CLOUD SELLERS

MODEL 180 DIRECTIONAL
OPERATION & MAINTENANCE INSTRUCTIONS

Read all instructions in this manual before operating machine.

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PRINCIPLES OF OPERATION

The Model 360 tank cleaning machine is hydraulically driven by the cleaning solution. As the fluid passes through the inlet, a stationary turbine (stator) forces the liquid past the rotor which causes it to rotate at high speed. The rotor is fastened to a chromium oxide coated rotor shaft which is supported radially by and upper and lower tungsten carbide bearing. The rotor shaft extends into the gearbox, and is connected to the geartrain which reduces the speed of the rotor shaft by either 655:1 or 273:1, depending on machine configuration, and transmits the rotation to the Tee Housing on a horizontal plane.

The Tee Housing has a fixed 61 tooth bevel gear which drives a 60 tooth bevel gear mounted on the Nozzle Housing. During tee housing rotation in the horizontal plane, the nozzle housing rotates in the vertical plane simultaneously. Due to the difference in the number of teeth on the bevel gears, an indexing occurs which precisely advances the nozzle housing rotation ahead of the tee housing, creating the spherical 360 degree spray pattern for complete tank coverage.

Cycle times will vary with water pressure, GPM and the machine configuration. Because no two cleaning applications are the same, the Model 360 tank cleaning machine can be configured for specific cycle times, nozzle dwell time and water usage. One basic machine can be altered with interchangeable nozzles, rotors, stators and geartrain ratios to maintain the highest degree of operating efficiency. Refer to the performance data sheet for sample cycle times and water usage, or call your sales representative for assistance in choosing the proper machine configuration for you tank cleaning needs.

The Model 360 tank cleaning machine has been designed for a long reliable service life. Every attempt has been made to design in reliability, but like all other man-made mechanical devices, this machine is subject t altered performance or break downs. Preventative maintenance is the key t maintaining uninterrupted machine performance, and minimal downtime. Due to the numerous factors that affect rotary tank cleaners such as GPM, pressure, chemical concentration, etc., it is necessary to create specific Preventative Maintenance (PM) programs for each machine that is being used under various operating conditions. Refer to Section 2: Preventative Maintenance or check with your distributor for specific recommendations.

PREVENTATIVE MAINTENANCE

The Model 360 tank cleaning machine has been designed to operate under a wide variety of conditions and to provide long-term reliability with a minimum amount of servicing. All wear parts are have been engineered for quick inspection and simple replacement. Servicing can be accomplished in the field, eliminating the need to send machine elsewhere for repair or maintenance.

Each cleaning application is unique, and therefore affects the seals, o-rings, cups and bearings in a different way. A good preventative maintenance program tailored for you specific tank cleaning machines will help to eliminate the possibility of failure during a cleaning cycle, or the need to replace major cast parts later from excessive wear. The expense of periodic inspection and subsequent replacement of wear parts on a regular basis is less costly than waiting until the machine fails to replace parts. The added advantage to PM is that you have control over when a machine is to be serviced; either between batches or during the off season, instead of during a cleaning cycle when you need reliability the most. Check with your distributor for advice on establishing a PM program at your facility.

CLEANING SOLUTION FILTRATION

It is recommended that a strainer be placed in line with the pump to filter out small particles which could lodge inside the tank cleaning machine decreasing its efficiency. This is very important where recirculation of the cleaning solution is being employed. The mesh and wire size of the strainer will vary depending on the type of cleaning and particle size. Be certain that the water supply system has been flushed out to remove any solid particles before attaching the Model 360 tank cleaner. Following each use of the tank cleaner, we recommend a clean water rinse to thoroughly remove any cleaning solution (recirculated or new) residue which could affect the seals and o-rings during non operational storage.

GEARBOX LUBRICATION

Oil level inside the gearbox should be checked regularly; the specific time period to be determined by the type of service the machine is in. The more severe the service, the more often it is recommended to check the oil level. To inspect oil level, turn machine upside down and remove the gearbox cover. The oil level should just cover the lower (623-A) gearset on the (616) final drive shaft (about 1” below the machined end of the gearbox). All lubricated machines are supplied with the following type of oil:

OIL TYPE: Food Grade U.S.D.A. Acceptable H-1
QTY. 14 oz. (414 ml.) S.A.E. – 90

Oil Alternatives: For non-food industry applications, H-2 lubricants can be used such as Keystone Keygear 90, KLC-20/50 or KSL-365. Lightweight gear oils (50-90) are also suitable. It should be noted that heavy weight (140) gear oils or greases will alter the performance of the machine regarding cycle times. If upon inspection of the gearbox there is cleaning solution mixed into the gear oil, then it is advisable to inspect the rotor shaft seals (641-TG), final shaft seal (640-V) and the gearbox cover o-ring (644). Replace seals and o-rings as necessary.

SEALS AND O-RINGS:
All of the Model 360 tank cleaners are shipped with o-rings constructed of a Flourocarbon Elastomer (Viton) compound. This compound is suitable for a broad range or temperatures and chemical resistance. The type of cleaning application and chemicals used will in large part determine the length of service for o-rings. Upon inspection, if an o-ring has any cracks, worn sections or is swollen in size, then replacement is recommended.

The spring energized seals (part #'s 635-TG, 636-TG, 641-TG and 643-TG) have a PTFE alloy jacket which increases the longevity and sealing capabilities. Once the seals have worn thru the jacket to the spring, they are no longer providing a proper seal. Particles in the cleaning solution are then able to lodge in the machine, decreasing its efficiency, and perhaps stopping it altogether. Prolonged use with worn out seals can damage the castings the seals were meant to protect.

A regularly scheduled inspection program is recommended for the main bearing seals (635-TG and 636-TG). Inspection is easily accomplished by removing the nameplate (606) and the nozzle housing assembly (605). If these seals are worn, or need to be cleaned of deposits, then the tee-housing seals will also need attention.

INSPECTION OF WEAR PARTS
All of the bearing clearances in the Model 360 tank cleaner have been designed to provide the best possible support for the adjacent parts, while maintaining reliability between servicing. Most of the bearing clearances are very close when the machine is assembled at the factory. This allows for longer periods of operation before overall machine performance is altered due to bearing wear. In many cases, the bearings can wear down 25% and the machine will continue to operate properly. It should be noted that while the machine may continue to operate with worn bearings, it is recommended that bearings be changed at the first evidence of wear to protect the long term performance and reliability of the unit. In severe service (high pressure and / or chemical concentration), the period between servicing will be shortened.
Several parts in the Model 360 have been designed as replaceable wear parts. These parts are easily replaced in the field at a reasonable cost, with a minimum of down time or labor costs.

MAIN BEARING: After removal, inspect the bearings; they may have grooves on the O.D. from particles or deposits that may have lodged between the bearing and cup during machine operation.

Also, if the clearance between the bearing O.D. and the cup I.D. is loose compared to when new, it may be time to change the bearings. The normal clearances between cups and bearings are held to close tolerances to maintain proper mesh of the bevel gears (617 and 618), and to allow the maximum amount of wear on the bearings before they need to be replaced.

Like any other type of bearing, if allowed to wear beyond normal limits or if used in severe service without any maintenance, the bearings may fail, which could alter the performance of the machine. Refer to page 3-NOZZLE HOUSING ASSEMBLY REMOVAL. Subsequently, if the nozzle housing bearings need replacement, then the tee housing bearings will also need to be changed. Refer to page 5- TEE HOUSING.

CUPS: After extended use, the cups may show signs of wear from one of the seals (636-TG or 635-TG) that has worn thru the jacket into the spring. Rotation of the nozzle housing or tee housing against the static seal can wear a groove into the cup. This groove will prevent proper sealing when a new seal has been installed. Replacement of the cup is recommended whenever visual grooves or wear marks are evident. (See Disassembly Procedure for removal).

Cups will also wear out from rotation against the bearings; however, often times the bearings can be changed 2 or 3 times before the cups may need to be replaced. This is dependent on the type of cleaning solution, pressure, chemicals and the regularity of inspection and preventative maintenance.

ROTOR SHAFT BEARINGS: The upper and lower carbide bearings that support the rotor shaft can easily be inspected while the machine is fully assembled. To inspect the upper and lower rotor shaft bearings (660-U and 660-L), remove the stator (609). Rotate the rotor shaft by turning the rotor (610) with your finger or a screwdriver. If the bearings allow side to side movement so that the rotor is contacting the inlet stem wall, then the bearings need to be replaced. Refer to Disassembly Procedure on page 4 and Assembly Procedure on page 6 for details on parts replacement.

GEARBOX BEARINGS: There are six bearings inside the gearbox, which maintain the gear shaft alignment. Removal of the gearbox cover (602) and the geartrain allows for inspection of these bearings. If there is notable side to side play of one of the gear shafts (# 615, 616 or 622-SA) and one of the mating bearings (# 626-A, 627, 628, 629, 630) then replacement is recommended. Refer to Disassembly Procedure on page 4 and Assembly Procedure on page 7 for details on parts replacement.

NOTE: while it may appear that the gearbox bearings are standard off-the-shelf bearings, they have all been modified by the manufacturer to meet the design specifications set forth by the manufacturer. Replacement of these bearings by any type other than O.E.M parts can compromise the performance of the machine.

DISASSEMBLY PROCEDURE

During disassembly of the Model 360 tank cleaner, several inspections can be made which aid in determining a preventative maintenance schedule or in trouble shooting, should there be a problem. If you have already disassembled a machine, read through the disassembly procedure then refer to the Assembly Procedure section beginning on page 5. Part numbers are shown in parentheses. A check mark √ precedes an inspection of a part or assembly. If upon your inspection you find something that differs from what is normal in a new part or assembly, make a note of it, and then continue the disassembly procedure. At the end of the disassembly, compare your notes to the trouble shooting guide at the back to find a solution.

STATOR (609) AND ROTOR (610) REMOVAL
With machine standing upright, remove stator retaining ring (645-3) with needle nose pliers. Lift out stator (609) with pliers or by hand.

√ check to see that rotor shaft spins free: rotate the rotor shaft by turning the rotor with your finger or a screwdriver. It should spin freely with minimum pressure, and the tee housing (604) will spin slowly.

√ check free play of tee housing up and down on the axis of the inlet stem (603). If there is no ovement, there could be scale or deposits trapped between the main tee housing bearings and the bearing cups, or the unit has been assembled incorrectly. Take note if there is no free play and refer to the trouble shooting guide for assistance.

NOZZLE HOUSING ASSEMBLY (605) REMOVAL

√ check the nozzle housing for free play (in and out) on the axis of the tee housing nose (604). If there is no movement, there could be scale or deposits trapped between the nozzle housing bearings and the bearing cups, or the unit has been assembled incorrectly. Take note if there is no free play and refer to the trouble shooting guide for assistance.

Remove the nameplate screws (648) with a 7/16” socket or end wrench. Grasp the nozzle housing assembly with one hand and gently pull off the tee housing (604). If the nozzle housing does not come off easily or if there was no free play, there may be deposits or scale built up between the cups (634) and the bearings (633). If so, use a plastic hammer to gently tap on the nozzle housing to loosen it, then remove from tee housing. The nameplate (606), outer bearing (633), and seal (636-TG), will come off with the nozzle housing assembly. Remove the inside bearing and seal from the tee housing. *NOTE: because the flange of the inside bearing is locked into the groove on the tee housing, it is necessary to rotate the bearing to loosen the flange.* Use two (2) screwdrivers to gently pry up on the flange of the bearing until you can grasp it with your fingers.

√ inspect the seals to be sure the jacket has not worn down thru to the spring.

√ examine the bearings for wear. They should be free from cracks, grooves on the O.D and should fit inside a nozzle housing cup (634) with a minimum of side to side movement.

√ inspect the inside of the cups for grooves or surface wear marks that could create a sealing problem.

Remove the bevel gear retaining ring (619); pry one of the ends out of the groove on the nozzle housing with a small screwdriver, working your way around until it is completely removed. Remove the bevel gear and the (637) o-ring.

√ visually inspect the nozzles; look down the end of the nozzle with the aid of a flashlight to see that there is no blockage of the stream straightener.

Remove the nozzles for cleaning if necessary using a large adjustable wrench or a pipe wrench.

NOZZLE HOUSING BEARING CUP REMOVAL
Before removal of the bearing cups, the bevel gear (618) should be removed. Insert tool # T-1 thru the bearing cup on the bevel gear side of the nozzle housing at a slight angle. Then line up the stepped side of T-1 with the bottom end of the cup. Using an arbor press, support the nozzle housing and press out cup. Insert tool # T-1 and remove remaining bearing cup.

GEARBOX COVER (602) REMOVAL
Invert machine so that the gearbox cover (602) is facing up. Remove the 2 gearbox cover screws (646) and lockwashers (647). Insert a stiff blade putty knife between the gearbox (601) and gearbox cover (602); tap on the end with a small hammer, then pry up on gearbox cover until the o-ring (644) is visible. Slowly lift the gearbox cover while holding the idler shaft (615) which may be lifted with the gearbox cover due to suction of the lower idler shaft bearing (628).

If the idler shaft is pulled out with the gearbox cover, the idler gearsets may disengage from the rest of the geartrain. If this occurs, simply remove the loose gearsets after the oil has been drained from the gearbox (601). When draining oil, be careful not to lose the 2 carbide thrust washers (623-W).

√ visually inspect the gearbox cover o-ring (644) for swelling or cracking.

√ inspect the idler shaft lower bearing (628) and the final shaft lower bearing (630) for wear on the flange surface thickness and the I.D.

√ inspect the rotor shaft thrust bearing (626-A) for wear on the flange surface. If the flange thickness has worn down 50% to 1/32”, then it must be replaced. Likewise if the I.D. has worn and the end of the rotor shaft has excessive side to side movement, then replacement is recommended.

REMOVAL OF 626-A, 628 AND 630 BEARINGS
626-A: Using a ¼-28 or ¼-20 tap; insert into I.D. and screw down with tap wrench until bearing is forced up out of gearbox cover bore. Once the tap is bottomed out, use pliers to finish removing 626-A. If the tap does not force the bearing up after bottoming out in the casting bore, change to the next size of tap (5/16-18 or 5/16-24).
628 and 630: Using a 5/16-18 or 5/16-24 tap; insert into I.D. and screw down with tap wrench until bearing is forced up out of gearbox cover bore. Once the tap is bottomed out, use pliers to finish removal. If the tap does not force the bearing up after bottoming out in the gearbox cover casting bore, change to next size of tap (3/8-16 or 3/8-24).

GEARTRAIN REMOVAL
NOTE: the rotor must be removed prior to removal of the geartrain. Remove the rotor shaft assembly (622-A) and the rotor shaft spacer (655). Next, remove the idler gear shaft (615) and the 3 gearsets (623-A, 623 and/or 623-C depending on the gear ratio). The remaining final drive gear shaft assembly (616) and the 2 gearsets (623-A, 623 and/or 623-B depending on the gear ratio) can now be removed. A medium length screwdriver with the tip bent at 90 degrees can assist by prying up on the final shaft bearing retainer (613) while pulling on the final shaft (616) with your fingers. NOTE: Do not use pliers or vise grips to pull on the final drive shaft, as the shaft may be damaged.

- √ inspect the gearsets for wear on the teeth. Replace gearsets when teeth are worn down by approximately 20-25%.

NOTE: The lower idler gearsets (623-A) with the thrust washer and the rotor shaft pinion gear (614-A) will wear faster than the rest of the gearsets due to rotation speed. Compare gearsets to get an idea of the wear on the teeth.

- √ inspect the idler and final shafts for wear; look for obvious grooves or highly polished areas. Replace as necessary.

- √ inspect the gearset bearings by testing them on the idler or final shafts; if there is excessive side to side motion, then replacement of the gearset bearings is recommended.

NOTE: the idler gear bearing is not a replaceable spare part where oilite bearings are concerned (normally lubricated gearboxes only).

- √ inspect the rotor shaft assembly: check the pinion gear (614-A) for wear on the teeth. Inspect the chromium oxide coated surface for wear from the carbide bearings. If there are grooves or cracking evident, the rotor shaft assembly (622-A) may need to be replaced.

FINAL DRIVE GEAR SHAFT DISASSEMBLY
Replacing upper final shaft bearing (629):
Using an arbor press; press the final shaft assembly (616-SA) out of the bore of the final drive gear (624). Support the final drive gear and press on the final shaft. Remove the final shaft bearing retainer (613).

- √ inspect the o-ring (640) for cracks or swelling; replace as necessary.

- √ inspect the final drive bearing (629); the I.D. should spin freely on the larger diameter of the final shaft and pinion (616-SA) with minimum of side to side motion. Replace the bearing if the flange thickness is less than 1/32" or if there is excessive side to side movement of the final shaft.

Remove the final shaft upper bearing (629) and final shaft seal (643-TG), using tool #T-7 from the tool kit. Support final shaft bearing retainer (613) in an arbor press, and press out bearing and seal. The seal will be damaged in the process and should be discarded and replaced. NOTE: some of the older model 613 bearing retainers have a smaller I.D. which do not allow removal of the (629) bearing or the 643-TG seal. Also, some older models may have a (613) sub-assembly which does not have a (629) bearing with a flange to distribute the thrust load. In both of these cases, replace the entire (613) sub-assembly.

GEARBOX DISASSEMBLY
Remove 3 gearbox bolts (650-3) with a 3/8" deep socket. Remove the three lockwashers (652-2). The gearbox (601) can now be removed from the inlet stem (603). If the gearbox (601) does not come off easily, there may be deposits or scale built up between the inlet stem (603) and the gearbox (601). Insert a medium screwdriver between the gearbox and the tee housing (604) to pry the gearbox loose from the inlet stem.

- √ inspect the gearbox stem o-ring (642-3) for cracks or swelling, replace as necessary.

Remove the upper rotor shaft bearing (660-D) or (660-DX) with pliers.

- √ inspect the upper rotor shaft bearing (660-D or 660-DX) for cracks in the carbide insert, or for obvious wear marks. Check the fit of the upper rotor shaft bearing (660-D or 660-DX) over a rotor shaft for proper bearing clearance. Check for wear on the 641-TG spring seal (lubricated gearboxes with 660-DX only) and replace if worn.

- √ inspect the upper idler shaft bearing (627) for excessive side to side play.

Removal of 627 bearing:
Using a 5/16-18 or 5/16-24 tap; insert into I.D. and screw down with tap wrench until bearing is forced up out of the gearbox bore. If the tap does not force the bearing up after bottoming out in the casting bore, change to the next size of tap (3/8-16 or 3/8-24).

Removal of 660-3A, 611-3A and 659-3:
Remove the lower rotor shaft bearing (660-3) and the rotor shaft seal housing (611-3A) from the gearbox by using tool # T-4. With gearbox upright, insert T-4 through bore that housed the upper rotor shaft bearing (660-D or 660-DX), and either strike T-4 with a hammer, or use an arbor press. The seal housing spacer (659-3) protects the rotor shaft seals (641-TG) from being damaged during disassembly.

TEE HOUSING AND INLET STEM
Remove ring gear retaining ring (621) with a small screwdriver. Lift out ring gear (620) and bevel gear (617) with your fingers. The tee housing can now be lifted off of the inlet stem (603).

- √ check the seals (635-TG) to be sure the jacket has not worn down thru to the spring.
- √ examine the bearings (631) for wear. They should be free from cracks, grooves on the O.D and should fit inside a tee housing cup (632) with a minimum of side to side movement.
- √ inspect the inside of the cups (632) for grooves or surface wear marks that could create a sealing problem.
- √ inspect the inlet stem (603) for grooves worn in casting that could prevent proper sealing.

Tee housing Bearing Cup Removal:
Insert tool # T-2 inside of tee housing and line up stepped side of tool with the bottom end of one of the cups. Using an arbor press, support the tee housing and press out cup. Repeat procedure with remaining cup.

ASSEMBLY PROCEDURE

INLET STEM
Stand up inlet stem (603) in inverted position (3 bolt holes facing up). Check to see that the three 5/16-18 bolt holes are free of oil or water. Install upper tee housing bearing (631); be sure to line up tab of bearing in notch of inlet stem so that the bearing flange sits flat on the machined surface of the inlet stem. Carefully install the tee housing seal (635-TG) with the spring facing up towards the 4 ports in the inlet stem. See Photo # 1

In cold temperatures, it is recommended that the seals be heated slightly in warm water, so that they will fit over the inlet stem O.D. easily. It is recommended that bearings and seals always be changed in pairs.

TEE HOUSING
Tee Housing Bearing Cup Installation:
Lubricate cup O.D. with a small amount of food grade gearbox oil. Using tool # T-3 and an arbor press, press cup down into tee housing until the flange is seated flat on the tee housing. Repeat procedure for other cup.

Tee Housing Assembly:
Wipe a small amount of food grade gearbox oil on I.D. of bearing cups. This reduces the initial friction between the seals and cups. Invert tee housing and place over bearing and seal on inlet stem.

Install lower seal, spring facing down towards the ports in the inlet stem. Next, place the lower 631 bearing over the inlet stem with the tab facing up.

Place tee housing bevel gear (617) on bearing. Line up notch on the I.D. of the bevel gear with the tab on the bearing as shown in the photo # 2. Rotate the bevel gear (617) and the bearing (631) until the notch on the bevel gear lines up with the locator mark on the inlet stem. The assembly should match the photo # 2 at this point.

Line up notch of ring gear (see photo # 4) with drive lug on 604 tee housing (see photo # 2). The side of the ring gear with the “Cloud 620” faces down towards the bevel gear. Some of the earlier models do not have “Cloud” or “620” cast into the ring gear, and some have 2 notches for locking the ring gear to the tee housing. All models of ring gears are interchangeable.

Install the ring gear retaining ring (621); place one end into groove in tee housing, then work the ring into the groove and press into place with a small screwdriver. Be sure the retaining ring is completely seated in the tee housing groove.

Place the 3 gearbox bolt o-rings (641-3) into the counterbores of the inlet stem. Lubricate the o-rings and the 1” bore of the inlet stem with gearbox oil. This will prevent twisting of o-rings during assembly.

GEARBOX SUBASSEMBLY
Install a new o-ring (662) on the upper rotor shaft bearing housing (660-U). Place the 660-U into the top end of the gearbox (601). Install a new o-ring (642-3) on the gearbox, using a small amount of oil for lubrication.

NOTE: Flow-thru machines do not have a seal protector (659-3), or a seal retainer 611-3A (which has 2-639 o-rings and 2-641-TG seals).

For Lubricated gearboxes:
Invert the gearbox, and place the seal protector (659-3) into the center bore of the gearbox. Install two (2) new rotor shaft seals (641-TG) and o-rings (639) on the seal retainer (611-3). Lubricate the o-rings and the bore of the gearbox, then place the seal retainer into the gearbox until it is seated against the seal protector.

Installation of Lower Rotor Shaft Bearing (660-L):
Replace o-ring (639), and lubricate with oil. Place lower rotor shaft bearing (660-L) into center bore of gearbox; and line up the flat on the flange with the large bore in the gearbox. This is important to prevent interference with the geartrain. Press down with your fingers until (639) o-ring is seated. Place tool # T-5 with a 12 oz. Hammer or use an arbor press to seat the flange of the lower rotor shaft bearing is against the gearbox bore face.

IMPORTANT NOTE: In order to maintain proper alignment between the upper and lower rotor shaft bearings, the flange of the lower rotor shaft bearing (660-L) must be completely seated against the face of gearbox (601-3) bore.

Inspection of bearing alignment:
Place the T-8 seal protector over the end of the rotor shaft assembly (622-A), and insert the rotor shaft thru the upper (660-U) and lower (660-L) rotor shaft bearings. The rotor shaft should spin freely; if there is resistance, it is probably because the flange of the lower rotor shaft bearing is not completely seated against the gearbox. Reseat the lower rotor shaft bearing (660-L) with the tool # T-5, and test the alignment once again.

ASSEMBLY OF GEARBOX TO INLET STEM
Check to see that the three 5/16-18 bolt holes in the inlet stem (603) are free of oil or water. Invert the gearbox and line up the tab on the gearbox (see photo # 3) with the notch on the bevel gear (617). Once the tab and notch are engaged, the gearbox can be rotated if necessary to line up the bolt holes. If the bevel gear (617) is aligned properly with the locator mark on the inlet stem, the gearbox bolt holes will be lined up with the inlet stem bolt holes. Refer to photo # 2. Apply a small amount of anti-seize compound to the threads of the bolts. Install the 3 gearbox bolts with lockwashers. Hand tighten bolts, then torque to 30ft/lbs for Stainless Steel, 23 ft/lbs for Bronze. If you do not have a torque wrench, tighten the bolts until snug. Do not overtighten.

GEARTRAIN SUBASSEMBLY
Final Drive Gear Shaft Subassembly:

1. Install the final shaft seal (643-TG) into the final shaft bearing retainer (613-S) with the spring facing upwards. Using an arbor press, press the final shaft upper bearing (629) into the final shaft bearing retainer (613-S). NOTE: the flow-thru type gearbox does not use the final shaft seal (643-TG).

2. Align the square drive of the final drive shaft (616) with the square of the final drive gear (624). Press the drive gear onto the shaft using an arbor press.

3. Install a new o-ring (640-3) on the final shaft bearing retainer.

4. Install the two gearsets on the shaft according to the type of gear ratio. Refer to photos # 5, 6, and 7. Be certain that the (623-A) gearset with the undercut for the thrust washer (623-W) is on the bottom end of the shaft, facing the gearbox cover (602).

Idler Gear Shaft Subassembly:
Place the 3 gearsets on the idler shaft (615) in the proper order according to the type of gear ratio. Refer to photos # 5, 6, and 7. Be certain that the (623-A) gearset with the undercut for the thrust washer (623-W) is on the bottom end of the shaft, facing the gearbox cover (602).

INSTALLATION OF GEARTRAIN INTO GEARBOX
Lubricate the (640) o-ring with gearbox oil. Place the final drive gear shaft subassembly (616-SA) into the gearbox and seat the shaft by pressing down on the gearsets. Hold the idler gear shaft subassembly (615) in your right hand and place into the gearbox next to the idler shaft upper bearing (627). With your left hand holding the idler shaft, move the subassembly over until the idler shaft (615) drops into the idler shaft upper bearing (627). Rotate the gearsets with the right hand to assist in meshing with the gearsets on the final shaft (616). Press down on the idler shaft to be certain that it is seated (see Photo # 8). Place the 2 thrust washers (623-W) with the lapped side facing up (towards the gearbox cover bearings). NOTE: the thrust washers (623-W) are lapped on one side only.

Place the rotor shaft spacer (655) on the rotor shaft (622-A). Place tool # T-8 seal protector on the rotor shaft end.

This tool protects the rotor shaft seals from damage during installation of rotor shaft. Push rotor shaft thru lower rotor shaft bearing until pinion gear engages with 623-A gearset. Remove the T-8 seal protector from the rotor shaft. Rotate the rotor shaft to be certain that all of the gears are properly engaged, and the rotor shaft bearings are aligned. *NOTE: Flow-thru machines do not have rotor shaft seals and therefore you do not need to use tool # T-8 seal protector when installing the rotor shaft assembly.*

GEARBOX LUBRICATION
Fill the gearbox with oil. The oil level should just cover the (623-A) gearset on the final shaft (616) as shown in photo # 8.

All Lubricated machines are supplied with the following type of oil:

OIL TYPE: Food Grade U.S.D.A Acceptable H-1
QTY: 14 oz. (414 ml.) S.A.E.-90

Note: Flow-thru machines do not have oil in the gearbox, they are lubricated by the cleaning solution.

OIL ALTERNATIVES:
For non-food industry applications, H-2 lubricants can be used such as Keystone Keygear 90, KLC-20/50 or KSL-365. Lightweight gear oils SAE 50-90 are also suitable. It should be noted that heavy weight (140) gear oils or greases will alter the performance of the machine regarding cycle times.

GEARBOX COVER ASSEMBLY
Use tool # T-6 to press the rotor shaft thrust bearing (626-A) into the center bore of the gearbox cover (602). Use tool # T-5 to press the idler shaft lower bearing (628) and the final shaft lower bearing (630) into their respective bores (refer to exploded view). Install a new o-ring (644) with lubricant.

GEARBOX COVER INSTALLATION
Lubricate the bore of the gearbox and the gearbox cover o-ring with gearbox oil. Align the gearbox cover with the shafts (# 615, 616, 622) and the dowel pin hole in the gearbox. Press down until o-ring is seated. Install split washers (647) and gearbox cover screws (646). Torque screws to 100 in/lbs for Stainless Steel and 80 in/lbs for Bronze. Do not overtighten.

ROTOR INSTALLATION
Turn machine right side up. Place rotor (610) on rotor shaft (622). Install lockwasher (647) and rotor nut (654). Tighten the nut while holding pressure against the rotor with a medium sized screwdriver wedged between the inlet stem and the rotor or use needle nose pliers to hold a fin on the rotor. Torque the rotor nut to 100 in/lbs for Stainless Steel and 80 in/lbs for Bronze. Be certain the rotor nut is tight, and that the rotor shaft is not rotating while tightening the nut. Rotate the rotor (610) with your finger or a small screwdriver. The rotor should rotate freely and the tee housing should begin to move slowly.

NOZZLE HOUSING SUBASSEMBLY
Bearing Cup Installation:
Lubricate cup O.D. with a small amount of food grade gearbox oil. Using tool # T-3 and an arbor press, press cup down into nozzle housing until the flange is seated flat on the nozzle housing. Repeat procedure for other cup.

Bevel Gear Installation:
Clutch Drive: Wipe a small amount of gearbox oil into the groove of the nozzle housing (605). Install a new o-ring (637). Place the nozzle housing bevel (618) on the nozzle housing. Install the bevel gear retaining ring (619) with a small screwdriver, be sure the retaining ring is completely seated in the groove of the nozzle housing.

Pin Drive: Place the bevel gear dowel pin (661) into the hole in the nozzle housing. Install a new o-ring (637). Line up the slot on the bevel gear with the pin, then install the bevel gear retaining (619) with a small screwdriver, be sure the retaining ring is completely seated in the groove of the nozzle housing.

Nozzles and Stream Straighteners: Tap stream straightener into nozzle with plastic faced hammer. Place a small amount of anti-seize compound or Teflon tape on the threads and the radius on the end of the nozzle. Insert the nozzle (607) into nozzle housing (605) and tighten with open end wrench or adjustable wrench.

ASSEMBLY-NOZZLE HOUSING TO TEE HOUSING

1. Place one of the nozzle housing bearings (633) over the nose of the tee housing (604), align the locator marks □ on the tee housing casting and the back of the bearing (refer to photo #'s 9 & 10). This will allow the bearing to fit flush against the tee housing. Rotate the bearing slightly and it will lock into place against the ridge cast into the tee housing.

2. Install one of the nozzle housing seals (636-TG), the spring side facing outward towards the ports in the tee housing.

3. Wipe a small amount of gearbox oil on the I.D. of the bearing cups (634) in the nozzle housing (605). This reduces the initial friction between the seals and cups.

4. Place the nozzle housing assembly (605) over the seal and bearing on the tee housing.

NAMEPLATE, BEARING & SEAL INSTALLATION

1. Install the outer seal (636-TG), with the spring facing inward toward the ports in the tee housing.

2. Align the locator mark □ on the nozzle housing bearing (633) with the dot on the nameplate (606). See Photo # 10. Push the bearing into the nameplate so that the flange of the bearing is seated against the nameplate. Install the nameplate and bearing onto the tee housing nose, check that the name is right side up.

3. Install the nameplate screws (648) and the lockwashers (647). Torque screws to 100 in/lbs for Stainless Steel and 80 in/lbs for Bronze. Do not overtighten.

FINAL INSPECTION

1. Check for end play (in and out) of nozzle housing on the axis of the tee housing nose. There should be some free play.

2. Check end play (up and down) of tee housing.

3. Rotate the rotor with your finger or a small screwdriver. The rotor should rotate freely and the tee housing should begin to move slowly.

NOTE: If you get negative results on any of these final inspections then refer to the trouble shooting guide that begins on page 11.

STATOR INSTALLATION
Place the stator (609) into the inlet stem (603) by rotating slightly until the weld on the I.D. of the inlet stem is in between 2 of the fins of the stator. The weld on the inlet stem keeps the stator from rotating. The stator retaining ring (645-3) can now be installed using a pair of needle nose pliers.

TECHNICAL SPECIFICATIONS

Casting Material: 316L Stainless Steel

Weight:

Stainless:	Dual Nozzle	25 lbs.	11.35 kg.
	Triple Nozzle	26 lbs.	11.80 kg.

Height: 12 ¼ in 31.12 cm

Minimum Tank Opening (Inside Diameter):

Dual Nozzle	6 ¼ in.	15.88 cm.
Triple Nozzle	10 ¼ in.	26.04 cm.

Inlet Connection:
ID= 2" NPT, Female Threads, 11.5 tpi
OD= 2 ½" Quick Disconnect Coupling
Cam Locking Type
OR
2 ½" NH, Male Threads, 7.5 tpi

Rotor Shaft: Stainless Steel substrate is plasma flame sprayed with Chromium Oxide, then ground to finish dimension. The final product is a hard, dense surface that is resistant to abrasive wear, high temperatures and chemical corrosion. The smooth surface also lends itself to sealing with rotary seals. The thrust imparted on the rotor shaft is distributed by a tungsten carbide thrust washer fastened to the rotor shaft pinion gear. Carbide is an excellent wear material and has very high corrosion resistance.

Main Bearings: The main bearings that support the rotation of the Tee Housing and Nozzle Housing are composed of a carbon fiber reinforced thermoplastic material, with 15% PTFE for lubricant. These bearings have an extremely low coefficient of thermal expansion, and both a low water absorption and wear factor. Ball bearings have been eliminated by the use of this bearing material.

Operating pressure / gpm range:

40 – 350 psi	2.81 – 24.61 kg /cm
30 – 300 gpm	1.89 – 18.92 ltr / sec

Temerature Range: up to 250 F (121 C)

Seals: Static seals (o-rings) are compounded for extended use in various tank cleaning applications. Several different types of o-rings are available to suit specific tank cleaning environments. Dynamic seals (which seal rotating parts) are specially designed spring or pressure seals. The jacket material is a Teflon alloy which increases wear life and corrosion resistance.

Geartrain: The internal gearbox reduction is achieved using a spur gear system, and is available in two gear ratios: 655: 1 and 273: 1. Switching from one ratio to the other is achieved by simply changing 2 of the 5 interchangeable stainless steel gearsets available.

Geartrain Lubrication: Two types of lubrication are available; sealed gearbox with food grade gear oil or flow-thru gearbox; where the cleaning solution lubricates the gears. Gearbox Qty = 14oz. (414 ml.) SAE 90. See preventative maintenance, page 2 for specific types of oil.

Nozzle Housing Drive: Pin drive or clutch drive is available. Pin drive is recommended for CIP applications, while the clutch drive is recommended for portable use, where the machine will be handled often.

CIP Applications: Several self cleaning features are built into all machines; rinsing of the bevel gears and ring gear assist in preventing a buildup of debris that could interfere with operating efficiency. CIP models can also be equipped with the optional self rinse nozzle which washes the exterior surfaces of the machine while it is operating. Additional passages allow high pressure rinsing of internal areas of the machine where deposits of solids could allow bacterial growth. Drainage holes can be provided for complete drainage of cleaning solution.

Nozzle Sizes: Nozzles are available in the following sizes:

¼ in.	6.35 mm.
9/32 in.	7.14 mm.
5/16 in.	7.94 mm.
3/8 in.	9.53 mm.
7/16 in.	7.94 mm.
½ in.	12.70 mm.
9/16 in.	14.29 mm.
5/8 in.	15.58 mm.

TROUBLE SHOOTING GUIDE

This section lists common problems that may be encountered during the operation of the Model 360 tank cleaning machine. Many problems – such as slow cycle times or if the nozzle housing does not rotate – are easy to solve. Proper operating environment and preventative maintenance can prevent many problems. The following sections describe problems that you might encounter and provides diagnostic instructions and possible solutions. A brief explanation of the problem & solution is followed by directions of where to look in the Operation & Maintenance Manual for further assistance or explanation. It is suggested that you have the exploded view available for reference when trouble shooting.

MAIN HOUSING BEARINGS

EXCESSIVE BEARING WEAR: Visually inspect the bearing for cracks or signs of corrosion. Check the bearing clearance between the I.D. of the cup (631 & 633) and the O.D. of the bearing. The normal clearance between the cup and bearing are held to close tolerances to allow for bearing wear, and to maintain the proper backlash of the bevel gears (617 & 618). If the bearings show signs of wear from deposits, sediment or other foreign matter, or have excessive side to side movement in the bearing cup, replacement is recommended. Refer to Disassembly Procedure – pages 3-5 and Assembly Procedure – pages 5 & 8 as necessary.

GEARBOX BEARINGS

EXCESSIVE BEARING WEAR: If there is excessive side to side play of one of the gear shafts (615, 616 or 622-SA) and one of the mating bearings (626-A, 627, 628, 629, 630) then replacement is recommended. Refer to Disassembly Procedure pages 4-5: Gearbox Cover Removal, Geartrain Removal, Final Drive Gear Shaft Disassembly and Gearbox Disassembly. NOTE: While it may appear that the gearbox bearings are standard off-the-shelf bearings, they have all been modified by the manufacturer to meet the design specifications set forth by the manufacturer. Replacement of these bearings by any type other than the O.E.M parts can compromise the performance of the machine. Refer to page 7 – Gearbox Cover Sub-Assembly for installation procedures.

POOR CLEANING PERFORMANCE

WATER PRESSURE & FLOW: Is there sufficient pump pressure or water flow at the tank cleaner? Minimum operating pressure is 30-40 psi measured at the inlet of the machine. Minimum pipe or hose diameter is 1 ½" I.D. Check to see that the pump is not cavitating or that the pump seals have not failed.

NOZZLE HOUSING ROTATES SLOW OR NOT AT ALL: Upon inspection of the nozzle housing bearings (633), is there a buildup of deposits, sand or scale? Inspect the seals (636-TG) for signs of wear. If they are worn out, they will allow particles in the cleaning solution in between the cups and bearings, which may alter the performance of the machine. Replace bearings, cups and seals as necessary. Often times, a thorough cleaning of the machine will eliminate slow rotation problems. The nozzle housing cups, bearings and seals can be used as a gage for the condition of the tee housing cups, bearings and seals. If the nozzle housing cups, bearings and seals need replacement or cleaning , it follows that the tee housing cups, bearings and seals will also need the same. Refer to pages 3-5 of Disassembly Procedure and pages 5-8 of Assembly Procedure.

ERRATIC ROTATION OF NOZZLE HOUSING:
If you are able to observe the machine in operation and notice the nozzle housing rotating, then stopping briefly, then rotating again, this could be symptoms of the following:

- Clutch o-ring is worn or corroded and is not seating completely against the nozzle housing bevel gear. Replace as necessary, refer to page 8 of Assembly Procedure.

- Damaged bevel gears (617 & 618): inspect the bevel gears for bent or excessively worn teeth. If the teeth are worn down approximately 25%, or if one or more teeth are bent, then the bevel gear(s) should be replaced. Refer to page 5 – Tee housing and page – 8 Nozzle Housing Sub-Assembly.

CLUTCH O-RING: Inspect the clutch o-ring (637) condition. Remove the nozzle housing and disassemble as described on page 4 of the Disassembly Procedure. If the clutch o-ring is cracked, or if corrosion has shrunken it in size and it is not filling the o-ring groove on the nozzle housing completely, then replacement is recommended. Refer to page 8 – Nozzle Housing Sub-Assembly.

NOZZLES CLOGGED: Inspect the nozzles for obstructions by solid particles trapped in the stream straighteners (608). Unscrew the nozzles and remove the particles as necessary. Use anti-seize compound or Teflon tape on nozzle threads prior to re-assembly.

MACHINE CONFIGURATION & CYCLE TIME:
Verify that the rotor / stator combination, nozzle size & gear ratio are configured properly for the type of cleaning required. Heavy deposits (paint, polymers, scale, etc.) require more dwell time from the nozzle streams (slower RPM's) to be effective. Conversely, some cleaning applications only require a rinse of the tank, and therefore a faster moving nozzle stream can be more effective. Refer to performance data sheets for flow rates, cycle times and the related machine configurations. Contact your local distributor or representative for further recommendations.

CLEANING SOLUTION COMPOSITION & TEMERATURE:
Check to see that the proper concentration and type of chemicals is being used for the material being cleaned, and that the solution is heated to the proper temerature.

TEE HOUSING:
SLOW ROTATION OR DOES NOT ROTATE

WATER PRESSURE & FLOW: Check supply pressure as described in Poor Cleaning Performance, on page 11.

LOOSE ROTOR NUT:
Check to see that the rotor retaining nut (654) is properly tightened on the rotor shaft. If the rotor nut is loose, the rotor may be rotating on the shaft, instead of rotating the rotor shaft through the geartrain. Tighten the rotor nut as described in the Rotor Installation page 8. Torque setting should be 80 in/lbs for bronze & 100 in/lbs for stainless steel.

ROTOR SHAFT DIFFICULT TO TURN:

- Misalignment of the carbide rotor shaft bearings (660-L & 660-U) as described on page 6: Gearbox Sub-Assembly can prevent smooth rotation of the rotor shaft bearing with Tool # T-5, then check the alignment once again.

- Foreign material jammed in geartrain. Remove gearbox cover (602) for inspection. Refer to Disassembly Procedure page 4. Remove foreign material, reassemble geartrain (page 6) and install gearbox cover (602) as described on page 7.

ROTOR SHAFT TURNS, BUT THE TEE HOUSING DOES NOT: This is an indication of possible geartrain malfunction. If the rotor shaft pinion gear or any of the gearsets (623) are worn out, then the tee housing will not rotate. Remove gearbox cover (602) for inspection, replace worn gears as necessary. Refer to Disassembly Procedure page 4-5, and Assembly Procedure pages 7 & 8.

DEPOSITS, SCALE, FOREIGN MATERIAL IN THE TEE HOUSING BEARINGS:

- Inspect the seals (635-TG) for signs of wear. If they are worn out, they will allow particles in the cleaning solution in between the cups and bearings, which will alter the performance of the machine. Replace bearings, cups and seals as necessary. Often, a thorough cleaning of the machine will eliminate slow rotation problems.

- Install an inline strainer between the pump and the machine to filter out sediment in the cleaning solution.

ERRATIC ROTATION OF TEE HOUSING:
If you are able to observe the machine in operation and notice the tee housing rotating, then stopping briefly, then rotating again, this could be due to improperly installed ring gear. The ring gear notch (see photo # 4, page 7) must be locked into the tee housing tab (photo # 3, page 7), in order to rotate the tee housing. With some of the models of ring gears, it is possible to install the ring gear into the tee housing without having the notch and tab lined up. The ring gear can then rotate within the tee housing, instead of rotating the tee housing. Refer to page 6 of the Assembly Procedure for ring gear installation.

CLOGGED STATOR OR ROTOR:
Remove stator retaining ring (645-3) and lift out stator (609). Remove any foreign objects from the stator or rotor that could be altering the normal flow of cleaning solution. Refer to page 3 of the Disassembly Procedure.

EXCESSIVE WATER LEAKAGE:
NOTE: In the CIP version of the Model 360 tank cleaners, some water leakage at the gap between the tee housing & gearbox and at the gap between the nozzle housing & tee housing is normal. There are two small holes in the tee housing that rinse the bevel gears, ring gear and the inside of several of the castings to prevent a buildup of deposits or sediment that could promote bacteriological growth.

WORN TEE HOUSING SEALS:
If the Model 360 is allowed to operate for a prolonged period of time after the seals have worn out, sediments and foreign particles will lodge between the inlet stem and the tee housing bearings and cups and cause abrasive wear on these parts. Corrosive chemicals can also have an affect on the sealing effectiveness; they can cause corrosion of the cups or castings. If the grooves or corrosion is severe, even new seals will not seal completely due to the uneven sealing surface.

Excessive water leakage at the top and bottom of the tee housing indicates a sealing problem which can be caused by:

- Seals worn out; no longer functioning properly. Replace worn seals, refer to page 5 of Assembly Procedure.

- Seals improperly installed. The spring side of the seal (the open section of the seal) faces the ports on the inlet stem. As the cleaning solution comes in contact with the seal, it spreads it apart so that contact is made against the tee housing bearing cup and the O.D. of the inlet stem. Refer to photo # 1 in the Assembly Procedure section.

- Inlet Stem (603) casting or tee housing cups (632) have wear grooves which prevent the seals from sealing. Replace the cups as outlined in Disassembly Procedure page 5 and Assembly Procedure also on page 5. Reassemble the machine and then check for excessive leakage. If there is still excessive leakage after installing new cups and seals, the inlet stem may have to be replaced.

WORN NOZZLE HOUSING SEALS:
If the Model 360 is allowed to operate for a prolonged period of time after the seals have worn out, sediments and foreign particles will lodge between the tee housing nose and the nozzle housing bearings and cups and cause abrasive wear on these parts. Corrosive chemicals can also have an affect on the sealing effectiveness; they can cause corrosion of the cups or castings. If the grooves or corrosion is severe, even new seals will not seal completely due to the uneven sealing surface.

Excessive water leakage around the nozzle housing indicates a sealing problem which can be caused by:

- Seals worn out; no longer functioning properly. Replace worn seals, refer to page 8 of Assembly Procedure.

- Seals improperly installed. The spring side of the seal (the open section of the seal) faces the ports on the nose of the tee housing. As the cleaning solution comes in contact with the seal, it spreads it apart so that contact is made against the nozzle housing bearing cup and the O.D. of the nose of the tee housing.

- Tee housing (604) or nozzle housing cups (632) has wear grooves which prevent the seals from sealing. Replace the cups as outlined in Disassembly Procedure page 3 and Assembly Procedure also on page 8. Reassemble the machine and then check for excessive leakage. If there is still excessive leakage after installing new cups and seals, the tee housing may have to be replaced.

NO FREE PLAY:

NOZZLE HOUSING FREE PLAY:
If there is no free play (in and out movement) of the nozzle housing (605) on the axis of the tee housing (604) check one of the following:

- Scale or deposit buildup between nozzle housing cups (634) and bearings (633). Remove the nozzle housing assembly (605) from the tee housing (604) as described in the Disassembly Procedure page 3. Inspect the bearings (633) and cups (634) for deposits and / or scale buildup. Remove the scale or deposit buildup from the cups and bearings. Inspect the nozzle housing seals (636-TG) for wear, replace as necessary, then reassemble the nozzle housing to the tee housing. Refer to Assembly Procedure page 8; Assembly - Nozzle Housing to Tee Housing. Inspect once again for free play. *NOTE: If the nozzle housing cups (634) and bearings (633) are in need of cleaning or replacement, then it follows that the tee housing bearings (631) and cups (632) will also need the same.*

- Improperly assembled: remove the nozzle housing assembly (605) from the tee housing (604) as described in the Disassembly Procedure page 3. Inspect the nozzle housing bearing (633) that is seated against the tee housing. Refer to Assembly Procedure page 8; Assembly – Nozzle Housing to Tee Housing.

TEE HOUSING FREE PLAY:
If there is no free play (up and down movement) of the tee housing (604) check one of the following:

- Scale or deposit buildup between tee housing cups (632) and bearings (631). Inspect the nozzle housing bearings and cups as described above for deposits and / or scale buildup. If the nozzle housing bearings and cups are in need of cleaning or replacement, the tee housing bearings (631) and cups (632) will also need the same. Dismantle the machine and remove the scale or deposit buildup from the cups and bearings. Inspect the tee housing seals (635-TG) for wear, replace if necessary. Reassemble the machine as described in Assembly Procedure page 5; test for free play once again.

- Improperly assembled: dismantle machine and note whether the ring gear (620) or bevel gear (617) are properly assembled in the tee housing. Remove the tee housing (604) from the inlet stem (603), inspect to see that the upper (631) bearing flange is seated flush against the inlet stem. Reassemble the machine as described in the Assembly Procedure on page 5.

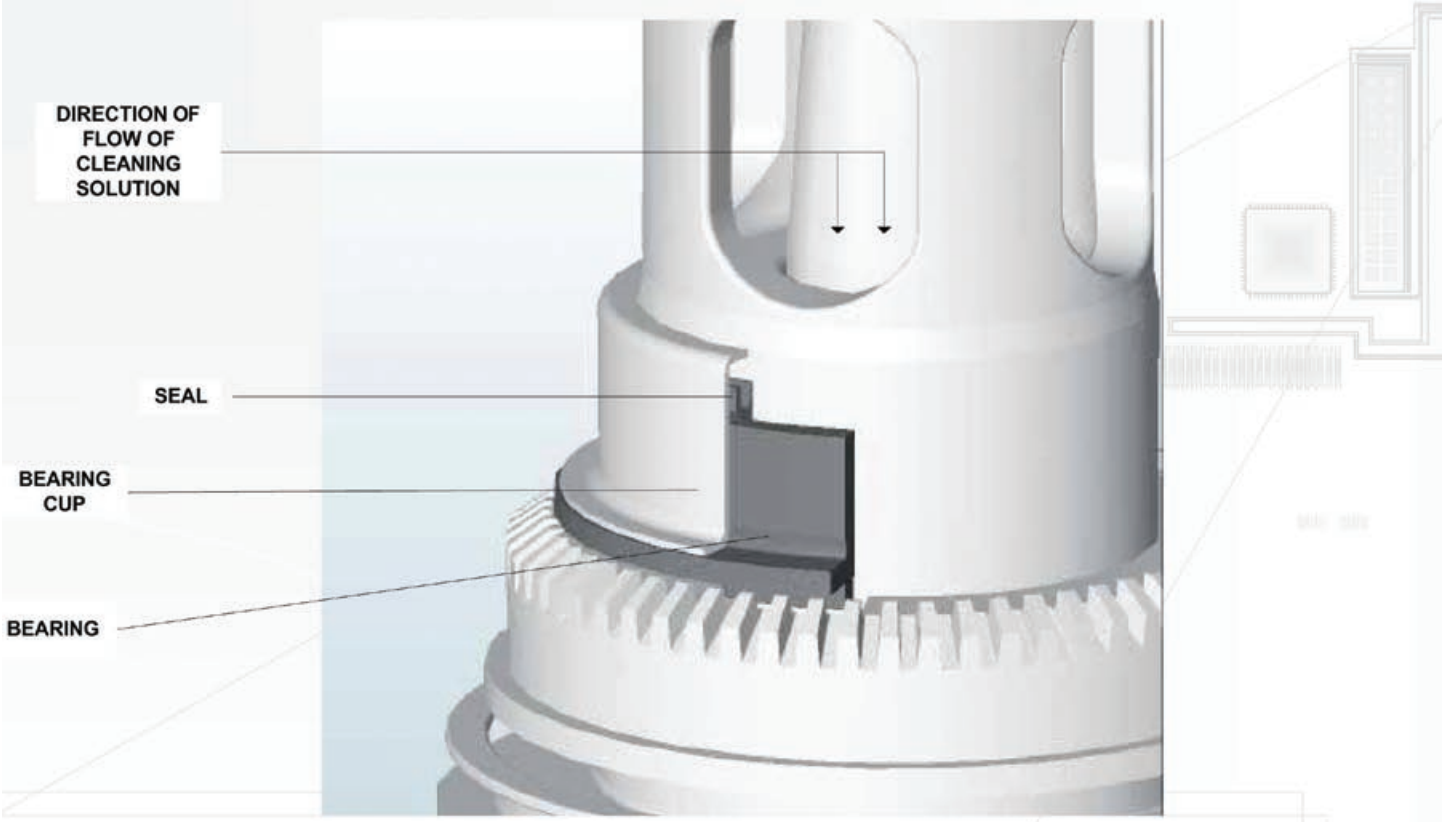


Photo 1
CUTAWAY VIEW OF SEALS, CUPS, BEARING

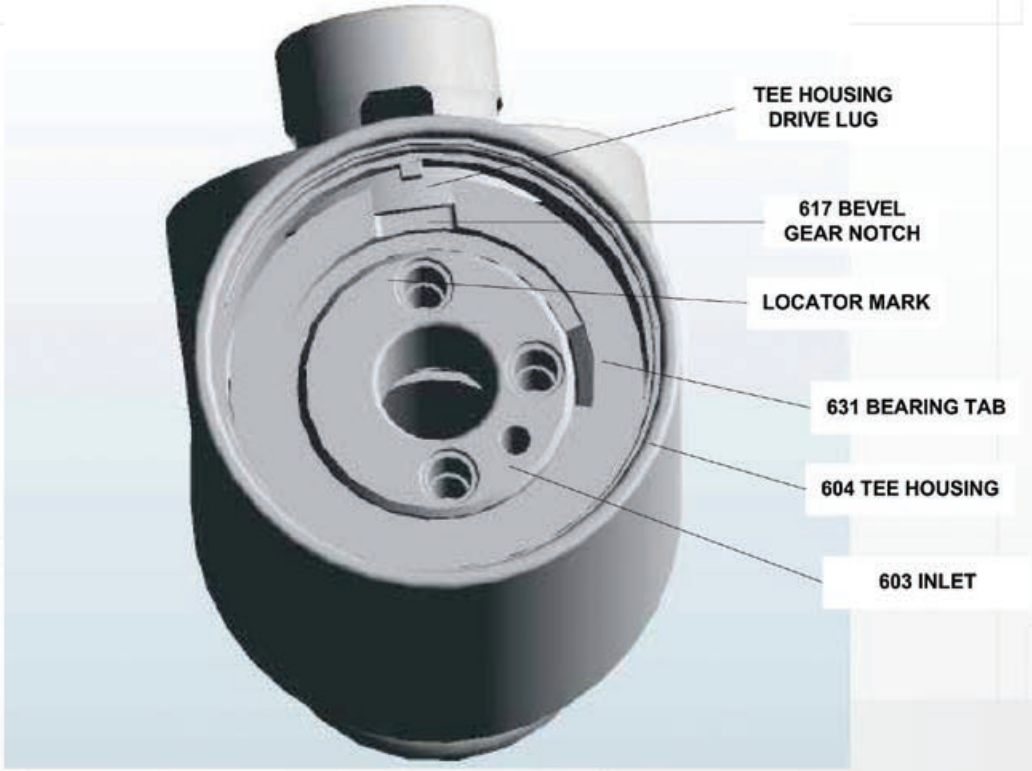


Photo 2
TEE HOUSING ASSEMBLY

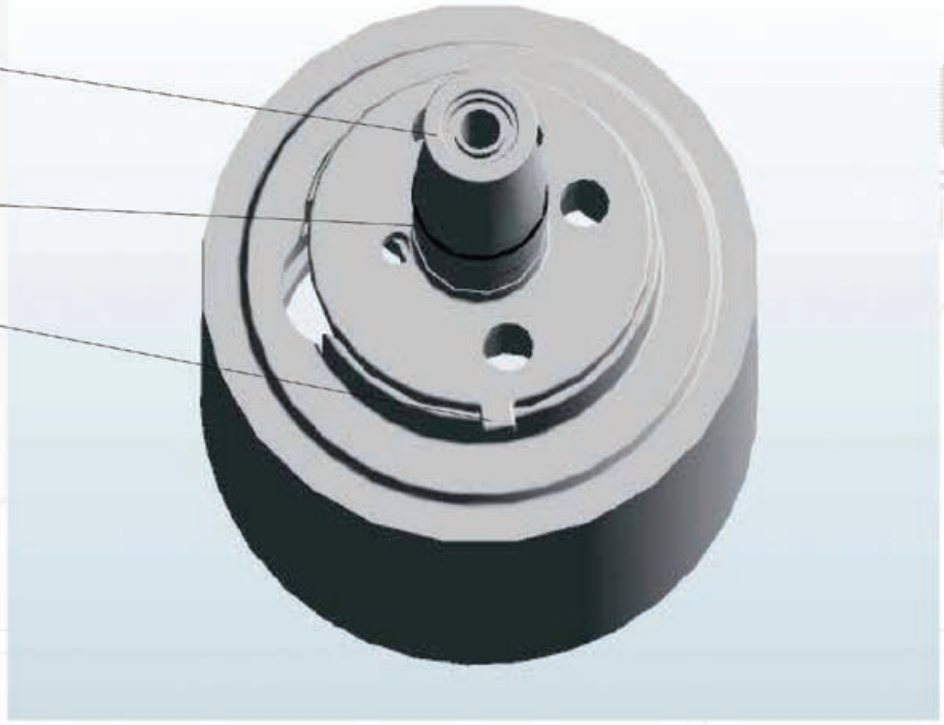


Photo 3
GEARBOX

Photo 4
RING GEAR

Photo 5
GEARSETS

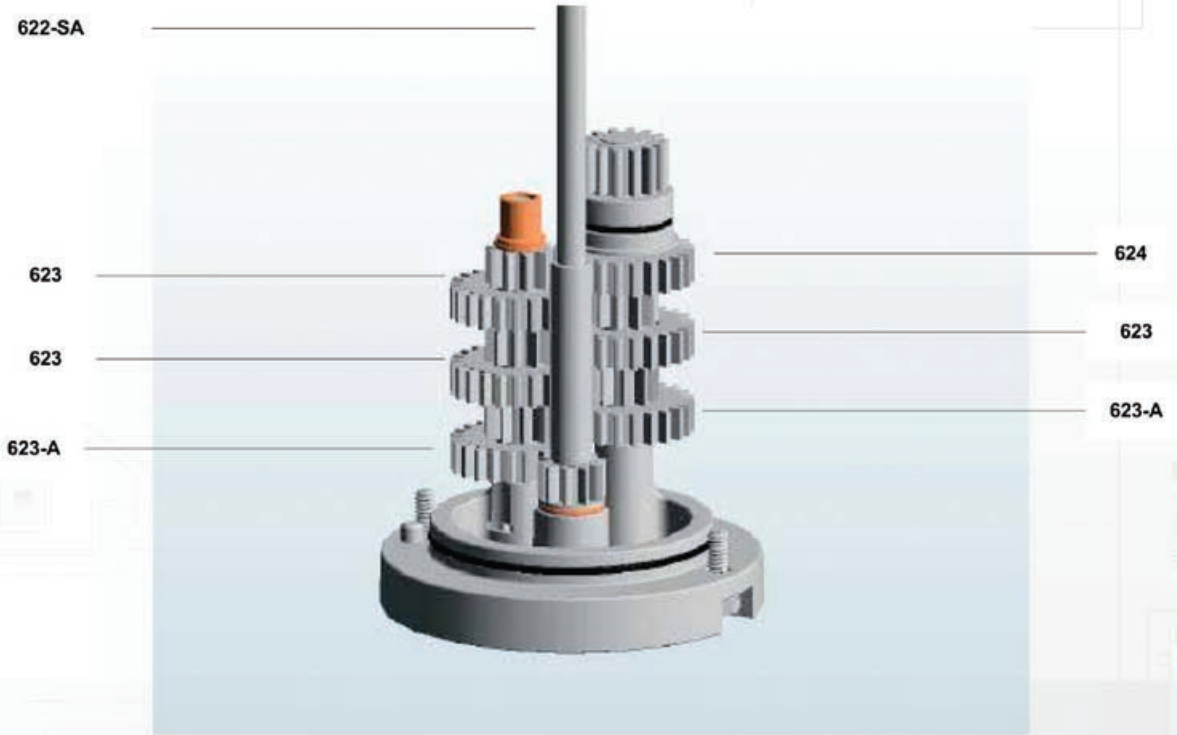


Photo 6
655:1 GEAR RATIO

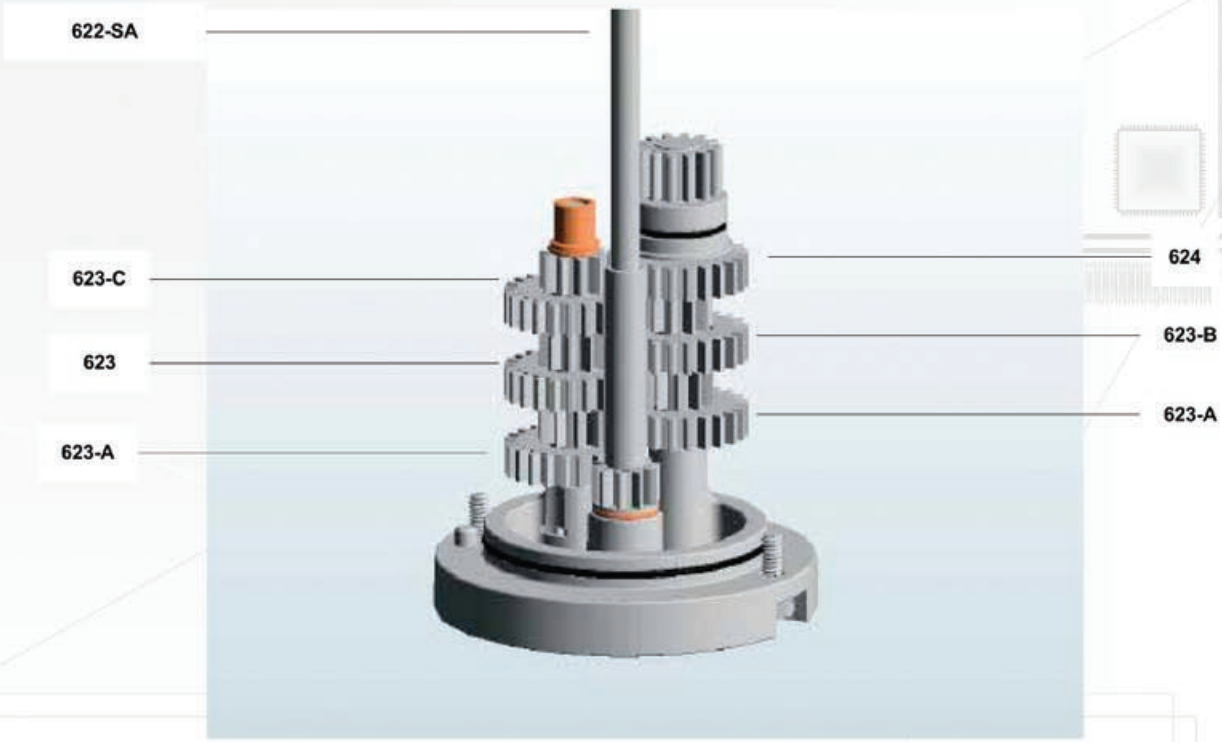


Photo 7
273:1 GEAR RATIO

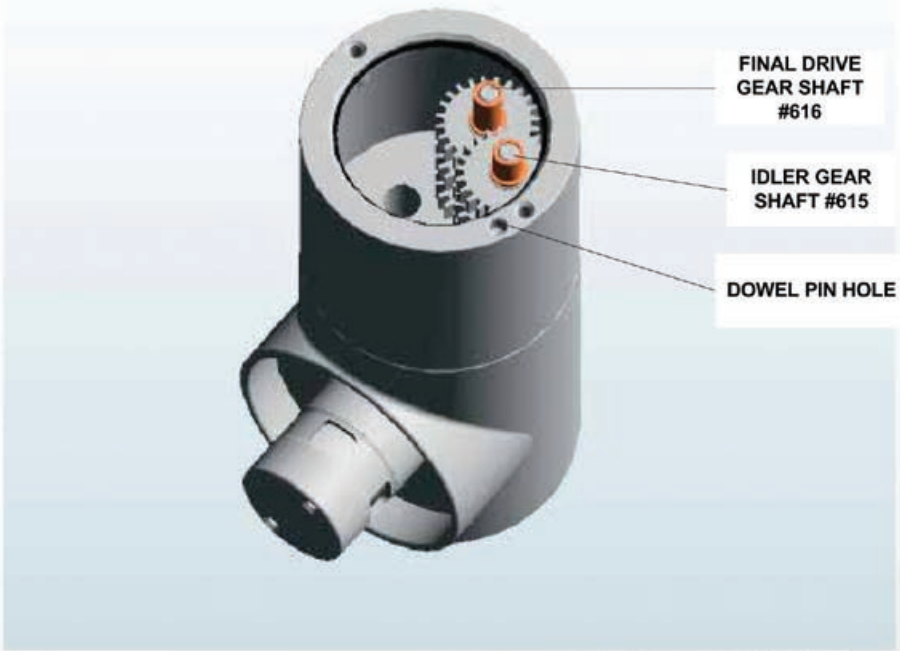


Photo 8
SEATING GEAR SHAFTS

Photo 9
BEARING LOCATOR MARK

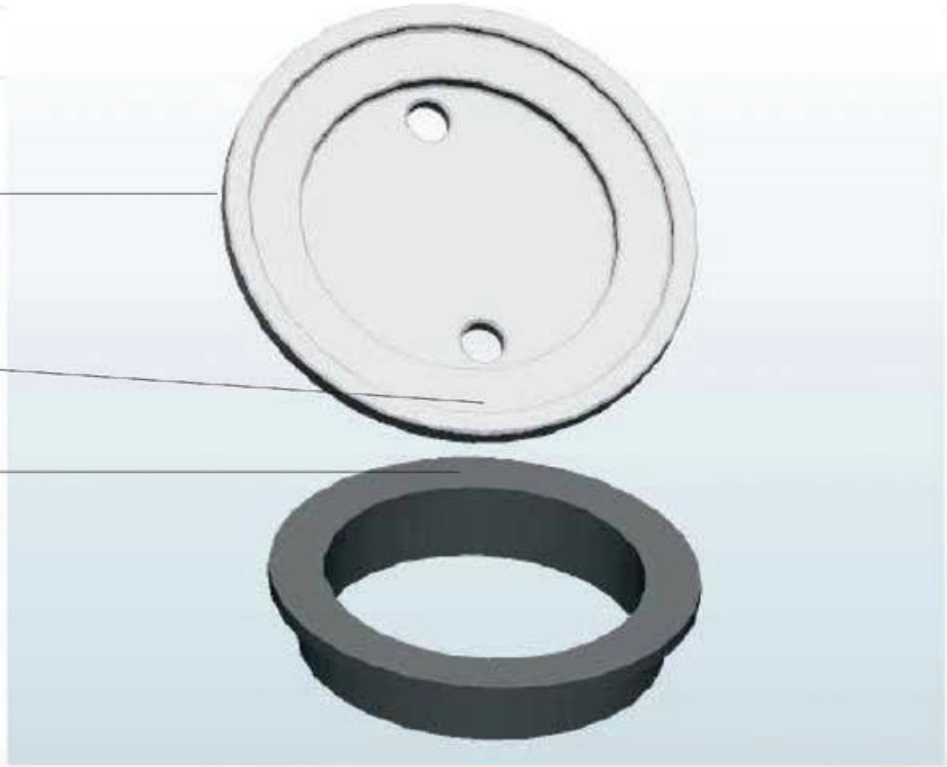
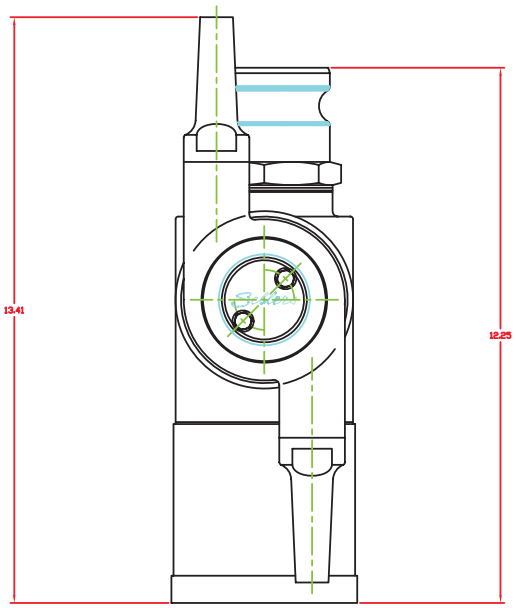
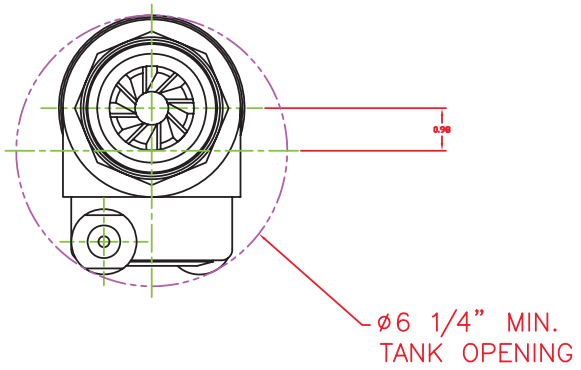


Photo 10
BEARING LOCATOR MARK ALIGNMENT





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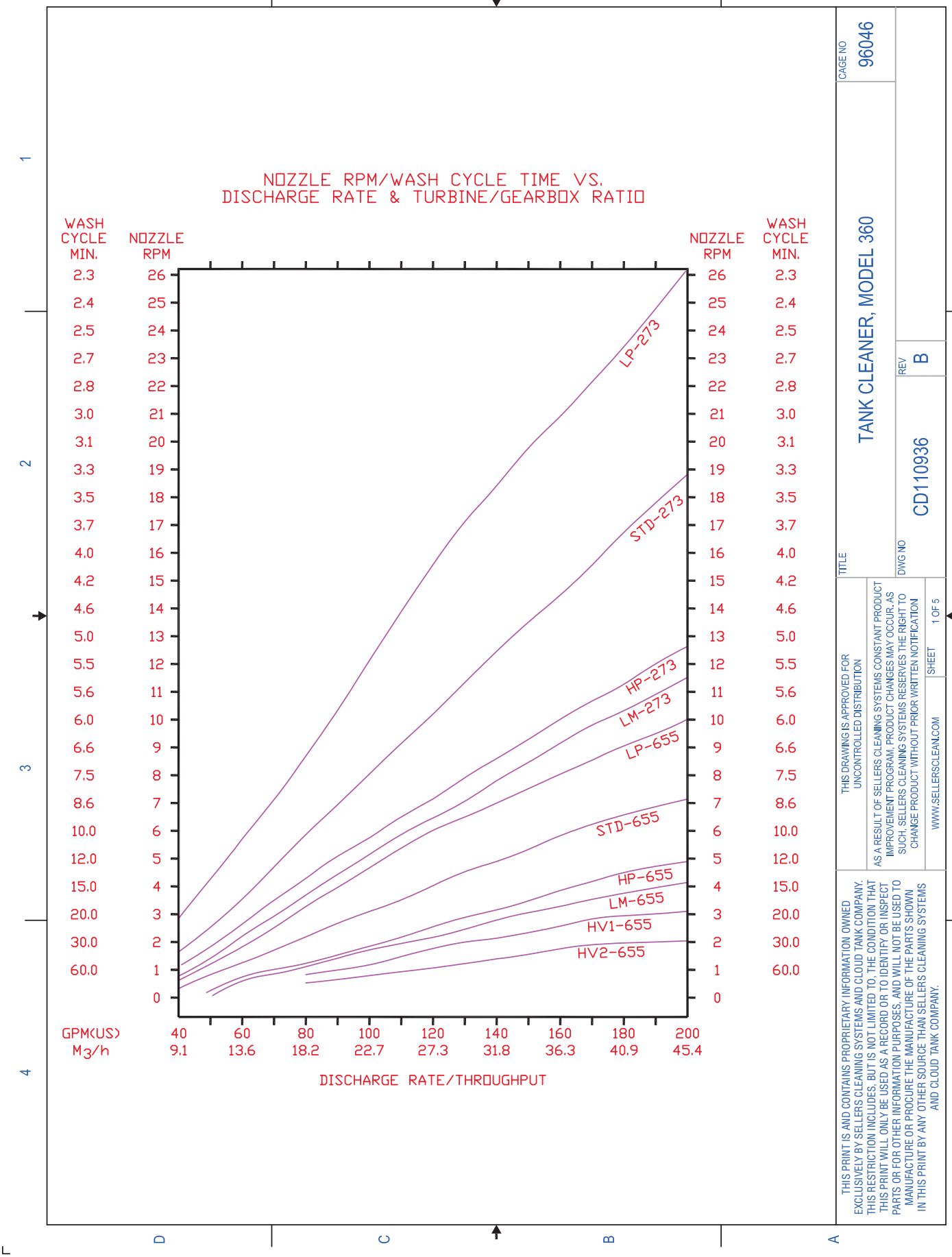
TITLE	CAGE NO
Sellers 360 w/Dual Nozzles Tank Opening	96046
DWG NO: CD110936	REV: C



CAGE NO 96046

TANK CLEANER, MODEL 360

DWG NO CD110936

REV B

TITLE

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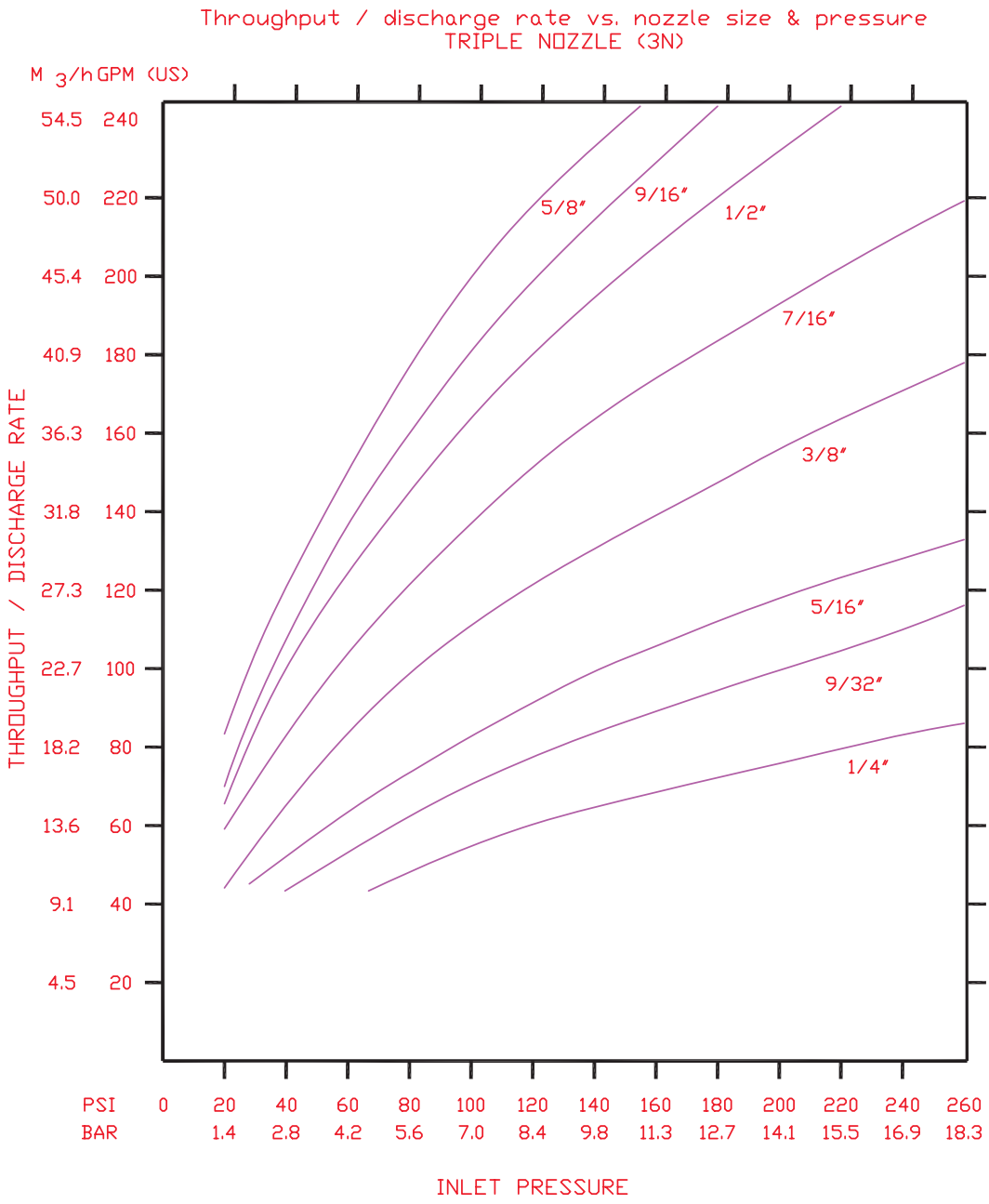

CAGE NO 96046

TITLE TANK CLEANER, 3 NZL, MODEL 360

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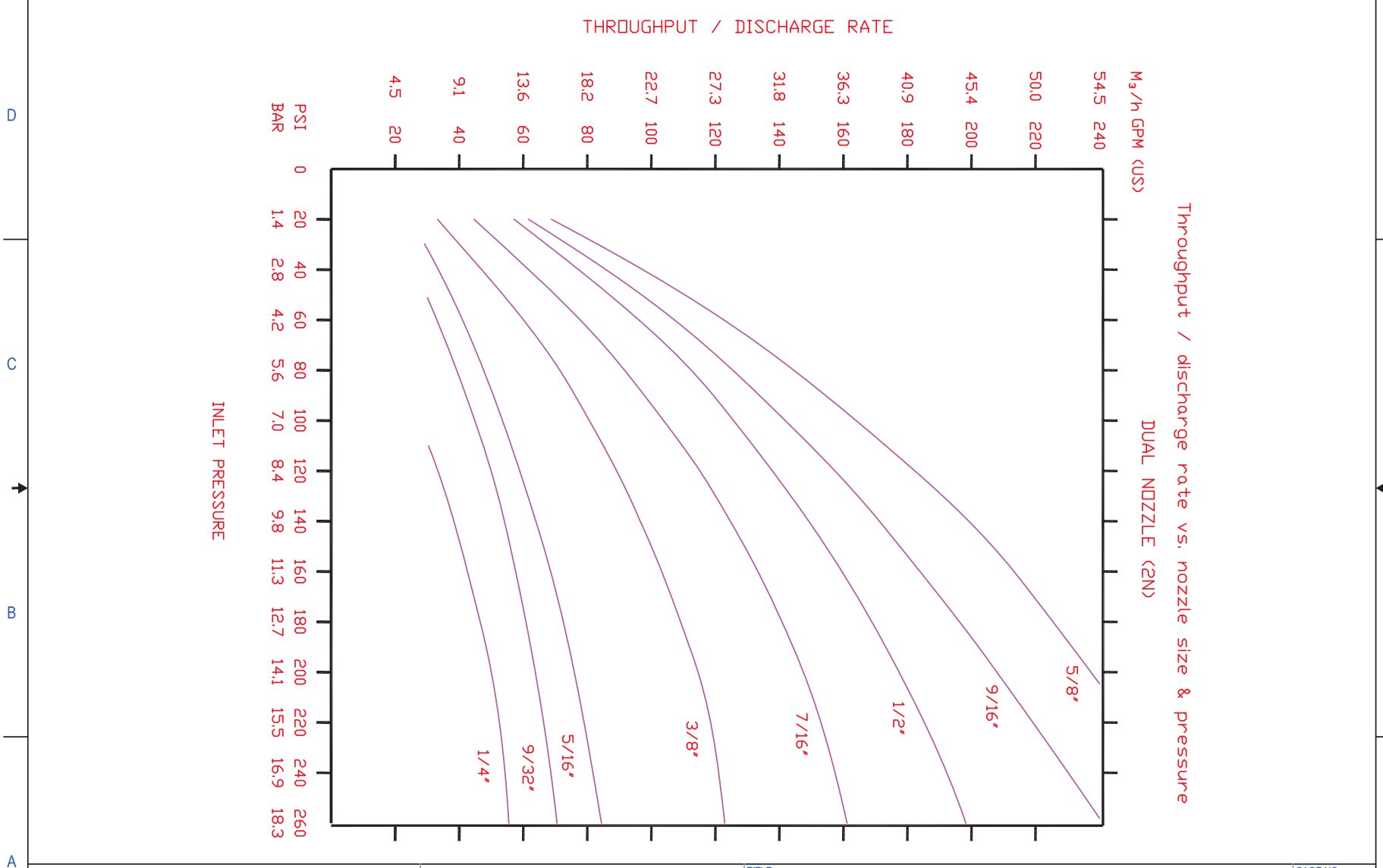

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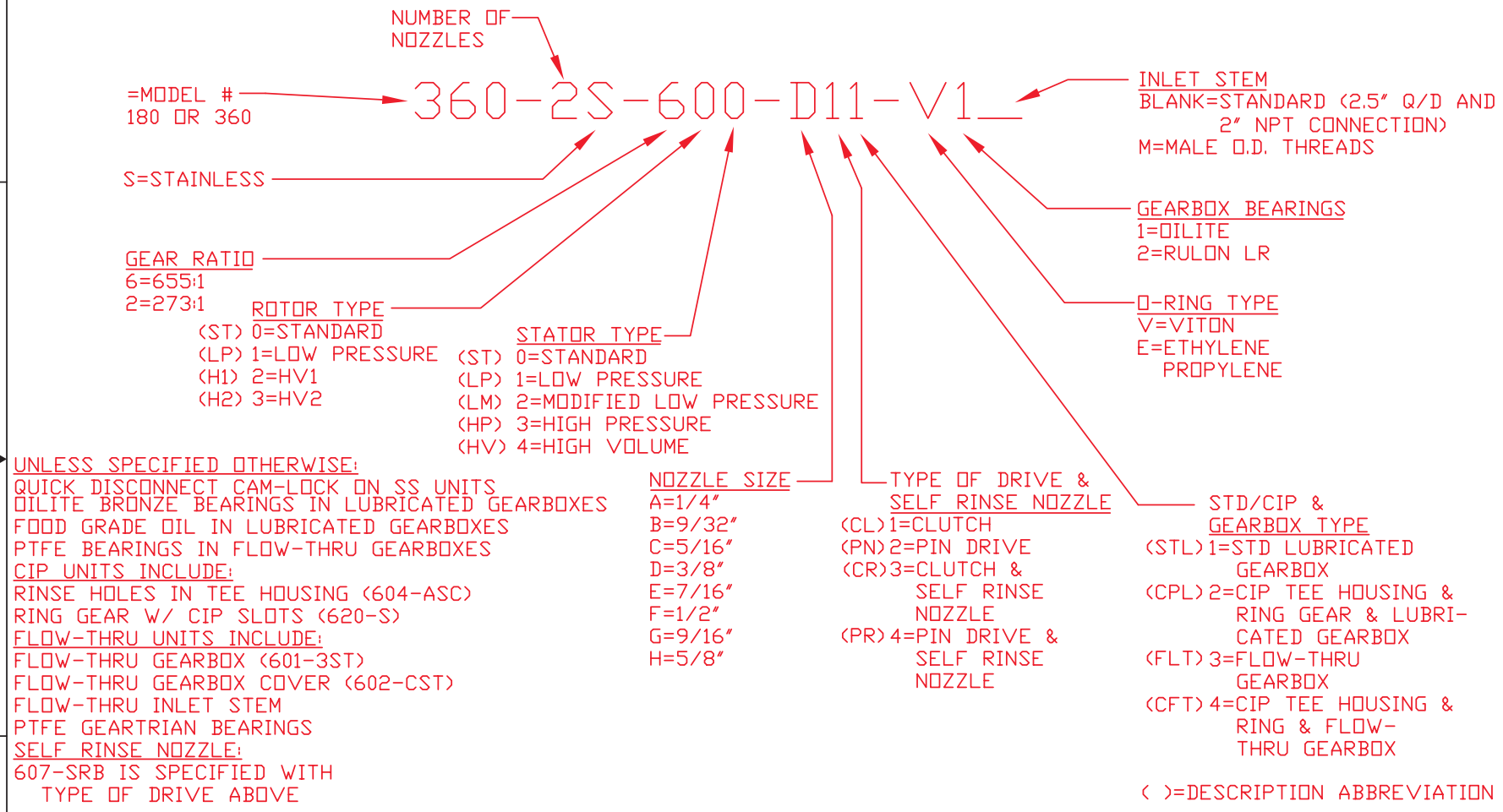
CAGE NO: 96046

DWG NO: CD110936

REV: B



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TITLE	CAGE NO
PRODUCT MATRIX	96046
DWG NO: CD110936	REV: B

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