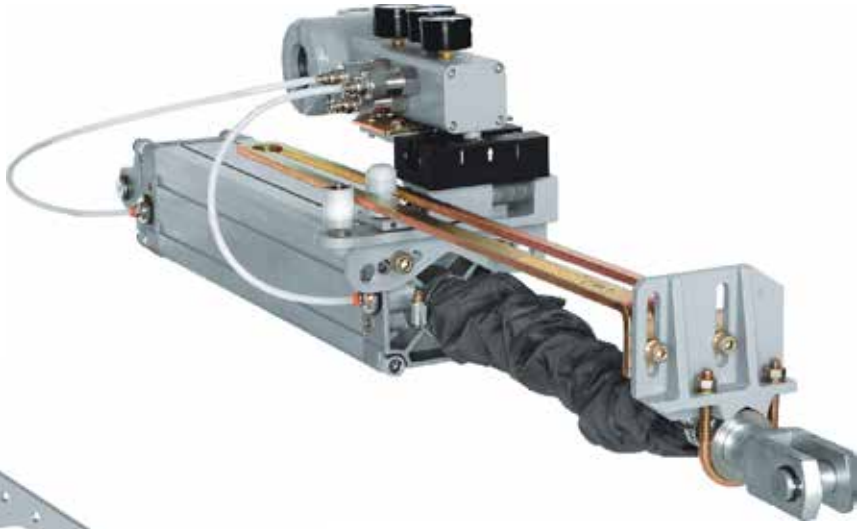
smar - ACP301

OPERATION, MAINTENANCE AND INSTRUCTION MANUAL

Pneumatic Cylinder Actuator



AUG / 11

ACP301

VERSION 3

ACP301ME

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INTRODUCTION

The **ACP301** - Pneumatic Cylinder Actuator, was designed by Smar to fit the growing demand from the industries, mainly to what concerns the control applications for pneumatic cylinders.

The **ACP301** - Pneumatic Cylinder Actuator allies the power of pneumatic cylinders to the FY301 microprocessed positioner capabilities, allowing the cylinder to be applied for modulating control. The **ACP301** modularity design is suitable for a wide range of cylinders through a unique solution for mounting brackets for an unnumbered variety of applications.

The **ACP301** - Pneumatic Cylinder Actuator is presented in different sizes, being selected according to the application and required travel. There are two available models: Linear and Rotary.

By using the FY301 valve positioner assembled to a double action pneumatic cylinder, with a non-contact linear or rotary magnet via Hall effect, it is possible to overcome the natural difficulties of a pneumatic cylinder to stop between the ends of his travel, promoting the modulating control on the final element.

The final control elements could be dampers (for furnace draft), sluices and huge control valves, besides other applications requiring torque and powered controlled movement.

The **ACP301** receives a 4-20 mA from a controller to drive the cylinder for an accurate required position, as per the control loop strategy and tuning. They bring the intelligence to the cylinder, the ACP allows to the user to configure the final element opening characteristic. For more sophisticated applications, the user can configure a customized curve for up to 16 points.

Additionally, the communication benefits on Hart®, Fieldbus, and Profibus™ open wide possibilities to link the field installations to the control room, with direct impact on installation cost reduction and lower operation and maintenance cost.

- Ø Modular and compact design;
- Ø Easy installation;
- Ø Position sensor, with no mechanical contact, via Hall effect;
- Ø For pneumatic double action actuators, for both rotary and linear models;
- Ø Easy parameters tuning through local adjustment and remote with handheld configurators or software for desk and palm top;
- Ø Explosion proof and intrinsically safe positioner;
- Ø Opening characteristic changeable via local and/or remote configuration;
- Ø Auto Setup in few minutes;
- Ø Self lubricated, no need for external lubrication;
- Ø Optional Limit switch for the cylinder;
- Ø Filter regulator incorporated.

Get the best results of the **ACP301** by carefully reading the instructions of this manual.

NOTE
This manual is compatible with version 3.XX, where 3 indicates software version and XX software release. The indication 3.XX means that this manual is compatible with any release of software version 3.

Waiver of responsibility

The contents of this manual abides by the hardware and software used on the current equipment version. Eventually there may occur divergencies between this manual and the equipment. The information from this document are periodically reviewed and the necessary or identified corrections will be included in the following editions. Suggestions for their improvement are welcome.

Warning

For more objectivity and clarity, this manual does not contain all the detailed information on the product and, in addition, it does not cover every possible mounting, operation or maintenance cases.

Before installing and utilizing the equipment, check if the model of the acquired equipment complies with the technical requirements for the application. This checking is the user's responsibility.

If the user needs more information, or on the event of specific problems not specified or treated in this manual, the information should be sought from Smar. Furthermore, the user recognizes that the contents of this manual by no means modify past or present agreements, confirmation or judicial relationship, in whole or in part.

All of Smar's obligation result from the purchasing agreement signed between the parties, which includes the complete and sole valid warranty term. Contractual clauses related to the warranty are not limited nor extended by virtue of the technical information contained in this manual.

Only qualified personnel are allowed to participate in the activities of mounting, electrical connection, startup and maintenance of the equipment. Qualified personnel are understood to be the persons familiar with the mounting, electrical connection, startup and operation of the equipment or other similar apparatus that are technically fit for their work. Smar provides specific training to instruct and qualify such professionals. However, each country must comply with the local safety procedures, legal provisions and regulations for the mounting and operation of electrical installations, as well as with the laws and regulations on classified areas, such as intrinsic safety, explosion proof, increased safety and instrumented safety systems, among others.

The user is responsible for the incorrect or inadequate handling of equipments run with pneumatic or hydraulic pressure or, still, subject to corrosive, aggressive or combustible products, since their utilization may cause severe bodily harm and/or material damages.

The field equipment referred to in this manual, when acquired for classified or hazardous areas, has its certification void when having its parts replaced or interchanged without functional and approval tests by Smar or any of Smar authorized dealers, which are the competent companies for certifying that the equipment in its entirety meets the applicable standards and regulations. The same is true when converting the equipment of a communication protocol to another. In this case, it is necessary sending the equipment to Smar or any of its authorized dealer. Moreover, the certificates are different and the user is responsible for their correct use.

Always respect the instructions provided in the Manual. Smar is not responsible for any losses and/or damages resulting from the inadequate use of its equipments. It is the user's responsibility to know and apply the safety practices in his country.

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Section 1

INSTALLATION

ACP - General Charateristics

The ACP is available for Hart® (301 line) Foundation Fieldbus (302), and Profibus™ (303) communications protocols. For both linear (ACP301L / 302L / 303L) and rotary (ACP301R / 302R / 303R) applications.

The ACP basic features are:

LINEAR Model
The main parts are the pneumatic double action cylinder, brackets for the cylinder, linear magnet and the FY positioner. The linear model uses a conic rule to change the linear pneumatic cylinder movement into a perpendicular movement related to the magnet.

Figure 1.1 - ACP Linear Model ACP301L / 302L / 303L

ROTARY Model
The main parts are the pneumatic double action cylinder, a jointed structure with a rotary lever, a rotary magnet and a FY positioner, promoting an angular movement.

Figure 1.2 - ACP Rotary Model ACP301R / 302R / 303R

ACP Linear Model (ACP301L/302L/303L)

The ACP modular design – Linear Model, allows the user to apply it in a wide variety of cylinder strokes and different sizes with just one design of mounting brackets.

The working strokes for ACP301L / 302L / 303L are:

100 mm.
125 mm.
160 mm.
200 mm.
250 mm.
320 mm.
400 mm.
500 mm.
630 mm.
800 mm.
1000 mm.

The internal cylinder diameters are:

63 mm.
80 mm.
100 mm.
125 mm.
160 mm.

The following chart shows the available stem force according to the working pressure and to the cylinder diameter:

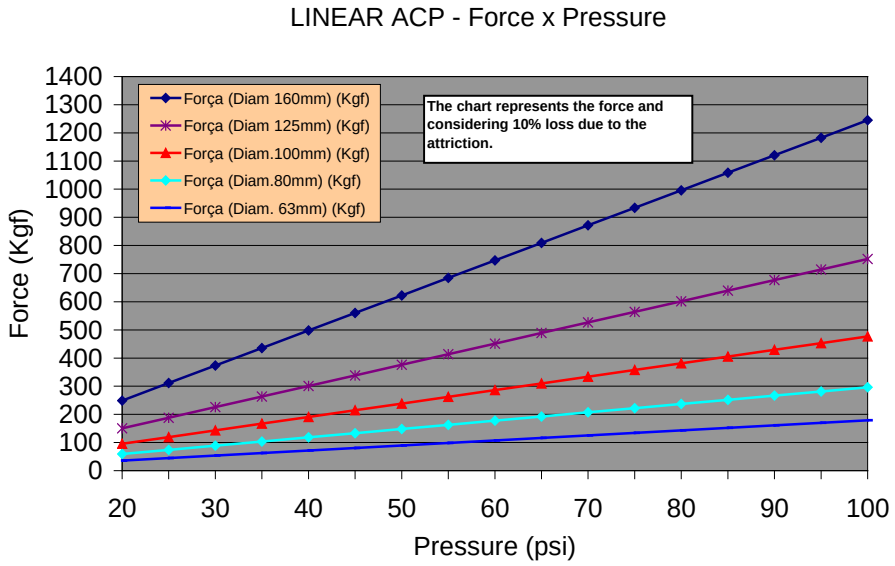


Figure 1.3 - ACP Linear Model – Stem Force x Working Pressure

The chart represents the force and considering 10% loss due to the attrition.

ACP Rotary Model (ACP301R / 302R / 303R)

The ACP Rotary Model is suitable for different strokes using the same structure. This structure allows selecting wider movements, using only one cylinder.

The standard cylinder for the Rotary Model has a 100 mm diameter, and 400 mm stroke. Combining the pre-defined holes at the ACP lever it is possible to get the following strokes:

100 mm.
150 mm.
200 mm.
250 mm.
300 mm.
350 mm.
400 mm.
450 mm.
500 mm.

The actuating force is directly proportional to the working pressure, and also proportional to the hole position. The forces available for the ACP301R / 302R / 303R are on the following chart.

Rotary ACP **-** Force x Actuation Travel

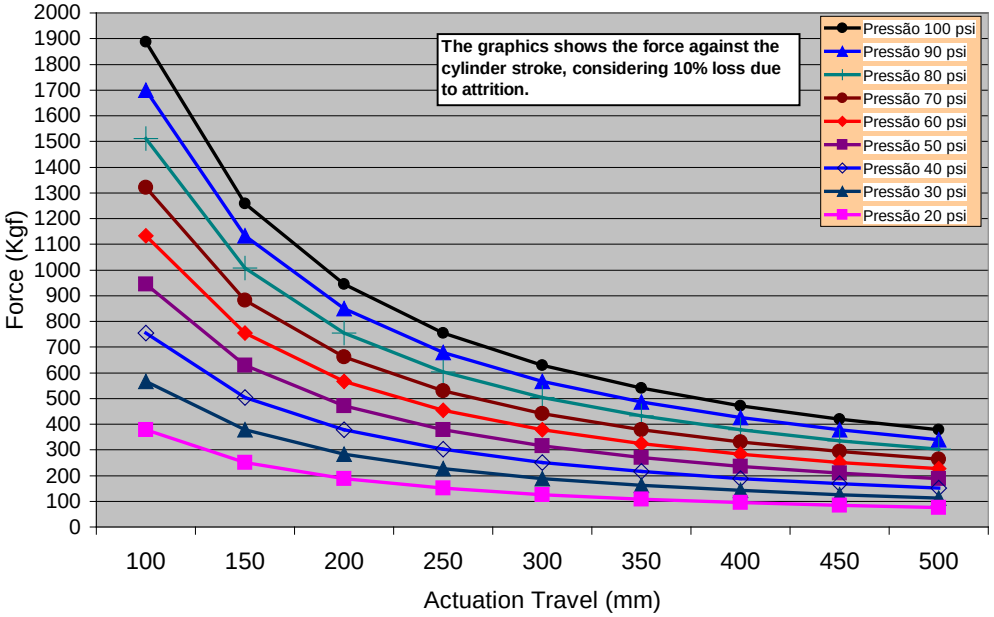


Figure 1.4 - Force x Actuation Travel Graphic - ACP - Rotary Model

The graphics shows the force against the cylinder stroke, considering 10% loss due to attrition.

ACP – Dimensional Drawings

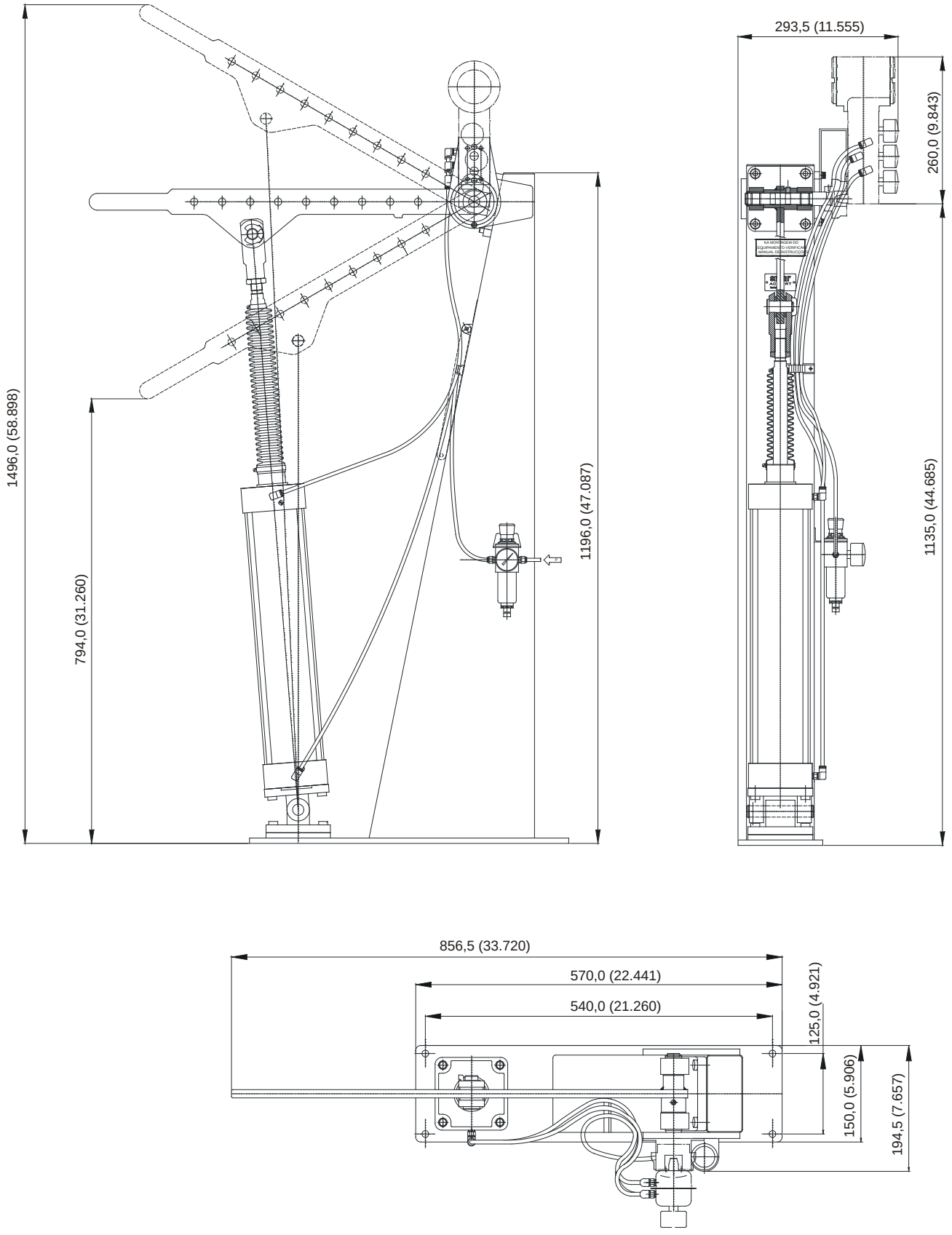


Figure 1.5 - Dimensional – Rotary ACP

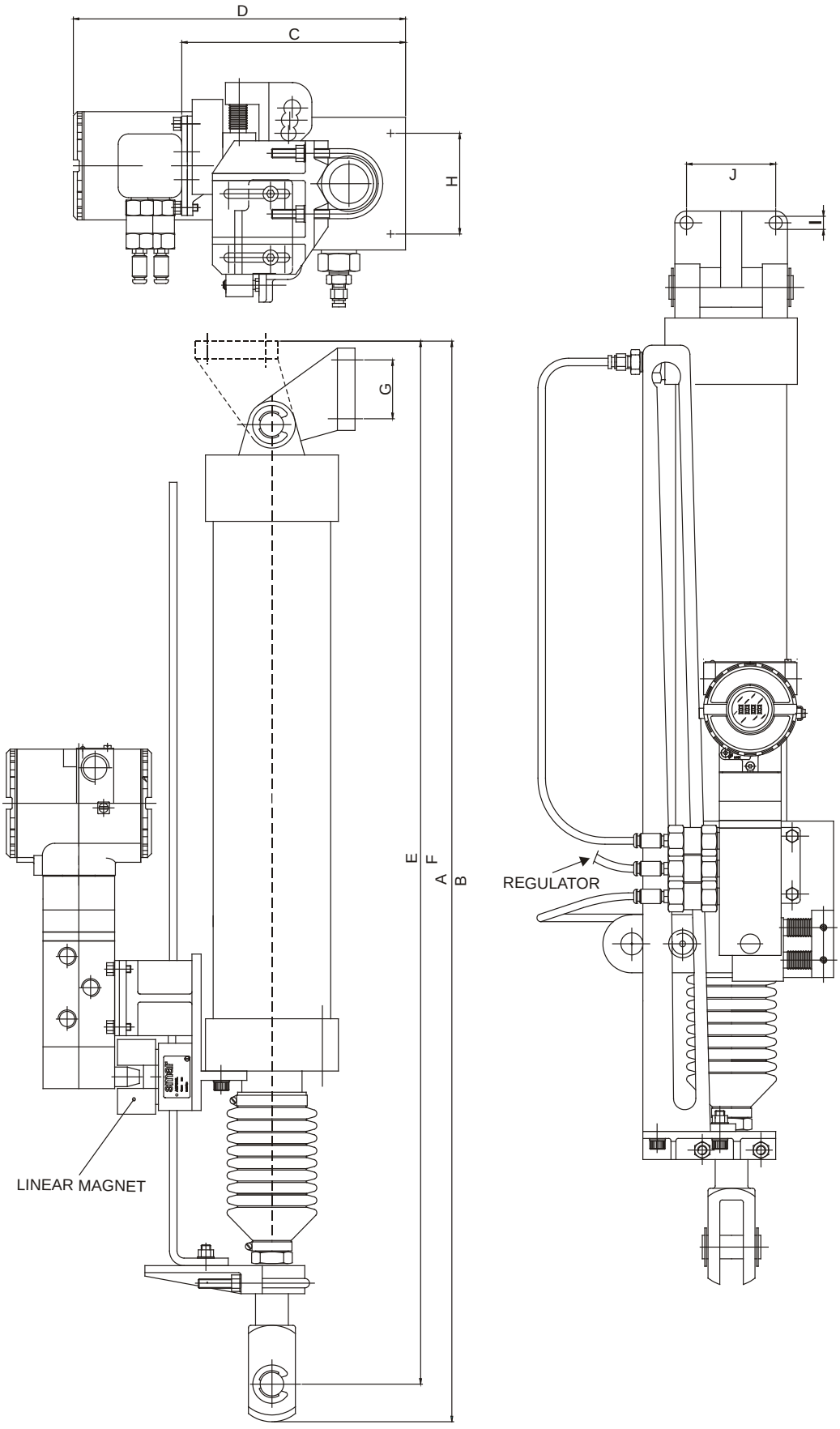


Figure 1.6 - Dimensional – Linear ACP

Linear ACP Main Dimensions Table

63, 80, 100, 125 and 160 mm Diameters

A Dimension = Backwarded cylinder

Cylinder Travel/Rule (mm)	Cylinder Diameter (mm)				
	63	80	100	125	160
	A (mm)				
100	466	530.8	558.8	679	797
125	491	562.05	590.05	709	827
160	526	605.8	633.8	751	869
200	566	655.8	683.8	799	917
250	616	718.3	746.3	859	977
320	686	805.8	833.8	943	1061
400	766	905.8	933.8	1039	1157
500	866	1030.8	1058.8	1159	1277
630	996	1193.3	1221.3	1315	1433
800	1166	1405.8	1433.8	1519	1637
1000	1366	1655.8	1683.8	1759	1877

B Dimension = Advanced cylinder

Cylinder Travel/Rule (mm)	Cylinder Diameter (mm)				
	63	80	100	125	160
	B (mm)				
100	566	630.8	658.8	779	897
125	616	687.05	715.05	834	952
160	686	765.8	793.8	911	1029
200	766	855.8	883.8	999	1117
250	866	968.3	996.3	1109	1227
320	1006	1125.8	1153.8	1263	1381
400	1166	1305.8	1333.8	1439	1557
500	1366	1530.8	1558.8	1659	1777
630	1626	1823.3	1851.3	1945	2063
800	1966	2205.8	2233.8	2319	2437
1000	2366	2655.8	2683.8	2759	2877

C Dimension = Cylinder header height until the FY fixation plate
D Dimension = Cylinder header height until the FY

	Cylinder Diameter (mm)				
Dimension	63	80	100	125	160
C (mm)	162.75	183	200	228.5	265
D (mm)	243.75	264	281	309.5	346

E Dimension = Backwarded cylinder until the center of the pin hole (of clevis)

Cylinder Travel/Rule (mm)	Cylinder Diameter (mm)				
	63	80	100	125	160
	A (mm)				
100	443.4	503.6	531.6	633.4	739.6
125	468.4	534.85	562.85	663.4	769.6
160	503.4	578.6	606.6	705.4	811.6
200	543.4	628.6	656.6	753.4	859.6
250	593.4	691.1	719.1	813.4	919.6
320	663.4	778.6	806.6	897.4	1003.6
400	743.4	878.6	906.6	993.4	1099.6
500	843.4	1003.6	1031.6	1113.4	1219.6
630	973.4	1166.1	1194.1	1269.4	1375.6
800	1143.4	1378.6	1406.6	1473.4	1579.6
1000	1343.4	1628.6	1656.6	1713.4	1819.6

F Dimension = Advanced cylinder until the center of the pin hole (of clevis)

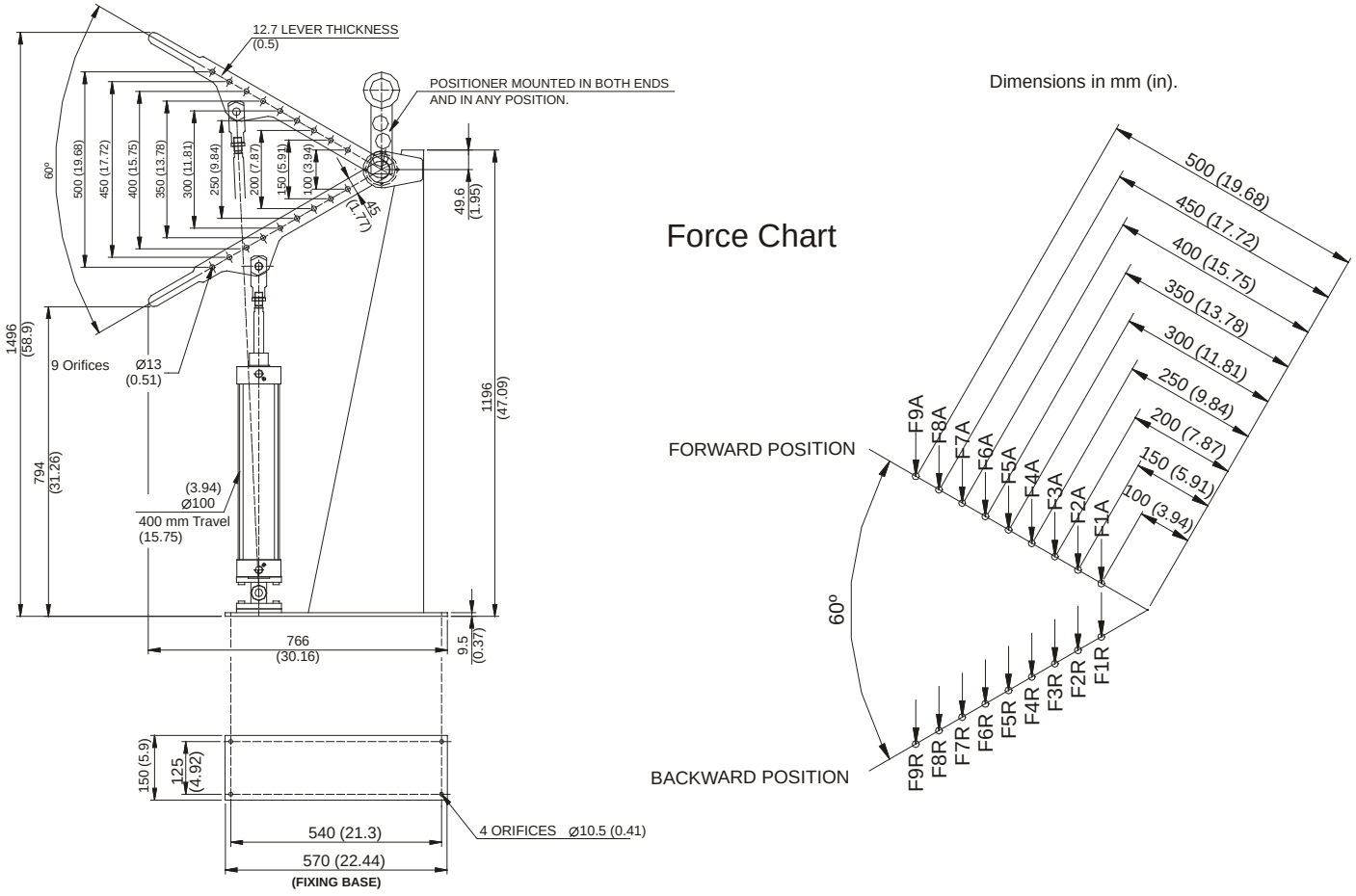
Cylinder Travel/Rule (mm)	Cylinder Diameter (mm)				
	63	80	100	125	160
	B (mm)				
100	543.4	603.6	631.6	733.4	839.6
125	593.4	659.85	687.85	788.4	894.6
160	663.4	738.6	766.6	865.4	971.6
200	743.4	828.6	856.6	953.4	1059.6
250	843.4	941.1	969.1	1063.4	1169.6
320	983.4	1098.6	1126.6	1217.4	1323.6
400	1143.4	1278.6	1306.6	1393.4	1499.6
500	1343.4	1503.6	1531.6	1613.4	1719.6
630	1603.4	1796.1	1824.1	1899.4	2005.6
800	1943.4	2178.6	2206.6	2273.4	2379.6
1000	2343.4	2628.6	2656.6	2713.4	2819.6

Dimension	Dimensional – Female back joint bracket (mm)				
	63	80	100	125	160
G (mm)	35	40	50	60	88
J (mm)	52	66	76	94	118
I (mm)	9	11	11	12	14

Dimension	Center of the cylinder holes (mm)				
	63	80	100	125	160
H (mm)	56.5	72	89	110	140

Reference values for pneumatic cylinders from usual manufacturers line, ISO series.

The values for A, B, E, F were considered with clevis totally threaded.



RESULTING FORCES IN (Kgf)

FORCES - BACKWARD POSITION

	20 psi (1.4 Kgf/ cm²)	100 psi (7.0 Kgf/ cm²)
F1R	377	1888
F2R	251	1259
F3R	188	944
F4R	151	755
F5R	125	629
F6R	107	539
F7R	94	472
F8R	83	419
F9R	75	377

FORCES - FORWARD POSITION (A)

	20 psi (1.4 Kgf/ cm²)	100 psi (7.0 Kgf/ cm²)
F1A	397	1987
F2A	265	1325
F3A	198	993
F4A	159	795
F5A	132	662
F6A	113	568
F7A	99	497
F8A	88	441
F9A	79	397

Figure 1.7 – Forces Table – Rotary ACP

Installation

The installation must consider the facilities for connection to the final control element, having enough space to allow smooth operation and further maintenance on the actuator and final control element.

Linear ACP

When necessary assembling in the field, position + ACP set, follow the installation procedures.

Assembling Procedure

The following instructions show the procedure for the ACP301LN - Linear Pneumatic Cylinder Actuator:

Place the fixing plate on the positioner and tight it with an Allen key size 5.

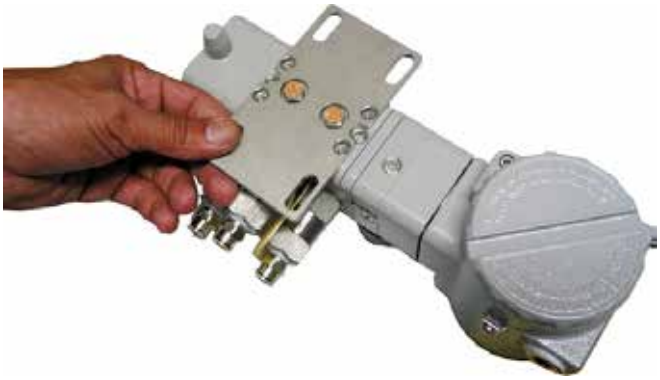


Figure 1.8 – Fixing Plate on the FY301 Positioner

When assembling the positioner, remember not to tight the screws, since it will necessary to align the magnet and positioner according to the cylinder stroke length. We suggest, if possible, assemble the positioner such as its air connections be at the same side of the cylinder air connections. Next, place the positioner on the cylinder and its bracket.

Figure 1.9 – Assembling the Positioner on the Cylinder

To align the magnet properly, first full close the cylinder and use a mark pen to set the close position on the rule.

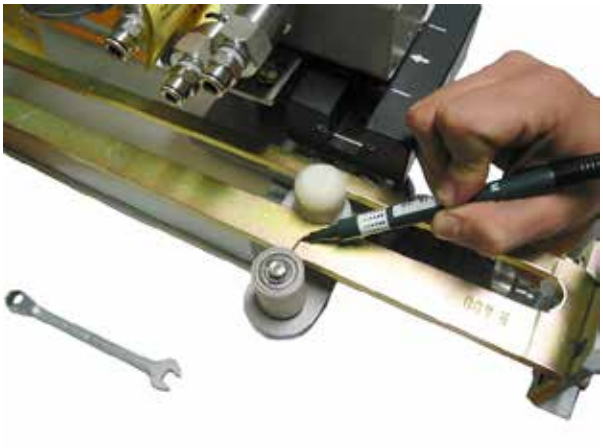


Figure 1.10 – Magnet Alignment

Full open the cylinder (use air pressure if necessary) and mark the open position on the rule. With a measuring tape, find the 50% stroke and mark with the proper pen.

Important: first, disconnect the pipes to facilitate the cylinder motion.

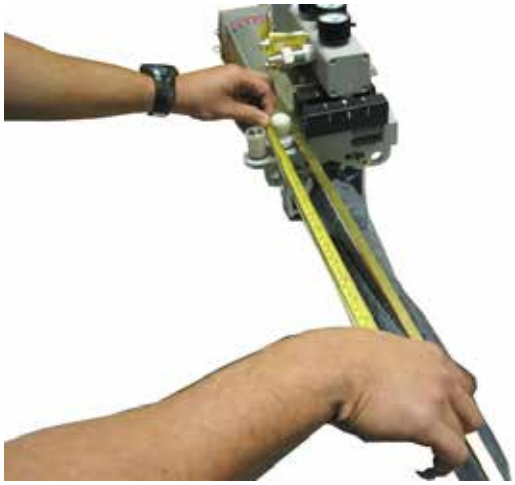


Figure 1.11 – Marking Full Open Position

Figure 1.12 – Marking 50% Position

Ensure that the magnet groove (with an arrow) is aligned with the Hall sensor.

Figure 1.13 – Magnet Alignment with the Hall Sensor

Adjust the magnet position taking the rule up to 50% stroke, aligning the magnet and Hall sensor arrows. Tight now the plate on the positioner using an Allen key size 10. Full open and full close the cylinder some times to be sure the assembly is correct. Check if the rule is running parallel to the cylinder and if the magnet arrow is assembled properly (arrows match). The Hall sensor does not scrape the magnet internal walls.

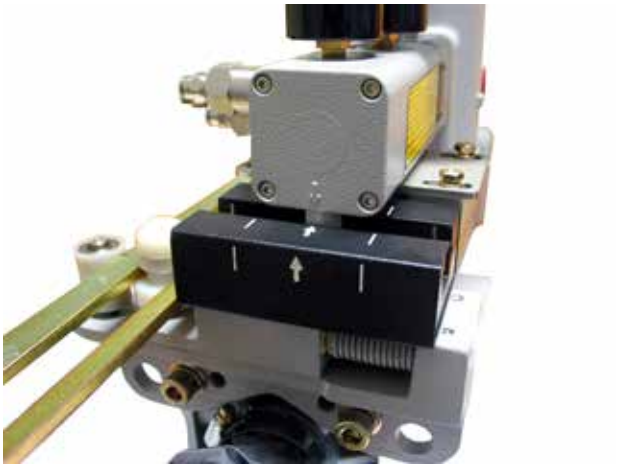


Figure 1.14 – Adjusting the Magnet Position

The limit switches (optional) are available and must be specified on the ordering code. They are reed switches and they are not for use in classified areas.

Rotary ACP

The Rotary ACP has four holes on the base for fixing and fastening on the ground. After pre-assembling it, place the washers and nuts. Tight them gradually preventing tensions or warping the structure. It follows the detailed installing procedure.

Installation Procedure

The following instructions cover the installing and assembling procedure for the ACPR – Rotary Pneumatic Cylinder Actuator.

To transport the ACP is packed with the lever loose. Use the other set of bolts and nuts to assemble the cylinder to the ACP lever.

Figure 1.15 – Rotary ACP Base with the Cylinder Installed

Notice in the next two pictures the details where to place the rotary magnet. Also notice the groove on the horizontal axis, for fixing the rotary magnet. Note that, if necessary, the positioner can be mounted on the opposite side.

Fix the rotary magnet to the base axis as shown in the picture guided by the groove. Use an Allen key size 5 mm just to place the magnet but do not tight it yet.

Figure 1.18 - Placing the Magnet

Figure 1.19 – Fixing the Screw (Do not tight it)

Next assemble the positioner bracket using the Allen key 5mm to tight the positioner to the bracket.

Figure 1.20 - Rotary ACP Mounting Bracket

Figure 1.21 - Assembling the Bracket and Positioner

Fix the set “positioner + bracket” to the ACP base and tight it with the Allen key 5mm.

Figure 1.22 - Positioner and Bracket Installed into the ACP Base

Ensure a 2 to 4 mm distance between the magnet face and the positioner face and check if there is no physical contact between the pieces, including the Hall sensor.

Figure 1.23 – Details of the Assembled Magnet

Displace manually the ACP lever to check the upper and lower limits. Place the lever at 50% stroke and use the auxiliary small lever to sustain the lever at that position. See the picture for details on how to use the auxiliary lever.

Figure 1.24 - Auxiliary Lever for 50% Stroke

Figure 1.25 - Rotary ACP on 50% Stroke

Place the magnet in such way that the 50% position matches with positioner arrow. On this position tight the two screws on the rotary magnet.

Figure 1.26 – Details of the Fixing Screws on the Rotary Magnet

Return the lever for its initial position and test. Place the ACP in upper and lower position.

Figure 1.27 - Lower Position

Figure 1.28 - Upper Position

Now, install the instrument air pipe on the positioner output 1 and output 2. Note that there are two fixing device on the ACP base for the pipe, preventing the pipe to move during the actuator displacement.

Figure 1.29 - Detail of the Pipe Installed on the Rotary ACP for Air Supply

Next, connect the pipe to the regulator filter, which can be installed at both sides of the rotary ACP. Clear regularly the filter for a better ACP performance.

NOTE
Cleaning will be much more frequent when the installation does not according the specification of the impurities amount or moisture in the air instrumentation. In this section, refer to item "Air Supply" for proper installation.

Figure 1.30 - Installing the Air Filter

Figure 1.31 – Air Filter Detail

Next the views of final ACP assembly. One can install the positioner at both ACP sides as per the field needs.

Figure 1.32 – Final Assembly – Up View

Figure 1.33 – Final Assembly

FY301 Positioner General Characteristics

The overall accuracy of measuring and control depends on several factors. In spite of the excellent performance, the positioner must be adequately installed so that it may work well.

Among all factors that may affect the positioner accuracy, environmental conditions are the most difficult to control. But there are ways to reduce the effects of temperature, humidity and vibration.

Installing the positioner in areas protected from extreme environmental changes can minimize temperature fluctuation effects. In warm environments, the positioner should be installed to avoid, as much as possible, direct exposure to the sun. Installation close to lines and vessels subjected to high temperatures should also be avoided. If not possible to avoid it, consider using the remote position sensor version.

Use thermal isolation to protect the positioner from external heart sources, if necessary.

Humidity is fatal to electronic circuits. In areas subjected to high relative humidity, the O-rings for the electronic housing covers must be correctly placed and the covers must be completely closed by tighten them by hand until you feel the O-rings being compressed. Do not use tools to tight the covers. Removal of the electronics cover in the field should be reduced to the minimum necessary, since each time it is removed; the circuits are exposed to the humidity.

The electronic circuit is protected by a humidity proof coating, but frequent exposures to humidity may affect the protection provided. It is also important to keep the covers tightened in place. Every time they are removed, the threads are exposed to corrosion, since painting cannot protect these parts. Sealing methods should be employed on conduit entering of the positioner.

IMPORTANT
Avoid to use thread sealant tapes on the air input and outputs connections, since small pieces of this type of sealant may block the air flow inside the positioner, affecting the overall equipment performance.

Although the positioner is practically vibration resistant, it is not recommended to install it near pumps, turbines or other equipment producing too much vibration. If not possible to avoid it, consider using of remote position sensor version.

Electronic Housing Rotating

The electronic housing can be rotated in order to offer a better to position the digital display and/or better access to the field wires. To rotate it, release the housing rotation set screw. The local indicator itself can also be rotated.

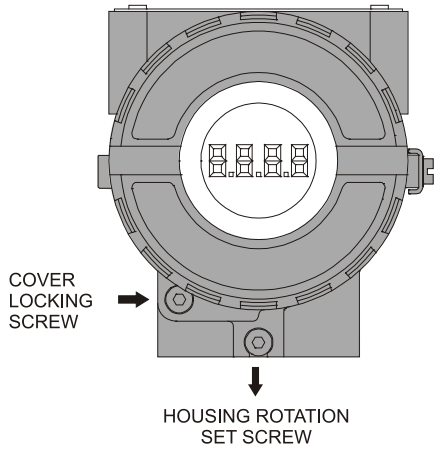


Figure 1.34 - Housing Rotation Set Screw

Reach the wiring block by removing the electrical connection cover. This cover can be locked closed by the cover locking screw. To release the cover, rotate the locking screw clockwise.

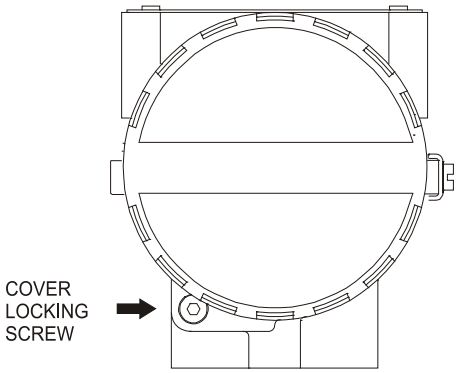


Figure 1.35 – Cover Locking Screw

Electric Wiring

The access to the signal cables to the terminal wiring can be done through of one of the housing passes and can be connected to a conduit. The wiring block has screws on which fork or ring-type terminals can be fastened. Use a plug to block the electrical connection not used. Tight it well and use thread sealing tape.

NOTE
If the user choose protection against noise induced by atmospheric discharges, overloads, weld machines and machines in general, it will be necessary to install a transient protector (protector acquired separately).

Test and communication terminals allow, respectively, to measure the current in the 4 - 20 mA loop, without opening it, and to communicate with the transmitter. To measure it, connect a multimeter in the mA scale in the "0" and "É" terminals, and to communicate, use a Hart® configurator in the "COMM" and "0" terminals. For convenience, there are three ground terminals: one inside the cover and two externals, located close to the conduit entries.

Attention to prevent the accidental feeding of the test terminals. This occurrence will cause damages in the equipment.

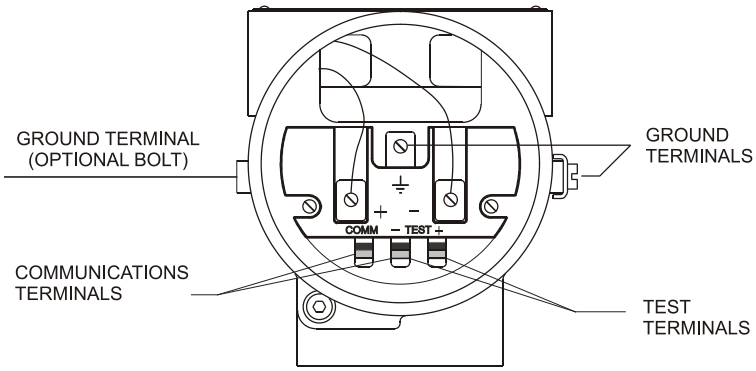


Figure 1.36 – Wiring Block

HAZARDOUS AREAS
In hazardous areas with explosion proof requirements, the covers must be tightened with at least 8 turns. In order to avoid the penetration of humidity or corrosive gases, tighten the o-ring until feeling the o-ring touching the housing. Then, tighten more 1/3 turn (120°) to guarantee the sealing. Lock the covers using the locking bolts. Conduit threads should be sealed by means of code-approved sealing methods. Explosion proof, non-incendive and intrinsic safety certification are standards for ACP301 controlled by **FY301 positioner**. For a complete list of available certificates, please consult **http://www.smar.com**

The conduit installation diagram shows the correct installation of the conduit, in order to avoid penetration of water or other substance, which may cause malfunctioning of the equipment.

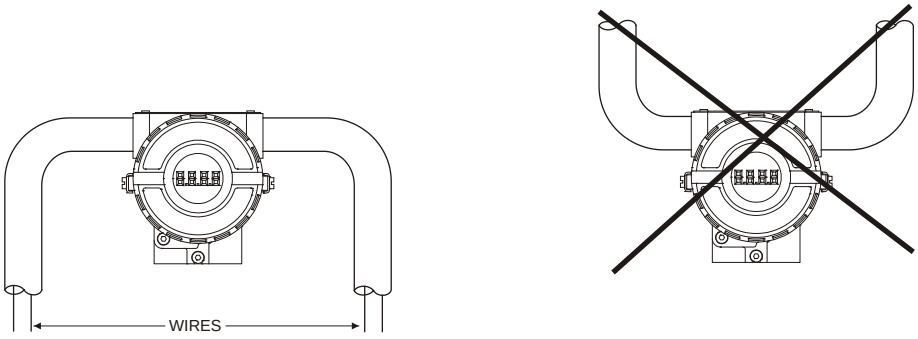


Figure 1.37 - Conduit Installation Diagram

Use of twisted pair (22 AWG or greater than) cables is recommended.

Avoid routing signal wiring close to power cables or switching equipment.

IMPORTANT
The **FY301 positioner** is protected against reverse polarity, and can withstand up to 50 mA and power supply of ± 60 Vdc without damage.

The FY301 positioner connection could be done according to the figures below. It is also recommended to ground the shield of shielded cables at one end only. The non-grounded end must be carefully isolated.

The configurator can be connected to the communication terminals of the positioner or at any point of the signal line by using the interface HPI311-M5P with “alligator” clips.

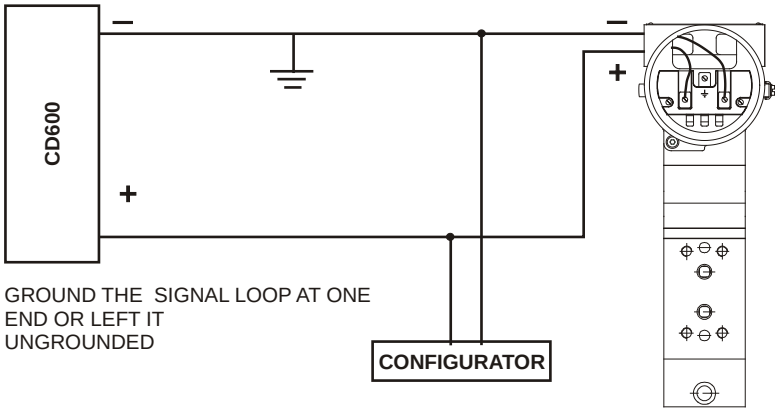


Figure 1.38 – FY301 Positioner Wiring Diagram

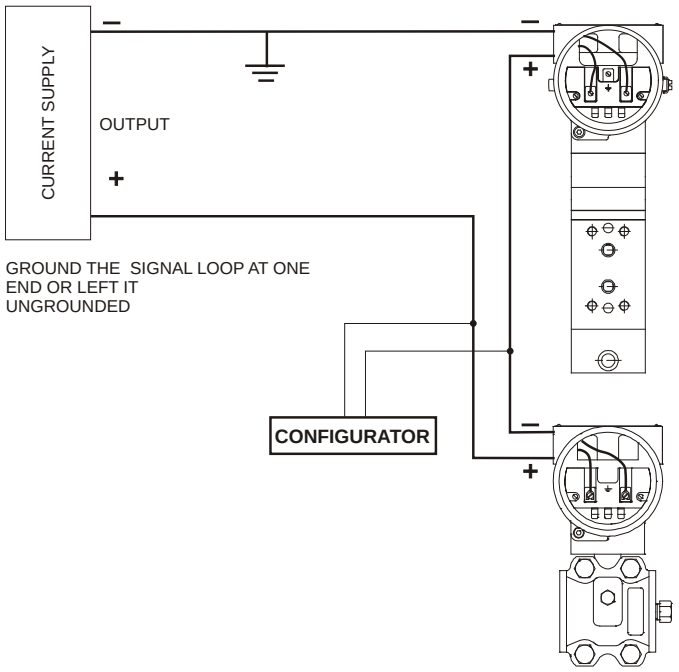


Figure 1.39 - FY301 Positioner Wiring Diagram Connected in the Transmitter

The FY301 has an equivalent impedance of 550 Ohms. Make sure that the current supply or analog output of DCS, CLP or single loop controller powering the positioner is capable to handle a voltage drop of 11 V for each positioner (550 x 0,02 = 11 Volts).

NOTE
If you are using two positioners in series as e. g., working in split range, the resulting impedance will be 1.100 Ohms. Therefore, the analog output should be capable to handle a voltage drop of 22 Volts.

Connection of the FY301 in multidrop configuration should be done as in figure 1.40. Note that a maximum of two positioners can be connected on the same line and that they should be connected in series.

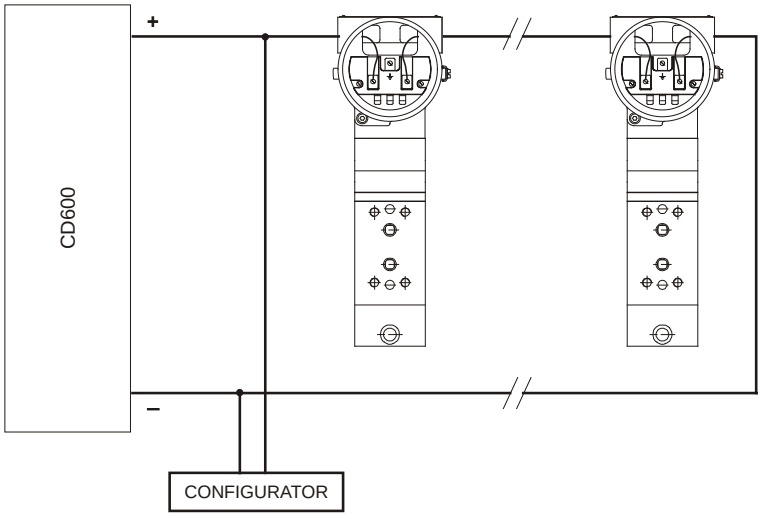


Figure 1.40 - FY301 Positioner Wiring Diagram for Multidrop Configuration (Split Ranges)

Air Supply Requirements

Before the air supply is connected to the positioner, we recommend the hose is opened freely for 2 to 3 minutes to allow any contamination to be blown out. Direct the air jet into a large paper towel to trap any water, oil, or other foreign materials. If this indicates that the air system is contaminated, it should be properly cleaned.

As soon as the positioner is connected and powered, internal air leakage will provide protection against corrosion and prevent moisture inside. For this reason, it is strongly recommended to keep the positioner pressurized as much as possible.

Recommendations for an Instrument Air Supply System

Instrument air quality shall be superior to that of industrial compressed air. Humidity, suspended particles and oil may impair the instrument operation, either temporarily or permanently in case of internal parts wearing.

As per standard *ANSI/ISA S7.0.01 - 1996 - Quality Standard for Instrument Air,* instrument air shall have the following characteristics:

Dew point	10°C below minimum instrument temperature
Size of particles (airborne)	40 µm (maximum)
Oil content	1 ppm w/w (maximum)
Contaminants	free from corrosive flammable gases

This standard recommends that the compressor intake be located in an area free from process spills and fitted with and adequate filter. It also recommends the use of non-lubricated type compressors, in order to prevent air contamination by lubricating oil. Where lubricated type compressors are adopted, there shall be used means to make the air oil free.

Figure 1.41 and 1.42 shows a typical system for air supply and air quality conditioning.

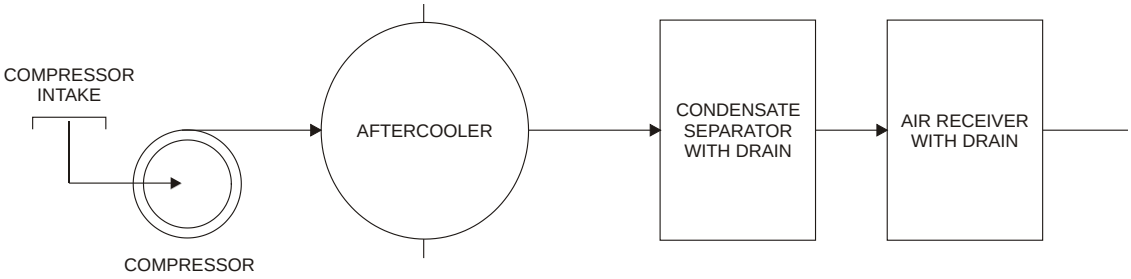


Figure 1.41 - Air Supply System

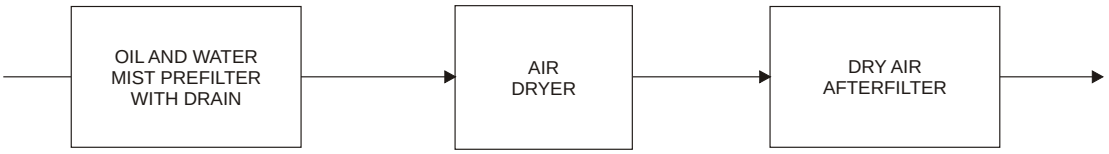


Figure 1.42 - Air Quality Conditioning System

Actuator Security Position

Important: If the FY301 positioner fails, for example, because of a power failure, the output identified as OUT1 (Output 1) goes to nearly zero, while the output identified as OUT2 (Output 2) goes to nearly the air supply pressure.

Double Action - Air to Open (Fail Close/ Return on Fail)
Connect Output 1 (OUT1) of the positioner to the input identified as OPEN in the pneumatic cylinder, and connect Output 2 (OUT2) of the positioner to the input CLOSE of the pneumatic cylinder.

Double Action - Air to Close (Fail Open/ Go on Fail)
Connect Output 2 (OUT2) of the positioner to the input identified as OPEN in the pneumatic cylinder, and connect Output 1 (OUT 1) of the positioner to the input CLOSE of the pneumatic cylinder.

There are five exhaust outputs in the FY301 positioner, all of them fitted with filters. It is very important that such outputs are neither blocked nor obstructed, because the air must circulate freely.

Connection of positioner air supply to the pneumatic cylinder should be accomplished with flexible pipe, due to oscillation of the equipment when in progress operation or return of the pneumatic cylinder.

Depending on the specifications, rigid or flexible air connections can be used for regulator filter supply. When possible, the pipe length must be minimum, with the objective of avoiding the delay in control signs.

OPERATION

Transducer Functional Description

The main parts of the output module are the pilot, servo, Hall effect position sensor and the output control circuit.

The control circuit receives a digital setpoint signal from the CPU and a feedback signal from the position sensor.

The pneumatic circuit is based on a well-known and widely adopted technology, which is described on item baffle and nozzle and Spool Valve.

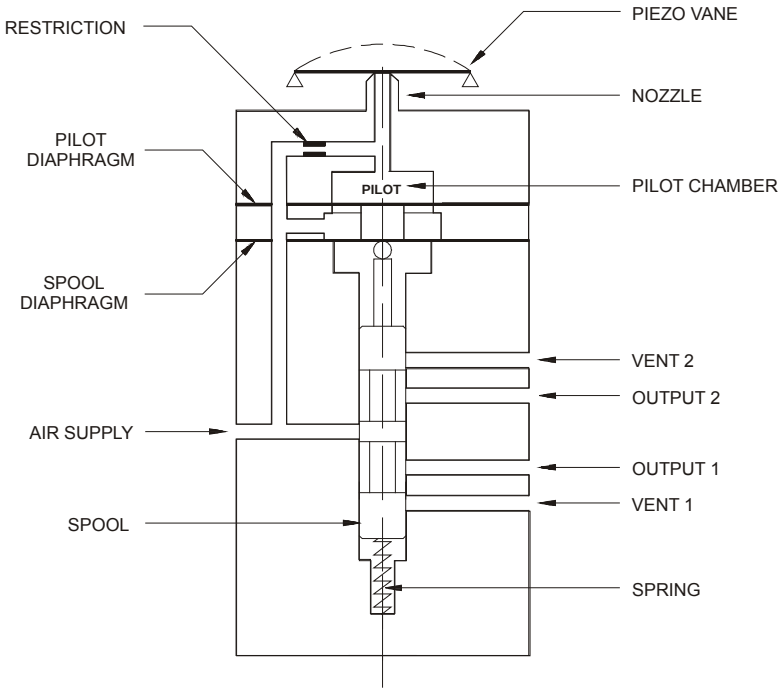


Figure 2.1 - Schematic Pneumatic Transducer

A piezoelectric disk is the flapper in the pilot stage. The flapper is deflected when the control circuit applies a voltage. A small stream of air flowing through the nozzle is obstructed causing an increase in pressure in the pilot chamber; this is called the pilot pressure.

The pilot pressure is too low, with a small flowing capacity, and for this reason, it must be amplified in the servo section. The servo section includes a diaphragm in the pilot chamber and a smaller one in the spool chamber. The pilot pressure applies a force at the pilot chamber's diaphragm, which, in the equilibrium state, will be equal to the force applied by the spool valve at the smaller diaphragm, which is in the spool chamber.

Upon every position change caused by the positioner, the pilot pressure increases or decreases, as explained in the pilot stage section. Such change in pilot pressure causes an upward or downward valve travel, which alters the pressure at Output 1 and Output 2, until a new balance is reached (new valve position).

Electronics Functional Description

Refer to the block diagram (Figure 2.2). The function of each block is described below.

A/D
Receives the 4 - 20 mA signal and converts it in the digital format for the CPU.

D/A
Receives the signal from the CPU and converts it to an analog voltage proportional to the desired position, used by the control.

Control
Controls the valve position according to data received from the CPU and the Hall effect sensor feedback.

Position Sensor
Measures the actual position and feedback to the control and CPU.

Temperature Sensor
Measures the temperature of the Transducer Circuit.

Isolation
Isolates the 4 - 20 mA signal from the piezoelectric signal.

EEPROM
A non-volatile memory that stores configuration data as a backup if the **FY301** main board be replaced.

Central Processing Unit (CPU), RAM, PROM and EEPROM
The CPU is the intelligent portion of the positioner, being responsible for the management and operation of block execution, self-diagnostics and communication. The program is stored in PROM. For temporary storage of data there is a RAM. The data in the RAM is lost if the power is switched off, however the device also has a nonvolatile EEPROM where data that must be retained is stored. Examples of such data are calibration and valve configuration.

HART Modem
The function of this system is to make possible the information exchange between Smar programmer and the positioner, over digital communication using Hart® protocol. Modulates and demodulates digital information transmitted by Smar programmer on the current line. A “1” is represented by 1200 Hz and “0” by 2200 Hz. The frequency signal is symmetrical and does not affect the DC-level of the 4 - 20 mA signal.

Power Supply
The positioner circuit receives supply from a 4 - 20 mA power supply or takes power of Loop Line to power the positioner circuit that is limited to 3.8 mA to work properly.

Display Controller
Receives data from the CPU and controls the (LCD) Liquid Crystal Display.

Local Adjustment
Local adjustment is provided by means of two magnetically actuated switches with no external electric or mechanical contact, by using a magnetic screwdriver.

Piezo Flapper Nozzle
The unit flapper nozzle converts the movement of piezoelectric into a pneumatic signal to control pressure in the pilot chamber.

Restriction
The restriction and the nozzle form a pressure-divided circuit. Air is supplied to the nozzle through a restriction.

Spool
The spool ensures a quick valve positioning by providing a greater airflow than one provided by the restriction.

Pressure Sensors
Measure the pressures of air pressure supply, pressure at Output 1 and Output 2. Available for Hart® reading.

NOTE
The pressure sensor's circuit board is optional. (See request code, session 6, K1 option).

Pressure Sensor Selector
Selects the sensor to be read from.

Sensor IN: Measures air supply pressure.
Sensor OUT1: Changes the pressure in output 1.
Sensor OUT2: Changes the pressure in output 2.

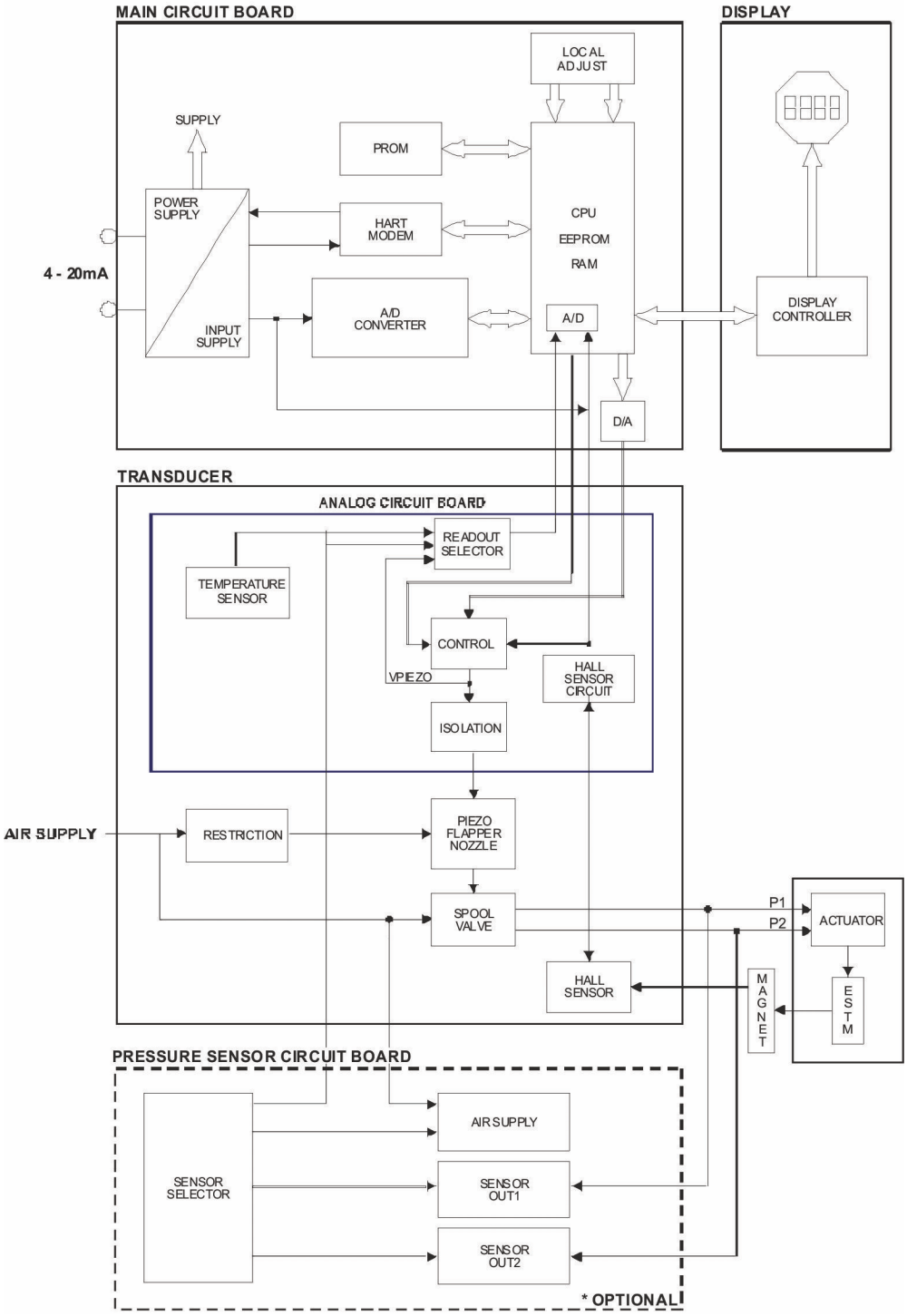


Figure 2.2 - Positioner Block Diagram

The Local Indicator

The LCD-Local Indicator is required for signaling and for operation in local adjustment.

Normal Indicator

During normal operation, the **positioner** remains in the monitoring mode and the display indicates the valve position, either as a percentage or as a current readout. The magnetic tool activates the local programming mode, by inserting it in orifice “Z” on the housing.

The possible configuration and monitoring operation are shown on figure 2.3.

Upon receiving power, the **positioner** initializes the position indication on the display, by showing model **positioner** and its software version (X.XX).

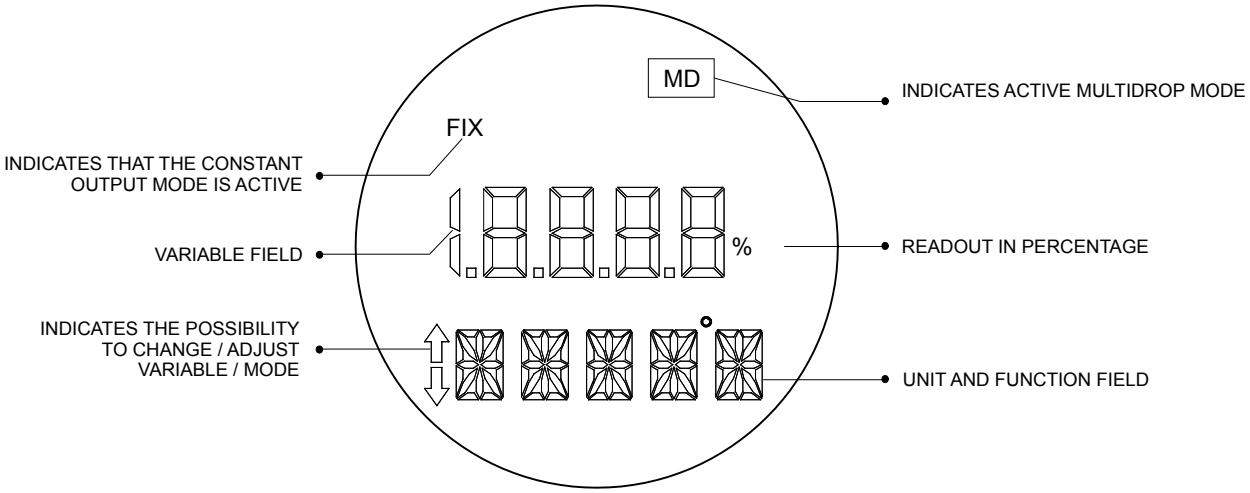


Figure 2.3 - Local Indicator

Monitoring
During normal operation, **positioner** remains in the monitoring mode. Figure 2.4 shows the positioning in percentage.

The display simultaneously shows readout and some other information.

Normal displaying is interrupted when the magnetic tool is placed in orifice “Z” (Local Adjustment), entering the programming mode local adjustment.

The above mentioned figure shows the result of tool insertion in orifices Z and S, which inform, respectively, movement and actuation of the selected options.

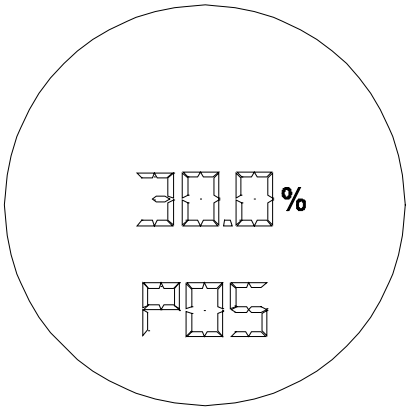


Figure 2.4 - Typical Indicator

CONFIGURATION

The FY301 Smart Positioner in the **ACP301** – Pneumatic Cylinder Actuator is a digital instrument with the most up-to-date features a measurement device can possibly have. The digital communication protocol (Hart®) enables the instrument to be connected to a computer, in order to be configured in a very simple and complete way. Such computers connected to the positioners, are called host computers. They can be either primary or secondary masters. Even though Hart® is a master-slave type of protocol, it is possible to work with up to two masters in a bus. Usually, the primary host plays the supervisory role and the secondary host plays the configurator role.

The positioners may be connected in a point-to-point or multidrop type network. In a point-to-point connection, the equipment's address must be "0". In a multidrop network, if the devices are recognized by their addresses, the positioners should be configured with a network address between "1" and "15". In this case, the positioners' output current is kept constant, at 4 mA each if the acknowledgement is via tag, the positioners addresses may be "0", and even in a multidrop configuration.

NOTE

In case of a multidrop network configuration for classified areas, the entity parameters allowed for the area shall be strictly observed. Therefore, the following shall be checked:

$Ca \geq \Sigma Ci_j + Cc$ $\quad La \geq \Sigma Li_j + Lc$

$Voc \leq min\ [Vmax_j]$ $\quad Isc \leq min\ [Imax_j]$

Where:

Ca, La = Allowed Capacitance and Inductance on the bus

$\boldsymbol{Ci_j}$, $\boldsymbol{Li_j}$ = Non protected internal Capacitance/Inductance of positioner *j (j = up to 15)*

Cc*, *Lc = Cable capacitance and Inductance

$\boldsymbol{V_{oc}}$ = Barrier open circuit voltage

$\boldsymbol{I_{sc}}$ = Barrier short circuit current

$\boldsymbol{Vmax_j}$ = Maximum allowable voltage to be applied to the instrument *j*

$\boldsymbol{Imax_j}$ = Maximum allowable current to be applied to the instrument *j*

The FY301 positioner includes a very encompassing set of Hart® Command functions that make it possible to access the functionality of what has been implemented. Such commands according to the Hart® protocol specifications, and are grouped as Universal Commands, Common Practice Controls Commands and Specific Commands. A detailed description of such commands may be found in the manual entitled Hart® Command Specification - **FY301** Smart Valve Positioner.

Smar developed two types of Configurators for its Hart® devices: CONF401 Configurator and HPC401 Configurator. CONF401 supports Windows platform (95, 98, 2000, XP and NT) and UNIX. It provides a simple configuration, field device monitoring, and ability to analyze data and modify field device performance. The HPC401 is the most up-to-date technology in Palm Handheld portable computers.

The operation and use characteristics of each one of the configurators are in their specific manuals.

Figure 3.1 and 3.2 show Palm and CONF401 screen with active advanced configuration.

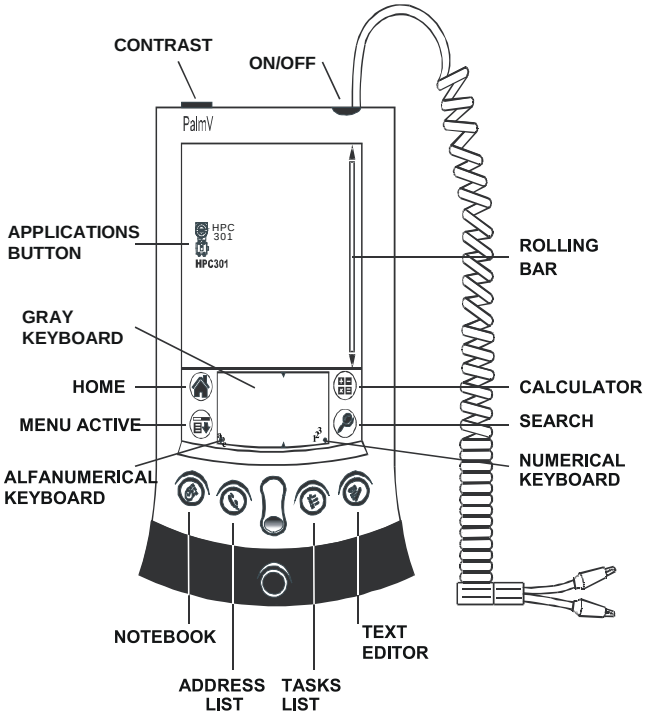


Figure 3.1 – Smar Configurator

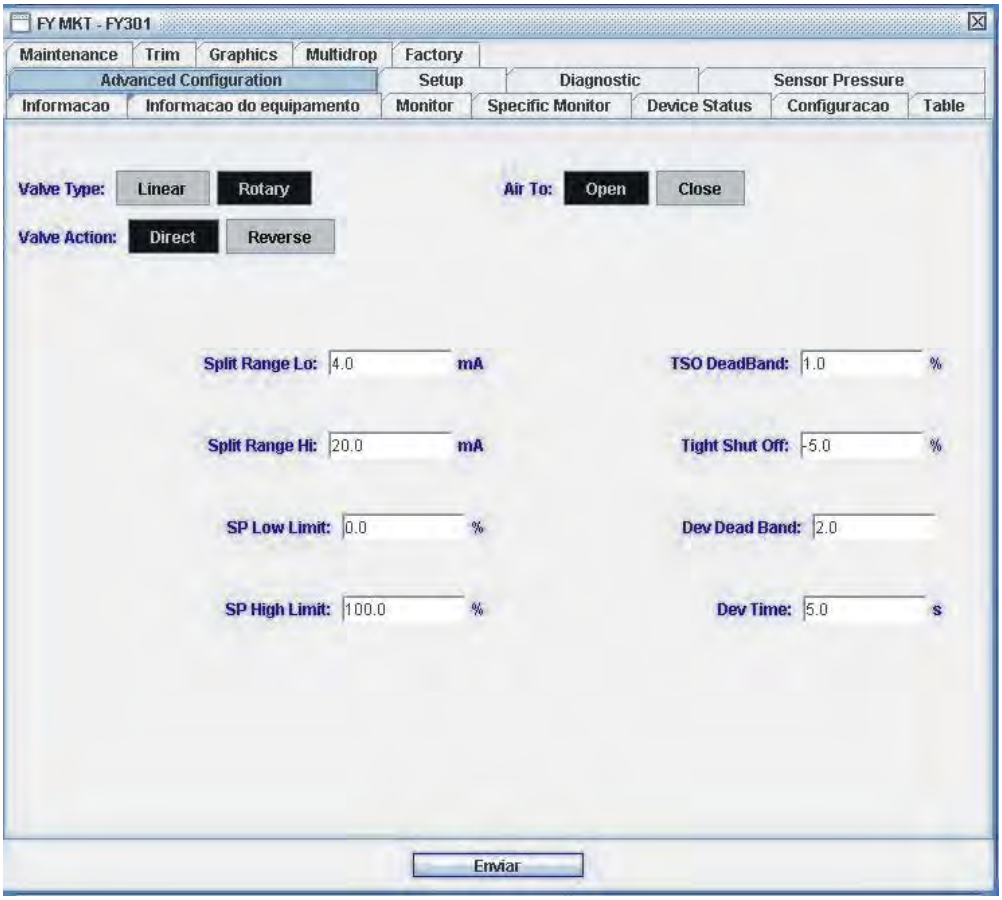


Figure 3.2 - CONF401 Screen - Active Advanced Configuration

Configuration Resources

By means of Hart® configurator, the FY301 firmware allows the following configuration features to be accessed:

- Positioner's Identification and Manufacturing Data;
- Remote movement;
- Monitoring of all device variables: input, setpoint, deviation and modulated output temperature;
- Diagnostic (Preventive Maintenance);
- Positioner diagnostic and fail determination;
- PID Controller Configuration;
- Device Configuration;
- Device Maintenance.

The operations between the configurator and the positioner, do not interrupt the cylinder position measurement, and do not disturb the output signal. The configurator can be connected to the same pair of wires as the 4-20 mA signal, up to 2 kilometers away from the positioner.

Identification and Manufacturing Data

The following information about the FY301 positioner manufacturing and identification data is available:

✓ **TAG** - 8-character alphanumeric field for identification of the positioner.

✓ **DESCRIPTION** - 16-character alphanumeric field for additional identification of the positioner. May be used to identify service or location.

✓ **MESSAGE** - 32-character alphanumeric field for any other information, such as the name of the person who made the last calibration, some special care to be taken, or if a ladder is needed for physical access to the positioner.

✓ **DATE** - The date may be used to identify a relevant date, such as the last calibration, the next calibration or the installation. The date is presented in the American standard e.g. (Example: Oct 30, 2003) is automatically assumed after the choice of these items.

✓ **UNIQUE ID** - Used to identify the device and in construction of Hart® long address.

✓ **DEVICE INFORMATION** - This button allows to read device identification and data recorded in the factory.

NOTE
These information items cannot be modified. They are read directly from the circuit memory.

Monitoring

This function allows remote monitoring of positioner variables. The time to start the reading is around 5 seconds. The values are always updated. Altogether, 20 items could be monitored. These items are: cylinder actual position in percentage, input in percentage of adjusted current range, input current in mA or %, device temperature in Celsius and in Fahrenheit degrees, etc.

Device Configuration

Besides the configuration services for equipment operation, the FY301 positioner allows self-configuration. Services from this group are related to: write protection, and local indication.

✓ **WRITE PROTECTION:** The configurator only shows that the writing is authorized if the W2 jumper from main board is connected to the pins under the word DOWN.

LOCAL INDICATION - The FY301 local indicator has three well-defined fields: information field with icons informing the active status of the configuration, 4 ½ numerical digit fields to value indication and alphanumeric field with 5-digit for status information and units.

The FY301 accepts up to two local indicator configurations, showed with a 2 seconds pause between each one. The parameters that can be selected to visualization are showed below in table.

PARAMETERS	DESCRIPTION
PV %	Process variable in percentage.
PV (mm)	Process variable in mm.
SP %	Setpoint in percentage.
SP(mm)	Setpoint in mm.

Advanced Configuration

This function affects actuator advanced configurations. With advanced configuration is possible to configure if it is air-to-open or air-to-close, cylinder action, setpoint limits and split-range.

Device Maintenance

This group includes maintenance services, related to obtainment of necessary information to the device maintenance and performance test. Some of the available services are: position adjustment and performance test, general information about the actuator, operations count, password level, code number model and performance.

Trim

There are two trim operations: current trim and temperature trim. Current trim allows to calibrate the positioner input current reading and temperature trim is the temperature reference to the positioner temperature sensor.

There are two current trims available:
4 mA TRIM: is used to adjust the input current reading correspondent to 0%.
20 mA TRIM: is used to adjust the input current reading correspondent to 100%.

Setup

This function allows to calibrate the cylinder travel automatically (Auto Setup), the points of the totally opened or totally closed travel with higher precision (lower and higher position), to adjust the opening and closing times and the proportional and integral actions of PI control, the state of air supply, the magnet, the sensor Hall, setup and the piezo voltage conditions.

During the setup process, the FY301 positioner takes the following steps:

10% - It opens or closes the cylinder, depending on the initial value of the piezo voltage;

20% - The positioner checks if the flat cable is connected, or if the Hall sensor is working properly. In case of error, the message “HALL” will appear at local indicator;

30% - The positioner checks whether the magnet is used;

40% - At this point, the positioner opens or closes the cylinder, depending on the initial position. Case the spool is obstructed or if the positioner has no air supply, the message “FAIL MOVE” will appear in the local indicator.

50% - At this moment, the positioner checks if the magnet is connected. If not, the message “MGNT” will appear in the local indicator;

60% - The positioner places the cylinder to 50**%.** The setup process could remain at this step if the Kp value is low;

70% - At this moment, the cylinder is close to 50%**.** The setup process could remain at this step, if the Kp value is high;

80% - The positioner adjusts its internal references to place the valve in 50%**.** The setup process could remain at this step, if the Kp value is high;

90% - The positioner checks if the magnet is correctly mounted (arrow in arrow). If not, the message “MGNT” will appear in the local indicator;

100% - End of setup;

Multidrop Configuration

ADDRESSING - FY301 contains a variable that define the device address in a HART® network. HART® addresses assume values from "0" to "15", the addresses "1" to "15" are specific addresses to multidrop connection. When FY301 is configured to multidrop, it means that the local indicator is showing “MD” and the address is a value from "1" to "15". FY301 is factory configured with address "0".

Diagnostic

This function allows engineering unit configuration, the parameters to diagnostic purposes and shows positioner general conditions.

Backup

Data transference from transducer to main board must be done immediately after the assembly when there is a transducer or main board substitution.

This process is automatically done when the positioner is powered. If necessary, the user could force transference using the option *read from sensor*.

The option *write on sensor* could be used to record changes previously made, for example, in Kp, Tr, etc., in transducer memory. The previous values for Kp, Tr, etc. will be lost.

Pressure Sensor

This function allows pressure trim adjustment, to view applied pressure status and to configure positioner input pressure in order to activate the alarm via HART communication, in case the applied input pressures are not in accordance with configured values.

Factory

This option is used only in the factory, and the user cannot access it.

LOCAL ADJUSTMENT PROGRAMMING

To enable local adjustment, move the W1 jumper to “ON”. This jumper is located on top of the main electronic circuit board.

There are two orifices on the positioner, under the nameplate, identified by “S” and “Z” respectively, which provide access to two magnetic switches actuated by means of a magnetic tool (Refer to figure 4.1).

NOTE
In this section, the “Magnetic Tool” will be referred to as “TOOL”, and the orifices identified by “S” and “Z” will be “ORIFICE S” and “ORIFICE Z”, respectively.

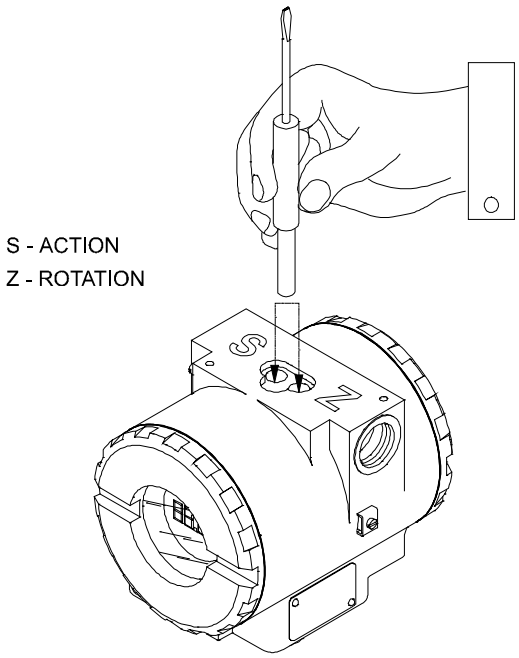


Figure 4.1 - Local Adjustment Orifices

The table indicates the results for the actions on orifices “Z” and “S” in FY301.

ORIFICE	ACTION
Z	Function browsing.
S	Selects the displayed function.

The digital display is required in order to show the programming performed via local adjustment.

W1 and W2 Jumpers Connection

W1 jumper connected in ON (See figure 4.2):
If W1 jumper is connected in ON, adjustment local enabled, the parameters of the programming tree can be modified.

W2 jumper connected in DOWN (See figure 4.2):
With W2 jumper connected in this mode, write protected, the positioner protects the configuration against improper modifications.

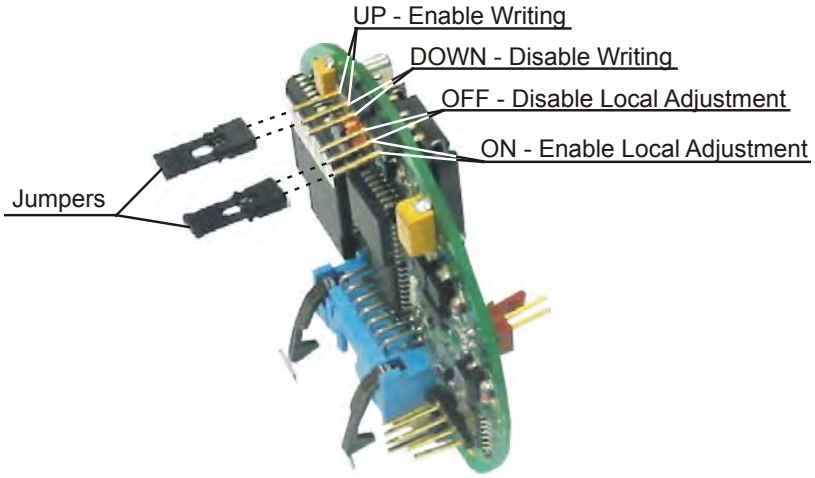


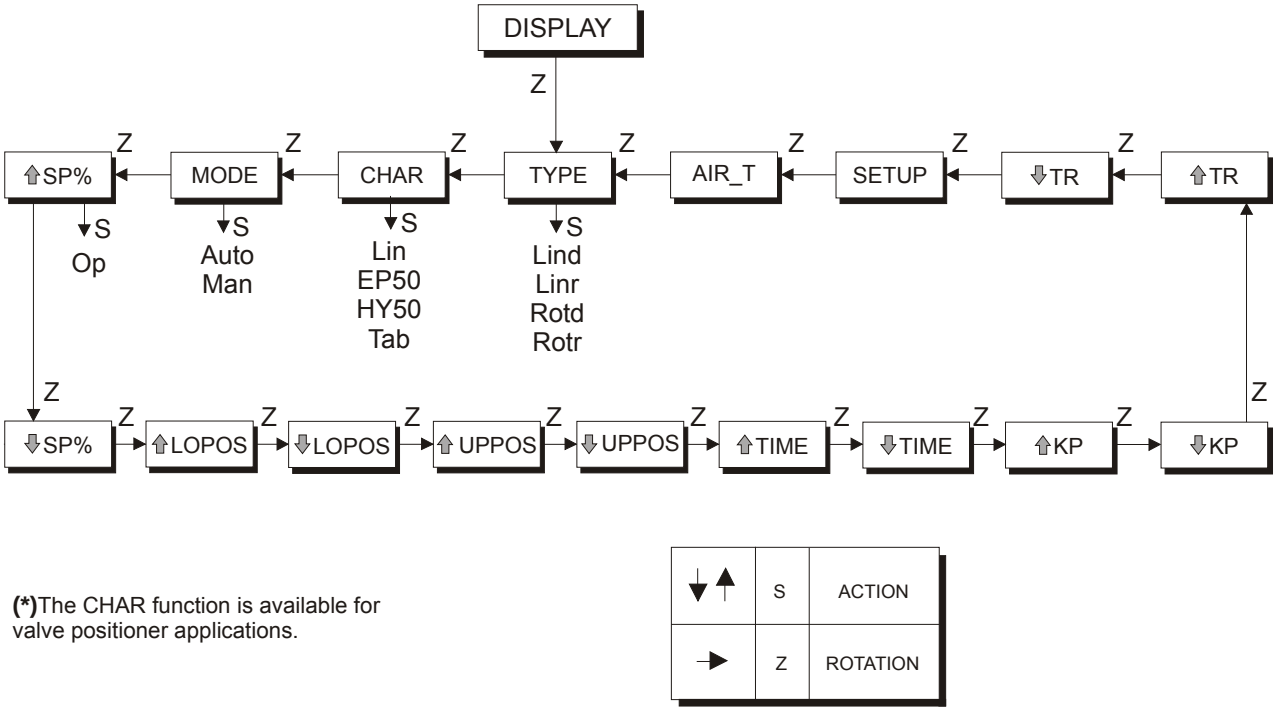
Figure 4.2 - W1 and W2 Jumpers

Local Programming Tree

The programming tree is a tree shaped structure with a menu of all available software functions, as shown on figure 4.3.

While in local adjustment, it is possible to browse through all configuration options by keeping the magnetic tool in orifice “Z”. Upon choosing the option as described, place the tool in orifice “S” in order to actuate.

By keeping the tool in orifice “S” it is possible to continuously actuate the selected parameter, since this is a numeric value. Actions by increment are performed by repeatedly placing and removing the magnetic tool until reaching the desired valve.



(*)The CHAR function is available for valve positioner applications.

Figure 4.3 - Local Programming Tree

NOTE
The user shall perform every parameter actuation judiciously, since actuation writes configuration parameters on a permanent basis and does not require confirmation. Once an actuation is performed it is assumed to be the desired configuration.

Adjustable Parameters

TYPE - Act Type
This parameter enables the user to configure action type. These are the options:
For Linear ACP:
- ✓ Lind: Linear and Direct;
- ✓ Linr: Linear and Reverse;

For Rotary ACP:
- ✓ Rotd: Rotary and Direct;
- ✓ Rotr: Rotary and Reverse.

Setup - Auto Positioning
After configuring the action type by means of parameter TYPE, the AUTO SETUP parameter shall be actuated. During the adjustment procedure the positioner will be in a state of auto positioning and the message "SETUP" will be flashing on the display.

During this process the control parameters are determined and the 0% and 100% trim is performed. This operation lasts approximately 4 minutes. While configuring the action type as described above, the user shall browse up to parameter SETUP (tool in orifice Z) and place the tool in orifice S in order to initiate the previous auto positioning of the cylinder.

NOTE
Not for **ACP** **CHAR - Valve Characterization Curve** This parameter allows the user to configure the type of valve characterization curve. Options are as follows: **Lin:** Linear; **EP50:** Equal Percentage 50%; **HY:** Hyperbolic.

MODE - Operation Mode
This parameter allows the user to choose operation mode. Upon turning the positioner on, it will always be in automatic mode, but it is possible to choose the operation mode. During operation there are the following options:
Auto - Automatic Mode
During automatic mode the positions is set in accordance with the input 4 to 20 mA current signal. While in automatic mode, local actuation in the SP% parameter is not allowed.
Man - Manual Mode
During manual mode the position is set in accordance with the SP% parameter value, independently from the input current. This is the only mode in which the SP% parameter can be actuated.

SP % - Set Point
This parameter represents the desired position value. While in "Manual" mode, it is possible to actuate this parameter remotely, independently from the input current. While in automatic, it is calculated from the input current level.

LOPOS - Lower Position
This parameter allows the lower position calibration as per the input current, usually 4 mA unless it is in split range operation. During calibration, notice if the control becomes saturated, that is, if the cylinder no longer moves in the desired direction. Should such a situation occur, the user shall actuate in the opposite direction to the cylinder movement. Calibration is performed in terms of percentage.

UPPOS - Upper Position
This parameter allows the upper position calibration as per the input current, usually 20 mA unless it is in split range operation. During calibration, notice if the control becomes saturated, that is, if the cylinder no longer moves in the desired direction. If such a situation occur, the user shall actuate in the opposite direction to the cylinder movement. Calibration is performed in terms of percentage.

TIME - Setpoint Variation Time
This allows the configuration of the setpoint variation rate. The unit is expressed in seconds. It is adjustable in the following range: 1 to 60.

KP - Proportional Gain
This parameter makes it possible to adjust the servo control proportional gain. It is adjustable within the following range: 0.5 to 45.

TR - Integral Time
This parameter makes possible to adjust the servo control integral time. It is adjustable within the following range: 0 to 999 minutes/repetition.

Procedure for Valve Calibration

STEP 1
Select action type by means of the menu TYPE, browsing at least once through the options (Lind, Linr, Rotd, and Rotr).

STEP 2
Setup
In order to start self-calibration, browse up to the parameter SETUP and insert the tool in S.

NOTE
In most cases, steps 1 and 2 are sufficient to provide a good calibration.

STEP 3
Set the KP to lower the value overshoot (the overshoot will require adjustment after the TIME as adjusted). The lower the KP is, the lower the overshoot will be, but cylinder positioning will be slower. Set TR in a value where the position does not oscillate and control is capable of quickly reaching the final position.

STEP 4
Time Adjustment (TIME)
Perform TIME adjustment for quick open.

STEP 5
Zero Adjustment by means of LOPOS (Lower Position)
At this moment, current shall be in the position that corresponds to 0% as, for example, 4 mA. A more practical way of performing this adjustment is to place the tool in orifice S, thus allowing the parameter to be continually actuated (increased or decreased). Upon noticing the valve action around the desired point, remove the tool from orifice S and slowly alter its value on an increment-by-increment basis, that is, by repeatedly placing and removing the tool in orifice S until reaching the desired point. At a certain point, it is more convenient to perform the adjustment on an increment-by-increment basis to avoid the risk of passing beyond the desired value.

STEP 6
Span Adjustment by means of UPPOS (Upper Position).
At this moment, current shall be in the position that corresponds to 100% as, for example, 20 mA. The procedure is similar to the one described for zero adjustment.

STEP 7
Air to Close / Air to Open (AIR_T)
This option configures the air pressure effect on the positioner.
If the positioner operates in “direct action”:

- It should be configured for AIR_OPEN, if the air is to open
- It should be configured for AIR_CLOSED, if the air is to close

In case the positioner is operating in “reverse action”:

- It should be configured for AIR_OPEN, if the air is to close
- It should be configured for AIR_CLOSED, if the air is to open

Section 5

MAINTENANCE PROCEDURES

Linear Model

In the maintenance of **ACP301** Linear, the state of conservation of the components should be observed below mentioned, and the substitution of each one of them is recommended to each 1.000.000 cycles, or in case of waste very accentuated excessively due to the work atmosphere aggressive (dust excessive, or abrasive). The components that need periodic visual inspection are:

- rotary bush
- rule
- rod with protection below
- bush support
- bush column
- column
- stem prolongation protection of the cylinder
- pneumatic cylinder

After the maintenance or repair of any item, it is recommended to setup the equipment.

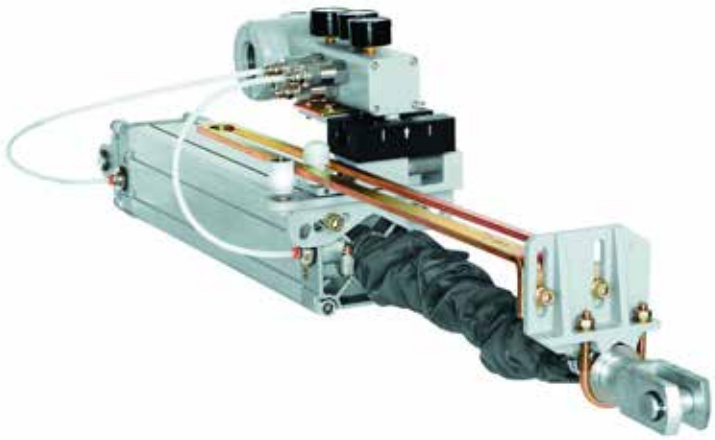


Figure 5.1 - Linear ACP

Disassembling Procedure - Linear ACP

Installation Procedure - Linear ACP
The instructions below indicate the procedure of ACP301L assembly - Linear Pneumatic Cylinder Actuator:

1. Remove the FY301 positioner air connections of the ACP301 and of the cylinder. To disassemble the FY301 positioner of ACP301 of cylinder and bracket, remove with an appropriate key - the screws that fix the support of the FY301 positioner to the cylinder.

Figure 5.2 - Disassembling the Positioner of the Cylinder

2. Disassemble the magnet of the bracket installed in the cylinder. Detail of the unfastening of the Allen screw. The other figure shows how to loosen the screws with Allen key.

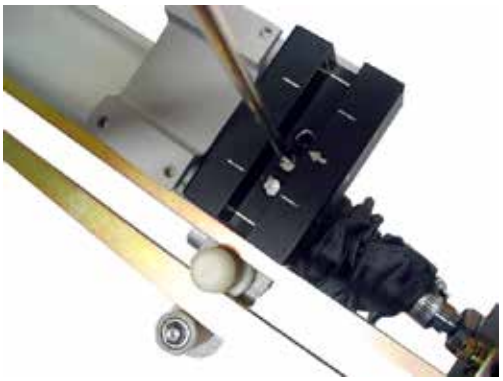


Figure 5.3 - Disassembling the bracket magnet

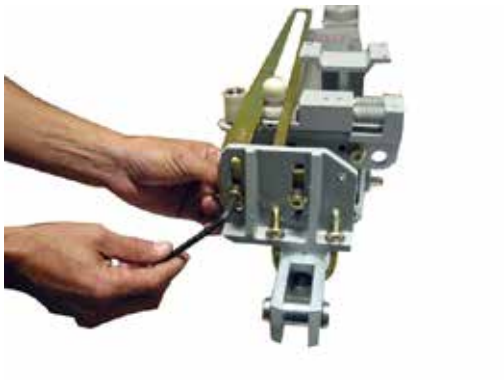


Figure 5.4 - Loosening the Screws with Allen key

3. Loosen the nuts of the U clamp with a 13 mm key, to loosen it of the actuator, offering mobility to the cylinder tip. Disconnect the clevis, uninstall the fixing plate ring, that has the function of facilitating fixation and alignment of rule/roller system. Disassemble the set removing the rule of the cylinder tip.

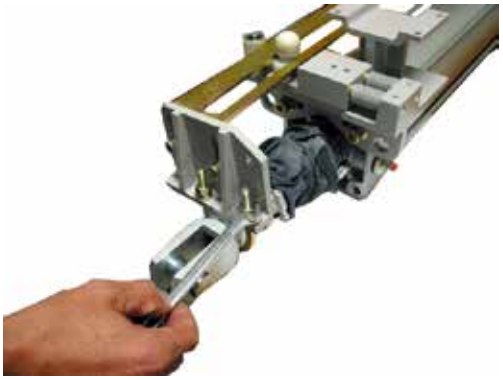


Figure 5.5 - Unfasten the "U" Clamp Screws

Figure 5.6 - Disconnecting the Clevis

4. Remove the FY301 positioner bracket loosening the Allen screws with an appropriate key. The bracket disassembling is showed below.

Figure 5.7 - Disassembling the FY301 Positioner Bracket

Figure 5.8 - Unfasten the Allen Screws

5. Disassemble the fixed roller. Loosen it with help of a key number 10.

Figure 5.9 - Disassembling the Fixed Roller

6. Disassemble the rule. The disassembling should be made using the side of rule internal contour. The rollers function as a support and your material was chosen to minimum attrition with the rule. The rollers were also covered with a layer to avoid dust accumulation and to difficult locking with the rule.

Figure 5.10 - Rule Disassembling

7. Disassemble the mobile base subset.

Figure 5.11 - Mobile Base Sub Set before Disassemble

Figure 5.12 - Disassembling the Mobile Base Sub Set

8. Loosen the mobile roller of the mobile base, remove the allen (without head) type screw, with help of a 2.5 mm allen key. Disassemble the mobile roller with rolling of the bracket.

Figure 5.13 - Loosening the mobile roller of the mobile base

Figure 5.14 - Disassembling the mobile roller

9. Disassemble the bush removing spring and bellow set.

Figure 5.15 - Disassembling Spring and Below Set

Rotary Model

In the maintenance of Rotary ACP301 the conservation state of the components should be observed, being recommended the substitution of each one of them to each 1.000.000 cycles, or in case of excessively waste due to work in aggressive conditions (excessive or abrasive dust). The components that need inspection are:

- joint;
- spacing washer;
- stem prolongation protection of the cylinder.

After the maintenance or repair of any item, it is recommended to setup the equipment.

ACP Positioner

FY301 Valve Positioners of ACP301 are extensively tested and inspected before delivered to the end user. Nevertheless, during their design and development, consideration was given to the possibility of repairs by the end user, if necessary.

In general, it is recommended that the end user do not try to repair printed circuit boards. Instead, he should have spare circuit boards, which may be ordered from Smar whenever necessary.

The maintenance procedure is a set of techniques with the purpose to keep the positioners of ACP301 with higher time of use (useful life), to operate in safe conditions and to promote costs reduction. The different maintenance types are described during this section.

Corrective Maintenance for the ACP301 Positioner

Maintenance not planned, with the purpose to locate and to repair problems in the of ACP301 positioners operating in continuous work, or either, specifically to suppress defects already presented by the equipment.

The diagnostic are a set of methods to detect, to locate and eventually to correct errors and problems or even verify fail effects in the ACP301 positioner.

ACP301 Positioner Diagnostics without Configurator

In order to carry out the diagnostics, refer to table below.

DIAGNOSTICS	
SYMPTOM	**PROBABLE ERROR SOURCE**
POSITION SHOWN ON DISPLAY	*Positioner Connections* Check wiring polarity and continuity. *Power Supply must be a current source* Check signal input current. Minimum current for positioner operation is 3.8 mA. *Electronics Failure* Check circuit boards for bad connections and replace them for spare boards.
NO RESPONSE TO INPUT SIGNAL	*Pressure Output Connections* Check up on air leaks. *Air Supply Pressure* Check the air supply pressure. The input pressure to positioner shall be between 20 psi and 100 psi. *Calibration* Check the positioner calibration points. *Obstructed Restriction and/or Blocked Output* Observe the following procedures described in this Manual: Output Connections and Restriction Cleaning.
OSCILLATING ACTUATOR	*Calibration* Adjust parameter Kp. Adjust parameter Tr.
SLOW ACTUATOR RESPONSE	*Adjustment Parameters are Too Low* Adjust parameter Kp or Time to Open or Time to Close.
TOO FAST ACTUATOR RESPONSE	*Adjustment Parameters are Too High* Adjust parameter Kp or Time to Open or Time to Close.

Table 5.1 - FY301 Diagnostics without the Configurator

ACP301 Positioner Diagnostics with Configurator

If the **ACP301** positioner is on and with the communication circuit and the processing unit working, the configurator can be used for diagnostic, in case of problems with the **ACP301** positioner. The configurator should be connected to the **ACP301** positioner according to the wiring diagrams show on Section 1.

Error Messages

The error messages inform the diagnostic through the self diagnostic of errors and malfunctioning. When the configurator is communicating with the **ACP301** positioner, the user is informed on any problem found, through the self diagnostic. At the **ACP301** positioner, the error messages always alternate with the information on the top line of the configurator's display. Table 5.2 lists the error messages and more details on corrective action.

ERROR MESSAGES	POTENTIAL SOURCE OF PROBLEM
PARITY ERROR OVERRUN ERROR CHECK SUM ERROR FRAMING ERROR	- The line resistance is not according to the technical characteristics. - Excessive noise or ripple. - Low level signal. - Interface damaged. - Power supply or battery voltage of the configurator lower than 9 V.
NO RESPONSE	- Positioner line resistance is not according to technical characteristics. - Positioner not powered. - Positioner not connected or damaged. - Positioner configured in multidrop mode being accessed by ON LINE SINGLE UNIT. - Positioner reversibly powered (polarity is reversed). - Interface damaged. - Power supply or battery voltage of the configurator lower than 9 V.
LINE BUSY	- Other device using the line.
CMD NOT IMPLEMENTED	- Software version not compatible between configurator and positioner.
DEVICE BUSY	- Positioner carrying out an important task, e.g., local adjustment.
POSITIONER MALFUNCTION	- Voltage to pressure transducer disconnected. - Voltage to pressure transducer failure.
COLD START	- Start-up or reset due to power supply failure.
OUTPUT FIXED	- Operating in local mode with fix position. - Connected in burnout.
OUTPUT SATURATED	- Position out of calibrated span or in fail-safe (Output current in 3.9 or 21 mA).
2 OUT OF LIMITS	- Temperature out of operating limits. - Temperature sensor damaged.
1 OUT OF LIMITS	- Position out of operation valve range. - Voltage to pressure transducer damaged or not connected. - Positioner with error configuration.
LOWER RANGE VALUE TOO HIGH	- The lower range value > (Upper limit of minimum span range).
LOWER RANGE VALUE TOO LOW	- The lower range value < (Upper limit of range).
UPPER RANGE VALUE TOO HIGH	- The upper range value > 110 % x (Upper limit of range).
UPPER RANGE VALUE TOO LOW	- The upper range value < - 10 % (Lower limit of range).
UPPER AND LOWER RANGE VALUES OUT OF LIMITS	- Both the upper and lower points are outside the positioner range limit.
SPAN TOO SMALL	- The difference, between the upper and lower points, is less than the allowed by the positioner.
ACTUAL POSITION	- The actual valve position was above of the upper range limit.
ACTUAL POSITION	- The actual valve position was below of the lower range limit.
PASSED PARAMETER TOO LARGE	- Parameter above operating limits.
PASSED PARAMETER TOO SMALL	- Parameter below operating limits.
CONTROL LOOP SHOULD BE IN MANUAL	- Indicates that the operation could affect the output.
CONTROL LOOP MAY BE RETURNED TO AUTO	- After the operation is complete, you are reminded to return the loop to automatic control.

Table 5.2 – FY301 Diagnostics with the Configurator

ACP301 Positioner Disassembly Procedure for Maintenance

1. Insert air pressure in the **ACP301** positioner input, without applying power supply. Verify if occurs air pressure leakage in output 1 (OUT1). In case of pressure leakage in output 1, an analysis of the mechanical parts is indicated.
2. Remove the restriction. Verify if the restriction is not obstructed. (See restriction cleaning procedure).
3. Disassemble the equipment as shown:

Figure 5.1 - ACP301 Positioner Disassembled

Maintenance – Mechanical Parts

1. Verify if the spool is moving freely.
2. Verify if the spool is not obstructed with dirty.
3. Verify if does not have obstructed way in the FY pneumatic block and in the exhaustion ways.
4. Verify if the diaphragm is not damaged.
5. Verify if the piezo isolating cover has holes.
6. Verify if the nozzle is with dirty.

Maintenance – Electronic Parts

Positioner Electronic Circuit

NOTE
The numbers indicated between parentheses refer to **ACP301** positioner exploded view**.**

To remove the plate of the circuit (**5**) and the indicator (**4**), first release the cover locking bolt (**6**) from the side not marked "Field Terminals", and after that release the cover (**1**).

ATTENTION
The circuit boards have CMOS components that can be damaged by electrostatic discharges. Verify the correct procedures to manipulate CMOS components. Also it is recommended to store the circuit boards in packs with electrostatic load proof.

Release the two screws **(3)** that fix the main board circuit and of the indicator. Pull out the indicator, after the main board **(5)**.

Verify the firmware version; must be version 2.12, 2.13 or higher. Mount the equipment; apply pressure supply of 30 psi and power on the equipment. When the equipment do not initializes, the display does not light on, proceed with the following procedures:

1. Disconnect the analog board from the digital board;

2. Case the equipment initializes, change the GLL1012, if it does not change the GLL1011.

Proceed with the setup. After the setup, verify if the **ACP301** positioner is working properly. For that, apply 12mA and be sure that the valve goes to the position correspondent to the 50% of the valve travel. If it does not occur, do the following:

1. In case you do not have the software, use a GLL1011;

2. Apply 4 mA and verify through the configurator if SP% is equal to 0%;

3. Apply 20 mA and verify through the configurator if SP% is equal to 100%;

4. If the values above were different, execute the 4 mA and 20 mA current trim;

5. Verify the Hall reading through the configurator. Apply pressure directly to the valve actuator and verify if there is modification in the Hall reading (65000 means that the Hall is not being read) and the defect can be the GLL1012 or GLL1019;

6. Verify the piezo voltage in the configurator;

7. The piezo voltage value must be between 30 and 70 Volts.

To verify the Hall value and the piezo voltage, do the following:

- Set the valve in 50% of the opening or closing travel;
- With the configurator, go to the “monitoring” mode and choose two parameters: Hall value and piezo voltage;
- The piezo voltage values must be the most closed possible to 26000 to 38000;
- The piezo voltage values must be between 30 and 70 Volts. If the voltage is not between these values, proceed with the piezo calibration.

Preventive Maintenance for the ACP301 Positioner

Planned Maintenance, consists in the set of procedures and anticipated actions to keep the device functioning, is effectuate with the special objective to prevent the occurrence of fail. Through adjustments, proves and measures according to the specified values, made before the appearing of defects. The preventive maintenance is recommended in the maximum period of one (1) year, or when the process stops.

ACP301 Positioner Disassembly Procedure

Transducer

To remove the transducer from the electronic housing, the electrical connections (in the field terminal side) and the main board connector must be disconnected.

Loosen the hex screw (**6**) and carefully unscrew the electronic housing from the transducer, observing that the flat cable is not excessively twisted.

CAUTION
Do not rotate the electronic housing more than 270° without disconnecting the electronic circuit from the power supply.

Figure 5.2 – Transducer Rotation

NOTE
The numbers indicated between parentheses refer to Figure 5.25 – Exploded View.

Figure 5.17 - Transducer Rotation Stopper

1. Remove the cover Allen fixing screw of the flat cable. (This part can not be washed);
2. Remove the flat cable cover. When removing this cover, take care to do not damage the internal boards, disassembly with care. (This part can not be washed);
3. Remove the analog board GLL1012 ;
4. Remove the electric piezo base (This part can not be washed);
5. Remove the piezo restriction for cleaning;
6. Remove the diaphragm for analysis and cleaning with water and neutral detergent; after that, wash with alcohol, dry before mounting;
7. Remove the spool valve; the cleaning is made with water and neutral detergent; after that, wash with alcohol, dry before mounting. This part must be mounted without lubrication;
8. The pneumatic block can be completely washed with water and neutral detergent, after that, wash with alcohol and verify if it is completely clean, without dust. For that, apply compressed air in all positioner orifices;
9. Verify if the Hall cover does not have indication of water infiltration. (This part can not be washed);
10. Verify if the GLL1019 (Hall flat cable) is damaged, curved, cut or oxidate.

ACP301 Positioner Assembly Procedure

To assembly the positioner:

1. Mount the piezoelectric sensor in the jig;
2. Apply 20 PSI in the air pressure input;
3. Apply 0 Volts, after that 100 Volts DC and after 0 Volts again (to avoid hysteretic error);
4. Apply 50 Volts DC to the piezoelectric sensor;
5. Verify the pilot chamber pressure measured in the correspondent manometer. The pressure must be between 5.8 and 6.2 PSI. In case it is different, made the adjustment rotating the superior disc of piezoelectric sensor set;

6. Once reached the previous adjustment, apply 0 Volts again and verify that the pressure in the pilot chamber must be between 2 PSI. After that, apply 100 Volts and verify that the pressure must be between 12 and 13 PSI;
7. Apply 50 Volts AC to the piezoelectric sensor. Verify the pilot chamber pressure measured in manometer, it must be between 5.8 and 6.2 PSI. In case it is different, made the adjustment again and rotating the superior disc of piezoelectric sensor set and repeating the procedure, to reach the specified values.
8. When these values are reached, the piezoelectric sensor is already calibrated;
9. After the piezoelectric sensor calibration, proceed with the final verification of the positioner;
10. Mount all positioner set with the calibrated piezoelectric sensor;
11. Made a setup in the positioner;
12. If the piezoelectric sensor voltage is not at indicated range, means that the piezoelectric sensor needs a new calibration or it needs to be changed.

Restriction Cleaning Procedure

The air flows to the nozzle through a restriction. Verify from time to time the restriction cleaning to assure a positioner good performance.

1. Be sure that the air supply of the equipment is blocked.

Figure 5.18 – ACP Positioner

2. With an appropriate tool, remove the transducer serial number plate. (New models have the plate placed on the opposite side of the transducer).

Figure 5.19 - Remove the Transducer Serial Number Plate

Figure 5.20 - Transducer Serial Number Plate Removed

3. Remove the restriction screw using an adequate tool;

Figure 5.21 - Removing Restriction Screw

4. Remove the o-ring's with an appropriate tool;

5. Dive the part in petroleum base solvent and dry it with compressed air (apply the compressed air directly in the smaller orifice for the air to get out through the bigger orifice).

6. Introduce the appropriate tool (PN 400-0726) into the restriction orifice to prevent any possible obstruction;

Figure 5.22 – Needle Cleaning Device for the Restriction and Restriction

Figure 5.23 – Needle in the Restriction Orifice (Restriction Cleaning Procedure)

7. Mount the o-rings again and screw the restriction in the positioner.
8. The equipment can be supplied with air again.

Change of the Filter Elements of ACP301 Positioner

Change the **ACP301** positioner filter elements with a minimum stated period of 1 (one) year.

The instrumentation air supply must be clean, dry and non-corrosive, following standards indicated for the American National Standard *"Quality Standard for Instrument Air*" - (ANSI/ISA S7.0.01 - 1996).

If the instrumentation air does not comply with the above mentioned standards, the user has to consider changing the **ACP301** positioner filter elements more frequently.

ACP301 Positioner Exhausts Ports

Air is vented to the atmosphere through the two exhausts ports located behind the transducer nameplate and 4 output of the opposite side from gage. A foreign object interfering or blocking exhaust port provides a way to increase the output. Cleaning by spraying it with a solvent.

ATTENTION
Never use oil or grease in the spool; otherwise the positioner performance will be impaired.

Electronic Circuit

Plug transducer connector and power supply connector to main board (**5**). Attach the display to the main board. Observe the four possible mounting positions. The 5 mark indicates up position.

Anchor the main board and indicator with their screws (**3**). After tightening the protective cover (**1**), mounting procedure is complete. The **ACP301** positioner is ready to be energized and tested.

ELECTRICAL CONNECTIONS
The plug must obligatorily be installed in the electric connection that will not be used, preventing the humidity accumulation. We suggested you to use a sealant on the thread closed by a firm squeeze. It is also certified if the two housing covers are firmly tight.

NOTE
The plug with sealant from factory is not certified for use in explosion proof installations.

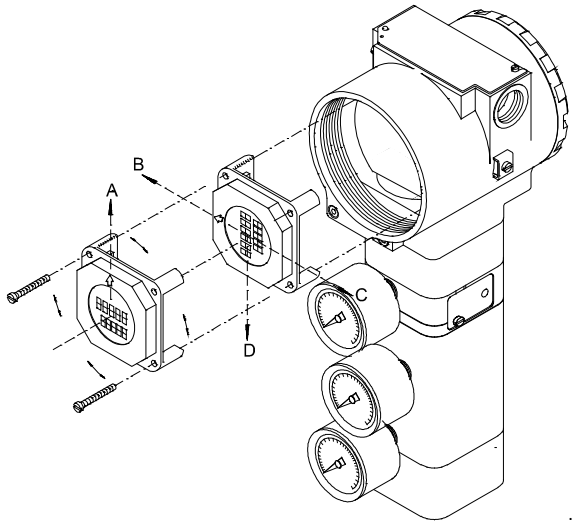


Figure 5.24 - Possible Positions for the Display

Pneumatic Cylinder Maintenance

The maintenance of the pneumatic cylinder should not be made with the equipment in the field. It is recommended to proceed with maintenance in a clean workbench and provided of compressed air.

The cylinder is auto-lubricated and doesn't need additional lubrication. In case the user decides for lubricating the cylinder, it will lose the warranty coverings of the product besides the decrease of useful life of FY301 positioner and of the cylinder.

The table below represents a basic orientation about the problems, probable causes and solutions for maintenance of the pneumatic cylinder.

Basic orientation of problems, probable causes and solutions		
Problem	**Probable causes**	**Solutions**
Leak for the opposite orifice to the air input	- piston sealings damaged - striped cylinder cover	- change sealings - change cover - verify air filter
Leak for the stem sealing	- damaged sealings - striped stem	- change sealings - change stem - protection below of the rod
Leak for the screw of damping adjustment	- damaged sealings	- change sealings
Leak for the cover junction with the heads	- damaged sealings	- change sealings

In the case of third part cylinders, Smar is not responsible in case the equipment doesn't offer stem prolongation protection of the cylinder, because there is not how to guarantee the attrition prevention and subsequent waste of the stem.

Package Content

When receiving the equipment, verify the package content. The number for items marked with (*) must be in accordance with the number of positioners.

- ACP301 Positioner Set / Cylinder
- Magnetic tool for local adjustment (*)
- Centralizer transmitter device (*)
- Cleaning device for the restriction (*)
- Operation, maintenance and instructions manual (*)

ACP301 Positioner Exploded View

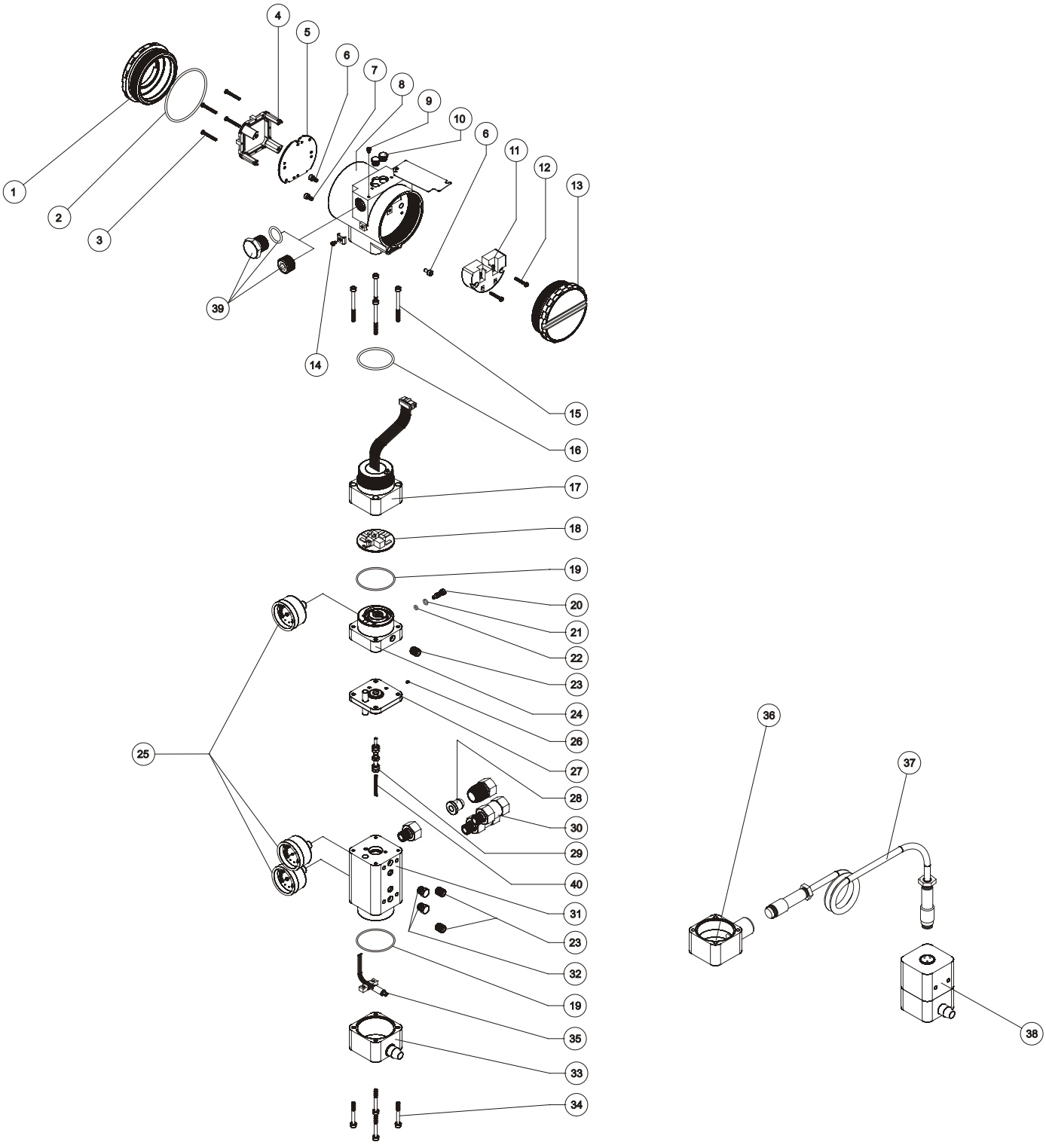


Figure 5.25 – ACP301 Positioner Exploded View

Accessories

ACCESSORIES	
ORDERING CODE	**DESCRIPTION**
SD-1	Magnetic tool for local adjustment.
HPC401*	Hart® HPI311-M5P for the PalmOS platform, including the configuration package for the Smar and generic transmitters.
HPI311-M5P*	Just the Hart® interface.
400-0726	Needle cleaning device for the restriction.

* For equipment updates and HPC401 software, just check: http://www.smarresearch.com .

Spare Parts List for ACP301 Positioner

SPARE PARTS LIST			
PARTS DESCRIPTION	**POSITION**	**CÓDE**	**CATEGORY (NOTE 4)**
HOUSING, Aluminum (**NOTE 1**)			
. 1/2 - 14 NPT	8	301-0340	-
. M20 x 1.5	8	301-0341	-
. PG 13.5 DIN	8	301-0342	-
HOUSING, 316 SS (**NOTE 1**)			
. 1/2 - 14 NPT	8	301-0343	-
. M20 x 1.5	8	301-0344	-
. PG 13.5 DIN	8	301-0345	-
COVER (INCLUDES O-RING)			
. Aluminum	1 e 13	204-0102	-
. 316 SS	1 e 13	204-0105	-
COVER WITH WINDOW FOR DISPLAY (INCLUDES O-RING)			
. Aluminum	1	204-0103	-
. 316 SS	1	204-0106	-
COVER LOCKING BOLT	6	204-0120	-
SENSOR LOCKING BOLT			
. M6 Without Head Screw	7	400-1121	-
EXTERNAL GROUND BOLT	14	204-0124	-
IDENTIFICATION PLATE FIXING BOLT	9	204-0116	-
			-
DIGITAL INDICATOR	4	214-0108	A
TERMINAL INSULATOR	11	400-0058	A
MAIN ELECTRONIC CIRCUIT BOARD	5	209-0230	A
O-RINGS COVER (**NOTE 2**)			
. Buna-N	2	204-0122	B
TERMINAL HOLDING BOLT HOUSING			
. Housing in 316 Aluminum	12	304-0119	B
. Housing in 316 Stainless Steel	12	204-0119	B
MAIN BOARD BOLT HOUSING IN ALUMINUM	3	304-0118	B
. Units with indicator	3	304-0117	B
. Units without indicator			
MAIN BOARD BOLT HOUSING IN 316 STAINLESS STEEL	3	204-0118	B
. Units with indicator	3	204-0117	B
. Units without indicator			
ALUMINUM CONNECTION COVER	15,16,17 and 18	400-0643	A
316 STAINLESS STEEL CONNECTION COVER	15,16,17 and 18	400-0644	A
. Connection Cover Bolt	15	400-0073	-
. Buna-N Neck O-ring	16	204-0113	B
. Assembled Connection Cover - Aluminum	17	400-0074	-
. Assembled Connection Cover - 316 Stainless Steel	17	400-0391	-
. Analog Board without Pressure Sensor GLL1012	18	400-0060	-
. Analog Board for Pressure Sensor GLL1204	18	400-0840	-

SPARE PARTS LIST			
PARTS DESCRIPTION	**POSITION**	**CÓDE**	**CATEGORY (NOTE 4)**
PIEZO BASE SET – ALUMINUM	19,20,21,22, 23,24 and 25	400-0645	A
PIEZO BASE SET – 316 STAINLESS STEEL	19,20,21,22, 23,24 and 25	400-0646	A
. Base and Block O-ring	19	400-0085	B
. Restriction	20	344-0165	B
. Restriction External O-ring	21	344-0155	B
. Restriction Internal O-ring	22	344-0150	B
. Syntherized Bushing	23	400-0033	B
. Assembled Base – Aluminum	24	400-0075	A
. Assembled Base – 316 Stainless Steel	24	400-0392	A
. Analog indicator (Gage - 316 Stainless Steel and Brass) (NOTE 6)	25	400-1120	B
. Identification tag bolt	26	344-0160	-
. Assembled diaphragm – Aluminum	27	400-0649	B
. Assembled diaphragm – 316 Stainless Steel	27	400-0650	B
ALUMINUM BLOCK SET	19,23,25,28,29,30,31 and 32	400-0651	A
316 STAINLESS STEEL BLOCK SET	19,23,25,28,29,30,31 and 32	400-0652	A
ALUMINUM BLOCK SET WITH PRESSURE SENSOR	19,23,25,28,29,30,31 and 32	400-1072	A
316 STAINLESS STEEL BLOCK SET WITH PRESSURE SENSOR	19,23,25,28,29,30,31 and 32	400-1073	A
. Base & Block O-ring	19	400-0085	-
. Syntherized Bushing	23	400-0033	-
. Analog indicator (Gage - 316 Stainless Steel and Brass) (NOTE 6)	25	400-1120	-
. Filtering Element	28	400-0655	-
. Spool valve	29	400-0653	A
. Spool valve Spring	40	400-0787	-
. 304 Stainless steel Filter- 1/4" NPT - includes filtering element	30	101B3403	B
. Assembled Block– Aluminum	31	400-0082	-
. Assembled Block – 316 Stainless Steel	31	400-0394	-
. Vent Plug - 316 Stainless Steel	32	400-0654	-
ALUMINUM HALL COVER SET	33,34 and 35	400-0656	A
316 STAINLESS STEEL HALL COVER SET	33,34 and 35	400-0657	A
. Aluminum Hall Cover Set	33	400-0089	-
. 316 Stainless Steel Hall Cover Set	33	400-0396	-
. Hall Cover Bolt	34	400-0092	-
. Hall Support + Hall Sensor + Flat cable	35	400-0090	B
ALUMINUM REMOTE HALL COVER SET (NOTE 5)	36	400-0853	-
316 STAINLESS STEEL REMOTE HALL COVER SET (NOTE 5)	36	400-0854	-
ALUMINUM REMOTE EXTENSION SET	38	400-0855	-
316 STAINLESS STEEL REMOTE EXTENSION SET	38	400-0856	-
CABLE SET + CONNECTOR, 5M	37	400-0857	-
CABLE SET + CONNECTOR, 10M	37	400-0858	-
CABLE SET + CONNECTOR, 15M	37	400-0859	-
CABLE SET + CONNECTOR, 20M	37	400-0860	-
1/2" NPT (Ex d) INTERNAL SOCKET SET PLUG IN BICHROMATIZED CARBON STEEL	39	400-0808	-
1/2" NPT (Ex d) INTERNAL SOCKET SET PLUG IN 304 SST	39	400-0809	-
1/2" NPT INTERNAL SOCKET SET PLUG IN BICHROMATIZED CARBON STEEL	39	400-0583-11	-
1/2" NPT INTERNAL SOCKET SET PLUG IN 304 SST	39	400-0583-12	-
M20 X 1.5 (Ex d) EXTERNAL SOCKET SET PLUG IN 316 SST	39	400-0810	-
PG13.5 (Ex d) EXTERNAL SOCKET SET PLUG IN 316 SST	39	400-0811	-
3/4" NPT (Ex d) ADAPTER IN 316 SST	39	400-0812	-
ALUMINUM TRANSDUCER SET	**NOTE 3**	209-0180	A
316 STAINLESS STEEL TRANSDUCER SET		400-0399	A
LOCAL ADJUSTMENT PROTECTION COVER	10	204-0114	-

SPARE PARTS LIST			
PARTS DESCRIPTION	**POSITION**	**CÓDE**	**CATEGORY (NOTE 4)**
MAGNETS			
. Linear magnet 15mm	-	400-0034	-
. Linear magnet 30mm	-	400-0748	-
. Linear magnet 50mm	-	400-0035	-
. Linear magnet 100mm	-	400-0036	-
. Rotary magnet	-	400-0037	-
MOUNTING BRACKET SCREW FOR POSITIONER ASSEMBLY (packaged with 12 units)	-	400-1190	-

Note
1) Includes terminal isolator, bolts (cover locking, ground and terminal isolator) and identification plate without certification.
2) O-rings are packaged with 12 units.
3) Includes all transducer's spare parts.
4) For category **A** it is recommended to keep in stock 25 parts installed for each set and 50 for category **B**.
5) This code includes the cover, the cable and the connector for the extension cable.
6) The pressure gauges for supply pressure, output 1 or output 2, will be supplied with the wet parts in brass.

Rotary ACP Exploded View

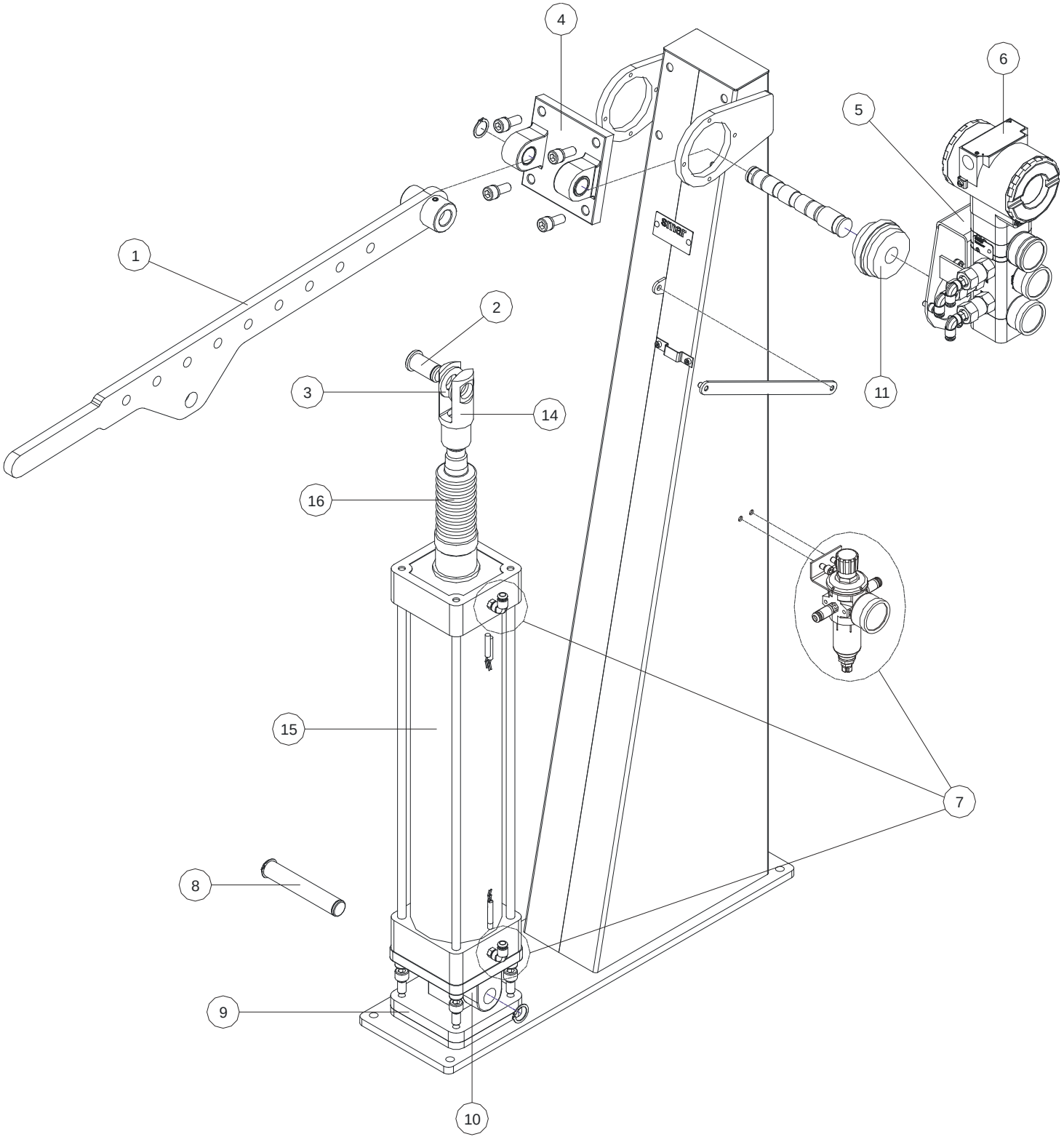


Figure 5.26 - Rotary ACP Exploded View

Spare Parts List For Rotary ACP301 (ACP301LN)

SPARE PARTS LIST FOR ROTARY ACP301 (ACP301LN)			
PARTS DESCRIPTION	**POSITION**	**CODE**	**CATEGORY**
LEVER SUB SET	1	400-0785	A
JOINT BOLT	2	400-0772	A
CLEVIS SPACING WASHER	3	400-0791	B
JOINT BASE	4	400-0774	A
FY301 POSITIONER BRACKET (FOR ROTARY ACP)	5	400-0781	A
FY301 POSITIONER (See positioner exploded view)	6	(FY code)	A
PNEUMATIC KIT (cylinder + protection below + clevis + clevis bolt + air connections)	7	400-0790	A
FIXATION BOLT (OF THE BACK JOINT)	8	400-0786	A
MALE BACK JOINT	9	400-0796	A
FEMALE BACK JOINT	10	400-0797	A
ROTARY MAGNET SET	11	400-0037	A
AIR FILTER REGULATOR FOR ACPRT	12	400-0784	A
MAGNETIC LIMIT SWITCH Magnetic Limit Switch 100 mm diameter cylinder	13	400-0771	B
CLEVIS	14	400-0800	A
CYLINDER	15	400-0798	A

A – Contains 1 unit.
B – Contains 2 units.
C – Contains 12 units.

Linear ACP Exploded View

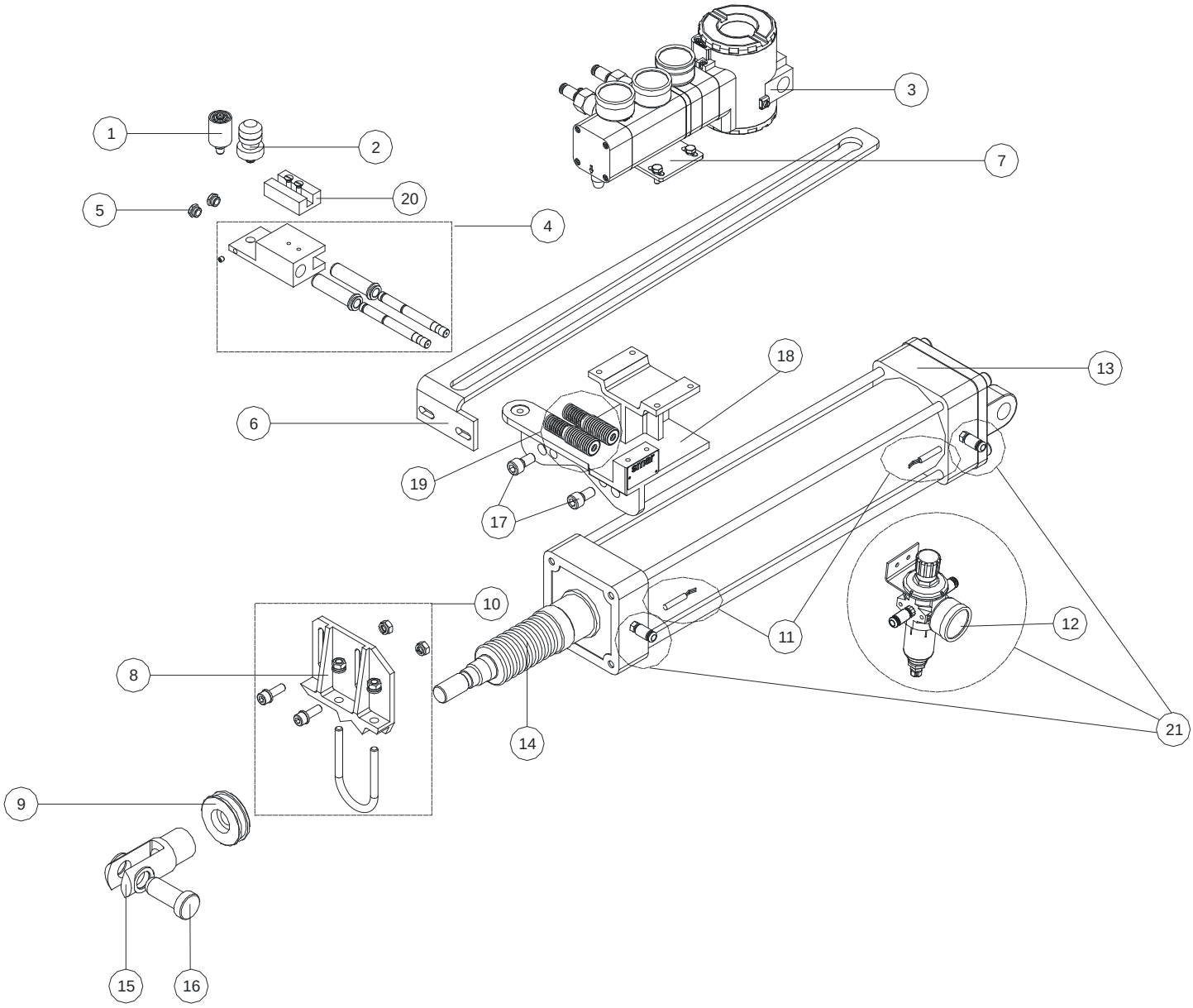


Figure 5.27 - Linear ACP Exploded View

Spare Parts List for Linear ACP301 (ACP301LN)

SPARE PARTS LIST FOR LINEAR ACP301 (ACP301LN)			
PARTS DESCRIPTION	**POSITION**	**CODE**	**CATEGORY**
FIXED ROLLER	1	400-0758	A
MOBILE ROLLER	2	400-0757	A
FY301 POSITIONER (See positioner exploded view)	3	(FY code)	A
MOBILE BASE SUB SET			
(mobile base + 2 bushes + 2 stainless steel columns)	4	400-0751	A
SYNTHERIZED SUB SET	5	400-0752	B
RULER IN CARBON STEEL			
100mm Ruler	6	400-0760	A
125mm Ruler	6	400-0761	A
160mm Ruler	6	400-0762	A
200mm Ruler	6	400-0763	A
250mm Ruler	6	400-0764	A
320mm Ruler	6	400-0765	A
400mm Ruler	6	400-0766	A
500mm Ruler	6	400-0767	A
630mm Ruler	6	400-0768	A
800mm Ruler	6	400-0769	A
1000mm Ruler	6	400-0770	A
RULER FIXATION PLATE	8	400-0773	A
RULE FIXING PLATE RING			
Rule Fixing Plate Ring - 63 mm diameter	9	400-0835	A
Rule Fixing Plate Ring - 80 and 100 mm diameters	9	400-0801	A
Rule Fixing Plate Ring - 125 mm diameter	9	400-0754	A
Rule Fixing Plate Ring - 160 mm diameter	9	400-0756	A
RULE FIXING PLATE SET			
(rule fixing plate + fixing screws + “U” fixation clamp)	10	400-0759	A
MAGNETIC LIMIT SWITCH			
Magnetic Limit Switch for 63/80/100 mm diameters cylinders	11	400-0771	B
Magnetic Limit Switch for 125 mm diameter cylinder	11	400-0802	B
Magnetic Limit Switch for 160 mm diameter cylinder	11	400-0803	B
AIR FILTER REGULATOR FOR ACPLN	12	400-0784	A
CYLINDER	13	400-0798	A
PROTECTION BELLOW	14	400-0799	A
CLEVIS	15	400-0800	A
JOINT BOLT	16	400-0772	A
BRACKET SCREW SET	17	400-0755	C
FY301 POSITIONER BRACKET			
FY Bracket for 63/100/160 mm diameters cylinders	18	400-0782	A
FY bracket for 80/125 mm diameters cylinders	18	400-0783	A
SET WITH SPRING AND BELOW	19	400-0753	B
MAGNET SET			
50 mm Linear Magnet	20	400-0035	A
PNEUMATIC KIT			
(cylinder + protection below + clevis + clevis bolt + air connections)	21	400-0790	A

A – Contains 1 unit. **B** – Contains 2 units. **C** – Contains 12 units.

Section 6

TECHNICAL CHARACTERISTICS

Cylinder Specifications

ISO Pneumatic Cylinder

The pneumatic cylinder has the following characteristics:

- ISO 6431, VDMA 24562, NFE 49-003-1, BS and CETOP standards.
- Double action
- Double dampening
- Magnetic piston
- Anodized aluminum cover
- Injected aluminum heads
- Piston and rod closing in polyurethane
- Stainless steel rod with protection below and extended rod
- Maximum work pressure for the pneumatic cylinder must be 10 bar
- Work temperature: -20 ºC to 80 ºC
- With female back articulation
- With male bracket for back articulation and pin
- Rod fork with pin
- Diameters of 100 and 125 mm
- Available travels: 100, 200, 400, 500, 800 and 1000 mm.

ACP301 working pressure has to attempt the maximum positioner pressure: 7 bar.

Limit Switch Characteristics

Options

- Magnetic sensor:
  - Voltage: 10 to 220 Vac/dc;
  - Current: 100 mA (maximum).
- External fixing through appropriate bracket
- Protection grade of IP65 sensor
- Independent of FY301 operation must be used only as an indicative system of cylinder position at end of travels.

Mounting Bracket Characteristics

- The bracket is according to the diameters of ISO6431 cylinders series.
- Materials: Cast aluminum with low magnesium contents, stainless steel, carbon steel with superficial treatment, bronze and Technyl.

NOTE
Consult Smar for customized applications.

ISO6431

ISO 6431 norm: “Pneumatic fluid power - Single rod cylinders, 1000 kPa (10 bar) series, with detachable mountains, bores from 32 mm to 320 mm - Mounting dimensions”.

This norm defines a metric series of assembly dimensions requested for interchangeability of the pneumatic cylinders for a maximum pressure of work of 1000 kPa (10 bar ≈ 145 psi).

FY301 Positioner Functional Specifications

Input Signal
4 - 20 mA, 2 wire.

Power
Supplied by the 4-20 mA current loop. No external supply required.

Input Impedance
550 Ω.

Minimum Current
3.8 mA.

Communication Protocol
Hart® Communication Protocol (is superimposed on the current signal).

Protection against Reverse Polarity
No damage occurs from reversal of normal supply current (4 - 20 mA) or from misapplication of up to 50 mA.

Output
Output to actuator 0 -100% supply air pressure. Single or double-action.

Pressure Supply
1.4 - 7 bar (20-100 psi). Free of oil, dust and water.

Indication
4 ½ numerical digits and 5 alphanumerical digits (Liquid Cristal Display).

Hazardous Location Certification
Explosion proof, weather proof and intrinsically safe from CEPEL, FM, CSA, NEMKO and DMT (pending).

Temperature Limits

Operation:	-40	to	85°C	(-40	to	185°F).
Storage:	-40	to	90°C	(-40	to	194°F).
Display:	-10	to	75°C	(14	to	167°F) operation.
	-40	to	85°C	(-40	to	185°F) without damage.

Humidity Limits
0 to 100% RH.

Gain
Through software. Locally adjustable.

Actual Position Sensing
Magnet (Non-contact), via Hall effect.

FY301 Positioner Performance Specifications

Resolution
≤ 0.1% F.S.

Repeatability
≤ 0.1% F.S.

Hysteresis
≤ 0.1% F.S.

Consumption
0.35 Nm^3 /h (0.20 SCFM) at 1.4 bar (20 psi) supply.
1.10 Nm^3 /h (1.65 SCFM) at 5.6 bar (80 psi) supply.

Output Capacity
13.6 Nm^3 /h (8 SCFM) at 5.6 bar (80 psi) supply.

Ambient Temperature Effect
0.8%/20°C do span

Supply Pressure Effect
Negligible

Vibration Effect
±0.3%/g of span during the following conditions:
- 5 - 15 Hz at 4 mm constant displacement.
- 15 - 150 Hz at 2g.
- 150 - 2000 HZ at 1g.

Reference SAMA PMC 31.1 - 1980, Sec. 5.3, Condition 3, Steady State.

Electro-Magnetic Interference Effect
Designed to comply with IEC 801 and European Standards EN50081 and EN50082.

FY301 Positioner Physical Specifications

Electrical Connection
½ - 14 NPT, Pg 13.5 or M20 x 1.5.

Pneumatic Connections
Supply and output: ¼ - 18 NPT
Gage: 1/8 - 27 NPT

Material of Construction
Injected low copper aluminum with polyester painting or 316 Stainless Steel housing, with Buna-N o-rings on covers (NEMA 4X, IP66).

Weight
Without display and mounting bracket: 2.7 kg. (Aluminum)
5.8 Kg. (Stainless Steel)
Add for digital display: 0.1 kg.

Weight Analysis for Linear ACP

PNEUMATIC KIT WEIGHT (Weigh in grams)

Pneumatic Kit Weight	Diameters				
Travel (mm)	63 mm	80 mm	100 mm	125 mm	160 mm
100	2,860	4,470	5,775	9,120	16,180
125	2,985	4,650	5,995	9,460	16,560
160	3,165	4,920	6,300	9,950	16,870
200	3,360	5,220	6,650	10,470	1,850
250	3,620	5,590	7,090	11,150	19,650
320	3,970	6,120	7,700	12,090	21,250
400	4,370	6,720	8,400	13,170	23,100
500	4,875	7,470	8,965	14,520	25,400
630	5,530	8,440	9,275	16,275	28,380
800	6,385	9,720	11,900	18,570	32,300
1000	7,390	11,215	13,650	21,270	36,900

Positioner Weight FY: 2,700 grams (without display e mounting bracket)
BFY Weight (Bracket): 4,500 grams
(Aluminium as Base Material)

RULE WEIGHT CARBON STEEL

Travel (mm)	Weigh (grams)
100	530
125	570
160	650
200	710
250	830
320	950
400	1140
500	1190
630	1510
800	1730
1000	2060

TOTAL WEIGHT (Weigh in grams)

	Diameters				
Travel (mm)	63 mm	80 mm	100 mm	125 mm	160 mm
100	10,590	12,200	13,505	16,850	23,910
125	10,755	12,420	13,765	17,230	24,330
160	11,015	12,770	14,150	17,800	24,720
200	11,270	13,130	14,560	18,380	9,760
250	11,650	13,620	15,120	19,180	27,680
320	12,120	14,270	15,850	20,240	29,400
400	12,710	15,060	16,740	21,510	31,440
500	13,265	15,860	17,355	22,910	33,790
630	14,240	17,150	17,985	24,985	37,090
800	15,315	18,650	20,830	27,500	41,230
1000	16,650	20,475	22,910	30,530	46,160

Ordering Code

ACP301L Model	Hart® Linear Pneumatic Cylindric Actuator

CODE	Cylinder Diameter
1	63 mm
2	80mm
3	100 mm
4	125 mm
5	160 mm

CODE	Cylinder and Ruler Travel
1	100 mm (3.94 in)
2	125 mm (4.92 in)
3	160 mm (6.30 in)
4	200 mm (7.87 in)
5	250 mm (9.84 in)
6	320 mm (12.60 in)
7	400 mm (15.75 in)
8	500 mm (19.68 in)
9	630 mm (24.80 in)
A	800 mm (31.50 in)
B	1000 mm (39.37 in)

CODE	Bracket Material
C	Carbon Steel Bracket
I	Stainless Steel Bracket

CODE	Magnetic Limit Switch
0	Without Limit Switch
1	One Limit Switch
2	Two Magnetic Limit Switch

CODE	Local Indicator
0	Without local indicator
1	With local indicator

CODE	Electrical Connection
0	½ – 14 NPT
A	M20 X 1.5
B	PG 13.5 DIN

SPECIAL OPTIONS

CODE	Identification Plate
I1	FM: XP, IS, NI, DI
I3	CSA: XP, IS, NI, DI
I4	EXAM (DMT): Ex-ia; NEMKO: Ex-d
I5	CEPEL: Ex-d, Ex-ia
I6	Without certification
I7	EXAM (DMT): Ex-ia; NEMKO: Ex-d
IM	BDSR – GOST: Ex-d, Ex-ia

CODE	TAG Plate
J0	With tag plate
J1	Tag plate without inscription
J2	Plate according to notes
ZZ	With special characteristics

ACP301L	1	1	C	1	0	0	*	*

* Leave it blank for no optional items.

Note: All the options for the actuator are only for cylinder in agreement with ISO norm. In case the cylinder is not normatized (ISO Cylinder) the special cylinder should necessarily be assembled in Smar. (Note: the cylinder assembly, freight and other costs are customer's responsibility).

ACP301R Model	Hart® Rotary Pneumatic Cylinder Actuator

CODE	Cylinder Diameter
1	100 mm (3.94 in)

CODE	Bracket Material
C	Carbon Steel

CODE	Magnetic Limit Switch
0	Without Magnetic Limit Switch
1	One Magnetic Limit Switch
2	Two Magnetic Limit Switches

CODE	Local Indicator
0	Without Local Indicator
1	With Local Indicator

CODE	Electrical Connections
0	½" – 14 NPT
A	M20 X 1.5
B	PG 13.5 DIN

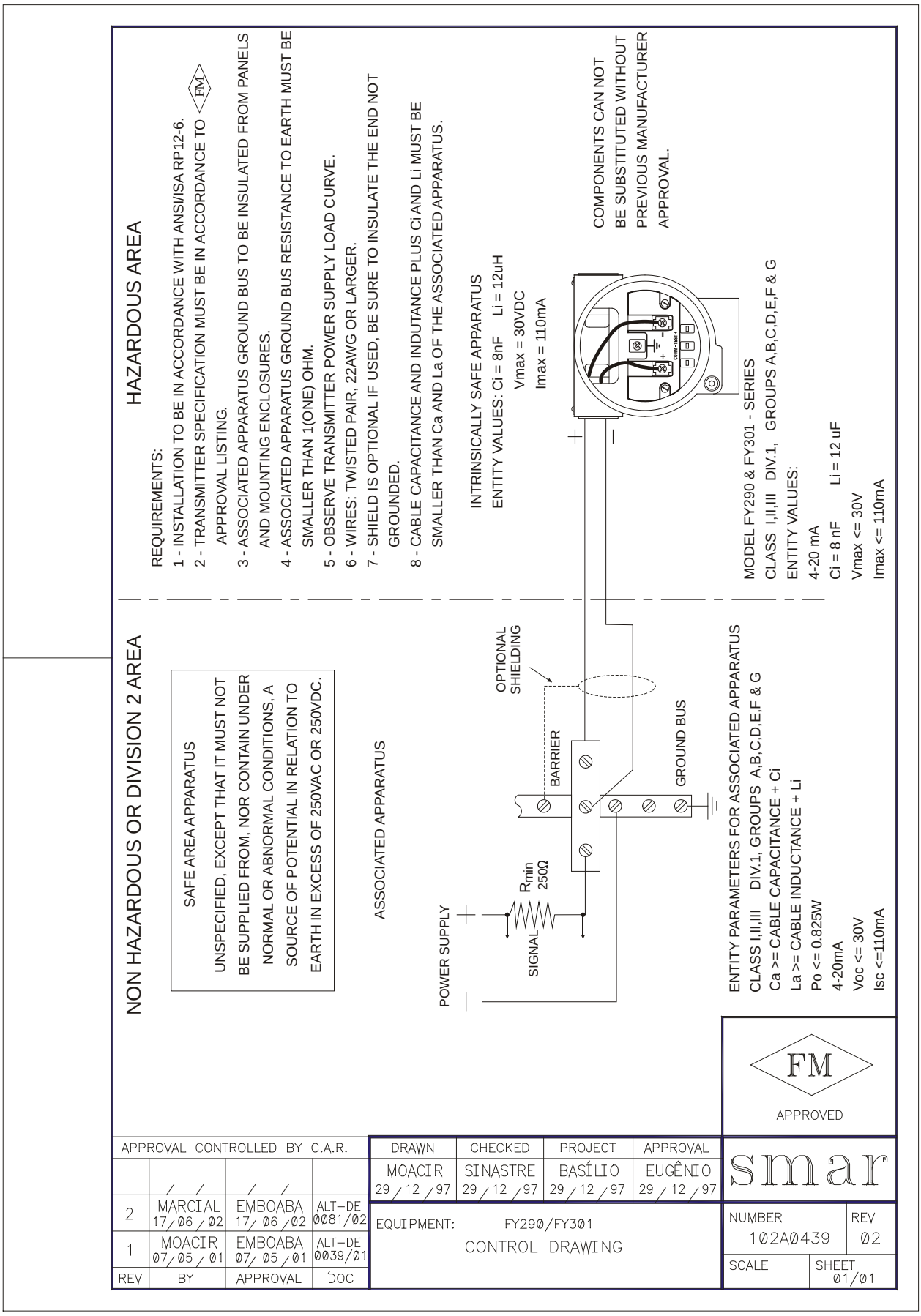
SPECIAL OPTIONS

CODE	Identification Plate
I1	FM: XP, IS, NI, DI
I3	CSA: XP, IS, NI, DI
I4	EXAM (DMT): Ex-ia; NEMKO: Ex-d
I5	CEPEL: Ex-d, Ex-ia
I6	Without certification
I7	EXAM (DMT): Ex-ia; NEMKO: Ex-d
IM	BDSR – GOST: Ex-d, Ex-ia

CODE	TAG Plate
J0	With tag plate
J1	Tag plate without inscription
J2	Plate according to notes
ZZ	With special characteristics

ACP301R	1	C	0	1	0	*	*

* Leave it blank for no optional items.


NON HAZARDOUS OR DIVISION 2 AREA
SAFE AREA APPARATUS
UNSPECIFIED, EXCEPT THAT IT MUST NOT BE SUPPLIED FROM, NOR CONTAIN UNDER NORMAL OR ABNORMAL CONDITIONS, A SOURCE OF POTENTIAL IN RELATION TO EARTH IN EXCESS OF 250VAC OR 250VDC.
ASSOCIATED APPARATUS
HAZARDOUS AREA
REQUIREMENTS:
1 - INSTALLATION TO BE IN ACCORDANCE WITH ANSI/ISA RP12-6.
2 - TRANSMITTER SPECIFICATION MUST BE IN ACCORDANCE TO APPROVAL LISTING.
3 - ASSOCIATED APPARATUS GROUND BUS TO BE INSULATED FROM PANELS AND MOUNTING ENCLOSURES.
4 - ASSOCIATED APPARATUS GROUND BUS RESISTANCE TO EARTH MUST BE SMALLER THAN 1(ONE) OHM.
5 - OBSERVE TRANSMITTER POWER SUPPLY LOAD CURVE.
6 - WIRES: TWISTED PAIR, 22AWG OR LARGER.
7 - SHIELD IS OPTIONAL IF USED, BE SURE TO INSULATE THE END NOT GROUNDED.
8 - CABLE CAPACITANCE AND INDUTANCE PLUS Ci AND Li MUST BE SMALLER THAN Ca AND La OF THE ASSOCIATED APPARATUS.
INTRINSICALLY SAFE APPARATUS
ENTITY VALUES: Ci = 8nF Li = 12uH
Vmax = 30VDC
Imax = 110mA
COMPONENTS CAN NOT BE SUBSTITUTED WITHOUT PREVIOUS MANUFACTURER APPROVAL.
MODEL FY290 & FY301 - SERIES
CLASS I,II,III DIV.1, GROUPS A,B,C,D,E,F & G
ENTITY VALUES:
4-20 mA
Ci = 8 nF Li = 12 uF
Vmax <= 30V
Imax <= 110mA
OPTIONAL SHIELDING
BARRIER
GROUND BUS
POWER SUPPLY
SIGNAL
Rmin 250Ω
ENTITY PARAMETERS FOR ASSOCIATED APPARATUS
CLASS I,II,III DIV.1, GROUPS A,B,C,D,E,F & G
Ca >= CABLE CAPACITANCE + Ci
La >= CABLE INDUCTANCE + Li
Po <= 0.825W
4-20mA
Voc <= 30V
Isc <=110mA
FM
APPROVED
APPROVAL CONTROLLED BY C.A.R.
REV | BY | APPROVAL | DOC
2 | MARCIAL 17/06/02 | EMBOABA 17/06/02 | ALT-DE 0081/02
1 | MOACIR 07/05/01 | EMBOABA 07/05/01 | ALT-DE 0039/01
DRAWN | CHECKED | PROJECT | APPROVAL
MOACIR 29/12/97 | SINASTRE 29/12/97 | BASÍLIO 29/12/97 | EUGÊNIO 29/12/97
EQUIPMENT: FY290/FY301
CONTROL DRAWING
smar
NUMBER 102A0439
REV 02
SCALE
SHEET 01/01

Appendix A

smar

SRF – Service Request Form

FY Positioner

GENERAL DATA

Model: FY290 ( ) Firmware Version: _____ FY301 ( ) Firmware Version: _____
FY302 ( ) Firmware Version: _____ FY303 ( ) Firmware Version: _____
FY400 ( ) Firmware Version: _____

Serial Number: _____ **Sensor Number:** _____

TAG: _____

Remote Position Sensor? Yes ( ) No ( )

Pressure Sensor? Yes ( ) No ( )

Action: Rotary ( ) Linear ( )

Travel: 15 mm ( ) 30 mm ( ) 50 mm ( ) 100 mm ( ) Other: _____ mm

Configuration: Magnetic Tool ( ) Palm ( ) Psion ( ) PC ( ) Software: _____ Version: _____

FINAL CONTROL ELEMENT DATA

Type: Valve + Actuator ( ) Pneumatic Cylinder (ACP) ( ) Other:_____

Size: _____

Travel: _____

Manufacturer: _____

Model: _____

AIR SUPPLY

Conditions: Dry and Clean ( ) Oil ( ) Water ( ) Other: _____

Work Pressure: 20 PSI ( ) 60 PSI ( ) 100 PSI ( ) Other: _____ PSI

PROCESS DATA

Hazardous Area Calssification Non-Classified ( ) Chemical ( ) Explosive ( ) Other: _____

Interference Types Vibration ( ) Temperature ( ) Eletromagnetic ( ) Others: _____

SITUATION DESCRIPTION

_____

_____

_____

_____

SERVICE SUGGESTION

Adjustment ( ) Cleaning ( ) Preventive Maintenance ( ) Update / Up-grade ( )

Other: _____

USER INFORMATION

Company: _____

Contact: _____

Title: _____

Section: _____

Phone: _____ _____ _____ _____ **Extension:**_____

E-mail: _____ **Date:** _____/ _____/ _____

For warranty or non-warranty repair, please contact your representative.
Further information about address and contacts can be found on www.smar.com/contactus.asp.

Returning Materials

Should it become necessary to return the ACP with positioner and/or configurator to SMAR, simply contact our office, informing the defective instrument serial number, and return it to our factory.

In order to speed up analysis and solution of the problem, the defective item should be returned with a description of the failure observed, with as much details as possible. Other information concerning the instrument operation, such as service and process conditions, is also helpful.

Instruments returned or to be revised outside the guarantee term should be accompanied by a purchase order or a quote request.

Appendix B

SMAR WARRANTY CERTIFICATE

1. SMAR guarantees its products for a period of 24 (twenty four) months, starting on the day of issuance of the invoice. The guarantee is valid regardless of the day that the product was installed.

2. SMAR products are guaranteed against any defect originating from manufacturing, mounting, whether of a material or manpower nature, provided that the technical analysis reveals the existence of a quality failure liable to be classified under the meaning of the word, duly verified by the technical team within the warranty terms.

3. Exceptions are proven cases of inappropriate use, wrong handling or lack of basic maintenance compliant to the equipment manual provisions. SMAR does not guarantee any defect or damage caused by an uncontrolled situation, including but not limited to negligence, user imprudence or negligence, natural forces, wars or civil unrest, accidents, inadequate transportation or packaging due to the user's responsibility, defects caused by fire, theft or stray shipment, improper electric voltage or power source connection, electric surges, violations, modifications not described on the instructions manual, and/or if the serial number was altered or removed, substitution of parts, adjustments or repairs carried out by non-authorized personnel; inappropriate product use and/or application that cause corrosion, risks or deformation on the product, damages on parts or components, inadequate cleaning with incompatible chemical products, solvent and abrasive products incompatible with construction materials, chemical or electrolytic influences, parts and components susceptible to decay from regular use, use of equipment beyond operational limits (temperature, humidity, etc.) according to the instructions manual. In addition, this Warranty Certificate excludes expenses with transportation, freight, insurance, all of which are the customer's responsibility.

4. For warranty or non-warranty repair, please contact your representative.

   Further information about address and contacts can be found on
   www.smar.com/contactus.asp

5. In cases needing technical assistance at the customer's facilities during the warranty period, the hours effectively worked will not be billed, although SMAR shall be reimbursed from the service technician's transportation, meals and lodging expenses, as well dismounting/mounting costs, if any.

6. The repair and/or substitution of defective parts do not extend, under any circumstance, the original warranty term, unless this extension is granted and communicated in writing by SMAR.

7. No Collaborator, Representative or any third party has the right, on SMAR's behalf, to grant warranty or assume some responsibility for SMAR products. If any warranty would be granted or assumed without SMAR's written consent, it will be declared void beforehand.

8. Cases of Extended Warranty acquisition must be negotiated with and documented by SMAR.

9. If necessary to return the equipment or product for repair or analysis, contact us.
   See item 4.

10. In cases of repair or analysis, the customer must fill out the Revision Requisition Form (FSR) included in the instructions manual, which contains details on the failure observed on the field, the circumstances it occurred, in addition to information on the installation site and process conditions. Equipments and products excluded from the warranty clauses must be approved by the client prior to the service execution.

11. In cases of repairs, the client shall be responsible for the proper product packaging and SMAR will not cover any damage occurred in shipment.

12. In cases of repairs under warranty, recall or outside warranty, the client is responsible for the correct packaging and packing and SMAR shall not cover any damage caused during transportation. Service expenses or any costs related to installing and uninstalling the product are the client´s sole responsibility and SMAR does not assume any accountability before the buyer.

13. It is the customer's responsibility to clean and decontaminate products and accessories prior to shipping them for repair, and SMAR and its dealer reserve themselves the right to refuse the service in cases not compliant to those conditions. It is the customer's responsibility to tell SMAR and its dealer when the product was utilized in applications that contaminate the equipment with harmful products during its handling and repair. Any other damages, consequences, indemnity claims, expenses and other costs caused by the lack of decontamination will be attributed to the client. Kindly, fill out the Declaration of Decontamination prior to shipping products to SMAR or its dealers, which can be accessed at www.smar.com/doc/declarationofcontamination.pdf and include in the packaging.

14. This warranty certificate is valid only when accompanying the purchase invoice.