TopWorx™ D-Series with DeviceNet™

Installation, Operation & Maintenance Manual

TOPWORX

EMERSON
Process Management

Emerson Process Management

Emerson Process Management is a powerful, global, single source of process improvement technology and expertise. We help major companies in selected industries optimize their plants and processes to achieve higher quality, greater reliability and faster time to market, while steadily advancing productivity and profitability.

Expertise and Innovation to Deliver Proven Results

Emerson Process Management is the automation innovator with the depth of expertise and breadth of technologies to take on our customers' toughest challenges and bring predictable success anytime, anywhere.

Global Industry Expertise

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TOPWORX

Installation on Actuator

Orientations, Normal and Reverse Acting

Normal acting is full CW when the process valve is closed and CCW when the process valve is open. *Reverse acting* is full CW when the process valve is open and CCW when the process valve is closed.

90° indicator dome assemblies are design to accommodate any mounting arrangement and can be adjusted up to 9° off axis if needed. 45° indicator dome assemblies can only accommodate *normal acting* applications that are *mounted parallel ±9°.* Consult your local distributor or factory representative for 45° *reverse acting* or *mounted perpendicular* applications.
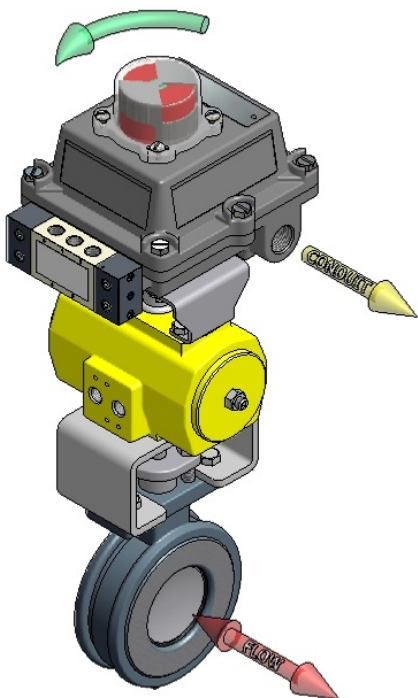
Illustration #1

The image to the left shows a Valvetop unit *mounted parallel* to the process valve in the closed position. The green arrow at the top shows the "*normal acting*" direction of travel to open the valve. This is the standard orientation and your unit unless otherwise specified will be factory set to operate in this fashion.
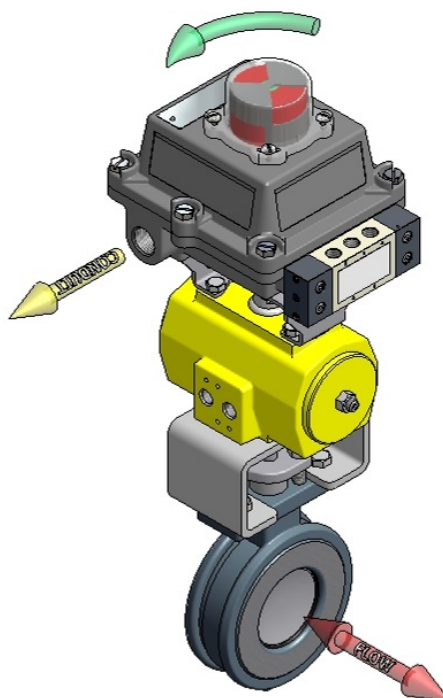
Illustration #2

The image to the right shows a Valvetop *mounted perpendicular* to the process valve in the closed position. The green arrow at the top shows the "*normal acting*" direction of travel to open the valve. Notice that the indicator dome has been rotated 90° compared to the unit above.

4

Installation on Actuator *(continued)*

Mounting

TopWorx has numerous mounting bracket kits available to meet your specific application, whether rotary or linear. Consult your local distributor or factory representative for ordering information. The illustration shows a direct Namur mount on a quarter turn valve. Refer to your mounting kit documentation for specific mounting instructions.

Storage
Until conduit, conduit plugs, and any applicable spool valve port connections are properly installed, the ValveTop unit will not support its IP/NEMA rating as the unit ships with temporary covers. Ensure that it is stored in a dry environment with a relative humidity range between 10%-95% and a temperature ranging from -40ºF (-40ºC) to 160ºF (71ºC). Once properly installed, the temperature range listed on the nameplate will supersede this storage temperature range.

Illustration #3: Mounting Assembly
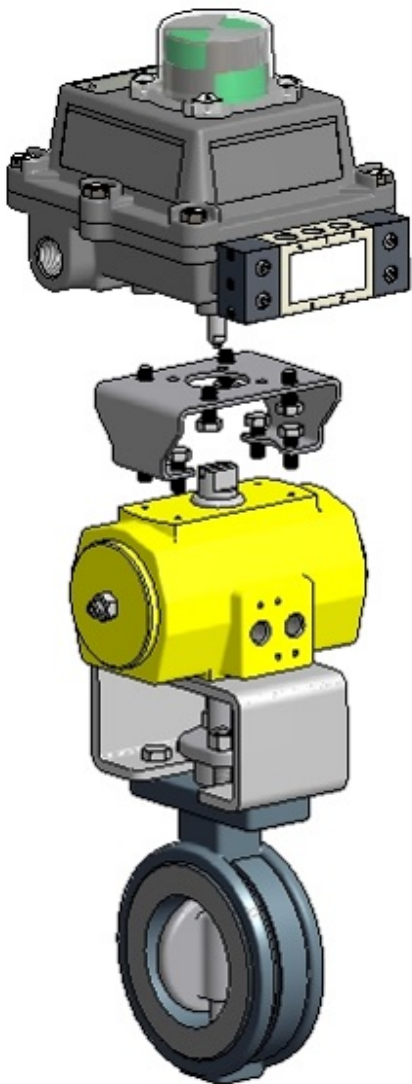
Installation Notes

1. Use caution not to allow undue axial (thrust) load on the shaft.

2. Cycle the valve a couple of times prior to final tightening of the mounting kit hardware. This allows the shaft to self-center in the pinion slot, or coupler. Refer to the *dimensions and materials section* of this document for appropriate tightening torque.

3. Always use sound mechanical practices when torqueing down any hardware or making pneumatic connections. Refer to the Integrated Pneumatic Control Valves section for detailed information on pneumatic connections.

4. This product comes shipped with plastic plugs in the conduit entries in an effort to protect the internal components from debris during shipment and handling. **It is the responsibility of the receiving and/or installing personnel to provide appropriate permanent sealing devices to prevent he intrusion of debris, or moisture, when stored outdoors or when installed.**

5. **It is the responsibility of the installer, or end user, to install this product in accordance with the National Electrical Code (NFPA 70) or any other national or regional code defining proper practices.**

Dimensions and Materials: Valvetop DXP

Illustration #4

MINIMUM 2.5" REQUIRED CLEARANCE
IN ORDER TO DISINGAGE THE SHAFT FROM THE ID BUSHING
AND REMOVE LID WHERE OPTIMUM CONDITIONS APPLY

6.21

4.52

.85 2.10

MOUNTING SURFACE

2.13

SHAFT TYPE OPTIONAL
SEE SHAFT DETAIL
SECTION

OPTIONAL CONDUIT ENTRIES
USED ONLY WHEN 4 ENTRIES
ARE SPECIFIED

MATERIALS OF CONSTRUCTION	
Enclosure	Cast A360 aluminum with dichro-mate conversion coating inside & out, epoxy coated exterior rated for 250 hrs salt spray per ASTM B117
Fasteners	304 Stainless Steel standard 316 Stainless Steel optional
Shaft	304 Stainless Steel standard 316 Stainless Steel optional
Shaft Bushing	Oilite Bronze
Indicator Dome	Polycarbonate, UV F1 rated
Seals	O-ring seals available in: Buna & Silicone

Maximum Fastener Torque Specifications	
Enclosure Housing Bolts	8 ft-lbs [10.8 N·m]
Indicator Dome Screws	20 in-oz [141 mN·m]
Bottom Mounting Holes	10 ft-lbs [13.6 N·m]

OPTIONAL CONDUIT ENTRIES

6.65

3.85

6.76

2.25

2.19

2.25

5/16-18 UNC - 2B
.44 DEEP

VALVE TYPE OPTIONAL
SEE INTEGRATED PNEUMATIC
CONTROL VALVES SECTION

Dimensions and Materials: Valvetop DXP - IIC

Illustration #5

MINIMUM 2.5" REQUIRED CLEARANCE
IN ORDER TO DISENGAGE THE SHAFT FROM THE ID BUSHING
AND REMOVE LID WHERE OPTIMUM CONDITIONS APPLY

6.15

4.45

.85

2.04

MOUNTING SURFACE

2.13

M20x1.5 - 6H

SHAFT TYPE OPTIONAL
SEE SHAFT DETAIL
SECTION

CONDUIT ENTRIES AS SHOWN
WHEN ORDERING 3/4 NPT THE M20 ENTRIES WILL BE PLUGGED
WHEN ORDERING M20 THE 3/4-NPT ENTRIES WILL BE PLUGGED

3/4-14 NPT

6.65

3.85

6.76

2.25

2.25

S-501-0012
S-501-0007

2.19

5/16-18 UNC - 2B
.44 DP

OPTIONAL SEE INTEGRATED PNEUMATIC
CONTROL VALVE SECTION
ALL UNITS ARE DESIGNED FOR VALVE
INTIGRATION WHEN NO VALVE IS SPECIFIED
ALLOW 1/2" FOR BLANKING PLATE CLEARANCE

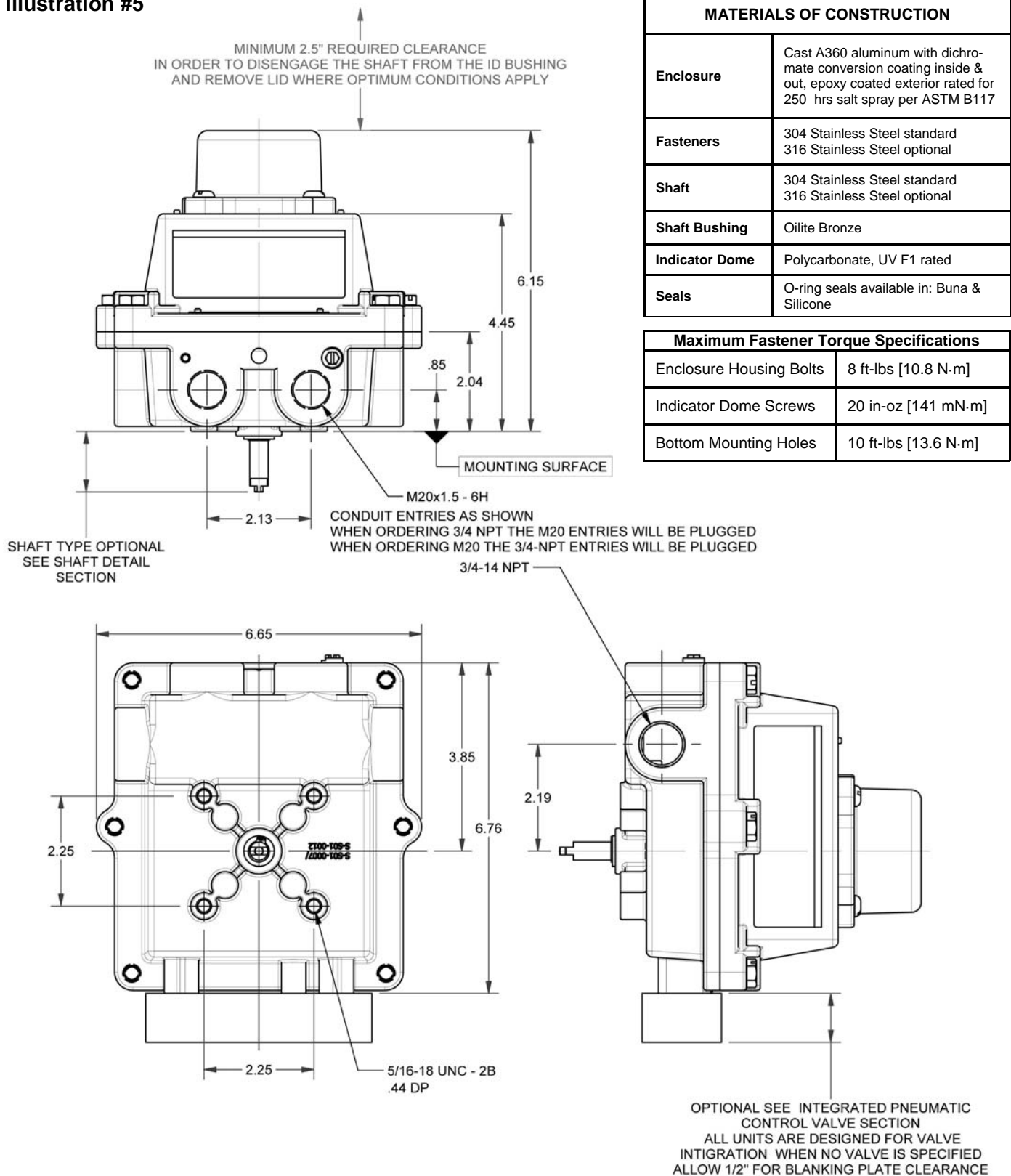| MATERIALS OF CONSTRUCTION	
Enclosure	Cast A360 aluminum with dichromate conversion coating inside & out, epoxy coated exterior rated for 250 hrs salt spray per ASTM B117
Fasteners	304 Stainless Steel standard 316 Stainless Steel optional
Shaft	304 Stainless Steel standard 316 Stainless Steel optional
Shaft Bushing	Oilite Bronze
Indicator Dome	Polycarbonate, UV F1 rated
Seals	O-ring seals available in: Buna & Silicone

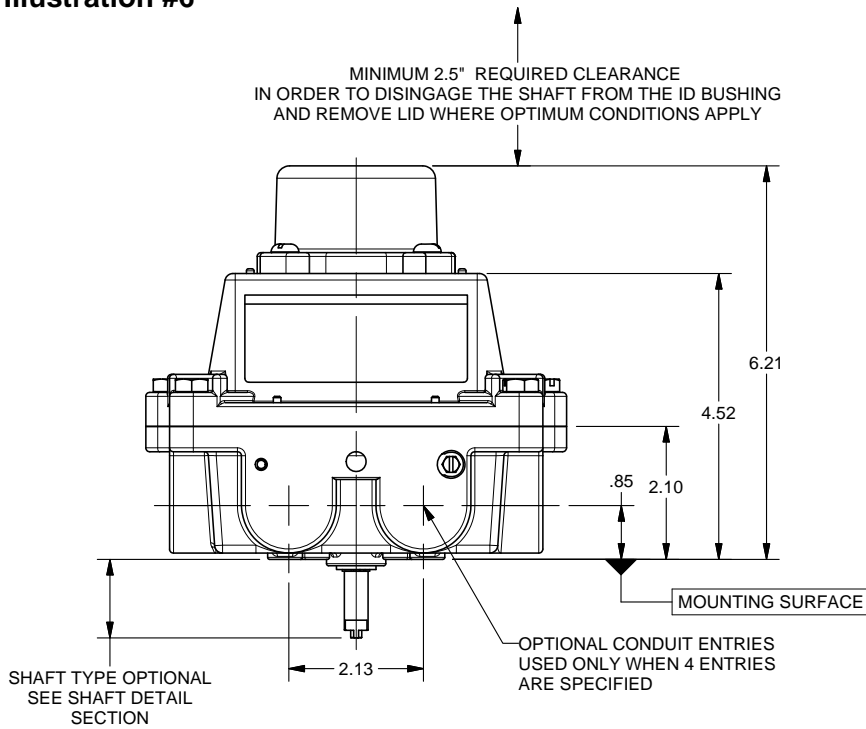| Maximum Fastener Torque Specifications	
Enclosure Housing Bolts	8 ft-lbs [10.8 N·m]
Indicator Dome Screws	20 in-oz [141 mN·m]
Bottom Mounting Holes	10 ft-lbs [13.6 N·m]

Dimensions and Materials: Valvetop DXS
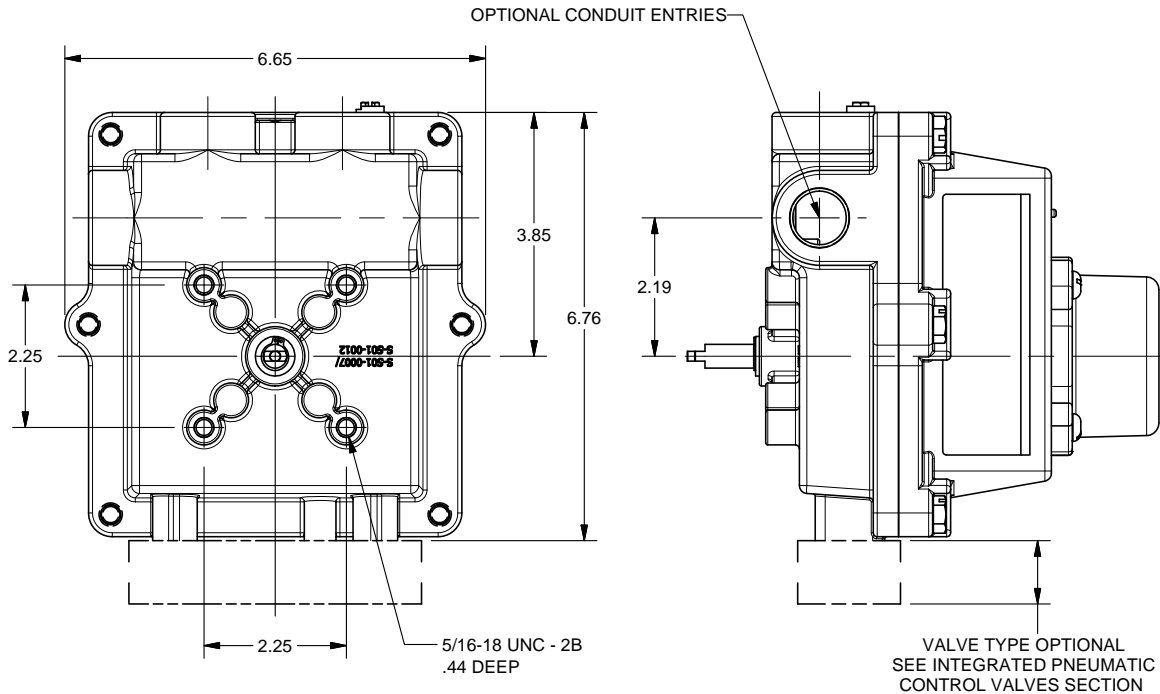
Illustration #6

MINIMUM 2.5" REQUIRED CLEARANCE
IN ORDER TO DISINGAGE THE SHAFT FROM THE ID BUSHING
AND REMOVE LID WHERE OPTIMUM CONDITIONS APPLY

6.21

4.52

.85   2.10

MOUNTING SURFACE

2.13

SHAFT TYPE OPTIONAL
SEE SHAFT DETAIL
SECTION

OPTIONAL CONDUIT ENTRIES
USED ONLY WHEN 4 ENTRIES
ARE SPECIFIED

MATERIALS OF CONSTRUCTION	
Enclosure	Cast 316 Stainless Steel
Fasteners	304 Stainless Steel standard 316 Stainless Steel optional
Shaft	304 Stainless Steel standard 316 Stainless Steel optional
Shaft Bushing	N/A
Indicator Dome	Polycarbonate, UV F1 rated
Seals	O-ring seals available in: Buna & Silicone

Maximum Fastener Torque Specifications	
Enclosure Housing Bolts	8 ft-lbs [10.8 N·m]
Indicator Dome Screws	20 in-oz [141 mN·m]
Bottom Mounting Holes	10 ft-lbs [13.6 N·m]

OPTIONAL CONDUIT ENTRIES

6.65

3.85

2.25

6.76

2.19

S-501-0007/
S-501-0012

2.25

5/16-18 UNC - 2B
.44 DEEP

VALVE TYPE OPTIONAL
SEE INTEGRATED PNEUMATIC
CONTROL VALVES SECTION

Dimensions and Materials: Valvetop DXR

Illustration #7

MINIMUM 2.5" REQUIRED CLEARANCE
IN ORDER TO DISINGAGE THE SHAFT FROM THE ID BUSHING
AND REMOVE LID WHERE OPTIMUM CONDITIONS APPLY

6.21

4.51

2.10

1.10

MOUNTING SURFACE

2.00

SHAFT TYPE OPTIONAL
SEE SHAFT DETAIL
SECTION

OPTIONAL CONDUIT ENTRIES
USED ONLY WHEN 4 ENTRIES
ARE SPECIFIED

OPTIONAL CONDUIT ENTRIES

5.03

3.66

6.10

2.25

2.14

2.25

5/16-18 UNC - 2B
.44DP

ES-00603-1
ES-00352-1

VALVE TYPE OPTIONAL
SEE INTEGRATED PNEUMATIC
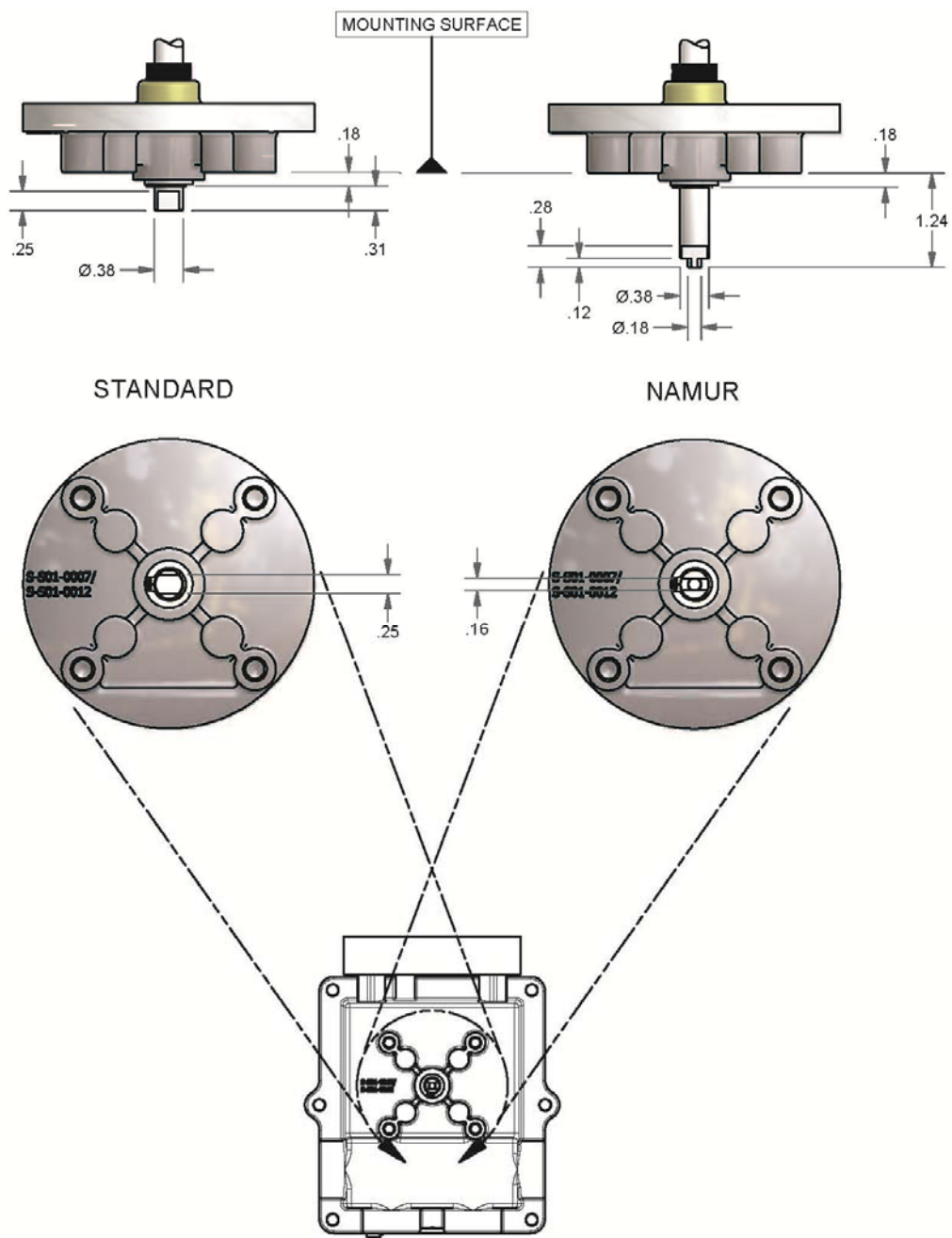CONTROL VALVES SECTION

MATERIALS OF CONSTRUCTION	
Enclosure	Valox® 364 Polybutylene Terephthalate (PBT)
Fasteners	304 Stainless Steel standard 316 Stainless Steel optional
Shaft	304 Stainless Steel standard 316 Stainless Steel optional
Shaft Bushing	Delrin® 500P white
Indicator Dome	Polycarbonate, UV F1 rated
Seals	O-ring seals available in: Silicone

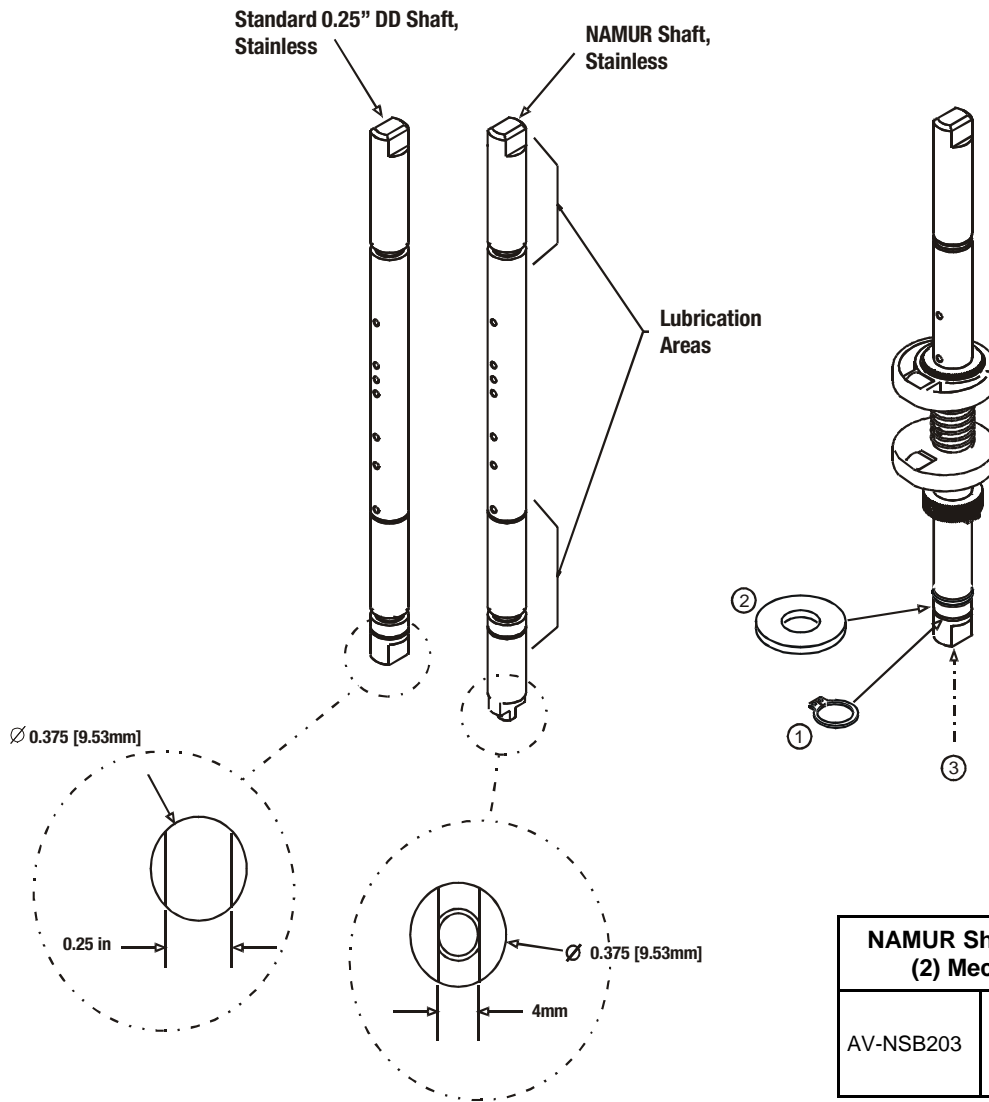| Maximum Fastener Torque Specifications	
Enclosure Housing Bolts	10 in-lbs [903 mN·m]
Indicator Dome Screws	20 in-oz [141 mN·m]
Bottom Mounting Holes	8 ft-lbs [13.6 N·m]
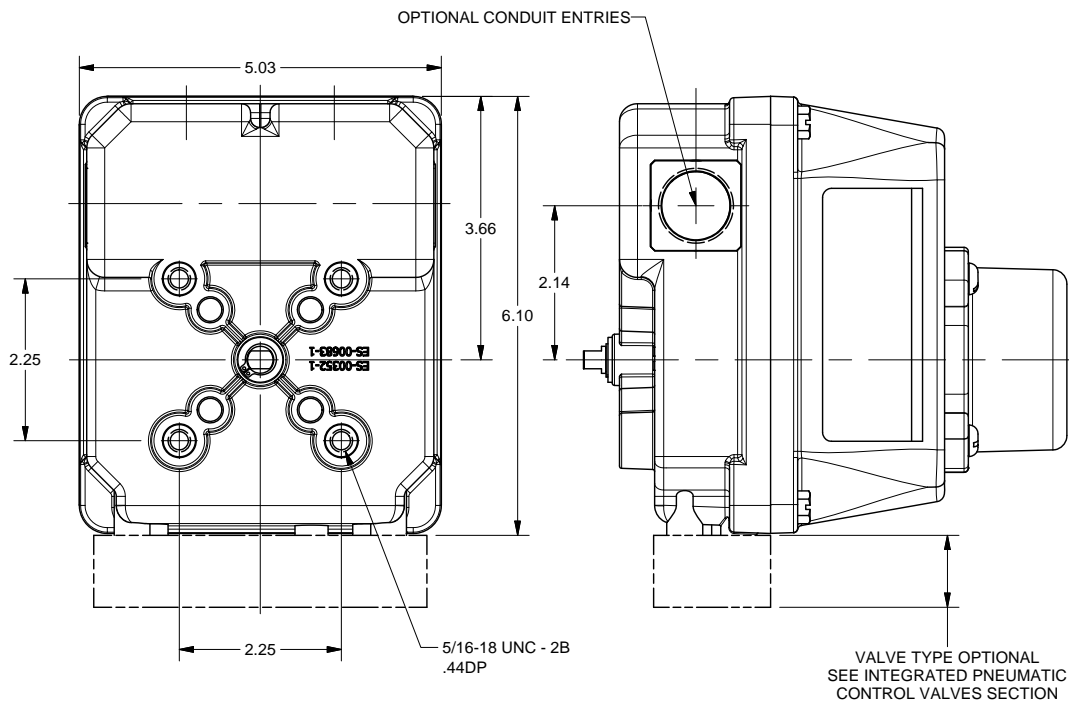
Dimensions and Materials: Shafts

Illustration #8: Shaft Detail

Shaft Assembly
Illustration #9 Shaft Assembly

Standard 0.25" DD Shaft, Stainless

NAMUR Shaft, Stainless

Lubrication Areas

∅ 0.375 [9.53mm]

0.25 in

∅ 0.375 [9.53mm]

4mm

① ② ③

NAMUR Shaft Replacement Kits (2) Mechanical Switches	
AV-NSB203	NAMUR Shaft w/Buna-N o-rings & (2) cam assembly with installation hardware

Shaft Replacement Kits (2) Mechanical Switches	
AV-SSB203	Standard Shaft w/Buna-N o-rings & (2) cam assembly with installation hardware

Pneumatic Hookup Procedures

Prior to connecting the supply air to the spool valve, flush the system to remove any debris or contaminates. Galvanized pipe can easily flake and contaminate the system and therefore is not recommended. A 40 micron point of use filter at every device is recommended.
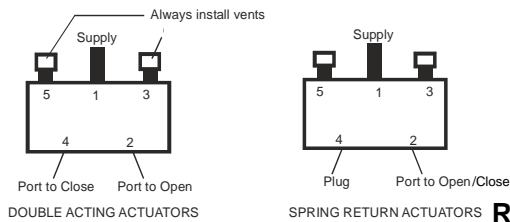
4-Way Spool Valves

The TopWorx spool valve is a 5 port, 4-way valve driven by an internally mounted pilot valve. The spool valve supply port and work ports are marked as follows:
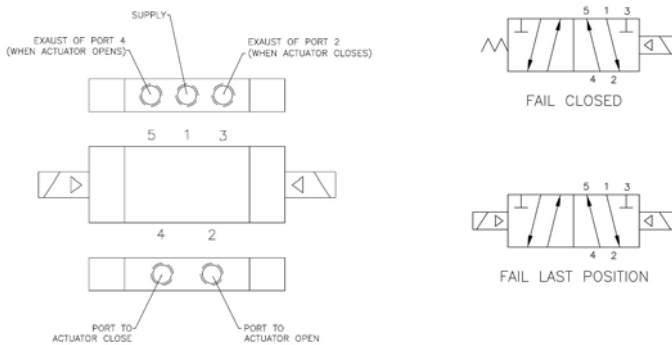
Spool Valve Specifications	
Medium	Dried, filtered air (40 micron)
Max Operating Pressure	100psi (0.7 MPa) (6.89Bar)
Min. Operating Pressure	30psi (0.28 MPa) (2.76Bar)
Ambient Temperature Range	Refer to Product Nameplate Marking
Flow Coefficient	1.2Cv or 3.0Cv
Environment Rating	Type 4, 4X, IP67
Port Size	1/2" NPT for 3.0Cv valve 1/4" NPT for 1.2Cv valve
Manual Override	Available in Latching/Non-Latching Push Type & Palm Actuator Type
Valve Body	Available in Hardcoat Anodized Aluminum, 304, or 316 Stainless Steel
Valve Seals	Spool Seals: Buna-N Valve Body Seals available in Buna & Silicone,

Never Plug, Block or Restrict Port 5

Highly DOUBLE ACTING ACTUATORS   SPRING RETURN ACTUATORS **Recommended**

Don't forget!
TopWorx has a complete line of breathers, flow controls, regulators and filters.

Check out **www.topworx.com** or call us at **502.969.8000** for more details

TopWorx highly recommends Locktite 567 brand thread sealant. Do not use a hard setting pipe compound. If Teflon thread seal tape is used, start the wrap on the second thread from the leading thread of the fitting. This will prevent tape shreds from contaminating the spool valve seals.

Breathers (AL-M31) should be installed in the exhaust ports to keep debris from falling into the spool valve and damaging the seals. This must be addressed prior to installation, or storage.

A flow control may be used in Port 3, but should NEVER BE USED in Port 5. Any blockage or restriction may cause an internal pressure build-up inside the encloser and pose a safety issue.

DID YOU KNOW?
TopWorx manufactures the globally-known GO Switch Leverless Limit Switch, which comprises a full line of harsh environment sensors. If your application is very cold, very hot, under water or in a caustic atmosphere, then GO Switch has the answer.

Spool Valves and Pilots

Fail Closed Spool Valve Replacement Assemblies	
AV-BFCVA20	Std Alum Spool Valve Assy w/Buna seals
AV-BFCVS20	Std 304SS Spool Valve Assy w/Buna seals
AV-BFCV620	Std 316SS Spool Valve Assy w/Buna seals

Fail Last Position Spool Valve Replacement Assemblies	
AV-BFLPVA20	Std Alum Spool Valve Assy w/Buna seals
AV-BFLPVS20	Std 304SS Spool Valve Assy w/Buna seals
AV-BFLPV620	Std 316SS Spool Valve Assy w/Buna seals

Block-Center Spool Valve Replacement Assemblies	
AV-BBCVA20	Std Alum Spool Valve Assy w/Buna seals
AV-BBCVS20	Std 304SS Spool Valve Assy w/Buna seals
AV-BBCV620	Std 316SS Spool Valve Assy w/Buna seals

**Consult factory for more options.
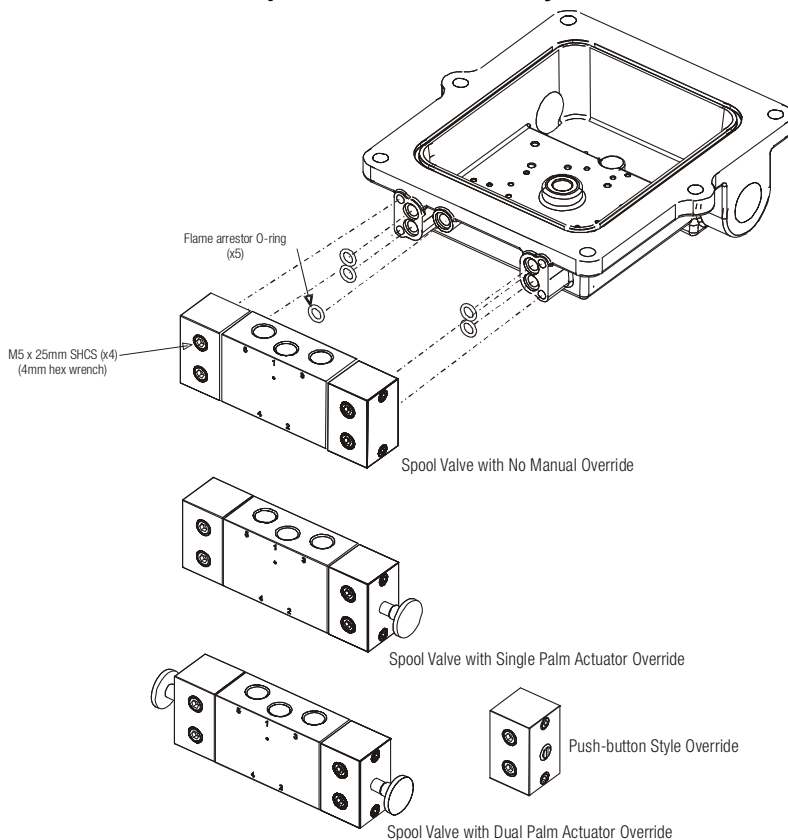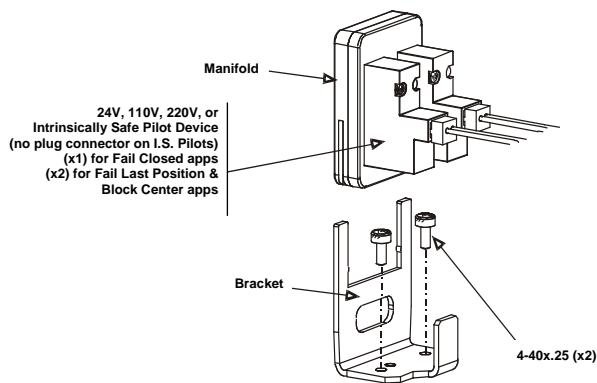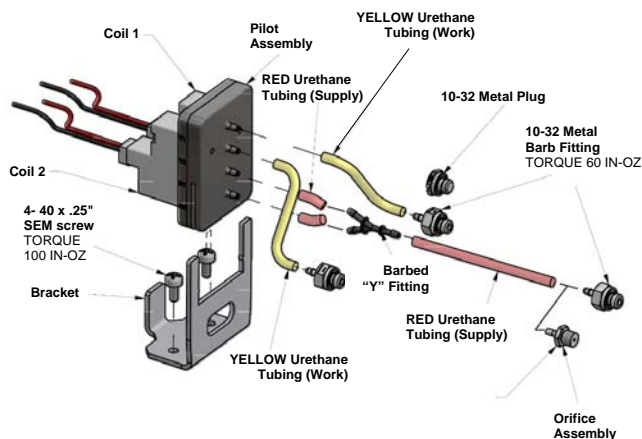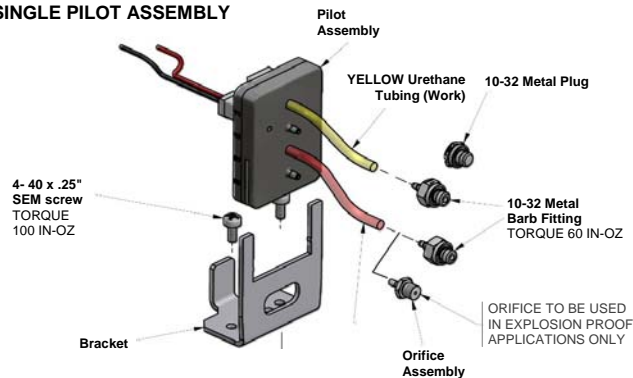
Illustration #10: Spool Valve Assembly

Flame arrestor O-ring (x5)

M5 x 25mm SHCS (x4) (4mm hex wrench)

Spool Valve with No Manual Override

Spool Valve with Single Palm Actuator Override

Push-button Style Override

Spool Valve with Dual Palm Actuator Override

Illustration #11: Pilot Device Assembly

Manifold

24V, 110V, 220V, or Intrinsically Safe Pilot Device (no plug connector on I.S. Pilots) (x1) for Fail Closed apps (x2) for Fail Last Position & Block Center apps

Bracket

4-40x.25 (x2)

SINGLE PILOT ASSEMBLY

Pilot Assembly

YELLOW Urethane Tubing (Work)

10-32 Metal Plug

4- 40 x .25" SEM screw TORQUE 100 IN-OZ

10-32 Metal Barb Fitting TORQUE 60 IN-OZ

ORIFICE TO BE USED IN EXPLOSION PROOF APPLICATIONS ONLY

Bracket

Orifice Assembly

**Orifice only applicable to Explosion Proof units. All others use standard fitting.

Coil 1

Pilot Assembly

YELLOW Urethane Tubing (Work)

RED Urethane Tubing (Supply)

10-32 Metal Plug

10-32 Metal Barb Fitting TORQUE 60 IN-OZ

Coil 2

4- 40 x .25" SEM screw TORQUE 100 IN-OZ

Bracket

Barbed "Y" Fitting

RED Urethane Tubing (Supply)

YELLOW Urethane Tubing (Work)

Orifice Assembly

13

Illustration #12: Enclosure Assembly

**Indicator Assembly
See Illustration #13**

Screws are captive

**Shaft Assembly
See Illustration # 9**

**Pilot Device Options:
See Illustration
#11**

**Sensor
Options:
See
pg. 13**

Internal Ground Lug

O-ring Seal

External Ground Lug

**Valve Options:
See Illustration #10**

Conduit Entry
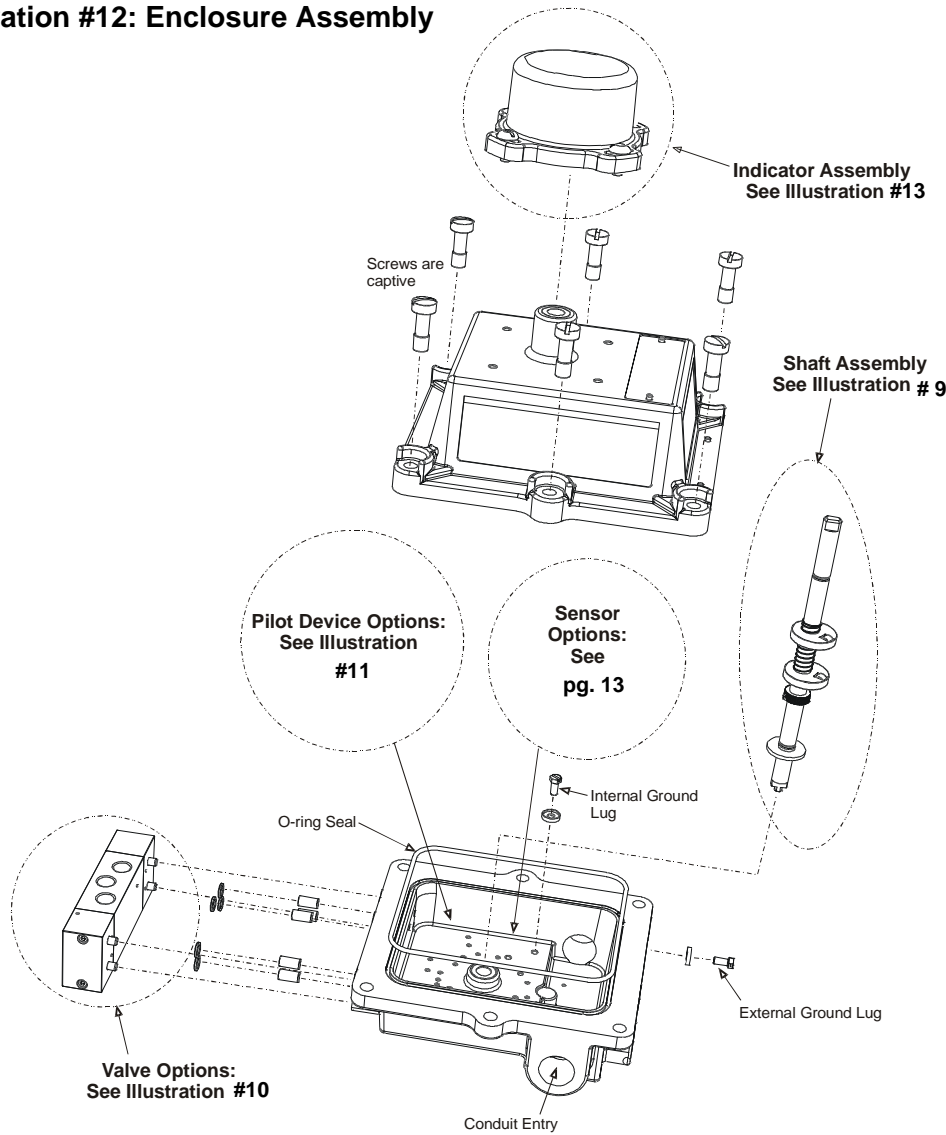
Illustration #13: Indicator Assembly

Indicator Dome,
$\pm\ 5^0$ adjustable
Polycarbonate
with keyed mask.
Several rotation and
form options.

10-32 Captive screws,
Stainless (x4)

O-ring
Available in Buna-N,
Silicone, EPDM, Viton

Color-coded Indicator is
available in several
coordinating rotations and
forms for various valve
types, such as 90^0, 180^0
and Thru-divert applications.
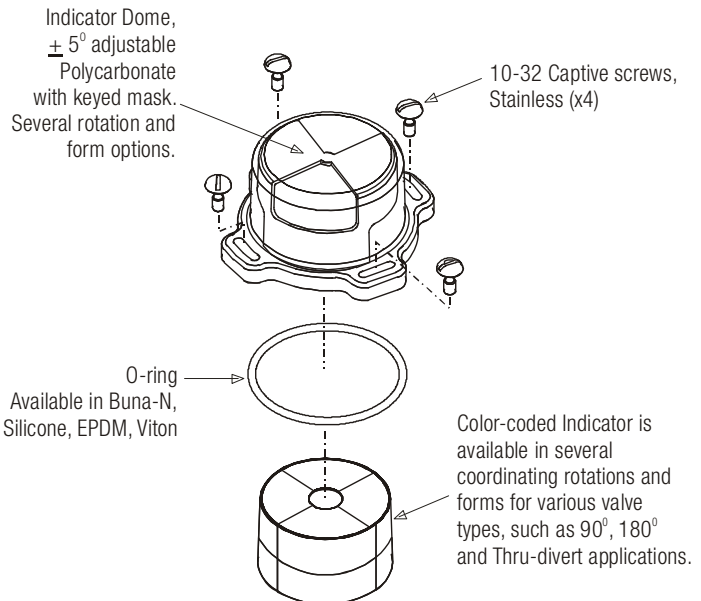
Indicator / Dome Replacement Kits	
AV-GB002	90º, Green/Open, Red/Closed, Buna O-Ring
AV-YB002	90º, Yellow/Open, Black/Closed, Buna O-Ring
AV-TB002	90º, Green/Thru, Red/Divert, Buna O-Ring
AV-4B002	90º, Green/Open, Red/Closed, Buna O-Ring

Basic DeviceNet I/O Operation

The DeviceNet Sensor-Communications Module (known hereafter as SCM-DN) operates as a combined discrete input and output device on the DeviceNet network. It is a slave (server) device that can be allocated by the system implementer to one specific master (client). There are several parameters that may be modified by the user. These are collected in a block of data called the Parameter Object (see Table 17, pg. 17). They may be left as defaulted, depending upon your application.

The Polled I/O feature follows the conventional method of a client requesting data from and/or sending data to one server at a time. This requires both a command message from the client and a response message from each server for every set of I/O. To improve throughput on the network Change-of-State and Cyclic I/O functions have been defined by the DeviceNet protocol. These functions are supported by the SCM-DN. The discrete data returned in the poll response to the client will contain both valve contact input and valve command output status data.

Polled I/O
The client can poll (read) the input and command the output status from the SCM-DN and can energize or de-energize the discrete outputs on the SCM-DN. The status LEDs report the actual state of the valve; i.e. the red led is lit when the valve is closed, and the green led is lit when the valve is open.

The client controls the valve outputs by sending a poll command to the SCM-DN. If no data is sent to the SCM-DN during a poll, then the outputs are put into the "idle" state and their actions are then governed by the Idle Action and Idle Value attributes of the Parameter Object (See Table 17, pg. 17).

Both idle and fault operations are implemented for the valve output points. The outputs can be set individually to hold last state or to implement user-defined states upon receipt of an "idle" command or upon a "fault" condition. You can implement these actions via the Parameter Object (See Table 17, pg. 17).

Cyclic and Change-of-State I/O
Both the Cyclic and Change-Of-State (COS) are activated by allocating a connection for one or the other using the allocate service of the DeviceNet Object (class 3), and setting the EPR (Expected Packet Rate) for that connection. The value for the EPR is used to set the various communication timers.

The Cyclic connection initiates a transmission every time the connection timer expires. The cyclic connection can only send data from the SCM-DN to it's assigned client. The polled and cyclic connections are not exclusive, so both can exist at the same time. The manner in which cyclic connection reports its data is the same as the polled connection.

The Change of State (COS) connection is the same as the cyclic connection except that as well as triggering communications on the expiration of the timer, the COS connection also initiates a transfer on a change of the valve's status. The COS connection is mutually exclusive with the cyclic connection, but can coexist with the polled connection. The COS connection operation is very useful in conserving bandwidth, and provides the client with the most current data as fast or faster than a poll connection. The COS connection automatically turns on the COS mechanism when the connection is created.

Quick Start for DeviceNet

Limit Switch Calibration
Never perform switch calibration while area is known to be hazardous.

Step 1: Once pneumatic hookup and wiring has been completed close the valve using the SCM-DN on-board calibration switch. If no DeviceNet network connection is available, you may connect to a 24VDC power supply.

Step 2: With the valve in the CLOSED position, disengage the bottom Cam from the splined Hub and rotate Clockwise until the Red LED lights. Release the Cam to re-engage the splined Hub. Be sure the Cam is seated on the Hub.

Step 3: Open the valve by sliding the calibration switch to the OPEN position.

Step 4: While the valve is in the OPEN position, disengage the top Cam from the splined Hub and rotate Counterclockwise until the Green LED lights. Release the Cam to re-engage the splined Hub. Be sure the Cam is seated on the Hub.

Step 5: Cycle the valve CLOSED and OPEN a few times using the calibration switch to verify both limit switches are maintaining their set points.

Step 6: Finally, slide the calibration switch to the DeviceNet position. The DeviceNet network will now have full control of the valve once the SCM-DN has been addressed.

How to Install and Establish DeviceNet Communications

Step 1: Connect the DeviceNet cable to the round 5-pin round mini or micro connector according to DeviceNet cable wiring specifications, or wire directly to the terminals on the SCM-DN.

Step 2: Make sure that the DeviceNet network is terminated properly.

Step 3: Set the baud rate and address of the SCM-DN if different from default (see Table 2).

Step 4: Make sure that there is power on the DeviceNet network and that it is plugged into a Master device.

Step 5: Wire the DeviceNet cable to the SCM-DN.

Step 6: In fixed baud rate mode, the SCM-DN will undergo its initialization sequence, flashing both LEDs. After approximately 4 seconds, the Module Status LED (labeled "MS") will go on solid green and the Network LED will flash green.

Step 7: In autobaud mode, the SCM-DN the Module Status LED will continue to blink until the SCM-DN recognizes valid traffic on the DeviceNet link and syncs to a specific baud rate.

Step 8: The green Network Status LED (labeled "NS") will go on solid once the Master recognizes the unit on the link and allocates the connection (commissions it).

Step 9: The SCM-DN is now operating on the network.

How to Configure the DeviceNet Node Address and Baud Rate

Step 1: The address and baud rate can be set using the 6-position DIP switch blocks, SW1 and SW2 (as seen in Illustration 14).

Step 2: Switches 1 and 2 on SW2 define the baud rate selection as shown in Table 2.

Step 3: Switches 1 through 6 on SW1 define the address selection as shown in Table 1.

Step 4: Switch setting changes will NOT take effect until the device is reset with either a RESET command or a power cycle.

### How to Configure the Network Communications Protocol

Step 1: Switches 3, 4 and 5 on SW2 define which link is selected – DeviceNet or Modbus – as shown in Table 3.

Step 2: For DeviceNet set all 3 switches OFF or 0.

Step 3: If you change the switches, the new selection will not become effective until the unit is power cycled or a Reset command is received by the SCM-DN.

Step 4: Switch 6 of SW2 selects the Modbus protocol for ASCII or RTU as shown in Table 4.

Illustration #14:
DeviceNet Sensor-Communication Module (SCM-DN)
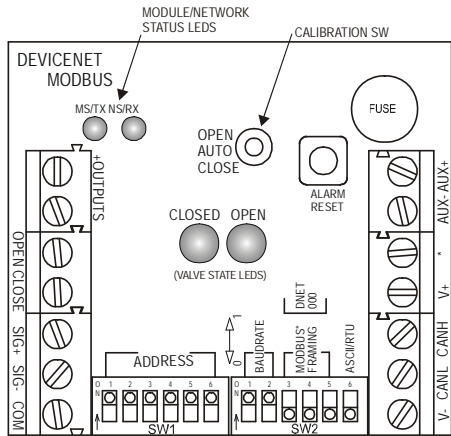
The network shield is not terminated. Connections to the pilot valve and relay contacts are all made internal to the enclosure.

Table 1 - Address Selection

Node Address	ADDRESS Switch Position					
	SW 1,1	SW 1,2	SW 1,3	SW 1,4	SW 1,5	SW 1,6
	Switch Position Values					
	32	16	8	4	2	1
0	OFF	OFF	OFF	OFF	OFF	OFF
1	OFF	OFF	OFF	OFF	OFF	ON
2	OFF	OFF	OFF	OFF	ON	OFF
3	OFF	OFF	OFF	OFF	ON	ON
4	OFF	OFF	OFF	ON	OFF	OFF
5	OFF	OFF	OFF	ON	OFF	ON
...						
62	ON	ON	ON	ON	ON	OFF
63	ON	ON	ON	ON	ON	ON

Table 2 - Baud Rate Selection

DeviceNet Baud Rate	DIP Switch Position	
	SW 2,1	SW 2,2
125k	OFF	OFF
250k	OFF	ON
500k	ON	OFF
Autobaud	ON	ON

Table 3 - Communications Protocol Selection

DeviceNet	Modbus	DIP Switch Position		
		SW 2,3	SW 2,4	SW 2,5
DeviceNet	N/A	OFF	OFF	OFF
N/A	7,N,2	OFF	OFF	ON
N/A	7,E,1	OFF	ON	OFF
N/A	7,0,1	OFF	ON	ON
N/A	8,N,1	ON	OFF	OFF
N/A	8,N,2	ON	OFF	ON
N/A	8,E,1	ON	ON	OFF
N/A	8,0,1	ON	ON	ON

Table 4 - Modbus Protocol

Modbus Protocol	DIP Sw Position
	SW 2,6
ASCII	OFF
RTU	ON

How to Read Discrete Input Data DeviceNet

Step 1: Plug the DeviceNet connector into the SCM-DN. This powers up the unit electronics.

Step 2: Allocate a Poll Connection to the SCM-DN from the client.

Step 3: Perform a poll command to the SCM-DN from the client. The SCM-DN returns 2 bytes of data using Assembly Instance 1 (default).

Step 4: The discrete input channel values will be available in the first 2 bits of data in the 1**st byte returned.**

Using Assembly Instance 2 (see Table 17, Parameter 10), the Cycle Open and Close Times are added to the poll bytes in Table 5, as shown above.

Table 6 - Poll Response Assembly Instance 2

BYTE	Description
1	Input Status Bits
2	Alarm Bits
3	LS Byte of Last Open Time
4	MS Byte of Last Open Time
5	LS Byte of Last Close Time
6	MS Byte of Last Close Time

Using Assembly Instance 3, the Cycle Count is added to the poll bytes in Table 5, as shown here.

Table 7 - Poll Response Assembly Instance 3

BYTE	Description
1	Input Status Bits
2	Alarm Bits
3	LS Byte of Cycle Count
4	MLS Byte of Cycle Count
5	MMS Byte of Cycle Count
6	MS Byte of Cycle Count

Table 5 - Poll Response (Input Data) Assembly Instance 1

				Bit Positions				
BYTE	7	6	5	4	3	2	1	0
1	Reset Sw Sate	Aux Input State	Calibrate Close Sw State	Calibrate Open Sw State	Close Output State	Open Output State	Close Limit Sw State	Open Limit Sw State
2	0	0	0	0	Analog Input Alarm	Cycle Count Alarm	Close Timeout Alarm	Open Timeout Alarm

Assembly Instance 4 incorporates all data.

Table 8 - Poll Response Assembly Instance 4

BYTE	Description
1	Input Status Bits
2	Alarm Bits
3	LS Byte of Last Open Time
4	MS Byte of Last Open Time
5	LS Byte of Last Close Time
6	MS Byte of Last Close Time
7	LS Byte of Cycle Count
8	MLS Byte of Cycle Count
9	MMS Byte of Cycle Count
10	MS Byte of Cycle Count

How to Energize and De-energize Valve Solenoids

1. Reconnect the SCM-DN and allocate a Poll Connection to the SCM-DN from the client.

2. Issue a Poll Command from the client with a data value of 00, 01 or 02. Each of the two possible outputs will be turned ON or OFF, as defined by a corresponding bit value of 1 or 0. Note that having both the Open and Close bit set is an illegal state and will be ignored by the SCM-DN.

Table 9 - Poll Request (Output Data)

				Bit Positions				
BYTE	7	6	5	4	3	2	1	0
1	0	0	0	Reset Cycle Count	Enable Cal Switch	Reset Alarms	Close	Open

The operation of the Open and Close control bits is as follows:

Table 10 - Solenoid Action Commands

Open Bit	Close Bit	SCM Action
OFF	OFF	De-energize both solenoid outputs
ON	OFF	Energize Open solenoid output, de-energize Close solenoid output
OFF	ON	Energize Close solenoid output, de-energize Open solenoid output
ON	ON	Holds Last State

To open the valve, set the Open bit to 1 for at least one poll message. A value of 0 will deactivate the output to the solenoid. The Close bit operates in the same fashion.

Setting the Reset Alarms bit to 1 clears the Open and Closed Time counters and resets all active alarm notification bits. As long as this bit is set, the alarms will be inactive.

The Enable Cal Switch bit is set to 1 to allow the Open/Close Calibration Switch on the module to be used manually to calibrate the limit switches. The calibration switch is also enabled if the device gets an empty poll message, which puts the device into Idle Mode.

The Reset Cycle Count bit is set to 1 to clear the Cycle Counter.

LED Indication Status Feedback

The DeviceNet module has two LEDs that provide visual status feedback to the user about the product and the DeviceNet network. These LED obviously are not visible with the enclosure lid attached, but are most beneficial when commissioning and testing the device and network.

Table 11 - Module Status, LED Indications

LED State	Module Status	Meaning
OFF	No Power	No power through DeviceNet
Green	Device Operational	SCM-DN operating normally
Flashing Green	Device in Standby	SCM-DN needs commissioning
Flashing Red	Minor Fault	Recoverable Fault
Red	Unrecoverable Fault	SCM-DN may need replacing
Flashing Red/Green	Device Self-testing	SCM-DN in self-test mode

Table 12 - Network Status, LED Indications

LED State	Module Status	Meaning
OFF	No power not online	SCM-DN has no power, or not completed the Dup_MAC_ID test
Flashing Green	Online, not connected	SCM-DN is Online but not allocated to a Master
Green	Online	SCM-DN operating normally
Flashing Red	Connection Timeout	One or more I/O connections have timed out
Red	Critical Link Failure	SCM-DN detected an error that makes it incapable of communicating on the link (Bus off or dup MAC_ID)

Valve State Indicator LEDs

There are two Valve State Indicating LEDs on the DeviceNet module. Again, these LEDs are not visible through the enclosure lid, but are used in set up and calibration of the device.

Table 13 - Valve Position Indication LEDs

LED State	Red	Green
OFF	Valve not Closed	Valve not Open
ON	Valve Closed	Valve Open
Flashing	Valve has timed out on stroke	Valve has timed out on stroke

DeviceNet Network Topology and Distances

DeviceNet specifications provide for the maximum distances allowable for the main trunk line and drops based on the baud rate selected.

Table 14 - Maximum Network Lengths

Baud Rate	Trunk Line Length		Drop Length			
	Max Distance		Maximum		Cumulative	
	Meters	Feet	Meters	Feet	Meters	Feet
125k	500	1640	6	20	156	512
250k	250	820	6	20	78	256
500k	100	328	6	20	39	128

Table 15 - DeviceNet Conductor sizes

Function	Thick wire	Thin wire
Power	15 AWG	22 AWG
Signal	18 AWG	24 AWG

Network Terminating Resistor

A DeviceNet system *must be terminated at each end of the trunk line.* The host controller and the last device on the network must always have a terminating resistor installed to prevent reflections, even if only two nodes are present.

Illustration 15:
Terminating Resistor Specs and Connection

Optional Termination Resistor:
121 Ohm, 1% Metal film, 1/4 Watt

V- CANL CANH V+   AUX- AUX+
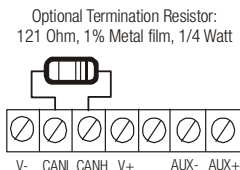
Caution: Per DeviceNet specifications, do not use a terminating resistor on any drop line devices.

I/O Connections (Solenoids)

The single pilot wires are factory terminated for the integral mount-ed spool valve. Use the table below if making your own pilot valve terminations.

Table 16 - Pilot Valve Terminations

Solenoid No.	Positive Terminal +24VDC	Negative Terminal Signal to Solenoid
1	+Output	Open
2	+Output	Close

Important: All DC output and DC input circuits are polarity sensitive. Proper operation requires they be wired as shown above. The outputs will not work and the device can be damaged if terminations do not conform to the table.

All terminals on the module accept 22 to 12AWG conductors.

Power Requirements

Device Power

The SCM-DN can be powered via the network connection or an external power supply. Typically the device is powered from the 11-25VDC network power. In Modbus mode, the DXP-DN is powered from a factory-supplied 24VDC source connected to the V+/V- terminals. The DXP-DN module consumes 45mA of current at 24VDC, or 1.1 Watts (Typical).

Utilizing an external power supply reduces the load on the DeviceNet power supply and provides a degree of electrical isolation between the device and the network. Power to and from the limit switch relays and the pilot valves are fed through the DeviceNet module via the device power connection.

Power Fuse

The DXP-DN module has an on-board 1 Amp fuse.

Note: Should the pilot device outputs exceed 1/2 Amp, this fuse may require replacing. Contact the factory.

Software Configuration

Parameters

The SCM-DN is software configurable for several parameters. The following table defines the legal and default values for the I/O configuration selections.

Table 17 - Configuration Parameters (Class 15)

Instance	Parameter Name	Values	Default Setting	Default Value	Description
1	Max Open Time	0 to 65535	Disabled	0	Max time allowed for valve to Open before triggering an alarm
2	Max Close Time	0 to 65535	Disabled	0	Max time allowed for valve to Close before triggering an alarm
3	Cycle Count Limit	0 to 4294967295	Disabled	0	Max number of cycles allowed before triggering an alarm
4	Analog High Limit	0 to 255	Disabled	255	Highest analog value before triggering an alarm
5	Analog Low Limit	0 to 255	Disabled	0	Lowest analog value before triggering an alarm
6	DNet Fault Action	0 or 1	Use Fault Value	0	0 = Use fault value 1 = Hold last state
7	DNet Fault Value	0 thru 3	OFF	0	0 = OFF 1 = Open 2 = Close 3 = No change
8	DNet Idle Action	0 or 1	Use Fault Value	0	0 = Use fault value 1 = Hold last state
9	DNet Idle Value	0 thru 3	OFF	0	0 = OFF 1 = Open 2 = Close 3 = No change
10	Ass'y Config	1 to 4	Standard Ass'y	1	1 = Status & Alarm bytes 2 = Status & Alarm bytes = last Open & Close Times 3 = Status & Alarm bytes + Cycle Count 4 = Status & Alarm bytes + last Open/Close Times + Cycle Count

Definitions of these parameters are as follows:

• **Max Open Time-**Maximum allowed time for the valve to open before triggering an alarm.
• **Max Close Time-**Maximum allowed time for the valve to close before triggering an alarm.
• **Cycle Count Limit-**Maximum number of valve cycles allowed before triggering an alarm.
• **Analog High Limit-**Highest analog value allowed before triggering an alarm.*
• **Analog Low Limit-**Lowest analog value allowed before triggering an alarm.*
• **Output Fault Action-**Selection to determine whether each output will hold its last state or assume the value identified in the next parameter upon a device fault.
• **Output Fault Value-**The value each output will assume after a fault if fault value is selected above (hold last state is not selected).
• **Output Idle Action-**Selection to determine whether each output will hold its last state or assume the value identified in the next parameter if an Idle Command is issued by the Master.
• **Output Idle Value-**The value each output will assume upon an Idle Command if Idle Value is selected above (hold last state is not selected).
• **Assembly Configuration-**This determines what data is returned in the poll response. See Tables 5 through 8 for values and data formats.

*Contact factory for information concerning Analog Input options.

Calibration of Limit Switches

A calibration switch is provided on the DeviceNet SCM-DN to allow for manual stroking of the actuator to set the limit switch trip points. A three position toggle on the device module is labeled:

OPEN-AUTO-CLOSE

The calibration switch is active ONLY while the device is in Idle Mode, or if the ENABLE_CAL_SWITCH bit is set in the poll output command byte. This allows the pilot valve outputs to be manually energized through the device module or the remote controller via network commands. The following tables describe the calibration switch and ENABLE_CAL_SWITCH features.

Table 18 - Enable Cal Switch Bit

ENABLE CAL SWITCH Bit Value	Manual Calibration Status
0 = OFF	Disabled. Calibration switch has no effect.
1 = ON	Enabled. Valve may be stroked using the calibration switch.

Table 19 - Calibration Switch Operation

Switch Position	Action
OPEN	Energizes the Open solenoid terminals, de-energizes the Close solenoid terminals
AUTO	Places control of solenoid terminals into DeviceNet network commands
CLOSE	Energizes the Close solenoid terminals, de-energizes the Open solenoid terminals

Open/Close Timers and Alarms

The SCM-DN tracks the time it takes the valve to open or close by recording the interval between when an Open, or Closed, command is received and the corresponding limit switch relays feedback. These times may be read in the poll response if Assembly Instance 2 or 4 is selected. Additionally, you may set corresponding alarm limits on these times by setting the appropriate parameters in the Parameter Object (see Table 17). When the configured time is exceeded during an Open or Closed operation, the corresponding alarm bit will be set and returned in the Alarm Byte (byte 2) of each input response to a poll command.

These Open/Close Time Alarms are set in 10 msec increments with a minimum of 10 msec, and a maximum of 109 min 13.5 sec. (65535 setting)

When an alarm is active the corresponding Position Indicating LED flashes, as defined in Table 13.

Cycle Counter and Alarm

The Cycle Counter is a means to track the total number of cycles an actuator will see during its life for diagnostic and maintenance information feedback.

The Cycle Counter counts the number of times an actuator performs one Open, one Closed cycle. The counter will register up to 4, 294, 967, 295 cycles before clearing and starting back at 0.

A Cycle Count Alarm may be set that when exceeded will activate an alarm condition. The actual count is written to the non-volatile (NV) memory. This is done only every 256 counts to avoid excessive writes to the NV register.

The Cycle Counter can be reset to 0 as appropriate, such as changing out an actuator, by setting Bit 4 in the Poll Command byte (see Table 9).

If the number of cycles exceeds the limit value you set in Parameter 3, the Cycle Alarm bit will be set, and returned, in the Alarm Byte (byte 2) of each Input Response to a Poll Command.

Configuring the Alarms

The alarms are not active if the limit values are zero. To activate an alarm, set a Limit Parameter to a non-zero value (see Table 17, Parameters 1, 2 and 3).

Clearing the Alarms

There are two ways to clear the alarms.

The Reset Alarms bit (bit 2 in Table 9) may be set to clear ALL alarms. If this bit is left active, the alarm counters and notifications will be cleared.

The other way is to push the Reset Alarms button on the DeviceNet module in the DXP-DN (see Illustration 14, pg. 14).

Note: If the cause of the alarm remains, resetting the alarms with the Reset Button, or the Output Command bit, only restarts the counters/timers on the next operation. To clear the alarm entirely, remove the alarm trip condition and then reset the alarm(s).

DeviceNet Technical Details

The following describes the DeviceNet Objects present in the SCM-DN. The SCM-DN conforms to a Type 7, Generic I/O device.

Table 20 - DeviceNet Objects

Object	DeviceNet Object Class	No. of Instances
Identity	1	1
Message Router	2	1
DeviceNet	3	1
Assembly	4	3
Connection	5	2 (Explicit msg, polled I/O)
Parameter	15 (F_{hex})	6
Serial ASCII Input/Output	100 (64_{hex})	1
Valve Controller	110 ($6E_{hex}$)	1
Alarm	111 ($6F_{hex}$)	5
Alarm Group	112 (70_{hex})	2

Identity Object Class 1. Instances 0 and 1 exist in the SCM-DN.

Table 21 - Identity Object Class Attributes (Instance 0)

Attribute ID	Access Rule	Name	DNet Data Type	Description of Attribute	Value
1	Get	Rev	UINT	Rev of this object	1
2	Get	Max. Obj Instance	UINT	Max Instance no. of current object	1
6	Get	Max. Class Attribute ID	UINT	Attr ID no. of last Class Attr of the Class Definition implemented in the device	7
7	Get	Max. Instance Attribute ID	UINT	Attr ID no. of last Instance Attr of the Class Definition implemented in the device	1

Table 22 - Identity Object Instance Attributes (Instance 1)

Attribute ID	Access Rule	Name	DNet Data Type	Description of Attribute	Value
1	Get	Vendor	UINT	ODVA Vendor No. for this product	9
2	Get	Device Type	UINT	ODVA General I/O Device Type	0
3	Set	Product Code	UINT	TopWorx Unique Product Code No.	110
4	Get	Revision	STRUCT of:	Revision of this device	2.050
		Major Rev	USINT		
		Minor Rev	USINT		
5	Get	Status	WORD	Summary Status of device	0
6	Get	Serial No.	UDINT	TopWorx Unique Device Serial No.	XXXX
7	Get	Product Name	SHORT STRING	ASCII Name of product	DNP
10	Get/Set	Heartbeat Intervall	USINT	The interval, in seconds, that the device generates a heartbeat message. A value of 0 disables heartbeat generation.	0

Table 23 - Identity Object Common Services

Service Code	Class	Instance	Service Name	Description of Service
05hex	YES	YES	Reset	Invokes the Reset Service for the device
0Ehex	YES	YES	Get_Attribute_Single	Returns contents of specified attribute
10hex	NO	YES	Set_Attribute_Single	Modifies an attribute value

Parameter Object - Class 15 (0F$_{hex}$)

There are many configurable data parameters associated with the SCM-DN. The SCM-DN uses a Parameter Object (a collection of user configurable parameters) to assist you in reading and changing the configurable data. These parameters are retained in the NV memory. Following are the Class Attributes, Instance Attributes and Services supported by the DXP-DN for the Parameter Object.

Table 24 - Parameter Class Attributes (Instance 0)

Attribute ID	Access Rule	Name	DNet Data Type	Description of Attribute	Value
1	Get	Revision	UINT	Rev of this object	1
2	Get	Max Instance	UINT	Max Instance no. of the Parameter Object	10
8	Get	Parameter Class Descriptor	WORD	Bits describing parameters	9

Table 25 - Parameter Instance Attributes

Attribute ID	Access Rule	Name	DNet Data Type	Description of Attribute	Value
1	Set	Parameter value	*Data type* specified in Descriptor Data Type and Size	Actual value of paramter. Can be read from or written to. This Attribute is read only if bit 4 of Attribute is TRUE.	0
2	Set	Link path size	USINT	Size of link path. If "0", no link is specified.	6
3	Set	Link path	ARRAY of DNet path:	Dnet path to the object from where this parameter's value is retrieved.	0
4	Get	Descriptor	UINT	Description of parameter.	X
5	Get	Data type	USINT	Data type code.	X
6	Get	Data size	USINT	No. of bytes in parameter value.	X

Table 26 - Parameter Object Common Services

Service Code	Class	Instance	Service Name	Description of Service
05$_{hex}$	Yes	No	Reset	Resets all parameters to factory defaults
0E$_{hex}$	Yes	Yes	Get_Attribute_Single	Returns the contents of the specified attribute
10$_{hex}$	Yes	Yes	Set_Attribute_Single	Modifies an attribute value

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General Specifications

General Specifications		
Description	Remote multiplexer, compatiable with ODVA's DeviceNet protocol for discrete I/O. Supports (3) discrete inputs, (2)discrete outputs and (1) analog 8 bit input	
Device Profile	General Purpose discrete I/O, Class 7 with objects	
	Identity	(Class 1)
	Message Router	(Class 2)
	DeviceNet	(Class 3)
	Assembly	(Class 4, 4 Instances)
	Connection	(Class 5)
	Parameter	(Class F_{hex}, 10 Instances)
	Valve	(Class $6E_{hex}$)
	Alarm	(Class $6F_{hex}$, 5 Instances)
	Alarm Group	(Class 70_{hex}, 2 Instances)
Device Conformance	Designed to conform to ODVA DeviceNet Spec Vol.I Version 2.0 & Vol. II Version 2.0	
Communications	Predefined Master/Slave Connection Set, Group 2 Only Server	
I/O Protocols	Polled I/O or Change of State (COS), Cyclic	
DeviceNet Connection	5-pin quick disconnect (See Fig. 2) or via terminal blcoks on device module	
Network Termination	None Required	
Status Indicators	Module Status	Green/Red Bicolor LED
	Network Status	Green/Red Bicolor LED
	Valve Open	Green High Intensity LED
	Valve Closed	Red High Intensity LED
Voltage Isolation	None	
Maximum Power	100mA @ 11VDC, 45mA @ 25VDC (1.1 watts) unregulated power supply excluding output load(s)	
I/O Refresh Rate	400 micro seconds (2.5kHz) minimum	
I/O Fuse	1 Amp	
Operating Temperature	0-60°C	
Humidity	0-95% RH, non-condensing	

I/O Electrical Specifications

Ratings	Min.	Typical	Max	Units	Comments
Input Power					
Device Power	11	24	25	VDC	per DeviceNet Spec
Discrete Inputs					
Aux Input	11	24	25	VDC	
Open/Close Outputs					
Max Voltage			25	VDC	
Output Current	0	0.5	0.5	Amp	
Surge Current			5	Amps - peak	
Turn On Time		10	40	msec	Resistive load
Turn Off Time		10	40	msec	Function of solenoid

Troubleshooting	
Problem	Solution
The Module Status LED is solid green The Network Status LED is flashing green The device will not communicate over the network	The network does not have a terminating resistor. Add 121 Ohm resistor as shown in Figure 3 at the first and last nodes.
The Module Status LED is solid red The device will not initialize	The EEprom chip has malfunctioned. Device may be damaged. Return to factory for evaluation.
The Module Status LED is solid green Network Status LED is flashing red	Another device has the same MacID (address). Remove power from the offending device and assign a unique MacID to it.
The Module Status LED is solid green The Network Status LED is solid green The valve does not operate with network command	There is a loose connection in the field wiring; the wiring has incorrect polarity on terminals; or the device is damaged.

Safe Use

Special Conditions of Safe Use (All installations)
Clean only with a damp cloth to prevent possibility of electrostatic discharge.

For Explosion Proof installations, the internal ground connection shall be used and the external ground connection, if supplied in addition, is supplemental bonding allowed where local authorities permit, or is required.

When installing with a third party listed nipple-mount solenoid, it is the responsibility of the installer to provide fittings, and apparatus, suitable for the area classification in accordance with the National Electrical Code.

All cable entry devices or conduit stopping boxes shall be certified in type of explosion protection 'd', suitable for the conditions of use and correctly installed.

The IIC enclosures are excluded from use in carbon disulphide atmospheres.

The air pressure to the valve block, when fitted, shall not exceed 7bar.

Preventative Maintenance
The TopWorx Valvetop is designed to operate for one million cycles without servicing. Call TopWorx when you are approaching this milestone for a preventative maintenance kit and instructions.

Certifications & Approvals

D-SERIES METAL (DXP/DXS)

INTRINSICALLY SAFE (WITHOUT THE VALVE OPTION)

CE ⟨Ex⟩ II1G II2G II2D IEC INMETRO PC Г606 c(UL)us LISTED

Ex ia IIC T6/T4 Ga*, Ex t IIIC T70°C Db, IP66/IP67
Ex ia IIC T6/T4 Gb*, Ex t IIIC T70°C Db, IP66/IP67
Ex ia IIC T4, DIP A21 TA 85°C IP66/IP67 (marking for GOST)
Ex ib IIC T4 Gb, Ex tb IIIC T80°C Db, IP67 (marking for FF and FF with FISCO)
-50°C ≤ Tamb ≤ +55°C (maximum*)
SIRA 07ATEX2214X
Baseefa 11ATEX0035X (FF and FF with FISCO)
IECEx SIR 09.0098X
IECEx BAS 11.0022X (FF and FF with FISCO)
NCC 12.1260X
GOST POCC US.Г506.B01346
P279671/1

Class I Div 1, Groups A,B,C,D; Type 4,4X; IP67

* Reference certificates for variations to Tamb and ELP due to sensing and/or o-ring material options.

INTRINSICALLY SAFE (WITH THE VALVE OPTION)

CE ⟨Ex⟩ II2G II2D PC Г606 c(UL)us LISTED

Ex ia IIC T6/T4 Ga/Gb, Ex t IIIC T70°C Db, IP66/IP67
Ex ia IIC T4, DIP A21 TA 85°C IP66/IP67 (marking for GOST)
Ex ib IIC T4 Gb, Ex tb IIIC T80°C Db, IP67 (marking for FF and FF with FISCO)
-40°C ≤ Tamb ≤ +60°C (maximum*)
SIRA 07ATEX2214X
Baseefa 11ATEX0035X (FF and FF with FISCO)
GOST POCC US.Г506.B01346
P279671/1

Class I Div 1, Groups A,B,C,D; Type 4,4X; IP67

* Reference certificates for variations to Tamb due to pilot options and ELP due to sensing and/or o-ring material options.

FLAMEPROOF (WITH & WITHOUT THE VALVE OPTION)

CE ⟨Ex⟩ II2G II2D IEC INMETRO PC Г606 c(UL)us LISTED

Ex d IIB+H2 T6 Gb
Ex tb IIIC T85° Db, IP66/IP67
Ex d IIB+H2 T4, DIP A21 TA 85°C IP66/IP67 (marking for GOST)
-50°C ≤ Tamb ≤ +60°C (maximum*)
SIRA 07ATEX1273X
IECEx SIR 07.0093X
NCC 12.1138X
GOST POCC US.Г506.B01346
P279673/1

Class I Div 1, Groups C,D; Class I Div 2, Groups A,B,C,D; Class II Div 2, Groups F,G; Type 4,4X; IP67

* Reference certificates for variations to Tamb.

CE ⟨Ex⟩ II2G II2D IEC INMETRO PC Г606

Ex d IIC T6/T5/T4 Gb
Ex tb IIIC T85°C/T100°C/T135°C Db, IP66/IP67
Ex d IIC T4, DIP A21 TA 85°C IP66/IP67 (marking for GOST)
-50°C ≤ Tamb ≤ +60°C/75°C/110°C (maximum*)
SIRA 07ATEX1273X
IECEx SIR 07.0093X
NCC 5614/09X
GOST POCC US.Г506.B00921
P279673/1

* Reference certificates for variations to Tamb.

NON-INCENDIVE

CE ⟨Ex⟩ II3G c(UL)us LISTED

Ex nC IIC T6 Gb; IP67*
-40°C ≤ Tamb ≤ +60°C

Class I Div 2, Groups A,B,C,D; Class II Div 2, Groups F,G; Type 4,4X; IP67

*Consult factory for available sensing options.

D-SERIES RESIN (DXR)

INTRINSICALLY SAFE (WITHOUT THE VALVE OPTION)

CE ⟨Ex⟩ II2GD IEC

Ex ia IIC T4 Gb, Ex t IIIC T70°C Db, IP67 (Silicone o-rings only)
Ex ib IIC T4 Gb, Ex tb IIIC T80°C DB, IP67 (marking for FF only)
-40°C ≤ Tamb ≤ +53°C (maximum*)
SIRA 07ATEX2214X
Baseefa 11ATEX0035X (FF and FF with FISCO)
IECEx SIR 09.0098X
IECEx BAS 11.0022X (FF and FF with FISCO)

* Reference certificates for variations to Tamb due to sensing options.

INTRINSICALLY SAFE (WITH THE VALVE OPTION)

CE ⟨Ex⟩ II2GD IEC

Ex ia IIC T4 Gb, Ex t IIIC T70°C Db, IP67 (Silicone o-rings only)
Ex ib IIC T4 Gb, Ex tb IIIC T80°C DB, IP67 (marking for FF only)
-20°C ≤ Tamb ≤ +52°C (maximum*)
SIRA 07ATEX2214X
Baseefa 11ATEX0035X (FF and FF with FISCO)
IECEx SIR 09.0098X
IECEx BAS 11.0022X (FF and FF with FISCO)

* Reference certificates for variations to Tamb due to pilot options.

INCREASED SAFETY (WITH & WITHOUT THE VALVE OPTION)

CE ⟨Ex⟩ II2GD IEC

Ex ie mb IIC T4 Gb
Ex tb IIIC T66°C Db, IP67(Silicone o-rings only)
-20°C ≤ Tamb ≤ +44°C (maximum*)
SIRA 09ATEX3209X
IECEx SIR 09.0088X
P279673/2

* Reference certificates for variations to Tamb due to pilot options.

NON-INCENDIVE

CE c(UL)us LISTED

Class I Div 2, Groups A,B,C,D; Class II Div 2, Groups F,G; Type 4,4X; IP67
T4 -40°C ≤ Tamb ≤ +60°C

GENERAL PURPOSE

CE c(CSA)us

Type 4, 4X

Warranty

TERMS AND CONDITIONS OF SALE

These terms and conditions, the attendant quotation or acknowledgment, and all documents incorporated by reference therein, binds TopWorx, Inc. hereinafter the Seller, and the buyer, hereinafter Buyer, and constitutes the entire agreement (Agreement) between Buyer and Seller for the provision of services (Services) and/or the sale of goods (Goods) including (except as provided in Section 10) firmware incorporated therein.

1.   PRICES: Unless otherwise specified by Seller, Seller's price for the Goods and/or Services shall remain in effect for thirty (30) days after the date of Seller's quotation or acceptance of the order for the Goods/Services, whichever is delivered first, provided an unconditional, complete authorization for the immediate manufacture and shipment of the Goods and/or provision of Services pursuant to Seller's standard order processing procedures is received and accepted by Seller within such time period. If such authorization is not received by Seller within such thirty (30) day period, Seller shall have the right to change the price for the Goods/Services to Seller's price in effect for the Goods/Services at the time the order is released to final manufacture. Prices for Goods do not cover storing, installing, starting up or maintaining Goods unless expressly stated in Seller's quotation. Notwithstanding the foregoing, the price for Goods/Services sold by Seller, but manufactured by others, shall be Seller's price in effect at the time of shipment to Buyer.

2.   DELIVERY, ORDER ACCEPTANCE AND DOCUMENTATION: All shipping dates are approximate and are based upon Seller's prompt receipt of all necessary information from Buyer to properly process the order. Notwithstanding any provisions to the contrary in this or other documents related to this transaction, and regardless of how price was quoted, whether FOB, FAS, CIF or otherwise, legal title to the Goods and risk of loss thereto shall transfer to Buyer as follows: for sales in which the end destination of the Goods is within the United States, upon delivery to the freight carrier at the shipping point; for sales in which the end destination of the Goods is outside of the United States, immediately after the Goods have passed beyond the territorial limits of the United States. Seller shall provide Buyer with that data/documentation which is specifically identified in the quotation. If additional copies of data/documentation or non-standard data/documentation are to be provided by Seller, they shall be provided to Buyer at Seller's price then in effect. Data/documentation marked as confidential or proprietary may not be reproduced or used for any purpose other than the purpose for which it was provided and may not be disclosed to third parties without the prior written permission of Seller.

3.   EXCUSE OF PERFORMANCE: Seller shall not be liable for delays in performance or for non-performance due to failure or interruption of computer or telecommunication systems, acts of God, war, riot, fire, terrorism, labor trouble, unavailability of materials or components, explosion, accident, compliance with governmental requests, laws, regulations, orders or actions, or other unforeseen circumstances or causes beyond Seller's reasonable control. In the event of such delay, the time for performance or delivery shall be extended by a period of time reasonably necessary to overcome the effect of the delay.

4.   TERMINATION AND SUSPENSION BY BUYER: Buyer may terminate or suspend its order for any or all of the Goods/Services covered by the Agreement provided that Buyer gives Seller reasonable advance written notice of such termination or suspension and reimburses Seller for all losses, damages, costs and expenses arising from such termination or suspension.

5.   LIMITED WARRANTY: Subject to the limitations contained in Section 6 herein, Seller warrants that the licensed firmware embodied in the Goods will execute the programming instructions provided by Seller, and that the Goods manufactured or Services provided by Seller will be free from defects in materials or workmanship under normal use and care. The foregoing warranties will apply until the expiration of the applicable warranty period. All other Goods are warranted for twelve (12) months from the date of shipment by Seller. Consumables and Services are warranted for a period of 90 days from the date of shipment or completion of the Services. Products purchased by Seller from a third party for resale to Buyer ("Resale Products") shall carry only the warranty extended by the original manufacturer. Buyer agrees that Seller has no liability for Resale Products beyond making a reasonable commercial effort to arrange for procurement and shipping of the Resale Products. If Buyer discovers any warranty defects and notifies Seller thereof in writing during the applicable warranty period, Seller shall, at its option, correct any errors that are found by Seller in the firmware or Services or repair or replace F.O.B. point of manufacture that portion of the Goods or firmware found by Seller to be defective, or refund the purchase price of the defective portion of the Goods/Services. All replacements or repairs necessitated by inadequate maintenance, normal wear and usage, unsuitable power sources or environmental conditions, accident, misuse, improper installation, modification, repair, use of unauthorized replacement parts, storage or handling, or any other cause not the fault of Seller are not covered by this limited warranty, and shall be at Buyer's expense. Seller shall not be obligated to pay any costs or charges incurred by Buyer or any other party except as may be agreed upon in writing in advance by Seller. All costs of dismantling, reinstallation and freight and the time and expenses of Seller's personnel and representatives for site travel and diagnosis under this warranty clause shall be borne by Buyer unless accepted in writing by Seller. Goods repaired and parts replaced by Seller during the warranty period shall be in warranty for the remainder of the original warranty period or ninety (90) days, whichever is longer. This limited warranty is the only warranty made by Seller and can be amended only in a writing signed by Seller. THE WARRANTIES AND REMEDIES SET FORTH ABOVE ARE EXCLUSIVE. THERE ARE NO REPRESENTATIONS OR WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, AS TO MERCHANTABILITY, FITNESS FOR PARTICULAR PURPOSE OR ANY OTHER MATTER WITH RESPECT TO ANY OF THE GOODS OR SERVICES.

6.   LIMITATION OF REMEDY AND LIABILITY: SELLER SHALL NOT BE LIABLE FOR DAMAGES CAUSED BY DELAY IN PERFORMANCE. THE REMEDIES OF BUYER SET FORTH IN THIS AGREEMENT ARE EXCLUSIVE. IN NO EVENT, REGARDLESS OF THE FORM OF THE CLAIM OR CAUSE OF ACTION (WHETHER BASED IN CONTRACT, INFRINGEMENT, NEGLIGENCE, STRICT LIABILITY, OTHER TORT OR OTHERWISE), SHALL SELLER'S LIABILITY TO BUYER AND/OR ITS CUSTOMERS EXCEED THE PRICE TO BUYER OF THE SPECIFIC GOODS MANUFACTURED OR SERVICES PROVIDED BY SELLER GIVING RISE TO THE CLAIM OR CAUSE OF ACTION. BUYER AGREES THAT IN NO EVENT SHALL SELLER'S LIABILITY TO BUYER AND/OR ITS CUSTOMERS EXTEND TO INCLUDE INCIDENTAL, CONSEQUENTIAL OR PUNITIVE DAMAGES. THE TERM "CONSEQUENTIAL DAMAGES" SHALL INCLUDE, BUT NOT BE LIMITED TO, LOSS OF ANTICIPATED PROFITS, REVENUE OR USE AND COSTS INCURRED INCLUDING WITHOUT LIMITATION FOR CAPITAL, FUEL AND POWER, AND CLAIMS OF BUYER'S CUSTOMERS.

7.   PATENTS: Subject to the limitations contained in Section 6, Seller shall defend any suits brought against Buyer based on a claim that use of the Goods manufactured by Seller constitutes an infringement of a valid patent of the United States, and shall pay any damages awarded therein against Buyer, provided that Buyer: promptly notifies Seller in writing of the filing of such suit or the threat thereof; permits Seller to control completely the defense or compromise of such claim of infringement; and provides all reasonable assistance and cooperation requested by Seller for the defense of such suit. In the event that only the Goods manufactured by Seller are held to be infringing in such suit and their use is enjoined, Seller shall, at its sole option and expense, provide a commercially reasonable alternative, including, but not limited to, procuring for Buyer the right to continue using the Goods, replacing them with a non-infringing product or modifying them so they become non-infringing. Buyer agrees that Seller shall not be liable for infringement, and that Buyer shall fully indemnify Seller therefore, if infringement is based upon the use of Goods in connection with goods not manufactured by Seller or in a manner for which the Goods were not designed by the Seller or if the Goods were not designed by the Seller or if the Goods were designed by the Buyer or were modified by or for the Buyer in a manner to cause them to become infringing.

8.   TAXES: Any tax or governmental charge payable by the Seller because of the manufacture, sale or delivery of the Goods, or provision of Services, may at Seller's option be added to the price herein specified. The foregoing shall not apply to taxes based upon Seller's net income.

9.   TERMS OF PAYMENT: Subject to the approval of Seller's Credit Department, terms are F.O.B. shipping point, net 30 days from date of Seller's invoice in U.S. currency, except for applicable milestone payments covered below or export shipments for which Seller may require other arrangements. Freight charges may include shipping and handling charges, and Buyer shall pay all such charges. If any payment owed to Seller hereunder is not paid when due, it shall bear interest at a rate 1-1/2% per month interest from the date on which it is due until it is received and future shipments may be placed on hold. Seller shall have the right, among other remedies, either to terminate the Agreement or to suspend further deliveries under this and/or other agreements with Buyer in the event Buyer fails to make any payment hereunder when due. Buyer shall be liable for all expenses attendant to collection of past due amounts, including attorneys' fees. Unless otherwise provided in Seller's written quotation, periodic milestone payments shall be made by Buyer when the purchase price of this Agreement exceeds $100,000. In such cases, invoices shall be issued by Seller and paid by Buyer based on the following milestones: Milestone 1: 30% of price upon acceptance of order by Seller. Milestone 2: 30% of price upon release by Seller of approved bills of material to manufacturing for assembly. Milestone 3: 40% of price upon shipment of the Goods by Seller. Seller reserves the right to designate additional Milestones where the Agreement provides for Services in excess of $50,000.

10.   SOFTWARE AND FIRMWARE: Notwithstanding any other provision herein to the contrary, Seller or applicable third party owner shall retain all rights of ownership and title in its respective firmware and software, including all copyrights relating to such firmware and software and all copies of such firmware and software. Except as otherwise provided herein, Buyer is hereby granted a nonexclusive, royalty free license to use firmware and software, and copies of firmware and software, incorporated into the Goods only in conjunction with such Goods and only at the Buyer's plant site where the Goods are first used. Buyer may negotiate with Seller separate licenses to use such copies and firmware and software at other plant sites. Buyer's use of certain firmware (as specified by Seller) and all other software shall be governed exclusively by Seller's and/or third party owner's applicable license terms.

11.   BUYER SUPPLIED DATA: To the extent that Seller has relied upon any specifications, information, representation of operating conditions or other data or information supplied by Buyer to Seller ("Data") in the selection or design of the Goods and/or provision of the Services and the preparation of Seller's quotation, and in the event that actual operating conditions or other conditions differ from those represented by Buyer and relied upon by Seller, any warranties or other provisions contained herein which are affected by such conditions shall be null and void.

12.   EXPORT/IMPORT: Buyer agrees that all applicable import and export control laws, regulations, orders and requirements, including without limitation those of the United States and the European Union, and the jurisdictions in which the Seller and Buyer are established or from which items may be supplied will apply to its receipt and use of Goods and Services. In no event shall Buyer use, transfer, release, import, export, or re-export Goods in violation of such applicable laws, regulations, orders, or requirements.

13.   GENERAL PROVISIONS: (a) Buyer shall not assign its rights or obligations under the Agreement without Seller's prior written consent; (b) there are no understandings, agreements or representations, express or implied, not specified in the Agreement; (c) no action, regardless of form, arising out of transactions under the Agreement, may be brought by either party more than two years after the cause of action has accrued; (d) any modification of these terms and conditions must be set forth in a written instrument signed by a duly authorized representative of Seller; (e) the Agreement is formed and shall be construed, performed and enforced under the laws of the State of Missouri (however, Buyer and Seller agree that the proper venue for all actions arising under the Agreement shall be only in the State where the Goods involved in such actions were manufactured; (f) The 1980 United Nations Convention on Contracts for the International Sale of Goods does not apply to this Agreement; (g) If any provision of the Agreement is invalid under any statute or rule of law, such provision, to that extent only, shall be deemed to be omitted without affecting the validity of the remainder of the Agreement; (h) Seller specifically objects to the application of any Federal Acquisition Regulation ("FAR") or other governmental procurement provision or clause to the Agreement; (i) UNLESS OTHERWISE SPECIFICALLY PROVIDED IN SELLER'S QUOTATION, GOODS AND SERVICES HEREUNDER ARE NOT INTENDED FOR USE IN ANY NUCLEAR OR NUCLEAR RELATED APPLICATIONS. Buyer (i) accepts Goods and Services in accordance with the restriction set forth in the immediately preceding sentence, (ii) agrees to communicate such restriction in writing to any and all subsequent purchasers or users and (iii) agrees to defend, indemnify and hold harmless Seller from any and all claims, losses, liabilities, suits, judgments and damages, including incidental and consequential damages, arising from use of Goods and Services in any nuclear or nuclear related applications, whether the cause of action be based in tort, contract or otherwise, including allegations that the Seller's liability is based on negligence or strict liability; (j) The rights, remedies and protections afforded to Seller under this Agreement, including but not limited to indemnification of Seller, limitation of remedy and liability and limited warranty shall extend to Seller and to its affiliates, subsidiaries, or related companies performing or supplying work, services, or products under this Agreement or any agreement into which it is incorporated by reference; and (k) Seller does not agree to: (i) indemnify Buyer; or (ii) name Buyer as an additional insured.

NOTES:

GLOBAL SUPPORT OFFICES

North America
3300 Fern Valley Road
Louisville, Kentucky 40213 USA
1 502 969 8000
info.topworx@emerson.com

Asia-Pacific
1 Pandan Crescent
Singapore 128461
65 6777 8211
info.topworx@emerson.com

Europe
Horsfield Way
Bredbury Industrial Estate
Stockport
SK6 2SU UK
44 0161 406 5155
info.topworx@emerson.com

Middle East
P.O. Box 17033
Jebel Ali Free Zone –South 2
Dubai 17033
United Arab Emirates
971 4 811 8283
info.topworx@emerson.com

Africa
24 Angus Crescent
Longmeadow Business Estate East
Modderfontein
Gauteng
South Africa
27 11 451 3700
info.topworx@emerson.com

Visit www.topworx.com for comprehensive information on our company, capabilities, and products – including model numbers, data sheets, specifications, dimensions, and certifications.

info.topworx@emerson.com

www.topworx.com

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