

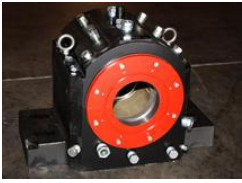


HIGH  
TEMP  
BEARINGS  
INC.

## CG-1 HYDRODYNAMIC BEARING ASSEMBLY INSTRUCTIONS



100% Made in America



## CG-1 HYDRODYNAMIC BEARING ASSEMBLY INSTRUCTIONS

**Introduction:** CG-1 Hydrodynamic bearings are high temperature, fully split, self-aligning bearings that are available in expansion or non-expansion variants. The core and housing, as size dictates, have been tapped with points to install lifting eyebolts for safe handling. When stored, the bearing should be kept in a clean location.

**DANGER:** To ensure that the drive is not unexpectedly started, turn off and lockout the power source before proceeding. Failure to observe these precautions could result in bodily injury or death.

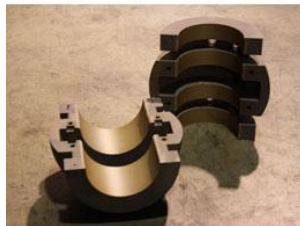
**Warning:** Always use the same lubricant that the bearing will be running on when using lubricant to aid in assembly. Mixing of oils will prevent the bearing from functioning properly.

**1. Clean the shaft and all bearing components.** Inspect the shaft carefully for any raised areas, burs or contamination. Any defects in the shaft will reduce bearing performance.

**Note:** If the bearing will have thrust plates installed, pay special attention to cleaning out the central pocket in the core. Slight contamination in the cavity can cause the thrust plates to lie slightly out of parallel, resulting in run-in and elevated bearing temperature.

**2. Check basic dimensions to ensure adapters and shaft diameters are correct.**

**3. Preparing the split housing and core for assembly.** Parts are milled as a set and will not align properly if mismatched. Consider numbering or match marking caps and bases if many bearings are being assembled. Clean any material or burs from the split faces. The housing and core have been doweled to help ensure that they are mated as they were bored.



Core Bottom and Top



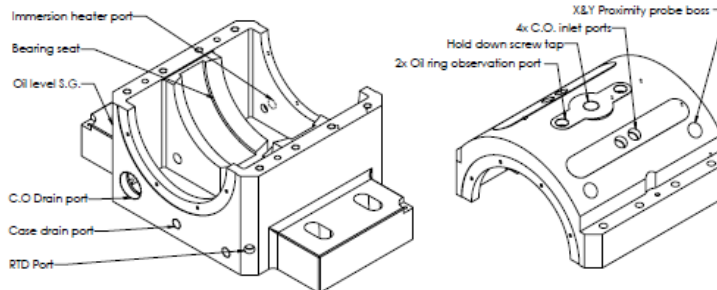
Housing Base



Housing Top

**4. Note the location of the ports.** Make sure that they will be oriented correctly for access as needed. Remove all housing plugs and thread seal as needed. **Plugs are not factory sealed.**

### Port Diagrams



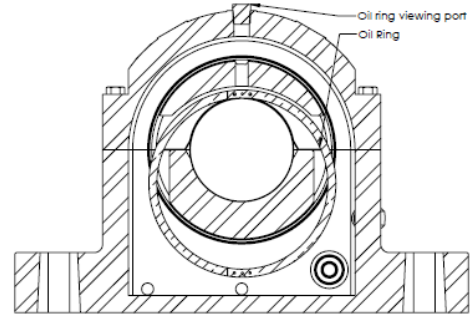
**5. Check the mounting location to ensure that it is rigid, level and free of debris.**

**6. Set the bearing base.** Set the lower half of the housing on the pedestal. Using the same lubricant that the bearing will be run on, lightly oil the bearing seat to aid in installation. DO NOT tighten the housing base to the pedestal at this point. Prepare the cap in a similar manner. Place in a clean area.

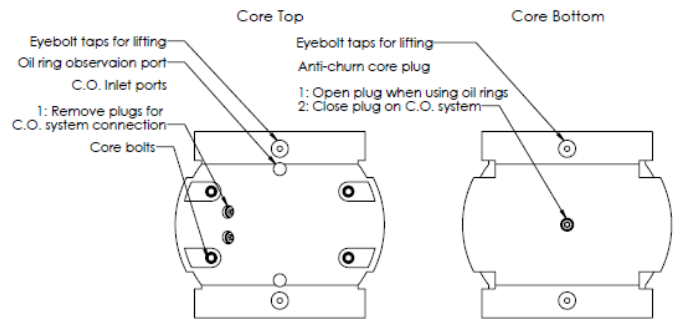
**OIL RING LUBRICATION SETUP:**



Use trapezoidal oil rings **ONLY!** Improperly designed rings will reduce oil flow



7. All bearings are shipped setup to run on oil ring lubrication. **The anti-churn core plug is removed, DO NOT PLUG IT!** If the bearing will be run on a circulated oil system, install the “Anti-churn core plug” located on the bottom of the core.



8. Set the core bottom into position and lower the shaft onto the bearing. The core split should be even and parallel with the housing split. Once the core bottom has been located properly, apply a heavy coating of lubricant over the bearing surface then lower the shaft into position

**Note:** If using a circulated oil system, note the oil inlet port locations. Verify that when the core bottom is set in place that the core top will be oriented properly to the side that the oil inlet piping will be brought in.



9. **Installation of the non-expansion bearing assembly:** follow the “non-expansion bearing installation instructions”, otherwise proceed to **step 10** for expansion bearing.

10. **Install both oil rings (if using circulated oil system see step 16):** The oil ring is split into halves, place one half of the oil ring around and outside of the core bottom and the other half over the top of the shaft so that the two halves mate. Install the oil ring screws and **apply a thread locking compound to prevent the screws from backing out.** The oil rings will run through the slots provided in the core top. **If using a C.O. system do not install oil rings.**



**Note:** Verify that the oil rings rotate freely and that there are no raised or sharp edges that could during operation. Oil ring rotation can be seen through the oil ring viewing ports on the top of the housing.

**Note:** Oil rings will wear overtime, leaving bronze in the bearing case. Regular inspection of bearing oil for wear debris is recommended. Periodic replacement is required. Do not use oil rings if the shaft surface speed is greater than 2700 FPM.

- 11. Install the core top:** Move the oil rings into place and for the non- expansion bearing be sure that the thrust plates are properly located. Lower the top into place, it should drop into position with minimal force. Once set torque the core bolts to the indicated amount in the **bolt torque table**.
- 12. Align the housing base:** Temporarily install the seal plates into the housing socket. Housing alignment must be done before the cap anti-rotation screw has been torqued down. Use of shims should be limited, use only full length shims under the base and avoid stacking. If using a C.O. system it maybe necessary to place the bearing cap to ensure that the pipe feeds from the core align properly with the housing cap. Once the bearing has been properly aligned, tighten the housing base “foot bolts” to the pedestal, using the appropriate bolt torque ranges (See **bolt torque table**). Use SAE grade 5 bolts or better and WAX/CAD Grade B or C nuts. Verify torque falls within bolt and nut acceptable min and max torque range to develop the proper bolt stretch.

Bolt Torque Table						
Bearing Size	Housing Cap Bolts		Foot Bolt		Core Bolt	
	Screw Size	Torque (lbs-in)	Screw Size	Torque (lbs-in)	Screw Size	Torque (lbs-in)
<b>3 7/16</b>	1/2-13 UNC	656	3/4-10 UNC	2100	1/4-20 UNC	120
<b>3 15/16</b>	1/2-13 UNC	656	7/8-9 UNC	2040	1/4-20 UNC	120
<b>4 7/16</b>	1/2-13 UNC	656	1-8 UNC	3000	5/16-18 UNC	132
<b>4 15/16</b>	5/8-11 UNC	820	1-8 UNC	3000	5/16-18 UNC	132
<b>5 7/16</b>	5/8-11 UNC	820	1-1/8-7 UNC	4200	5/16-18 UNC	132
<b>6</b>	5/8-11 UNC	820	1-1/4-7 UNC	6000	7/16-14 UNC	350

- 13. Install the housing cap:** RTV Silicone Gasket Maker must be applied at the split surfaces to prevent oil seepage. Sealing compound must be applied sparingly. Excess compound will interfere with proper seating. Wipe a thin film near the outer edges. Back the anti-rotation set screw out. Place the cap onto the bearing. Dowel pins are located to prevent error in orientation. The cap should be fully seated before tightening the cap bolts. A rubber mallet maybe needed to help force the housing cap and base together. Once seated tightened the cap to the specified torque in the **bolt torque table**.

**Warning:** Caps and bases of pillow blocks are machined as a set. Each cap and base must be assembled with its mating part.

- 14. Set the housing cap anti-rotation screw:** The anti-rotation screw acts to prevent movement of the core while in service. Tighten the hold down screw until it begins to bite into the core, this will prevent rotation of the core in the housing, then secure with the supplied nut and jam nut combination. **For cap loaded bearings:** the shaft must be held down to install the cap, tighten the anti-rotation screw until it starts to bite into the core. Remove the external shaft hold down mechanism completely and tighten the locknut.

**Note:** DO NOT over tighten the anti-rotation screw this can misalign the liner and constrict the core, manual shaft turnover will be difficult if over-tightened. Only a short handled wrench should be needed to tighten the lock nut.

**Note:** DO NOT tighten anti-rotation screw on the accompanying base loaded bearing until cap loaded bearing has been installed and shaft hold down mechanism has been removed.

**15. Install bearing seals:**

a. **LER plates:** The shaft seal area has approximately .0025” radial clearance, the flange socket has .015” radial clearance to allow for alignment. Shaft clearance will vary depending on precise shaft diameter and seal alignment. Some run-in may occur during startup, however effort should be made to minimize rubbing. The plates are doweled together (some sizes are also bolted) and may be difficult to separate when new.

1. Completely clean the housing flange face, cavity edge, mating seal plate flange faces and mating seal split faces.
2. Apply a film of gasket maker on the bearing cavity edge and flange face. Sealing compound around the seal or housing socket should be applied very sparingly. Too much sealer will remove clearance for the seal to properly align with the shaft.
3. Apply a thin film of gasket maker on the seal split faces
4. Holding the bottom and top plate around the shaft push the two halves together, they will be properly aligned by pre-installed dowel pins. Wipe any excess sealer off.



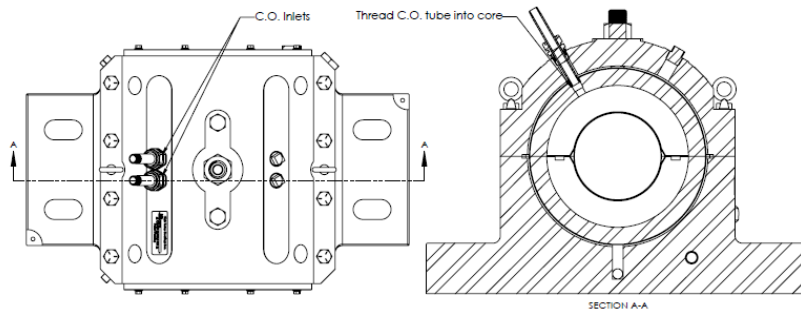
5. Slide the assembled seal into the bearing housing cavity. The split line should be aligned with the housing split; the **LER seal drain port must be oriented on the bottom of the housing (see diagram)**.
6. Lightly screw the seal plate flange to the bearing housing, minimize seal contact with the shaft as much as possible.
7. Once positioned tighten the flange mounting screws. Use of a temporary thread locking compound to prevent backing out is recommended.

b. **Felt seal:** The central cavity of the LER seal plate may be packed with ½” oil soaked felt rope or PTFE cord to provide contact sealing.

**CIRCULATED OIL SYSTEM SETUP:**

**16. Connection of a circulated oil system to the inlet ports of the bearing:**

- a. Clean and flush the oil lines being connected to the bearing prior to installation!
- b. Each bearing has four C.O. inlet ports on the housing cap for alignment with two threaded ports in the bearing core top. Both bearing core ports should be connected so that each end of the bearing is properly lubricated (**See diagram**).



- c. Push the C.O. Inlet pipe through the supplied case fitting and thread the NPT pipe into the core inlet ports. Then thread the case fitting into the case C.O. inlet port. Careful alignment of the ports is required due to the tight seal.

- d. Connect flexible or hard hydraulic line to the C.O. inlet pipes as required
- e. Connect C.O. outlet on the housing to the C.O. system return: The bearing housing has a large NPT circulated oil outlet for gravity return back to an external reservoir. For optimal draining the outlet piping should slope →continued on next page... away from the bearing at 15° or more, and should be vented to prevent suction clogging. For a single drain the oil inflow should not exceed the drain rate list in the C.O. connection table, additional ports maybe tapped for increase draining.

**Note:** Filtration should be installed on the pump outlet rather than on the return side, or run on a separate filtration loop. The bearing housing is not pressurized when using standard seals.

### Circulated Oil Connection Table

Bearing Size	C.O Inlet Case Thread (NPTF)	C.O core connection Diameter (NPT)	C.O. outlet (NPTF)	*REFERENCE NPT pipe Scd. 40 gravity drian rate 50% cap. 2° min pitch (GPM)
3 7/16	1/2	1/8	1-1/4	4.0
3 15/16	1/2	1/8	1-1/4	4.0
4 7/16	1/2	1/8	1-1/4	4.0
4 15/16	3/4	¼	1-1/2	5.4
5 7/16	3/4	¼	1-1/2	5.4
6	3/4	3/8	2	8.9

\*Better gravity drain rates may be achieved with thin wall piping, higher pipe drain slope or additional ports  
 \* High viscosity oil will reduce drain rates

**Note:** When using sealant do not apply it to the last 3 courses of threads, to avoid contamination of the bearing housing

- 17. Auxiliary hardware installation (Options):** See “proximity probe mounting” and “Thermal monitoring sections” Install thermal probes on ports located on the edge of the case; probe length should not exceed 2” of insertion. Install oil level gauge, heater or vibration sensors in the designated port locations. PTFE thread sealant should be used where needed.
- 18. Add lubricant to system:** fill the bearing housing with lubricant until the level is at the oil level sight glass midline. Overfilling may cause oil to run out along the shaft during operation

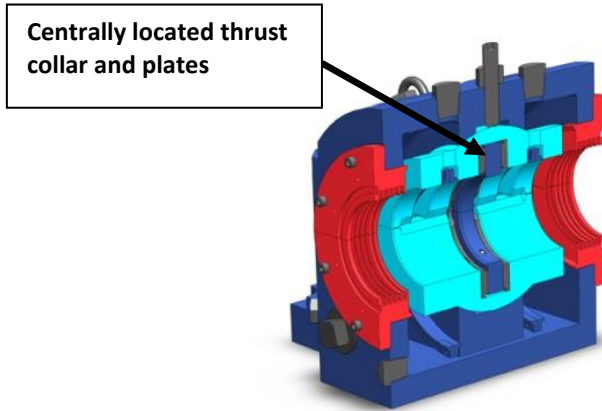
Bearing Size	Approx. Oil Capacity (US fl. oz.)
3 7/16	54
3 15/16	75
4 7/16	131
4 15/16	143
5 7/16	215
6	378

**Warning:** Use of a lubricant other than what has been specified by the OEM during product sizing may result in reduced performance or bearing failure!

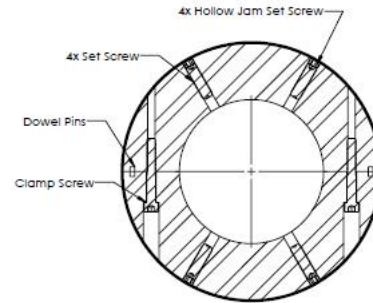
- 19. Startup:** Verify lubricant is getting to the bearing prior to start up, by manually rotating the shaft prior to applying power. The shaft should turn over without significant resistance from the bearing. (I.E. a 20,000 lbs. rotor coupled to a drive can be turned slowly by a single person with a 4 ft. pipe wrench) If the rotor size makes this impossible, bump start the system and allow it to coast down. If at any time binding, noise or other noticeable effects between the bearing and shaft are observed, investigate prior to full startup. Once running, bearing performance issues will typically manifest within the first minutes to hour of operation and can be damaging to the bearing if not addressed early.

## STEP 9: NON-EXPANSION BEARING ASSEMBLY INSTRUCTIONS

The CG-1 non-expansion bearing requires a thrust collar. If using a split collar it must be located on the appropriate machined shaft groove. Thrust plates maybe bumper thrust, stepped land or tilt pad variety depending on the application. Installation is the same for all options. Four thrust tabs + 4x, 6-32 socket head screws or 4x, ¼-20 truss head screws with no tabs are provided to prevent the plates from shifting while in service.



**CAUTION:** The split collars must remain as a set, marking halves with a marker is recommended; **do not to mar or damage in anyway the faces of the collar or plates!**



Collar Bolt Torque Table						
Bearing Size	Clamp Screw		Set Screw		Hollow Jam Set Screw	
	Screw Size	Torque (lbs-in)	Screw Size	Torque (lbs-in)	Screw Size	Torque (lbs-in)
<b>3 7/16</b>	1/4-20 UNC	160	5/16-24 UNF	160	5/16-24 UNF	16
<b>3 15/16</b>	1/4-20 UNC	160	5/16-24 UNF	160	5/16-24 UNF	16
<b>4 7/16</b>	1/4-20 UNC	160	5/16-24 UNF	160	5/16-24 UNF	16
<b>4 15/16</b>	5/16-18 UNC	325	5/16-24 UNF	160	5/16-24 UNF	16
<b>5 7/16</b>	3/8-16 UNC	580	3/8-16 UNC	275	3/8-16 UNC	27.5
<b>6</b>	1/2-13 UNC	1425	3/8-16 UNC	275	3/8-16 UNC	27.5

- a. **Back out all of the set screws on the ID of the split thrust collar.** The thrust collars are designed to have an interference fit with the shaft and are set in a groove milled into the shaft created by the original equipment manufacturer; (*for new equipment contact HTB corporation for groove dimensions or see print documentation*). Mild heating of the collars maybe required to assist with seating. To expand the collars use an oil bath or bearing induction heater. 200-300 °F maybe necessary to expand the bore adequately to provide assembly clearance. Do not use high heat sources on the bearing as

this will damage the thrust plates and bearing surface. Smooth any rough spots on the collar faces or thrust plates using a fine crocus cloth (DO NOT use Emery or Sandpaper)

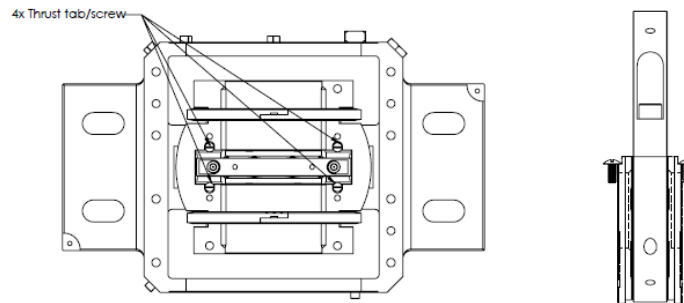
**Note:** Be sure to completely clean the bearing central cavity and plates to prevent parallelism issues due to trapped material.

**Note:** The shaft collar groove may develop a slight deformation on the sharp edge transition. It may be necessary to sand down the edge break to allow the collar to seat properly.

- b. The collar is located in the milled shaft groove, which must be centered in the bearing core cavity to allow for installation of the thrust plates.
- c. Torque the collar screws to the proper values per the “collar bolt torque table”. The collar halves should meet with no offset or raised edges. Torque the clamp screws first, and then each set-screw alternating and evenly. Blue (temporary) Loctite™ on the jam screws is beneficial to prevent backing out from vibration.

**Note:** The collar faces must be true to the shaft within .001” total indicator reading (T.I.R.)

- d. Oil the collar and thrust plates, then slide the plates into position on either side of the collar on the bottom half of the core. **Make sure that the plate with the regular grooves or movable pads (front view) is facing the thrust collar. Proper orientation is critical.** When properly oriented it will be possible to install all four thrust tabs or truss head screws flush with the milled screw pocket in the core and stepped edge on the back of the thrust plates.



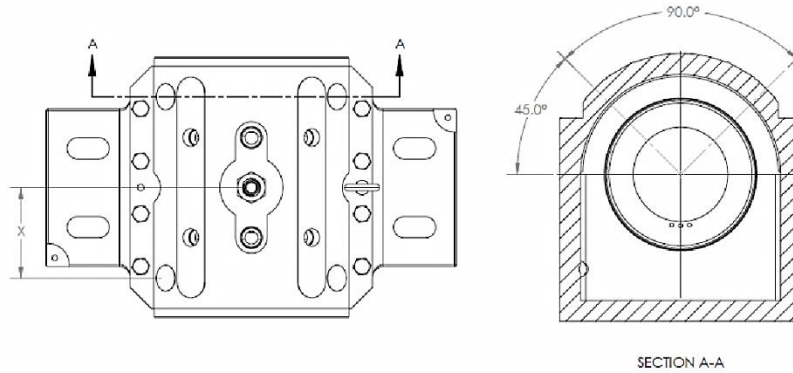
- e. Secure the thrust plates by screwing the 4 thrust tabs down into position with the provided screws #6-32 socket head cap screws, or ¼-20 pan head screws depending on core size (no tabs needed). The tabs must be oriented so that the thrust plates cannot rotate with the collar while in service.

**Note:** Total clearance within the cavity, with the collar and all thrust plates installed is .015” to .030”. If clearance is reduced check to make sure no material has been trapped behind the plates and that all surfaces are parallel.

- f. Place top thrust plates against thrust collar. A film of lubricant on the collar and plates will help hold the upper plates to the collar.
- g. Proceed to STEP 10 of general assembly instructions.



## PROXIMITY PROBE MOUNTING



### Proximity Probe locations:

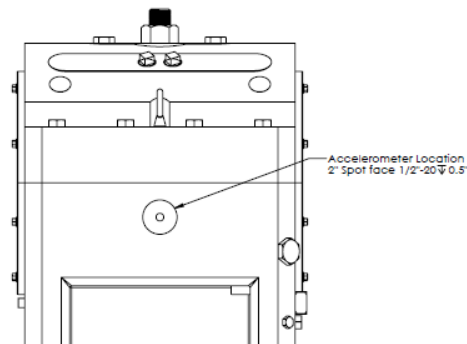
Bearing Size	X
3 7/16	N/A
3 15/16	3.8125
4 7/16	4.3125
4 15/16	4.875
5 7/16	5.375
6	5.8125

Raised bosses have been provided on the housing for the appropriate location of shaft proximity probes. Tapping of the probe locations can be accomplished by the end user.

- 3-7/16" housing is not provided with proximity probe location points.
- 3-15/16" housings should be tapped for 3/8-24 UNF probe mounting.
- All bearing sizes 4-7/16" and up can be tapped with 3/8-24 UNF or 7/8-14 UNF threads
- When the estimated bearing temperature is greater than 200 F, consideration should be made on selecting high temperature probes versus standard construction.

### Accelerometer:

- An accelerometer probe can be attached at the tapped 1/2"-20 UNF port on the side of the bearing housing.



## CG-1 BEARING TEMPERATURE MONITORING:

Temperature monitoring is an economical method for verifying proper bearing operation. By design, CG-1 bearings will typically run hotter than water cooled bearings. When establishing new control limits for temperature, it is not unusual to set new ranges well above 212 °F for the oil sump.

**Bearing preheating:** The bearing oil should be preheated to 70° F prior to startup. Warming is especially important for bearings running high viscosity oil (ISO 100 or greater). Low watt density heating methods are superior when heating fluids. Excessive heater surface temperature will damage the oil within the bearing. The housing has been drilled through to accept a thermostatically controlled immersion heater with a ½” NPT connection. Heat tracing or adhesive warming pads may also be used to preheat the bearing prior to cold starting. Once running the bearing will generate enough heat during operation that the heater may be shut off.

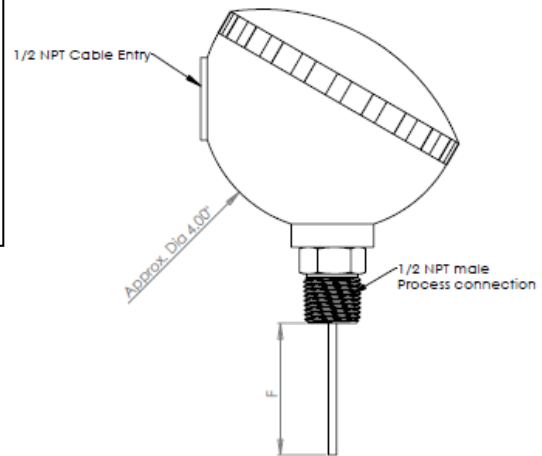
**Note:** Insulation commonly used with cold weather heat tracing will interfere with heat dissipation during steady operation and may significantly reduce bearing performance.

**Housing surface probe:** A probe can be placed midway between the bearing base and split along the centerline. Tap depth should not exceed 0.500”.

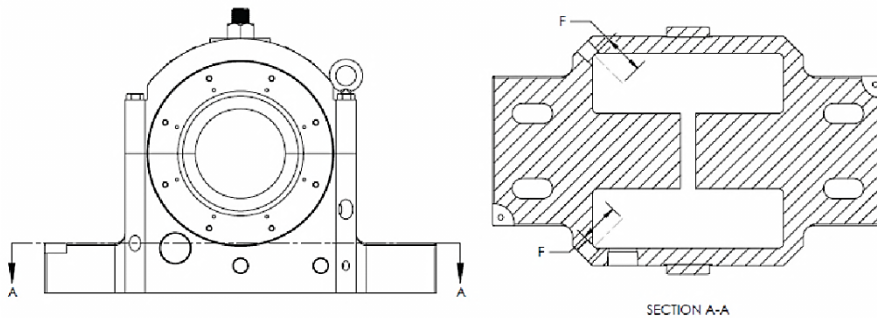
### RTD insertion into oil sump through pre-tapped port:

RTD Thermal Probe	
Bearing Size	F
3 7/16	2.000
3 15/16	2.000
4 7/16	2.000
4 15/16	2.000
5 7/16	2.000
6	2.000

**Basic RTD Thermal Probe Standard:**  
 Process connection: ½ NPT Male  
 Insertion length (F): 2.00”  
 Junction type: Grounded  
 Thermocouple Type: J  
 Sheath: 1/8” Diameter, 304 SS  
 Insulation: MgO  
 Terminal housing: Aluminum die-cast  
 Cable entry: ½ NPT



**Note:** RTD's should be grounded to eliminate signal noise due the electrically insulating properties of the bearing liner.



## SHAFT FINISH RECOMMENDATION:

1. Shaft taper should be limited to 0.0002 in/in.
2. Out of roundness should be limited to 0.0005" for shafts up to 5" and 0.001" for shafts above 5" in diameter.
3. Shaft finish should have a Ra of 8-32 micro-inch, and be protected from nicks or scratches.
4. Shaft should be plunge ground to remove machining lead
5. Shaft hardness should be a minimum of RHB 93, target hardness should be RHC 50. In general it is desirable to harden the shaft surface to obtain longer life, improve wear and abrasion characteristics.
6. Shaft diameter tolerance is H7, although higher precision maybe required.

## LUBRICANT CONTROL:

All CG series bearings are specified with a lubricant viscosity and synthetic chemistry. If a lubricant is substituted without the correct properties the bearing may fail. CG series bearings rely on proper chemistry to provide sufficient oil life and adequate oil film to support bearing loads. HTB general specification for lubricant will include ISO viscosity and synthetic chemistry base stock.

### Key Lubricant Features:

1. Conforms to the OEM specified single grade, full synthetic base chemistry (PAO, PAG, POE, or PFPE)
2. Conforms to the OEM specified ISO viscosity
3. Rated for turbine, gearbox or compressor applications

- **Full synthetic PAO:** (I.E. SHC 600 series oils) for applications up to 221 °F using select viscosity
- **Full synthetic PAG:** (I.E. Dow Chemical UCONALL series) applications up to 245 °F using select viscosity
- **Full synthetic POE:** applications up to 375 °F using select viscosity

**Never use multi-grade oils with a CG-1 Hydrodynamic bearing.** In most applications this will result in sudden loss of load capacity and bearing wipe.

**Lubricant contamination:** Abrasive materials in the lubricant will damage the bearing surface. The bearing, housing, hardware and any connected oil lines should be cleaned prior to installation. New lubricant should be filtered to levels of 10 micron or better, the operating bearing oil film is on the order of 25 micron. When inspecting the bearing, care should be taken to not introduce dirt through the filler ports or inspection covers. If a circulated oil system is used, in-line filtration is highly recommended.

**Lubricant distribution:** The minimum allowable oil flow rate to the bearing to sustain hydrodynamic behavior and shaft surface speed will determine if oil ring lubrication is suitable or if a circulated oil system is needed.

After a protracted shut-down or a new installation, it is recommended that the shaft is manually rotated through several revolutions to help distribute the lubricant to the bearing surface. This will prevent wear to the liner caused by lubricant being squeezed out while sitting idle. If using oil rings, check to make sure that the rings are not hung up by looking through the inspection ports while rotating the shaft. When connected to a circulated oil system verify that oil is flowing through the bearing and draining from the housing prior to rotating the shaft.

**Lubricant PM:** The maximum operating temperature and useful service life of a lubricant will vary depending on how it is used. Contamination and oxidation temperature will influence the service life of the lubricant. The user must determine the appropriate PM schedule. Under normal use we suggest checking the lubricant every 2,500 hours. We recommend regular inspection of the bearing to ensure that no significant oil loss or seal failure has occurred and active temperature monitoring of the oil sump.

Analysis of acidity (TAN), viscosity, and particulate is recommended to determine if the lubricant is has been degraded and to understand the best PM interval. The color of the oil is not an acceptable indicator quality, often new oil will darken rapidly once in service. When monitoring the bearing oil temperature a gradual increase in average running temperature over time is an indication the lubricant may need to be changed due to thickening or a loss of oil, this is a reflection that as lubricant degrades often the viscosity increases. During oil changes, the used oil should be completely drained and replaced rather than topped off. Care must be taken to not mix or use a different grade of oil than what is specified for the bearing.