WARNING

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

Examples of misapplication or misuse of any ITT Engineered Valves, LLC products include use in an application in which the pressure/temperature rating is exceeded or failure to maintain valve as recommended and use of products to handle caustic and/or hazardous substances when not designed for that purpose.

If valve exhibits any indication of leakage, do not operate. Isolate valve and either repair or replace.
# Record of Revisions

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<td>Updated for new “WARNING” block, company name, and Item No. changes to match product drawing revisions</td>
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### DRAWINGS

- 03-014 Valve Assembly - Model T4100 Systems
- 117591 Valve and Actuator Assembly
- 117620 Wiring Diagram (Peter Paul solv. only)
- 123979 Wiring Diagram Ext. Lim. Switches
- 123980 Wiring Diagram Ext. Go Switches
- 62-010 Pneumatic Schematic - Fail Closed (w/Peter Paul solv.)
- 119429 Pneumatic Schematic – Fail Closed (w/Versa solv.)
- 117624 Pneumatic Schematic – Fail In Last Position
- 60-021 Electric Schematic - Fail-in-Last
- 60-022 Electric Schematic - Fail Closed
I. DESCRIPTION

The Series T4100C Skotch® Burner Valve System provides all the isolation and venting functions necessary for automated operation of gas-fired burners in utility and industrial power plants. This includes double block of the main gas line and venting the chamber between blocks to atmosphere. Hence, the term "Double Block and Vent" or “Double Block and Bleed”. The vents are sized in accordance to IRI’s (Industrial Risk Insurers) and NFPA (National Fire Protections Association) recommended vent sizes. To satisfy code requirements, a Proof of Closure (POC) switch utilizing valve seal overtravel is supplied as standard to prove the valve is closed.

The Model T4105C valve system, which is the Fail-in-Last Position model, utilizes a dual coil momentary contact pilot solenoid for pneumatic operation and requires compressed air and electric power to open and close. The system fails in the last position on loss of pneumatic or electric power. It will not hold this position indefinitely if air is lost.

Due to the failure mode, Model T4105C valve systems can never be Factory Mutual (FM) approved.

The Model T4106C & T4107C valve systems, which is the Fail Closed model, utilizes a single coil maintain contact spring return pilot solenoid for pneumatic operation and requires compressed air and electric power to open. The system closes on a loss of pneumatic or electric power.

Model T4106C valves incorporating specific options which are Factory Mutual approved for Natural Gas Safety Shutoff Valves per FM Approval Standard Class 7400. Valves meeting the requirements of FM are tagged as such.

Model T4107C valves incorporating specific options may not be Factory Mutual listed with valve configuration. Due to specific options the valves are not Factory Mutual (FM) approved.

A single Skotch gas 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 solenoid assembly nameplate or purchase order specifications to determine appropriate line voltage and type. Operation is in accordance with referenced drawings.

A. Open Block Valves (Close Vent)

T4105C, T4106C and T4107C valves follow similar opening protocol.

With pneumatic supply pressure regulated to a minimum of 60 psig and a maximum of 120 psig, apply line voltage across terminal points 1 and 2 for AC (DC voltage, apply across terminal points 18 and 19). This energizes the pilot solenoid, allowing pneumatic pressure into the cylinder.

As pressure is admitted to the cylinder, the outlet valve return spring is compressed and the outlet valve plug moves out of its seat ring. Concurrently, the vent valve moves into its seat until first the soft seal and then a metal to metal backup seal is made closing the vent.

Upon vent closure, the piston continues to stroke. This pushes the inlet valve plug out of its seat ring, compressing the inlet valve return spring. Stroking stops when the piston contacts a travel stop in the actuator section. Flow commences only after the inlet plug clears its seat. Thus, no flow occurs until the vent is closed.

B. Close Block Valves (Open Vent)

How the valve is commanded Closed differs between different model numbers.

For T4105C valves:

Deleting voltage from terminals 1 and 2 and applying momentarily voltage to terminals 2 and 3 energizes the exhaust coil and exhausts pneumatic pressure from the cylinder (for DC voltage, delete voltage from terminals 18 and 19; apply voltage to terminals 20 and 21). Note: Never energize both solenoid coils simultaneously. Doing so, will permanently damage the coils.

For T4106C and T4107C valves:

Deleting voltage from terminals 1 and 2 (for DC, delete voltage from terminals 18 and 19) de-energizes the pilot solenoid and exhausts pneumatic pressure from the cylinder.
For all models:

Upon exhausting the cylinder, both inlet and outlet return springs move their respective plugs toward their seat rings. First the inlet valve soft seal makes, halting gas flow through the assembly, then its metal back-up. Next the vent moves off its seat, opening the vent and relieving downstream pressure. Finally, the outlet valve soft seal, followed by its metal back-up close, completing the cycle. Two independent blocks are formed between system inlet and outlet, with the chamber between the block valves ported to vent. The POC switch trips when the outlet valve soft seal enters its seat.

C. Notes

For Model T4105C valves, the solenoid pilot valve is a dual coil momentary contact type, rated for continuous duty at the service voltage. Note: Never energize both solenoid coils simultaneously. Doing so, will permanently damage the coils.

For Model T4106C and T4107C valves, the solenoid pilot valve is a maintained contact type, rated for continuous duty at the service voltage.

A proof of closure (POC) switch is provided as standard for the outlet valve. The outlet valve POC is located either inside the yoke or mounted above the cylinder depending on customer requirements. Logic is shown on the referenced wiring diagram. Some valves may be equipped with an optional open limit switch located either in the yoke or mounted on the top of the actuator.

Note: Switches located inside the yoke can only be supplied with SPDT contact configuration. External switches may be either SPDT or DPDT contact configuration. Assemblies supplied with DPDT Switches provide all terminal points noted on Wiring Diagram. Valves supplied with SPDT switches have a reduce number of terminals. Reference wiring diagram for details.
III. INSTALLATION

A. Unpacking

☑ Do not remove protective plastic plugs until ready to install.

☑ Verify no debris or foreign objects are inside the valve.

☑ Transporting - use proper hoisting procedures to avoid damage to valve. If using a sling, it should be placed on the body, not the actuator.

☑ Purge the gas line prior to installing the valve.

☑ Purge all air lines prior to connecting solenoids.

☑ Do not pull on the wires located inside the yoke for the internally mounted switches. Doing so can cause the switches to loose calibration.

☑ Historically many problems at start-up are due to mishandling of the valve and poor purging of the fuel and pneumatic control lines.
B. Valve Installation

☑ The T4100C Skotch Trifecta Valve System is typically supplied with a female NPT vent connection and spigot inlet and outlet connections. (Note: Other end configurations available upon request.) Refer to order specification or purchase order specifications for type supplied. Valve installation should be in accordance with standard practices for end connection provided. Flanges are raised face carbon steel per ANSI B16.5. Threads are per ANSI B2.1. Ensure the weight of the system is properly supported to prevent excessive stresses. Valve may be installed in any orientation. Ensure flow direction is appropriate for intended installation. Valves incorporating welded ends should follow special precaution to insure weld heat does not damage the valve seals and gaskets. Temperatures in these areas should be kept below 200°F.

CAUTION

Vent pipe size should be equivalent to the vent fitting size supplied. Reducing vent size may result in insufficient flow capacity. Under NO circumstance should the vent be blocked or plugged.

NOTE:

Prior to installation and/or start-up, 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.

C. Pneumatic/Electrical Hook Up

☑ Purge pneumatic supply lines prior to connecting to the solenoid.

☑ Utilities required for operation are electrical power and clean dry compressed air. Wiring should be in accordance with referenced drawings and all applicable codes. Supply air should be filtered to 40 microns minimum and connected per referenced drawing. Supply air pressure should be 60 to 120 psig at all times.

☑ For internal switches, do not pull on the wires. Doing so may cause the switch to come out of adjustment.
Note: Some assemblies may include a filter regulator (Optional).

Use suitable thread sealing compound only. Do not use PTFE tape.

The exhaust side of the solenoid should not be restricted. This will slow the closing rate of the valve.

IV. COMMISSIONING

After installation, connections should be tested to confirm integrity.

V. DISASSEMBLY AND MAINTENANCE INSTRUCTIONS

All T4100C Systems may be completely disassembled without removal from the piping. However, it is recommended that it be rebuilt in a shop with suitable fixturing, hoisting equipment and tools.

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 (866) 812-8302 and ask to speak to Skotch, Customer Service for quotation and instructions.

Item numbers refer to referenced drawings. Ensure all manual isolation valves are closed and tagged out, all electrical circuits are de-energized and that the pneumatic supply and valve are isolated and depressurized before performing any work on the valves.

IMPORTANT: Special tools are needed for disassembly and assembly. They should be procured before work begins.

Special tools include:

- ITT P/N: 38861, Seat Ring Wrench. Needed to remove the seat from the body
- ITT P/N: 85-034, Spring Assembly Tool. Needed to safely compress/release the outlet valve return spring
- ITT P/N: 38988, Protective sleeve. Needed during installation of outlet valve
Disassembly

A clean dry area should be provided for valve disassembly.

Continue as follows (Reference drawing 03-014):

Remove valve actuator from valve by loosening the three set screws (item 103 drawing, 117591) and sliding it off the valve.

Unscrew vent connector (Item 40) from the valve body (Item 1). Remove o-ring (Item 29), vent shaft seal (Item 28) and thrust washer (Item 27).

Slide out inlet valve return spring (Item 26) and inlet valve subassembly. Remove inlet valve seal (Item 47) by unthreading inlet plug (Item 46) from the vent shaft (item 35).

Remove button head screw (Item 6) and stem cap (Item 7) from outlet valve stem.

Remove hex nut (Item 8) using P/N 85-034 disassembly tool. Thread the assembly tool to the end of the outlet valve shaft. Engage the socket over the nut. While holding the tool rod stationary unthread the hex nut using the socket portion of the tool. Do not remove the assembly tool from the end of the outlet valve until the spring is completely relaxed.

**CAUTION**

This nut (Item 8) is under spring tension. The tool must be used to unscrew this nut and relieve outlet valve spring (Item 11) tension. If it is not used, serious injury may result.

After nut is removed, remove thrust washer (Item 9) and piston (Item 10). Slide outlet valve assembly out through the bottom of the valve. The sleeve (Item 12) will fall out. Remove vent seal (Item 56) and outlet valve seal (Item 52) by unthreading the cap screw (Item 57) and outlet plug (Item 53) from the outlet valve stem (Item 50).

Unscrew spring holder (Item 37) from body (Item 1). Remove retaining ring (Item 16) and remove the seal washer (Item 15), outlet valve shaft seal (Item 14), u-cup seal (Item 38) and washer (Item 39). Remove o-ring (Item 13). Using the seat ring wrench, P/N 38861, remove the valve seat ring (Item 21) and o-ring (Item 22).
The valve is now completely disassembled.

A. **Actuator Removal with Internal Limit Switches**

Reference Drawing 117591:

Remove four cylinder mounting screws (Item 102) and separate cylinder assembly (Item 165) from yoke (Item 101).

B. **Actuator Removal with External Limit Switches**

Reference Drawing 117591:

Remove limit switch by unscrewing switch mounting screw (Item 117). If auxiliary switch is provided it must also be removed.

Remove four cylinder mounting screws (Item 102) and separate cylinder assembly (Item 165) from yoke assembly (Item 101).

C. **Maintenance**

Periodic leak testing of both block valves and verification of proper operation of proof of closure switch is recommended per applicable codes. See Section VI for leak testing and Section VII for switch setting techniques.

Upon disassembly, all sealing and bearing surfaces, including metal back-up seats, should be inspected for nicks or other surface finish damage. Damaged items should be replaced. Prior to reassembly, scrape any remaining gasket material from mating surfaces. Clean gasket surfaces with a good quality solvent.
D. Reassembly

To reassemble system, reverse steps of Section A and make certain all components are clean and undamaged. Lubricate o-rings and seals with a suitable lubricant, such as Dow Corning 55. Threaded joints on the inlet valve subassembly, outlet valve subassembly, spring holder, vent connection and button head screw (Item 6 on drawing 03-014) should be assembled using Loctite 242 and appropriate primer to ensure that these parts do not come apart during operation. When installing the outlet valve assembly through the spring holder a special tool (P/N: 38988) is needed to ensure the u-cup seals (Items 14 and 38) are not damaged during assembly. To use, thread the protective sleeve to the outlet valve stem subassembly until it shoulders. Slide the stem through the seals and bushings in the spring holder. Once the outlet valve assembly is in place remove the tool and proceed with assembly. After reassembly, the valve and switches should be tested per the following procedures in Sections VI and VII.

VI. LEAK TESTING

It is necessary to leak test each block valve and the vent valve individually to properly qualify the status of each seal. The valves are named in accordance to their position and function within the valve system.

A. Inlet Valve

1. Verify the valve is in the closed position.

2. Seal the outlet of the valve.

3. Pressurize inlet with 50 psig clean dry air while monitoring leak rate from the vent port. FM specifies a leak rate of 24 in³/hr or less.
B. Outlet Valve

1. Verify the valve is in the closed position.
2. Seal the inlet side of the valve.
3. Pressurize the vent with 50 psig clean dry air while monitoring leak rate from the outlet. FM specifies a leak rate of 24 in³/hr or less.

C. Vent Valve

1. Verify the valve is in the open position.
2. Seal the outlet port.
3. Pressurize the inlet with a maximum of 50 psig clean dry air, while monitoring the leak rate from the vent port. FM specifies a leak rate of 24 in³/hr or less.

VII. PROOF OF CLOSURE SWITCH TESTING

The T4100C valve system is provided with one proof of closure switch as standard. It can be provided with an optional open switch. The valves can also be provided with an external POC switch as well as an external open switch. Check the order specification for configuration provided.

The intent of the POC switch is to trip during valve seal overtravel of the outlet valve. Valve seal overtravel is the additional travel the valve strokes after flow stops. For reference FM defines the point of valve closure when flow < 24 in³/hr. The switches should only change contact state when there is no flow. For example: When going from open to close, gas flow should stop and then the POC switch trip. Conversely, when going from closed to open the POC switch should change contact states prior to flow starting.

The POC switches should be tested after the valve has been leak tested.
A. Testing Internal POC Switch

1. Testing
   
a) Verify the valve is in the closed position and the normally closed contacts are made.

b) Plug the inlet port. Stroke the valve very slowly until the switch trips. At this point, stop movement of the actuator and verify flow has not commenced (< 24 in³/hr) by pressurizing the vent port to 20 psig and measuring flow at the outlet. The actuator can be stroked slowly by regulating air pressure to the actuator.

c) If there is evidence of flow prior to the POC switch tripping, the POC switch needs to be adjusted.

2. Setting with Internal Switch
   
a) Ensure the valve is in the fully closed position then remove the actuator from the valve by loosening the three set screws holding the actuator to the body.

b) Measure the distance from the base of the cylinder actuator to the outside edge of the switch roller lever. The distance should be between 0.840” and 0.870” and the roller should be resting approximately half way up the 45° chamfer on the actuator shaft.

c) If the switch is too far down on the shaft, i.e. greater than 0.870”, bend the switch mounting bracket slightly away from the shaft to a position within the specified measurements. The switch mounting bracket should be bent the opposite direction if the roller is riding too far up on the shaft, i.e. less than 0.840”.

d) Stroke the actuator. The normally open contacts of the limit switch should change state. If they do not, slightly bend the switch mounting bracket. Continue until switch contacts change state.

e) Place the actuator on the valve and retest per section VII. A. 1.

B. Testing Valve with External Limit Switches
1. Testing
   a) Check switch setting per section VII.A.1.

2. Setting
   a) Loosen the roller switch lever (Item 161 or 151).
   b) Place an 1/8" shim between the switch actuator (Item 147) and the roller switch lever.
   c) While holding the roller firmly against the actuator shaft, rotate the switch actuator shaft until the normally closed contacts of the switch break. At this point secure fasten the lever to the switch actuator shaft.
   d) Remove the spacer. The roller switch lever should be firmly resting on the switch shaft and the normally closed contacts made.
   e) Check switch setting by stroking the valve to the open position. Pressurize the vent with 20 psig and monitor the flow at the outlet valve. If the switch trips before flow ceases, repeat but decrease shim thickness by 1/32". If the switch does not reset, increase the shim thickness by 1/32".

C. Testing Valve with External GO Switches

1. Testing
   a) Check switch setting per section VII.A.1.

2. Setting
   a) Loosen switch from mounting bracket and slide switch to desired position.
   b) Tighten switch to mounting bracket ensuring the distance between the end of switch and target is per manufacturer’s recommendations.
   c) Check switch setting by stroking the valve to the open position. Pressurize the vent with 20 psig and monitor the flow at the outlet valve.
valve. If the switch trips before flow ceases, repeat slide switch away from top of actuator.

VIII. MISCELLANEOUS INSTRUCTIONS FOR SPECIAL OPTIONS

Due to customer requirements, some T4100C 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.

IX. SPARE PARTS ORDERING INFORMATION

Orders for T4100C Systems Spare Parts should be placed with

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

Phone: 717-509-2200
Fax: 800-348-9000

Please be advised that spare parts should be ordered directly from ITT Engineered Valves, as such materials are specially designed for Skotch Trifecta Valve Systems. Other replacement parts, although they may be similar in function, will void the FM rating. To maintain FM Approval, FM also requires technicians servicing/repairing the Skotch Trifecta Valve Systems to be trained by ITT Engineered Valves.

X. REFERENCE INFORMATION

The following pages contain drawings and reference information alluded to in above sections.
ITEM 35 TO BE PRESSED FLUSH WITH THIS SURFACE

DETAIL A
SCALE 2:1

ITEM 41 TO BE PRESSED FLUSH WITH THIS SURFACE

DETAIL B
SCALE 2:1

DETAIL C
SCALE 2:1

DETAIL D
SCALE 2:1

ECN#3575

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ITT Engineered Valves
ITT Fluid Technology Corporation
Lancaster, PA

PART NO. - PATTERN NO. -

C 03-014 REV F
FAIL CLOSED PILOT SOLENOID
COIL A "FIRE"

FAIL IN LAST PILOT SOLENOID
COIL A "FIRE" & COIL B "CLOSED"

NOTES:
1. ALL SWITCHES SHOWN WITH BLOCK VALVES CLOSED.
   VENT OPEN
2. PROOF OF CLOSURE SWITCH CHANGES STATE ON INITIAL
   STEM MOVEMENT. AUXILIARY OR OPEN SWITCH
   (IF SUPPLIED) CHANGES STATE WHEN OPEN.
3. O - REPRESENTS A WIRE MARKER NUMBER
4. FOR EXTERNAL MOUNTED SWITCHES (OPTIONAL) SEE
   SWITCH NAMEPLATE
5. IF EQUIPPED GREEN WIRE FOR GROUND IS NOT MARKED
   WITH WIRE NUMBERS
6. FOR OPTIONAL GO PROXIMITY SWITCHES, WIRE
   IDENTIFICATION IS AS FOLLOWS:
   NORMALLY OPEN: BLUE WIRE
   COMMON: BLACK WIRE
   NORMALLY CLOSED: RED WIRE

ECN# 09272

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS IN BRACKETS ARE MILLIMETERS. PATTERN NO. -

WIRING DIAGRAM

14100C

ENGINEERED VALVES GROUP
Lancaster, PA USA

INLET, 1/4 NPT
DRY, CLEAN REGULATED
PNEUMATIC SUPPLY
(60-120 PSIG) FILTERED
TO 40 MICRONS OR LESS

NOTES:
1. SV-1A IS A SINGLE COIL SPRING RETURN SOLENOID
OPERATED PILOT VALVE, MAINTAINED CONTACT TYPE,
WHICH CONTROLS THE MAIN VALVES POSITION.
2. PILOT VALVE SHOWN IS IN DE-ENERGIZED STATE.
Check Valve

INLET 1/4 NPT
DRY, CLEAN REGULATED
PNEUMATIC SUPPLY
FILTERED TO 40 MICRONS
OR LESS

TO ACTUATOR

NOTES:
1. VALVE SHOWN WITH COIL B LAST ENERGIZED.

ECN#3575

PNEUMATIC SUPPLY
GAS BURNER VALVE
T4100
FAIL IN LAST

SUPERSEDES:

ITT Engineered Valves
ITT Fluid Technology Corporation
Lancaster, Pa

A 117624
FILE COPY

NOTES:
1. SV-1A AND SV-1B FORM A DUAL COIL SOLENOID VALVE CONTROLLING GAS FLOW.
2. SWITCHES ARE MOMENTARY CONTACT TYPE.
3. ○ - REPRESENTS A WIRE #.
4. WIRE #'S SHOWN ARE FOR AC SOLENOIDS. FOR DC VOLTAGE, SUBSTITUTE WIRE #18 FOR #1, WIRE #19 FOR SV-1A COIL WIRE #2, WIRE #20 FOR #3, AND WIRE #21 FOR SV-1B COIL WIRE #2.
5. SEE ORDER SPECIFICATION FOR SOLENOID VOLTAGE RATING.
6. APPLICATION - ALL T4X05 SYSTEMS ("X" DENOTES LINE SIZE).

PART NO.-

PATTERN NO.-

SUPPLIED BY
CUSTOMER

OPEN BLOCK
VALVES
CLOSE VENT

CLOSE BLOCK
VALVES
OPEN VENT

LINE VOLTAGE
(AS SPECIFIED)

SV-1A

SV-1B

SEE NOTE 4

SEE NOTE 4

WR#: -

- - - - - -

TOLERANCES
EXCEPT AS NOTED
DEVIATIONS
XXX ± 0.02

ANGLES 10°-30°
REMOVE ALL BURRS
AND SHARP EDGES
ALL MACHINED
SURFACES TO BE
125% EXCEPT AS
NOTED

WEIGHT

SCALE

ELECTRICAL SCHEMATIC
GAS BURNER VALVE
PNEUMATIC - FAIL IN LAST

OWN 1/69 GCS

CHKO 1/69 JRJ

APVO

SUPERSEDES: -
THIS IS A FACTORY MUTUAL CONTROLLED DOCUMENT. CHANGES MUST BE APPROVED BY FM PRIOR TO IMPLEMENTING.

WR# - PART NO. - PATTERN NO. -

- - - -
- - - -

C 1002
date
A 1/99
REV DATE ECN NOR
BY CHKD APV

TOLERANCES EXCEPT AS NOTED
DECIMALS .XX & .02
.000 & .005
ANGLES 45°-90°
REMOVAL BURRS AND SHARP EDGES
ALL MACHINED SURFACES TO BE
125" EXCEPT AS NOTED

ELECTRIC SCHEMATIC
GAS BURNER VALVE
PNEUMATIC - FAIL CLOSED

REVIEW DATE ECN NOR
BY CHKD APV

FILE COPY

SEE NOTE 4

NOTES:
1. SV-1A IS A SINGLE COIL SPRING RTN SOLENOID VALVE CONTROLLING GAS FLOW.
2. SWITCHES ARE MAINTAINED CONTACT TYPE.
3. O - REPRESENTS A WIRE NUMBER.
4. WIRE #'S SHOWN ARE FOR AC SOLENOIDS.
   FOR DC VOLTAGE, SUBSTITUTE WIRE #18 FOR #1, WIRE #19 FOR #2.
5. SEE ORDER SPECIFICATION OR SOLENOID NAMEPLATE FOR SOLENOID VOLTAGE RATING.
6. APPLICATION - ALL T4x06 SYSTEMS
   ("x" DENOTES LINE SIZE).