

COLLEN SECTION	
Project No & Title:	U011 Yonder LON1X2
Submittal Ref / Description:	LON1X2 – Elec – AVK – DS3300 Generator-Technical Submittal
Revision:	C01
Submittal Issue Date:	14 th January 2025
Required Response Date:	24 th January 2025
To:	Company: Ampromech, JDA
	Attention: To Whom it may Concern
From:	Company: AVK

New Submittal Re-Submittal & Revision No:

Submission Details				
Doc No.	Description of Item Submitted (Type, Size, Model Number, Etc.)	Certification (CE Cert, Declaration of Performance, Technical Data Sheet, Safety Data Sheet)	Drawing / Brochure No	Status (A, B, C)
1	DS3300 Generator	EU Declaration of Conformity	LON1X2-AVK-XX-XX-TS-E-0001	
2				
3				
4				

Employers Requirements Specification:

Contractor to confirm compliance with relevant Specifications as listed below:

LON1X2-JDA-XX-XX-SP-E-9057-P03

Contractor to tick relevant box:

- YES
 NO

If No, Contractor to confirm in detail reason for derogation from Specification:

Refer to Compliance Statement (LON1X2-AVK-XX-XX-TS-E-0002) for clarifications deviations to the specification.

DESIGN TEAM SECTION

Submittal Status:

- A. No Comment - Permission to proceed
 B. Comments As Noted – Incorporate all comments and proceed
 C. Re-Submit – Incorporate all comments and resubmit prior to proceeding

Design Team Comments	

Sign off	
Approved by: (Print & Signature)	
On behalf of:	
Date Returned:	



Comments & Clarifications on Rev P01

Design Team Comment Raised on Rev P01

BIM model required as part of technical submittals.

AVK Clarification

BIM models have been provided

Design Team Comment Raised on Rev P01

Wiring diagrams required.

AVK Clarification

Please refer to AVK Schematics reference LON1X2-AVK-CZ-XX-DR-E-1001 and LON1X2-AVK-CZ-XX-DR-E-1002.

Design Team Comment Raised on Rev P01

VFC details and quantities required

AVK Clarification

Please refer to AVK Schematics reference LON1X2-AVK-CZ-XX-DR-E-1001 and LON1X2-AVK-CZ-XX-DR-E-1002 for connection details for each generator.

With the generator enclosure the following connections are required: -

1. Modbus Connection wired to the Generator Control Panel
2. Modbus Connection wired to the Generator Switchboard.

Hardwired Connection from GCP

Remote Start Stop Signal wired to the Generator Control Panel.

1. Remote Start = XD100- 34.1 (Gnd), 35.1 (input)
2. Ready For Load = XD100- 53.1 (C), 53.3 (n/o) – N/O status provided by AVK
3. Inhibit = XD100- 55.1 (C), 55.3 (n/o) - N/O status provided by Generator Switchboard local ACB status



Design Team Comment Raised on Rev P01

Will current be limited to sub 4000A given the breaker sizes at the gen and downstream?

AVK Clarification

Yes confirmed.

For the site acceptance test the client have confirmed that all load testing and transients will be carried out at 0.8PF using a resistive/reactive load bank terminated to the Generator Loadbank LV switchboard (The generator is de-rated to 2200Kw as engine full load capacity of 2400Kw load at 0.8pf cannot be achieved due to the ACB & busbar rating at 4000A).

On completion of the testing the generator is left to align to the building power factor.

Technical Submittal



Generators

1.1 Overview

Supply of 32 no. 3000kVA/2400kW net emissions optimised (NOx) DCC rated, LV diesel generating set. Complete with mechanically driven cooling package and generator mounted controller.

16No. Control Panels on Left Hand side,

16No. Control Panels on Right Hand side,

1.2 Generator

MTU DS3300 diesel generating set with MTU 20V4000G34F NOx turbocharged diesel engine and Leroy Somer LSA53.2 L14 / 4p brushless synchronous alternator.

Generating set sized to support a DCC rated load of 3000kVA/2400kW at 400V, 3-phase, 50Hz, 1500 rev/min, for an unlimited number of operating hours per year with varying load conditions (average load factor < 100%), in accordance with ISO 8528-1 and ISO 3046-1. A 10% overload capacity is available for one hour in twelve.

Generating set designed to performance class G3.

Generating set exceeds ISO8528-5 load step performance G2.

Generating set supplied with:

- Integrated digital automatic voltage regulator (AVR)
- Dual 24V electrical starter motor with battery charging alternator (redundant operation)
- Dual 24V low maintenance lead acid starting batteries
- 24V battery chargers
- Air, fuel and lube oil filters
- Electronic engine management
- Common rail electronic injection system
- Low lube oil pressure protection switch
- High water temperature protection switch
- Low coolant level alarm
- Common skid frame with rubber type anti-vibration pads between engine/alternator and skid to give approximately 80-85% isolation.
- Thermostatically controlled water jacket heater and circulating pump.
- Flanged exhaust bellows
- CE label

See the following appendices for further details:

[Appendix 01 – Generator Datasheet](#)

[Appendix 02 – Engine Datasheet](#)

[Appendix 03 – Alternator Datasheet](#)

1.2.1 Engine

In-line, liquid-cooled, four-stroke MTU 20V4000G34F emissions optimised turbocharged diesel engine. Electronically controlled common rail fuel injection system with low and high-pressure fuel pumps, fuel pressure accumulator, high pressure fuel lines, duplex fuel filter and fuel priming pump for initial system filling and venting.

Forced-feed lubrication system with piston cooling, lube oil circulation pump with safety valve, automatic lube oil make-up system, lube oil multi-stage filter, lube oil heat exchanger, oil filler neck and oil dipstick for measurement on non-running engine and closed crankcase venting system. Hand pump included for manual lube oil extraction.

Thermostatically controlled water jacket heater with coolant circulation pump and coolant thermostat for charge air cooling circuit.

Engine warranted to operate using the fluids and lubricants specified in Appendix 04 – MTU Fluids and Lubricants.

See the following appendices for further details:

[Appendix 02 – Engine Datasheet](#)

[Appendix 04 – MTU Fluids and Lubricants](#)

[Appendix 05 – Emissions Datasheet](#)

[Appendix 10 – HVO Confirmation Letter](#)

1.2.2 Alternator

Leroy Somer LSA 53.2 L14 / 4p brushless self-excited, self-regulating, double bearing, IP23 drip proof, class H alternator sized to support a DCC rated load of 3000kVA/2400kW at 400V, 3-phase, 50Hz, 1500 rev/min, for an unlimited number of operating hours per year with varying load conditions (average load factor < 100%), in accordance with ISO 8528-1 and ISO 3046-1. A 10% overload capacity is available for one hour in twelve.

Integrated digital type automatic voltage regulator (AVR) included to maintain alternator output voltage of 400V \pm 5% from no load to full load, unity to 0.8 lagging power factor, 3-phase, 50 Hz, 400V, 1500 rev/min and a total harmonic distortion (THD) of < 3.5%.

Excitation based upon PMG

See the following appendices for further details:

[Appendix 03 – Alternator Datasheet](#)

[Appendix 06 – AVR Datasheet](#)

1.2.3 Radiator

The generating set is supplied with a set mounted two-circuit type radiator assembly complete with expansion tank & cap and mechanically driven cooling fan.

Specifications:

Cooling ambient design - 40°C

Radiator Airflow - 48.35m³/s

Engine coolant capacity - 205 litres (+/- 10%)

Intercooler coolant capacity - 50 litres

Coolant Type - Glycol-Ethylene 35/65

Thermostat - 79-92°C

1.2.4 Starting System

The generating set starting system comprises:

24V 15kW electrical starter motor and redundant starter motor

24V dual set low maintenance lead acid starting batteries (each sized for maximum 3 x genset starting attempts, 6 total crank cycles of 10 seconds with redundant operation)

Battery charging alternator

Dual battery chargers fed from auxiliary supply

See the following appendices for further details:

[Appendix 07 – Battery Datasheet](#)

1.2.5 Earthing

Earthing points are provided on the generator base frame.

1.2.6 Generator Controller

The generating sets are controlled via ComAp IntelliSys controllers located within the generator control panel mounted on the bedframe of the generator set. The ComAp controller provides individual set control and monitoring. The control panel is fed from the 24V DC battery backed generator supply and is operated with an 8-inch ergonomic touch screen.

The ComAp control panel provides:

- Control of the genset in both automatic and manual mode
- Testing of the generating set both on/off load
- Display of genset measurement values (electrical and mechanical)
- Status of generating set (both current and historical)
- Time-stamped event display with log for up to defined amount of events
- Adjustment of genset parameters with appropriate user level (i.e. timer settings)
- Automatic cooldown periods with user defined time settings
- Engine oil pressure
- Engine water temperature
- Engine oil temperature
- Engine speed
- Hours run
- Number of start attempts
- Battery voltage

Event-based history (up to 1000 records) with customer-selectable list of stored values; RTC; statistic values. See the following appendices for further details:

[Appendix 08 – ComAp Datasheet](#)

[Appendix 09 – ComAp HMI Datasheet](#)

2.0 – Interfaces and Dependencies Schedule

Auxiliary Supply Required	Detail	Quantity Required	Provided By	Final Connection By
1 x 100A TP+N 400V AC supply	Maintained Generator Auxiliary Supply	1 per generating set	Others	Others
1 x 32A TP+N 400V AC	Generator Control System	1 per generating set	AVK	AVK
	Battery Charger 1 – 10A			
	Battery Charger 2 – 10A			
	Jacket Water Heater – 20A			
	Anti-Condensation Heater – 10A			
	Internal Socket – 13A			
1 x 32A SP+N 230V AC	Container sockets	1 per container	AVK	AVK
1 x 6A SP+N 230V AC	Internal Container lights	1 per container	AVK	AVK
1 x 6A SP+N 230V AC	External Container lights	1 per container	AVK	AVK
1 x 6A SP+N 230V AC	Container tubular heater	1 per container	AVK	AVK
1 x 6A SP+N 230V AC	Fuel Polisher	1 per container	AVK	AVK
High Level Interface	Generator alarm monitoring (Modbus)	1 per generating set	Others	Others
Low Level Interface	Generator alarm monitoring (VFC's)	TBC	Others	Others

3.0 – Appendices

Item	Document Name
01	Generator Datasheet
02	Engine Datasheet
03	Alternator Datasheet
04	MTU Fluids and Lubricants
05	Emissions Datasheet & Letter & Emissions Statement
06	AVR Datasheet
07	Battery Datasheet
08	ComAp Datasheet
09	ComAp HMI Datasheet
10	HVO Confirmation Letter



Appendix 01 - Generator Datasheet



Diesel Generator Set

mtu 20V4000 DS3300

380V – 11 kV/50 Hz/data center continuous power/
NOx emission optimized/20V4000G34F/water charge air cooling



*Project Specific Datasheet LON1X2 Build C

Optional equipment and finishing shown. Standard may vary.

Product highlights

Benefits

- Low fuel consumption
- Optimized system integration ability
- High reliability
- High availability of power
- Long maintenance intervals

Support

- Global product support offered

Standards

- Engine-generator set is designed and manufactured in facilities certified to standards ISO 2008:9001 and ISO 2004:14001
- Generator set complies to ISO 8528
- Generator meets NEMA MG1, BS 5000, ISO, DIN EN and IEC standards
- NFPA 110

Power rating

- System ratings: 3020 kVA - 3130 kVA
- Accepts rated load in one step per NFPA 110*
- Generator set complies to G3 according to ISO 8528-5
- Generator set exceeds load steps according to ISO 8528-5*

Performance assurance certification (PAC)

- Engine-generator set tested to ISO 8528-5 for transient response
- 100% load factor
- Verified product design, quality and performance integrity
- All engine systems are prototype and factory tested

Complete range of accessories available

- Control panel
- Power panel
- Circuit breaker/power distribution
- Fuel system
- Fuel connections with shut-off valve mounted to base frame
- Starting/charging system
- Exhaust system
- Mechanical and electrical driven radiators
- Medium and oversized voltage alternators

Emissions

- NOx emission optimized

Certifications

- CE certification option
- Unit certificate acc. to VDE-AR-N 4110

* Changes to the standard parameter sets (alternator-regulator and genset-controller) are necessary



A Rolls-Royce
solution

Application data ¹⁾

Engine

Manufacturer	mtu
Model	20V4000G34F
Type	4-cycle
Arrangement	20V
Displacement: l	95.4
Bore: mm	170
Stroke: mm	210
Compression ratio	16.4
Rated speed: rpm	1500
Engine governor	ECU 9
Max power: kWm	2590
Air cleaner	dry

Fuel system

Maximum fuel lift: m	5
Total fuel flow: l/min	27

Fuel consumption ²⁾

	l/hr	g/kwh
At 100% of power rating:	689.6	221
At 75% of power rating:	510.2	218
At 50% of power rating:	335.5	215

Liquid capacity (lubrication)

Total oil system capacity: l	390
Engine jacket water capacity: l	205
Intercooler coolant capacity: l	50

Combustion air requirements

Combustion air volume: m ³ /s	3.7
Max. air intake restriction: mbar	50

Cooling/radiator system

Coolant flow rate (HT circuit): m ³ /hr	80
Coolant flow rate (LT circuit): m ³ /rh	32.5
Heat rejection to coolant: kW	1100
Heat radiated to charge air cooling: kW	660
Heat radiated to ambient: kW	105
Fan power for electr. radiator (40°C): kW	70

Exhaust system

Exhaust gas temp. (after turbocharger): °C	535
Exhaust gas volume: m ³ /s	10.3
Maximum allowable back pressure: mbar	85
Minimum allowable back pressure: mbar	30

Standard and optional features

System ratings (kW/kVA)

Generator model	Voltage	NOx emission optimized					
		without radiator			with mechanical radiator		
		kWel	kVA*	AMPS	kWel	kVA*	AMPS
Leroy-Somer LSA53.2 MI2 (Low-voltage Leroy-Somer standard)	380 V	2488	3110	4725	2424	3030	4604
	400 V	2488	3110	4489	2424	3030	4373
	415 V	2488	3110	4327	2424	3030	4215
Marathon 1030FDL7094 (Low-voltage Marathon)	380 V	2496	3120	4740	2416	3020	4588
	400 V	2488	3110	4489	2416	3020	4359
	415 V	2488	3110	4327	2416	3020	4201
Marathon 1040FDH7102 (Medium-volt. marathon)	11 kV	2496	3120	164	2416	3020	159
Leroy-Somer LSA54.2 XL11 (Med. volt. Leroy-Somer)	11 kV	2504	3130	164	2424	3030	159

* cos phi = 0.8

Leroy-Somer LSA53.2 L14 (12% volt. Leroy-Somer)	400V	2488	3110	4489	2424	3030	4373
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¹⁾ All data refers only to the engine and is based on ISO standard conditions (25°C and 100m above sea level).

²⁾ Values referenced are in accordance with ISO 3046-1. Conversion calculated with fuel density of 0.83 g/ml. All fuel consumption values refer to rated engine power.

Standard and optional features

Engine

- 4-cycle
- Standard single stage air filter
- Oil drain extension & shut-off valve
- Closed crankcase ventilation improved oil separator
- Governor-electronic isochronous
- Common rail fuel injection
- NOx emission optimized engine
- Centrifugal oil filter

Generator

- 4 pole three-phase synchronous generator
- Brushless, self-excited, self-regulating, self-ventilated
- Digital voltage regulator
- Anti condensation heater
- Stator winding Y-connected, accessible neutral (brought out)
- Protection IP23
- Insulation class H, utilization acc. to H
- Radio suppression EN 55011, group 1, cl. B
- Short circuit capability $3 \times I_n$ for 10sec
- Winding and bearing RTDs (without monitoring)
- Excitation by AREP
- Mounting of CT's: 2 core CT's
- Winding pitch: 2/3 winding
- Voltage setpoint adjustment $\pm 10\%$
- Meets NEMA MG-1, BS 5000, IEC 60034-1, VDE 0530, DIN EN 12601, AS 1359 and ISO 8528-3 requirements
- Leroy Somer low voltage generator
- Marathon low voltage generator
- Oversized generator
- Medium voltage generator

Cooling system

- Jacket water pump
- Thermostat(s)
- Water charge air cooling
- Mechanical radiator
- Electrical driven front-end cooler
- Jacket water heater

Control panel

- Unit cabling with coded plugs for easy connection of customer-specific controls (V0)
- Pre-wired control cabinet for easy application of customized controller (V1+)
- Island operation (V2)
- Automatic mains failure operation with ATS (V3a)
- Automatic mains failure operation incl. control of generator and mains breaker (V3b)
- Island parallel operation of multiple gensets (V4)
- Automatic mains failure operation with short (< 10s) mains parallel overlap synchronization (V5)
- Mains parallel operation of a single genset (V6)
- Mains parallel operation of multiple gensets (V7)
- Basler controller
- Deif controller
- Complete system metering
- Digital metering
- Engine parameters
- Generator protection functions
- Engine protection
- SAE J1939 engine ECU communications
- Parametrization software
- Multilingual capability
- Multiple programmable contact inputs
- Multiple contact outputs
- Event recording
- IP 54 front panel rating with integrated gasket
- Different expansion modules
- Remote annunciator
- Daytank control
- Generator winding temperature monitoring
- Generator bearing temperature monitoring
- Modbus TCP-IP

Connectivity

The engine system automatically collects and transfers engine data to the manufacturer from time to time. The data is used by the manufacturer for the purposes of product

development and improvement as well as service optimization. Users can log in or register via <https://mtu-go.com> and also gain insight into the data.

- Represents standard features
- Represents optional features

Standard and optional features

Power panel

- Supply electrical driven radiator from 45kW – 75kW

Circuit breaker/power distribution

- 3-pole circuit breaker
- 4-pole circuit breaker
- Electrical-actuated circuit breaker
- Base frame mounted GCB, pre-wired with generator, ready for commissioning

Fuel system

- Flexible fuel connectors mounted to base frame
- Fuel filter with water separator
- Fuel filter with water separator heavy-duty
- Switchable fuel filter with water separator
- Switchable fuel filter with water separator heavy-duty
- Seperate fuel cooler
- Fuel cooler integrated into cooling equipment

Starting/charging system

- 24V starter
- Redundant starting system
- Starter batteries, cables, rack, disconnect switch (lockable)
- Battery charger
- Alternator

Mounting system

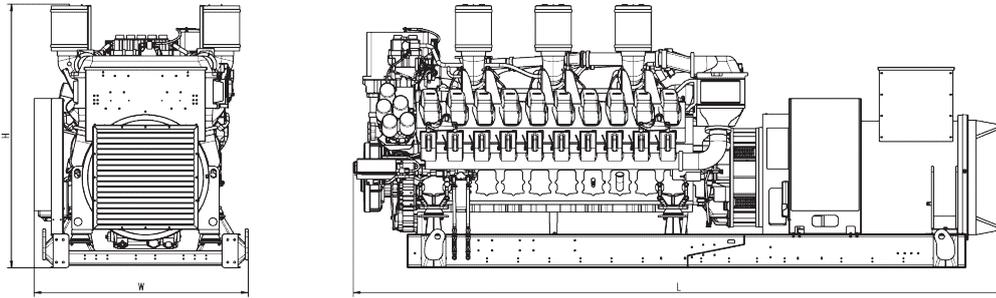
- Welded base frame
- Resilient engine and generator mounting
- Modular base frame design
- Base frame mounting on foundation/base plate with using clamping brackets

Exhaust system

- Exhaust bellows with connection flange
- Exhaust silencer with 10 dB(A) sound attenuation
- Exhaust silencer with 30 dB(A) sound attenuation
- Exhaust silencer with 40 dB(A) sound attenuation
- Y-connection-pipe

- Represents standard features
- Represents optional features

Weights and dimensions



Drawing above for illustration purposes only, based on a standard open power 400 Volt engine-generator set. Lengths may vary with other voltages. Do not use for installation design. See website for unit specific template drawings.

System	Dimensions (LxWxH)	Weight (dry/less tank)
Open power unit (OPU)	5760 x 1887 x 2332 mm	15819 kg

Weights and dimensions are based on open power units and are estimates only. Consult the factory for accurate weights and dimensions for your specific engine-generator set.

Sound data

— Consult your local **mtu** distributor for sound data.

Emissions data

— Consult your local **mtu** distributor for emissions data.

Rating definitions and conditions

- Data center continuous power ratings (DCP) apply to data center installations where a reliable utility power is available and comply with Uptime Institute Tier III and IV requirements. At constant or varying load, the number of generator set operating hours is unlimited. A 10% overload capacity is available for one hour in twelve. Ratings are in accordance with ISO 8528-1, ISO 3046-1, BS 5514 and AS 2789. Average load factor: $\leq 100\%$.
- Consult your local **mtu** distributor for derating information.



Appendix 02 - Engine Datasheet



Name	20V4000G34F	Speed [rpm]	1500
Application Group	3F	Nominal power [kW]	2590
Dataset	Ref. 25°C/55°C	Nominal power [bhp]	3473
		Nominal power [kVA]	-
		Nominal power [kWeI]	-
		Frequency [Hz]	50

Exhaust Regulations NOx emission optimized ;

Reference conditions

No.	Description	Index	Value	Unit
6	Intake air temperature		25	°C
7	Charge-air coolant temperature		55	°C
8	Barometric pressure		1000	mbar
9	Site altitude above sea level		100	m
10	Raw-water inlet temperature		-	°C

[BL] Reference value: fuel stop power
Maximum engine power that cannot be run continuously on some applications (stabilization reserve)

[DL] Reference value: continuous power
Engine power that can be run continuously under standard conditions

[>] Actual value must be greater than specified value
[<] Actual value must be less than specified value

[X] Applicable
The module is valid for this product type

[] Non-applicable
The module is not valid for this product type

[N] Value not named
The value has not yet been named or will not be named

[*] Adequate verification not yet available (tolerance +/-10%)
[] Adequate verification not yet available (tolerance +/-5%)**

[A] Design value
Value required for the design of an external system (plant)

[R] Guideline value
Typical average value as information – only suitable for design purposes to a limited extent

[L] Limit value
A value representing the lower limit/minimum value or upper limit/maximum value that may not be exceeded. Not suitable for design purposes



Name	20V4000G34F	Speed [rpm]	1500
Application Group	3F	Nominal power [kW]	2590
Dataset	Ref. 25°C/55°C	Nominal power [bhp]	3473
		Nominal power [kVA]	-
		Nominal power [kWeI]	-
		Frequency [Hz]	50

Exhaust Regulations NOx emission optimized ;

0. Data-relevant engine design configuration

No.	Description	Index	Value	Unit
12	Engine with sequential turbocharging (turbochargers with cut-in/cut-out control)		-	-
13	Engine without sequential turbocharging (turbochargers without cut-in/cut-out control)		X	-

[BL] Reference value: fuel stop power
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		Nominal power [kVA]	-
		Nominal power [kWeI]	-
		Frequency [Hz]	50

Exhaust Regulations NOx emission optimized ;

1. Power-related data

No.	Description	Index	Value	Unit
1	Engine rated speed	A	1500	rpm
2	Reduction gear - Output speed	A	-	rpm
3	Mean piston speed		10.5	m/s
4	Continuous power ISO 3046 (10% overload capability) (design power DIN 6280, ISO 8528)	A	2590	kW
5	Fuel stop power ISO 3046	A	2849	kW
8	Mean effective pressure (MEP) (Continuous power ISO 3046)		21.7	bar
9	Mean effective pressure (MEP) (Fuel stop power ISO 3046)		23.9	bar
18	Performance map No.		-	-
38	Performance map No. (cont.)		-	-
20	Performance map, amendment index		-	-

[BL] Reference value: fuel stop power
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Dataset	Ref. 25°C/55°C	Nominal power [bhp]	3473
		Nominal power [kVA]	-
		Nominal power [kWeI]	-
		Frequency [Hz]	50

Exhaust Regulations NOx emission optimized ;

2. General Conditions (for maximum power)

No.	Description	Index	Value	Unit
46	Individual power calculation (ESCM) required for maximum power		X	-
1	Intake air depression (new filter)	A	15	mbar
2	Intake air depression, max.	L	50	mbar
51	Exhaust overpressure (total pressure against atmosphere)	A	30	mbar
52	Exhaust overpressure, max. (total pressure against atmosphere)	L	85	mbar
5	Fuel temperature at fuel feed connection	R	25	°C
9	Fuel temperature at fuel feed connection, max. (w/o power reduction)	L	55	°C
10	Fuel temperature at fuel feed connection, max.	L	55	°C
18	Fuel temperature at fuel feed connection, min.	L	-	°C

[BL] Reference value: fuel stop power
Maximum engine power that cannot be run continuously on some applications (stabilization reserve)

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Dataset	Ref. 25°C/55°C	Nominal power [bhp]	3473
		Nominal power [kVA]	-
		Nominal power [kWeI]	-
		Frequency [Hz]	50

Exhaust Regulations NOx emission optimized ;

3. Consumption

No.	Description	Index	Value	Unit
17	Specific fuel consumption (be) - 100 % CP (+ 5 %; EN 590; 42.8 MJ/kg)	R	221	g/kWh
18	Specific fuel consumption (be) - 75 % CP (+ 5 %; EN 590; 42.8 MJ/kg)	R	218	g/kWh
19	Specific fuel consumption (be) - 50 % CP (+ 5 %; EN 590; 42.8 MJ/kg)	R	215	g/kWh
20	Specific fuel consumption (be) - 25 % CP (+ 5 %; EN 590; 42.8 MJ/kg)	R	225	g/kWh
21	Specific fuel consumption (be) - FSP (+ 5 %; EN 590; 42.8 MJ/kg)	R	209	g/kWh
56	Specific fuel consumption (be) - 100 % FSP (+ 5 %; EN 590; 42.8 MJ/kg)	R	-	g/kWh
57	Specific fuel consumption (be) - 75 % FSP (+ 5 %; EN 590; 42.8 MJ/kg)	R	-	g/kWh
58	Specific fuel consumption (be) - 50 % FSP (+ 5 %; EN 590; 42.8 MJ/kg)	R	-	g/kWh
59	Specific fuel consumption (be) - 25 % FSP (+ 5 %; EN 590; 42.8 MJ/kg)	R	-	g/kWh
73	No-load fuel consumption	R	38	kg/h
92	Lube oil consumption after 100 h of operation (B = fuel consumption per hour) Guideline value does not apply for the design of EGAT systems. Please consult the Applications Center with regard to the layout of EGA systems.	R	0.3	% of B
62	Lube oil consumption after 100 h of operation, max. (B = fuel consumption per hour)	L	1.0	% of B

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Maximum engine power that cannot be run continuously on
some applications (stabilization reserve)

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Engine power that can be run continuously under standard
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Name	20V4000G34F	Speed [rpm]	1500
Application Group	3F	Nominal power [kW]	2590
Dataset	Ref. 25°C/55°C	Nominal power [bhp]	3473
		Nominal power [kVA]	-
		Nominal power [kWeI]	-
		Frequency [Hz]	50

Exhaust Regulations NOx emission optimized ;

4. Model-related data (basic design)

No.	Description	Index	Value	Unit
1	Naturally aspirated engine		-	-
2	Engine with exhaust turbocharger (ETC)		-	-
3	Engine with exhaust turbocharger (ETC) and intercooler		X	-
4	Exhaust piping, non-cooled		X	-
5	Exhaust piping, liquid-cooled		-	-
33	Working method: four-cycle, diesel, single-acting		X	-
34	Combustion method: direct injection		X	-
36	Cooling system: conditioned water		X	-
37	Direction of rotation: c.c.w. (facing driving end)		X	-
6	Number of cylinders		20	-
7	Cylinder configuration: V angle		90	degrees (°)
8	Cylinder configuration: in-line vertical		-	-
10	Bore		170	mm
11	Stroke		210	mm
12	Displacement, cylinder		4.77	liter
13	Displacement, total		95.4	liter
14	Compression ratio		16.4	-
40	Cylinder heads: single-cylinder		X	-
41	Cylinder liners: wet, replaceable		X	-
42	Piston design: composite piston		-	-
49	Piston design: solid-skirt piston		X	-
21	Number of piston compression rings		2	-
22	Number of piston oil control rings		1	-

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		Nominal power [kVA]	-
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		Frequency [Hz]	50

Exhaust Regulations NOx emission optimized ;

24	Number of inlet valves, per cylinder		2	-
25	Number of exhaust valves, per cylinder		2	-
15	Number of turbochargers		6	-
16	Number of L.P. turbochargers		6	-
17	Number of H.P. turbochargers		-	-
18	Number of intercoolers		1	-
19	Number of L.P. intercoolers		1	-
20	Number of H.P. intercoolers		-	-
28	Standard flywheel housing flange (engine main PTO)		00	SAE
50	Static bending moment at standard flywheel housing flange, max.	L	15	kNm
51	Dynamic bending moment at standard flywheel housing flange, max.	L	75	kNm
29	Standard flywheel housing flange (reduction gearbox main PTO)		-	SAE
43	Flywheel interface (DISC)		21	-

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		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50

Exhaust Regulations NOx emission optimized ;

5. Combustion air / exhaust gas

No.	Description	Index	Value	Unit
8	Charge-air pressure before cylinder - CP	R	3.6	bar abs
27	Charge-air pressure before cylinder - FSP	R	3.6	bar abs
9	Combustion air volume flow - CP	R	3.7	m ³ /s
10	Combustion air volume flow - FSP	R	3.6	m ³ /s
11	Exhaust volume flow (at exhaust temperature) - CP	R	10.3	m ³ /s
12	Exhaust volume flow (at exhaust temperature) - FSP	R	10.3	m ³ /s
13	Exhaust temperature before turbocharger - CP	R	725	°C
14	Exhaust temperature before turbocharger - FSP	R	730	°C
15	Exhaust temperature after turbocharger - CP	R	535	°C
16	Exhaust temperature after turbocharger - FSP	R	540	°C
17	Exhaust temperature after engine - CP	R	515	°C
18	Exhaust temperature after engine - FSP	R	515	°C

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Exhaust Regulations NOx emission optimized ;

6. Heat dissipation

No.	Description	Index	Value	Unit
10	Heat dissipated by engine coolant - FSP with oil heat	R	-	kW
12	Heat dissipation by engine coolant - FSP with oil heat, with charge-air heat	R	-	kW
62	Heat dissipated by engine coolant - FSP (high-temperature circuit)	R	-	kW
63	Heat dissipated by engine coolant - FSP (low-temperature circuit)	R	-	kW
14	Heat dissipated by engine coolant - FSP without oil heat, with charge-air heat	R	-	kW
15	Heat dissipated by engine coolant - CP with oil heat, without charge-air heat	R	1100	kW
16	Heat dissipated by engine coolant - FSP with oil heat, without charge-air heat	R	1130	kW
18	Heat dissipated by engine coolant - FSP without oil heat, without charge-air heat	R	-	kW
23	Heat dissipated by oil - FSP	R	-	kW
26	Charge-air heat dissipation - CP	R	660	kW
27	Charge-air heat dissipation - FSP	R	670	kW
39	Heat dissipated by exhaust gas - FSP	R	-	kW
31	Heat dissipated by return fuel flow - CP	R	7.5	kW
32	Heat dissipated by return fuel flow - FSP	R	-	kW
33	Radiation and convection heat, engine - CP	R	105	kW
34	Radiation and convection heat, engine - FSP	R	-	kW
36	Radiation and convection heat, genset - FSP (engine + generator + 10m insulated exhaust pipework)	R	-	kW

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		Nominal power [kVA]	-
		Nominal power [kWeI]	-
		Frequency [Hz]	50

Exhaust Regulations NOx emission optimized ;

7. Coolant system (high-temperature circuit)

No.	Description	Index	Value	Unit
9	Coolant temperature (at engine outlet to cooling equipment; with max. 40% antifreeze)	A	-	°C
17	Coolant temperature (at engine outlet to cooling equipment)	A	100	°C
57	Coolant temperature differential after/before engine, from	R	9	K
58	Coolant temperature differential after/before engine, to	R	11	K
23	Coolant temperature differential after/before engine	L	13	K
20	Coolant temperature after engine, limit 1	L	102	°C
21	Coolant temperature after engine, limit 2	L	104	°C
25	Coolant antifreeze content, max.	L	50	%
30	Cooling equipment: coolant flow rate	A	80	m³/h
31	Coolant pump: pressure differential	R	2.3	bar
35	Coolant pump: inlet pressure, min.	L	0.5	bar
36	Coolant pump: inlet pressure, max.	L	2.5	bar
39	Engine: coolant pressure differential with thermostat	R	1.7	bar
41	Pressure loss in off-engine cooling system, max.	L	0.7	bar
72	Pressure loss in off-engine cooling system, min.	L	0.55	bar
43	Pressure loss in off-engine cooling system, max. without thermostat	L	0.7	bar
70	Pressure loss in off-engine cooling system, min. without thermostat	L	0.55	bar
47	Breather valve (expansion tank) opening pressure (excess pressure)	R	1.0	bar
54	Cooling equipment: height above engine, max.	L	15	m

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		Nominal power [kVA]	-
		Nominal power [kWeI]	-
		Frequency [Hz]	50

Exhaust Regulations NOx emission optimized ;

53	Cooling equipment: operating pressure	A	2.5	bar
73	Coolant level in expansion tank, below min. alarm	L	-	-
74	Coolant level in expansion tank, below min. shutdown	L	X	-
50	Thermostat, starts to open	R	79	°C
51	Thermostat, bypass closed	R	92	°C
52	Thermostat, fully open	R	92	°C
48	Breather valve (expansion tank) opening pressure (depression)	R	-0.1	bar
49	Pressure in cooling system, max.	L	5.0	bar

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		Nominal power [kVA]	-
		Nominal power [kWeI]	-
		Frequency [Hz]	50

Exhaust Regulations NOx emission optimized ;

8. Coolant system (low-temperature circuit)

No.	Description	Index	Value	Unit
53	Coolant temperature (at engine outlet to cooling equipment)	R	75	°C
9	Coolant temperature before intercooler (at engine inlet from cooling equipment)	A	55	°C
14	Coolant temperature before intercooler, limit 1	L	75	°C
61	Coolant temperature before intercooler, shutdown	L	-	°C
15	Coolant temperature before intercooler, limit 2	L	-	°C
54	Coolant temperature differential after/before intercooler, min.	L	13	K
55	Coolant temperature differential after/before intercooler, max.	L	17	K
13	Coolant antifreeze content, max.	L	50	%
17	Charge-air temperature after intercooler, max.	L	80	°C
76	Temperature differential between intake air and charge-air coolant before intercooler	A	30	K
75	Temperature differential between intake air and charge-air coolant before intercooler, max.	L	32	K
56	Coolant pump: flow rate	A	32.5	m³/h
18	Coolant pump: flow rate (± 5 %)	R	32.5	m³/h
20	Cooling equipment: coolant flow rate	A	32.5	m³/h
21	Intercooler: coolant flow rate	R	32.5	m³/h
22	Coolant pump: pressure differential	R	1.7	bar
24	Coolant pump: inlet pressure, min.	L	0.5	bar
25	Coolant pump: inlet pressure, max.	L	2.5	bar
29	Pressure loss in off-engine cooling system, max.	L	0.7	bar
62	Pressure loss in off-engine cooling system, min.	L	0.55	bar

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		Nominal power [kVA]	-
		Nominal power [kWeI]	-
		Frequency [Hz]	50

Exhaust Regulations NOx emission optimized ;

31	Pressure loss in off-engine cooling system, max. without thermostat	L	0.7	bar
63	Pressure loss in off-engine cooling system, min. without thermostat	L	0.55	bar
43	Cooling equipment: height above engine, max.	L	15	m
36	Breather valve (expansion tank) opening pressure (excess pressure)	R	1.0	bar
37	Breather valve (expansion tank) opening pressure (depression)	R	-0.1	bar
42	Cooling equipment: operating pressure	A	2.5	bar
67	Coolant level in expansion tank, below min. alarm	L	-	-
68	Coolant level in expansion tank, below min. shutdown	L	X	-
39	Thermostat, starts to open	R	38	°C
40	Thermostat, bypass closed	R	51	°C
41	Thermostat, fully open	R	51	°C

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		Nominal power [kVA]	-
		Nominal power [kWeI]	-
		Frequency [Hz]	50

Exhaust Regulations NOx emission optimized ;

10. Lube oil system

No.	Description	Index	Value	Unit
1	Lube oil operating temp. before engine, from	R	88	°C
2	Lube oil operating temp. before engine, to	R	98	°C
3	Lube oil operating temp. after engine, from	R	98	°C
4	Lube oil operating temp. after engine, to	R	108	°C
5	Lube oil temperature before engine, limit 1	L	99	°C
6	Lube oil temperature before engine, limit 2	L	101	°C
7	Lube oil operating pressure before engine (measuring block)	R	5.2	bar
8	Lube oil operating press. bef. engine, from	R	4.5	bar
9	Lube oil operating press. bef. engine, to	R	7.3	bar
10	Lube oil pressure before engine, alarm	L	-	bar
33	Lube oil pressure before engine, limit 1 (speed-related value, consult Rolls-Royce Solutions GmbH)	L	3.5	bar
11	Lube oil pressure before engine, shutdown	L	-	bar
34	Lube oil pressure before engine, limit 2 (speed-related value, consult Rolls-Royce Solutions GmbH)	L	3.2	bar
17	Lube oil pump(s): oil flow, total	R	835	liter/min
19	Lube oil fine filter (main circuit): number of units		1	-
20	Lube oil fine filter (main circuit): number of elements per unit		5	-
21	Lube oil fine filter (main circuit): particle retention	R	0.014	mm
32	Lube oil fine filter (main circuit): pressure differential, max.	L	1.5	bar
35	Lube oil fine filter (main circuit): make (standard): MANN & HUMMEL		X	-

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Exhaust Regulations NOx emission optimized ;

11. Fuel system

No.	Description	Index	Value	Unit
1	Fuel pressure at engine fuel feed connection, min. (when engine is starting)	L	-0.1	bar
2	Fuel pressure at engine fuel feed connection, max. (when engine is starting)	L	1.5	bar
65	Fuel pressure at engine fuel feed connection, max. (when engine is running)	L	0.5	bar
4211	Max. fuel supply volume Normal mode	A	20.1	liter/min
4212	Fuel supply volume, max. Fault mode	A	22.6	liter/min
4	Fuel pressure before injection pump, from (high-pressure pump)	R	6.0	bar
5	Fuel pressure before injection pump, to (high-pressure pump)	R	11.0	bar
6	Fuel pressure before injection pump, min. (high-pressure pump)	L	5.0	bar
7	Fuel pressure before injection pump with engine not running, max. (high-pressure pump)	L	1.5	bar
4213	Max. fuel return volume Normal mode	A	5.5	liter/min
4214	Fuel return volume, max. Fault mode	A	21.8	liter/min
10	Fuel pressure at return connection on engine, max.	L	0.5	bar
12	Fuel temperature differential before/after engine	R	30	K
38	Fuel temperature after high-pressure pump, alarm	L	100	°C
15	Fuel prefilter: number of units	A	-	-
16	Fuel prefilter: number of elements per unit	A	-	-
17	Fuel prefilter: particle retention	A	-	mm
29	Fuel prefilter: make (standard): MANN & HUMMEL		-	-

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Exhaust Regulations NOx emission optimized ;

18	Fuel fine filter (main circuit): number of units	A	1	-
19	Fuel fine filter (main circuit): number of elements per unit	A	1	-
20	Fuel fine filter (main circuit): particle retention	A	0.005	mm
21	Fuel fine filter (main circuit): pressure differential, max.	L	1.0	bar
32	Fuel fine filter (main circuit): make (standard): MANN & HUMMEL		X	-

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Name	20V4000G34F	Speed [rpm]	1500
Application Group	3F	Nominal power [kW]	2590
Dataset	Ref. 25°C/55°C	Nominal power [bhp]	3473
		Nominal power [kVA]	-
		Nominal power [kWeI]	-
		Frequency [Hz]	50

Exhaust Regulations NOx emission optimized ;

12. General operating data

No.	Description	Index	Value	Unit
1	Cold start capability: air temperature (w/o starting aid, w/o preheating) - (case A)	R	10	°C
2	Additional condition (to case A): engine coolant temperature	R	10	°C
3	Additional condition (to case A): lube oil temperature	R	10	°C
4	Additional condition (to case A): lube oil viscosity	R	15W40	SAE
9	Cold start capability: air temperature (w/o starting aid, w/ preheating) - (case C)	R	0	°C
10	Additional condition (to case C): engine coolant temperature	R	40	°C
11	Additional condition (to case C): lube oil temperature	R	-10	°C
12	Additional condition (to case C): lube oil viscosity	R	15W40	SAE
21	Coolant preheating, heater performance (standard)	R	9	kW
22	Coolant preheating, preheating temperature, min.	L	32	°C
3506	Coolant preheating, preheating temperature, max.	L	55	°C
23	Lube oil priming pump: flow rate	R	N	liter/min
24	Lube oil priming pump: pressure	R	N	bar
25	Lube oil priming pump: rated power	R	N	kW
26	Lube oil priming pump: cut-in interval pump cut-in every ... minutes	R	N	min
27	Lube oil priming pump: cut-in duration	R	N	min
28	Breakaway torque (without driven machinery) coolant temperature +5°C	R	2600	Nm
30	Breakaway torque (without driven machinery) coolant temperature +40°C	R	2200	Nm
29	Cranking torque at firing speed (without driven machinery) coolant temperature +5°C	R	1400	Nm

[BL] Reference value: fuel stop power
Maximum engine power that cannot be run continuously on some applications (stabilization reserve)

[DL] Reference value: continuous power
Engine power that can be run continuously under standard conditions

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Application Group	3F	Nominal power [kW]	2590
Dataset	Ref. 25°C/55°C	Nominal power [bhp]	3473
		Nominal power [kVA]	-
		Nominal power [kWeI]	-
		Frequency [Hz]	50

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31	Cranking torque at firing speed (without driven machinery) coolant temperature +40°C	R	1100	Nm
96	Starting is blocked if the engine coolant temperature is below		0	°C
92	Run-up period to rated speed (without driven machinery)	R	N	s
93	Run-up period to rated speed (with driven machinery) (* at general conditions)	R	N	s
37	High idling speed, max. (static)	L	1700	rpm
38	Limit speed for overspeed alarm / emergency shutdown	L	1950	rpm
39	Limit speed for overspeed alarm	L	1950	rpm
42	Firing speed, from	R	80	rpm
43	Firing speed, to	R	120	rpm
44	Engine coolant temperature before starting full-load operation, recommended min. (for emergency/standby sets with coolant preheating the minimum preheating temperature referred to extended property No.22 is sufficient)	R	60	°C
3515	Minimum continuous load (operation > 10h)	R	30	kW/cyl
49	Extended low or no-load operation possible (consultation required)		X	-
50	Engine mass moment of inertia (without flywheel)	R	24.6	kgm ²
52	Standard flywheel mass moment of inertia	R	10.2	kgm ²
51	Engine mass moment of inertia (with standard flywheel)	R	34.8	kgm ²
69	Speed droop (with electronic governor) adjustable, from	R	0	%
70	Speed droop (with electronic governor) adjustable, to	R	7	%
95	Number of starter ring-gear teeth on engine flywheel		182	-

[BL] Reference value: fuel stop power
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Dataset	Ref. 25°C/55°C	Nominal power [bhp]	3473
		Nominal power [kVA]	-
		Nominal power [kWeI]	-
		Frequency [Hz]	50

Exhaust Regulations NOx emission optimized ;

13. Starting (electric)

No.	Description	Index	Value	Unit
2309	Manufacturer		Delco	-
4101	Type		50MT	-
2310	Number of starter		2	-
2312	Starter electrically redundant		-	-
2313	Rated power per starter	R	9	kW
2314	Starter, rated voltage	R	24	VDC
2315	Rated short-circuit current per starter	L	1900	A
2316	Power consumption per starter (at an engine speed of 100 rpm)	R	580	A
2317	Internal resistance of power supply + line resistance per starter	A	0.008	Ω
2318	Manufacturer		Bosch	-
4118	Type		HEP	-
2319	Number of starter		2	-
2320	Starter electrically redundant		-	-
2321	Rated power per starter	R	11.3	kW
2322	Starter, rated voltage	R	24	VDC
2323	Rated short-circuit current per starter	L	2190	A
2324	Power consumption per starter (at an engine speed of 100 rpm)	R	750	A
2325	Internal resistance of power supply + line resistance per starter	A	0.0047	Ω
2326	Manufacturer		Prestolite	-
4119	Type		S-152	-
2327	Number of starter		1	-
2328	Starter electrically redundant		-	-

BL Reference value: fuel stop power
Maximum engine power that cannot be run continuously on some applications (stabilization reserve)

DL Reference value: continuous power
Engine power that can be run continuously under standard conditions

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Name	20V4000G34F	Speed [rpm]	1500
Application Group	3F	Nominal power [kW]	2590
Dataset	Ref. 25°C/55°C	Nominal power [bhp]	3473
		Nominal power [kVA]	-
		Nominal power [kWe]	-
		Frequency [Hz]	50

~~Exhaust Regulations~~ NOx emission optimized ;

2329	Rated power per starter	R	15	kW
2330	Starter, rated voltage	R	24	VDC
2331	Rated short-circuit current per starter	L	3000	A
2332	Power consumption per starter (at an engine speed of 100 rpm)	R	1400	A
2333	Internal resistance of power supply + line resistance per starter	A	0.0049	Ω
2334	Manufacturer		Prestolite	-
4120	Type		S-152	-
2335	Number of starter		2	-
2336	Starter electrically redundant		X	-
2337	Rated power per starter	R	15	kW
2338	Starter, rated voltage	R	24	VDC
2339	Rated short-circuit current per starter	L	3000	A
2340	Power consumption per starter (at an engine speed of 100 rpm)	R	1400	A
2341	Internal resistance of power supply + line resistance per starter	A	0.0049	Ω
4104	Manufacturer		Prestolite	-
4105	Type		M128R	-
4106	Number of starter		2	-
4107	Starter electrically redundant		-	-
4108	Rated power per starter	R	9.4	kW
4109	Starter, rated voltage	R	24	VDC
4110	Rated short-circuit current per starter	L	2000	A
4111	Power consumption per starter (at an engine speed of 100 rpm)	R	600	A
4112	Power consumption per starter (at an engine speed of 100 rpm, SAE0)	R	-	A
4113	Power consumption per starter (at an engine speed of 100 rpm, SAE1)	R	-	A

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Application Group	3F	Nominal power [kW]	2590
Dataset	Ref. 25°C/55°C	Nominal power [bhp]	3473
		Nominal power [kVA]	-
		Nominal power [kWeI]	-
		Frequency [Hz]	50

Exhaust Regulations NOx emission optimized ;

4114	Internal resistance of power supply + line resistance per starter	A	0.008	Ω
2347	Generally valid data for starter		X	-
2342	Rated starting-attempt Duration (at +20°C ambient temperature with battery full)	R	5	s
2343	Interval between starts (at rated starting-attempt duration), min.	L	20	s
2345	Maximum acceptable starting-attempt duration	L	15	s
2344	Interval between starts (when starting-attempt duration > rated starting-attempt duration)	R	60	s
2346	Starting attempts within 30 minutes (at +20°C ambient temperature with battery full), max.	L	6	-
3565	Disengagement of starter pinion at engine Speed Note: Exceeding the guideline value of the disengagement speed will reduce the life cycle of the starter depending on how often and how much the speed has been exceeded	R	400	rpm
3566	Disengagement of starter pinion at engine speed, max.	L	500	rpm

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Dataset	Ref. 25°C/55°C	Nominal power [bhp]	3473
		Nominal power [kVA]	-
		Nominal power [kWeI]	-
		Frequency [Hz]	50

Exhaust Regulations NOx emission optimized ;

14. Starting (air in cylinder)

No.	Description	Index	Value	Unit
1	Starting air pressure before engine, min.	R	-	bar
2	Starting air pressure before engine, max.	R	-	bar
3	Starting air pressure before engine, min.	L	-	bar
4	Starting air pressure before engine, max.	L	-	bar
20	Start attempt duration (engine preheated)	R	-	s
21	Start attempt duration (engine not preheated)	R	-	s
22	Start attempt duration	L	-	s
23	Air consumption / start attempt (engine preheated)	R	-	m ³ n
24	Air consumption / start attempt (engine not preheated)	R	-	m ³ n
25	Starting air tank for 3 start attempts (max. 40 bar) (engine preheated)	R	-	liter
26	Starting air tank for 3 start attempts (max. 30 bar) (engine preheated)	R	-	liter
27	Starting air tank for 6 start attempts (max. 40 bar) (engine preheated)	R	-	liter
28	Starting air tank for 6 start attempts (max. 30 bar) (engine preheated)	R	-	liter
29	Starting air tank for 10 start attempts (max. 40 bar) (engine preheated)	R	-	liter
30	Starting air tank for 10 start attempts (max. 30 bar) (engine preheated)	R	-	liter
31	Starting air tank for 3 start attempts (max. 40 bar) (engine not preheated)	R	-	liter
32	Starting air tank for 3 start attempts (max. 30 bar) (engine not preheated)	R	-	liter
33	Starting air tank for 6 start attempts (max. 40 bar) (engine not preheated)	R	-	liter

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Application Group	3F	Nominal power [kW]	2590
Dataset	Ref. 25°C/55°C	Nominal power [bhp]	3473
		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50

Exhaust Regulations NOx emission optimized ;

34	Starting air tank for 6 start attempts (max. 30 bar) (engine not preheated)	R	-	liter
35	Starting air tank for 10 start attempts (max. 40 bar) (engine not preheated)	R	-	liter
36	Starting air tank for 10 start attempts (max. 30 bar) (engine not preheated)	R	-	liter

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Application Group	3F	Nominal power [kW]	2590
Dataset	Ref. 25°C/55°C	Nominal power [bhp]	3473
		Nominal power [kVA]	-
		Nominal power [kWe]	-
		Frequency [Hz]	50

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15. Starting (pneumatic/oil pressure starter)

No.	Description	Index	Value	Unit
35	Pneumatic starter: make Cali		-	-
36	Pneumatic starter: make TD1		X	-
5	Starting air pressure before starter motor, min.	R	8	bar
6	Starting air pressure before starter motor, max.	R	9	bar
7	Starting air pressure before starter motor, min.	L	8	bar
8	Starting air pressure before starter motor, max.	L	9	bar
18	Start attempt duration (engine preheated)	R	3	s
19	Start attempt duration (engine not preheated)	R	5	s
20	Start attempt duration, max.	L	-	s
114	Air consumption/start attempt (engine preheated) Engine without generator Control with engine controller	R	1.4	m ³ n
115	Air consumption/start attempt (engine not preheated) Engine without generator Control with engine controller	R	1.6	m ³ n
116	Air consumption with external control for air starter (per second)	R	0.7	m ³ n
23	Starting air tank for 3 start attempts (max. 40 bar) (engine preheated)	R	-	liter
24	Starting air tank for 3 start attempts (max. 30 bar) (engine preheated)	R	-	liter
25	Starting air tank for 6 start attempts (max. 40 bar) (engine preheated)	R	-	liter
26	Starting air tank for 6 start attempts (max. 30 bar) (engine preheated)	R	-	liter
27	Starting air tank for 10 start attempts (max. 40 bar) (engine preheated)	R	-	liter

[BL] Reference value: fuel stop power
Maximum engine power that cannot be run continuously on some applications (stabilization reserve)

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Engine power that can be run continuously under standard conditions

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Application Group	3F	Nominal power [kW]	2590
Dataset	Ref. 25°C/55°C	Nominal power [bhp]	3473
		Nominal power [kVA]	-
		Nominal power [kWel]	-
		Frequency [Hz]	50

Exhaust Regulations NOx emission optimized ;

28	Starting air tank for 10 start attempts (max. 30 bar) (engine preheated)	R	-	liter
29	Starting air tank for 3 start attempts (max. 40 bar) (engine not preheated)	R	N	liter
30	Starting air tank for 3 start attempts (max. 30 bar) (engine not preheated)	R	N	liter
31	Starting air tank for 6 start attempts (max. 40 bar) (engine not preheated)	R	N	liter
32	Starting air tank for 6 start attempts (max. 30 bar) (engine not preheated)	R	N	liter
33	Starting air tank for 10 start attempts (max. 40 bar) (engine not preheated)	R	N	liter
34	Starting air tank for 10 start attempts (max. 30 bar) (engine not preheated)	R	N	liter

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Application Group	3F	Nominal power [kW]	2590
Dataset	Ref. 25°C/55°C	Nominal power [bhp]	3473
		Nominal power [kVA]	-
		Nominal power [kWeI]	-
		Frequency [Hz]	50

Exhaust Regulations NOx emission optimized ;

16. Inclinations - standard oil system (ref.: waterline)

No.	Description	Index	Value	Unit
15	Longitudinal inclination, continuous max. driving end down (Option: max. operating inclinations)	L	5	degrees (°)
16	Longitudinal inclination, temporary max. driving end down (Option: max. operating inclinations)	L	-	degrees (°)
17	Longitudinal inclination, continuous max. driving end up (Option: max. operating inclinations)	L	5	degrees (°)
18	Longitudinal inclination, temporary max. driving end up (Option: max. operating inclinations)	L	-	degrees (°)
19	Transverse inclination, continuous max. (Option: max. operating inclinations)	L	10	degrees (°)
20	Transverse inclination, temporary max. (Option: max. operating inclinations)	L	-	degrees (°)

[BL] Reference value: fuel stop power
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Dataset	Ref. 25°C/55°C	Nominal power [bhp]	3473
		Nominal power [kVA]	-
		Nominal power [kWeI]	-
		Frequency [Hz]	50

Exhaust Regulations NOx emission optimized ;

17. Inclinations - special oil system (ref.: waterline)

No.	Description	Index	Value	Unit
1	Longitudinal inclination, continuous max.	L	-	degrees (°)
7	Transverse inclination, continuous max.	L	-	degrees (°)

[BL] Reference value: fuel stop power
Maximum engine power that cannot be run continuously on some applications (stabilization reserve)

[DL] Reference value: continuous power
Engine power that can be run continuously under standard conditions

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Application Group	3F	Nominal power [kW]	2590
Dataset	Ref. 25°C/55°C	Nominal power [bhp]	3473
		Nominal power [kVA]	-
		Nominal power [kWeI]	-
		Frequency [Hz]	50

Exhaust Regulations NOx emission optimized ;

18. Capacities

No.	Description	Index	Value	Unit
1	Engine coolant capacity (without cooling equipment)	R	205 *	liter
10	Intercooler coolant capacity	R	50	liter
11	On-engine fuel capacity	R	9	liter
14	Engine oil capacity, initial filling (standard oil system) (Option: max. operating inclinations)	R	390 *	liter
20	Oil change quantity, max. (standard oil system) (Option: max. operating inclinations)	R	340 *	liter
28	Oil pan capacity, dipstick mark min. (standard oil system) (Option: max. operating inclinations)	L	268	liter
29	Oil pan capacity, dipstick mark max. (standard oil system) (Option: max. operating inclinations)	L	315	liter

BL Reference value: fuel stop power
Maximum engine power that cannot be run continuously on some applications (stabilization reserve)

DL Reference value: continuous power
Engine power that can be run continuously under standard conditions

≥ Actual value must be greater than specified value
≤ Actual value must be less than specified value

X Applicable
The module is valid for this product type

□ Non-applicable
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Application Group	3F	Nominal power [kW]	2590
Dataset	Ref. 25°C/55°C	Nominal power [bhp]	3473
		Nominal power [kVA]	-
		Nominal power [kWeI]	-
		Frequency [Hz]	50

Exhaust Regulations NOx emission optimized ;

19. Masses / dimensions

No.	Description	Index	Value	Unit
9	Engine mass, dry (basic engine configuration acc. to scope of supply specification)	R	9290	kg

BL Reference value: fuel stop power
Maximum engine power that cannot be run continuously on
some applications (stabilization reserve)

DL Reference value: continuous power
Engine power that can be run continuously under standard
conditions

> Actual value must be greater than specified value
< Actual value must be less than specified value

X Applicable
The module is valid for this product type

□ Non-applicable
The module is not valid for this product type

N Value not named
The value has not yet been named or will not be named

□ Adequate verification not yet available (tolerance +/- 10%)
□ Adequate verification not yet available (tolerance +/- 5%)

A Design value
Value required for the design of an external system
(plant)

R Guideline value
Typical average value as information – only suitable
for design purposes to a limited extent

L Limit value
A value representing the lower limit/minimum value or
upper limit/maximum value that may not be
exceeded. Not suitable for design purposes



Name	20V4000G34F	Speed [rpm]	1500
Application Group	3F	Nominal power [kW]	2590
Dataset	Ref. 25°C/55°C	Nominal power [bhp]	3473
		Nominal power [kVA]	-
		Nominal power [kWeI]	-
		Frequency [Hz]	50

Exhaust Regulations NOx emission optimized ;

21. Exhaust emissions

No.	Description	Index	Value	Unit
1947	Emissions data sheet: "TA-Luft" - CP		X	-

[BL] Reference value: fuel stop power
Maximum engine power that cannot be run continuously on some applications (stabilization reserve)

[DL] Reference value: continuous power
Engine power that can be run continuously under standard conditions

[>] Actual value must be greater than specified value
[<] Actual value must be less than specified value

[X] Applicable
The module is valid for this product type

[] Non-applicable
The module is not valid for this product type

[N] Value not named
The value has not yet been named or will not be named

[*] Adequate verification not yet available (tolerance +/-10%)
[] Adequate verification not yet available (tolerance +/-5%)**

[A] Design value
Value required for the design of an external system (plant)

[R] Guideline value
Typical average value as information – only suitable for design purposes to a limited extent

[L] Limit value
A value representing the lower limit/minimum value or upper limit/maximum value that may not be exceeded. Not suitable for design purposes



Name	20V4000G34F	Speed [rpm]	1500
Application Group	3F	Nominal power [kW]	2590
Dataset	Ref. 25°C/55°C	Nominal power [bhp]	3473
		Nominal power [kVA]	-
		Nominal power [kWeI]	-
		Frequency [Hz]	50

Exhaust Regulations NOx emission optimized ;

22. Acoustics

No.	Description	Index	Value	Unit
101	Exhaust noise, unsilenced - CP (free-field sound-pressure level Lp, 1m distance, ISO 6798, +3dB(A) tolerance)	R	116	dB(A)
201	Exhaust noise, unsilenced - CP (sound power level LW, ISO 6798, +3dB(A) tolerance)	R	129	dB(A)
102	Exhaust noise, unsilenced - FSP (free-field sound-pressure level Lp, 1m distance, ISO 6798, +3dB(A) tolerance)	R	-	dB(A)
202	Exhaust noise, unsilenced - FSP (sound power level LW, ISO 6798, +3dB(A) tolerance)	R	-	dB(A)
103	Exhaust noise, unsilenced - CP (free-field sound-pressure level Lp, 1m distance, ISO 6798) Spectrum No.	R	735830e	-
203	Exhaust noise,unsilenced - CP (sound power level LW, ISO 6798) Spectrum No.	R	N	-
104	Exhaust noise, unsilenced - FSP (free-field sound-pressure level Lp, 1m distance, ISO 6798) Spectrum No.	R	-	-
204	Exhaust noise,unsilenced - FSP (sound power level LW, ISO 6798) Spectrum No.	R	-	-
109	Engine surface noise with attenuated intake noise (filter) - CP (free-field sound-pressure level Lp, 1m distance, ISO 6798, +2dB(A) tolerance)	R	109	dB(A)
209	Engine surface noise with attenuated intake noise (filter) - CP (sound power level LW, ISO 6798, +2dB(A) tolerance)	R	128	dB(A)

[BL] Reference value: fuel stop power
Maximum engine power that cannot be run continuously on
some applications (stabilization reserve)

[DL] Reference value: continuous power
Engine power that can be run continuously under standard
conditions

[>] Actual value must be greater than specified value
[<] Actual value must be less than specified value

[X] Applicable
The module is valid for this product type

[] Non-applicable
The module is not valid for this product type

[N] Value not named
The value has not yet been named or will not be named

[*] Adequate verification not yet available (tolerance +/-10%)
[]** Adequate verification not yet available (tolerance +/-5%)

[A] Design value
Value required for the design of an external system
(plant)

[R] Guideline value
Typical average value as information – only suitable
for design purposes to a limited extent

[L] Limit value
A value representing the lower limit/minimum value or
upper limit/maximum value that may not be
exceeded. Not suitable for design purposes



Name	20V4000G34F	Speed [rpm]	1500
Application Group	3F	Nominal power [kW]	2590
Dataset	Ref. 25°C/55°C	Nominal power [bhp]	3473
		Nominal power [kVA]	-
		Nominal power [kWeI]	-
		Frequency [Hz]	50

Exhaust Regulations NOx emission optimized ;

110	Engine surface noise with attenuated intake noise (filter) - FSP (free-field sound-pressure level Lp, 1m distance, ISO 6798, +2dB(A) tolerance)	R	-	dB(A)
210	Engine surface noise with attenuated intake noise (filter) - FSP (sound power level LW, ISO 6798, +2dB(A) tolerance)	R	-	dB(A)
111	Engine surface noise with attenuated intake noise (filter) - CP (free-field sound-pressure level Lp, 1m distance, ISO 6798) Spectrum No.	R	738 662e	-
211	Engine surface noise with attenuated intake noise (filter) - CP (sound power level LW, ISO 6798) Spectrum No.	R	N	-
112	Engine surface noise with attenuated intake noise (filter) - FSP (free-field sound-pressure level Lp, 1m distance, ISO 6798) Spectrum No.	R	-	-
212	Engine surface noise with attenuated intake noise (filter) - FSP (sound power level LW, ISO 6798) Spectrum No.	R	-	-
132	Engine surface noise, without intake noise - FSP (free-field sound-pressure level Lp, 1m distance, ISO 6798, +2dB(A) tolerance)	R	-	dB(A)
232	Engine surface noise, without intake noise - FSP (sound power level LW, ISO 6798, +2dB(A) tolerance)	R	-	dB(A)
134	Engine surface noise, without intake noise - FSP (free-field sound-pressure level Lp, 1m distance, ISO 6798) Spectrum No.	R	-	-
234	Engine surface noise, without intake noise - FSP (sound power level LW, ISO 6798) Spectrum No.	R	-	-
118	Intake noise, unsilenced - FSP (free-field sound-pressure level Lp, 1m distance, ISO 6798)	R	-	dB(A)

[BL] Reference value: fuel stop power
Maximum engine power that cannot be run continuously on some applications (stabilization reserve)

[DL] Reference value: continuous power
Engine power that can be run continuously under standard conditions

[>] Actual value must be greater than specified value
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[] Non-applicable
The module is not valid for this product type

[N] Value not named
The value has not yet been named or will not be named

[*] Adequate verification not yet available (tolerance +/-10%)
[]** Adequate verification not yet available (tolerance +/-5%)

[A] Design value
Value required for the design of an external system (plant)

[R] Guideline value
Typical average value as information – only suitable for design purposes to a limited extent

[L] Limit value
A value representing the lower limit/minimum value or upper limit/maximum value that may not be exceeded. Not suitable for design purposes



- Product Data -

Name	20V4000G34F	Speed [rpm]	1500
Application Group	3F	Nominal power [kW]	2590
Dataset	Ref. 25°C/55°C	Nominal power [bhp]	3473
		Nominal power [kVA]	-
		Nominal power [kWeI]	-
		Frequency [Hz]	50

Exhaust Regulations NOx emission optimized ;

218	Intake noise, unsilenced - FSP (sound power level LW, ISO 6798)	R	-	dB(A)
120	Intake noise, unsilenced - FSP (free-field sound-pressure level Lp, 1m distance, ISO 6798) Spectrum No.	R	-	-
220	Intake noise, unsilenced - FSP (sound power level LW, ISO 6798) Spectrum No.	R	-	-
125	Structure borne noise at engine mounting brackets in vertical direction above resilient engine mounts - CP Spectrum No.	R	735852e	-
126	Structure borne noise at engine mounting brackets in vertical direction above resilient engine mounts - FSP Spectrum No.	R	-	-
128	Structure born noise, vertically below the resilient engine mounts - FSP Spectrum No.	R	-	-

BL Reference value: fuel stop power
Maximum engine power that cannot be run continuously on
some applications (stabilization reserve)

DL Reference value: continuous power
Engine power that can be run continuously under standard
conditions

> Actual value must be greater than specified value
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The module is valid for this product type

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A Design value
Value required for the design of an external system
(plant)

R Guideline value
Typical average value as information – only suitable
for design purposes to a limited extent

L Limit value
A value representing the lower limit/minimum value or
upper limit/maximum value that may not be
exceeded. Not suitable for design purposes



Appendix 03 - Alternator Datasheet

ALTERNATOR TECHNICAL DESCRIPTION
LSA 53.2 L14 / 4p

LS Reference: DW902-06-2022-1 1

Date: 13.06.2022	V6.08 - 08/2021	1
Nidec ACIM Germany GmbH	Project Manager : MB.13.06.2022	1
Electric Power Generation	daniel.werder@mail.nidec.com	
Eschborner Landstrasse 166 - 60489 Frankfurt am Main	+49 (0) 69 780708-52	
	DW	

Main data C 1

Generator type:	LSA 53.2 L14 / 4p			1
Power:	3 050 kVA	2 440 kWe	2 523 kWm	1
Voltage:	400 V	Star serial		1
Rated voltage range:	+5/-5%			1
Power factor - Lagging:	0,8			1
Frequency:	50 Hz			1
Speed:	1 500 rpm			1
Nominal current:	4 402 A			1
Winding type:	p2/3			1
Classes (Insulation / Temperature Rise):	H / H			1
Ambient temperature:	40 °C			1
Altitude:	1 000 m			1

Installation IEC Quantity 32 1

Client:	Rolls-Royce Solutions GmbH	1
Project:	Yondr Frankfurt 012270066	1
Site:	to define	1
Prime mover:	Reciprocating engine	1
Manufacturer:	MTU	1
Type:	to define	1
Duty:	Base Rating	1
Industry:	Construction	1

Mechanical construction IM1101 1

Type of construction:	Two bearing	1
Mounting arrangement:	Horizontal Axis	1
Direction of rotation:	Clockwise (seen when facing the drive end - DE)	1
Bearing type:	Anti-friction	1
Bearing Lubrication:	Regreasable	1
Bearing insulation:	Not insulated	1
Shaft end type:	Cylindrical with keyway	1
Balancing - Class (ISO 1940/1):	Half key - G2,5 (std)	1
Flange:	None / without	1
Shaft height:	500 mm	1
Width:	1 150 mm	1

Additional specificities 1

Stabilized Runaway speed:	1 800 rpm - 2 min.	1
---------------------------	--------------------	---

ALTERNATOR TECHNICAL DESCRIPTION
LSA 53.2 L14 / 4p

LS Reference: DW902-06-2022-1

Cooling Method		IC01	1
Degree of protection:	IP23		1
Coolant:	Air / Temperature: 40 °C		1
Air quality:	Clean		1
Ventilation (internal):	Self-ventilated		1
Filters:	Without		1
Ducting for air inlet:	No		1
Ducting for air outlet:	No		1
Connection, Excitation & Regulation			1
Parallel operation:	With mains (3F) - use of measuring CT		1
Excitation:	Self-excited - Brushless - Type: PMG		1
Sustained 3-phase Isc:	> 3 x FLC for 10s.		1
AVR type:	Leroy Somer - D550 - Digital		1
AVR location:	In terminal box		1
Alternator Voltage sensing:	In terminal box		1
Additional features:	Three-phase sensing		1
	Diode failure detector		1
Terminal box			1
Power connection:	4 connectors (brought out neutral)		1
Main terminal box location:	1 terminal box on the top		1
Line side outlet:	Left hand side (seen when facing the drive end - D)		1
Gland plate:	Non magnetic, Undrilled		1
Auxiliaries	In main terminam box		1
	-		1
Protection and measurement accessories			1
Temperature detection			1
Stator windings:	6 x 3-wire PT100 RTDs		1
Combined guide and thrust bearing - DE:	1 x 3-wire PT100 RTD		1
Guide bearing - NDE:	1 x 3-wire PT100 RTD		1
Anti-condensation heating			1
	Voltage: 230 V - 1Ph / Power: 500 W		1
Transformers (Client use)			1
LS Supply		<i>Transformers' curve & test report required</i>	1
Set of 3 x CTs (measuring and/or protection):	I Primary / I Secondary / Power / Class		1
<i>Preliminary</i> Neutral side	S1 4500 / 1A / 10VA / Cl. 0,5 FS5		1
	S2 4500 / 1A / 10VA / Cl. 5P10		1
Various items			1
Paint:	C3M-P - Polyurethane - RAL code acc. to RRS request		1
Documentation:	PDF manual		1
Documentation Language:	English		1

ALTERNATOR TECHNICAL DESCRIPTION
LSA 53.2 L14 / 4p

LS Reference: DW902-06-2022-1 1

Controls

QUAL/INES/006 001	Measurement of winding resistance	1
QUAL/INES/006 021	Insulation check on sensors (when fitted)	1
QUAL/INES/006 002	Voltage balance and phase order check	1
QUAL/INES/006 007	Overspeed test (according to test bench limitation)	1
QUAL/INES/006 009	High potential test	1
QUAL/INES/006 010	Insulation resistance measurement	1
		-
		-

ALTERNATOR ELECTRICAL DATA
LSA 53.2 L14 / 4P

LS Reference: DW902-06-2022-1

Date: 13.06.2022

V6.08 - 08/2021

Main data:				C
Power:	3 050 kVA	2 440 kW _e	2 523 kW _m	1
Voltage:	400 V	Frequency:	50 Hz	1
Rated voltage range:	+5% / -5%	Speed:	1500 rpm	1
Power factor - Lagging:	0,8			1
Nominal current:	4 402 A	Phases	3	
Insulation / Temperature rise:	H / H	Connexion	Star serial	1
Cooling:	IC01	Winding type:	p2/3	1
		Winding:	- 6 Wires	1
Ambient temperature:	40 °C			1
Altitude:	1000 m	Overspeed (rpm)	1800	1
Duty: Base Rating		Total Harmonic Distortion (THD) <	3,5%	1

Efficiency (Base 2440 kW _e)		IEC				
		25%	50%	75%	100%	110%
Power factor - Lagging: 0,8		93,6	96,0	96,6	96,7	96,7
Power factor - Lagging: 1		94,0	96,6	97,3	97,5	97,6

Reactances (%) - (Base 3050 kVA)																																							
Unitary impedance (1 per unit) = 0,052459 ohms																																							
	<table border="1"> <thead> <tr> <th></th> <th>Unsaturated</th> <th>Saturated</th> <th>Unsaturated</th> <th>Saturated</th> </tr> </thead> <tbody> <tr> <td></td> <td colspan="2">Direct axis</td> <td colspan="2">Quadrature axis</td> </tr> <tr> <td>Synchronous reactance</td> <td>X_d</td> <td>218</td> <td>143</td> <td>X_q</td> <td>111</td> <td>73</td> </tr> <tr> <td>Transient reactance</td> <td>X'_d</td> <td>21,7</td> <td>18,5</td> <td>X'_q</td> <td>111</td> <td>73</td> </tr> <tr> <td>Subtransient reactance</td> <td>X''_d</td> <td>11,4</td> <td>9,7</td> <td>X''_q</td> <td>12,1</td> <td>10,3</td> </tr> <tr> <td>Negative sequence reactance</td> <td>X₂</td> <td>11,8</td> <td>10,0</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>		Unsaturated	Saturated	Unsaturated	Saturated		Direct axis		Quadrature axis		Synchronous reactance	X _d	218	143	X _q	111	73	Transient reactance	X' _d	21,7	18,5	X' _q	111	73	Subtransient reactance	X'' _d	11,4	9,7	X'' _q	12,1	10,3	Negative sequence reactance	X ₂	11,8	10,0			
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Negative sequence reactance	X ₂	11,8	10,0																																				
X ₀	1,9	Zero sequence reactance																																					
X _l	5,7	Stator leakage reactance																																					
X _r	17,3	Rotor leakage reactance																																					
K_c	0,70	Short-circuit ratio																																					

Time constants (s)																
	<table border="1"> <thead> <tr> <th></th> <th>Direct axis</th> <th>Quadrature axis</th> </tr> </thead> <tbody> <tr> <td>Open circuit transient time constant</td> <td>T'_{do}</td> <td>3,43</td> </tr> <tr> <td>Short-circuit transient time constant</td> <td>T'_d</td> <td>0,341</td> </tr> <tr> <td>Open circuit subtransient time constant</td> <td>T''_{do}</td> <td>0,038</td> </tr> <tr> <td>Subtransient time constant</td> <td>T''_d</td> <td>0,020</td> </tr> </tbody> </table>		Direct axis	Quadrature axis	Open circuit transient time constant	T' _{do}	3,43	Short-circuit transient time constant	T' _d	0,341	Open circuit subtransient time constant	T'' _{do}	0,038	Subtransient time constant	T'' _d	0,020
	Direct axis	Quadrature axis														
Open circuit transient time constant	T' _{do}	3,43														
Short-circuit transient time constant	T' _d	0,341														
Open circuit subtransient time constant	T'' _{do}	0,038														
Subtransient time constant	T'' _d	0,020														
T _a	0,039	Armature time constant														

Resistances (%)					
R _a	1,0	Armature resistance	R ₀	0,6	Zero sequence resistance
X/R	10,1	X/R ratio (without unit)	R ₂	2,4	Negative sequence resistance

Voltage accuracy: 0,25%

Maximum inrush current for a voltage dip of 15%: 2750 kVA
when starting an AC motor having a starting power factor between 0 and 0.4

Rating is provided for the specified temperature rise, by resistance measurement according to IEC60034-1

According to: I.E.C. 60034.1 - 60034.2 - NEMA MG 1-32

Products and materials shown in this catalogue may, at any time, be modified in order to follow the latest technological developments.

ALTERNATOR MAIN CURVES
LSA 53.2 L14 / 4P

LS Reference: DW902-06-2022-1

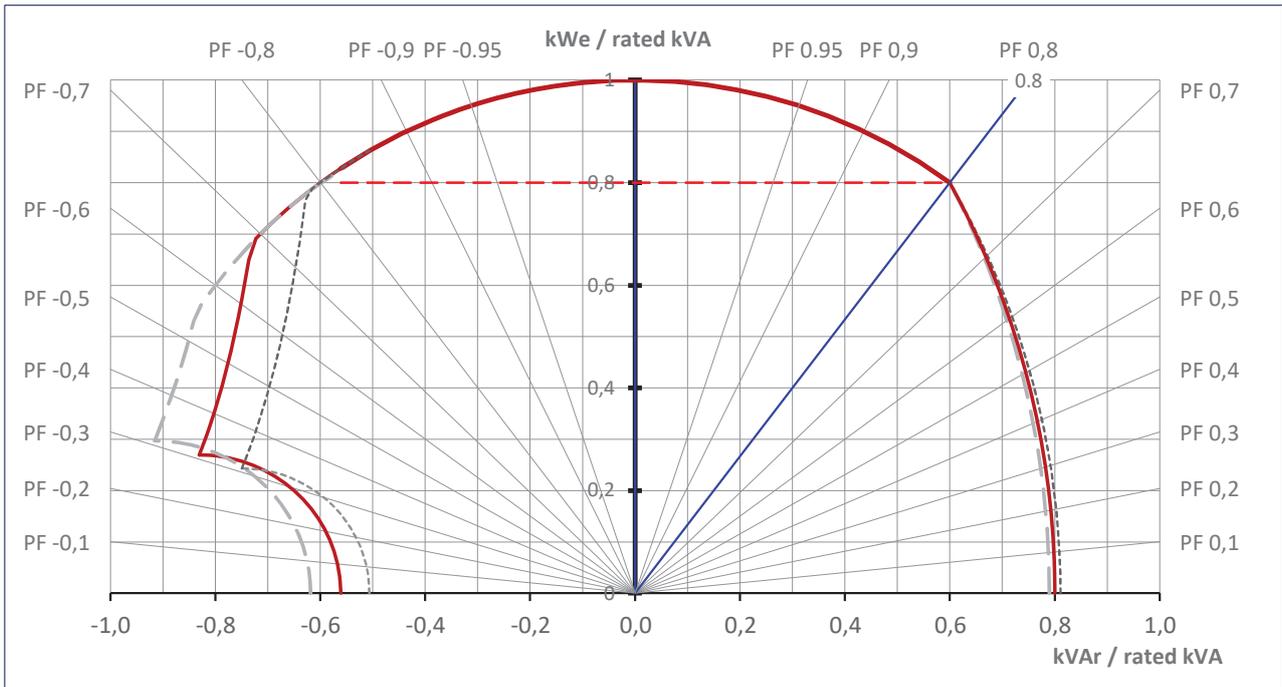
Date: 13.06.2022

3050kVA - 400V - 50 Hz

V6.08 - 08/2021

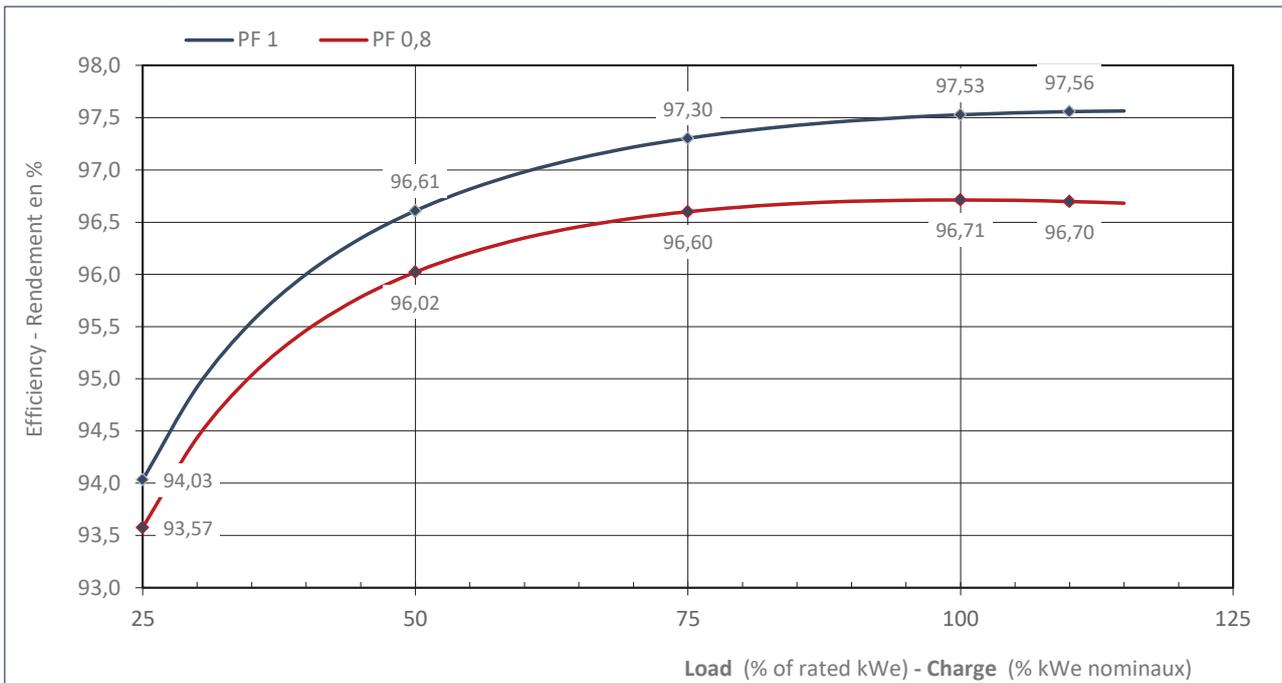
Capability Curve

---	Umax	+ 5%	420	V
—	Un		400	V
- - -	Umin	- 5%	380	V



Efficiency Curves

According to: IEC

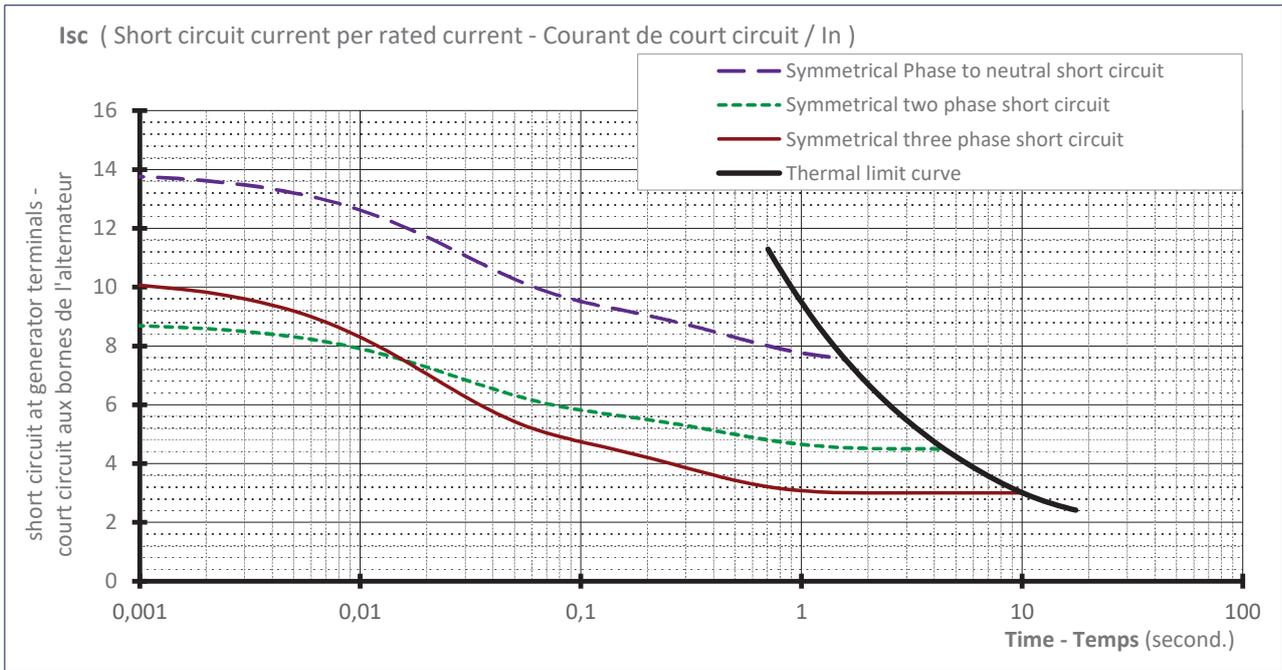


ALTERNATOR MAIN CURVES
LSA 53.2 L14 / 4P

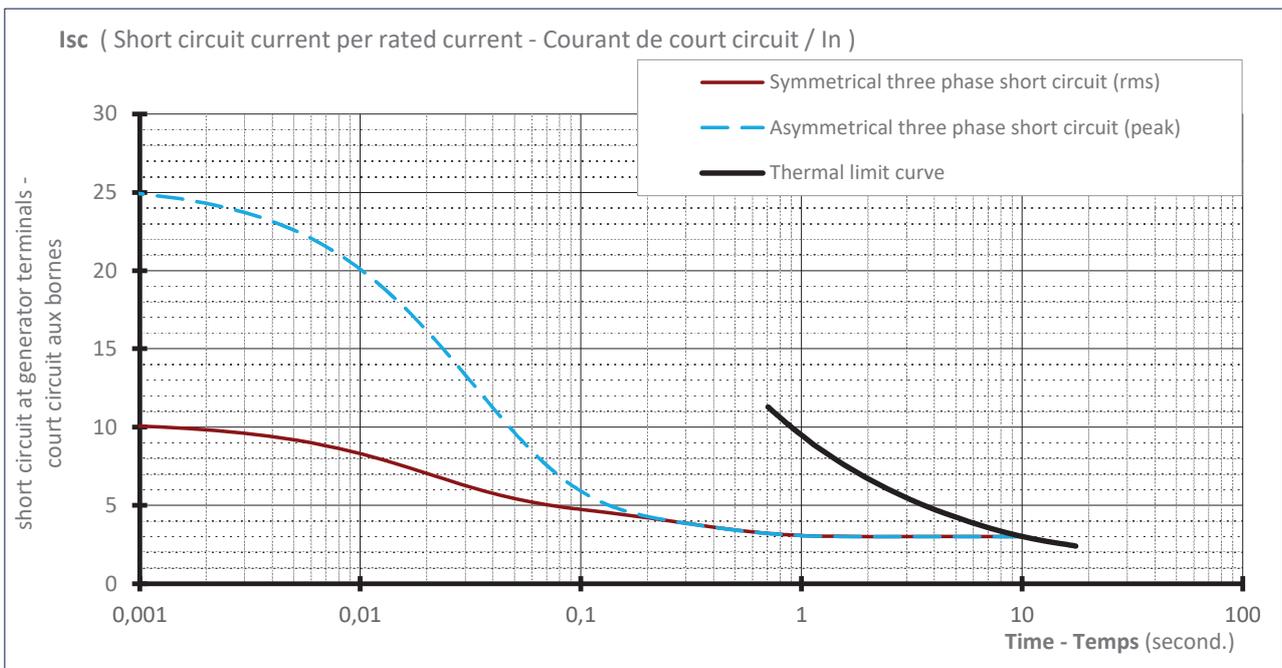
LS Reference: DW902-06-2022-1

Stator Current decrement curves

Symmetrical phase to neutral short-circ	—	initial	60 575	A	13,8 x In	
Symmetrical two phase short-circuit	- - -	max	38 253	A	8,7 x In	In = 4402 A
Symmetrical three phase short-circuit	—	value	44 289	A	10,1 x In	
Thermal Limit	—					



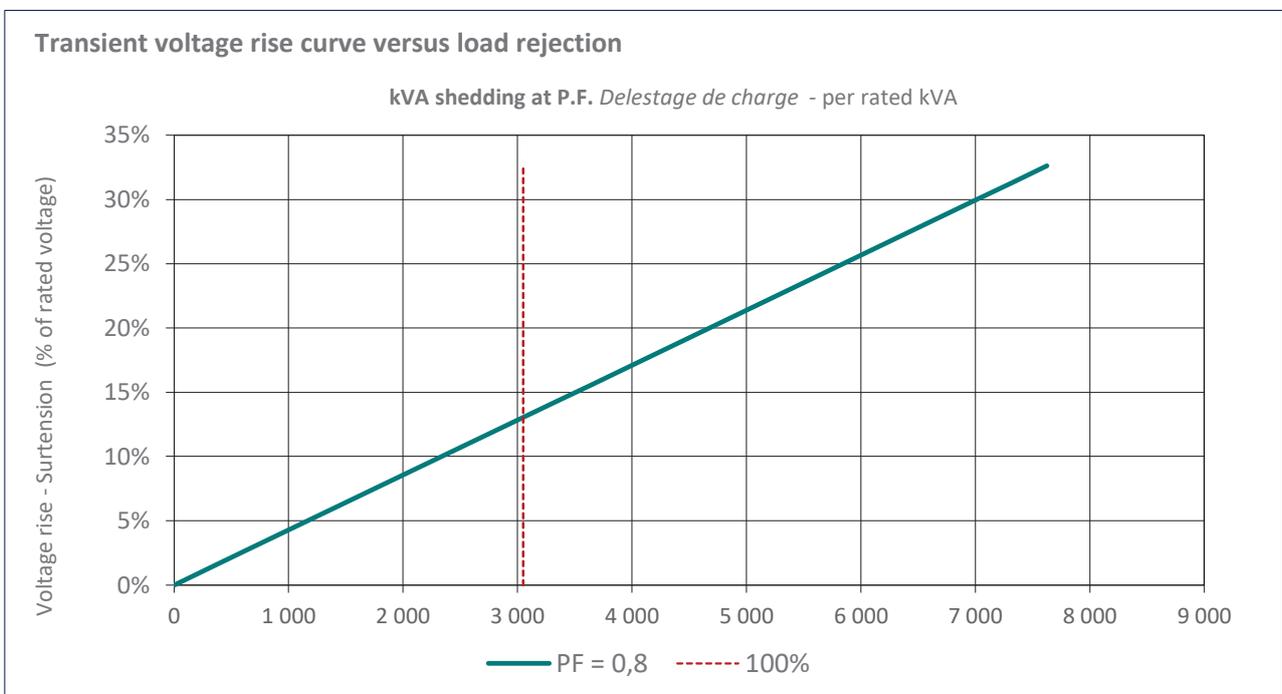
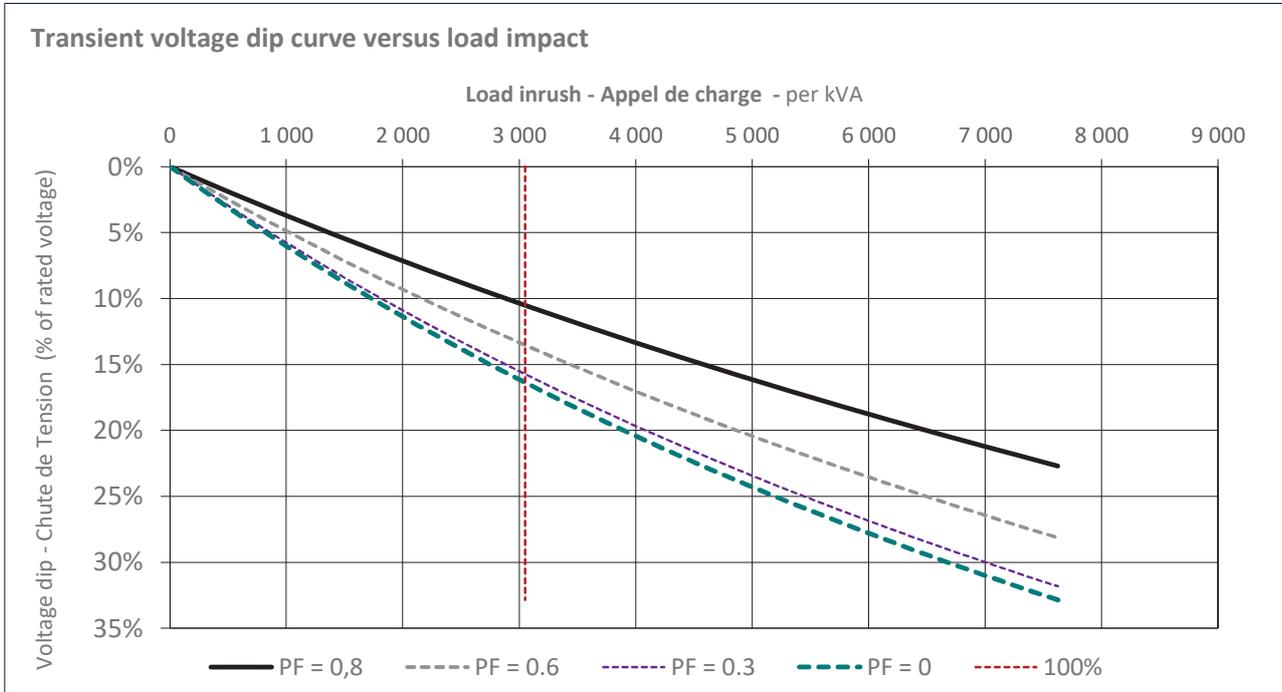
Asymmetrical three phase short-circuit — IP 108 655 A 24,7 x In



ALTERNATOR MAIN CURVES
LSA 53.2 L14 / 4P

LS Reference: DW902-06-2022-1

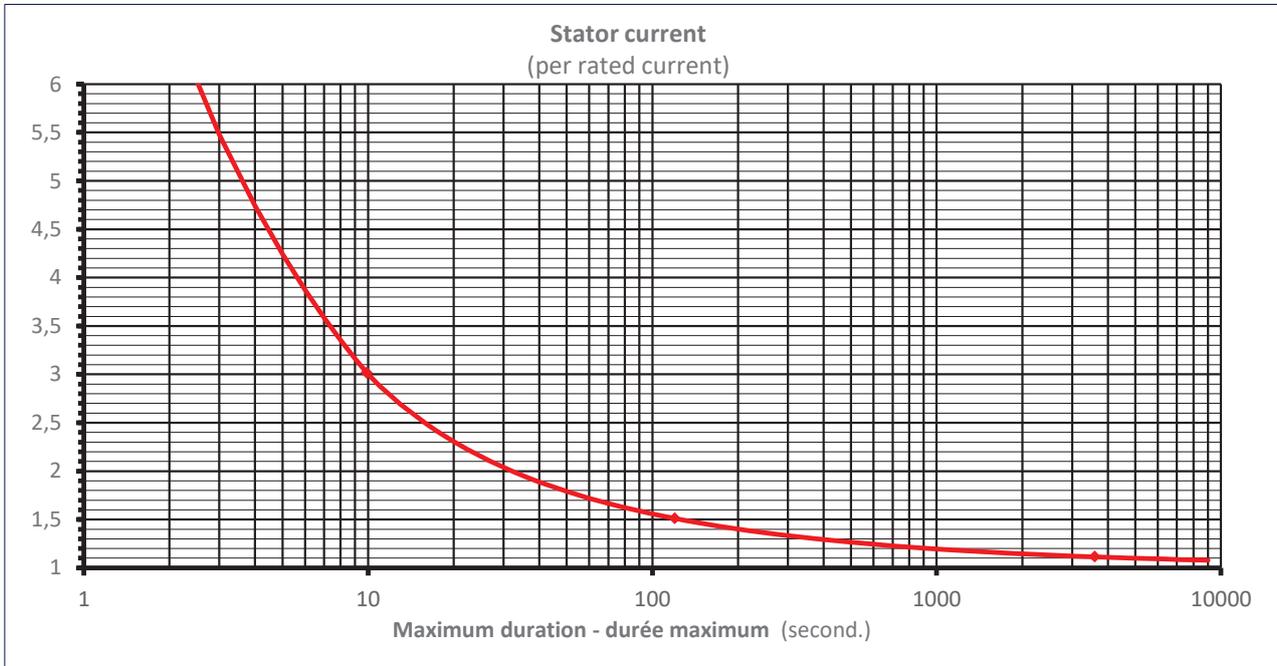
Transient Voltage Variation



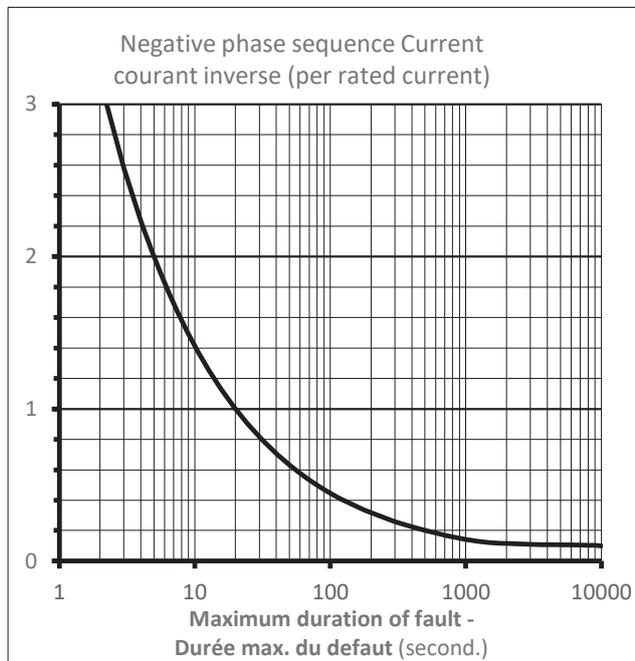
ALTERNATOR MAIN CURVES
LSA 53.2 L14 / 4P

LS Reference: DW902-06-2022-1

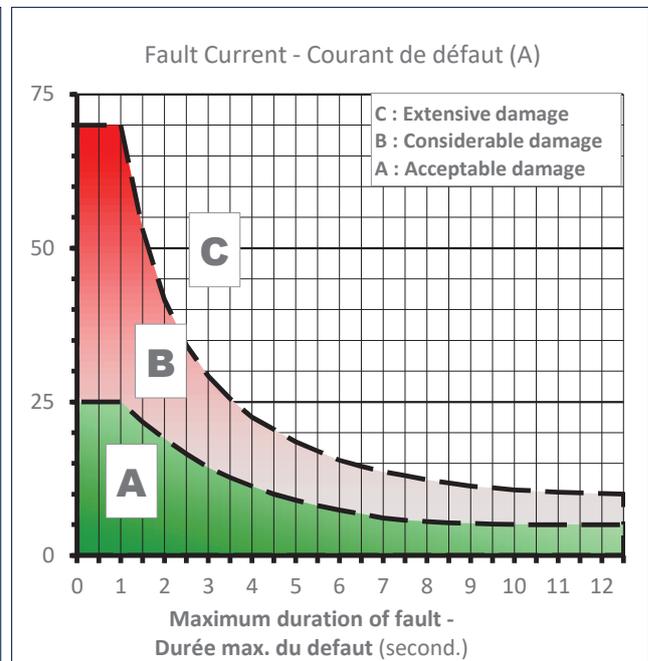
Thermal Damage Curve



Unbalance Load Curve



Stator Earth Fault Current





Appendix 04 - MTU Fluids and Lubricants



Fluids and Lubricants Specifications

Diesel engine-generator sets
with **Series 2000 and 4000 MTU engines**

A001064/09E

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1 Preface

1.1 General information

Used symbols and means of representation

The following instructions are highlighted in the text and must be observed:

Important

This field contains product information which is important or useful for the user. It refers to instructions, work and activities that have to be observed to prevent damage or destruction to the material.

Note:

A note provides special instructions that must be observed when performing a task.

Fluids and lubricants

The service life, operational reliability and function of the drive systems are largely dependent on the fluids and lubricants employed. The correct selection and treatment of these fluids and lubricants are therefore extremely important.

Test standard	Designation
DIN	Federal German Standards Institute
EN	European Standards
ISO	International Standards Organization
ASTM	American Society for Testing and Materials
IP	Institute of Petroleum

Applicability of this document

These Fluids and Lubricants Specifications define the fluids and lubricants for diesel engine-generator sets from MTU Onsite Energy with the following MTU engines:

- Series 2000Gx5
- Series 2000Gx6
- Series 4000Gx3, application groups 3B, 3D, 3E, 3F, 3G
- Series 4000Gx4

Note: Please ignore references to other series in this document.

Up-to-dateness of this document

The Fluids and Lubricants Specifications are revised or supplemented as required. Before using them, make sure you have the latest version (publication number A001064/..). The latest version is available at: www.mtuonsiteenergy.com in the area "Parts and Service" under "MTU ValueCare for Diesel Generator Sets" > "Technical Documentation".

Warranty

Use of the approved fluids and lubricants, either under the brand name or in accordance with the specifications given in this publication, constitutes part of the warranty conditions.

The supplier of the fluids and lubricants is responsible for the worldwide standard quality of the named products.

Important

Fluids and lubricants for diesel engine-generator sets can be hazardous materials. Certain regulations must be obeyed when handling, storing and disposing of these substances.

These regulations are contained in the manufacturers' instructions, legal requirements and technical guidelines valid in the individual countries. Great differences can apply from country to country and a generally valid guide to applicable regulations for fluids and lubricants is therefore not possible within this publication.

Users of the products named in these specifications are therefore obliged to inform themselves of the locally valid regulations. MTU accepts no responsibility whatsoever for improper or illegal use of the fluids and lubricants which it has approved.

MTU Onsite Energy recommends consultation with the suppliers of all fluids and lubricants to request the relevant safety data sheets prior to storing, handling and using these fluids and lubricants.

Safe disposal

Important

To prevent environmental pollution and infringements of statutory requirements, used fluids and lubricants must be disposed of in accordance with local regulations.
Never dispose of or burn the used oil in the fuel tank.

The regulations for the disposal of fluids and lubricants differs from place to place. Environmental protection is one of the fundamental corporate objectives of MTU Onsite Energy. We therefore recommend the recycling of fluids and lubricants wherever possible. If recycling is not possible, MTU Onsite Energy recommends consulting the local waste-disposal authorities before disposing of fluids and lubricants to determine the best option. Users of the products named in these specifications are therefore obliged to inform themselves of the locally valid regulations. MTU accepts no responsibility whatsoever for improper or illegal use of the fluids and lubricants which it has approved.

Registered trademarks

All brand names are registered trademarks of the manufacturer concerned.

Preservation

The document "Preservation and Re-preservation Specifications" (publication number A001070/..) contains all information on:

- Preservation
- Re-preservation and de-preservation
- Permissible preservatives

The latest version is available at: www.mtuonsiteenergy.com in the area "Parts and Service" under "MTU ValueCare for Diesel Generator Sets" > "Technical Documentation".

2 Lubricants

2.1 Engine oils – General information

Important

Dispose of used fluids and lubricants in accordance with local regulations.
Used oil must never be disposed of via the combustion engine!

Requirements of the engine oils for MTU approval

MTU conditions for the approval of engine oils for diesel engines are defined in the MTU standards and available under these numbers:

- MTL 5044: Engine oils for diesel engines; Requirements
- MTL 5051: Initial operation and corrosion inhibitor oil for internal preservation of engines

Manufacturers of engine oils are notified in writing if their product is approved.

Approved engine oils are divided into the following MTU quality groups:

- Oil category 1: Standard quality / Single and multigrade oils
- Oil category 2: Higher quality / Single and multigrade oils
- Oil category 2.1: Multigrade oils with a low ash-forming additive content (low SAPS oils)
- Oil category 3: Highest quality / Multigrade oils
- Oil category 3.1: Multigrade oils with a low ash-forming additive content (low SAPS oils)

Low SAPS oils are oils with a low sulfur and phosphor content and an ash-forming additive content of $\leq 1\%$.

They are only approved if the sulfur content in the fuel does not exceed 50 mg/kg. When using diesel particulate filters, it is advisable to use these oils to avoid fast coating of the filter with ash particles.

Selection of a suitable engine oil is based on fuel quality, projected oil drain interval and on-site climatic conditions. At present there is no international industrial standard which alone takes into account all these criteria.

Important

The use of engine oils not approved by MTU can mean that statutory emission limits can no longer be observed. This can be a punishable offense.

Important

Mixing different engine oils is strictly prohibited!

Changing to another oil grade can be done together with an oil change. The remaining oil quantity in the engine oil system is not critical in this regard.

This procedure also applies to MTU's own engine oils in the regions Europe, Middle East, Africa, America and Asia.

Important

When changing to an engine oil in Category 3, note that the improved cleaning effect of these engine oils can result in the loosening of engine contaminants (e.g. carbon deposits).

It may be necessary therefore to reduce the oil change interval and oil filter service life (one time during change).

Special features

MTU engine oils for diesel engines

At MTU, the following single and multigrade oils are available in the individual regions:

Manufacturer & sales region	Product name	SAE grade	Oil category	Part No.
MTU Friedrichshafen Europe Middle East Africa	Diesel Engine Oil DEO SAE 15W-40	15W-40	2	20 l canister: X00070830 210 l barrel: X00070832 IBC: X00070833 Loose items: X00070835 (only on request)
	Power Guard® DEO SAE 40	40	2	20 l canister: X00062816 210 l barrel: X00062817 IBC: X00064829
MTU America America	Power Guard® SAE 15W-40 Off Highway Heavy Duty	15W-40	2.1	5 gallons: 800133 55 gallons: 800134 IBC: 800135
	Power Guard® SAE 40 Off Highway Heavy Duty	40	2	5 gallons: 23532941 55 gallons: 23532942
MTU Asia Asia	Diesel Engine Oil DEO SAE 15-W40	15W-40	2	18 l canister: 64247/P 200 l barrel: 65151/D
MTU Asia China	Diesel Engine Oil - DEO 15W-40	15W-40	2	20 l canister: 64242/P 205 l barrel: 65151/D
	Diesel Engine Oil - DEO 10W-40	10W-40	2	20 l canister: 60606/P
	Diesel Engine Oil - DEO 5W-30	5W-30	3	20 l canister: 60808/P
MTU Asia Indonesia	Diesel Engine Oil - DEO 15W-40	15W-40	2	20 l canister: 64242/P 205 l barrel: 65151/D
MTU India Pvt. Ltd. India	Diesel Engine Oil - DEO 15W-40	15W-40	2	20 l canister: 63333/P 205 l barrel: 65151/P
	Diesel Engine Oil - DEO 40	40	2	20 l canister: 73333/P 205 l barrel: 75151/D

Restrictions for certain applications

- Series 2000 Gx6
- Series 4000 Gx3, application groups 3F, 3G

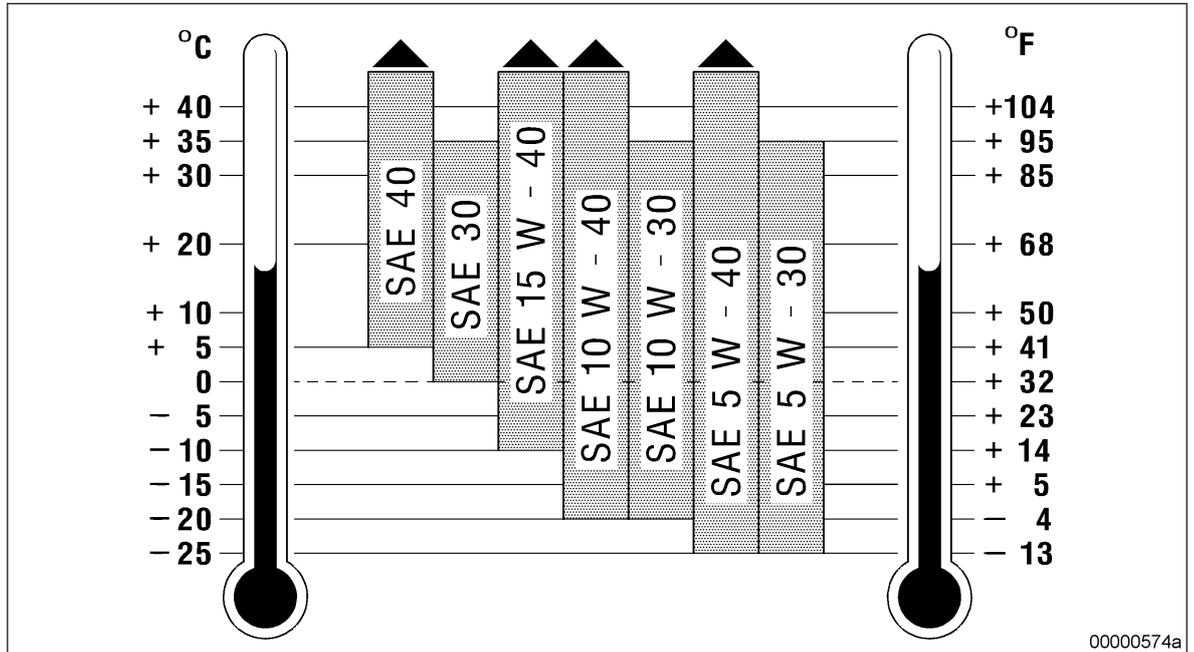
Important

Oils in oil category 1 must not be used!

Selection of viscosity grades

Selection of the viscosity grade is based primarily on the ambient temperature at which the engine is to be started and operated. If the relevant performance criteria are observed the engines can be operated both with single grade and multigrade oils, depending on the application. Guide values for the temperature limits of the individual viscosity classes, see (→ Figure 1).

If the prevailing temperature is too low, the engine oil must be preheated.



00000574a

Figure 1: Viscosity grade chart

Oil drain intervals for diesel engines

Engine oil drain intervals depend on the engine-oil quality, its conditioning, the operating conditions and the fuel used.

The intervals quoted (Table) are guide values based on operational experience and are valid for applications with a standard load profile.

Transmission fluid change intervals

Oil category	Without centrifugal oil filter	With centrifugal oil filter or by-pass filter
1	250 operating hours	500 operating hours
2	500 operating hours	1000 operating hours
2.1 ¹⁾	500 operating hours	1000 operating hours
3	750 operating hours	1500 operating hours
3.1 ¹⁾	750 operating hours	1500 operating hours

Table 1:

¹⁾ = To be used in conjunction with fuels with max. 50 mg/kg sulfur content.

Important

The oil drain intervals in the table (→ Table 1) are recommended guide values when using diesel fuels with < 0.5 % sulfur content. The defined limit values for the used oil (→ Table 2) must be observed. The numbers of operating hours quoted for oils must be confirmed by means of oil analysis.

The oil drain intervals must be determined by oil analysis if one or more of the following difficult operating conditions are encountered:

- Extreme climatic conditions
- High engine startup frequency
- Frequent and prolonged idling or low-load operation
- High fuel sulfur content of 0.5 to 1.5% by weight (see "Use of High-Sulfur Fuel")

For applications involving low runtimes, the engine oil must be changed every two years at the latest irrespective of its category.

Where engine oils with higher-grade corrosion-inhibiting characteristics are in use (→ Page 13), a change must be carried out every 3 years at the latest.

In individual cases the service life of the engine oil can be optimized by regular laboratory analysis and appropriate engine inspections in consultation with the MTU service point responsible:

- The first oil sample should be taken from the engine as a “basic sample” after the engine has run for approximately 1 hour after being filled with fresh oil.
- Further samples are to be analyzed at specific intervals (see "Laboratory Analysis").
- The appropriate engine inspections are to be carried out before and after the oil analyses.
- After completion of all analyses, and depending on the findings, special agreements can be reached for individual cases.
- Oil samples must always be taken under the same conditions and at the point provided for that purpose (see Operating Instructions).

Special additives

Engine oils approved have been specially developed for diesel engines and have all necessary properties. Further additives are therefore superfluous and may even be harmful.

Laboratory analysis

Spectrometric oil analysis

Analysis of the engine oil's additive-metal content is carried out by the MTU laboratory to determine the brand of oil.

MTU does not generally analyze the oil's wear-metal contents in order to determine the degree of engine wear. These content levels are very much dependent on the following factors, among others:

- Individual engine equipment status
- Tolerance scatter
- Operating conditions
- Duty profile
- Fluids and lubricants
- Miscellaneous assembly materials

Unambiguous conclusions as to the wear status of the engine components involved are therefore not possible. This means that no limit values can be given for wear-metal contents.

Used-oil analysis

In order to check the used oil, it is recommended that regular oil analyses be carried out. Oil samples should be taken and analyzed at least once per year and during each oil change and under certain conditions, depending on application and the engine's operating conditions, sampling / analysis should take place more frequently.

The specified test methods and limit values (Analytical Limit Values for Used Diesel Engine Oils) (→ Table 2) indicate when the results of an individual oil sample analysis are to be regarded as abnormal.

An abnormal result requires immediate investigation and remedy of the abnormality.

The limit values relate to individual oil samples. When these limit values are reached or exceeded, an immediate oil change is necessary. The results of the oil analysis do not necessarily give an indication of the wear status of particular components.

In addition to the analytical limit values, the engine condition, its operating condition and any operational faults are decisive factors with regard to oil changes.

Some of the signs of oil deterioration are:

- Abnormally heavy deposits or precipitates in the engine or engine-mounted parts such as oil filters, centrifugal oil filters or separators, especially in comparison with the previous analysis
- Abnormal discoloration of components

Analytical limit values for used diesel engine oils

Characteristics of the engine oil	Test method	Limit values	
Viscosity at 100 °C max. mm ² /s	ASTM D445 DIN 51562	SAE 30 SAE 5W-30 SAE 10W-30	15.0
		SAE 40 SAE 5W-40 SAE 10W-40 SAE 15W-40 SAE 20W-40	19.0
SAE 30 SAE 5W-30 SAE 10W-30		9.0	
SAE 40 SAE 5W-40 SAE 10W-40 SAE 15W-40 SAE 20W-40		10.5	
min. mm ² /s			
Flashpoint °C (COC)	ASTM D92 DIN EN ISO 2592	Min. 190	
Flashpoint °C (PM)	ASTM D93 ISO 2719	min. 140	
Soot content (by weight %)	DIN 51452 CEC-L-82-A-97	Max. 3.0 (Oil category 1) Max. 3.5 (Oil category 2, 2.1, 3 and 3.1)	
Total base number (mg KOH/g)	ASTM D2896 ISO 3771 DIN 51639	Min. 50% of new-oil value	
Proportion of water (vol. %)	ASTM D6304 EN 12937 ISO 6296	max. 0.2	
Oxidation (A/cm) ¹⁾	DIN 51453 ¹⁾	Max. 25	
Ethylene glycol (mg/kg)	ASTM D2982	max. 100	

Table 2:

¹⁾ = only possible if there are no ester compounds

Use of high-sulfur diesel fuel

The following measures must be taken in the case of diesel fuels with a sulfur content above 0.5%:

- Use of an engine oil with a total base number (TBN) of more than 8 mgKOH/g
- Shorten oil draining intervals (see oil change intervals)
- Series 4000: TBO (Time Between Overhaul) for cylinder head: Shorten time between overhauls (→ Page 36)

Figure (→ Figure 2) shows the recommended minimum total base numbers for new and used oils depending on the sulfur content of the diesel fuel.

For the total base numbers (TBN) of the approved engine oil, see (→ Page 13).

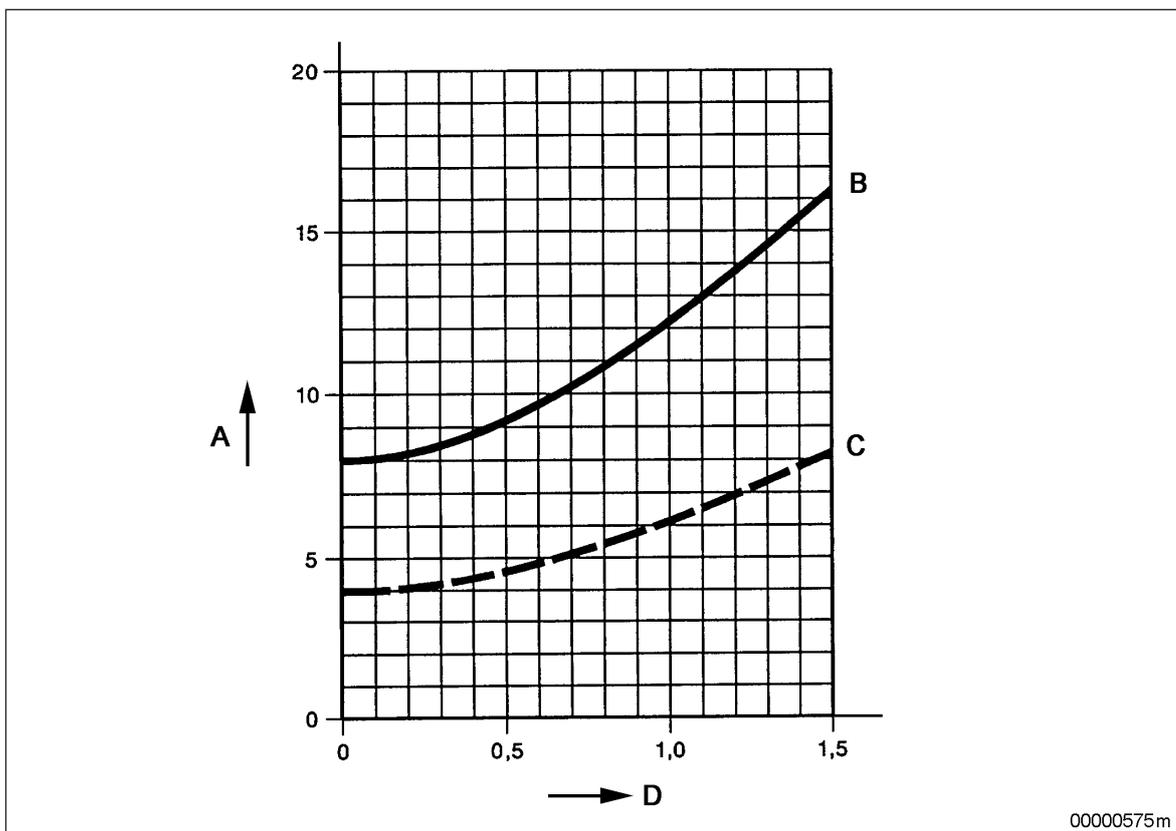


Figure 2: Engine oil Total Base Numbers depending on the Diesel Fuel's Sulfur Content

- | | |
|---|--|
| A Total base number in mgKOH/g, ISO 3771 | C Minimum total base number for used oil |
| B Recommended minimum total base number for fresh oil | D Sulfur content of fuel in % weight |

Use of low-sulfur diesel fuel

The use of diesel fuels with low sulfur content (< 0.5%) does not influence the oil drain intervals.

Minimum requirements for operational checks

Oil analyses can be carried out using the MTU Test Kit. The Test Kit contains all the equipment required as well as instructions for use.

The following checks can be performed:

- Determination of oil dispersing capacity (spot test)
- Determination of diesel fuel content in oil
- Determination of water content in oil

Test Package for North America

The MTU Advanced Fluid Management System is available in North America, which contributes to preventive maintenance through innovative diagnostics.

MTU Advanced Fluid Management System for engine oils, see (→ Page 16).

2.2 Series-based usability for engine oils

Series-based usability of engine oils in MTU oil categories

Series	Approved engine oils		
	MTU oil category 1	MTU oil category 2 and 2.1 (Low Saps)	MTU oil category 3 and 3.1 (Low Saps)
2000Gx5	<ul style="list-style-type: none"> • Single-grade oils (→ Page 67) • Multigrade oils (→ Page 69) 	<ul style="list-style-type: none"> • Single-grade oils (→ Page 70) • Multigrade oils (→ Page 73) • Multigrade oils (Low SAPS) (→ Page 82) 	<ul style="list-style-type: none"> • Multigrade oils (→ Page 85) • Multigrade oils (Low SAPS) (→ Page 90)
2000Gx6	Not approved	<ul style="list-style-type: none"> • Single-grade oils (→ Page 70) • Multigrade oils (→ Page 73) • Multigrade oils (Low SAPS) (→ Page 82) 	<ul style="list-style-type: none"> • Multigrade oils (→ Page 85) • Multigrade oils (Low SAPS) (→ Page 90)
4000Gx3, application groups 3B, 3D, 3E	<ul style="list-style-type: none"> • Single-grade oils (→ Page 67) • Multigrade oils (→ Page 69) 	<ul style="list-style-type: none"> • Single-grade oils (→ Page 70) • Multigrade oils (→ Page 73) • Multigrade oils (Low SAPS) (→ Page 82) 	<ul style="list-style-type: none"> • Multigrade oils (→ Page 85) • Multigrade oils (Low SAPS) (→ Page 90)
4000Gx3, application groups 3F, 3G	Not approved	<ul style="list-style-type: none"> • Single-grade oils (→ Page 70) • Multigrade oils (→ Page 73) • Multigrade oils (Low SAPS) (→ Page 82) 	<ul style="list-style-type: none"> • Multigrade oils (→ Page 85) • Multigrade oils (Low SAPS) (→ Page 90)
4000Gx4	<ul style="list-style-type: none"> • Single-grade oils (→ Page 67) • Multigrade oils (→ Page 69) 	<ul style="list-style-type: none"> • Single-grade oils (→ Page 70) • Multigrade oils (→ Page 73) • Multigrade oils (Low SAPS) (→ Page 82) 	<ul style="list-style-type: none"> • Multigrade oils (→ Page 85) • Multigrade oils (Low SAPS) (→ Page 90)

2.3 Fluorescent dyestuffs for detecting leaks in the lube oil circuit

The fluorescent dyestuffs listed below are approved for detection of leaks in the lube oil circuit.

Manufacturer	Product name	Concentration for use	Part No.	Container size	Storage stability ¹⁾
Chromatech Europe B.V.	D5 1000A Chromatint Fluorescent Yellow 175	0.04 % - 0.07 %	X00067084	16 kg	2 years
Cimcool, Cincinnati	Producto YFD-100	0.5 % - 1.0 %		5 gallons (canister) 55 gallons (barrel)	6 months

Table 3:

¹⁾ = ex works delivery, based on original and hermetically sealed containers in frost-free storage (> 5 °C).

The fluorescence (light-yellow color tone) of both dyestuffs is made visible with a UV lamp (365 nm).

2.4 Lubricating greases

Requirements

The MTU conditions for lubricating-grease approval are specified in the MTU Factory Standard MTL 5050, which can be ordered under this reference number.

Grease manufacturers are notified in writing if their product is approved by MTU.

Lubricating greases for general applications

Lithium-saponified greases are to be used for all lubrication points with the exception of:

- Emergency-air shutoff flaps fitted between turbocharger and charge-air cooler (see Special-purpose lubricants)
- Coupling internal centering

Lubricating greases for applications at high temperatures

High-temperature grease (up to 250 °C) must be used for emergency-air shutoff flaps located between turbocharger and intercooler:

- Aero Shell Grease 15
- Optimol Inertox Medium

General purpose greases suffice for emergency-air shutoff flaps located before the turbocharger or after the intercooler.

Greases for internal centerings of couplings

Greases for internal centerings:

- Esso Unirex N3 (stable up to approx. 160 °C)

Special-purpose lubricants

Oil for turbochargers

Exhaust turbochargers with integrated oil supply are generally connected to the engine oil system.

For ABB turbochargers which are not connected to the engine lube oil system, mineral-based turbine oils with viscosity grade ISO-VG 68 must be used.

Lubricating greases for curved tooth couplings

Depending on the application, the following lubricants have been approved for curved tooth couplings:

- - Klüber: Structovis BHD MF (highly viscous lubricating oil)
- - Klüber: Klüberplex GE11-680 (adhesive transmission lubricant)

Guidelines on use and service life are contained in the relevant Operating Instructions and Maintenance Schedules.

2.5 MTU Advanced Fluid Management System for engine oils – Test package for North America

A sophisticated system for diagnostics and preventive maintenance is available in North America. This system allows the following:

- Optimized oil change intervals
- Extended engine service life
- Detection of minor problems before they become major problems
- Maximization of diesel engine-generator set's reliability
- Higher resale value of diesel engine-generator set

For full information on the MTU Advanced Fluid Management System available in North America, please contact an authorized MTU Onsite Energy service partner.

The following test packages from MTU Advanced Fluid Management System can be ordered from authorized MTU Onsite Energy service partners in North America:

- BMP32
Extended test – monitoring of wear and contamination
- AMP51R
Extended Test Plus – extension of the oil change intervals

The following engine oil parameters can be determined:

Engine oil parameters	BMP32	AMP51R
24 elementary metals *	✓	✓
percent water *	✓	✓
Viscosity at 40 °C for ISO engine oils	✓	✓
Viscosity at 100 °C for SAE engine oils	✓	✓
Percent fuel dilution **	✓	✓
Percent soot **	✓	✓
Oxidation/nitration	-	✓
Total base number **	-	✓
Total acid number	-	✓

* Samples of non-engine oils submitted with Order No. BMP32, are only examined spectrometrically for metals and the proportion of water and viscosity are determined.

** Samples of non-engine oils submitted with Order No. AMP51R are not examined for fuel dilution, soot content and base number.

The MTU Advanced Fluid Management System with trend analysis provides information for maximizing system reliability. The following guidelines must be followed to obtain the best results.

Samples must be taken:

- While the engine is operating under normal conditions or immediately after stopping the engine while the engine is still at operating temperature
- Every 250 hours at the same point
- By means of suction pump via dipstick tube or sampling cock in filter return

Note: The software offered by MTU for online reporting with trend analyses shows the procedure for optimizing evaluation of the gathered information after completion of the analysis.

Note: The MTU Advanced Fluid Management System works together with independent test laboratories accredited according to ISO 17025 A2LA. This accreditation is the highest level of quality obtainable by a test laboratory in North America.

3 Coolants

3.1 Coolants – General information

Coolant

Definition

Coolant = coolant additive (concentrate) + fresh water to predefined mixing ratio
Ready for use in engine

The corrosion-inhibiting effect of coolant is only ensured with the coolant circuit fully filled.

Apart from that, only the corrosion inhibitors approved for internal preservation of the coolant circuit provide proper corrosion protection when the medium was drained. This means that after draining the coolant the cooling circuit must be preserved if no more coolant is to be filled. The procedure is described in the Preservation and Represervation Specifications for MTU Onsite Energy (publication number A001070/..).

Coolants must be prepared from suitable fresh water and an MTU-approved coolant additive. Conditioning of the coolant takes place outside the engine.

Important

Mixtures of various coolant additives and supplementary additives (also in coolant filters and filters downstream of plant components) are not permitted!

The conditions for the approval of coolant additives are specified in the following MTU works standards (MTL):

- MTL 5048: Corrosion inhibiting antifreeze
- MTL 5049: Water-soluble corrosion inhibitor

Coolant manufacturers are informed in writing if their product is approved by MTU.

To prevent cooling system damage:

- When topping up (following loss of coolant) it must be ensured that not only water but also concentrate is added. The specified antifreeze and/or corrosion inhibitor concentration must be maintained.
- Flushing with water is required at every change to a different coolant product. For flushing and cleaning specifications for engine coolant circuits, see (→ Page 117).
- The corrosion inhibitor concentration must not exceed 55 % by volume (max. antifreeze) corrosion inhibitor. Concentrations in excess of this reduce antifreeze protection and heat dissipation. Only exception: BASF G206 (special application)
- The coolant must not contain any oil or copper residue (in solid or dissolved form).
- The majority of corrosion inhibitors currently approved for internal coolant circuit preservation are water-soluble and do not provide antifreeze protection. Make sure that the engine is stored safe from frost, because a certain amount of coolant remains in the engine after draining.
- A coolant circuit can not usually be drained completely, i.e. residual quantities of used coolant or fresh water from a flushing procedure remain in the engine. These residual quantities can result in the dilution of a coolant to be filled (mixed from a concentrate or use of a ready mixture). This dilution effect is higher the more add-on components there are on the engine. Check the coolant concentration in the coolant circuit and adapt it if necessary.

Important

All coolants approved in these Fluids and Lubricants Specifications generally relate only to the coolant circuit of MTU engines. In the case of complete propulsion plants, the operating fluids approvals of the component manufacturer must be observed!

Important

For corrosion-related reasons, it is not permissible to operate an engine with pure water without the addition of an approved corrosion inhibitor!

Special features

MTU coolants

The following coolant additives are available from MTU:

Manufacturer & sales region	Product name	Type
MTU Friedrichshafen and MTU Asia Europe Middle East Africa Asia	Antifreeze	
	Coolant AH 100 Antifreeze Concentrate	X00057231 (20 l) X00057230 (210 l) X00068202 (1000 l)
	Coolant AH 50/50 Antifreeze Premix	X00070528 (20 l) X00070530 (210 l) X00700527 (1000 l) (sales region: England)
	Coolant AH 40/60 Antifreeze Premix	X00070533 (20 l) X00070531 (210 l) X00700532 (1000 l) (sales region: England, Spain)
	Coolant RM 30 Readmix Coolant 40/60	X00073922 (20 l) X00073916 (205 l) X00073923 (1000 l)
	Coolant AH 35/65 Antifreeze Premix	X00069382 (20 l) X00069383 (210 l) X00069384 (1000 l) (sales region: Italy)
	Coolant without antifreeze	
	Coolant CS 100 Corrosion Inhibitor Concentrate	X00057233 (20 l) X00057232 (210 l) X00070455 (1000 l)
	Coolant CS 10/90 Corrosion Inhibitor Premix	X00069385 (20 l) X00069386 (210 l) X00069387 (1000 l) (sales region: Italy)

Manufacturer & sales region	Product name	Type
MTU America America	Antifreeze	
	Power Cool [®] Off-Highway Coolant 50/50 Premix	23533531 (5 gallons) 23533532 (55 gallons)
	Power Cool [®] Universal 50/50 mix	800069 (1 gallon) 800071 (5 gallons) 800084 (55 gallons)
	Power Cool [®] Universal 35/65 mix	800085 (5 gallons) 800086 (55 gallons)
	Power Cool [®] 3 149 Concentrate	23528572 (55 gallons) 23528571 (1000 l)
	Coolant without antifreeze	
	Power Cool [®] Plus 6000 Concentrate	23533526 (1 gallon) 23533527 (5 gallons) colored green

Note

For ready mixtures, the proportion of coolant additive (concentrate) is always named first.

Example:

- Coolant AH 40/60 Antifreeze Premix = 40 % coolant additive by volume / 60 % fresh water by volume

3.2 Operational monitoring

Inspection of the fresh water and continuous monitoring of the coolant are essential for trouble-free engine operation. Fresh water and coolant should be inspected at least once per year and with each fill-up. Inspections can be carried out using the MTU Test Kit which contains the necessary equipment, chemicals and instructions for use.

The following tests can be conducted with the MTU Test Kit:

- Determination of total hardness (°d)
- pH value
- Chloride content of fresh water
- Corrosion-inhibiting oil content
- Determination of antifreeze content
- Determination of the concentration of coolant without antifreeze

Orders for fresh water and coolant analysis may be placed with MTU. Samples of min. 0.25 l must be supplied.

Important information

In the 4000-04-05 Series, an additional exhaust gas cooler is installed and the cooling system reacts more sensitively. A regular check of the coolant is therefore very important to ensure trouble-free engine operation. This check must be carried out annually or after 3000 operating hours and every time the coolant is filled.

The concentration, pH value and silicon content (only with coolant that contain Si) must be within the values specified in the MTU Fluids and Lubricants Specifications.

Important information

Due to thermal stress of the coolant in plants with preheating, a semi-annual analysis of the coolant is recommended.

Permissible concentrations

	Minimum				Maximum
Emulsifiable corrosion inhibitor oils without antifreeze	1% by volume	-	-	-	2% by volume
Antifreeze on ethylene glycol basis	35% by volume	40% by volume	45% by volume	50% by volume	55% by volume
with antifreeze protection up to*	-20 °C	-25 °C	-31 °C	-37 °C	-45 °C
Antifreeze on propylene glycol-basis	35% by volume	-	-	-	50% by volume
with antifreeze protection up to*	-18 °C	-	-	-	-32 °C
BASF G206	65% by volume for application at outside temperatures of up to -65 °C in arctic regions				

Table 4:

* = antifreeze specifications determined as per ASTM D 1177

Operational monitoring for permissible concentrations, coolant without antifreeze

Permissible concentration range	Manufacturer	Brand name vol%	Reading on hand refractometer ¹ at 20 °C (= degrees Brix)					
			7	8	9	10	11	12
9 to 11% by volume	MTU Friedrichshafen	Coolant CS 100 Corrosion Inhibitor Concentrate	3.5	4.0	4.5	5.0	5.5	6.0
		Coolant CS 10/90 Corrosion Inhibitor Premix	3.5	4.0	4.5	5.0	5.5	6.0
	MTU America	Power Cool® Plus 6000	3.5	4.0	4.5	5.0	5.5	6.0
	Arteco	Freecor NBI	Please use test kit of manufacturer					
	BASF SE	Glysacorr G93 green	3.5	4.0	4.5	5.0	5.5	6.0
	BP Lubricants	Castrol Extended Life Corrosion Inhibitor	4.9	5.6	6.3	7.0	7.7	8.4
	CCI Corporation	A 216	4.9	5.6	6.3	7.0	7.7	8.4
	CCI Manufacturing IL Corporation	A 216	4.9	5.6	6.3	7.0	7.7	8.4
	Chevron	Texcool A -200	Please use test kit of manufacturer					
	Detroit Diesel Corporation	Power Cool Plus 6000	4.9	5.6	6.3	7.0	7.7	8.4
	Drew Marine	Drewgard XTA	3.5	4.0	4.5	5.0	5.5	6.0
	ExxonMobil	Mobil Delvac Extended Life Corrosion Inhibitor	4.9	5.6	6.3	7.0	7.7	8.4
	Ginouves	York 719	3.5	4.0	4.5	5.0	5.5	6.0
	Old World Industries Inc.	Final Charge Extended Life Corrosion Inhibitor (A 216)	4.9	5.6	6.3	7.0	7.7	8.4
	Valvoline	Zerex G-93	3.5	4.0	4.5	5.0	5.5	6.0
7 to 11% by volume	Arteco	Havoline Extended Life Corrosion Inhibitor XLI [EU 32765]	2.6	3.0	3.4	3.7	4.1	4.4
	Nalco	Alfloc (Maxitreat) 3443	1.75	2.0	2.25	2.5	2.75	3.0
		Alfloc (Maxitreat) 3477	1.75	2.0	2.25	2.5	2.75	3.0
	PrixMax Australia Pty. Ltd.	PrixMax RCP	2.6	3.0	3.4	3.7	4.1	4.4
Total	WT Supra	2.6	3.0	3.4	3.7	4.1	4.4	
5 to 6% by volume	Fleetguard	DCA-4L	Please use test kit of manufacturer					
	Detroit Diesel Corporation	Power Cool 3000						
	Penray	Pencool 3000						

Permissible concentration range	Manufacturer	Brand name vol%	Reading on hand refractometer ¹⁾ at 20 °C (= degrees Brix)					
			7	8	9	10	11	12
3 to 4% by volume	Detroit Diesel Corporation	Power Cool 2000	Please use test kit of manufacturer					
	Nalco	Alfloc 2000						
		Nalco 2000						
		Nalcool 2000						
		Trac 102						
Penray	Pencool 2000							

Table 5:

¹⁾ = concentration determination by means of suitable hand refractometer

Calibrate the hand refractometer with clean water at coolant temperature. The coolant temperature should be 20 °C. Observe the specifications of the manufacturer.

Operational monitoring of permissible concentrations, antifreeze on ethylene glycol basis

The concentration is determined using a suitable glycol refractometer and direct reading of the scale value in % by vol.

Calibration table for antifreeze for special applications

Reading on hand refractometer at 20 °C (= degrees Brix)		Corresponds to a concentration of
I. Propylene glycol antifreeze	II. BASF G206	
26.3	24.8	35% by volume
26.9	25.5	36% by volume
27.5	26.1	37% by volume
28.2	26.7	38% by volume
28.8	27.4	39% by volume
29.5	28.0	40% by volume
30.1	28.6	41% by volume
30.8	29.2	42% by volume
31.3	29.8	43% by volume
31.9	30.4	44% by volume
32.5	30.9	45% by volume
33.1	31.5	46% by volume
33.7	32.1	47% by volume
34.2	32.6	48% by volume
34.8	33.2	49% by volume
35.3	33.8	50% by volume
	34.4	51% by volume

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Reading on hand refractometer at 20 °C (= degrees Brix)		Corresponds to a concentration of
I. Propylene glycol antifreeze	II. BASF G206	
	34.9	52% by volume
	35.5	53% by volume
	36.1	54% by volume
	36.7	55% by volume
	37.2	56% by volume
	37.8	57% by volume
	38.3	58% by volume
	38.9	59% by volume
	39.4	60% by volume
	39.9	61% by volume
	40.5	62% by volume
	41.0	63% by volume
	41.5	64% by volume
	42.0	65% by volume

Table 6:

3.3 Series-based usability of coolant additives

All details are based on the coolant circuit on the engine side, no allowance is made for external add-on components.

Important

In the case of an engine coolant circuit with no light metal elements but with external add-on components containing light metal (e.g. cooling system or preheater), the coolant approvals for cooling systems containing light metal shall apply. If you have any doubts about a coolant application, consult your contact person at MTU.

For details and special information, see section “Coolants” (→ Page 17)

Any deviating special agreements between the customer and MTU-Friedrichshafen shall remain valid.

Series	Cooling system containing light metals	Coolant without antifreeze
2000Gx5 2000Gx6	Yes	<ul style="list-style-type: none"> • Concentrates for cooling systems containing light metal, see (→ Page 96) • Ready mixtures for cooling systems containing light metal, see (→ Page 98)
4000Gx3 4000Gx4	No *	<ul style="list-style-type: none"> • Concentrates for cooling systems containing light metal, see (→ Page 99) • Ready mixtures for cooling systems containing light metal, see (→ Page 101)

Series	Cooling system containing light metals	Antifreeze	
2000Gx5 2000Gx6	Yes	<ul style="list-style-type: none"> • Concentrates for cooling systems containing light metal, see (→ Page 102) • Concentrates for special applications, see (→ Page 105) • Ready mixtures for cooling systems containing light metal, see (→ Page 106) 	<ul style="list-style-type: none"> • Concentrates based on ethylene glycol (suitable for series with and without light metal), see (→ Page 115)
4000Gx3 4000Gx4	No *	<ul style="list-style-type: none"> • Concentrates for cooling systems containing light metal, see (→ Page 108) • Concentrates for special applications, see (→ Page 111) • Ready mixtures for cooling systems containing light metal, see (→ Page 112) 	<ul style="list-style-type: none"> • Ready mixture based on propylene glycol for series free of light metal, see (→ Page 116)

* In the case of an engine coolant circuit with no light metal elements but with external add-on components containing light metal (e.g. cooling system or preheater), the coolant approvals for cooling systems containing light metal shall apply.

3.4 Unsuitable materials in the coolant circuit

Components made of copper, zinc and brass materials

Unless various preconditions are observed, components made of copper, zinc and brass materials in the coolant circuit can cause an electrochemical reaction in conjunction with base metals (e.g. aluminum). As a result, components made of base metals are subject to corrosion or even corrosive pitting. The coolant circuit becomes leaky at these points.

Requirements

Based on current knowledge, the following materials and coatings must not be used in an engine coolant circuit because negative mutual reactions can occur even with approved coolant additives.

Metallic materials

- No galvanized surfaces
The entire cooling system must be free of zinc components. This also applies to coolant supply and drain lines as well as to storage containers.
- No copper-based alloys as material with the use of coolant containing nitrite, with the exception of the following two alloys:
 - CuNi10Fe1Mn corresponds to CW-352-H
 - CuNi30Mn1Fe corresponds to CW-354-H
- Do not use components containing brass in the coolant circuit (e.g. coolers made of CuZn30) if exposed to ammoniacal solutions (e.g. amines, ammonium, ...) and solutions containing nitrite or sulfide. Stress-corrosion cracking is possible in the presence of tensile stress and a critical potential area. "Solutions" refer to cleaning agents, coolants and similar substances.

Non-metallic materials

- Do not use EPDM or silicone elastomers if emulsifiable corrosion inhibitor oils are used or other oils are introduced to the coolant circuit.

Coolant filter / filter downstream of plant components

- If such filters are used, only products that do not contain additives may be used.
Supplementary additives such as silicates, nitrites etc. can diminish the protective effect or service life of a coolant and, possibly, attack the materials installed in the coolant circuit.

Information:

In case of doubt about the use of materials on the engine and add-on components / components in coolant circuits, consultation with the respective MTU specialist department must be held.

3.5 Fresh water requirements

For preparation of coolant without antifreeze protection

Only clean, clear water with values in accordance with those in the following table must be used for preparing the coolant. If the limit values for the water are exceeded, de-mineralized water can be added to reduce the hardness or mineral content.

Parameters	Minimum	Maximum
Sum of alkaline earth metals *) (Water hardness)	0 mmol/l 0°d	2.7 mmol/l 15°d
pH value at 20 °C	5.5	8,0
Chloride ions		100 mg/l
Sulphate ions		100 mg/l
Anions total		200 mg/l
Bacteria		10 ³ CFU (colony forming unit)/ml
Fungi, yeasts	are not permitted!	

*) Common designations for water hardness in various countries:

1 mmol/l = 5.6°d = 100 mg/kg CaCO₃

- 1°d = 17.9 mg/kg CaCO₃, USA hardness
- 1°d = 1.79° French hardness
- 1°d = 1.25° English hardness

3.6 Antifreeze

The preceding MTU Fluids and Lubricants Specifications used the designation "Corrosion inhibiting anti-freeze". This designation will be replaced with immediate effect to "Antifreeze".

Antifreezes are necessary for engines without heating facilities and operating in areas where below-freezing temperatures may occur.

Most of the antifreezes approved at MTU are based on ethylene glycol.

Exceptions:

- Ready mixture Fleetguard PG XL based on propylene glycol (→ Page 116)
- Concentrate BASF G206 as a mixture of ethylene glycol and propylene glycol

Provided that they are used in approved concentrations, antifreezes approved by MTU provide effective protection against corrosion, see section "Operational monitoring" (→ Page 20).

The antifreeze concentration must be determined not only in accordance with the minimum anticipated temperatures but also with the corrosion protection requirements.

Important

For the coolant additives approved for the individual series, see (→ Page 24).

Special approvals presently in effect remain valid.

Important

Coolant additives containing nitrite must not be used in conjunction with coolers that contain brass!

Note:

- Propylene glycol-based antifreezes are stipulated for use in some types of applications. These products have a lower thermal conductivity than the usual ethylene glycol products. This brings about a higher temperature level in the engine.
- The product BASF G206 is available for use at extremely low temperatures (< -40 °C).
- Flushing with water is required at every change to a different coolant product. For flushing and cleaning specifications for engine coolant circuits, see (→ Page 117).

3.7 Coolant without antifreeze

The preceding MTU Fluids and Lubricants Specifications used the designation "water-soluble corrosion inhibiting antifreeze". This designation will be replaced with immediate effect with "coolant without antifreeze".

Engine coolant without antifreeze is required in the case of higher coolant temperatures or larger temperature gradients in heat exchangers, e.g. in TB systems (with plate-core heat exchanger) and TE systems.

Provided that they are used in adequate concentration, coolants without antifreeze approved by MTU provide effective corrosion protection. The relevant concentration range for use is listed in the section on operational monitoring.

Important

For approved coolant additives for the individual engine series, refer to section "Approved coolants" (→ Page 24).

Special arrangements presently in effect remain valid.

Important

Coolant additives containing nitrite must not be used in conjunction with coolers that contain brass!

Flushing with water is required at every change to a different coolant product. For preserved engines (new engines, field engines, reserve stock engines, etc.), a flushing run must be carried out prior to filling with engine coolant if the engines were preserved with an emulsifiable corrosion inhibitor. The necessary work is described in the section "Flushing and cleaning specifications for engine coolant circuits" (→ Page 117).

3.8 Emulsifiable corrosion-inhibiting oils

Emulsifiable corrosion-inhibiting oils must not be used with the following Series:

- Series 2000
- Series 4000

Special approval presently in effect remain valid.

3.9 Limit values for coolants

pH value when using:		
- Emulsifiable corrosion inhibiting oil	Min. 7.5	Max. 9.5
- Antifreeze	Min. 7.5	Max. 9.0
- Coolant without antifreeze for engines containing light metal	Min. 7.5	Max. 9.0
- Coolant without antifreeze for engines free of light metal	Min. 7.5	Max. 11.0
Silicon (valid for coolants containing Si)	Min. 25 mg/l	

Table 7:

The coolant must be changed in case of non-compliance with the above specifications.

Note:

For a holistic appraisal of a coolant function, apart from the above-mentioned limit values the respective coolant-specific characteristic data and the fresh water quality used must be taken into consideration.

3.10 Storage capability of coolant concentrates

The storage capability specifications refer to coolant concentrates in original, hermetically sealed packing with storage temperatures up to max. 30 °C.

The instructions of the manufacturer must also be observed.

Coolant concentrate	Limit value	Brand name / Comments
Emulsifiable corrosion-inhibiting oil	6 months	
Antifreeze	Approx. 3 years	Observe manufacturer's specifications
Products containing propylene glycol	3 years	BASF G206
Coolant without antifreeze	6 months	Nalco Trac 102
	1 year	Detroit Diesel Corp. Power Cool 3000 Penray Pencool 3000
	2 years	Arteco Freecor NBI Chevron Texcool A-200 – Nalco Alfloc 2000 Nalco Nalcool 2000 Nalco Nalco 2000 Detroit Diesel Corp. Power Cool 2000 Penray Pencool 2000 PrixMax RCP
	3 years	BASF Glyscorr G93 green Drew Marine Drewgard XTA Ginouves York 719 MTU Friedrichshafen Coolant C150 MTU America Power Cool® Plus 6000 Nalco Alfloc (Maxitreat) 3477 Valvoline ZEREX G-93
	5 years	Arteco Havoline Extended Life Corrosion Inhibitor XLI [EU 032765] BP Castrol Extended Life Corrosion Inhibitor CCI Corporation A216 CCI Manufacturing IL A216 Chevron Texaco Extended Life Corrosion Inhibitor Nitrite Free [US 236514] Detroit Diesel Corp. Power Cool Plus 6000 ExxonMobil Mobil Delvac Extended Life Corrosion Inhibitor Fleetguard DCA-4L Old World Industries Final Charge Extended Life Corrosion Inhibitor (A216) Total WT Supra

Table 8:

Note:

For reasons of corrosion protection, do not store in galvanized bins. Take this requirement into account when coolant must be transferred.

Containers must be hermetically sealed and stored in a cool, dry place. Frost protection must be provided in winter.

Further information can be obtained from the product and safety data sheets for the individual coolants.

3.11 Color additives for detection of leaks in the coolant circuit

The following listed fluorescent dyes are approved as additives for coolant without antifreeze for the detection of leaks.

Manufacturer	Product name	Part No.	Container size	Storage stability ¹⁾
Chromatech Inc. Chromatech Europe B.V.	D11014 Chromatint Uranine Conc	X00066947	20 kg	2 years

Table 9: Approved dye additives

¹⁾ = based on original and hermetically sealed containers in frost-free storage (> 5 °C)

Application:

Approx. 40 g dye must be added to 180 l coolant.

This dye quantity is already very generous and must not be exceeded.

The fluorescence (yellow color tone) is easily recognizable in daylight. In dark rooms, UV light can be used with a wave length of 365 nm.

3.12 MTU Advanced Fluid Management System for coolant – Test package for North America

A sophisticated system for diagnostics and preventive maintenance is available in North America. This system allows the following:

- Optimization of the coolant change intervals
- Evaluation of metal migration
- Evaluation of the coolant's corrosive properties
- Detection of the causes of problems in the cooling system in connection with blown cylinder-head gaskets, electrical ground problems, localized overheating and contaminants within and outside the system

For full information on the MTU Advanced Fluid Management System available in North America, please contact an authorized MTU Onsite Energy service partner.

The following test packages from MTU advanced Fluid Management System can be ordered from authorized MTU Onsite Energy service partners in North America:

- C-P92
Basic test – For monitoring the corrosivity of the coolant and for detecting metal migration
- C-P94
Extended test – Identification of the causes of leaks in the combustion system, grounding problems and contamination in the plant
- C-P93
Extended Test Plus – Monitoring of corrosivity and metal migration plus HPLC analysis and IC analysis for confirmation of the determined contamination of the corrosion inhibitor

The following coolant parameters can be determined:

Coolant parameters	C-P92	C-P94	C-P93
15 elementary metals	✓	✓	✓
Glycol percentage	✓	✓	✓
Freezing point	✓	✓	✓
Boiling point	✓	✓	✓
pH value	✓	✓	✓
Total hardness	✓	✓	✓
SCA number	✓	✓	✓
Nitrite	✓	✓	✓
Specific conductivity	✓	✓	✓
Carboxylic acid	✓	✓	✓
Sensory parameters (color, oil, fuel, magnetic precipitation, amagnetic precipitation, odor and foam)	✓	✓	✓
Contamination and corrosion inhibitor through IC (chloride, sulfate, nitrite, nitrate, phosphate and glycolate)	-	✓	✓
HPLC	-	-	✓

The MTU Advanced Fluid Management System with trend analysis provides information for maximizing system reliability. The following guidelines must be followed to obtain the best results.

Samples must be taken:

- While the engine is operating under normal conditions or immediately after stopping the engine while the engine is still at operating temperature
- Every 250 hours at the same point

Note: The software offered by MTU for online reporting with trend analyses shows the procedure for optimizing evaluation of the gathered information after completion of the analysis.

Note: The MTU Advanced Fluid Management System works together with independent test laboratories accredited according to ISO 17025 A2LA. This accreditation is the highest level of quality obtainable by a test laboratory in North America.

4 Liquid Fuels

4.1 Diesel fuels – General information

Important

Dispose of used fluids and lubricants in accordance with local regulations.
Used oil must never be disposed of via the combustion engine!

Selection of a suitable diesel fuel

The quality of the fuel is very important for satisfactory engine performance, long engine service life and acceptable exhaust emission levels.

Important

Diesel fuels are not available worldwide in the quality required according to (→ Table 10).
The fuel properties depend on many factors, in particular, region, time of year and storage.

Unsuitable fuel usually leads to a reduced service life of engine components and can also cause engine damage.

Further details on fuel qualities, tank care and filtration are available in the publication "Useful information on fuels, tank systems and filtration" (publication number A060631/..).

Characteristics of the fuel		Test method		Limit values
		ASTM		
Composition				The diesel fuel must be free of inorganic acids, visible water, solid foreign matter and chlorine compounds.
Total contamination (= elements insoluble in fuel)	max.	D6217	EN 12662	24 mg/kg
Density at 15 °C	min.	D1298	EN ISO 3675	0.820 g/ml
	max.	D4052	EN ISO 12185	0.860 g/ml
API gravity at 60 °F	min.	D287		41
	max.			33
Viscosity at 40 °C	min.	D445	EN ISO 3104	1.5 mm ² /s
	max.			4.5 mm ² /s
Flashpoint (closed crucible)	min.	D93	EN ISO 2719	55 °C
Boiling curve:		D86	EN ISO 3405	
- Initial boiling point				160 to 220 °C
- Volume share at 250 °C	max.			65% by volume
Recovery at 350 °C	min.			85% by volume
- Residue and loss	max.			3% by volume

¹⁾ Filter plugging point or Cold Filter Plugging Point (CFPP) denotes the temperature at which a test filter is blocked under defined conditions by precipitated paraffins. This characteristic is used for diesel fuels as per DIN EN 590 to describe the climatic requirements (e.g. summer and winter diesel).

²⁾ The cloud point is the temperature at which a liquid product becomes turbid in the test glass due to precipitation of paraffin. This must not be higher than the ambient temperature.

Note: 1% by weight = 10000 mg/kg = 10000 ppm

Characteristics of the fuel		Test method		Limit values
		ASTM		
Fatty acid methyl ester content (FAME) ("Biodiesel")	max.		EN 14078 Internal MTU procedure	7.0% by volume
Proportion of water: (absolute, no free water)	max.	D6304	EN ISO 12937	200 mg/kg
Carbon residue from 10% distillation residue	max.	D189	EN ISO 10370	0.30% by weight
Oxide ash:	max.	D482	EN ISO 6245	0.01% by weight (100 mg/kg)
Sulfur content: 2000Gx5, 4000Gx3, 4000Gx4	max.	D5453, D2622	EN ISO 20846, EN ISO 20884	0.5% by weight (5000 mg/kg)
Sulfur content: 2000Gx6				0.05% by weight (500 mg/kg)
Cetane number	min.	D613	EN ISO 5165, EN ISO 15195	45
Cetane index	min.	D976	EN ISO 4264	42
Copper corrosion 3 hrs at 50 °C	Max. degree of corrosion	D130	EN ISO 2160	1 a
Oxidation stability(Rancimat)	min.		EN 15751	20 hours
Oxidation stability	max.	D2274	EN ISO 12205	25 g/m ³
Lubricity at 60 °C (HFRR value)	max.	D6079	EN ISO 12156-1	520 µm
Filter plugging point (CFPP)		D6371	DIN EN 116	See ¹
Cloud Point		D2500	DIN EN 23015	See ²
Neutralization number	max.	D974		0.2 mg KOH/g

¹⁾ Filter plugging point or Cold Filter Plugging Point (CFPP) denotes the temperature at which a test filter is blocked under defined conditions by precipitated paraffins. This characteristic is used for diesel fuels as per DIN EN 590 to describe the climatic requirements (e.g. summer and winter diesel).

²⁾ The cloud point is the temperature at which a liquid product becomes turbid in the test glass due to precipitation of paraffin. This must not be higher than the ambient temperature.

Note: 1% by weight = 10000 mg/kg = 10000 ppm

Table 10:

The fuel supplier must ensure that the fuel can still be used at extremely low temperatures and correct engine operation can be guaranteed. Extremely low temperatures must be noted, which can be expected under the given geographical and other local conditions.

The operator must ensure that fuel necessary for the corresponding climatic requirements is used.

Note:

The engines are certified for operation with the fuels approved in the MTU Fluids and Lubricants Specifications.

The component TBO specified in the maintenance schedule relates to operation of the engine with diesel fuel as per DIN EN 590.

For operation with a high sulfur content in the fuel, the following must be observed:

Series 4000

When a fuel with sulfur content > 1500 mg/kg is used, the times specified in the maintenance schedule for component TBO of the cylinder head may be reduced, see following table (→ Page 38)

TBO cylinder head as a function of sulfur content in the fuel

Sulfur content in fuel (mg/kg)	TBO cylinder head (h)
<1500	According to maintenance schedule
1500 to 3000	12000 ¹⁾
3000 to 4000	7000 ¹⁾
4000 to 5000	5000 ¹⁾

Table 11:

¹⁾= If the TBO cylinder head specified in the maintenance schedule is shorter, the shorter TBO shall always apply.

Important

If the sulfur content in the fuel is > 0.5% by weight (> 5000 ppm), please consult with the MTU-Friedrichshafen (application engineering).

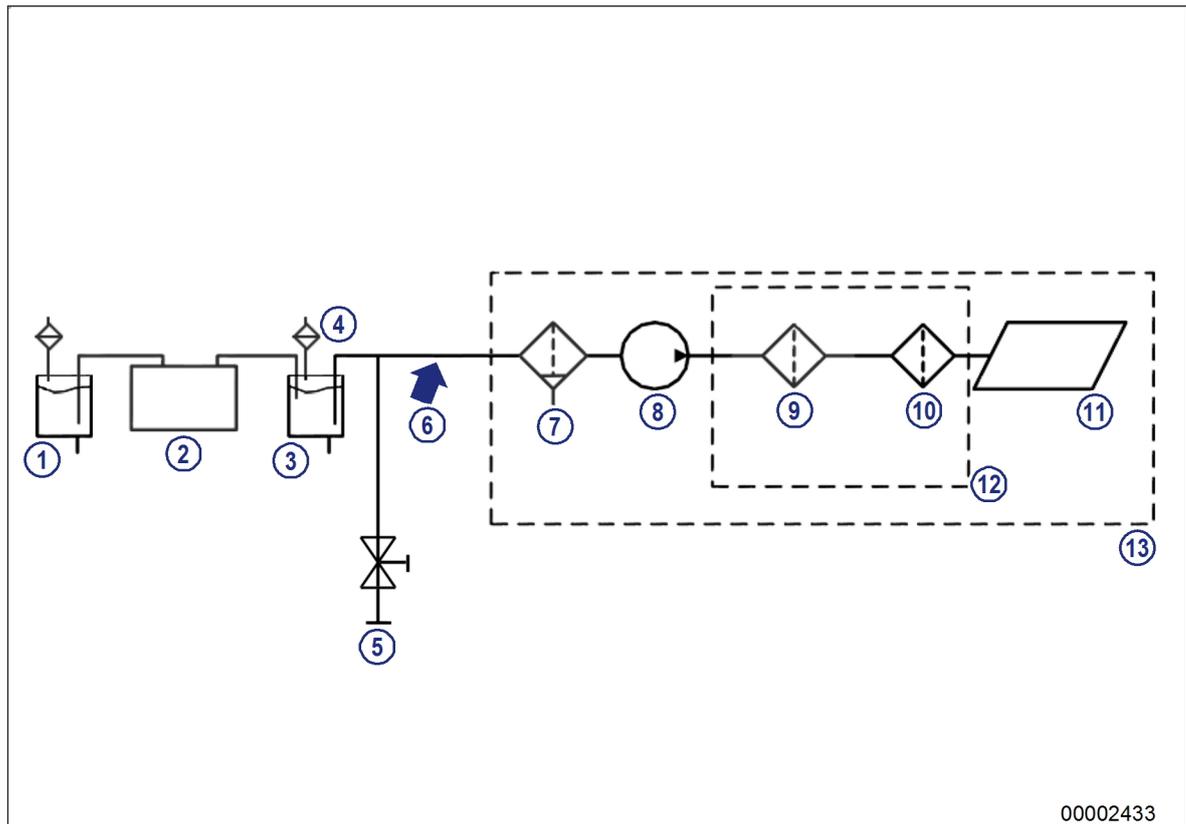


Figure 3: Fuel system

- | | | |
|------------------------------|--|---------------------|
| 1 Fuel tank | 6 Interface for fuel specification | 11 Injection system |
| 2 Fuel conditioning (option) | 7 Fuel prefilter with water separator (option) | 12 Engine filter |
| 3 Last tank before engine | 8 Fuel low-pressure pump | 13 Engine scope |
| 4 Tank ventilation filter | 9 Intermediate filter (option) | |
| 5 Sample extraction | 10 Main filter | |

Note:

The limit values named in the table (→ Table 10) must be observed at the interface [(→ Figure 3), item 6] at the latest to guarantee safe and efficient engine operation. This applies in particular to water and total contamination.

Important
In addition to the limit values listed in the table (→ Table 10), a particle distribution in the fuel in acc. with ISO 4406 must be observed, see (→ Table 12).

Particle distribution for fuels

Particle distribution	Test method ASTM		Limit values	
			Series 2000 Gx6, Series 4000 Gx3, Series 4000 Gx4	Series 2000 Gx5
Particle distribution for fuel between last tank before engine and prefilter [(→ Figure 3), item 6]	D7619 D7647	Coding of number of particles as per ISO 4406	max. ISO Code 18/17/14 for 4/6/14 µm particle size	max. ISO Code 21/20/17 for 4/6/14 µm particle size

Table 12:

Important
The limit values named in the table (→ Table 12) must already be observed in the feed between the last tank before the engine and the prefilter (if necessary, with water separator).

For plants without a prefilter, this refers to the feed between the last tank and the MTU equipment. For the analysis of the fuel quality, an interface (sample extraction cock) must be provided for sample extraction during operation.

For existing plants without an accessible feed, a sample extraction point in the last tank before the MTU equipment is permissible.

Note:

With poorer particle distribution, it is necessary to integrate further / more-optimized filter stages in the fuel system to achieve the operational life of fuel filters and components of the injection system.

For the limit values named for the interface, it has been validated that MTU-approved prefilters provide sufficient filtration.

MTU Friedrichshafen GmbH shall not provide warranty cover for damage and impairment to engine caused by the following usage:

- Fuel grades not approved by MTU (see (→ Table 10), (→ Table 12), (→ Page 41))
- Prefilters not approved by MTU

Laboratory analysis

An order for fuel analysis can be placed with MTU.

The following data is required:

- Fuel specifications
- Sampling point
- Serial number of engine from which fuel sample was taken

Submit the following:

- 0.5 liters of fuel
- 1.5 liters of fuel (with additional determination of cetane number)

Test Package for North America

The MTU Advanced Fluid Management System is available in North America, which contributes to preventive maintenance through innovative diagnostics.

MTU Advanced Fluid Management System for fuels, see (→ Page 65).

4.2 Series-dependent approval of fuel grades for MTU engines

4.2.1 Distillate fuels according to DIN EN 590 and ASTM D975

Commercially available diesel fuels meeting the following specifications are approved for use:

Approved fuels Fuel specifications	Series 2000	
	2000Gx5	2000Gx6
DIN EN 590: 2014-4 <ul style="list-style-type: none"> • Summer and winter quality • Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Approved	Approved
ASTM D975-16 <ul style="list-style-type: none"> • Grade 1-D • S 15, S 500, S 5000 • Density: 0.820 to 0.860 g/ml • Proportion of water: Max. 200 mg/kg • Total contamination: Max. 24 mg/kg • Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Approval issued if: <ul style="list-style-type: none"> • Viscosity min. 1.5 mm²/s • Cetane number min. 45 or centane index min. 42 • Sulfur content max. 500 mg/kg 	Approval issued if: <ul style="list-style-type: none"> • Viscosity min. 1.5 mm²/s • Cetane number min. 45 or centane index min. 42 • Sulfur content max. 500 mg/kg
ASTM D975-16 <ul style="list-style-type: none"> • Grade 2-D • S 15, S 500, S 5000 • Density: 0.820 to 0.860 g/ml • Proportion of water: Max. 200 mg/kg • Total contamination: Max. 24 mg/kg • Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Approval issued if: <ul style="list-style-type: none"> • Cetane number min. 45 or centane index min. 42 • Sulfur content max. 500 mg/kg 	Approval issued if: <ul style="list-style-type: none"> • Cetane number min. 45 or centane index min. 42 • Sulfur content max. 500 mg/kg

Approved fuels Fuel specifications	Series 4000	
	4000Gx3	4000Gx4
DIN EN 590: 2014-4 <ul style="list-style-type: none"> • Summer and winter quality • Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Approved	Approved
ASTM D975-16 <ul style="list-style-type: none"> • Grade 1-D • S 15, S 500, S 5000 • Density: 0.820 to 0.860 g/ml • Proportion of water: Max. 200 mg/kg • Total contamination: Max. 24 mg/kg • Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Approval issued if: <ul style="list-style-type: none"> • Viscosity min. 1.5 mm²/s • Cetane number min. 45 or centane index min. 42 	Approval issued if: <ul style="list-style-type: none"> • Viscosity min. 1.5 mm²/s • Cetane number min. 45 or centane index min. 42
ASTM D975-16 <ul style="list-style-type: none"> • Grade 2-D • S 15, S 500, S 5000 • Density: 0.820 to 0.860 g/ml • Proportion of water: Max. 200 mg/kg • Total contamination: Max. 24 mg/kg • Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Approval issued if: <ul style="list-style-type: none"> • Cetane number min. 45 or centane index min. 42 	Approval issued if: <ul style="list-style-type: none"> • Cetane number min. 45 or centane index min. 42

4.2.2 British Standard 2869

Commercially available diesel fuels meeting the following specifications are approved for use:

Approved fuels Fuel specifications	Series 2000	
	2000Gx5	2000Gx6
BS 2869:2010 <ul style="list-style-type: none"> Part 1 Class A2 Density: max. 860 kg/m³ Viscosity: max. 4.5 mm²/s. If viscosity min. 4.5 mm²/s: Preheating required Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Not approved	Not approved
BS 2869:2010 <ul style="list-style-type: none"> Part 2 Class D Density: max. 860 kg/m³ Viscosity: max. 4.5 mm²/s. If viscosity min. 4.5 mm²/s: Preheating required Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Not approved	Not approved

Approved fuels Fuel specifications	Series 4000	
	4000Gx3	4000Gx4
BS 2869:2010 <ul style="list-style-type: none"> Part 1 Class A2 Density: max. 860 kg/m³ Viscosity: max. 4.5 mm²/s. If viscosity min. 4.5 mm²/s: Preheating required Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Approved	Not approved
BS 2869:2010 <ul style="list-style-type: none"> Part 2 Class D Density: max. 860 kg/m³ Viscosity: max. 4.5 mm²/s. If viscosity min. 4.5 mm²/s: Preheating required Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Approved	Not approved

4.2.3 Chinese distillate fuels as per GB 19147-2013

Commercially available diesel fuels meeting the following specifications are approved for use:

Approved fuels Fuel specifications	Series 2000	
	2000Gx5	2000Gx6
GB 19147-2013 <ul style="list-style-type: none"> • Grade 0 • III: S max. 350 mg/kg • IV: S max. 50 mg/kg • V: S max. 10 mg/kg • Density: 0.820 to 0.860 g/ml* * deviating values: Approval possible project-specifically. If the density is too low, this can result in a power reduction. In the framework of power re-adjustment, it is possible that the engine operational values change • Proportion of water: Max. 200 mg/kg • Total contamination: Max. 24 mg/kg • Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) • Neutralization number: Max 0.2 mgKOH/g • Viscosity at 40 °C: 1.5 to 4.5 mm²/s 	Approved	Approved
Approved fuels Fuel specifications	Series 4000	
	4000Gx3	4000Gx4
GB 19147-2013 <ul style="list-style-type: none"> • Grade 0 • III: S max. 350 mg/kg • IV: S max. 50 mg/kg • V: S max. 10 mg/kg • Density: 0.820 to 0.860 g/ml* * deviating values: Approval possible project-specifically. If the density is too low, this can result in a power reduction. In the framework of power re-adjustment, it is possible that the engine operational values change • Proportion of water: Max. 200 mg/kg • Total contamination: Max. 24 mg/kg • Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) • Neutralization number: Max 0.2 mgKOH/g • Viscosity at 40 °C: 1.5 to 4.5 mm²/s 	Approved	Not approved

4.2.4 Heating oil

Commercially available diesel fuels meeting the following specifications are approved for use:

Heating oil

Approved fuels Fuel specifications	Series 2000	
	2000Gx5	2000Gx6
DIN 51603-1:2011-09, heating oil EL Standard <ul style="list-style-type: none"> • Cetane number min. 45 or centane index min. 42 • Lubricity max. 520 µm • Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Approval issued if: <ul style="list-style-type: none"> • Density at 15 °C min. 0.820 g/ml • Sulfur content max. 500 mg/kg 	Approval issued if: <ul style="list-style-type: none"> • Sulfur content max. 500 mg/kg
DIN 51603-1:2011-09, heating oil EL low-sulfur <ul style="list-style-type: none"> • Cetane number min. 45 or centane index min. 42 • Lubricity max. 520 µm • Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Approved	Approved
DIN 51603-6:2011-09, heating oil EL alternative	Not approved	Not approved
Approved fuels Fuel specifications	Series 4000	
	4000Gx3	4000Gx4
DIN 51603-1:2011-09, heating oil EL Standard <ul style="list-style-type: none"> • Cetane number min. 45 or centane index min. 42 • Lubricity max. 520 µm • Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Approved	Not approved
DIN 51603-1:2011-09, heating oil EL low-sulfur <ul style="list-style-type: none"> • Cetane number min. 45 or centane index min. 42 • Lubricity max. 520 µm • Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Approved	Not approved
DIN 51603-6:2011-09, heating oil EL alternative	Not approved	Not approved

4.2.5 Marine distillate fuels in accordance with ISO 8217:2013-12

Commercially available diesel fuels meeting the following specifications are approved for use:

Approved fuels Fuel specifications	Series 2000	
	2000Gx5	2000Gx6
DMX <ul style="list-style-type: none"> • Proportion of water: 200 mg/kg • Total contamination: Max. 24 mg/kg • Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Not approved	Not approved
DMZ <ul style="list-style-type: none"> • Proportion of water: 200 mg/kg • Total contamination: Max. 24 mg/kg • Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Not approved	Not approved
DMA <ul style="list-style-type: none"> • Proportion of water: 200 mg/kg • Total contamination: Max. 24 mg/kg • Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Not approved	Not approved
DMB	Not approved	Not approved
Approved fuels Fuel specifications	Series 4000	
	4000Gx3	4000Gx4
DMX <ul style="list-style-type: none"> • Proportion of water: 200 mg/kg • Total contamination: Max. 24 mg/kg • Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Approval issued if: <ul style="list-style-type: none"> • Viscosity > 4.5 mm²/s: Preheating required 	Not approved
DMZ <ul style="list-style-type: none"> • Proportion of water: 200 mg/kg • Total contamination: Max. 24 mg/kg • Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Approval issued if: <ul style="list-style-type: none"> • Viscosity 1.5 to 4.5 mm²/s • Outside the limit range between 1.5 and 4.5 mm²/s: Approval following co-ordination with MTU possible • Density 0.820 to 0.870 g/ml • Cetane number min. 45 or cetane index min. 42 	Not approved

TIM-ID: 0000080026 - 001

Approved fuels Fuel specifications	Series 4000	
	4000Gx3	4000Gx4
DMA <ul style="list-style-type: none"> • Proportion of water: 200 mg/kg • Total contamination: Max. 24 mg/kg • Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Approval issued if: <ul style="list-style-type: none"> • Viscosity 1.5 to 4.5 mm²/s • Outside the limit range between 1.5 and 4.5 mm²/s: Approval following co-ordination with MTU possible • Density 0.820 to 0.870 g/ml • Cetane number min. 45 or centane index min. 42 	Not approved
DMB	Not approved	Not approved

4.2.6 Aviation turbine fuels

Commercially available diesel fuels meeting the following specifications are approved for use:

Approved fuels Fuel specifications	Series 2000	
	2000Gx5	2000Gx6
F-34 / F-35 • JP-8	Generally not approved, approval upon request	Generally not approved, approval upon request
F-44 • JP-5	Generally not approved, approval upon request	Generally not approved, approval upon request
F-63 • In accordance with DCSEA 108/A	Generally not approved, approval upon request	Generally not approved, approval upon request

Approved fuels Fuel specifications	Series 4000	
	4000Gx3	4000Gx4
F-34 / F-35 • JP-8	Generally not approved, approval upon request	Generally not approved, approval upon request
F-44 • JP-5	Generally not approved, approval upon request	Generally not approved, approval upon request
F-63 • In accordance with DCSEA 108/A	Approved	Generally not approved, approval upon request

4.2.7 NATO diesel fuels

Commercially available diesel fuels meeting the following specifications are approved for use:

Diesel fuel NATO Code F-54

Approved fuels Fuel specifications	Series 2000	
	2000Gx5	2000Gx6
NATO Code F-54 in accordance with TL 9140-0001 Edition 8 <ul style="list-style-type: none"> Approval if fuel corresponds to diesel fuel DIN EN 590:2014-04 Total contamination: Max. 24 mg/kg Lubricity: Max. 520 µm Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Approval issued if: <ul style="list-style-type: none"> Sulfur content max. 500 mg/kg 	Approval issued if: <ul style="list-style-type: none"> Sulfur content max. 500 mg/kg
NATO Code F-54 in accordance with STANAG 7090 Edition 4 <ul style="list-style-type: none"> Approval if fuel corresponds to diesel fuel DIN EN 590:2014-04 Density: min. 0.820 g/ml Total contamination: Max. 24 mg/kg Lubricity: Max. 520 µm Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Approval issued if: <ul style="list-style-type: none"> Sulfur content max. 500 mg/kg 	Approval issued if: <ul style="list-style-type: none"> Sulfur content max. 500 mg/kg
Approved fuels Fuel specifications	Series 4000	
	4000Gx3	4000Gx4
NATO Code F-54 in accordance with TL 9140-0001 Edition 8 <ul style="list-style-type: none"> Approval if fuel corresponds to diesel fuel DIN EN 590:2014-04 Total contamination: Max. 24 mg/kg Lubricity: Max. 520 µm Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Approved	Not approved
NATO Code F-54 in accordance with STANAG 7090 Edition 4 <ul style="list-style-type: none"> Approval if fuel corresponds to diesel fuel DIN EN 590:2014-04 Density: min. 0.820 g/ml Total contamination: Max. 24 mg/kg Lubricity: Max. 520 µm Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Approved	Not approved

Diesel fuel NATO Code F-75

Approved fuels Fuel specifications	Series 2000	
	2000Gx5	2000Gx6
NATO-Code F-75 in accordance with TL 9140-0003 <ul style="list-style-type: none"> Reduced power possible due to min. density of 0.815 g/ml Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Not approved	Not approved
NATO-Code F-75 in accordance with STANAG 1385 <ul style="list-style-type: none"> Possible power reduction and increase due to density range of 0.815 to 0.880 g/ml max. sulfur content 1.0 % Adapt oil and oil change interval Proportion of water: Max. 200 mg/kg Total contamination: Max. 24 mg/kg Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Not approved	Not approved
Approved fuels Fuel specifications	Series 4000	
	4000Gx3	4000Gx4
NATO-Code F-75 in accordance with TL 9140-0003 <ul style="list-style-type: none"> Reduced power possible due to min. density of 0.815 g/ml Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Approved	Not approved
NATO-Code F-75 in accordance with STANAG 1385 <ul style="list-style-type: none"> Possible power reduction and increase due to density range of 0.815 to 0.880 g/ml max. sulfur content 1.0 % Adapt oil and oil change interval Proportion of water: Max. 200 mg/kg Total contamination: Max. 24 mg/kg Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Approval issued if: <ul style="list-style-type: none"> Cetane number min. 45 or cetane index min. 42 	Not approved

Diesel fuel NATO Code F-76

Approved fuels Fuel specifications	Series 2000	
	2000Gx5	2000Gx6
NATO Code F-76 in accordance with STANAG 1385 Edition 6 <ul style="list-style-type: none"> Proportion of water: Max. 200 mg/kg Total contamination: Max. 24 mg/kg Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Generally not approved, approval upon request	Generally not approved, approval upon request
NATO-Code F-76 in accordance with DEF-STAN 91-4 Issue 8 <ul style="list-style-type: none"> Proportion of water: Max. 200 mg/kg Total contamination: Max. 24 mg/kg Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Generally not approved, approval upon request	Generally not approved, approval upon request
NATO-Code F-76 in accordance with MIL-DTL-16884N <ul style="list-style-type: none"> Proportion of water: Max. 200 mg/kg Total contamination: Max. 24 mg/kg Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Generally not approved, approval upon request	Generally not approved, approval upon request
Approved fuels Fuel specifications	Series 4000	
	4000Gx3	4000Gx4
NATO Code F-76 in accordance with STANAG 1385 Edition 6 <ul style="list-style-type: none"> Proportion of water: Max. 200 mg/kg Total contamination: Max. 24 mg/kg Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Approval issued if: <ul style="list-style-type: none"> Cetane number min. 45 or centane index min. 42 	Not approved
NATO-Code F-76 in accordance with DEF-STAN 91-4 Issue 8 <ul style="list-style-type: none"> Proportion of water: Max. 200 mg/kg Total contamination: Max. 24 mg/kg Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Approved	Not approved
NATO-Code F-76 in accordance with MIL-DTL-16884N <ul style="list-style-type: none"> Proportion of water: Max. 200 mg/kg Total contamination: Max. 24 mg/kg Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 36) 	Approval issued if: <ul style="list-style-type: none"> Cetane number min. 45 or centane index min. 42 	Not approved

4.2.8 Paraffinic diesel fuel according to DIN EN 15940

Selected paraffinic diesel fuels according to DIN EN 15940 are currently in the qualification phase.

Important information

Project-specific approval from MTU-Friedrichshafen GmbH is possible upon request.

4.2.9 B20 diesel fuel

B20 diesel fuel is a diesel fuel with a biodiesel share of 20%.

Important information

Project-specific approval from MTU-Friedrichshafen GmbH is possible upon request.

The following section provides additional information on B20 diesel fuel.

Use of B20 diesel fuels

Biodiesel mixtures consist of fuels which are obtained from biological raw materials and mixed with conventional diesel fuel. For instance, B20 denotes a mixture comprising 20% biodiesel and 80% fuel based on crude oil/mineral oil. MTU engines were not specially designed to be operated with biodiesel mixtures. For this reason, the use of biodiesel mixtures may have negative effects in terms of engine power, service and maintenance requirements, emissions and service life.

Operators of MTU engines therefore need to be clear about the effects that biodiesel may have on their engines, and must take all of the necessary measures to ensure the reliability and safety of their engines. This letter provides MTU customers with important information on the use of biodiesel mixtures in MTU engines, and explains the potential impact these fuels may have on the MTU warranty. Please read this information carefully before using biodiesel mixtures in MTU engines.

1. Regarding the use of approved biodiesel mixtures

At present, only biodiesel mixtures with up to 7% biodiesel (in accordance with DIN EN 590) or 5% biodiesel (in accordance with ASTM D 975) are approved for use in the MTU Fluids and Lubricants Specifications.

Although biodiesel mixtures with up to 20% biodiesel (B20) are not yet approved in the MTU Fluids and Lubricants Specifications at present, they can be used in the engines listed below in section 6, AS LONG AS the following requirements are met:

- The biodiesel complies with DIN EN 14214 or ASTM D 6751.
- The B20 fuel grade corresponds with DIN EN 16709.
- The distilled diesel fuel added to the biodiesel is approved in the latest version of the MTU Fluids and Lubricants Specifications.
- The operator complies with the operating requirements given in section 2 and the additional maintenance recommendations from section 5.

Important information

The provisions with regard to requirements placed on fuel may differ depending on legislation and application of the engine. The operator is responsible for ensuring that only fuels which comply with the applicable provisions are used in the engines.

2. Operating requirements for the use of B20

The following operating requirements must be met when biodiesel mixtures are used in MTU engines:

- a For engines used in emergency generators, an additive must be used to improve the oxidation stability of the biodiesel.
- b All engines used in fire pumps, fire-extinguishing equipment or police equipment must be thoroughly rinsed with pure, high-quality distilled diesel fuel which complies with the MTU Fluids and Lubricants Specifications each time they are operated with a biodiesel mixture. Furthermore, an additive must be used in these engines to improve the oxidation stability of the biodiesel.
- c All engines which are only used seasonally or which are not operated for extended periods between uses must be thoroughly rinsed with pure, high-quality distilled diesel fuel which complies with the MTU Fluids and Lubricants Specifications before they are decommissioned.
- d Biodiesel mixtures cannot be used in engines equipped with an exhaust gas after-treatment system (e.g. catalytic converters, particle filters (DPF) and/or systems for reducing NOx emissions, e.g. SCR systems).

3. Impact on the MTU warranty

The manufacturer shall not be responsible for breakdowns which can be attributed to the use of fuels not approved in the MTU Fluids and Lubricants Specifications and such breakdowns shall therefore not be covered by the MTU warranty. MTU shall reject all warranty claims connected to the use of biodiesel mixtures with a biodiesel content of more than 7% (in accordance with DIN EN 590) or 5% (in accordance with ASTM D 975) if the operator is unable to prove that the operating requirements and recommendations contained in this letter were met and strictly followed. Regardless of this, MTU shall on no account be liable for providing compensation for costs arising from the effects described below in section 4.

Important information

All properties guaranteed by MTU in terms of engine power and/or availability in operation only apply to the cases in which fuels approved by MTU are used and the engine demonstrates no defects or damage arising from operation with fuels not approved in the MTU Fluids and Lubricants Specifications.

4. Effects of biodiesel on engines/exclusion of liability

The biodiesel contained in biodiesel mixtures is a natural product and therefore undergoes natural aging processes. These may have a negative effect on the engines in which the biodiesel mixtures are used. The effects that biodiesel may have on engines are explained below.

Important: THESE EFFECTS ARE NOT FAULTS CAUSED BY THE ENGINE MANUFACTURER. THEY ARE THEREFORE EXCLUDED FROM THE MTU WARRANTY. MTU SHALL NOT ASSUME ANY LIABILITY FOR COSTS ARISING FROM THE EFFECTS DESCRIBED BELOW.

- The formation of deposits may cause components to become "sticky", which potentially restricts their movement. On engines with long downtimes, this can result in a situation where the engine can no longer be started. This is why additives for improving the oxidation stability of the biodiesel must be employed when biodiesel mixtures are used in emergency generators. MTU SHALL ACCEPT NO LIABILITY IN THE EVENT THAT THE ENGINE IN AN EMERGENCY GENERATOR CAN NOT BE STARTED AS A RESULT OF THE FORMATION OF DEPOSITS.
- The formation of deposits may have an adverse effect on the interaction of components inside the unit. This results in an increased risk of components failing, and even the breakdown of entire cylinders. The high operating temperatures in the surroundings encourage the formation of mineral deposits, other deposits and encrustations which may render the valve unable to correctly regulate the fuel supply. This means that it is no longer possible for the quantity of fuel required at full load to be injected into the engine, thereby reducing the maximum engine power.
- The viscosity properties of biodiesel are less favorable at low temperatures. The use of biodiesel at low temperatures may therefore cause the fuel filter to become blocked.
- On all engines, lubricating the piston skirts with oil leads to a small amount of fuel entering the engine oil. This is generally of little importance with conventional diesel fuels in accordance with the MTU Fluids and Lubricants Specifications since the fuel evaporates quickly upon reaching the operating temperature. On the other hand, biodiesel evaporates much less effectively, with the result that more biodiesel accumulates in the oil. Aging of the biodiesel can therefore cause residues to form, filters to become clogged and ultimately cause the engine to come to a stop, resulting in significantly shorter oil change intervals.
- Compared to conventional diesel fuels according to the MTU Fluids and Lubricants Specifications, biodiesel has a lower energy density. Operating the engine with B20 results in a power reduction of approximately 2% and an increase in fuel consumption of around 3%.
- Biodiesel contains chemical components which can interact with the sensors in the exhaust gas recirculation system in such a way that incorrect data is reported to the engine control system. This can have consequences such as engine operation being adapted to the wrong values and emissions therefore no longer complying with the applicable provisions. This is why biodiesel must not be used in engines which feature exhaust gas recirculation (EGR) and/or exhaust gas after-treatment systems.
- Compared to conventional diesel fuels according to the MTU Fluids and Lubricants Specifications, biodiesel has a higher water solubility, meaning that a higher proportion of water should be expected depending on the fuel temperature. This can lead to increased corrosion and faster microbe growth in the fuel system. Due to the higher proportion of water in biodiesel, reduced water separator performance must be expected.
- Biodiesel is a solvent. After switching over to a biodiesel mixture, impurities and certain deposits may become loose in the tank and lines, causing the fuel filter to be subjected to an increased accumulation of these. Biodiesel mixtures may also strip paint when they come into contact with painted surfaces.
- On engines with exhaust gas aftertreatment systems, the functioning of the catalytic converter may be impaired as biodiesel mixtures can contain a higher proportion of trace elements (e.g. calcium, magnesium, sodium, potassium and phosphorus) than conventional diesel fuels according to the MTU Fluids and Lubricants Specifications. This means that the legally prescribed emission limits are not complied with and the operating license becomes invalid. Furthermore, legally prescribed technologies for checking emissions on these engines (e.g. NOx monitoring diagnostics) lead to a significant decrease in engine power. The aforementioned trace elements may also result in excess ash formation and accumulations in the soot filters and catalytic converters. Excess ash formation results in a constantly rising exhaust back pressure and can therefore cause a slow reduction in engine power.

The aforementioned points do not constitute a complete risk assessment. MTU is unable to assess all biodiesel variants and their long-term effects on MTU products.

5. Additional maintenance recommendations

The following requirements must be met to ensure the quality and availability of your engine:

- Select the highest possible content of distilled fuel. Only use fuels approved in the MTU Fluids and Lubricants Specifications.
- After switching over to a biodiesel mixture, replace the fuel filters after 50 operating hours at the latest (in order to remove the impurities which become loose from the tank and lines).
- The fuel filters and fuel prefilters must be renewed every 250.
- Install a fuel preheating system if the engine is operated at temperatures below 0 °C (32 °F). This can reduce the negative effect on the fuel supply.
- Follow the recommendations below with regard to engine oil and maintenance:
 - If biodiesel mixtures are used, the change intervals for engine oil and filters must be halved in comparison to the intervals stated in the MTU Fluids and Lubricants Specifications.
 - The TO for the LP fuel pump, the O-rings in the LP fuel system as well as the valves in the fuel filter head is shortened to TBO/3.
 - In addition to changing the oil and filters on time, the engine oil and filters must be analyzed regularly in order to ensure that the oil quality is correct. Interval: Every 100 operating hours or every three months, depending on which comes first. A decision must be made to either further reduce or extend the change intervals on the basis of the results.
 - The oil and oil filter must be replaced before biodiesel is used.
 - High-quality engine oil must be used. Operating the engine without high-quality category 2 oil leads to a deterioration in oil quality. The MTU Fluids and Lubricants Specifications contain a list of approved oil types.
- Use a suitable tank and line system:
 - Do not use any components which contain zinc, copper or NBR seals.
 - Ensure that the system can be filled up to the fill line.
 - Minimize the entry of atmospheric oxygen through the tank vent in the event of temperature fluctuations, etc. (e.g. by installing a pressure relief valve and filter; contact your tank supplier to do this).
 - It is recommended to use a tank vent with humidity separator.
- For systems without a water separator: Retrofit a water separator to reduce the risk of microbe growth and corrosion in the fuel system.
- Regular maintenance of the water separator is mandatory. Separated water must be drained off daily, depending on the water quantity.
- Avoid relatively long engine downtimes and temporary decommissioning (more than one week). If downtimes cannot be avoided, you must use a suitable additive to improve oxidation stability. In Q4/2013, MTU approved an additive specially certified for MTU diesel engines. When this additive is used, B20 can be stored for up to four months, depending on the storage conditions and quality of the biodiesel. Prior to this point, we provided an additive on request.
- For engines used seasonally, we strongly recommend rinsing the fuel system, including the fuel tank, with pure, high-quality distilled diesel fuel in accordance with the MTU Fluids and Lubricants Specifications before the engine is decommissioned for a relatively long period (more than one week).
- Prevent biodiesel from coming into contact with painted surfaces to avoid damaging and stripping the paint.
- You must also always comply with the latest version of the MTU Fluids and Lubricants Specifications.

More extensive preventative measures are additionally required for some applications. Our Customer Service department is available to answer any questions you may have on this topic.

6. Affected engines

This customer information applies to the following engine series:

Series	Remarks
S1600Gx0	All years of manufacture
S2000Gx2	All years of manufacture
S2000Gx3	With metal low-pressure fuel lines
S2000Gx4	All years of manufacture
S2000Gx5	All years of manufacture
S2000Gx6	All years of manufacture
S4000Cx0	All years of manufacture
S4000Cx1	All years of manufacture
S4000Gx1	With metal low-pressure fuel lines
S4000Gx2	All years of manufacture
S4000Gx3	All years of manufacture

Table 13:

Should you have any questions about this customer information, please contact your on-site MTU representative.

4.3 Biodiesel – Biodiesel admixture

The standardized general term "FAME", (Fatty Acid Methyl Esters) is used here to designate biodiesel fuels.

General information

- We can make no comment with regard to the level of FAME resistance of the fuel system, which is not part of our scope of supply.
- FAME is an extremely effective solvent. Any contact with paint, for example, must therefore be avoided.
- The characteristic smell of FAME exhaust, especially during long periods of idling, may be perceived as unpleasant. The nuisance caused by smell can be reduced by an oxidation catalyst which may be installed by the vehicle / equipment manufacturers at their own risk.

Important information

Our company accepts no responsibility for and provides no warranty in respect of any fault or damage connected in any way with the use of FAME of a lower quality or resulting from noncompliance with our specifications on operation using FAME. All resultant irregularities and consequential damage lie outside our responsibility.

Use of B20 fuels

Important information

Information on the use of B20 fuels can be obtained from the chapter (→ Page 53).

The following engines are approved/not approved for operation with 100% FAME in compliance with DIN EN 14214:2014-06.

Approved/non-approved engines for operation with 100% FAME

Series	Approved / Not approved	Conversion necessary
SUN	No approval	
700	No approval	
750	No approval	
OM 457 LA	From series introduction	no
460	From series introduction	no
900	From series introduction	no
500	From series introduction	no
S40	No approval	
S50	No approval	
S60	No approval	
183	No approval	
2000	No approval	
396	No approval	
4000	No approval	
538	No approval	
595	No approval	
956	No approval	

Series	Approved / Not approved	Conversion necessary
1163		No approval
8000		No approval

Table 14:

Important information
Diesel fuel with a FAME content of max. 7% in compliance with DIN EN 590:2014-04 may be used. Such fuel may also be used in engines which have not been approved for operation with FAME, without affecting oil drain intervals.

Fuel

- The fuel must comply with DIN EN 14214:2014-06. Operation with fuels of lower quality can lead to damage and malfunctions.
- Either FAME or diesel fuel may be used. The various mixtures of FAME and normal diesel fuel, which may occur in the fuel tank as a result, present no problems.

Engine oil and servicing

- For operation using 100% FAME, engine oils are to be preferred which comply with MB Fluids and Lubricants Specifications, Sheet 228.5 or Oil Category 3 in accordance with MTU Fluids and Lubricants Specifications. Engine oils in accordance with Sheet 228.3 or Oil Category 2 as per MTU Fluids and Lubricants Specifications may also be used provided that oil drain intervals are reduced.
- A certain amount of fuel always finds its way into the engine oil via the pistons and cylinders. Its high boiling point means that FAME does not evaporate but remains in the engine oil in its entirety. Under certain conditions chemical reactions may take place between FAME and the engine oil. This can lead to engine damage.
- For this reason, engine oil and filter change intervals must be shortened for operation both with pure FAME and with FAME-diesel mixtures.
- For Series 457, 460, 900 and 500 engines, special equipment is available which facilitates an increase in the engine oil change intervals for operation with 100% FAME (→ Table 15). This involves fitting the engines with special equipment Code MK21 (special unit pump) and Code MK04 (fuel prefilter with heated water separator).

Effects on the engine oil change interval with operation with 100% FAME

Engine version	Engine oil change interval
Engines not fitted with special equipment for operation with FAME	Reduction of engine oil change interval to 30% of the standard interval required for operation with fossil diesel fuels
Engines fitted with special equipment Code MK21 and Code MK04	Reduction of engine oil change interval to 50% of the standard interval required for operation with fossil diesel fuels

Table 15:

Important information
The relevant engine oil change intervals must be complied with without fail! Exceeding the engine oil change intervals can cause engine damage!

- Operation with 100% FAME requires shortened fuel filter change intervals. A new fuel filter must be fitted each time the engine oil is changed.
- FAME has a high cleaning effect, which results in a risk of clogging by loosened deposits. If a switch has been made to FAME, a fuel filter and engine oil change should therefore be carried out after approx. 25 operating hours.
- Over longer periods, fuel filter service life may be reduced as a result of old residues being carried into the filter from the fuel system. A special, approved fuel prefilter can be installed as an improvement. This fuel prefilter with heated water separator is already installed on engines fitted with special equipment Code MK04.

Engine power and engine standstill

- Due to its calorific value, operation with 100% FAME involves a reduction of approx.8% to 10% in engine power. This leads to a corresponding increase in fuel consumption as compared to operation with diesel fuel. Engine power corrections are not permissible.
- Prior to any extended period out of operation, the fuel system must be flushed out in order to prevent congestion. For flushing, the engine must be operated for at least 30 minutes on FAME-free diesel fuel.

Vegetable oils as an alternative to diesel fuel

Important information

The use of pure vegetable oils as an alternative to diesel fuel or FAME is strictly prohibited due to the absence of standardization and to negative experience (engine damage caused by coking, deposits in the combustion chambers and oil sludge)!

Diesel fuels in winter operation

At low outdoor temperatures, the diesel fuel's fluidity can be inadequate on account of paraffin precipitation.

In order to prevent operational problems (e.g. clogged filters) during the winter months, diesel fuel with suitable cold-flow characteristics is available on the market. Deviations are possible during transitional periods and in individual countries.

4.4 Heating oil EL

Heating oil differs from diesel fuel mainly because of the following non-specified characteristics:

- Cetane number
- Sulfur content
- Oxidation stability
- Corrosion effect on copper
- Lubricity
- Low temperature behavior

If the heating requirements comply with the specifications of the diesel fuel DIN EN 590:2014-04 (summer and winter quality), there are no technical reasons why it can not be used in the diesel engine

4.5 Supplementary fuel additives

Supplementary fuel additives

The engines are designed such that satisfactory operation with normal, commercially available fuels is ensured. Many of these fuels already contain performance-enhancing additives.

The additives are added by the supplier as the agent responsible for product quality.

The anti-wear additives and biocides represent an exception(→ Page 62).

Important information

Attention is drawn to the fact that the use of diesel fuels or additives other than those stipulated in the MTU Fluids and Lubricants Specifications is always the responsibility of the operator.

Diesel fuels with sulfur content < 500 mg/kg

On Series 362, 396, 538, 652, 595, 956, 1163-02 and -03 engines with cylinder heads not fitted with valve seat inserts, the use of low-sulfur fuel (< 500 mg/kg) can lead to increased valve seat wear. If anti-wear additives are mixed in, this wear can be reduced. The approved supplementary additives must be mixed with the fuel in the predefined concentration. The additive must be filled before every refueling.

Microorganisms in fuel

Bacterial attack and sludge formation may occur in the fuel under unfavorable conditions. In such cases, the fuel must be treated with biocides in accordance with the manufacturer's specifications. Overconcentration must always be avoided.

The biocides approved at MTU are listed in table (→ Table 17).

Approved anti-wear additives

Manufacturer	Brand name	Concentration for use
The Lubrizol Corporation 29400 Lakeland Boulevard Wickliffe, Ohio 44092 USA Tel. 01 440-943-4200	ADX 766 M	250 to 350 mg/kg
Tunap Industrie GmbH Bürgermeister-Seidl-Str. 2 82515 Wolfratshausen Tel. +49 (0) 8171 1600-0 Fax. +49 (0) 8171 1600-91	Tunadd PS	250 to 350 mg/kg

Table 16:

Important information

The use of anti-wear additives is not permitted on engines/plants with exhaust aftertreatment!

Approved biocides

Biocides should have a pure hydrocarbon structure, i.e. should only consist of the following components:

- Carbon
- Hydrogen
- Oxygen
- Nitrogen

They must not contain inorganic substances because they can cause damage to the engine. The use of halogenated biocides is prohibited due to their effects on the engine system and the environment.

A release for biocides that meet the above requirements is possible upon request.

Manufacturer	Brand name	Concentration for use
ISP Biochema Schwaben GmbH Ashland Specialty Ingredients Luitpoldstrasse 32 87700 Memmingen Tel. +49 (0)8331 9580 0 Fax. +49 (0)8331 9580 51	Bakzid	100 ml / 100 l
Maintenance Technologies Paddy's Pad 1056 CC t/a Maintenance Technologies Tel. +27 21 786 4980 Cell +27 82 598 6830	Diesecure Fuel Decontainment	1 : 1200 (833 mg/kg)
Adolf Würth GmbH & Co. KG Reinhold Würth-Straße 12-17 74653 Künzelsau Tel. +49 (0) 7940 15-2248	Diesecure Fuel Decontainment	1 : 1200 (833 mg/kg)
Schülke und Mayr 22840 Norderstedt Tel. +49 (0) 40 52100-00 Fax. +49 (0) 40 52100-244	grotamar 71 grotamar 82 StabiCor 71	0.5 l / ton 1.0 l / 1000 l 0.5 l / ton
Supafuel Marketing CC PO Box 1167 Allens Nek 1737 Johannesburg South Africa Tel. +27 83 6010 846 Fax. +27 86 6357 577	Dieselfix / Supafuel	1:1200 (833 mg/kg)
Wilhelmsen Ships Service AS Willem Barentszstraat 50 3165 AB Rotterdam-Albrtand-swaard Tel. +31 10 487 7777 Fax. +31 10 487 7888 Netherlands	DieselPower MAR 71 (Biocontrol MAR 71)	333 ml / ton

Table 17:

Flow improvers

Flow improvers can not prevent paraffin precipitation but they do influence the size of the crystals and thus allow the diesel fuel to pass through the filter.

The effectiveness of the flow improvers is not guaranteed for every fuel.

Certainty is only assured after laboratory testing of the filtering capability.

Required quantities and mixing procedures must be carried out according to the manufacturer's instructions.

4.6 Unsuitable materials in the diesel fuel circuit

Components made of copper and zinc materials

The use of components made of copper and zinc materials in the fuel circuit is prohibited. They can cause chemical reactions in the fuel and thus lead to formation of a coating in the fuel system.

Requirements

Based on current knowledge, the following materials and coatings must not be used in a diesel fuel circuit because negative mutual reactions can occur even with approved coolant additives.

Metallic materials

- Zinc, also as surface protection
- Zinc-based alloys
- Copper
- Copper-based alloys with the exception of CuNi10 and CuNi30 (e.g. seawater cooler)
- Tin, also as surface protection
- Magnesium-based alloys

Non-metallic materials

- Elastomers: Nitrile rubber, natural rubber, chloroprene rubber, butyl rubber, EPDM
- Silicone elastomer
- Fluorosilicone elastomer
- Polyurethane
- Polyvinyl

Information:

In case of doubt about the use of materials on the engine and add-on components / components in coolant circuit, consultation with the respective MTU specialist department must be held.

4.7 MTU Advanced Fluid Management System for fuels – Test package for North America

A sophisticated system for diagnostics and preventive maintenance is available in North America. This system allows the following:

For full information on the MTU Advanced Fluid Management System available in North America, please contact an authorized MTU Onsite Energy service partner.

The following test packages from MTU Advanced Fluid Management System can be ordered from authorized MTU Onsite Energy service partners in North America:

- F-PDFM1
Basic test – For checking the degree of contamination of the diesel fuel.
The test determines existing metallic elements and examines the proportion of water and contamination with bacteria and particles.
- F-PDFM2
Extended test – Includes the basic test plus an examination for determination of the degree of contamination, any possible filter contamination and ignition behavior of the engine.
- F-PDFM3
Extended Test Plus – Includes the extended text plus a lubricity analysis.
Maintenance of the correct lubricity has a positive effect on the service life of the components of the engine fuel system.

The following fuel parameters can be determined:

Fuel parameter	F-PDFM1	F-PDFM2	F-PDFM3
24 elementary metals	✓	✓	✓
Viscosity at 40 °C	-	✓	✓
Percent sulfur	-	✓	✓
Water and sediment	✓	✓	✓
Pour point	✓	✓	✓
Thermal stability	✓	✓	✓
Bacteria, fungi and mildew	✓	✓	✓
Flashpoint according to Pensky-Marten	-	✓	✓
Calculated centane index	-	✓	✓
Distillation	-	✓	✓
Cloud point	-	✓	✓
Percentage of water according to Karl Fischer	✓	✓	✓
Particle content	✓	✓	✓
Density according to API	-	✓	✓
Lubricity	-	-	✓

The MTU Advanced Fluid Management System with trend analysis provides information for maximizing system reliability. The following guidelines must be followed to obtain the best results.

Samples must be taken:

- While the engine is operating under normal conditions or immediately after stopping the engine while the engine is still at operating temperature
- Every 250 hours at the same point

Note: The software offered by MTU for online reporting with trend analyses shows the procedure for optimizing evaluation of the gathered information after completion of the analysis.

Note: The MTU Advanced Fluid Management System works together with independent test laboratories accredited according to ISO 17025 A2LA. This accreditation is the highest level of quality obtainable by a test laboratory in North America.

5 Approved Engine Oils and Lubricating Greases

5.1 Single-grade oils – Category 1, SAE grades 30 and 40 for diesel engines

For details and special features, see chapter "Lubricants for four-cycle engines" (→ Page 7)

Single-grade oils

Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	>12 mgKOH/g	
Addinol Lube Oil	Addinol Marine MS4011	40	X			
	Addinol Turbo Diesel MD305	30		X		
	Addinol Turbo Diesel MD405	40		X		
Aegean Oil SA	Vigor Super D	40	X			
Avia	Avia Special HDC	30, 40	X			
Castrol Ltd.	Castrol MLC	30, 40		X		
Cepsa Lubricantes	Cepsa Rodaje Y Proteccion	30	X			Increased corrosion protection
Cyclon Hellas	Cyclon D Prime	30, 40	X			
Gulf Oil International	Gulf Superfleet	40	X			
Motor Oil (Hellas)	EMO Turbo Champion Plus	30, 40	X			
Petrobras Distribuidora S.A.	Marbrax CCD-310	30		X		
	Marbrax CCD-410	40		X		
PT. Pertamina Lubricants	Meditiran SMX	40	X			
PTT Public Comp.	PTT Navita MTU Type 1	40	X			
Repsol Lubricantes y Especialidades, S.A.	Repsol Serie 3	30, 40		X		
	Repsol Marino 3	30		X		
	Repsol Marino 3 SAE 40	40			X	
SRS Schmierstoff Vertrieb GmbH	SRS Rekord	30, 40		X		
Shell International Petroleum Company	Shell Gadinia S	30, 40		X		
	Shell Rimula R3	30, 40	X			
	Shell Rimula R3+	30	X			
	Sirius	30	X			
	Shell Sirius Monograde	30, 40	X			
SK Lubricants	SD 5000	40	X			
Total	Total Caprano TD 30	30		X		
	Total Caprano TD 40	40		X		

Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	>12 mgKOH/g	
United Oil	XD 7000 Extra Duty-3U		X			
	XD 7000 Extra Duty-4U		X			

Table 18:

5.2 Multigrade oils - Category 1, SAE grades 15W-40 for diesel engines

For details and special features, see chapter "Lubricants for four-cycle engines" (→ Page 7)

Important information

¹⁾ = These multigrade oils can only be used if crankcase ventilation is routed to atmosphere.

²⁾ = Engine oils marked ²⁾ are also permitted for the "Series 60"

Multigrade oils

Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	>12 mgKOH/g	
Addinol Lube Oil	Addinol Super Star MX 1547	15W-40		X		
Advanced Lubrication Specialties	Translub 15W40 CI-4	15W-40		X		
BP p.l.c.	BP Vanellus Multi	15W-40	X			
ENI S.p.A	eni i-Sigma universal DL	15W-40	X			
Exxon Mobil Corporation	Mobil Delvac Super 1400E	15W-40	X			
Exxon Mobil Corporation	Mobil Delvac XHP	15W-40	X			
Gulf Oil International	Gulf Superfleet	15W-40	X			
Manufacture Zavod imeni Shau-myana	M5z/14D ₂ CE	15W-40			X	
Petróleos de Portugal, Petrogal S.A.	Galp Galaxia Super 15W-40	15W-40	X			
Singapore Petroleum Company Limited	SPC SDM 801	15W-40	X			
SRS Schmierstoff Vertrieb GmbH	SRS Primalub	15W-40	X			
Total	Total Caprano TD	15W-40	X			
Unil Opal	Intercooler 400	15W-40	X			
United Oil	XD 9000 Ultra Diesel-U	15W-40	X			

Table 19:

5.3 Single-grade oils – Category 2, SAE-grades 30 and 40 for diesel engines

For details and special features, see chapter "Lubricants for four-cycle engines" (→ Page 7)

MTU single-grade oils

Manufacturer	Brand name	SAE viscosity class	TBN			Comments / material number
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	>12 mgKOH/g	
MTU Friedrichshafen GmbH	Power Guard® DEO SAE 40	40	X			20 l container: X00062816 210 l container: X00062817 IBC: X00064829
MTU America	Power Guard® SAE 40 Off-Highway Heavy Duty	40		X		5 gallons: 23532941 55 gallons: 23532942 Approved for Series 8000 [(→ Table 20), note] available through MTU America Not approved for Series 2000 M72
MTU India Pvt Ltd.	Diesel Engine Oil DEO SAE 40	40		X		20 l container: 73333/P 205 l container: 75151/D Sale of Indian oil only intended in Indian market

Table 20:

Important information
For Series 8000 engines, the approved SAE class 40 engine oils may only be used in combination with pre-heating and oil priming ($T_{oil} > 30 \text{ }^{\circ}\text{C}$).

Further single-grade oils

Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	>12 mgKOH/g	
Addinol Lube Oil GmbH	Addinol Turbo Diesel MD 407	40	X			
Adnoc Distribution	ADNOC Voyager Plus 40 CF/SL	40	X			
Atak Madeni Yag Lubricants	Protector MX 30	30			X	
	Protector MX 40	40			X	

Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	>12 mgKOH/g	
BayWa AG	Tectrol HD 30	30		X		
	Tectrol HD 40	40		X		
Belgin Madeni Yaglar	Lubex Marine M	30		X		
	Lubex Marine M	40		X		
	Lubex Marine LTM-30	30		X		
	Lubex Marine LTM-40	40		X		
Bucher AG Langenthal	Motorex Monolube	30		X		
Castrol Ltd.	Castrol HLX	30, 40		X		Approved for fast commercial vessels up to 1500 h, Series 595, 1163
Cepsa Lubricants	Cepsa Petrel HDL 40	40			X	
Chevron Lubricants (Texaco)	Ursa Premium TDX	40		X		
	Delo 400	30, 40		X		
	Delo Gold	40		X		
Chevron – Lyteca – (Texaco)	Ursa Premium TDX	40		X		
Cyclon Hellas	Cyclon D Super	40		X		
Delek	Delkol Super Diesel	40		X		
	Delkol Super Diesel MT Mono	40	X			
ENI S.p.A.	Agip Sigma GDF	40		X		
ENOC Marketing L.L.C.	ENOC Strata Super Duty	40		X		
Exxon Mobil Corporation	Mobil Delvac 1630	30		X		Not approved for Series 2000 M72
	Mobil Delvac 1640	40		X		Not approved for Series 2000 M72
Fuchs Europe Schmierstoffe GmbH	Titan Universal HD	30, 40	X			
	Titan Universal HD 30 MTU	30	X			Increased corrosion protection
Gulf Oil International	Gulf Superfleet Plus	40	X			
Gulf Western Oil, Australia	Turboil	40			X	
GS Caltex Corporation	Kixx D1 40	40	X			
Hyrax Oil Sdn Bhd	Hyrax Top Deo	40	X			
Koçak Petrol Ürünleri San. ve TIC. Ltd.	Speedol Ultra HDX 30 TBN 12	30		X		
	Speedol Ultra HDX 40 TBN 12	40		X		
	Speedol Deniz Dizel Motor Yağı	30, 40		X		
	Speedol Ultra HDX	30, 40	X			
Kuwait Petroleum	Q8 T 750	30, 40	X			

TİM-İD: 0000018996 - 006

Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	>12 mgKOH/g	
Manufacture Zavod imeni Shau-myana Ltd.	M-14D2CE	40			X	
Motor Oil, Hellas	EMO SHPD Plus	30, 40		X		
OOO Lukoil International	Lukoil Avantgarde M 40	40	X			
Oryx Energies	Supreme RR	40			X	
Panolin AG	Panolin Extra Diesel	40	X			
Paz Lubricants & Chemicals	Pazl Marine S 40	40	X			
Petrobras Distribuidora S.A.	Marbrax CCD-310-AP	30		X		
	Marbrax CCD-410-AP	40		X		
Petroleos de Portugal, Petrogal S.A.	Galp Galaxia 40	40		X		
Prista Oil Holding EAD	Prista SHPD 40	40			X	
PTT Public Comp.	PTT Navita MTU Type 2	40		X		
	Navita Plus, SAE 40	40		X		
Repsol Lubricantes y Especialidades, S.A.	Repsol Diesel Serie 3 MT	40			X	
Shell International Petroleum Company	Shell Sirius X	30			X	
	Shell Sirius X	40			X	
Singapore Petroleum Company Limited	SPC SDM 900, SAE30	30		X		
	SPC SDM 900, SAE40	40		X		
Sonol	Seamaster 40	40	X			
SRS Schmierstoff Vertriebs GmbH	SRS Rekord plus 30	30		X		
	SRS Rekord plus 40	40		X		
	SRS Antikorrol M plus	30		X		Increased corrosion protection Only permitted for run-in and series acceptance
	SRS Motorenöl O-278	40		X		
Total	Total Caprano MT 30	30			X	
	Total Caprano MT 40	40			X	
	Total Disola MT 30	30	X			
	Total Disola MT 40	40	X			
	Total Rubia MT 30	30			X	
	Total Rubia MT 40	40			X	
Viva Energy Australia	Penske Power Systems Premium	40			X	

Table 21:

5.4 Multigrade oils – Category 2 of SAE grades 10W-40, 15W-40 and 20W-40 for diesel engines

For details and special features, see chapter "Lubricants for four-cycle engines" (→ Page 7)

Important information

²⁾ Engine oils marked ²⁾ are also approved for "Series 60"

MTU multigrade oils

Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	>12 mgKOH/g	
MTU Friedrichshafen GmbH	Diesel Engine Oil DEO SAE 15W-40	15W-40		X		20 l container: X00070830 210 l container: X00070832 IBC: X00070833 Loose items: X00070835 (only on request)
MTU Asia	Diesel Engine Oil - DEO 15W-40	15W-40		X		20 l container: 64247/P 200 l container: 65151/D
MTU Asia China	Diesel Engine Oil - DEO SAE 15W-40	15W-40		X		20 l canister: X00064242/P 205 l barrel: 65151/D
	Diesel Engine Oil - DEO SAE 10W-40	10W-40		X		20 l canister: 60606/P
MTU India Pvt. Ltd.	Diesel Engine Oil - DEO 15W-40	15W-40		X		20 l canister: 63333/P ²⁾ 205 l barrel: 65151/D Sale only intended in Indian market

Table 22:

Further multigrade oils

Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	> 12 mgKOH/g	
Adnoc Distribution	Adnoc Voyager Plus	15W-40		X		²⁾
Aegean Oil S.A.	Vigor Turbo SD 15W-40	15W-40	X			²⁾
Addinol Lube Oil	Addinol Super Longlife MD1047	10W-40		X		²⁾
	Addinol Diesel Longlife MD1548	15W-40		X		²⁾

Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	> 12 gKOH/g	
Anomina Petroli Italiana	IP Tarus	15W-40	X			
	IP Tarus Turbo	15W-40	X			
	IP Tarus Turbo Plus	15W-40	X			2)
Arabi Eneritech KSC	Burgan Ultra Diesel CH-4	15W-40		X		2)
Aral AG	Aral Turboral 10W-40	10W-40		X		
	Aral Turboral 15W-40	15W-40		X		2)
Atak Madeni Yag Lubricants	Alpet Turbot Fleetmax 1540	15W-40		X		2)
Auto-Teile-Ring GmbH	Cartechnic Motorenöl SAE 15W-40	15W-40	X			
Avista Oil Refining & Trading Deutschland GmbH	Avista Advantage SHPD	15W-40	X			
	Avista Advantage UHPD	15W-40	X			
	Pennasol Turbo Super	15W-40		X		2)
	MOTOR GOLD Turbotec	15W-40		X		2)
Bahrain Petroleum Company B.S.C.	Frontier Megatek	10W-40	X			
	Frontier Super Plus	15W-40		X		2)
	Frontier Turbo	15W-40		X		
	Frontier Turbo LD	10W-40		X		
BayWa AG	Tectrol Turbo 4000	10W-40		X		
Belgin Madeni Yaglar	Lubex Marine M	15W-40		X		
BP p.l.c.	BP Vanellus C6 Global Plus	10W-40		X		
	BP Vanellus Multi-Fleet	15W-40			X	2)
	BP Multi Mine	15W-40	X			2)
	BP Mine Multi 15W-40	15W-40		X		2)
	BP Vanellus Longdrain	15W-40		X		2)
	BP Vanellus Multi A	10W-40		X		2)
	BP Vanellus Agri	10W-40		X		2)
	BP Vanellus Multi A	15W-40	X			2)
	BP Vanellus Agri	15W-40	X			2)
	BP Vanellus Max Extra	15W-40			X	2)
Bucher AG Langenthal	Motorex Universal	10W-40		X		

Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	> 12 gKOH/g	
Castrol Ltd.	Castrol CRB Multi 10W-40 CI-4/E7	10W-40		X		
	Castrol CRB Multi 15W-40 CI-4/E7	15W-40		X		2)
	Castrol CRB Turbo 15W-40 CH-4/E7	15W-40	X			2)
	Castrol Rivermax CRB 15W-40 CI-4/E7	15W-40		X		2)
	Castrol Rivermax RX+ 15W-40	15W-40	X			2)
	Castrol Vecton 15W-40 DH-1	15W-40			X	2)
	Castrol RX Diesel	15W-40	X			
	Castrol RX Diesel 15W-40 CI-4/E7	15W-40		X		2)
	Castrol Vecton	10W-40		X		
	Castrol Vecton 15W-40 CI-4/E7	15W-40		X		2)
	Castrol Vecton 15W-40 CI-4/E7	15W-40			X	2)
Cepsa	Cepsa Euromax SHPD	15W-40		X		2)
Champion Chemicals N.V.	Champion New Energy	15W-40		X		2)
Chevron Lubricants (Caltex)	Delo SHP Multigrade	15W-40		X		
	Delo Gold Multigrade	15W-40	X			
	Delo Gold Ultra	15W-40		X		
	Delo Gold Ultra E	10W-40		X		
	Delo Gold Ultra E	15W-40	X			2)
	Delo 400 Multigrade	15W-40			X	2)
	OEC SAE 15W-40	15W-40		X		
Chevron Lubricants (Texaco)	Ursa Super TD	15W-40		X		2)
	Ursa Premium TDX	15W-40		X		2)
	Ursa Premium TDX Plus	15W-40		X		2)
	Ursa Heavy Duty	15W-40	X			
CPC Corporation, Taiwan	CPC Superfleet CG4 Motor Oil	15W-40	X			
Cubalub	Cubalub Extra Diesel MX	15W-40			X	2)
	Cubalub Extra Diesel	15W-40	X			
Cyclon Hellas	Cyclon D Super	15W-40	X			2)
Delek	Delkol Super Diesel	15W-40	X			
Delek Industries Ltd.	Super Diesel	15W-40		X		
Dunwell Petro-Chemical Co., Ltd.	Apex Super Motor Oil SL/CI-4, 15W-40	15W-40		X		2)
EKO A.B.E.E.	Eko Forza plus	15W-40	X			
Engen Petroleum Ltd.	Engen Dieselube 600 Super	15W-40	X			2)
	Engen Dieselube 700 Super	15W-40		X		2)

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Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	> 12 gKOH/g	
eni S.p.A.	Agip Blitum T	15W-40	X			
	eni i-Sigma super fleet	15W-40		X		
	eni i-Sigma performance E3	15W-40	X			
	eni i-Sigma performance E7	15W-40		X		2)
	eni i-Sigma performance E7	15W-40	X			2)
Exol Lubricants Ltd.	Taurus Extreme M	15W-40	X			2)
	Taurus Extreme HST	15W-40		X		2)
Exxon Mobil Corporation	Mobilgard 1 SHC	20W-40			X	Approved for fast commercial vessels up to 1500 h, 396, 1163
	Mobil Delvac Super 1400	15W-40	X			
	Mobil Delvac MX	15W-40		X		
	Mobil Delvac MX Extra	15W-40		X		
	Mobil Delvac Advanced City Logistics	15W-40	X			
Finke Mineralölwerk GmbH	AVIATICON Turbo Super Plus	15W-40	X			2)
Fuchs Europe Schmierstoffe GmbH	Fuchs Titan Truck Plus	15W-40		X		2)
	Titan Unimax Ultra MC	10W-40		X		
	Titan Formel Plus	15W-40		X		
	Fuchs Titan Truck	15W-40	X			2)
	Titan Unimax Plus MC	10W-40		X		
	Fuchs Titan Universal HD	15W-40	X			
Fuchs Lubrifiants France	Cofran Plura Super	15W-40		X		2)
Fuchs Petrolub SE	Fuchs Max Way	15W-40		X		2)
	Fuchs Titan Truck Plus	10W-30		X		
	Fuchs Titan Truck Plus	15W-40		X		
Gazpromneft Lubricants Ltd.	Belaz G-Profi Mining	15W-40		X		2)
	Belaz G-Profi Mining FF	15W-40		X		2)
	G-Profi MSI 10W-40	10W-40		X		
	G-Profi MSI 15W-40	15W-40		X		
	G-Profi MSH 15W-40	15W-40		X		
	G-Profi MSI Plus	15W-40		X		2)
	Gazpromneft Diesel Premium	15W-40	X			2)

Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	> 12 gKOH/g	
German Mirror Lubricants and Greases Co. FZE	Mirr Turbo Plus Diesel Engine Oil API CI-4 SAE 10W-40	10W-40		X		
	Mirr Turbo Plus Diesel Engine Oil API CI-4 SAE 15W-40	15W-40	X			2)
	Mirr Turbo Diesel Engine Oil API CH-4 SAE 15W-40	15W-40	X			2)
Ginouves Georges SAS	York 849	15W-40		X		2)
GS Caltex India Private Limited	Kixx Dynamic Gold	15W-40		X		2)
GS Caltex Corporation	Kixx HD 1	10W-40		X		
	Kixx HD 1	15W-40		X		2)
Gulf Oil International	Gulf Super Duty VLE	15W-40	X			
	Gulf Superfleet LE	10W-40		X		
	Gulf Superfleet LE	15W-40	X			2)
	Gulf Superfleet Supreme	10W-40		X		
	Gulf Superfleet Supreme	15W-40		X		2)
	Gulf Superfleet Plus	15W-40	X			
Gulf Western Oil, Australia	TOP DOG XDO	15W-40	X			2)
Hafa France	Stradex 1800	10W-40		X		
Hessol Lubrication GmbH	Hessol Turbo Diesel	15W-40		X		2)
	Hessol Super Longlife	10W-40		X		
High Industrial Lubricants & Liquids Corporation (HILL)	Fastroil Force F300 Diesel	15W-40		X		2)
	Fastroil Force F500 Diesel	15W-40		X		2)
	Fastroil Force F700 Diesel Pro	10W-40		X		
Hitachi Construction Machinery CO., Ltd.	Hitachi Premium Orange	15-W40	X			
Huiles Berliet S.A.	RTO Maxima RD	15W-40	X			2)
	RTO Maxima RLD	15W-40		X		2)
Hyrax Oil Sdn Bhd	Hyrax Admiral 15W-40	15W-40	X			2)
INA Maziva Ltd.	INA Super Max	15W-40		X		2)
Indian Oil Corporation	Servo Premium (N)	15W-40		X		
Ipiranga Produtos des Petróleo S.A.	Ipiranga Brutus Alta Performance	15W-40		X		2)
Kuwait National Lube Oil MfgCo (KNLOC)	Burgan Ultra Diesel CH-4	15W-40		X		2)
Kuwait Petroleum	Q8 T 750	15W-40	X			2)
	Q8 T 800	10W-40	X			2)
Kocak Petrol Ürünleri San	Speedol SHPD Tirot 15W-40	15W-40		X		

Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	> 12 gKOH/g	
Liqui Moly	Liqui Moly Marine 4T Motor Oil	15W-40		X		2)
	Liqui Moly Touring High Tech SHPD	15W-40	X			
Lotos Oil	Turdus Powertec CI-4 15W-40	15W-40		X		2)
	Turdus Powertec 1000	15W-40		X		2)
LPC S.A.	Cyclon Granit Maximum	15W-40		X		2)
Lubricantes de América	Generac Aceite	15W-40		X		
	Lubral Nano Diesel	15W-40		X		
Lubricating Specialties Company (LSC)	Top 1 Transport	15W-40		X		2)
Lubrisa	Gulf Superfleet Supreme	15W-40		X		2)
Lukoil Lubricants Europe Oy	Teboil Power Plus	15W-40	X			
	Tepoil Super HPD	15W-40		X		
	Tepoil Super HPD C	10W-40		X		
Mega Lube Marketers cc.	Megalube Diesel Engine Oil	15W-40		X		
Meguín GmbH	megol Motorenoel SHPD	15W-40	X			
Modriča Oil Refinery	Maxima Turbo	15W-40		X		
MOL-LUB Kft..	MOL Dynamic MK9	15W-40		X		
	MOL Mk-9	15W-40		X		
	Mol Dynamic Super Diesel	15W-40	X			
	Mol Dynamic Transit	10W-40		X		2)
	Mol Dynamic Transit	15W-40		X		2)
	MOL Super Diesel	15W-40	X			
Motor Oil, Hellas	EMO SHPD Plus	15W-40		X		
MPM International Oil Company B.V.	Motor Oil 15W-40 Super High Performance	15W-40		X		2)
NetLube Iran	Max Turbo	15W-40		X		2)
NSL OilChem Trading Pte Ltd	Liquid Gold D-Flo X4	15W-40		X		2)
Oman Oil Marketing Company SAOG	Omanoil Maximo Super 15W40 CH-4	15W-40	X			2)
Orlen Oil	Mogul Diesel DTT Extra	15W-40			X	2)
	Platinum Ultor	15W-40	X			2)
	Platinum Ultor Plus	15W-40			X	2)

Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	> 12 gKOH/g	
OOO "LLK-International"	BELAZ CI-4	15W-40	X			2)
	Lukoil Avantgarde Extra	15W-40	X			
	Lukoil Avantgarde Ultra	15W-40		X		
	Lukoil Avantgarde NP	15W-40		X		
	Lukoil Avantgarde Ultra Plus	10W-40		X		
Oryx Energies	Enduro 600	15W-40		X		
Panolin AG	Panolin Universal SFE	10W-40		X		
	Panolin Diesel Synth	10W-40		X		
PDVSA CA	PDV Ultradiesel	15W-40		X		2)
Pertamina	Meditran SX Plus	15W-40		X		2)
Petrobras Colombia Combustibles	Petrobras Top Turbo T2	15W-40	X			
Petrobras Distribuidora S.A.	Lubrax Nautica Diesel	15W-40		X		2)
Petro-Canada Lubricants	Duron	15W-40		X		2)
	Duron XL	15W-40		X		2)
Petroleos de Portugal, Petrogal S.A.	Galp Galaxia LD star	15W-40		X		
Petron Corporation	Petron Rev-x Premium Multi Grade	15W-40		X		2)
Petronas Lubricants International	Petronas Urania 3000	15W-40		X		2)
	Petronas Urania LD7	15W-40		X		
	Petronas Urania LD 7	10W-40	X			
	Petronas Urania Supremo CI-4	10W-40	X			2)
	Petronas Urania Supremo CI-4	15W-40	X			2)
Petromin Corporation	Petromin Turbomaster XD	15W-40		X		2)
Phillips 66 Lubricants	Conoco Hydroclear Power D	15W-40			X	
Prista Oil AD	Prista Turbo Diesel	15W-40	X			
PTT Public Limited	Navita Plus SAE 15W-40	15W-40	X			
Qatar Lubricants Company Ltd.	QALCO Topaz HMF	15W-40	X			
Qingdao Copton Technology Co., LTD.	Copton CH-4 Diesel Engine Oil	15W-40	X			
Raloy Lubricantes, S.S. de C.V.	Raloy Diesel Power	15W-40		X		2)
Raj Petro Specialities P Ltd.	Zoomol Rforce 3100 RF1	15W-40	X			2)
	Zoomol Rforce 3100 RF4	15W-40		X		2)
Ravensberger Schmierstoffvertrieb GmbH	RAVENOL Expert SHPD	10W-40		X		
	RAVENOL Mineralöl Turbo Plus SHPD	15W-40	X			2)

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Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	> 12 gKOH/g	
Repsol Lubricantes y Especialidades, S.A.	Repsol Diesel Super Turbo SHPD	15W-40	X			2)
	Repsol Neptuno S-Turbomar	15W-40	X			2)
RN-Lubricants, LLC	Rosneft Revolut D2	15W-40	X			
	Rosneft Revolut D3	15W-40		X		2)
	Rosneft Revolut D5	15W-40		X		
ROWE Mineralölwerk GmbH	ROWE Hightec Formula GT SAE 10W-40 HC	10W-40		X		2)
S.A.E.L.	Gulf Gulfleet Long Road	15W-40	X			
Shell International Petroleum Company	Shell Rimula MV	15W-40	X			
	Shell Rimula R3 MV	15W-40	X			2)
	Shell Rimula R3 X	15W-40		X		2)
	Shell Rimula R4	15W-40		X		2)
	Shell Rimula R4 X	15W-40		X		2)
	Shell Rimula RT4	15W-40		X		2)
	Shell Rimula RT4 X	15W-40		X		2)
	Shell Rimula T3	15W-40		X		2)
	Shell Rimula T4	15W-40		X		2)
	Shell Rimula X	15W-40		X		
	Shell Rotella T2	15W-40		X		
	Shell Rotella T Multigrade	15W-40		X		2)
	Shell Sirius	15W-40		X		2)
	Eicher Premium Plus Diesel Engine Oil	15W-40		X		2)
Shanghai HIRI Lubricants R & D Centre	HIRI	15W-40	X			
Singapore Petroleum Company Limited	SDM 900 SAE 15W40	15W-40		X		
Sinopec Lubricant Co., Ltd.	Sinopec Tulux T500	15W-40		X		2)
SK Lubricants Co. Ltd.	ZIC X5000 10W-40	10W-40		X		
	ZIC X5000	15W-40	X			2)
	ZIC X7000 CI-4 10W-40	10W-40		X		
	ZIC X7000 CI-4	15W-40	X			2)

Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	> 12 gKOH/g	
SRS Schmierstoff Vertrieb GmbH	SRS Motorenöl O-236	15W-40	X			2) enhanced corrosion protection
	SRS Multi-Rekord top	15W-40		X		2)
	SRS Multi Rekord plus	15W-40	X			
	SRS Turbo Rekord	15W-40	X			2)
	SRS Cargolub TFX	10W-40		X		
Tesla Technoproducts FZE	Denebola Saheli Ultra XS 1120	15W-40		X		2)
Total Lubrificants	Antar Milantar PH	15W-40	X			2)
	Antar Milantar PX	15W-40	X			2)
	Fina Kappa Optima	15W-40		X		2)
	Fina Kappa Extra Plus	15W-40	X			2)
	Total Caprano Energy FE	15W-30		X		
	Total Caprano TDH	15W-40		X		2)
	Total Caprano TDI	15W-40		X		2)
	Total Disola W	15W-40		X		
	Total Genlub TDX	15W-40	X			
	Total Rubia TIR 6400	15W-40	X			
	Total Rubia Works 1000	15W-40		X		2)
	Hitachi Genuine Engine Oil 15W40 DH-1	15W-40		X		2)
Unil Opal	Medos 700	15W-40	X			2)
Valvoline EMEA	All-Fleet Extra SAE 15W-40	15W-40	X			2)
	All-Fleet Plus	15W-40	X			2)
	NextGen All-Fleet extra	15W-40		X		2)
	Premium Blue Classic	15W-40		X		2)
	Valvoline Premium Blue 7800	15W-40		X		
Viscolube	Revivoil - Re Refined High-Tech HD Motoroil	15W-40	X			2)
Viva Energy Australia	Penske Power Systems Premium	15W-40	X			2)
Wolf Oil Corporation NV.	Wolf Vitaltech 15W40	15W-40		X		2)
Wunsch Öle GmbH	Wunsch Rekord TLM-TU 10W-40	10W-40		X		

Table 23:

5.5 Multigrade oils – Category 2.1 (Low SAPS oils) of SAE grades 0W-30, 10W-30, 5W-40, 10W-40 and 15W-40

For details and special features, see chapter "Lubricants for four-cycle engines" (→ Page 7)

Important information
²⁾ Engine oils marked ²⁾ are also approved for "Series 60"

MTU multigrade oils

Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	>12 mgKOH/g	
MTU America	Power Guard® SAE 15W-40 Off-Highway Heavy Duty	15W-40	X			5 gallons: 800133 55 gallons: 800134 IBC: 800135 available through MTU America ²⁾

Table 24:

Further multigrade oils

Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	>12 mgKOH/g	
Bucher AG Langenthal	Motorex Focus CF	15W-40	X			²⁾
BP p.l.c.	BP Vanellus Eco	15W-40	X			²⁾
Castrol Ltd.	Castrol CRB Mining 15W-40	15W-40	X			²⁾
	Castrol CRB Mining 15W-40 CK-4		X			²⁾
	Castrol CRB Turbo G4 15W-40	15W-40	X			²⁾
	Castrol Hypuron	10W-30		X		
Champion Chemicals N.V.	Champion OEM Specific 15W40 MS	15W-40	X			
Chevron Lubricants (Caltex)	Delo 400 LE	15W-40	X			²⁾

Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	>12 mgKOH/g	
Chevron Lubricants (Chevron)	Delo 400 LE	15W-40	X			2) also approved for Series 4000-04 T
	Delo 400 MGX	15W-40	X			2)
	Delo 400 SDE	15W-40	X			2)
	Delo 400 XLE	10W-30		X		
	Delo 400 XLE	15W-40		X		2)
Chevron Lubricants (Texaco)	Ursa Ultra LE	15W-40	X			2)
ExxonMobil Corporation	Mobil Delvac 1 ESP	0W-30	X			
	Mobil Delvac 1 ESP	5W-40		X		
	Mobil Delvac 1300 Super F2	15W-40	X			
	Mobil Fleet	15W-40	X			2)
eni S.P.A.	eni i-Sigma top MS	15W-40	X			2)
Fuchs Europe	Fuchs Titan Cargo	15W-40	X			2)
Fuchs Petrolub SE	Fuchs Titan Cargo	10W-30	X			
	Fuchs Titan Cargo	15W-40	X			2)
Gulf Oil International	Gulf Supreme Duty XLE	15W-40	X			2)
	Gulf Supreme Duty XLE	10W-30	X			
Hitachi	Hitachi Genuine Engine Oil 10W-40 DH-2	10W-40	X			
Kuwait Petroleum	Q8 T 760	10W-30	X			
Lotos Oil	Turdus Powertec 1100	15W-40	X			2)
Morris Lubricants	Versimax HD6	15W-40	X			2)
MPM International Oil Company B.V.	Motor Oil 15W-40 Extra High Performance	15W-40	X			2)
OOO "LLK-International"	Lukoil Avantgarde Professional LA	10W-30	X			
	Lukoil Avantgarde Professional LA	10W-40	X			
	Lukoil Avantgarde Professional LA	15W-40	X			2)
Panolin AG	Panolin Universal LA-X	15W-40	X			2)
Pennzoil Products	Pennzoil Long-Life Gold	15W-40		X		2)
Petro-Canada	Duron -E	15W-40	X			2)
Phillips 66 Lubricants	Fleet Supreme EC	15W-40	X			2) also approved for Series 4000-04 C
	Guardol ECT	15W-40	X			2)
	Kenndall Super-D XA	15W-40	X			2)

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Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	>12 mgKOH/g	
Prolube Lubricants	Prolube Ultraplus	15W-40	X			2)
Repsol Lubricantes Y Especialidades, S.A.	Repsol Diesel Turbo THPD Mid Saps	15W-40	X			2)
Shell International Petroleum Company	Shell Rimula Super	15W-40		X		2)
	Shell Rimula RT4L	15W-40		X		2)
	Shell Rotella T	15W-40		X		2)
	Shell Rotella T3	15W-40		X		2)
	Shell Rotella T5	10W-30	X			
	Shell Rotella T5	10W-40	X			
	Shell Rotella T6	5W-40		X		
	Shell Rimula R5 LE	10W-30	X			
	Shell Rimula R5 LE	10W-40	X			
	Shell Rotella T Triple Protection	15W-40		X		
	Shell Rimula R4 MV	15W-40	X			2)
	Shell Rimula R4 L	15W-40	X			2)
	SK energy	ZIC XQ 5000	15W-40	X		
SRS Schmierstoff Vertrieb GmbH	SRS Turbo Rekord plus	15W-40	X			2)
	SRS Turbo Rekord plus FE	10W-40	X			
Total Lubrifiants	Total Rubia TIR 7900	15W-40	X			
	Total Rubia Works 2000	10W-40	X			
	Total Max Star FE	10W-30	X			
	Total Rubia Works 2000 FE 10W-30	10W-30	X			
Trinidad & Tobago National Petroleum Marketing Company Ltd. (NPMC)	Ultra Duty 15W-40 Engine Oil	15W-40	X			2)
Valvoline EMEA	Valvoline All Fleet Extra LE SAE 15W-40	15W-40	X			2)
	All-Fleet Extra LE NT1	15W-40	X			2)
	Premium Blue 8100 15W-40	15W-40	X			2)
Valvoline USA	All Fleet Plus	15W-40	X			2)
Verco International	April Superpro RXL 1 Gold Plus	15W-40	X			2)

Table 25:

5.6 Multigrade oils – Category 3 of SAE grades 5W-30, 5W-40 and 10W-40 for diesel engines

For details and special features, see chapter "Lubricants for four-cycle engines" (→ Page 7)

MTU multigrade oils

Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	> 12 mgKOH/g	
MTU Asia China	Diesel Engine Oil - DEO 5W-30	5W-30			X	20 l canister: 60808/P available through MTU Suzhou

Table 26:

Further multigrade oils

Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	> 12 mgKOH/g	
Addinol Lube Oil GmbH	Addinol Commercial 1040 E4	10W-40		X		
	Addinol Ultra Truck MD 0538	5W-30			X	
	Addinol Super Truck MD 1049	10W-40			X	
Aral AG	Aral Mega Turboral	10W-40			X	
	Aral Mega Turboral 10W-40	10W-40			X	
	Aral Super Turboral	5W-30			X	
Avia Mineralöl AG	Avia Turbosynth HT-E	10W-40			X	
	Avia Turbosynth HT-U	5W-30			X	
BayWa AG	Tectrol Super Truck 530	5W-30			X	
	Tectrol Super Truck 1040	10W-40		X		
Bucher AG Langenthal - Motorex Schmiertechnik	MC Power Plus SAE 10W/40	10W-40			X	
BP p.l.c.	BP Energol IC-MT 10W-40	10W-40			X	
	BP Vanellus Max	5W-30			X	

Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	>12 mgKOH/g	
Castrol Ltd.	Castrol CRB Turbomax 10W-40 E4/E7	10W-40			X	
	Castrol Enduron MT	10W-40			X	
	Castrol Enduron Plus	5W-30			X	
	Castrol Elixion HD	5W-30			X	
	Castrol Vectron 10W-40 E4/E7	10W-40			X	
	Castrol Vectron Long Drain	10W-40			X	
	Castrol Vectron Long Drain 10W-40 E4/E7	10W-40			X	
	Castrol Vectron 5W-30 Arctic	5W-30			X	
	Castrol Vectron Fuel Saver 5W-30	5W-30			X	
	Castrol Vectron Fuel Saver E7	5W-30			X	
Cepsa	Cepsa Eurotrans SHPD	5W-30			X	
	Cepsa Eurotrans SHPD	10W-40		X		
Champion Chemicals N.V.	Champion New Energy 10W40 Ultra	10W-40			X	
Chemicis Khavremianeh Kohan	Chemicis Excel Plus	10W-40			X	
Chevron Lubricants (Caltex)	Delo Gold Ultra T	10W-40			X	
	Delo XLD Multigrade	10W-40			X	
Chevron Lubricants (Texaco)	Ursa HD	10W-40			X	
	Ursa Premium FE	5W-30			X	
	Ursa Super	10W-40		X		
	Ursa Super TDX	10W-40			X	
	Ursa TDX	10W-40			X	
Deutsche Ölwerke Lubmin GmbH	AVENO HC PT Diesel	10W-40			X	
eni S.P.A.	Agip Sigma Trucksint TFE	5W-40			X	
	Agip Sigma Super TFE	10W-40			X	
	eni i-Sigma top	10W-40			X	
Enoc Marketing LLC	Enoc Vulcan 770 SLD	10W-40		X		
	Enoc Vulcan SLD	10W-40			X	
Exxon Mobil Corporation	Mobil Delvac XHP Extra	10W-40			X	
	Mobil Delvac XHP Ultra 5W-30	5W-30			X	
	Mobil Delvac 1 SHC 5W-40	5W-40			X	
Exol Lubricants Ltd.	Taurus Extreme M3	10W-40			X	
Fabrika Maziva, FAM AD	Fenix Ultra Sint	10W-40			X	
Finke Mineralölwerk GmbH	AVIATICON Finko Truck LD	10W-40			X	
Fuchs Europe Schmierstoffe GmbH	Titan Cargo SL	5W-30			X	
	Titan Cargo MC	10W-40			X	

Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	>12 mgKOH/g	
Fuchs Lubricants France	Cofran Marathon	10W-40			X	
	Fuchs Max Way E4	10W-40				
	Fuchs Max Way Ultra	5W-30				
Gulf Oil International	Gulf Fleet Force synth.	5W-30			X	
	Gulf Superfleet ELD	10W-40			X	
	Gulf Superfleet XLD	10W-40			X	
	Gulf Superfleet Synth ELD	10W-40			X	
High Industrial Lubricants & Liquids Corporation	Fastroil Force Ultra High Performance Diesel (UHPD)	10W-40			X	
Huiles Berliet S.A.	RTO Extensia RXD ECO	5W-30			X	
Iranol Oil Co.	Iranol D40000-EIII	10W-40			X	
Kuwait Petroleum	Q8 T 860	10W-40		X		
	Q8 T 860 D	10W-40			X	
	Q8 T 860 S	10W-40			X	
	Q8 T 905	10W-40	X			
Lotos Oil	Turdus Powertec 3000	10W-40			X	
	Turdus Powertec Synthetic	5W-30			X	
Lukoil Lubricants Europe Oy	Teboil Super XLD-2	5W-30			X	
Meguin	Megol Motorenöl Super LL Dimo Premium	10W-40			X	
MOL-LUB Kft	MOL Synt Diesel	10W-40		X		
	MOL Dynamic Synt Diesel E4	10W-40			X	
Orlen Oil Sp.o.o.	Platinum Ultor Max	5W-30			X	
OOO LLK International	Lukoil Avantgarde Professional	5W-30			X	
	Lukoil Avantgarde Professional	10W-40			X	
	Lukoil Avantgarde Professional M5	10W-40			X	
	Lukoil Avantgarde Professional M6	10W-40			X	
	Lukoil Avantgarde Ultra M3	15W-40			X	
Panolin	Panolin Diesel HTE	10W-40			X	
Petroleos de Portugal, Petrogal S.A.	Galp Galaxia Extreme	5W-30		X		
	Galp Galaxia Ultra XHP	10W-40			X	
Petromin Corporation	Petromin Turbo Master LD	10W-40			X	

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Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	>12 mgKOH/g	
Petronas Lubricants International	Petronas Akros Synt Gold	10W-40			X	
	Arexons HD-Truck E7	10W-40			X	
	Urania Maximo	10W-40			X	
	Petronas Urania Optimo	10W-40			X	
	Urania 100 K	10W-40			X	
	Urania 5000 F	5W-30			X	
	Urania 5000 LD	10W-40			X	
	Urania FE	5W-30			X	
	Petronas Urania Maximo	5W-30			X	
PHI OIL GmbH	Motordor Silver 10W40	10W-40			X	
Raj Petro Specialities P Ltd.	Zoomol Rforce 8200 RF1	10W-40			X	
Ramoil S.p.A.	Duglas Oil Ultra HC 10W-40 UHPDO	10W-40			X	
Ravensberger Schmierstoff Vertrieb GmbH	RAVENOL Super Performance Truck	5W-30			X	
	RAVENOL Performance Truck	10W-40			X	
Repsol Lubricantes y Especialidades S.A.	Repsol Turbo UHPD	10W-40			X	
	Repsol Diesel Turbo VHPD	5W-30			X	
	Repsol Diesel Turbo UHPD Urban	10W-40			X	
RN-Lubricants, LLC	Rosneft Revolux D4	10W-40			X	
ROWE Mineralölwerk GmbH	ROWE Hightec Formula GT SAE 10W-40 HC	10W-40			X	
SCT Vertriebs GmbH	Fanfaro TRD E4 UHPD	10W-40		X		
	Mannol TS-6 UHPD Eco	10W-40		X		
	Pemco Diesel G-6 Eco UHPD	10W-40		X		
Shell International Petroleum Company	Shell Rimula R5 M	10W-40			X	
	Shell Rimula R6 M	10W-40			X	
	Shell Rimula R6 ME	5W-30			X	
	Shell Rimula R6 MS	10W-40			X	
SK Lubricants Co.	ZIC X7000	5W-30			X	
SRS Schmierstoff Vertrieb GmbH	SRS Cargolub TFF	10W-40			X	
	SRS Cargolub TFL	5W-30			X	
	SRS Cargolub TFG	10W-40			X	
	SRS Cargolub TFG plus	10W-40			X	
Tedex SA	Tedex Diesel Truck UHPD (S) Motor Oil	10W-40			X	
Total Lubrifiants	Gulf Gulfleet Highway 10W-40	10W-40			X	
	RTO Extensia ECO	5W-30			X	
	Total Rubia TIR 9200 FE	5W-30			X	

Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	>12 mgKOH/g	
Transnational Blenders B. V.	Engine Oil Super EHPD	10W-40			X	
Unil Opal	Unil Opal LCM 800	10W-40			X	
Valvoline EMEA	All Fleet Superior	10W-40			X	
	Profleet	10W-40			X	
	Valvoline All-Fleet Extreme NTI	10W-40		X		
Wolf Oil Corporation N.V.	Wolf Vitaltech 10W40 Ultra	10W-40			X	
	Champion New Energy 10W40 Ultra	10W-40			X	

Table 27:

5.7 Multigrade oils – Category 3.1 (Low SAPS oils) of SAE grades 5W-30, 10W-30 and 10W-40

For details and special features, see chapter "Lubricants for four-cycle engines" (→ Page 7)

Important information
²⁾ Engine oils marked ²⁾ are also approved for "Series 60"

Multigrade oils

Manufacturer	Brand name	SAE viscosity class	TBN			Comments / material number
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	>12 mgKOH/g	
Addinol Lube Oil	Addinol Extra Truck MD 1049 LE	10W-40	X			
Aral AG	Aral Mega Turboral LA	10W-40	X			
	Aral Super Turboral LA	5W-30	X			
BayWa AG	Tectrol Super Truck Plus XL 1040	10W-40	X			
Bucher AG Langenthal	Motorex Focus QTM	10W-40	X			
	Motorex Nexus FE SAE 5W-30	5W-30	X			
BP p.l.c.	BP Vanellus Max Drain Eco	10W-40		X		
	BP Vanellus Max Eco 10W-40	10W-40		X		
BVG Vertriebsgesellschaft AG	Alpha Advanced Eco-Efficiency low SAPS	10W-40	X			
Castrol Ltd.	Castrol Vecton Long Drain 10W-30 E6/E9	10W-30	X			
	Castrol Vecton Long Drain 10W-40 E6/E9	10W-40	X			
	Castrol Vecton Fuel Saver 5W-30 E6/E9	5W-30	X			
Cepsa Comercial Petroleo, SA	Cepsa Eurotech LS 10W40 Plus	10W-40		X		
Champion Chemicals N.V.	Champion OEM Specific 10W40 Ultra MS	10W-40		X		
Chevron Lubricants (Caltex)	Delo XLE Multigrade	10W-40	X			
Chevron Lubricants (Chevron)	Delo 400 RDE	10W-30		X		
	Delo 400 RDS	10W-40		X		
	Delo 400 XLE	15W-40	X			
	Delo 400 XLE HD	5W-30			X	
	Delo 400 XLE HD	10W-40			X	
	Delo 400 XLE SYN-HD	10W-40			X	
	Delo 400 XLE Synthetic	5W-30	X			
	Delo 400 LE Synthetic	5W-30	X			
Chevron Lubricants (Texaco)	Ursa Ultra X	10W-30		X		

Manufacturer	Brand name	SAE viscosity class	TBN			Comments / material number
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	>12 mgKOH/g	
CONDAT Lubrifiants	Vicam Planet 10W40	10W-40			X	
Deutsche Ölwerke Lubmin GmbH	AVENO Universal UHPD	10W-40				
De Oliebron B.V.	Tor Turbosynth LSP Plus	10W-40			X	
eni S.p.a.	eni i-Sigma top MS	10W-40	X			
Enoc Marketing L.L.C.	Enoc Vulkan Green	10W-40			X	
Exxon Mobil Corporation	Mobil Delvac 1 ESP	5W-30		X		
	Mobil Delvac 1 LE	5W-30	X			
	Mobil Delvac HD	10W-40		X		
	Mobil Delvac XHP ESP M	10W-40			X	
	Mobil Delvac XHP LE	10W-40			X	55 gallons: 800141
	Mobil Delvac XHP Ultra LE	5W-30		X		
Finke Mineralölwerk GmbH	AVIATICON Finko Super Truck LA Plus	10W-40		X		
Fuchs Petrolub SE	Titan Cargo Maxx	5W-30			X	
	Titan Cargo Maxx	10W-40			X	
	Fuchs Titan Cargo EU6	5W-30	X			
Fuchs Schmierstoffe GmbH	Fuchs Titan Cargo LA	5W-30	X			
Gulf Oil International	Gulf Superfleet Synth ULE	5W-30	X			
	Gulf Superfleet XLE	10W-40	X			
	Gulf Superfleet Synth XLE	10W-30		X		
	Gulf Superfleet Synth XLE	10W-40	X			
	Gulf Superfleet Universal	10W-40			X	
Helios Lubeoil	Helios Premium KMXX 10W-40	10W-40	X			
Huiles Berliet S.A.	RTO Extensia FP	10W-40	X			
Igol	PRO 200 X	10W-40	X			
INA Maziva d.o.o.	INA Super 2009 5W-30	5W-30	X			
	INA Super 2009	10W-40			X	
Kuwait Petroleum R&T	Q8 905	10W-40	X			
	Q8 T 904	10W-40		X		
	Q8 T 904 FE	10W-30	X			
	Q8 T 905	10W-40	X			
	Q8 T 910	5W-30	X			
	Q8 Formula Truck 8500 FE	10W-30	X			
	Q8 Formula Truck 8700 FE	5W-30	X			
LLK finland Oy	Teboil Super XLD-2	5W-30			X	
Meguin GmbH & Co. KG	megol Motorenoel Low Saps	10W-40		X		

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Manufacturer	Brand name	SAE viscosity class	TBN			Comments / material number
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	>12 mgKOH/g	
Morris Lubricants	Ring Free Ultra	10W-40		X		
	Fendt Power Grade 10W-40	10W-40		X		
MPM International Oil Company B.V.	Motor Oil 10w-40 Premium Synthetic Ultra High Performance Diesel	10W-40		X		
Oel-Brack AG	Midland maxtra	10W-40		X		
OMV Petrol Ofisi A.Ş	Maximus HD-E	5W-30	X			
OOO LLK International	Lukoil Avantgarde CNG	10W-40	X			
	Lukoil Avantgarde Professional LE	5W-30			X	
	Lukoil Avantgarde Professional LS	5W-30	X			
	Lukoil Avantgarde Professional LS	10W-40			X	
	Lukoil Avantgarde Professional LS5	5W-30	X			
	Lukoil Avantgarde Professional LS5	10W-40	X			
Orlen Oil	Platinum Ultor Complete	10W-40	X			
	Platinum Ultor Optimo	10W-30	X			
	Platinum Ultor Progress	10W-40		X		
	Mogul Diesel L-SAPS	10W-40		X		
Panolin	Panolin Diesel Synth EU-4	10W-40	X			
	Panolin Ecomot	5W-30		X		
	Panolin Ecomot	10W-30	X			
	Panolin Ecomot	10W-40	X			
Petro-Canada Lubricants Inc.	Duron UHP 5W30	5W-30	X			
	Duron UHP E6 10W40	10W-40	X			
Petróleos de Portugal	Galp Galaxia Ultra LS	10W-40	X			
Petronas Lubricants International	Petronas Urania 5000 E	5W-30			X	
	Petronas Urania 5000 E	10W-40			X	
	Petronas Urania FE LS	5W-30			X	
	Petronas Urania Ecotech	10W-40			X	
PHI OIL GmbH	Motodor LSP Gold 5W30	5W-30			X	
	Motodor LSP Silver	10W-40		X		
Prista Oil Ad	Prista UHPD	10W-40	X			
Ravensberger Schmierölvertrieb GmbH	Ravenol Euro VI Truck	10W-40	X			
Repsol Lubricantes y Especialidades, S.A.	Repsol Diesel Turbo UHPD MID SAPS	10W-40	X			
	Repsol DieselTurbo VHPD Mid Saps	5W-30		X		
Rowe Mineralölwerk GmbH	Rowe Hightec Truckstar SAE 10W-40 HC-LA	10W-40		X		

Manufacturer	Brand name	SAE viscosity class	TBN			Comments / material number
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	>12 mgKOH/g	
Shell International Petroleum Company	Shell Rimula R6 LM	10W-40	X			Increased corrosion protection
	Shell Rimula R6 LME	5W-30		X		
	Shell Rimula Ultra	5W-30			X	
SK energy	ZIC XQ 5000	10W-40	X			
SRS Schmierstoff Vertrieb GmbH	SRS Antikorrol MLA	10W-40		X		Increased corrosion protection
	SRS Cargolub TLA	10W-40	X			
	SRS Cargolub TLS	5W-30			X	
	SRS Cargolub TLS plus	5W-30		X		
	SRS Turbo Diesel LA	10W-40	X			
	SRS Cargolub low-friction engine oil LA	10W-40		X		
	SRS Turbo-Rekord top FE	10W-40		X		
	SRS Turbo-Rekord ultra FE	10W-40	X			
Statoil Lubricants	MaxWay Ultra E6 10W-40	10W-40			X	
Total Lubrificants	Total Rubia TIR 8900	10W-40	X			
	Total Rubia Works 2500	10W-40	X			
Transnational Blenders B. V.	Engine Oil Synthetic UHPD E6	10W-30		X		
	Engine Oil Synthetic UHPD E6	10W-40		X		
	Motor oil SCR	10W-40	X			
Valvoline EMEA	Valvoline ProFleet LS	5W-30			X	
	Valvoline ProFleet LS	10W-40	X			
	ProFleet LS NTI	10W-40	X			
Wibo Schmierstoffe GmbH	Wibokraft Ultra AF 10W40	10W-40		X		
Wolf Oil Corporation N.V.	Wolf Officialtech 10W40 Ultra MS	10W-40		X		
	Champion OEM Specific 10W40 Ultra MS	10W-40		X		
Yacco SAS	Yacco Transpo 65	10W-40			X	

Table 28:

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5.8 Lubricating Greases

5.8.1 Lubricating greases for general applications

For details and special features, see chapter "Lubricating greases" (→ Page 15)

Manufacturer	Brand name	Notes
Aral AG	Mehrzweckfett Arallub HL2	
BP p.l.c.	Energrease LS2	
Castrol Ltd.	Spheerol AP2	
Chevron	Multifak EP2	
SRS Schmierstoff Vertrieb GmbH	SRS Wiolub LFK2	
Shell Deutschland GmbH	Shell Gadus S2 V220 2	
Total	Total Multis EP2	
Veedol International	Multipurpose	

Table 29:

5.8.2 Lubricating greases for diesel engine-generator set components

Important		
Mixtures of different greases are not permitted!		
Manufacturer	Brand name	Notes
Exxon Mobil Corporation	Mobil Polyrex EM	High-temperature grease: Lubricity in the range from -30 to 250 °C (-22 to 482 °F) For: <ul style="list-style-type: none"> • Generator bearings of Marathon generators • Generator bearings of Leroy-Somer generators^{*)} • Fan wheel and belt pulley bearing on electrically driven coolant cooler, Series 4000
Shell	GADUS S3 V220C	For generator bearings of Leroy-Somer generators ^{*)}
SKF	Mehrzweckfett LGMT2	For generator bearings of HM generators
ROCOL Limited	Rocol RTD-Compound	For belt tensioner on electrically driven coolant cooler, Series 4000
ASCO Power Technologies	Lubrication Kit 75-100	For automatic transfer switch (ATS) ASCO

^{*)} NOTE: For information about the applicable lubricating greases for Leroy-Somer generators, refer to the nameplate on the generator.

For information about lubricating greases for generators made by other manufacturers, please contact MTU Onsite Energy service partners.

6 Approved Coolants

6.1 Coolants without antifreeze for cooling systems containing light metal

6.1.1 Coolant without antifreeze – Concentrates for cooling systems containing light metal

For details and special features, see chapter on “Coolants” (→ Page 17)

Important information

For the marine engine Series 1163-03 and 1163-04, only coolants marked with an asterisk * in the brand name can be used!

Coolants without antifreeze – concentrates

Manufacturer	Brand name	Inhibitors					Operating time Hour / Year	Comments / Material number
		Organic	Silicon	Nitrite	Phosphatized	Molybdate		
MTU Friedrichshafen GmbH	Coolant CS100 Corrosion Inhibitor Concentrate*		X				6000 / 2	X00057233 (20 l) X00057232 (210 l) X00070455 (1000 l) also available through MTU Asia
MTU America Inc.	Power Cool® Plus 6000 Concentrate*		X				6000 / 2	colored green 23533526 (1 gallon) 23533527 (5 gallons) available through MTU America
Arteco NV	Freecor NBI		X				6000 / 2	
BASF SE	Glyscorr G93 green*		X				6000 / 2	X00054105 (barrel) X00058062 (canister)
BP Lubricants	Castrol Extended Life Corrosion Inhibitor	X				X	6000 / 2	
CCI Corporation	A 216	X				X	6000 / 2	
CCI Manufacturing IL Corporation	A 216	X				X	6000 / 2	X00051509 (208 l)
Chevron Corp.	Texcool A – 200		X				6000 / 2	
Detroit Diesel Corp.	Power Cool Plus 6000	X				X	6000 / 2	colored red
Drew Marine	Drewgard XTA*		X				6000 / 2	
ExxonMobil	Mobil Delvac Extended Life Corrosion Inhibitor	X				X	6000 / 2	
Old World Industries Inc.	Final Charge Extended Life Corrosion Inhibitor (A 216)	X				X	6000 / 2	

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Manufacturer	Brand name	Inhibitors					Operating time Hour / Year	Comments / Material number
		Organic	Silicon	Nitrite	Phosphatized	Molybdate		
Valvoline	ZEREX G-93*		X				6000 / 2	
YORK SAS	York 719*		X				6000 / 2	

Table 30:

6.1.2 Coolant without antifreeze – Ready mixtures for cooling systems containing light metal

For details and special features, see chapter on “Coolants” (→ Page 17)

Important information

For the marine engine Series 1163-03 and 1163-04, only coolants marked with an asterisk * in the brand name can be used

Coolant without antifreeze, ready mixtures

Manufacturer	Brand name	Inhibitors					Operating time Hour / Year	Comments / Material number
		Organic	Silicon	Nitrite	Phosphatized	Molybdate		
MTU Friedrichshafen GmbH	Coolant CS10/90 Corrosion Inhibitor Premix*		X				6000 / 2	X00069385 (20 l) X00069386 (210 l) X00069387 (1000 l) (sales region: Italy)

Table 31:

6.2 Coolants without antifreeze for cooling systems free of light metal

6.2.1 Coolants without antifreeze – Concentrates for cooling systems free of light metal

For details and special features, see chapter on “Coolants” (→ Page 17)

Coolants without antifreeze – concentrates

Manufacturer	Brand name	Inhibitors					Operating time Hour / Year	Comments / Material number
		Organic	Silicon	Nitrite	Phosphatized	Molybdate		
MTU Friedrichshafen GmbH	Coolant CS100 Corrosion Inhibitor Concentrate		X				6000 / 2	X00057233 (20 l) X00057232 (210 l) X00070455 (1000 l) also available through MTU Asia
MTU America Inc.	Power Cool®Plus 6000 Concentrate		X				6000 / 2	colored green 23533526 (1 gallon) 23533527 (5 gallons) available through MTU America
Arteco NV	Freecor NBI		X				6000 / 2	
	Havoline Extended Life Corrosion Inhibitor [EU Code 32765] (XLI)	X					6000 / 2	
BASF SE	Glysacorr G93 green		X				6000 / 2	X00054105 (barrel) X00058062 (canister)
BP Lubricants	Castrol Extended Life Corrosion Inhibitor	X				X	6000 / 2	
CCI Corporation	A 216	X				X	6000 / 2	
CCI Manufacturing IL Corporation	A 216	X				X	6000 / 2	X00051509 (208 l)
Chevron Corp.	Texcool A – 200		X				6000 / 2	
Detroit Diesel Corp.	Power Cool Plus 2000		X	X			6000 / 2	
	Power Cool Plus 6000	X				X	6000 / 2	colored red
Drew Marine	Drewgard XTA		X				6000 / 2	
ExxonMobil	Mobil Delvac Extended Life Corrosion Inhibitor	X				X	6000 / 2	
Fleetguard	DCA-4L		X	X	X		2000 / 1	

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Manufacturer	Brand name	Inhibitors					Operating time Hour / Year	Comments / Material number
		Organic	Silicon	Nitrite	Phosphatized	Molybdate		
Nalco	Alfloc (Maxitreat) 3477	X					6000 / 2	
	Alfloc 2000		X	X			6000 / 2	
	Nalco 2000		X	X			6000 / 2	
	Nalcool 2000		X	X			6000 / 2	
	Trac 102		X	X			6000 / 2	
Old World Industries Inc.	Final Charge Extended Life Corrosion Inhibitor (A 216)	X				X	6000 / 2	
Penray	Pencool 2000		X	X			6000 / 2	
PrixMax Australia Pty. Ltd.	PrixMax RCP	X					6000 / 2	
Total	Total WT Supra	X					6000 / 2	
Valvoline	Zerex G-93		X				6000 / 2	
YORK SAS	York 719		X				6000 / 2	

Table 32:

6.2.2 Coolant without antifreeze – Ready mixtures for cooling systems free of light metal

For details and special features, see chapter on “Coolants” (→ Page 17)

Coolant without antifreeze, ready mixtures

Manufacturer	Brand name	Inhibitors					Operating time Hour / Year	Comments / Material number
		Organic	Silicon	Nitrite	Phosphatized	Molybdate		
MTU Friedrichshafen GmbH	Coolant CS 10/90 Corrosion Inhibitor Premix		X				6000 / 2	X00069385 (20 l) X00069386 (210 l) X00069387 (1000 l) (sales region: Italy)
Nalco	Alfloc (Maxitreat) 3443 (7 %)	X					6000 / 2	

Table 33:

6.3 Antifreezes for cooling systems containing light metal

6.3.1 Antifreeze – Concentrates for cooling systems containing light metal

For details and special features, see chapter on “Coolants” (→ Page 17)

Antifreeze, concentrates

Manufacturer	Brand name	Inhibitors					Operating time Hour / Year	Comments / Material number
		Organic	Silicon	Nitrite	Phosphatized	Molybdate		
MTU Friedrichshafen GmbH	Coolant AH100 Antifreeze Concentrate	X	X				9000 / 5	X00057231 (20 l) X00057230 (210 l) X00068202 (1000 l) also available through MTU Asia
Avia Mineralöl AG	Antifreeze APN	X	X				9000 / 5	
	Antifreeze APN - S	X					9000 / 3	
BASF SE	Glystantin G05		X	X			9000 / 5	
	Glystantin G48 blue green	X	X				9000 / 5	X00058054 (25 l) X00058053 (210 l)
	Glystantin G30 pink	X					9000 / 3	X00058072 (canister) X00058071 (barrel)
BayWa AG	Tectrol Coolprotect	X	X				9000 / 5	
BP Lubricants	Aral Antifreeze Extra	X	X				9000 / 5	
	Castrol Heavy Duty Extended Life Coolant	X				X	9000 / 3	
Bucher AG Langenthal	Motorex Coolant G48	X	X				9000 / 5	
Castrol	Castrol Radicool NF	X	X				9000 / 5	
CCI Corporation	L 415	X				X	9000 / 3	
CCI Manufacturing IL Corporation	C 521	X				X	9000 / 3	
Clariant	Genantin Super		X	X			9000 / 5	
Classic Schmierstoff GmbH + Co KG	Classic Kolda UE G48	X	X				9000 / 5	
Comma Oil & Chemicals Ltd.	Comma Xstream® G30® Antifreeze Coolant Concentrate	X					9000 / 3	
	Comma Xstream® G48® Antifreeze Coolant Concentrate	X	X				9000 / 5	
Detroit Diesel Corp.	Power Cool Antifreeze		X	X			9000 / 3	
	Power Cool Plus Coolant	X				X	9000 / 3	
	Power Cool Diesel Engine Coolant		X	X			9000 / 3	

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Manufacturer	Brand name	Inhibitors					Operating time Hour / Year	Comments / Material number
		Organic	Silicon	Nitrite	Phosphatized	Molybdate		
ExxonMobil	Mobil Delvac Extended Life Coolant	X				X	9000 / 3	
	Mobil Antifreeze Advanced	X					9000 / 3	
	Mobil Antifreeze Extra	X	X				9000 / 5	
	Mobil Antifreeze Special		X	X			9000 / 5	
	Mobil Heavy Duty Coolant		X	X			9000 / 3	
	Mobil Mining Coolant		X	X			9000 / 3	
	Esso Antifreeze Advanced	X					9000 / 3	
	Esso Antifreeze Extra	X	X				9000 / 5	
Finke Mineralölwerk GmbH	AVIATICON Finkofreeze F30	X					9000 / 3	
	AVIATICON Finkofreeze F48	X	X				9000 / 5	
Fuchs Petrolub SE	Maintain Fricofin	X	X				9000 / 5	
	Maintain Fricofin G12 Plus	X					9000 / 3	X00058074 (canister) X00058073 (barrel)
Gazpromneft Lubricants Ltd.	Belaz G-Profi Antifreeze Red	X					9000 / 3	
Krafft S.L.U.	Refrigerante ACU 2300		X	X			9000 / 3	X00058075 (barrel)
Kuttenkeuler GmbH	Kuttenkeuler Antifreeze ANF KK48	X	X				9000 / 5	
	Glycostar®ST48	X	X				9000 / 5	
INA Maziva Ltd.	INA Antifriz AI Super	X	X				9000 / 5	
Mitan Mineralöl GmbH	Alpine C48	X	X				9000 / 5	
Nalco	Nalcool 5990	X	X				9000 / 3	
Nalco Australia	Nalcool NF 48 C	X	X				9000 / 5	
Old World Industries Inc.	Blue Mountain Heavy Duty Extended Life Coolant	X				X	9000 / 3	
	Fleet Charge SCA Pre-charged Coolant / Antifreeze		X	X			9000 / 3	
	Final Charge Global Extended Life Coolant Antifreeze	X				X	9000 / 3	
OMV	OMV Coolant Plus	X	X				9000 / 5	
	OMV Coolant SF	X					9000 / 3	
Panolin AG	Panolin Anti-Frost MT-325	X	X				9000 / 5	
Penske Power Systems	Power Cool - HB500 Coolant Concentrate	X	X				9000 / 3	
Raloy Lubricantes	Antifreeze Long Life NF-300 Concentrate	X	X				9000 / 5	
Recochem Inc.	R542	X	X				9000 / 3	

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Manufacturer	Brand name	Inhibitors					Operating time Hour / Year	Comments / Material number
		Organic	Silicon	Nitrite	Phosphatized	Molybdate		
SMB - Sotagal / Mont Blanc	Antigel Power Cooling Concentrate	X	X				9000 / 5	
Total	Glacelf MDX	X	X				9000 / 5	
Valvoline	Zerex G-05		X	X			9000 / 5	
	Zerex G-48	X	X				9000 / 5	
	Zerex G-30	X					9000 / 3	
YORK SAS	York 716	X	X				9000 / 5	
ZAO Obninskorgsintez	Lukoil Antifreeze HD G12 K	X					9000 / 3	

Table 34:

6.3.2 Antifreeze – Concentrates for special applications

For details and special features, see chapter on “Coolants” (→ Page 17)

Concentrates for special applications

Manufacturer	Brand name	Inhibitors					Operating time Hour / Year	Comments / Material number
		Organic	Silicon	Nitrite	Phosphatized	Molybdate		
BASF SE	G206	X	X				9000 / 3	For use in arctic regions (< -40 °C)

Table 35:

6.3.3 Antifreeze – Ready mixtures for cooling systems containing light metals

For details and special features, see chapter on “Coolants” (→ Page 17)

Ready mixtures for cooling systems containing light metals

Manufacturer	Brand name	Inhibitors					Operating time Hour / Year	Comments / Material number
		Organic	Silicon	Nitrite	Phosphatized	Molybdate		
MTU Friedrichshafen GmbH	Coolant AH 35/65 Antifreeze Premix	X	X				9000 / 5	X00069382 (20 l) X00069383 (210 l) X00069384 (1000 l) (sales region: Italy)
	Coolant AH 40/60 Antifreeze Premix	X	X				9000 / 5	X00070533 (20 l) X00070531 (210 l) X00070532 (1000 l) (sales region: England, Spain)
	Coolant AH 50/50 Antifreeze Premix	X	X				9000 / 5	X00070528 (20 l) X00070530 (210 l) X00070527 (1000 l) (sales region: England)
	Coolant RM30 (40 %)	X					9000 / 3	X00073922 (20 l) X00073916 (205 l) X00073923 (1000 l)
MTU America Inc.	Power Cool® Universal 35/65 mix	X	X				9000 / 5	800085 (5 gallons) 800086 (55 gallons)
	Power Cool® Universal 50/50 mix	X	X				9000 / 5	800071 (5 gallons) 800084 (55 gallons)
	Power Cool® Off-Highway Coolant 50/50 Premix		X	X			9000 / 5	23533531 (5 gallons) 23533532 (55 gallons)
Bantleon	Avilub Antifreeze Mix (50 %)	X	X				9000 / 5	X00049213 (210 l)
BayWa AG	Tectrol Coolprotect Mix 3000	X					9000 / 3	Antifreeze protection up to -24 °C
BP Lubricants	Castrol Heavy Duty Extended Life Prediluted Coolant (50/50)	X				X	9000 / 3	
Bucher AG Langenthal	Motorex Coolant G48 ready to use (50/50)	X	X				9000 / 5	
Castrol	Castrol Radicool NF Pre-mix (45%)	X	X				9000 / 5	
CCI Corporation	L 415 (50%)	X				X	9000 / 3	
CCI Manufacturing IL Corporation	C 521 (50%)	X				X	9000 / 3	
Cepsa Comercial Petróleo S.A.U.	XTAR Super Coolant Hybrid NF 50%	X	X				9000 / 5	

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Manufacturer	Brand name	Inhibitors					Operating time Hour / Year	Comments / Material number
		Organic	Silicon	Nitrite	Phosphatized	Molybdate		
Detroit Diesel Corp.	Power Cool Plus Prediluted Coolant (50/50)	X				X	9000 / 3	
	Power Cool Prediluted 50/50 Diesel Engine Coolant		X	X			9000 / 3	
Exxon Mobil	Mobil Delvac Extended Life Prediluted Coolant (50/50)	X				X	9000 / 3	
Finke Mineralölwerk GmbH	AVIATICON Finkofreeze F48 RM 50/50	X	X				9000 / 5	
	AVIATICON Finkofreeze F30 RM 40:60 +	X					9000 / 3	
Old World Industries Inc.	Blue Mountain Heavy Duty Extended Life Prediluted Coolant (50/50)	X				X	9000 / 3	
	Final Charge Global Extended Life Prediluted Coolant/ Antifreeze (50/50)	X				X	9000 / 3	
	Fleet Charge SCA Pre-charged 50/50 Prediluted Coolant		X	X			9000 / 3	
Penske Power Systems	Power Cool - HB500 Premix 50/50	X	X				9000 / 3	
Raloy Lubricantes	Antifreez Long Life NF-300 Ready-to-Use (50:50)	X	X				9000 / 5	
SMB - Sotragal / Mont Blanc	L.R.-30 Power Cooling (44%)	X	X				9000 / 5	
	L.R.-38 Power Cooling (52%)	X	X				9000 / 5	
Tosol-Sintez	Glystantin Alu Protect G30 Ready Mix	X					9000 / 3	
	Glystantin Alu Protect Plus G48 Ready Mix	X	X				9000 / 5	
Total	Coolelf MDX (-26 °C)	X	X				9000 / 5	
Valentin Energie GmbH	Valentin Coolant Plus -25 °C Ready	X					9000 / 3	
Valvoline	Zerex G-05 50/50 Mix		X	X			9000 / 5	
ZAO Obninskorgsintez	Lukoil Antifreeze HD G12 (50%)	X					9000 / 3	

Table 36:

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6.4 Antifreezes for cooling systems free of light metal

6.4.1 Antifreeze – Concentrates for cooling systems free of light metal

For details and special features, see chapter on “Coolants” (→ Page 17)

Important information

For the Series 4000-04 and 4000-05, only coolants marked with an asterisk * in the brand name can be used!

Antifreeze, concentrates

Manufacturer	Brand name	Inhibitors					Operating time Hour / Year	Comments / Material number
		Organic	Silicon	Nitrite	Phosphatized	Molybdate		
MTU Friedrichshafen GmbH	Coolant AH100* Antifreeze Concentrate	X	X				9000 / 5	X00057231 (20 l) X00057230 (210 l) X00068202 (1000 l) also available through MTU Asia
Arteco NV	Havoline Extended Life Coolant XLC [EU Code 30379]	X					9000 / 3	
Avia Mineralöl AG	Antifreeze APN*	X	X				9000 / 5	
	Antifreeze APN - S*	X					9000 / 3	
BASF SE	Glystantin G05		X	X			9000 / 5	
	Glystantin G48 blue green*	X	X				9000 / 5	X00058054 (25 l) X00058053 (210 l)
	Glystantin G30 pink*	X					9000 / 3	X00058072 (canister) X00058071 (barrel)
BayWa AG	Tectrol Coolprotect*	X	X				9000 / 5	
BP Lubricants	ARAL Antifreeze Extra*	X	X				9000 / 5	
	Castrol Heavy Duty Extended Life Coolant*	X				X	9000 / 3	
Bucher AG Langenthal	Motorex Coolant G48*	X	X				9000 / 5	
Caltex	Caltex Extended Life Coolant [AP Code 510614] (XLC)	X					9000 / 3	
Castrol	Castrol Radicool NF*	X	X				9000 / 5	
CCI Corporation	L415*	X				X	9000 / 3	
CCI Manufacturing IL Corporation	C521*	X				X	9000 / 3	
Chevron Corp.	Havoline Dexcool Extended Life Antifreeze [US Code 227994]	X					9000 / 3	
Clariant	Genantin Super		X	X			9000 / 3	

Manufacturer	Brand name	Inhibitors					Operating time Hour / Year	Comments / Material number
		Organic	Silicon	Nitrite	Phosphatized	Molybdate		
Classic Schmierstoff GmbH + Co. KG	Classic Kolda UE G48*	X	X				9000 / 5	
Comma Oil & Chemicals Ltd.	Comma Xstream® G30®* Antifreeze Coolant Concentrate	X					9000 / 3	
	Comma Xstream® G48®* Antifreeze Coolant Concentrate	X	X				9000 / 5	
Detroit Diesel Corp.	Power Cool Antifreeze		X	X			9000 / 3	
	Power Cool Plus Coolant*	X				X	9000 / 3	
	Power Cool Diesel Engine Coolant		X	X			9000 / 3	
ExxonMobil	Mobil Delvac Extended Life Coolant*	X				X	9000 / 3	
	Mobil Antifreeze Advanced*	X					9000 / 3	
	Mobil Antifreeze Extra*	X	X				9000 / 5	
	Mobil Antifreeze Special		X	X			9000 / 5	
	Mobil Heavy Duty Coolant		X	X			9000 / 3	
	Mobil Mining Coolant		X	X			9000 / 3	
	Esso Antifreeze Advanced*	X					9000 / 3	
	Esso Antifreeze Extra*	X	X				9000 / 5	
Finke Mineralölwerk GmbH	AVIATICON Finkofreeze F30*	X					9000 / 3	
	AVIATICON Finkofreeze F48*	X	X				9000 / 5	
Fuchs Petrolub SE	Maintain Fricofin*	X	X				9000 / 5	
	Maintain Fricofin G12 Plus*	X					9000 / 3	X00058074 (canister) X00058073 (barrel)
	Maintain Fricofin HDD [Oil-code T-AF3-1]		X	X		X	9000 / 3	
Gazpromneft Lubricants Ltd.	Belaz G-Profi Antifreeze Red*	X					9000 / 3	
	G - Energy Antifreeze SNF	X					9000 / 3	
Krafft S.L.U	Refrigerante ACU 2300		X	X			9000 / 3	X00058075 (barrel)
Kuttenkeuler GmbH	Kuttenkeuler Antifreeze ANF KK48*	X	X				9000 / 5	
	Glycostar® ST48*	X	X				9000 / 5	
INA Maziva Ltd.	INA Antifriz AI Super*	X	X				9000 / 5	
Mitan Mineralöl GmbH	Alpine C48*	X	X				9000 / 5	
MOL-Lub Kft.	EVOX Premium concentrate	X					9000 / 3	

Manufacturer	Brand name	Inhibitors					Operating time Hour / Year	Comments / Material number
		Organic	Silicon	Nitrite	Phosphatized	Molybdate		
Nalco	Nalcool 4070	X	X	X			9000 / 3	
	Nalcool 5990	X	X				9000 / 3	
Nalco Australia	Nalcool NF 48 C*	X	X				9000 / 5	
OAQ Technoform	Cool Stream Premium C	X					9000 / 3	
Old World Industries Inc.	Blue Mountain Heavy Duty Extended Life Coolant*	X				X	9000 / 3	
	Fleetcharge SCA Pre-charged Coolant / Anti-freeze		X	X			9000 / 3	
	Final Charge Global Extended Life Coolant Antifreeze*	X				X	9000 / 3	
OMV	OMV Coolant Plus*	X	X				9000 / 5	
	OMV Coolant SF*	X					9000 / 3	
Panolin AG	Panolin Anti-Frost MT-325*	X	X				9000 / 5	
Penske Power Systems	Power Cool - HB500	X	X				9000 / 3	
	Power Cool - HB800	X	X	X			9000 / 3	
Raloy Lubricantes	Antifreeze Long Life NF-300 Concentrate*	X	X				9000 / 5	
Recochem Inc.	R542	X	X				9000 / 3	
	R824M	X	X	X			9000 / 3	
Shell	Shell HD Premium N		X	X			9000 / 3	
SMB - Sotragal / Mont Blanc	Antigel Power Cooling Concentrate*	X	X				9000 / 5	
Total	Glacelf Auto Supra	X					9000 / 3	
	Glacelf MDX*	X	X				9000 / 5	
	Glacelf Supra	X					9000 / 3	
Valvoline	Zerex G-05		X	X			9000 / 5	
	Zerex G-48*	X	X				9000 / 3	
	Zerex G-30*	X					9000 / 5	
YORK SAS	York 716*	X	X				9000 / 5	
ZAO Obninskorgsintez	Lukoil Antifreeze HD G12 K*	X					9000 / 3	

Table 37:

6.4.2 Antifreeze – Concentrates for special applications

For details and special features, see chapter on “Coolants” (→ Page 17)

Concentrates for special applications

Manufacturer	Brand name	Inhibitors					Operating time Hour / Year	Comments / Material number
		Organic	Silicon	Nitrite	Phosphatized	Molybdate		
BASF SE	G206	X	X				9000 / 3	For use in arctic regions (< -40 °C) No approval for Ser- ies 4000-04

Table 38:

6.4.3 Antifreeze – Ready mixtures for cooling systems free of light metals

For details and special features, see chapter on “Coolants” (→ Page 17)

Important information

For the Series 4000-04 and 4000-05, only coolants marked with an asterisk * in the brand name can be used!

Antifreeze, ready mixtures

Manufacturer	Brand name	Inhibitors					Operating time Hour / Year	Comments / Material number
		Organic	Silicon	Nitrite	Phosphatized	Molybdate		
MTU Friedrichshafen GmbH	Coolant AH 35/65 Antifreeze Premix*	X	X				9000 / 5	X00069382 (20 l) X00069383 (210 l) X00069384 (1000 l) (sales region: Italy)
	Coolant AH 40/60 Antifreeze Premix*	X	X				9000 / 5	X00070533 (20 l) X00070531 (210 l) X00070532 (1000 l) (sales region: England, Spain)
	Coolant AH 50/50 Antifreeze Premix*	X	X				9000 / 5	X00070528 (20 l) X00070530 (210 l) X00070527 (1000 l) (sales region: England)
	Coolant RM 30 (40%)*	X					9000 / 3	X00073922 (20 l) X00073916 (205 l) X00073923 (1000 l)
MTU America Inc.	Power Cool® Universal 35/65 mix*	X	X				9000 / 5	800085 (5 gallons) 800086 (55 gallons)
	Power Cool® Universal 50/50 mix*	X	X				9000 / 5	800071 (5 gallons) 800084 (55 gallons)
	Power Cool® Off-Highway Coolant 50/50 Premix		X	X			9000 / 5	23533531 (5 gallons) 23533532 (55 gallons)
Arteco NV	Havoline Extended Life Coolant + B2 50/50 OF01 [EU Code 33073] (50%)	X					9000 / 3	
	Havoline Extended Life Coolant + B2 40/60 OF01 [EU Code 33069] (40%)	X					9000 / 3	
	Havoline Extended Life Coolant + B2 35/65 OF01 [EU Code 33074] (35%)	X					9000 / 3	
Bantleon	Avilub Antifreeze Mix (50%)*	X	X				9000 / 5	X00049213 (210 l)
BayWa AG	Tectrol Coolprotect Mix 3000*	X					9000 / 3	Antifreeze protection up to -24 °C

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Manufacturer	Brand name	Inhibitors					Operating time Hour / Year	Comments / Material number
		Organic	Silicon	Nitrite	Phosphatized	Molybdate		
BP Lubricants	Castrol Heavy Duty Extended Life Prediluted Coolant (50/50)*	X				X	9000 / 3	
Bucher AG Langenthal	Motorex Coolant G48 ready to use (50/50)*	X	X				9000 / 5	
Caltex	Caltex Extended Life Coolant Pre-Mixed 50/50 [AP Code 510609] (50 %)	X					9000 / 3	
Castrol	Castrol Radicool NF Premix (45 %)*	X	X				9000 / 5	
CCI Corporation	L 415 (50 %)*	X				X	9000 / 3	
CCI Manufacturing IL Corporation	C 521 (50 %)*	X				X	9000 / 3	
Cepsa Comercial Petróleo S.A.U.	Xtar Super Coolant Hybrid NF 50%*	X	X				9000 / 5	
Chevron Corp.	Havoline Dexcool Extended Life Prediluted 50/50 Antifreeze Coolant [US Code 227995]	X					9000 / 3	
Detroit Diesel Corp.	Power Cool Plus Prediluted Coolant (50/50)*	X				X	9000 / 3	
	Power Cool Prediluted 50/50 Diesel Engine Coolant		X	X			9000 / 3	
ExxonMobil	Mobil Delvac Extended Life Prediluted Coolant (50/50)*	X				X	9000 / 3	
Finke Mineralölwerk GmbH	AVIATICON Finkofreeze F48 RM 50/50*	X	X				9000 / 5	
	AVIATICON Finkofreeze F30 RM 40:60 +	X					9000 / 3	
Fuchs Petrolub SE	Maintain Fricofin HDD Premix 50/50 [Oilcode T-AF3-2]		X	X		X	9000 / 3	
Nalco	Nalcool 4100 (50 %)	X	X	X			9000 / 3	
Old World Industries Inc.	Blue Mountain Heavy Duty Extended Life Prediluted Coolant (50/50)*	X				X	9000 / 3	
	Final Charge Global Extended Life Prediluted Coolant / Antifreeze (50/50)*	X				X	9000 / 3	
	Fleet Charge SCA Pre-charged 50/50 Prediluted Coolant		X	X			9000 / 3	

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Manufacturer	Brand name	Inhibitors					Operating time Hour / Year	Comments / Material number
		Organic	Silicon	Nitrite	Phosphatized	Molybdate		
Penske Power Systems	Power Cool - HB500 Premix 50/50	X	X				9000 / 3	
	Power Cool - HB800 Premix 50/50	X	X	X			9000 / 3	
Raloy Lubricantes	Antifreeze Long Life NF-300 Ready-to-Use (50:50)*	X	X				9000 / 5	
SMB - Sotragal / Mont Blanc	L.R.-30 Power Cooling (44 %)*	X	X				9000 / 5	
	L.R.-38 Power Cooling (52%)*	X	X				9000 / 5	
Total	Coolelf MDX (-26 °C)*	X	X				9000 / 5	
	Coolelf Supra (40%)	X					9000 / 3	
	Coolelf GF NP (50%)	X					9000 / 3	
Tosol-Sinzez	Glystantin Alu Protect/G30 Ready Mix*	X					9000 / 3	
	Glystantin Protect Plus/G48 Ready Mix*	X	X				9000 / 5	
Valentin Energie GmbH	Valentin Coolant Plus -25 °C Ready*	X					9000 / 3	
Valvoline	Zerex G-05 50/50 Mix		X	X			9000 / 5	
ZAO Obninskorgsintez	Lukoil Antifreeze HD G12 (50%)*	X					9000 / 3	

Table 39:

6.5 Coolant Additives with Limited Series Approval

6.5.1 Antifreeze - Concentrates and ready mixtures on ethylene-glycol basis for series with and without light metal

Antifreeze, concentrates

Manufacturer	Brand name	Inhibitors					Operating time Hour / Year	Comments / Material number
		Organic	Silicon	Nitrite	Phosphatized	Molybdate		
BASF SE	Glysantin®G40 pink (concentrate)	X	X				9000 / 3	X00066724 (20 l) X00066725 (210 l) Concentration for use: 40 to 50% by volume
Bucher AG Langenthal	Motorex Coolant M 4,0 Concentrate	X	X				9000 / 3	Antifreeze protection up to -38 °C
Valvoline	ZEREX G40 (concentrate)	X	X				9000 / 3	Concentration for use: 40 to 50% by volume Material number (USA): 800180 (Drum)

Table 40:

Antifreezes - ready mixtures

Manufacturer	Brand name	Inhibitors					Operating time Hour / Year	Comments / Material number
		Organic	Silicon	Nitrite	Phosphatized	Molybdate		
Bucher AG Langenthal	Motorex Coolant M 4,0 Ready to use	X	X				9000 / 3	Antifreeze protection up to -38 °C

Table 41:

6.5.2 Antifreeze – Ready mixtures based on propylene glycol for series free of light metal

Antifreeze, ready mixture

Manufacturer	Brand name	Inhibitors					Operating time Hour / Year	Comments / Material number
		Organic	Silicon	Nitrite	Phosphatized	Molybdate		
Fleetguard	PG XL (40%) ready mixture		X	X	X		9000 / 3	

Table 42:

7 Flushing and Cleaning Specifications for Engine Coolant Circuits

7.1 General information

In the course of time, sludge deposits from aging coolant additives can accumulate in the coolant circuits. Reduced cooling capacity, clogged vent lines and drain points and dirty coolant level sight-glasses can result.

Below-standard water quality or incorrect coolant preparation can also heavily contaminate the system.

If such conditions occur, the coolant circuit is to be flushed out with fresh water, repeatedly if necessary.

If these flushing sequences are insufficient or if the system is too heavily contaminated, the coolant circuit and all affected parts must be cleaned.

Only clean, fresh water (no river or sea water) must be used for flushing.

Only products approved by MTU or corresponding products at the specified concentrations may be used for cleaning, see (→ Page 118). The specified cleaning procedure is to be complied with.

Immediately after flushing or cleaning, fill the coolant circuits with treated engine coolant as stipulated in the current MTU Fluids and Lubricants Specifications. Otherwise there is a danger of corrosion!

Important

Fluids and lubricants (e.g. treated engine coolant), used flushing water, cleaning agents and cleaning solutions can be hazardous materials. Certain regulations must be obeyed when handling, storing and disposing of these substances.

These regulations are contained in the manufacturer's instructions, legal requirements and technical guidelines valid in the individual countries. Considerable differences can apply from country to country so that no generally valid statement on the applicable regulations for fluids and lubricants etc. can be made in this publication.

Users of the products named in these specifications are therefore obliged to inform themselves of the locally valid regulations. MTU accepts no responsibility whatsoever for improper or illegal use of the fluids and lubricants / cleaning agents which it has approved.

Important

Scrap oil heat exchangers from engines with bearing or piston seizures or friction damage!

Test equipment, auxiliary materials and fluids and lubricants

MTU test kit or electric pH-value measuring instrument

Required auxiliary materials:

- Compressed air
- Superheated steam

Required fluids and lubricants:

- Fresh water
- Prepared engine coolant

7.2 Approved cleaning agents

Manufacturer	Product name	Concentration for use		Order No.
For coolant systems:				
Kluthe	Hakutex 111 ^{1, 5)}	2% by volume	Liquid	X00065751
	Hakupur 50-706-3 ¹⁰⁾	2% by volume	Liquid	X00055629
For subassemblies:				
Henkel	Bonderite C-AK FD ²⁾	1 to 10% by weight	Powder	⁷⁾
	Bonderite C-MC 11120 ³⁾	2 to 10% by weight	Powder	⁷⁾
Kluthe	Hakutex 60 MTU	100% by volume	Liquid	X00070585 (25 kg)
For coolant systems contaminated with bacteria, fungi or yeast (so-called system cleaners):				
Schülke & Mayr GmbH	Grotan WS Plus ⁵⁾	0.15% by volume	Liquid	X00065326 (10 kg)
	Grotanol SR2 ⁶⁾	0.5% by volume	Liquid	X00069827 (10 kg)
For external cooler on air side:				
Kluthe	Hakupur 50 K ⁹⁾	0.5 to 5% by volume	Liquid	X00070940 ⁷⁾
For painted, contaminated surfaces:				
Kluthe	Hakupur 449 ⁹⁾	1% by volume	Liquid	X00071179 ⁷⁾

Table 43:

¹⁾ For light lime deposits, light corrosion

²⁾ For greasy lime deposits

³⁾ Preferred for heavy lime deposits

⁴⁾ For heavy lime deposits

⁵⁾ Bacteria contamination up to 10^4

⁶⁾ Bacteria contamination up to $> 10^4$, contamination with fungi and yeast

⁷⁾ Not stocked by MTU

⁸⁾ With serious corrosion; not permitted for aluminum materials

⁹⁾ Cleaning agent for cleaning with high-pressure cleaning device (parameter: Pressure: 15 bar, gentle spray jet, cleaning agent temperature: 80 °C)

¹⁰⁾ Not suitable for galvanized surfaces

Important information

The technical data sheets and safety data sheets of the product must be observed!

7.3 Engine coolant circuits - Flushing

1. Drain engine coolant.
2. Measure pH-value of the fresh water using the MTU test kit or electric pH-value measuring device.
3. Fill coolant circuit with fresh water.

Important information

Never pour cold water into a hot engine!

4. Preheat, start and run engine until warm.
5. Run engine for approx. 30 minutes at increased speed.
6. Take flush-water sample at engine-coolant-sample extraction cock.
7. Shut down engine.
8. Drain flush water.
9. Measure pH value of flush-water sample using the MTU test kit or electric pH value measuring device and compare with the pH value of the fresh water.
 - a) pH value difference < 1 : Fill system with treated coolant and start engine.
 - b) pH value difference > 1 : Fill system with fresh flush water and repeat flushing process.
 - c) If the pH value difference is still > 1 after 4 to 5 flushing operations: The coolant circuit must be cleaned, see (→ Page 120). The assemblies may also have to be cleaned, see (→ Page 121).

Important information

Refer to the engine operating instructions for additional information.

7.4 Engine coolant circuits – Cleaning

1. Cleaning agents for coolant circuits are prepared in warm, fresh water as a concentrated solution, see (→ Page 118).
2. In the case of powdered products, stir until the cleaning agent is completely dissolved and without sediment.
3. Pour solution together with fresh water into coolant circuit.
4. Start engine and run until warm.
5. Select temperature and duration of residence time according to the specifications of the technical data sheets of the manufacturer.
6. Shut down engine.
7. Drain off cleaning agents and flush the engine coolant circuit with fresh water.
8. Take flush-water sample at engine-coolant-sample extraction cock.
9. Measure pH value of flush-water sample using the MTU test kit or electric pH value measuring device and compare with the pH value of the fresh water.
 - a) pH value difference < 1: Fill system with treated coolant and start engine.
 - b) pH value difference > 1: Clean assemblies, see (→ Page 121).

Important information

Refer to the engine operating instructions for additional information.

7.5 Assemblies – Cleaning

1. Remove, disassemble and clean assemblies that are exposed to heavy sludge deposits e.g. expansion tanks, preheating units, heat exchangers (coolant cooler, oil heat-exchanger, charge-air cooler, charge-air preheater, fuel preheater etc.) and lower sections of pipework.
2. Before cleaning, examine degree of contamination on water sides.
3. If greasy lime deposits are found, first degrease the water side.
4. Deposits in charge-air coolers caused by oil mist can be removed using Kluthe Hakutex 60.
5. Remove hard lime deposits with a decalcifying product. In the event of stubborn lime deposits, if necessary a 10% inhibited hydrochloric acid solution may have to be used.
6. Dissolve deposits on and in heat-exchanger elements in a heated cleaning bath. Observe the manufacturer's specifications and use only approved detergents in the permissible concentration, see (→ Page 118)

Important information

Deposits on the oil side can also be dissolved in a kerosene bath.

The dwell time in the cleaning bath depends on the type and degree of contamination, as well as the temperature and activity of the bath.

7. Clean individual components such as housings, covers, pipes, sight glasses, heat-exchanger elements with superheated steam, a nylon brush (soft) and a powerful water jet.

Important information

In order to avoid damage:

Do not use hard or sharp-edged tools (steel brushes, scrapers, etc.) (oxide protective layer).

Do not set the pressure of the water jet too high (may damage cooler fins, for example).

8. After cleaning, blow through the heat exchanger elements with low-pressure steam in the direction opposite to operational flow, rinse with clear water (until pH-value difference is < 1) and blow dry with compressed or hot air.
9. Check that all components are in perfect condition, repair or replace as necessary.
10. Flush oil and engine coolant sides of heat-exchanger elements with corrosion-inhibiting oil. This step may be omitted if the heat exchanger is installed and taken into service immediately after cleaning.
11. After installing all assemblies, flush engine coolant circuit once, see (→ Page 119).
12. Check coolant system for leaks during initial operation of engine.

Important information

For further information, see the Maintenance Manual for the engine in question.

7.6 Coolant circuits contaminated with bacteria, fungi or yeast

System cleaning

The system cleaner must flow a sufficiently long time through the complete cooling system to ensure effective cleaning and disinfection.

Therefore, the predefined amount of the approved system cleaner must be added to the contaminated coolant in the system, see (→ Page 118). Use a circulating pump to provide continuous mixture flow through the coolant system for at least 24 hours or max. 48 hours.

Flushing

When the coolant and system cleaner have been drained, the cooling circuit must be flushed with fresh water. Flushing must be carried out until no more contaminants are visible and the flushing liquid has the same pH-value as the fresh water used (max. pH-value difference < 1).

Refill

Before refilling the circuit, make sure the system is free of contaminants.

Refill must be performed directly after flushing to avoid the risk of corrosion!

8 Revision Overview

8.1 Revision overview from version A001064/08 to version A001064/09

Seq. No.	Section	Subject	Page	Action
1	2.1	Engine oils – General information	(→ Page 7)	Revised
2	3.2	Operational monitoring	(→ Page 20)	Revised
3	3.5	Fresh water requirements	(→ Page 26)	Revised
4	3.9	Limit values for coolants	(→ Page 30)	Revised
5	3.10	Coolant concentrates – Storage capability	(→ Page 31)	Revised
6	4.1	Diesel fuels – General information	(→ Page 36)	Revised
7	4.2.1	Distillate fuels according to DIN EN 590 and ASTM D975	(→ Page 41)	Revised
8	4.2.3	Chinese distillate fuels according to GB 19147-2013 and 252-2011	(→ Page 44)	Revised
9	4.2.4	Heating oil	(→ Page 45)	Revised
10	4.2.6	Aviation turbine fuel	(→ Page 48)	Revised
11	4.2.7	NATO diesel fuels	(→ Page 49)	Revised
12	4.2.9	B20 diesel fuel	(→ Page 53)	Revised
13	4.5	Unsuitable materials in diesel fuel circuit	(→ Page 64)	Revised
14	5.1	Single-grade oils – Category 1, SAE grades 30 and 40 for diesel engines	(→ Page 67)	Revised
15	5.2	Multigrade oils – Category 1, SAE grades 15W-40 for diesel engines	(→ Page 69)	Revised
16	5.3	Single-grade oils – Category 2, SAE-grades 30 and 40 for diesel engines	(→ Page 70)	Revised
17	5.4	Multigrade oils – Category 2 of SAE grades 10W-40, 15W-40 and 20W-40 for diesel engines	(→ Page 70)	Revised
18	5.5	Multigrade oils – Category 2.1 (Low SAPS oils) of SAE grades 0W-30, 10W-30, 5W-40, 10W-40 and 15W-40	(→ Page 82)	Revised
19	5.6	Multigrade oils – Category 3 of SAE grades 5W-30, 5W-40 and 10W-40 for diesel engines	(→ Page 85)	Revised

Seq. No.	Section	Subject	Page	Action
20	5.7	Multigrade oils – Category 3.1 (Low SAPS oils) of SAE grades 5W-30, 10W-30 and 10W-40	(→ Page 90)	Revised
21	6.1.1	Coolant without antifreeze – Concentrates for cooling systems containing light metal	(→ Page 96)	Revised
22	6.2.1	Coolants without antifreeze – Concentrates for cooling systems free of light metal	(→ Page 99)	Revised
23	6.3.1	Antifreeze – Concentrates for cooling systems containing light metal	(→ Page 102)	Revised
24	6.3.3	Antifreeze – Ready mixtures for cooling systems containing light metals	(→ Page 106)	Revised
25	6.4.1	Antifreeze – Concentrates for cooling systems free of light metal	(→ Page 108)	Revised
26	6.4.3	Antifreeze – Ready mixtures for cooling systems free of light metals	(→ Page 112)	Revised
27	6.5.1	Antifreeze – Concentrates and ready mixtures on ethylene-glycol basis for series with and without light metal	(→ Page 115)	Revised
28	7.2	Approved cleaning agents	(→ Page 118)	Revised

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Application group	3B, 3E, 3F, 3G				
Emission Stage/Optimisation	TA-Luft				
Test cycle	D2 + 110%				
Data Set	XZ59654100943				
Fuel sulphur content [ppm]	5				

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Not to exceed Werte <i>Not to exceed values</i>	15% O2 15% O2	7	

Unterschriftenweg	EDS erstellt	TETC Teamleiter	TET Leiter Org.-Einheit	Baureihen - Teamleiter	Baureihen Leiter Org.-Einheit	Freigabe im Windchill
Datum	19.04.2018	-	-	20.04.2018	20.04.2018	24.04.2018
Org.-Einheit	TKF	-	-	TKF	TKF	TKM
Name	Khakholka	-	-	Dr. Kneifel	Dr. Baumgarten	Link

 MTU Friedrichshafen GmbH		WORD	Datum/ Date	Name	Projekt-/Auftrags-Nr. Project/Order No.	Format/Size A3
		Erstell. Drawn	2018-02-12 15:38:29	link	Verwendbar f. Typ Applicable to Model	
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		Inhalt Content	19.04.2018	Khakholka	Benennung/ Title	
		Gepr. Checked	2018-04-25 10:28:05	kneifel al	EMISSIONSDATENBLATT	
		Aenderungsbeschreibung/Description of Revision Freigabe		Kommt vor/Frequency	Motortyp / Engine Type 20V4000G34F	
Zeichnungs-Nr./Drawing No.		ZNG00013285			Blatt/ Sheet 1 von/of 7	
Buchst./Rev. Ltr.	Aenderungs-Nr./Revision Notice No.	Bearbeitungsstatus/Lifecycle	Beschreibung/Description			
-2	PR028476	Released				

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Motordaten

engine data

	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	20V4000G34F 6ETC				
Application group	3B, 3E, 3F, 3G				
Emission Stage/Optimisation	TA-Luft				
Test cycle	D2 + 110%				
fuel sulphur content [ppm]	5				
mg/m ³ values base on residual oxygen value of [%]	measured				

See also page 18

Motor Rohemissionen*

Engine raw emissions*

Cycle point	[-]	n1	n2	n3	n4	n5	n6	n7	n8
Power (P/PN)	[-]	1,10	1,00	0,75	0,50	0,25	0,10		
Power	[kW]	2849	2590	1942	1295	647	259		
Speed (n/nN)	[-]	1	1	1	1	1	1		
Speed	[rpm]	1500	1500	1500	1500	1500	1500		
Exhaust temperature after turbine	[°C]	523	516	486	450	351	232		
Exhaust massflow	[kg/h]	15488	15474	11998	8404	5723	4778		
Exhaust back pressure	[mbar]	23	20	14	6	2	1		
NOx	[g/kWh]	5,1	4,5	4,3	4,5	6,1	10,6		
	[mg/m ³]	1389	1111	1032	1024	992	817		
CO	[g/kWh]	0,8	0,7	0,6	0,5	1,3	3,2		
	[mg/m ³]	199	173	143	102	202	230		
HC	[g/kWh]	0,06	0,07	0,08	0,11	0,19	0,66		
	[mg/m ³]	15	16	17	24	30	47		
O2	[%]	9,0	9,4	10,2	10,8	13,1	16,2		
Particulate measured	[g/kWh]	-	-	-	-	-	-		
	[mg/m ³]	-	-	-	-	-	-		
Particulate calculated	[g/kWh]	0,06	0,07	0,07	0,06	0,15	0,19		
	[mg/m ³]	15	15	14	12	21	13		
Dust (only TA-Luft)	[mg/m ³]	-	-	-	-	-	-		
FSN	[-]	0,4	0,4	0,4	0,3	0,7	0,3		
NO/NO2**	[-]	-	-	-	-	-	-		
CO2	[g/kWh]	658,5	695,4	674,1	669,8	706,6	888,4		
	[mg/m ³]	169083	161994	151161	142427	108667	64175		
SO2	[g/kWh]	0,002	0,002	0,002	0,002	0,002	0,003		
	[mg/m ³]	0,5	0,5	0,5	0,5	0,3	0,2		

* Emission data measurement procedures are consistent with the respective emission evaluation process. Noncertified engines are measured to sales data (TVU/TEN) standard conditions.

These boundary conditions might not be representative for detailed dimensioning of exhaust gas aftertreatment, in this case it is recommended to contact the responsible department for more information.

Measurements are subject to variation. The nominal emission data shown is subject to instrumentation, measurement, facility, and engine-to-engine variations.

All data applies to an engine in new condition. Over extended operating time deterioration may occur which might have an impact on emission. Exhaust temperature depends on engine ambient conditions.

** No standard test. To be measured on demand.

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-2	PR028476	Released							

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Motordaten

engine data

	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	20V4000G34F 6ETC				
Application group	3B, 3E, 3F, 3G				
Emission Stage/Optimisation	TA-Luft				
Test cycle	D2 + 110%				
fuel sulphur content [ppm]	5				
mg/mN³ values base on residual oxygen value of [%]	5				

Motor Rohemissionen*

Engine raw emissions*

Cycle point	[-]	n1	n2	n3	n4	n5	n6	n7	n8
Power (P/PN)	[-]	1,10	1,00	0,75	0,50	0,25	0,10		
Power	[kW]	2849	2590	1942	1295	647	259		
Speed (n/nN)	[-]	1	1	1	1	1	1		
Speed	[rpm]	1500	1500	1500	1500	1500	1500		
Exhaust temperature after turbine	[°C]	523	516	486	450	351	232		
Exhaust massflow	[kg/h]	15488	15474	11998	8404	5723	4778		
Exhaust back pressure	[mbar]	23	20	14	6	2	1		
NOx	[g/kWh]	5,1	4,5	4,3	4,5	6,1	10,6		
	[mg/mN³]	1846	1537	1534	1612	2022	2743		
CO	[g/kWh]	0,8	0,7	0,6	0,5	1,3	3,2		
	[mg/mN³]	265	239	213	160	411	773		
HC	[g/kWh]	0,06	0,07	0,08	0,11	0,19	0,66		
	[mg/mN³]	20	22	26	37	60	159		
O2	[%]	9,0	9,4	10,2	10,8	13,1	16,2		
Particulate measured	[g/kWh]	-	-	-	-	-	-		
	[mg/mN³]	-	-	-	-	-	-		
Particulate calculated	[g/kWh]	0,06	0,07	0,07	0,06	0,15	0,19		
	[mg/mN³]	20	21	21	19	43	42		
Dust (only TA-Luft)	[mg/mN³]	-	-	-	-	-	-		
FSN	[-]	0,4	0,4	0,4	0,3	0,7	0,3		
NO/NO2**	[-]	-	-	-	-	-	-		
CO2	[g/kWh]	658,5	695,4	674,1	669,8	706,6	888,4		
	[mg/mN³]	224590	224021	224625	224182	221385	215397		
SO2	[g/kWh]	0,002	0,002	0,002	0,002	0,002	0,003		
	[mg/mN³]	0,7	0,7	0,7	0,7	0,7	0,7		

* Emission data measurement procedures are consistent with the respective emission evaluation process. Noncertified engines are measured to sales data (TVU/TEN) standard conditions.

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-2	PR028476	Released							

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Motordaten

engine data

	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	20V4000G34F 6ETC				
Application group	3B, 3E, 3F, 3G				
Emission Stage/Optimisation	TA-Luft				
Test cycle	D2 + 110%				
fuel sulphur content [ppm]	5				
mg/mN³ values base on residual oxygen value of [%]	15				

Motor Rohemissionen*

Engine raw emissions*

Cycle point	[-]	n1	n2	n3	n4	n5	n6	n7	n8
Power (P/PN)	[-]	1,10	1,00	0,75	0,50	0,25	0,10		
Power	[kW]	2849	2590	1942	1295	647	259		
Speed (n/nN)	[-]	1	1	1	1	1	1		
Speed	[rpm]	1500	1500	1500	1500	1500	1500		
Exhaust temperature after turbine	[°C]	523	516	486	450	351	232		
Exhaust massflow	[kg/h]	15488	15474	11998	8404	5723	4778		
Exhaust back pressure	[mbar]	23	20	14	6	2	1		
NOx	[g/kWh]	5,1	4,5	4,3	4,5	6,1	10,6		
	[mg/mN³]	692	576	575	605	758	1029		
CO	[g/kWh]	0,8	0,7	0,6	0,5	1,3	3,2		
	[mg/mN³]	99	90	80	60	154	290		
HC	[g/kWh]	0,06	0,07	0,08	0,11	0,19	0,66		
	[mg/mN³]	8	8	10	14	23	60		
O2	[%]	9,0	9,4	10,2	10,8	13,1	16,2		
Particulate measured	[g/kWh]	-	-	-	-	-	-		
	[mg/mN³]	-	-	-	-	-	-		
Particulate calculated	[g/kWh]	0,06	0,07	0,07	0,06	0,15	0,19		
	[mg/mN³]	7	8	8	7	16	16		
Dust (only TA-Luft)	[mg/mN³]	-	-	-	-	-	-		
FSN	[-]	0,4	0,4	0,4	0,3	0,7	0,3		
NO/NO2**	[-]	-	-	-	-	-	-		
CO2	[g/kWh]	658,5	695,4	674,1	669,8	706,6	888,4		
	[mg/mN³]	84221	84008	84234	84068	83019	80774		
SO2	[g/kWh]	0,002	0,002	0,002	0,002	0,002	0,003		
	[mg/mN³]	0,3	0,3	0,3	0,3	0,3	0,3		

* Emission data measurement procedures are consistent with the respective emission evaluation process. Noncertified engines are measured to sales data (TVU/TEN) standard conditions.

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			MTU Friedrichshafen GmbH		Erstell. Drawn	2018-02-12 15:38:29	link	Verwendbar f. Typ Applicable to Model	A3
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					Inhalt Content	19.04.2018	Khakholk	Benennung/ Title	EMISSIONSDATENBLATT
					Gepr. Checked	2018-04-25 10:28:05	kneifel al	EMISSION DATA SHEET	
					Motortyp / Engine Type		20V4000G34F		
					Zeichnungs-Nr./Drawing No.			ZNG00013285	Blatt/ Sheet 4 von/of 7
Buchst./Rev. Ltr.	Aenderungs-Nr./Revision Notice No.	Bearbeitungsstatus/Lifecycle	Beschreibung/Description						
-2	PR028476	Released							

Revision					
Change index					

Motordaten

engine data

	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	20V4000G34F 6ETC				
Application group	3B, 3E, 3F, 3G				
Emission Stage/Optimisation	TA-Luft				
Test cycle	D2 + 110%				
fuel sulphur content [ppm]	5				
mg/mN³ values base on residual oxygen value of [%]	measured				

Not to exceed Werte*

not to exceed values*

Cycle point	[-]	n1	n2	n3	n4	n5	n6	n7	n8
Power (P/PN)	[-]	1,00	0,75	0,50	0,25				
Power	[kW]	2590	1942	1295	647				
Speed (n/nN)	[-]	1	1	1	1				
Speed	[rpm]	1500	1500	1500	1500				
Exhaust back pressure	[mbar]	20	14	6	2				
NOx	[g/kWh]	5,8	5,6	5,9	9,1				
	[mg/mN³]	1444	1342	1331	1489				
CO	[g/kWh]	1,3	1,1	0,9	2,6				
	[mg/mN³]	294	244	193	403				
HC	[g/kWh]	0,12	0,13	0,21	0,39				
	[mg/mN³]	27	30	45	59				
O2	[%]	9,4	10,2	10,8	13,1				
Particulate calculated	[g/kWh]	0,11	0,11	0,09	0,22				
	[mg/mN³]	23	23	18	31				

* Calculated values are not proven by tests and therefore the accuracy cannot be guaranteed.

Emissions data measurement procedures are consistent with those described in the applicable rules and standards.

The NOx, CO, HC and PM emission data tabulated here were taken from a single new engine under the test conditions shown above and are valid for the following conditions:

- Ambient air pressure 1 bar
- Air intake temperature approx. 25°C
- Rel. Humidity 30%-60%
- New Engine
- New standard- air filter
- Exhaust gas back pressure according the given value in this EDS
- Fuel according to EN 590 or US EPA 40CFR89
- Coolant and Lubricants according MTU Fuels and Lubricants Specification
- measured after combined exhaust streams.

The nominal emissions data shown is subject to instrumentation, measurement, facility and engine to engine variations. Emissions data is based on single operating points and thus cannot be used to compare to EPA regulations which use values based on a weighted cycle. Emissions data may vary depending on the type of exhaust gas aftertreatment that may be installed on the engine, therefore it is suggested that the engine manufacturer be contacted directly for further information.

Field emission test data are not guaranteed to these levels. Actual field test results may vary due to test site conditions, installation, fuel specification, test procedures, and instrumentation. Over time deterioration may occur which may have an impact on emission levels. Engine operation with excessive air intake or exhaust restriction beyond published maximum limits, or with improper maintenance, may results in elevated emission levels.

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		WORD	Datum/ Date	Name	Projekt-/Auftrags-Nr. Project/Order No.	Format/Size A3
		Erstell. Drawn	2018-02-12 15:38:29	link	Verwendbar f. Typ Applicable to Model	
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		Inhalt Content	19.04.2018	Khakholik	Benennung/ Title	
Änderungsbeschreibung/Description of Revision Freigabe		Gepr. Checked	2018-04-25 10:28:05	kneifel al	EMISSIONSDATENBLATT	
		Motortyp / Engine Type		20V4000G34F		EMISSION DATA SHEET
		Zeichnungs-Nr./Drawing No.			ZNG00013285	
Buchst./Rev. Ltr.	Änderungs-Nr./Revision Notice No.	Bearbeitungsstatus/Lifecycle		Beschreibung/Description		
-2	PR028476	Released				
						Blatt/ Sheet 5 von/of 7

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Motordaten

engine data

	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	20V4000G34F 6ETC				
Application group	3B, 3E, 3F, 3G				
Emission Stage/Optimisation	TA-Luft				
Test cycle	D2 + 110%				
fuel sulphur content [ppm]	5				
mg/mN ³ values base on residual oxygen value of [%]	5				

Not to exceed Werte*

not to exceed values*

Cycle point	[-]	n1	n2	n3	n4	n5	n6	n7	n8
Power (P/PN)	[-]	1,00	0,75	0,50	0,25				
Power	[kW]	2590	1942	1295	647				
Speed (n/nN)	[-]	1	1	1	1				
Speed	[rpm]	1500	1500	1500	1500				
Exhaust back pressure	[mbar]	20	14	6	2				
NOx	[g/kWh]	5,8	5,6	5,9	9,1				
	[mg/mN ³]	1998	1994	2096	3033				
CO	[g/kWh]	1,3	1,1	0,9	2,6				
	[mg/mN ³]	406	362	304	821				
HC	[g/kWh]	0,12	0,13	0,21	0,39				
	[mg/mN ³]	38	44	71	121				
O2	[%]	9,4	10,2	10,8	13,1				
Particulate calculated	[g/kWh]	0,11	0,11	0,09	0,22				
	[mg/mN ³]	32	34	29	64				

* Calculated values are not proven by tests and therefore the accuracy cannot be guaranteed.

Emissions data measurement procedures are consistent with those described in the applicable rules and standards.

The NOx, CO, HC and PM emission data tabulated here were taken from a single new engine under the test conditions shown above and are valid for the following conditions:

- Ambient air pressure 1 bar
- Air intake temperature approx. 25°C
- Rel. Humidity 30%-60%
- New Engine
- New standard- air filter
- Exhaust gas back pressure according the given value in this EDS
- Fuel according to EN 590 or US EPA 40CFR89
- Coolant and Lubricants according MTU Fuels and Lubricants Specification
- measured after combined exhaust streams.

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		Inhalt Content	19.04.2018	Khakholik	Benennung/ Title		
		Gepr. Checked	2018-04-25 10:28:05	kneifel al	EMISSIONSDATENBLATT		
		Motortyp / Engine Type		20V4000G34F		EMISSION DATA SHEET	
Zeichnungs-Nr./Drawing No.		ZNG00013285				Blatt/ Sheet 6 von/of 7	
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-2	PR028476	Released					

Revision					
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Motordaten

engine data

	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	20V4000G34F 6ETC				
Application group	3B, 3E, 3F, 3G				
Emission Stage/Optimisation	TA-Luft				
Test cycle	D2 + 110%				
fuel sulphur content [ppm]	5				
mg/mN³ values base on residual oxygen value of [%]	15				

Not to exceed Werte*

not to exceed values*

Cycle point	[-]	n1	n2	n3	n4	n5	n6	n7	n8
Power (P/PN)	[-]	1,00	0,75	0,50	0,25				
Power	[kW]	2590	1942	1295	647				
Speed (n/nN)	[-]	1	1	1	1				
Speed	[rpm]	1500	1500	1500	1500				
Exhaust back pressure	[mbar]	20	14	6	2				
NOx	[g/kWh]	5,8	5,6	5,9	9,1				
	[mg/mN³]	749	748	786	1137				
CO	[g/kWh]	1,3	1,1	0,9	2,6				
	[mg/mN³]	152	136	114	308				
HC	[g/kWh]	0,12	0,13	0,21	0,39				
	[mg/mN³]	14	16	27	45				
O2	[%]	9,4	10,2	10,8	13,1				
Particulate calculated	[g/kWh]	0,11	0,11	0,09	0,22				
	[mg/mN³]	12	13	11	24				

* Calculated values are not proven by tests and therefore the accuracy cannot be guaranteed.

Emissions data measurement procedures are consistent with those described in the applicable rules and standards.

The NOx, CO, HC and PM emission data tabulated here were taken from a single new engine under the test conditions shown above and are valid for the following conditions:

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-2	PR028476	Released				



Rolls-Royce Solutions GmbH

Maybachplatz 1
88045 Friedrichshafen
Germany
T +49 7541 90-0

To whom it may concern

Contact: Robert Welz
e-Mail: robert.welz2@ps.rolls-royce.com

Tel. No.: +49 7541 904675
Fax No.:

Date: 23 March 2022
Ref.:

Explanation Nominal Emissions and Not to Exceed Emissions in the Emission Data Sheets

Nominal emission values are the result of one specific measurement on one single engine. These measurements have been done under standard conditions on test benches in Friedrichshafen. Because it's a single measurement of one single engine it doesn't show engine to engine variations, nor measurement to measurement variations.

Based on experience, our development team defines safety margins for each load point covering such effects. These safety margins are then added to the nominal emission values. As a result, we have the "not to exceed (NTE)" values in our EDS, which will be valid for all engines out of the series production – as long as the conditions are standard conditions.

These NTE- values will cover any tolerances, deviations etc. and therefore we consider all engines will be within the NTE- emission values under the conditions stated on the Emission Data Sheet.

Sincerely,



Digitale Unterschrift - Original abgelegt bei TSF.

i.V. Michael Koliwer
Director of PG Engineering
Rolls Royce Solutions GmbH



Digital Signature - Original filed at TSL

i.A. Robert Welz
Senior Manager of PG Engineering
Rolls Royce Solutions GmbH

Luke Spenst | AVK

From: James.Pidding@ps.rolls-royce.com
Sent: 23 June 2022 16:32
To: George Close | AVK
Cc: Ben Pritchard | AVK; Myles.Osborn@ps.rolls-royce.com; Luke Spenst | AVK
Subject: Yondr - DS3300 NOx Emissions Statement

Hi George,

I can confirm that the Rolls-Royce mtu DS3300 3F NOx optimised genset will comply to 2g TA-Luft or <2000mg NOx as required by the UK Environment Agency.

Mit freundlichen Grüßen / Kind regards

James Pidding
Key Account Manager – PowerGen Sales

James.Pidding@ps.rolls-royce.com
T +44 (0) 1342 335451 | M +44 (0) 7710 094987

Rolls-Royce Solutions UK Ltd.
Unit 29, The Birches Industrial Estate,
East Grinstead,
West Sussex,
RH19 1XZ,
United Kingdom
www.mtu-solutions.com

VAT number: GB811152282
Company registration number: 04691779



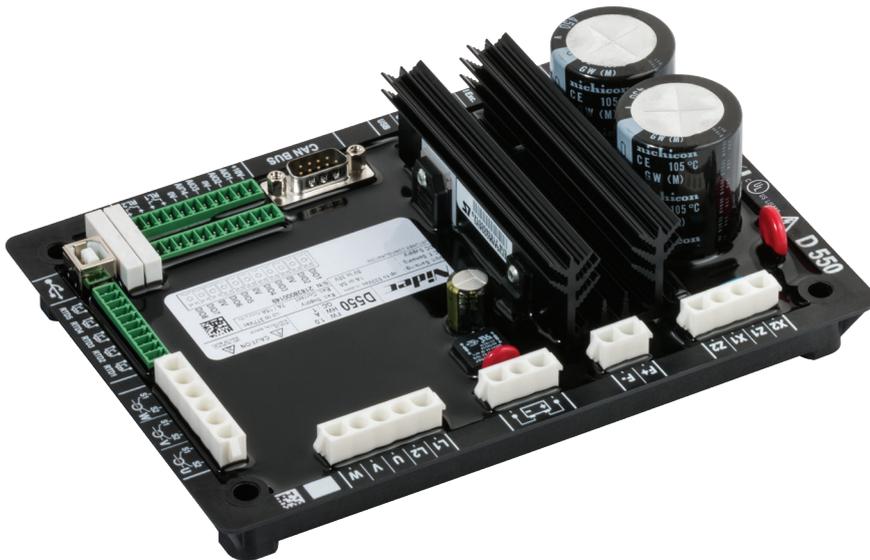
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Appendix 06 - AVR Datasheet

D550 DIGITAL AVR

FOR ALTERNATORS WITH SHUNT, AREP OR PMG EXCITATION



The D550 is a digital automatic voltage regulator (AVR) for alternators with rated field current up to 8 A at 55°C.

It offers a vast array of regulation modes suitable for all power generation applications, including grid-connected configurations.

The D550 also integrates a visual interface through the EasyReg Advanced software, which allows the user to read the configuration values and parameters. It can also be configured directly via USB without external power supply.

The D550 also includes several protections and functions to keep the alternator running in full safe operation, in particular settings to comply with public network connection instructions (grid code).

The communication port is CANJ1939 compatible.

DATASHEET

KEY FEATURES

- **Regulation modes:**
 - Voltage regulation accuracy: $\pm 0.25\%$
 - Field current (manual mode)
 - Generator power factor
 - Grid power factor
 - Generator kVAR
- **Regulation features:**
 - Voltage equalization
 - Droop management
 - Cross current compensation
 - Soft start
 - Load Acceptance Module (L.A.M.) function to assist during heavy load application events
 - Negative field forcing
- **kW, kVAR, kVA and PF calculation**
- **Protections & Limitations:**
 - Under and over field current limitation
 - Loss of field sensing
 - Generator under/over voltage
 - Loss of sensing
 - V/Hz regulation mode
 - Diode fault monitor
- **Data logger** (option)
- **Synchronization monitoring**
- **Events log**

ELECTRICAL FEATURES

- **Generator voltage measurement:**
 - 3-phase, 2-phase
 - Range: 0-230-530 VAC
 - Consumption: < 2 VA
- **Grid voltage measurement:**
 - 2-phase
 - Range: 0-230-530 VAC
 - Consumption: < 2 VA
- **Generator current measurement:**
 - 1 or 3-phase
 - Secondary range: 1 or 5 A
 - Consumption: < 2 VA
- **AC supply input:**
 - PMG, AREP, SHUNT
 - Range: 50-277 VAC
- **Excitation:**
 - Rated field current (continuous):
 - 7 A at 70°C
 - 8 A at 55°C
 - Field forcing current (10s max):
 - 15 A at 70°C
 - Recommended field resistance:
 - > 4 ohms
- **Auxiliary supply: 8-35 VDC**
 - Consumption: < 1 A
- **Frequency range: 30-400 Hz**
- **Storage temperature range:**
 - 55°C +85°C
- **Operating temperature range:**
 - 40°C +70°C

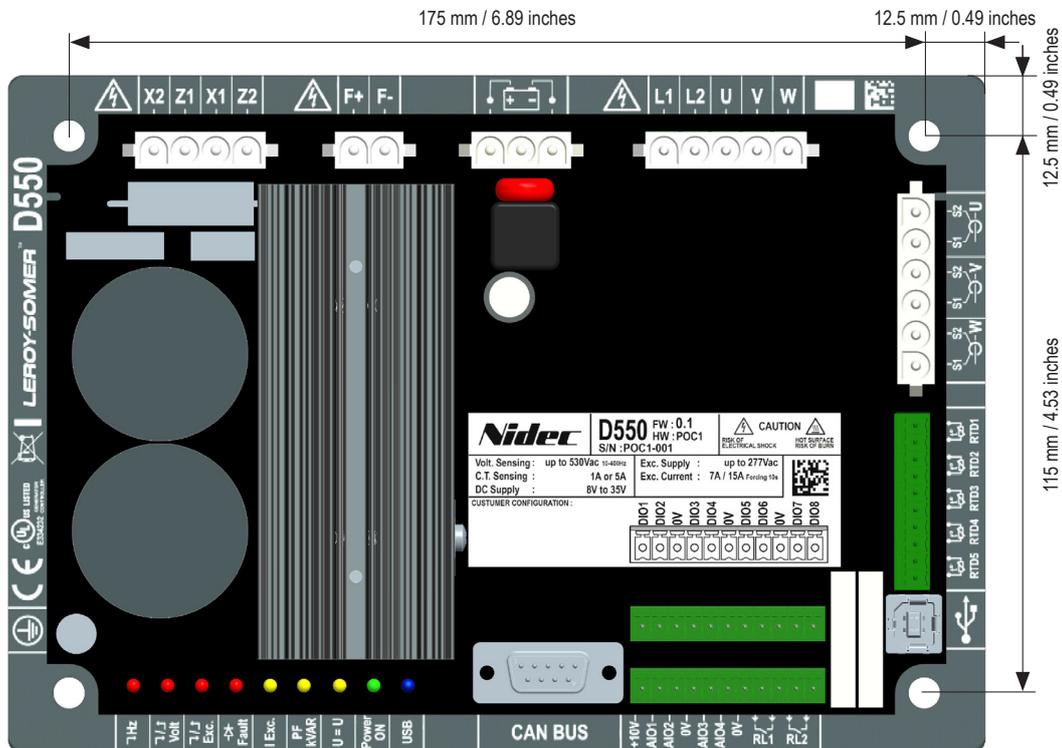
INPUTS / OUTPUTS

- **8 programmable digital inputs & outputs:**
 - Output specification: 150 mA - 30 VDC
- **4 programmable analog inputs & outputs:**
 - 4-20 mA / ± 10 V / 0-10 V / potentiometer (1 k Ω)
- **2 relay outputs:**
 - Specifications: 125 VAC - 5 A
- **5 temperature sensings:**
 - Type: Pt100/CTP
 - Programmable threshold

COMMUNICATION AND SETTINGS

- Software configuration (PC tool)
- USB port (self powered)
- CAN J1939 and Proprietary (Nidec Leroy-Somer protocol)

DIMENSIONS





Appendix 07 - Battery Datasheet

OPTIMA® YellowTop S 5,5



Battery Model: YT S 5,5

Part Number: 851 187 000 888 2

Nominal Voltage: 12 volts

NSN: 6140 01 502 4973

Description: High power, dual purpose engine start and deep cycle, sealed lead acid battery

Physical Characteristics:

Plate Design: High purity lead-tin alloy. Wound cell configuration utilizing proprietary SPIRALCELL® technology.

Electrolyte: Sulfuric acid, H₂SO₄

Case: Polypropylene

Color: Case: Light Gray
Cover: "OPTIMA" Yellow

Group Size: BCI: 31

	Standard	Metric
Length:	12.813"	325 mm
Width:	6.500"	165 mm
Height:	9.375"	238 mm (height at the top of the terminals)
Weight:	59.8 lb	26.5 kg

Terminal Configuration: SAE / BCI automotive.

Performance Data:

Open Circuit Voltage (fully charged): 13.1 volts

Internal Resistance (fully charged): 0.0025 ohms

Capacity: 75 Ah (C/20)

Reserve Capacity: BCI: 155 minutes

(25 amp discharge, 80°F (26.7°C), to 10.5 volts cut-off)

Power:

CCA (EN -18°C): 975 amps

MCA (BCI 0°C): 1125 amps

Recommended Charging:

The following charging methods are recommended to ensure a long battery life: (Always use a voltage regulated charger with voltage limits set as described below.)

Model: YT S 5,5

These batteries are designed for starting and deep cycling applications and for use in vehicles with large accessory loads.

OPTIMA® YellowTop S 5,5

Recommended Charging Information:

Alternator:	13.65 to 15.0 volts
Battery Charger (Constant Voltage):	13.8 to 15.0 volts; 10 amps maximum; 6-12 hours approximate
Float Charge:	13.2 to 13.8 volts; 1 amp maximum (indefinite time at lower voltages)
Rapid Recharge: (Constant voltage charger)	Maximum voltage 15.6 volts. No current limit as long as battery temperature remains below 50°C (125°F). Charge until current drops below 1 amp.
Cyclic or Series String Applications:	14.7 volts. No current limit as long as battery temperature remains below 50°C (125°F). When current falls below 1 amp, finish with 3 amp constant current for 1 hour. All limits must be strictly adhered to.

Recharge Time: (example assuming 100% discharge – 10.5 volts)

Current	Approx. time to 90% charge
100 amps	52 minutes
50 amps	112 minutes
25 amps	210 minutes

Recharge time will vary according to temperature and charger characteristics. When using Constant Voltage chargers, amperage will taper down as the battery becomes recharged. When amperage drops below 1 amp, the battery will be close to a full state charge.

(All charge recommendations assume an average room temperature of 25°C, 77°C)

Always wear safety glasses when working with batteries.

Always use a voltage regulated battery charger with limits set to the above ratings. Overcharging can cause the safety valves to open and battery gases to escape, causing premature end of life. These gases are flammable! You cannot replace water in sealed batteries that have been overcharged. Any battery that becomes very hot while charging should be disconnected immediately.

Not fully charging a battery can result in poor performance and a reduction in capacity.

Shipping and Transportation Information:

OPTIMA batteries can be shipped by AIR. The battery is nonspillable and is tested according to ICAO Technical Instructions DOC. 9284-AN/905 to meet the requirements of Packing Instructions No. 806 and is classified as non-regulated by IATA Special Provision A-48 and A-67 for UN2800. Terminals must be protected from short circuit.

Manufacturing Location:

OPTIMA Batteries
17500 East 22nd Avenue
Aurora, CO 80011
United States of America
Phone: 303-340-7400
Fax: 303-340-7474

BCI = Battery Council International

OPTIMA Batteries
Product Specifications: Model YT S 5,5
June 2005



Appendix 08 - ComAp Datasheet

InteliSys^{NTC} BaseBox



Order code: IS-NTC-BB

Gen-set controller

Datasheet

Product description

- ▶ Comprehensive paralleling gen-set controller
- ▶ Parallel operation up to 32 gen-sets
- ▶ High level control for complex systems
- ▶ CHP and gas engine controller

Key features

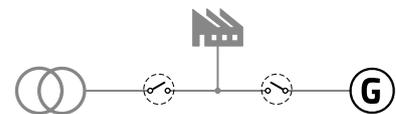
- ▶ Load sharing and VAr sharing via CAN
- ▶ Virtual shared inputs and outputs via CAN
- ▶ Support of wide range of applications
 - Single or multiple gen-sets in parallel to mains operation with automatic back up function, multiple island operation
- ▶ Advanced power management function
- ▶ Customizable load control in parallel to mains
- ▶ Wide range of ECU support
- ▶ Extended communication capabilities
 - Built-in web server
 - Full Modbus slave support
 - GPS and AirGate support and more
- ▶ Highly configurable
 - Timers, Extended internal PLC , Force values and more

- ▶ Compatible with ComAp's InteliVision displays
- ▶ Active e-mail messaging and SMS
- ▶ Extensive built-in protection functions
 - Standard protections
 - User configurable protection
- ▶ Extendable with ComAp's extension modules
- ▶ True RMS (TRMS) is used with Voltage, Current and Power measurement

Application overview

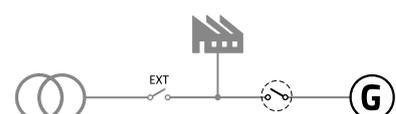
SPtM

Mains & Generator
Circuit Breaker



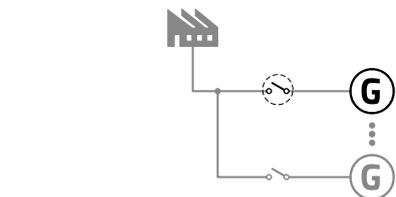
SPI

Generator Circuit
Breaker



MINT

Generator Circuit
Breaker



Technical data

Power supply

Power supply range	8-36 VDC
Power consumption	0.4 A / 8 VDC 0.15 A / 24 VDC 0.1 A / 36 VDC
RTC battery	10 years (replaceable by official service)
Fusing	2 A (without BOUT consumption)

Operating conditions

Operating temperature	-40°C to +70°C
Storage temperature	-40°C to +80°C
Operating humidity	95% w/o condensation
Vibration	5-25 Hz, ± 1.6 mm 25-100 Hz, $a=4$ g
Shocks	$a=200$ m/s ²

Voltage measurement

Measurement inputs	3 ph-n Gen voltage 3 ph-n Mains/Bus voltage
Measurement range	110V / 277V
Max allowed voltage	125 %
Accuracy	1 % of 110V / 277V
Frequency range	40-70 Hz (at accy 0.1 Hz)
Input impedance	0.6 M Ω ph-ph 0.3 M Ω ph-n

Current measurement

Measurement inputs	3 ph Gen current 1 ph Mains current
Measurement range	1 A / 5 A
Max allowed continuous current	200 % / 200 %
Accuracy	2 % of 1 A / 5 A
Input impedance	<0.1 Ω

Binary inputs

Number	16 non-isolated
Input resistance	4.7 k Ω
Close/Open indication	0-2 VDC close contact >4 VDC open contact

Binary outputs

Number	16 non-isolated
Max current	0.5 A (2 A per group)
Switching to	negative/positive supply terminal

Analog inputs

Number	4 non-isolated
Type	Switchable (Voltage, Resistance, Current)
Resolution	10 bits, max 4 decimals
Range	0-5 VDC/0-2500 Ω /0-20 mA
Input impedance	>100 k Ω / >100 k Ω /180 Ω
Accuracy	± 1 % of meas. value ± 1 mV ± 2 % of meas value ± 2 Ω ± 1 % of meas value ± 0.5 mA

Analog outputs

Number	1
Type	Switchable (Voltage, Current)
Range	0-10 VDC/0-20 mA
Max current/load	5 mA/500 Ω
Accuracy	± 0.5 % of output value ± 20 mV ± 0.5 % of output value ± 100 μ A

Magnetic pick-up

Voltage input range	2 Vpk-pk to 50 V _{eff}
Frequency input range	4 Hz to 15 kHz
Frequency measurement tolerance	0.2 %

Voltage regulator output

Type	5 V TTL PWM / ± 10 VDC with IG-AVRi interface
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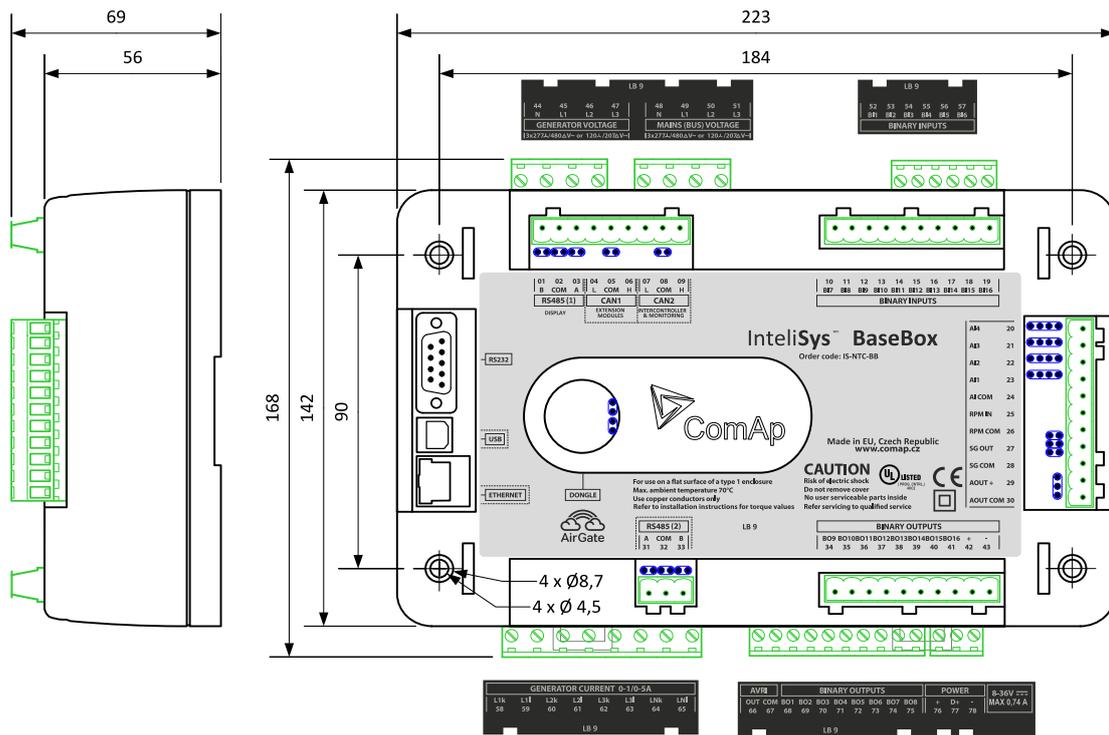
Speed governor output

Voltage output	± 10 VDC / max. 15 mA
Voltage output via resistor	± 10 VDC via 10 k Ω resistor / max. 1 mA
PWM	500-3000 Hz / 5V / max. 10mA

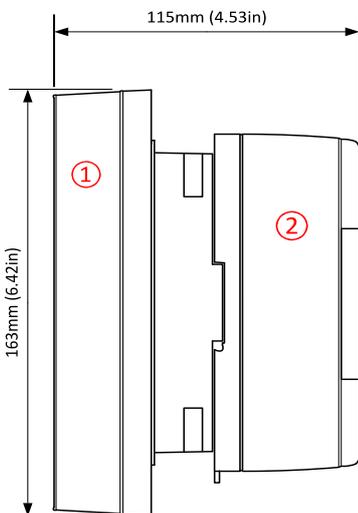
Communications

RS232	Direct/Modbus, non-isolated
RS485	Direct/Modbus, isolated
Display port	non-isolated RS485, only terminal connection
USB port	Direct, isolated
Ethernet port	LAN/Internet, Modbus TCP, SNMP, WebServer, AirGate
CAN1	External modules 250 kbps, max 200 m, Isolated
CAN2	Intercontroller and comm extensions 250/50 kbps, max 200/1000 m, Isolated

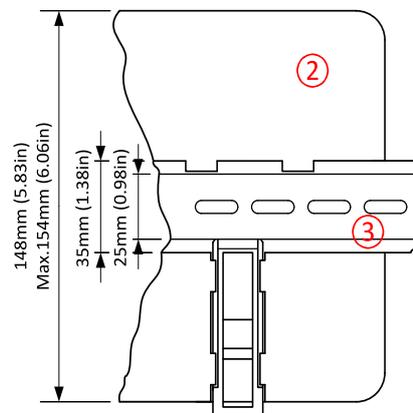
Dimensions, terminals and mounting



Panel door mounting with IntelliVision 5

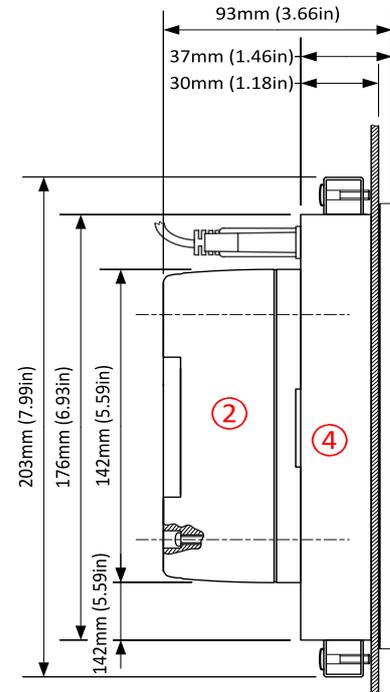


DIN-rail mounting



- ① IntelliVision5
- ② IntelSys^{NTC} BaseBox
- ③ DIN-rail
- ④ IntelliVision 8

Panel door mounting with IntelliVision 8



Note: IntelSys^{NTC} BaseBox can be mounted on a standard DIN rail or, in combination with IntelliVision 5 or IntelliVision 8, it can be door mounted. IntelliVision 5 features mounting rail for direct mounting. Mounting in combination with IntelliVision 8 uses four screws provided in the IntelSys^{NTC} BaseBox package.

Available extension modules

Product	Description	Order code
Intel IO8/8	8 Binary inputs, 8 Binary outputs and 2 Analog outputs packed in a small unit (HW switchable to IO16/0)	I-IO8/8
Intel IO8/8	HW switchable to IO16/0 - 16 Binary inputs packed in a small unit	I-IO8/8
Intel AIN8	8 Analog inputs (R, I, V) and 1 pulse/frequency input in a small unit	I-AIN8
Intel AIN8TC	8 Thermocouple Analog inputs in a small unit	I-AIN8TC
Intel AIO9/1	9 Analog inputs (4x DC, 4x thermocouples, 1x R) in a small unit	I-AIO9/1
IS-AIN8	8 Analog inputs packed in a rugged metal unit	IS-AIN8
IGS-PTM	8 Binary inputs, 8 Binary outputs, 4 Analog inputs and 1 Analog output in a unit	IGS-PTM
IGL-RA15	15 Binary LED output (3 colors) packed in a rugged metal unit	IGL-RA15
I-AOUT8	8 Analog outputs packed in a rugged metal unit	I-AOUT8
InternetBridge-NT	Multiple Internet connections (PC and Modbus) to all controllers on CAN2 or RS485	IB-NT
I-LB+	Direct connection (PC) to all controllers on CAN2 or RS485	I-LB+

Related products

Product	Description	Order code
IntelVision 5	Color 5.6" display for monitoring and control	INTELVISION 5
IntelVision 8	Color 8" display for advanced monitoring, control & trending, USB capable	INTELVISION 8
IntelVision 12Touch	Color 12" touch display for advanced monitoring, control & trending, USB capable	RD11V12TBZH
IntelVision 17Touch	Color 17" touchscreen display designed for complete monitoring and control of multiple controllers or cogeneration installation.	IV17T2
ECON-4	Digital speed governor dedicated for speed control of gas or diesel engines.	ECON-4

Functions and protections

The described product fully supports the following functions and protections as defined by ANSI (American National Standards Institute):

Description	ANSI code	Description	ANSI code
Synchronism check	25	Earth fault current	50N+64
Undervoltage	27	Overcurrent (IDMT)	51
Overload	32	Earth fault current IDMT	51N+64
Load shedding	32P	Power factor	55
Reverse power	32R	Overvoltage	59
Undercurrent	37	Gas (fuel) level	71
Excitation loss	40	Vector shift	78
Current unbalance	46	AC reclosing	79
Voltage asymmetry and phase sequence	47	Overfrequency	81H
Temperature monitoring	49T	Underfrequency	81L
Generator overcurrent	50	ROCOF	81R

Certificates and standards

This product is CE compliant.	
<ul style="list-style-type: none"> ▶ EN 60068-2-6 ed.2:2008; EN 60068-2-27 ed.2:2010; EN 60068-2-30, May 2000 ▶ EN 60068-2-64; EN 61010-1:2003 	
All certificates and standards are available on: https://webstore.iec.ch/	





Appendix 09 - ComAp HMI Datasheet

InteliVision 8



CONTROLLER COLOUR DISPLAY UNIT



Description

InteliVision 8 is a colour display unit designed as a simple, easy-to-use Plug and Play solution and delivers high visibility of all engine data, monitoring information and trend history in a bright, colorful and forward looking design. It can be used for either InteliGen^{NT}, InteliSys^{NT}, InteliMains^{NT}, InteliDrive DCU and InteliDrive Mobile.

InteliVision 8 comes with the large high-resolution colour TFT display, which helps visibility and definition of onscreen information. The control interface has user-friendly, intuitive active buttons – giving users access to more information in less time. InteliVision 8 boasts the unique TRENDS monitoring as a standard feature, helping you evaluate past events easily on one screen. It offers a site data storage using a USB stick and permits adding external pictures for customization of screens.

InteliVision 8 includes ComAp's standard communication interface using RS232/485 and CAN bus communication. Designed to be mounted in both monitoring and engine room, InteliVision 8 gives complete access to all control functions when connected to control unit.



Galvanically separated CAN and RS-485 interface



Screen editor



Tier 4



Trends



USB import & export



Front IP65



Plug and play interface



Large history



Insert images



Configurable buttons



ComAp is a member of AMPS (The Association of Manufacturers of Power generating Systems).



ComAp products meet the highest standards, with every stage of production undertaken in accordance with the ISO certification obtained in 1998.



The product has the UL Certification.

USB as data storage



InteliVision 8 makes working with your data even easier. You can export data to a USB flash drive, in order to work with data later at your computer with ease.

Data export capability:

- ▶ History
- ▶ Controller archive
- ▶ InteliVision firmware
- ▶ Trend – single export & continuous logging

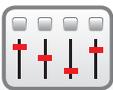
The history and trend data is saved in a format that is supported by third party software. It is also possible to import trend data from a USB flash drive to InteliVision 8 and analyse them in the Trend screen.

USB as Login key



If quick, convenient access to InteliVision 8 is what you need, you can use a USB flash drive as a login key. When a user's password is saved onto a USB flash drive, simply plug it into InteliVision 8 and you are automatically logged in – no need to enter a password manually! A great idea for high security operations, as only staff with the correct USB flash drive are able to access the unit.

Configurable functional buttons



If you need quick access to frequently used functions on InteliVision 8, there are a number of user customisable buttons to which you can assign commands.

Offers fast access to frequently used functions:

- ▶ Binary signal activation
- ▶ Associate the buttons with generator or engine commands
- ▶ Fast jump to any measurement or Setpoints screen

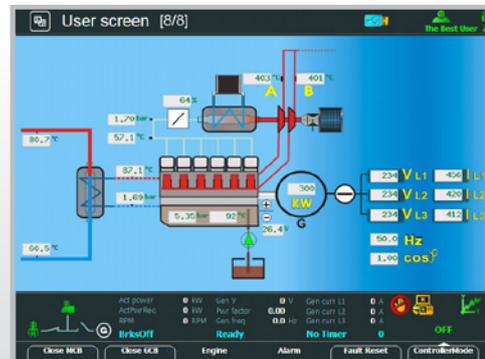
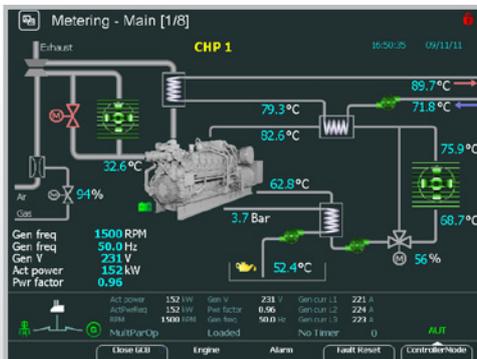
Configuration of these buttons is easy in ScreenEditor, which is part of GenConfig software application.

Import pictures and ScreenEditor



If you need to see a particular engine reading, a certain graph, or other frequently accessed information it is possible with ScreenEditor to customise InteliVision 8 to your preference. You can even add your company logo, or any other photo to further make InteliVision 8 unique to your application.

Screen examples



Trends improvement



Working with trends is now much easier. We have added new features such as:

- ▶ Faster movement through Trends
- ▶ The ability to evaluate change in trends across several screen
- ▶ Indication of remaining time for saving of trends

A major new feature is the ability to display only data from the binary signal that the user wants to see. This is a big change from the previous method of having to see all data, and find the section you need.



Benefits

- ▶ Large, colour screen with high-resolution
- ▶ PLUG and PLAY operation (auto configuration based on controller application)
- ▶ Simpler, faster and more intuitive control
- ▶ More information in less time
- ▶ TRENDS monitoring screen
- ▶ USB flash disk as file STORAGE (export trends, history and archive to USB flash disk)
- ▶ Quick AUTO login with USB stick
- ▶ User's PICTURES import to measurement screen
- ▶ Easy Drag & Drop screen CONFIGURATION by customer in new GRAPHICAL Editor
- ▶ CONFIGURABLE soft keys buttons
 - Fast jump to any Measurement or Setpoints screens
 - Binary signal activation – toggle button/pulse generator
 - Associating of genset commands
- ▶ ADAPTIVE and COLOR alarm list displaying
- ▶ Support of Tier 4 icons
- ▶ Direct connection to the controller (converters are not needed)

Features

- ▶ 8" colour TFT display with resolution 800×600 pixels
- ▶ Customized initial screen logo and the content of a controller help
- ▶ Same language support as IntelliGen^{NT}, IntelliSys^{NT}, IntelliMains^{NT}, IntelliDrive DCU and IntelliDrive Mobile
- ▶ Allows full monitoring of ONE controller (in case of more controllers on CAN it is possible to switch over among controllers monitoring by change of CAN address)
- ▶ The same dimensions as IS-Display (possible as a replacement for IG-Display LT GC, IS-Display or I-RD-CAN)
- ▶ Connection via of RS232/485 and CAN bus
- ▶ Possibility to mount IntelliGen^{NT} BaseBox, IntelliGen^{NTC} BaseBox, IntelliSys^{NTC} BaseBox or IntelliSys^{NT} BaseBox to the rear side of IntelliVision 8
- ▶ Windows CE operating system
- ▶ Operating temperature: -20 to + 70°C
- ▶ Face is sealed to IP65
- ▶ EMC, climatic and mechanical tests
- ▶ CE, UL certification

Connection Possibilities

The table shows the number of IntelliVision 8 that can be connected to each port controller.

	RS232	RS485	Display port (RS485)	CAN2
IntelliGen ^{NT}	1	0	1	4
IntelliGen ^{NT} BaseBox	1	0	2	4
IntelliGen ^{NTC} BaseBox	1	1	2	4
IntelliSys ^{NT} BaseBox	1-2*	0*-1	3	4
IntelliSys ^{NTC} BaseBox	1	1	3	4
IntelliMains ^{NT}	1	0	1	4
IntelliMains ^{NT} BaseBox	1	1	2	4
IntelliMains ^{NTC} BaseBox	1	0	2	4
IntelliDrive DCU Industrial	1	0	0	3
IntelliDrive DCU Marine	1	0	0	4
IntelliDrive Mobile	0	1	0	2

* Port is shared (can be set either as 485(2) or as RS232(2))

Order code

Controller	Order code
IntelliVision 8	INTELIVISION 8

Appendix 10 - HVO Confirmation Letter



Rolls-Royce Solutions GmbH

Maybachplatz 1
88045 Friedrichshafen
Germany
T +49 7541 90-0

Ben Pritchard
Sales Director
AVK – SEG (UK) Ltd
77 Bastwick St.
London, United Kingdom

Contact:
e-Mail: @ps.rolls-royce.com

Tel. No.:
Fax No.:

Date: XX.XX.XX
Ref.: IPAS XXXXXX

Confirmation of Generating Set performance when utilising EN15940 compliant HVO and GtL fuels: LON1X2 build C

Dear Mr. Pritchard,

Following your recent enquiry regarding the performance of our Generating Sets that are pro-posed for your LON1X2 build C project, I am pleased to confirm that using any HVO/ GtL fuel compliant to EN15940 will cause no negative influence on Genset power.

Equally, there will be no negative impact on emissions or additional wear and tear over and above what would be expected running on conventional EN590 Diesel.

Additional Fuel consumption of approximately 3% can occur because EN15940 fuels have a lower density / caloric heat value. This lower density is compensated by our fuel system by extending the duration of the injection and hence increasing consumption slightly.

For reference, please see below the confirmed Generating Set specification for LON1X2 build C:

Product: **mtu 20V4000 DS3300**
Engine: 20V4000G34F
Alternator: LSA 52.3 ŠF4 / 4p
Voltage: 400 V
Application: 3F – Data Center Continuous
Optimisation: NOx Emissions Optimised

Please note that all data provided is valid in conjunction with the Genset datasheets and engine 'TEN' technical data for the configuration above. Of course, site conditions above those agreed at tender (40°C ambient and F00M above sea level) can cause power derates with any fuel.

Sincerely,

i.V
Director of PG Engineering
Rolls Royce Solutions GmbH

i.A.
Senior Manager of PG Engineering
Rolls Royce Solutions GmbH

Board of Management: Andreas Schell (President and CEO), Louise Öfverström, Dr. Otto Preiss.
Chairwoman of the Supervisory Board: Jasmin Staiblin. Domicile: Friedrichshafen. Register Court: Ulm, Nr. I No. HRB 630 227.
Bank Details: Deutsche Bank AG Stuttgart: (all currencies) SWIFT/BIC DEUTDESSXXX, IBAN DE35 6007 0070 0162 9039 00.
Commerzbank AG Friedrichshafen: (EUR) SWIFT/BIC COBADEFF651, IBAN DE68 6514 0072 0170 0038 00.
V.A.T. No. DE 811121844