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INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

MODEL T1001 & T1003

SKOTCH[®] TRIFECTA[®] OIL VALVE SYSTEMS

WARNING

Valves and valve actuators supplied by Engineered Valves are designed and manufactured using good workmanship and materials, and they meet the applicable industry standards. These valves are available with components of various materials, and they should be used only in services recommended herein or by a company valve engineer. Misapplication of the product may result in injuries or property damage. A selection of valve components of the proper material consistent with the particular performance requirement, is important for proper application.

Examples of the misapplication or misuse of a valve or valve actuator includes use in an application that exceeds the pressure/temperature rating, or failure to maintain the equipment as recommended.

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REV LEVEL -

TABLE OF CONTENTS

SECTION		PAGE
I.	Description	4
II.	Operation	5
III.	Installation	7
IV.	Maintenance & Disassembly Instructions	9
V.	Leak Testing	17
VI.	Proof of Closure Switch Testing	19
VII.	Miscellaneous Instructions for Special Options	21
VIII.	Spare Parts Ordering Information	21
IX.	Reference Information	21

DRAWINGS

03-001	Valve Assembly - Model T1000 Systems
03-016	Valve Assembly - Model T1001, T1003
57-002	Dimensions - Model T1001, T1003
60-001	Wiring Diagram - Model T1001
60-005	Wiring Diagram - Model T1003

I. DESCRIPTION

The Model T1001 and T1003 Oil Valves are an integral valve system with all components housed within a single valve body. It is typically used on all oil-fired burners and igniters where steam or air atomization is required. The Scotch Trifecta's unique two-stem three-seat design enables it to perform all key functions, including fuel sequencing, atomization and purging of downstream piping by providing three distinct valve positions.

1. Closed - Both oil and atomizing/purge media off
2. Fire - Both atomizing and oil flowing while purge is off
3. Purge - Both atomizing and purge media flowing while oil flow is off

The Model T1001 utilizes an electro-hydraulic actuator and requires electric power to open, purge and close. The system fails in the last position upon loss of electrical power.

Due to the failure mode, Model T1001 valve systems can never be Factory Mutual (FM) approved.

The Model T1003 utilizes an electro-hydraulic actuator and requires electric power to open and purge. The system goes to the Closed position on loss of electric power. Valves incorporating specific options may be Factory Mutual Approved (FM) for use as a "Combination Oil Safety Shutoff, Atomizing and Purge Valve".

A single Scotch oil valve is typically installed in place of a multiple valve arrangement.

Consult order specification for detailed specifications of equipment supplied on each project.

II. OPERATION

Refer to Purchase Order Specification or solenoid valve assembly nameplate to determine proper line voltage. Operation is in accordance with reference drawings.

Check specific order options and wiring diagrams (60-008 for AC voltage or 60-009 for DC voltage) for electrical terminals supplied inside the junction box.

A. *Closed: Oil Flow Off, Purge and Atomizing Media Flow Off*

In this position the atomizing valve plug is held against the atomizing seat by the actuator return spring, blocking flow of the atomizing media. The oil valve plug is held in the oil seat by the oil valve return spring, blocking oil flow. The oil valve proof of closure (POC) switch is made. The valve closed limit switch is actuated and the valve open limit switch is deactuated.

Model T1001: Applying line voltage to terminal points 2 and 3 moves the system to the closed position.

Model T1003: Delete line voltage from all terminal points (1, 2, 3, and 7) to moves the system to the closed position.

B. *Fire: Atomizing Media and Oil Flowing, Purge Off*

Commanding the actuator to the Fire position causes the atomizing stem to move downward towards the oil stem. As the atomizing stem contacts the oil stem, it forces the oil plug out of its seat ring initiating oil flow while simultaneously seating in the purge seat. Prior to any oil flowing the oil valve POC switch changes contact states. The valve open and close limit switches change states from the valve closed position (Valve open actuated & valve closed deactuated).

Model T1001: Applying line voltage across terminal points 1 and 3 moves the system to the fire position.

Model T1003: Applying line voltage across terminal points 1, 2, and 3 moves the system to the fire position.

C. *Purge: Atomizing and Purge Media Flowing, Oil Off*

Commanding the Actuator to the Purge position moves the atomizing stem to the purge position. In this position the atomizing plug is positioned between, but not in contact with the atomizing and purge seats. Accordingly, the atomizing stem is not in contact with the oil plug, therefore the oil valve remains in the closed position. The atomizing media flows from the atomizing inlet to both the atomizing and oil outlets, purging or clearing any oil which, remains in the downstream oil piping. There is no oil flow in the purge position and the oil valve POC switch is made. Both the valve open and valve closed limit switches are deactuated.

Model T1001: Applying line voltage across terminal points 3 and 7 moves the system to the purge position.

Model T1003: Applying line voltage across terminal points 1 and 7 moves the system to the purge position.

D. *Notes*

Some installations may require tip warm up prior to light-off. This can be accomplished by commanding the valve to "Purge" for a period before commanding to "Fire". Atomizing steam then passes down both atomizing and fuel lines, warming up the tip in preparation for ignition.

III. INSTALLATION

WARNING

Prior to installation and/or start-up, inlet piping should be verified as being free of dirt, grit, welding slag, or other particulate contamination. Failure to do so may result in damage to valve internals.

A. Unpacking

Do not remove protective plugs from valve and solenoid until ready to install.

If plastic protective caps are missing, verify no debris or foreign objects are inside valve.

Transporting - Use proper hoisting procedures to avoid damage to valve. Do not lift by conduit, switches, etc.

B. Valve Installation

The oil valve installation should be in accordance with standard practices for end connection selected. Valves with weld end connections are supplied with end connections of sufficient length to prevent thermal damage to valve internals. As a safety precaution, methods to thermally block the transfer of heat to the valve body should be employed during welding. ***The end connections should not be modified to a shorter length.*** The weight of the valve must be properly supported to prevent excessive piping stresses. The valve may be installed in any position, but the ***actuator should be supported when the valve is installed horizontally.*** ***Adequate clearance should be provided for valve maintenance and repair.***

CAUTION

Valve must be installed in proper flow direction, per valve flow tag. Improper installation will result in fuel contamination of atomizing piping, and improper valve operation.

CAUTION

Ensure piping upstream of fuel inlet DOES NOT include a check valve since this will cause hydraulic locking of the oil valve in the closed position.

CAUTION

The valve must be installed with the actuator in the vertical upright position *ONLY*.

C. Electrical Hook Up

Electrical power is required to operate the oil valve system. Wiring should be in accordance with referenced drawings and all applicable codes. All wiring connections are on the main terminal board located inside the terminal board compartment, to limit switches inside the limit switch compartment and to the oil valve POC switch.

Warning

Make certain electrical supply is isolated and tagged out before proceeding with electrical connections.

D. Start-Up

When valve is placed in service, stroke the main stem and oil stem two or three times (Fire cycles) and then check for packing leaks. If leakage is present, tighten adjusting nut 1/8 turn, stroke valve several times to ensure proper setting of packing and recheck. Repeat until leakage is stopped. This should occur before nut is completely tight. If leakage is present when nut is completely tight, packing must be replaced and the stem inspected for wear. Refer to instructions in Section V.

CAUTION

DO NOT OVER-TIGHTEN PACKING. Over-tightened packing may cause excessive stem friction, inhibiting stem movement.

IV. MAINTENANCE AND DISASSEMBLY INSTRUCTIONS**A. Maintenance**

The Scotch Trifecta Valve Systems requires periodic maintenance and adjustments in order to function properly. The following is a list of items which, must be inspected on a regular basis.

1. Testing Oil Valve Seal

Periodic leak testing should be performed per all applicable codes to verify proper operation of oil valve seal. See Section V for leak testing procedures.

2. POC Verification

Periodic testing should be performed per all applicable codes to verify proper operation of the oil valve POC switch. See Section VI for POC switch setting procedures.

3. Packing Inspection

Both the oil valve and the atomizing packing should be inspected regularly for leakage. If any leakage is noted the packing should be adjusted until the leakage has stopped. See Section III.D for instructions.

4. Actuator Maintenance and Adjustment.

The electrohydraulic actuators supplied with the T1001 & T1003 systems require very little preventative maintenance. The reference actuator assembly drawing identifies and shows location of those parts that may require corrective maintenance over the service life of the system and are field repairable. The actuator cannot be disassembled in the field due to internal spring preload.

NOTICE

**Do not remove actuator nameplate to access actuator internals.
There are no field replaceable parts below the nameplate.**

To repair or replace field serviceable items other than Auxiliary Limit Switches, refer to ASCO General Controls Bulletin contained in the reference information at the end of this publication.

To repair, replace or adjust Auxiliary Limit Switches, refer to ASCO General Controls Bulletin contained in the reference section and the following. Switches LS-1 and LS-2 are factory set and should not require adjustment during normal operation. If it becomes necessary to adjust these switches, the following procedure should be used:

- a) Ensure the actuator is in the fully closed position.
- b) Adjust the cam on LS-1 so that the normally open contacts of the switch are made when the valve is closed. Adjust the cam so the normally open contacts break when it is rotated 40° to 45°.

- c) Set the cam on LS-2 such that the Switch Arm just falls off the cam when rotated counterclockwise two teeth further than switch LS-1.
- d) Verify proper switch setting by verifying no oil stem movement when the system is stroked to the purge position. If the oil stem moves, rotate the cam for switch LS-1 counterclockwise two teeth. Switch LS-2 should also be rotated counterclockwise two teeth.
- e) Repeat test per (d) above. Switch setting is satisfactory when no oil stem movement occurs when the valve is stroked to the purge position.

WARNING

If LS-2 normally open contacts change state prior to the normally open contacts of LS-1, the actuators pump unit will run continuously, cycling between LS-1 normally open contacts make and break point. This will cause the pump unit to fail prematurely. Ensure the normally open contacts of LS-1 break before the normally open contacts of LS-2.

5. Body to End Flange Joint Inspection

Body end flange joints should be inspected regularly for leakage. Any leakage should be repaired immediately. See following Section for instructions.

CAUTION

Failure to repair atomizing end flange joint on steam atomized systems may result in steam cutting of valve body, end flange assembly or both. This may result in serious damage to the valve.

All T1000 series Skotch Trifecta Valve Systems may be disassembled without removal from piping. It is recommended the work area be as clean as possible. Ensure all manual isolation valves are closed and tagged out and all electrical circuits are de-energized. BE SAFE!

The following instructions describe how to fully disassemble the valve system. Individual corrective tasks may not require complete disassembly. The user should judge what steps are appropriate for each task.

Special tools are needed to remove the valve seats. The following tools are available:

ITT P/N: 99-002, Oil seat ring tool. This tool will only remove the oil seat ring. This tool is only good for working on the oil side of the valve and is an economical solution in servicing the oil side of the valve.

ITT P/N: 85-002, T1000 seat ring tool, This tool will remove all three seats (atomizing, purge and oil) from the oil valve body and is needed when servicing the atomizing side of the valve. With this tool it is not necessary to purchase 99-002.

NOTE: Customers that do not feel comfortable with rebuilding and testing Skotch valves can have them rebuilt by the factory. Call the number located on the front cover or (800) 366-1111 and ask to speak to Skotch, Customer Service for quotation and instructions.

1. Actuator Removal

Note: Electrical power is required for actuator removal.

CAUTION

Valve system MUST be stroked to purge position prior to decoupling stem connector for actuator removal. Failure to do so may result in damage to upper seat ring and/or main stem subassembly.

Reference Drawing 03-016. Commence actuator removal by stroking the system to the purge position in accordance with Section II.B. Loosen

screw on actuator's wrench arm and carefully slide up. Ensure the Switch Cam driven by the Wrench Arm does not move. Loosen setscrew on Union Nut (Item 5). Unscrew Union Nut. Close (retract) the actuator. Unscrew Yoke Lock Nut (Item 4). Carefully lift Actuator off of the valve making sure not to hit the valve stem. Loosen Stem Nut SetScrew and unscrew Stem Nut (Item 7) from valve stem. Remove Union Nut (Item 5).

2. Atomizing/Purge Valve Disassembly

After completing Paragraph IV.B.1, unscrew Socket Head Cap Screws (Item 6) which retain End Flange (Item 2) to Body (Item 1). Remove End Flange and Body Gasket (Item 7). Be sure to thoroughly clean mating gasket surface, but do not damage it. Insert Seat Ring Wrench (P/N: 85-002) into lugs on Upper Seat Ring (Item 9). Unscrew and remove Seat Ring (Item 9), Seat Ring Gasket (Item 21), and Main Stem (Item 8). Insert other end of wrench into holes in Purge Seat Ring (Item 10) and remove.

3. Oil Valve Disassembly

Remove Hex Nuts (Item 29) holding Limit Switch Box (Item 13) to End Flange (Item 39). Note: These two nuts must be removed uniformly. Remove Limit Switch Box (Item 13) and Oil Valve Return Spring (Item 19). Loosen Set Screw (Item 18) and unscrew Spring Seat (Item 17) from Oil Stem (Item 12). Remove the Socket Head Cap Screws (Item 6) securing End Flange (Item 39) to Body (Item 1), then remove End Flange (Item 39), Oil Stem (Item 12) and Body Gasket (Item 7). Insert Seat Ring Wrench in lugs of Oil Seat Ring (Item 11), and remove Oil Seat Ring and Seat Ring Gasket (Item 21).

CAUTION

To properly unload the Oil Valve Return Spring, make certain the nuts (Item 29) unthread from the studs. A hex wrench can be used to keep the studs from rotating.

4. Packing Removal

After removing end flanges in Paragraphs IV.B.2 and IV.B.3 above, unscrew Packing Nut (Item 3) and remove Packing (Item 4) and Packing Spring (Item 5).

5. Inspection

After disassembly, inspect all sealing and bearing surfaces on valve and actuator parts for physical damage including nicks, scratches or corrosion. Be sure all gasket surfaces are thoroughly cleaned and free of old gasket material. Replace packing. Inspect atomizing, oil and purge seat ring and the oil and atomizing stem/plugs. If any visual damage is apparent, replace part. Check electro-hydraulic actuator for hydraulic fluid leakage. Any component found to be faulty should be repaired or replace.

C. Reassembly**1. Packing/End Flange Reassembly**

Place Packing Spring (Item 5) in stuffing box. Lubricate each individual packing component (Item 4) with KRYTOX[®] lubricant from DuPont. Individually install the components into the End Flange. The assembly order is male ring first, then chevrons, then female ring. Screw packing nut (Item 3) into end flange (Item 2 or 39) and snug up by hand. Do not tighten at this time. Take special precaution not to damage the packing when sliding over the stem threads. Some means of protecting the packing from damage during installation should be employed.

WARNING

Assure packing is installed in the correct orientation. See Drawing 03-001 for proper orientation. Failure to do so will cause the valve to leak severely from packing gland.

2. Oil Valve Reassembly

Lubricate the Oil Seat Ring (Item 11) soft seal sealing surface located on the inside diameter with Magnalube[®]-G from the Carleton-Stuart Corporation. Clean the body oil seat threads and gasket area. Apply Grafoil[®] GTS[®] sealant to both the Body (Item 1) and Oil Valve Seat Ring threads (Item 11), place the Seat Ring Gasket (Item 21) on the Oil Valve Seat Ring (Item 11) and thread into Body (Item 1). Torque to 130 Ft-Lbs (176.3 Nm). Lubricate the oil stem plug with Magnalube[®]-G and the shaft with antiseize lubricant. Carefully slide the oil stem (Item 12) into the End Flange (Item 39), making sure not to damage the Packing (Item 4). Slide the Body Gasket (Item 7) over the End Flange subassembly (Item 39). Lubricate the 4 end flange Screws (Item 6) with antiseize compound and fasten the End Flange assembly (Item 39) onto the Valve Body (Item 1), ensuring the limit switch box Studs (Item 14) are properly oriented (In line with piping). Torque the end flange Screws (Item 6) in two uniform increments. Torque screws initially in a crisscross pattern to 40 Ft-Lbs (54.2 Nm), repeat using 65-70 Ft-Lbs (88.1 - 94.9 Nm) and recheck. Push the Oil Stem (Item 12) up into the Valve Body (Item 1) until it seats in the Oil Valve Seat Ring (Item 11). This may require that the Oil Stem (Item 12) be lightly struck with a mallet until it is fully seated. Screw Spring Seat (Item 17) onto the Valve Stem (Item 12). Hold the Limit Switch Box (Item 13) in place, while adjusting the spring seat position to 2.05" (52.1 mm). This is measured from the inside surface of the Switch Box (Item 13) on which the spring rest to the spring seating surface on the Spring Seat (Item 17). Tighten the Set Screw (Item 18) so the spring seat is secure. Remove the Limit Switch Box (Item 13). Place Oil Valve Return Spring (Item 19) into the Spring Seat (Item 17) and mount the Limit Switch Box (Item 13) using the 2 mounting Nuts (Item 29) with Lock Washers (Item 28). Tighten these fasteners in a uniform manner, so the box is not cocked during assembly. Item 29 should be torqued to approximately 150 In-Lbs (14.1 Nm). Mount the Oil Valve POC Switch (Item 20) to the Limit Switch Box (Item 13) using Washer (Item 23), Lock Washer (Item 24) and Screw (Item 22). Verify the Spring Seat (Item 17) dimension is set correctly. The Oil Valve POC Switch must be set per section VI.

3. Atomizing/Purge Valve Reassembly

Clean the thread/surface area in the Body (Item 1) of both the Purge Seat (Item 10) and Seat Ring (Item 9). Apply Grafoil[®] GTS[®] sealant to both the Purge Seat (Item 10) and Body (Item 1) threads, and screw into the Valve Body (Item 1). Torque to 100 Ft-Lbs (135.6 Nm). Insert the Main Stem (Item 8) into the Valve Body (Item 1). Place the Seat Ring Gasket (Item 21) over the Seat Ring (Item 9), apply Grafoil[®] GTS[®] sealant to both the Seat Ring (Item 9) threads and body threads and screw into Valve Body (Item 1). Torque to 130 Ft-Lbs (176.3 Nm). Place Body Gasket (Item 7) on End Flange (Item 2). Carefully slide End Flange (Item 2) and Body Gasket (Item 7) over the Main Stem (Item 8) making sure not to damage the Packing (Item 4). Lubricate the 4 end flange Screws (Item 6) with antiseize compound and fasten the End Flange assembly (Item 2) onto the Valve Body (Item 1). Torque the end flange Screws (Item 6) in two uniform increments. Torque screws initially in a crisscross pattern to 40 Ft-Lbs (54.2 Nm), repeat using 65-70 Ft-Lbs (88.1 - 94.9 Nm) and recheck. Screw the stem connector onto the Main Stem (Item 8) and tighten set screws.

4. Actuator Reinstallation

After disassembly, inspect all sealing and bearing surfaces on valve and actuator parts for physical damage including nicks, scratches or corrosion. Be sure all gasket surfaces are thoroughly cleaned and free of old gasket material. Replace packing. Inspect atomizing, oil and purge seat ring and the oil and atomizing stem/plugs. If any visual damage is apparent, replace part. Check electro-hydraulic actuator for hydraulic fluid leakage. Any component found to be faulty should be repaired or replace.

5. Test

Conduct the following tests to assure system performance is satisfactory after rebuild.

a) Valve Stroke

Verify no oil stem movement occurs when the valve strokes from the Closed to Purge position. If the oil stem moves, reset LS-1 and LS-2 per Section IV.A.4. and retest. Continue until no movement occurs.

b) Oil Valve Proof of Closure

The oil valve Proof of Closure switch must be adjusted in accordance to Section VI.

V. Leak Testing

After assembly, the Scotch Trifecta Valve should be leak tested to verify proper operation as follows:

A. Atomizing Seat

1. Place the valve in the Closed position.
2. The fuel inlet and outlet ports must be plugged so that test media cannot escape for these ports.
3. Pressurize the atomizing inlet to 50 PSIG (344.7 KPa) air while monitoring the leakage rate from the atomizing outlet. The leakage rate should not exceed ANSI Class IV limits or 1254 cc/min.

4. If leakage is excessive, stroke the valve 10 to 20 times to allow the metal seat to wear in with the metal plug and retest the valve. If valve leakage is still excessive, the main stem and seat should be replaced and the valve retested.

Note: If the actuator was removed anytime prior to testing, the actuator/valve coupling nut should be checked for proper installation. The atomizing stem closure force is due to the return spring located inside the actuator. If the coupling nut is not adjusted correctly it is possible for the actuator to reach its home position without the atomizing plug contacting the seat. If this occurs atomizing seat leakage will take place regardless of the plug and seat condition. The atomizing seat and plug should limit the actuator travel in the Closed position.

B. Purge Seat

1. Stroke the valve to the Fire position using a control pressure between 70 and 120 PSIG (482.6 - 827.4 KPa).
2. The atomizing outlet and fuel inlet should be plugged to keep the test media from escaping from these ports.
3. Pressurize the atomizing inlet to 50 PSIG (344.7 KPa) air while monitoring the fuel outlet port for leakage. The allowable leakage rate per ANSI Class IV is 439 cc/min.
4. If leakage is excessive, stroke the valve 10 to 20 times to allow the metal seat to wear in with the metal plug and retest the valve. If valve leakage is still excessive, the main stem and purge seat should be replaced and the valve retested.

C. Oil Seat

1. The valve should be in fully closed position.
2. The atomizing inlet and outlet should be plugged.
3. Pressurize the fuel inlet port to 50 PSIG (344.7 KPa) air while measuring the leakage rate from the fuel outlet. The allowable leakage rate is one bubble per minute or Class VI.
4. If leakage is excessive, stroke the valve 10 to 20 times to allow the soft seal in the oil seat to wear in with the metal plug and retest the valve. If valve leakage is still excessive the oil seat and/or stem should be replaced and the valve retested.

VI. PROOF OF CLOSURE (POC) SWITCH TESTING

The POC switches should be tested after the valve has been leak tested.

The intent of the Proof of Closure (POC) switch is to prove the valve is in the closed position. To accomplish this, the oil valve is designed with valve seal over-travel. That is, the seal will stop the flow of oil and continue to move in the valve seat bore until the metal seat is made. During this portion of valve stroke the oil valve is effectively sealed, the POC switch contacts must change state. That is, the POC Switch changes state before oil flows regardless of whether the valve moves from the Closed position to Fire or Fire to Closed (Purge).

1. Ensure the valve is in the closed position.
2. Wire the switch to a test device.
3. Loosen switch and push it towards the end flange (up - orientation assumes the valve actuator is on top) to edge of slot or until switch boot hits the edge of the hole. This will typically move the switch roller actuator past the tripping device.
4. Move the switch away from the end flange (down) until it trips. Try and keep the switch level.

5. Mark the limit switch box 0.14" (3.6 mm) from the switch surface opposite the end flange (bottom surface), for the entire length of the switch. This can be accomplished by placing a 0.14" (3.6 mm) thick metal plate on the switch and marking along the edge. Caution with how close the mark is to the plate. If the marking device is always 0.03" (0.8 mm) higher, the plate should then be 0.11" (2.8 mm), so the end result is always 0.14" (3.6 mm).
6. Move switch to the line and tighten the two screws to prevent movement.
7. Plug the atomizing inlet and outlet pipes.
8. With the oil valve fully closed, pressurize the oil inlet to 10 to 20 PSIG (68.9 - 137.9 KPa). While monitoring the outlet for leakage, slowly open the valve. The normally open contacts of the switch should change state before flow commences ($> 1 \text{ Ft}^3/\text{Hr}$ or $0.03 \text{ M}^3/\text{Hr}$). If it does not, loosen the screws, securing the switch and move the switch downward 0.015" (0.4 mm). Tighten retaining screws and repeat test.
9. Pressurize the oil valve inlet between 10 and 20 PSIG (68.9 - 137.9 KPa) while monitoring the outlet for leakage. Stroke the valve to open position. Slowly close the valve while monitoring the normally open switch contacts. Flow should cease ($< 1 \text{ Ft}^3/\text{Hr}$ or $0.03 \text{ M}^3/\text{Hr}$) before contacts change state. If it does not, loosen the screws, securing the switch and move the switch upward 0.015" (0.4 mm). Tighten retaining screws and repeat test. If any adjustments are made during this step, step 8 must be repeated.
10. Switches are properly set when both conditions in Step 8 and 9 are satisfied.

VII. MISCELLANEOUS INSTRUCTIONS FOR SPECIAL OPTIONS

Due to customer requirements, some T1000 Systems incorporate special options. Any special procedures not covered in the above material can be found in the Reference Section of this manual as addenda.

VIII. SPARE PARTS ORDERING INFORMATION

Orders for T1000 Systems Spare Parts should be placed with

*ITT Engineered Valves
33 Centerville Road
Lancaster, PA 17603-2064*

Please be advised that such items as solenoids and switches should not be ordered directly from their manufacturers, as materials may be specially designed for Skotch Trifecta System service. Other replacement parts, although they may be similar in function, will void the FM rating. *To ensure FM rating and/or proper operation, replacement components should be purchased through ITT Engineered Valves.*

IX. REFERENCE INFORMATION

The following pages contain drawings and reference information alluded to in above sections.