



WICHITA WATER UTILITIES

Sewage Treatment Plant
2305 E. 57th St. S.
Wichita, KS 67216

2016

Reuse Water Pumps

This simplified manual focuses on the operating variables and the troubleshooting guides needed to facilitate the operation of our facility in a cost-efficient and effective manner. It is not meant to cover every aspect of our equipment. It is a quick reference, designed to be used as a working tool for both new and experienced operators. It is also available in electronic format for editing, as the need arises, to keep it always current.

General Process Description



I. PUMPING

1. Two 8-stage Model 7CHC high-service (HS) pumps are rated for 260 gpm at 214 feet total dynamic head (TDH). One of these pumps is shown in Figure 1. The 17 HP motor is designed to operate at 1,770 RPM. The pump's run out capacity is 331 gpm and shut off pressure (from the manufacturer) is 118.6 psi.

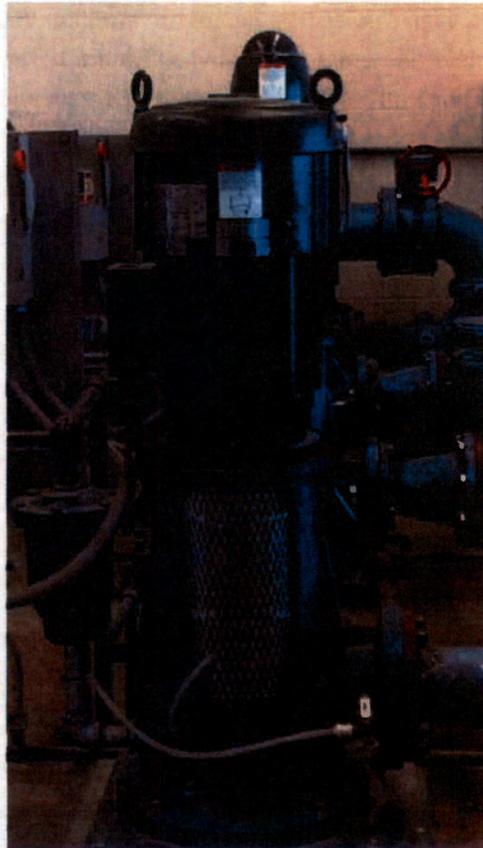
Figure 1: Goulds (7CHC) 260 GPM Pump



2. The 8-stage Model 8RAHC low-service (LS) pump, shown in Figure 2, is rated for 70 gpm at 212 feet total dynamic head (TDH). The 5 HP motor is designed to operate at 1,770 RPM. The pump's run out capacity is 103 gpm and shut off pressure (from the manufacturer) is 108.7 psi.



Figure 2: Goulds (8RAHC) 70 GPM Pump



II. PRESSURE REDUCING CONTROL VALVE

The Watts Pressure Reducing Control Valve, located on the downstream side of the reuse pump discharge header, throttles to reduce high upstream pressure to constant lower downstream pressure (refer to Figure 3).

Figure 3: Pressure Reducing Valve



III. WELL LEVEL MONITOR

The Siemens clearwell level monitor detects water depth in the reuse water clearwell (refer to Figure 4). This information is relayed back to the PLC which, in turn, shuts off pumps if the clearwell water level is too low.

Figure 4: Well Level Monitor



Pump Start-Up Checklist



IV. PRE-START CHECKLIST

Prior to startup, be sure to remove all hand tools and to install the coupling guards around all exposed shafts and couplings. Failure to comply may result in severe personal injury or death. Prior to startup, check the following:

1. Confirm that the following procedures (detailed description of each in pump manufacturer's Instruction Manual) have been installed:
 - a. Wiring of driver.
 - b. Driver must rotate counterclockwise (CCW) when viewed from above. (Warning: do not check motor rotation unless motor is bolted to pump and drive coupling is removed.)
 - c. Check alignment of pump and driver.
 - d. Impeller adjustment has been made.
 - e. Mechanical seal lock collar is attached to shaft.
2. Make sure mechanical seal is properly lubricated and all piping to seal is connected. Also, check that all cooling, heating and flushing lines are operating and regulated.
3. Open the air release system isolation valve. Adjusting the air release system throttling device so that it is partially open. It should not be closed or fully open. **NOTE: Not exhausting the air or exhausting it too fast can damage the pump.**
4. All connections to driver and starting device match wiring diagram.
5. Rotate shaft manually to ensure impellers are not binding.
6. Verify that driver bearings are properly lubricated and check oil level in housing.
7. Inspect discharge piping connection, valves and pressure gauges for proper operation.

V. PUMP STARTUP

1. Partially close the valve in the discharge line.
2. Start the pump. If any abnormal noises, jerking or vibration is noted, stop the pump immediately, determine the cause of the abnormalities and correct them.
3. After the pump is operating at full speed, slowly open discharge valve. If driver overheats or there is excessive vibration, stop the pump, determine the causes and correct them.
4. If the air release valve is manually operated, close it.
5. These pumps have open (hollow) line shafts. There should be some leakage at the stuffing box packing. The correct leakage rate is approximately one drop per second. Check the temperature of the leakage as well as the discharge head. If the pump runs hot and the leakage begins to choke off, stop the pump and allow it to cool down. A few light taps with a hammer on the gland will upset the packing sufficiently to resume leakage. After pump has cooled, restart pump and follow preceding procedure. Run pump 15 minutes, check leakage, if it exceeds two drops per

second, adjust packing as described in "Packing Adjustment and Replacement" section of the manufacturer's Installation, Operation and Maintenance (IOM) manual.

6. These pumps have mechanical seals. If the seal leaks slightly at startup, allow a reasonable amount of time for seal to adjust itself. Liquids with good lubricating qualities normally take longer to wear in the seal than liquid with lesser qualities. When a seal starts out with a slight leak and gets progressively less while running, it is indicative of leakage across the seal faces. Continued running will eliminate this. Where leakage occurs immediately and remains constant, unaffected by running, it usually indicates secondary seal (shaft packing) damage, or seal faces are warped out of flat.



Control Scheme



Pump operations are shown here graphically. Pump modes are controlled by flowrate, shown along the x-axis as GPM in Table 1.

Table 1: Pump operation modes



The pump operation is disabled upon detection of low wet well level via the Siemens clearwell level sensor. The LS pump has an ultimate shutoff at wet well water level of 1.5 ft. The HS pumps have an ultimate shutoff at wet well water level of 2 feet. If any pump reaches its ultimate shutoff, it will be permitted to turn on again when the wet well water level returns to 2.5 feet. The discharge header PRV is set to provide system pressure of 90psi.

The pumps shall be capable of being controlled locally at the motor or from their respective motor starter (see Table 2). Pumps may also be controlled remotely by the Plant PLC when the LOCAL/OFF/Remote switches are in REMOTE (see

Table 3). The pump operation is disabled if either switch is in the OFF position. Pump switches are shown in Figure 5 and Figure 6.



Table 2: Local control description

LOCAL Control

- | | |
|----------|--|
| 1 | At equipment: <ul style="list-style-type: none">a. The pump is operated locally (at the pump) when the starter selector is in the REMOTE (AUTO) position and the field selector switch is in the HAND position.b. The pump will run continuously without process control system interfacing. |
| 2 | At starter: <ul style="list-style-type: none">a. The pump is operated locally (at the starter) when the selector is in the HAND position.b. The pump will run continuously without process control system interfacing. |

Table 3: Remote control (AUTO) description

Remote Control (AUTO)

- 1 The pumps are operated via the plant control system when both switches are in the REMOTE (AUTO) position.
 - 2 Pump modes are operated based on system flow.
 - 3 The low service pump turns on when the flowrate reaches 20 GPM (Mode 1). The low service pump runs until the flowrate reaches 65 GPM.
 - 4 At the 65 GPM threshold, a 15 second flow verification occurs. An additional 30 second delay occurs while the low service pump (Mode 1) shuts down and one high service pump starts up (Mode 2).
 - 5 The high service pump shall run in Mode 2 until the system flowrate reaches 200 GPM. As the flowrate increases over 200 GPM, a 15 second flow verification occurs. An additional 30 second delay occurs while the second high service pump is started and both high service pumps run concurrently (Mode 3).
 - 6 Should the flowrate fall below 200GPM, an 8 minute flow verification occurs before transition to Mode 2 occurs. After the 8 minute flowrate verification, one high service pump shuts down immediately while the other high service pump continues to run.
 - 7 Should flowrate fall below 65GPM, an 8 minute flowrate verification occurs before transition to Mode 1 occurs. After the 8 minute flowrate verification, the high service pump turns off and the low service pump starts immediately.
 - 8 Should the flowrate fall below 20GPM the low service pump shuts down.
 - 9 The high service pumps shall be rotated in a lead/lag rotation with the rotation of the pumps occurring each time a pump is stopped.
 - 10 In high flow situations (greater than 200 GPM) the high service pumps shall be cycled in a first in, first out rotation.
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Figure 5: Pump Starter Switch

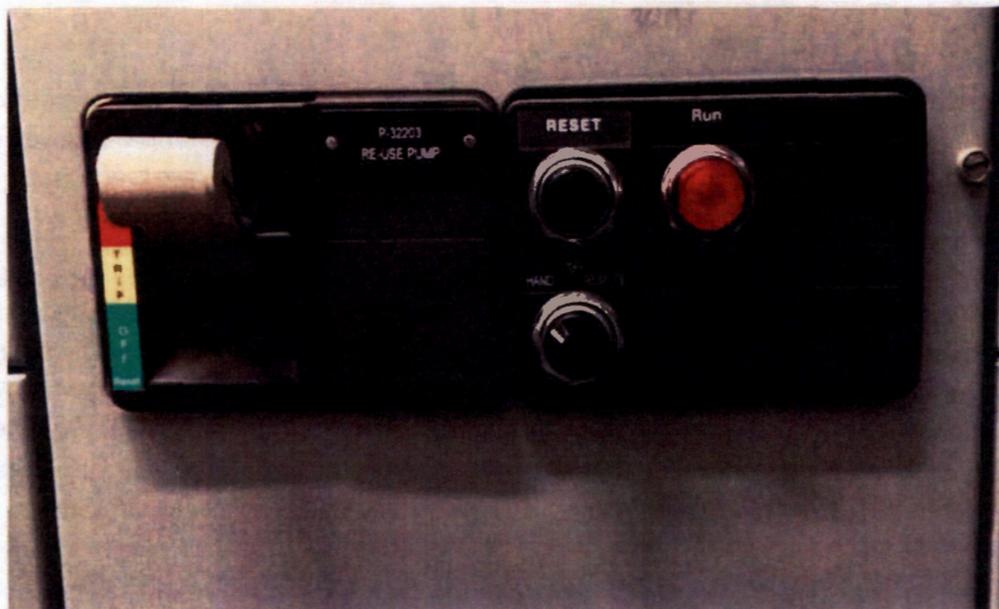


Figure 6: Field Pump Selector Switch



Warning: Before initiating maintenance procedures, disconnect all electric sources to the equipment and accessories completely. Discharge all parts and accessories which retain electric charges. Failure to comply may result in severe personal injury or death.

Preventative maintenance includes periodic re-lubrication of electric motors, gear drives and prime mover. Systematic inspection of the pump and its components shall be made at regular intervals. The frequency required depends upon the operating conditions of the pump and its environment. See the following Preventative Maintenance schedule. Consult the applicable manufacturer's instructions for detailed information on maintenance for the prime mover, driveshaft, electric motors and gear drives. Any deviation in performance or operations from what is expected can be traced to a specific cause. Variances from initial performance will indicate changing system conditions, wear, or impending breakdown of the unit.

PREVENTATIVE MAINTENANCE SCHEDULE

Refer to Table 4 for preventative maintenance on reuse pumps and motors.

Table 4: Preventative maintenance schedule

Procedure	Time Interval
Clean dirt, oil and grease from driver and discharge head.	As required
Clean driver ventilation passage to prevent overheating.	As required
Change lubrication in gear drive.	Every 2,000 service hours or once per year
Check oil level in the reservoir. It should never be less than half full. Refill, check drip rate.	Every 24 operating hours
Tighten all loose bolts and check for excessive vibration.	As required.
Check that there is some leakage through stuffing box while pump is in operation. Do not tighten gland nuts unless necessary.	As required
Maintain a liquid film of lubrication between the seal rubbing faces.	As required
Change the motor bearing oil.	Annually

PACKING ADJUSTMENT AND REPLACEMENT

These pumps are equipped with packing, which should be adjusted whenever the leakage rate exceeds two drops per second. If there is no leakage or the stuffing box overheats, do not back off gland nuts while the pump is running. This will allow the entire set of rings to move away from the bottom of the

box without relieving pressure of the packing on the shaft. Stop the pump and allow packing to cool; then restart the pump.

It may be necessary to repeat this procedure several times before the proper amount of liquid comes through. If leakage is excessive, adjust the stuffing box as follows:

1. With the pump in operation, tighten the gland nuts one-quarter turn for each adjustment. Allow packing to equalize against the increased pressure and leakage to gradually decrease to a steady rate before making another adjustment. **CAUTION: Do not over-tighten the stuffing box. Excessive pressure can wear out packing prematurely and seriously damage the pump shaft.**
2. With the pump shut down and when the packing has been compressed to the point that the gland is about to contact the upper face of the stuffing box, remove the split gland, add one extra packing ring and readjust. If this fails to reduce leakage to two drops per second, remove all packing rings and replace with new rings.
3. Remove the packing with the aid of a packing hook. If a lantern ring is provided, remove it by inserting a wire hook into the slots of the ring and pull it from the packing box. Thoroughly clean the stuffing box of all foreign matter.
4. If the replacement packing is in the form of a continuous coil or rope, it must be cut into rings before installing. Tightly wrap one end of the packing material around the top shaft like one coil spring, and cut through the coil with a sharp knife. For re-packing sequence, refer to "Installing the Stuff Box" section of manufacturer's IOM.

SEASONAL SHUTDOWN

1. If the pump is to be shut down for an extended period of time, operate it for at least 15 minutes with adequate pre-lubrication every two weeks.
2. Before resuming normal operations, oil should be changed on drivers and right angle gear. After 15 minutes of operation adjust the lateral.

Troubleshooting Guide

Refer to Table 5 for a list of potential problems and recommended solutions for the reuse water pumping system.

Table 5: Troubleshooting guide for reuse pumps and motors

Problem	Probable Cause	Recommended Solution
Insufficient reuse water pressure at application point.	Pumps shut off to prevent overpumping (see next problem).	See next problem.
Reuse pumps shut off although there is field demand.	Clearwell is being drawn down too much, and water level sensor is causing automatic shutoff of pumps to protect from overdrawing.	Reduce field consumption. If any process is on that consumes substantial amounts of re-use water, shut the process off for several minutes and see if the problem is remedied. If this is the problem, consult supervisor.
	Check-valve failure (immediately downstream of low-capacity pump), causing excessive pressure between low-capacity pump and discharge header.	Repair check-valve.
Pump will not deliver normal amount of water.	Discharge valve partially closed.	Fully open discharge valve and see if pump rate increases. Make sure pump does not break suction.
	Speed is too low.	Check if driver is directly across and line and receiving full voltage.
	Obstruction in liquid passage.	Pull pump, inspect suction strainer, impeller and bowls.
	Air or gas in the water.	If successive starts and stops do not remedy, close discharge valve to maintain well pumping level at a lower GPM.
	Driver with reduced voltage, or reduced current starting does not come up to speed.	Check RPM, voltage and amps.
	Pump breaking suction, water level in well near or below pump intake (in this case, water level sensor may be out of service).	Partially throttle discharge valve. The discharge rate may actually decrease, but the water level in the well should rise and the pump should no longer break suction. Notify supervisor or well service company.
	Pump worn, hydraulic problems, intake plugging. Could also be damaged bowl assembly; broken or disconnected shaft.	Notify supervisor or pump service company. Pump must be pulled and damaged components repaired.
	Field head requirement greater than design head.	Consult engineer.

Pump will not start.	No power to switch box.	Check position of main electrical disconnect arm (main switch) and make sure it is in the up (energized) position. If main power supply is interrupted, auxiliary power system (generator) should be started.
	Electrical circuit open or not completed. Possibly circuit breaker or overload relay tripped.	Reset breaker or overload relay. If pump does not start within a few minutes, start motor by turning the "Hand/Off/Automatic Switch" to the HAND (manual) position for approximately 2 to 5 minutes (make sure not to over pressurize the distribution system). If motor runs, return the HOA switch to the AUTO position. Notify supervisor. If motor does not run, see other probable causes below.
	Electrical circuit open or not completed. Possibly fuses burned out.	Check for cause and replace fuses with correct type and sized fuses. Make sure to pull down (de-energize) the main electrical disconnect arm (main switch) before opening the panel and replacing the fuses.
	Improper lateral adjustment Impeller on bottom.	Reset impeller adjustment (see pgs. 20 or 22 of manufacturer's Installation, Operation and Maintenance Instructions.
	Defective flow switch or automatic control system.	Turn the "Hand/Off/Automatic Switch" to the HAND (manual) position for a short period. If the pump starts, the problem is in the automatic control system. Notify supervisor or electrician experienced with industrial controls to repair automatic control system. Pump can be operated in manual position in order to supply water, however the operator must monitor the discharge flow and pressure (pressure on the distribution system) and make sure that normal working pressure is not exceeded.
	Defective motor.	Consult factory.
	All of the above checked and the pump will still not run.	Notify supervisor, or electrician experienced with industrial controls.
Pump will not shut off.	Defective flow switch or automatic control system. Flow cut-off setpoints may need to be adjusted.	Turn the "Hand/Off/Automatic Switch" to the OFF position. If pump stops, the problem is in the automatic control system. Notify supervisor, or electrician experienced with industrial controls to repair automatic control system. Pump can be operated in manual position in order to supply water, however the operator must monitor the discharge pressure (pressure on the distribution system) and make sure that the normal

		working pressure is not exceeded. The pump should not be left in the OFF position long enough to allow the distribution system pressure to drop below the normal minimum working pressure.
Pump works for a while and quits.	Excessive horsepower required.	Consult factory.
	Mechanical failure of critical parts.	Check bearings and impellers for damage. Any irregularities in these parts will cause a drag on the shaft.
	Suction strainer clogged.	Pull pump and clean the strainer.
	Misalignment.	Realign pump and driver.
Pump starts too frequently.	Leaking check valve.	During the OFF cycle, listen for water running back into the well and check the water flow meter to see if it is running backward. If the check valve is of the swing-type, it may be stuck in the open position. With the well pump running (on), try manually lifting/lowering the operating arm on the check valve. With the well pump off, slowly and gently push the operating arm to the closed position. If the problem persists, notify supervisor, or well service company.
	Defective pressure switch or automatic control system. High or Low pressure cutoff switches may need to be adjusted.	Notify supervisor or electrician experienced with industrial controls.
Fuses blow, circuit breaker or overload relays trip when pump is in operation.	Insufficient discharge head causing a high amperage (electrical current) draw.	Check water flow meter to see if the discharge rate is much higher than normal and the discharge pressure gauge to see if the pressure is lower than normal. If so, the water system could be out of water (no pressure) and/or there could be a very large leak in discharge line or in the distribution system. At the well station, with the pump running, try throttling back on the discharge gate valve until the pressure reaches the normal operating pressure. DO NOT close the valve completely or operate the pump for an extended period time against a throttled valve. Immediately notify the supervisor.
	Incorrect voltage, excessive heat in control panel, motor overloaded, incorrect fuses, breakers, or overload relays.	Notify supervisor or electrician experienced with industrial controls.
	Damaged impeller.	Inspect, replace if damaged.
	Foreign object lodged between impeller and bowl.	Remove object as required.

Pump consumes too much power.	Defective bearing.	Replace bearing, check shaft or shaft sleeve for scoring.
	Packing is too tight.	Release gland pressure. Retighten. Keep leakage flowing. If no leakage, check packing, sleeve or shaft.
Pump is too noisy.	Cavitation.	Insufficient NPSH available. Consult supervisor.
	Bent shaft.	Straighten as required.
	Rotating parts binding, loose or broken.	Replace as required.
	Bearings are worn out.	Replace bearings.
	Resonance.	Check piping strain, consult factory.
Excessive vibrations.	Coupling misalignment, bent impeller imbalance, worn bearings, cavitation, piping strain and/or resonance.	Determine cause utilizing shaft vibration frequency analyzer and/or disassemble pump. Complex problem may require factory service assistance.
	Motor or gear driveshaft end play maladjustment.	See manufacturer's Installation, Operation and Maintenance Instructions section on "Installation of Hollow Shaft Driver (VHS)."
	Bent shaft.	Straighten as required.
Pump leaks excessively at stuffing box.	Defective packing.	Replace worn packing.
	Wrong type of packing.	Replace packing not properly installed or run-in. Replace improper packing with correct grade for liquid being pumped.
Stuffing box is overheating.	Packing is too tight.	Release gland pressure. Retighten. Keep leakage flowing. If no leakage, check packing, sleeve or shaft.
	Packing is not lubricated.	Release gland pressure and replace all packing if burnt or damaged. Re-grease packing as required.
	Wrong grade of packing.	Consult factory.
	Stuffing box improperly packed.	Repack stuffing box.
Packing wears too fast.	Shaft or shaft sleeve worn.	Pull pump and remachine, or replace shaft and/or sleeve.
	Insufficient or no lubrication.	Repack and make sure packing is loose enough to allow some leakage.
	Improperly packed.	Repack properly, make sure all old packing is removed and stuffing box is clean.
	Wrong grade of packing.	Consult factory.