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Clarke Fire Protection Products

Providing adequate Raw Water Supply to the Heat Exchanger Cooled Fire Pump Engines

Most fire pump engine failures occur due to plugged cooling loop strainers! It can be not stressed enough how important it is to keep these strainers clean. If the raw water supply has debris in it (leaves, stones, sand, silt, pond scum, etc) as the strainer accumulates more debris (that will not pass thru it), the flow rate will continue to diminish which will eventually starve the engine of adequate cooling water flow which will lead to engine overheat and could cause catastrophic engine failure. ***When this occurs you have no fire protection!*** NFPA 25 2008 requires that the cooling loop strainers be check quarterly (Table 8.5.3). Clarke recommends that after the initial engine commissioning and also prior to each weekly exercise of the engine, both strainers be removed and cleaned and then re-installed before starting the engine.

Note: Regardless of the interval, there should be qualified operating personnel in attendance during operation to observe the operating conditions of the engine (NFPA 25 2008 Section 8.3.2.1).

As discussed below, there is a Normally Open (Automatic) flow line and a Normally Closed (Manual by-pass) flow line. If flow through the automatic flow line diminishes, as described on the instruction plate on the engine instrument panel, open the Manual by-pass line. You can service the strainer in the automatic flow line with the engine running and Manual by-pass line open by closing the shut off valves at both ends of the Automatic flow line. This will isolate the strainer, regulator and solenoid for maintenance.

After the Manual by-pass has been used and the Automatic flow line has been properly serviced, be sure to remove and clean the strainer in the Manual by-pass line. Always remember to leave the Automatic flow line valves open after completing any strainer cleaning or cooling loop maintenance.

Raw Water Supply

Most Clarke diesel engine fire pump drivers are heat exchanger cooled and some engines also have a charge air cooler (CAC) that uses raw water to cool the air before entering the intake manifold. If you have a radiator cooled Clarke engine, you can disregard this section. Heat exchanger cooled diesel engine drivers require a clean source of pressurized water from the discharge side of the fire pump in order to keep the engine from overheating by providing a specified minimum amount of raw water flow.

Cooling Loop

Figure #1 shows the standard NFPA 20 cooling loop piping arrangement. The cooling loop consists of an Automatic flow line with a 12v or 24v solenoid valve (HSC and ES pump applications only) that is energized to open anytime the engine is called upon to run from either the fire pump controller or from the engine instrument panel.

NOTE: *VT type pumps applications do not require a solenoid valve in the Automatic flow line.*

NOTE*: With the Clarke Mechanical Engine and Alarm Control Board (being released 4th quarter 2010), the solenoid valve will open 15 seconds after engine shutdown and will stay open for 60 seconds. This allows for raw water to flow through the heat exchanger and reduce the heat soak rise caused in the engine.*

The second flow line is called the Manual by-pass line and it can be opened at any time if for any reason the engine shows signs of overheating. Each line has two (quarter turn) shutoff values installed and the normal position of the shutoff valve is to remain open in the Automatic flow line and remain closed in the Manual by-pass flow line.

NOTE: *Opening up both lines to flow is never a problem should there be some concern of engine overheat, especially if there is an emergency situation. The Manual by-pass line can only be opened by an operator in the pump room.*

The shutoff valves are all identified to show which are Normally Open (Automatic flow line) and which are Normally Closed (Manual by-pass flow line). The shutoff valves are also used to isolate water pressure in the event of maintenance to pressure regulators, strainers and solenoid valve.

In each flow line there is also a pressure regulator. Each pressure regulator protects the downstream piping from over-pressurization which includes the tube side of the engine shell & tube heat exchanger (or CAC) and to control raw water flow rate. Typically the pressure regulators are set to limit downstream pressure to 60 psi (4 Bar). There is a pressure gauge installed just upstream of the engine heat exchanger (or CAC) and downstream of the each pressure regulator. Under normal engine operating conditions with adequate cooling water flowing thru the heat exchanger (or CAC) this gauge should typically read below 20 psi (1.4 Bar).

Strainers are used to remove debris from the raw water supply. One strainer is in the Automatic flow line and the other is in the Manual by-pass flow line.

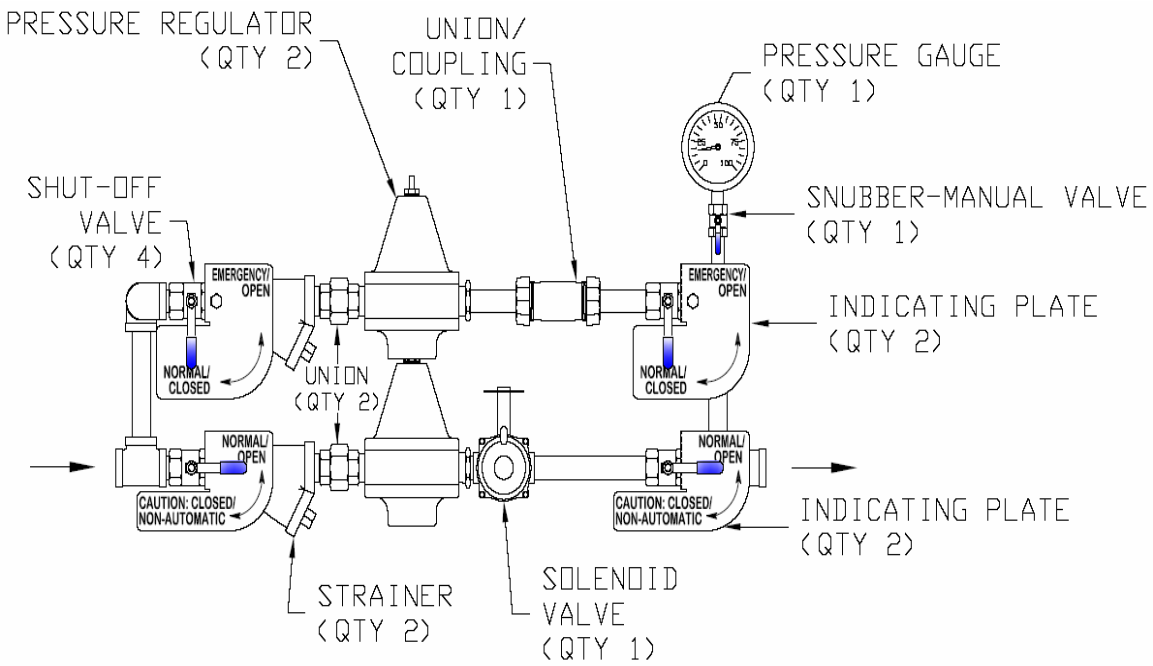

Figure #1

Setting Raw Water Flow Rate

The proper amount of raw water flow thru this line is of the utmost importance, and the pressure gauge value does little to indicate if there is sufficient flow. When the engine is exercised weekly, the amount of raw water flow exiting the piping to a floor drain should always be checked to verify it does not appear to have diminished.

During initial commissioning of the engine, it is important to correctly set the raw flow rate going thru the cooling loop. Each Clarke engine model has an Installation and Operation (I&O) Datasheet that provides basic operating conditions of the engine and most values are given based upon engine speed. You will find this datasheet in the Technical Catalog that is shipped with the engine for your specific Clarke model.

This datasheet must be available during commissioning in order to set the proper minimum raw water flow. You will need to measure the raw water temperature and then find the value for recommended minimum raw water flow at your measured raw water temperature on the I&O Datasheet and then; with the fire pump flowing 150% of rated flow, and the Automatic flow line open; set minimum flow by using the adjusting screw at the top of the pressure regulator.

NOTE: To increase flow turn the adjusting screw clockwise and to reduce flow turn the adjusting screw counterclockwise.

You will need to capture the flow for a specific amount of time coming out of the heat exchanger and going to a floor drain in order to establish a reasonably accurate flow rate value. Using a container or bucket of known volume, record the time required to fill the container and compare

to the gpm or L/min value provided on the I&O datasheet. ***THIS IS CRITICAL FOR PROPER ENGINE COOLING AT MAXIMUM PUMP LOAD!*** After setting the pressure regulator in the Automatic flow line, open the Manual by-pass line valves, and then close the Automatic flow line valves and repeat the above process in order to set the flow rate going thru the pressure regulator in the Manual by-pass line. Once this is completed; close the Manual by-pass valves and open the Automatic flow line valves to restore conditions back to normal.

Raw Water Outlet

NOTE: NFPA 20 does allow for the heat exchanger outlet flow to be returned to a suction reservoir. This makes it very difficult to measure the flow rate. When discharging to a suction reservoir, NFPA provides additional requirements:

1) A visual flow indicator and temperature indicator are installed in the discharge (waste outlet) piping.
2) When waste outlet piping is longer than 15ft (4.6m) and / or the outlet discharges are more than 4ft (1.2M) higher than the heat exchanger, the pipe size increased by at least one size.
3) Verify that when the correct flow rate is achieved that the inlet pressure to the heat exchanger (or CAC) does not exceed 60psi (4bar)

If you have such an installation, it is recommended that you run the engine for a period of time at 150% of rated flow and confirm the visual flow indicator is showing water flow, the temperature rise is not excessive (usually no more than 40F (4.5C) over ambient raw water temperature) and the engine is showing no signs of overheating.

Raw Water Quality, Strainers and Deterioration of Heat Exchanger (or CAC)

Over time, as the heat exchanger (or CAC) begins to plug and foul, this pressure will rise and the flow will diminish which could mean that the heat exchanger (or CAC) may have to be replaced.

Backflow Preventers

NFPA20 allows for the use of backflow preventers in the Automatic and Manual flow line of the cooling loop as required by local code. For specific application information contact the factory.

Raw Water Outlet Temperature

Certain local codes may not allow you to discharge the waste water outlet from the engine heat exchanger either due to its temperature or it now being considered hazardous waste. It is recommended you always check local codes regarding waste water discharge.