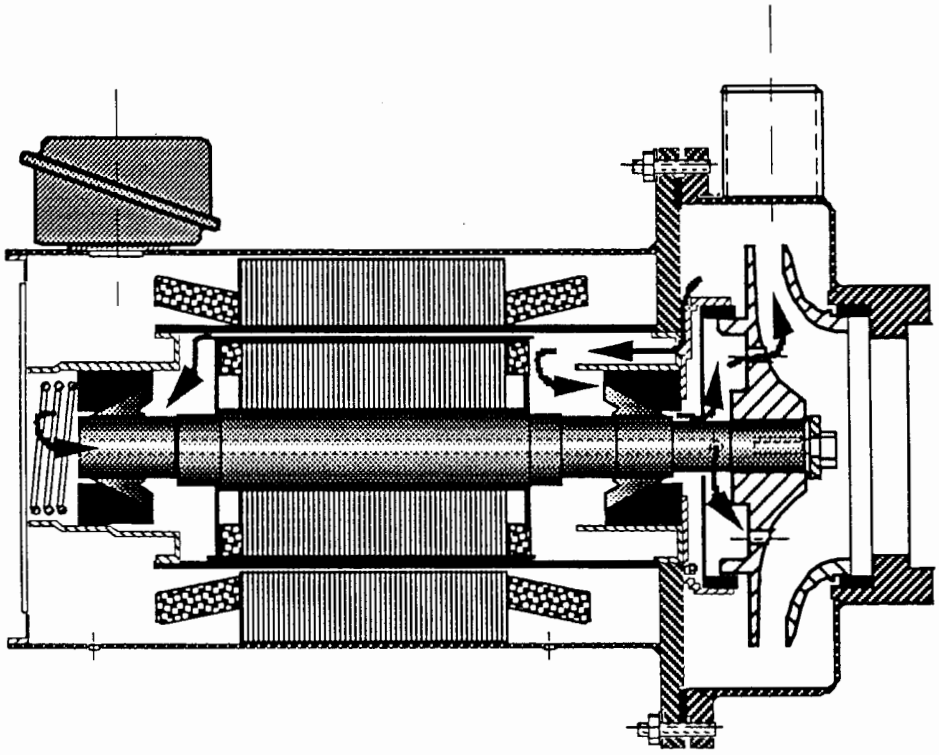
BUFFALO PUMP MANUAL FOR YORK "G" SERIES PARAFLOW CHILLERS

The Buffalo pumps used on ParaFlow chillers single suction, single-stage, hermetically sealed centrifugal pumps designed for zero leakage. The pumps employ a unique spring loaded conical bearing design that allows for long life between overhauls. The pump bearings are cooled and lubricated by the pumping fluid (refrigerant water or lithium bromide solution). The pumping liquid also carries away heat generated by the motor.



INSPECTION PRIOR TO START-UP

CAUTION: ***Open and lock out all electrical disconnects to the ParaFlow unit for the following tests.***

1. Remove the pump wiring connections inside the Power Panel. Using a standard 500 volt megohm meter, meg the motor windings phase-to-phase and phase-to-ground. Winding resistance should not be less than 1 megohm on a cold motor or less than 500,000 ohms on a warm motor. If insulation resistance is less, look for abrasion damage to motor lead insulation material. If the insulation is not damaged, look for moisture accumulation in the stator housing. Be sure that the motor drain holes are positioned so that free water will drain from the stator housing.

2. Reconnect all pump wiring in the Power Panel. Check all wiring to and from the pump contactors and overloads in the Power Panel. Insure that conductors are fully engaged in the terminal holes and that the terminal screws are tight.

3. Check that the pump overloads in the Power Panel are set the same as the pump motor rated full load amps.

PUMP START-UP PROCEDURE

CAUTION: ***Do not run the pump dry. Even momentary operation without the pump and motor casing filled with liquid will damage pump bearings.***

1. Be sure the pump is completely filled with liquid. Run the pump for only a few seconds to make sure it operates smoothly. There should be no unusual vibration, grinding or scraping noises.

NOTE: To operate the pumps, first confirm the correct voltage is supplied to the Power Panel. Close the applicable pump Overload in the Power Panel. Using the PUMP STATUS key on the Micro Panel, select either the Refrigerant Pump or the Solution Pump. The pump can then be turned on by using the MANUAL PUMP key. The Micro Panel must be in the Service Mode to manually operate either the Refrigerant or the Solution Pump. Before operating the pumps, refer to the Micro Panel Operating Manual (Form 155.17-O2) for a thorough understanding of this procedure.

2. Be sure motor drain holes (located on both ends of motor on bottom quadrant of motor housing) are clear.

3. Confirm correct pump rotation:

   a. Install an accurate compound pressure gauge in the pump discharge sample valve. A gauge with a maximum pressure of 30 psig will be sufficient.

NOTES: If the discharge sample valve on the pump is of the spindle valve type, a specific spindle valve adapter fitting must be used to adapt from the sample valve straight thread to the gauge pipe thread. Be sure that the O-ring is in place on the spindle valve body before installing the adapter. Use of silicone vacuum grease is recommended on the straight threads and O-ring surface of the special adapter. Use only Loctite Grade 567 pipe sealant on the gauge pipe threads after priming them with Locquic® Primer Grade N.

On Models 19GL through 22GL, it will be necessary to use the individual disconnects in the Power Panel so that all solution pumps can be run individually. Do not run P1 (Main Solution Pump) by itself for more than a few minutes or solution will back up in the First and Second stage generator. When running P2 (Strong Solution Spray Pump) always run P1 or P2 will run dry. P4 (Weak Solution Spray Pump) may be run by itself. P3 (Refrigerant Pump) may also be run by itself as long as there is sufficient liquid level in the refrigerant tank. The Micro Panel must be in the Service Mode in order to manually operate the pumps. Check the Refrigerant Pump (P3) in the normal manner, then check the three Solution Pumps as follows:

- *Check P1 first. Select the Solution Pump using the PUMP STATUS key and then using the MANUAL PUMP key, turn it on. P1 and P4 will start. Turn P4 off by pressing the red button on P4's Overload in the Power Panel. It will now be possible to check P1 by itself.*
- *Check P4 next. This can be done in exactly the same manner as the procedure for P1, only this time turn P1's Overload off and P4's Overload on.*
- *Check P2 last. First turn on P1. You may leave P4's Overload turned off at this point. To start P2, use the PUMP STATUS key on the Micro Panel and select the Second Spray Pump. Turn it on using the MANUAL PUMP key. During normal unit operation, P2 has an adjustable time delay between the time P1 starts and the time it starts.*

   b. After the pressure gauge is installed, start the pump. Open the sample valve approximately one

turn. After the gauge pressure has stabilized, record the pressure indicated on the gauge. Close the sample valve and shut the pump off.

c. Disconnect all power to the unit. (Be sure the purge pump is valved off.) Using a voltmeter, check that no voltage is present at the pump contactor. Interchange any two of the three phases going from the contactor to the pump. This will cause the pump to run in the opposite direction.

d. Reapply power to the unit. Start the pump. Open the sample valve again and record the pump discharge pressure.

e. The direction of rotation that produces the higher discharge pressure is the correct rotation. If necessary, disconnect power to the unit and change the wiring back to the original configuration. Since the unit was run at the factory, normally the phasing of all pumps will be the same. However, all pumps should still be checked individually. Be aware that both of the discharge pressure readings may be in a vacuum on some pumps. For example, if the pump discharge was –500 mm Hg running one direction and –200 mm Hg running the other direction, the correct rotation would be the one where the discharge pressure was –200 mm Hg. If a ParaFlow unit is ready for operation, pumps rotating in the correct direction will have a sound that is similar to "popcorn popping", only louder. Pumps running in the wrong direction will tend to be relatively quiet. Comparing amperage draw to determine correct rotation will not be conclusive since the power curves of these pumps are very flat.

3. After correct rotation has been confirmed, run the pump again. Record the voltage and amperage draw of all three phases along with the pump discharge pressure on the start-up log.

4. Check for abnormal sounds or vibration.

TROUBLESHOOTING

Pump Tripping on Overloads – Check voltage supply on all three phases to be sure it is correct for the pump motor in question. Check Overload for proper amperage setting (Pump Motor FLA), loose wires or poor connections that generate heat and trip the overload. If no problems are found, shut off all power to the unit, lock out and tag all disconnects. Check the motor connections to be sure the pump is wired correctly. Using a megohm meter, check the pump motor windings for shorts or grounds. (See Overhaul Section for more information on this procedure.) If motor problems are found, motor replacement will be necessary. If no problems are found during this procedure, reconnect the motor. Apply power to the unit and run the pump, while watching the operating amps. If high amps are encountered, the problem may be mechanical, such as bearing seizure. Pump inspection will be necessary. If the overload continues to trip but the motor amperage is within the allowable range, the overload is defective.

Pump Tripping on Thermal Protection – If the winding temperature thermostat is tripping the pump, allow the thermostat to reset. Exercise caution, the motor housing skin temperature should be in excess of 300°F when the winding temperature thermostat trips. Although rare, if the thermostat will not reset in a reasonable period of time, it may be defective. If this is the case, temporarily bypass the thermostat and run the pump. Check the motor housing temperature with an infrared thermometer. The average outside skin temperature of a solution pump motor housing is 190°F at stable operating conditions (100°F Suction Temperature). Refrigerant pumps run cooler than this. Check to be sure that the pump is not running dry periodically or that either the suction/discharge isolation valves are closed. Check to see that the pump is not pumping abnormally high temperature liquid for some reason. If no problems related to flow through the pump are found, the internal coolant passages may be blocked. Pump disassembly will be required.

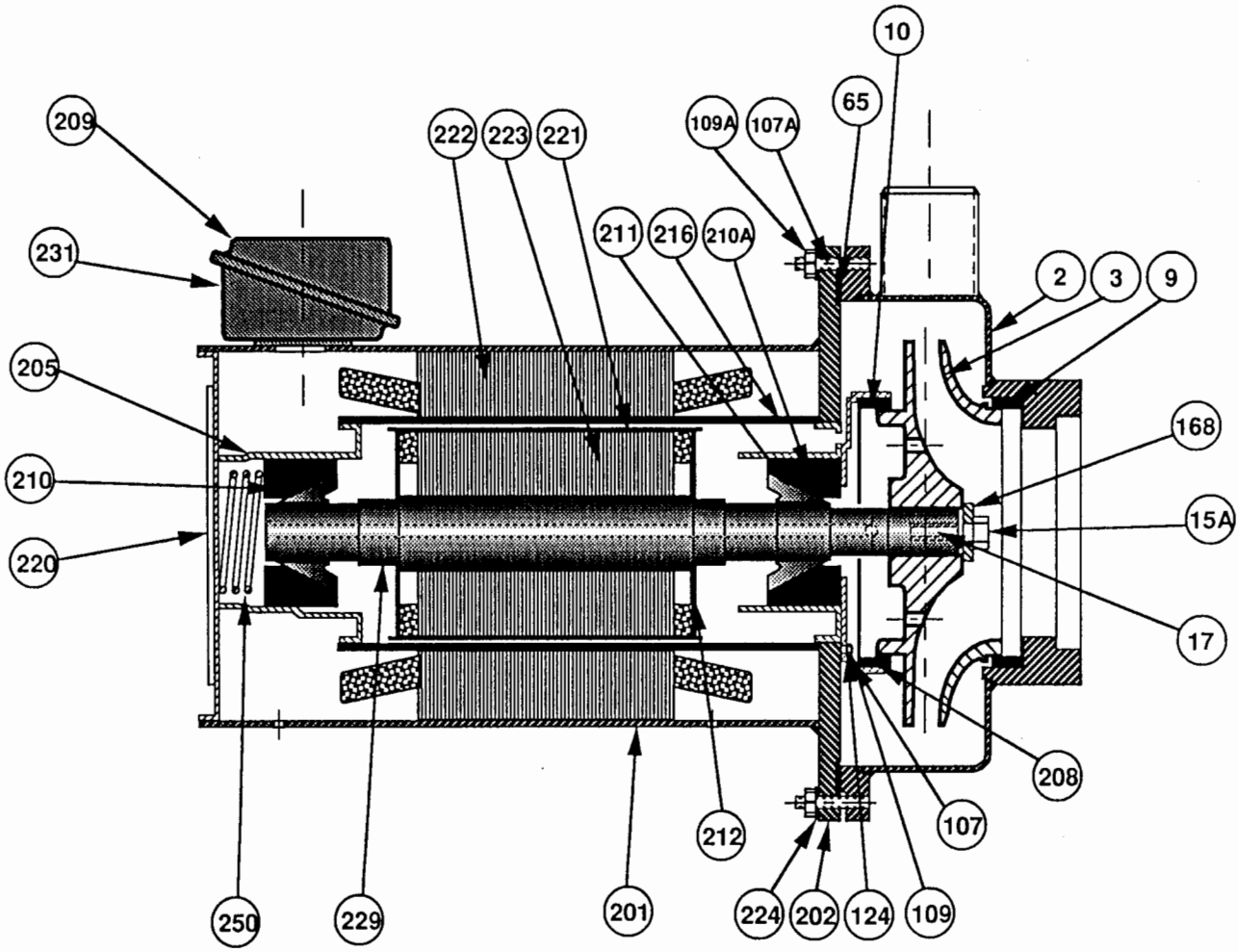
Pump Does Not Make Pressure – Be sure pump is running. Other unit sounds and vibrations may make this difficult to determine by feel alone. Pump may be running backward. Check pump rotation. Check that suction and discharge isolation valves are not closed. Note that most pumps do not produce a positive discharge pressure, i.e. most of the pumps will have a discharge pressure in a vacuum. (See Start-Up Section for more details.)

Unusual Noise/Vibration – Pumps will make some noise during normal operation. Abnormal sounds and vibration may be due to foreign material such as weld slag or debris trapped in the coolant circuit and rubbing between the stator and rotor. Noise may be a resullt of extreme bearing wear. Pump disassembly is required.

PUMP OVERHAUL

The expected time span between Buffalo Pump overhauls on a properly maintained ParaFlow unit should be between 50,000 and 60,000 hours. Pumps installed on units running with high amounts of suspended solids or high amounts of dissolved copper in the solution will suffer shorter lives.

1. Disconnect all primary power to the unit. Lock and tag out all switches, circuit breakers and cutouts in the open position. Note connection sequence and



label power leads to motor. Disconnect power leads and tape off the line side bare ends.

2. Close pump suction and discharge isolation valves and tag. Break vacuum by introducing dry nitrogen or argon into the discharge sample valve of pump. (Use spindle valve adapter if sample valve is spindle-type.) Drain trapped solution or refrigerant into suitable container.

3. Match mark casing (2) and motor mounting flange (202) for use at reassembly. Support motor end of unit. An improvised wooden cradle positioned on the forks of a pallet truck will greatly aid the installation. Note the weights of motor and impeller assembly on Table 1. Remove nuts (109A) and lock washers (224) from studs (107A) holding motor mount flange to the pump casing.

PUMP MODEL NUMBER	NOMINAL MOTOR HORSEPOWER	WEIGHT OF MOTOR ASSEMBLY[1]
215ZB	10 HP	211 LBS.
215R	7.5 HP	184 LBS.
66V	3 HP	164 LBS.
66M	2 HP	106 LBS.

[1]Weight includes complete pump less pump volute casing.

4. Break joint between casing (2) and motor flange (202). Carefully slide motor away from the casing. Do not allow the impeller (3) to drop onto the casing wearing ring (9) as this will break or damage the casing wearing ring. More trapped liquid may run out of the pump casing as the pump is slid out so be prepared with a suitable container. Pump and motor assembly should be placed in a vertical position, impeller up, for disassembly.

NOTE: Pumps should be completely disassembled, each part thoroughly flushed with tap water and then dried before reassembling. Pump casing, gasket surfaces and studs should be washed clean of Lithium Bromide solution and blown dry to prevent damaging corrosion. Even traces of Lithium Bromide solution remaining on pump parts exposed to the air may render the parts useless when attempting reassembly. DO NOT IMMERSE THE MOTOR HOUSING IN WATER.

5. Remove and discard casing gasket (65). Use a new gasket on reassembly.

6. Bend tangs of lock washer (16B) away from impeller locking screw (15A) and locking washer (16B). Prevent impeller (3) from rotating by inserting a length of

bar stock between impeller shrouds. *Do not hammer on shaft (229).* Remove impeller locking screw (15A).

7. Remove impeller (3) using a claw type gear puller. Be sure puller is assembled properly to avoid bending parts. *Do not use hammer to remove impeller (3).* Pull on hub shroud at the vanes only. Remove feather key (17) from notch in shaft and place with impeller.

8. Mark alignment between wearing ring housing (208) and motor flange (202) for use at reassembly.

9. Remove nuts (109) and lock washers (124) under motor side wearing ring (10). Wearing ring may have to be removed and replaced. The wearing ring housing may either snap out or follow the nuts (109) due to the spring pressure (250). Carefully remove wearing ring housing (208) being careful not to drop pump end bearing (210A). Identify bearing location in housing and identify bearing (impeller end bearing and rear bearing may not be identical – 215R and 215Z motors have larger impeller end bearings than motor end) for later examination. Remove bearing (210A) from wearing ring housing (208).

CAUTION: Do not allow the sharp edge of the rotor to puncture the stator inner liner (216). The rear carbon bearing (210) may stick to the bearing journal. Do not allow the carbon bearing to drop off of the rotor as it is lifted.

10. Lift the rotor directly up, guiding it out of the motor cavity with thumb and forefinger on each side. As soon as the lower journal is visible, check to see if the lower bearing (21) is sticking to the rotor. If the bearing is stuck to rotor, grasp it and do not allow to drop.

11. After removal, protect the rotor so that the thin outer liner (221) is not damaged. The rotor should be supported at the shaft ends only – not on the rotor outer liner or bearing journals.

12. If the rear bearing (210), did not come out with the rotor, remove it now from the rear bearing housing – reaching in through the pump end of the motor housing. If the bearing is bound in the housing, carefully apply heat to the bearing housing with a torch to expand the housing enough to permit the bearing removal. To prevent a future recurrence of the bearing binding, sand the OD. of the bearing with fine emery cloth until the bearing will slip into the housing freely. In cases of binding due to foreign particles, clean and reinstall first before sanding. If binding still occurs, sand the bearing OD.

13. Remove the spring assembly (250) from the bearing housing (205).

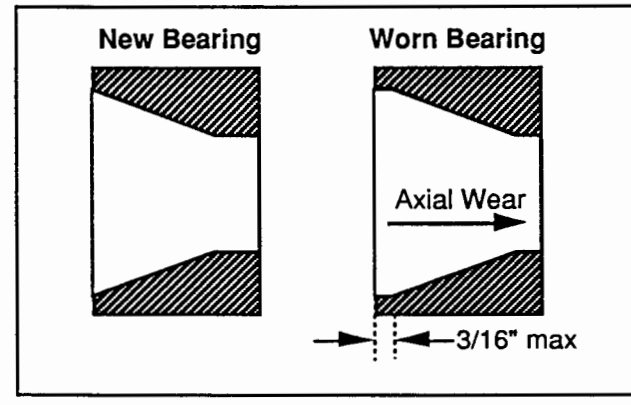
14. Wearing rings (9) and (10) should not be removed unless inspection shows that they should be replaced. To remove the wearing rings, carefully crack and remove in pieces. Use care not to damage the casing (2) or wearing ring housing (208).

INSPECTION AND PARTS REPLACEMENT

Impeller (3) – After thoroughly cleaning, inspect the impeller (3) for unusual wear on the wearing ring mating surfaces. Examine the impeller closely for copper or other metal deposits in the vane areas. These will affect impeller blance. Remove any deposits found. Check the impeller vanes for foreign object damage. An impeller with grooved seal areas or severe foreign object damage should be replaced.

Wearing Rings (9, 10) – If the pump has been in operation for some time, wear may have increased the clearance between the wearing rings (9,10) and impeller (3) to the point where efficiency is considerably reduced. Check the radial clearance between the hubs of the impeller (3) and the inside of the wearing rings (9, 10). If the radial clearance is more than .018 inch (normal radial clearance is .006 to .009 inch), break out the old wearing rings (9,10) being careful not to damage ring fits in casing (2) or wearing ring housing (208). Clean the ring fits thoroughly and install new wearing rings (9,10) as described under the Reassembly Section.

Bearings (210) and (210A) – An indication of conical bearing wear can be obtained by measuring the bearings. Check each bearing for: (a) cracks; (b) axial wear, which is measured parallel to the rotor shaft (229) from the face at the large end of the cone to the point where the taper begins (maximum amount of wear is 3/16 inch); (c) uneven radial wear, which can be detected by comparing the annular thickness of the section at the large end of the cone at several points. If any of the above conditions exist, replace the bearing.



Hot Bearing – A darkened journal (211) indicates that the bearing has been running hot, probably due to insufficient liquid circulation. In this case the journal should be cleaned with Scotch Brite® and light oil. The circulation passages in the impeller (3) and wearing ring housing (208) should be checked and cleaned. Be sure to completely clean any oil or solvents from the parts prior to reassembly.

Bearing Journals (211) – Check shaft journals for copper or other metal deposits. If deposits other than graphite are found on the surfaces of the conical journals, remove with crocus cloth. If the bearing journals are scored over 1/64 inch, determine the cause and replace the rotor.

Rotor and Stator Cans (216) and (221) – Check for punctures, weld failures or worn-through spots in both the stator and rotor cans. Check for evidence of rubbing between the rotor can and the stator can. Also check for rubbing or marking caused by deposits or loose foreign matter between the stator and rotor cans. If either or both cans are punctured or have spots that have worn through or have cracked welds, the motor must be replaced. If there is evidence of rubbing, but no actual failure of either member, try to determine the cause of the rubbing so that corrective measures can be taken.

The following are possible cause and effects of rotor rubbing on the stator.

- If rubbing marks are localized on the rotor and continuous on the stator, the condition is caused by a high spot or area on the rotor.
- If the marks are localized on the stator and continuous on the rotor, the indication is that there is a high spot in the stator can or that there is excessive or uneven bearing wear.
- If there is continuous marking on both stator and rotor cans, the cause is probably loose foreign material.
- If the marking indicates high spots on either can, check first for copper or other deposits and remove them if they are present.

If the high spots are caused by protrusion of either can, they may be removed by tamping them down gently using a hardwood block and a hammer. If these high spots do not respond to the above treatment, the motor must be replaced. If no foreign material or high spots are found, check the bearings for excessive wear, uneven wear, or ineffective spring action.

Circulating Passages – Check circulating passages which consist of radial holes through wearing ring housing and axial holes through pump end bearing housing. If the circulating passages are partially or completely blocked by copper or other metal deposits, corrective action should be taken. Check hollow shaft (229) for obstructions.

Motor Lead Insulation – Check the insulation on the motor leads in the area of where the leads pass through the hole in the motor frame for worn or cracked insulation. If possible, reinsulate with tubing, tape, etc. If not accessible, replace the motor.

Motor Windings – Check motor winding for grounds, short, opens, or unbalanced resistance in all phases. If defective in any of these respects, replace the motor.

Winding Insulation – Check the insulation resistance with a megohm meter. Readings should not be below 1 megohm on a cold motor or 500,000 ohms on a warm motor. If the insulation resistance is below these values, check for abraded motor leads. If this is not the trouble, check for moisture accumulation in the stator housing. Turn the motor to a position with condensate drain holes down and look for free water. If moisture is found, drain all free water out condensate hole and place the motor in an oven at 200°F for 2 hours. If the insulation resistance is still low after baking, replace motor.

All Parts – Inspect all parts for cracks, distortion and unusual wear. Parts should be cleaned and any deposits removed. It is essential that the circulating holes in the impeller (3) and the wearing ring housing (208) be kept open.

REASSEMBLY

Before reassembling the pump, be sure that all parts are clean, oil-free, and free of grit.

Place the unit in a vertical position; use a hand hoist to lower the rotor into the motor cavity if necessary.

To replace the wearing rings, if they had to be removed, proceed as follows:

1. Wipe wearing rings (9,10), casing bore and motor wearing ring bore free of oil, grease or other foreign substance.

2. Spray the OD of the carbon and inside of the ring bores including the bottom shoulder with Loctite Locquic Primer grade T.

3. Wait about one minute after the primer is applied; run a small bead of Loctite 620 around the bores near the top.

4. Press rings (9,10) in place. Press wearing ring (10)

into wearing ring housing (208) until flush with the top surface. Press wearing ring (9) into casing (2) until it seats against the bottom shoulder.

5. Let cure until handling strength is reached (about 3 minutes) before proceeding with assembly.

6. Install spring (25) in bearing cap (205).

7. Align tab in bearing housing (205) with square slot of bearing O.D. and slide rear bearing (210) into the rear bearing housing (205). The bearing should have a free-sliding fit with no excessive radial play.

8. Lift rotor using an eyebolt inserted in the rotor shaft (229) and a hand hoist, over motor housing and lower rotor into motor cavity. Guide rotor on reassembly as on disassembly.

9. Insert impeller end bearing (210A) into wearing ring housing (208) aligning tab in housing with slot in O.D. of bearing and carefully position over shaft bearing journal. Align wearing ring housing over studs in motor housing flange making sure previously scribed match marks line up. A slight pressure will be required to push the wearing ring housing in to overcome the spring pressure. Install the lock washers (124) and nuts (109) on the studs while holding the wearing ring housing in with the other hand.

10. Tighten the nuts (109) using a staggered tightening pattern. Torque to 100-150 in/lbs (9-12 ft/lbs).

11. Check for loose or insecure rotor by pushing the end of the exposed shaft and observing it the rotor returns to its original position. Normal axial movement is 1/16 to 1/4 inch. If it is impossible to move the rotor axially by hand pressure, possible causes are:

    a. Bearing bound in housing.

    b. Broken or damaged spring.

    c. Foreign particles between the bearing and housing.

Disassemble the pump to determine and correct the cause before proceeding.

12. Check for radial movement by grasping the shaft extension with one hand and attempting to move the shaft perpendicular to the shaft axis. Total free radial movement of 1/32 inch or more is excessive and remedial action should be taken.

13. Re-install feather key (17) in shaft (229). Slide the impeller (3) onto the shaft (229) being sure it seats against the shoulder. Do not pound the impeller onto the shaft.

14. Install impeller locking washer (16B) (Lock washer must be replaced if both sets of tangs have been used) and impeller screw (915A). Tighten impeller screw to 40 ft/lb. Bend one set of tangs of the locking washer (16B) over the flats on screw (16A).

15. Using rubber cement, glue a new casing gasket (65) in position on the motor housing flange. Extra care to adequately secure the gasket will pay off when positioning the pump into the casing in the next steps.

16. Position the pump assembly in the horizontal position. Using a support cradle, place the pump so that it can be slid into the casing. Be sure to line it up so that the pump assembly matches the previous marks made on the casing during disassembly. (A pallet truck may work to position the pump in its casing.) It is important to slide the assembly into the casing exactly centered and parallel so that the impeller does not damage the casing wearing ring. Be sure to watch the gasket closely during this procedure to make sure it is not pinched.

17. While holding the pump assembly against the pump casing, install two lock washers (224) and nuts (109A) onto studs (107A). Snug the two nuts up to temporarily position the pump assembly while installing the remaining lock washers and nuts. Snug all nuts evenly using a staggered pattern.

18. Torque nuts (109A) to 35 ft/lb using a staggered rotating pattern. Initial torque tolerance is ±5%. Note, breakaway torque will be greater than this value.

19. Remove the temporary motor support and reinstall any permanent support brackets.

20. Pressurize the pump assembly using the pump discharge sample valve with 12 psig of dry nitrogen or argon. Leak check the pump flange using a liquid soap leak check method. Repair if necessary.

21. Evacuate the pump assembly through the pump discharge sample valve with the unit purge pump to at least 3 mm of Hg. Valve off the pump sample valve. Open the pump suction and discharge isolation valves.

22. Connect the electrical conduit to the pump motor terminal box and reconnect the power leads and control wiring to the pump motor. Install terminal box cover.

23. Follow the instructions in the Start-Up Procedures Section to confirm correct pump rotation and satisfactory operation.

P.O. Box 1592, York, Pennsylvania USA 17405-1592

Form 155.17-N4
Supersedes: Nothing

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