ENGINEERING
TOMORROW

Data Sheet

Pressure operated water valve
Type **WVO**

Compact valve

Pressure operated water valve type WVO is used for regulating the flow of water in refrigeration plant with water-cooled condensers.

The pressure operated water valve gives modulating regulation of the condensing pressure and so keeps it constant during operation. When the refrigeration plant is stopped, the cooling water flow is shut off automatically.

Pressure operated water valve can be used with flammable refrigerants. Double sealing between the refrigerant and the water line ensures that in case the bellows damage and the refrigerant leak, it cannot enter into the water. This severely limits the safety implications.

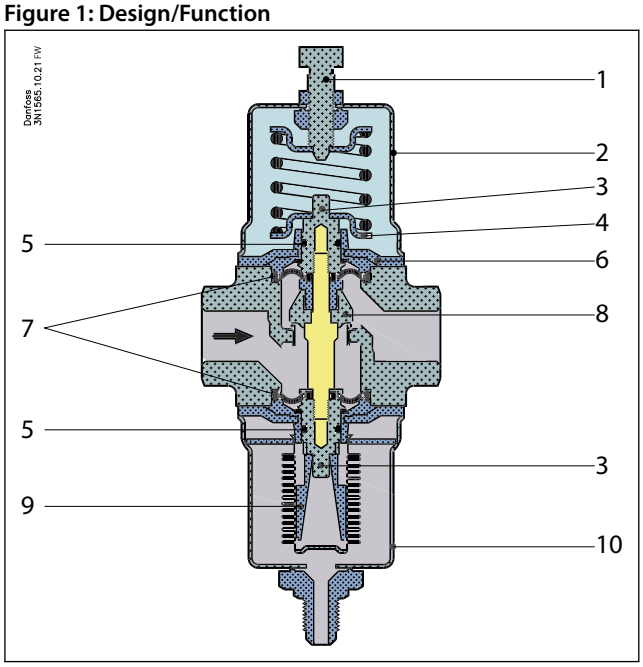
It means that the valve can be used together with a double walled heat exchanger and water circuit in such a system does not need to be considered as a part of the installation for flammable refrigerants (EN378-1:2008, clause 4.4.2.2).

Features

- Compact valve
- Setting pressure done by factory (optional)
- HCFC, HFC and HC
- NPT threads on request
- Capillary tube available as option
- Stainless steel version available for request
- Suitable for flammable refrigerants
- May be used in the following EX range: Category 3 (Zone 2)

Functions

Figure 1: Design/Function



1	Screw for setting pressure
2	Spring housing
3	Spindle retainer
4	Spring retainer
5	O-ring
6	Guide bush
7	Diaphragm
8	Valve plate
9	Thrust pad
10	Bellows element

Condensing pressure impulses are transmitted via the bellows element to the valve cone so that the valve - even at very small pressure variations - is able to adapt the quantity of water required by the condenser.

If fluorinated refrigerants are to be used a capillary tube connection is required, 1 m capillary tube with ¼ in. / 6 mm flared union nuts at either end can be supplied. The valves are pressure-relieved in such a way that a variation in the water pressure will not affect their setting.

To protect the refrigeration plant against high head pressures - in the event that the water supply to the condenser should fail - a safety switch type KP or RT should be fitted on the high pressure side.

The valve plate (8) is a brass plate with a vulcanized layer of special rubber to form an elastic seal against the valve seat. The valve is externally sealed by the diaphragms (7).

The top and bottom of the valve plate holder is extended by a guide that is fitted with O-rings (5) to ensure the internal operating parts move correctly. These O-rings, fitted in conjunction with the diaphragms, also provide extra protection against external leakage.

The valve seat is made of stainless steel and is swaged to the valve body.

Media

Table 1: Media specification

Features	Water side	Refrigerant side
Max. working pressure PS / MWP	16 bar / 232 psig	26.4 bar / 383 psig
Max. test pressure PT	24 bar / 350 psig	38 bar / 551 psig
Media	Fresh water and neutral brine	R22, R134a, R290[1], R404A, R407A, R407C, R407F, R407H, R422B, R422D, R448A, R449A, R449B, R450A, R452A, R454A[1], R454C[1], R455A[1], R507A, R513A, R600[1], R600a[1], R1234yf[1], R1270[1]
Max. differential pressure	10 bar / 145 psi	–
Temperature range	-25 – 130 °C / -13 – 266 °F	-25 – 130 °C / -13 – 266 °F

[1] WVO is evaluated for R290, R454A, R454C, R455A, R600, R600a, R1234yf, R1270 by ignition source assessment in accordance with standard EN ISO80079-36. Flare connections are only approved for A1 and A2L refrigerants.

For complete list of approved refrigerants, visit store.danfoss.com, where refrigerants are listed as part of technical data.

Product specification

Technical data

Table 2: Orifice size

Type	Orifice size		k_v value [1]	C_v value [2]
	[mm]	[in]	[m³/ h]	[gal / min]
WVO 10 LF	10	2⁄5	0.63	0.7
WVO 10	10	2⁄5	1.4	1.6
WVO 15	15	3⁄5	1.9	2.2
WVO 20	20	4⁄5	3.4	3.9
WVO 25	25	1	5.5	6.4

[1] The k_v value is the flow of water in [m³ / h] at a pressure drop across valve of 1 bar, ρ = 1000 kg / m³
[2] The C_v value is the flow of water in [gal / min] at a pressure drop across valve of 1 psi, ρ = 10 lbs / gal

Capacity

The capacity curves show the capacities of the individual valves (water quantity in [m³ / h]) depending on the water pressure drop across the valve. The capacity given apply at 85% valve opening and are obtained with the offset shown on Figure 4: Offset.

Figure 2: Capacity - SI unit

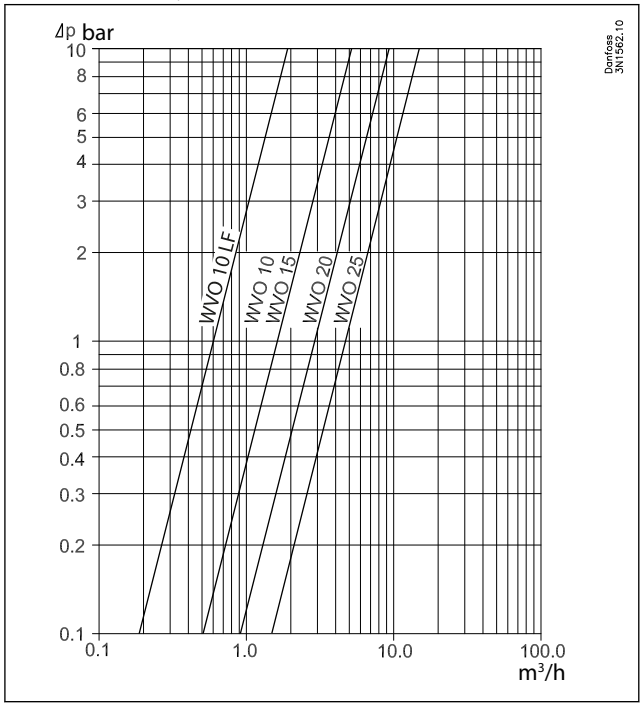
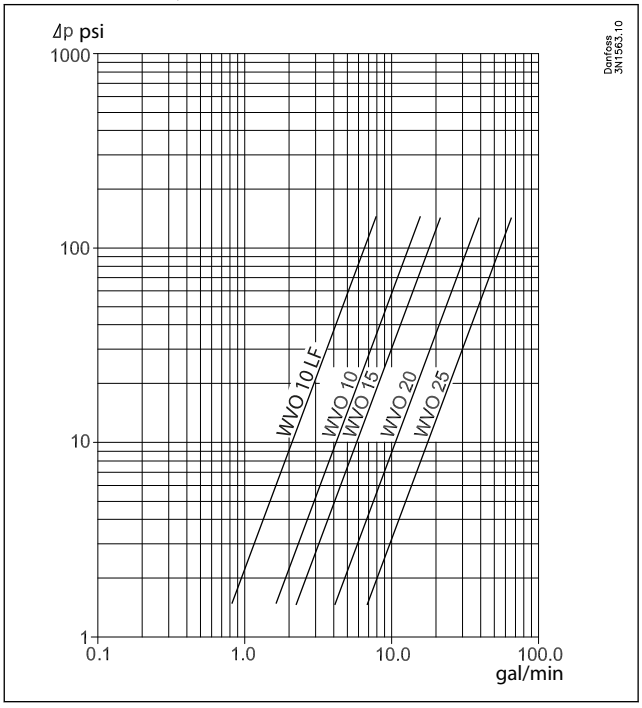


Figure 3: Capacity - US unit



Sizing

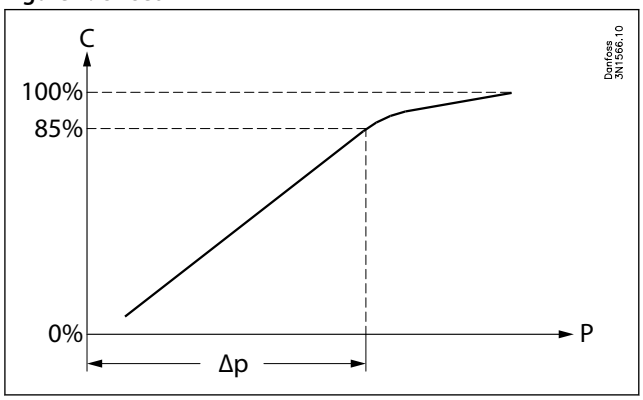
When sizing and selecting water regulating valves it is most important to ensure that the valve at any time is able to give the necessary quantity of cooling water.

To select a suitable size of valve it is necessary to know the precise amount of cooling required. On the other hand, to avoid the risk of unstable regulation (hunting) the valve should not be oversized. In general, the aim should be to select the smallest valve capable of giving the required flow .

To obtain a precise control it can be recommended to only use 85% of the capacity.

Below 85% the ratio between flow and condensing difference pressure is linear. Above 85% the ratio is no longer linear. To reach a 100% capacity the WVO needs significant increase of condensing pressure. See table at the bottom of the page.

Figure 4: Offset



C	Water capacity
P	Condensing pressure
Δp	Δp offset

Table 3: Offset

Type	Δp offset	
	[bar]	[psi]
WVO 10 LF	1.6	23
WVO 10	2.0	30
WVO 15	2.5	35
WVO 20	3.0	43
WVO 25	3.5	50

Valve size

The following data is used when selecting the size of WVO
- Cooling capacity of condenser
- Temperature rise in cooling media
- Differential pressure across valve
- Condensing temperature
- Specific heat capacity of cooling media
- Refrigerant

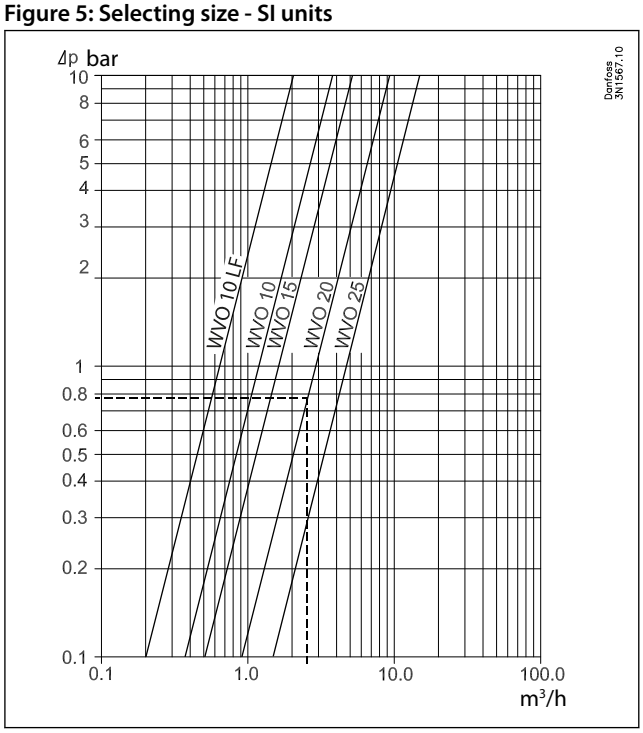
Calculating size in SI Unit

Example 1:
- Condenser capacity Q_0: 30 kW
- Condensing temperature t_c: 35 °C
- Refrigerant: R134a
- Cooling media: water
- Specific heat capacity of water C_p: 4.19 kj / (kg*K)
- Water inlet temperature t_1: 15 °C
- Water outlet temperature t_2: 25 °C
- Pressure drop across valve Δ_p: max. 1.0 bar

Table 4: Calculation for size - SI units

Features	Calculation
Necessary mass flow	$\dot{m} = \frac{Q_C}{C_p.(t_2 - t_1)} . 3600 = \frac{30}{4.19 . (25 - 15)} . 3600 = 2577$ kg/h
Volume flow	$\dot{V} = \frac{\dot{m}}{\rho} = \frac{2577}{1000} = 2.6\ m^3/h$

Figure 5: Selecting size - SI units



Selecting WVO 20 code number
The saturated pressure for R134a: T_c = 35 °C → P_c = 7.9 barg
Choose a WVO 20 with 6 – 10 barg range

Example 2:
- Condenser capacity Q_0: 20 kW
- Condensing temperature t_c: 35 °C
- Refrigerant: R134a
- Cooling media: Brine
- Density of brine ρ: 1015 kg / m³
- Specific heat capacity of brine C_p : 4.35 kj (kg*K)
- Brine inlet temperature t_1: 20 °C
- Brine outlet temperature t_2: 25 °C
- Pressure drop across valve Δ_p: max. 2.0 bar

Table 5: Calculation for size - SI units

Features	Calculation
Necessary mass flow	$\dot{m} = \frac{Q_C}{C_p.(t_2 - t_1)} . 3600 = \frac{20}{4.35 . (25 - 20)} . 3600 = 3310$ kg/h
Volume flow	$\dot{V} = \frac{\dot{m}}{\rho} = \frac{3310}{1015} = 3.26\ m^3/h$
k_v value	$K_V \geq \frac{\dot{V}}{\sqrt{\frac{1000 . \Delta p}{\rho}}} = \frac{\dot{V}}{\sqrt{\frac{1000 . 2.0}{1015}}} = 2.32\ m^3/h$

Selecting size of WVO 20
kv ≥ 2.32 m³ / h → **WVO 20**
WVO 20 has k_v = 3.4 m³ / h and the necessary capacity is below 85% of full capacity.

Code number
The saturated pressure for 134a: T_c = 35 °C P_c = 7.9 barg
Choose a WVO 20 with 6 – 10 barg range

Calculating size in US Unit

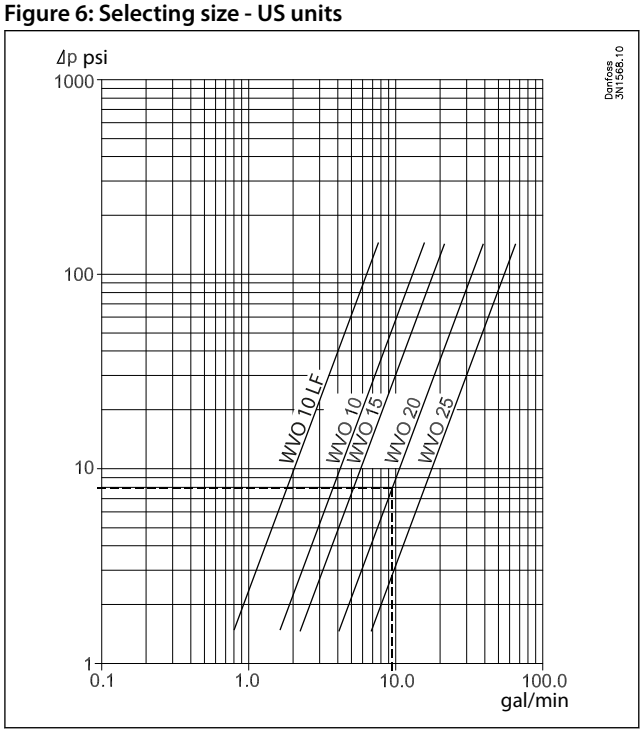
Example 1:

- Condenser capacity Q_c: 5 TR
- Condensing temperature t_c: 95 °F
- Refrigerant: R134a
- Cooling media: water
- Water inlet temperature t_1: 60 °F
- Water outlet temperature t_2: 75 °F
- Pressure drop across valve Δp: max. 15 psi

Table 6: Calculation for size - US units

Features	Calculation
Necessary water flow	$V = \frac{Q_c \cdot 15000}{500.(t_2 - t_1)} = \frac{5 \cdot 15000}{500.(75 - 60)} = 10$ GPM

Figure 6: Selecting size - US units



Selecting WVO 20 code number

The saturated pressure for R134a: T_c = 95 °F → P_c = 115 psig

Choose a WVO 20 with 85 – 145 psig range

Dimensions and weights

Figure 7: Dimensions for Valve

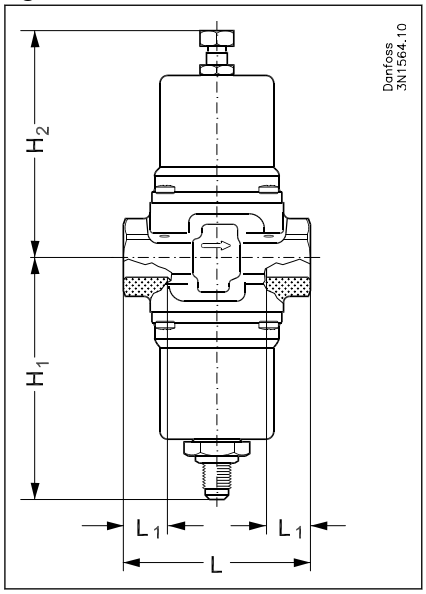


Figure 8: Dimensions for Bracket

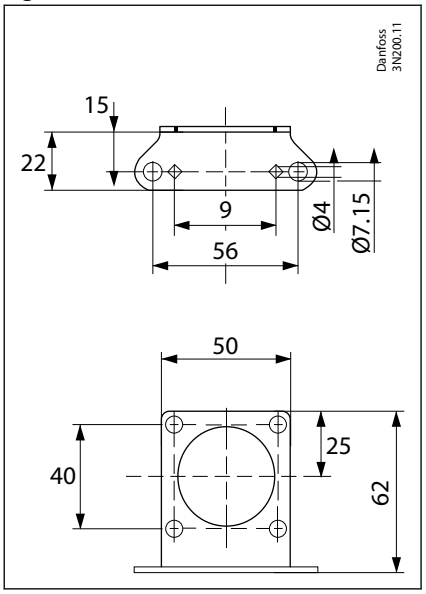


Table 7: Dimensions and weights

Type	H_1		H_2		L		L_1		Net weight	
	[mm]	[in]	[mm]	[in]	[mm]	[in]	[mm]	[in]	[kg]	[lbs]
WVO 10	91	3.58	89	3.50	72	2.83	11	0.43	1.0	2.20
WVO 15	91	3.58	89	3.50	72	2.83	14	0.55	1.0	2.20
WVO 20	91	3.58	89	3.50	90	3.54	16	0.63	2.0	4.40
WVO 25	96	3.78	94	3.70	96	3.74	19	0.75	2.0	4.40

Ordering

Table 8: Ordering

Type	Connection type	Connection standard	Pressure range		Code no.
			[bar]	[psig]	
WVO 10 LF	G ⅜	ISO 228–1	8 – 12	115 – 175	003N8053 [2]
WVO 10 LF	G ⅜	ISO 228–1	14 – 18	200 – 260	003N8054 [2]
WVO 10	G ⅜	ISO 228–1	8 – 12	115 – 175	003N5203
WVO 10	G ⅜	ISO 228–1	14 – 18	200 – 260	003N5206
WVO 10	G ⅜	ISO 228–1	16 – 20	232 – 290	003N5207
WVO 10	G ⅜	ISO 228–1	16 – 22	232 – 320	003N6220 [1]
WVO 15	G ½	ISO 228–1	Available on request		
WVO 20	G ¾	ISO 228–1	Available on request		
WVO 25	G 1	ISO 228–1	Available on request		
WVO 10	NPT ⅜	ANSI/ASME B1.20.1	6 – 10	85 – 145	003N8052
WVO 10	NPT ⅜	ANSI/ASME B1.20.1	14 – 18	200 – 260	003N8056
WVO 15	NPT ½	ANSI/ASME B1.20.1	6 – 10	85 – 145	003N8062
WVO 15	NPT ½	ANSI/ASME B1.20.1	14 – 18	200 – 260	003N8066
WVO 20	NPT ¾	ANSI/ASME B1.20.1	14 – 18	200 – 260	003N8076
WVO 25	NPT 1	ANSI/ASME B1.20.1	Available on request		

[1] with 0.8 m capillary tube and valve opener
[2] WVO 10 low flow version with kv value: 0,63 m^3/h

NOTE:
Codes for valve with prefabricated factory setting, other sizes and pressure ranges are available on request.

Accessories

Table 9: Accessories

Description	Code no.
1 m (39 in) capillary tube ¼ in. (6 mm) flare coupling nuts at each end	060-007166
Bracket	003N0388

Certificates, declarations, and approvals

The list contains all certificates, declarations, and approvals for this product type. Individual code number may have some or all of these approvals, and certain local approvals may not appear on the list.

Some approvals may change over time. You can check the most current status at danfoss.com or contact your local Danfoss representative if you have any questions.

Table 10: Certificates, declarations, and approvals

Document name	Document type	Document topic	Approval authority
003N9617.AB	Manufacturers Declaration	PED/RoHS	Danfoss
UL SA7200	Mechanical - Safety Certificate		UL
003N9614.AA	Manufacturers Declaration	China RoHS	Danfoss
003N9616.AA	Manufacturers Declaration	ATEX	Danfoss

ENGINEERING
TOMORROW

Online support

Danfoss offers a wide range of support along with our products, including digital product information, software, mobile apps, and expert guidance. See the possibilities below.

The Danfoss Product Store

The Danfoss Product Store is your one-stop shop for everything product related—no matter where you are in the world or what area of the cooling industry you work in. Get quick access to essential information like product specs, code numbers, technical documentation, certifications, accessories, and more.
Start browsing at store.danfoss.com.

Find technical documentation

Find the technical documentation you need to get your project up and running. Get direct access to our official collection of data sheets, certificates and declarations, manuals and guides, 3D models and drawings, case stories, brochures, and much more.

Start searching now at www.danfoss.com/en/service-and-support/documentation.

Danfoss Learning

Danfoss Learning is a free online learning platform. It features courses and materials specifically designed to help engineers, installers, service technicians, and wholesalers better understand the products, applications, industry topics, and trends that will help you do your job better.

Create your Danfoss Learning account for free at www.danfoss.com/en/service-and-support/learning.

Get local information and support

Local Danfoss websites are the main sources for help and information about our company and products. Find product availability, get the latest regional news, or connect with a nearby expert—all in your own language.

Find your local Danfoss website here: www.danfoss.com/en/choose-region.

Coolselector®2 - find the best components for you HVAC/R system

Coolselector®2 makes it easy for engineers, consultants, and designers to find and order the best components for refrigeration and air conditioning systems. Run calculations based on your operating conditions and then choose the best setup for your system design.

Download Coolselector®2 for free at coolselector.danfoss.com.