and accurate for calibration micro-climate may be created for the XTR100 and XTR65 sensors by cupping the sensor in the palm of one's hand during the autocal procedure. Remember that the micro-climate does not have to be accurate, it just has to be higher than the designed saturation level. The dewpoint of the micro-climate within the fingers is usually higher than the dewpoint of the room air and probably well above the +20°C upper range of the sensor. On a dry day one may need to exhale in the hand before cupping the sensor to guarantee a high dewpoint. The sensor should be warmed up close to body temperature before performing this procedure. Care must be taken that the sensor temperature is not below the temperature of the hand, as in such case condensation could occur and super saturate the sensor. For the same reason, avoid exhaling directly onto the sensor.

4.2.5 Viewing Serial Number Mode

In this mode the user can view the serial number of the instrument. The display shows the serial number by alternately displaying SEn and the number. If the number is larger than 1999 then it is displayed in 2 parts, first part is the thousands signified by the $x10^3$ legend in the upper right corner of the display and the second part is the units. For example serial number 12345 will be shown as:



Pressing the UP and DOWN buttons simultaneously resets the instrument, this is useful for restarting in the set-up state, in installations where power can not be turned on and off easily.

Pressing the ‘Mode’ button changes the unit to the Viewing Dewpoint Mode.

4.3 Set-up State

To enter the Setup State power-up the unit (or reset it from the serial number Mode) while depressing the Mode key.
Refer to Appendix B for a flow diagram of the Set-up State.
The set-up state provides the following eleven capabilities:

1. Display of alternate units: In this mode, a second unit can be chosen to be displayed alternating with the unit selected in the operating state, for example, a dewpoint can be displayed alternating with the sample temperature, or dewpoint can be alternately shown in °C and PPM.
2. Selecting the sensor type: In this mode the user can select the software matching the type of sensor installed in the instrument; XTR-100 (-100°C to +20°C); XTR-65 (-65°C to +20°C).
3. Adjusting low end sensor attenuation and/or dewpoint: These modes are used to enter a data pair representing a low dewpoint and the sensor attenuation measured at this low dewpoint.

2), 3) and 4) are set at the factory and need only be modified when a sensor is changed.

4. Calibration Adjustment: In this mode the user can enter a sensor specific Adjustment Value to improve the instruments’ accuracy in the range of -50°C to -10°C, this adjustment has very little or no effect outside this range. The Calibration Adjustment Value may be supplied with the sensor, or may be derived if the sensor can be exposed to a known reference.
   A) Deriving an Adjustment Value: If the adjustment value for your sensor is not known, contact your representative and follow the instructions in the next section. If it is still not available, then it may be derived using a manual method, provided that a moisture calibration lab is available.
   The calibration must be done in the range of -40°C to -20°C (attempting to calibrate outside this range may cause inaccuracies), the dewpoint must be kept stable during calibration and it must be measured accurately by a reference instrument such as a chilled mirror. One must also note the state of pressure compensation and turn it on or off as applicable to the reference.
   The necessary steps are described below (also refer to the Set-Up State flow diagram in Appendix A):
   a. Make sure that the low attenuation and low dewpoint are correctly entered for this sensor.
   b. Autocal the sensor.
   c. Dry-down the sensor for at least 12 hrs.
   d. Expose the sensor to the known dewpoint (-40°C to -20°C), for a sufficient time (at least 30 min.)
   e. Go to the CAL/AdJ mode and press the UP button, the display will show the current value, in the range of -1.99 to +1.99 followed by blinking horizontal lines.
   f. Observe the display, if the buttons are not being pressed; the display will every few seconds show for a short duration the dewpoint as being computed at the moment (utilizing the current cal-adjust value in the computation).

g. Use the UP or DOWN buttons to modify the cal-adjust value and observe the alternately displayed dewpoint. Perform this adjustment until the dewpoint matches the value shown by the reference instrument.
h. Press the MODE button to go to the next mode, this will save the new cal-adjust value, and it will be retained even if power is turned off.
B) Entering a known Adjustment Value: If the sensor is being replaced an adjustment value should be supplied with the sensor, to enter it into the instrument:
a. Go to the CAL/AdJ mode and press the UP button, the display will show the current value, in the range of -1.99 to +1.99 followed by blinking horizontal lines, ignore the alternately displayed dewpoint.
b. Use the UP or DOWN buttons to modify the cal-adjust value as necessary.
c. Press the MODE button to go to the next mode, this will save the new cal-adjust value, and it will be retained even if power is turned off.

5. Analog Output Span selection. 0 to 24mA or 4-20mA
6. Testing the optional analog output: By pushing the up, down or pressure correct buttons, the user forces the analog output to its low, high and mid values, respectively. This facilitates the hook-up and testing of the remote terminal.
7. Output range setting: These modes are used to set dewpoints corresponding to the low and/or high end of the current loop output.
8. Lock/Unlock the instrument: This mode is used to block access to parameter settings, protecting the instrument from unauthorized or inadvertent changes of parameters. Attempting to change settings while instrument is locked will display LoC and beep.
   To unlock the instrument press the up key, to lock the instrument press the down key.
   Note: It is imperative that one returns the instrument to the locked mode to avoid unauthorized changes.
9. Sensor Cable Compensation: As noted in previous sections this instrument measures the capacitance of the sensor (in the form of attenuation in decibels) from which it computes the dewpoint. At very low dewpoints the capacitance is small enough to be in the same order of magnitude as a long coaxial cable. Thus the measurement circuit must be compensated for the capacitance of the sensor cable. **Instruments which are sold with a cable are already compensated at the factory and should not be compensated again**, however if a new cable is added, the following procedure should be used for compensation (also refer to the Set-Up State flow diagram in Appendix A):
   a. Disconnect the sensor from the cable by unplugging the BNC connector, keep the cable connected to the instrument.
   b. Prepare a means by which the BNC connector at the end of the cable could be reliably shorted (using a jumper clip etc.), do not attempt to short at the instrument screw terminals as this approach will not account for the cable resistance.
   c. Go to the CnF/CbL/oPn (Confirm Cable Open) mode.
   d. Leave the BNC connector open and press the UP key. The instrument will show oPn and beep for a few seconds. Then it will show CnF/CbL/SHr (Confirm Cable Short).
   e. Short the BNC connector and press the UP key, the unit will show SHr and beep

for a few seconds. Then it will show CnF/CbL/oPn again.
f. Leave the BNC connector open again and press the UP button. The instrument will show oPn and beep for a few seconds. Then it will show End

The compensation data will be retained even if power is turned off.

4.4 RS232C interface protocol

The instrument uses a simple protocol to communicate to a host computer through its RS-232C interface, see section 3.3.5 for electrical connections. The interface is configured as 9600 baud, Even Parity, 8 Bits, 1 Stop; and it echoes all received characters.
To illustrate the protocol, the following notation conventions are used in this section: The characters sent or received are depicted in bold. Send refers to sending from the host computer to the XDT. Receive refers to receiving from the XDT into the host computer. The commands and arguments are shown in capital letters while place holders for choices are labeled with lowercase italic letters, with the allowed characters shown below, “nn” denotes a numeric value. Bytes which are not characters are shown with diagonally placed mnemonics, for example Escape is depicted as $^{E}S_{C}$, this signifies a single byte (hex 1B). Optional characters or command arguments are encompassed with brackets [ ].
The commands may be sent in either upper or lower case. Arguments may be delimited with space or comma.

4.4.1 HELP command

Lists all of the available commands.

send: **H**[**ELP**]$^{C}_{R}$

receive: **Help** **?** **Data** **SN**$^{C}_{R}{}^{L}_{F}$

Who **Reset** **Login**$^{C}_{R}{}^{L}_{F}$

4.4.2 DATA command

Selects the reporting format of the current measurement.
This formatting will be retained until the next DATA command even if the power is turned off.

send: **D**[**ATA**] ***units*** [***interval*** [***mode***]]$^{C}_{R}$

C	nn	N
F		G
P		
L		
G		
D		
U		

The *units* argument selects the units in which the measurement will be reported.
C,F,P,L & G select the dewpoint in °C,°F,ppm,Lbs H_20/mmscf and gm/m^3 respectively.

D selects decibels which is the measured sensor attenuation.
U selects using whatever units are selected by the user on the display.

The *interval* argument is optional, if it is not entered then the measurement will be reported only on a query with the “?” command. However if it is desired for the unit to report the measurement on a regular interval without a query then an interval in seconds may be specified in the range 1 to 255 seconds. This feature allows the user to log the measurement on a dumb terminal or a printer.

The *mode* argument is optional and may be specified only if an interval was specified. It may be “N” for numeric reporting or “G” for graphic reporting of the measurement. The mode argument defaults to numeric mode. The graphic mode may be chosen only for °C or °F, it will plot a graph of the measurement on printers which can respond to the Epson Graphic Commands, and have at least 80 character columns.

In the NUMERIC mode the instrument will report the measurement in the following format

$^{B}_{L}$***Measurement Units***$^{S}_{P}$***Elapsed Time***$^{S}_{P}$***Alarm Status***$^{C}_{R}{}^{L}_{F}$

The bell character is used to denote the beginning of each line. The measurement is a floating point decimal number. The units are the appropriate character string: "**degF**", "**degC**", "**ppmV**", "**LbsH2O/mmscf**" or "**g/m3**". The elapsed time since the unit was powered up (with 24hr roll over) is in HH:MM:SS format. The alarm status appears only if alarms are installed, it is indicated with a character string: **HiAlrm** or **LoAlrm** or **NoAlrm**.
If an error condition exists then the report will have the following format:

$^{B}_{L}{}^{B}_{L}$***ErrorString***$^{C}_{R}{}^{L}_{F}$

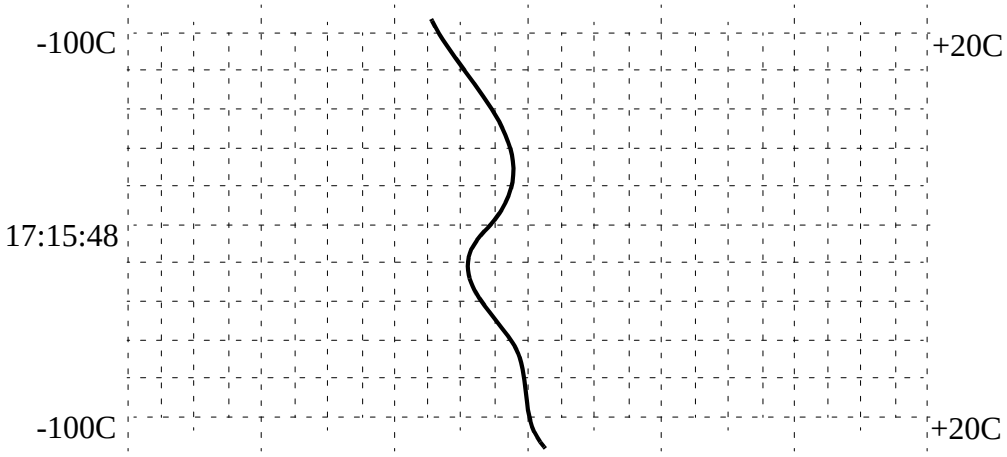
The ErrorString may be one of the following:
“**Error SensOpen”** or “**Error SensShort”** or “**Error SensSat”**.

In the GRAPHIC mode the instrument will transmit Epson Graphic Command compatible data strings at the selected interval. Each string has the following format:

$^{D}C_{1}{}^{E}S_{C}A^{0}_{1}{}^{E}S_{C}K^{n}_{n}{}^{m}_{m}$.....$^{L}_{F}{}^{C}_{R}{}^{E}S_{C}A^{0}_{9}{}^{D}C_{3}$

where: DC1 selects the printer; Escape A 01 sets the advance to 1 dot per line; Escape K nnmm selects the graphic mode with mmnn bytes to follow; then the graphic bytes are sent 1 byte per horizontal dot (corresponding to 1 degree being plotted) where the MSbit represents the dot the other bits are not used; Line Feed & Carriage Return advance the line; Escape A 09 sets the advance to the normal 9 dots per line, DC3 deselects the printer.
In addition every 200 lines, a text line will be sent to alternately time-stamp the plot or label the extreme dewpoint axis.

This will produce a graph which looks as follows.



The printer should have at least 80 character columns, and it is best to use continuous form paper.

4.4.3 ? command

Requests a single report of the measurement in the currently selected format.

send:**?$^{C}_{R}$** The unit will respond in the format selected with the Data command, for example:

receive: **$^{B}_{L}$-59.3degC$^{S}_{P}$01:23:45$^{S}_{P}$NoAlrm$^{C}_{R}{}^{L}_{F}$**

The default factory setting for the instrument is to respond in numeric format in the user chosen units. See the section about the DATA command for more details.

4.4.4 Serial Number Command

send: **SN$^{C}_{R}$**

receive: **Ser$^{S}_{P}$Num$^{S}_{P}$nn$^{C}_{R}{}^{L}_{F}$**

where nn is the instrument serial number

4.4.5 Who Command

send: W[HO]$^{C}_{R}$

receive: **Dev$^{S}_{P}$Type=XDT$^{S}_{P}$Ver=2.3$^{C}_{R}{}^{L}_{F}$**

4.4.6 Reset Command

send: **R[ESET]$^{S}_{P}$Y$^{C}_{R}$**

the unit will perform power on reset.

4.4.7 Login Command

send: **L**[**OGIN**]$^{C}_{R}$

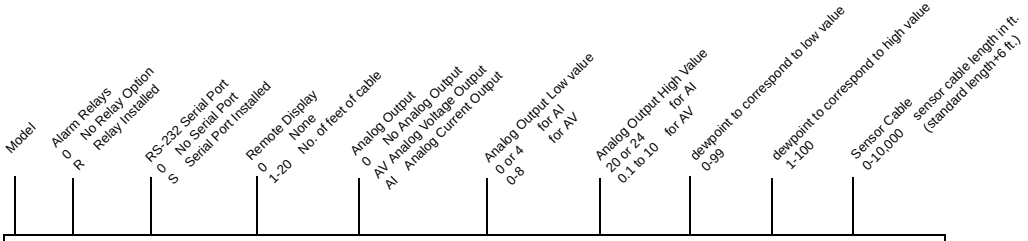
receive: **Level**$^{S}_{P}$**0**$^{C}_{R}$$^{L}_{F}$

5 Part number, Serial Number and Instrument Configurations

Instruments are labeled with part numbers and serial numbers. Labels showing the part number and serial number are located on a label on the circuit board, as well as on the rear panel of DIN boxes.

5.1 Part number

The part number consists of a code indicating the instrument's configuration. Please refer to the following diagram.



XDT- R- S- 6- AI- 4- 20- -100- +20- 6

Example 1
Instrument configured with Alarms, RS-232, 4-20mA output covering full range of sensor, a remote mounting bezel with 6 feet of cable and 6 feet of sensor cable.

XDT- 0- 0- 0- AV- 1- 5- -100- +20- 6

Example 2
Instrument configured with no options except 1-5V analog output covering the full sensor range and 6 feet of sensor cable.

5.2 Serial number

In addition to the instrument label, the serial number is also stored in the instrument's memory and can be looked up by scrolling through the function list using the MODE button, see section 4.2.5.
Please have your serial number ready when you call your representative for technical support.

6 Trouble-shooting

This instrument performs diagnostic tests on power up as well as once every two minutes. Follow the instructions in the tables of sections 6.1 and 6.2 fro trouble shooting problems.

6.1 Special messages, warnings and error indications

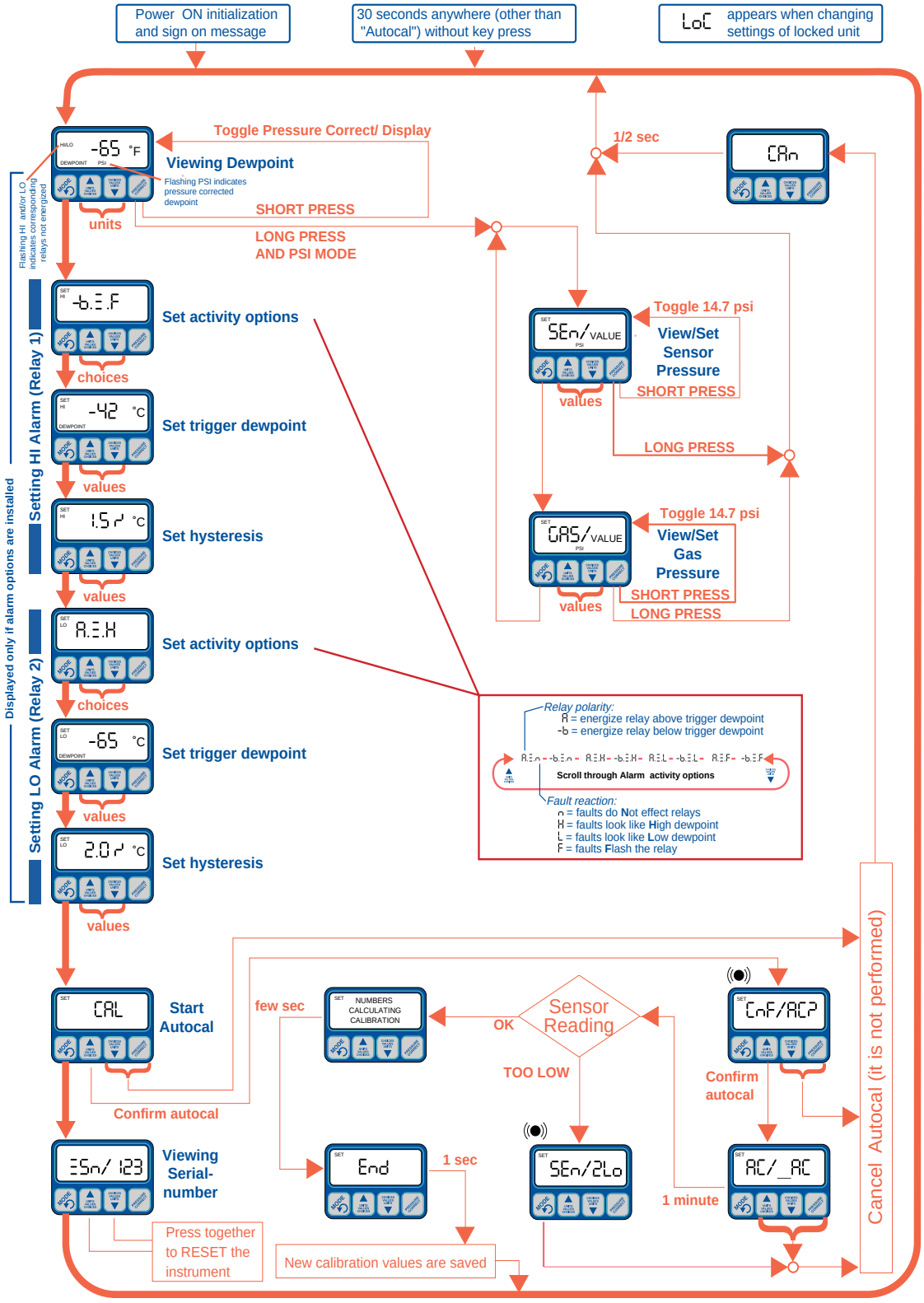
DISPLAY	EXPLANATION		REQUIRED ACTION
LO Err 🔔	PROM check sum failed.	power on tests	cycle power if problem persists, return to your representative for service.
HI Err 🔔	RAM write/read test failed.		
% Err 🔔	Unidentified power-up failure.		
C.S.F/ 🔔	EEPROM ***C***heck ***S***um ***F***ailed.		
Err/Ad 🔔	***A/D*** converter failure.	system tests once per 2 min.	
Err/rEF 🔔	***Ref***erence voltage for A/D out of spec.		
Lo/bAt 🔔	***Lo***w ***supply*** voltage.		
LO rnG/ TEMP 🔔	Instrument ***lo***w ***temp***erature ***rang***e has been exceeded.		make sure that the unit is at a temperature of -10°C to +70°C.
HI rnG/ TEMP 🔔	Instrument ***hi***gh ***temp***erature ***rang***e has been exceeded.		
oPn/ 🔔	Sensor circuit is ***open***.	dewpoint displays tests	see table in section 6.2
SAt/ 🔔	Sensor is ***sat***urated.		
SHr/ 🔔	Sensor circuit is ***shor***ted.		
...	Trying to calculate dewpoint for undefined sensor.		select sensor and autocal.
db 🔔	Trying to calibrate an undefined sensor.	autocal tests	see autocal instructions.
SEn/2Lo 🔔	***Sen***sor reading is '***too' lo***w to be from a saturated sensor, for autocal.		
Err/EEP 🔔	***EEP***ROM write cycle not completed.	miscellaneous	if this persists, return for service.
LoC 🔔	Attempting to modify a ***loc***ked unit.		unlock unit, see set-up mode.
HI (flashing while viewing DEWPOINT)	The HI Alarm (alarm #1) relay is deenergized.		See section 4.4.2 Setting the Alarms.
LO (flashing while viewing DEWPOINT)	The LO Alarm (alarm #2) relay is deenergized.		
ΞEn 🔔	Turn on message, ***Xen***taur (*Greek* Ξ=X)		

Legend: 🔔 denotes a beeping accompaniment to the message.
/ denotes alternately flashing messages**.**

6.2 Trouble-shooting Unexpected Readings

Symptom	Possible Cause	Diagnostic/Remedy
Reading is not changing	Condensation in sample system.	Condensation will occur if the temperature of the sample system, at any point is below (colder) the dewpoint temperature of the sample gas. Once having formed, the sample reaching the sensor will have a dewpoint equal to the temperature of the condensation, regardless of the dewpoint of the sample at the sample point.
Slow Response	1. Water vapor in the system. 2. Flow rate too low. 3. Sample pipe too large. 4. Unsuitable sample pipe.	It is usually more satisfactory to bleed a sample gas at atmospheric pressure through the sensor sampling chamber, and to use 1/8" (3mm) o.d. sample pipe. See below re sample pipe material, also *see section 3.1*.
Dry Reading	Automatic Calibration, wrongly set, or faulty Sensor.	Check Automatic Calibration, or return sensor for full calibration to your representative.
Wet Reading	Leak in system or use of unsuitable pipe.	Cure the leak, or replace unsuitable pipe with copper or stainless steel. Flexible connections should be made with PTFE pipe. NEVER use rubber or plastic pipe.
	Comparison of readings with manual cooled-mirror instrument.	This type of indicator reads about 10ºC dry at about -50ºC dewpoint due to temperature gradients within the device. The error increases at drier levels.
Display Shows SAt	Wet gas.	Dry down the sensor (*see section 4.2.3*).
Display Shows SHr	1. Instrument Failure	Disconnect cable from input terminals, if the instrument still reads SHr the problem is with the instrument, *(see section 6.3*.) However, if the instrument reads oPn then check possible causes 2 or 3.
	2.Short circuit on sensor cable or connections.	Disconnect cable from sensor and if meter still reads SHr, cure the short circuit in the cable or connections or replace cable; otherwise check the sensor.
	3.Short circuited sensor.	Disconnect cable from sensor and note that the meter reading returns to oPn. Use a new sensor, or apply approximately 20V DC to the sensor MOMENTARILY with the sensor in a known dry condition. Polarity is not important, but the contact MUST be very brief or the sensor may be damaged.
Display Shows oPn.	1. Instrument failure.	Short the SIG and SHIELD contacts of the sensor input terminal, if the instrument reads SHr the problem is in the cable or sensor, otherwise return the instrument for service.
	2.Open circuit on cable.	Disconnect cable from sensor and short center pin of plug to the outer shell. If the display still shows oPn, repair cable.
	3. Open circuit on sensor.	Check sensor connection or replace sensor.

Appendix A: Flow Diagram of XDT Operating State User Interface

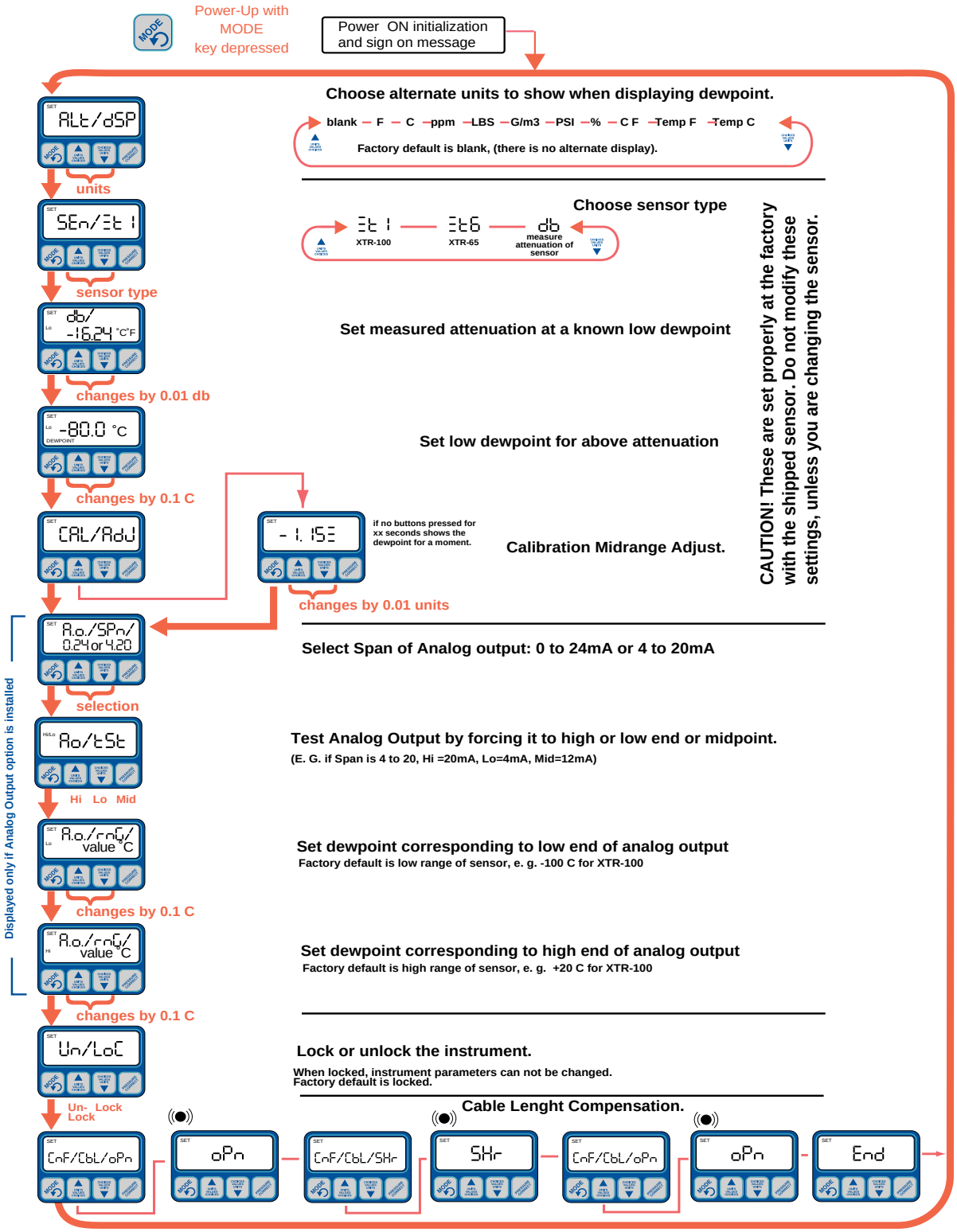


Legend: / separates alternately displayed messages

(•) denotes beeping

Buttons without designator or arrow leading out, perform no function

Appendix A: Flow Diagram of XDT Set-Up State User Interface



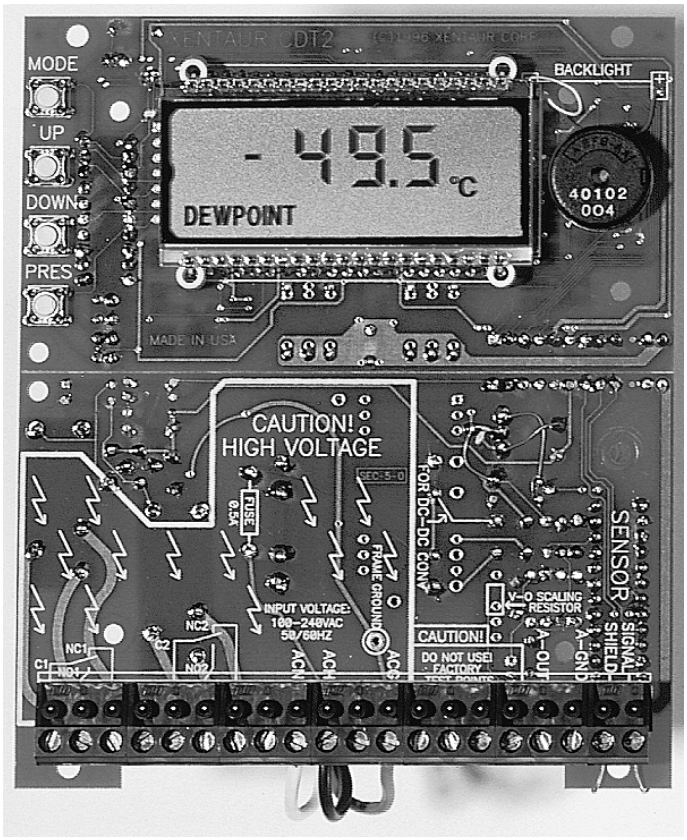
Legend: **/** separates alternately displayed messages

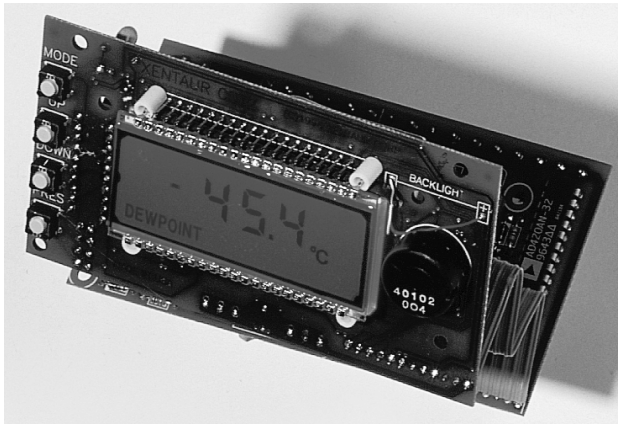
((●)) denotes beeping

Buttons without designator or arrow leading out, perform no function

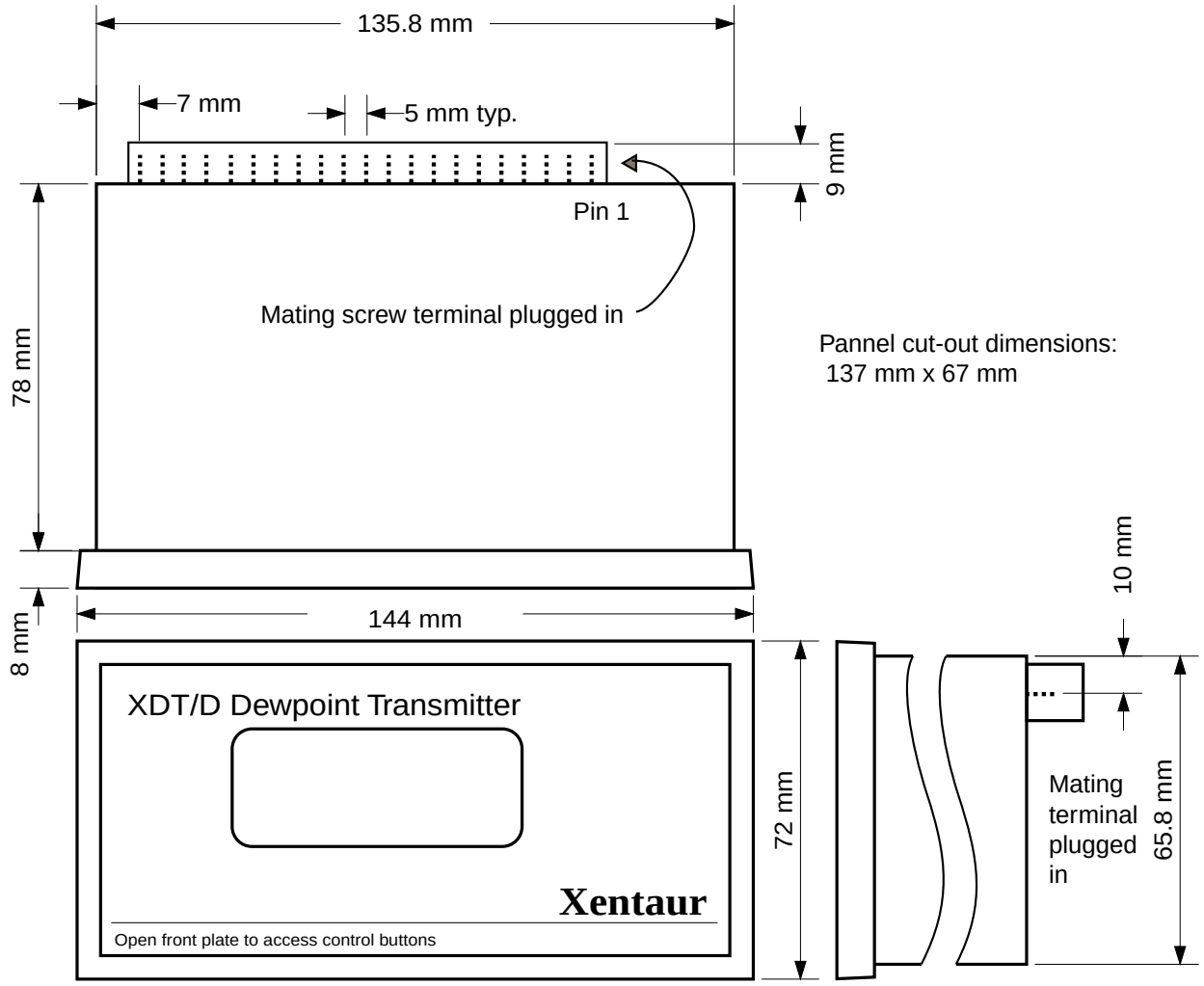
Appendix B: XDT Board

Front View

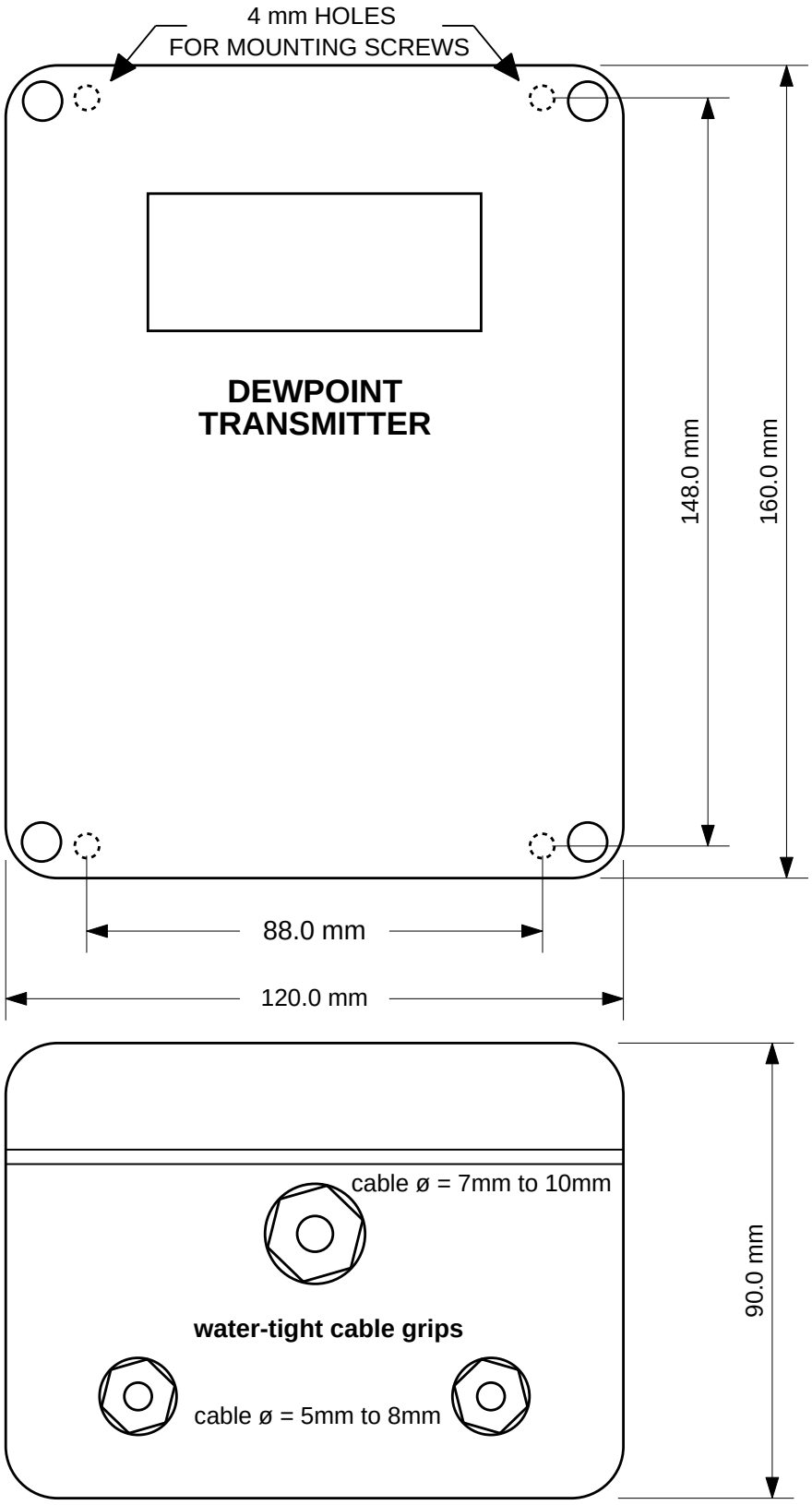




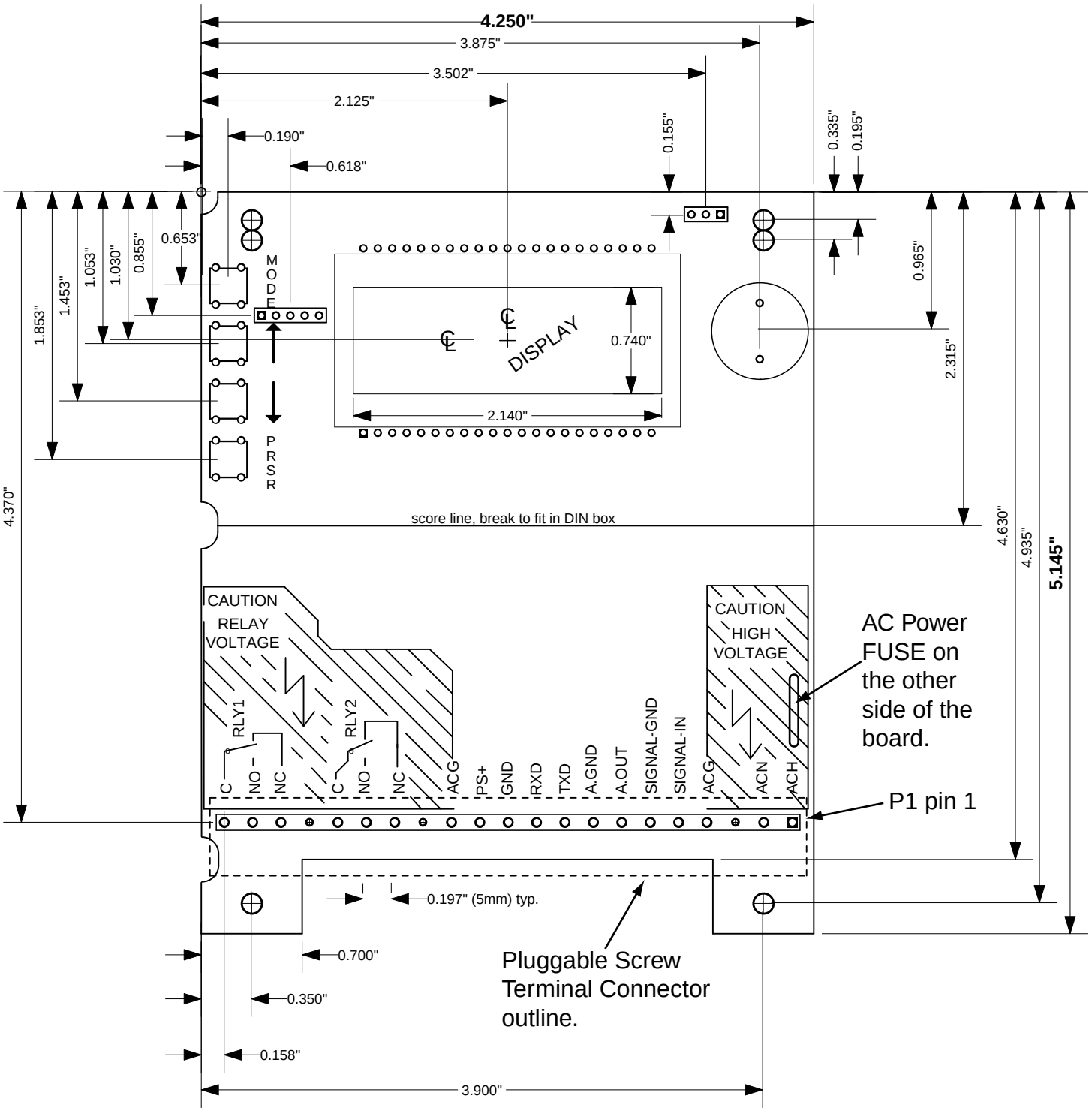
Appendix B: XDT Din Box



Appendix B: XDT NEMA Box

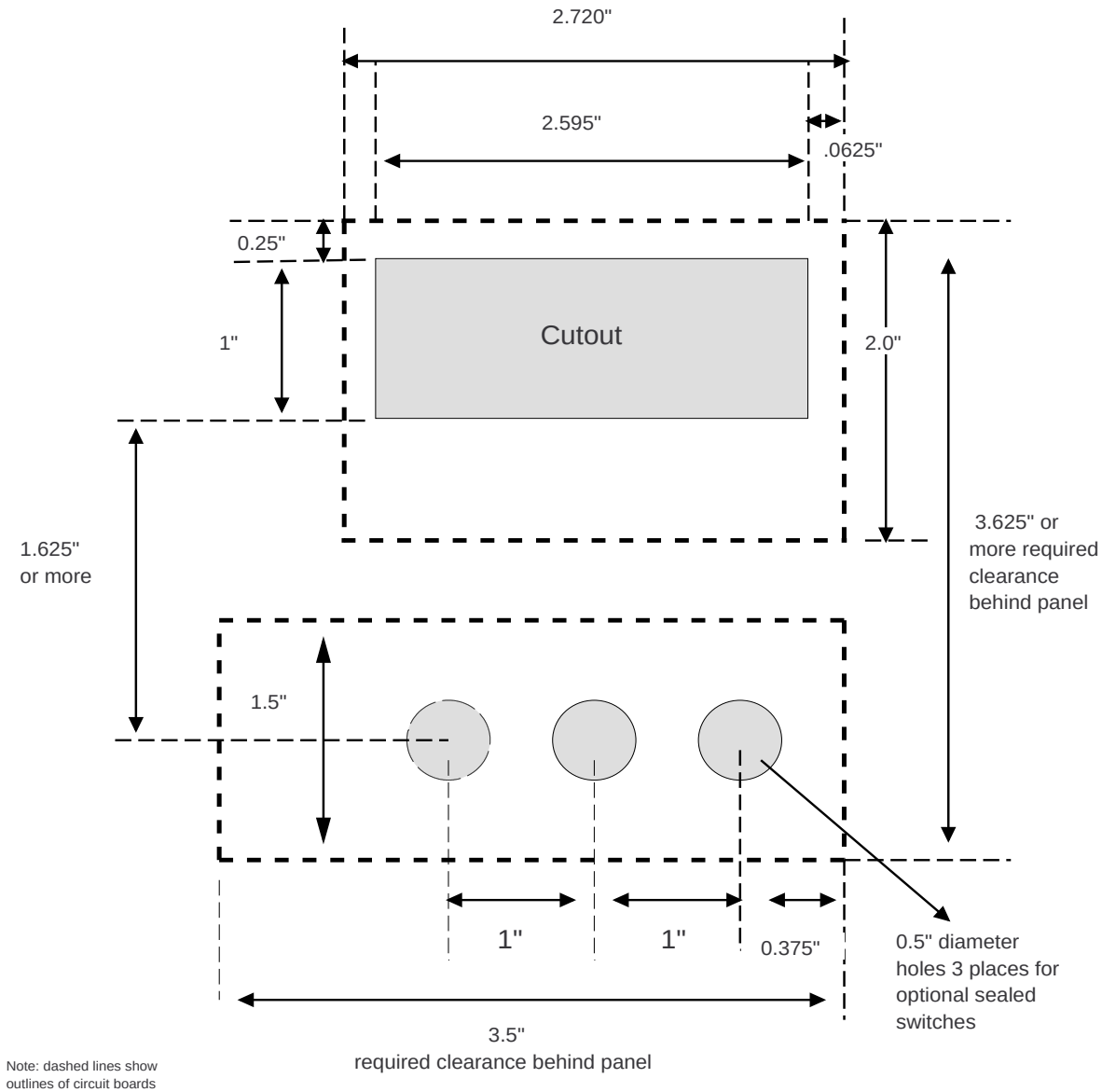


Appendix C: CDT Electronics Assembly - Mechanical Drawings



Appendix C: CDT Electronics Assembly - Mechanical Drawings

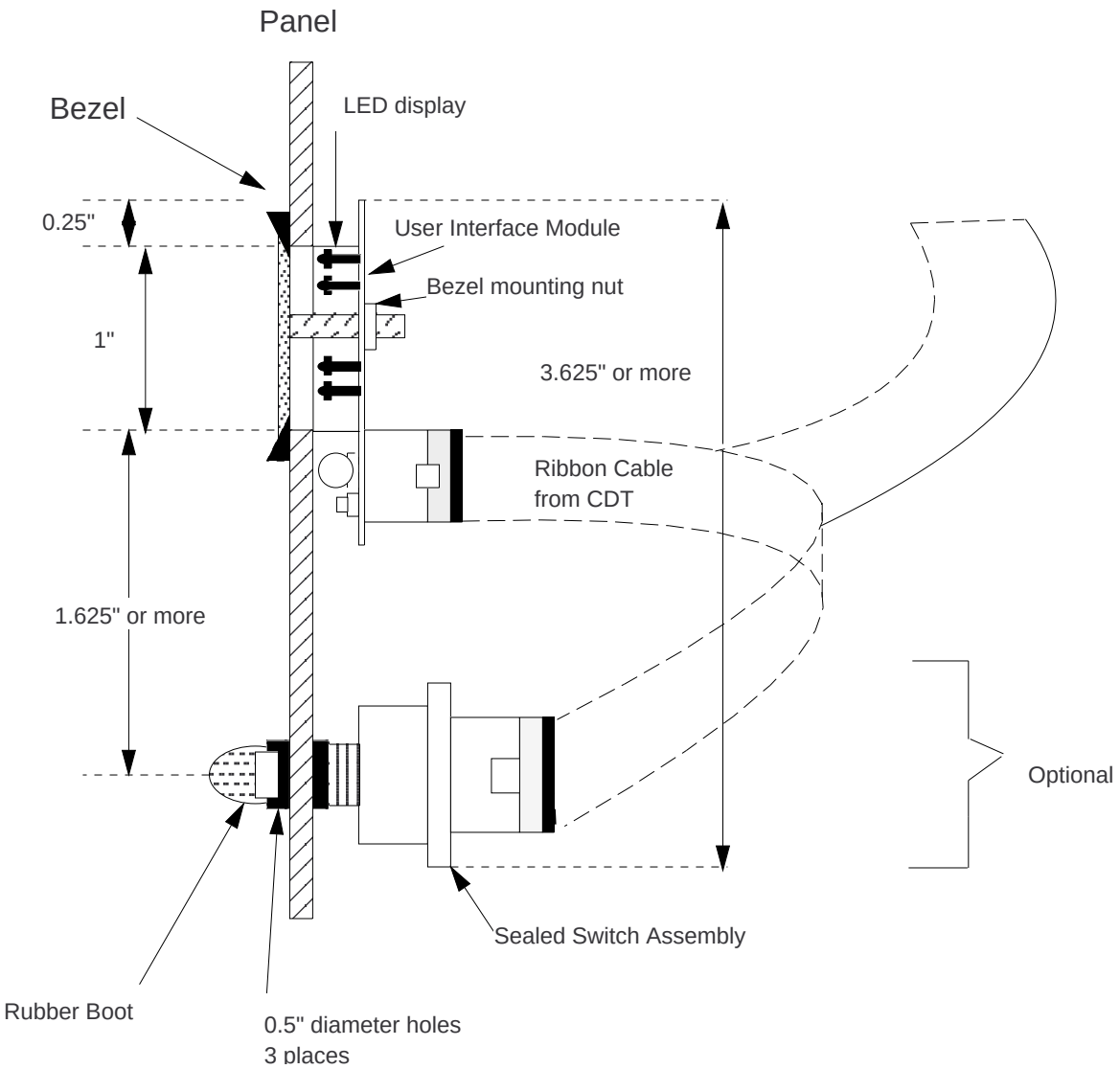
Front View of Panel Cutout
for Mounting
CDT Remote Display Bezel
and
(Optional) Sealed Switch Assembly



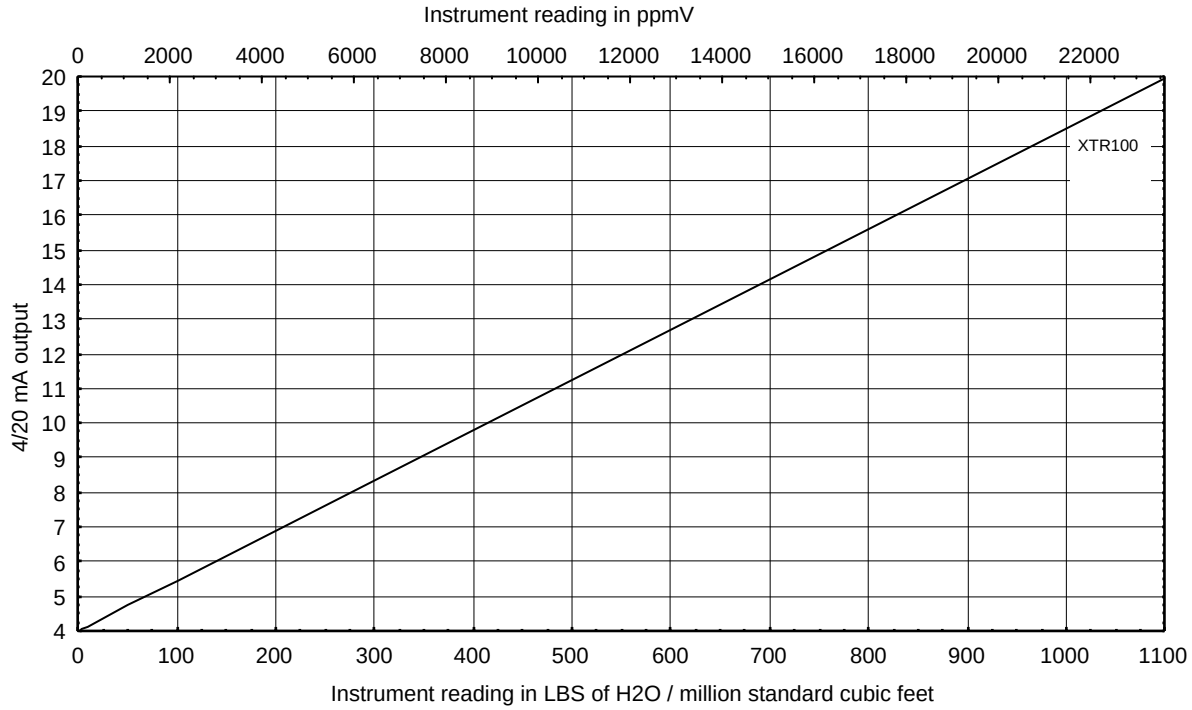
Note: dashed lines show outlines of circuit boards behind panel.

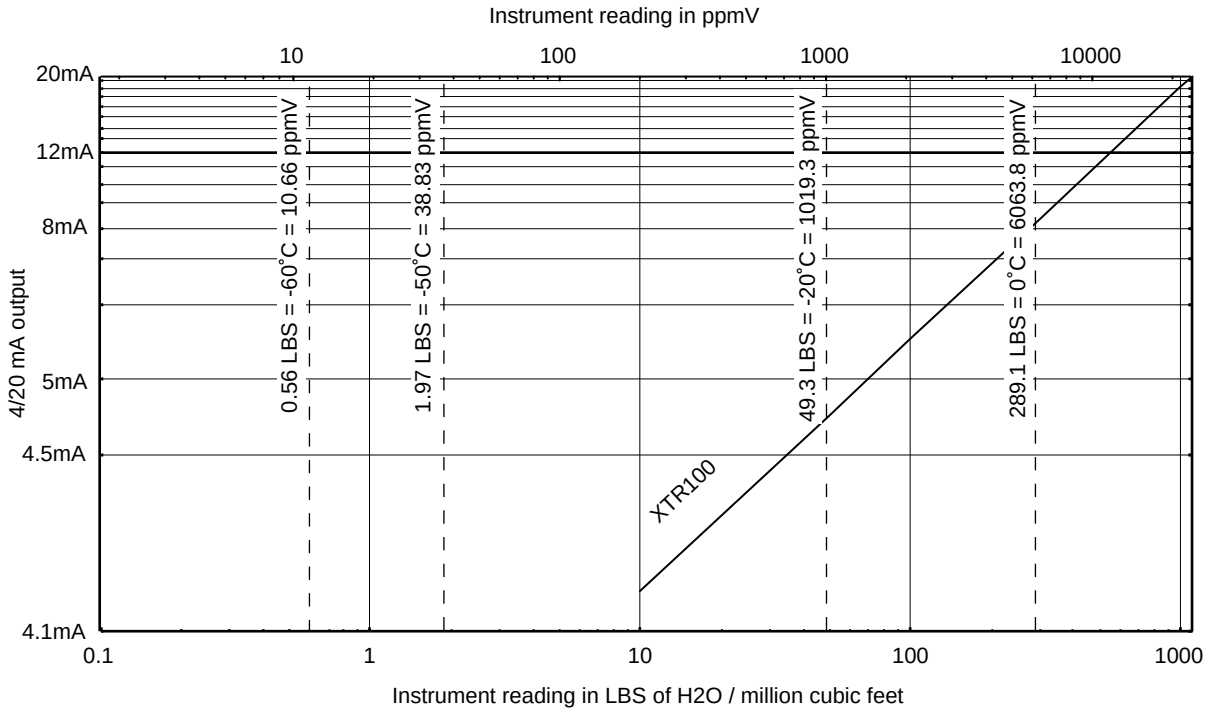
Appendix C: CDT Electronics Assembly - Mechanical Drawings

Side View of Mounted
CDT Remote Display and
Sealed Switch Assembly

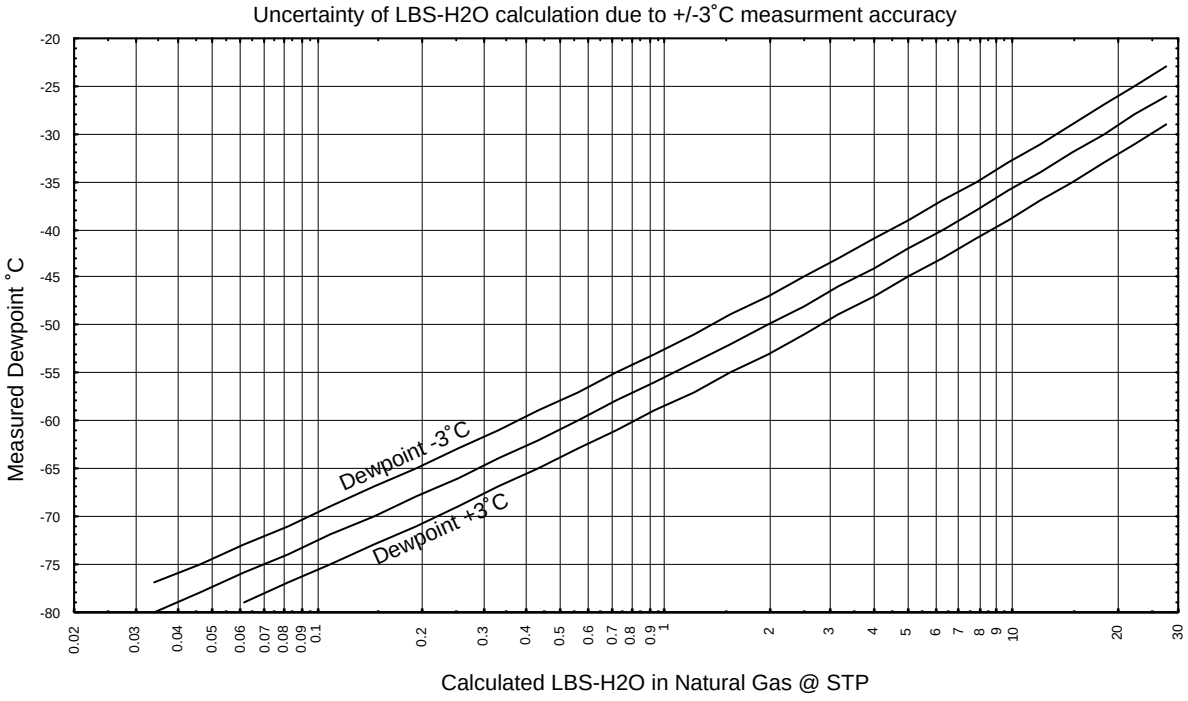


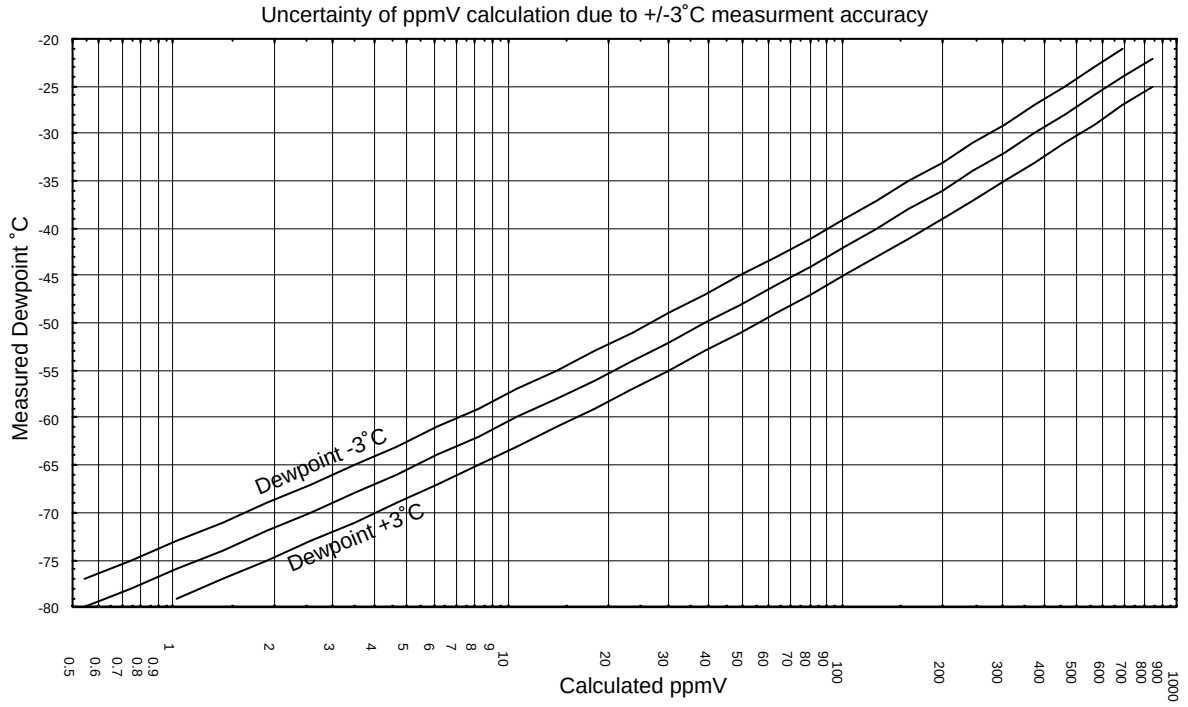
Appendix D:
Relationship of Instrument Reading and 4-20mA output when lbs of H_20/million standard cft or ppmv engineering units are selected





Appendix E: Uncertainty in LBS of H2O or ppmV calculations





Material Safety Data Sheet

Revision Date: 08/09/99 Originated: 01/23/81

DRIOUT DESICCANT: (1/8" Dia.), (3/16" Dia.), (1/4" Dia.), (3/8" Dia.), (1/2" Dia.)

PRODUCT NAME: DRIOUT DESICCANT

COMPANY IDENTIFICATION

SUPPLIERS NAME: Flair Corporation

ADDRESS: 4647 S.W. 40th Avenue
Ocala, Florida 34474-5799 USA

EMERGENCY TELEPHONE No. *352-237-1220*

FOR PRODUCT INFORMATION *352-237-1220*

1. CHEMICAL PRODUCT IDENTIFICATION

Trade Name and Synonyms: Activated Alumina

USA Phones: 352-237-1220, contact Customer Service

2. COMPOSITION / INFORMATION ON INGREDIENTS

Component	CAS NO.	%	OSHA/PEL	ACGIH/TLV
Aluminum oxide (non-fibrous)	1333-84-2	< 97	15 mg/m^3 (total dust) 5 mg/m^3 (respirable)	10.0 mg/m^3
Loss on ignition (water)		4.0 - 7.0		

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

No unusual fire or spill hazard. Dust may be irritating to eyes.

Alumina is a low health risk by inhalation and should be treated as a nuisance dust as specified by the American Conference of Governmental Industrial Hygienists (ACGIH).

Medical conditions aggravated by exposure to the product: Skin rashes, chronic lung disease, asthma.

4. FIRST AID MEASURES

After eye contact: Immediately flush eyes with plenty of water for at least 15 minutes. Consult a physician.

After skin contact: Wash with soap and water for at least 15 minutes. Consult a physician.

After inhalation: Remove victim to fresh air. Check for clear airway, breathing, and presence of pulse. Provide CPR for persons without pulse or respirations. Consult a physician immediately.

After swallowing: Do not induce vomiting. Never give anything by mouth to a convulsing or unconscious person. If swallowed, dilute by drinking large amounts of water. Contact the local Poison Control Center and consult a physician immediately.

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media: Use fire fighting measures that suit the environment.

Protective Equipment: Wear self-contained respiratory protective device. Wear fully protective suit.

6. ACCIDENTAL RELEASE MEASURES

Person-Related Safety Precautions: Wear protective clothing.

Measures For Environmental Protection: No special measures required.

Measures For Cleaning/Collecting: Clean up using dry procedures; avoid dusting.

Additional Information: No dangerous substances are released.

7. HANDLING AND STORAGE

Information for Safe Handling: Ensure good ventilation/exhaust at the workplace. Prevent formation of dust. Provide suction extractors if dust is formed.

Information About Protection Against Explosions and Fires: No special measures required.

Storage Requirements to be met by Storerooms and Receptacles: Keep material dry.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

General Protective and Hygienic Measures: Do not inhale dust. Avoid contact with eyes.

Respiratory Protection: Use suitable respiratory protective device in case of insufficient ventilation.
Short term filter device: Filter F2

Skin Protection: Wear appropriate gloves to avoid direct skin contact.

Eye Protection: Safety glasses recommended.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance: Off-white crystalline or gelatinous granules, pellets/powder

Boiling Point: Undetermined

Melting Point: 2038° C (3700° F)

Solubility in Water: Insoluble.

Density (at 20°C): Loose Bulk: 39-52 lbs/ft^3 (0.62-0.83 g/cm^3)

pH (at 20°C): 9.4 - 10.1 (10% in water)

Odor: None

Flash Point: Not applicable.

Auto-Igniting: Product is not self-igniting.

Danger of Explosion: Product does not present an explosion hazard.

10. STABILITY AND REACTIVITY

Thermal Decomposition (Conditions to avoid): No decomposition if used according to specifications.

Dangerous Reactions: Heating occurs when water is added.

Dangerous Products of Decomposition: No dangerous decomposition products known.

Additional Information: Non-corrosive.

11. TOXICOLOGICAL INFORMATION

Primary Irritant Effect:

On The Eye: Can cause mild irritation.
On The Skin: Can cause mild irritation.
Inhalation: Can cause mild upper respiratory tract irritation.
Ingestion: Can cause mild irritation.

Additional toxicological information: The product is not subject to classification according to the calculation method of the General EU Classification Guidelines for Preparations as issued in the latest version.

12. ECOLOGICAL INFORMATION

General Notes:
Water hazard class 0 (German Regulations) (Self-assessment): Generally not hazardous for water.

13. DISPOSAL CONSIDERATION

Product Recommendation: Collect in containers, bags, or covered dumpster boxes. If reuse or recycling is not possible, material may be disposed of at an industrial landfill.

European Waste Disposal Key: 16 03 01 513 05

Uncleaned Packagings Recommendation: Disposal must be made according to official regulations.

14. TRANSPORT INFORMATION

DOT Regulations: U.S.A. DOT: Not Regulated - Enter the proper freight classification, "MSDS Number", and "Product Name" on the shipping paperwork.

Canadian TDG Hazard Class & PIN: Not regulated.

Maritime Transport IMDG:

Marine Pollutant: No

15. REGULATORY INFORMATION

U.S. FEDERAL REGULATION:

TSCA STATUS: All components of this product are listed on the TSCA Inventory.

*For TSCA inventory reporting purposes, CAS No. 1344-28-1 was assigned for all forms of aluminum oxide instead of the CAS number 1333-84-2 as indicated in Section 2.

CERCLA REPORTABLE QUANTITY: None.

SARA TITLE III:

Section 302 Extremely Hazardous Substances: None
Section 311/312 Hazardous Categories: Immediate (Acute)
Section 313 Toxic Categories: None

Other information:
In reference to Title VI of the Clean Air Act of 1990, this material does not contain nor was it manufactured using ozone-depleting chemicals.

Markings according to EU guidelines:
Observe the general safety regulations when handling chemicals. The product is not subject to identification regulations under EU Directives and the Ordinance on Hazardous Materials (GefstoffV).

Classification according to VbF: Void

Water Hazard Class: Water hazard class 0 (German Regulation): Generally not hazardous for water.

INTERNATIONAL REGULATIONS:

Canadian Domestic Substances List (DSL): All components of this product are listed on the Canadian DSL.
Japan Ministry of International Trade Industry (MITI): All components of this product are listed on MITI.
Australian Inventory of Chemical Substances (AICS): All components of this product are listed on the AICS Inventory.

16. OTHER INFORMATION

MSDS Status: Supersedes 01/25/96
Product Use: Adsorbent; dehydration agent; catalyst support.

REFERENCES

- Guide to Occupational Exposure Values - 1998. Compiled by the American Conference of Governmental Industrial Hygienists (ACGIH)
- Documentation of the Threshold Limit Values and Biological Exposure Indices. Sixth Edition, 1991, Compiled by the American Conference of Governmental Industrial Hygienists (ACGIH).
- NIOSH Pocket Guide to Chemical Hazards. U.S. Department of Health and Human Services, June 1994.
- Dangerous Properties of Industrial Materials. Sax, N. Irving, Van Nostrand Reinhold Co., Inc., 1984.
- Patty's Industrial Hygiene and Toxicolgy: Volume II: Toxicology, 4th Edition, 1994, Patty, F.A..; edited by Clayton, G.D. and Clayton, F.E.: New York: John Wiley & Sons, Inc.

Quick Identifier

DRIOUT DESICCANT: (1/8" Dia.), (3/16" Dia.), (1/4" Dia.), (3/8" Dia.), (1/2" Dia.)

Material Safety Data Sheet

ATTENTION: Plant Manager/Safety Director:

This MSDS supersedes all prior data sheets received for this product. We urge you to study it carefully. This is provided with each container as our way of communicating Health, Safety, and Environmental Protection Information to our customers.

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FLAIR
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LEGEND:

ACGIH	American Conference of Government Industrial Hygienists
AICS	Australian Inventory of Chemical Substances
CAS	Chemical Abstract Services
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
DOT	Department of Transportation
DSL	Domestic Substances List (Canada)
ECOIN	European Core Inventory
EINECS	European Inventory of Existing Commercial Chemical Substances
EWC	European Waste Catalog
EPA	Environmental Protection Agency
IARC	International Agency for Research on Cancer
LC	Lethal Concentration
LD	Lethal Dose
MAK	Maximum Workplace Concentration (Germany)
NDSL	Non-Domestic Substances List (Canada)
NFPA	National Fire Protection Agency
NIOSH	National Institute of Occupational Safety and Health
NTP	National Toxicology Program
OEL	Occupational Exposure Limit
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
PIN	Product Identification Number
RCRA	Resource Conservation and Recovery Act
SARA	Superfund Amendments and Reauthorization Act
STEL	Short Term Exposure Limit
TCLP	Toxic Chemicals Leachate Program
TDG	Transportation of Dangerous Goods
TLV	Threshold Limit Value
TSCA	Toxic Substances Control Act
TWA	Time Weighted Average

atm	atmosphere
cm	centimeter
g, gm	gram
in	inch
kg	kilogram
lb	pound
m	meter
mg	milligram
ml, ML	milliliter
mm	millimeter
n.o.s.	not otherwise specified
ppb	parts per billion
ppm	parts per million
psia	pounds per square inch
µ, u	micron
µg	microgram

Material Safety Data Sheet

Revision Date: 03/03/98 Originated: 01/23/81

DRIOUT BED SUPPORT: (1/8" Dia.), (1/4" Dia.) (1/2" Dia.), (1" Dia.)

PRODUCT NAME: BED SUPPORT

COMPANY IDENTIFICATION

SUPPLIERS NAME:	Flair Corproration	EMERGENCY TELEPHONE No.	*352-237-1220*
ADDRESS:	4647 S.W. 40th Avenue Ocala, Florida 34474-5799 USA	FOR PRODUCT INFORMATION	*352-237-1220*

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: Tabular Bed Support CAS No.: None Known.

CHEMICAL NAME: Chemical Stoneware

CHEMICAL FAMILY: Aluminum Silicate

2. COMPOSITION / INFORMATION ON INGREDIENTS

COMPONENT	CAS NO.	%	OSHA/PEL	ACGIH/TLV
Aluminum oxide	1333-84-2	40	Not available	Not available
Silicon Dioxide	7631-86-9	60	Not available	Not available

3. HAZARDS IDENTIFICATION

The health effects noted below are consistent with requirements under the OSHA Hazard Communication Standard (29CFR 1910.1200)

Potential Health Effects

EYES: This product may be mildly irritating to the eyes.

SKIN: This product is non-irritating to the skin.

INHALATION: Dust may cause irritation to respiratory tract if inhaled. Long term exposure (10-25 years) to dust may cause cough, chest pains, dyspnea, decreased vital capacity and diminished chest expansion. Treat as a nuisance dust

INGESTION: This product is generally considered to have a low order of acute oral toxicity.

SIGNS AND SYMPTOMS: Irritation as noted above.

4. FIRST AID MEASURES

EYES: If dust comes into contact with the eyes, flush with large amounts of water. If irritation persists, consult a physician immediately.

SKIN: If dust contacts the skin, wash area with soap and water. Personnel should shower after handling material if frequent contact with dust is experienced..

INHALATION: Dust may cause irritation or discomfort. Remove person from exposure and seek medical help if symptoms do not disappear.

INGESTION: Drink plenty of water and consult a physician.

5. FIRE FIGHTING MEASURES

FLASH POINT METHOD: Will not burn (see below).

FLAMMABLE LIMITS/% VOLUME IN AIR

Lower: Not applicable Upper: Not applicable

EXTINGUISHING MEDIA: Will not burn. Use an extinguishing media appropriate for the surrounding fire.

SPECIAL FIRE FIGHTING PROCEDURES AND PRECAUTIONS: Will not burn.

6. SPECIAL PRECAUTIONS AND SPILL/LEAK PROCEDURES

HANDLING:	Desiccant should be handled so as to avoid generation of dusty conditions in the workplace. Use adequate ventilation. If dust develops, use a NIOSH approved respirator to avoid drying of mucous membranes in nose and throat.
STORAGE:	Stack securely and keep contents dry prior to use.
OTHER PRECAUTIONS:	In dusty conditions, prolonged contact may cause irritation of skin. If contact with skin is unavoidable, wear close-weave gloves with tight fitting wristlets. These should be washed frequently.
STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:	Vacuum or sweep up immediately. Spilled material can be slippery. This will minimize chance of injury due to falls.

7. EXPOSURE CONTROLS / PERSONAL PROTECTION

RESPIRATORY PROTECTION: NIOSH-approved dust respirator where exposure limit is or may be exceeded.

SKIN PROTECTION: Protective gloves recommended.

EYE PROTECTION: Safety glasses recommended.

OTHER PROTECTIVE CLOTHING or EQUIPMENT: Work Uniform recommended.

8. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE AND ODOR: Buff colored solid — odorless.

BOILING POINT: Approximately 4000°F.

MELT POINT: Approximately 3700°F.

VAPOR PRESSURE (mm): Not significant.

VAPOR DENSITY (air=1): Not applicable.

SOLUBILITY IN WATER: Negligible.

SPECIFIC GRAVITY: Not applicable

BULK DENSITY: 92 lbs/ft^3.

9. STABILITY AND REACTIVITY

CHEMICAL STABILITY: Stable.

CONDITIONS TO AVOID: None known.

INCOMPATIBILITY: None known.

HAZARDOUS DECOMPOSITION PRODUCTS: Not applicable.

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: None Known.

10. TOXICOLOGICAL INFORMATION

No LD_{50} or LC_{50} found for oral, dermal, or inhalation routes of administration.

11. ENVIRONMENTAL PROTECTION

The material is inert itself. It will not of itself contaminate other equipment

If the product is used by the customer with chemicals, further handling and treatment should be based upon that exposure.

12. DISPOSAL CONSIDERATIONS

Dispose of unused desiccant in accordance with Federal, State, and Local Regulations.

SPECIAL CAUTION

When disposing of used desiccant, material must be handled with special precautions. Desiccant is an adsorbent material. Following contact with typical petrochemicals or gases, the combination of desiccant and retained material can be hazardous, toxic and/or flammable. It is highly recommended that all used desiccant be analyzed to determine content before disposal. Appropriate care and procedure should be followed in handling and storage of used materials. Once content is deter-mined, containers should be properly labeled and disposed of in accordance with Federal, State and Local Regulations.

13. TRANSPORTATION REQUIREMENTS

Department of Transportation Classification: Not hazardous by DOT Regulations.

14. REGULATORY INFORMATION

The components of this product are listed on the EPA/TSCA inventory of chemical substances.

The reportable chemical substances in this product are regulated by the OSHA Hazard Communication Standard (29 CFR 1910.1200) solely because they are listed by ACGIH. However, they do not fit any of the five proposed hazard categories under Section 311 or 312 of SARA.

For purpose of SARA III reporting, this substance contains no ingredients listed on the Extremely Hazardous, CERCLA, or Section 313 Lists.

15. OTHER INFORMATION

MSDS Status: New Area Code and New Format. Added Legend.
Supersedes: 02/08/95.
Product Use: Support Media

HMIS™ - Hazardous Materials Identification System

HMIS™ Ratings:

Health	1
Flammability	0
Reactivity	0

0 - minimal hazard; 1 - slight hazard; 2 - moderate hazard; 3 - serious hazard; 4 - severe hazard

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LC_{LO}	Lowest Published Lethal Concentration
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ppb	parts per billion
ppm	parts per million
psia	pounds per square inch
µ, u	micron
µg	microgram

MAINTENANCE RECORD

DATE	WORK DONE	WORK BY