# INSTALLATION AND SERVICE INSTRUCTIONS FOR

## GR20 Gerotor Pump




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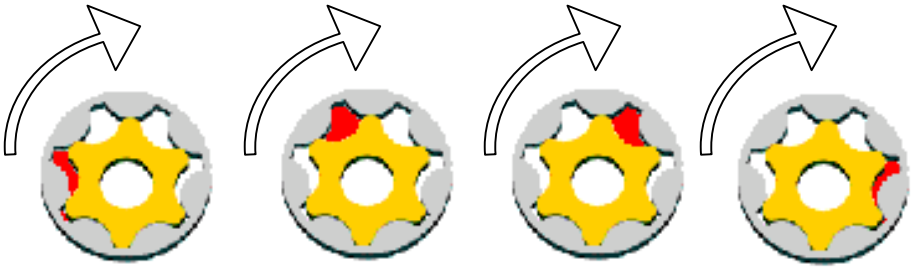
## General Description

Tuthill's GR20 Series are compact, highly efficient, cast iron positive displacement gerotor type gear pump with a mechanical seal. Gerotor type gears have a long service life because the relative velocity between the inner and outer rotor is very low. For example, when a gerotor assembly consisting of an 8-tooth inner rotor and a 9-tooth outer rotor is operating at 1800 rpm, the relative speed between the inner and outer rotors is only 200 rpm. The GR20 series give a nominal capacity from 3.5 to 15 gallons per minute and pressures up to 200 psi. They are self-priming and particularly suited to handle liquids of 35 to 1000 SSU viscosity. Higher viscosities can be handled at reduced speeds.

The GR20 Series is supplied with a two bolt on flange. The pump head is mounted onto an adaptor. An external relief valve is also an option.

## The Pumping Principle

The gerotor is a positive displacement-pumping unit consisting of just two elements: an inner rotor and an outer rotor. The outer rotor has one more tooth than the inner rotor and has its centerline positioned at a fixed eccentricity from the centerline of the shaft.
Although gerotors come in a variety of geometric configurations, materials, and sizes, all gerotor sets share the basic principle of having conjugately-generated tooth profiles, which provide continuous fluid-tight sealing during operation.
As the rotors rotate about their respective axes, fluid is drawn into the enlarged chamber to a maximum volume. As rotation continues, chamber volume decreases, forcing the fluid out of the chamber. The process occurs constantly for each chamber, providing a smooth pumping action.



## ⚠ WARNING

Failure to follow these instructions could result in serious bodily injury or death.

These pumps should **not** be used for handling plain water, corrosive or abrasive liquids or liquids not possessing adequate lubricity.

Do not attempt to work on any Tuthill pump installation before completing the steps below.

Disconnect the drive so that it cannot be started while work is being performed.

Review the Material Safety Data Sheet (MSDS) applicable to the liquid being pumped to Determine its characteristics and the precautions necessary to ensure safe handling.

Vent all pressure within the pump through the suction or discharge lines.

All Tuthill pumps contain residual ISO 32 lube oil from the factory production test. Determine if this is compatible with the fluid you are pumping. If the fluid is incompatible, consult the factory.

## Location

The pump should be located as close to the source of supply as conditions will permit, below the level of the liquid in the reservoir, if possible. Pumps should be located in a dry and clean place, with space to work around them.
When necessary to locate pumps in pits, provisions should be made to safeguard against floods. Care must be taken to properly support the suction and discharge piping so that no strain can be put on the pump from either its weight or expansion. Piping strains are very often the cause of misalignment, hot bearings, worn couplings and vibrations.

## Proper Installation

A large percentage of unsatisfactory pump installations is caused by failure to observe the natural laws limiting the suction lifts on volatile materials. At temperatures of approximately $70^0$F or lower, kerosene and light fuel oils may be pumped at nearly full volumetric efficiency when combined vertical lift and friction in the suction line do not cause a vacuum to exceed 10 inches of mercury at the suction port of the pump. Ten inches vacuum on kerosene oil is equal to approximately fourteen feet of vertical lift without pipe friction. This varies with the temperature and various oils, but if, in laying out the suction line, the maximum vacuum is kept at this figure or lower, good results may be expected. If this vacuum is exceeded, it is almost certain to result in cavitation, loss of volume and a noisy installation.

When pipelines are installed, an inverted "U" bend should be incorporated in the suction line close to the pump to trap liquid in the pump for priming. The suction line must be kept free from air leaks and air pockets.

When handling liquids of high viscosity, such as asphalt, heavy gear lubricants, linseed oil, Bunker “C" fuel oil, molasses, etc., the speed of the pumps and the running clearances are important. Consult Tuthill UK, whenever unusual conditions of speed, pressure, vacuum or viscosity are encounted.

Before initial start of the pump, it is recommended that some of the liquid to be pumped be introduced into the pump ports to insure wetting of the rotation elements. Check alignment and rotation of the driver to see that pump will rotate in the designated proper direction of rotation.

## Filter Protection

Piping or tubing should be cleaned out thoroughly to remove chips and pipe scale before connecting the piping to the pump.

Neglect of this precaution may result in damage to the pump when it is put in operation. The suction piping should be as short and direct as possible. Grit, pipe chips, or other foreign substance that is allowed to pass through the, pump, will almost surely injure and possibly ruin it. Always remember the following in the selection and position of a filter:

1. A filter should be installed to protect the pump whenever conditions permit.
2. When uncertain of pressure drop through the filter, obtain this data from manufacturer, giving pump capacity and type of liquid to be handled.
3. Install filter according to arrows or notation designating flow.
4. Have filter accessible for servicing.
5. Use duplex type where shutdown during servicing is not permitted.
6. Provide a vacuum gauge in the suction line for determining when the filter requires cleaning
7. The greater the free opening, the less attention the filter will require.

## ⚠ WARNING

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If the pump is to operate at elevated temperatures, it should be brought up to operating temperature gradually. Rapid or sudden introduction of liquid at an elevated temperature into the cold liquid chamber of the pump could cause damage to the seal or other internal parts.

Do not run the pump dry. This could cause severe damage to the seal, bushings and/or metal parts.

**Startup**

Prior to starting the pump double check the following:

- Pressure and vacuum gauges should be installed as close as possible to the pump.
- Rotate pump shaft to ensure it turns freely without binding.
- Recheck alignment and ensure all guards are in place.
- Make sure piping is independently supported and no strain is being transmitted to the pump.
- Make sure the safety relief valve is installed correctly.
- Check pump rotation.
- Open suction and discharge gate valves.
- Check for any leaks once gate valves are open.

After completing these checks the pump can be started.

## ⚠ CAUTION

The pump should not be run dry. If after approximately 60 seconds there is no discharge of liquid, stop the pump and investigate the possible cause. Failure to comply with this could cause severe damage to internal seals, bushings and/or metal parts.

## ⚠ WARNING

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Do not attempt to work on any Tuthill pump installation before completing the steps below.

Disconnect the drive so that it cannot be started while work is being performed.

Review the Material Safety Data Sheet (MSDS) applicable to the liquid being pumped to determine its characteristics and the precautions necessary to ensure safe handling.

Vent all pressure within the pump through the suction or discharge lines.

All Tuthill pumps contain residual ISO 32 lube oil from the factory production test. Determine if this is compatible with the fluid you are pumping. If the fluid is incompatible, consult the factory.

**Disassembly of Seal**

1. Deburr shaft especially around the keyway area.

2. Hold the pump in a vice, cover down and unscrew seal plug and remove from shaft (this may be tight due to the bearing).

3. Gently remove carbon carrier and spring from the shaft. Then the drive ball and spring plate can be removed.

4. Remove static seal plate from bearing housing (this may be tight due to the O ring)

5. Inspect rotor, if badly scored in seal or bearing area, rotor should be replaced. Also check seal faces for the same scoring. Remove 0-rings and check for deformation, again replace if there is any doubt.

6. Clean all parts thoroughly and replace static seal plate.

7. Refit spring plate and drive ball ensuring that the ball seats correctly into the hole in the shaft.

8. Replace the spring and carbon carrier on the shaft and push down gently until spring is down to the spring plate.

9 Ensuring that the groove on the carbon carrier is in line with the drive ball, then refit seal plug and screw down.

## Disassembly of Pump

1. Deburr shaft especially around the keyway area.

2. Hold the pump in a vice, cover down and unscrew seal plug and remove from shaft (this may be tight due to the bearing).

3. Gently remove carbon carrier and spring from the shaft. Then the drive ball and spring plate can be removed.

4. Remove static seal plate from bearing housing (this may be tight due to the O ring)

5. Hold body in the vice with the shaft pointing downwards. Remove the 4 off 6mm cap head screws and remove the cover by pulling upwards, place to one side.

7. The inner rotor is attached to the shaft so both can be removed together by pulling on the end of the shaft. Once they are out then remove the outer rotor.

8. The individual parts must now be inspected for damage. The keyway in the end of the rotor must be in good condition and there must not be any deep scratches or grooves on the following surfaces:

a. The ID surface of the housing.
b. The OD of the outer rotor.
c. Both faces of outer rotor.
d. The OD of the inner rotor.
e. Both faces of the inner rotor.
f. The surfaces of the cover.
g. Areas on the shaft of the rotor where the seal and the bearing seats.

## Inspection

Check cover, housing, inner and outer rotor for wear, chipped or broken teeth. Drop off in capacity is generally caused by the abrasive action of foreign materials in the oil, resulting in endplay of both the rotors.

Check for side movement in the shaft assembly, as this indicates potential bearing failure.

## Reassembly of Pump

1. Clean all parts thoroughly using great care to eliminate dirt.

2. Take the body with the seal area facing downwards and push the shaft and inner rotor into the bores ensuring that it is pushed down onto the bottom face. Once these are in place the outer rotor over the inner rotor ensuring that the teeth mesh with no problems.

3. Place the cover onto the shaft (the cover will only fit one way due to the offset on the cover and the bore in the body).

4. Hold the body in a vice with the shaft facing upwards and make sure that the shaft turns freely.

5. Refit spring plate and drive ball ensuring that the ball seats correctly into the hole in the shaft.

6. Replace the spring and carbon carrier on the shaft and push down gently until spring is down to the spring plate.

7. Ensuring that the groove on the carbon carrier is in line with the drive ball, then refit seal plug and screw down.

## Pump selection

The above pumps are only suitable for liquids having self-lubricating properties.
The table below shows the capacity and suggested driving motor size for different speeds and pressures. These figures are based upon pumping a liquid of about 200 S.S.U. viscosity, and with a 10-inch vacuum. While Tuthill pumps will develop as high as 27 inches of vacuum, it is sound engineering to reduce the vacuum to a minimum. The speed of the pump must be reduced when handling liquids of high viscosity and the size on lines increased to prevent cavitation, loss of capacity and high power requirements.

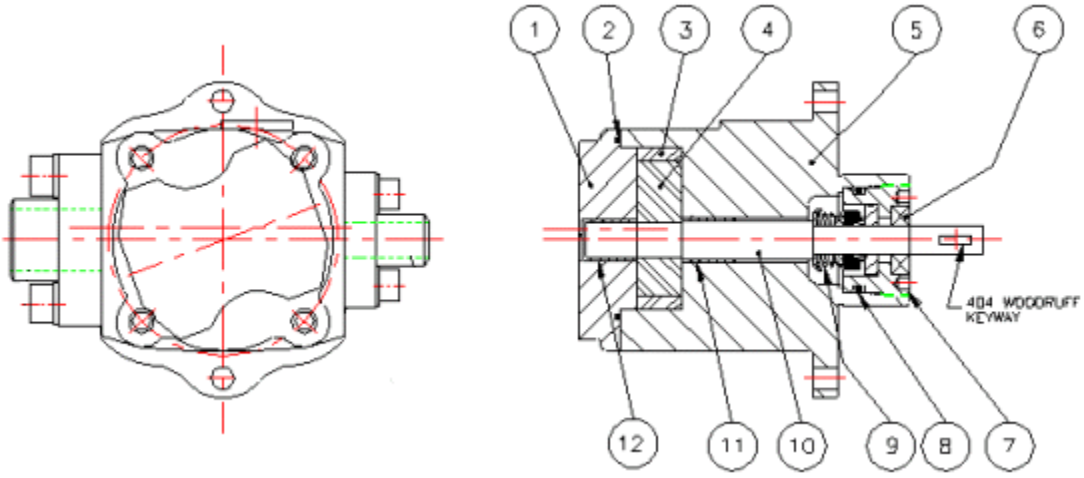
Caution: Remember that the pipeline friction increases at a rapid rate with increase in viscosity. For a given pump and motor, larger pipelines are necessary to maintain the same pump pressure when changing from a thin liquid to a thick liquid. Viscous liquid pumping installations are notoriously underpowered, due to lack of knowledge in computing pipeline friction. Handling of viscous liquids is a special hydraulic engineering problem, which the Engineering Department of Tuthill is well equipped to solve for you.

Consult Tuthill Pumps Ltd. in selecting the proper pump, size of motor and pipeline size for your job, giving them the following information:

1. Capacity required.
2. Maximum and minimum liquid temperature when entering the pump.
3. The viscosity at the minimum temperature.
4. Total length of suction pipe and discharge pipe.

5. Suction lift and height to which the pump must force the liquid.

| Pressure (PSI) | 0 | | 25 | | 50 | | 75 | | 100 | | 125 | | 150 | | 175 | | 200 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pump Speed | L/MIN | GPM | L/MIN | GPM | L/MIN | GPM | L/MIN | GPM | L/MIN | GPM | L/MIN | GPM | L/MIN | GPM | L/MIN | GPM | L/MIN | GPM |
| 720 RPM | 14.9 | 3.3 | 14.5 | 3.2 | 13.5 | 3 | 12.6 | 2.8 | 11.9 | 2.6 | 11 | 2.4 | 10.2 | 2.2 | 9.5 | 2 | 8.7 | 1.9 |
| 860 RPM | 17.8 | 3.9 | 17.5 | 3.85 | 16.4 | 3.6 | 15.5 | 3.4 | 14.7 | 3.2 | 13.9 | 3.1 | 13 | 2.9 | 12.3 | 2.7 | 11.6 | 2.6 |
| 960 RPM | 19.8 | 4.4 | 19.5 | 4.3 | 18.5 | 4.1 | 17.5 | 3.9 | 16.8 | 4 | 16 | 3.5 | 15.1 | 3.3 | 14.3 | 3.1 | 13.6 | 3 |
| 1150 RPM | 23.8 | 5.2 | 23.5 | 5.2 | 22.4 | 4.9 | 21.5 | 4.7 | 20.7 | 4.6 | 19.9 | 4.4 | 19.1 | 4.2 | 18.2 | 4 | 17.5 | 3.9 |
| 1420 RPM | 29.4 | 6.5 | 29.1 | 6.4 | 28 | 6.2 | 27.1 | 6 | 26.3 | 5.8 | 25.5 | 5.6 | 24.7 | 5.4 | 23.8 | 5.2 | 23 | 5.1 |
| 1700 RPM | 35.2 | 7.7 | 34.9 | 7.7 | 33.8 | 7.4 | 32.9 | 7.2 | 32 | 7 | 31.2 | 6.9 | 30.3 | 6.7 | 29.6 | 6.5 | 28.7 | 6.3 |
| 2800 RPM | 58.1 | 12.8 | 57.9 | 12.7 | 56.8 | 12.5 | 55.7 | 12 | 54.9 | 12.1 | 54 | 11.9 | 53.2 | 11.7 | 52.4 | 11.5 | 51.6 | 11.4 |
| 3300 RPM | 68.2 | 15 | 68.1 | 14.9 | 67.1 | 67.1 | 66 | 15 | 65.1 | 14.3 | 64.1 | 14.1 | 63.1 | 13.9 | 62 | 13.6 | 61.1 | 13.4 |




| ITEM | DESCRIPTION | QUANTITY | PART NUMBER | DRAWING NUMBER | MATERIAL |
|---|---|---|---|---|---|
| 1 | COVER | 1 | | B1509UK | CAST IRON |
| 2 | O RING | 1 | BS2-148 | | NEOPRENE |
| 3 | GEAR ASSY | 1 | | B1665UK | |
| 4 | GEAR ASSY | 1 | | B1665UK | |
| 5 | BODY | 1 | | B1646UK | CAST IRON |
| 6 | BEARING | 1 | | 6001ZZ | VARIOUS |
| 7 | HOUSING PLUG | 1 | | A1188UK | STEEL |
| 8 | O RING | 1 | BS 222 | | NEOPRENE |
| 9 | SEAL ASSY | 1 | A1187UK | | VARIOUS |
| 10 | SHAFT | 1 | GEAR ASSY | B1665UK | |
| 11 | BUSH | 1 | 10DU14 | | STEEL |
| 12 | BUSH | 1 | 09DU12 | | STEEL |

| SIZE | FLANGE | O RING |
|---|---|---|
| 1/2" | AFS-80-ST | BS 210 |
| 1" | AFS-102-ST | BS 219 |

| | | |
|---|---|---|
| **1 1/4"** | *AFS-104-ST* | BS 222 |

**Field checklist**

WHAT TO LOOK FOR WHEN:

1. No Oil is delivered.

a) Suction lift too high for vapour pressures of liquid pumped. While Tuthill Pumps will develop as high as 27 inches of vacuum, it is wise to reduce the vacuum to a minimum.
b) Bad leaks in suction line or port passages can be detected by submerging pressure line from discharge side of pump into a pail of oil where the air will be seen in the form of bubbles.
c) Wrong direction of shaft rotation.
d) Pump shaft not rotating. (Check coupling or drive).
e) Relief valve setting too low. (Discharging fluid through by-pass port.)

2. Capacity is too Low

a) Suction lift too high.
b) Air leaks in suction line.
c) Suction line too small.
(Can be detected by installing a vacuum gauge directly at the pump suction. The maximum vacuum at the pump suction should never exceed 1 5 inches of mercury. It is necessary to keep below 1 5 inches not because of the inability of the pump to handle a higher vacuum, but primarily because of the vaporization that is liable to take place at a higher vacuum. Vaporization caused by higher vacuums will generally result in capacity drop-off.
d) Pump speed too slow.
e) Filter too small or obstructed.
f) Suction pipe or port not immersed in the liquid deep enough.
g) Piping improperly installed, permitting air pocket to form in pump.
h) Increased clearance or wear in the pump will sometimes cause the pump to deliver an insufficient supply of liquid.

A folded gasket or a slight amount of dirt not only will frequently exaggerate the original trouble but will also be the cause of leakage.

3. Pump Works Spasmodically

a) Leaky suction lines.
b) Suction lift too high.
c) Air or vapour in liquid.
d) Coupling slipping on pump shaft.

4. Pump Wastes Power

a) Pressure too high.
b) Liquid more viscous than desired.
c) Suction or discharge lines obstructed.
d) Mechanical defects.
(End thrust on pump shaft.)
(Tuthill pumps are not designed to take end thrust toward the pump cover and care must be taken to prevent thrust in this direction).
Drive shaft and pump shaft misaligned.
The pump may be binding due to insufficient end clearance. Pump shaft bent.
Misalignments within pump due to bad piping or poor installation, causing strains or distortion.

5. Pump is Noisy

a) Machine or part of it is acting as a sounding board.
b) Misalignment or bad design of coupling.
c) Coupling set too close to pump.
d) Vibration of pump because of bent shaft or worn parts.
e) Air leaks on suction side of pump.
f) Suction lift too high, causing vaporization.

6. Pump Leaks

a) Cover bolts need tightening, or cover gasket is defective.
b) Seal is defective or worn,

**Material Returns**

If it becomes necessary to return a pump to the factory, a Return Goods Authorization (RGA) must be obtained from either your local Authorized Distributor or our plant. No RGA can be issued until a completed Material Safety Data Sheet (MSDS) has been forwarded to our plant and return of the pump approved.

- Tuthill pumps are precision built and must be handled with care.
- Pumps must be drained of all fluid and the ports plugged to prevent foreign material from getting into the pump.
- Pumps must be packaged securely to prevent damage while in transit.