M54-003A

INSTRUCTION MANUAL
FOR THE
INSTALLATION, OPERATION AND MAINTENANCE
OF THE
BELOIT GEAR REDUCER
SIZE 350

Revised December, 1995
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BELOIT

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SAFETY

SAFETY FIRST

It is important to observe safety precautions to protect personnel from possible injury.

Personnel should be instructed to:

1. Avoid contact with moving parts or electrically energized circuits.
2. DISCONNECT AND LOCK-OUT ALL POWER SOURCES IN ACCORDANCE WITH APPLICABLE OSHA STANDARDS* BEFORE INITIATING ANY MAINTENANCE OR REPAIR.
3. Use procedures in accordance with applicable OSHA standards when handling and lifting this equipment.
4. Be sure equipment is provided with proper safeguards, such as Belt Guards, Chain Guards, Coupling Guards, Safety Signs and Color Coding (**) Kick Boards and Railings on Stairs and Catwalks in accordance with applicable OSHA standards.
5. Be familiar with the equipment and read this Instruction Manual thoroughly before installing, operating and maintaining this equipment.

* Refer to following page for Lock-Out OSHA Regulation 1910.261.

** Refer to the Appendix located at the end of this manual for a pamphlet on Pulp and Paper Mill Safety.

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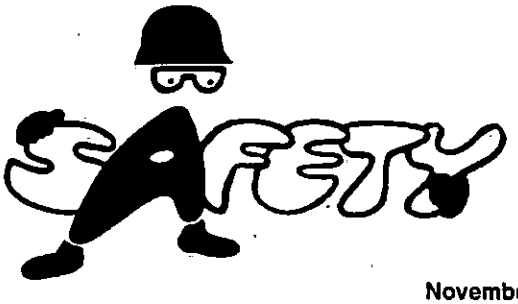


November 1977

LOCK OUT SAFETY

One of the greatest potential hazards in the paper mill is failure to lock out power sources and drives. Because of the large size of the equipment, there is a possibility that components may be started up while machine tenders are out of sight of the operator. Safety with controls cannot be emphasized enough. Complete safety instructions and periodic refresher courses should be given to operating personnel so they are keenly aware of lock out procedures.

OSHA regulations, under Section 1910.261, Pulp, Paper and Paperboard Mills, paragraph (4) Lockouts, reads, "Devices, such as padlocks shall be provided for locking out the source of power at the main disconnect switch. Before any maintenance, inspecting, cleaning, adjusting when machine is stopped, or servicing of equipment (electrical, mechanical, or other) that requires entrance into or close contact with the machinery or equipment, the main power disconnect switch or valve, or both, controlling its source of power or flow of material, shall be secured or blocked off with padlock, blank flange, or similar device."

The following lock out procedures are meant to be suggestions only. Most mills have their own lock out procedures, we want to create an awareness for the need to practice the procedures as established by the mill to maintain safe working conditions. Lock out procedures established by mills should comply with the procedures recommended by OSHA and by the state in which the mill is located. Some states have very specific procedures regarding these important safety precautions.

SUGGESTED LOCK OUT PROCEDURES

In order to prevent personal injury to employees and/or damage to machinery, the following recommended lock out procedures should be followed:

1. Notify the operating supervisor or operator or both of the particular equipment or section that has to be shut down and locked out.
2. If the source of power is electrical, an electrician, usually the one responsible for the equipment in question, must be notified that a disconnect has to be opened:
3. When the electrician opens the disconnect he must test the circuit with a meter and make sure the current is broken and the disconnect switch locked out.
4. A group supervisor and/or individual worker must then apply his lock to the disconnect or switch box. Many mills have set up color codes for locks and provide them from a central source, or the workers may have their own locks identified by-color, name, clock number, and/or combination thereof. Each worker working on the machine is required to put his lock on the switch. There are a variety of devices on the market that permit a number of locks to be placed on a single disconnect or switch.

5. A worker applying a lock must have the electrician test the circuit to confirm the identification of the circuit that has been taken out of service.
6. Where electrical disconnects may be hazardous, an electrician may apply or remove the lock for a non-electrical worker . . .but, only while the worker is present because each worker is responsible for his lock.
7. When working on mechanically driven devices powered by hydraulics, gas, air or steam, the control levers, electrical power to the pump motors, and valves must be locked out to prevent starting of the equipment. Operating personnel are normally responsible for closing valves, draining lines, etc. Each employee working on this type of equipment is to attach his lock to the device before initiating work on it.
8. When the work has finished, the last person to remove his lock must inform the operating supervisor or operator or both that the equipment is ready to be put back in service.

Provisions for lock removal in case a worker is relieved before the job is completed or leaves the mill premises for an extended time, should be set up by the mill to conform with their own policy. A lock must never be removed in the absence of a worker unless it has been established that this worker will not return within a reasonable work period. Removal of this lock, if necessary, must be handled through proper mill management channels. On major shutdowns, such as clothing changes, i.e., wires, felts or dry felts, it is recommended that a senior shift supervisor be required to lock out the equipment involved. He should follow lock out procedures as established by the mill which, in turn conform to OSHA and state regulated safety acts.

TANKS AND CHESTS

When a worker must enter a tank, chest, barking drum, dryer cylinder or other potentially hazardous area, it is extremely important that all controls be locked out. Also, valves for all inputs to these vessels must be secured and locked. Note: pressure vessels must be properly ventilated before the worker enters them.

In addition to following lock out procedures as previously described, the worker must securely attach his safety lock to all access doors or openings through which tanks, chests, drums, or cylinders are entered. Upon leaving any of the above, the worker is to remove his lock. If other locks are at the entrance, he must not disturb them.

We cannot emphasize it enough, the employee must adhere to lock out procedures established by the mill. If they have not become familiar with these procedures and find themselves in a position where equipment must be locked out, the employee is to ask his supervisor for the procedures.

And, as "Your Partners in Papermaking", we are available to provide assistance for your safety training programs for the paper machine. If we can be of any help to you, please contact your Beloit representative.

SAFETY PRECAUTIONS AND SUGGESTIONS

GENERAL

These instructions are provided in the interest of reducing equipment related injuries. The safety requirements listed here are not all inclusive, but can be used to reinforce a mill's safety program.

Read and understand this manual before operating and maintaining the equipment.

1. Keep loose clothing and all parts of the body away from rotating mechanisms.
2. Bearings and drive units should be lubricated periodically so that they will rotate when required.
3. When components require replacement, only original part manufacturer components should be used.
4. Wipe up spilled oil, grease or water which may cause a person to slip and fall.
5. Although safety signs, in and of themselves, do not prevent accidents they can be helpful as reminders to mill personnel that hazardous conditions may exist if proper safety practices are not observed. These signs should not be interpreted as presenting the machine as an unsafe piece of equipment.

OPERATION

1. Have drive guards installed before starting drive motor.
2. Keep drive guards on during machine operation.
3. Machine should not run faster than specified.

INSTALLATION MAINTENANCE

1. Use procedures in accordance with applicable OSHA Standards when handling and lifting this equipment.
2. Know the weight of an asembly or part before lifting it.
3. Tie slings securely when attempting to lift machine components. Rapid shifting of position of out-of-balance pieces could be hazardous.
4. Inspect slings and cables for worn or weak spots before using. Keep all personnel away from under machine components when lifting to prevent injury if slings, cable or hoists should break.
5. Do not depend on hydraulic or pneumatic devices to hold equipment in a raised position while performing maintenance. Pin or chain in raised position as a precautionary measure.
6. "TAG" out or "LOCK" out all drives and controls before performing maintenance.

SAFETY PRECAUTIONS AND SUGGESTIONS

(Continued)

Accidental start-up may injure personnel.

7. Use lifting points as specified by manufacturer. Where provisions have been made for lifting eyes to be screwed into a tapped hole, make certain that eyebolt is tightened to the shoulder and that eye is parallel to the lifting plane to prevent breakage.

8. Inspect chains and clevis pins for possible corrosion. Block under or around unit raised by the chains when performing maintenance, to prevent injury to personnel in case of breakage.

9. Use proper stops when applying hydraulic removal equipment to bearing, head, gears, etc. These items may travel at high rates of speed once they have broken loose from the shaft.

10. Perform all wiring in accordance with existing electrical codes.

SECTION I

GENERAL

INTRODUCTION

The BELOIT-JONES Gear Reducers covered by this instruction manual are carefully designed and constructed of high quality materials to give long periods of trouble-free service when properly installed and maintained.

DESCRIPTION

Housing

The housing is made of high grade cast iron, is durable and highly corrosion-proof. The walls and ribs are proportioned to withstand any severe stress encountered during operation. The round shape of castings results in a rigid structure that maintains precise alignment of gears and bearings. The housing is split horizontally and is provided with large inspection openings for convenient examination of gears (Figure 9).

Gears

The Spiral Bevel Gears are manufactured from alloy steel forgings (Figure 10). Pinions and gears are manufactured and lapped in matched sets to provide a quiet running unit with perfect tooth bearing (Figure 11).

Shafting

Heavy Duty Shafts are designed for high torque and overhung load capacity.

Bearings

Anti-friction tapered roller bearings are used throughout to hold the gears in permanent alignment and are conservatively selected to give minimum B-10 life of 100,000 hours.

Lubrication

A circulating oil system, driven by a motor and pump independently of the gear unit, permits the use of an electrical interlock to ensure circulation of oil before the gear unit is started. This assures ample oil delivery to the bearings and gearing before they are rotated. The separate oil supply system provides the added safeguard of permitting the use of a heat exchanger and filter to assure that clean and cool oil is delivered to the bearings and gearing at all times.

Seals

Frictionless labyrinth seals and slingers are provided on shaft extensions to retain oil within the housing and exclude dirt and water.

SECTION II

INSTALLATION

RECEIVING

The BELOIT-JONES Vertical Gear Reducer is normally assembled to the pulping unit at the factory and shipped as a complete assembly mounted on a skid. The lubrication unit/components are shipped separately.

Each Gear Reducer should be carefully examined upon arrival. If any damage has occurred during shipment, request an inspection by the carrier before removing from the car. The mill must initiate any claims for damages when BELOIT ships F.O.B.

If the gear reducer is not to be installed immediately, it should be stored in a clean, dry location. Precautions must be taken to prevent entrance of moisture, dust or dirt during storage and installation. Unit should not be stored near vibrating machines in order to avoid damage to bearings.

If the storage period is to exceed three months, unit should be rotated monthly. See "Long Term Storage".

Space must be provided around the gear reducer for normal maintenance.

All vertical gear reducers are furnished with a forced feed lubrication system.

FOUNDATION

To obtain long trouble-free performance from the speed reducer, care must be taken with the mounting to secure and maintain good support and alignment of the various elements of the drive. A level and flat foundation should be provided to secure an even distribution of the weight of all foundation bolts. The foundation must be rigid to withstand the weight and torque reactions of the gear unit. The unit should be isolated as much as possible from the effects of external vibration. It is recommended that the mounting surface be made of finished steel or cast iron (Figure 1).

ALIGNMENT

Readings using a dial indicator are recommended and should be made and recorded while motor and reducer are cold. After the initial run-in of the reducer under load and its rise to uniform temperature, a temporary shutdown should be made and the line-up checked immediately. Average "hot" or "cold" readings should then be considered as the actual shaft runout and corrections should be made accordingly.

Recheck alignment of motor and reducer after several weeks and make any necessary adjustments. After alignment is made, dowel reducer and motor to base plate.

LUBRICATION SYSTEM

Install lubrication system. Make pipe and tube connections between lubrication system and gear case as described under "Lubrication" and shown on "Lubrication System" Drawing. See Figures in Section IV (Maintenance).

WATER DRAIN

A 2" pipe tap is provided in the upper gear case for draining excess water from packing box seal. Connect to sewer.

PREPARING UNIT FOR OPERATION

During the time of manufacturing, testing, and preparation for shipment, basic precautions are taken by the factory to guard against corrosion. Reducers are operated and tested in the factory with a rust-inhibiting oil in the lubrication system. To reduce shipping weight and facilitate handling, units are shipped dry and must be filled to the mark indicated on the column type view gauge. The lubricant used should be selected from the approved list included under "Lubrication".

Although the reducers are shipped without oil, a rust-inhibiting film remains on the gears and on critical bearing surfaces during transit and for short periods of storage. When the unit has been stored for an extended period, the gear set should be inspected and cleaned, if necessary, before installation of lubricant.

Internal condensation due to temperature changes may cause water accumulation in the gear case even when the unit is protected from the elements.

WIRING

Make electrical connections to the motor using voltage, phase, and cycle as designated on the motor nameplate, and in accordance with existing electrical codes.

Direction of rotation of the reducer drive motor is indicated on the reducer input shaft end cover and direction of rotation of the lubrication pump motor is indicated on top of pump. If motor direction of rotation is incorrect, reverse two leads.

Before starting reducer drive motor, check to ensure that oil is being pumped and that the Bowser flow indicator micro-switches are interlocked with drive motor as shown on the wiring diagram.

RUN-IN

Each unit is given a short run-in at the factory as part of the inspection procedure. An additional 12-24 hours run-in under light load after the unit has been installed will contribute appreciably to its life.

LONG TERM STORAGE

A. Seal all openings.

B. Remove breather and install a blank cover.

C. Fill labyrinth in input end cover with grease and seal around the shaft.

D. Fill reducer with oil. Oil to cover the top thrust bearing.

E. Check for oil leakage at joints and seal if necessary.

F. Rotate input shaft once a month (counter clockwise). Check for oil leakage.

G. The oil reservoir should be drained, flushed and refilled before start-up. Install the breather plate.

LUBRICATION SYSTEM

(Figure 6)

Description

The BELOIT-JONES Gear Reducer is supplied with a separately mounted oil pressure lubrication system. This system uses a gear type, integral pump and motor unit. Make electrical connections to the motor using voltage, phase and cycle as designated on the motor nameplate, and in accordance with existing electrical codes.

Oil flows through the system as follows:

1. Oil enters pump from gear housing.

2. Oil passes through a relief valve which regulates pressure in the system. The relief valve is set at 100 psi and diverts excess oil back to gear case.

3. Oil then passes through a filter and heat exchanger.

4. A thermometer is mounted at oil outlet of heat exchanger. The desired temperature at this point is 125 degrees - 135 degrees F.

5. Oil passed through oil flow indicators which are equipped with micro-switches. When flow of oil is interrupted, the micro-switches will shut down the reducer drive motor. Reducer drive motor can be restarted only after an adequate oil flow has been restored.

6. Orifices at the end of each oil line distribute oil flow to individual bearings and to gear spray.

An oil filler-breather is mounted on the inspection cover. In addition to its basic function as a sealable opening for filling the reservoir, the breather also strains entering oil, allows reservoir to breathe and filters breathing air.

An oil level gauge mounted on lower gear housing is marked to indicate proper oil level. The 1" and 3/8" pipes adjacent to the gauge serve as oil outlets. Both have to be opened for complete draining.

Optional Equipment

Where unit is operated in an area of high humidity or where housing temperatures fluctuate rapidly, internal condensation may cause water accumulation in the gear case. It is recommended that valves (3/8: NPT and 1" NPT) be installed in the oil drain piping for bleeding off water accumulation and draining.

Since oil temperature increases during operation, it must have a viscosity required at unit operating temperatures. Minimum viscosity under operating conditions ranges from 150 to 400 SSU. Oils having this viscosity under operating conditions are not normally satisfactory for cold temperature starting and a heater must be used. A 2-1/2" pipe tap is provided in the lower gear case for installation of a thermostatically controlled oil immersion heater, if required.

The desired operating oil temperature is 120 degrees to 135 degrees F with a maximum of 160 degrees F.

Oil temperature is controlled by the temperature actuated water flow regulating valve. The valve has an adjustable range of 115 degrees to 180 degrees F and is set to open at 130 degrees F. To raise valve opening point, turn adjusting screw counter-clockwise; to lower valve opening point, turn screw clockwise. As a safety feature, the valve has an orifice bypass for a continuous minimum flow of water.

Installation

The lubrication unit is mounted on a plate provided with four (4) 1/2" holes for bolting to the foundation. Locate the unit near the gear reducer allowing the shortest and most direct route for supply and suction lines.

Use 1 1/2" piping for pump inlet from reducer housing.

Use 1 1/4" piping for relief valve outlet to reducer housing.

Connect the 1/2" Bowser flow indicator to the orifice fitting of the upper thrust bearing; use 1/2" pipe or preferably 1/2" O.D. copper tubing.

Connect the 3/4" Bowser flow indicator to the piping leading to input shaft bearing and gear spray; use 3/4" piping or 3/4" O.D. tubing.

Connect cold water supply to heat exchanger.

Connect Bowser micro-switches in series and interlock with reducer drive motor control as shown on the wiring diagram. Make electrical connections to the pump motor.

Fill gear case with recommended oil to proper level as marked on view gauge.

OIL SPECIFICATIONS

Lubricating oil should be an extreme pressure (EP) lubricant of the mild inactive type. It should have excellent anti-foam, anti-rust, and anti-oxidation characteristics and must not be corrosive to gears or roller bearings.

Ambient temperatures should be considered in selection of oil viscosity:

1. Under 60 degrees F use AGMA #4 EP premium grade gear oil with mild EP additives and viscosity of 727-765 SSU at 100 degrees F.

   Use SHELL OMALA-150 or equivalent.

2. Over 60 degrees F use AGMA #5 EP oil with mild EP additives and viscosity of 918-1122 SSU at 100 degrees F.

   Use SHELL OMALA-220 or equivalent.

   Drain. Flush and renew every three (3) months.

The user should consult his lubricant supplier for recommendation of brand name to meet the above specifications.

A partial list of brand names is shown below:

Name of Manufacturer	#4 EP For Ambient Temp. 15° F - 60° F	#5 EP For Ambient Temp. Above 60° F
Atlantic Richfield	Pennant NL-150	Pennant NL-220
Exxon	Spartan-15	Spartan-220
Gulf Oil Company	HD-150	HD-220
Shell Oil Company	Omala 150	Omala 220
Socony Mobil Oil Co.	Mobil Gear 150	Mobil Gear 220
Standard Oil Co. (Ohio)	Gear EP 150	Gear EP 220

SECTION III

OPERATION

CHECK LIST BEFORE INITIAL START-UP

Following items should be checked before initial start-up of the machine.

1. Be sure that reducer turns freely.
2. Check tightness of all foundation bolts.
3. Check oil level in gear housing.
4. Check connections to lubrication system.
5. Make certain that all protective accessories are connected and function properly.

   NOTE: Oil flow indicators have adjustable electric contacts. Check adjustment of these indicators to ascertain that contacts close on increase in flow, and open on decrease in flow.

6. Check for proper motor direction of rotation.
7. Be sure that cooling water supply to oil cooler is operative.

START-UP

1. Start lubrication pump motor.
2. Start reducer drive motor when flow indicators show oil flow in system.

   NOTE: Pump should be run at least one minute before starting unit.

3. Operate gear unit at no load for a period of time sufficient to allow oil temperature to level off.

SHUT-DOWN

1. Stop reducer drive motor.

2. Stop lubrication pump motor.

   NOTE: Unit must be shut down and examined in event of any objectionable noise, excessive vibration, or any undue rise in bearing temperatures.

SECTION IV

MAINTENANCE

CAUTION: Before starting any maintenance work or inspection on the gear reducer, be sure that all electrical disconnects are "LOCKED" in the "OFF" position.

INSPECTION

Reducers should be given a routine inspection at least once daily to check for oil leakage, abnormal noises, or vibrations. In addition to a daily observation of the overall condition and operation of the reducer, it is recommended that a regular inspection routine be established to periodically check the following items:

1. General Cleanliness
2. Lubrication System
3. Protective Devices
4. Alignment

Alignment of reducer to connected drive motor must be maintained. Inaccuracies in alignment may cause unnecessary noise and wear resulting in reduced life.

INITIAL LUBRICATION

After the first two weeks of normal operation, or the first month of intermittent duty, the original lubricating oil should be drained from the unit. If possible, drain while oil is still warm and unsettled, immediately after unit has been in operation. The system should be flushed with an SAE 10 straight run-in mineral flushing oil, drained, and refilled with fresh oil.

NORMAL LUBRICATION

Oil should be changed at regular intervals. The time interval between oil changes is dependent upon the severity of operation; therefore, it must be determined by the user. The average is four oil changes per year, or after every 2500 hours of operation, whichever occurs first. However, special conditions, such as rapidly changing housing temperature -- causing sweating of walls, and sludge formation -- high ambient temperatures, or a moist or dirty atmosphere, may necessitate more frequent oil changes.

Occasionally drain a few quarts of oil through oil drain piping located at the bottom of gear case next to oil sight gauge. If excessive sludge is encountered, clean filter and gear case and replace with clean oil.

OIL FILTER

Cleaning filter cartridge is accomplished by one complete turn of the handle. This should be done at regular intervals. Periodically, when system is shut down, the filter should be drained, removing any sludge which might collect in the bottom. This can be done by removing drain plug in bottom of filter and vent plug in top of filter.

COUPLING

Lubricate the Falk Steelflex coupling at least once a year with one of the greases recommended in Falk's Service Manual. See Section V (Appendix) of this manual.

ACCESSORIES

Check pressure gauges and thermometer periodically for accuracy and smooth operation. Check relief valve for proper operation. See operating instructions for heat exchangers and pumps.

WARNING: Never use flame near Gear Case Openings!

DISASSEMBLY AND REASSEMBLY

GENERAL

When disassembling and assembling, use extreme care to prevent damage to gears, shafts and bearings. Repair and replacement of parts should be undertaken only by competent, trained personnel. When removing any part which is shimmed to establish its location, wire the shims to that part. As a further precaution, measure total shim thickness and record amount for each part. Thoroughly clean all parts. Protect all parts from rust, dirt and damage.

REMOVAL OF GEARS AND BEARINGS
(See Assembly Drawings)

Removal of Output Shaft Assembly:
(Figure 10)

1. Drain Pulper Tank.
2. Drain oil from unit.
3. Uncouple Motor.
4. Disconnect all piping leading to reducer and to pulping unit.
5. Unscrew reducer anchor bolts.
6. Pull out reducer and pulping unit through tank opening.
7. Dismantle pulping unit.
8. Remove screws at housing split.
9. Lift upper housing vertically.
10. Support upper housing and shaft. Free output shaft assembly from upper housing by removing screws on inner bolt circle of adjustment ring.
11. Lift upper housing.
    Output shaft bearings and gear may now be disassembled while free of unit.

Removal of Output Shaft Thrust Bearing:

1. Remove key.

2. Remove water flinger by loosening two set screws.

   NOTE: On some models, where the packing sleeve diameter is larger than inside diameter of water flinger, remove sleeve first. Heat sleeve to 450 degrees F to soften Loctite. Remove sleeve from shaft while hot. See pulper manual for "Sleeve Installation Info".

3. Remove clamp ring.

4. Pull out thrust bearing carrier.

5. Remove locknuts and lock-washer.

6. Press off thrust bearing. Apply pressure to shaft spacer or bearing cone (inner race).

Removal of Output Shaft Radial Bearings:

1. Remove lock wire.

2. Remove lock disk.

3. Press off radial bearing. Apply pressure to inner race.

Removal of Gear:

1. Remove screws.

   NOTE: Screws are secured in place with dowel pins.

2. Press off gear ring.

Removal of Input Shaft Parts:
(Figure 11)

1. Remove orifice fitting from radial bearing housing.
2. Remove screws on pinion bearing carrier.
3. Pull out pinion shaft and bearing assembly from reducer housing. Bearing and pinion may now be disassembled while free of unit.
4. Remove lock wire.
5. Remove lock disk.
6. Press off radial bearing. Apply pressure to inner race.
7. Slide off spacer.
8. Press off pinion.
9. Unscrew end cover and remove bearing carrier.
10. Press off thrust bearing. Apply pressure to inner race.

NOTE: Disassembly of pulping unit and gear case is not required for replacement of input shaft bearings. See instructions below.

Removal of Input Shaft Bearings Only:

1. Drain oil from unit.
2. Uncouple and remove motor.
3. Open round inspection cover and remove orifice fitting from the radial bearing housing (located inside the gear housing).

Proceed as indicated above, under "Removal of Input Shaft Parts", No. 2 and No. 10.

HYDRAULIC JACK SIZE REQUIRED FOR GEAR INSTALLATION OR REMOVAL

GEAR BOX SIZE	PINION	MAIN GEAR
250V	20 Ton	45 Ton
350V	40 Ton	55 Ton
600V	45 Ton	65 Ton
900V	65 Ton	100 Ton

NOTE:
1. The theoretical or calculated pressure required is approximately 50% of the listed values.
2. Always use lubricant on fits for pressing to help prevent seizing 9NEVER SEEZ or equivalent.)

REASSEMBLY PROCEDURE

1. Thoroughly clean gear housing and parts. For reassembly, follow disassembly procedure in reverse order.

2. Bearing cones may be heated in oil or by other approved methods to 250 degree F to ease assembly. Rotate bearings while clamping up tightly through cones (cups) to insure proper seating of the rollers, then lock.

3. Assembly spacer on output shaft for chamber to clear fillet on shaft.

4. Inspect gaskets and "O" rings; replace if necessary.

5. Determine required thickness of vellumoid gaskets, measure gap between bearing carrier and end cover. Use 10-25% thicker gasket and compress gasket to original spacing.

6. Line up oil hole in pinion radial bearing with orifice fitting hole in bearing housing. When assembling orifice fitting, make sure end of fitting is not bottoming in bearing cup.

7. Keep matched gears in their original sets; replace both members of a pair.

8. Set pinion to correct mounting distance by adding or removing shims under bearing carrier flange. The mounting distance is stamped on pinion. See Figure 2. Read the dimensions and gear set Serial Number before assembling the gear set. Beloit factory stamps the mounting dimensions on input shaft bearing carrier flange, See Figure 11. When installing a new gear set, read the mounting dimensions and gear set Serial Number and stamp then on bearing carrier flange. Remove old stampings.

9. Set gear for recommended backlash by adding or removing shims under adjustment ring. The recommended backlash is stamped on gear.

10. Paint teeth with a marking compound and check for correct tooth bearing pattern under light load. Re-adjust position of gears if necessary.

11. Following reassembly, repeat installation and start-up procedure as given in the appropriate sections.

COMMON CAUSES OF REDUCER MALFUNCTION

CONDITION	POSSIBLE CAUSE	PRACTICAL SOLUTION
Over heating	Oil level too high.	Drain oil to proper level.
	Oil level too low.	Open water valve.
	cooling water not circulating.	Open water valve.
	Improper lubricant.	Use recommended oil.
	Lubricant dirty.	Flush out and change oil.
	Water flinger rubbing against stationary cover.	Check running clearance of rotating seal to eliminate rubbing.

	Improper gear mounting. NOTE: Mounting distance and gear backlash must be checked after replacement of a thrust bearing. gears. Use	Set pinions to correct mounting distance and set gear for recommended backlash as stamped on shims for adjustment.
Vibration	Imbalance	Check balance of rotating parts. balance machine.
	Misalignment	Correct alignment.
	Induced vibration.	Isolate unit from effect of external vibration.
Noise	Loose or worn bearings	Replace bearings.
	Worn Coupling.	Replace.
	Misalignment.	Correct alignment.
	Insufficient lube.	Check lubrication system.
	Improper gear backlash.	See above under "Over Heating".
	Motor trouble.	Check motor.
Oil Leakage	Clogged oil return hole in bearing carrier	Remove pinion end cover and clean out drain hole in pinion bearing carrier.
	Loose plug or fitting.	Make tight connections.
	Damaged gaskets or O-rings.	Replace.

Water in Gear Case	Internal condensation.	Bleed off water accumulation and add necessary make-up oil.

NOTE: Badly contaminated oil needs a very thorough treatment. The following method for cleaning unshielded bearings, as suggested by ABEC (Annular Bearing Engineers' Committee) is recommended for cleaning of bearings as assembled in an installation.

1. For cleaning bearings without dismounting, hot, light oil at 180 degrees to 200 degrees F may be flushed through the housing while the shaft or spindle is slowly rotated. In cases of badly oxidized oil, hot, aqueous emulsions may be run into the housing, preferably while rotating the bearings until the bearing is satisfactorily cleaned. The solution must then be drained thoroughly, providing rotation if possible, and then bearings and hosing flushed with hot, light oil and again drained before adding new lubricant.

2. Oils used for cleaning:

   Light transformer oils, spindle oils or automotive flushing oil are suitable for cleaning bearings, but anything heavier than light motor oil (SAE 10) is not recommended.

   Use adequate amount of flushing oil to operate the circulating oil system.

Beloit Pulping
Nashua, New Hampshire
Phone (800) 261-9351
Fax (603) 595-0035

Date : 2/2/2000

Spare Parts List

Part Number	Description	Start Up	1st Year	Long Term
Equipment: 54-139	**Integral R.A. Gear Reducer 350V for Pulper Service Serial No. 99T1318**			
54-809029-1	Gasket-Vellumoid Input End Cover	0	0	1
011202	Thrust Bearing-Timken (Input) 2 Cones #HM821547 Matched 1 Cup #HM821511D Set 1 Spacer #HM821547XA	0	1	0
011204	Radial Bearing-Timken (Input) 2 Cones #33287 Matched 1 Cup #33462DC Set 1 Spacer #X3S-33287	0	1	0
97-915001-22	O-Ring (Buna-N)	0	0	1
97-915001-19	O-Ring	0	1	0
97-915001-23	O-Ring (Buna-N)	0	1	0
54-809031-1	Gasket-Vellumoid Output Clamp Ring	0	0	1
97-219002-28	Lockwasher #W-32	0	2	0
97-220002-28	Locknut #AN-32	0	2	0

Beloit Pulping
Nashua, New Hampshire
Phone (800) 261-9351
Fax (603) 595-0035

Date : 2/2/2000

Spare Parts List

Part Number	Description	Start Up	1st Year	Long Term
Equipment: 54-139	**Integral R.A. Gear Reducer 350V for Pulper Service Serial No. 99T1318**			
011263	Thrust Bearing-Timken (Matched Set) 2 Cones #H936349, 2 Cups #H936310 1 Spacer #H936310EA (End Play = 0.0080")	0	1	0
011206	Radial Bearing-Timken (Output) 2 Cones #64433 Matched 1 Cup #64700DC Set 1 Spacer #X1S-64433	0	1	0
54-823013-1	Shim Set - S/S Adjustment-Gear Clearance	0	1	0
54-809032-1	Gasket-Vellumoid Output End Cap	0	0	1

Remarks

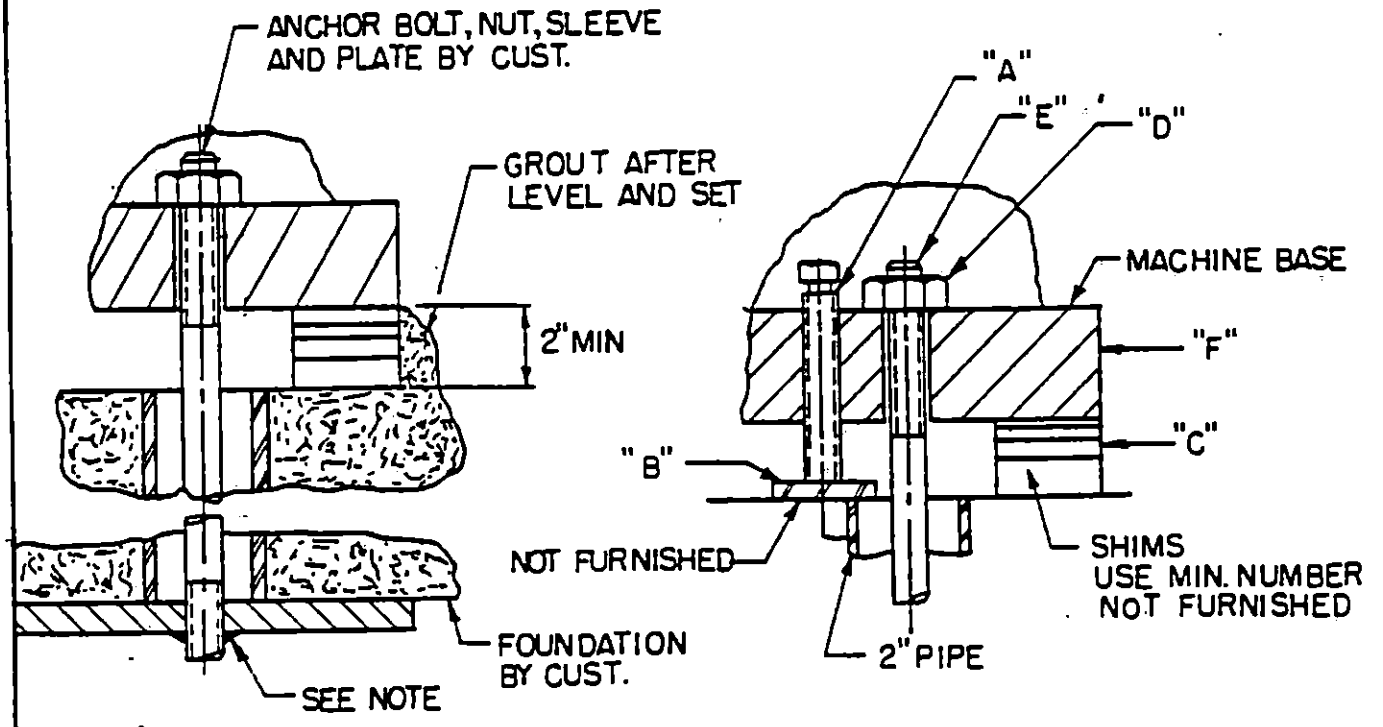
1. Refer to machine instruction manual for more complete information.

2. Always give machine serial number when placing orders.

3. Prices are F.O.B. points of shipment in **U.S. Funds** and subject to 30 days acceptance.

4. Stock-status and lead times vary by item. Bearings, sleeves, etc. are normally carried in Beloit Pulping stock. Larger items may be manufactured to order with up to four months lead-time.

5. In deciding on quantities to purchase, consideration should be given to number of units in service, specified delivery times as quoted, for items required, and downtime protection desired.



Accurate leveling and setting up of machine must be done with extreme care to obtain proper functioning of parts. Adherence to following steps will eliminate misalignment, vibration and poor performance often associated with improper leveling.

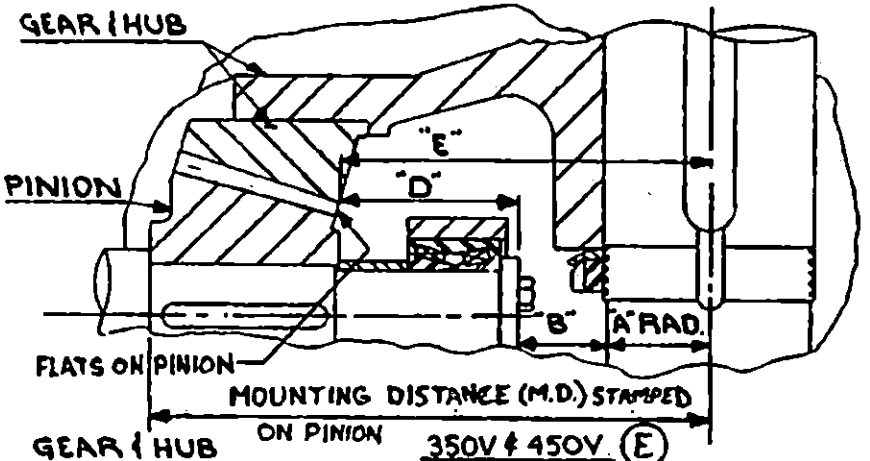
1. Prepare machine site per instructions on installation drawing. Base must be set on a firm concrete foundation.
2. Place plate "B" under leveling screw "A" (if applicable). Level machined areas of base lengthwise and across width by using a spirit level and properly adjusting leveling screws or other leveling device used.
3. Build up shims "C" to tightly fill space under base "F" at all anchor bolt locations, using least number of shims possible.
4. Back off leveling screw "A" or leveling device used and tighten nut "D" against shims. (The leveling device used should never be used to support weight of machine during grouting.)
5. Recheck base for level in all directions and repeat steps 2, 3 and 4 if necessary.
6. Tack weld nut "D" to anchor bolt "E".
7. Grout under base "F" carefully, avoid overlapping of sides and allow grout to harden.

NOTE:

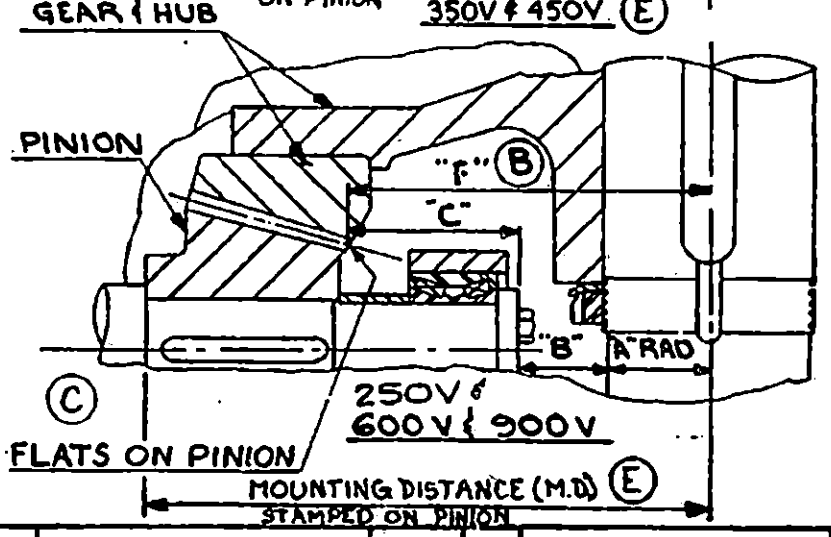
If anchor bolts project through floor, tack weld plate to bottom of pipe before starting to level so bolts will not turn.

INSTALLATION OF ANCHOR BOLTS

FIGURE - 1



"E" OR "F" ARE FRONT MOUNTING DIMENSIONS (F.M.D.) STAMPED ON PINION. (D)



NOTES
1. MEASURE DIMENSIONS "C" OR "D" AT SUB ASSY
2. ADD "C" OR "D" TO "A" AND SUBTRACT FROM MOUNTING DIMENSION STAMPED ON GEAR TO FIND "B"
3. CHECK "B" DIMENSION USING ADJUSTABLE PARALLEL JN54-46 WITH SHOE

REV	ALTERATIONS	DATE	BY
E	ADD MOUNTING DISTANCE (M.D.)	4-1-91	CJC
D	PINION. WAS GEAR	7-5-89	CJC
C	ADD 250V & FLATS ON PIN	8-18-67	NMH
B	"C" WAS "F" "F" WAS "C"	7-11-66	SL
A	REVISED & REDRAWN	5-12-66	SL

SUPERSEDES — SUPERSEDED BY

MACHINING TOLERANCES
1. or 1.000 = ±.04
1.0 = 1.000 = ±.02
1.00 = 1.000 = ±.01
1.000 = .000 = ±.005
FOR CUTTER, FABRICATION AND CASTING TOLERANCES AND OTHER SHOP PRACTICES, SEE FACTORY MANUAL SECTION 2

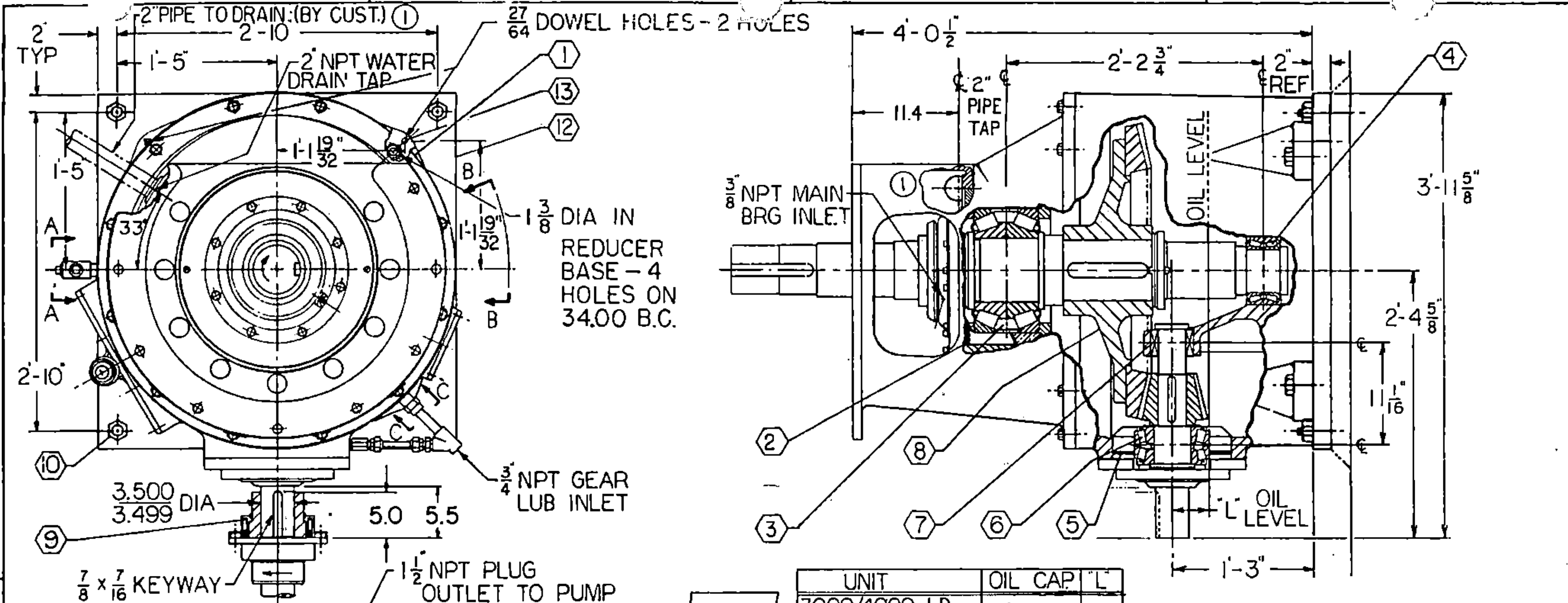
BELOIT

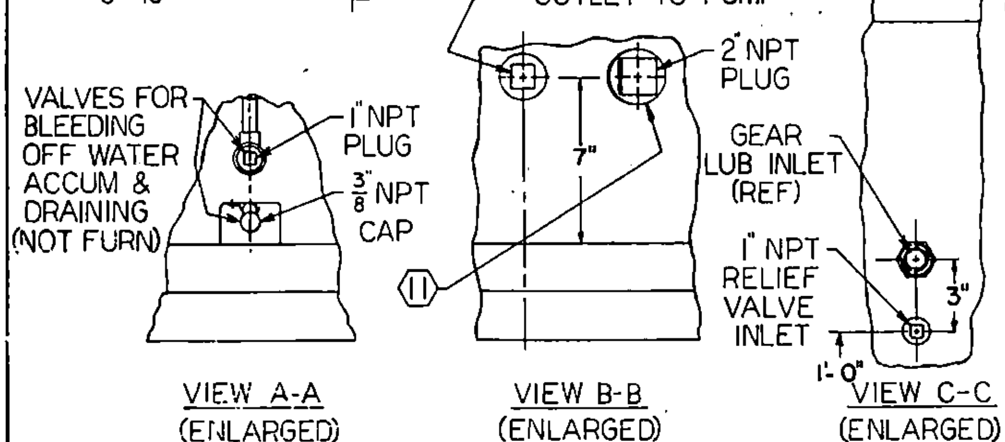
PT NO	MATERIAL	SIZE OR PATT NO.	WEIGHT	REQ'D	WANTED
FIRST USED ON					
DATE 5-12-66					

METHOD OF SETTING PINION GEAR
JONES GEAR REDUCER

DRAWN	APP'VD	ENG	SCALE	SH	
SL	GH	I.W.F.	—	1	A54-199009

FIGURE 2





UNIT	OIL CAP.	"L"
3000/4000 LB SHARK 1800 RPM	27 GAL	3.7
3000/4000 LB SHARK 1200 RPM	22 GAL	5.0
1500/2000 LB BARR 1800 RPM	24 GAL	4.5
1500/2000 LB BARR 1200 RPM	18 GAL	6.0

(A)

ITEM	DESCRIPTION
13	DOWELS (BY CUST)
12	SOLE PLATE (B54-101037-1)
11	IMMERSION HEATER (OPTIONAL)
10	4-1¼ DIA ANCHOR BOLTS (NOT FURN)
9	COUPLING (REF)
8	GEAR SET (MATCHED)
7	RADIAL BEARING (PINION SHAFT)
6	THRUST BEARING (PINION SHAFT)
5	O-RING SEAL (PINION SHAFT)
4	RADIAL BEARING (MAIN SHAFT)
3	THRUST BEARING (MAIN SHAFT)
2	O-RING SEAL (MAIN SHAFT)
1	GEAR REDUCER (SHOP ASS'Y)

A	REMOVED OIL SPECIFICATION	1-19-84	SAM
-2	ITEM-12 WAS B54-101037-1	7-8-81	JSB
-1	Picture change to clarify 2" pipe drain	4-10-79	WKR
	ALTERATIONS	DATE	BY

SUPERSEDES — SUPERSEDED BY

MACHINING TOLERANCES

1.	or	1.▽000 =	±.04
1.0	"	1.0▽00 =	±.02
1.00	"	1.00▽0 =	±.01
1.000	"	1.000 =	±.005

FOR CUTOFF, FABRICATION AND CASTING TOLERANCES AND STD SHOP PRACTICES, SEE FACTORY MANUAL SECTION 2.

BELOIT

PT NO	MATERIAL	SIZE OR PATT NO.	WEIGHT	REQ/	WANTED

FIRST USED ON

GEAR REDUCER 350 V
(VERT R.A. DRIVE)

DATE 15 DEC 1964

DRAWN	APP'V'D	ENG	SCALE	SH	
RAB	G3H	ℓ.O. NFH	NONE	1 OF 1	C54-114002

FIGURE 3

Barracuda, Shark — Series 3000 Batch & Cont.	All sizes of these pulpers allow reducer removal through tank
Shark — Series 4000 CWP	

However, most vertical batch Series 4000 Shark Pulpers (Models 41XX-S) do not allow reducer removal through the tank:

Pulping Unit Size (in.)	Reducers which will pass through the tank	
	c/w Input Shaft	w/o Input Shaft*
22"	None	None
28"	None	None
35"	None	None
44"	None	250V
55"	350V	600V

* See Reducer Instruction Manual for Input Shaft Removal Procedure

REDUCER REMOVAL
VERTICAL PULPERS

FIGURE-4

LUBRICATION REQUIREMENTS

(G.P.M.)

	Gear Reducer Size				Bearing Units
	250 V	350 V	600 V	900 V	A & B
Main Thrust Brg.	1.0	1.0	1.0	1.4	0.31
Main Radial Brg.	Bath	Bath	Bath	Bath	—
Pinion Thrust Brg.	0.5	0.6	0.6	1.0	—
Pinion Radial Brg.	0.5	0.5	0.5	0.6	—
Gear Spray	2.5	5.0	5.0	9.0	—
TOTAL	4.5	7.1	7.1	12.0	0.31
TOTAL Lube System (G.P.M.)	5	10	10	15	0.31
Reference Assembly Drawing	209011 209005	209007	209007	209018	209013

FIGURE-5

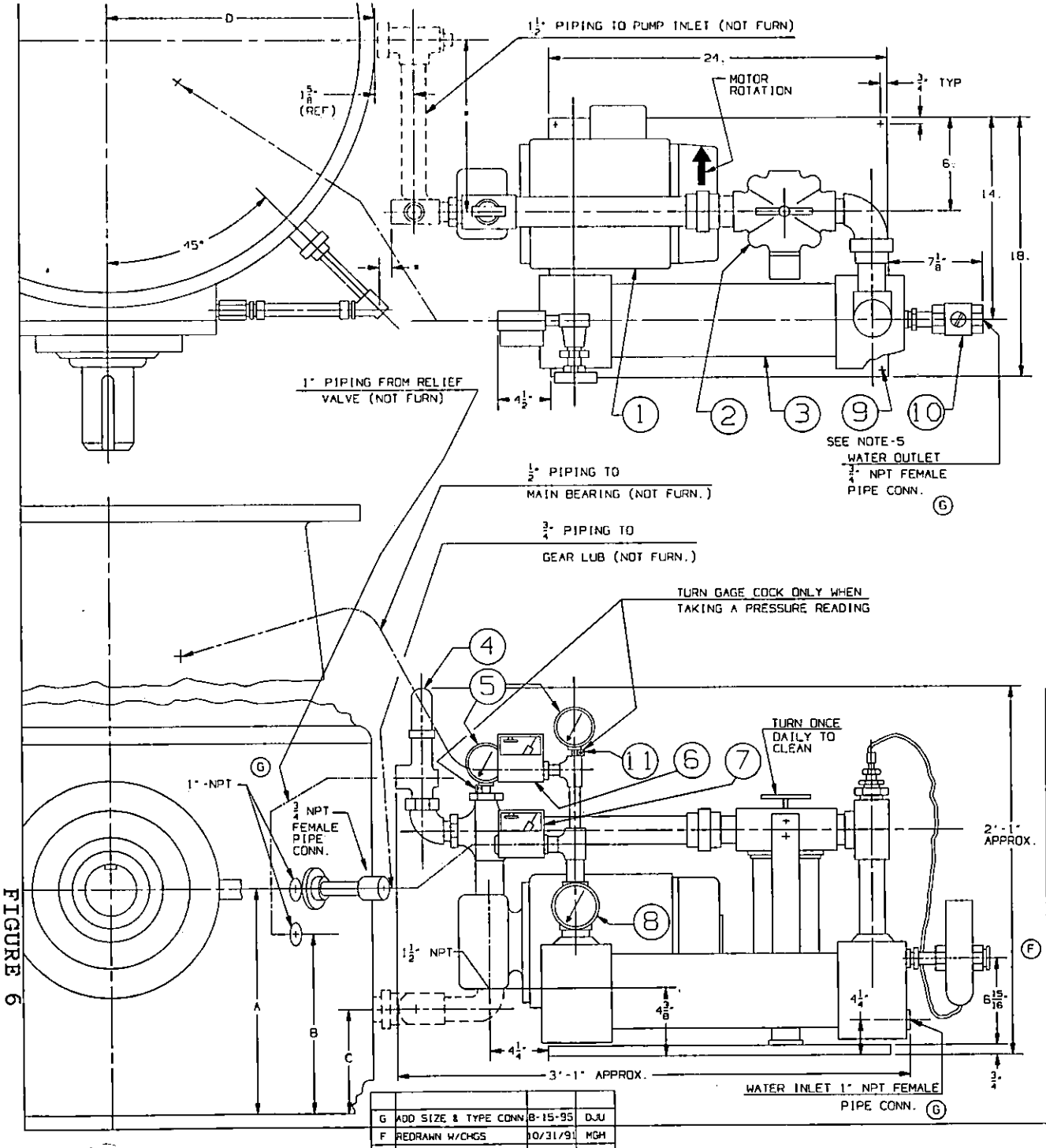


FIGURE 6

* = BY CUST TO SUIT

NOTES:

1 - LOCATE OILING SYSTEM AS CLOSE TO GEAR REDUCER AS POSSIBLE PRESUMABLY AS SHOWN

2 - EST. MAX. COOLING WATER 10 GPM - 70°F OR 20 GPM @ 95°F

3 - INTERLOCK FLOWMETER MICRO SW. WITH MAIN MOTOR

4 - 125°F TO 135°F DESIRED TEMP. OF OIL DURING OPERATION, NOT TO EXCEED 160°F

5 - 1-½" CLEARANCE ABOVE PLATE FOR ANCHOR BOLTS

6 - WEIGHT - 316 LBS

REDUCER	A	B	C	D	
350V 450V	1'-3"	1'-0"	0'-7"	1'-7"	
600V	1'-5"	1'-1 5/16"	0'-8"	1'-11¾"	

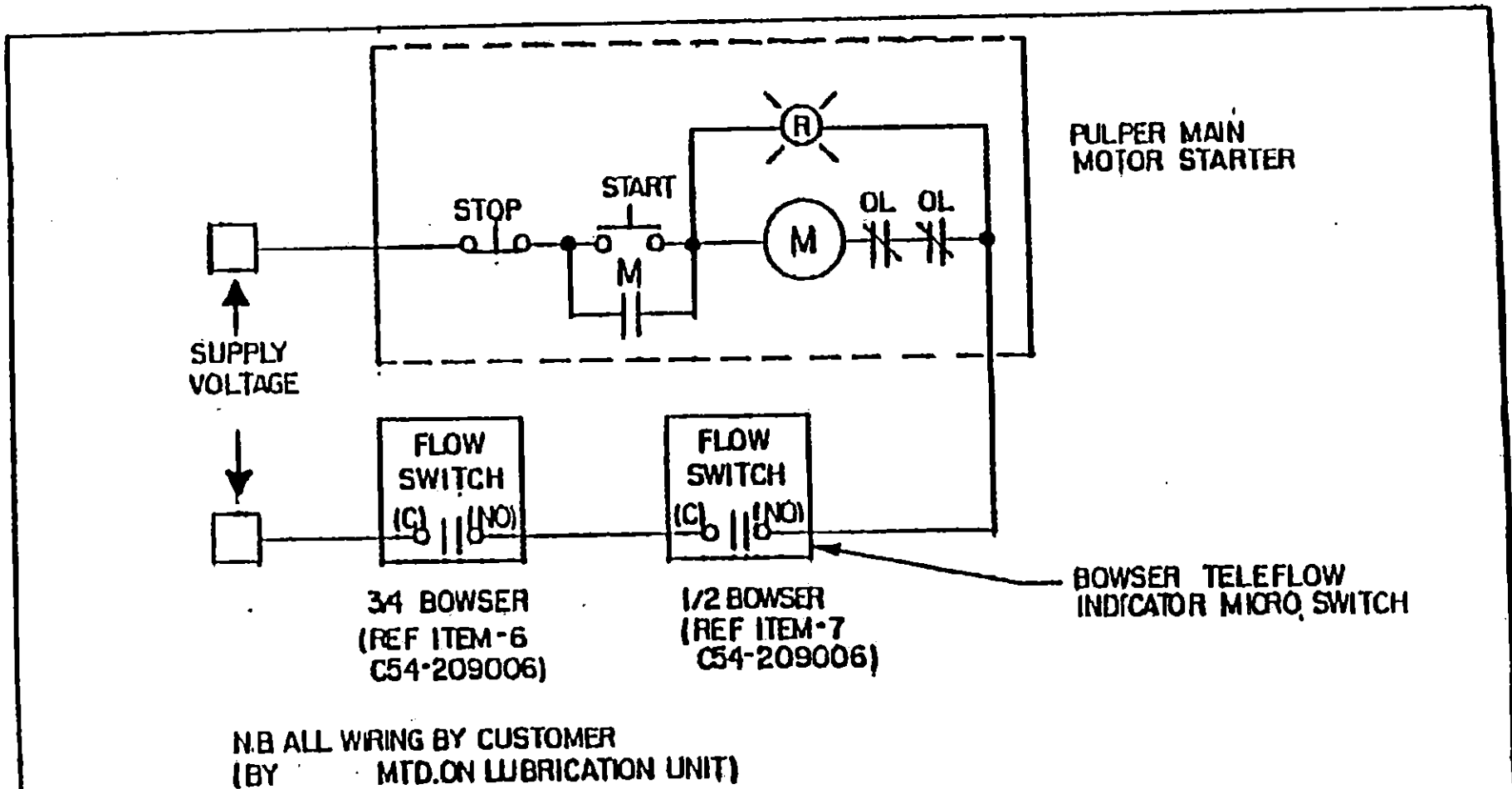
ITEM	DESCRIPTION
11	2-GAGE COCKS
10	TEMP CONTROLLED WATER REG. VALVE.
9	4-1/2" DIA ANCHOR BOLTS (NOT FURN)
8	THERMOMETER
7	FLOW METER (3/4 NPT) W/MICRO SW.
6	FLOW METER (1/2 NPT) W/MICRO SW.
5	2-PRESSURE GUAGES.
4	RELIEF VALVE
3	HEAT EXCHANGER
2	OIL FILTER
	SHEET OR LIST OF ASSEMBLIES.
	CYCLE, AND SPEED SEE CUSTOMER CERT..
1	PUMP WITH 2HP MOTOR FOR MOTOR VOLTAGE.

LUBRICATION SYSTEM FOR GEAR REDUCERS

DATE	DRAWN	APP'V'D	ENG	SCALE	SH
6-24-69	AS	GH	WFW	NONE	1OF1

BELOIT C54-209008

REV	ALTERATIONS	DATE	BY
G	ADD SIZE & TYPE CONN.	8-15-95	DJU
F	REDRAWN W/CHGS	10/31/91	MGM



REV	ALTERATIONS	DATE	BY
	STARTER (BY CUST)	3-22-70	R.C.G
B	WAS LUB OIL PUMP MTR		
A	REVISED & REDRAWN	3 27 69	[illegible]

SUPERSEDES SUPERSEDED BY

MACHINING TOLERANCES

BELOIT

PT NO	MATERIAL	SIZE OR PATT NO	WEIGHT	REQ'D	WANTED
FIRST USED ON					

WIRING DIAGRAM
OIL CIRCULATION CUTOUT
SHARK-BARRACUDA

DATE 1-9-65

DRAWN	APPVD	ENG	SCALE	SIZE	DWG NO
JMC	GN	JKS	—		A42-432647

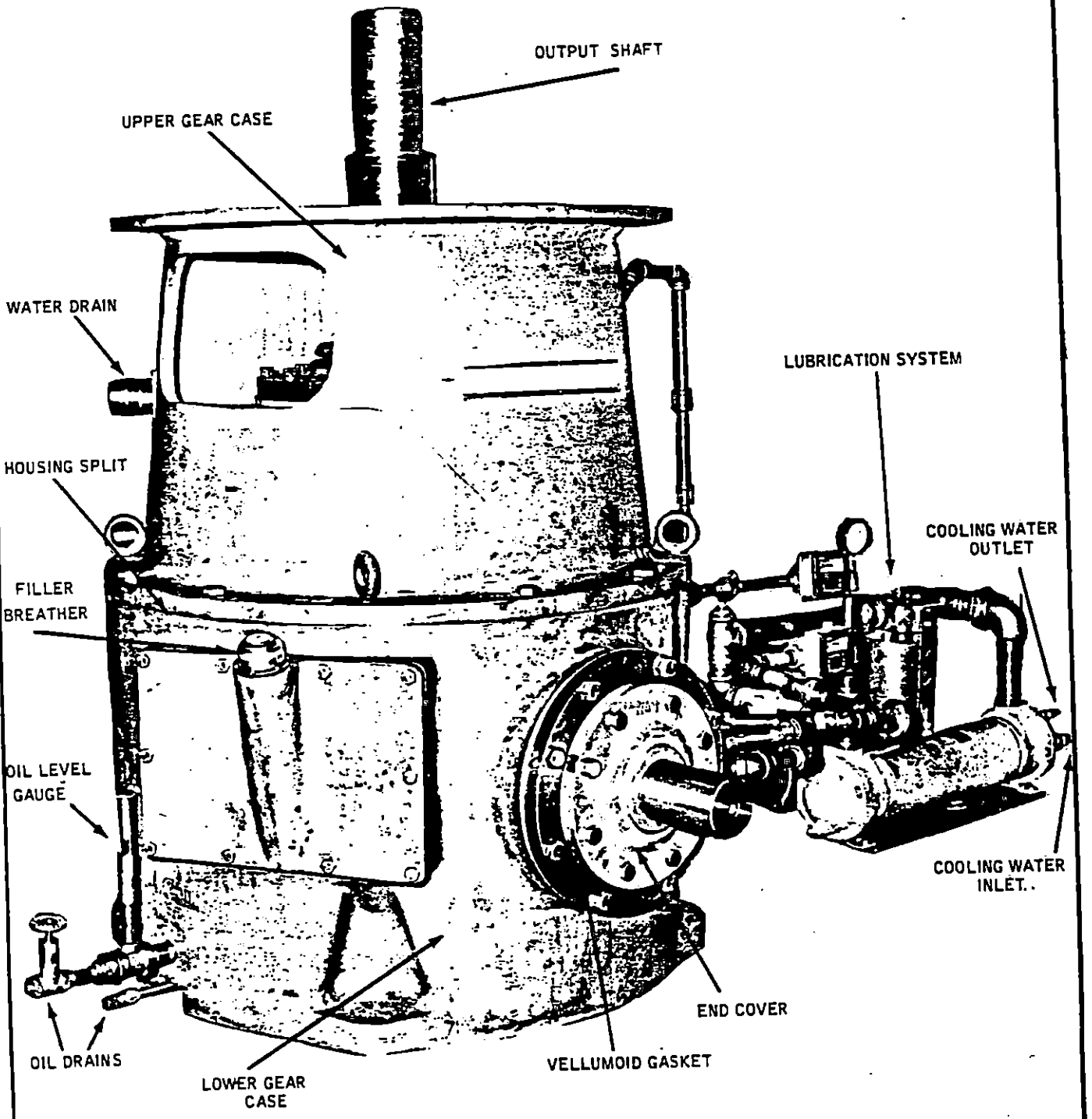
FIGURE 7

COOLING WATER FLOW RATE GPM
6
7
8
9
10
12
14
16
18
20
60
70
80
90
100 MAX.
COOLING WATER TEMP F°

FIGURE - 8

BELOIT GEAR REDUCERS
FOR BARRACUDA-SHARK PULPERS

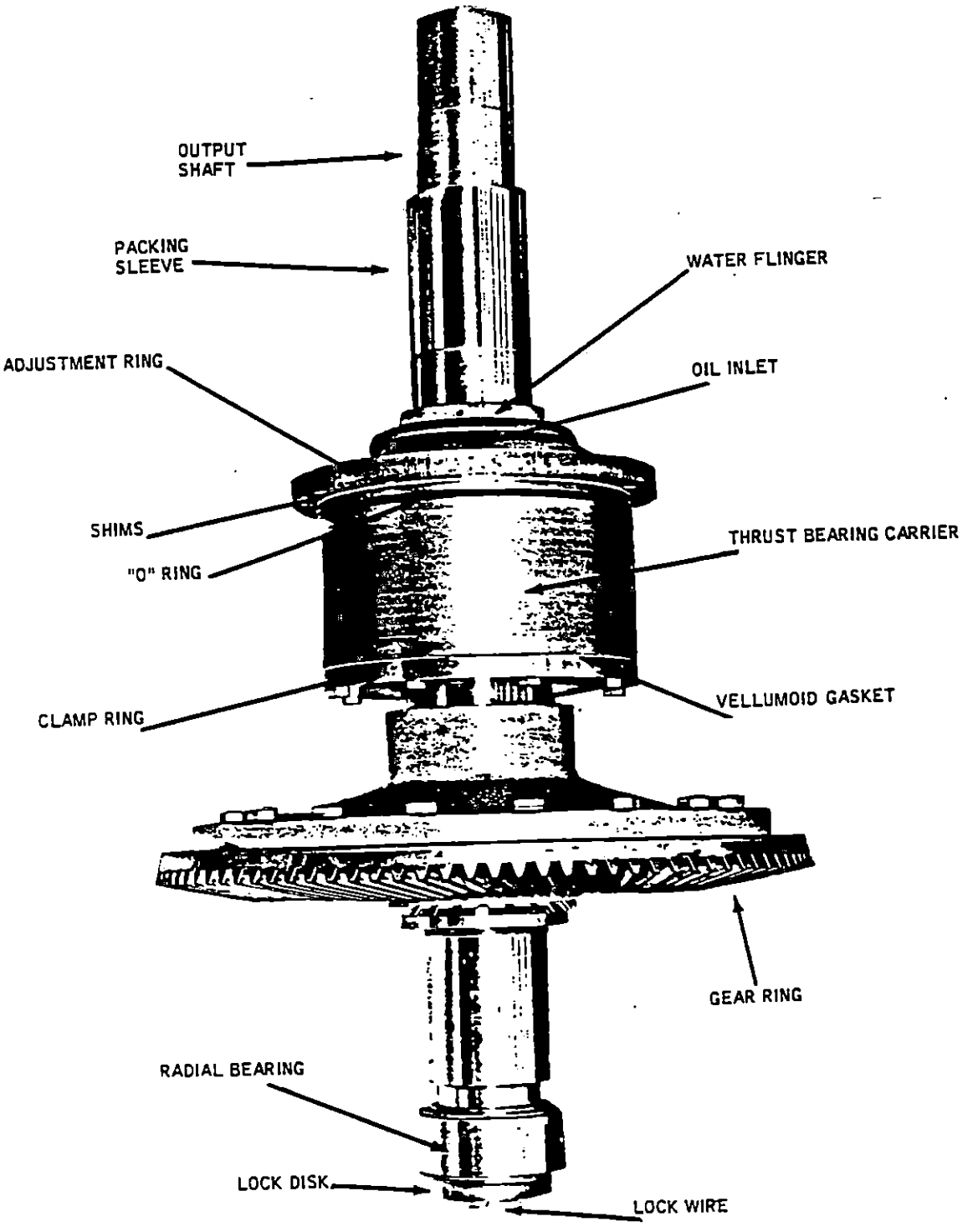
PHOTOGRAPHS



GEAR REDUCER ASSEMBLY
(LEFT SIDE)

FIGURE - 9

BELOIT GEAR REDUCERS
FOR BARRACUDA-SHARK PULPERS
PHOTOGRAPHS

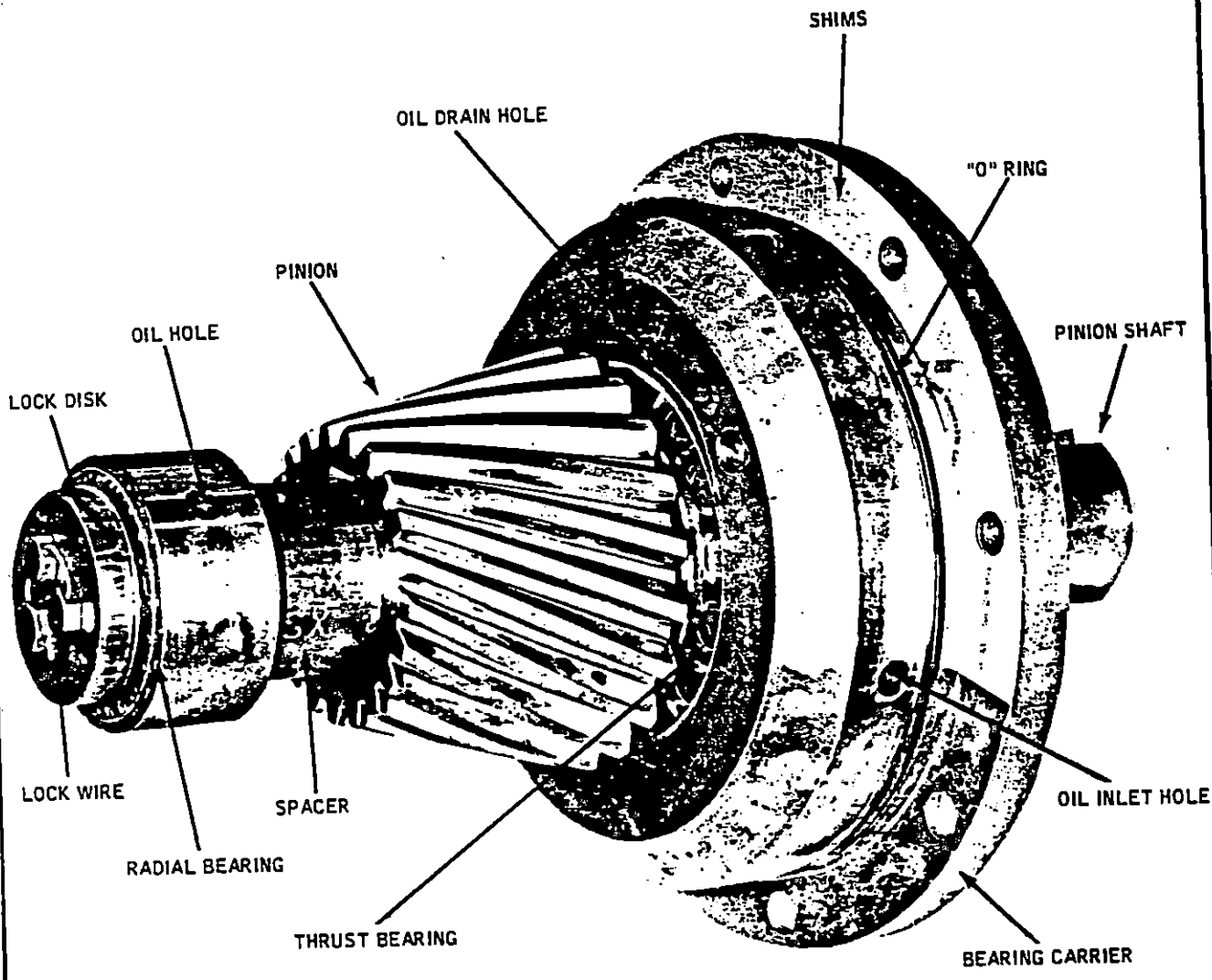


OUTPUT SHAFT ASSEMBLY

FIGURE-10

BELOIT GEAR REDUCERS
FOR BARRACUDA-SHARK PULPERS

PHOTOGRAPHS

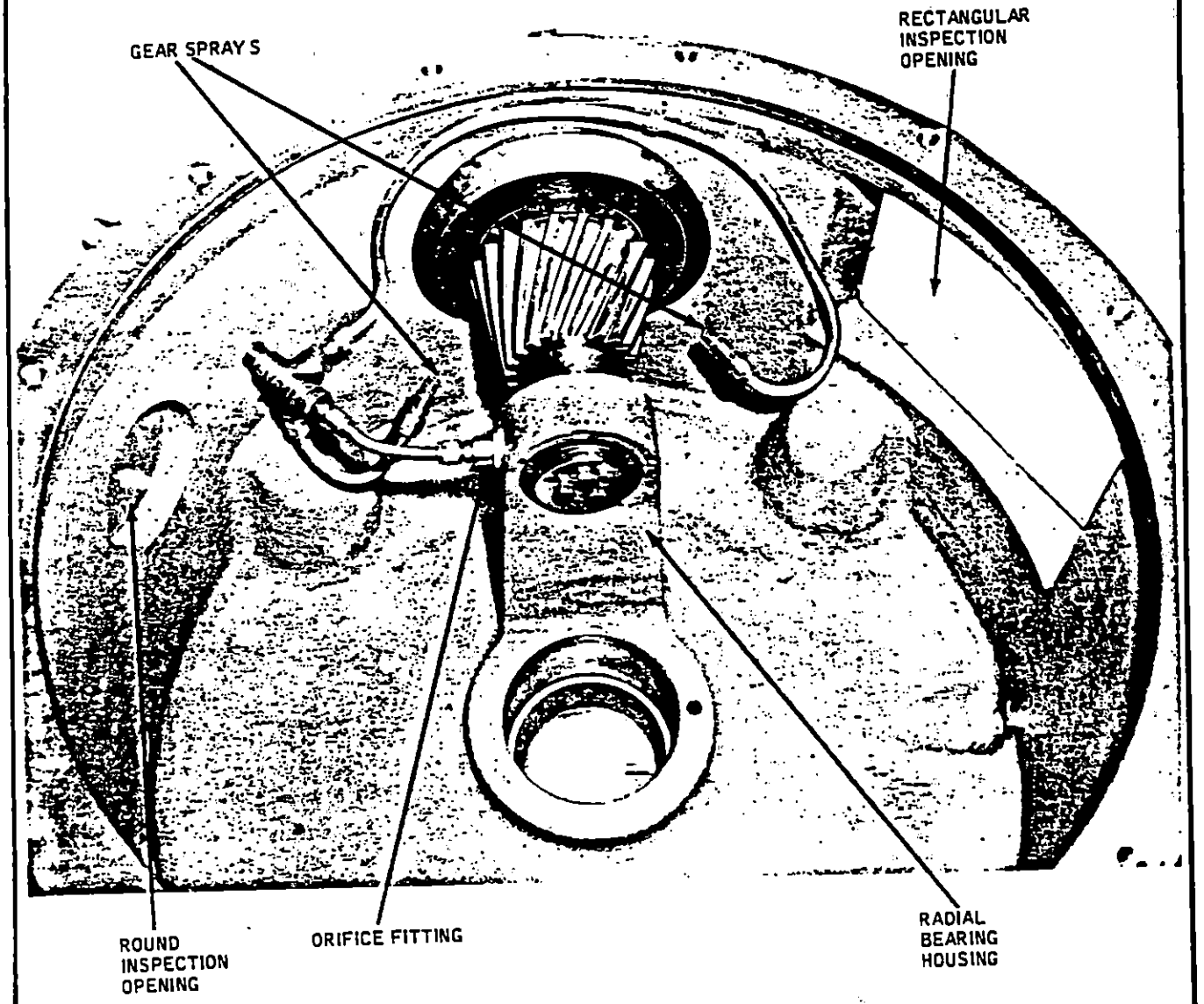


INPUT SHAFT ASSEMBLY

FIGURE-11

BELOIT GEAR REDUCERS
FOR BARRACUDA-SHARK PULPERS

PHOTOGRAPHS



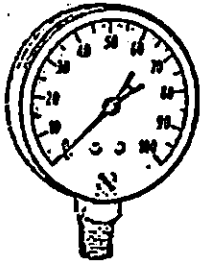
LOWER GEAR CASE

FIGURE - 12

Type 1000 Ashcroft Pressure Gauges

For Use With Air, Water, Steam, Oil or Brine

For use with any liquid or gas not corrosive to brass. Has brass precision movement and drawn steel case with black finish and slip ring. Connection is ¼-inch male N.P.T. from bottom or back of case. The 3½-inch size is made with ¼-inch bottom connection only. Can be supplied with 2 and 2½-inch size tee handle cock at extra charge.



Standard Graduations

Two-inch gauge made in ranges 15 to 300 lb. incl.

SIZE	PT. No.	Total Grad. Lb.	Fig. Interv. Lb.	Intermediate Grad. Lb.	
2	1	0-15	3	½	(1)
	2	0-30	5	1	
	3	0-60	10	1	
	4	0-100	10	1	
	5	0-160	20	2	
2½	6	0-15	3	½	(1)
	7	0-30	5	1	
	8	0-60	10	1	
	9	0-100	10	1	
	10	0-160	20	2	
3	11	0-15	3	½	(1)
	12	0-30	5	1	
	13	0-60	10	1	
	14	0-100	10	1	
	15	0-160	20	2	

PT NO.	MATERIAL	SIZE OR PATT NO.	WEIGHT	REQ'D	WANTED

FIRST USED ON

USED ON

ALL THREADS UNC STANDARD SHOP PRACTICES & TOLERANCES PER SECTION 2 OF THE FACTORY MANUAL UNLESS OTHERWISE SPECIFIED.

PRESSURE GAUGE

SCALE — IN. = 1 FT. DATE 12-10-62

BELOIT

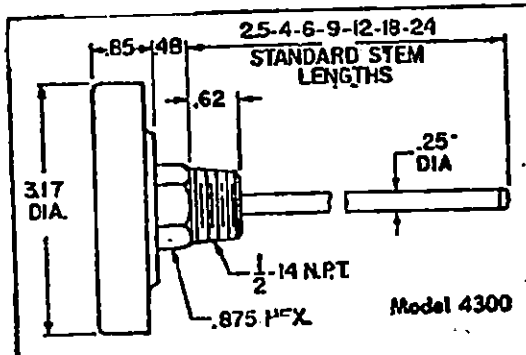
DRAWN	CHECKED	M ✗ T	COPY	ENG
EJS	EJS			

SH	SH		REV
1	OF 1	A97-924001	—

REV	ALTERATIONS	DATE	BY
1	GEN CHANGES	2-2-65	JMK

SUPERSEDES SUPERSEDED BY

FIGURE 13



PT NO	STEM LENGTH	TEMP RANGE
1	2½	0°-200°
2	4	
3	6	20°-240°
4	9	
5	12	
6	18	
7	24	

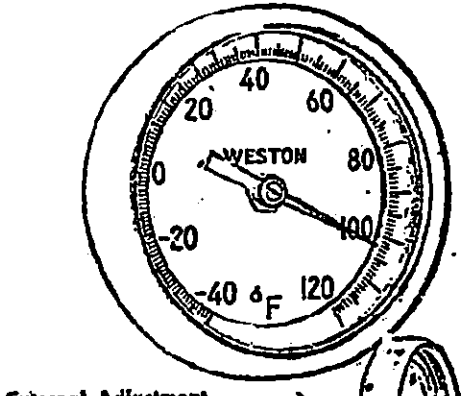
HEAD: Model 4300, 3" diameter with stainless steel cases and bezels. Heavy glass windows provide high resistance to breakage. Removable covers simplify replacement of glass in the field. Equipped with quick-lock bezels and special gasket material which protect against breathing and leakage under outdoor environmental conditions and low temperature service without fogging or freeze-up. Even with external changes in temperature "no breathing" action takes place, thus providing the maximum protection for the internal parts of the instruments.

SCALE and POINTER: In-line scale and pointer provide accurate readings at any eye level. Metal scale plate, with permanent black figures and markings. Pointers are damped against excessive movement in the presence of vibration.

Models 4300 scale lengths are 6".

STEM: 18-8 Type 304 Stainless Steel, ¼" diameter. Standard lengths are 2½", 4", 6", 9", 12", 18" and 24". (Can also be supplied with stem lengths from 2½" to 12" in ½" increments and from 12" to 36" in 1" increments. From 36" to 72" in 6" increments

All stainless steel welds are used at both plug and case ends of the stem, thus providing high resistance to corrosion.



Model 4300
Back-Connected

PT NO.	MATERIAL	SIZE OR PATT NO.	WEIGHT	REQ/	WANTED

FIRST USED ON

USED ON

ALL THREADS UNC STANDARD SHOP PRACTICES & TOLERANCES PER SECTION 2 OF THE FACTORY MANUAL UNLESS OTHERWISE SPECIFIED.

3" STANDARD INDUSTRIAL THERMOMETERS

SCALE — IN. = 1 FT. DATE 12-14-62

BELOIT

DRAWN	CHECKED	M & T	COPT	ENG
EJS	EJS			

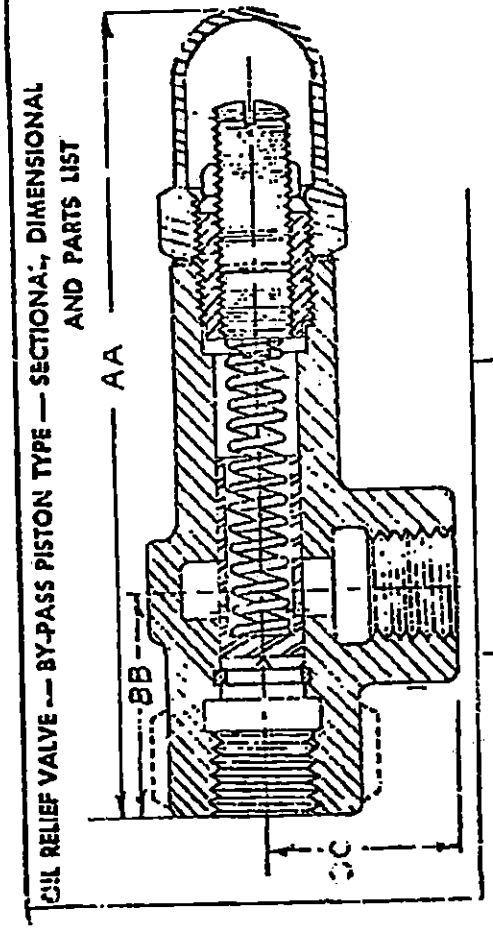
SH 1 OF SH 1 A97-924002 REV —

REV	ALTERATIONS	DATE	BY
A	ADD TEMP RANGE	5-11-66	RJR

SUPERSEDES SUPERSEDED BY

FIGURE 14

OIL RELIEF VALVE — BY-PASS PISTON TYPE — SECTIONAL, DIMENSIONAL AND PARTS LIST



PT. NO	Pipe Size	VALVE SYM. NO. C.I.	SPRING PRESSURE A Low	A High	U Low	U High	W Low	W High	X Low	X High	Y Low	Y High	Z Low	Z High	DIMENSIONS AA	BB	CC
1	¼"	VJ-1	2	12	7	20	15	100	40	140	90	350	100	500	5 11/32"	1 11/32"	1 3/32"
2	3/8"	VJ-2	2	12	7	20	15	100	40	140	90	350	100	500	5 11/32"	1 11/32"	1 3/32"
3	½"	VJ-3	5	18	8	30	20	100	60	170	60	325	150	500	6 1/16"	1 11/16"	1 7/16"
4	¾"	VJ-4			5	25	25	70	40	180	90	375	250	500	6 1/16"	1 11/16"	1 7/16"
5	1"	VJ-5	2	14	10	30	30	100	55	180	70	350	150	500	8 5/32"	2 1/32"	2 1/16"
6	1¼"	VJ-6	5	15	10	30	15	60	30	140	125	360	150	500	9 11/32"	2 9/16"	2 17/32"
7	1½"	VJ-7	5	25	10	30	20	50	70	170	60	275	250	400	11 13/32"	2 11/16"	2 23/32"
8	2"	VJ-8	2	15	10	40	20	100	25	180	100	400	250	600	13 3/32"	3"	2 15/32"

DATA SHEET No. 315
Sept. 25, 1951
Supersedes Data Nos. 302, 312, 301, 303

NOTE: For O-Ring Seal, add the suffix "R" to Valve Sym. No., Cap Part No., and Gasket Part No.

(A) NOTE: THE FOLLOWING RELIEF VALVES TO BE FACTORY SET AS FOLLOWS:

PT Nº.	SYM Nº.	SETTING
-5	VJ-5	75 P.S.I. @ 70°F OIL TEMP
-6	VJ-6	85 P.S.I. @ 70°F OIL TEMP

THE FULFLO SPECIALTIES CO. INC.

FOR REF SEE A97-902013 B/P

REV	ALTERATIONS	DATE	BY
A	ADD NOTE FOR RELIEF P.S.I	5-18-90	CJC

SUPERSEDES — SUPERSEDED BY

PT NO.	MATERIAL	SIZE OR PATT NO.	WEIGHT	REQ.	WANTED

NEXT ASSEMBLY

USED ON

ALL THREADS UNC STANDARD SHOP PRACTICES & TOLERANCES PER SECTION 2 OF THE FACTORY MANUAL UNLESS OTHERWISE SPECIFIED. 2-5-63

RELIEF VALVE
CAST IRON

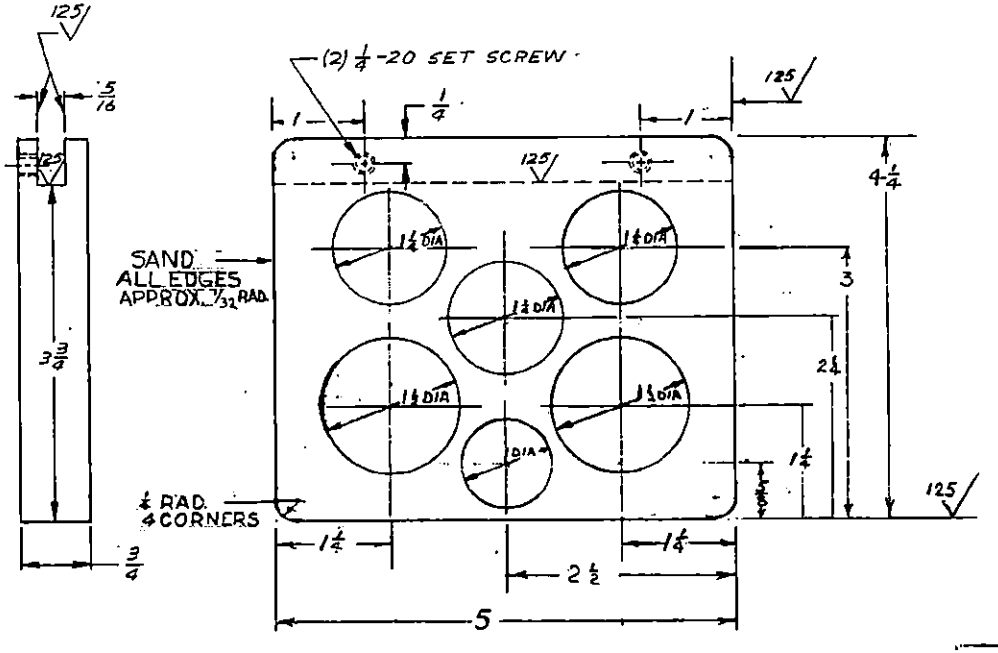
SCALE — IN. = 1 FT. | DATE 2-4-63

BELOIT

DRAWN	CHECKED	M & T	APPROVALS
LAW	BK		ALW

SH 1 OF SH 1 | A97-902011 | REV A

FIGURE 15



EXSTENSION SHOE – (1) REQ'D – STEEL

STAMP:
TOOL NAME & DWG. No. CT-3904
PART DWG. No. 056-114005
JIG. No. JN54-46

USE WITH STARRET ADJ. PARALLEL CAT. NO 154F

PT NO	Pt No	Mat'l	SIZE OR PATT NO.	REQ/QTY	WANTED
3	161008	STL	Soc Hd Set Scr .25-20 n. 25 Lg	2	
2	P.O.#	—	Starrett Adj. Parallel #154F	1	
1	#386229	HRS	Flat ÷ .75" x 4.5" x 5.25" Lg	1	

FIRST USED ON

DATE FEB 25 '68

DRAWN MM | APP'V'D | ENG | SCALE 1:1 | SH 1 OF 1

EXTENSION SHOE
VERT. R.A. GEAR REDUCER

CT-3904

ADDE ENGINEERING INC. ANS NO. 384

SUPERSEDES	ALTERATIONS	DATE	BY
A	ADD'S LIST	4-4-83	BM

SUPERSEDED BY

MACHINING TOLERANCES
1. or 1.000 = ±.04
1.0 " 1.00 = ±.02
1.00 " 1.00 = ±.01
1.000 " 1.000 = ±.005
FOR CUTOFF, FABRICATION AND CASTING TOLERANCES AND STD SHOP PRACTICES, SEE FACTORY MANUAL SECTION 2.

BELOIT

FIGURE 16

SECTION V

APPENDIX

How To Use This Manual

This manual provides detailed instructions on maintenance, lubrication, installation, and parts identification. Use the table of contents below to locate required information.

Table of Contents

Introduction . . . . . Page 1
Lube Fittings. . . . . Page 1
Limited End Float . . . . . Page 1
Lubrication . . . . . Pages 1-2
Installation & Alignment Instructions . . . . . Pages 2-4
Annual Maintenance, Relube & Disassembly . . . . . Page 4
Installation & Alignment Data . . . . . Page 5
Parts Identification & Parts Interchangeability . . . . . Page 6

CAREFULLY FOLLOW THE INSTRUCTIONS IN THIS MANUAL FOR OPTIMUM PERFORMANCE AND TROUBLE FREE SERVICE.

INTRODUCTION

This manual applies to Sizes 1020T thru 1140T and 20T thru 140T10 Falk Steelflex Tapered Grid Couplings. Unless otherwise stated, information for Sizes 1020T thru 1140T applies to Sizes 20T thru 140T respectively, e.g. 1020T = 20T, 1100T = 100T, etc. These couplings are designed to operate in either the horizontal or vertical position without modification. Beginning in 1994, these couplings are being supplied with one set of inch series fasteners and one set of metric fasteners. Use either set of fasteners, depending on your preference. Refer to Page 6 for part interchangeability.

The performance and life of the couplings depend largely upon how you install and service them.

CAUTION: Consult applicable local and national safety codes for proper guarding of rotating members. Observe all safety rules when installing or servicing couplings.

WARNING: Lockout starting switch of prime mover and remove all external loads from drive before installing or servicing couplings.

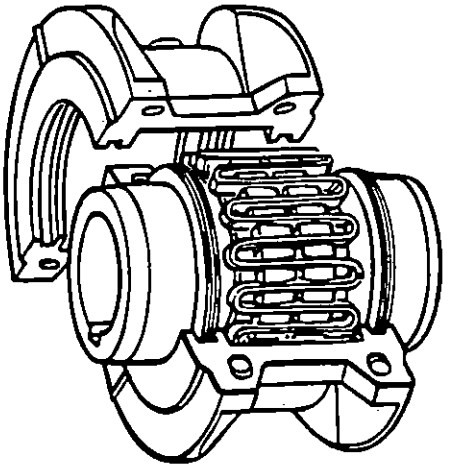
LUBE FITTINGS

Cover halves have $^1/_8$ NPT lube holes. Use a standard grease gun and lube fitting as instructed on Page 4.

LIMITED END FLOAT

When electric motors, generators, engines, compressors and other machines are fitted with sleeve or straight roller bearings, limited axial end float kits are recommended for protecting the bearings. Falk Steelflex couplings are easily modified to limit end float; refer to Manual 428-820 for instructions.

TYPE T10 STEELFLEX COUPLING



LUBRICATION

Adequate lubrication is essential for satisfactory operation. Page 2 provides a list of typical lubricants and specifications for general purpose and long term greases. Because of its superior lubricating characteristics and low centrifuge properties, Falk Long Term Grease (LTG) is highly recommended. Sizes 1020T to 1090T10 are furnished with a pre-measured amount of grease for each coupling. The grease can be ordered for larger size couplings.

The use of general purpose grease requires re-lubrication of the coupling at least annually.

Long Term Grease (LTG)

The high centrifugal forces encountered in couplings separate the base oil and thickener of general purpose greases. Heavy thickener, which has no lubrication qualities, accumulates in the grid-groove area of Steelflex couplings resulting in premature hub or grid failure unless periodic lubrication cycles are maintained.

Falk Long Term Grease (LTG) was developed specifically for couplings. It resists separation of the oil and thickener and is an extreme pressure grease.

Steelflex couplings initially lubricated with LTG will not require re-lubrication until the connected equipment is stopped for servicing. If a coupling leaks grease, is exposed to extreme temperatures, excessive moisture, or experiences frequent reversals, more frequent lubrication may be required.

Although LTG grease is compatible with most other coupling greases, the mixing of greases may dilute the benefits of LTG.

USDA Approval

LTG has the United States Department of Agriculture Food Safety & Inspection Service approval for applications where there is no possibility of contact with edible products. (H-2 ratings).

CAUTION: Do not use LTG in bearings.

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428-110
March 1998
Supersedes 1-94

Specifications — Falk LTG

The values shown are typical and slight variations are permissible.

AMBIENT TEMPERATURE RANGE — -20°F (-29°C) to 250°F (121°C). Min. Pump = 20° F (-7° C).

MINIMUM BASE OIL VISCOSITY — 3300SSU (715cST) @ 100°F (38°C).

THICKENER — Lithium & soap/polymer.

CENTRIFUGE SEPARATION CHARACTERISTICS — ASTM #D4425 (Centrifuge Test) — K36 = 2/24 max., very high resistance to centrifuging.

NLGI GRADE (ASTM D-217) — $^1/_2$

MINIMUM DROPPING POINT — with 60 stroke worked penetration value in the range of 320 to 365 — 350°F (177°C) min.

MINIMUM TIMKEN O.K. LOAD — 40 lbs.

ADDITIVES — Rust and oxidation inhibitors that do not corrode steel or swell or deteriorate synthetic seals.

Packaging

14 oz. (0,4 kg) CARTRIDGES — Individual or case lots of 10 or 60.

35 lb. (16 kg)PAIL, 120 lb. (54 kg) KEG & 400 lb. (181 kg) DRUMS.

General Purpose Grease

Annual Lubrication — The following specifications and lubricants for general purpose grease apply to Falk Steelflex couplings that are lubricated annually and operate within ambient temperatures of 0°F to 150°F (-18°C to 66°C). For temperatures beyond this range (see Table 1), consult the Factory.

If a coupling leaks grease, is exposed to extreme temperatures, excessive moisture or experiences frequent reversals, more frequent lubrication may be required.

Specifications — General Purpose Coupling Lubricants

The values shown are typical and slight variations are permissible.

DROPPING POINT — 300°F (149°C) or higher.

CONSISTENCY — NLGI No. 2 with 60 stroke worked penetration value in the range of 250 to 300.

SEPARATION AND RESISTANCE — Low oil separation rate and high resistance to separation from centrifuging.

LIQUID CONSTITUENT — Possess good lubricating properties equivalent to a high quality, well refined petroleum oil.

INACTIVE — Must not corrode steel or cause swelling or deterioration of synthetic seals.

CLEAN — Free from foreign inclusions.

General Purpose Greases Meeting Falk Specifications

Lubricants listed below are typical products only and should not be construed as exclusive recommendations.

TABLE 1 — General Purpose Greases ★

Ambient Temperature Range	0°F to 150°F (-18°C to 66°C)	-30°F to 100°F (-34°C to 38°C)
Manufacturer	**Lubricant †**	**Lubricant †**
Amoco Oil Co.	Amolith Grease #2	Amolith Grease #2
BP Oil Co.	Energrease LS-EP2	Energrease LS-EP1
Chevron U.S.A. Inc.	Dura-Lith EP2	Dura-Lith EP1
Citgo Petroleum Corp.	Premium Lithium Grease EP2	Premium Lithium Grease EP1
Conoco Inc.	EP Conolith Grease #2	EP Conolith Grease #2
Exxon Company, USA	Unirex N2	Unirex N2
E.F. Houghton & Co.	Cosmolube 2	Cosmolube 1
Imperial Oil Ltd.	Unirex N2L	Unirex N2L
Kendall Refining Co.	Lithium Grease L421	Lithium Grease L421
Keystone Div. (Pennwalt)	81 EP-2	81 EP-1
Lyondell Petrochemical (ARCO)	Litholine H EP 2 Grease	Litholine H EP 2 Grease
Mobil Oil Corp.	Mobilux EP111	Mobilith AW1
Petro-Canada Products	Multipurpose EP2	Multipurpose EP1
Phillips 66 Co.	Philube Blue EP	Philube Blue EP
Shell Oil Co.	Alvania Grease 2	Alvania Grease 2
Shell Canada Ltd.	Alvania Grease 2	Alvania Grease 2
Sun Oil Co.	Ultra Prestige 2EP	Ultra Prestige 2EP
Texaco Lubricants	Starplex HD2	Multifak EP2
Unocal 76 (East & West)	Unoba EP2	Unoba EP2
Valvoline Oil Co.	Multilube Lithium EP Grease	. . .

★ Grease application or re-lubrication should be done at temperatures above 20°F (-7°C). If grease must be applied below 20°F (-7°C), consult The Falk Corporation.

† Lubricants listed may not be suitable for use in the food processing industry; check with lube manufacturer for approved lubricants.

INSTALLATION OF TYPE T10 STEELFLEX TAPERED GRID COUPLINGS

Installation

Only standard mechanics tools, wrenches, a straight edge and feeler gauges are required to install Falk Steelflex couplings. Coupling Sizes 1020T thru 1090T are generally furnished for CLEARANCE FIT with setscrew over the keyway. Sizes 1100T and larger are furnished for an INTERFERENCE FIT without a setscrew.

CLEARANCE FIT HUBS — Clean all parts using a non-flammable solvent. Check hubs, shafts and keyways for burrs. Do not heat clearance fit hubs. Install keys, mount hubs with flange face flush with shaft ends or as otherwise specified and tighten setscrews.

INTERFERENCE FIT HUBS — Furnished without setscrews. Heat hubs to a maximum of 275°F (135°C) using an oven, torch, induction heater or an oil bath. To prevent seal damage, DO NOT heat hubs beyond a maximum temperatue of 400°F (205°C).

When an oxy-acetylene or blow torch is used, use an excess acetylene mixture. Mark hubs near the center of their length in several places on hub body with a temperature sensitive crayon, 275°F (135°C) melt temperature. Direct flame towards hub bore using constant motion to avoid overheating an area.

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WARNING: If an oil bath is used, the oil must have a flash point of 350°F (177°C) or higher. Do not rest hubs on the bottom of the container. Do not use an open flame in a combustible atmosphere or near combustible materials.

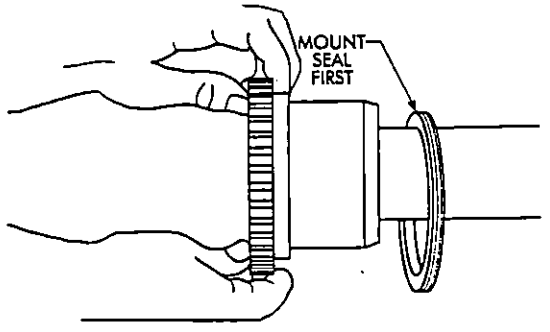
Heat hubs as instructed above. Mount hubs as quickly as possible with hub face flush with shaft end. Allow hubs to cool before proceeding. Insert setscrews (if required) and tighten.

Maximize Performance And Life

The performance and life of couplings depend largely upon how you install and maintain them. Before installing couplings, make certain that foundations of equipment to be connected meet manufacturers' requirements. Check for soft foot. The use of stainless steel shims is recommended. Measuring misalignment and positioning equipment within alignment tolerances is simplified with an alignment computer. These calculations can also be done graphically or mathematically.

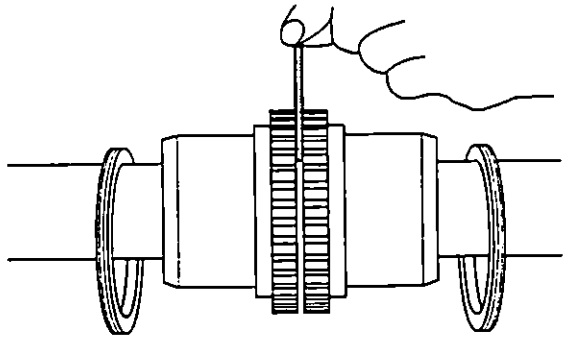
Alignment is shown using spacer bar and straight edge. This practice has proven to be adequate for many industrial applications. However, for superior final alignment, the use of dial indicators (see Manual 458-834 for instructions), lasers, alignment computers or graphical analysis is recommended.

1— Mount Seals And Hubs



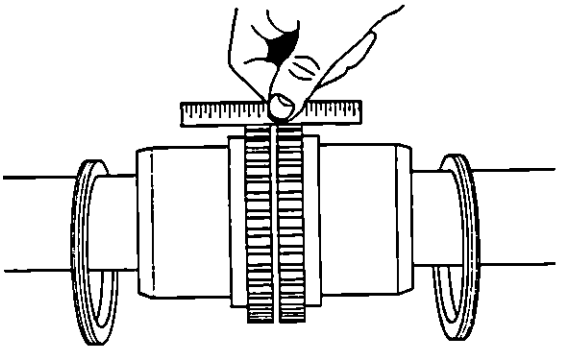
Lock out starting switch of prime mover. Clean all metal parts using a non-flammable solvent. Lightly coat seals with grease and place on shafts BEFORE mounting hubs. Heat interference fit hubs as previously instructed. Seal keyways to prevent leakage. Mount hubs on their respective shafts so the hub face is flush with the end of its shaft unless otherwise indicated. Tighten setscrews when furnished.

2 — Gap and Angular Alignment



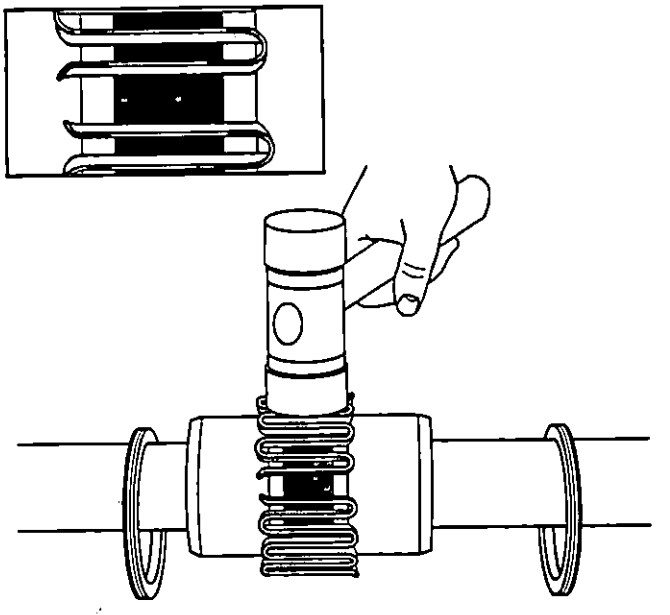
Use a spacer bar equal in thickness to the gap specified in Table 2, Page 5. Insert bar as shown below left, to same depth at 90° intervals and measure clearance between bar and hub face with feelers. The difference in minimum and maximum measurements must not exceed the ANGULAR installation limits specified in Table 2.

3 — Offset Alignment



Align so that a straight edge rests squarely (or within the limits specified in Table 2) on both hubs as shown above and also at 90° intervals. Check with feelers. The clearance must not exceed the PARALLEL OFFSET installation limits specified in Table 2. Tighten all foundation bolts and repeat Steps 2 and 3. Realign coupling if necessary.

4 — Insert Grid



Pack gap and grooves with specified lubricant before inserting grid. When grids are furnished in two or more segments, install them so that all cut ends extend in the same direction (as detailed in the exploded view picture above); this will assure correct grid contact with non-rotating pin in cover halves. Spread the grid slightly to pass over the coupling teeth and seat with a soft mallet.

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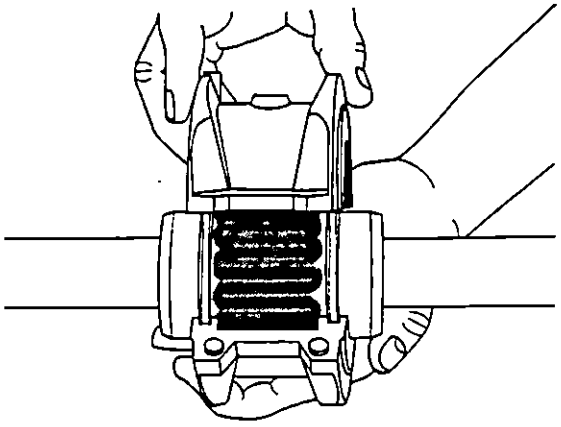
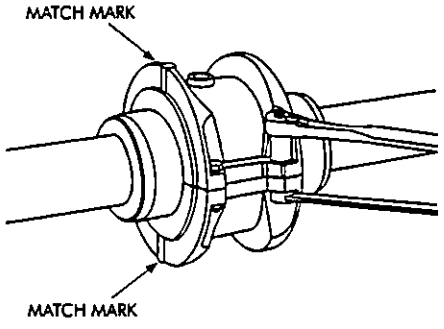
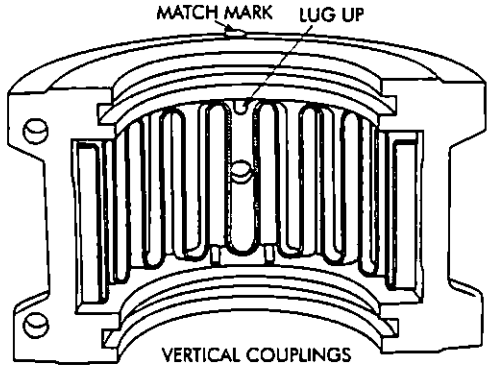
5 — Pack With Grease And Assemble Covers





Pack the spaces between and around the grid with as much lubricant as possible and wipe off excess flush with top of grid. Position seals on hubs to line up with grooves in cover. Position gaskets on flange of lower cover half and assemble covers so that the match marks are on the same side (see above). If shafts are not level (horizontal) or coupling is to be used vertically, assemble cover halves with the lug and match mark



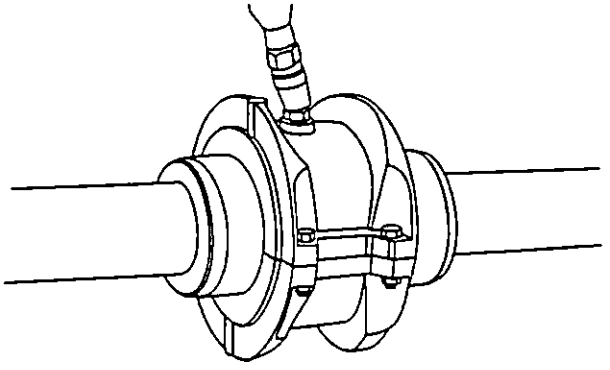
UP or on the high side. Push gaskets in until they stop against the seals and secure cover halves with fasteners, tighten to torque specified in Table 2. Make sure gaskets stay in position during tightening of fasteners. *CAUTION: Make certain lube plugs are installed before operating.*

ANNUAL MAINTENANCE

For extreme or unusual operating conditions, check couplin more frequently.

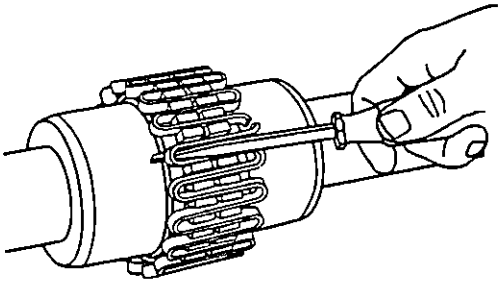
1. Check alignment per steps on Page 3. If the maximum operating misalignment limits are exceeded, realign the coupling to the recommended installation limits. See Table 2 for installation and operating alignment limits.
2. Check tightening torques of all fasteners.
3. Inspect seal ring and gasket to determine if replacement is required. If leaking grease, replace.
4. When connected equipment is serviced, disassemble the coupling and inspect for wear. Replace worn parts. Clean grease from coupling and repack with new grease. Install coupling using new gasket as instructed in this manual.

Periodic Lubrication



The required frequency of lubrication is directly related to the t of lubricant chosen, and the operating conditions. Steelflex couplings lubricated with common industrial lubricants, such as those shown in Table 1, should be relubed annually. The use of Falk Long Term Grease (LTG) will allow relube intervals to be extended to beyond five years. When relubing, remove both lube plugs and insert lube fitting. Fill with recommended lubricant until an excess appears at the opposite hole. *CAUTION:* Make certain all plugs have been inserted after lubricating.

Coupling Disassembly And Grid Removal



Whenever it is necessary to disconnect the coupling, remove the cover halves and grid. A round rod or screwdriver that will conveniently fit into the open loop ends of the grid is required. Begin at the open end of the grid section and insert the rod or screwdriver into the loop ends. Use the teeth adjacent to each loop as a fulcrum and pry the grid out radially in even, gradual stages, proceeding alternately from side to side.

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TYPE T COUPLING INSTALLATION & ALIGNMENT DATA

Maximum life and minimum maintenance for the coupling and connected machinery will result if couplings are accurately aligned. Coupling life expectancy between initial alignment and maximum operating limits is a function of load, speed and lubrication. Maximum operating values listed in Table 2 are based on cataloged allowable rpm.

Values listed are based upon the use of the gaps listed, standard coupling components, standard assemblies and cataloged allowable speeds.

Values may be combined for an installation or operating condition.

Example: 1060T max. operating misalignment is .016" parallel plus .018" angular.

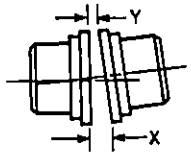
NOTE: For applications requiring greater misalignment, refer application details to the Factory.

Angular misalignment is dimension X minus Y as illustrated below.

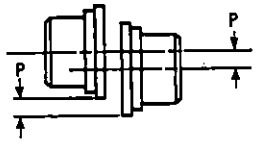
Parallel misalignment is distance P between the hub center lines as illustrated below.

End float (with zero angular and parallel misalignment) is the axial movement of the hubs(s) within the cover(s) measured from "O" gap.

ANGULAR MISALIGNMENT



PARALLEL OFFSET MISALIGNMENT



END FLOAT

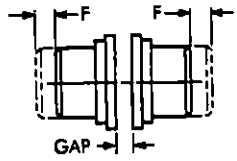


TABLE 2 — Misalignment & End Float

SIZE	Installation Limits						Operating Limits						Cover Fastener Tightening Torque Values		Allow Speed (rpm)	Lube Wt	
	Parallel Offset-P		Angular (x-y)		Hub Gap ± 10%		Parallel Offset-P		Angular (x-y)		End Float Physical Limit (Min) 2 x F						
	Max Inch	Max mm	Max Inch	Max mm	Inch	mm	Max Inch	Max mm	Max Inch	Max mm	Inch	mm	In Series Fasteners (lb-in)	Metric Fasteners (Nm)		lb	kg
1020T	.006	0,15	.003	0,08	.125	3	.012	0,30	.010	0,25	.210	5,33	100	11,3	4500	.06	0,03
1030T	.006	0,15	.003	0,08	.125	3	.012	0,30	.012	0,30	.198	5,03	100	11,3	4500	.09	0,04
1040T	.006	0,15	.003	0,08	.125	3	.012	0,30	.013	0,33	.211	5,36	100	11,3	4500	.12	0,05
1050T	.008	0,20	.004	0,10	.125	3	.016	0,41	.016	0,41	.212	5,38	200	23,6	4500	.15	0,07
1060T	.008	0,20	.005	0,13	.125	3	.016	0,41	.018	0,46	.258	6,55	200	23,6	4350	.19	0,09
1070T	.008	0,20	.005	0,13	.125	3	.016	0,41	.020	0,51	.259	6,58	200	23,6	4125	.25	0,11
1080T	.008	0,20	.006	0,15	.125	3	.016	0,41	.024	0,61	.288	7,32	200	23,6	3600	.38	0,17
1090T	.008	0,20	.007	0,18	.125	3	.016	0,41	.028	0,71	.286	7,26	200	23,6	3600	.56	0,25
1100T	.010	0,25	.008	0,20	.188	5	.020	0,51	.033	0,84	.429	10,90	312	35	2440	.94	0,43
1110T	.010	0,25	.009	0,23	.188	5	.020	0,51	.036	0,91	.429	10,90	312	35	2250	1.1	0,51
1120T	.011	0,28	.010	0,25	.250	6	.022	0,56	.040	1,02	.556	14,12	650	73	2025	1.6	0,74
1130T	.011	0,28	.012	0,30	.250	6	.022	0,56	.047	1,19	.551	14,00	650	73	1800	2.0	0,91
1140T	.011	0,28	.013	0,33	.250	6	.022	0,56	.053	1,35	.571	14,50	650	73	1650	2.5	1,14

TABLE 3 — Coupling Cover Fastener Identification

SIZE	Inch Series Fasteners				METRIC FASTENERS	
	Old Style		New Style			
1020-1070T10		SAE Grade 8 [1]		SAE Grade 8		Property Class 10.9
1080-1090T10		SAE Grade 8		SAE Grade 8		Property Class 10.9
1100-1140T10		SAE Grade 5		SAE Grade 5		Property Class 8.8

★ Older style covers, Sizes 1020T10 thru 1070T10 must utilize socket head cap screws and locknuts held by the cover.

PARTS IDENTIFICATION

All coupling parts have identifying part numbers as shown below. Parts 3 and 4 (Hubs and Grids), are the same for both Type T10 and T20 couplings. All other coupling parts are unique to Type T10. When ordering parts, always SPECIFY SIZE and TYPE shown on the COVER.

PARTS INTERCHANGEABILITY

Parts are interchangeable between Sizes 20T and 1020T, 30T and 1030T, etc. except as noted.

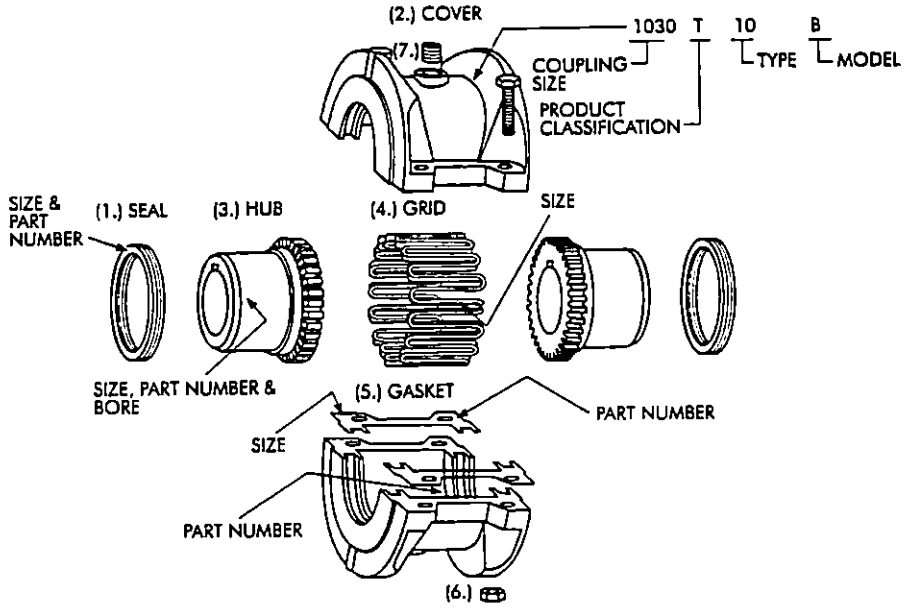
GRIDS — Size 1020T thru 1140T Steelflex couplings use blue grids. Older models, 20T thru 140T, use orange grids.

CAUTION: Blue grids may be used in all applications, but DO NOT substitute orange grids for blue.

COVERS — CAUTION: DO NOT mix cover halves of different designs. Sizes 1020T thru 1070T10 covers have been manufactured in several different two-rib designs and 80T thru 140T covers have been manufactured with two and three ribs.

HARDWARE — Older style covers, Sizes 1020T10 thru 1070T10, utilized socket head cap screws with captured locknuts. The new style covers use hex head cap screws (either inch or metric) and unrestrained locknuts. Specify either inch series SOCKET head or metric series HEX head cap screws when ordering replacement parts.

PART NUMBER LOCATION



PART DESCRIPTION

1. Seal (T10)
2. Cover (T10)
3. Hub (Specify bore and keyway)
4. Grid
5. Gasket (T10)
6. Fasteners (T10) — Coupling may be supplied with one set each of inch series fasteners and metric fasteners.
7. Lube Plug

ORDER INFORMATION

1. Identify part(s) required by name above.
2. Furnish the following information.

   EXAMPLE:
   Coupling Size: 1030
   Coupling Type: T10
   Model: B
   Bore: 1.375
   Keyway: .375 x .187
3. Price parts from Price List 422-110 and appropriate discount sheet.

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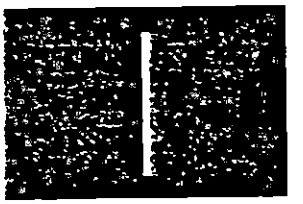
TECHNICAL SERVICE MANUAL

GENERAL PURPOSE SPECIAL MOUNTED PUMPS
SERIES 75 AND 475
SIZES G-HL



VIKING PUMP HOUDAILLE
ONE OF THE HOUDAILLE PUMP GROUP

INTRODUCTION

The illustrations used in this manual are for identification purposes only and *should not be used for ordering parts.* Secure a parts list from the factory or a Viking representative. Always give complete name of part, part number and material, with the model number and serial number of the pump when ordering repair parts. The model number and serial number can be found on the name plate attached to the pump casing. This is important identification for ordering parts or a replacement pump. It is positive assurance you will receive the correct pump parts.

Your pump is composed of four major parts. Only two of these are moving parts, the rotor and idler.

An exploded parts drawing and list of parts is included to help you identify each part correctly. How to disassemble and reassemble the pump will be covered step by step (see pages 2-7).

UNMOUNTED PUMP MODELS	
WITH LIP SEAL	WITH MECHANICAL SEAL
G75	G475
GG75	GG475
H75	H475
HJ75	HJ475
HL75	HL475

MOUNTED PUMP MODELS			
		NOMINAL GPM	
WITH LIP SEAL	WITH MECHANICAL SEAL	@ 1200 RPM	@ 1800 RPM
G75M	G475M	5	7
GG75M	GG475M	7	10
H75M	H475M	10	15
HJ75M	HJ475M	13	20
HL75M	HL475M	20	30

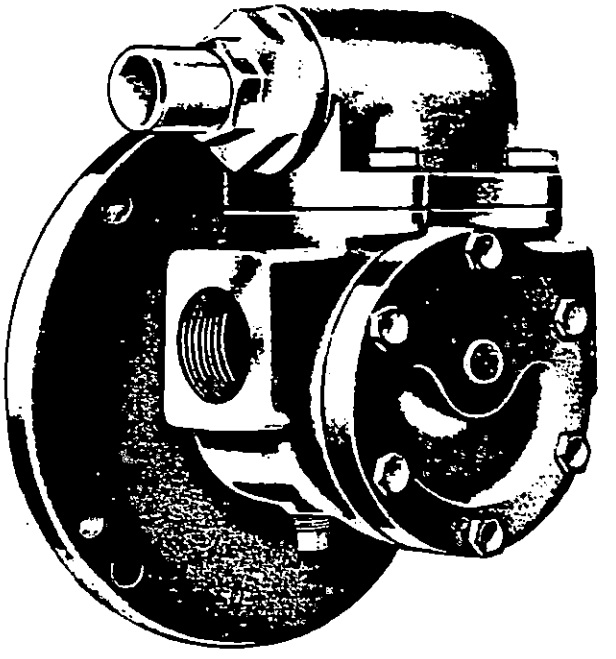


FIGURE 1
UNMOUNTED PUMP SHOWING FRONT VIEW OF G AND GG SIZE

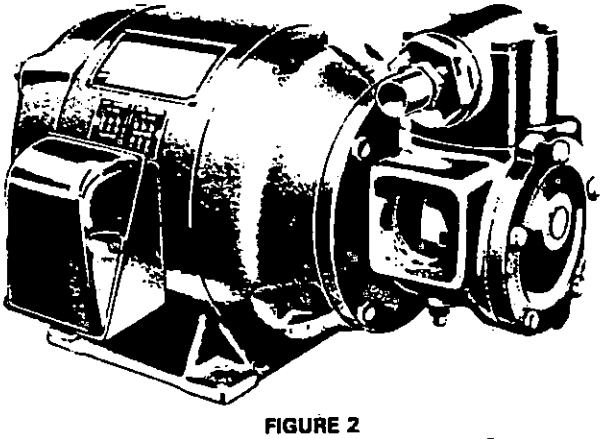


FIGURE 2
MOTOR MOUNTED PUMP SHOWING H, HJ AND HL SIZE

INTERCHANGEABILITY

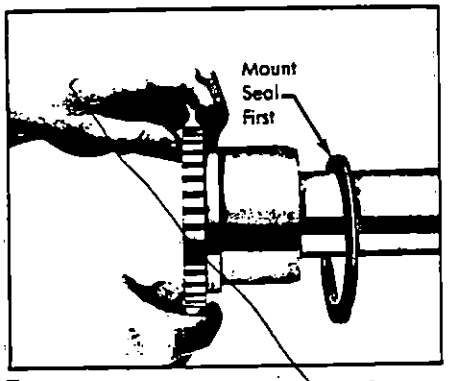
These pumps are furnished with either a mechanical seal or lip seal.

All models of the mechanical seal pumps and lip seal pumps are dimensionally interchangeable on any NEMA "C" flange motor. The mechanical seal is interchangeable with the lip seal in all pump sizes.

Installation

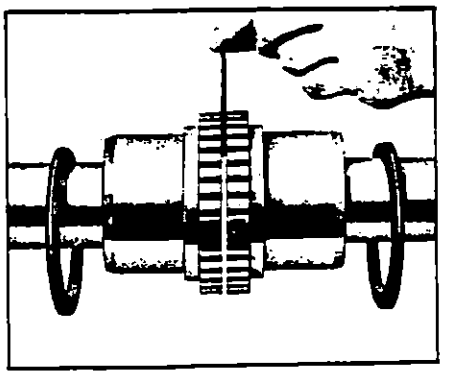
The suction line should be airtight and at least as large as the pump suction port connections to prevent loss of prime or capacity. It should also be equipped with a strainer and if pumping light liquids at a high suction lift, a foot or check valve should be used. Always avoid high spots and obstructions in the suction line as these may cause noise, loss of capacity or air lock. Since these pumps are the positive displacement type, be sure there is no obstruction in the discharge line and all valves are in operating position before starting the pump. Be sure the adjusting screw of the relief valve on the pump points toward the suction port. Factory assembled pumps will have right hand port suction and left hand port discharge unless otherwise specified. Port location is determined by looking at mounting flange end of pump. The relief valve on the pump is excellent insurance against a clogged discharge line or closed valves in the discharge line.

INSTALLATION OF TYPE T10 STEELFLEX TAPERED GRID COUPLINGS



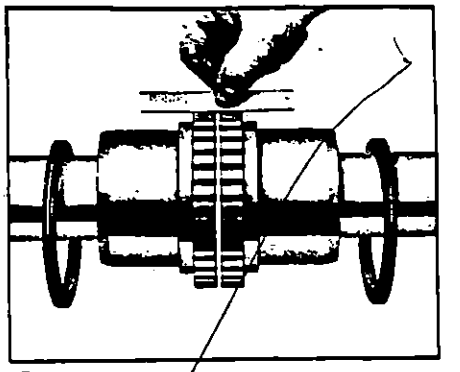
1 MOUNT SEALS AND HUBS

Lock out starting switch of prime mover. Clean all metal parts using a non-flammable solvent. Lightly coat seals with grease and place on shafts BEFORE mounting hubs. Mount hubs on their respective shafts so the hub face is flush with the end of its shaft. Tighten set screws when furnished. Heat interference fit hubs as instructed on Page 1.



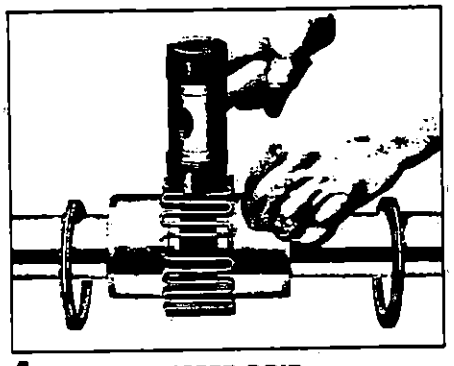
2 GAP & ANGULAR ALIGNMENT

Use a spacer bar equal in thickness to the gap specified in Table 1. Insert bar, as shown above, to same depth at 90° intervals and measure clearance between bar and hub face with feelers. The difference in minimum and maximum measurements must not exceed the ANGULAR limit specified in Table 1.



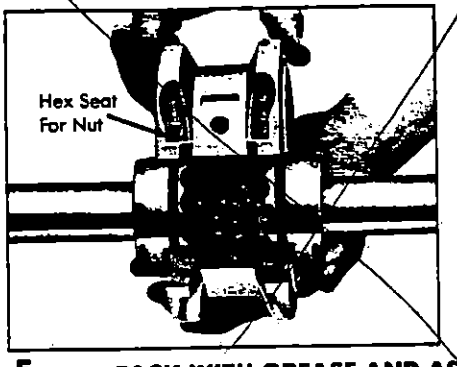
3 OFFSET ALIGNMENT

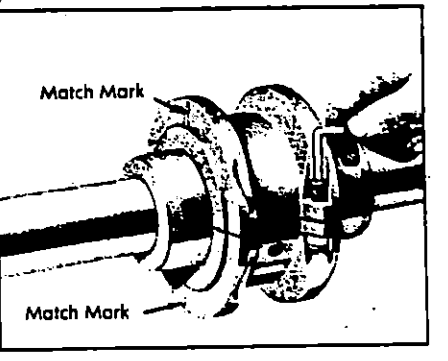
Align so that a straight edge rests squarely (or within the limits specified in Table 1) on both hubs as shown above and also at 90° intervals. Check with feelers. The clearance must not exceed the OFFSET limit specified in Table 1. Tighten all foundation bolts and repeat Steps 2 and 3. Realign coupling if necessary. NOTE: Use a dial indicator for more accurate alignment.



4 INSERT GRID

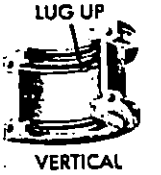
Pack gap and grooves with specified lubricant before inserting grid. When grids are furnished in two or more segments, install them so that all cut ends extend in the same direction; this will assure correct grid contact with non-rotating pin in cover halves. Spread the grid slightly to pass over the coupling teeth and seat with a soft mallet.





5 PACK WITH GREASE AND ASSEMBLE COVERS

Pack the spaces between and around the grid with as much lubricant as possible and wipe off excess flush with top of grid. Position seals on hubs to line up with grooves in cover. Position gaskets on flange of lower cover half and assemble covers so that the match marks are on the same side (see above). If shafts are not level (horizontal) or coupling is to be used vertically, assemble cover halves with the lug and match mark UP, or on the high side. Secure cover halves with fasteners and tighten to torque specified in Table 1. (Note that Sizes 1020 thru 1070 have a self-locking feature for the stop nuts.) CAUTION: Make certain lube plugs are installed before operating.



VERTICAL COUPLINGS

TABLE 1 INSTALLATION DATA* (Dimensions-Inches)

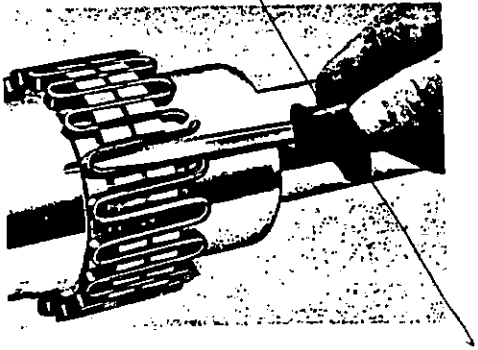
SIZE	Gap	Operating■ Alignment Limits		Cover Bolt Torque (lb-in)	Max Speed (rpm)	Lube Wt (lb)
		Offset (Max)	Angular (Max)			
1020T	125	005	005	100	4500	.06
1030T	125	005	005	100	4500	.06
1040T	125	005	005	100	4500	.12
1050T	125	005	005	200	4500	.12
1060T	125	010	010	200	4350	.19
1070T	125	010	010	200	4125	.19
1080T	125	010	010	200	3600	.38
1090T	125	012	012	200	3600	.56
1100T	188	012	012	260	2440	.94
1110T	188	012	012	260	2250	1.1
1120T	.250	012	012	650	2025	1.6
1130T	.250	012	012	650	1800	2
1140T	.250	015	015	650	1650	2.5

* Refer to Bulletin 421-110 for maximum bores and Engineering 427-108 for reboring instructions.
■ Align couplings within "Operating Alignment Limits" specified above. Exceeding these limits reduces coupling life.

6 PERIODIC LUBRICATION—Remove both lube plugs and insert lube fitting. Fill with recommended lubricant until an excess appears at the opposite hole. CAUTION: Make certain all plugs have been inserted after lubricating.

COUPLING DISASSEMBLY AND GRID REMOVAL

Whenever it is necessary to disconnect the coupling, remove the cover halves and grid. A round rod or screw driver that will conveniently fit into the open loop ends of the grid is required. Begin at the open end of the grid section and insert the rod or screw driver into the loop ends. Use the teeth adjacent to each loop as a fulcrum and pry the grid out radially in even, gradual stages, proceeding alternately from side to side.



Pumps not furnished with a safety relief valve on the pump should be provided with some means of over pressure protection such as an in-line safety relief valve, torque limiting device, etc.

If the pump rotation is to be reversed frequently during normal operation—using the same pump to load and unload—then over pressure protection should be provided on both sides of the pump.

Additional discussion on safety relief valves can be found in Technical Service Manual TSM000.

SPECIAL INFORMATION

NOTE: Lip seal pumps, Model G75, GG75, H75, HJ75, HL75, G75M, GG75M, H75M, HJ57M and HL75M are equipped with an internal suckback arrangement. A small suckback screw (self-locking) is inserted in a hole on the discharge side of the pump. This can be seen through the port opening and behind the rotor (see Figure 3). *The hole on the suction side must be left open* to prevent damage to the lip seals. Both holes are plugged in the mechanical seal pump Model G475, GG475, H475, HJ475, HL475, G475M, GG475M, H475M, HJ475M and HL475M. Since these pumps have only two moving parts and are all performance tested at the factory, they seldom cause trouble. If trouble does occur we always advise investigating all other possible causes before disassembling the pump. Most troubles are caused by air leaks and obstructions in the suction line.

ADJUSTMENT

CAUTION: BEFORE MAKING ANY PUMP ADJUSTMENT OR OPENING THE PUMP LIQUID CHAMBER IN ANY MANNER, MAKE SURE 1) THAT ANY PRESSURE IN THE PUMPING CHAMBER HAS BEEN VENTED THROUGH THE SUCTION OR DISCHARGE LINES AND THAT 2) THE DRIVER HAS BEEN "LOCKED OUT" SO THAT IT CANNOT BE INADVERTENTLY STARTED WHILE WORK IS BEING DONE ON THE PUMP.

The efficiency of the pump may decrease after considerable use due to gradual wear. Efficiency of a worn pump may be improved somewhat by removing one or more of the thin head gaskets. This reduces the end clearance where most wear occurs.

Disassembly

1. *REMOVE THE PUMP FROM THE MOTOR.* Remove the four capscrews and use three as jackscrews in the threaded holes of the pump casing to pull pump from motor shaft.
   NOTE: If the pump has a valve it must be removed first to have room for the jackscrews.
2. *REMOVE PUMP HEAD.*
   NOTE: Mark the head and casing before disassembly to make sure they are reassembled properly. The idler pin

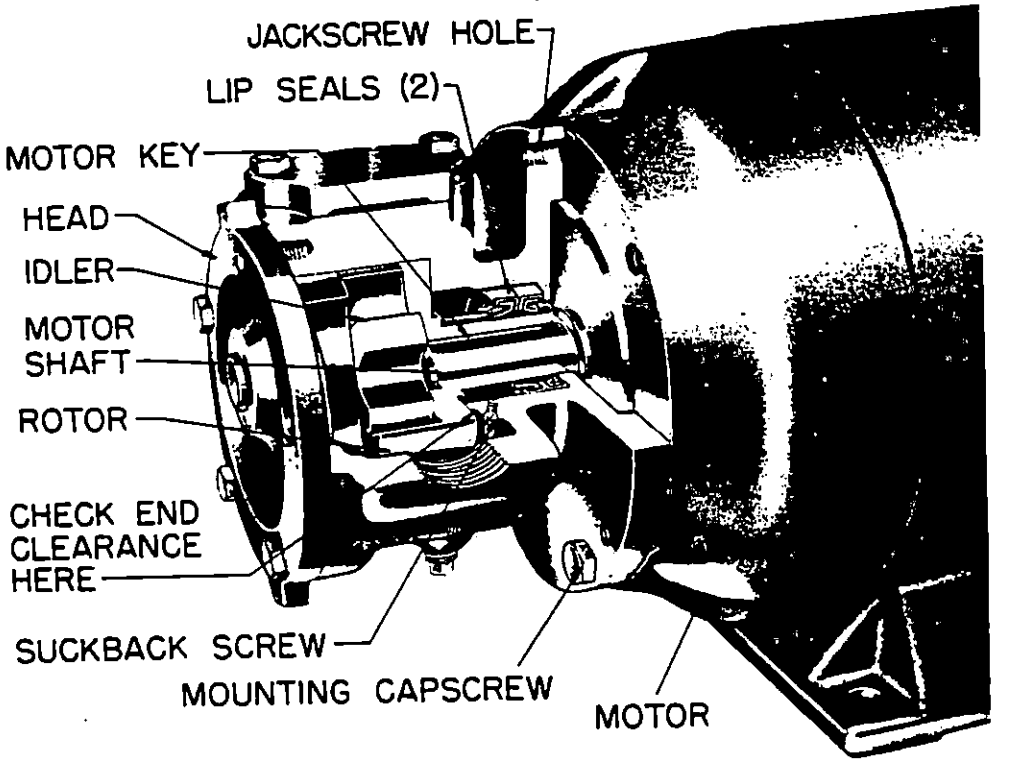


FIGURE 3
CUTAWAY OF H, HJ, HL75 LIP SEAL PUMP

which is offset in the pump head, should be properly positioned toward and equal distance between the port connections to allow for proper flow of liquid through the pump.

If it is necessary to disassemble the pump for inspection or repair, first remove the head capscrews and remove the head by tapping the head removing lugs lightly.

CAUTION: WHEN THE HEAD IS BEING REMOVED, THE IDLER USUALLY STAYS ON THE IDLER PIN. AVOID TILTING THE INSIDE OF THE HEAD DOWNWARD, AS THE IDLER MAY SLIDE OFF THE IDLER PIN AND FALL. A FALL ON A HARD SURFACE CAN DAMAGE THE IDLER. IF THE IDLER SHOULD FALL, CHECK CAREFULLY AND FILE OR STONE ALL NICKED OR ROUGH PLACES BEFORE RE-ASSEMBLY.

3. *REMOVE THE HEAD GASKETS.* If a new set is not available, the original gaskets may be reused provided they are not damaged.
4. *REMOVE THE IDLER FROM THE IDLER PIN.* If the idler pin is worn, both the head and idler pin and idler bushing should be replaced.

   If the idler bushing is worn, a new bushing is needed.

   If the new bushing is carbon graphite, special care must be taken when pressing it into the idler. An arbor press should always be used; be sure the bushing is started straight. *DO NOT STOP* the pressing operation until bushing is in its proper location. Carbon graphite is brittle; starting and stopping the pressing operation frequently results in a cracked bushing. If cracked in the idler, the bushing will quickly disintegrate.
5. *REMOVE THE ROTOR FROM THE CASING.* The rotor of the two smaller pumps (G and GG sizes) can be removed by pressing on the hollow drive end of the rotor. It will be necessary on the models with mechanical seals (G475 and GG475) to use an arbor press and an arbor of approximately 1-3/8" diameter. The seal will remain in the casing.

   The rotor of the three larger size pumps (H, HJ, HL sizes) can also be removed by pushing on the hollow drive end of the rotor. The spring and rotary member of the mechanical seal will come out with the rotor in these pumps.
6. *REMOVE THE MECHANICAL SEAL OR LIP SEALS.* (See Figure 4.) Remove the snap ring in the casing of the two smaller pumps (G and GG sizes) and the complete seal can be removed out of the large flanged end of the casing. In the case of the G & GG size lip seal pumps these have no snap rings and the lip seals can be removed out the large flanged end of the casing. Remove the spring and rotary member from the rotor and the seal seat or lip seals from the pump end of the casing of the three larger size pumps (H, HJ, HL).

Reassembly

Reassembly of these pumps is explained by one of the following sets of instructions. Follow the instructions for the proper pump model.

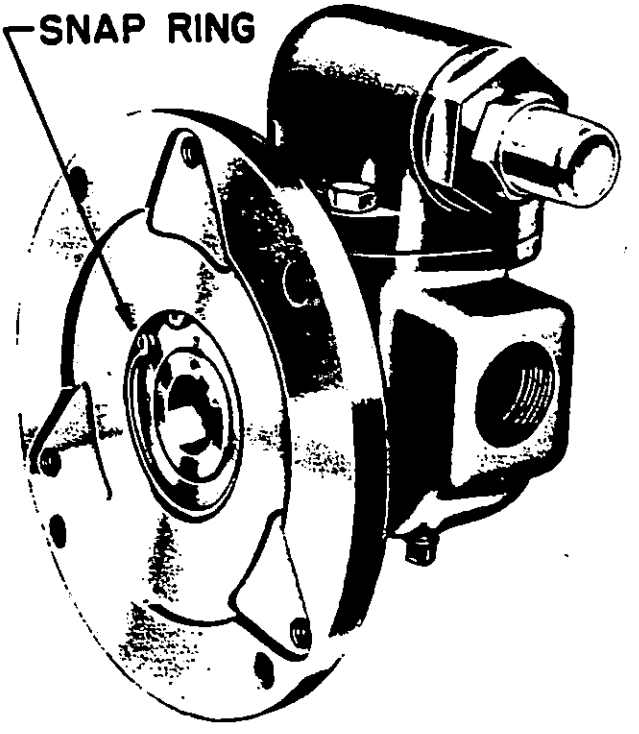


FIGURE 4
VIEW OF FLANGE END OF G AND GG475
MECH. SEAL PUMPS

Before starting to reassemble the pump, clean all parts thoroughly and replace those which show signs of excessive wear or damage.

To Reassemble Model G75 or GG75 Lip Seal Pumps: (see Figure 7)

1. *INSTALL THE LIP SEALS.* The lip seals should be installed in the casing one at a time from the large flanged end. The sealing lips must face away from each other.

   NOTE: Use an arbor press with an arbor of 2-3/16" diameter and press the lip seals in the casing as far as they will go. See Figures 7, 8, 9 and 10 for a cross section of your pump models.
2. *LUBRICATE THE LIP SEALS.* Fill the area between the lips of the lip seals with grease.
3. *INSTALL THE ROTOR.* Flush the rotor hub with light oil (not grease) and insert the rotor in the casing with the hub through the lip seals.

TECHNICAL SERVICE MANUAL

GENERAL PURPOSE SPECIAL MOUNTED PUMPS
SERIES 75 AND 475
SIZES G-HL

VIKING PUMP HOUDAILLE
ONE OF THE HOUDAILLE PUMP GROUP

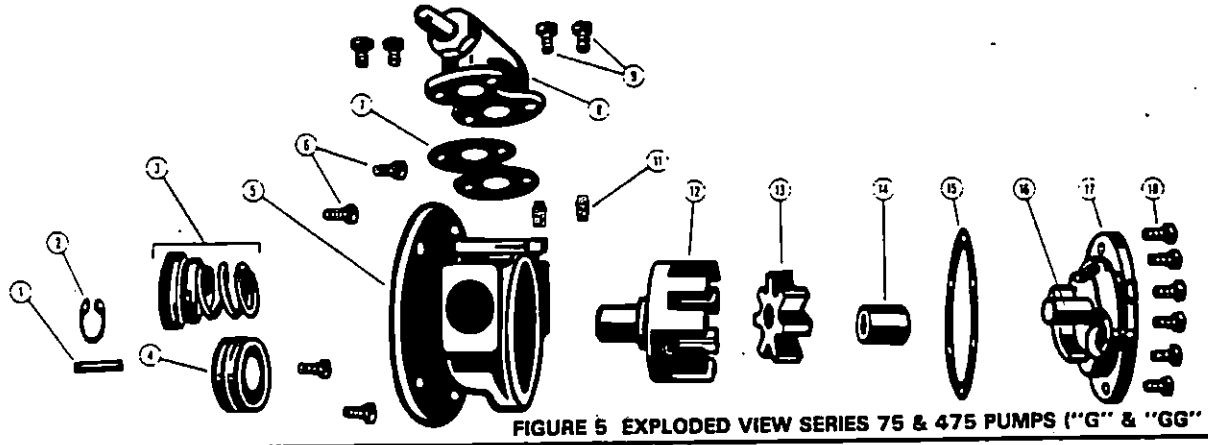


FIGURE 5 EXPLODED VIEW SERIES 75 & 475 PUMPS ("G" & "GG" SIZE)

ITEM	NAME OF PART	ITEM	NAME OF PART
1	Key For Motor Shaft (Full Length)	10	Pipe Plugs—¼"
2	Snap Ring (Used with Mech. Seal Pumps Only)	11	Machine Screw (2 for Mech. Seal Pump, 1 for Lip Seal Pump)
3	Mechanical Seal, (Complete)	12	Rotor
4	Lip Seal (2)	13	Idler
5	Casing	14	Idler Bushing
6	Capscrews (Pump to Motor)	15	Gasket (For Head)
7	Gasket (For Relief Valve or Cover Plate)	16	Idler Pin
8	Relief Valve	17	Head
9	Capscrews (For Relief Valve or Cover Plate)	18	Capscrews (For Head)

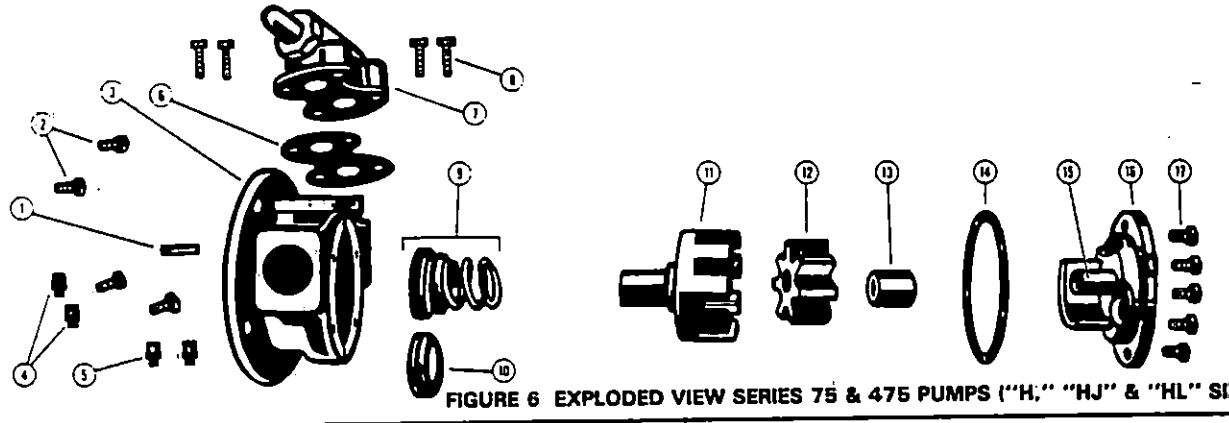
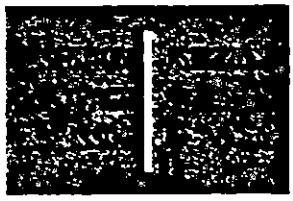


FIGURE 6 EXPLODED VIEW SERIES 75 & 475 PUMPS ("H," "HJ" & "HL" SIZE)

ITEM	NAME OF PART	ITEM	NAME OF PART
1	Key For Motor Shaft (Full Length)	10	Lip Seal (2)
2	Capscrews (Pump to Motor)	11	Rotor
3	Casing	12	Idler
4	Machine Screw (2 for Mech. Seal Pump, 1 for Lip Seal Pump)	13	Idler Bushing
5	Pipe Plugs—¼"	14	Gasket (For Head)
6	Gasket (For Relief Valve or Cover Plate)	15	Idler Pin
7	Relief Valve	16	Head
8	Capscrews (For Relief Valve or Cover Plate)	17	Capscrews (For Head)
9	Mechanical Seal (Complete)		



CAUTION: TURN THE ROTOR BACK AND FORTH AS YOU EXERT ENOUGH FORCE TO PUSH IT THROUGH THE LIP SEAL AND TO THE BOTTOM OF THE CASING. BE CAREFUL NOT TO FOLD UNDER THE LIP OF THE INNER SEAL.

4. *INSTALL THE IDLER.* Put the idler with bushing on the idler pin.
5. *PLACE THE HEAD GASKETS ON THE PUMP HEAD.* The proper amount of gaskets should be used to provide necessary end clearance within the pump so it turns freely with no appreciable end play. Gasket Table 1 gives the normal amount of gaskets used.
6. *THE HEAD CAN NOW BE ASSEMBLED ON THE PUMP.* Tilt the top of the head away from the pump slightly until the crescent enters the inside diameter of the rotor and rotate the idler until its teeth mesh with the rotor teeth. Do not damage the head gaskets. Note correct position of idler and crescent (See Figure 7 and Disassembly Step 2). Tighten the head capscrews and then check the end clearance.

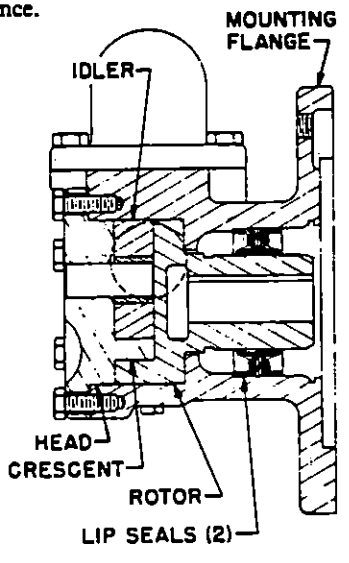


FIGURE 7
SECTIONAL DRG. OF MODELS G75 AND GG75 LIP SEAL PUMPS

7. *CHECK PUMP END CLEARANCE.* Measure the clearance between the back of the rotor and the machined surface in the bottom of the casing by inserting a feeler gauge through the port opening. This is the end clearance; normal amount is 0.003" to 0.005". Add or remove gaskets until this figure is reached.

GASKET TABLE 1

PUMP MODELS	NORMAL AMOUNT USED	ONE SET OF GASKETS CONSISTS OF THE FOLLOWING
G75 and GG75 Lip Seal Pumps	.010" - .015"	2—.005" Plastic 3—.002" Plastic

8. *BOLT THE VALVE TO THE CASING.* Place the valve gasket and valve or coverplate on the pump and fasten securely with the four capscrews.

CAUTION: BE SURE THE ADJUSTING SCREW OF THE RELIEF VALVE POINTS TOWARD THE SUCTION PORT.

9. *ASSEMBLE THE PUMP ON THE MOTOR.* Install the full length key in the keyway of the motor shaft.
   NOTE: Key must be *full* length to avoid misalignment of the pump rotor which could cause serious damage to the pump. Slide the pump on the motor shaft and fasten securely with the four capscrews.

To Reassemble Model H75, HJ75 or HL75 Lip Seal Pumps: (see Figure 8)

1. *INSTALL THE LIP SEALS.* The lip seals should be installed in the casing one at a time from the head end. The sealing lips must face away from each other.
   NOTE: Use an arbor press with an arbor of 2-3/16" diameter and press the lip seals in the casing as far as they will go.
2. *LUBRICATE THE LIP SEALS.* Fill the area between the lips of the lip seals with grease.
3. *INSTALL THE ROTOR.* Flush the rotor hub with light oil (not grease) and insert the rotor in the casing with the hub through the lip seals.

CAUTION: TURN THE ROTOR BACK AND FORTH AS YOU EXERT ENOUGH FORCE TO PUSH IT THROUGH THE LIP SEALS AND TO THE BOTTOM OF THE CASING. BE CAREFUL NOT TO FOLD UNDER THE LIP OF THE INNER SEAL.

4. *INSTALL THE IDLER.* Put the idler with bushing on the idler pin.
5. *PLACE THE HEAD GASKETS ON THE PUMP HEAD.* The proper amount of gaskets should be used to provide the necessary end clearance within the pump so it turns freely with no appreciable end play. Gasket Table 2 gives the normal amount of gaskets used.
6. *THE HEAD CAN NOW BE ASSEMBLED ON THE PUMP.* Tilt the top of the head away from the pump slightly until the crescent enters the inside diameter of the rotor and rotate the idler until its teeth mesh with the rotor teeth. Do not damage the head gaskets. Note correct position of idler and crescent. (See Figure 8 and Disassembly Step 2). Tighten the head capscrews and then check the end clearance.
7. *CHECK PUMP END CLEARANCE.* Measure the clearance between the back of the rotor and the machined surface in the bottom of the casing by inserting a feeler gauge through the port opening. This is the end clearance. Nor-

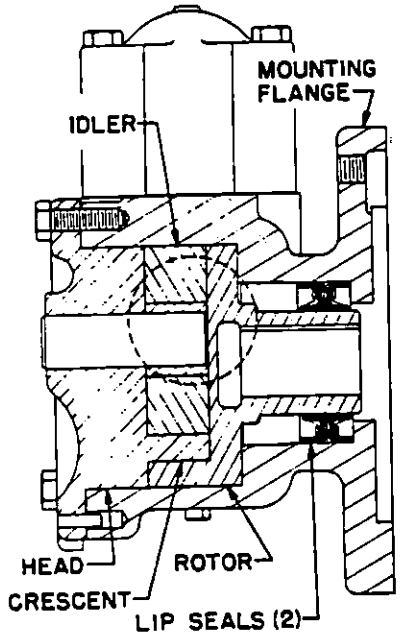


FIGURE 8
SECTIONAL DRG. OF MODELS H75, HJ75 AND HL75 LIP SEAL PUMPS

mal amount is 0.003" to 0.005". Add or remove gaskets until this figure is reached.

GASKET TABLE 2

PUMP MODELS	NORMAL AMOUNT USED	ONE SET OF GASKETS CONSISTS OF THE FOLLOWING
H75, HJ75 and HL75 Lip Seal Pumps	.010" - .015"	2—.002" Plastic 3—.006" Paper

8. *BOLT THE VALVE TO THE CASING.* Place the valve gasket and valve or coverplate on the pump and fasten securely with the four capscrews.

CAUTION: BE SURE THE ADJUSTING SCREW OF THE RELIEF VALVE POINTS TOWARD THE SUCTION PORT.

9. *ASSEMBLE THE PUMP ON THE MOTOR.* Install the full length key in the keyway of the motor shaft.

   NOTE: Key must be *full* length to avoid misalignment of the pump rotor which could cause serious damage to the pump. Slide the pump on the motor shaft and fasten securely with the four capscrews.

To Reassemble Model G475 or GG475 Mechanical Seal Pumps: (see Figure 9)

1. *INSTALL THE ROTOR IN THE CASING.*
2. *INSTALL THE IDLER.* Put the idler with bushing on the idler pin.
3. *PLACE THE HEAD GASKETS ON THE HEAD.* The proper amount of gaskets should be used to provide the necessary end clearance within the pump so it turns freely with no appreciable end play. Gasket Table 3 gives the normal amount of gaskets used.

GASKET TABLE 3

PUMP MODELS	NORMAL AMOUNT USED	ONE SET OF GASKETS CONSISTS OF THE FOLLOWING
G475 and GG475 Mech. Seal Pumps	.010" - .015"	2—.005" Plastic 3—.002" Plastic

4. *THE HEAD CAN NOW BE ASSEMBLED ON THE PUMP.* Tilt the top of the head away from the pump slightly until the crescent enters the inside diameter of the rotor and rotate the idler until its teeth mesh with the rotor teeth. Do not damage the head gaskets. Note correct position of idler and crescent (see Figure 9 and Disassembly Step 2). Tighten the head capscrews and then check the end clearance.

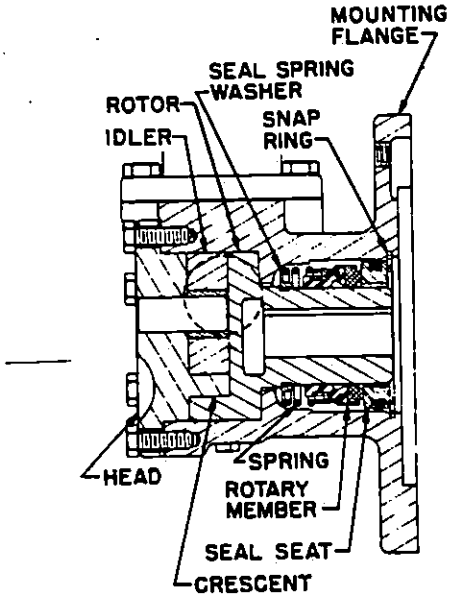
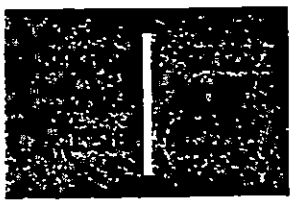


FIGURE 9
SECTIONAL DRG. OF MODELS G475 AND GG475 MECH. SEAL PUMPS

5. *CHECK PUMP END CLEARANCE.* Measure the clearance between the back of the rotor and the machined surface in the bottom of the casing by inserting a feeler gauge through the port opening. This is the end clearance. Normal amount is 0.003" to 0.005". Add or remove gaskets until this figure is reached.



6. *INSTALL THE MECHANICAL SEAL.* Slide the seal spring washer over the rotor hub as far as it will go. Flush the rotor hub and seal housing bore with light oil (not grease) and assemble spring, rotary member and seat of the mechanical seal in position (see Figure 9).

CAUTION: NEVER TOUCH THE SEALING FACES OF THE MECHANICAL SEAL WITH ANYTHING EXCEPT FINGERS OR A CLEAN CLOTH.

7. *INSTALL THE SNAP RING.* Install the snap ring in the groove in the casing. This will hold the seal at its proper working length.
8. *BOLT THE VALVE TO THE CASING.* Place the valve gasket and valve or coverplate on the pump and fasten securely with the four capscrews.

CAUTION: BE SURE THE ADJUSTING SCREW OF THE RELIEF VALVE POINTS TOWARD THE SUCTION PORT.

9. *ASSEMBLE THE PUMP ON THE MOTOR.* Install the full length key in the keyway of the motor shaft.
   NOTE: Key must be *full* length to avoid misalignment of the pump which could cause serious damage to the pump. Slide the pump on the motor shaft and fasten securely with the four capscrews.

To Reassemble Model H475, HJ475 or HL475 Mechanical Seal Pumps: (see Figure 10)

1. *INSTALL THE SEAL SEAT.* Lubricate the outside diameter of the seal seat and the inside of the seal housing bore with light oil (not grease). Start the seal seat in the casing and press into place.

CAUTION: NEVER TOUCH THE SEALING FACES OF THE MECHANICAL SEAL WITH ANYTHING EXCEPT THE FINGERS OR A CLEAN CLOTH.

2. *INSTALL THE ROTARY MEMBER OF SEAL.* Flush the rotor hub and the inside of the rotary member with light oil. Slide the spring and rotary member over the rotor hub only far enough to hold the spring in position. Do not compress the spring at this time.
3. *INSTALL THE ROTOR IN THE CASING.*
4. *INSTALL THE IDLER.* Put the idler with bushing on the idler pin.
5. *PLACE THE HEAD GASKETS ON THE HEAD.* The proper amount of gaskets should be used to provide the necessary end clearance within the pump so it turns freely with no appreciable end play. Gasket Table 4 gives the normal amount of gaskets used.

GASKET TABLE 4

PUMP MODELS	NORMAL AMOUNT USED	ONE SET OF GASKETS CONSISTS OF THE FOLLOWING
H475, HJ475 and HL475 Mechanical Seal Pumps	.010" - .015"	2—.002" Plastic 2—.006" Paper

6. *THE HEAD CAN NOW BE ASSEMBLED ON THE PUMP.* Tilt the top of the head away from the pump slightly until the crescent enters the inside diameter of the rotor and rotate the idler until its teeth mesh with the rotor teeth. Do not damage the head gaskets. Note correct position of idler and crescent. (See Figure 10 and Disassembly Step 2). Tighten the head capscrews and then check the end clearance.

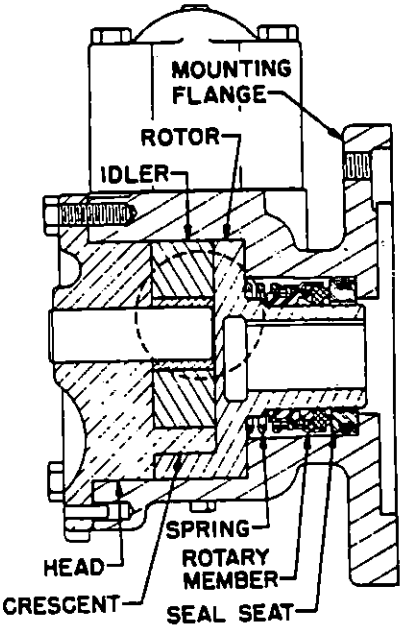


FIGURE 10
SECTION DRG. OF MODELS H475, HJ475 AND HL475 MECH. SEAL PUMPS

7. *CHECK PUMP END CLEARANCE.* Measure the clearance between the back of the rotor and the machined surface in the bottom of the casing by inserting a feeler gauge through the port opening. This is the end clearance; normal amount is 0.003" and 0.005". Add or remove gaskets until this figure is reached.
8. *BOLT THE VALVE TO THE CASING.* Place the valve gasket and valve or coverplate on the pump and fasten securely with the four capscrews.

CAUTION: BE SURE THE ADJUSTING SCREW OF THE RELIEF VALVE POINTS TOWARD THE SUCTION PORT.

9. *ASSEMBLE THE PUMP ON THE MOTOR.* Install the full length key in the keyway of the motor shaft.
   NOTE: Key must be *full* length to avoid misalignment of the pump rotor which could cause serious damage to the pump. Slide the pump on the motor shaft and fasten securely with the four capscrews.

SAFETY RELIEF VALVE INSTRUCTIONS

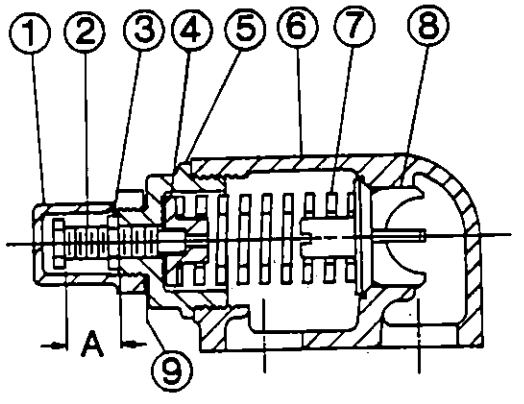


FIGURE 11
VALVE—G, GG, H, HJ AND HL SIZE

LIST OF PARTS

1. Valve Cap
2. Adjusting Screw
3. Lock Nut
4. Spring Guide
5. Bonnet
6. Valve Body
7. Valve Spring
8. Poppet
9. Cap Gasket

Disassembly

NOTE: Mark valve and head to be sure they are reassembled in the same relative position.

1. Remove valve cap.
2. Measure and record the length of extension of the adjusting screw. See "A" on figure 11.
3. Loosen the lock nut and back out adjusting screw until spring pressure is released.
4. Remove bonnet, spring guide, spring and poppet from valve body. Clean and inspect all parts for wear or damage and replace as necessary.

Assembly

Follow the procedure outlined under disassembly.

If valve is removed for repairs, be sure to replace in same position. The valve cap should point towards the suction port.

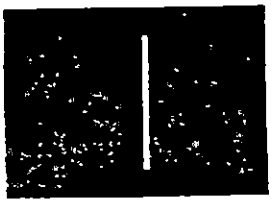
PRESSURE ADJUSTMENT

If the pressure setting of the safety relief valve is to be changed from that which the factory has set, the following instructions should be carefully followed: Remove the valve cap which covers the adjusting screw, and loosen the lock nut which locks the adjusting screw so pressure setting will not change during operation of pump. A pressure gauge somewhere in the discharge line must be used for actual adjustment operation. The adjusting screw should be turned in for increasing the pressure or turned out for decreasing the pressure. With the discharge line closed at a point beyond the pressure gauge, the gauge will show the maximum pressure the valve will allow while pump is in operation.

IMPORTANT

In ordering parts for safety relief valve, always be sure to give Model and Serial Number of pump as it appears on name plate and the name of the part wanted. When ordering springs, be sure also to give the pressure setting desired.

VIKING HEAVY-DUTY PUMPS
195 SERIES



MAINTENANCE AND REPAIR INSTRUCTIONS

INTRODUCTION

The illustrations used in this article are for identification purposes only and *should not be used for ordering parts.* Secure a parts list from the factory or a Viking representative. Always give complete name of part, part number and material with the model and serial number of the pump when ordering repair parts. The unmounted pump or unit model and serial number can be found on a nameplate attached to the pump or base.

In the Viking model number system, the basic size letters are combined with the series number (195) indicating both the unmounted or mounted pump units.

UNMOUNTED PUMP AND UNIT MODEL NUMBERS

UNMOUNTED PUMP MECH. SEAL	UNIT
GG195 HJ195 HL195 AS195 AK195 AL195	Units are designated by the unmounted pump model numbers followed by a letter indicating drive style. D—Direct Drive

Maintenance

Model 195 pumps are designed for long, trouble free life under a wide variety of application conditions with a minimum of maintenance, however the following should be considered:

1. END CLEARANCE ADJUSTMENT—After long term operation it is sometimes possible to improve the performance of the pump, without major repair, thru adjustment of end clearance of the pump. Refer to instructions under Re-assembly of the pump for information regarding this procedure.
2. CLEANING THE PUMP—It is good practice to keep the pump as clean as possible. This will facilitate inspection, adjustment and repair work and help prevent omission of lubrication to fittings covered or hidden with dirt.
3. STORAGE—If the pump is to be stored or not used for any appreciable length of time it should be drained and a light coat of lubricating and preservative oil should be applied to the internal parts. Lubricate all fittings.

Disassembly

1. Remove the head capscrews.
2. Remove the head and O-Ring gasket.

CAUTION: AVOID TILTING THE HEAD DOWN, AS THE IDLER MAY SLIDE OFF.

3. Remove the idler from the idler pin. If the idler pin is worn, the head, idler pin and the idler bushing should be replaced.
   If the idler bushing is worn, it is strongly recommended that the idler and bushing be replaced. This bushing can be replaced in the field, but is very difficult. It is a brittle material, and extreme care should be taken to prevent breaking when it is being installed in the idler. If it is cracked in the idler, this bushing will quickly disintegrate. A hydraulic press should be used to install carbon graphite bushings. Be sure the bushing is started straight. DO NOT STOP the pressing operation until the bushing is in the proper position.
4. Remove the locknut from the shaft. A piece of brass rod or hardwood inserted in the port opening will hold the shaft from turning.
5. The rotor and shaft can now be removed from the casing. The spring and rotary member of the mechanical seal will come out with the shaft.

NOTE: On the HJ and HL size pumps the bearing housing and double row ball bearing must be removed before the snap ring in the shaft can be removed. The rotor and shaft cannot be removed until the snap ring is removed from the shaft.

6. Loosen the two (2) setscrews in the end of the bearing housing, turn the bearing housing coun-

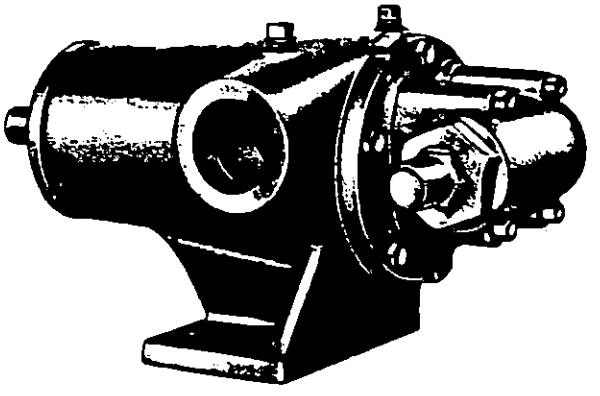


FIGURE 1
GG, HJ AND HL195 UNMOUNTED PUMP

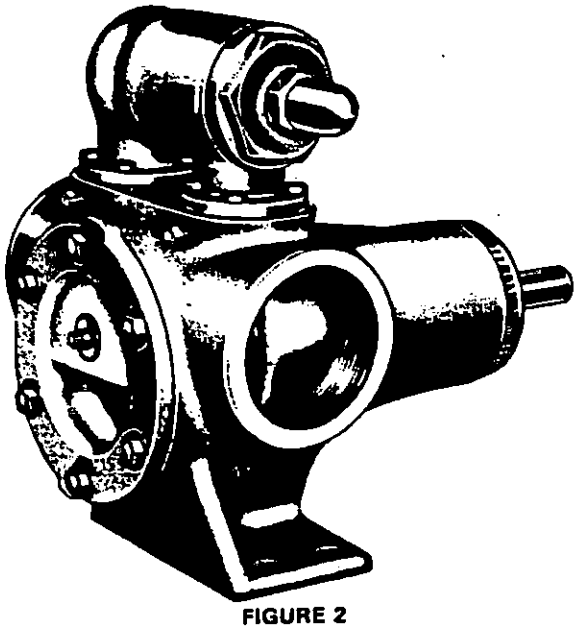


FIGURE 2
AS, AK AND AL195 UNMOUNTED PUMP

terclockwise and remove from the casing. Remove the snap ring from the bearing housing on GG, HJ and HL size pumps and the double row ball bearing can be removed. On the AS, AK, and AL size pumps you must loosen the setscrews in the outer ring of the bearing housing and remove bearing housing end cap, closure and bearing collar. Use a spanner wrench to remove the end cap.

Wash the bearing thoroughly and examine. If there is any evidence of wear or damage, a new bearing should be used.

7. Remove the snap ring and casing ball bearing in the GG, HJ and HL size pumps. Remove the bearing spacer in the AS, AK and AL size pumps. The bearing retainer washer, located between the casing bearing and seal seat, can now be removed if it did not stay on the rotor shaft when the shaft was removed.
8. The seal seat or stationary part of the seal can now be removed from the casing.
9. The casing should be examined for wear, particularly at the seal area between the port openings.

All parts should be checked for wear before the pump is put together. When making major repairs, such as replacing a rotor and shaft, it is usually advisable to also install a new head and idler.

Reassembly

1. Installing New Seal: See Figure 3. The seal is simple to install and good performance will result if care is taken in its installation.

NOTE: Never touch the sealing faces with anything except the fingers or a clean cloth. Clean the rotor hub, shaft and seal seat housing in the casing, making sure they are clean and free from dirt and grit.

Coat the outside diameter of the seal seat and the inside diameter of the seal housing bore with light oil. With thumb and forefinger, push the seal seat into place in the casing.

Place the tapered sleeve (furnished with replacement seals) on the shaft as far as it will go. Thin end must be toward end of shaft. See Figure 3. Coat the inside of the rotary member and the outside of the tapered sleeve with light oil. Be sure the shaft is free of nicks and burrs. Place the spring and rotary member on the shaft, spring first, over the sleeve and against the hub of the rotor. *Remove the tapered sleeve.*

2. Flush the sealing faces of both the rotary member and seal seat with light oil and install rotor and shaft. Push the rotor and shaft into the casing slowly until the ends of the rotor teeth are just beyond the face of the casing.
3. Place the idler on the idler pin and the O-ring head gasket on the head. Place the head assembly on the pump and tighten the capscrews evenly and securely. The seal is now automatically compressed to its proper working length.
4. Pack the single row ball bearing with grease and install in the casing. Install the snap ring in GG, HJ and HL pumps.

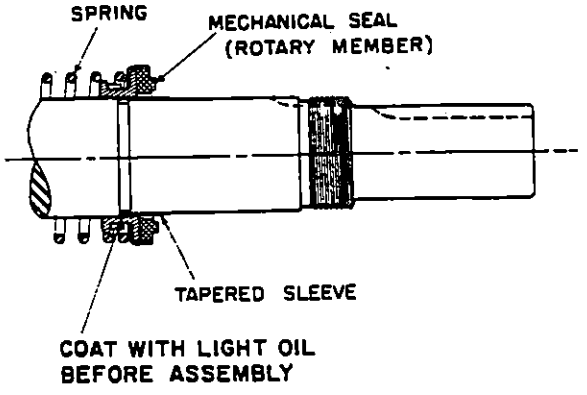


FIGURE 3

NOTE: The AS, AK and AL pumps do not have a snap ring, but the bearing retainer washer must be assembled over the end of the shaft before the bearing is assembled.

5. Place the bearing spacer over the shaft and against the single row ball bearing in the casing. (AS, AK, & AL size pumps).
6. Install the snap ring in the groove in the shaft on the HJ or HL size pumps.
7. Pack the lubrication chamber between the casing ball bearing and the double row ball bearing in the bearing housing approximately half full with *lithium base ball bearing grease.*
8. Pack the double row ball bearing with *lithium base ball bearing grease* and press into the bearing housing. Install the snap ring to hold the bearing in place.

NOTE: On AS, AK and AL pumps, install the closure in the bearing housing end cap. Put the bearing spacer sleeve in the closure and install this in the bearing housing and tighten securely.

9. Start the bearing housing into the casing. Turn by hand until tight. This forces the rotor against the head. Replace and tighten the locknut on the shaft. Insert a piece of brass or hardwood through the port opening between the rotor teeth to keep the shaft from turning.
10. Adjust the pump end clearance as follows:

Thrust Bearing Adjustment

Loosen the two setscrews in the bearing housing and turn counterclockwise ½" measured on the outside of the bearing housing of GG, HJ and HL size pumps. This represents approximately .003" end clearance. On the AS, AK and AL size pumps, turn the thrust bearing assembly counterclockwise two notches which represents approximately .003" end clearance.

NOTE: Be sure the shaft can be rotated freely. If not, turn the bearing housing counterclockwise until the shaft can be turned. Be sure set screws are tightened securely after adjustment is made. High viscosity liquids require additional end clearance. The amount of end clearance depends on the viscosity of the liquid being pumped.

VIKING HEAVY-DUTY PUMPS
195 SERIES

MAINTENANCE AND REPAIR INSTRUCTIONS

Disassembly

1. Remove valve cap.
2. Measure and record the length of extension of the adjusting screw.
3. Loosen the lock nut and back out adjusting screw until spring pressure is released.
4. Remove bonnet spring guide, spring and poppet from valve body. Clean and inspect all parts for wear or damage and repair or replace as necessary.

Reassembly

Follow the procedure outlined under disassembly. If valve is removed for repairs, be sure to replace in same position. The valve cap should point towards the suction port.

Valve Instructions

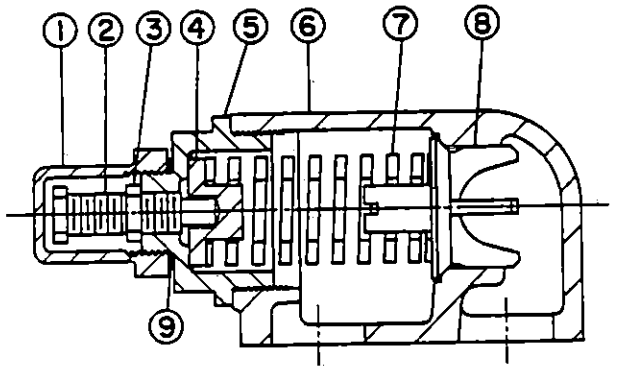


FIGURE 4 GG, HJ, HL SIZE VALVE

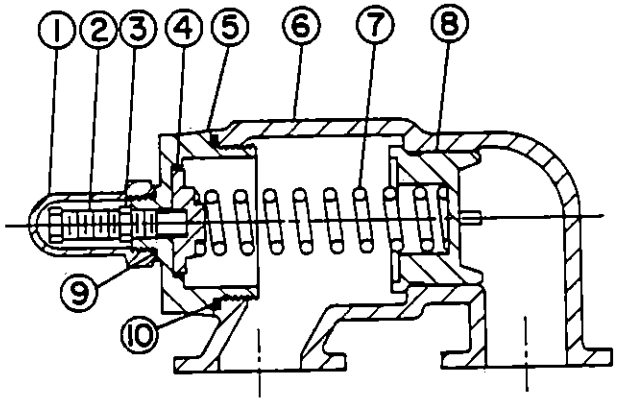


FIGURE 5 AS, AK, AL SIZE VALVE

LIST OF PARTS

1. Valve Cap
2. Adjusting Screw
3. Lock Nut
4. Spring Guide
5. Bonnet
6. Valve Body
7. Valve Spring
8. Poppet
9. Cap Gasket
10. Bonnet Gasket

Pressure Adjustment

If the pressure setting of the valve is to be changed from that which the factory has set, the following instructions should be carefully followed: Remove the valve cap which covers the adjusting screw, and loosen the lock nut which locks the adjusting screw so pressure setting will not change during operation of pump. A pressure gauge somewhere in the discharge line must be used for actual adjustment operation. The adjusting screw should be turned in for increasing the pressure or turned out for decreasing the pressure. With the discharge line closed at a point beyond the pressure gauge, the gauge will show the maximum pressure the relief valve will allow while pump is in operation.

Important

In ordering parts for relief valve on head, always be sure to give Model and Serial Number of pump as it appears on name plate and the name of the part wanted. When ordering springs, be sure to give the pressure setting desired.

VIKING HEAVY-DUTY PUMPS
195 SERIES

MAINTENANCE AND REPAIR INSTRUCTIONS

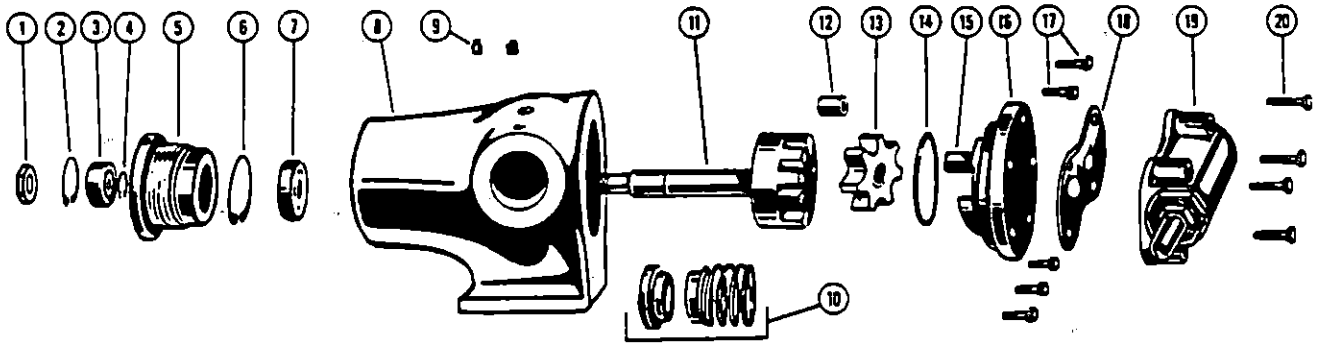


FIGURE 6 EXPLODED VIEW GG, HJ, HL195 PUMPS

ITEM	NAME OF PART	ITEM	NAME OF PART	ITEM	NAME OF PART	ITEM	NAME OF PART
1	Locknut	6	Snap Ring	11	Rotor and Shaft	16	Head
2	Snap Ring	7	Ball Bearing	12	Idler Bushing	17	Capscrew for Head
3	Ball Bearing	8	Casing	13	Idler	18	Gasket for Relief Valve
4	Snap Ring	9	Pipe Plug	14	O-Ring Gasket	19	Relief Valve
5	Bearing Housing	10	Mechanical Seal	15	Idler Pin	20	Capscrew

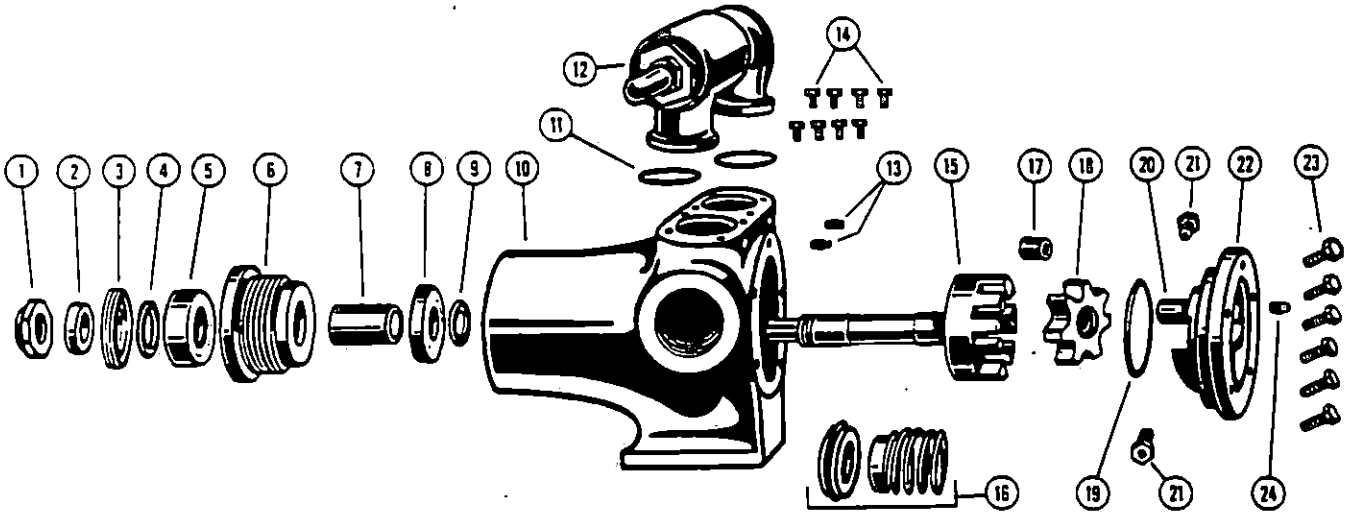
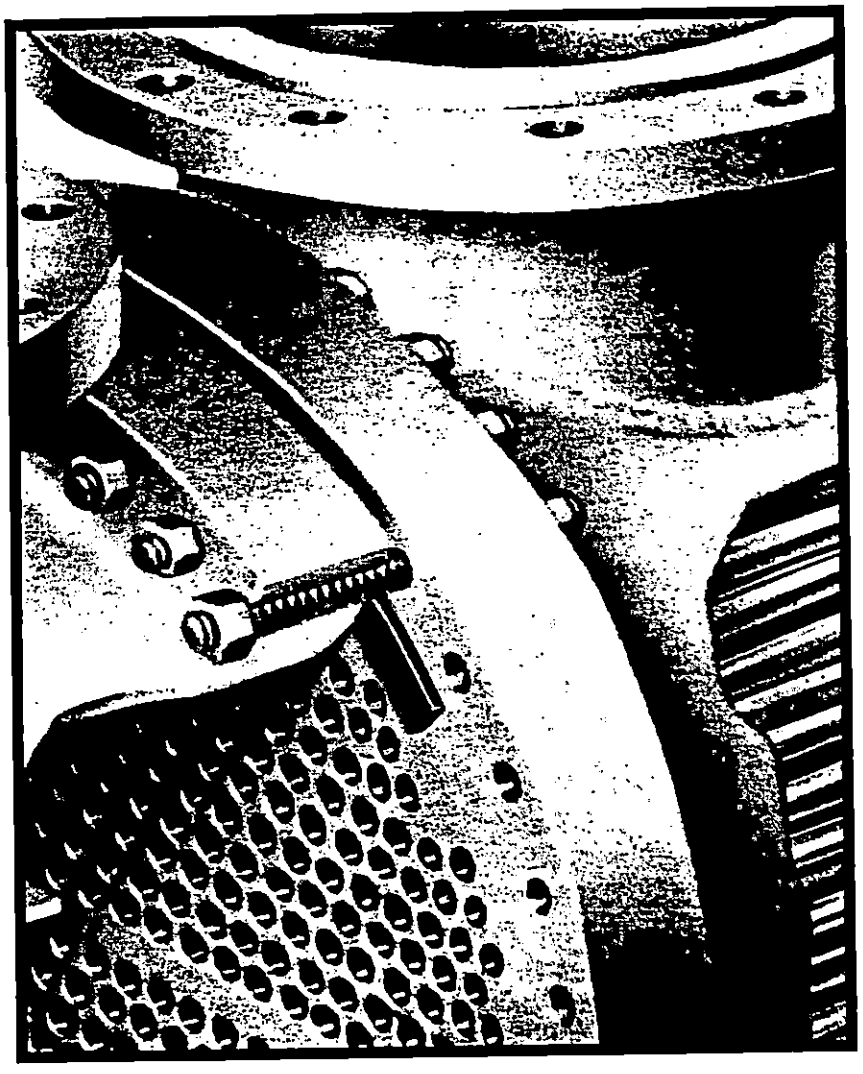


FIGURE 7 EXPLODED VIEW AS, AK, AL195 PUMPS

ITEM	NAME OF PART	ITEM	NAME OF PART	ITEM	NAME OF PART	ITEM	NAME OF PART
1	Locknut	7	Bearing Spacer	13	Pipe Plug	19	O-Ring Gasket
2	Bearing Spacer Collar	8	Ball Bearing (1-Row)	14	Capscrew for Valve	20	Idler Pin
3	End Cap for Bearing Housing	9	Bearing Retainer Washer	15	Rotor and Shaft	21	Check Valve
4	Closure for Bearing Housing	10	Casing	16	Mechanical Seal	22	Head
5	Ball Bearing (2-Row)	11	O-Ring Gasket	17	Idler Bushing	23	Capscrew for Head
6	Bearing Housing	12	Relief Valve	18	Idler	24	Pipe Plug

Heat Exchangers



Storage,
Installation,
Operation
and
Maintenance

ITT Standard
ITT Fluid Technology Corporation

This bulletin has been prepared as an aid and guide to maintenance personnel. Read it thoroughly prior to installation of any ITT Standard heat exchanger in order to ensure correct installation and best performance.

NOTE: Before placing this equipment in operation, environment and service conditions should be checked for compatibility with materials of construction. Contact your nearest ITT Standard representative if you are not sure what the actual materials of construction are.

Successful performance of heat transfer equipment, length of service and freedom from operating difficulties are largely dependent upon:

1. Proper thermal design.
2. Proper physical design.
3. Storage practice prior to installation.
4. Manner of installation, including design of foundation and piping.
5. The method of operation.
6. The thoroughness and frequency of cleaning.
7. The materials, workmanship, and tools used in maintenance and making repairs and replacements.

Failure to perform properly may be due to one or more of the following:

1. Exchanger being dirty.
2. Failure to remove preservation materials after storage.
3. Operating conditions being different than design conditions.
4. Air or gas binding.
5. Incorrect piping connections.
6. Excessive clearances between internal parts due to corrosion.
7. Improper application.

Storage

ITT Standard heat exchangers are protected against the elements during shipment. If they cannot be installed and put into operation immediately upon receipt at the jobsite, certain precautions are necessary to prevent deterioration during storage. Responsibility for integrity of the heat exchangers must be assumed by the user. ITT Standard will not be responsible for damage, corrosion or other deterioration of heat exchanger equipment during transit and storage.

Good storage practices are important, considering the high costs of repair or replacement, and the possible delays for items which require long lead times for manufacture. The following suggested practices are provided solely as a convenience to the user, who shall make his own decision on whether to use all or any of them.

1 On receipt of the heat exchanger, inspect for shipping damage to all protective covers. If damage is evident, inspect for possible contamination and replace protective covers as required. If damage is extensive, notify the carrier immediately.

2 If the heat exchanger is not to be placed in immediate service, take precautions to prevent rusting or contamination.

3 Heat exchangers for oil service, made of ferrous materials, may be pressure-tested with oil at the factory. However, the residual oil coating on the inside surfaces of the exchanger does not preclude the possibility of rust formation. Upon receipt, fill these exchangers with appropriate oil or coat them with a corrosion prevention compound for storage. These heat exchangers have a large warning decal, indicating that they should be protected with oil.

4 The choice of preservation of interior surfaces during storage for other service applications depends upon your system requirements and economics. Only when included in the original purchase order specifications will specific preservation be incorporated prior to shipment from the factory.

5 Remove any accumulations of dirt, water, ice or snow and wipe dry before moving exchangers into indoor storage. If unit was not filled with oil or other preservative, open drain plugs to remove any accumulated moisture, then reseal. Accumulation of moisture usually indicates rusting has already started and remedial action should be taken.

6 Store under cover in a heated area, if possible. The ideal storage environment for heat exchangers and accessories is indoors, above grade, in a dry, low-humidity atmosphere which is sealed to prevent entry of blowing dust, rain or snow. Maintain temperatures between 70°F and 105°F (wide temperature swings may cause condensation and "sweating" of steel parts). Cover windows to prevent temperature variations caused by sunlight. Provide thermometers and humidity indicators at several points, and maintain atmosphere at 40% relative humidity or lower.

7 In tropical climates, it may be necessary to use trays of renewable dessicant (such as silica gel), or portable dehumidifiers, to remove moisture from the air in the storage enclosure. Thermostatically controlled portable heaters (vented to outdoors) may be required to maintain even air temperatures inside the enclosure.

8 Inspect heat exchangers and accessories frequently while they are in storage. Start a log to record results of inspections and maintenance performed while units are in storage. A typical log entry should include, for each component, at least the following:

a. Date
b. Inspector's name
c. Identification of unit or item
d. Location
e. Condition of paint or coating
f. Condition of interior
g. Is free moisture present?
h. Has dirt accumulated?
i. Corrective steps taken

9 If paint deterioration begins, as evidenced by discoloration or light rusting, consider touch-up or repainting. If the unit is painted with our standard shop enamel, areas of light rust may be wire brushed and touched-up with any good quality air-drying synthetic enamel. Units painted with special paints (when specified on customers' orders) may require special techniques for touch-up or repair. Obtain specific information from the paint manufacturer. Painted steel units should never be permitted to rust or deteriorate to a point where their strength will be impaired. But a light surface rusting, on steel units which will be re-painted after installation, will not generally cause any harm. (See Items 3 and 4 for internal surface preservation.)

10 If the internal preservation (Items 3 and 4) appears inadequate during storage, consider additional corrosion prevention measures and more frequent inspections. Interiors coated with rust preventive should be restored to good condition and re-coated promptly if signs of rust occur.

CAUTION:
Provide fire extinguishers, fire alarms or telephone to protect building and equipment against fire damage. Be sure that the building and storage practices meet all local, state, and federal fire and safety codes.

Installation Planning

1 On removable bundle heat exchangers, provide sufficient clearance at the stationary end to permit the removal of the tube bundle from the shell. On the floating head end, provide space to permit removal of the shell cover and floating head cover.

2 On fixed bundle heat exchangers, provide sufficient clearance at one end to permit removal and replacement of tubes and at the other end provide sufficient clearance to permit tube rolling.

3 Provide valves and bypasses in the piping system so that both the shell side and tube side may be bypassed to permit isolation of the heat exchanger for inspection, cleaning and repairs.

4 Provide convenient means for frequent cleaning as suggested under maintenance.

5 Provide thermometer wells and pressure gauge pipe taps in all piping to and from the heat exchanger, located as close to the heat exchanger as possible.

6 Provide necessary air vent valves for the heat exchanger so that it can be purged to prevent or relieve vapor or gas binding on both the tube side and shell side.

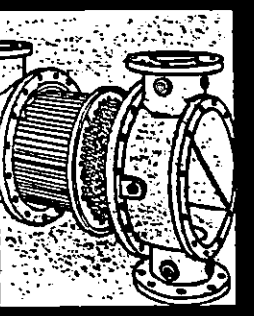
7 Provide adequate supports for mounting the heat exchanger so that it will not settle and cause piping strains. Foundation bolts should be set accurately. In concrete footings, pipe sleeves at least one pipe size larger than the bolt diameter slipped over the bolt and cast in place are best for this purpose as they allow the bolt centers to be adjusted after the foundation has set.

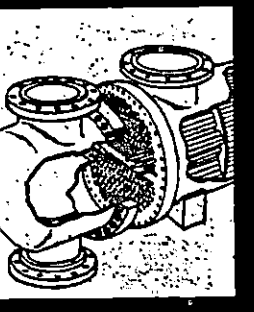
8 Install proper liquid level controls and relief valves and liquid level and temperature alarms, etc.

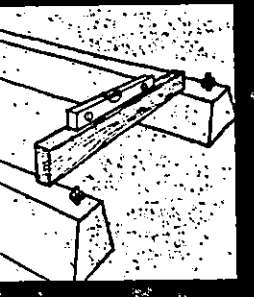
9 Install gauge glasses or liquid level alarms in all vapor or gas spaces to indicate any failure occurring in the condensate drain system and to prevent flooding of the heat exchanger.

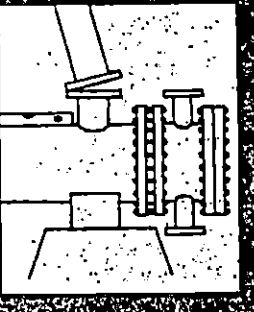
10 Install a surge drum upstream from the heat exchanger to guard against pulsation of fluids caused by pumps, compressors or other equipment.

11 Do not pipe drain connections to a common closed manifold; it makes it more difficult to determine that the exchanger has been thoroughly drained.

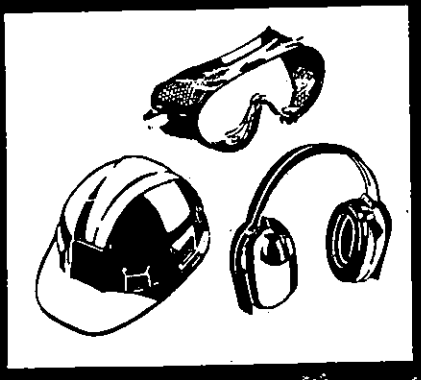








CAUTION:
Dress properly for the job. You may need any number of special items — safety hat, safety shoes, goggles, heavy gloves, ear protective devices, etc., for your own protection. Find out what items are required and wear them.



CAUTION:
A heat exchanger is a pressure vessel designed for operation at certain specific limits of pressure and temperature. The cooling or process system, which includes the heat exchanger, must be safeguarded with safety valves and controls so that these heat exchanger design conditions are not exceeded. All operating personnel should be made aware of these specific design pressures and temperatures.

CAUTION:
Many heat exchangers circulate fluids which are irritating or dangerous to the human system. These fluids could cause problems if bolted or threaded joints are not maintained in a leak-tight condition at operating pressures, temperatures and no-flow ambient conditions.

Installation at Jobsite

1 If you have maintained the heat exchanger in storage, thoroughly inspect it prior to installation. Make sure it is thoroughly cleaned to remove all preservation materials unless stored full of the same oil being used in the system, or the coating is soluble in the lubricating system oil.

If the exchanger was oil-tested by ITT Standard and your purchase order did not specify otherwise, the oil used was Tectyl 754, a light-bodied oil which is soluble in most lubricating oils. Where special preservations were applied, you should consult the preservative manufacturer's product information data for removal instructions.

2 If the heat exchanger is not being stored, inspect for shipping damage to all protective covers upon receipt at the jobsite. If damage is evident, inspect for possible contamination and replace protective covers as required. If damage is extensive, notify the carrier immediately.

3 When installing, set heat exchanger level and square so that pipe connections can be made without forcing.

4 Before piping up, inspect all openings in the heat exchanger for foreign material. Remove all wooden plugs, bags of dessicant and shipping covers immediately prior to installing. Do not expose internal passages of the heat exchanger to the atmosphere since moisture or harmful contaminants may enter the unit and cause severe damage to the system due to freezing and/or corrosion.

5 After piping is complete, if support cradles or feet are fixed to the heat exchanger, loosen foundation bolts at one end of the exchanger to allow free movement. Oversized holes in support cradles or feet are provided for this purpose.

6 If heat exchanger shell is equipped with a bellows-type expansion joint, remove shipping supports per instructions.

Operation

1 Be sure entire system is clean before starting operation to prevent plugging of tubes or shell side passages with refuse. The use of strainers or settling tanks in pipelines leading to the heat exchanger is recommended.

2 Open vent connections before starting up.

3 Start operating gradually. See Table 1 for suggested start-up and shut-down procedures for most applications. If in doubt, consult the nearest ITT Standard representative for specific instructions.

4 After the system is completely filled with the operating fluids and all air has been vented, close all manual vent connections.

5 Re-tighten bolting on all gasketed or packed joints after the heat exchanger has reached operating temperatures to prevent leaks and gasket failures. Standard published torque values do not apply to packed end joints.

6 Do not operate the heat exchanger under pressure and temperature conditions in excess of those specified on the nameplate.

7 To guard against water hammer, drain condensate from steam heat exchangers and similar apparatus both when starting up and shutting down.

8 Drain all fluids when shutting down to eliminate possible freezing and corroding.

9 In all installations there should be no pulsation of fluids, since this causes vibration and will result in reduced operating life.

10 Under no circumstances is the heat exchanger to be operated at a flowrate greater than that shown on the design specifications. Excessive flows can cause vibration and severely damage the heat exchanger tube bundle.

11 Heat exchangers that are out of service for extended periods of time should be protected against corrosion as described in the storage requirements for new heat exchangers.

Heat exchangers that are out of service for short periods and use water as the flowing medium should be thoroughly drained and blown dry with warm air, if possible. If this is not practical, the water should be circulated through the heat exchanger on a daily basis to prevent stagnant water conditions that can ultimately precipitate corrosion.

RECOMMENDED START-UP AND SHUT-DOWN PROCEDURES

CAUTION: Every effort should be made to avoid subjecting the unit to thermal shock, overpressure, and/or hydraulic hammer, since these conditions may impose stresses that exceed the mechanical strength of the unit or the system in which it is installed which may result in leaks and/or other damage to the unit and/or system.

TABLE 1

Heat Exchanger Type of Construction	Fluid Location & Relative Temp.				Start-Up Procedure	Shut-Down Procedure
	Shell Side		Tube Side			
	Type of Fluid	Rel. Temp.	Type of Fluid	Rel. Temp.		
Fixed Tubesheet (Non-Removable Bundle)	Liquid	Hot	Liquid	Cold	Start both fluids gradually at the same time.	Shut down both fluids gradually at the same time.
	Condensing Gas (e.g., steam)	Hot	Liquid or Gas	Cold	Start hot fluid first, then slowly start cold fluid. Avoid temperature shock. (1)	Shut down cold fluid first, then hot fluid.
	Gas	Hot	Liquid	Cold	Start cold fluid first, then hot fluid.	Shut down cold fluid gradually, then hot fluid.
	Liquid	Cold	Liquid	Hot	Start both flows gradually at the same time.	Shut down both fluids gradually at the same time.
	Liquid	Cold	Gas	Hot	Start cold fluid first, then hot fluid.	Shut down hot fluid first, then cold fluid.
U-Tube Packed Floating Head Packed Floating Tubesheet Internal Floating Head (All these types have Removable Bundles)	Liquid	Hot	Liquid	Cold	Start cold fluid first, then start hot fluid gradually.	Shut down hot fluid first, then cold fluid.
	Condensing Gas (e.g., steam)	Hot	Liquid or Gas	Cold	Start cold fluid first, then start hot fluid gradually.	Shut down cold fluid first, then shut down hot fluid gradually.
	Gas	Hot	Liquid	Cold	Start cold fluid first, then start hot fluid gradually.	Shut down hot fluid first, then cold fluid.
	Liquid	Cold	Liquid	Hot	Start cold fluid first, then start hot fluid gradually.	Shut down hot fluid first, then cold fluid.
	Liquid	Cold	Gas	Hot	Start cold fluid first, then start hot fluid gradually.	Shut down hot fluid first, then cold fluid.

General Comments:

1.) In all start-up and shut-down operations, fluid flows should be regulated so as to avoid thermal shocking the unit regardless of whether the unit is of either a removable or non-removable type construction.

2.) For fixed tubesheet (non-removable bundle) type units where the tube side fluid cannot be shut down, it is recommended that: a) A bypass arrangement be incorporated in the system; and, b) the tube side fluid be bypassed before the shell side fluid is shut down.

3.) Extreme caution should be taken on insulated units where fluid flows are terminated and then restarted. Since the metal parts could remain at high temperatures for an extended period, severe thermal shock could occur.

Maintenance

1 Clean exchangers subject to fouling (scale, sludge deposits, etc.) periodically, depending on specific conditions. A light sludge or scale coating on either side of the tube greatly reduces its effectiveness. A marked increase in pressure drop and/or reduction in performance usually indicates cleaning is necessary. Since the difficulty of cleaning increases rapidly as the scale thickens or deposits increase, the intervals between cleanings should not be excessive.

2 Neglecting to keep tubes clean may result in random tube plugging. Consequent overheating or cooling of the plugged tubes, as compared to surrounding tubes, will cause physical damage and leaking tubes due to differential thermal expansion of the metals.

3 To clean or inspect the inside of the tubes, remove only the necessary tube side channel covers or bonnets, depending on type of exchanger construction.

4 If the heat exchanger is equipped with sacrificial anodes or plates, replace these as required.

5 To clean or inspect the outside of the tubes, it may be necessary to remove the tube bundle. (Fixed tubesheet exchanger bundles are non-removable).

6 When removing tube bundles from heat exchangers for inspection or cleaning, exercise care to see that they are not damaged by improper handling.

- The weight of the tube bundle should not be supported on individual tubes but should be carried by the tubesheets, support or baffle plates or on blocks contoured to the periphery of the tube bundles.
- Do not handle tube bundles with hooks or other tools which might damage tubes. Move tube bundles on cradles or skids.
- To withdraw tube bundles, pass rods through two or more of the tubes and take the load on the floating tubesheet.
- Rods should be threaded at both ends, provided with nuts, and should pass through a steel bearing plate at each end of the bundle.
- Insert a soft wood filler board between the bearing plate and tubesheet face to prevent damage to the tube ends.
- Screw forged steel eyebolts into both bearing plates for pulling and lifting.
- As an alternate to the rods, thread a steel cable through one tube and return through another tube.
- A hardwood spreader block must be inserted between the cable and each tubesheet to prevent damage to the tube ends.

7 If the heat exchanger has been in service for a considerable length of time without being removed, it may be necessary to use a jack on the floating tubesheet to break the bundle free.

- Use a good-sized steel bearing plate with a filler board between the tubesheet face and bearing plate to protect the tube ends.

8 Lift tube bundles horizontally by means of a cradle formed by bending a light-gauge plate or plates into a U-shape. Make attachments in the legs of the U for lifting.

9 Do not drag bundles, since baffles or support plates may become easily bent. Avoid any damage to baffles so that the heat exchanger will function properly.

10 Some suggested methods of cleaning either the shell side or tube side are listed below:

- Circulating hot wash oil or light distillate through tube side or shell side will usually effectively remove sludge or similar soft deposits.
- Soft salt deposits may be washed out by circulating hot fresh water.
- Some commercial cleaning compounds such as "Oakite" or "Dowell" may be effective in removing more stubborn deposits. Use in accordance with the manufacturer's instructions.

11 Some tubes have inserts or longitudinal fins and can be damaged by cleaning when mechanical means are employed. Clean these types of tubes chemically or consult the nearest ITT Standard representative for the recommended method of cleaning.

- If the scale is hard and the above methods are not effective, use a mechanical means. Neither the inside nor the outside of the tube should be hammered with a metallic tool. If it is necessary to use scrapers, they should not be sharp enough to cut the metal of the tubes. Take extra care when employing scrapers to prevent tube damage.

Do not attempt to clean tubes by blowing steam through individual tubes. This overheats the individual tube and results in severe expansion strains and leaking tube-to-tubesheet joints.

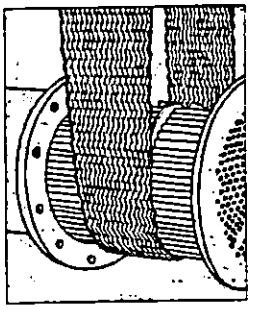
12 Table 2 shows safe loads for steel rods and eyebolts.

STEEL RODS			STEEL EYEBOLTS	
Tube Size	**Rod Size**	**Safe Load Per Rod**	**Size**	**Safe Load**
5/8"	3/8"	1,000 lbs.	3/4"	4,000 lbs.
3/4"	1/2"	2,000 lbs.	1"	6,000 lbs.
1" or larger	5/8"	3,000 lbs.	1-1/4"	10,000 lbs.
			1-1/2"	15,000 lbs.

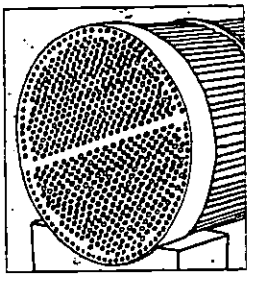
TABLE 2

13 To locate ruptured or corroded tubes or leaking joints between tubes and tubesheets, the following procedure is recommended:

- Remove tube side channel covers or bonnets.
- Pressurize the shell side of the exchanger with a cold fluid, preferably water.
- Observe tube joints and tube ends for indication of test fluid leakage.

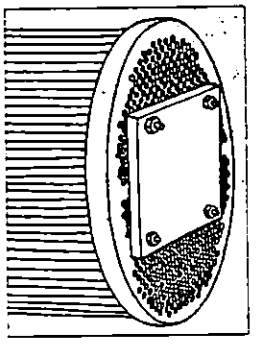


14 With certain styles of exchangers, it will be necessary to buy or make a test ring to seal off the space between the floating tubesheet and inside shell diameter to apply the test in paragraph 13. Consult your nearest ITT Standard sales representative for reference drawings showing installation of a test ring in your heat exchanger.



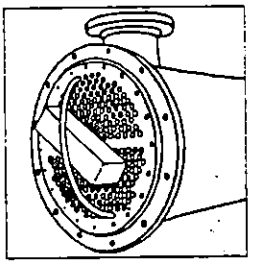
15 To tighten a leaking tube joint, use a suitable parallel roller tube expander.

- Do not roll tubes beyond the back face of the tubesheet. Maximum rolling depth should be tubesheet thickness minus 1/8".
- Do not re-roll tubes that are not leaking since this needlessly thins the tube wall.



16 It is recommended that when a heat exchanger is dismantled, new gaskets be used in reassembly.

- Composition gaskets become brittle and dried out in service and do not provide an effective seal when reused.
- Metal or metal jacketed gaskets in initial compression match the contact surfaces and tend to work-harden and cannot be recompressed on reuse.



17 Use of new bolting in conformance with dimension and ASTM specifications of the original design is recommended where frequent dismantling is encountered.

CAUTION:
Do not remove channel covers, shell covers, floating head covers or bonnets until all pressure in the heat exchanger has been relieved and both shell side and tube side are completely drained.

CAUTION:
Since many of the removable components of the heat exchanger, particularly in the larger sizes, are too heavy for people to handle, care must be used to take this weight with proper rigging to avoid injury. Wear hard hats and safety shoes as required.

CAUTION:
Do not thread rods or cables through tubes of a heat exchanger equipped with ITT Standard Amatrand tubes, or any with internal fins.

CAUTION:
When the heat exchanger is cleaned, it is important that full characteristics of the fouling material and the cleaning agent be known and care exercised in handling them according to instructions. Use eye protection to prevent damage to your eyes. Wear a respirator when required.

CAUTION:
Do not blow out heat exchangers with air when the normal process fluids or the cleaning fluids being handled are inflammable.

Warranty

WARRANTY OF SELLER'S PRODUCTS

Except where a different express warranty has been issued with respect to a particular product, no warranty of any kind, express or implied, is extended by the seller to any person or persons other than its direct Buyers. To direct Buyers, the Seller warrants only that it will furnish by freight a replacement for, or at its option repair, any product of its manufacture or part or portion thereof, proved to its satisfaction to be defective in material or workmanship under normal use and service (i) within a period of six (6) months from date of shipment as to those parts which contain perishable elastomers or (ii) within one year from the date all other equipment or part thereof is first placed in use, or two years from the date of shipment, whichever shall be less.

The Seller shall have no responsibility for the performance of any product sold by it under conditions varying materially from those under which such product is usually tested under existing industry standards, nor for any damage to the product from abrasion, erosion, corrosion, deterioration or the like due to abnormal temperatures or corrosive fluids or the influence of foreign matter or energy, or flow induced vibration caused by associated equipment or external influences; nor for the design or operation of any system of which any such product may be made a part or for the suitability of any such product for any particular application. The Seller shall not be liable for any cost or expense, including, without limitation, labor expense, in connection with the removal or replacement of alleged defective equipment or any part or portion thereof nor for incidental or consequential damages of any kind, nor under any circumstances for any damage beyond the price of the goods sold. Any freight allowance in connection with a replacement will be on the same terms as were applicable to the original sale, except that a replacement for a product or part or portion thereof which is proved to the Seller's satisfaction to be defective in material or workmanship as provided herein above, will in any event be furnished with freight (but not local cartage) allowed, within the country of origin, to the first destination. Any substitution of parts not of Seller's manufacture or not authorized by Seller, or any modification, tampering, or manipulation of Seller's product, shall void the warranty.

Other Warranties — The foregoing warranty is in lieu of all other warranties of any kind, express or implied, and of all other obligations or liabilities, on the part of the Seller. The Seller neither assumes, nor does it authorize any other person to assume on its behalf, any other liability in connection with the sale of its products.

Seller expressly disclaims the implied warranties of merchantability and fitness for a particular purpose.

Goods of Other Manufacturers — Goods of other manufacturers sold by the Seller are not warranted except by express warranties which may be issued in writing from time to time with respect to a particular product or a particular sale; but the Seller will endeavor to secure for its direct Buyers the benefits of warranties extended by the manufacturers of such goods sold but not manufactured by the Seller.

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Issued 6-24-83
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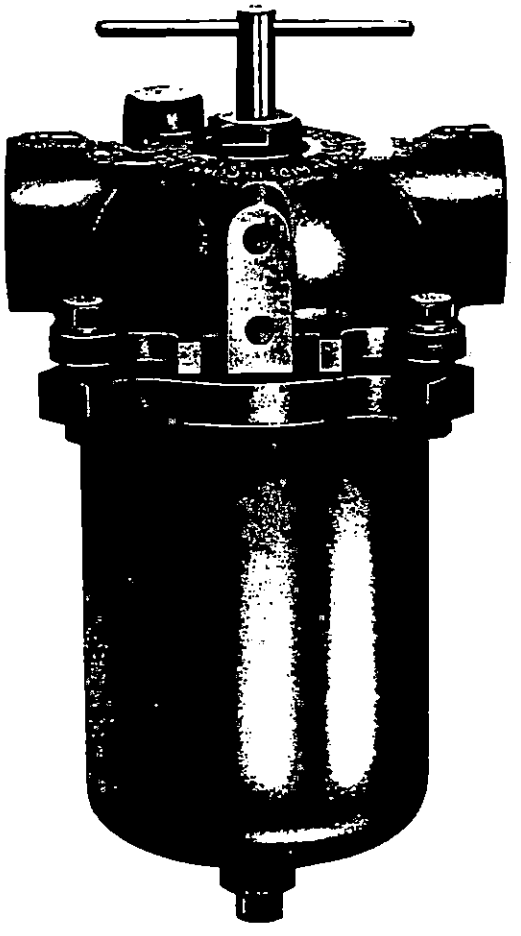
specifications

MODEL EG & EGS
AUTO-KLEAN® FILTER
SUPER AUTO-KLEAN® FILTER

All metal filter. Edge type metal cartridge is cleanable without interrupting flow by one complete turn of the handle. Sump is gasket sealed and held to the head by a clamping ring and four bolts . . . can be removed without disturbing pipe connections. Mounting holes are drilled and tapped permitting the filter to be mounted to a vertical surface. Vent screw and sludge drain are provided.

Model EGU is listed by Underwriters' Laboratory File MP 485 as suitable for service on oil burners for pressures up to 100 psi and for capacities up to 158 gallons per hour. The Underwriters' Laboratory rating for gallons per hour burning rate equals the free area in square inches of the cartridge x 10.



SPECIFICATIONS	EG AUTO-KLEAN	EGS SUPER AUTO-KLEAN
Filter Data		
inlet-outlet	1" or 1½" NPTF	
drain connection	3/4" NPT	
vent size	1/8" NPT	
max. operating pressure	125 psi @ 200°F	
sludge capacity		
5" cartridge	16.2 cu. in.	
8" cartridge	11.0 cu. in.	
approx. shipping weight		
5" cartridge	24 lbs.	
8" cartridge	25 lbs.	
Housing Data		
head	cast iron	
sump	drawn steel	
head gasket	Buna N/cork	
gland packing	teflon-asbestos	
Cartridge Data		
cartridge diameter	2¼"	2¼"
cartridge lengths	5" or 8"	5" or 8"
cartridge materials	steel or 304 stain. st.	steel or 316 stain. st.
spacings	.0035", .005" .008" or .0150"	.0015"

FILTER CATALOG NUMBERS

Filter Model	Cart. Length	Spacing	Filter Catalog No.	Cartridge Catalog No.
1" NPTF Connections — Steel Cartridge				
EGS*	5"	.0015"	12838-21-50-0015	12840-03-50-0015
EG	5"	.0035"	12318-25-50-0035	14145-08-50-0035
EG	5"	.005"	12318-25-50-0050	14145-08-50-0050
EG	5"	.008"	12318-25-50-0080	14145-08-50-0080
EG	5"	.015"	12318-25-50-0150	14145-08-50-0150
EGS*	8"	.0015"	12838-22-50-0015	12840-04-50-0015
EG	8"	.0035"	12320-29-50-0035	14145-17-50-0035
EG	8"	.005"	12320-29-50-0050	14145-17-50-0050
EG	8"	.008"	12320-29-50-0080	14145-17-50-0080
EG	8"	.015"	12320-29-50-0150	14145-17-50-0150
1½" NPTF Connections — Steel Cartridge				
EGS*	8"	.0015"	12907-16-50-0015	12840-04-50-0015
EG	8"	.0035"	11076-29-50-0035	14145-17-50-0035
EG	8"	.005"	11076-29-50-0050	14145-17-50-0050
EG	8"	.008"	11076-29-50-0080	14145-17-50-0080
EG	8"	.015"	11076-29-50-0150	14145-17-50-0150
1½" NPTF Connections — Stainless Steel Cartridge				
EGS*	8"	.0015"	12907-16-40-0015	12840-04-40-0015
EG	8"	.0035"	11076-29-40-0035	14145-17-40-0035
EG	8"	.005"	11076-29-40-0050	14145-17-40-0050
EG	8"	.008"	11076-29-40-0080	14145-17-40-0080
EG	8"	.015"	11076-29-40-0150	14145-17-40-0150

*Super Auto-Klean Filter

FILTER FLOW CAPACITY

Flow rates given in table are based on clean fluid at 3 psi pressure drop across filter. Flows at other viscosities are approximately proportional. Select filter model according to nature and concentration of suspended solids.

Filter Cart. Length	Spacing (Degree of Filtration)	Screen Mesh Equiv.	Free Area Sq. In.	VISCOSITY IN S.S.U. 100	300	700	2000
				Flow in G.P.M.			
5"	*.0015"	400	2.6	34	21	11	4.6
5"	.0035"	170	5.2	18	12	6.5	2.9
5"	.005"	120	7.9	25	16	9.0	4.2
5"	.008"	70	9.9	30	21	12	5.9
5"	.015"	40	14.3	30	26	15	7.5
8"	*.0015"	400	4.2	45	32	17	7.0
8"	.0035"	170	8.3	24	16	9.5	4.7
8"	.005"	120	12.6	29	20	12	6.1
8"	.008"	70	15.8	30	25	16	8.3
8"	.015"	40	22.9	30	30	18	9.4

OPERATING INSTRUCTIONS
MODEL EG & MODEL EGS

Before installing the filter, remove the shipping covers from the inlet and outlet ports. All steel cartridges have been covered with a vegetable type oil as a rust preventative. If this oil is incompatible with the service fluid, it should be removed by flushing with a solvent. The cartridge handle should be turned four or five revolutions during the flushing operation. This will loosen any dried or gummy oil.

INSTALLING THE FILTER

Note IN and OUT markings indicating direction of flow through filter. Filter inlet is supply end, filter outlet is discharge end. DO NOT INSTALL BACKWARDS.

Fitting a valve to the drain connection permits convenient blow-down of accumulated solids while system is under pressure.

FILTER OPERATION

The stack of discs and spacers is closed at one end with the opposite end connected to the filter housing discharge. The thickness of spacers is uniform to maintain uniform openings between discs. All fluid must penetrate the openings to pass through the filter. Turning the cartridge handle rotates the discs and spacer assembly past the fixed cleaner blades which extend into the openings between the discs. Thus, by rotating the disc and spacer assembly one revolution, in either direction, all particles lodged on or between discs are carried to the cleaner blades and are positively removed, or combed, from the surface of the filter cartridge without interruption of flow.

CLEANING THE CARTRIDGE — MOTOR DRIVEN MODELS

NEVER use a wrench or other tool to turn a cartridge which has become plugged. This will damage the cartridge. To free a plugged cartridge, close inlet and outlet line valves, drain sump, remove sump, and remove cartridge. Soak cartridge in solvent until discs can be turned freely. A filter which requires frequent turning should be replaced by a larger filter or a motor driven type.

Drain sump as often as experience indicates is necessary. During periods of shutdown or overhaul, sump should be removed for flushing and cartridge inspection. Care should be exercised not to damage discs or cleaner blades. DO NOT use a metal or hard implement to clean a cartridge.

HIGH TEMPERATURE OPERATION

Auto Klean and Super Auto-Klean filters should not be NOT be subjected to thermal shock, that is, subjected to a high temperature fluid instantaneously. The filter should be brought up to operating temperature slowly and the handle turned ONLY WHEN the filter temperature has stabilized. Special design filters for high temperature service are available.

FILTER CONVERSION

Auto-Klean filters can be converted to Super Auto-Klean cartridges if filtration in the .0015" range is desired. Conversion kits are available.

REPLACEMENT PARTS

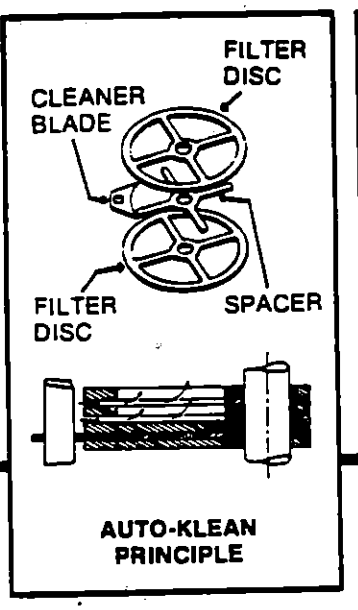
Your AMF Cuno Master Distributor stocks replacement parts for your convenience. To order, specify filter catalog number, description of part, material and quantity required.

REPLACEMENT PART IDENTIFICATION

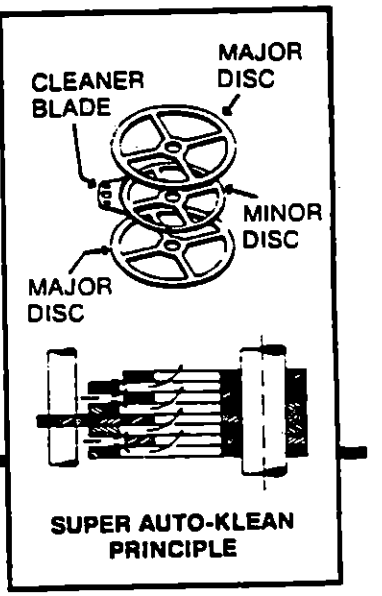
For Model EG and EGS — Assembly Nos. 11076-29-40, 11076-29-50, 12318-25-50, 12320-29-50, 12838-21-50, 12838-22-50, 12907-16-40 and 12907-16-50 ONLY

DESCRIPTION OF PART	PART MATERIAL	PART NUMBER
gland nut gland follower gland packing	brass brass teflon-asbestos	Kit 98801-03
pin handle	steel	22183-03
head — 1" NPTF	cast iron	22114-05
head — 1½" NPTF	cast iron	23911-06
head gasket	Buna N/cork	22120-31
ring	aluminum	22118-34
sump — 5" cartridge	steel	22121-00
sump — 8" cartridge	steel	23908-00
Auto-Klean cartridge		*
SUPER AUTO-KLEAN CARTRIDGE MOUNTING PARTS		
SAK cartridge seal plate	 steel 302 stain. st.	* 25869-00 25880-00
coupling pin	steel steel	Kit 98800-03
coupling pin	316 stain. st. 316 stain. st.	Kit 98800-04
bushing spacer	steel 316 stain. st.	30094-32 30094-37
upper spindle	steel 316 stain. st.	32754-32 32754-33

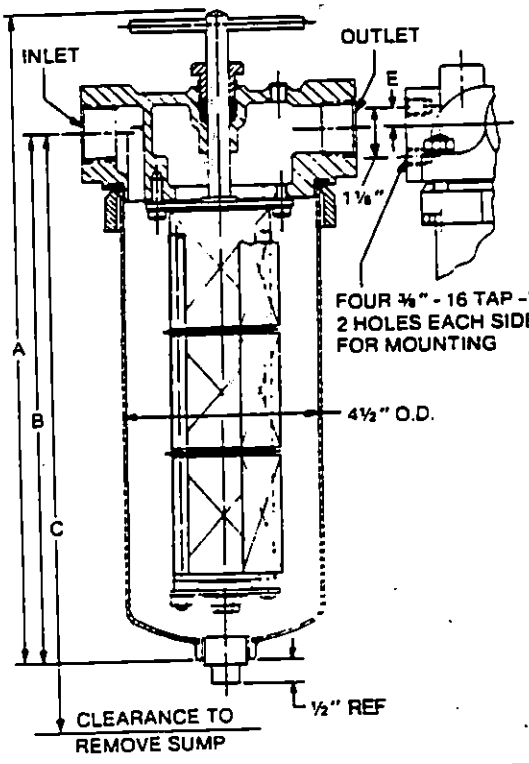
*Refer to Filter Catalog Number section

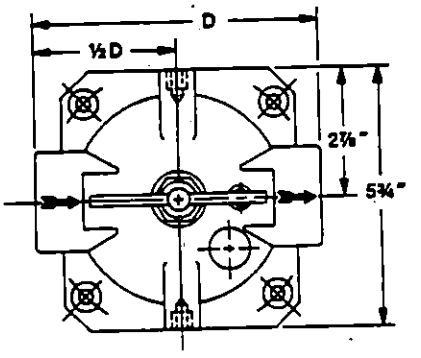


AUTO-KLEAN PRINCIPLE



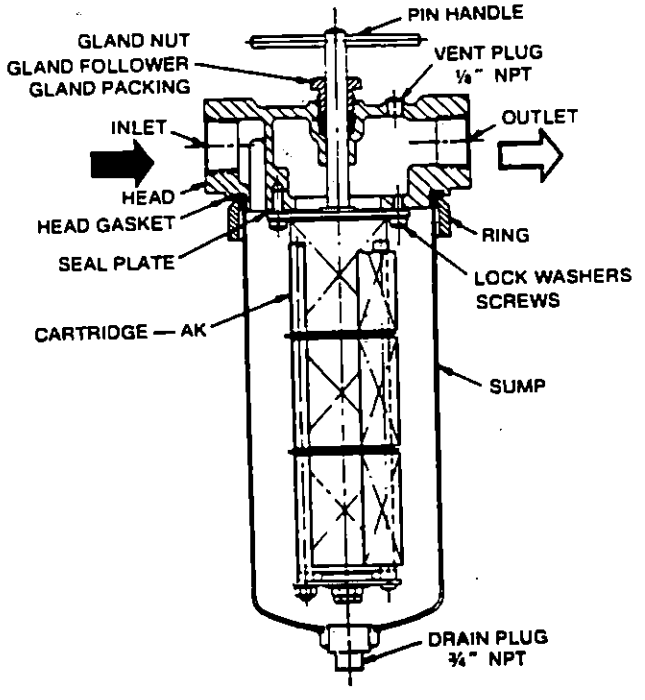
SUPER AUTO-KLEAN PRINCIPLE

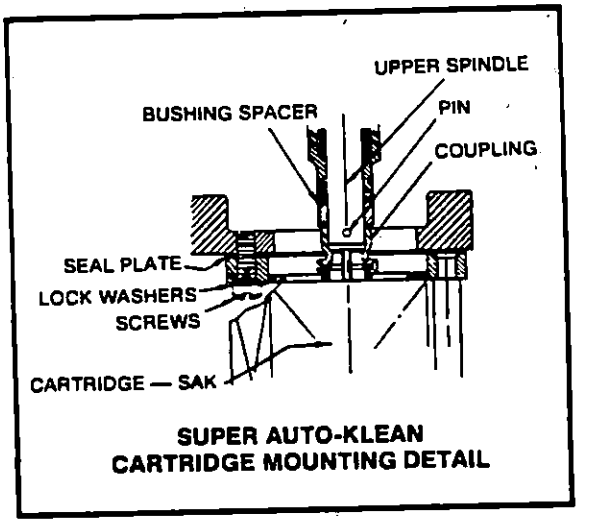




Model	Effective Ctg. Lgth.	Dimensions A	B	C
EG	5"	12½"	9⁹⁄₁₆"	18"
	8"	15⁵⁄₈"	12¼"	25"
EGS	5"	12¼"	9⁹⁄₁₆"	18"
	8"	14¾"	12¼"	25"

Inlet and Outlet NPTF	Dimensions D	E
1"	7⅜"	⅜"
1½"		





SUPER AUTO-KLEAN CARTRIDGE MOUNTING DETAIL

series V47

TEMPERATURE ACTUATED MODULATING WATER VALVES

APPLICATION

These modulating valves regulate the flow of water to maintain a desired temperature. Series V47A valves OPEN on a temperature increase at the bulb while Series V47N valves CLOSE on a temperature increase at the bulb. Refer to Bulletin 1986 for pressure actuated water valves.

Series V47 temperature valves are widely used on heat exchangers to maintain optimum operating temperatures of internal combustion engines, air compressors, hydraulic oil, etc. Important benefits from the use of water valves include maximum operating efficiency of the equipment and a substantial savings effected by the conservation of water flow. They are used on condenser applications where expensive fluids are economically recovered or where the use of cooling water is restricted and on such varied applications as the temperature control of swimming pools, the control of paint temperatures on industrial printing machines and the flow of gasoline or other fuels into direct fired portable heaters.

Temperature actuated three-way diverting valves are available for special applications. Write to Customer Service for additional information.

For use with liquids other than water, consult district office or Customer Service.

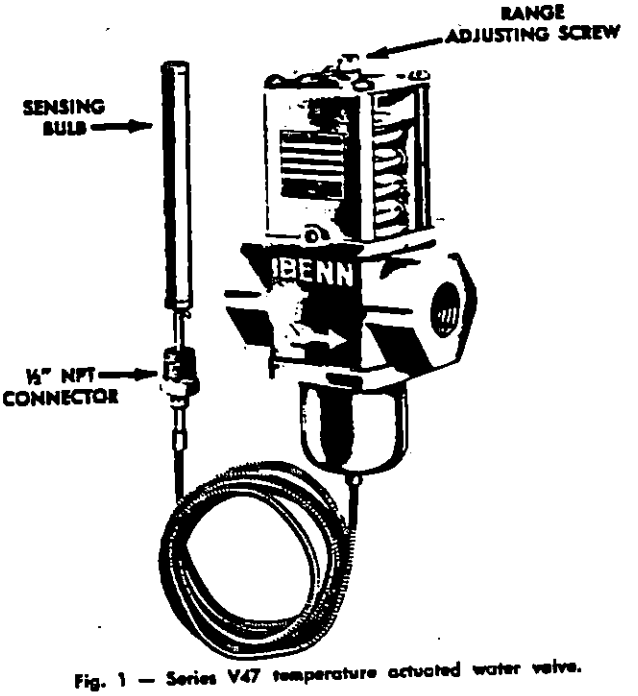
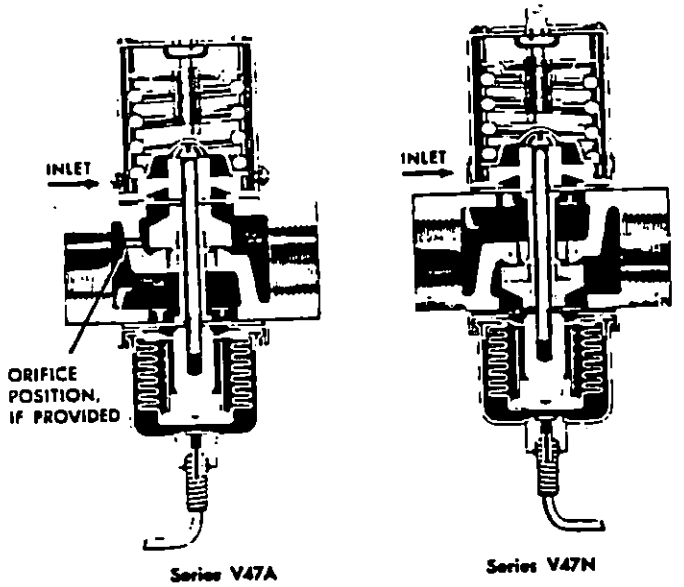


Fig. 1 — Series V47 temperature actuated water valve.



Series V47A Series V47N

Fig. 2 — Typical cross-sections of threaded type valves. Interiors of flange models are similar.

FEATURES

- No close fitting sliding parts in water.
- Range spring does not come in contact with the cooling water.
- Easy manual flushing.
- Valves will not chatter.
- Free movement of all parts provide fast response.
- Adjustment affected only slightly by substantial water pressure variations.
- Withstands most high pressure hydraulic shock waves without damage.

GENERAL DESCRIPTION

A pressure-balanced design, employing synthetic rubber sealing diaphragms correctly proportioned to the valve port area, balances valves against both gradual and sudden water pressure changes, seals water away from range spring and guides and provides protection against high water surge pressures. Range spring and sliding parts are not submerged in water where they would be subject to sedimentation and corrosion. Only three parts, made of corrosion resistant material, come in contact with the water . . . valve disc holder, valve seat and extension sleeve.

TYPE NUMBER SELECTION (Commercial Valves)

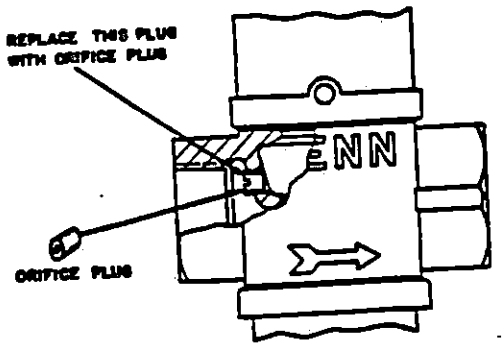
For use in ordering valves other than shown in the Catalog Number Selection Chart.

Valve Size	Flow Coefficient With Valve Fully Open Cv	Type Number		Approx. Shipping Wt.-Lbs.
		Open on Temp. Rise	Close on Temp. Rise	
THREADED CONNECTION (FEMALE NPT)				
⅜	2.5	V47AA	V47NA	3
½	3.4	V47AB	V47NB	4
¾	5.5	V47AC	V47NC	5
1	8.5	V47AD	V47ND	8
1¼	11.0	V47AE	V47NE	10
FLANGE CONNECTION — A.S.M.E. SPECIFICATIONS*				
1½	14.0	V47AR	V47NR	16
2	21.0	V47AS	V47NS	25
2½	29.0	V47AT	V47NT	31

* Same as American Standards Association B16 Flange Specifications for 125 lb. pressure. See Roughing-in Dimensions.

STOCK TEMPERATURE VALVES

Due to many variations of temperature actuated valves, a group of standard V47 (open high) valves are maintained in stock for shipment on short notice. These valves are available in three temperature ranges and are furnished with 6 feet of armored capillary and a Style 4 temperature bulb (closed tank immersion). All stock valves are supplied with a drilled and tapped internal by-pass in the regulator body. A solid plug is installed in this hole for 100% shut-off. A drilled plug is packed in an envelope with each valve for field installation, if continuous minimum flow is required.



TEMPERATURE ELEMENTS

Standard temperature elements are furnished with 6' capillary. Optional capillary lengths are available on quantity orders, lengths 2', 4', 10' and longer in increments of 5' at extra cost. Temperature bulbs and ranges currently available are listed in Temperature Ranges and Bulb Dimension Chart. Finned air immersion type temperature bulbs, special elements and special temperature ranges are available. Consult district office or customer service.

MISCELLANEOUS SPECIFICATIONS

Valve Body: Commercial types in ⅜", ½" and ¾" have cast brass bodies. Larger commercial types have cast iron bodies with rust resisting finish. Naval bronze bodies available, write customer service.

Valve Disc: Buna N in brass disc retainer for commercial valves. Naval bronze valves have monel disc retainer.

STOCK CATALOG VALVES

Catalog Number	Pipe Size NPT	Range ° F. (Opening Point)	Bulb Size	By-Pass Orifice Diameter	Maximum Bulb Temperature (° F)	Shipping Wt. Lbs.
V47AA-3	⅜"	75 to 135 **	1/16" x 6"	.062"	155	3.1
V47AB-5	½"	75 to 135 **	1/16" x 10"	.062"	155	4.3
V47AC-6	¾"	75 to 135 **	1/16" x 10"	.062"	155	5.8
V47AD-1	1"	75 to 135 **	1/16" x 16¼"	.093"	155	10.0
V47AE-1	1¼"	75 to 135 **	1/16" x 16¼"	.093"	155	12.1
V47AR-1	1½" *	75 to 135 **	1/16" x 16¼"	.093"	155	18.0
V47AS-3	2" *	75 to 115 **	13/16" x 43"	.125"	135	27.0
V47AT-3	2½" *	75 to 115 **	13/16" x 43"	.125"	135	33.0
V47AA-1	⅜"	115 to 180	1/16" x 3¼"	.062"	200	3.1
V47AB-3	½"	115 to 180	1/16" x 3¼"	.062"	200	4.3
V47AC-3	¾"	115 to 180	1/16" x 3¼"	.062"	200	5.8
V47AD-2	1"	115 to 180	1/16" x 6"	.093"	200	10.0
V47AE-2	1¼"	115 to 180	1/16" x 6"	.093"	200	11.8
V47AR-2	1½" *	115 to 180	1/16" x 6"	.093"	200	17.5
V47AS-1	2" *	115 to 160	1/16" x 10"	.125"	180	27.0
V47AT-1	2½" *	115 to 160	1/16" x 10"	.125"	180	33.0
V47AA-2	⅜"	160 to 230	1/16" x 3¼"	.062"	250	3.1
V47AB-4	½"	160 to 230	1/16" x 3¼"	.062"	250	4.3
V47AC-4	¾"	160 to 230	1/16" x 3¼"	.062"	250	5.8
V47AD-3	1"	160 to 230	1/16" x 6"	.093"	250	10.0
V47AE-3	1¼"	160 to 230	1/16" x 6"	.093"	250	11.8
V47AR-3	1½" *	160 to 230	1/16" x 6"	.093"	250	17.5
V47AS-2	2" *	160 to 205	1/16" x 10"	.125"	225	27.0
V47AT-2	2½" *	160 to 205	1/16" x 10"	.125"	225	33.0

All stock valves supplied with 6' armored capillary and ½" NPT closed tank connectors. To order, specify Catalog Number only.

* A.S.M.E. Flange.

** Regularly supplied with cross-ambient bulb.

Valve Seat: Aluminum bronze valve seats on commercial valves. Monel seats optional at extra cost. Monel valve seats standard on naval bronze valves.

Extension Sleeve: Brass sleeve used on commercial valves. Monel sleeve used on naval bronze valves.

Diaphragms: Nylon reinforced Buna N.

Water Supply Pressure: 150 psig maximum.

Water Supply Temperature: 170° F. maximum.

Manual Flushing: Valves may be manually flushed by lifting range spring follower with screwdrivers at two sides of lower spring cap to open valve. This does not change valve adjustment.

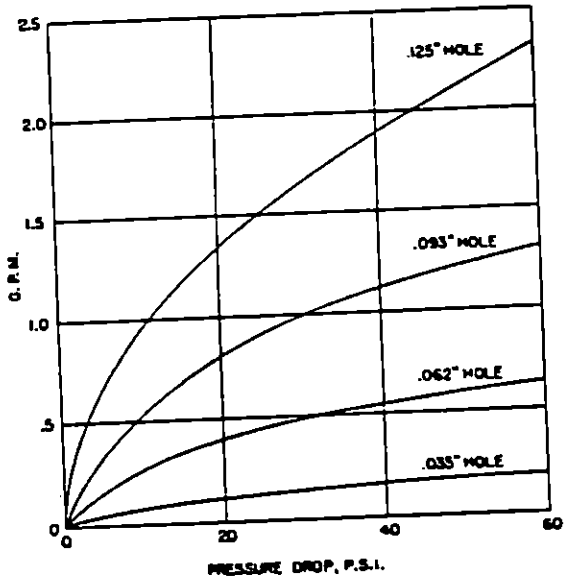
Adjustment: Valves may be adjusted with standard service valve wrenches or with screwdrivers. Range adjusting screw is located at the top of the range spring housing.

Mounting: Vertically with temperature element down.

OPTIONAL CONSTRUCTIONS

Internal By-Pass: Drilled hole provided in valves which are actuated by temperature of water passing through valve. Hole in valve body provides continuous by-pass flow permitting temperature actuated bulb to sense temperature change. Eliminates requirement for special by-pass line. Specify internal by-pass hole size required. By-pass hole sizes are .035", .062", .093" or .125".

FLOW THROUGH INTERNAL BY-PASS



Stainless Steel Bulb: Models with stainless bulb, support tube, and closed tank fitting are available at extra cost on special orders.

Valves For L.P. Gas: Temperature actuated modulating valves for regulating flow of L.P. gas to crop driers or outdoor industrial equipment are shown in Bulletin No. 3302.

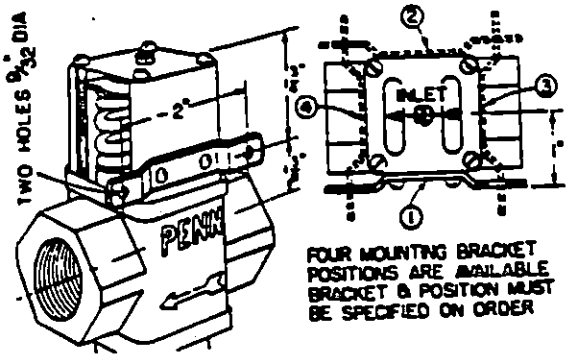


Fig. 3 — Mounting bracket, Part No. 230-115 for ⅜" valve. Position number 1 is illustrated at the left.

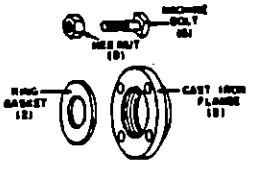
Mounting Bracket: Mounting bracket (Part No. 230-115) as illustrated in Fig. 3 available on ⅜" valve only when specified. Specify bracket position required. Other styles of brackets on ⅜" and ½" valves available on quantity orders. Consult district office or customer service.

Disc Holder, Valve Seat and Extension Sleeve: Available in monel on commercial valves at additional cost.

Capillary Protection: Armored capillary tubing is available at additional cost (standard on stock valves). An oil resistant rubber coating on capillary and bulb (MIL-R-3065 grade SB-515-ABFF neoprene) is also available on quantity orders at additional cost for temperature ranges below 135° F.

Companion Flanges and Gaskets: Kits available at additional cost, when specified. For 1½", 2" and 2½" sizes . . . A.S.M.E. 125 lb. standard only. Each flange kit contains two ring gaskets, two cast iron flanges, eight machine bolts and eight hex nuts.

Kit No.	Water Valve Size
KIT14A-612	1½"
KIT14A-613	2"
KIT14A-614	2½"



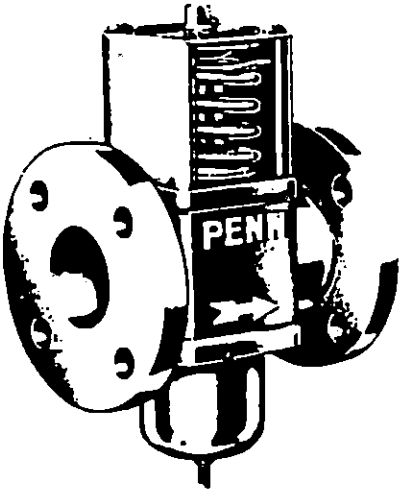
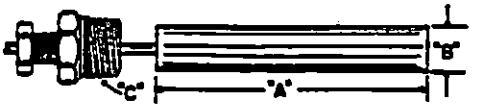


Fig. 4 — A.S.M.E. flange type water valve (four flange bolt holes).

BULB DIMENSIONS

STYLE 1 BULB
(Immersion or Surface Contact)

STYLE 4 BULB
(Closed Tank Immersion)



VALVE SIZE	TABLE 1 — HEATING BULB			TABLE 2 — CROSS-AMBIENT		
	"A"	"B"	"C" THREAD *	"A"	"B"	"C" THREAD *
⅜"	3¼"	1 1/16"	½" NPT	6"	1 1/16"	½" NPT
½"	3¼"	1 1/16"	½" NPT	10"	1 1/16"	½" NPT
¾"	3¼"	1 1/16"	½" NPT	10"	1 1/16"	½" NPT
1"	6"	1 1/16"	½" NPT	16¼"	1 1/16"	½" NPT
1¼"	6"	1 1/16"	½" NPT	16¼"	1 1/16"	½" NPT
1½"	6"	1 1/16"	½" NPT	16¼"	1 1/16"	½" NPT
2"	10"	1 1/16"	½" NPT	43"	1 1/16"	½" NPT
2½"	10"	1 1/16"	½" NPT	43"	1 1/16"	½" NPT

TEMPERATURE RANGES**

SERIES V47A Adjustable		
Standard		
Range (°F)	Maximum Bulb Temp. (°F)	Size of Valve
75 to 115	135	2", 2½"
75 to 135	155	⅜" thru 1½"
115 to 160	180	2", 2½"
115 to 180	200	⅜" thru 1½"
160 to 205	225	2", 2½"
160 to 230	250	⅜" thru 1½"
Special (1)		
20 to 65	85	⅜" thru 1½"
40 to 85	105	½" thru 1½"
200 to 250	270	½" thru 1½"

SERIES V47N Adjustable		
Standard		
Range (°F)	Maximum Bulb Temp. (°F)	Size of Valve
85 to 130	150	2", 2½"
85 to 155	175	⅜" thru 1½"
125 to 175	195	2", 2½"
125 to 200	220	⅜" thru 1½"
175 to 220	240	2", 2½"
175 to 250	270	⅜" thru 1½"
Special (1)		
45 to 85	105	⅜" thru 1½"
55 to 100	120	½" thru 1½"
225 to 275	295	½" thru 1½"

When valve is opening a change of 3° to 5° F. is required to start valve closing or vice versa.

* Style 4 only.

** Series V47 open high ranges indicate the valve opening point; Series V47 close high ranges indicate the valve closing point.

(1) For ranges other than shown in tables consult the Customer Service.

Note: On cross-ambient bulbs the bulb length will be increased 1" for each 5' of capillary or fraction thereof over 10'.

IMPORTANT: Before using this chart determine type of bulb needed in particular application.

Table 1 — Heating Bulb — Bulb temperature is always HIGHER than bellows temperature.

Table 2 — Cross-ambient Bulb — Bulb temperature rises higher and drops lower than bellows temperature. Recommended for general use with standard 75° - 135° F. range to maintain control at bulb location.

Note: To provide satisfactory operation, always install valve with bellows down and spring cage up. Capillary end of temperature bulb should always be higher than plugged-end of bulb, or if horizontal, the word TOP should be at the top or uppermost surface of bulb.

Never subject temperature bulb to temperatures in excess of 20° F. above maximum range temperature. (Example: 75/135° F. range; maximum bulb temperature not to exceed 155° F.)

BULB WELLS

Bulb well dimensions

Part Number	Dimensions "A"	Dimensions "B"	Description
WEL17A-600	11 1/32"	10 9/16"	Copper Bulb Well, Tin Plated, Malleable Hex Connector.
WEL17A-601	9 13/32"	8 21/32"	Copper Bulb Well, Tin Plated, Malleable Hex Connector.
WEL17A-603	11 1/32"	10 1/16"	Monel Bulb Well and Connector.
WEL18A-600	4 9/32"	3 1/2"	Steel Well, Cadmium Plated, Malleable Hex Connector.
WEL18A-601	4 9/32"	3 1/2"	Monel Bulb Well and Connector.
WEL18A-602	4 9/32"	3 1/2"	Brass Bulb Well, Tin Plated, Malleable Hex Connector.

ORDERING INFORMATION

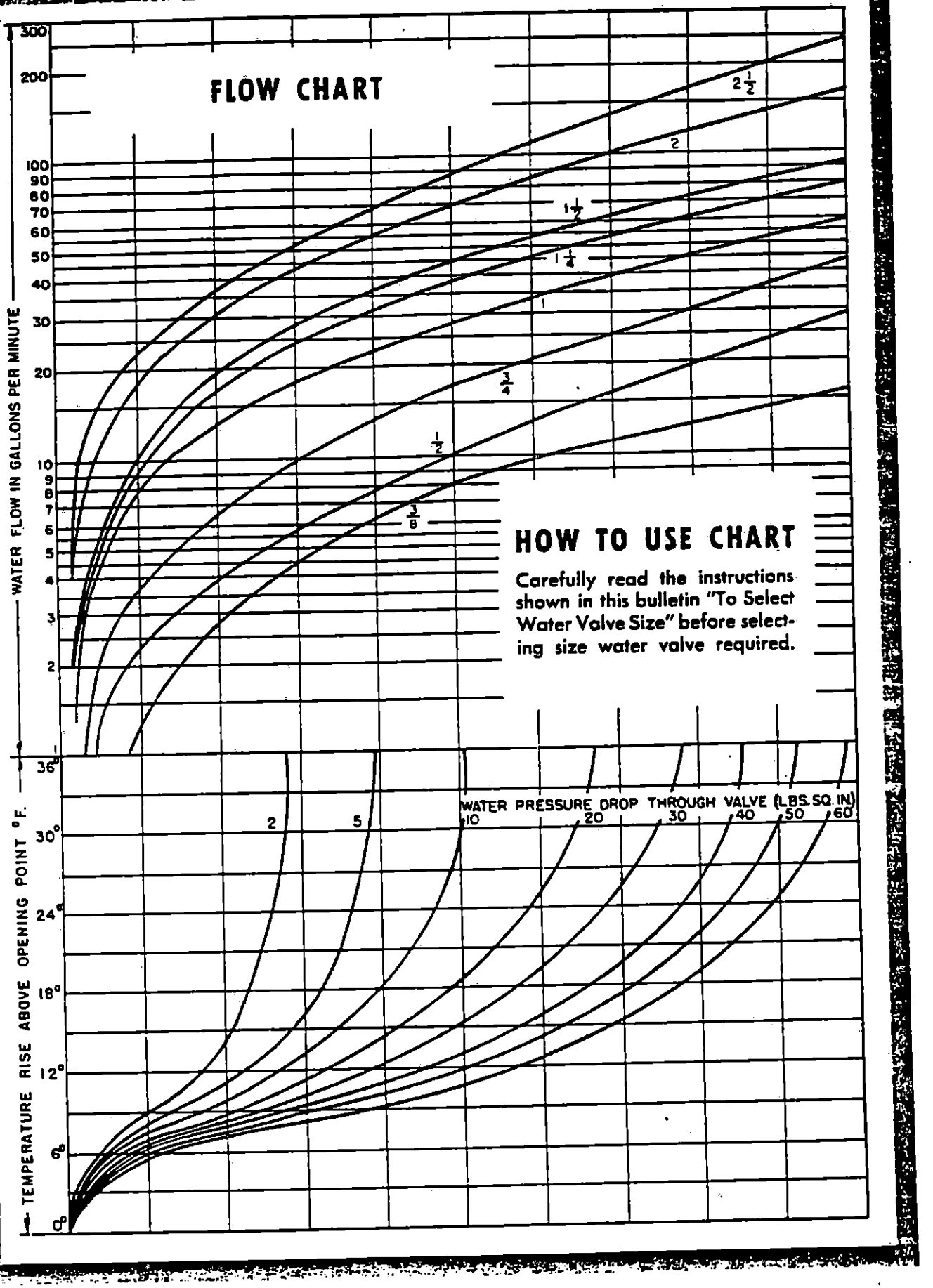
When ordering water valves, specify the following:

1. Catalog Number, if established.
2. If a stock valve cannot be used specify Product No. if available.
3. If Product Number is not available specify the following:
   (a.) Type Number (see "Type Number Selection Chart").
   (b.) Temperature range required.
   (c.) Style and size of temperature element or bulb.
   (d.) Length of capillary tubing.
   (e.) Fluid to be handled by valve.
4. Specify special features, when required, such as:
   (a.) Internal by-pass and diameter.
   (b.) Mounting bracket (3/8" size only) and position on valve.
   (c.) Monel disc holder, valve seat, and extension sleeve.
   (d.) Naval bronze valve body.
   (e.) Armored capillary tubing.
   (f.) Oil resistant rubber coating on capillary and bulb.
   (g.) Companion flange kit, specify Part Number.
5. Bulb well, by Part Number, if needed.

REPAIRS AND SERVICE

All water valves may be repaired in the field. For service or repair parts, contact the nearest Penn-Baso Counterline Wholesaler or the Customer Service.

See Page 6 and 7 for Flow Chart and how To Select Water Valve Size.


FLOW CHART
WATER FLOW IN GALLONS PER MINUTE
300
200
100
90
80
70
60
50
40
30
20
10
9
8
7
6
5
4
3
2
1
2½
2
1½
1¼
1
¾
½
⅜
HOW TO USE CHART
Carefully read the instructions shown in this bulletin "To Select Water Valve Size" before selecting size water valve required.
TEMPERATURE RISE ABOVE OPENING POINT °F.
36°
30°
24°
18°
12°
6°
0°
2
5
WATER PRESSURE DROP THROUGH VALVE (LBS. SQ. IN.)
10
20
30
40
50
60

TO SELECT WATER VALVE SIZE

(Series V47)

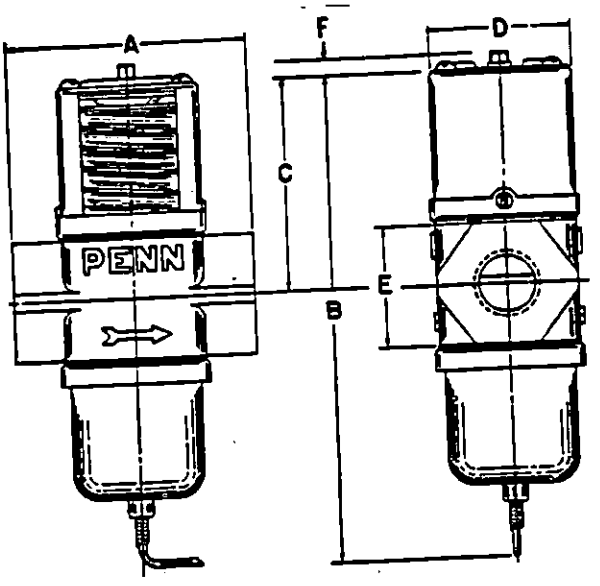
Refer to Flow Chart for selection of valves. Carefully follow steps as outlined below.

1. Determine the maximum water flow required and draw a horizontal line across upper half of Flow Chart through this flow.
2. Determine the temperature rise above the valve opening point.
   (a.) Valve closing point is the highest temperature at which it is desired to have no flow through the valve.
   (b.) Valve opening point will be about 5° F. above the valve closing point.
   (c.) Determine the temperature the valve is to maintain.
   (d.) Subtract the temperature opening point from the operating temperature. This gives the temperature rise.
3. Draw horizontal line across lower half of Flow Chart through this value.
4. Determine the allowable pressure drop through the valve — this is the pressure actually available to force liquid through the valve.
5. On lower half of curve, mark point on drawn-in horizontal temperature line at pressure determined in Step 4. Interpolate between curves, or pick curve for nearest lower pressure drop for which curve is drawn (this gives an automatic safety factor).
6. From this point draw line vertically upward until it intersects drawn-in horizontal water flow line in upper half of Flow Chart.
7. If intersection falls on a valve size curve this is the valve size.
8. If intersection falls between two curves the required valve size is the larger of the two.

See Page 8 for Dimension Drawings

ROUGHING-IN DIMENSIONS

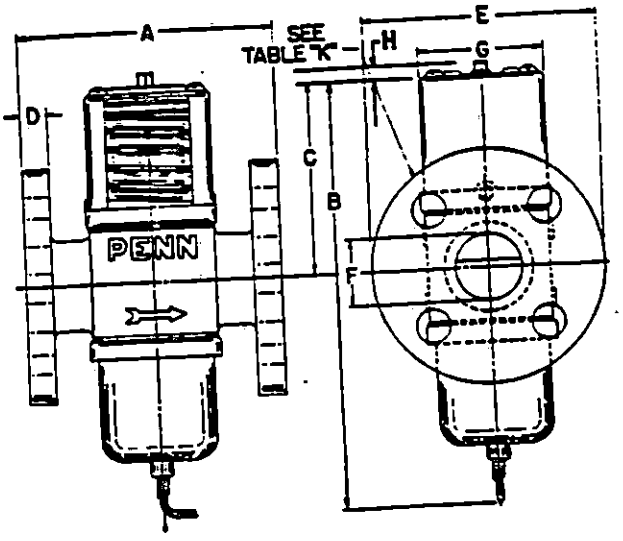
THREADED TYPE
(Cast Iron or Bronze Body)



Valve Size	Dimensions in Inches					
	A	B	C	D	E	F
3/8"	2 7/8	6 11/32	3 1/8	1 1/2	1 1/4	1 3/32
1/2"	3 1/4 (3 13/64)*	7	3 3/8	1 27/32	1 1/2	1 3/32
3/4"	3 9/16 (3 13/64)*	7 23/64	3 5/16	2 1/32	1 3/4	1 3/32
1"	4 11/32 (4 13/64)*	10 3/64	5 3/16	2 1/32	2 3/8	2 1/2
1 1/4"	4 5/16 (4 7/8)*	10 3/64	5 43/64	2 3/8	2 3/8	1/2

* NOTE: Figures in ( ) are for Maritime Valves. All other dimensions remain the same.

FLANGE TYPE
(Cast Iron . . . A.S.M.E. Flange Specs.)

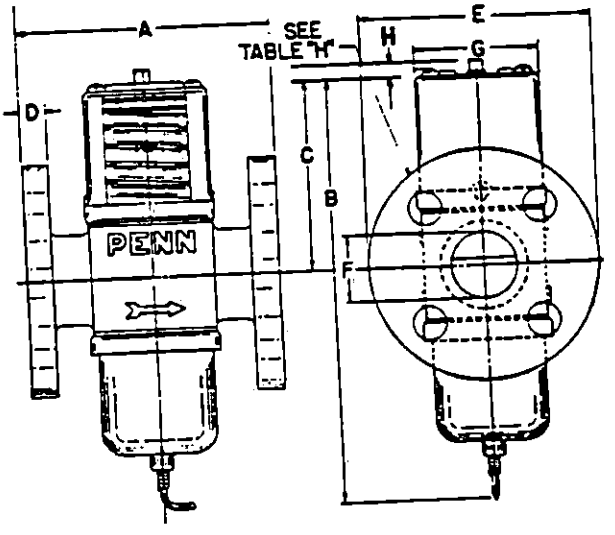


Valve Size	Dimensions in Inches							
	A	B	C	D	E	F	G	H
1 1/2"	5 5/16	10 31/64	5 43/64	9/16	5	1 7/8 Dia.	2 3/8	1/2
2"	6 3/8	12 23/64	6 11/32	3/4	6	2 1/4 Dia.	3 1/2	1/2
2 1/2"	6 3/4	12 23/64	6 11/32	3/4	7	2 3/4 Dia.	3 1/2	1/2

TABLE "K"

Valve Size	No. of Holes	Hole Size	Bolt Circle
1 1/2"	4	5/8"	3 7/8"
2"	4	3/4"	4 3/4"
2 1/2"	4	3/4"	5 1/2"

FLANGE TYPE . . . BRONZE BODY



NAVY "BuShips" SERVICE . . . NAVY FLANGE SPECIFICATIONS								
Valve Size	Dimensions in Inches							
	A	B	C	D	E	F	G	H
3/4"	4 5/16	7 11/64	3 61/64	9/16	3 13/16	1 1/8	2 1/32	1/2
1"	5 5/16	8 1/2	4 1/2	1/2	4 1/4	1 1/4	2 3/8	1/2
1 1/4"	5 5/16	8 21/32	4 11/16	1/2	4 1/2	1 3/8	2 3/8	1/2
1 1/2"	5 5/16	9 13/32	4 11/16	1/2	5 1/16	1 7/8	2 3/8	1/2
2"	6 3/8	13 11/16	6 3/4	1/2	5 1/16	2 3/4	3 1/2	1/2
2 1/2"	6 3/8	13 11/16	6 3/4	1/2	6 1/8	2 3/4	3 1/2	1/2
MARITIME SERVICE . . . A.S.M.E. FLANGE SPECIFICATIONS								
1 1/2"	5 5/16	10 31/64	5 43/64	9/16	5	1 7/8 Dia.	2 3/8	1/2
2"	6 3/8	12 23/64	6 11/32	1/2	6	2 3/4 Dia.	3 1/2	1/2
2 1/2"	6 3/4	12 23/64	6 11/32	11/16	7	2 3/4 Dia.	3 1/2	1/2

TABLE "H"

NAVY "BuShips" SERVICE . . . NAVY FLANGE SPECIFICATIONS			
Valve Size	No. of Holes	Hole Size	Bolt Circle
3/4"	4	9/16"	2 11/16"
1"	4	9/16"	3 1/8"
1 1/4"	4	9/16"	3 3/8"
1 1/2"	6	9/16"	3 15/16"
2"	6	9/16"	4 1/16"
2 1/2"	6	9/16"	5"
MARITIME SERVICE . . . A.S.M.E. FLANGE SPECIFICATIONS			
1 1/2"	4	5/8"	3 7/8"
2 1/2"	4	3/4"	5 1/2"

Performance specifications appearing herein are nominal and are subject to accepted manufacturing tolerances and application variables.

KEENE
CORPORATION

FILTRATION DIVISION

MODEL 816BC TELEFLO DIAL INDICATOR

Bulletin 4.6.000

DESCRIPTION

A rugged design and positive operation permits a wide range of applications. For over 30 years Teleflo Indicators have provided electrical liquid flow control, protecting thousands of installations against costly equipment damage.

APPLICATIONS

Activation of controls for:
Equipment Shut Down
Alarm
Other Desired Controls

FEATURES

- Separate headcasting and a spring loaded vane to gauge liquid flow.
- Easy access for electrical connection to switch terminals or switch cam adjustment.
- Factory adjustment, causing switch operation when the dial pointer advances 1½ = ½ graduations from the rest or no-flow conditions.
- After establishing the dial pointer position for the desired liquid flow, the switch cam may be adjusted for increased or decreased liquid flow.
- Complete liquid flow control may be obtained by installing two Teleflo Indicators; one set for increased liquid flow, and one set for decreased liquid flow control.

INSTALLATION AND ADJUSTMENT

Teleflo Indicators may be installed in any position in the liquid line. The position of the red pointer during the desired liquid flow must be determined and noted for later resetting. **Maintain this flow during switch adjustment.** Graduation mark 15 is used here as an example for the desired liquid flow.

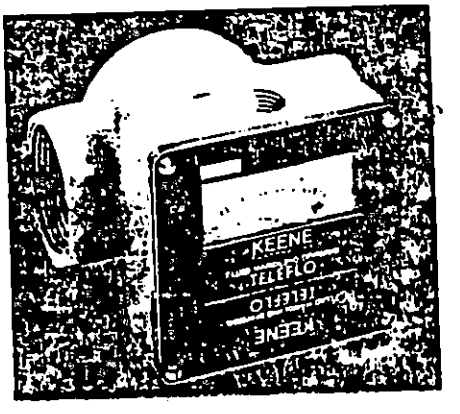
Procedure:
Remove the four round head screws holding the cover, glass and dial in position.

Temporarily replace the dial with the same four screws.

For Increased Liquid Flow
Hold the red pointer firmly with fingers and loosen the slotted shaft nut. Rotate the red pointer in a direction against the liquid flow until switch click or continuity tested indicates switch closure. Retighten nut. Holding the red pointer, loosen the round head positioning screw and rotate the red pointer to the desired flow graduation position, mark 15, and retighten red pointer positioning screw. Test for switch closure by increasing liquid flow.

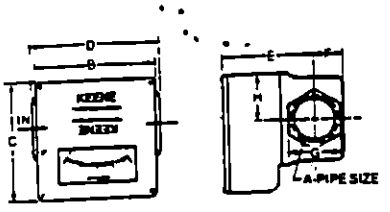
For Decreased Liquid Flow
Hold the red pointer firmly with fingers and loosen the slotted shaft nut. Rotate the red pointer in a direction against liquid flow until switch click or continuity tester indicates switch opening, then rotate back to obtain switch closure and retighten nut. Proceed as in adjustment for increased liquid flow and test for switch opening by reducing liquid flow.

Connect necessary switch leads and replace cover, glass and dial.



Model 816BC Teleflo Dial Indicator

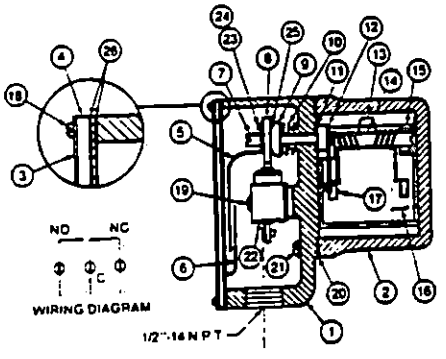
SPECIFICATIONS AND REPAIR PARTS



Dimensions

	*General Assembly Number	51B22	51B05	51B08	51B06	51B09
	NPT Opening	½	¾	1	1½	2
A	Pipe Tap Size	½	¾	1	1½	2
B	Width of Dial	3⅜	3⅜	3⅜	3⅜	4½
C	Height	3⅜	3⅜	3⅜	3⅜	4½
D	Length Overall	3⅜	3⅜	3⅜	4⅜	6½
E	Center to Front	2¼	2¾	2¾	2¾	3¾
F	Center to Front	11/16	15/16	15/16	1⅜	1⅜
G	Hex. Across Flats	1⅜	1⅜	1⅜	2¼	3¼
H	Height From c of Pipe	1⅜	1⅜	1⅜	1 11/16	2⅛

*Specify general assembly number when ordering for desired NPT opening.



Repair Parts List

	Description	No. Req'd.	½"	¾"	1"	1½"	2"
1	Head-Mod. 816BC	1	88044	88044	88044	88045	88048
2	Body	1	51B23	51B10	51B11	51B13	51B14
3	Cover	1	29N19	29N19	29N19	29N19	29N20
4	Window	1	13N50	13N50	13N50	13N50	13N55
5	Pointer	1	88059	COMMON TO ALL SIZES			
6	Dial	1	88060	88060	88060	88060	88061
7	Shaft Nut	1	87311	COMMON TO ALL SIZES			
8	Pointer Spacer	1	87308	COMMON TO ALL SIZES			
9	Spring Retainer	1	87331	COMMON TO ALL SIZES			
10	Shaft Spring	1	26A82	COMMON TO ALL SIZES			
11	Gasket	1	04E79	COMMON TO ALL SIZES			
12	Shaft Arm Assly.	1	87305	COMMON TO ALL SIZES			
13	Flap Spring	1	50B53	87328	87328	87317	87329
14	Flap Screw	1	37B57	37B58	37B58	37B59	37B60
15	Spacer	2	37B56	COMMON TO ALL SIZES			
16	Flap	1	50B51	37B65	37B65	37B66	37B67
17	Toggle Link	1	87314	87314	87314	87315	87316
18	Screw R H M.S.	4	24024	COMMON TO ALL SIZES			
19	M/S Mtd. Screws	2	24010	COMMON TO ALL SIZES			
20	Head Gasket	1	87736	87736	87736	87737	87738
21	Screw	4	21263	21263	21263	26584	26585
22	Micro Switch	1	87319	COMMON TO ALL SIZES			
23	Screw	1	24412	COMMON TO ALL SIZES			
24	Lockwasher	1	29288	COMMON TO ALL SIZES			
25	Lockwasher	1	29281	COMMON TO ALL SIZES			
26	Gasket	1	13N48	13N48	13N48	13N48	13N53

Specifications

1. Body and head casting—Bronze—85-5-5-5.
2. Finish—bronze acid dip.
3. Dial—aluminum background with black graduations.
4. Pointer—brass painted red.
5. Window—clear acrylic plastic.
6. Switch—S.P.D.T.—15A-125V, 7A-250V.
7. Head Gasket—Garlock 7022.
8. Seal—Viton A "O" Ring seal.
9. Pressure—125 PSI at 200°F.
10. Weatherproof head.

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11/80

Teleflo dial indicators

DESCRIPTION

Rugged design and positive operation permits a wide range of applications. For over 25 years Teleflo Indicators have provided liquid flow control protecting thousands of installations against costly equipment damage. Sight glass windows are eliminated with Teleflo indicators.

CONSTRUCTION

The dial, dial pointer and switch are installed in a separate headcasting. A spring loaded vane gages liquid flow in the body casting. The vane rotates the dial pointer and switch cam through Viton A "O" ring seal.

Removal of four cover screws permits easy access for connecting electrical leads to switch terminals or switch cam adjustment.

Model 816BC Teleflo Indicator with switch is factory adjusted to cause switch operation when the dial pointer advances 1½ ± ½ graduations from the rest or no-flow conditions.

APPLICATIONS

Model 815BC, Dial Only—Used when visual identification of liquid flow is required. Particularly beneficial when used with dark or opaque liquids.

Model 816BC, Dial and Switch—Used when electrical control of liquid flow is required. The dial provides visual identification, an added safety feature.

The factory switch adjustment permits electrical switch control for a liquid "Flow-No Flow" condition. The switch can activate controls for: equipment shut down, alarm or other desired controls in the event of an interruption in liquid flow.

Upon establishing the dial pointer position for the desired liquid flow the switch cam may be adjusted for one of the following conditions: switch operation for increased liquid flow, switch operation for decreased liquid flow.

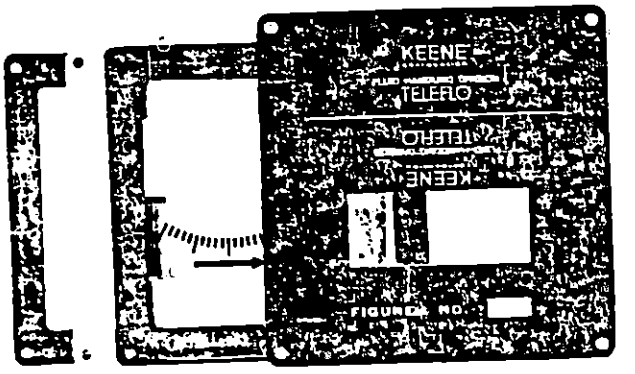
Complete liquid flow control may be obtained by installing two Teleflo Indicators; one set for increased liquid flow, one set for decreased liquid flow control.

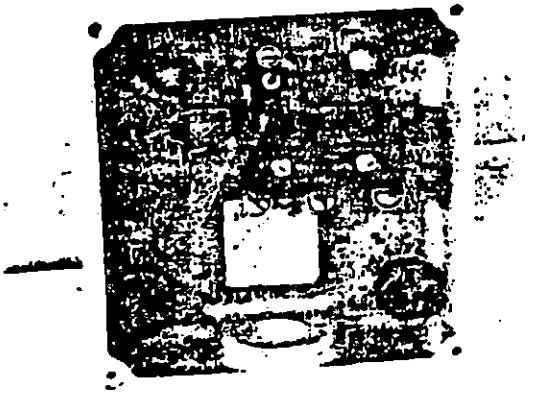
SPECIFICATIONS

Body and head casting: Bronze—85-5-5-5
Finish: Bronze acid dip
Dial: Aluminum background with black graduations
Pointer: Brass painted red
Window: Clear acrylic plastic
Switch: S.P.D.T.—15A-125V, 7A-250V
Head Gasket: Garlock 7022
Seal: Viton A "O" Ring Seal
Pressure: 125 psi at 200°F
Weatherproof head

INSTALLATION

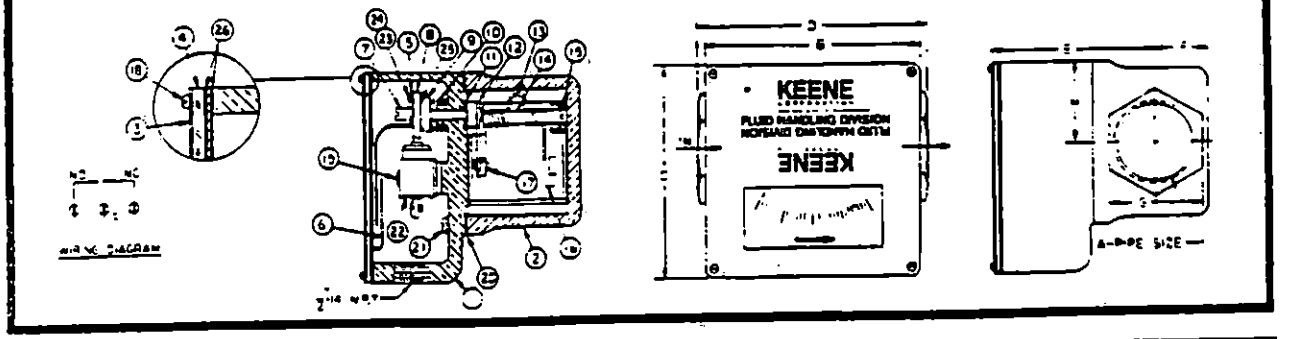
Teleflo Indicators may be installed in any position.





MODEL 816BC (SHOWN)

Specifications



Specify general assembly number when ordering for desired NPT opening.

	GENERAL ASSEMBLY NUMBERS							
NPT Opening	⅜	½	¾	1	1¼	1½	2	2½
Model 816BC	51B21	51B22	51B05	51B06	51B07	51B08	51B09	11N93
Model 815BC	51B19	51B20	51B00	51B01	51B02	51B03	51B04	11N94

DIMENSIONS

A	Pipe Tap Size	⅜	½	¾	1	1¼	1½	2	2½
B	Width of Dial	3⅜	3⅜	3⅜	3⅜	3⅜	3⅜	4½	4½
C	Height	3⅜	3⅜	3⅜	3⅜	3⅜	3⅜	4½	4½
D	Length Overall	3⅜	3⅜	3¼	3¼	4¾	4¾	6½	6½
E	Center to Front	2¼	2¼	2⅜	2⅜	2⅞	2⅞	3⅜	3⅜
F	Center to Back	1¹⁄₁₆	1¹⁄₁₆	1¹⁵⁄₁₆	1¹⁵⁄₁₆	1⅜	1⅜	1¾	1¾
G	Hex., Across Flats	1³⁄₁₆	1³⁄₁₆	1³⁄₁₆	1³⁄₁₆	2¼	2¼	3¼	3¼
H	Height From c of Pipe	1³⁄₁₆	1³⁄₁₆	1³⁄₁₆	1³⁄₁₆	1¹³⁄₁₆	1¹³⁄₁₆	2³⁄₃₂	2³⁄₃₂

REPAIR PARTS LIST

	Description	No. Req'd.	⅜"	½"	¾"	1"	1¼"	1½"	2"	2½"
1	Head-Mod. 816BC	1	88044	88044	88044	88044	88046	88046	88046	88046
1a	Head-Mod. 815BC	1	88045	88045	88045	88045	88047	88047	88049	88049
2	Body	1	51B23	51B24	51B10	51B11	51B12	51B13	51B14	11N95
3	Cover	1	29N19	29N19	29N19	29N19	29N19	29N19	29N20	29N20
4	Window	1	13N50	13N50	13N50	13N50	13N50	13N50	13N55	13N55
5	Pointer	1	88059	—	COMMON TO ALL SIZES					
6	Dial	1	88050	88050	88050	88050	88050	88050	88051	88051
7	Shaft Nut	1	87311	—	COMMON TO ALL SIZES					
8	Pointer Spacer	1	87308	—	COMMON TO ALL SIZES					
9	Spring Retainer	1	87331	—	COMMON TO ALL SIZES					
10	Shaft Spring	1	28A82	—	COMMON TO ALL SIZES					
11	Gasket	1	04E79	—	COMMON TO ALL SIZES					
12	Shaft Arm Ass'y.	1	87305	—	COMMON TO ALL SIZES					
13	Flap Spring	1	50B53	50B53	87328	87328	87317	87317	87329	87329
14	Flap Screw	1	37B57	37B57	37B58	37B58	37B59	37B59	37B60	37B60
15	Spacer	2	37B56	—	COMMON TO ALL SIZES					
16	Flap	1	50B51	50B51	37B65	37B65	37B66	37B66	37B67	37B67
17	Toggle Link	1	87314	87314	87314	87314	87315	87315	87316	87316
18	Screw R.H.M.S.	4	24024	—	COMMON TO ALL SIZES					
*19	M/S Mtd. Screws	2	24010	—	COMMON TO ALL SIZES					
20	Head Gasket	1	87736	87736	87736	87736	87737	87737	87738	87738
21	Screw	4	21263	21263	21263	21263	28564	28564	28585	28585
*22	Micro Switch	1	87319	—	COMMON TO ALL SIZES					
23	Screw	1	24412	—	COMMON TO ALL SIZES					
24	Lockwasher	1	29288	—	COMMON TO ALL SIZES					
52	Lockwasher	1	29291	—	COMMON TO ALL SIZES					
26	Gasket -	1	13N48	13N48	13N48	13N48	13N48	13N48	13N53	13N53

*Not used on Model 815BC

SHADED SIZES NO LONGER AVAILABLE

MODEL 816BC SWITCH CAM ADJUSTMENT PROCEDURE

The Model 816BC Teleflo Indicator is supplied with a switch having a normally open and a normally closed set of contacts. The switch operating cam has been factory adjusted to open the normally closed contact and close the normally open contact when the red pointer advances 1½ ± ½ graduations from the rest or no-flow position.

The 816BC Teleflo Indicator switch cam can be adjusted to provide the following additional electrical switch control relative to liquid flow:

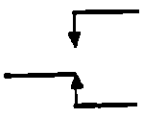
"A" Switch Control for Increased Liquid Flow
The normally closed contact remains closed during desired liquid flow and opens with increased flow.

"B" Switch Control for Decreased Liquid Flow
The normally closed contact remains closed during reduced liquid flow and opens with desired flow.

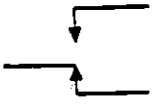
1. Since the Teleflo Indicator is not a flow meter, it is necessary to install the Teleflo Indicator in the liquid line and determine the position of the red pointer during the desired liquid flow. **IMPORTANT: Maintain the desired liquid flow during switch adjustment.**
2. Note the graduation position of the red pointer during desired flow as it will be necessary to reset the red pointer. In describing the following adjustments, graduation mark 15 is used as an example for the desired liquid flow.
3. Remove the four round head screws holding the cover, glass and dial in position.
4. Temporarily replace the dial with the same four screws.
5. A. **Switch Cam Adjustment for "A" Control** Hold the red pointer firmly with fingers and loosen the slotted shaft nut. Rotate the red pointer in a direction against liquid flow until switch closure occurs. This may be determined by the switch click or a continuity tester. Retighten slotted shaft nut. Holding the red pointer, loosen the round head positioning screw and rotate red pointer to the desired flow graduation position, mark 15, and retighten red pointer positioning screw.
   Test for switch closure beyond mark 15 by increasing liquid flow.
   B. **Switch Cam Adjustment for "B" Control** Hold the red pointer firmly with fingers and loosen the slotted shaft nut. Rotate the red pointer in a direction against liquid flow until switch opening occurs, then rotate back to obtain switch closure and retighten slotted shaft nut. Switch closure may be determined by the switch click or a continuity tester. Holding the red pointer, loosen the round head positioning screw and rotate red pointer to the desired flow graduation position, mark 15, and retighten red pointer positioning screw.
   Test for switch opening by reducing liquid flow.
6. Connect necessary switch leads and replace cover, glass and dial.

SWITCH CONTACT DIAGRAM

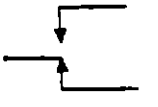
FACTORY SETTING



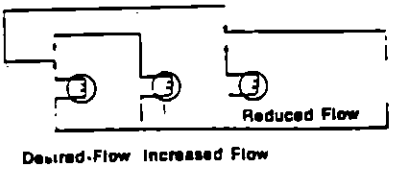
INCREASED LIQUID FLOW CONTROL

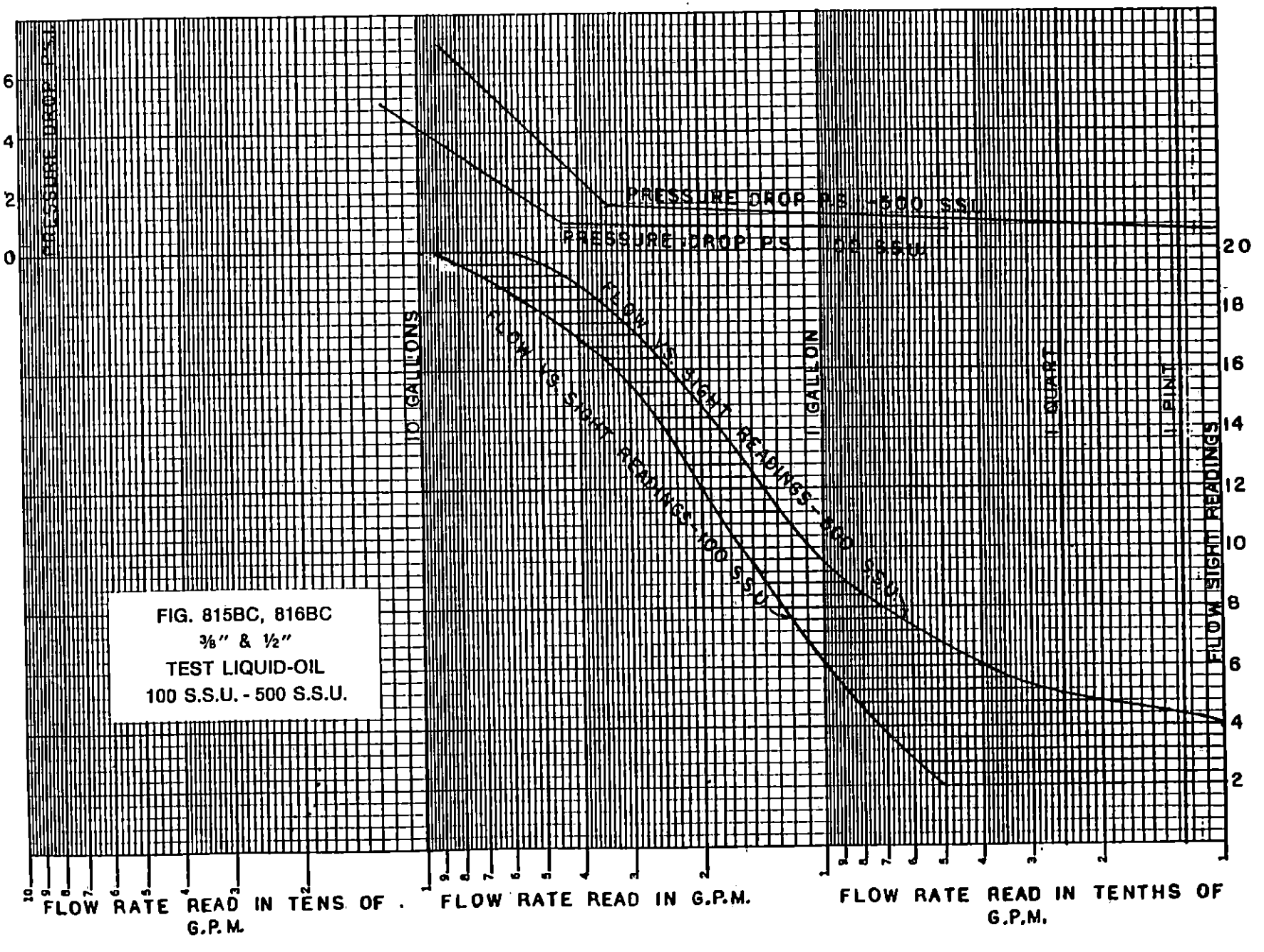


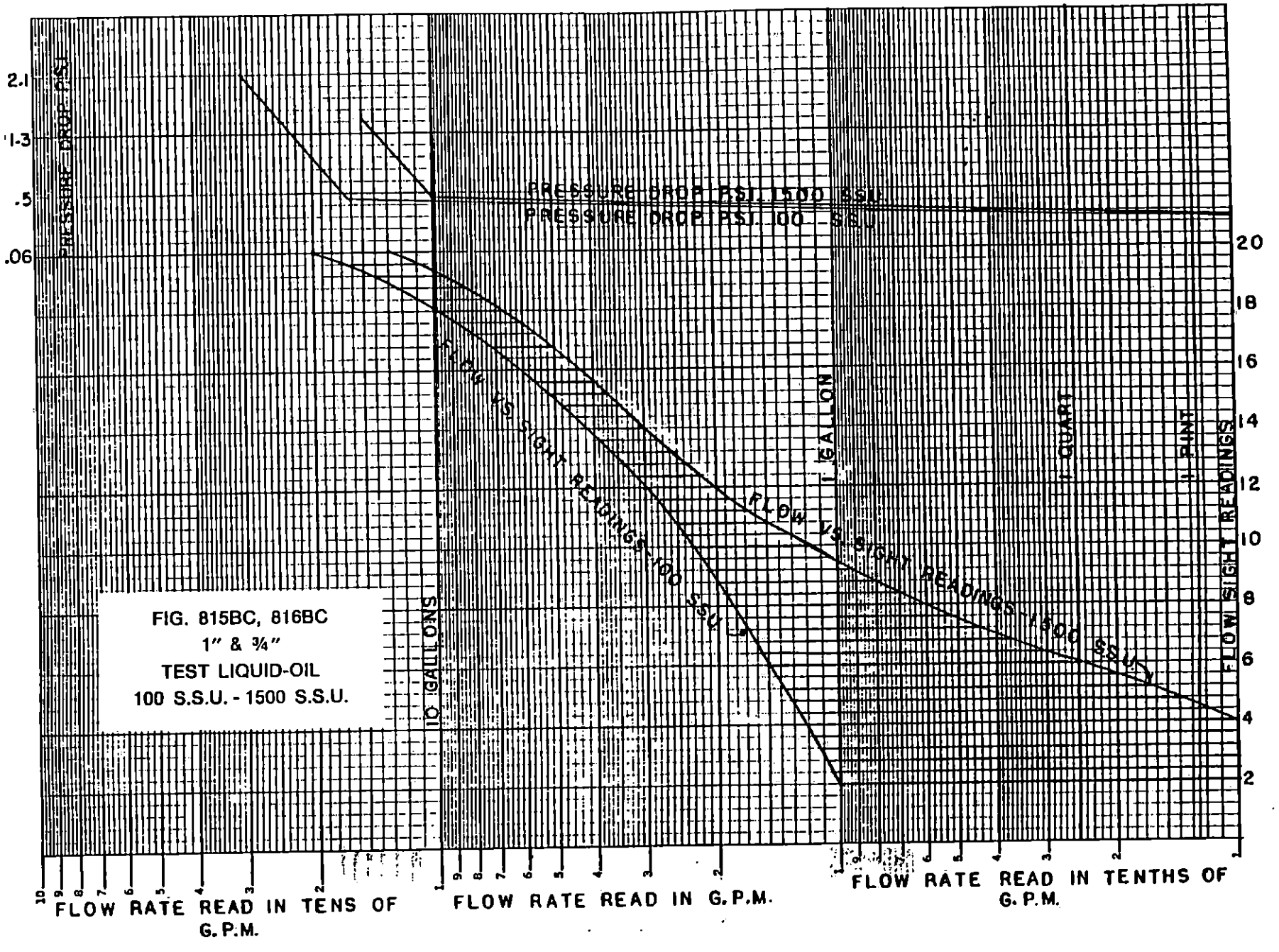
DECREASED LIQUID FLOW CONTROL

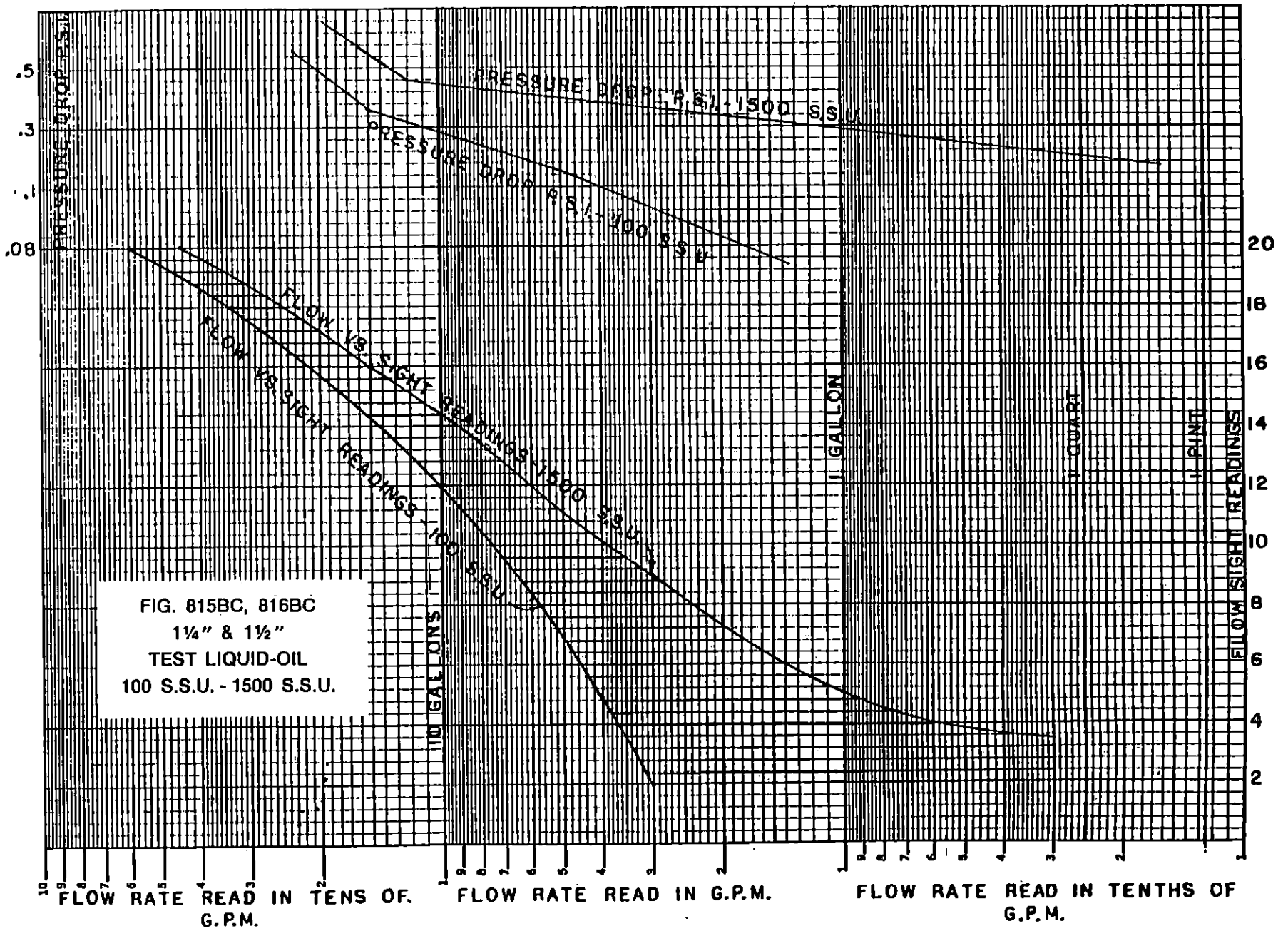


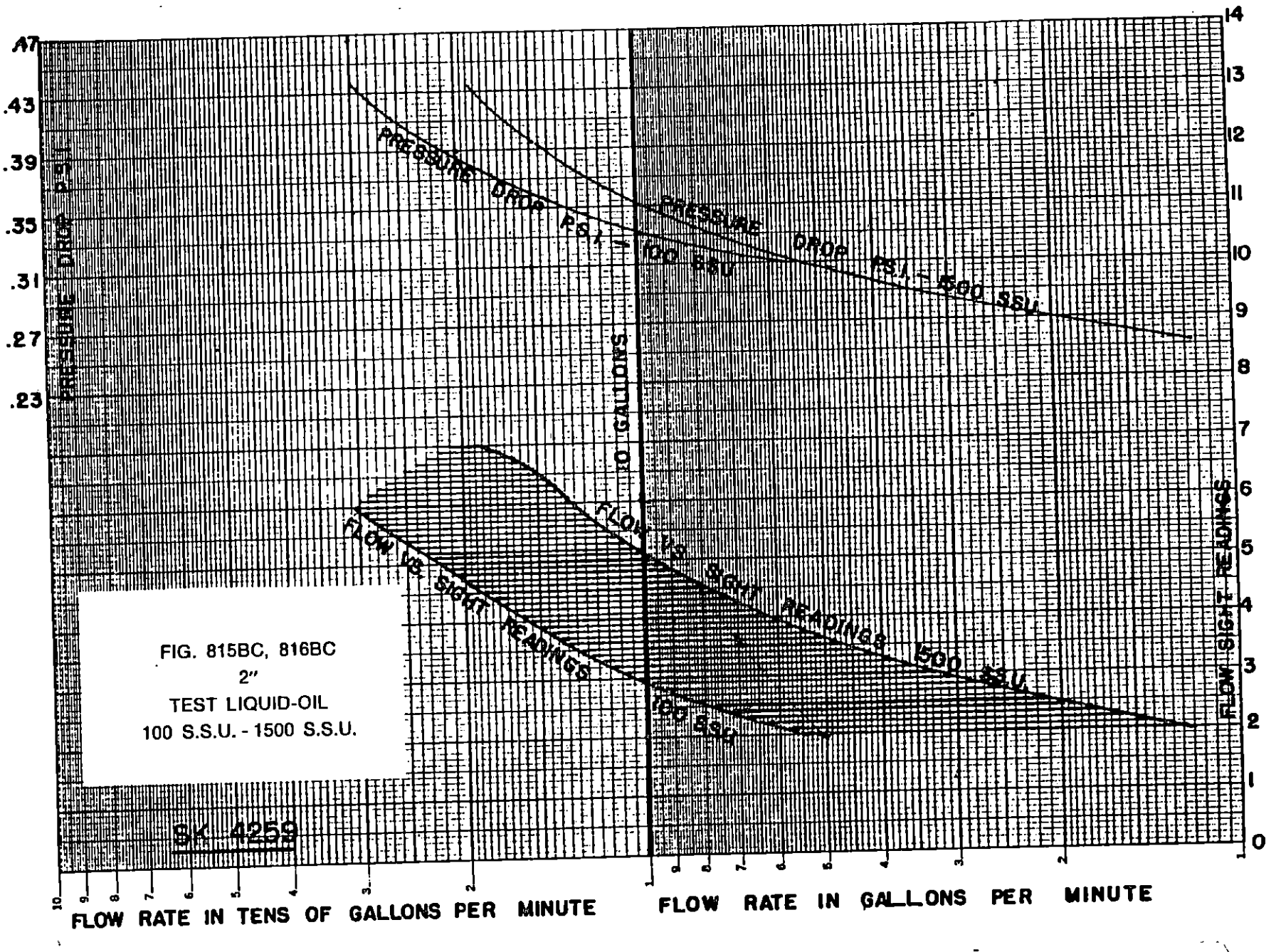
Complete liquid flow control can be obtained by installing two Teleflo Indicators; one set for increased liquid flow control, one set for reduced liquid flow control.




PRESSURE DROP P.S.I.
6
4
2
0
PRESSURE DROP P.S.I. - 500 S.S.U.
PRESSURE DROP P.S.I. - 100 S.S.U.
FLOW VS. SLOW READINGS - 500 S.S.U.
FLOW VS. SLOW READINGS - 100 S.S.U.
10 GALLONS
1 GALLON
1 QUART
1 PINT
FLOW SIGHT READINGS
20
18
16
14
12
10
8
6
4
2
FIG. 815BC, 816BC
3/8" & 1/2"
TEST LIQUID-OIL
100 S.S.U. - 500 S.S.U.
FLOW RATE READ IN TENS OF G.P.M.
FLOW RATE READ IN G.P.M.
FLOW RATE READ IN TENTHS OF G.P.M.


PRESSURE DROP PSI
2.1
1.3
.5
.06
PRESSURE DROP PSI. 1500 SSU
PRESSURE DROP PSI. 100 SSU
FLOW VS SIGHT READINGS 100 SSU
FLOW VS SIGHT READINGS 1500 SSU
10 GALLONS
1 GALLON
1 QUART
1 PINT
FLOW SIGHT READINGS
20
18
16
14
12
10
8
6
4
2
FIG. 815BC, 816BC
1" & ¾"
TEST LIQUID-OIL
100 S.S.U. - 1500 S.S.U.
FLOW RATE READ IN TENS OF G.P.M.
FLOW RATE READ IN G.P.M.
FLOW RATE READ IN TENTHS OF G.P.M.


.5
.3
.1
.08
PRESSURE DROP P.S.I.
PRESSURE DROP @ S.S.U. 1500 S.S.U.
PRESSURE DROP @ S.S.U. 100 S.S.U.
FLOW VS SIGHT READINGS 1500 S.S.U.
FLOW VS SIGHT READINGS 100 S.S.U.
10 GALLONS
1 GALLON
1 QUART
1 PINT
FLOW SIGHT READINGS
20
18
16
14
12
10
8
6
4
2
FIG. 815BC, 816BC
1¼" & 1½"
TEST LIQUID-OIL
100 S.S.U. - 1500 S.S.U.
FLOW RATE READ IN TENS OF G.P.M.
FLOW RATE READ IN G.P.M.
FLOW RATE READ IN TENTHS OF G.P.M.


.47
.43
.39
.35
.31
.27
.23
PRESSURE DROP P.S.I.
PRESSURE DROP P.S.I. 100 SSU
PRESSURE DROP P.S.I. 500 SSU
10 GALLONS
FLOW IN SIGHT READINGS
FLOW IN SIGHT READINGS 500 SSU
100 SSU
FLOW SIGHT READINGS
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
FIG. 815BC, 816BC
2"
TEST LIQUID-OIL
100 S.S.U. - 1500 S.S.U.
SK 4259
FLOW RATE IN TENS OF GALLONS PER MINUTE
FLOW RATE IN GALLONS PER MINUTE

OIL SPECIFICATIONS

Lubricating oil should be an extreme pressure (EP) lubricant of the mild inactive type (lead naphthenate type). It should have excellent anti-foam, anti-rust, and anti-oxidation characteristics and must not be corrosive to gears or roller bearings.

Ambient temperatures should be considered in selection of oil viscosity:

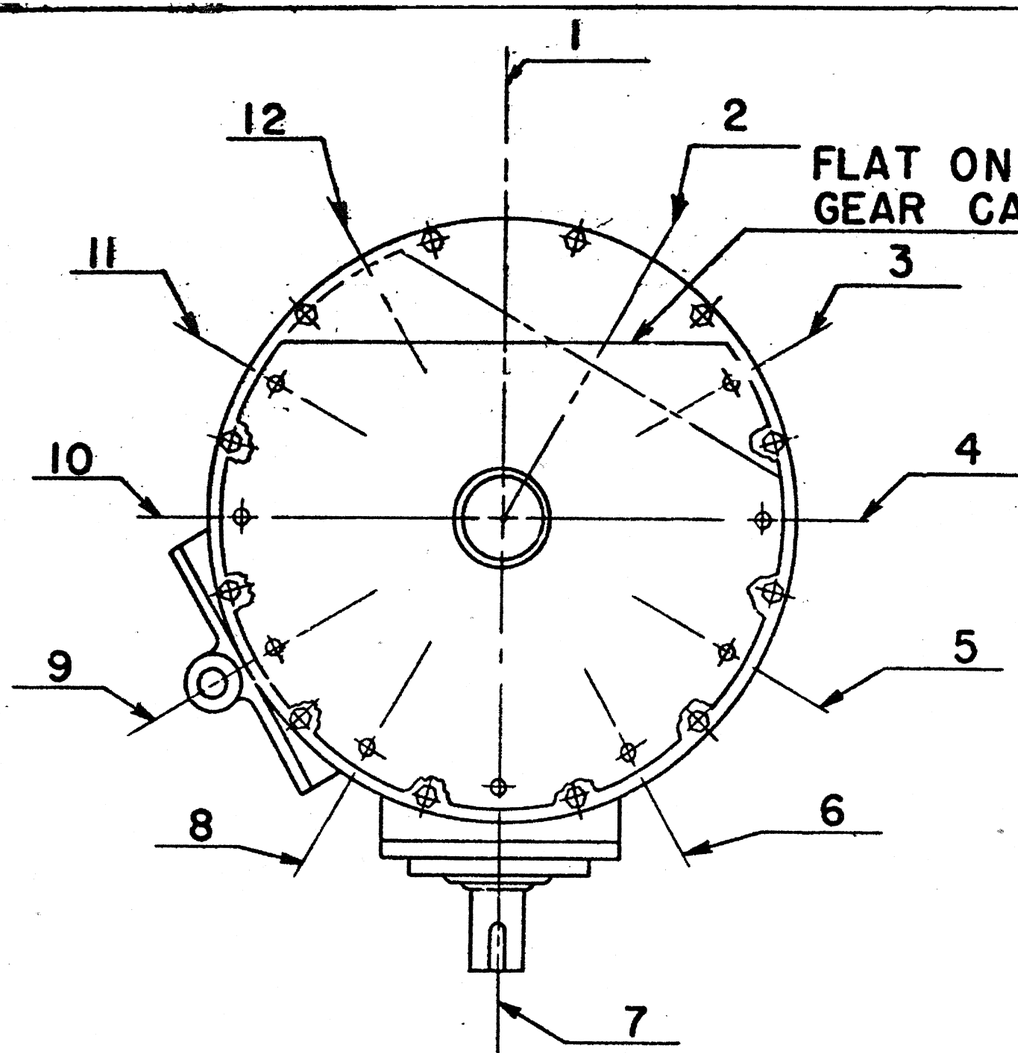
1. For low average ambient temperature (15° to 60°F), a viscosity of approximately 700 to 1000 SSU at 100°F (75 SSU at 210°F) (AGMA #4EP).

2. For higher average ambient temperature, a viscosity of approximately 80-105 SSU at 210°F (AGMA #5EP). (1200-1500 SSU at 100°F)

The user should consult his lubricant supplier for recommendation of brand name to meet the above specifications.

A partial list of brand names is shown below.

Name of Manufacturer	#4EP For Ambient Temp. 15° - 60°F	#5EP For Ambient Temp. Above 60°F
Atlantic Refining Co.	Premier 12	Premier 13
Esso Standard Oil Co.	PEN-O-LED EP2	PEN-O-LED EP3
Gulf Oil Company	EP Lubricant #75	EP Lubricant #95
Keystone Lubricating		W. G. IX
Shell Oil Company	Macoma Oil 68	Macoma Oil 72
Sinclair Refining Co.	Pennant EP #2	Pennant EP #3
Socony Mobil Oil Co.	Mobil Gear 630	Mobil Gear 630
Standard Oil Co. (Calif.)		Gear Compound #100
Standard Oil Co. (Indiana)		Amogear Compound #4
Standard Oil Co. (Ohio)	Factolube 2	Factolube 3
Sun Oil Company	Sun EP 70-90	Sun EP 90
The Texas Company	Meropa Lubricant #2	Meropa Lubricant #3



FLAT ON UPPER GEAR CASE

1-POSITION 1 IS THE STANDARD POSITION FOR POSITION 2 ROTATE UPPER GEAR CASE (D54-164001) OR (D54-164016) IN RELATION TO THE LOWER GEAR CASE, 30° CLOCKWISE FROM POSITION 1
FOR POSITION 3 ROTATE UPPER GEAR CASE 60° FROM POSITION 1
POSITION 4, ETC.

© 2-POSITIONAL ASSEMBLY NUMBER SELECTED IS THE CENTERLINE OF THE PULPER DISCHARGE ELBOW, WHICH WILL EXTEND RADIALLY ALONG THAT LINE.
(CONTINUOUS PULPERS ONLY)

Ⓔ 3-SEE CUSTOMER LIST OF ASSYS FOR POSITION Nº

REV	ALTERATIONS	DATE	BY
E	ADD NOTE #3	5-18-80	RJB
	C54-199033	5-23-80	RJB
D	ADD "SUPERSEDES		
C	ADD NOTE 2	3-22-73	RW
B	REDRAWN	7-7-69	P.J.S.

SUPERSEDES C54-199033 SUPERSEDED BY

JONES FORM 9436

MACHINING TOLERANCES

1.	or	1.▽000 = ±.04
1.0	"	1.0▽00 = ±.02
1.00	"	1.00▽0 = ±.01
1.000	"	1.000 = ±.005

FOR CUTOFF, FABRICATION AND CASTING TOLERANCES AND STD SHOP PRACTICES, SEE FACTORY MANUAL SECTION 2

BELOIT

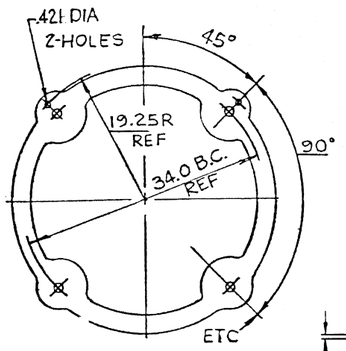
PT NO.	MATERIAL	SIZE OR PATT NO.	WEIGHT	REQ/	WANTED

FIRST USED ON D54-114001

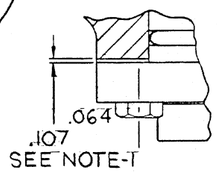
DATE 6-16-66

POSITIONAL ASSY ARR
JONES GEAR REDUCER
SIZE 250V-350V

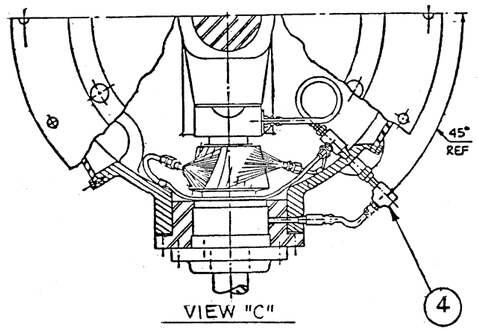
DRAWN	APP'VD	ENG	SCALE	SH	
SL	GH	JFR	—	1	B54-199011



VIEW-B
SCALE 1:10

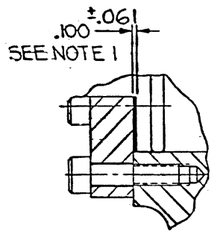


DETAIL "E"
SCALE=1:2



VIEW "C"

PARTS



DETAIL-D
SCALE=1:2

ITEM	PART No. OR SIZE	MATL	DESCRIPTION	KIT Nº & QTY. P1	P2	P3	P4	P5	P6	P7	P8
29	323056	BR	GAGE-OIL SIGHT (LUBE DEV. #G321-4)	1							
30	492009	MI	PIPE CAP .375" NPT	1							
31	498540	CI	PIPE PLUG 2"	1							
32	498520	CI	PIPE PLUG 1"	1							
33	510025	STL	COUPLING .5" NPT	1							
34	566315	MI	REDUCING TEE 1"x1"x.5"	1							
35	C97-891006-35A	STL	NIPPLE 1"x2.5" LG.	1							
36	C97-891004-2A	STL	NIPPLE .5"x3.0" LG.	1							
37	C97-891004-35A	STL	NIPPLE .5"x1.5" LG.	1							
38	529004		FILLER-BREATHER	1							

HARDWARE KIT D54-114035-K_

				KIT Nº & QTY. K1	K2	K3	K4	K5	K6	K7	K8
39	105388	STL	SCREW-HEX HD CAP .75"x2.25" LG.	8							
40	105396	STL	SCREW-HEX HD CAP .75"x2.50" LG.	12							
41	105216	STL	SCREW-HEX HD CAP .50"x1.50" LG.	6							
42	105212	STL	SCREW-HEX HD CAP .50"x1.25" LG.	14							
43	100177	STL	SCREW-SOC HD CAP .625"x2.50" LG.	16							
44	151535	STL	SCREW-#10-24 SELF TAPPING .50" LG.	1							
(F) 45	587023	BR	CLIP-TUBE .625" PARKER #3121-10	1							
46	137045	STL	SCREW-FLAT HD. .25"x1.5" LG.	2							
47	227010	STL	NUT-HEX .25"	2							
(F) 48	151537	STL	SCREW-RD.HD. SELF TAP .25-20x.5" LG.	1							

NOTES:

1 — ASSEMBLY OF GEARS: SET BEVEL PINION TO CORRECT MOUNTING DIMENSION (STAMPED ON PINION). SEE A54-199009 FOR PROCEDURE TO CHECK PINION MOUNTING DIMENSION. AFTER PINION IS IN PLACE, DETERMINE CORRECT POSITION OF GEAR BY MOVING IT ALONG ITS AXIS AND INTO MESH WITH PINION UNTIL SPECIFIED BACKLASH IS OBTAINED. FOR SPACING OF PINION & GEAR USE SHIM SET, ITEM-16 (1-SHIM SET IS ADEQUATE FOR BOTH GEARS. USE AS REQUIRED) (C) (F)

2 — USE ADJUSTABLE PARALLEL JN54-46 FOR MEASURING MOUNTING DIMENSIONS

3 — UPPER GEAR CASE POSITIONED PER B54-199011 SEE CUST L/A FOR POSITION

4 — LUBRICANT FOR JONES SHOP TEST RUN WILL BE SHELL OIL CO. OMALA 220 OIL. OIL MUST BE DRAINED BEFORE SHIPMENT. TAG GEAR UNIT — "GEAR UNIT PROTECTED WITH RUST INHIBITING OIL BEFORE SHIPMENT. FILL WITH PROPER LUBRICATING OIL BEFORE STARTING. SEE BELOIT JONES OPERATING MANUAL

5 - #25(.1495) DRILL, .6 DEEP 1-HOLE LOCATE FROM ITEM -28

6 - USE NIPPLE THAT WILL PLACE THE SIGHT GAGE IN A POSITION WHERE THE SCRIBE MARK WILL BE APPROX. IN THE CENTER OF GAGE

ITEM	PART No. OR SIZE	MATL.	DESCRIPTION	GROUP & QTY. 1	2	3	4	5	6	7	8
1	D54-164001-1	C.I. CL-50	UPPER GEAR CASE	1	1						
2	D54-164002-1	C.I. CL-50	LOWER GEAR CASE	1	1						
3	D54-200005-G1		PINION SHAFT & BEARING ASSY	1	—						
4	D54-209020-P1		LUBRICATION PARTS KIT ASSY	1	1						
5	D54-864001-1	C.I. CL-35	COVER-ACCESS HOLE	1	1						
6	B54-814003-1	HRS	COVER-INSPECTION HOLE	1	1						
7	D54-114035-P1		PARTS KIT	1	1						
8	D54-114035-K1		HARDWARE KIT	1	1						
9	D54-200057-G1		BEARING PARTS-MAIN SHAFT	1	1						
10	C54-203012-1	C.I. CL35	END COVER	1	1						
11	C54-211003-1	HRS	ADJUSTMENT RING	1	1						
12	D54-200011-G1		PINION SHAFT & BEARING ASSEMBLY	—	1						

PARTS KIT D54-114035-P_

				KIT Nº & QTY. P1	P2	P3	P4	P5	P6	P7	P8
13	531022	BRASS	CONN. MALE .5" TUBE x .5" NPT	1							
14	C97-891003-34A	STL	PIPE NIPPLE - .375" NPT	1							
15	B52-609001-1	CR BR	ORIFICE FITTING	1							
16	B54-823013-1	SST	SHIM SET	1							
17	B97-915001-22	BUNA	"O" RING PARKER #2-453 OR EQIV.	1							
18	B97-915001-23	BUNA	"O" RING PARKER #2-459 OR EQIV.	1							
19	B54-809032-1	VELLUM	GASKET	1							
20	501217	PLASTIC	CAPLUG .500" NPT #11	1							
21	501208	PLASTIC	CAPLUG 1" NPT #14	1							
22	501212	PLASTIC	CAPLUG 1.5" NPT #20-S	1							
23	531046	BR	PARKER TUBE FITTING #8-6FB12-B								
			.5 O.D. TUBE .375 NPT MALE OR EQIV	1							
24	525246	CU	COPPER TUBING .5" O.D. x .032 WALL x 12" LG	1							
25	B54-809030-1	VELLUM	GASKET	1							
26	B54-809033-1	VELLUM	GASKET	1							
27	A54-199009		PINION GEAR MOUNTING DWG.	1							
28	587018	BR	PARKER TUBE CLIP #3121-1-8 FOR .5" O.D. TUBE OR EQIV.	1							

(B)

DASH NO. IDENTITY:
- G1 = ASSEMBLY
- P1 = PARTS KIT
- K1 = HARDWARE KIT
- (E) - G2 = ASSEMBLY (SPECIA (4(RATIO, GEAR SET D54-164042-G1 W/LARGER PINION BORE)

REV	ITEM	DATE	BY				
—	IT. #24 WAS 16." LG.	10-7-83	MGH.				
C	ADD IT. #13; IT. #23 QTY. WAS 2;	—	—				
- 2	ADD NOTE-7	1-24-83	JB	F	ITEM-24 WAS 30" LG, ADD ITEMS 45 & 48 ITEM-23 QTY. WAS (3), AND 14	3-16-87	JB
- 2	ADD REF. DATA #12 & MOVED DET. "E"	7/1/81	MGH.	-	REMOVED NOTE-7 GROUP 2 AND ITEM 12 FROM NOTE 7,	1-22-86	RW/VM
- 1	CHGD TITLE BLOCK LINE-1 & 3	10-30-80	MGH	-	BLOCK TO BE SHT. 1 OF 3, ADDED	———	—
A	REM. ITEMS 13 & 14	4-16-80	RJB	—	TO NEW SHEET #3; REV. TITLE	———	—
REV	ALTERATIONS	DATE	BY	E	REM. REF. DATA CHART & ADD	———	—
SUPERSEDES	SUPERSEDED BY			D	ADD REF DATA #14	9-24-85	TR

MACHINING TOLERANCES
1. or 1.▽000 = ±.04
1.0 " 1.0▽00 = ±.02
1.00 " 1.00▽0 = ±.01
1.000 " 1.000 = ±.005
FOR CUTOFF, FABRICATION AND CASTING TOLERANCES AND STD SHOP PRACTICES, SEE FACTORY MANUAL SECTION 2.

BELOIT

DASH Nº	MAT'L-DRAWING-PT Nº	MATERIAL	DESCRIPTION	SIZE OR PATT Nº	WEIGHT	QTY.REQ	WANTED
				(1) GEAR REDUCER ASSEMBLY PARTS 350V			
				(1) VERT. R.A.			

FIRST USED ON D54-195002
DATE 2-11-80

DRAWN	APP'V'D	ENG	SCALE	SH	
R.J.B.	WFW	E.H.S.	NONE	1 OF 3	D54-114035

REV H LEVEL

ITEM	PART No. OR SIZE	MATL.	DESCRIPTION	GROUP & QTY. 1 2 3 4 5 6 7 8

REF DATA Nº	DIM'S SAME AS ASSEMBLY - COMMENTS	MACHINE SIZE	E	F	G	H	J	OIL CAP.	DRIVE HP(MAX)	INPUT RPM - OUTPUT RPM	WEIGHT	SHAFT REF.	Ⓖ GEAR SET REF.	ADAPTA RING (REF.)
1	D54-114001-G1 & D54-114028-G1	44"J CWP SHARK 3000	61.34	3.844	15.750	3.7	13.7	27 GAL.	350 HP	1800 RPM INPUT - 400 RPM OUTP.	3800#	C54-306014-G2	D54-164041-G1	B54-251007-1
2	D54-114001-G2 & D54-114028-G2	44"J CWP SHARK 3000	61.34	3.844	15.750	5.	15.	22 GAL.	350 HP	1200 RPM INPUT - 400 RPM OUTP.	3800#	C54-306014-G2	D54-164041-G3	B54-251007-1
3	D54-114001-G3 & D54-114028-G3	35"C BARRACUDA 3000	59.87	3.813	17.000	4.5	14.5	24 GAL.	350 HP	1800 RPM INPUT - 514 RPM OUTPUT	3825#	C54-306015-G2	D54-164041-G2	B54-251007-2
4	D54-114001-G4 & D54-114028-G4	35"C BARRACUDA 3000	59.87	3.813	17.000	6.	16.	18 GAL.	350 HP	1200 RPM INPUT - 514 RPM OUTPUT	3810#	C54-306015-G2	D54-164041-G4	B54-251007-2
5	D54-114001-G5 & D54-114028-G5	44"J BATCH SHARK 4000	54.35	—	15.750	3.7	13.7	27 GAL.	350 HP	1800 RPM INPUT - 400 RPM OUTPUT	3800#	D54-306065-G2	D54-164041-G1	B54-251007-1
6	D54-114001-G6 & D54-114028-G6	44"J BATCH SHARK 4000	54.35	—	15.750	5.	15.	22 GAL.	350 HP	1200 RPM INPUT - 400 RPM OUTPUT	3800#	D54-306065-G2	D54-164041-G3	B54-251007-1
7	D54-114001-G7 & D54-114028-G7	35"C BARRACUDA 3000	59.87	3.813	17.000	5.	15.	22 GAL.	350 HP	1500 RPM INPUT - 500 RPM OUTPUT	3810#	C54-306015-G2	D54-164041-G3	B54-251007-2
8	D54-114001-G8 & D54-114028-G8	44" CWP SHARK 4000	61.34	3.590	—	4.5	14.5	24 GAL.	350 HP	1200 RPM INPUT - 337 RPM OUTPUT	3780#	C54-306073-G2	D54-164041-G2	———
9	D54-114001-G9 & D54-114028-G9	44"J BATCH SHARK 4000	54.35	—	15.750	4.5	14.5	24 GAL.	200/350 HP	1200 RPM INPUT - 335 RPM OUTPUT	3000#	D54-306065-G2	D54-164041-G2	B54-251007-1
10	——— D54-114028-G10	44" CWP SHARK 4000	61.34	3.590	—	3.7	13.7	27 GAL.	250/350 HP	1800 RPM INPUT - 400 RPM OUTPUT	3780#	C54-306073-G2	D54-164041-G1	———
11	——— D54-114028-G11	55" BATCH SHARK 4000	55.05	—	—	3.7	13.7	27 GAL.	200/250 HP	945 RPM INPUT - 210 RPM OUTPUT	3800#	C54-306101-G2	D54-164041-G1	———
12	D54-114001-G10 ———	44"J CWP SHARK 3000	61.34	3.844	15.750	4.5	14.5	24 GAL.	250/350 HP	1200 RPM INPUT - 337 RPM OUTPUT	3780#	C54-306014-G2	D54-164041-G2	B54-251007-1
13	* SPECIAL, USE GROUP Nº 2	44"J BATCH SHARK 4000	54.35	—	15.750	3.7	13.7	27 GAL.	250/350 HP	1180 RPM INPUT - 295 RPM OUTPUT	3800#	D54-306065-G2	D54-164042-G1	B54-251007-1
14	TAPERED SHAFT	42" TRI-DYNE 5000	61.34	12.84	———	5.	15.	22 GAL.	200 HP	900 RPM INPUT - 290 RPM OUTPUT	3780*	D54-306126-G1	D54-164041-G3	———
15	TAPERED SHAFT	44" BATCH SHARK 4000	54.35	5.85	15.750	3.7	13.7	27 GAL.	250/350 HP	1800 RPM INPUT - 400 RPM OUTPUT	3800*	D54-306133-G2	D54-164041-G1	B54-251007-1
16	TAPERED SHAFT	44" BATCH SHARK 4000	54.35	5.85	15.750	5.	15.	22 GAL	250/350 HP	1200 RPM INPUT - 400 RPM OUTPUT	3800*	D54-306133-G2	D54-164041-G3	B54-251007-1
17	TAPERED SHAFT	44" CWP SHARK 4000	61.34	12.84	———	4.5	14.5	24 GAL	250/350 HP	1200 RPM INPUT - 337 RPM OUTPUT	3780*	D54-306134-G2	D54-164041-G2	———
18	TAPERED SHAFT	44" CWP SHARK 4000	61.34	12.84	———	3.7	13.7	27 GAL	250/350 HP	1800 RPM INPUT - 400 RPM OUTPUT	3780*	D54-306134-G2	D54-164041-G1	———
19	TAPERED SHAFT	44" BATCH SHARK 4000	54.35	5.85	15.750	4.5	14.5	24 GAL	350 HP	1180 RPM INPUT - 337 RPM OUTPUT	3800#	D54-306133-G2	D54-164041-G2	B54-251007-1
20	TAPERED SHAFT	42" TRI-DYNE 5000	61.34	12.84	———	3.7	13.7	27 GAL	200/300 H	1500 RPM INPUT - 325 RPM OUTPUT	3800#	D54-306126-G1	D54-164041-G1	———
21	* SPECIAL, USE GROUP #2 [RATIO 4:1]	44" BATCH SHARK 4000	54.35	5.85	15.750	3.7	13.7	27 GAL	300 HP	1180 RPM INPUT - 295 RPM OUTPUT	3800#	D54-306133-G2	D54-164042-G1	B54-251007-1
22	D54-114001-G1 & D54-114028-G1	44" CWP SHARK 3000	61.34	3.844	15.750	3.7	13.7	27 GAL	350 HP	1500 RPM INPUT - 400 RPM OUTPUT	3800#	C54-306014-G2	D54-164040-G1	B54-251007-1
23	TAPERED SHAFT	42" TRI-DYNE 5000	61.34	12.84	———	3.7	13.7	27 GAL	250 HP	1200 RPM INPUT - 337 RPM OUTPUT	3800*	D54-306126-G1	D54-164041-G2	———
24	STRAIGHT SHAFT	SPECIAL GEAR REDUCER CONVERSION	63.175	10.66	———	3.7	13.7	27 GAL	350 HP	1800 RPM INPUT - 400 RPM OUTPUT	3800#	D54-306177-G1	D54-164041-G1	———
25	TAPERED SHAFT	35" TRI-DYNE 5000	61.34	12.84		3.7	13.7	27 GAL	150 HP	1200 RPM INPUT - 335 RPM OUTPUT	3800#	D54-306126-G1	D54-164041-G2	———

REV	ALTERATIONS	DATE	BY
G	GEAR SET REF: D54-164041 WAS D54-164021 D54-164042 WAS D54-164013	11-26-90	EBH

SUPERSEDES — SUPERSEDED BY

JOSEPH MERRITT & CO

UNLESS OTHERWISE SPECIFIED:
MACHINING TOLERANCES
1. or 1.000 = ± .04
1.0 or 1.000 = ± .02
1.00 or 1.000 = ± .01
1.000 or 1.000 = ± .005
FOR CUTOFF, FABRICATION AND CASTING TOLERANCES AND STD SHOP PRACTICES, SEE FACTORY MANUAL SECTION 2.
ANGULARITY TOLERANCES ±½°
PROJECTION

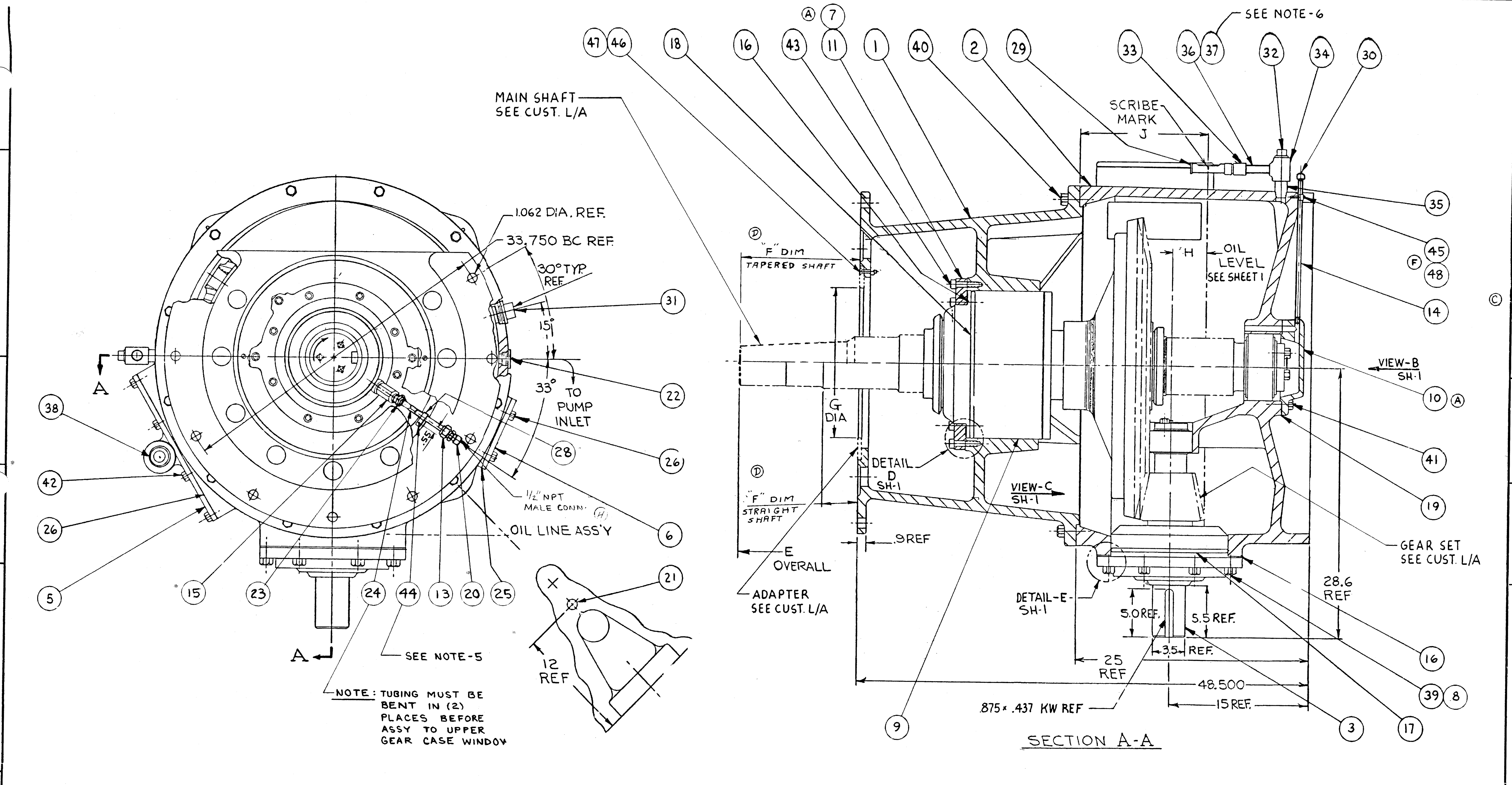
DASH Nº	MAT'L-DRAWING-PT Nº	MATERIAL	DESCRIPTION	SIZE OR PATT Nº	WEIGHT	QTY.REQ	WANTED

BELOIT

FIRST USED ON	GEAR REDUCER ASSEMBLY PARTS
SIMILAR TO	350 V
DATE 2-10-86	VERT. R.A.

DRAWN	CHK'D	APP'V'D	ENG.	I.E.	SCALE	SH	
RW/VM					NONE	3 OF 3	D54-114035

ITEM	PART No. OR SIZE	MATL.	DESCRIPTION	GROUP & QTY. 1	2	3	4	5	6	7	8



REV		ALTERATIONS	DATE	BY
H		ADD [illegible] CONN.	8-15-95	DJW
		REV. PIC. OF OIL INLET (THRUST BRG)	3-16-87	SB
F		REV DRAIN CONN WAS COPPER TUBING		
E		WAS SHT. 2 OF 2 NOW 2 OF 3	1-22-86	RGW
D		ADD NOTE TO "F" DIM'S	10-17-85	TR
-		ADD NOTES	10-7-83	MGH.
C		ADD BALLOONS #13, #23, & #24		
-	1	CHGD TITLE BLOCK LINE -3 & 1 FROM 13	10-30-80	MGH.
			4-16-80	RJB
		BALLOON 7 TO 11, REM. BALLOON 7		
A	-	BALLOON 10 WAS 13, BALLOON 13 REM, ADD		

SUPERSEDES | SUPERSEDED BY

SEPIA OF D54-114028

MACHINING TOLERANCES			
1.	or	1.▽000 =	±.04
1.0	"	1.0▽00 =	±.02
1.00	"	1.00▽0 =	±.01
1.000	"	1.000 =	±.005

FOR CUTOFF, FABRICATION AND CASTING TOLERANCES AND STD SHOP PRACTICES, SEE FACTORY MANUAL SECTION 2.

DASH No	MAT'L-DRAWING-PT No	MATERIAL	DESCRIPTION	SIZE OR PATT No	WEIGHT	QTY. REQ	WANTED

BELOIT

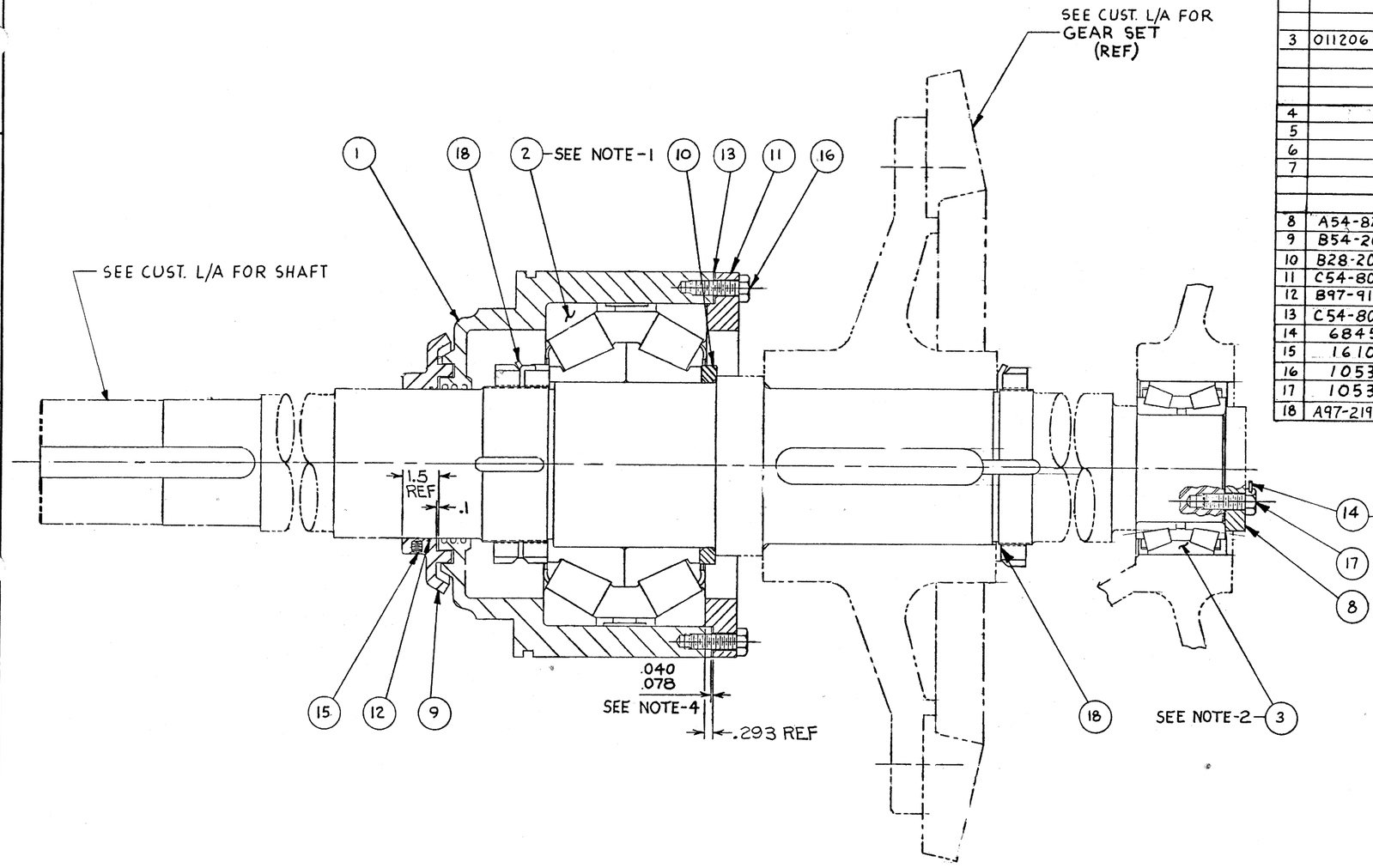
FIRST USED ON D54-195002

① GEAR REDUCER ASSEMBLY, PARTS 350V

DATE 2-11-80

① VERT. R. A.

DRAWN	APP'V'D	ENG	SCALE	SH	
R. J. B.	WW	EHS	1:5	2 of 3	D54-114035



ITEM	PART No. OR SIZE	MATL.	DESCRIPTION	GROUP & QTY. 1	2	3	4	5	6	7	8
1	C54-203011-1	C.I. CL50	CARRIER	1							
2	011263		TIMKEN BEARING ASSY "2TS5"								
			2-CUPS H936310 13.0000 O.D.								
			2-CONES H936349 6.625 I.D.								
			1-SPACER H936310EA (SEE NOTE-1)	1							
3	011206		TIMKEN BEARING ASSY #9-87								
			1-CUP 64700 DC 7.000 O.D.								
			2-CONES 64433 4.3304 I.D.								
			1-SPACER X15-64433 (SEE NOTE-2)	1							
4											
5											
6											
7											
8	A54-820001-1	HRS	LOCK DISC	1							
9	B54-205011-1	C.I. CL-35	WATER FLINGER	1							
10	B28-206001-1	HRS	SHOULDER COLLAR	1							
11	C54-806003-1	HRS	CLAMP RING	1							
12	B97-915001-19	BUNA "N"	"O" RING LINEAR #11-258 OR EQUIV	1							
13	C54-809031-1	VELLUM	GASKET	1							
14	684549	STL	WIRE .047 DIA. × 15.0" LG	1							
15	161095	STL	SOC SET SCR .375" × .50" LG.	2							
16	105308	STL	HEX HD CAP SCR .625" × 2.0" LG.	8							
17	105304	STL	HEX HD CAP SCR .625" × 1.75" LG.	3							
18	A97-219002-28		LOCKWASHER W-32	2							

NOTES:

1 — TIMKEN BEARING "2TS5"
BENCH END PLAY = .007 TO .009
MOUNTED END PLAY = .0021 TO .0074
CONE FIT = .001 TO .003 TIGHT

2 — TIMKEN BEARING #9-87
BENCH END PLAY = .007 TO .009
MOUNTED END PLAY = .0002 TO .0074
CONE FIT = .0006 TO .0026 TIGHT

3 — PURCHASE AND INSTALL CUPS, CONES, AND SPACERS OF TIMKEN BEARINGS AS MATCHED SETS

4 — MEASURE GAP AT ASSY AND USE 10 — 25% THICKER GASKET AND COMPRESS TO ORIGINAL THICKNESS

SEPIA OF D54-200042

REV	ALTERATIONS	DATE	BY
SUPERSEDES	SUPERSEDED BY		

MACHINING TOLERANCES
1. or 1.▽000 = ±.04
1.0 " 1.0▽00 = ±.02
1.00 " 1.00▽0 = ±.01
1.000 " 1.000 = ±.005
FOR CUTOFF, FABRICATION AND CASTING TOLERANCES AND STD SHOP PRACTICES, SEE FACTORY MANUAL SECTION 2.

DASH NO	MAT'L-DRAWING-PT NO	MATERIAL	DESCRIPTION	SIZE OR PATT NO	WEIGHT	QTY.REQ	WANTED

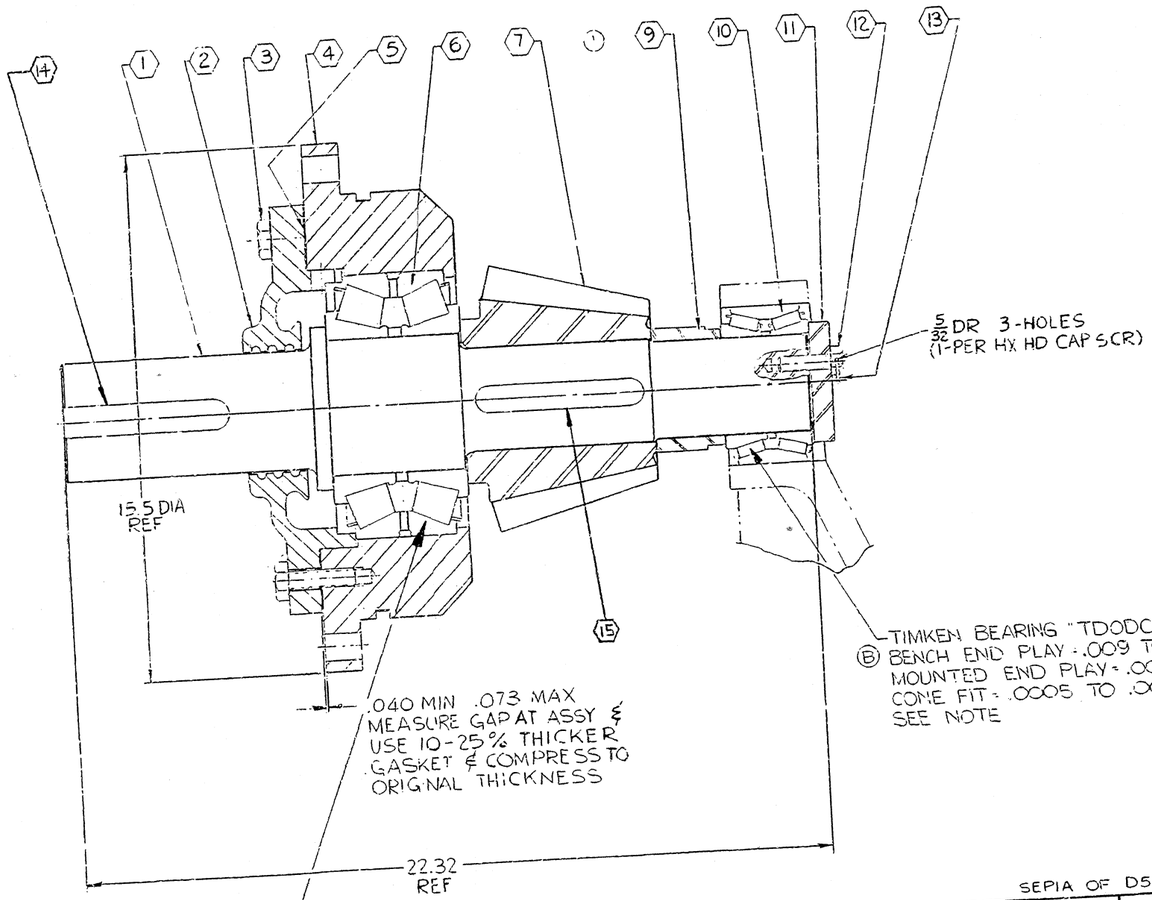
BELOIT

FIRST USED ON	BEARING PARTS - MAIN SHAFT
D54-114035	
DATE 2-7-80	350 V GEAR REDUCER (VERT. R.A.)

DRAWN	APP'V'D	ENG	SCALE	SH	
RJB	WFW	EHS	NONE	1 OF 1	D54-200057

ITEM	PART No. OR SIZE	MATL	DESCRIPTION	GROUP & QTY 1	2	3	4
Ⓓ 1	B54-306021-1	HRS	PINION SHAFT	1			
2	C54-203013-1	C.I. CL-35	THRUST BRG END COVER	1			
3	105308	ST	HX HD CAP SCR 5/8 x 2 LG	8			
4	D54-201011-1	C.I. CL-35	PINION THRUST END CARRIER	1			
5	C54-309029-1	VELL.	GASKET	1			
6	011202		TIMKEN BRG "TDOS"				
Ⓑ	SEE NOTE		1-CUP HM 821511D 7.7500 O.D.				
			2-CONES HM 821547 3.9362 BORE				
			1-SPACER HM 821547XA	1			
Ⓒ 7	(REF)		PINION GEAR SET (SEE D54-164004-1)	—			
Ⓐ				1			
9	B54-211004	CDS	PINION SPACER				
10	011204		TIMKEN BRG "TDODC"				
Ⓔ	SEE NOTE		1-CUP 33462-DC				
			2-CONES 33287. 2 7/8 BORE				
			1-SPACER X35-33287	1			
				1			
11	A54-820002	HRS	LOCK DISK	3			
12	105216	ST	HX HD CAP SCR 1/2 x 1 1/2 LG	1			
Ⓓ 13	684830	ST	WIRE 1/8 DIA x 7 LG	1			
Ⓓ 14	C97-873090-7A	CDS	KEY .875" x .875" x 5" LG	1			
Ⓓ 15	C97-873135-4A	CDS	KEY .75" x .75" x 5" LG	1			

NOTE:
Ⓔ PURCHASE & INSTALL CUPS, CONES & SPACERS OF TIMKEN BEARINGS AS MATCHED SETS



REV	ALTERATIONS	DATE	BY
	TO ITEM-1	1-24-83	JB
	ADD ITEMS-14 & 15 & DASH-1		
D	ADD PT. NO TO ITEM-13.	12-29-71	GH
C	QUANITY WAS 1	2-6-67	
B	ADD BRG INFO-NOTE-SEE NOTE-REM WIDTH	4-25-66	RCG
A	REM ITEM 8 KEY		

SUPERSEDES SUPERSEDED BY

SEPIA OF D54-200005

ESTIMATED WEIGHT 272 LB / 123 KG

MACHINING TOLERANCES

1.	or	1.▽000 = ±.04
1.0	"	1.0▽00 = ±.02
1.00	"	1.00▽0 = ±.01
1.000	"	1.000 = ±.005

FOR CUTOFF, FABRICATION AND CASTING TOLERANCES AND STD SHOP PRACTICES, SEE FACTORY MANUAL SECTION 2.

BELOIT

PT NO	MATERIAL	SIZE OR PATT NO	WEIGHT	REQ/MCH	WANTED
FIRST USED ON	D54-114003	PINION SHAFT & BRG ASSY			
		SPECIAL VERT RA GEAR			
DATE	4-5-1965	REDUCER #350V			

DRAWN	APP'V'D	ENG	SCALE	SH	
JC	GH		1=2	1 of 1	D54-200011