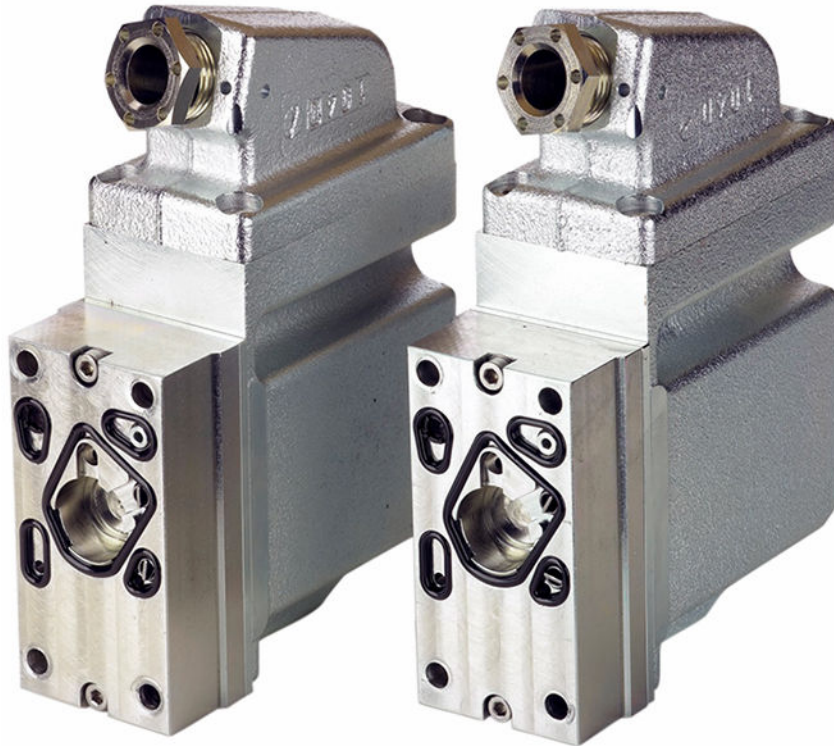


Technical Information

# Electrohydraulic Actuators for PVG32, PVG100 and PVG120 PVE-EX Ex db version



**Revision history**

*Table of revisions*

<b>Date</b>	<b>Changed</b>	<b>Rev</b>
October 2017	Major revision	0102
January 2017	First edition	0101

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## General information

### PVE-EX Introduction

The Danfoss PVE-EX is a PVE series 7 actuator for PVG32, PVG100 and PVG120.

The PVE-EX is an explosion proved PVE designed to be used in harsh environments like mining and oil and gas industries.

The PVE-EX has been certified by NEMKO, IECEx and MA.

### Literature Reference

*Literature reference for PVG and PVE products*

Title	Type	Order number
PVG 32 Proportional Valve Groups	Service Manual	11039167
PVG 100 Proportional Valve Groups	Service Manual	11048807
PVG 32 Proportional Valve Groups	Technical Information	520L0344
PVG 100 Proportional Valve Groups	Technical Information	520L0720
PVG 120 Proportional Valve Groups	Technical Information	520L0356
PVG 32 Metric ports	Technical Information	11051935

### Product Certification

#### **The PVE-EX db version is developed according to and in compliance:**

- EN ISO 4413:2010 Hydraulic fluid power - General rules and safety requirements for systems and their components
- EN 60079-0:2012/A11:2013, IEC 60079-0:2011 Explosive atmospheres - Part 0: Equipment - General requirements
- EN/IEC 60079-1:2014 Electrical apparatus for explosive gas atmospheres-part 1: Flameproof enclosures "d"

#### **Installation and Maintenance standards:**

- EN/IEC 60079-14 Explosive atmospheres - Part 14: Electrical installations design, selection and erection
- EN/IEC 60079-17 Explosive atmospheres - Part 17: Electrical installations inspection and maintenance

#### **The PVE-EX is in conformity with listed EU Directive(s):**

- EMC Directive 2004/108/EC
- EN/IEC 61000-6-2:2005 Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
- EN 61000-6-4:2007/A1:2011, IEC 61000-6-4:2006 Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments

### Protection

All PVE-EX modules comply with protection class IP66 and IP69k according to EN60529. However, in particularly exposed applications, protection in the form of shielding is recommended.

### Warnings

Before implementing actuators in any application, read all warnings.

Warnings are listed next to the most relevant section and repeated in Warnings chapter.

**General information**

Do not regard the warnings as a full list of potential dangers. Depending on the application and use, other potential dangers can occur.

** Warning**

---

All brands and all types of directional control or proportional valves, which are used in many different operation conditions and applications, can fail and cause serious damage.

Analyze all aspects of the application. The machine builder/system integrator alone is responsible for making the final selection of the products and assuring that all performance, safety and warning requirements of the application are met.

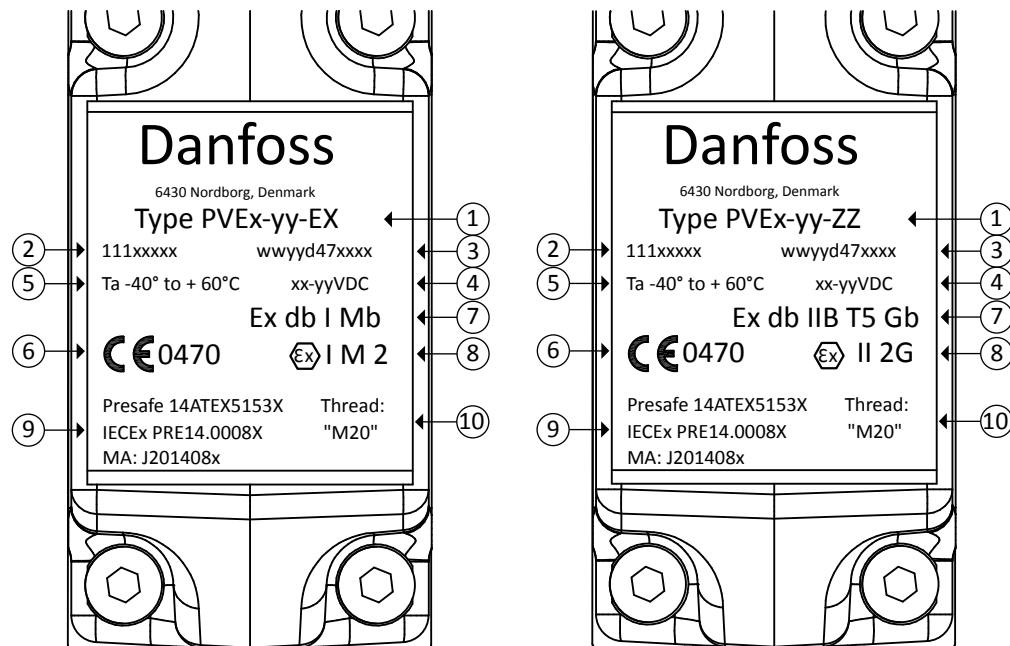
The process of choosing the control system and safety levels is governed by the machine directives EN 13849 (Safety related requirements for control systems).

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**General information**

**Nameplate Description (PVE-EX db version)**

*PVE-EX Ex db version, Group I (left) and Group II (right)*



V310 459

*Nameplate legend*

Number	Description	
1	PVE-EX type, see the table below.	
2	Part Number	<i>Example:</i> 111xxxxx
3	Production date and serial number	<i>Example:</i> 42 12 C xxxxxx Week: 42 Year: 2012 Day: C=Wednesday (A=Monday) serial Number
4	Supply voltage	
5	Ambient temperature range	
6	Notified body	<i>Example:</i> NEMKO/Presafe
7	IECEx Equipment Group and protection category X-marking	
8	ATEX Equipment Group and protection category X-marking	
9	Ex Certificate Number	Specific conditions for safe use ("X"-mark) Originally supplied "SD cable glands" may not provide sufficient clamping. User shall provide additional clamping of the cable to ensure that pulling and twisting is not transmitted to the terminations.
10	Thread	Threaded entry: M20 x 1.5 Determined temperature at entry point is +76° C, use appropriate cables and cable gland

*PVE-EX Ex db types with part numbers, Group I and Group II*

Group I		Group II	
Type	Part No.	Type	Part No.
PVEO-EX-12V	11156462	PVEO-EX-24V	11156467
PVEO-EX-24V	11123165	PVEH-EX	11156463

## General information

*PVE-EX Ex db types with part numbers, Group I and Group II (continued)*


Group I		Group II	
Type	Part No.	Type	Part No.
PVEO-DI-EX-24V	11156461	PVES-EX	11156464
PVEH-DI-EX	11127696	PVEH-U-EX	11156465
PVEH120-DI-EX	11166357	PVES-U-EX	11156466
PVEO120-DI-EX-12V	11170401	PVES120-U-EX	11156568
		PVEO120-EX-24V	11156468
		PVES120-EX	11156567
		PVEH120-EX	11161000

## Description of the EX Code (PVE-EX db)

### IEC marking of the EX code db version

Description	IEC Marking	
Explosion protection marking	<b>Ex</b>	
Protection type	<b>db</b>	
Equipment Group	<b>I</b>	<b>IIB</b>
T-class	<b>N/A</b>	<b>T5</b>
Equipment Protection Level (EPL)	<b>Mb</b>	<b>Gb</b>

### EU marking of the EX code db version

Description	EU Marking	
CE conformity marking	<b>CE</b>	
Identification number of notified body involved in production control stage	<b>0470</b>	
Explosion protection marking		
Equipment Group	<b>I</b>	<b>II</b>
Equipment Category	<b>M2</b>	<b>2G</b>

## EPL / Equipment Category

### EPL/Equipment Category

Definition	Level of protection	Typical zone of application	IEC		EU	
			EPL	Group	Category	Group
Mines	very high	N/A	Ma	I	M1	I
	high		Mb		M2	
Gas atmospheres	very high	0	Ga	II	1G	II
	high	1	Gb		2G	
	enhanced	2	Gc		3G	



## Functionality

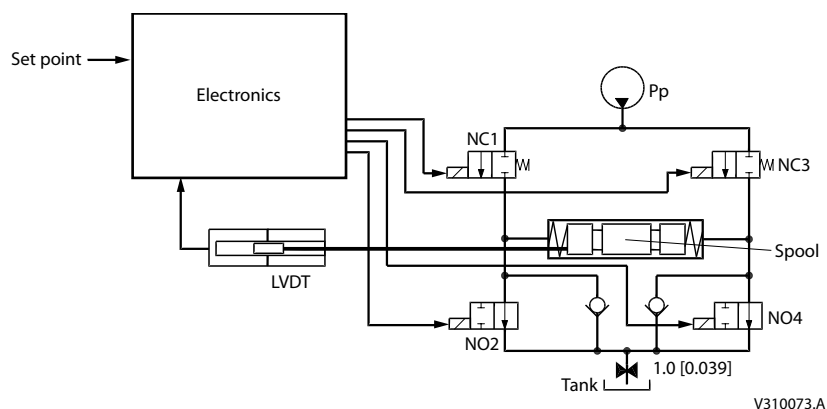
### PVE-EX functionality

The PVE-EX is an electro mechanical device, meaning that functionality is depending on mechanical, hydraulic, electrical and control conditions given by PVE, PVG, application and vehicle. The result of this is that implementing operation and safety conditions also must include vehicle specific considerations.

#### PVE hydraulic subsystems

The hydraulic subsystem is used for moving the spool and thereby open the valve for work flow.

*Pilot oil diagram*



The hydraulic subsystem moves the spool and thereby opens the valve for work flow. The heart in the hydraulic subsystem is the solenoid valve bridge which controls the Pilot Pressure (Pp) on spool ends. It consist of four poppet valves, the two upper are normally closed (NC) and the two lower are normally open (NO).

The Pp will work against the PVBS neutral spring when the spool is moved out of blocked (neutral) and together with the spring when going in blocked. This combined with a larger opening in the NO than in the NC will give a faster movement towards blocked than out of blocked.

When the PVE is powered the solenoids are all put in closed state. To move the PVBS to the right NC1 and NO4 are opened and NC3 and NO2 are kept closed.

The activation of the solenoid valves represents oil consumption and thereby also a pressure drop in the pilot oil gallery. By simultaneous use of multiple PVE the Pp can fall and result in performance problems.

The two check valves next to the NO are anti-cavitation valves. The orifice to tank reduces tank pressure spikes and can also be used for ramp function.

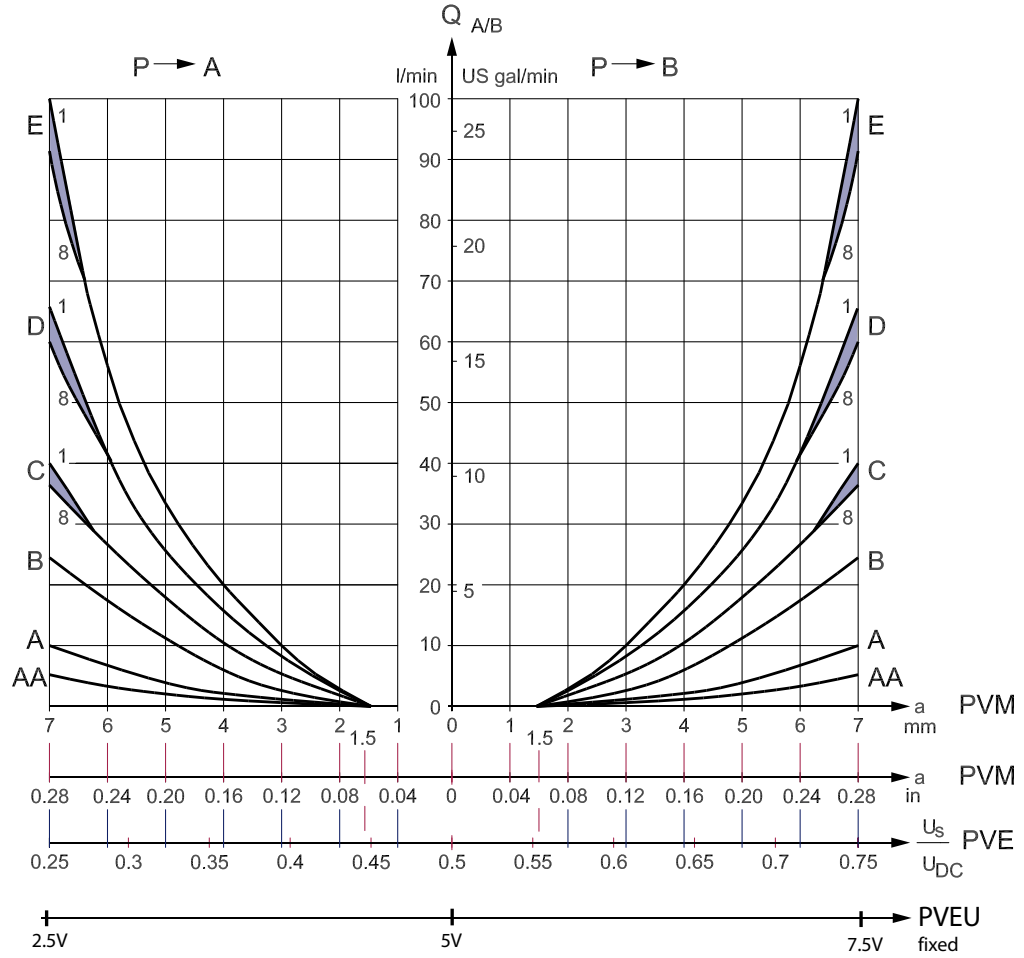
#### **Warning**

Obstacles for the Pilot oil pressure (Pp) can have direct influence on spool control. Reduced Pp will limit spool control. Too high Pp can harm the PVE.

**PVE-EX control**

**PVE-EX: PVE control by voltage**

*PVE characteristic – control by voltage*

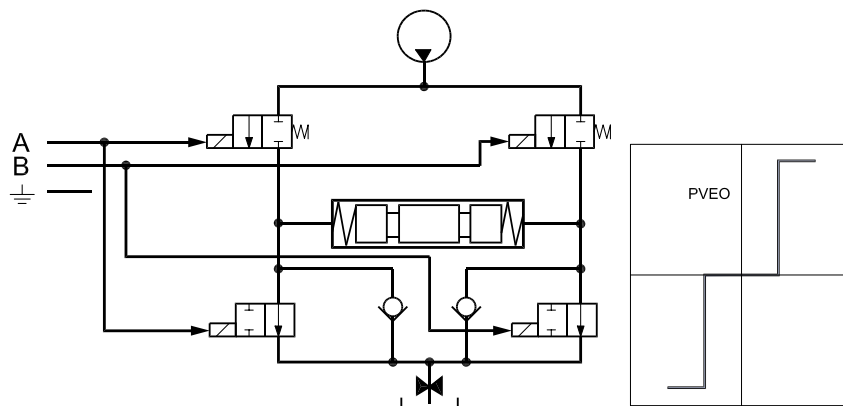


**PVE-EX ON/OFF activation**

The PVEO has two independent powered sets of solenoids. By powering a set of pins the actuator is activated. By standard mounted PVE the A set gives full flow on A port and B gives on B port. Both directions activated at same time will keep the spool in neutral.

**PVE-EX control**

*PVEO schematic and characteristic*



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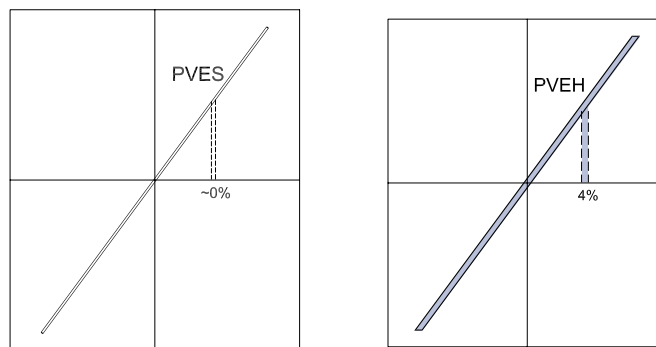
**⚠ Warning**

The PVEO is designed to have  $U_{DC}=12\text{ V}$  or  $U_{DC}=24\text{ V}$ .  
 The solenoids might be activated by voltage down to 6 V.

**PVE-EX: PVE hysteresis**

The controllability of the PVE depends on the solenoid valve bridge and the electronic capacity of the module. Hysteresis is a measurement on spool position precision and repeatability. Hysteresis is not a description of position maintaining.

*PVES (left) and PVEH (right) position diagrams*



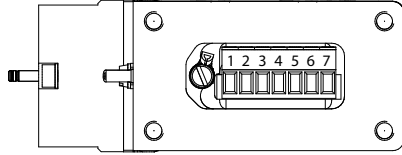
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The PVES has an ASIC closed loop circuit and NC-S solenoids.  
 The PVEH has an ASIC closed loop circuit and NC solenoids.

## Specifications

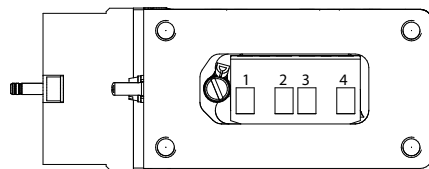
### 7-pin Layout

7-pin connector



### 4-Pin layout

4-Pin connector, Group II



Versions	Pin 1	Pin 2	Pin 3	Pin 4
PVEO-EX-24V, PVEO120-EX-24V	$U_{DC-A}$	$U_{DC-B}$	GND	—
PVEH/-EX/-U-EX, PVES/-EX/-U-EX, PVES120/-EX/-U-EX, PVEH120-EX	$U_s$	$V_{bat}$	GND	Error

### Radiometric Control Signal

Radiometric control signal for PVEH/PVES

PIN		Function of the pin	Versions
1	$U_s$	Demand signal	PVES-EX PVEH-EX PVES120-EX PVEH120-EX PVEH-DI-EX PVEH120-DI-EX
2	$V_{bat2}$	Supply voltage to solenoid valves (can be switched off separately)	
3	GND	Ground	
4	Error	Error pin (See <a href="#">PVE-EX fault monitoring</a> on page 23)	
5	GND DI-A	Signal low when spool is stroked to A side (Only for DI versions)	
6	GND DI-B	Signal low when spool is stroked to B side (Only for DI versions)	
7	$V_{bat}^*$	Supply voltage to DI versions	

\* Pin 2 and 7 shall be connected together for PVE modules without the DI function.

Signal voltage ( $U_s$ ) Control

Neutral	Q: P → A	Q: P → B
$U_s = 0.5 \cdot U_{DC}$	$U_s = (0.5 \rightarrow 0.25) \cdot U_{DC}$	$U_s = (0.5 \rightarrow 0.75) \cdot U_{DC}$

### Radiometric Fixed Control Signal (0-10 V)

Radiometric control signal for PVEH/PVES

PIN		Function of the pin	Versions
1	$U_s$	Demand signal	PVEH-U PVES-U-EX PVES120-U-EX
2	$V_{bat}$	Supply Voltage	
3	GND	Ground	
4	Error	Error pin (See <a href="#">PVE-EX fault monitoring</a> on page 23)	

## Specifications

### Signal voltage ( $U_S$ ) Control

Neutral	Q: P → A	Q: P → B
$U_S = 5\text{ V}$	$U_S = 5\text{ V} \rightarrow 2.5\text{ V}$	$U_S = 5\text{ V} \rightarrow 7.5\text{ V}$

## Radiometric Control Signal – On/Off Activation

### Radiometric control signal for PVEO versions

PIN		Function of the pin	Versions
1	$U_{DC}(A)$	Input signal direction A	PVEO-EX-12V PVEO-EX-24V PVEO-DI-EX-24V PVEO120-EX-24V PVEO120-DI-EX-12V
2	$U_{DC}(B)$	Input signal direction B	
3	GND	Ground	
4	GND	Ground	
5	DI-A	Signal low when spool is stroked to A side (Only for DI versions)	
6	DI-B	Signal low when spool is stroked to B side (Only for DI versions)	
7	$V_{bat}$	Supply voltage to DI versions	

### Signal voltage Control

Signal voltage	Neutral	Q: P → A	Q: P → B
<b>A</b>	0	$U_{DC}(A)$	0
<b>B</b>	0	0	$U_{DC}(B)$

## Adjustment/calibration

The PVE-EX is pre-calibrated from the factory to be inside the dead band of the proportional valve. The position sensor built into the PVE-EX cannot be adjusted by user. Any biasing of the position has to be incorporated in the demand signal.

**Technical data**
**Fluid specification**

The following data is from typical test results. Mineral based hydraulic oil with a viscosity of 21 mm<sup>2</sup>/s [102 SUS] and a temperature of 50 °C [122 °F] was used for the hydraulic system testing.

**⚠ Warning**

The PVE is designed for use with pilot oil supply. Use without oil supply can harm the system. Intermision is no longer than 5 seconds and not more than once per minute.

*Oil consumption*

Supply voltage	Pilot oil flow per PVE-EX Function	PVEO Versions	PVEH Versions	PVES Versions
		l/min	l/min	l/min
Without	Neutral	0	0	0
With	Locked	0.1	0.1	0.1
	Actuating	0.7	0.7	0.8

*Oil viscosity, Oil temperature and Pilot pressure*

Parameter	Minimum	Maximum	Range
Oil viscosity	4 mm <sup>2</sup> /s [39 SUS]	460 mm <sup>2</sup> /s [2128 SUS]	12 - 75 mm <sup>2</sup> /s [65 - 347 SUS]
Oil temperature	-30 °C [-22 °F]	90 °C [194 °F]	30 to 60 °C [86 to 140 °F]
Pilot pressure (relative to T pressure)	10 bar [145 psi]	15 bar [217 psi]	Nominal 13.5 bar [196 psi]
Intermittent pressure peaks up to	–	50 bar [725 psi]	–

*Filtering in the hydraulic system*

Required operating cleanliness level (ISO 4406, 1999 version)	18/16/13
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**PVE-EX electrical data**

Specification		PVEO Versions	PVEH and PVES Versions
Grade of enclosure EN 60529		IP 66 and IP 69k	
Ambient temperature	Minimum	-40 °C [-40 °F]	
	Maximum	60 °C [140 °F]	
Maximum (submitting) surface temperature, T5		100 °C [212 °F]	
Supply voltage	Rated	12 / 24 V <sub>DC</sub>	11-30 V <sub>DC</sub>
	Range PVE-EX-12V	11-16 V <sub>DC</sub>	N/A
	Range PVE-EX-24V	22-30 V <sub>DC</sub>	N/A
	Maximum ripple	5%	5%
Current consumption at rated voltage (12/24 V <sub>DC</sub> )	Typical	0.74 A / 0.37 A	0.57 A / 0.33 A
	Minimum	0.55 A / 0.29 A	N/A
	Maximum	0.82 A / 0.42 A	N/A
Power consumption at rated voltage		9 W	7 W
Current via DI		0.1 A	0.1 A
Input impedance in relation 0.5 x U <sub>DC</sub>		N/A	12 kΩ
Fault monitoring	Maximum load	N/A	60 mA
	Reaction time at fault	N/A	500 ms

[For more information about PVEO, PVES and PVEH versions please refer to Nameplate description.](#)

## Technical data

### Reaction times

*Reaction time for PVES/PVEH versions*

Supply voltage	Function	Minimum	Rated	Maximum
Disconnected by means of neutral switch	From neutral position to max. spool travel	120 ms	150 ms	230 ms
	From max. spool travel to neutral position	65 ms	90 ms	175 ms
Constant voltage	From neutral position to max. spool travel	50 ms	120 ms	200 ms
	From max. spool travel to neutral position	65 ms	90 ms	100 ms

*Reaction time for PVEO versions*

Supply voltage	Function	Minimum	Rated	Maximum
Power on	From neutral position to max. spool travel	120 ms	180 ms	235 ms
Power off	From max. spool travel to neutral position			

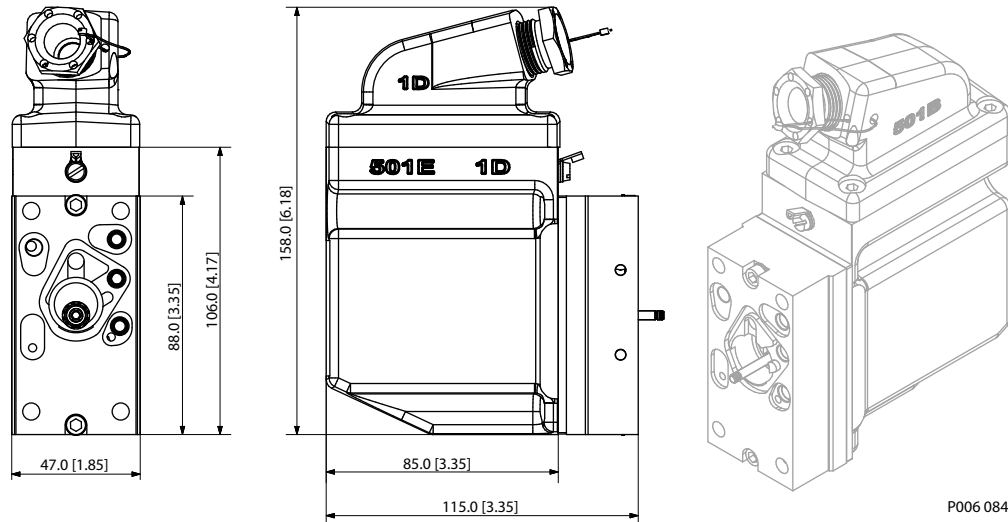
### Adjustment/calibration

The PVE-EX is pre-calibrated from the factory to be inside the dead band of the proportional valve. The position sensor built into the PVE-EX cannot be adjusted by user. Any biasing of the position has to be incorporated in the demand signal.

## Installation

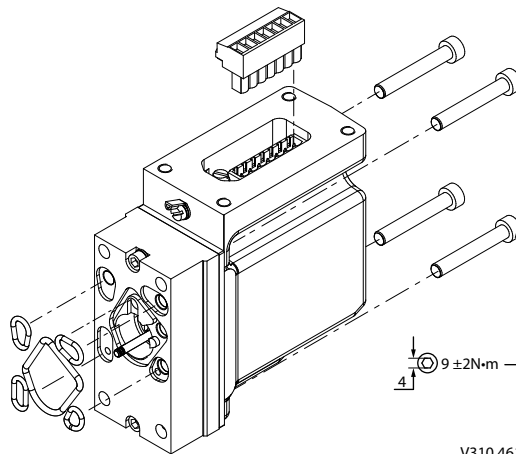
### PVE-EX Dimensions

PVE-EX dimensions, mm [in]



### Mounting of PVE-EX

1. Protect the LVDT pin (PVEH-EX and PVES-EX modules)
2. Ensure all O-rings are mounted and properly aligned in the grooves before mounting the PVE-EX to the PVG valve.
3. The four screws (M6x40 mm) must be tightened to  $9 \pm 2 \text{ N}\cdot\text{m}$  [ $6.63 \pm 1.48 \text{ lbt}\cdot\text{ft}$ ]



### Warning

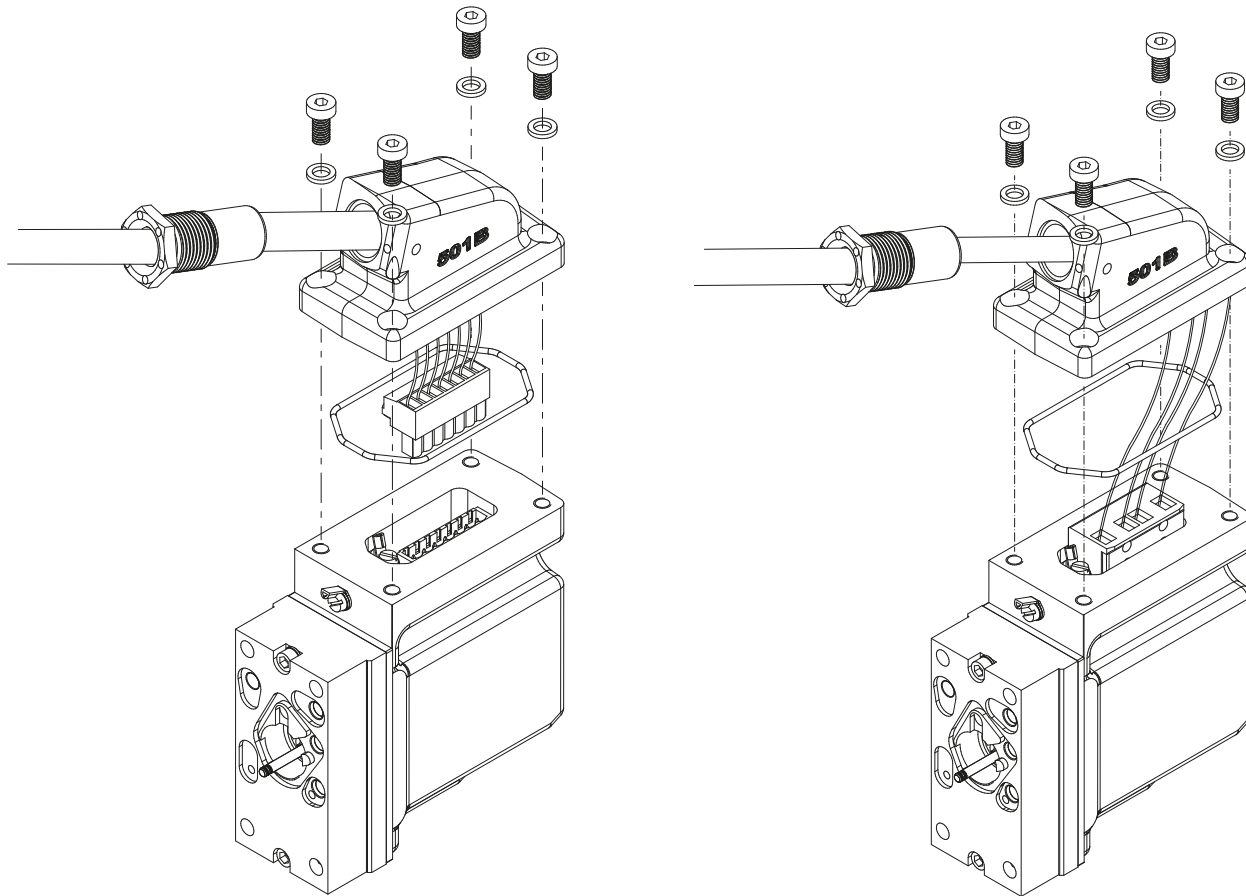
The installation must be performed as intended in order to have a safe system and a proper functional application. In a case of damage to enclosure, plug or cable, the PVE-EX module must be replaced. Please refer to the information in this manual for an assistance, or consult with a professional.



## Installation

### Cable

Mounting of cable, Group I (left) and Group II (right)



kwa1464204172786

[Use screws made from stainless steel grade A4 or stronger \(enclosed\).](#)

### Mounting of Cable

The PVE-EX is equipped with a top part that holds the cable gland for cable installation.

1. Remove the shield of an appropriate length to expose the wires.

If shield shall be connected to the earthing terminal, make sure to have shield enough to crimp into the cable shoe and attach properly to the chassis.

[Cable material must be according to the specification.](#)

2. Strip the wires such that a suitable length of cooper is exposed.
3. Insert wires and cable through the gland and grommet.
4. Insert wires into screw terminals and tighten the screws.
5. Pull the cable back to the position where the cable jacket is still going through the grommet.
6. Immerse the terminal compartment and mate the male and female connector.
7. Ensure that the O-ring is properly seated in its groove and that excess wires are not trapped between the two elements.
8. Tighten the screws to the specified torque  $6 \pm 1$  N•m.
9. Tighten the gland to the specified torque in which the cable is locked correctly.

[Use screws made from stainless steel grade A4 or stronger \(enclosed\).](#)

## Installation

### Cable Gland

The PVE-EX is required to be installed with a cable specified to the surrounding conditions and to the given diameter of the cable gland. There are two options available for cable glands:

- Supplied built-in cable gland (certified with the product)
- Pre-certified standard cable gland (M20 x 1.5 mm threaded entry and 20 x 1.5 mm O-ring).

#### Supplied Built-in Cable Gland

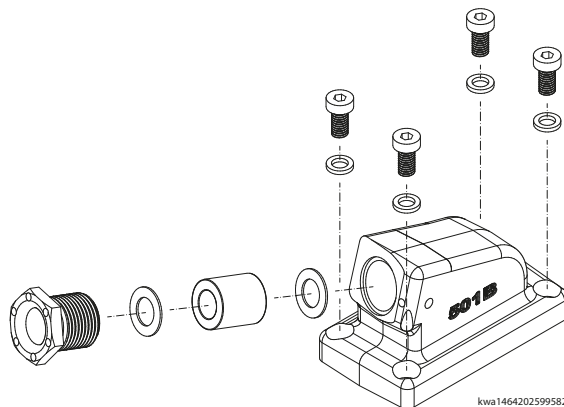
The PVE-EX has a built in cable gland for cable installation. The cable gland and grommet ensures that the internal components are not exposed to the outside. Furthermore, the cable gland arrangement has to retain any flame and pressure that can occur inside the PVE-EX.

1. Choose the grommets delivered with PVE-EX for different cable diameters. (see the table below)

The cable gland needs to meet the diameter of the cable and to the PVE-EX.

Grommet (inner dia)		
<b>Cable diameter span</b>	9.9 to 10.5 mm [0.4 to 0.42 in]	12.7 to 13.5 mm [0.51 to 0.54 in]
<b>Thread type, size</b>	M20, 1.5 mm [0.06 in]	
<b>Temperature span</b>	-40 °C to +76 °C [-40 °F to +168.8 °F]	
<b>Tightening torque</b>	20 N·m	

2. Screw the cable gland at least 5 full threads.
3. Tighten the cable gland to the specified torque.
4. Install the safety wire (not included) between the cable gland and the top gland.



#### PVE-EX Pre-certified Cable Gland

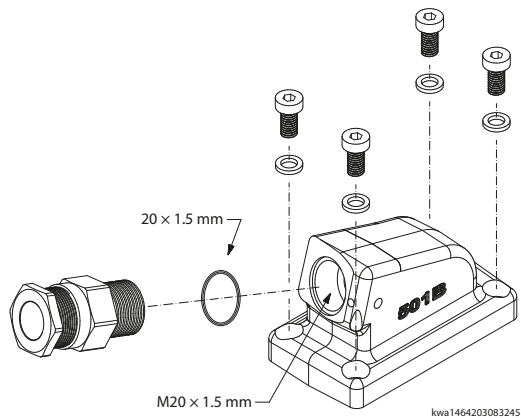
For cable diameter specification, refer to the relevant instruction from the supplier of the pre-certified gland. In order to comply with the product certification the pre-certified cable gland must be marked with the following markings:

Marking	EU	IEC
<b>Group I</b>	I M2	Ex I Mb (-40° C ≤ ta ≤ +80° C) [-40° F to +176° F]
<b>Group II</b>	II 2G	Ex IIB Gb (-40° C ≤ ta ≤ +80° C) [-40° F to +176° F]

#### Warning

Pre-certified cable gland must have thread: M20 x 1.5 mm and must be sealed with O-ring 20 x 1.5 mm at the threaded entry.

## Installation



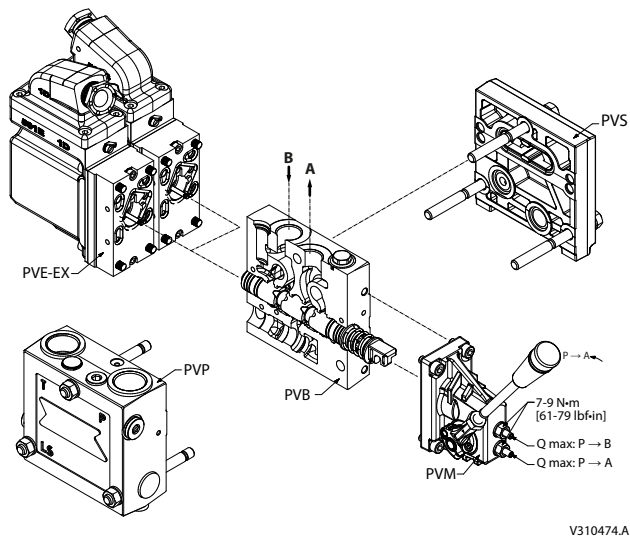
## Mounting of PVG

[For mounting information regarding PVG products, see Literature reference.](#)

### Mounting options and guidelines

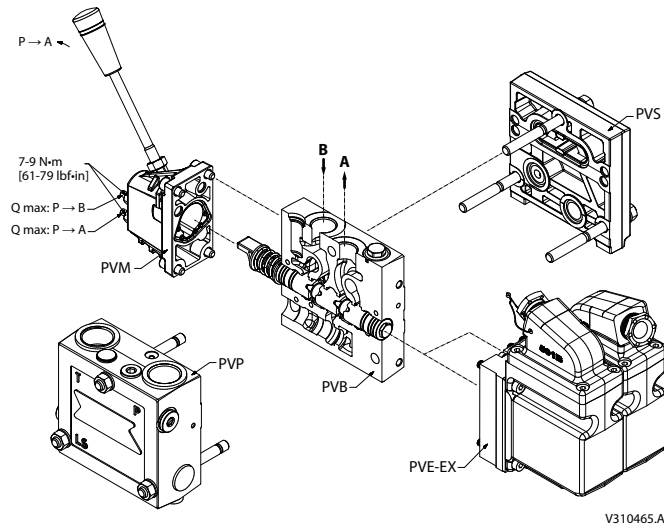
The PVE-EX can be installed as either standard mount or optional mount.

#### Standard assembly



**Installation**

*Optional assembly*



**Direction of cable exit**

The design of the PVE-EX enables the customer to choose if the cable will exit towards or away from the PVG group.

*Cable exits towards PVG (left); Cable exits away from PVG (right)*



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## Safety and monitoring

### Safety in application

All types of control valves (incl. proportional valves) can fail, thus the necessary protection against the serious consequences of function failure should always be built into the system. For each application an assessment should be made for the consequences of pressure failure and uncontrolled or blocked movements. To determine the degree of protection that is required to be built into the application, system tools such as FMEA (Failure Mode and Effect Analysis) and Hazard and Risk Analysis can be used.

#### FMEA – IEC EN 61508

FMEA (Failure Mode and Effect Analysis) is a tool used for analyzing potential risks. This analytical technique is utilized to define, identify, and prioritize the elimination or reduction of known and/or potential failures from a given system before it is released for production. Please refer to the standard IEC FMEA 61508.

#### Hazard and risk analysis ISO 12100-1/14121

This analysis is a tool used in new applications as it will indicate whether there are special safety considerations to be met according to the machine directives EN 13849. Dependent on the determined levels conformity this analysis will determine if any extra requirements for the product design, development process, production process or maintenance, example the complete product life cycle.

#### Warning

All brands and all types of directional control or proportional valves, which are used in many different operation conditions and applications, can fail and cause serious damage. Analyze all aspects of the application. The machine builder/system integrator alone is responsible for making the final selection of the products and assuring that all performance, safety and warning requirements of the application are met. The process of choosing the control system and safety levels is governed by the machine directives EN 13849 (Safety related requirements for control systems).

### Safety guidelines

- When failure, damage or defect occurs, the PVE-EX has to be replaced.
- A failing PVE-EX must under no circumstance be repaired.
- No modifications, which could damage the explosion-safety and protection, are allowed to the PVE-EX, the cable gland, or on the cable.
- Demounting a PVE-EX should be done in an atmosphere with no potential for explosions.
- The machine and system approval has to be issued before using the PVE-EX in explosive-areas.
- The manufacturer has the application responsibility and is solely responsible for the safety of the system.
- Deviations from recommended torque when mounting parts can harm performance and the PVE-EX.
- Do not adjust, bend or damage the position transducer (LVDT) as this will influence the safety and performance.
- When replacing the PVE-EX, the electrical and the hydraulic systems must be turned off and the oil pressure released.
- Hydraulic oil can cause both environmental damage and personal injuries.
- Module replacement can introduce contamination and errors to the system. It is important to keep the work area clean and components should be handled with care.

## Safety and monitoring

### PVE-EX fault monitoring and reaction

PVE-EX is available with fault monitoring and spool direction indication.

The fault monitoring system is available in two versions:

- Active fault monitoring provides a warning signal and deactivates the solenoid valves. A reboot of the PVE is required to reactivate.
- Passive fault monitoring provides a warning signal only. A reboot is not required.

Both active and passive fault monitoring systems are triggered by the same three main events:

- Control signal monitoring
- Transducer supervision
- Supervision of spool position

#### Control signal monitoring

The Control signal voltage (US) is continuously monitored. The permissible range is between 15% and 85% of the supply voltage. Outside this range the PVE-EX will switch into an error state.

#### Transducer supervision

The internal LVDT wires are monitored. If the signals are interrupted or short-circuited, the PVE-EX will switch into an error state.

#### Supervision of spool position

The actual position must always correspond to the demanded position (US).

If the actual spool position is further out from neutral than the demanded spool position >12% or in opposite direction, the PVE will switch into an error state.

With neutral/blocked setpoint the tolerance is  $\pm 0.5$  mm relative the calibrated neutral position. Spool position closer to neutral and in same direction will not cause an error.

- Active fault reaction is activated when the failure has been active for 500 ms
  - The solenoid valve bridge is disabled and the PVBS is released to spring control
  - The error output pin goes high
  - The state is memorized and continues until PVE reboot
- Passive fault reaction is activated when the failure has been active for 500 ms
  - The solenoid valve bridge is NOT disabled and the PVBS is NOT released
  - The error output pin goes high (for PVE with direction indication both DI pins goes low by fault)
  - The state is active for minimum 100 ms and is reset when error disappears

To avoid the electronics in undefined state a general supervision of power supply (UDC) an internal clock frequency is implemented. This function applies to PVEH and PVES independently of fault monitoring version and will not activate fault monitoring.

#### **Warning**

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Error pins from more PVEs may not be interconnected. Not activated error pins are connected to ground and will disable any active signal. Error pins are signal pins and can only supply very limited power consumption.

---

- The solenoid valves are disabled when

## Safety and monitoring

- the supply voltage exceeds 36 V
- the supply voltage falls below 8.5 V
- the internal clock frequency fails

### PVE-EX fault monitoring

#### Fault monitoring overview

PVE type	PVEH/PVES-U versions	PVES versions	PVEO versions
Fault monitoring	Active	Passive	No
Delay before error out	500 ms	250 ms	—
Closed loop deactivated memory (reset needed)	Yes	No	—
Error mode	No fault	Error output status – Low Fault output on PVE: < 2 V	—
	Input signal fault Transducer (LVDT) Close loop fault	Error output status – High Fault output on PVE: $U_{DC}$	—

#### Caution

The installation must be performed as intended in order to have a safe system.  
Please refer to the information in this manual for an assistance, or consult with a professional.

## Direction indication feedback (-DI)

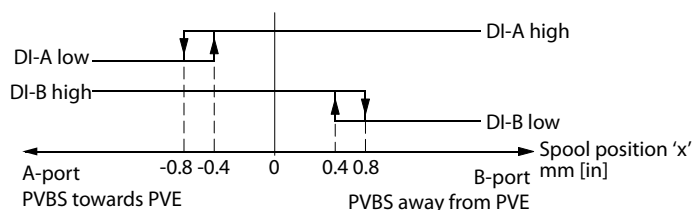
PVE with build in indication for spool movement direction are available.

The PVE-DI has dual power supply.  $U_{DC1}$  only supplies solenoid valves.  $U_{DC2}$  supplies electronics and feed back. The PVE does not work without  $U_{DC2}$ . DI-A and DI-B are relative standard mounting. The input signal fault monitoring is disabled if  $U_{DC1}$  is disabled. DI-A and DI-B are relative standard mounting.

The DI has two direction feedback signals with output high (close to  $U_{DC}$ ) when the spool is in neutral position. If the spool moves out of neutral position, the direction signal switches to low (< 0.2 V). One of the signals goes low by spool ~0.8 mm out of neutral and high by spool within 0.4 mm out of neutral.

**Both direction indication signals go low when the error indicator goes high.**

#### Direction indication feedback



157-435.10

As shown in the figure, both "DI-A" and "DI-B" signals are "High" when the spool is in neutral position. When the spool is moving in the A direction, the "DI-A" signal goes "Low" and the "DI-B" signal stays "High". The reverse is true when the spool is moved in the B direction.

#### Values for Direction Indicators (-DI)

Transition from high to low	$0.8 \pm 1$ mm [0.031 in]
Transition from low to high	$0.4 \pm 1$ mm [0.015 in]

**Safety and monitoring***Values for Direction Indicators (-DI) (continued)*

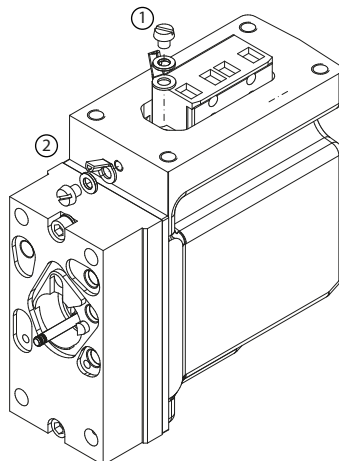
<b>Transition to low both pins</b>	error pin goes high
<b>Maximum load of DI-A, DI-B</b>	50 mA
<b>Voltage DI high by load 20 mA</b>	$> U_{DC} - 1.5 V$
<b>Voltage DI high by load 50 mA</b>	$> U_{DC} - 2.0 V$
<b>Voltage DI low</b>	$< 0.2 V$



## Internal and external earth-connection

### Earthing terminals

*4-pin earthing terminal*



- 1.** Internal earthing terminals
- 2.** External earthing terminals

### Internal earth-connection

Internal earthing terminal enables a shield to be connected to chassis.

- 1.** Remove the jacket from the shield at a length that allows mounting the cable shoe into the threaded hole next to the connector.
- 2.** Crimp or solder the shield into the cable shoe.
- 3.** Attach the cable shoe to the chassis via the M4 screw and the self-locking ring.
- 4.** Tighten the screws to the specified torque  $5 \pm 2$  N•m.

## **Internal and external earth-connection**

### **External earth-connection**

External earthing terminal enables a earth wire to be connected to the PVE-EX.

- 1.** Crimp or solder the earth wire into the cable shoe.
- 2.** Attach the cable shoe to the chassis via the M4 screw and the self-locking ring.
- 3.** Tighten the screws to the specified torque  $5 \pm 2 \text{ N}\cdot\text{m}$ .

## Maintenance, service, troubleshooting

### PVE-EX installation, start-up, and operation

The PVE-EX is primarily maintenance free, except for the flame paths that need to be inspected regularly according to the code of protection Ex **db**.

The inspection intervals and definitions are to be seen in the standard IEC 60079-17 and the corresponding Inspection schedules-table. Operators must under no circumstance try to repair or open a PVE-EX. A failing or damaged PVE-EX is to be replaced.

#### **Warning**

---

The installation must be performed as intended in order to have a safe system and a proper functional application. In a case of damage to enclosure, plug or cable, the PVE-EX module must be replaced. Please refer to the information in this manual for an assistance, or consult with a professional.

---

#### **Warning**

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All national safety regulations must be fulfilled in connection with installation, start-up and operation of Danfoss PVE-EX electrical actuation's. Furthermore, the requirements of the Declaration of Conformity and national regulations for installations in potentially explosive atmospheres applies as well. Disregarding such regulations involves a risk of serious personal injury or extensive material damage.

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#### **Warning**

---

Work in connection with the electrical actuations must be performed only by professionals and qualified persons.

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## Warnings

### PVE-EX warnings

---

#### **Warning**

All brands and all types of directional control or proportional valves, which are used in many different operation conditions and applications, can fail and cause serious damage.

Analyze all aspects of the application. The machine builder/system integrator alone is responsible for making the final selection of the products and assuring that all performance, safety and warning requirements of the application are met.

The process of choosing the control system and safety levels is governed by the machine directives EN 13849 (Safety related requirements for control systems).

---

#### **Warning**

The installation must be performed as intended in order to have a safe system and a proper functional application. In a case of damage to enclosure, plug or cable, the PVE-EX module must be replaced. Please refer to the information in this manual for an assistance, or consult with a professional.

---

#### **Warning**

- Not applying to the Operational Conditions can compromise safety.
  - A PVG with PVE-EX can only perform according to description if conditions in this Technical Information are met.
  - In particularly exposed applications, protection in the form of a shield is recommended.
  - When the PVE-EX is in fault mode the quality of performance and validity of feedback is limited depending on the fault type.
  - Error pins from more PVE-EX's may not be connected. Inactive error pins are connected to ground and will disable any active signal. Error pins are signal pins and can only supply very limited power consumption.
  - After replacement of modules or cables wiring quality must be verified by a performance test.
  - By actuation at voltage below nominal PVG will have reduced performance.
  - The PVE-EX is not designed for use with voltage outside nominal.
  - Obstacles for the Pilot oil can have direct influence on spool control.
  - Reduced pilot oil pressure will limit spool control.
  - Too high pilot oil pressure can harm the PVE-EX.
-

**Code numbers**

**PVE-EX Ex part numbers**

*PVE-EX Ex db types with part numbers, Group I and Group II*

Group I		Group II	
Type	Part No.	Type	Part No.
PVEO-EX-12V	11156462	PVEO-EX-24V	11156467
PVEO-EX-24V	11123165	PVEH-EX	11156463
PVEO-DI-EX-24V	11156461	PVES-EX	11156464
PVEH-DI-EX	11127696	PVEH-U-EX	11156465
PVEH120-DI-EX	11166357	PVES-U-EX	11156466
PVEO120-DI-EX-12V	11170401	PVES120-U-EX	11156568
		PVEO120-EX-24V	11156468
		PVES120-EX	11156567
		PVEH120-EX	11161000

**Declaration of conformity**

**EC-Declaration of Conformity**



**Danfoss Power Solutions Aps**  
 6430 Nordborg  
 Denmark

CVR No.: 25 81 43 63  
 Telephone: +45 7488 4444  
 Telefax: +45 7488 4400  
 Homepage: danfoss.com  
 powersolutions.danfoss.com

**EC-DECLARATION OF CONFORMITY**  
**Danfoss Power Solutions Aps**

declare under our sole responsibility that the following product(s) / component(s)

**Product(s)**

Description

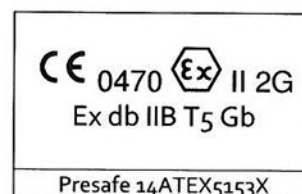
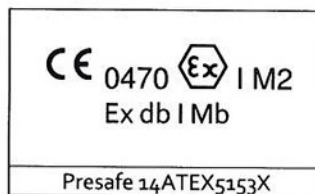
**Variant(s)**

Group I: PVEO-EX-12V, PVEO-EX-24V, PVEO-DI-EX-24V, PVEH-DI-EX, PVEH120-DI-EX, PVEO120-DI-EX-12V  
 Group IIB: PVEO-EX-24V, PVEH-EX, PVEH-U-EX, PVES-EX, PVES-U-EX, PVEO120-EX-24V, PVEH120-EX, PVES120-EX, PVES120-U-EX

**Part number(s)**

11123165, 11127696, 11156461, 11156462, 11156463, 11156464, 11156465, 11156466, 11156467, 11156468, 11156567, 11156568, 11161000, 11166357, 11170401

Covered by this declaration is in conformity with the following directive(s), standard(s) or other normative document(s), provided that the product is used in accordance with our instructions.



QAN Notified body: 0470

Continued...

Date 2017.02.07	Issued by <b>Lars Althof</b> Director R&D Engineering	Date 2017.02.07	Approved by <b>Lars Otten</b>  Senior Director Global R&D & Eng
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Danfoss only vouches for the correctness of the English version of this declaration. In the event of the declaration being translated into any other language, the translator concerned shall be liable for the correctness of the translation

**Declaration of conformity**



**ATEX Directive**  
 EN60079-0:2012/A11:2013

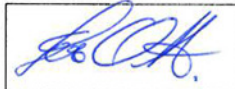
EN60079-1:2014

**2014/34/EU**  
 Electrical apparatus for explosive gas atmospheres-part 0: General requirements  
 Electrical apparatus for explosive gas atmospheres-part 1: Flameproof enclosures "d"

**EMC Directive**  
 EN61000-6-4:2007/A1:2011

EN61000-6-2:2005


**2014/30/EU**  
 Electromagnetic compatibility - Emissions  
 Electromagnetic compatibility - Immunity

Date 2017.02.07	Issued by <b>Lars Althof</b> Director R&D Engineering	Date 2017.02.07	Approved by <b>Lars Otten</b>  Senior Director Global R&D & Eng
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Danfoss only vouches for the correctness of the English version of this declaration. In the event of the declaration being translated into any other language, the translator concerned shall be liable for the correctness of the translation

**Certificates**

**EU-Type Examination Certificate**



# EU-Type Examination Certificate

[2] **EQUIPMENT OR PROTECTIVE SYSTEM INTENDED FOR USE IN POTENTIALLY EXPLOSIVE ATMOSPHERES DIRECTIVE 2014/34/EU**

[3] **EU-Type Examination Certificate Number:** Presafe 14 ATEX 5153X Issue 2

[4] **Product:** Electrohydraulic actuator for proportional valve

[5] **Manufacturer:** Danfoss Power Solutions ApS

[6] **Address:** Nordborgvej 81, DK-6430 Nordborg, Denmark

[7] **This product and any acceptable variation thereto is specified in the schedule to this certificate and the documents therein referred to.**

[8] **DNV Nemko Presafe AS, notified body number 2460, in accordance with Article 17 of Directive 2014/34/EU of the European Parliament and of the Council, dated 26 February 2014, certifies that this product has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of products intended for use in potentially explosive atmospheres given in Annex II to the Directive.**  
 The examination and test results are recorded in confidential reports listed in section 16.


[9] **Compliance with the Essential Health and Safety Requirements has been assured by compliance with:**  
 EN 60079-0:2012/A11:2013, EN 60079-1:2014.


[10] **If the sign "X" is placed after the certificate number, it indicates that the product is subject to the Specific Conditions of Use specified in the schedule to this certificate.**

[11] **This EU - TYPE EXAMINATION CERTIFICATE relates only to the design and construction of the specified product. Further requirements of the Directive apply to the manufacturing process and supply of this product. These are not covered by this certificate.**

[12] **The marking of the product shall include the following:**

⊕	I M2	Ex db I Mb, Ta -40°C to +60°C
	II 2 G	Ex db IIB T5 Gb, Ta -40°C to +60°C

  
 Asle Kaastad  
 For DNV Nemko Presafe AS  
Information on electronic signature [www.presafe.com](http://www.presafe.com)



Date of issue: 2016-12-21


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

DNV Nemko Presafe AS, Gaustadalléen 30, 0373 Oslo, Norway

1 of 3



**Certificates**



# EU-Type Examination Certificate

**[13]**

**Schedule**

**[14]**

**EU-TYPE EXAMINATION CERTIFICATE No.:** Presafe 14 ATEX 5153 X

Issue 2

**[15]**

**Description of Product**

Electrohydraulic actuator PVEx-yy-Ex is used for proportional valves. It is protected with flameproof enclosure. It consists of "housing", "housing top", "base plate", "valve block" with solenoid valves, "LVDT tube" and "PVG valve" fixed together by special fasteners. PVG valve isn't included in the models without "LVD tube (PVEO-EX-12V, PVEO-EX-24V, PVEO120-EX-24V).

"Valve Block", "Base plate", "SD cable gland" are made from (carbon steel), Housing and Housing top made from cast iron with Zn plating (Cr3)12 µm. Enclosure is additionally protected against corrosion by coating of non-metallic layer.

Enclosure is provided with one threaded entry M20x1.5 located in "housing top. It is originally supplied with (integrated) "SD" cable glands certified as part of enclosure but it is also approved as threaded hole for pre-certified cable glands.

**Type identification designation:**

Type Designation	Applicable models	
PVEx – yy - EX	<u>Group I</u>	<u>Group II B</u>
	PVEO-EX-12V	PVEO-EX-24V
	PVEO-EX-24V	PVEH-EX
	PVEO-DI-EX-24V	PVES-EX
	PVEH-DI-EX	PVEH-U-EX
	PVEH120-DI-EX	PVES-U-EX
	PVEO120-DI-EX-12V	PVEO120-EX-24V
	PVES120-EX	
	PVES120-U-EX	
	PVEH120-EX	

**Electrical Data**  
 Voltage: 11-30 V DC  
 Current: 0.33 A

**Ambient temperature range:**  
 -40°C to +60°C

**Routine tests**  
 N/A.

**[16]**

**Report No.:** D0002643

DNV Nemko Presafe AS, Gaustadalléen 30, 0373 Oslo, Norway

2 of 3

**Certificates**



# EU-Type Examination Certificate

Presafe 14 ATEX 5153 X, Issue 2

**[17] Specific Conditions of Use**

"X" - The flameproof joints not intended to be repaired.

"X" - Originally supplied "SD cable glands" may not provide sufficient clamping. User shall provide additional clamping of the cable to ensure that pulling and twisting is not transmitted to the terminations.

"X" - Fasteners used for enclosure shall be made from stainless steel grade A4 or stronger (yield stress 210Mpa).

**[18] Essential Health and Safety Requirements**

Essential Health and Safety Requirements (EHSRs) are covered by the standards listed at item 9

**[19] Drawings and documents**

Number	Title	Rev.	Date
DWG12065175	PVE32-LVDT-Ex d	I	2016-12-09
DWG12065459	PVE32-NO LVDT-Ex d	H	2016-12-09
DWG12065565	PVE120-No LVDT-Ex d	H	2016-12-09
DWG12068468	PVE120- LVDT-Ex d	F	2016-12-09
DOC12065362	PVEx-EX d Group I plate marking	03	2016-12-13
DOC12065363	PVEx-EX d Group II plate marking	03	2016-12-13

**[20] Certificate History**

Issue	Description	Issue date	Report no.
0	Original issue	2014-12-15	D0001015
1	Design change regarding the flameproof joints dimension and "SD cable gland", two new models.	2015-08-21	D0001015
2	Update according to latest standards issues, minor documentation change	2016-12-21	D0001015

END OF CERTIFICATE

## Certificates

### IECEX Certificate of Conformity

IEC		IECEX		IECEX Certificate of Conformity	
INTERNATIONAL ELECTROTECHNICAL COMMISSION IEC Certification Scheme for Explosive Atmospheres <small>for rules and details of the IECEx Scheme visit www.iecex.com</small>					
Certificate No.:	IECEx PSE 14 0056X	Issue No. 2	Certificate history	Issue No. 2 (2015-12-21)	Issue No. 1 (2015-08-21)
Status:	Current	Page 1 of 4	Issue No. 2 (2015-12-21)	Issue No. 1 (2015-08-21)	Issue No. 0 (2014-12-18)
Date of Issue:	2016-12-21				
Applicant:	DANFOSS POWER SOLUTIONS ApS Nordborgvej 81 DK-6050 Randers Denmark				
Equipment:	Electrohydraulic actuator for proportional valve				
Optional accessory:					
Type of Protection:	Exd				
Marking:	Ex d I Mb, -40°C + T amb + 120°C Ex d II 1G Db, -40°C + T amb + 120°C				
Approved for issue on behalf of the IECEx:	Aale Kjaerstad				
Certification Body:	DNV Norske				
Position:	Certification Manager				
Signature: (for printed version)					
Date:	2016-12-21				
1. This certificate and schedule may only be reproduced in full. 2. This certificate is not transferable and remains the property of the issuing body. 3. The Status and Authenticity of this certificate may be verified by visiting the Official IECEx Website.					
Certificates issued by:	DNV Norske Porselund AS Ousestrømsveien 50 P.O. Box 73 Blindern 0214 Oslo Norway				


Certificates

		<b>IECEX Certificate of Conformity</b>	
Certificate No:	IECEX PRE 14.0008X	Issue No:	2
Date of Issue:	2016-12-21	Page 2 of 4	
Manufacturer:	<b>DANFOSS POWER SOLUTIONS ApS</b> Nordborgvej 81 DK-6430 Nordborg Denmark		
Additional Manufacturing location(s):			
This certificate is issued as verification that a sample(s), representative of production, was assessed and tested and found to comply with the IEC Standard list below and that the manufacturer's quality system, relating to the Ex products covered by this certificate, was assessed and found to comply with the IECEX Quality system requirements. This certificate is granted subject to the conditions as set out in IECEX Scheme Rules, IECEX 02 and Operational Documents as amended.			
<b>STANDARDS:</b> The electrical apparatus and any acceptable variations to it specified in the schedule of this certificate and the identified documents, was found to comply with the following standards:			
IEC 60079-0 : 2011 Edition: 6.0	Explosive atmospheres - Part 0: General requirements		
IEC 60079-1 : 2014-06 Edition: 7.0	Explosive atmospheres - Part 1: Equipment protection by flameproof enclosures "d"		
<i>This Certificate does not indicate compliance with electrical safety and performance requirements other than those expressly included in the Standards listed above.</i>			
<b>TEST &amp; ASSESSMENT REPORTS:</b> A sample(s) of the equipment listed has successfully met the examination and test requirements as recorded in			
<u>Test Report:</u> <a href="#">NO/PRE/EXTR14.0009/02</a>			
<u>Quality Assessment Report:</u> <a href="#">NO/NEM/QAR13.0010/02</a>			

**Certificates**

		<h2>IECEX Certificate of Conformity</h2>
Certificate No:	IECEX PRE 14.0008X	Issue No: 2
Date of Issue:	2016-12-21	Page 3 of 4
<b>Schedule</b>		
<b>EQUIPMENT:</b>		
<i>Equipment and systems covered by this certificate are as follows:</i>		
<p>Electrohydraulic actuator PVEx-yy-EX is flameproof enclosure used for proportional valves.</p> <p>It consist of "housing", "housing top", "base plate", "valve block" with solenoid valves, "LVDT tube" and "PVG valve" fixed together by special fasteners. PVG valve isn't included in the models without "LVDT tube (PVEO-EX-12V, PVEO-EX-24V, PVEO120-EX-24V). "Valve Block", "Base plate", "SD cable gland" are made from (carbon steel), Housing and Housing top made from cast iron with Zn plating (Cr3)12 µm. Enclosure is additionally protected against corrosion by coating of non-metallic layer. Enclosure is provided with one threaded entry M20x1.5 located in "housing top. It is originally supplied with (integrated) "SD" cable gland certified as part of enclosure but it is also approved as threaded hole for pre-certified cable gland.  <b>Type designation:</b> PVEx - yy - EX</p>		
<p>Applicable models:</p> <p>Group I - PVEO-EX-12V, PVEO-EX-24V, PVEO-DI-EX-24, PVEH-DI-EX, PVEH120-DI-EX, PVEO120-DI-EX-12V</p> <p>Group II - PVEH-EX, PVES-EX, PVEH-U-EX, PVES-U-EX, PVEO-EX-24V, PVEO120-EX-24V, PVES120-EX, PVES120-U-EX, PVEH120-EX</p>		
<p><b>Electrical rating:</b>  Voltage: 11-30 V DC  Current: 0.33 A  <b>Ambient temperature range:</b>  -40°C &lt; Tamb &lt; +60°C .  <b>Marking location</b>  Engraved in "Housing" surface.</p>		
<p><b>INFORMATIVE MARKING</b></p> <p>-This equipment (if using for group IIB) shall be installed so that the flanged joints are not within 30 mm of a solid object that are not part of this equipment.  -Threaded entry: M20 x 1.5  -Determined temperature at entry point is +76°C, use appropriate cables and cable gland.</p>		
<p><b>Special condition of use</b></p> <p>- To maintain the Ex protection, the instruction file which accompanies with the product shall be considered.</p>		
<p><b>CONDITIONS OF CERTIFICATION: YES as shown below:</b></p>		
<p><b>"X"-specific condition for safe use</b></p> <p>- "The flameproof joints not intended to be repaired".</p> <p>- "SD cable glands may not provide sufficient clamping. User shall provide additional clamping of the cable to ensure that pulling and twisting is not transmitted to the terminations".</p> <p>- "Fasteners used for enclosure shall be made from stainless steel grade A4 or stronger (yield stress 210 MPa)".</p>		

**Certificates**

	<b>IECEX Certificate of Conformity</b>	
Certificate No:	IECEX PRE 14.0008X	Issue No: 2
Date of Issue:	2016-12-21	Page 4 of 4
<b>DETAILS OF CERTIFICATE CHANGES (for Issues 1 and above):</b>		
Update according to newer version of standard (IEC 60079-1:2014) and minor documentation changes.		

**Certificates**

**Safety certificate J2014084**



## 矿用产品安全标志证书

### SAFETY CERTIFICATE OF APPROVAL FOR MINING PRODUCTS

安全标志编号: J2014084      有效期: 2014. 6. 3 ~ 2019. 6. 3  
APPROVAL No.      PERIOD OF VALIDITY

**单位名称:** 丹佛斯动力系统 (Danfoss Power Solutions ApS)  
COMPANY

**产品名称:** PVEH-Ex 矿用隔爆型电液比例驱动器  
NAME OF PRODUCT      PVEH-Ex mining explosion-proof electro-hydraulic proportional actuator

**使用场所:** 严格按煤矿安全有关规定使用。  
APPLICATION PLACE      Strictly using in accordance with the relevant rule for mining safety.

**执行标准:** GB3836-2010 Q/DNF0SS01-2012  
STANDARD

**备注:** 该产品配套用Dania A/S生产的11106421壳体、11106547顶部壳体、中国国泰达鸣精密机件(深圳)有限公司生产的M20X.15电缆引入装置。  
DESCRIPTION      This product use 11106421 housing and 11106547 top housing from Dania A/S, M20X1.5 cable gland from Cathy.

**发证部门**  
ISSUED BY

2014-6-3



国家安全生产监督管理总局监制

**Certificates**

**Safety certificate J2014085**



## 矿用产品安全标志证书

### SAFETY CERTIFICATE OF APPROVAL FOR MINING PRODUCTS

安全标志编号: J2014085      有效 期: 2014. 6. 3 ~ 2019. 6. 3  
APPROVAL No.                      PERIOD OF VALIDITY

**单 位 名 称:** 丹佛斯动力系统 (Danfoss Power Solutions ApS)  
COMPANY

**产 品 名 称:** PVE0-Ex 矿用隔爆型电液开/关驱动器  
NAME OF PRODUCT              PVE0-Ex mining explosion-proof electro-hydraulic on/off actuator

**使 用 场 所:** 严格按煤矿安全有关规定使用。  
APPLICATION PLACE              Strictly using in accordance with the relevant rule for mining safety.

**执 行 标 准:** GB3836-2010 Q/DNFOSS01-2012  
STANDARD

**备 注:** 该产品配套用Dania A/S生产的11106421壳体、11106547顶部壳体、中国国泰达鸣精密机件(深圳)有限公司生产的M20X.15电缆引入装置。  
DESCRIPTION                      This product use 11106421 housing and 11106547 top housing from Dania A/S, M20X1.5 cable gland from Cathy.

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