

Data sheet

Electric expansion valve for R744 (CO₂) Type AKVH



AKVH are electrically operated expansion valves designed for refrigerating plants using R744 refrigerant.

The AKVH valves are normally controlled by a controller from Danfoss' range of ADAP- KOOL® controllers.

The AKVH valves are supplied as a component program, as follows:

- Separate valve.
- Separate coil with junction box or conduit hub.
- Spare parts in the form upper part, orifice and filter.

The orifice assembly is replaceable.

The AKVH 10 valves cover a capacity range from 0.1 TR to 3 TR in refrigeration applications and 0.2 TR to 6.25 TR in freezing applications.

Features

- For R744 refrigerant.
- The valve requires no adjustment.
- Wide regulation range.
- Replaceable orifice assembly.
- Normally closed, solenoid tight expansion valve.
- Wide range of a.c. coils.
- Enables energy saving minimum stable superheat and adaptive defrost algorithms.
- Provides excellent distribution and oil return due to turbulent flow.

Approvals

PED (97/23/EC A3.P3)



(Refrigerant valve) 53RO


 The Low Voltage Directive 73/23/EC
with amendments EN 60730-2-8

Technical data

Valve type	AKVH 10
Working principle (Pulse-width modulation)	PWM
Recommended period of time	6 Seconds
Capacity (R744)	Refrigeration: 0.1 TR – 3 TR Freezing: 0.2 TR – 6.25 TR
Regulation range (Capacity range)	10 – 100%
Connection	Solder
Evaporating temperature	- 76 – 140 °F
Ambient temperature	- 58 – 122 °F
Leak of valve seat	<0.02% of C _v -value
MOPD	435 psi (30 bar)
Filter, replaceable	Internal 100 µm
Max. working pressure	1305 psig / 90 barg ¹⁾

¹⁾ 1305 psig / 90 barg under stand still conditions, but under normal operating conditions, there must be liquid to the inlet of the valve.

The individual capacities are indicated with a number forming part of the type designation. The number represents the size of the orifice of the valve in question. A valve with orifice 3 will for example be designated AKVH 10-3.

Rated capacity and ordering

AKVH 10

R744

Valve type / orifice no.	Rated capacity TR		C _v value gal/min	Connection size Solder ODF/ODF		Single pack 1 valve each
	Refrigeration	Freezing		[in.]	[mm]	
AKVH 10-0	0.1	0.2	0.132	3/8 × 1/2 in.	–	068F4078
AKVH 10-0	0.1	0.2	0.132	–	10 × 12 mm	068F4088
AKVH 10-1	0.3	0.6	0.044	3/8 × 1/2 in.	–	068F4079
AKVH 10-1	0.3	0.6	0.044	–	10 × 12 mm	068F4089
AKVH 10-2	0.5	1.0	0.074	3/8 × 1/2 in.	–	068F4080
AKVH 10-2	0.5	1.0	0.074	–	10 × 12 mm	068F4090
AKVH 10-3	0.7	1.5	0.110	3/8 × 1/2 in.	–	068F4081
AKVH 10-3	0.7	1.5	0.110	–	10 × 12 mm	068F4091
AKVH 10-4	1.2	2.5	0.202	3/8 × 1/2 in.	–	068F4082
AKVH 10-4	1.2	2.5	0.202	–	10 × 12 mm	068F4092
AKVH 10-5	1.9	3.8	0.282	3/8 × 1/2 in.	–	068F4083
AKVH 10-5	1.9	3.8	0.282	–	10 × 12 mm	068F4093
AKVH 10-6	3.0	6.1	0.502	3/8 × 1/2 in.	–	068F4084
AKVH 10-6	3.0	6.1	0.502	–	10 × 12 mm	068F4094

AKVH 10

R744

Valve type / orifice no.	Rated capacity TR		C _v value gal/min	Connection size Solder ODF/ODF		Industrial pack 32 valves each
	Refrigeration	Freezing		[in.]	[mm]	
AKVH 10-0	0.1	0.2	0.132	3/8 × 1/2 in.	–	068F4068
AKVH 10-0	0.1	0.2	0.132	–	10 × 12 mm	068F4058
AKVH 10-1	0.3	0.6	0.044	3/8 × 1/2 in.	–	068F4069
AKVH 10-1	0.3	0.6	0.044	–	10 × 12 mm	068F4059
AKVH 10-2	0.5	1.0	0.074	3/8 × 1/2 in.	–	068F4070
AKVH 10-2	0.5	1.0	0.074	–	10 × 12 mm	068F4060
AKVH 10-3	0.7	1.5	0.110	3/8 × 1/2 in.	–	068F4071
AKVH 10-3	0.7	1.5	0.110	–	10 × 12 mm	068F4061
AKVH 10-4	1.2	2.5	0.202	3/8 × 1/2 in.	–	068F4072
AKVH 10-4	1.2	2.5	0.202	–	10 × 12 mm	068F4062
AKVH 10-5	1.9	3.8	0.282	3/8 × 1/2 in.	–	068F4073
AKVH 10-5	1.9	3.8	0.282	–	10 × 12 mm	068F4063
AKVH 10-6	3.0	6.1	0.502	3/8 × 1/2 in.	–	068F4074
AKVH 10-6	3.0	6.1	0.502	–	10 × 12 mm	068F4064

Spare parts



Orifice no.	Contents	Code no.
0	4 pc. orifice 4 pc. gasket	068F5283
1		
2		
3	3 pc. orifice 3 pc. gasket	068F5284
4		
5		
6		

Data sheet

Electric expansion valves type AKVH for R744 (CO₂)

Technical data

Design

In accordance with UL 429

Insulation of coil wire

Class H according to IEC 85

Power supply

Alternating current (a.c.)

Connection

Junction box or Conduit boss

Permissible voltage variation

Alternating current (a.c.):
50 Hz and 60 Hz: -10% – 15%
50/60 Hz: +/- 10%

Enclosure, IEC 60529

Junction box NEMA 2 ~ IP 12-32
Conduit boss NEMA 4 ~ IP 54

Power consumption

Alternating current (a.c.): Inrush: 49 VA;
Holding: 28 VA, 16 W

Ambient temperature

-40 °F – 122 °F / -40 °C – 50 °C

Ordering



BJ and BX Coils

BJ and BX coils

Valve type	Coil type	Wire length		Voltage [V a.c.]	Frequency [Hz]	Power consumption [W]	Code no.
		[in.]	[cm]				
Junction box NEMA 2							
AKVH / EVRH	BJ120BS	7	18	120	60	16	018F4130
	BJ208BS	7	18	208	60	16	018F4132
	BJ240BS	7	18	240	60	16	018F4134
Conduit boss NEMA 4							
AKVH / EVRH	BX120BS	98	250	120	60	16	018F4131
	BX208BS	98	250	208	60	16	018F4133
	BX240BS	98	250	240	60	16	018F4135

Capacity

Capacity in TR

R744

Valve type	Pressure drop across valve Δp psi ¹⁾								
	29	58	87	116	145	174	203	232	261
AKVH 10-0	0.094	0.125	0.151	0.168	0.185	0.199	0.208	0.216	0.222
AKVH 10-1	0.256	0.341	0.427	0.455	0.512	0.540	0.569	0.597	0.597
AKVH 10-2	0.398	0.569	0.654	0.739	0.796	0.881	0.910	0.938	0.967
AKVH 10-3	0.626	0.881	1.052	1.166	1.251	1.365	1.422	1.479	1.535
AKVH 10-4	1.024	1.393	1.649	1.848	2.019	2.189	2.275	2.360	2.417
AKVH 10-5	1.592	2.189	2.616	2.900	3.156	3.412	3.583	3.696	3.839
AKVH 10-6	2.559	3.497	4.151	4.635	5.004	5.431	5.687	5.914	6.113

Valve type	Pressure drop across valve Δp psi								
	290	319	348	377	406	435	464	493	507
AKVH 10-0	0.227	0.230	0.233	0.239	0.242	0.242	0.245	0.247	0.247
AKVH 10-1	0.626	0.626	0.654	0.654	0.654	0.682	0.682	0.682	0.682
AKVH 10-2	0.995	1.024	1.052	1.052	1.081	1.081	1.081	1.081	1.081
AKVH 10-3	1.564	1.592	1.621	1.649	1.678	1.678	1.706	1.706	1.706
AKVH 10-4	2.502	2.531	2.588	2.644	2.673	2.701	2.701	2.730	2.730
AKVH 10-5	3.924	4.009	4.095	4.151	4.208	4.237	4.265	4.265	4.265
AKVH 10-6	6.256	6.369	6.512	6.625	6.682	6.739	6.796	6.796	6.824

¹⁾ Rated capacities are based on
Subcooling $t_{sub} = 7.2^\circ F$
Evaporating temperature $t_e = -13^\circ F$
Superheating $t_{sup} = 9^\circ F$

Valve sizing using calculation software

It is strongly recommended to use Cool Selector to find the correct valve for our application. The software can be downloaded from the Danfoss website. When using the calculation software it is recommended to choose a valve that is between 50 and 75% loaded at the nominal capacity. In addition, the liquid velocity in the line leading to the valve should not exceed 3ft/s (1m/s).

Valve sizing

To obtain an expansion valve that will function correctly under different load conditions it is necessary to consider the following points when sizing the valve.
These points must be dealt with in the following sequence:

- 1) Evaporator capacity
- 2) Pressure drop across the valve
- 3) Correction for subcooling
- 4) Correction for evaporating temperature
- 5) Determination of valve size
- 6) Correctly dimensioned liquid line

1) Evaporator capacity

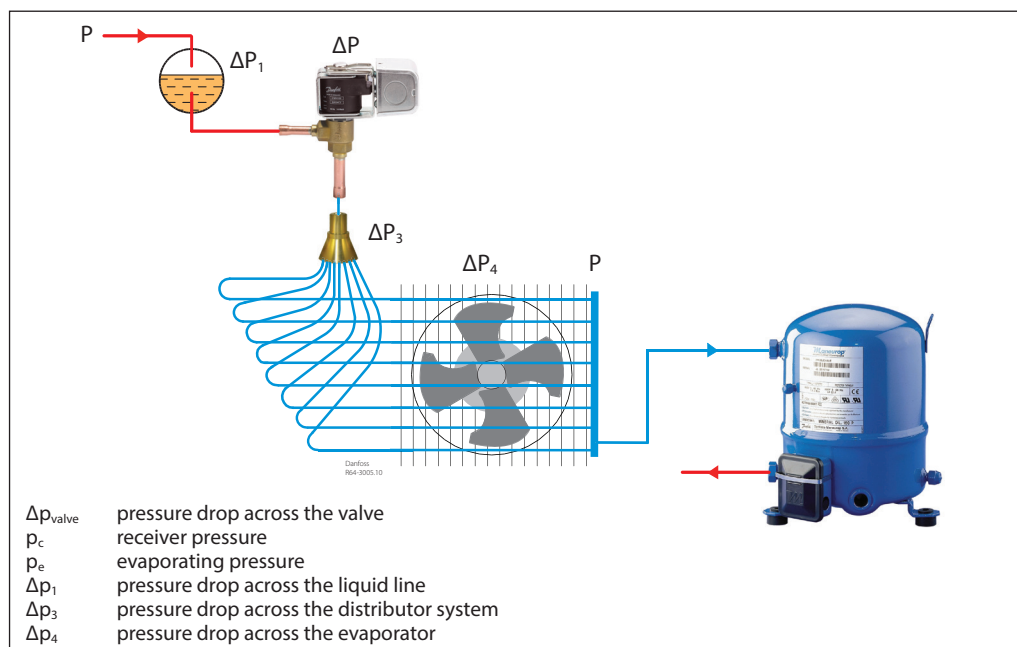
The evaporator capacity is found in the specifications from the evaporator supplier.

2) Pressure drop across the valve

The pressure drop across the valve directly determines the capacity and must therefore be considered.

The pressure drop across the valve is normally calculated as the receiver pressure less the evaporating pressure and sundry other pressure drops in the liquid line, distributor, evaporator, etc. It is indicated in the following formula:

$$\Delta p_{\text{valve}} = p_c - (p_e + \Delta p_1 + \Delta p_3 + \Delta p_4)$$



Note! The pressure drop across the liquid line and the distributor system must be calculated on the basis of the valve's max. capacity, as the valve operates with pulse-width modulation.

Example of calculation of pressure drop across a valve:

Refrigerant: R744

p_c = Receiver pressure: 580 psig (at 43 °F)

Evaporating temperature: 23 °F (p_e = 426 psig)

Δp_1 = 2.9 psi

Δp_3 = 12 psi

Δp_4 = 1.5 psi

This will give you the following equation:

$$\begin{aligned} \Delta p_{\text{valve}} &= p_c - (p_e + \Delta p_1 + \Delta p_3 + \Delta p_4) \\ &= 40 - (29.4 + 0.2 + 0.8 + 0.1) \\ &= 580 - (426 + 2.9 + 12 + 1.45) \\ &= 138 \text{ psi} \end{aligned}$$

The found value for "pressure drop across the valve" is used later in the section "Determination of valve size".

Valve sizing

3) Correction for subcooling

The evaporator capacity used must be corrected, if the subcooling deviates from -452.47 °F. Use the actual correction factor indicated in the table.

Multiply the evaporator capacity by the correction factor to obtain the corrected capacity.

Correction factors for subcooling Δt_{sub}

Correction factor [°F]	7.2	18	27	36	45	54	63	72	81	90
R744	1.00	0.91	0.86	0.81	0.77	0.73	0.69	0.66	0.63	0.60

Corrected capacity = evaporator capacity x correction factor.

The corrected capacity is used in the section "Determination of valve size".

Correction factor according to the table = 0.91
Corrected capacity = 1.42 x 0.91 = 1.29 TR.

Example of correction:

Refrigerant: R744

Evaporator capacity Q_e : 1.42 TR

Subcooling: 18 °F

Note: Too little subcooling may cause flash gas.

4) Correction for transient conditions and evaporating temperature (t_e)

To obtain a correctly dimensioned valve it is important that the application is considered. Depending on the application, the valve should have an overcapacity enabling it to cope with the extra amount of refrigeration needed during certain periods, e.g. during the defrost recovery process.

The valve's opening degree should therefore be between 50 and 75% when regulating. In this way it is ensured that the valve has a sufficiently wide regulation range, so that it can manage changed loads at or near the normal working point. The change in capacity as an effect of the deviation in refrigerant density is included in this correction factor.

Correction factor for transient conditions and evaporating temperature (t_e)

Evaporating temperature t_e °F	50 to -58
AKVH 10	1.6

5) Determination of valve size

When the valve size meeting the required capacity is selected it is important to note that the capacity indications are the valve's rated capacity, i.e. when the valve is 100% open. In this section we tell you how the valve's size is determined.

There are three factors that have an influence on the choice of the valve:

- the pressure drop across the valve
- the corrected evaporator (correction for subcooling)
- the corrected capacity for evaporating temperature

The three factors have been described earlier in this section on dimensioning. When these three factors have been established, the selection of the valve can be made:

- First you multiply the "corrected capacity" by a value stated in the table.
- Use the new value in the capacity table in combination with the pressure drop value.
- Now select the valve size.

Example of selection of valve

Use as starting point the two earlier mentioned examples, where the following two values have been obtained:

$\Delta p_{valve} = 138$ psi

$Q_{e \text{ corrected}} = 1.29$ TR

The valve should be used in a coldroom.

1.6 is the "correction factor for the evaporating temperature".

The dimensioned capacity will then be:
 $1.6 \times 1.29 \text{ TR} = 2.07 \text{ TR}$.

Now select a valve size from one of the capacity tables.

With the given values $\Delta p_{valve} = 138$ psi and a capacity of 2.07 TR, select the valve size for AKVH 10-5.

This valve has a capacity of approx. 2.90 TR

Valve sizing

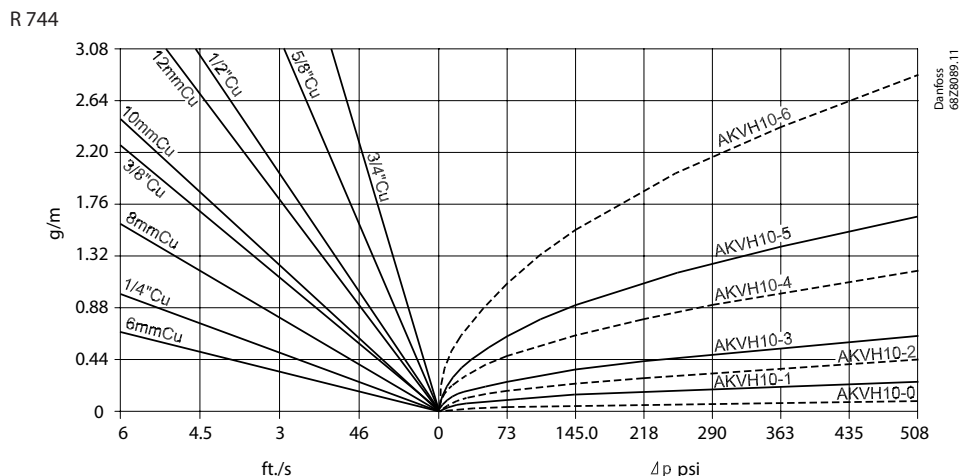
6) Correctly dimensioned liquid line

To obtain a correct supply of liquid to the AKVH valve, the liquid line to the individual AKVH valve must be correctly dimensioned.

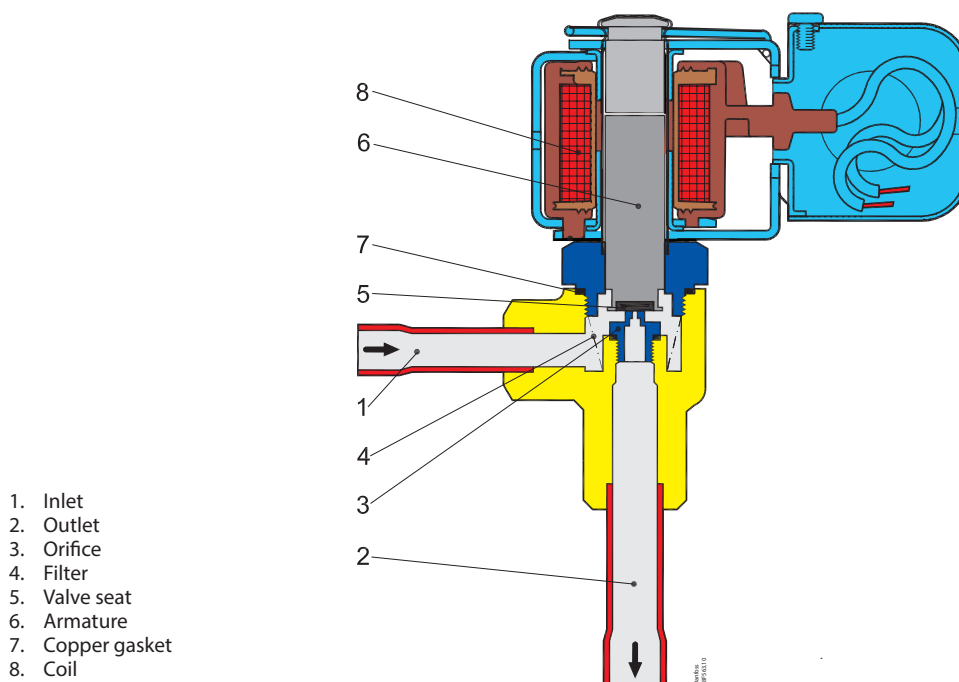
The liquid flow rate should not exceed 3 ft/s

This must be observed on account of the pressure drop in the liquid line (lack of subcooling) and pulsations in the liquid line.

Dimensioning of the liquid line must be based on the capacity of the valve at the pressure drop with which it is operating (cf. capacity table), and not on the evaporator's capacity.



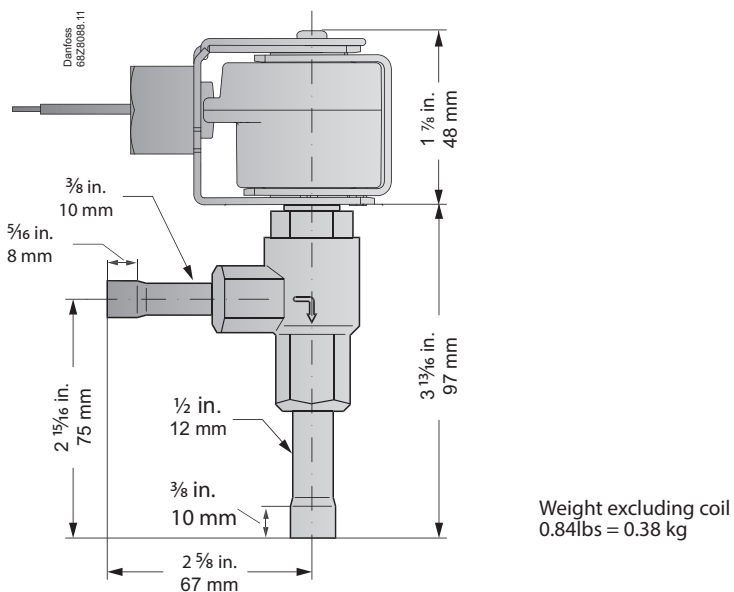
Design and function



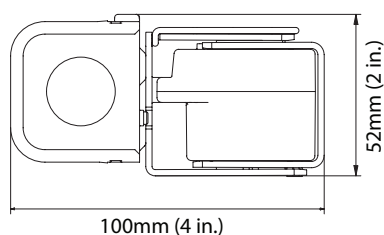
The valve capacity is regulated by means of pulse-width modulation. Within a period of six seconds a voltage signal from the controller will be transmitted to and removed from the valve coil. This makes the valve open and close for the flow of refrigerant. The relation between this opening and closing time indicates the actual capacity. If there is an intense need for refrigeration, the valve will remain open

for almost all six seconds of the period. If the required amount of refrigeration is modest, the valve will only stay open during a fraction of the period. The amount of refrigeration needed is determined by the controller. When no refrigeration is required, the valve will remain closed and thus function as a solenoid valve.

Dimensions and weight AKVH valve

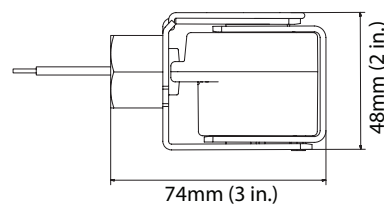


Dimensions and weight Coils



100mm (4 in.)

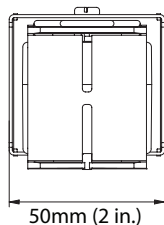
52mm (2 in.)



74mm (3 in.)

48mm (2 in.)

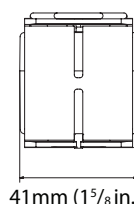
Danfoss
18F07.11



50mm (2 in.)

Junction box

Weight: 0.86 lbs / 0.39 kg



41mm (1 5/8 in.)

Conduit boss

Weight: 0.72 lbs / 0.33 kg