Danfoss

Thermostatic valve
AVTA

Contents   **Page**

Features

AVTA
- Insensitive to dirt
- Insensitive to water pressure
- Needs no power supply - self acting
- Opens on rising sensor temperature
- Differential pressure: 0 to 10 bar
- Max. working pressure: 16 bar
- Max. test pressure: 25 bar
- Max.pressure on sensor: 25 bar
- Stainless Steel version available
- The valves are pressure-relieved, i.e. the degree of opening is not affected by differential pressure Δp (pressure drop).
- The regulation range is defined for the point at which the valve begins to open.

Introduction

Thermostatic valves are used for the infinite, proportional regulation of flow quantity, 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 the 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.
The operating economy and efficiency is maximized.

How it works

Thermostatic valves consist of three main elements:

- Setting section with knob, reference spring and setting scale.

- Valve body with orifice, closing cone and sealing elements.

- Hermetically sealed thermostatic element with sensor, bellows and charge.
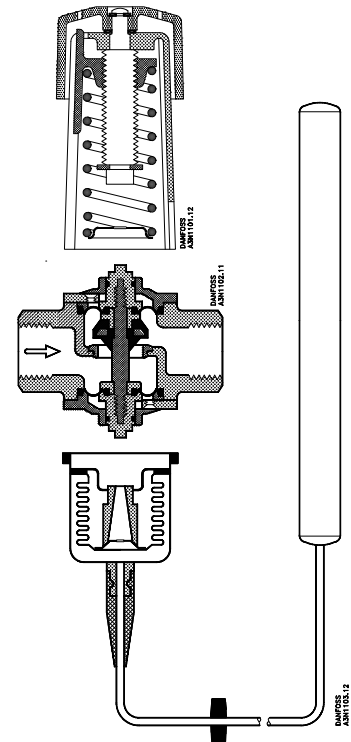
When the three elements are built together, the valve is installed and the sensor is located at the point where the temperature is to be regulated, the function sequence is as follows:

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.

How it works (continued)

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 settings - 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.

AVTA application

AVTA thermostatic 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.
Standard version of thermostatic valve AVTA can be used with fresh water or neutral brine.

- Typical application areas
- Injection moulding machines
- Compressors
- Vacuum pumps
- Dry cleaning machines
- Destillation plants
- Printing machines
- Hydraulic systems
- Rolles/ mills
- Biomass boilers
- Industrial lasers
- Steam sterilizers
- Medical equipment
- Food processing
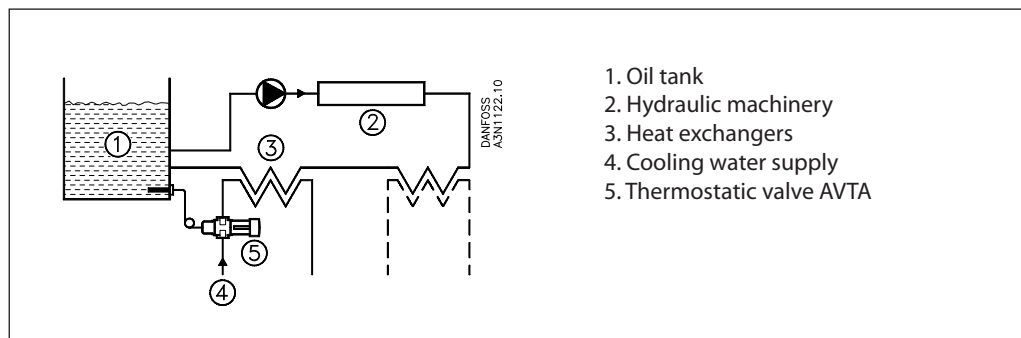
1. Oil tank
2. Hydraulic machinery
3. Heat exchangers
4. Cooling water supply
5. Thermostatic valve AVTA

Materials
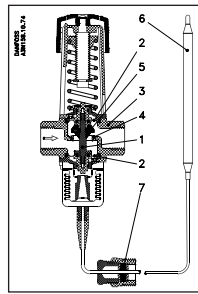
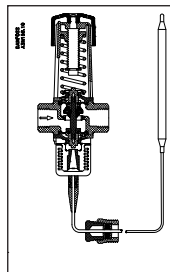| No.	Description	Material
1	Spindle	Brass W.no. 2.0401
2	Diaphragms	Rubber - ethylene - propylene (EPDM).
3	Valve body and other metal parts	Forged brass W.no. 2.0402
4	Valve cone	Nitrile rubber (NBR)
5	Valve seat	Stainless steel W.no. 1.4305/AISI 303
6	Sensor	Copper W.no. 2.0090
7	Capillary tube gland	Nitrile rubber (NBR) Brass W.no. 2.0321 / 2.0401

Charges

Thermostatic valve AVTA with different types of charge
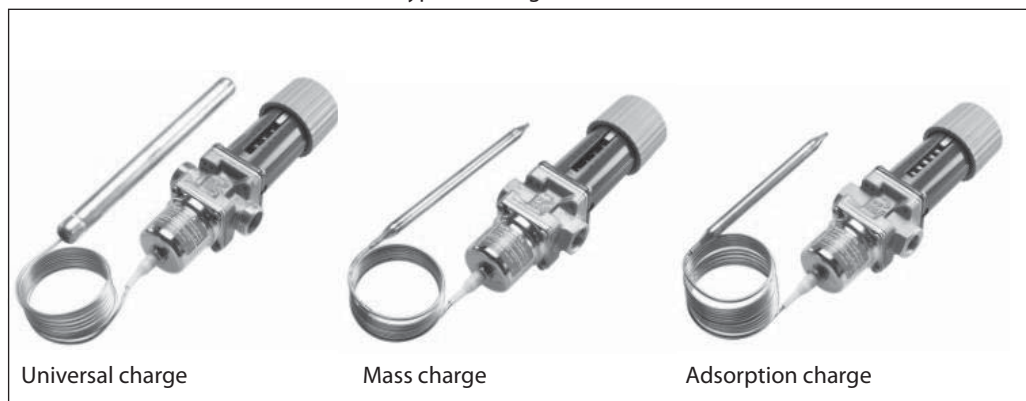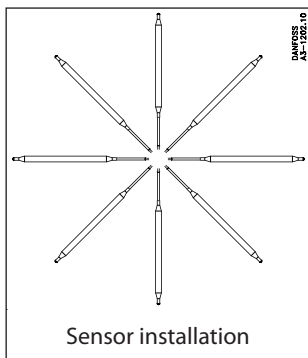

Universal charge   Mass charge   Adsorption charge

Ordering
AVTA with adsorption charge

- Wide regulating range
- Can be installed in any position as far as orientation and - temperature are concerned
- Withstands up to +130°C sensor temperature
- Small sensor dimensions - Ø 9,5 x 150 mm
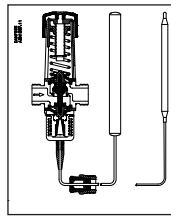- Max. pressure on sensor 25 bar.

The charge consists of active carbon and CO_2 which is adsorbed on falling sensor temperature and thereby produce pressure changes in the element.

Sensor installation

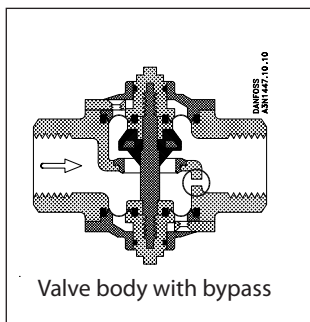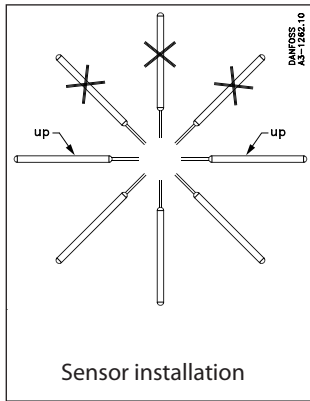| Connection ISO 228	Regulating range [^{o}C]	Max. temp. sensor [^{o}C]	k_v value (m^3/h at Δp = 1 bar)	Capillary tube length [m]	Type	Code no. [1]
G 3/8			1.4	2.3	AVTA 10	003N1144
G 1/2			1.9	2.3	AVTA 15	003N0107
G 1/2	+10 → +80	130	1.9	2.3 armoured	AVTA 15	003N2114
G 3/4			3.4	2.3	AVTA 20	003N0108
G 1			5.5	2.3	AVTA 25	003N0109

[1] Code no. covers complete valve incl. cappillary tube gland.

Immersion pockets, see "Spare parts and accessories", page 11-12.

Ordering
AVTA with universal charge

- Sensor dimensions Ø 18 x 210 mm
- Sensor can be installed colder or warmer than the valve
- Sensors must be orientated as shown in sketch below
- Max. pressure on sensor 25 bar.

The charge is a mix of liquid and gas where the liquid surface (regulating point) is always inside the sensor. Wich charge medium is used depends on the regulation range.
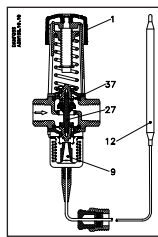

Sensor installation

Valve body with bypass

Connection ISO 228	Regulating range [°C]	Max.temp. sensor [°C]	k_V value (m³/h at Δ p = 1 bar)	Capillary tube length [m]	Type	Code no. [1]
G 3/8	+0 → +30	57	1.4	2.0	AVTA 10	**003N1132**
G 1/2			1.9		AVTA 15	**003N2132**
G 3/4			3.4		AVTA 20	**003N3132**
G 1			5.5		AVTA 25	**003N4132**
G1			5.5	2.0 armoured	AVTA 25	**003N4133**
G 3/8	+25 → +65	90	1.4	2.0	AVTA 10	**003N1162**
G 1/2			1.9	2.0	AVTA 15	**003N2162**
G 1/2			1.9	2.0 (armoured)	AVTA 15	**003N0041**
G 3/4			3.4	2.0	AVTA 20	**003N3162**
G 3/4			3.4	5.0	AVTA 20	**003N3165**
G 3/4			3.4	2.0 (armoured)	AVTA 20	**003N0031**
G 1			5.5	2.0	AVTA 25	**003N4162**
G 1			5.5	2.0 (armoured)	AVTA 25	**003N0032**
G 1			5.5	5.0	AVTA 25	**003N4165**
G 3/8	+50 → +90	125	1.4	2.0	AVTA 10	**003N1182**
G1/2			1.9	2.0	AVTA 15	**003N2182**
G 3/4			3.4	2.0	AVTA 20	**003N3182**
G 1			5.5	2.0	AVTA 25	**003N4182**
G 1			5.5	3.0	AVTA 25	**003N4183** [2]

[1] Code no. covers complete valve incl. cappillary tube gland.
[2] A Ø 2 mm bypass is drilled in the valve body.

Immersion pockets, see "Spare parts and accessories", page 11-12.

Ordering
AVTA with mass charge

- Small sensor dimensions - Ø 9,5 x 180 mm
- Short time constant
- Sensor must always be installed warmer than the valve
- Max. pressure on sensor 25 bar

The Charge is a mix of liquid and gas. Due to the volumetric conditions the sensor must be installed warmer than the valve, since the liquid Surface (regulation point) must be in the Sensor.
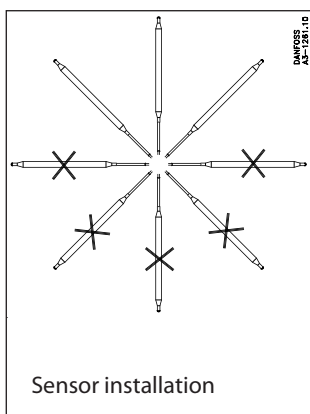
Sensor installation

Connection ISO 228	Regulating range [°C]	Max.temp. sensor [°C]	k_V value (m³/h atΔ p = 1 bar)	Capillary tube length [m]	Type	Code no. [1]
G 1/2	+0 → +30	57	1.9	2.0	AVTA 15	**003N0042**
G 3/4			3.4		AVTA 20	**003N0043**
G 1/2	+25 → +65	90	1.9	2.0	AVTA15	**003N0045**
G 1/2			1.9	2.0 (armoured)	AVTA 15	**003N0299**
G 1/2			1.9	5.0	AVTA 15	**003N0034**
G 3/4			3.4	2.0	AVTA 20	**003N0046**
G 1			5.5	2.0	AVTA 25	**003N0047**

[1] Code no. covers complete valve incl. cappillary tube gland.

Dimensions and weights

Danfoss 3N1437.12
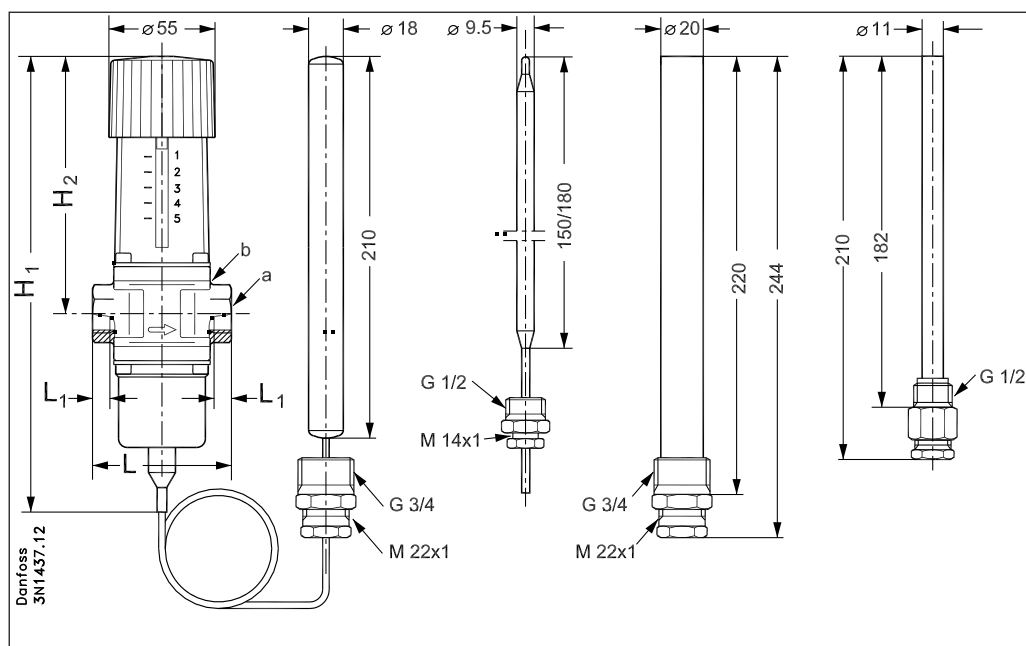
| Type	H_1 [mm]	H_2 [mm]	L [mm]	L_1 [mm]	a	b [mm]	Weight [kg]
AVTA 10	240	133	72	14	G 3/8	◇ 27	1.45
AVTA 15	240	133	72	14	G 1/2	◇ 27	1.45
AVTA 20	240	133	90	16	G 3/4	⬡ 32	1.50
AVTA 25	240	138	95	19	G 1	◇ 41	1.65

Features

AVTA SS for aggressive media.
- Insensitive to dirt
- Insensitive to water pressure
- Needs no power supply - self acting
- Opens on rising sensor temperature
- Differential pressure: 0 to 10 bar
- Max. working pressure: 16 bar
- Max. test pressure: 25 bar
- Max. pressure on sensor: 25 bar
- The valves are pressure-relieved, i.e. the degree of opening is not affected by differential pressure ∆ p (pressure drop).
- The regulation range is defined for the point at which the valve begins to open.

Application

AVTA SS for aggressive media.
A valve body in stainless steel means that the valve can be used for aggressive media in such applications as the marine sector and the chemical industry.

AVTA SS valves have an adsorption charge as standard.
For special request we have also AVTA SS with mass and universal charges available.

Materials
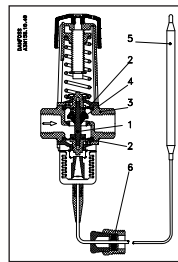
No.	Description	Material
1	Spindle	Stainless steel W.no. 1.4539
2	Diaphragms	Rubber - ethylene - propylene (EPDM).
3	Valve body	Stainless steel W.no. 1.4581
4	Valve cone	Nitrile rubber (NBR)
5	Sensor	Copper W.no. 2.0090
6	Capillary tube gland	Nitrile rubber (NBR), Brass W.no. 2.0321 / 2.0401

Ordering
AVTA in stainless steel with adsorption charge
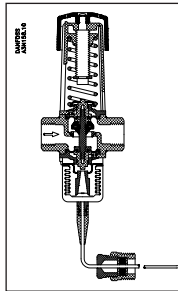
- Wide regulating range
- Can be installed in any position as far as orientation and temperature are concerned
- Withstands up to +130°C sensor temperature
- Small sensor dimensions - Ø 9,5 x 150 mm
- Max. pressure on sensor 25 bar.

The charge consists of active carbon and CO_2 which is adsorbed on falling sensor temperature and thereby produce pressure changes in the element.
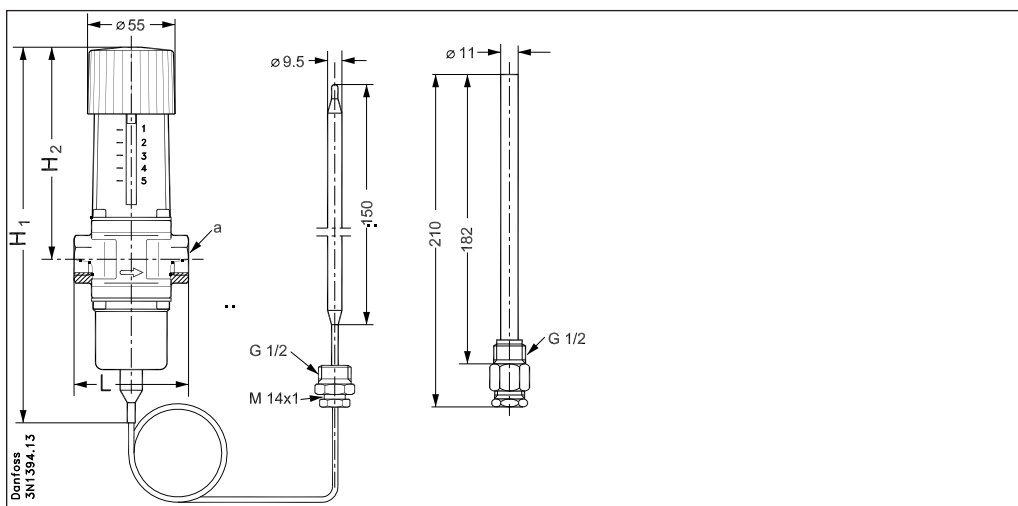

Sensor installation
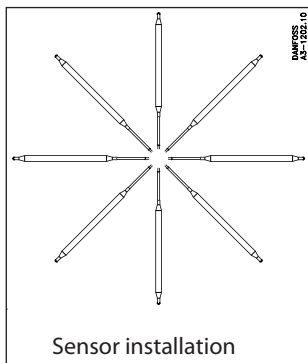
Connection ISO 228	Regulating range [°C]	Max.temp. sensor [°C]	k_V value (m³/h) at ∆p = 1 bar)	Capillary tube length [m]	Type	Code no. [1]
G 1/2	+10 to +80	130	1.9	2.3	AVTA 15	**003N2150**
G 3/4			3.4		AVTA 20	**003N3150**
G 1			5.5		AVTA 25	**003N4150**

[1] Code no. covers complete valve incl. cappillary tube gland.

Immersion pockets, see "Spare parts and accessories", page 11-12.

Dimensions

Type	H₁ [mm]	H₂ [mm]	L [mm]	a ISO 228/1
AVTA 15	240	133	72	G 1/2
AVTA 20	240	133	90	G 3/4
AVTA 25	240	138	95	G 1

Installation

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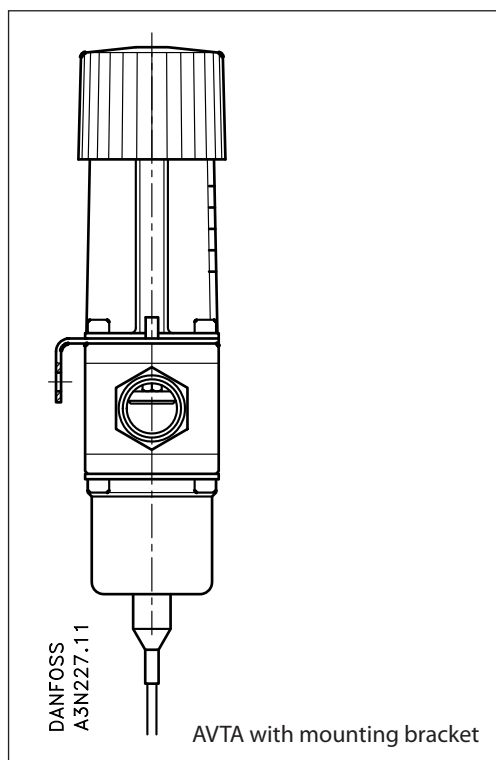
The valves can be installed in any position. An arrow on the valve body indicates the direction of flow.
AVTA valves are also marked so that the letters RA can be read straightforwardly when the valve is held as shown.
The installation of an FV filter ahead of the valve is recommended.

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.
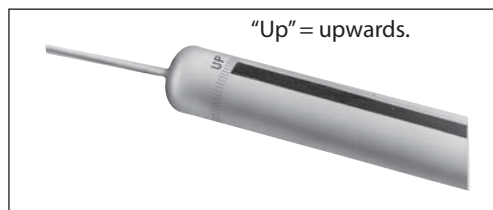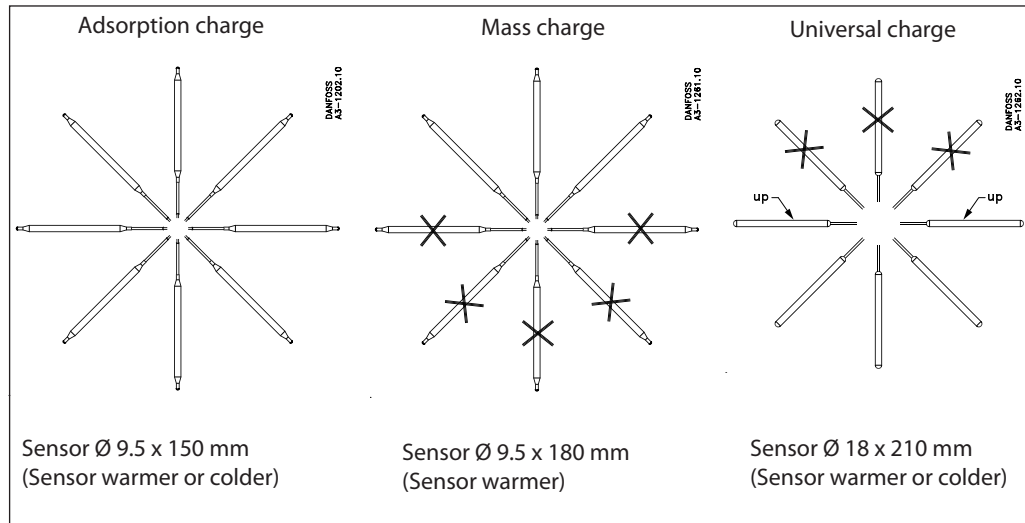
Note:
Where AVTA is used, the sensor must be able to react to variations in cooling water temperature on system start. Therefore a bypass line with a shut-off valve might be necessary to ensure fl ow at the sensor during start-up.
If a mounting bracket is used - see "Spare parts and accessories" page 11-12 - it must always be between valve body and setting section (see illustration).
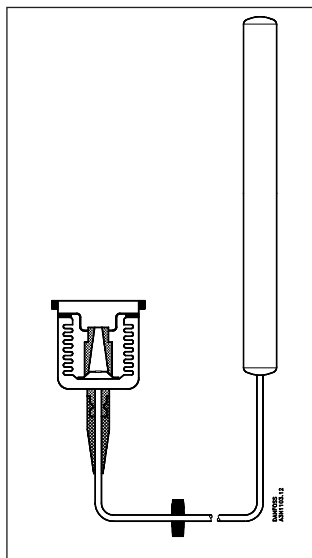
Sensor installation

If an immersion pocket is installed, the use of heat-conductive compound is recommended. This will reduce reaction time. See "Spare parts and accessories", page 11-12.

AVTA with mass charge (sensor Ø9.5 x 180 mm) must always have valve housing fitted in the inlet, where the regulated liquid is coldest ("sensor warmer").

Adsorption charge	Mass charge	Universal charge

Sensor Ø 9.5 x 150 mm (Sensor warmer or colder)

Sensor Ø 9.5 x 180 mm (Sensor warmer)

Sensor Ø 18 x 210 mm (Sensor warmer or colder)

"Up" = upwards.

Accessories

	Designation	Description	Code no.
	Immersion sensor max. pressure 50 bar L = 220 mm	Brass for Ø 18 sensor R 3/4	**003N0050**
		Brass for Ø18 mm sensor 3/4 - 14 NPT	**003N0051**
		18/8 steel [1] for Ø 18, 3/4 - 14 NPT	**003N0053**
		18/8 steel [1] for Ø18 sensor R 3/4	**003N0192**
	Immersion sensor max. pressure 50 bar L = 182 mm	Brass for Ø 9.5 sensor G 1/2	**017-436766**
		18/8 steel [1] for Ø 9.5 sensor R 1/2	**003N0196**
	Mounting bracket	For AVTA	**003N0388**
	Heat-conductive compound	5 gram tube	**041E0110**
		0.8 kg	**041E0111**
	1 set of nitrile (NBR) diaphragm for mineral oil	For AVTA 10/15	**003N0445**
		For AVTA 20	**003N0446**
		For AVTA 25	**003N0447**
	Capillary tube gland	G 1/2 G 3/4 1/2 - 14 NPT 3/4 - 14 NPT	**017-422066** **003N0155** **003N0157** **003N0056**
	Plastic hand knob	For AVTA	**003N0520**

1) W. no. 1.4301

Spare parts

Service elements for AVTA

	Temperature range [°C]	Capillary tube length [m]	**Code no.**
Adsorption charge - sensor Ø 9.5 x 160 mm	+10 → +80	2.3	**003N0278**
Universal charge - sensor Ø 18 x 210 mm	0 → +30	2	**003N0075**
		5	**003N0077**
	+25 → +65	2	**003N0078**
		5	**003N0080**
		2 (armoured)	**003N0063**
		3	**003N0079**
	+50 → +90	2	**003N0062**
		3	**003N0089**
Mass charge - sensor Ø9.5 x 190 mm	0 → +30	2	**003N0066**
	+25 → +65	2	**003N0091**
		5	**003N0068**

Sizing

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

The type of charge must be selected on the basis of the temperature to be maintained, and on an assessment of the characteristics of each type, as described in the foregoing.

In general the aim should be to select the smallest valve capable of giving the required flow.

It is also recommended that the temperature range be chosen so that the required sensor temperature lies in the middle of the regulation range.

To help fine-setting the valve, a thermometer should be installed near the sensor.

Valve size
The following data are used when selcting valve size:
- Required cooling water flow, Q [m^3/h]
- Temperature rise in cooling water, [Δt] (°C)
- Differential pressure across valve, [Δp] (bar).
With fully open valve the differential pressure should be around 50% of the total pressure drop across the cooling system.
The diagrams on page 10 are intended to make valve sizing easier.

Fig. 1 - Relation between heat quantity [kW] and cooling water quantity
Fig. 2 - Graphs of k$_v$ values
Fig. 3 - Valve operating range
Fig. 4 - Flow quantities as a function of pressure drop [Δp]

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

Since direct regulation of the oil temperature is required, an AVTA valve is suitable. The sensor position is horizontal - and small dimensions are desired.

Given data:
- Necessary cooling at full load 10 kW.
- Oil temperature to be maintained constant at +45ºC
- Cooling water p_1 = 3 bar
- Outlet p_3 = 0 bar

- $p_2 = \dfrac{p_1 + p_3}{2}$ (guess)

- Cooling water temperature t_1 = +20ºC
- Outlet temperature t_2 = +30ºC

1. The graphs in fig. 1 can be used to find the necessary cooling water quantity at
Δt = 10ºC (+30ºC - +20ºC) to 0.85 m^3/h.

The graphs in fig. 2 show the necessary k_v value for 0.85 m^3/h with

$\Delta p = p_1 - p_2$ = 3 - 1.5 = 1.5 bar for 0.7 m^3/h.

The columns in fig. 3 show that all four AVTA valves can be used, but in practice an AVTA 10 or 15 shall be selected, so the necessary water flow is in the middle of the regulating range.

Fig.4
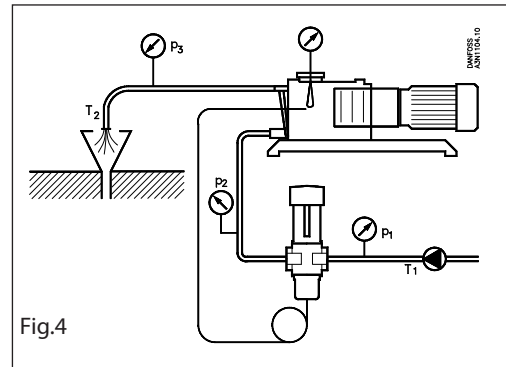
The above considerations apply to both AVTA and FJVA types.

Operating conditions and other product require-ments in this example mean that a valve with adsorption charge is the correct choice.
The temperature range +10 → +80ºC is in order.

The table at the top of page 3 shows AVTA 10, code no. 003N1144, or AVTA 15, code no. 003N0107. Both fulfil the requirements named.

In many applications, installation conditions make the use of sensor pockets advisable.

"Accessories" on page 11 gives the code nos. for sensor pockets for Ø 9.5 mm sensors in brass and stainless steel: 017-436766 and 003N0196, respectively.
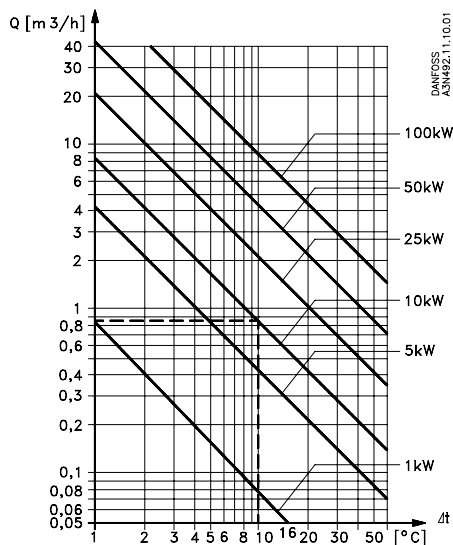
Sizing

Fig. 1
Heating or cooling with water.
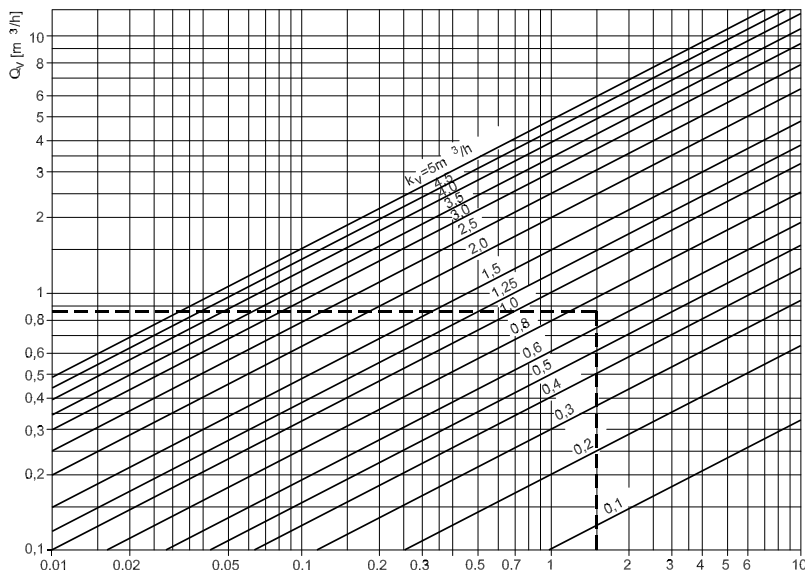Example: Necessary cooling output 10 kW with Δ t = 10°C
Required flow 0.85 m³/h.

Fig. 2
Relation between water quantity and pressure drop across valve.
Example: Flow 0.85 m³/h with a pressure drop of 1.5 bar.
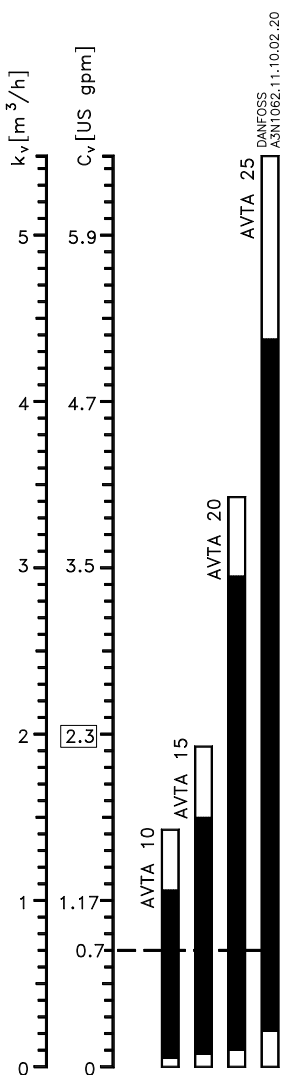The k_v value becomes 0.7 m³/h.

Fig. 3
Nomogram showing the valve k_v range. k_v values are always given for water flow in m³/h with a pressure drop Δ p of 1 bar. The valve should be selected so that the necessary k_v value lies in the middle of the regulation range.
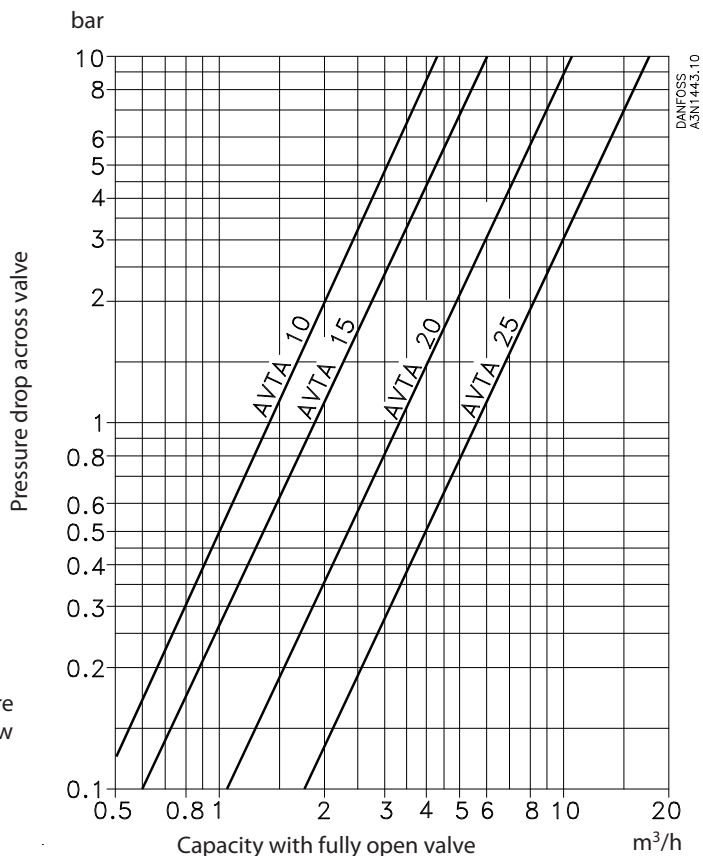Example: AVTA 10 and 15 are the most suitable for a k_v value of 0.7

Fig. 4
Valve flow quantity in fully open position, as a function of pressure drop Δp.

Options

- DZR brass
- Outer thread connecting
- Other lenghts of capillary tubes
- Armouring of capillary tubes
- Other combinations of sizes, materials and ranges
- NPT - connection, see separate datasheet for USA / Canada