ESA PYRONICS INTERNATIONAL
SIAD Group

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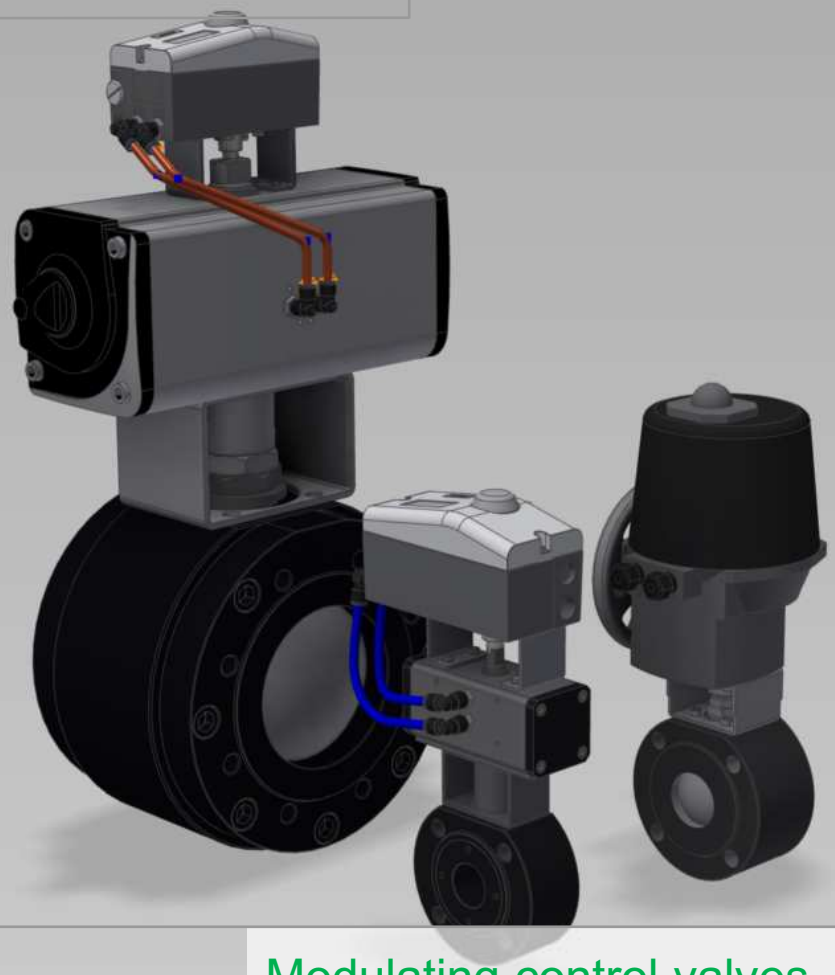


Modulating control valves

VL-2R-HP

www.esapyronics.com

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 VL-2R-HP series identifies a series of valves suitable for regulating the flow rates of fluids in both high and low pressure ducts. They are used for regulating the flow of fuels and combustion agents well as for their partialization.

FEATURES

Technical features

Fluids:	Non aggressive gases according to EN437
Maximum working pressure:	16 [bar] @ 25 [°C] *232 [psi] @ 77 [°F]*
Maximum fluid temperature:	60 [°C] *140 [°F]*
Operating temperature:	-20 ÷ +60 [°C] *-4 ÷ +140 [°F]*
Storage temperature:	0 ÷ +25 [°C] *32 ÷ 77 [°F]*
Leakage with closed valve:	< 0.1%
Available sizes:	DN15 PN16 to DN120 PN16 on ISO 7005 flange
Rotation angle:	0-90°
Valve body base connection:	Lug Type - Flanged

Construction features

Valve body:	Acciaio al carbonio / AISI 316
Ball:	AISI 316
Thigtness:	TFM 1600
Actuator support plate:	AISI 316
Actuator coupling shaft:	AISI 316

Electric motorizations

Coupling with valve:	Direct (D)
Valve control type:	3-point / proportional float

Pneumatic actuation

Coupling with valve:	Direct (D)
Valve control type:	Proportional
Pilot air pressure:	See specific documentation
Pilot air filtration degree:	See specific documentation

Accessories

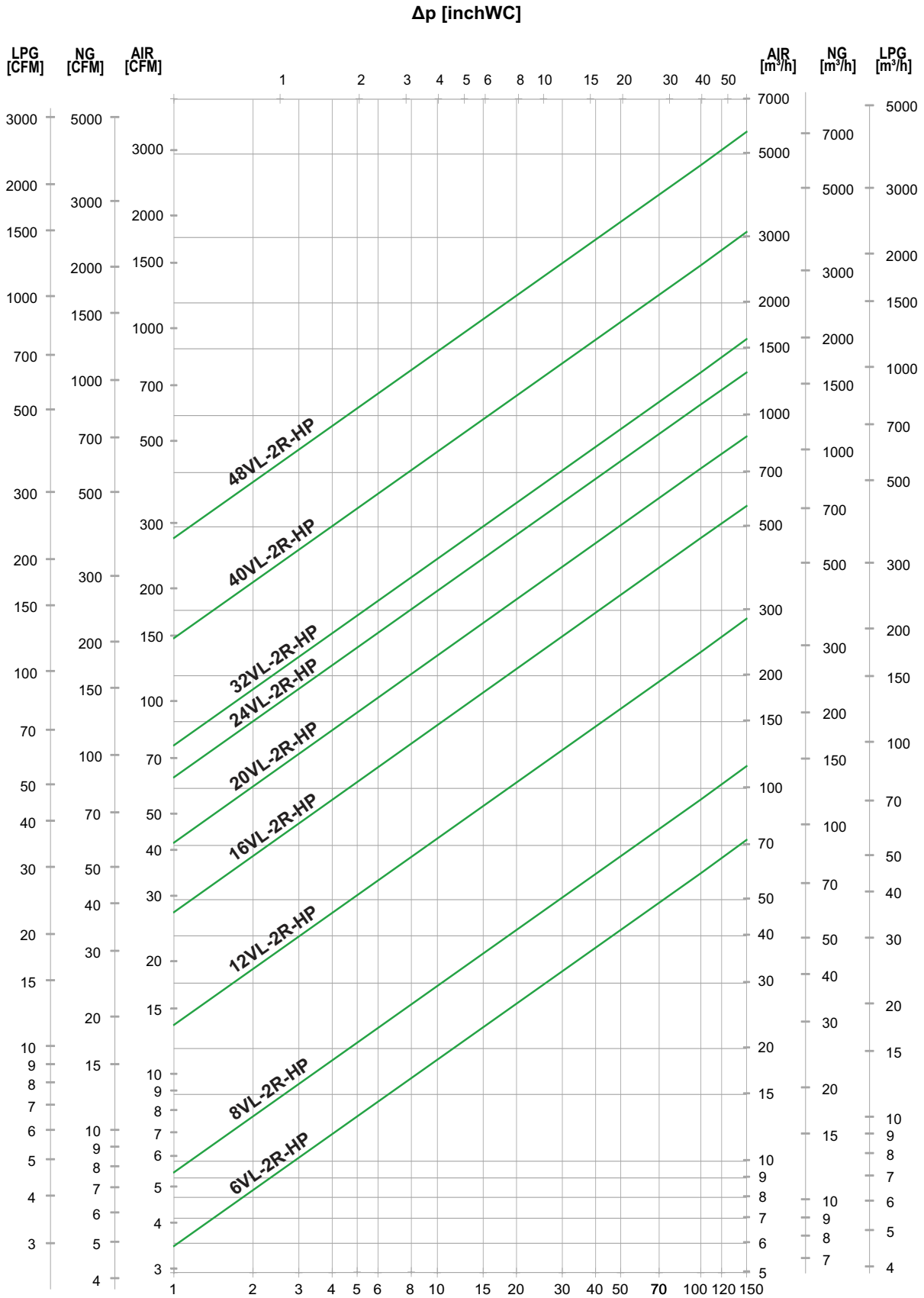
Connection flange:	ISO 7005 PN16
Gaskets:	EN 1514-1 AFM-34 / PTFE
Pneumatic actuator:	Positioner with analog feedback

GALLERY

VL-2R-HP-CMAP

VL-2R-HP-CPAP

FLOW CHART FULLY OPEN VALVE



T=0 [°C] e Ps=1013 [mbar]

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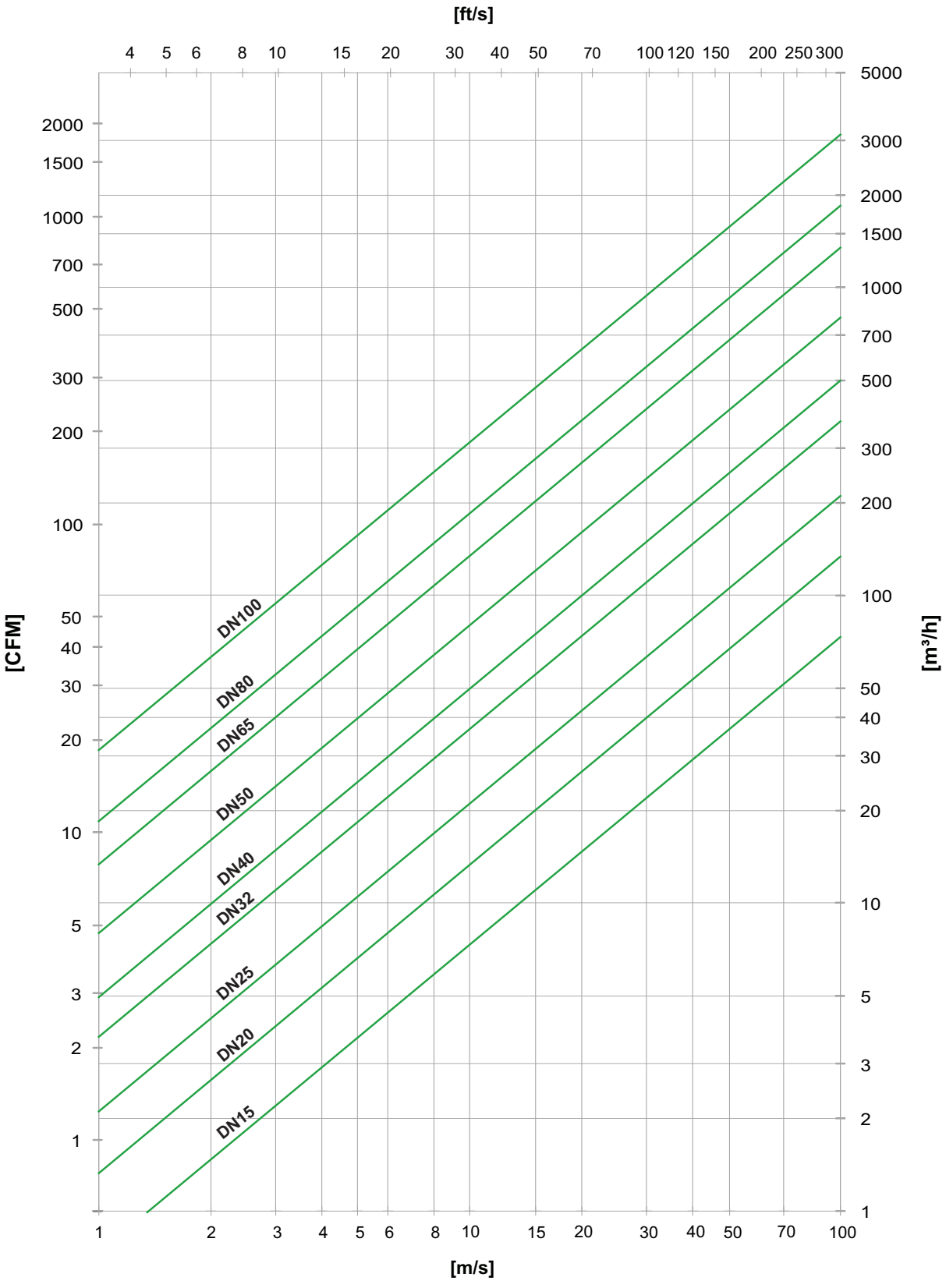
VELOCITY CHARTS

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 950 [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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FLOW CALCULATION 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, for a gas other than those listed above, starting fromair 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] and 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 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 16VL-2R-HP valve at a Δp of 10 [mbar], for natural gas, the air flow rate is obtained on the graph (specifically, it reads about 150 [m³/h]).

Using the previous formula and we get:

$$Q_{gas} = \sqrt{\frac{1.2928}{0.78}} * 150 = 193\ [m^3/h]$$

This formula allows us to calculate the volumetric flow rate in [m³/h]; to obtain the flow rate in [Nm³/h] the following parameters must be considered:
- P_{in} Inlet pressure
- Fluid temperature
- Altitude of the application (in this case the P_{atm} changes)

See the following year for the calculation of the flow rate in [Nm³/h].

EG.2
We calculate the flow rate of a 16VL-2R-HP valve with a Δp of 10 [mbar] and an inlet pressure of 80 [mbar], which is used for air at a Tref=40 [°C].
We find the air flow on the graph in [m³/h].

$$Q_{air}\ 0\ [°C] = 150\ [m^3/h]$$

It is now necessary to transform the flow rate from [m³/h] into [Nm³/h], with the following procedure.

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

$$\rho_{air}\ [40\ °C] = \frac{P_{atm} + P_{in}}{\left(\frac{8314}{MM}\right) * T\ [°K]}$$

FLOW CALCULATION 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.

with the project data you get:

$$\rho_{air}\,[40\,°C] = \frac{101325 + 8000}{\left(\frac{8314}{28.96}\right) * 323.15} = 1.171\ [kg/m^3]$$

Proceed with the calculation of the flow rate with the following formula:

$$Q_{[Nm^3/h]} = \frac{\rho_{air}\,[40\,°C]}{\rho_{air}\,[0\,°C]} * Q_{[m^3/h]}$$

By entering the project data we get:

$$Q_{[Nm^3/h]} = \frac{1.171}{1.2928} * 150 = 135.9\ [m^3/h]$$

Select the correct size of a valve starting from a system datum with flow rate in [Nm³/h], if you perform the inverse procedure, obtaining the density at a given temperature and using the inverse formula of the previous one:

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

VALVE SIZING

Since the valve has a flow regulation function:

- 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 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 [Nm³/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 VL-2R-HP valves it appears that the valve that guarantees the required flow rate is DN50. Given the diameter of the pipes, the valve will be installed in the pipe without reductions.The inlet pressure to the pipeline must therefore be:

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

Any pressure drops in the line upstream of the valve must be added to this data. This data will be used for the correct sizing of the combustion fan.

WARNINGS

The VL-2R-HP 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 performed by unauthorized personnel compromises the safety of the application and automatically invalidates the general warranty conditions.For correct use, observe the following warnings.

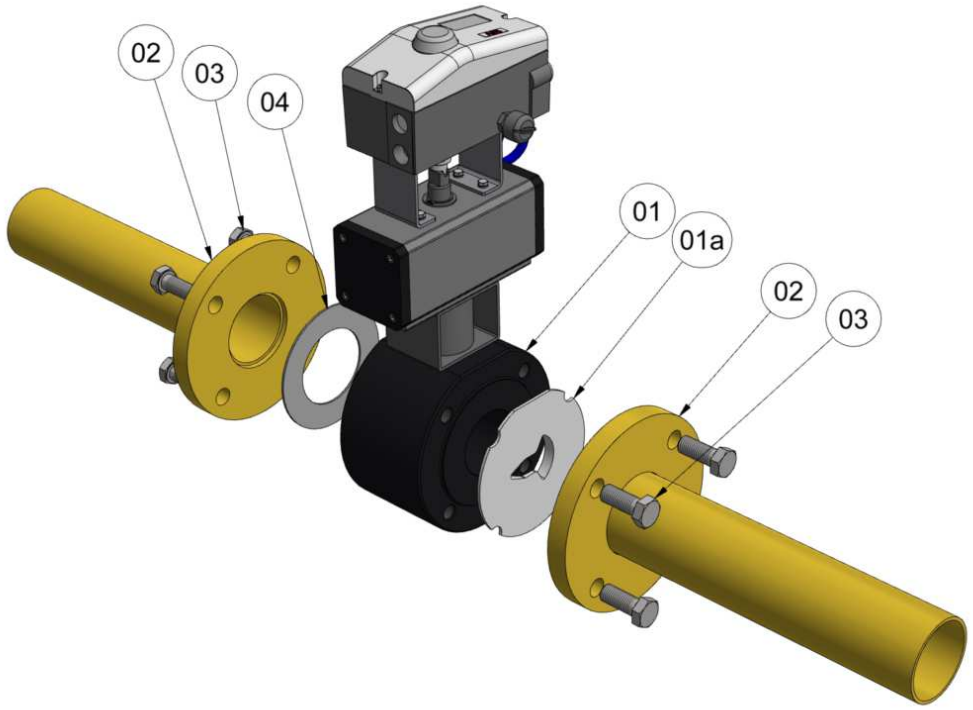
- Make sure that all the system features are compatible with the valve specifications: hydraulic connections, type of fluid, operating pressure, flow rate, temperature range, voltage, etc ... Before proceeding with any installation or service operation, close the air / gas flow upstream and disconnect the power supply.
- Before proceeding with any installation or service operation, close the upstream air / gas flow and disconnect the power supply.
- Respect the “Warnings” specified in the technical documentation of the actuators mounted on the valve.
- 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.
- The valves of the VL-2R-HP series are supplied without coupling flanges and gaskets; make sure to supply flanges and gaskets suitable for the application.
- 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, let alone force its movement by acting on the lever or using tools.

- The valve must be installed correctly to prevent any kind of accidental / unwanted heat transmission to the operator.
- In insulated pipes, check that there is sufficient space for tightening the bolts.
- In case of passage of heated fluids check the thermal resistance of the gaskets.

In case of valve or actuator malfunction, follow the instructions in this manual in the "MAINTENANCE" chapter or contact the ESA PYRONICS assistance service.

VL-2R-HP INSTALLATION



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The valves of the VL-2R-HP series are supplied without coupling flanges and gaskets. The flanges and gaskets to be applied must be suitable for the type of valve and application. However, replacement is recommended after each disassembly operation. Any chips, dirt or sealing materials must not come into contact with the internal parts of the valve.
The valve (**pos. 01**) can be installed in any position. Check with the documentation of the selected actuator for any limitations on positioning. Keep a distance from the surrounding obstructions so that free circulation of air is allowed.
A straight section of piping upstream and downstream of the valve of at least 2xDN is recommended check that the valve is installed correctly before starting the flow in the pipeline.

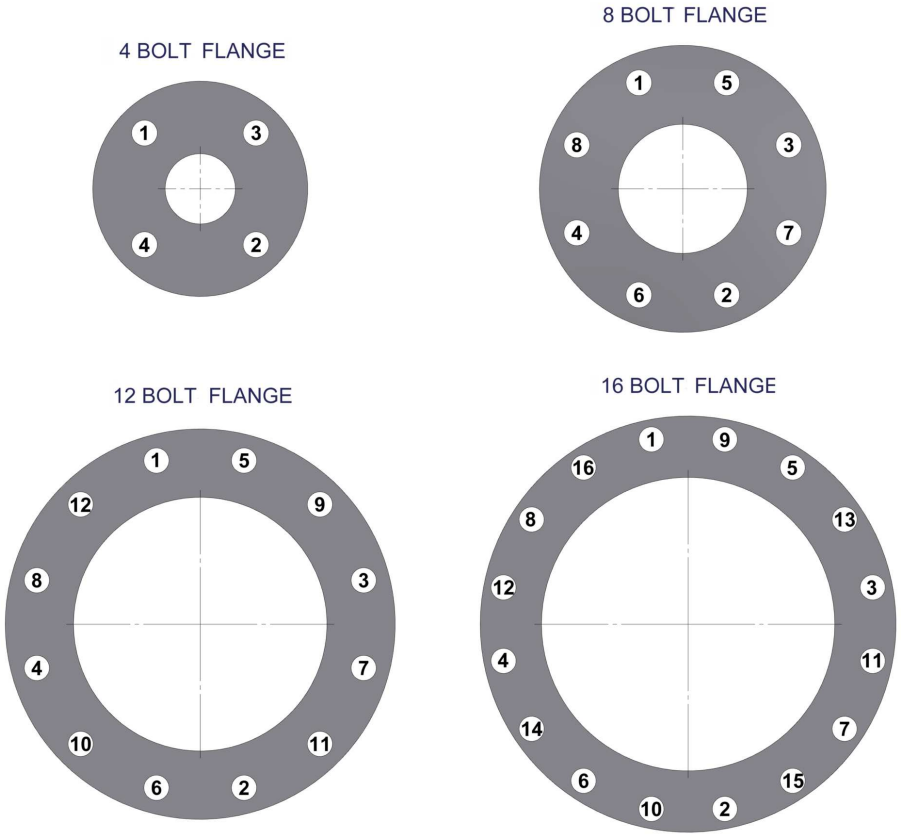
A	Check the correct alignment of the connection pipes and verify the correct distance between the pipes and the assembly (flanges/gaskets/valve body), in order to avoid exerting tension on the pipes during the tightening phase.
B	Weld the flanges (**pos. 02**) at the ends of the pipes, eliminating any welding burrs.
C	Make sure that there are no foreign bodies inside the valve or in the pipes before assembling, if necessary remove impurities.
D	Insert the bolts (**pos.05**) in the fixing holes of one of the two flanges (**pos.02**) and position the valve and the first gasket (**pos.04**); then fit the remaining nuts (**pos.03**), washers (**pos.06**) and gasket (**pos.04**).
E	Using suitable tools, progressively screw the bolts crosswise, avoiding excessive tightening as indicated in the appropriate paragraph "screw tightening sequence on the flanges".
F	After assembly, check the correct opening and closing movement of the valve and its moving parts.
G	In insulated pipes, provide adequate space for mounting the valve fastening bolts.
H	For the electrical and/or pneumatic connection of the actuators, refer to the technical documentation of the actuator used.

SEQUENCE OF SCREWS TIGHTENING ON ATTACHMENT FLANGES

Tighten the bolts and nuts in a crisscross pattern, using a minimum of three tightening passes and maximum bolt stress as defined in the tables below.

STEP 1: Torque up to a maximum of 30% of the final torque value according to the torque sequence. Make sure the gasket is compressed evenly.
STEP 2: Torque up to a maximum of 60% of the final torque value.
STEP 3: Torque at final torque value (100%).

After completing the three basic torque steps, retighten the nuts at least once using the final torque crosswise until no further nut rotation is observed.



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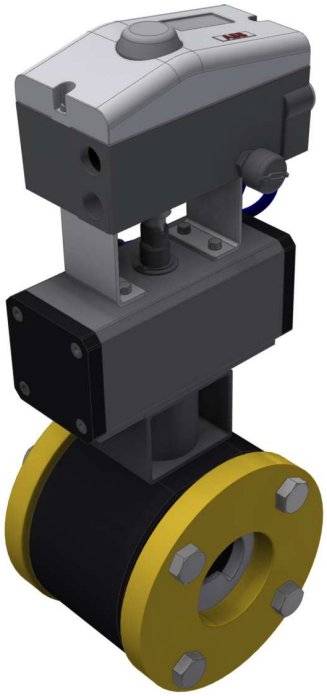
4 bolt flange: 1,2,3,4
8 bolt flange: 1,2,3,4,5,6,7,8
12 bolt flange: 1,2,3,4,5,6,7,8,9,10,11,12
Flange 16 bolts: 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16

DN	PN16	
[mm]	[Nm]	[Ft/lbs]
15/20/25	50	37
32/40/50	50	37
65/80	70	52
100/125	90	66
150/200	120	88
250	150	111
300	200	148
350	250	184
400	300	221
450/500	400	295

VL-2R-HP REGULATION AND CALIBRATION



D1672I03

All adjustment and calibration operations must be carried out exclusively by expert technical personnel qualified for the operation. During all calibration operations, monitor the flow rate in the pipeline by means of flow meters (eg calibrated flanges, differential pressure gauges, etc...).

ESA performs a preliminary calibration of the VL-2R-HP-D valves with a 0÷90° adjustment. The VL-2R-HP-D are adjusted by acting on the stroke of the actuator, so refer to the technical documentation of the valve.

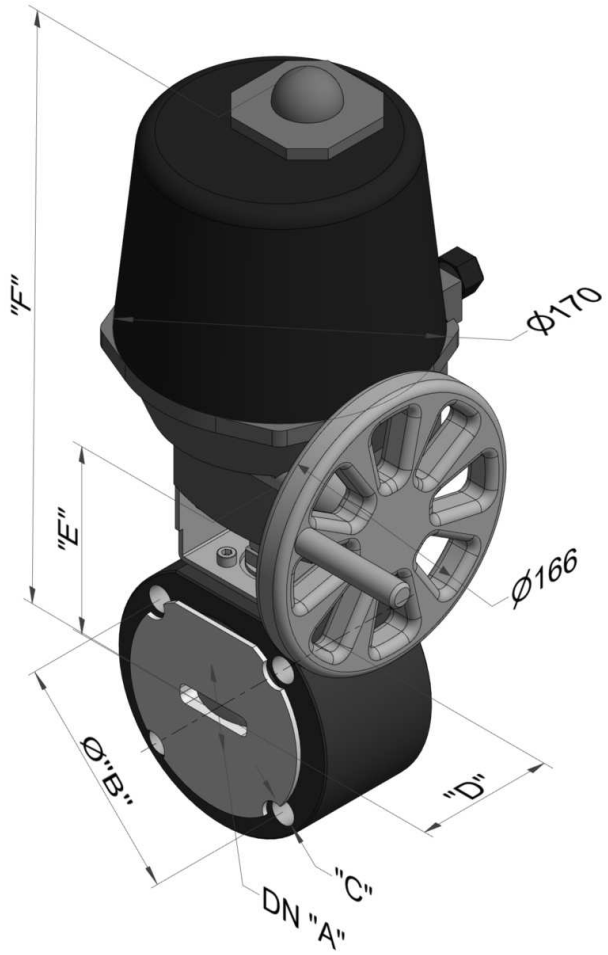
MAINTENANCE

All maintenance operations, due to the short time 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
Gasket 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.
Bolt tightening	12	6 months in vibration applications.
Valve movement	6	Check that there are no obstacles to the movement of the valve. If necessary, lubricate with mineral oil suitable for high temperatures.
Valve calibration	12	Check the flow adjustment performed by the valve as indicated in the REGULATION - CALIBRATION paragraph.
Valve maintenance	12	Check the condition of the internal elements of the valve. Clean the inside of the valve body and the throttle unit with a clean cloth and compressed air. Do not use tools that could damage the internal parts.
Actuator	O/S	Refer to the actuator's technical documentation.

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

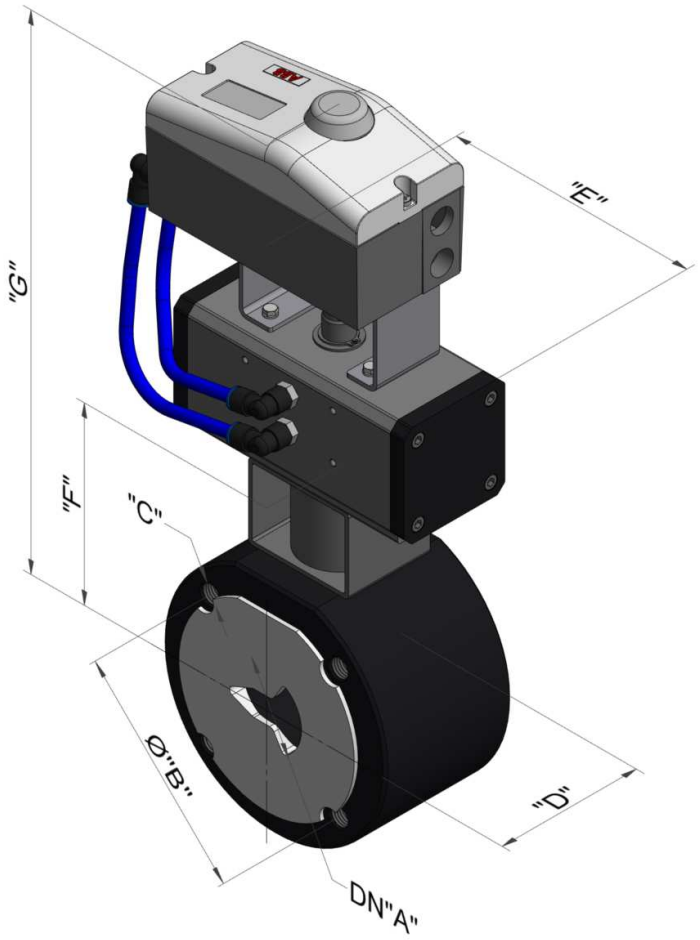
VL-2R-HP-CMAP OVERALL DIMENSIONS



D1672I04

Model	DN "A" (*)	Ø "B"		Ø "C"	"D"		"E"		"F"		Mass	
		[mm]	[inch]		[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[Kg]	[lbs]
4 VL-2R-HP-CMAP	DN 15	90	*3.35/64*	M12	36	*1.27/64*	72	*2.53/64*	330	*12.63/64*	7.5	*16.5*
6 VL-2R-HP-CMAP	DN 20	100	*3.15/16*	M12	39	*1.17/32*	75	*2.61/64*	333	*13.7/64*	7.8	*17.2*
8 VL-2R-HP-CMAP	DN 25	110	*4.21/64*	M12	43	*1.11/16*	82	*3.15/64*	340	*13.25/64*	8.6	*19*
12 VL-2R-HP-CMAP	DN 40	140	*5.33/64*	M16	63	*2.31/64*	108	*4.1/4*	366	*14.13/32*	12	*26.4*
16 VL-2R-HP-CMAP	DN 50	150	*5.29/32*	M16	83	*3.17/64*	117	*4.39/64*	375	*14.49/64*	15.4	*34*
20 VL-2R-HP-CMAP	DN 65	178	*7.1/64*	M16	107	*4.7/32*	143	*5.5/8*	401	*15.25/32*	23.2	*51.1*
24 VL-2R-HP-CMAP	DN 80	190	*7.31/64*	M16	120	*4.23/32*	150	*5.29/32*	408	*16.1/16*	27.0	*59.5*
32 VL-2R-HP-CMAP	DN 100	220	*8.21/32*	M16	152	*5.63/64*	181	*7.1/8*	439	*17.9/32*	41.5	*91.5*
40 VL-2R-HP-CMAP	DN 125	250	*9.27/32*	Ø18	325	*12.51/64*	197	*7.3/4*	455	*17.29/32*	77.5	*170.8*
48 VL-2R-HP-CMAP	DN 150	285	*11.7/32*	Ø22	350	*13.25/32*	254	*10*	512	*20.5/32*	142	*313*

VL-2R-HP-CPAP OVERALL DIMENSIONS



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Model	DN "A" (*)	Ø "B"		Ø "C"	"D"		"E"		"F"		"G"		Mass	
		[mm]	[inch]		[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[Kg]	[lbs]
4 VL-2R-HP-CPAP	DN 15	90	*3.35/64*	M12	36	*1.27/64*	130	*5.1/8*	72	*2.53/64*	254	*10*	7.5	*16.5*
6 VL-2R-HP-CPAP	DN 20	100	*3.15/16*	M12	39	*1.17/32*	130	*5.1/8*	75	*2.61/64*	286	*11.17/64*	7.8	*17.2*
8 VL-2R-HP-CPAP	DN 25	110	*4.21/64*	M12	43	*1.11/16*	130	*5.1/8*	82	*3.15/64*	294	*11.37/64*	8.6	*19*
12 VL-2R-HP-CPAP	DN 40	140	*5.33/64*	M16	63	*2.31/64*	152	*5.63/64*	108	*4.1/4*	329	*12.61/64*	12	*26.4*
16 VL-2R-HP-CPAP	DN 50	150	*5.29/32*	M16	83	*3.17/64*	169	*6.21/32*	117	*4.39/64*	345	*13.37/64*	15.4	*34*
20 VL-2R-HP-CPAP	DN 65	178	*7.1/64*	M16	107	*4.7/32*	184	*7.1/4*	143	*5.5/8*	390	*15.23/64*	23.2	*51.1*
24 VL-2R-HP-CPAP	DN 80	190	*7.31/64*	M16	120	*4.23/32*	212	*8.11/32*	150	*5.29/32*	407	*16.1/32*	27.0	*59.5*
32 VL-2R-HP-CPAP	DN 100	220	*8.21/32*	M16	152	*5.63/64*	388	*15.9/32*	181	*7.1/8*	477	*18.25/32*	41.5	*91.5*
40 VL-2R-HP-CPAP	DN 125	250	*9.27/32*	Ø18	325	*12.51/64*	295	*11.39/64*	197	*7.3/4*	488	*19.7/32*	77.5	*170.8*
48 VL-2R-HP-CPAP	DN 150	285	*11.7/32*	Ø22	350	*13.25/32*	567	*22.21/64*	254	*10*	621	*24.29/64*	142	*313*

ORDERING CODE

01	-	VL-2R-HP	-	02	-	03	-	04	-	05

MODEL	cod.	01
DN15	**4**	
DN20	**6**	
DN25	**8**	
DN40	**12**	
DN50	**16**	
DN65	**20**	
DN80	**24**	
DN100	**32**	
DN125	**40**	
DN150	**48** (*)	

03	VALVE BODY MATERIAL	cod.
	Carbon steel	**ASTM A 105**
	INOX	**AISI**
	Brass	**OT**

04	ACTUATOR POWER SUPPLY	cod.
	24Vac 50÷60Hz	**24V**
	100-240Vac 50÷60Hz	**100-240**

TYPOLOGY	cod.	02
Electric actuator	**CMAP**	
Electro-pneumatic actuator	**CPAP**	

05	PROPORTIONAL COMMAND TYPE	cod.
	In current	**4-20mA**
	In tension	**0-10V**

Note
(*) Size available only for the motorized series with actuator.

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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