



II 3G

## Operating instruction

# Refrigerant Valves PS45 CDV..MVL..

for flammable and safety refrigerants

- One valve type for expansion, hot-gas and suction throttle applications
- Approved according to directive 94/9/EC (ATEX 95)
- Certificate: SEV 05 ATEX 0154X
- Four valve sizes with  $k_{vs}$  values from 0.25 to 6.3 m<sup>3</sup>/h
- Selectable standard interface DC 0/2...10 V or DC 0/4...20 mA
- Short positioning time (< 1 s)
- Closed when deenergized
- Hermetically sealed towards outside
- Robust and maintenance-free

### Use



II 3G EEx nAC IIC T4

Refrigerant valve CDV..MVL.. is a device of device group II, category 3G pursuant to Directive 94/9/EG (ATEX 95) Appendix, that can be used pursuant to Directive 99/92/EG (ATEX 137) in zone 2 as well as natural gas groups IIA, IIB, and IIC, that are a risk of explosion in the range for temperature classes T1 to T4 due to flammable materials.

Permissible ambient temperature is -25°C to +55°C.

## Type summary

Type reference	Base valve <sup>3)</sup>	DN	$k_{vs}$ [m <sup>3</sup> /h]	$k_{vs}$ reduced <sup>1)</sup> [m <sup>3</sup> /h]	$\Delta p_{max}$ [MPa]	$Q_0 E$ [kW]	$Q_0 H$ [kW]	$Q_0 D$ [kW]
CDV..MVL..	MVL661.15-0.4	15	0.40	0.25	2,5	47	9.2	1.7
CDV..MVL..	MVL661.15-1.0	15	1.0	0.63		117	23	4,2
CDV..MVL..	MVL661.20-2.5	20	2.5	1.6		293	57	10
CDV..MVL..	MVL661.25-6.3	25	6.3	4.0		737	144	26

<sup>1)</sup>  $k_{vs}$  and  $Q_0$  refrigeration capacity can be reduced to 63 % of nominal  $k_{vs}$ , refer to « $k_{vs}$  reduction» on page 3

<sup>2)</sup> The data sheet references for ease of understanding and reading to CDV..MVL661..

<sup>3)</sup> For ease of use and understanding CDV..MVL661.. is used as term.

$k_{vs}$  Nominal flow rate of refrigerant through the fully open valve ( $H_{100}$ ) at a differential pressure of 100 kPa (1 bar) to VDI / VDE 2173

$Q_0 E$  Refrigeration capacity in expansion applications

$Q_0 H$  Refrigeration capacity in hot-gas bypass applications

$Q_0 D$  Refrigeration capacity in suction throttle applications and  $\Delta p = 0.5$  bar

$Q_0$  With R407C at  $t_0 = 0$  °C,  $t_c = 40$  °C

The pressure drop across evaporator and condenser is assumed to be 0.3 bar each, and 1.6 bar upstream of the evaporator (e.g. spider).

The capacities specified are based on superheating by 6 K and sub-cooling by 2 K.

## Ordering

The product may only be ordered as customized device variant (CDV).

Example

Type reference	Stock number	Description
CDVxxMVLyy	CDV..MVL..	Refrigerant valve

xx 5-digit number created especially for a CDV or

yy Sequence number created for CDVV order

## Replacement electronics

Replacement electronics may be ordered as customized device variant (CDV).

## Revision numbers

See overview, page 11.

## Function / mechanical design

### Features and benefits

- Four selectable standard signals for set and actual value
- DIL switch to reduce the  $k_{vs}$  value to 63 % of the nominal value
- Potentiometer for adjustment of minimum stroke for suction throttle applications
- Automatic stroke calibration
- Forced control input for “Valve closed” or “Valve fully open”
- LED for indicating the operating state

### Control

The CDV..MVL661.. can be driven by Siemens or third-party controllers that deliver a DC 0/2...10 V or DC 0/4...20 mA output signal.

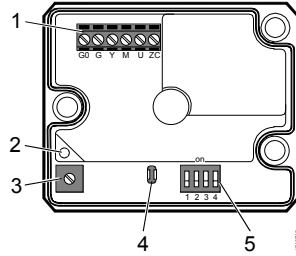
For optimum control performance, we recommend a 4-wire connection between controller and valve. When operating on DC voltage, a 4-wire connection is **mandatory!**

The valve stroke is proportional to the control signal.

### Spring return function

The return spring causes the actuator to close the valves control path A → AB on power failure or interruption of the control signal.

## Operator controls and indicators in the electronics housing



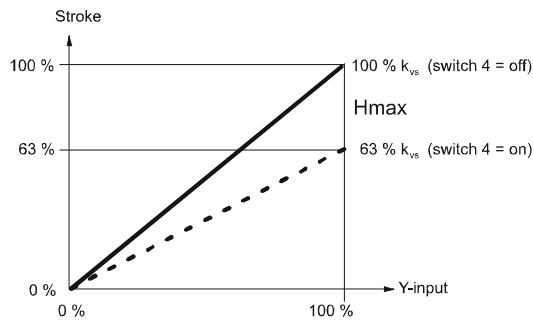
- 1 Connection terminals
- 2 LED for indication of operating state
- 3 Minimal stroke setting potentiometer Rv
- 4 Autocalibration
- 5 DIL switches for mode control

## Configuration DIL switch

DIL switch	Function	ON / OFF	Description
 1	positioning signal Y	ON	Current [mA]
		OFF	<b>Voltage [V]</b> <sup>1)</sup>
 2	Positioning signal range Y and U	ON	DC 2...10 V, 4...20 mA
		OFF	<b>DC 0...10 V</b> , 0...20 mA <sup>1)</sup>
 3	Position feedback signal U	ON	Current [mA]
		OFF	<b>Voltage [V]</b> <sup>1)</sup>
 4	Nominal flow rate $k_{vs}$	ON	63 %
		OFF	<b>100 %</b> <sup>1)</sup>

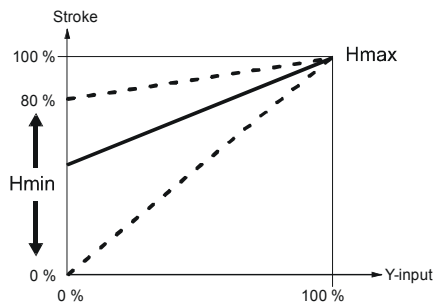
<sup>1)</sup> **Factory setting**

## $k_{vs}$ reduction



When  $k_{vs}$  reduction (DIL switch 4 in position on) the stroke will be limited to 63 % mechanical stroke. 63 % of full stroke then corresponds to an input / output signal of 10 V. If, in addition, the stroke is limited to 80 %, for example, the minimum stroke will be  $0.63 \times 0.8 = 0.50$  of full stroke.

## Minimum opening with minimum stroke setting



In the case of the suction throttle valve, it is essential that a minimum stroke limit be maintained to ensure compressor cooling and efficient oil return. This can be achieved with a reinjection valve, a bypass line across the valve, or a guaranteed minimum opening of the valve. The minimum stroke can be defined via the controller and control signal Y, or it can be set directly with potentiometer Rv.

The **factory setting** is zero (mechanical stop in counterclockwise direction, CCW). The minimum stroke can be set by turning the potentiometer Rv clockwise to a maximum of 80 %  $k_{vs}$ .

**Attention**

**Under no circumstances must potentiometer Rv be used to limit the stroke on expansion applications. It must be possible to close the valve fully.**

## Forced control input ZC

		ZC – Function		
		no function	fully open	closed
Connections				
	Transfer			
Function		<ul style="list-style-type: none"> <li>• ZC not connected</li> <li>• Valve will follow Y-signal</li> <li>• Minimal stroke setting with potentiometer Rv possible</li> </ul>	<ul style="list-style-type: none"> <li>• ZC connected with G</li> <li>• Valve will fully open control path A → AB</li> </ul>	<ul style="list-style-type: none"> <li>• ZC connected with G0</li> <li>• Valve will close control path A → AB</li> </ul>

## Signal priority

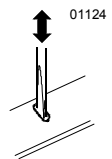
1. Forced control input ZC
2. Positioning signal Y and/or minimal stroke setting potentiometer Rv

## Calibration

The printed circuit board of the CDV..MVL661.. has a slot to facilitate calibration. To calibrate, insert a screwdriver in the slot so that the contacts inside are connected. As a result, the valve will first be fully closed and then fully opened.

Calibration matches the electronics to the valve mechanism.

During calibration, the green LED flashes for about 10 seconds; refer to "Indication of operating state" (page 4).



## CDV..MVL661.. refrigerant valves are supplied fully calibrated.

When is calibration required?

After replacement of the electronics, when the red LED is lit, or when the valve (valve seat) is leaking.

## Indication of operating state

LED	State	Function	Comment, action
Green	Steady on	Operation	Automatic mode; everything ok
	Flashing	Calibration in progress	Wait until calibration is terminated (LED stops flashing)
Red	Steady on	Calibration error	Start stroke calibration again (short-circuit contacts via slot in PCB)
		Internal error	Replace electronics
	Flashing	Mains fault	Check mains power supply (e.g. outside the frequency or voltage range)
Both	Off	No power supply Faulty electronics	Check mains power supply, check wiring Replace electronics

## Connection type <sup>1)</sup>

The 4-wire connection should always be given preference!

4-wire connection  
3-wire connection

Product number	S <sub>NA</sub> [VA]	P <sub>MED</sub> [W]	I <sub>F</sub> [A]	Wire cross-section [mm <sup>2</sup> ]		
				1.5	2.5	4.0 <sup>2)</sup>
max. cable length L [m]						
CDV..MVL661...-	22	12	1.6...4 A	65	110	160
CDV..MVL661...-	22	12	1.6...4 A	20	35	50

S<sub>NA</sub> = nominal apparent power for selecting the transformer

P<sub>med</sub> = typical power consumption

I<sub>F</sub> = required slow fuse

L = max. cable length; with 4-wire connections, the max. permissible length of the separate 1.5 mm<sup>2</sup> copper positioning signal wire is 200 m

<sup>1)</sup> All information at AC 24 V

<sup>2)</sup> With 4 mm<sup>2</sup> electrical wiring reduce wiring cross-section for connection inside valve to 2.5 mm<sup>2</sup>.

## Engineering notes

Depending on the application, it may be necessary to observe additional installation instructions and fit appropriate safety devices (e.g. pressostats, full motor protection, etc.).

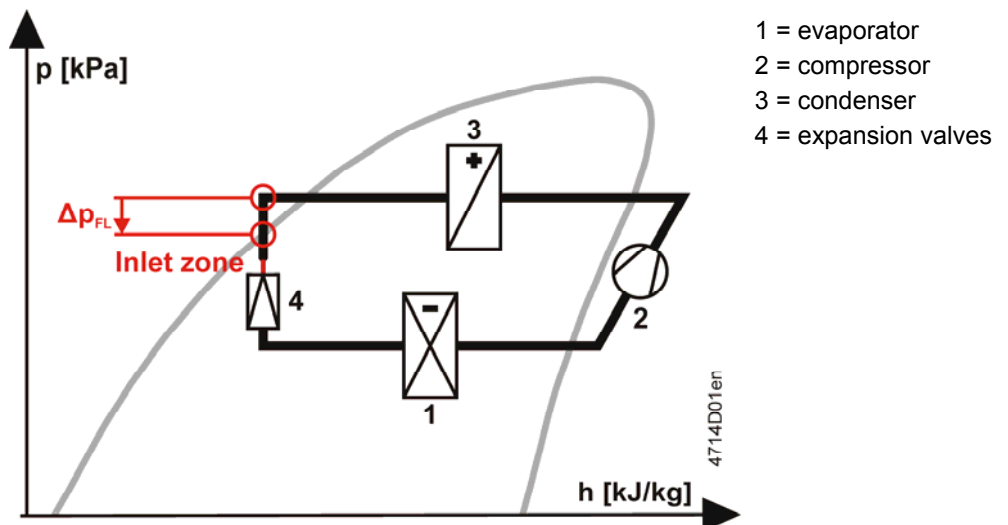
### Warning

In order not to damage the seal inside the valve insert, the plant must be vented on the low-pressure side after the pressure test has been made (valve port AB), or the valve must be fully open during the pressure test and during venting (power supply connected and positioning signal at maximum or forced opening by G → ZC).

## Expansion application

To prevent formation of flash gas on expansion applications, the velocity of the refrigerant in the fluid pipe may not exceed 1 m/s. To assure this, the diameter of the fluid pipe must be greater than the nominal size of the valve, using reducing pieces for making the connections to the valve.

Engineering notes



- The differential pressure over reduction must be less than half the differential pressure  $\Delta p_{FL}$ .
- The inlet path between diameter reduction and expansion valve inlet
  - Must be straight for at least 600 mm
  - May not contain any valves

**A filter / dryer must be mounted upstream of the expansion valve.  
It is not approved for use with ammonia (NH<sub>3</sub>, R717).**



The valve is supplied complete with mounting instructions.

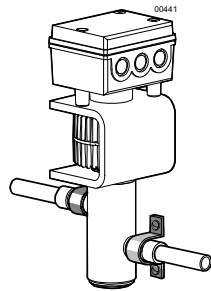
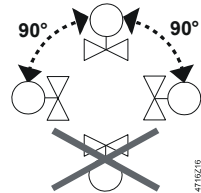
## Mounting instructions

The valve should be mounted and commissioned by qualified staff. The same applies to the replacement electronics and the configuration of the controller.



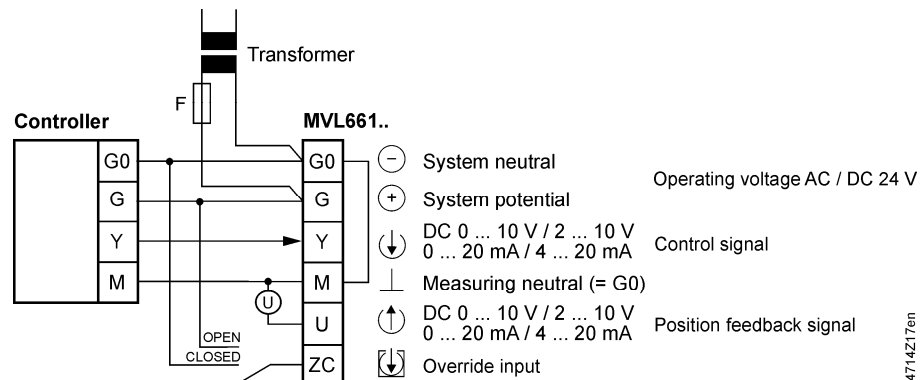
Comply with requirements per EN 60079-14 for use / installation.

Note additional installation notes depending on application and use the appropriate safety elements (e.g. pressure control, motor full protection).



- The refrigerant valves can be mounted in any orientation, but upright mounting is preferable.
- Arrange the pipework in such a way that the valve is not located at a low point in the plant where oil can collect.
- The pipes should be fitted in such a way that the alignment does not distort the valve connections. Fix the valve body so that it cannot vibrate. Vibration can lead to burst connection pipes.
- Before soldering the pipes, ensure that the direction of flow through the valve is correct.
- The pipes must be soldered with care. To avoid dirt and the formation of scale (oxide), inert gas is recommended for soldering.
- The flame should be large enough to ensure that the junction heats up quickly and the valve does not get too hot.
- The flame should be directed away from the valve.
- During soldering, cool the valve with a wet cloth, for example, to ensure that it does not become too hot.
- Port B must be sealed off when a 2-port valve (AB → A) is used.
- The valve body and the connected pipework should be lagged.
- The actuator must not be lagged.

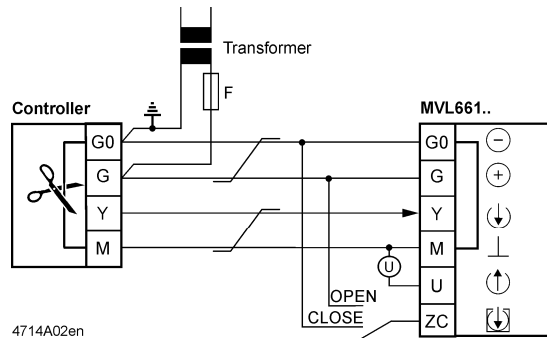
## Connection terminals



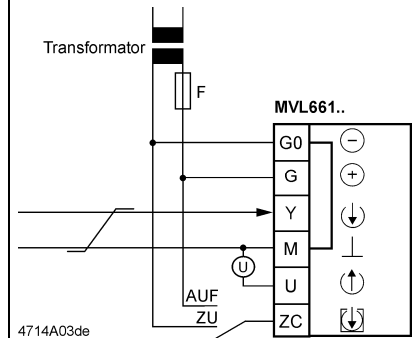
## Connection diagrams

### Terminal assignment for controller with 4-wire connection (to be preferred!)

#### Common Transformer

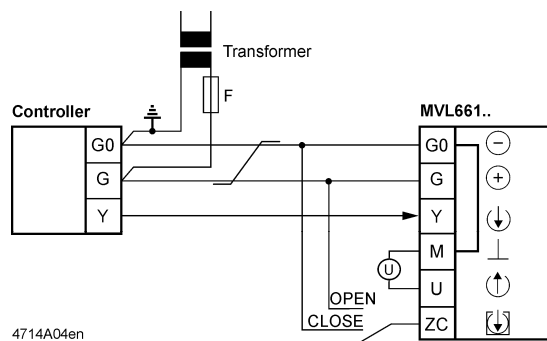


#### Separate Transformer

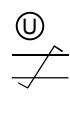
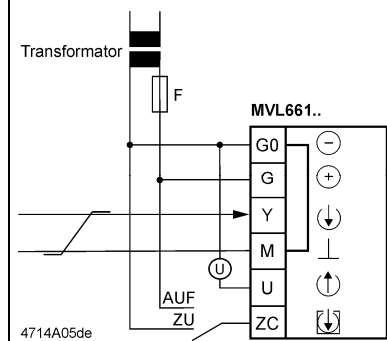


### Terminal assignment for controller with 3-wire connection

#### Common Transformer



#### Separate Transformer



Indication of valve position (only if required). DC 0...10 V → 0...100 % volumetric flow V100

Twisted pairs. If the lines for AC 24 V power supply and the DC 0...10 V (DC 2...10 V, DC 0... 20 mA, DC 4... 20 mA) positioning signal are routed separately, the AC 24 V line need not be twisted.

### Warning

#### Piping must be connected to potential earth!

### DIL switch

Factory setting: Valve characteristics equal-percentage, positioning signal DC 0...10 V. Details see "Configuration DIL switches", page 3.

### Calibration

See "Calibration", page 4.

### Special conditions

See also ATEX valve supplementary sheet delivered with.

### Cabling and wiring

Cabling and wiring of CDV..MVL661.. must meet the requirement under EN 60079-15 Section 6.2.6. and for which an separate certificate exists (separate certified "EEx e" cabling can be used).

### Cable openings

Unused cable openings with knock outs must be closed accordingly. Separately certified "EEx e" sealing plugs are used.

### Degree of protection

Degree of protection (solid foreign object, dust and water protection) per IEC/EN 60529, at a minimum IP 54 for installation and in operation, is only achieved with proper cabling and wiring as well as sealing plugs as required.

### Protection against UV radiation

The refrigerant valve CDV..MVL661.. must be installed in a manner providing sufficient protection against sunlight and other sources of UV radiation.

Exceeding rated voltage      Measures must be undertaken outside field devices (refrigerant valve CDV..MVL661..) to prevent temporary faults from exceeding more than 40 % of rated voltage (transient protection).

## Maintenance notes

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The refrigerant valve is maintenance-free.

Valve repair

The valve can not be repaired. It has to be replaced as a complete unit.

Replacement electronics

Should the valve electronics prove faulty, the electronics module can easily be replaced. Replacement electronics are ordered as customized device variant (CDV). Mounting Instruction is included.

**Caution** 

**Always disconnect power before fitting or removing the electronics module.**

After replacing the electronics module, calibration must be triggered in order to optimally match the electronics to the valve (refer to "Calibration", page 4).

**Caution** 

**Under operating conditions within the limits defined by the application data, the actuator will become hot, but this does not represent a burn risk. Always maintain the minimum clearance specified, refer to "Dimensions", page 11.**

## Disposal



The actuator must not be disposed of together with domestic waste. This applies in particular to the PCB.

Legislation may demand special handling of certain components, or it may be sensible from an ecological point of view

**Current local legislation must be observed.**

## Warranty

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Application-specific technical data must be observed.

**If specified limits are not observed, Siemens Switzerland Ltd / CPS Products will not assume any responsibility.**



## Technical data

### Functional actuator data

Power supply	Extra low-voltage only (SELV, PELV)		
AC 24 V	Operating voltage	AC 24 V ± 20 %	
	Rated voltage to EN 60730	AC 24 V	
	Frequency	45...65 Hz	
	Typical power consumption $P_{med}$		12 W
		Standby	< 2 W (valve closed)
	Apparent power $S_{NA}$	22 VA (for selecting the transformer)	
Required fuse	1.6...4 A (slow)		
DC 24 V	Operating voltage	DC 20...30 V	
	Rated voltage to EN 60730		
	Current draw	0.5 A / 2 A (max.)	
Signal inputs	Positioning signal Y	DC 0/2...10 V or DC 0/4...20 mA	
	Impedance	DC 0/2...10 V	100 kΩ // 5nF
		DC 0/4...20 mA	240 Ω // 5nF
	Forced control input ZC		
Signal outputs	Impedance	22 kΩ	
	close valve (ZC connected to G0)	< AC 1 V; < DC 0.8 V	
	open valve (ZC connected to G)	> AC 6 V; > DC 5 V	
	no function (ZC not wired)	positioning signal Y active	
	Position feedback signal U	Voltage	DC 0/2...10 V; load resistance ≥ 500 Ω
	Current	DC 0/4...20 mA; load resistance ≤ 500 Ω	
	Stroke detection	Inductive	
	Nonlinearity	Accuracy ± 3 % full scale	
Positioning time	Positioning time	< 1 s	
Electrical connections	Cable entry glands	3 x Ø 17 mm (for M16)	
	Min. wire cross-section	0.75 mm <sup>2</sup>	
	Max. cable length	See «Connection type», page 5	
Functional valve data	Permissible operating pressure	4.5 MPa (45 bar) <sup>1)</sup>	
	Differential pressure $\Delta p_{max}$	2.5 MPa (25 bar)	
	Valve characteristics (Hub, $k_v$ )	linear to VDI / VDE 2173	
	Leakage rate (internally across seat)	max. 0.002 % $k_{vs}$ respectively	
		max. 1 NI/h Gas at $\Delta p = 400$ kPa (4 bar)	
		Shut/off function, like solenoid normally closed (NC) function	
	External seal	hermetically sealed (fully welded, no static or dynamic seals)	
	Permissible media	For common safety refrigerants (R22, R134a, R404A, R407C, R410A, R507 usw.) sowie R744 (CO <sub>2</sub> ).	
		Not suitable for ammonia (R717)	
	Medium temperature	-40...120 °C; max. 140 °C for 10 min	
	Stroke resolution $\Delta H / H_{100}$	1 : 1000 (H = Stroke)	
	Hysteresis	Typically 3 %	
	Mode of operation	modulating	
	Position when deenergized	Control path A → AB closed	
	Orientation	upright to horizontal <sup>2)</sup>	
	Dimensions and weight	refer to "Dimensions", page 11	
	Materials	Valve body	Steel / CrNi steel
Seat, piston		CrNi steel / brass	
Sealing disk		PTFE	
Pipe connections	Sleeves	internally soldered, CrNi steel	

## Norms and Standards

CE-conformity	
EMC-directive	2004/108/EC
	Immunity EN 61000-6-2:[2005] Industrial <sup>3)</sup>
	AC: Emission EN 61000-6-3:[2007] Residential
Electrical safety	EN 60730-1
Protection class	Class III as per EN 60730
Degree of pollution	Degree 2 as per EN 60730
Housing protection	
Upright to horizontal	IP65 to EN 60529 <sup>2)</sup>
	Vibration <sup>5)</sup> EN 60068-2-6 5 g acceleration, 10...150 Hz, 2,5 h (5 g horizontal, max. 2 g upright)
Environmental compatibility	ISO 14001 (Environment) ISO 9001 (Quality) SN 36350 (Environmentally compatible products) RL 2002/95/EG (RoHS)
Directive potentially explosive atmosphere	94/9/EC (ATEX 95)
ATEX approval certificate	II 3G EEx nAC IIC T4
Pressure Equipment Directive	PED 97/23/EC
Pressure Accessories	as per article 1, section 2.1.4
Fluid group 1	without CE-marking as per article 3, section 3 (sound engineering practice)

<sup>1)</sup> To EN 12284 tested with 1,43 x operating pressure at 65 bar

<sup>2)</sup> At  $45\text{ °C} < T_{\text{amb}} < 55\text{ °C}$  and  $80\text{ °C} < T_{\text{med}} < 120\text{ °C}$  the valve must be installed on its side to avoid shortening the service life of the valve electronics

<sup>3)</sup> Comply with special conditions on page 5 and requirements per EN 60079-14 when using in potentially explosive atmospheres

<sup>4)</sup> Transformer 160 VA (e.g. Siemens 4AM 3842-4TN00-0EA0)

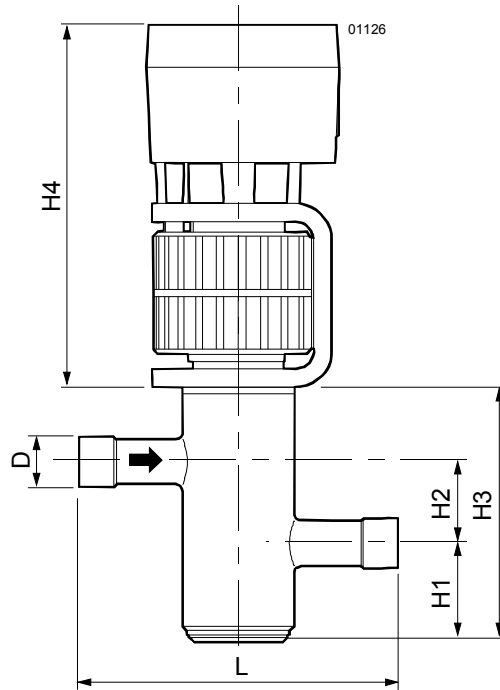
<sup>5)</sup> In conjunction with severely vibrating plant, use only highly flexible stranded wires

## General ambient conditions

	Operation EN 60721-3-3	Transport EN 60721-3-2	Storage EN 60721-3-1
Environmental conditions	Class 3K6	Class 2K3	Class 1K3
Temperature	-25...55 °C	-25...70 °C	-5...45 °C
Humidity	10...100 % r.h.	< 95 % r.h.	5...95 % r.h.

## Dimensions

Dimensions in mm



Type reference	DN	D [inch]	L [mm]	H1 [mm]	H2 [mm]	H3 [mm]	H4 [mm]	T [mm]	M [kg]
<b>MVL661.15-0.4</b>	15	5/8	140	44	36	113	160	103	4.4
<b>MVL661.15-1.0</b>	15	5/8	140	44	36	113	160	103	4.4
<b>MVL661.20-2.5</b>	20	7/8	150	41	41	119	160	103	4.5
<b>MVL661.25-6.3</b>	25	1 1/8	160	40	47	126	160	103	4.6

DN Nominal size  
D Pipe connections [inch], inside dimensions  
T Depth  
M Weight including packaging [kg]

## ATEX Marking

	Siemens Switzerland Ltd., CH-6301 Zug Type MVL661.. Year of construction: 200x II 3G EEx nAC IIC T4 SEV 05 ATEX 0154X  ! Observe operating instruction
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## Revision numbers

Type	Valid from rev. no.
<b>MVL661.15-0.4</b>	..C
<b>MVL661.15-1.0</b>	..C
<b>MVL661.20-2.5</b>	..D
<b>MVL661.25-6.3</b>	..C

