Data sheet

# Pressure operated water valve Type WVO

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
- Compliant with ATEX hazard zone 2

## Technical data

| | 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 | HCFC, HFC and HC |
| **Max. differential pressure** | 10 bar/145 psi | — |
| **Temperature range** | -25 – 130 °C/-13 – 266 °F | |

| Type | Orifice size | | $k_v$ value [1] | $C_v$ value [2] |
|---|---|---|---|---|
| | [mm] | [in.] | [$m^3/h$] | [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 [$m^3/h$] at a pressure drop across valve of 1 bar, ρ = 1000 kg/$m^3$

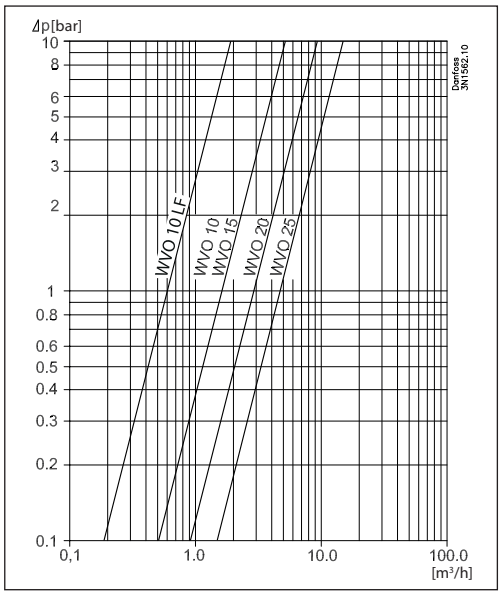
[2] The $C_v$ value is the flow of water in [gal/min] at a pressure drop across valve of 1 psi, ρ = 10 lbs/gal

## Capacity

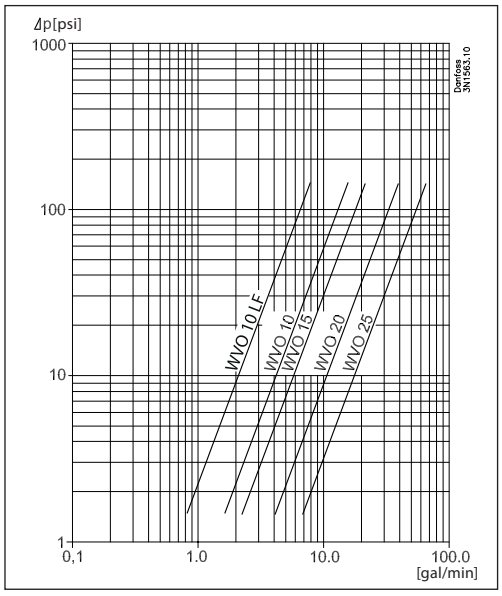
The capacity curves show the capacities of the individual valves (water quantity in [$m^3/h$]) depending on the water pressure drop across the valve.

The capacity given apply at 85% valve opening and are obtained with the offset shown on page 4.

*SI unit*




*US unit*



## Ordering

| Type | Connection type | Connection standard | Pressure range | | Code no. |
|---|---|---|---|---|---|
| | | | [bar] | [psig] | |
| **WVO 10 LF** | G 3/8 | ISO 228–1 | 8 – 12 | 115 – 175 | **003N8053** [2] |
| **WVO 10 LF** | G 3/8 | ISO 228–1 | 14 – 18 | 200 – 260 | **003N8054** [2] |
| **WVO 10** | G 3/8 | ISO 228–1 | 8 – 12 | 115 – 175 | **003N5203** |
| **WVO 10** | G 3/8 | ISO 228–1 | 14 – 18 | 200 – 260 | **003N5206** |
| **WVO 10** | G 3/8 | ISO 228–1 | 16 – 20 | 232 – 290 | **003N5207** |
| **WVO 10** | G 3/8 | ISO 228–1 | 16 – 22 | 232 – 320 | **003N6220** [1] |
| **WVO 15** | G 1/2 | ISO 228–1 | Available on request | | |
| **WVO 20** | G 3/4 | ISO 228–1 | Available on request | | |
| **WVO 25** | G 1 | ISO 228–1 | Available on request | | |
| **WVO 10** | NPT 3/8 | ANSI/ASME B1.20.1 | 6 – 10 | 85 – 145 | **003N8052** |
| **WVO 10** | NPT 3/8 | ANSI/ASME B1.20.1 | 14 – 18 | 200 – 260 | **003N8056** |
| **WVO 15** | NPT 1/2 | ANSI/ASME B1.20.1 | 6 – 10 | 85 – 145 | **003N8062** |
| **WVO 15** | NPT 1/2 | ANSI/ASME B1.20.1 | 14 – 18 | 200 – 260 | **003N8066** |
| **WVO 20** | NPT 3/4 | 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 $k_v$ value: 0,63 $m^3/h$

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

*Accessories*

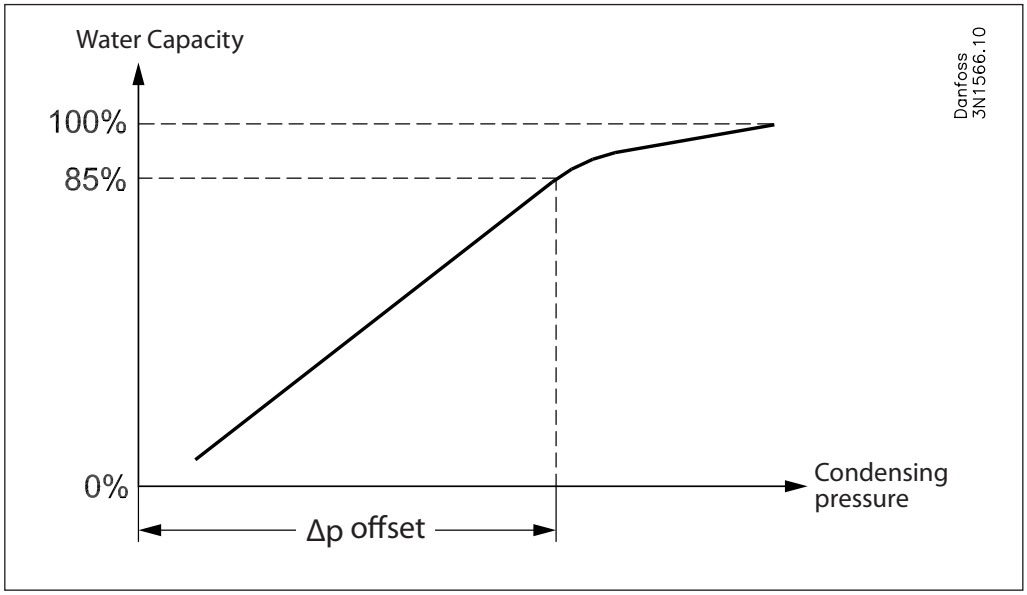
| Description | Code no. |
|---|---|
| 1 m (39 in.) capillary tube ¼ in. (6 mm) flare coupling nuts at each end | **060-007166** |
| Bracket | **003N0388** |

## 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.

## 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.

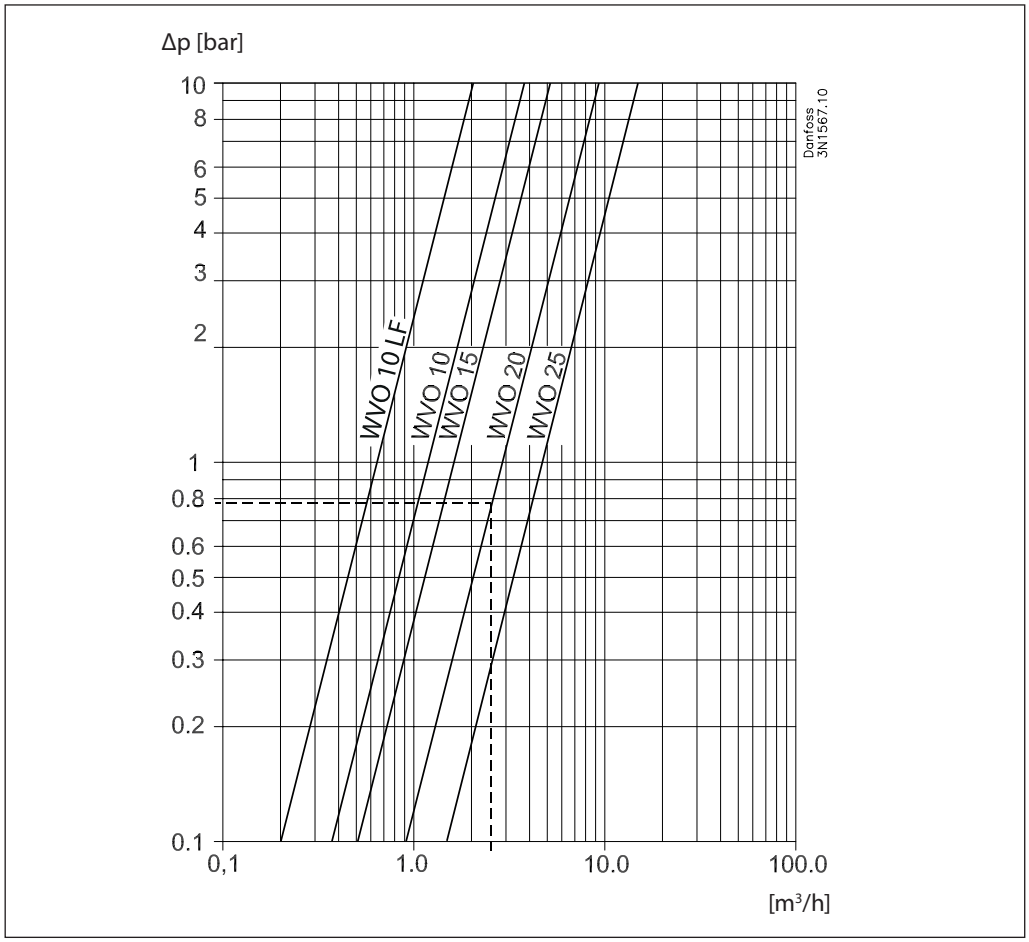
## Calculating size in SI Unit

*Example 1:*

- Condenser capacity $Q_0$: 30 kW,
- Condensing temperature $t_0$: 35 °C,
- Refrigerant: R404A,
- 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 $\Delta_p$: max. 1.0 bar

| | |
|---|---|
| **Necessary mass flow** | $\dot{m} = \frac{Q_c}{C_p \cdot (t_2 - t_1)} \cdot 3600 = \frac{30}{4.19 \cdot (25 - 15)} \cdot 3600 = 2577$ kg/h |
| **Volume flow** | $\dot{V} = \frac{\dot{m}}{\rho} = \frac{2577}{1000} \approx 2.6$ m³/h |

*Selecting size*




*Selecting WVO 20 code number*

The saturated pressure for R404A
$T_c = 35$ °C ⇒ $P_c = 7.9$ barg

**Choose a WVO 20 with 6 – 10 barg range.**

**Calculating size in SI Unit**
*(continue)*

*Example 2:*

- Condenser capacity $Q_c$: 20 kW,
- Condensing temperature $t_c$: 35 °C,
- Refrigerant: R134a,
- Cooling media: Brine,
- Density of brine ρ: 1015 kg/m$^{3,}$
- 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 Δp: max. 2.0 bar.

| | |
|---|---|
| **Necessary mass flow** | $\dot{m} = \frac{Q_c}{C_p \cdot (t_2 - t_1)} \cdot 3600 = \frac{20}{4.35 \cdot (25-20)} \cdot 3600 = 3310 \text{ kg/h}$ |
| **Volume flow** | $\dot{V} = \frac{\dot{m}}{\rho} = \frac{3310}{1015} \approx 3.26 \text{ m}^3\text{/h}$ |
| **$k_v$ value** | $k_v \geq \frac{\dot{V}}{\sqrt{\frac{1000 \cdot \Delta p}{\rho}}} = \frac{3.26}{\sqrt{\frac{1000 \cdot 2.0}{1015}}} = 2{,}32 \text{ m}^3\text{/h}$ |

*Selecting size of WVO 20*

$k_v \geq 2.32$ m$^3$/h ⇒ **WVO 20**
WVO 20 has $k_v = 3.4$ m$^3$/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.**

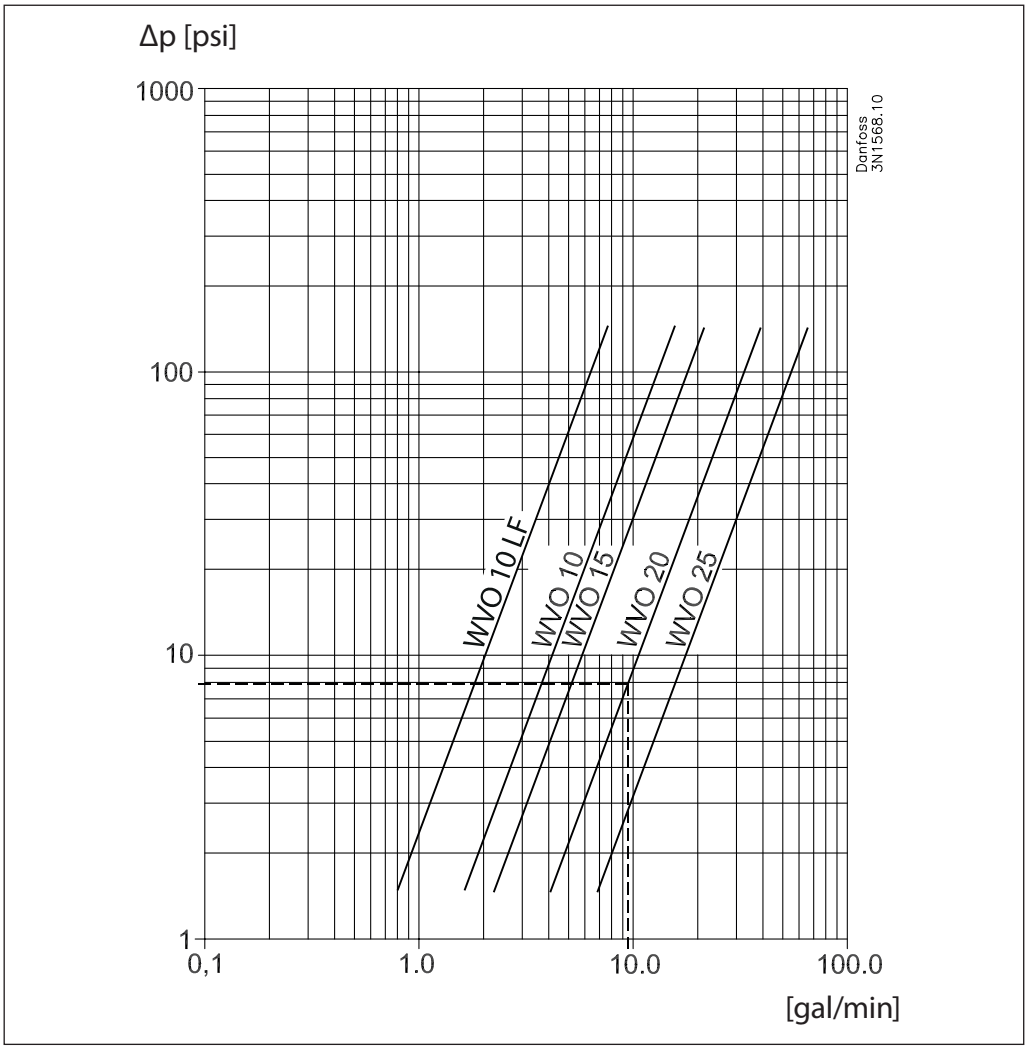
## Calculating size in US Unit

*Example 1:*

- Condenser capacity $Q_c$: 5 TR,
- Condensing temperature $t_c$: 95 °F,
- Refrigerant: R404A,
- 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.

| | |
|---|---|
| **Necessary water flow** | $V = \frac{Qc \cdot 15000}{500 \cdot (t_2 - t_1)} = \frac{5 \cdot 15000}{500 \cdot (75 - 60)} = 10$ GPM |

*Selecting size*

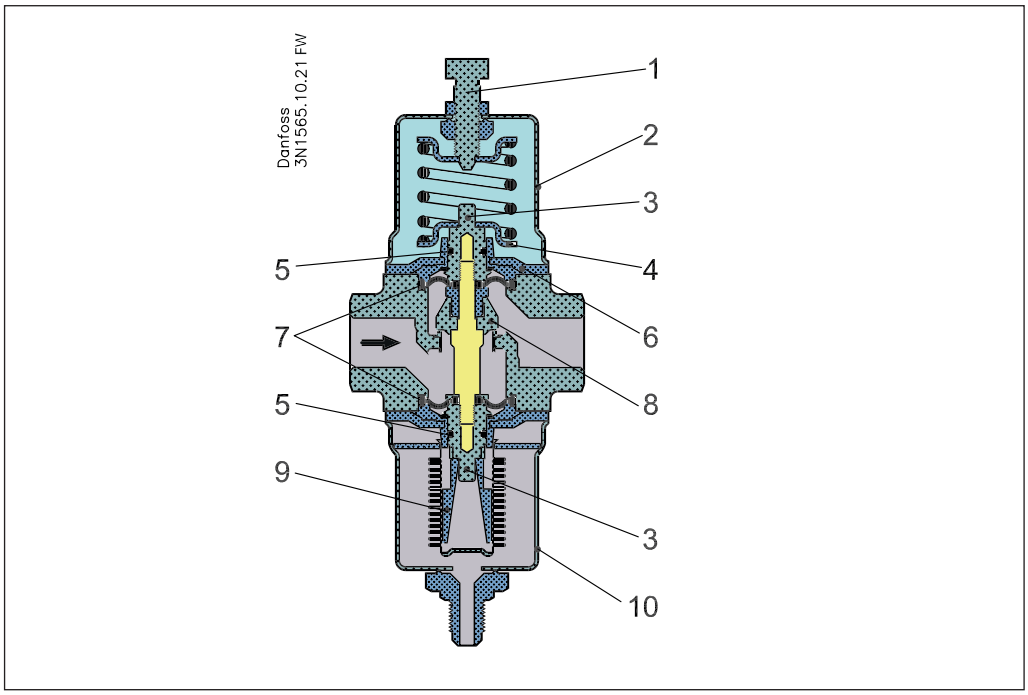



*Selecting WVO 20 code number*

The saturated pressure for R404A
$T_c = 95$ °F $\Rightarrow P_c = 115$ psig

**Choose a WVO 20 with 85 – 145 psig range.**

## 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.

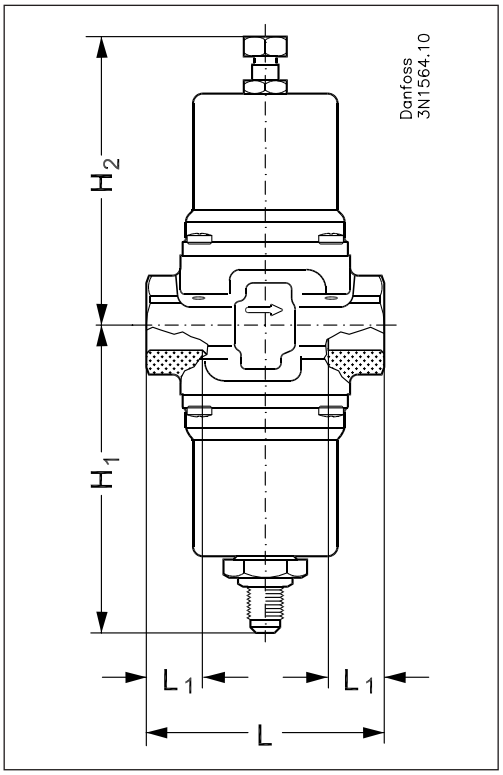
The valve plate (8) is a brass plate with a vulcanized layer of special rubber to form an elastic seal against the valve seat. The valve is externally sealed by the diaphragms (7).
The top and bottom of the valve plate holder is extended by a guide that is fitted with O-rings (5) to ensure the internal 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.

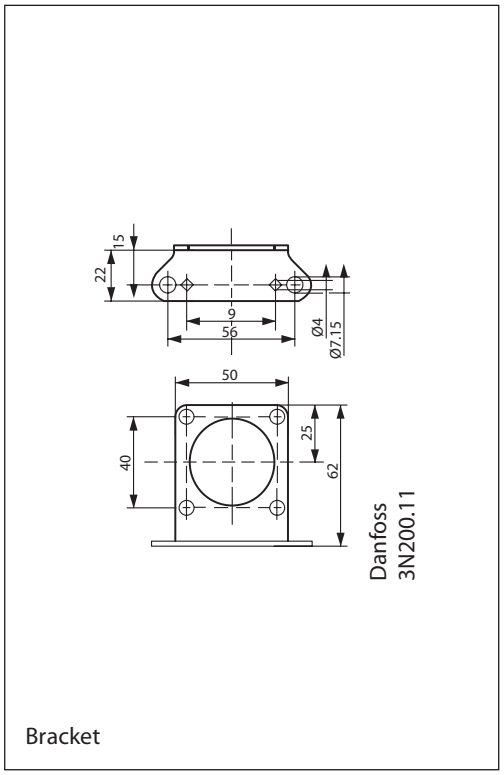
## Installation

Between the flare connection of the pressure operated water valve and the pipe line / compressor Danfoss recommends to use capillary tube to avoid fatigue error due to the vibration from the compressor.

The installation of an MESH 40 filter ahead of the valve is recommended.
If a mounting bracket is used it must always be between valve body and setting section.

## 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 |