Read and understand this manual prior to operating or servicing the products.
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GENERAL DESCRIPTION

Waukesha® LTC Oil Filtration Systems have been designed to remove operating contaminants from the insulating oil of load tap changers. The removal of contaminants can help maintain the oil at the highest possible dielectric strength and minimize equipment failure and downtime. Filtering systems can be installed on existing transformers in the field or specified on new transformers. Oil filtration systems can be configured with various industry-standard filters.

This instruction manual outlines the external mounting configuration, installation and operation of the various units.

SYSTEM SPECIFICATIONS

1) Rugged Weatherproof Cabinet – Outdoor cabinet specifically designed for the oil filtration task with integral mounting flanges and anti-condensate heating.

2) Integral Catch Sump – Built-in 8 gallon catch sump to ensure the avoidance of any environmental spills.

3) Internal Systems – Systems are integrated into the cabinet construction to promote a compact, smooth running design.

4) Automatic Systems Monitoring – Control system, with electrical surge protection, monitors the critical system operation parameters noted below, providing for automatic shut-down and alarm relays that allow for customer monitoring:
   a. **High Pressure** – System monitors the oil pressure and provides for automatic system shut-down if pressure exceeds 85 PSI. A 5-minute delay on start-up is included to prevent false alarm conditions. High pressure normally indicates the need for filter maintenance (set at the factory to 68 PSIG if pleated filter option is chosen).
   b. **Low Flow** – System monitors the oil flow rate and provides automatic system shut-down if the flow rate drops below 0.25 GPM. A 15 second start-up delay is provided to prevent false alarm conditions. Low flow alarm can normally indicate either a need for filter maintenance or a system blockage such as a Clogged Y-Strainer (see page 14 for Y-Strainer location, page 17 for procedure).
   c. **Leak Detection** – High reliability sensor located in the cabinet sump monitors for system leaks and provides for automatic system shut-down if a leak is detected.
   d. **Customer Remote Shut-Down Relay** – This relay will allow the customer to remotely shut down the system by sending a 120 VAC signal from an LTC oil level sensor (or similar).

5) High Reliability Pump System
   a. **Integral pressure activated (110 PSI) oil bypass** – Provides for oil recirculation in the pump to prevent system over-pressure conditions (set at the factory to 72 PSIG if pleated filter option is chosen).
   b. **System Hoses** – 3000 PSI burst strength stainless steel braid covered hoses will provide years of leak-free service.
   c. **Mechanical Seal Design** – Provides the maximum life for pump systems as compared to typical lip-seal designs.
COMPACT LTC OIL FILTRATION SYSTEM MANUAL

SYSTEM SPECIFICATIONS (continued)

6) **Continuous Duty** – Industrial grade, totally enclosed 1/2 HP motor, with automatic reset thermal protection, rated for continuous operation.

7) **Robust Filtering** – System accepts standard 7”x18” filter cartridges:
   a. *Depth Filters* – High capacity depth filter system with SAE J1858 test score of $\beta_5 = 500$ for 5 um particle size and a score of $\beta_3 = 150$ for 3 um particle size.
   b. *Pleated filters* – Optional 0.3 micron pleated filter element.

8) **Ease of Maintenance** – Unique tilt-out canister system allows for ease of filter element maintenance, tool-free:
   a. *Fast* – Filter change without breaking any oil line connections.
   b. *Convenient* – Simple 3-way valve system for secure system isolation and addition of oil make-up. Output isolation check valve presents backflow during filter element maintenance.
   c. *Easy* – Reliable, top-of-canister valve with vent tube for the venting of trapped air during startup or filter medium maintenance. Convenient bottom drain valve for use during routine maintenance.

9) **Flow Indication** – Visible paddlewheel-style flow indicator on the output allows for quick inspection of oil quality and system operation.

TOOLS FOR NORMAL MAINTENANCE

The following tools will be required for normal filter change and strainer service:

- Filter Change – No tools required.
- Strainer Service – Open end wrench, socket or adjustable wrench capable of 1-9/32”. See Maintenance Section for service procedure.
- For Both – Suitable oil containment/disposal vessels and shop towels.

CONSTRUCTION

The filtration system has the pump, motor, controls and filter cartridge all located in a single enclosure. The cabinet has a built-in 8 gallon sump with automatic leak detection. The filter canister is designed for replaceable cartridges and will accept most 7”x18” oil filtration cartridges on the market today. The system is also available with an installation kit that includes all hoses, entrance tube components and fittings necessary for the oil filtration system installation.

CONTROL BOX FEATURES

1) **Enclosure** – UL Type 12 steel construction.

2) **Timer Controller** – Field-proven, sealed and potted IC controller with field adjustable timer settings.

3) **Bypass Switch** – Positioning this switch in the “Timer Bypass” mode will allow for continuous operation (24/7) of the system without changing the programming of the timer. When operating in this mode, all alarm conditions are still monitored as described above.
CONSTRUCTION:  CONTROL BOX FEATURES (continued)

4) **Runtime Meter** – This meter is located on the front cover and records total number of hours the pump has run.

5) **High Pressure Alarm Relay** – Relay output directly wired to the customer connection terminal block to monitor the low flow and leak detection alarm.

6) **Low Flow/Leak Detection Alarm Relay** – Relay output directly wired to the customer connection terminal block to monitor the low flow and leak detection alarm.

7) **Remote Shutdown Relay** – Relay wired directly to the customer connection terminal block to shut down the system from a customer-supplied signal (i.e. LTC oil level gauge).

8) **Indicator LED Lights** – Red or amber LEDs provide status indication at a glance:
   a. *Amber* – System on
   b. *Red 1* – Low Flow Alarm and/or Leak Detected
   c. *Red 2* – High Pressure Alarm
CONSTRUCTION: CONTROL BOX FEATURES (continued)

Figure 1 – Standard Control Box with Bypass Switch and Motor Runtime Meter
CONSTRUCTION (continued)

FILTER HOUSING
The basic filter configuration is designed for LTC tanks up to 1000 gallons. The canister is designed to use most commercially available 7”x18” filters. The canister is rated for continuous operation at 125 PSI.

The system utilizes a common replaceable filter element that is housed within a canister that swings out to allow easy cartridge replacement without oil spills or the disconnection of any lines.

PUMP AND MOTOR
The Waukesha® oil filtration system is designed with a continuous duty rated pump with a flow rate of 1.0 GPM. The pump is equipped with a mechanical high reliability sealing system. The pump is also equipped with an integral pressure by-pass which is factory set at 110 PSI. All pumps are driven by a totally enclosed, continuous duty, thermally protected 1/2 HP motor (set at the factory to 73 PSIG if pleated filter option is chosen).

The system is equipped with a pinwheel-style visual flow indicator to assist in determining proper system operation.
INSTALLATION

The filter assembly may be either pad mounted or mounted on a transformer stiffener. Mounting lugs are provided to accommodate four 1/2” mounting bolts. The filter assembly weighs approximately 200 lbs.

Electrical power can be brought into either side of the main cabinet and routed, via the wire duct, the main power wiring point located in the upper left hand corner of the cabinet. On most systems, power requirements are 120V AC; however, a single-phase transformer option for 240V input power is also available (see Figure 2 below).

ELECTRICAL POWER CONNECTIONS

![Diagram of 120VAC and 240VAC Input Connections]

**NOTE:** System ground pad is provided on the lower right side of the cabinet.

*Figure 2 – 120VAC and 240VAC Input Connections*
NOTE: All connections are located on the Aux Terminal strip located in the upper right hand corner of the main enclosure, behind the filter canister.

For the **HIGH PRESSURE** alarm, connect to the terminal positions #6 and #7 on the Aux Terminal Strip. This is a **NORMALLY OPEN** contact from relay 63PS/AUX. This alarm will activate as the pressure increases to 85 PSIG rising (set at the factory to 68 PSIG if pleated filter option is chosen).

For the **LOW FLOW** and/or **SUMP LEAK** alarms, connect to the terminal positions #7 and #8 on the Aux Terminal Strip. This is a **NORMALLY OPEN** contact from relay 80FS/AUX. This alarm will activate as the flow drops below 0.25 GPM.

To utilize the **Remote System Shutdown** feature, connect to the terminal positions #11 and #12 on the Aux Terminal Strip. Applying a 120 VAC to these terminal positions will activate the relay OL/AUX and cause the system to shut down. The system will remain shut down as long as the 120 VAC is applied. When the 120 VAC signal is removed, the system will automatically initiate a normal filtering cycle.
INSTALLATION (continued)

A complete flexible tube installation kit is recommended; however, the customer may also hard pipe the oil inlet and outlet from the oil filter system. These guidelines should be followed when installing the supply and return piping:

1) Plumbing from the TLC compartment to the filter should be 0.50” inside diameter or larger.
2) Do not use galvanized pipe or fittings; copper or stainless steel tubing is recommended.
3) Do not exceed six (6) elbows on the supply piping or six (6) elbows on the return piping.
4) If the total length of inlet plus outlet piping exceeds 75 feet, use 0.75” inside diameter piping or larger.
5) Inlet oil connection is 3/4” NPT female pipe thread.
6) Outlet oil connection is 3/4” NPT female pipe thread.
7) Suction and return tubes should be mounted as far from each other as possible to induce cross-flow.
8) Suction and return tubes should be mounted as close to side walls as possible.
9) The return tube should terminate at the top of the LTC tank.
10) The suction tube should draw oil from the bottom of the LTC tank and should be installed so that the tube opening is 1/2” from the bottom of the tank.
11) An anti-siphon hole must be drilled in the suction tube at 1/2” below the minimum LTC tank oil level. The anti-siphon hole prevents damage to the pumping system by preventing it from drawing air into its systems before the oil level in the LTC tank can be serviced. Drawing air into the pumping system can cause damage over time, and the air drawn in may be forced back into the LTC tank which is not a desirable situation. Moreover, in the event that the LTC oil level continues to fall, the anti-siphon hole will limit the extent of oil loss. Upon starting to draw air, the pump will shut down based on the low flow sensor.
INSTALLATION (continued)

PROCEDURE FOR INITIAL PUMP PRIMING
The manufacturer recommends that the pump be primed prior to start-up. This can be achieved by adding load tap changer oil directly into the oil input line by following these steps:

1) With the pump OFF, turn the 3-way valve to the horizontal position (refer to Figure 4 on page 11).
2) Place sample/prime hose in a supply of clean transformer oil (strongly recommend positioning this above the height of the 3-way valve).
3) Place the canister vent hose in a suitable oil catch container.
4) Open the canister air vent valve.
5) Turn the pump ON. Ensure that oil from the priming oil supply is flowing into the system.
6) Monitor the canister vent hose for fluid flow*.
7) **Monitor the canister vent hose, continue the priming operation until the oil coming out of the canister vent hose is bubble-free.**
8) Turn pump OFF
9) Turn the 3-way valve handle to the DOWN/vertical position.
10) Close the canister vent valve.
11) Unit is now ready for normal operation.

* The pump may shut off due to a low flow alarm after 15 seconds. Return the power switch to the OFF position to reset the alarm and then back to the ON position to continue the priming operation. You may have to repeat this reset procedure several times before the system is fully primed.
INSTALLATION: PROCEDURE FOR INITIAL PUMP PRIMING (continued)

Figure 4 – System Priming Valves
OPERATION

The system operates by circulating oil from the LTC switching compartment through the filter. The pump draws oil from the LTC oil compartment at a rate of 1.0 GPM. The oil is forced through the moisture absorbent filter element which absorbs water and removes particulates suspended in oil.

Pump operation can be manually initiated by turning the power switch to the OFF position and back on. If equipped, the bypass switch will manually operate the pump without the timer functions. The safety functions of the system are always in effect and cannot be bypassed. The system will always alarm when the pressure reaches 85 PSIG rising (set at factory to 68 PSIG filter option is chosen) which would normally signify the immediate need for a filter change. However, for best operation, the filter should be changed when the pressure indicated on the pressure gauge reaches 60-65 PSI, or as recommended by the filter cartridge manufacturer, whichever comes first (wait at least one minute before reading to allow the pressure to stabilize). Filter life will vary depending on the number of LTC operations, pump size used, filter size used, pump timer settings and volume of oil in the LTC tank. The high pressure setting on the pressure switch is set at 85 PSI (set at the factory to 68 PSIG if pleated filter option is chosen). The low flow switch will shut the system off if the flow drops below 0.25 GPM. For additional safety, the integral pump pressure by-pass automatically bypasses the oil if the pressure exceeds 110 PSI.

Timing operations of the filtering system are controlled by the timer/controller located inside the control box. The timer can be accessed by removal of the front cover screws. Factory Default setting is ALL DIP switches in the OFF position (run 2 hours every day).

**TIMER PROGRAMMING**

<table>
<thead>
<tr>
<th>Duration of Operation</th>
<th>DIP SWITCH NUMBER 1</th>
<th>DIP SWITCH NUMBER 2</th>
<th>RUN TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. 2 hours</td>
<td>OFF</td>
<td>OFF</td>
<td>2 HOURS</td>
</tr>
<tr>
<td>b. 4 hours</td>
<td>OFF</td>
<td>ON</td>
<td>4 HOURS</td>
</tr>
<tr>
<td>c. 8 hours</td>
<td>ON</td>
<td>OFF</td>
<td>8 HOURS</td>
</tr>
<tr>
<td>d. 24 hours</td>
<td>ON</td>
<td>ON</td>
<td>CONTINUOUS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Frequency of Operation</th>
<th>DIP SWITCH NUMBER 3</th>
<th>DIP SWITCH NUMBER 4</th>
<th>RESTART EVERY</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Daily</td>
<td>OFF</td>
<td>OFF</td>
<td>1 DAY</td>
</tr>
<tr>
<td>b. Every Other Day</td>
<td>OFF</td>
<td>ON</td>
<td>2 DAYS</td>
</tr>
<tr>
<td>c. Weekly</td>
<td>ON</td>
<td>OFF</td>
<td>7 DAYS</td>
</tr>
<tr>
<td>d. Every Other Week</td>
<td>ON</td>
<td>ON</td>
<td>14 DAYS</td>
</tr>
</tbody>
</table>
OPERATION (continued)

CONTROL BOX
High pressure and low flow alarm/leak detection conditions are monitored by separate high pressure and low flow/leak detection switches. The time has built-in time delays on both the high pressure and low flow alarms to prevent false alarming at start-up. After start-up, the system automatically shuts down in the event of a high pressure or low flow/leak detection condition.

The high-pressure alarm has a 5-minute delay, which provides time for warm oil to circulate through the filter during cold weather, reducing the chance of false alarms. The system will alarm on high pressure if the filter becomes clogged or return line becomes blocked.

The low flow alarm has a 15 second delay and will provide indication if an insufficient volume of oil is flowing through the unit. Possible causes of this can be attributed to the following: motor fails to start, a break occurs in the oil supply line, oil level falls below the anti-siphon hole (this situation only applies if the customer has installed the stainless steel entrance tube kid as recommended by SPX Waukesha).

The leak detection sensor, located in the cabinet sump, immediately shuts down the system upon detecting fluid in the cabinet sump. This alarm cannot be reset until the fluid has been removed from the cabinet sump.

To reset the system after an alarm, turn the power switch to the OFF/RESET position and back to ON. The alarms will reset and the timer will also reset initiating operation of the pump for the duration of the timer setting. NOTE the exception for the leak detection alarm in the previous paragraph.

Each of the alarm relays is wired out to the Aux Terminal Strip and can be wired into the customer's SCADA system (see wiring schematics on page 8 of this manual).

COLD TEMPERATURE OPERATION
SPX Waukesha recommends that this unit be operated in the continuous mode when temperatures are below –6°C (21°F) to avoid excessive wear on the close tolerances in the gear pump due to cold starts. See Appendix E on page 27 for Optional Auto Run Cold System description.
MAINTENANCE

NOTE: Some optional equipment is shown.

Figure 5 – Component Identification
MAINTENANCE (continued)

The compact LTC oil filtration system requires minimal maintenance; the unit has been designed to shut down if problems occur. To reset the alarm lights and place the filter system back in service, turn the power switch to OFF/RESET, then back ON.

ANNUAL INSPECTION

1) Annually (or if the system has shut down due to LOW Flow), **CLEAN out the Y Strainer** before any other action.

2) Check system for leaks.

3) Check LTC oil level.

4) Check operation by turning to OFF/RESET and back ON. This will initiate a pump cycle.

5) Check the pressure on the gauge when the pump is running. If the pressure is above 60 PSI under normal temperature conditions, change the filter.

6) Check the service date of the filter cartridge. If it is beyond the manufacturer’s recommended life cycle date, change the filter cartridge.

SYSTEM FILTER REPLACEMENT

1) Turn the power switch to the OFF/RESET position.

2) Let the system set for a few minutes to allow system pressure to equalize.

3) Turn the 3-way valve to the right/horizontal position to isolate the LTC (see Figure 4 on page 11). Any remaining system pressure will be released through the make-up hose.

4) Loosen the left canister bracket wing nut (see Figure 4 on page 11). The right canister bracket bolt is fixed.

5) Support the canister while swinging the loose canister bracket to the right, out of the way.

6) Gently allow the canister to swing forward until the canister restraint cable stops its movement.

7) Place the canister vent hose in a suitable oil catch container.

8) Slowly open the canister vent valve to release any pressure that may still exist in the canister.

9) Place the canister DRAIN hose, located at the bottom of the canister, into a suitable oil catch container. Open the drain valve to drain oil from the canister. Close the drain valve once the canister is emptied. **NOTE:** This step is optional but reduces the chance of an oil spill during the filter change process.

10) Loosen and remove the canister lid clamp using the “T” handle.

11) Remove the canister lid and canister lid clamp; place aside in a clean area.
MAINTENANCE: SYSTEM FILTER REPLACEMENT (continued)

12) Loosen and remove the hand tightened filter retaining nut located at the top of the exposed filter on the center post. Place aside in a clean area. If pleated filter option is used, remove the top filter adapter.

13) Lift out the filter element and place in a suitable container for later disposal.

14) Insert a fresh filter element, ensuring it seats properly on the bottom seal. If pleated filter option is used, replace the top filter adapter.

15) Replace and securely hand tighten the filter retaining nut on the center post.

16) Carefully inspect the filter lid seal ring for any signs of damage or wear and replace, if necessary. Then replace the canister lid, seating it properly. Install the lid clamp and “T” handle. Position the “T” handle so it will be parallel to the back of the cabinet. Use the “T” handle to tighten the lid clamp securely.

17) Gently swing the canister back to the vertical position and swing the canister bracket back into position. Replace the canister bracket washer and wing nut and securely hand tighten.

18) Check that the canister vent hose is in a suitable oil catch container and that the canister drain valve is CLOSED.

19) Turn the 3-way valve to the DOWN/vertical position.

20) Turn the pump motor control ON and monitor the canister vent hose for oil flow.

   NOTE: The pump may shut off due to a low flow alarm after 15 seconds. Return the power switch to the OFF/RESET position to reset the alarm and then back to the ON position to continue the filter canister filling operation. You may have to repeat this reset procedure several times before the filter canister is completely fully and de-aired.

21) **Continue monitoring the canister vent hose until it is running solid with oil without any bubbles.**

22) Turn the pump control to OFF and close the canister vent valve.

23) Turn the pump control to the ON position.

24) With the pump running, check for leaks and ensure that the visual paddlewheel flow indicator is spinning.

25) Check the LTC oil level and add any make-up oil following the “Make-up Oil Procedure” on page 17 of this manual.

26) System is now ready for normal operation.

⚠️ **CAUTION:** For low oil volume LTCs, up to 5 gal of make-up oil may need to be added to avoid tripping the LTC low oil level alarm after a filter cartridge change.
MAINTENANCE (continued)

MAKE-UP OIL ADDITION PROCEDURE

1) Turn the pump control to the OFF/RESET position.
2) Place prime/make-up hose in a supply of clean transformer oil, strongly recommended to be placed above the height of the sample/prime valve.
3) Turn the 3-way valve to the RIGHT/horizontal position.
4) Turn the pump ON. Ensure the oil from the priming oil supply is flowing into the system.
5) After the desired quantity of oil has been introduced into the system, turn the pump control to the OFF/RESET position.
6) Turn the 3-way valve to the DOWN/vertical position.
7) Unit is now ready for normal operation.
8) With the system running, check for leaks.

STRAINER CLEANING PROCEDURE

1) Turn the pump control to the OFF/RESET position.
2) Place a suitable oil catch tray under the strainer position.
3) Wait several minutes to allow the system pressure to dissipate.
4) Turn the 3-way valve to the RIGHT/horizontal position (any residual system pressure will vent through the prime/make-up hose).
5) Observe the pressure gauge, which should be at zero. If not at zero, after placing the canister vent hose in a suitable container, slowly open the canister vent valve to vent the pressure.
6) Slowly loosen and remove the strainer hex nut/seal that is holding the strainer screen.
7) Replace the strainer screen and the retainer hex nut/seal; tighten the hex nut.
8) Turn the 3-way valve to the DOWN/vertical position.
9) Turn the pump control from OFF/RESET to the ON position.
10) Monitor the canister vent hose for air that might have been trapped in the system. Close the canister vent valve when all air has been purged.
11) The system is now ready for normal operation.
12) With the system running, check for leaks.
TROUBLESHOOTING

1. Motor will not operate.
   a. Check for 115 VAC control power at terminals 2 and 7.
   b. Check for voltage at the motor.

2. Low Pressure and/or Low Flow
   a. Check motor power supply at terminals 2 and 7.
   b. Check operation of pump.
   c. Check that the LTC input valve is completely open.
   d. Check that the LTC oil level is above the anti-siphon hole level.
   e. Check the visual flow indicator for indications of the system’s operation.

3. High Pressure and/or Low Flow
   a. Check to confirm the filter does not need to be changed.
   b. Check for other blockages in the system.
   c. Check the visual flow indicator for explanations of the system’s operation.

4. General Oil Leaks
   a. Check connections for tightness
   b. Check tubing for cracks and replace, if necessary.

REPLACEMENT PARTS AND SERVICE

Please contact us at 800-338-5526 for replacement parts and/or service. Or visit us online at www.waukeshacomponents.com.
APPENDIX A: General Dimensions

Figure 6 – Compact Oil Filtration System with Rear Mounting Dimensions
APPENDIX B: General Piping Diagrams

NOTE: See written instructions and additional diagrams on Pages 9, 20 and 21.

Figure 7 – Installation Using Flexible Hose Kit (OPTIONAL)
APPENDIX B (continued)

<table>
<thead>
<tr>
<th>Recommended Tubing Length</th>
<th>0 Elbows</th>
<th>1 Elbow</th>
<th>2 Elbows</th>
<th>3 Elbows</th>
<th>4 Elbows</th>
<th>5 Elbows</th>
<th>6 Elbows</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2” I.D. Tubing (ft)</td>
<td>14</td>
<td>11</td>
<td>9</td>
<td>7</td>
<td>5</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>3/4” I.D. Tubing (ft)</td>
<td>70</td>
<td>67</td>
<td>64</td>
<td>62</td>
<td>59</td>
<td>56</td>
<td>53</td>
</tr>
<tr>
<td>1.0” I.D. Tubing (ft)</td>
<td>220</td>
<td>217</td>
<td>214</td>
<td>212</td>
<td>209</td>
<td>206</td>
<td>203</td>
</tr>
</tbody>
</table>

FLEXIBLE HOSE KIT ASSEMBLY NOTES
1) Mark and cut hose to desired length using a fine tooth hacksaw or cutoff machine.
2) Remove nipple from socket and place nipple aside.
3) Place socket in vice and screw in hose counter-clockwise until the hose bottoms out (approx. 1.0”). Back hose out 1/2 turn. Mark hose with grease pencil or equivalent.
4) Oil inside of hose and nipple threads liberally with transformer oil. Do not oil hose cover.
5) Screw the nipple assembly into the socket using a wrench on the nipple hex until the nipple hex shoulders against the socket.
6) Ensure the grease mark has not separated during the tightening of the assembly.

Figure 8 – Instructions for Installation of Flexible Hose Kit (Optional)
APPENDIX B (continued)

HOLE TO BE DRILLED IN THE FIELD 1/2" BELOW THE LOW ALARM OIL LEVEL. HOLE TO BE Ø 0.125 (3.175mm) IN DIAMETER THROUGH ONE SIDE.

TUBE TO BE CUT TO LENGTH AFTER ASSEMBLY IN THE FIELD.

Figure 9 – Instructions for Anti-Siphon Hole on Suction Tube of Entrance Kit
APPENDIX C: Ladder/Point Wiring Diagrams

<table>
<thead>
<tr>
<th>CONTROL RELAY</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>63PS</td>
<td>HI PRESSURE, SNAP LEAK DETECT ALARM RELAY</td>
</tr>
<tr>
<td>60PS</td>
<td>LG FLOW DETECT ALARM RELAY</td>
</tr>
<tr>
<td>CL/AUX</td>
<td>CUSTOMER REMOTE SHUTDOWN RELAY</td>
</tr>
<tr>
<td>SP</td>
<td>TIMER ENABLE/DISABLE SWITCH (SPDT)</td>
</tr>
<tr>
<td>L3</td>
<td>HIGH PRESSURE ALARM LED INDICATION (RED)</td>
</tr>
<tr>
<td>L2</td>
<td>LOW FLOW &amp;/OR LEAK DET. ALARM LED (RED)</td>
</tr>
<tr>
<td>L1</td>
<td>POWER ON LED (AMBER)</td>
</tr>
<tr>
<td>SLD</td>
<td>SNAP LEAK DETECT SENSOR</td>
</tr>
<tr>
<td>HPS</td>
<td>HIGH PRESSURE SWITCH (25 PSI)</td>
</tr>
<tr>
<td>LFM</td>
<td>LOW FLOW SIGNAL MIRROR RELAY</td>
</tr>
</tbody>
</table>

**NOTES:**

1. ALL RELAY/SWITCH CONTACTS SHOWN WITHOUT POWER APPLIED.
2. ALL SENSOR CONTACTS SHOWN AT ZERO PRESSURE/ZERO FLOW.

Figure 10
APPENDIX C (continued)

Figure 11 – Standard Control/Alarm Circuit
APPENDIX D: Optional Flow & Pressure Transducers

Typical Transducer Monitoring Loops

**NOTE:** All connections are located on the Aux Terminal strip located in the upper right hand corner of the main enclosure, behind the filter canister.

For the **Flow Transducer**, connect the current loop to the terminal positions #1 (minus) and #2 (plus) on the Aux Terminal Strip. Shielded cable is recommended with the cable shield connected to terminal #3.

For the **Pressure Transducer**, connect the current loop to the terminal positions #4 (minus) and #5 (plus) on the Aux Terminal Strip. Shielded cable is recommended with the cable shield connected to the terminal #3.
1. Setting the Flow Transducer LOW (4 mA) Endpoint
   a. With the system ON but the pump not running, locate the flow transducer and the flow transducer configuration panel (see Figure 4 on page 11).
   b. While watching the flow transducer INDICATOR LIGHT, press and hold both the “SET” and “4” buttons.
   c. Release them both when the INDICATOR LIGHT blinks.

2. Setting the Flow Transducer High (20 mA) Endpoint
   a. With the system ON and the pump running, locate the flow transducer and the flow transducer configuration panel (see Figure 4 on page 11).
   b. Allow the flow to stabilize for a minimum of 5 minutes.
   c. While watching the flow transducer INDICATOR LIGHT, press and hold both the “SET” and “20” buttons.
   d. Release them both when the INDICATOR LIGHT blinks.

3. The Pressure Transducer is factory calibrated for 4 mA @ 0 PSIG and 20 mA @ 150 PSIG.

NOTE: During the high and low flow transducer set point procedure, if the new settings are very different from the previous settings, it is possible to reverse the 4 mA and 20 mA set points so that the 4 mA frequency is higher than the 20 mA frequency. The situation corrects itself after you complete both set points. If the new settings are close to the previous settings, you may safely set the low and high settings independently.
APPENDIX E: Optional Auto Run Cold System

Optional Auto Run Cold System will automatically start the filtration system if the outside temperature falls below 20°F, even if no scheduled run period is programmed. This feature ensures the filtration system continues to provide clean mineral oil to the tank, protecting it during cold weather events and avoids the problem of cold weather starts which can produce high system pressure shut-downs.

When the outside ambient temperature rises to above 30°F, the system reverts to the normal programmed run pattern.
APPENDIX F: Oil PCB-Free Statement

SPX Transformer Solutions, Inc. certifies that the OF2 Oil Filtration System and any oil residue from factory testing prior to shipment will be free of PCB (Polychlorinated Biphenyl) contamination.

REPLACEMENT PARTS AND SERVICE

Please contact us at 800-338-5526 for replacement parts and/or service. Or visit us online at www.waukeshacomponents.com.