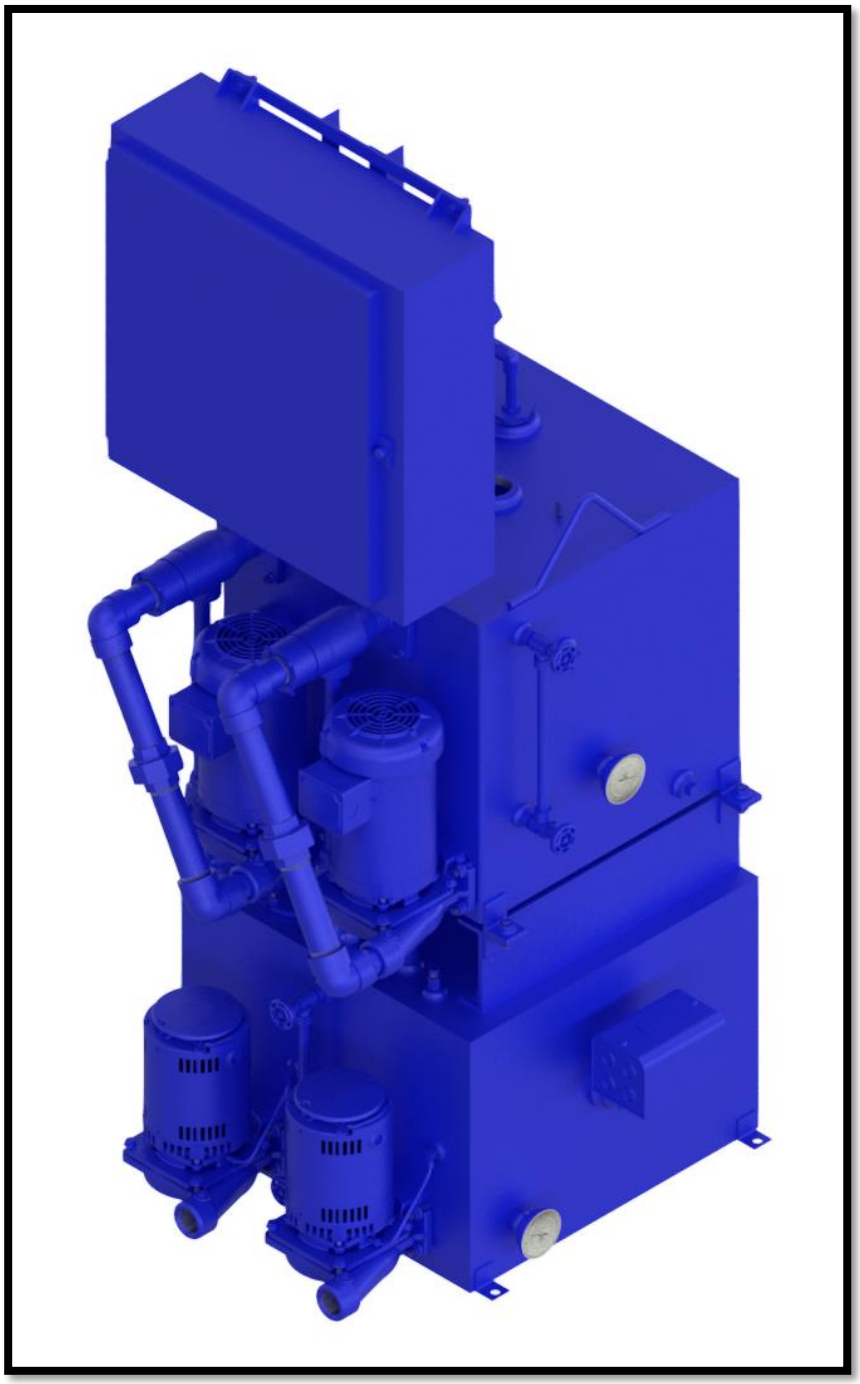
Vent-Rite®
A Swan Group Company

Revision 2
Form SMV3618C

VR, VRA, VRD, VRDA, DV, DVA, DVD, DVDA, & VARI-VAC®
Model E3 Vacuum Pumps

Installation, Operation & Maintenance Manual



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INTRODUCTION

The Vent-Rite model E3 vacuum pumps are designed to promote circulation, sustain system vacuum, minimize warm up periods and provide lower operating temperatures for system components, by exhausting the air and other non-condensable gases from the heating system. It also provides a positive means of returning the condensate to the boiler or boiler feed unit, and through its lower system temperature provides lower maintenance and operating costs for the system components.

The vacuum pumps are complete assemblies which include motor driven centrifugal pumps, kinetic exhausters, tanks and controls. Types VR and VRD are, respectively, units with single and duplex pumping systems for use on vacuum return line systems. VRA and VRDA units have an auxiliary condensate accumulator tank mounted upstream of the vacuum pump. The type DV, DVA, DVD and DVDA pumps are similar with the exception that they are designed for use with Vent-Rite Vari-Vac Differential Heating Systems, and they employ a differential controller to provide and sustain the vacuum and maintain the desired pressure differential between the supply and return mains which ensures continuous circulation.

GENERAL

This equipment is a factory built and tested vacuum pump designed for the purpose of sustaining a vacuum in a heating system. To assure satisfactory operation and to avoid costly damage to the unit, the following procedures should be observed.

It is not the intent of these instructions to give complete design procedures for a heating system, but only to guard against some of the common misapplications. These instructions are general in nature and are for standard cataloged units. Non-standard units may vary in some respects from these instructions.

INSTALLATION

A. RECEIVING INSPECTION

When the unit is delivered, an immediate visual inspection of the unit and its accessories should be made in the presence of the carrier's representative. If there is any evidence of rough handling or damage, a notation should be made on the delivery receipt. Shipping damages are the responsibility of the carrier, and it is the obligation of the customer to file a claim. If requested, Vent-Rite will assist in the filing of the claim.

B. UNCRATING

When uncrating the pump be sure that all temporary plugs remain in their tappings until you are ready to connect it to the system, and all instructional tags are attached.

C. RIGGING

Each unit has been carefully tested and inspected at the factory where every precaution was taken to assure that it reaches its destination in perfect condition. It is very important that the installers, movers, and riggers use the same care in handling of the unit. Chains, cables, or other moving equipment should be placed to avoid damage to any part of the unit.

D. PLACEMENT

The foundation for the vacuum pump must be of solid concrete which rises from three (3) to six (6) inches above the floor. It must also be level for proper operation and functioning of controls. Three and one-half (3½) inch bolts should be imbedded in the foundation with one and one-half (1½) inches protruding from it to mount the pump. The pump should then be mounted and shimmed level (if necessary) and grouted with cement. When the cement has hardened, tighten down the hold-down bolts.

E. PIPING CONNECTIONS

All units are provided with heavy steel threaded fittings on both the water inlet and outlet. Installation of valves with pipe flanges or unions, rather than couplings, is recommended to permit ease of installation and removal. All piping should be tight and properly supported by hangers, not by its connections to the units.

Typical piping systems are shown in figures 1 and 2. There are points however, that cannot be properly shown in the drawing. They are listed below.

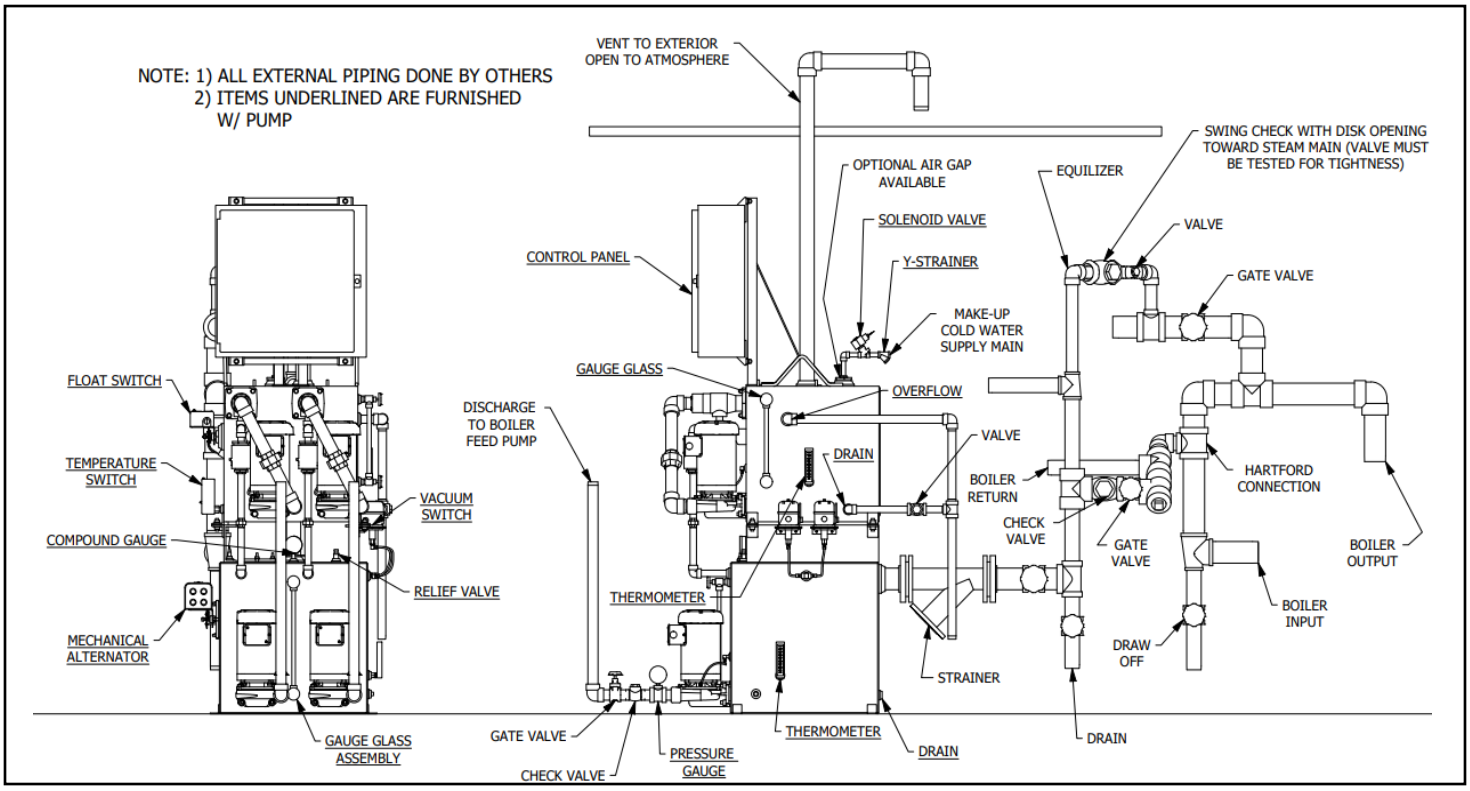


Figure 1

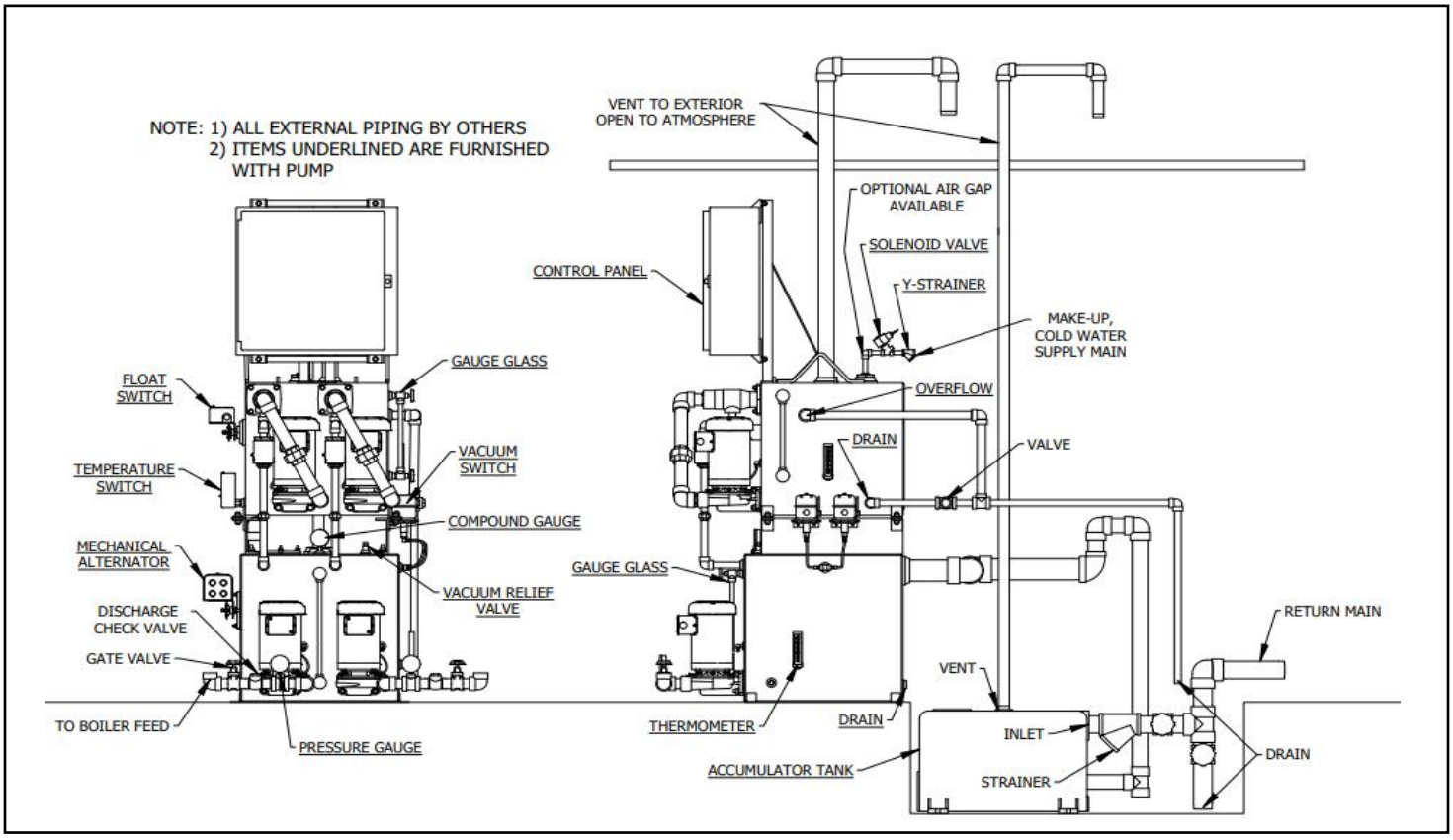


Figure 2

1. RETURN MAINS

CAUTION: DO NOT connect steam returns from equipment or common returns which carry high pressure steam directly to vacuum return mains or to the vacuum pump. High pressure steam returns MUST be piped through a properly sized flash tank or economizer, prior to connecting them to the vacuum return mains.

Return mains should be sloped downward toward the vacuum pump accumulator tank (VR, VRD, DV, DVD), or toward the auxiliary condensate accumulator tank (VRA, VRDA, DVA, DVDA). The returns should be piped through a gate valve, furnished by the contractor, and the strainer furnished with the unit. Lift connections should NOT be used on return mains, they may be used on systems using VRA, VRDA.,DVA and DVDA vacuum pumps, but only between the vacuum pump and its auxiliary accumulator tank. If it is necessary to lift the condensate to a height greater than four (4) feet, several steps of lift connections should be used.

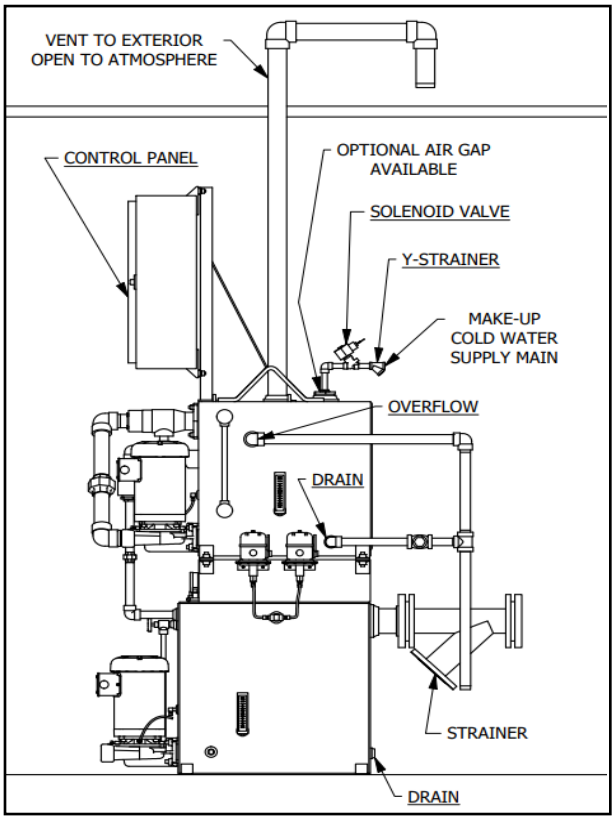


Figure 3

2. VENT CONNECTIONS

a. A vent should be installed extending from the accumulator tank of the vacuum pump to a point near the ceiling, but NO LESS than twelve (12) inches above the boiler water line. "Units with an auxiliary condensate accumulator tank require a vent for the auxiliary tank that should terminate in an air check. The vent should be installed extending from the auxiliary condensate accumulator tank to a point near the ceiling, but no less than twelve (12) inches above the boiler water line (See Fig. 2 & 4)." **WARNING** Venting to same room as the system may cause humidity that can lead to equipment damage. Vent to exterior of building when possible.

b. The hurling tank also requires a vent. It should rise to a point near the ceiling, but NO LESS than twelve (12) inches above the boiler water line. This vent must terminate over a floor drain or into a waste system, as depicted in Figure 3.

3. EQUALIZER CONNECTIONS

A three-quarter (¾) inch equalizing line should be installed between the steam main and return main through a swing check valve and hand valve as depicted in Figure 4. It is not necessary to install an equalizer connection on systems using DV, DVD, DVA and DVDA units as it is incorporated in the differential controller installation.

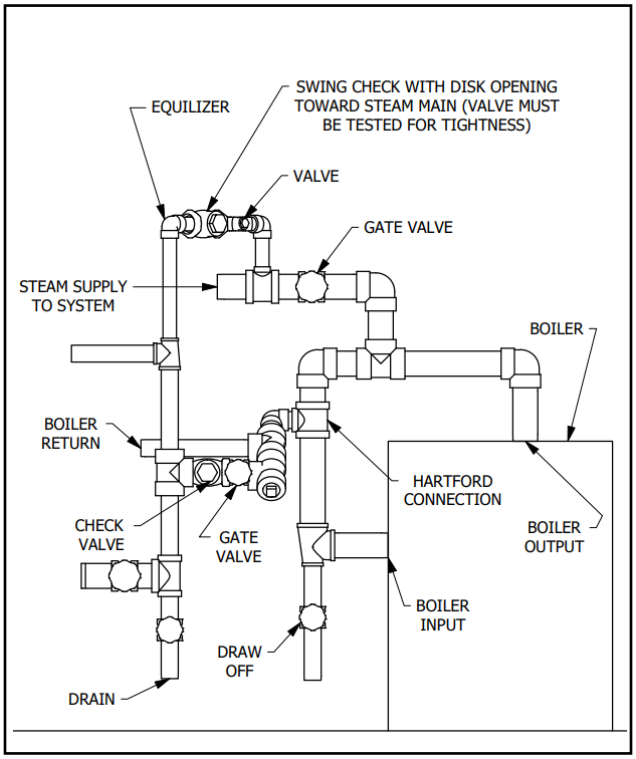


Figure 4

4. HURLING TANK WATER MAKE-UP

A water make-up line for the hurling tank should be connected from city water to the make-up solenoid valve. As some locations may not have city water readily available, a line may be connected from the vacuum pump discharge line to the make-up solenoid valve, as shown in Figure 5.

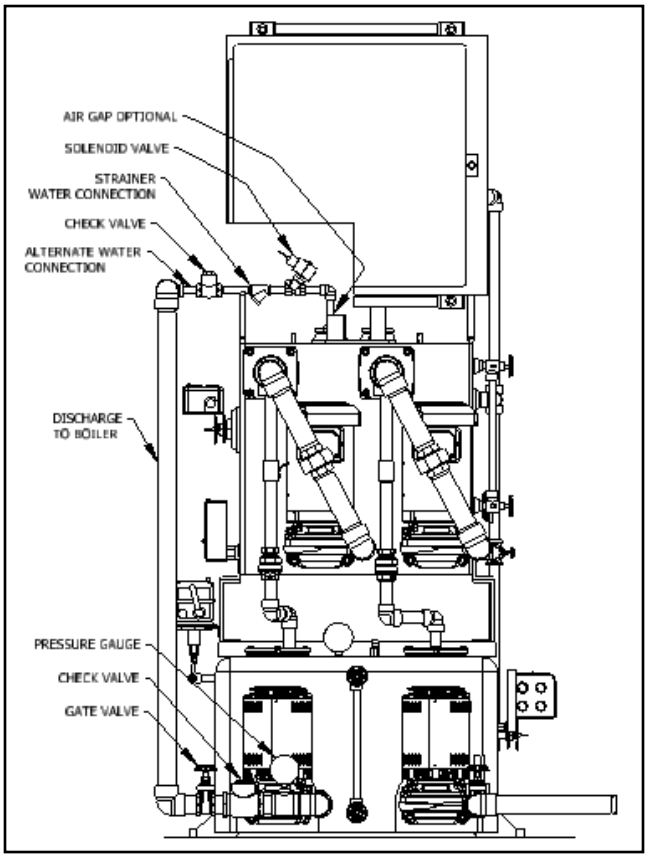


Figure 5

5. TIGHTNESS

Prior to filling any tanks or opening any valves to the system, be sure that all connections are tight and that all drain plugs have been installed.

F. ELECTRICAL WIRING

The only wiring required for vacuum return line system pumps, VR and VRD, is a power connection. All other pumps require additional external wiring.* Prior to start-up of the unit the following checks and observations should be made:

1. Connections to the unit should match the unit nameplate in volts, phase and hertz with a maximum variation of 10% of nameplate.
2. A fused disconnect switch must be installed by the customer to protect the system against short circuiting and overload.
3. All field wiring is to be in accordance with the National Electric Code and must comply with federal, state and local codes.
4. All wiring checked for damage and all terminal connections are checked for tightness.

*For units controlled by differential controllers consult differential roller installation & operating instructions, FORM #3441.

OPERATION

A. PRELIMINARY OPERATION

Prior to placing the vacuum pump into service, close the gate valve before the return main strainer and open the draw-off valve. Operate the heating system for a period of time, preferably two weeks, to flush the system of dirt, grease, scale and other foreign matter. When wasting the condensate to the sewer, be sure to supply make-up water to the boiler to maintain the proper water line. Once placed in service the Model E3 vacuum pump will require a minimum amount of attention by the operating engineer. With a properly equipped, designed and tight piping system, the pump should furnish full and complete satisfaction.

1. FINAL CHECK OF THE UNIT

   Prior to starting the unit recheck the following:

   a. PLUMBING
      1. All connections are tight.
      2. All drain plugs are installed.
      3. Disks for air checks are clean and properly installed.
      4. Hand valves for the condensate return main, discharge main and hurling tank are closed.

   b. ELECTRICAL
      1. All connections match the nameplate in volts, phase and hertz with a maximum variation of 10% nameplate.
      2. All field wiring is in accordance with the National Electric Code, and it complies with federal, state and local codes.
      3. All wiring has been checked for damage and all terminal connections checked for tightness.
      4. Fuses are properly sized in accordance with ampacity required.

B. PRINCIPLE OF OPERATION

When the hurling tank of the vacuum pump has been primed with water, both return condensate main and discharge main gate valves are open, the hurling pump selector switch and the accumulator tank discharge pump selector switches can be turned to the “AUTO” position.

As there is no vacuum in the accumulator tank, the vacuum switch will cause the hurling pump to operate, forcing water under steady pressure through the kinetic jet exhauster back into the hurling tank. The velocity of the water through the jet exhauster causes a low-pressure area to be developed in it, which is called a “Venturi Effect”. This low

pressure will enable air, water vapor and other non-condensables to be sucked from the condensate accumulator tank through a suction check valve into the stream of high velocity water, and then into the hurling tank where they are vented into the atmosphere.
When a vacuum of eight (8) inches of mercury has been reached, the pump will shut off. If there is insufficient water in the hurling tank, its float switch will cause the make-up water solenoid valve to open and fill the tank to the proper level.

On duplex units the hurling pumps will go on and off together. When a vacuum is created in the condensate accumulator tank, it will cause the condensate in the system to flow toward it more rapidly. As the condensate accumulates in the tank its float switch will close, starting the condensate discharge pump which will empty the accumulator tank. On duplex units the pumps will alternate operation under the control of the alternating float switch, and if the level of the condensate in the tank should rise above a set point, both pumps will operate.

C. TRIAL OPERATION OF THE VACUUM PUMP

1. HURLING PUMP
   a. Be sure that the hand operated gate valves are closed in the condensate return and condensate discharge lines.
   b. Fill the hurling tank with water until the level in the sight glass indicates that the tank is approximately one-half full, then open the make-up water gate valve.
   c. Place all the hurling pump selector switches in the “OFF” position.
   d. Place the electrical disconnect switches in the “ON” position. None of the pumps will operate, however the make-up water solenoid should open to allow water to enter the tank. When the water has reached the proper level the hurling tank float switch will open to deenergize the make-up water solenoid valve.
   e. Check the hurling pump by placing its selector switch in the “AUTO” position. (With duplex units check one pump at a time.) Check the rotation of the pump. The water will circulate through the hurling tank and cause a vacuum to be created in the condensate accumulator tank. The vacuum switch will shut off the hurling pump at a vacuum of eight (8) inches of mercury. If this does not happen in one (1) minute, shut off the pump and check for air leaks.
   f. Break the vacuum in the accumulator tank by either opening the main condensate return line or by removing the disk from the air check valve.
   g. For duplex pumps repeat steps “e” and “f” for the second pump.
2. ACCUMULATOR TANK DISCHARGE PUMP
   a. Be sure that the hand operated gate valves for the condensate return and discharge mains are closed.
   b. Place the condensate discharge pump selector switch in the “AUTO” position.
   c. Remove the pipe plug from the top of the condensate accumulator tank and fill the tank approximately two-thirds (2/3) full or until the discharge pump starts. Check the pump for proper rotation and “dead head” discharge pressure. The pressure gauge should read at least five (5) pounds more than the rated discharge pressure. For vacuum pumps with single discharge pumps skip to step “e".
   d. For duplex units continue to add water to the tank until the second discharge pump starts. Check it for proper rotation and discharge pressure which should be a least five (5) pounds more than its rated pressure.
   e. Open the discharge gate valve slowly to allow the water in the tank to be pumped to the boiler. When the pump stops, refill the tank to see if the pumps alternate. Repeat this step if necessary.
   f. Be sure that the discharge valve is fully open. Replace the fill plug and tighten it to be sure that it has an airtight seal. The vacuum pump is now ready for preliminary operation.

D. CONTROLS

The electric controls consist of an accumulator tank float switch, vacuum switch, starters, a hurling tank float switch and solenoid valve, a three-position switch for each hurling pump and one for each condensate discharge pump.

1. The accumulator tank float switch controls the level of condensate in the accumulator tank by actuating the discharge pump; on duplex systems a float switch which alternates is used. This switch alternates the use of the discharge pumps and if one pump fails it will bring the other into service. In addition, if one pump cannot handle the condensate load it will cause both pumps to operate simultaneously.
2. The vacuum switch is factory set. Its settings however are not always applicable under all operating conditions. It is set to turn on the hurling pump(s) at a vacuum of three (3) inches of mercury as measured in the vacuum pump accumulator tank, and to stop them when the vacuum reaches eight (8) inches of mercury.
3. Motor starters for the pumps have overload relays which are melting alloy type and are designed to protect the circuit from current overloads. If an overload should occur, the relays will open, the cause of the overload will have to be corrected and the relays manually reset.
4. The hurling tank reverse acting float switch and high temperature limit switch operating in accord with the solenoid valve are used to maintain hurling tank water level and water temperature. If the water level drops

the reverse acting float switch will close to provide a circuit to the solenoid valve in the make-up water line, to maintain proper water level. If water temperature rises to an improper level, the high temperature limit switch will also provide a circuit to the make-up solenoid valve providing quench water to lower the hurling water temperature back to the proper temperature. The excess water is removed by the overflow connection. NOTE: Connect make-up water solenoid valve and strainer to cold water supply only.

5. The hurling pump selector switch has three positions. HAND-OFF-AUTO. When the switch is in the HAND position, the hurling pump will operate continuously, when it is in the OFF position the pump will not operate but the hurling tank float switch will, allowing the tank to fill to its proper level. In the AUTO position the hurling pump will operate under the control of the vacuum switch. Systems with the auxiliary accumulator tanks have switches which are marked HAND-FLOAT-AUTO. In the HAND position the pumps will operate continuously, in the FLOAT position the pump will operate under the control of the float switch in the auxiliary accumulator tank and in the AUTO position it will be controlled by either the auxiliary tank float switch or the vacuum switch as they are wired in parallel.
6. The condensate discharge pump selector switch has three settings which are marked HAND-OFF-AUTO. In the HAND position the discharge pump will operate continuously, in the OFF position it will be inoperable and in the AUTO position it will operate under the control of the accumulator tank float switch. On duplex systems the float switch will alternate the operation of the discharge pumps. If it is necessary to readjust the vacuum switch, the 'range' and 'differential' settings may be changed as follows: To adjust the set point at which the hurling pump will operate use the 'range' adjustment. To determine the set point at which the hurling pump will shut down, adjust the 'differential' screw.

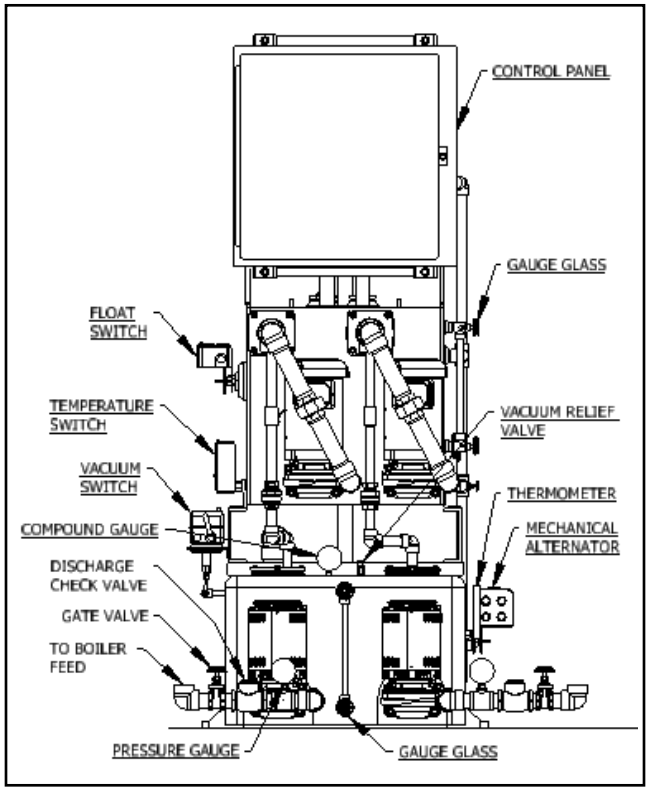


Figure 6

MAINTENANCE

A. PERIODIC CHECKS

Maintenance of the vacuum pump is minimal, and most problems can be eliminated through periodic checks of the unit.

1. Monthly periodic checks and maintenance should be accomplished to be sure that all sight glasses are kept clean and that the pressure and vacuum gauges and the thermometers are operating properly.
2. Every year the following checks and maintenance should be completed.
   a. The hurling tank should be flushed to prevent mineral build-up.
   b. Float and/or alternating float switches and vacuum switches should be checked to assure proper operation.
   c. The hurling pump(s) and tank should be checked to determine if they are capable of producing and holding the required vacuum.

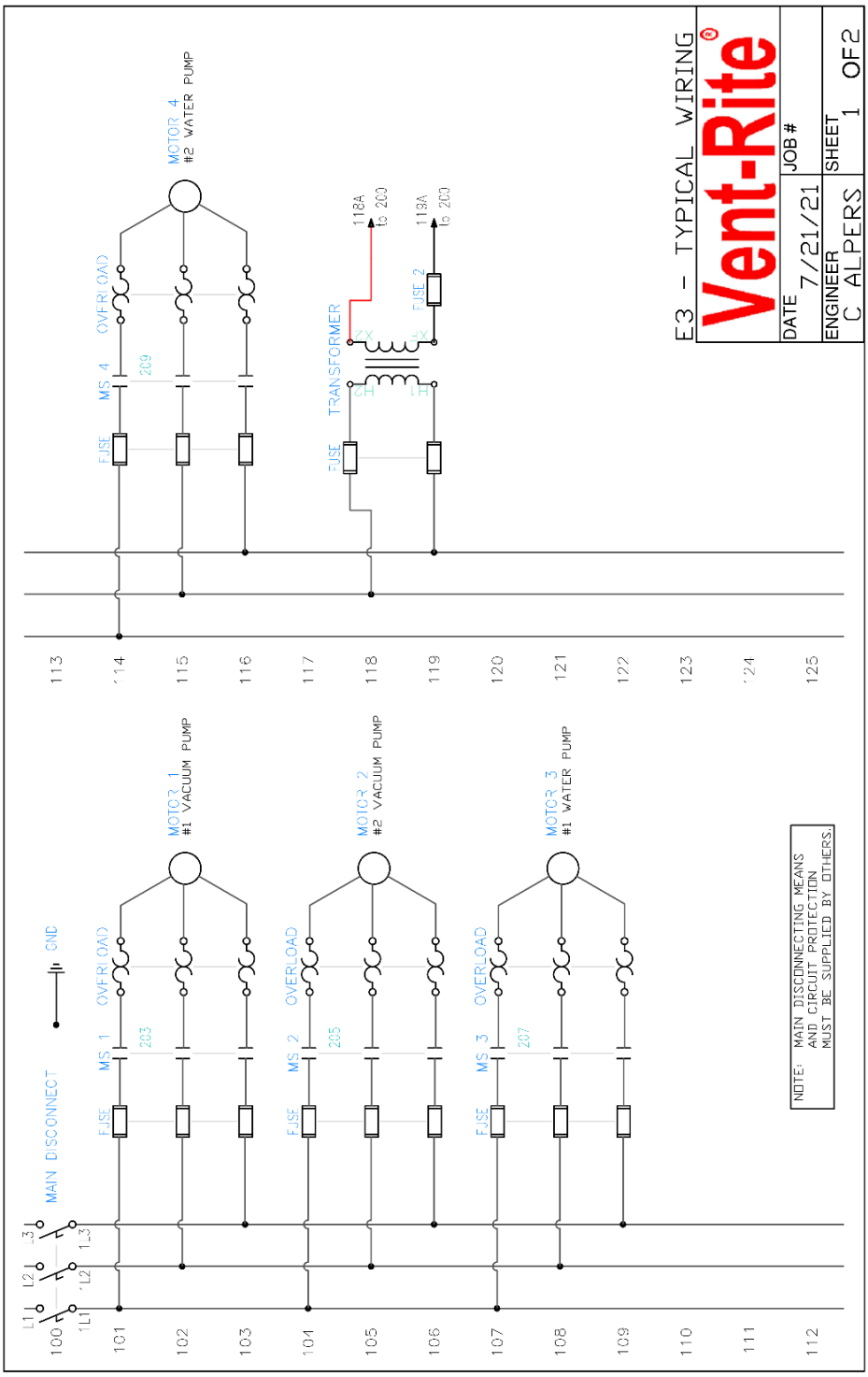
B. CHECKING THE VACUUM PUMP

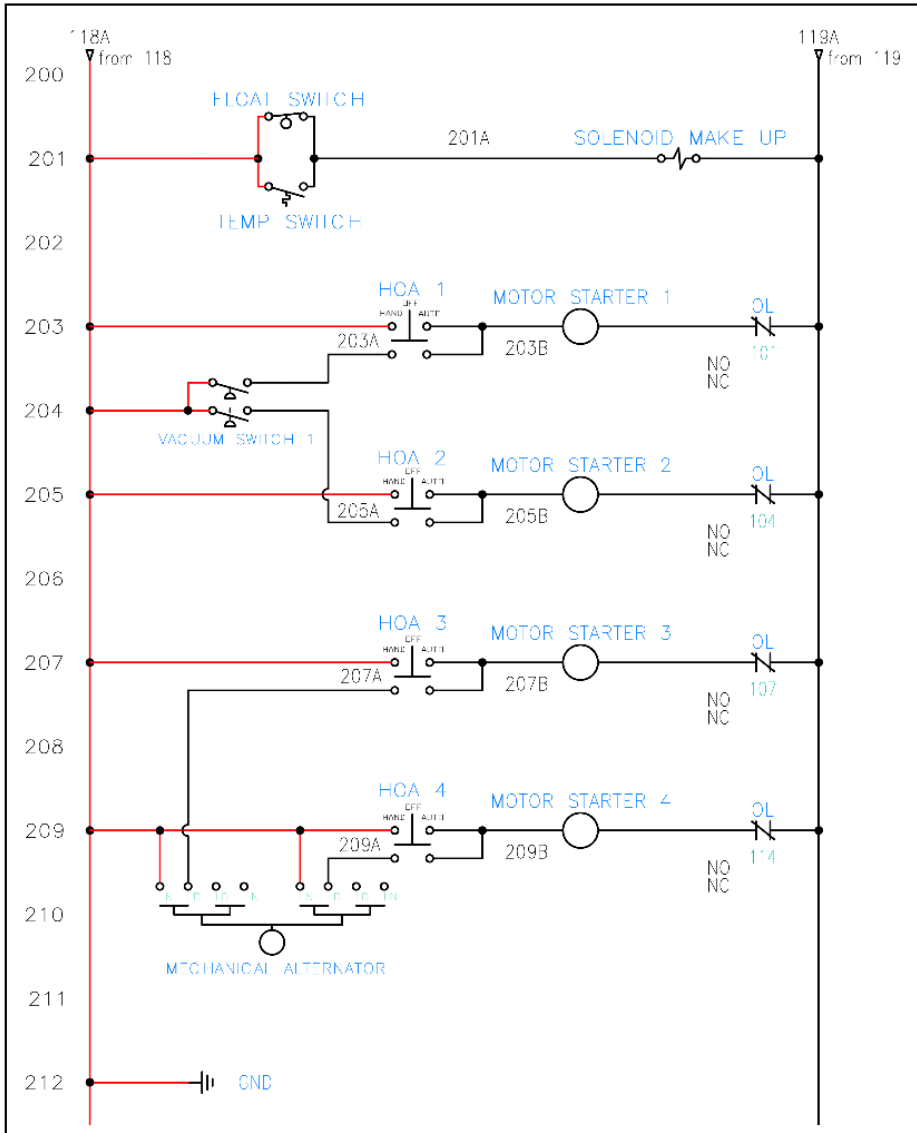
1. HURLING TANK PUMP
   Close the main condensate return line valve and operate the hurling pump(s) on "HAND". A vacuum of twenty (20) inches of mercury should be achieved in less than two (2) minutes, depending on the condensate temperature. Stop the hurling pumps by switching to the "OFF" position and observe the rate of loss of the vacuum. If the loss is more than three (3) inches of mercury in two (2) hours, check for a leaking suction check valve or other areas where the accumulator tank might leak.
2. CONDENSATE ACCUMULATOR TANK AND PUMP(S)
   Close the main condensate discharge valve and operate the discharge pump(s) on "HAND". The pressure gauges should read at least five (5) pounds more than the rated pressure.
3. HURLING TANK FLOAT SWITCH AND MAKE-UP WATER SOLENOID VALVE

Open the hurling tank drain valve and draw off enough water until the tank is approximately one-half (2) full. The make-up water solenoid valve should open and refill the tank until it is approximately two-thirds (2/3) full.

4. CONDENSATE FLOAT SWITCH OR ALTERNATING CONDENSATE FLOAT SWITCH

   Place the hurling pump selector switch(es) in the “OFF” position and the selector switch(es) of the condensate discharge pump(s) in the “AUTO” position. Leave both the condensate return main and the condensate discharge main valves open and remove the fill plug. Add water through the fill opening until the pump starts. If it is a duplex unit note which pump is operating, the tank should empty rapidly, and the pump should stop operating. On duplex units refill the tank and check to see that the second pump operates. The fill cap can now be replaced and tightened. On duplex units, prior to replacing the cap, refill the tank until the pump operates and note if the second pump is operating. Shut off the condensate discharge valve until the pumps shut off. Replace the fill cap and tighten it.





TERMINAL BLOCK

POSITION	ID.
1	118A
2	118A
3	118A
4	118A
5	119A
6	119A
7	119A
8	203A
9	205A
10	207A
11	209A
12	
13	
14	
15	

E3 - TYPICAL WIRING

Vent-Rite®

DATE 7/21/21	JOB #
ENGINEER C ALPERS	SHEET 2 OF2

TROUBLESHOOTING

Operating personnel must be completely familiar with the equipment. This will be necessary for correct diagnosis of any troubles and will permit immediate correction of minor difficulties. It is important that operators be able to quickly distinguish conditions to minimize down-time and maintenance expense.

The following chart will be of assistance in locating and correcting problems.

SYMPTOMS	POSSIBLE CAUSE	REPAIR
1. Insufficient condensate discharge pump pressure shown on the pressure gauge.	a. Inoperative pressure gauge	1. Tap gauge, it may be stuck 2. Check fitting for dirt 3. Replace gauge
	b. Inoperative pump	1. Check for blown fuse or circuit breaker 2. Check for loose terminals and open wiring 3. Replace pump
	c. Insufficient motor speed	1. Check voltage
	d. Pump cavitation	1. Hot condensate (over 180° F) Check for leaky traps in the system. Repair or replace. 2. Inoperative condensate float valve. Repair or replace.
	e. Plugged impeller vanes	1. Clean impeller vanes
	f. Improper motor rotation	1. Reverse the two outside connections to the pump motor.
2. Leaking Pump	a. Mechanical seal defective	1. Replace mechanical seal
3. Poor or no vacuum	a. Inoperative vacuum gauge	1. Check vacuum gauge by tapping it. It may be stuck. 2. Check fitting for dirt 3. Replace
	b. Inoperative pump	1. Check for blown fuses or circuit breaker 2. Check for loose terminals or open wiring 3. Replace pump
	c. Low motor speed	1. Check for proper voltage
	d. Air leaks	1. Check air check to be sure disk is not worn, is clean and properly sealed. 2. Check hose line from accumulator tank check valve to jet exhauster for sponginess. Replace if necessary. 3. Check all plugged openings for tightness
	e. Priming boiler	1. Clean boiler and system
	f. Improper motor rotation	1. Reverse the two outside connections to the pump motor

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