ESA PYRONICS INTERNATIONAL
SIAD Group

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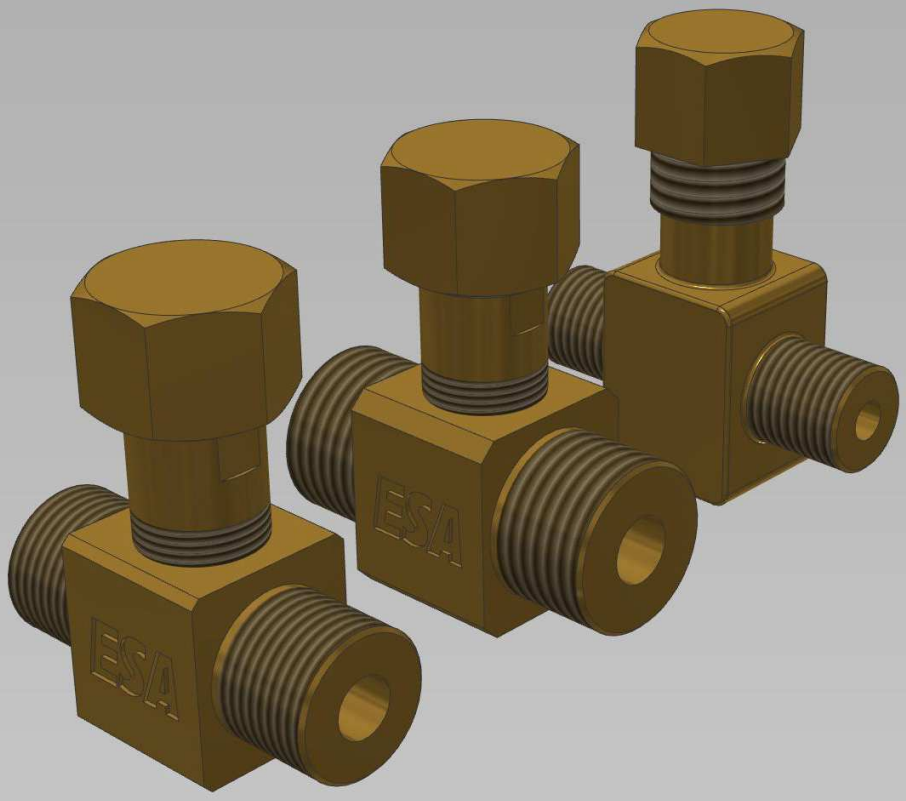

Micrometric valves
TO-M

www.esapyronics.com

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- 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.
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- 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

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 TO-M series identifies non-sealing manual micrometric valves designed to quickly and accurately regulate gas and air flow rates in low pressure ducts. They are available in different configurations, with threaded connections (according to ISO 7/1).

CHARACTERISTICS

Technical features

Fluids:	Non-aggressive gases according to EN437 (standard execution) and hot air and flue gases (special execution)
Maximum working pressure:	3000 [mbar] @ 60 [°C] 1000 [mbar] @ 180 [°C] *1180 ["WC] @ 140 [°F] 395 ["WC] @ 356 [°F]*
Maximum fluid temperature:	60 [°C] *140 [°F]* in standard execution 180 [°C] *356 [°F]* in special execution
Operating temperature:	-20 ÷ +60 [°C] *-4 ÷ +140 [°F]*
Storage temperature:	0 ÷ +25 [°C] *32 ÷ 77 [°F]*
Leakage with closed valve:	less than 0.5%
Available sizes:	from 1/4 "to 1/2" (according to ISO 7/1), NPT thread on request
Type of regulation	Micrometric screwdriver type manual

Construction features

Valve body:	OT58
Adjusting piston:	OT58
End cap:	OT58
Estate:	NBR O-RING (special seals on request)

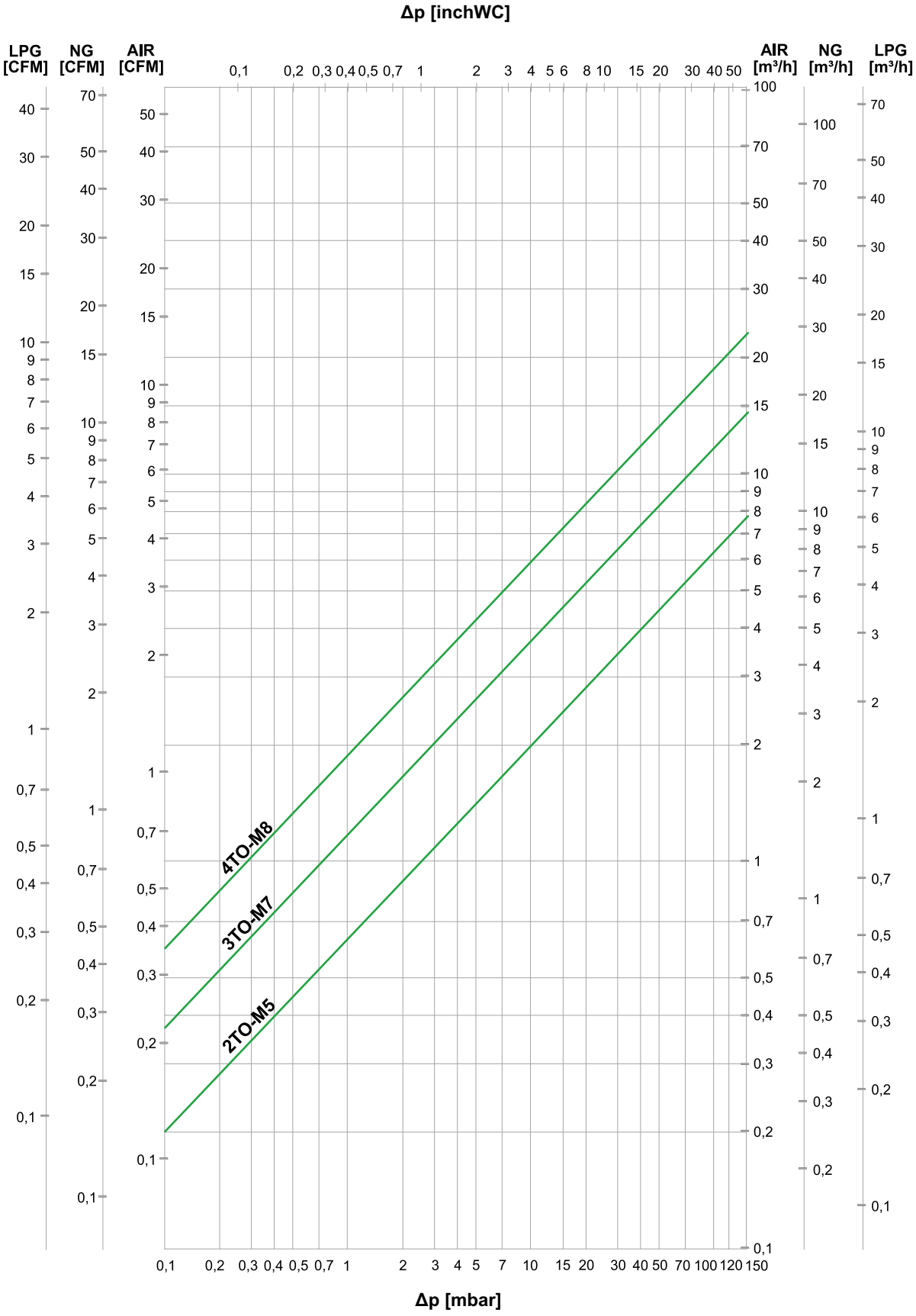
GALLERY

TO-M

TO-M

TO-M

FLOW CHART FULLY OPEN VALVE



T=0 [°C] e Ps=1013 [mbar]

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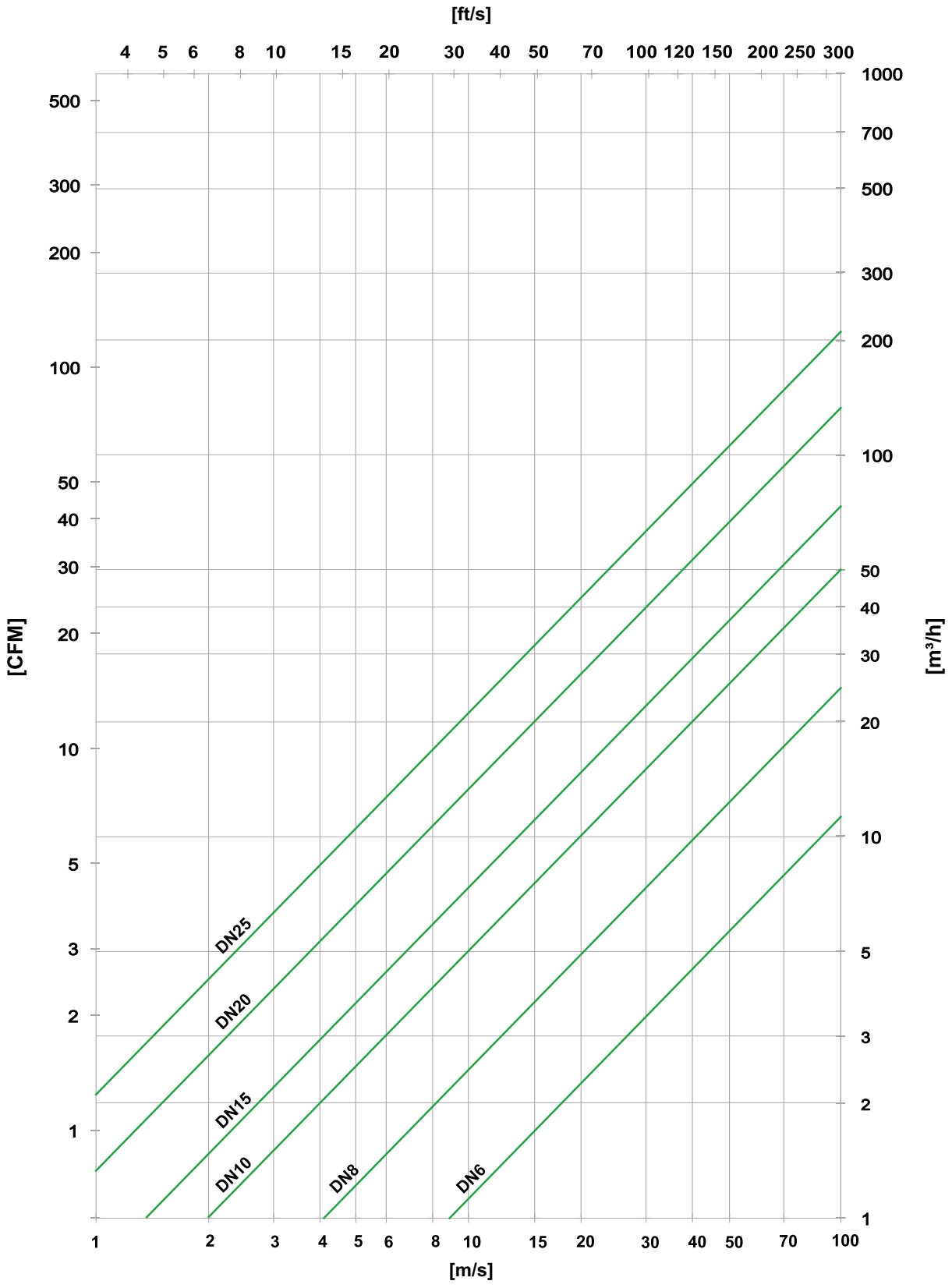
VELOCITY GRAPH

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.



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

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

T= 0 [°C] e Ps 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/m³]	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_nH_m 7% CO 3% CO_2 7% N_2)	0.553	12.39
CO_2	1.976	44.01
Exhausted by NG (3% O_2)	1.243	27.85
Exhausted by LPG (3% O_2)	1.271	28.47

EG.1
To calculate the flow rate of a 4TO-M8 valve at 10 [mbar] of Δp, used for natural gas, the air flow rate is obtained on the graph (specifically, it reads about 6 [m³/h]).

Using the above formula:

$$Q_{gas} = \sqrt{\frac{1.2928}{0.78}} * 6 = 7.7\ [m^3/h]$$

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 4TO-M8 valve at 10 [mbar] of Δp with an inlet pressure of 80 [mbar], used for preheated air at T_{ref}=80 [°C], the air flow rate is obtained on the graph in [m³/h]:

$$Q_{air}\ 0\ [°C] = 6\ [m^3/h]$$

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

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

$$\rho_{N_2}\ [80\ °C] = \frac{P_{atm} + P_{in}}{\left(\frac{8314}{MM}\right) * T\ [°K]}$$

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:

$$\rho_{N_2}[80\ °C] = \frac{101325 + 8000}{\left(\frac{8314}{28.01}\right) * (80 + 273.15)} = 1.04\ [kg/m^3]$$

Now we calculate the flow rate with the following formula:

$$Q_{[Nm^3/h]} = \frac{\rho_{N_2}[80\ °C]}{\rho_{air}\ [0\ °C\ ]} * Q_{\ [m^3/h]}$$

Which with the project data results:

$$Q_{\ [Nm^3/h]} = \frac{1.04}{1.2928} * 6 = 4.82\ [Nm^3/h]$$

To select the size of a valve starting from a plant data with flow rate in [Nm³/h], the reverse procedure is carried out, obtaining the density at a given temperature and using the inverse formula with compared with to the previous one:

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

VALVE SIZING

To size the valve correctly, proceed as follows:

- select 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 15÷20% of the valve inlet pressure (a = $\Delta p/p_1$ = 0.15÷0.20) and that the pressure downstream of the valve p_2 s 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=10 [Nm³/h]. In order not to exceed the recommended flow rate, DN20 pipes can be used.
The pressure drop will be:

$$\Delta p_{100\%} = \frac{0.2 * 45[mbar]}{(1 - 0.2)} = 11.25[mbar]$$

From the diagram of the TO valves it appears that the valve that guarantees the required flow rate is DN25 (8TO). If the size of the piping does not correspond to that of the valve, use reducing fittings.

The inlet pressure to the pipeline must therefore be:

$$p_1 = \Delta p_{100\%} + p_2 = 45 + 11.25 = 56.25[mbar]$$

This data, added to other pressure drops in the line that may be present upstream of the valve, will be used for the correct sizing of the inlet pressure to the supply line.

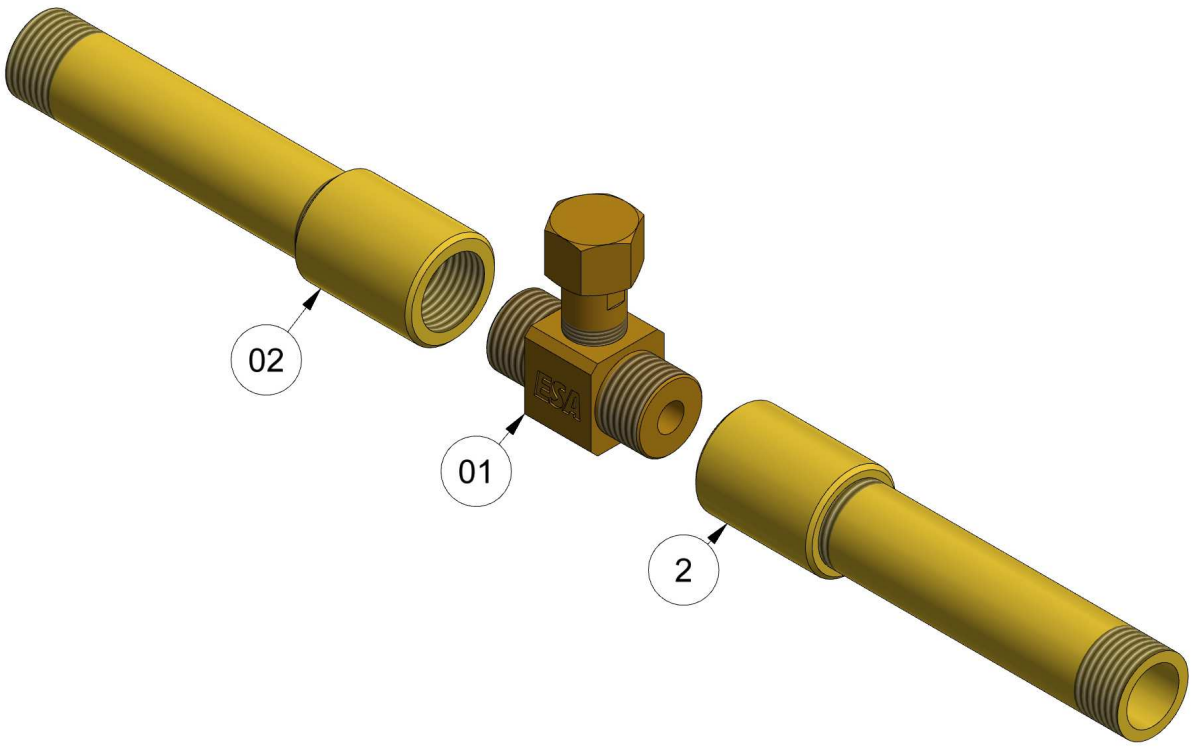
WARNINGS

The TO-M series valves are regulating and not safety devices, the tightness is guaranteed only for leaks towards the outside, they are not suitable for 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, etc...
- Avoid excessive amounts of sealant on 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 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 threads.

- Do not insulate the valve with thermal insulation.

INSTALLATION TO-M



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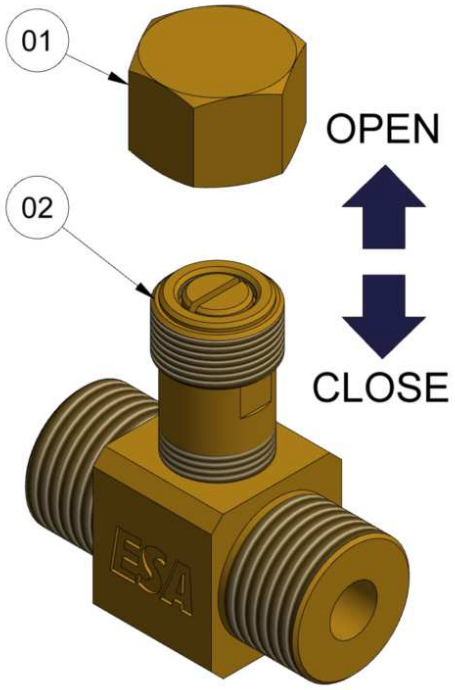
The TO-M series valves have threaded connections according to ISO 7/1, use sealing pastes suitable for the type of application.
The valve can be installed horizontally or vertically, respecting a straight section of upstream and downstream piping of at least 2xDN.
Maintain a distance from the surrounding obstructions that allows the correct adjustment of the micrometric screw, free circulation of air and proper maintenance.

A	Connect the pipes (**pos.02**) to the micrometric valve using thread sealing paste, taking care not to introduce excess sealant inside the valve.
B	Check the correct alignment of the pipes (**pos.02**), in order to avoid exerting tension on the pipes during the tightening phase.
C	Make sure that no foreign body is present inside the valve (**pos.01**) or in the pipes (**pos.02**) before carrying out the assembly.
D	Do not screw the valve on the pipe by levering the adjustment stem.
E	After assembly, check the correct opening and closing movement of the valve and return the adjustment screw to the closed position.
F	The correct installation and sealing of the valve and its gaskets towards the outside must be performed through a functional test at a test pressure 1.1 times the working pressure.

REGULATION AND SETTING TO-M



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To calibrate the TO-M valves, use a flat screwdriver by acting on the adjustment screw located inside the valve body.
During the adjustment phase, monitor the pressure and flow rate parameters of the pipeline using suitable instruments (calibrated flanges, differential pressure gauges, etc...).

A	Remove the protection cap (**pos.01**) on the valve body.
B	Turn the adjustment screw (**pos.02**) to the desired position. To open the valve, act counterclockwise, to close the valve, act clockwise.
C	Put the protection cap (**pos.01**) back on the valve body.
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.

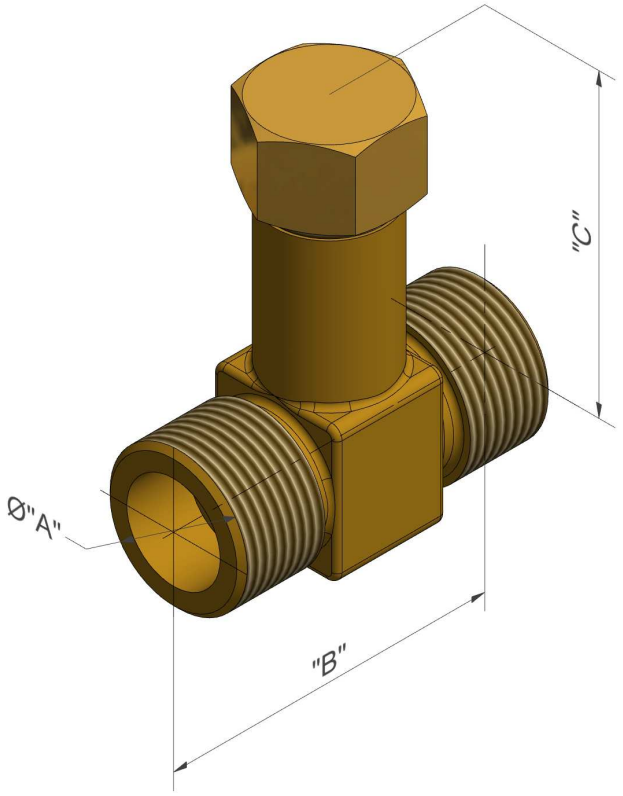
MANUTENZIONE

All maintenance operations, due to the short time and working conditions in which they can be carried out, involve 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
Tightness integrity	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.
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.
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
Regolation valve	10	N/A
Regulators	10	N/A
Servomotors	10	N/A

OVERALL DIMENSIONS TO-M



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Model	Ø "A" (*)	"B"		"C"		Mass	
		[mm]	[inch]	[mm]	[inch]	[Kg]	[lbs]
2TO-M5	R. 1/4"	46	*1.13/16*	40	*1.37/64*	0.1	*0.22*
3TO-M7	R. 3/8"	46	*1.13/16*	39	*1.17/32*	0.11	*0.24*
4TO-M8	R. 1/2"	46	*1.13/16*	40	*1.37/64*	0.12	*0.26*

(*) NPT thread on request

ORDERING CODE

01	TO-M	-	02

VALVE DIMENSIONS	cod. 01
1/4”	**2**
3/8”	**3**
1/2”	**4**

02 VALVE PASSAGE	cod.
5 mm (only for 2TO)	**5**
7 mm (only for 3TO)	**7**
8 mm (only for 4TO)	**8**

ESA contacts

The information contained herein is offered for use by technically qualified personnel at their discretion and risk without warranty of any kind.

We regularly update our data, for updated data please visit our web site www.esapyronics.com

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