



ACVATIX™

## Modulating refrigerant valves, PS53

**MVS661..N**

for ammonia (R717) and safety refrigerants

- 
- One valve type for expansion, hot-gas and suction throttle applications
  - Hermetically sealed
  - Selectable standard interface DC 0/2...10 V or DC 0/4...20 mA
  - High resolution and control accuracy
  - Precise positioning control and position feedback signal
  - Short positioning time (< 1 second)
  - Closed when deenergized
  - Robust and maintenance-free
  - DN 25 with  $k_{vs}$  values from 0.10 to 6.3 m<sup>3</sup>/h

### Use

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The MVS661..N refrigerant valve is designed for modulating control of refrigerant circuits including chillers and heat pumps. It is suitable for use in expansion, hot-gas and suction throttle applications. In addition to ammonia (R717), the valve can handle all standard safety refrigerants, noncorrosive gases / liquids and CO<sub>2</sub> (R744). It is not suited for use with inflammable refrigerants.

## Type summary

The refrigeration capacity refers to applications using ammonia.

Product number	DN	$k_{vs}$	$k_{vs}$ reduced	$\Delta p_{max}$	$Q_0 E$	$Q_0 H$	$Q_0 D$	$S_{NA}$	$P_{med}$
		[m <sup>3</sup> /h]	[m <sup>3</sup> /h]						
<b>MVS661.25-016N</b>	25	0,16	0,10	2,5	95	10	2	22	12
<b>MVS661.25-0.4N</b>	25	0,40	0,25		245	26	5		
<b>MVS661.25-1.0N</b>	25	1,0	0,63		610	64	12		
<b>MVS661.25-2.5N</b>	25	2,5	1,6		1530	159	29		
<b>MVS661.25-6.3N</b>	25	6,3	4,0		3850	402	74		

$k_{vs}$  = Nominal flow rate of refrigerant through the fully open valve ( $H_{100}$ ) at a differential pressure of 100 kPa (1 bar) to VDI 2173  
If required  $k_{vs}$ -value and refrigeration capacity  $Q_0$  can be reduced to 63 %, refer to « $k_{vs}$  reduction» on page 3

$\Delta p_{max}$  = Maximum permissible differential pressure across the control path A → AB of the valve, valid for the entire actuating range of the motorized valve

$Q_0 E$  = 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

$S_{NA}$  = nominal apparent power for selecting the transformer

$P_{med}$  = typical power consumption

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 subcooling by 2 K.

## Accessories

Valve insert ASR..N

Product number	DN	$k_{vs}$
		[m <sup>3</sup> /h]
<b>ASR0.16N</b>	25	0,16
<b>ASR0.4N</b>	25	0,40
<b>ASR1.0N</b>	25	1,0
<b>ASR2.5N</b>	25	2,5
<b>ASR6.3N</b>	25	6,3

The refrigeration capacity for various refrigerants and operating conditions can be calculated for the 3 types of application using the tables starting from page 12.

For accurate valve sizing, the valve selection program "Refrigeration VASP" is recommended.

## Ordering

Valve body and magnetic actuator form one integral unit and cannot be separated.

Example:

Product number	Stock number	Designation	Quantity
MVS661.25-0.4N	MVS661.25-0.4N	Refrigerant valve	1

## Spare parts

Replacement electronics ASR61

Should the valve's electronics become faulty, the entire electronics housing is to be replaced by spare part ASR61, which is supplied complete with Mounting Instructions (74 319 0270 0).

Rev. no.

See table on page 16.

Valve insert ASR..N



If plant is resized, or should excessive wear impact the valve's performance, a new valve insert ASR...N will restore the valve's characteristics to its original specifications.

The valve insert is supplied complete with Mounting Instructions (74 319 0486 0).

**Features and benefits**

- 4 selectable standard signals for setpoint and measured 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

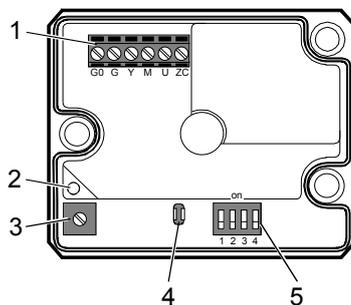
**Control**

The MVS661..N refrigerant valve 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**

If the positioning signal is interrupted, or in the event of a power failure, the valve's return spring will automatically close control path 1 → 3.

**Operator controls and indicators in the electronics housing**



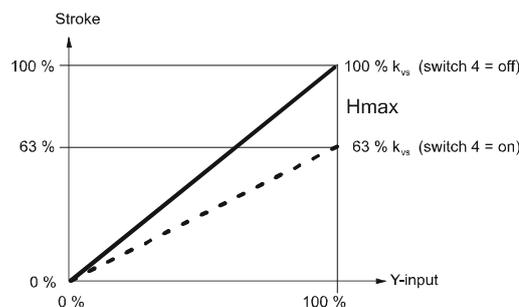
- 1 Connection terminals
- 2 LED for indication of operating state
- 3 Minimal stroke setting potentiometer Rv
- 4 Autocalibration
- 5 DIL switches for mode control

**Configuration of DIL switches**

Switch	Function	ON / OFF	Description
 1	Positioning signal Y	ON	Current [mA]
		OFF	<b>Voltage [V]</b> <sup>1)</sup>
 2	Positioning range Y and U	ON	DC 2...10 V, 4...20 mA
		OFF	<b>DC 0...10 V, 0...20 mA</b> <sup>1)</sup>
 3	Position feedback 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>

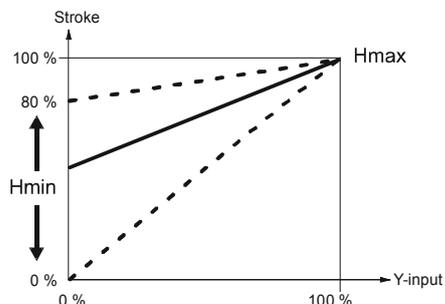
<sup>1)</sup> **Factory setting**

**$k_{vs}$ -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 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 clockwise (CW) 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 the Y-signal</li> <li>Minimum stroke setting with potentiometer Rv possible</li> </ul>	<ul style="list-style-type: none"> <li>ZC connected to G</li> <li>Valve will fully open control path A → AB</li> </ul>	<ul style="list-style-type: none"> <li>ZC connected to G0</li> <li>Valve will close control path A → AB</li> </ul>

## Signal priority

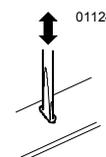
1. Forced control signal ZC
2. Signal input Y and/or minimum stroke setting with potentiometer Rv possible

## Calibration

The printed circuit board of the MVS661..N has a slot to facilitate calibration. To make the calibration, 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's mechanism.

During the calibration process the green LED flashes for about 10 seconds; refer to "Indication of operating state" (page 5).



**MVS661..N refrigerant valves are supplied fully calibrated.**

When is a calibration required?

Execute a calibration after replacing the electronics, when the red LED is on or when the valve is leaking (at seat).

## Indication of operating state

LED	Indication	Function	Remarks, troubleshooting
Green	Lit 	Control mode	Automatic operation; everything o.k.
	Flashing 	Calibration in progress	Wait until calibration is finished (green or red LED will be lit)
Red	Lit 	Calibration error Internal error	Recalibrate (operate button in opening 1x) Replace electronics module
	Flashing 	Mains fault	Check mains network (outside the frequency or voltage range)
Both	Dark 	No power supply Electronics faulty	Check mains network, check wiring Replace electronics module

## 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]		
MVS661..N	22	12	1.6...4 A	65	110	160
MVS661..N	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>.

## Sizing

For straightforward valve sizing, refer to the tables for the relevant application (from page 9).

For accurate valve sizing, we recommend to make use of the valve sizing software "Refrigeration VASP", available from your local Siemens office.

### Notes

The refrigeration capacity Q<sub>0</sub> is calculated by multiplying the mass flow by the specific enthalpy differential found in the h, log p-chart for the relevant refrigerant. To help determine the refrigeration capacity more easily, a selection chart is provided for each application (from page 10). With direct or indirect hot-gas bypass applications, the enthalpy differential of Q<sub>c</sub> (the condenser capacity) must also be taken into account when calculating the refrigeration capacity.

If the evaporating and/or condensing temperatures are between the values shown in the tables, the refrigeration capacity can be determined with reasonable accuracy by linear interpolation (refer to the application examples from page 11).

At the operating conditions given in the tables, the permissible differential pressure Δp<sub>max</sub> (25 bar) across the valve is within the admissible range for these valves.

If the evaporating temperature is raised by 1 K, the refrigeration capacity increases by about 3 %. If, by contrast, subcooling is increased by 1 K, the refrigeration capacity increases by about 1 to 2 % (this applies only to subcooling down to approximately 8 K).

## Engineering notes

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

### Warning

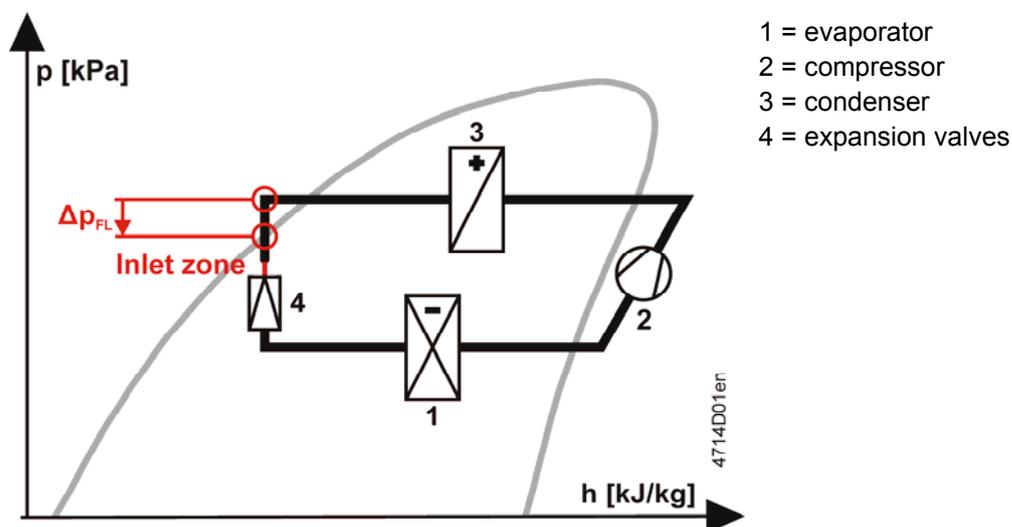
In order not to damage the seal inside the valve insert, the plant must be vented on the low-pressure side after the pressure test has been made (valve port AB), or the valve

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 the formation of flash gas on expansion applications, the velocity of the refrigerant in the fluid pipe must not exceed 1 m/s. To assure this, the diameter of the fluid pipe must under certain circumstances be greater than the nominal size of the valve.

Engineering notes

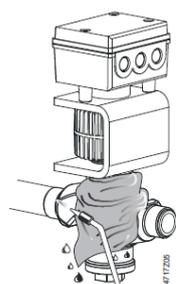
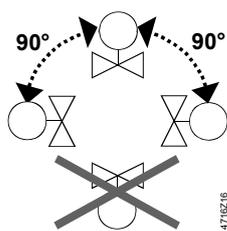


- The differential pressure over reduction must be less than half the differential pressure  $\Delta p_{FL}$ .
- The inlet path between diameter reduction and expansion valve inlet
  - Must straight for at least 600 mm
  - May not contain any valves

**A filter / dryer must be mounted upstream of the expansion valve.  
The valve is not explosion-proof.**

## Mounting notes

The valve should be mounted and commissioned by qualified staff. The same applies to the replacement electronics and the configuration of the controller (e.g. SAPHIR or PolyCool).



- 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 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.

The valve is supplied complete with Mounting Instructions 74 319 0707 0.

## Maintenance notes

The refrigerant valve is maintenance-free.

### Repair

If the valve's interior is subjected to great wear, the valve can be repaired by replacing the ASR..N valve insert.

### Disposal



The actuator contains electrical and electronic components and must not be disposed of together with domestic waste.

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

Application-specific technical data must be observed.

**If specified limits are not observed, Siemens Building Technologies / CPS Products will nor 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 %		
	Frequency	45...65 Hz		
	Typical power consumption	$P_{med}$	12 W	
		Stand by	< 1 W (valve closed)	
	Rated apparent power $S_{NA}$	22 VA (for selecting the transformer)		
Required fuse $I_F$	1,6...4 A, slow			
DC 24 V	Operating voltage	DC 20...30 V		
	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 (load < 0,1 mA)	
	Forced control ZC	DC 0/4...20 mA	240 Ω // 5nF	
		Input impedance	22 kΩ	
Signal outputs	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 U	Voltage	DC 0/2...10 V; load resistance ≥ 500 Ω	
		Current	DC 0/4...20 mA; load resistance ≤ 500 Ω	
Stroke measurement	Inductive			
Nonlinearity	± 3 % of end value			
Positioning time	Positioning time < 1 s			
Electrical connection	Cable entry 3 x Ø 17 mm (for M16)			
	Minimal wire cross-section 0.75 mm <sup>2</sup>			
	Maximum cable length Refer to "Connection type", page 5			

<b>Functional valve data</b>	Permissible operating pressure	max. 5.3 MPa (53 bar) <sup>1)</sup>		
	Differential pressure $\Delta p_{max}$	2.5 MPa (25 bar)		
	Valve characteristic (stroke, $k_v$ )	linear (to VDI / VDE 2173)		
	Leakage rate (internally across seat)	max. 0,002 % $k_{vs}$ resp. max. 1 NI/h gas at $\Delta p = 4$ bar Shut/off function, like solenoid normally closed (NC) function		
	External seal	hermetically sealed!		
	Permissible media	Ammonia (R717), CO2 (R744) and all safety refrigerants (R22, R134a, R404A, R407C, R507, etc); Not suited for use with inflammable refrigerants		
	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		
	Mounting position <sup>2)</sup>	Upright to horizontal		
	<b>Materials</b>	Valve body	steel / CrNi steel	
		Seat / piston	CrNi steel	
Sealing disk / O-rings		PTFE / CR (chloroprene)		
<b>Dimensions and weight</b>	Dimensions	refer to "Dimensions", page 10		
	Weight	5.17 kg		
<b>Pipe connections</b>	Solder (weld-on-ends)	Referring to EN 1092-1 and ASME B16.25 schedule 40		
		Inner diameter	22.4 mm	
		Outer diameter	33.7 mm	
<b>Norms and standards</b>	CE conformity to EMV-requirements	2004/108/EC		
		Immunity	EN 61000-6-2:[2005] Industrial <sup>3)</sup>	
		Emission	EN 61000-6-3:[2007] Residential	
	Electrical safety	EN 60730-1		
	Protection class	Class III to EN 60730		
	Pollution degree	Degree 2 to EN 60730		
	Housing protection Upright to horizontal	IP65 to EN 60529 <sup>2)</sup>		
	Vibration <sup>4)</sup>	EN 60068-2-6 5 g acceleration, 10...150 Hz, 2.5 h (5 g horizontal, max. 2 g upright)		
	Conform to	UL standards	UL 873	
		CSA, Canada	C22.2 No. 24	
		C-tick	N 474	
	Environmental compatibility	ISO 14001 (Environment) ISO 9001 (Quality) SN 36350 (Environmentally compatible products) RL 2002/95/EG (RoHS)		
	Permissible operating pressure	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 76 bar

<sup>2)</sup> At 45 °C < Tamb < 55 °C and 80 °C < Tmed < 120 °C the valve must be installed on its side to avoid shortening the service life of the valve electronics

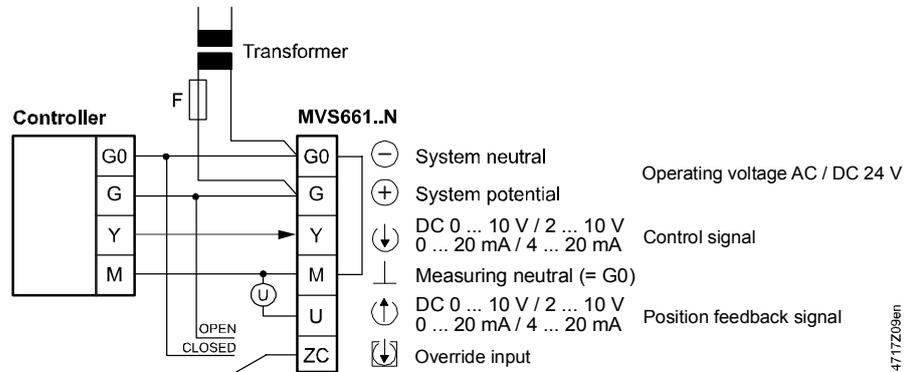
<sup>3)</sup> Transformer 160 VA (e.g. Siemens 4AM 3842-4TN00-0EAO)

<sup>4)</sup> In case of strong vibrations, use high-flex stranded wires for safety reasons.

**General environmental conditions**

	Operation EN 60721-3-3	Transport EN 60721-3-2	Storage EN 60721-3-1
Climatic 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.

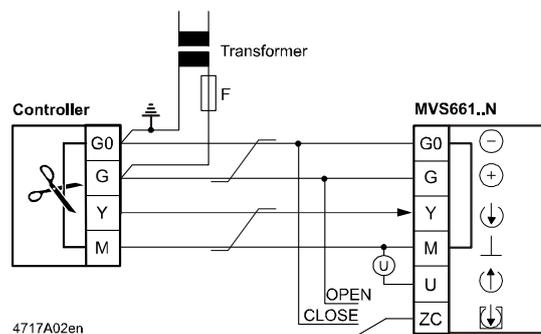
**Connection terminals**



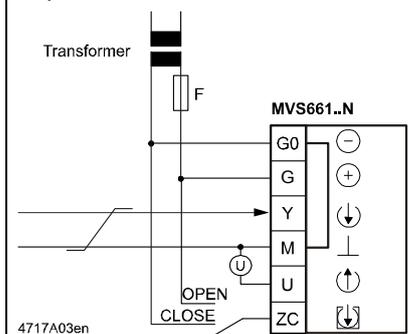
**Connection diagrams**

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

**Common Transformer**

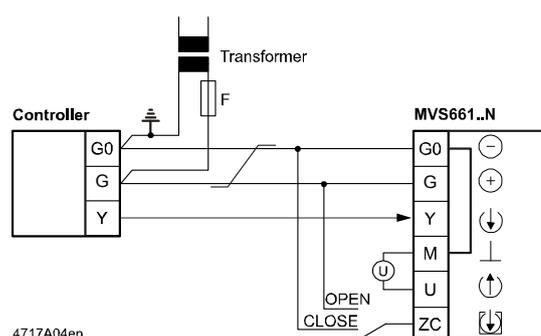


**Separate Transformer**

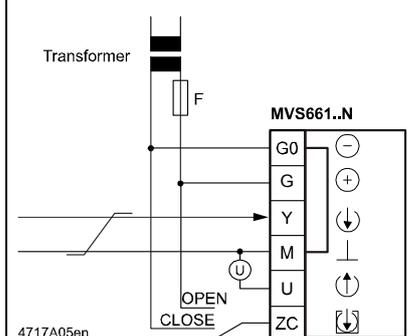


**Terminal assignment for controller with 3-wire connection**

**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!**

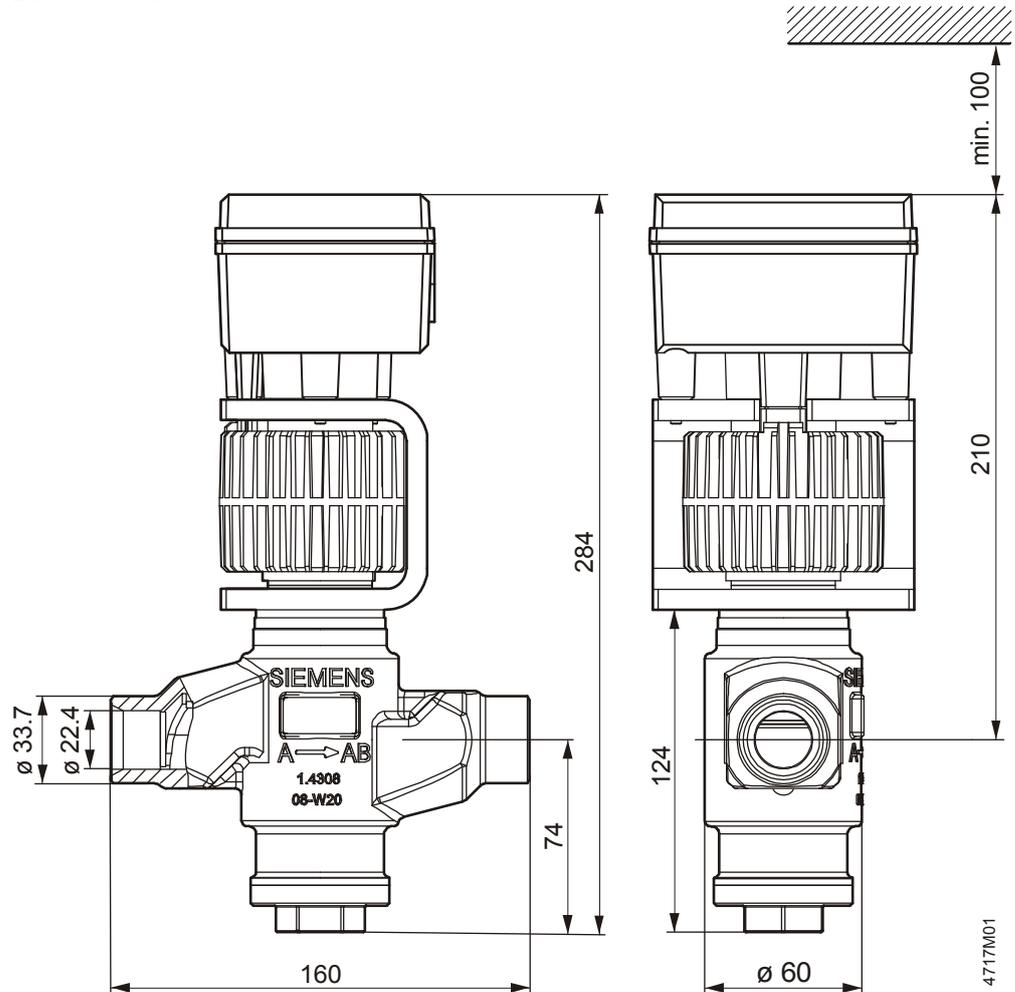
**DIL switch**

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

**Calibration**

See "Calibration", page 4.

Dimensions in mm



Valve sizing with correction factor

The applications and correction tables on the following pages are designed for help with selecting the valves. To select the correct valve, the following data is required:

- **Application**
  - Expansion (starting on page 11)
  - Hot-gas (starting on page 13)
  - Suction throttle (starting on page 15)
- **Refrigerant type**
- **Evaporating temperature  $t_0$  [ °C ]**
- **Condensing temperature  $t_c$  [ °C ]**
- **Refrigeration capacity  $Q_0$  [kW]**

To calculate the nominal capacity, use the following formula:

•  $k_{vs} [m^3/h] = Q_0 [kW] / K...*$  \*  $K...$  for Expansion = **KE**  
 for hot-gas = **KH**  
 for suction throttle = **KS**

- The theoretical  $k_v$  value for the nominal refrigeration capacity of the plant should not be less than 50 % of the  $k_{vs}$  value of the selected valve
- For accurate valve sizing, the valve selection program "Refrigeration VASP" is recommended

The application examples on the following pages deal with the principles only. They do not include installation-specific details such as safety elements, refrigerant collectors, etc.

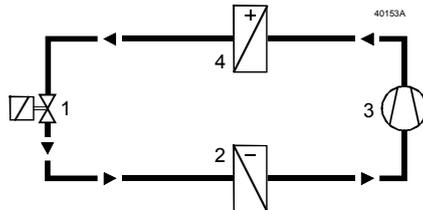
## Use of the MVS661..N as an expansion valve

### Note

Observe engineering notes page 5

- Typical control range 20...100 %.
- Increased capacity through better use of the evaporator
- The use of 2 or more compressors or compressor stages significantly increases efficiency with low loads
- Especially suitable for fluctuating condensing and evaporating pressures

### Capacity optimization



- 1 = MVS661..N
- 2 = evaporator
- 3 = compressor
- 4 = condenser

Electronic superheat control is achieved by using additional control equipment (e.g. PolyCool).

### Application example

Refrigerant R717C;  $Q_0 = 205 \text{ kW}$ ;  $t_0 = -5 \text{ °C}$ ;  $t_c = 35 \text{ °C}$

The correct  $k_{vs}$  value for the MVS661..N valve needs to be determined.

The important section of table KE for R717 is the area around the working point. The correction factor KE relevant to the working point should be determined by linear interpolation from the 4 guide values.

### Note on interpolation

In practice, the KE, KH or KS value can be estimated because the theoretical  $k_{vs}$ -value ascertained will be rounded off by up to 30 % to 1 of the 10 available  $k_{vs}$ -values. So you can proceed directly with Step 4.

- Step 1: For  $t_c = 35 \text{ °C}$ , calculate the value for  $t_0 = -10 \text{ °C}$  between values  $20 \text{ °C}$  and  $40 \text{ °C}$  in the table; result: **574**
- Step 2: For  $t_c = 35 \text{ °C}$ , calculate the value for  $t_0 = 0 \text{ °C}$  between values  $20 \text{ °C}$  and  $40 \text{ °C}$  in the table; result: **553**
- Step 3: For  $t_0 = -5 \text{ °C}$ , calculate the value for  $t_c = 35 \text{ °C}$  between correction factors 574 and 553; calculated in steps 1 and 2; result: **450**
- Step 4: Calculate the theoretical  $k_{vs}$  value; result:  **$0.46 \text{ m}^3/\text{h}$**
- Step 5: Select the valve; the valve closest to the theoretical  $k_{vs}$  value is the **MVS661.25-0.4N**
- Step 6: Check that the theoretical  $k_{vs}$  value is greater than 50 % of nominal  $k_{vs}$  value

KE R717C	$t_0 = -10 \text{ °C}$	$t_0 = 0 \text{ °C}$
$t_c = 20 \text{ °C}$	481	376
$t_c = 35 \text{ °C}$	574	553
$t_c = 40 \text{ °C}$	605	612

Interpolation at	$t_c = 35 \text{ °C}$
$481 + [(605 - 481) \times (35 - 20) / (40 - 20)]$	574
$376 + [(612 - 376) \times (35 - 20) / (40 - 20)]$	553

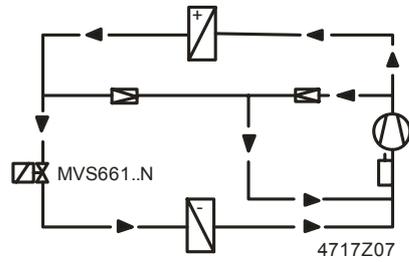
Interpolation at	$t_0 = -5 \text{ °C}$
$574 + [(553 - 574) \times (-5 - 0) / (-10 - 0)]$	450

$k_{vs}$  theoretical =  $205 \text{ kW} / 450 = 0.46 \text{ m}^3/\text{h}$

Valve MVS661.25-0.4N is suitable, since:  $0.46 \text{ m}^3/\text{h} / 0.4 \text{ m}^3/\text{h} \times 100 \% = 115 \% (> 50 \%)$

### Capacity control

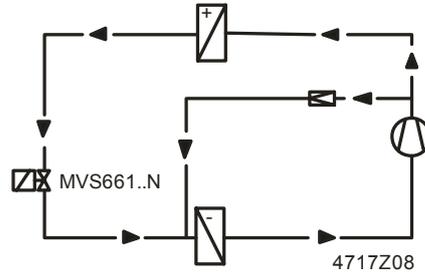
a) Refrigerant valve MVS661..N for capacity control of a dry expansion evaporator.



Suction pressure and temperature are monitored with a mechanical capacity controller and reinjection valve.

- Typical control range 0...100 %
- Energy-efficient operation with low loads
- Ideal control of temperature and dehumidification

b) Refrigerant valve MVS661..N for capacity control of a chiller.



- Typical control range 10...100 %
- Energy-efficient operation with low loads
- Allows wide adjustment of condensing and evaporating temperatures
- Ideal for use with plate heat exchangers
- Very high degree of frost protection

Note A larger valve may be required for low-load operation than is needed for full load conditions. To ensure that the selected valve will not be too small for low loads, sizing should take account of both possibilities.

**Correction table KE**  
Expansion valve

$t_c \setminus t_o$	R717					
	-40	-30	-20	-10	0	10
00	324	265	124			
20	481	488	494	481	376	124
40	581	590	598	605	612	618
60	662	673	683	693	701	708

$t_c \setminus t_o$	R22					
	-40	-30	-20	-10	0	10
00	82	68	37			
20	101	104	107	105	81	18
40	108	111	114	118	120	123
60	104	108	112	116	119	122

$t_c \setminus t_o$	R744					
	-40	-30	-20	-10	0	10
-20	226	149				
00	262	264	241	166		
20	245	247	247	246	213	

$t_c \setminus t_o$	R134a					
	-40	-30	-20	-10	0	10
00	27					
20	71	74	77	66	43	
40	74	78	81	85	89	92
60	67	72	76	81	85	89

$t_c \setminus t_o$	R402A					
	-40	-30	-20	-10	0	10
00	73	69	50			
20	77	81	85	88	74	35
40	71	75	80	84	88	91
60	50	55	60	65	69	74

$t_c \setminus t_o$	R401A					
	-40	-30	-20	-10	0	10
00	31					
20	80	83	85	72	46	
40	87	90	94	97	101	102
60	85	89	94	98	102	106

$t_c \setminus t_o$	R407A					
	-40	-30	-20	-10	0	10
00	79	67	40			
20	91	95	98	102	82	30
40	89	94	98	102	106	110
60	72	77	82	87	92	96

$t_c \setminus t_o$	R404A					
	-40	-30	-20	-10	0	10
00	69	63	44			
20	70	74	78	81	68	30
40	61	65	70	74	78	81
60	36	41	46	51	55	59

$t_c \setminus t_o$	R407C					
	-40	-30	-20	-10	0	10
00	79	65	31			
20	98	101	105	108	85	21
40	100	104	109	113	117	121
60	87	93	98	103	108	113

$t_c \setminus t_o$	R407B					
	-40	-30	-20	-10	0	10
00	72	66	45			
20	77	80	84	88	75	34
40	69	74	78	83	87	91
60	46	51	56	61	66	70

$t_c \setminus t_o$	R507					
	-40	-30	-20	-10	0	10
00	72	66	47			
20	78	81	83	86	71	33
40	74	78	81	84	87	90
60	53	57	61	64	68	71

- With superheat = 6 K      With subcooling = 2 K
- $\Delta p$  condenser = 0.3 bar     $\Delta p$  evaporator = 0.3 bar

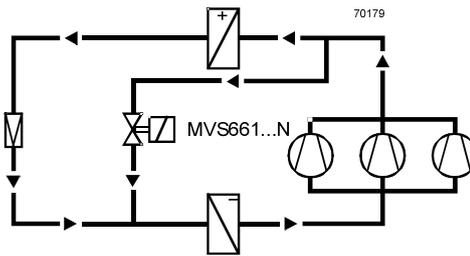
$t_c \setminus t_o$	R410A					
	-40	-30	-20	-10	0	10
00	116	117	91	12		
20	125	130	133	137	120	69
40	119	124	129	133	137	140
60	90	96	101	106	110	114

$\Delta p$  upstream of evaporator = 1.6 bar

## Use of the MVS661...N as a hot-gas valve

The control valve throttles the capacity of a compressor stage. The hot gas passes directly to the evaporator, thus permitting capacity control in the range from 100 % down to approximately 0 %.

### Indirect hot-gas bypass application



Suitable for use in large refrigeration systems in air conditioning plant, to prevent unacceptable temperature fluctuations between the compressor stages.

### Application example

With low loads, the evaporating and condensing pressures can fluctuate depending on the type of pressure control. In such cases, evaporating pressure increases and condensing pressure decreases. Due to the reduction in differential pressure across the fully open valve, the volumetric flow rate will drop – the valve is undersized. This is why the effective pressures must be taken into account when sizing the valve for low loads.

Refrigerant R507; 3 compressor stages;  $Q_0 = 75 \text{ kW}$ ;  $t_o = 4 \text{ }^\circ\text{C}$ ;  $t_c = 40 \text{ }^\circ\text{C}$   
 Part load  $Q_0$  per stage =  $28 \text{ kW}$ ;  $t_o = 4 \text{ }^\circ\text{C}$ ;  $t_c = 23 \text{ }^\circ\text{C}$

KH R507	$t_o = 0 \text{ }^\circ\text{C}$	$t_o = 10 \text{ }^\circ\text{C}$
$t_c = 20 \text{ }^\circ\text{C}$	14,4	9,0
$t_c = 23 \text{ }^\circ\text{C}$	15,6	11,0
$t_c = 40 \text{ }^\circ\text{C}$	22,4	22,0

Interpolation at	$t_c = 23 \text{ }^\circ\text{C}$
$14,4 + [(22,4 - 14,4) \times (23 - 20) / (40 - 20)]$	15,6
$9,0 + [(22,0 - 9,0) \times (23 - 20) / (40 - 20)]$	11,0

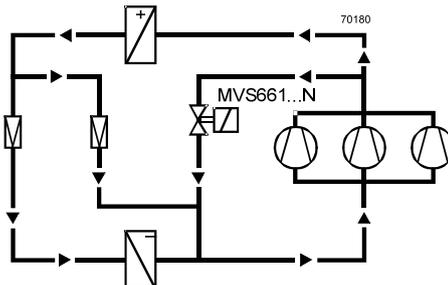
Interpolation at	$t_o = 4 \text{ }^\circ\text{C}$
$15,6 + [(11,0 - 15,6) \times (4 - 0) / (10 - 0)]$	13,8

$$k_{vs} \text{ theoretical} = 28 \text{ kW} / 13,8 = 2,03 \text{ m}^3/\text{h}$$

Valve MVS661.25-2.5N is suitable, since:  $2.03 \text{ m}^3/\text{h} / 2.5 \text{ m}^3/\text{h} \times 100 \% = 81 \% (> 50 \%)$

### Direct hot-gas bypass application

The control valve throttles the capacity of one compressor stage. The gas is fed to the suction side of the compressor and then cooled using a reinjection valve. Capacity control ranges from 100 % down to approximately 10 %.



Suitable for large refrigeration systems on air conditioning applications with several compressors or compressor stages, and where the evaporator and compressor are some distance apart (attention must be paid to the oil return).

## Correction table KH

Hot-gas valve

$t_c \setminus t_o$	R717					
	-40	-30	-20	-10	0	10
00	20	19	14			
20	38	38	38	38	35	19
40	67	66	65	64	64	63
60	110	107	105	103	102	100

$t_c \setminus t_o$	R22					
	-40	-30	-20	-10	0	10
00	8,9	8,4	6,3			
20	15,3	15,1	14,8	14,6	13,2	6,5
40	24,2	23,7	23,2	22,8	22,4	22,1
60	35,7	34,7	33,8	33,0	32,3	31,7

$t_c \setminus t_o$	R744					
	-40	-30	-20	-10	0	10
-20	38,1	30,5				
00	60,9	59,8	58,1	47,1		
20	87,3	84,9	82,5	80,2	76,1	

$t_c \setminus t_o$	R134a					
	-40	-30	-20	-10	0	10
00	4,5					
20	9,8	9,6	9,5	9,2	7,4	
40	15,9	15,6	15,3	15,1	14,9	14,7
60	23,8	23,2	22,7	22,3	21,9	21,6

$t_c \setminus t_o$	R402A					
	-40	-30	-20	-10	0	10
00	9,7	9,5	8,3			
20	15,9	15,7	15,4	15,2	14,5	9,3
40	23,7	23,2	22,7	22,4	22,0	21,7
60	31,5	30,7	29,9	29,2	28,7	28,1

$t_c \setminus t_o$	R401A					
	-40	-30	-20	-10	0	10
00	4,7					
20	10,2	10,0	9,9	9,5	7,6	
40	16,9	16,6	16,2	16,0	15,8	15,6
60	25,9	25,2	24,6	24,1	23,7	23,3

$t_c \setminus t_o$	R407A					
	-40	-30	-20	-10	0	10
00	8,9	8,6	6,7			
20	15,7	15,4	15,2	15,0	14,1	8,0
40	24,9	24,4	23,9	23,5	23,1	22,8
60	35,9	34,9	34,0	33,2	32,6	32,0

$t_c \setminus t_o$	R404A					
	-40	-30	-20	-10	0	10
00	9,4	9,2	7,8			
20	15,2	15,0	14,8	14,6	13,9	8,6
40	22,3	21,8	21,5	21,1	20,9	20,6
60	28,8	28,0	27,4	26,8	26,4	25,9

$t_c \setminus t_o$	R407C					
	-40	-30	-20	-10	0	10
00	8,6	8,1	5,9			
20	15,3	15,0	14,8	14,6	13,6	7,0
40	24,7	24,2	23,7	23,3	22,9	22,6
60	36,3	35,3	34,4	33,6	33,0	32,4

$t_c \setminus t_o$	R407B					
	-40	-30	-20	-10	0	10
00	9,0	8,8	7,4			
20	15,3	15,1	14,8	14,7	14,0	8,8
40	23,3	22,8	22,4	22,0	21,7	21,5
60	31,6	30,7	30,0	29,3	28,8	28,3

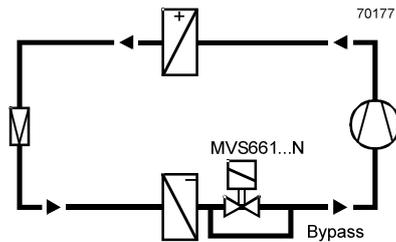
$t_c \setminus t_o$	R507					
	-40	-30	-20	-10	0	10
00	9,8	9,5	8,1			
20	16,1	15,8	15,5	15,3	14,4	9,0
40	24,5	23,8	23,3	22,8	22,4	22,0
60	33,1	31,8	30,7	29,8	29,0	28,3

$t_c \setminus t_o$	R410A					
	-40	-30	-20	-10	0	10
00	14,5	14,3	13,2	6,2		
20	24,2	23,7	23,3	23,0	22,1	15,9
40	36,8	35,9	35,1	34,4	33,7	33,1
60	50,0	48,5	47,2	46,0	44,9	43,8

- With superheat = 6 K      With subcooling = 2 K
- $\Delta p$  condenser = 0.3 bar       $\Delta p$  evaporator = 0.3 bar

$\Delta p$  upstream of evaporator = 1.6 bar

## Use of the MVS661..N as a suction throttle valve



Typical control range 50...100 %.

Minimum stroke limit control:

To ensure optimum cooling of the compressor, either a capacity controller must be provided for the compressor, or a minimum stroke must be set via the valve electronics.

The minimum stroke can be limited to a maximum of 80 %. At zero load, the minimum stroke must be sufficient to ensure that the minimum gas velocity in the suction line is  $> 0.7$  m/s and that the compressor is adequately cooled.

As the control valve closes, the evaporating temperature rises and the air-cooling effect decreases continuously. The electronic control system provides demand-based cooling without unwanted dehumidification and costly retreatment of the air.

The pressure at the compressor inlet falls and the power consumption of the compressor is reduced. The energy savings to be anticipated with low loads can be determined from the compressor selection chart (power consumption at minimum permissible suction pressure). Compressor energy savings of up to 40 % can be achieved.

**The recommended differential pressure  $\Delta p_{V100}$  across the fully open control valve is between  $0.15 < \Delta p_{V100} < 0.5$  bar.**

### Application example

Refrigerant R134A;  $Q_0 = 9,5$  kW;  $t_o = 4$  °C;  $t_c = 40$  °C;

Differential pressure across MVS661..N:  $\Delta p_{V100} = 0,25$  bar

In this application example,  $t_o$ ,  $t_c$  and  $\Delta p_{V100}$  are to be interpolated.

KS R134a	$t_o = 0$ °C	$t_o = 10$ °C
0,15 / 20	<b>2.2</b>	<b>2.7</b>
0,15 / 50	<b>1.7</b>	<b>2.1</b>
0,45 / 20	<b>3.6</b>	<b>4.5</b>
0,45 / 50	<b>2.7</b>	<b>3.4</b>

Interpolation at	$t_o = 4$ °C
$2,2 + [(2,7 - 2,2) \times (4 - 0) / (10 - 0)]$	2,4
$1,7 + [(2,1 - 1,7) \times (4 - 0) / (10 - 0)]$	1,9
$3,6 + [(4,5 - 3,6) \times (4 - 0) / (10 - 0)]$	4,0
$2,7 + [(3,4 - 2,7) \times (4 - 0) / (10 - 0)]$	3,0

$t_o = 4$ °C	$t_c = 20$ °C	$t_c = 50$ °C
$\Delta p_{V100} 0,15$	<b>2.4</b>	<b>1.9</b>
$\Delta p_{V100} 0,45$	<b>4.0</b>	<b>3.0</b>

Interpolation at	$t_c = 40$ °C
$2,4 + [(1,9 - 2,4) \times (40 - 20) / (50 - 20)]$	2,1
$4,0 + [(3,0 - 4,0) \times (40 - 20) / (50 - 20)]$	3,3

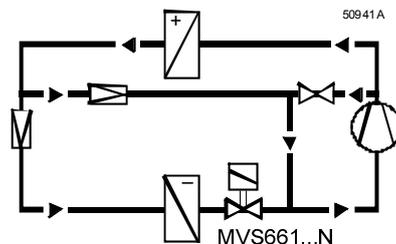
$t_c = 40$ °C	$\Delta p_{V100} 0,15$	$\Delta p_{V100} 0,45$
	<b>2.1</b>	<b>3.3</b>

Interpolation at	$\Delta p_{V100} 0,25$
$2,1 + [(3,3 - 2,1) \times (0,25 - 0,15) / (0,45 - 0,15)]$	2,5

$k_{vs}$  theoretical =  $9,5$  kW /  $2,5 = 3,8$  m<sup>3</sup>/h

Valve MVS661.25-6.3N is suitable, since  $3,8$  m<sup>3</sup>/h /  $6,3$  m<sup>3</sup>/h  $\times 100$  % = 60 % ( $> 50$  %)

It is recommended that the  $k_{vs}$  value be set to 63 % =  $4$  m<sup>3</sup>/h



Typical control range 10...100 %.

The capacity controller ensures that the compressor is adequately cooled, making it unnecessary to set a minimum stroke in the refrigerant valve.

**Correction table KS**  
Suction throttle valve

$t_c$	R717					
	$\Delta p_{v100} \setminus t_o$	-40	-30	-20	-10	0
0.15 / 20	2.7	3.7	4.8	6.0	7.3	8.8
0.15 / 50	2.3	3.2	4.2	5.2	6.4	7.8
0.45 / 20	3.2	5.2	7.4	9.7	12.1	14.8
0.45 / 50	2.8	4.6	6.5	8.5	10.7	13.1

$t_c$	R22					
	$\Delta p_{v100} \setminus t_o$	-40	-30	-20	-10	0
0.15 / 20	1,2	1,5	1,9	2,4	2,9	3,4
0.15 / 50	0,9	1,2	1,5	1,9	2,3	2,7
0.45 / 20	1,5	2,3	3,0	3,9	4,8	5,7
0.45 / 50	1,2	1,8	2,4	3,0	3,8	4,6

$t_c$	R152A					
	$\Delta p_{v100} \setminus t_o$	-40	-30	-20	-10	0
0.15 / 20	0,9	1,3	1,7	2,2	2,7	3,3
0.15 / 50	0,7	1,0	1,4	1,7	2,2	2,7
0.45 / 20	1,0	1,5	2,4	3,3	4,3	5,3
0.45 / 50	0,7	1,2	1,9	2,6	3,5	4,4

$t_c$	R134a					
	$\Delta p_{v100} \setminus t_o$	-40	-30	-20	-10	0
0.15 / 20	0,7	1,0	1,4	1,8	2,2	2,7
0.15 / 50	0,5	0,7	1,0	1,3	1,7	2,1
0.45 / 20	0,7	1,2	1,9	2,7	3,6	4,5
0.45 / 50	0,5	0,9	1,4	2,0	2,7	3,4

$t_c$	R402A					
	$\Delta p_{v100} \setminus t_o$	-40	-30	-20	-10	0
0.15 / 20	1,1	1,4	1,8	2,2	2,7	3,3
0.15 / 50	0,7	0,9	1,2	1,5	1,8	2,3
0.45 / 20	1,5	2,2	2,9	3,7	4,6	5,6
0.45 / 50	0,9	1,4	1,9	2,4	3,1	3,8

$t_c$	R401A					
	$\Delta p_{v100} \setminus t_o$	-40	-30	-20	-10	0
0.15 / 20	0,8	1,1	1,5	1,9	2,3	2,9
0.15 / 50	0,6	0,8	1,1	1,5	1,8	2,3
0.45 / 20	0,8	1,3	2,1	2,9	3,7	4,7
0.45 / 50	0,6	1,0	1,6	2,3	3,0	3,7

$t_c$	R407A					
	$\Delta p_{v100} \setminus t_o$	-40	-30	-20	-10	0
0.15 / 20	1,0	1,4	1,8	2,3	2,9	3,5
0.15 / 50	0,7	1,0	1,3	1,6	2,1	2,6
0.45 / 20	1,3	2,0	2,9	3,8	4,7	5,9
0.45 / 50	0,9	1,4	2,0	2,7	3,4	4,3

$t_c$	R404A					
	$\Delta p_{v100} \setminus t_o$	-40	-30	-20	-10	0
0.15 / 20	1,0	1,3	1,7	2,2	2,7	3,3
0.15 / 50	0,6	0,8	1,1	1,4	1,7	2,1
0.45 / 20	1,4	2,1	2,8	3,6	4,5	5,5
0.45 / 50	0,8	1,2	1,7	2,3	2,9	3,6

$t_c$	R407C					
	$\Delta p_{v100} \setminus t_o$	-40	-30	-20	-10	0
0.15 / 20	1,0	1,4	1,8	2,3	2,9	3,5
0.15 / 50	0,7	1,0	1,3	1,7	2,1	2,6
0.45 / 20	1,3	2,0	2,8	3,8	4,8	5,9
0.45 / 50	0,9	1,4	2,1	2,8	3,5	4,4

$t_c$	R407B					
	$\Delta p_{v100} \setminus t_o$	-40	-30	-20	-10	0
0.15 / 20	1,0	1,3	1,7	2,2	2,7	3,3
0.15 / 50	0,6	0,8	1,1	1,4	1,8	2,2
0.45 / 20	1,3	2,0	2,7	3,5	4,5	5,5
0.45 / 50	0,8	1,2	1,7	2,3	3,0	3,8

$t_c$	R507					
	$\Delta p_{v100} \setminus t_o$	-40	-30	-20	-10	0
0.15 / 20	1,1	1,4	1,8	2,3	2,7	3,3
0.15 / 50	0,7	1,0	1,3	1,6	1,9	2,4
0.45 / 20	1,6	2,2	2,9	3,7	4,6	5,6
0.45 / 50	1,1	1,5	2,0	2,6	3,2	4,0

$t_c$	R410A					
	$\Delta p_{v100} \setminus t_o$	-40	-30	-20	-10	0
0.15 / 20	1,5	2,0	2,5	3,0	3,6	4,4
0.15 / 50	1,0	1,3	1,7	2,1	2,6	3,1
0.45 / 20	2,3	3,1	4,0	5,0	6,1	7,4
0.45 / 50	1,6	2,1	2,8	3,5	4,4	5,3

- With superheat = 6 K      With subcooling = 2 K       $\Delta p$  upstream of evaporator = 1.6 bar
- $\Delta p$  condenser = 0.3 bar       $\Delta p$  evaporator = 0.3 bar

**Revision numbers**

Product number	Valid from rev. no.
MVS661.25-016N	A
MVS661.25-0.4N	A
MVS661.25-1.0N	A
MVS661.25-2.5N	A
MVS661.25-6.3N	A