

# **TopWorx™ D-Series with AS-interface**

## **Installation, Operation & Maintenance Manual**



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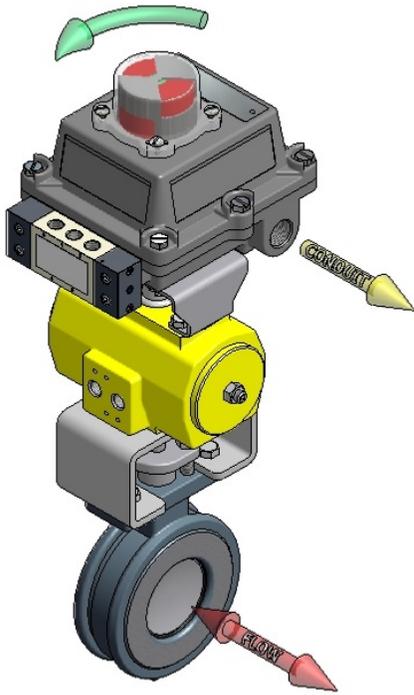
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## Installation on Actuator

### 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*  $\pm 9^\circ$ . Consult your local distributor or factory representative for 45° *reverse acting* or *mounted perpendicular* applications.

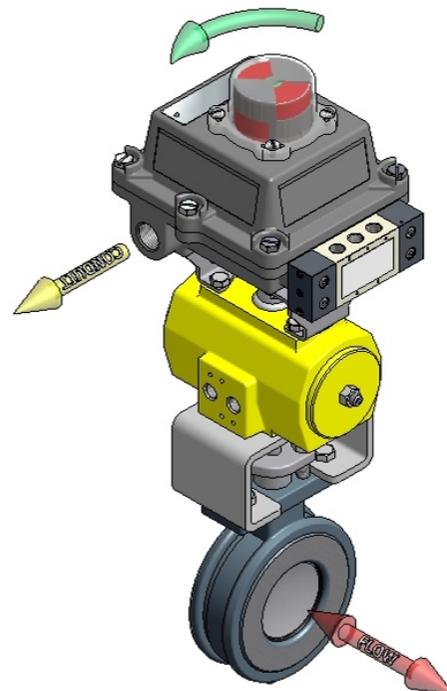


#### Illustration #1

The image to the left shows a TopWorx™ 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 TopWorx™ *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.



## Installation on Actuator (continued)

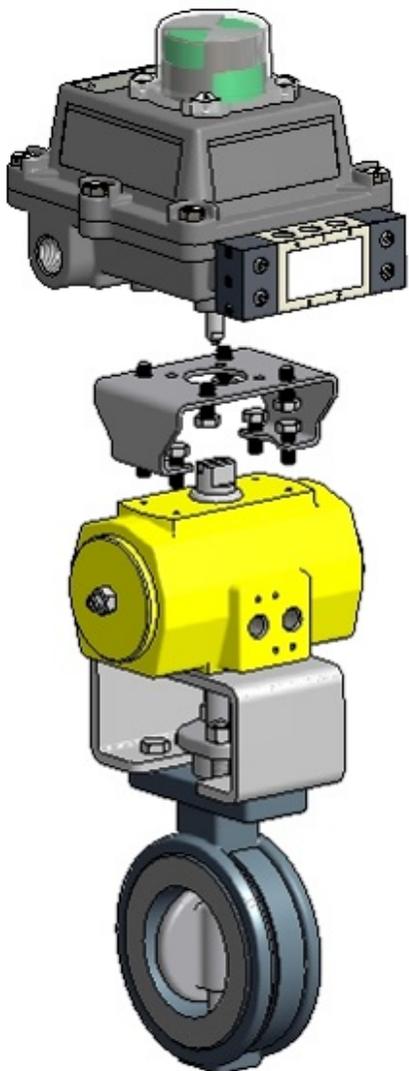
### Mounting

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 TopWorx™ 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 -40°F (-40°C) to 160°F (71°C). Once properly installed, the temperature range listed on the nameplate will supersede this storage temperature range.

### Illustration #3: Mounting Assembly



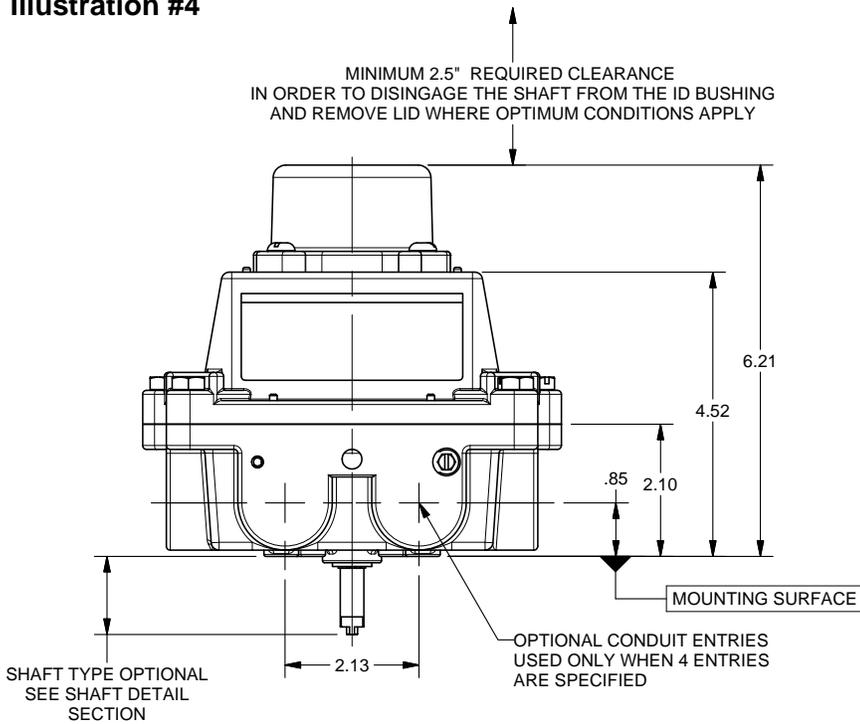
### Installation Notes

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 torquing 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 the 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.**



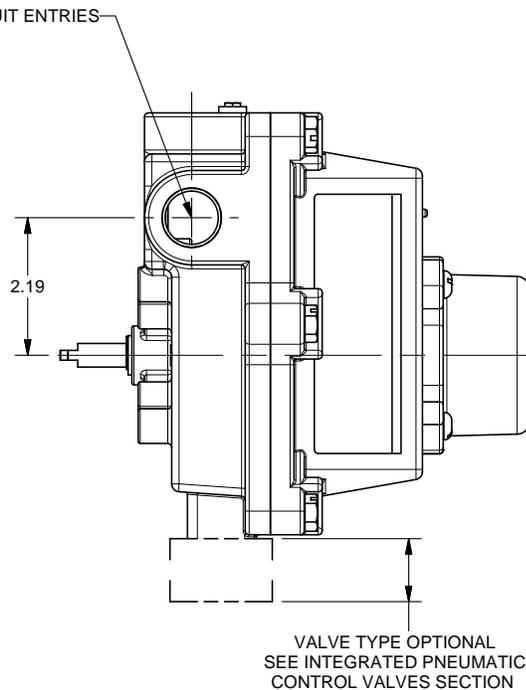
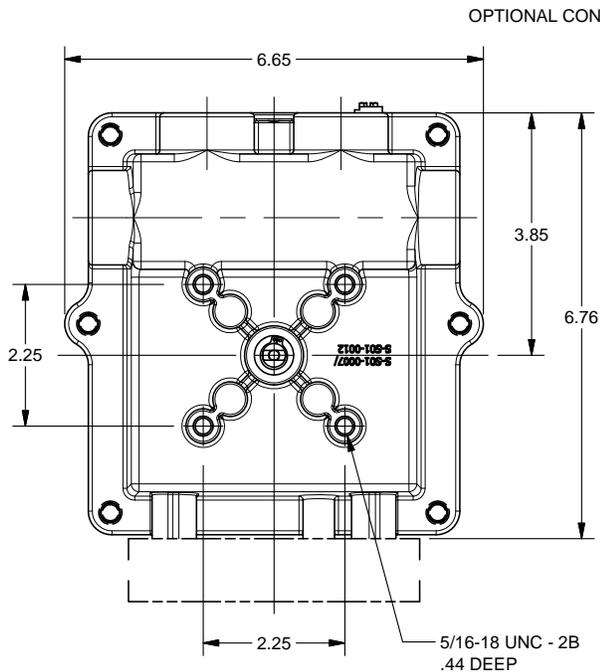
# Dimensions and Materials: TopWorx™ DXP

Illustration #4



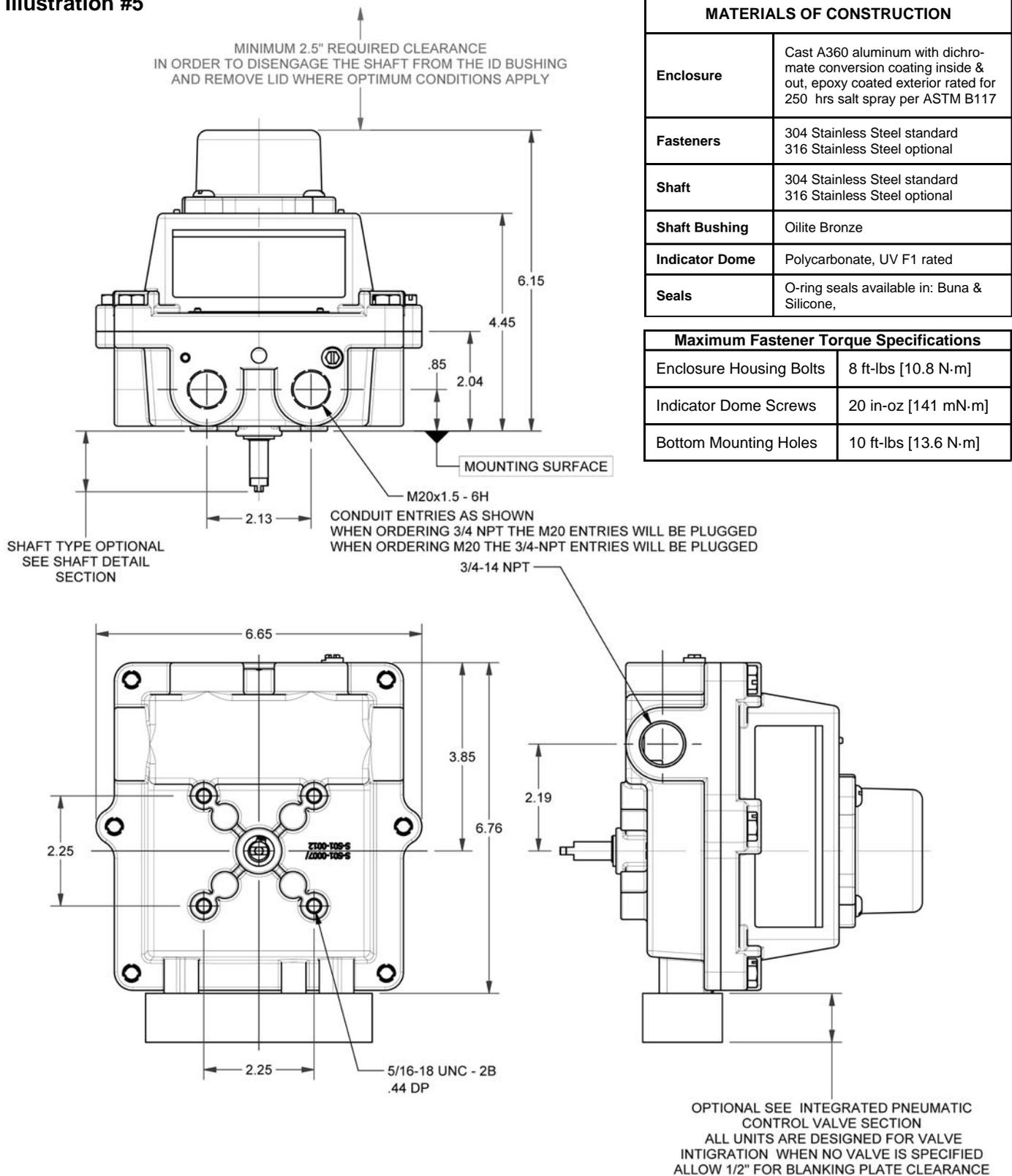
MATERIALS OF CONSTRUCTION	
Enclosure	Cast A360 aluminum with dichromate conversion coating inside & out, epoxy coated exterior rated for 250 hrs salt spray per ASTM B117
Fasteners	304 Stainless Steel standard 316 Stainless Steel optional
Shaft	304 Stainless Steel standard 316 Stainless Steel optional
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]



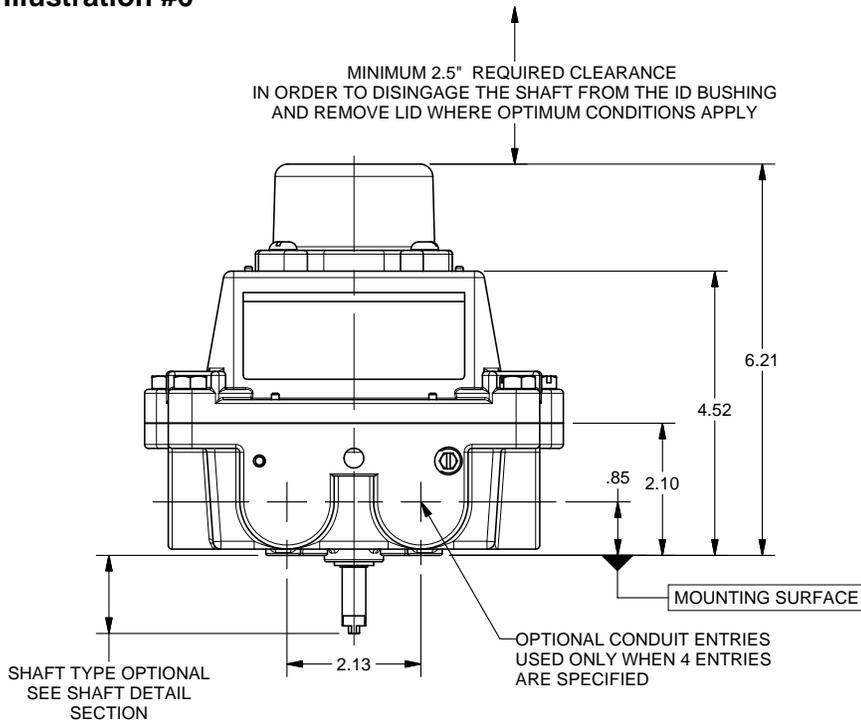
## Dimensions and Materials: TopWorx™ DXP - IIC

Illustration #5



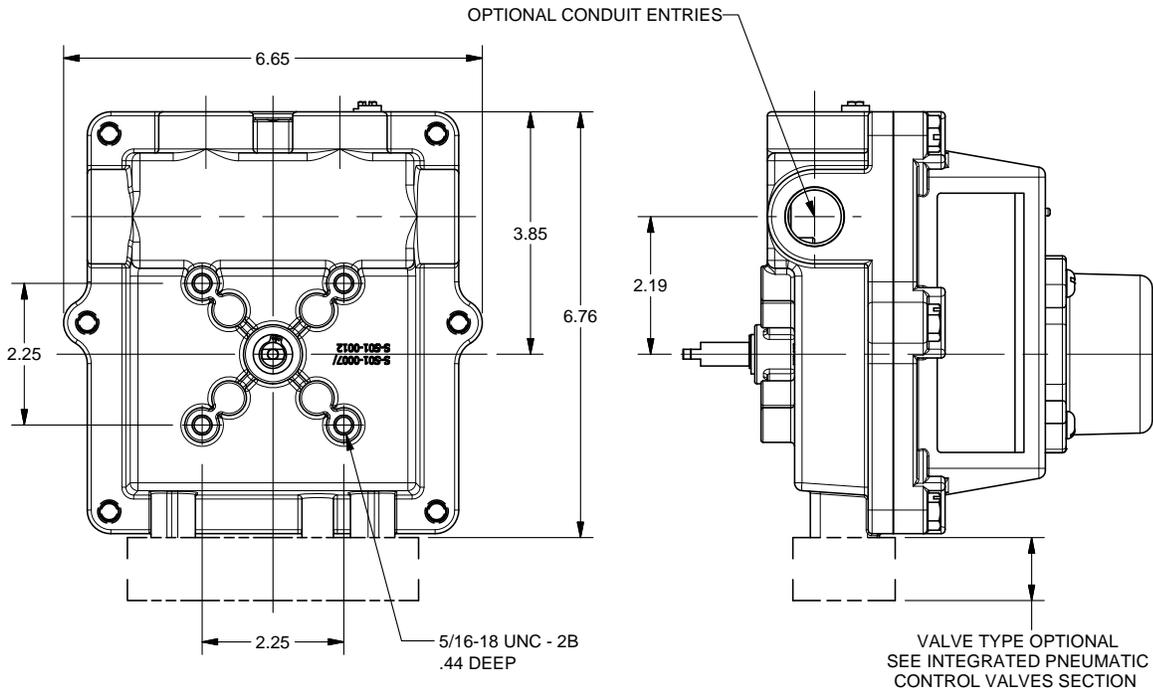
# Dimensions and Materials: TopWorx™ DXS

Illustration #6



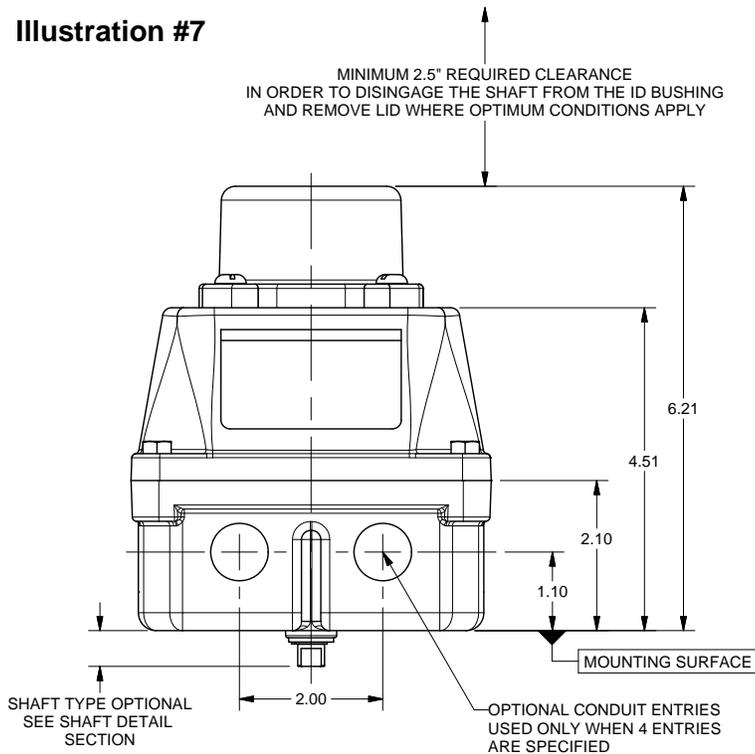
MATERIALS OF CONSTRUCTION	
Enclosure	Cast 316 Stainless Steel
Fasteners	304 Stainless Steel standard 316 Stainless Steel optional
Shaft	304 Stainless Steel standard 316 Stainless Steel optional
Shaft Bushing	N/A
Indicator Dome	Polycarbonate, UV F1 rated
Seals	O-ring seals available in: Buna & Silicone,

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]



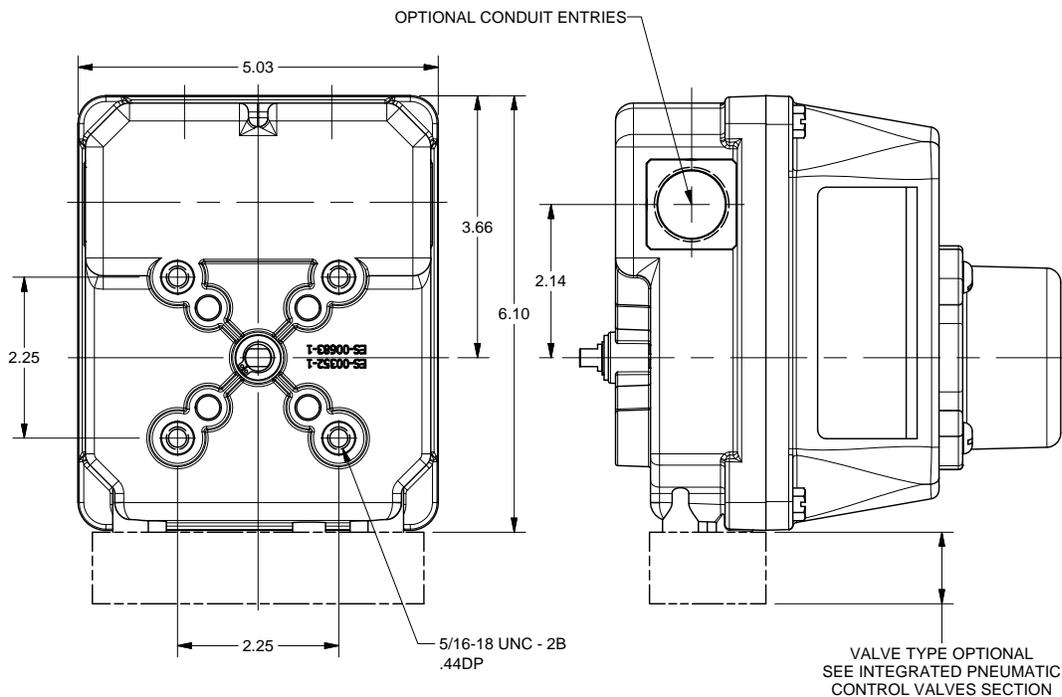
## Dimensions and Materials: TopWorx™ DXR

Illustration #7



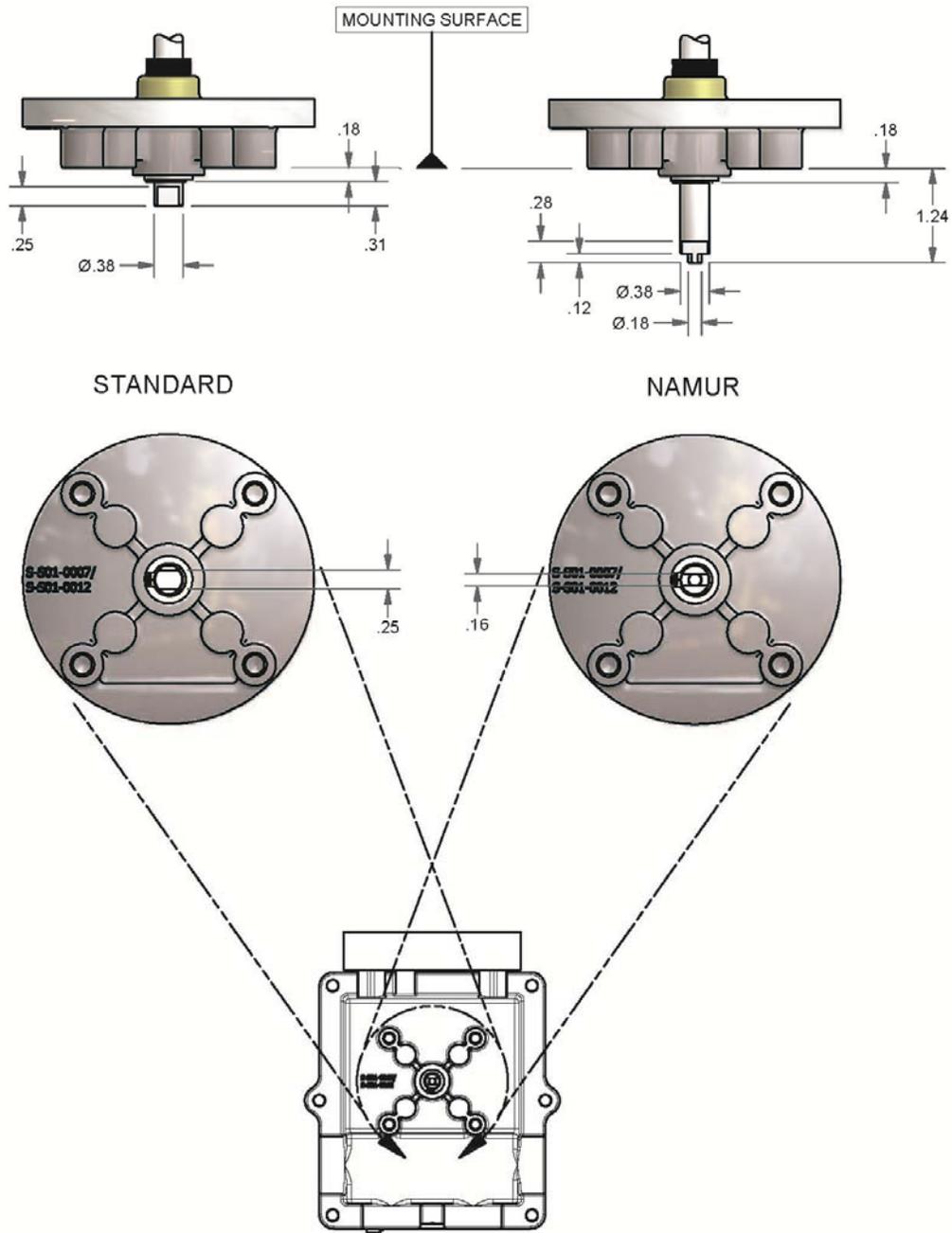
MATERIALS OF CONSTRUCTION	
Enclosure	Valox® 364 Polybutylene Terephthalate (PBT)
Fasteners	304 Stainless Steel standard 316 Stainless Steel optional
Shaft	304 Stainless Steel standard 316 Stainless Steel optional
Shaft Bushing	Delrin® 500P white
Indicator Dome	Polycarbonate, UV F1 rated
Seals	O-ring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

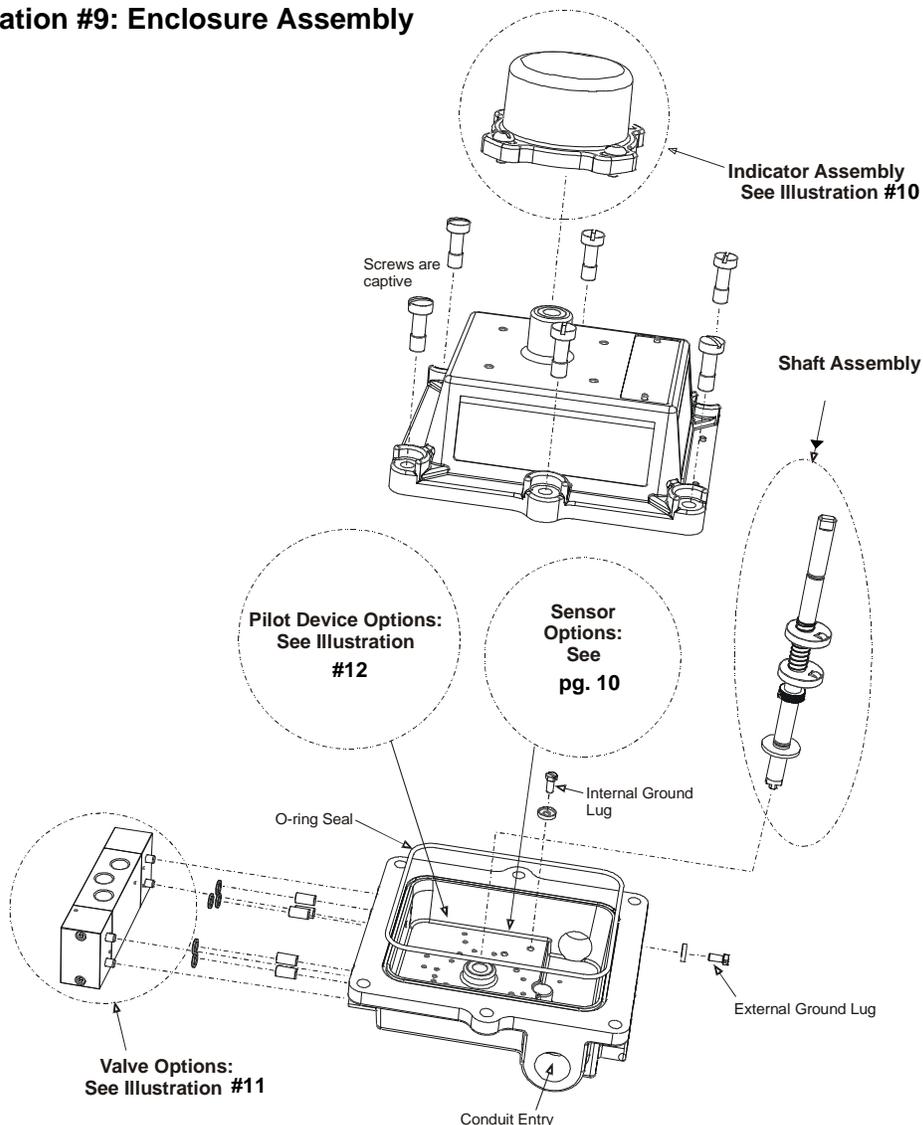


### Dimensions and Materials: Shafts

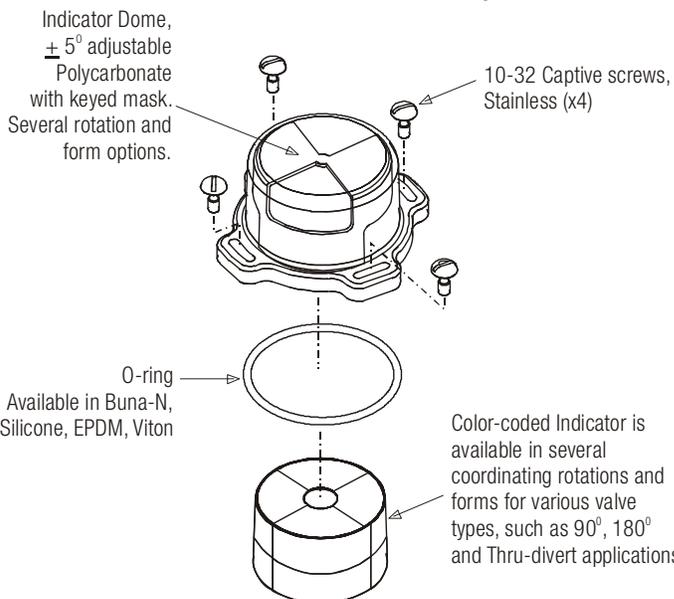
Illustration #8: Shaft Detail



**Illustration #9: Enclosure Assembly**

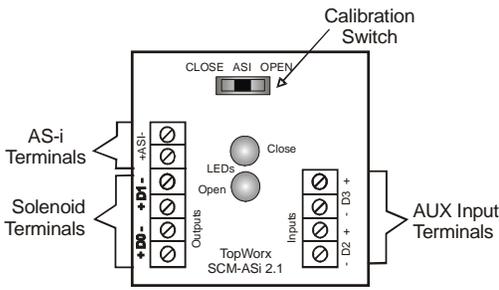


**Illustration #10: Indicator Assembly**

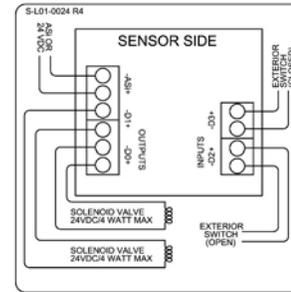


Indicator / Dome Replacement Kits	
AV-GB002	90°, Green/Open, Red/Closed, Buna O-Ring
AV-YB002	90°, Yellow/Open, Black/Closed, Buna O-Ring
AV-TB002	90°, Green/Thru, Red/Divert, Buna O-Ring
AV-4B002	90°, Green/Open, Red/Closed, Buna O-Ring

**Illustration #11: SCM-ASI Sensor Communication Module**



**Illustration #12: SCM-ASI Wiring Diagram**



**Solenoid Note:** Internal mount pilot in the DXP/DXS is 0.6W. For any externally mounted, or customer supplied, solenoid valve 4 watt maximum power consumption is allowed. A 170 mA max surge current limitation is required to prevent activation of the short circuit protection.

**D-Series with ASi Wiring**

**Step 1**

For internally-mounted or external pilot device(s), wire the '+' and '-' leads to the terminals marked D0 (open) and D1 (closed). The internally-mounted pilot has an LED indicator for power verification. **Note: For an externally mounted solenoid valve, 4 watt maximum power consumption is allowed. A 160 mA surge current limit is required to prevent activation of the short circuit protection circuit.**

**Step 2**

Connect the AS-i communication wires to the terminals marked AS-i '+' and AS-i '-'. (See Illustration 12 for wiring diagram) **Note: For calibration of the switches, a 24 VDC power supply may be used instead of an ASI Controller. If an ASI Controller is not available, wire +24 VDC to ASI+, and GND to ASI-. The calibration switch will still be able to actuate the valve.**

**Additional Instruction for wiring an external switch input.**

For externally mounted auxiliary input limit switches, wire switches to the terminals marked -D2+ for the open switch and -D3+ for the closed limit switch.

**Calibrating Limit Switches inside the SCM-ASi Module**

**Never** perform the switch calibration procedure where area is known to be hazardous.

**Step 1**

Once pneumatic hookup and wiring has been completed close the valve using the SCM-ASI on-board calibration switch, as seen in Illustration 11. If no AS-i network connection is available, you may connect a 24VDC power supply to the + ASI - terminals as previously described.

**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.

**Step 3**

Open the valve by sliding the calibration switch to the OPEN position.

AS-i Specifications	
Profile	S-B.A.0
Device ID Device I/O	A Free Profile B 2 Inputs / 2 Outputs
Inputs D2 Open Limit Switch D3 Closed Limit Switch	0 Switch Open 1 Switch Closed
Outputs D1 Solenoid #1 (Close) D0 Solenoid #2 (Open)	0 De-energize Solenoid 1 Energize Solenoid
Current	40mA + open solenoid current and closed solenoid current Max solenoid current = 160mA per output Max power = 4 watts per output
Voltage	20 to 30VDC



**NOTE:** When upgrading a TopWorx AS-i module with a new TopWorx AS-i 2.1 module, make sure the input and output data bit positions are updated as indicated above.

**Step 4**

Once the valve is in the OPEN position, disengage the TOP cam from the splined hub and rotate Counter-clockwise until the Green LED lights. Release the Cam to re-engage the splined Hub.

**Step 5**

Cycle the valve CLOSED and OPEN several times using the calibration switch to verify both limit switches are maintaining their set points.

**Step 6**

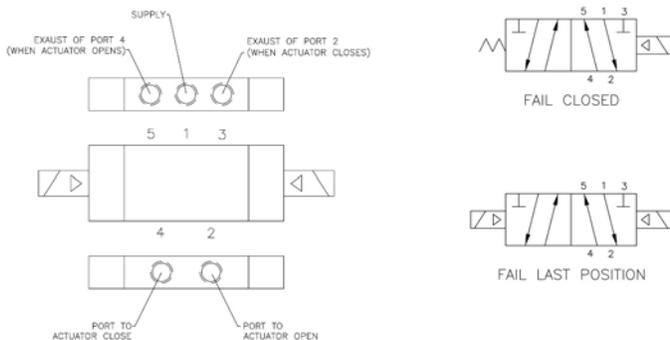
Finally, slide the calibration switch to the ASI position. The AS-i network will now have full control of the valve once the SCM-ASI has been addressed.

## Pneumatic Hookup Procedures

Prior to connecting the supply air to the spool valve, flush the system to remove any debris or contaminants. 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.

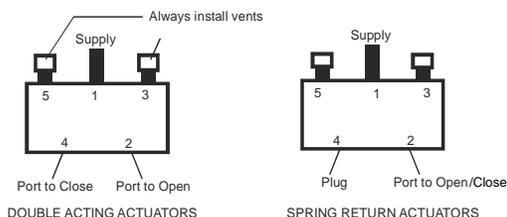
### 4-Way Spool Valves

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\*\*\***



### Don't forget!

TopWorx has a complete line of breathers, flow controls, regulators and filters.

Check out [www.topworx.com](http://www.topworx.com) or call us at **502.969.8000** for more details

## Highly Recommended

TopWorx highly recommends Loctite 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 enclosure and pose a safety issue.

### Spool Valves and Pilots

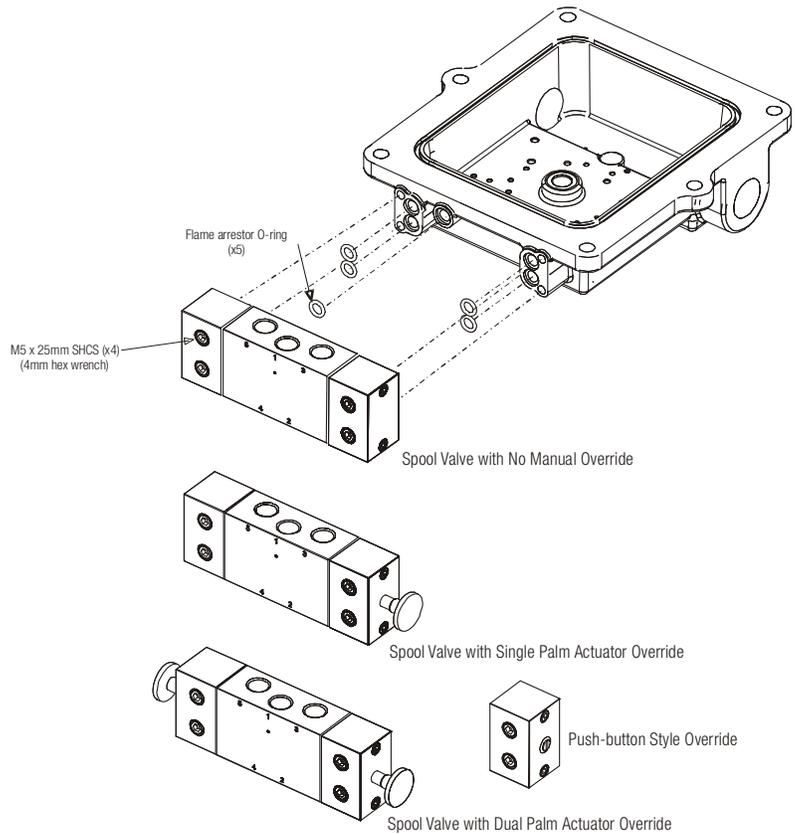
Fail Closed Spool Valve Replacement Assemblies	
<b>AV-BFCVA20</b>	Std Alum Spool Valve Assy w/Buna seals
<b>AV-BFCVS20</b>	Std 304SS Spool Valve Assy w/Buna seals
<b>AV-BFCV620</b>	Std 316SS Spool Valve Assy w/Buna seals

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

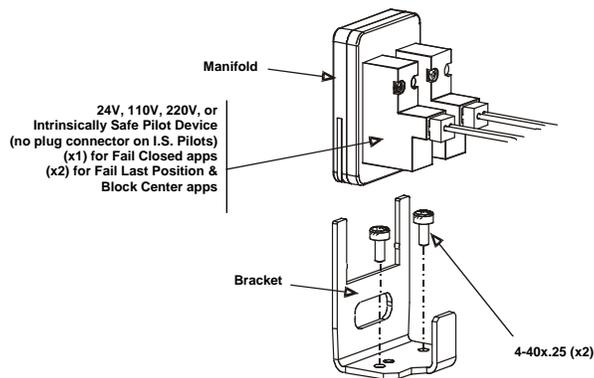
Block-Center Spool Valve Replacement Assemblies	
<b>AV-BBCVA20</b>	Std Alum Spool Valve Assy w/Buna seals
<b>AV-BBCVS20</b>	Std 304SS Spool Valve Assy w/Buna seals
<b>AV-BBCV620</b>	Std 316SS Spool Valve Assy w/Buna seals

\*\*Consult factory for more options.

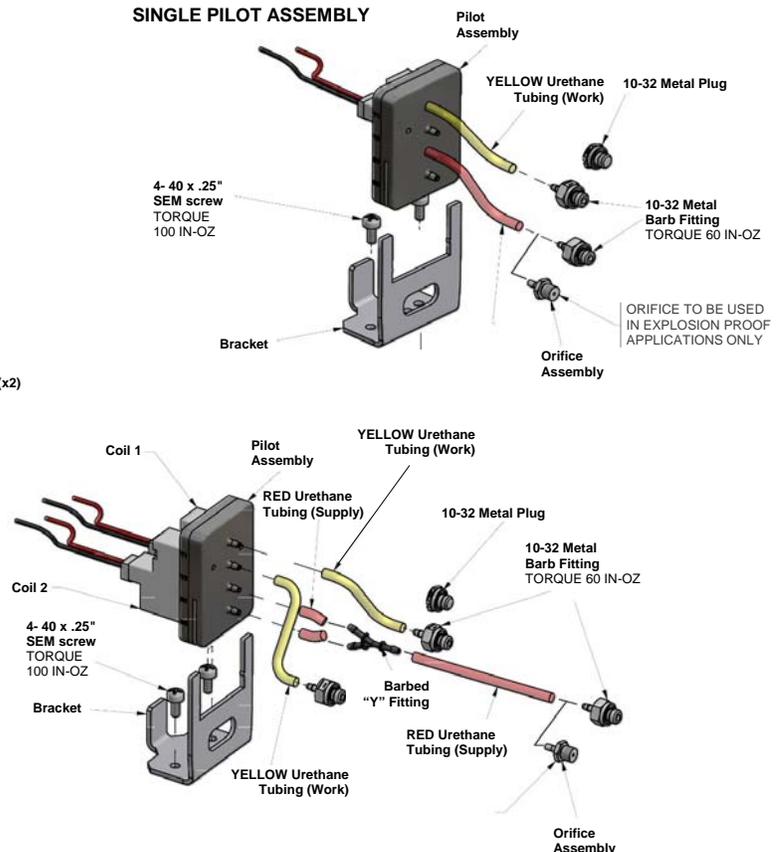
**Illustration #13: Spool Valve Assembly**



**Illustration #14: Pilot Device Assembly**



**SINGLE PILOT ASSEMBLY**



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

## 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™ Discrete Valve Controllers are 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)



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\*)  
 SIR A 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.I.T506.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)



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\*)  
 SIR A 07ATEX2214X  
 Baseefa 11ATEX0035X (FF and FF with FISCO)  
 GOST POCC US.I.T506.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)



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\*)  
 SIR A 07ATEX1273X  
 IECEX SIR 07.0093X  
 NCC 12.1138X  
 GOST POCC US.I.T506.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.



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\*)  
 SIR A 07ATEX1273X  
 IECEX SIR 07.0093X  
 NCC 5614/09X  
 GOST POCC US.I.T506.B00921  
 P279673/1

\* Reference certificates for variations to Tamb.

#### NON-INCENDIVE



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)



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\*)  
 SIR A 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)



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\*)  
 SIR A 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)



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

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

#### NON-INCENDIVE



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



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.

## GLOBAL SUPPORT OFFICES

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