Customer Information

Handling Laboratory Samples

A001080/00E

A Rolls-Royce solution

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1 Preface

1.1 General information

This document describes the procedure for handling media samples, elastomers and residues as well as fresh reference samples from drive units and test benches which are dispatched sent for further analysis at MTU Friedrichshafen GmbH or an independent laboratory.

The entire sample handling procedure from collection through packaging to shipment is described here. The shipping requirements specified in this document may have to be adjusted to meet individual national or laboratory conditions where necessary.

The results of fuel, oil, coolant and freshwater analyses are to be evaluated on the basis of the specifications in the latest Fluids and Lubricants Specifications for the engine series concerned.

Definition of MTU

MTU refers to Rolls-Royce Power Systems AG and MTU Friedrichshafen GmbH or an affiliated company pursuant to Section §15 AktG (German Stock Corporation Act) or a controlled company (joint venture).

Symbols and presentation

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.

Applicability of this publication

These instructions may be amended or supplemented as necessary. Be sure to consult the latest version. The most recent version can be retrieved from:

http://www.mtu-solutions.com

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

Samples

The useful life, operational reliability and function of any drive unit or test bench depend to a great extent on the fluids, lubricants and elastomers used. Proper care and treatment of these fluids and lubricants is therefore crucial and must be verified at regular intervals.

Analyzing media samples, elastomers or residues may prove useful in determining the root cause(s) of damage in a drive unit.

Note:

For reasons of clarity, the NOx reducing agents AUS 32 and AUS 40 are referred to hereinafter by their brand name “AdBlue”. However, this is intended to include all commercially-available NOx reducing agents.

The term “elastomer” as used in this document signifies all non-metallic materials .

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2 Sample Vessels and Labeling

2.1 Media Samples

2.1.1 Media sample vessels

1. Always use new, clean, dry and tightly sealed sample vessels (not drinks bottles), preferably with a wide neck (→ Page 27).
2. Sample vessels must be compatible with the media samples being taken. Suitable bottles are made of e.g. PE, PP, PET, PTFE. Check compatibility on-site.
3. The sample vessels used must meet the requirements of the relevant national shipping regulations (→ Page 27).
4. Never use glass bottles or metallic sampling vessels made of e.g. copper-based alloys, aluminum or magnesium, or containers with galvanized or nickel-plated surfaces or their alloys.
5. The size of the sample bottle depends on the volume required for analysis (→ Page 14). Do not fill sample bottles to the brim to allow for thermal expansion. Excessively low filling levels accelerate aging due to the increased oxygen content. A thumb's width below the neck of the bottle can serve as a rough guide to maximum filling quantity.
6. The sample vessels must be tightly closed after filling.

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2.1.2 Labeling media samples

Packaged samples must be clearly identified with a suitably inscribed label. Both the label and the lettering must be resistant to water and solvents.

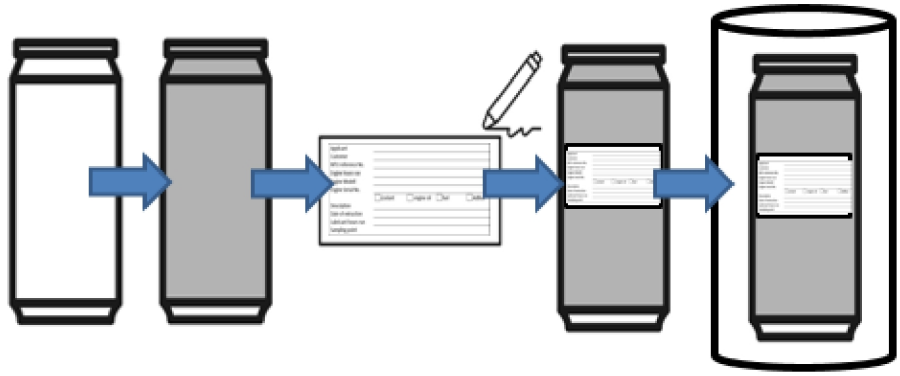

Figure 1: Schematic representation for drawing and labeling media samples

A separate document must be completed if it is not possible to list all the key data on a label. This document must be clearly assigned to the sample under analysis.

Sample containers must be labeled with the following key which apply to all fluids and lubricants. Independent laboratories may require additional key data. Direct any inquiries to the laboratory concerned when requesting an analysis.

Fluid/Lubricant	Fuel	Engine oil	Coolant	AdBlue
	- Fuel specifications	- Viscosity class - Lubricant run time since last change	- Initial filling (yes or no) - Last coolant change: • Details of date and engine operating hours - Preheating time and temperature since first filling or last coolant change	- Run time since last refill
	- Submitter - Customer - MTU reference number (e.g. Toga/FiRe) - Engine operating hours - Engine model (e.g. 20V4000R84) - Engine serial number - Precise brand name of the product - Precise specification of the manufacturer - Sampling point - Sampling date			

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Labels are available from MTU-Friedrichshafen GmbH:

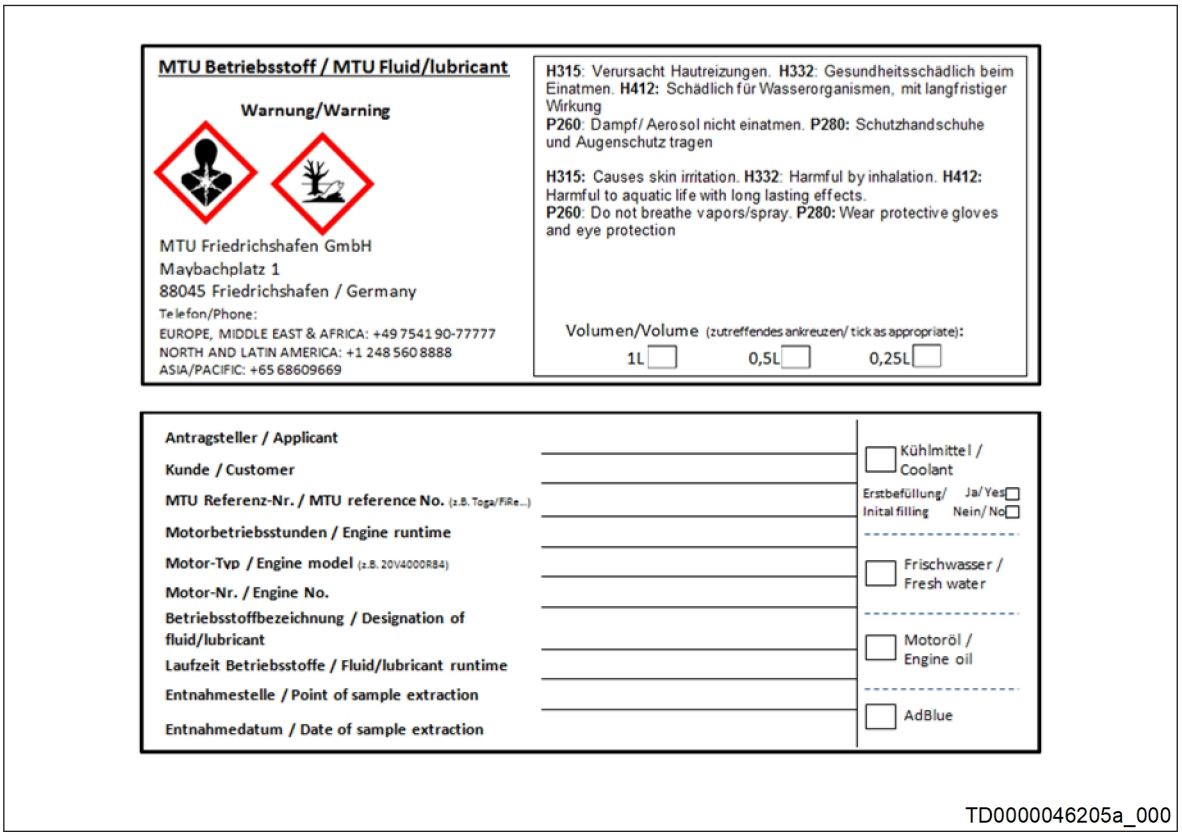

Figure 2: Label for engine oil, coolant and AdBlue (material number X00E00400025)

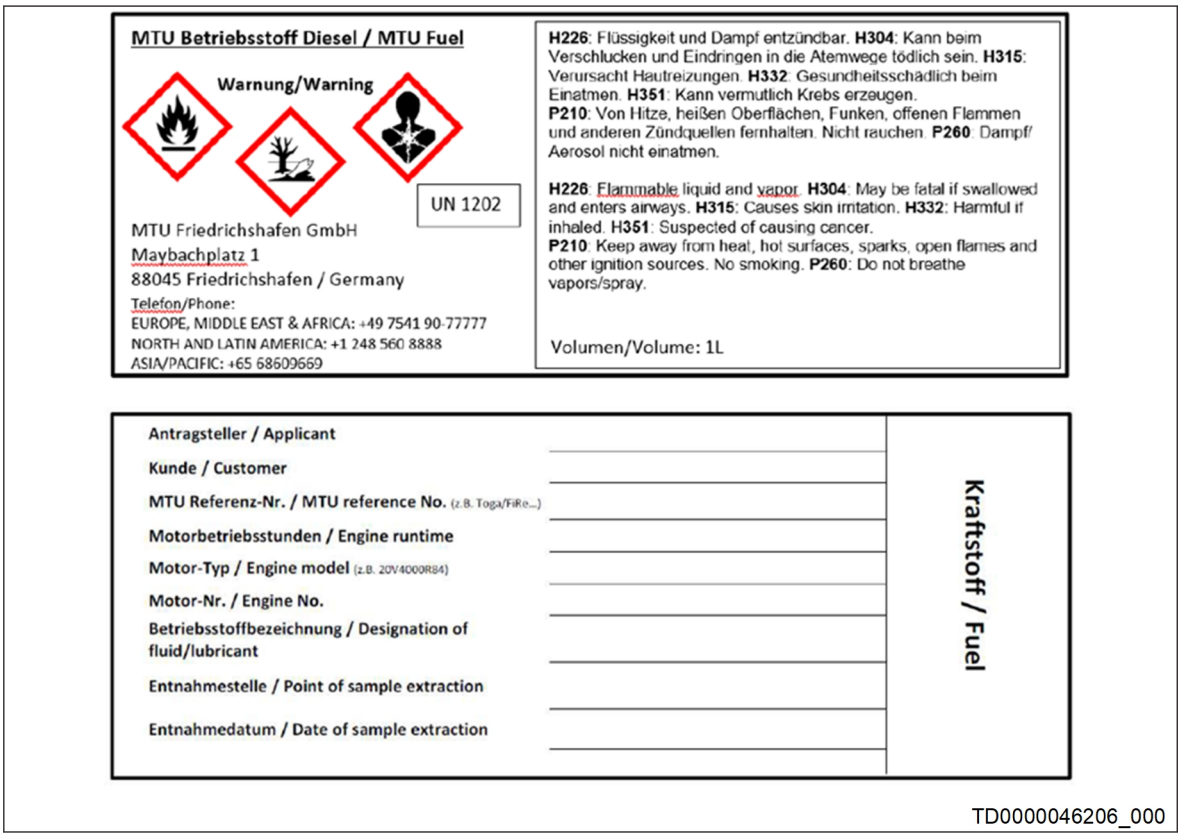

Figure 3: Label for fuel (material number X00E00400026)

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2.2 Elastomers

2.2.1 Elastomer sample bags

Elastomer components must be individually packed and sealed in plastic bags or plastic containers. Plastic bags are available from MTU Friedrichshafen GmbH:

Designation	Dimensions (mm)	Material number
PE flat bag	265 x 180	41814
PE flat bag	355 x 220	41820

Table 1:

TIM-ID: 0000092545 - 001

2.2.2 Labeling elastomer samples

Packaged samples must be clearly identified with a suitably inscribed label. Both the label and the lettering must be resistant to water and solvents.

A separate document must be completed if it is not possible to list all the key data on a label. This document must be clearly assigned to the part under investigation.

Part under investigation	Elastomers
Key data	- Submitter - Customer - MTU reference number (e.g. Toga/FiRe) - Engine operating hours - Engine model (e.g. 20V4000R84) - Engine serial number - Material number - Contact media (fluid/lubricant designation, run time, reference samples of possible contact media to be included) - Installation location (e.g. cylinder B1) - Installation drawing - Removal date

Table 2:

TIM-ID: 0000092474 - 001

2.3 Residues

2.3.1 Residue sample bags

Residues must be individually packed and tightly sealed in plastic bags or containers (→ Figure 4). Plastic bags are available from MTU Friedrichshafen GmbH:

Designation	Dimensions (mm)	Material number
PE flat bag	265 x 180	41814
PE flat bag	355 x 220	41820

Table 3:

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Figure 4: Plastic container for residues

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2.3.2 Labeling residue samples

Packaged samples must be clearly identified with a suitably inscribed label. Both the label and the lettering must be resistant to water and solvents.

A separate document must be completed if it is not possible to list all the key data on a label. This document must be clearly assigned to the part under investigation.

Sample	Residues
	- Submitter - Customer - MTU reference number (e.g. Toga/FiRe) - Engine operating hours - Engine model (e.g. 20V4000R84) - Engine serial number - Contact media (fluid/lubricant designation, run time, reference samples of possible contact media to be included) - Installation location (e.g. cylinder B1) - Installation drawing - Sampling date

Table 4:

TIM-ID: 0000092547 - 001

3 Sampling

3.1 Media Samples

3.1.1 Sampling time

The time at which the samples are taken depends on the specific reason for their analysis. However, three basic sampling times are considered sound practice (without dismissing others at differing points):

Fresh samples

Fresh samples can be taken either directly on tanking or from original, sealed containers.

Used samples

Used samples should be taken immediately after shutting the engine down from partial or full load operation. This returns a “mixed sample” containing impurities and the fluid or lubricant concerned which duly reflects the actual quality in use.

Failure/damage

In case of failure or damage, samples must be taken as soon as feasibly possible following the event.

Important
Always follow the hazard and safety instructions as well as requirements to wear personal protective equipment specified in the Operating Instructions for the engine when handling or taking samples of fluids and lubricants.

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3.1.2 General information on all media samples

Important

1. Always wear appropriate personal protective equipment when taking samples. Always follow the hazard and safety instructions as well as requirements to wear personal protective equipment (PPE) specified in the Operating Instructions for the engine.
2. Use suitable vessels for sampling (→ Page 27).
3. Clean the sampling point as well as possible prior to sampling (with a clean, lint-free cloth, etc.).
4. Do not open the sampling vessel until immediately before taking the sample. Place the lid of the vessel on a clean surface with the underside facing up.
5. Draw the sample directly into the sample vessel ensuring that the sampling cock/valve does not make contact with the sampling vessel.
6. Take care to prevent dust or liquids etc. entering the sampling vessel or contaminating the lid when sampling.
7. Dispose of the first liter (first flow) of the fluid or lubricant (it serves as a “flushing medium”). This prevents any remaining impurities at the sampling point from contaminating the sampling vessel. However, this does not apply to AdBlue or coolant. The requirements for coolant and AdBlue are listed separately in (→ Page 20) and (→ Page 23) respectively.
8. Open and close the sampling valve/cock repeatedly while draining the “flushing medium” to loosen any impurities.
9. Dispose of the flushing medium in accordance with the applicable regulations in force on-site.
10. Close the sampling vessel immediately after taking the sample and affix a label as described in (→ Page 6).
11. Dispatch samples for analysis as soon as possible. For details of storage and shipping, see (→ Page 26).
12. Procedure for insufficiently sized containers (mixed sample):
    If sufficiently sized containers are not available for sampling, the overall sampling volume must be split over a number of separate containers and a mixed sample prepared from these prior to analysis in the laboratory (see description below). The individual containers must be numbered in the order in which the samples were taken. However, this means that the sample has to be taken continuously at the same time and place without any interruption.
13. Preparation of reserve samples:
    A reserve sample is a sample which is stored for later testing or repeat analyses. Proceed as follows if a reserve sample is required (e.g. by a Work Instruction, project-specific conditions, etc.):
    Take the reserve sample at the same time and place without interruption, and affix labels in the same way as the for the standard sample adding the words ”Reserve Sample”. Note the storage requirements specified in (→ Page 26).

Preparing a mixed sample in the laboratory immediately prior to analysis

1. Shake all the samples individually to homogenize them in preparation for mixing.
2. Then combine the same sampling volume from each container in a new, larger container, and homogenize this mixed sample by shaking for another minute.
3. Do not attempt to prepare a mixed sample from samples which are visibly contaminated (particulate matter or different phases). In this case, each individual sampling bottle must be analyzed separately and recorded the order of filling.

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3.1.3 Sampling Points, Sample Volumes and Scope of Analysis

3.1.3.1 General information

The following sample volumes are to be taken and submitted in suitable sampling vessels (→ Page 27) for analysis at MTU Friedrichshafen GmbH. Independent laboratories may require other volumes.

TIM-ID: 0000092572 - 001

3.1.3.2 Fuel

The sampling point is dictated largely by the issue under investigation. The various sampling points are defined below:

Issue / Investigation	Location in fig.	Sampling point / Comment(s)	Volume in liters (l)
Failure/damage	3	Depends on the issue under investigation, but usually the last tank before the engine.	2
Delivery quality	-	The sample is taken directly on filling.	2
Fuel quality before filtering	1	The sample is taken from the first tank of the drive unit, generally the bunker tank.	1
Compliance with particle distribution (as per MTU Fluids and Lubricants Specifications)	5	The sample is taken from the supply line between the last tank and the scope of supply (on existing systems without any accessible supply line, samples may be taken from the last tank before the scope of supply).	1
Final fuel quality used in the engine	Between points 12 and 11	The sample is taken after the filter on the engine. Taking such samples may occasionally prove complex and sometimes even unfeasible. If sampling is not possible here, the sample may be taken from the last tank before the scope of supply.	2
Return fuel	14	The sample is taken directly from the return flow.	1

Table 5:

Various options are provided for sampling depending on the engine. Consult the relevant Operating Instructions of the engine concerned for details of the defined sampling points. In rare cases, sampling points may not be accessible on the engine. If so, contact MTU-Friedrichshafen GmbH product support.

Important
Fuel quality may vary depending on the sampling point used (upper tank content, sump, fuel return, before filter, after filter, etc.).

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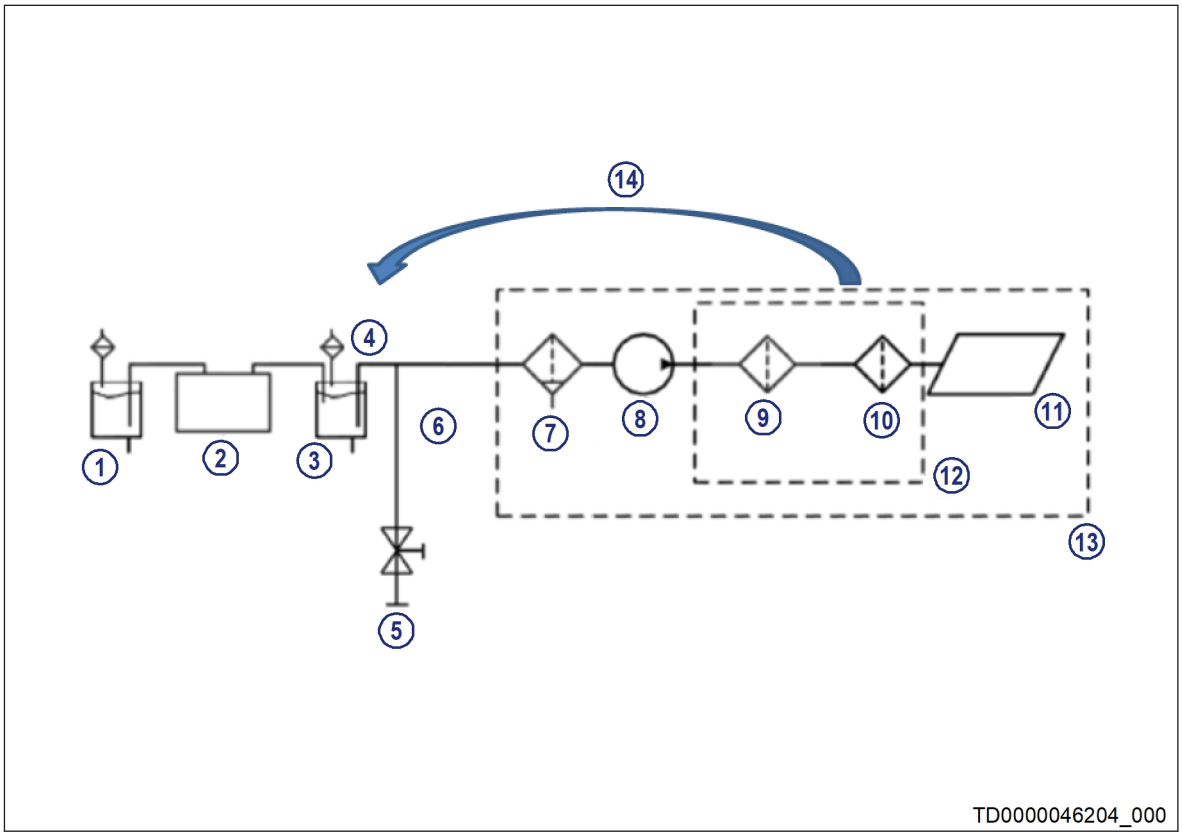

Figure 5: Schematic representation of the fuel system and sampling point locations

1 Fuel tank
2 Fuel treatment (option)
3 Last tank before engine
4 Tank breather filter
5 Sampling point
6 Interface for fuel specification
7 Fuel before filter can be switched off in case of water (option), CJC™ fine filter system mandatory for 12V4000U83
8 LP fuel pump
9 Intermediate filter (option)
10 Main filter
11 Injection system
12 Engine filter
13 Engine scope of supply
14 Fuel return

Scope of analysis for fuels

The scope of analysis depends on the issue under investigation, but can generally be defined according to the table below. Please consult MTU-Friedrichshafen GmbH to clarify specific cases, e.g. the quality of a fuel used for purposes of certification or engine acceptance. Independent testing laboratories must satisfy the specified scope of testing. Consult MTU-Friedrichshafen GmbH if this is not possible.

TIM-ID: 0000088771 - 001

Issue / Investigation	Scope of analysis
Failure or damage / Delivery quality / Final fuel quality used	Compliance with all specified fuel parameters and particle distribution in accordance with the latest Fluids and Lubricants Specifications for the engine series concerned (see section on “Fuel”)
Fuel quality before/after filtering. Compliance with particle distribution i.e. verification of fuel filtering system functionality	Visual assessment of sediment and water Overall contamination Particle distribution Water content Density Viscosity Cetane index Sulfur content
Return fuel	Visual assessment of sediment and color Particle distribution Elements in fuel

Table 6:

TIM-ID: 0000088771 - 001

3.1.3.3 Engine oil

The sampling point is dictated largely by the issue under investigation.

The various sampling points are defined below:

Issue / Investigation	Sampling point / Comment(s)	Volume in liters (l)
Reusability	Oil pan or oil cooler: • Fresh and used oil samples must be submitted.	0.25 each
Failure/damage	Oil pan or oil cooler and oil filter/ centrifugal filter: • Fresh and used oil samples must be submitted. Drain 2 l before sampling from the centrifugal oil filter.	0.25 each
Monitoring of: Physico-chemical characteristics e.g. water content, abrasion debris, viscosity	Oil pan or oil: • Fresh and used oil samples must be submitted. Oil samples taken from the oil filter and centrifugal filter are unsuitable for monitoring abrasion debris.	0.25 each
Identity verification	When analyzing fresh oil: • Sample from delivery container.	0.25
	When analyzing used oil: • Used oil sample from the oil pan or oil cooler, and a fresh oil sample from the delivery container.	0.25 each

Table 7:

Various options are provided for sampling depending on the engine. Consult the relevant Operating Instructions of the engine concerned for details of the defined sampling points. In rare cases, sampling points may not be accessible on the engine. If so, contact MTU-Friedrichshafen GmbH product support.

Scope of analysis for engine oil

The scope of analysis depends on the issue under investigation, but can generally be defined according to the table below. Independent testing laboratories must satisfy the specified scope of testing. Consult MTU-Friedrichshafen GmbH if this is not possible.

The defined characteristic values are to be evaluated on the basis of the specifications in the latest Fluids and Lubricants Specifications for the engine series concerned. Oil properties for diesel engines shall be assessed in accordance with document no. A001061/.., and for gas engines in accordance with A001072/.., should the relevant Fluids and Lubricants Specifications fail to specify relevant limit values.

	Cylinder arrangement	Scope of analysis
Reusability	Diesel engine	As per A001061/.. For single-grade oils: Viscosity 100 °C For multi-grade oils: Viscosity 100 °C + 40 °C + Viscosity index
	Gas engine	As per A001072/..

TIM-ID: 0000088776 - 001

	Cylinder arrangement	Scope of analysis
Failure/damage / Investigation	Diesel engine	As per A001061/.. When investigating coolant leakage, also: For single-grade oils: Viscosity 100 °C For multi-grade oils: Viscosity 100 °C + 40 °C + Viscosity index When investigating coolant leakage: • Represent as ethylene glycol when coolants containing antifreeze are used • Analyze by means of ICP (Inductively Coupled Plasma) when aqueous coolants are used,
	Gas engine	As per A001072/.. When investigating coolant leakage: • Represent as ethylene glycol when coolants containing antifreeze are used • Analyze by means of ICP (Inductively Coupled Plasma) when aqueous coolants are used,
Monitoring	Diesel engine	One or more parameters are monitored.
	Gas engine	One or more parameters are monitored.
Identity verification	Diesel engine	• Flashpoint • Water content • Comparison with reference oil sample by infrared spectroscopy • Comparison of additive content with reference values For single-grade oils: • Viscosity 100 °C For multi-grade oils: • Viscosity 100 °C + 40 °C + Viscosity index
	Gas engine	• Viscosity 100 °C • Water content • Base number • Acid number • ipH value • Comparison with reference oil sample by infrared spectroscopy • Comparison of additive content with reference values

Table 8:

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3.1.3.4 Coolant

Coolant sampling depends largely on the issue under investigation and accessibility on the engine.

1. In the event of failure/damage:

a. The coolant is generally drawn from the engine at the lowest point possible in order to collect any solids content present in the coolant system.
The first flow is normally discarded and the mid-flow used for sampling purposes. However, the first flow should be used in case of residue-related damage.
b. On suspecting the ingression of any component which is lighter than coolant, such as oil, fuel or assembly compounds, the sample should be taken from an accessible point further upstream in the coolant system.
c. Depending on the nature of the failure/damage, it may be advisable to take a coolant sample not only from the engine, but also from external components such as the external cooling system or preheater.

Any contamination of the coolant sample which might have occurred during the process, e.g. in the course of component removal, must be duly noted and disclosed.

2. To verify identity:

a. An actual coolant sample is taken from an accessible point in the engine cooling system.
b. A target coolant sample is taken from a sealed original container.
c. A sample of the freshwater used in preparing the coolant is taken from a sealed original container or the relevant water pipe (discarding the first flow).
d. c. does not apply if ready-mixed COTS products are used.

3. To establish actual coolant condition before and after engine operation (commissioning and routine analyses):

a. Coolant is taken from the mixing container, storage tank or the intermediate storage container (as the case may be) during initial filling or refilling of the engine cooling system.
b. Transfer coolant from the engine cooling system and take a coolant sample.
c. Additional coolant samples are taken at defined intervals at the same sampling points as listed under 2 (identity verification).

Any changes to the coolant such as topping up, draining and refilling in the course of maintenance and repair work. Observe points a. to c. in the latter case.

4. Sample volumes required:

Fluid	Volume in liters (l)
Routine coolant analysis	0.25
Coolant-related failure/damage	0.25
Coolant-related failure/damage involving residues/ contamination (solids/liquids)	0.5
Coolant concentrate (original container)	0.25
Ready-mixed coolant (original container)	0.25
Freshwater	0.25

Table 9:

TIM-ID: 0000088777 - 001

Proposed scope of coolant analysis:

Issue / Investigation	Analysis	Scope
Routine analysis of inlet fluid on test stand / flushing and cooling system / hydraulic pressure testing trolley	See MTV 5073	-
Routine coolant analysis	Visual inspection	Appearance, color, odor, contamination
	Physico-chemical characteristics	Concentration, refractive index, pH value, alkalinity, conductivity, water hardness or sum of alkaline earth metals
	Anions (IC)	Chloride, fluoride, nitrite, nitrate, benzoate, phosphate, sulphate
	*Elements (ICP)	Silicon, aluminum, copper, iron, lead, zinc, sodium, potassium, calcium, magnesium, boron, molybdenum Possibly also phosphorus and sulfur depending on the coolant
	Germs (bacteria, yeasts, fungi)	Dipslide test for aqueous coolants only
	Contamination	Only where necessary and by agreement between customer and contractor
Routine freshwater analysis	Visual inspection	Appearance, color, odor, contamination
	Physico-chemical characteristics	pH value, conductivity, water hardness or sum of alkaline earth metals
	Anions (IC)	Chloride, fluoride, nitrite, nitrate, phosphate, sulphate
	*Elements (ICP)	Silicon, aluminum, copper, iron, lead, zinc, sodium, potassium, calcium, magnesium
	Germs (bacteria, yeasts, fungi)	Dipslide test
Coolant identity verification	- See routine coolant analysis - HPLC - Density analysis	
Failure/damage investigation	Also depends on the nature of the damage suffered. - See routine coolant analysis - HPLC - Determination of glycol degradation products (IC) - Analysis of contaminants/residues	

Table 10:

= Applicable standards may vary in composition depending on the laboratory involved. The information provided is therefore not intended to be exhaustive.

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3.1.3.5 Freshwater

Freshwater used for mixing coolants must meet the requirements specified in the Fluids and Lubricants Specifications . Freshwater quality must be verified in good time before mixing the coolant.

- When using mixed water its quality is decisive.
- The analysis certificate provided by the local water utility works will suffice when using drinking water from the tap.

Samples are taken as described in section (→ Page 13)

The minimum sample volume is 0.25 l.

Freshwater samples should be analyzed within 3 weeks of sampling, wherever possible. If this is not feasible, the samples should be stored as cool as possible (e.g. in a refrigerator) in order to avoid falsifying the germ count as a result of storage.

TIM-ID: 0000088778 - 001

3.1.3.6 NOx reducing agent / AdBlue

The sampling point is dictated largely by the issue under investigation.

Issue / Investigation	Sampling point / Comment(s)	Volume in liters (l)
Delivery quality	The sample is taken when filling or from the freshly delivered container. The first 2-3 liters must be discarded if the sample is taken from the pipe. Samples taken from the container must be drawn from approximately half the filling level of the container.	0.25
Quality at the dispenser	The sample is taken directly from the spray head. The sample should be taken from the first flow of the medium.	0.25
Actual AdBlue condition	The sample is taken from the container. Samples taken from the tank must be drawn from approximately half the filling level of the tank.	0.25
Return medium	The sample is taken directly from the return flow.	0.25

Table 11:

Important
Stubborn encrustations may be cleaned away with warm water, before rinsing thoroughly with bi-distilled water immediately afterwards.

Scope of analysis for AdBlue

The scope of analysis for all issues under investigation is specified in the latest version of the Fluids and Lubricants Specifications. Independent laboratories may base their analysis on different test catalogs.

TIM-ID: 0000088779 - 001

3.2 Elastomers

3.2.1 Elastomers

Take a photo to document the installation location of the elastomer component. Attach the photo to the shipping documents or email to Chemistrylab@ps.rolls-royce.com. Please mark the orientation of the component in its installed state, or which side of the component was exposed to which medium. Avoid cleaning (wiping) the component to facilitate diagnosing the media / ambient conditions to which the component has been subjected. It may be advisable to deliver the component to the laboratory in-situ on the workpiece (decision reserved for L3 diagnosticians).

Contact media must be specified by name (e.g. on the return material tag or by emailing Chemistry@ps.rolls-royce.com) or shipped with the component for analysis.

The scope of analysis depends on the issue under investigation. Potential parameters for analysis may be hardness, density, etc.

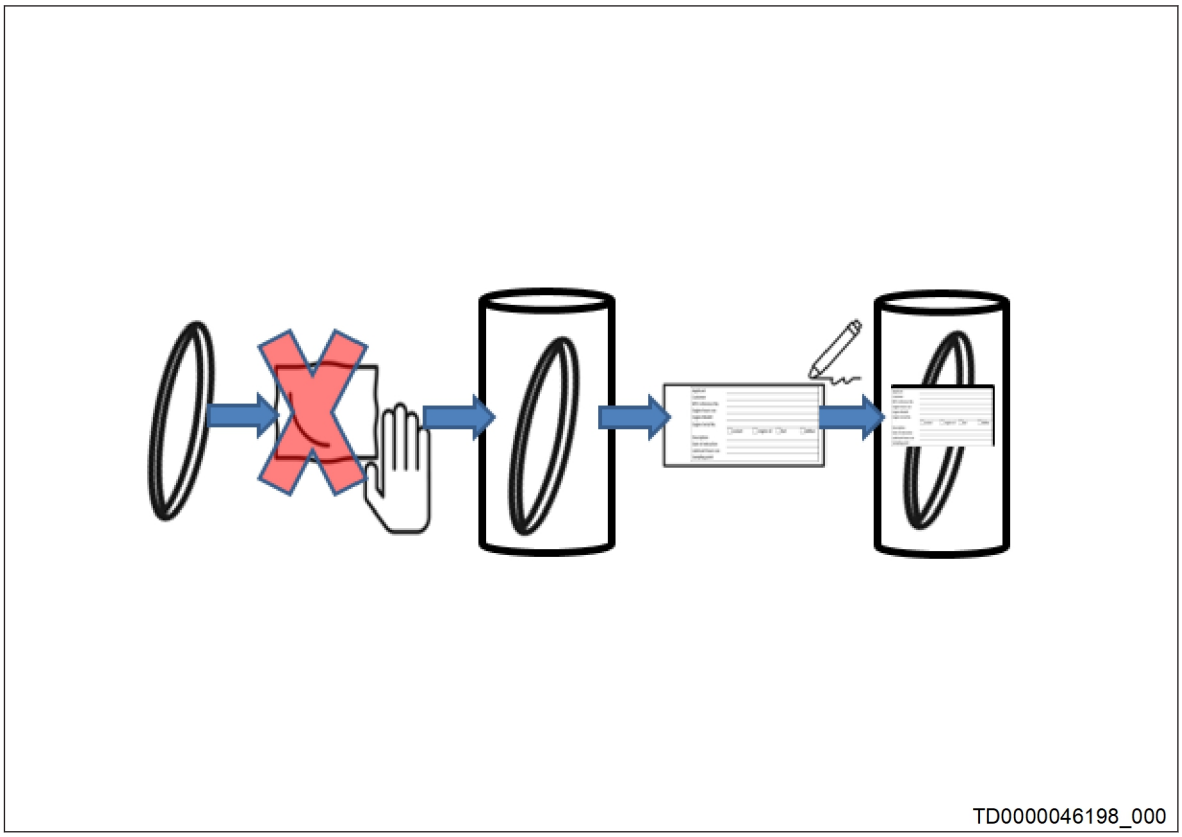

Figure 6: Schematic representation of packaging and labeling for elastomer samples

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3.3 Residues

3.3.1 Residues

Take a photograph of the specific location before removing any residue.

Attach the photo to the shipping documents or email to Chemistrylab@ps.rolls-royce.com.

Use clean, new sampling utensils (spatula, pipette, plastic sheet) to collect residues. Avoid using cotton cloths or cellulose tissues. Include a clean sampling utensil as a reference when submitting.

Sometimes, it may be advisable to submit the residue to the laboratory in-situ on the workpiece, e.g. to analyze the material under the deposit for changes or corrosion (decision for L3 diagnostician). Packaging must be clarified with the L3 diagnostician in such case.

Reference samples from possible sources must be included (max. 100 g).

The scope of analysis depends on the issue under investigation. Potential parameters for analysis are:
- Microscopic and macroscopic examination
- Infrared spectrometry (organic components)
- Elemental analysis by X-ray fluorescence analysis (XRF) or X-ray spectroscopy (EDX)
- Thermal analysis methods
- Other analytical methods for fluids and lubricants possible depending on the sample

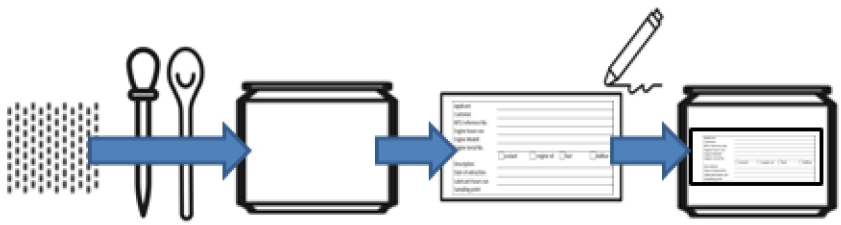

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Figure 7: Schematic representation for drawing packaging and labeling residue samples

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4 Storage, Packaging and Shipping

4.1 Storage

1. National requirements must be observed when storing laboratory samples.
2. Media samples, residues and elastomers should be submitted for analysis as soon as possible (preferably within 3 weeks).
3. Fluid and lubricant samples should be kept as cool as possible in storage prior to shipment and analysis, and in transit. Temperatures of between 10 °C and 25 °C are ideal.
4. Temperatures below 5 °C must be avoided to prevent aqueous media freezing or crystallizing (AdBlue).
5. Temperatures above 25 °C over longer periods accelerate aging of the samples which may falsify the results of the analysis. Brief exposure to temperatures exceeding 25 °C have no significant impact on aging.
6. Coolant samples should be examined within 3 weeks of sampling wherever possible. If this is not feasible, samples should be stored as cool as possible (e.g. in the refrigerator), especially in the case of coolants without antifreeze additives, to avoid falsifying the germ count as a result of storage. Coolants (with and without antifreeze) filled in transparent plastic containers must be stored in a dark place. Light may otherwise induce precipitation in the coolant.
7. To avoid e.g. microbial growth (AdBlue, aqueous media) or precipitation (coolant), the samples should not be exposed to direct sunlight and UV radiation for any length of time.

TIM-ID: 0000088784 - 001

4.2 Packaging and shipping

Packaging must meet the requirements for transporting hazardous goods. National and/or laboratory-specific requirements must also be fulfilled. The forwarder must clarify these requirements on-site in advance.

The requirements for handling hazardous goods specified in this document are based on the requirements stipulated in the document IATA DGR Issue 61 and ADR2019.

TIM-ID: 0000088806 - 001

4.3 Packaging and shipping media samples

Fuel samples are subject to the regulations governing the transportation of hazardous goods. Samples of fresh and used engine oil, coolant and AdBlue are not classed as hazardous goods.

Important

Note the following requirements concerning international shipping.
When shipping fluids and lubricants for analytical purposes:
- Consignments must not exceed 4 liters each.
- The actual total consignment volume must be recorded in the shipping documents, e.g. as a proforma invoice.
- Samples (e.g. fuel, engine oil, coolant, AdBlue, etc.) may be shipped together in one consignment, the total volume must not exceed 4 liters, however.

Note the following requirements in addition to those mentioned above when shipping fresh/unused fluids and lubricants for analytical purposes, e.g. as reference samples:
- Consignments must not exceed 5 fresh/unused fluid/lubricant samples each.
- These samples may be from different product groups (e.g. fuel, engine oil, coolant, AdBlue, etc.).
- Consignments may, however, include up to 5 samples from just one product group (e.g. engine oil) providing that the shipping documents, e.g. pro forma invoice, duly reflect that the samples are from different products, manufacturers or batches of a given product. The volume in the individual containers must be specified separately as proof.

Shipping by road freight

Internal packaging	General information	• Various samples (e.g. fuel, engine oil, coolant, freshwater and AdBlue) may be packaged and shipped together in one consignment. • For customs clearance, the consignment must be accompanied by a safety data sheet for each type of fluid or lubricant (oil, fuel, etc.). • The duly labeled or inscribed sample vessels must be individually wrapped in plastic film and properly sealed. • The sample vessels are then placed upright in a cardboard box and secured with filling material. • Documents detailing key sample data must be included with the consignment (→ Page 6).	
	Fuel, engine oil, coolant, freshwater and AdBlue	• Sample bottles for liquid media are available from MTU-Friedrichshafen GmbH:	
		Volume (ml)	SAP material number
		250	41426
		500	41416
		1000	41417

TIM-ID: 0000092622 - 001

External packaging (Instructions for packaging and forwarder)	• Sturdy packing unit (testing not required) • Details of the recipient and forwarder • “Limited quantity” label The limited quantity label (ADR 3.4) is intended for road freight – The package must not exceed a gross mass of 30 kg in the case of national shipping. – To clear customs, the content for international consignments is restricted to a maximum of 4 liters. • “Orientation arrows” (on 2 opposing sides)	

Table 12:

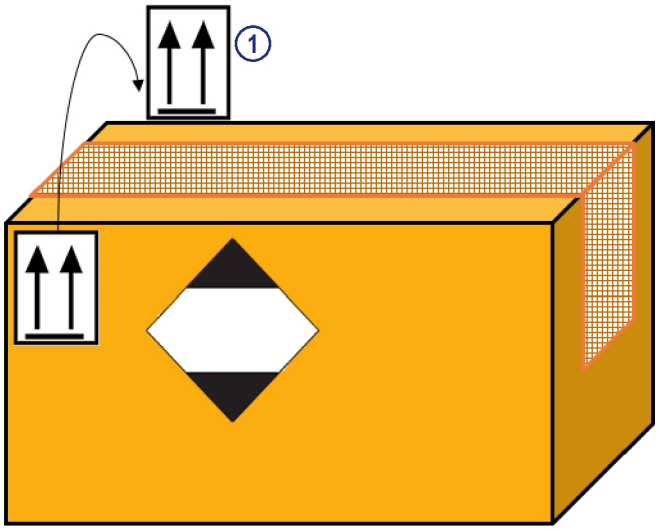


Figure 8: External packaging for road freight

1 Affix orientation label (TOP) on the opposite side also.

TIM-ID: 0000092622 - 001

Shipping by air freight

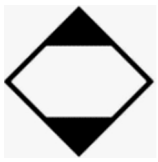
<table>
<tr><td rowspan="2">Internal packaging</td><td>General information</td><td colspan="2">• Fuel engine oil and fluid samples may be packaged and shipped together in one consignment.
• For customs clearance, the consignment must be accompanied by the safety data sheet for the fluid/lubricant sample(s).
• The duly labeled or inscribed sample vessels must be individually packed in a plastic bag and properly sealed.
• The sample vessels are then placed upright in a cardboard box and secured with filling material.
• Documents detailing key sample data must be included with the consignment (see Labeling (→ Page 6)).</td></tr>
<tr><td>Fuel, engine oil, coolant, freshwater and AdBlue</td><td colspan="2">• Sample bottles for liquid media offering differential pressure stability to 75 kPa (IATA DGR 5.0.2.9) are available from MTU-Friedrichshafen GmbH:</td></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td>Volume (ml)</td><td>SAP material number</td></tr>
<tr><td>1000</td><td>X00081946</td></tr>
<tr><td colspan="2">External packaging
(Instructions for packager and forwarder)</td><td colspan="2">• Tested external packaging (4GV)
• Details of the recipient and forwarder.
• “Limited quantity” label (required for road transport to and from the airport).
To clear customs, the content for international consignments is restricted to a maximum of 4 liters.
• “Orientation arrows” (on two opposing sides)
• “Hazard label class 3” for fuel samples
• Manual, indelible, water and solvent resistant marking: “DIESEL FUEL; UN1202” (size: min. 12 mm)
• Manual, indelible, water and solvent resistant marking: “NET QUANTITY” indicating the weight of the hazardous material contained in the package in kg (size: min. 12 mm)</td></tr>
<tr><td colspan="2"></td><td>
</td><td>  </td></tr>
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Table 13:

TIM-ID: 0000092622 - 001

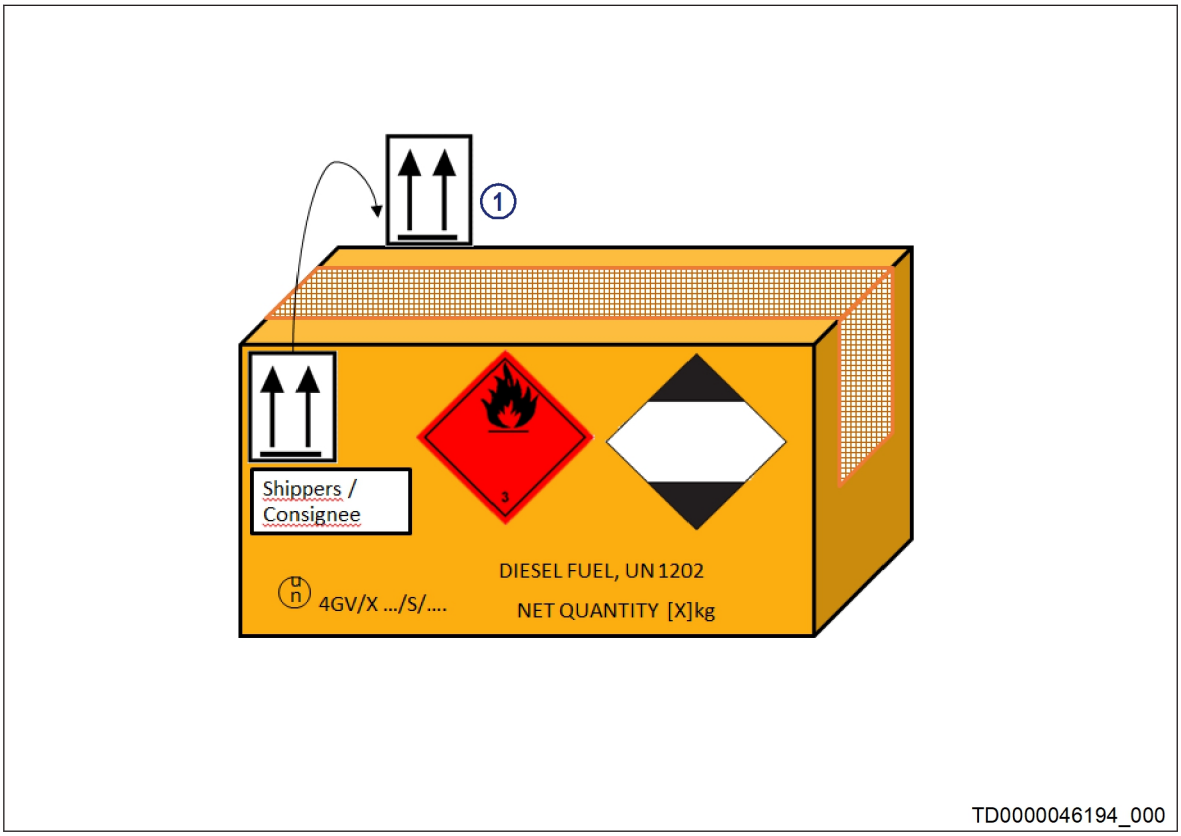


Figure 9: External packaging for air freight

1 Affix orientation label (TOP)
on the opposite side also.

TIM-ID: 0000092622 - 001

4.4 Packaging and shipping elastomers

Elastomer components should generally be labeled as “Elastomers” when shipping.

Internal packaging	• Media samples, elastomers and residues may be packed together in one consignment providing there is no risk of any chemical reaction.. • The elastomers must be packed individually in labeled or inscribed plastic bags ((→ Page 8)). • Documents detailing key sample data (→ Page 9) must be included with the consignment.
External packaging (Instructions for packager and forwarder)	• Sturdy packing unit (testing not required). • Details of the recipient and forwarder

Table 14:

TIM-ID: 0000092642 - 001

4.5 Packaging and shipping residue samples

Internal packaging	• Media samples, elastomers and residues may be packed and shipped together in one consignment providing there is no risk of any chemical reaction.. • Residues must be packed individually in tightly sealed, labeled or inscribed plastic vessels ((→ Page 10)). • Documents detailing key sample data ((→ Page 11)) must be included with the consignment.
External packaging (Instructions for packager and forwarder)	• Sturdy packing unit (testing not required). • Details of the recipient and forwarder

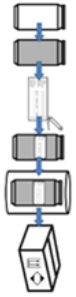
Table 15:

TIM-ID: 0000092649 - 001

5 Appendix A

5.1 Handling Laboratory Samples 37

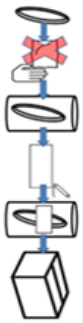
5.1 Handling Laboratory Samples

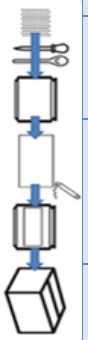


Flyer: Handling of Laboratory Samples (A001080/..x)

Medium	Fuel			Engine oil			Coolant/freshwater			NOx reducing agent / AdBlue		
Sampling point • See Engine Operating Instructions for details • Clean the exterior of the sampling point (lint-free, clean cloth) before sampling • Sampling – Unless otherwise specified: After flushing the sampling point (discard 1l)	**Failure/damage**	Depends on the issue under investigation, usually the last tank before the engine	2x 1l	**Failure/damage**	Oil pan, oil cooler and oil filter/centrifugal filter*1	0.25l*2	**Failure/damage** No residue	Low point. Dispose of first flow, draw mid-flow	0.25l	**Delivery quality**	Tank: The first 2-3l must be discarded if the sample is taken from the pipe. Container: Draw from approximately half the filling level of the tank	0.25l
	Delivery quality	Directly on tanking: Tank, container	2x 1l	**Re-usability**	Oil pan, oil cooler	0.25l*2	With residue (suspended solids, sediment)	Low point. Draw first flow	0.5l			
	Fuel quality before filtering	First tank of the drive unit, generally the bunker tank	1l	**Parameter monitoring**	Oil pan, oil cooler	0.25l*2	With floating phase e.g. oil	Highest point on the engine	0.5l	**Quality at the dispenser**	Directly from the spray head. First flow	0.25l
	Compliance with particle distribution	Supply line between last tank and MTU scope of supply	1L	**Identity check**	Fresh oil: Oil drum	0.25l	**Identity check** Current sample: Target sample: Ready mixture Target sample: Self-mixed	Engine cooling system Sealed original container	0.25l each	**Current AdBlue condition**	Container: Draw at approx. half the filling level when sampling from the tank	0.25l
					Used oil: Oil pan, oil cooler	0.25l*2						
	Final fuel quality used in the engine	After filter on engine	2x 1l	*1 When sampling from the centrifugal filter: Flush min. 2l *2 Take one fresh and one used oil sample								
	Return fuel	Directly from the return flow	1l				**Establishing coolant condition** Sample before engine filling Sample from engine (recirculated) Further samples at defined intervals		0.25l each	**Return medium**	Directly from the return flow	0.25l
							Freshwater		0.25l			
Timing	Basically three points in time (deviations possible): **For fresh samples:** Directly on tanking or from original, sealed containers / **For used samples:** Immediately after shutting the engine down from partial or full load operation / **In case of failure or damage:** As soon as feasibly possible following the event.											
Packaging	**General information**	Packaging must meet the requirements for transporting hazardous goods. Laboratory-specific requirements must also be fulfilled. The forwarder must clarify these requirements on-site in advance. Inner (sample bottle) and outer packaging depends on the shipping option.										
	Labeling	Sample vessels must be clearly identified with a suitably inscribed label. Both label and lettering must be resistant to water and solvents. A separate document must be completed if it is not possible to list all the key data on a label and clearly assigned to the vessel. Labels are available from MTU-Friedrichshafen GmbH under the following SAP material numbers. **Fuel: X00E00400026** — **Oil, coolant, freshwater, AdBlue: X00E00400025**										
Road freight	**Interior packaging**	Clean, new, dry unused and tightly sealed sample vessels made of PE, PP, PET, PFTE. Check compatibility on-site; enclose safety data sheets of the media concerned.										
	Exterior packaging	Sturdy packing unit (testing not required); Details of the recipient and forwarder, “Limited quantity” label; “Orientation arrows” (on two opposing sides)										
Air freight	**Interior packaging**	Clean, new, dry unused and tightly sealed sample bottles offering differential pressure stability to 75 kPa (ATADGR 5.0.2.9); enclose safety data sheets of the media concerned.										
	Exterior packaging	Tested external packaging (4GV); Details of the recipient and forwarder; “Limited quantity” label (required for road transport to and from the airport); “Orientation arrows” (on two opposing sides)										
	Additionally for fuel samples	Hazard label class 3; Manual, indelible, water and solvent resistant marking: “DIESEL FUEL”; UN1202 (size min. 12mm); Manual, indelible, water and solvent resistant marking: “NET QUANTITY” indicating the weight of the hazardous material contained in the package in kg (size min. 12mm)										
Package size	**National** **International**	The package must not exceed a gross mass of **30 kg** in the case of national shipping. To clear customs, the content for international consignments is restricted to a **max. 4 liters**. The forwarder must state the actual quantity in liters on the invoice.										

Important: Always follow the hazard and safety instructions as well as requirements to wear personal protective equipment specified in the Operating Instructions for the engine when handling or taking samples of fluids and lubricants. Hot media pose a risk of injury depending on the sampling point/time.





Flyer: Handling of Laboratory Samples (A001080/..x)

Elastomers / non-metallic materials

General information		Take a photo to document the installation location of the component, Attach the photo to the shipping documents or email to Chemistrylab@ps.rolls-royce.com. Please mark the orientation of the component in its installed state, or which side of the component was exposed to which fluid. Avoid cleaning (wiping) the component to facilitate diagnosing the media / ambient conditions to which the component has been subjected. It may be advisable to deliver the component to the laboratory in-situ on the workpiece (decision reserved for the L3 diagnostician).
Labeling		Packaged samples must be clearly identified with a suitably inscribed label. Both the label and the lettering must be resistant to water and solvents. Submitter; Material number; Engine model/number; Removal date; Engine operating hours Customer; Installation drawing; Installation location (e.g. cylinder B1); MTU reference number (e.g. TOGA/FiRe) Contact media (see "Media" for requirements relating to removal, labeling and packaging)
Packaging	Interior packaging	The elastomer must be individually packed and sealed in plastic bags or plastic containers. Plastic bags are available from MTU-Friedrichshafen GmbH.
	Exterior packaging	Sturdy packing unit (testing not required); Details of the recipient and forwarder

Designation	Dimensions	Material number
PE flat bag	265x180	41814
PE flat bag	355x220	41820

Residues

General information		Take a photograph of the specific location before removing any residue. Attach the photo to the shipping documents or email to Chemistry@ps.rolls-royce.com. Use clean, new sampling utensils (spatula, pipette, plastic sheet) to collect residues. Avoid using cotton cloths or cellulose tissues. Include a clean sampling utensil as a reference when submitting. It may be advisable to deliver the residue to the laboratory in-situ on the workpiece (decision reserved for the L3 diagnostician) e.g. to analyze the material under the deposit for changes or corrosion. Packaging must be clarified with the L3 diagnostician in such case.
Labeling		Packaged samples must be clearly identified with a suitably inscribed label. Both the label and the lettering must be resistant to water and solvents. Submitter; Material number; Engine model/number; Removal date; Engine operating hours Customer; Installation drawing; Installation location (e.g. cylinder B1); MTU reference number (e.g. TOGA/FiRe) Contact media (see "Media" for requirements relating to removal, labeling and packaging)
Packaging	Interior packaging	The elastomer must be individually packed and sealed in plastic bags or plastic containers. Plastic bags are available from MTU-Friedrichshafen GmbH.
	Exterior packaging	Sturdy packing unit (testing not required); Details of the recipient and forwarder

Designation	Dimensions	Material number
PE flat bag	265x180	41814
PE flat bag	355x220	41820

Note:
Media samples, elastomers, non-metallic materials and residues may be packed and shipped together in one consignment providing there is no risk of any chemical reaction. The requirements and specifications for the outer packaging are dictated by the content with the highest hazardous goods classification.

6 Appendix B