

User Manual

ATEX instruction for OMT and OMV Special conditions for safe use



Revision history*Table of revisions*

Date	Changed	Rev
June 2021	Removed obsolete products	0301
February 2021	Added UK Importer section	0105
February 2020	Major revision	0104
September 2016	Minor updates	0103
March 2016	Minor updates	0102
April 2015	First edition	AA

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Declaration

UK Importer

Danfoss Power Solutions Ltd., Oxford Road, Denham, UB9 4LH, UK

Introduction OMT and OMV

This documentation applies to the following products:

- Hydraulic Orbital Motor type OMT and OMTS
- Hydraulic Orbital Motor type OMV and OMVS

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 certified motors.

This User Manual is a supplement to existing product instruction as ATEX components are subjected to some limitations compared to standard components. The limitations are described in this ATEX instruction.

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 motor.

This User Manual must lie close to the motor.

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 documentation.
- 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 motor 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 motor converts hydraulic energy (pressure, oil flow) into mechanical energy (torque and speed). They are designed for mobile and stationary applications.

The motors fulfill the explosion requirements with the Directive 2014/34/EU for the category shown on the name plate.

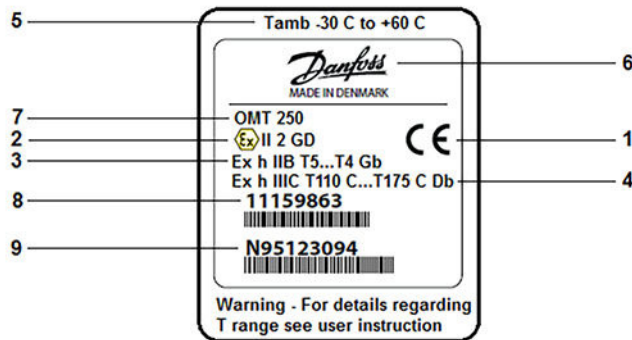
The OMT and OMV motors have an identifying name plate. The name plate provides essential information and specification for correct and safe use.

This identifying plate has to be maintained so that the data can be clearly read; consequently, a periodic cleaning of the plate is required.

Introduction OMT and OMV

Marking of Danfoss motors

The Danfoss OMT/V motors are marked for application in gaseous and dusty environments according to the below:



Key to label image:

1. CE Conformity marking
2. EU marking (per 2014/34/EU) - Directive part

Description	EU Marking
CE conformity marking	CE
Explosion protection marking	
Equipment group	II
Equipment Category	2G / 2D

3. EU marking (per EN ISO 80078-36.2016 Standard part)

Description		EU Marking	
Protection principle		h	
Explosion protection marking		Ex	
Equipment group		II / III	
Equipment protection level (EPL)		Gb / Db	
T-class	OMT	Gas	T5...T4
		Dust	T110°C...T175°C
	OMTS	Gas	T5...T4
		Dust	T75°C...T125°C
	OMV	Gas	T5...T4
		Dust	T120°C...T190°C
	OMVS	Gas	T5...T4
		Dust	T75°C...T125°C

EPL/Equipment category

Definition	Level of protection	Typical zone of application	EN ISO		EU	
			EPL	Group	Category	Group
Gas atmosphere	Very high	0	Ga	II	1G	II
	High	1	Gb		2G	
	Enhanced	2	Gc		3G	

Introduction OMT and OMV

EPL/Equipment category (continued)

Definition	Level of protection	Typical zone of application	EN ISO		EU	
			EPL	Group	Category	Group
Dust atmosphere	Very high	20	Da	III	1D	II
	High	21	Db		2D	
	Enhanced	22	Dc		3D	

- 4. See item 3
- 5. Min and max ambient temperature (See [T codes and maximum surface temperature for OMT and OMV motors](#) on page 8).
- 6. Manufacturer
- 7. Motor type and displacement
- 8. Code number
- 9. Production number, date, and series number

Example of item 9: **N95123094**

- N** Manufacturing location (N = Nordborg)
- 9** Year 2019
- 51** Week 51
- 2** Tuesday (1 = Monday)
- 3094** Consecutive number

Introduction OMT and OMV

T codes and maximum surface temperature for OMT and OMV motors

T codes for OMT motors – Gaseous environment (Group II)

OMT motors - Maximum fluid and ambient temperature

Maximum oil temperature	Maximum ambient temperature		
	≤ 20 °C [68 °F]	≤ 40 °C [104 °F]	≤ 60 °C [140 °F]
≤ 40 °C [104 °F]	T5	T5	T4
≤ 60 °C [140 °F]	T5	T4	T4
≤ 80 °C [176 °F]	T4	T4	T4

OMTS motors (short motor) - Maximum fluid and ambient temperature

Maximum oil temperature	Maximum ambient temperature		
	≤ 20 °C [68 °F]	≤ 40 °C [104 °F]	≤ 60 °C [140 °F]
≤ 40 °C [104 °F]	T5	T5	T5
≤ 60 °C [140 °F]	T5	T4	T4
≤ 80 °C [176 °F]	T4	T4	T4

T codes for OMV motors – Gaseous environment (Group II)

OMV motors - Maximum fluid and ambient temperature

Maximum oil temperature	Maximum ambient temperature		
	≤ 20 °C [68 °F]	≤ 40 °C [104 °F]	≤ 60 °C [140 °F]
≤ 40 °C [104 °F]	T5	T5	T4
≤ 60 °C [140 °F]	T4	T4	T4
≤ 80 °C [176 °F]	T4	T4	T4

OMVS motors (short motor) - Maximum fluid and ambient temperature

Maximum oil temperature	Maximum ambient temperature		
	≤ 20 °C [68 °F]	≤ 40 °C [104 °F]	≤ 60 °C [140 °F]
≤ 40 °C [104 °F]	T5	T5	T5
≤ 60 °C [140 °F]	T5	T4	T4
≤ 80 °C [176 °F]	T4	T4	T4

Classification of maximum surface temperatures for Group II equipment

Temperature class	Maximum surface temperature	
	°C	[°F]
T3	200	[392]
T4	135	[275]
T5	100	[212]

For Group II with T4 classification it is acceptable that small surface areas (total areas ≥ 20 mm² and ≤ 1000 mm²) can have surface temperature up to 200 °C.

For T5 classification it is acceptable that small surface areas (total areas ≤ 1000 mm²) can have surface temperature up to 150 °C.

Introduction OMT and OMV

Maximum surface temperature – Dusty environment (Group III)

OMT motors - Maximum surface temperatures

Maximum oil temperature	Maximum ambient temperature		
	≤ 20 °C [68 °F]	≤ 40 °C [104 °F]	≤ 60 °C [140 °F]
≤ 40 °C [104 °F]	110 [230]	130 [266]	150 [302]
≤ 60 °C [140 °F]	120 [248]	140 [284]	160 [320]
≤ 80 °C [176 °F]	135 [275]	155 [311]	175 [347]

OMTS motors (short motor) - Maximum surface temperature

Maximum oil temperature	Maximum ambient temperature		
	≤ 20 °C [68 °F]	≤ 40 °C [104 °F]	≤ 60 °C [140 °F]
≤ 40 °C [104 °F]	75 [167]	85 [185]	95 [203]
≤ 60 °C [140 °F]	90 [194]	100 [212]	110 [230]
≤ 80 °C [176 °F]	105 [221]	115 [239]	125 [257]

OMV motors - Maximum surface temperatures

Maximum oil temperature	Maximum ambient temperature		
	≤ 20 °C [68 °F]	≤ 40 °C [104 °F]	≤ 60 °C [140 °F]
≤ 40 °C [104 °F]	120 [248]	140 [284]	160 [320]
≤ 60 °C [140 °F]	135 [275]	155 [311]	175 [347]
≤ 80 °C [176 °F]	150 [302]	170 [338]	190 [374]

OMVS motors (short motor) - Maximum surface temperature

Maximum oil temperature	Maximum ambient temperature		
	≤ 20 °C [68 °F]	≤ 40 °C [104 °F]	≤ 60 °C [140 °F]
≤ 40 °C [104 °F]	75 [167]	85 [185]	95 [203]
≤ 60 °C [140 °F]	90 [194]	100 [212]	110 [230]
≤ 80 °C [176 °F]	105 [221]	115 [239]	125 [257]

Above maximum surface temperatures are without any deposited dust on the motors. 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 motor must be guaranteed by the end user.

⚠ Warning

It is compulsory to use oils whose inflammable degree is at least 50K above the maximum surface temperature of the motor. See also *Oil types / Operating fluids* on page 12

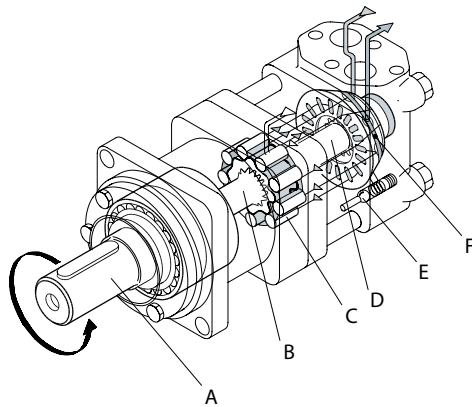
Technical information

Product description

Operating principle for OMT and OMV motors

Hydraulic orbital motors convert hydraulic energy (pressure, oil flow) into mechanical energy (torque and speed). The orbital motors are of fixed displacement high-torque design. For a given oil flow and given pressure the displacement (size of motor) determines the speed and torque. For a given displacement (size of motor) the speed is determined by the oil flow rate and the torque is determined by the pressure differential.

The operating principle of the motor is based on an internal gear design, consisting of a fixed external gear reaching against an internal gear through which the output torque and speed are transmitted. The distributor valve in OMT and OMV motors is of the disc valve design which is driven synchronously by the internal gear through a cardan shaft ensuring that the individual chambers of the motor are filled and emptied precisely.



151-1053.10

- A:** Output shaft
- B:** Cardan shaft
- C:** Gearwheel set
- D:** Valve drive
- E:** Check valve
- F:** Disc valve

All parts included in the motors are designed to provide long service life, i.e. long service life with high efficiency and a minimum level of required service.

Technical specification for OMT and OMV motors

All necessary design information for instance maximum pressure rating, maximum flow, maximum radial load etc. is provided in the Technical Information catalogues.

Relevant literature

Title	Document number
OMT and OMV Technical Information	BC152886483862

The rated data which we publish in our Technical Information is based on the use of premium mineral based hydraulic oil with a viscosity of 35 mm²/s.

Technical information

Danfoss declines any responsibility in case of use of the motor in operating conditions not allowed according to the information shown in this User Manual and above Technical Information.

Technical information

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 motor components.

Mineral oils for OMT and OMV motors

For systems containing mineral hydraulic oil with anti-wear additives, type HLP [DIN 51524] or HM (ISO 11158) **must be used**.

Mineral oils without anti-wear additives or engine oils can also be used, provided operating conditions are suitable.

Warning

It is compulsory to use oils whose inflammable degree is at least 50K above the maximum surface temperature of the motor. Maximum surface temperature can be found under: [T codes and maximum surface temperature for OMT and OMV motors](#) on page 8.

Mixing oils of different brands or different oils of the same brand may lead to the formation of sediment and sludge. Consequently a rapid, irreversible deterioration of the system is induced.

Temperature and viscosity

Ambient temperature

Maximum ambient temperature depends on the requested ATEX class needed – please see [T codes and maximum surface temperature for OMT and OMV motors](#) on page 8.

In general, the ambient temperature should be between -30 °C [-22 °F] and +60 °C [+140 °F].

Oil temperature

Maximum oil temperature depends on the requested ATEX class needed. See [T codes and maximum surface temperature for OMT and OMV motors](#) on page 8.

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

Fluid temperature affects the viscosity of the fluid and resulting lubricity and film thickness. High temperatures can also limit seal life, at most nonmetallic materials are adversely affected by use at elevated temperatures.

Fluids may break down or oxidize at high temperature, reducing their lubricity and resulting in reduced life of the unit. Oil life is greatly reduced if its temperature exceeds +60 °C [+140 °F]. As a general rule, oil life is halved for each 8 °C [46 °F] its temperature exceeds +60 °C [+140 °F].

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.

Technical information

Fluid viscosity limits

Conditions	mm ² /s (cSt)	SUS
Minimum	12	66
Continuous	20 - 80	98 - 370
Maximum	1500	6950

We recommend the use of an oil type having a viscosity of 35 mm²/s 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 motor is 22/20/16 (ISO 4406-1999).

Painting of the motor

Warning

ATEX certified motors are without painting. In case of additional painting of the motor please make sure that the thickness is in accordance with the relevant standards.

Installation, operation and maintenance

This section is intended for personnel assigned to install the motor on the machine or system for which the unit has been purchased. Therefore the importance of this section is emphasized since the optimum operation of group machine/system – motor is the consequence of correct assembly of the parts; the correct installation will limit the sources of danger for people working near to the structure.

Installation

Installation of OMT and OMV motor to the system

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

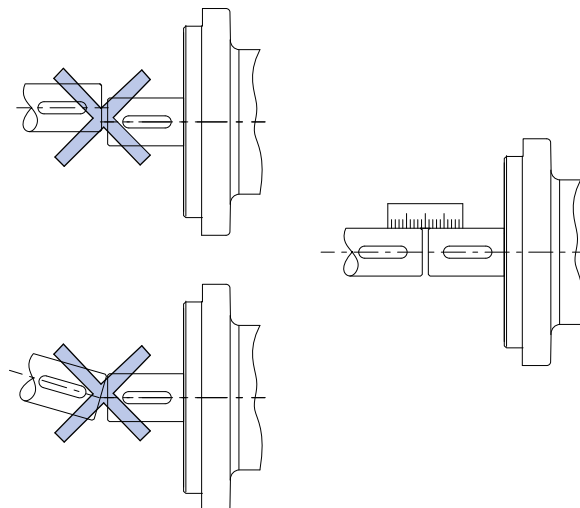
Only use the motor as required by the explosion protection shown on the name plate.

Always ensure that the following is maintained:

- The supporting frame, chassis, or structure of equipment containing the motor 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 motor.
- It is compulsory to use oils whose inflammable degree is at least 50K above the maximum surface temperature of the motor. Maximum surface temperature for Group II and III can be found under [T codes and maximum surface temperature for OMT and OMV motors](#) on page 8.
- Make sure that all type of accessory installed on the motor are ATEX certified and have been installed in accordance with ATEX requirements.
- There are no creeping metal elements external to the motor.
- There are no plastic parts that might accumulate electrostatic; or they are shielded.
- The maximum permissible oil and ambient temperature is monitored and not exceeded for the category and temperature class of the associated zone.
- For installation in zones 21 and 22 the user has to adopt a scheduled periodic clearing plan of the motor surface and recesses to prevent more than 5 mm thickness of dust deposits.

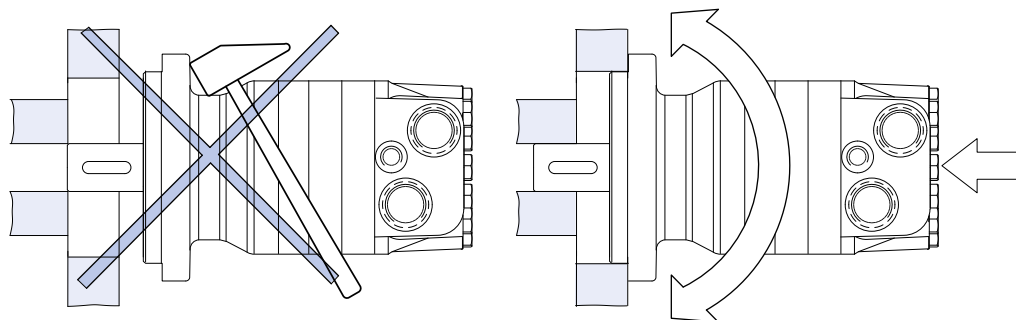
Regarding the assembly flange on the machine/system where the motor has to be installed: the relevant surface has to be perfectly smooth, completely de-greased and non-deforming.

It is necessary to verify the perfect alignment between the motor output shaft and the counter part – the fitment between motor shaft and application's driven shaft must be executed so that no radial or axial pre-load is generated – these extra loads reduce the bearings expected lifetime.



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Installation, operation and maintenance



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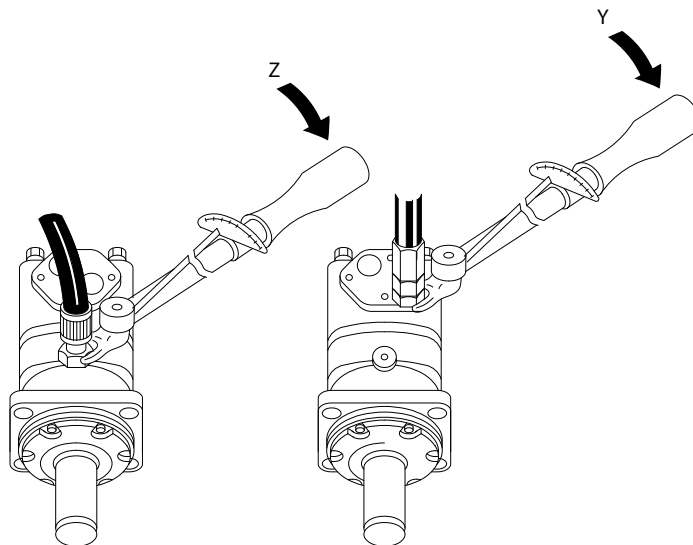
Hydraulic connections for OMT and OMV motors

Main inlet hoses connections (Y)

The motor has two port connections on the end cover which can be both inlet or outlet ports depending on the application.

Drain line connection (Z)

The drain line relieves the pressure on the shaft seal to tank. The tank pressure must be less than or equal to the maximum permissible seal pressure – see seal graph shown in the Technical Information catalogue.



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The following main rules apply to drain lines fitted to hydraulic motors:

- We recommend a drain line when the maximum pressure on the shaft seal is exceeded, i.e. the life of the shaft seal can otherwise be significantly reduced.
- We always recommend a drain line when
 - A short motor (bearing less motor) is built together with e.g. a gear.
 - The motor is used in hydrostatic transmissions that do not have a separate flushing valve.

Tightening torque

The recommended tightening torque for the hoses are shown in the table below.

Installation, operation and maintenance

Maximum tightening torque

Screwed connection	G 1/4	G 1/2	G 3/4	G 1
- with steel washer	40 N•m [350 lbf•in]	130 N•m [1,150 lbf•in]	210 N•m [1,850 lbf•in]	280 N•m [2,500 lbf•in]
- with cutting edge	40 N•m [350 lbf•in]	130 N•m [1,150 lbf•in]	210 N•m [1,850 lbf•in]	280 N•m [2,500 lbf•in]

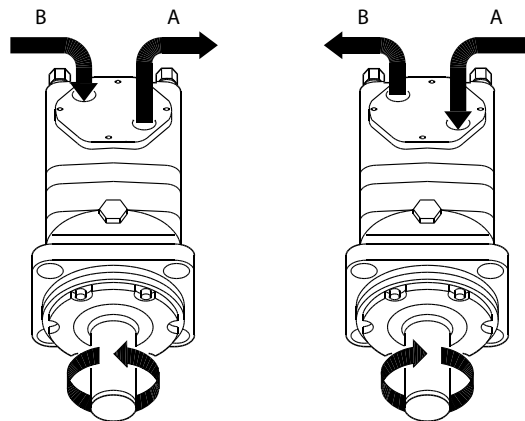
Operation

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

Pre start up controls for OMT and OMV motors

Before performing the first motor start up, the following points have to be checked:

- Hydraulic components must be installed in accordance with their individual instruction.
- To avoid contamination, plastic plugs in connection ports must not be removed until just before connections are made.
- Make sure the motor hydraulic connections allow the motor to rotate in the desired direction. For motors with standard direction of rotation:
 - Clockwise rotation (viewed facing the output shaft) with inlet pressure in the A port.
 - Counter-clockwise rotation (viewed facing the output shaft) with inlet pressure in the B port.



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- Select the hydraulic fluid as specified in [Oil types / Operating fluids](#) on page 12.
- There must be full contact between motor mounting flange and connecting part.
- Avoid pressing the motor 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.
- Make sure that all couplings are completely tightened to prevent leakage – never use more torque than max values given in instructions.
- Check to make sure the purity of the oil is better than 22/20/16 (ISO 4406-1999) and always use a filter when replenishing the system.

⚠ Warning

The motor must be filled with fluid prior to any load applications.

Installation, operation and maintenance

Start up

During and immediately after the motor start up, any hydraulic system must be closely and frequently checked.

1. To assure best motor performance, run the motor for approximately one hour at 30% of rated pressure and speed before running at full load.
When running make sure the motor 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.
2. Check for system leakage and make sure the system is operating satisfactorily.
3. To ensure that the contamination in the hydraulic system does not damage the motor; 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.

During operation

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.

It is recommended to:

- Regularly verify that the temperature of the ambient and the operating oil are those initially determined.
- Do not subject the motor to pressure, pressure drop or speeds exceeding the maximum values stated in the appropriated catalogues.
- Filter the oil to maintain the grade of contamination at 22/20/16 (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.

- 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.
- 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 [Viscosity](#) on page 12.

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

Installation, operation and maintenance

tank's bed. If its presence is determined, water must be regularly purged. Presence of water in the hydraulic system can severely damage the motor.

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.

- For installation in zones 21 and 22 the user has to adopt a scheduled periodic clearing plan of the motor surfaces and recesses to prevent more than 5mm thickness of dust deposits.

Service and repair of OMT and OMV motors

In case a service or repair intervention on the motor is required, it has to be performed according to the information shown in the respective Repair Instructions.

The Repair Instruction includes the spare part list and information about how dismantling and assembling of the motor is done properly.

- *Orbital Motors OMT Series 2 Repair Instruction*: Literature number AX152886480596
- *Orbital Motor OMV Repair Instruction*: Literature number AX152886482374

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.

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.

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

Installation, operation and maintenance** 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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EU DECLARATION OF CONFORMITY**Danfoss A/S****Danfoss Power Solutions ApS**

declares under our sole responsibility that the

Product category:

Orbital Hydraulic Motors

Type designation(s):

OMT 160 – 500 and OMTS 160 – 500

OMV 315 – 800 and OMVS 315 - 800

Part number(s) / Serial number / date of manufactured:

Specifically identified on label affixed to product

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.

European Directive: ATEX 2014/34/EU

International Standards: EN ISO 80079-36 : 2016, EN ISO 80079-37 : 2016

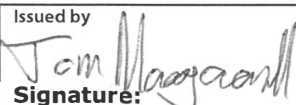
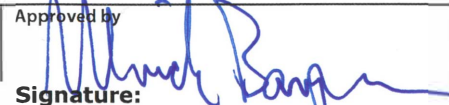
Danfoss declares that the machine has been designed, constructed and tested to fully comply with the health and safety requirements of the Directive, as mentioned above. Any modification to the machine without our prior permission renders this declaration null and void.

ATEX marking: See tabel 1

Technical dossier and archive:

No: 0396 Archive No: DTI 2014-1-0171A

Technological Institute, Kongsvang Allé 29, DK-8000 Aarhus C

Date: 2021.06.18 Place of issue: Nordborg	Issued by  Signature: Name: Tom Maagaard Title: Manager Engineering	Date: 2021.06.18 Place of issue: Nordborg	Approved by  Signature: Name: Ulrich Bargum Title: Director Product Application
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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

Tabel 1ATEX marking:

Motor type	Gas environment	Dust environment
OMT 160 – 500 OMTS 160 – 500	Ex h IIB T5...T4 Gb Ex h IIB T5...T4 Gb	Ex h IIIC T110 °C...T175 °C Db Ex h IIIC T75 °C...T125 °C Db
OMV 315 – 800 OMVS 315 – 800	Ex h IIB T5...T4 Gb Ex h IIB T5...T4 Gb	Ex h IIIC T120 °C...T190 °C Db Ex h IIIC T75 °C...T125 °C Db

Products we offer:

- Cartridge valves
- DCV directional control valves
- Electric converters
- Electric machines
- Electric motors
- Gear motors
- Gear pumps
- Hydraulic integrated circuits (HICs)
- Hydrostatic motors
- Hydrostatic pumps
- Orbital motors
- PLUS+1® controllers
- PLUS+1® displays
- PLUS+1® joysticks and pedals
- PLUS+1® operator interfaces
- PLUS+1® sensors
- PLUS+1® software
- PLUS+1® software services, support and training
- Position controls and sensors
- PVG proportional valves
- Steering components and systems
- Telematics

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