CLASS BEV-EV-GT-GTS PUMPS
Two Stage, Horizontally Split,
Double Suction,
General Purpose Pumps

Instructions for
INSTALLATION-OPERATION & MAINTENANCE

Note: It is important that the entire contents of this booklet be studied before installation.
GENERAL CONSTRUCTION (cont’d)

Sleeve Bearings with Kingsbury thrust bearing can be furnished.

Exception: Cannot be supplied on 1½ and 8GT.

Lubrication to the sleeve bearing will be found fully described in section IV of the book.

Stuffing Boxes can be packed solid or arranged for liquid sealing. See section No. V for more complete description.

Shaft and Shaft Sleeves—The shaft is protected throughout its entire length by shaft sleeves, intermediate sleeves and impellers.

The Shaft Sleeves are tubular type keyed to the shaft and are held in position by shaft sleeve nuts which are locked against rotation by means of set screws.
SECTION II

INSTALLATION

CHECK UPON ARRIVAL

Your pump was carefully checked at our shops prior to shipment to assure its meeting the requirements of your order.

It is suggested the pump be inspected upon arrival and that any irregularities arising due to shipping be reported immediately to the carrier.

CARE DURING STORAGE

If it is necessary to store the pump any length of time before installation, find a location where it will be protected from unfavorable weather.

The nozzle covers provided with the pump should be left in place during storage.

Parts on Parts Orders are protected with thin film polar type rust preventive.

This can be removed with mild alkali at 180°F or petroleum solvents.

CLEANING THE PUMP

Before putting the pump into operation it should be thoroughly flushed out to remove the rust preventive as well as any foreign matter which may have accumulated during installation.

Take all possible care not to contaminate your system.

LOCATION

Install the pump as close as possible to the source of the liquid to be pumped.

When selecting the location be sure to allow adequate space for operation as well as for maintenance operations involving dismantling and inspection of parts.

On the larger pumps, head room is an important consideration as a lift of some type is usually required.

Electric motor driven pumps should not be located in damp places without special protection for the motor.

The elevation drawing furnished for each pump will provide pertinent dimensions.

FOUNDATION

The foundation should be sufficiently rigid and substantial to prevent any pump vibration and to permanently support the bedplate at all points.

Note:

Unless otherwise specified all bedplates are designed such that they must be grouted in place.

The most satisfactory foundations are made of reinforced concrete. These should be poured well in advance of the installation to allow proper time for drying and curing.

---

<table>
<thead>
<tr>
<th>INSTALLATION CHECK LIST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleaning the Pump</td>
</tr>
<tr>
<td>Location</td>
</tr>
<tr>
<td>Foundation</td>
</tr>
<tr>
<td>Leveling the Baseplate</td>
</tr>
<tr>
<td>Aligning the Pump</td>
</tr>
<tr>
<td>Mounting Driver in Field</td>
</tr>
<tr>
<td>Grouting</td>
</tr>
<tr>
<td>Driver</td>
</tr>
<tr>
<td>Piping</td>
</tr>
</tbody>
</table>

The above outlines procedure. Detailed explanations follow below.

Fig. 2-1—Installation Checking List.

RUST PREVENTIVE

Internal parts of pumps and bearing housings are protected prior to shipment by flushing with thin film polar type rust preventive.

This can be cleaned out by flushing with a mild alkali at 180°F. Petroleum solvents are also effective.

External machined surfaces are protected with durable drying type rust preventive.

This can be removed with kerosene or safety solvent.
Many of our customers have standardized methods of construction. The following steps are offered as suggestions to those customers installing an occasional pump and who desire such aid.

The elevation drawing will furnish anchor bolt locations, size of bolts as well as a dimension for required grout.

**Fig. 2-2—Template for hanging foundation bolts while pouring foundation.**

Figure 2-3 illustrates a recommended foundation bolt arrangement. Notice the large washer with lugs. This should be welded at the bottom to the bolt and pipe sleeve to prevent turning.

Allow a little more than the specified threaded bolt length above rough surface of concrete. The excess can always be cut off if not needed.

A rough finish top surface is best when applying grout. Refer to the elevation drawing for grout dimension.

**Fig. 2-3—Arrangement of foundation bolt in foundation.**

**LEVELING THE BASEPLATE**

1. Before putting the unit on the foundation, thoroughly clean the top of the foundation. Break off any loose pieces of cement and roughen the top with a chisel to afford a good hold for the grout.

2. Stuff waste around the foundation bolt holes to prevent their filling in when grout is poured.

3. If the coupling has been made up between the pump and driver, disconnect it before setting the baseplate on foundation.

4. Prepare enough iron wedges or shims to be placed on each side of each foundation bolt. These wedges should be about 4 to 6 inches long, 2 to 3 inches wide and thick enough to allow for \( \frac{3}{4} \) to 1\( \frac{1}{2} \) inches of grout under the edge of the baseplate. Place wedges as shown in Fig. 2-4.

5. Level the baseplate by using a machinist’s level on the machined surface of the pump and the driver pads. When the baseplate is leveled, pull down the foundation bolts so they are snug. The baseplate may have been disturbed by tightening down the foundation bolts, therefore, recheck with level and make necessary adjustments by driving wedges or by shimming.

**Fig. 2-4—Methods of leveling bedplate by means of wedges, or shims and a pinch bar.**
ALIGNING THE UNIT

For successful pump operation accurate alignment of pump and driver is a "must".

As a flexible coupling is not a universal joint it will not compensate for misalignment between pump and driver.

The pump and driver, when supplied by Ingersoll-Rand as a unit, are aligned at the factory.

The pump and driver feet are placed on mounting pads having machined surfaces. Shims are placed under the feet to facilitate adjustment.

Shipment as well as handling in the field may have disturbed this alignment. It is essential that alignment be checked and the unit realigned.

**CAUTION:** COUPLING ALIGNMENT MUST BE CORRECT FOR SUCCESSFUL OPERATION. FLEXIBLE COUPLINGS WILL NOT COMPENSATE FOR ANY APPRECIABLE MISALIGNMENT, AND RAPID WEAR, NOISE, VIBRATION AND ACTUAL DAMAGE TO THE EQUIPMENT MAY BE CAUSED BY MISALIGNMENT. THEREFORE, THE COUPLING MUST BE ALIGNED WITHIN THE LIMITS GIVEN.

**WARNING:** THE DRIVER ROTATION MUST BE CHECKED BEFORE MAKING UP COUPLING. ACTUAL DAMAGE TO THE EQUIPMENT AND PERSONAL INJURY COULD RESULT FROM OPERATING THE UNIT WITH WRONG ROTATION.

**Important:**

There will be vertical expansion when the pump is running under normal operating conditions.

The vertical difference, measured when the pump and driver were cold, is recorded on the tag attached to the coupling.

<table>
<thead>
<tr>
<th>Type of Unit</th>
<th>Vertical difference measured at coupling halves when both pump and driver are cold.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor and Engine-Driven Pumps</td>
<td></td>
</tr>
<tr>
<td>Pump handling cold liquid.</td>
<td>Driver .005&quot; to .008&quot; lower than pump.</td>
</tr>
<tr>
<td>Pump handling hot liquid. (250°F).</td>
<td>Driver .002&quot; to .005&quot; higher than pump.</td>
</tr>
<tr>
<td>Turbine-Driven Pumps (Turbine having centerline support)</td>
<td></td>
</tr>
<tr>
<td>Pump handling cold liquid.</td>
<td>Turbine .005&quot; to .008&quot; lower than pump.</td>
</tr>
<tr>
<td>Pump handling hot liquid. (250°F).</td>
<td>Turbine .001&quot; to .004&quot; higher.</td>
</tr>
<tr>
<td>Turbine-Driven Pumps (Turbine without centerline support)</td>
<td></td>
</tr>
<tr>
<td>Pump handling cold liquid.</td>
<td>Turbine .020&quot; to .023&quot; lower than pump.</td>
</tr>
<tr>
<td>Pump handling hot liquid. (250°F).</td>
<td>Turbine .014&quot; to .017&quot; lower than pump.</td>
</tr>
<tr>
<td>Belt-Driven Pumps (Pulley on separately-mounted Jackshaft)</td>
<td></td>
</tr>
<tr>
<td>Pump handling cold liquid.</td>
<td>Coupling halves even within .003&quot;</td>
</tr>
<tr>
<td>Pump handling hot liquid. (250°F).</td>
<td>Jackshaft .006&quot; to .009&quot; higher than pump.</td>
</tr>
</tbody>
</table>

Fig. 2-5—Cold setting for Vertical Coupling alignment.

ALIGNING STANDARD COUPLINGS

Use a straight edge, a tapered wedge gauge or feeler gauges to perform the steps shown in Fig's. 2-6a, 2-6b, 2-6c and 2-6d.

**Important:**

Alignment must be within .003" when the unit is operating at its normal temperature and conditions. Therefore, make allowance for any temperature rise when cold setting the unit.

Use the table, Fig. 2-5 as a guide.

Fig. 2-6a—Measuring vertical angular misalignment. (Coupling faces must be parallel within .003)

Fig. 2-6b—Measuring horizontal angular misalignment. (Coupling faces must be parallel within .003)

Fig. 2-6c—Measuring vertical alignment. (Coupling faces must be parallel within .003)

Fig. 2-6d—Measuring horizontal alignment.
GEAR-TYPE COUPLINGS

The procedure to align a unit having a Gear Type Coupling (without a spacer) is the same as the preceding except first slide back the movable sleeves and take the readings on the gear hubs as shown in the illustration, Fig. 2-7.

Fig. 2-7—Method of taking alignment measurement on gear-type couplings.

PROCEDURE FOR ALIGNING SPACER TYPE COUPLINGS. (OR FLOATING SHAFT)

1. Remove the spacer or floating Jack Shaft between the pump and driver.
   The inside faces of driver and pump half couplings must be parallel within .0031" and can best be determined by the use of hand held inside micrometer marked "B" in Fig. 2-8.
   Be sure each coupling half is pushed outboard as far as possible each time when performing the above alignment.

Fig. 2-8—Method of aligning a spacer type coupling.

2. Make up a bracket as shown in Fig. 2-8 which can be fastened to one half coupling and is long enough to reach the other half coupling.

3. Fasten this bracket to the pump half coupling and a dial indicator to the bracket arm so that it is in contact with the rim of the driver half coupling.

4. Now rotate the pump half coupling by hand so that the indicator moves around the driver half coupling as described below.

Note:
It is suggested that you mark the coupling so that you can rotate at one quarter intervals. Mark at 3-6-9 and 12 o’clock.
Rotate the pump half coupling one quarter turn clockwise.
Rotate the driver half coupling one quarter turn in the same direction as pump half coupling.
Now check indicator reading.
Repeat the above steps at the 6-9 and 12 o’clock marking.

Important:
Alignment must be within .0031" when the unit is operating at its normal temperature and conditions. Therefore, make allowance for any temperature rise when cold setting the unit in accordance with the table. Fig. 2-5.
A final check must be made after the unit has been in operation a sufficient length of time to assume its normal operating temperature and conditions.
If the pump has been properly cold set, the alignment will be within .0031" when in operation.

GEAR TYPE COUPLING (WITH SPACER PIECE)

The procedure to align a unit having a Gear Type Spacer Coupling is the same as the preceding except first slide back the movable sleeves and take the readings on the gear hubs as shown in the Illustration, Fig. 2-9.

Fig. 2-9—Gear-type Coupling (with spacer piece).

Caution:
Do not make up coupling until you make certain rotation of the driver coincides with rotation direction indicated on the pump.
MOUNTING DRIVER IN FIELD

When a unit is shipped without the driver, the bedplate is machined at the factory but the driver bolt holes are not drilled.

Chalk the bedplate driver pads so that the bolt holes for the driver can be located.

Set the driver on the bedplate so that the gap between the coupling halves is that indicated on the certified elevation plan of the unit. In doing this, set the rotor of the driver in the center of its total end play.

Important: Check driver run-out.

During the assembly of the pump in our shops the run-out of all rotating parts is carefully checked.

Before the pump and driver are aligned as a unit, the driver coupling run-out is also checked.

Broken shafts sometimes result because of the failure in the field to check the driver shaft run-out.

The procedure is similar to that described under Aligning The Unit. Use the type of bracket described.

To obtain pump coupling run-out.

1. Mount the bracket with indicator (described under Aligning The Unit), on the driver half coupling so that the indicator rests upon the top or rim of the pump half coupling.

2. Rotate the pump rotor.
   Measure the run-out of the pump half coupling using the indicator.

To obtain the driver coupling run-out, simply reverse the above procedure.

1. Mount the bracket on the pump half coupling so that the indicator rests upon the top or rim of the driver half coupling.

2. Rotate the driver rotor.
   Measure the run-out of the driver half coupling using the indicator.

(Maximum run-out of couplings not to exceed .005 in)

Now align the couplings. However, for the present time do so without regard to vertical misalignment.

Then scribe on the bedplate pads the circumference of the bolt holes in the driver feet. Remove the driver, drill and tap the bedplate pads after first locating the center of the scribed circles with dividers.

Set the driver on the bedplate and align the couplings as described under Aligning the Unit.

DOWELING

The unit must not be doweled until a final check is made on alignment under actual operating conditions. Diagonally opposite feet of pump and driver should be drilled and reamed for these dowels.

GROUTING

Build a dam around the foundation as shown in Fig. 2-10. It is a matter of personal preference whether the leveling wedges under the baseplate should be removed after grouting. If you do want to remove the wedges, carefully mark their locations before pouring grout.

---

A good mixture for grout is one part cement to two parts clean sharp sand, with enough water so that the mixture flows evenly and is about the consistency of heavy cream. Too much water will let the cement separate, however, so use care in mixing.

Holes are provided in the baseplate to permit pouring the grout and stirring. They also act as air vents. Fill under the baseplate completely, stirring to assure proper distribution of the grout. Check to see that the grout flows under the edge of the baseplate evenly.

When the grout is thoroughly hardened, remove the dam and wedges, if desired, filling in the holes they leave with grout.
PIPING

Suction and discharge piping should be of ample size installed in direct runs and having a minimum of bends.

Velocities of 8 ft. per second (8 f p s) for suction lines and 15 ft. per second (15 f p s) for discharge lines have been found satisfactory in general pumping practice.

Do not connect any piping until the grout has thoroughly hardened and the foundation bolts have been finally pulled down.

DISCHARGE PIPE

Install a check valve and a gate valve in the discharge pipe. When the pump is stopped, the check valve will protect the pump against excessive pressure and will prevent the pump from running backward. The check valve should be installed between the gate valve and the pump nozzle in order to permit its inspection. The gate valve is also useful in priming and starting the pump.

Exception:—For high-capacity low-head pump installations such as condenser circulating and irrigation service, the check valve may safely be omitted.

SUCTION PIPE

1. Only clear, cold liquids can be pumped with a suction lift.

2. Arrange the length and size of suction pipe so that the maximum suction lift, including all losses, will be in accordance with the manufacturer's recommendations. However, it must never exceed 20'-0' of water (17.5" of mercury).

3. Hot liquids must flow to the pump under sufficient positive head to prevent vaporization at the impeller inlet.

See explanation of NPSH, under Section VII, Technical Data.

4. Keep the suction pipe short and direct.

5. Use a suction pipe at least one size larger than the pump suction nozzle.

6. Keep the suction pipe free of air pockets.

   a. When the pump operates with a suction lift, the suction pipe should slope upward to the pump nozzle from the source of supply.

   b. Horizontal suction pipes should have a gradual rise. Do not install any part or section of a horizontal suction pipe higher than the pump suction nozzle.

   c. Whenever another pipe or other obstruction requires bending from the natural slope, run the suction pipe under the obstruction rather than above it.

   d. The pipe reducer at the pump suction nozzle must be of the eccentric type to prevent air pockets in the suction line.

   e. Gate valves should never be necessary in a suction pipe under suction lift; however, when they are used, air pockets can be eliminated by turning the valve stem in a horizontal or bottom direction. When used, their size should be equal to that of the largest pipe used in the suction line.

7. Horizontal elbows in the suction line should be at a lower elevation than the pump nozzle. Never install a horizontal elbow next to the pump. Where possible have a vertical elbow lead into the pipe reducer next to the pump. (See Fig. 2-11).

![Correct and Wrong methods of installing Suction Pipe on Double Suction Pumps.](image-url)
10. The pump must never be throttled on the suction side.

11. After installation, test the suction line with water under 30 lb. per sq. in. pressure to detect air leaks.

**AUXILIARY PIPING**

Cooling Water service may be required for one or all of the following services:

- Elevation drawing will furnish required data.
- Generally, 1 gpm per bearing is required.

1. Stuffing Box Cooling.
2. Stuffing Box Sealing.
   (See Page 18 for Illustrations).
3. Cooling Lube-Oil.
5. Bearing Body Cooling.

6. Fig. 2-13 shows suggested methods of controlling the cooling water at bearing housing.
   - a. Valve on supply line should be fully opened.
   - b. The amount of cooling water can be controlled by a globe valve on the discharge line.
   - c. A sight glass permits visual control. As an alternate arrangement a funnel can be used to view the amount of water passing through the bearing housing.

---

**Fig. 2-12**—Correct and wrong methods of installing suction and discharge pipes.

8. If more than one pump is to be operated at the same time from the same source of supply, use separate suction lines.

9. The end of the suction pipe should be at least 3 ft. below the minimum pumping level of the liquid being pumped.
When the unit is being started, the gauges on each side of the screen should be carefully watched. An increase in pressure differential between the two gauges indicates that the screen is becoming clogged with dirt and scale. At this point the pump should be shut down, the screen cleaned and replaced. When the scale and dirt have been removed from the system as indicated by no further pressure drop across the screen, it may be removed.

The screen should be used for at least 24 hours under normal temperature conditions before removal.

**BY-PASS PIPING FOR MULTI-STAGE PUMPS**

In any centrifugal pump the difference between the amount of horsepower put into the pump shaft by the driver and the amount delivered by the pump is absorbed within the pump in the form of heat. This difference is greatest at low capacities.

A minimum flow of liquid through the pump must be maintained when the pump is operating at light load to remove this heat, and prevent flashing or vaporizing of the liquid within the pump.

Such a flow is best insured by means of a by-pass line, installed between the pump discharge and the first valve and connected back to the source of the suction supply.

It is highly important that this line be open during periods of light load. (For example when starting and stopping the pump.)

Failure to provide the necessary minimum flow can cause the rotor to seize and the result would be damaging to the internal parts.
PRE-STARTING PRECAUTIONS

In new installations, where the services of an Ingersoll-Dresser Pumps Field Service Engineer have been secured, he can explain the proper procedure and answer any questions pertaining to the pump.

Where a Field Service Engineer is not present, the following procedure is outlined to help you start your pump correctly.

Clean the unit, checking all main and auxiliary piping making certain it is connected properly as described under Piping in Section II.

Clean and lubricate the pump bearings as described in Section IV.

If the piping has been connected after the unit has been aligned, re-check alignment as described in Section II.

Prepare the driver for operation as instructed by the driver manufacturer.

Check the driver for rotation making sure it agrees with rotation indicated on the pump, before connecting coupling.

Assemble the coupling and, if it is a lubricated type, fill with proper lubricant as specified by coupling manufacturer.

**WARNING:** IN THE INTEREST OF OPERATOR SAFETY THE UNIT MUST NOT BE OPERATED ABOVE THE NAMEPLATE CONDITIONS. SUCH OPERATION COULD RESULT IN UNIT FAILURE CAUSING INJURY TO OPERATING PERSONNEL. CONSULT INSTRUCTION BOOK FOR PROPER OPERATION AND MAINTENANCE OF THE PUMP AND ITS SUPPORTING COMPONENTS.

BOILER FEED OPERATION

There are four general precautions necessary to insure satisfactory operation of a high-pressure centrifugal pump:

1. Always keep more liquid (as liquid, not vapor) available on the suction side than is required on the discharge side.
2. Always maintain sufficient flow through the pump to prevent flashing of the liquid passing through the pump. At low flows a large proportion of the horsepower input is absorbed by the liquid as heat, and the flow must be maintained at a point sufficient to keep the temperature rise through the pump within a safe limit.
3. Avoid severe thermal shocks to the pump as a result of sudden liquid temperature changes. Due to the heavy metal sections of high pressure equipment the casing temperature will lag the liquid temperature during such changes, and severe temperature stresses and subsequent misalignment of machined fits may result.
4. Both the bearings and the stuffing-box packing require adequate lubrication. The interruption of lubrication in either place will result in costly damage to the pump.
STARTING THE PUMP

CAUTION: WHEN OPERATING FOR SOME TIME AT REDUCED CAPACITY, MUCH OF THE PUMP HORSE-POWER WILL GO INTO THE LIQUID IN THE FORM OF HEAT. A BY-PASS MUST BE PROVIDED UNDER THESE CONDITIONS TO PREVENT THE LIQUID IN THE PUMP FROM BECOMING HOT ENOUGH TO VAPORIZE.

CAUTION: DAMAGE TO PUMP MAY RESULT FROM PROLONGED OPERATIONS AT CAPACITIES LESS THAN TWENTY-FIVE PERCENT OF THE BEST EFFICIENCY POINT.

Having performed the operations under "Pre-Starting Precautions", Page 12, your pump will be ready to start.

Given below is the procedure you should follow when you want to put the pump on stream.

1. Close Discharge Valve
   Close the discharge valve if it is not already closed.

2. Open Injection Valve (When External Seal Is used).
   On pumps having externally sealed stuffing boxes, open the injection line valves and allow sealing liquid to flow to the seal cages.
   On pumps having internally sealed stuffing boxes, close the needle valves.

3. Open Suction—Prime The Pump
   Before any centrifugal pump can be started, the casing and suction line must be completely filled with the liquid to be pumped.
   The rotating parts depend upon this liquid for lubrication.
   CAUTION:—Your pump may seize if operated dry.
   If the pump is installed below the liquid to be pumped, it will prime itself if you close the discharge valve and open the vent connection on top of casing.
   If the pump is above the liquid from which it takes suction, it can be primed by the use of an ejector, a vacuum pump.

4. Start The Driver

NOTE:—Turbine Driven Pumps

1. Prepare the turbine for start-up in accordance with the manufacturer’s instructions.
2. Start the turbine and bring it up to speed quickly.
3. Slowly Open Discharge Valve
   As soon as the pump is up to the rated speed, open the discharge valve slowly. This will avoid abrupt changes in velocity and surging in the suction line.

6. Stopping The Turbine Driven Pump
   Stop the turbine driven pump by manually tripping the overspeed trip.
   A pump should be shut down rapidly to protect the internal wearing parts which are lubricated by the liquid being pumped.
   Lubrication is reduced when a pump is stopped slowly and seizure could result.

OPERATING CHECKS

Systematic checks following start up operations are a factor in avoiding costly shut downs.

1. Stuffing Box Packing
   Check for overheating of packing. If apparent, stop and start the pump a few times until leakage breaks thru the packing.
   If there is no response to this treatment, the stuffing box evidently was packed too tight and must be repacked.

2. Recheck of Alignment
   Recheck pump alignment after the pump has been in operation a few hours.

3. Bearings
   While bearings will run at a constant temperature, this temperature will rise or fall with changes in the room temperature.
   If the oil temperature ever exceeds 160°F, stop the pump. Locate the cause of such overheating and correct it before resuming operations.

WARNING: OPERATION OF THE UNIT WITHOUT PROPER LUBRICATION CAN RESULT IN OVERHEATING OF THE BEARINGS, BEARING FAILURES, PUMP SEIZURES AND ACTUAL BREAKUP OF THE EQUIPMENT EXPOSING OPERATING PERSONNEL TO PERSONAL INJURY.

4. Cooling Water
   Check flow of cooling water frequently. See Page 10 for suggested methods of piping and controlling cooling water.

5. Suction And Discharge Pressure
   Suction and discharge pressure gauges should be checked to see that they indicate the proper operating conditions.
   If at any time the discharge gauge should drop to zero, shut down the pump immediately.
   See Page 14 - Performance Checks.
The discharge gauge should show an increase in the pressure as the pump picks up speed. If it does not, shut down the pump and locate the cause of the trouble.

6. Doweling

The unit must not be doweled until a final check is made on alignment under actual operating conditions. Taper dowel pins are furnished. Diagonally opposite feet of pump and driver should be drilled and reamed for those dowels.

7. Freezing

When the pump is exposed to freezing temperatures while not in operation, care should be taken to prevent the liquid from freezing within the pump.

The pump casing should be drained by removing the pipe plugs in the bottom of the casing.

---

### PERFORMANCE CHECKS

Important: First Check Rating Shown on Pump Nameplate.

| NO LIQUID DELIVERED | 1. Pump not primed.  
|                     | 2. Speed too low. Check motor voltage.  
|                     | 3. Discharge head too high.  
|                     | 4. Impeller plugged up.  
|                     | 5. Wrong direction of rotation. |
| NOT ENOUGH LIQUID DELIVERED | 1. Speed too low.  
|                           | 2. Impeller partially plugged.  
|                           | 4. Total head too high.  
|                           | 5. Pump defects:  
|                           | a. Excessive ring clearance.  
|                           | b. Excessive drum clearance.  
|                           | c. Damaged impeller. |
| NOT ENOUGH PRESSURE | 1. Speed too low.  
|                     | 2. Pump defects:  
|                     | a. Excessive ring clearances.  
|                     | b. Excessive drum clearances.  
|                     | c. Impeller diameter too small. |
| MOTOR RUNS HOT | 1. Pump taking too much power:  
|                 | a. Speed too high.  
|                 | b. Head lower than rating allowing pump to handle too much liquid.  
|                 | c. Liquid heavier and more viscous than rating.  
|                 | d. Pump defects:  
|                 | 1. Excessive ring clearance.  
|                 | 2. Stuffing boxes too tight.  
|                 | 3. Rotor binding.  
|                 | 2. Electrical defects:  
|                 | a. Voltage and frequency lower than rating.  
|                 | b. Defects in motor.  
|                 | 3. Poor installation.  
|                 | a. Lack of ventilation. |

**NOTE:**
Check Actual Temperature With Thermometer.
SECTIoN IV-A
LUBRICATION

OIL LUBRICATION—BALL BEARING

PROCEDURE

Flush out the bearing housing thoroughly with kerosene or safety solvent.

Fill the reservoir to the proper level as described below. If the pump is fitted with a constant-level oiler, check Fig. 4-3 to see that the oil will be maintained at the proper level. The level may be adjusted by changing the height of the cross arms which support the glass reservoir. Refer Table 1 for oil level dimensions.

When the housing is equipped with a sight glass, Fig. 4-2, pour oil into the top of the housing until level with the brass ring on the sight gauge. Refer Table 1.

After the pump has been started, watch the oil level in the gauge glass until oil has been stabilized.

If the oil is below the marker on the oil gauge, add oil.

If, during operation, the oil level is above the marker, the bearing will overflow when the pump is shut down.

MAKE PERIODIC INSPECTIONS

Remember that oil requires frequent replenishment at normal temperatures and very frequent replenishment at high temperatures. Oil is always subject to gradual deterioration from use and contamination from dirt and moisture. In time, the accumulated sludge will be harmful to the bearing and cause premature wear. For this reason, draining and flushing are necessary at regular intervals.

TABLE 1.
Oil Level Dimensions “From center-line of bearing housing tap”.

<table>
<thead>
<tr>
<th>“A” Dimension</th>
<th>1\1/2 GT—9/16”</th>
<th>4 GTS—23/4”</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 GT—13/8”</td>
<td>5 GT—13/8”</td>
<td>6 GT—13/8”</td>
</tr>
<tr>
<td>3 GT—13/8”</td>
<td>8 GT—23/8”</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 4-1—Oil Lubricated Ball Bearings.

It is good practice to change the oil after every 600 hours of operation. The ideal bearing lubricant is a straight, well-refined, neutral mineral oil, preferably of the turbine type i.e. SAE number 10 motor oil. It should not contain free acid, chlorine, sulphur or more than a trace of free alkali.

Fig. 4-2—Bearing housing equipped with sight gauge glass.

Fig. 4-3—Bearing housing equipped with constant-level oiler.
SECTION IV-B

SLEEVE BEARING AND LUBRICATION

VISCOOLER TYPE

With the cooling head arrangement, oil is scraped from the Viscoil disc and flows under pressure through a spiral cooling passage cast on the inner face of the cooling head. From this passage it flows through a hole drilled in the end of the shaft, then through radial holes to the chamber surrounding the thrust shoes. This chamber runs completely full of oil, and excess oil is forced through the relief hole at the top of the bushing. When the unit is shut down oil is trapped in the lower part of the Kingsbury thrust bearing bushing to provide lubrication for the next startup. With the Viscoil-cooling head arrangement, the Kingsbury thrust bearing only can be force-feed and the plain bearing is lubricated by oil rings.

When replacing the locking screw, make sure that it fits into the bushing. The bushing must not be allowed to rotate.

Note—Before Operating

Remove the bearings caps, linings, thrust shoes and drain plugs.

Flush out the bearing bodies with kerosene. If a viscoil pump is used, flush out with kerosene.

Wash the bearing linings (and pump if used) with fresh lubricating oil and allow to drain.

The bearing bodies are fitted with sight gauges. The correct oil level is marked with a brass ring.

Replace the drain plugs, assemble the bearing and fill the body to the correct level with a good grade of turbine oil.

Pump Now Ready For Operation

After the pump has been started, watch the oil level in the gauge glass until oil has been stabilized.

If the oil is below the marker on the oil gauge, add oil.

If, during operation, the oil level is above the marker, the bearing will overflow when the pump is shut down.

GEAR OIL PUMP

In this system the gear oil pump takes suction from the thrust bearing body reservoir and forces oil through piping to the shell-and-tube cooler, which is mounted on the baseplate, and then back to the Kingsbury thrust bearing. The oil is forced into the chamber surrounding the thrust shoes and discharges through a relief hole in the top of the bushing. When the unit is shut down oil is trapped in the lower part of the Kingsbury thrust bearing bushing to provide lubrication for the next startup.

Note:—Prime before initial startup as described at left. See Fig. 4-4.

Fig. 4-5 Kingsbury thrust Fig. 4-6 Self aligning sleeve bearing—with gear oil pump. Bearing—inboard end.

Fig. 4-4—Priming the Kingsbury thrust bearing. (Viscooler Type Illustrated)

IMPORTANT—Prime the Kingsbury Thrust Bearing (See Fig. 4-4).

1. Before starting the pump for the first time, or after a long shutdown.
2. After an oil change.
3. After bearing has been dismantled.

PROCEDURE:

Remove the locking screw in the top of the thrust bearing cap and pour a liberal amount of oil into the bushing (Fig. 4-4). This is required to fill the cavity surrounding the thrust collar and thrust shoes and assures an adequate oil supply at the thrust shoes and bearings until the oil pump furnishes the required amount.
SPECIAL APPLICATION ONLY

VISCOIL PUMP SHOWN BELOW USED ON SPECIAL APPLICATIONS ONLY.

LUBRICATION

Oil pressure for the bearings is supplied by a viscoil pump mounted on the outboard end of the thrust bearing. This pump consists of pump disk, pump casing and casing cover. The rotor picks up oil from the suction passage cast in the pump casing. The oil is then carried around the casing by the disk and discharged through a cast-in passage. There is a pressure adjusting screw located in the pump casing over the inlet to the oil cooler.

The oil flows from the viscoil pump through the cooler to the bearing. The thrust bearing body serves as a reservoir and the oil flows from this reservoir to the pump suction passage through a cored hole.

Remove bearing caps, linings, thrust shoes and drain plugs. Flush out the bearing bodies, oil piping, oil pump and cooler with kerosene. Wash the bearing linings and flush out the entire system with lubricating oil and allow latter to drain. The bearing bodies are fitted with oil sight gauges, the correct oil level being marked with a brass ring. Replace the drain plugs, assemble the bearings and fill the bearing bodies to the correct level with a good grade of turbine oil.

IMPORTANT—Before starting the unit for the first time or after oil has been changed or bearing disassembled, remove the locking screw in the top of the thrust bearing cap and pour a liberal amount of oil into the bushing. Fig. 4-4. Replace the locking screw, making sure that it fits into the bushing to prevent latter from rotating.

The unit is now ready for operation. The pressure adjusting screw has been set at the factory. However, it may require adjustment due to difference in oil viscosity. Watch the oil level in the gauge glass after the pump has been started until the oil level has stabilized. If the level is below the marker on the oil gauge, add oil. If the oil level is above the marker, adjust the pressure adjusting screw by turning it to the right until oil level drops to its correct position. The oil pressure in the feed line should be between 5 and 10 pounds per square inch after the oil temperature in the system has stabilized. When the pump is first started and the oil is cold the oil pressure may be somewhat higher.

For Oil Specification See Page 15
The pump is shipped without packing in the stuffing boxes. A complete set of packing is usually shipped in a separate box attached to the pump crate. Preserve the wrapper on the packing so that replacements can be ordered accordingly.

The stuffing box arrangement varies with the liquid, temperature and pressure.

Fig. 5-1 shows stuffing box packed solid. When there is a clean liquid and a positive pressure on the suction, the stuffing boxes can be packed solid and adjusted so that a slight spray leakage cools and lubricates the packing. Note Figure 5-4 on next page.

![Stuffing-box packed solid.](image)

Fig. 5-1—Stuffing-box packed solid.

It is always important to prevent air leakage into the stuffing box. This is especially true when the pump is working under suction lift.

Fig. 5-2 shows stuffing box arrangement having an internal seal. Here, the liquid being pumped is used as the sealing liquid. It is injected at the seal ring, usually located near the center of the box.

Fig. 5-3 shows stuffing box arrangement having an external seal. This method is recommended when the liquid being pumped is gritty or corrosive. The liquid used for sealing should be cool and clean. The required pressure (P.S.I.) is shown on the elevation drawing. This pressure must be 15 P.S.I. (minimum) above the suction pressure.

![Stuffing-box with internal seal.](image)

Fig. 5-2—Stuffing-box with internal seal.

![Stuffing-box with external seal.](image)

Fig. 5-3—Stuffing-box with external seal.
PACKING THE STUFFING BOX

Note the directions with the packing and proceed as follows:

1. Remove the gland, pull out the seal cage and clean out the stuffing box.
2. Measure the location of the sealing passage so that when the box is packed, the cage will line up with the seal hole.
3. Put one ring in the box at a time, making sure it is properly seated.
4. Stagger the joints of succeeding rings.
5. When the last ring is in place, assemble the gland and pull up the nuts evenly until snug. Then back off the nuts and retighten finger tight.

The stream of leakage following pump startup can be controlled by taking up gland nuts. It is suggested this be done slowly, one flat a time until satisfactory leakage or lubrication has been attained.

STUFFING BOX PACKING

Properly packed stuffing boxes are a MUST for efficient pump operation.

NOTE: PACKING GLANDS MUST NEVER BE TIGHTENED TO THE POINT WHERE LEAKAGE FROM THE PACKING IS STOPPED. A SMALL AMOUNT OF LEAKAGE IS REQUIRED FOR LUBRICATION OF THE PACKING. SHUTTING OFF LEAKAGE FLOW FROM THE PACKING WILL RESULT IN BURNED PACKING AND SCORED SHAFT SLEEVES.

In Figure 5-4 the packing was first placed in box too tight. When signs of smoke appeared from the overheated packing the gland nuts were loosened to relieve the condition. The several rings of packing moved out as a unit, thus allowing space in the bottom of the box for a stream of liquid to escape as shown. The packing having become hardened when overheated, no longer provides the necessary lubrication (or leakage). Scored shaft sleeves are the result.

Fig. 5-4—Correct and wrong methods of packing stuffing-box.
SECTION VI

MAINTENANCE

PREVENTIVE MAINTENANCE

Serious or troublesome pump problems can often be avoided by systematic maintenance checks. A page on PERFORMANCE CHECKS, as well as a page showing a suggested "PUMP RECORD FORM", is a part of this book as an aid to such a program.

A properly packed stuffing box is a MUST for efficient pump operation.

A scored shaft sleeve is often the result when the stuffing box is packed too tight. Packing becomes hardened when overheated and will then not allow the proper leakage which furnishes the necessary lubrication.

SEE STUFFING BOX, SECTION V.

FOR LUBRICATION, SEE SECTION IV.

WARNING: BEFORE ATTEMPTING ANY INSPECTION OR REPAIR ON THE PUMP THE DRIVER CONTROLS MUST BE IN THE "OFF" POSITION, LOCKED AND TAGGED TO PREVENT INJURY TO PERSONNEL PERFORMING SERVICE ON THE PUMP.

DISMANTLING PROCEDURES

FOR BALL BEARING EQUIPPED PUMPS SEE PAGE NO. 21.

FOR SLEEVE BEARING EQUIPPED PUMPS SEE PAGE NO. 24.

<table>
<thead>
<tr>
<th>NOMINAL RUNNING CLEARANCE OF WEARING PARTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUMP SIZE</td>
</tr>
<tr>
<td>--------------</td>
</tr>
<tr>
<td>2 &amp; 3 BEV</td>
</tr>
<tr>
<td>4, 5, 6 EV</td>
</tr>
<tr>
<td>8EV</td>
</tr>
<tr>
<td>1½ GT</td>
</tr>
<tr>
<td>2 &amp; 3 GT</td>
</tr>
<tr>
<td>4, 5, 6, &amp; 8 GT</td>
</tr>
<tr>
<td>4 GTS</td>
</tr>
</tbody>
</table>
Dismantling Procedure for Pumps Equipped with Ring-Oiled Ball Bearings.

See Page 24 for Sleeve Bearings

The following procedure is general in nature, therefore, refer to the Sectional Assembly furnished for your pumps.

Example: Form 7616-11 for 2 and 3 GT pumps with ball bearings.

See Page 30 for complete list of forms showing Sectional Assemblies and Parts Lists available for this class of pumps.

Procedure

1. First when necessary, remove the auxiliary piping.

2. Disconnect the coupling.

3. Loosen and remove stuffing box glands as well as packing.

4. Loosen and remove casing bolts and remove the upper half casing. (Use the jack screws provided if necessary.)

5. To remove the bearing housing from the casing first remove the dowel pins and then loosen and remove tap bolts.

6. By the use of straight lift cables remove the rotor from the lower half casing and place it on horses for dismantling the rotor.

7. Couplings furnished on pumps up to 200 horsepower have a .000" to .002" loose fit. Pumps over 200 horsepower have the couplings installed with a shrink fit. These couplings have to be heated and removed with an approved puller.

Thrust Bearing

1. Loosen finger and push inboard as far as possible.

2. Remove bolts on the inboard cover and push inboard as far as possible.

3a. Lift up the oil ring and hold it in line with the hole in the inboard side of the bearing housing.

3b. Then remove the bearing housing from the shaft. (Take care not to injure the oil ring.)

4. Remove bearing lock nut.

5. Remove lock washer.

6. Remove bearing with an approved type puller.

The fit in the housing is a push fit. The bearing should be pulled with a puller or an arbor press where size permits. Never press or hit against the outer race, balls or ball cage of ball bearings.

Plain or Radial Bearing

1. Loosen finger and push outboard as far as possible.

2. Remove bolts on outboard cover and push inboard as far as possible.

3a. Lift up the oil ring and hold it in line with the hole in the inboard side of the bearing housing.

3b. Remove housing from bearing. (Take care not to injure the ring.)

4. The ball bearing is mounted on an adapter. The adapter is a slide fit on the shaft and held in place by a locking screw.

To remove the adapter (or Journal Sleeve), loosen the locking screw and slide off.

Note: Remove thru lock nut and lock-washer which holds the ball bearing to the adapter. Press the ball bearing from the adapter.
9. Loosen set screws, then loosen and remove the shaft sleeve nut using the pin spanner wrench provided.

10. Remove shaft sleeve.

11. Impellers on pumps up to 200 horsepower per stage have a .001" to .003" loose fit. Pumps over 200 horsepower per stage have a light shrink fit. These must be heated prior to removal.

**NOTE:** HEAT ONLY ENOUGH FOR EASY REMOVAL.

12. **IMPORTANT:** Before removing the outboard shaft sleeve, measure the distance from the shoulder on the shaft to which the thrust ball bearing is locked to the inboard end of the outboard shaft sleeve. Record the dimension for use when replacing the impeller on the shaft. If used, this dimension will locate the impeller on the shaft and it will be properly aligned in the casing.

13. Now remove the shaft sleeve nut and shaft sleeve.

14. This completes dismantling of the rotating parts.

**INSPECTION OF PARTS**

1. Having completely dismantled the rotor, check the shaft for runout using V-Blocks or rollers placed under the normal bearing areas. Maximum permissible shaft runout is .002".

2. The bearing components should be examined carefully for cracks, uneven wear, scored races or balls and corrosion.

3. Wire brush the parts thoroughly. Clean off all scale, carbon, etc. Examine parts for washing, corrosion, and erosion. Restore the parts to the original tolerances and reassemble only after all the parts have been thoroughly cleaned, checked for burrs or any other damage that may have occurred in handling while dismantling.

**PUMP REASSEMBLY**

1. Reverse The Dismantling Procedure.

2. Build and indicate the rotor assembly. The total runout of the rotating parts should not exceed .005" maximum.

3. **Before Replacing Rotor**
   Be sure that all scale, rust, etc. has been thoroughly removed from the running fits before replacing the rotor in the casing.

**NOTE:** SEE PAGE 28 PROCEDURE TO RENEW PARTING FLANGE GASKET.

Turn back the portion of gasket which overhangs at ring fits so as not to interfere with the proper seating of the rotor in casing. See Fig. 6-11.

4. **Replace Rotor In Casing**

   a. First blow out all dirt and dust particles from the rotor, using an air hose.

   b. Then gently lower the rotor into the casing.

**CAUTION:** TO AVOID DAMAGE, CAREFULLY ALIGN ROTOR PARTS WITH THE CASING FITS AS ROTOR IS BEING LOWERED INTO PLACE.

5. **Replace Thrust Bearing**
   When reassembling, make sure that the two mating parts are mounted back-to-back as shown in Fig. 6-2. The clearance between the outer face and the bearing end-cover should be .005" to

![Fig. 6-2—Mounting of matched bearings.](image_url)
.010". This clearance can be adjusted when necessary by changing the thickness of the gasket between the end-cover and the bearing housing. BALL BEARINGS have a light tap fit on the shaft, which means .0001" to .0002" press fit. The fit in the housing is a push fit.

6. Replace Plain Bearing

Follow the procedure below when:

a. Reassembling.
b. Installing new bearing.
c. Installing new shaft.

The rotor having been replaced in the casing, install the thrust bearing and tighten it to the casing.

Figure 6-3 shows the ball bearing mounted on an adapter or journal sleeve. Locate the ball bearing approximately in the center of the available space as shown.

MARK LOCATION OF ADAPTER ON SHAFT

a. "Z" dimension can be measured directly.
b. Place straight edge on face of bearing housing mounting flange.

7. Replace Upper Half Casing

a. To permit easy separation of upper and lower half casings it is suggested that the top surface of gasket be coated with a powder such as graphite, powdered mica, etc.
b. When lowering the upper half casing align with the rotor parts carefully to avoid damage.

c. Install dowel pins for proper alignment.
d. Install and tighten bolts.
e. Use feeler gauges at the gasket cutouts for proper gasket compression,.025" or as stamped on the lower half casing flange face.
GENERAL DESCRIPTION

Figures 6-4, 6-5 and 6-6 show the construction of the spherically seated, self-aligning sleeve bearings. The bearing bodies are separate and are bolted and doweled to the lower half casing.

The bearing bodies are arranged with jackets for water cooling when conditions warrant it.

The bushings are cast iron babbit-lined, and there is no adjustment for wear. Do not file the mating faces of the two halves to take up bearing clearance, as this will merely give extra clearance to spherical seat in the body.

On bushings with renewable linings, it is only necessary to replace both halves of the linings when the bearings are worn.

When babbit is cast in the bushing, it is necessary to replace the complete bushing.

THRUST BEARING

With this type of bearing, thrust is taken by a Kingsbury type thrust bearing, mounted in the center of the spherically seated outboard sleeve bearing. The thrust bearing is of the center collar segmented type with the thrust shoes supported by spherically seated aligning washers. See Fig. No. 6-5.

The following procedure is general in nature, therefore, refer to the Sectional Assembly furnished for your pumps.

Example: FORM 7616-5 FOR 2 AND 3 GT PUMPS WITH SLEEVE BEARINGS.

See Page 30 for complete list of forms showing Sectional Assemblies and Parts Lists available for this class of pumps.

Fig. 6-5—The thrust bearing with the cover removed.
PROCEDURE

1. First where necessary, remove the auxiliary piping.

2. Disconnect the coupling.

3. Loosen and remove stuffing box glands as well as packing.

4. Loosen and remove casing bolts and remove the upper half casing. (Use the jack screws provided if necessary.)

5. Remove nuts holding upper half of bearing Housing.

6. Remove bolts holding Cooling Head to Bearing Housing.

7. Dismantle upper half Bearing Housing and Cooling Head.

8. Remove the upper half Bushing by taking out the taper dowel pins which hold the two halves together.

9. Lift up and remove Bearing Bushing.

10. Remove the lock nut which holds the oil pump rotor and remove rotor.

11. Remove Thrust Collar, Thrust Shoes and Aligning Washers as a unit.

12. Remove Thrust Collar Key and Shims and Oil Deflector from Shaft.

**DISMANTLING RADIAL OR PLAIN BEARING**

13. Remove bolts holding upper half Bearing housing.

14. Remove the upper half Bearing Housing.

15. Remove Dowel Pins and upper half Bearing Bushing.

16. By the use of straight lift cables, remove the rotor from the lower half casing and place it on horses for dismantling the rotor.

17. Couplings furnished on pumps up to 200 horsepower have a .000” to .002” loose fit. Pumps over 200 horsepower have the couplings installed with a shrink fit. These couplings have to be heated and removed with an approved puller.

18. Remove Oil Deflectors and oil ring from the Shaft.

19. Then dismantle rotor.

20. Loosen set screws, then loosen and remove the shaft sleeve nut using the pin spanner wrench provided.

21. Remove shaft sleeve.

Impellers on pumps up to 200 horsepower per stage have a .001” to .003” loose fit. Pumps over 200 horsepower per stage have a tight shrink fit. These must be heated prior to removal.

**NOTE:** HEAT ONLY ENOUGH FOR EASY REMOVAL

**Important:** BEFORE REMOVING THE OUTBOARD SHAFT SLEEVE MEASURE THE DISTANCE FROM THE SHOULDER ON THE SHAFT TO WHICH THE THRUST BALL BEARING IS LOCKED TO THE INBOARD END OF THE OUTBOARD SHAFT SLEEVE.
Record the dimension for use when replacing the impeller on the shaft. If used, this dimension will locate the impeller on the shaft and it will be properly aligned in the casing.

22. Now remove the shaft sleeve nut and shaft sleeve.

23. This completes dismantling of the rotating parts.

**INSPECTION OF PARTS**

1. Having completely dismantled the rotor, check the shaft for runout using V-Blocks or rollers placed under the normal bearing areas. Maximum permissible shaft runout is .002".

2. The bearing components should be examined carefully for:
   - Wiped or worn babbit bearing surfaces including thrust shoes.
   - Scored or unevenly worn thrust collar.

3. Wire brush the parts thoroughly.
   - Clean off all scale, carbon, etc.
   - Examine parts for washing corrosion, erosion.

**PUMP REASSEMBLY**

1. Reverse the dismantling procedure.

2. Build and indicate the rotor assembly.
   - The total runout of the rotating parts should not exceed .005" maximum.

3. **Before Replacing Rotor**
   - Be sure that all scale, rust, etc. has been thoroughly removed from the running fits before replacing the rotor in casing.
   - Turn back the portion of gasket which overhangs at ring fits so as not to interfere with the proper seating of the rotor in casing. See Fig. 6-11.

**NOTE:** SEE PAGE 28 PROCEDURE TO RENEW PARTING FLANGE GASKET.

4. **Replace Rotor in Casing**
   - a. First blow out all dirt and dust particles from the rotor, using an air hose.
   - b. Then gently lower the rotor into the casing.

**CAUTION:** TO AVOID DAMAGE, CAREFULLY ALIGN ROTOR PARTS WITH THE CASING FITS AS ROTOR IS BEING LOWERED INTO PLACE.

5. **Replace Thrust Bearing and Thrust Shoes**
   - When assembling the thrust shoes it will be found convenient to put grease on the back of the shoes to hold them in the aligning washers until the bushing is assembled. When necessary to replace any thrust shoes always replace a complete set, that is inboard and outboard. Otherwise the new shoes will take all the load and burn out. See Fig. 6-7 and 6-8 for correct arrangement of thrust shoes.

**NOTE:**

WHEN REASSEMBLING
ALWAYS PLACE TOE OF THRUST SHOES AGAINST ROTATION AS SHOWN

(ALIGNING WASHERS NOT SHOWN)

Fig. 6-7—Reassembly of thrust shoes.
7. Check Rotor End Play
Axial end play should be .012" to .027".

8. Replace Upper Half Casing
   a. To permit easy separation of upper and lower half casings it is suggested that the top surface of gasket be coated with a powder such as graphite, powdered mica, etc.
   b. When lowering the upper half casing align with the rotor parts carefully to avoid damage.
   c. Install dowel pins for proper alignment.
   d. Install and tighten bolts. See table below.
   e. Use feeler gauges at the gasket cutouts for proper gasket compression. .025" or as stamped on the lower half casing flange face.

9. Try turning the rotor. If the rotor seems too tight, remove the dowel pins and adjust the bearing housings until the rotor turns freely.

---

**Pump Casing Bolting Torque Values**

(Foot-Pounds)

<table>
<thead>
<tr>
<th>Pump</th>
<th>1½ GT</th>
<th>2 GT</th>
<th>3 GT</th>
<th>4 GT</th>
<th>4 GTS</th>
<th>5 GT</th>
<th>6 GT</th>
<th>8 GT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Torque</td>
<td>180</td>
<td>180</td>
<td>180</td>
<td>500</td>
<td>400</td>
<td>400</td>
<td>500</td>
<td>1¼&quot;-500</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1¾&quot;-850</td>
</tr>
</tbody>
</table>

---

![Fig. 6-8—Kingsbury thrust shoes. Note part number indicated in symbol.](image)

![Fig. 6-9—Replacing Bushing.](image)

![Fig. 6-10—Rolling Bottom Bearing Bushing into place.](image)
RENEWING THE PARTING FLANGE GASKET

PROCEDURE

Renew the parting flange gasket whenever the pump has been dismantled.

The gasket material is usually furnished in sheets.

Always remove all traces of the old gasket before applying the new one.

Since the upper half casing does not have projecting studs or bolts, it will provide the best pattern for preparing the new gasket.

Use the ball end of a ball peen hammer and tap lightly around the holes. This will provide openings for the studs or bolts.

Cut four windows as indicated by No. 3 in Figure 6-11 to provide space for feeler gauges. These should be inserted when both halves have been bolted together, to determine proper compression.

To determine proper gasket thickness, note the shim thickness stamped on the apron (or corner) of the parting flange of the lower-half casing.

<table>
<thead>
<tr>
<th>Stamping</th>
<th>Gasket Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bored with .025&quot; shim</td>
<td>⅛&quot; or .031&quot;</td>
</tr>
<tr>
<td>Bored with .012&quot; shim</td>
<td>¼&quot; or .015&quot;</td>
</tr>
</tbody>
</table>

When cutting out the gasket allow an overhang of .010" at all ring fits and at the stuffing boxes. This will prevent leakage of liquid around wearing rings, stuffing box bushings and packing, during operation.

This overhang must be turned back before replacing the rotor so as to not interfere with the proper seating, as noted in PUMP REASSEMBLY.

Shellac the lower half casing. Do not use oil, varnish or grease as an adhesive.

Set the upper half casing on the lower half allowing it to remain for two or three hours. This will hold the gasket in position while the shellac is drying. Allow sufficient time for the gasket to properly set.

Then remove the upper half casing and cut out the gasket with a sharp knife.
SECTION VII

TECHNICAL DATA

These pumps are furnished for a particular service condition. Changes in the hydraulic system may affect the pump's performance adversely. This is especially true if the changes reduce the pressure at the suction flange or if the liquid temperature is increased. In case of doubt, contact the nearest I-R office.

EFFECTS OF SPECIFIC GRAVITY

The capacity and total head in feet of liquid developed by a centrifugal pump are fixed for every point on the curve and are always the same for the same speed. Neither capacity nor total head will be affected by a change in the specific gravity of the liquid pumped. However, since the developed pressure in psi (pounds per square inch) and the brake horsepower to drive the pump are a function of the specific gravity of the liquid, both will be affected in direct proportion by any change in specific gravity. Therefore, a change in specific gravity will affect the discharge pressure and is dangerous in that it may overload the pump's driver.

EFFECTS OF VISCOSITY

The pump is designed to deliver rated capacity at rated head for a liquid with a particular viscosity. When contemplating operation at some viscosity other than that for which the pump was originally designed, the changed conditions should be referred to Ingersoll-Rand Company for our recommendation.

CHANGING PUMP SPEED

Changing the speed of a centrifugal pump changes the capacity, total head and brake horsepower. The capacity will vary in a direct ratio with the speed, whereas the total head will vary as the ratio of the speed squared. The brake horsepower will vary as the ratio of the speed cubed except in cases where the speed change also reduces the efficiency of the pump.

NET POSITIVE SUCTION HEAD (NPSH)

Any liquid, hot or cold, must be pushed into the impeller of the pump by some absolute pressure, such as the atmosphere or the vessel pressure from which the pump takes its suction.

The head in feet of liquid necessary to push the required flow into the pump is called the Net Positive Suction Head. This value, more commonly called NPSH, is measured above the vapor pressure of the liquid at the pumping temperature.

There are two kinds of NPSH: the NPSH required by the pump, and shown on the pump curve, is the head needed to cover the losses in the pump suction; the second NPSH is that available in the system taking into account friction loss in suction piping, valves, fittings, etc. In all cases the NPSH available, measured above vapor pressure, must exceed the NPSH required in order to push the liquid into the pump.
A SUPPLEMENT TO THIS BOOK WILL GIVE YOU SPECIFIC

- Ordering Instructions
- Part List
- Sectional Assembly
- For your Pump

These Forms are listed below and should be ordered by Form Number.

<table>
<thead>
<tr>
<th>PUMP TYPE</th>
<th>BALL BEARING FORM NO.</th>
<th>SLEEVE BEARING FORM NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1/2 GT</td>
<td>7616-10</td>
<td>...</td>
</tr>
<tr>
<td>2 GT</td>
<td>7616-11</td>
<td>...</td>
</tr>
<tr>
<td>3 GT</td>
<td>7616-11</td>
<td>...</td>
</tr>
<tr>
<td>4 GT</td>
<td>7616-12</td>
<td>7616-6</td>
</tr>
<tr>
<td>5 GT</td>
<td>7616-13</td>
<td>...</td>
</tr>
<tr>
<td>6 GT</td>
<td>7616-13</td>
<td>...</td>
</tr>
<tr>
<td>8 GT</td>
<td>7616-14</td>
<td>...</td>
</tr>
<tr>
<td>4 GTS</td>
<td>7616-12</td>
<td>7616-6</td>
</tr>
</tbody>
</table>
This manual contains instructions for installation, operation and maintenance of your Ingersoll-Dresser Centrifugal Pump. It has been designed to provide safe and reliable service. However, it is both a pressure vessel and a piece of rotating machinery. Therefore, the operator(s) must exercise good judgement and proper safety practices to avoid damage to the equipment and surroundings and prevent personal injury. The instructions in this manual are intended for personnel with a general training in operation and maintenance of centrifugal pumps.

SAFETY
It is assumed that your safety department has established a safety program based upon a thorough analysis of industrial hazards. Before installing and operating or performing maintenance on the pump and associated components described in this manual, it is suggested that the safety program be reviewed to ensure that it covers the hazards arising from high speed rotating machinery.

It is also important that due consideration be given to those hazards which arise from the presence of electrical power, hot oil, high pressure and temperature liquids, toxic liquids and gases, and flammable liquids and gases. Proper installation and care of protective guards, shutdown devices and over pressure protection equipment should also be considered an essential part of any safety program.

Also essential are special precautionary measures to prevent the possibility of applying power to the equipment at any time when maintenance work is in progress. The prevention of rotation due to reverse flow should not be overlooked.

In general, all personnel should be guided by all the basic rules of safety associated with the equipment and the process.

It should be understood that the information contained in this manual does not relieve operating and maintenance personnel of the responsibility of exercising normal good judgement in operation and care of the pump and its components.

INSTALLATION, OPERATION AND MAINTENANCE SAFETY PROCEDURES
In the following safety procedures you will encounter the words WARNING, CAUTION AND NOTE. These are intended to emphasize certain areas in the interest of personal safety and satisfactory pump operation and maintenance. The definitions of these words are as follows:

WARNING: An operating procedure, practice, etc. which, if not correctly followed, could result in personal injury, or loss of life.

CAUTION An operating procedure, practice, etc. which, if not strictly observed, could result in damage to, or destruction of, equipment.

NOTE: An operating procedure, condition, etc. which is essential to highlight.

These safety procedures are to be used in conjunction with the installation, operating and maintenance instructions contained in this pump manual.

Ingersoll-Dresser Pumps Class BEV-EV-GT-GTS are horizontally split, two stage, double suction, volute type.

EXCEPTION: Sizes 1½, 2 and 3 GT have single suction impellers.

Pressures: to 450 psi
Heads: to 1050 ft.
Capacities: 100 to 2200 gpm
Sizes: 1½, 2, 3, 4, 5, 6, and 8 in.
Temperature: 1½, 2, 3, 4GT, 300°F maximum.
5, 6, 8GT, 250°F maximum.

APPLICATION
These units are designed for general hydraulic, boiler feed, mine and pipe line service and other services within their ratings.

GENERAL CONSTRUCTION
Rotation—Right hand rotation is standard. (See Page 12. Left hand possible.)

Casing—The casings are horizontally split with suction and discharge nozzles cast in the lower half. Side suction and side discharge are standard.

Bearings—These pumps are fitted with ring oil lubricated ball bearings.

The bearing housings are jacketed for water cooling when conditions require it.

Exceptions—Cannot Supply water cooled bearings on 1½GT.

WARNING
OBSERVE EXTREME CAUTION WHEN VENTING AND/OR DRAINING HAZARDOUS LIQUIDS. WEAR PROTECTIVE CLOTHING IN THE PRESENCE OF CAUSTIC, CORROSIVE, VOLATILE, FLAMMABLE, OR HOT LIQUIDS. DO NOT BREATHE TOXIC VAPORS. DO NOT ALLOW SPARKING, FLAMES, OR HOT SURFACES IN VICINITY OF THE EQUIPMENT.
Nothing contained in this brochure is intended to extend any warranty or representation, expressed or implied, regarding the products described herein. Any such warranties or other terms and conditions of sales of products shall be in accordance with Ingersoll-Dresser Pumps' standard terms and conditions of sale for such products, which are available on request.

We recommend use of original IDP replacement parts in the maintenance of your unit. Precise tolerances, metallurgy, manufacturing processes and heat treatment are important factors in the design of each component and the service it will provide. Failure of any component can possibly result in extensive damage to your unit. Warranty may be terminated based on the installation of non OEM parts.

IDP Regional Entry Centers are designed to be responsive when replacement parts are needed quickly. Direct lines connecting our Parts Distribution Center, Distributors and Pump Repair Centers create a network able to respond almost instantly to your requests.

FASTRAQ (Fast Transactions/Responses/Answers/Quotations) can be accessed by our Order Entry Group or an IDP Distributor to give accurate, up-to-the-minute information on needed parts. In addition, FASTRAQ can provide quotes and place orders.

For repair parts service contact your nearest IDP pump sales office or Pump House distributor. They’re in the Yellow Pages.

For the name, address and phone number of your nearest authorized Ingersoll-Dresser Pump distributor, Call 1-800-728-7867

Ingersoll-Dresser Pumps
3800 COOK BOULEVARD • CHESAPEAKE, VA 23323-1626

© 1996 Ingersoll-Dresser Pump Company