



## WORCESTER CONTROLS

# APEX W7000 Pneumatic Positioner

## Installation Operation Maintenance

FCD WCENIM2077-01

### Principles of Operation:

The Apex W7000 positioner causes rotation (or linear movement) of valve actuator in proportion to an input signal. This signal may take the form of pneumatic pressure (Model W7000 and W7600) or electric current (Models W7100, W7200, W7400, W7500). Supply pressure is directed to the actuator through a precision spool valve. As input pressure is varied, the balance beam shifts away from its neutral position. The spool also shifts and a differential pressure is created across the actuator causing rotation (or linear movement). Actuator motion is fed back through the positioner shaft and cam. Cam rotation causes movement of the feedback arm, changing compression in the feedback spring, forcing the balance beam and spool back to their neutral position. This shuts off the flow of air to the actuator and rotation stops.

### Installation:

The Apex W7000 positioner can be installed on rotary and linear actuators. Actuators can be either double acting or spring return. Positioners can be set up for rotation in either direction (direct or reverse acting).

### Supply Air Requirements:

Air pressure must be limited to 150 psi for supply and 30 psi for instrument signal to avoid damage to the positioner. Supply air must be clean, dry and oil free instrument quality air in accordance with ISA S7.3 specifications (dew point >18 degrees below ambient temperature, particle size <5 microns, oil content <1ppm).

### Mounting:

The following instructions apply to rotary actuators only. Linear applications require special mounting and coupling (consult factory).

1. Mount bracket to actuator. Tighten bolts finger tight only at this time. A standard bracket is available for mounting to NAMUR compliant actuators.
2. Install coupler (not required if installing to a NAMUR compliant actuator) on actuator shaft making sure it is centered.
3. Verify that orientation of actuator (and coupler) flats match positioner shaft flats. If necessary, rotate the cam before installing positioner (see "Cam Installation"). **NOTE:** *Actuator should be in orientation corresponding to zero input signal.*
4. Install positioner onto bracket. Make sure positioner shaft and coupler are engaged and centered. Tighten bolts finger tight only at this time.  
**Pneumatic Connections:** All pneumatic connections, the supply, both output ports, and instrument ports are female 1/4" NPT. All connections require user-supplied tubing fittings. **Caution:** *Do not use Teflon tape as a pipe thread sealant. Use only a liquid or paste non-hardening pipe sealant on the threads.*
5. Connect positioner ports C1 and C2 to actuator. Port C2 is **always** connected to the actuator port used to drive actuator away from its start or fail position (the factor cam setting is full clockwise at minimum input). Port C1 is connected to the opposite port or may be plugged for spring return actuators. **Note:** *For fail counterclockwise applications, the cam must be flipped over so the "R" side is facing upwards (see "Cam Installation").*



6. Connect supply air to port marked "S".
7. Connect instrument signal air to the port marked "I" for model W7000 and W7600. For models W7100, W7200, or W7500, connect 4-20 mA and ground (-). For intrinsically-safe applications (Model W7400 only), see separate intrinsically-safe I/P IOM for barrier requirements and schematics. The I-P is factory calibrated and cannot be adjusted.
8. Stroke actuator/valve two or three times to align positioner, coupler and actuator. With 50% input (actuator at 45 degrees), tighten all mounting bolts. Stroke actuator/valve again to verify there is no misalignment throughout stroke.

## Calibration:

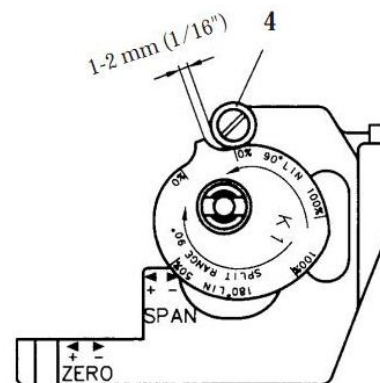
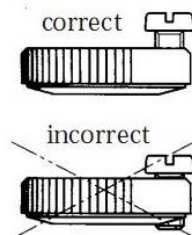
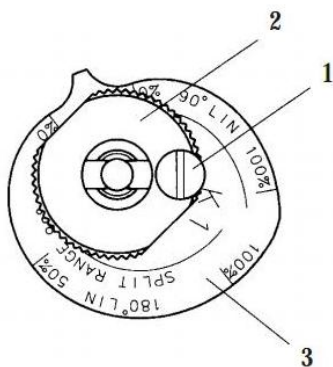
The unit is shipped from the factory pre-calibrated for 90 degree travel ( $\pm 0.5$  degrees rotation – can also be 30/45/60 degrees, see installed cam). For most applications, the valve closed position is much more critical than the valve open position. Most attention should be made to the valve closed position. Always start calibration procedure by applying 0% input signal, then adjusting zero position.

*Caution: Cam pinch points may injure fingers. Be sure to avoid placing fingers and other objects in cam pinch points. Also avoid touching balance bean and spool while making adjustments as an unpredictable cam rotation may result. Finally, maintain control of input signal while making adjustments.*

After mounting the position on the actuator, check cam setting and if needed, perform a cam adjustment:

## Cam Adjustment:

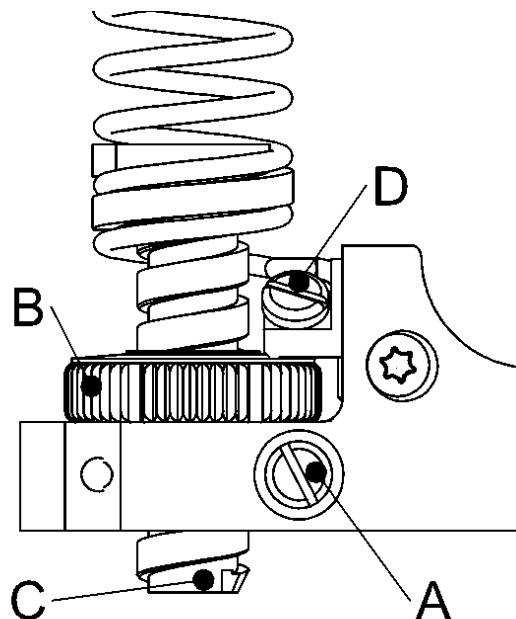
1. Remove cover and indicator.
2. Loosen the screw (1) and turn the cam locking nut (2) counter-clockwise until the cam loosens.
3. Adjust the cam (3) as desired making sure that the ball bearing (4) is riding on an active lobe on the cam.
4. To secure the cam, make sure that the screw (1) is backed out from the locking nut (2) then finger tighten the locking nut and tighten screw (1).
5. Install and adjust the indicator and re-install cover.





### Calibration Procedure:

1. Apply 0% input signal (0% = 20 kPa, 3 psi, or 4 mA).
2. Wait for steady state. It is important to wait for steady state. On very large actuators, it can take minutes to establish.
3. Loosen locking screws **A** and **D** by about 1 turn. Locking screw **D** is the angled screw, just above and to the right of the Zero thumbwheel. If the locking screws are excessively loose, you risk introducing unwanted movement.
4. Adjust “ZERO” position using thumbwheel **B**. You may find it convenient to turn the thumbwheel by using a screwdriver blade in the slots.
  - If using a spring-return actuator, the zero point should be the point at which the positioner output pressure is still zero, but just begins to increase on any tiny increase of signal. This enables all available spring forces to be applied to move the valve to its safe position.
  - If using a double-acting actuator, the zero point is the point at which the actuator will move on any signal increase.
  - If the valve jumps upscale on the initial incremental signal change, the cam is likely misaligned. See page 2 for cam alignment instructions. Revivify cam alignment, then recheck the zero adjustment
- 4b. Retighten locking screw **D** to lock the Zero Nut. DO not retighten **A** at this time
5. Apply 100% input signal (100% = 100 kPa, 15 psi, or 20 mA).
6. Wait for steady state.
7. Adjust the “SPAN” setting by turning screw **C** with a flat-blade screwdriver. This adjustment is accessed by removing the rubber plug in the bottom of the case. The valve should stroke to 100% of desired travel, but should not be loaded against a mechanical stop. Slightly decrease the signal to verify that the valve is tracking the signal value. Span is calibrated when the valve strokes to 100% at exactly 100% signal:
8. Lock the calibration mechanism in place by tightening locking screw **A**.
9. Apply 0% signal and verify zero position. Recalibrate if necessary.





**Cam Installation:**

**Introduction:** The standard cam (labeled “K1” features linear, 90 degree operation for full 3-15 psi input, 3-9 and 9-15 psi split ranges, and 3-15 psi 180 degree operation. The factory setting is 3-15 psi, 90 degrees, with “D: (direct) side up for full clockwise position at 3 psi for 90 degree operation.

**Caution:** Be sure supply air pressure is removed and no pressure exists in the actuator before adjusting cam.

**Cam Adjustment/Replacement:**

1. Remove cover and indicator.
2. Loosen the cam lock screw (1) and turn the cam locking nut (2) counter-clockwise until the cam is loose. It may be necessary to brace the output shaft while loosening the cam locking nut.
3. Adjust the cam (3) as desired, making sure that the cam follower (4) always rides on an active lobe on the cam.
4. Secure the cam by finger tightening the cam locking nut (2) and then tighten the cam lock screw (1) see below

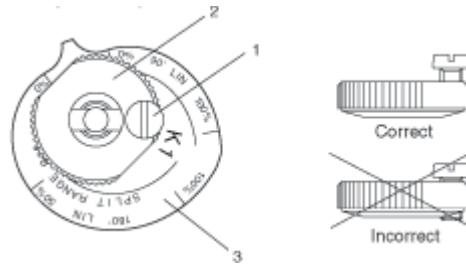


Figure below shows cam setting for Direct Action increasing signal 0-100% (20 – 100 kPa, 3-15 psi) to open. Cam follower to ride on lobe D, 0-100%

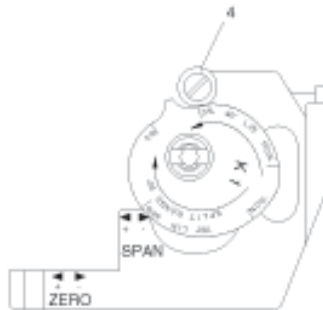
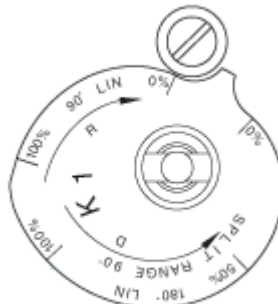


Figure below shows cam setting for reverse action, decreasing signal 100 – 0% (100 – 20 kPa, 15-3 psi) to open. Flip cam over, cam follower to ride on lobe R, 0-100%





Split Range lobe is used to achieve high resolution in split range applications, where only a portion of the signal is used to obtain 90 degrees valve travel. For example, to operate 0 to 90 degrees rotation with 0-50% input signal (20 – 60 kPa, 3-9 psi), adjust cam follower to ride on Split Range 0-50% lobe D. **Note:** to obtain reverse action, flip cam over and use lobe R.

### Spool Valve Installation:

To change out or inspect spool valve, air supply to the positioner must be removed.

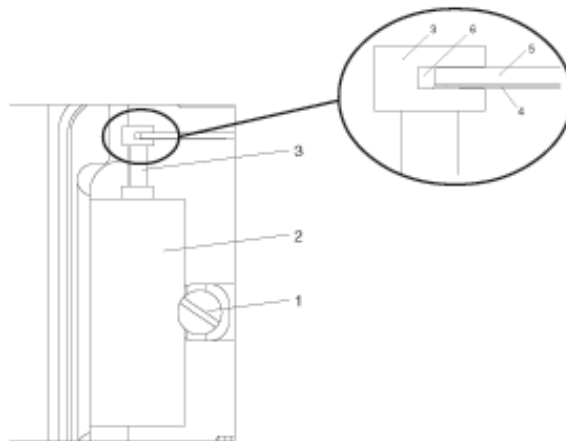
To remove spool valve:

1. Remove screw (1).
2. Carefully lift out entire spool valve assembly (2), disengaging spool (3) from balance arm (5).

To maintain highest performance, do not mix spool and block. Do not lubricate valve.

To Install new spool valve:

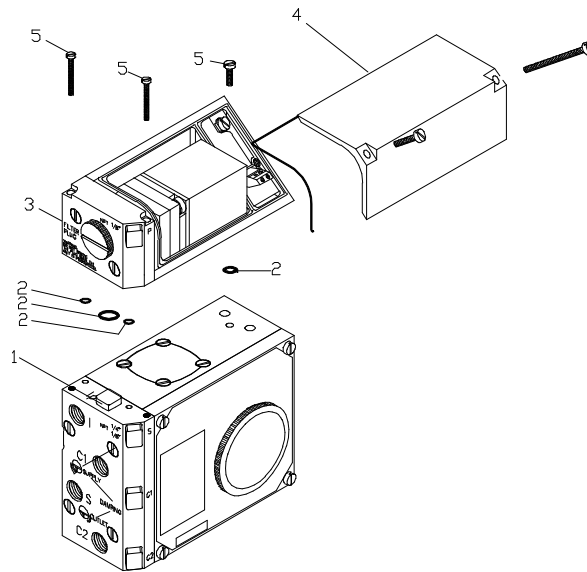
1. Check that O-rings are in place.
2. Insert spool valve assembly (2), making sure that the leaf spring (4) and balance arm (5) engage the slot in spool (6).
3. Tighten screw (1).
4. Check for smooth operation of assembly.



### I-P Installation:

All I-O modules are factory calibrated and cannot be adjusted. Kits are available to allow easy field installation of various input options. Kits include modules, mounting hardware, fasteners, and O-rings.

1. Disconnect signal and supply air from positioner.
2. Remove Plug (1) from positioner housing.
3. Make sure O-rings (2) are seated correctly in I-P housing.
4. For weatherproof or intrinsically-safe I-P module, remove cover (4) to allow access to third mounting screw (5).
5. Attach I-P module (3) to positioner housing with three mounting screws (5) provided.



## Electrical Specifications

Model	Agency Approvals	Hazardous Location Rating <sup>1</sup>	Max Voltage (vdc)	Min. Voltage (vdc)	Max. Current (mA)
W7000	None	None	N/A	N/A	N/A
W7100	None	None	30 vdc	6 vdc	150 mA
W7200	FM	(EX) Cl. I Div 1, Gr. B-D	30 vdc	6 vdc	150 mA
	CSA	(EX) Cl. I Div. 1 Gr. B-D	30 vdc	6 vdc	150 mA
	ATEX/IECEX	(EX) Ex d IIC T4-T6 <sup>3</sup>	30 vdc <sup>4</sup>	6 vdc	50 mA <sup>4</sup>
W7400 <sup>2</sup>	FM	(IS) Cl. I Div. 1 Gr. A-D	28 vdc <sup>4</sup>	6 vdc	50 mA <sup>4</sup>
	CSA	(IS) Cl. I Div. 1 Gr. A-D	28 vdc <sup>4</sup>	6 vdc	50 mA <sup>4</sup>
	ATEX/IECEX	(IS) Ex ia IIC T6 <sup>3</sup>	30 vdc <sup>4</sup>	6 vdc	110 mA <sup>4</sup>
W7500	None	None	30 vdc	6 vdc	30 mA
W7600	None	None	N/A	N/A	N/A

**Warning:** These instruments must be installed in accordance with local national electrical codes, especially for hazardous locations. Consult unit label to determine specific unit certifications.

Notes:

- 1 See hazardous location certificate for detailed temperature ratings. All Apex W7000 units comply with ATEX directive for non-electric equipment intended for use in hazardous locations to Ex II 2 G.
- 2 Additional information regarding entity parameters and instructions for wiring to intrinsically-safe I-P may be found in separate IOM, as well as in the hazardous location certificate.
- 3 See hazardous location certificate for special conditions for safe use.
- 4 Maximum voltage and current considerations may be affected by application specifics, such as choice of barrier, ambient temperatures, etc. See hazardous location certificate for additional information.

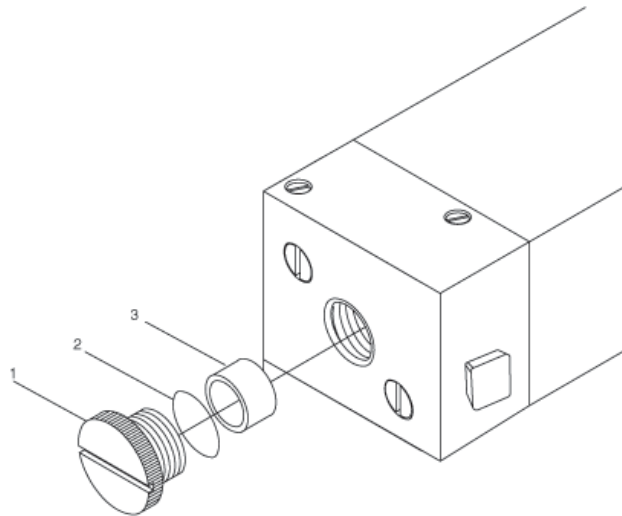


### Filter Plug Replacement:

**Caution:** Do not operate the unit without filter and filter plug installed. Do not attempt to unscrew filter plug while positioner is pressurized.

**Note:** This filter is not designed to act as a permanent source of clean, dry air.

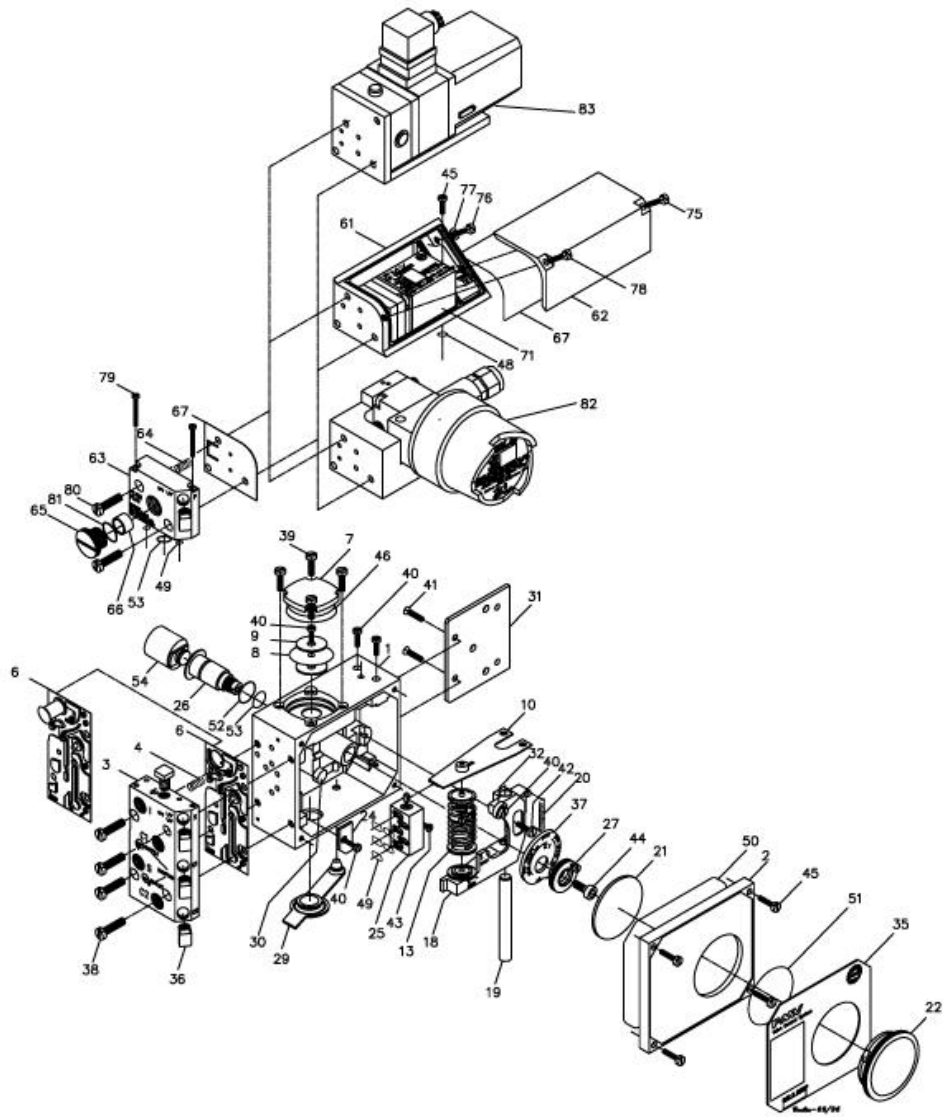
1. Remove air supply pressure from positioner.
2. Unscrew filter plug (1) and O-ring.
3. Remove filter (3) and inspect filter and filter compartment. If moisture is found, check upstream filters and oil-water separators. Moisture can cause I-P failure.
4. Replace filter if necessary and reinstall.



### Maintenance:

The Apex W7000 positioner is designed for long life and trouble-free operation. The following steps should be followed every six months to assure proper operation.

1. Check air supply and associated filtration equipment. See "Supply Air Requirements."
2. Make sure arms, bearings, and adjustment screws move freely. **Caution:** Moving parts to check freedom with supply pressure connected will cause rotation of cam. Be sure to keep fingers away from cam pinch points. If parts do not move freely disassemble and lubricate with a light, instrument grade grease (Lubriplate MAG 1 or equivalent).
3. Check for smooth operation of the spool valve. If it sticks or feels "gummy", remove and clean both spool and valve bore with solvent. Make sure both parts are clean and dry before reinstalling. Do **NOT** apply grease to these parts.
4. Check for air leaks in air supply.
5. Refer to "Troubleshooting" sections if maintenance does not cure problem.



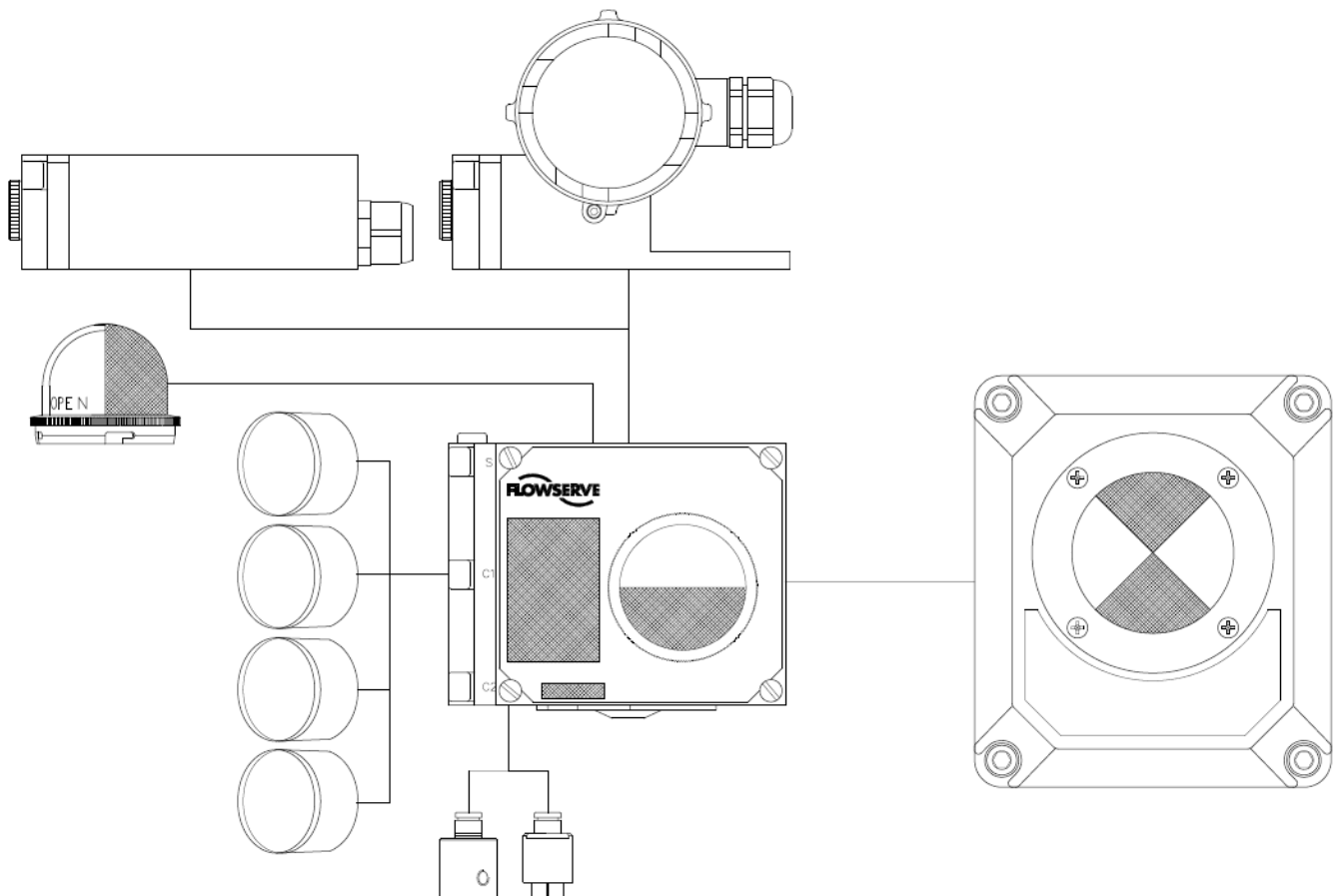
**SPARE PARTS APEX W7000**

DWG No	FLS p/n	Description	Qty
1		Housing	N/A
2	X01370	Front cover incl. O-ring and screws	1
3	X01371	Connecting block NPT 1/4" assembly	1
3	X01372	Connecting block G 1/4" assembly	1
4	X01373	Relief valve spring Set of 5 pcs	1
6	X01374	Gasket W7000	1



6	X01375	Gasket W7100	1
7	X01376	Diaphragm cover incl. O-ring	1
8	X01377	Diaphragm	1
9	X01378	Diaphragm washer	2
10	X01379	Balance arm	1
13	X01380	Feedback spring 3-15 psi assembly	1
13	X01381	Feedback spring 6-30 psi assembly	1
18	X01382	Lower arm assembly	1
19	X01383	Rod	1
20	X01384	Spring	1
21	X01386	Indicator flat, green/black	1
22	X01389	Indicator cover flat for flag incl. O-ring	1
22	X01390	Indicator cover Blind	1
	XK0296	Indicator "Flat" assy	1
22	XK0297	Dome indicator "Pharos" assy	1
24	X01391	Twist stop	1
25	X01433	Pilot valve incl. O-rings	1
25	X01444	Pilot valve P5 assembly, low-bleed	1
26	X01393	Shaft incl. O-rings, screw	1
27	X01394	Cam locking nut incl. screw	1
29	X01395	Zero cover	1
30	X01396	Cover	1
31	X01397	Mounting adapter incl. screws	1
32	X01398	Ball bearing	1
35	X01399	Identification cover 90 deg scale (for flat indicator)	1
36	X01406	Identification cover no scale (for Pharos indicator)	1
36	X01400	Plug NPT 1/8" Set of 25 pcs	1
36	X01401	Plug 1/8" G Set of 25 pcs	1
37	X01437	Cam K1 90°/180° Linear 0-100%, split range 0-50-100%	1
37	X01438	Cam K3 30°/60° Linear 0-100%, split range 0-50-100%	1
37	X01411	Cam K8 90° =% and SQR 0-100%,	1
38-45, 75-80	X01403	Screw set A2/A4 P5/EP5	Set
46-53, 70, 81	X01404	Seal and O-ring set NBR, Nitrile rubber W7000/W7100	Set
46-53, 70, 81	X01405	Seal and O-ring set Q, silicon rubber W7000/W7100	Set
54	X54519	Spindle adaptor (Consult Flowserve)	1
61		I/P housing base	N/A
62	X01408	I/P cover incl. screws	1
63	X01409	I/P nose NPT 1/4" assembly	1
63	X01410	I/P nose G 1/4" assembly	1
64	X01373	Relief valve spring Set of 5 pcs	1
65	X01412	Filter plug assy. incl. filter and O-ring	1
66	X01413	Filters (5 pcs)	Set
67	X01414	Gasket I/P	1
70	KM71	I/P converter general purpose	1
82	KM72	I/P converter explosionproof	1
83	KM75	I/P converter fail-in-place	1

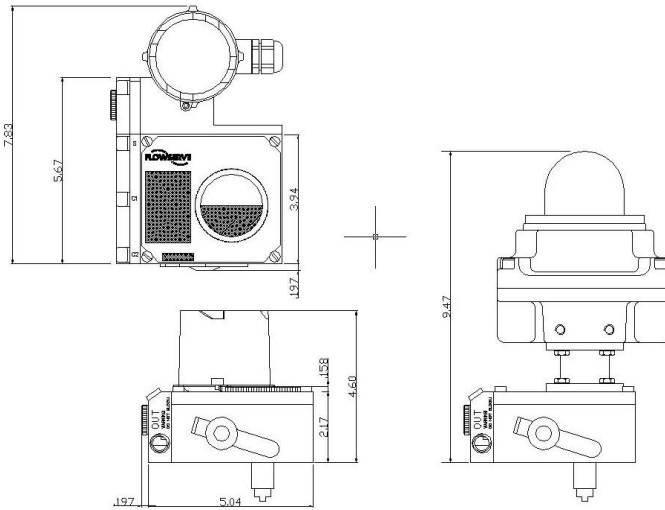
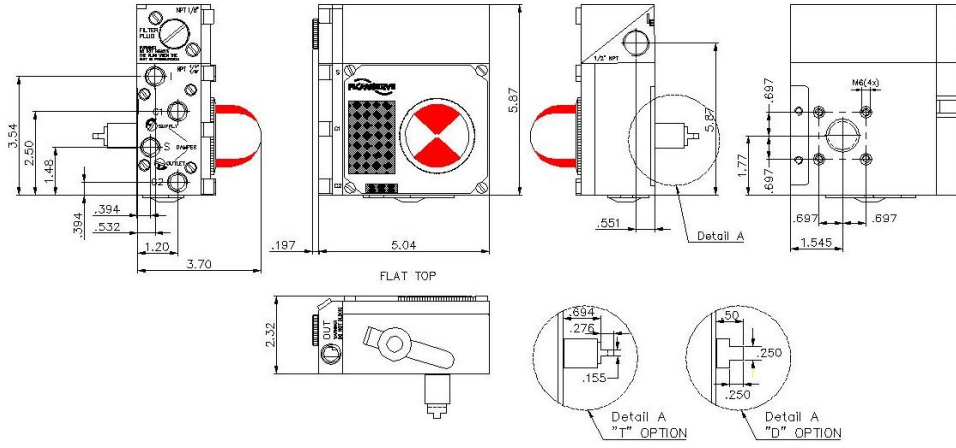
## APEX W7000 SYSTEM



- I/P CONVERTERS
- DOME INDICATOR
- GAUGES
- SWITCHBOXES



**DIMENSIONS:**





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