

Thermostatically operated
cooling water valves
Types AVTA and FJVA

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Introduction

Thermostatically controlled valves are used for the infinite proportional regulation of flow quantities, depending on the setting and the sensor temperature.

The Danfoss range of thermostatic valves includes a series of industrial products for both refrigeration and heating regulation. The valves are self-acting, i.e. they operate without a supply of auxiliary energy such as electricity or compressed air.

Because the valves constantly match flow quantity to demand they are especially suitable for temperature regulation.

The required temperature is maintained constant with no overconsumption of - cooling water in cooling systems - hot water or steam in heating systems. Thus operating economy and efficiency is maximized.

- AVTB for heat regulation 1/2" → 1"
- AVTA for cooling regulation 1/2" → 1"
- IVT for heat regulation 1/2" → 2"
- WVTS for cooling regulation 1 1/4" → 4"

For further information please contact Danfoss.

Technical data

General

Thermostatic valves consist of three main elements.

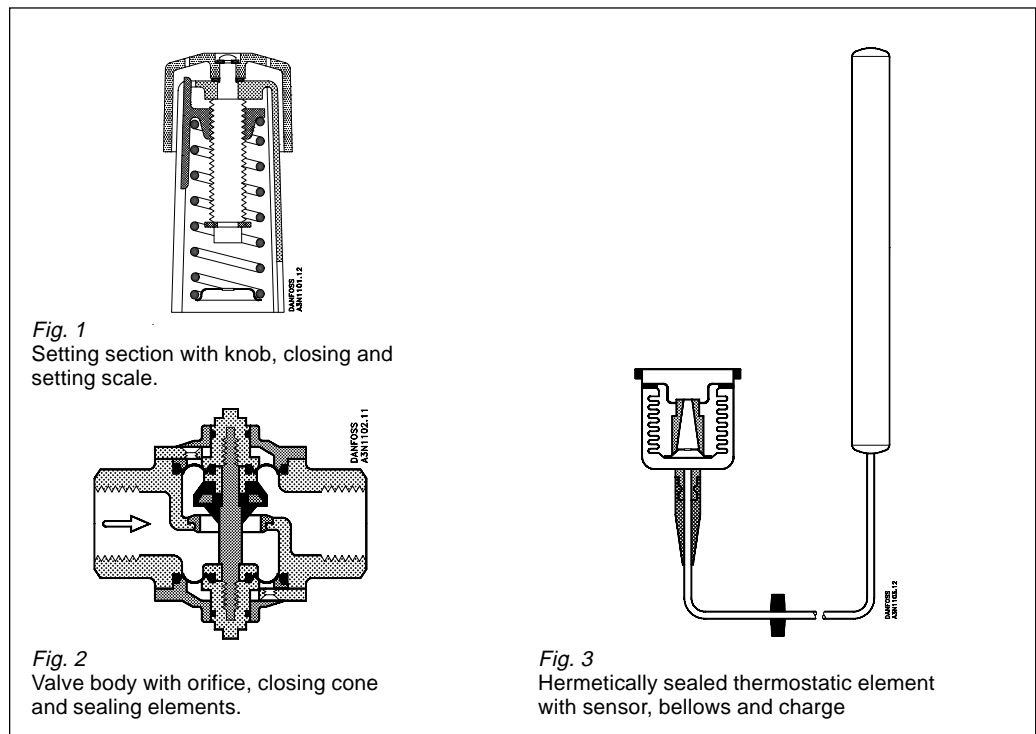


Fig. 1 Setting section with knob, closing and setting scale.

Fig. 2 Valve body with orifice, closing cone and sealing elements.

Fig. 3 Hermetically sealed thermostatic element with sensor, bellows and charge

Function

When the three elements are built together and the sensor is located at the point where the temperature is to be regulated, the function sequence is as follows:

1. A temperature-dependent pressure – charge vapour pressure – builds up in the sensor.
2. This pressure is transferred to the valve via the capillary tube and bellows and acts as an opening or closing force.
3. The knob on the setting section and the spring exert a force that acts counter to the bellows.

4. When balance is created between the two opposing forces the valve spindle remains in its position.
5. If the sensor temperature – or the setting – is changed, the point of balance becomes displaced and the valve spindle moves until balance is re-established, or the valve is fully open or closed.
6. On sensor temperature change the flow quantity change is approximately proportional.

The illustrations show an AVTA cooling water valve, but the function principle applies to all types of thermostatic valves.

Types AVTA and FJVA

Application AVTA

Self-acting AVTA cooling water valves are widely used for temperature regulation in many different machines and installations where cooling is required. AVTA always opens to admit flow on rising sensor temperature. The valve can be installed either in the cooling water flow line or return line.

Typical application areas

- Injection moulding machines
- Compressors
- Vacuum pumps
- Dry cleaning machines
- Distillashon plants
- Printing machines
- Hydraulic systems
- Rollers/mills

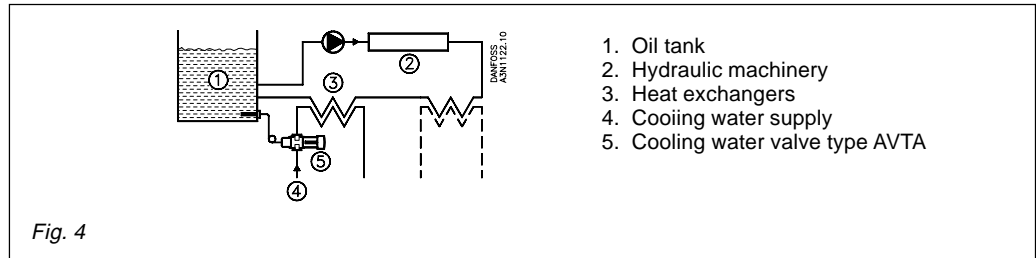


Fig. 4

1. Oil tank
2. Hydraulic machinery
3. Heat exchangers
4. Cooling water supply
5. Cooling water valve type AVTA

Specifications and products

- Opens on rising sensor temperature
- Media temperature $-13^{\circ} \rightarrow +266^{\circ} \text{F}$
- Differential pressure $0 \rightarrow 145 \text{ Psi}$
- Max. test pressure 362 Psi
- Max. working pressure 232 Psi
- The valves are pressure-relieved, i.e. the degree of opening is not affected by differenhal pressure Δp (pressure drop).

No.	Description	Material
4	Spindle	Brass(DIN 17660)W.No.20401
5	Diaphragms	Ethylene-propylene-rubber(EPDM)
7	Valve body and other parts	Forged brass(DIN 17660)W.No.2.0402
8	Valve cone	Nitrile rubber (NBR)
9	Valve seat	Stainless steel (DIN 17440)W.No.1.4305
12	Sensor	Copper(DIN 1787)W.No.2.0090
13	Capillary tube gland	Nitrile rubber(NBR),Brass DEN 17660 W.No. 2.0321 og W.No.2.0401

AVTA valves are available with three different types of charge.

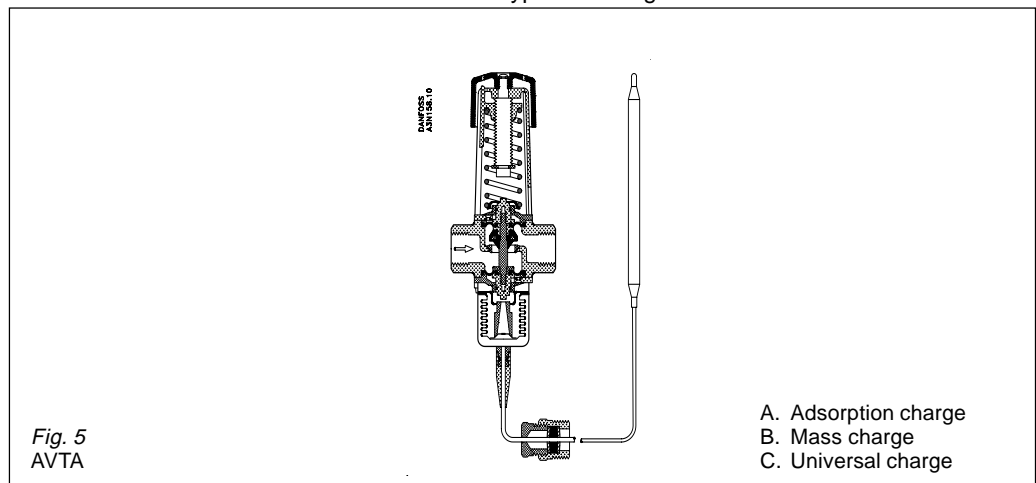


Fig. 5
AVTA

- A. Adsorption charge
- B. Mass charge
- C. Universal charge

Types AVTA and FJVA

AVTA with adsorption charge

The charge consists of active carbon and CO₂ which are absorbed or absorbed on rising or falling sensor temperature and produce pressure changes in the element.

Special characteristics

- Can be installed in any position.
- Withstands up to 266 °F sensor temperature
- Small sensor dimensions - 0.4" × 6.3"
- Max. pressure on sensor 362 Psi

Connection NPT	Regulating range °F	Cv-value US gpm	Capillary tube length Ft.	Type	Code no.
1/2" - 14	50 - 176	2.2	7' 6"	AVTA 15	003N6115
3/4" - 14		4.0		AVTA 20	003N7120
1" - 1 1/2		6.4		AVTA 25	003N8125

Code no. covers complete value incl. capillary tube gland, sensor pockets, see "Accessories"

AVTA with universal charge

The charge is liquid / gas where the liquid surface (regulation point) is always inside the sensor. Which charge medium is used depends on the temperature range.

Special characteristics

- Sensor dimensions 0.7" × 8.3"
- Sensor can be installed colder or warmer than the valve
- Sensors must be orientated as shown in the sketch.
- Max. pressure on sensor 362 Psi

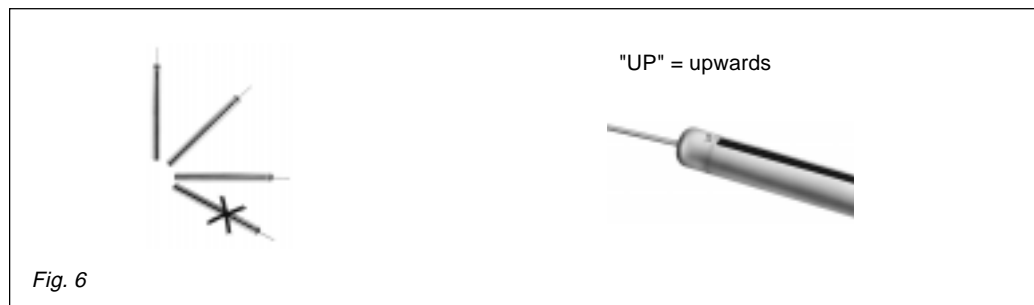


Fig. 6

Type	Connection NPT	Setting range °F	Capillary tube length Ft.	Cv-value US gpm	Max. bulb temperature °F	Code no.
AVTA 15	1/2" - 14	32- 86	6' 6"	2.2	135	003N6132
		77-149			194	003N6162
		122-194			257	003N6182
AVTA 20	3/4" - 14	32- 86	6' 6"	4.0	135	003N7132
		77-149			194	003N7162
		122-194			257	003N7182
AVTA 25	1" - 1 1/2	32- 86	6' 6"	6.4	135	003N8132
		77-149			194	003N8162
		122-194			257	003N8182

Code no. covers complete value incl. capillary tube gland, sensor pockets, see „Accessories“, page 10.

Types AVTA and FJVA

AVTA with mass charge

The charge is liquid/gas. Because of the volumetric conditions the liquid surface (regulation point) can be either in the sensor or the bellows, depending on the temperature conditions.

Special characteristics:

- Small sensor dimensions –0.4" × 7.5"
- Short time constant
- Sensor must always be installed warmer than the valve
- Max. pressure on sensor 362 Psi

For further information please contact Danfoss.

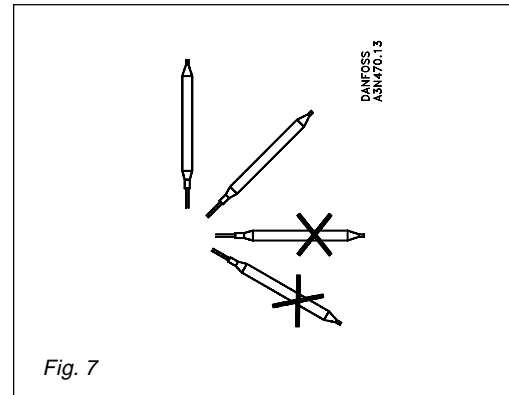


Fig. 7

Application FJVA

F1VA valves are for applications where, because of installation problems, etc. it is desirable to avoid using capillary tube. This applies mainly where regulation accuracy requirements are more moderate and where an integral bypass can be accepted. In FJVA the whole bellows element is used as the sensor. The valve reacts against the cooling water temperature and therefore it must always be installed in the return line. Thus, indirect regulation is involved. Valves of this type operate with significantly longer time constants than AVTA valves where the sensor is located at the point at which the temperature is to be regulated. FJVA is mainly used in systems where large and sudden load changes do not occur.

For further information please contact Danfoss.

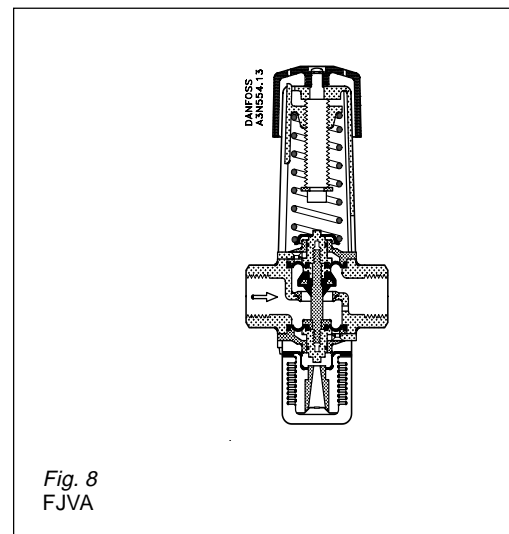


Fig. 8
FJVA

Sizing

When sizing and selecting a thermostatic valve, the most important point is to ensure that irrespective of the load the valve will always give the necessary quantity of cooling water. To be able to select a suitable size of valve, a necessary precondition is that information on the cooling effect is available. On the other hand, the valve must not be too large, otherwise there will be a risk of unstable regulation (hunting).

The choice of charge is based on the temperature to be maintained, and on an assessment of the characteristics of the individual types, as previously described.

In general, the aim must be to select the smallest valve capable of ensuring adequate flow.

A further recommendation is that the temperature range be selected so that the required sensor temperature lies at range mid-point.

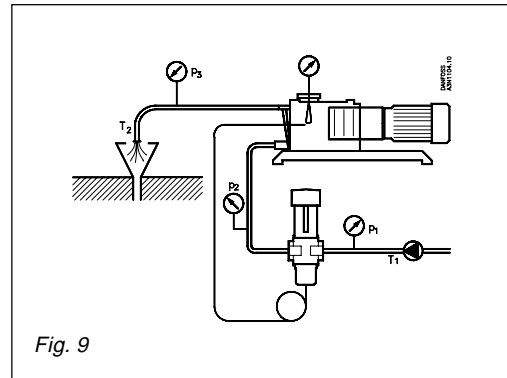
To enable fine adjustment of the valve, a thermometer should be installed near the sensor.

Types AVTA and FJVA

Valve size

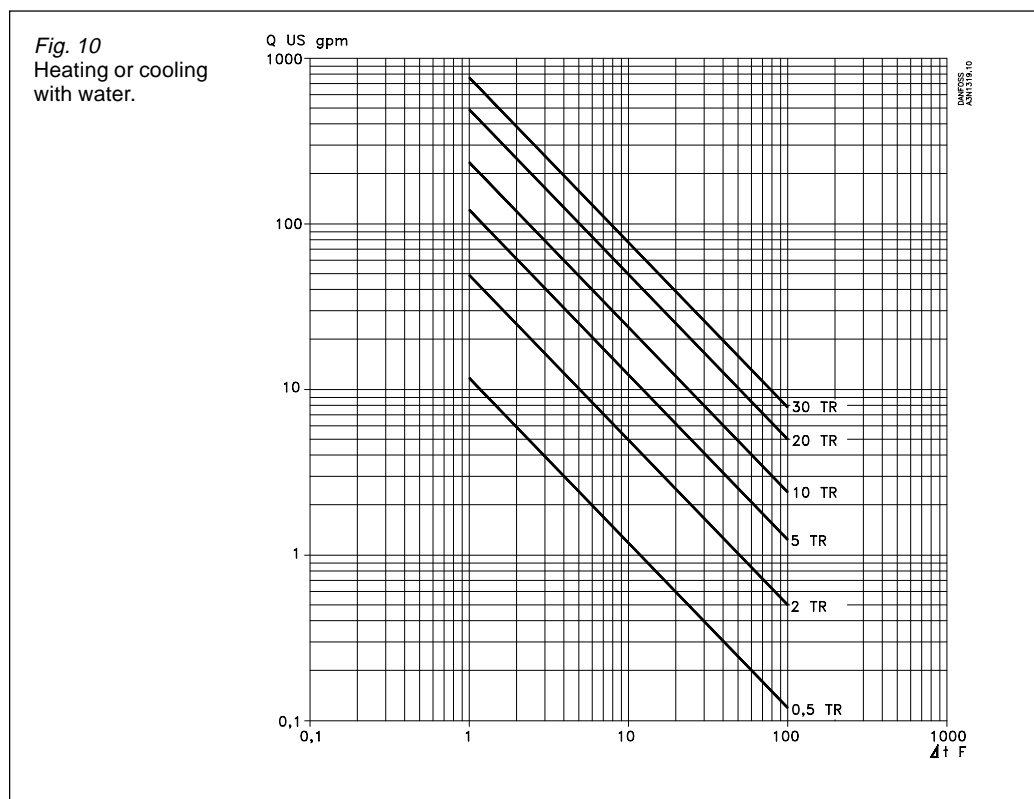
When selecting valve size, the following data applies:

- Necessary cooling water quantity Q - US gpm
- Temperature rise in cooling water Δt - F
- Differential pressure across valve, Δp - Psi. When the valve is fully open the differential pressure ought to be about 50% of the total pressure drop across the cooling system.



The diagrams make it easy to select valve size.

Example



Example
Necessary cooling effect 5 TR with $t = 20^\circ\text{F}$.
Flow is 6 US gpm.

A cooling water valve must be selected for the temperature regulation of a vacuum pump.

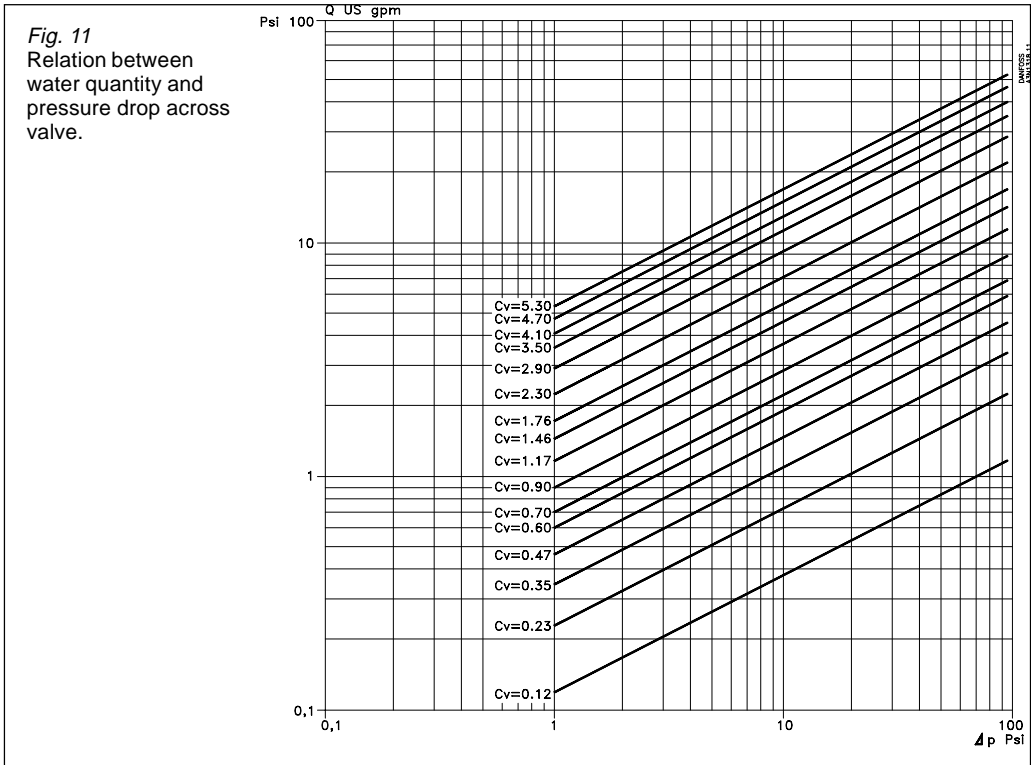
Since direct regulation of the oil temperature is required, select an AVTA. The sensor position is horizontal and small dimensions are desirable.

Given data

- Necessary cooling effect with full load 5 TR
- Oil temperature to be maintained at 113°F
- Cooling water $p_1 = 60$ Psi
- Discharge $p_3 = 0$ Psi
- Discharge temperature $t_1 = 88^\circ\text{F}$

1. Using the graph in fig.10, you find the necessary cooling water quantity at $\Delta t = 20^\circ\text{F}$ ($88 - 68^\circ\text{F}$) for 6 US gpm.

Types AVTA and FJVA



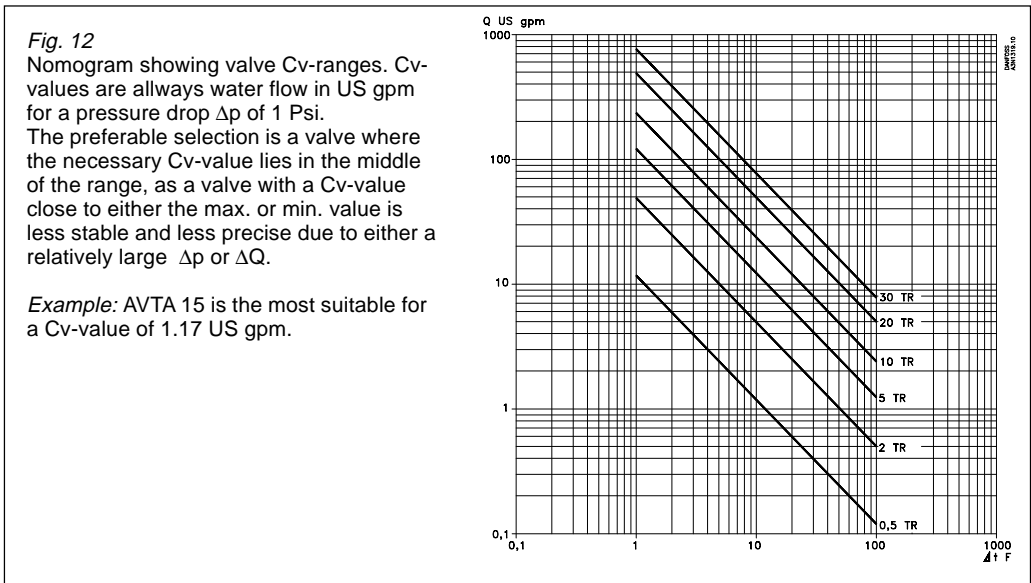
Example
Flow 6 US gpm with a pressure drop of 30 Psi. The Cv-value becomes 1.17 US gpm.

- Using the graph in fig. 11, you find the necessary Cv-value for 6 US gpm at $\Delta p = 30$ Psi $((60 - 0)/2)$ for 1.17 US gpm.
- It can be seen from the columns in fig.12 that all three AVTA valves can be used, but the preferable selection is a valve where the necessary Cv-value lies in the middle of the range. So in practice an AVTA 15 ought to be selected as it fully meets the demand.

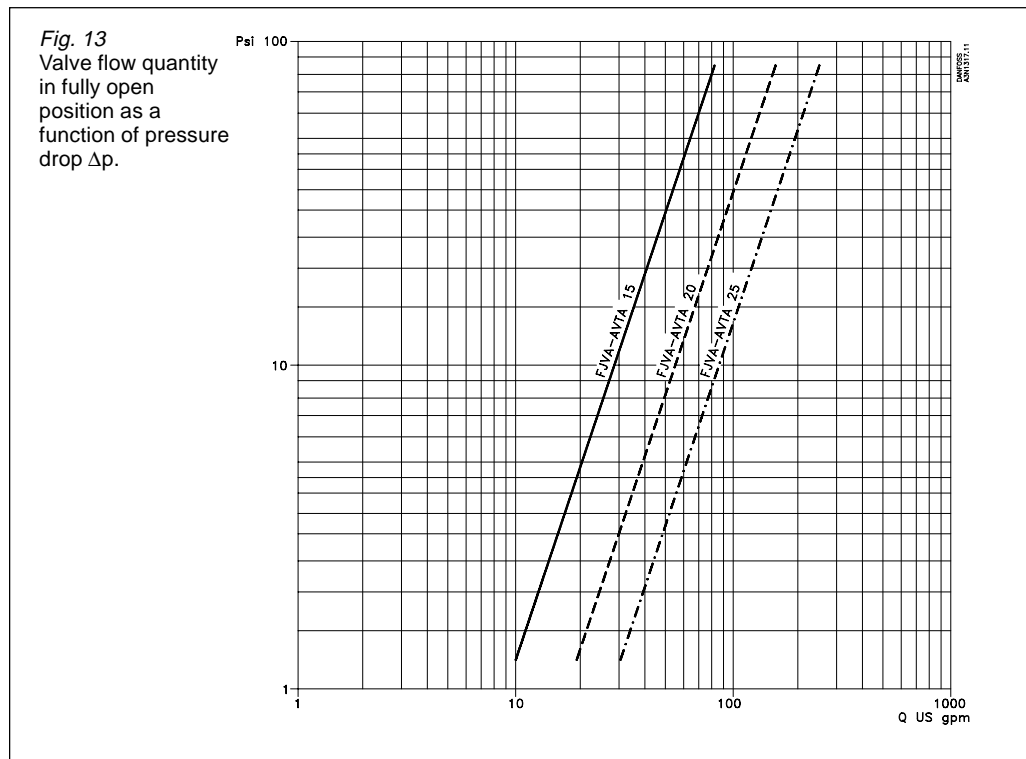
Operating conditions and other requirements on the product in this example indicate that a valve with an adsorption charge is the most correct. The temperature range must be $50 \rightarrow 176$ °F.

The table on page 5 gives AVTA 15, code no. **003N6115**, which fulfill the requirements. To facilitate the installation a sensor pocket is often used. A sensor pocket for $\varnothing 0,4$ " sensor in brass, code no. **993N3569**, or in stainless steel, code no. **003N0196**, is listed under "Accessories" on page 10.

Consideration on the determination of valve size apply to both AVTA and FJVA.



Types AVTA and FJVA



Installation of AVTA / FJVA

- The valves can be installed in any position.
- An arrow on the valve body indicates the direction of the flow.
- AVTA and FJVA are also marked so that the letters RA can be read straightforwardly when the valve is held as shown.
- The installation of a filter ahead of the valve is recommended.

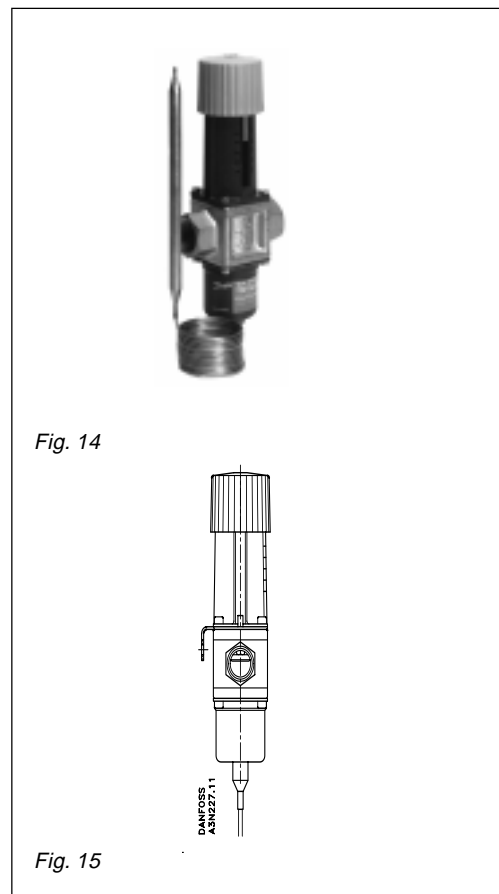
Capillary tube

Install the capillary tube without sharp bends (no „kinks“). Relieve the capillary tube at the ends. Relief is important where vibration might occur.

Note: Where AVTA is used, the sensor must be able to react to temperature variations in the cooling water on system start. Therefore a bypass line with shut-off valve might be necessary to ensure flow at the sensor during start-up.

If a mounting bracket is used it must always be between valve body and setting section. Sensors must be installed as given in the description of the respective types.

If sensor pockets are used, it is advantageous to apply heat-conductive compound to reduce the reaction time. See "Accessories" page 10.



Types AVTA and FJVA

Spare parts

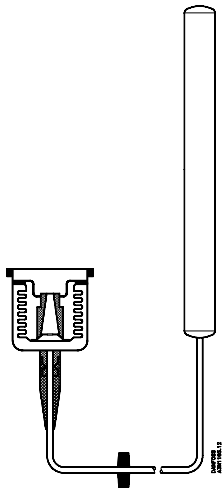


Fig. 16

Service elements for AVTA

Description	Temperature range °F	Capillary tube length Ft.	Code no.
Adsorption charge - sensor Ø 0.4" × 6.39"	50 → 176	7' 6"	003N0278
Universal charge - sensor Ø 0.7" × 8.3"	32 → 86	6' 6"	003N0075
		16' 5"	003N0077
	77 → 149	6' 6"	003N0078
		16' 5"	003N0080
		6' 6" amoured	003N0063
			10"
Mass charge - sensor Ø 0.4" × 7.5" See mounting instructions	32 → 86	-	003N0066
	77 → 149	6' 6"	003N0091

Service elements for AVTA

Without capillary tube and sensor	32 → 86	-	003N0285
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Accessories

Designation	Description	Code no.
	Sensor pocket, max. pressure 341 Psi, L = 8.7"	Brass for Ø 0.7" - sensor G 3/4" 003N0050
		Brass for Ø 0.7" - sensor 3/4"-14 NPT 003N0051
		ss Ø 0.7" 3/4" NPT 003N0053
		18/8 steel Ø 0.7" - sensor G 3/4" 003N0192
	Sensor pocket, max. pressure 341Psi, L = 7.2"	Brass for Ø 0.4" - sensor G 1/2" 993N3569
		18/8 steel for Ø 0.4" - sensor G 1/2" 003N0196
	Mounting bracket	For AVTA / FJVA 003N0388
	Heat-conductive compound	041E0110
	1-off nitrile diaphragm for mineral oil	For AVTA 15 003N0445
		For AVTA 20 003N0446
		For AVTA 25 003N0447
	Capillary tube gland	G 1/2" 017-4220
		G 3/4" 003N0155
		G 1/2"-14 NPT 003N0157
		G 3/4"-14 NPT 003N0056
	O-ring (2-off) Diaphragm (2-off) Valve cone (1-off)	For AVTA / FJVA 15 003N4006
		For AVTA / FJVA 20 003N4007
		For AVTA / FJVA 25 003N4008
	Top section	For AVTA / FJVA 003N0001

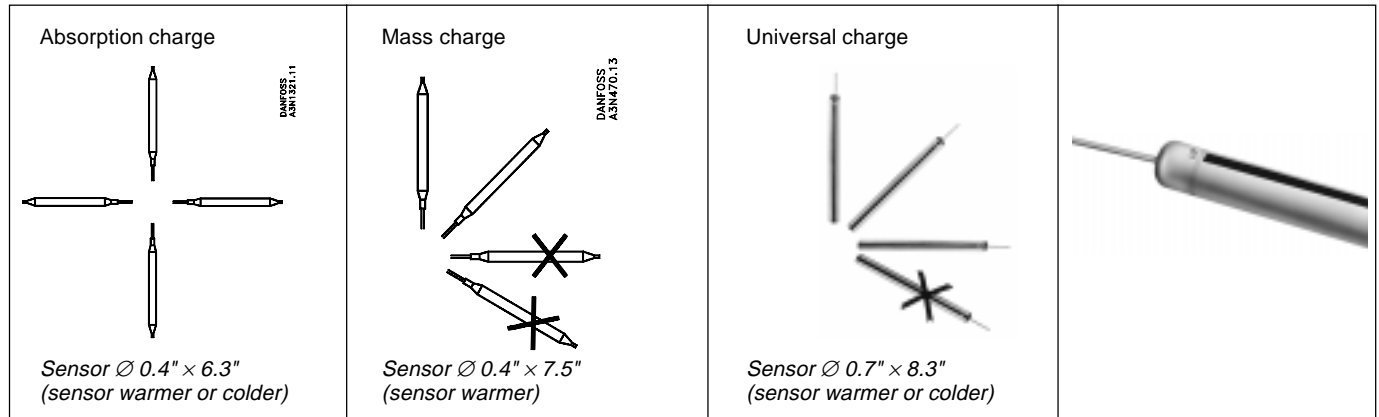
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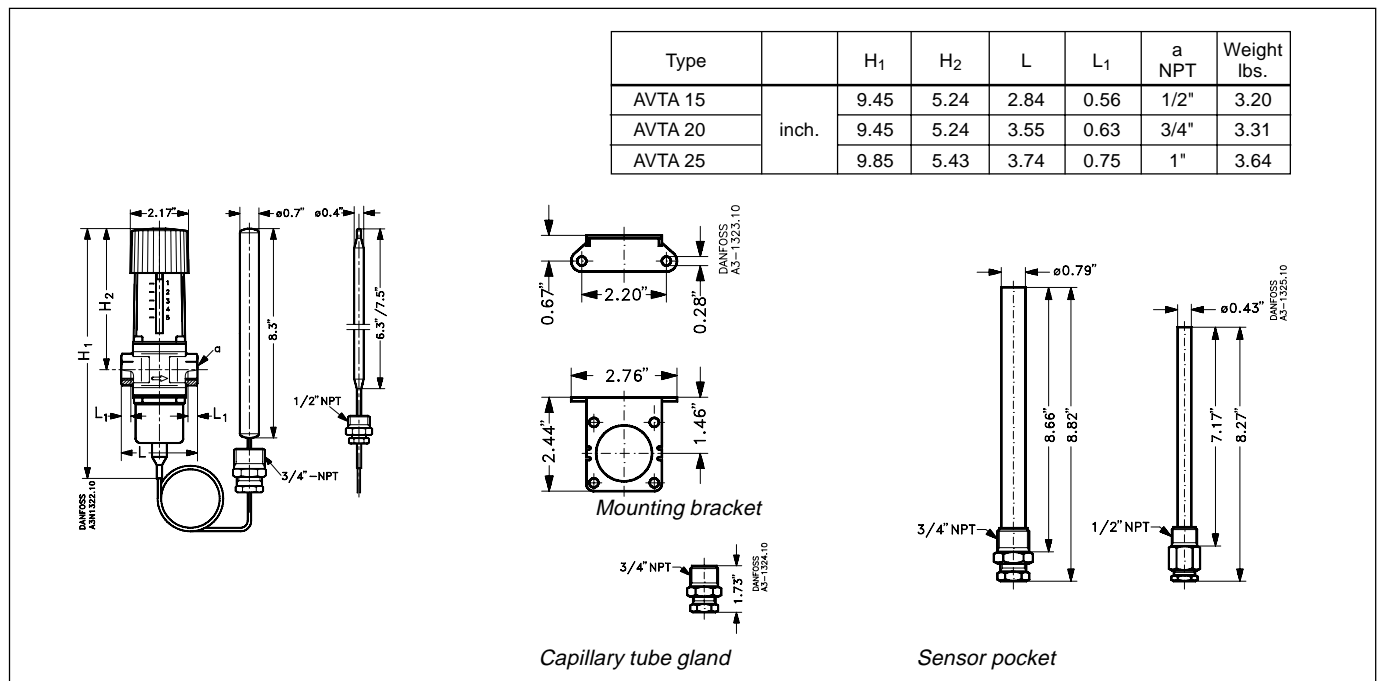
Installation

The valve can normally be fitted in the supply or return, in any position, provided the flow is always in the direction indicated by the arrow.

Elements with a small sensor $\varnothing 0.4" \times 7.5"$ ("sensor warmer") must always have the valve housing fitted in the inlet.



Dimensions



ISO 9001

Danfoss A/S has achieved BSI Certification meeting the international standard ISO 9001. This means that Danfoss meets the international standards of product development,

design, production and sales. BSI will currently supervise that Danfoss observes this standard as well as Danfoss own quality control system.

Types AVTA and FJVA

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