MAKING MODERN LIVING POSSIBLE

Application guide

Industrial Refrigeration systems in Potentially Explosive Atmospheres (Hazardous area) ATEX 94/9/EC Directive [ATmosphères EXplosives]

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Contents

Introduction

Industrial refrigeration components are mainly used in ammonia refrigeration systems, but some components are used in related applications, where locations are classified as hazardous areas.

Fig. 1 - EU and EFTA Member states

Danfoss has over a number of years supplied components to this business area, particularly in Europe. However, due to new, more restrictive regulations, refrigeration components and refrigeration systems have to fulfil requirements for potentially explosive atmospheres, as specified in the ATEX directive. PRS systems (Process Refrigeration Systems) are typically classified as hazardous areas, where the ATEX requirements also have to be fulfilled.

The ATEX 94/9/EC directive is one of the "new" European directives. The ATEX directive specifies the requirements for equipment intended for use in potentially explosive atmospheres. ATEX is derived from the French term "**AT**mosphères **EX**plosives".

The ATEX directive replaces the previous EC directive 76/117/EC which only included *electrical* equipment, whereas ATEX *includes both electrical and non-electrical equipment*.

The ATEX directive became mandatory from 1st July 2003 in all EU and EFTA member states.

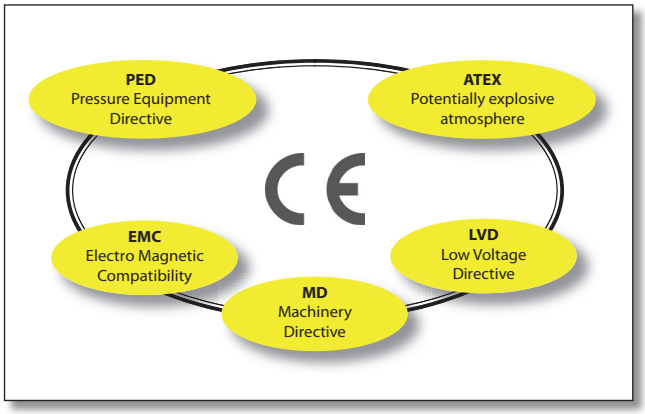


Fig. 2 - EC directives

ATEX is just one of a number of EC directives refrigeration equipment manufacturers have to comply with, before their equipment can be "placed on the market" in the member states. Other relevant directives for refrigeration equipment are PED-Pressure Equipment Directive, EMC Electro Magnetic Compatibility, MD-Machinery Directive and LVD-Low Voltage Directive. The Directives are "law" in the member states, and only equipment fulfiling the requirements must be CE marked and "placed on the market".

Application area for ATEX and Harmonised Standards

The ATEX as well as the harmonised technical standards state requirements for:

- Design of equipment / manufacture of equipment / testing of equipment
- Compliance with the ATEX directive ensures free movement of goods / equipment between all EU-member states and it also ensures that the equipment can be put into service, if there are no particular requirements for the country of destination.
  Important! - The zone classification for the country of destination of a final refrigeration system has to be approved by local authorities. If local authorities require higher classification than the actual equipment is approved for, the system must not be used.
- Installation and start up.

The ATEX directive does not state requirements for:

- **Operation** – When the equipment is operating at the end-users facility, national laws become effective.

Degree of protection	Protection	Category
Very High	Two independent protection measures or safe if two errors occur independently	**Category 1**
High	Safe in normal operation and in anticipated case of commonly occurring errors	**Category 2**
Normal	Safe in normal operation	**Category 3**

Fig. 3 - ATEX categories / degree of protection

Scope of ATEX

Included in the ATEX Directive: -

- Mining and non-mining equipment.
- Explosive atmospheres caused by gas and dust.
- Electrical and non-electrical equipment.
- Equipment (machines, devices, built-in instruments or mobile devices).
- Security systems (equipment which can stop / limit explosions).
- Components (parts without any independent function).
- Security control and regulation devices intended for use outside explosive areas but which secure the equipment in the hazardous areas .

Not included in the ATEX Directive: -

- Medical equipment for hospital environments.
- Equipment and protection systems for use in connection with explosive or unstable chemicals.
- *Household appliances and equipment intended for use in non-commercial surroundings.*
- Personal Protection Equipment directive 89/686/EC.
- Tankers and mobile offshore units.
- Means of transport except vehicles.

Equipment for mining industries and explosive atmospheres caused by dust are not covered in this application guide.

Non-mining equipment for potential explosive atmospheres; classified as:
Equipment Group II.
– Category 1
– Category 2
– Category 3

The requirements in the categories depend on the type of equipment.

- Simple mechanical components like valves, filters, check valves, etc. do normally not contain any potential ignition source, and are therefore not covered by the ATEX-directive. Manufacturers of this kind of equipment, must nevertheless carry out and keep a risk assessment report, to prove that the equipment do not have an ignition source, and are safe for the purpose.
- Mechanical components with potential ignition sources e.g. components containing non conductive materials, are covered by the ATEX-directive. These products have to fulfil all requirements in the ATEX directive, and have to be marked with the required Ex marking.
- Electrically operated components are covered by the ATEX-directive, and have to fulfil all requirements in the ATEX directive, and have to be marked with the required Ex marking.

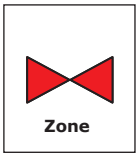
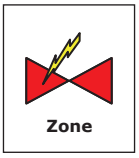
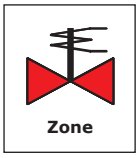
	Non electrical valve <u>without</u> potential ignition source	**Non electrical valve <u>with</u> potential ignition source**	**Electrical operated valve**
	 – Stop valves – Filters – Check valves – Etc.	 – Not relevant for common industrial refrigeration components	 – Electronic components – Solenoid coils – Etc.
Category 1 (Zone 0)	*Not covered by the scope of ATEX Directive 94/9/CE*	**CE-Type approval III + IV or V**	**CE-Type approval III + IV or V**
Category 2 (Zone 1)		Documentation at Notified Body (VIII partly)	CE-Type approval III + IV or VII
Category 3 (Zone 2)		Internal quality control (VIII)	Internal quality control (VIII)

Fig. 4 - ATEX-requirements

NOTE:
The letters I, II,….VIII in figure 4, specify the relevant ATEX 94/9/EC directive "modules" that need to be complied with.

Explosion triangle
The explosion triangle (fig. 5) shows the principle of explosion. All three elements must be present before an explosion can take place.

Removing one of the elements eliminates all risk of explosion.

In refrigeration, the consideration regarding the risk of explosion is limited to the outside of the system itself. Within the refrigeration system, there is 100% concentrated refrigerant with no oxygen present, consequently there is no risk of explosion.

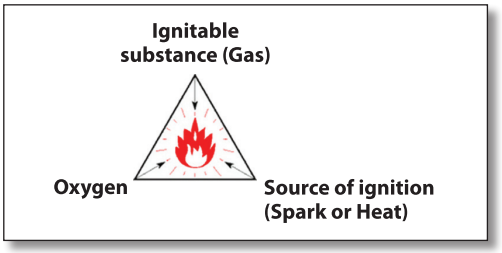


Fig. 5 - The explosion triangle

Non-electrical equipment

The requirements for non-electrically equipment in hazardous areas are new. The risk analysis of non-electrical refrigeration equipment (valves and similar components) has to focus on ignition sources.

The requirements for this kind of equipment are specified in:

- EN 1127-1 Explosive atmospheres. Explosion prevention and protection, Part 1. Basic concepts and methodology.
- EN 13463-1 Non-electrical equipment for potentially explosive atmospheres, Part 1. Basic methods and requirements.
- EN 13463-6 Non-electrical equipment for potentially explosive atmospheres, Part 6. Protection by control of ignition.

Examples:

- Non-conductive materials (e.g. plastic) are *not acceptable*. Non-conductive material can create "static electricity".
- Category 2: Magnesium content must be less than 7.5%.
- Hot surfaces.
- All possible sources of ignition have to be analysed and avoided.

Simple components like stop valves, filters etc. without the above mentioned ignition sources, are normally not covered within the scope of the ATEX directive.

Electrical equipment

The requirements for electrical equipment in hazardous areas are not new. The requirements specified in the ATEX directive are almost identical with the previous legislation and are much more demanding than the requirements for non-electrical equipment.

A number of different methods can be used to protect electrical equipment. Detailed below are two commonly used methods of electrical protection. Further methods are described in Annex I.

Intrinsic safety protection method
Intrinsic safety is an explosion protection technique ensuring there is insufficient energy to cause the ignition of a surrounding explosive atmosphere by an electrical spark or the heating of components or circuitry.

Due to power consumption restrictions, this method is only suitable for equipment with low power consumption and is commonly used for measuring devices.

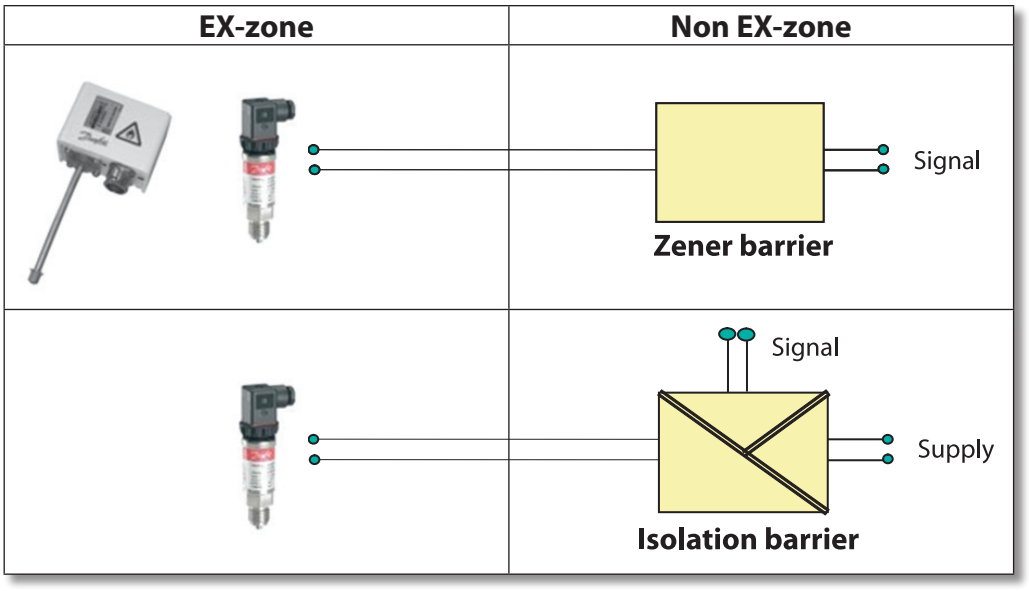


Fig. 6 - Intrinsic safety protection method

Encapsulation
Encapsulation is an explosion protection technique where the electrical components are fully encapsulated. This method is often used for components with"higher" power consumption e.g. solenoid coils. However, power consumption is also a limiting factor with this method due to the risk of "high" surface temperature of the component.

Note:
Solenoid valves with these coils can have relatively low MOPD.

Marking

Components covered within the scope of the ATEX directive have to be CE-marked, and marked with the specific Ex - sign. The marking depends on the actual type of equipment.

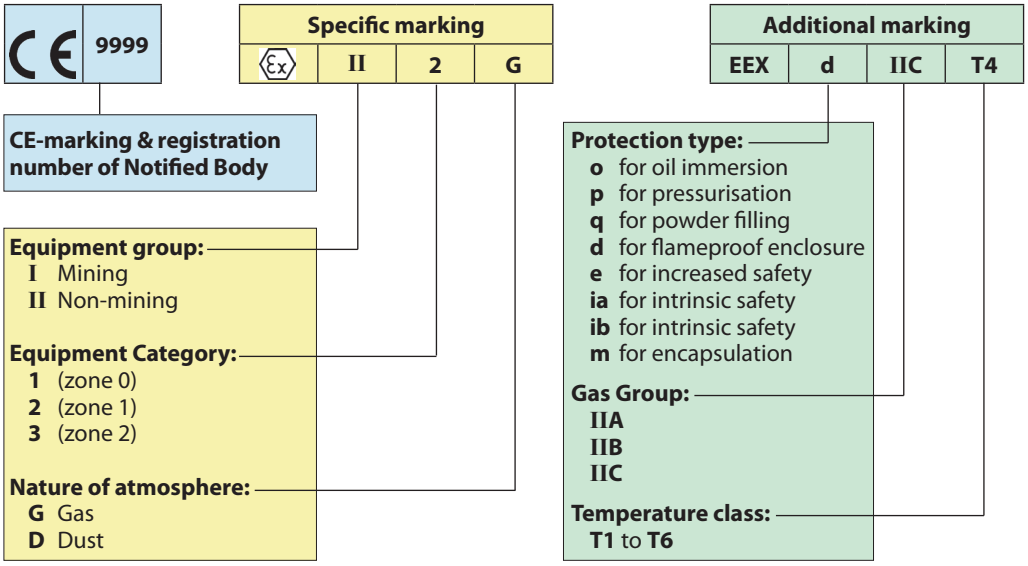


Fig. 7 - Ex-marking

Documentation

The required documentation depends on whether the component has an ignition source or not.

All components covered within the scope of the ATEX directive must be supplied with a CE declaration of conformity.

Non-electrical equipment without any ignition source, is not covered within the scope of the ATEX directive, but has to be supplied with the manufacturer's declaration.

The manufacturer's declaration must declare that the equipment is suitable for the purpose, and that it does not have any ignition sources. The manufacturer also has the obligation to document a safety risk assessment for the equipment.

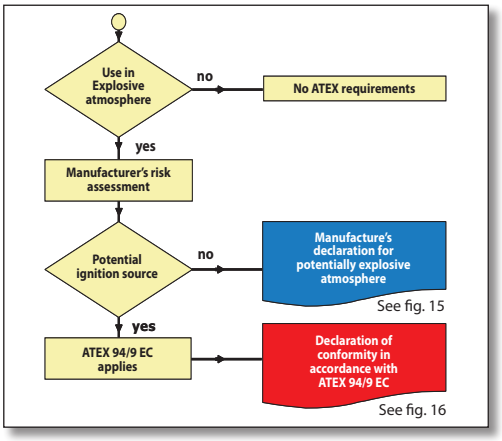


Fig. 8 - Documentation

Other requirements

The ATEX directive does not differentiate between different refrigerant types and for manufacturers of refrigerant valves, this is an important issue.

Refrigeration valves are normally designed for use with specific refrigerant types or groups of refrigerants. In PRS systems flammable refrigerants like propylene are often used.

When propylene is compared to e.g. ammonia it has many different material compatibility issues.

It is therefore very important that material compatibility is also evaluated.

The suitability of O-rings with the different refrigerant types depends on the compatibility judgement, and the actual type of sealing. An O-ring with a judgement "fair", is normally suitable for all internal sealings, but not necessarily for external sealings. It is important to make sure that specific products are approved for the actual refrigerant.

Refrigerant (flammable)	Neoprene / CR (cloroprene) *Used for standard refrigeration valves*	Nitrile / NBR	Flourcarbon FPM (Viton) [1]
Propane	**fair**	**satisfactory**	**satisfactory**
Butane	**satisfactory**	**satisfactory**	**satisfactory**
Iso-butane	**fair**	**satisfactory**	**satisfactory**
Propylene	**unsatisfactory**	**doubtful**	**satisfactory**
Ethane	**fair**	**satisfactory**	**satisfactory**

Fig. 9 - Material compatibility (sealing material / O-rings)

[1]) There are no FPM O-rings available for low temperature (below –40°C)

General zone classification

Components for use in hazardous areas are classified from Category 1 to Category 3. Hazardous areas are classified in Zones; Zone 0 is the most restrictive and Zones 1 and 2 are less restrictive.

The zone classification of final equipment is very important. It is also important to acknowledge that local authorities have to approve the specified zone classification of the final equipment. There is no standard available, where an exact definition of zones are made.

Valves and similar equipment in refrigeration systems located in hazardous areas classified for zone 2, 1 or 0, have to fulfil the requirements in ATEX directive (Directive 94/9/EC).

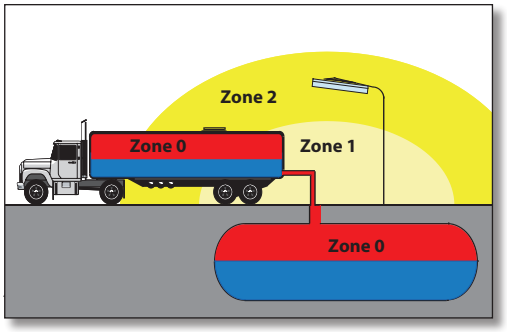


Fig. 10 - Zone-classification principle

Guideline – zone classification of refrigeration systems

- Locations for "standard "refrigeration systems with CFC, HCFC, HFC, Ammonia are "normally" not classified as hazardous areas. Requirements for ammonia are specifically mentioned in EN 378-2 (for information also see prEN 378-2).
- Refrigeration systems located in hazardous areas (e.g. in petro chemical plants) have to fulfil requirements for "Potentially explosive atmospheres" irrespective of the refrigerant.
- Industrial refrigeration systems with HC refrigerants (e.g. Propane, Butane, Propylene, etc) are "normally" classified as hazardous areas.
- Certain local authorities interpret the requirements so that equipment located in a machinery room for a HC refrigeration system is classified as Zone 2 if only one compressor is employed. If two compressors are present, and one of these is under service (e.g. changing oil), then it becomes Zone 1.
- "Potentially explosive atmospheres" do not occur inside a refrigeration system because no oxygen is present. (Refrigeration systems designed and maintained according to EN 378 fulfil this requirement).
- "Potentially explosive atmospheres" can occur outside a refrigeration system (in the location of a refrigeration system).
- Refrigeration systems in "Potentially explosive atmospheres" can contain flammable or non-flammable refrigerants.
- For refrigerant systems with flammable refrigerants, special consideration should be given to:
  - The tightness of the system.
  - The correct equipment is being used e.g. sealing materials must be compatible with the refrigerant.
  - The system is maintained correctly.

Zone classification for refrigeration systems
Refrigeration systems are classified in relevant zones according to the risk for the location for a particular refrigerant system.

A particular refrigeration system can be classified in different zones, for different part of the system.

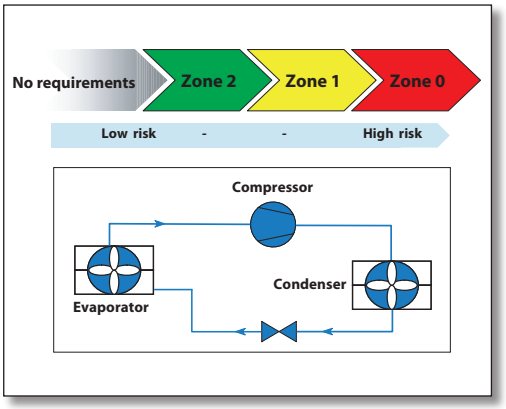


Fig. 11 - Zone-classification principle for a refrigeration system

Equipment group and zones

Equipment located in zone specified areas must fulfil the following requirements:

- Category 3 - approved equipment can be installed in hazardous areas zone 2 and outside zone categorised areas.
- Category 2 - approved equipment can be installed in hazardous areas zone 1, zone 2 and outside zone categorised areas.
- Category 1 - approved equipment can be installed in hazardous areas zone 2, zone 1, zone 0 and outside zone categorised areas.

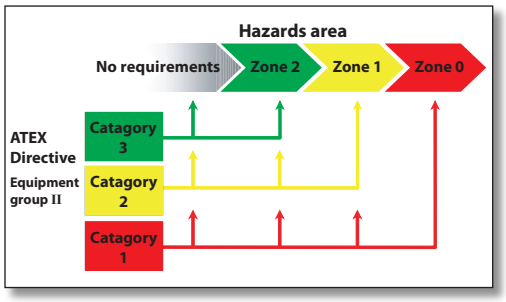


Fig. 12 - Category relations

Requirements for refrigeration components in countries outside Europe

USA & Canada
Mechanical components without any electrical equipment generally do not need to be approved.
Electrical components have to be approved according to UL, Division 1 or 2. When the electrical equipment is mounted on e.g. a valve, the complete valve assembly has to be approved.

Approval cost is generally relatively high for these products, depending of actual division and product type.

Other countries (China, Japan, Brazil, …..)
In particular electrical equipment has to be type approved in several countries, and the requirements are different (e.g. only available in local language).

Definition	Degree of protection	Protection	Europe	USA & Canada
Areas in which a gas/ oxygen mixture occurs **CONTINUOUSLY** or for extended periods.	Very High	Two independent protection measures or safe if two errors occur independently.	**Zone 0**	**Division 1**
Areas in which a gas/ oxygen mixture occurs **OCCASIONALLY.**	High	Safe in normal operation and in anticipated case of commonly occuring errors.	**Zone 1**	
Areas in which a gas/ oxygen mixture occurs **EXCEPTIONALLY** and only for short periods.	Normal	Safe in normal operation.	**Zone 2**	**Division 2**

Fig. 13 - Hazardous areas Europe / USA

Danfoss solenoid coils, pressure controls and gas detectors suitable for use in installations located in potentially explosive atmospheres

Solenoid coils type BP

Ex II 2 G EEx m II T4

The coils are suitable for use in installations located in potentially explosive atmospheres.

- ATEX Category 2 (Zone 1).
- Grade of enclosure: IP 67.
- Supplied with 3 m moulded-in 3-core cable.
- 16 W dc.

NOTE 1: The coil has reduced MOPD (MOPD~8 bar depending of actual valve type).

NOTE 2: The supply must be secured against a too high power consumption in case of a short circuit.

Literature No.: DKACV.PD.600.A

Category 2 – Zone1

Solenoid coils type "refrigeration"

Ex II 3 G EEx nA II T3

The coils are suitable for use in installations located in potentially explosive atmospheres.

- ATEX Category 3 (Zone 2).
- Grade of enclosure: IP 67.
- Supplied with 1 m moulded-in 3-core cable or terminal. 1- 20 W dc & ac

NOTE: The supply must be secured against a too high power consumption in case of a short circuit.

Literature No.: RD3JE

Category 3 – Zone 2

Pressure Control type MP 55E

Ex II 3 G EEx nL IIC T6

The differential pressure controls are suitable for use in installations located in potentially explosive atmospheres.

- ATEX Category 3 (Zone 2).
- Grade of enclosure: IP 20.
- Max working pressure PS = 17 bar.
- ATEX design
  - o Gold contactors.
  - o Stainless steel bellow with restricted movement.
  - o Soldering connection.

NOTE: Contact loads - Must be used with reliable means of limiting the voltage and current to prevent sparks between the contact surfaces. This could be zener diodes or Ex barriers.

Literature No.: RD5CB

Category 3 – Zone 2

Pressure Control type KPE

Ex II 3 G EEx nL IIC T6

The pressure controls are suitable for use in installations located in potentially explosive atmospheres.

- ATEX Category 3 (Zone 2).
- Grade of enclosure: IP 30 or IP 40
- Max working pressure: KP 1E: PS = 8 bar.
  KP 7E: PS = 32 bar.
- ATEX design
  - o Gold contactors.
  - o Stainless steel bellow with restricted movement.
  - o Soldering connection.

NOTE: Contact loads - Must be used with reliable means of limiting the voltage and current to prevent sparks between the contact surfaces. This could be zener diodes or Ex barriers.

Literature No.: RD5AC

Category 3 – Zone 2

Danfoss solenoid coils, pressure controls and gas detectors suitable for use in installations located in potentially explosive atmospheres
(continued)

	**Pressure Transmitter Type MBS 4201** **(Ex) II 1 G EEx ia IIC T4 – T6** The pressure transmitters are suitable for use in installations located in potentially explosive atmospheres. ● ATEX Category 1 (Zone 0). ● Grade of enclosure: IP 65 / IP67. ● Measuring range 0 - 600 bar. **NOTE:** Must be used in conjunction with safety barriers - (see DKACT.PD.P20y1.02). Literature No.: DKACT.PD.P20.W	Category 1 – Zone 0
	**Gas detector type GD** **(Ex) II 2 G EEx d IIB + H2 T3 –T6** The gas detectors are suitable for use in installations located in potentially explosive atmospheres. ● ATEX Category 2 (Zone 1). ● Grade of enclosure: IP 65. **NOTE:** - Literature No.: RD7HA	Category 2 – Zone 1
	**RT- pressure and temperature controls** **(Ex) II 2 G EEx ia IIC T6** The RT- pressure and temperature controls are suitable for use in installations located in potentially explosive atmospheres. ● ATEX design ● ATEX Category 2 (Zone 1) ● Grade of enclosure IP 67 ● Gold contactors ● Stainless steel bellow with restricted movement ● Stainless steel frame (conductive) **NOTE:** Contact loads - Must be used with reliable means of limiting the voltage and current to prevent sparks between the contact surfaces. This could be zener diodes or Ex barriers. Literature No.: RD5BA	Category 2 – Zone 1
	**Accessories for Potentially Explosive Atmospheres** ● Safety barriers. ● I.S Isolator, transmitter supply unit Safety barriers and I.S Isolator. Literature No.: DKACT.PD.P20.Y	

Fig. 14

Manufacturer's declaration for potentially explosive atmospheres

Manufacturer's Declaration to the European Directive ATEX 94/9/CE

Group **D**

Component with special sealing material for HC-refrigerants (Propane, Butane, Iso-butane and Propylene)
and - can be mounted with electrically pilots / equipment
and - have no ignition sources

Main Valves (control valves)	ICS 3E
Modulating liquid level regulators	PMFLE
Pilots for ICS Valves	CVP-HPE
Pilots for ICS Valves	EVME

For the above listed valves a hazard analysis to the directive ATEX 94/9/EC has been carried out with the following result:

- This non-electrical equipment holds no potential ignition source at normal usage.
- The listed valves are **not covered by the scope of ATEX Directive 94/9/EC**.
- The valves my be used in the following EX range:
  - Category 2 (Zone 1) and Category 3 (Zone 2)

IMPORTANT:
The above-mentioned valves are not identically to standard refrigeration valves.
The valves are equipped with special o-rings compatible with the specified refrigerants.
The valves have a reduced temperature range.

Note 1:
Valves used for the above condition has to installed and maintained according to the requirements in EN 378.

Note 2:
Electronic / Mechanical actuators / pilots used to operate the above-mentioned equipment, has to undergo a separate conformity assessment.

Reference to standards and directives:

EN 13453-1
EN 13453-5
EN 378
ATEX 94/9/EC

14/04/2005
Danfoss Industrial Refrigeration A/S

Danfoss Industrial Refrigeration has a quality and environmental management system that is certified in accordance with international standards ISO 9001 and ISO 14001.
Our products comply with the requirements of the Pressure Equipment Directive 97/23/EC and are approved by TÜV Nord (0045)

Fig. 15

Declaration of conformity in accordance with ATEX 94/9 EC

EU-Overensstemmelseserklæring
EU-Declaration of confirmity
EU-Übereinstimmungserklärung
UE-Declaration de conformite
EU-Declaración de conformidad

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Industrial & Appliance Controls
DK-6430 Nordborg, Denmark

DK
erklærer på eget ansvar, at følgende produkt(er) - Tryktransmittere med følgende typebetegnelser:
AKS 4201; AKS 4251; AKS 4701; AKS 4751, MBS 4201; MBS 4251; MBS 4701; MBS 4751.
som er omfattet af denne erklæring, er i overensstemmelse med følgende direktiv(er), standard(er)
eller andet/andre normativ(e) dokument(er), forudsat det anvendes efter vore forskrifter:
EMC Direktiv 89/336/EF inkl. ændringer. - EN 61000-6-3: 2001, EN 61000-6-2: 2001
ATEX Direktiv 94/9/EC inkl. ændringer. - EN 50014: 1997, EN 50020: 2002, EN 50284: 1999

GB
declare under our sole responsibility that the product(s) - Pressure Transmitters with the following type designations:
AKS 4201; AKS 4251; AKS 4701; AKS 4751, MBS 4201; MBS 4251; MBS 4701; MBS 4751.
to which this declaration relates is in conformity with the following directive(s), standard(s) or other normative document(s), provided that it is used according to our instructions:
EMC Directive (89/336/EC) incl. amendments. EN 61000-6-3: 2001, EN 61000-6-2: 2001
ATEX Directive (94/9/EC) incl. amendments.: EN 50014: 1997, EN 50020: 2002, EN 50284: 1999

D
erklärt auf eigene Verantwortung, daß die erwähnten Produkte (Druckmeßumformer) mit den folgenden Typenbezeichnungen:
AKS 4201; AKS 4251; AKS 4701; AKS 4751, MBS 4201; MBS 4251; MBS 4701; MBS 4751, auf die sich diese Erklärung bezieht, mit den folgenden Vorschriften, Standards oder anderen normativen Dokumenten übereinstimmen, vorausgesetzt, daß sie nach unseren Vorschriften verwendet werden:
EMC Direktive 89/336/EF einschl. Änderungen - EN 61000-6-3: 2001, EN 61000-6-2: 2001
ATEX Direktive 94/9/EC einschl. Änderungen - EN 50014: 1997, EN 50020: 2002, EN 50284: 1999

F
Transmetteurs de Pression avec les types de désignations suivantes: AKS 4201; AKS 4251; AKS 4701; AKS 4751, MBS 4201; MBS 4251; MBS 4701; MBS 4751. déclare ces produits sous notre seule responsabilité
que cette déclaration indique que nous sommes en conformité avec les directives, standards ou autres normes ou documents d'actualité qui suivent,les produits fournis sont utilisé selon nos instructions:
Directive CEM (89/336/EC) incl. amendements. EN 61000-6-3: 2001, EN 61000-6-2: 2001
Directive ATEX (94/9/EC) incl. amendements.: EN 50014: 1997, EN 50020: 2002, EN 50284: 1999

E
declara bajo nuestra única responsabilidad que los productos - Transmisores de Presión con las siguientes designaciones tipo:
AKS 4201; AKS 4251; AKS 4701; AKS 4751, MBS 4201; MBS 4251; MBS 4701; MBS 4751.
relativos a ésta declaración cumplen con las siguientes directivas, estandar u otro documento normativo, siempre que sean utilizados de acuerdo a nuestras instrucciones :
EMC Directiva (89/336/EC) incl. enmiendas. EN 61000-6-3: 2001, EN 61000-6-2: 2001
ATEX Directiva (94/9/EC) incl. enmiendas.: EN 50014: 1997, EN 50020: 2002, EN 50284: 1999

Date	Issued by	Date	Approved by
2004-09-14	Ole Lundby, Quality Assurance	2004-09-14	Gunnar Christensen, Quality Manager

9

DEMKO

NATION CERTIFICATE

ctive System Intended for use
xplosive atmospheres
ive 94/9/EC

Number: DEMKO 01 ATEX 127938X

Pressure Transmitter MBS / AKS Type 4xx1 –xxxx-xxxxx

Denmark

m and any acceptable variation there to is specified in the documents therein referred to.

fied body number 0539 in accordance with Article 9 of the March 1994, certifies that this equipment or protective system has ential Health and Safety Requirements relating to design and tective systems intended for use in potentially explosive he Directive.

e recorded in confidential report no. 127938

lth and Safety Requirements has been assured by compliance EN50020 : 1994 - EN50284 : 1999

rtificate number, it indicates that the equipment or protective ons for safe use specified in the schedule to this certificate.

CERTIFICATE relates only to the design and construction of ve system. If applicable, further requirements of this Directive ly of this requirement or protective system.

rotective system shall include the following:

EEx ia IIC T4 -T6

o A/S Herlev, 2001-01-31

Steen Lumby
Certification Manager

This certificate may only be reproduced in its entirety and without any change, schedule included.

Notified body: UL International Demko A/S, P. O. Box 514, Lyskaer 8, DK-2730 Herlev, Denmark,
Phone +45 44 85 65 65, Fax +45 44 85 65 00.

Ref.: 01 ATEX 127938 Page 1

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Fig. 16

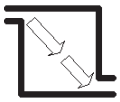
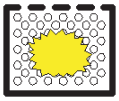
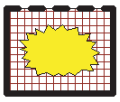
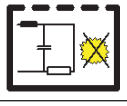
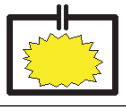
Annex I

Gas Groups and Temperature Classes

Gas Group		Gas	Ignition temperature [°C]	Temperature Class T1	T2	T3	T4	T5	T6
II	A	Acetone	540	×					
		Acetic acid	485	×					
		Ammonia	630	×					
		Ethane	515	×					
		Methylene chloride	556	×					
		Methane (CH_4)	595	×					
		Carbon monoxide	605	×					
		Propane	470	×					
		n-Butane	365		×				
		n-Butyl	370		×				
		Hydrogen sulfide	270			×			
		n-Hexane	240			×			
		Acetaldehyde	140				×		
		Ethyl ether	170				×		
		Ethyl nitrite	90						×
	B	Ethylene	425		×				
		Ethyl oxide	429 - 440		×				
	C	Acetylene (C_2H_2)	305		×				
		Carbon bisulphide (CS_2)	102					×	
		Hydrogen (H_2)	560	×					
Max. allowed equipment surface temp. [°C]				450	300	200	135	100	85

The ignition temperature of a fluid is the lowest temperature at which the fluid / vapour will be ignited. This temperature defines the Temperature Class. The Temperature Class, defines the highest allowable surface temperature . E.g. Equipment used with Butane must have a max. allowable surface temperature of 300°C (Temperature Class T2), this means that equipment with Temperature Class T2 to T6 can be used.

Protection methods

Technique	Protection type	Ex	Symbol	EN Standard	Typical application
Separation	Overpressure	p		EN50 016	Control rooms
	Lowered in oil	o		EN50 015	Analysis
	Powder filling	q		EN50 017	Instumentation
	Encapsulaiton	m		EN50 028	Instrumentation solenoid coils e.g. 
Refined mechanical design	Increased safety	e		EN50 019	Engines, lighting, junction boxes
Energy limitation	Intrinsic safety	ia ib		EN50 020	Instrumentation e.g. MBS Pressure Transmitters 
Encapsulation	Explosion-flameproof	d		EN50 018	Engines / pumps
Special	Special	s			
General requirements for all methods				EN50 014	

Annex II

Classification of Danfoss Industrial Refrigeration products

Group	Product groups - ATEX requirements		"Non-flammable" refrigerants (Ammonia, CFC,HCFC, HFC,CO_2)				Flammable refrigerants (Propane, Butane, Iso-butane, Propylene, ethane)				Comments
	Hazardous area		Outside catagory / zone	Zone 2	Zone 1	Zone 0	Outside catagory / zone	Zone 2	Zone 1	Zone 0	
	ATEX Equipment group II / Component type		Outside catagory / zone	Category 3	Category 2	Category 1	Outside catagory / zone	Category 3	Category 2	Category 1	
A	*Components which can be used with all refrigerants and - cannot be mounted with any electrically pilots / equipment and - have no ignition sources*										
	Stop Valves	SVA-HS, X1	X	X	X	-	X	X	X	-	
	Filters	FIA	X	X	X	-	X	X	X	-	
	Check Valves	NRVS	X	X	X	-	X	X	X	-	
	Check Valves	NRVA	X	X	X	-	X	X	X	-	
B	*Components which can be used with Ammonia, CO2, CFC, HCFC, HFC refrigerants and - cannot be mounted with any electrically pilots / equipment and - have no ignition sources*										
	Stop Valves	SVA-ST	X	X	X	-	-	-	-	-	
	Regulating Valves	REG	X	X	X	-	-	-	-	-	
	Stop Check Valves	SCA	X	X	X	-	-	-	-	-	
	Check Valves	CHV	X	X	X	-	-	-	-	-	
	Float Valves	HFI	X	X	X	-	-	-	-	-	
	Float Valves	SV	X	X	X	-	-	-	-	-	
	Pilots for ICS Valves	CVP, CVPP	X	X	X	-	-	-	-	-	
	Safety Valves	SFA	X	X	X	-	-	-	-	-	
	Safety Valves	SFV	X	X	X	-	-	-	-	-	
	Safety Valves	BSV	X	X	X	-	-	-	-	-	
	Change Over Valves for Safety Valves	DSV	X	X	X	-	-	-	-	-	
	Safety Valves	POV	X	X	X	-	-	-	-	-	
C	*Components which can be used with Ammonia, CO_2, CFC, HCFC, HFC refrigerants and - can be mounted with electrically pilots / equipment and - have no ignition sources*										***Note:*** *Only EX approved coils, if any coils are used*
	Main Valves (control valves)	ICS 1 ICS 3	X	X	X	-	-	-	-	-	
	Main Valves (control valves)	PM1 PM3 PML PMLX	X	X	X	-	-	-	-	-	
	Modulating liquid level regulators	PMFH	X	X	X	-	-	-	-	-	
	Pilots for ICS Valves	EVM	X	X	X	-	-	-	-	-	
	Electrically operated expansion valve	AKVA	X	X	X	-	-	-	-	-	
	Solenoid Valves	EVRS	X	X	X	-	-	-	-	-	
	Solenoid Valves	EVRA	X	X	X	-	-	-	-	-	
D	*Components with special sealing material for use with HC-refrigerants (Probane, Butane, Iso-butane and Propylene) and - can be mounted with electrically pilots / equipment and - have no ignition sources*										***Note:*** *Only EX approved coils, if any coils are used*
	Main Valves (control valves)	ICS3E	-	-	-	-	X	X	X	-	
	Modulating liquid level regulators	PMFHE	-	-	-	-	X	X	X	-	
	Pilots for ICS Valves	CVP-HPE	-	-	-	-	X	X	X	-	
	Pilots for ICS Valves	CVCE	-	-	-	-	X	X	X	-	
	Pilots for ICS Valves	EVME	-	-	-	-	X	X	X	-	
E	*Components not to be used in hazardous areas Components in this group has an ignition source*										
	Motor Valves	ICM, ICAD 600/900	-	-	-	-	-	-	-	-	
	Motor Valves	MRV / MEV	-	-	-	-	-	-	-	-	
	Level controls	38E, AKS 38, AKS 41/41U	-	-	-	-	-	-	-	-	
	Electronic regulators	EKC 2.., EKC 3..	-	-	-	-	-	-	-	-	
	"Standard" solenoid coils	all	-	-	-	-	-	-	-	-	
	Pilots	CVQ, CVPM	-	-	-	-	-	-	-	-	
F	*Electrical components for use in hazardous areas*										
	RT-Safety pressure control	RTE	X	X	X	-	X	X	X	-	
	RT-Differential pressure control	RTE	X	X	X	-	X	X	X	-	
	RT-Thermostats	RTE	X	X	X	-	X	X	X	-	
	KPE-Safety pressure control	KPE; Ex II 3 G EEx nL IIC T6	-	-	-	-	X	X	-	-	Literature No.: RD5CB102
	MP 55E-Differential pressure control	MP 55E; Ex II 3 G EEx nL IIC T6	-	-	-	-	X	X	-	-	Literature No.: RD5AC103
	MBS Pressure transmitter	MBS 42xx; Ex II 1 G EEx ia II T4 - T6	X	X	X	X	X	X	X	X	Literature No.: DKACT.PD.P20.W1.02
	EX solenoid coils	BP; Ex II 2 G EEx m II T4	X	X	X	-	X	X	X	-	Literature No.: DKACV.PD.600.A4.03
	EX solenoid coils	" "; Ex II 3 G EEx nA II T3	X	X	-	-	X	X	-	-	Literature No.: RD5AC103
	Gas detector	GD; Ex II 2 G EEx d IIB + H2 T3 –T6	X	X	X	-	X	X	X	-	Literature No.: RD5AC103

Annex III

Valves for HC-refrigerants

ICS pilot control		Code no.
ICS3E	20 D-5	**027H1060**
ICS3E	20 D-10	**027H1061**
ICS3E	20 D-15	**027H1062**
ICS3E	20 D-20	**027H1063**
ICS3E	20 D-25	**027H1064**
ICS3E	25 D-5	**027H2175**
ICS3E	25 D-10	**027H2176**
ICS3E	25 D-15	**027H2177**
ICS3E	25 D-20	**027H2178**
ICS3E	25 D-25	**027H2179**
ICS3E	32 D	**027H3029**
ICS3E	40 D	**027H4038**
ICS3E	50 D	**027H5037**
ICS3E	65 D	**027H6038**

PMFHE High pressure float valve		Code no.
PMFHE	80-2	**027F4038**
PMFHE	80-3	**027F4039**
PMFHE	80-4	**027F4040**
PMFHE	80-5	**027F4041**
PMFHE	80-6	**027F4042**
PMFHE	80-7	**027F4043**
PMFHE	125	**027F4044**
PMFHE	200	**027F4045**
PMFHE	300	**027F4046**
PMFHE	500	**027F4047**

PMFLE Low pressure float valve		Code no.
PMFLE	80-1	**027F4048**
PMFLE	80-2	**027F4049**
PMFLE	80-3	**027F4050**
PMFLE	80-4	**027F4051**
PMFLE	80-5	**027F4052**
PMFLE	80-6	**027F4053**
PMFLE	80-7	**027F4054**
PMFLE	125	**027F4055**
PMFLE	200	**027F4056**

SV3E Pilot float valve	Code no.
SV3E	**027B0081**

CVP-HPE Pressure control pilot		Code no.
CVP-HPE	4 to 22 bar	**027B0083**
CVP-HPE	4 to 28 bar	**027B0084**
CVP-HPE	-0,66 to 7 bar	**027B0085**

CVCE Pressure control pilot		Code no.
CVCE	–0.45 to 7 bar	**027B0086**

EVME Solenoid pilot	Code no.
EVME	**032F8029**

Annex IV

ICS3E valves

- Are servo operated valves which belong to the ICV (Industrial Control Valve) family.
- Are special valves which can be used with Hydro Carbon refrigerants.
- Have three pilot pressure connections.

Technical data
Refrigerants:
Applicable to HC refrigerants (e.g. Propane, Butane, Propylene, …..)

Temperature range: –40/+120°C (–40/+248°F).

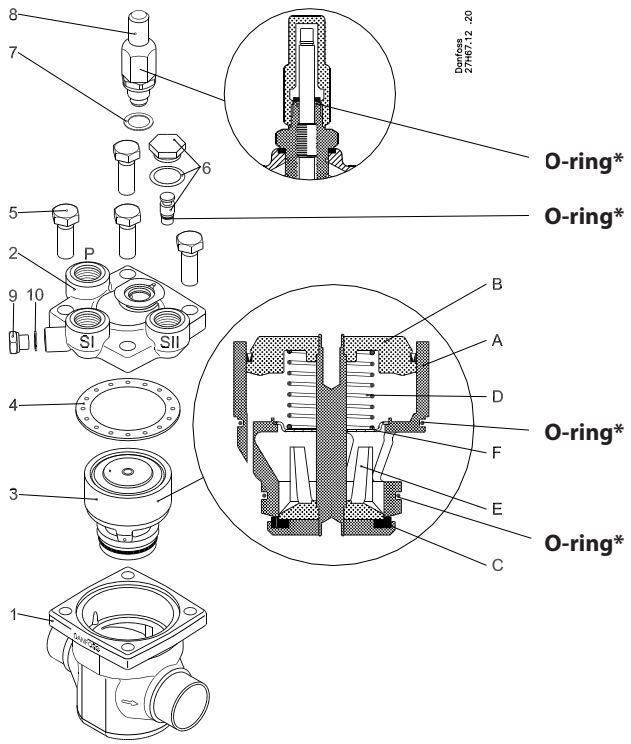
Max. working pressure: 52 bar g (754 psig)

O-ring material:
Fluorocarbon (Viton) compound for low temperature application

Marking:
The valve is marked with the name "ICS3E".

All dimensions and performance data are identical to the standard ICS (Literature no.: PD.HS0.A)

Material specification



No.	Part	Material	EN	ASTM	JIS
1	Body	Low temperature steel	G20Mn5QT, EN 10213-3	LCC A352	SCPL1 G5151
2	Top cover	Low temperature steel	G20Mn5QT, EN 10213-3	LCC A352	SCPL1 G5151
3	Function module (assembled)				
A	Cylinder	Steel			
B	Piston	Steel			
C	Valve plate	PTFE			
D	Spring	Steel			
E	Cone	Steel			
F	Intermediate plate	Steel			
4	Gasket	Fibre, non-asbestos			
5	Bolts	Stainless steel	A2-70, EN 1515-1	Grade B8 A320	A2-70, B 1054
6	Plug	Steel			
7	Gasket	Aluminium			
8	Manual operating spindle	Steel			
9	Plug	Steel			
10	Gasket	Aluminium			
*	**O-ring**	**Flourocarbon (Viton)**			

PMFHE or PMFLE valves

- Are modulating servo-controlled main expansion valves, controlled by pilot float valve type SV3E.
- Are special valves which can be used with Hydro Carbon refrigerants.
- Have one pilot pressure connection.

Technical data
Refrigerants:
Applicable to HC refrigerants (e.g. Propane, Butane, Propylene, …..)

Temperature range: –40/+120°C (–40/+248°F).

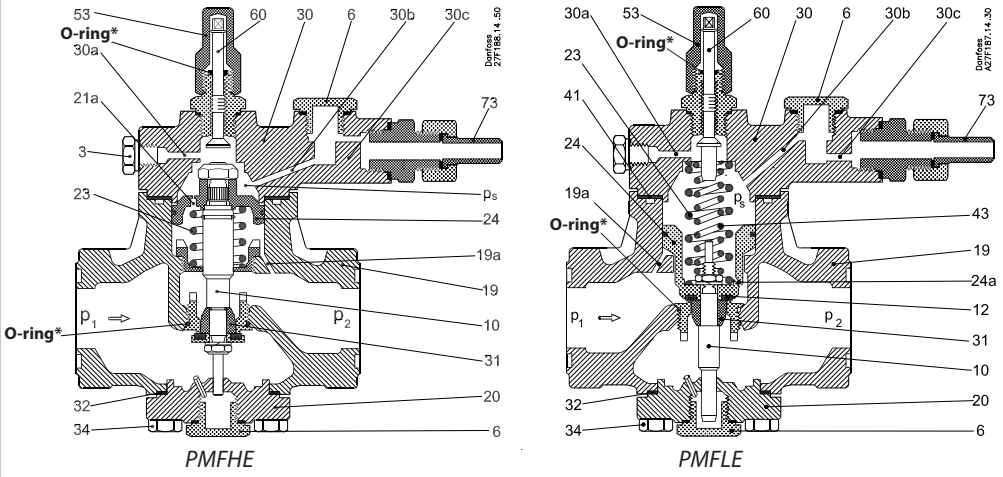
Max. working pressure: 28 bar g (406 psig)

O-ring material:
Fluorocarbon (Viton) compound for low temperature application

Marking:
The valve is marked with the name "PMFHE" or "PMFLE".

All dimensions and performance data are identical to the standard PMFH or PMFL (Literature no.: RD2CB).

Material specification



No.	Part	Material	DIN/EN	ISO	ASTM
2	Gasket between body and flange	Non-metal Non-asbestos			
3	Bolts for flange	Stainless steel	A2-70	A2-70	Type 308
4	Flange PM 5 - 65	Steel	RSt. 37-2, 10025	Fe360 B, 630	Grade C, A 283
6	Plug	Steel	9SMn28 1651	Type 2 R683/9	1213 SAE J 403
10	Valve spindle	Steel	9SMn28 1651	Type 2 R683/9	1213 SAE J 403
12	Valve seat	Teflon [PTFE]			
19	Valve body	Low temperature cast iron (spherical)	EN-GJS-400-18-LT EN-1693		
20	Bottom cover	Low temperature cast iron (spherical)	EN-GJS-400-18-LT EN-1693		
23	Spring	Steel			
24	Servo piston	Cast iron	GG-25	Grade 250	Class 40B
30	Cover	Low temperature cast iron (spherical)	EN-GJS-400-18-LT EN-1693		
31	Trottle cone	Steel	9SMn28 1651	Type 2 R683/9	1213 SAE J 403
32	Gasket between body and bottom cover	Non-metal Non-asbestos			
34	Bolts for top and bottom cover	Stainless steel	A2-70	A2-70	Type 308
41	Gasket	Non-metal Non-asbestos			
43	Spring	Steel			
53	Spindle cap	Steel	9SMn28 1651	Type 2 R683/9	1213 SAE J 403
60	Setting / manual operating spindle	Steel	9SMn28 1651	Type 2 R683/9	1213 SAE J 403
73	Pilot connection	Steel	9SMn28 1651	Type 2 R683/9	1213 SAE J 403
*	**O-ring**	**Flourocarbon (Viton)**			

SV3E valves

- Can be used separately as a modulating liquid level regulator in refrigerating, freezing and air conditioning systems for ammonia or fluorinated refrigerants. However, in most cases, the SV3E is used as a float pilot valve for the main expansion valve type PMFHE.
- Are special valves which can be used with Hydro Carbon refrigerants.

Technical data
Refrigerants:
Applicable to HC refrigerants (e.g. Propane, Butane, Propylene, …..)

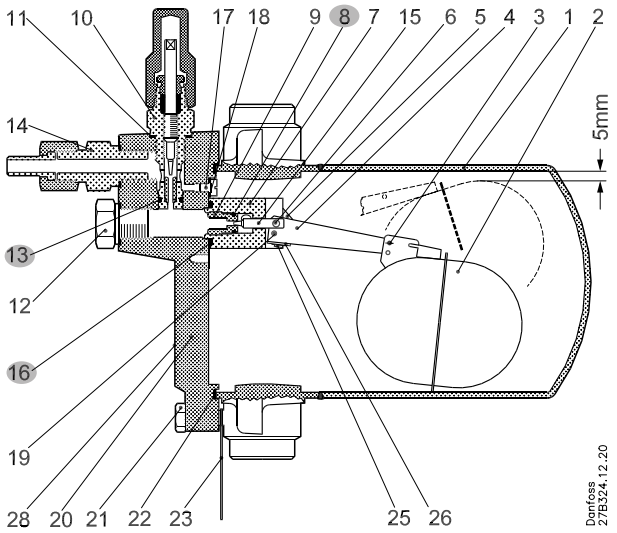
Temperature range: –40/+120°C (–40/+248°F).
Max. working pressure: 28 bar g (406 psig)

O-ring material:
Fluorocarbon (Viton) compound for low temperature application

Marking:
The valve is marked with the name "SV3E".

All dimensions and performance data are identical to the standard SV (Literature no.: RD2BB).

Material specification



No.	Part	Material	DIN / EN
1	Float housing	Stainless steel Low temperature, steel	X5CrNi18-10, DIN 17440 P285QH, EN 10222-4
2	Float	Stainless steel	
3	Split pin	Steel	
4	Float arm	Stainless steel	
5	Link	Steel	
6	Pin	High density polymer	
7	Valve housing	Steel	
8	**O-ring**	**Flourocarbon (Viton)**	
9	Float orifice	High density polymer	
10	Manual regulation unit. Throttle valve	Steel	
11	Gasket	Non asbestos	
12	Plug	Steel	
13	**O-ring**	**Flourocarbon (Viton)**	
14	Pilot connection (spare part)	Steel	
15	Orifice needle	Plastic	
16	**O-ring**	**Flourocarbon (Viton)**	
17	Screw	Steel	
18	Gasket	Non asbestos	
19	Pin	Steel	
20	Cover	Low temperature, cast iron (spherical)	EN-GJS-400-18-LT EN 1563
21	Screw	Stainless steel	A2-70
22	Gasket	Non asbestos	
23	Label	Cardboard	
25	Screw	Steel	
26	Spring washer	Steel	
28	Sign	Aluminium	

CVP-HPE valves

- Are constant pressure pilot valves for high pressure applications.
- Are special valves which can be used with Hydro Carbon refrigerants.

Technical data
Refrigerants:
Applicable to HC refrigerants (e.g. Propane, Butane, Propylene, …..)

Temperature range: –40/+120°C (–40/+248°F).

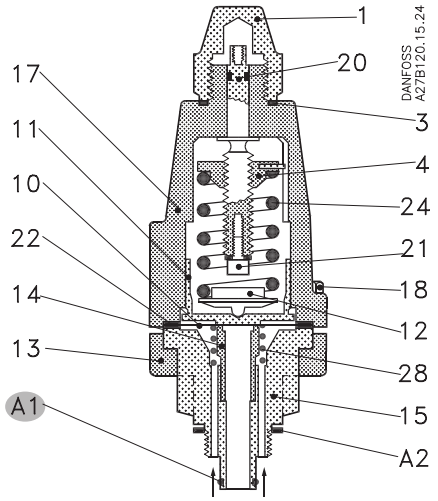
Max. working pressure: 28 bar g (406 psig)

O-ring material:
Fluorocarbon (Viton) compound for low temperature application

Marking:
The valve is marked with the name "CVP-HPE".

All dimensions and performance data are identical to the standard CVP (Literature no.: PD.HN0.A).

Material specification



No.	Part	Material
A1	**O-ring**	**Flourocarbon (Viton)**
A2	Seal	Non-asbestos
1	Protective cap	Steel
3	Seal	Non-asbestos
4	Nut	Stainless steel
10	Diaphragm	Stainless steel
11	Thrust pad	Stainless steel
12	Spring guide	Stainless steel
13	Flange	Steel
14	Orifice	Stainless steel
15	Base	Stainless steel
17	Valve body	Cast iron
18	Cover bolt	Steel
20	Setting spindle	Stainless steel
21	Screw (M6 × 10)	Steel
22	Cover gasket	Non-asbestos
24	Spring	Steel
28	Spring	Steel

CVCE valves

- Are pressure-operated pilot valves with an external signal connection that can be used to obtain an indication of the system reference pressure.
- Are special valves which can be used with Hydro Carbon refrigerants.

Technical data
Refrigerants:
Applicable to HC refrigerants (e.g. Propane, Butane, Propylene, …..)

Temperature range: –40/+120°C (–40/+248°F).

Max. working pressure: 28/17 bar (406/247 psig)

O-ring material:
Fluorocarbon (Viton) compound for low temperature application

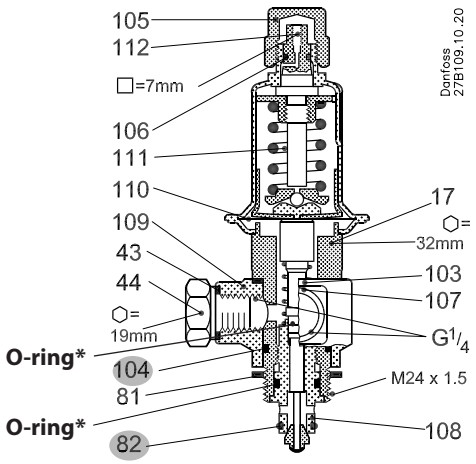
Marking:
The valve is marked with the name "CVCE".

All dimensions and performance data are identical to the standard CVC (Literature no.: PD.HN0.A).

The maximum working pressure (MWP) refers to the high-pressure side of the valve (28 bar); the reference pressure (17 bar) refers to the low-pressure side of the system.

The reference pressure must be connected to the low-pressure side of the system.

Material specification



No.	Part	Material
17	Valve body	Stainless steel
43	Seal	Aluminium
44	Blanking plug for pressure gauge connection	Stainless steel
81	Seal	Non-asbestos
82	**O-ring**	**Flourocarbon (Viton)**
103	Banjo fitting	Steel
104	**O-ring**	**Flourocarbon (Viton)**
105	Protective cap	Steel
106	O-ring	Cloroprene (Neoprene)
107	Signal connection	
108	Pilot orifice	Stainless steel
109	Connector on banjo fitting 103	Steel
110	Diaphragm	Stainless steel
111	Spring	Steel
112	Setting spindle	Stainless steel
*	**O-ring**	**Flourocarbon (Viton)**

EVME valves

- Are pilot solenoid valves suitable for liquid, suction and hot gas lines applications.
- Are special valves which can be used with Hydro Carbon refrigerants.

Technical data
Refrigerants:
Applicable to HC refrigerants (e.g. Propane, Butane, Propylene, …..)

Temperature range: –40/+120°C (–40/+248°F).

Max. working pressure: 42 bar (609 psig).

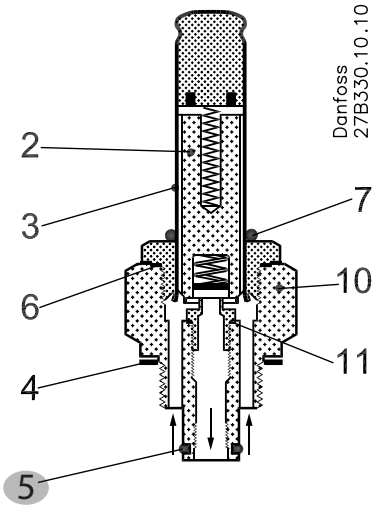
O-ring material:
Fluorocarbon (Viton) compound for low temperature application

Marking:
The valve is marked with the name "EVME".

All dimensions and performance data are identical to the standard EVM (Literature no.: PD.HN0.A).

Note: Solenoid coils must be EX approved.

Material specification



No.	Part	Material
2	Armature	Stainless steel
3	Armature tube	Stainless steel
4	Seal	Non-asbestos
5	**O-ring**	**Flourocarbon (Viton)**
6	Seal	Aluminium
7	Spacing ring	
10	Valve body	Steel
11	Valve seat	Teflon (PTFE)