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.
**Data sheet**

**Electric expansion valves type AKVH for R744 (CO₂)**

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**Approvals**

PED (97/23/EC A3.P3)  
Refrigerant valve 53RO  
The Low Voltage Directive 73/23/EC with amendments EN 60730-2-8

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**Technical data**

<table>
<thead>
<tr>
<th>Valve type</th>
<th>AKVH 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working principle (Pulse-width modulation)</td>
<td>PWM</td>
</tr>
<tr>
<td>Recommended period of time</td>
<td>6 Seconds</td>
</tr>
</tbody>
</table>
| 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 Cₕ-value |
| MOPD | 435 psi (30 bar) |
| Filter, replaceable | Internal 100 μm |
| Max. working pressure | 1305 psig / 90 barg¹ |

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.
Spare parts

<table>
<thead>
<tr>
<th>Orifice no.</th>
<th>Contents</th>
<th>Code no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>4 pc. orifice</td>
<td>068F5283</td>
</tr>
<tr>
<td>1</td>
<td>4 pc. gasket</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3 pc. orifice</td>
<td>068F5284</td>
</tr>
<tr>
<td>5</td>
<td>3 pc. gasket</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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

**Ambient temperature**
-40 °F – 122 °F / -40 °C – 50 °C

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

Ordering

|------------|-----------|------------------|-----------------|-----------------|-----------------|----------------------|---------|
| BJ and BX Coils

**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

<table>
<thead>
<tr>
<th>Valve type</th>
<th>Pressure drop across valve $\Delta p$ psi $^{1)}$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>29</td>
</tr>
<tr>
<td>AKVH 10-0</td>
<td>0.094</td>
</tr>
<tr>
<td>AKVH 10-1</td>
<td>0.256</td>
</tr>
<tr>
<td>AKVH 10-2</td>
<td>0.398</td>
</tr>
<tr>
<td>AKVH 10-3</td>
<td>0.626</td>
</tr>
<tr>
<td>AKVH 10-4</td>
<td>1.024</td>
</tr>
<tr>
<td>AKVH 10-5</td>
<td>1.592</td>
</tr>
<tr>
<td>AKVH 10-6</td>
<td>2.559</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Valve type</th>
<th>Pressure drop across valve $\Delta p$ psi $^{1)}$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>290</td>
</tr>
<tr>
<td>AKVH 10-0</td>
<td>0.227</td>
</tr>
<tr>
<td>AKVH 10-1</td>
<td>0.626</td>
</tr>
<tr>
<td>AKVH 10-2</td>
<td>0.995</td>
</tr>
<tr>
<td>AKVH 10-3</td>
<td>1.564</td>
</tr>
<tr>
<td>AKVH 10-4</td>
<td>2.502</td>
</tr>
</tbody>
</table>

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

### 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).
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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:

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

\( \Delta p_{\text{valve}} \) pressure drop across the valve
\( p_c \) receiver pressure
\( p_e \) evaporating pressure
\( \Delta p_1 \) pressure drop across the liquid line
\( \Delta p_3 \) pressure drop across the distributor system
\( \Delta p_4 \) pressure drop across the evaporator

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
\( p_c = \text{Receiver pressure: 580 psig (at 43 °F)} \)
Evaporating temperature: 23 °F (\( p_e = 426 \text{ psig} \))
\( \Delta p_1 = 2.9 \text{ psi} \)
\( \Delta p_3 = 12 \text{ psi} \)
\( \Delta p_4 = 1.5 \text{ psi} \)

This will give you the following equation:

\[ \Delta p_{\text{valve}} = p_c - (p_e + \Delta p_1 + \Delta p_3 + \Delta p_4) \]
\[ = 580 - (426 + 2.9 + 12 + 1.45) \]
\[ = 138 \text{ psi} \]

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

\( \Delta p_{\text{valve}} \) pressure drop across the valve
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.

Example of correction:
- Refrigerant: R744
- Evaporator capacity \( Q_e \): 1.42 TR
- Subcooling: 18 °F
- Correction factor according to the table = 0.91
- Corrected capacity = 1.42 x 0.91 = 1.29 TR.

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.

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:
\( \Delta P_{valve} = 138 \text{ psi} \)
\( Q_{e, corrected} = 1.29 \text{ TR} \)

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 \( \Delta P_{valve} = 138 \text{ psi} \) 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.
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Dimensions and weight
AKVH valve

Dimensions and weight Coils

Junction box

Conduit boss

Weight excluding coil 0.84lbs = 0.38 kg