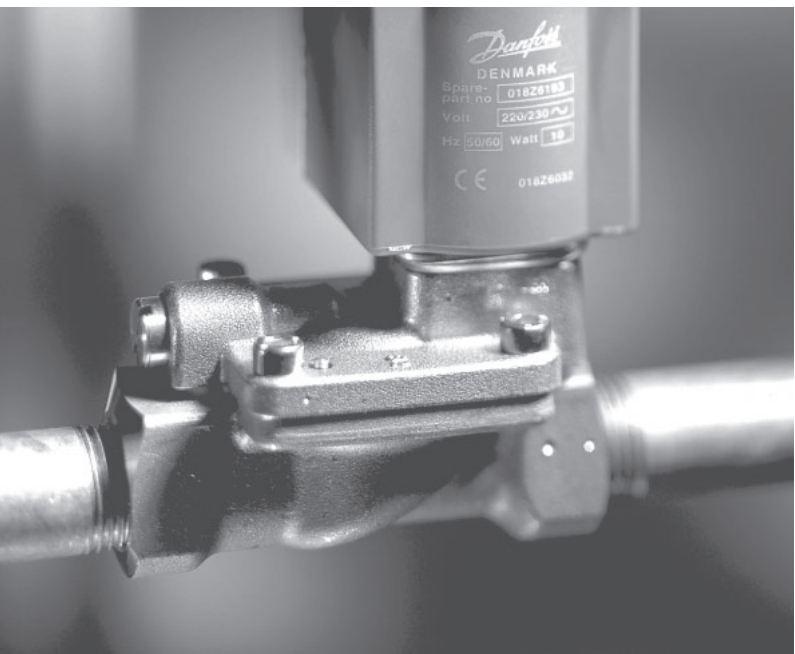


*Danfoss*

# how to use solenoid valves



## Wide range

Our range of industrial valves covers:

- 2- and 3-way versions
- Electromagnetically direct- and servo-operated valves
- Externally operated valves
- Thermostatically operated valves
- Valves for both neutral and aggressive liquids and gases
- Valves with very small to very large flow capacities

The composition of the range is a result of more than 50 years' experience as a supplier of valves for innumerable industrial applications.

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## Flexible and user-friendly

Danfoss solenoid valve bodies and electrical coils are normally supplied separately and then combined together. They are assembled quickly and simply without any tools. This provides optimum product flexibility and availability. If a coil does need to be replaced then it can be done without stopping or draining any system.

The solenoid valves are also available as assembled units if required.

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## Worldwide sales and service network

With more than 40 sales companies and representatives in more than 100 countries Danfoss is present virtually throughout the world. A global network consisting of more than 17,000 employees is at your service to provide advice, supplies, service and spare parts. This means fast support and troubleshooting – on a worldwide basis.



# how to use solenoid valves

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This booklet has been compiled to help in the installation of solenoid valves and in locating faults in systems with solenoid valves.

The booklet also contains an overview of solenoid valves with dimensions to help in sizing valves for new installations and the modernisation of existing plant.

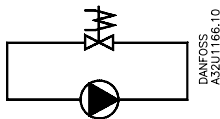
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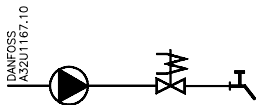
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### Choosing the correct solenoid valve

In a closed circuit system, typically with low pressures, a valve symbolised thus must be chosen.

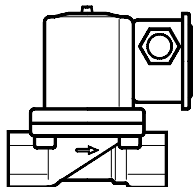


With an open system, e.g. for drinking water, a valve under this symbol must be chosen.



Note that this booklet describes only brass solenoid valves.  
For other types, please contact Danfoss.

## Flow direction



To be able to operate correctly, all solenoid valves must be installed with the arrow cast on the body pointing in the direction of flow.

## Water hammer

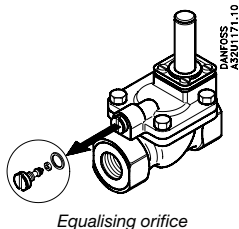
Water hammer is a typical result of high liquid velocity (high pressure and high flow velocity through small pipe diameters).

There are several reasonable solutions to the problem:

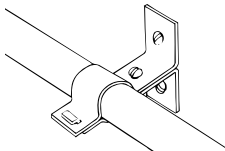
A: Reduce the pressure by installing a pressure reduction valve ahead of the solenoid valve. If possible, increase the pipe diameter.

B: Damp the water hammer by installing a flexible hose or flexible buffer ahead of the solenoid valve.

C: Use a solenoid valve of the type EV220B 15-50. The equalising orifice can be replaced by a version with smaller diameter. This gives a longer closing time (see “Spare parts” and “Opening and closing times”).

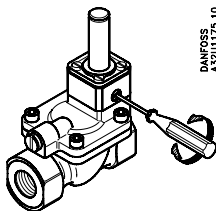


### Pipe



The pipes on both sides of the valve must be securely fastened.

### Test pressure



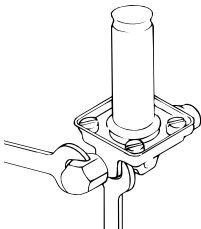
When applying test pressure: All valves in the system must be open. There are three ways of doing this:

1. By applying voltage to the coil
2. By opening the valves manually (when the manual override accessory is fitted)
3. By connecting the Danfoss permanent magnet (see Tools, page 25)

Note that the manual opening unit is *not* supplied as standard, but as an accessory for EV220B valves (see page 9).

Remember to screw the opening unit back (CLOCKWISE) before starting up the system, otherwise the valve cannot close.

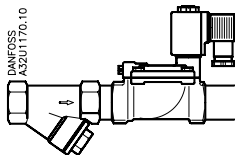
### Tightening up



Always use counter-force when tightening up pipe connections, i.e. use a spanner on both the valve body as well as on the pipe connector (as shown).

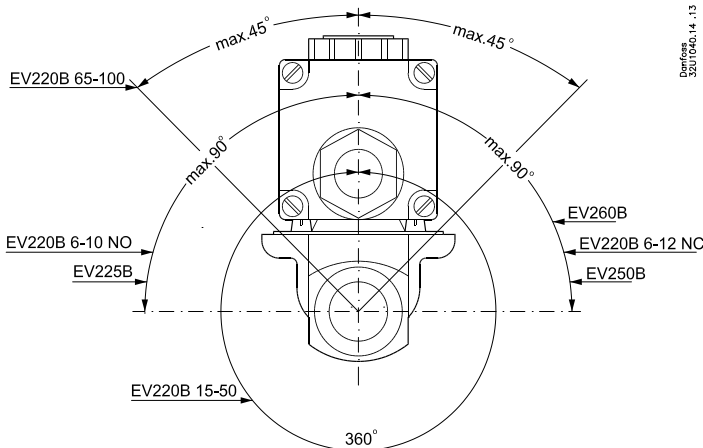
## Dirt in the system

Always flush out piping before installing a solenoid valve. If there is dirt in the medium, a filter should be installed ahead of the valve (see page 9).

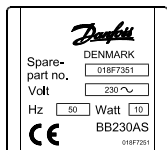


## Installing the coil

Danfoss recommends that the solenoid valve be installed with coil upwards. This minimises the risk of dirt collecting in the armature tube. If "clean" media is used, i.e. media containing no dirt particles, the solenoid valve will operate when installed in the orientation as shown below.



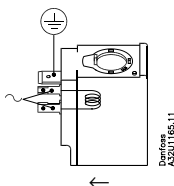
## Coil



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A32U1165.12

Check to ensure that the coil operating voltage is correct (see text on coil, in “Volt”). Also ensure that the data is correct (voltage and frequency) and matches the supply. If the two sets of data do not correspond, the coil might burn out.

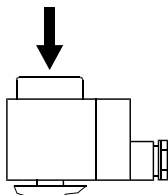
As far as possible, always choose single-frequency coils; they give off less heat than double-frequency versions.



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A32U1165.11

The coil has three pins. The middle pin is marked according to the illustration (left) and must be used for earthing.

The two other pins are coil terminals and either can be used for the phase or neutral supply. The terminals can be used respectively for phase and neutral as required.

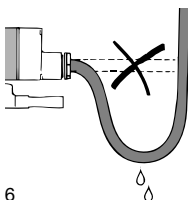


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A32U1.395.10

When mounting the clip-on coil, simply press it gently onto the armature, until it clicks into place. An O-ring should normally be fitted over the armature tube before fitting the coil.

Cable entries must always be screwed in correctly.

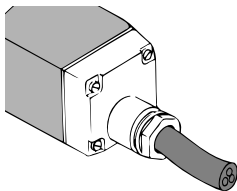
## Cable connection



The cable must be installed as shown in the illustration to avoid water running into the terminal box.



## Cable



To avoid moisture penetrating in the terminal box, the whole cable diameter must be secured in the entry. For this reason, always use round cables as they are the only type that can be effectively sealed.

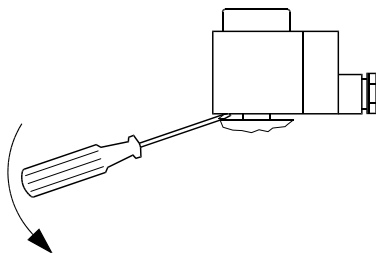


Note the colours on the cable leads. Yellow/green is always earth. The other leads should be for the phase and neutral supply.

## Coil replacement

When replacing a coil, use a screwdriver to lever it from the armature.

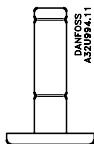
**Note:** Before removing a coil, voltage **must** be disconnected, otherwise the coil will burn out.



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A.32U139610

## Normally open components (NO)

The set contains locking button and nut for coil, normally open assembly kit (armature and armature tube) and an O-ring.



Type	Code numbers	
	FKM seal material <sup>1)</sup>	EPDM seal material <sup>1)</sup>
EV210B 1.5-3 NO	032U2004	032U2005
EV220B 6 NO	032U0166	032U0165
EV220B 10 NO	032U0167	-
EV220B 15-50 NO	032U0295	032U0296

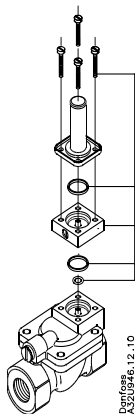
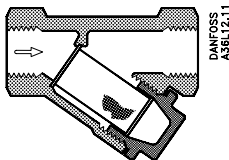
*NO components are also available for Danfoss valves with other seal materials.*

<sup>1)</sup> See page 16 for seal material description.

**Manual opening unit**

The manual opening unit for EV220B 15-50 can be used to open and close the valve in the event of power failure or when applying test pressure.

Code no. **032U0150**


**Filter type FV for water**


Type	Con- nection	Medium temp. [°C]	Test pres- sure [bar]	$k_{vs}$ [m <sup>3</sup> /h]	Code number
FV 10	G $\frac{3}{8}$	0 - +130	25	3.6	<b>036L0010</b>
FV 15	G $\frac{1}{2}$	0 - +130	25	4.7	<b>036L0015</b>
FV 20	G $\frac{3}{4}$	0 - +130	25	9.1	<b>036L0020</b>
FV 25	G 1	0 - +130	25	15	<b>036L0025</b>

See data sheet DKACV.PD.600.B for more information on FV filters.

Spare parts set for  
EV210B NC

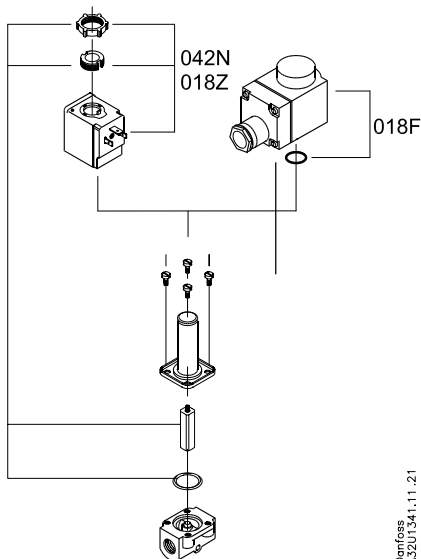
The spare parts set contains locking button and nut for coil, armature with valve plate and spring, and O-rings.

EPDM<sup>1)</sup> versions

Orifice size	Code no.
1.5 - 4.5	032U6000
6	032U2006

FKM<sup>1)</sup> versions

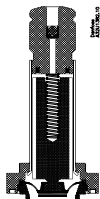
Orifice size	Code no.
1.5 - 4.5	032U2003
6	032U2011



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A32U1341.11.21

## Isolating diaphragm kit for EV210B 1.5-4.5 NC and EV220B 15-50 NC

Avoids build up of contaminants that can block movement of the armature. Permits use of more aggressive media that would normally attack the armature. Gel filled; guarantees operation after long periods on inactivity.

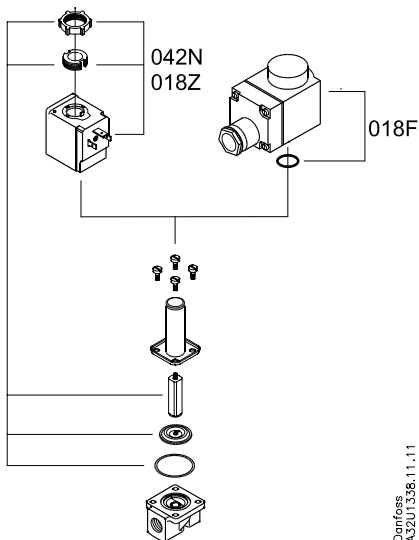


Seal material	Code no.
EPDM <sup>1)</sup>	042U1009
FKM <sup>1)</sup>	042U1010

<sup>1)</sup> See page 16

## Spare parts set for EV220B 6-12 NC

The spare parts set contains locking button and nut for coil, armature with valve plate and spring, diaphragm and two O-rings.



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A32U1358.11.11

### EPDM versions

Valve type	Code no.
EV220B 6 NC	032U1062
EV220B 10 NC	032U1065
EV220B 12 NC	032U1068

Spare parts sets are also available for Danfoss EV220B valves with other seal materials (see page 16 for seal material description).



## Spare parts set for EV250B 12-22 NC

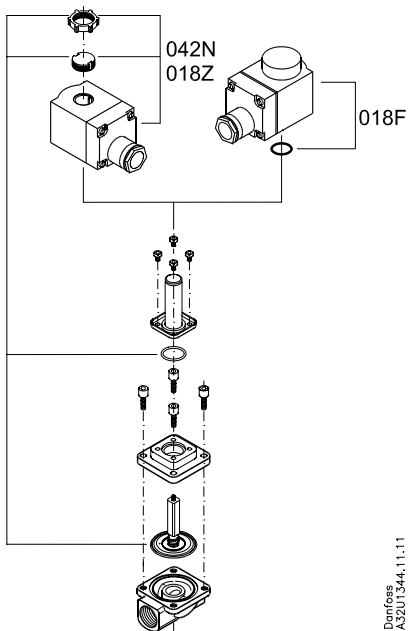
The spare parts set contains locking button, nut and O-ring for coil, armature, spring and valve plate all assembled onto the diaphragm.

EPDM<sup>1)</sup> versions

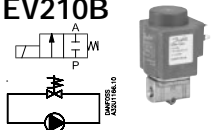
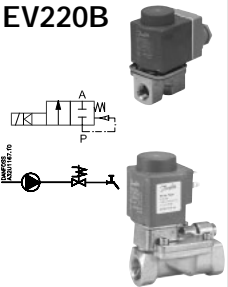
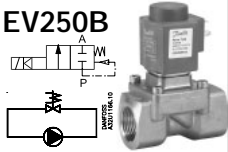
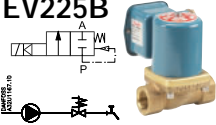
Orifice size	Code no.
10-12	032U5270
18-22	032U5272

Spare parts sets are also available for Danfoss EV250B valves with other seal materials.

<sup>1)</sup> See page 16 for description of seal materials



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A32U1344.11.11

	Medium				Connection [ISO 228/1]
	Air and neutral gases	Water	Oil	Steam	
<b>EV210B</b> 	X	X	X		G 1/8" - G 3/8"
<b>EV220B</b> 	X	X	X		G 1/4" - G 1"
	X	X	X	X	G 1/2" - G 2"
<b>EV250B</b> 	X	X	X	X	G 3/8" - G 1"
<b>EV225B</b> 				X	G 1/4" - G 1"



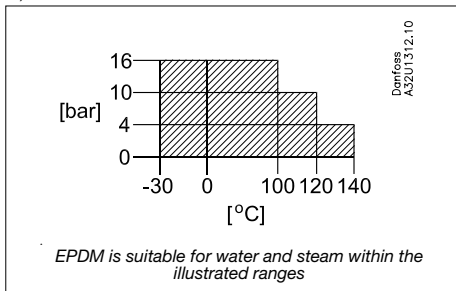
Characteristics					Description
Function	Orifice size [mm]	$K_v$ value [m <sup>3</sup> /h]	Diff. pressure [bar]	Max. media temp. [°C]	
NC/NO	1.5 - 6	0.05 - 8	0 - 30	140	EV210B covers a wide range of direct-operated 2/2-way solenoid valves for universal use. EV210B is a real robust valve program with high performance and can be used in all kind of tough working conditions.
NC/NO	6 - 22	0.7 - 6	0.1 - 30	100	EV220B 6-22 is a direct servo-operated 2/2-way solenoid valve program. This program is especially for OEM applications demanding a robust solution and moderate flow rates.
NC/NO	15 - 50	4 - 40	0.3 - 16	140	EV220B 15-50 is a universal indirect servo-operated 2/2-way solenoid valve program. Valve body in brass, dezincification resistant brass and stainless steel ensures that a broad variety of applications can be covered.
NC	10 - 22	2.5 - 7	0 - 16	140	EV250B with assisted lift is especially to use in closed circuits with low differential pressure, but demanding moderate flow rates. Valve body in DZR brass ensures a long life, even in connection with aggressive steam media.
NC	6 - 25	0.3 - 6	0.2 - 10	185	The EV225B design is based on a PTFE diaphragm and valve body in dezincification resistant brass, ensuring high reliable function and long life even in connection with contaminated steam.

## Media table

°C	Seal material			
	EPDM <sup>1)</sup>	FKM	NBR	PTFE
Medium				
Water / glycols	-30 → +140	0 → +60 0 → +100*	-10 → +90	-
Oil	-	0 → +100	-10 → +90	-
Air	-	0 → +100	-10 → +90	-
Steam	→ +140	-	-	→ +185

\* Direct-operated valves

1)



**BB coils (IP65)**

Coil consumption	Voltage	Code no.
10 W without cable plug	220 - 230 V ac / 50 Hz	018F7351
10 W without cable plug	110 V ac / 50 Hz	018F7360
10 W without cable plug	24 V ac / 50 Hz	018F7358
18 W without cable plug	24 V dc	018F7397
Cable plug for BB coils		042N0156
O-ring for fixing and sealing coil		018F0094

**BG coils (IP67)**

Coil consumption	Voltage	Code no.
20 W with terminal box	12 V dc	018F6856
20 W with terminal box	24 V dc	018F6857
O-ring for fixing and sealing coil		018F0094

**For installations sensitive to noise****BN coil (hum-free, IP65)**

Coil consumption	Voltage	Code no.
20 W with 1 m cable	220-230 V ac / 50-60 Hz	018F7301
O-ring for fixing and sealing coil		018F0094

<sup>1)</sup> For other voltages or coil types, please contact Danfoss.



## Closing times and water hammer

With the larger valves, very short closing times can cause water hammer.

The EV220B servo-operated valves have damped closing and fulfil EN 60730-2-8 specifications.

The table gives the opening/closing times of the various types, but it must be emphasised that differences in operating conditions - especially pressure - can cause deviations from the values given.

Type	Opening [ms]	Closing [ms]
EV210B 1.5	10	20
EV210B 3	20	20
EV210B 6	20	20
EV250B 12	100	100
EV250B 18	150	100
EV250B 22	150	100
EV220B 10	50	300
EV220B 12	60	300
EV220B 15	40	350
EV220B 20	40	1000
EV220B 25	300	1000
EV220B 32	1000	2500
EV220B 40	1500	4000
EV220B 50	5000	10000

## Changing opening and closing times

EV220B 15-50 closing times can be changed by replacing the equalising orifice at the inlet side of the valve (see "Water hammer", page 11, and "Spare parts", page 23). To decrease water hammer, choose a smaller equalising orifice.

The table shows the opening and closing times depending on the equalising orifice chosen (standard times marked in bold). The times stated cover water as a medium, and are for guidance only. Operating conditions, for example differential pressure, may influence the values.

Orifice		EV220B 15		EV220B 20		EV220B 25		EV220B 32		EV220B 40		EV220B 50	
[mm]	grooves	Open	Close	Open	Close	Open	Close	Open	Close	Open	Close	Open	Close
		[s]											
0.5	1	<b>0.04</b>	<b>0.35</b>	<b>0.04</b>	<b>1.0</b>	0.11	3.0	1.6	6.0	1.3	8.0	3.4	40.0
0.8	2	0.04	0.3	0.04	0.5	<b>0.3</b>	<b>1.0</b>	<b>1.0</b>	<b>2.5</b>	<b>1.5</b>	<b>4.0</b>	3.6	11.0
1.2	3	0.04	0.12	0.04	0.25	0.30	0.5	1.2	1.0	1.5	2.0	<b>5.0</b>	<b>10.0</b>
1.4	4	0.04	0.1	0.06	0.18	0.30	0.4	1.0	0.8	2.0	1.5	5.2	6.5

<sup>1</sup> Number of grooves

## Symptom: Solenoid valve does not open

Probable cause	Remedy
<i>No voltage on coil</i>	<p>Check whether valve is de-energised open or closed (NO or NC):</p> <ol style="list-style-type: none"> <li>1. Use a magnetic detector</li> <li>2. Lift coil slightly and note whether it offers resistance against lifting</li> </ol> <p>Note: Never remove a coil with voltage applied - it may burn out.</p> <p>Check relay contacts. Check lead connections. Check fuses.</p>
<i>Incorrect voltage/frequency</i>	<p>Check to make sure the coil's electrical requirements are the same as the installation supply. Measure the operating voltage at the coil. Permissible voltage variation:</p> <p>±10% for dual frequency; dc and NO applications +10% / -15% for ac on single frequency voltages</p> <p>If necessary, replace coil with correct version.</p>
<i>Coil burnt out</i>	See page 20
<i>Diff. pressure too high</i>	<p>Check coil data. If necessary, replace coil with correct version.</p> <p>Reduce differential pressure, e.g. by limiting inlet pressure.</p>
<i>Diff. pressure too low</i>	Check coil data and differential pressure. If necessary, replace coil with correct version.
<i>Damaged/bent armature tube</i>	Replace valve
<i>Dirt at diaphragm<sup>2)</sup></i>	Clean diaphragm. If necessary, replace defective component(s) <sup>1)</sup> .
<i>Dirt in valve seat/dirt in armature/armature tube<sup>2)</sup></i>	Clean valve; if necessary, replace defective component(s).
<i>Corrosion</i>	Replace defective component(s) <sup>1)</sup>
<i>Components missing after valve dismantling</i>	Fit missing component(s) <sup>1)</sup> .

## Symptom: Solenoid valve partly opens

Probable cause	Remedy
<i>Differential pressure too low</i>	Check valve data, incl. differential pressure. Replace valve with correct version.
<i>Damaged or bent armature tube</i>	Replace valve.
<i>Dirt at diaphragm</i>	Clean diaphragm. If necessary, replace defective component(s) <sup>1)</sup> .
<i>Dirt in valve seat/dirt in armature/armature tube<sup>2)</sup></i>	Clean valve, if necessary, replace defective component(s).
<i>Corrosion</i>	Replace defective component(s) <sup>1)</sup> .
<i>Components missing after valve dismantling</i>	Fit missing component(s) <sup>1)</sup> .

<sup>1)</sup> See "Spare parts"

<sup>2)</sup> If there is repeated build up of dirt in the armature / armature tube, consider the installation of an isolating diaphragm kit, if applicable (see "Spare parts")

**Symptom:** Solenoid valve does not close/partly closes

Possible cause	Remedy
<i>Voltage remains on coil</i>	First lift coil slightly and note whether it offers resistance. <i>Note: Never remove a coil with voltage applied - it might burn out.</i> Check wiring diagram and wiring. Check relay contacts. Check lead connections.
<i>Dirt in or closed pilot orifice/ equalising piece (??)</i>	Clean orifice with needle or similar (max. dia. 0.5 mm). Blow clean with compressed air. If necessary, replace defective component(s).
<i>Manual opening unit cannot be screwed back after use.</i>	Check position of opening unit and adjust as necessary.
<i>Pulsation in pressure line. Differential pressure too high in open position. Pressure on outlet side periodically higher than pressure on inlet side.</i>	Check valve data. Check pressure and liquid flow. Replace valve with one more suitable. Check rest of installation.
<i>Damaged/bent armature tube</i>	Replace valve.
<i>Defective valve plate, diaphragm or valve seat</i>	Check pressure and liquid flow. Replace defective component(s) <sup>1)</sup> .
<i>Diaphragm upside down</i>	Check correct installation of valve <sup>1)</sup>
<i>Dirt in valve seat/dirt in armature tube</i>	Clean valve; if necessary, replace defective components
<i>Corrosion, pilot/main orifice</i>	Replace defective components.
<i>Valve installed wrong way round</i>	Check liquid flow direction and make sure the arrow is pointing in the same direction.
<i>Components missing after valve dismantling</i>	Fit missing component(s) <sup>1)</sup> .



## Symptom: Solenoid valve sounds wrong

Probable cause	Remedy
<i>Hum</i>	Hum caused by ac frequency. Can be removed by changing to coil with rectifier (see page 17).
<i>Water hammer when valve opens</i> <i>Water hammer when valve closes</i>	See "Installation"
<i>Differential pressure too high and/or pulsation in pressure line</i>	Check valve data and differential pressure. Check pressure and liquid flow. Replace with more suitable valve. Check rest of installation.

<sup>1)</sup> See "Spare parts"

**Symptom:** Coil burnt - cold with voltage on

Probable cause	Remedy
<i>Incorrect voltage/frequency</i>	Check coil data. If necessary, change to correct coil type. Check wiring diagram and wiring. Check maximum voltage variation: Permissible voltage variation: ±10% for dual frequency; dc and NO applications +10% / -15% for ac on single frequency voltages
<i>Coil short-circuit (could be moisture in coil)</i>	Check rest of installation for possible short-circuiting. Check lead connections at coil. When fault has been found, replace coil. (See also "Coil" in section "Installation"). Consider fitting a 'clip-on' style coil with additional sealing O-ring.
<i>Armature sluggish</i> a) <i>Damaged/bent armature tube</i> b) <i>Damaged armature</i> c) <i>Dirt in armature tube</i>	Replace defective component(s). Remove dirt.
<i>Temperature of medium too high</i>	Check valve and coil data in relation to installation specification. Change to suitable coil or valve.
<i>Ambient temperature too high</i>	If possible, move valve to cooler surroundings. Check valve and coil data in relation to installation specification. Increase ventilation around valve and coil.



### **Magnetic field indicator**

This handy key ring tool reacts to magnetic fields from solenoid valves. Place the indicator close to the coil, and the red-white disc will prove the coil to be active by rotating.



### **Permanent magnet**

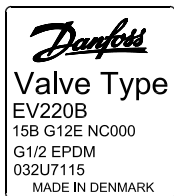
With this tool it is possible to operate solenoid valves without wiring up the electrical coil.

*Please contact your local Danfoss office to obtain these popular tools.*

## Danfoss solenoid valves

### 1. Identification of Danfoss solenoid valves:

Illustration 1 shows the label with relevant information that is attached to the coil.

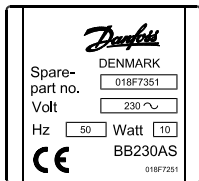


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①

The example here is from an EV220B solenoid valve:

- 15: 15 mm orifice
- B: Brass body material
- G 12: ISO 228/1, 1/2 inch connection
- E: EPDM seal material (for water, brine and glycol)
- NC: Normally closed

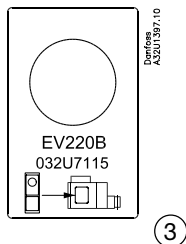


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A32U1169.12

②

The coil type (BB230AS) is printed on the front of the coil as well as voltage (V) and frequency (Hz) - see illustration 2.

After identification, see the first section of this handbook.



2. If the the coil label cannot be read, the valve can be identified from the letter/number combination stamped in the valve body.

Also, on more recent valves, a slip beneath the coil (illustration 3) shows type and code number.

## Valves of other makes

If no code is stamped in the valve, or if the solenoid valve is of another make, the following information will be of great help when ordering Danfoss solenoid valves as replacements:

- Application (closed circuit, open system or drain application)?
- Function (de-energised open or closed)?
- End connection?
- Medium (water, oil, air, etc.)?
- $k_v$  value?
- Coil voltage?
- Alternating (ac) or direct current (dc)?



## Quality approval

Danfoss high quality level also applies to our valve range. Continuous monitoring of all processes in the valve factories ensure a uniform, high quality level is achieved by the international standard ISO 9001 approved quality assurance system. This means that Danfoss complies with the requirements on product development, design, production and sales.



## Environmental certifications

Danfoss recognises environmental management as one of the top corporate priorities, and we consider ourselves as being among the most environmentally conscious companies in our branch of industry. In order to promote sustainable development we will prevent, limit and as far as possible eliminate environmental effects. Having ISO 14001-certification and EMAS<sup>1)</sup>-registration proves these traditional Danfoss values to be fully implemented in the Industrial Controls unit.



<sup>1)</sup> *Eco Management and Audit Scheme*

# One call and you're in control

One call to Danfoss gives you access to an entire range of high-quality industrial controls. The Danfoss line encompasses components for industrial monitoring and control systems based on the principles of pressure and temperature measurement, electrical power, and fluid control, and includes:

- Electro-mechanical contactors
- Electronic contactors and motor controllers
- Pressure and temperature switches
- Pressure transmitters
- Temperature sensors and transmitters
- Solenoid valves
- Externally operated valves
- Thermostatically operated valves

Given their important monitoring and control functions, Danfoss components are designed for accuracy, reliability and long life. And our determination to guarantee a high-quality product is matched by an equally strong commitment to customer service. A specialist in the Danfoss industrial controls group can advise you on product selection and configuration, based on long experience in your industry. You'll find that with sales and service centers in over 100 countries, Danfoss is usually only a local call away.

For more information about Danfoss and solenoid valves, please visit  
[www.danfoss.com/ic](http://www.danfoss.com/ic)

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The Danfoss logo is written in a stylized, red, cursive script. It features a prominent underline that extends to the left and then curves back under the letters 'f' and 's'. The letters are bold and have a slight shadow effect.