Fluids and Lubricants Specifications

Fluids and Lubricants Specifications for Series 1800 PowerPack

A001062/04E

A Rolls-Royce solution

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1 Preface

1.1 General

These Fluids and Lubricants Specifications contain general instructions for the proper and safe operation of your product from the manufacturer Rolls-Royce Solutions.

Symbols and presentation form used

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 material damage or destruction.

Note:

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

Fluids and lubricants

The useful life, operational reliability, and function of the drive units largely depend on the fluids and lubricants used. The correct selection and treatment of these fluids and lubricants are therefore extremely important. This publication specifies which fluids and lubricants must be used.

Test standard	Designation
DIN	Deutsches Institut für Normung (Federal German Standards Institute)
EN	Europäische Normung (European Standards)
ISO	International Standards Organization
ASTM	American Society for Testing and Materials
IP	Institute of Petroleum
DVGW	Deutscher Verein des Gas- und Wasserfaches e. V. (German Gas and Water Industry Association)
BS	British Standard

Table 1: Test standards for fluids and lubricants

Monitoring of fluids and lubricants

The maintenance of fluids and lubricants includes regular monitoring. Relevant information on how samples must be taken and handled can be found in the Customer Information “Taking and handling samples for laboratory analyses” (publication number A001080/..). The most recent version can be retrieved from:

http://www.mtu-solutions.com

Applicability of this publication

These Fluids and Lubricants Specifications will be amended or supplemented as necessary. Make sure you have the latest version before use. The latest version is also available at:

http://www.mtu-solutions.com (applies to Series 1800 PowerPack only).

Your contact will be happy to help you with any inquiries.

The Fluids and Lubricants Specifications apply to PowerPacks with Series 6H 1800 engines which comply with the emission levels

- Euro 3
- EU stage IIIA / EPA Tier 3 (with diesel particulate filter but without SCR exhaust gas aftertreatment)
- EU Stage IIIB / EPA Tier 4i
- EU Stage V

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 drive units can be considered hazardous materials. Certain regulations must be observed when handling, storing, and disposing of these substances.

These regulations are contained in the manufacturers' instructions, statutory regulations, and technical guidelines valid in the individual countries. Great differences can apply from country to country, and a generally valid statement on applicable regulations is therefore not possible within these Fluids and Lubricants Specifications.

Users of the products named in these specifications are therefore obliged to inform themselves of the locally applicable regulations. Rolls-Royce Solutions accepts no liability whatsoever for improper or illegal use of the fluids and lubricants which it has approved.

Preservation

All information on preservation, represervation, and depreservation including the approved preservatives is available in the Preservation and Represervation Specifications (publication number A001070/...). The latest version is also available at:

http://www.mtu-solutions.com

2 Engine Oils

2.1 General information

Engine oils

Important
Dispose of used fluids and lubricants in accordance with local regulations!

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 multi-grade oils, depending on the application. Standard values for the temperature limits in each viscosity grade are shown in Chart 1.

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

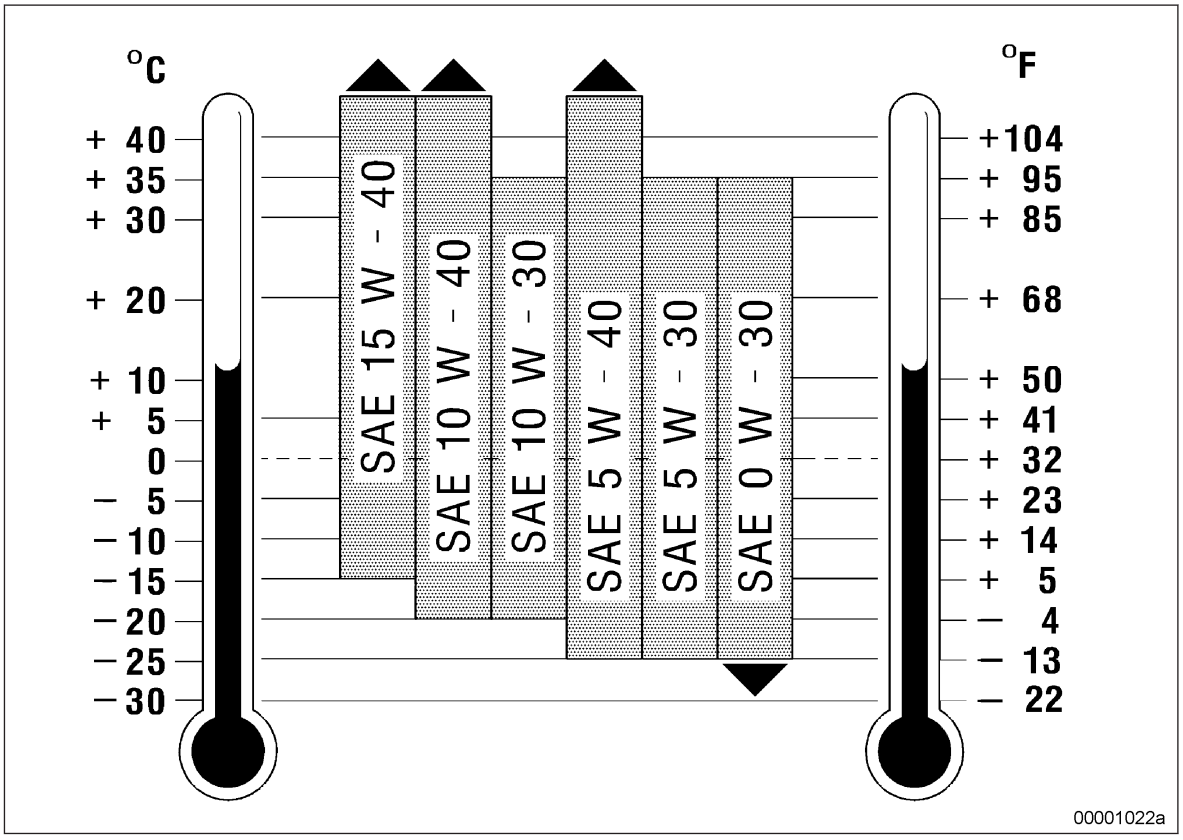

Figure 1: Diagram

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Engine oils for Series 6H 1800 engines

Important

For engine model 6H 1800, only engine oils in accordance with chapter 2.2 (→ Page 8) can be used.
For engines equipped with diesel particulate filter, only “Low SPAsh oils” in accordance with chapter 2.2 (→ Page 8) can be used.
The use-dependent oil change intervals based on run time or time frame specified in the Operating Instructions / Maintenance Schedule only apply when using approved fuels as listed in section 7 (→ Page 46).
The use of non-approved fuels can void the emissions approval.
Prior to using non-approved fuels, contact Rolls-Royce Solutions to determine the applicable oil change intervals.
Operating the engines with biodiesel/FAME according to DIN EN 14214[1)] curtails the oil change intervals, see section 7 (→ Page 46).

[1)] = Latest edition

Mixing engine oils

Important

Mixing engine oils with different specifications and/or viscosity grades is strictly prohibited!
Topping up engine oil with a different approved oil brand than currently used in the engine is also 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 case.

2.2 Approved multi-grade oils according to MB specifications

Approved engine oils

Follow the following links for approved engine oils as specified in MB fluids and lubricants list:

- Multi-grade oils according to MB specification DTFR 15B120 *https://bevo.mercedes-benz-trucks.com* for Euro 3 and EU Stage IIIA engines without DPF
- Multi-grade oils Low SPAsh according to MB specification DTFR 15C110 *https://bevo.mercedes-benz-trucks.com* open page 228.51 in the open website.

Important

Mixing engine oils with different specifications and/or viscosity grades is strictly prohibited!
Topping up engine oil with a different approved oil brand than currently used in the engine is also strictly prohibited!

Emission level	DPF	DTFR 15B120	DTFR 15C110 Low ash	DTFR 15C120 Low ash
Euro 3 EU Stage IIIA without DPF	Without	Approved	Approved	-
Euro 3 EU Stage IIIA EU Stage IIIB	If retrofitted by customer	-	Approved	-
EU Stage V	With	-	Approved	Approved

Note

Initial filling for EU Stage IIIA, EU Stage IIIB and EU Stage V follows Installation Supplement WT00056257 which accompanies the PowerPack.
Engine oils with the same specification (e.g. MB228.51) and viscosity (e.g. 5W30) can be mixed, the brand is irrelevant. To monitor the oil and/or track wear using oil samples, a “pure” oil grade originating from the same oil producer is required/advisable.

3 Generator Lubricants

3.1 Lubricating greases

Lubricating greases for TSA traction generators

Extract from TSA operating and assembly instructions documentation

TSA documents are updated from time to time. Make sure you have the latest version before use. Please contact your Rolls-Royce Solutions representative to clarify.

Important
Mixtures of different lubricating greases are not permitted!

Lubricating grease change intervals based on operating hours/years

Operating hours	Years
2000	1 (12 months)

Table 2: Lubricating grease change intervals based on operating hours/years

Lubricating greases for TSA traction generators

TSA documents are updated from time to time. Make sure you have the latest version before use. Please contact your Rolls-Royce Solutions representative to clarify.

Important
Use TSA-approved grease only. The use of other types of grease, grease blends or contaminated lubricating grease is prohibited! Operating the generator with any grease which has not been approved by TSA will void the warranty for the generator!

Manufacturer	Brand name	Remarks
Schaeffler AG	FAG Arcanol Tempo 90	

Table 3: Lubricating greases for TSA traction generators

4 Transmission Oils

4.1 Transmission oils for ZF transmissions

Lubricant classes for ZF transmissions

(Excerpt from the ZF List of Lubricants TE-ML16, Edition 2021-04-01)

The ZF Lists of Lubricants are updated every three months on 01.01., 04.01., 07.01., and 10.01.. Make sure you have the latest version before use. The latest version is also available at:

https://aftermarket.zf.com/remotemedia/lol-lubricants/lol-de/lol-te-ml-16-de.pdf. An excerpt from this list is shown in the following table.

Product groups automatic transmissions for rail vehicles	Lubricant classes for service filling[1] Transmission without/with ZF Intarder
ASRail • 12 AS 2303, 12 AS 2703, 12 AS 3103, 16 AS 2603	16K / 16P
Ecomat • HP 500 R, HP 590 R, HP 600 R • HP 502 R, HP 592 R, HP 602 R	16M / 16N Automatic Transmission Fluid (ATF)[2]
Ecomat • HP902 R	16N
EcoLife • 6AP2000R, 6AP2500R	16N / 16Q /16S
EcoLife 2 • 6AP2520R	16N / 16Q
EcoWorld • 6AP2004RI, 6AP2504RI	16N / 16Q

Table 4: Excerpt from the list

[1] = Approved commercial products , oil change intervals, and low temperature limits (listed in the following table).

[2] = Particularly recommended: The fully synthetic ATF ZF-Ecofluid A Life was developed specifically for use in Ecomat transmissions. This combination of a synthetic base oil with a specially balanced additive package delivers excellent oxidation stability, highly consistent friction characteristics, and high-quality protection for all transmission components. With its flat viscosity curve, this oil is particularly well-suited to operation in cold as well as in hot climatic zones.

Follow the instructions for greasing points in the manual.

Important
Additives of any kind added later to the oil change the oil in a manner that is unpredictable, and they are therefore not permitted. ZF accepts no liability whatsoever for any damage resulting from the use of such additives.

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Oil change intervals for ASRail transmissions:

Lubricant classes[1]	Oil change interval [km/years] [2,3]
16K	300,000 km / every 2 years
16P	360,000 km / every 3 years

[1] = Pay attention to approved trade products and lubricant classes.

(2) = Oil change required, depending on what occurs first.

(3) = After consultation with the product support department of ZF Friedrichshafen AG, Special Drive Technology, and after an oil analysis has been made (after agreed mileages), longer oil change intervals can be applied to some reference transmissions. The procedure for taking oil samples is described in the respective Service Information.

Oil and filter change intervals for Ecomat transmissions HP 500 R, HP 590 R, HP 600 R, HP 502 R, HP592 R, HP 602 R for rail vehicles:

Lubricant classes(1)	Oil and filter change interval [km/years] (2,3)
16M	120,000 km / every 2 years
16N	150,000 km / every 3 years

(1) = Pay attention to approved trade products and lubricant classes.

(2) = Oil change required, depending on what occurs first.

(3) = After consultation with the product support department of ZF Friedrichshafen AG, Special Drive Technology, and after an oil analysis has been made (after agreed mileages), longer oil change intervals can be applied to some reference transmissions. The procedure for taking oil samples is described in the respective Service Information.

Oil and filter change intervals for Ecomat transmissions HP 902 R for rail vehicles:

Lubricant classes(1)	Oil and filter change interval [km/years] (2,3)
16N	120,000 km / every 3 years

(1) = Pay attention to approved trade products and lubricant classes.

(2) = Oil change required, depending on what occurs first.

(3) = After consultation with the product support department of ZF Friedrichshafen AG, Special Drive Technology, and after an oil analysis has been made (after agreed mileages), longer oil change intervals can be applied to some reference transmissions. The procedure for taking oil samples is described in the respective Service Information.

Oil and filter change intervals for EcoLife and Ecolife 2 transmissions for rail vehicles:

Lubricant classes(1)	Oil and filter change interval [km/years] (2,3)
16S	120,000 km / every 2 years
16N / 16Q	180,000 km / every 3 years

(1) = Pay attention to approved trade products and lubricant classes.

(2) = Oil change required, depending on what occurs first.

(3) = After consultation with the product support department of ZF Friedrichshafen AG, Special Drive Technology, and after an oil analysis has been made (after agreed mileages), longer oil change intervals can be applied to some reference transmissions. The procedure for taking oil samples is described in the respective Service Information.

Oil and filter change intervals for EcoWorld transmissions for rail vehicles:

Lubricant classes(1)	Oil and filter change interval [km/years] (2,3)
16N / 16Q	180,000 km / every 3 years

(1) = Pay attention to approved trade products and lubricant classes.

(2) = Oil change required, depending on what occurs first.

(3) = After consultation with the product support department of ZF Friedrichshafen AG, Special Drive Technology, and after an oil analysis has been made (after agreed mileages), longer oil change intervals can be applied to some reference transmissions. The procedure for taking oil samples is described in the respective Service Information.

The above oil change intervals only apply to complete fills. If oil is changed to another class of lubricants, the following oil and filter change intervals apply :

Changing class of lubricant from	Oil and filter change interval [km/years] (1)
16M => 16N	150,000 km / every 3 years

(1) = Oil change required, depending on what occurs first.

Application areas of lubricants

The following illustration shows application areas of the various SAE classes in relation to the ambient temperatures to be expected.

The oils have a bottom limit of max. dynamic viscosity (Brookfield) of 150,000 mPas, which roughly corresponds to the viscosity limit at low temperatures.

The upper limit is determined by the load in the transmission and the temperature experienced during operation. It can be assumed that high ambient temperatures will also result in higher oil sump temperatures. For detailed information on the low temperature behavior of the specific product see at the safety data sheet of the supplier.

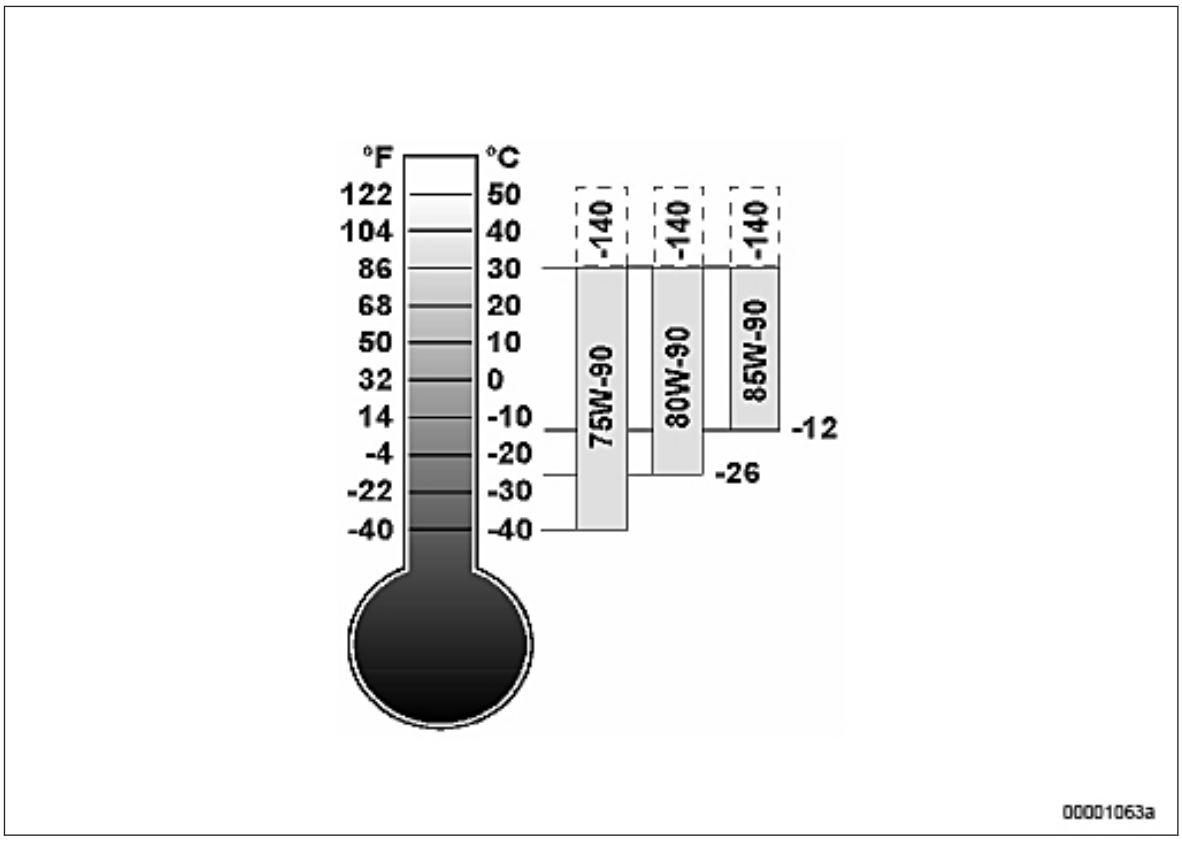

Figure 2: Range of use for hydraulic oil

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The user must observe the low temperature limits!

Lubricant classes	Viscosity grades	Use at oil sump temperature as over
16K / 16M / 16N / 16P / 16Q / 16S	75W-80 / 75W-85 / 75W-90 / 75W-110 / 75W-140 / ATF	- 40 °C

Fluids and lubricants for ZF transmissions

Details of currently approved fluids and lubricants for ZF transmissions can be downloaded free-of-charge from the following Internet address:

https://aftermarket.zf.com/de/aftermarket-portal/services-und-support/technische-informationen/schmierstoffe/

Before use, make sure you have the latest version and compare it with the excerpts from the list shown here.

Lubricant class 16K – Transmission oil of viscosity class: SAE 75W-80 (base oil partly-synthetical, synthetical, suitable for intarders)

Manufacturer	Product name
Addinol Lube Oil GmbH, Leuna/DE	Addinol Getriebeöl GS 75W-80 SL
Aral AG, Bochum/DE	Aral Getriebeoel SNS 75W-80
BayWa AG München, Munich/DE	Tectrol Syntogear MA 7580
Bucher AG Langenthal, Langenthal/CH	York 994
Bucher AG Langenthal, Langenthal/CH	Motorex Prisma TF SAE 75W/80
Bucher AG Langenthal, Langenthal/CH	Motorex/York Prisma TF SAE 75W/80
Castrol LTD, London/GB	Castrol Syntrans Z 75W-80
Castrol LTD, London/GB	Transmax Manual Z 75W-80
Cepsa Comercial Petróleo S.A.U., Madrid/ES	Cepsa Transmisiones FE+LD 75W-80
Chevron Lubricants, San Ramon, CA/US	Delo SYN-MTF XZ 75W-80
Condat Lubrifiants, Chasse Sur Rhone/FR	Gear TDS 75W80
De Oliebron BV, Zwijndrecht/NL	Tor MT/LD Gear Oil 75W80
Deutsche Ölwerke Lubmin, Lubmin/DE	Aveno Truck Gear Longlife 75W-80
Dongfeng Commercial Vehicle CO. LTD, Hubei/CN	DFCV-HDT 31
ENI S.P.A., Rome/IT	ENI Rotra Multigear 75W-80
Europart Trading GmbH, Hagen/DE	Europart Syntogear Int. 75W80
ExxonMobile Corporation, Houston, TX/US	Mobil Delvac 1 Transmission Fluid 75W-80
Finke Mineralölwerk GmbH, 27374 Visselhövede/DE	AVIATICON Finkogear MTF 75W-80
Fuchs Petrolub SE, Mannheim/DE	Fuchs Titan Cytrac MAN SYNTH SAE 75W-80
Fuchs Petrolub SE, Mannheim/DE	Pentosin TLD 75W-80
Fuchs Petrolub SE, Mannheim/DE	Gearway S4 LT 75W-80
Fuchs Petrolub SE, Mannheim/DE	Gearway S4 75W-80
Fuchs Petrolub SE, Mannheim/DE	Fuchs Titan Cytrac MAT SAE 75W-80
Gazpromneft-Lubricants, Moscow/RU	Kamaz G-Profi Service Line Z 75W-80
Gazpromneft-Lubricants, Moscow/RU	G-Truck Z 75W-80
Gulf Oil International, Mumbai/IN	Gulf Syngear FE 75W-80
Gulf Western Oil (Aust) PTY LTD, St. Marys/AT	Ultra Shift M Synthetic Manual Transmission Fluid
Igol France, Amiens/FR	Igol Trandgear ZF Plus 75W-80
INA Maziva LTD., Zagreb/HR	INA Transmol HD SAE 75W-80
Kuwait Petroleum International Lubricant, Antwerp/NL	Q8 Gear Oil V 75W-80
Kuwait Petroleum International Lubricant, Antwerp/NL	Q8 T 60 Ntech 75W-80
Liqui Moly GmbH, Ulm/DE	Liqui Moly Truck Getriebeöl HC GL4 SAE 75W-80

Manufacturer	Product name
Meguin GmbH & Co. KG, Saarlouis/DE	Megol Premium Getriebeoel HC GL 4 75W80
Minerva-Oil SAS, Meuzac/FR	PBH EP 75W-80 LD
MOL-LUB Kft. Almasfuzito/HU	Mol Hykomol Syntrans 75W80
Motul SA, Aubervilliers/FR	Motul Gear Synth XD 75W-80
Olipes S.L., Campo Real - Madrid/ES	Maxigear TS 7400 - SAE 75W-80
OOO “LLK-International”, Moscow/RU	Lukoil Transmission LDI 75W-80
OOO “LLK-International”, Moscow/RU	Lukoil Transmission Synth MPV 75W-80
Oy Teboil AB, Helsinki/FI	Teboil Gear MTF-V
Pakelo Motor Oil, San Bonifacio (VR)/IT	Goldengear LD Plus SAE 75W-80
PAZ Lubricants & Chemicals, Haifa/IL	PAZ Trans Ultra 75W-80
Petro-Canada Lubricants INC., Mississauga, Ontario/CA	Traxon Synthetic MTF 75W-80
Petrobras Distribuidora S.A., Duque de Caxias/BR	Lubrax Gold XP SAE 75W-80
Petrochina Lubricant Company, Beijing/CN	Kunlun ZFGO 02L
Petrogal S.A., Lisboa/PT	Galp Transvex TDL Ultra 75W80
Petrol Ofisi A.S., Istanbul/TR	Maxigear S 75W-80
Petromin Oils Company, Jeddah/SA	Petromin Gear Box Z2 SAE 75W80
Petronas Lubricants International SDN BH, Kuala Lumpur/MY	Tutela Transmission FE-Gear (SAE 75W-80)
Petronas Lubricants International SDN BH, Kuala Lumpur/MY	Petronas Tutela MTF 700 HD 75W-80
Petronas Lubricants International SDN BH, Kuala Lumpur/MY	Tutela Transmission FE-Gear (SAE 75W-80)
Raloy Lubricantes, S.A. DE C.V., Santiago Tianguisten/MX	Krönen Transmission Synthetic Oil 341
Ravensberger Schmierstoffvertrieb GmbH, Werther/DE	Ravenol SSG Spec Synt LKW Getriebeöl 75W-80
Repsol Lubricantes y Especialidades, S.A, Madrid/ES	Repsol Cartago Cajas FE LD 75W80
Rolf Lubricants GmbH, Leverkusen/DE	Rolf Transmission S7 GE 75W-80
S-OIL Corporation, Seoul/KR	S-OIL 7 Gear EP LL
Sasol Energy, Johannesburg/ZA	SYN Gearbox Oil 75W-80
Shell International Petroleum Comp. LTD, London/GB	Shell Spirax S6 GXME 75W- 80
Sinopec Lubricant CO., LTD., Beijing/CN	Sinopec Greatwall MTF 02L 75W-80
SK Lubricants, Seoul/KR	SK Gear EP 75W-80 ZF
Tamoil Italia SPA, Milan/IT	Tamoil Tamgear Plus SAE 75W-80
Tide Water Oil CO. (India) LTD., NAVI Mumbai/IN	Veedol Multigear LD 75W-80
Tongyi Petroleum Chemical CO., LTD., Beijing/CN	Tongyi Gear Oil MTF 75W-80
Total Lubrifiants S.A., Nanterre/FR	Transmission Gear 8 FE 75W-80
Unil Opal, Saumur/FR	Gerion LD 75W80
Valvoline Europe, Dordrecht/NL	Valvoline Heavy Duty Gear Oil PRO 75W-80 LD
Valvoline Europe, Dordrecht/NL	NESTE Pro Gear 75W-80

Manufacturer	Product name
Yacco SAS, St. Pierre Les Elbeuf/FR	BVX Z 1000 75W-80
Zeller+Gmelin GmbH&CO.KG, Eislingen/DE	Divinol Synthogear Int. 75W80

Lubricant class 16M (ATF)

Manufacturer	Product name
Addinol Lube Oil GMBH, Leuna/DE	Addinol ATF XN HD
Allegheny Petroleum, Wilmerding, PA/US	Altra SHL Extended Drain ZF 20C
Amsoil, Inc., Superior, WI/US	Torque-Drive Synthetic ATF
Aocusa, Pico Rivera/US	MV Type 20C ATF
Aral AG, Bochum/DE	Aral Getriebeöl ATF LD
BASF SE, Ludwigshafen/DE	Emgard 2805
BP PLC., London/GB	BP Autran SYN 295
Bucher AG Langenthal, Langenthal/CH	ATF VZ
Bucher AG Langenthal, Langenthal/CH	York 886
Castrol LTD, London/GB	Castrol Transmax Z
Castrol LTD, London/GB	Castrol Transynd
Castrol LTD, London/GB	Castrol Transmax ATF Z
Castrol LTD, London/GB	TES-295 SYN Transmission Fluid
Exol Lubricants LTD, Wednesbury/GB	Autotrans ELC
ExxonMobil Corporation Houston, TX/US	Mobil Delvac 1 ATF
Fuchs Petrolub SE, Mannheim/DE	Transway ATF ULTRA
Fuchs Petrolub SE, Mannheim/DE	Fuchs Titan ATF 5500
Gulf Western Oil (AUST) PTY LTD, St. Marys/AT	SYN-TS®ZFV
H. Bantleon GmbH / Gesells. d. Avia, Ulm/DE	Avilub Fluid ATZ 295
Hi-Tec Oils, Smithfield/AU	Multitrans Plus ATF
John Deere, Moline, Illinois/US	HD Synthetic Transmission Fluid
Motul SA, Aubervilliers/FR	Motul ATF HD
OOO “LLK-International”, Moscow/RU	Lukoil ATF Synth MN Z3
Opet Fuchs Madeni Yag. San. ve TIC. A.S., IZMIR/TR	Otokar Spectra ATF Z
Oy Teboil AB, Helsinki/FI	Teboil Fluid ES-Max
Pakelo Motor Oil, San Bonifacio (VR)/IT	ATF XT III Fluid Plus
Petro-Canada Lubricants Inc., Mississauga, Ontario/CA	Duradrive HD Long Drain ATF
Petrogal S.A., Lisboa/PT	Galp Transmatic Z
Petromin Oils Company, Jeddah/SA	Petromin ATF Z20 LD
Petronas Lubricants International SDN BH, Kuala Lumpur/MY	Petronas Tutela ATF 900 HD
Petronas Lubricants International SDN BH, Kuala Lumpur/MY	Tutela ATF 900 HD
Repsol Lubricantes y Especialidades, S.A, Madrid/ES	Repsol Matic Sintetico
S.I.RA.L., Nola Napoli/IT	Siroil ATF Maximum

Manufacturer	Product name
Sasol Energy, Johannesburg/ZA	SYN Transmission Oil VI
Singapore Petroleum Company Limited, Singapore/SG	Durashift ATF HDLD
Sinopec Lubricant CO., LTD., Beijing/CN	Sinopec Greatwall Fully Synthetic ATF HD S
Sinopec Lubricant CO., LTD., Beijing/CN	Sinopec Greatwall Synthetic ATF HD
Tedex S.A., Warsaw/PL	Tedex ATF Synthetic (S)
Tongyi Petroleum Chemical CO., Ltd., BEIJING/CN	Lingxian 10+ Automatic Transmission Fluid
Valvoline Australia Pty. Ltd, Wetherill Park, NSW/AU	Heavy Duty ATF Pro Eco Plus
Valvoline Europe, Dordrecht/NL	Valvoline Heavy Duty ATF Pro Eco

Lubricant class 16N (ATF)

Manufacturer	Product name
Petronas Lubricants International SDN BH, Kuala Lumpur/MY	Tutela Transmission ATF 120
Shell International Petroleum Comp. LTD., London/GB	Shell Spirax S6 ATF ZM
ZF Friedrichshafen AG, Friedrichshafen/DE	ZF-Ecofluid A Life

Lubricant class 16P – Transmission oil of viscosity class: SAE 75W-80

Manufacturer	Product name
Aral AG, Bochum/DE	Aral Getriebeöl SNS-M 75W-80
Castrol LTD, London/GB	Castrol Syntrans Z Long Life 75W-80
Castrol LTD, London/GB	Castrol Transmax Manual Z Long Life 75W-80
Cepsa Comercial Petróleo S.A.U., Madrid/ES	Cepsa Transmisiones Z5 FE+LD 75W80
Fuchs Petrolub SE, Mannheim/DE	Fuchs Titan Cytrac Ultra Synth SAE 75W-80
Huiles Berliet S.A., Saint-Priest/FR	RTO Longevia BZV ECO 75W-80
Petronas Lubricants International SDN BH, Kuala Lumpur/MY	Tutela Transmission XT-D 540 (SAE 75W-80)
Total Lubrifiants S.A., Nanterre/FR	Traxium Gear 9 FE 75W-80
ZF Friedrichshafen AG, Friedrichshafen/DE	ZF Ecofluid M SAE 75W-80

Lubricant class 16Q

Manufacturer	Product name
ZF Friedrichshafen AG, Friedrichshafen/D	ZF-Ecofluid Life Plus

Lubricant class 16S

Manufacturer	Product name
Addinol Lube Oil GMBH, Leuna/DE	Addinol ATF XN HD
Allegheny Petroleum, Wilmerding, PA/US	Altra SHL Extended Drain ZF 20C
Amsoil, Inc., Superior, WI/US	Torque-Drive Synthetic ATF
Aocusa, Pico Rivera/US	MV Type 20C ATF
Aral AG, Bochum/DE	Aral Getriebeöl ATF LD

Manufacturer	Product name
BASF SE, Ludwigshafen/DE	Emgard 2805
BP PLC., London/GB	BP Autran SYN 295
Bucher AG Langenthal, Langenthal/CH	ATF VZ
Bucher AG Langenthal, Langenthal/CH	York 886
Castrol LTD, London/GB	Castrol Transmax Z
Castrol LTD, London/GB	Castrol Transynd
Castrol LTD, London/GB	Castrol Transmax ATF Z
Castrol LTD, London/GB	TES-295 SYN Transmission Fluid
Exol Lubricants LTD, Wednesbury/GB	Autotrans ELC
ExxonMobil Corporation Houston, TX/US	Mobil Delvac 1 ATF
Fuchs Petrolub SE, Mannheim/DE	Transway ATF ULTRA
Fuchs Petrolub SE, Mannheim/DE	Fuchs Titan ATF 5500
Gulf Western Oil (AUST) PTY LTD, St. Marys/AT	SYN-TS®ZFV
H. Bantleon GmbH / Gesells. d. Avia, Ulm/DE	Avilub Fluid ATZ 295
Hi-Tec Oils, Smithfield/AU	Multitrans Plus ATF
John Deere, Moline, Illinois/US	HD Synthetic Transmission Fluid
Kuwait Petroleum International Lubricant, Antwerp/NL	Q8 Auto 15 S
Liqui Moly GmbH, Ulm/DE	Liqui Moly Top Tec ATF 1700
MOL-LUB Kft. Almasfuzito/HU	MOL ATF 295
Motul SA, Aubervilliers/FR	Motul ATF HD
OOO “LLK-International”, Moscow/RU	Lukoil ATF Synth MN Z3
Opet Fuchs Madeni Yag. San. ve TIC. A.S., IZMIR/TR	Otokar Spectra ATF Z
Oy Teboil AB, Helsinki/FI	Teboil Fluid ES-Max
Pakelo Motor Oil, San Bonifacio (VR)/IT	ATF XT III Fluid Plus
Petro-Canada Lubricants Inc., Mississauga, Ontario/CA	Duradrive HD Long Drain ATF
Petrogal S.A., Lisboa/PT	Galp Transmatic Z
Petromin Oils Company, Jeddah/SA	Petromin ATF Z20 LD
Petronas Lubricants International SDN BH, Kuala Lumpur/MY	Petronas Tutela ATF 900 HD
Petronas Lubricants International SDN BH, Kuala Lumpur/MY	Tutela ATF 900 HD
Repsol Lubricantes y Especialidades, S.A, Madrid/ES	Repsol Matic Sintetico
S.I.RA.L., Nola Napoli/IT	Siroil ATF Maximum
Sasol Energy, Johannesburg/ZA	SYN Transmission Oil VI
Singapore Petroleum Company Limited, Singapore/SG	Durashift ATF HDLD
Sinopec Lubricant CO., LTD., Beijing/CN	Sinopec Greatwall Fully Synthetic ATF HD S
Sinopec Lubricant CO., LTD., Beijing/CN	Sinopec Greatwall Synthetic ATF HD
Tamoil Italia SPA, Milan/IT	Tamoil ATF Long Life HD
Tedex S.A., Warsaw/PL	Tedex ATF Synthetic (S)

Manufacturer	Product name
Tongyi Petroleum Chemical CO., Ltd., BEI-JING/CN	Lingxian 10+ Automatic Transmission Fluid
Valvoline Australia Pty. Ltd, Wetherill Park, NSW/AU	Heavy Duty ATF Pro Eco Plus
Valvoline Europe, Dordrecht/NL	Valvoline Heavy Duty ATF Pro Eco

4.2 Transmission oils for Voith transmissions

Fluids and lubricants for Voith transmissions T 211.re.4 + KB190

Voith hydrodynamic transmissions:

Make sure the that the fluids and lubricants listed in the following table are still approved before use. The latest specifications are available at: *https://voith.com/corp-en/services/power-transmission/download.html?id=2255*

Important
Only use Voith approved transmission oils when filling the turbo transmission. The use of other oil grades and blends or contaminated oils is prohibited. No liability whatsoever will be accepted if oils for which Voith has not granted approval are used in the turbo transmission.

Approved power transmission oils for Voith turbo transmissions T 211 re.4 + KB190

Manufacturer	Product name	Index	Suitable for low temperatures*) down to
Addinol	SGL 18	1	-25 °C
ARAL	ARAL Degol BG 32		-20 °C
Caltex	Torque Fluid 32	2	-25 °C
Castrol	Castrol Alpha VT 32	1	-25 °C
	Castrol Hyspin HL-XP 32	2	-25 °C
Chevron Texaco	Textran V 32	2	-25 °C
Exxon Mobil	Mobilfluid 125	2	-20 °C
Finke	Aviaticon ML 32 SG	1	-25 °C
Fuchs-Europe	Renofluid TF 1500	1	-25 °C
INA Maziva	INA Fluid V 32	2	-25 °C
	INA Fluid VT 32	1	-25 °C
Q8	Q8 Auto R 26	2	-25 °C
Shell	Shell Tegula V 32	1	-25 °C
SRS	SRS Wiolan HF 32 DB	1	-25 °C
	SRS Wiolan HF 32 synth	3	-40 °C
Total	Total Azolla VTR 32		-20 °C
Voith Turbo s,r,l.	Turbo Transmission Fluid	1	-25 °C
	Turbo Transmission Fluid Synth	3	-40 °C

Table 5: Excerpt from the list

Explanation of the Index column:

1 = Increased thermal-oxidation resistance

2 = Oil is not suitable for all electronically-controlled turbo transmissions except for T 211...

3 = Especially increased thermal-oxidation resistance (synthetic oil)

*) = Minimum admissible oil sump temperature. Other requirements for operation of the turbo transmission are specified in the Operating Instructions.

Fluids and lubricants for Voith transmission unit DIWA 884.5 / SWG

Voith transmission unit DIWA 884.5 / SWG:

Make sure that the fluids and lubricants listed in the following table are still approved before use. Make sure you have the latest list of DIWA approved oils before use. The latest version is also available at:

https://voith.com/corp-de/services/antriebstechnik/download.html?id=H55.6336xx

Approved fluids and lubricants for Voith transmission unit DIWA 884.5 / SWG

Manufacturer	Product name
Addinol Lube Oil GmbH	Addinol ATF XN 5
Amsoil Inc.	Torque-Drive Synthetic Automatic Transmission Fluid
Aral AG	Aral Getriebeöl ATF LD
BP Lubricants USA Inc.	BP Autran Syn 295
Castrol Ltd.	Castrol Transmax Z
	Castrol Transmax ATF Z
	Castrol TranSynd
Cepsa Comercial Petróleo S.A.	CEPSA ATF 3000 S
Chevron	Synthetic ATF Heavy Duty Delo Syn ATF HD
Daqing LETOF Lubricating Oil Co., Ltd.	VH556
Delek Industries Ltd.	Delek ATF LD V D-III
Ellis Enterprises East d.o.o. Kruševac	Motoil D IIIH
ENI S.p.A.	ENI Rotra ATF II E
ENOC Marketing LLC	ENOC Active SYN VVM
Exol	Autotrans ELC
ExxonMobil Corp.	Mobil Delvac Synthetic ATF
	Mobil ATF SHC
	Mobil Delvac 1 ATF
	Mobil ATF LT 71141
Fuchs Petrolub SE	Titan ATF 5005
Gazpromneft Lubricants Ltd.	G-Box ATF DX III
Gulf Oil International	Gulf Multi-Vehicle ATF
Hi-Tec Oil Traders Pty Ltd.	Hi-Tec Multitrans Plus
ICONIC Lubrificantes S.A.	Ipiranga ATF OEM Premium
INA Maziva Ltd.	INA ATF DX IIIH
	INA ATF Ekstra
Jiangsu Lopal Tech. CO., Ltd.	ATF III
Kuwait Petroleum	Q8 Auto 15 S
	Q8 Auto 15 ED
Liqui Moly GmbH	Liqui Moly Top Tec ATF 1700
Lotos Oil	LOTOS ATF SUPER IIIG
Meguin GmbH & Co. KG, Mineralölwerke	megol Getriebeöl ATF Synergistic
Mol-Lub	Mol ATF Synt 3H
	Mol ATF Synt
	Mol ATF 295

Manufacturer	Product name
Motorex AG	Motorex ATF TP
NIS AD Novi Sad	Nisotec ATF III Sinth
OOO “LLK-International”	Lukoil ATF Synth MN Z 3
	Lukoil ATF Synth
	Lukoil ATF Synth Multi
Opet Fuchs	Opet ATF XO
Opet Fuchs Madeni Yag San Tic. A.S.	Otokar Spectra ATF VTH
Orlen Oil SP Z O.O	Hipol ATF II E
Pakelo Motor Oil S.r.L	Pakelo ATF XT III Fluid plus
	Pakelo Auxon III Plus
	Pakelo Auxon II E
Panolin AG	Panolin ATF Super VTX
	Panolin ATF Synth
Paz Lubricants & Chemicals	PAZ Power ATF
Petrobras Distribuidora S.A.	Lubrax ATF HD
Petro-Canada Lubricants	DuraDrive HD Synthetic Blend ATF
Petrogal S.A.	Galp Transmatic Z
Petrol Ofisi A.S.	Petrol Ofisi ATF 3
Petronas Lubricants International	Petronas Tutela ATF 90
	Petronas Tutela ATF 700 HD
Phi Oil GmbH	ATF D3 Gold
Qatar Lubricants Company (QALCO)	QALCO ATF VM
Ravensberger Schmierstoffvertrieb	Ravenol Dexron II E
	Ravenol Dexron III H
Repsol Lubricantes y Especialidades, S.A.	Repsol Matic III
RN-Lubricants LLC	Rosneft Kinetic ATF III Synt
Shell International Petroleum Company	Shell Spirax S4 ATF HDX
Sinopec Lubricant C., LTD.	Sinopec Greatwall Fully Synthetic ATF HD S
	Sinopec Greatwall ATF HD
	Sinopec Greatwall ATF HD S
SRS Schmierstoff Vertrieb GmbH	SRS Wiolin ATF III MV
Strub + Co. AG	Strub ATF Synthetic M-V
Suomen Petrooli Oy	Teboil Fluid ES-MAX (E-25112)
Tamoil Italia S.p.A.	ATF Long Life HD
TEDEX S.A.	TEDEX ATF Synthetic (S)
	TEDEX Synthetic ATF
TEDEX Vertriebs GmbH Berlin	TEDEX ATF Synthetic (S)
	TEDEX Synthetic ATF
Tong Yi Petroleum Chemical Co., Ltd.	LingXian 10+ Automatic transmission Fluid
Total Lubrifiants S.A.	Total Fluide XLD FE
Valvoline	Heavy Duty ATF Pro Eco Plus
	Valvoline™ SynGard™ ATF ES

Manufacturer	Product name
Valvoline Europe	Valvoline Heavy Duty ATF Pro LD
Voith Turbo S.r. l., VTIV	V Liquid BLU S

Table 6: Excerpt from the list

4.3 Fluids and lubricants for Rolls-Royce Solutions intermediate gears (Hybrid-PowerPack®)

Important
Mixing transmission oils with different specifications and/or viscosity grades is strictly prohibited! Topping up engine oil with a different approved oil brand than currently used in the engine is also strictly prohibited!

First oil change after 500 h, then every 2000 h

Approved fluids and lubricants for Rolls-Royce Solutions intermediate gears

Manufacturer	Product name
Aral AG	Aral Getriebeöl ATF LD
Castrol Ltd.	Castrol Transmax ATF Z

5 Hydraulic Oils

5.1 General

General

Note

The oil from the barrel must be filtered when changing oil in hydraulic systems. **Recommendation** -> Use 1000 l containers instead of oil drums to reduce dirt ingress (for Panolin: Filter mesh size 7 µm, for engine oil observe the purity class in table “Analytical limits” (→ Page 25)).

The following chapters provide details.

- Chapter 5.2 Hydraulic system based on engine oil (with PowerPack first manufactured before approx. 2023)
- Chapter 5.3 Hydraulic system based on Panolin HLP Synth 68 - Basis; (with PowerPack first manufactured after approx. 2023)

Important

The distinctive feature between both systems is a new hydraulic oil expansion tank. The following figure shows the new hydraulic oil expansion tank for the Panolin-based hydraulic system.

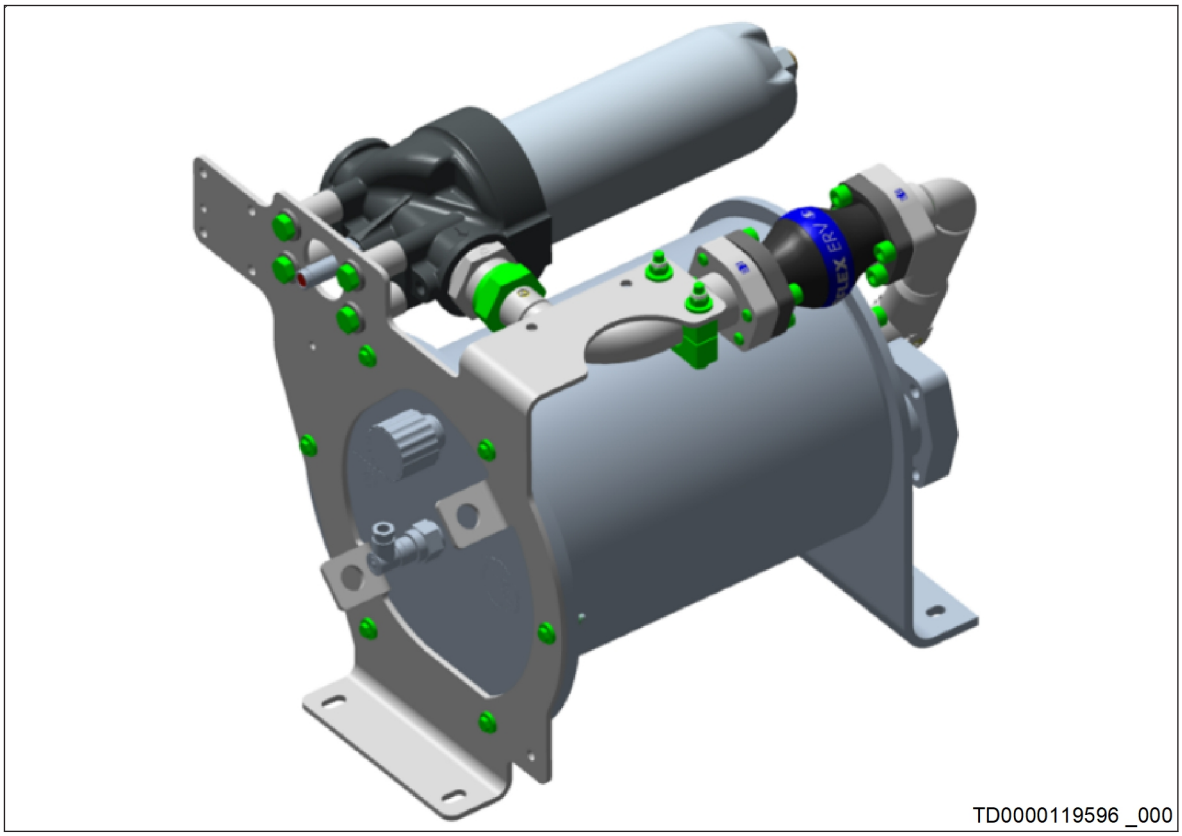

Figure 3: Hydraulic oil expansion tank with material number X50441300480/87

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5.2 Hydraulic system based on engine oil

Fluids and lubricants for hydrostatic drive systems (fans, generator drive)

Use approved engine oils as listed in the following table as operating fluids in the hydraulic system.

Engine oils

Important
Mixing different engine oils is strictly prohibited! Topping up engine oil with a different approved oil brand than currently used in the engine is also strictly prohibited!

For details and special features, see chapter 2 “Lubricants” (→ Page 6) .

Hydraulic system

Important
The oil change interval for the hydraulic system is 4000 operating hours / max. 2 years! The latest order-specific Maintenance Schedule can list other change intervals which then supersede the Fluids and Lubricants Specifications. Mixing different hydraulic oils is strictly prohibited!

Analytical limit values

	Test method	Limit values
Water content (mg/kg)	ASTM D6304 EN 12937 ISO 6296	< 1000
Cleanliness class	ISO 4406	19/17/14

Table 7: Analytical limit values

5.3 Hydraulic system based on Panolin

Hydraulic system

Important
The oil change interval for the hydraulic system is 4000 operating hours / max. 2 years! The latest order-specific Maintenance Schedule can list other change intervals which then supersede the Fluids and Lubricants Specifications. Mixing different hydraulic oils is strictly prohibited!

Approved hydraulic oil : HLP Synth 68

Analytical limit values

	Test method	Limit values	
Water content (mg/kg)	ASTM D6304 EN 12937 ISO 6296	< 1000	
Cleanliness class	ISO 4406	20/18/15	

Table 8: Analytical limit values

6 Coolants

6.1 General information

Coolant definition

Coolant	= Coolant additive (concentrate) + freshwater in the specified mixing ratio ready for use in the engine.

Requirements

Coolants must be prepared from suitable freshwater and a coolant additive approved by Rolls-Royce Solutions. Prepare the coolant away from the PowerPack!

The corrosion-inhibiting effect of coolant is only ensured with the coolant circuit fully filled. This means that the engine must be preserved when coolant was drained off and refilling is not planned. Refer to the Preservation and Represervation Specifications A001070/.. for a description of the preservation procedure.

The entire cooling system must be free of zinc components. This also applies to coolant supply and return/ drain lines as well as to storage bins.

Important

Mixing of different coolant additives and supplementary additives is prohibited!
To avoid corrosion, it is not permissible to operate an engine with pure water without the addition of an approved corrosion inhibitor!

The quantity of coolant remaining in the PowerPack coolant circuit during a coolant change is not critical.

To prevent cooling system damage:
- For initial filling, an antifreeze concentration of 50% by volume must be ensured.
- For topping up coolant (after a coolant loss) or when the antifreeze concentration falls below 40% by volume, a concentration of 50% by volume must be established in the cooling system.
- An antifreeze concentration lower than 40% by volume is inadmissible to avoid compromising corrosion protection.
- Never exceed an antifreeze concentration of 55% by volume Use antifreeze. Concentrations in excess of this reduce antifreeze protection and heat dissipation.
- The coolant must not contain any oil or copper residue (in solid or dissolved form).
- A coolant circuit can not usually be drained completely, i.e. residual quantities of used coolant or freshwater 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.

Coolant mixing ratio

Antifreeze protection down to °C[1)]	-25	-31	-37	-45
Water % by volume	60	55	50	45
Antifreeze % by volume	40	45	50	55
[1)] = Antifreeze specifications determined as per ASTM D 1177				

Table 9: Coolant mixing ratio

Calculating the antifreeze quantity for refilling

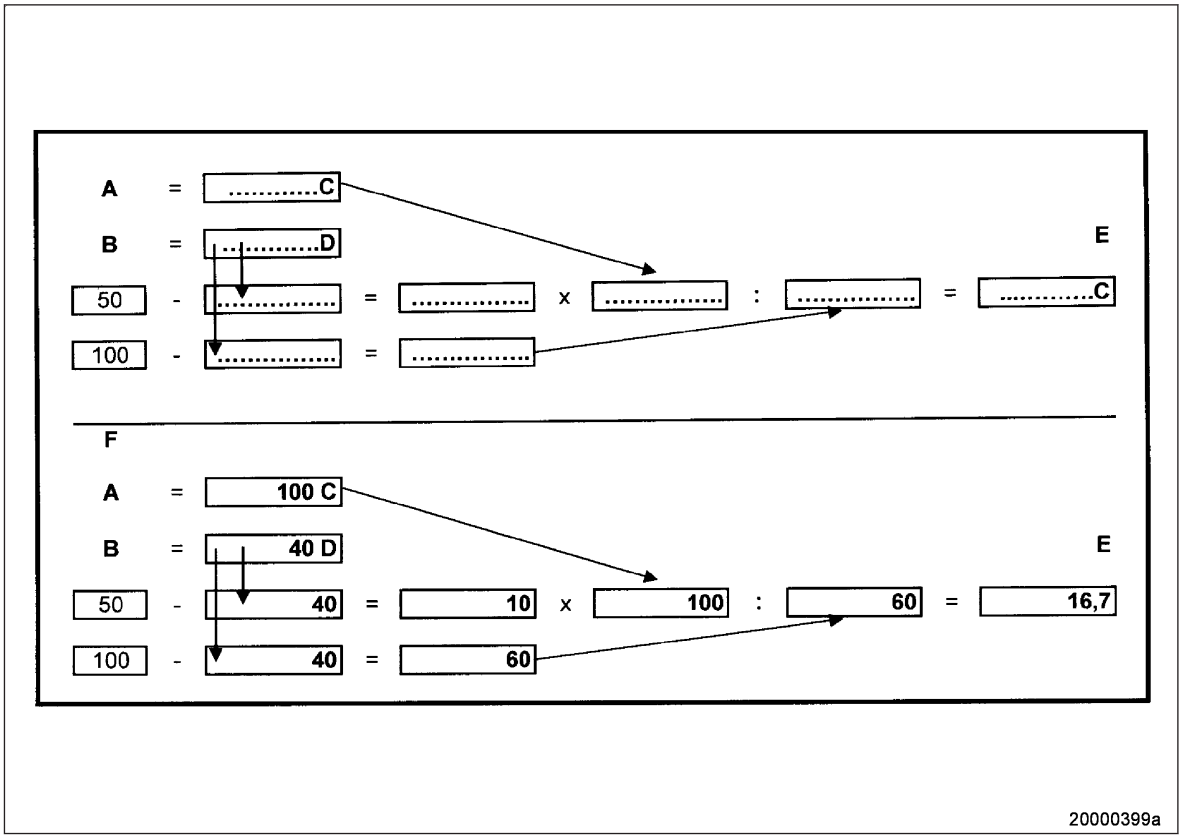

Figure 4: Calculation example

A Coolant capacity (total)
B Measured concentration
C Liters
D Percent by volume
E Antifreeze refill quantity (this quantity must be drained off if the coolant level is within the specifications!)
F Calculation example

Engine coolant or coolant additives

The following engine coolants/coolant additives are available in the framework of mtu ValueCare.

Manufacturer & sales region	Product name	Type
Rolls-Royce Solutions GmbH Rolls-Royce Solutions Asia Europe Middle East Africa Asia	Coolant AH 100 Antifreeze Concentrate	[1]
	Coolant AO 100 Antifreeze Concentrate	X00086249 (20 l) X00086253 (210 l)
	Coolant AS 100 Antifreeze Concentrate	X00086255 (20 l) X00086256 (210 l)
	Coolant AH 50/50 Antifreeze Premix	X00070528 (20 l) X00070527 (1000 l) (Sales region: United Kingdom)
	Coolant AH 40/60 Antifreeze Premix	X00070533 (20 l) X00070532 (1000 l) (Sales region: United Kingdom)

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Manufacturer & sales region	Product name	Type
Rolls-Royce Solutions America Inc. Americas	Power Cool®Universal 50/50 mix	800069 (1 gallon) 800071 (5 gallons) 800084 (55 gallons)
[1)] = No longer included in portfolio. Remaining stocks of this product can be used up as long as the shelf life has not expired. Ready mixtures are still offered.		

Table 10: Engine coolant or coolant additives

6.2 Unsuitable materials in the coolant circuit

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 starts to leak 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 return/ drain lines as well as to storage bins.
- 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.
- Avoid copper materials wherever possible or keep their effective surface area to the bare minimum. Use coolants with purely organic inhibitors if copper alloys are involved.

Non-metallic materials

- Do not use EPDM or silicon 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 useful life of a coolant and, possibly, attack the materials installed in the coolant circuit.

Information:

Consult the relevant Rolls-Royce Solutions specialist department in case of doubt about the use of materials on the engine / externally mounted components in coolant circuits.

6.3 Freshwater

Freshwater

Only clean, clear water with values in accordance with those in the following table can be used for preparing the coolant. If the limit values for the water are not achieved, its hardness or mineral content can be decreased by adding demineralized water.

	Min.	Max.
Total earth alkalines[1)] (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
Total chloride + sulfate ions		200 mg/l
Bacteria		10^3 CFU (colony forming unit)
Fungi, yeasts	Not permitted!	
[1)] Common designations for water hardness in various countries:		

Table 11: Values for freshwater

6.4 Operational checks

Operational checks

Analysis of the freshwater and continuous monitoring of the coolant are essential for trouble-free PowerPack operation. Freshwater and coolant should be checked at least once per year and with each fill-up. Inspections can be carried out using the mtu test kit, or by an authorized laboratory. The mtu test kit contains the necessary equipment, chemicals and instructions for use.

Analysis	Method for on-site checks (mtu test kit)	Method for lab analysis
Determination of the water hardness	Titration	Determination of the Ca and Mg content by means of ICP and calculation of the hardness in °dH or mmol/l
Determination of the pH value	Litmus paper strips for an appropriate measuring range	ASTM D 1287
Determination of the chloride content	Titration	IC
Determination of the sulfate content	-	IC
Determination of the silicon content	-	ICP
Determination of antifreeze concentration	Glycol refractometer, concentration in % by volume can be read off directly	Refractometer method DIN 51423, calculation through refraction index or product-specific factor
Determination of bacterial count for aqueous media e.g. freshwater		Dip slides (tube with culture medium, e.g. VWR Prolabo No. 535112D or equivalent) incubation time: 4 days at 30 °C

Table 12: Minimum requirements and methodology for coolant monitoring

Orders for freshwater and coolant analysis may be placed with Rolls-Royce Solutions. In certain cases, operational monitoring can entail more checks that those listed in table (→ Table 12). Consult your contact if necessary.

The following tests can be conducted with the mtu test kit:

Limit values for coolants

pH value when using – Antifreeze (ASTM D 1287, ISO 976)	Min. 7.5	Max. 9.0
Silicon content (ICP) – Applicable to coolants containing Si	Min. 25 mg/l	

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

Note:

For a comprehensive appraisal of a coolant function, apart from the aforementioned limit values the respective coolant-specific characteristic data and the freshwater quality used must be taken into consideration.

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6.5 Coolant concentrates – Storage capability

Coolant concentrates – Storage capability

Antifreeze	Approx. 3 years	Observe manufacturer's specifications

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

Note:

For reasons of corrosion protection, do not store in galvanized containers. Take this requirement into account when transferring coolant.

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.

6.6 Color additives to detect leakage in the coolant circuit

Color additives to detect leakage 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	Material number	Container size	Storage stability[1)]
Chromatech Inc. Chromatech Europe B.V.	D 11014 Chromatint Uranine Conc	X00066947	20 kg	2 years

Table 13: Approved color 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 tone) is easily recognizable in daylight. In dark rooms, UV light can be used with a wave length of 365 nm.

6.7 Coolant additives

For details and special information, see chapter 6 “Coolants” (→ Page 27)

Special arrangements presently in effect remain valid.

Important

Mixing of different coolant additives and supplementary additives is prohibited!
Before changing from an antifreeze concentrate containing silicates to a silicate-free antifreeze concentrate, flush the coolant circuit with freshwater!
Before changing from a silicate-free antifreeze concentrate to an antifreeze concentrate containing silicates, flush the coolant circuit with freshwater!

Antifreeze concentrates (containing silicates)

Manufacturer	Brand name	Inhibitors					Runtime Hours/Years	Comments / Material number
		Organic	Silicon	Nitrite	Phosphate	Molybdate		
Rolls-Royce Solutions GmbH	Coolant AH100 Anti-freeze Concentrate	X	X				- / 3	X00057231 (20 l) X00057230 (210 l) X00068202 (1000 l)
Alliance Automotive Service GmbH	NAPA Premium Kühler-schutz N48	X	X				- / 3	
Avia AG	Antifreeze APN	X	X				- / 3	
BASF SE	Glysantin G05		X	X			- / 3	
	Glysantin G48 blue green	X	X				- / 3	X00058054 (25 l) X00058053 (210 l)
BayWa AG	Tectrol Coolprotect	X	X				- / 3	
BP Lubricants	Aral Antifreeze Extra	X	X				- / 3	
Castrol	Castrol Radicool NF	X	X				- / 3	
Clariant	Genantin Super		X	X			- / 3	
Classic Schmierstoff GmbH + Co KG	Classic Kolda UE G48	X	X				- / 3	
Comma Oil & Chemi-cals Ltd.	Comma Xstream® G48® Antifreeze Coolant Con-centrate	X	X				- / 3	
COPARTS Autoteile GmbH	CAR 1 Premium Longlife Kühlerschutz C48	X	X				- / 3	
ExxonMobil	Mobil Antifreeze Extra	X	X				- / 3	
	Esso Antifreeze Extra	X	X				- / 3	
Finke Mineralölwerk GmbH	AVIATICON Finkofreeze F30	X					9000 / 3	
	AVIATICON Finkofreeze F40	X	X				- / 3	
	AVIATICON Finkofreeze F48	X	X				- / 3	

Manufacturer	Brand name	Inhibitors					Runtime Hours/Years	Comments / Material number
		Organic	Silicon	Nitrite	Phosphate	Molybdate		
Fuchs Petrolub SE	Maintain Fricofin	X	X				- / 3	
	Maintain Fricofin G12 Plus	X					9000 / 5	
INA Maziva Ltd.	INA Antifriz Al Super	X	X				- / 3	
Krafft S.L.U.	Refrigerante ACU 2300		X	X			- / 3	X00058075 (barrel)
Kuttenkeuler GmbH	Kuttenkeuler Antifreeze ANF KK48	X	X				- / 3	
	Glycostar®ST48	X	X				- / 3	
LAEMMLE Chemicals AG	ANTI-FROST MT-325	X	X				- / 3	
Lukoil Lubricants Europe GmbH	Lukoil Coolant Plus	X	X				- / 3	
	Lukoil Coolant SOT	X	X				- / 3	
Mitan Mineralöl GmbH	Alpine C30	X					9000 / 3	
	Alpine C48	X	X				- / 3	
MJL Bangladesh Ltd.	Omera Premium Coolant	X					9000 / 3	
MOFIN Deutschland GmbH & Co KG	MOFIN Kühlerschutz M40 Extra	X	X				- / 3	
	MOFIN Kühlerschutz M48 Premium Protect	X	X				- / 3	
Motorex AG	Motorex Coolant M 4.0 Concentrate	X	X				- / 3	
	Motorex Coolant G48	X	X				- / 3	
Nalco Water An Ecolab Company	Nalcool NF 48 C	X	X				- / 3	
Navistar Inc.	Fleetrite Nitrite-Free Extended Life Coolant	X				X	9000 / 3	
Puma Energy International S.A.	Puma HD Hybrid Coolant	X	X				- / 3	
Old World Industries Inc.	Blue Mountain Heavy Duty Extended Life Coolant	X				X	9000 / 3	
	Final Charge Global Extended Life Coolant Antifreeze	X				X	9000 / 3	
Raloy Lubricantes	Antifreeze Long Life NF-300 Concentrate	X	X				- / 3	
SMB - Sotragal / Mont Blanc	Antigel Power Cooling Concentrate	X	X				- / 3	
Recochem Inc.	HD Expert™ Endurance	X				X	9000 / 3	
Total Lubrifiants	Glacelf MDX	X	X				- / 3	

Manufacturer	Brand name	Inhibitors					Runtime Hours/Years	Comments / Material number
		Organic	Silicon	Nitrite	Phosphate	Molybdate		
Valvoline	Zerex G 05		X	X			- / 3	
	Zerex G-30	X					9000 / 3	
	Zerex G 40 (concentrate)	X	X				- / 3	Material number (USA): 800180 (drum)
	Zerex G 48	X	X				- / 3	
	OEM Advanced 05		X	X			- / 3	
	OEM Advanced 30	X					9000 / 3	
	OEM Advanced 40	X	X				- / 3	
	OEM Advanced 48	X	X				- / 3	
Volvo Trucks	Road Choice Nitrite-Free OAT Extended Life Coolant	X				X	9000 / 3	
YORK SAS	York 716	X	X				- / 3	

Table 14: Antifreeze concentrates (containing silicates)

Antifreeze concentrates (silicate-free)

Manufacturer	Brand name	Inhibitors					Runtime Hours/Years	Comments / Material number
		Organic	Silicon	Nitrite	Phosphate	Molybdate		
Rolls-Royce Solutions GmbH	Coolant AO 100 Antifreeze Concentrate	X					9000 / 3	X00086249 (20 l) X00086253 (210 l)
Avia AG	Antifreeze APN - S	X					9000 / 3	
BASF SE	Glysantin G30 pink	X					- / 3	X00058072 (canister) X00058071 (barrel)
CCI Corporation	L 415	X				X	- / 3	
	L 415 (50%)	X				X	9000 / 3	
Comma Oil & Chemicals Ltd.	Comma Xstream® G30® Antifreeze Coolant Concentrate	X					- / 3	
Daimler Trucks North America	Alliance OAT Extended Life Coolant	X				X	- / 3	
	Alliance 50/50 Prediluted OAT Extended Life Coolant	X				X	9000 / 3	
Detroit Diesel Corp.	Power Cool Plus Coolant	X				X	- / 3	
	Power Cool Plus Prediluted Coolant (50/50)	X				X	9000 / 3	
Drew Marine	Drewgard ZX	X					- / 3	

Manufacturer	Brand name	Inhibitors					Runtime Hours/Years	Comments / Material number
		Organic	Silicon	Nitrite	Phosphate	Molybdate		
ExxonMobil	Mobil Delvac Extended Life Coolant	X				X	- / 3	
	Mobil Antifreeze Advanced	X					- / 3	
	Esso Antifreeze Advanced	X					- / 3	
	Mobil Delvac Extended Life Prediluted Coolant (50/50)	X				X	9000 / 3	
Finke Mineralölwerk GmbH	AVIATICON Finkofreeze F30	X					- / 3	
	AVIATICON Finkofreeze F30 RM 40:60 +*	X					9000 / 3	
Fuchs Petrolub AG	Maintain Fricofin G 12 Plus	X					- / 3	X00058074 (canister) X00058073 (barrel)
Gazpromneft Lubricants Ltd.	Belaz G-Profi Antifreeze Red	X					- / 3	
LLK-International (Lukoil Lubricants Co)	Lukoil Antifreeze HD G 12 K	X					- / 3	
Lukoil Lubricants Europe GmbH	Lukoil Coolant SF	X					- / 3	
Mitan Mineralöl GmbH	Alpine C30	X					- / 3	
MJL Bangladesh Ltd.	Omera Premium Coolant	X					- / 3	
Navistar Inc.	Fleetrite Nitrite-Free Extended Life Coolant	X				X	- / 3	
	Fleetrite 50/50 Prediluted Nitrite-Free Life Coolant	X				X	9000 / 3	
Old World Industries Inc.	Blue Mountain Heavy Duty Extended Life Coolant	X				X	- / 3	
	Final Charge Global Extended Life Coolant Antifreeze	X				X	- / 3	
	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	
Recochem	HD Expert™ Endurance	X				X	- / 3	
	HD Expert ™ Endurance 50-50 Prediluted	X				X	9000 / 3	
Valvoline	Zerex G 30	X					- / 3	
	OEM Advanced 30	X					- / 3	

Manufacturer	Brand name	Inhibitors					Runtime Hours/Years	Comments / Material number
		Organic	Silicon	Nitrite	Phosphate	Molybdate		
Volvo Trucks	Road Choice Nitrite-Free OAT Extended Life Coolant	X				X	- / 3	
	Road Choice 50/50 Prediluted Nitrite-Free OAT Extended Life Coolant	X				X	9000 / 3	
YPF S.A. Argentina	Kriox MTL50	X				X	9000 / 3	

Table 15: Antifreeze concentrates (silicate-free)

Antifreeze ready mixtures (containing silicates)

Manufacturer	Brand name	Inhibitors					Runtime Hours/Years	Comments / Material number
		Organic	Silicon	Nitrite	Phosphate	Molybdate		
Rolls-Royce Solutions GmbH	Coolant AH 50/50 Antifreeze Premix	X	X				- / 3	X00070528 (20 l) X00070530 (210 l) X00070527 (1000 l) (Sales region: England)
	Coolant AH 100 Antifreeze Concentrate	X	X				9000 / 5	No longer included in portfolio. Remaining stocks of this product can be used up as long as the shelf life has not expired.
Rolls-Royce Solutions America Inc.	Power Cool® Universal 50/50 mix	X	X				- / 3	800071 (5 gallons) 800084 (55 gallons)
	Power Cool® Off-Highway Coolant 50/50 Premix		X	X			- / 3	23533531 (5 gallons) 23533532 (55 gallons)
Alliance Automotive Service GmbH	NAPA Premium Kühlerschutz N48	X	X				9000 / 5	
Avia AG	Antifreeze APN	X	X				9000 / 5	
BASF SE	Glysantin G05		X	X			9000 / 5	
	Glysantin G48 blue green	X	X				9000 / 5	X00058054 (25 l) X00058053 (210 l)
BayWa AG	Tectrol Coolprotect	X	X				9000 / 5	
Bantleon	Avilub Antifreeze Mix (50 %)	X	X				- / 3	X00049213 (210 l)
BP Lubricants	Aral Antifreeze Extra	X	X				9000 / 5	
Castrol	Castrol Radicool NF	X	X				9000 / 5	
Castrol Ltd.	Castrol Radicool NF Premix (45%)	X	X				- / 3	
Classic Schmierstoff GmbH + Co KG	Classic Kolda UE G48	X	X				9000 / 5	

Manufacturer	Brand name	Inhibitors					Runtime Hours/Years	Comments / Material number
		Organic	Silicon	Nitrite	Phosphate	Molybdate		
Cepsa Comercial Petróleo S.A.U.	XTAR Super Coolant Hybrid NF 50%	X	X				- / 3	
COPARTS Autoteile GmbH	CAR 1 Premium Longlife Kühlerschutz C48	X	X				9000 / 5	
Finke Mineralölwerk GmbH	AVIATICON Finkofreeze F48 RM 50/50	X	X				- / 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)
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	
Laemmle Chemicals AG	Roxor Anti-Frost MT-325	X	X				9000 / 5	
Motorex AG	Motorex Coolant G48 ready to use (50/50)	X	X					
	Motorex Coolant M 4.0 Ready to use	X	X				- / 3	Antifreeze protection down to -38 °C
Mitan Mineralöl GmbH	Alpine C48	X	X				9000 / 5	
MOFIN Deutschland GmbH & Co KG	MOFIN Kühlerschutz M48 Premium Protect	X	X				9000 / 5	
Moove Lubricants Limited	Mobil Antifreeze Extra	X	X				9000 / 5	
Motorex AG	Motorex Coolant G48	X	X				9000 / 5	
Nalco Water An Ecolab Company	Nalcool NF 48 C	X	X				9000 / 5	
Puma Energy International S.A.	Puma HD Hybrid Coolant 5050	X	X				- / 3	
Raloy Lubricantes	Antifreez Long Life NF-300 Ready-to-Use (50:50)	X	X				- / 3	
	Antifreeze Long Life NF-300 Concentrate	X	X				9000 / 5	
SMB - Sotragal / Mont Blanc	L.R.-38 Power Cooling (52%)	X	X				- / 5	
	Antigel Power Cooling Concentrate	X	X				9000 / 5	
Tosol-Sintez	Glysantin Alu Protect Plus G48 Ready Mix	X	X				- / 3	

Manufacturer	Brand name	Inhibitors					Runtime Hours/Years	Comments / Material number
		Organic	Silicon	Nitrite	Phosphate	Molybdate		
Total Lubrifiants	Total Coolelf MDX -37	X	X				- / 3	
	Glacelf MDX	X	X				9000 / 5	
Valvoline	Zerex G-05		X	X			9000 / 5	
	OEM Advanced 05		X	X			9000 / 5	
	Zerex G05 50/50 Mix Antifreeze		X	X			- / 3	
	Zerex G-48	X	X				9000 / 5	
	OEM Advanced 48	X	X				9000 / 5	
	OEM Advanced 48 premix 50%	X	X				- / 3	
	Zerex G-48 premix 50%	X	X				- / 3	

Table 16: Antifreeze ready mixtures (containing silicates)

Ready mixtures for cooling systems containing light metals (silicate-free)

Manufacturer	Brand name	Inhibitors					Runtime Hours/Years	Comments / Material number
		Organic	Silicon	Nitrite	Phosphate	Molybdate		
CCI Corporation	L 415 (50%)	X				X	- / 3	
Daimler Trucks North America	Alliance 50/50 Prediluted OAT Extended Life Coolant	X				X	- / 3	
Detroit Diesel Corp.	Power Cool Plus Prediluted Coolant (50/50)	X				X	- / 3	
Exxon Mobil	Mobil Delvac Extended Life Prediluted Coolant (50/50)	X				X	- / 3	
Fast Chemical SRL	Fast Coolant 630 50%	X					9000 / 3	
Finke Mineralölwerk GmbH	AVIATICON Finkofreeze F30 RM 40:60 +*	X					9000 / 3	
LLK-International (Lukoil Lubricants Co)	Lukoil Antifreeze HD G 12 (50%)	X					- / 3	
Navistar Inc.	Fleetrite 50/50 Prediluted Nitrite-Free Life Coolant	X				X	- / 3	
Old World Industries Inc.	Blue Mountain Heavy Duty Extended Life Prediluted Coolant (50/50)	X				X	- / 3	
	Final Charge Global Extended Life Prediluted Coolant/Antifreeze (50/50)	X				X	- / 3	
Recochem	HD Expert ™ Endurance 50-50 Prediluted	X				X	- / 3	

Manufacturer	Brand name	Inhibitors					Runtime Hours/Years	Comments / Material number
		Organic	Silicon	Nitrite	Phosphate	Molybdate		
Tosol-Sintez	Glysantin Alu Protect G30 Ready Mix	X					- / 3	
Volvo Trucks	Road Choice 50/50 Pre-diluted Nitrite-Free OAT Extended Life Coolant	X				X	- / 3	
YPF S.A. Argentina	Kriox MTL50	X				X	- / 3	

Table 17: Ready mixtures for cooling systems containing light metals (silicate-free)

Antifreeze concentrates (containing silicates)

Manufacturer	Brand name	Inhibitors					Runtime Hours/Years	Comments / Material number
		Organic	Silicon	Nitrite	Phosphate	Molybdate		
Rolls-Royce Solutions GmbH	Coolant AS 100 Anti-freeze Concentrate	X	X				9000 / 3	X00086255 (20 l) X00086256 (210 l)
BASF SE	Glysantin®G40 pink (concentrate)	X	X				9000 / 3	X00066724 (20 l) X00066725 (210 l)
Finke Mineralölwerk GmbH	AVIATICON Finkofreeze F40	X	X				9000 / 3	
Fuchs Petrolub SE	Maintain Fricofin DP	X	X				9000 / 3	
MOFIN Deutschland GmbH & Co KG	MOFIN Kühlerschutz M40 Extra	X	X				9000 / 3	
Motorex AG	Motorex Coolant M 4.0 Concentrate	X	X				9000 / 3	
Puma Energy International S.A.	Puma HD Hybrid Coolant	X	X				9000 / 3	
Valvoline	ZEREX G40 (concentrate)	X	X				9000 / 3	Material number (USA): 800180 (Drum)
	OEM Advanced 40	X	X				9000 / 3	

Table 18: Antifreeze concentrates (containing silicates)

Antifreeze ready mixtures (containing silicates)

Manufacturer	Brand name	Inhibitors					Runtime Hours/Years	Comments / Material number
		Organic	Silicon	Nitrite	Phosphate	Molybdate		
Fuchs Petrolub SE	Maintain Fricofin DP 50	X	X				9000 / 3	(50% by vol.)
Motorex AG	Motorex Coolant M 4.0 Ready to use	X	X				9000 / 3	Antifreeze protection down to -38 °C (50% by vol.)
Puma Energy International S.A.	Puma HD Hybrid Coolant 5050	X	X				9000 / 3	(50% by vol.)

Table 19: Antifreeze ready mixtures (containing silicates)

Ready mixtures for cooling systems containing light metals (containing silicates)

Manufacturer	Product/Brand name	Inhibitors					Runtime Hours/Years	Comments / Material number
		Organic	Silicon	Nitrite	Phosphate	Molybdate		
Rolls-Royce Solutions GmbH	Coolant AH 40/60 Antifreeze Premix*	X	X				9000 / 5	X00070533 (20 l) X00070532 (1000 l) (Sales region: United Kingdom, Spain)
	Coolant AH 50/50 Antifreeze Premix	X	X				9000 / 5	X00070528 (20 l) X00070530 (1000 l) (Sales region: United Kingdom)
Rolls-Royce Solutions America Inc.	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)
Castrol	Castrol Radicool NF Premix (45%)	X	X				9000 / 5	
Cepsa Comercial Petróleo S.A.U.	XTAR Super Coolant Hybrid NF 50%	X	X				9000 / 5	
Finke Mineralölwerk GmbH	AVIATICON Finkofreeze F48 RM 50/50	X	X				9000 / 5	
Fuchs Petrolub SE	Maintain Fricofin 50 (Ready Mix)	X	X				9000 / 5	
Moove Lubricants Limited	Mobil Coolant Extra Ready -36 °C	X	X				9000 / 5	
Motorex AG	Motorex Coolant G48 ready to use (50/50)	X	X				9000 / 5	
Raloy Lubricantes	Antifreez Long Life NF-300 Ready-to-Use (50:50)	X	X				9000 / 5	

Manufacturer	Product/Brand name	Inhibitors					Runtime Hours/Years	Comments / Material number
		Organic	Silicon	Nitrite	Phosphate	Molybdate		
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 Lubrifiants	Coolelf MDX -26 °C*	X	X				9000 / 5	
	Coolelf MDX -37 °C	X	X				9000 / 5	
Valvoline	Zerex G-05 50/50 Mix		X	X			9000 / 5	
	Zerex G-48 premix 50%	X	X				9000 / 5	
	OEM Advanced 48 premix 50%	X	X				9000 / 5	

Table 20: Ready mixtures for cooling systems containing light metals (containing silicates)

6.8 Coolant for battery cooling

For details and special information, see chapter 6 “Coolants” (→ Page 27)

Special arrangements presently in effect remain valid.

Important
Mixing of different coolant additives and supplementary additives is prohibited! Before changing from an antifreeze concentrate containing silicates to a silicate-free antifreeze concentrate, flush the coolant circuit with freshwater! Before changing from a silicate-free antifreeze concentrate to an antifreeze concentrate containing silicates, flush the coolant circuit with freshwater!

Corrosion-inhibiting antifreeze concentrates for battery cooling

Manufacturer	Brand name	Runtime Hours/Years	Remarks
BASF	Glysantin G48	- / 3	Mixed with 50% pure water
	Glysantin G30	- / 3	Mixed with 50% pure water
Clariant	Antifrogen N	- / 3	Mixed with 50% pure water

Table 21: Corrosion-inhibiting antifreeze concentrates for battery cooling

7 Liquid Fuels

7.1 Fuels

Diesel fuels

Selecting 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.

In order to achieve optimum engine performance and satisfactory service life for the entire fuel and injection system, the limit values for water, total contamination, and particle distribution must be complied with in the vehicle tank for all approved fuel qualities.

Limit values for water and total contamination

		Test methods		Limit values
		ASTM	ISO	
Water content	Max.	D6304	EN 12937	200 mg/kg
Total contamination	Max.	D6217	EN 12662	24 mg/kg
Particle distribution for fuel in tanks	Max.		ISO 4406	ISO classes 18/17/14

We urgently recommend integrating an additional filtering system in the fuel system.

Important
The use of fuels which have not been approved can lead to considerable deviations from the specified engine power and to severe engine damage. Rolls-Royce Solutions must be consulted prior to using non-approved fuels! If fuels which have not been approved are used, shorter oil change intervals are to be expected. Prior to using non-approved fuels, contact Rolls-Royce Solutions to determine the applicable oil change intervals. Operating the engines with biodiesel/FAME according to DIN EN 14214[1)] curtails the oil change intervals, see “Engine oil and maintenance” (→ Page 47). Dispose of used fluids and lubricants in accordance with local regulations!

[1)] = Latest edition

Requirements

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

Distillate fuels

	Diesel fuel according to DIN EN 5901[1)]	ASTM D975[1)] Grade 2-D		BS 2869:2017 Part 1 Class A2	EN 15940 [2)]
		S15	S500		
Euro 3	Approval granted	Approval granted	Approval granted	Approval granted	Approval not granted
Up to EU Stage IIIA / EPA Tier 3	Approval granted	Approval granted	Conditional approval [3)]	Approval granted	Approval granted

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	Diesel fuel according to DIN EN 5901[1]	ASTM D975[1] Grade 2-D		BS 2869:2017 Part 1 Class A2	EN 15940 [2]
		S15	S500		
From EU Stage IIIB / EPA Tier 4i	Approval granted	Approval granted	Conditional approval [3]	Approval granted	Approval not granted
EU Stage V	Approval granted	Approval granted	Conditional approval [3]	Approval granted	Approval granted

[1] = Latest edition

[2] = Increased additional volumetric consumption or marginal power loss due to reduced density possible.

[3] = Note on D975 Grade 2 with high sulfur content, S500:
- Curtails the maintenance intervals of all oil changes by a factor of 2-3 and increases wear, adapted oil grades required.
- Increases particulate emissions significantly from the certification limit.
- Operation therefore only admissible in regions which permit such levels.

Biodiesel

The standardized general term “FAME” (Fatty Acid Methyl Ester) is used here to designate biodiesel fuels.

Important
The basic configuration of the PowerPack is not equipped with a fuel system suitable for FAME. Before using biodiesel (FAME) fuels or diesel fuels with a FAME content exceeding the limit values of DIN EN 590[1], the fuel system of the PowerPack must be modified! Consultation with Rolls-Royce Solutions is mandatory! The use of diesel fuels with a FAME content according to DIN EN 590[1] does not present a problem. This fuel has no influence on the oil change intervals. Consult Rolls-Royce Solutions if the FAME content is higher.

[1] = Latest edition

Approval/requirements for the engine/PowerPack for operation with 100% FAME – generally not admissible for EU Stage IIIB engines and higher

Engine/Series	Approval/requirements
PowerPack 6H 1800 Euro 3 / EU Stage IIIA	Only with optional equipment for Euro 3
Engine 6H 1800 Euro 3 / EU Stage IIIA	Approved as from series production

Fuel (FAME)

- The fuel must comply with DIN EN 14214[1]. Operation with fuels of lower quality can lead to damage and malfunctions.
- Either FAME or diesel fuel can be used. The various mixtures of FAME and normal diesel fuel which can occur in the vehicle tank as a result, present no problem.

[1] = Latest edition

Engine oil and servicing

- 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 can 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 460/1800, special equipment is available which facilitates an extension in the engine oil change intervals for operation with 100% FAME. For this application, the engines must be fitted with special equipment, i.e. special unit pumps and a fuel prefilter with heated water separator on the frame.

Engine version	Engine oil change interval
Engines not fitted with special equipment for operation with FAME.	Reduction of the engine oil change interval to 30% of the operating hours.
Engines with special equipment: • Special unit pump • Fuel prefilter with heated water separator on the vehicle frame	Reduction of the engine oil change interval to 50% of the operating hours.

Important

The relevant engine oil change and filter replacement 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.
- Fuel and engine oil must be changed approximately 25 operating hours after conversion to FAME due to the danger of blockage caused by loosened deposits (FAME has a pronounced cleaning effect).
- Over longer periods, fuel filter service life can 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.

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 diesel fuel (without FAME).

General notes

- 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, can be perceived as unpleasant. The nuisance caused by smell can be reduced by an oxidation catalyst which can be installed by the vehicle/equipment manufacturers at their own risk.

Important

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.

Vegetable oils as an alternative to diesel fuel

Important

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)!

Low-sulfur diesel fuels

Sulfur is contained in chemically bound form in crude oil and is therefore present in fuel at varying levels.

A sulfur content of max. 50 mg/kg or 10 mg/kg (depending on category) has been a European Union requirement since January 1, 2005. The term “sulfur-free” is used here to designate diesel fuels with a sulfur content of max. 10 mg/kg. Low-sulfur diesel fuels (max. 50 mg/kg) are to be recommended for environmental reasons. In order to avoid problems with wear, lubricity additives, among other things, are added by the manufacturer.

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 must be used.

Flow improvers

Flow improvers cannot prevent paraffin precipitation but they do influence the size of the crystals and 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 analyses of the filtering capability.

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

Microorganisms in fuel

Bacterial attack and sludge formation can 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.

For prophylactic use, the appropriate concentration must be identified in consultation with the relevant manufacturer.

Approved biocides

Manufacturer	Brand name	Concentration for use
Schülke und Mayr 22840 Norderstedt Tel. +49 (0) 40/52100-00 Fax. +49 (0) 40/52100-244	Grota MAR 71	0.5 l / ton

8 NOx Reducing Agent AUS 32 for SCR Exhaust Gas Aftertreatment Systems

8.1 General

SCR (Selective Catalytic Reduction) catalysts can be used to reduce NO_x emissions. The reducing agent (aqueous urea solution (reducing agent with a concentration of 32.5% urea)) in such catalysts reduces the nitrogen oxide emissions.

In addition to ensuring compliance with exhaust emission requirements, reducing agents are used to safeguard the functionality of the exhaust gas aftertreatment system throughout its useful life. The reason for this is that the reducing agent is used to cool some of the component parts of the exhaust gas aftertreatment system (e.g. the reducing agent dosing units). Furthermore, some of the component parts of the exhaust gas aftertreatment system (e.g. the reducing agent supply units) can become clogged and damaged as a result of crystallization. Basically, the exhaust gas aftertreatment system can only be operated with a sufficient quantity of reducing agent filled in the reducing agent tank. To avoid damaging the system, only downtimes lasting less than < 24 h are acceptable from a technical point of view. Longer downtimes > 24 h without using reducing agent will damage the component parts of the exhaust gas aftertreatment system.

To ensure efficient operation of the exhaust gas aftertreatment system, the reducing agent must comply with the quality requirements stipulated in DIN 70070 / ISO 22241-1.

In Europe, this reducing agent is often offered under the brand name “AdBlue”.

The testing procedures to determine the quality and characteristics of the reducing agent are specified in the standards DIN 70071 / ISO 22241-2.

Important

SCR systems from Rolls-Royce Solutions are designed for a concentration of 32.5% urea. The use of NOx reducing agents with other concentrations of urea (AUS 40, AUS 48) is not approved!
The use of antifreeze additives for AUS 32, or winter urea, is generally not approved!

8.2 Reducing agent storage

For instructions on storage, packing, and transport, refer to the ISO 22241-3 standard. The instructions of the manufacturer must be observed.

Storage temperatures according to ISO 22241-3: max. 30 °C, min. -5 °C

The reducing agent crystallizes at -11 °C.

Avoid direct sunlight because it promotes the development of microorganisms and decomposition of the reducing agent.

9 Flushing and Cleaning Instructions

9.1 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.

Inadequate water quality or incorrect coolant preparation can also heavily contaminate the system.

If such conditions occur, the coolant circuit must be flushed out with freshwater, repeatedly if necessary.

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

Only clean freshwater (no river or seawater) must be used for flushing.

Only products approved by Rolls-Royce Solutions or corresponding products (→ Page 59) at the specified concentrations can be used for cleaning. The specified cleaning procedure must be complied with.

Immediately after flushing or cleaning, fill the coolant circuits with treated engine coolant as stipulated in these Fluids and Lubricants Specifications (→ Page 27). 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 observed when handling, storing, and disposing of these substances.
These regulations are contained in the manufacturer's instructions, statutory 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 applicable regulations. Rolls-Royce Solutions accepts no responsibility whatsoever for improper or illegal use of the fluids and lubricants or cleaning agents which it has approved.
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 electrical pH value measuring instrument
- Freshwater
- Prepared engine coolant
- Superheated steam
- Compressed air

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9.2 Freshwater requirements for cleaning solutions and flushing water

Important
Only clean, clear water with values in accordance with those in the following table must be used for preparing cleaning solutions. If the limit values for the water are exceeded, hardness or mineral content can be decreased by adding demineralized water. The cleaning agent concentrates used for the preparation of the cleaning solution must not contain more than 100 mg/l chloride and/or 100 mg/l sulfate.

Item	Minimum	Maximum
Total earth alkalines[1)] (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
Total chloride + sulfate ions		200 mg/l
Bacteria		10^3 CFU (colony forming unit)/ml
Fungi, yeasts	Not permitted!	

Table 22: Values for freshwater

[1)] = Common designations for water hardness in various countries: 1 mmol/l = 5.6°d = 100 mg/kg $CaCO_3$

- 1°d = 17.9 mg/kg $CaCO_3$, USA hardness
- 1°d = 1.79° French hardness
- 1°d = 1.25° English hardness

9.3 Coolant Circuits

9.3.1 Engine coolant circuits – Flushing

1. Drain engine coolant.
2. Measure pH value of the freshwater using the mtu test kit or electrical pH value measuring device.
3. Fill coolant circuit with freshwater.

   Important

   Never pour cold water into a hot engine!
   Refer to the Operating Instructions of the engine for additional information.
4. Preheat, start, and run engine until warm.
5. Run engine for approx. 30 minutes at increased speed.
6. Shut down the engine.
7. Take flushing water sample at engine-coolant-sample extraction cock.
8. Drain flushing water.
9. Measure pH value of flushing water sample using the mtu test kit or electrical pH value measuring device and compare with the pH value of the freshwater.
   a) pH value difference < 1: Fill system with treated coolant and start engine.
   b) pH value difference > 1: Fill system with fresh flushing 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 55). The assemblies may also have to be cleaned, see (→ Page 57).

9.3.2 Engine coolant circuits – Cleaning

1. Mix cleaner to the specified concentration with freshwater. Use warm freshwater (45 °C) if the engine is warm.
2. Cleaning agents for coolant circuits are prepared in warm freshwater as a concentrated solution, see (→ Page 59).
3. In the case of powdered products, stir until the cleaning agent is completely dissolved and without sediment.
4. Pour solution together with freshwater into coolant circuit.
5. Start engine and run until warm.
6. Select temperature and duration of residence time according to the specifications of the technical data sheets of the manufacturer.
7. Shut down engine.
8. Drain off cleaning agents and flush the engine coolant circuit with fresh water.
9. Take flushing liquid sample at engine-coolant-sample extraction cock.
10. Measure pH value of flushing liquid sample using the mtu test kit or electrical pH value measuring device and compare with the pH value of the freshwater.
    a) pH value difference **<** 1: Fill system with treated coolant and start engine.
    b) pH value difference **>** 1: Clean assemblies, see (→ Page 57).

Important

Refer to the engine operating instructions for additional information.

9.3.3 Removal of heavy corrosion in coolant circuits using Decorrdal 20-1

1. Drain all coolant from engine coolant circuit.
2. Fill engine coolant circuit with fresh water and flush the cooling system.
3. Drain flush water completely.
4. Fill coolant circuit completely with a water solution containing 10% Decorrdal 20-1.
5. Start engine and run to operating temperature, 20 minutes.
6. Perform cleaning cycle with the engine running, with circulating Decorrdal 20-1, duration: 4 hours.
7. Vent the coolant circuit several times while running the cleaning cycle to ensure complete filling.
8. Allow the engine to cool down to approx. 45 °C.
9. When the temperature reaches 45 °C, drain Decorrdal 20-1.
10. First flushing cycle: Fill the coolant circuit with 10% Glysacorr P113 solution in water immediately after draining the cleaning solution.
11. Operate the engine for 30 minutes, vent the coolant circuit several times.
12. Allow the engine to cool down to 45 °C.
13. Drain the Glysacorr P113 flushing solution completely.
14. Second flushing cycle: Fill coolant circuit again with a fresh water solution containing 10% Glysacorr P113.
15. Operate the engine for 30 minutes, vent the coolant circuit several times.
16. Allow the engine to cool down to 35 °C.
17. Drain the Glysacorr P113 flushing solution completely.
18. Fill engine with coolant.
19. Rust removal is complete.
20. Put engine into operation.

Important

The engine coolant circuit must always be vented properly to ensure complete filling. This applies when filling the engine with water, cleaning agent, corrosion inhibitor and coolant as well as in engine operation with one of the mentioned media.
In zones where air is present, neither rust removal nor preservation take place, and corrosion occurs again.
All crankcase openings, hose connection openings, etc. must be closed immediately if no longer required.
There is a risk of corrosion in the area of the openings.

9.3.4 Cleaning engine coolant circuit assemblies

1. Remove, disassemble and clean assemblies in the engine coolant circuit 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. In case of lime deposits that contain oil and grease, degrease the water side first.
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 59)

Important

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

In order to avoid damage:
Do not use hard or sharp-edged tools (steel brushes, scrapers, etc.) (oxide protective layer).
The pressure of the water jet must not be ≤ 60 bar (to avoid damage, e.g. of the cooler fins).

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 54).
12. Check coolant system for leaks during initial operation of engine.

Important

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

9.3.5 Coolant circuits contaminated with bacteria, fungi or yeast

Disinfection and prevention

Microbiologically contaminated systems:

The disinfecting agent is added to the contaminated coolant.

The prerequisite for effective disinfection of the engine coolant system is that the disinfecting agent has a sufficiently long reaction time and can reach all areas of the cooling system. All external storage tanks and pipes must also be reached by the disinfecting agent.

Dwell time:	Not less than 12 hours
Temperature:	Maximum temperature 55 °C (higher temperatures destroy the disinfecting agent)

Prevention:

If an engine is to be shutdown for a long period, disinfecting agent can be added as a preventive measure. Before the engine is put back into operation, always ensure that the coolant is still in good condition. During return to operation, the coolant containing disinfecting agent can remain in the system and be reused.

The dosing (→ Page 59) and work safety specifications must be strictly observed.

Flushing

When the coolant is drained, the cooling circuit must be flushed with freshwater. The coolant circuit must be flushed as long as visible contamination can be detected and the flushing water has the same pH value as the fresh water used (maximum deviation of pH value < 1).

Refill

Before refilling with coolant, ensure that the cooling system is free of contaminants.

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

9.3.6 Approved cleaning agents

Manufacturer	Product name	Working concentration		Order no.
For coolant systems:				
Kluthe	Hakutex 111 [1, 5)]	2% by volume	Liquid	X00065751
	Decorrdal 20-1 [8)]	10% by volume	Liquid	[7)]
	Hakupur 50-706-3 [4)]	2% by volume	Liquid	X00055629
For cooling circuit assemblies:				
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 [9)]	100% by volume	Liquid	X00070585 (25 kg)
For coolant circuits contaminated with bacteria, fungi or yeast:				
Thor	Acticide MV14[6)]	0.01% by volume	Liquid	X00079756

Table 23: Approved cleaning agents

[1)] For light lime deposits, light corrosion

[2)] For lime deposits containing oil and grease

[3)] Preferred for heavy lime deposits

[4)] For oily and greasy residues. Not suitable for galvanized surfaces

[5)] Bacteria contamination up to 10^4

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

[7)] Not stocked by Rolls-Royce Solutions

[8)] With serious corrosion; not permitted for aluminum materials

[9)] Solvent cold cleaner for oily and greasy residues

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

The cleaning agents are available world-wide through the branches of the manufacturers or their trading partners.

9.4 Cleaning the Product Externally

9.4.1 General information

If, in the course of time, contaminants such as oil deposits and leaves have accumulated on the engine, it can be necessary to clean it. This must be done with due care and only superficially.

Wash-cleaning the engine can – at the worst – have the opposite effect if carried out incorrectly.

Before getting started and using cleaning products, electric components (battery-charging generator, plug connections, ignition cables etc.), and the air intake must be protected with covers to avoid water ingress into the plug connections or combustion chambers, which can cause damage.

Only clean freshwater (no river or seawater) must be used for spray-washing.

All plug connections must be checked and, if necessary, blown out with compressed air after cleaning to avoid misfiring and other electrical problems.

Only products approved by Rolls-Royce Solutions GmbH at the specified concentrations can be used for cleaning. The specified cleaning procedure must be complied with.

Important

Cleaning must be carried out with pressure washers at an operating pressure of ≤ 60 bar to avoid damaging the cooler and the engine. High-pressure cleaners with an operating pressure > 60 bar are not permitted.
After the clean-washing procedure, the equipment must be thoroughly rinsed with freshwater. The specifications in chapter 9.2 “Freshwater requirements for cleaning solutions and flushing water” apply (→ Page 53).
The technical data sheets and safety data sheets of the product must be observed!
Fluids and lubricants (e.g. treated engine coolant), used flushing water, cleaning agents, and cleaning solutions can be hazardous materials. Certain regulations must be observed when handling, storing, and disposing of these substances.
These regulations are contained in the manufacturer's instructions, statutory 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 applicable regulations. Rolls-Royce Solutions GmbH accepts no responsibility whatsoever for improper or illegal use of the fluids and lubricants or cleaning agents which it has approved.

Test equipment, auxiliary materials, and fluids and lubricants

mtu test kit or electrical pH value measuring instrument

- Freshwater
- Superheated steam
- Compressed air

9.4.2 Approved cleaning agents

Manufacturer	Product name	Working concentration		Order no.
For remote cooler on air side:				
Kluthe GmbH	Hakupur 50 K [1)]	0.5% by volume - 5% by volume	Liquid	X00070940[2)]
For cleaning painted, contaminated surfaces externally:				
Kluthe GmbH	Hakupur 449 [3)]	1% by volume	Liquid	X00071179[2)]

Table 24: Approved cleaning agents

[1)] Cleaning agent for cleaning with pressure cleaner (parameters: Pressure: ≤ 60 bar, gentle spray jet, distance from nozzle to object at least 25 cm, cleaning agent temperature: 80 °C).

[2)] Not stocked by Rolls-Royce Solutions.

[3)] The cleaner is unsuitable for components made of aluminum materials (e.g. Al coolers) and must not be used.

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

The cleaning agents are available world-wide through the branches of the manufacturers or their trading partners.

10 Revision Overview

10.1 Revision overview from version A001062/03 to A001062/04

General

This publication applies to Series 1800 PowerPacks only.

All the relevant information on other mtu Series and mtu-DD Series S60 can be found in the Fluids and Lubricants Specifications for the respective engine models which you can find here:

www.mtu-solutions.com

Changes

Seq. no.	Page	Subject	Action	Measure
0	1-xx	Structure	Updated	-

11 Appendix

11.1 Index