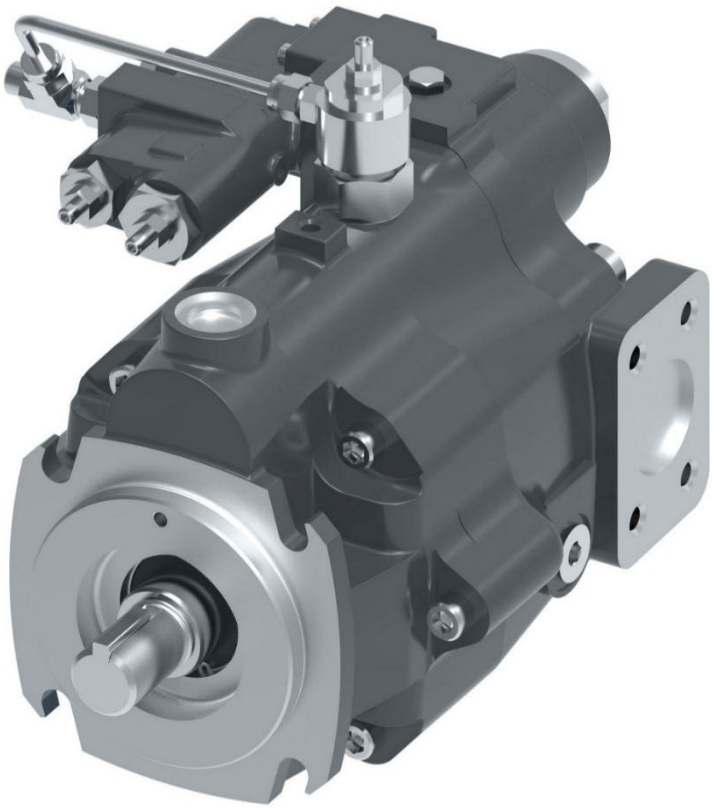
User Manual

ENGINEERING TOMORROW

Vickers® by Danfoss
PVM Variable Displacement Piston Pump

ATEX / UKEX Certified
PVM Code A & B, 18 – 141 cc



ATEX Directive 2014/34/EU

CE Ex II 3G Ex h IIC T4 Gc X

CE Ex II 3G Ex h IIC T3 Gc X

UKEX SI 2016 No. 1107

UKCA Ex II 3G Ex h IIC T4 Gc X

UKCA Ex II 3G Ex h IIC T3 Gc X

VICKERS by Danfoss

powersolutions.danfoss.com

Revision History

Table of Revisions

Date	Changed	Rev
Feb 2024	First edition	0101

Contents

Introduction

General Information

Purpose of this Document

This User Manual has been prepared by the manufacturer in order to provide important information regarding the safe installation, operation and maintenance of ATEX / UKEX certified pumps. The items set out within this document are mandatory unless stated otherwise.

This User Manual is a supplement to existing product instruction as ATEX / UKEX components are subjected to some limitations compared to standard components. The limitations are described in this instruction. Items or limitations within this document override any contradictory information which may be found in the product catalog.

It is intended for machine/system manufacturers, fitters and service technicians. Please read this User Manual carefully before you work with and start-up the pumps.

This User Manual must be stored in close proximity to the pumps.

Product Description

PVM pumps are a range of variable displacement, high power open circuit pumps designed for industrial applications. They feature a swashplate design with a maximum continuous working pressure of 315 or 230 bar. They can be supplied in “higher speed” or “quiet” versions.

Manufacturer Responsibility

The manufacturer declines any responsibility in case of:

- Use of the product not according to safety regulations and legislation valid in the user’s country.
- Use of the product in operating conditions not allowed according to the product technical information.
- Improper installation: the instructions given in this User Manual are not followed or not properly followed.
- Hydraulic system problems.
- Modification of the product.
- Operations executed by personnel not properly trained or not assigned to such a kind of operations.

Product Safety

The safety of the product depends upon the strict observation of the indications given in this User Manual: in particular, it is necessary to:

- Always operate within allowed product working operating conditions (please refer to the Technical Information of the pumps in usage).
- Always perform an accurate ordinary maintenance activity.
- Assign the inspection activity as well as maintenance activity to duly trained personnel.
- Only use original spares.
- Always use the product according to the indications you find in this manual.

Intended Use

Hydraulic pumps convert mechanical energy (torque and speed) into hydraulic energy (pressure, oil flow). PVM pumps are designed for industrial applications.

The pumps fulfill the explosion requirements of the Directive 2014/34/EU and UKEX SI 2016 No. 1107 for the category shown on the name plate within the limiting conditions mentioned within this user manual or product catalog/ technical information.

PVM pumps have an identifying name plate. The name plate provides essential information and specification for correct and safe use.

This identifying plate has to be maintained so that the data can be clearly read; consequently, a periodic cleaning of the plate is required. If the nameplate or other labels need to be removed for maintenance or service, they need to be reinstalled before the pump is being recommissioned.

Marking of Vickers by Danfoss PVM Pumps

The PVM hydraulic pumps are marked as equipment for Group II, category 3 for gas environment and with ignition protection **constructional safety** and **liquid immersion**.

Temperature class/Maximum surface temperature depends on the operating conditions (ambient and fluid temperature) as well as application duty cycles.

Marking	For model code option
Ex II 3G Ex h IIC T3 Gc X	G (see *Table 1*, page 7 for requirements)
Ex II 3G Ex h IIC T4 Gc X	G (see *Table 1*, page 7 for requirements)

For detailed information on selecting the appropriate T-Codes as well as fluid viscosity and temperature requirements, please see Chapter "*T-Codes and Maximum Surface Temperature*" on page 7.

Production Place and Date of Pump

The production location is shown on the pump label as pictured below. The date of the pumps is not shown on the pump label; however it can be determined by contacting Danfoss and providing the serial number.

The ATEX certification of the units are done under the scope of:

"Directive 2014/34/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres."

And UKEX Statutory Instruments:

"2016 No. 1107 HEALTH AND SAFETY The Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 2016"

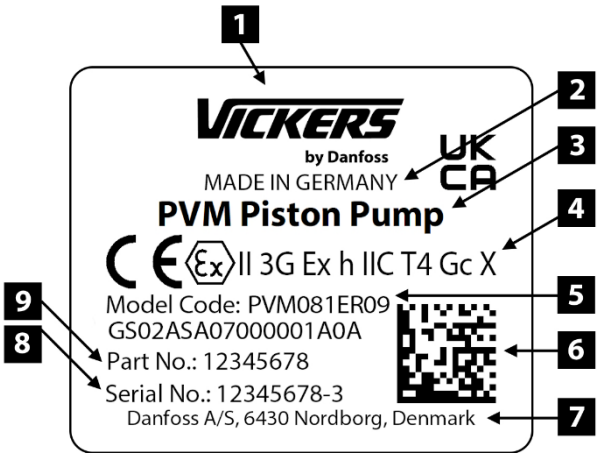
With following parameters:

- Equipment group: II, non-mining equipment
- Equipment Category: 3G
- Temperature class: T4...T1
- Gas Group: IIC
- Equipment protection level (EPL): Gc
- Resulting Zone: 2 (Gas Environment)

The Conformity Assessment Procedure must be executed according to:
/1/ Directive 2014/34/EU, annex VIII, Modul A: Internal Production Control (see article 13, section 1 (c))
/2/ UKEX SI 2016 No. 1107 Schedule 3A, Part 6: Internal Production control (see Part 3, article 39 (1)(c))

The EU declaration of conformity has to be prepared and issued with regard to annex X of */1/*. The "Essential Health and Safety Requirements" defined by */1/*, annex II, have to be considered.

The UK declaration of conformity has to be prepared and issued with regard to schedule 6 of */2/*. The "Essential Health and Safety Requirements " defined by */2/*, schedule 1, have to be considered.

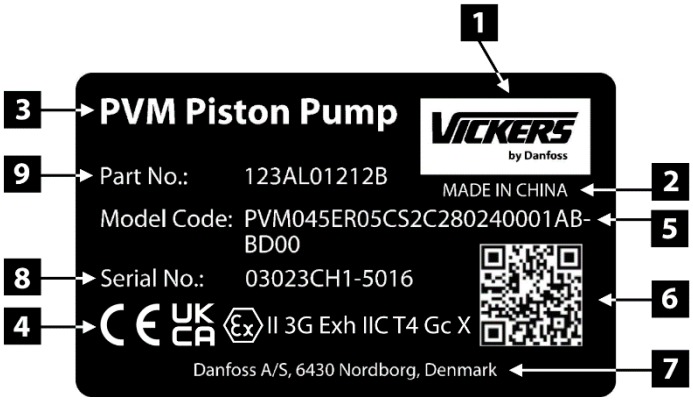


Example ATEX / UKEX Label – PVM

Legend

1. Manufacturer
2. Location of Production
3. Type/Brand Name of Product
4. ATEX / UKEX Code
5. Pump Model Code
6. 2D-Code for Identification
7. Manufacturer Address
8. Serial Number
9. Material/Part Number

Figure 1: PVM Sticker Label Example



Alternative PVM Black Anodized Aluminum Label
For legend, see label above.

Figure 2: PVM Anodized Aluminum Label Example

Warning

Avoid impact on the aluminum nameplate material to eliminate thermite sparks

Technical Information

ATEX / UKEX Technical Specifications

The technical specifications in this chapter are supplemental for ATEX / UKEX systems only. For comprehensive technical specifications, including maximum pressure rating, maximum flow, etc. please refer to the standard PVM Technical Information and Technical Catalog documents.

Danfoss does not claim responsibility for the use of the pumps in operating conditions not allowed according to the information shown in this document and the standard PVM Technical Information documents.

Painting or coating can be an electric insulator if a thickness greater than 200 µm is applied. The thickness of the painting of original DPS paint is less than 200 µm. If the customer chooses to add an additional layer of paint, the total layer thickness cannot exceed 200 µm.

The pumps are approved only for correct and proper use in accordance with their designated purpose, in standard industrial atmospheres. Contravention of such conditions voids any warranty claims and any responsibility on the part of the manufacturer.

T-Codes and Maximum Surface Temperature

Gaseous Environment (G)

Table 1: Temperature Classes at Maximum Ambient and Oil Temperatures

Maximum Oil Temperature (at Inlet)	Max. Ambient Temperature	
	≤ 40 °C ≤ 104 °F	≤ 60 °C ≤ 140 °F
≤ 20 °C [68 °F]	T4	T4
≤ 40 °C [104 °F]	T4	T4
≤ 60 °C [140 °F]	T4	T4
≤ 80 °C [176 °F]	T4	T3

Table 2: T-Codes with respective Maximum Surface Temperature

T-Code / Temperature Class	Maximum Surface Temperature	
	°C	°F
T3	200	392
T4	135	275

To ensure that the surface temperature will not exceed the allowed value according to the used temperature class, it is recommended to attach a suitable temperature sensor to the pumps in the shown area on one of the central surfaces at the bottom side of the pumps.

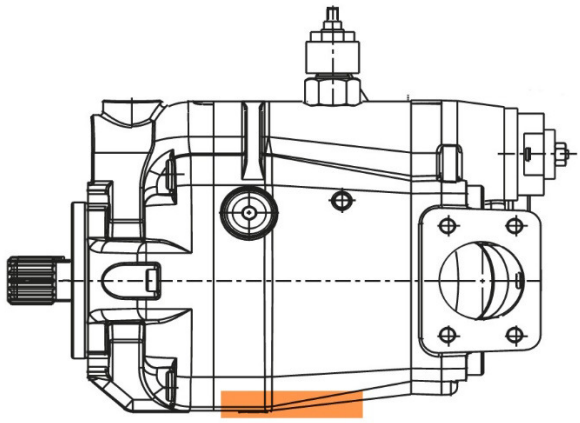


Figure 3: Recommended Location to attach Temperature Sensor

Oil Types / Operating Fluids

In a hydraulic system the most important task of the oil is to transfer energy. At the same time the oil must lubricate moving parts in hydraulic components, protect them from corrosion, and transport dirt particles and heat out of the system. To ensure that hydraulic components operate without problems and have long operating life, it is therefore vital to select the correct oil type with the necessary additives.

Ratings and performance data are based on operating with hydraulic fluids containing oxidation, rust and foam inhibitors. These fluids must possess good thermal and hydrolytic stability to prevent wear, erosion and corrosion of pump components.

Warning

It is compulsory to use oils whose inflammable degree is at least 50K above the maximum surface temperature of the pump. Maximum surface temperature for Group IIG can be found under *Table 2: T-Codes with respective Maximum Surface Temperature* on page 7.

Fluid Viscosity and Temperature for ATEX / UKEX PVM Pumps

Table 3: Fluid Viscosity and Temperature Rating of PVM ATEX / UKEX Units

Features		Data
Viscosity	Minimum Intermittent[1)]	10 mm^2/s [90 SUS]
	Recommended Range	16 – 40 mm^2/s [83 – 187 SUS]
	Maximum (Cold Start)[2)]	1000 mm^2/s [4550 SUS]
Inlet Temperature	Minimum (Cold Start)[2)]	-28 °C [-18°C]
	Maximum Rated	80 °C [176 °F]
	Maximum Intermittend[1)]	104 °C [3)] [219 °F] [3)]

[1)] Intermittent = Short term t < 3 min per incident.

[2)] Cold start = Short term t < 3 min; p ≥ 50 bar; n ≤ 1000 min^{-1} (rpm); please contact Danfoss Power Solutions especially when the temperature is below -25 °C [-13 °F].

[3)] Must not be exceeded locally either (e.g. in the bearing area) . The temperature in the bearing area is (depending on pressure and speed) up to 5 °C [41 °F] higher than the average case drain temperature.

Above maximum surface temperatures are without any deposited dust on the product. The possible insulation effect of a dust layer on the surface has to be taken into account by the safety margin to the minimum ignition temperature of the dust concerned. For up to 5 mm [1.97 in] layer thickness the safety margin is 75 °C [167 °F]. For further information please see IEC 60079-14.

Warning

The above operating temperatures (ambient and oil) of the pump must be guaranteed by the end user.

Ambient Temperature

Maximum ambient temperature depends on the requested protection class needed. Refer to *Table 1: Temperature Classes at Maximum Ambient and Oil Temperatures* on page 7.

In general, the ambient temperature should lie between -30° C [-22° F] and +60° C [140 °F] to ensure that the shaft seal retains its sealing capacity.

Oil Temperature

Maximum oil temperature depends on the requested protection class needed. Refer to *Table 1: Temperature Classes at Maximum Ambient and Oil Temperatures* on page 7.

Under normal operating conditions it is recommended to keep the temperature in the range of 30 °C [86 °F] to 60 °C [140 °F] to achieve the expected unit lifetime

Viscosity

Maintain fluid viscosity within the recommended range for maximum efficiency and bearing life.

Minimum viscosity should only occur during brief occasions of maximum ambient temperature and severe duty cycle operation. Maximum viscosity should only occur at cold start. Limit speeds until the system warms up.

See *Table 3: Fluid Viscosity and Temperature Rating of PVM ATEX / UKEX Units* on page 8 for viscosity rating and limitations.

We recommend the use of an oil type having a viscosity of 16 – 40 mm^2/s [83 – 187 SUS] at the actual operating temperature.

Filtering

It is necessary to keep the level of oil contamination at an acceptable level to ensure problem-free operation. The recommended maximum level of contamination in systems in the hydraulic pumps is 20/18/13 (ISO 4406-1999). Further information can be found in the pump's technical catalog.

Installation, Operation and Maintenance

Installation, Commissioning and General Operation of ATEX / UKEX PVM Pumps

When assembling the pump in the machine/system it is the builder's responsibility that the parts used conform to the ATEX directive or UKEX statutory instruments and that the components are assembled and running according to the operational data/design found in product data sheets and instructions.

Only use the pump as required by the explosion protection shown on the name plate.

Always ensure that the following is maintained:

- The ambient conditions specified in this manual are maintained.
- The pump may only be operated with the housing fully mounted, unopened and in an undamaged condition.
- The pump must be installed per specific orientation as specified within the pump catalog. The pump should be mounted in such a way, so that the case drain port is on the top of the pump.
- The supporting frame, chassis, or structure of equipment containing the pump shall be constructed of electrically conducting material and shall be so arranged as to provide a leakage path to earth (ground) for any static electricity which occurs on the pump.

  If this is not possible, a grounding wire needs to be attached to the pump housing. Consult Danfoss for recommendations on connection placement.
- The pump is approved for operation with the selected hydraulic fluid.
- It is compulsory to use oils whose inflammable degree is at least 50K above the maximum surface temperature of the pump according to the temperature classification (T4, T3…).
- The hydraulic fluid must be filtered to ensure the cleanliness stated above.
- All types of accessories installed on the pump are ATEX / UKEX specified and have been installed in accordance with ATEX / UKEX requirements.
- There are no creeping metal elements external to the pump.
- There are no plastic parts that might accumulate electrostatic; or they are shielded.
- The **inlet and case drain oil and ambient temperature is monitored** to not exceed the maximum permissible for the category and temperature class of the associated zone. The system must shut down if the case drain oil temperature exceeds 118 °C [245 °F] or inlet temperatures exceed the limits stated within this manual.
- The pump may only be operated when fully primed and filled with oil. An active oil level alarm shall be used. The system should safely shut down in the event of a low oil alarm.
- The pump must be protected against overloading and over-speeding using suitable measures. This includes the installation of pressure-relief valves to prevent the pump from exceeding the maximum allowable pressures as given by the catalog.
- For applications where running the pump for extended periods (>3 min) at "high-pressure – low flow" (e.g. pressure compensated stand-by) conditions cannot be avoided, it is highly recommended to install case flushing. Consult Danfoss representative for advice.

Manufacture the assembly flange on the machine/system where the pump has to be installed: the relevant surface has to be perfectly smooth, completely de-greased and non-deforming. Coupling and protection elements shall meet the material requirements relevant to the respective ATEX / UKEX requirements (e.g. avoiding magnesium, titanium, zirconium)

It is necessary to verify the perfect alignment between the prime mover (e.g. engine/ e-motor) output shaft and the pump – the fitment between pump shaft and prime mover shaft must be executed so that no radial or axial pre-load is generated – these extra loads reduce the bearings expected lifetime and can increase heat generation.

Start-Up Procedure

The purpose of this section is to indicate the necessary procedures to perform the pump start-up.

Pre-Start-Up Controls for PVM Pump

Before performing the first pump start up, the following points have to be checked.

Hydraulic components must be installed in accordance with their individual instruction.

1. To avoid contamination, plastic plugs in connection ports must not be removed until just before connections are made. All inlet connections must be tight to prevent air leaks.
2. Select the hydraulic fluid as specified in the product catalog.
3. Make sure the reservoir and circuit are clean and free of dirt/debris prior to filling with hydraulic fluid. Fill the reservoir with filtered oil to a sufficient level to prevent vortexing at suction connection to pump inlet. (It is good practice to clean the system by flushing and filtering using an external pump prior to first start-up)
4. Make sure the pumps hydraulic connections allow the pumps to rotate in the desired direction. For pumps with direction of rotation:

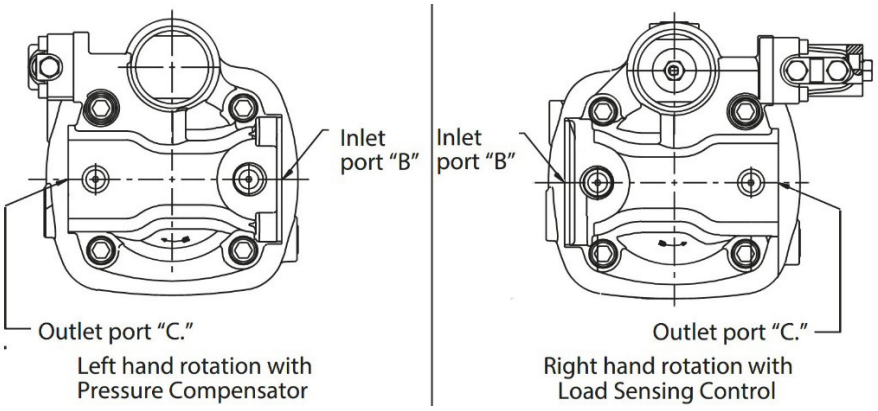


Figure 4: PVM (side-ported) Back View, Port Configuration LH/RH

Generic illustration shown (here PVM131/141 side-ported)

5. Ensure full contact between pump mounting flange and prime mover.

Avoid pressing the pumps into place by tightening the fixing bolts. Avoid unsuitable seal materials, for example, twine and Teflon, on threaded unions. Use only the seals supplied, such as O-rings, steel washers.

6. Make sure that all couplings are completely tightened to prevent leakage.

   Do not use more torque than the maximum values given in the instructions.
7. Before the pump is started, fill the case through the uppermost drain port with hydraulic fluid of the type to be used. The case drain line must be connected directly to the reservoir and must terminate below the oil level.
8. Check to make sure the purity of the oil is greater than 20/18/13 (ISO 4406-1999) and always use a filter when replenishing the system.

Warning

The pumps must be filled with fluid prior to any load applications

First Start-Up

1. Make sure the reservoir and pump housing are filled with fluid and the inlet and outlet lines are open and unobstructed.
2. Start the prime mover at reduced speed. Once the pump is started it should prime within a few seconds.

   If the pump does not prime, check to make sure that there are no restrictions between the reservoir and the inlet to the pump, that the pump is being rotated in the proper direction, and that there are no air leaks in the inlet line and connections. Also check to make sure that trapped air can escape at the pump outlet.
3. After the pump is primed, operate for five to ten minutes (unloaded) to remove all trapped air from the circuit.

   If the reservoir has a sight gage, make sure the fluid is clear – not milky.
4. To assure best pump performance, run the pump for approximately one hour at 30% of rated pressure and speed before running at full load.

   When running make sure the pump and oil temperature and noise level are sufficiently low. High temperature or noise level might be symptoms of unforeseen operation conditions that have to be analyzed and cleared.
5. Check for system leakage and make sure the system is operating satisfactorily.
6. To ensure that the contamination in the hydraulic system does not damage the pump; the following procedure is recommended after a brief period in operation:
   a. After a brief period in operation, have a hydraulic fluid specimen analyzed for the required cleanliness level.
   b. Replace oil filter or change the hydraulic fluid if the required cleanliness level is not reached.

Operational checks

The product is a component which requires no settings or changes during operation.

The machine/system manufacturer is responsible for the proper project planning of the hydraulic system and its control.

Danfoss recommends ongoing tests for optimal pump performance.

1. Continuously verify that the temperature of the ambient and the operating oil are those initially determined.
2. Do not subject the pumps to pressure, pressure drop or speeds exceeding the maximum values stated in the appropriate catalogs.
3. Filter the oil to maintain the grade of contamination at 20/18/13 (ISO 4406-1999) or better.

Maintenance

Warning

If maintenance has to be performed in an explosive and hazardous atmosphere, an anti-sparking safety tool must be used.

Maintenance measures involving disassembly or opening of the pump must only be carried out in non-explosive atmospheres.

Prior to loosening any connection of the hydraulic system, ensure the residual pressure has been removed from the system in a safe manner.

With hydraulic systems the main criterion for reliability and operating life is very thorough regularly maintenance.

Regularly check the system for presence of leakage and the oil level. The equipment must be regularly serviced and cleaned in the explosive atmosphere. The intervals are specified by the operator on-site in accordance with the environmental impact to which the equipment is exposed.

During system's function, it is necessary regularly to verify that the temperature of the ambient and the operating oil are those initially determined. Replenish and change the oil, the oil and air filters as stated in the respective instructions.

Regularly check the condition of the oil – viscosity, oxidation, filtration level etc:

Viscosity — Verify that the viscosity level is within the recommended values as indicated in *Table 3: Fluid Viscosity and Temperature Rating of PVM ATEX / UKEX Units* on page 8.

Oxidation — Mineral oil gets oxidized proportional to the usage degree and operating temperature. The oxidation of oil is evident because of its change of color, bad smell, acidity increase and because of the generation of sludge inside the tank. In case symptoms of this kind are detected, the system oil must be immediately changed.

Water presence — The presence of water inside oil can be determined by taking oil samples from the bed of the oil tank: oil floats on water, if present, water tends to stay on the tank's bed. If its presence is determined, water must be regularly purged. Presence of water in the hydraulic system can severely damage the pump.

Degree of contamination — A high degree of contamination of the operating oil causes a severe wear of all hydraulic components: for this reason, the cause of the contamination must be identified and eliminated. In order to avoid mixing of different oils, when replacing the operating fluid. It is necessary to empty all the machinery and pipes, clean them carefully and clean the tank.

Recommended Check Activities

Activity	Visual Check[1] Monthly	Close-Up Check[1] Every 6 Months or 4000hr	Detailed Check[1] Every 12 Months or 8000hr
Visual check pump for leaks, remove dust/dirt/debris deposits	●		N/A
Check external temperature of the pump using suitable measuring aids to ensure it is below 125°C [257°F] when pump is operating at cut-off		●[2]	N/A

[1] Definitions of terms as per IEC 60079-17
[2] Not necessary if monitored by recommended surface temperature sensor

Service and Repair

Only Authorized Service Centers or Danfoss Technicians may perform repairs specified in the Service Manual.

The pump shall be overhauled or replaced prior to reaching the anticipated operating life as specified within the product catalog. For specific application inquiries contact Danfoss Technical Support.

Pump components may only be replaced by genuine original Danfoss service parts which are also approved for use in explosive atmospheres. This also applies to the lubricants and service products used.

In case a service or repair intervention on the pumps is required, it must be performed according to the information shown in below mentioned Service Manual.

The Service Manual includes the spare part list and information about how dismantling and assembling of the pumps is done properly.

See *PVM Piston Pumps Service Manual;* Literature Number: *AX445454003735en-000101*

Safety Precautions

Always consider safety precautions before beginning a service procedure. Protect yourself and others from injury. Take the following general precautions whenever servicing a hydraulic system.

Tools

Warning

It is compulsory to use anti sparking safety tools in case the service/repair activity has to be performed in explosive hazardous atmosphere.

Sparking from External Impacts

Warning

Avoid impact on the aluminum nameplate material to eliminate risk of thermite sparks. Only applicable if aluminum nameplate is used.

Unintended Machine Movement

Warning

Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. To protect against unintended movement, secure the machine or disable/disconnect the mechanism while servicing. Follow the manufacturers instructions for securing the machine.

Personal Safety

Warning

Protect yourself from injury. Use proper safety equipment, including safety glasses, at all times.

Hot Surfaces

Warning

The pump surface temperature may exceed 70°C [158°F] during operation and after system power-down. Precautions should be taken to prevent accidental skin contact.

Flammable Cleaning Solvents

Warning

Some cleaning solvents are flammable. To avoid possible fire, do not use cleaning solvents in an area where a source of ignition may be present

Fluid Under Pressure

Warning

Escaping hydraulic fluid under pressure can have sufficient force to penetrate your skin causing serious injury and/or infection. This fluid may also be hot enough to cause burns. Use caution when dealing with hydraulic fluid under pressure. Relieve pressure in the system before removing hoses, fittings, gauges, or components. Never use your hand or any other body part to check for leaks in a pressurized line. Seek medical attention immediately if you are cut by hydraulic fluid.

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