Danfoss AKV Electronic Expansion Valves

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1. About this Publication

These instructions have been prepared according to the following standards:

- BS EN ISO 11442: Technical product documentation. Document management;
- BS EN ISO 12100: Safety of machinery - General principles for design - Risk assessment and risk reduction;
- BS EN 62023: Structuring of technical information and documentation;
- BS EN 82079-1: Preparation of instructions for use. Structuring, content and presentation. General principles and detailed requirements.

1.1. Safety Warnings and Symbols

The system of safety warnings and symbols is based on:

- BS EN ISO 7010: Graphical symbols. Safety colours and safety signs. Registered safety signs;
- BS EN 82079-1: Preparation of instructions for use. Structuring, content and presentation. General principles and detailed requirements.

⚠ DANGER

This indicates a hazard with a high level of risk, which if not avoided, will result in death or serious injury if instructions, including recommended precautions, are not followed.

⚠ WARNING

This indicates a hazard with a medium level of risk, which if not avoided, will result in death or serious injury if instructions, including recommended precautions, are not followed. In addition, there is a high risk of damage to the component, product or process.

⚠ CAUTION

This indicates a hazard with a low level of risk, which if not avoided, will result in minor or moderate injury if instructions, including recommended precautions, are not followed. In addition, there is a potential risk of damage to the component, product or process.

NOTE: Draws attention to important additional information.

1.2. Units of Measurement

Quantities are expressed in SI units or SI derived units; refer to J & E Hall International Standard JEH-ES-02 Guide to the International System of Units (SI).

1.3. Terminology

Terminology, abbreviations and acronyms are those currently in use throughout the refrigeration and air conditioning industry; refer to J & E Hall International Standard JEH-ES-01 Definition of Terms and Acronyms Used in the Refrigeration Industry.

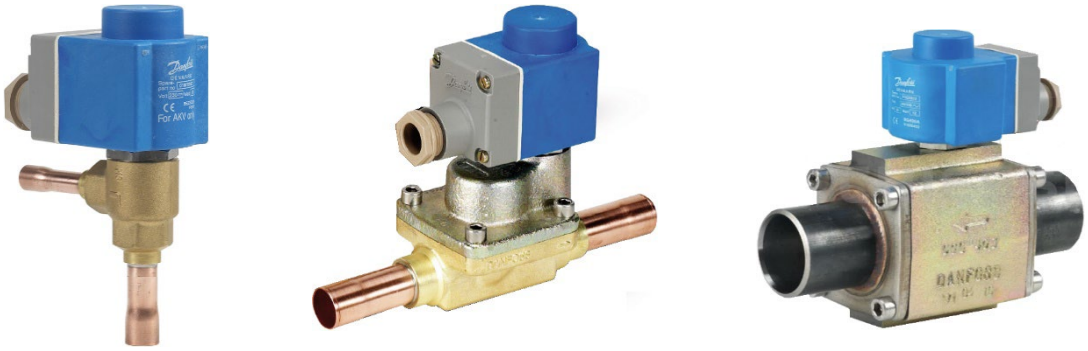
1.4. Additional Copies

Obtain additional copies of these instructions from J & E Hall International; go to www.jehall.com.

2. Application

AKV electronic expansion valves are used in conjunction with an electronic controller to precisely meter refrigerant flow, providing much more accurate control than that afforded by a conventional thermostatic expansion valve. Besides performing the refrigerant metering function, the valve shuts off refrigerant flow when the plant is stopped. Therefore, in most applications, the AKV valve can serve as an expansion valve and a solenoid valve.

Valve capacity is indicated by a number forming part of the model designation. The number identifies the size of orifice fitted to the valve. For example, an AKVA 10-3 is fitted with a number 3 orifice. The orifice assembly is replaceable.



AKV 10P | AKV 15 | AKVA 20

Fig 1 AKV Electronic Expansion Valves, Examples

This publication covers the following AKV ranges:

- AKV 10P and AKV 10PS;
- AKVO 10;
- AKVH 10;
- AKV 10, 15 and 20;
- AKVA 10, 15 and 20.

The main characteristics of these valves is detailed in Table 1 and Table 2.

AKV valve capacity is regulated by pulse-width operation via a suitable controller, examples as follows:

Danfoss EKC 315A Controller.
Danfoss EKC 319A Controller.
Danfoss EKE 315A Controller.
J & E Hall Fridgewatch 4000 Controller.
J & E Hall Fridgewatch 4100 Controller.

The location and details of the valve(s) can be found from the system schematic flow diagram, instrument schedule and in Part A : Specification in Section 1 of the plant instruction manual.

3. Technical Data

3.1. Technical Data AKV 10P, AKV 10PS and AKVO 10

Parameter		AKV 10P	AKV 10PS	[1]AKVO 10
Refrigerant temperature at valve outlet		-60.0 °C to +60.0 °C		-50.0 °C to +60 °C
Ambient temperature (coil dependent)		-50.0 °C to +80.0 °C		-50.0 °C to +50 °C
Maximum working pressure		90.0 bar g		28.0 bar g
Opening pressure differential	Maximum	AKV 10P0 to 10P6 = 35.0 bar AKV 10P7 to AKV 10P8 = 18.0 bar	35.0 bar	18.0 bar
	Minimum	0.0 bar	0.1 bar	-
Refrigerants		Chlorofluorocarbon and hydrofluorocarbon refrigerants. These valves are **NOT** suitable for R717 (ammonia).		Chlorofluorocarbon and hydrofluorocarbon refrigerants, R744 (CO_2). These valves are **NOT** suitable for R717 (ammonia).
Method of operation		Direct operation	Servo operation (piston)	
Strainer		100 µm (internal)	53 µm (internal)	60 mesh (internal)
Installation option		Braze		
Working principle		Pulse Width Modulation (PWM) (valve open/close by controller)		
Cycle time		6 seconds (recommended)		
Regulation range		10 % to 100 %		
Leakage through valve seat		N/A		
Coil		Refer to JEH-ES-11-013 Application Guide to Danfoss Solenoid Coils		

[1]AKVO discontinued, replaced by AKV 10P and 10PS.

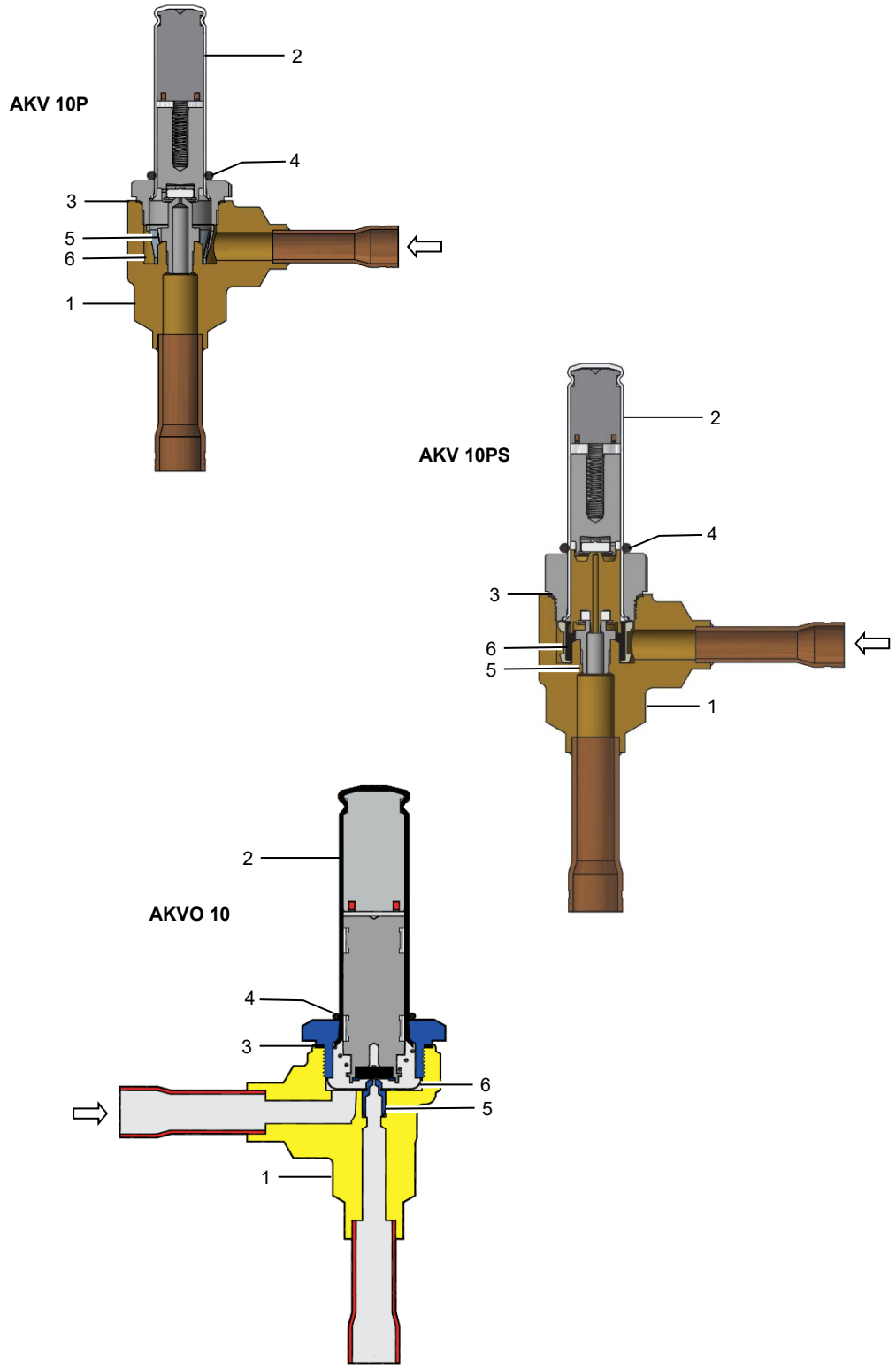
Table 1 Technical Data AKV 10P, AKV 10PS and AKVO 10

3.2. Technical Data AKVH 10, AKV 10 to 20 and AKVA 10 to 20

Parameter	[1]AKVH 10	[1]AKV 10 and AKVA 10	AKV 15	AKVA 15	AKV 20	AKVA 20
Refrigerant temperature at valve outlet	-60.0 °C to +60.0 °C	-50.0 °C to +60.0 °C	50.0 °C to +60.0 °C	40.0 °C to +60.0 °C	-40.0 °C to +60.0 °C	
Ambient temperature (coil dependent)	-50.0 °C to +50.0 °C		-40.0 °C to +50.0 °C			
Maximum working pressure	90.0 bar g	AKV 10-1 to 10-6 = 52.0 bar g AKV 10-7 and AKVA 10-1 to 10-8 = 42.0 bar g	46.0 bar g	42.0 bar g	28.0 bar g	42.0 bar g
Maximum opening pressure differential	30.0 bar	18.0 bar	22.0 bar		18.0 bar	
Refrigerants	Specifically designed for use with refrigerant R744 (CO_2).	AKV valves: Chlorofluorocarbon and hydrofluorocarbon refrigerants, R744 (CO_2). AKV valves are **NOT** suitable for R717 (ammonia) (use AKVA). AKVA valves: Chlorofluorocarbon and hydrofluorocarbon refrigerants, R717 (ammonia) and R744 (CO_2).				
Method of operation	Direct operation		Servo operation (piston)			
Strainer	100 µm (internal)			Fit external strainer before valve inlet		
Installation option	Braze	Braze or butt weld	AKV = Braze, AKVA = Flange		Butt weld	
Working principle	Pulse Width Modulation (PWM) (valve open/close by controller)					
Cycle time	6 seconds (recommended)					
Regulation range	10 % to 100 %					
Leakage through valve seat	<0.02 % of k_v value					
Coil	Refer to JEH-ES-11-013 Application Guide to Danfoss Solenoid Coils					

[1]AKV 10 and AKVH 10 discontinued, replaced by AKV 10P and 10PS.

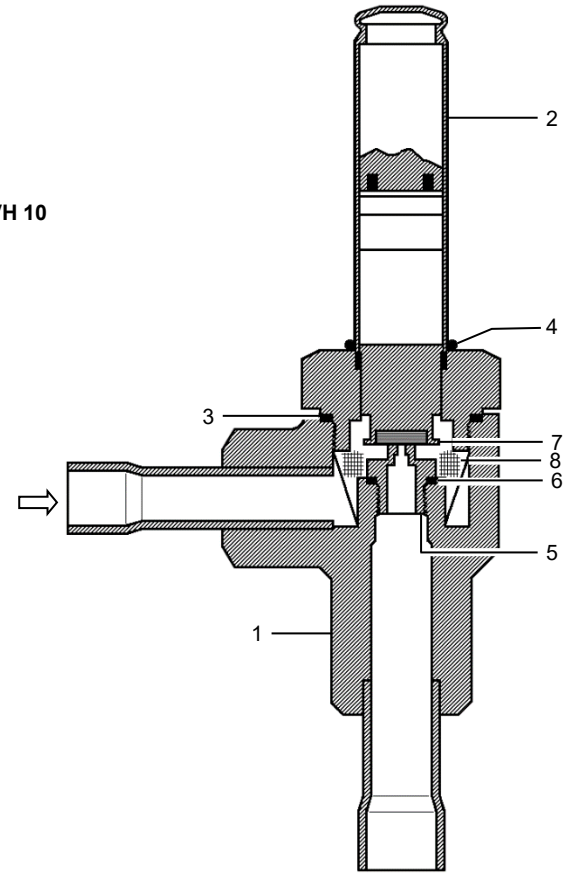
Table 2 Technical Data AKVH 10, AKV 10 to 20 and AKVA 10 to 20



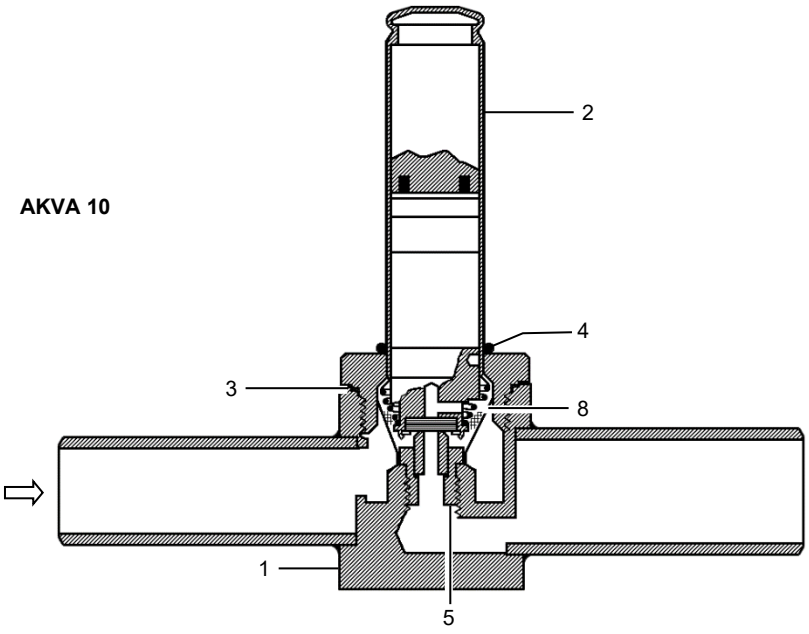
Item	Description	Item	Description	Item	Description
1	Body	3	Gasket (Cu) - tube to body	5	Orifice
2	Armature tube	4	'O' ring - coil	6	Strainer

Fig 2 AKV 10P, AKVA 10PS and AKVO 10

AKV 10 and AKVH 10



AKVA 10



Item	Description	Item	Description	Item	Description
1	Body	4	'O' ring - coil	7	Valve seat
2	Armature tube	5	Orifice	8	Strainer
3	Gasket (Cu) - tube to body	6	Gasket (Al) – orifice to body		

Fig 3 AKV 10, AKVA 10 and AKVH 10

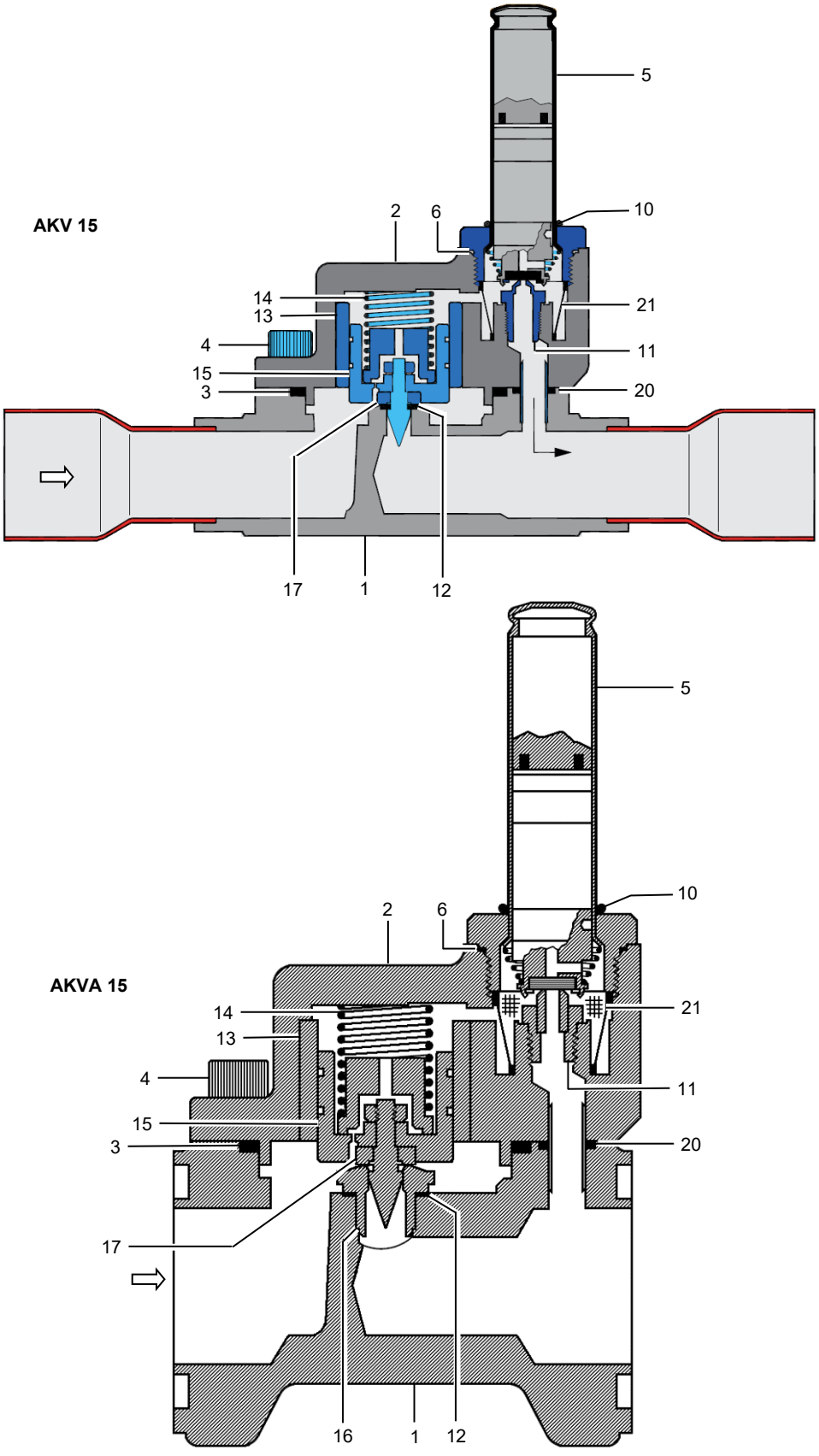
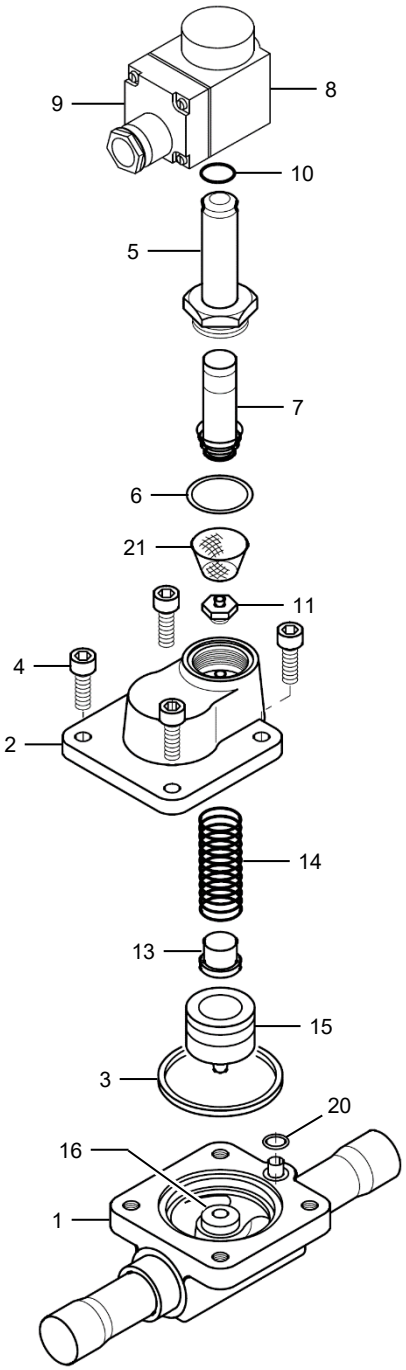


Fig 4 AKV 15 and AKVA 15



AKV 15 Illustrated

Item	Description	Item	Description	Item	Description
1	Body	8	Coil	15	Piston assembly
2	Cover	9	Terminal box	16	Main orifice
3	'O' ring – cover to body	10	'O' ring - coil	17	Valve seat
4	Screw – cover to body	11	Pilot orifice	18	*Not used*
5	Armature tube	12	Gasket (Al) – orifice to body	19	*Not used*
6	Gasket (Cu) - tube to body	13	Insert	20	'O' ring – pilot orifice to body
7	Armature	14	Spring	21	Strainer

Fig 4 (continued) AKV 15 and AKVA 15

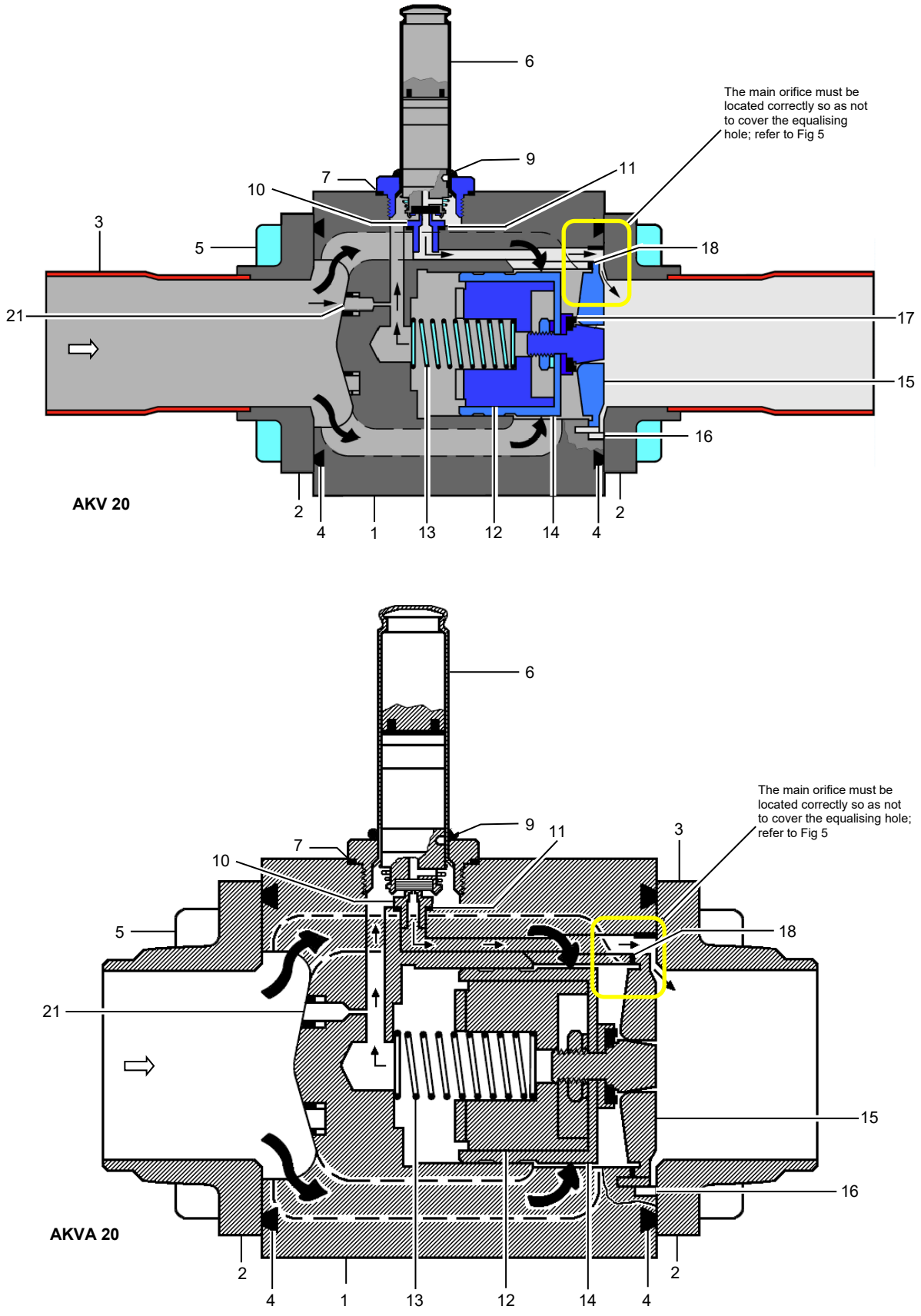
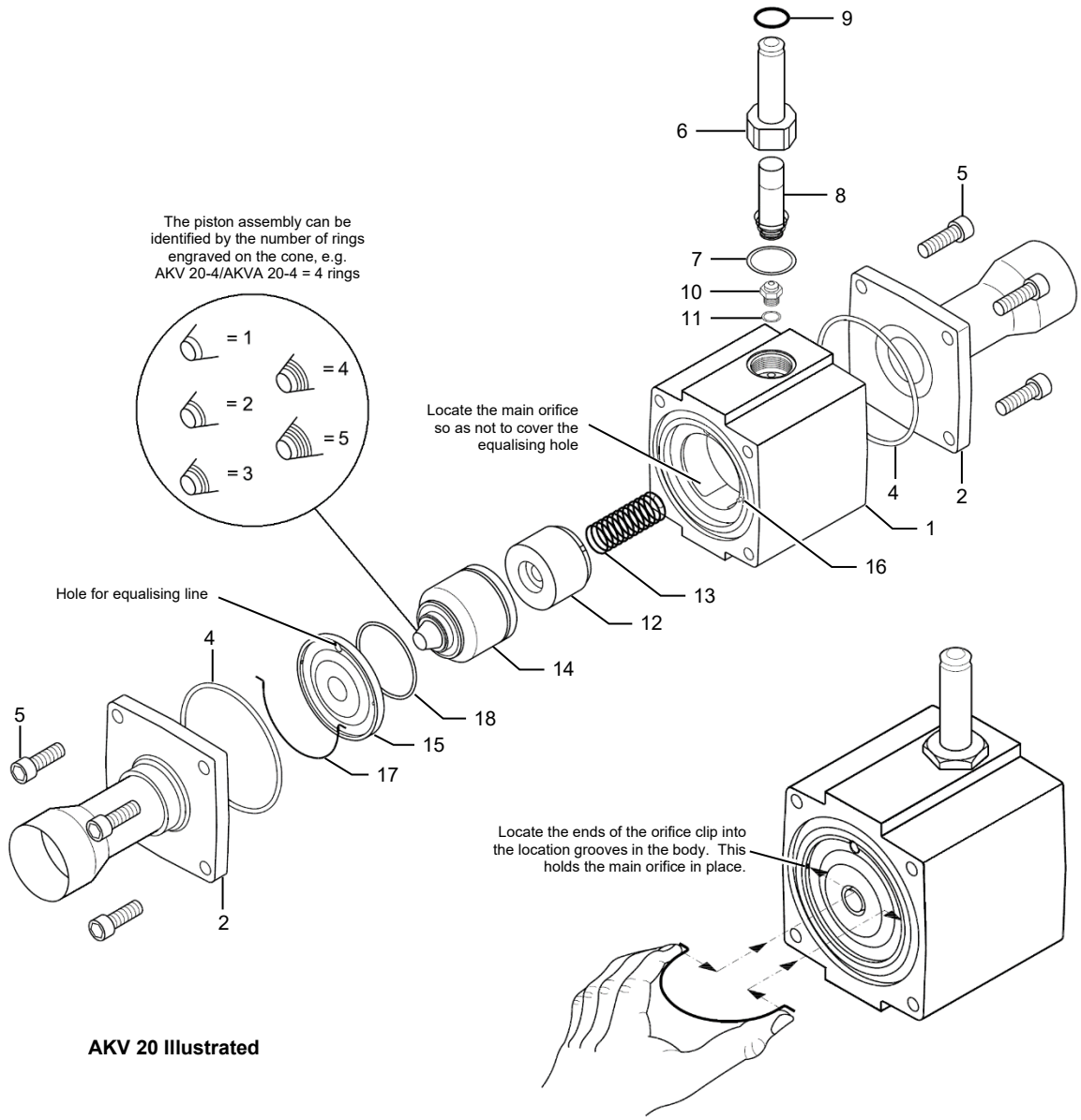


Fig 5 AKV 20 and AKVA 20



AKV 20 Illustrated

Item	Description	Item	Description	Item	Description
1	Body	7	Gasket - tube to body	13	Spring - insert
2	Flange – braze (AKV)	8	Armature	14	Piston assembly
3	Flange – weld (AKVA)	9	'O' ring - coil	15	Main orifice
4	Gasket - flange to body	10	Pilot orifice	16	Location pin – main orifice
5	Screw – flange to body	11	Gasket – pilot orifice to body	17	Clip – main orifice
6	Armature tube	12	Insert	18	'O' ring – main orifice

	AKV/AKVA 20-0.6 to 20-3	AKV/AKVA 20-4 and 20-5
Main orifice diameter	8.0 mm	14.0 mm
Pilot orifice diameter	1.8 mm	2.4 mm

Fig 5 (continued) AKV 20 and AKVA 20

4. Operation

4.1. Direct Operation AKV 10P, AKVH 10, AKV 10 and AKVA 10

The valve opens to full flow when the coil is energised and the armature attracted upward into the coil's magnetic field. The valve operates with zero differential pressure between the inlet and outlet.

Inlet pressure acts above the armature and hence on the pilot valve plate which is positioned at the base of the armature. The weight of the armature, the armature spring force and inlet pressure all combine to close the valve when the solenoid coil is de-energised.

4.2. Servo Operation AKV 10PS, AKVO 10, AKV 15, AKVA 15, AKV 20 and AKVA 20

These valves utilise the differential pressure between inlet and outlet to open and close the valve to flow.

Energising the solenoid coil opens the valve. The electric current generates a magnetic field in the coil which attracts the armature upward, lifting the pilot valve plate at the bottom of the armature from its seat. Inlet pressure in the space above the piston is now free to relieve through the pilot orifice to the outlet side of the valve.

As the pressure above the piston equalises to outlet pressure, inlet pressure acting on the annular area under the piston lifts the piston and opens the valve to full flow through the main orifice.

When the solenoid coil is de-energised, the armature falls and closes the pilot orifice. The pressure on the upper side of the piston now increases via the equalising hole until it is equal to inlet pressure. Inlet pressure acting on top of the piston forces the piston onto its seat and closes the valve to flow. The weight of the armature, the armature spring force and the differential pressure between inlet and outlet combine to keep the pilot orifice closed and the piston firmly on its seat.

4.3. Capacity Regulation

The AKV valve's capacity is regulated by pulse width modulation (PWM).

Within a period defined by the cycle time (maximum and minimum values defined by the controller), a 'valve open' signal from the controller is supplied to and removed from the valve coil, opening and closing the valve to refrigerant flow. The duration of the 'open' signal, computed by the controller P + I or P + I + D control algorithm, determines the capacity of the valve for each cycle time period.

Example, refer to Fig 6.

Cycle time = 6 seconds.

When 100 % valve capacity is called for, the valve is opened for the entire 6 second period. When only 60 % capacity is required, the valve is open for 60 % of the period, closed for 40 %.

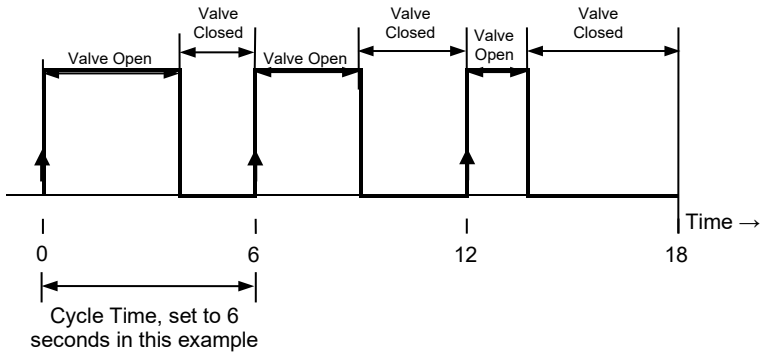


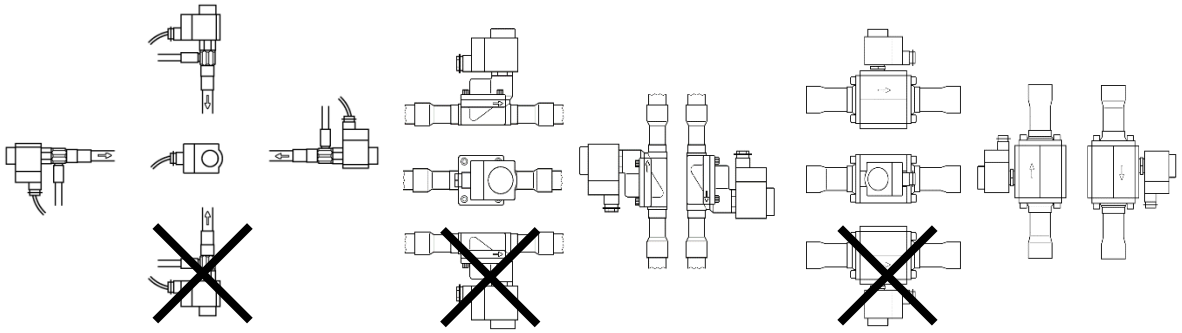
Fig 6 Cycle Time

5. Installation

Dirt and other foreign matter are prevented from entering the valve by protective covers fitted to the inlet and outlet connections. These covers should remain in place until immediately before the valve is installed.

Permitted valve orientation is illustrated in Fig 7. The coil can be turned in relation to the valve body.

NOTE: The arrow on the side of the valve body must point in the direction of flow.

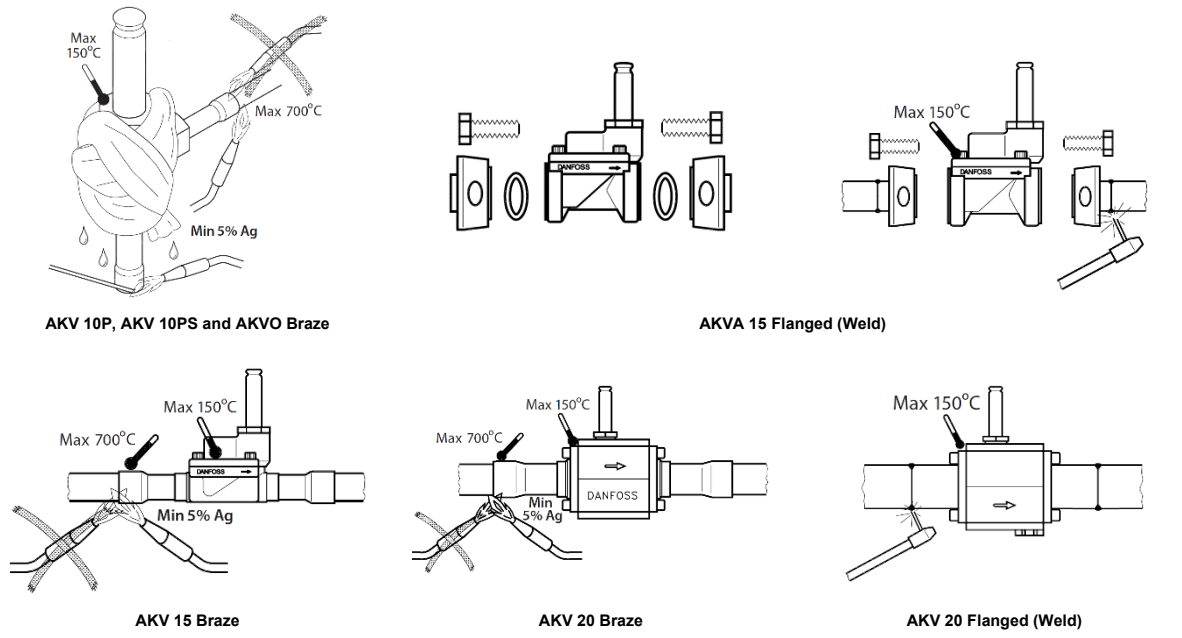


AKV 10P, AKV 10PS, AKVO 10 AKV 10, AKVA 10 and AKVH 10 | **AKV 15 and AKVA 15** | **AKV 20 and AKVA 20**

Fig 7 Permitted Valve Orientation

Refer to Fig 8.

AKV valves other than AKVA are designed for brazing into line, AKVA valves are designed for welding. AKVA 15 valves are fitted into line between flanges held in place between two long studs. The latter method of installation is sometimes used when the valve is fitted with a close-coupled inlet strainer.



AKV 10P, AKV 10PS and AKVO Braze | **AKVA 15 Flanged (Weld)**

AKV 15 Braze | **AKV 20 Braze** | **AKV 20 Flanged (Weld)**

Fig 8 Installation

Wrap the valve with wet rag to prevent overheating before brazing or welding takes place; direct the torch flame away from the valve body. For valves with a close-coupled strainer, remove the strainer basket.

For flanged valves, tack-weld the flanges, then dismantle the valve and strainer body (if fitted) from between the flanges before completing the welding/brazing operation. Remove any dirt, scale or weld from the line; this is an essential precaution to prevent these contaminants entering the system.

Reassemble checking that the valve body strainer (if fitted) are correctly seated between the flanges; the arrow embossed on the valve and strainer bodies must point in the direction of flow. Tighten the flange screws evenly to ensure the flanges and gaskets seat square; refer to Table 3. Do not attempt to align the pipework by tightening the screws excessively. If the screws bind in their holes or the flanges spring out of line when the screws are removed, obviously there is a misalignment which must be corrected. Refit the strainer basket.

After installation, check the valve and flange joints for leaks.

5.1. Solenoid Valve Coils

Danfoss standard 'clip-on' coils are listed in publication 4-300 Danfoss Solenoid Valve Coils.

For Zone 1 and Zone 2 hazardous areas it is necessary to use a special explosion-proof coil, either supplied by Danfoss (refer to publication 4-300) or Valvex (refer to Fig 9.

5.1.1. Fitting Valvex Explosion-proof Coil

Refer to Fig 9.

Use a piece of hardwood dowel and a hammer to fit the top piece over the armature tube. Locate the explosion-proof coil over the armature tube. Fit the cover and washer and secure in place with the cap-screw. Do not over-tighten.

5.1.2. Installing Wiring and Coils

Before connecting wiring to the solenoid coil, check the coil voltage and frequency correspond to the supply values.

Installing Danfoss 'clip-on' coils is described in publication 4-300.

6. Maintenance

AKV valves other than AKV 20 and AKVA 15 to 20 incorporate an integral fine mesh strainer. For valves without a strainer, fit a separate strainer before the valve inlet.

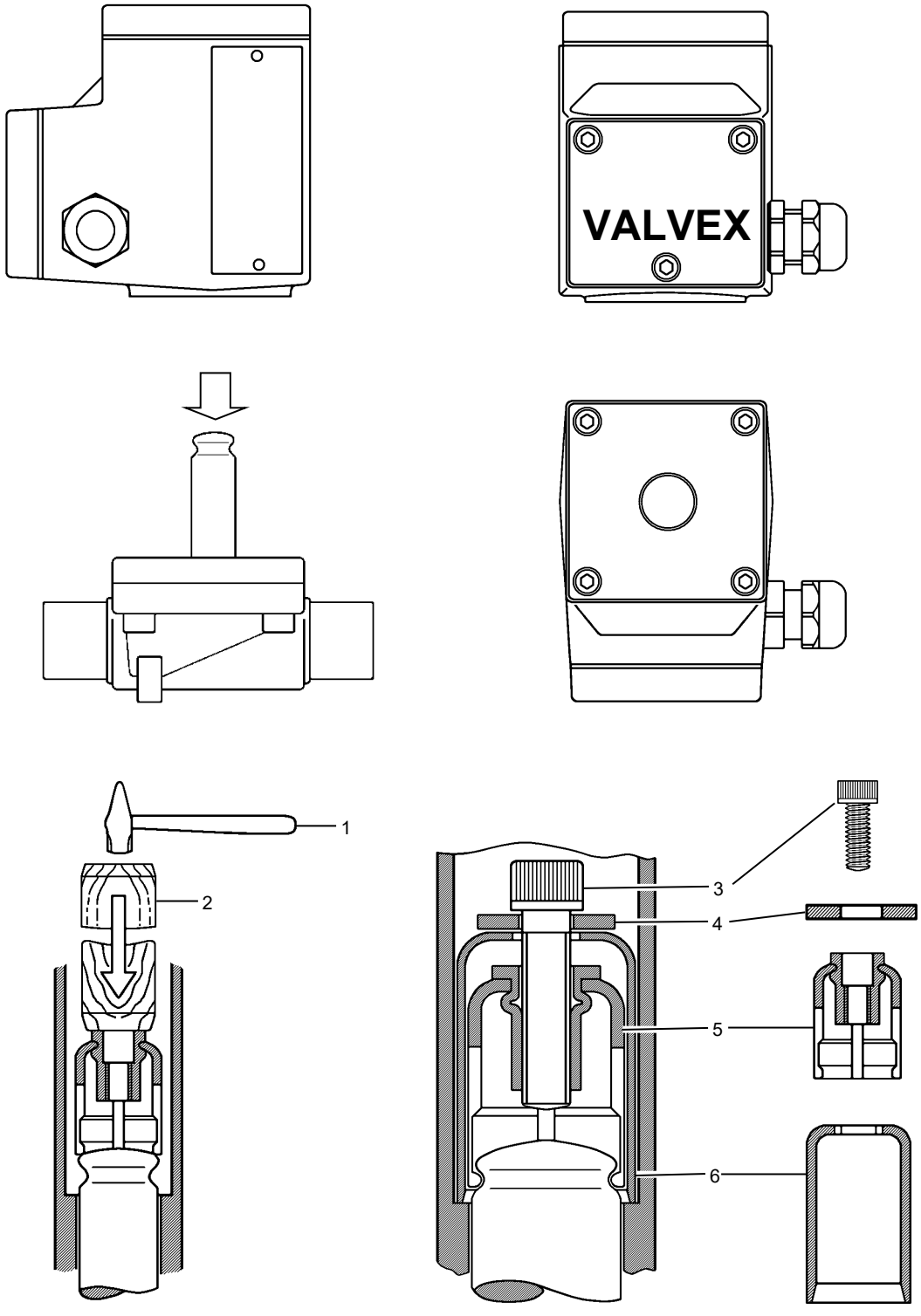
Clean the integral or inline strainer after the first 200 hours operation, then annually, or at intervals of 5,000 operating hours, whichever is the sooner. Experience of running the plant may suggest that more frequent cleaning is necessary.

7. Servicing

Spares kits are available from the address at the end of this publication. It is important to use spares obtained from J & E Hall International. 'O' rings and gaskets must be compatible with the system refrigerant and lubricating oil.

7.1. Fitting a New Coil

Isolate the valve from the electrical supply. Disconnect wiring at the coil. Before connecting wiring to the new coil, check that the coil voltage and frequency correspond to the supply values.



Item	Description	Item	Description	Item	Description
1	Hammer	3	Cap screw	5	Top piece
2	Hardwood dowel	4	Washer	6	Cover

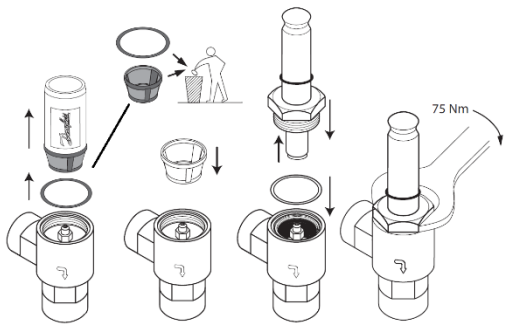
Fig 9 Valvex Explosion-proof Coils

7.2. Dismantling

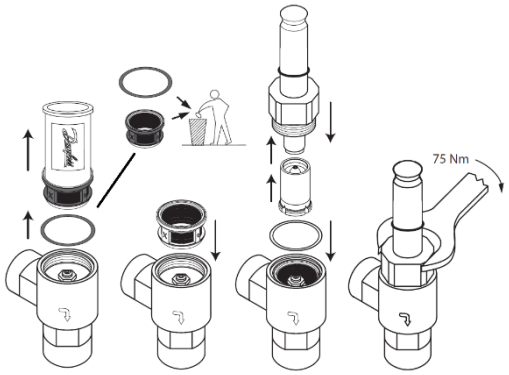
Isolate the valve from the electrical supply. Disconnect wiring at the coil.

⚠ WARNING

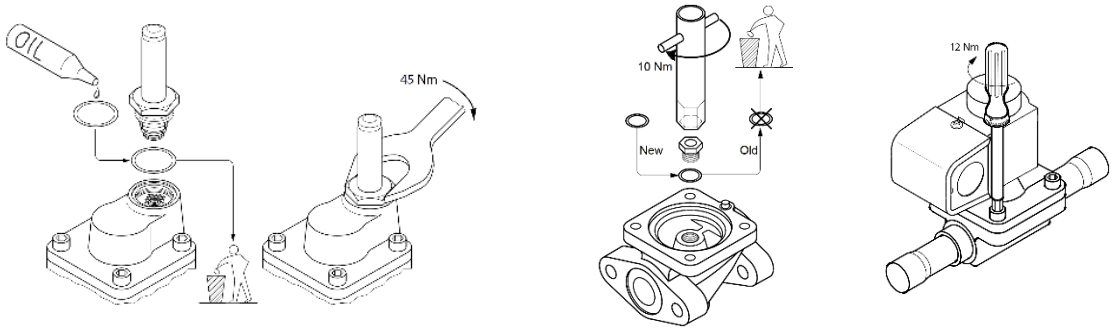
The valve is in direct contact with the system environment. DO NOT attempt to dismantle the valve or remove it from the line until it has been isolated and that part of the system cleared of oil/refrigerant. Suitable clothing must be worn; this should include goggles, gloves etc., and, on a system using ammonia refrigerant, a suitable respirator.



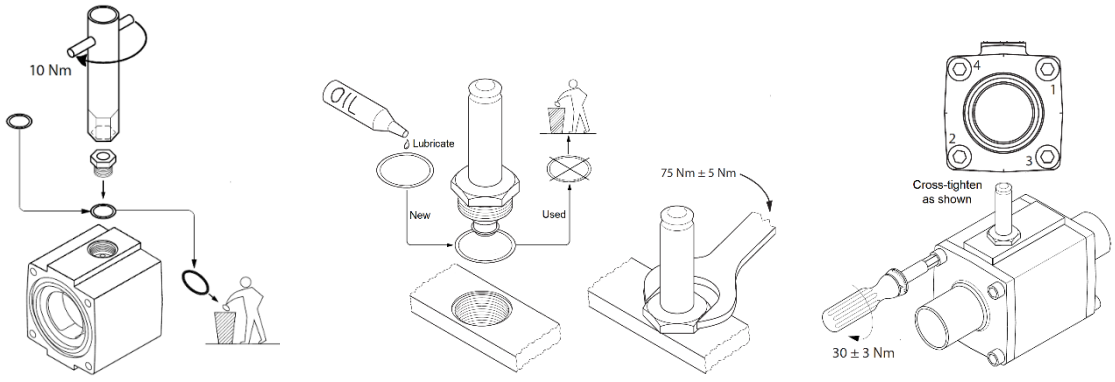
AKV 10P



AKV 10PS



AKV 15 and AKVA 15 Pilot Orifice and Armature Tube



AKV 20 and AKVA 20 Pilot Orifice and Armature Tube

Fig 10 Servicing

(a) Clear the part of the system containing the valve by pumping over refrigerant charge. Close isolating stop valves.

- For systems charged with CFC, HFC, HCFC or HFO refrigerant, use a pump-out unit to remove the rest of the refrigerant.
- For systems charged with R717 (ammonia) refrigerant, purge off the remaining refrigerant using the apparatus and method illustrated and described under Apparatus for Purging Ammonia Vapour and Draining Oil in publication 5-20 in Section 5 of the plant instruction manual.

(b) Dismantle the valve; refer to Fig 3 to Fig 5.

For valves fitted with a servo piston, remove the piston by screwing a cover bolt into the threaded hole in the piston.

(c) Clean parts with a suitable solvent, preferably by applying and then blowing-off with compressed air; abrasives must **NOT** be used for this purpose. Examine parts for damage or wear: scoring or chatter-marks for example, fit new parts as required.

7.3. Reassembly

(a) Reassemble the valve using new gaskets and 'O' rings.

- Check that the pressure equalising hole is free of dirt;
- The gaskets under the armature tube assembly and pilot orifice **MUST** be replaced to avoid leakage.
- Tighten fastenings to the torques shown in Table 3.

(b) Evacuate that part of the system opened up to atmosphere. The procedure to adopt is described in Part E : Evacuation and Dehydration in Section 1 of the plant instruction manual.

(c) Open stop valves to reunite the system. Check for leaks.

Application	AKV 10P, AKV 10PS, AKVO 10, AKVH 10, AKV 10 and AKVA 10	AKV 15 and AKVA 15	AKV 20 and AKVA 20
Armature tube to top cover or body	45 N m	75 N m	
Top cover screws to body		12 N m	
End cover screws to body			30 N m
Pilot orifice to body	10 N m		

Table 3 Tightening Torques for Fastenings

8. Faults and Remedies

Some of the more common fault conditions are given in Table 4.

1. FAULT: Valve fails to open	
Probable Cause	**Remedy**
Voltage too low to energise coil or wrong coil fitted.	Check supply voltage and frequency. Fit new coil if necessary.
Overheated/burnt-out coil. Wrong supply voltage or frequency, wrong coil fitted.	
Pressure equalising hole blocked. AKV/AKVA 20 - check the main orifice is in the correct position; refer to Fig 5.	Unblock equalising hole.
	AKV/AKVA 20 - move main orifice to correct position.
AKV/AKVA 15 to 20 valves fitted with a piston - piston seized or worn (too much clearance).	Dismantle and clean piston. Fit new piston if required. Check for erosion due to flash-gas.
Not a valve fault. Open signal not available.	If signal not available this is a wiring or control fault.
2. FAULT: Valve fails to close	
Probable Cause	**Remedy**
Armature or valve seat damaged or armature not seating properly, sufficient flow to keep valve open.	Replace armature or valve seat. Check for dirt.
AKV/AKVA 15 to 20 valves fitted with a piston - piston seized.	Dismantle and clean piston. Fit new piston if required.
Not a valve fault. Close signal not available.	If signal not available this is a wiring or control fault.
3. FAULT: Excessive pressure drop across valve	
Probable Cause	**Remedy**
Inlet or outlet restricted.	Check for blocked strainer upstream from valve. Clean if necessary. Check/clean or replace integral strainer.
Excessive amount of flash-gas.	Eliminate source of flash-gas.

Table 4 Common Faults and Remedies

9. Spares

9.1. Coils

For coil information and spares, refer to publication 4-300 Danfoss Solenoid Valve Coils.

Coils for AKV valves must be ordered separately. Refer to J & E Hall International Engineering Standard JEH-ES-11-013 Application Guide to Danfoss Solenoid Coils.

Always quote the coil supply voltage and frequency.

9.2. AKV Valve Assemblies

For available sizes, connections and part numbers refer to J & E Hall International Engineering Standard JEH-ES-06-004 Part 9.

9.3. Spares Ordering

Obtain spare parts from the address below:

J & E Hall International
Hansard Gate,
West Meadows
Derby,
DE21 6JN
England

Telephone: +44 (0) 1332-253400
Fax: +44 (0) 1332-371061
Email: spares@jehall.co.uk
Website: www.jehall.com

When ordering always quote the J & E Hall International contract number and the component serial number (if available).

9.4. Spares Kits

Valve		Seal Kits		Piston Kits		Orifice Kits		Armature Kits
AKV 10P	AKV 10P0 to 10P3					N30210070		[1]N30270554
	AKV 10P4 to 10P8					N30210071		
AKV 10PS	AKV 10PS4 to 10PS8					N30210072		[2]N30270555
AKVH	AKVH 10-0 to 10-3					N30210073		N30270556
	AKVH 10-4 to 10-6					N30210074		
AKV	AKV 10-0 to 10-3					N30210073		
	AKV 10-4 to 10-6					N30210074		
	AKV 10-7 to 10-8					N30210075		
	AKV 15-1			N30290249				N30270557
	AKV 15-2			N30290250				
	AKV 15-3			N30290251				
	AKV 15-4			N30290252				
	AKV 20-0.6	N30230129		N30290253		N30210076		
	AKV 20-1			N30290254				
	AKV 20-2			N30290255				
	AKV 20-3			N30290256				
	AKV 20-4			N30290257		N30210077		
	AKV 20-5			N30290258				
AKVA	AKVA 10-1					N30210078		
	AKVA 10-2					N30210079		
	AKVA 10-3					N30210080		
	AKVA 10-4					N30210081		
	AKVA 10-5					N30210082		
	AKVA 10-6					N30210083		
	AKVA 10-7					N30210084		
	AKVA 10-8					N30210085		
	AKVA 15-1	N30230130		N30290249		N30210086		
	AKVA 15-2			N30290250				
	AKVA 15-3			N30290251				
	AKVA 15-4			N30290252				
	AKVA 20-0.6	N30230129		N30290253		N30210076		
	AKVA 20-1			N30290254				
	AKVA 20-2			N30290255				
	AKVA 20-3			N30290256				
	AKVA 20-4			N30290257		N30210077		
	AKVA 20-5			N30290258				

Strainer Kits	AKV 10P0 to 10P8	N12050782
	AKV 10PS4 to 10PS8	N12050783
	AKV 10-0 to 10-8 AKVH 10-0 to 10-6 AKVA 10-1 to 10-8 AKV 15-1 to 15-4 AKVA 15-1 to 15-4	N12050784

[1]Kit can be used to convert AKV 10-1 to 10-7, AKVH 10-0 to 10-6 and AKV 10PS4 to 10PS8, to AKV 10P0 to 10P8.
[2]Kit can be used to convert AKV 10-1 to 10-7, AKVH 10-0 to 10-6 and AKV 10P0 to 10P8, to AKV 10PS4 to 10PS8.

Table 5 Spares Kits

10. Safe Disposal, End-of-life (EOL)

At the end of the valve's working life, it should not be classed as domestic waste but be disposed of separately by a registered recycling company according to local and currently valid legislation.