



Preservation and Represervation Specifications

Gas engine-generator sets
Series 500

A001074/00E



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1 Preface

1.1 Notes on the validity and use of the Preservation and Represervation Specifications

Validity of the Preservation Specifications

These Preservation Specifications define the media for preservation/represervation (preservatives) and the guidelines for depreservation and packaging of gas engine-generator sets with Series 500 engines from Rolls-Royce Solutions.

The Preservation Specifications apply to the following products:

- Gas engine-generator sets with Series 500 engines from Rolls-Royce Solutions
 - Gas engine-generator sets stored in reserve
 - Installed gas engine-generator set that have not yet been put into service
 - Gas engine-generator sets in the field with long out-of-service-periods, e.g. normal operational interruptions, out-of-service periods for scheduled maintenance or unscheduled repair work

The preservation / represervation scope is the same for all gas engine-generator sets.

When preserving complete engine-generator sets, the preservation specifications of component manufacturers, e.g. of the generator, must also be observed.

In addition to these Preservation and Represervation Specifications, the respective documentation of gas engine-generator set must also be observed. Work and tests during an interruption of operation and prior to a renewed startup are to be performed according to this documentation.

Other applicable documents

- Documentation of the gas engine-generator set
- Safety data sheets for preservation media
- Current Fluids and Lubricants Specifications

Applicability of this publication

The Preservation and Represervation Specifications are modified or supplemented as required. Before using them, make sure you have the latest version. Before using them, contact Service to make sure you have the latest version of this publication (publication number A001074/..).

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

Warranty

Use of the approved preservatives, 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 preservatives is responsible for the worldwide standard quality of the named products. Rolls-Royce Solutions accepts no liability whatsoever for improper or illegal use of the preservatives which it has approved. Users of the products named in these specifications are therefore obliged to inform themselves of the locally valid regulations.

Important

As the represervation intervals and the medium also depend on the storage conditions and type of packaging, the warranty shall become invalid in the event of incorrect storage or packaging.

These regulations are derived from the manufacturers' specifications, statutory regulations 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 preservatives is therefore not possible within this publication.

Users of the products named in these Fluids and Lubricants Specifications are therefore obliged to inform themselves of the locally valid regulations. Rolls-Royce Solutions accepts no liability whatsoever for improper or illegal use of the preservatives which it has approved.

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.

Registered trademarks

All brand names are registered trademarks of the manufacturer concerned.

1.2 Safety instructions for handling preservatives

Important

Preservatives for drive systems can be inherently dangerous. Certain regulations must be observed 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 preservatives 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. Rolls-Royce Solutions accepts no liability whatsoever for improper or illegal use of the preservatives which it has approved.

1.3 Notes on preservation and reprereservation

Preservation

The term "preservation" refers to:

- Initial preservation in the plant
- Preservation of the gas engine-generator set in the field prior to long out-of-service periods

Series 500 gas engine-generator sets are usually provided with initial preservation before leaving the factory. This is generally carried out after factory acceptance.

In the case of scheduled decommissioning or intermediate storage of more than 2 months, Series 500 gas engine-generator sets must be preserved.

Preservation measures are carried out in the same manner as reprereservation. The scope of preservation depends on the duration of the out-of-service period.

In event of extended out-of-service periods, machined, non-protected surfaces, for example cylinder liner running faces, are susceptible to corrosion and must therefore be preserved.

Important

Gas engine-generator set engines that were put out of service for a scheduled major overhaul must be preserved immediately after their last service period.

Important

Coolant circuits must always be preserved after the coolant has been drained. Preservation is not required if the coolant is left in the system.

When gas engine-generator sets are delivered to the operating company, responsibility for preservation and storage, including their monitoring, also passes to the operator.

Preservation must be repeated at regular intervals (reprereservation).

Reprereservation

"Reprereservation" refers to the renewal of already existing preservation at specified time intervals.

The intervals differ for internal and external preservation and – for internal preservation – according to the different media (oil, fuel, coolant) and filling levels. For reprereservation intervals, refer to (→ Page 18) and (→ Page 23)

Important

As the reprereservation intervals and the medium also depend on the storage conditions and type of packaging, the warranty shall become invalid in the event of incorrect storage or packaging.

For storage conditions and packaging types, see (→ Page 22), (→ Page 33).

Preservatives

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

For preservation and reprereservation of the gas engine-generator sets, only the preservatives approved in these Preservation and Reprereservation Specifications must be used (→ Page 12).

Documentation requirements

Preservation, represervation, depreservation, storage and transport must be documented by persons carrying out the work:

- Checklist for preservation of the gas engine-generator set (→ Page 9)
- Checklist for represervation of the gas engine-generator set (→ Page 9)
- Checklist for storage and transport
- Instruction sheet for depreservation if climate-compatible packaging is used (→ Page 32)
- Monitoring Sheet for products with climate-compatible packaging (→ Page 38)

The following details are mandatory and must be documented regularly:

- Photos of the preservation:
 - Initial preservation
 - Covering of all openings
 - Packaging and securing of peripheral plant components
- Date of preservation and represervation
- Date of further tasks:
 - Barring of engine and generator
 - Check of the covers
 - Check of the storage conditions

2 Check Sheets for Preservation and Re Preservation

2.1 Check sheet for preservation and re preservation of Series 500 engine-generator sets

Important

All preservation work that is performed must be recorded on the check sheet shown below. For engines stored with a manufacturer guarantee, the Monitoring Sheet (→ Page 38) must also be filled out and sent back to Rolls-Royce Solutions in due time before putting the engine back into operation.

Correct completion of the preservation tasks as specified in the preservation specifications must be confirmed on this check sheet by the person completing the various tasks.

Model designation of the engine-generator set:	Number of the engine-generator set:	Acceptance date:

Tasks performed	Date	Name
Engine crank chamber/oil chamber <ul style="list-style-type: none"> • Drain engine oil • Preservative sprayed in via oil filler neck • Openings sealed off 		
Gas system <ul style="list-style-type: none"> • Flush with inert gas if necessary • Cover such that the gas system is protected against dust and other environmental influences 		
Coolant circuit, filled <ul style="list-style-type: none"> • Operated with corrosion inhibitors approved in the Fluids and Lubricants Specifications and vented • Coolant not drained • Coolant brand used: 		
Coolant circuit, unfilled <ul style="list-style-type: none"> • Operated with corrosion inhibitors approved in the Fluids and Lubricants Specifications • Corrosion inhibitor is drained, connections sealed • Corrosion inhibitor used: 		
Combustion chamber/valve cover chamber <ul style="list-style-type: none"> • Preserved with preserving agent. • Oil brand used: 		

Tasks performed	Date	Name
<p>Electrical parts</p> <ul style="list-style-type: none"> • All components with external power supply are de-energized. This applies, for example, to: <ul style="list-style-type: none"> – Battery charger – Control panel – Circuit breakers – spring is released – Automatic transfer switch – spring is released – Components of fuel and cooling systems • Starter batteries are disconnected and dismantled. • If necessary, packed with foil to protect against environmental influences. 		
<p>Non-painted parts</p> <ul style="list-style-type: none"> • Unpainted bare parts, such as flywheel, starter ring gear, starter pinion, bare connections of electrical components are treated with corrosion inhibitor. • Corrosion inhibitor used: • Unpainted flanges, shafts, driver disks and connections on the generator are treated with corrosion inhibitor. • Corrosion inhibitor used for generator: 		
<p>Miscellaneous</p> <ul style="list-style-type: none"> • Connections/openings are sealed according to the specifications. • Generator bearings are lubricated. • Lubricating grease used: 		
Engine-generator set is preserved according to specifications.		
Photo documentation		
Represervation performed according to specifications.		

Further procedure

1. After completing preservation work, put the completed check sheet into a closed plastic sleeve.
2. Seal the sleeve at the open side and attach it to the engine-generator set so that it is clearly visible.
3. Store the check sheet until depreservation beside the engine and send back to Rolls-Royce Solutions in good time before initial operation.

2.2 Check sheet for check of preservation/storage

Correct inspection of the preservation/storage with the described tasks must be confirmed on this check sheet by the person completing the various tasks.

Plant ID number		Yes	No	Date	Carried out by
Photo documentation					
Visual inspection: Foil, cover in good condition					
Visual inspection of generator	6				
Rotor of generator turned (every 6 month ¼ rotation)	12				
Regreasable generator bearings greased	18				
	24				
Generator maintenance after 3 years					
Engine inspection Combustion chambers in good condition? If not: Also send photos to Rolls-Royce Solutions Represervation of the combustion chambers after 12 months (earlier if necessary if storage conditions are poor)					

Further procedure

1. After completing preservation work, put the completed check sheet into a closed plastic sleeve.
2. Seal the sleeve at the open side and attach it to the engine-generator set so that it is clearly visible.
3. Store the check sheet until depreservation beside the engine and send back to Rolls-Royce Solutions in good time before initial operation.

3 Approved Preservatives

3.1 Preservatives – Requirements

These Preservation and Represervation Specifications define the preservatives for the preservation and represervation of Series 500 engine-generator sets from Rolls-Royce Solutions.

For preservation and represervation of engines, only the preservatives approved in these preservation specifications must be used.

For different operating area, distinctions are made in each case:

- Corrosion inhibitors for internal preservation of the coolant circuit
- Corrosion inhibitor for the preservation of the combustion chamber/oil chamber
- Corrosion inhibitors for external preservation

Note on initial operation

Before commissioning of the gas engine-generator set, it has to be depreserved (→ Page 32).

3.2 Corrosion Inhibitor for Internal Preservation

3.2.1 Corrosion inhibitors for oil chamber and combustion chamber

The media in the table below, with one exception, are suitable for internal preservation of the oil chamber as well as preservation of the combustion chamber.

Manufacturer	Brand name	Material number	Remarks
Hermann Bantleon GmbH (Avia)	AVILUB VCI 1410	X00083394	1 l can Protection for Fe and non-Fe metal against corrosive influences. The effective period in closed systems, depending on stress, 2 to 3 years.

Table 1: Corrosion inhibitors for the oil circuit and the combustion chamber of diesel and gas engines

Volumes of corrosion inhibitor

Engine model	Total volume	Per combustion chamber	Per valve cover chamber	Intake pipe	Remainder in oil pan
6 cylinders	175 ml	3 ml (6x)	2 ml (6x)	2 ml	approx. 143 ml
8 cylinders	250 ml	3 ml (8x)	2 ml (8x)	2 ml	approx. 208 ml
12 cylinders	500 ml	3 ml (12x)	2 ml (12x)	2 ml	approx. 438 ml

Spray in combustion chamber using disposable injector with PVC hose, 3 ml per combustion chamber.

The volume of corrosion inhibitor in the valve cover chamber is 2 ml.

The remaining corrosion inhibitor (volume of the oil chamber preservative) is sprayed via the oil filler neck into the oil pan. Engine oil must be drained beforehand.

Intake pipe after air filter: 2 ml.

3.2.2 Coolant circuits with and without corrosion inhibitor

State	Corrosion inhibitor	Remarks	Suitability for engine preservation	
			Filled	Unfilled
Filled	All corrosion inhibitors approved for the respective series in accordance with the applicable Fluids and Lubricants Specifications	The engine can then be operated with this engine coolant. Precondition: <ul style="list-style-type: none"> • Corrosion inhibitor is approved for engine operation • Shelf life not expired 	x Vented	-
Unfilled	Unfilled/sealed	For transport and storage	-	x Sealed

x suitable for engine preservation
- unsuitable for engine preservation

Table 2: Coolant circuits with and without corrosion inhibitor on Series 500 gas engines

Important
<p>The coolant circuit is drained and closed after factory acceptance. If the engine-generator set is taken out of service for a long period, ensure that the coolant circuits are kept either filled and vented or completely drained and sealed.</p> <p>The coolant circuits must be drained prior to transport of the engine-generator set.</p>

3.2.3 Corrosion inhibitor for the fuel system

Gas engines (natural gas and biogas)

When the engine is shut down, it can be assumed that the entire fuel system is filled with air only. If, however, there are still small amounts of gas in the engine, they do not have a corrosive effect. Preservation is therefore not required.

Before place in storage, the gas system of the gas engine-generator set must be flushed with inert gas.

However, you should ensure that there is no moisture between mixture cooler and cylinder head. If moisture is detected, the engine must be run 2 to 3 hours in partial load.

The approved gases are listed in the current Fluids and Lubricants Specifications.

3.3 Corrosion inhibitors for external preservation

When preserving the engine exterior shell, all non-painted parts must be treated with a corrosion inhibitor. This forms a waxy protective coating after the solvent has evaporated.

Manufacturer	Brand name	Material number	Remarks
BALLISTOL GmbH	Universal oil	X00075700	Waxy protective coating

Table 3: Corrosion inhibitors for external preservation of the engine

Represervation requirement

- See Represervation intervals (→ Page 18), (→ Page 23).
- Parts to be treated, see (→ Page 25).

3.4 Corrosion inhibitor for non-engine components

Manufacturer	Brand name	Material number	Remarks
ExxonMobil	Unirex™ N 3	40330/1	For regreasable generator bearings

Represervation requirement

- All generator types must be barred every 6 months (→ Page 23). On this occasion, the lubrication of the bearings should be checked and regreased with lubrication grease if necessary.

4 Represervation Intervals

4.1 Engine-generator set – Represervation intervals

The performance of represervation must always be documented in the check sheets and the product history.

Notes:

- If the engine-generator set is not operated for a long period, preservation must be repeated after two years at the latest.
- Under extreme weather conditions, in particular, the repetition rate may have to be increased upon consultation with Rolls-Royce Solutions.
- For peripheral components, check whether the relevant manufacturers prescribe a shortened preservation period. Manufacturer's specifications always have priority over the specifications in the Operating Instructions from Rolls-Royce Solutions.
- Climate-compatible packaging is not permissible with filled media circuits.
- Prior to putting the engine into operation, an oil switch to an oil approved as per the Fluids and Lubricants Specifications must be made.
- For definition of storage conditions and packaging types, see the corresponding chapters.

Storage conditions

The preservation measures depend on the storage conditions. A distinction is made between the following storage conditions:

Storage conditions	Operating areas
Normal storage conditions	<p>Requirements of the rooms:</p> <ul style="list-style-type: none"> • Frost-free, closed and heated rooms, clean (no contamination, tire-wear particles, road salt, grit, sand, etc.) • Dry room climate, monthly average air humidity < 60%, frost-free, heated if necessary. • Closed hall. Windows and gates/doors are closed. They must not be permanently opened. <p>Storage conditions:</p> <ul style="list-style-type: none"> • Room between temperature +10 °C and +40 °C, low fluctuations, temperatures outside this range are not permitted. • Dew point is not undershot – i.e. no high temperature fluctuations within a short time. • Monthly average relative air humidity ≤ 65% • Keep room air free of substances that attack materials, e.g. hygroscopic materials, aggressive vapors such as ammonia. • No contamination by corrosive substances, such as sulfur dioxide and/or chlorides. • Keep storage room free of vermin, such as rodents (prevents damage to hoses and cables).
Difficult storage conditions	<p>Requirements of the rooms:</p> <ul style="list-style-type: none"> • Clean (no contamination, tire-wear particles, road salt, grit, sand, etc.). • Dry, frost-free. • The building can be open on one side. The open side must not face the cardinal direction from which the most severe weather is to be expected. Windows or doors can be opened. • Also in a hall with one side open, or with opened windows or doors, the stored items must not be exposed directly to the weather, e.g. solar radiation, rain, snow or dust. <p>Storage conditions:</p> <ul style="list-style-type: none"> • Monthly average relative air humidity > 65%. • Room temperature ≥ +10 °C to ≤ +40 °C (temperatures outside this range are not permitted). • Dew point is not undershot – i.e. no high temperature fluctuations within a short time.
Unsuitable, impermissible storage conditions	<ul style="list-style-type: none"> • In general, if the criteria named under normal and difficult storage conditions are not met. • Storage out of doors is not permitted.

The aim should always be storage under normal storage conditions.

Notes:

- Goods must not be stored in the direct vicinity of heaters or other heat radiation sources. This applies, in particular, to elastomers and components that contain elastomers.
- There must be no strong vibrations at the storage location.
- In all storage locations and in all storage rooms: Continuous monitoring, recording and saving of temperature and air humidity at intervals of 60 minutes.
- Storage of the data for at least 36 months.

Service lives of the preservation

A distinction is made between 2 cases for preservation:

- Case A: Preservation after completion of the factory test run
- Case B: Preservation after shutdown of a plant in operation

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Case A: Factory preservation	
Storage conditions	Service life Engine-generator set/combustion chamber
Normal	24/12 months
Difficult	12/12 months

The preservation measures in case B are necessary when the service interruption of the engines and modules/engine-generator sets exceeds the periods specified in the table.

Case B: Preservation after shutdown from operation (taking out of operation)		
Storage conditions	Service interruptions	Service life
Normal	> 2 months	12 months
Difficult	> 1 month	6 months

Represervation intervals, case A and case B

Represervation is carried out after the service lives listed in the tables for case A and case B have elapsed.

Represervation intervals	
Storage conditions	Represervation interval
Normal	12 months
Difficult	6 months

Packaging and represervation intervals

Packaging	Represervation intervals in months Applicable to filled and unfilled medium circuits: Oil, fuel, coolant Combustion chamber, external preservation			Difficult storage conditions
	Normal storage conditions			
	Combustion chamber	Engine-generator set	Outside	
Transport packaging, commercially available, for surface transport	12	24	Check every 6 months. Result: OK, no corrosion: In this case, a further 6 months of storage are permitted.	Storage under difficult conditions in this type of transport packaging is not permitted .
Transport packaging, sea transport, light	12	24	After a total of 24 months, represervation is mandatory. Result: Not OK, corrosion: In this case, remove corrosion. If necessary, touch up the paintwork. Represervation is mandatory.	
Climate-compatible packaging in container	Every 12 months			

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Packaging	Represervation intervals in months Applicable to filled and unfilled medium circuits: Oil, fuel, coolant Combustion chamber, external preservation
Climate-compatible packaging in heavy-cargo box	Every 12 months
Long-term climate-compatible packaging in heavy-cargo box	Every 24 months

4.2 Dependency between storage conditions and type of packaging

Products preserved in the factory must be represerved to retain the corrosion protection. Only approved preservatives must be used for represervation (→ Page 12).

The represervation intervals depend on the storage conditions and type of packaging.

Storage and storage location conditions

The point in time at which the storage time and the period up to the first represervation starts is the day on which the products leave the production plant. This applies to all types of packaging and storage conditions.

A distinction is made between the following storage conditions:

- Normal storage conditions
- Difficult storage conditions
- Unsuitable, impermissible storage conditions

Types of packaging

- Transport packaging, commercially available, surface transport
- Transport packaging, seaborne, light
- Climate-compatible packaging in containers or heavy-cargo box
- Long-term climate-compatible packaging in heavy-cargo box

Products with light commercially available transport packaging for surface or sea transport are intended for immediate use and must not be stored longer than 6 months. Represervation within this period is not required.

Important:

For information on packaging types and storage conditions, see (→ Page 33).

4.3 Represervation intervals for non-engine components

The represervation intervals for non-engine components depend on the manufacturer and type and apply to storage under the recommended storage conditions.

Generator

Manufacturer/type	Represervation interval	Recommended storage conditions
Leroy Somer (with gas engine-generator sets)	Every 6 months	<ul style="list-style-type: none"> • Clean, dry area in a closed room with no rapid changes in temperature and air humidity to prevent condensation. • Room heating elements are required in unheated or damp areas • Keep covered. • Unpainted flanges, shafts, driver disks and fittings with are treated with corrosion inhibitor. <p>The following measures must be carried out for all generators that have been out of service for longer than six months:</p> <ul style="list-style-type: none"> • Lubricate the bearings of the stationary generator with double the quantity of lubricant required during standard servicing. • Turn the shafting a few revolutions every 6 months. Then apply a quantity of lubricant that corresponds to standard servicing.

Starter battery

Manufacturer/type	Represervation interval	Recommended storage conditions
Exide	Every 6 months	<ul style="list-style-type: none"> • Clean, dry area in a closed room • 5 °C to 25 °C • Disconnected and removed
Panther	Every 6 months	<ul style="list-style-type: none"> • Clean, dry area in a closed room • 5 °C to 25 °C • Disconnected and removed
Varta	Every 12 months	<ul style="list-style-type: none"> • Clean, dry area in a closed room • 5 °C to 25 °C • Disconnected and removed
Optima	Every 6 months	<ul style="list-style-type: none"> • Clean, dry area in a closed room • 5 °C to 25 °C • Disconnected and removed

5 Preservation and Represervation

5.1 Preface

This chapter applies to the preservation of gas engines or gas engine-generator sets of the 500 Series.

A distinction is made between the following 3 designs of gas engine-generator sets:

- GC (Genset Combined): Gas engine-generator set with heat recovery and integrated exhaust gas heat exchanger
- GR (Genset Reduced): Gas Engine-Generator Set with Heat Recovery
- GB (Genset Basic): Gas Engine-Generator Set without Heat Recovery

For the measures, a distinction is made between:

- Preservation:
Preservation is carried out after the factory test run at Rolls-Royce Solutions (case A) and before long service interruptions (case B), also refer to Service life of the preservation (→ Page 18).
- Represervation:
When the service life of the preservation has elapsed, carry out represervation at appropriate intervals.
- Return to operation

5.2 Service interruption of engine-generator set for more than two months

- Note:
- Preservation of the engines according to the points listed below is always necessary if the engine is to be taken out of service for a long period. Rolls-Royce Solutions prescribes preservation if the engine is not expected to be operated within two months at least once for a period of six hours at full load without interruption. Furthermore, Rolls-Royce Solutions also recommends preservation for shorter out-of-service periods from a few weeks. As Rolls-Royce Solutions has no influence on the method of operation of the engine-generator set, it is the responsibility of the plant operator to carry out the preservation work and document it.
 - Engine components: Represervation takes place according to the specified represervation intervals depending on the storage conditions (→ Page 18).
 - Non-engine components: Represervation takes place according to the specified represervation intervals depending on the storage conditions (→ Page 23).
 - All fluids and lubricants remain in the gas engine-generator set.
The oil should be drained as completely as possible for long out-of-service periods. Seal openings on the oil side tightly with plastic caps.
 - The engine-generator set is empty when transported.
 - If there is a danger of frost: Coolant with antifreeze in acc. with the Fluids and Lubricants Specifications. Drain and seal off heating water.
 - To protect the coolant cooler during the out-of-service time, add coolant until the coolant level exceeds the filler neck base.
 - If a different corrosion inhibitor is used, it must be flushed before returning to operation and replaced with an approved coolant. For coolant additives approved for operation, see (→ Fluids and Lubricants Specifications for gas engine-generator sets).
 - Document the scope of preservation, see (→ Page 9)

Preservation	Preservation procedure
Preparations/preconditions	<ol style="list-style-type: none"> 1. Operation has been carried out with the prescribed coolant (mixture of water and corrosion inhibitor/antifreeze). 2. Run the engine-generator set/module to warm it up and shut down with dry exhaust gas heat exchanger
Crank chamber and oil chamber	<ul style="list-style-type: none"> • Drain the oil as completely as possible. • To keep the oil circuit protected against corrosion, seal all openings on the oil side tightly with plastic caps.
Combustion chamber	<ul style="list-style-type: none"> • Remove spark plugs. • Bar engine once manually and completely (two rotations). • At each cylinder, spray approx. 2 to 3 ml preservative (specific for Series 500) into the combustion chamber. • Seal combustion chamber with the spark plug or, ideally, with a suitable plug. • Spray in preservative with a PVC hose or a disposable injector.
Valve cover chamber	<ul style="list-style-type: none"> • Spray in 2 ml preservative.
Switchgear	<ul style="list-style-type: none"> • Insulate lines. • Avoid open contact points. • Protect control cabinet additionally with a foil if necessary. • If the storage conditions can not be met, introduce additional measures to protect the sensitive electronics of the switchgear. • During de-commissioning, ensure that the switchgear is de-energized and correctly disconnected from the power supply. • Do not disassemble optional control cabinet air-conditioning units. They must remain installed in an upright position on the control cabinet.

Preservation	Preservation procedure
Oil storage tanks	For storage of the engine oil, the safety data sheet of the relevant oil grade must always be observed.
Interfaces	Seal all connections/openings tightly.
Coolant circuits	<ul style="list-style-type: none"> • Coolant circuits are either filled and vented or completely drained and sealed. • The coolant circuits must be drained prior to transport.
Heating circuits (heating water system)	<ul style="list-style-type: none"> • Heating circuit is either filled and vented or completely drained and sealed. • The heating circuit must be drained prior to transport.
Gas system	<ul style="list-style-type: none"> • Flush with inert gas prior to placement in storage • Cover such that the gas system is protected against dust and other environmental influences.
Air intake system	<ul style="list-style-type: none"> • Remove air filter from engine and wrap in PE foil. • Spray approx. 2 ml preservative into the intake air system and seal the opening with plastic caps or tear-resistant foil.
Exhaust system	<ul style="list-style-type: none"> • For long periods out of service, the exhaust gas interface between engine-generator set and customer-provided exhaust system must be separated by a blanking plate and sealed off. • Prior to transport, the exhaust gas interface of the engine-generator set must be sealed. • Ensure that no water from the outside can accumulate in the exhaust system.
Batteries	<ul style="list-style-type: none"> • Disconnect the plug connection for the battery to prevent discharging of the battery. • Charge completely every 6 months to prevent total discharge and permanent damage to the battery.
External preservation	Spray metallically bright surfaces with exterior preservative.
Engine-generator set	Covered with foil.

5.3 Non-engine components – Service interruption of more than 2 months

- Note:
- Represervation takes place according to the specified represervation intervals depending on the storage conditions (→ Page 23).
 - All fluids and lubricants remain in the gas engine-generator set.
The oil should be drained as completely as possible for long out-of-service periods. Seal openings on the oil side tightly with plastic caps.
 - If there is a danger of frost: Coolant with antifreeze in acc. with the Fluids and Lubricants Specifications. Drain and seal off heating water.
 - To protect the coolant cooler during the out-of-service time, add coolant until the coolant level exceeds the filler neck base.
 - Before putting the gas engine-generator set into operation, ensure that a switch has been made to an approved coolant if necessary. For coolant additives approved for operation, see (→ Fluids and Lubricants Specifications for gas engine-generator sets).

Preservation	Preservation procedure
Pumps	<ol style="list-style-type: none"> 1. Do not drain media circuits. 2. To prevent frost damage, fill coolant circuits with a sufficient amount of water-glycol mixture. 3. Circulate the water/antifreeze volume several times in the circuit so that the complete circuit is flushed. 4. To prevent the rotary seals from jamming, put the pumps into operation once a month with the system filled.
Piping	When the piping is being drained, provide spare rotary seal and replace prior to putting into operation.
Exhaust gas heat exchanger provided	<ol style="list-style-type: none"> 1. Ensure that all surfaces of the exhaust gas heat exchanger are protected against contamination and are stored in a dry place to prevent corrosion damage. 2. Drain fluids and lubricants from the coolant circuit and flush it if necessary to remove residual coolant.
Gas train	<p>Ensure that components of the gas train are always stored in a temperature range from +10 °C to +40 °C. Seal openings airtight. With viton diaphragms, the storage temperature is > 0 °C.</p>
Catalytic converter	<ol style="list-style-type: none"> 1. Catalytic converters can remain installed for storage. 2. For de-commissioning, the removal of the catalytic converter is recommended: Clean the catalytic converter, cover it with foil and store in a dry place.
Generator	<ol style="list-style-type: none"> 1. Ensure that the generator is protected against moisture (air humidity below 90%), mounted such that it is protected against temperature fluctuations and strong vibrations and that it is barred manually every six months by ¼ rotation. After 3 years of storage, service the generator. 2. Keep regreasable generator bearings lubricated. 3. According to the represervation interval, bar the engine manually to rotate the shaft several turns for distributing the grease in the bearings.
Safety temperature limiter, safety pressure limiter, three-way valve, fire detector, gas detector, expansion tank, safety valve	General information applies.

Preservation	Preservation procedure
Biogas compressor	<ol style="list-style-type: none"> 1. Remove blower at the inlet and outlet from the flange or insert blanking plates. 2. Dry blower and flush with an inert gas. After flushing, ensure that the blower is sealed airtight. 3. Check blower for ease of movement and turn it. <ul style="list-style-type: none"> • With a changing room temperature, once a month • With a constant room temperature, every second month 4. A shutdown may result in overlapping with the maintenance interval for the shaft seals. They should be replaced every 16,000 operating hours or every 2 years to keep the blower gastight.
Neutralization system	<ol style="list-style-type: none"> 1. Clean the neutralization system. 2. Replace used up or missing granulate. 3. Keep flushing until clear water emerges at the outlet of the neutralization system. 4. Store neutralization system after it is cleaned.
Valves and fittings, exhaust flaps, louver dampers	<ol style="list-style-type: none"> 1. Move valves and fittings that remain continuously in the same position three to four times a year. 2. Check servomotors twice a year. 3. In case of a long storage period, check servomotors in the factory prior to operation.
Horizontal-core radiator	As different horizontal-core radiators are installed by Rolls-Royce Solutions, it is essential to refer to the supplier documentation on storage and preservation.

5.4 Special measures during operational interruption

Component	Action
Generator	<p>Bar the generator manually every six months by $\frac{1}{4}$ of a rotation with a suitable barring tool.</p> <ol style="list-style-type: none">1. Apply grease to regreasable bearings.2. Document barring of the generator continuously. <p>Service the generator after 3 years in storage. This prevents damage to the generator.</p>

5.5 Return to operation

Sequence of return to operation

Note: Before returning to operation, check all preservation steps. The following steps, among others, must be carried out prior to return to operation:

1. Clean engine-generator set if necessary.
2. Remove all seals from the engine-generator set.
3. Unpack air filter, assemble it and replace if necessary.
4. Check lines, exhaust gas heat exchanger for rust, slag and contamination.
5. Fill up drained fluids and lubricants according to the Fluids and Lubricants Specifications.
6. Unscrew spark plugs.
7. Bar the engine once manually (with barring tool).
8. Install spark plugs.
9. After a long out-of-service period, or under difficult storage conditions, carry out an insulation measurement of the generator according to the manufacturer's specifications.
10. Visual inspect the operational availability: Remove blanking plate, packaging and connection covers.
11. Mount and connect starter batteries.
12. Check switchgear. Work through the start-up steps (→ Operation and Maintenance Manual).
13. Start engine.
14. Short-term operation until engine is free of preservative oil.
15. Install catalytic converter.

5.6 Re preservation

Note: • Re preservation takes place according specified intervals depending on the storage conditions (→ Page 22).

Sequence of re preservation

1. Remove the catalytic converter from re preservation.
- Result: Catalytic converter is protected against preservative oil.
2. Unscrew spark plugs
3. Carry out combustion chamber preservation according to (→ Page 13). Use Series 500-specific preservative.
4. Screw in spark plugs.
5. Visually check all openings on the engine-generator set for leaks.
6. Replace closures on openings if necessary.

6 Depreservation

6.1 Instruction sheet for de-preservation of mtu products in climate-compatible packaging

Important

Before opening the packaging, please read this instruction sheet and follow the instructions without fail, in particular the notes on when it is necessary to notify Rolls-Royce Solutions.

Instruction sheet for de-preservation of products

1.	Read off the humidity values on the humidity indicator and enter them on the Monitoring Sheet. Humidity indicator (→ Page 35) Monitoring Sheet (→ Page 38) Evaluation: a If all three fields on the humidity indicator show blue, everything is OK. b If fields 30 and 40 have turned partly or completely pink, examine the packaging for damage. If the packaging is damaged, notify Rolls-Royce Solutions. c If all three fields are pink, do not open the packaging material and report to Rolls-Royce Solutions.
2.	If the humidity values are OK and if there are no other visible defects, remove the laminated aluminum foil from the product.
3.	Check product externally when foil has been removed. Enter date and findings of check in Monitoring Sheet.
4.	Visually check all rubber hose connections. The connections must not be brittle or swollen.
5.	In the event of complaints, contact Rolls-Royce Solutions without delay and wait for further messages. In the meantime, do not prepare or modify the engine for installation, but store it so that it is dry and covered.
6.	Enter the date of de-preservation on the Monitoring Sheet.
7.	Do not remove the seals of the engine openings until just prior to use. This relates to: <ul style="list-style-type: none">• Turbocharger inlet• Exhaust manifold outlet• Coolant inlet and outlet• Connecting flanges for vent lines at coolant distribution pipes
8.	For initial operation, please observe the product documentation.

7 Packaging

7.1 Types of packaging

Note:

Protection of the products is only guaranteed if the packaging is not damaged. This applies, in particular, to closed packaging.

Type of packaging	Operating areas
Transport packaging Commercially available, surface transport	<ul style="list-style-type: none"> • Normal storage conditions • For engines and engine-generator sets intended for immediate use • Storage time max. 6 months • Simple, open transport packaging and weather protection for <ul style="list-style-type: none"> – painted engines and engine-generator sets for surface transport in a container and for air cargo
Transport packaging Sea transport, light	<ul style="list-style-type: none"> • Normal storage conditions • For engines and engine-generator sets intended for immediate use • Storage time max. 6 months • Simple, closed transport packaging and weather protection for <ul style="list-style-type: none"> – painted engines and engine-generator sets for sea and surface transport in a container and for air cargo
Climate-compatible packaging (desiccant + humidity incator) in container or heavy-cargo box	<ul style="list-style-type: none"> • Difficult storage conditions • No antifreeze protection • Storage time max. 12 months • Hermetically sealed transport packaging for <ul style="list-style-type: none"> – painted engines and engine-generator sets dispatched per surface transport or sea transport and then stored for a long period • Not for engines with filled medium circuits
Long-term climate-compatible packaging (desiccant + humidity incator) in heavy-cargo box	<ul style="list-style-type: none"> • Difficult storage conditions • No antifreeze protection • Storage time max. 24 months • Hermetically sealed transport packaging for <ul style="list-style-type: none"> – painted engines and engine-generator sets dispatched per surface transport or sea transport and then stored for a long period • Not for engines with filled medium circuits

Notes:

- Ensure that the applied (engine) paintwork has completely hardened prior to this.
- The climate-compatible packaging must be applied directly after preservation.
- If climate-compatible packaging is used, where possible all media (fuel, oil, coolant) should be drained completely out of the respective medium circuit.
- Check the humidity indicator in the packaging every 3 to 4 months. The result must be documented in the Monitoring Sheet and, if necessary, measures initiated (→ Page 38). In case of high moisture levels, the packaging must be checked and replaced if necessary.
- In the case of long-term storage of engines and engine-generator sets, for example, for 3, 5 or 10 years in climate-compatible packaging, regular reprereservation in accordance with the specified intervals is nevertheless necessary (→ Page 18), (→ Page 23).
- Incorrect storage will render the warranty invalid.
- Existing special agreements still retain their validity.
- The customer must provide details on the storage location and planned storage duration. The packaging type is selected on this basis.
- For the customer, the prescribed type of packaging is binding. If the customer insists on a different type of packaging, his attention must be drawn to the fact that the warranty for consequential damage in such a case shall become void.
- The following descriptions refer to the use of climate-compatible packaging for the storage of preserved engines.

7.2 Climate-Compatible Packaging - Check and Monitoring

7.2.1 Humidity indicator

To monitor the degree of saturation of the desiccant, a humidity indicator is attached to the aluminum foil packaging.

Humidity indicators show when the specified relative air humidity is exceeded by changing color. The increase in relative air humidity, e.g. if the packaging is not airtight or the laminated aluminum foil is damaged, poses a risk of corrosion to the engine.

A vision panel with humidity indicator is screwed into the laminated aluminum foil, which must be as far away from the desiccant as possible. The vision panel allows the relative air humidity within the laminated aluminum foil or any changes to be checked at all times.

Example of a humidity indicator



Note:

- The air humidity inside the packaging must be checked regularly every 3 months and documented (Monitoring Sheet for products with climate-compatible packaging).
- Measures to be carried out in case of changes to the relative air humidity are listed in the following table.

Reading the humidity indicator

Area	Discoloration as an indicator of the relative air humidity	Measures to be initiated
30	Pink discoloration: Relative humidity above 30%	<ul style="list-style-type: none"> • Shorten checking period • Check humidity indicator every 4 weeks
40	Pink discoloration: Relative humidity above 40%	<ul style="list-style-type: none"> • Replace desiccant, ensure the same amount is added. • Distribute new desiccant evenly in the packaging area • Extract air from the packaging and reseal laminated foil.
50	Pink discoloration: Relative humidity above 50%	<ul style="list-style-type: none"> • Check packaged products • Re-preserve the engine • Replace desiccant, ensure the same amount is added. • Distribute new desiccant evenly in the packaging area • Extract air from the packaging and reseal laminated foil.

Note:

- The humidity indicator regenerates itself automatically.
- Replacement following opening and sealing of the packaging area is not required.

7.2.2 Climate-compatible packaging – Check and repair

Note: When checking the climate packaging, the laminated aluminum foil must not be damaged. Open the transport box (if available) with utmost care. The condition of the laminated aluminum foil must be inspected thoroughly during customs, stock or storage checks. Protection against corrosion is not guaranteed if the aluminum composite foil is damaged.

Checking the air humidity

1. Check humidity level regularly every 3 months.
2. Enter findings in Monitoring Sheet (→ Page 38). If the engine's warranty period is still valid, send the Monitoring Sheet to Rolls-Royce Solutions.

Replacing desiccant

1. Open the laminated aluminum foil at the upper area and remove the desiccant.
2. Place the same amount of new desiccant in the upper area.
3. Extract air and reseal laminated aluminum foil with manual foil-sealing device until airtight.

Repair of climate-compatible packaging

Note: If the laminated aluminum foil is damaged, the damaged section can be cut out and replaced by a repair piece. Incorrect repair work, e.g. using adhesive tape, is not permitted since it would not maintain the vacuum in the packaging.

1. Cut out damaged laminated aluminum foil section.
2. Seal new laminated aluminum foil section with manual foil-sealing device.
3. Place new desiccant in packaging.
4. Prior to final sealing of the laminated aluminum foil, use a vacuum pump (e.g. vacuum cleaner) to extract the entrapped air in the packaging.
5. Reseal laminated aluminum foil with manual foil-sealing device.

7.2.3 Monitoring Sheet for mtu products with climate-compatible packaging

The following checks are to be made before, during and at the end of the product storage period and correct execution must be confirmed by date and signature.

Note: For new products, the delivery date must always be entered.

Product type:	Product no.:	Delivery date:
Date of scheduled initial operation of product:		

No.	Task	Date	Name
1	Visual inspection of special packaging for damage Relative air humidity: _____ %		
2	Relative air humidity: _____ %		
3	Relative air humidity: _____ %		
4	Relative air humidity: _____ %		
5	Relative air humidity: _____ %		
6	Relative air humidity: _____ %		
7	Relative air humidity: _____ %		
8	Relative air humidity: _____ %		
9	Relative air humidity: _____ %		
10	Relative air humidity: _____ %		
11	Relative air humidity: _____ %		
12	Relative air humidity: _____ %		
13	Inspection of the hygrometer before opening the packaging Relative air humidity: _____ %		
14	De-preservation completed		

No.	Possible necessary correction work (e.g. on the aluminum foil or transport box)	Date of Performance	Name of person responsible
1			
2			
3			
4			
5			

Important note on the warranty period

Important
Notify Rolls-Royce Solutions: <ul style="list-style-type: none"> • if two or all three fields of the humidity indicator are pink • if, during de-preservation of the product, external signs of corrosion or damage to the rubber hose connections are detected • in due time before initial operation of the product

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8 Exhaust aftertreatment system - preservation and re-preservation

8.1 Introduction

This chapter contains information on the preservation of the exhaust aftertreatment system, in this case the SCR system (Selective Catalytic Reduction).

The SCR system consists of:

- A mixing section with injector installed on the engine-generator set
- SCR housing with SCR element and sensor system
- Separate RA dosing system (RA = reducing agent) with SCR control unit, day tank and RA dosing pump

8.2 SCR System

8.2.1 Preservation, re-preservation and return to operation of the SCR system

No preservation measures are required for SCR components not put into operation and packed in the factory; store SCR components in a dry place.

Preservation of the SCR system with de-commissioning

It is important that SCR systems are stored in a dry place and protected against dust and other aggressive substances in the ambient air. Otherwise the honeycombs can be damaged and, when the catalytic converter is returned to operation, it may be unable to reach its full performance level.

Preservation	Preservation procedure
SCR system	<ol style="list-style-type: none"> 1. Completely drain the reducing agent (RA). 2. Flush the SCR system completely with demineralized water to remove residual reducing agent. 3. Ensure that the water is completely drained and that the SCR system is dry and stored protected against dust (see Fluids and Lubricants Specifications of the manufacturer).

The SCR housing does not require preservation and re-preservation.

For the SCR housing and the catalytic converters, it is sufficient during disassembly to seal all openings (flanges of exhaust pipework) to prevent the entry of contamination from the air.

Ideally, installed sensor systems and attachments remain installed in the system structure during long out-of-service periods and are serviced or replaced in accordance with the Maintenance Schedule.

Depending on the application, the system is protected against external influences by suitable packaging material (optional).

Important
The entry of air and contamination into the system that conveys reducing agent leads to the crystallization or encrustation of system-related components which can endanger or impair functioning of the system.

Preservation of components of the SCR system

Preservation	Preservation procedure
Dosing unit	<ol style="list-style-type: none"> 1. Drain RA lines and the RA day tank. 2. Flush with demineralized water and drain again. 3. Disassemble and drain supply unit and line if necessary. If there is no risk of frost, protect the dosing unit with packaging material against external influences.
Storage tank	Drain supply line from supply tank to day tank. Flush with demineralized water and drain again. Disassemble connection and seal to prevent air inclusion.

Re-preservation of SCR system

Check for contamination and impairment.

Replace covers/packaging if necessary.

Return to operation of SCR system

Preconditions for carrying out start-up:

- Before these measures are performed, at least one visual check of the system must be carried out.
- The medium or fluid in the deactivated system is liquid. It must not be frozen. For the temperature of the medium in the tank and the system circuit or the freezing temperature of the medium (→ Manufacturer's specifications or Fluids and Lubricants Specifications).
- The system is self-contained. There are no leaks in the system
- A sufficient amount of suitable brand-new medium or fluid is provided. Fill the tank so that the intake points in the tank are sufficiently covered with reducing agent. Replace unsuitable, old medium.
- Replace the filter units depending on the out-of-service duration in case of contact with reducing agent.

Before returning the SCR system to operation, check all of the preservation steps. The following steps, among others, must be carried out prior to return to operation:

1. Remove all seals on the SCR housing and dosing unit.
2. Check SCR system for operational availability.
3. Fill up drained fluids and lubricants according to the Fluids and Lubricants Specifications. Check the durability of the reducing agent in the supply tank
4. Remove and check sensor system. Reinstall after a visual inspection or replace if necessary.
5. Check switchgear. Work through the start-up steps (→ Operation and Maintenance Manual).

8.3 Gas engine-generator sets Series 500 – Catalytic converter

After an out-of-service period of more than a year, the catalytic converter must be removed, cleaned and stored in a dry place.

9 Appendix A

9.1 Contact person/Service partner

Service

The worldwide network of the sales organization with subsidiaries, sales offices, representatives and customer service centers ensure fast and direct support on site and ensure the high availability of our products.

Local Support

Experienced and qualified specialists place their knowledge and expertise at your disposal.

For locally available support, go to the Internet site: <http://www.mtu-solutions.com>

24 h Hotline

With our 24 h hotline and high flexibility, we are your contact around the clock: during each operating phase, preventive maintenance and corrective operations in case of a malfunction, for information on changes in conditions of use and for supplying spare parts.

Your contact person in our Customer Assistance Center:

E-mail: service.de@ps.rolls-royce.com

Spare Parts Service

Quick, easy and correct identification of the spare part required for your system. The right spare part at the right time at the right place.

With this aim in mind, we can call on a globally networked parts logistics system.

Your contact at Headquarters:

Germany:

- Tel: +49 821 74800
- Fax: +49 821 74802289
- E-mail: spareparts-oeg@ps.rolls-royce.com

Worldwide:

- Tel: +49 7541 9077777
- Fax: +49 7541 9077778
- E-mail: spareparts-oeg@ps.rolls-royce.com

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