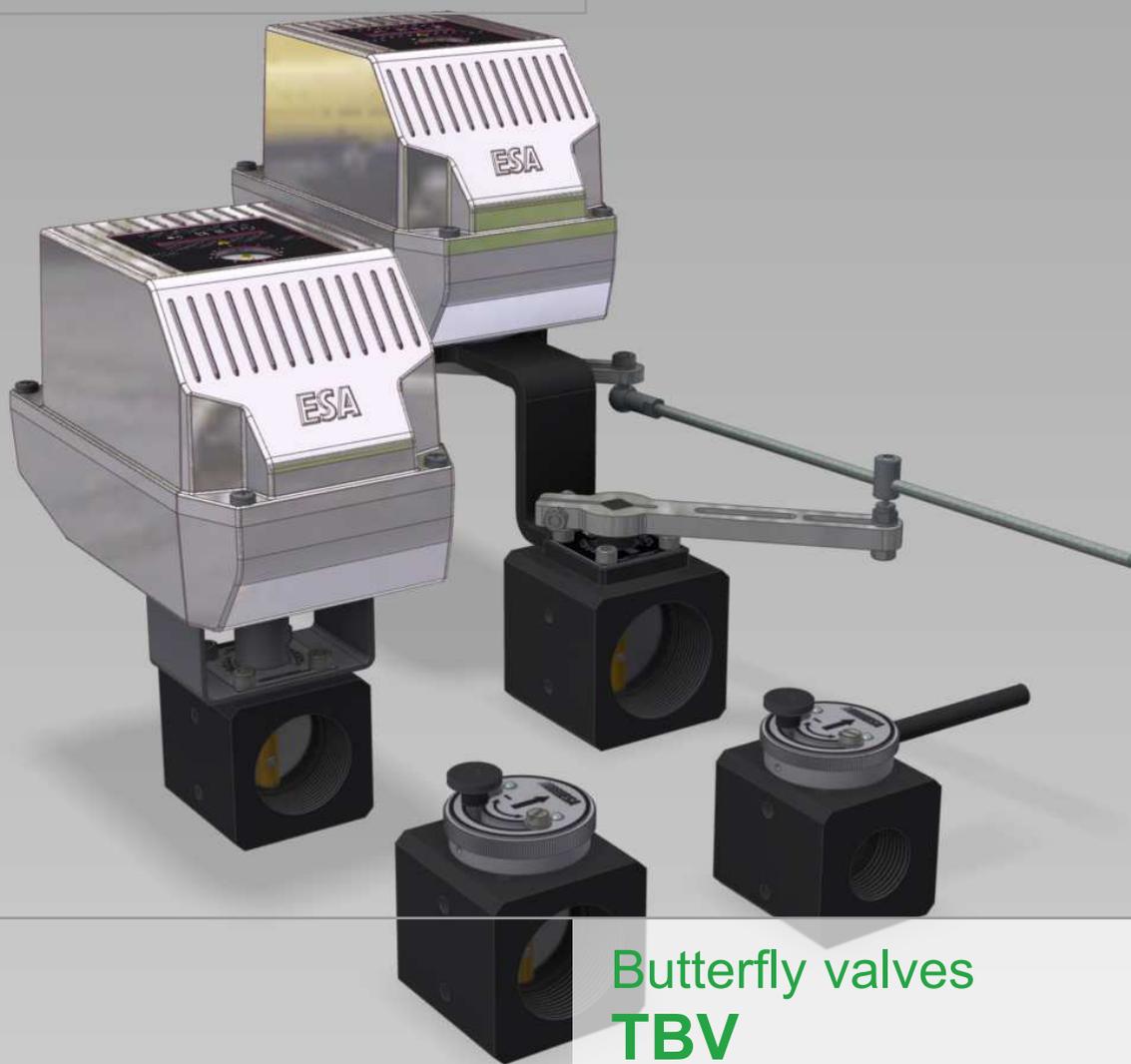


E1311 - E1312 rev.2.00 - 25/08/2020



Butterfly valves
TBV

GENERAL WARNINGS



- Each manual, including this one, is an integral part of the ESA catalog.
- Each manual may contain errors or give rise to interpretative doubts. ESA invites you to report any interpretative errors or doubts but will not be able to consider such occurrences as the cause of any disputes.
- This manual and all its parts (logos, texts, photos, tables, graphics, etc ...) cannot be reproduced or modified in whole or in part without the written consent of ESA.
- The technical information relating to the design, installation, regulation and operation of the combustion plant intended to host ESA products must be previously shared with ESA. Failing this, ESA declines all responsibility in relation to damage to things and people deriving from improper use of the products.
- In general, a combustion plant is not designed for oven drying refractories. In case of this use, ESA declines any responsibility in this regard.
- The performance of the products indicated in each manual is the result of tests conducted using ESA equipment at our Research and Development Center, under certain operating conditions. These performances cannot be guaranteed using other equipment or outside the aforementioned conditions.
- The design, installation, adjustment and operation of a combustion plant require compliance with all applicable safety standards and regulations. ESA declines any responsibility in relation to its products, if used in plants or in circumstances in which the regulations in force in the place of use are not respected.
- All installation, maintenance, ignition and calibration operations must be carried out by qualified personnel in compliance with all the points indicated in this manual. The indications given in this document do not exempt the customer/user from observing the general and specific legal provisions.
- All personnel responsible for checking and operating the device must be informed of the contents of this manual and must strictly follow its instructions. The operator must wear suitable clothing and PPE according to the legal requirements, respecting the general safety and risk prevention rules. If clarifications, additional information or training are required, contact the ESA sales offices.
- ESA reserves the right to modify the technical characteristics of the products by updating the relative manual at any time and without notice. By consulting the website **www.esapyronics.com** it is possible to download the manuals updated to the latest revision in Italian and English.

LOGISTICS AND DISPOSAL



- **Transport:** protect the equipment from shocks, vibrations, atmospheric agents, etc... Upon receipt of the product, check the labeling in accordance with the order and promptly notify any discrepancies and/or transport damage.
- **Storage:** store the product in a suitable place, according to the product specifications.
- **Packaging:** the material used must be disposed of according to local regulations.
- **Disposal:** comply with local legislation on this matter.

CERTIFICATIONS



CE according to Annex II No. 1B of the Machinery Directive **2006/42/EC**: the valve implemented is considered a partly completed machine, for which the declaration of incorporation is available.



EAC for the Eurasian market (Russia, Belarus and Kazakhstan).

- ESA adopts the Quality System certified by DNV GL in compliance with the **UNI EN ISO 9001** standard.
- ESA adopts the Code of Ethics and Behavior pursuant to Legislative Decree **231/01**.
- ESA products are designed, manufactured and controlled in compliance with the Directives/Regulations, in particular **UNI EN 746-2** "Industrial thermal process equipment - Part 2: Safety requirements for combustion and for the handling and treatment of fuels" harmonized with the Machinery Directive **2006/42/EC**.

DESCRIPTION

The TBV series identifies non-sealed butterfly valves designed to quickly and accurately regulate air or fume flow rates in low pressure ducts. They are available in different configurations, manual or automatic. The TBV series valves are divided into three models:

- TBV-M: composed of a valve body and a manual control lever complete with locking device for opening in several positions.
- TBV-D: the valve is connected directly to an electric or pneumatic actuator.
- TBV-L: the valve is connected to an actuator mounted on a spacer plate by means of a system of levers that allow precise adjustment. The "L" version is highly recommended for hot air.

CHARACTERISTICS

Technical features

Fluids:	Non-aggressive gases according to EN437, hot air and flue gases.
Maximum working pressure:	450 [mbar] @ 60 [°C] 200 [mbar] @ 250 [°C] 180 [°WC] @ 140 [°F] 80 [°WC] @ 482 [°F]
Maximum fluid temperature:	250 [°C] 482 [°F]
Operating temperature:	-20 ÷ +60 [°C] -4 ÷ +140 [°F]
Storage temperature:	0 ÷ +25 [°C] 32 ÷ 77 [°F]
Leakage with closed valve:	about 2% (metal seal models on request)
Available sizes:	from Rp 3/4" to Rp 2" according to ISO 7/1, NPT thread on request
Rotation angle:	0-90°
Valve body base connection:	ISO5211 (F.05/F.07)

Construction features

Valve body:	AVP
Lens holder shaft:	OT58
Valve disc:	AISI304 optionally AISI316
Hand-operated handwheel:	Aluminum (M version)
Actuator support plate:	AISI304
Actuator coupling rod:	Aluminum
Valve control lever:	AISI304+Fe360 galvanized
Shaft seal:	"O" ring (special seals on request)

Electric motorizations

Coupling with valve:	direct (D) or with levers (L)
Off/min/max management:	ESA SERIO TPF E7301
3-point floating management:	ESA SERIO FLT E7302
Proportional management:	ESA SERIO PRP E7303

Pneumatic motorizations

Coupling with valve:	direct (D)
Valve control type:	ON/OFF or proportional
Pilot air pressure:	see specific documentation
Pilot air filtration degree:	see specific documentation

GALLERY



TBV-M manual

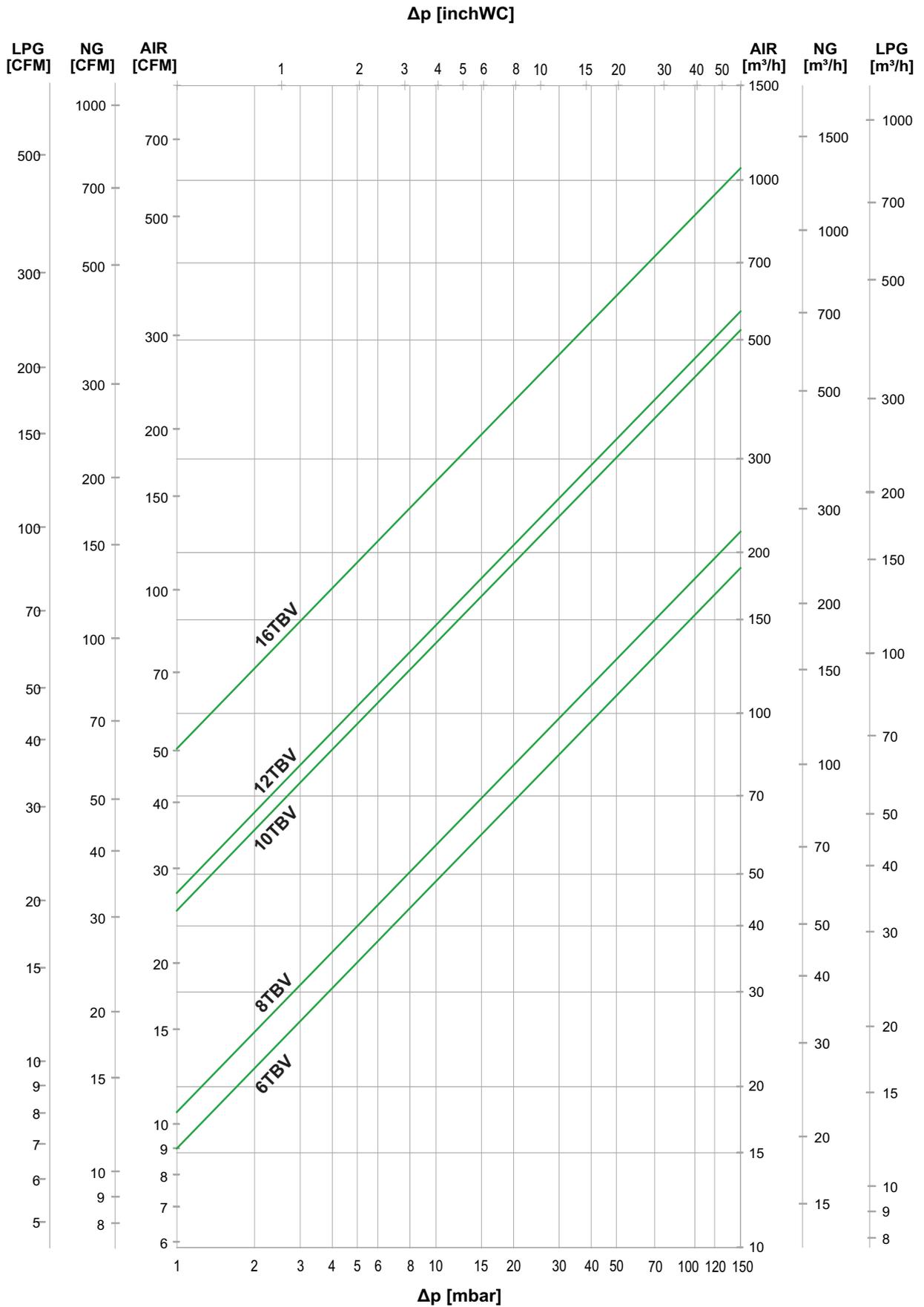


TBV-D direct connection



TBV-L connection with levers

FLOW CHART FULLY OPEN VALVE

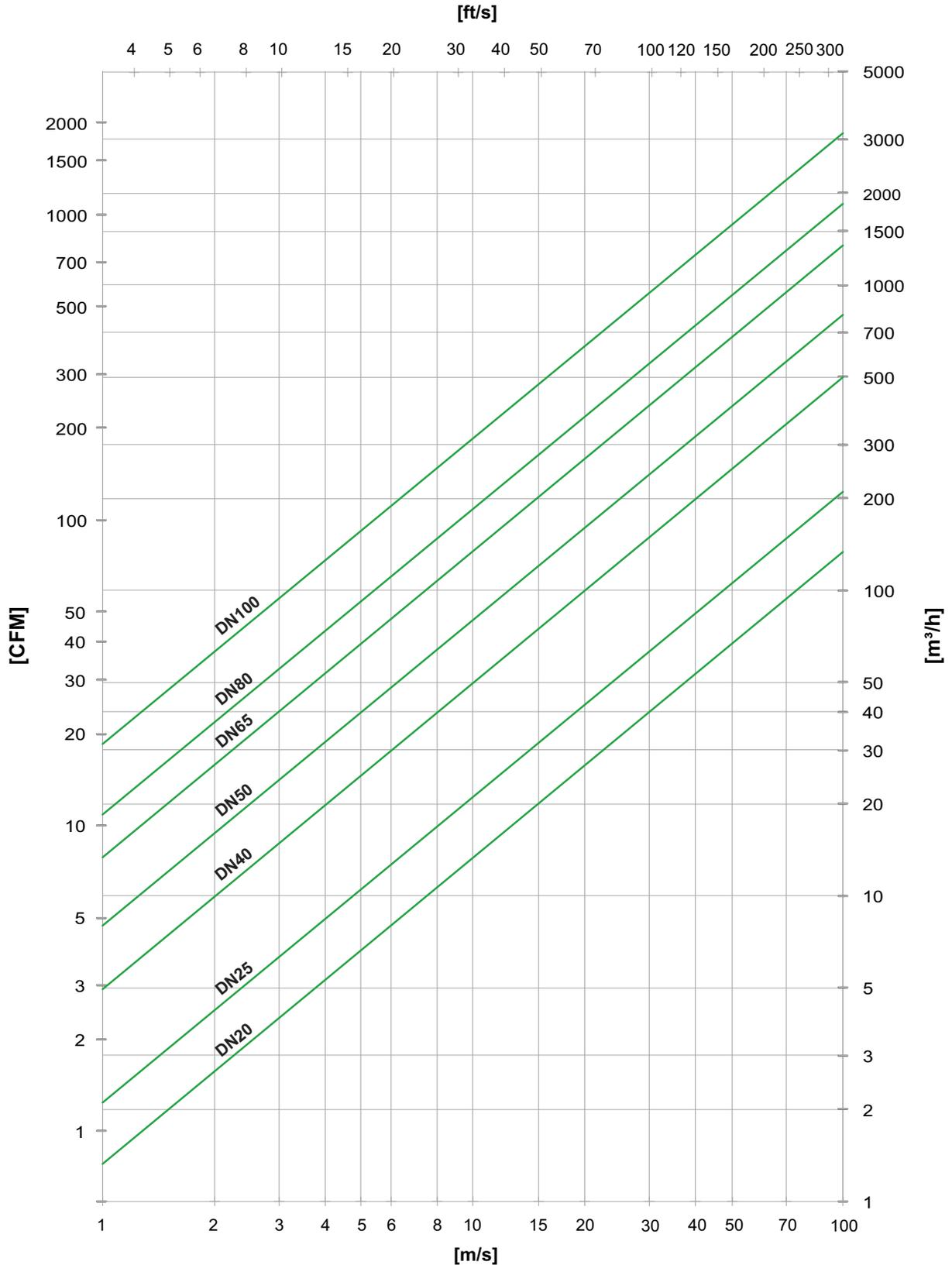


T=0 [°C] e P_s=1013 [mbar]

G1311-12101

VELOCITY GRAPH

To correctly size noise and pressure drops, the maximum recommended speed of the flow inside a pipe must be limited to 30 [m/s] or 5920 [ft/min] (ESA recommends <20 [m/s] or 3950 [ft/min]). The velocities are calculated taking into account carbon steel pipes according to the standard EN 10255 Medium Series. Different pipe thickness will correspondingly result in different flow rates.



G1311-12I01

CALCULATION OF THE FLOW OF A GAS OTHER THAN AIR

The flow rate diagram refers to the three main fluids used in applications relating to combustion plants (air, natural gas and LPG).

To calculate the valve flow rate, related to a gas other than those listed above, starting from the air flow rate resulting from the graph, the following formula can be used:

$$Q_{\text{gas}} = \sqrt{\frac{1.2928}{\rho_{\text{gas}}}} * Q_{\text{air}}$$

T= 0 [°C] e P_s 1013 [mbar]

knowing the density of the gas whose flow rate is to be calculated. Typical densities of some common gases can be found below:

Gas type	ρ _{gas} @0 [°C] [Kg/m ³]	MM molecular mass [-]
Air	1.2928	28.96
Natural gas	0.78	18.2
LPG (95% propane)	2.01	45.50
Nitrogen	1.25	28.01
BFG (60% N ₂ , 24% CO, 12% CO ₂ , 4% H ₂)	1.29	28.89
COG (50% H ₂ 30% CH ₄ 3% C _n H _m 7% CO 3% CO ₂ 7% N ₂)	0.553	12.39
CO ₂	1.976	44.01
Exhausted from NG (3% O ₂)	1.243	27.85
Exhausted from LPG (3% O ₂)	1.271	28.47

EG.1

To calculate the flow rate of a 16TBV valve at 10 [mbar] of Δp, used for natural gas, the air flow rate is obtained on the graph (specifically, about 280 [m³/h]).

Using the above formula:

$$Q_{\text{gas}} = \sqrt{\frac{1.2928}{0.78}} * 280 = 360 \text{ [m}^3\text{/h]}$$

This simplified formula calculates a volumetric flow rate in [m³/h]; to have a reference in [Nm³/h] the following parameters must be taken into consideration:

- P_{in} input pressure
- Fluid temperature
- Altitude of the application (this value changes the P_{atm})

The following exercise explains the conversion process between [m³/h] and [Nm³/h].

EG.2

To calculate the flow rate of a 16TBV valve at 10 [mbar] of Δp with an inlet pressure of 80 [mbar], used for preheated air at T_{ref}=250 [°C], obtain the air flow on the graph in [m³/h]:

$$Q_{\text{air}} [0 \text{ } ^\circ\text{C}] = 1450 \text{ [m}^3\text{/h]}$$

Now it is necessary to transform [m³/h] into [Nm³/h], using the following procedure.

Obtain the density of the gas at the operating temperature and pressure with the following formula:

$$\rho_{\text{air}} [250 \text{ } ^\circ\text{C}] = \frac{P_{\text{atm}} + P_{\text{in}}}{\left(\frac{8314}{\text{MM}}\right) * T \text{ [} ^\circ\text{K]}}$$

CALCULATION OF THE FLOW OF A GAS OTHER THAN AIR

where is it:

- P_{atm} atmospheric pressure at a given altitude.
- P_{in} pressure at the valve inlet.
- MM molecular mass of the gas used.
- T temperature in degrees Kelvin of the gas.

which, with the project data it results:

$$\rho_{air [250\text{ }^{\circ}\text{C}]} = \frac{101325 + 8000}{\left(\frac{8314}{28.96}\right) * 523.15} = 0.687 \text{ [kg/m}^3\text{]}$$

Now we calculate the flow rate with the following formula:

$$Q_{[Nm^3/h]} = \frac{\rho_{air [250\text{ }^{\circ}\text{C}]}}{\rho_{air [0\text{ }^{\circ}\text{C}]}} * Q_{[m^3/h]}$$

Which with the project data results:

$$Q_{[Nm^3/h]} = \frac{0.687}{1.2928} * 280 = 148.8 \text{ [Nm}^3\text{/h]}$$

Select the size of a valve starting from a plant data with flow rate in $[Nm^3/h]$, the reverse procedure is carried out, obtaining the density at a given temperature and using the inverse formula compared with to the previous one:

$$Q_{[m^3/h]} = \frac{\rho_{gas\ 0\text{ }[^{\circ}\text{C}]}}{\rho_{gas\ Tref}} * Q_{[Nm^3/h]}$$

VALVE SIZING

If the valve has the shut-off function:

- select the diameter of the pipe according to the maximum speed to be respected ($<20[m/s]$)
- select the same size of the valve (ex. for a DN100 pipe the shut-off valve will be a 32EBV).

If the valve has a flow control function:

- selected the diameter of the pipe according to the maximum speed to be respected ($<20[m/s]$).
- considering that, for optimal valve regulation, the Δp must be approximately 25÷30% of the valve inlet pressure ($a = \Delta p/p_1 = 0.25\div 0.30$) and that the pressure downstream of the valve p_2 is a known variable, calculate the Δp of the valve according to the following formula:

$$\Delta p_{100\%} = \frac{a * p_2}{(1 - a)}$$

EG. Select an air valve with $p_2=45[mbar]$ and flow rate $V=100[Nm^3/h]$. In order not to exceed the recommended flow rate, DN50 pipes can be used.

The pressure drop will be:

$$\Delta p_{100\%} = \frac{0.3 * 45[mbar]}{(1 - 0.3)} = 19.3[mbar]$$

From the diagram of the TBV valves it appears that the valve that guarantees the required flow rate is DN32. Given the diameter of the pipes, the valve will be installed in the pipe with two reductions DN50xDN32.

The inlet pressure to the pipeline must therefore be:

$$p_1 = \Delta p_{100\%} + p_2 = 64.3[mbar]$$

This data, added to other line pressure losses possibly present upstream of the valve, will be used for the correct sizing of the combustion fan.

WARNINGS

The TBV series valves are regulating and not safety devices, the tightness is guaranteed only for leaks towards the outside, they are not suitable for the interception of fuels and are not part of the protection system according to EN746-2.

Any modification or repair carried out by unauthorized personnel compromises the safety of the application and automatically invalidates the general warranty conditions. For correct use, observe the following warnings.



- Make sure that all system features are compatible with the valve specifications: hydraulic connections, type of fluid, operating pressure, flow rate, temperature range, voltage, etc ...
- Avoid excessive amounts of sealant in case of threaded connections, which could enter the valve.
- Before proceeding with any installation or service operation, close the upstream air / gas flow and disconnect the power supply.
- If the valve is equipped with an actuator, respect the "Warnings" specified in the technical documentation of the same.
- If the valve accidentally falls, it can suffer permanent damage; in this case it is mandatory to replace the equipment.
- Avoid water hammer.
- Any dirt chips, welding residues or sealing materials must not come into contact with the internal parts of the valve.
- It is good practice to install a filter upstream of the supply piping.
- Do not damage the sealing surfaces of the flanges.



- To avoid the risk of burns and electrocution, the operator must not come into contact with electrical devices.
- Operate on the actuator and on the connected devices only in the absence of power supply.
- Check that the utilities do not have an absorption higher than the maximum capacity of the limit switch contacts or of the feedback signal.
- In order not to damage the electric actuator, do not manually rotate the shaft, do not force its movement by acting on the lever or use tools.

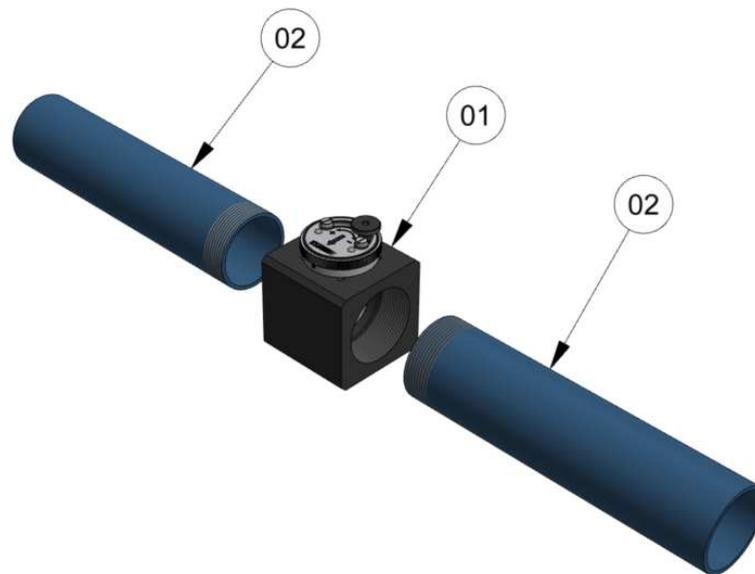


- In insulated pipes, check that there is sufficient space for tightening the bolts.
- Do not insulate the butterfly valve with thermal insulation.
- To improve heat dissipation, rotate the butterfly valve during assembly so that the actuator or handle are positioned to the side of the pipe.
- In case of media temperature > 250[°C] 482 [°F], insert heat sink plates.
- Check the thermal resistance of the gaskets.



- Work on the actuator and on the connected devices paying attention, for the EBV-L versions, to the movement of the return levers between the valve shaft and the servomotor.

TBV-M / TBV-D / TBV-L INSTALLATION



D1311-12I01

The TBV series valves are equipped with threaded connections.

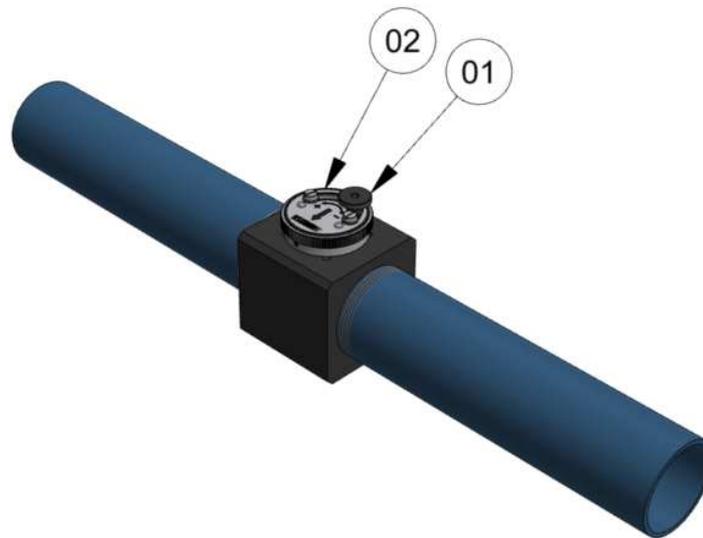
The valve can be installed in a horizontal or vertical position, but not upside down, respecting a straight section of upstream and downstream piping of at least 2xDN.

Maintain a distance from the surrounding obstructions that allows free air circulation and proper maintenance. In the case of installing contiguous valves, check that there is no interference between the levers during their movement.

For the installation of TBV-D or TBV-L valves, also refer to the technical documentation of the actuator.

- A** Check that the valve (**pos. 01**) is completely closed, otherwise it cannot be inserted / extracted from the piping.
- B** Check the correct alignment of the pipes (**pos. 02**) and the spacing between the flanges, in order to avoid exerting tension on the pipes during the tightening phase.
- C** Make sure that no foreign bodies are present inside the valve or in the piping before carrying out the assembly.
- D** Screw the valve to the threaded pipes (**pos. 02**) using thread sealing paste.
- E** After assembly, check the correct opening and closing movement of the valve and its moving parts before starting the flow in the pipeline.
- F** The external seal of the valve and its gaskets must be carried out through a functional test at a test pressure 1.1 times the working pressure.
- G** In case of installation on pipes with preheated air, rotate the valve during assembly so that the actuator or the handle are on the side of the pipe for better heat dissipation.
- H** In insulated pipes, provide adequate space for assembly and disassembly.

TBV-M ADJUSTMENT AND CALIBRATION



D1311-12102

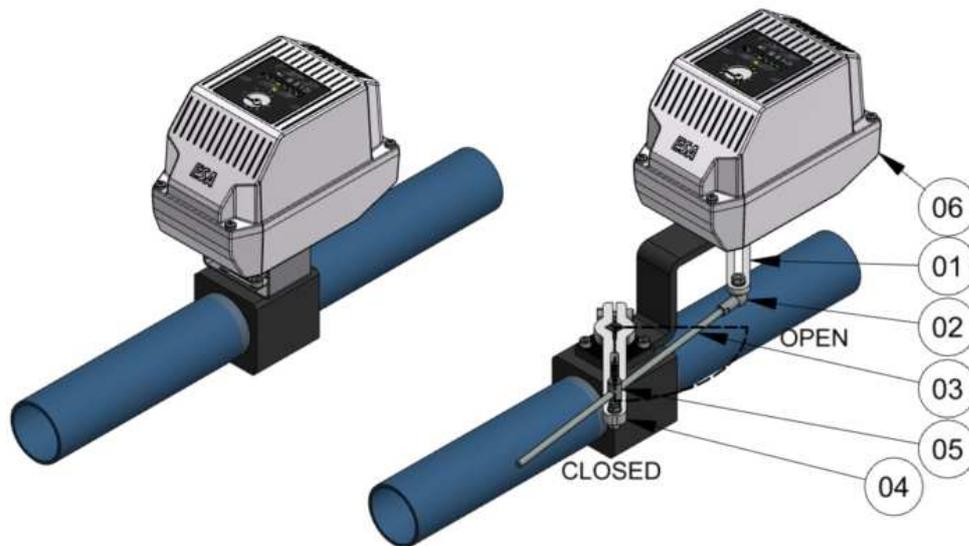
To calibrate the TBV-M manual valves, use the indications on the graduated plate under the handwheel as references.

During the adjustment phase, monitor the pressure and flow rate parameters of the pipeline using suitable instruments (calibrated flanges, differential pressure gauges, etc ...).

The rotation angle of the valve is 90°: when the arrow on the handwheel is perpendicular to the pipeline the valve is CLOSED, when it is in the longitudinal position the valve is OPEN.

- A** Loosen the locking ring nut (**pos. 01**).
- B** Turn the handwheel (**pos. 02**) to the desired position.
- C** Once the adjustment position has been reached, screw the ring nut (**pos. 01**) until the valve locks. Check that the handwheel cannot move.
- D** If several valves are adjusted on the outlets of the same duct, check that the previously performed calibrations have not undergone any changes, otherwise carry out the adjustment again.

ADJUSTMENT AND CALIBRATION TBV-D & TBV-L



D1311-12103

TBV-D & TBV-L valves are supplied with a preliminary calibration with $0 \pm 90^\circ$ adjustment. During the adjustment phase, monitor the pressure and flow rate parameters of the pipeline using suitable instruments (calibrated flanges, differential pressure gauges, etc...).

- The TBV-D are adjusted by acting on the actuator stroke, referring to the technical documentation of the same.
- The TBV-L are calibrated by acting on the levers and return joints: acting on the stroke of the actuator, in particular in the floating and proportional versions, would reduce its accuracy. If there is an ESA SERIO servomotor, proceed as follows:

- A** Open the actuator cover to access the local control station. Activate the "Manual" mode using the specific selector, disabling the remote control.
- B** Command the actuator to close, so that the valve closes completely.
- C** Loosen the rod locking dowel located on the joint (**pos. 04**). Adjust the minimum opening by sliding the rod (**pos. 03**) into the joint and move the valve using the slotted lever (**pos. 05**), until the required flow rate is reached. At the end, tighten the set screw.
- D** Command the actuator so that the valve opens completely.
- Check the flow rate between minimum and maximum opening: if the maximum flow rate is reached before the actuator reaches full opening, the valve stroke must be reduced, otherwise it must be increased. The goal can be achieved in two ways:
 - E** - bring the joint (**pos. 02**) close to the actuator pin (**pos. 06**), making it slide into the slotted lever (**pos. 01**).
 - remove the joint (**pos. 04**) from the pin by sliding it into the slotted lever (**pos. 05**).
- F** Carry out the minimum opening adjustment again as described in point **C**.
- G** Check the new regulation by repeating the operations indicated between points **D** and **E** until the required flow regulation is obtained.
- H** Activate the "automatic" mode using the specific selector, checking that the commands from the control system are consistent with the movement of the actuator.
- I** At the end, close the lid, checking the correct positioning of the gasket and making sure that the electrical conductors do not remain pressed between the lid and the base.
- L** It is recommended to mark the locking positions of the joints on the levers: this maintains the set setting in case of replacement of the actuator.

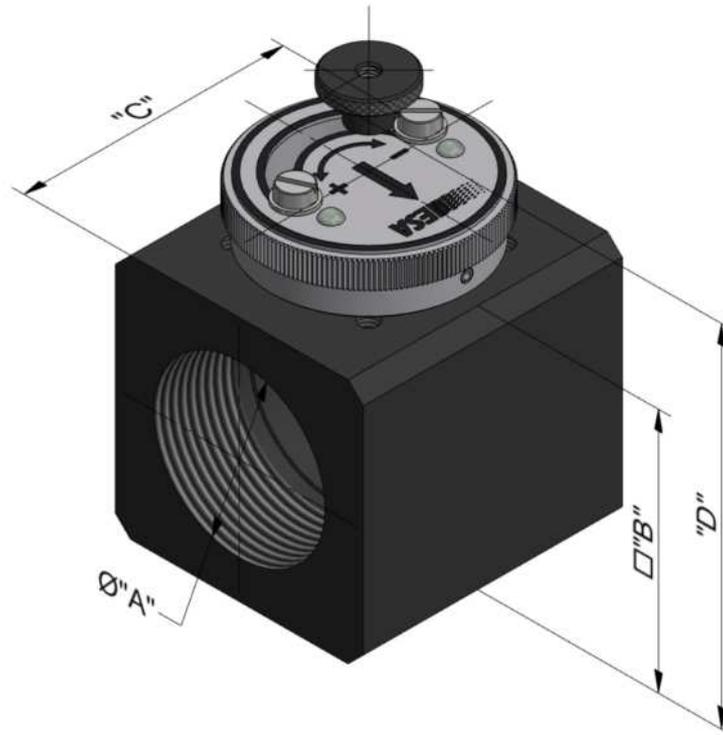
MAINTENANCE

All maintenance operations, due to the short times and working conditions in which they can be carried out, imply a greater risk of errors and accidents and must therefore be carried out after careful and in-depth analysis of the risks for the operators and for the process, making sure all necessary precautions are in place.

Operation	Frequency [months]	Note
Integrity of gaskets	12	Check that there are no leaks to the outside with adequate leak detection liquids. In case of replacement, follow the instructions given in the INSTALLATION paragraph.
Bolt tightening	12	6 months in vibration applications.
Valve movement	6	Check that the valve rotates without friction, lubricate if necessary.
Valve calibration	12	Check the pressure and flow rate parameters of the pipeline using suitable instruments (calibrated flanges, differential pressure gauges, etc...). If necessary, repeat the calibration operations.
Butterfly valve maintenance	12	Check the condition of the internal elements, clean with a clean cloth and compressed air, taking care not to damage the internal parts.

Component	Useful life [years]	Command cycles
Valve seal control systems	10	250.000
Pressure switches	10	N/A
Burner control device	10	250.000
UV flame sensor / electrodes	10.000 operating hours	
Gas regulators	10	N/A
Solenoid valves	10	250.000
Relief valve	10	N/A
Regulation valve	10	N/A
Regulators	10	N/A
Servomotors	10	N/A

TBV-M OVERALL DIMENSIONS

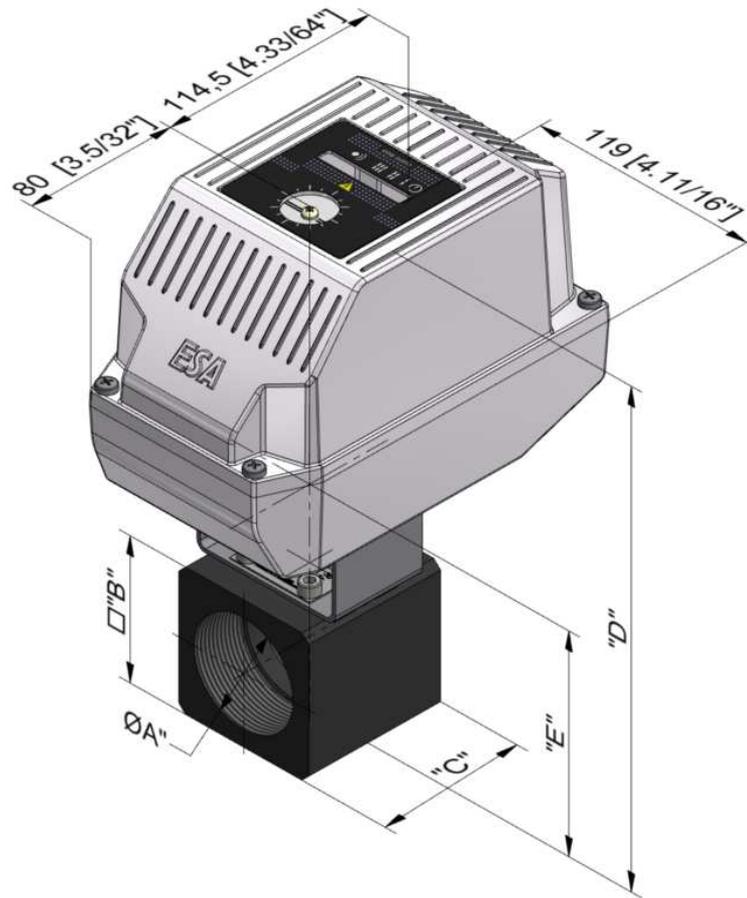


D1311-12I04

Model	DN "A" (*)	Ø "B"		"C"		"D"		Mass	
		[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[Kg]	[lbs]
6TBV	Rp 3/4"	60	2.23/64	68	2.43/64	88	3.15/32	1.8	3.9
8TBV	Rp 1"	60	2.23/64	68	2.43/64	88	3.15/32	1.7	3.7
10TBV	Rp 1.1/4"	65	2.9/16	68	2.43/64	93	3.21/32	1.7	3.7
12TBV	Rp 1.1/2"	65	2.9/16	68	2.43/64	93	3.21/32	1.6	3.5
16TBV	Rp 2"	75	2.61/64	76	2.63/64	103	4.1/16	2.0	4.4

(*) NPT thread on request

TBV-D OVERALL DIMENSIONS ELECTRIC ACTUATOR ESA SERIO

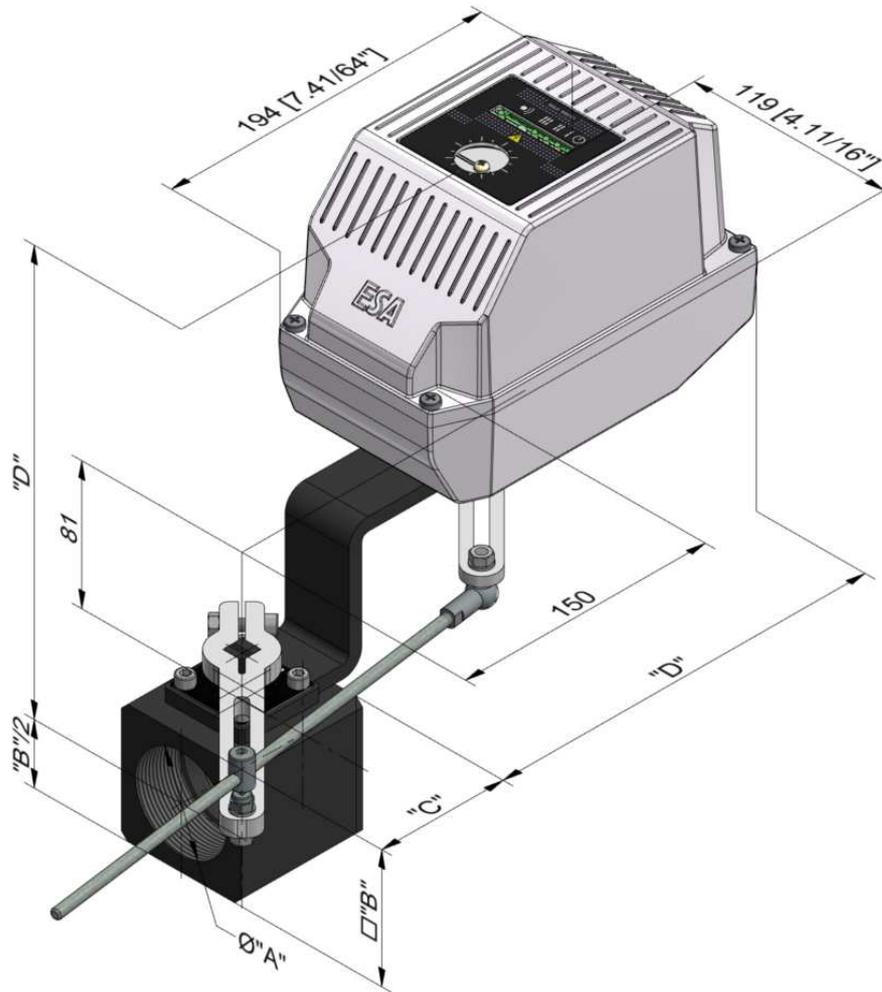


D1311-12105

Model	DN "A" (*)	Ø "B"		"C"		"D"		"E"		Mass	
		[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[Kg]	[lbs]
6TBV	Rp 3/4"	60	2.23/64	68	2.43/64	243	9.9/16	100	3.15/16	4.0	8.8
8TBV	Rp 1"	60	2.23/64	68	2.43/64	243	9.9/16	100	3.15/16	4.0	8.8
10TBV	Rp 1.1/4"	65	2.9/16	68	2.43/64	248	9.49/64	105	4.9/64	4.0	8.8
12TBV	Rp 1.1/2"	65	2.9/16	68	2.43/64	248	9.49/64	105	4.9/64	4.0	8.8
16TBV	Rp 2"	75	2.61/64	76	2.63/64	258	10.5/32	115	4.17/32	4.3	9.5

(*) NPT thread on request

TBV-L OVERALL DIMENSIONS ELECTRIC ACTUATOR ESA SERIO



D1311-12106

Model	DN "A" (*)	Ø "B"		"C"		"D"		"E"		Mass	
		[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[Kg]	[lbs]
6TBV	Rp 3/4"	60	2.23/64	68	2.43/64	253	9.69/64	265	10.7/16	4.8	10.5
8TBV	Rp 1"	60	2.23/64	68	2.43/64	253	9.69/64	265	10.7/16	4.7	10.3
10TBV	Rp 1.1/4"	65	2.9/16	68	2.43/64	256	10.5/64	265	10.7/16	4.5	9.9
12TBV	Rp 1.1/2"	65	2.9/16	68	2.43/64	256	10.5/64	265	10.7/16	4.5	9.9
16TBV	Rp 2"	75	2.61/64	76	2.63/64	261	10.9/32	265	10.7/16	5.0	11.0

(*) NPT thread on request

ORDERING CODE

 - TBV - - - - - -

01 02 03 04 05 06

VALVE DIMENSIONS cod. 01

Rp 3/4"	6
Rp 1"	8
Rp 1.1/4"	10
Rp 1.1/2"	12
Rp 2"	16

04 VALVE CONNECTION cod.

BSP thread	B
NPT thread	N

VALVE CONTROL cod. 02

Manual lever	M
Direct coupling actuator	D
Actuator coupled with levers	L

05 ACTUATOR cod.

ESA SERIO off/min/max	TPF
ESA SERIO floating	FLT
ESA SERIO proportional	PRP
Pneumatic actuator	CPAP
Special actuator	...

VALVE VERSION cod. 03

Standard	LT
Special	...

06 ACTUATOR PARAMETERS cod.

ESA SERIO-TPF see E7301	...
ESA SERIO-FLT see E7302	...
ESA SERIO-PRP see E7303	...
CPAP actuator OFF/ON (*)	DPF
CPAP actuator proportional with positioner (**)	...

Note

(*) The code must be completed with the voltage of the actuator control solenoid valve.

(**) The code must be completed with the model of the positioner.

ESA contacts



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