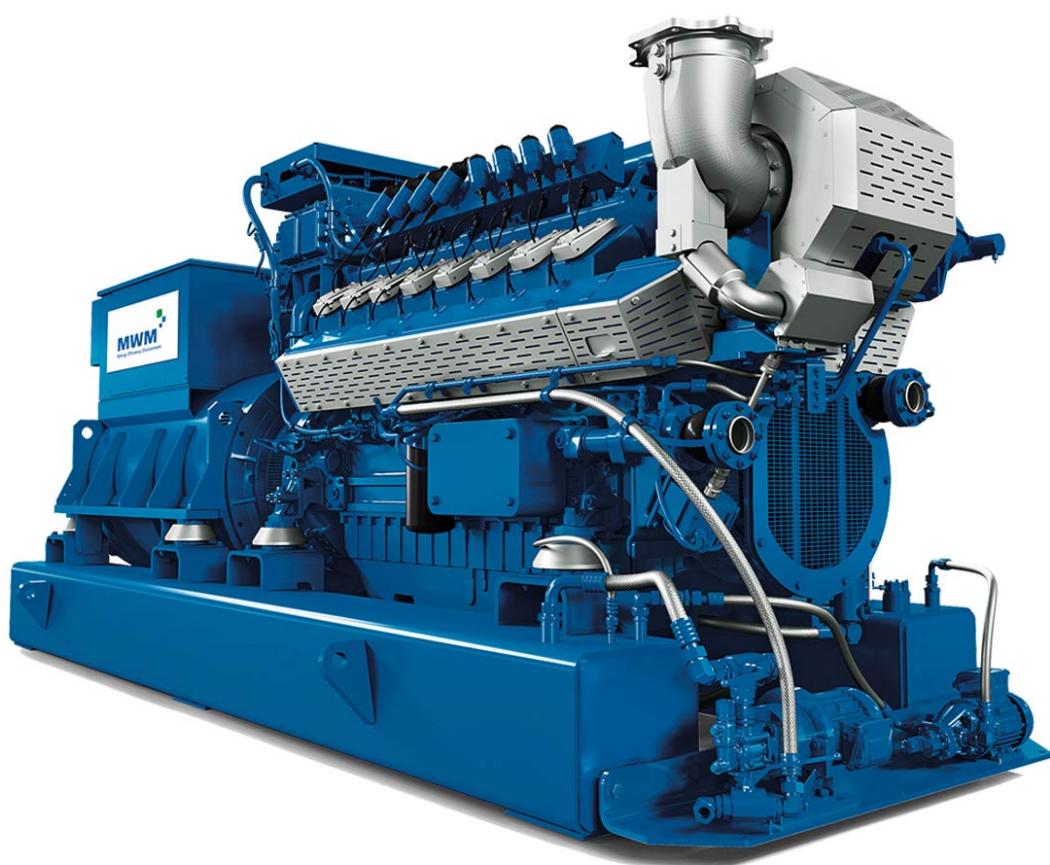


# Genset

**TCG 3016  
valid from TPEM 1.9  
Operating manual  
2024-08, Language EN  
Operator Level (OL)**



The original language of this document is German.  
All translations are based on the German original.

Technical modifications required to improve our products are reserved with regard to specification data and other technical information contained in the document. No parts of this document may be reproduced in any form or by any means without the written approval of the manufacturer.

The document contains information that is necessary for maintenance and repair work on the product. When performing the work listed in the maintenance schedule, only original parts or parts and operating media approved by the manufacturer may be used.

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## 1 Release notes

Glossary	See Contents	Replaces the List of abbreviations
OL-MRA10 / 00-25-01	<a href="#">Checking pollutant emissions in the exhaust gas (TPEM) [▶ 288]</a>	New work instructions
OL-MRA10 / 00-15-30	<a href="#">Performing the auxiliary drive test (TPEM) [▶ 202]</a>	Updated for TPEM version 1.9
OL-MRA10 / 02-01-22	<a href="#">Perform a lube oil change [▶ 314]</a>	Terminology updated
OL-MRA10 / 26-03-37	<a href="#">Setting the global ignition angle [▶ 361]</a>	New work instructions
OL-MRA10 / 72-27-12	<a href="#">Dismantling and mounting the control device holder [▶ 468]</a>	New work instructions
Chapter Operation	<a href="#">Notes on operation with hydrogen [▶ 139]</a>	New chapter
Chapter Operation	<a href="#">Overview of the operation modes [▶ 142]</a>	Added notes on stationary and transient operation
OL-MRA10 / 43-17-03	<a href="#">Visually inspecting the wastegate [▶ 403]</a>	Replaces work instructions OL-MRA10 / 43-27-03 Visually inspecting the wastegate connecting parts.
Personal protective equipment	<a href="#">Industrial safety around the genset [▶ 140]</a>	Reference to cut-resistant gloves as per DIN EN 388 added
OL-MRA10 / 48-11-10	<a href="#">Removing and installing the crankshaft sensor [▶ 405]</a>	<ul style="list-style-type: none"><li>• Technical data updated</li><li>• Reference to installation position added</li></ul>



## 2 Safety information

### 2.1 General safety notes

For general safety notes, see Service Library, [Safety and Product Information Specification](#).

- Please take note of all instructions in that document.

### 2.2 Information on operating media

All information on operating media can be accessed in the Service Library. When using operating media, observe the respective specification:

- [Specification for fuel gas](#)
- [Specification for auxiliary media](#)
- [Specification for coolant](#)
- [Specification for lube oil](#)
- [Specification for combustion air](#)



## 3 Technical data

### Contents

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### 3.1 Genset product data

All product data for the genset can be found in the genset data sheet, see *order-specific operating manual, chapter Technical data, section Genset*.

### 3.2 Technical data

#### 3.2.1 Genset

##### 3.2.1.1 Genset rating plate



18014400158375179

- 1 Power code
- 2 Manufacturer
- 3 Year of manufacture
- 4 Rated power factor
- 5 Maximum ambient temperature (degrees Celsius)
- 6 Rated voltage (volts)
- 7 Mass (kilograms)
- 8 Fuel
- 9 Power class according to DIN 8528-5
- 10 Rated current (Ampere)
- 11 Rated frequency (Hertz)
- 12 Maximum installation height (meters)
- 13 Rated power (kilowatts)
- 14 Serial number

### 3.2.1.2 Tightening specifications for metric coarse pitch thread

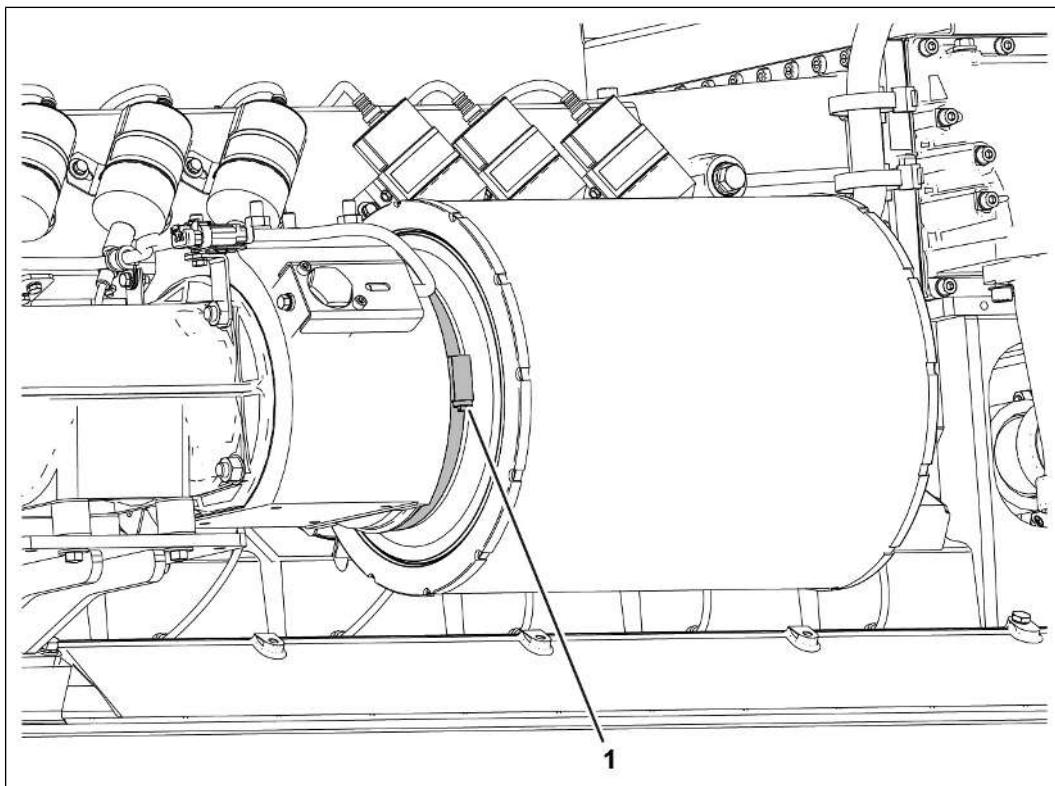
The following table is valid for all screw connections for which component-specific torque data have not been specified.

<b>Standard metric thread*</b>	<b>Torque for each strength class</b>		
	<b>8.8</b>	<b>10.9</b>	<b>12.9</b>
M4	2.5 Nm	3.5 Nm	4.5 Nm
M5	5.0 Nm	7.5 Nm	8.5 Nm
M6	8.5 Nm	13 Nm	15 Nm
M8	20 Nm	30 Nm	36 Nm
M10	42 Nm	60 Nm	70 Nm
M12	70 Nm	110 Nm	120 Nm
M14	110 Nm	170 Nm	200 Nm
M16	180 Nm	260 Nm	300 Nm
M18	260 Nm	360 Nm	420 Nm
M20	360 Nm	500 Nm	600 Nm
M22	480 Nm	700 Nm	800 Nm
M24	600 Nm	850 Nm	1000 Nm
M27	900 Nm	1300 Nm	1500 Nm
M30	1200 Nm	1700 Nm	2000 Nm

\*) The table applies to all screw connections for which component-specific torque data have not been specified.

### 3.2.2 Intake air filter

#### 3.2.2.1 Technical data



9007199562601867

Clamping clip on intake air filter
1

Hand tight
------------

### 3.2.3 Cooling system

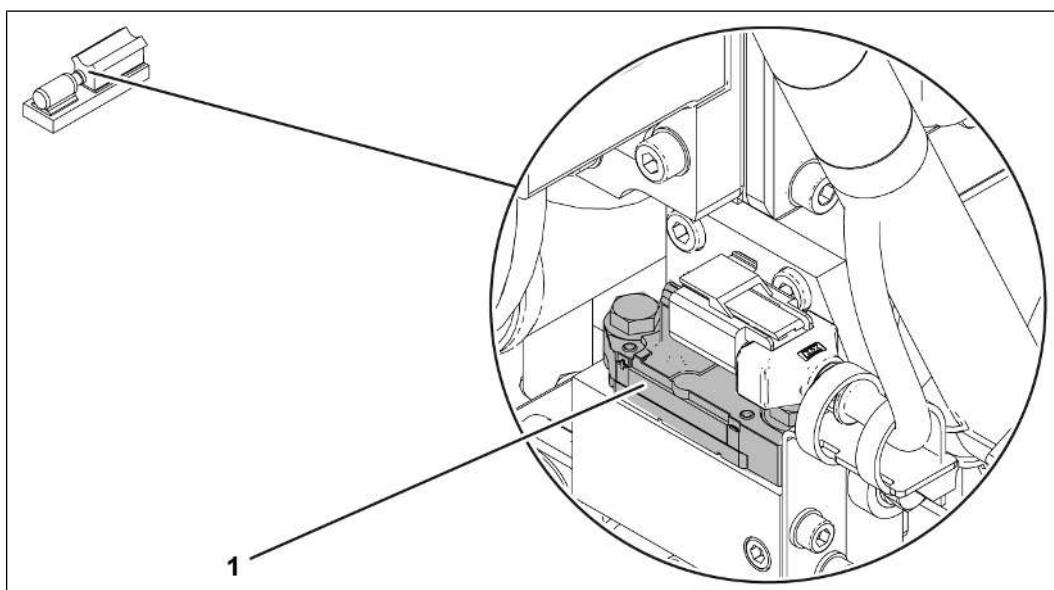
#### 3.2.3.1 Technical data

<b>Hollow screws</b>	
<b>Size of thread</b>	<b>Torque</b>
M8 x 1	12 Nm
M10 x 1	18 Nm
M12 x 1.5	29 Nm
M14 x 1.5	39 Nm
M16 x 1.5	49 Nm

<b>Union nut</b>	
<b>Pipe diameter</b>	<b>Torque</b>
6 mm	35 Nm
8 mm	45 Nm
10 mm	60 Nm
12 mm	75 Nm

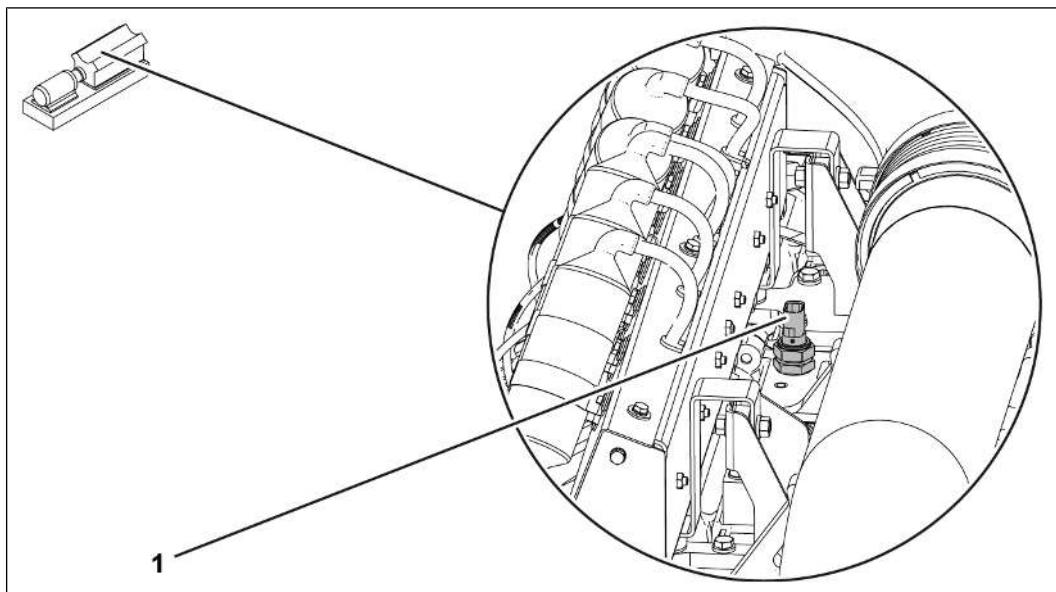
### 3.2.4 Pressure sensor

#### 3.2.4.1 Technical data



18014398821024651

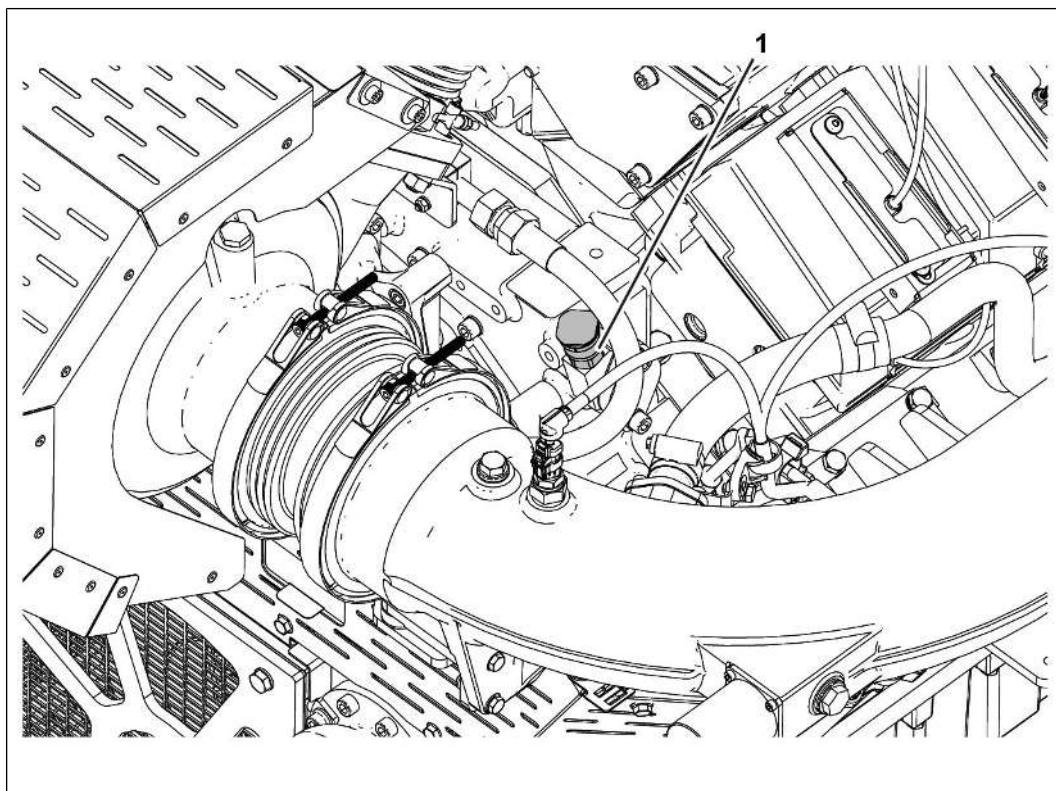
Differential pressure sensor on holder <sup>1)</sup>		
1	M8 x 25 – 10.9	20 Nm
<sup>1)</sup> Replace sealing ring.		



18014398820568075

Mixture pressure sensor<sup>1)</sup> on mixture housing

1 M14 x 1.5 10 Nm

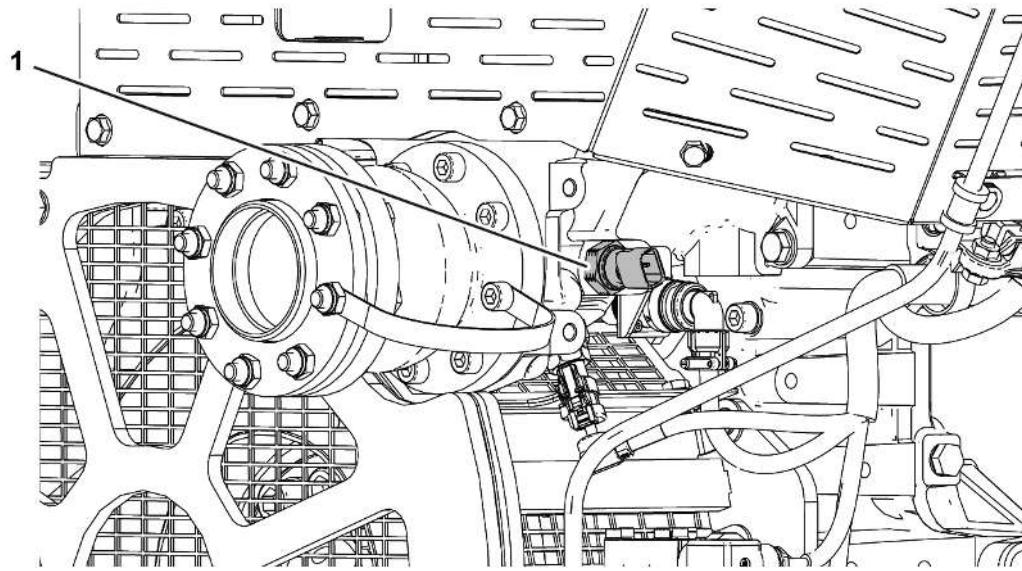
<sup>1)</sup> Replace sealing ring.

18014398820465803

Crankcase pressure sensor<sup>1)</sup> on face cover

1	1/2A	20 Nm
---	------	-------

<sup>1)</sup> Replace sealing ring.

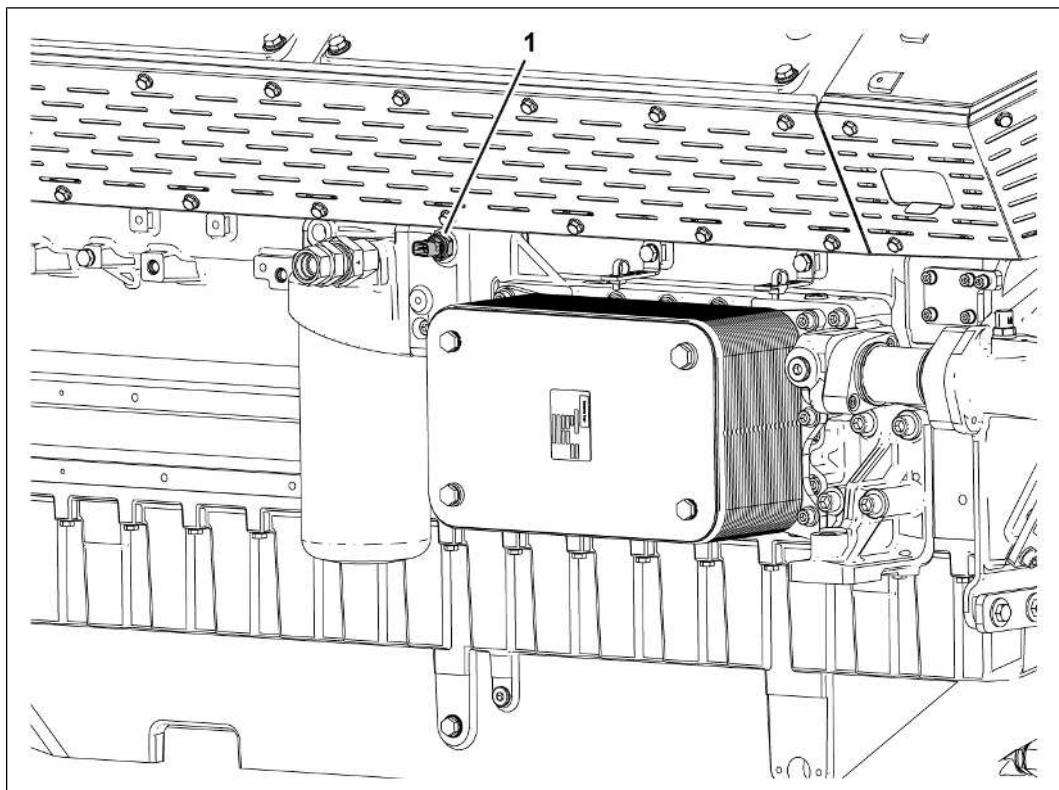


18014398820102155

Coolant pressure sensor<sup>1)</sup> on flange

1	M14 x 1.5	10 Nm
---	-----------	-------

<sup>1)</sup> Replace sealing ring.

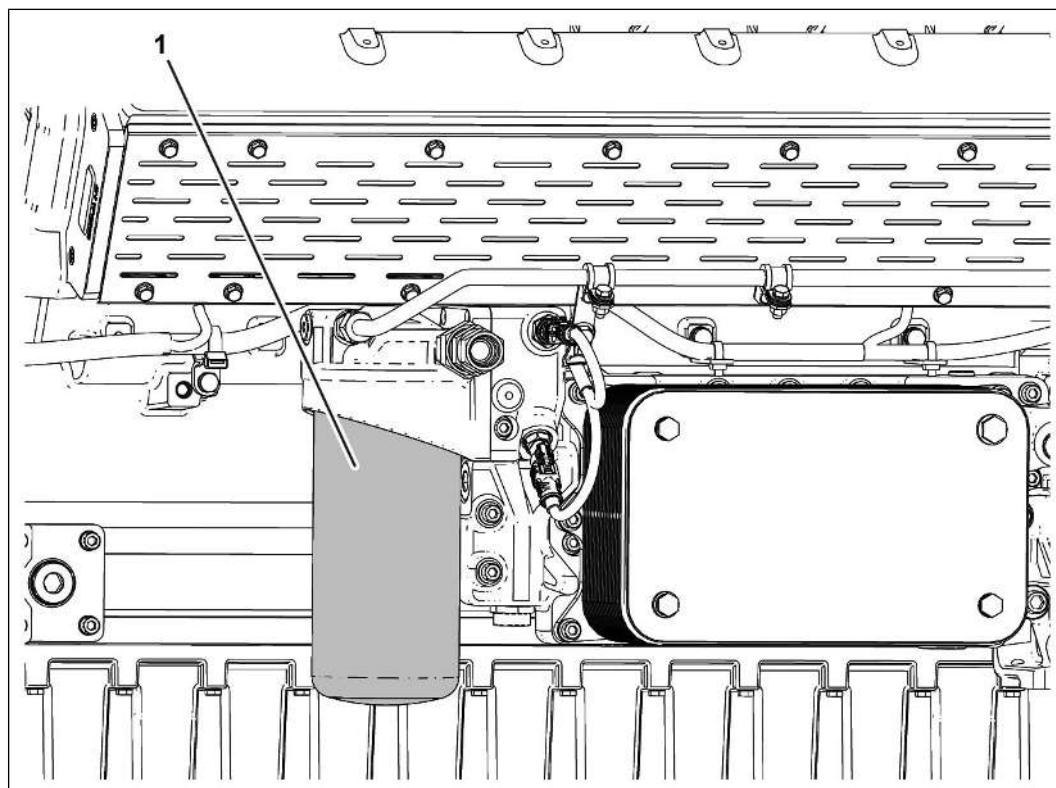


18014398819899275

Lube oil pressure sensor<sup>1)</sup> on crankcase

1 M12 x 1.5 10 Nm

<sup>1)</sup> Replace sealing ring.

**3.2.5 Lube oil filter****3.2.5.1 Technical data**

379318795

Lube oil filter on lube oil filter console

1

25 Nm

**3.2.6 Lube oil system****3.2.6.1 Technical data**

Pumping out time for extended oil circulation volume		
V8 engine	15 minutes	(900 s)
V12 engine	17.5 minutes	(1050 s)
V16 engine	20 minutes	(1200 s)
Pumping out time when the lube oil sump is full		
V8 engine	2.25 minutes	(135 s)
V12 engine	3.5 minutes	(210 s)
V16 engine	4.5 minutes	(270 s)

**3.2.7 Crankcase****3.2.7.1 Technical data**

Crankcase chamber pressure	
On commissioning	0 to -10 mbar

### 3.2.8 Cylinder head

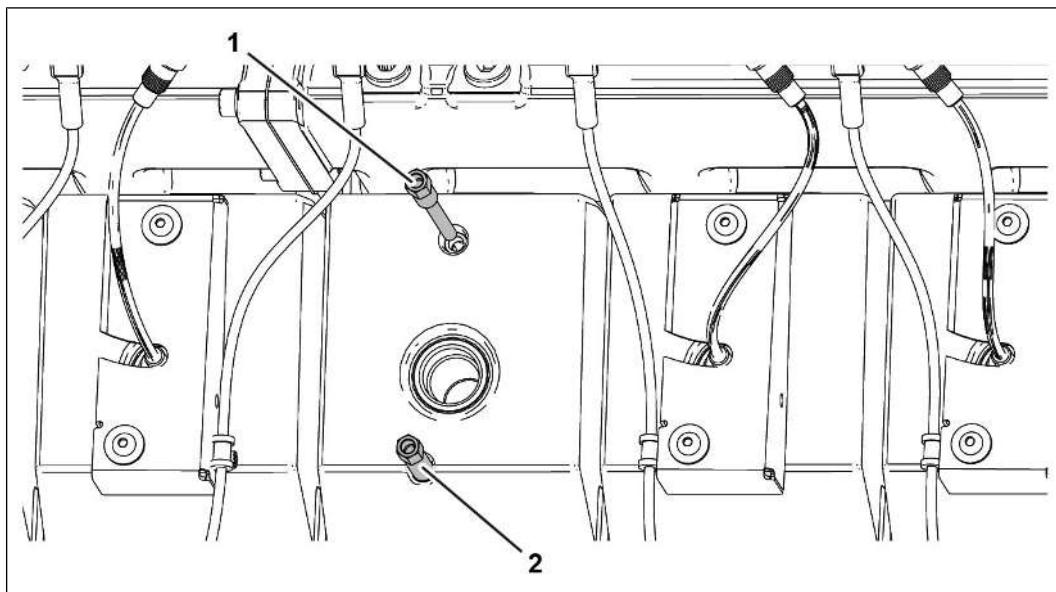
#### 3.2.8.1 Technical data

V8 engine valve setting	
Ignition TDC	A1 B2 A3 B1 A4 B3 A2 B 4
Overlap	A4 B3 A2 B4 A1 B2 A2 B 4
V12 engine valve setting	
Ignition TDC	A6 B2 A2 B4 A4 B1 A1 B 5 A5 B3 A3 B6
Overlap	A1 B5 A5 B3 A3 B6 A6 B 2 A2 B4 A4 B1
V16 engine valve setting	
Ignition TDC	A1 B3 A3 B7 A7 B5 A5 B 8 A8 B6 A6 B2 A2 B4 A4 B1
Overlap	A8 B6 A6 B2 A2 B4 A4 B 1 A1 B3 A3 B7 A7 B5 A5 B8

Table 1: Valve setting per engine

Valve clearance	
Inlet	0.3 mm
Outlet	0.7 mm

Table 2: Valve clearance



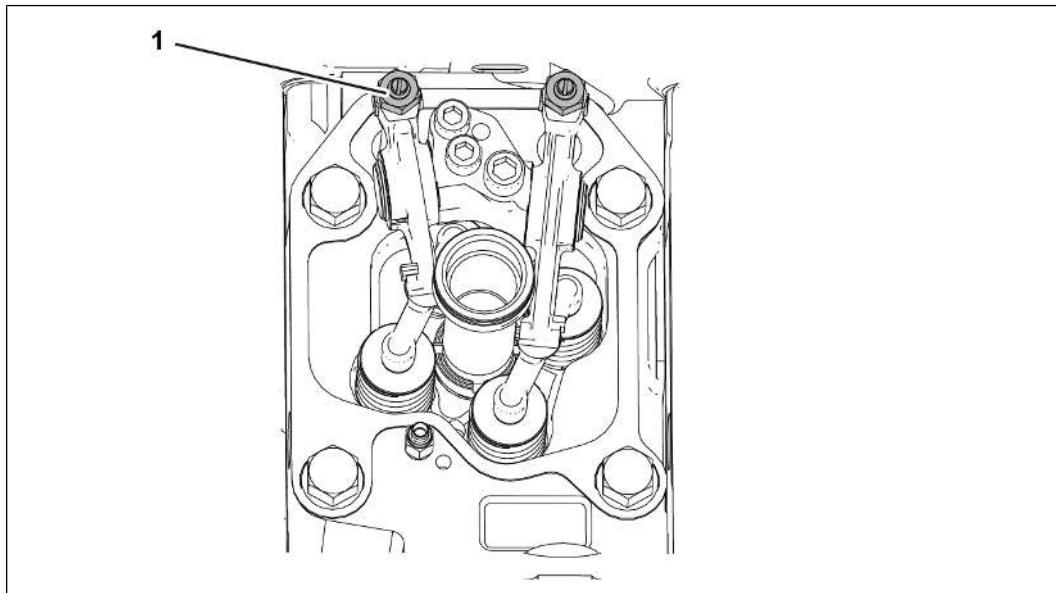
9007199562019595

Cylinder head cover on cylinder head<sup>1)</sup>

1	M8 x 80	25 Nm
---	---------	-------

2	M8 x 85	25 Nm
---	---------	-------

<sup>1)</sup> Replace sealing rings.



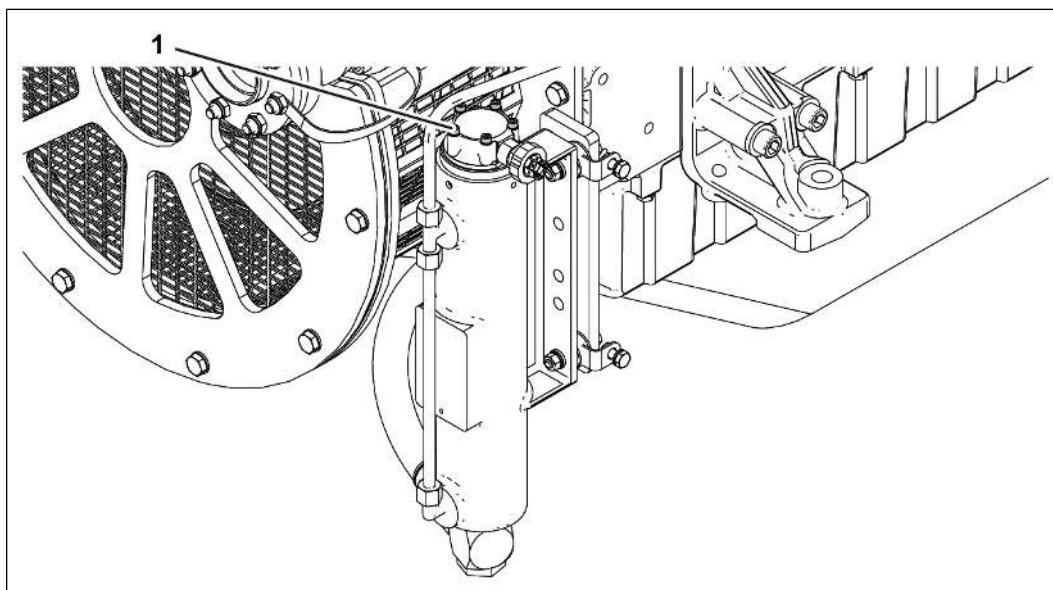
9007199561816331

## Lock nut on rocker arm

1	M10 x 1	45 Nm
---	---------	-------

### 3.2.9 Fill level probe

#### 3.2.9.1 Technical data



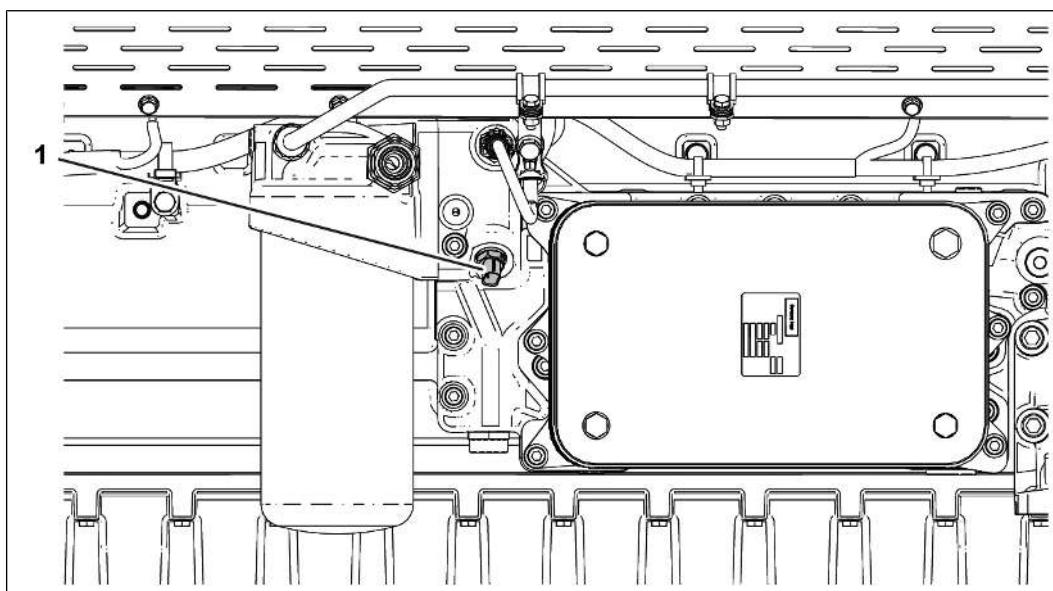
9007199564930315

Fill level probe on spacer

1	M5 x 35 – 10.9	1.5 Nm
---	----------------	--------

### 3.2.10 Temperature sensor

#### 3.2.10.1 Technical data

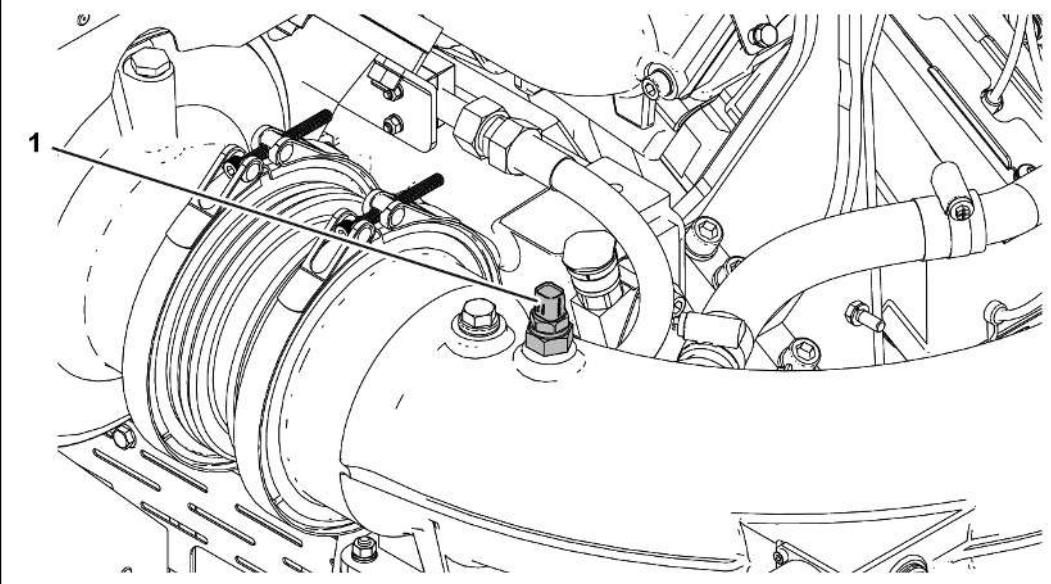


310518027

Lube oil temperature sensor<sup>1)</sup> on the lube oil filter console

1	$\frac{3}{4}$ – 16 – 2A	20 Nm
---	-------------------------	-------

<sup>1)</sup> Replace sealing ring.

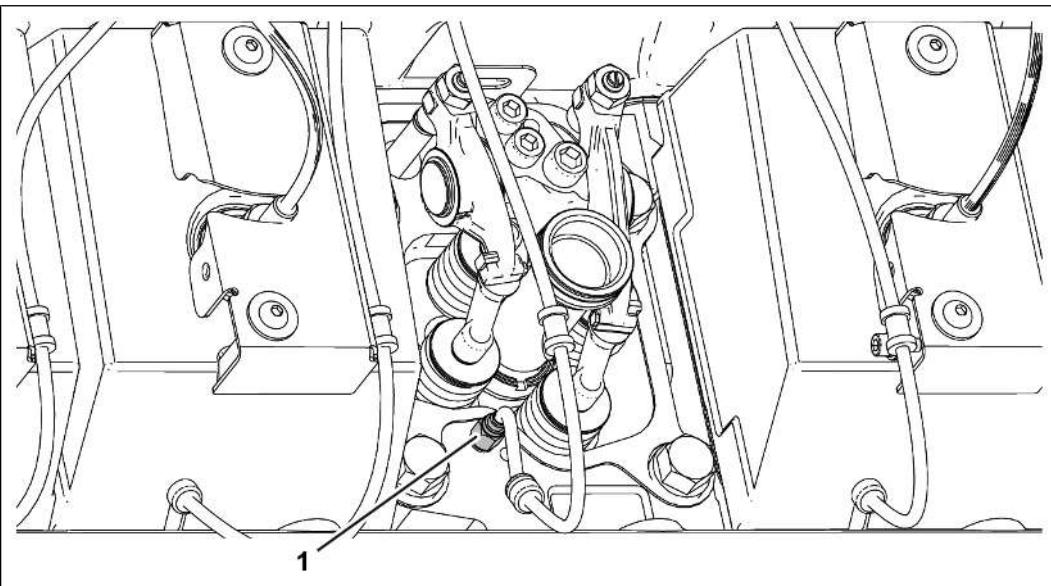


310736907

Mixture temperature sensor<sup>1)</sup> on mixture pipe

1	$\frac{3}{4}$ – 16 – 2A	20 Nm
---	-------------------------	-------

<sup>1)</sup> Replace sealing ring.

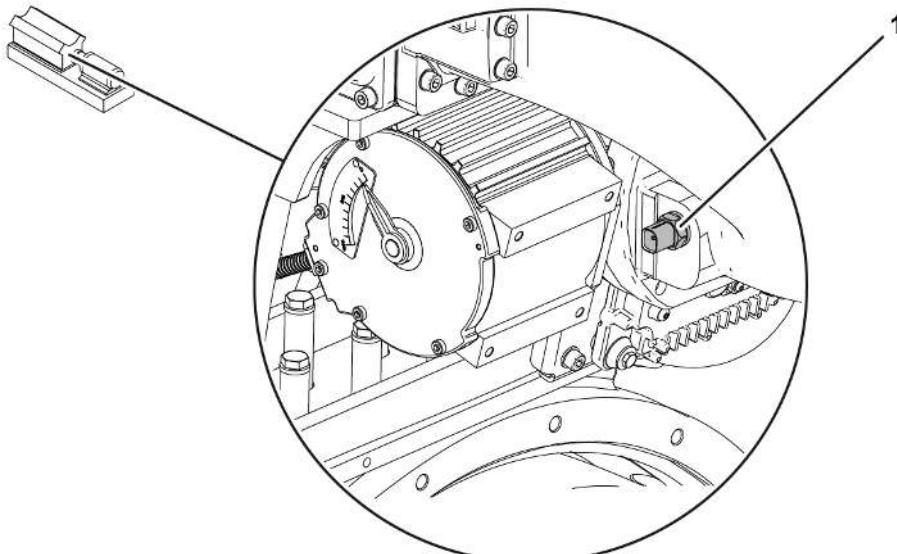


310873483

Combustion chamber temperature sensor<sup>1)</sup> on cylinder head

1 M12 x 1

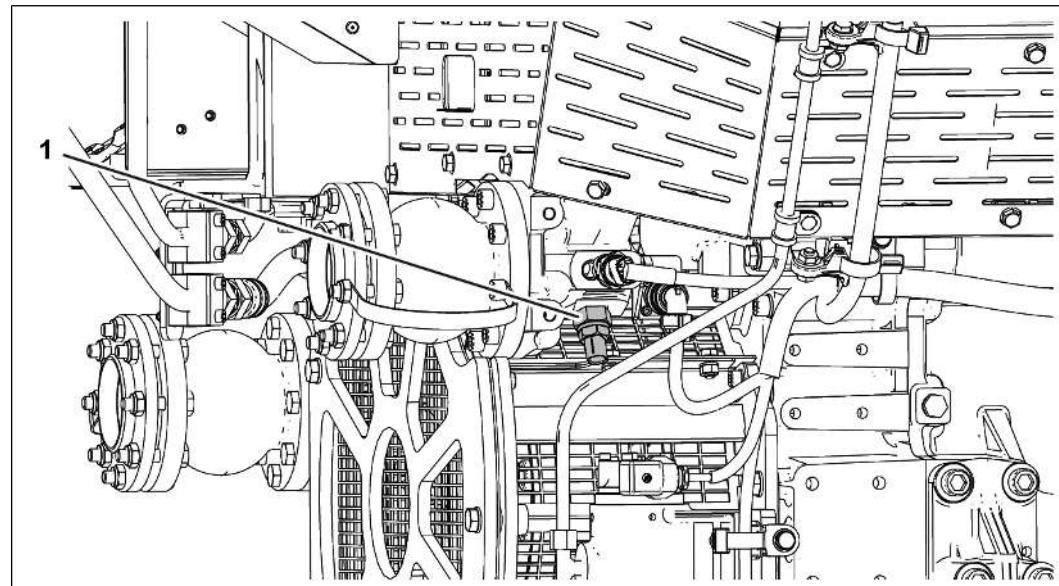
10 Nm

<sup>1)</sup> Replace sealing ring.

9007199566009227

Mixture temperature sensor<sup>1)</sup> on mixture cooler1  $\frac{3}{4}$  – 16 – 2A

20 Nm

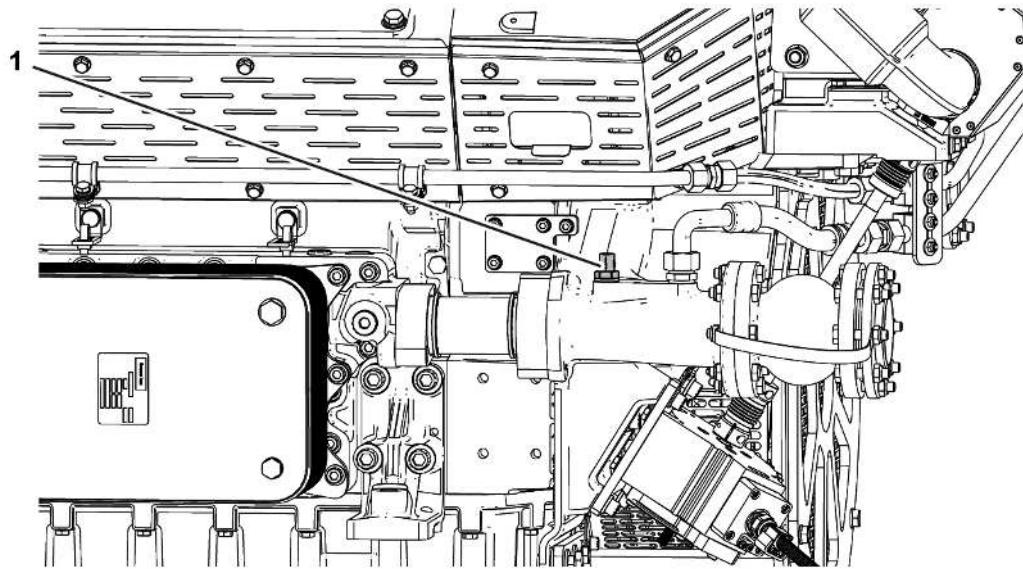
<sup>1)</sup> Replace sealing ring.

311390347

Coolant temperature sensor<sup>1)</sup> on coolant housing

1	$\frac{3}{4}$ – 16 – 2A	20 Nm
---	-------------------------	-------

<sup>1)</sup> Replace sealing ring.

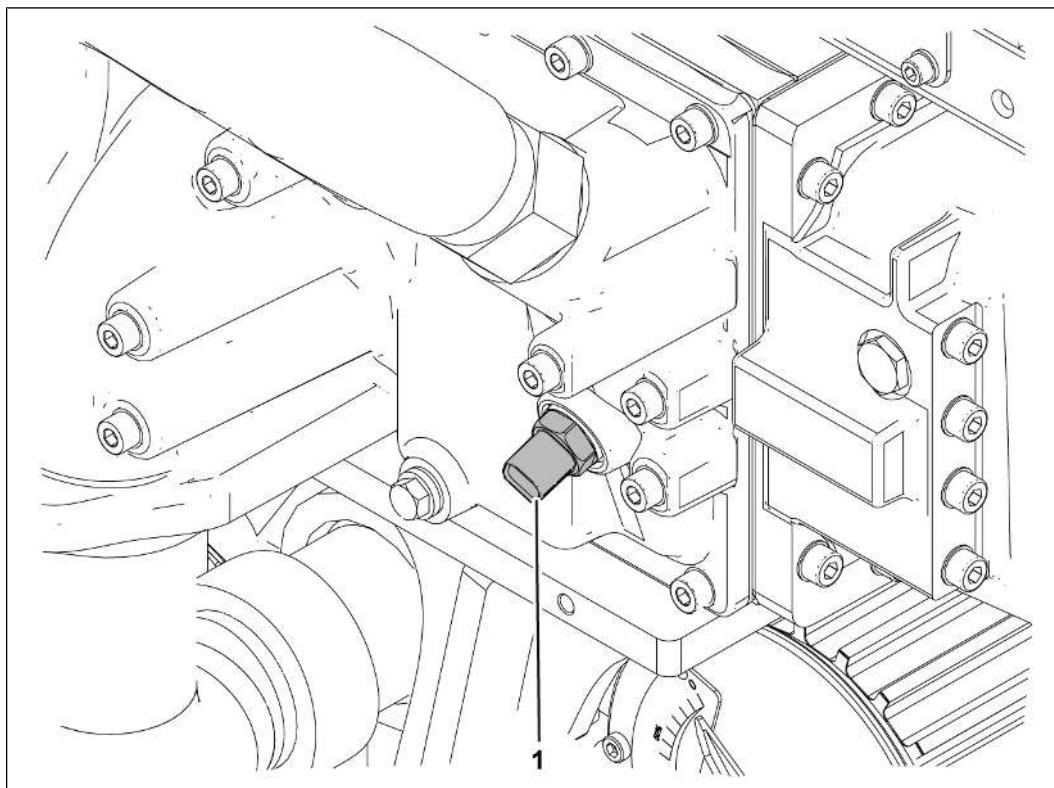


311507851

Coolant temperature sensor<sup>1)</sup> on coolant housing

1	$\frac{3}{4}$ – 16 – 2A	20 Nm
---	-------------------------	-------

<sup>1)</sup>Renew sealing ring



327482379

Coolant temperature sensor<sup>1)</sup> on mixture cooler

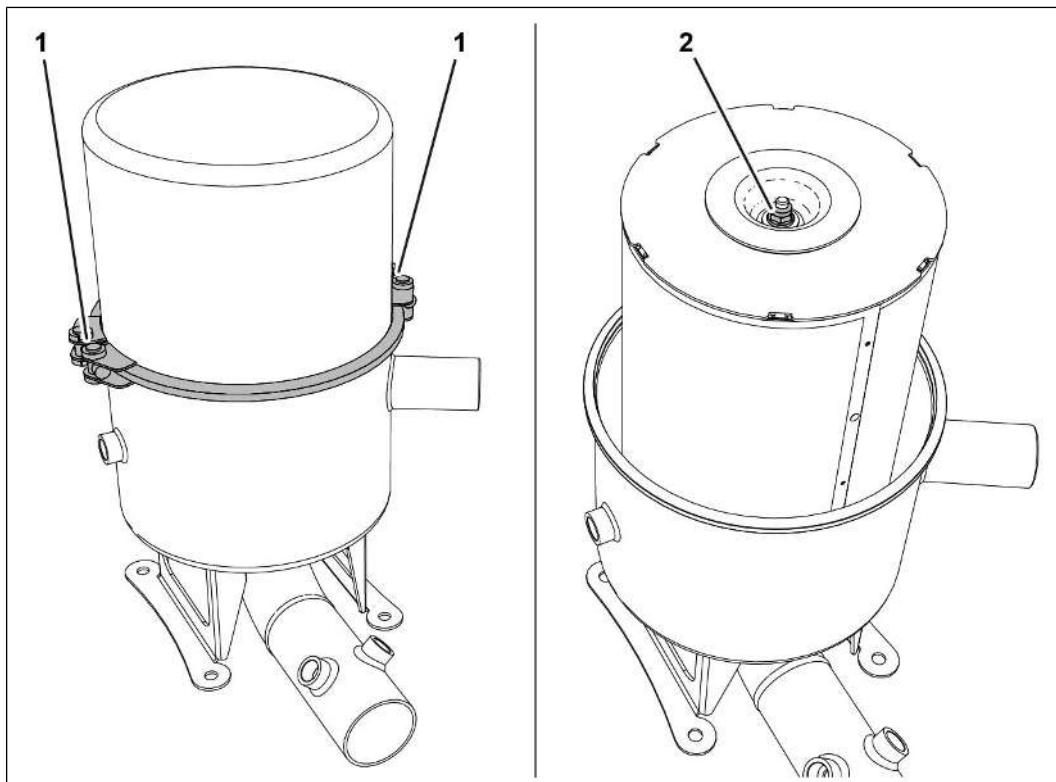
1	$\frac{3}{4}$ – 16 – 2A	20 Nm
---	-------------------------	-------

<sup>1)</sup> Replace sealing ring.

### 3.2.11 Crankcase ventilation

Part number: (null)

#### 3.2.11.1 Technical data



376914827

##### Clamping clip on filter housing

1	M10	Hand tight
---	-----	------------

##### Nut on filter housing

2	M8 x 60	10 Nm
---	---------	-------

##### Differential pressure via crankcase ventilation (UPF)

Rated value	-2 to -4 mbar
Limit value <sup>1)</sup>	0 mbar

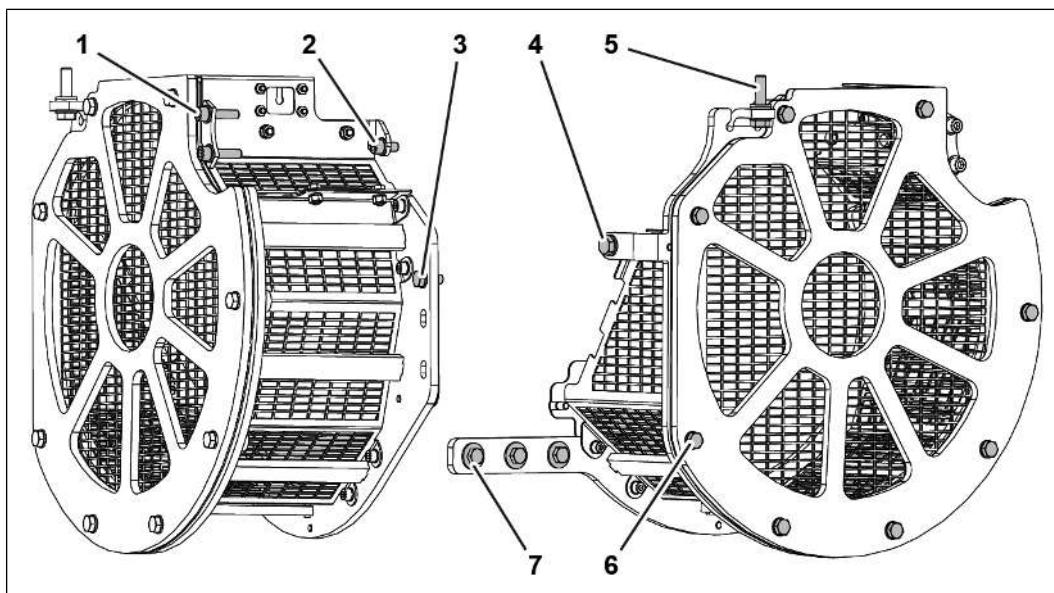
##### Separation quality

measured after filter insert	max. 2 mg/m <sup>3</sup>
------------------------------	--------------------------

<sup>1)</sup> Replace the filter insert after limit value is reached

### 3.2.12 Torsional vibration damper guard

#### 3.2.12.1 Technical data

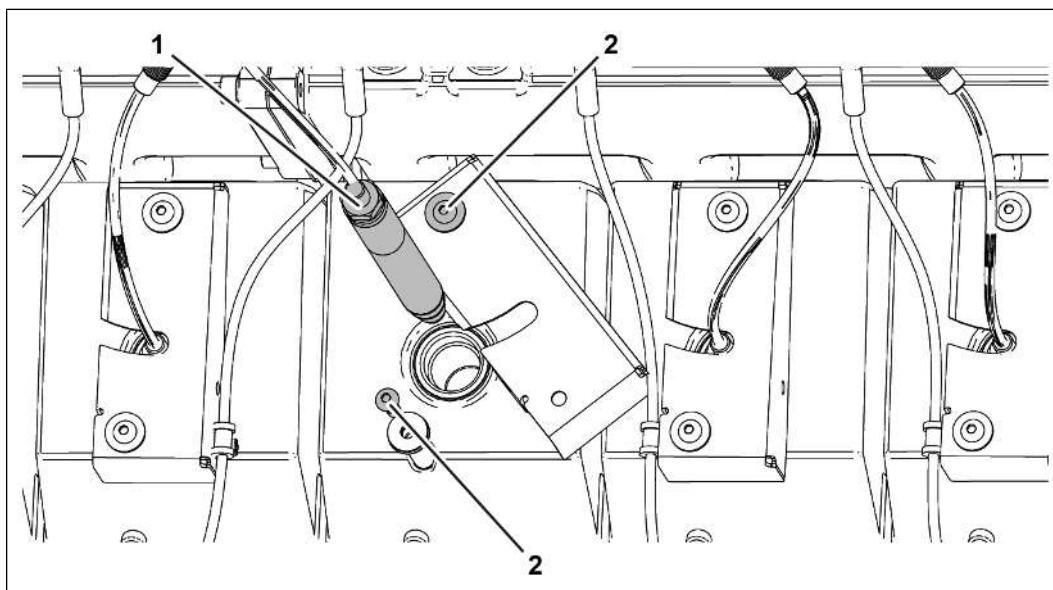


9007199564058379

Torsional vibration damper guard on crankcase		
1	M10 x 40 – 10.9	60 Nm
2	M10 x 20 – 10.9	60 Nm
3	M10 x 25 – 10.9	60 Nm
4	M12 x 30 – 10.9	110 Nm
5	M12 x 50 – 10.9	110 Nm
6	M10 x 40 – 10.9	23 Nm
7	M10 x 30 – 10.9	60 Nm

### 3.2.13 Spark plug

#### 3.2.13.1 Technical data



307281035

##### Spark plug in spark plug sleeve<sup>1)</sup>

1	M18 x 1.5	50 Nm
---	-----------	-------

##### Fall protection on cylinder head cover

2	M8 x 25	12 Nm
---	---------	-------

<sup>1)</sup> Replace sealing ring.

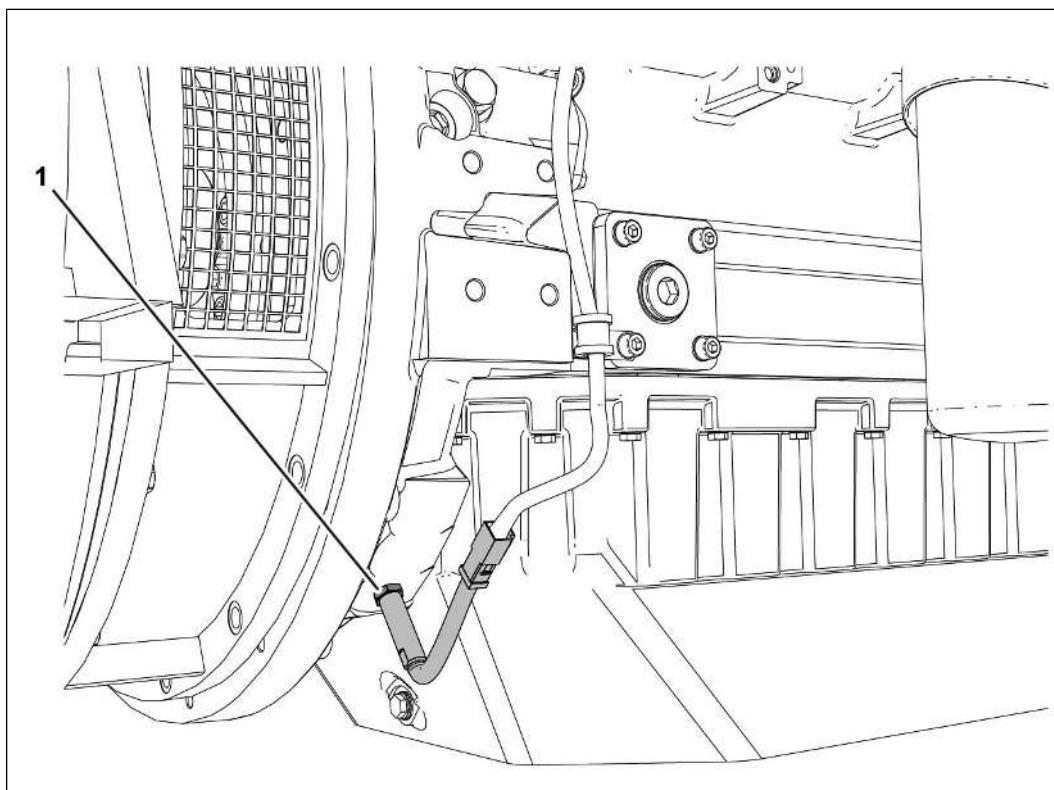
##### Spark plug (short-circuit test)

Spark plug socket against spark plug body	Infinite kOhm
--	---------------

##### Sealing ring

Sealing ring thickness <sup>1)</sup>	1.9 mm
--------------------------------------	--------

<sup>1)</sup> If the value is below the specified value, replace sealing ring.

**3.2.14 Crankshaft sensor****3.2.14.1 Technical data**

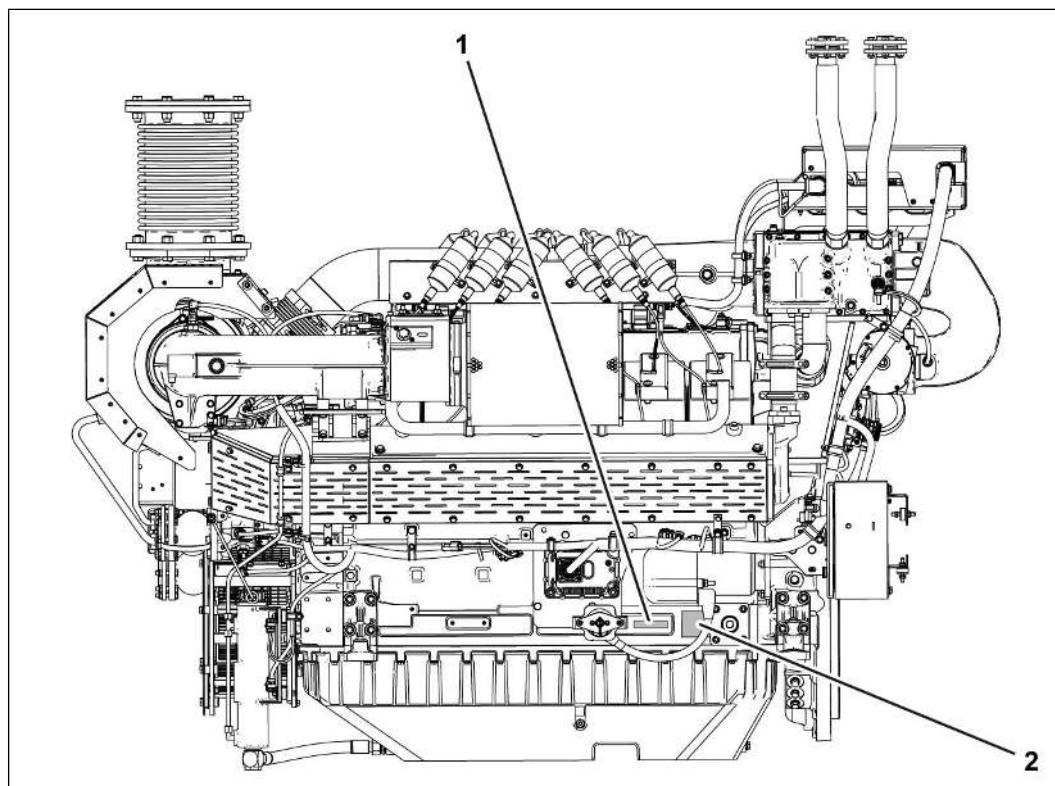
9007199595252747

Lock nut for crank speed sensor on flywheel housing			
1	M18 x 1 - A2K	Type Jaquet (PN 1232 4043)	30 Nm
	G5/8 - 18 - 2A	Type FAH13 (PN 1232 4415)	25 Nm

Crank speed sensor (PN 1232 4043)	
Start position	Screw in the crank speed sensor until it rests on the flywheel.
Setting or positioning	Unscrew by 0.75 of a turn (270°).
	The marking on the sensor is pointing in the direction of rotation of the flywheel.
Crank speed sensor (PN 1232 4415)	
Start position	Screw in the crank speed sensor until it rests on the flywheel.
Setting or positioning	Unscrew by 2/3 of a turn (240°). That is the equivalent of turning by 4 corners of the hexagon.
	The marking on the sensor is pointing in the direction of rotation of the flywheel.

### 3.2.15 Engine

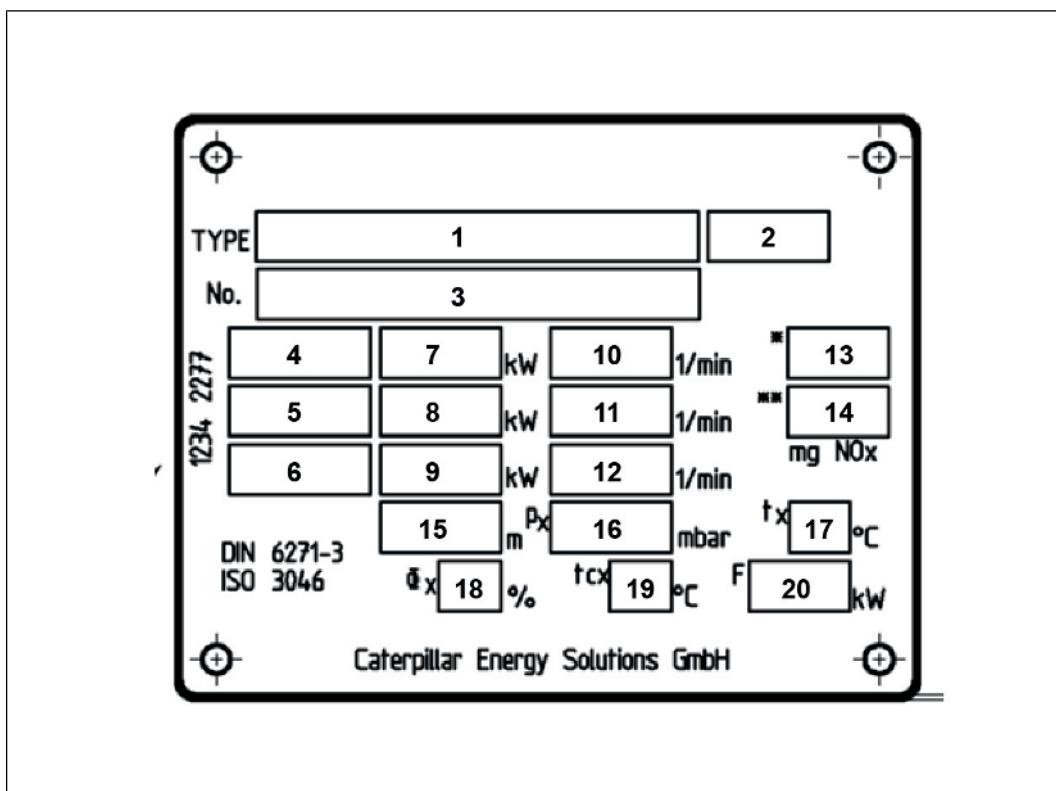
#### 3.2.15.1 Engine rating plate



9007199804921867

1 Engine number

2 Rating plate



397495435

- 
- 1 Designation of engine design
  - 2 Year of construction
  - 3 Engine number
  - 4 Power code according to DIN ISO 3046 Part 7 and power code for the gas type,  
see Information on the power codes
  - 5 As position 4
  - 6 As position 4
  - 7 Power (kilowatts)
  - 8 As position 7
  - 9 As position 7
  - 10 Engine speed (revolutions per minute)
  - 11 As position 10
  - 12 As position 10
  - 13 Nitrous oxide emission (milligram)
  - 14 As position 13
  - 15 Maximum installation height (meters)
  - 16 Air pressure at the installation location (millibar)
  - 17 Charge air coolant temperature at the installation location (degree Celsius)
  - 18 Relative humidity at the installation location (percent)
  - 19 Mixture coolant temperature at the installation location (degree Celsius)
  - 20 Lube oil pump power (kilowatts)

### Information on the power codes

In this document, the following power codes are used:

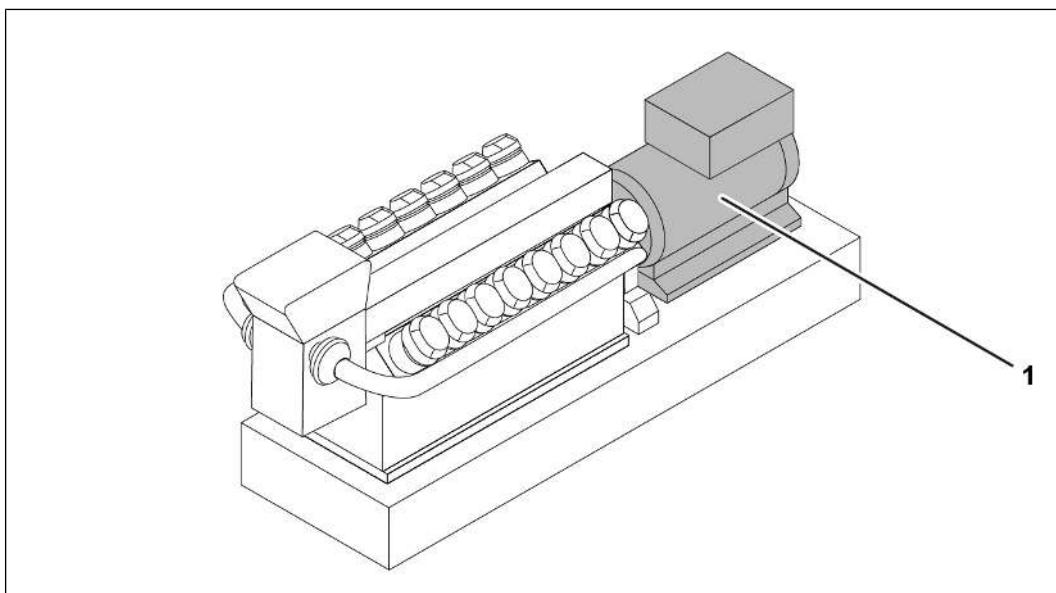
- b = Biogas
- n = Natural gas
- s = Sewage gas
- l = Landfill gas
- m = Mine gas
- p = Propane gas

The symbols \* or \*\* before the power codes refer to the corresponding nitrous oxide emission, refer to positions 13 and 14.

### 3.2.16 Generator

Part number: (null)

#### 3.2.16.1 Generator rating plate



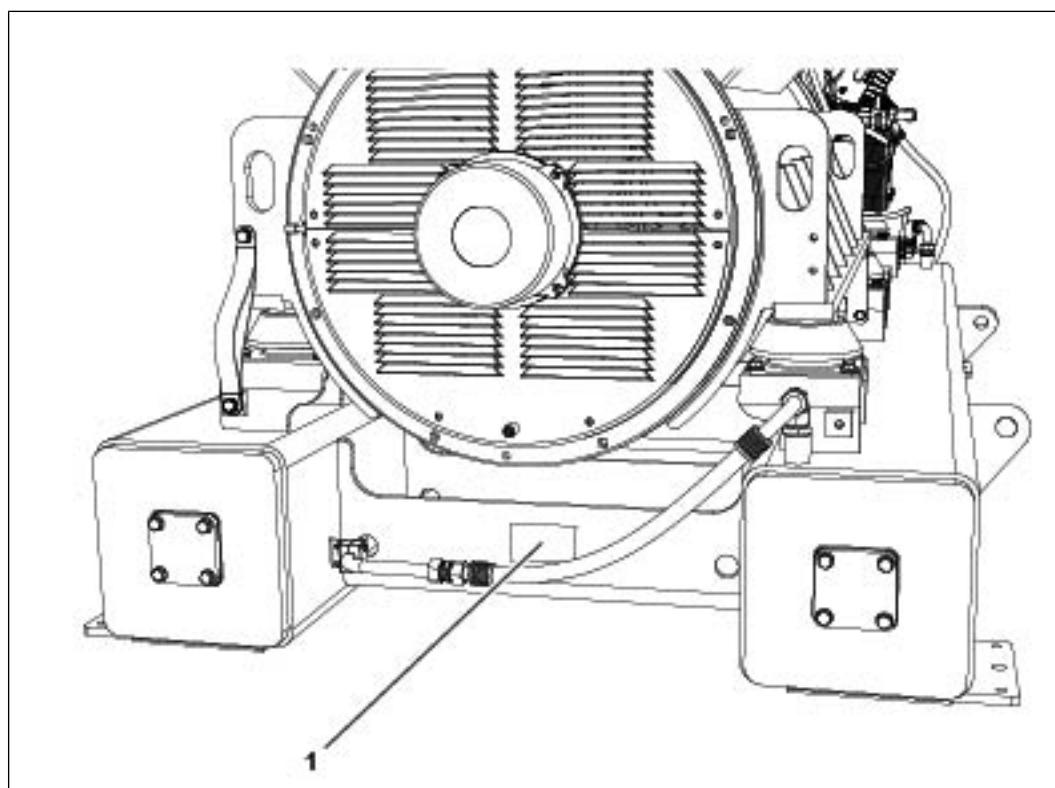
397672203

1 Generator side with rating plate

The description of the rating plate is included in the corresponding component documentation, see *order-specific operating manual, chapter Technical data, section Generator*.

### 3.2.17 Base frame

#### 3.2.17.1 Base frame rating plate



1647261323

1 Rating plate

TYPSCHILD GRUNDRAHMEN	
GR-TEILE-NR.	: 1 KZ
GR-ZEICHNG.-NR.	: 2 UA/Ind.
FERTIGGEWICHT	: 3 KG
DRUCKPRÜFUNG	: 4 bar
FABRIK-NR. LIEF.	: 5
BAUMON./-JAHR	: 6 /

605088267: Rating plate

- 1 Base frame part number
- 2 Drawing number
- 3 Finished weight or empty weight for base frame with lube oil tank (kilograms)
- 3 Pressure test (bar)
- 5 Manufacturer's serial number
- 6 Year of construction (month/year)

### 3.2.18 Ignition system

#### 3.2.18.1 Technical data

<b>Global ignition angles at 50 Hz for standard gases</b>	
<b>Configuration</b>	<b>Global ignition angle</b> [° crankshaft before top dead center]
P	23
S	23
X	27

<b>Global ignition angles at 60 Hz for standard gases</b>	
<b>Configuration</b>	<b>Global ignition angle</b> [° crankshaft before top dead center]
P	27
S	----
X	29

<b>Global ignition angles at 50 Hz for natural gases with hydrogen</b> <b>(Configuration P+ and S+)</b>	
<b>Hydrogen content of natural gas</b> [Vol. % H <sub>2</sub> ]	<b>Global ignition angle</b> [° crankshaft before top dead center]
0 %	23
up to 5 %	21
up to 10 %	19
up to 15 %	17
up to 20 %	16
up to 25 %	14

<b>Global ignition angles at 60 Hz for natural gases with hydrogen (Configuration P+)</b>	
<b>Hydrogen content of natural gas</b>	<b>Global ignition angle</b>
<b>[Vol. % H<sub>2</sub>]</b>	<b>[° crankshaft before top dead center]</b>
0 %	27
up to 5 %	25
up to 10 %	23
up to 15 %	21
up to 20 %	20
up to 25 %	18

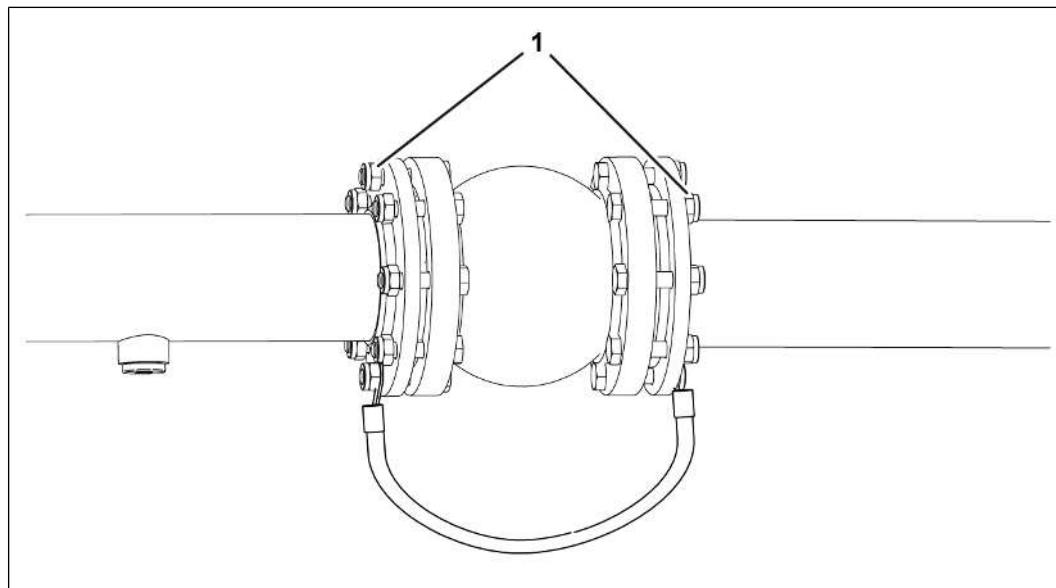
<b>Global ignition angles at 50 Hz for sewage gas, landfill gas and other biogases (Configuration X)</b>	
<b>Methane content of biogas</b>	<b>Global ignition angle</b>
<b>[Vol. % CH<sub>4</sub>]</b>	<b>[° crankshaft before top dead center]</b>
up to 55 %	28
up to 60 %	26
from 60 %	24

<b>Global ignition angles at 60 Hz for sewage gas, landfill gas and other biogases (Configuration X)</b>	
<b>Methane content of biogas</b>	<b>Global ignition angle</b>
<b>[Vol. % CH<sub>4</sub>]</b>	<b>[° crankshaft before top dead center]</b>
up to 55 %	30
up to 60 %	29
from 60 %	28

### 3.2.19 Rubber expansion joint

#### 3.2.19.1 Technical data



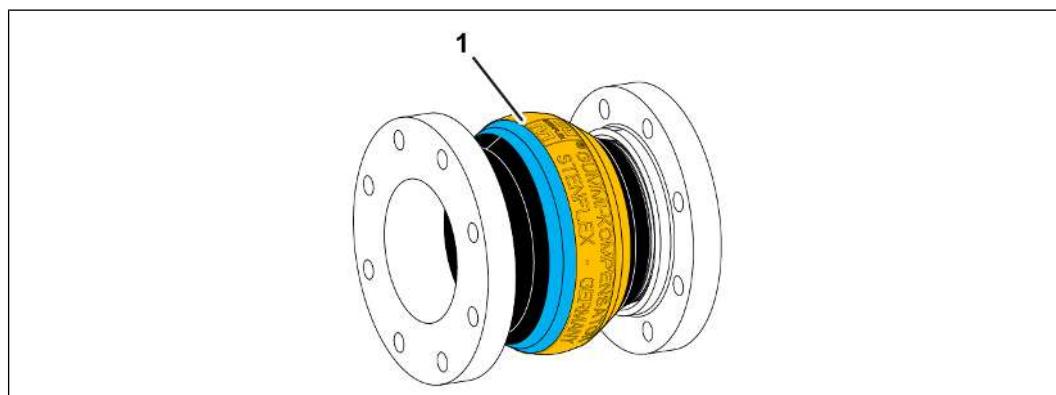
309646219

Rubber expansion joint on flange		
1	DN 40/50	15 Nm
	DN 65/80/100/125	20 Nm
	DN 150	25 Nm

#### 3.2.19.2 Rating plate

The expansion joint's rubber bellows are highlighted with a color field.

The colors mark the permissible area of use.



9007202899425675

1	Color field	Orange / blue
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Operating medium	Coolant
Material (interior / exterior)	EPDM / CR

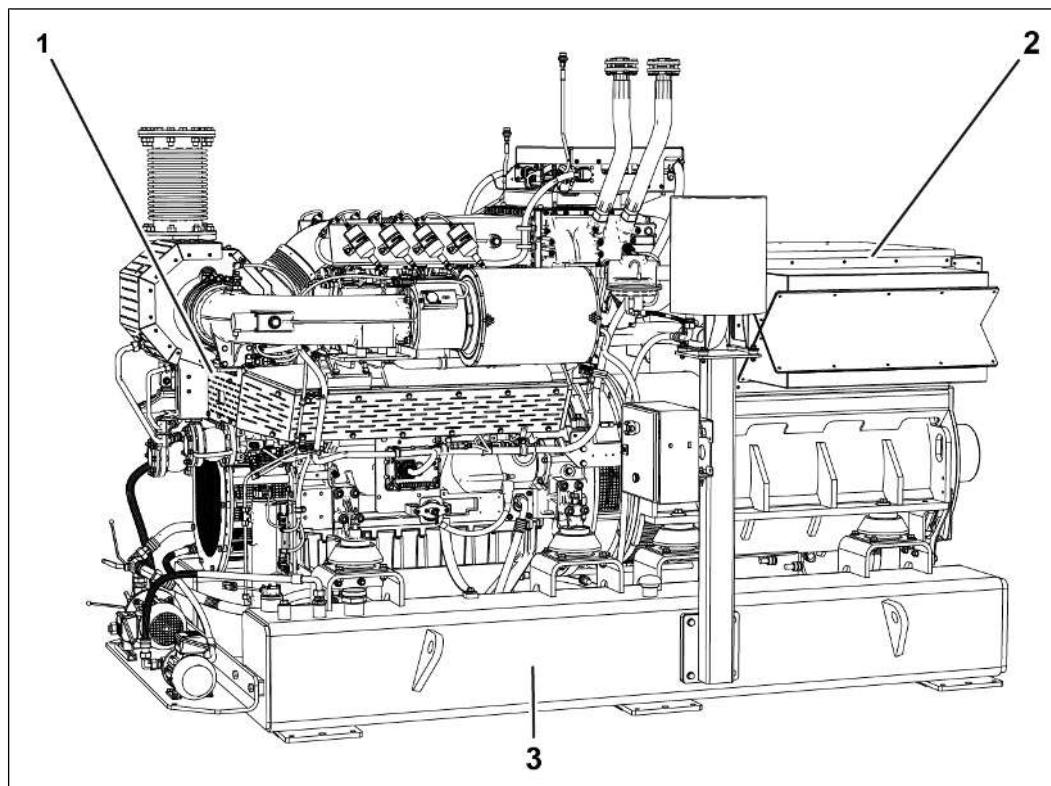


## 4 Structure and function

### 4.1 Genset

#### 4.1.1 Genset

##### 4.1.1.1 Functional description



2786611595

- 1 Engine
- 2 Generator
- 3 Base frame

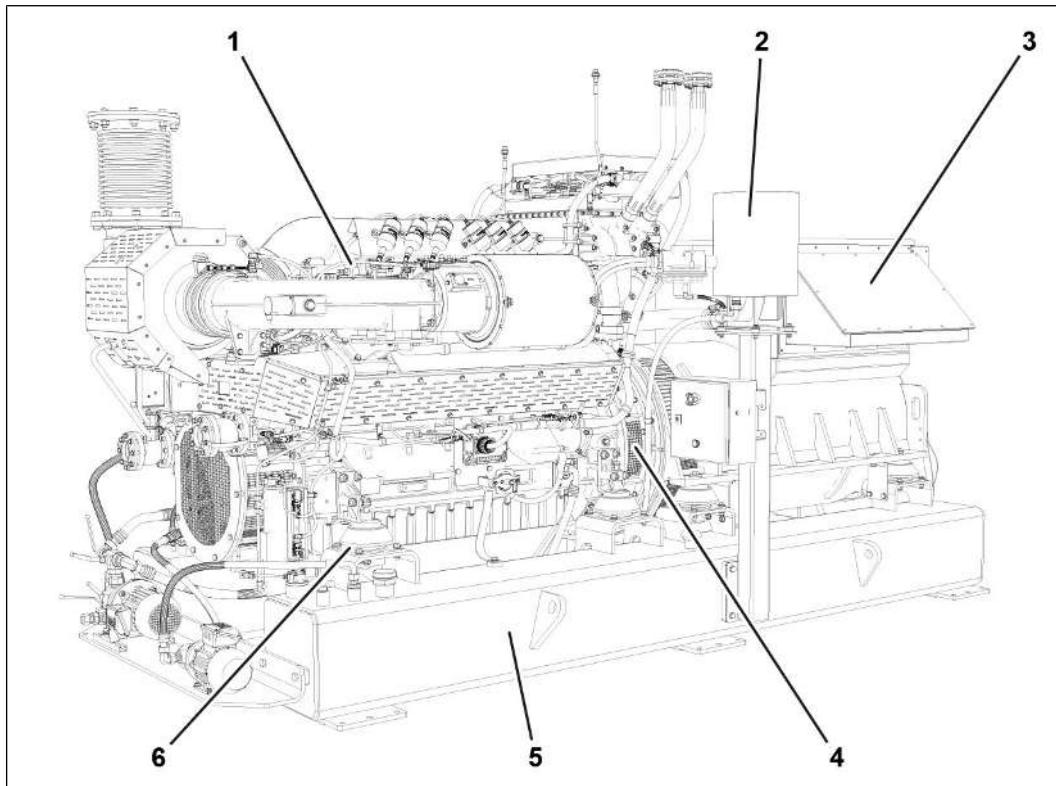
The genset consists of an engine and a generator, which are mounted on a base frame.

The genset generates electric current and heat from the fuel gas it runs on.

A generator converts the mechanical energy of the combustion process into electrical energy.

The electrical energy can either be consumed directly or fed into the electric grid.

#### 4.1.1.2 Assemblies



9007199643646731: Genset with V12 engine; V8 and V16 are similar

- 1 Engine
- 2 Crankcase ventilation
- 3 Generator
- 4 Coupling
- 5 Base frame
- 6 Anti-vibration mounting

The genset consists of the following main assemblies:

- Engine
  - Intake air system
  - Exhaust system
  - Fuel gas system
  - Lube oil system
  - Cooling system
  - Electrical system
- Crankcase ventilation
- Generator
- Coupling

- Base frame
- Anti-vibration mounting

#### 4.1.1.3 Speed control

The [electronic control](#) [▶ 56] regulates the speed. A speed sensor detects the actual speed. The electronic control compares the sensor signal of the actual speed with the active set speed. The electronic control compensates for speed deviations by adjusting the actuator. The actuator is connected to the [throttle valve](#) [▶ 66]. The throttle valve affects the engine.

Speed control by the electronic control is only possible when idle and in island operation. When idle and in grid-parallel operation, the engine should run at a constant speed. Load changes of the consumers cause speed changes. As long as the load changes of the consumers are small enough, the speed changes caused by them are completely compensated for by the electronic control. The power controller is deactivated.

For detailed notes and information on speed control and power control, see *Operating Manual, chapter Operation, section Control*.

#### 4.1.1.4 Power control

The power control takes place electromechanically. Here, an actuator adjusts the [throttle valve](#) [▶ 66]. The [electronic control](#) [▶ 56] regulates the actuator. Power control is possible only in mains parallel mode.

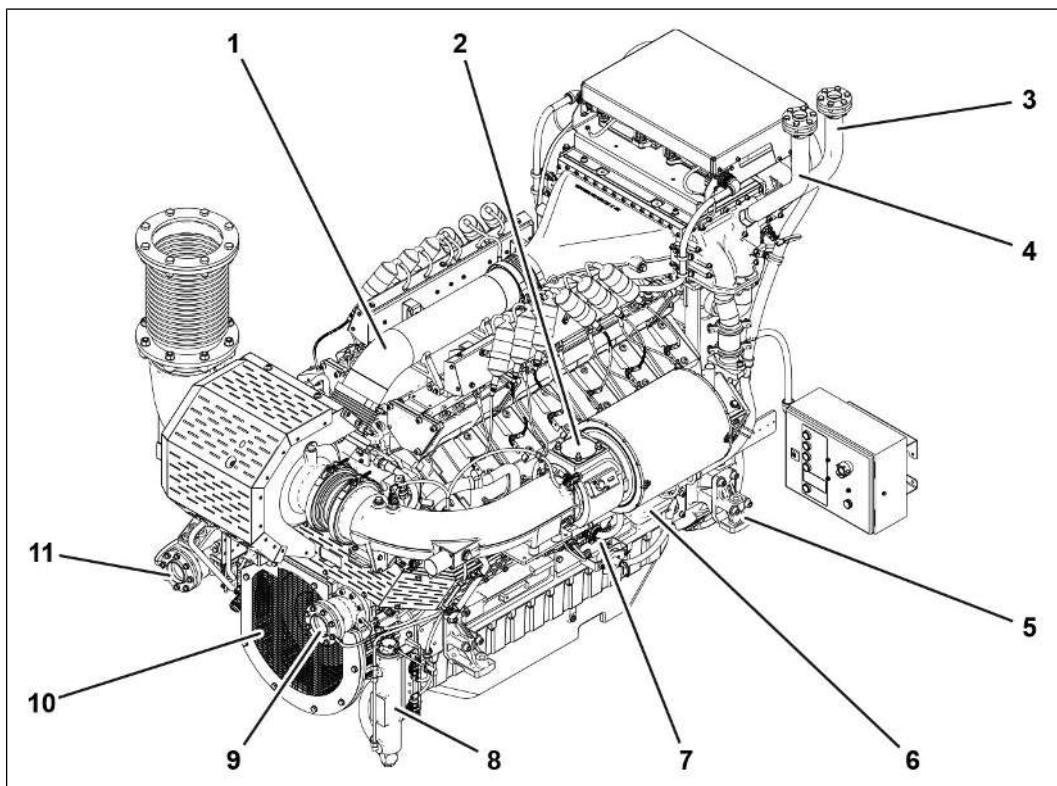
For detailed notes and information about power control, see *Operating Manual, chapter Operation, section Control*.

The power is controlled in pre-defined load steps. The power controller is activated. For detailed information on load steps, see *Operating Manual, chapter General, section Installation directive*.

## 4.2 Engine

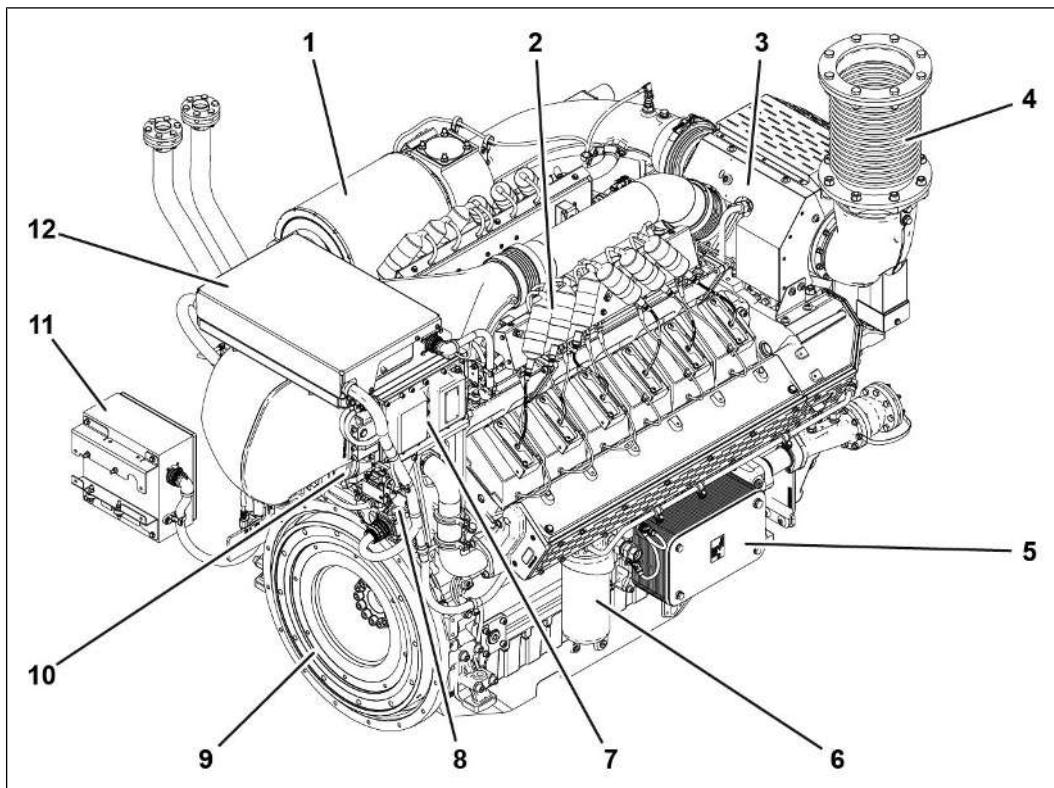
### 4.2.1 Engine

#### 4.2.1.1 Assembly overview



18014398898447115: Cylinder side A: V12 engine; V8 and V16 engines are similar

- 1 Mixture pipe
- 2 Gas-air mixer
- 3 Coolant inlet (mixture cooling circuit)
- 4 Coolant outlet (mixture cooling circuit)
- 5 Lug
- 6 Starter
- 7 Gas-air mixer output stage control device
- 8 Lube oil level sensor
- 9 Coolant outlet expansion joint (engine cooling circuit)
- 10 Torsional vibration damper guard
- 11 Coolant inlet expansion joint (engine cooling circuit)



18014398898440715: Cylinder side B: V12 engine; V8 and V16 engines are similar

- 1 Intake air filter
- 2 Ignition coil
- 3 Exhaust turbocharger
- 4 Exhaust expansion joint
- 5 Lube oil cooler
- 6 Lube oil filter
- 7 Mixture cooler
- 8 Throttle valve/wastegate output stage control device
- 9 Flywheel
- 10 Actuator
- 11 TPEM Connection Box
- 12 Holder for main control device and auxiliary control device

#### 4.2.1.2 Functional description

The engine is a liquid-cooled four-stroke gas engine. The gas type depends on the location and operational area of the engine. The permissible gas type is indicated on the rating plate of the engine.

The engine drives the generator. The engine is connected to the generator shaft by a coupling.

## 4.2.2 Rubber expansion joint

### 4.2.2.1 Functional description

#### General information

The piping from the genset is connected to the plant piping by means of a rubber expansion joint.

Different rubber expansion joints are used for the lube oil system and the cooling system.

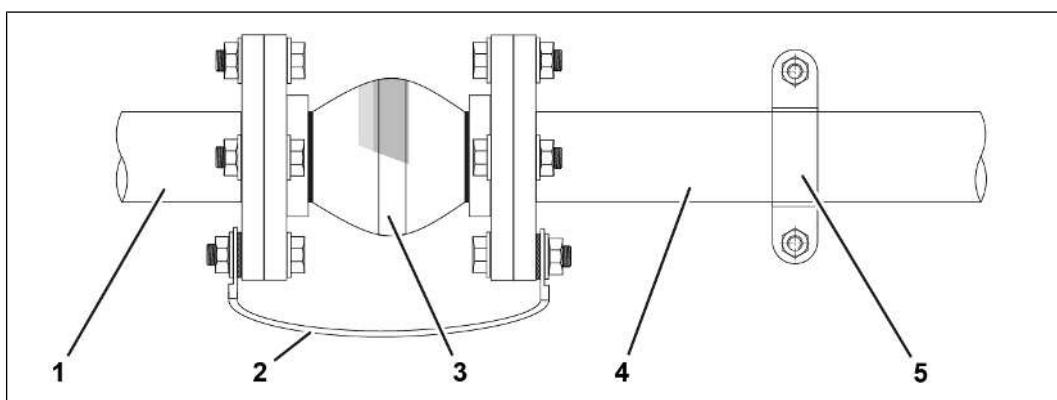
- The rubber expansion joints for the cooling system have an orange-and-blue marking.
- The rubber expansion joints for the lube oil system have a red-and-blue marking.

#### Rubber expansion joint for coolant

**Note:** The rubber expansion joint is not intended to compensate for assembly inaccuracies.

The rubber expansion joint has the following tasks:

- Isolation of the vibrations of the elastically-mounted genset from the installed piping fixed in the plant.
- Reduction of the thermal and mechanical stresses in piping and the system components thereof.
- Vibration and noise damping.
- Absorption of axial, lateral and angular movements while in operation.



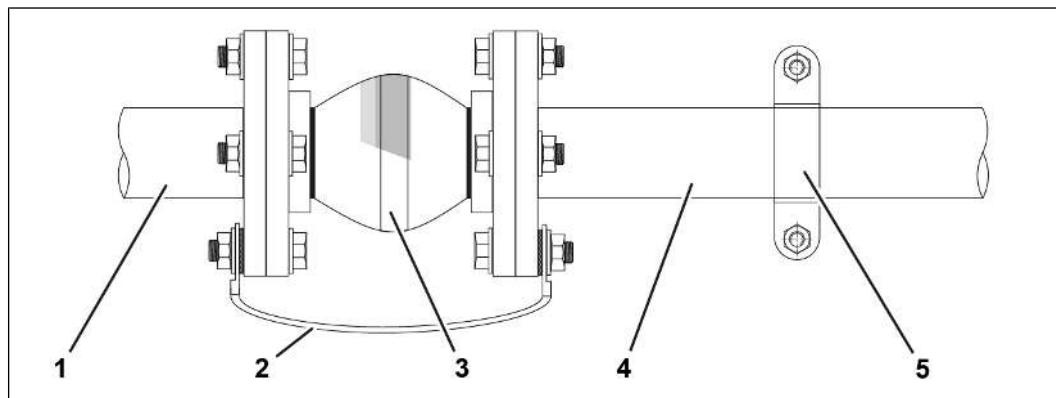
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### Rubber expansion joint for lube oil

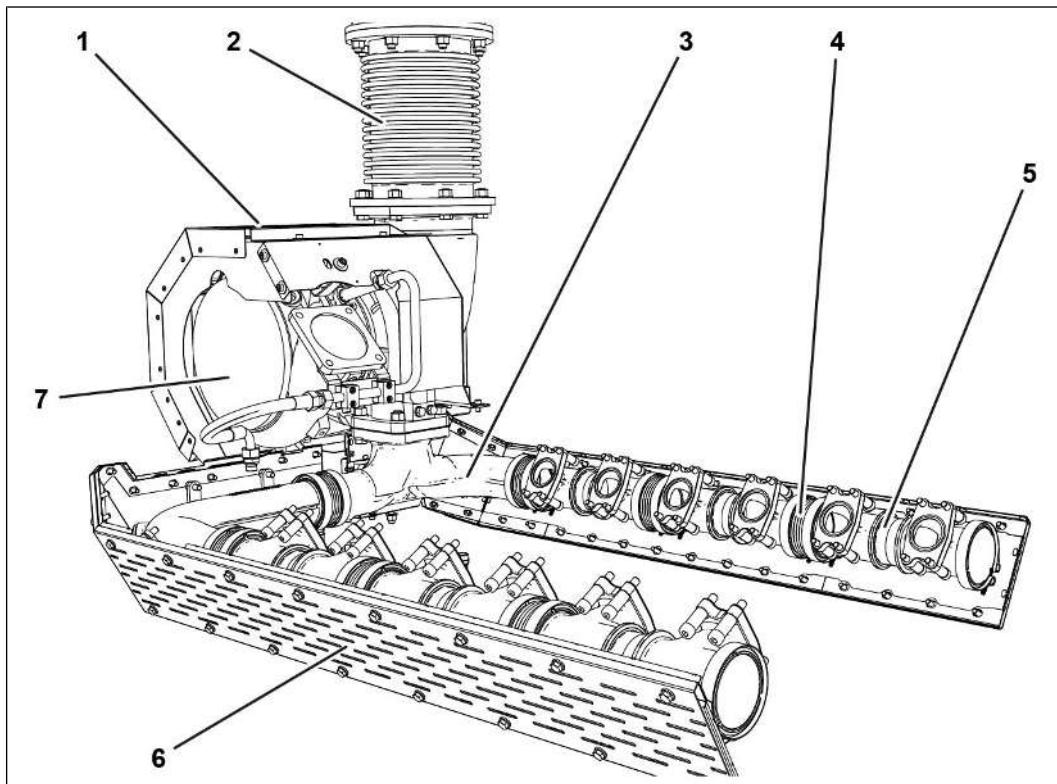
**Note:** The rubber expansion joint is not intended to compensate for assembly inaccuracies.

The rubber expansion joint has the following tasks:

- Isolation of the vibrations of the elastically-mounted genset from the installed piping fixed in the plant.
- Reduction of the thermal and mechanical stresses in piping and the system components thereof.
- Vibration and noise damping.
- Absorption of axial, lateral and angular movements while in operation.



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**4.2.3 Exhaust system****4.2.3.1 Exhaust system****Functional description**

9007199645536011

- 1 Exhaust turbocharger cover
- 2 Exhaust expansion joint
- 3 Exhaust manifold
- 4 Expansion joint
- 5 Exhaust pipe
- 6 Contact protection
- 7 Exhaust turbocharger

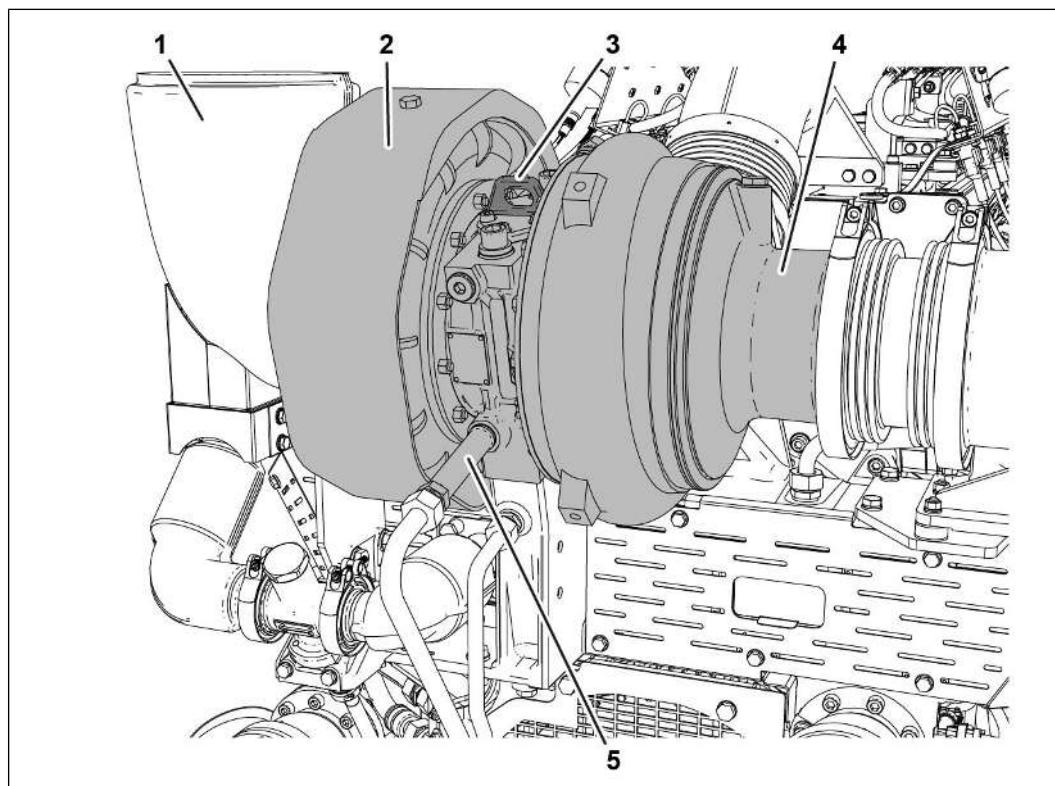
Exhaust gas is produced during the combustion of the gas-air mixture.

The exhaust manifold and the exhaust pipes direct the exhaust gases out of the cylinders and into the atmosphere. The exhaust turbocharger is connected to an exhaust expansion joint and exhaust pipe via an exhaust manifold.

Depending on the genset design, the exhaust system may be equipped with a wastegate.

#### 4.2.3.2 Exhaust turbocharger

##### Functional description

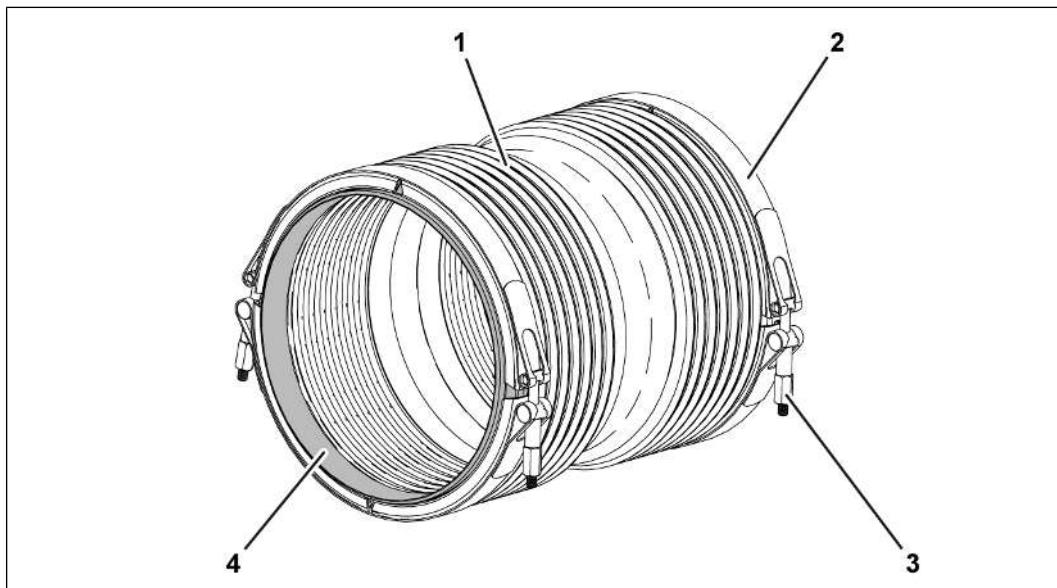


9007199745329035

- 1 Exhaust manifold
- 2 Exhaust turbocharger
- 3 Lifting lug
- 4 Inlet connecting piece
- 5 Coolant connection

The exhaust turbocharger uses the exhaust energy and compresses the gas-air mixture (mixture turbocharging). The mixture turbocharging enables a higher level of performance of the engine, while at the same time reducing pollutant emissions.

Since the temperature of the gas-air mixture increases drastically when it is compressed by the exhaust turbocharger, a mixture cooler is assembled upstream of the mixture pipe. The mixture cooler cools the gas-air mixture to the set temperature before the gas-air mixture enters the cylinders through the mixture pipe and the inlet valves. The exhaust gas flows out of an output and into the atmosphere via the exhaust pipe and the exhaust muffler.

**4.2.3.3 Exhaust expansion joint****Functional description**

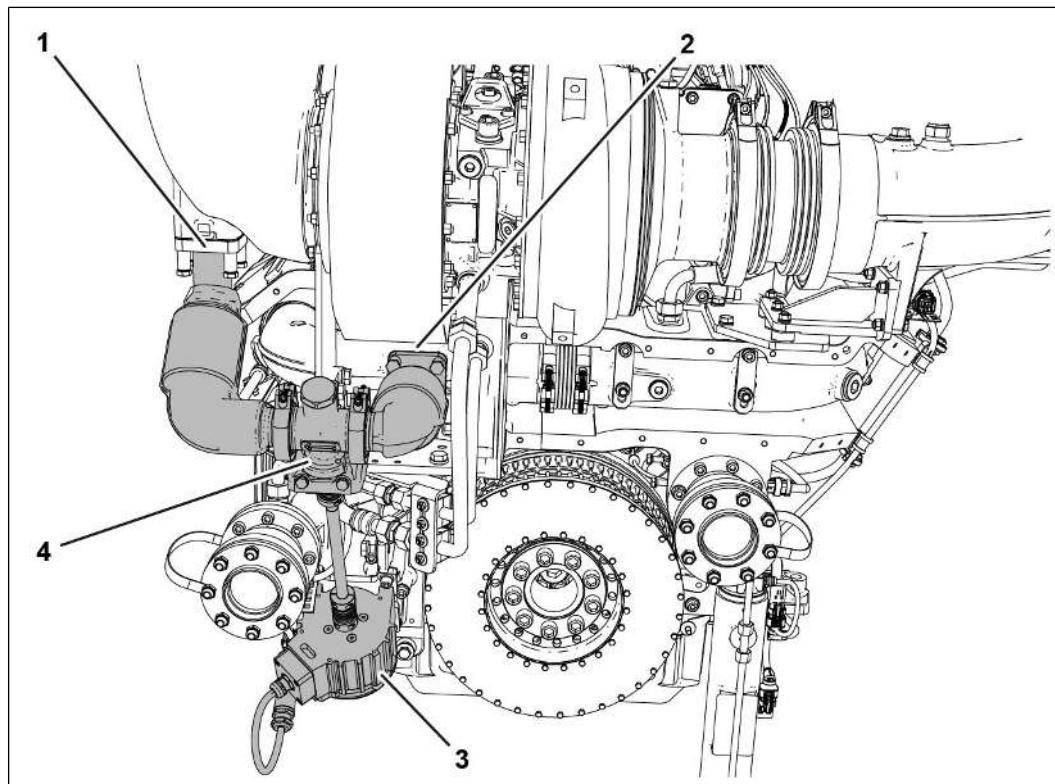
605240459

- 1    Exhaust expansion joint
- 2    Clamping clip
- 3    Tensioning nut
- 4    Flared tube end

The exhaust expansion joint is mounted between the exhaust turbocharger and exhaust line. The exhaust expansion joint compensates for changes in the length of the exhaust pipe that occur due to heating. In addition, it attenuates oscillations and vibrations in the elastically-affixed genset from the immovable on-site exhaust line.

#### 4.2.3.4 Wastegate

##### Functional description

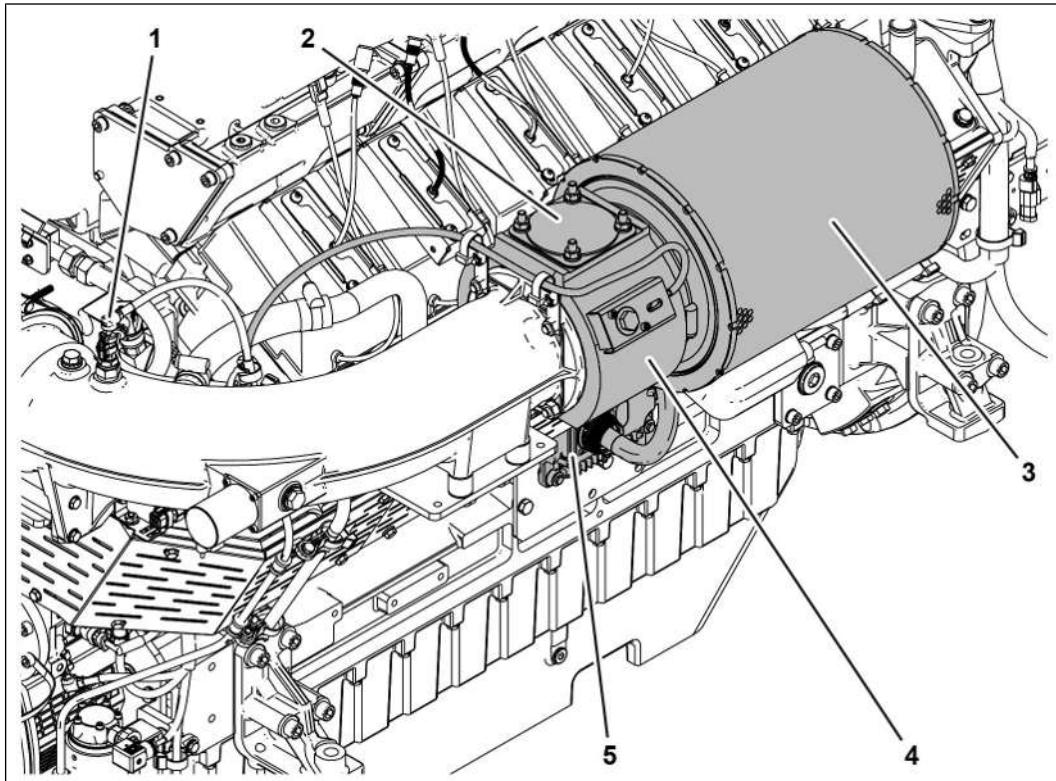


9007199652566539

- 1 Exhaust manifold to on-site exhaust system
- 2 Exhaust pipe to exhaust turbocharger
- 3 Actuator
- 4 Exhaust flap

The wastegate regulates the power of the exhaust turbocharger. The unneeded exhaust gas quantity reaches the exhaust pipe directly and does not pass through the turbine wheel. The wider the wastegate is open, the more exhaust gas flows past the exhaust turbocharger and the lower the power from the exhaust turbocharger.

The electronic control regulates the actuator in accordance with the currently measured values of intake air temperature and air pressure. The wastegate compensates for fluctuating environmental conditions in the intake air temperature and the air pressure.

**4.2.4 Intake air system****4.2.4.1 Intake air system****Functional description**

18014398899496715

- 1 Mixture temperature sensor
- 2 Fuel gas inlet
- 3 Intake air filter
- 4 Gas-air mixer
- 5 Output stage control device (gas-air mixer)

The combustion air drawn in mixes with the fuel gas in the gas-air mixer.

- The intake air filter guides the necessary air from the outside. The air that is drawn in this manner is known as intake air or combustion air.
- The intake air must be clean to ensure stable operation and optimum efficiency of the genset. Refer to the order-specific genset data sheet for the optimum intake air temperature values. Maintain the temperature values specified in the genset data sheet. The temperature of the intake air is measured by a temperature sensor that transmits the measured values to the electronic control.

A temperature sensor is mounted in the mixture manifold. The temperature sensor measures the temperature of the combustion air mixed with fuel gas and transmits the measured values to the electronic control.

The combustion air that mixes with the fuel gas passes from the gas-air mixer to the exhaust turbocharger either via a mixture manifold or a mixture pipe.

Upstream of the exhaust turbocharger is an expansion joint that decouples the intake air system from the fluctuations and vibrations of the exhaust system.

---

**NOTE**

The design of the intake air system depends on several factors (e.g. installation site, power demand).

The project planner defines the design of the intake air system in the project phase.

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For necessary information on the requirements for intake air, see Technical Bulletin (TR) 2132, [Specification for combustion air](#) or the *genset data sheet*.

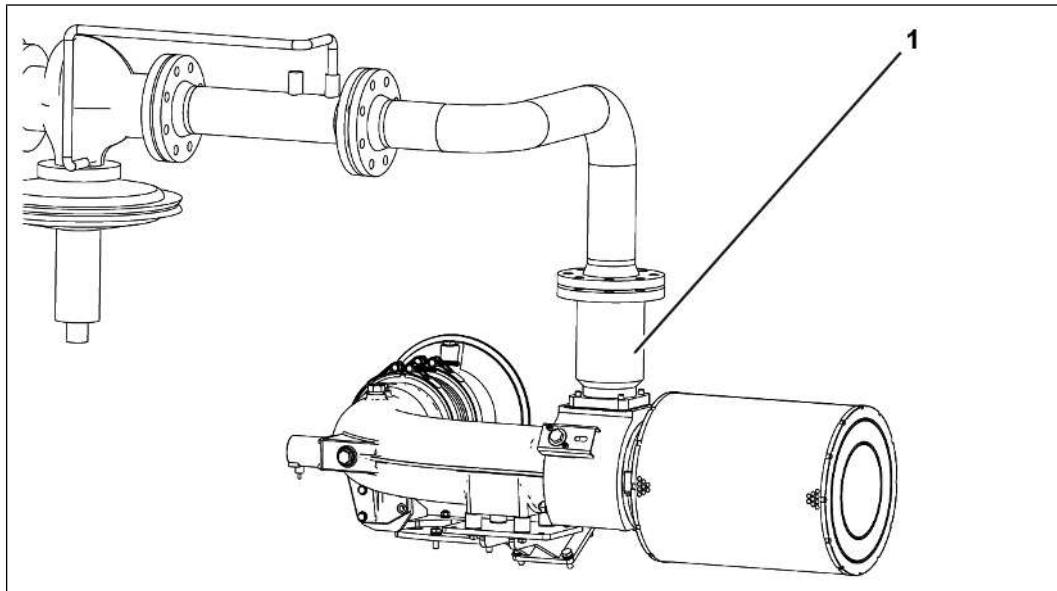
**4.2.5 Fuel gas system****4.2.5.1 Fuel gas system****Functional description**

For safety reasons when the genset is being stopped, all the fuel gas is removed from the gas train, the mixture system and the cylinders. This process is known as purging. The electronic control automatically performs the purging.

The electronic control closes the gas valves in the gas train. The following components are drained until empty by the suction effect of the coasting engine:

- Gas supply to the engine
- Gas-air mixer
- Exhaust turbocharger
- Mixture cooler
- Mixture pipe

The ignition remains on until the fuel gas left in the cylinder has been combusted completely. Only when the crankshaft has shut down does the electronic control switch off the ignition.

**Functional description****Connection to the gas train**

27021598160622731

1 Expansion joint

The gas-air mixer is connected to the fuel gas line leading to the gas train via an expansion joint.

- The expansion joint attenuates oscillations and vibrations between the elastically-affixed genset and the immovable gas train.

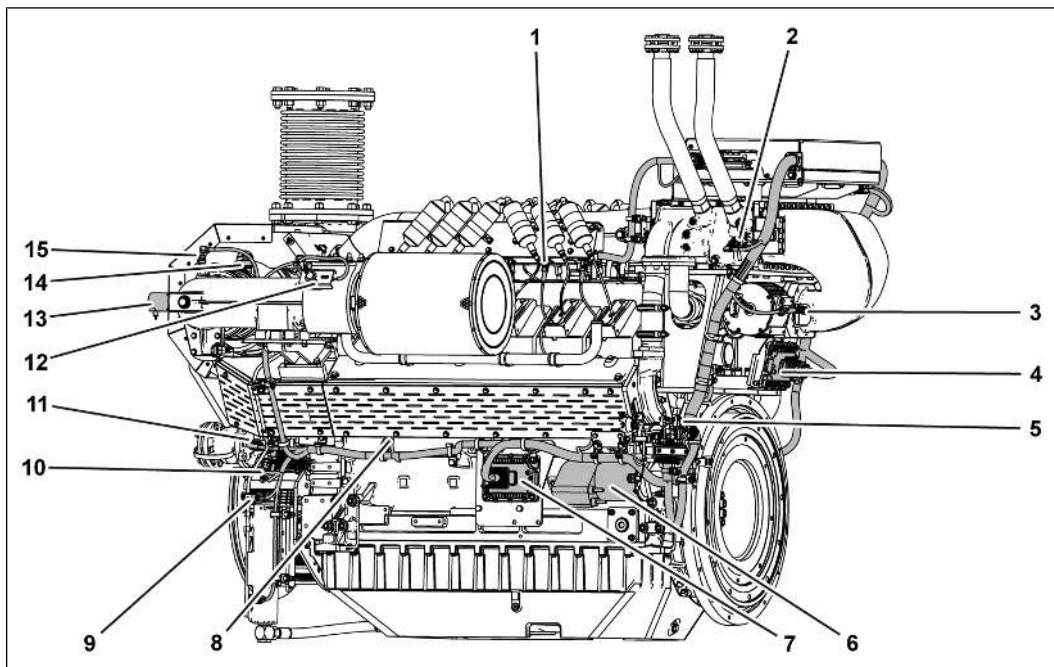
**4.2.6 Electrical system****4.2.6.1 Electrical system****Functional description**

Parts of the electrical system are installed both on the engine and in the plant.

The engine electrical system consists of the following components:

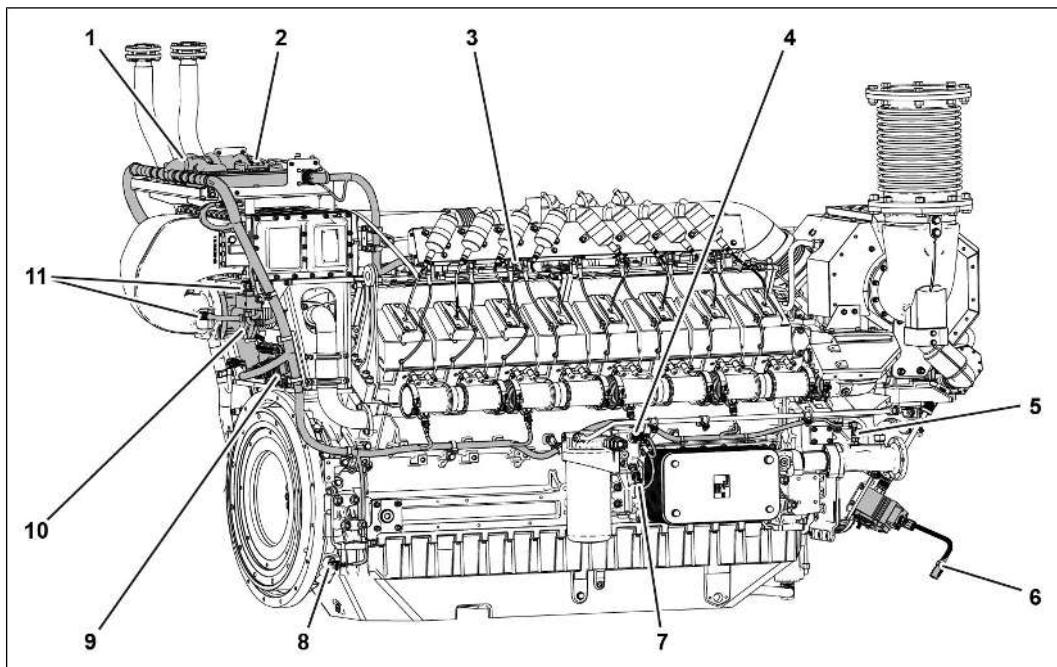
- Starter
- Ignition system
- Anti-knock control
- Control devices, wiring harness, and sensors
- Electronic control

For more information on the electronic control system, see the [TPEM Operating Manual](#).



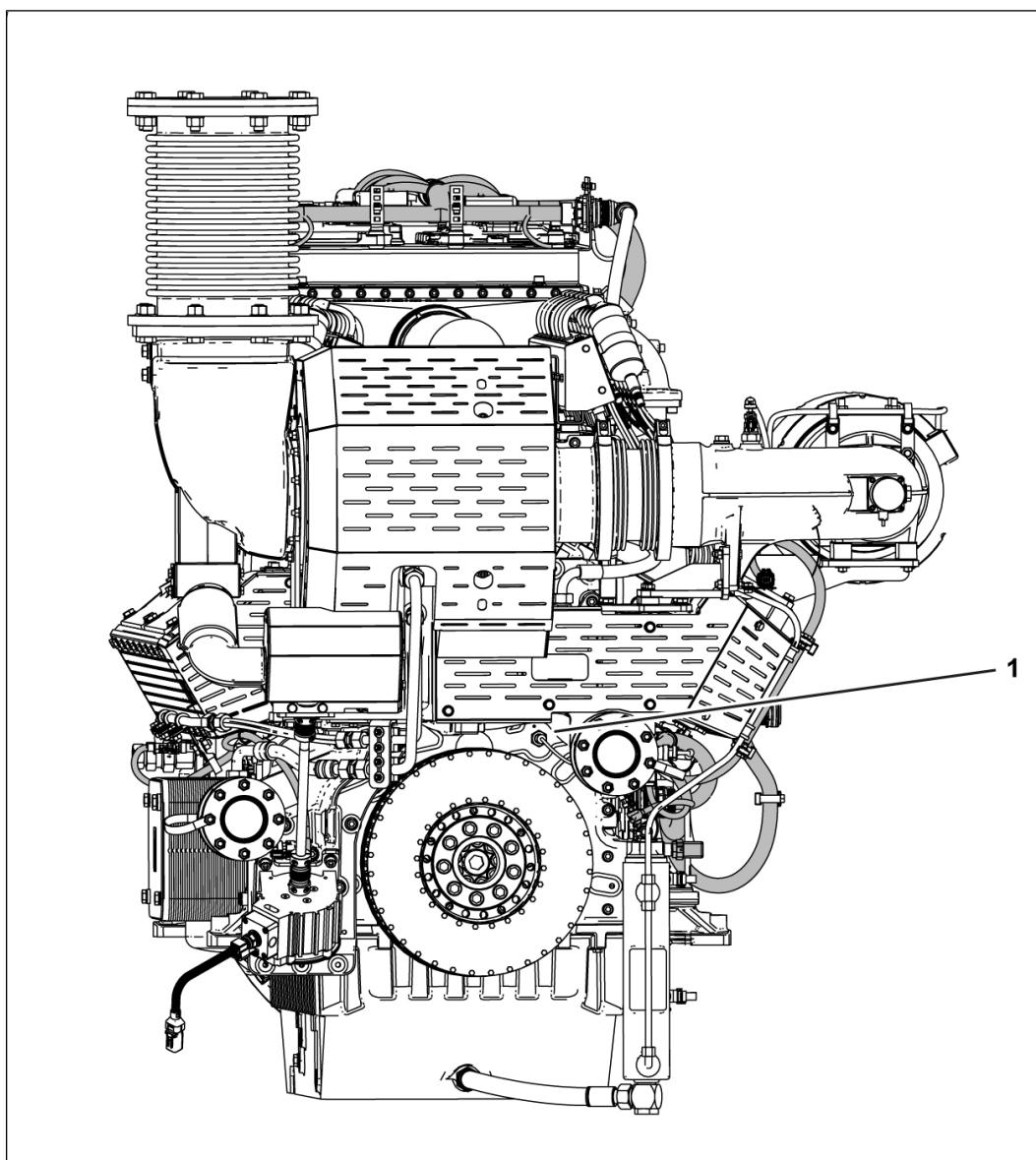
9007199590487179: Electrical components, cylinder side A

- 1 Combustion chamber temperature sensor
- 2 Coolant temperature sensor
- 3 Mixture temperature sensor
- 4 Output stage control device (wastegate/throttle valve)
- 5 Motor relay
- 6 Starter
- 7 Output stage control device (gas-air mixer)
- 8 Knock sensor
- 9 Lube oil level sensor
- 10 Coolant temperature sensor
- 11 Coolant pressure sensor
- 12 Limit stop sensor
- 13 Stepper motor for gas-air mixer
- 14 Crankcase pressure sensor
- 15 Mixture temperature sensor



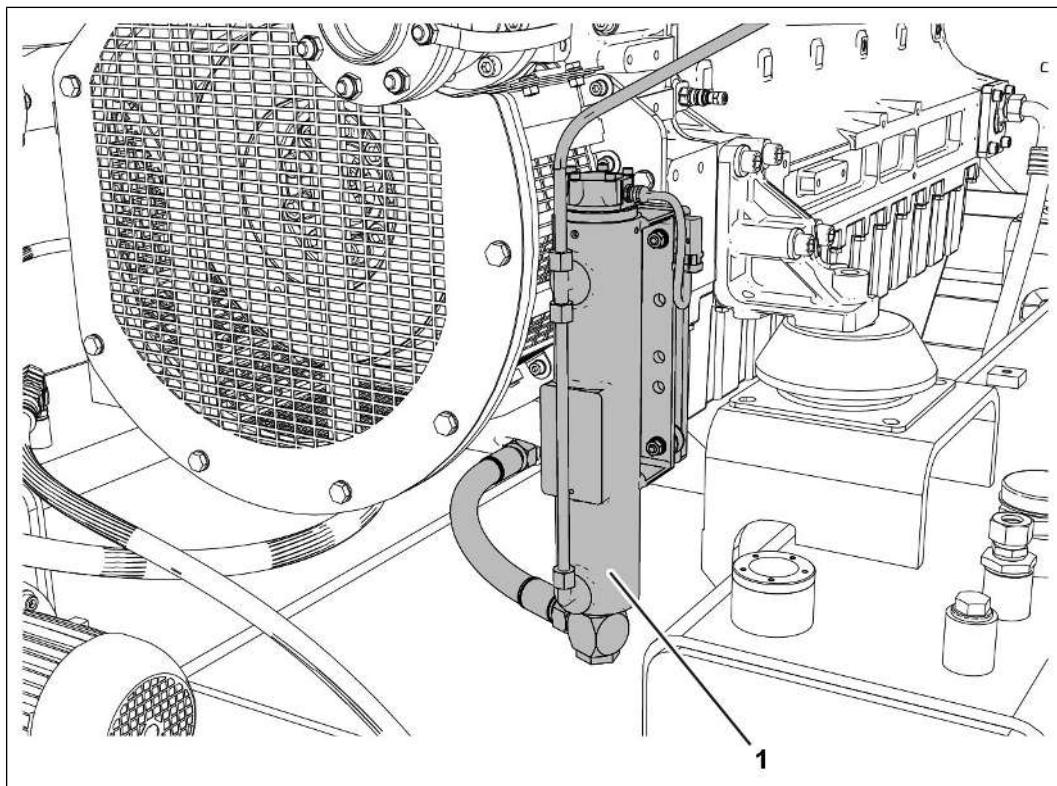
9007199590528651: Electrical components on cylinder side B

- 1 Auxiliary control device
- 2 Main control device
- 3 Mixture pressure sensor
- 4 Lube oil pressure sensor
- 5 Coolant temperature sensor
- 6 Wastegate actuator
- 7 Lube oil temperature sensor
- 8 Crankshaft sensor
- 9 Actuator for output stage control device (wastegate/throttle valve)
- 10 Throttle valve actuator
- 11 Differential pressure sensor



9007199590492043: Electrical components on free end

1 Camshaft sensor

**4.2.6.2 Level sensor****Functional description**

9007199645896459

**1 Level sensor**

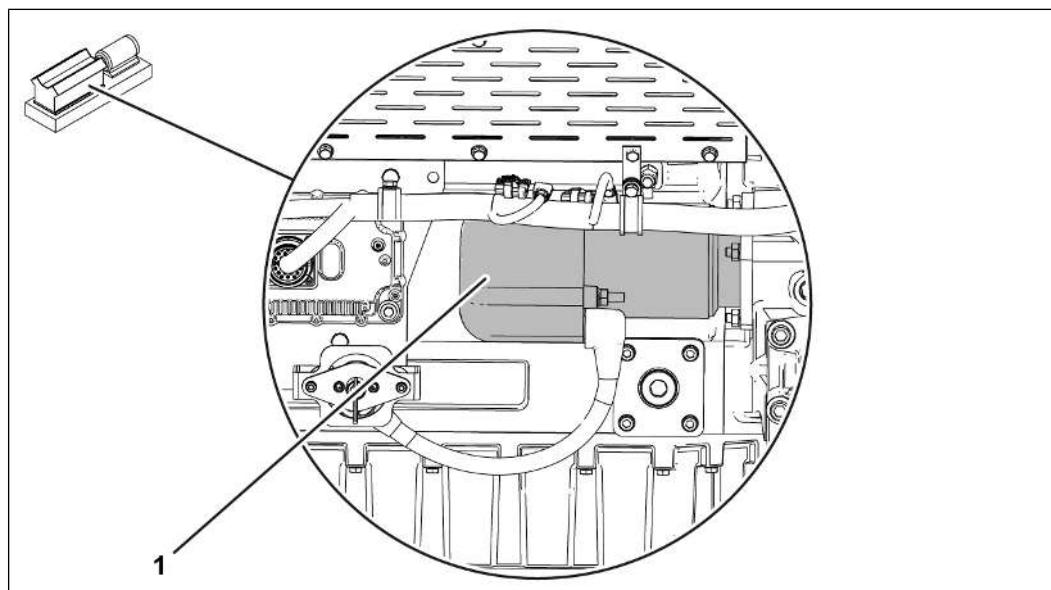
The level sensor is mounted on the free end of the engine.

The level sensor transmits the current measured lube oil level from the engine to the electronic control.

- This controls the automatic lube oil refill and the lube oil change.

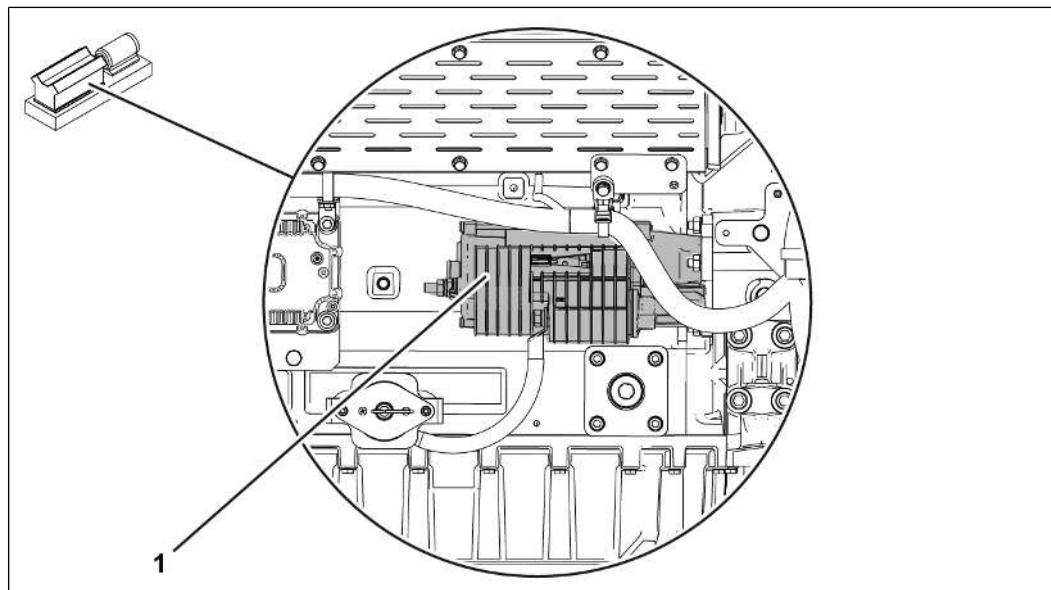
#### 4.2.6.3 Electric starter

##### Functional description



9007199649447563: V8 and V12 engine

1 Electric starter



9007199649449995: V16 engine

1 Electric starter

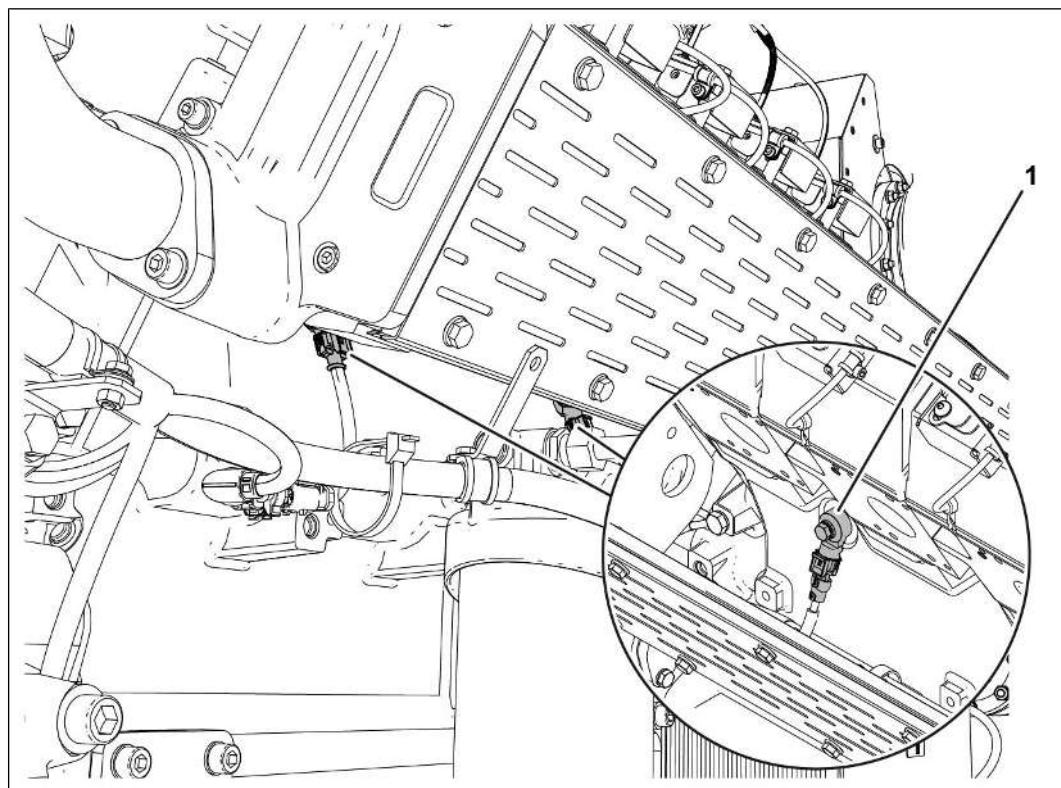
The engine is equipped with an electric starter. The electronic control controls the engine start. To start the engine, the electric motor presses the starter pinion into the flywheel gear ring. Then the electric starter brings the engine up to the starting speed.

Engine start is initiated only if the starter pinion is aligned into the flywheel gear ring. A communication cable connects the electric starter with the electronic control and reports the alignment of the starter pinions to the electronic control.

The electric starter turns the engine until the combustion process starts. The electronic control then gives the command to decouple the starter pinion from the flywheel gear ring. While the engine is running, the electronic control blocks any other attempts to start it.

#### 4.2.6.4 Knock sensor

##### Functional description



9007199649470731: Knock sensor installation position

1 Knock sensor

The knock sensors are installed on the crankcase between the cylinders. Each knock sensor monitors two cylinders. Together with the control, the knock sensors make up the anti-knock control (**AKC**), which reduces the danger of autoignition of the fuel gas (knocking combustion).

The following conditions can lead to knocking combustion:

- Fuel gases with a fluctuating methane number
- Fuel gases with a low methane number
- Change of the fuel gas composition

Knocking combustion causes extreme mechanical and thermal stresses. Knocking combustion can cause engine damage. The anti-knock control constantly adjusts the ignition timing until knocking combustion is sufficiently reduced. The anti-knock control determines the optimum ignition timing for every single cylinder and ensures safe operation of the genset.

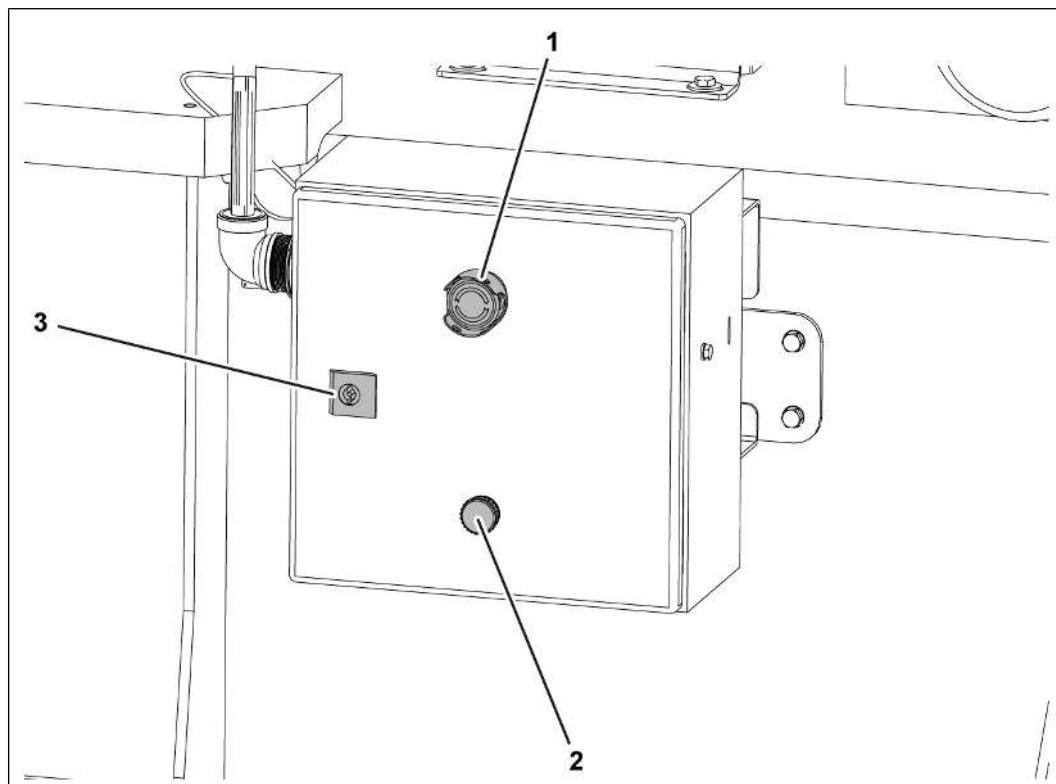
If the following conditions occur at the same time, the electronic control stops the genset:

- Ignition timing is below 9° before top dead center (9° before TDC).
- Knocking combustion

For all necessary information on the fuel gas types, see *Operating Manual, chapter Operating media regulations, Technical Bulletin (TR) 3017 Specification for fuel gas*.

#### 4.2.6.5 TPEM Connection Box

##### Functional description



396650123

- 1 Emergency stop button
- 2 Service interface
- 3 Locking mechanism

The TPEM CB forms the interface between the electronic control and the plant control.

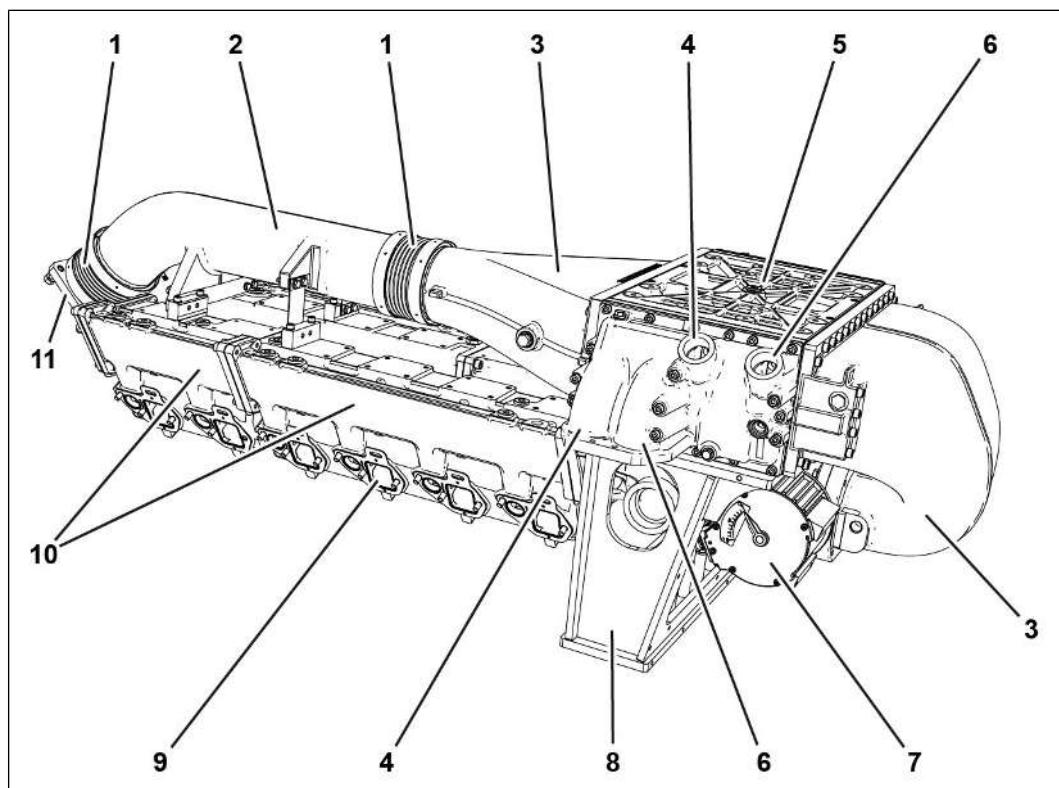
The TPEM CB is mounted either on the crankcase ventilation holder or on the base frame.

For detailed information on the control, see *Operating Manual, chapter Operation, section Control*.

#### 4.2.7 Mixture system

##### 4.2.7.1 Mixture system

###### Functional description



9007199795600267

- 1 Expansion joint
- 2 Mixture pipe
- 3 Mixture cooler cover
- 4 Coolant outlet
- 5 Mixture cooler
- 6 Coolant inlet
- 7 Throttle valve with actuator
- 8 Holder for mixture cooler
- 9 Cylinder head connection
- 10 Mixture housing
- 11 Exhaust turbocharger connection flange

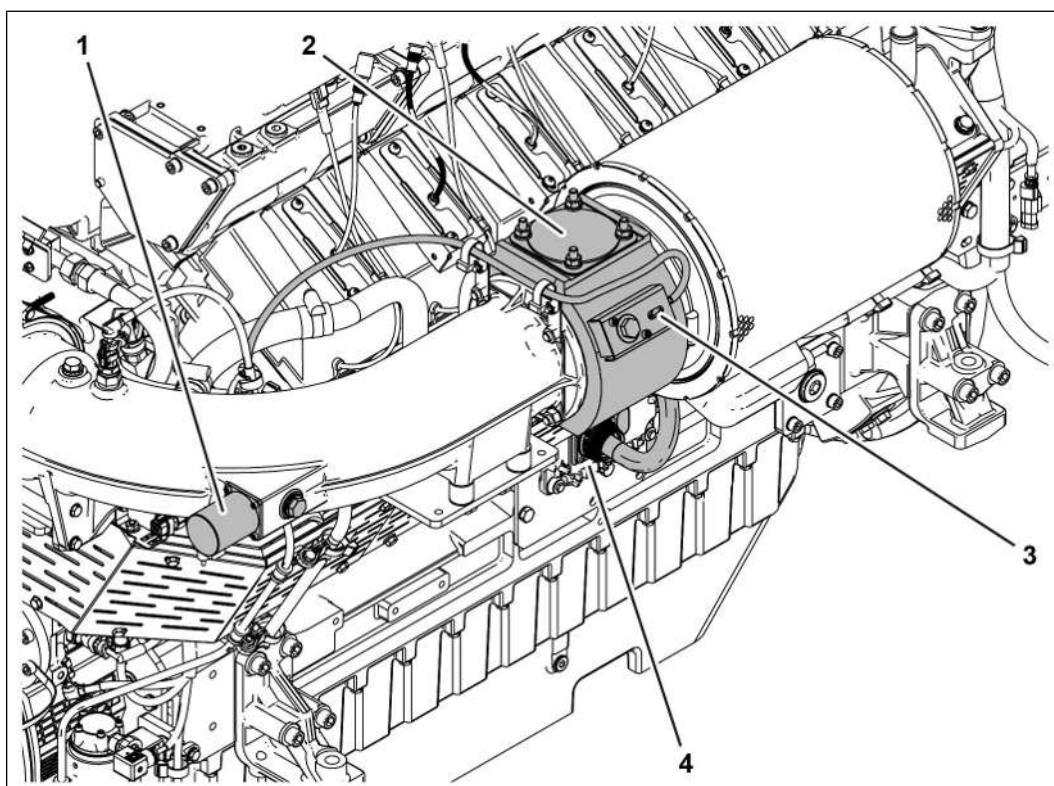
The mixture system feeds the turbocharged mixture through the mixture cooler to the cylinder heads.

The mixture pipe and the mixture manifold direct the turbocharged mixture from the exhaust turbocharger to the mixture cooler, where the turbocharged mixture is cooled to the setpoint temperature specified by the control, see also [Functional description \[▶ 75\]](#).

The cooled mixture is fed from the mixture cooler to the inlet channels in the cylinder heads. The throttle valve regulates the flow rate of the mixture.

#### 4.2.7.2 Gas-air mixer

##### Functional description



54043195919535115

- 1 Stepper motor
- 2 Gas-air mixer
- 3 Proximity switch
- 4 Output stage control device (gas-air mixer)

The gas-air mixer is the connection to the gas train. It is installed between the intake air system and the mixture system.

- The gas-air mixer mixes fuel gas and intake air in an optimal ratio to form a combustible mixture.

The gas-air mixer works according to the Venturi principle.

- The flow speed is at maximum at the tightest point in the gas-air mixer, resulting in negative pressure.
- With the resulting negative pressure, a ring gap mixes in the fuel gas.
- The stepper motor regulates the ring gap, which in turn determines the mixing ratio of fuel gas to intake air.

### Additional information

The gas train supplies the engine with fuel gas, necessary for the operation of the genset.

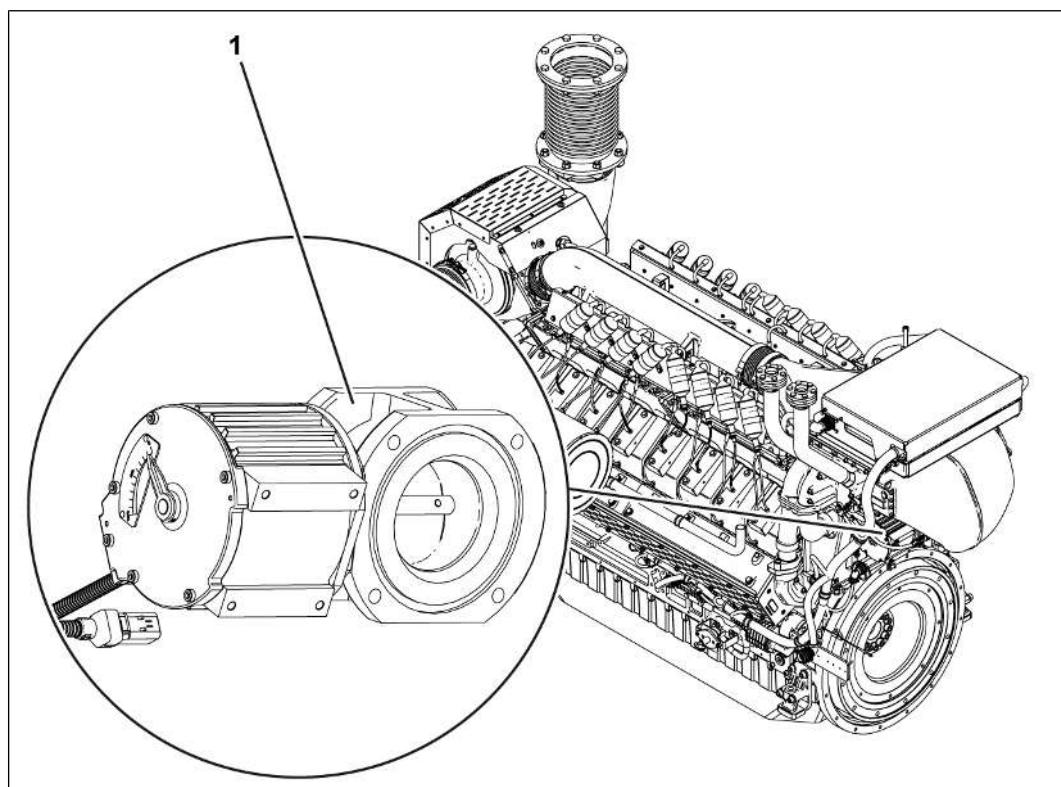
- For more information on the gas train, see *Operating Manual, chapter Operation, section Gas supply*.

For more information on fuel gas, see [Technical Bulletin \(TR\) 3017 Specification for fuel gas](#).

For more information on combustion air, see Technical Bulletin (TR) 2132, [Specification for combustion air](#).

#### 4.2.7.3 Throttle valve

##### Functional description



9007199644674315

- 1 Throttle valve with actuator

The engine is equipped with a throttle valve. The actuator controls the throttle valve.

Together with the actuator, the throttle valve regulates the amount of mixture.

The actuator has the following characteristics:

- High adjusting forces which act in both directions
  - Insensitivity towards a slow change in voltage of the power supply
- Low current consumption
- Insensitivity towards a slow change in voltage of the power supply
  - Sudden, abrupt voltage changes in quick succession can lead to controller malfunctions.

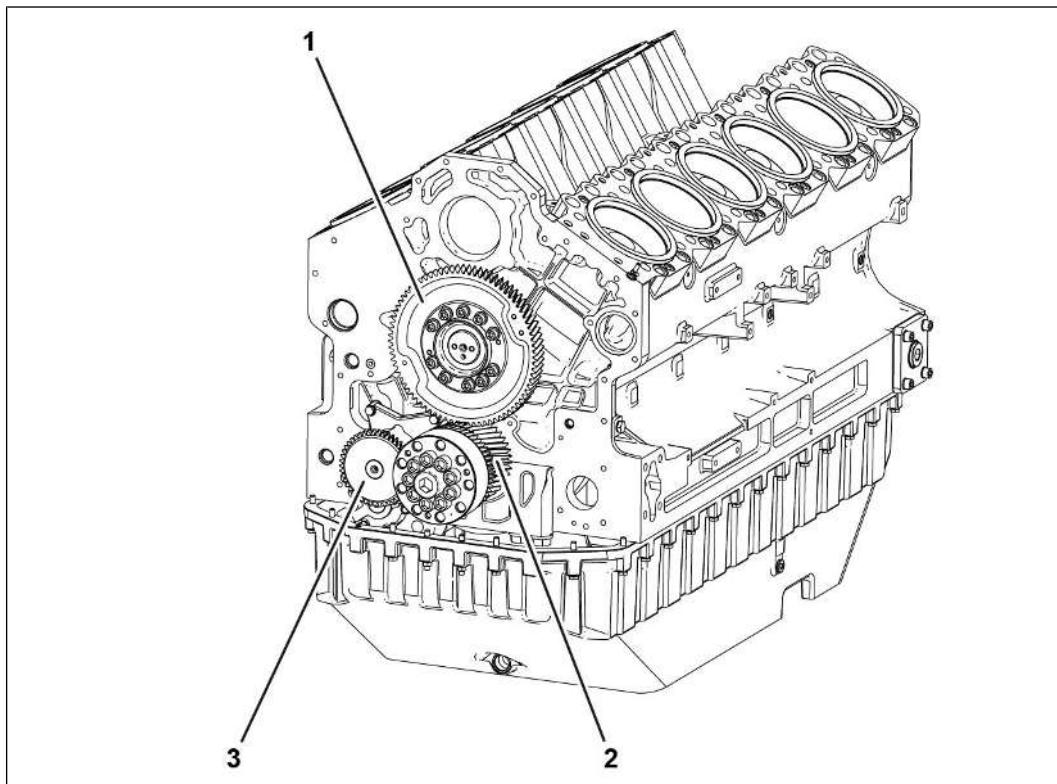
The actuator contains a DC motor that applies torque to the regulator output shaft via an intermediate gearbox.

A sensor takes contactless readings of the position of the feedback cam on the actuator's output shaft and transmits the values to the electronic control.

## 4.2.8 Mechanical system

### 4.2.8.1 Mechanical engine control

#### Functional description



9007199643794059

- 1 Camshaft gear wheel
- 2 Crankshaft gear wheel
- 3 Lube oil pump gear wheel

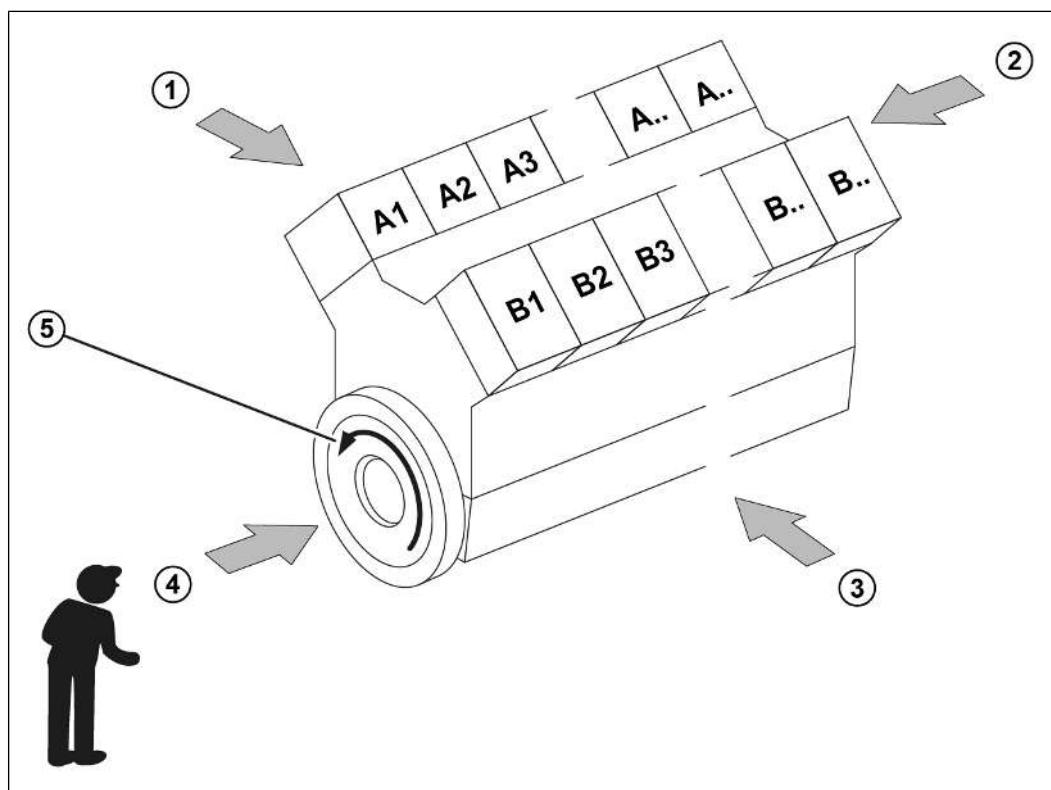
The mechanical engine control consists of the gear drive and [Functional description \[▶ 71\]](#). The gear drive is installed on the free end.

The crankshaft gear wheel arranged in the center powers the valve train of both cylinder banks using the camshaft gear wheel. Parallel to the camshaft gear wheel, the crankshaft gear wheel drives the lube oil pump gear wheel.

The camshaft is mounted in replaceable bearing liners in the crankcase. The camshaft controls the inlet valves and outlet valves in accordance with the ignition sequence. The inlet valves and outlet valves are controlled via the valve train.

#### 4.2.8.2 Cylinder designation

##### Cylinder designation



9007201097739019

- 1 Cylinder side A (left engine side)
- 2 Free end (face side, i.e. side opposite the coupling)
- 3 Cylinder side B (right engine side)
- 4 Drive end (flywheel side or coupling side)
- 5 Flywheel direction of rotation (arrow)

Every cylinder has an alphanumeric code.

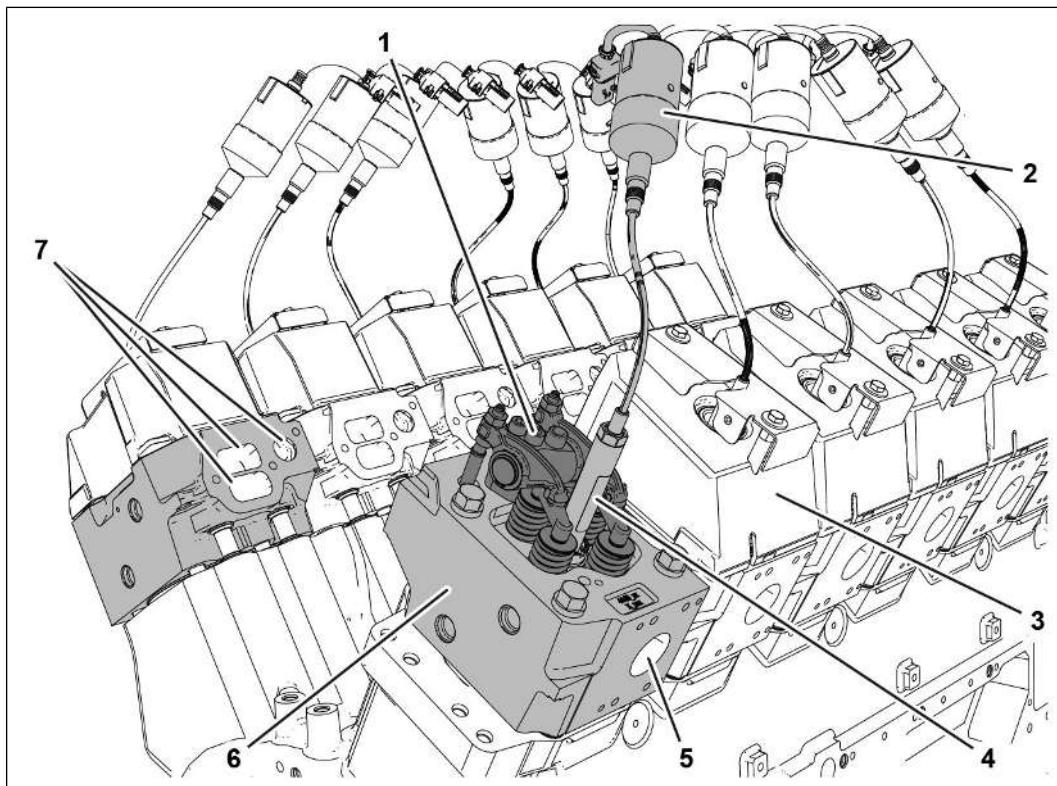
The cylinders are counted sequentially, beginning from the drive end.

- The first cylinder on the left engine side has the code A1.
- The first cylinder on the right engine side has the code B1.
- The cylinders are counted sequentially on each engine side.

The engine's direction of rotation is counterclockwise as seen from the drive end (anticlockwise rotation).

#### 4.2.8.3 Cylinder head

##### Functional description



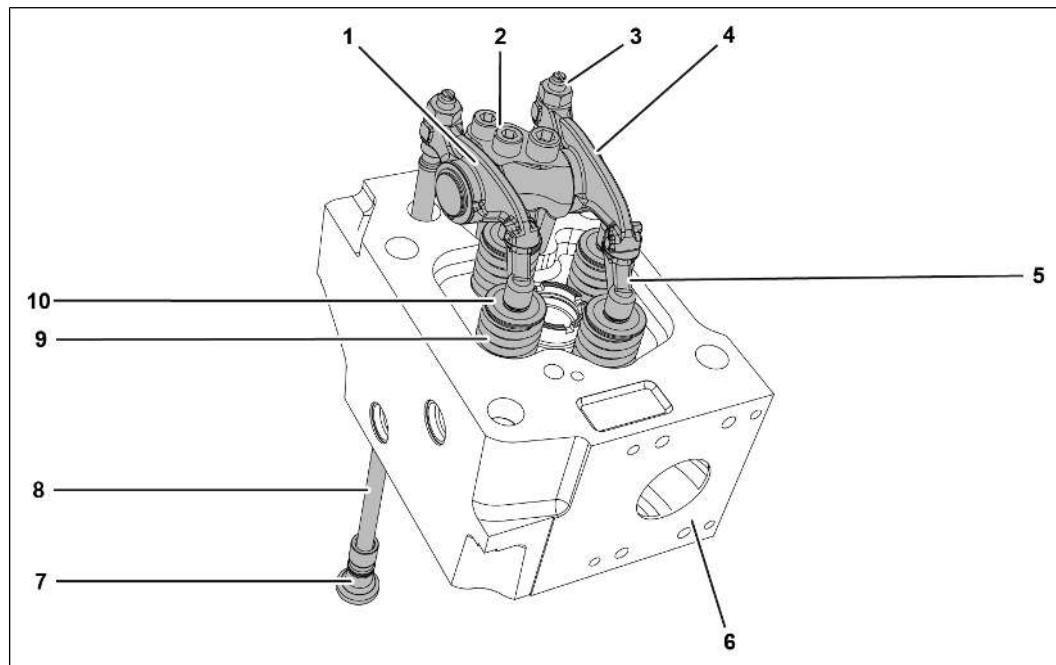
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- 1 Valve train
- 2 Ignition coil
- 3 Cylinder head cover
- 4 Spark plug
- 5 Outlet duct
- 6 Cylinder head
- 7 Inlet ducts

Each cylinder has its own cylinder head that covers the engine combustion chamber. The cylinder head contains inlet ducts for the gas-air mixture and the outlet duct for the exhaust gas; it also contains the valve train.

- It is possible to replace an individual cylinder head very quickly thanks to its superb accessibility and optimized design.
- The cylinder heads are liquid-cooled and integrated in the engine cooling system.

The spark plug is screwed into the cylinder head and connected to the ignition coil by the ignition cable. For safety, a spark plug cover is installed over the spark plug.

**Functional description**

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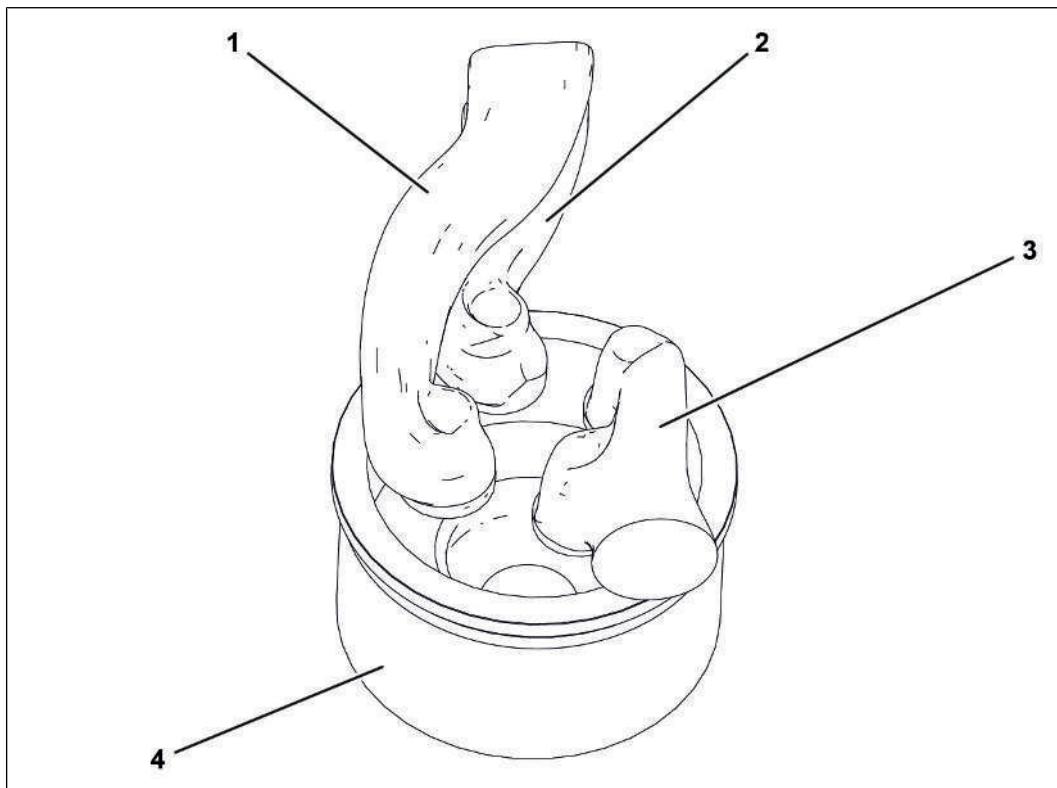
- 1 Inlet rocker arm
- 2 Setting screws for valve crossheads
- 3 Setting screw for valve clearance
- 4 Outlet rocker arm
- 5 Valve crosshead
- 6 Cylinder head
- 7 Roller tappet
- 8 Push rod
- 9 Valve spring
- 10 Spring plate

Each cylinder head has four valves.

- Two inlet valves ensure an optimum filling degree per cylinder.
- Two outlet valves enable exhaust gas to quickly flow out.

The push rods are moved by the camshaft in a linear fashion, and transmit the motion to the rocker arms, which in turn press on the valve crossheads.

- One valve crosshead controls both inlet valves while another controls both outlet valves.

**Functional description**

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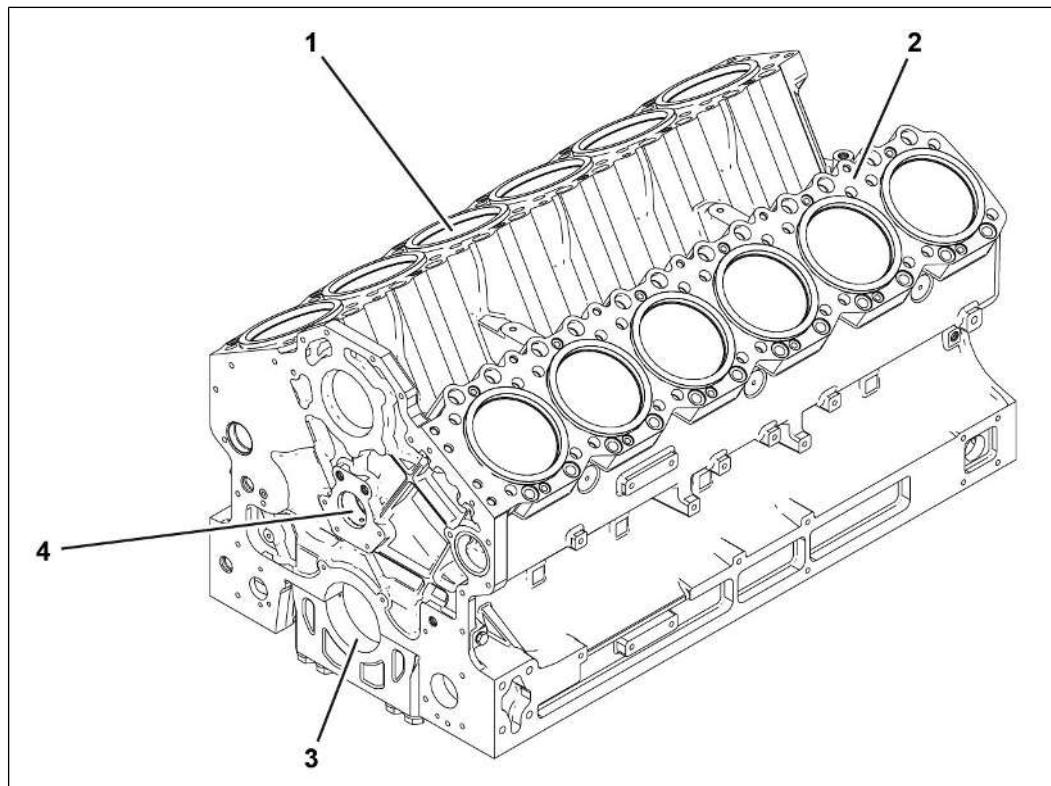
- 1     Swirl duct
- 2     Filling duct
- 3     Outlet duct
- 4     Cylinder liner

The cylinder heads are designed according to the cross flow principle. Here, the inlet and outlet ducts are arranged tangentially opposite each other.

The inlet ducts are aligned so that the gas-air mixture flows vertically onto the recess on the combustion side of the piston. The outlet ducts route the exhaust gases into the exhaust system from the cylinder head. The outlet ducts converge into one single channel.

#### 4.2.8.4 Crankcase

##### Functional description



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- 1 Bore for cylinder liner
- 2 Support for cylinder heads
- 3 Support for crankshaft
- 4 Bore for camshaft

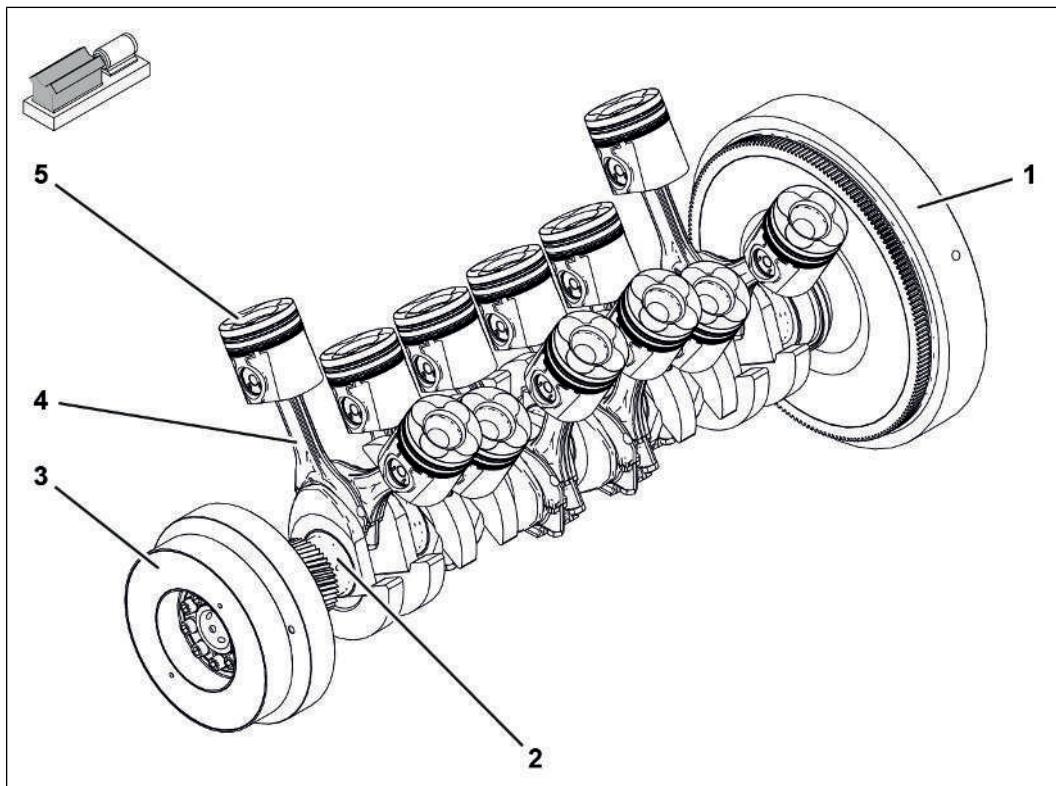
The crankcase is the central component of the engine.

The crankcase is used to accommodate:

- Cylinder heads
- Cylinder liners
- Crankshaft
- Camshaft
- Mechanical engine control

#### 4.2.8.5 Crankshaft drive

##### Functional description



9007199643750923

- 1 Flywheel
- 2 Crankshaft
- 3 Torsional vibration damper
- 4 Con-rod
- 5 Piston

The crankshaft drive is installed in the crankcase.

- The crankshaft drive converts the linear motion of the pistons into the rotary motion of the crankshaft.
- The con-rod transmits the piston force, resulting from the combustion pressure, to the crankshaft.
  - The crankshaft transmits the kinetic energy to the flywheel.

The flywheel in turn transmits the stored kinetic energy onward to the generator shaft via the coupling.

- The inertia of the flywheel ensures a uniform transmission of the force.

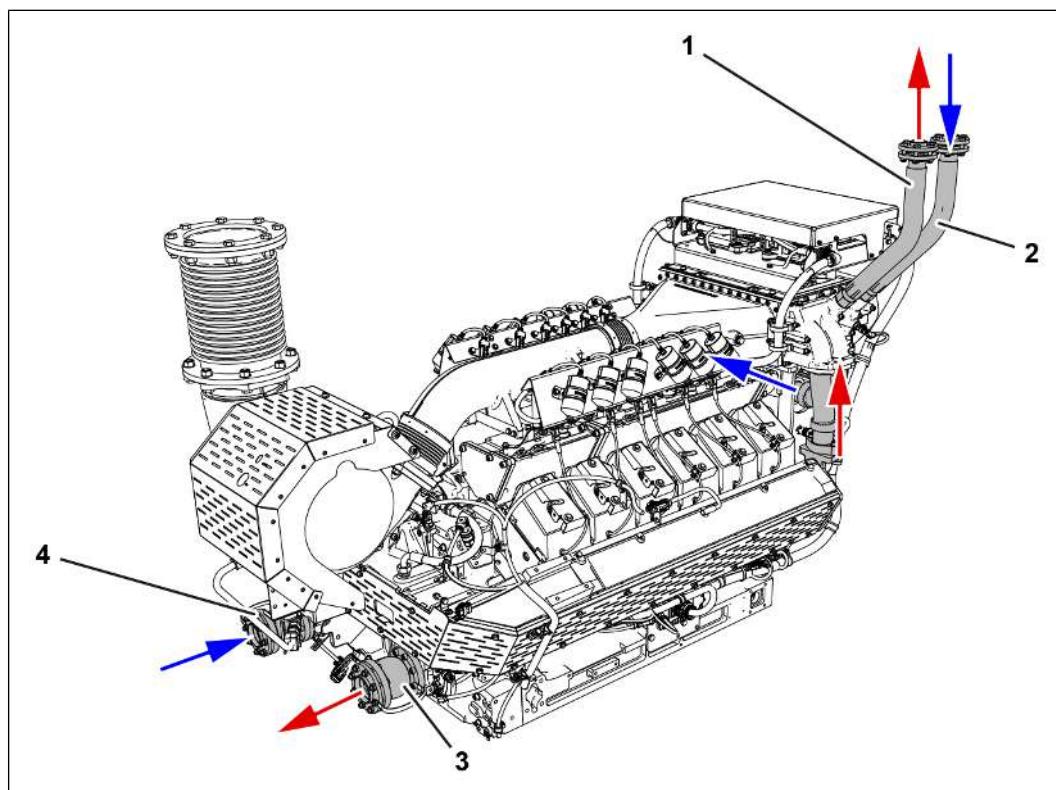
A torsional vibration damper may be installed on the crankshaft on the engine side opposite the flywheel.

- The torsional vibration damper reduces the short-term torque spikes caused by the discontinuous power transmission of the pistons in the combustion process.
- In this way, the torsional vibration damper relieves the crankshaft and ensures smooth engine operation and stable speeds.

## 4.2.9 Cooling system

### 4.2.9.1 Cooling system

#### Functional description



45035996665947531

- 1 Coolant outlet (mixture cooling circuit)
- 2 Coolant inlet (mixture cooling circuit)
- 3 Coolant outlet (engine cooling circuit)
- 4 Coolant inlet (engine cooling circuit)

The cooling system has the following functions:

- Dissipating combustion heat
- Cooling the engine
- Cooling the gas-air mixture

The cooling system consists of the engine cooling circuit and mixture cooling circuit.

### Engine cooling circuit

The engine cooling circuit is the high-temperature circuit and contains the following assemblies:

- Mixture cooler
- Lube oil cooler
- Engine
- Dump cooling circuit (optional)
- Heat utilization

### Mixture cooling circuit

The mixture cooling circuit is the low-temperature circuit and contains the following assemblies:

- Mixture cooler
- Radiator

The mixture cooling circuit lowers the mixture temperature and increases the engine power.

### Control and monitoring

The electronic control monitors the following in the cooling system:

- Coolant temperature
- Coolant fill level
- Coolant pressure

### Coolant

The coolant consists of water mixed with a cooling system protection agent. The cooling system protection agent prevents damage resulting from:

- Corrosion
- Frost
- Cavitation

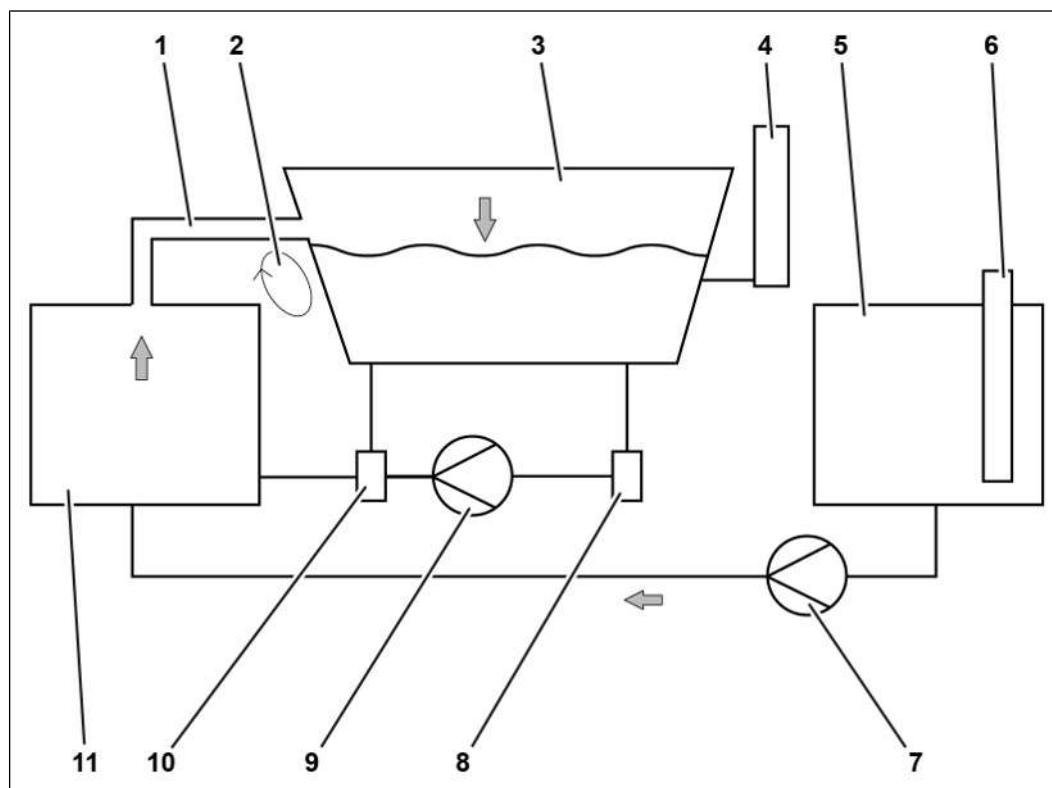
### External cooling system

For additional information and a schematic diagram of the external cooling system, see *Operating Manual, chapter General, section P&l diagram*.

#### 4.2.10 Lube oil system

##### 4.2.10.1 Lube oil system

###### Functional description



9007199645852939

- 1 Expanded overflow lube oil volume in the base frame
- 2 Lube oil pump
- 3 Lube oil sump
- 4 Lube oil level sensor
- 5 Lube oil reservoir in base frame
- 6 Sensor in lube oil reservoir
- 7 Fresh oil pump
- 8 Prelubrication pump valve
- 9 Prelubrication pump
- 10 Prelubrication pump valve
- 11 Expanded lube oil volume in the base frame

The engine lubrication is designed as a wet sump lubricating system. As well as the components listed above, the lube oil system includes the following components

- Lube oil filter
- Lube oil cooler

- Fresh oil tank with fresh oil pump (optional)
- Waste oil tank (optional)

The lube oil from the lube oil sump and in the expanded lube oil volume forms the lube oil volume that is available to the engine for lubrication.

The lube oil pump supplies lube oil from the lube oil sump to the engine. In the flow pipe, a [lube oil cooler \[▶ 79\]](#) cools the lube oil before it flows into the engine via the [lube oil filter \[▶ 80\]](#).

The [prelubrication pump \[▶ 81\]](#) pumps a small amount from the cooled lube oil back into the extended lube oil volume. The expanded lube oil volume is always fully filled with lube oil. Overflow causes the lube oil to flow depressurized from the expanded lube oil volume back into the lube oil sump. In this way the entire lube oil volume is recycled once to twice per hour. After a cold start, the lube oil system requires 3 to 4 operating hours until the lube oil is heated uniformly.

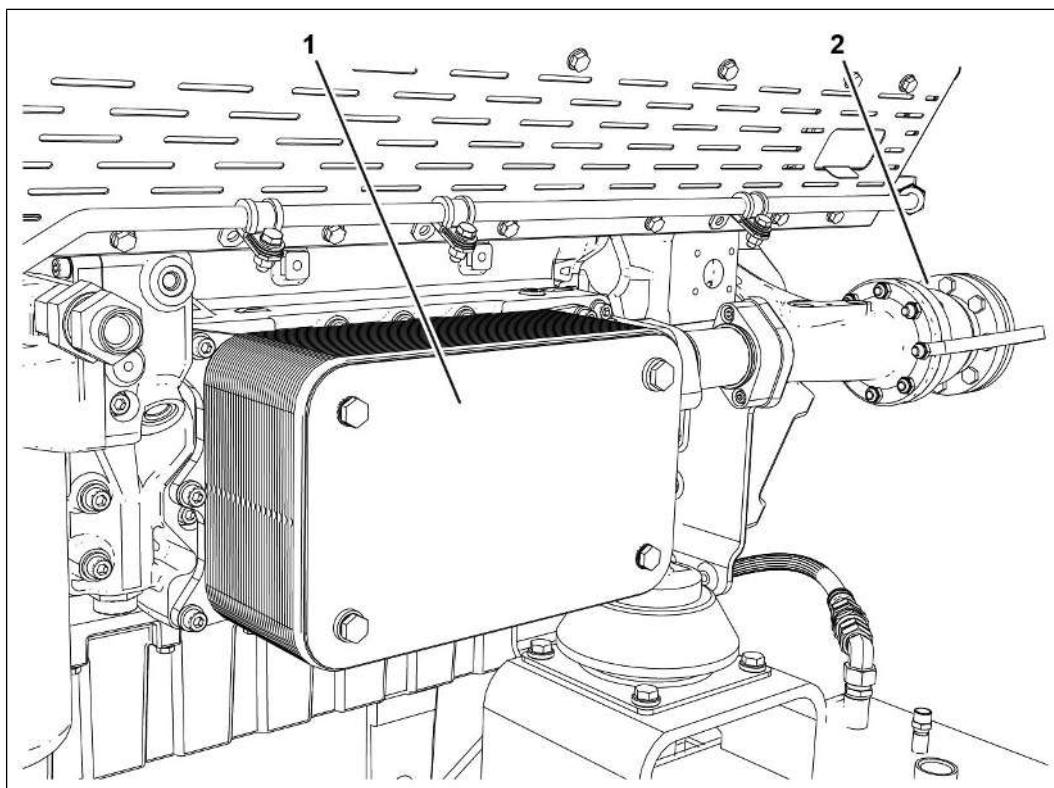
The prelubrication pump lubricates the engine automatically every time before each start. Prelubrication reduces engine wear. When the engine is shut down, relubrication takes place.

The electronic control controls the refilling of the lube oil. For this, the electronic control in the lube oil sump and in the lube oil reservoir monitors the lube oil levels with a [fill level probe \[▶ 60\]](#). If the oil level in the lube oil sump drops, the clean oil pump pumps lube oil from the lube oil reservoir into the expanded lube oil volume.

If the lube oil level of the lube oil volume drops below the minimum level, the electronic control system shuts down the engine after a fault is reported. In this case, restart the engine only if the lube oil level has been adjusted and the prelubrication has been carried out. The prelubrication ceases after a pre-specified time.

#### 4.2.10.2 Lube oil cooler

##### Functional description



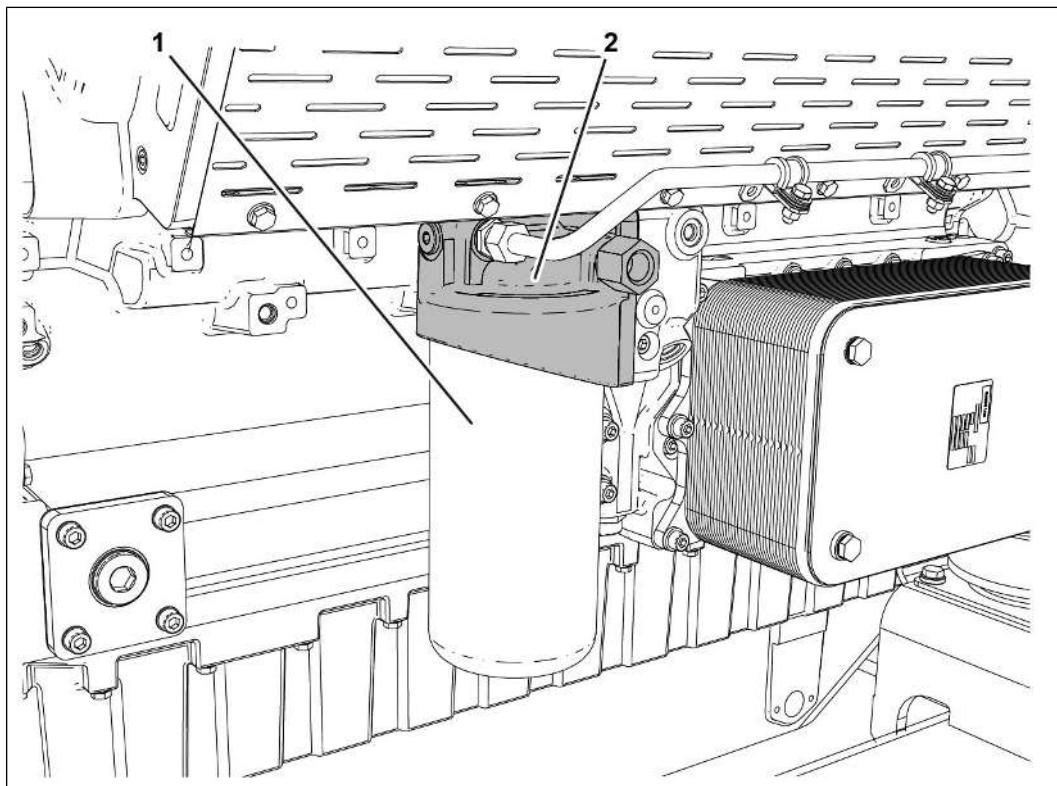
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- 1 Lube oil cooler
- 2 External cooling system connection

The lube oil cooler is mounted in the flow direction upstream of the lube oil filter. The lube oil cooler consists of a heat exchanger. Flowing on one side of the heat exchanger is lube oil and on the other side, coolant. This balances the temperature of both operating media:

- Lube oil which is cooler than the coolant heats up.
- Lube oil which is warmer than the coolant cools down.

The lube oil cooler is connected to the external cooling system. The lube oil cooler is the interface between the lube oil system and cooling system. The lube oil cooler is mounted on the base frame on the free end.

**4.2.10.3 Lube oil filter****Functional description**

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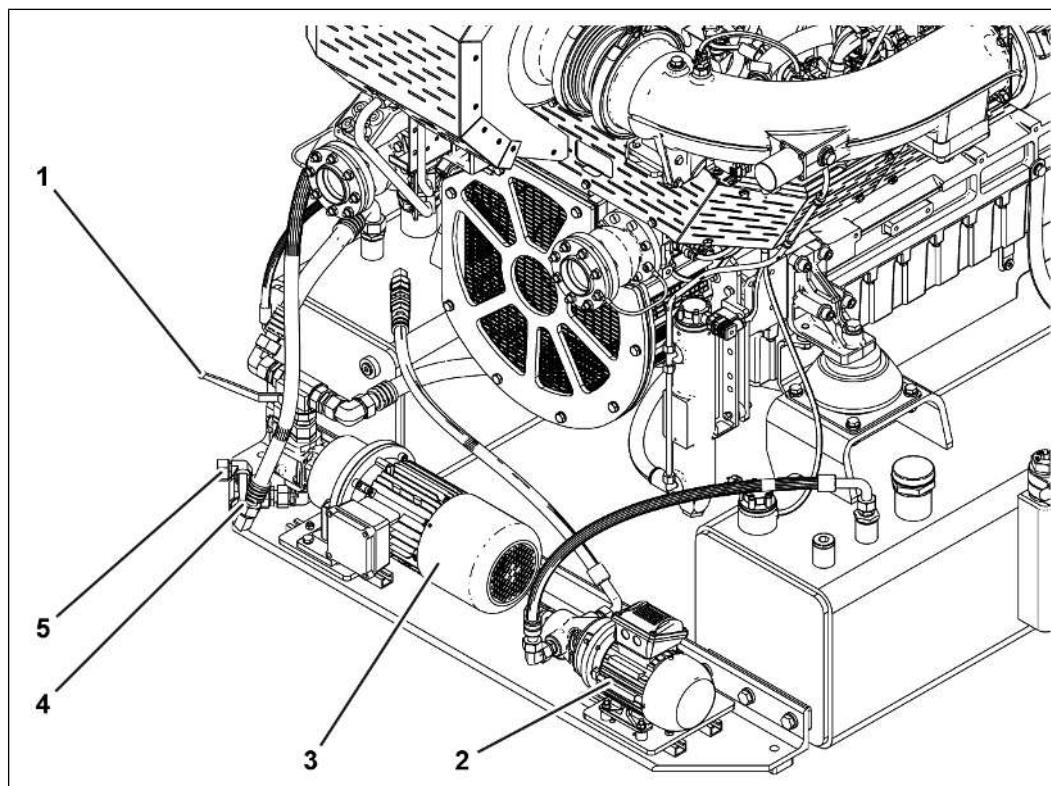
- 1 Lube oil filter
- 2 Lube oil filter console

The lube oil filter is mounted in the flow direction downstream of the lube oil cooler. The lube oil filter is screwed in the lube oil filter console. The lube oil filter console is mounted on the crankcase.

The lube oil pump transports the lube oil through the lube oil filter. Once filtered, the lube oil reaches the lubrication points in the engine.

#### 4.2.10.4 Prelubrication pump

##### Functional description



9007199645887243

- 1 Prelubrication pump valve
- 2 Fresh oil pump
- 3 Prelubrication pump
- 4 Prelubrication pump valve
- 5 Connection for draining lube oil

The prelubrication pump is installed on the free end of the genset.

Before the genset is started, the electronic system turns on the prelubrication pump. The duration and intervals of the prelubrication process are defined in the electronic system.

In the case of gensets that are in operationally-ready condition, the electric prelubrication pump lubricates the genset at regular intervals.

A start is only possible once the prelubrication process has been cycled through completely.

The prelubrication pump has the following functions:

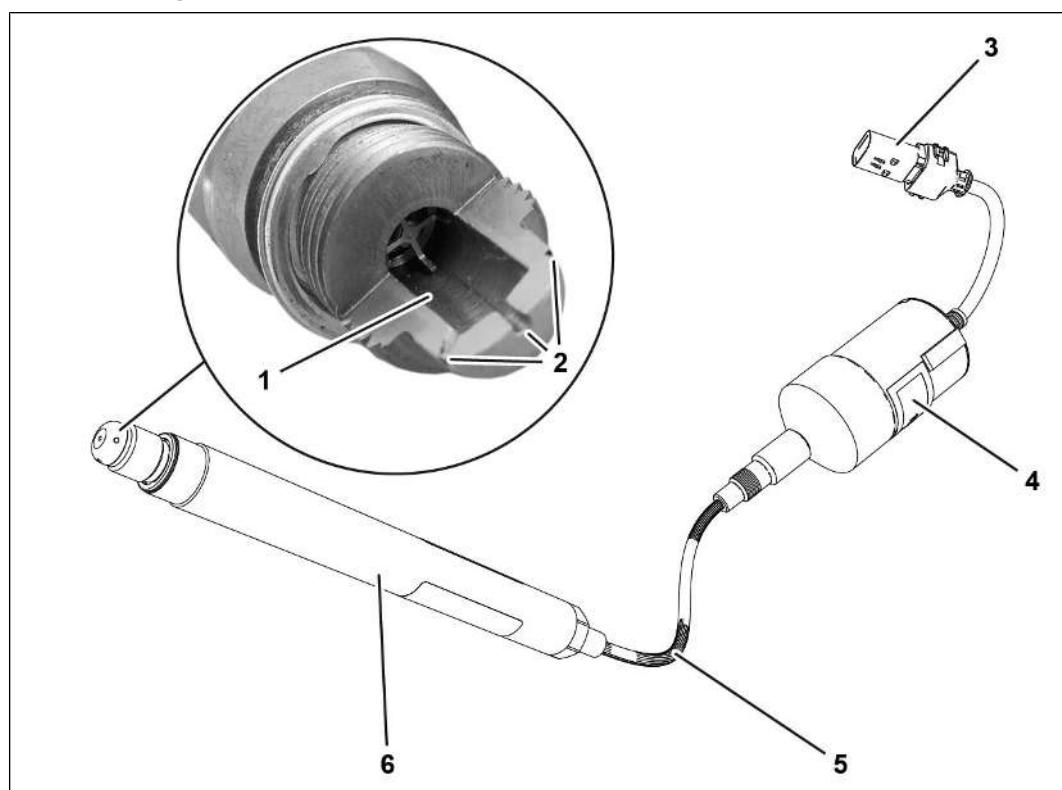
- Interval lubrication
- Prelubrication before every engine start
- Relubrication after shutting down engine

- Pumping out the lube oil for a lube oil change
- Filling the lube oil cooler and lube oil filter after a lube oil change

### 4.2.11 Ignition system

#### 4.2.11.1 Ignition system

##### Functional description



394471947

- 1 Spark plug chamber
- 2 Bore
- 3 Connector
- 4 Ignition coil
- 5 Ignition cable
- 6 Spark plug

---

The electronic control generates the ignition pulse and transmits the ignition pulse to the ignition coils as a voltage pulse.

The high voltage generated in the ignition coil is transmitted to the spark plug via the ignition cable.

At the head of the spark plug is the spark plug chamber, which has holes in it.

A voltage pulse sets off a spark in the spark plug chamber, which ignites the mixture in the spark plug chamber.

The resulting flame fronts pass through the holes and into the cylinder combustion chamber, igniting the mixture.

Advantages of a prechamber spark plug:

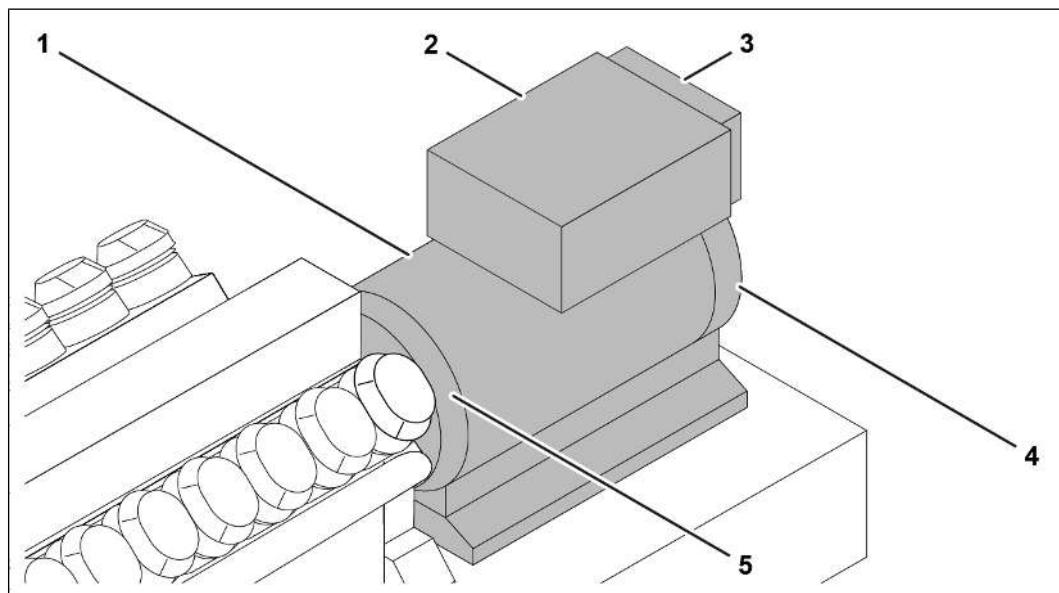
- Uniform propagation of the flame front across the entire combustion chamber
- More effective combustion
- Low electrode wear and therefore:
  - Greater service life of the spark plug

### 4.3 Generator

#### 4.3.1 Generator

Part number: (null)

##### 4.3.1.1 Functional description



408368011

- 1 Generator
- 2 Main terminal box
- 3 Auxiliary terminal box (if necessary, also mounted on the drive end)
- 4 Non-drive end
- 5 Drive end

---

The generator converts the mechanical energy of the engine into electrical energy.

As standard, brushless, self-excited and self-regulating three-phase synchronous generators are used, which, depending on the intended application, are suitable for a grid-parallel operation, mains back-up or island operation.

The generator is mounted on the base frame in the power flow direction downstream of the engine and coupling.

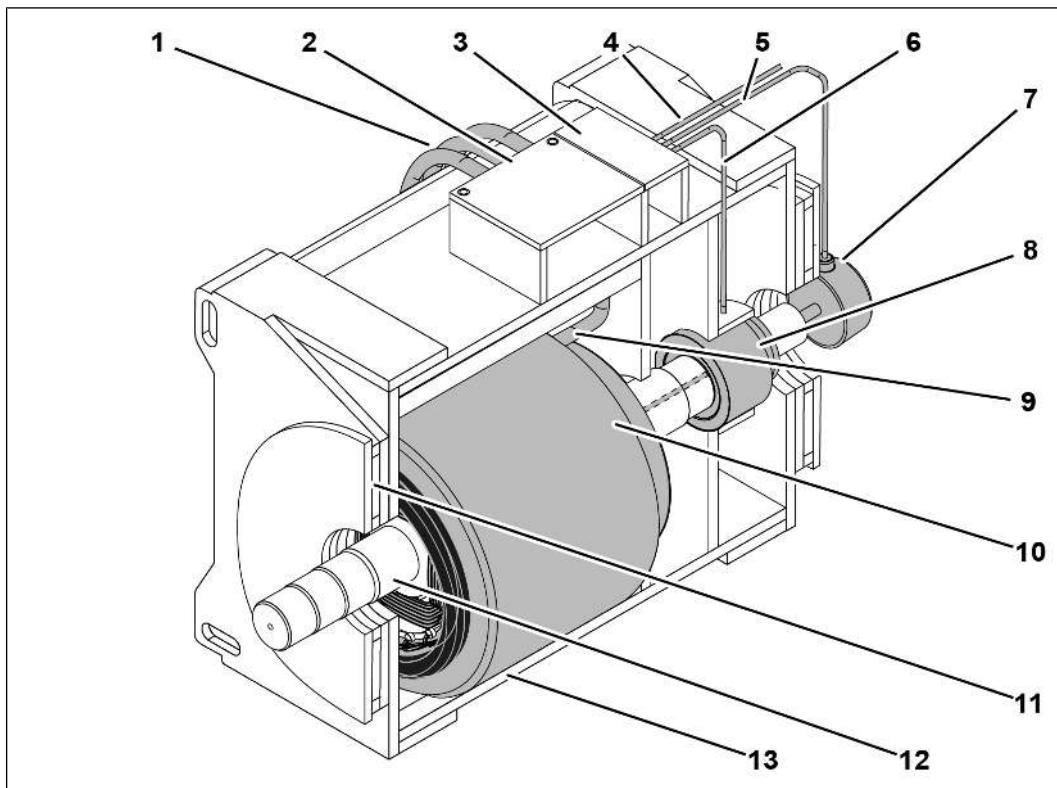
One generator bearing each is mounted both on the drive end and on the non-drive end of the generator. Depending on the type of generator, these generator bearings can be designed as sleeve bearings or roller bearings.

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**NOTE**

For the sake of clarity, the cut-away view omits the generator bearing, rectifier and fan impeller.

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151266827: Sample illustration of a three-phase synchronous generator with pilot exciter

- 1 Load cables
- 2 Main terminal box
- 3 Auxiliary terminal box
- 4 Control system signal lines and measuring lines
- 5 Connection cable for permanent magnet generator (PMG)
- 6 Exciter supply line
- 7 Permanent magnet generator (PMG)
- 8 Exciter
- 9 Main machine and main terminal box connection cable
- 10 Stator of the main machine
- 11 Bearing shield for fixing the sleeve bearing or for installing a roller bearing
- 12 Rotor shaft
- 13 Generator housing

A generator consists of the following main assemblies:

- Primary machine (primary rotor and primary stator)
  - The primary machine generates the current for the feed-in to the mains.
- Exciter (exciter rotor and exciter stator)

- The exciter generates three-phase AC current. A rectifier converts the three-phase AC current into DC current. A connection cable supplies the DC power to the rotor of the primary machine.
- Rotor shaft
  - The fan impeller, primary machine (primary rotor), rectifier and exciter (exciter rotor) are mounted on the rotor shaft.
  - A generator bearing is mounted on the drive end and on the non-drive end of the rotor shaft. Depending on the type of generator, these generator bearings can be designed as sleeve bearings or roller bearings.
- Main terminal box
  - The six ends of the main windings are located in the main terminal box.
  - The main terminal box also contains current transformers and voltage transformers for transmitting the measured values to the generator controller.
- Auxiliary terminal box
  - The connections for the sensors are located in the auxiliary terminal box.
  - The generator controller is installed in the auxiliary terminal box.
- Generator controller
  - The generator controller supplies the exciter with direct current.
  - The type of generator controller provided depends on the generator type and the configuration of the genset. Depending on the generator type and the requirement, the auxiliary exciter can be replaced with an additional auxiliary winding in the primary machine, a permanent magnet generator (PMG), or an external power source; alternatively, power can be provided directly from the generator terminals.

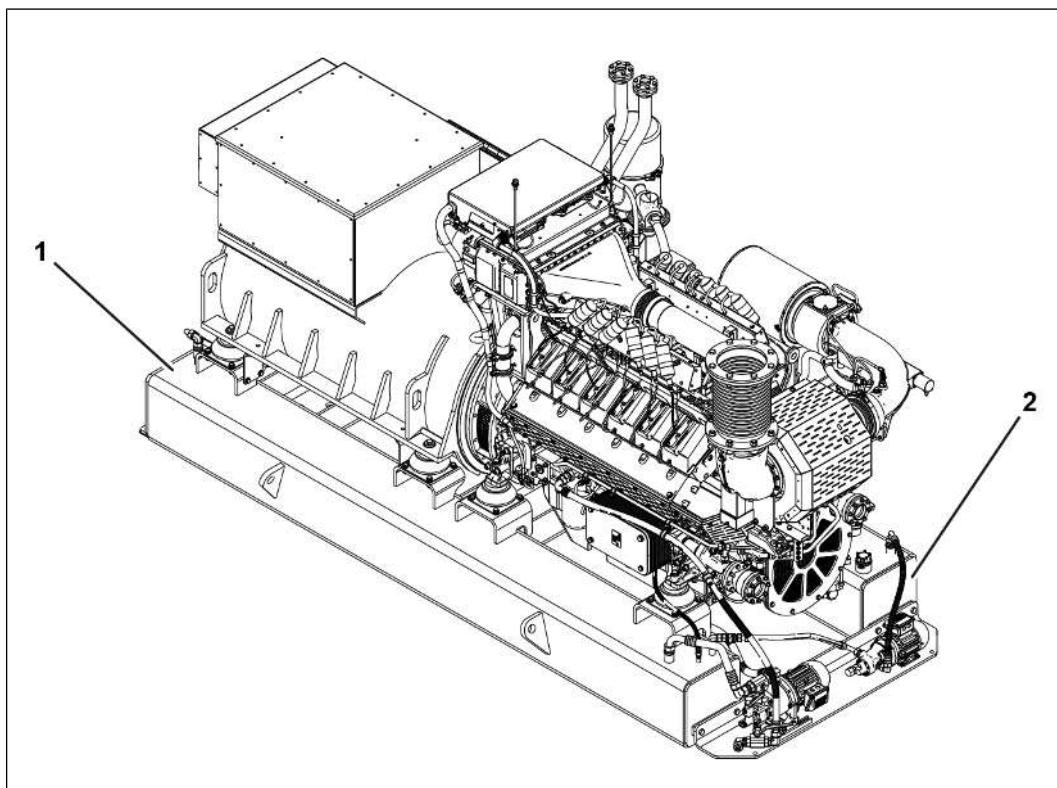
### Frequency

The frequency of the three-phase alternating voltage generated depends on the speed of the generator and the number of its pole pairs. Depending on the regional requirements, generators are designed for a frequency of either 50 Hz or 60 Hz.

## 4.4 Base frame

### 4.4.1 Base frame

#### 4.4.1.1 Functional description



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1 Expanded lube oil volume

2 Lube oil reservoir

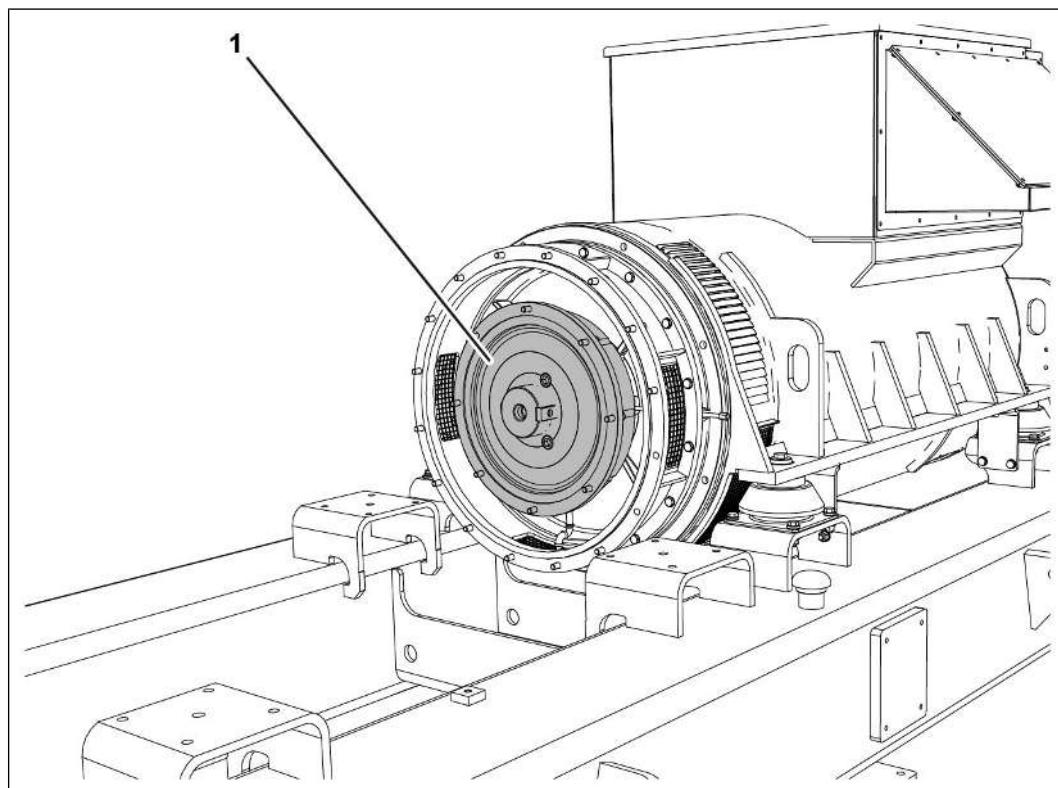
The base frame consists of two columns with several crossbraces. The generator and engine are mounted on the base frame. The prelubrication pump and fresh oil pump are mounted on the base frame. In order that the vibrations of the engine and generator are not transmitted to the base frame, [Functional description \[▶ 91\]](#) are installed.

The [lube oil tank \[▶ 77\]](#) is integrated in base frame. The lube oil tank consists of two parts, each of which are accommodated in a column of the base frame. One column contains the lube oil reservoir. The other column contains the expanded lube oil volume. Together, both parts form the increased lube oil volume for the engine. Thanks to the greater lube oil volume, longer intervals are achieved between the lube oil changes.

## 4.5 Coupling

### 4.5.1 Coupling

#### 4.5.1.1 Functional description



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##### 1 Coupling

An elastic coupling connects the engine and generator with each other. The coupling is not switchable.

The coupling has the following functions:

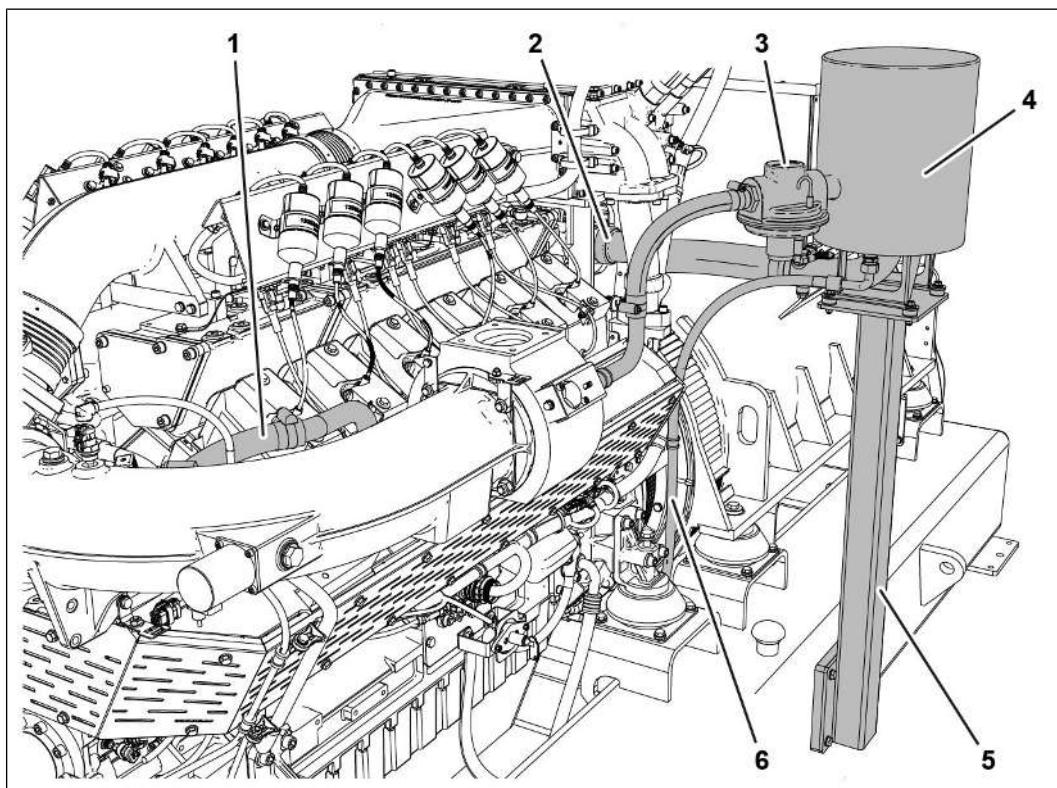
- Torque transmission from the crankshaft to the generator shaft
- Absorption and damping of rotational vibrations and load surges
- Compensation for radial, axial, and angular shaft misalignment within the tolerance range

## 4.6 Crankcase ventilation

### 4.6.1 Crankcase ventilation

Part number: (null)

#### 4.6.1.1 Functional description



403698059

- 1 Blow-by gas return line to the intake line
- 2 Blow-by gas supply line to the oil separator
- 3 Gas pressure controller
- 4 Oil separator
- 5 Support
- 6 Lube oil drain to lube oil sump

Negative pressure sucks blowby gas through a lube oil separator and into the engine's intake air system.

The lube oil separator separates the lube oil particles from the blowby gas and directs the filtered lube oil back into the lube oil sump.

During compression of the gas-air mixture in the cylinder, a small amount of the gas-air mixture flows from the combustion chamber into the crankcase chamber.

Inside the crankcase chamber, the blowby gas mixes with the lube oil mist; the mass of the mixture and the motion of the piston together produce a positive pressure.

Under sufficient pressure, the blowby gas can become an explosive mixture.

To prevent the formation of such an explosive mixture, the blowby gas is vacuumed out of the crankcase by the crankcase ventilation.

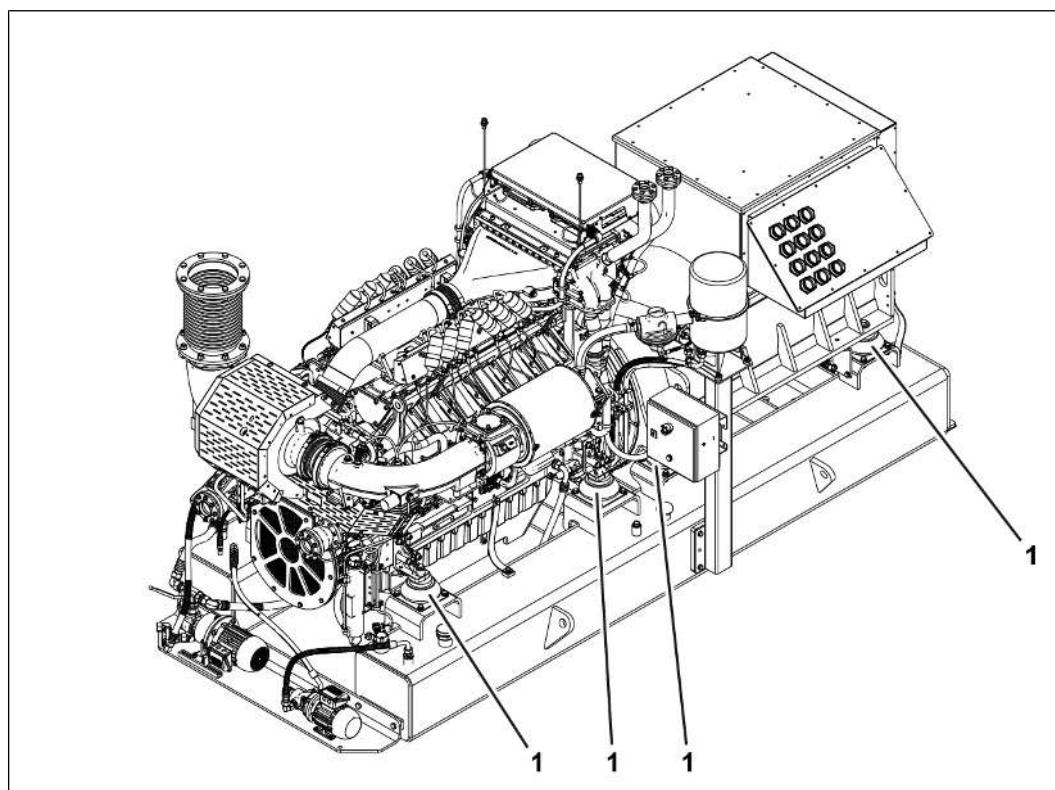
A return line directs the filtered lube oil back to the lube oil sump.

The electronic control monitors the crankcase chamber pressure with the aid of a gas pressure controller.

## 4.7 Anti-vibration mounting

### 4.7.1 Anti-vibration mounting

#### 4.7.1.1 Functional description



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##### 1 Anti-vibration mountings

Compared to the base frame and foundation, the anti-vibration mounting enables vibration isolation from the genset. The anti-vibration mounting also reduces transmission of sound from the genset to the base frame and foundation. This reduces sound emissions into the environment.

For detailed information on sound emissions and vibration isolation, see *Operating Manual, chapter General, section Installation directive*.



## 5 Transport and storage

### 5.1 Genset

#### 5.1.1 Preservation, packaging, transport, and storage

For general information on this topic, see [Specification for corrosion protection, packaging, transport, and storage](#).

### 5.2 Rubber expansion joint

#### 5.2.1 Transporting the rubber expansion joint

Protect the component from impacts, shocks and vibrations.

Do not roll the component on the rubber bellows.

The rubber bellows may not be misused as lifting points for lifting equipment.

Protect the component from intensive sunlight.

Permissible transport temperature: -0 ... +60 °C

#### 5.2.2 Storing the rubber expansion joint

The following points should be observed during storage:

- Clean the component thoroughly.
- Seal all openings.
- Store the component in a clean, dry and weather-protected place.
  - High air humidity and fluctuating ambient temperatures can cause condensation to form.
- Protect the component from intensive sunlight.
- Permissible storage temperature: -0 ... +60 °C



## 6 Assembly

### 6.1 Genset

#### 6.1.1 Installing the genset



##### CAUTION

Danger of crushing limbs when transporting the genset on steel rollers

This can lead to minor or severe injuries.

- Before transporting the genset on steel rollers, ensure that all persons have left the danger zone.
- Wear personal protective equipment.
- Perform work with care and attention.
- Perform work in pairs.

##### Notes on safety regulations

Observe the applicable safety regulations for operation, maintenance, and servicing. Observe and comply with all instructions for handling and safety notes given in this document. Failure to do so can result in substantial hazards.

The product is used in the commercial sector. The operator is subject to the legal obligations for health and safety at work.

The operator must comply with the following for the product's and overall plant's area of application:

- Safety notes in this document
- Safety regulations
- Accident prevention regulations
- Environmental protection specifications
- General rules on health and safety at work
- Operator's job safety analysis
- Directives and ordinances on operational safety

Laws, directives, ordinances and regulations are available from trade associations or specialist dealers.

You will find required information on the safety regulations in the document *Safety regulations*. You can find this document in the order-specific operating manual or in the Service Library.

**Notes on the target group**

This description is intended for qualified specialist personnel. Only qualified and instructed specialist personnel may perform the described activities.

You will find further information on the requirements and qualifications of the target group in the document *Safety regulations*. You can find this document in the order-specific operating manual or in the Service Library.

**Notes on installation site**

Once at the installation site, the genset must be transported into the genset room through the access opening and aligned. Suspension points (lifting lugs) are affixed to the sides of the genset's base frame for transport purposes.

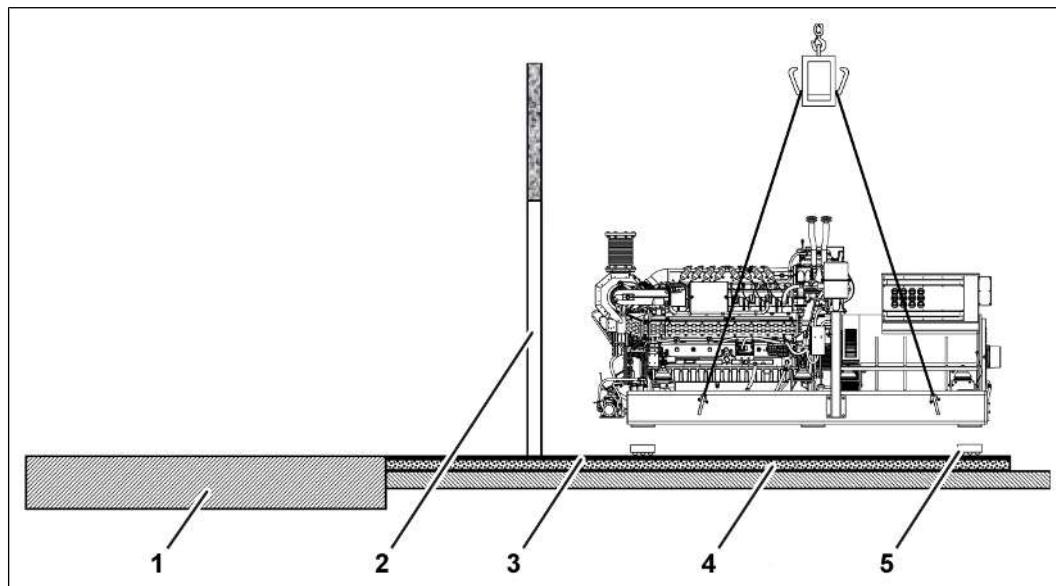
The suspension points are arranged symmetrically about the genset's center of gravity. If you use four pieces of lifting tackle of equal length (e.g. slings or chains), the genset will hang in a stable horizontal position when lifted.

You will find required information on the installation site and foundation in the document Layout of power plants. You can find this document in the order-specific operating manual or in the Service Library.

**Notes on stationary plants**

First install the genset and align it on the foundation before you seal the foundation surface.

The concrete under the bearing elements must not be sealed or tiled.

**Notes on the foundation and setup area**

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- 1 Installation site foundation
- 2 Access opening
- 3 Steel plates
- 4 Ballast bed
- 5 Steel roller

An appropriately designed foundation forms the installation site for the genset (1).

Place the genset onto steel rollers (5) in front of the access opening (2) for installation. The surface (setup area) must be even and load-bearing.

Temporarily set up a 2-lane setup area depending on the conditions on site. The setup area consists of a ballast bed (4) covered with steel plates (3). The setup area ends flush with the upper edge of the installation site. You can set the genset down fully on the setup area outside of the genset room.

**Foundation preparation**

Tools:

- Standard tools
- Crane
- Suitable load suspension devices:
  - Vertical beam
  - Equally long round slings or sling chains
  - High-strength shackles
- At least two guide ropes

- At least four steel rollers
    - Use enough steel rollers so that the base frame does not bend.
  - At least four hydraulic cylinders
    - The space between the base frame and the foundation is very tight. Therefore, use low-profile hydraulic cylinders.
    - Use enough hydraulic cylinders so that the base frame does not bend.
  - Two winches
  - Hardwood blocks or short hardwood beams
  - Isolation plates (rubber mats) for decoupling the base frame and foundation
    - Approx. 350 × 250 × 4 mm
    - Select a hardness based on the vibration assessment in accordance with DIN ISO 8528-9 (ISO 8528-9).
- ✓ The genset has arrived at its final destination
- ✓ There is a suitable foundation at the installation site for the genset, see Layout of power plants
- ✓ The customer's connections for operating media, supply air and outlet air are available
- ✓ Sufficient free space around the genset is available for assembly work
- ✓ There is a load-bearing and even surface (setup area) between the genset room and access opening in the extended area of the installation site
- ✓ The installation site for the mobile crane has sufficient load bearing capacity
1. Check that the foundation and setup area are level.
  2. Remove all objects from the genset room and from the setup area.
    - Remove tools, components and transport packaging.
    - Sweep the genset room and setup area.
  3. **WARNING! Earthing leads that protrude from the foundation could cause severe injury or death.** Secure protruding earthing leads
    - Indicate earthing leads clearly (e.g. traffic cone, barrier tape).
    - Cover earthing leads with shock-absorbing caps (e.g. foam).
    - Bend earthing leads so that their tips do not protrude upward.
  4. Block off ample room on both sides for transport paths and swivel radii.

## Lifting and transporting the genset

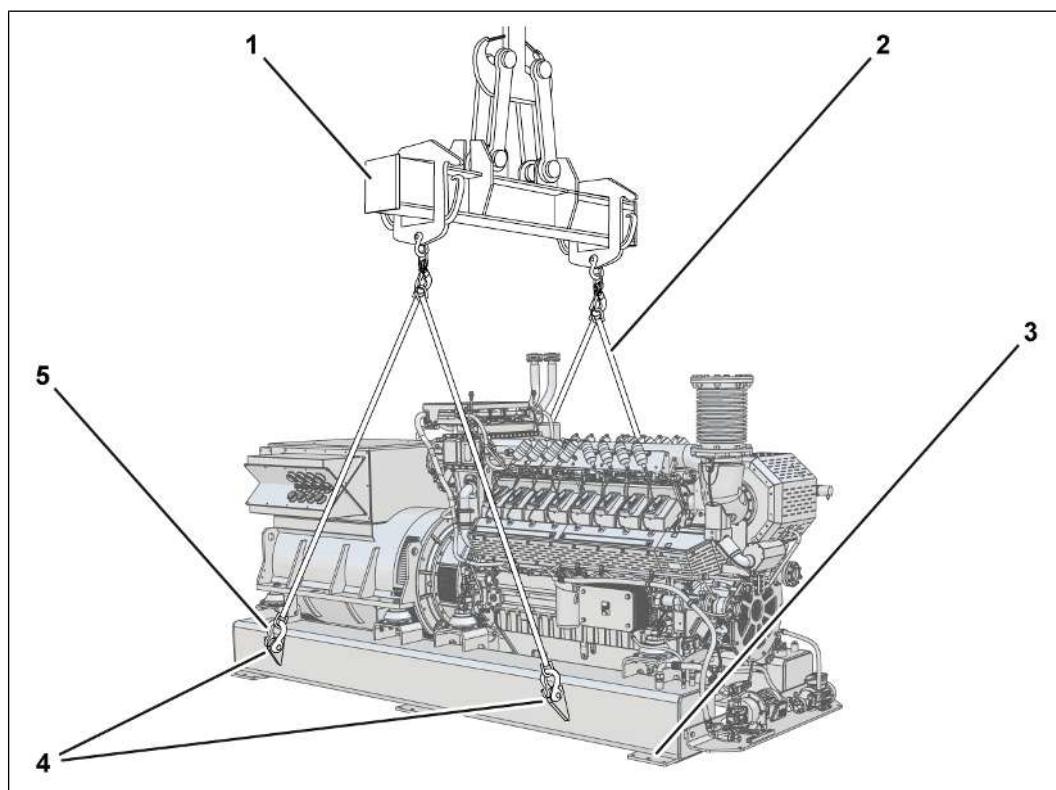


### Risk of destruction of components

Due to improper genset transport

The genset can be damaged or destroyed.

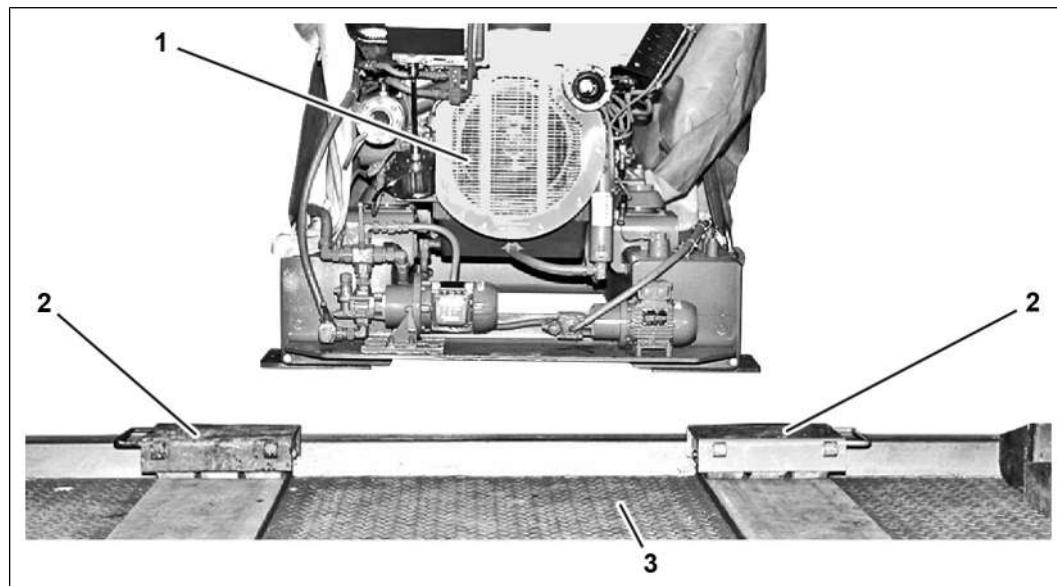
- Only hoist the genset at the specified lifting points.
- The load suspension device and lifting tackle must be designed for at least double the actual load.
- Move slowly when installing the genset.
- To avoid damage to the base frame, always set the genset down with the support plates fully within the setup area.



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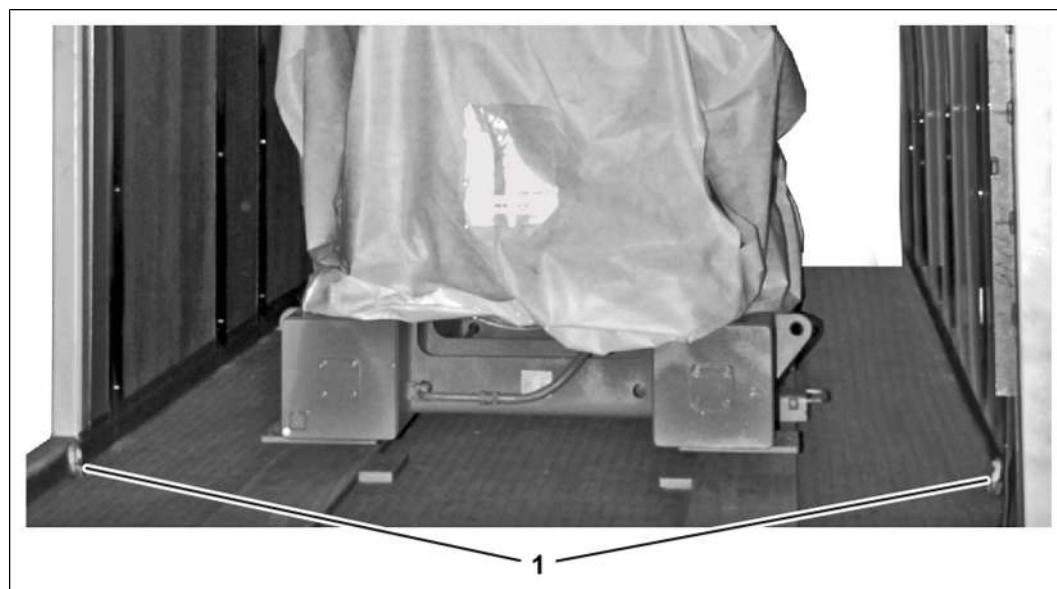
1. Prepare the load suspension device (1) and lifting tackle (2).
  - Check that the load suspension device (1) and lifting tackle (2) are suitable.
  - Hang the load suspension device (1) on the crane hook and secure it from falling out unexpectedly.
  - Hang equal-length, suitable lifting tackle (2) from the load suspension device (1) and secure the tackle against falling out unexpectedly.

2. Position the load suspension device (2).
  - **NOTE! The center of gravity is marked with a corresponding symbol on the base frame.** Move the crane hook with load suspension device (1) and lifting tackle (2) until it is plumb above the center of gravity.
3. Attach the genset.
  - Use heavy-duty shackles (5) to attach the genset.
  - Properly attach the lifting tackle to the genset's lifting points (4).
  - Secure a guide rope to at least one corner of the base frame in order to control the movement and position of the genset.
4. Lift the genset slightly as a test.
5. Check the lifting tackle (2) for the following:
  - Load hangs horizontally
  - Each piece of lifting tackle (2) bears the same weight
  - Lifting tackle (2) makes contact only with the lifting points (4), not with components
6. Attach the genset again if necessary.
  - Set down the genset.
  - When setting down the genset, make sure that the support plates (3) make complete contact with the ground below.
7. Transport the genset in front of the access opening.
  - Lift the genset.
  - Use the guide ropes to control the motion and position of the genset during transport.

**Positioning the genset on steel rollers**

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1. Position steel rollers (2) at the access opening (3).
  - Check that the steel rollers (2) are aligned with the installation site.
2. Use the guide rope to position the genset (1) over the steel rollers (2).
3. Set the genset down on the steel rollers at the access opening (1).
  - Ensure a uniform load share.
  - Set the genset (1) down in such a way that it is centered and aligned with the installation site.

**Pulling the genset to the installation site**

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If the genset is installed in a container, use the transport safety lugs (1) to pull the genset to the installation site. The transport safety lugs (1) are bolted to the container floor at the center of each side of the container.

If you cannot mount suitable winches for installing the genset in the genset room, you can also push the genset to the installation site using a suitable forklift (e.g. a heavy-duty telescopic loader). For more information on the installation site, see Layout of power plants. You can find the document in the order-specific operating manual or in the Service Library.

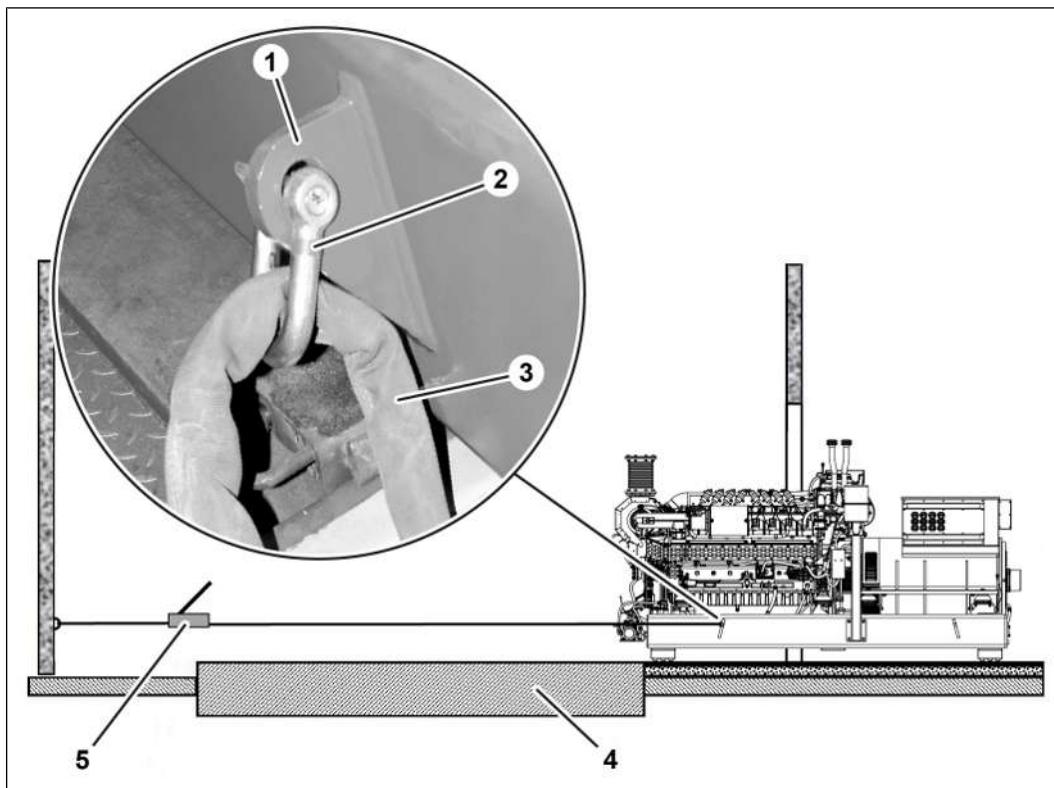


### Risk of destruction of components

Due to incorrect handling of forklift trucks

The genset can be damaged or destroyed.

- In order to protect the genset from possible damage, place a shim (e.g. hardwood plank) between the base frame and the fork of the forklift.
  - Secure the genset to the fork of the forklift with slings to prevent it from rolling away unexpectedly.
  - Make sure that all lifting points can sustain enough tensile force.
-



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1. Tension two cable winches (5) between the base frame and the rear wall of the genset room
  - Attach each winch (5) to one of the lifting points (1) on the base frame using heavy-duty shackles (2) and suitable lifting tackle (3)
  - Attach the winches (5) to fixed points on the rear wall of the genset room.
2. Slowly pull the genset to the installation site (4) with the winches (5)
3. Check the orientation of the genset before reaching the installation site (4)
4. Align the genset if necessary.
  - Lift the rear part of the genset slightly using hydraulic props.
  - Check that the genset is still positioned securely on the steel rollers.
  - Place a hydraulic prop horizontally between the base frame and the wall of the genset room.
  - Check the orientation of the genset during the entire process. Work in pairs.
  - Align the genset using the hydraulic prop.
5. Set the genset down safely and securely on the steel rollers
  - Once the genset is aligned, remove the hydraulic prop.
6. Use the winches (4) to pull the genset until the exhaust manifold is directly beneath the on-site exhaust line
7. Place it under the contact surface of the base frame

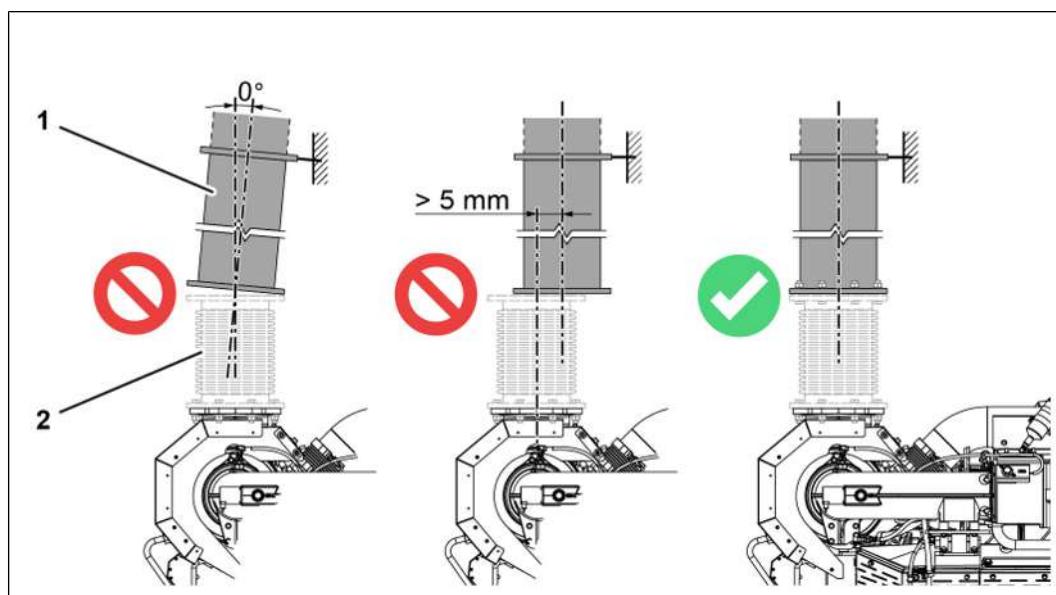
### Aligning the genset at the installation site

The genset is aligned correctly when the genset's exhaust manifold is in line with the on-site exhaust line connection.

When the genset is in operation, the function of the exhaust expansion joint is to compensate for excessive forces from the site's duct system on the exhaust turbocharger housing. The exhaust expansion joint prevents engine vibrations from being transmitted to the duct system. The exhaust expansion joint can only fulfill this function if there are no unfavorable stresses in the pipes that cause torsion.

If you mount the on-site exhaust duct connection after installing the genset, you must align the site's exhaust duct connection with the exhaust manifold. If the on-site exhaust duct connection is already installed, align the genset with the exhaust duct connection at the installation site before setting down the genset. For more information, see also the drawing below.

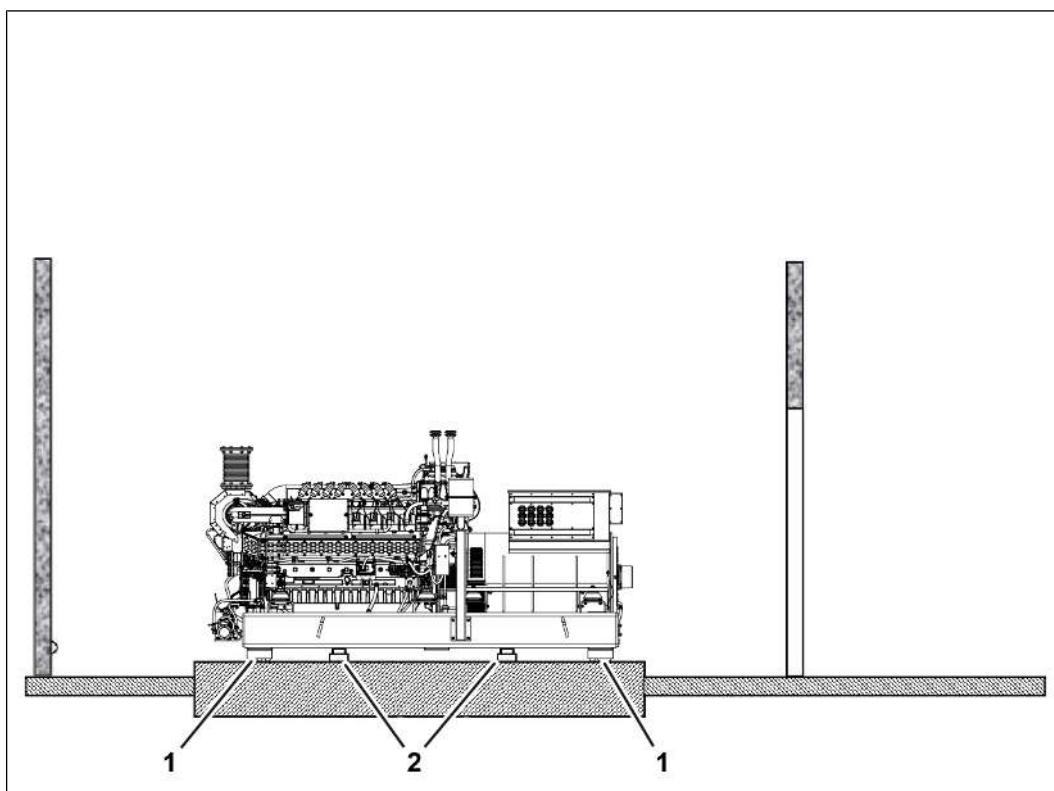
#### 1. Align the genset.



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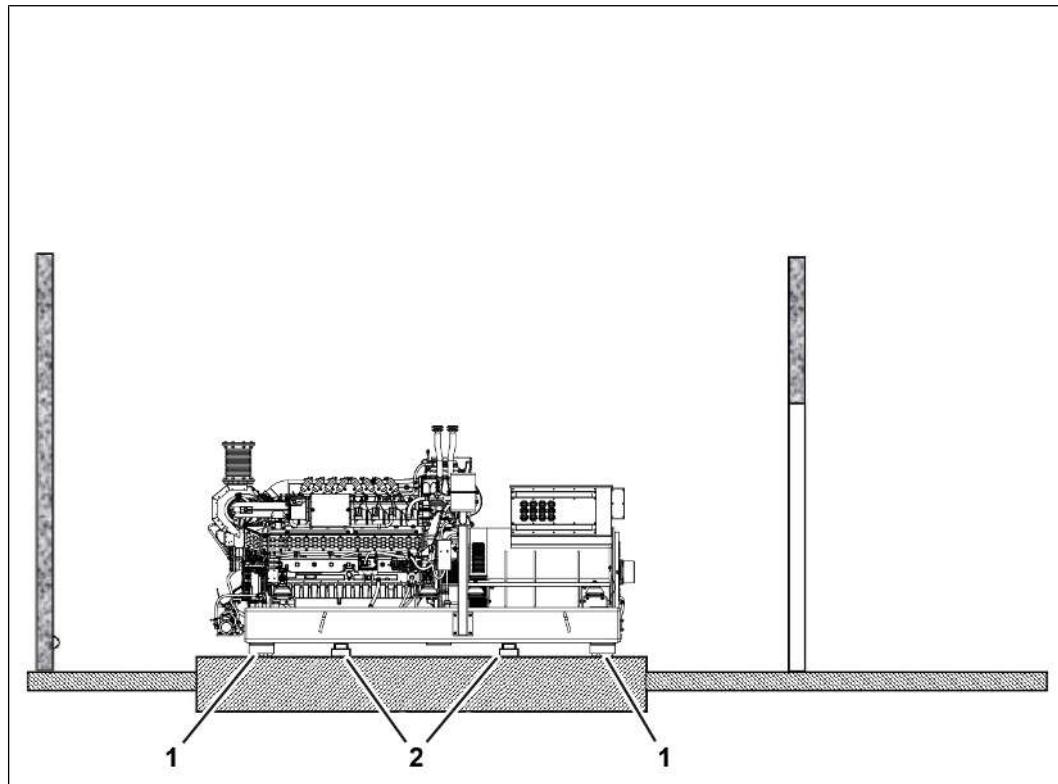
#### 2. Mount the exhaust expansion joint.

- The exhaust expansion joint (2) and the on-site exhaust line (1) are plumb with each other.
- Check the specified installation tolerances between the exhaust expansion joint and the on-site connection point.
- For all required information for mounting and aligning exhaust expansion joints, see order-specific operating manual.



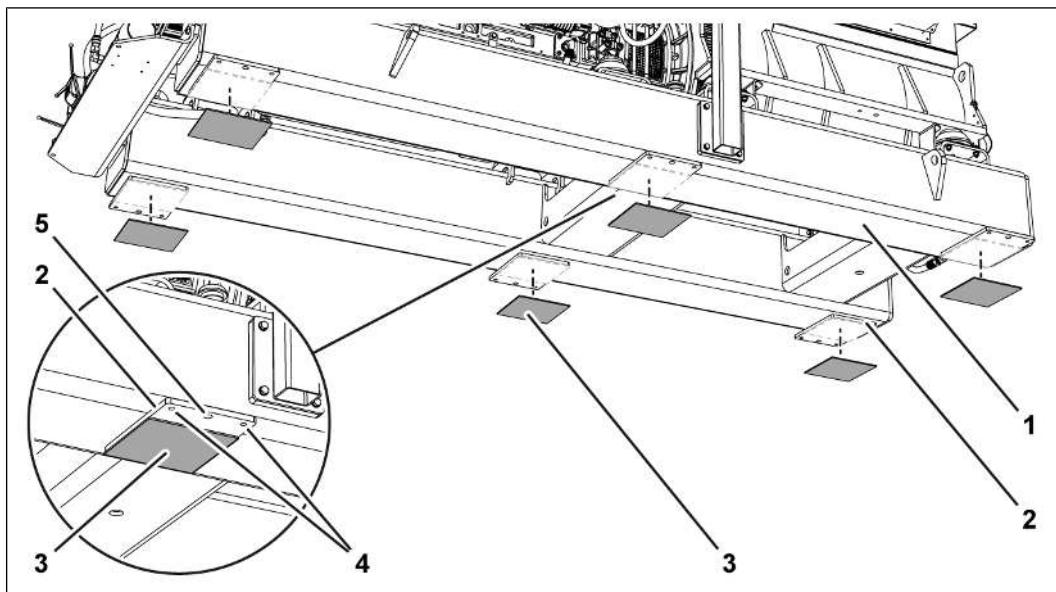
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3. Correct the genset's longitudinal position if necessary
  - Either pull the genset forward or backward.
4. Correct the genset's lateral position if necessary
  - Lift the genset evenly using at least four hydraulic cylinders (2).
  - Rotate the steel rollers (1) by 90°.
  - Set down the genset on the steel rollers.
  - Align the genset side-to-side by pushing or pulling (e.g. with a hydraulic cylinder or winch). In doing so, secure the base frame from damage using hardwood beams.

**Setting down the genset on the foundation**

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1. Lift the genset evenly using at least four hydraulic cylinders (2)
2. Support the genset with hardwood blocks or hardwood beams
  - Do not cover the support plates of the base frame with shims or hydraulic cylinders.
  - Ensure a uniform load share.
  - Place the genset safely and securely onto the wooden substructure.
  - Remove the steel rollers (1) from under the genset



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3. Place damper plates (3) on the foundation under the support plates (2)
  - Make sure that the damper plates (3) line up with the inner edge of the base frame (1).
  - The holes (4, 5) in the support plates must remain unobstructed (inset).
4. Remove wooden shims/substructure
  - Lift the genset evenly with the hydraulic cylinders to perform this step.
5. Set down the genset on the damper plates (3)
6. Remove hydraulic cylinders

---

#### NOTE

Special requirements for earthquake-prone regions

- Anchor the genset's support plates with the foundation. A structural engineer must check this connection.
- Different regions of the world require you to use different screw connections:
  - For the Asia region, use M16 screws in the smaller corner holes in the support plates.
  - For the rest of the world, use M20 screws in the larger middle holes in the support plates.

7. Affix the genset's support plate with screws in the foundation of a stationary plant
  - Insert screws into the appropriate holes (4, 5) in the support plates (3) and screw them into the foundation.

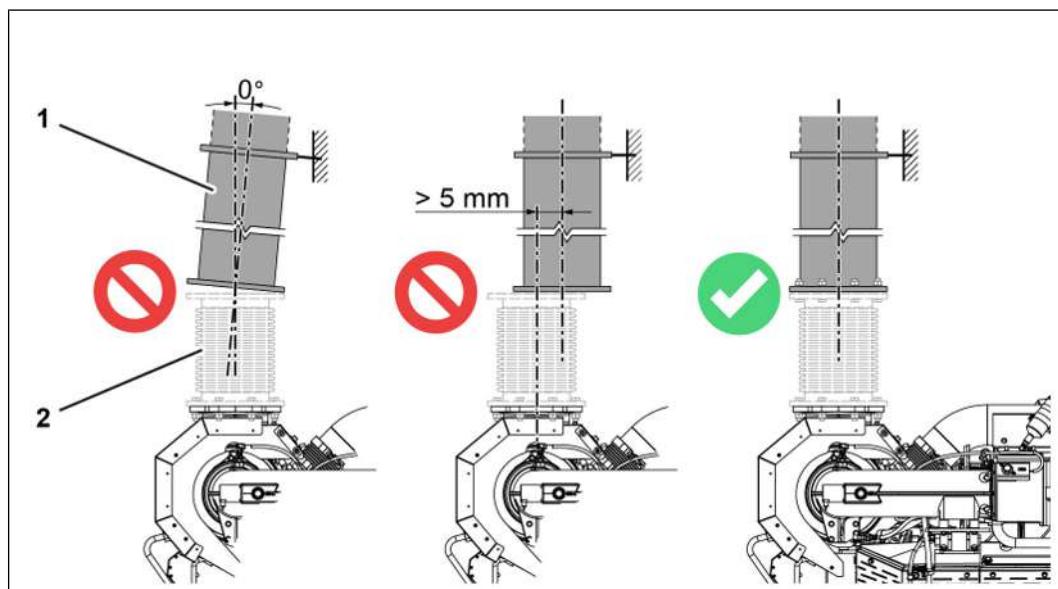
- Have a structural engineer check the connection.
8. Inside of the container, screw the genset and its support plates to the steel rails.
    - Insert screws into the appropriate holes (4, 5) in the support plates (3) and screw them into the steel rails.
    - Fix the genset at the corners with steel stoppers.
- ⇒ The genset has been moved into position, aligned and screwed to the foundation at the installation site.

### 6.1.2 Assembling the genset



Tools:

- Standard tools
- ✓ [Installing the genset \[▶ 95\]](#)



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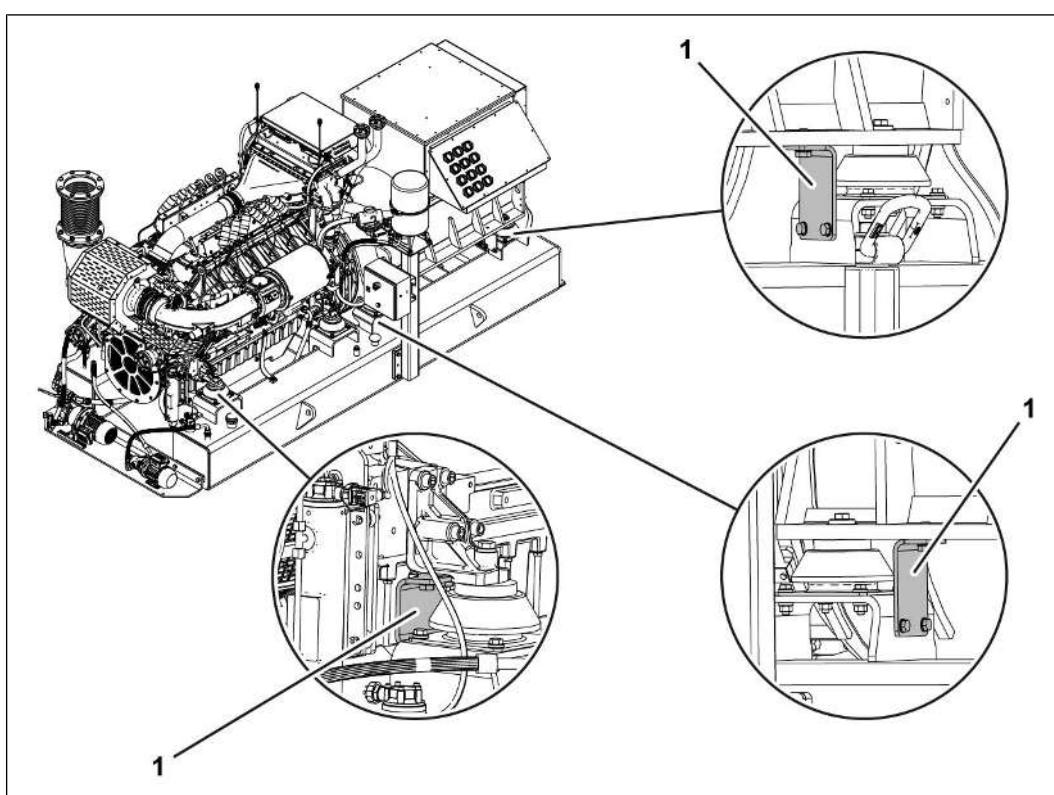
1. Screw together the exhaust expansion joint and the flange of the on-site exhaust line
  - Observe the specified installation tolerances between the exhaust expansion joint (2) and the on-site connection point (1).
  - Check that no foreign objects are stuck to the folds of the exhaust expansion joint and clean if necessary.
2. **NOTE! Re-tighten screw connections after 100 operating hours. Exchange any damaged insulation.** Check that the screw connections are tight

### 6.1.3 Removing the transport safety lock



Tools:

- Standard tools
- ✓ The genset is positioned and anchored at the installation location.



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1. Install transport safety locks (1) on both cylinder sides

#### 6.1.4 Connecting the gensest to the electrical supply

##### Description

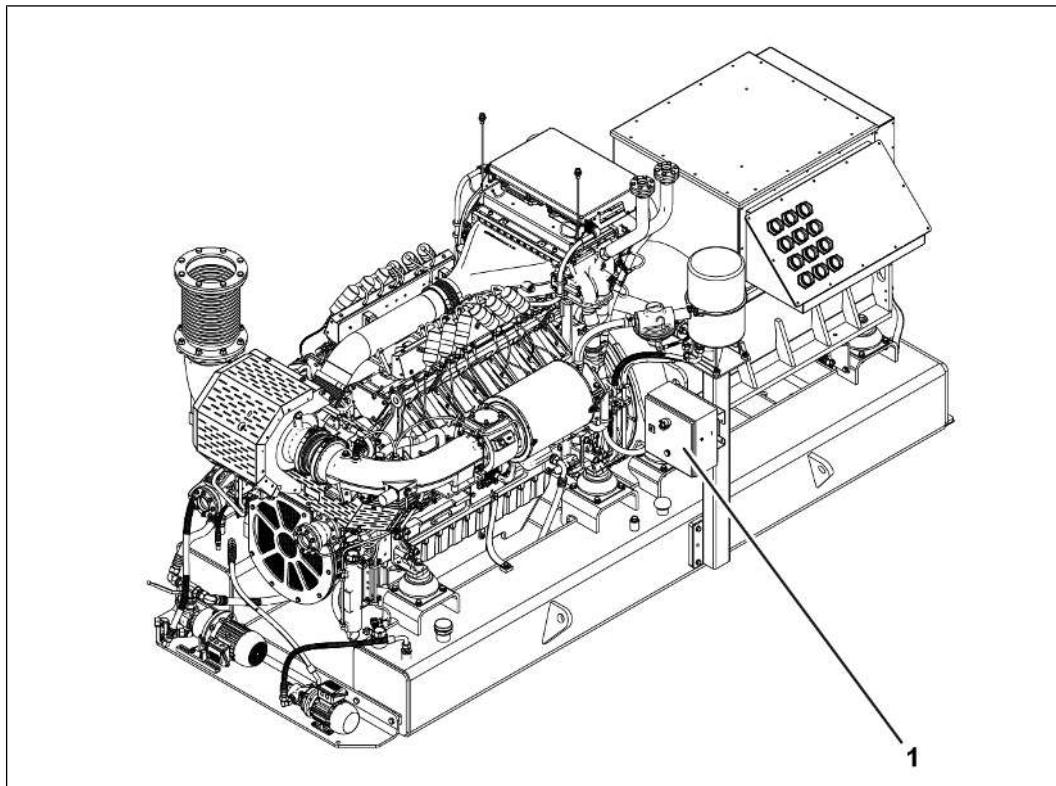
On the gensest, all the sensors and electrical consumers are combined in the wiring harness. The wiring harness is connected to the TPEM Connection Box with a connector. The TPEM Connection Box is the interface to the TPEM Control Cabinet.

For detailed notes on the electrical connection of the gensest, see:

- Operating Manual, chapter Assembly note
  - Section Switch cabinet TPEM Control Cabinet control (switch cabinet TPEM Control Cabinet)

##### Procedure

- ✓ Crankcase ventilation is fully mounted.
- ✓ All the required switch cabinets have been built.



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1. Connect the TPEM Connection Box (1) to the TPEM Control Cabinet

#### 6.1.5 Earthing the genset



Tools:

- Standard tools

---

**DANGER**

Electric shock if live components are touched

Severe injury or death may result.

- Only authorized specialist personnel may work on the electrical system.
- Turn off electrical power supply and secure against restarting prior to all work.

✓ Plant is stopped.

1. Connect the protective conductor and the protective equipotential bonding according to the circuit diagram
2. Create protective earthing and operational earthing on the plant

## 6.2 Exhaust system

### 6.2.1 Connecting the on-site exhaust system to the genset



Tools:

- Recommended measuring devices
  - TESTO 340
  - TESTO 350 XL or Ecom D

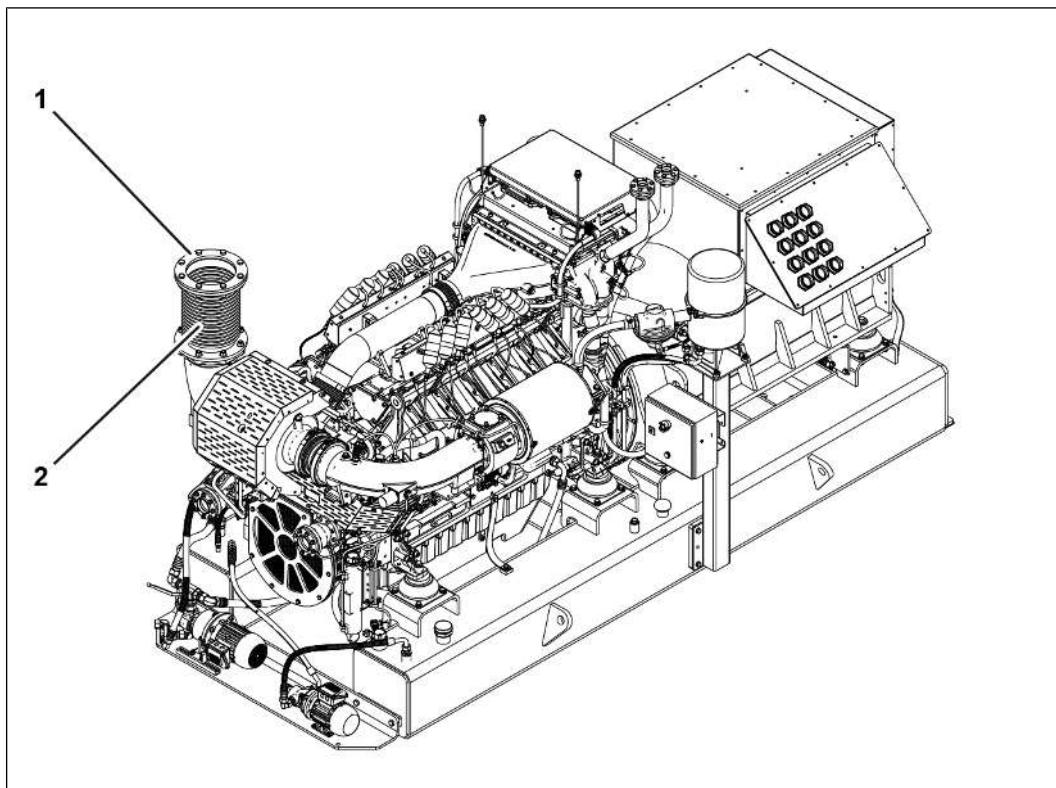
#### Description

For detailed notes on installing the on-site exhaust system, see:

- P&I diagram
- Technical Drawings
- [Assembly \[▶ 95\]](#)

These documents can be found in the Service Library and in the order-specific operating manual.

- ✓ The on-site exhaust system has been fully assembled and properly insulated.
- ✓ All the piping has been cleaned.
- ✓ Leak test of the on-site exhaust system has been performed.



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1. Check and clean bellows of the exhaust expansion joint (2)
2. Connect the flange of the exhaust expansion joint (1) to the flange of the exhaust line
3. Check that all screw connections of the exhaust system are tight
  - After 100 operating hours or 14 days, check again that the screw connections are tight.
4. Perform a leak test after commissioning
  - Proceed down the exhaust line with a measuring device to find leaks.
5. Check exhaust line for the following signs of leaks:
  - Isolated hot spots
  - Charged shielding on the insulation
  - Condensate leaks out and builds up on insulation
6. After 100 operating hours or 14 days, check the insulation for damage.

## 6.3 Intake air filter

### 6.3.1 Connecting the on-site intake air system to the gensex



Spare parts:

- Flexible pipe
  - Pipe length depends on the on-site installation situation.

### Combustion air requirements

The intake air must fulfill specific requirements. If the requirements cannot be fulfilled or can be fulfilled only partially, the operating conditions and thus the maintenance intervals and maintenance measures will change.

Always contact the manufacturer if this is the case.

For detailed notes on the requirements for combustion air and installing the on-site intake air system, see:

- P&I diagram
- Technical Drawings
- [Assembly \[▶ 95\]](#)
- [Specification for combustion air](#)

These documents can be found in the Service Library and in the order-specific operating manual.

### Connecting the on-site intake air system to the genset:

- ✓ The on-site intake air system has been fully assembled.
  - ✓ The genset has been bolted to the foundation and aligned with the intake air system.
  - ✓ All piping has been cleaned.
  - ✓ The leak test of the on-site intake air system has been conducted.
1. Clean connection nozzles of the intake filter, see [Dismantling the intake air filter \[▶ 358\]](#)
  2. In the case of remote intake air filters, fix the connection nozzle of the intake filter with a flexible pipe on the intake air inlet pipe
  3. Check all the screw connections on pipe flanges and hose flanges, as well as on the connection nozzle of the intake air system for tight fit.

## 6.4 Fuel gas system

### 6.4.1 Connecting the fuel gas system to the genset

#### General information

For detailed instructions on assembling the on-site fuel gas system, see:

- [Layout of power plants](#), see Service Library
- P&I diagram
- See Service Library, Technical Bulletin (TR 3017), [Specification for fuel gas](#)

These documents can be found in the Service Library and in the order-specific operating manual.



## DANGER

Explosion due to flammable gases.

Severe injury or death can result.

- Sufficiently ventilate the room.
- Do not smoke.
- Do not use any naked flames.
- Use only ATEX-approved devices and tools.
- Only qualified specialist personnel may work on the fuel gas system.

## NOTE

When using solid piping, oscillations and vibrations are transmitted from the genset to the fuel gas line.

The fuel gas line and components of the fuel gas system may be damaged.

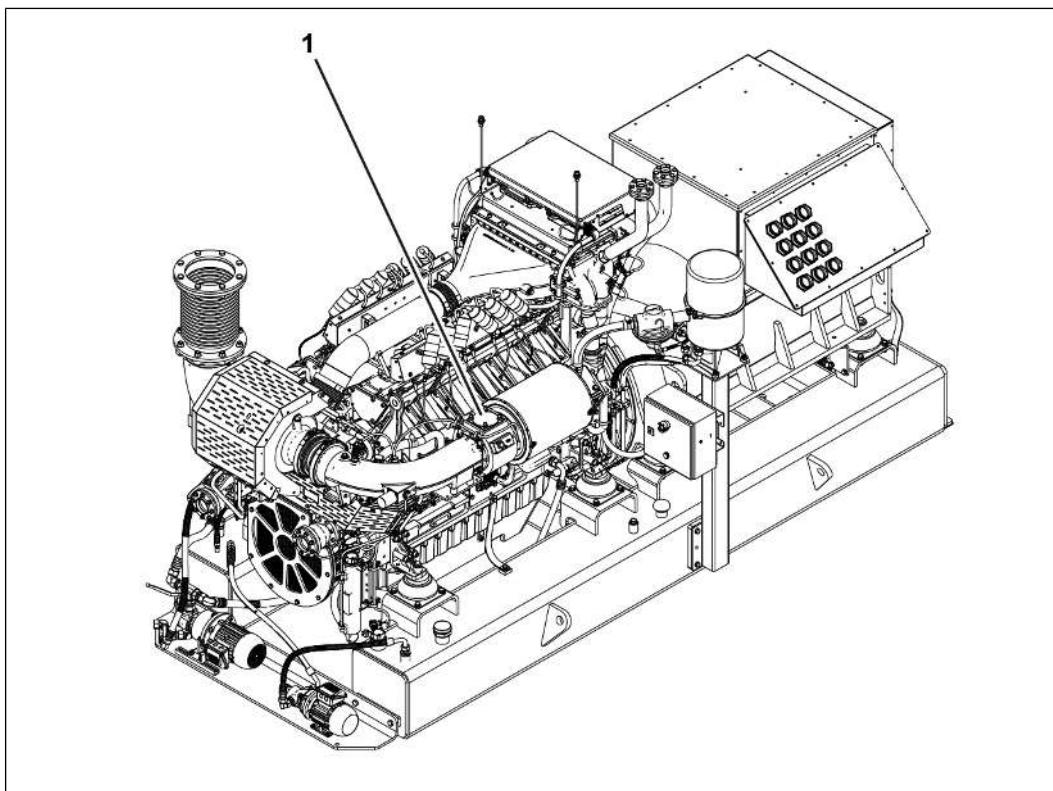
- Use a suitable expansion joint to decouple the genset and thereby minimize vibrations.

## Connecting the fuel gas system to the genset:

The prerequisite for this is:

- ✓ The gas train has been fully assembled.
- ✓ All piping has been cleaned.
- ✓ A leak test has been carried out on the on-site gas connection.
- ✓ All safety functions for explosion protection have been checked and are functioning properly.

1. Check whether all the flanges and line sections are dry, clean, and free of welding beads and cinders.



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2. Mount fuel gas line or fuel gas hose to the gas-air mixer (1)
  - To prevent uncontrolled vibrations, decouple genset with a suitable expansion joint.
  - Assemble the fuel gas line or fuel gas hose so that it is decoupled from the system and not under tension.
3. Assemble the flange connections.

#### See also

Assembly [▶ 95]

## 6.5 Cooling system

### 6.5.1 Connecting the on-site cooling system to the genset

#### Description

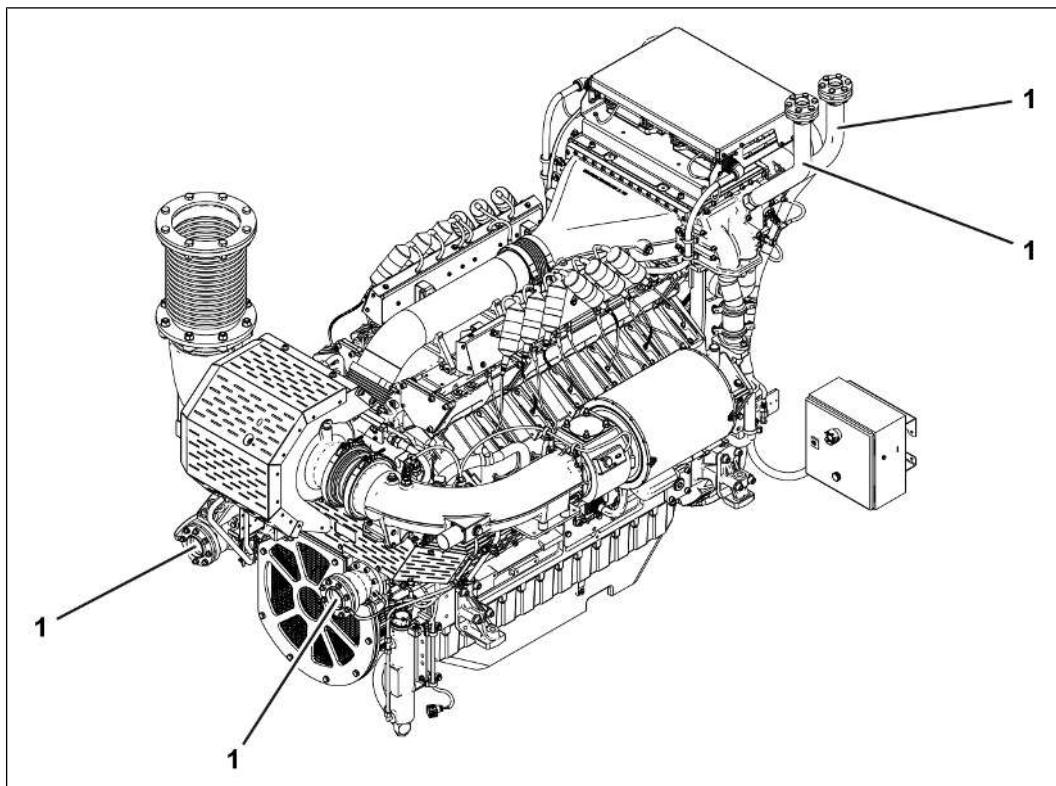
For detailed notes on installing the on-site cooling system, see:

- *Operating Manual, chapter General*
  - Section Diagrams
- *Operating Manual, chapter Assembly note*

- Section Genset add-on parts

### Procedure

- ✓ On-site cooling system is fully installed.
- ✓ All piping has been cleaned.
- ✓ Leak test of on-site cooling system has been conducted.



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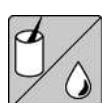
1. **CAUTION! Piping and hoses can tear off. Minor or severe injuries may result. Always install the piping and hoses so that they are free of tension and are decoupled from the system.** Connect the flange of the rubber expansion joint (1) to the flange of the coolant line
  - For information on installation of the rubber expansion joints, see *Genset add-on parts, Rubber expansion joint*

#### See also

-  Filling the cooling system [▶ 390]

## 6.6 Lube oil system

### 6.6.1 Connecting the on-site lube oil system to the genset



Auxiliary media:

- Lube oil

## General information

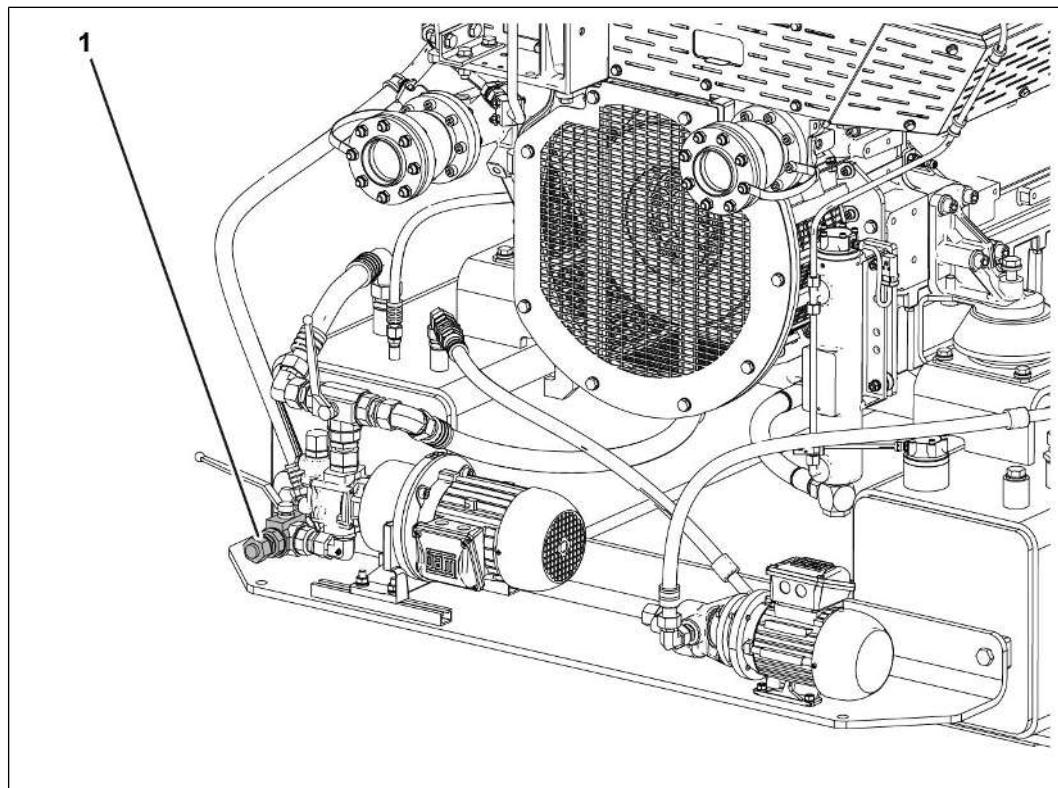
For detailed notes on installing the on-site lube oil system, see:

- Operating Manual, chapter General - section P&I diagrams
- Operating Manual, chapter Assembly notes - section Lube oil system
- Operating Manual, chapter Operating media regulations
  - Technical Bulletin TR 2105 [Specification for lube oil](#)

## Connecting the on-site lube oil system to the genset:

The prerequisite for this is:

- The on-site lube oil system has been installed fully.
- All piping has been cleaned.
- A leak test has been carried out on the on-site lube oil system.



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1. **CAUTION! Piping and hoses can tear off. Minor or severe injuries may result. Always install the piping and hoses so that they are free of tension and are decoupled from the system.** Connect the on-site lube oil connection to the prelubrication pump connection (1).

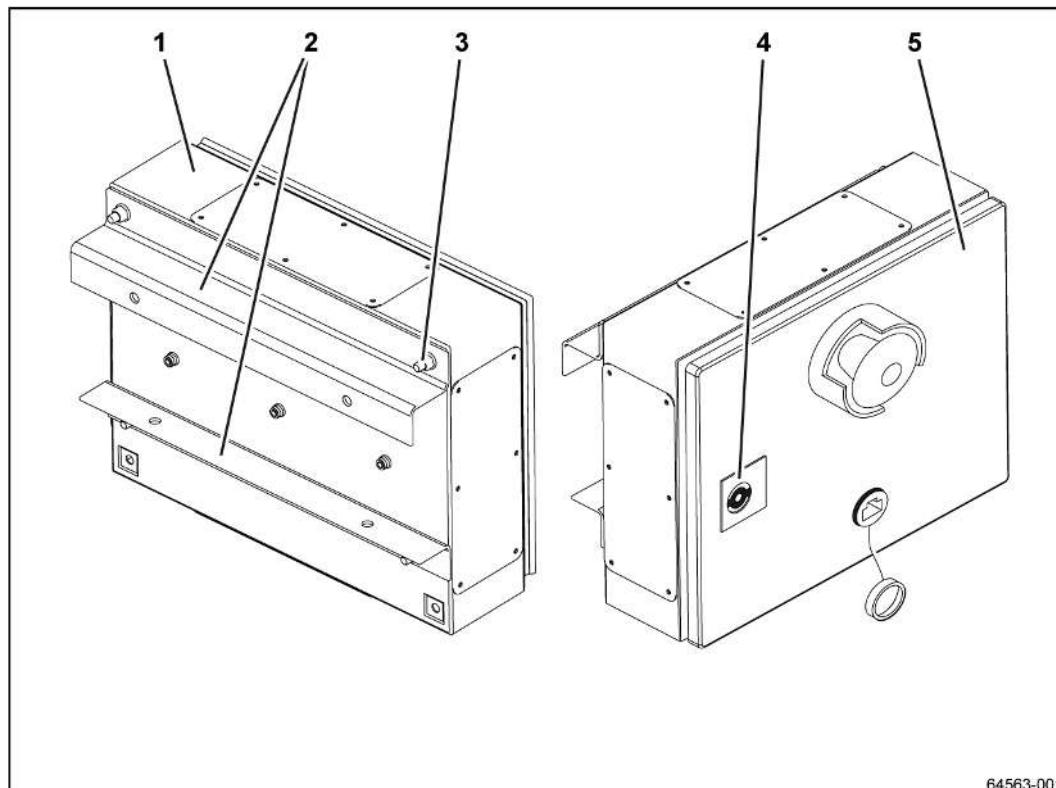
Additionally perform the following work steps to connect an external lube oil supply (optional):

1. Close all lube oil valves on the genset.
2. Close all lube oil valves on the external lube oil equipment.

- 
3. Fill external lube oil supply with lube oil.
  4. Open all lube oil valves on the genset.
  5. Open all lube oil valves on the external lube oil equipment.
  6. Start TPEM.
  7. Start the prelubrication pump.
    - The prelubrication fills, if necessary, the lube oil tank in the base frame of the genset.
    - The TPEM automatically stops the prelubrication when the lube oil level is too low.
  8. Check lube oil level in the TPEM.

## 6.7 TPEM Connection Box

### 6.7.1 Installing the TPEM Connection Box (TPEM CB)



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1 TPEM Connection Box (TPEM CB)

2 Mounting bracket

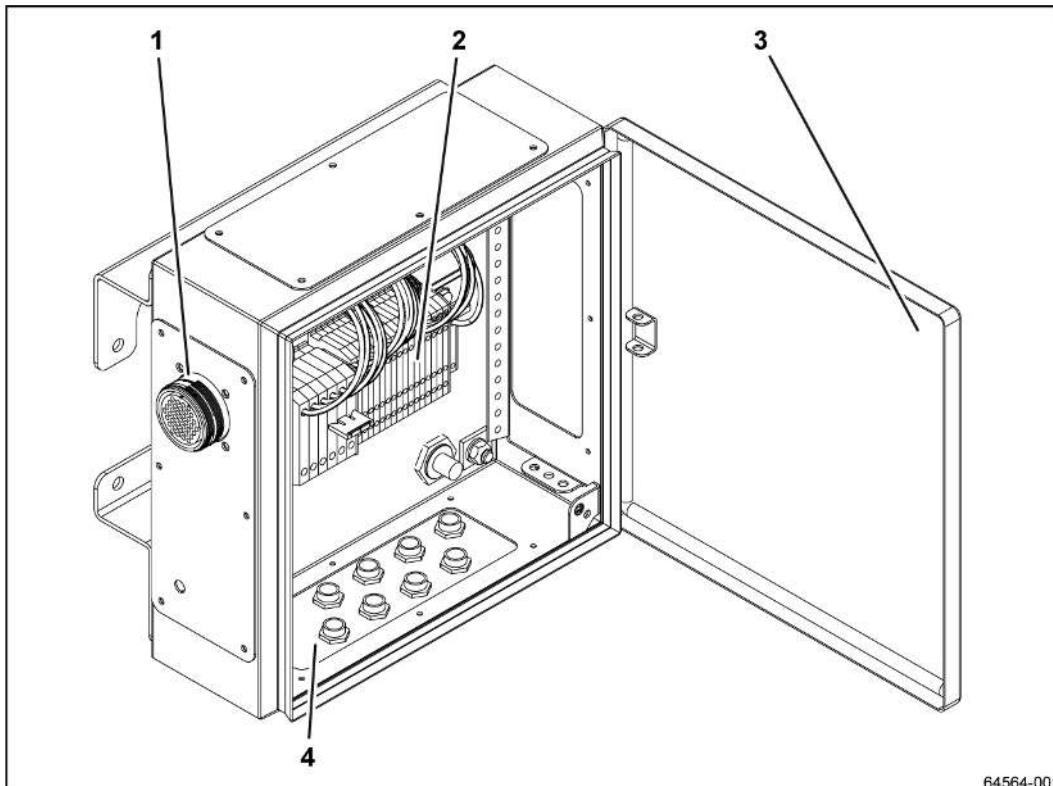
3 Fastening

4 Lock

5 Door

1. Fit the mounting brackets (2)
  - Open the lock (4)
  - Open the door (5)
  - Remove the mounting brackets (2) from the TPEM CB (1)
  - Attach the mounting brackets (2) to a suitable holder
  - Attach the TPEM CB (1) to the mounting brackets (2)

### 6.7.2 Connecting the TPEM Connection Box (TPEM CB) to the electrical power supply



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1 Connection of wiring harness

2 Terminal strip

3 Door

4 Flange plate with cable inlets

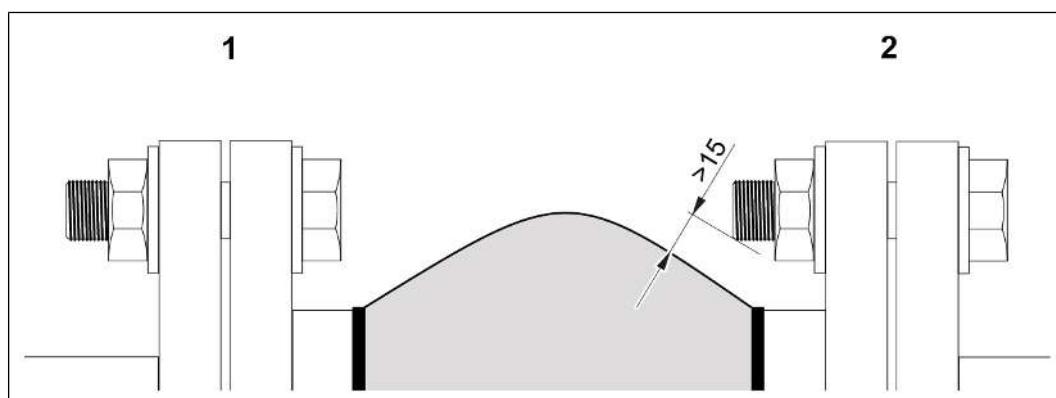
1. Open door (3)
2. Connect the wiring harness at the connector (1)
3. Look up the number of cables and their diameters in the circuit diagram and create the corresponding openings in the flange plate (4). Prepare the openings such that the protection against moisture and dirt in the switch cabinet is not detrimentally affected
4. Insert each individual cable from below through the cable inlet holes
5. Shorten cables and attach with resistance to tensile forces
6. **NOTE! The TPEM CB does not provide its own equipotential bonding. Equipotential bonding is achieved with the genset.** Connect cables to the terminal strip (2) as specified by the markings.
  - The markings are also found on the cables and terminal points, in addition to being marked in the circuit diagram.
  - Check that all connections sit tightly.
- 7.

## 6.8 Rubber expansion joint

### 6.8.1 Assembly notes

Nuts must be provided on the side of the counter flange to prevent damaging the rubber bellows due to the protruding screw thread (see diagram item 1).

If this is not possible, the screw length must be selected such that the distance between the rubber bellows and the screw thread is a minimum of 15 mm (see diagram item 2).

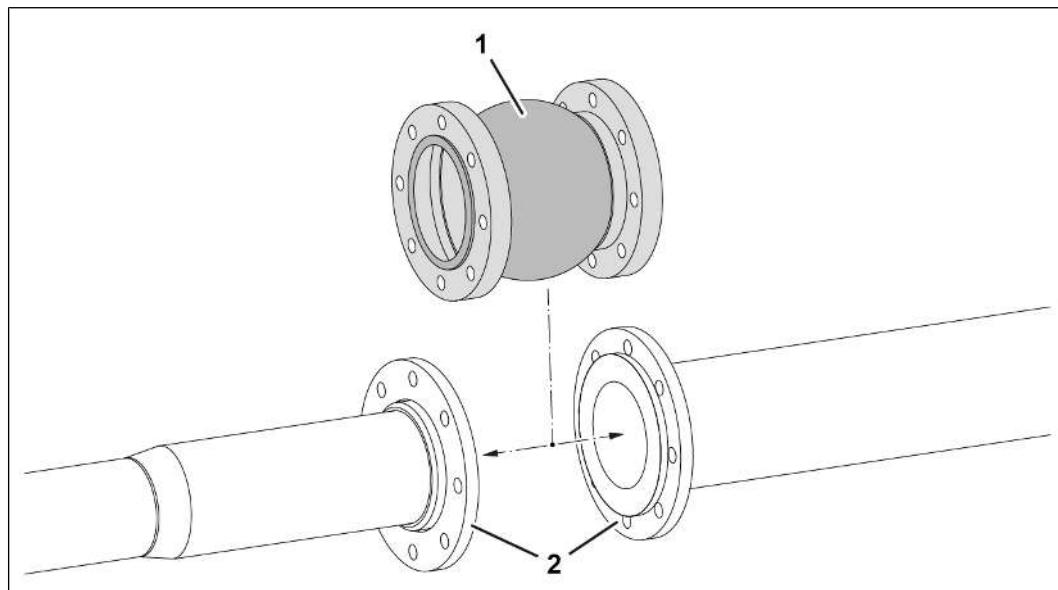


3659008139: Example assembly

Observe the following points during assembly:

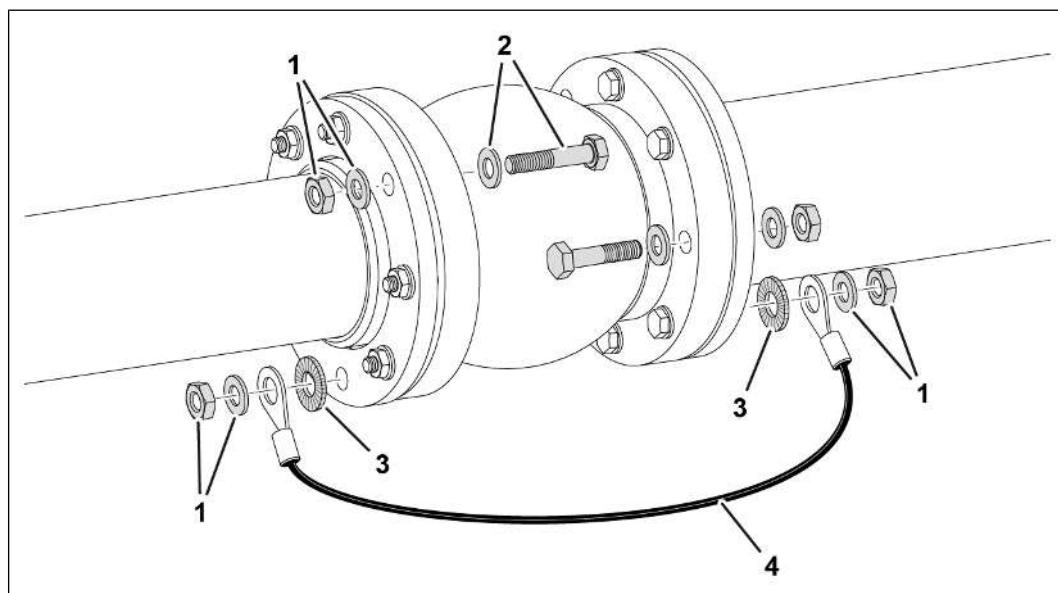
- Check the rubber expansion joint prior to assembly.
  - Make sure there is no damage.
  - Remove dirt and foreign particles.
- Protect/cover the rubber expansion joint during construction work.
- Do not fasten chains or ropes to the rubber bellows.
- The length of the installation position must be equal to the structural length of the rubber expansion joint.
- Tension-free installation must be ensured.
- Torsional stress (rotation) is not permissible.
- The plant-side piping must be fixed to a fixed point after max. 3x DN.
- The rubber expansion joint must remain paint-free.

For further information on the assembly of the rubber expansion joints, see Layout of power plants

**6.8.2 Mounting the rubber expansion joint**

3659018251: Example illustration

1. Position rubber expansion joint(1) between flanges (2) and align.



3659063435: Example illustration

2. **Note:** Insert equipotential bonding (4) with lock washer (3) in a screw connection.
3. Insert all screws with washers (2) and nuts with washers (1).
  - Observe the installation position of the screws.
4. Tighten all screwed joints.

## 7 Commissioning

### 7.1 Cooling system

#### 7.1.1 Filling the cooling system for the first time



Auxiliary media:

- Cooling system protection agents

##### Description

For detailed notes on installing the on-site cooling system, see:

- *Operating Manual, chapter General*
  - Section Diagrams
  - Section Specifications, Genset data sheet
- Operating Manual, chapter Operating media regulations
  - Specification for coolant

##### Procedure

- ✓ Quality of the coolant is checked and is OK.
- 1. Close all the coolant valves on the genset
- 2. Close all the coolant taps on the external cooling devices
- 3. [Filling the cooling system \[► 390\]](#)
- 4. Check the coolant level, see [Filling the cooling system \[► 390\]](#)
  - For detailed information on the coolant volume, see the genset data sheet.
- 5. Start coolant pump and ventilate cooling system
- 6. Check the coolant level again, see [Filling the cooling system \[► 390\]](#)
- 7. Perform a leak test

### 7.2 Filling the lube oil system for the first time

#### 7.2.1 Filling the lube oil system for the first time



Auxiliary media:

- Lube oil

##### Description

For detailed information on lube oil system, see:

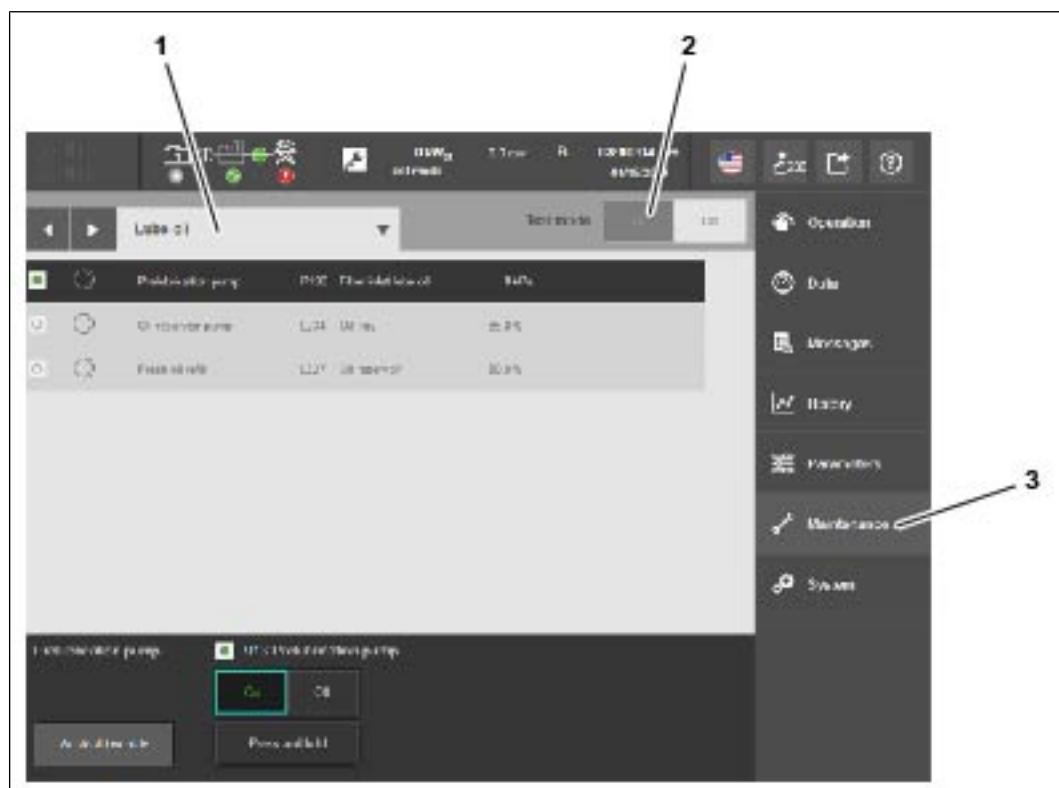
- Operating Manual, chapter General
  - section P&I Diagram

- Operating Manual, chapter Assembly note
  - section Lube oil system

For detailed information on lube oil, see [Specification for lube oil](#).

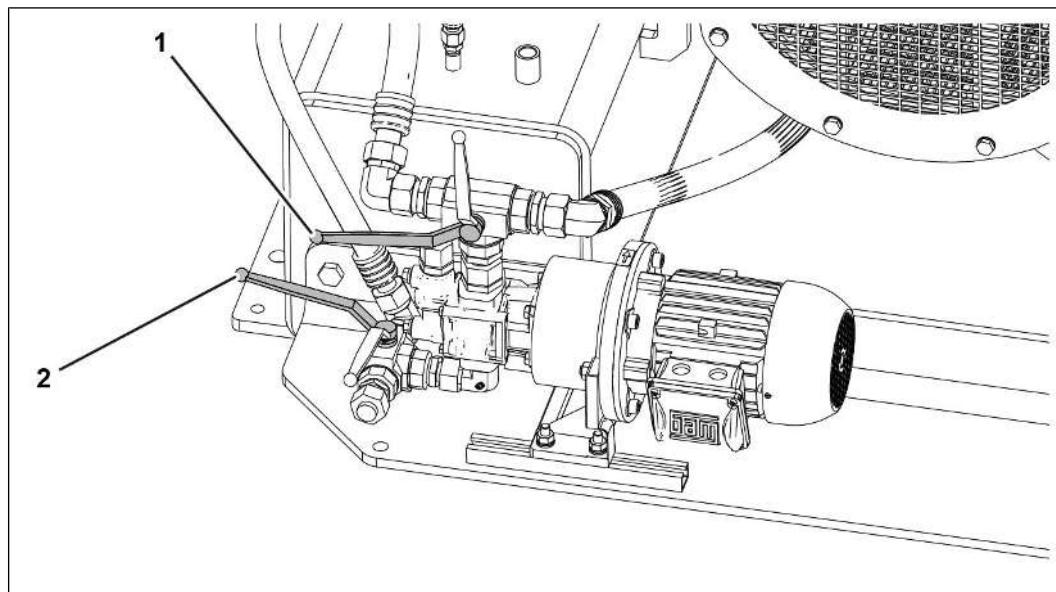
### Procedure

- ✓ The current lube oil level is read on the control.
- ✓ On-site lube oil system is fully mounted.
- ✓ The genset is aligned on the lube oil system and screwed into the base.
- ✓ All piping has been cleaned. Leak test of the on-site lube oil system has been conducted.
- ✓ All required parameters have been activated, see [Preparing the lube oil change](#)  
[\[▶ 316\]](#)



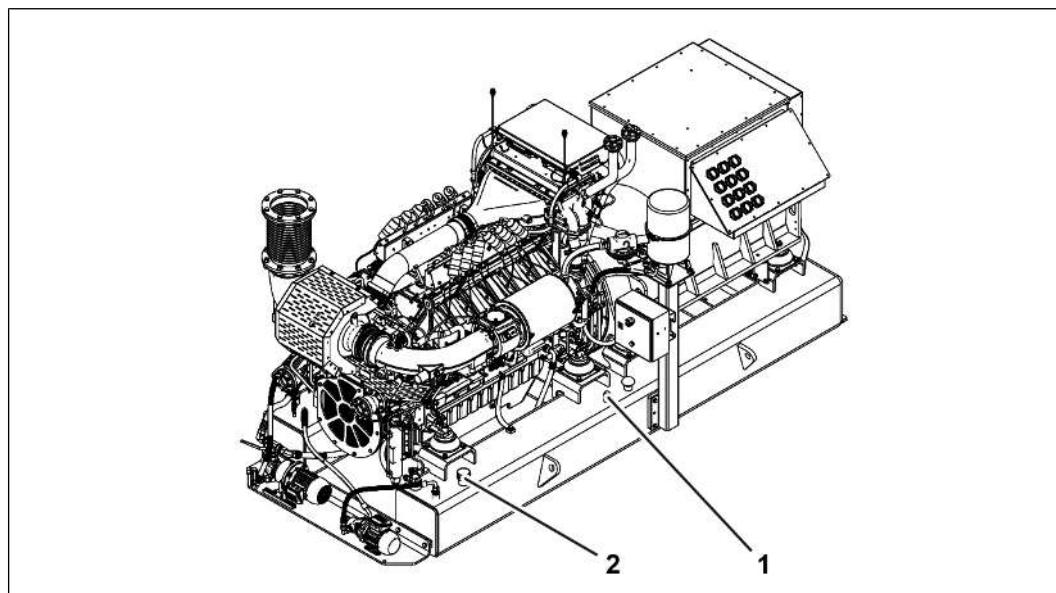
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1. Activate the auxiliary drive function test on the TPEM system
  - Press functional group Service (3).
2. Select and open the auxiliary drive subgroup
  - Tap the Lube oil (1) button, the pull-down menu opens.
  - Press the Test mode ON button (2).
  - The auxiliary drive test is activated.



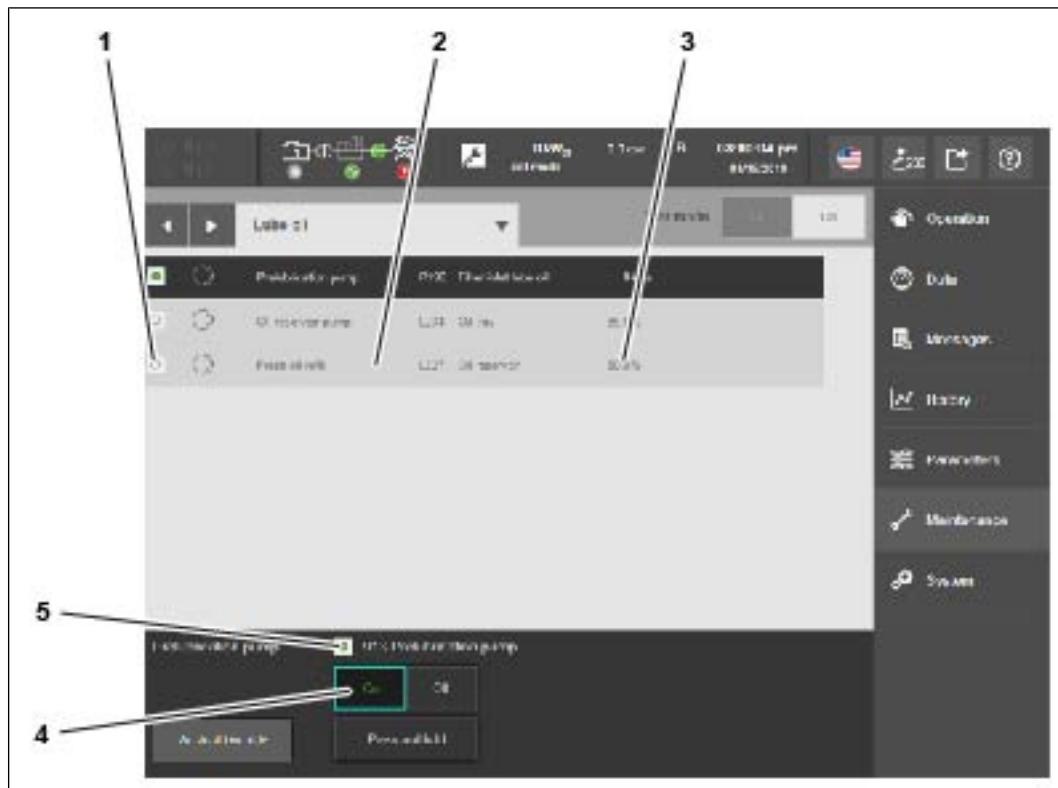
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3. Set the valves to position (1) and position (2)



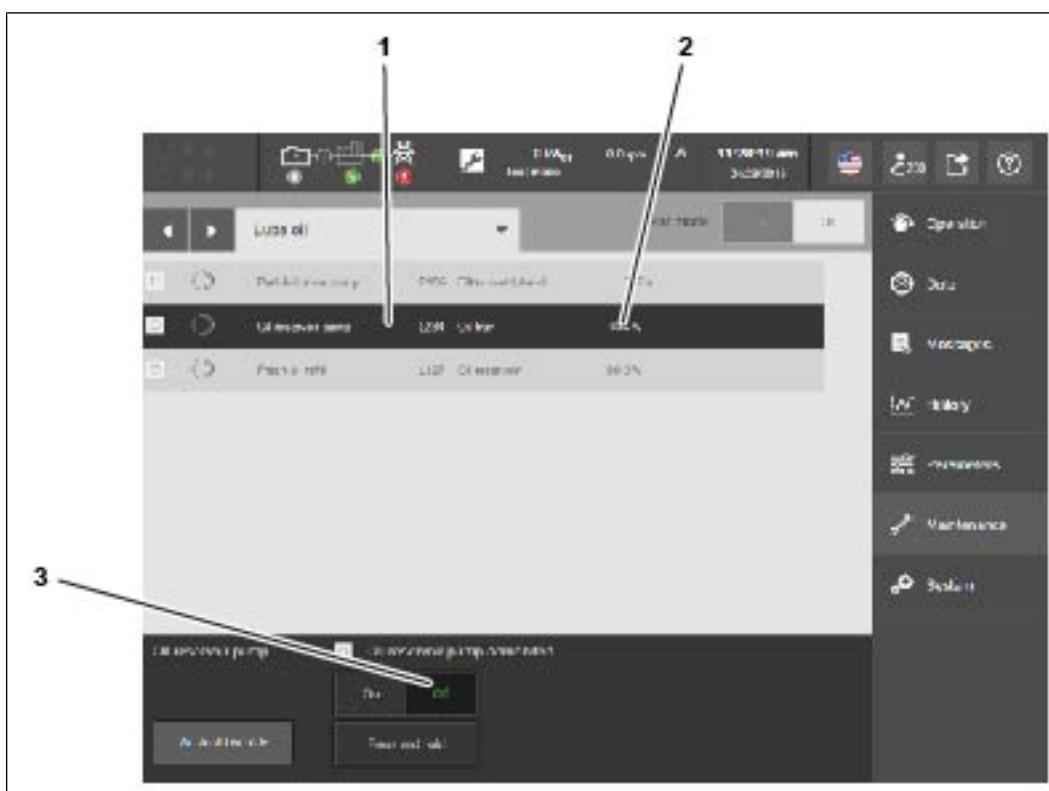
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4. Connect the lube oil supply to connection (1) or (2)



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5. Tap the Fresh oil refill (2) line in the dialog area
6. Tap the ON (4) button
  - A green dot (1) is shown in the Fresh oil refill dialog area.
  - A green dot (5) is shown in the Fresh oil refill demanded dialog area.
7. If the value L327 Oil reservoir (3) reaches the value that is preset in parameter 20190013 Oil reservoir oil level stop value refill, the fresh oil refill will automatically switch off.
8. **NOTE! The lube oil from the lube oil reservoir is not sufficient to completely fill the lube oil system.** Press the Fresh oil refill line (2) to refill the lube oil reservoir
  - The fresh oil pump can continue running. Make sure that the value L327 Oil reservoir (3) is greater than 30 %.
9. Tap the ON (4) button
  - A green dot (5) is shown in the Fresh oil refill demanded dialog area.
10. When the value L327 Oil reservoir reaches the value set in parameter 20190013 Oil reservoir oil level stop value refill, the fresh oil refill will automatically switch off.



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11. **NOTE!** The oil reservoir pump dialog area (1) displays value L234 oil sump (2). Value L234 oil sump (2) has been pre-set in parameter 20130240 oil sump oil level stop value refill. The oil reservoir pump switches off automatically as soon as the preset value is reached. The default value is 85 %. Tap the OFF (3) button
- ⇒ The lube oil system is fully filled.

## 7.3 Genset

### 7.3.1 Initial commissioning

The initial commissioning is carried out in consultation between the operator and the commissioner.

Have the work for the initial commissioning carried out according to the commissioning specification. Only have the work performed by employees from the manufacturer or people authorized by the manufacturer.

### 7.3.2 Check before commissioning

For information on the operating media, see [Information on operating media \[▶ 9\]](#). You will find the document in the chapter Regulations in the order-specific operating manual.

Always perform all the work described below in the following situations:

- Before the initial commissioning
- After long pauses in operation

- After maintenance work
- After repair work

## General checks

1. Check all lines and connections for leaks, see [Visually inspecting the genset \[▶ 192\]](#)
2. Check that electrical cabling is in good condition, see [Visually inspecting the genset \[▶ 192\]](#)
3. Check control cables and sensors, see [Performing test run and function run \[▶ 199\]](#)
4. Check all monitoring equipment, shut-off equipment and remote control equipment for functionality, see [Performing test run and function run \[▶ 199\]](#)
5. Check that the actuator moves freely, see [Checking the throttle valve \[▶ 377\]](#)
6. Check the gas train for leaks, see *Operating Manual, chapter Technical data, section Genset.*
  - You will find information on the gas train under the heading *Fuel system* in the order-specific operating manual.

## Checking the coolant level

1. Close all valves and plug valves for draining coolant on the genset and cooling devices.
  - Vent the coolant chambers via the venting lines with the coolant pump running, see [Filling the cooling system \[▶ 390\]](#).
2. Check the coolant level, see [Filling the cooling system \[▶ 390\]](#)
3. Set the pressure on the expansion vessel according to the specifications in the genset data sheet.
  - You will find the genset data sheet under the heading *Genset* in the chapter *Technical data* in the order-specific operating manual.

## Checking the intake air temperature

1. Check the room temperature value on the electronic control, see *Operating Manual, chapter Control.*
  - You will find information on the control system under the heading *Control system* in the order-specific operating manual.
  - If necessary, cool down the room temperature using an external air conditioner.
  - If in doubt, do not start the genset.

## Checking the lube oil level

1. Check the lube oil level using the electronic control
  - You will find information on the control system under the heading *Control system* in the order-specific operating manual.

- If necessary, see [Filling the lube oil system \[▶ 330\]](#)

### 7.3.3 Establishing operational readiness

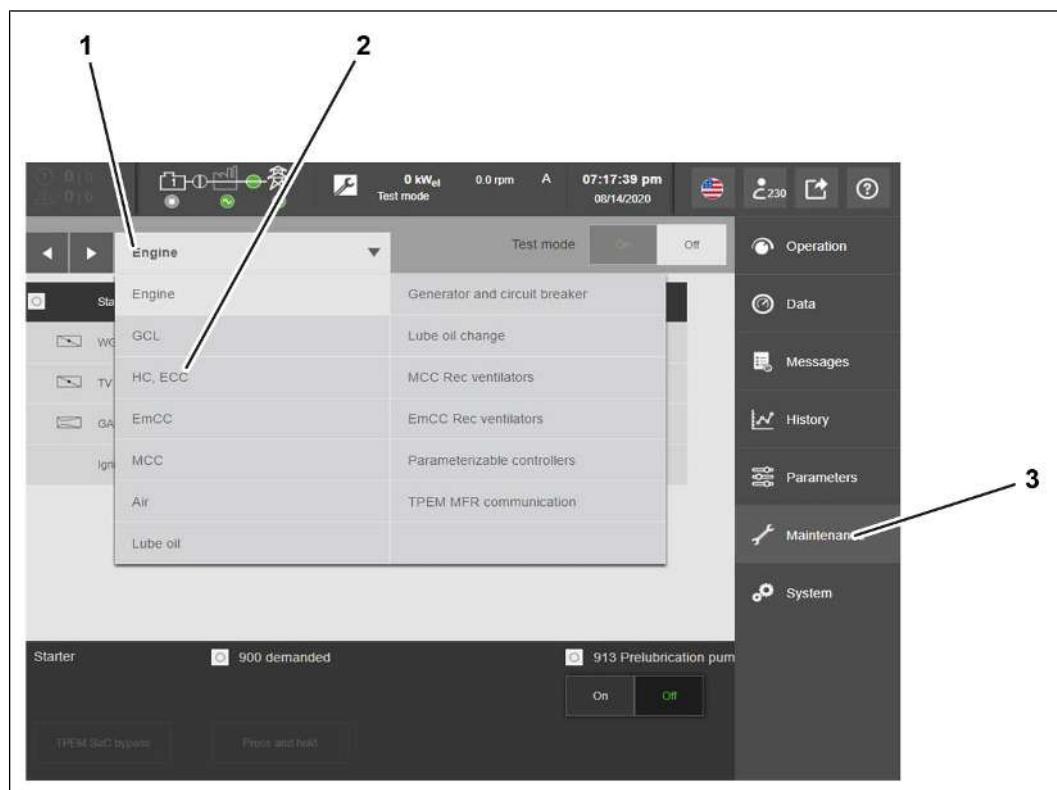
#### Preheating the genset

##### NOTE

A prerequisite for preheating the genset is that the lube oil system is sufficiently filled. Before commissioning the genset for the first time, you must fill the lube oil system, see [Filling the lube oil system for the first time \[▶ 123\]](#).

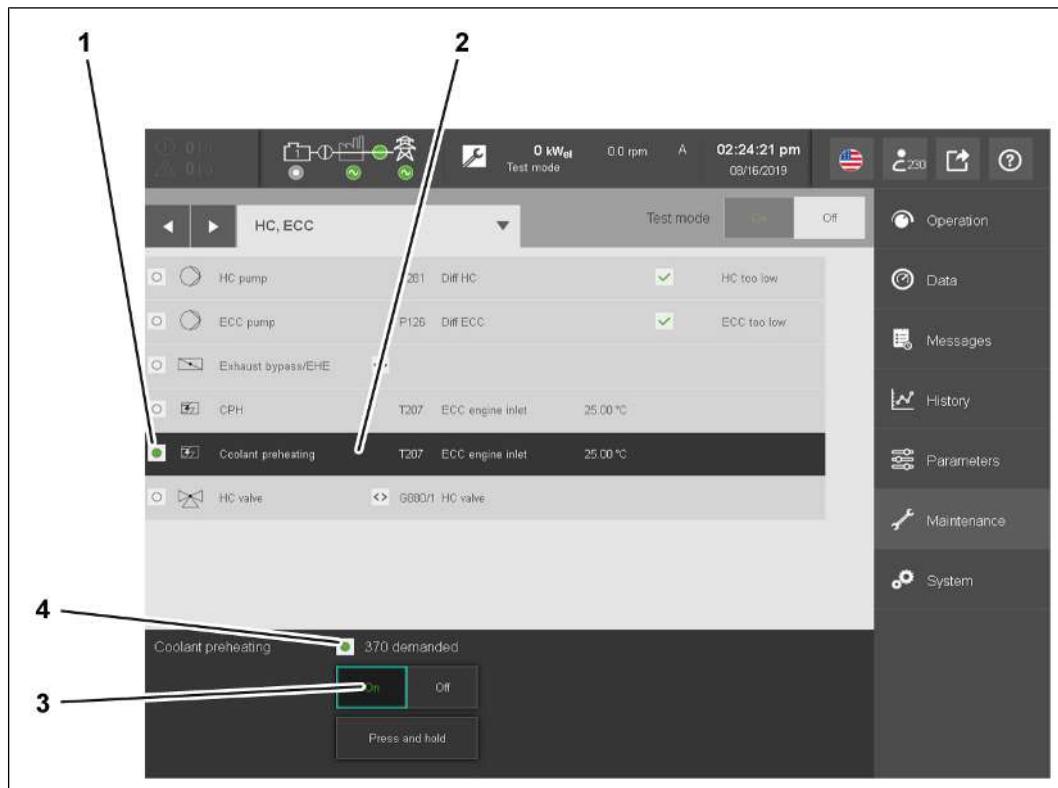
The preheating unit keeps the coolant at the preset temperature, even if the genset has been stopped.

In the engine cooling circuit the coolant temperature hence reaches the required operating temperature even shortly after starting. The coolant is preheated independently of the temperature in the heating circuit.



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1. Tap the "Service" function group (3) button.
2. Click on the HC, ECC (2) line in the pull-down menu (1).



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3. Tap the Coolant preheating (2) line in the pull-down menu.
  4. Tap the On (3) button
    - The font color in the On (3) button changes from white to green.
    - A green dot (4) appears in the Coolant preheating 370 demanded dialog area.
    - A green dot (1) appears in the Coolant preheating dialog area.
- ⇒ Coolant preheating is switched on.

#### Checking the genset room ventilation

- ✓ Genset room ventilation is installed
- ✓ Electronic control is operational, see order-specific operating manual, chapter *Control system*

1. Check the room temperature value on the electronic control
  - If necessary, cool down the room temperature using an air conditioner.
  - If in doubt, do not start the genset.

#### Checking the intake air temperature

- ✓ Intake air preheating is installed (optional)

- ✓ Electronic control is operational, see order-specific operating manual, chapter *Control system*
- 1. Check the intake air temperature value on the electronic control.
  - You will find information on the control system in the chapter *Control system* in the order-specific operating manual.
  - If necessary, warm up the intake air temperature using the intake air preheating (optional).
  - Alternatively, cool down the intake air temperature using an external air conditioner.
  - If in doubt, do not start the genset.

### Checking the lube oil supply on the exhaust turbocharger



#### Risk of destruction of components

Improper maintenance of the exhaust turbocharger

The genset can be damaged.

- Only allow service personnel to service the exhaust turbocharger
- Only allow authorized specialist personnel to perform repairs on the exhaust turbocharger.

1. **NOTE! During operation, the exhaust turbochargers heat up. This heating can cause lubricants and pastes that were used during assembly to melt and evaporate. In the first few hours following commissioning, the heated lubricants and pastes can escape as oily liquids.** Check lube oil supply

- If oily liquid continues to escape a few hours after commissioning, identify the root cause and remedy it immediately.
- If oily liquid escapes even though the lube oil supply of the exhaust turbocharger is working properly, contact service partner.

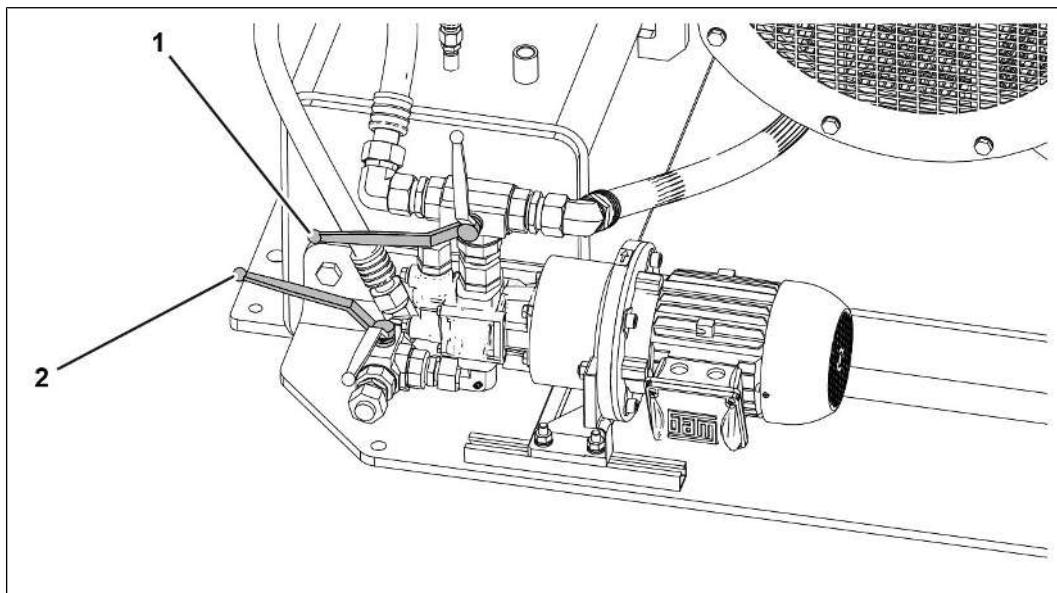
### Checking the lube oil pressure using the control

1. **NOTE! The electronic control monitors the lube oil pressure. If the measured lube oil pressure falls below the permissible limit value, the electronic control outputs a warning message. Afterwards, the electronic control automatically stops the genset.** Checking the lube oil pressure using the electronic control
  - You will find information on the control system in the chapter *Control system* in the order-specific operating manual.
  - Top up the lube oil if necessary, see [Filling the lube oil system \[▶ 330\]](#)

### Prelubricating the genset

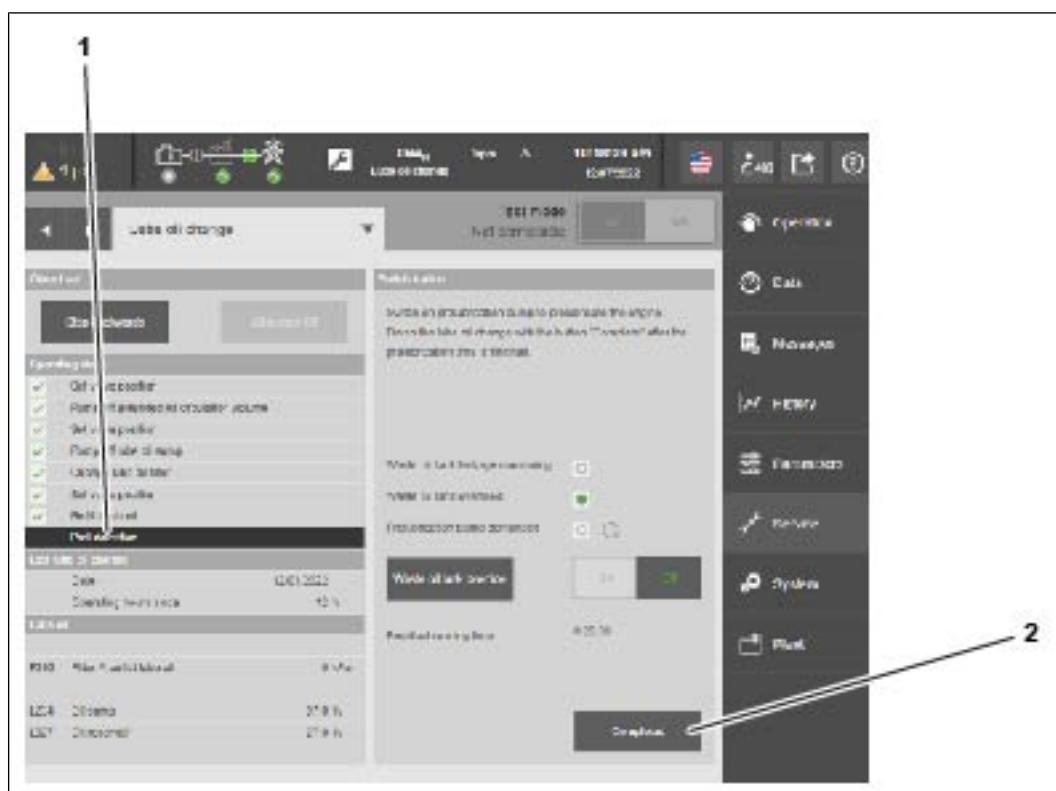
If the genset receives a start demand, the electronic control automatically starts the prelubrication.

A prelubrication process always lasts at least 20 minutes. The electronic control starts the engine only if the prelubrication is fully completed.



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1. Set the valves to position (1) and position (2)
2. Tap the On (3) button
  - A green dot (2) appears in the dialog area.
  - The residual running time is shown in the dialog area (5).
  - The genset is prelubricated.
3. Leave the prelubrication pump switched on for 20 minutes
4. To stop prelubrication manually, tap the All pumps off (1) or off (4) button.
  - The green dot (2) disappears from the dialog area.
  - The residual running time is stopped in the dialog area (5).
5. To continue prelubrication, tap the On (3) button.
  - A green dot (2) appears in the dialog area.
  - The residual running time resumes in the dialog area (5).



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## 6. Confirm prelubrication

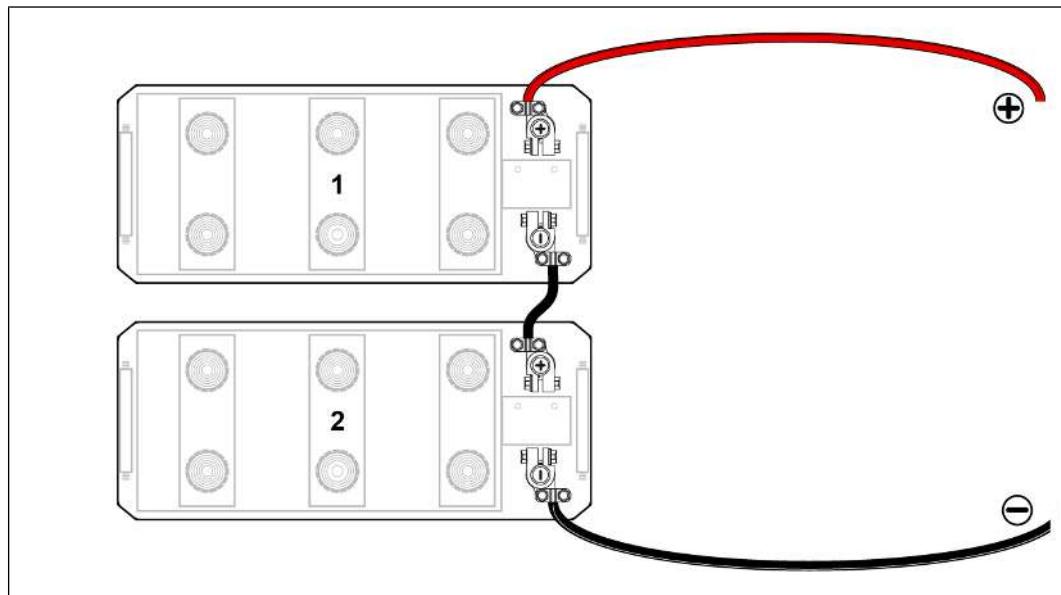
- Tap the Completed button (2).
- The operating step Prelubrication (1) is completed.
- The system returns to the start screen.

## Establishing operational readiness using the control system

1. Check whether there are pending messages on the electronic control
  - You will find information on the control system in the chapter *Control system* in the order-specific operating manual.
  - If warnings and alarms are pending, correct the root causes.
  - Acknowledge pending warnings and alarms.
2. [Starting the genset \[▶ 143\]](#)
3. [Performing test run and function run \[▶ 199\]](#)

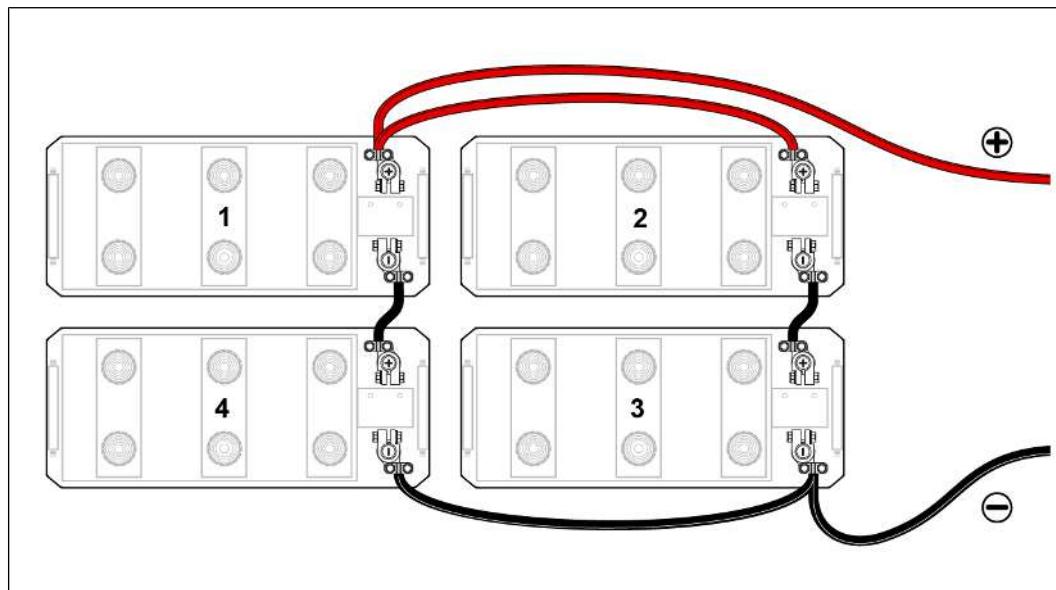
### 7.3.4 Commissioning the genset

#### Connect the starter battery (two starter batteries):



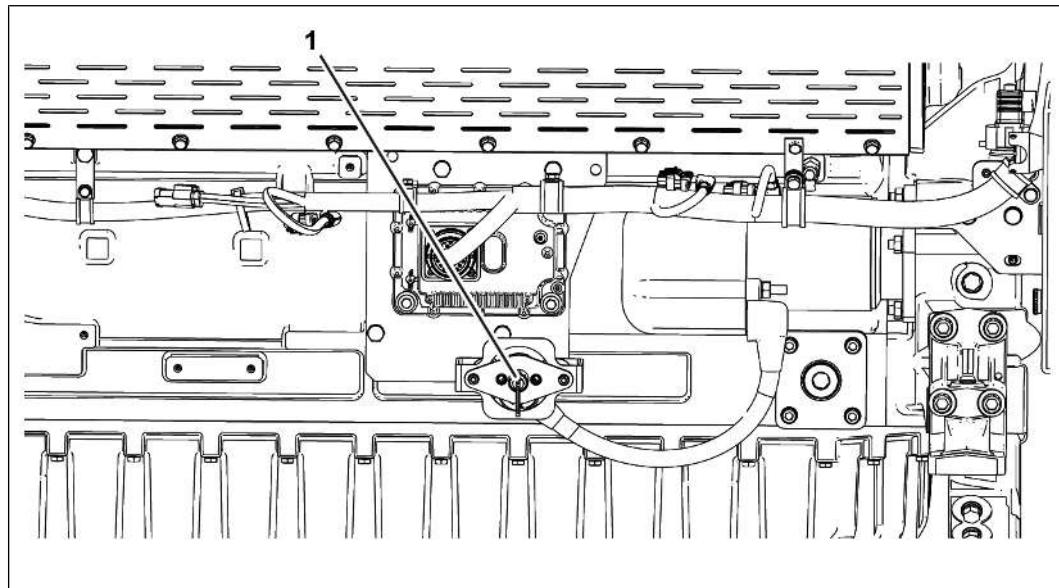
9007200101080459: Two starter batteries

1. Mount connection bridge on starter battery 1
  - Dismantle the terminal cover on the positive terminal.
  - Mount the connection bridge on the positive terminal.
  - Re-mount the terminal cover on the positive terminal.
2. Mount connection bridge on starter battery 2
  - Mount the connection bridge on the negative terminal.

**Connect the starter battery (four starter batteries):**

9007200101082891: Four starter batteries

1. Mount connection bridge on starter battery 2
  - Dismantle the terminal cover on the positive terminal.
  - Mount the connection bridge on the positive terminal.
  - Re-mount the terminal cover on the positive terminal.
2. Mount connection bridge on starter battery 1
  - Dismantle the terminal cover on the positive terminal.
  - Mount the connection bridge on the positive terminal.
  - Re-mount the terminal cover on the positive terminal.
3. Mount connection bridge on starter battery 4
  - Mount the connection bridge on the negative terminal.
4. Mount connection bridge on starter battery 3
  - Dismantle the connection bridge on the negative terminal.

**Closing the battery disconnection switch**

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1. Set the battery disconnection switch (1) to the ON position.

**Starting the gas analysis device (optional):**

1. Remove all locks from the hose lines
2. Connect the gas analysis device to the gas supply
  - Screw the cutting ring screw connection onto the process gas input connection.
  - Screw the cutting ring screw connection onto the calibration gas input connection.
  - Screw the cutting ring screw connection onto the purge gas input connection.
  - Screw the cutting ring screw connection onto the process gas output connection.
3. Switch on the gas analysis device
  - Open housing.
  - Put the circuit breaker into the ON position.
  - The gas analysis device starts a self-test.
  - Close the housing.

**Opening the fuel gas supply:**

1. Start all gas analysis devices with their own pump, see *Operating Manual, chapter Work instructions, Gas supply*
2. Build up pressure in the fuel gas line
  - Remove the chain and U-lock from the hand lever of the ball valve.
  - Close the ball valve in the drain.

3. Check that pressure has built up in the fuel gas line
  - Read the display on the pressure gauge in the fuel gas line.
4. Open ball valve upstream of the gas train in the fuel gas line
  - Remove the chain and U-lock from the hand lever of the ball valve.

**Starting the prelubrication pump:**

1. **NOTE! To guarantee sufficient preheating of the engine, the prelubrication time is programmed to a fixed value in the control.** Start the prelubrication pump
  - Wait until the prelubrication time has elapsed.

**Starting the genset**

1. [Starting the genset \[▶ 143\]](#)

**7.3.5 Recommissioning the genset**

- ✓ The preheating device for the coolant is operated with reduced power during decommissioning
1. Start up the preheating device for the coolant at the standard value
    - If possible, operate the preheating device for the coolant for three days before the recommissioning.

**7.3.6 Recommissioning the genset within two months****Work that must be performed by the operator or operating personnel:**

1. Open the shut-off device in the gas train
2. Unlock the battery disconnection switch and secure the key to the terminal box in such a way that it cannot be detached
3. At temperatures that pose a risk of frost, switch off the preheating device for the coolant

**7.3.7 Recommissioning the genset after more than two months**

After decommissioning for more than two months, the recommissioning must be performed by the service personnel.

**Work that must be performed by the operator or operating personnel:**

1. Remove all the covers
2. Open the shut-off device in the gas train
3. Open the exhaust flap if necessary in the case of a multi-engine plant

## **Work that must be performed by the service personnel:**

1. Perform a propulsion chamber check (optional)
2. Check combustion chambers with endoscope
3. Re-couple generator with roller bearings with the engine
4. Check and, if necessary, top up the lube oil level for generators with sleeve bearings
5. Check the connection points between the genset and plant
6. Visually inspect the exhaust turbocharger (inlet and outlet)
7. Perform checks as per maintenance level E60
8. Perform and document commissioning in accordance with the commissioning specification

## **7.4 TPEM Connection Box**

### **7.4.1 Commissioning the TPEM Connection Box (TPEM CB)**

The plant or genset and the TPEM Connection Box (TPEM CB) are commissioned at the same time. All functions are only available upon simultaneous commissioning.

1. Establish power supply
2. Switch on plant
3. Carry out electrical safety tests
4. Slowly start up plant
5. Run acceptance procedure
6. Switch off plant and secure
7. Create acceptance protocol

## 8 Operation

### 8.1 Genset

#### 8.1.1 Notes on operation with hydrogen

The transition from fossil fuels to renewable energy production is subject to natural fluctuations. Depending on the available energy from wind and solar power, regeneratively produced hydrogen can be fed into the natural gas grid. This compensates for fluctuations in the energy grid.

The TCG 3016 and TCG 3020 series gensets of the configurations P+, PV+, R+ and RV+ with the corresponding H2 kit (see below) are approved for operation with natural gas containing up to 25 vol.% hydrogen.

- Operation with up to 10 vol.% necessitates no structural modifications.
- Structural modifications are required for operation with a hydrogen content of up to 25 vol.%.

The manufacturer offers gensets with the following adapted or newly developed genset components:

- Flame arrester elements are installed in the mixture housings. Flame arrester elements prevent back-propagating ignition of hydrogen.
- The wastegate is designed for the altered charging pressure.
- The gas train is equipped for hydrogen operation.
- The software contains all necessary parameters for hydrogen operation.

All genset components are installed during assembly and setup and then commissioned.

- All necessary parameter assignments are configured and set during commissioning.



#### Risk of destruction of components

Incorrect parameters for hydrogen operation

The genset can be damaged or destroyed.

- Always operate the genset with the parameters specified for the given hydrogen content:
  - [Setting the global ignition angle \[▶ 361\]](#)
  - Adjust the set combustion chamber temperature: [Checking pollutant emissions in the exhaust gas \(TPEM\) \[▶ 288\]](#)

Compared to natural gas, hydrogen combusts more rapidly.

- The faster combustion is regulated by adjusting the global ignition angle and a modified set combustion chamber temperature.
- The global ignition angle and the temperature curve for the set combustion chamber temperature must be stored in the engine control for each hydrogen concentration.

## 8.1.2 Industrial safety around the genset

The warning messages apply to all [work instructions](#) for target groups with competence levels Operator Level, Maintenance Level, and Service Level.

---

### DANGER



Explosion due to gases which ignite.

This leads to severe injuries and even death.

- Sufficiently ventilate the room.
  - Do not smoke.
  - Do not use any naked flames.
  - Use only ATEX-approved devices and tools.
  - Only qualified specialist personnel may work on the fuel gas system.
- 

### DANGER



Risk of falling as a result of unsecured work at great height.

Severe injury or death can result.

- Wear personal protective equipment.
  - Use a scaffold or fall protection for carrying out work at a height of 1.70 m or higher.
  - Secure components and tools from falling down.
- 

### DANGER



From rotating components.

Severe injury or death can result.

- Only perform assembly work when the genset is switched off.
    - Secure against reconnection.
  - Only begin assembly when rotating components have come to a complete stop.
  - Reattach dismantled protective covers and protective claddings after assembly.
-

**DANGER**

Electric shock from touching live components.

This leads to severe injuries and even death.

- Only authorized specialist personnel may work on the electrical system.
- In the case of single-phase motors, the residual charge of the capacitor can also result in an electrical voltage via the motor terminals when the motor is at a standstill.
- Perform the following points in the described sequence:
  - Switch off electrical supply and disconnect the plant.
  - Secure against restarting.
  - Check that the plant is de-energized.
  - Ground and short-circuit the electrical system.
  - Cover or cordon off adjacent live components.

**CAUTION**

Risk of burns from touching hot operating media or hot components

This can lead to minor or severe injuries.

- Wear personal protective equipment.
- Allow the operating media or components to cool down to ambient temperature.

**CAUTION**

Injuries from touching sharp edges

This can lead to minor or severe injuries.

- Wear personal protective equipment.
  - Use cut-resistant safety gloves as per DIN EN 388.
- Handle sharp-edged components carefully.

**CAUTION**

Injury due to particles of dirt

Minor or severe injuries may result.

- Wear personal protective equipment.



## Danger to the environment

When components or operating media which are transported, stored or disposed of incorrectly.

Contamination of the environment.

- Store operating materials and components so that they do not enter the environment or damage the environment.
- Collect escaping operating media and soak it up with thickeners if necessary.
- Always store operating media separately and in tightly sealed tanks intended for those materials.
- Properly dispose of operating media and components in accordance with national regulations.

The area at the installation site and at the genset is divided into workstation, operating range, and danger zone. All required information about these areas and about access authorization can be found under the heading *Danger zone, operating range, and workstation* in Chapter *Safety information* in the order-specific operating manual.

### 8.1.3 Overview of the operation modes

The electronic control system has the following operation modes:

- Grid-parallel operation: power-controlled
- Island operation: speed-controlled

You will find all required information on the operation modes in section *Control system* in the chapter *Operation* in the order-specific documentation.

The following operation modes are defined for the genset's operation:

- Steady-state operation:

In this operation mode, the following parameters do not change:

- Temperature
- Power
- Engine speed
- Emissions

Steady-state operation can take place both in grid-parallel operation as well as in island operation.

- Transient operation:

In this operation mode, one or more of the following parameters will change:

- Load ramp (in grid-parallel operation)
- Load spikes (in island operation)
- Engine speed
- Gas composition
- The genset actively responds to faults in the grid (Grid Code case).

Transient operation can take place both in grid-parallel operation as well as in island operation.

#### 8.1.4 Commissioning or starting the genset

This document distinguishes between two types of commissioning:

- Starting the genset
- Commissioning the genset

##### 8.1.4.1 Starting the genset

The following control types can be activated on the electronic control:

- AUTO (automatic operation)
  - The electronic control automatically starts the genset once a demand is made.
- MANUAL (manual operation)
  - The electronic control starts the genset once the start demand is manually triggered.

You will find all required information on the control types under the heading *Control system* in the chapter *Operation* in the order-specific operating manual.

✓ The genset is operational, see [Establishing operational readiness \[▶ 129\]](#).

1. Activate AUTO control mode
2. Or activate MANUAL control mode

##### 8.1.4.2 Commissioning the genset

The genset must be decommissioned in order to perform maintenance tasks or troubleshooting. In this state, the genset is secured against restarting unintentionally. You must recommission the genset once you have completed all tasks.

1. Commission the genset, see [Commissioning the genset \[▶ 134\]](#)

#### 8.1.5 Stopping or decommissioning the genset

This document distinguishes between two types of decommissioning:

- Stopping the genset
- Decommissioning the genset

### 8.1.5.1 Stopping the genset

The genset is stopped under the following conditions:

- Engine is not running
- Electronic control is switched off
- Power supply is **not** interrupted

If the genset is stopped, the genset is **not** secured against restarting unintentionally. In this state, troubleshooting and maintenance work cannot be carried out safely.

For certain troubleshooting and maintenance work, you cannot decommission the genset. You can only stop it. If you stop the genset, the operating state must be monitored and maintained during the entire duration of the work.

There are two ways to stop the genset.

1. Stop the genset using the AUTO (automatic operation) control function.
2. Stop the genset using the MANUAL (manual operation) control function.
3. After stopping the genset, ensure that it cannot be started unintentionally.
  - Make sure that no one starts the genset during maintenance or repair work.
  - Interrupt the power supply if necessary, see [Decommissioning the genset \[▶ 146\]](#).

#### Stopping the genset using the AUTO (automatic operation) control function:

##### NOTE

Automatic operation

The genset is decommissioned by a demand signal of the superior control.

- The electronic control automatically stops the genset.
- 
- ✓ The person responsible for the work has reported to the person responsible for the plant that the genset and the associated plant periphery have been stopped.
1. **NOTE! The control system powers down the genset automatically in automatic operation.** Trigger the demand signal for disconnecting the generator circuit breaker in the superior plant control.
    - The electronic control system powers down the genset in a controlled manner until the generator circuit breaker opens.
  2. Wait until the prelubrication pump and coolant pump have come to a complete standstill.
    - The prelubrication pump and coolant pump continue running for a time preset in the control.
  3. Allow the ventilation to keep running until the temperature preset in the control is reached.

4. Switch off the control system.
  - Activate the emergency stop button.
5. **NOTE! If the voltage supply to the control system is interrupted, the control system can become damaged. The voltage supply to the buffer battery must be guaranteed during maintenance work. Do not switch off the fuse for the buffer battery.** Switch off fuses.
6. Allow the genset and plant periphery to cool down to the ambient temperature.

**Stopping the genset using the MANUAL (manual operation) control function:**

- ✓ The person responsible for the work has reported to the person responsible for the plant that the genset with the associated plant periphery has been decommissioned.
1. Press the OPEN GCB (5) button.
    - The symbol (2) flashes.
    - The display in the status bar (4) shows Relieving.
    - After successful relief: the symbol (2) lights up continuously gray (opened).
    - The display in the status bar (4) shows Idle and the idle speed.
  2. Press the MODULE STOP (3) button.
    - The symbol (1) flashes.
    - The display in the status bar (4) shows Shutting down.
    - After successful shutting down: the symbol (2) lights up continuously gray (still).
    - The display in the status bar (4) shows Ready-to-start.
  3. Allow the ventilation to keep running until the temperature preset in the control is reached.
  4. Switch off the control.
    - Activate the emergency stop button.
  5. Switch off fuses.
  6. Allow the genset and plant periphery to cool down to the ambient temperature.

**Ensure that the genset cannot be started unintentionally**

1. **WARNING! Persons can be severely injured if the genset is started unintentionally.** Ensure that the genset cannot be started unintentionally.
  - Activate the emergency stop button on the control terminal.
  - Attach an information sign to the switchgear cabinet and genset with the following text: ATTENTION! Maintenance work! Do not start the genset!
  - Lock the emergency stop button with a U-lock.
  - Keep the key of the U-lock safely with you during maintenance work.

### 8.1.5.2 Decommissioning the genset

The genset is decommissioned under the following conditions:

- Engine is not running
- Electronic control is switched off
- Power supply is interrupted

When the genset is decommissioned, it is secured against restarting unintentionally. In this state, troubleshooting and maintenance work can be performed safely.

#### Stopping the genset:

1. Stop the genset and secure it against restarting, see [Stopping the genset \[▶ 144\]](#)

#### Shutting off the fuel gas supply:

1. Close ball valve upstream of the gas train in the fuel gas line
  - Secure the hand lever of the ball valve on the fuel gas line against switching with a chain and U-lock.
2. Stop all gas analysis devices with their own pump, see *Operating Manual, chapter Work instructions, Gas supply*
3. Relieve pressure in the fuel gas line
  - Open ball valve in the drain.
  - Secure the hand lever of the ball valve on the drain against switching with a chain and U-lock.
4. Check that the fuel gas line is free of pressure
  - Read the display on the pressure gauge in the fuel gas line.

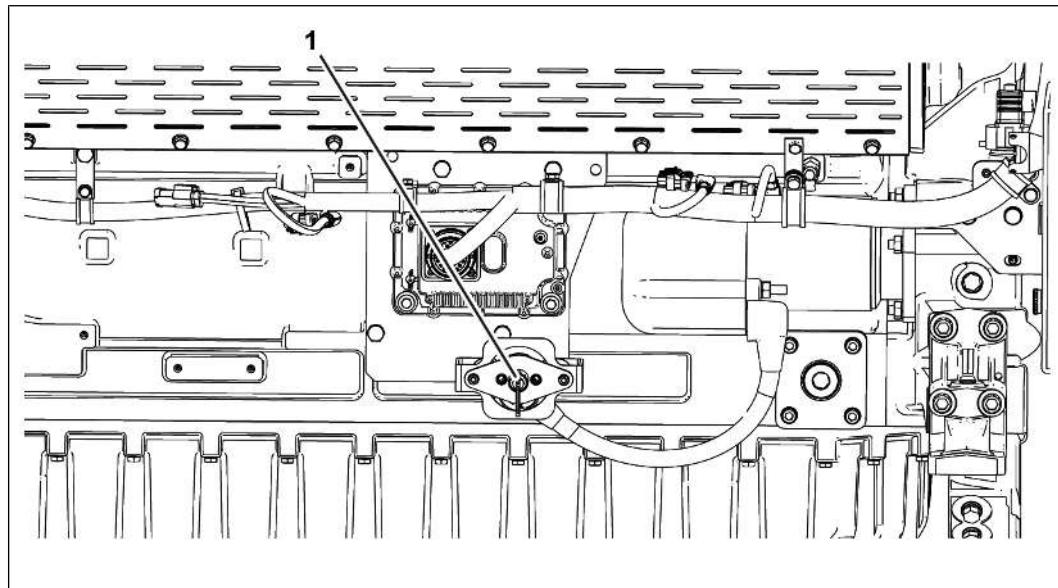
#### Stopping the gas analysis device (optional):

1. Disconnect the gas analysis device from the gas supply
  - Unscrew the cutting ring screw connection from the process gas input connection.
  - Unscrew the cutting ring screw connection from the calibration gas input connection.
  - Unscrew the cutting ring screw connection from the purge gas input connection.
  - Unscrew the cutting ring screw connection from the process gas output connection.
2. Properly seal all hose lines
3. Purge the gas analysis device with ambient air
  - Start the Cal. purge gas function on the control.
4. Switch off the gas analysis device
  - Open housing.

- Put the circuit breaker into the OFF position.

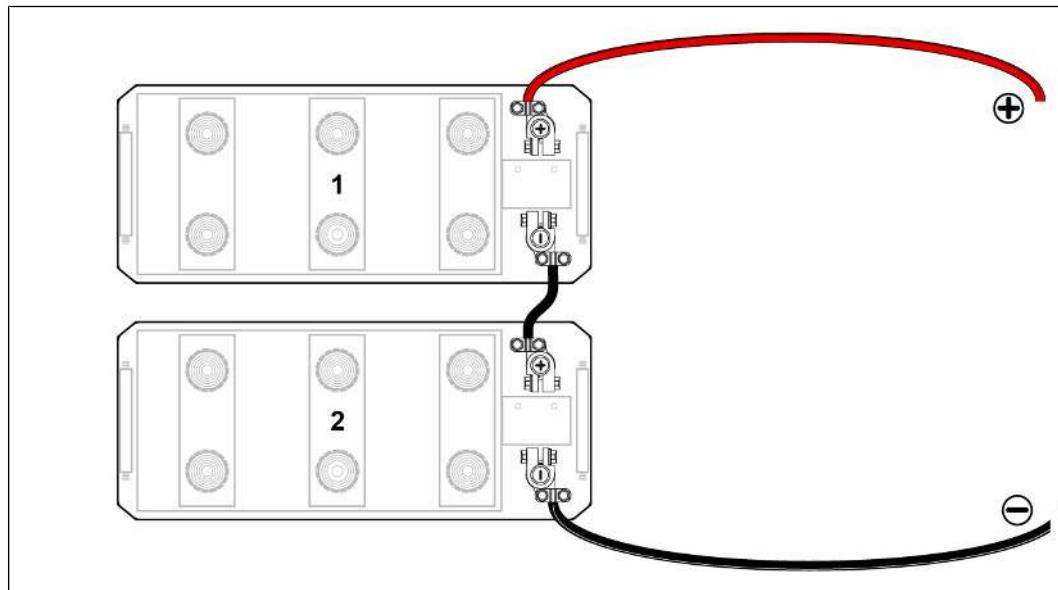
#### **Disconnecting the compressed air supply (optional)**

1. Relieve existing pressure
  - Close the supply valve on the compressed air system.
  - Open the valve for the compressed air relief in the compressed air line.
  - Relieve the line pressure completely.
2. Close ball valve upstream of the starter valve in the compressed air line
  - Secure the hand lever of the ball valve on the compressed air line against switching with a chain and U-lock.
  - Keep the key in a safe place.
3. Check that the compressed air line is free of pressure
  - Ventilate the compressed air line between the starter valve and ball valve.

**Closing the battery disconnection switch**

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1. Set the battery disconnection switch (1) to the OFF position.

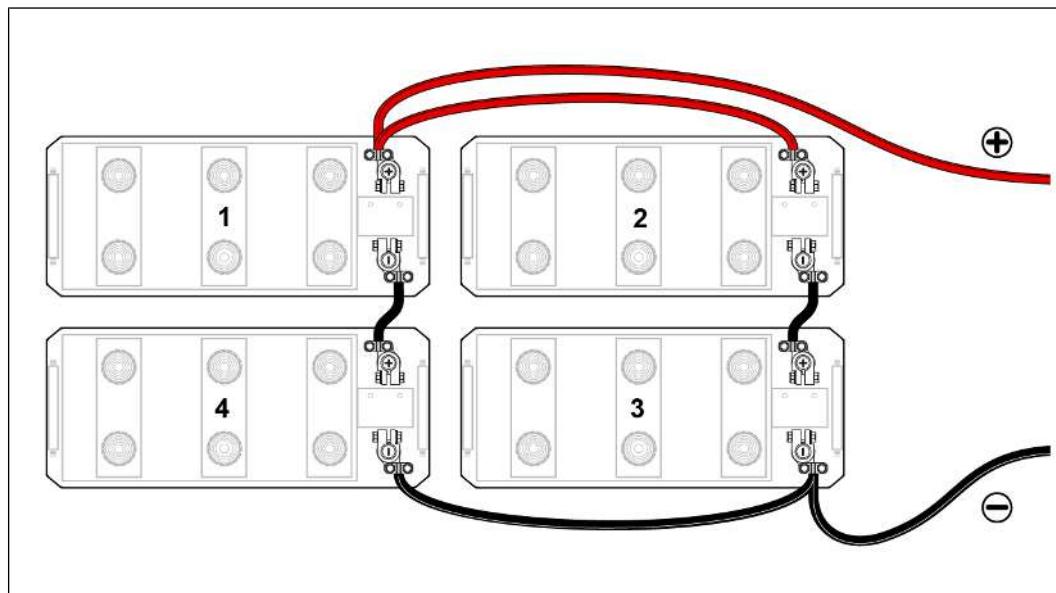
**Disconnecting the starter battery (two starter batteries)**

9007200101080459: Two starter batteries

1. Dismantle connection bridge on starter battery 2
  - Dismantle the connection bridge from the negative terminal.
2. Dismantle connection bridge on starter battery 1
  - Dismantle the terminal cover on the positive terminal.
  - Dismantle the connection bridge from the positive terminal.

- Re-mount the terminal cover on the positive terminal.
3. Keep the connection bridge in a safe place

#### Disconnecting the starter battery (four starter batteries)



9007200101082891: Four starter batteries

1. Dismantle connection bridge on starter battery 4
  - Dismantle the connection bridge from the negative terminal.
2. Dismantle connection bridge on starter battery 3
  - Dismantle the connection bridge from the negative terminal.
3. Dismantle connection bridge on starter battery 1
  - Dismantle the terminal cover on the positive terminal.
  - Dismantle the connection bridge from the positive terminal.
  - Re-mount the terminal cover on the positive terminal.
4. Dismantle connection bridge on starter battery 2
  - Dismantle the terminal cover on the positive terminal.
  - Dismantle the connection bridge from the positive terminal.
  - Re-mount the terminal cover on the positive terminal.
5. Keep the connection bridges in a safe place

#### Stopping the prelubrication pump

1. **NOTE! In order to guarantee sufficient cooling of the engine, the prelubrication pump continues running. The follow-up time is programmed to a fixed value in the control.** Wait for the follow-up time of the prelubrication pump to elapse
  - Ensure that the emergency stop button is activated.

- Interval lubrication is switched off.
- The prelubrication pump is not running.

## 8.1.6 Stopping the genset in an emergency

Stopping the genset in an emergency:

1. Activate the emergency stop switch immediately
2. Inform those responsible at the operating site
3. Alert a doctor and the fire department.
4. Keep people out of the danger zone
5. Initiate first aid measures.
6. Switch off main switch and secure against restarting
7. Keep access routes clear for rescue vehicles

After emergency services / evacuation measures:

1. If required due to the severity of the emergency, inform the responsible authorities
2. Commission specialist personnel with the task of troubleshooting
3. Visually inspect the genset before starting, see [Visually inspecting the genset \[▶ 192\]](#)
4. Perform test run and function run before starting, see [Performing test run and function run \[▶ 199\]](#)
5. Ensure that all safety devices are installed and functional

## 8.1.7 Monitoring the operation

### Check immediately after commissioning

1. Check the genset for smoothness of operation and noise:
  - [Performing test run and function run \[▶ 199\]](#)
2. Check genset and plant components for leaks:
  - [Visually inspecting the genset \[▶ 192\]](#)
  - [Performing the auxiliary drive test \(TPEM\) \[▶ 202\]](#)

## Monitoring during operation



### Risk of destruction of components

Risk of destruction of components due to improper recommissioning or improper operation following a warning or fault message

Components can be damaged or destroyed.

- If the electronic control has stopped the genset because of a fault, always rectify the root cause of the fault first
- Never continue operating the genset in case of a warning or alarm, without having rectified the root cause of the warning or alarm
- Restart the genset only after the fault has been properly eliminated
- Acknowledge a warning or alarm only if the root cause of the warning or fault message has been eliminated
- If the genset is continued to be operated or begins operation again without the root cause of the fault having been eliminated, the warranty claim against the manufacturer expires

Two fixed limit values are defined in the electronic control for all the operation parameters. If the first limit value is reached, the electronic control displays a warning. If the second limit value is exceeded, the electronic control displays a fault message and stops the genset.

The electronic control constantly monitors the operation of the genset and the related plant components.

1. At regular operating time intervals, check the operation values of the genset and the related plant components
  - Check operation values daily, see order-specific operating manual, chapter *Operation*, heading *Control system*.
  - In the event of deviations from the standard values, search for and eliminate the root causes.
2. Record all the warning and fault messages before eliminating the root causes



## Monitoring in the event of reverse power

### Risk of destruction of components

Risk of destruction of components due to reverse power

Components can be damaged or destroyed.

- In the event of reverse power, always disconnect the genset from the electric grid.
- Do not use the emergency stop button to stop the genset.
- In the event of reverse power, ensure that the coolant pumps are in operation during the entire reverse power episode. If necessary, establish a separate power supply.

Reverse power is generated if the following events occur simultaneously:

- The genset is running under load in grid-parallel operation
  - The electronic control stops the genset
  - The generator circuit breaker does not open

If the electronic control stops the genset, also close the safety shut-off valves in the gas train. The electronic control switches off the ignition. Combustion is no longer possible.

The electronic control opens the network section switch. If the network section switch clamps mechanically, the power connection between the generator and utility grid remains active. In this case, manually disconnect the generator section switch from the electric grid. If the generator section switch is not disconnected from the electric grid, the generator acts as an electric motor due to the power input. The generator continues to turn the engine of the genset at rated speed.

If the heat is no longer being dissipated, for instance because the coolant pumps are switched off, the engine can overheat until irreparably damaged.

1. Ensure that all the coolant pumps are running for the entire duration of the reverse power
  - Do not use the emergency stop button to stop the genset.
2. Disconnect the generator section switch manually from the utility grid
3. Inform those responsible for the plant of the reverse power
4. Check the cooling system pressure, see next section.

### Monitoring the coolant volume of the genset

1. Monitor the coolant volume:
  - Check the cooling system pressure, see [Filling the cooling system \[▶ 390\]](#)
  - Check the coolant quality, see [Checking the cooling system protection agent \[▶ 394\]](#)
  - Top up the coolant level, see [Filling the cooling system \[▶ 390\]](#)

### **Checking the electric starter**

1. Check the electric starter weekly:
  - Check the electric starter, see [Checking the starting system \[▶ 281\]](#).
  - Check the function of the electric starter, see [Engine auxiliary drive test \[▶ 206\]](#)
  - If the electric starter needs to be replaced, contact your service partner.

### **Checking the compressed air starter (optional)**

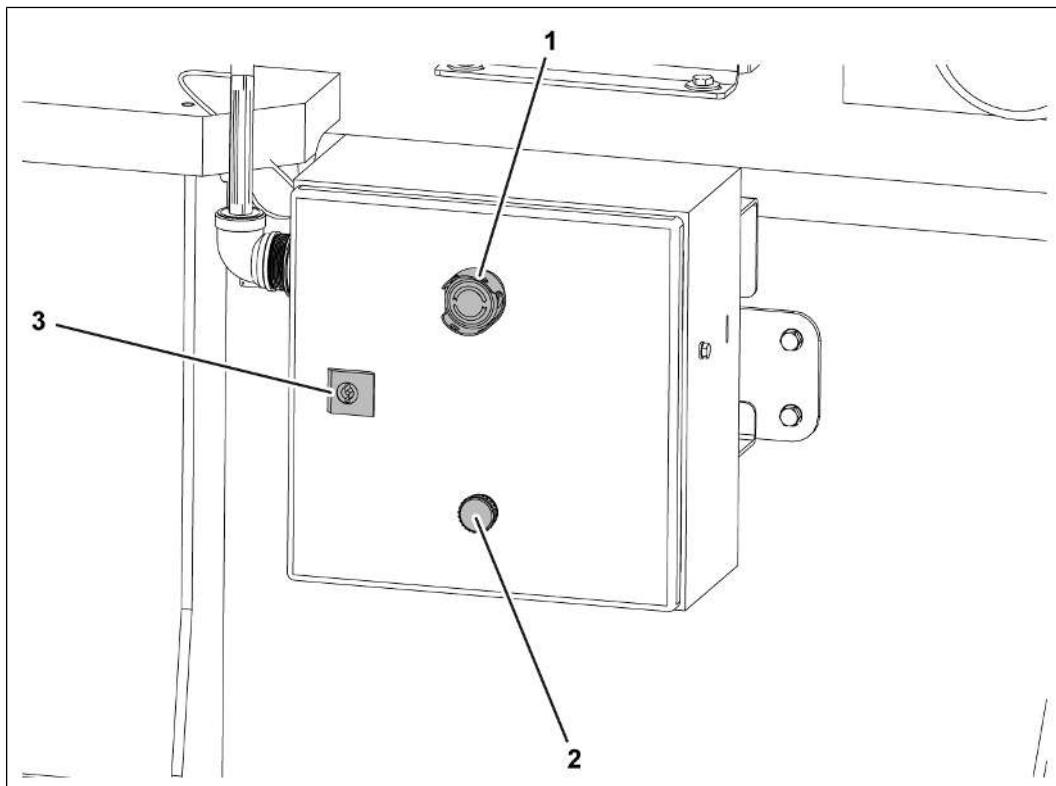
1. Check the compressed air starter weekly:
  - Check the compressed air starter, see [Checking the starting system \[▶ 281\]](#).
  - Check the function of the compressed air starter, see [Engine auxiliary drive test \[▶ 206\]](#).
  - If the compressed air starter needs to be replaced, contact your service partner.

### **Checking the double starter (optional)**

1. Check the double starter weekly:
  - Check the double starter, see [Checking the starting system \[▶ 281\]](#).
  - Check the function of the double starter, see [Engine auxiliary drive test \[▶ 206\]](#).
  - If the double starter needs to be replaced, contact your service partner.

## 8.2 TPEM Connection Box

### 8.2.1 Operating elements on the TPEM Connection Box (TPEM CB)



396650123

- 1 EMERGENCY stop button
- 2 Service interface
- 3 Locking mechanism

## 8.3 Generator

Part number: (null)

### 8.3.1 Generator operating states

#### Main machine idle

If the generator is running without being connected to the mains and excitation is approved, then the main windings will be live even when no load current is flowing. The electronic control maintains the speed of the drive engine. The drive engine is under low load in idle mode.

## Main machine with load

The magnetic field of the turning rotor induces a voltage in the generator's main windings. The rotor draws the energy required for generating the magnetic field from the exciter (excitation), which is activated by the automatic generator voltage controller (AVR). The current consumed by the consumers creates a counter-magnetic field.

The counter-magnetic field generates a counter-torque at the generator shaft. The counter-torque brakes the gas engine. The greater the current strength in the main windings, the stronger the braking torque.

The actuator regulates the speed of the engine and thus the power output of the engine. The frequency of the generator depends on the engine speed.

The generator voltage controller (AVR) indirectly controls the strength of the magnetic field and thus the generator's voltage.

## Island operation/Grid-parallel operation

Single genset in island operation Adjustment of excitation by the voltage controller causes a direct change in voltage at the generator terminals.

Multiple genset plants in island operation or grid-parallel operation Adjustment of excitation changes the reactive power output or reactive power consumption of the relevant generator (and ultimately also indirectly changes the system voltage in island plants).

For this reason, the "power factor control" mode (constant ratio of active and apparent power) is often used in grid-parallel operation. "Automatic reactive power load share" mode (equal, percentage distribution of the reactive power requirement that occurs in island operation to all gensets involved) dominates in multiple genset plants in island operation.

## Synchronization



### Risk of destruction of components

If the generator is connected in parallel to a high-power grid without sufficient synchronization, damage can occur to the generator's rotor shaft and to the engine.

If the generator is connected in parallel to a lower-power grid without sufficient synchronization, damage can occur to devices in the grid.

- Preset parameters are stored in the control system. Never change these parameters arbitrarily.

---

Synchronization is required so that the generator can feed electric current into the interconnected grid or consumer mains. The voltage and frequency are defined by the grid. A single genset in island operation is an exception. In this case, it can be connected immediately once the generator's rated voltage is reached.

A synchronization device handles synchronization of the generator with the grid. The synchronization device adjusts the engine speed and generator voltage during the synchronization process. The synchronization function is part of the supplied TPEM Multi Function Relay ([TPEM MFR](#)). Generator protection is also integrated in the TPEM MFR.

In order to synchronize the generator with the grid, the synchronization device correlates the current angular position and voltage differential of the voltage generated by the generator to the grid voltage. The engine control initially regulates the engine speed and transfers control to the synchronization device at rated speed. The synchronization device determines the difference between the value, frequency, and phase position of the generator voltage to the mains voltage. The synchronization device then automatically synchronizes the generator with the grid by adjusting the voltage and speed.

The phase position of the generator is adjusted to the mains voltage by briefly changing the engine speed. The same applies to adjusting the generator voltage using the voltage controller. When the adjustment is carried out, the synchronization device closes the generator circuit breaker (GCB).

From this point on, the required operating modes as well as the setpoints that may be required for these can now be set externally using various connection options.

---

#### NOTE

The relevant grid operator specifies the grid code according to the requirements of the grid in question. For this, the grid operator takes into account regulations coordinated and laid out in associations, as well as national, European, or international committees.

## 9 Decommissioning

### 9.1 Genset

#### 9.1.1 Decommissioning the genset



##### Risk of destruction of components

Components can be damaged or destroyed due to improper decommissioning.

- Perform the work specified in this chapter in accordance with the duration of the decommissioning
- Secure the genset against starting for the entire duration of the decommissioning
  - Attach signs to the touchscreen, switchgear cabinet, and genset with the following text: CAUTION! OUT OF ORDER! Start the genset ONLY after consulting the operator.



##### Risk of destruction of components

Components can be damaged or destroyed due to improper storage.

- Ensure the following storage conditions:
  - Frost-proof (constant temperature of +10 °C to +40 °C)
  - Neutral, dry atmosphere (constant humidity up to maximum 60 % rH)
  - In a humid environment, use desiccants to prevent the build-up of condensation or use heating
  - If necessary, add anti-freeze agents to the coolant or empty the cooling system
  - Necessary information on coolant, storage, and preservation can be found in the order-specific operating manual in chapter *Regulations*.
- Ensure that no foreign bodies, dust or humidity penetrate

Different work must be performed depending on the duration of the decommissioning.

The following periods are distinguished between for the decommissioning:

- Decommissioning for maximum two months, see [Decommissioning the genset for up to two months \[▶ 158\]](#)
- Decommissioning for two to eight months, see [Decommissioning the genset for two to eight months \[▶ 158\]](#)
- Decommissioning for more than eight months, see [Decommissioning the genset for more than eight months \[▶ 159\]](#)

The power supply for the plant must be ensured during the entire decommissioning period. The superior control system must therefore remain ready for operation.

In order to save energy, the preheating device for the coolant can be operated at reduced power (approx. 25 °C).

### 9.1.2 Decommissioning the genset for up to two months

#### Work that must be performed by the operator or operating personnel:

1. Close the shut-off device in the gas train
2. Lock battery disconnection switch and keep the key in a safe place
3. The preheating device for the coolant must be switched on if there is a risk of frost

### 9.1.3 Decommissioning the genset for two to eight months

#### Work that must be performed by the operator or operating personnel:

- ✓ All work is performed as in section [Decommissioning the genset for up to two months](#)  
[▶ 158]
- 1. **NOTE! Avoid aeration inside the engine (chimney effect).** Decommissioning the exhaust system and charging
  - Seal intake air filter shut with suitable cover (e.g. film).
  - In the case of a multi-engine plant with a common exhaust line, close the exhaust flap of the decommissioned genset.
  - Additional information on the exhaust line and shut-off flap can be found in the order-specific operating manual in chapter *Notes on planning*.
- 2. Decommissioning the fuel gas system
  - Close the shut-off device in the gas train.
- 3. Decommissioning the lube oil system
  - Perform a lube oil analysis.
  - If the results of the lube oil analysis exceed or undercut the limit values, renew the lube oil.
  - After changing the lube oil, operate the genset for at least twelve hours.
  - Information on the limit values for lube oil can be found in the order-specific operating manual in chapter *Regulations*.
- 4. Decommissioning the cooling system
  - Switch on the coolant pumps once a month and let them run for ten minutes.
- 5. Decommissioning the compressed air system (optional)
  - Drain the compressed air container once a month.
  - After draining, fill the compressed air container with compressed air.
  - Check the system pressure each month if using a version with automatic drainage. Replenish the compressed air if necessary.

**Work that must be performed by a qualified gas technician:**

1. Decommissioning the fuel gas system
2. **NOTE! Gas trains for natural gas plants are excluded from the cleaning.** Clean the gas train

**Work that must be performed by a qualified electrician:**

1. Decommissioning the generator
  - Check the insulation resistance of the generator every six months.
  - If necessary, dry the generator.

**9.1.4 Decommissioning the genset for more than eight months****Work that must be performed by the operator or operating personnel:**

- ✓ All work is performed as in section [Decommissioning the genset for two to eight months \[▶ 158\]](#)

1. Decommissioning the plant
  - Close all the openings on the genset

**Work that must be performed by the service personnel:**

1. **NOTE! Generators with roller bearings can be damaged or destroyed due to improper decommissioning. To avoid damage to the roller bearings due to hardened lubricating grease, rotate the generator shaft during the shutdown time.**

Decommissioning the generator with roller bearings

- Disconnect the generator from the engine.
- Starting after eight months, the generator shaft must be turned through 30 revolutions each month.

2. **NOTE! Generators with sleeve bearings can be damaged or destroyed due to improper decommissioning. To avoid damage to the sleeve bearings, the generator shaft must not be rotated during the shutdown time.** Decommissioning the generator with sleeve bearings

- Disconnect the generator from the engine.
- Secure the rotor with a blocking clip.
- Fill corrosion protection agent into the filler openings of the sleeve bearings.



## 10 Troubleshooting

### 10.1 Genset

#### 10.1.1 Fault displays

The majority of fault displays appear on the TPEM Touch Panel (**TPEM TP**) as text messages.

Acoustic or visual fault displays may be installed in the immediate vicinity of the genset, if applicable. The operator is responsible for integrating the genset into the signal chain of the overall plant.

For relevant information on the fault displays, see *Operating Manual, chapter Control, section TPEM Operating manual*.

#### 10.1.2 Checking after troubleshooting

1. Ensure that all the protective covers are mounted completely and functional
2. Ensure that all safety devices are mounted completely and functional
3. Ensure that there are no people in the danger zone
4. Reset emergency stop devices.
5. Acknowledge faults on the TPEM Touch Panel (**TPEM TP**), see TPEM Operating manual.
  - You can find the document in the order-specific operating manual or in the Service Library.

### 10.2 Exhaust system

#### 10.2.1 Fault table for exhaust system

Component and fault	Possible cause	Troubleshooting
Flange connection to the exhaust heat exchanger is leaking	Gasket faulty	1. Contact person: service partner
	Loose screw connection	1. Contact person: service partner
Insufficient performance of the exhaust heat exchanger (pressure loss)	Upstream side of the exhaust heat exchanger is dirty	1. Contact person: service partner

Component and fault	Possible cause	Troubleshooting
	Exhaust gas side of the exhaust heat exchanger is dirty	1. Contact person: service partner
Water comes out the condensate nozzle of the exhaust heat exchanger when the genset is switched off	Pressure tank leaking	1. Decommission the exhaust heat exchanger immediately 2. Contact person: service partner
	Loose screw connection	1. Contact person: service partner

Table 3: Exhaust system is leaking or faulty

## 10.3 Lube oil system

### 10.3.1 Fault table for lube oil system

Component and fault	Possible cause	Troubleshooting
Prelubrication pump does not function	Fuse faulty	1. Contact person: Qualified electrician
	Cable clamp loose	1. Contact person: Qualified electrician
	Prelubrication pump faulty	1. Contact person: Qualified electrician
Prelubrication pump output is too low	Pressure limiting valve contaminated	1. Overhaul pressure limiting valve
	Air in lube oil system	1. Contact person: service partner
	Speed too low	1. Contact person: Qualified electrician
	Prelubrication pump faulty	1. Contact person: Qualified electrician
Prelubrication pump is making noises	Bearing faulty	1. Contact person: service partner

Component and fault	Possible cause	Troubleshooting
Lube oil pump does not function	Lube oil level too low	1. Top up lube oil
Lube oil pump output too low	Lube oil level too low	1. Top up lube oil
	Lube oil pump faulty	1. Contact person: service partner
Lube oil pump is making noises	Intake air pipe blocked	1. Contact person: service partner
	Bearing faulty	1. Contact person: service partner
Engine stopped by electronic control (lube oil level too low)	Lube oil level too low	1. Top up lube oil
	Lube oil level sensor faulty	1. Exchange lube oil level sensor
	Leakage	1. Contact person: service partner
Engine stopped by electronic control (lube oil temperature too high)	Lube oil heat exchanger is dirty	1. Contact person: service partner
	Coolant has been used up	1. Check coolant, top up if necessary
	Lube oil temperature sensor faulty	1. Exchange lube oil temperature sensor
Engine stopped by electronic control (lube oil pressure too high or too low)	Lube oil level too low	1. Top up lube oil
	Lube oil filter contaminated	1. Exchange lube oil filter
	Pressure limiting valve contaminated	1. Overhaul pressure limiting valve
	Lube oil level too high	1. Contact person: service partner
	Lube oil pressure sensor faulty	1. Exchange the lube oil pressure sensor

Table 4: Lube oil system depressurized or faulty

## 10.4 Mixture system

### 10.4.1 Fault table for mixture system

Component and fault	Possible cause	Troubleshooting
Flange connections of the mixture housing are leaking	Seal faulty	1. Contact person: service partner
	Loose screw connection	1. Contact person: service partner
Connection pipe between the mixture housings is leaking	<ul style="list-style-type: none"> <li>• Seals on mixture housing faulty</li> <li>• Sealing rings on spacer faulty</li> </ul>	1. Contact person: service partner
	Loose screw connection	1. Contact person: service partner

Table 5: Mixture housing is leaking

Component and fault	Possible cause	Troubleshooting
Mixture temperature is too high	Mixture temperature sensor (before exhaust turbocharger) is faulty	1. Renew mixture temperature sensor (before exhaust turbocharger)
Mixture temperature is too low	Mixture temperature sensor (before mixture cooler) is faulty	1. Renew mixture temperature sensor (before mixture cooler)
Mixture pressure is too high	Mixture pressure sensor (after mixture cooler) is faulty	1. Renew mixture pressure sensor
Mixture pressure is too low		

Table 6: Mixture values are not correct

## 10.5 Generator

### 10.5.1 Fault table for generator

Component and fault	Possible cause	Troubleshooting
Generator voltage is too high	Nominal value specification adjusted incorrectly	1. Contact person: Qualified electrician
	Measuring lines connected incorrectly	1. Contact person: Qualified electrician
	Generator controller is defective	1. Contact person: Qualified electrician
Voltage fluctuations in the generator	Engine speed is not constant	1. Check engine speed 2. Correct load step if necessary 3. Contact person: service partner
	Nominal value specification adjusted incorrectly	1. Contact person: Qualified electrician
	Generator controller is defective	1. Contact person: Qualified electrician
Generator voltage cannot be increased	Set point adjuster or connection line broken	1. Contact person: Qualified electrician 2. Contact person: service partner
Generator builds no voltage	Exciter safety switch has been triggered	1. Contact person: service partner
	Excitation diodes faulty	
Generator voltage drops greatly under load	Input speed drops under load	1. Contact person: service partner
	Protective fuse faulty	
	Excitation diodes faulty	

Table 7: Generator generates no voltage or an incorrect voltage, or is faulty

## 10.6 Engine

### 10.6.1 Fault tables for engine

Component and fault	Possible cause	Troubleshooting
Gas supply interrupted	Gas shut-off elements closed	1. Open gas shut-off elements
	Leakage	1. Contact person: Qualified gas technician
	Gas pressure controller is hanging	1. Contact person: Qualified gas technician
Gas supply interrupted	Gas pressure too high or too low	1. Contact person: Qualified gas technician
Speed control is not functioning	Actuator faulty	1. Contact person: service partner
Power supply interrupted	Power supply to the genset switch cabinet interrupted	1. Contact person: Qualified electrician
Ignition does not take place	Control device faulty	1. Contact person: service partner
	Cable broken	
Camshaft sensor does not give any signal	Spacing too large	1. Contact person: service partner
	Sensor or sensor cable faulty	1. Contact person: service partner
Crankshaft sensor does not give any signal	Spacing too large	1. Check setting
	Sensor or sensor cable faulty	1. Renew sensor
The electronic control has stopped the engine (cooling system is not functioning)	Too little coolant	1. Check coolant
	Leakage	1. Contact person: service partner
	Coolant pump faulty	1. Contact person: service partner
	Coolant pump leaking	1. Contact person: service partner

<b>Component and fault</b>	<b>Possible cause</b>	<b>Troubleshooting</b>
	Cooling system dirty	1. Contact person: service partner

Table 8: Engine is at a standstill

<b>Component and fault</b>	<b>Possible cause</b>	<b>Troubleshooting</b>
Gas supply interrupted	Gas shut-off elements closed	1. Open gas shut-off elements
Power supply interrupted	Power supply to the genset switch cabinet interrupted	1. Contact person: Qualified electrician
	Power supply to the starter interrupted	1. Checking battery disconnection switch
Ignition does not take place	Spark plug faulty	1. Check spark plug
	Ignition cable faulty	1. Check ignition cable
	Ignition coil faulty	1. Contact person: Qualified electrician
	Main control device faulty	1. Contact person: service partner
Engine does not turn	Starter system faulty	<ol style="list-style-type: none"> <li>1. Check power supply</li> <li>2. Checking the starter</li> <li>3. Check start signal</li> <li>4. Check compressed air supply (optional)</li> <li>5. Contact person: service partner</li> </ol>
Camshaft sensor does not give any signal	Spacing too large	1. Contact person: service partner
Crankshaft sensor does not give any signal	Spacing too large	1. Check setting

Table 9: Engine does not start

Component and fault	Possible cause	Troubleshooting
Inlet valves do not close	Valve clearance too small	1. Checking the valve clearance
	Inlet valve leaking	1. Contact person: service partner
Outlet valves do not close	Valve clearance too small	1. Checking the valve clearance
	Outlet valve leaking	1. Contact person: service partner
	Oil residues at the outlet valve	1. Contact person: service partner
Compression pressure too low	Piston rings faulty	1. Contact person: service partner
	Cylinder liner worn	1. Contact person: service partner
Gas supply is impaired	Gas line not ventilated	1. Contact person: Qualified gas technician
	Stepper motor of gas-air mixer faulty	1. Contact person: service partner
Ignition takes place irregularly or does not take place at all	Spark plug faulty	1. Check spark plug

Table 10: Engine is misfiring and does not run quietly

Component and fault	Possible cause	Troubleshooting
Ignition does not take place	Spark plug faulty	1. Check spark plug
	Ignition cable faulty	1. Check ignition cable
	Ignition coil faulty	1. Contact person: Qualified electrician
	Main control device faulty	1. Contact person: service partner
Signal from camshaft sensor is too weak	Spacing too large	1. Contact person: service partner

Component and fault	Possible cause	Troubleshooting
	Camshaft sensor faulty	1. Contact person: service partner
Signal from crankshaft sensor is too weak	Spacing too large	1. Check setting
	Crankshaft sensor faulty	1. Renew crankshaft sensor

Table 11: Engine ignites irregularly

Component and fault	Possible cause	Troubleshooting
Poor heat transmission (primary heating circuit to secondary heating circuit)	Heat exchanger silted	1. Contact person: service partner
Poor heat transmission (secondary heating circuit)	3-way valve faulty	1. Contact person: service partner
Poor cooling efficiency (cooling circuit)	Coolant pressure too low	1. Checking the coolant level
	Coolant pressure sensor faulty	1. Renew coolant pressure sensor
	Coolant temperature sensor faulty	1. Renew coolant temperature sensor
	Leakage	1. Contact person: service partner
	Coolant pump faulty	1. Contact person: service partner
	Coolant pump leaking	1. Contact person: service partner

Table 12: Engine is overheating

## 10.7 Intake air filter

### 10.7.1 Fault table for intake air system

Component and fault	Possible cause	Troubleshooting
Air supply interrupted	Intake air filter faulty	Exchange intake air filter

Component and fault	Possible cause	Troubleshooting
	Clamping clips loose	Tighten screw connection
Air supply insufficient	Intake air filter faulty	Exchange intake air filter
	Check air quality	1. Contact person: service partner

Table 13: Intake air system is leaking or faulty

## 10.8 Cooling system

### 10.8.1 Fault table for cooling system

Component and fault	Possible cause	Troubleshooting
Coolant pump not functioning	Fuse faulty	1. Contact person: Qualified electrician
	Cable clamp loose	1. Contact person: Qualified electrician
	Coolant pump faulty	1. Contact person: Qualified electrician
Coolant pump output is too low	Air in cooling system	1. Contact person: service partner
	Coolant pump is connected in the wrong direction of rotation	1. Contact person: Qualified electrician
	Speed too low	1. Contact person: Qualified electrician
	Coolant pump faulty	1. Contact person: Qualified electrician
Coolant pump is making noises	Pre-pressure too low	1. Adjust pre-pressure as per specification
	Bearing faulty	1. Contact person: service partner
Engine stopped by the electronic control (coolant volume too low)	Too little coolant	1. Check coolant 2. Top up coolant if necessary

Component and fault	Possible cause	Troubleshooting
	Leakage	1. Contact person: service partner
Engine stopped by the electronic control (coolant temperature too high)	Too little coolant	1. Check coolant 2. Top up coolant if necessary
	Coolant temperature sensor defective	1. Replace coolant temperature sensor

Table 14: Cooling system is depressurized or faulty



## 11 Maintenance

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## 11.1 Genset

### 11.1.1 Maintenance and inspection schedule

All maintenance work that is required for fault-free operation is summarized in the maintenance and inspection schedule. The maintenance and inspection schedule is sorted according to maintenance levels (M levels) and stored accordingly.

In the following cases, always contact the manufacturer:

- Increased wear is noticeable during checks or maintenance work.
- Questions arise during maintenance work
- Questions arise during maintenance intervals

The manufacturer's contact details can be found in the Masthead or on the [homepage](#).

For all required information on the maintenance and inspection schedule, see [Maintenance \[▶ 173\]](#).

### 11.1.2 Performing cleaning

For instructions on cleaning the genset, see [Cleaning the genset \[▶ 195\]](#).

For instructions on cleaning the components, see the respective component documentation in the order-specific operating manual or consult the Service Library.

### 11.1.3 Performing maintenance work

Each maintenance procedure is described in a separate work instruction. The maintenance and inspection schedule specifies the correct work instructions for each maintenance procedure. The respective maintenance procedures are described in detail in the work instructions, see [Work instructions \[▶ 185\]](#).

For more information on maintenance procedures on individual components, see the order-specific operating manual or consult the Service Library.

### 11.1.4 Conducting checks after maintenance is complete

- ✓ The maintenance tasks are complete
- 1. Ensure that all the protective covers are mounted completely and functional
- 2. Ensure that all safety devices are mounted completely and functional
- 3. Ensure that there are no people in the danger zone
- 4. [Commissioning the genset \[▶ 134\]](#)

## 11.2 Rubber expansion joint

### 11.2.1 Notes on the maintenance schedule

It is imperative that maintenance and repair work be performed.

- The maintenance intervals specified in the maintenance and inspection schedule shall apply.
- The maintenance information on the rating plate and in the original supplier documentation of single components is not binding.

The relevant work requires specialist knowledge.

Therefore, the work can only be performed by personnel who meet the qualification (competency) specified in the maintenance and inspection schedule.

- Further information on personnel and personnel qualifications
  - see Operating Manual > Chapter Personnel and competencies

The abbreviations in the maintenance and inspection schedule have the following meanings:

- **OL:** the maintenance activity requires competence level "Operator Level" (formerly competence level 1)
- **ML:** the maintenance activity requires competence level "Maintenance Level"
- **SL:** the maintenance activity requires competence level "Service Level" (formerly competence levels 2 and 3)
- **BL:** the maintenance activity requires competence level "BOP Specialist Level" (formerly competence level Q)

### 11.2.2 Maintenance schedule

#### Every 24 hours (daily)

Task	Work instructions
Visually inspecting the rubber expansion joint	<a href="#">Visually inspecting the rubber expansion joints [▶ 296]</a>

**If required**

Task	Work instructions
Cleaning the rubber expansion joint	<a href="#">Visually inspecting the rubber expansion joints [▶ 296]</a>
Replacing the rubber expansion joint	<a href="#">Removing and installing the rubber expansion joint [▶ 396]</a>

## 11.3 Tools

### 11.3.1 Tool competence level OL

#### 11.3.1.1 Tool kit (standard kit, small) 1215 0000

	<p>Tool kit consisting of:</p> <ul style="list-style-type: none"> <li>• 1215 8074 Tool case</li> <li>• 0115 4248 Open-end wrench 8 × 10</li> <li>• 0115 4250 Open-end wrench 12 × 14</li> <li>• 0115 4251 Open-end wrench 13 × 17</li> <li>• 0115 4252 Open-end wrench 14 × 15</li> <li>• 0115 4254 Open-end wrench 19 × 22</li> <li>• 0112 9228 Open-end wrench 24 × 27</li> <li>• 0703 8432 Open-end wrench 30 × 32</li> <li>• 0112 4755 Box wrench 13 × 17</li> <li>• 0115 4230 Box wrench 19 × 22</li> <li>• 0115 4231 Box wrench 24 × 27</li> <li>• 0115 4367 Feeler gauge set 0.05 to 1.0 × 100</li> <li>• 0110 3964 Socket wrench insert 10 × 12.5</li> <li>• 0110 3965 Socket wrench insert 13 × 12.5</li> <li>• 0110 3966 Socket wrench insert 14 × 12.5</li> <li>• 0110 3967 Socket wrench insert 17 × 12.5</li> <li>• 0110 3968 Socket wrench insert 19 × 12.5</li> <li>• 0110 2416 Socket wrench insert 22 × 12.5</li> <li>• 0115 2905 Cross handle A 12.5</li> <li>• 0110 2415 Extension B 12.5 × 250</li> <li>• 0115 4232 Universal joint C 12.5</li> </ul>
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- 0110 3385 Screwdriver A 0.8 × 4.0
- 0110 4281 Screwdriver A 1 × 5.5

### 11.3.1.2 Tool kit (standard kit, small) 1215 0004

	<p>Tool kit consisting of:</p> <ul style="list-style-type: none"><li>• 1221 1002 Tool case</li><li>• 0115 4249 Open-end wrench 10 × 12</li><li>• 0115 4251 Open-end wrench 13 × 17</li><li>• 0115 4252 Open-end wrench 14 × 15</li><li>• 0115 4254 Open-end wrench 19 × 22</li><li>• 0115 8173 Feeler gauge set 0.2 to 0.45</li><li>• 0110 1243 Socket wrench insert 13 × 12.5</li><li>• 0110 2880 Socket wrench insert 15 × 12.5</li><li>• 0110 1245 Socket wrench insert 17 × 12.5</li><li>• 0110 1246 Socket wrench insert 19 × 12.5</li><li>• 0110 9772 Socket wrench insert 22 × 12.5</li><li>• 0110 9773 Socket wrench insert 24 × 12.5</li><li>• 0110 2882 Socket wrench insert 27 × 12.5</li><li>• 0115 2906 Cross handle A 12.5</li><li>• 0110 4327 Extension B 12.5 × 250</li><li>• 0110 3385 Screwdriver A 0.8 × 4.0</li><li>• 1215 8115 Square socket set width across flats 3.25</li></ul>
---	---

### 11.3.1.3 Tool kit (standard kit, large) 1215 0005

	<p>Tool kit consisting of:</p> <ul style="list-style-type: none"><li>• 1215 8079 Tool case</li><li>• 0115 4249 Open-end wrench 10 × 12</li><li>• 0115 4251 Open-end wrench 13 × 17</li><li>• 0115 4252 Open-end wrench 14 × 15</li><li>• 0115 4254 Open-end wrench 19 × 22</li><li>• 0112 9228 Open-end wrench 24 × 27</li><li>• 0703 8432 Open-end wrench 30 × 32</li><li>• 0112 4755 Box wrench 13 × 17</li></ul>
---	---

- 0115 4230 Box wrench 19 × 22
- 0115 4231 Box wrench 24 × 27
- 0115 4367 Feeler gauge set 0.05 to 1.0 × 100
- 0115 1243 Socket wrench insert 13 × 12.5
- 0115 2880 Socket wrench insert 15 × 12.5
- 0115 1245 Socket wrench insert 17 × 12.5
- 0115 1246 Socket wrench insert 19 × 12.5
- 0115 9772 Socket wrench insert 22 × 12.5
- 0115 9773 Socket wrench insert 24 × 12.5
- 0115 2882 Socket wrench insert 27 × 12.5
- 0115 2905 Cross handle A 12.5
- 0110 4327 Extension B 12.5 × 125
- 0110 2415 Extension B 12.5 × 250
- 0115 4232 Universal joint C 12.5
- 1203 0362 Ratchet 1/2 inch
- 1215 8146 Tubular handle
- 1215 8139 Torque wrench 0 to 210 Nm
- Extension lever for 1215 8139 (0 to 420 Nm)
- 0110 3385 Screwdriver A 0.8 × 4.0
- 1215 8115 Square socket set width across flats 3.25

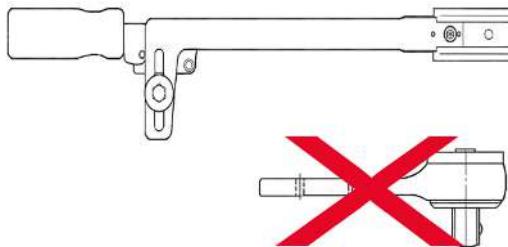
#### 11.3.1.4 Tool kit (standard kit, small) 1214 1852

	<p>Tool kit consisting of:</p> <ul style="list-style-type: none"><li>• 1218 9924 Socket wrench 3/3 inch No. 33</li><li>• 0703 7936 Socket wrench insert 16 × 12.5</li><li>• 0703 7935 Wrench B 16</li><li>• 1215 8153 Strap wrench B 12.5 × 250</li><li>• 1214 1829 Pliers, valve stem gasket</li><li>• 1221 7605 Socket wrench insert for spark plug</li></ul>
---	---

### 11.3.1.5 Tool kit (extension II) 1216 3078

	<p>Tool kit consisting of:</p> <ul style="list-style-type: none"><li>• 1231 1004 Tool case</li><li>• 1215 7944 Acidimeter for battery</li><li>• 1215 8292 Lab case for fluid</li><li>• 1215 8153 Strap wrench for filter cartridges</li><li>• 0115 3425 square wrench (double filter switchover)</li></ul>
---	--

### 11.3.1.6 Torque wrench 1203 0350

	<p>Torque wrench, measuring range 1 to 210 Nm (0 to 21 kpm).</p> <p><b>The ratchet is not included!</b></p> <ul style="list-style-type: none"><li>• Ratchet 3/4 inch 1203 0352</li><li>• Ratchet 1/2 inch 1203 0362</li></ul>
--	---

### 11.3.1.7 Extension for torque wrench 1203 0356

	<p>Extension or lever</p> <ul style="list-style-type: none"><li>• Included in tool kit 3 (Part no. 1221 1523).</li></ul>
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**11.3.1.8 Measuring device for valve recession 1231 9857**

	For mounting on the cylinder head for the valve recession measurement Includes depth caliper gauge 1221 7475
---	---

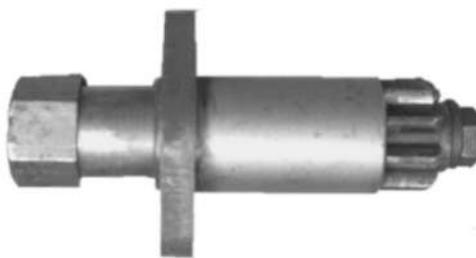
**11.3.1.9 Depth caliper gauge for valve wear 1221 7475**

	For measuring valve wear.
--	---------------------------

**11.3.1.10 Key for the setting screw of the valve crosshead 1230 3225**

	For tightening the lock nut during the valve crosshead setting.
---	---

**11.3.1.11 Engine turning gear 1227 6678**

 A cylindrical metal tool with a hexagonal nut at one end and a gear-like teeth at the other, used for turning crankshafts.	For turning the crankshaft
--	----------------------------

**11.3.1.12 Engine turning rod 1242 0844**

 A long, straight metal rod used for turning crankshafts.	For turning the crankshaft.
---	-----------------------------

**11.3.1.13 Lube oil filter key 1215 8153**

 A tool consisting of a long metal handle with a textured grip and a circular metal ring attached to the end, used for loosening lube oil filter cartridges.	For loosening the lube oil filter cartridge.
---	--

**11.3.1.14 Set for cooling water test 1221 7483**

 A photograph showing the contents of the set: a small metal box labeled 'CL1' and '1221 7483', a black plastic case containing several circular components, and some loose circular parts.	To determine the fresh water values and coolant values. • (Replaces test cases 1213 0382 and 1215 8292).
--	---

**11.3.1.15 Socket wrench insert for spark plug (prechamber spark plug) 1230 1538**

 A photograph of a long, cylindrical metal socket wrench insert with a hexagonal head at one end and a threaded bore for a spark plug.	For removing and installing the prechamber spark plug.
--	--

**11.3.1.16 Spark plug thread cleaner 1251 5557**

 A photograph of a spark plug thread cleaner, which is a threaded metal tool with a hexagonal head and a central bore.	For cleaning spark plug thread and spark plug seat in the spark plug adaptor.
---	---

**11.3.1.17 Timing light 1221 7826**

For checking the ignition timing.

- Replaces the part number 1215 3977.

**11.3.1.18 Acidimeter 1215 7944**

For checking the battery fluid.

- Measuring the acid density

**11.3.1.19 Lubricating grease mass flowmeter 1221 8953**

For measuring the lubricating grease quantities for the generator rolling bearing.

In conjunction with:

- Hand-operated grease pumps
- Electrically operated grease pumps
- Compressed air operated grease pumps



## 12 Work instructions

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## Safely detecting and disposing of residue from hexavalent chromium

Valid for:  
TCG 3016



Tools:

- Standard tools



Auxiliary media:

- Lube oil
  - WD-40 or equivalent
- Personal protective equipment
  - Single-use nitril gloves of standard EN 374-1
  - Eye protection EN 166
  - Chemical protective clothing, category III, type 5-B
  - Breathing protection FFP3 or maintenance-free half-mask with FFP3 filter
- For disposal
  - PVC bag
  - Lockable transport box
  - National regulations for disposal

### Description

Yellow-colored residue can appear on the heat or exhaust system.

---

### NOTE

Observe the following when working on components with hexavalent chromium (Cr<sub>6</sub>) residue:

- Wash hands and face before eating, drinking or smoking.
  - Wash hands before using the restroom.
- 

### Appraisal:

- ✓ [Decommissioning the genset \[▶ 146\]](#)

**WARNING**

Injuries due to improper handling when working with components contaminated with hexavalent chromium (Cr6)

This can lead to minor or severe injuries.

- Close off the working area for unauthorized persons.
- Wear personal protective equipment.
- Avoid contact with skin.
- Use a suitable tool for inserting and removing the components into and from the tank.
- Use a suitable tank.
- Treat residues and components according to national regulations.
- Take off soiled clothing immediately and dispose of them according to the national regulations.

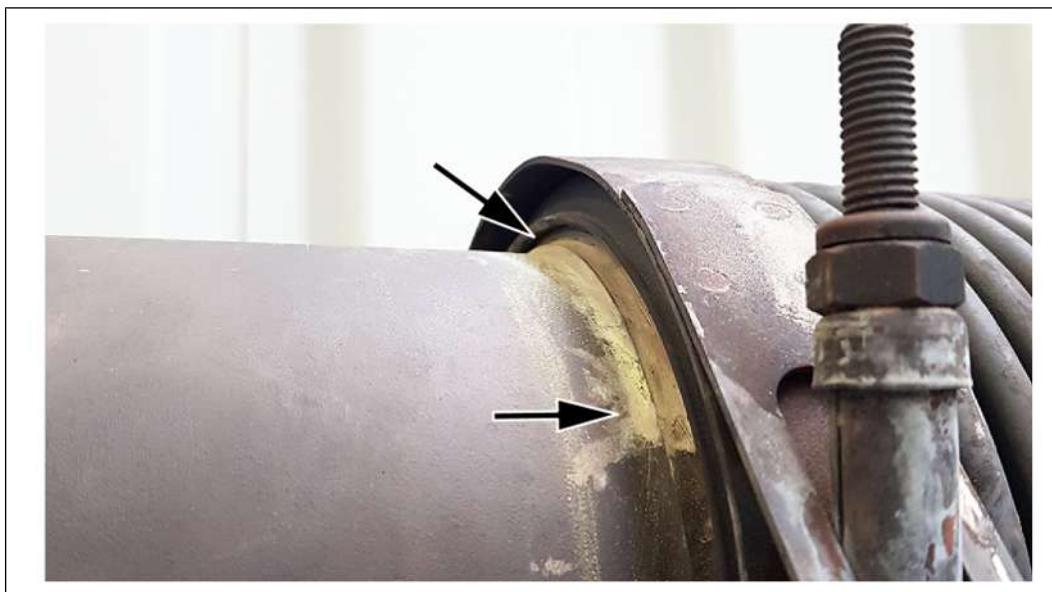
**Danger to the environment**

Due to components or residues which are not transported, stored and disposed of properly.

- When working with hexavalent chromium (Cr6), take appropriate protective measures for persons and the environment.
- Collect and dispose of hexavalent chromium (Cr6) properly according to the national regulations.



302623883: Heat cladding with yellow residue

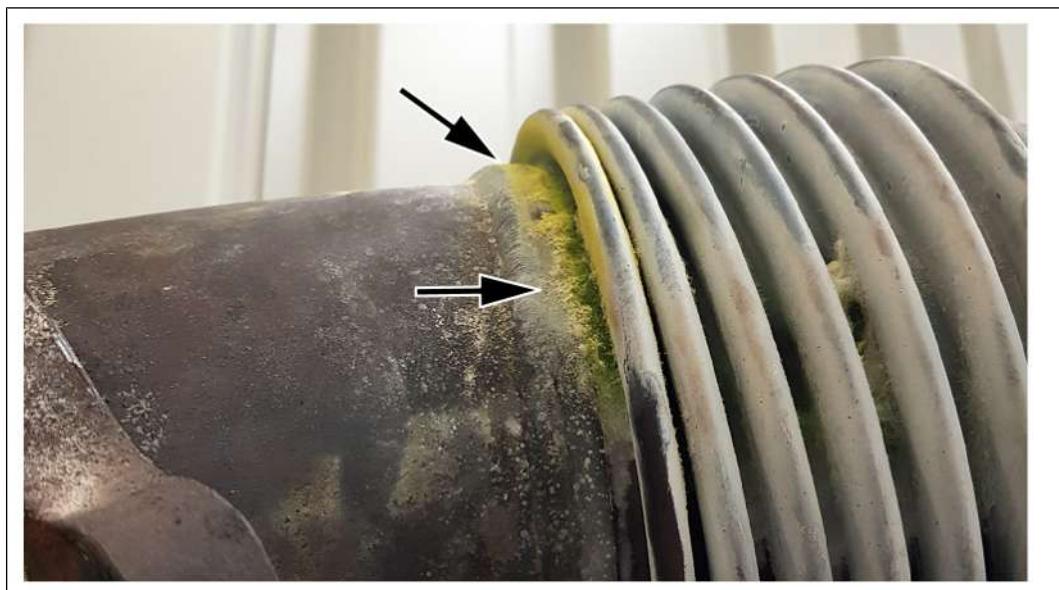


302627723: Exhaust system with yellow residue

1. Check, whether yellow residue (arrows) is visible on the heat or exhaust system
2. Photograph residue
3. Document appraisal with the following information:
  - Engine serial number
  - Engine series
  - Engine operation location/region
  - Engine operating hours
  - Engine installation site
  - Components on which residue was found
  - If applicable, part/area of the engine/etc.

#### **Removing residue from hexavalent chromium (Cr6):**

- ✓ [Decommissioning the genset \[▶ 146\]](#)
1. Put on personal protective equipment
  2. Close off work area against unauthorized access



302625803

3. **CAUTION! Never remove yellow-colored residue dry. Keep as dust-free as possible. Do not use wire brushes for scraping away. Do not use compressed air.**  
Dampen yellow-colored residue (arrows) with lube oil (WD-40)
4. Remove yellow-colored residue (arrows)
  - Scrape off residue and collect with suitable equipment.
  - Wipe off residue with a cleaning cloth.
5. Dispose of residue according to the national regulations
6. Take off protective equipment
  - Store protective equipment in a suitable container for hazardous waste and dispose of in accordance with national regulations.
7. Clean face and hands with water and soap
8. [Commissioning the genset \[▶ 134\]](#)

**Having an appraisal and cause clarified:**

1. For further assistance, please contact your service center
  - Your requests are forwarded by the service center to the technical support and to CES Service EHS.
2. Forward the appraisal to your service center, including photos and the following information:
  - Engine serial number
  - Engine series
  - Engine operation location or region
  - Engine operating hours

- 
- Engine installation site
  - Components or engine area on which residue occurs

## Visually inspecting the genset

Valid for:

TCG 3016



Tools:

- Standard tools

### Checking the general condition of the genset and the installation room:

1. Check the genset for cleanliness
2. Check safety devices for completeness and functionality
  - Check the flywheel guard for completeness and tight fit.
  - Key and chain are available on the double starter terminal box or on the battery disconnection switch.

### Checking the electronic control:

1. Check all display data and pilot lights on the switchgear and electronic control, see *Operating Manual, chapter Operation, Control system*
2. Compare the current operation values with the values in the commissioning report from the operation log, see *Operating Manual, chapter Operation, Control system*
  - If values are outside the tolerance range, contact service partner.

### Checking the engine:

1. Check the engine for smooth running and noise emission
  - If the engine is not running smoothly or in case of abnormal noise emission, contact service partner.

### Checking the intake air system:

1. Visually inspect the service indicator on the intake air filter
  - If necessary, replace the intake air filter, see [Removing and installing the intake air filter \[▶ 358\]](#)

### Checking the exhaust system:

1. Check the exhaust system and all the components connected to it for tight fit:
  - Check all connections and screw connections for tight fit.
  - Check for leaks.
  - If there are leaks, contact service partner.

**Checking the fuel gas system:**

1. Check the gas pressure in the gas train
  - If necessary, replace the gas filter insert, see *Operating Manual, chapter Work instructions for the fuel system.*
2. Check the fuel gas system and all the components connected to it for leaks
  - If there are leaks, contact service partner.

**Checking the lube oil system:**

1. Visually inspect the lube oil system and all the components connected to it for leaks
  - [Visually inspecting the rubber expansion joints \[▶ 296\]](#)
  - If there are leaks, contact service partner.
2. Check the lube oil levels
  - Check the engine lube oil level.
  - Check the lube oil level of the daily oil tank, if present.
  - Check the lube oil level of the fresh oil tank, if present.
  - If a lube oil level is too low, top up with lube oil, see [Filling the lube oil system \[▶ 330\]](#).

**Checking the cooling system**

1. Visually inspect the cooling system and all the components connected to it for leaks
  - [Visually inspecting the rubber expansion joints \[▶ 296\]](#)
  - If there are leaks, contact service partner.

**Visually inspecting the compressed air system (optional)**

1. Drain the compressed air container and top it up
2. Visually inspect the compressed air system and all the components that are connected to it for leaks
  - If there are leaks, contact service partner.

**Checking the coupling**

1. Checking the coupling
  - [Visually inspecting the coupling \[▶ 467\]](#)
  - Check the coupling for noises
  - If there are increased or abnormal noises, contact service partner.

**Checking the transmission (optional)**

1. Check the transmission for smooth running and noises
  - If there are increased or abnormal noises, contact service partner.

2. Visually inspect the transmission for leaks
  - If there are leaks, contact service partner.
3. Check the service indicator on the lube oil filter
  - Clean the lube oil filter in case of a corresponding degree of contamination. Replace the lube oil filter if necessary.
4. Check the lube oil level
5. Check the lube oil pressure
  - In case of deviating lube oil pressure, contact service partner.
6. Check the lube oil temperature
  - In case of deviating lube oil temperature, contact service partner.

### **Checking the generator**

1. Check the generator for noises
  - If there are increased or abnormal noises, contact service partner.
2. If necessary, grease the generator rolling bearings, see *Operating Manual, chapter Work instructions for the genset*.
3. Check the sensors for proper functioning on the generator bearings
  - In case of strongly fluctuating or higher-than-average bearing temperatures, contact service partner.

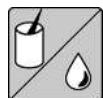
### **Checking the electrical system**

1. Check all connectors for correct fit
  - Tighten loose connectors.
  - Have damaged connectors replaced. Commission a qualified electrician.
2. Visually inspect all electrical cables and components for damage
  - Replace damaged cables. Commission a qualified electrician.
  - Repair or replace damaged components. Commission a qualified electrician.

## Cleaning the genset

Valid for:

TCG 3016



Auxiliary media:

- Cleaning agents
- Sealing plugs, covers
- Compressed air

### Preparing for cleaning:

- ✓ [Decommissioning the genset \[▶ 146\]](#)
- 1. Dismantle the housing covers (e.g. protective covers)
- 2. Dismantle the housing panels (e.g. heat insulating covers) of the exhaust pipes
- 3. Seal electric and electronic components or cover so that they are watertight
- 4. **NOTE! The genset can be damaged or destroyed due to improper preparation for engine cleaning.** Seal engine openings (e.g. air inlet) or cover so that they are waterproof
  - Particularly openings in the engine housing resulting from the dismantling of attachments.
- 5. Select cleaning agent, see *Operating Manual, chapter General, section Operating media regulations*

### Performing cleaning:

1. Spray the genset with cleaning agent
2. Dismantle protective covers and heat insulating covers and spray with cleaning agents
3. Wait for the reaction time specified by the manufacturer
4. **NOTE! Components can be damaged or destroyed due to cleaning with pressure cleaning systems. Do not use pressure cleaning systems. Lubricated components or components with grease filling (e.g. joints, bearings) can lose their lubrication protection or their grease filling. Sensitive components (e.g. sensors, rubber nozzles, sealing rings) can be damaged due to high pressures. Contact with cleaning agents can corrode internal components.** Spray the genset, dismantled housing covers and housing panels with strong water jet or wash off
5. If the desired cleanliness is not achieved, repeat the cleaning procedures.

**Ending the cleaning procedure:****DANGER**

Explosion due to gas formation or deflagration

This can lead to severe injuries and even death.

- Thoroughly dry the housing covers and housing panels before mounting.
- 1. Carefully blow off the accumulated water with compressed air
- 2. Remove covers from electric and electronic components
- 3. Remove covers and seals from engine openings
- 4. Dry and mount the housing covers (e.g. heat insulating coverings of the exhaust lines)
- 5. Dry and mount the housing covers (e.g. protective covers)
- 6. Mount all safeguards and check that they are working correctly.
- 7. [Commissioning the genset \[▶ 134\]](#)

## Performing a test run

Valid for:  
TCG 3016

### Description of the test runs

There are two types of test runs:

- Function test runs without load to check the control and proper stopping of the engine
- Load test runs with load to check the proper functioning of the genset

Perform a load test run with load at the latest after ten function test runs without load.

Conduct a load test run after you have carried out all the repair work (e.g. replacing pistons, cylinder liners). If this is not possible, perform a function test run. You must perform a load test run at the latest before (re)commissioning.

#### Starting the genset:

1. Check on the control whether the genset is operational.
2. Check the lube oil level
  - If necessary, top up lube oil to the MAX mark
3. [Starting the genset \[▶ 143\]](#)
4. **NOTE! If the engine runs into overspeed, the genset can be severely damaged.**  
Immediately press the emergency stop button and stop the genset.
  - Contact service partner.

#### Performing a function test run:

1. On the control, check whether the engine runs at a constant speed without load
2. On the control, check for correct functioning of all displays and control functions.
3. During the function test run [Visually inspecting the genset \[▶ 192\]](#)
4. If irregularities occur, stop the genset. See [Stopping the genset \[▶ 144\]](#)
5. Find and eliminate the root cause of the irregularity
  - If you have to work on the genset, [Decommissioning the genset \[▶ 146\]](#)
6. Repeat the function test run

#### Perform a load test run

---

#### NOTE

- Allow for a duration of at least one hour for the load test run.
-

1. Perform a load test run
  - Operate the engine with at least 40 % of the maximum load.
  - Increase the engine load by 10 % every ten minutes until 100 % load is reached.
2. During the load test run [Visually inspecting the genset \[▶ 192\]](#)
3. If irregularities occur, stop the genset. See [Stopping the genset \[▶ 144\]](#)
4. Find and eliminate the root cause of the irregularity
  - If you have to work on the genset, [Decommissioning the genset \[▶ 146\]](#)
  -
5. Repeat the load test run

### Stopping the engine

1. Stop the engine, see [Stopping the genset \[▶ 144\]](#)
2. [Visually inspecting the genset \[▶ 192\]](#)
3. **NOTE! The control for the pump run-on only functions if the control stops the engine. Never stop the engine using an emergency stop.** If available, check the function of the residual heat removal control, see [Heating circuit \(HC\) and engine cooling circuit \(ECC\) auxiliary drive test \[▶ 222\]](#)

## Performing test run and function run

Valid for:  
TCG 3016, TCG 3020

### General information

Perform a test run and function run after all work for maintenance and repair. If any irregularities occur during the test run and function run, [Decommissioning the genset](#) [▶ 146].

The operation values are specified in the commissioning report. If a commissioning report is not available, use the report from the test bench inspection.

The test run and function run last at least one hour.

### Starting the genset:

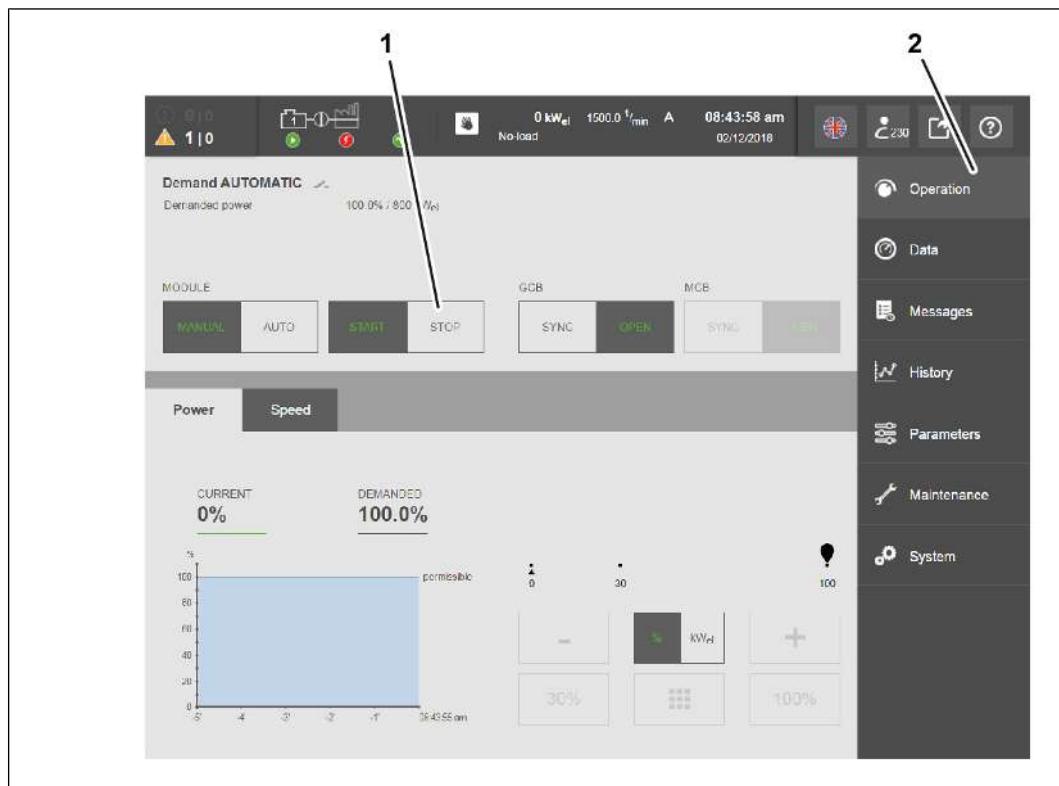


306249739: Abbreviations used: GCB SYNC

1. Press functional group Operation (4).
2. Tap the MANUAL (1) button.
  - Manual operation is set.
3. Tap the START (3) button.
  - The genset starts.

4. Tap the GCB SYNC (4) button
  - The synchronization starts.
5. Wait until the power demand 50.0 % is reached in the Power (2) dialog area.
6. Tap the + (6) button until the power demand 100.0 % is reached in the Power dialog area.
  - The genset progresses over the power ramp to 100.0 % power or to the power permissible for the operation.
7. If the maximum power is reached, document the operation values and compare them to the values in the commissioning report or in the test bench report.
  - In the event of warnings or fault messages, find and eliminate the cause before putting the genset back into operation. If in doubt, contact service partner.

#### Stopping the genset after the test run and function run:



306254603

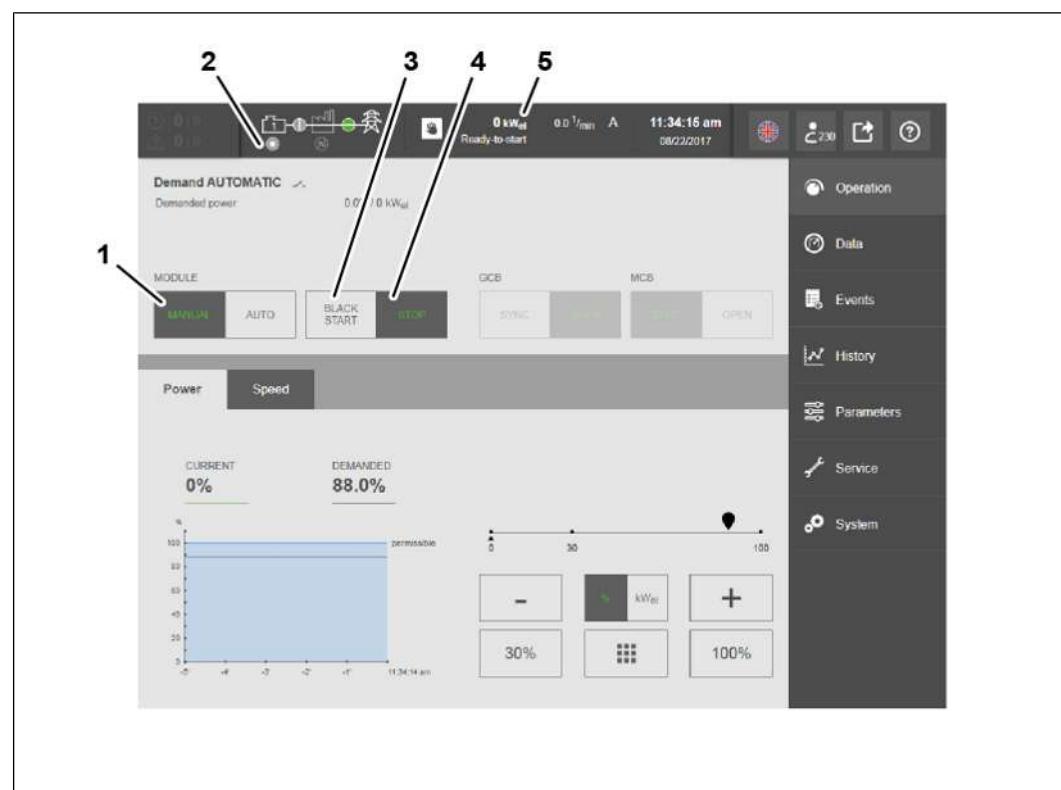
1. Press functional group Operation (2).
2. Tap the STOP (1) button.
  - The engine is stopped.
3. Check whether all the auxiliary drives are functioning and running properly, see [Performing the auxiliary drive test \(TPEM\) \[▶ 202\]](#)
4. Then perform a visual inspection, see [OL-MRA10 / 00-02-03 Visually inspecting the genset \[▶ 192\]](#)

## Performing black start

Valid for:  
TCG 3016, TCG 3020

### Procedure to follow:

- ✓ 24 V voltage supply
- ✓ Demand contact 179 on the [TPEM I/O Controller](#) closed (customer side)
- ✓ Parameter 20105303 Black start possible activated, see *Operating Manual chapter Operation, TPEM Operating manual*



306600459

1. In the functional group **Operation**, tap the button **MANUAL** (1)
2. Manual operation is activated.
3. Tap the **BLACK START** (3) button
  - The engine performs the black start automatically.
  - Black start is displayed in the status bar (2).
  - The electric power (5) is displayed in the status bar (2).
4. To end the Black start function, tap the **STOP** (4) button

## Performing the auxiliary drive test (TPEM)

### General information



#### Risk of destruction of components

Insufficient prelubrication can damage the engine.

- Allow the prelubrication pump to run for at least three minutes before every auxiliary drive test.

Some of the test steps listed in the following are optional depending on the engine variant and engine equipment.

The plant control only allows auxiliary drives to be tested if they are available and activated in the parameters. In some cases you can enter only odd values in the parameters for the maximum values:

- e.g. 6999 instead of 7000
- Or 1 % instead of 0 %

In the test mode the control checks whether the superior plant control correctly activates the individual auxiliary drives.

The test mode is only available under the following preconditions:

- Genset is stopped
- Manual operation is selected
- Quick stop function is not activated

No engine start is possible in test mode. You can only activate individual auxiliary drives (e.g. starter) via the Press and hold button for safety reasons. The auxiliary drive then only stays switched on for as long as the Press and hold button is pressed.

Some auxiliary drive tests contain visual and audio samples. To do this, the operator must be in the immediate vicinity of the genset.

If the touch panel is not installed in the immediate vicinity of the genset, these auxiliary drive tests must then be performed in pairs.

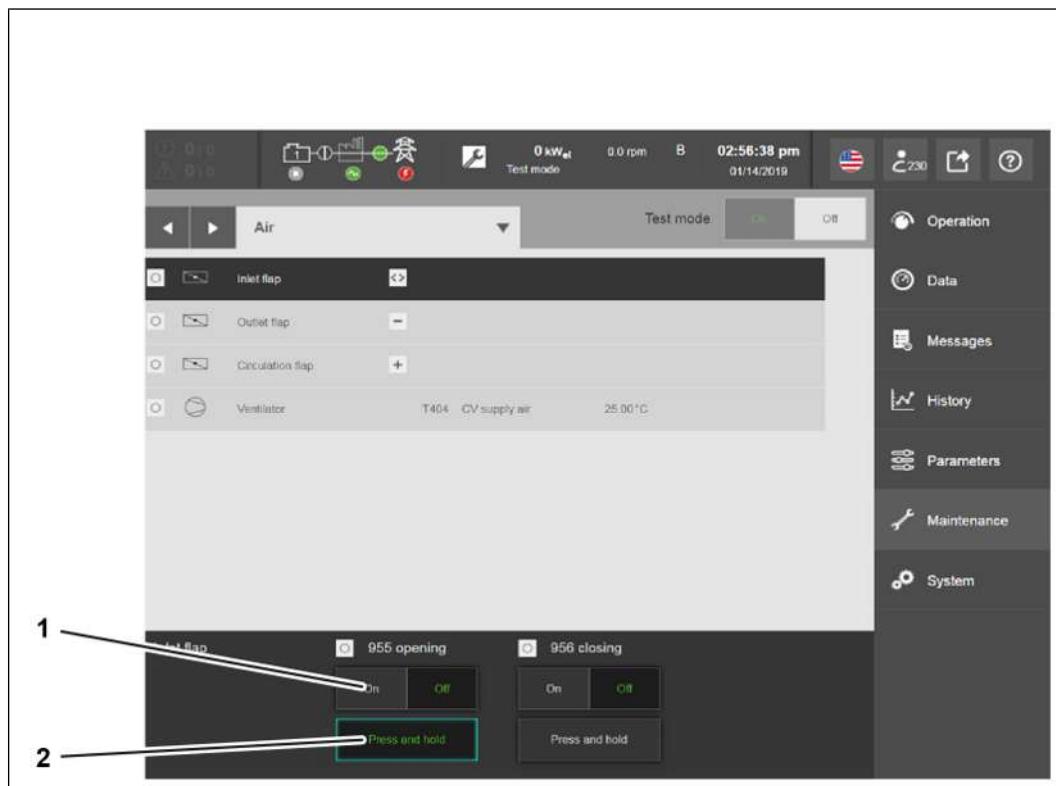
### Description of the buttons

Activated or activatable buttons have the following features:

- Cyan colored border
- Black button
- Green writing

Not activated or non-activatable buttons have the following features:

- Light gray or dark gray button
- Light gray or dark gray writing

**Information about the Press and hold button**

3122733451: Abbreviation used: CV

The Press and hold (2) button is active during some auxiliary drive tests. You can then also perform the required auxiliary drive test using the Press and hold (2) button. The Press and hold (2) button activates the relevant auxiliary drive only for as long as you keep pressing the Press and hold (2) button. To perform auxiliary drive tests for valves, radiators or pumps, you must move them to their end positions. In these cases, it is easier to perform the required auxiliary drive test using the On(1) button. The control system then automatically moves to the end positions.

The information provided for the individual auxiliary drive tests describes which button you can use to perform the relevant auxiliary drive test.

### Description of the test results and measured values

Symbol	Description	Function and meaning
	Red lightning bolt	Test result is not OK
	Green check mark	Test result is OK
	Gray rotation arrow	Check running (e.g. calibration)
	Plus sign	Actuator has reached the plus limit stop (e.g. rich, hot)
	Minus sign	Actuator has reached the minus limit stop (e.g. lean, cold)
	Double arrow	Actuator moves or stops between the limit stops

Table 15: Test result description symbols

**Selecting the auxiliary drive test, activating and deactivating the test mode:**

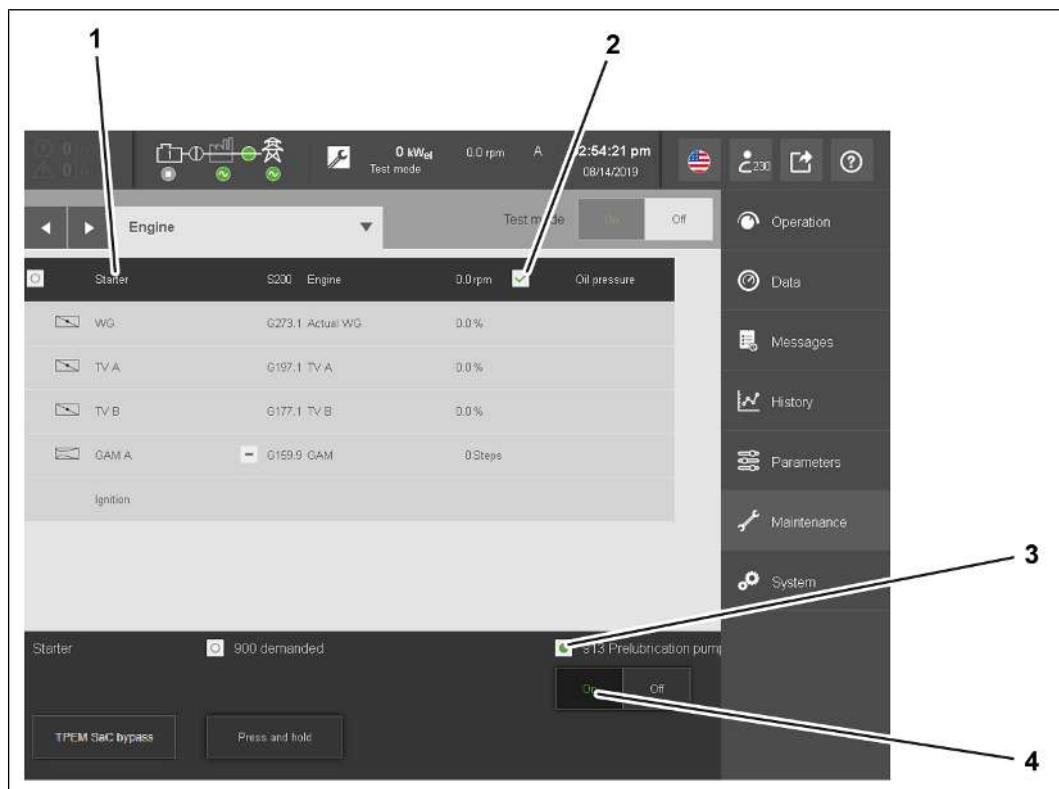
18014398812766091

1. Tap the Service (6) button.
  - The Engine auxiliary drive subgroup is open and the Starter line has a black background.
  - The Test mode dialog area shows the operating state (3) of the engine.
2. Select and open an auxiliary drive subgroup.
  - Tap the Engine (2) button, the pull-down menu opens.
  - Tap the desired auxiliary drive subgroup in the pull-down menu line.
  - The selected auxiliary drive subgroup opens.
  - Tap the buttons (1) to toggle between the individual auxiliary drive subgroups.
3. Tap the Test mode ON (4) button.
  - Test mode is activated.
4. Tap the Test mode OFF (5) button.
  - Test mode is deactivated.

## Engine auxiliary drive test

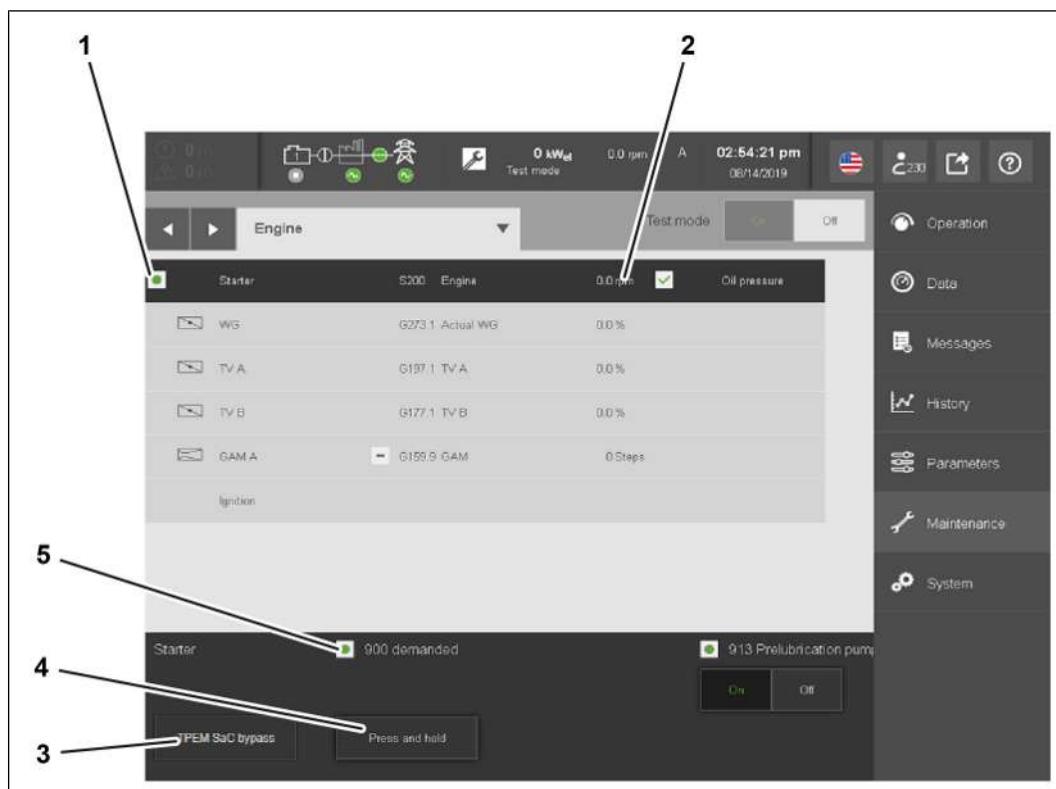
Valid for:  
TCG 3016, TCG 3020

### Checking the starter



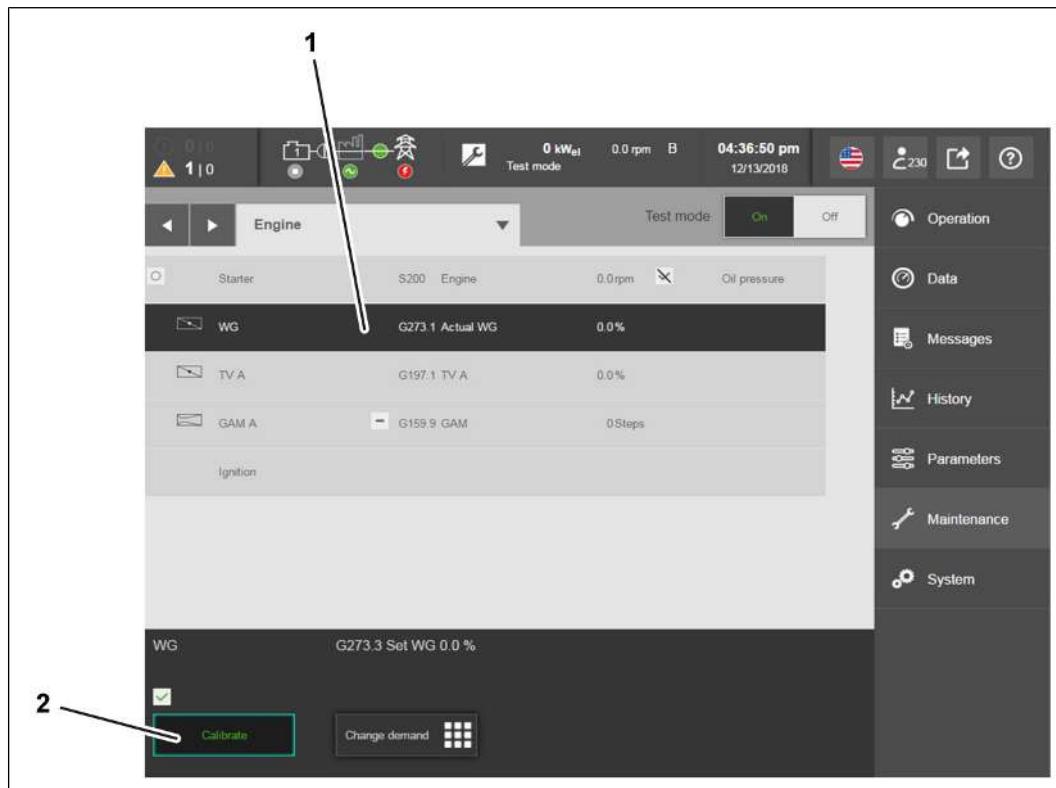
9007199557793163

1. Tap Starter (1) line in the pull-down menu
2. Press the On (4) button
  - A green dot (3) appears in the 913 Prelubrication pump dialog area. The output 114K1D06 is demanded.
  - When the required oil pressure is reached, a green check mark (2) appears in the Starter (1) dialog area.



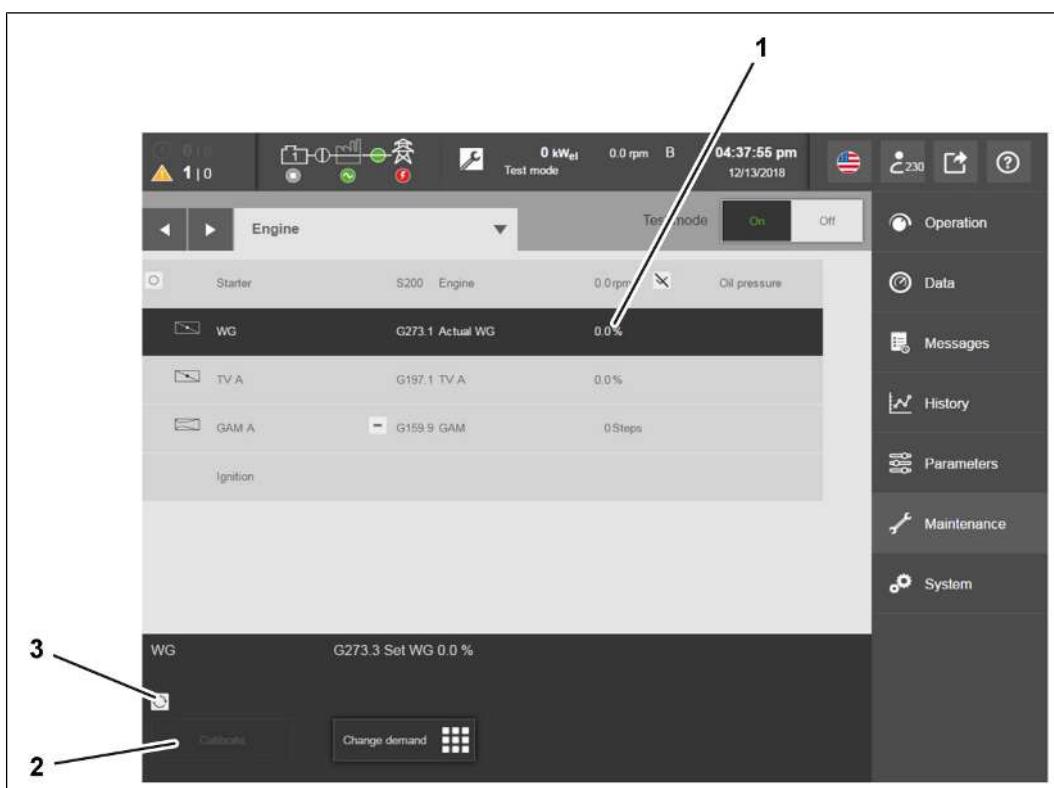
9007199558136203: Abbreviations used: TPEM SaC

3. The button **TPEM SaC bypass** (5) is activated. The auxiliary drive test **Starter** is activated.
4. Press the **Press and hold** (3) button and hold for a short time
  - A green dot (4) appears in the **Starter demanded** dialog area. The output **DO9 Module 60K4** is demanded.
  - A green dot (1) appears in the **Starter** dialog area.
  - When the speed display (2) changes in the **Starter** dialog area, the starter is functional. Otherwise, you must check the starter and replace it if necessary. For more information, contact the service partner.

**Performing wastegate calibration**

303411339: Abbreviations used: WG

1. Tap the WG (1) line in the pull-down menu
2. Tap the Calibrate (2) button



303573771

### 3. Wait for wastegate calibration

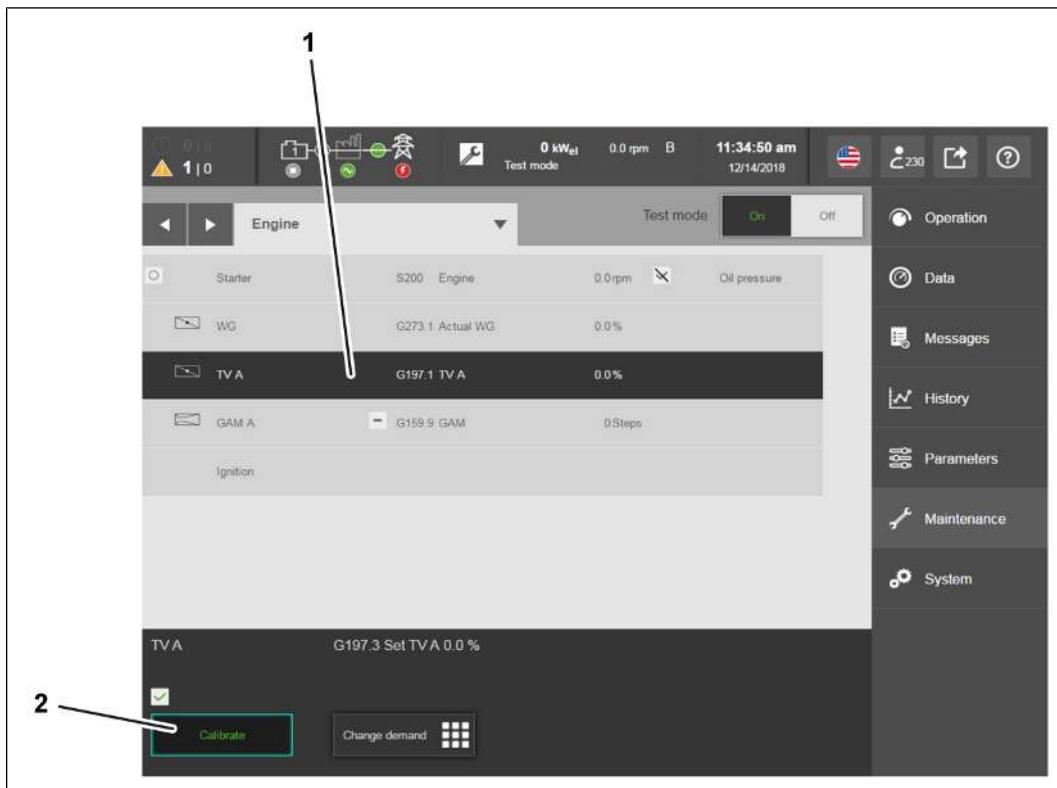
- The actuator conducts a calibration cycle. To do this, the actuator moves up from 0 % to 100 % (open) and back down to 0 % (closed).
- The Calibrate (2) button is grayed out during calibration.
- A percentage shows the wastegate presetting in the dialog area (1).
- A rotation arrow shows the duration of the calibration in the dialog area (3).
- The result of the check is displayed by a symbol in the dialog area (3)

### 4. If the result is not OK, contact service partner

## Calibrating throttle valve A

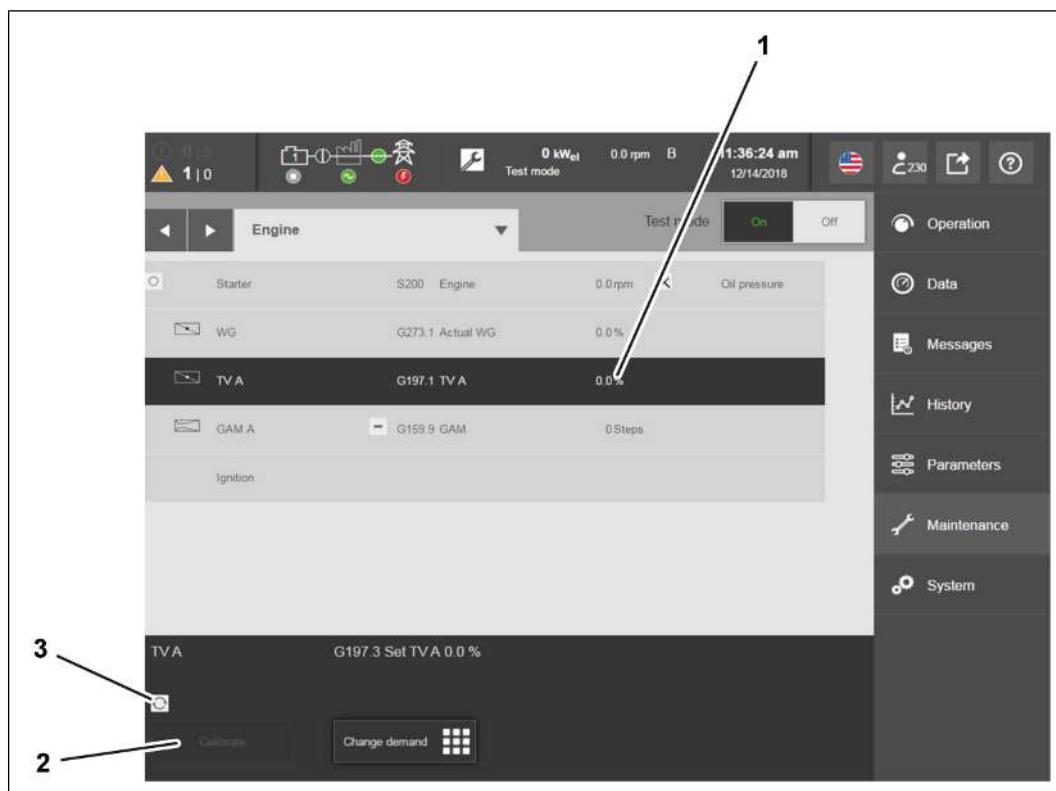
### NOTE

If available, perform the throttle valve B check according to the throttle valve A calibration.



303590411: Abbreviations used: TV

1. Tap the TV A (1) line in the pull-down menu
2. Tap the Calibrate (2) button



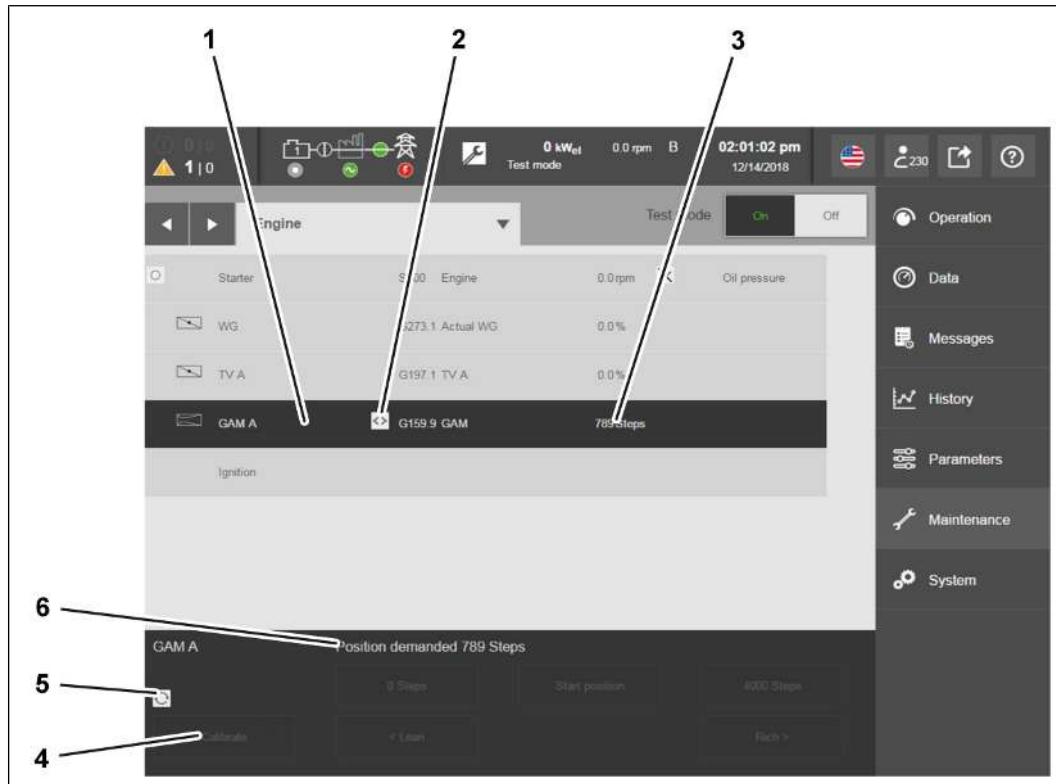
303637771

3. Wait for calibration of throttle valve A

- The actuator conducts a calibration cycle. To do this, the actuator moves up from 0 % to 100 % (open) and back down to 0 % (closed).
- The Calibrate (2) button is grayed out during calibration.
- A percentage shows the throttle valve A presetting in the dialog area (1).
- A rotation arrow shows the duration of the calibration in the dialog area (3).
- The result of the check is displayed by a symbol in the dialog area (3)

4. If the result is not OK, contact service partner

### Calibrating gas-air mixer A



303652491: Abbreviations used: GAM

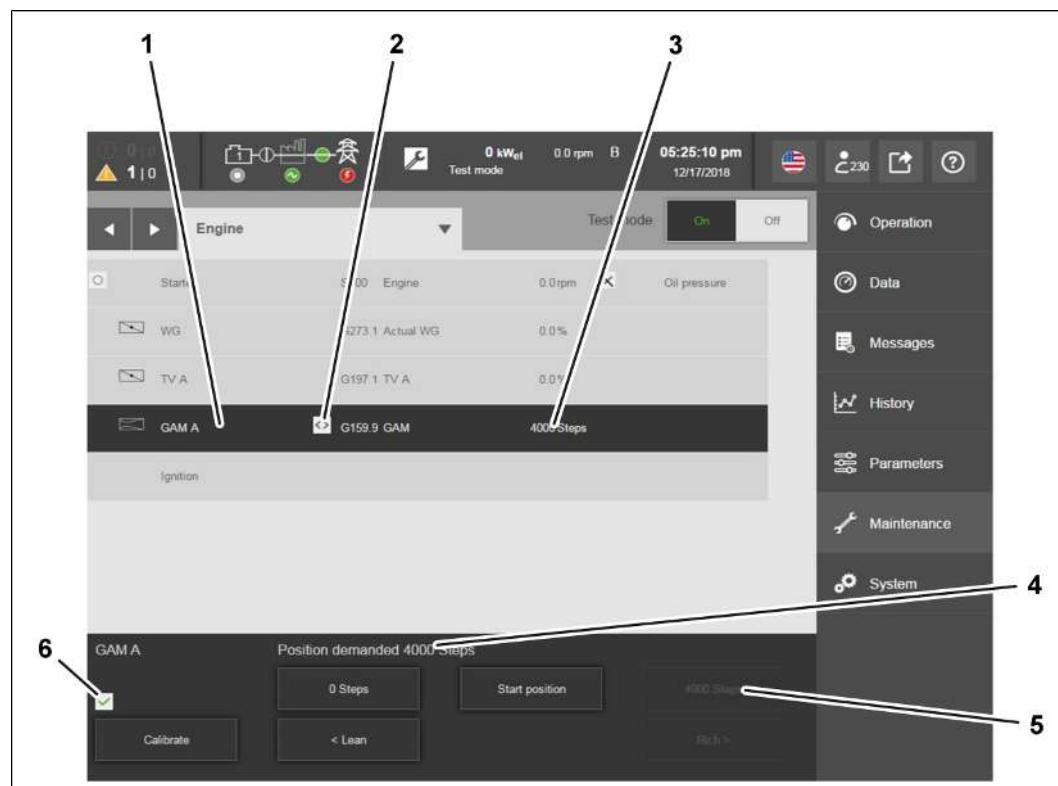
1. Tap the GAM A (1) line in the pull-down menu
2. **NOTE! You must calibrate the gas-air mixer before starting the test. The gas-air mixer moves up to a maximum of 4000 Steps. A non-calibrated gas-air mixer can move the 4000 Steps in addition to its actual start position. At an actual start position of 500 Steps, for example, the gas-air mixer tries to move an additional 4000 Steps. The gas-air mixer gets stuck. In this case, you must remove the gas-air mixer and make it move again.** Calibrating gas-air mixer A
  - Tap the Calibrate (4) button. The Calibrate (4) button is grayed out during calibration.
  - The display of the start position, e.g. 789 Steps, set in the parameters appears in the Position demanded (6) dialog area.
  - The gas-air mixer moves from its current position to the 0 Steps position.
  - The gas-air mixer moves from position 0 Steps to the start position, e.g. 789 Steps, set in the parameters.
  - A rotation arrow (5) appears in the GAM A dialog area during calibration.
  - The dialog area GAM A shows the start position of the gas-air mixer in Steps (3).
  - The position of the gas-air mixer is indicated by a symbol (2) in the GAM A dialog area.

## Checking the gas-air mixer A stop position

### NOTE

If available, perform the gas-air mixer B check according to the gas-air mixer A check.

Before you check the stop position, you must calibrate the gas-air mixer, see section *Calibrating the gas-air mixer*.



303681675

1. Tap the 4000 Steps (5) button

- Observe gas-air mixer A via the inspection window to see whether it adjusts itself in the rich direction.
- The 4000 Steps display appears in the Position demanded (4) dialog area.
- Gas-air mixer A moves to the Rich position.
- The position of the gas-air mixer is indicated by a symbol (2) in the GAM A dialog area.
- The dialog area GAM A shows the position of the gas-air mixer in Steps (3).
- A symbol (6) shows the result of the check in the GAM A dialog area.

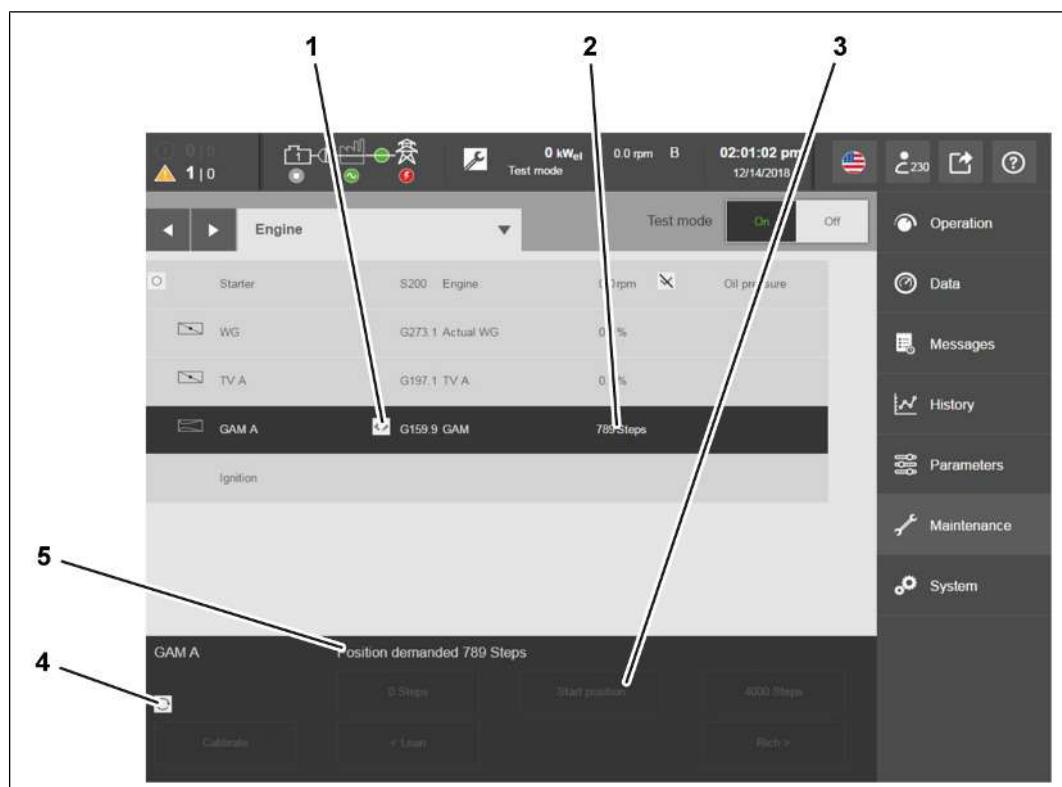
**NOTE**

- If a red lightning bolt appears in the GAM A dialog area, repeat the auxiliary drive test for the gas-air mixer A start position.
- If a red lightning bolt also appears in the GAM A dialog area when the auxiliary drive test is repeated, contact service partner

**Checking the gas-air mixer A start position****NOTE**

If available, perform the gas-air mixer B check according to the gas-air mixer A check.

Before you check the start position, you must calibrate the gas-air mixer, see section *Calibrating the gas-air mixer*.



303712267

1. Tap the Start position (3) button

- Observe gas-air mixer A via the inspection window to see whether it adjusts in the lean direction.
- Gas-air mixer A moves to the Lean position.
- The 0 Steps display appears in the Position demanded (5) dialog area.
- The position of the gas-air mixer is indicated by a symbol (1) in the GAM A dialog area.

- The GAM A dialog area shows the position of the gas-air mixer in Steps (2).
- A symbol (4) shows the result of the check in the GAM A dialog area

#### NOTE

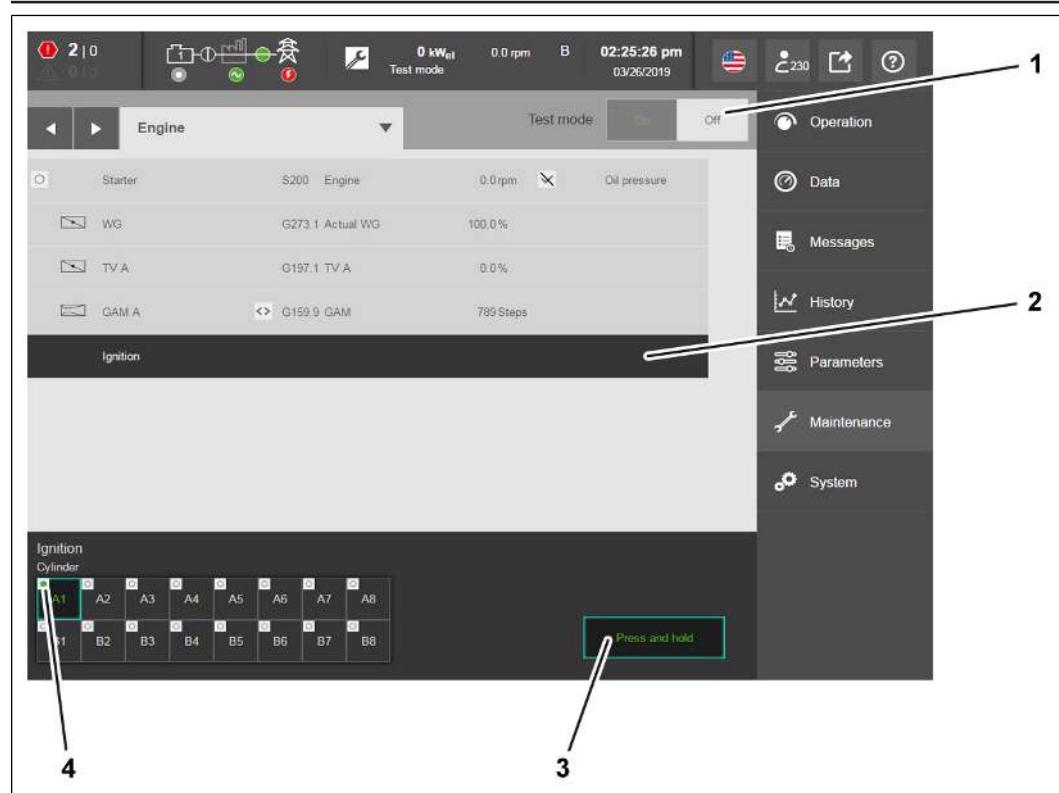
If a red lightning bolt appears in the GAM A dialog area, repeat the auxiliary drive test for the gas-air mixer A start position. If a red lightning bolt also appears in the GAM A dialog area when the auxiliary drive test is repeated, contact service partner.

#### Checking the ignition

#### NOTE

The engine variant determines the number of cylinders. Perform the ignition check for each displayed cylinder.

- Perform the test for the other cylinders according to the ignition check for cylinder A1.



304259723

1. Tap the Ignition (2) line in the pull-down menu
2. Tap the A1 (4) button
  - The ignition check is activated for cylinder A1.

3. Press the Press and hold (3) button and hold for a short time
    - A green dot (3) appears in the A1 button. The main control device controls the ignition coil.
    - The font color in the A1 button changes from white to green.
    - **DANGER! Risk of fatal injuries from high-voltage ignition coils. All work on ignition bars and ignition coils must only be performed by qualified electricians.** If the result is not OK, there is no voltage on the ignition coil. Contact the service partner.
  4. Repeat the ignition check for all the other cylinders.
  5. If you do not want to carry out any more auxiliary drive tests, press the Test mode OFF (1) button.
  6. If you want to perform additional auxiliary drive tests, select and open the next auxiliary drive subgroup.
  7. If you do not want to carry out any more auxiliary drive tests, press the Test mode OFF (1) button.
- ⇒ The auxiliary drive test is finished.

## Gas train (GTR) auxiliary drive test

Valid for:

TCG 3016, TCG 3020

### Checking the GTR A gas shut-off valves:

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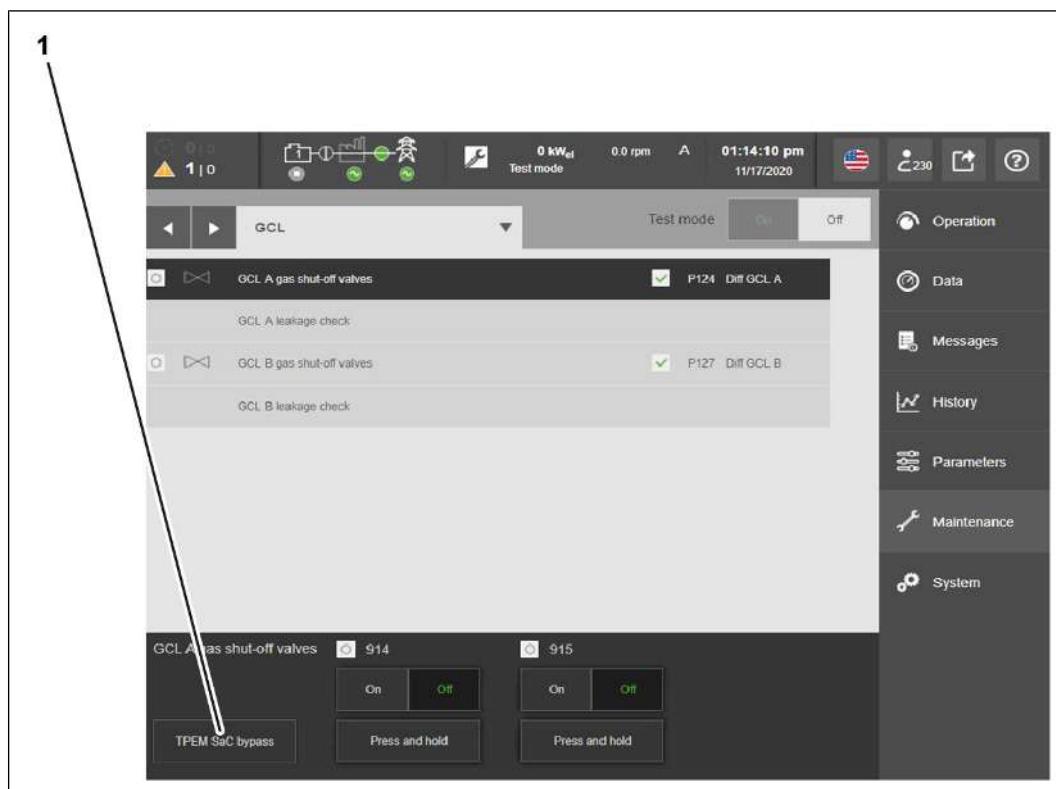
#### NOTE

The control displays the auxiliary drive test for additional gas shut-off valves for dual gas operation only.

Perform the check for all additional gas shut-off valves according to the check of the **GTR A** gas shut-off valve.

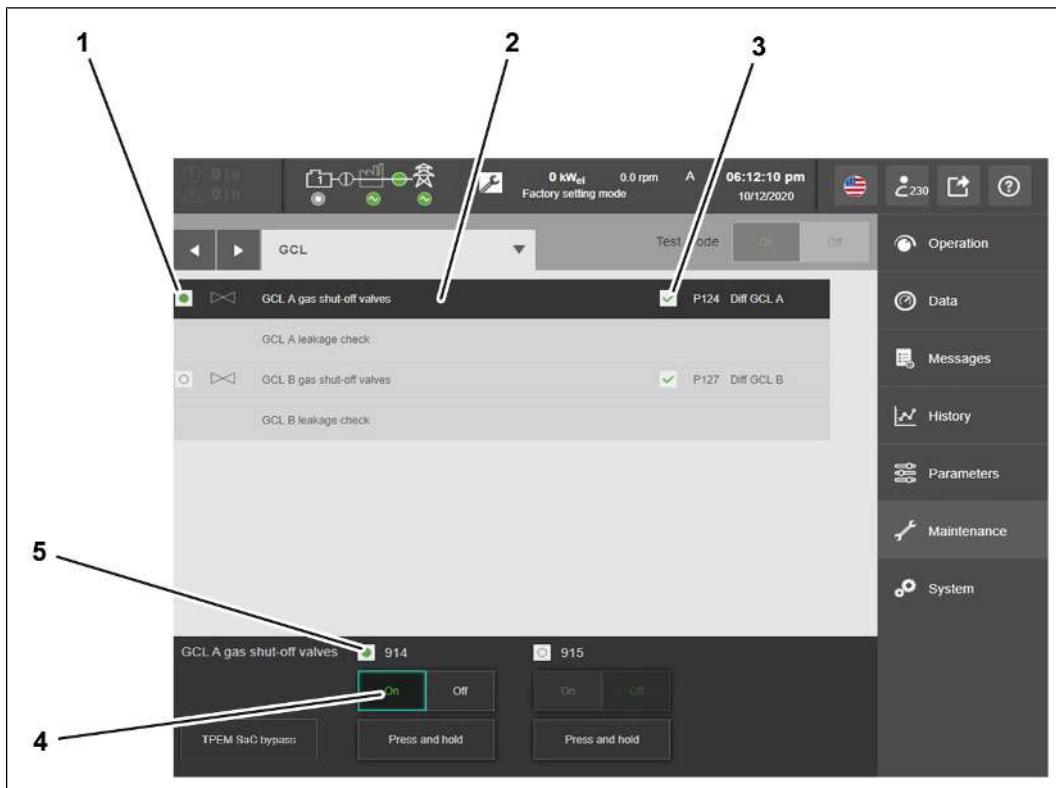
The following outputs are used on the central unit for the GTR B gas shut-off valve:

- Tapping the On button will select the outputs 50K6 and 50K7.
- If the TPEM SaC bypass function is active, the outputs 47Q7 and 47Q8 will be selected.



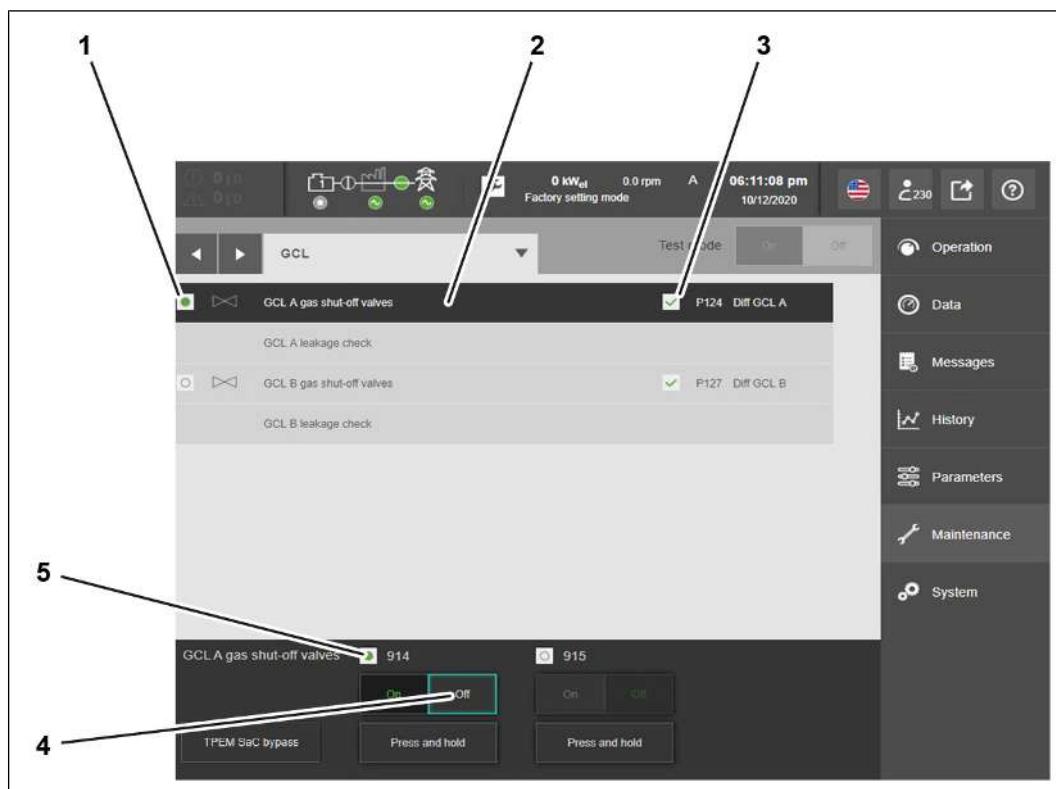
304290187

1. Check whether the TPEM SaC bypass (1) button is activated
  - If the TPEM SaC bypass (1) button is not activated, check oil pressure.
  - Activate prelubrication pump if necessary, see [Engine auxiliary drive test \[▶ 206\]](#).



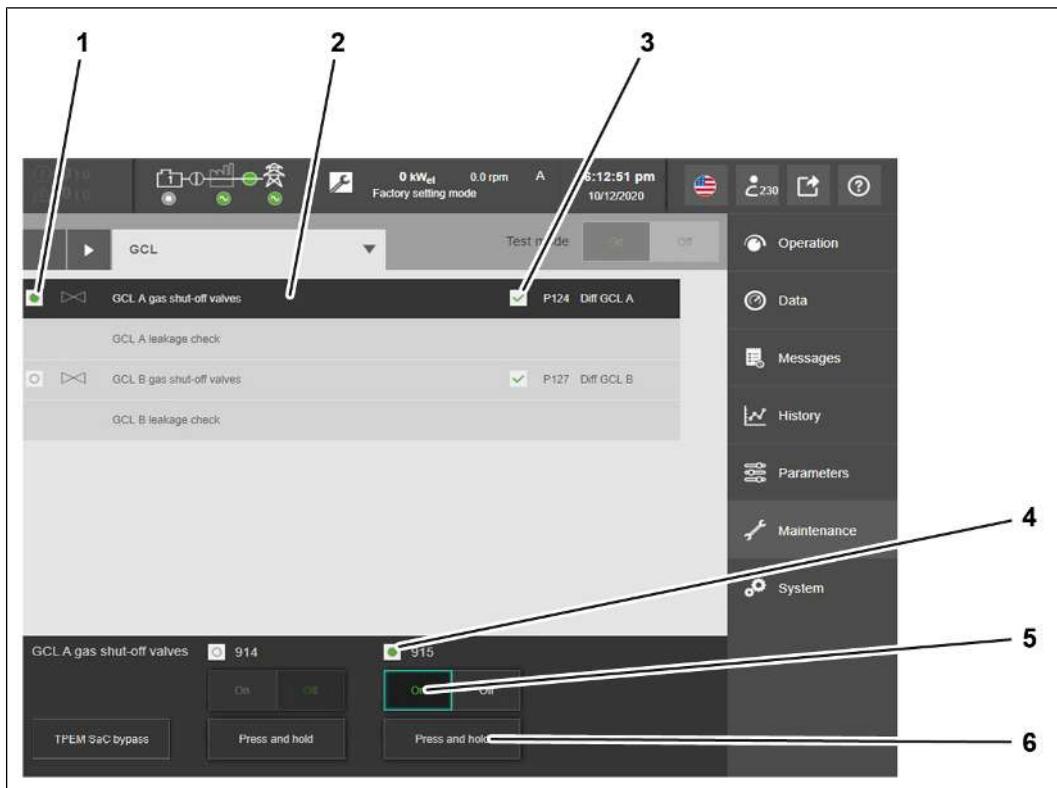
304303627: Abbreviations used: Diff GTR

2. Tap the GTR A gas shut-off valves (2) line in the pull-down menu.
  - A green check mark (3) appears in the P124 Diff GTR A dialog area.
3. **NOTE! You can only activate one solenoid valve at a time. While the solenoid valve is activated, the other solenoid valve is deactivated. You can touch the deactivated solenoid valve. When you touch the deactivated solenoid valve, the solenoid valve opens audibly and noticeably in terms of tactile perception.** Tap the On (4) button
  - The font color in the On (4) button changes from white to green.
  - A green dot (1) appears in the GTR A gas shut-off valves (2) dialog area.
  - A green dot (5) appears in the GTR A gas shut-off valves 914 dialog area. The output 50K4 is demanded in the central unit.
  - If the TPEM SaC bypass function is active, the output 46Q7 is demanded.
  - The solenoid valve opens audibly and noticeably in terms of tactile perception.



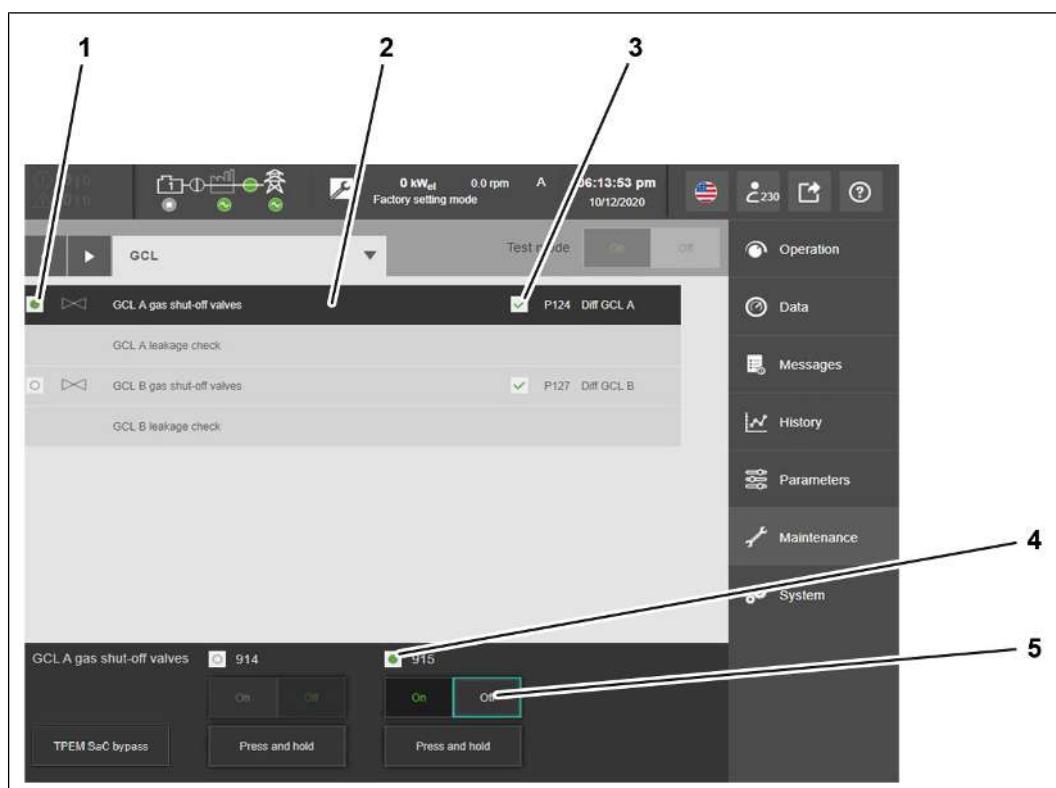
304329867

4. Press the **Off** (4) button.
  - The font color in the **Off** (4) button changes from white to green.
  - The green dot (1) disappears from the GTR A gas shut-off valves (2) dialog area.
  - A green check mark (3) appears in the P124 Diff GTR A dialog area.
  - The green dot (5) disappears from the GTR A gas shut-off valves 914 dialog area. The output 50K4 is no longer demanded in the central unit.
  - If the TPEM SaC bypass function was active, the output 46Q7 is no longer demanded.



304356107

5. Tap the GTR A gas shut-off valves (2) line in the pull-down menu.
  - A green check mark (3) appears in the P124 Diff GTR A dialog area.
6. Press the On (5) button.
  - The font color in the On (5) button changes from white to green.
  - A green dot (1) appears in the GTR A gas shut-off valves (2) dialog area.
  - A green dot (5) appears in the GTR A gas shut-off valves 914 dialog area. The output 50K5 is demanded in the central unit.
  - If the TPEM SaC bypass function is active, the output 46Q8 is demanded.
7. Press the Press and hold (6) button and hold for a short time.
  - The solenoid valve switches audibly and noticeably in terms of tactile perception.



304382347

8. Tap the Off (6) button.

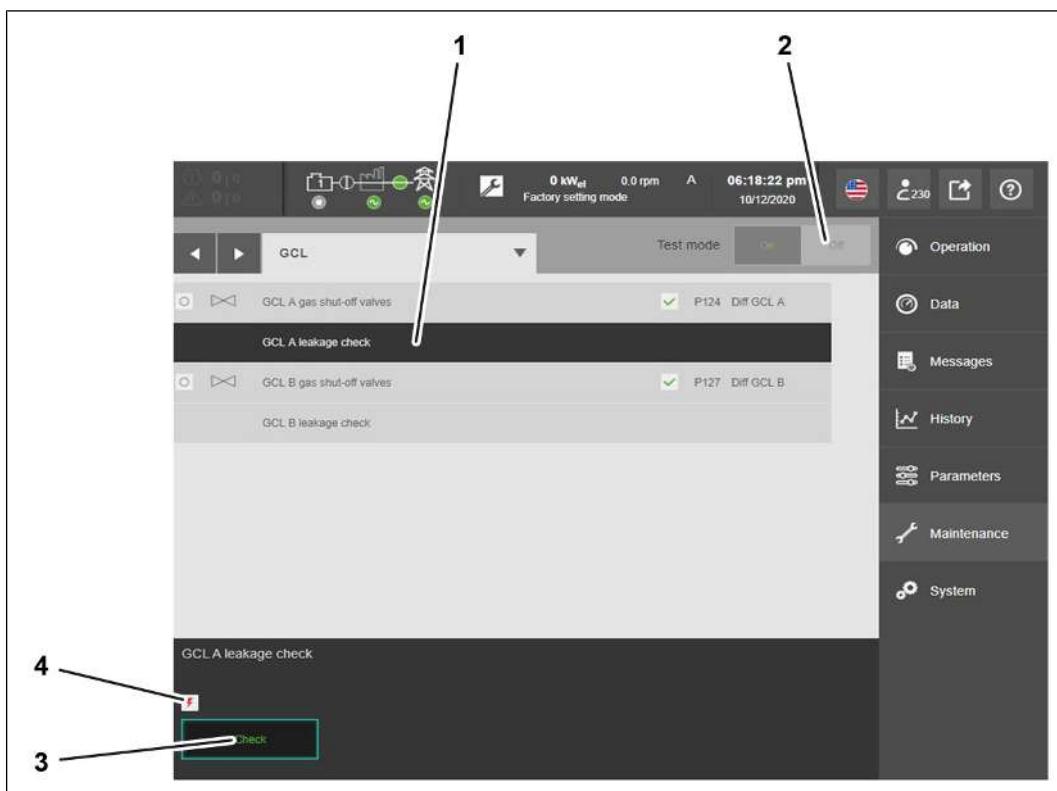
- The font color in the Off (6) button changes from white to green.
- The green dot (1) disappears from the GTR A gas shut-off valves (2) dialog area.
- A green check mark (3) appears in the P124 Diff GTR A dialog area.
- The green dot (5) disappears from the GTR A gas shut-off valves 914 dialog area. The output 50K5 is no longer demanded in the central unit.
- If the TPEM SaC bypass function was active, the output 46Q8 is no longer demanded.

#### Valve proving system for the GTR A gas shut-off valves:

##### NOTE

The control displays the auxiliary drive test for additional gas shut-off valves for dual gas operation only.

Perform the check for all additional gas shut-off valves according to the check of the GTR A gas shut-off valve.



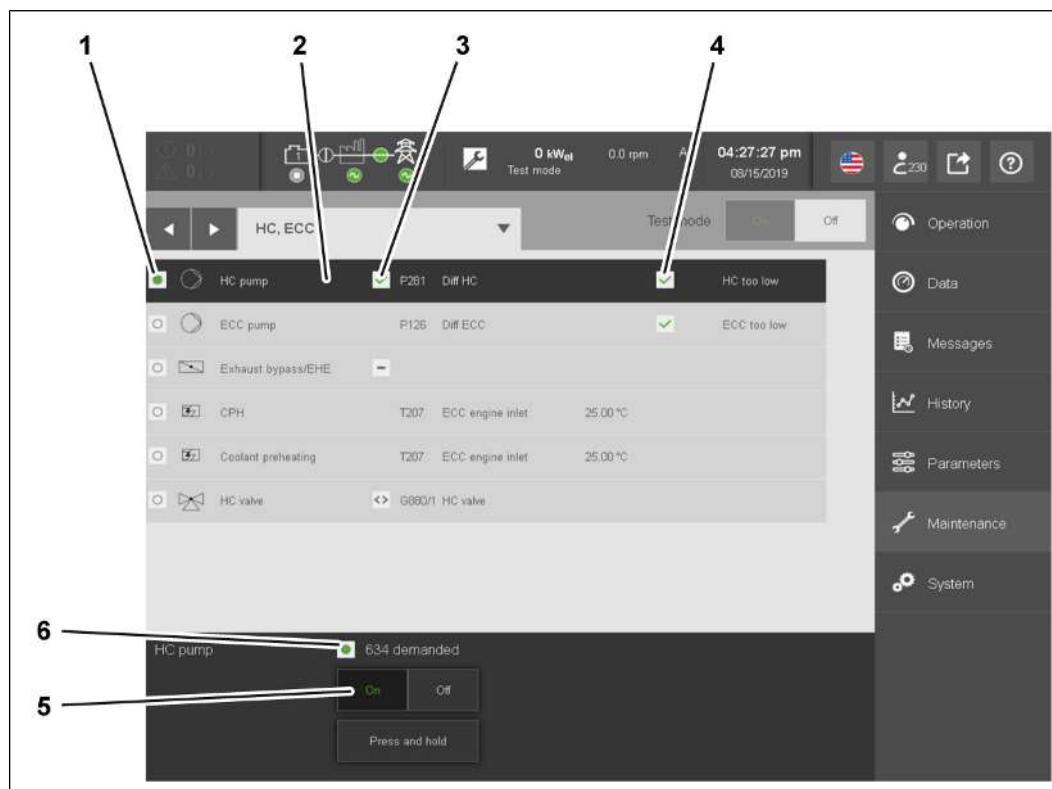
304395787

1. Tap the GTR A leakage check (1) line in the pull-down menu.
2. Tap the Check (3) button.
  - Wait for the check result. The check can take up to 90 seconds.
  - The result of the check is indicated by a symbol (4) in the GTR A leakage check dialog area.
3. If the result is not OK, contact the service partner.
4. If you want to perform additional auxiliary drive tests, select and open the next auxiliary drive subgroup.
5. If you do not want to perform any more auxiliary drive tests, press the Test mode OFF (2) button.
  - ⇒ The auxiliary drive test is finished.

## Heating circuit (HC) and engine cooling circuit (ECC) auxiliary drive test

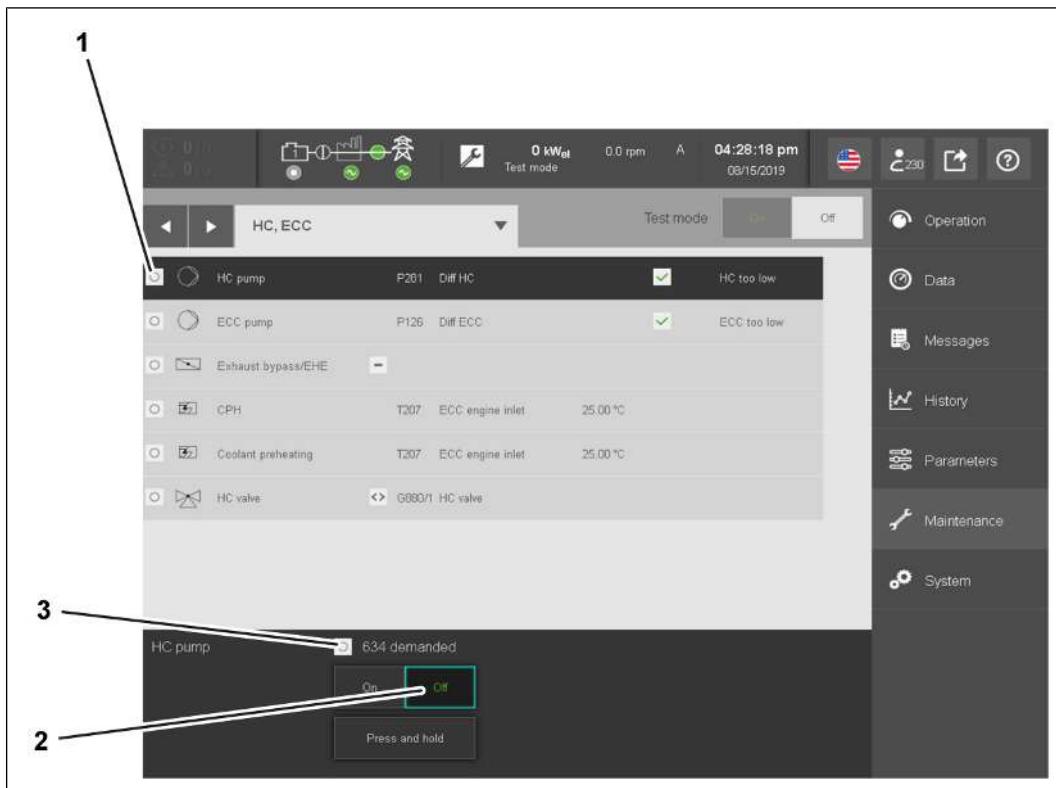
Valid for:  
TCG 3016, TCG 3020

### Checking the heating circuit pump



304428427: Abbreviations used: HC, Diff HC

1. Tap the HC pump (2) line in the pull-down menu.
  - A green check mark appears in the L280 HC too low (4) dialog area. The liquid level is OK. You can start the auxiliary drive test.
  - A red lightning bolt appears in the L280 HC too low (4) dialog area. The liquid level is not OK. Find and correct the root cause of the low liquid level before starting the auxiliary drive test. If necessary, contact the service partner.
2. Press the On (5) button.
  - The font color in the On (5) button changes from white to green.
  - A green dot (1) appears in the HC pump (2) dialog area.
  - A green dot (6) appears in the HC pump 634 demanded dialog area. The output 114K1D08 is demanded.
3. Check the function and direction of rotation of the pump.
  - A green check mark (3) appears in the P281 Diff HC dialog area. The flow monitor measures the differential pressure. The pump is running.
  - Visually inspect the direction of rotation. If the direction of rotation of the pump is incorrect, contact your service partner.
  - A red check mark (3) appears in the P281 Diff HC dialog area. The differential pressure sensor does not measure any differential pressure. [Removing and installing the differential pressure sensor \[▶ 412\]](#).



304477707

4. Tap the **Off** (2) button.
  - The font color in the **Off** (2) button changes from white to green.
  - The green dot (3) disappears from the HC pump 634 demanded dialog area. The output 114K1D08 is no longer demanded.
  - The green dot (1) disappears from the HC pump dialog area.

#### **Checking the engine cooling circuit pump:**

---

##### **NOTE**

Perform the engine cooling circuit pump check according to the heating circuit pump check.

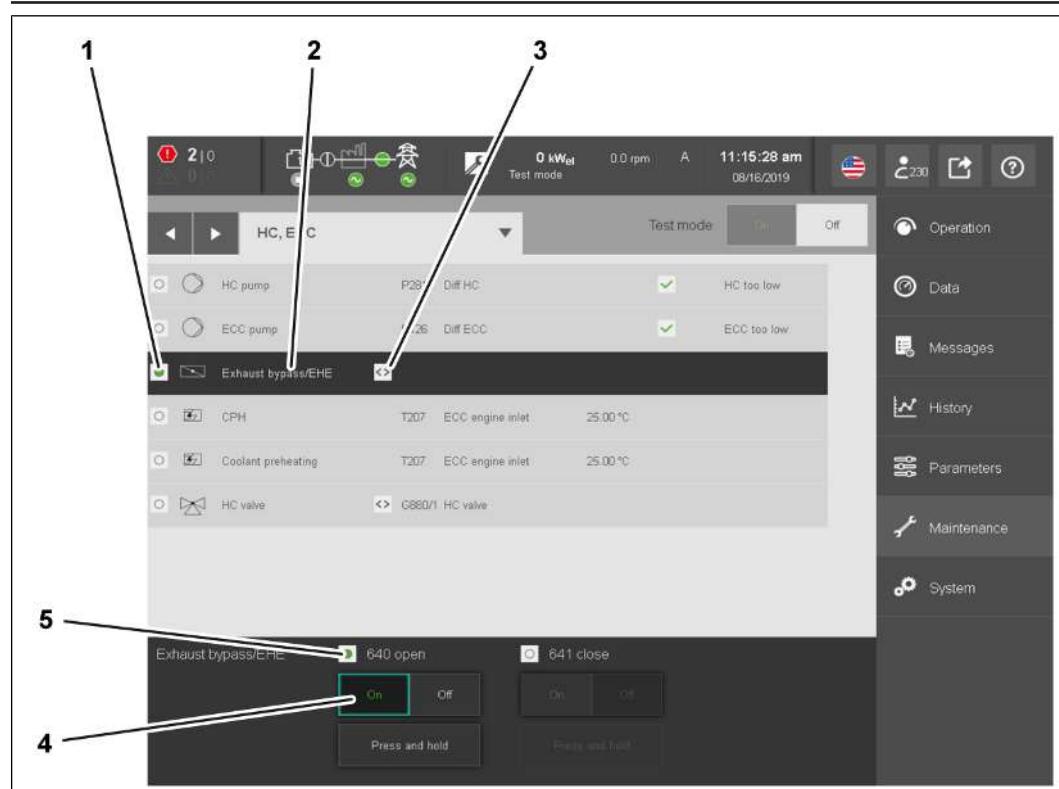
- The output 114K1D011 is demanded during the check.
-

## Checking exhaust bypass/EHE

### NOTE

Perform the check for the limit stop, minus (close) according to the check for the limit stop, plus (open).

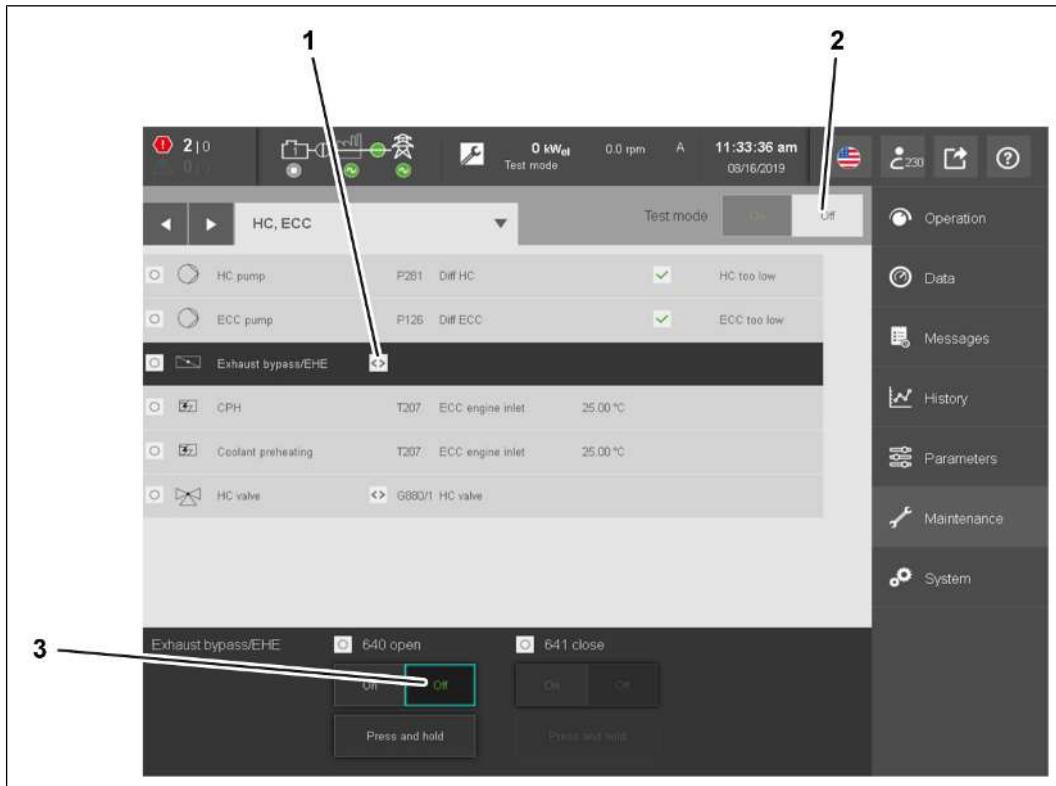
- The output 114K2D06 is demanded during the check.
- Check the activation of the engine cooling circuit pump during the exhaust bypass/EHE auxiliary drive test. Activation is indicated by a green dot in the ECC pump line.



9007199559291147: Abbreviations used: EHE

1. Tap the Exhaust bypass/EHE (2) line in the pull-down menu.
  - A green dot (2) appears in the Exhaust bypass/EHE dialog area.
2. Tap the On (4) button.
  - A double arrow (3) appears in the Exhaust bypass/EHE dialog area.
  - The font color in the On (4) button changes from white to green.
  - A green dot (5) appears in the Exhaust bypass/EHE 640 open (2) dialog area. The output 114K2D05 is demanded.
3. Check that the exhaust flap is working correctly.
  - Visually inspecting the wastegate [▶ 403]
  - A symbol (3) in the Exhaust bypass/EHE dialog area indicates the position of the exhaust flap.

- If the exhaust flap is not working correctly, contact your service partner.



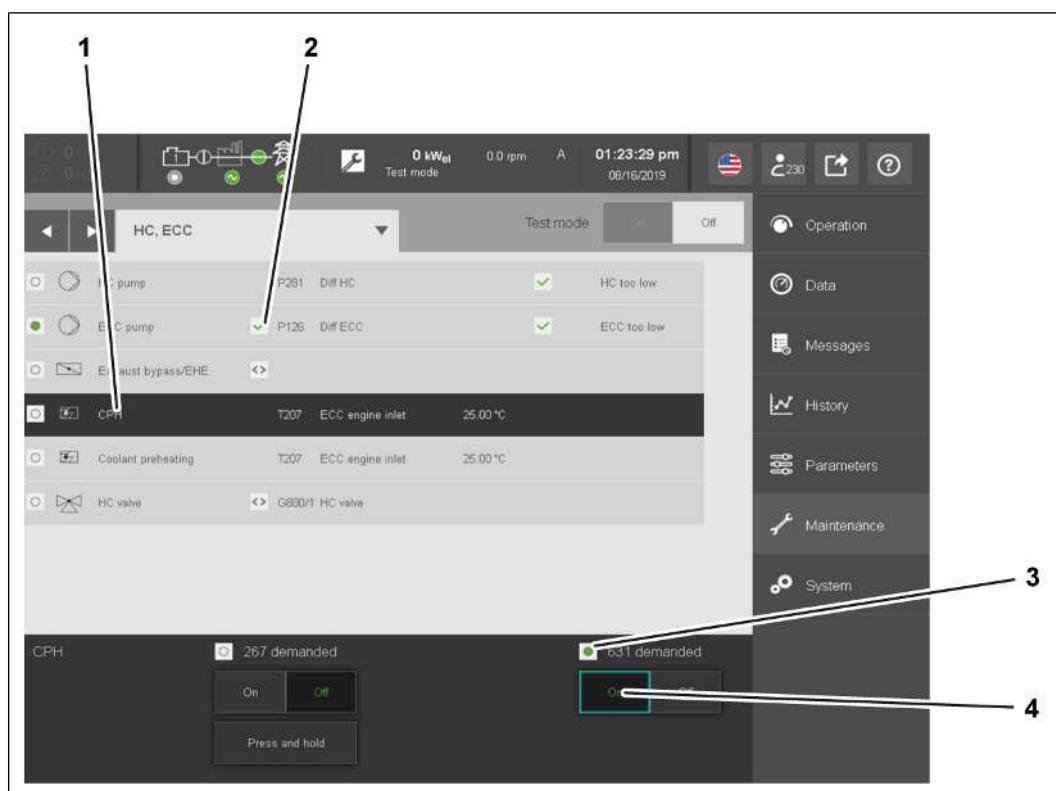
9007199559300875

4. Tap the **Off** (3) button.
  - The font color in the **Off** (3) button changes from white to green.
  - The position of the heating circuit valve is indicated by a symbol (1) in the **Exhaust bypass/EHE** dialog area.
  - The green dot (5) disappears from the **Exhaust bypass/EHE 640 open** (2) dialog area. The output **114K2D05** is no longer demanded.
5. If you do not want to perform any more auxiliary drive tests, press the **Test mode OFF** (2) button.
6. If you want to perform additional auxiliary drive tests, select and open the next auxiliary drive subgroup.

### Checking the CPH

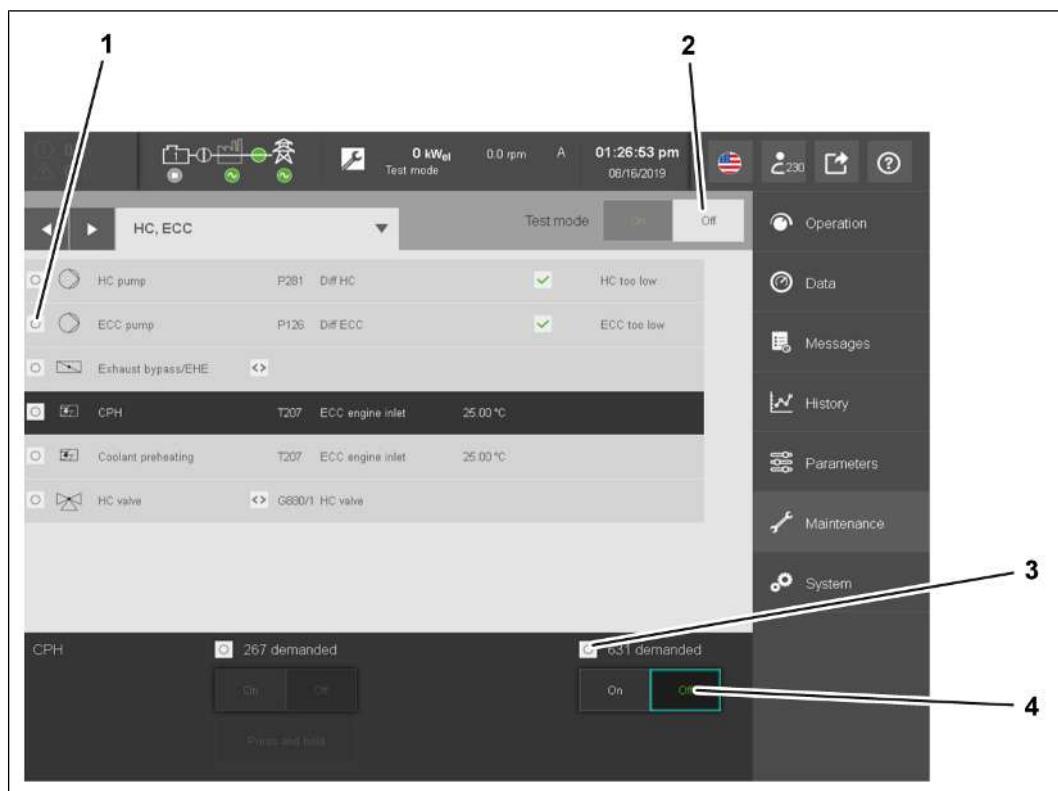
#### NOTE

- Check the activation of the engine cooling circuit pump during the exhaust bypass/EHE auxiliary drive test.
  - Activation will be indicated by a green dot in the **ECC pump** (2) line.
- The output **114K2D014** is demanded during the check.



304601611: Abbreviations used: CPH

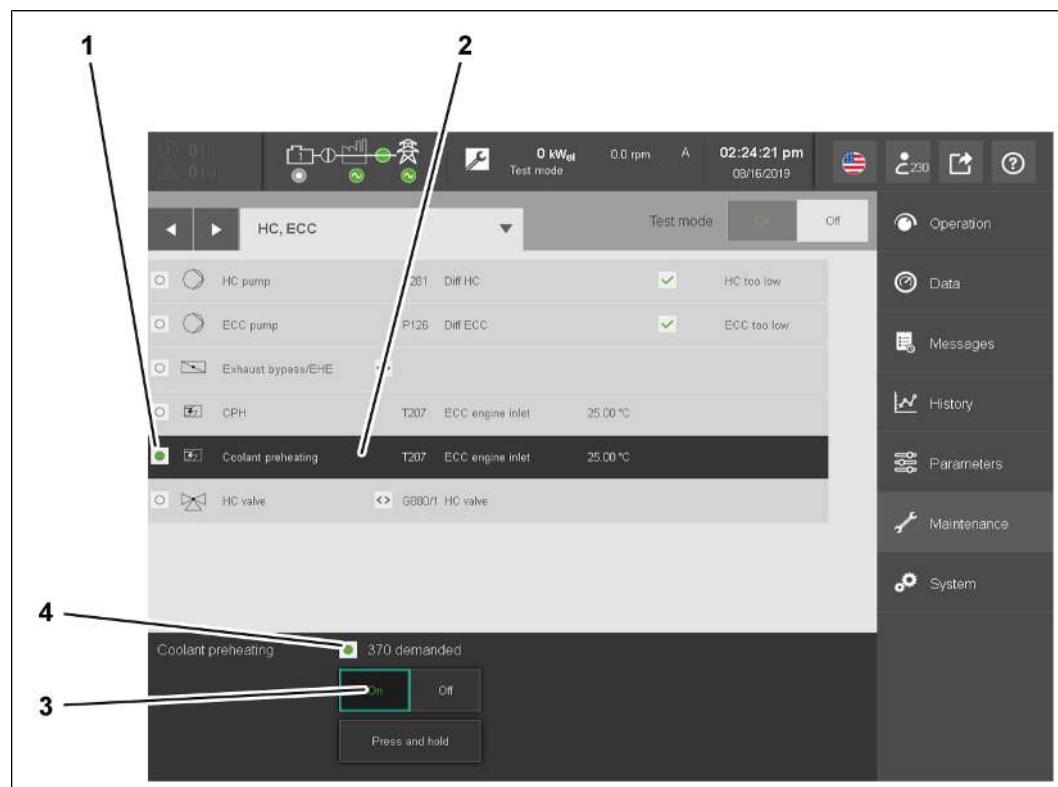
1. Tap the CPH (1) line in the pull-down menu
2. Tap the On (4) button.
  - The font color in the On (4) button changes from white to green.
  - A green dot (1) appears in the CPH (1) dialog area.
  - A green dot (3) appears in the 631 demanded dialog area. The output 114K1D011 is demanded.
3. Check whether the coolant lines are warming up.
4. If the coolant lines are not warming up, contact service partner.



304636171: Abbreviations used: ECC

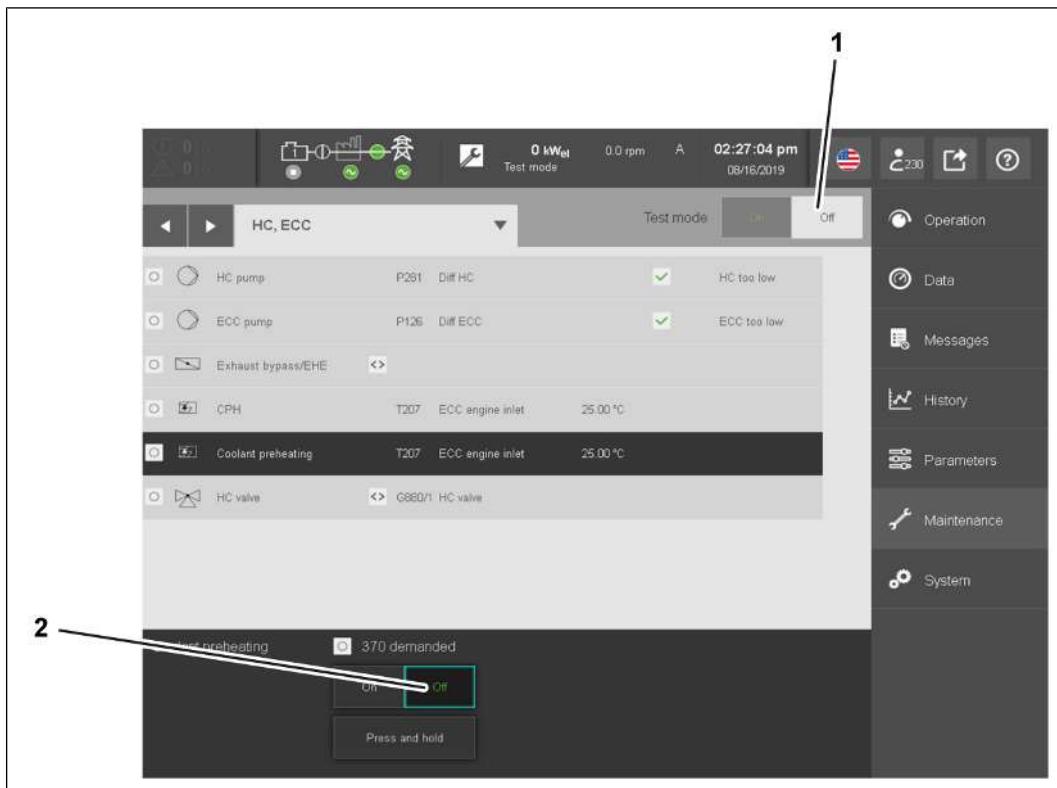
5. Press the **Off** (1) button.
  - The **Off** (1) button font color changes from white to green.
  - The green dot (1) disappears from the ECC pump dialog area.
  - The green dot (3) disappears from the CPH 631 demanded dialog area. The output **114K1D011** is no longer demanded.
6. Repeat the procedure for 267 demanded.
7. If you do not want to perform any more auxiliary drive tests, press the **Test mode Off** (2) button.
8. If you want to perform additional auxiliary drive tests, select and open the next auxiliary drive subgroup.

### Checking coolant preheating



9007199559453323

1. Tap the Coolant preheating (2) line in the pull-down menu.
2. Tap the On (3) button.
  - The font color in the On (3) button changes from white to green.
  - A green dot (1) appears in the Coolant preheating dialog area.
  - A green dot (4) appears in the Coolant preheating 370 demanded dialog area. The output 114K1D05 is demanded.
3. Check whether the coolant lines are warming up
4. If the coolant lines are not warming up, contact service partner.



9007199559463051

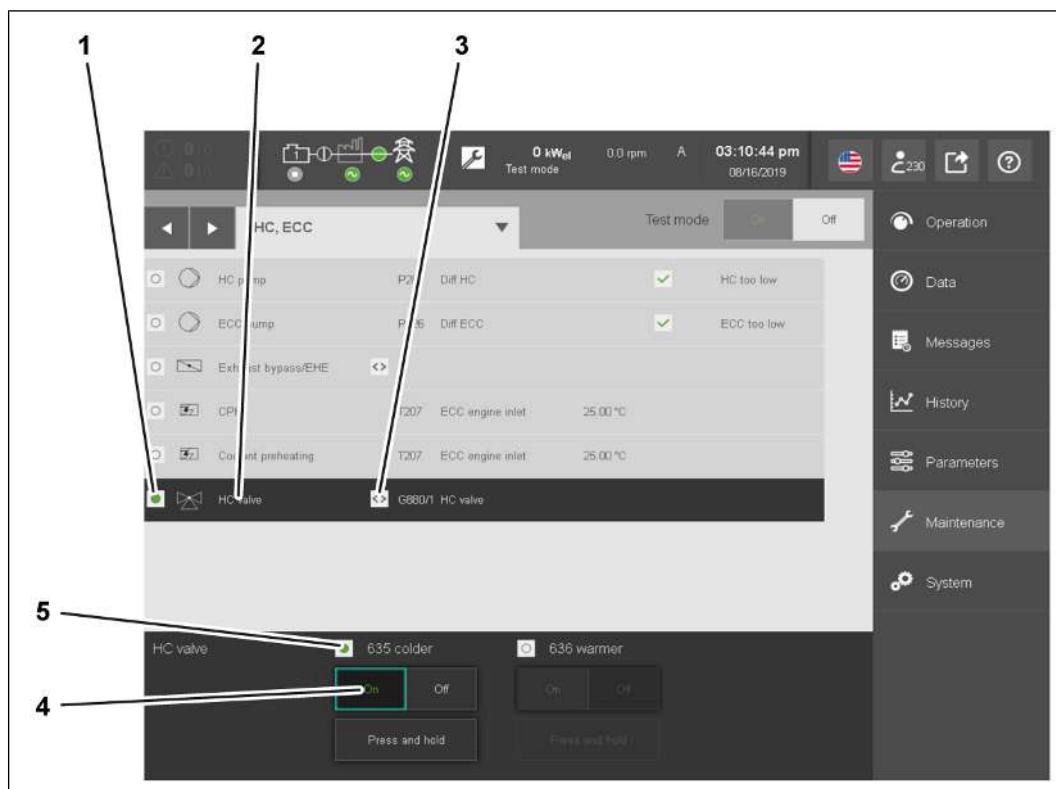
5. Tap the Off (2) button.
  - The font color in the Off (2) button changes from white to green.
  - The green dot (4) disappears from the Coolant preheating 370 demanded dialog area. The output 114K1D05 is no longer demanded.
6. If you do not want to carry out any more auxiliary drive tests, press the Test mode OFF (1) button.
7. If you want to perform additional auxiliary drive tests, select and open the next auxiliary drive subgroup.

#### Checking the heating circuit valve:

##### NOTE

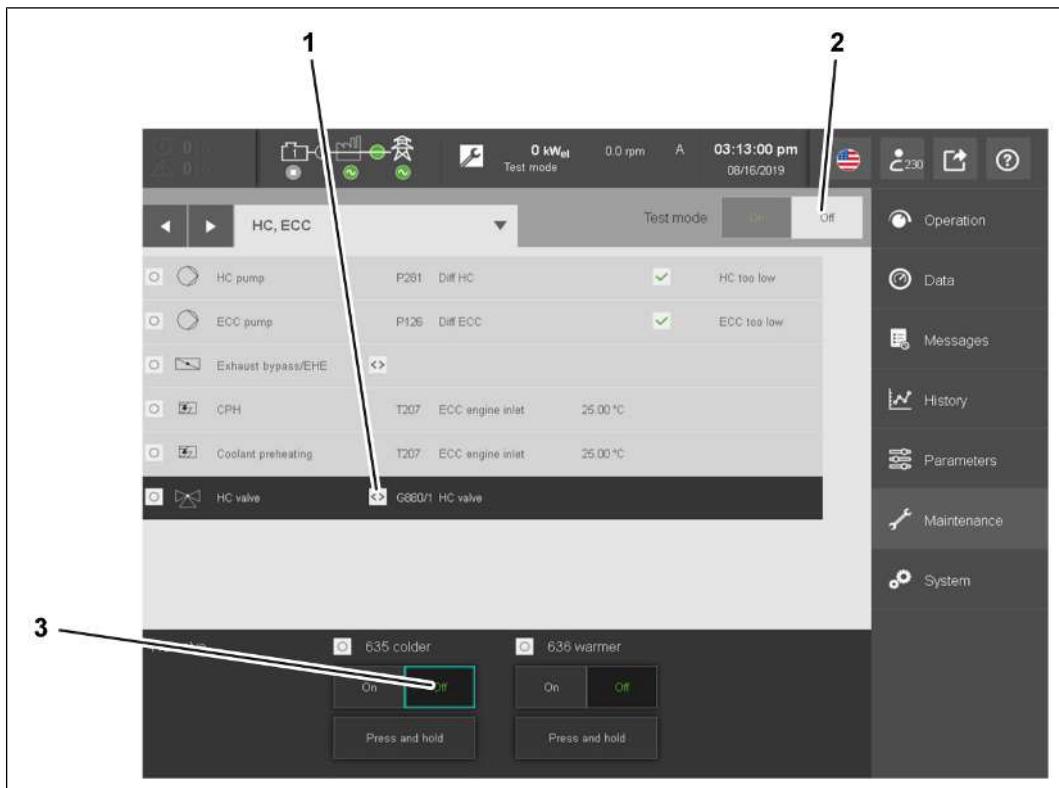
Perform the check for the limit stop, plus (warmer) according to the check for the limit stop, minus (colder).

- Activation will be indicated by a green dot in the HC valve 636 warmer dialog area. The output 114K1D015 is demanded.



304810251

1. Tap the **HC valve** (2) line in the pull-down menu.
  - A double arrow (3) appears in the G880/1 HC valve dialog area.
2. Tap the **On** (4) button.
  - The font color in the **On** (4) button changes from white to green.
  - A green dot (1) appears in the **HC valve** (2) dialog area.
  - A green dot (5) appears in the **HC valve 635 colder** dialog area. The output 114K1D016 is demanded.
3. Check that the heating circuit valve is working.
  - You must be able to hear the heating circuit valve switching.
  - The position of the heating circuit valve is indicated by a symbol (2) in the G880/1 HC valve dialog area.
  - If the heating circuit valve is not working correctly, contact your service partner.



304819979

4. Tap the Off (3) button.
  - The font color in the Off (3) button changes from white to green.
  - The position of the heating circuit valve is indicated by a symbol (1) in the G880/1 HC valve dialog area:
  - The green dot (5) disappears from the HC valve 635 colder dialog area. The output 114K1DO16110K1DI14 is no longer demanded.
5. If you want to perform additional auxiliary drive tests, select and open the next auxiliary drive test.
6. If you do not want to perform any more auxiliary drive tests, press the Test mode OFF (2) button.
 

⇒ The auxiliary drive test is finished.

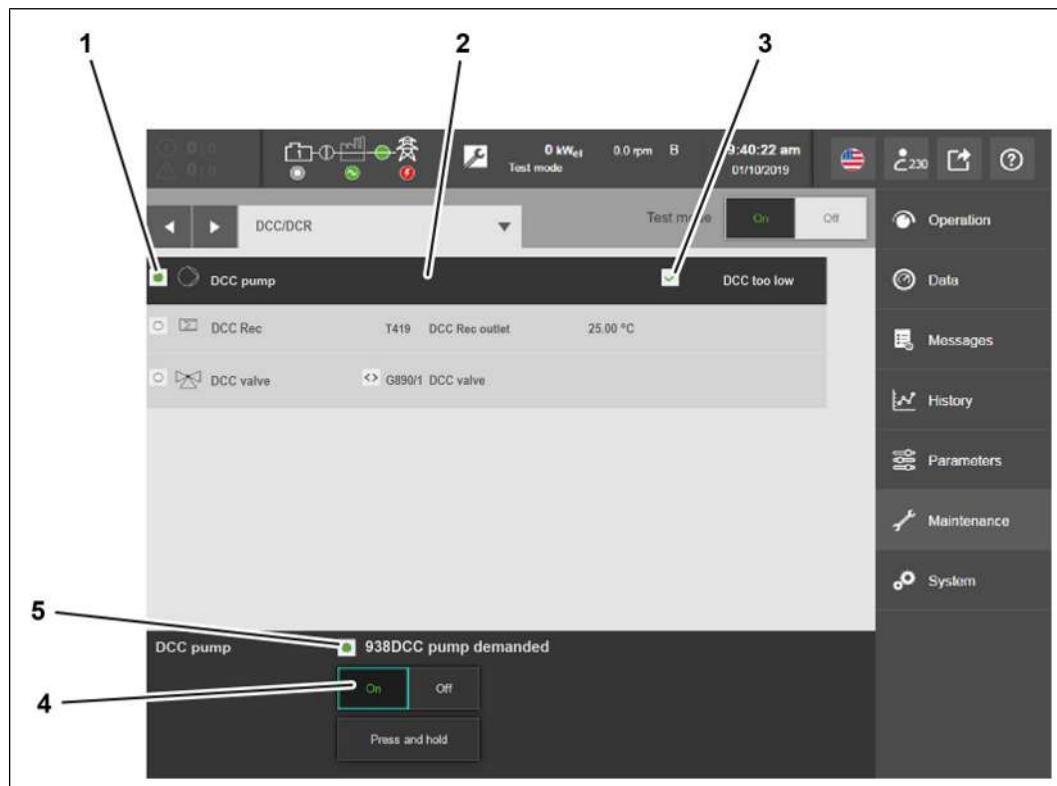
## Dump cooling circuit and dual core radiator (DCC/DCR) auxiliary drive test for frequency control

Valid for:

TCG 3016, TCG 3020

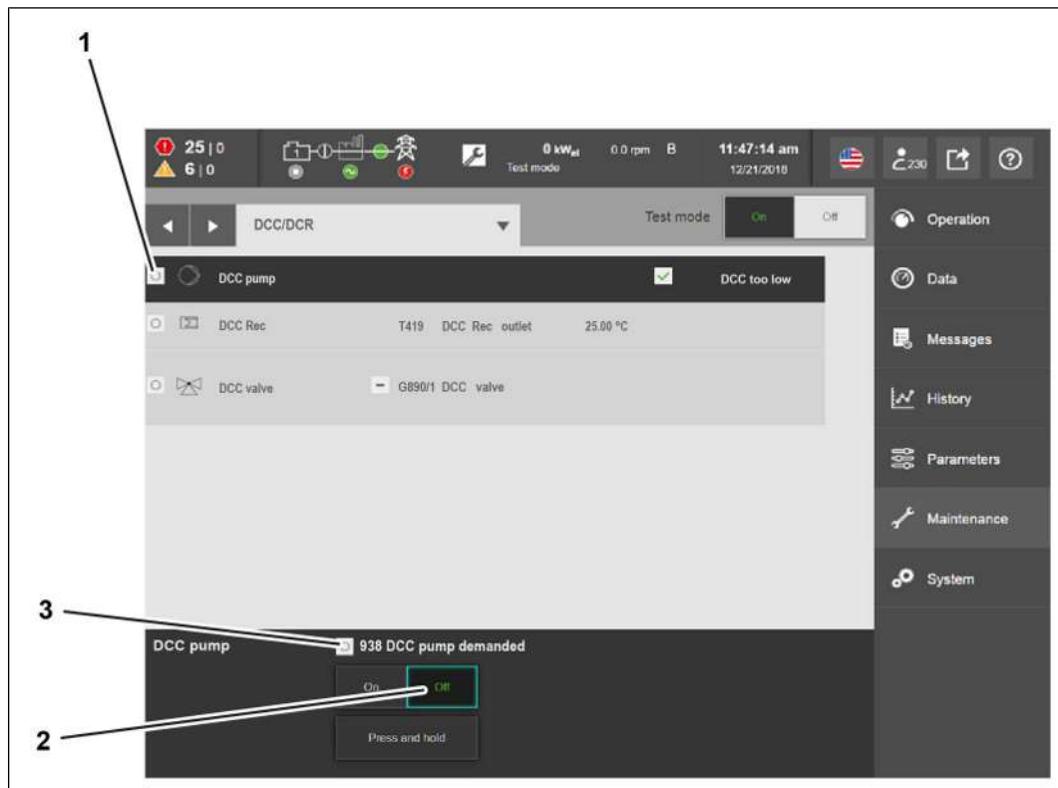
**NOTE**

You must activate Frequency control for the dump cooling circuit as the Initial setup in the Parameters so that the checks are visible.

**Checking the dump cooling circuit pump**

9007199559602315: Abbreviations used: DCC

1. Tap the DCC pump (2) line in the pull-down menu
  - A green check mark (3) appears in the L458 DCC too low dialog area. The liquid level is OK. You can start the auxiliary drive test.
  - A red lightning bolt appears in the L458 DCC too low (4) dialog area. The liquid level is not OK. Find and correct the root cause of the low liquid level before starting the auxiliary drive test. If necessary, contact the service partner.
2. Tap the On (4) button.
  - The font color in the On (4) button changes from white to green.
  - A green dot (1) appears in the DCC pump (2) dialog area.
  - A green dot (5) appears in the DCC pump 938 demanded dialog area. The output 114K2DO2 is demanded.
3. Check the function and direction of rotation of the pump.
  - Visually inspect the direction of rotation. If the direction of rotation of the pump is incorrect, contact service partner.



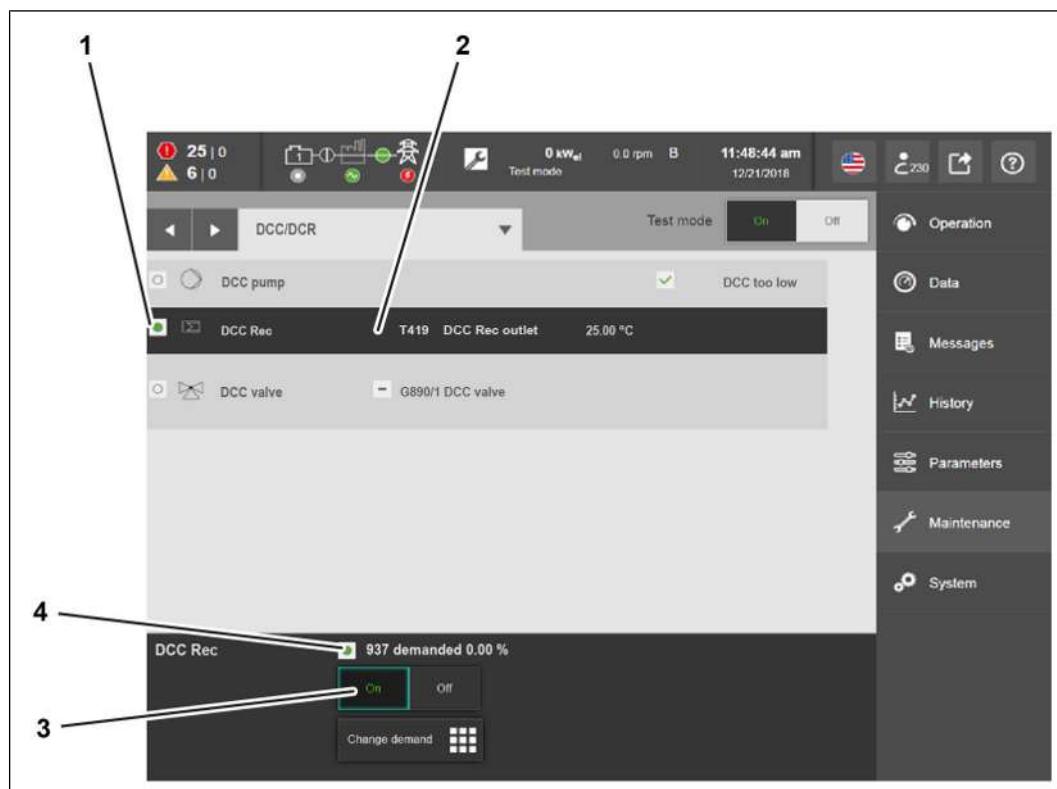
9007199559612043

4. Tap the **Off** (2) button
  - The font color in the **Off** (2) button changes from white to green.
  - The green dot (3) disappears from the DCC pump 938 demanded dialog area. The output 114K2D02 is no longer demanded.
  - The green dot (1) disappears from the DCC pump dialog area.

#### Checking the dump cooling circuit radiator

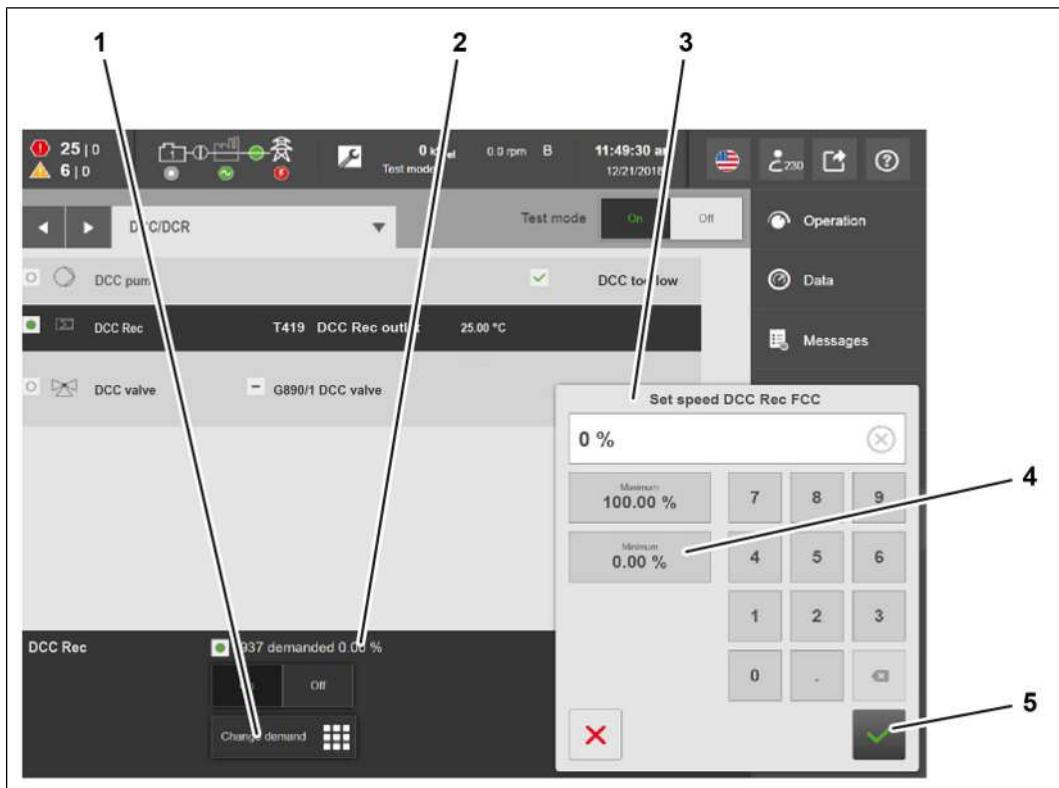
##### NOTE

Perform the check for the dump cooling circuit radiator with stage switching according to the check for the [Mixture cooling circuit \(MCC\) auxiliary drive test for stage control \[▶ 242\]](#).



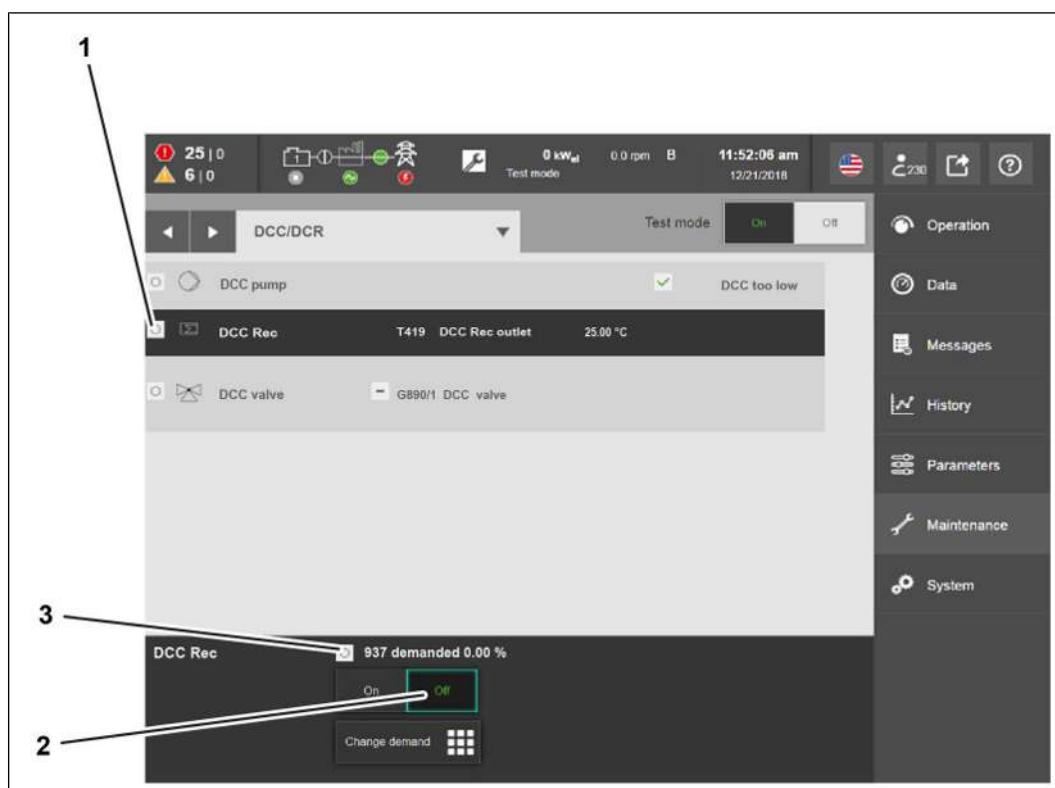
9007199559675531: Abbreviations used: DCC RDTR

1. Tap the DCC RDTR (2) line in the pull-down menu
2. Tap the On (3) button
  - The font color in the On (3) button changes from white to green.
  - A green dot (1) appears in the DCC RDTR (2) dialog area.
  - A green dot (4) appears in the DCC RDTR 937 demanded – % dialog area. The output 114K2DO1 is demanded.



9007199559680395: Abbreviation used: DCC RDTR/DCR FC

3. Tap the Change demand (1) button
  - The Set speed DCC RDTR/DCR FC (3) input mask opens.
4. Enter setpoint 0 %
  - Tap the Minimum 0.00 % (4) button in the Set speed DCC RDTR/DCR FC (3) input mask.
  - Press the Accept input (5) button.
  - The Set speed DCC RDTR/DCR FC (3) input mask closes.
  - The dialog area DCC RDTR 937 demanded shows the setpoint 0.00 % (2).
  - The fan continuously decreases the speed until the setpoint of 0.00 % is reached.
5. Repeat the procedure for the setpoint of 100.00 %.
  - The fan continuously increases the speed until the setpoint of 100.00 % is reached.
6. If the result is not OK, contact your service partner.



9007199559685259

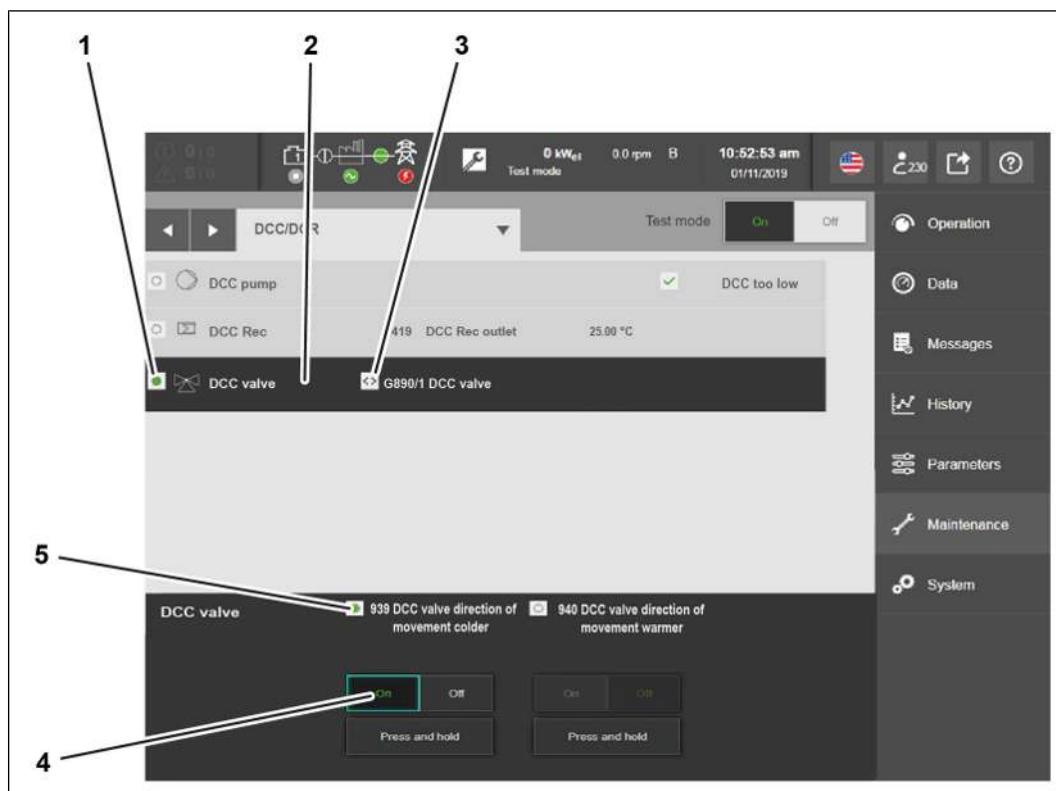
7. Tap the Off (2) button
  - The font color in the Off (2) button changes from white to green.
  - The green dot (1) disappears from the DCC RDTR dialog area.
  - The green dot (3) disappears from the DCC RDTR 937 demanded dialog area.  
The output 114K2DO1 is no longer demanded.

### Checking the dump cooling circuit valve

#### NOTE

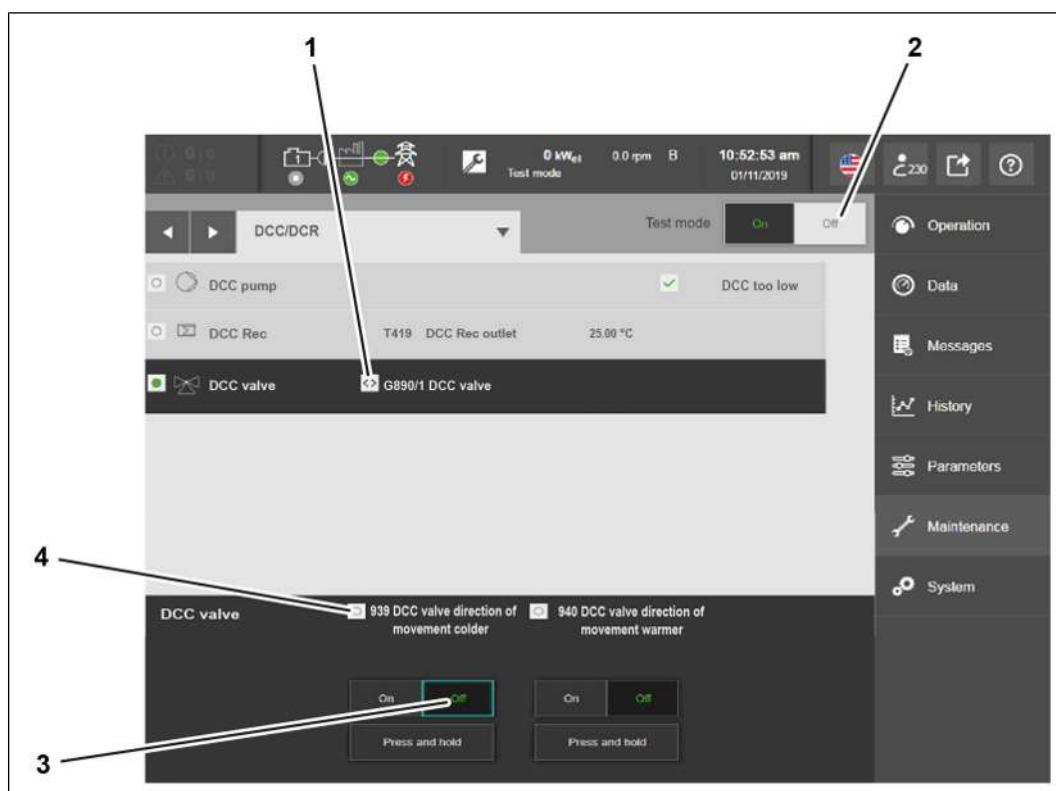
Perform the check for the limit stop, plus (warmer) according to the check for the limit stop, minus (colder).

- Activation is indicated by a green dot in the 940 DCC valve direction of movement colder line. The output 114K2DO3 is demanded.



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1. Tap the **DCC valve** (2) line in the pull-down menu
  - A double arrow (3) appears in the G890/1 DCC valve dialog area.
2. Press the **On** (4) button
  - The font color in the **On** (4) button changes from white to green.
  - A green dot (1) appears in the **DCC valve** (2) dialog area.
  - A green dot (5) appears in the **939 DCC valve direction of movement colder** dialog area. The output 114K2DO4 is demanded.
3. Check that the dump cooling circuit valve is working correctly.
  - You must be able to hear the heating circuit valve switching.
  - The position of the dump cooling circuit valve is indicated by a symbol (1) in the G890/1 DCC valve dialog area.
  - If the dump cooling circuit valve is not working correctly, contact your service partner.



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4. Tap the Off (3) button.
  - The font color in the Off (3) button changes from white to green.
  - The position of the dump cooling circuit valve is indicated by a symbol (1) in the G890/1 DCC valve dialog area.
  - The green dot (5) disappears from the 939 DCC valve direction of movement colder dialog area. The output 114K2D04 is no longer demanded.
5. If you want to perform additional auxiliary drive tests, select and open the next auxiliary drive subgroup.
6. If you do not want to perform any more auxiliary drive tests, press the Test mode OFF (2) button.
  - ⇒ The auxiliary drive test is finished.

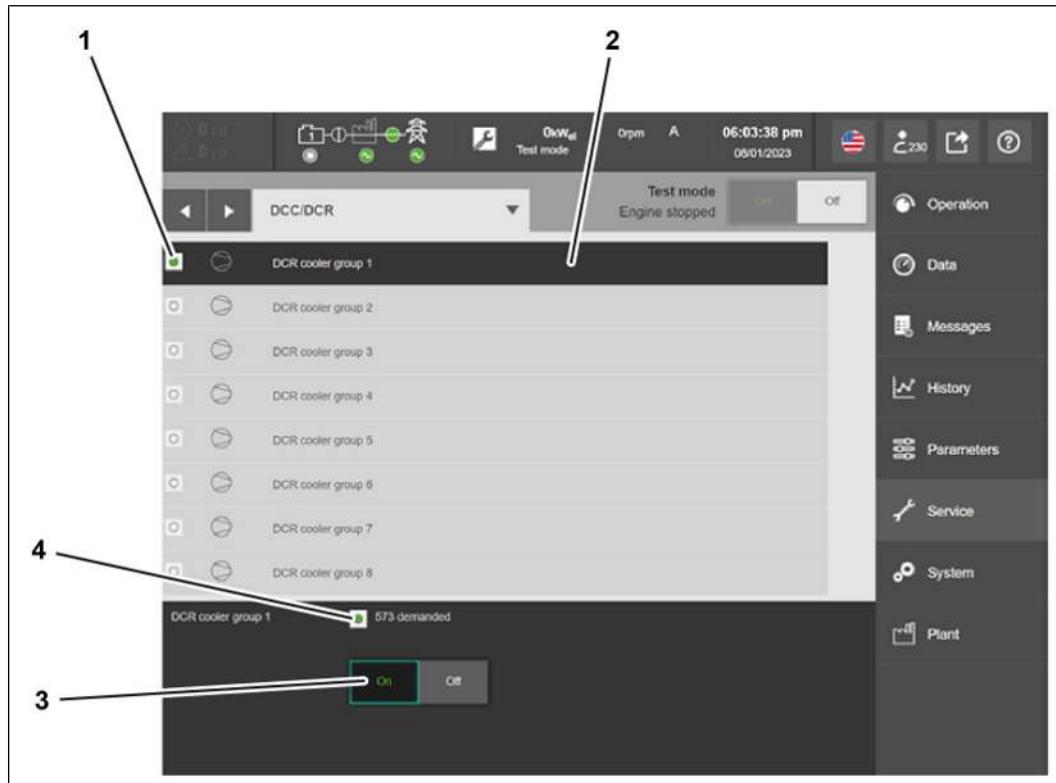
## Dump cooling circuit and dual core radiator (DCC/DCR) auxiliary drive test for stage control

Valid for:

TCG 3016, TCG 3020

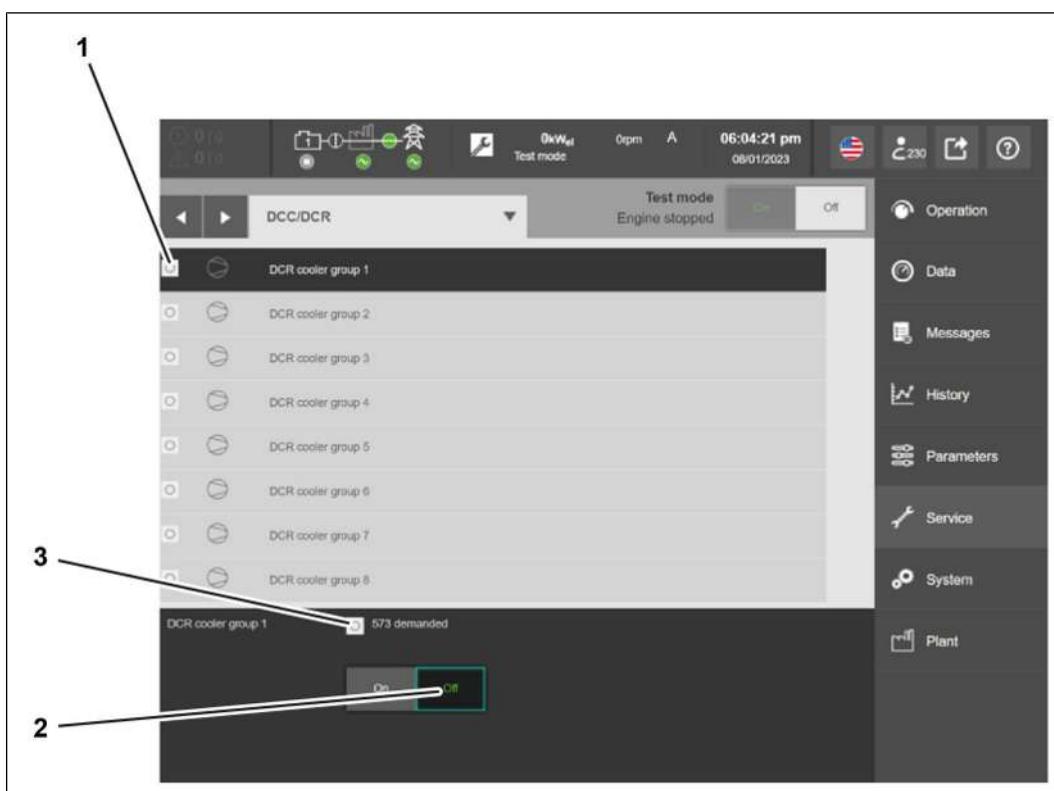
**NOTE**

You must activate Stage control for the dual core radiator as the Initial setup in the Parameters so that the checks are visible.

**Checking DCR cooler group 1**

2801986827: Abbreviations used: DCR

1. Tap the DCR cooler group 1 (2) line in the pull-down menu.
2. Tap the On (3) button.
  - The font color in the On (3) button changes from white to green.
  - A green dot (1) appears in the DCR cooler group 1 (2) dialog area.
  - A green dot (4) appears in the 573 demanded dialog area. The output 114K5DO1 is demanded.



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3. Tap the **Off** (2) button
  - The font color in the **Off** (2) button changes from white to green.
  - The green dot (1) disappears from the DCR cooler group 1 dialog area.
  - The green dot (3) disappears from the 573 demanded dialog area. The output 114K5D01 is no longer demanded.
4. Perform all other checks for the DCR cooler groups as described above.
5. If you want to perform additional auxiliary drive tests, select and open the next auxiliary drive subgroup.
6. If you do not want to perform any more auxiliary drive tests, press the **Test mode OFF** (2) button.
  - ⇒ The auxiliary drive test is finished.

## Mixture cooling circuit (MCC) auxiliary drive test for frequency control

Valid for:

TCG 3016, TCG 3020

### Checking the mixture cooling circuit pump:

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#### NOTE

- Perform the mixture cooling circuit pump check according to the dump cooling circuit pump check: [Dump cooling circuit and dual core radiator \(DCC/DCR\) auxiliary drive test for frequency control \[▶ 232\]](#)
- 

### Checking the mixture cooling circuit radiator:

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#### NOTE

- Perform the mixture cooling circuit radiator warmer check according to the dump cooling circuit radiator colder check: [Dump cooling circuit and dual core radiator \(DCC/DCR\) auxiliary drive test for frequency control \[▶ 232\]](#)
    - The setpoint for the mixture cooling circuit radiator warmer check is 100.00 %.
- 

### Checking the mixture cooling circuit valve:

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#### NOTE

- Perform the mixture cooling circuit valve check according to the dump cooling circuit valve check: [Dump cooling circuit and dual core radiator \(DCC/DCR\) auxiliary drive test for frequency control \[▶ 232\]](#)
- 

## Mixture cooling circuit (MCC) auxiliary drive test for stage control

Valid for:

TCG 3016, TCG 3020

### Checking MCC cooler group 1:

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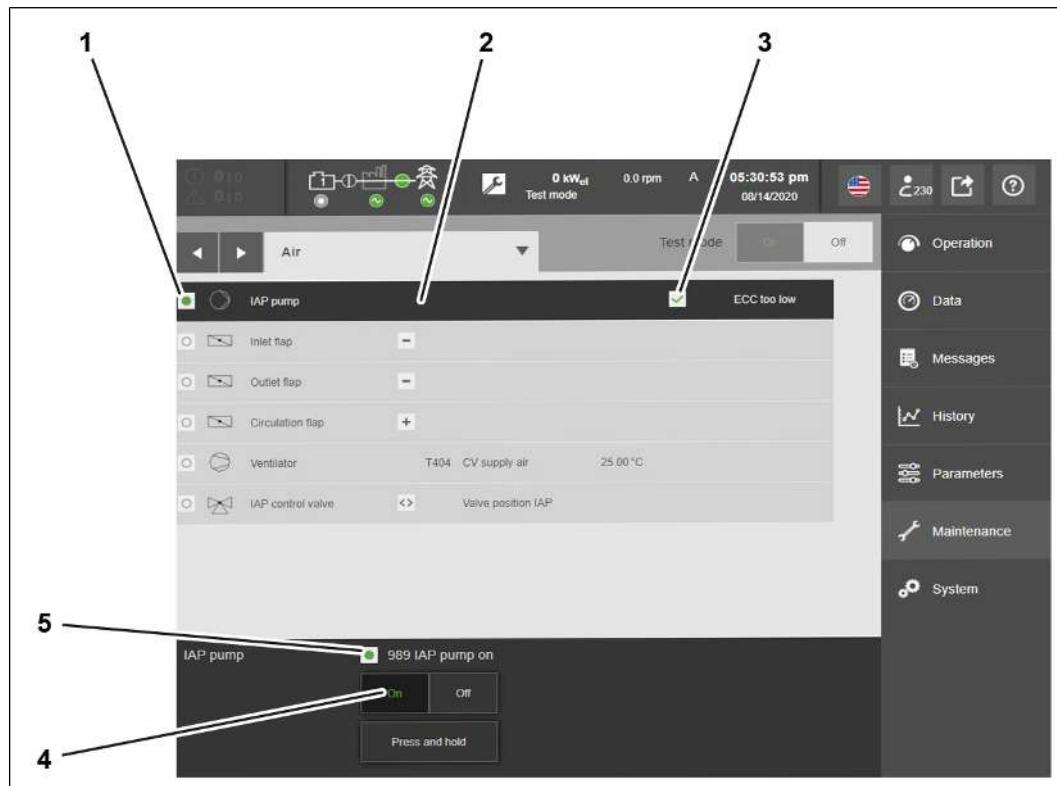
#### NOTE

- Perform the checks for the MCC cooler groups according to the checks for the DCC cooler groups: [Dump cooling circuit and dual core radiator \(DCC/DCR\) auxiliary drive test for stage control \[▶ 239\]](#)
- 

## Air auxiliary drive test

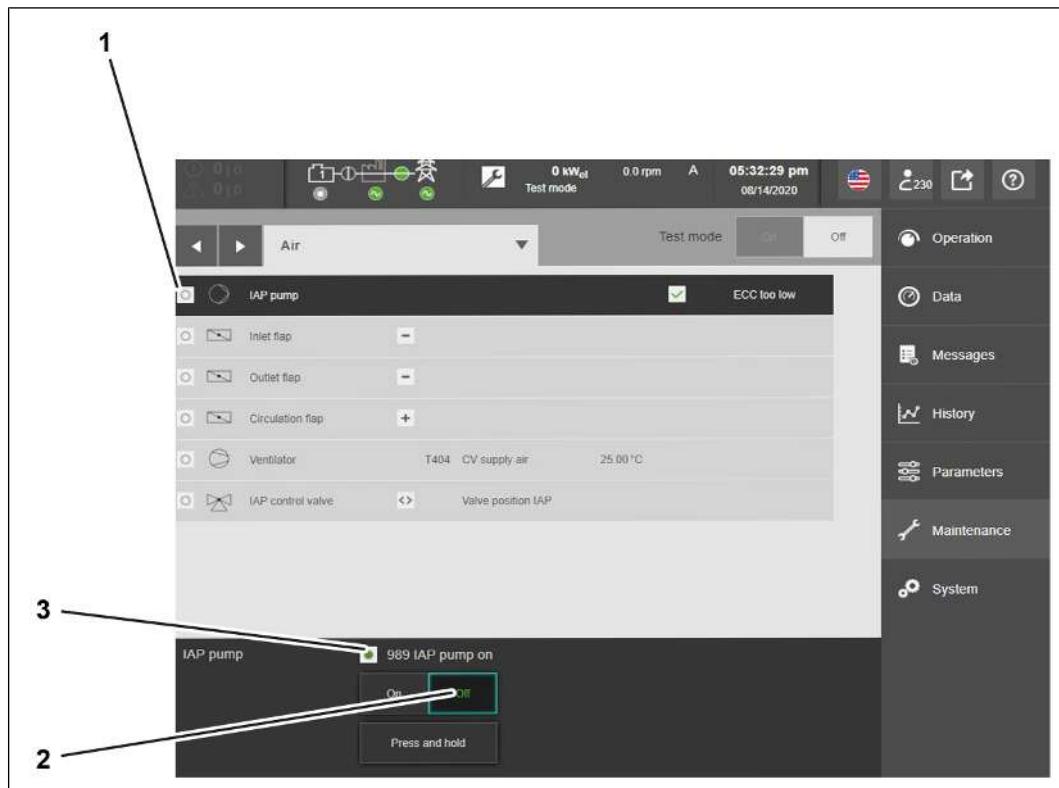
Valid for:

TCG 3016, TCG 3020

**Checking the IAP pump:**

305076491: Abbreviations used: IAP

1. Tap the IAP pump (2) line in the pull-down menu
  - A green check mark appears in the ECC too low (3) dialog area. The liquid level is OK. You can start the auxiliary drive test.
  - A red lightning bolt appears in the ECC too low (3) dialog area. The liquid level is not OK. Find and correct the root cause of the low liquid level before starting the auxiliary drive test. If necessary, contact service partner.
2. Press the On (4) button
  - The font color in the On (4) button changes from white to green.
  - A green dot (1) appears in the IAP pump (2) dialog area.
  - A green dot (5) appears in the IAP pump 989 IAP pump on dialog area. The output 114K3D013 is demanded.
3. Check the function and direction of rotation of the pump.
  - Visually inspect the direction of rotation. If the direction of rotation of the pump is incorrect, contact the service partner.



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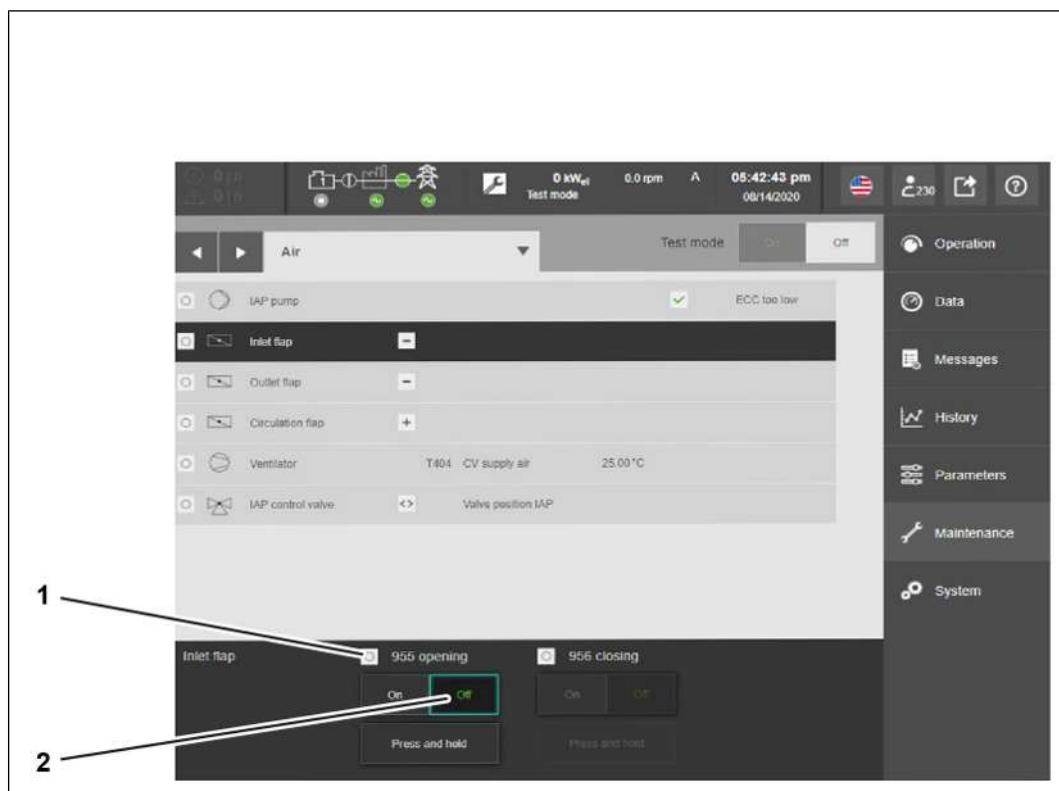
4. Tap the **Off** (2) button
  - The font color in the **Off** (2) button changes from white to green.
  - The green dot (1) disappears from the **IAP pump** dialog area.
  - The green dot (3) disappears from the **IAP pump 989 IAP pump on** dialog area. The output **114K3DO13** is no longer demanded.

### Checking the supply air louver damper



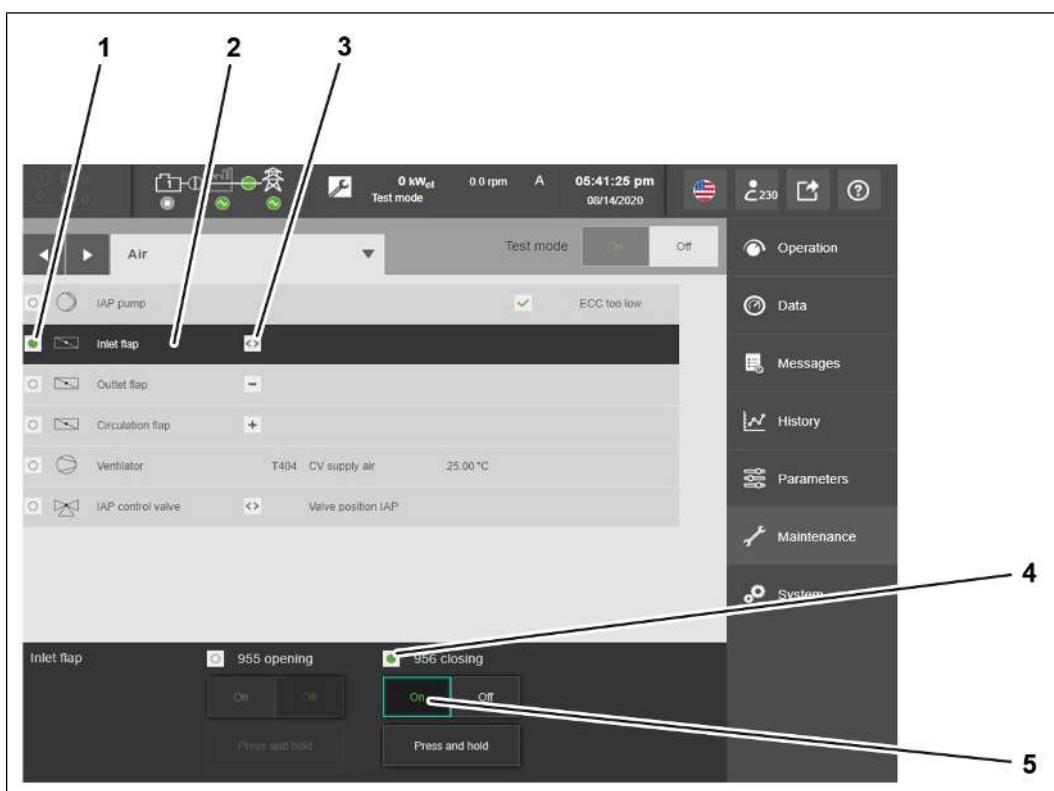
305140747

1. Tap the Supply air louver damper (2) line in the pull-down menu
  - A green dot (1) appears in the Inlet flap dialog area.
2. Press the On (4) button
  - A double arrow (3) appears in the Inlet flap dialog area.
  - The font color in the On (4) button changes from white to green.
  - A green dot (5) appears in the Inlet flap 955 open dialog area. The output 114K2D09 is demanded.
3. Check that the supply air louver damper is working correctly.
  - The position of the supply air louver damper is indicated by a symbol (3) in the Supply air louver damper dialog area.
  - The slats of the supply air louver damper must be fully open.
  - If the supply air louver damper is not working correctly, contact the service partner.



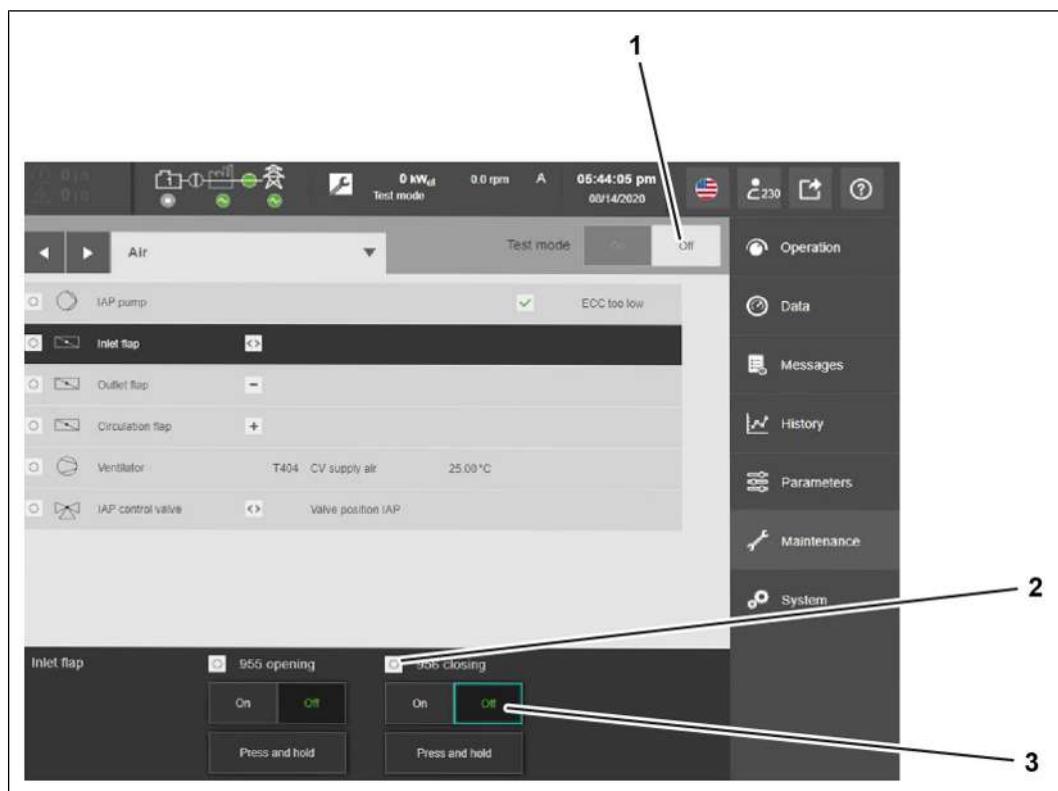
9007199559891467

4. Tap the **Off** (1) button
  - The **Off** (1) button font color changes from white to green. The output 114K2D09 is no longer demanded.



305155339

5. Tap the Inlet flap (2) line in the pull-down menu
  - A green dot (1) appears in the Inlet flap dialog area.
6. Press the On (4) button
  - A double arrow (3) appears in the Inlet flap dialog area.
  - The font color in the On (4) button changes from white to green.
  - A green dot (5) appears in the Inlet flap 956 close dialog area. The output 114K2D08 is demanded.
7. Check that the supply air louver damper is working correctly.
  - The position of the supply air louver damper is indicated by a symbol (3) in the Supply air louver damper dialog area.
  - The slats of the supply air louver damper must be fully closed.
  - If the supply air louver damper is not working correctly, contact the service partner.



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8. Tap the **Off** (2) button
  - The font color in the **Off** (2) button changes from white to green. The output **114K2D08** is demanded.
9. If you do not want to carry out any more auxiliary drive tests, press the **Test mode OFF** (1) button.
10. If you want to perform additional auxiliary drive tests, select and open the next auxiliary drive subgroup.

#### **Checking the exhaust air louver damper**

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##### **NOTE**

Perform the exhaust air louver damper check according to the supply air louver damper check.

- The following outputs will be demanded during this check:
  - **114K2D010** Close exhaust air louver damper
  - **114K2D011** Open exhaust air louver damper

## Checking the circulating air louver damper

### NOTE

Perform the exhaust air louver damper check according to the circulating air louver damper check.

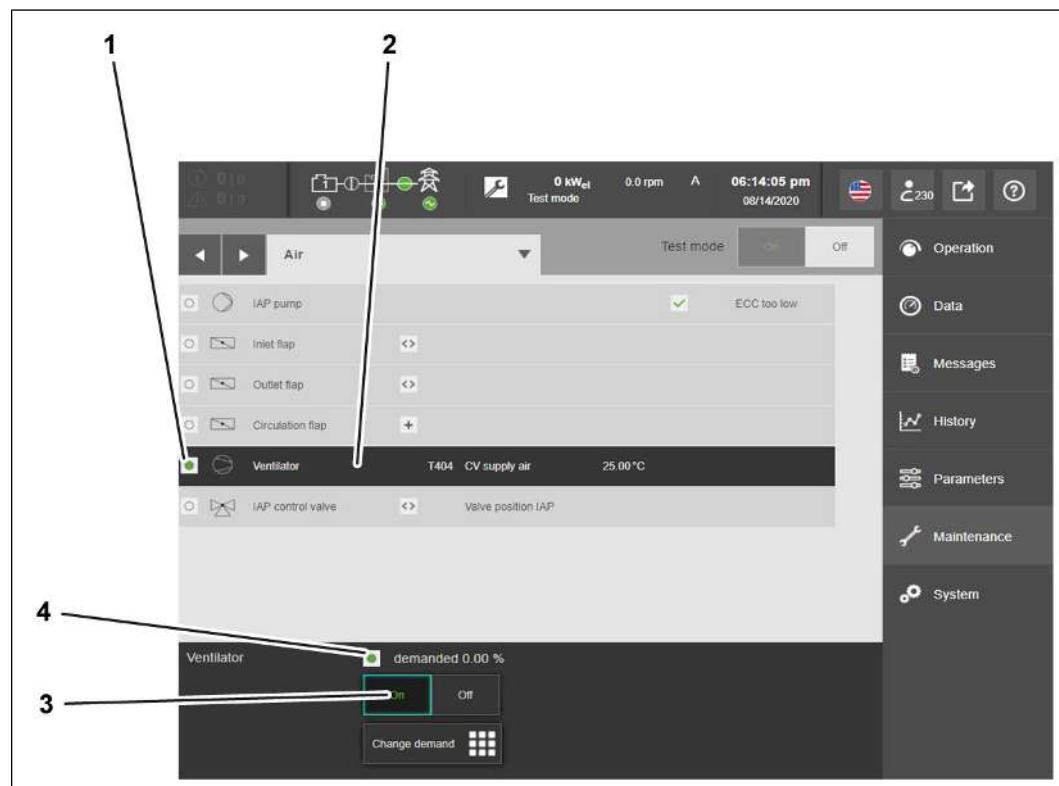
- The following outputs will be demanded during this check:
  - 114K2D012 Close circulating air louver damper
  - 114K2D013 Open circulating air louver damper

## Checking the ventilator

### NOTE

Perform the ventilator warmer check according to the ventilation colder check.

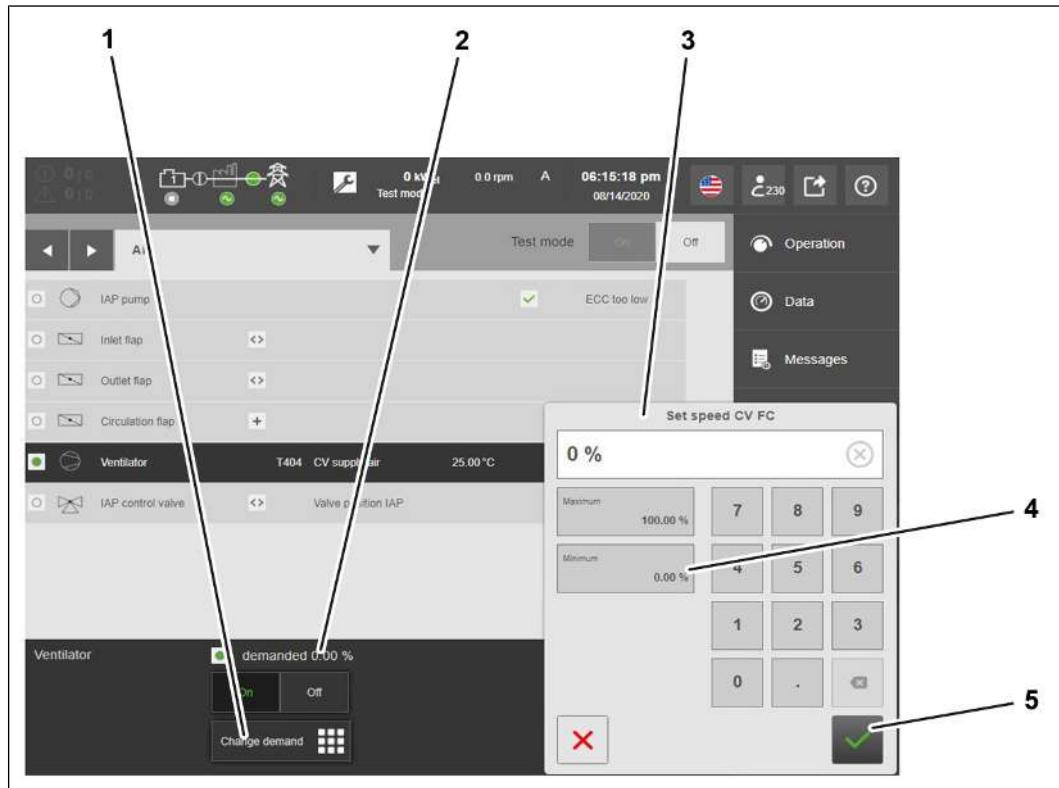
- The setpoint of the ventilator warmer check is 100.00 %.
- The output 114K2D07 will be demanded during this check.



305255691: Abbreviations used: CV supply air

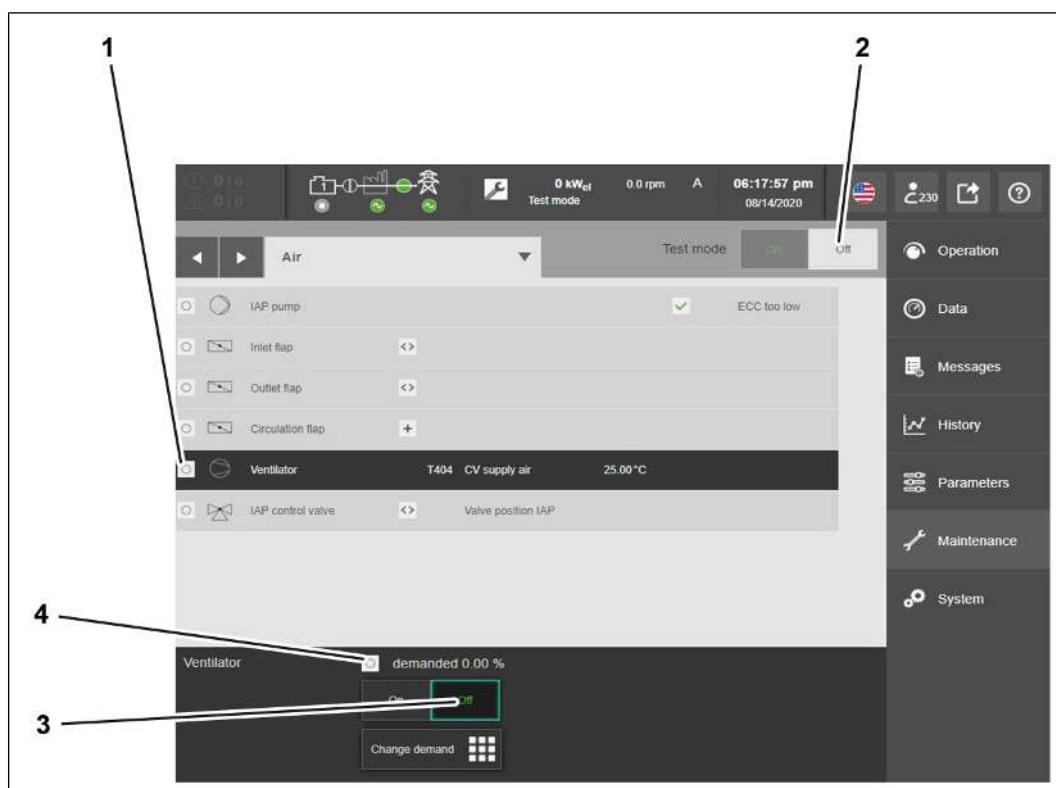
1. Tap the Ventilator (2) line in the pull-down menu
2. Tap the On (3) button
  - A green dot (1) appears in the Ventilator (2) dialog area.
  - The font color in the On (3) button changes from white to green.

- A green dot (4) appears in the Ventilator demanded 0.00 % dialog area. The output 114K2DO7 is demanded.



305260555: Abbreviations used: Set speed CV FC

3. Tap the Change demand (1) button
  - The Set speed CV FC (3) input mask opens.
4. Enter setpoint 0 %
  - Tap the Minimum 0.00 % (4) button in the Set speed CV FC (3) input mask.
  - Press the Accept input (5) button.
  - The Set speed CV FC (3) input mask closes.
  - The setpoint 0.00 % (2) appears in the Ventilator demanded dialog area.
  - The fan continuously decreases the speed until the setpoint is reached.
5. If the result is not OK, contact service partner



305265419

6. Tap the Off (3) button
  - The font color in the Off (3) button changes from white to green.
  - The green dot (1) disappears from the Ventilator dialog area.
  - The green dot (4) disappears from the Ventilator demanded dialog area. The output 114K2D07 is no longer demanded.
7. If you want to perform additional auxiliary drive tests, select and open the next auxiliary drive subgroup.
8. If you do not want to perform any more auxiliary drive tests, press the Test mode OFF (2) button.
  - ⇒ The auxiliary drive test is finished.

### Checking the IAP control valve

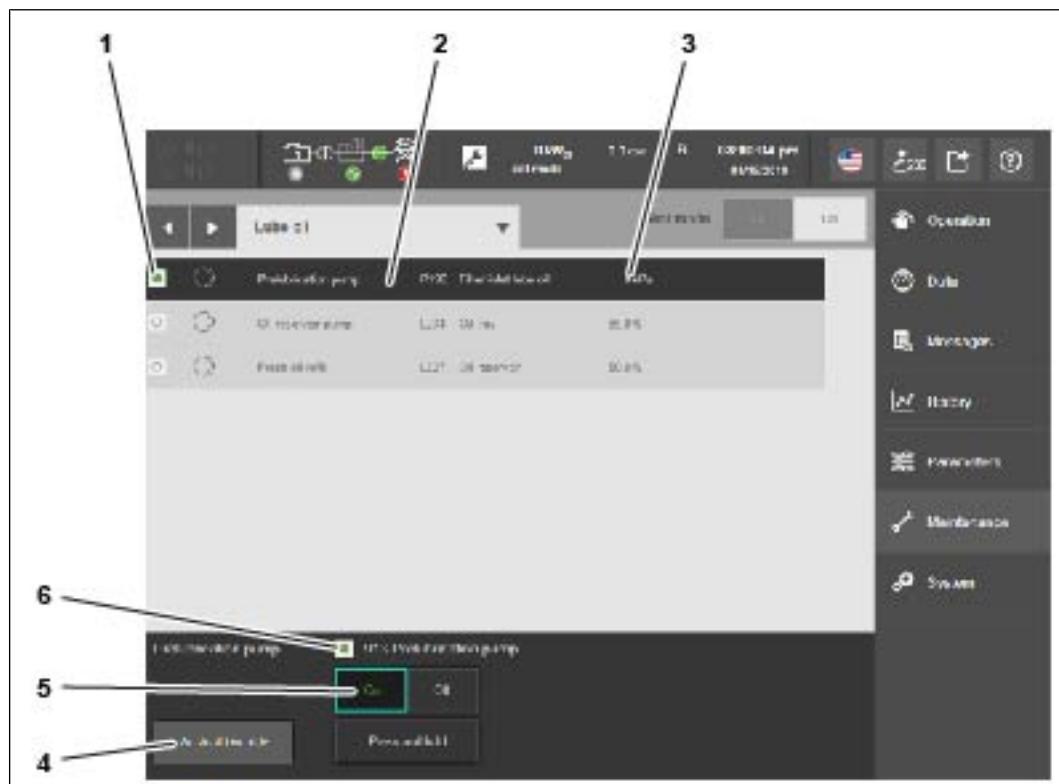
#### NOTE

Perform the check for the IAP control valve according to the check for the HC valve, see [Heating circuit \(HC\) and engine cooling circuit \(ECC\) auxiliary drive test \[▶ 222\]](#).

## Lube oil auxiliary drive test

Valid for:  
TCG 3016, TCG 3020

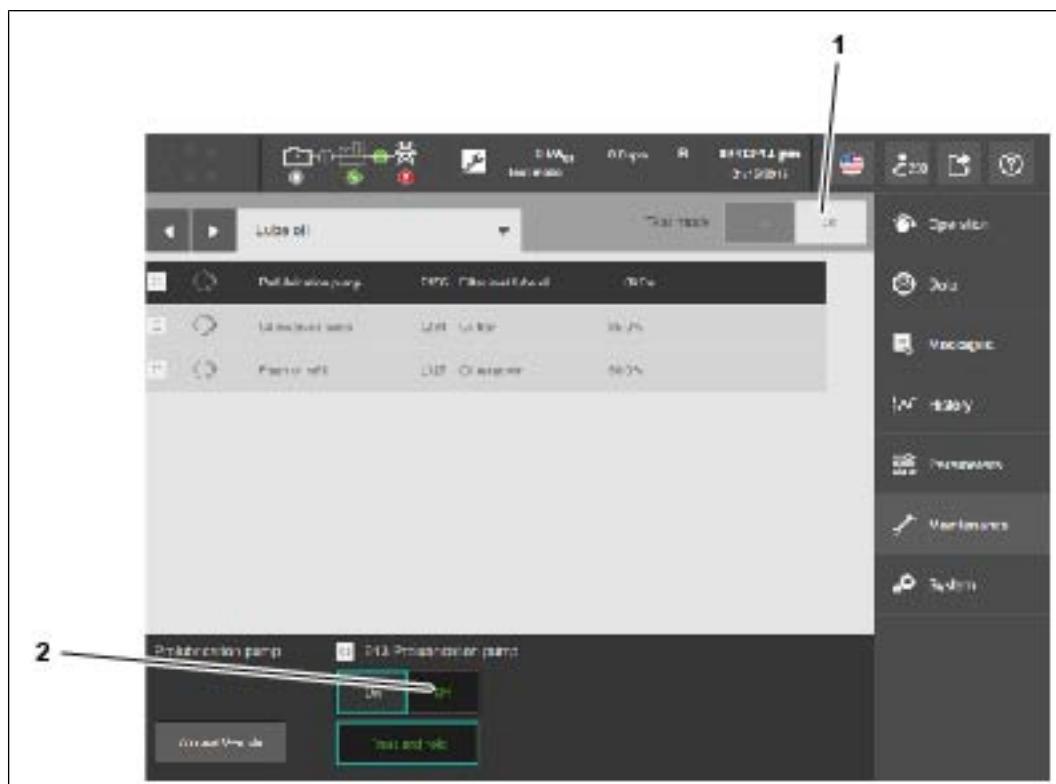
### Checking the prelubrication pump



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- NOTE! If a warning about waste oil tank overfilling or leakage is present on the electrical control system, you cannot activate the prelubrication pump.** Press the Waste oil tank override (4) button
- Tap the Prelubrication pump (2) line in the pull-down menu.
  - The control displays the current oil pressure (3) in the P196 Filter inlet lube oil dialog area.
  - Tap the ON (5) button.
  - The font color in the On (5) button changes from white to green.
  - A green dot (1) appears in the Prelubrication pump (2) dialog area.
  - A green dot (6) appears in the Prelubrication pump 913 Prelubrication pump dialog area. The output 114K1D06 is demanded.
  - The dialog area continuously displays the oil pressure (2) in the P196 Filter inlet lube oil.

3. If the lube oil pressure display does not change, check the lube oil level
  - Top up the lube oil if necessary.
  - If the lube oil level is OK, contact service partner.



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4. Tap the OFF (2) button
  - The font color in the OFF (2) button changes from white to green. The output 114K1DO6 is no longer demanded.
5. If you do not want to carry out any more auxiliary drive tests, press the Test mode OFF (1) button.

#### Checking the oil reservoir pump:

##### NOTE

Perform the oil reservoir pump check according to the fresh oil refill check.

- The output 114K2DO15 is demanded during the check.

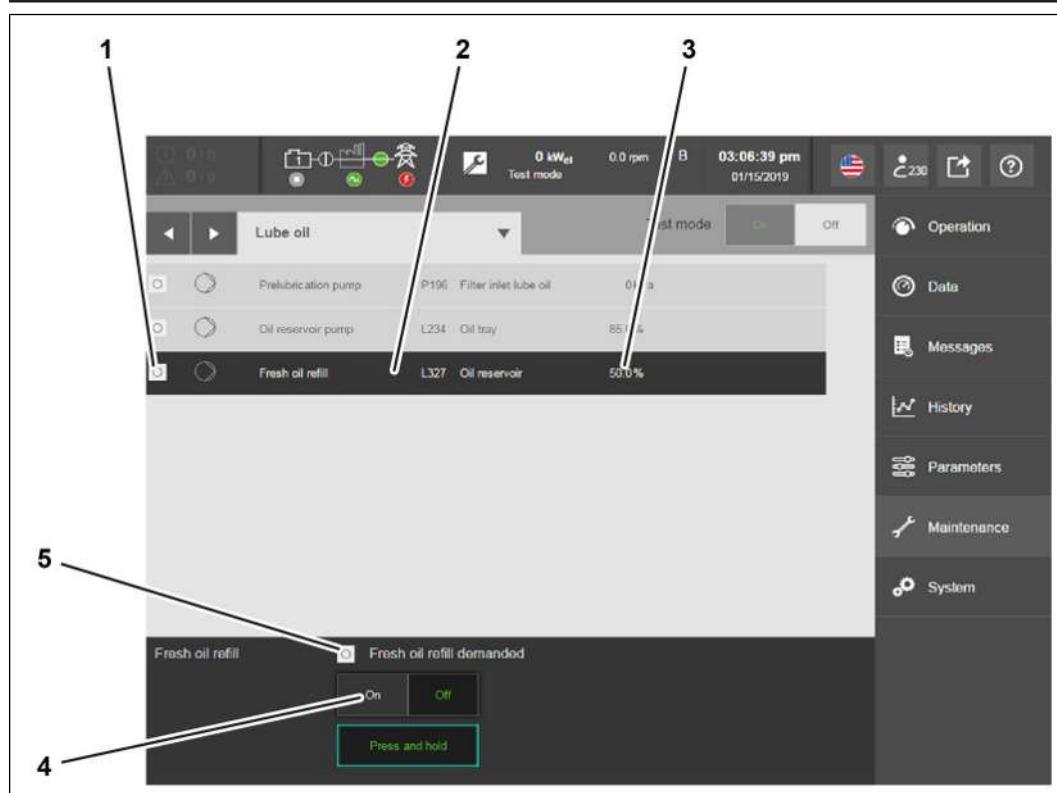
### Checking the fresh oil refill:

#### NOTE

The auxiliary drive test for fresh oil refill checks the solenoid valves for the lube oil supply. Depending on the structure of the plant, various solenoid valves are installed in differing numbers.

During the auxiliary drive test for the fresh oil refill, open the solenoid valves and top up the lube oil sump with lube oil from the extended oil circulation volume. There is no feedback regarding the current lube oil level of the expanded circulating oil volume in the fresh oil refill dialog area.

- Depending on the fill level of the lube oil sump, the check of the solenoid valves for the lube oil supply may be deactivated. Contact service partner.



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- Tap the Fresh oil refill (2) line in the pull-down menu



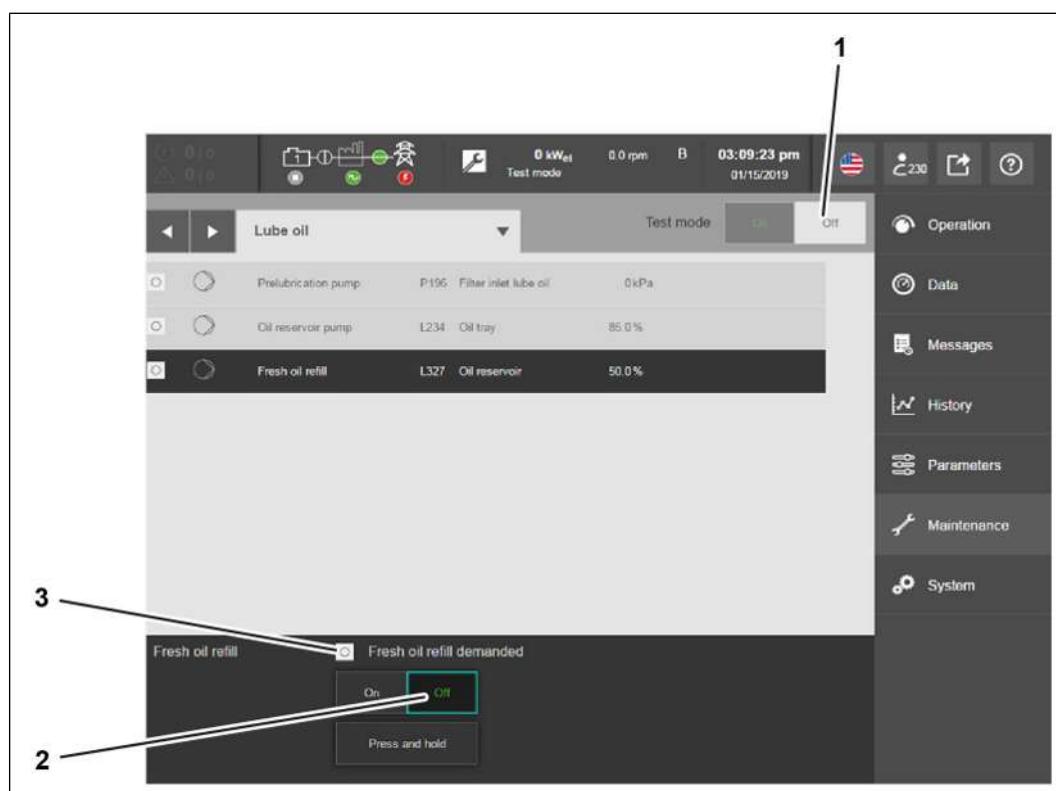
#### Risk of destruction of components

Risk of destruction of components

Components can be damaged or destroyed due to an excessively high lube oil level

- Do not top up the lube oil reservoir over 100.00 %
- Observe the oil level during the fresh oil refill and stop the fresh oil refill in time.

2. Tap the On (4) button.
  - A green dot (1) appears in the Fresh oil refill (2) dialog area.
  - The font color in the On (4) button changes from white to green.
  - The control system displays the current fill level in percent (3) in the L327 Oil reservoir dialog area.
  - A green dot (5) appears in the Fresh oil refill Fresh oil refill demanded dialog area. The output 114K4D05 is demanded.
  - The control continuously displays the oil level in percent (2) in the L327 Oil reservoir dialog area.
3. Check the lube oil level.
  - If the displayed lube oil level in the oil reservoir does not change, check the lube oil level in the fresh oil tank.
  - Top up the lube oil if necessary.
  - If the lube oil level is OK, contact your service partner.



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4. Tap the Off (2) button.
  - The font color in the Off (2) button changes from white to green.
  - The green dot (3) disappears from the Fresh oil refill Fresh oil refill demanded dialog area. The output 114K4D05 is no longer demanded.

- 
5. If you want to perform additional auxiliary drive tests, select and open the next auxiliary drive subgroup.
  6. If you do not want to carry out any more auxiliary drive tests, press the Test mode OFF (1) button.
    - ⇒ The auxiliary drive test is ended.

## Lube oil change auxiliary drive test

Valid for:  
TCG 3016, TCG 3020

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### NOTE

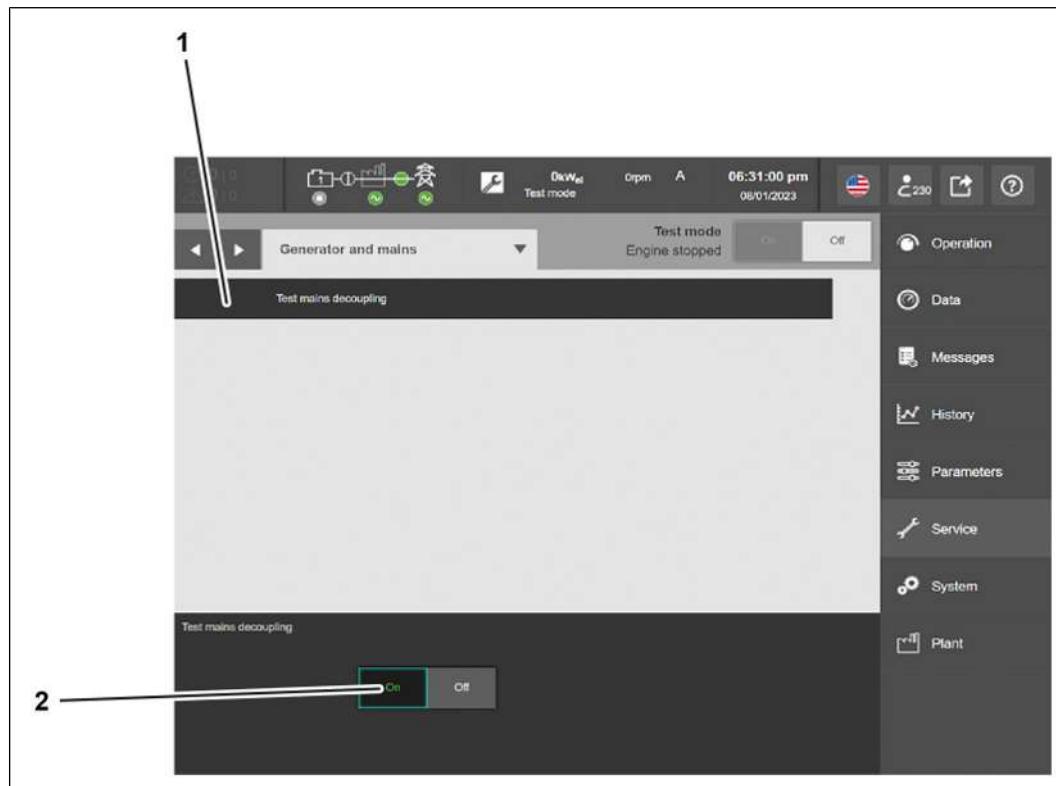
The lube oil change auxiliary drive test is described in the job card [Perform a lube oil change](#) [▶ 314].

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## Generator and mains auxiliary drive test

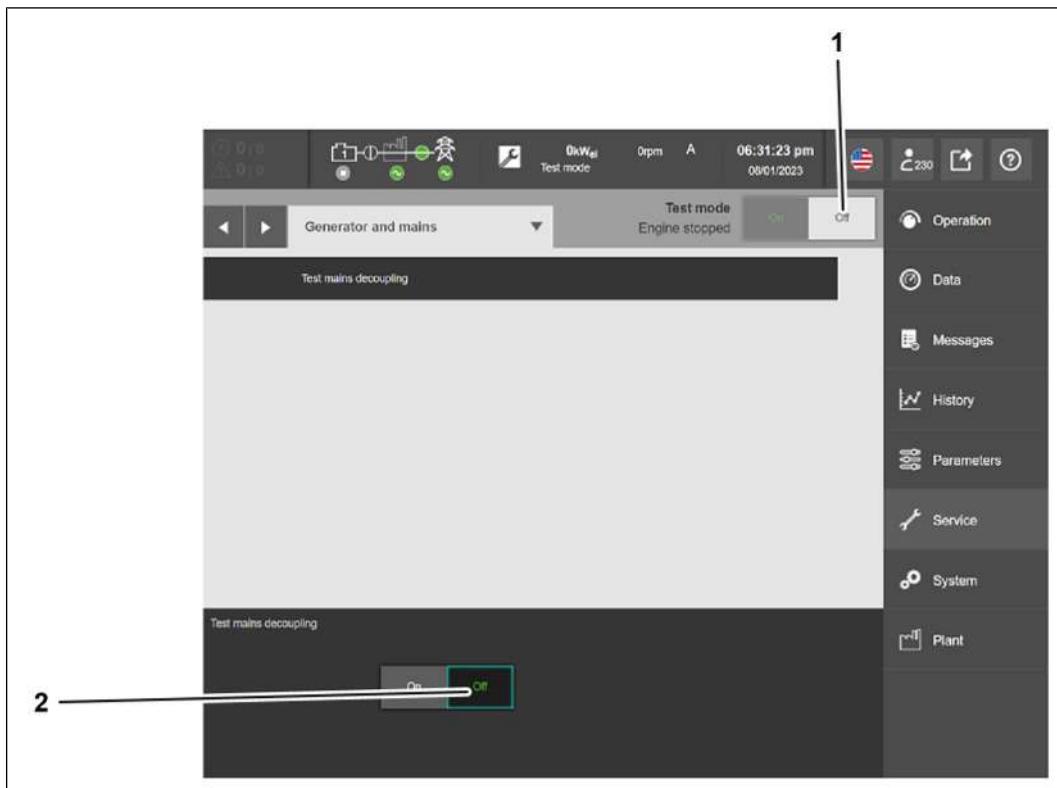
Valid for:  
TCG 3016, TCG 3020

### Checking the mains coupling test mode



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1. Tap the Test mains decoupling (1) line in the pull-down menu
2. Tap the On (2) button.
  - The font color in the On (2) button changes from white to green.



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3. Tap the OFF (2) button
  - The font color in the OFF (2) button changes from white to green.
4. If you want to perform additional auxiliary drive tests, select and open the next auxiliary drive subgroup.
5. If you do not want to carry out any more auxiliary drive tests, press the Test mode OFF (1) button.
  - ⇒ The auxiliary drive test is ended.

## Parameterizable controllers auxiliary drive test

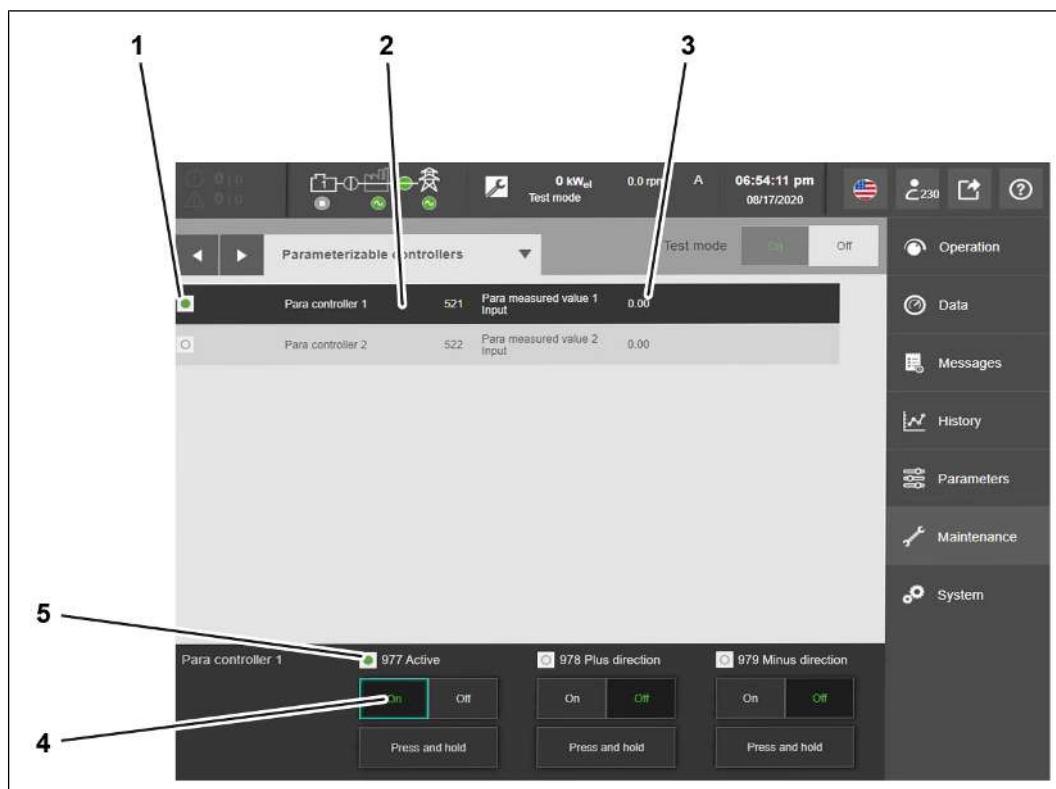
Valid for:

TCG 3016, TCG 3020

### Checking the parameterizable controllers:

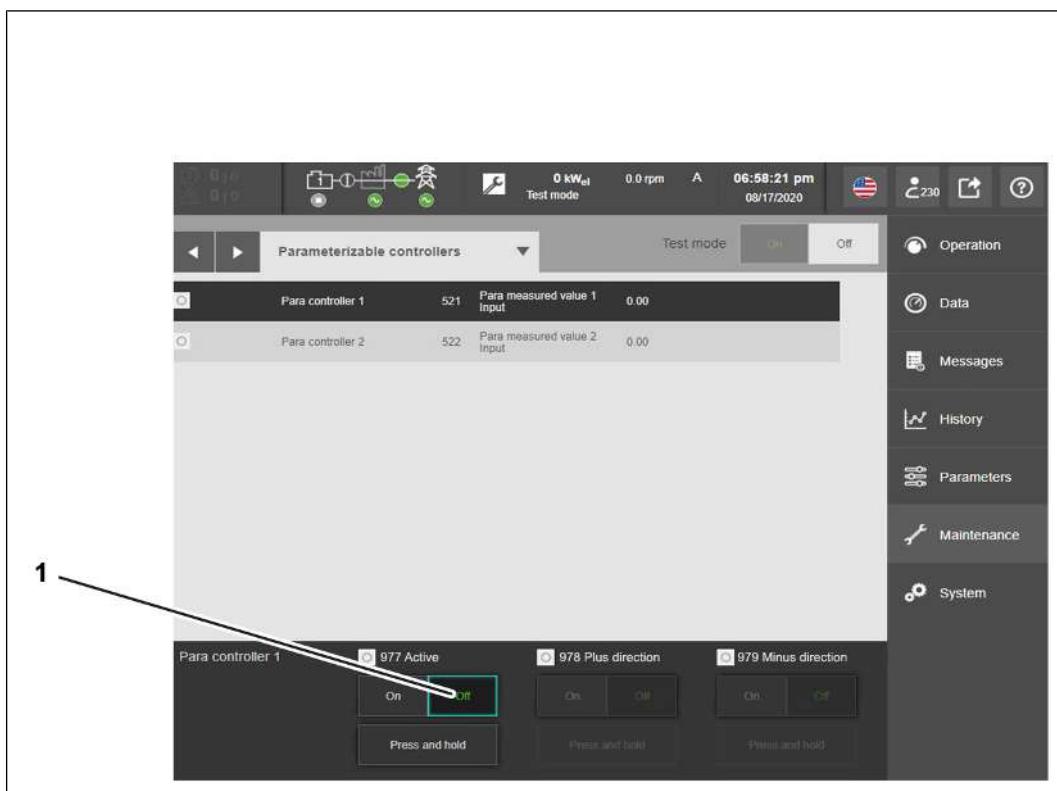
#### NOTE

- Perform the check for all additional parameterizable controllers according to the parameterizable controller 1 check



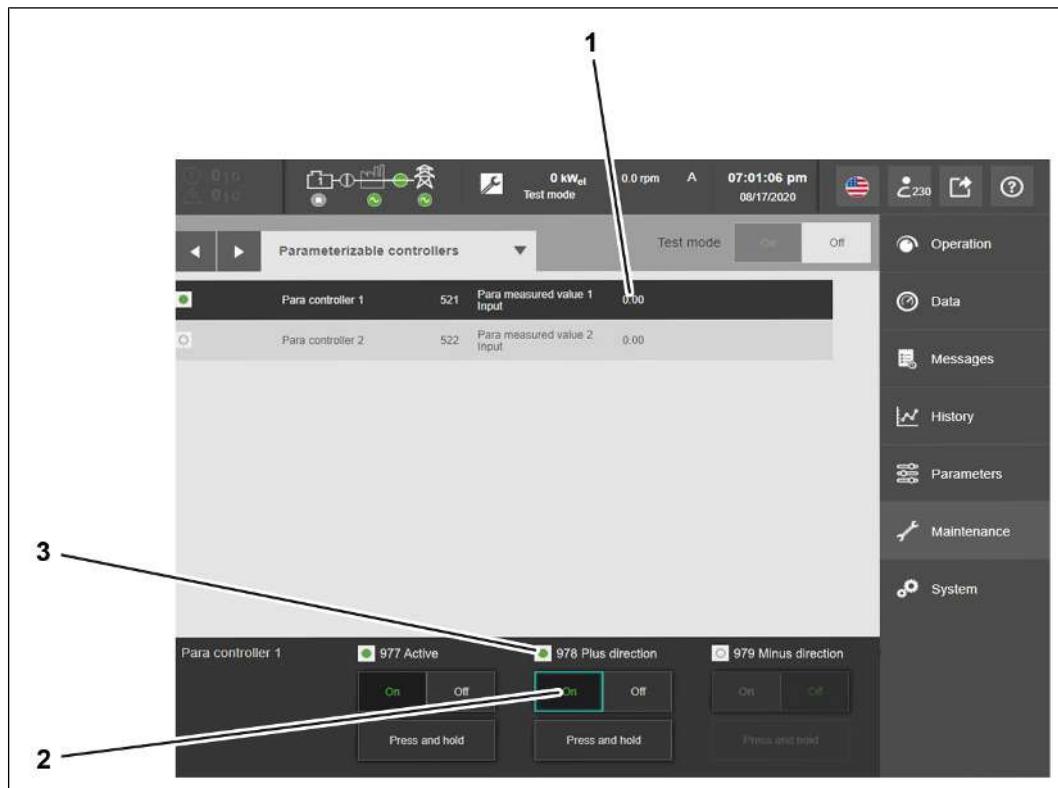
9007199560300683: Abbreviations used: Para controller

1. Tap the Para controller 1 (2) line in the pull-down menu
  - A measured value (3) is shown in the 521 Para measured value 1 Input dialog area.
2. Press the On (4) button
  - A green dot (1) appears in the Para controller 1 dialog area.
  - The font color in the On (4) button changes from white to green.
  - A green dot (5) appears in the Para controller 1 977 Para controller 1 Active dialog area. The output 114K3DO3 is demanded.
  - The current measured value (3) is shown in the 521 Para measured value 1 Input dialog area.



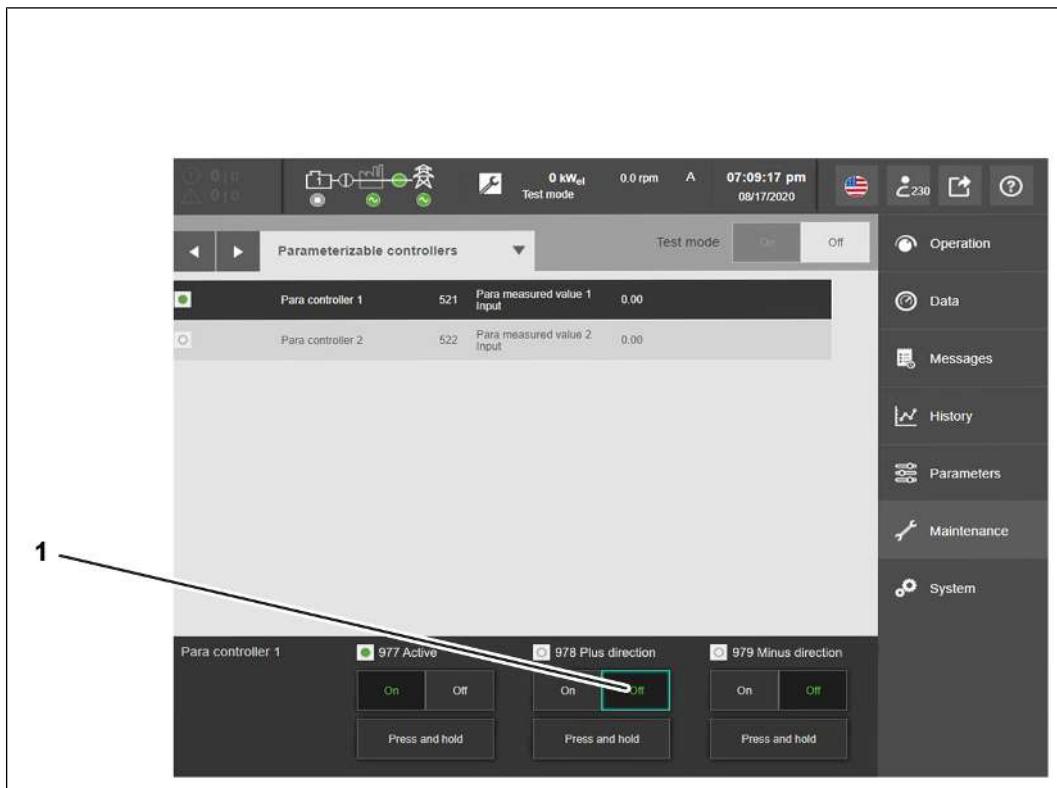
9007199560310411

3. Tap the **Off** (1) button
  - The **Off** (1) button font color changes from white to green. The output 114K3D03 is no longer demanded.



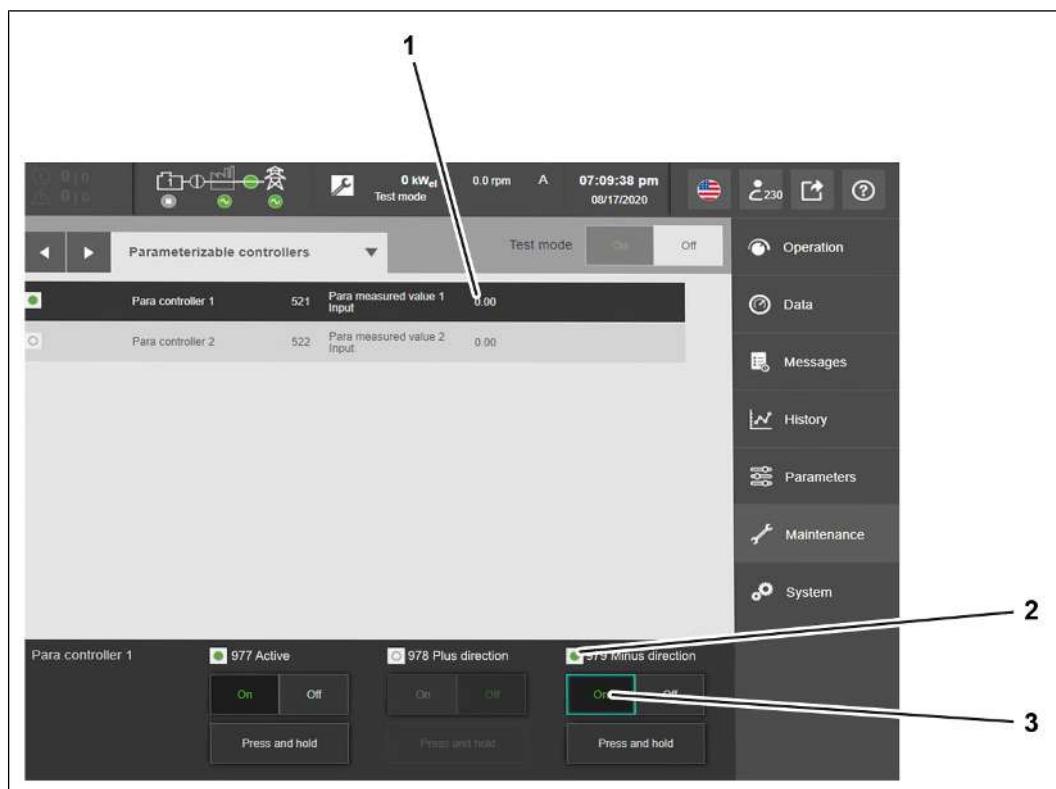
9007199560315275

4. Tap the On (2) button
  - The On (2) button font color changes from white to green.
  - A green dot (3) appears in the Para controller 1 978 Para controller 1 Plus direction dialog area. The output 114K3D04 is demanded.
  - An increasing measured value (2) is shown in the 521 Para measured value 1 Input dialog area.



9007199560325003

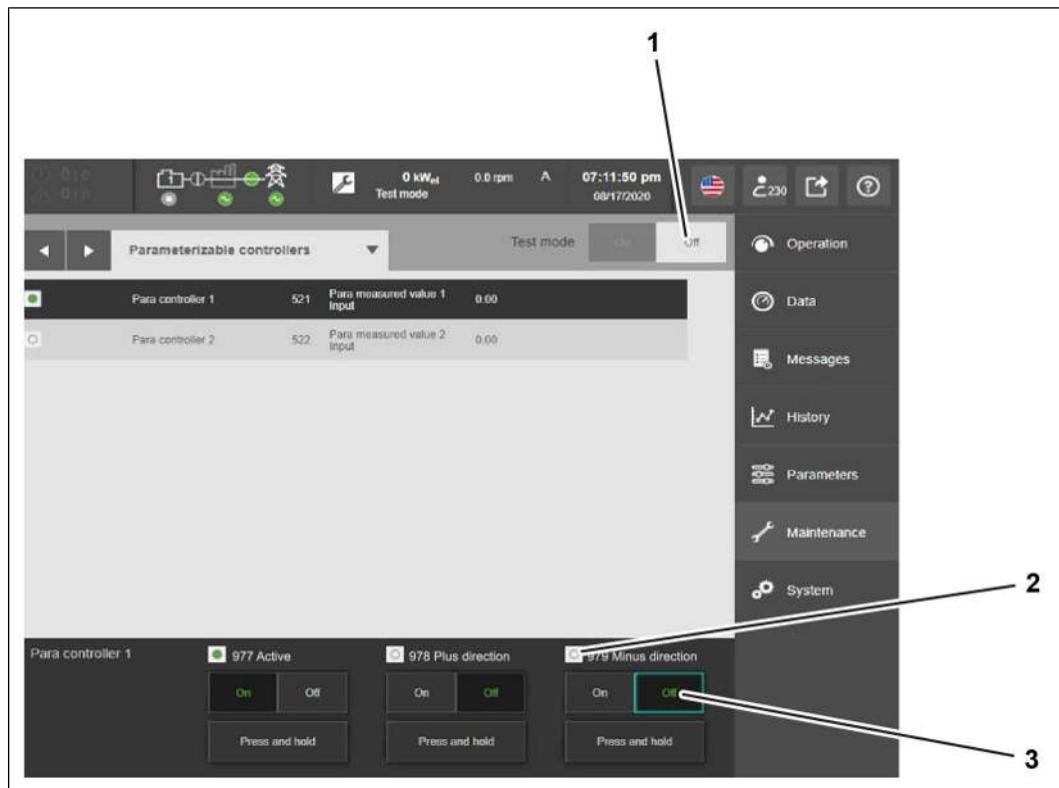
5. Tap the **Off** (1) button
  - The **Off** (1) button font color changes from white to green. The output 114K3D04 is no longer demanded.



9007199560329867

6. Tap the On (3) button

- The font color in the On (3) button changes from white to green.
- A measured value (1) appears in the 521 Para measured value 1 Input dialog area.
- A green dot (2) appears in the Para controller 1 979 Para controller 1 Minus direction dialog area. The output 114K3D05 is demanded.
- The 521 Para measured value 1 Input dialog area shows a decreasing measured value (1).

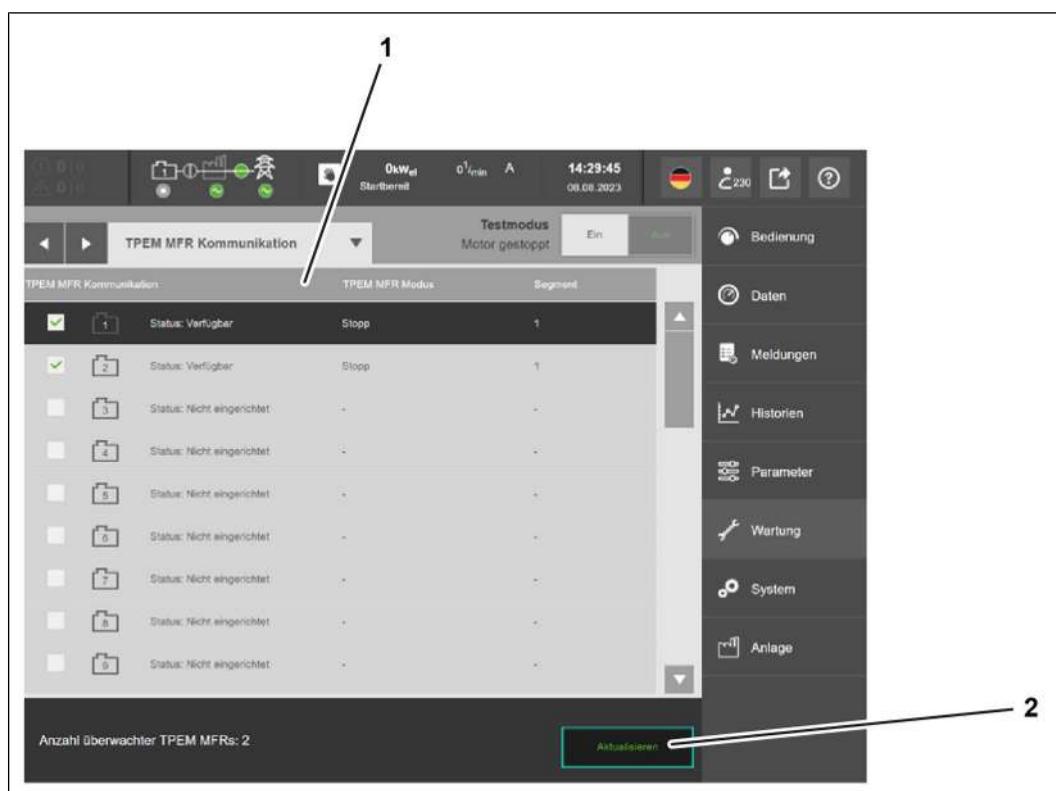


18014398815080587

7. Tap the **OFF** (2) button
  - The font color in the **OFF** (2) button changes from white to green. The output **114K3D05** is no longer demanded.
8. If you want to perform additional auxiliary drive tests, select and open the next auxiliary drive subgroup.
9. If you do not want to carry out any more auxiliary drive tests, press the **Test mode OFF** (1) button.
  - ⇒ The auxiliary drive test is finished.

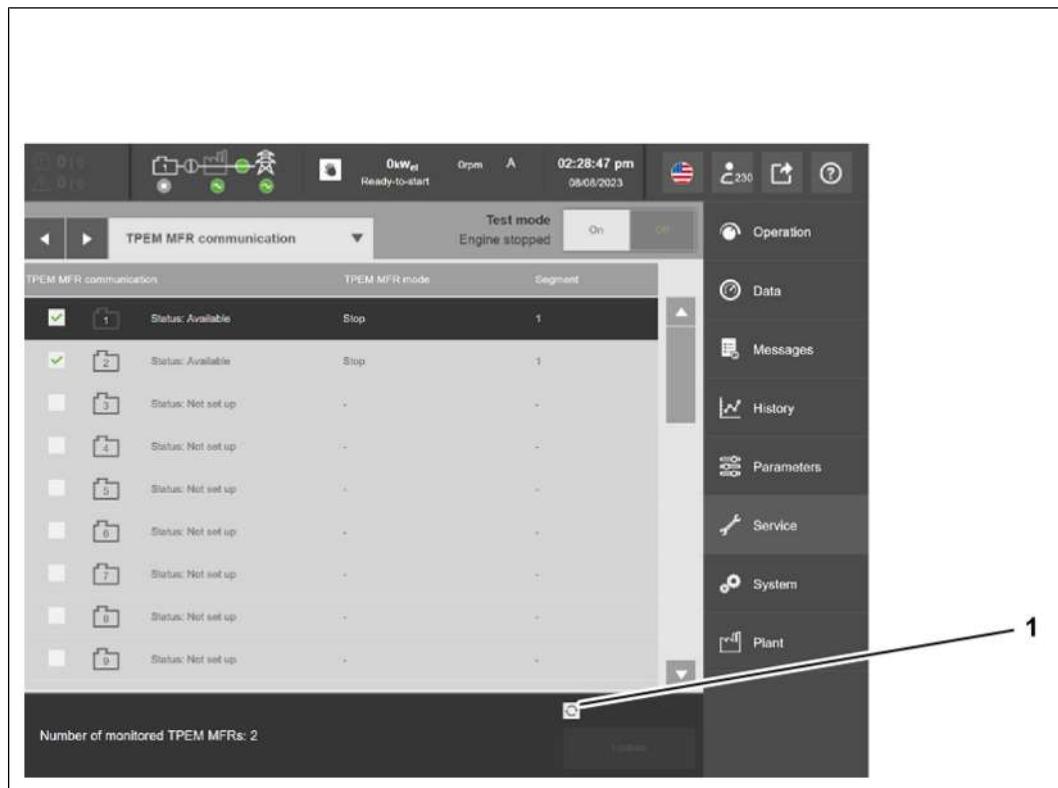
### TPEM MFR communication auxiliary drive test

Valid for:  
TCG 3016, TCG 3020



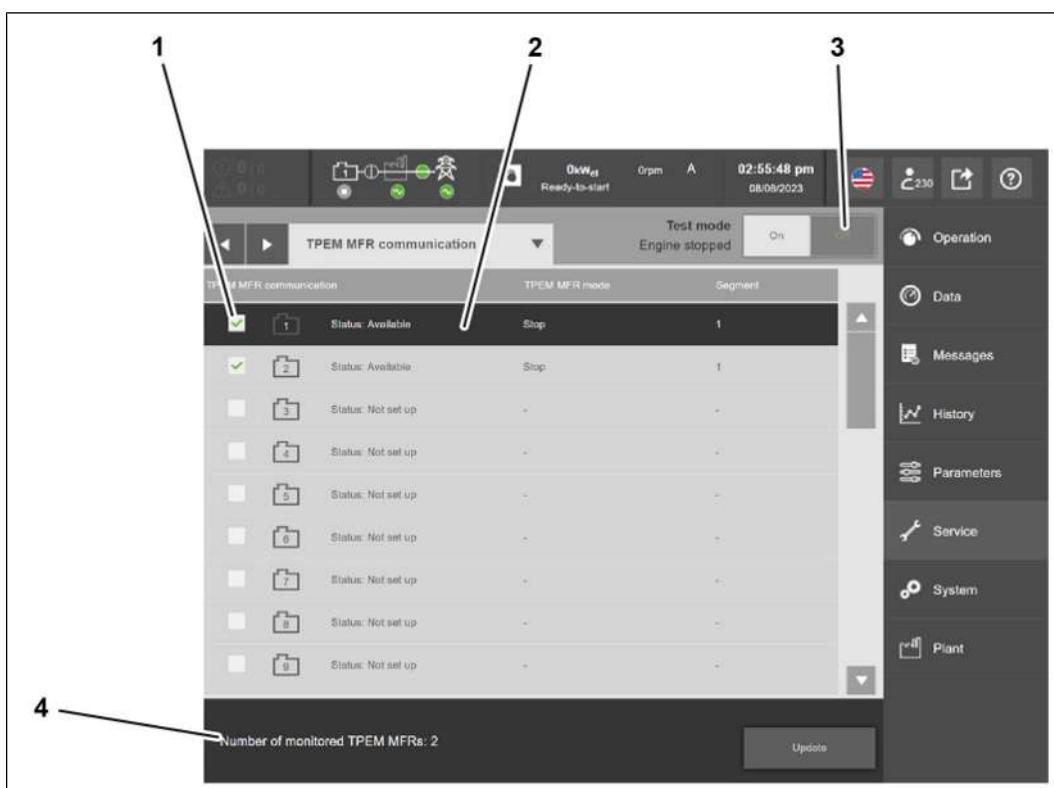
2806349195: Abbreviations used: TPEM MFR

1. The TPEM MFR communication dialog box displays all TPEM MFR device locations.
2. Tap the Update (4) button.
  - The font color in the Update (4) button changes from white to green.



2806544139

- A symbol (1) in the Number of monitored TPEM MFRs: dialog area indicates the duration of the check.



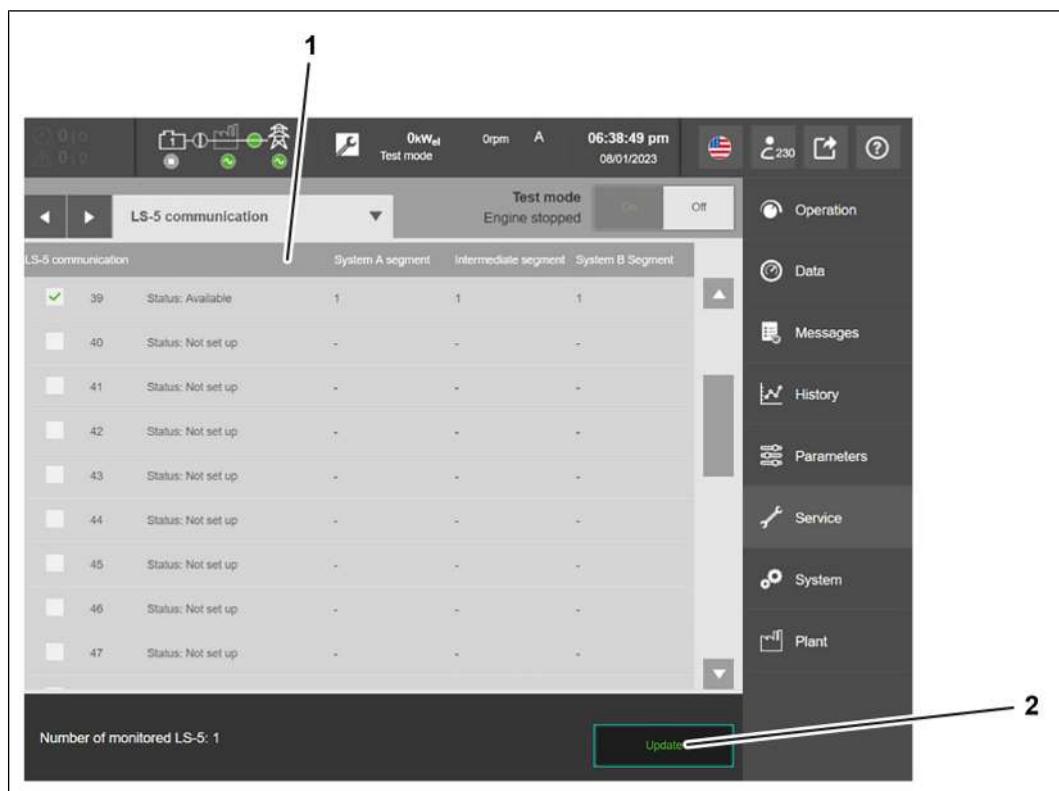
2806547083

3. Use the scrollbar to display all available TPEM MFR devices.
  - A green check mark (1) in the TPEM MFR communication (2) dialog area marks every available LS-5 device.
  - The Number of monitored TPEM MFRs: dialog area (4) shows the total number of available TPEM MFR devices.
4. If you want to perform additional auxiliary drive tests, select and open the next auxiliary drive subgroup.
5. If you do not want to perform any more auxiliary drive tests, press the Test mode Off (3) button.
  - ⇒ The auxiliary drive test is finished.

## LS-5 communication auxiliary drive test

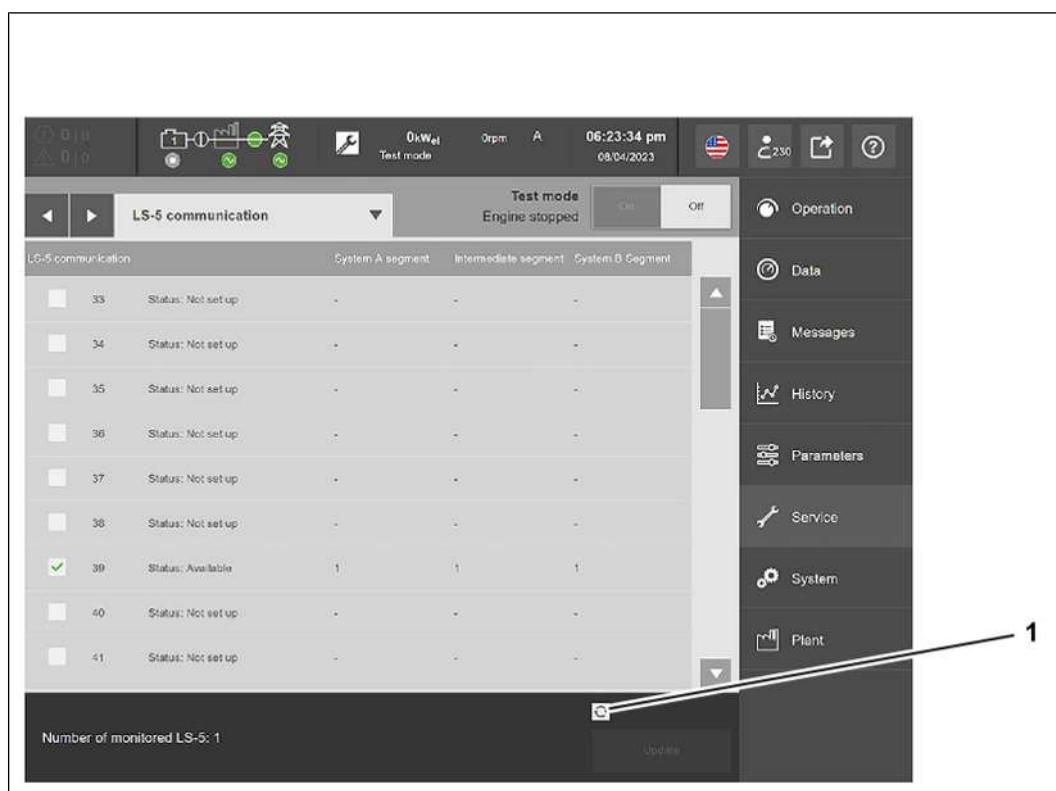
Valid for:

TCG 3016, TCG 3020



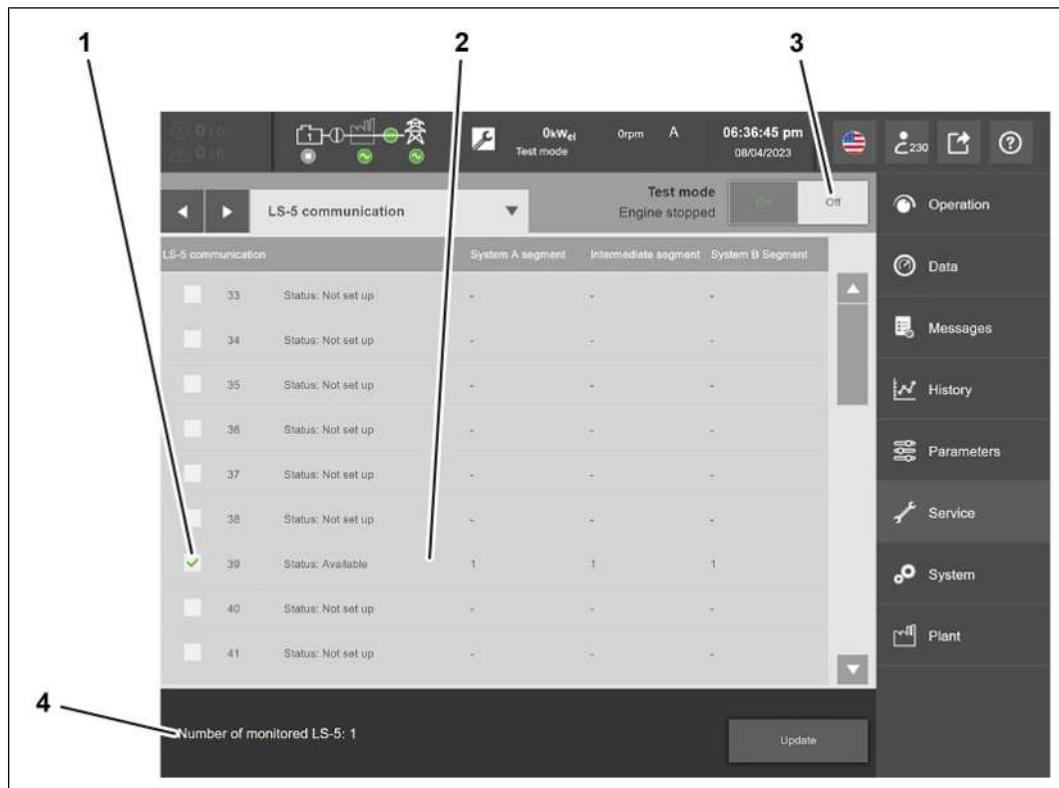
2804753675: Abbreviations used: LS

1. The LS-5 communication dialog box displays all LS-5 device locations.
2. Tap the Update (4) button.
  - The font color in the Update (4) button changes from white to green.



9007202058765707

- A symbol (1) in the Number of monitored LS-5: dialog area indicates the duration of the check.



2804552843

3. Use the scrollbar to display all available LS-5 devices.
  - A green check mark (1) in the LS-5 communication (2) dialog area marks every available LS-5 device.
  - The Number of monitored LS-5: dialog area (4) shows the total number of available LS-5 devices.
4. If you want to perform additional auxiliary drive tests, select and open the next auxiliary drive subgroup.
5. If you do not want to perform any more auxiliary drive tests, press the Test mode Off (3) button.
  - ⇒ The auxiliary drive test is finished.

## Idle tests auxiliary drive test

Valid for:

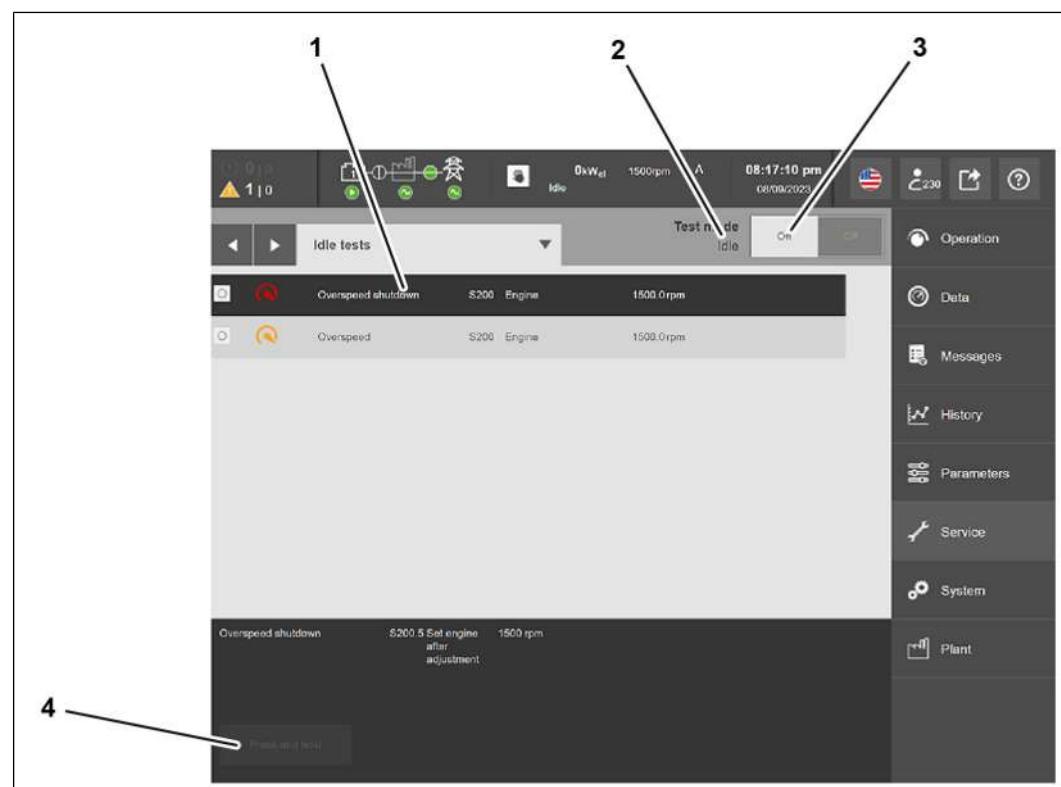
TCG 3016, TCG 3020

**NOTE**

The engine must be idle in order to be able to perform the Idle tests auxiliary drive test. The control system stops the idle state after 10 minutes. You can start the engine in idle mode again if necessary.

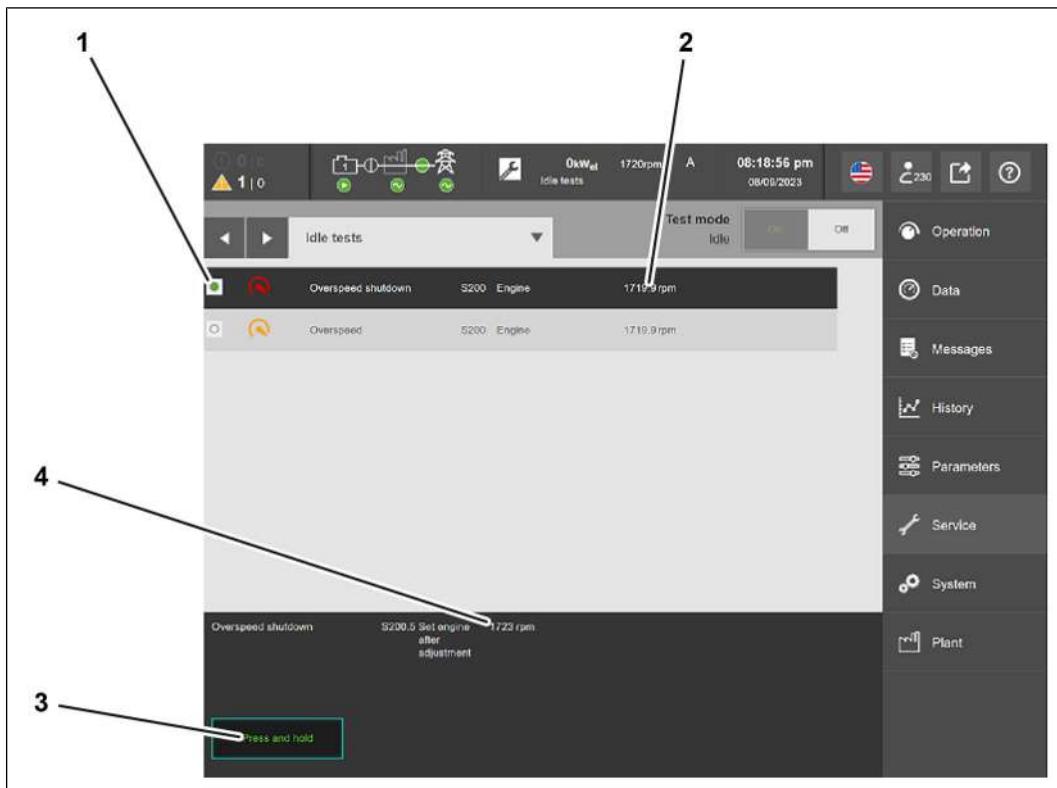
**Checking overspeed shutdown:**

- ✓ MANUAL operation mode is activated
- ✓ The generator circuit breaker (GCB) is open
- ✓ The engine is idling



2810213899

1. Tap the Overspeed shutdown (1) line in the pull-down menu.
2. **NOTE! If you cannot tap the On button, check whether Idle is displayed in the Test mode (2) dialog area. If Idle is not displayed, you must start the engine in idle mode.** Tap the On (3) button
  - The Press and hold (4) button is activated.

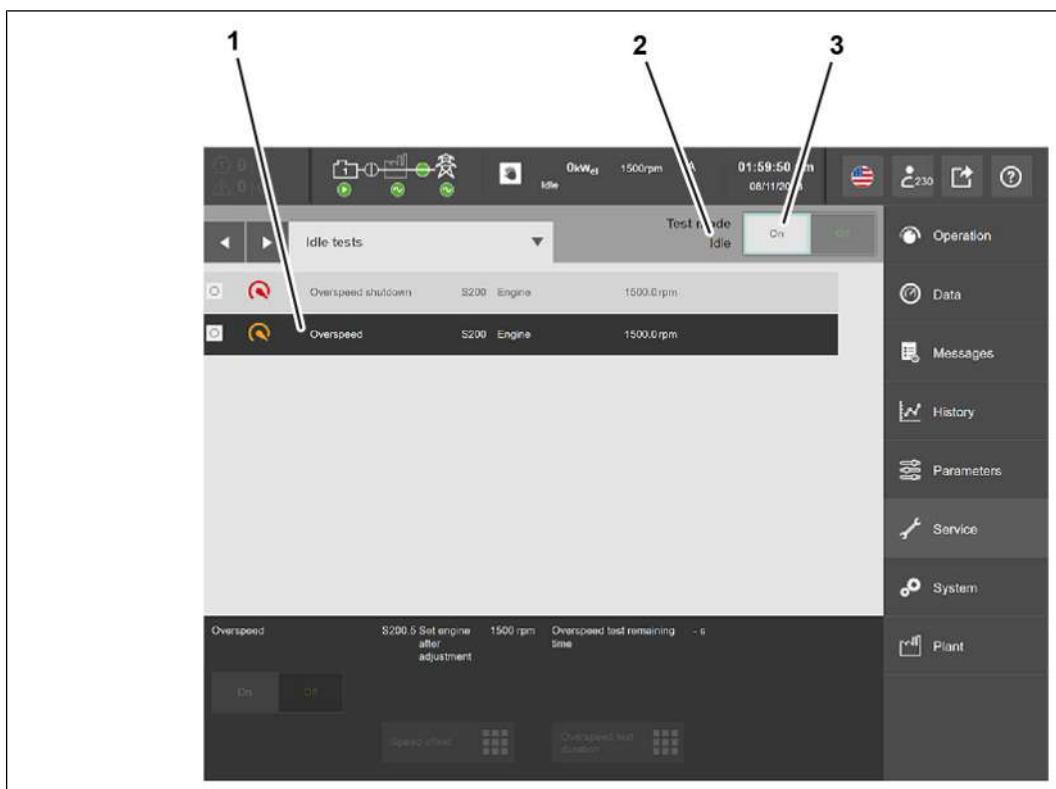


2809402635

3. Press the Press and hold (3) button and keep it pressed.
    - A green dot (1) appears in the Overspeed shutdown dialog area.
    - The speed (3) changes in the S200.5 Set engine after adjustment dialog area.
    - The speed (2) changes in the Overspeed shutdown dialog area.
- ⇒ The speed increases up to a threshold of max. 25 % above the rated speed. Before reaching this threshold, the control system must stop the genset and display a fault message.
- ⇒ If the control system does not stop the genset or does not display a fault message, contact your service partner.

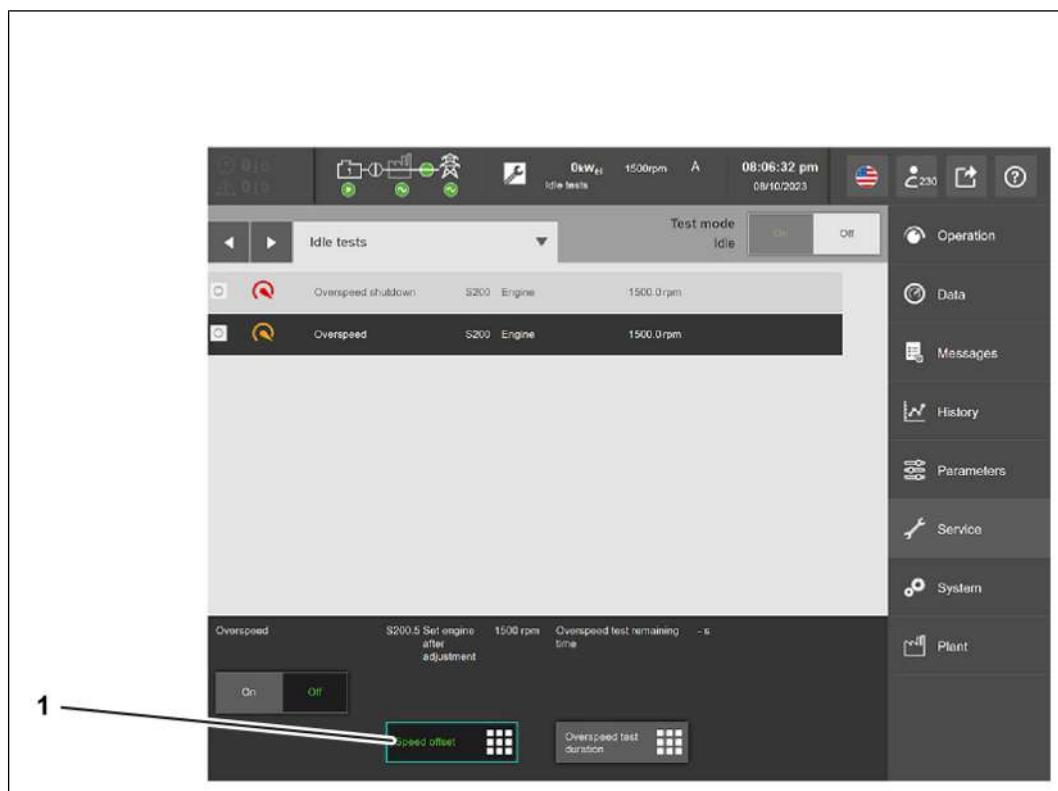
#### **Checking overspeed:**

- ✓ MANUAL operation mode is activated
- ✓ The generator circuit breaker (GCB) is open
- ✓ The engine is idling



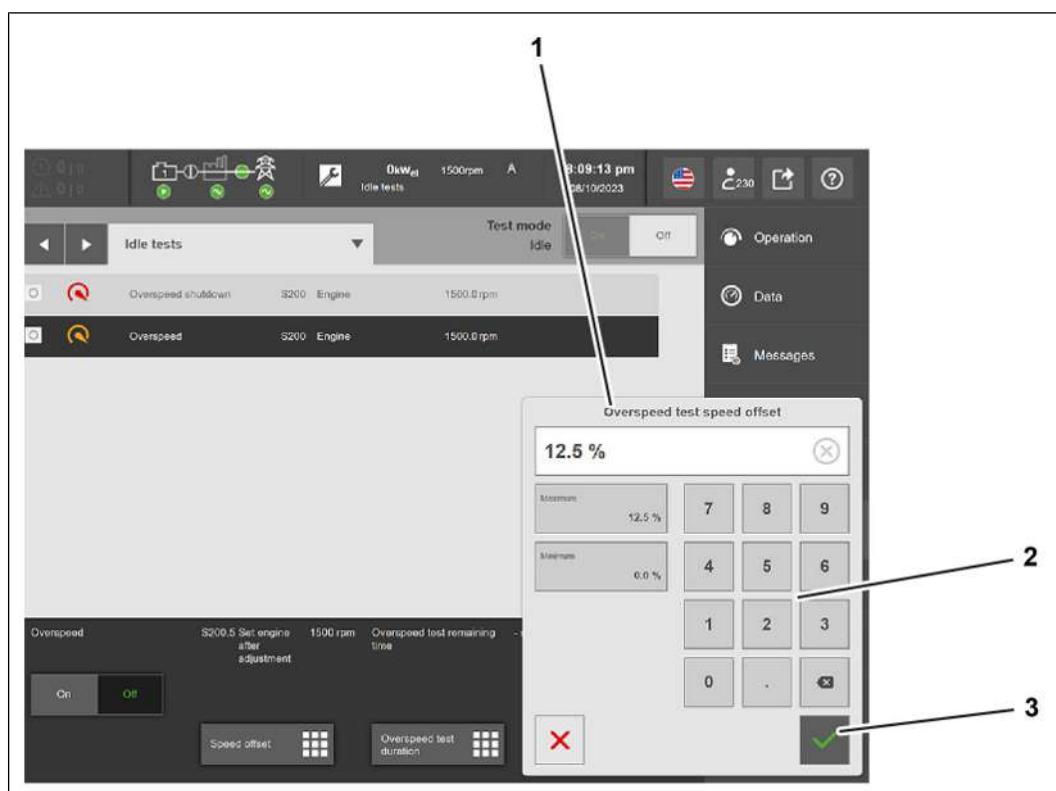
2814827787

1. Tap the Overspeed (1) line in the pull-down menu.
2. **NOTE! If the On (3) button is not activated, check whether Idle (2) is displayed in the Test mode dialog area. If Idle is not displayed, you must start the engine in idle mode.** Tap the On (3) button



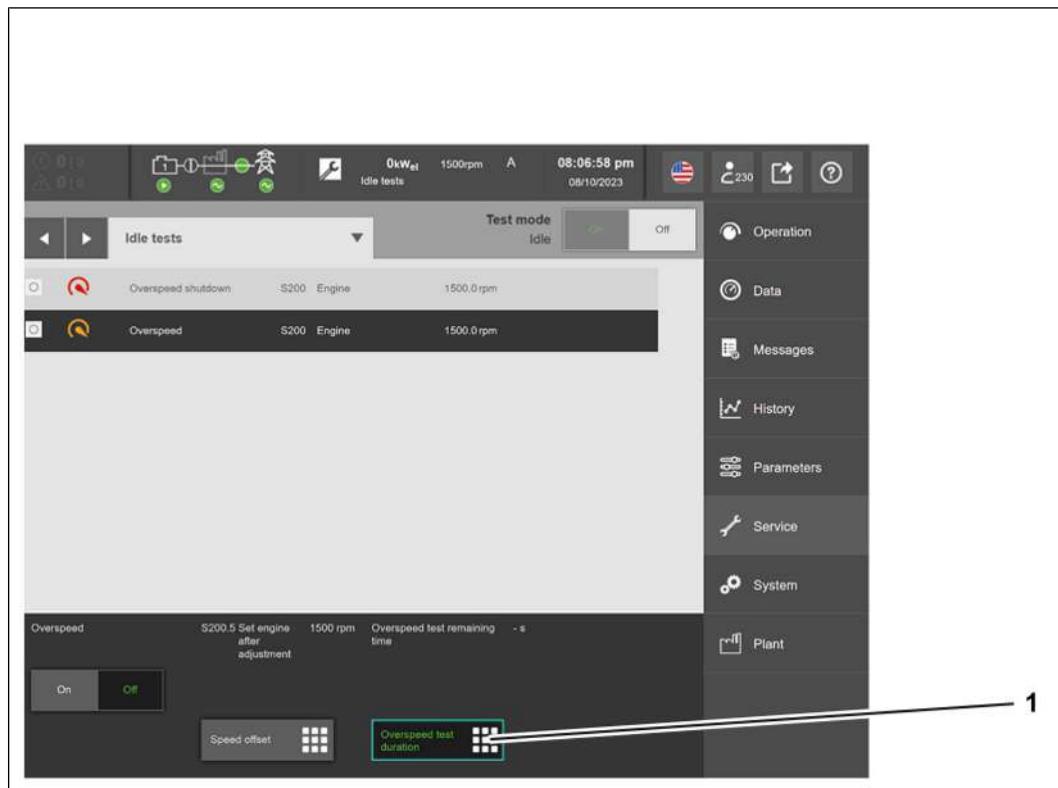
2812057099

3. Tap the Speed offset (1) button to set the speed offset.
  - The Overspeed test speed offset input mask opens.



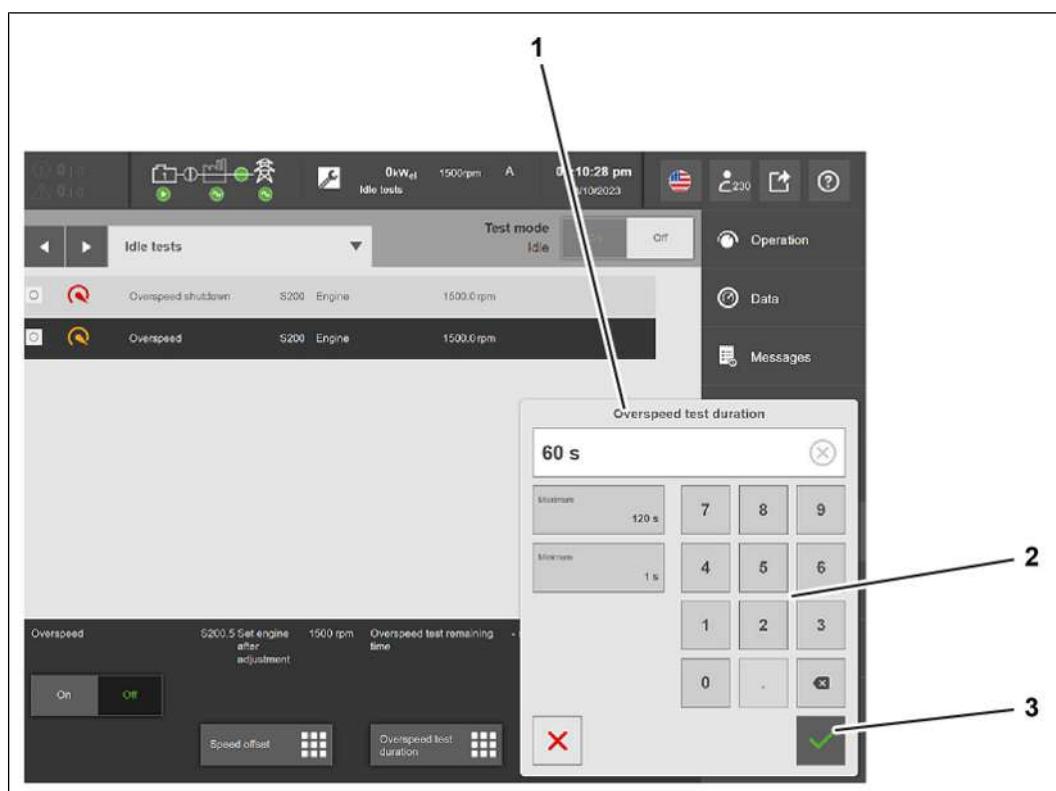
2814824843

4. Use the numeric keypad (2) to enter the desired speed offset as a percentage.
  - The input value must be between 0.0 and 12.5.
  - Tap the Accept input (3) button.
  - The Overspeed test speed offset (1) input mask closes.



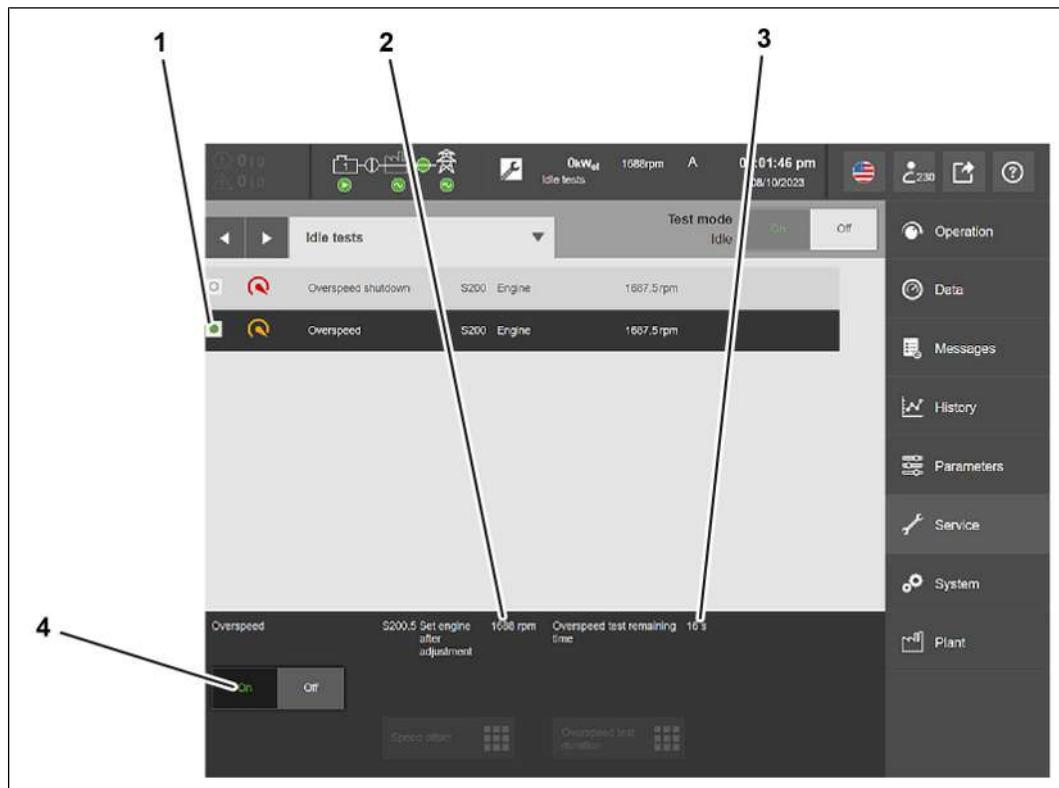
2812051211

5. Tap the Overspeed test duration (1) button to set the duration for the overspeed test.
  - The Overspeed test duration input mask opens.



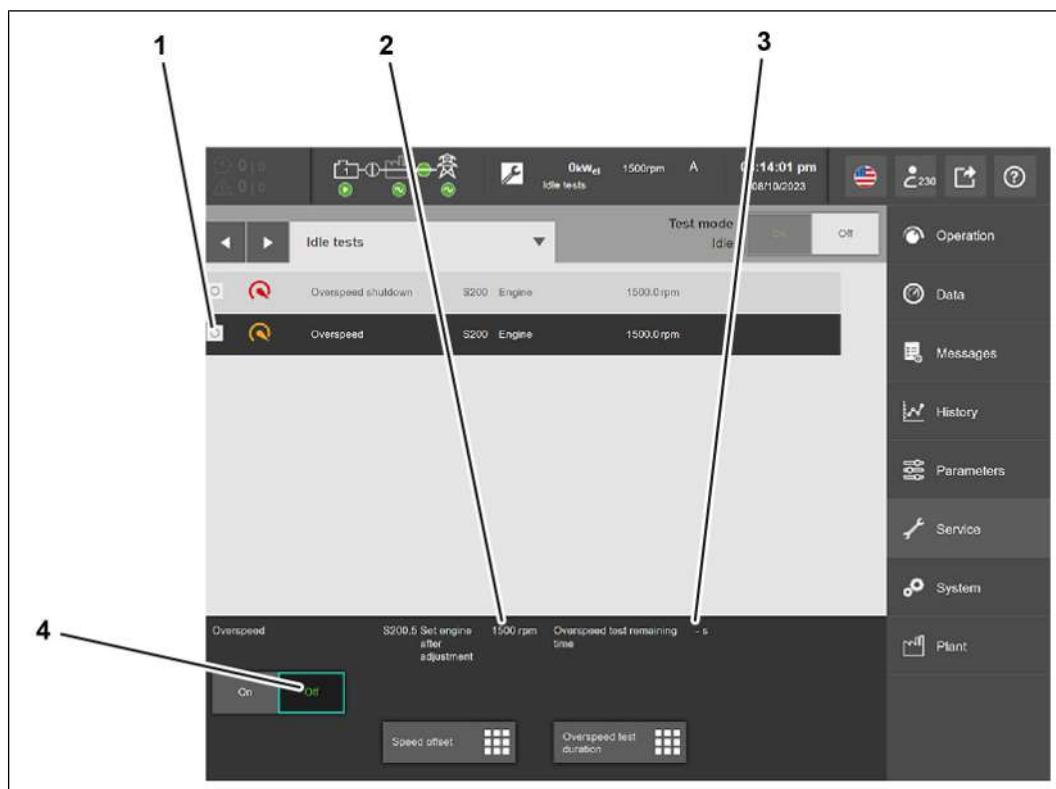
2812054155

6. Use the numeric keypad to enter the desired test duration in seconds.
  - The input value must be between 1 and 120.
  - Tap the Accept input (3) button.
  - The Overspeed test duration (1) input mask closes.



2814830731

7. Tap the On (1) button to start the overspeed test.
  - A green dot (1) appears in the Overspeed dialog area.
  - The speed continuously increases in the S200.5 Set engine after adjustment (1) dialog area until the overspeed that was set is reached.
  - Once the overspeed that was set is reached, the running time that was set for the overspeed test starts. The Overspeed test remaining time dialog area shows the residual running time.

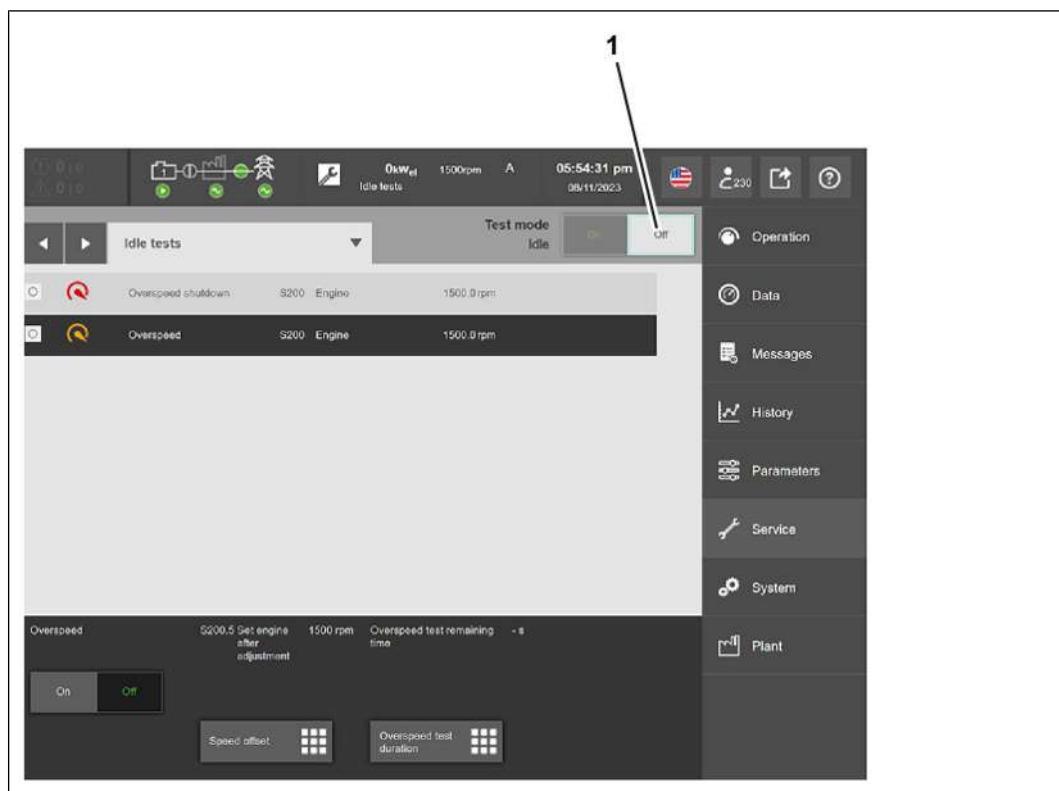


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8. You can stop the overspeed test by tapping the **Off** (4) button.
  - The green dot (1) disappears from the Overspeed shutdown dialog area.
  - The speed continuously decreases in the S200.5 Set engine after adjustment (2) dialog area until the rated speed is reached.
  - The Overspeed test remaining time (3) dialog area shows a dash.

⇒ The control system must not stop the genset or display a fault message during the overspeed test.

⇒ If the control system stops the genset or displays a fault message, contact your service partner.



2812048267

1. If you want to perform additional auxiliary drive tests, select and open the next auxiliary drive subgroup.
2. If you do not want to carry out any more auxiliary drive tests, press the test mode **OFF** (1) button.
  - The auxiliary drive test is finished.

## Checking the starting system

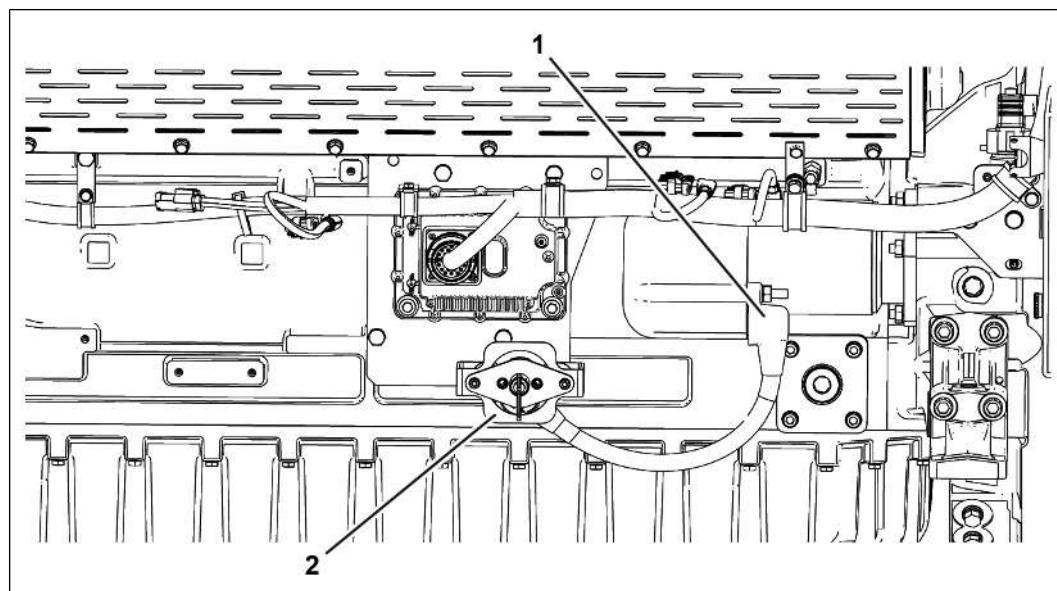
Valid for:

TCG 3016

### Implementation:

- ✓ [Decommissioning the genset \[▶ 146\]](#)

1. Check the battery terminals for tight fit



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2. Check the terminals on the battery disconnection switch (2) for a tight fit
3. Check the starter (1) terminals for tight fit
4. Visually inspect the components for damage
5. [Commissioning the genset \[▶ 134\]](#)

## Taking lube oil samples

Valid for:

TCG 3016



Tools:

- Standard tools
- Special tool
  - Lube oil sample containers with cover, acid-resistant, content min. 50 ml to max. 100 ml

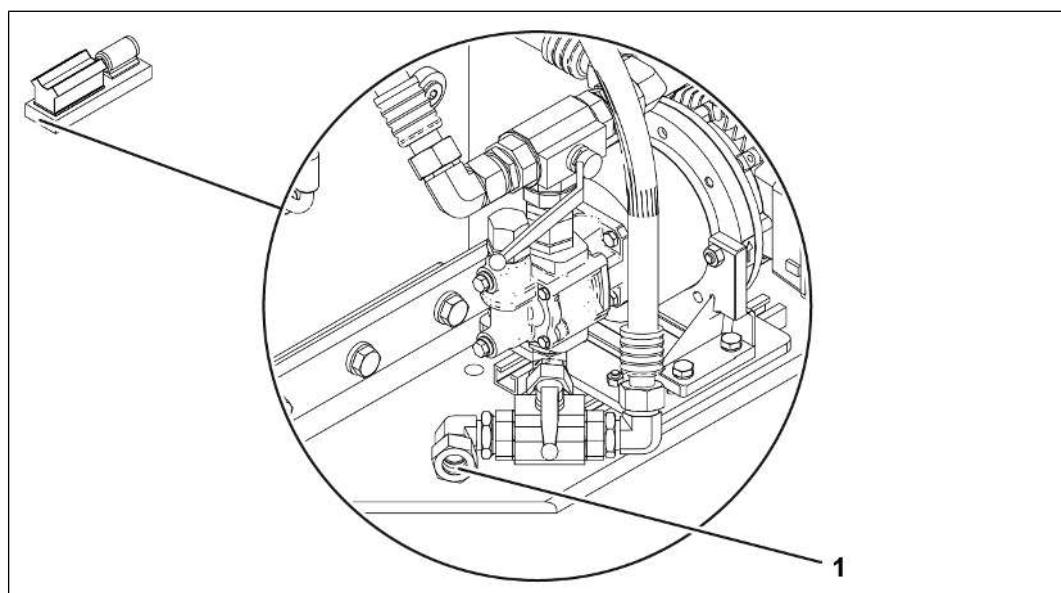
### Information on lube oil

The flawless operation and a good wear behavior of the engine depend essentially on the condition of the lube oil. The lube oil gives important information about the condition of the engine. An accurate inspection of the lube oil sample is only possible in a laboratory.

#### Procedure to follow:

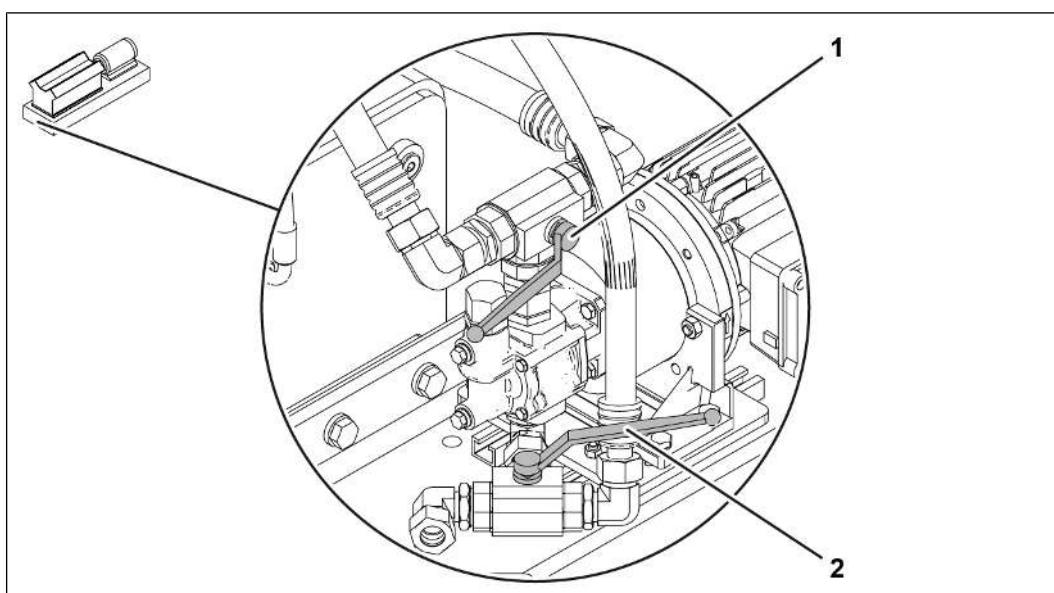
- ✓ Lube oil temperature is at least 60 °C

1. Stop the genset [► 144]



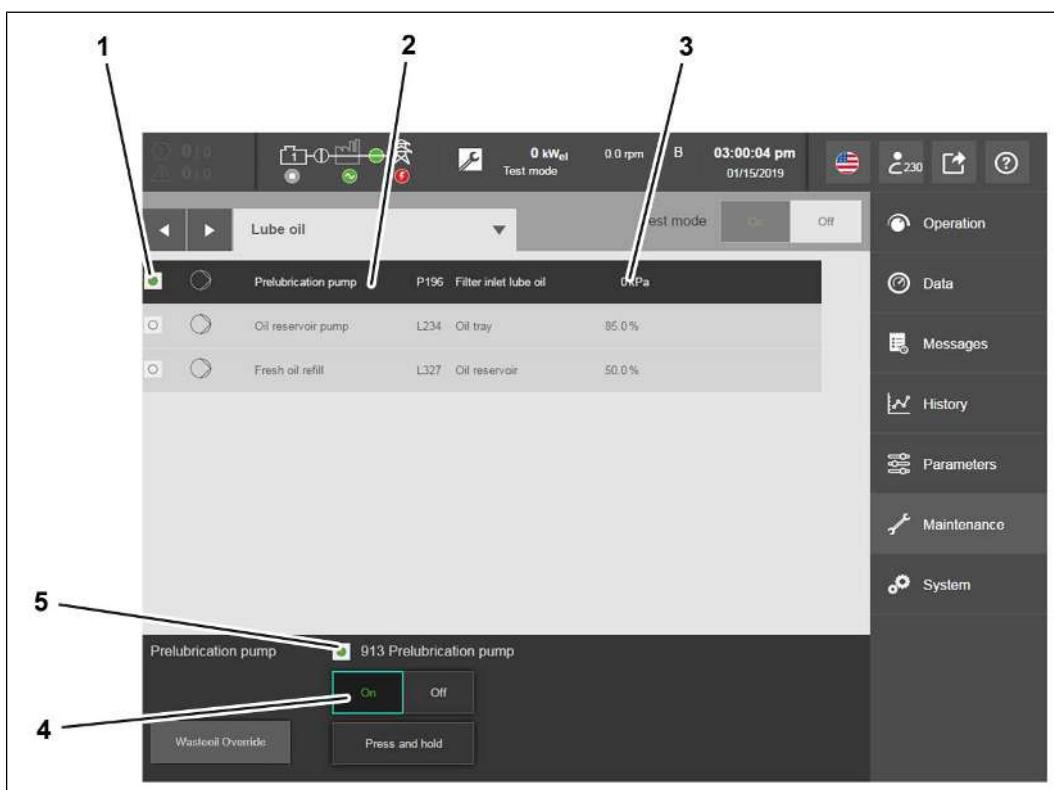
308116875

2. Put collecting tray under the connection (1).



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3. Set the valves of the prelubrication pump to position (1) and position (2)
4. Place the lube oil sample container under the valve
5. Starting the genset [▶ 143]

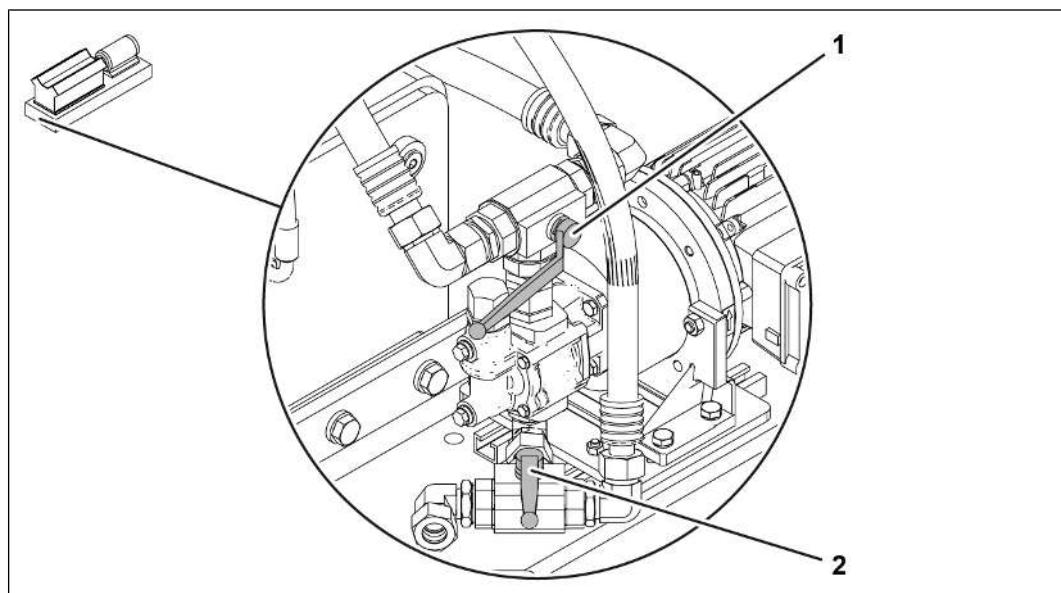


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6. In the functional group Lube oil, tap line Prelubrication pump (1)
7. Press the On (4) button
  - The font color in the On (4) button changes from white to green.

- A green dot (1) appears in the P196 Filter inlet lube oil (2) dialog area.
- The dialog area Prelubrication pump P196 Filter inlet lube oil (2) displays the value 0 kPa (3).
- A green dot (5) appears in the Prelubrication pump 913 Prelubrication pump dialog area.
- **CAUTION! Risk of burns from touching hot operating media. Do not reach into the escaping lube oil stream. Let the lube oil sample container cool down to the ambient temperature before touching it.** The lube oil is pumped from the lube oil sump into the lube oil sample container.

8. [Stopping the genset \[▶ 144\]](#)



308121739

9. Set the valves of the prelubrication pump back to position (1) and position (2)
10. [Starting the genset \[▶ 143\]](#)
11. Create the sample cover letter.
12. Send the lube oil sample container with the lube oil sample and the sample cover letter to the laboratory for the lube oil analysis
  - Pack the lube oil sample container in such a way that it will not be damaged.
13. Depending on the result of the analysis: [Perform a lube oil change \[▶ 314\]](#)

## Sampling the fuel gas

Valid for:

TCG 3016, TCG 2032, TCG 2020, TCG 3020



Tools:

- Standard tools

Sample bag (polyvinyl fluoride)



Auxiliary media:

- Extraction valve (stainless steel or nickel-plated brass)

Extraction hose (Teflon), length max. 0.5 m, diameter 6 x 1 mm

Adapter for connecting the bag

### **Additionally for non-natural gas:**

- Pressure measuring device

Temperature measuring device

Humidity measuring device

## General information

Fuel gas analyses must be clearly labeled. The fuel gas analysis must contain the fuel gas type in accordance with a selection of the analysis values. In case of doubt regarding the required scope of the analysis for the respective fuel gas type, contact service partner

For further information on analysis methods and analysis values, see the cover letter for fuel gas sampling.

- The form for documentation can be found in the Service Library [OL-MRA10 00-21-25 Measurement sheet for fuel gas sampling](#).

Use a sample bag made of polyvinyl fluoride for correctly taking a sample of the fuel gas.

- For further information, contact service partner.



## DANGER

Explosion due to gases which ignite.

This leads to severe injuries and even death.

- Sufficiently ventilate the room.
- Do not smoke.
- Do not use any naked flames.
- Use only ATEX-approved devices and tools.
- Only qualified specialist personnel may work on the fuel gas system.

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**NOTE**

Condensate ruins the fuel gas sample taken

Condensate can ruin the result even if it was drained before taking the sample and the fuel gas is visually dry.

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**Sampling the fuel gas:**

- ✓ The genset is in operation.
  - ✓ The fuel gas production has been running for at least three hours.
  - ✓ The engine load is 100 % (full load).
  - ✓ The gas volume flow must be at least 75 % of the operating volume flow which occurs at full load operation of the gas engine system.
  - ✓ The sample bags and extraction hose for fuel gas sampling must be made of polytetrafluoroethylene (PTFE), e.g. Tedlar film.
  - ✓ The extraction hose is made as short as possible.
  - ✓ All the surfaces which come in contact with the fuel gas during sampling are free from deposits (dirt, condensate).
  - ✓ In the piping, the fuel gas temperature is maximum 50 °C. There is a risk of condensate formation in case of large differences between the ambient temperature and the fuel gas temperature. In order to prevent condensate formation, heat the sampling valves if necessary.
  - ✓ All valves which come into contact with the fuel gas sample are designed in stainless steel or nickel-plated brass.
  - ✓ The sampling point of the fuel gas sample is in the fuel gas line upstream of the engine (excess pressure range).
  - ✓ In the case of landfill gas installations, ensure that the intake pressure when taking the fuel gas sample is at a similar order of magnitude as the intake pressure at full-load operation.
  - ✓ In the case of landfill gas installations, sampling is only usable from gas collecting lines.
1. Select a line section for the sampling point (2) of the fuel gas sample
    - Gas must constantly flow through the line section and the line section must be free of condensate. Falling or rising pipes are very suitable (3).
    - In case of horizontal pipes (1), select a sampling point (2), which diverges from the pipe upwards or laterally
    - In case of sampling points (4) which e.g. diverge downwards, there is the danger of condensate accumulating in the fuel gas sample.
  2. Connect the sample bag (1) with the extraction hose (4) to the valve (2) of the sampling point

- 
3. Open the ball valve (3) of the valve
  4. Fill the sample bag (1) with the fuel gas sample
  5. Close the ball valve (3) of the valve
  6. Remove the sample bag (1) from the extraction hose (4) and close it securely
  7. Remove the extraction hose (4) from the valve (2)
  8. Fill out the sample cover letter
    - Always specify the deviations from the prerequisites described above while taking a sample of the fuel gas ⇒ see Appendices b, cover letter for the fuel gas sampling.
  9. Send the sample bag (1) and sample cover letter for the fuel gas analysis to a certified laboratory
    - Pack the sample bag (1) so that it is not damaged.

## Checking pollutant emissions in the exhaust gas (TPEM)

Valid for:  
TCG 3020, TCG 3016

Tools:

- Recommended measuring devices
  - TESTO 340
  - TESTO 350 XL or Ecom D

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### NOTE

Dual gas operation requires separate parameter settings for each type of gas being used. For exhaust emissions measurements in dual gas operation, consult your service partner.

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### Notes on the purpose of nitrogen oxide measurement

When operating the product, you must comply with locally applicable laws, regulations, ordinances, and directives regarding emission protection. The nitrogen oxide level ( $\text{NO}_x$ ) in the exhaust gas is a reference value for emission protection.

The operator is required to conduct emission measurements in order to prepare for measurements by an accredited body. The operator's emissions measurements are not a replacement for measurements carried out by an accredited body.

Adjust the engine to the available fuel gas based on the measured nitrogen oxide concentration. In this way, you can adjust the mixture ratio of your gas-air mixture to make it either richer or leaner.

### Notes on measurement devices

In order to properly measure the nitrogen oxide level, use a measuring device capable of measuring at least the values of the following gas components **at the same time**:

- Oxygen (O) in volume percent (% by vol.)
- Nitrogen monoxide (NO) in parts per million (ppm)
- Nitrogen dioxide ( $\text{NO}_2$ ) in parts per million (ppm)

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Caterpillar Energy Solutions GmbH recommends the use of one of the measuring devices listed above.

### **Notes on the target group**

The operator will require access authorization Level 100 in order to change the parameters. After the completion of a training module, the operator receives access authorization in the form of a personalized TPEM USB token.

After the exhaust gas measurement, have the engine settings adjusted only by persons qualified and trained by the manufacturer.

The required information on training options can be found on the homepage <https://www.mwm.net/en/trainings/learning-center-service/seminar-program/>

### **Notes on the exhaust gas measurement process**

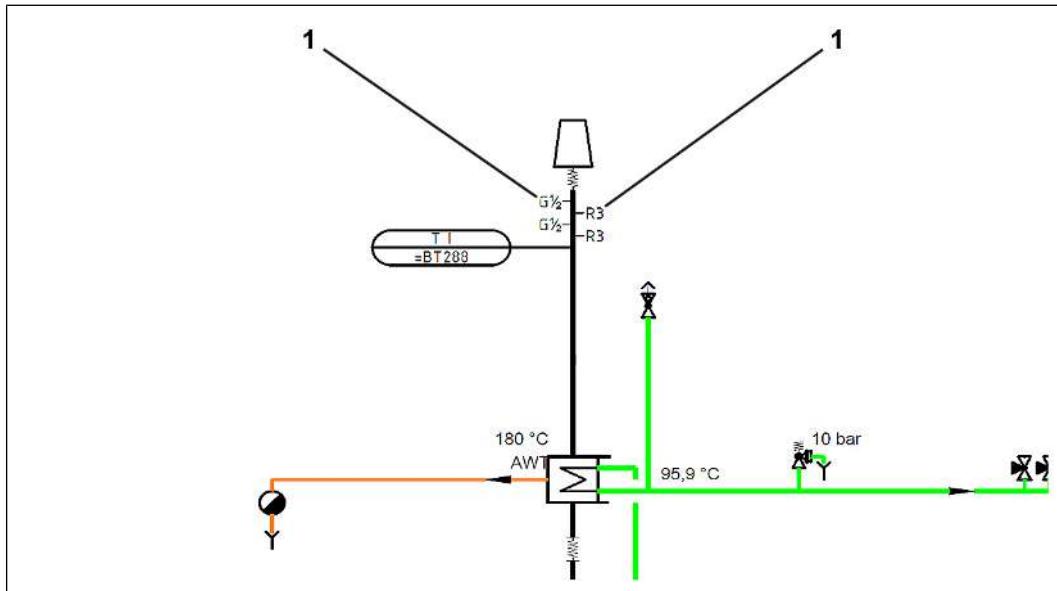
For a relevant exhaust gas measurement, the exhaust system must have heated up to operational temperature. Before starting the exhaust gas measurement, the genset must run at 100 % load until all operation values have reached steady state.

The genset must run in grid-parallel operation. In certain cases, however, the genset can only run in island operation if, for example, no mains connection is present. The operator must ensure that the genset runs in stationary mode without any change to the load.

To obtain relevant nitrogen oxide values during exhaust gas measurement, you must perform multiple measurements in the standard operational load range. Operationally relevant load ranges run between a minimal continuous power of 50 % and the maximum

power of 100 %. Notes on the operationally relevant load ranges are provided in the genset data sheet. You will find the document in the chapter [Technical data \[▶ 11\]](#) in the order-specific operating manual.

### Selecting an emissions-relevant measuring point



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1. You will find a suitable gauge fitting (1) for the exhaust gas measurement in the exhaust line in front of the flue opening.
  - You will find further information on the installation location of the gauge fitting (1) in the P&I diagram. You will find the document in the chapter [P&I diagram](#) in the order-specific operating manual.

### Performing an emissions-relevant exhaust gas measurement

- ✓ [Starting the genset \[▶ 143\]](#)
  - ✓ Parameter 20260431 T combustion chamber Set 2 control type is Grid-parallel / Island changeover. You will find further information on the parameters in the parameter description. You can find the document in the chapter [Control system](#) in the order-specific documentation and in the Service Library.
  - ✓ Exhaust system has warmed up to operating temperature
  - ✓ Instrumentation has been calibrated according to manufacturer instructions
  - ✓ Work in pairs
1. Select a measuring point on the on-site exhaust line.
  2. **CAUTION! Touching hot components can cause minor to severe burns. Wear fireproof gloves.** Unscrew the sealing plug from the measuring point



676409355

3. Check whether the genset is running with the highest operation-relevant load (maximum load: 100 %)
  - Push the measuring sensor (2) into the measuring point.
  - Start the measuring procedure.
  - **NOTE! The procedure for exhaust gas measurement depends on the measuring device used. Observe the instructions from the manufacturer.** Read and document measurement results from the display (1).
4. Repeat the measurement procedure for the following load ranges:
  - Average operation-relevant load (ideal load: 75 %)
  - Minimum operation-relevant load (minimum recommended load: 50 %)
  - Minimum load (minimum load: >30 % in automatic operation)
5. Assess the result after each measurement. See section *Assessing the measurement result*.
6. After each measurement, correct the nitrogen oxide concentration according to the measurement result. See section *Correcting nitrogen oxide concentration in the exhaust gas*.

#### **Assessing the measurement result**

1. **NOTE! The oxygen concentration depends on the type of fuel gas. When biogas is used, the oxygen concentration is approx. 7 percent by volume. When using natural gas or mixtures of natural gas and hydrogen, the oxygen concentration is approx. 11 percent by volume.** Assess the oxygen concentration
  - An excessive oxygen concentration indicates external fresh air intake or an incorrect engine setting. Remedy the cause of the problem and repeat the measurement.

- Too low oxygen concentration indicates an incorrect engine setting or a defective measuring device. Remedy the cause of the problem and repeat the measurement.
2. Convert the nitrogen oxide values' unit of measurement:
    - $\text{NO (ppm)} + \text{NO}_2 \text{ (ppm)} = \text{NO}_x \text{ (ppm)}$
    - $\text{NO}_x \text{ (ppm)} \times 2.05 (21 \% - 5 \%) / (21 \% - O_{2 \text{ meas}}) = \text{NO}_x \text{ mg/m}^3$
  3. If the measurement result is incorrect, you must correct the combustion chamber set temperature.

#### **Correcting nitrogen oxide concentration in the exhaust gas**

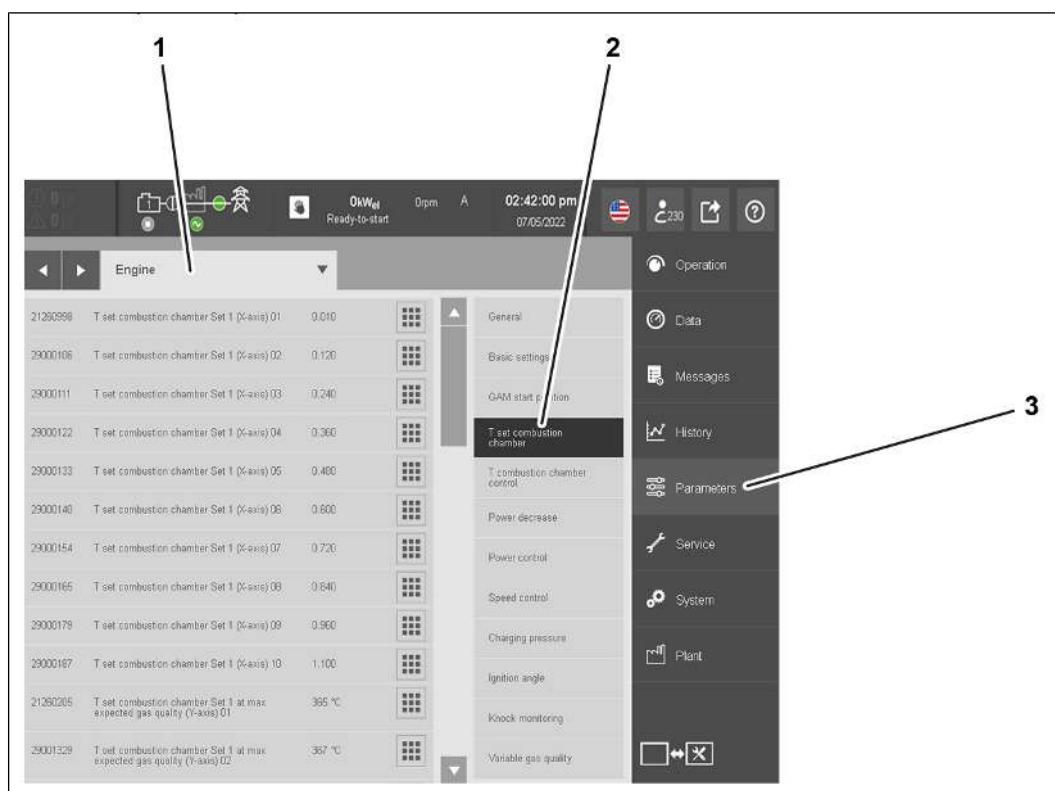
**NOTE! If you have measured a nitrogen oxide value higher than the value specified in the genset data sheet, you must lower the combustion chamber set temperature. If you have measured a nitrogen oxide value lower than the value specified in the genset data sheet, you must raise the combustion chamber set temperature.**

Additional information on adjusting the combustion chamber set temperature for special gas types or operating modes can be found in the following Service Bulletins:

- For information about the TCG 3020 series, see Service Library, Service Bulletin (SM 6643) [Reduction of the combustion chamber temperature](#).
- For information about all other series, see Service Library, Service Bulletin (SM 6643) [Setting Values and Mode of Operation for Biogas](#).

For more information, contact your service partner.

- ✓ Measuring device is connected to the measuring point and is in operation.
1. **CAUTION! The operator must take into account deviating nitrogen oxide values when operating the genset. Deviating nitrogen oxide values cause environmental damage and engine damage. The operator must maintain the nitrogen oxide values specified in the genset data sheet.** Compare the converted nitrogen oxide value with the genset-specific value
    - The genset-specific value is indicated on the genset data sheet. You can find the document in the chapter [Technical data \[▶ 11\]](#) in the order-specific operating manual.



960779019

2. Adjust the combustion chamber set temperature.
  - Open the functional group **Parameters** (3).
  - Select the subgroup **Engine** (1).
  - Select the function **T set combustion chamber** (2).



960773771

3. Select the corresponding parameter depending on the gas quality.

#### NOTE

10 load points are defined for each combustion chamber set temperature characteristic curve. The load points are defined as a function of the respective gas quality. The intervals between the load points correspond to a load change of 10 %. For example, given a maximum expected gas quality, if you want to change the combustion chamber set temperature for the 20 % load range, select the parameter 29004787 T set combustion chamber Set 2 at max expected gas quality (Y-axis).

- Use the scroll bar (5) to navigate to the desired parameter, e.g. T set combustion chamber Set 2 at average expected gas quality (Y-axis).
- Tap the symbol (2) in the dialog area T set combustion chamber Set 2 at max expected gas quality (Y-axis) (1). The input mask opens.

---

**NOTE**

The load points for the existing combustion chamber set temperature characteristic curve must be adjusted upward if the hydrogen concentration is 10 vol % or higher.

At a nitrogen oxide value of 250 mg, the load points must be increased once by at least 30 Kelvin. At a nitrogen oxide value of 500 mg, the load points must be increased once by at least 15 to 30 Kelvin. Perform subsequent fine-tuning in increments of 2 to 3 K as described below.

If the hydrogen content of the natural gas changes, you must re-adjust the load points to maintain the desired emission values.

---

- Use the keypad (3) to adjust the combustion chamber set temperature in increments of 2 to 3 K.
  - Confirm entry by pressing the green check mark (4).
4. After each change, allow the genset to continue running unaltered for at least 5 minutes.
  5. Measure the nitrogen oxide concentration in the exhaust gas.
    - Perform the exhaust gas measurement as described above.
  6. Continue to adjust the combustion chamber set temperature according to the measurement result, if necessary.
  7. **NOTE! The combustion chamber set temperature characteristic curve must have a continuous contour. The combustion chamber set temperature characteristic curve must not have any discontinuities.** Adjust the combustion chamber set temperature for the neighboring load points if necessary
  8. Repeat the procedure until the required nitrogen oxide limit has been reached.
    - The nitrogen oxide limit has been met when the nitrogen oxide measurement plus the measuring instrument's measurement error are cumulatively below the nitrogen oxide limit.
- ⇒ **NOTE! The setting is for stationary operation. In transient operation, the emissions may deviate from the configured nitrogen oxide values.** The exhaust gas measurement is complete, and the nitrogen oxide value has been set.

## Visually inspecting the rubber expansion joints

Valid for:

TCG 3016



Tools:

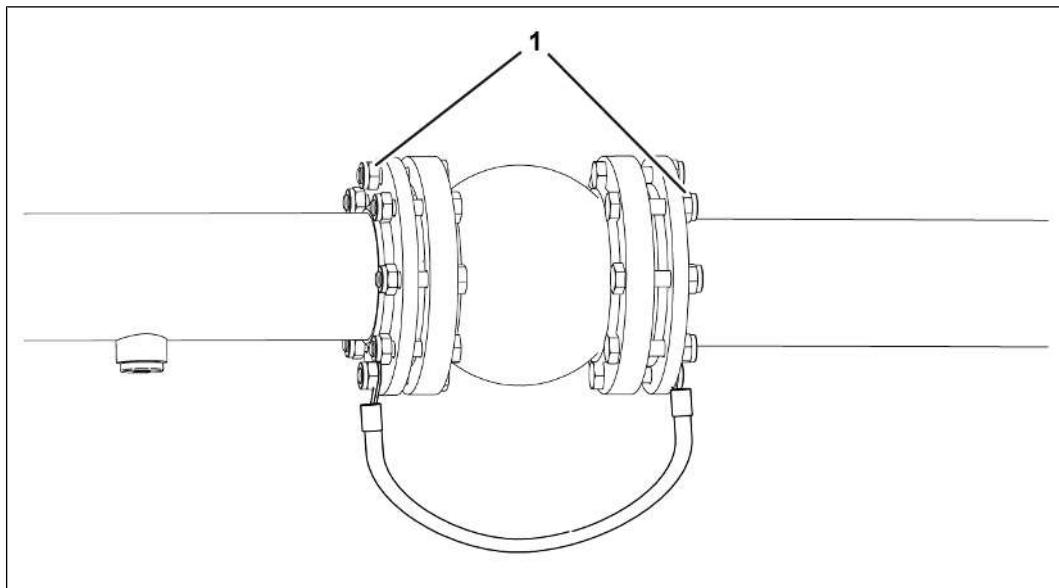
- Standard tools



Auxiliary media:

- Standard cleaning agent
  - Soap etc.

### Technical data



309646219

Rubber expansion joint on flange		
1	DN 40/50	15 Nm
	DN 65/80/100/125	20 Nm
	DN 150	25 Nm

### Procedure to follow:

- ✓ Decommissioning the genset [▶ 146]



### Risk of destruction of components

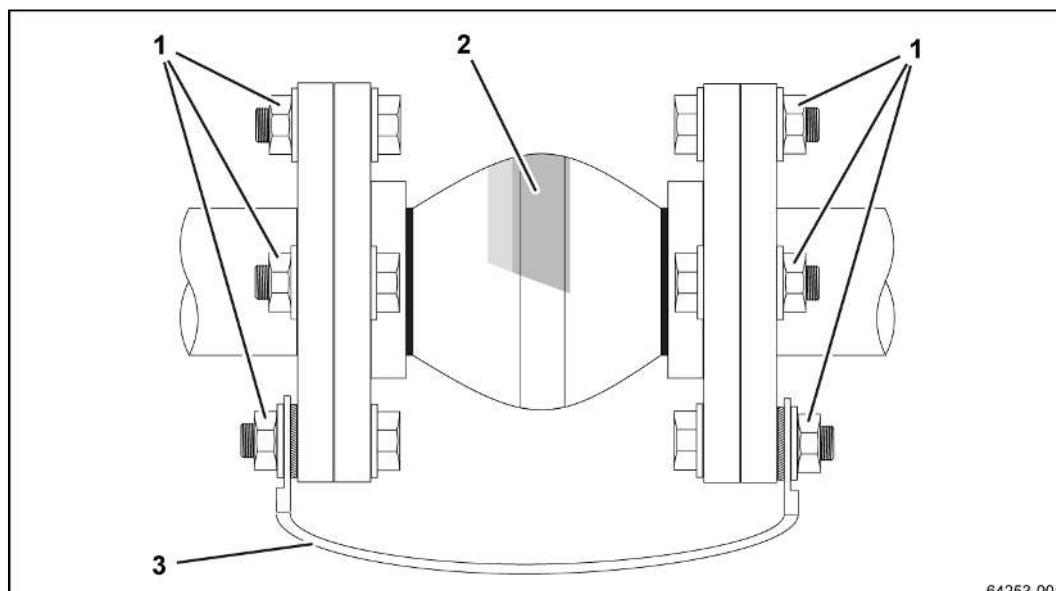
#### Incorrect cleaning

The rubber bellows can be damaged or destroyed.

- Do not use solvents.
- Do not use sharp-edged objects, wire brushes or abrasive papers as cleaning aids.
- Use only soap and warm water for cleaning.

#### 1. Visually inspect the rubber expansion joint for obvious defects:

- In cases of recognizable defects, contact service partner.
- Examples of recognizable defects include bubbles forming, surface cracks, irregular deformations.



109202827

2. Clean the rubber bellows (2)
3. Check all screw connections (1) for tight fit
4. Check ground strap (3) for damage
5. [Commissioning the genset \[▶ 134\]](#)

## Working with fluoropolymer elastomers

Valid for: all gensets

### General information

Installed seals, o-rings and molded parts for high thermal loads are partially manufactured from fluoropolymer elastomers (FPM).

The material decomposes and forms caustic acids at temperatures above 315 °C (caused by engine fire for example).

- The residues are sticky and have a black appearance.

---

### NOTE

Information on disposal

For the corresponding disposal regulations, see the genset operating manual under user instructions.

---

---

### DANGER



Heated fluoropolymer elastomers.

Severe injury or death can result.

- Wear personal protective equipment.
  - Ensure sufficient ventilation.
  - Take off soiled clothing immediately and dispose of them according to the national regulations.
- 

### Handling components made of elastomers containing fluoride:

1. If damage to seals, o-rings and molded parts made of fluoropolymer elastomers (FPM) has occurred due to high temperatures, proceed as follows:
  - Visual inspection of all seals, o-rings and molded parts that are damaged by the effects of heat.
  - Remove and dispose of material residues properly.
  - Items of clothing that came into contact with material residues must be disposed of according to the national regulations.

## Performing cutting work, grinding work, soldering work, and welding work

Valid for:

TCG 3016

### General information

---

#### NOTE

Necessary qualification for performing the work.

Welding work may only be carried out by qualified personnel.

- A welding supervisor with the corresponding qualification must be involved, for protection.
- 

Person responsible for cutting work, grinding work, soldering work, and welding work:

- Has been made aware of the potential dangers by the client.
- Is aware of the applicable directives and regulations as well as local safety notes.
- Knows the local accident prevention regulations of the country-specific legislation and observes them.

The following points are observed and complied with.

---

#### DANGER



Explosion due to gases which ignite.

This leads to severe injuries and even death.

- Sufficiently ventilate the room.
  - Do not smoke.
  - Do not use any naked flames.
  - Use only ATEX-approved devices and tools.
  - Only qualified specialist personnel may work on the fuel gas system.
- 

---

#### CAUTION



Optical radiation.

Minor or severe injuries may result.

- Wear personal protective equipment.
  - Close off the working area for unauthorized persons.
-

**DANGER**

Poisoning from vapors and gases

This leads to severe injuries and even death.

- Wear personal protective equipment.
- Ensure sufficient ventilation.
- Extract vapors.

**Performing cutting work, grinding work, soldering work, and welding work:**

✓ [Decommissioning the genset \[▶ 146\]](#)

1. Protect components in the immediate vicinity of the working area.
  - Remove the battery and store it safely if necessary.
  - Remove connector from the electronic components (e.g. switch cabinet, switch box, control device, sensors).
  - Remove electronic components in the immediate vicinity of the working area.
  - Sensitive surfaces (e.g. air cleaner) must be covered with non-conductive and non-flammable material.
  - Seal or cover openings on the genset.
2. When welding, always attach the earth terminal of the welding device in the immediate vicinity of the welding location.
  - If necessary, remove paint from the area of the earth terminal.
3. Avoid fire hazards and flying sparks.
  - Fully remove flammable substances from the area at risk.
  - Flammable objects (e.g. cables, expansion joints) must be covered with non-conductive or non-flammable material or removed.
4. Seal or cover openings to other work areas.
5. When working with powerful heat development on the fuel gas system:
  - Fully empty, vent, and if necessary purge the fuel gas system.
  - Lock the fuel gas lines.
6. Keep a sufficient number of fire extinguishers within easy reach.
7. Perform cutting work, grinding work, soldering work, and welding work.
8. Re-establish the fuel gas supply.
9. Remove covers and seals to other work areas.
10. Remove covers and seals from the genset and components.
11. Install the removed components.

---

12. Reattach connector to the electronic components (e.g. switch cabinet, switch box, control device, sensors).

13. Install battery if necessary.

⇒ [Starting the genset \[▶ 143\]](#)

## Checking the crankcase chamber pressure

Valid for:

TCG 3016

Crankcase chamber pressure
On commissioning      0 to -10 mbar

### Procedure to follow:

- ✓ [Starting the genset \[▶ 143\]](#)

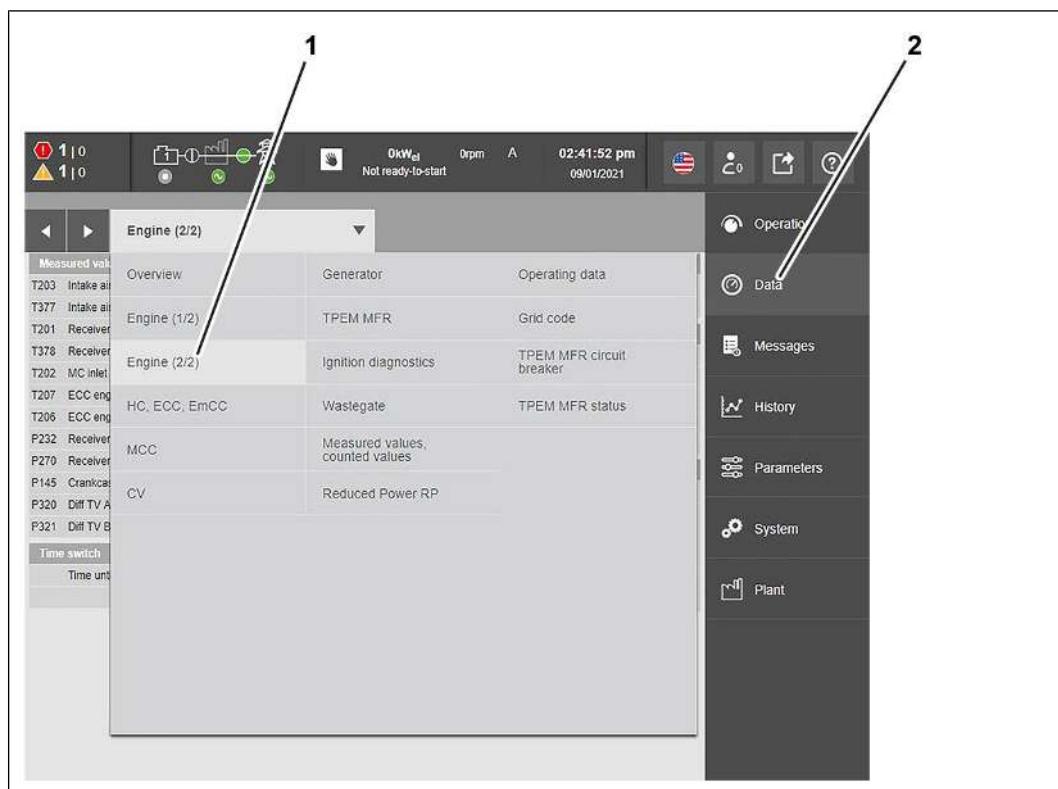


### Risk of destruction of components

Due to incorrect crankcase chamber pressure

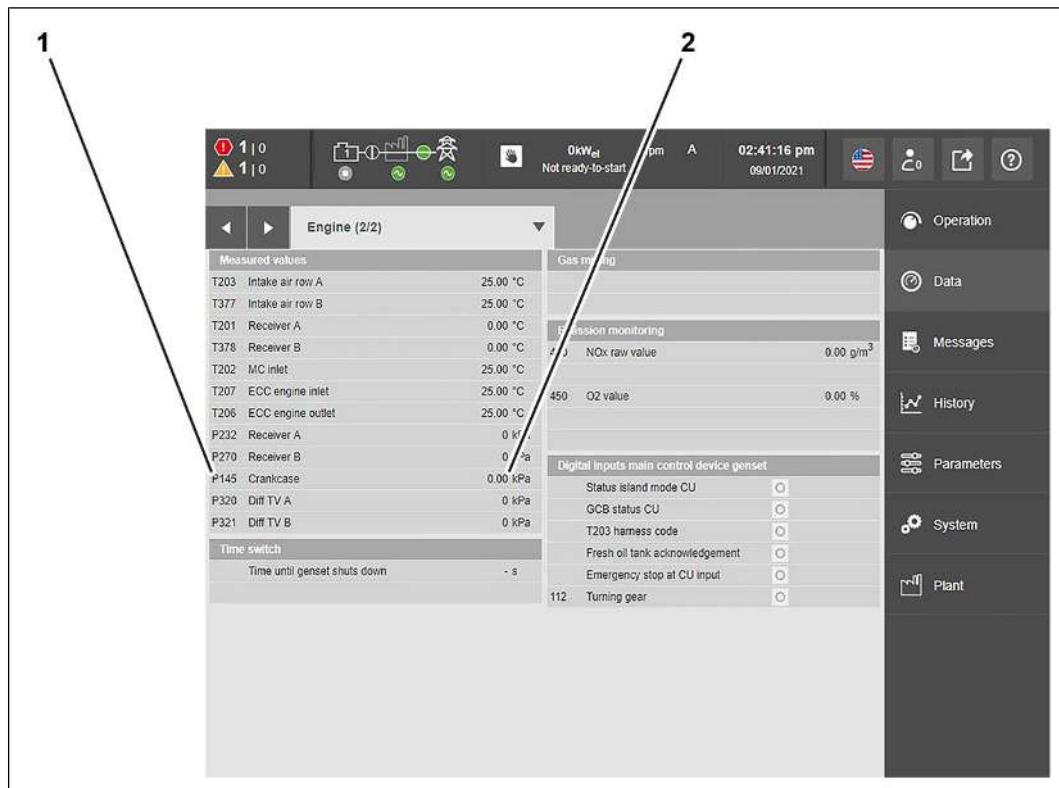
The engine can be destroyed due to incorrect crankcase chamber pressure.

- If the control shuts down the genset and displays the P145 Crankcase chamber fault message, do not restart the genset.
- Do not acknowledge the fault message.
- Contact service partner.



9007200217270411

1. Tap the Data (2) button
2. In the Selection mask, press the selection group Engine 2/2 (1)
  - The selection group Engine (2/2) (1) opens.



9007200217273995

3. Read the value (2) of the crankcase chamber pressure from the P145 Crankcase chamber (1) dialog area.
  - Document measured values, see <https://caterpillar.service-library.net/cds/online/#link/c=69783435,264941067,3326665355,63308171>
  - If the value displayed is 0.00 kbar: [Servicing the crankcase ventilation \[▶ 305\]](#)
  - Service the gas pressure controller if the value is below -4 kbar. Contact service partner.

#### Documents on this

- █ OL-MRA10 / 01-01-01 Crankcase ventilation (model UPF) measurement sheet (Resources/xltx/3355659275.xltx)

## Servicing the crankcase ventilation

Valid for:

TCG 3016

12520749, (null)



Tools:

- Standard tools
- Special tool
  - Measuring device for separating quality



Auxiliary media:

- Acid-free grease



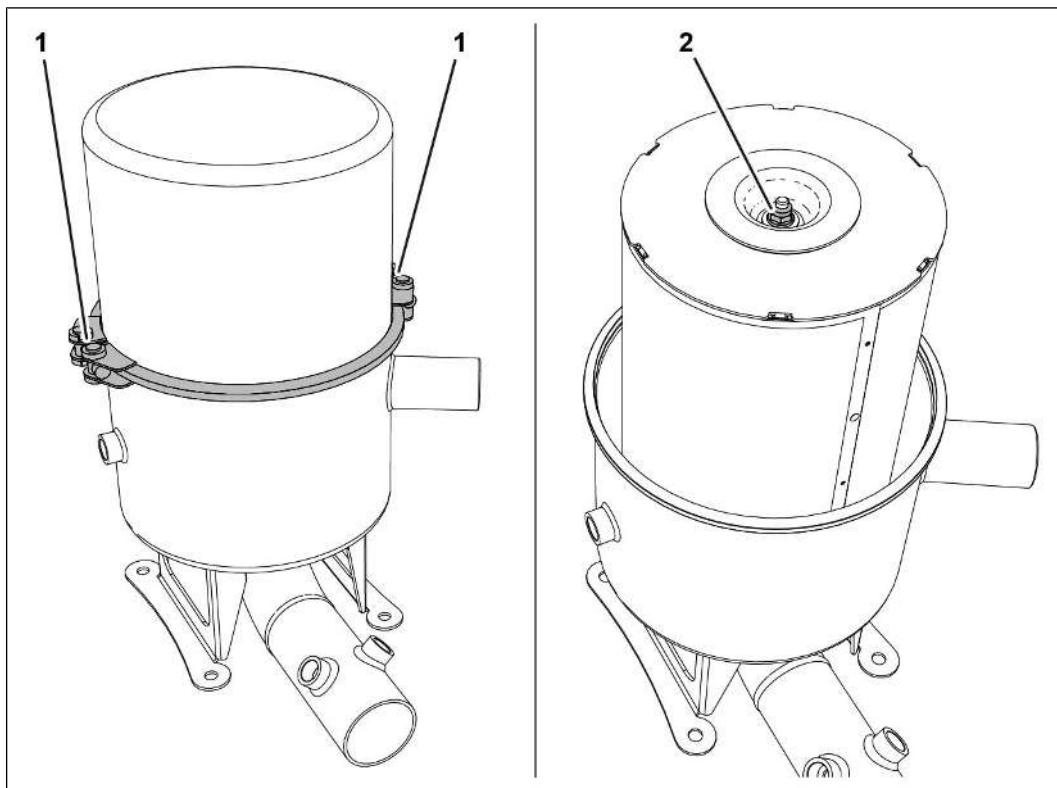
Spare parts:

- Filter insert
- If required, seals

### Technical data

Differential pressure via crankcase ventilation (UPF)		
	Rated value	-2 to -4 mbar
	Limit value <sup>1)</sup>	0 mbar
Separation quality		
	measured after filter insert	max. 2 mg/m <sup>3</sup>

<sup>1)</sup> Replace the filter insert after limit value is reached



376914827

## Clamping clip on filter housing

1 M10

Hand tight

## Nut on filter housing

2 M8 x 60

10 Nm

**Information on the measuring point****Risk of destruction of components**

Due to coolant in the lube oil system

Lube oil mixed with coolant can lead to severe engine damage.

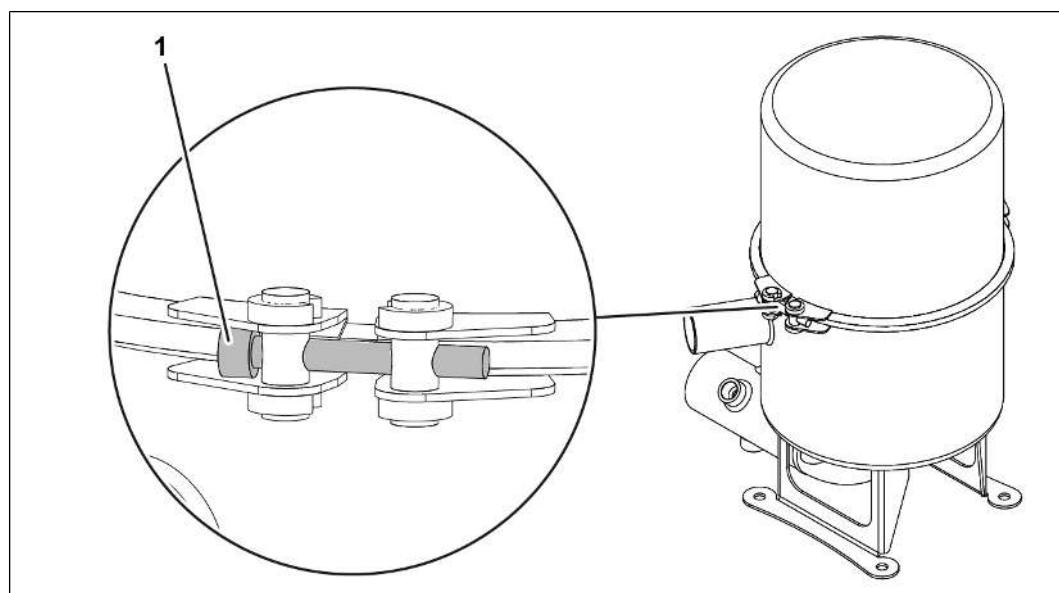
- After coolant has entered the lube oil system, immediately replace all filter elements in the crankcase ventilation

Select a point downstream of the crankcase ventilation as a measuring point for the lube oil content in the blow-by. Owing to the insufficient measuring range of the measuring device, measurement is not possible at points upstream of the crankcase ventilation.

Only use the measuring points described to measure the separating quality.

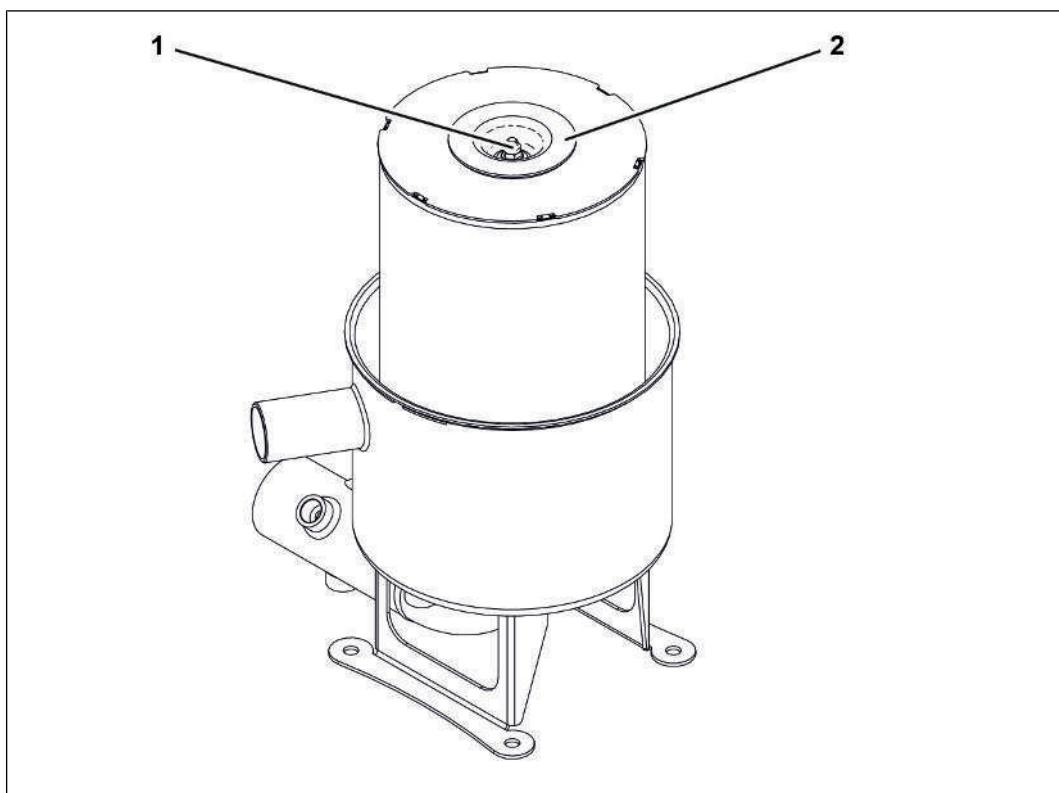
**Measuring the separating quality:**

- ✓ [Decommissioning the genset \[► 146\]](#)
- 1. Measure the lube oil content using the measuring device
  - Document measured values, see [OL-MRA10 01-01-01 Crankcase ventilation \(model UPF\) measurement sheet](#).
  - **NOTE! Overpressure in the crankcase due to a clogged UPF filter can cause the genset to stop. Never clean the filter elements; replace the filter inserts instead. Do not change the preset value of the gas pressure controller. Observe the specified maintenance intervals.** If the measured value exceeds the limit for the filter insert, replace the filter insert.

**Removing the filter insert:**

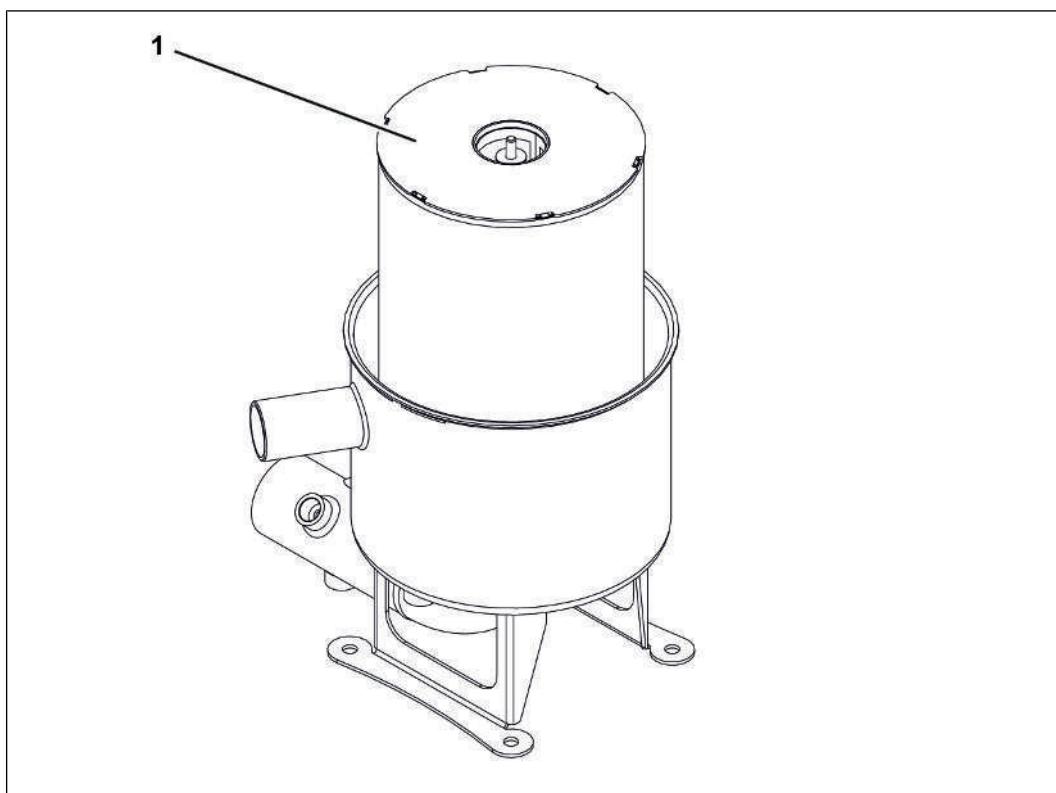
307513483

1. Dismantle the filter housing cover
  - Loosen the screws (1) on the clamping clip.
  - Remove the clamping clip.
  - Remove the filter housing cover.



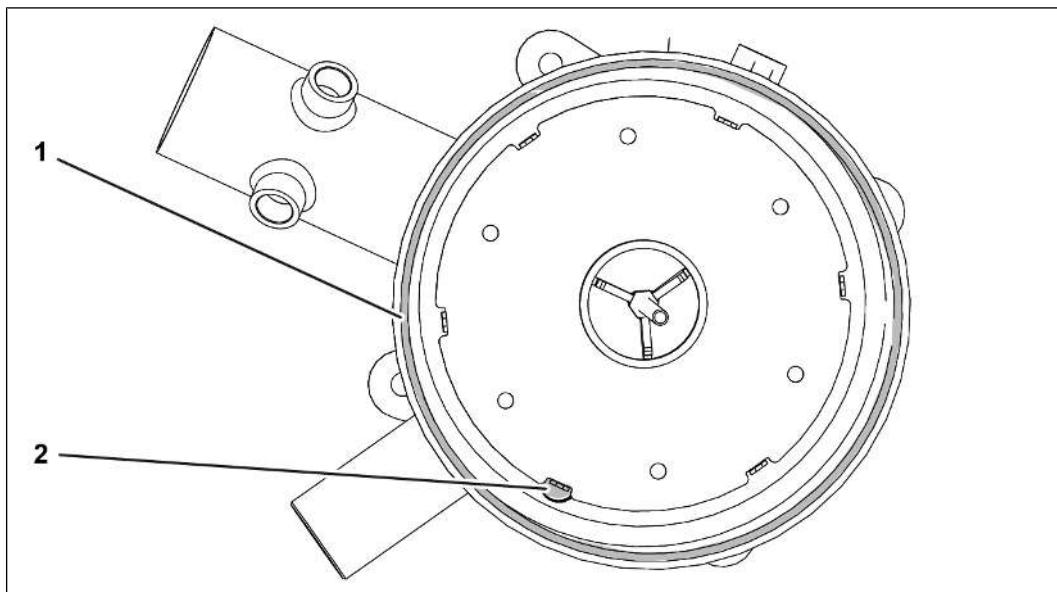
307515915

2. Unscrew the nut with washer (1) from the threaded rod
3. Remove the plate with seal (2)



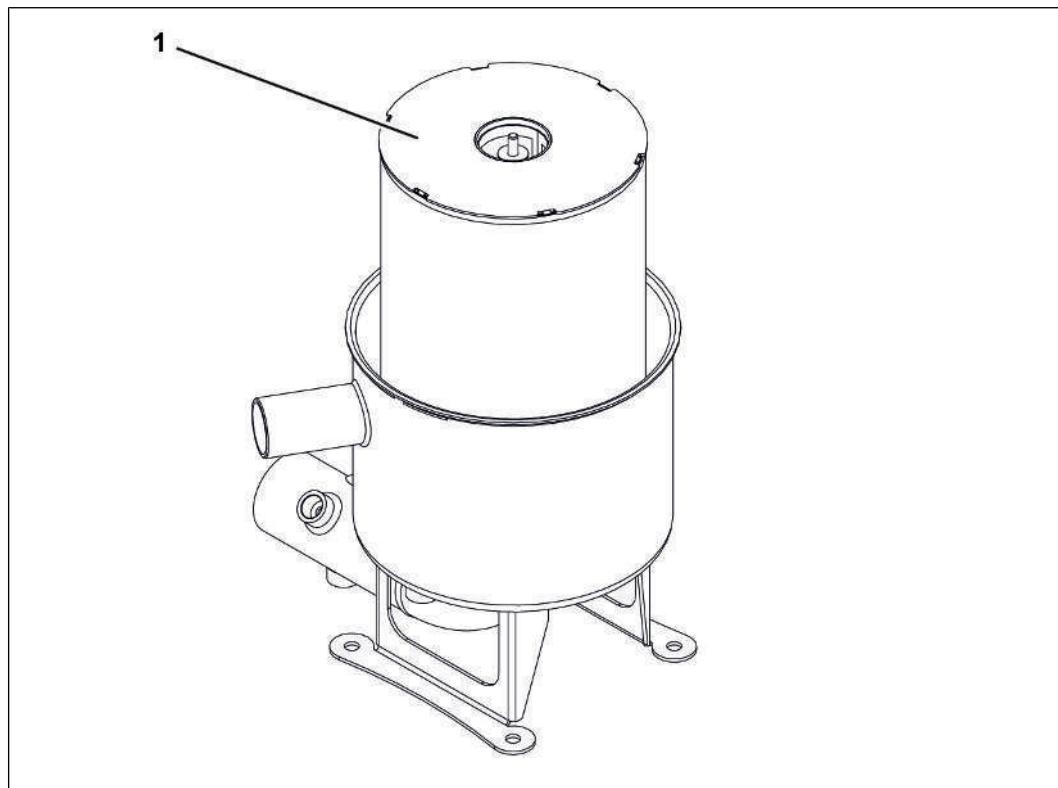
307518347

4. Lift the filter insert (1) up from the threaded rod



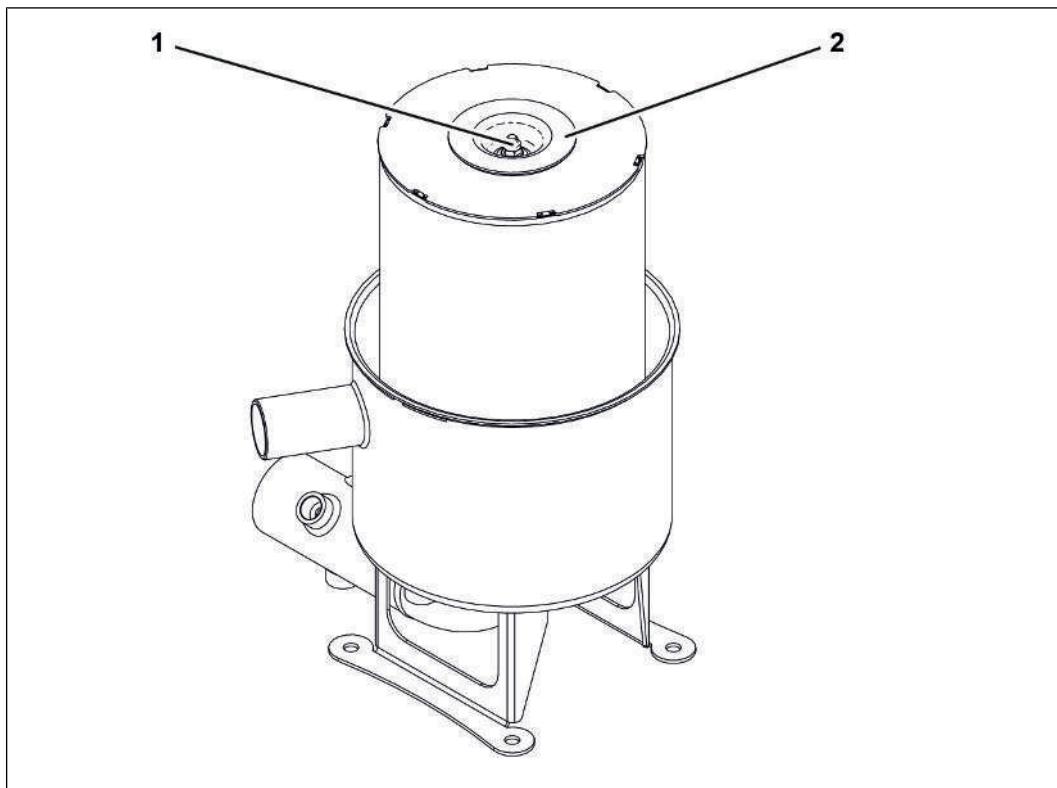
307520779

5. Clean the drain (2) in filter housing
  - If lube oil or condensate is present in the filter housing, remove and clean the connecting hose between the gas pressure controller and engine.
6. Visually inspect the sealing rubber (1) for damage and replace if necessary
  - Remove the sealing rubber (1) from the filter housing and clean with a soft fuzz-free cloth.
  - Thinly wet sealing rubber (1) with acid-free grease
  - Place the sealing rubber (1) on the edge of the lower filter housing and check it for a correct fit.

**Installing the filter insert:**

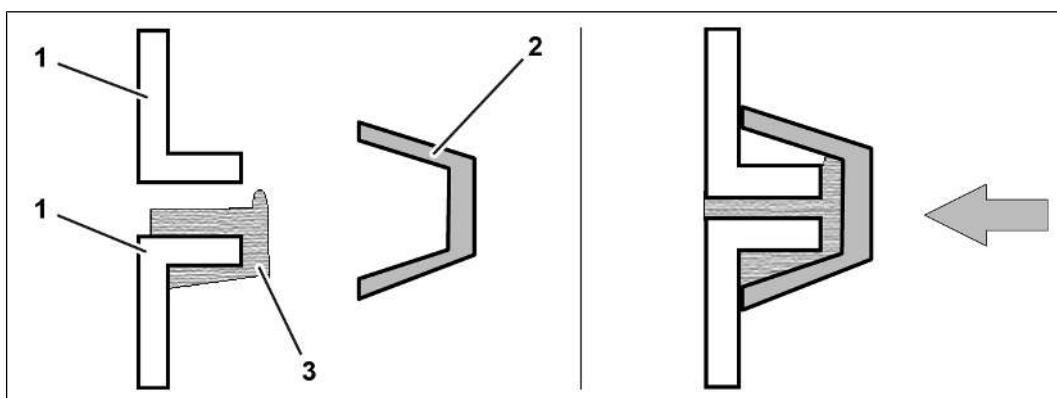
307518347

1. Insert the filter element (1) using the threaded rod in the lower filter housing
  - Check the filter insert (1) for correct fit.



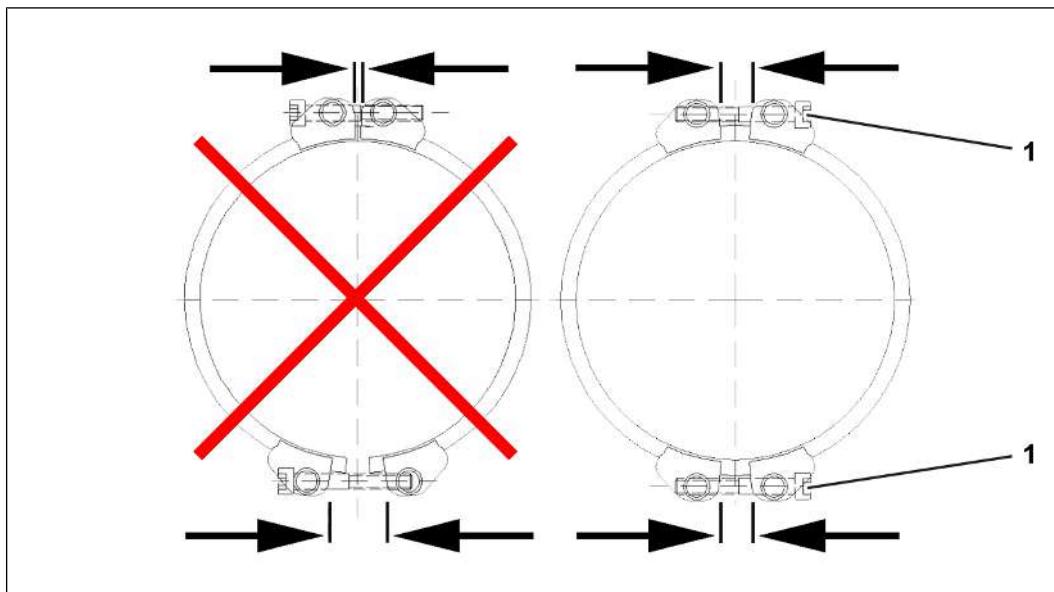
307515915

2. Screw the filter insert tightly
  - Fit the plate with seal (2).
  - Tighten the nut with washer (1).



307511051

3. **NOTE! If the clamping clip (2) does not enclose the sealing rubber (3) completely, the filter housing (1) is not leak-proof. The UPF filter does not separate or does not completely separate the lube oil.** Fit and center the filter housing cover
  - Set the clamping clip (2) on the filter housing (1) so the clamping clip (2) completely encloses the sealing rubber (3).



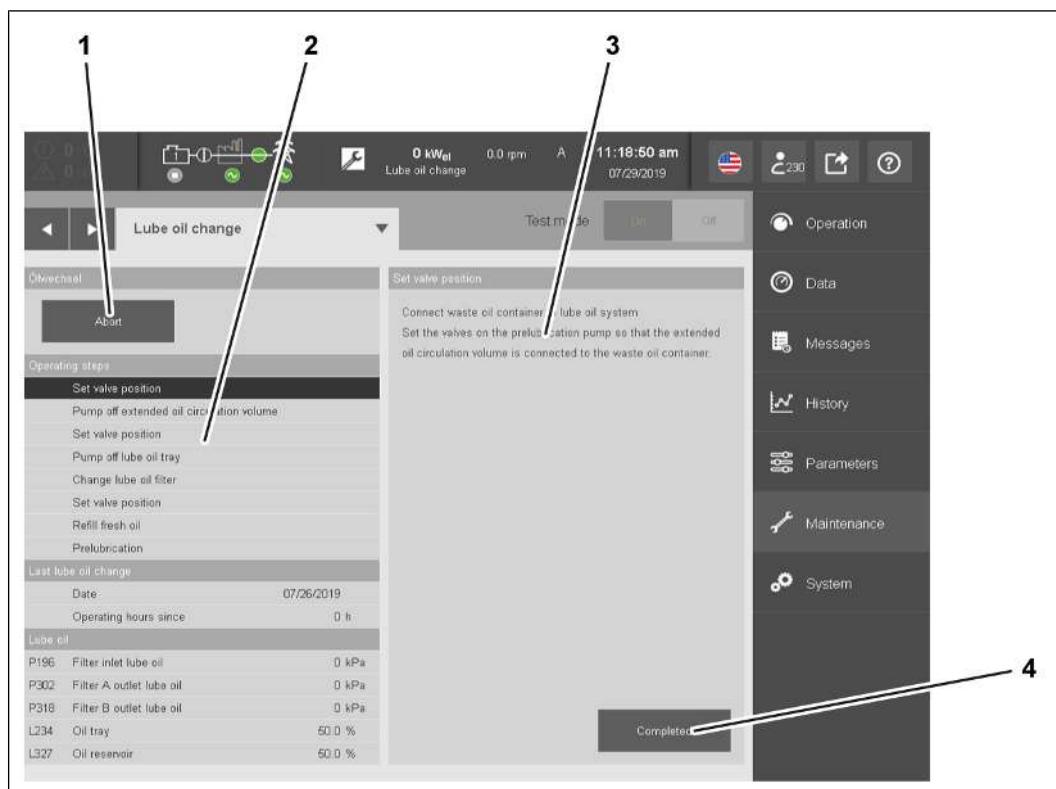
307523211

- Tighten the screws (1) evenly on the clamping clip.
  - Visually inspect that the filter cover is properly fit, correct if necessary.
4. Perform a control measurement of the separating quality
  5. Document servicing and replacement of the filter elements in the measurement sheet, see [OL-MRA10 01-01-01 Crankcase ventilation \(model UPF\) measurement sheet](#)
    - Always fill out the execution record in full.
  6. [Commissioning the genset](#) [▶ 134]

## Perform a lube oil change

Valid for:  
TCG 3016

Pumping out time for extended oil circulation volume		
V8 en- gine	15 minutes	(900 s)
V12 engine	17.5 minutes	(1050 s)
V16 engine	20 minutes	(1200 s)
Pumping out time when the lube oil sump is full		
V8 en- gine	2.25 minutes	(135 s)
V12 engine	3.5 minutes	(210 s)
V16 engine	4.5 minutes	(270 s)



308241547

The operating steps for the lube oil change are listed in the **Lube oil change start** mask (2). The current operating step is briefly described in the dialog area (3). When an operating step is completed, you must acknowledge this operating step in the dialog area with the **Completed** (4) button.

You can cancel the lube oil change with the **Abort** button (1). If you have started the lube oil change, the **Abort** button (1) will change its function to **Step backwards**. Then you can jump back to the previous operating step with the **Step backwards** button.

Once you have started pumping out the lube oil, you must perform a complete lube oil change.

## Preparing the lube oil change

Valid for:

TCG 3016



### Risk of destruction of components

Due to prelubrication pump running dry

The prelubrication pump can be damaged or destroyed.

- Never leave the genset unattended during a lube oil change.
  - If it runs dry, immediately stop the prelubrication pump manually.
- 
- The lube oil temperature is at least 60 °C.
  - No fault messages and no warning messages on the control are pending regarding the lube oil change.
  - The auxiliary drive test function is deactivated on the control, see [Performing the auxiliary drive test \(TPEM\) \[▶ 202\]](#).
  - The MANUAL operation mode has been set on the control.
  - Parameter 20130594 Alternative oil level limits for oil change is activated.
  - **NOTE! The parameters described below are optional.** Parameter 20130547 Waste oil tank monitoring is activated.
    - Parameter 20130552 Waste oil tank leakage monitoring is activated. This parameter is only active if you have activated parameter 20130547 Waste oil tank monitoring.

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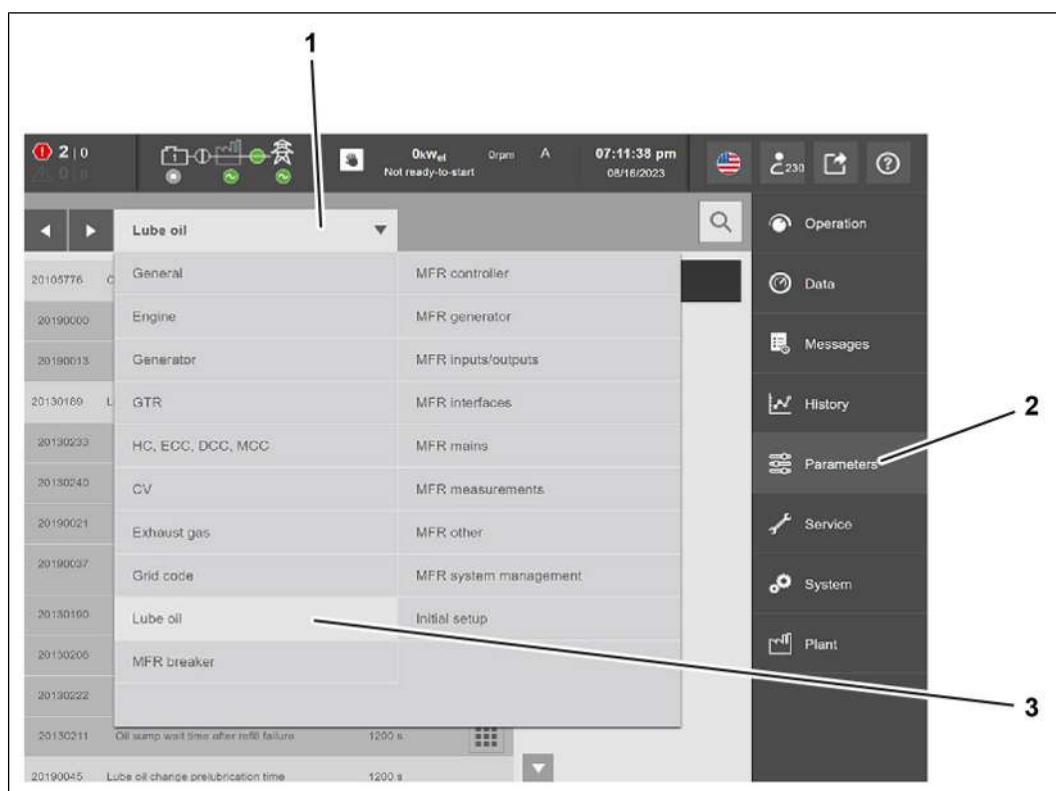
### NOTE

- For detailed information on fault messages and warning messages, see: [TPEM Operating manual](#).
  - For detailed information on activating and setting parameters, see: [TPEM Parameter description](#).
- 

## Activating parameter 20105776 Oil reservoir automatic refill

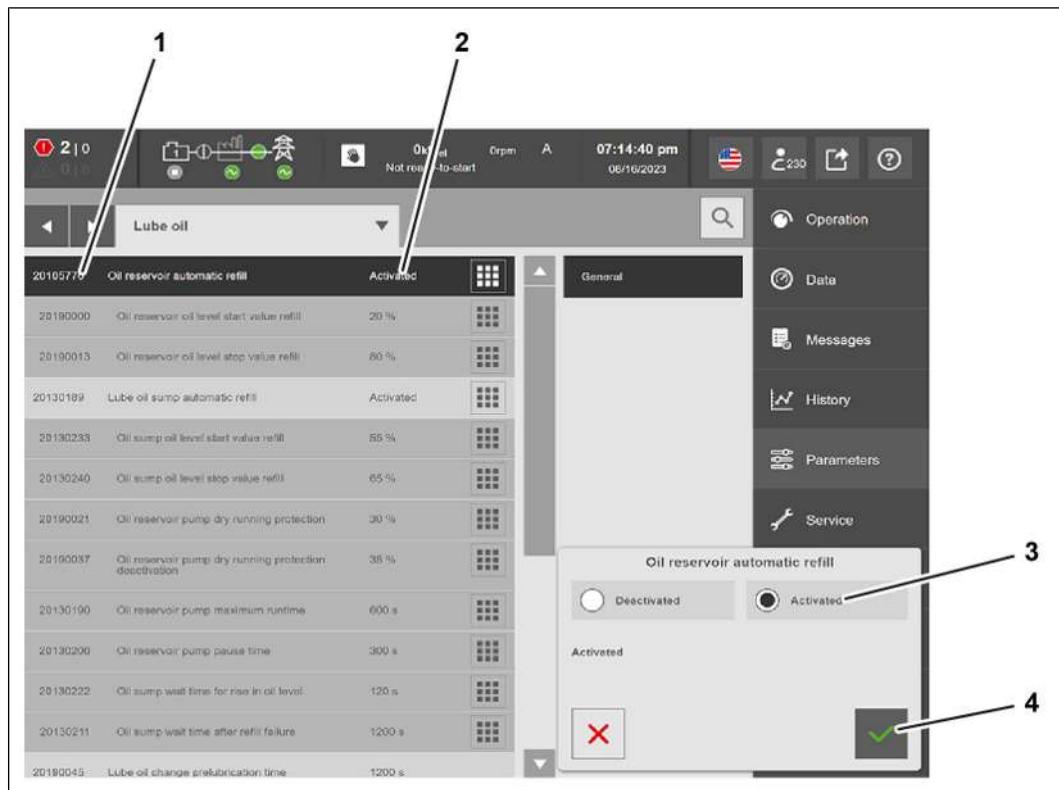
Valid for:

TCG 3016



9007199562972811

1. Open the Lube oil parameter group
  - Tap the Parameter (2) button
  - In the Parameter pull-down menu (1), tap the Lube oil line (3)



9007199563168395

2. Activate parameter 20105776 Oil reservoir automatic refill
    - Tap line 20105776 Oil reservoir automatic refill (1).
    - In the input mask 20105776 Oil reservoir automatic refill, tap the Activated button (3).
    - Confirm entry with the Accept input (4) button
    - The text Activated (2) will appear in the line 20105776 Oil reservoir automatic refill (1).
- ⇒ Parameter 20105776 Oil reservoir automatic refill is activated.

### Activating parameter 20130189 Lube oil sump automatic refill

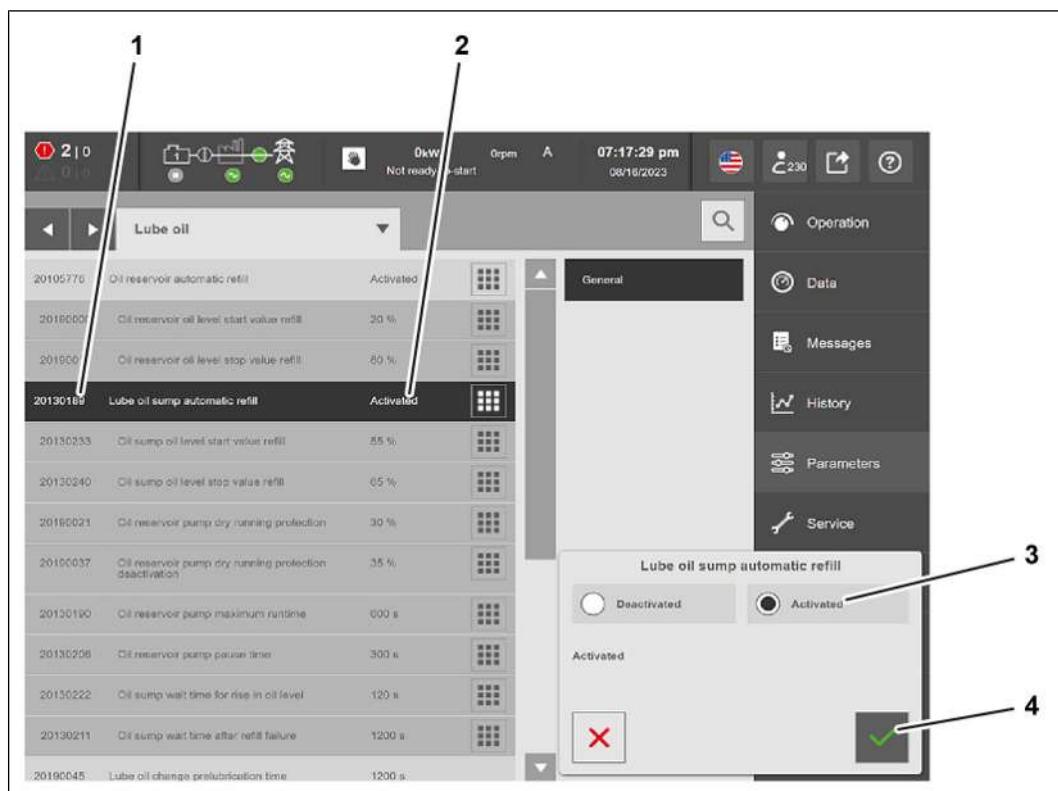
Valid for:

TCG 3016



9007199562972811

1. Open the Lube oil parameter group
  - Tap the Parameter (2) button
  - In the Parameter pull-down menu (1), tap the Lube oil line (3)



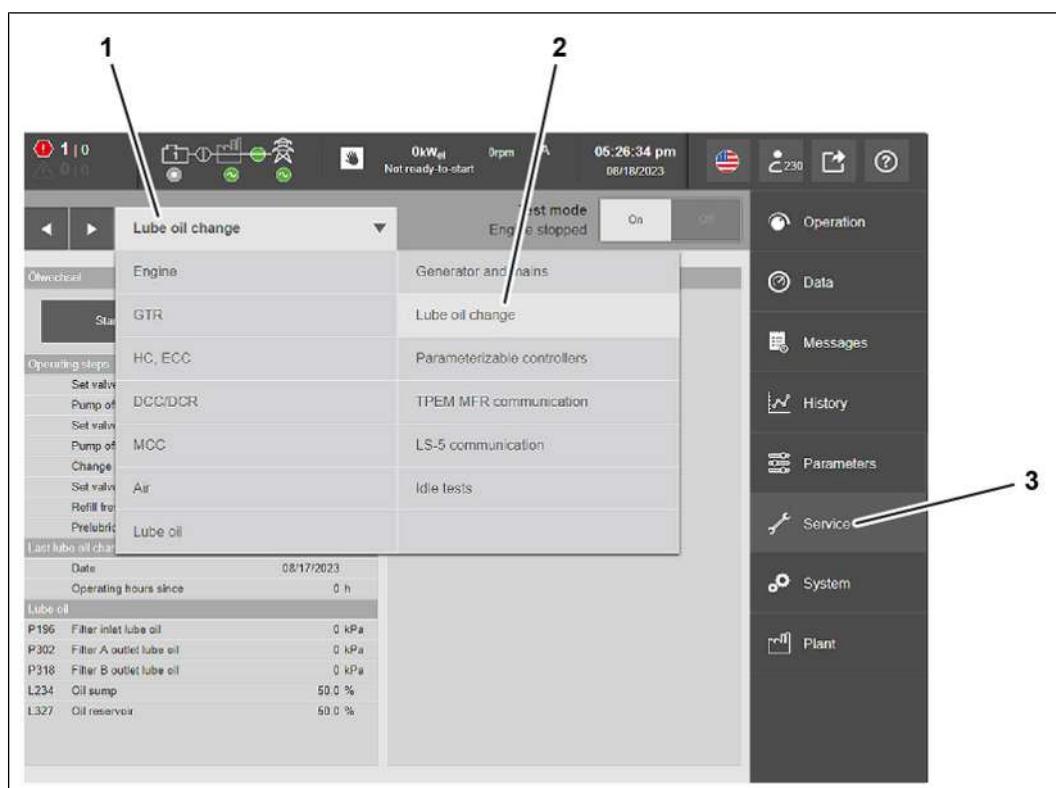
9007199563163531

2. Activate the 20130189 Lube oil sump automatic refill parameter.
    - Tap the 20130189 Lube oil sump automatic refill (1) line.
    - In input mask 20130189 Lube oil sump automatic refill, tap the Activated button (3).
    - Confirm entry with the Accept input (4) button.
    - Line 20130189 Lube oil sump automatic refill (1) will display the word Activated (2).
- ⇒ Parameter 20130189 Lube oil sump automatic refill is activated.

## Starting the lube oil change

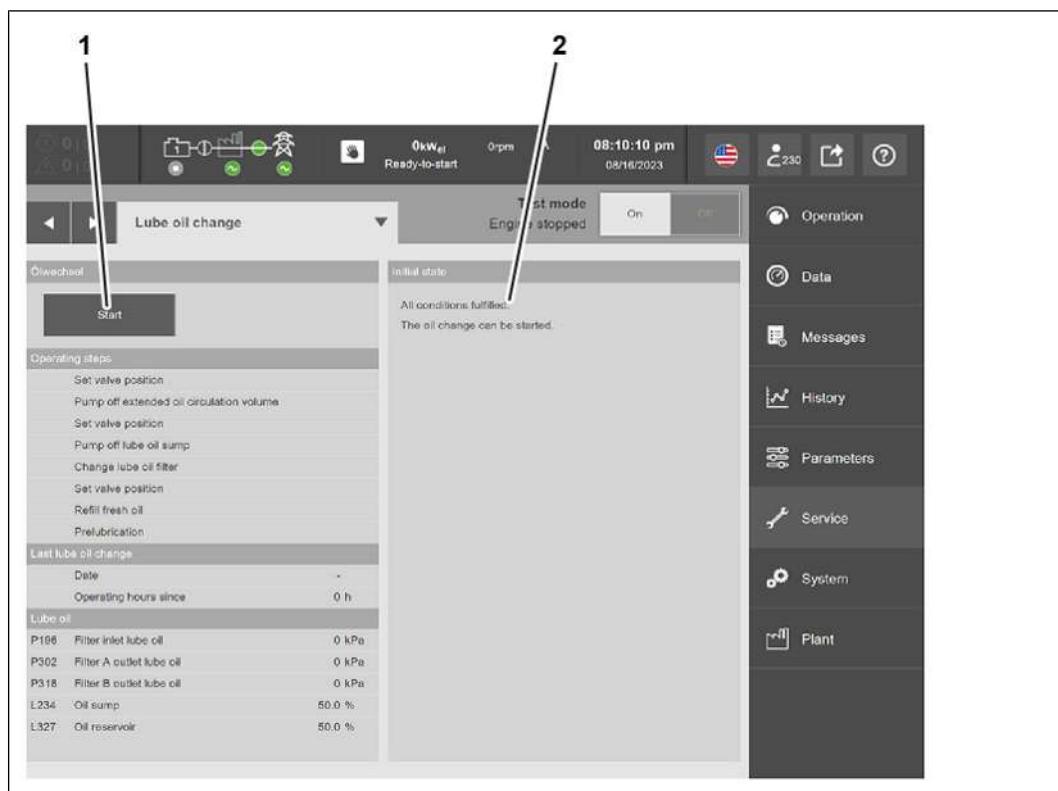
Valid for:

TCG 3016



9007199562977675

1. Open functional group Lube oil change
  - Tap the Service (3) button.
  - In the pull-down menu (1), tap the Lube oil change line (2).
  - The mask Lube oil change opens.



2826864011

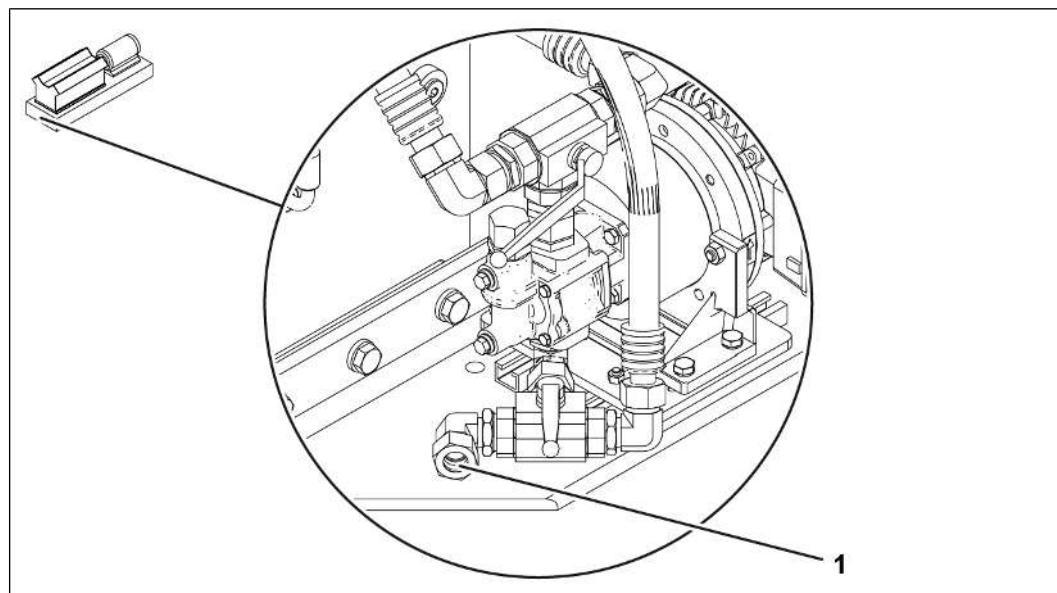
2. **NOTE! When test mode is activated, the Start button (1) is grayed out. You cannot start the lube oil change when test mode is activated. For all required conditions to enable the lube oil change, see the dialog area (2). Tap the Start button (1).**

### Pumping off old lube oil from the extended oil circulation volume

Valid for:

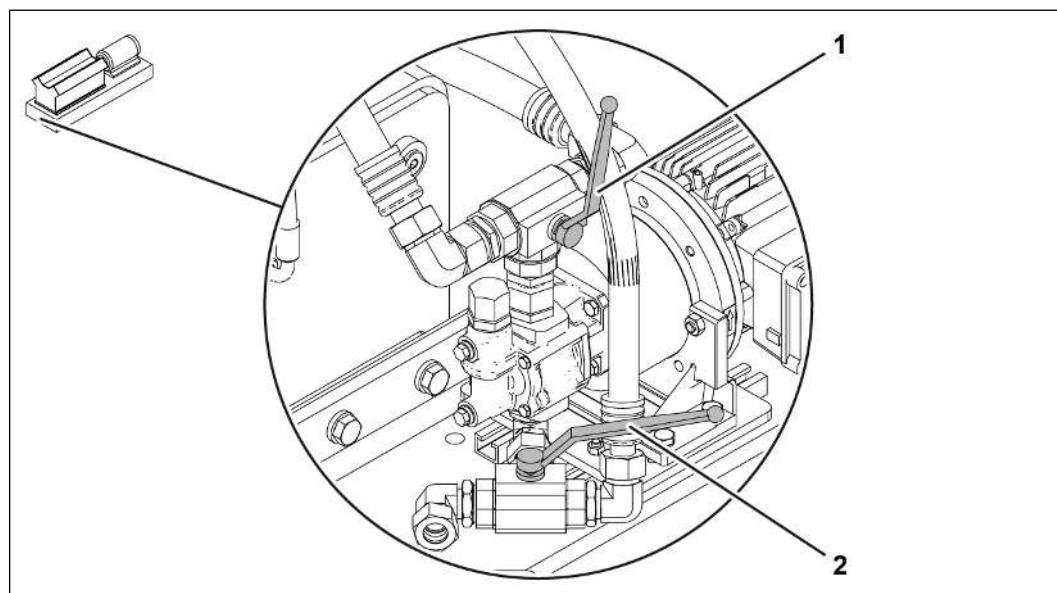
TCG 3016

1. [Stopping the genset \[▶ 144\]](#)



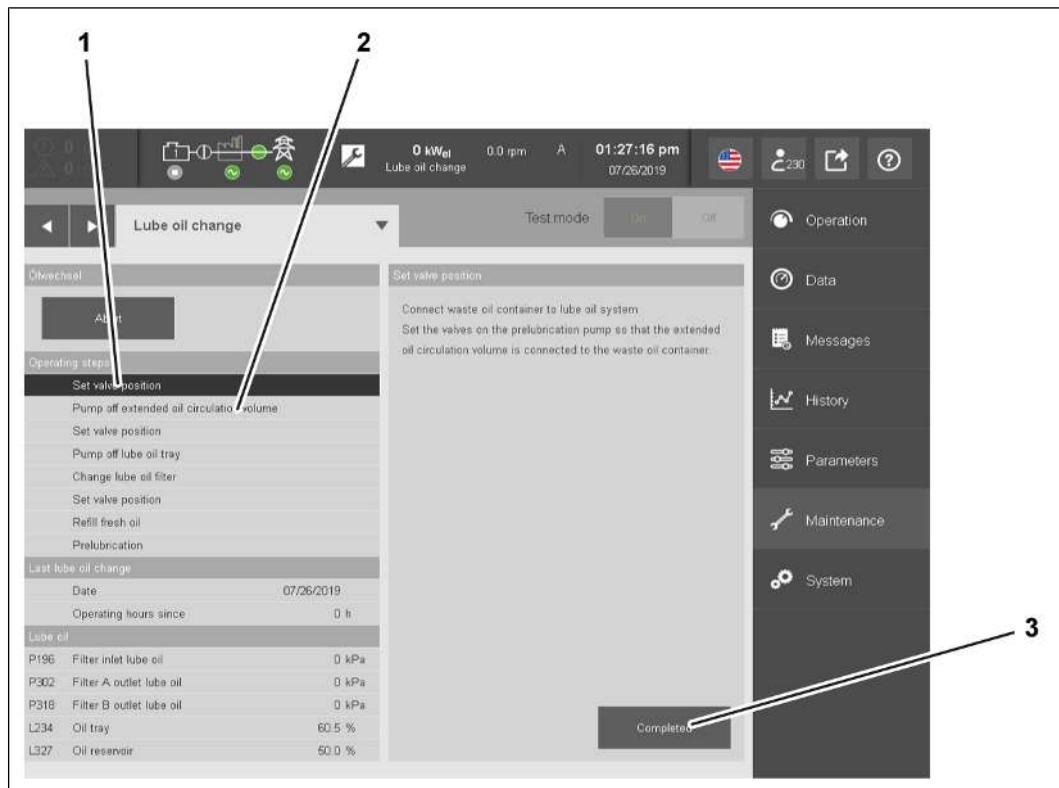
308116875

2. Put collecting tray under the connection (1)
3. Connect lube oil tank for old lube oil to connection (1)



308617867

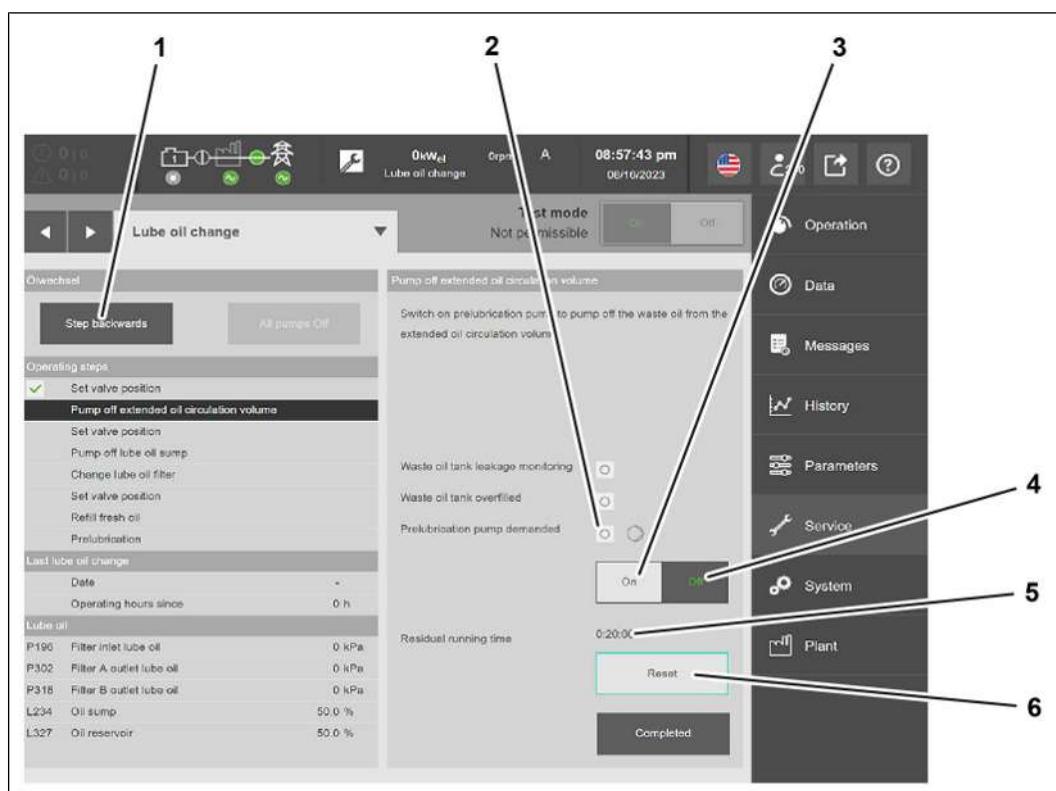
4. Set the valves of the prelubrication pump to position (1) and position (2)
5. [Starting the genset \[▶ 143\]](#)



9007199562986891

## 6. Confirm setting of valve positions

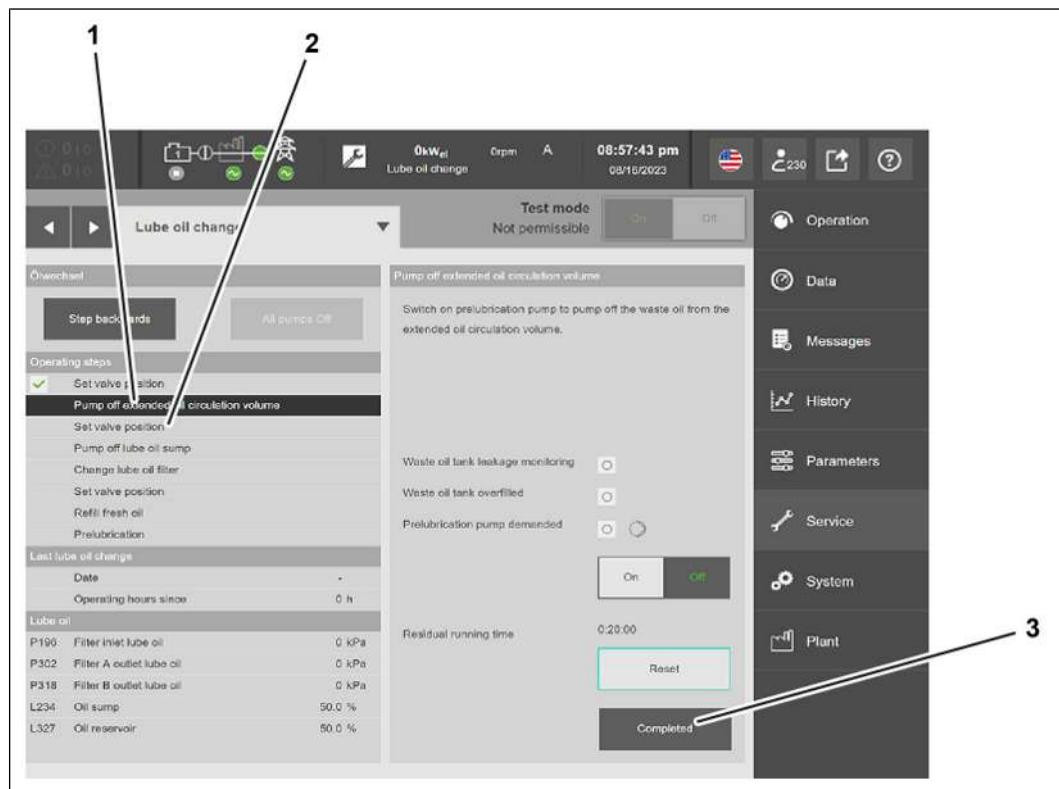
- Tap the Completed (3) button.
- The operating step Set valve position (1) is completed.
- The operating step Pump off extended oil circulation volume (2) is activated.



27021598072473739

7. Start pumping the extended lube oil volume out into the lube oil tank for old lube oil
  - **NOTE! If a warning for waste oil tank overfilling or leakage is present at the electrical control, the prelubrication pump cannot be activated. In the lube oil auxiliary drive test you must confirm that the genset is not connected to the waste oil tank.** Tap the On (3) button
  - A green dot (2) appears in the dialog area.
  - **WARNING! After the preset pumping out time has elapsed, the system stops pumping out automatically. The pumping out time corresponds to the extended lube oil volume.** The dialog area shows the residual running time (5).
  - The lube oil is pumped out of the extended lube oil volume and into the lube oil tank for old lube oil.
8. You can terminate the pumping out of the extended lube oil volume before it is finished:
  - When you tap the Off button (4), the control will stop pumping out oil.
9. Resume pumping
  - Tap the On (3) button.
  - A green dot (2) appears in the dialog area.
  - The residual running time resumes in the dialog area (5).
10. When you tap the Reset button (6), the control will reset the residual running time (5).

11. When you tap the Step backwards button (1), the control will return to the Set valve position step.



27021598072478603

12. Confirm pumping out from the extended oil volume.

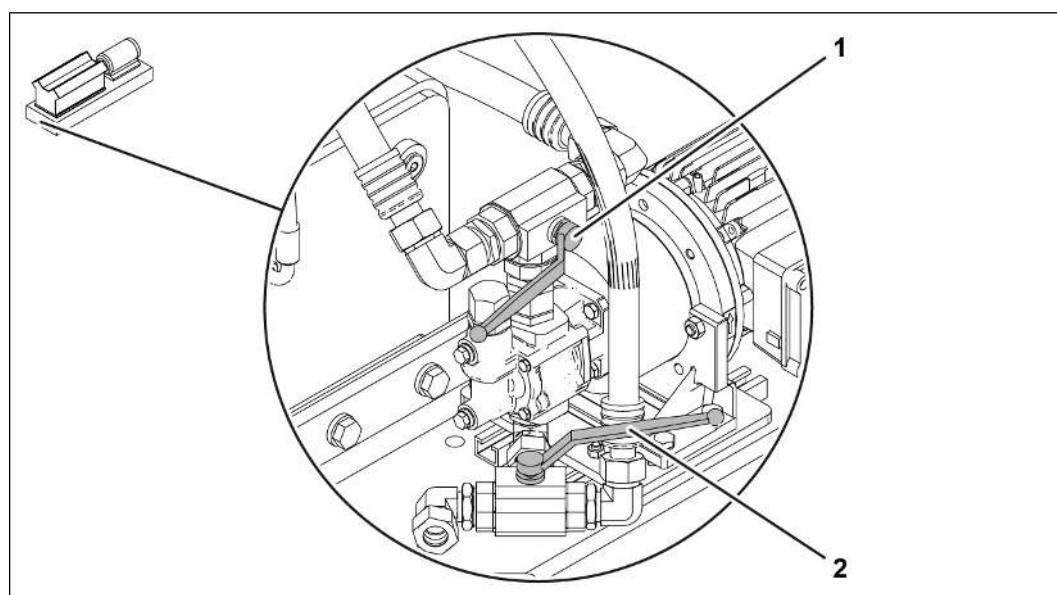
- Tap the Completed (3) button.
- ⇒ The operating step Pump off extended oil circulation volume (1) is completed.
- ⇒ The operating step Set valve position (2) is activated.

## Pumping lube oil out of the lube oil sump

Valid for:

TCG 3016

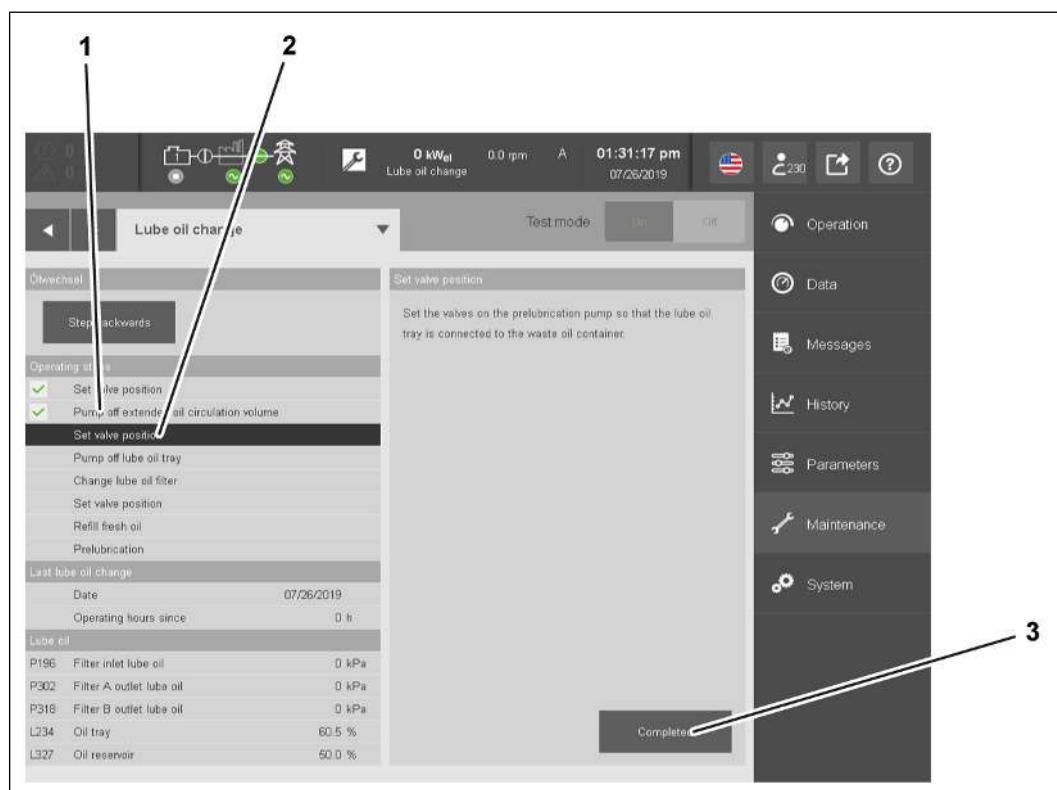
### 1. Stopping the gensex [▶ 144]



308119307

### 2. Set the valves of the prelubrication pump to position (1) and position (2)

### 3. Starting the gensex [▶ 143]



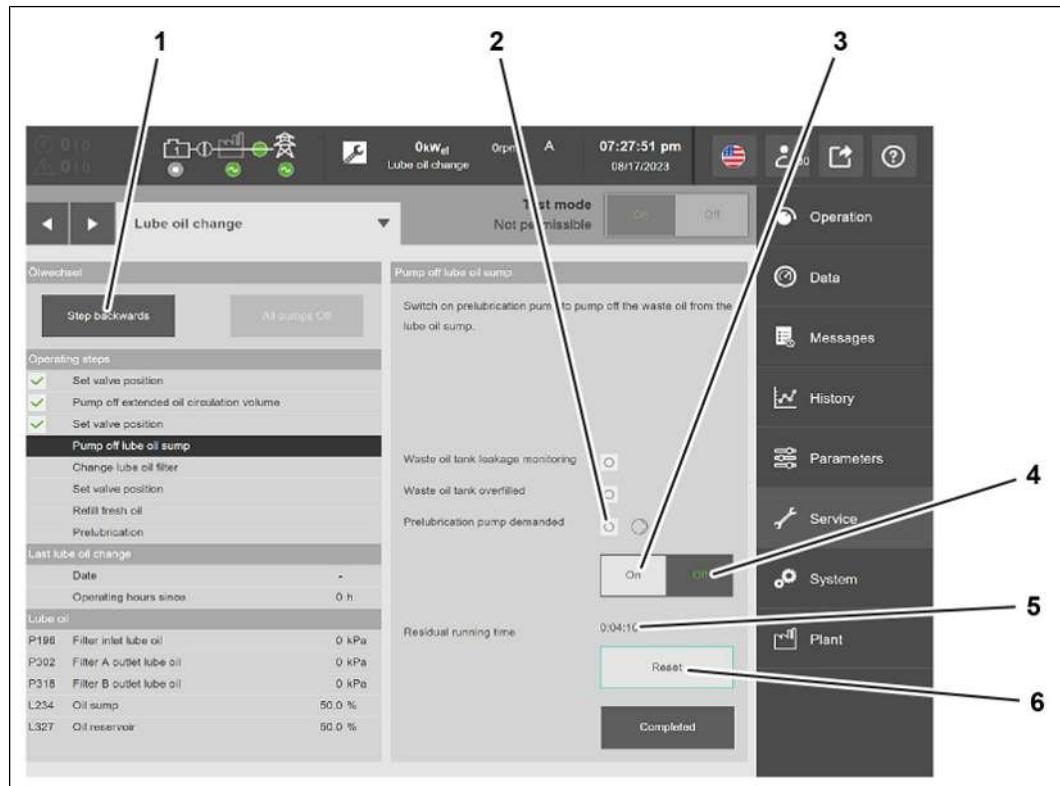
18014398817742475

### 4. Confirm setting of valve positions

- Tap the Completed (3) button.

⇒ The operating step Set valve position (1) is completed.

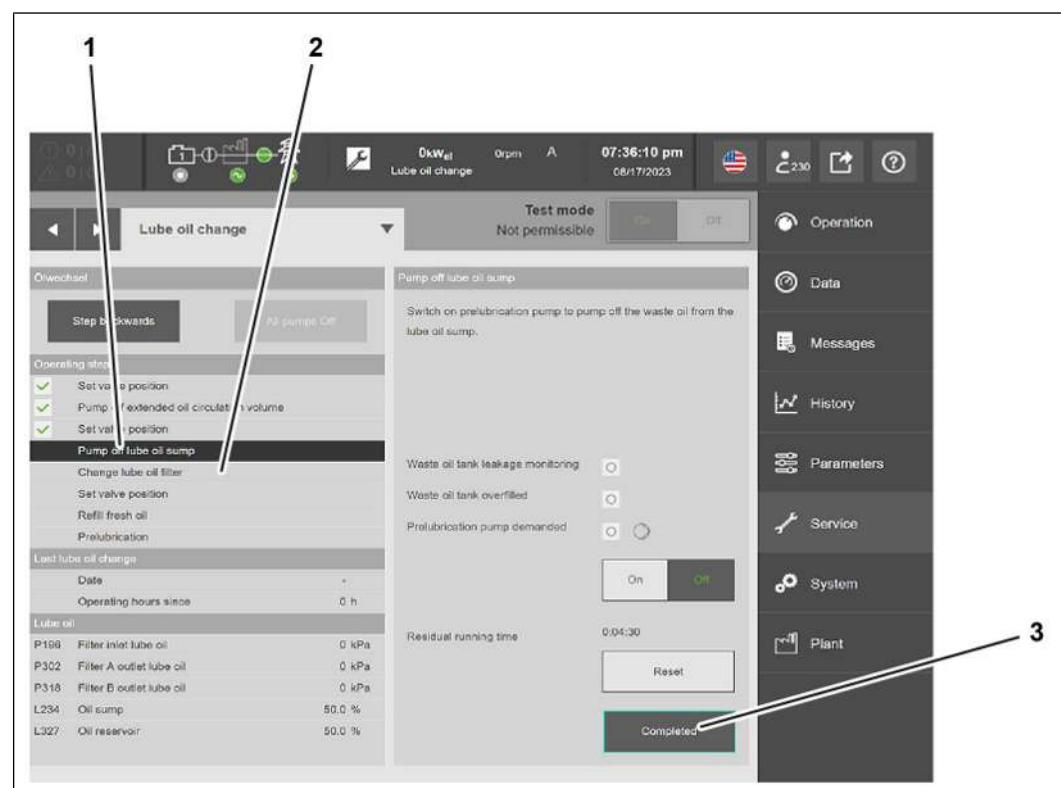
⇒ The operating step Pump off lube oil sump (2) is activated.



27021598072440203: Replace image - no "All pumps Off"

1. Start pumping lube oil out of the lube oil sump and into the lube oil tank for old lube oil.
  - Tap the On (3) button
  - A green dot (2) appears in the dialog area.
  - **NOTE! After the preset pumping out time has elapsed, the system stops pumping out automatically. The pumping out time corresponds to the extended lube oil volume. When the lube oil volume is lower, you must manually stop pumping out.** The residual running time is shown in the dialog area (5).
  - The lube oil is pumped from the lube oil sump into the lube oil tank for old lube oil.
2. You can terminate the pumping out of the lube oil sump before it is finished:
  - When you tap the Off (4) button, the control will stop pumping out oil.
3. Resume pumping
  - Tap the On (3) button.
  - A green dot (2) appears in the dialog area.
  - The residual running time resumes in the dialog area (5).
4. When you tap the Reset button (6), the control will reset the residual running time (5).

5. When you tap the Step backwards button (1), the control will return to the Set valve position step.



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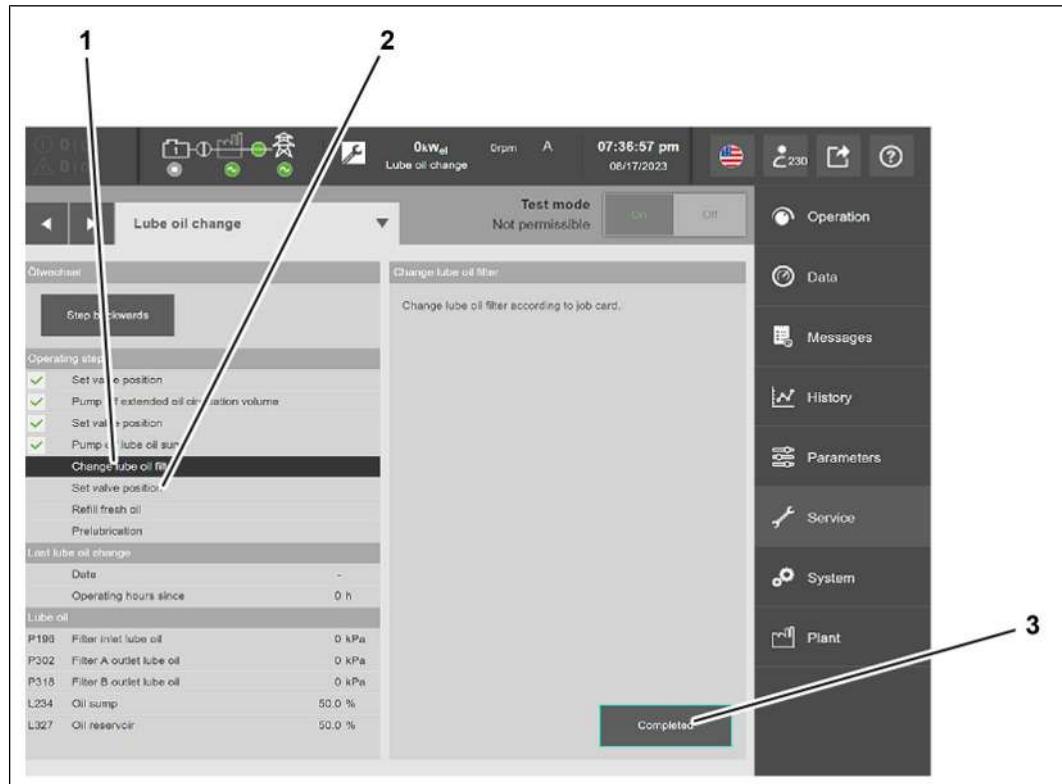
6. Confirm pumping lube oil out of the lube oil sump
- Tap the Completed (3) button.
  - ⇒ The operating step Pump off lube oil sump (1) is completed.
  - ⇒ The operating step Change lube oil filter (2) is activated.

## Replace the lube oil filter

Valid for:

TCG 3016

1. Removing and installing the lube oil filter [▶ 354]



9007199563011211

2. Confirm lube oil filter change

- Tap the Completed button (3).

⇒ The Change lube oil filter operating step (1) is complete.

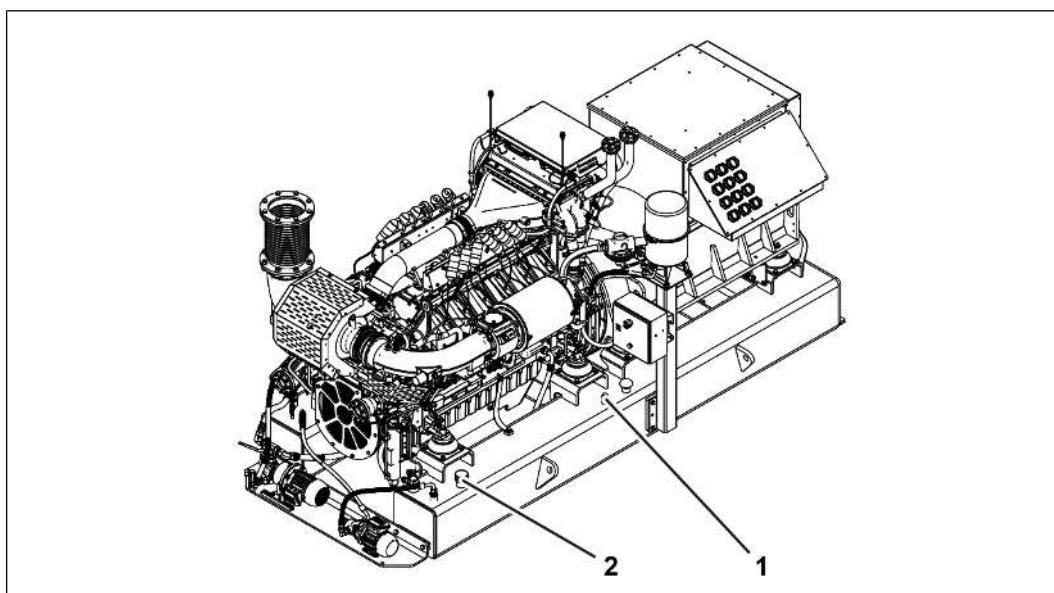
⇒ The operating step Set valve position (2) is activated.

## Filling the lube oil system

Valid for:

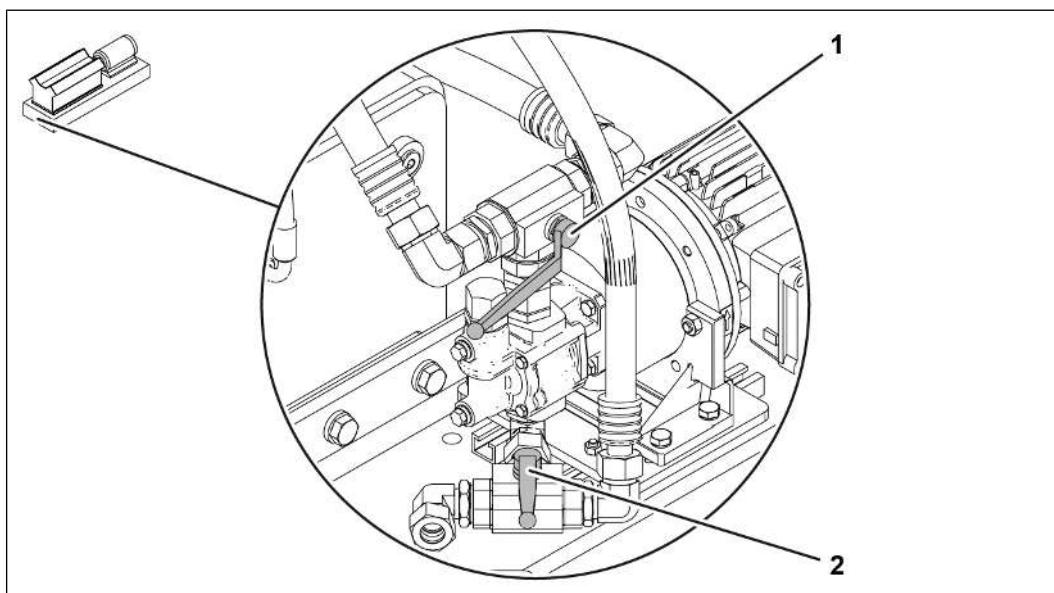
TCG 3016

1. [Stopping the genset \[▶ 144\]](#)



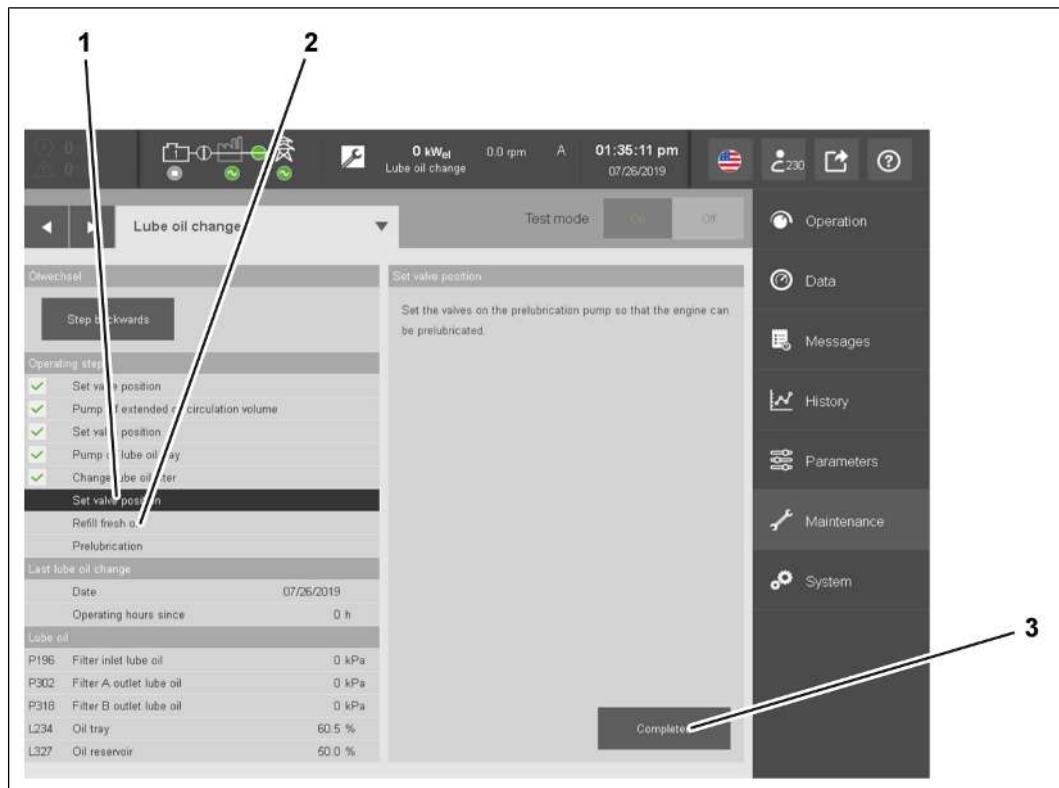
308614923

2. Place the collecting tray underneath connection (1) or connection (2)
3. Connect the lube oil supply to the appropriate connection



308121739

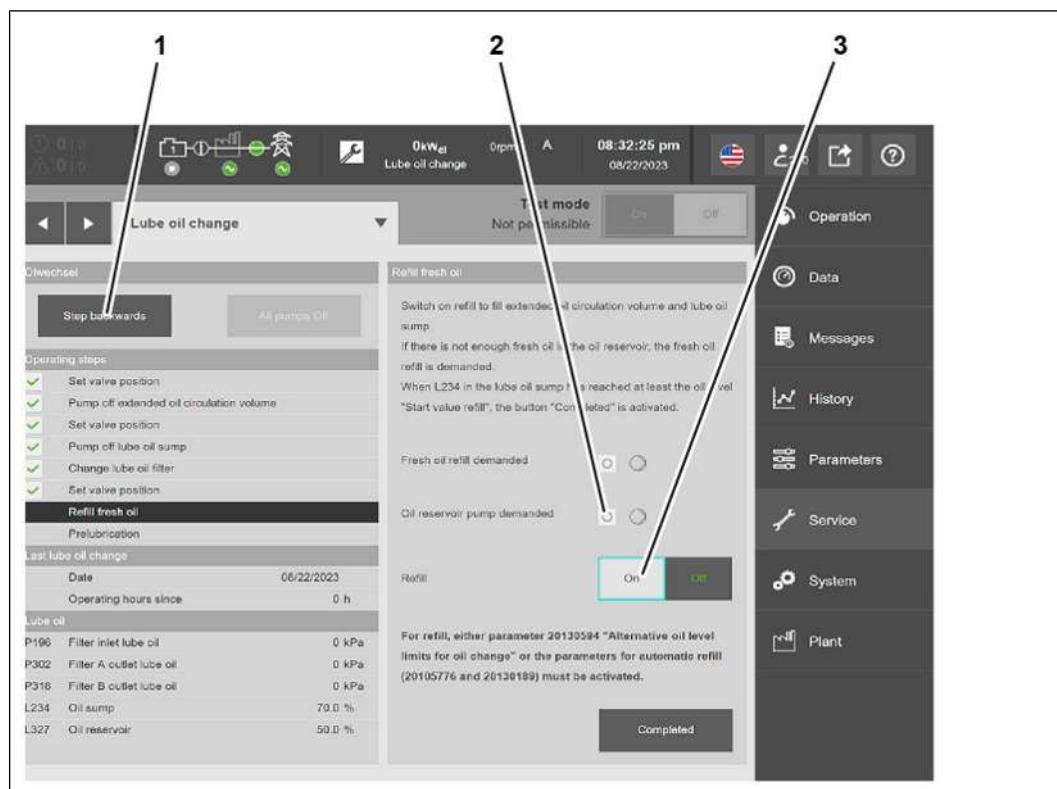
4. Set the valves of the prelubrication pump to position (1) and position (2)
5. [Starting the genset \[▶ 143\]](#)



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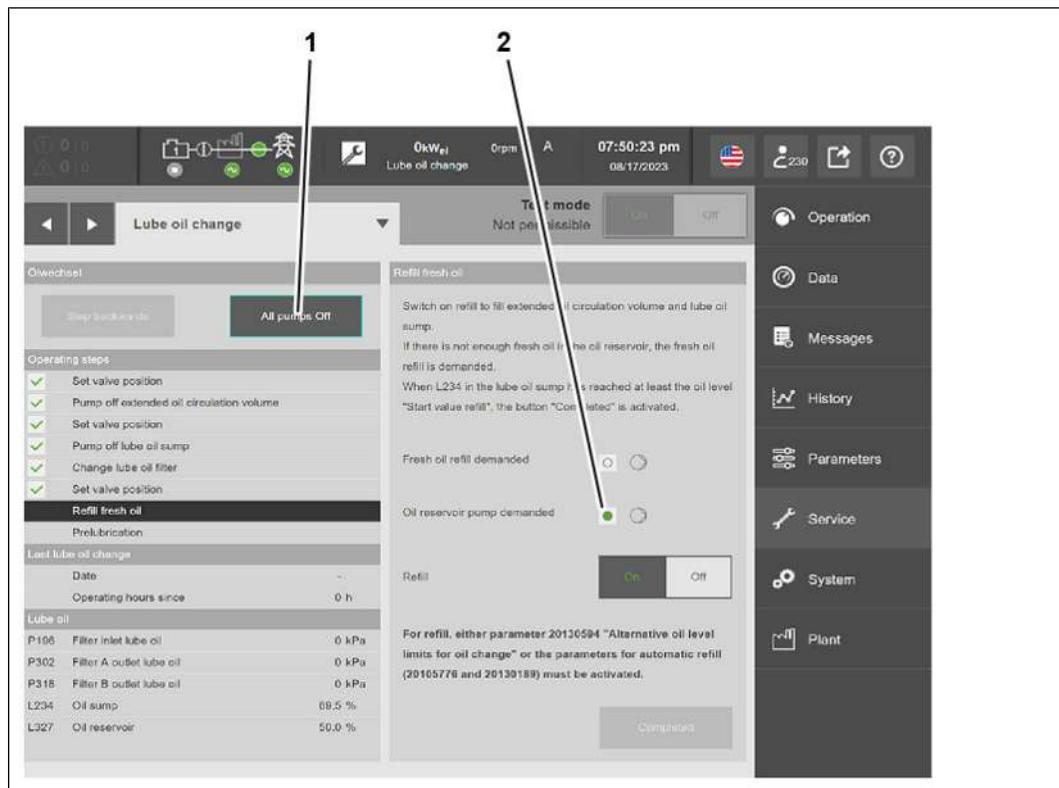
#### 6. Confirm setting of valve positions

- Tap the Completed (3) button.
- ⇒ The operating step Set valve position (1) is completed.
- ⇒ The operating step Refill fresh oil (2) is activated.
- ✓ [Activating parameter 20105776 Oil reservoir automatic refill \[▶ 316\]](#)
  - ✓ [Activating parameter 20130189 Lube oil sump automatic refill \[▶ 318\]](#)



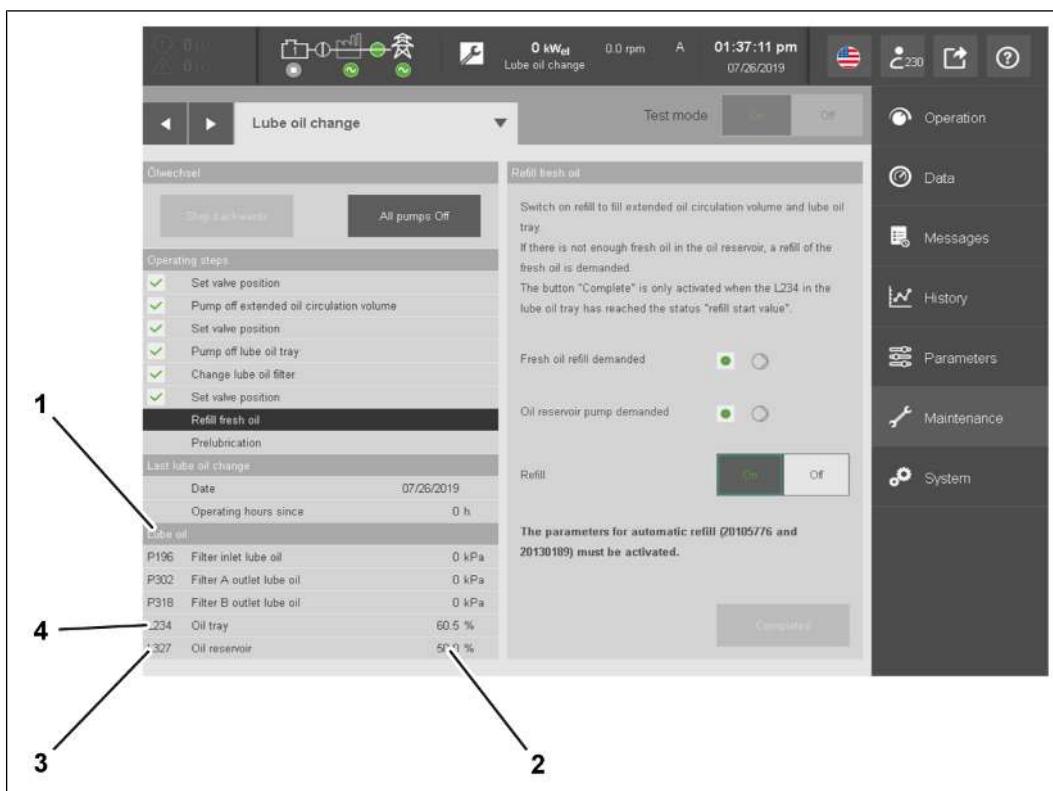
2831452171

1. Using fresh oil, fill the extended oil volume and the lube oil sump up to the predefined maximum value.
  - Tap the On (3) button
  - A green dot (2) appears in the Oil reservoir pump demanded dialog area.
  - Extended oil volume and lube oil sump are filled with fresh oil.
2. You can terminate the filling of the lube oil volume before the process is finished:
  - The control will stop the filling process if you tap the Off button (3).
  - When you tap the Step backwards button (1), the control will return to the Set valve position step.



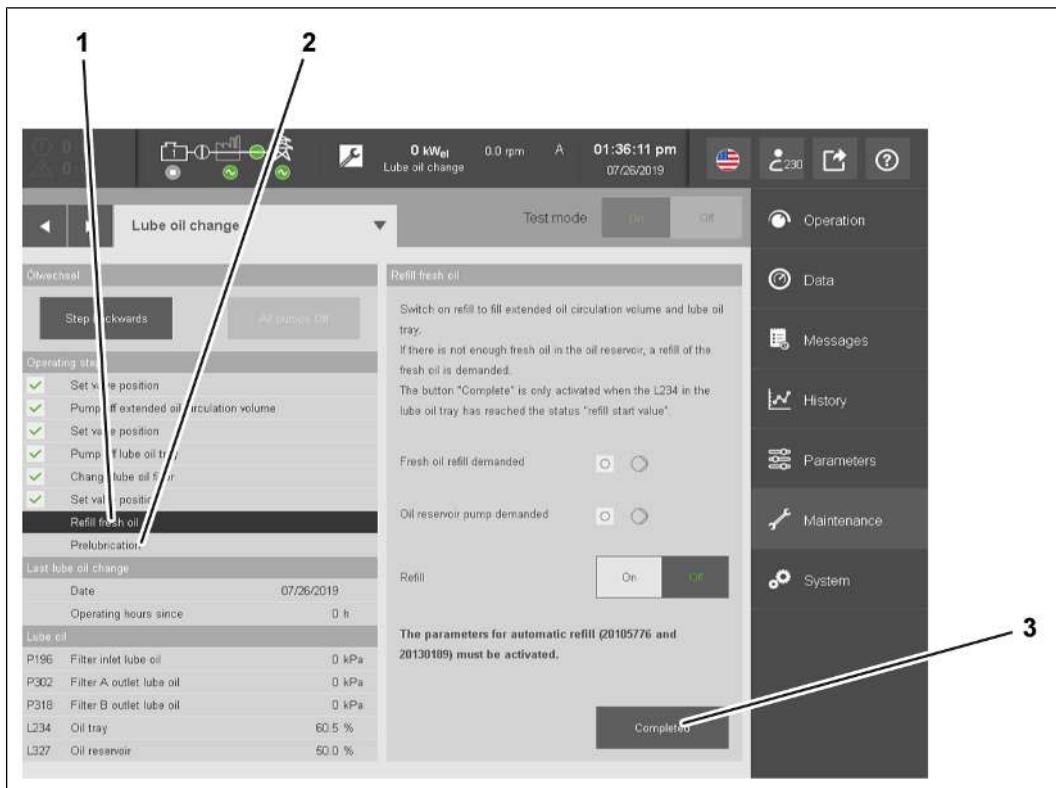
2832370827

3. Manually stop the prelubrication pump when the preset maximum value is reached
  - Tap the All pumps Off button (2)



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4. **NOTE! The oil reservoir pump can run dry due to insufficient filling of the oil reservoir. Therefore, switch off the oil reservoir pump immediately as soon as the oil reservoir reaches its minimum fill level. Always fill the oil reservoir up to the preset maximum value of parameter L327 Oil reservoir (3). Fill the oil reservoir manually if necessary.** Wait for the lube oil to fill
  - The lube oil levels (3) and (4) are shown in percentages in the dialog area Lube oil (1).
  - Once the preset value L234 Oil sump (4) is reached, the oil reservoir pump switches off automatically.
  - When the preset value L327 Oil reservoir (3) is reached, the control will deactivate the function Fresh oil pump demanded.
5. Check the value of the parameter L327 Oil reservoir (2)
  - If necessary, fill the oil reservoir to the preset maximum value of parameter L327 Oil reservoir (3) manually or using an external fresh oil pump.



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#### 6. Confirm fresh oil refill

- Tap the **Completed** (3) button.
- ⇒ The operating step **Refill fresh oil** (1) is completed.
- ⇒ The operating step **Prelubrication** (2) is activated.

### Prelubricating the engine

Valid for:

TCG 3016



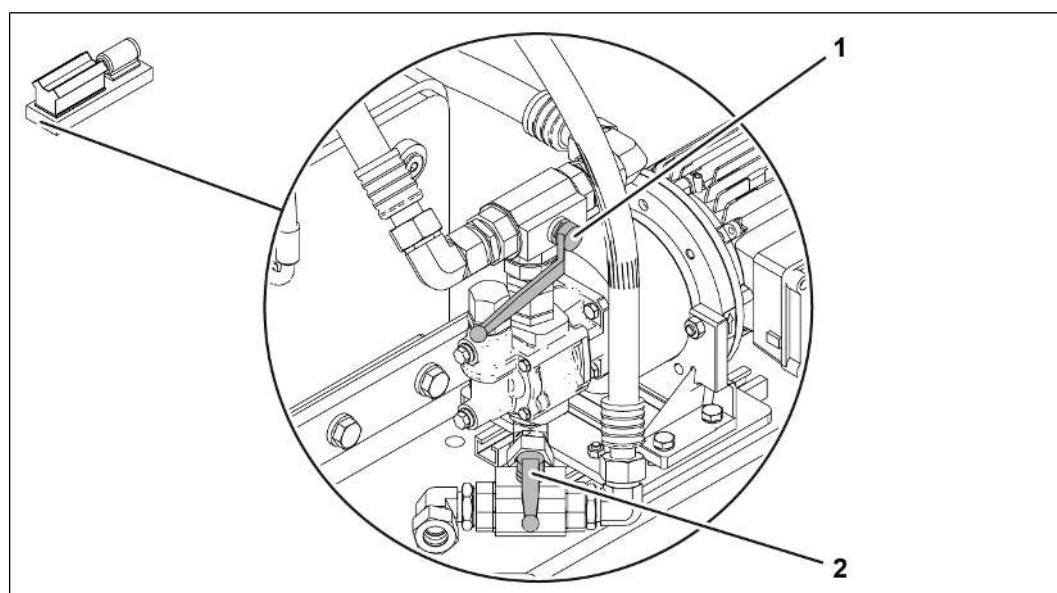
#### Risk of destruction of components

Insufficient prelubrication of the genset

The genset can be damaged and its power affected

- Always prelubricate completely before starting the genset.
- Continue prelubrication immediately after an interruption until the preset prelubrication time is reached.

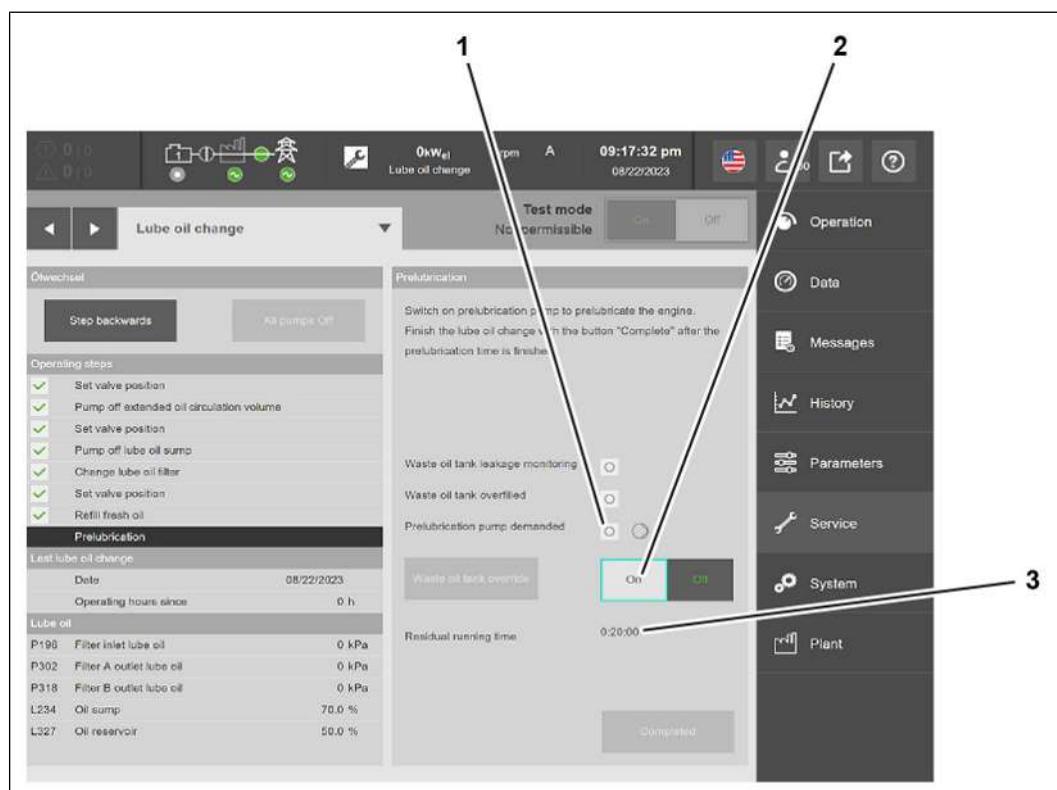
1. Stopping the genset [▶ 144]



308121739

2. Check whether the valves are in position (1) and position (2)

3. Starting the genset [▶ 143]

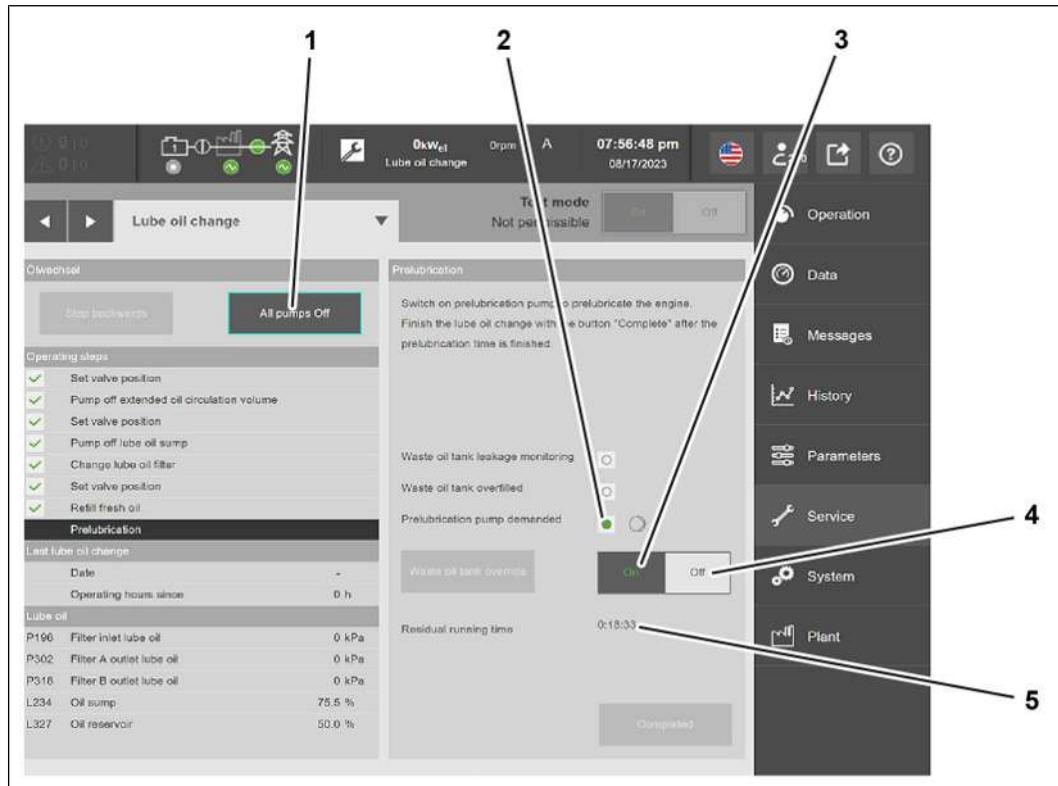


2832361483

4. Start the prelubrication

- Press the ON button (2)
- A green dot (1) appears in the dialog area.

- The residual running time is shown in the dialog area (3).
5. Leave the prelubrication pump switched on for 20 minutes



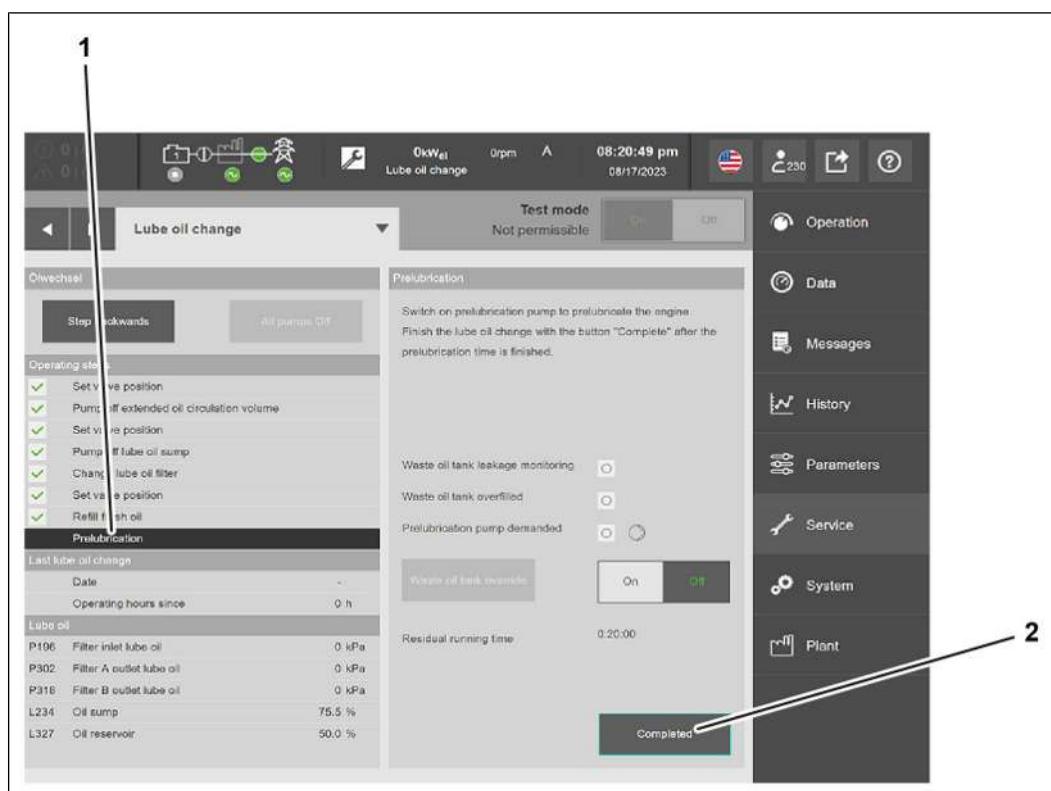
2832369931

6. **NOTE! After the preset prelubrication time has elapsed, the control stops prelubrication automatically. Prelubrication can be interrupted manually at any time. The control will only activate the Completed button once the prelubrication time has elapsed.** Manually stop the prelubrication pump

- Tap the All pumps Off (1) or Off (4) button.
- The green dot (2) disappears from the dialog area.
- The residual running time stops in the dialog area (5).

7. Continue prelubrication

- Tap the On (3) button.
- A green dot (2) appears in the dialog area.
- The residual running time resumes in the dialog area (5).



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8. Confirm prelubrication.

- Tap the Completed button (2).
- The operating step Prelubrication (1) is completed.

⇒ The lube oil change is completed.

⇒ The control returns to the home screen.

## Final work

Valid for:

TCG 3016

1. Check the lube oil level, top up if necessary
2. [Stopping the genset \[▶ 144\]](#)
3. Remove collecting trays
4. Properly dispose of collected operating medium
5. [Starting the genset \[▶ 143\]](#)
6. Visually inspect all the components and screw connections for leaks

## Checking the valve clearance

Valid for:

TCG 3016



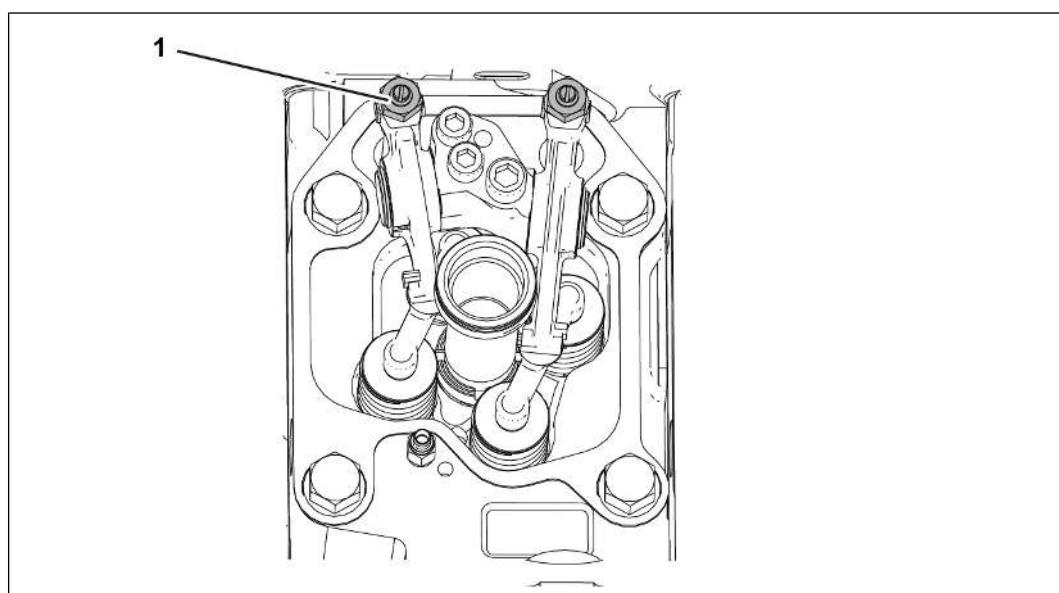
Tools:

- Standard tools
- Torque wrench with ring insert



Spare parts:

- Sealing ring for spark plug
- If necessary, seal for cylinder head cover



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Lock nut on rocker arm		
1	M10 x 1	45 Nm
Valve clearance		
Inlet		0.3 mm
Outlet		0.7 mm

Table 16: Valve clearance

V8 engine valve setting	
Ignition TDC	A1 B2 A3 B1 A4 B3 A2 B 4
Overlap	A4 B3 A2 B4 A1 B2 A2 B 4
V12 engine valve setting	
Ignition TDC	A6 B2 A2 B4 A4 B1 A1 B 5 A5 B3 A3 B6
Overlap	A1 B5 A5 B3 A3 B6 A6 B 2 A2 B4 A4 B1
V16 engine valve setting	
Ignition TDC	A1 B3 A3 B7 A7 B5 A5 B 8 A8 B6 A6 B2 A2 B4 A4 B1
Overlap	A8 B6 A6 B2 A2 B4 A4 B 1 A1 B3 A3 B7 A7 B5 A5 B8

Table 17: Valve setting per engine

## General information



### Risk of destruction of components

Improper adjustment of valve clearance

The engine can be damaged.

- Check and adjust valve clearance compensation and valve clearance only when the engine is cold
- When measuring, ensure that the valves are completely closed.

Adhere to the valve clearance accurately so that the operating safety of the engine is ensured and the service life is preserved for a long time.

If a valve clearance that is too large emerges during the check, the valve train starts to wear out. If the difference between the actual value and the setpoint of the relevant cylinder is outside the permissible tolerance range, document the difference measured. The valve clearance must be then set correctly and the root cause of the deviation must be eliminated.

#### **Consequences of valve clearance being too small:**

If the valve clearance is too small, the valves will only close briefly or not at all.

- A valve clearance that is too small reduces the compression and leads to power losses.
- If the valves close only briefly or not at all, the valve seats and valve plates overheat. The valves can burn down.
- A flashback in the exhaust duct or intake duct can cause an engine fire.

#### **Consequences of valve clearance being too large:**

If the valve clearance is too large, the valves open later and close earlier.

- A valve clearance that is too large reduces the filling degree of the engine. This results in power losses.
- A valve clearance that is too large causes the valve control to wear out faster.

#### **Checking the valve clearance:**

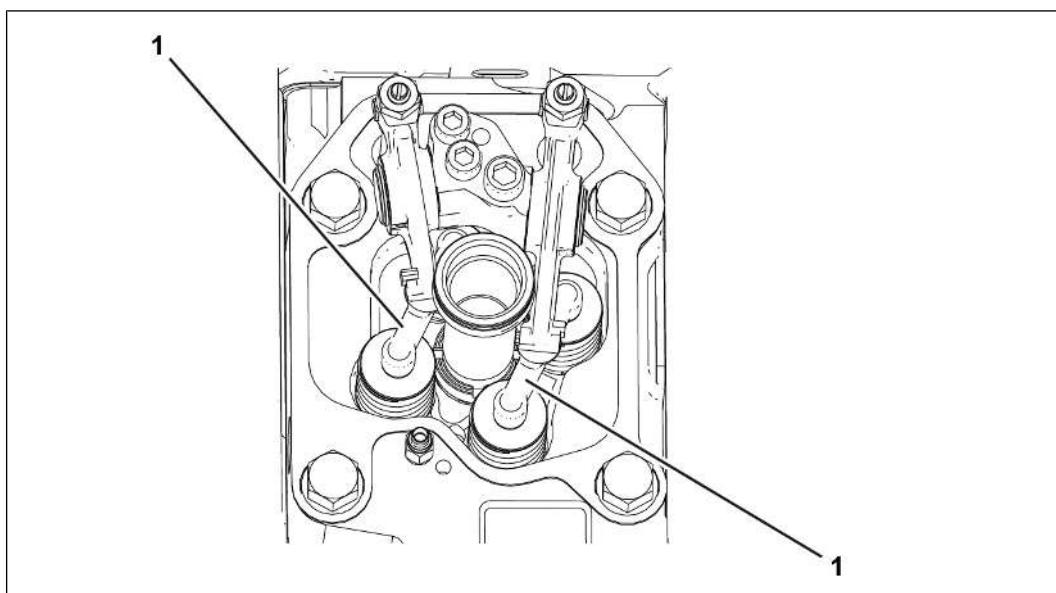
- ✓ [Dismantling the cylinder head cover \[▶ 348\]](#)
- ✓ [Mounting the engine turning gear \[▶ 463\]](#)

---

#### **NOTE**

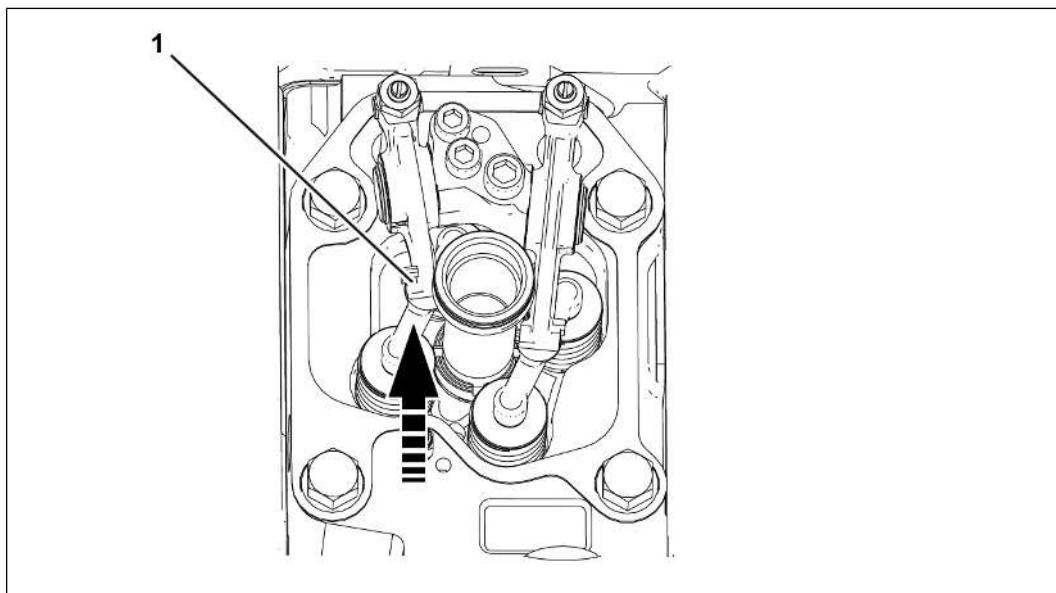
- Check and adjust all the valves in accordance with the description given below.

1. Turn the engine in direction of rotation until cylinder B1 is in the ignition TDC
2. Check whether the partner cylinder is overlapping
  - The valves are free on cylinder B1.
  - The valves are fixed on the partner cylinder.



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3. Visually inspect the valve crosshead (1)



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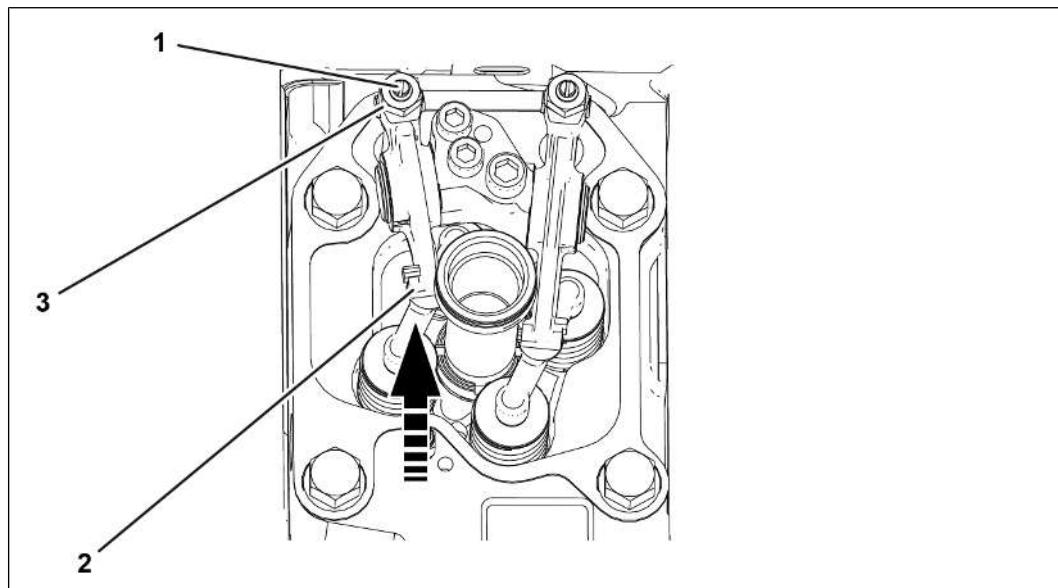
4. Push in feeler gauge

- In the direction of the arrow between valve crosshead and rocker arm (1).

5. Checking the valve clearance

- Check if it is possible to move the feeler gauge evenly without too much resistance.
- Adjust valve clearance, if necessary

### Adjusting the valve clearance:



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1. Unscrew the nut (3)
2. Push in feeler gauge
  - In the direction of the arrow between valve crosshead and rocker arm (2).
3. Unscrew or screw in a setting screw (1) until the valve clearance is set correctly
4. Ascertain the valve clearance
  - Tighten the nut (3).
  - Counter-hold on the setting screw (1).
5. Check the valve clearance again
  - Push in a feeler gauge in the direction of the arrow between a valve crosshead and rocker arm (2).
  - Check if it is possible to move the feeler gauge evenly without too much resistance.
  - Adjust valve clearance again, if necessary.
6. Check the valve clearances on the opposite valve crosshead
  - Turn the engine in the direction of rotation until the next cylinder is in overlap.
  - Adjust valve clearance, if necessary.
7. Repeat the checking and setting procedure until the valve clearance has been set for all cylinders
8. [Dismantling the engine turning gear \[▶ 465\]](#)
9. [Mounting the cylinder head cover \[▶ 349\]](#)

## Checking the valve recession

*Cylinder head mounted*

Valid for:

TCG 3016



Tools:

- Standard tools
- Special tool
  - Measuring device for valve wear
  - Depth caliper gauge



Spare parts:

- Sealing ring for spark plug

### Valve clearance

Inlet	Nominal value	65.0 mm
	Wear limit	62.5 mm
Outlet	Nominal value	65.0 mm
	Wear limit	62.5 mm

V8 engine valve setting	
Ignition TDC	A1 B2 A3 B1 A4 B3 A2 B 4
Overlap	A4 B3 A2 B4 A1 B2 A2 B 4
V12 engine valve setting	
Ignition TDC	A6 B2 A2 B4 A4 B1 A1 B 5 A5 B3 A3 B6
Overlap	A1 B5 A5 B3 A3 B6 A6 B 2 A2 B4 A4 B1
V16 engine valve setting	
Ignition TDC	A1 B3 A3 B7 A7 B5 A5 B 8 A8 B6 A6 B2 A2 B4 A4 B1
Overlap	A8 B6 A6 B2 A2 B4 A4 B 1 A1 B3 A3 B7 A7 B5 A5 B8

Table 18: Valve setting per engine

### General information

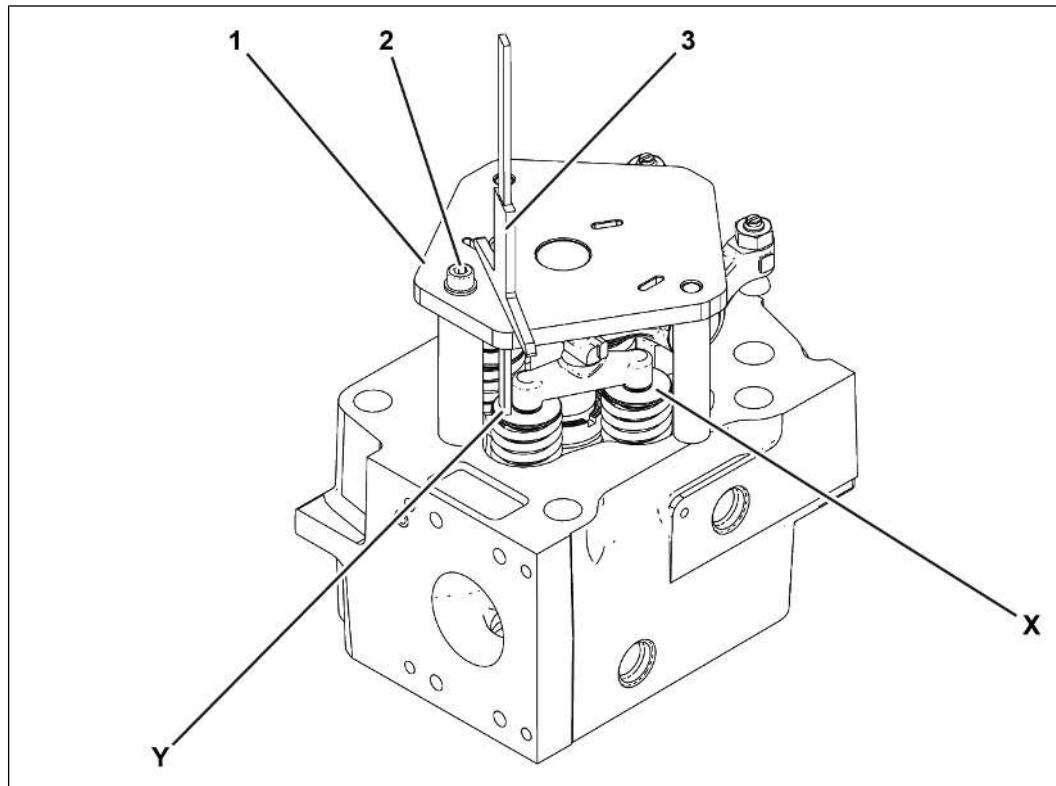
If you measure the valve recession in regular intervals, you will draw conclusions about the wear of valve cones and valve seats.

Measure in accordance with the intervals at all the inlet valves and outlet valves. The intervals are specified in the maintenance schedule. You will find the maintenance schedule in the order-specific documentation.

### Procedure

- ✓ [Dismantling the cylinder head cover \[▶ 348\]](#)
- ✓ The cylinder to be checked is in the TDC position.

1. **NOTE! If you measure the valve recession with an overlying seal of the cylinder head cover, the measurement results for the valve recession are incorrect.** Remove seal of the cylinder head cover



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2. Attach the measuring device (1)
3. Tighten screw (2)
4. Insert the depth caliper gauge (3) into the measuring device (1) one after the other at the specified points
5. **NOTE! When measuring, ensure that the valves are completely closed.** Measure the valve recession
  - Measure on every inlet valve and on every outlet valve at positions (X) and (Y).
  - Measure from the upper side of the valve spring plate up to the measuring device.
6. Document measured values. See [Valve recession measurement sheet](#)
7. If the maximum permissible valve recession value is exceeded, contact service partner.
8. Repeat the measurement for all cylinders
9. [Dismantling the engine turning gear \[▶ 465\]](#)
10. [Mounting the cylinder head cover \[▶ 349\]](#)

#### Documents on this

- ❑ OL-MRA10 / 08-03-01 Valve recession measurement sheet (Resources/xltx/3355692043.xltx)

## Dismantling and mounting the cylinder head cover

### Dismantling the cylinder head cover

Valid for:

TCG 3016

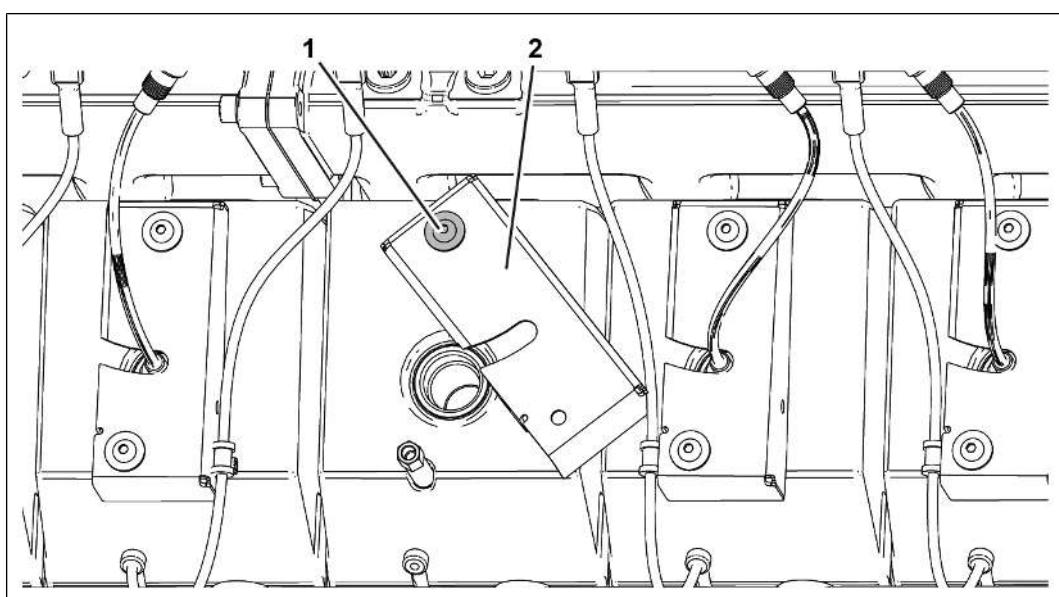


Tools:

- Standard tools

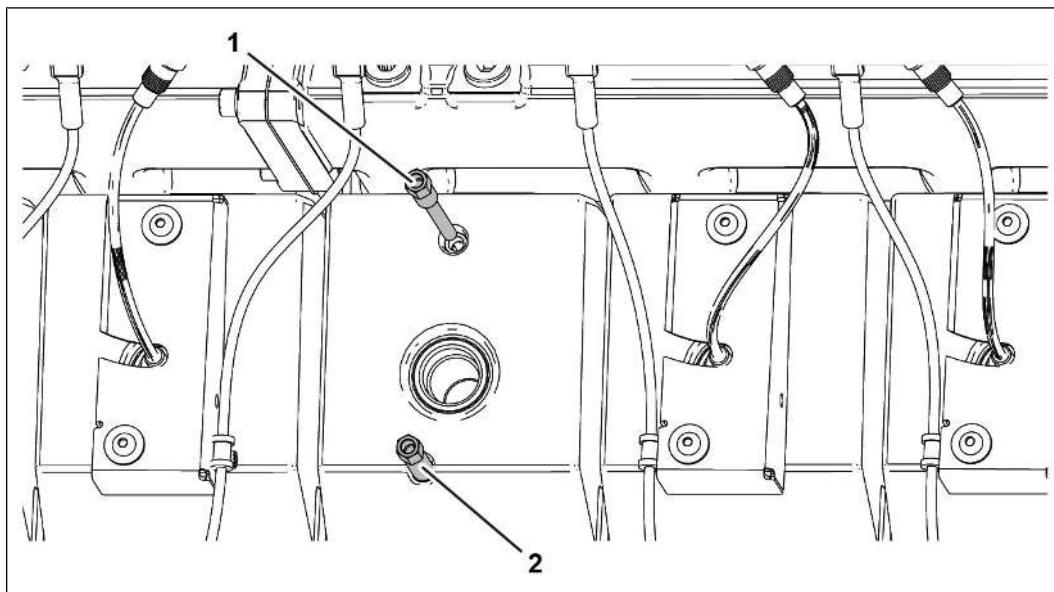
#### Implementation:

- ✓ [Removing the spark plug \[▶ 366\]](#)



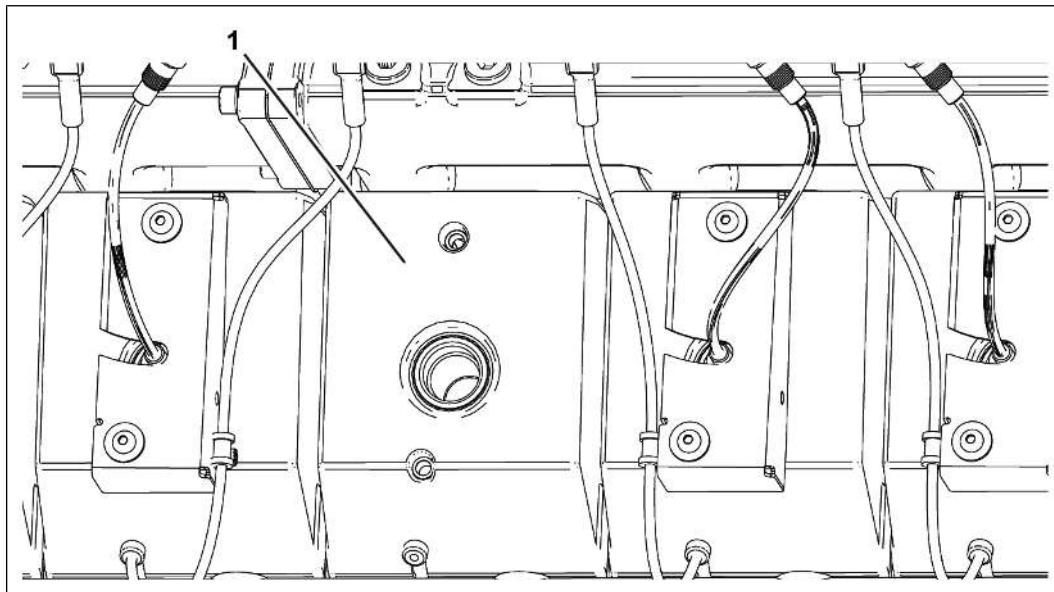
9007199562012299

1. Unscrew the screw (1)
2. Remove the fall protection (2)



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## 3. Unscrew screws (1)



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## 4. Remove the cylinder head cover (1)

**Mounting the cylinder head cover**

Valid for:

TCG 3016



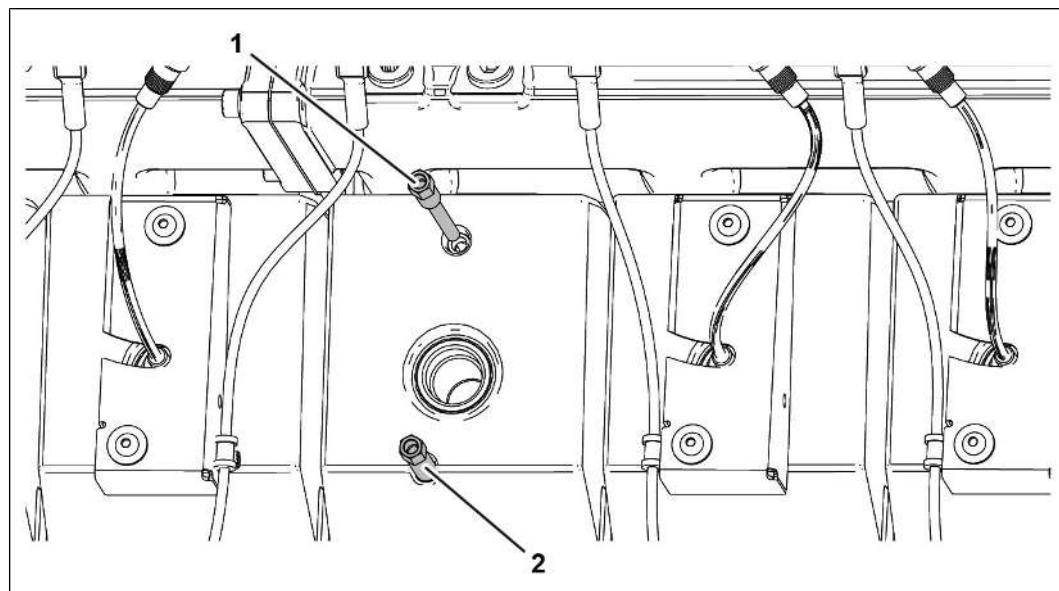
Tools:

- Standard tools



Spare parts:

- Seal
- Sealing rings

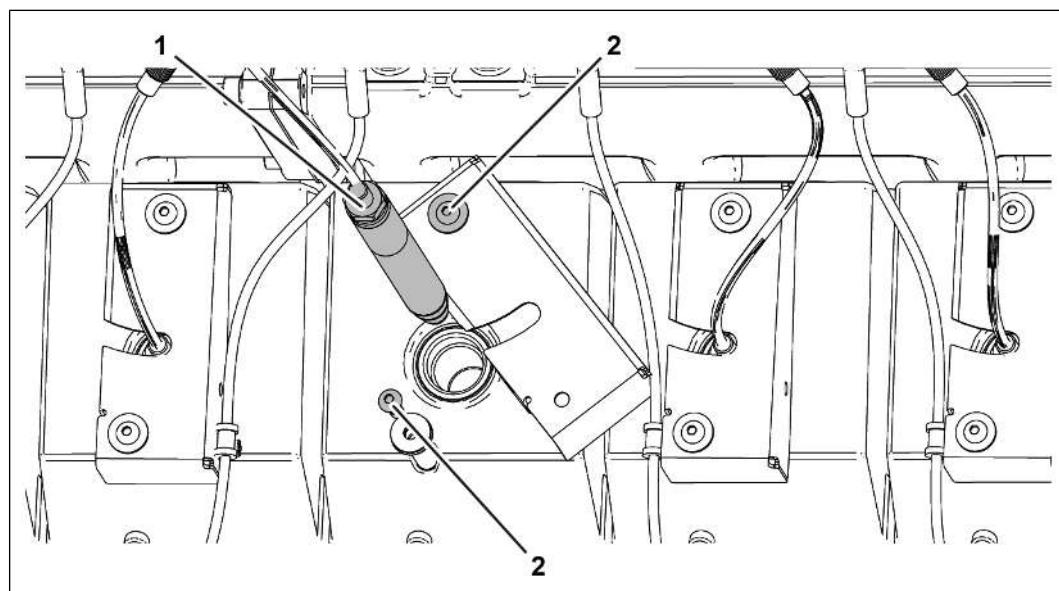


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Cylinder head cover on cylinder head<sup>1)</sup>

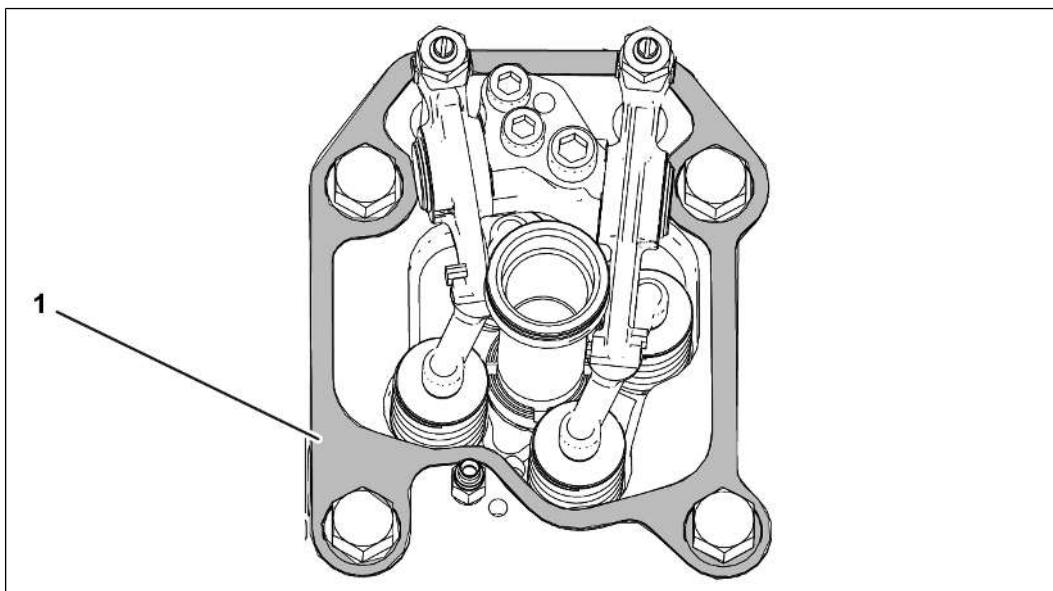
1	M8 x 80	25 Nm
2	M8 x 85	25 Nm

<sup>1)</sup> Replace sealing rings.



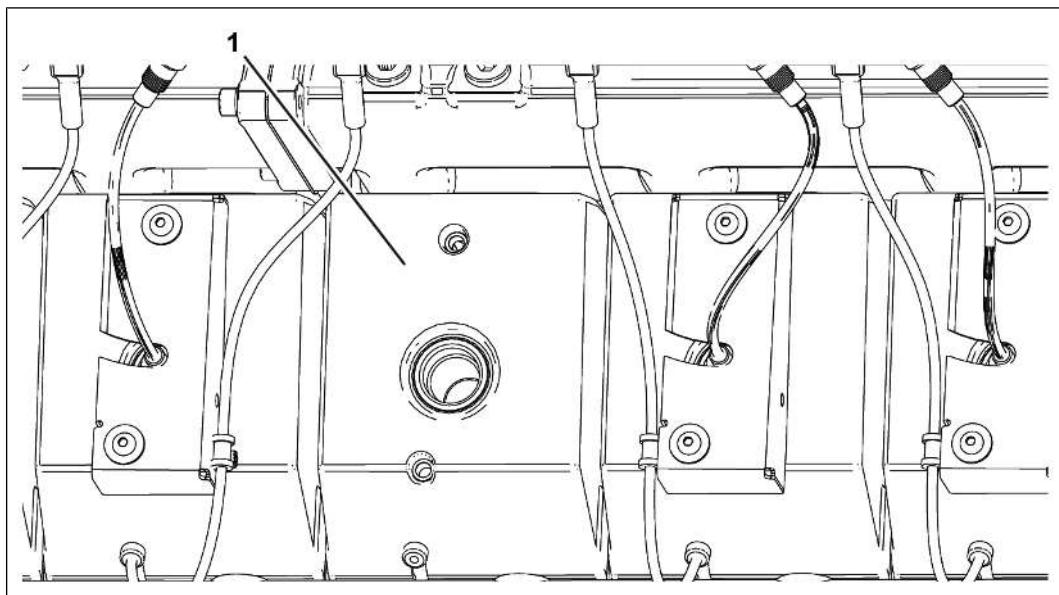
307281035

Spark plug in spark plug sleeve <sup>1)</sup>		
1	M18 x 1.5	50 Nm
Fall protection on cylinder head cover		
2	M8 x 25	12 Nm
<sup>1)</sup> Replace sealing ring.		

**Procedure to follow:**

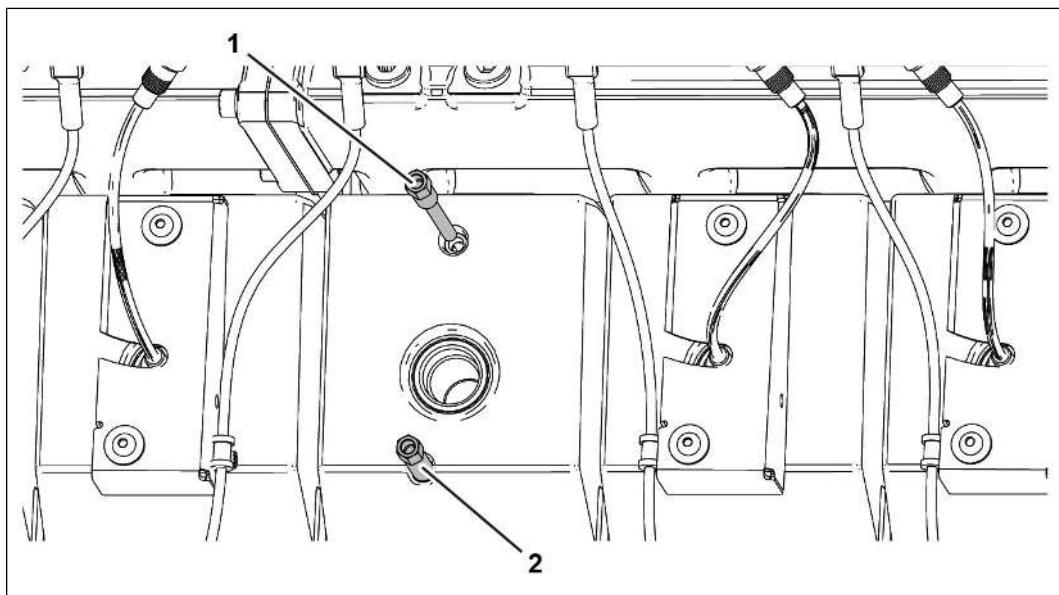
9007199562014731

1. Fit the seal (1) on the cylinder head
  - Clean the sealing surfaces
  - If there are cracks and signs of wear on the seal, replace the seal.



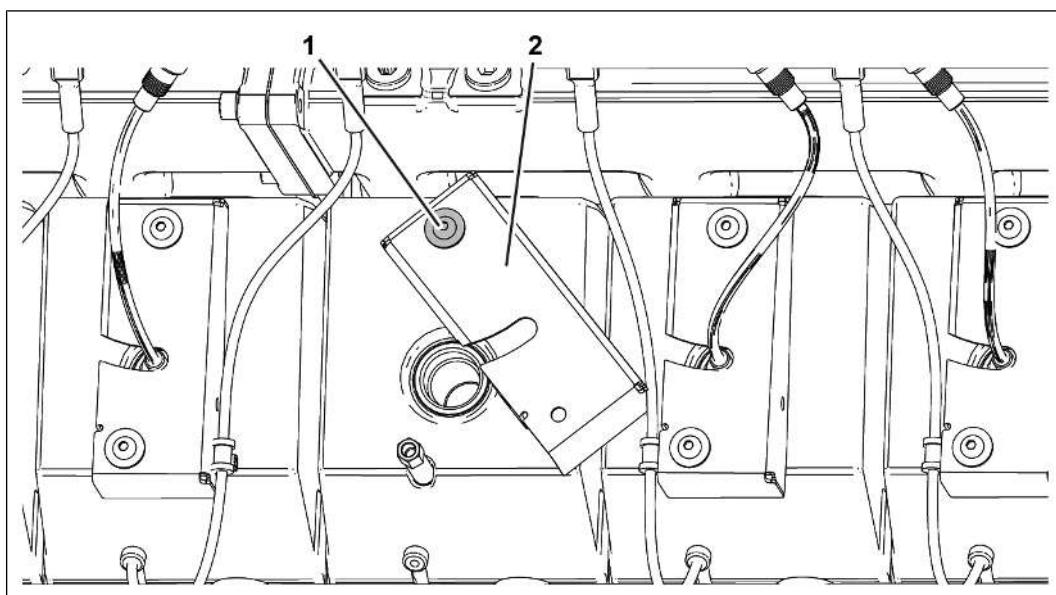
9007199562017163

2. Place the cylinder head cover (1) on the cylinder head



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3. Screw in screws (1)



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4. Attach fall protection (2)
5. Screw in screw (1) with washers
6. [Installing the spark plug \[▶ 369\]](#)

## Removing and installing the lube oil filter

### Removing the lube oil filter

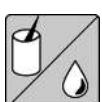
Valid for:

TCG 3016



Tools:

- Standard tools



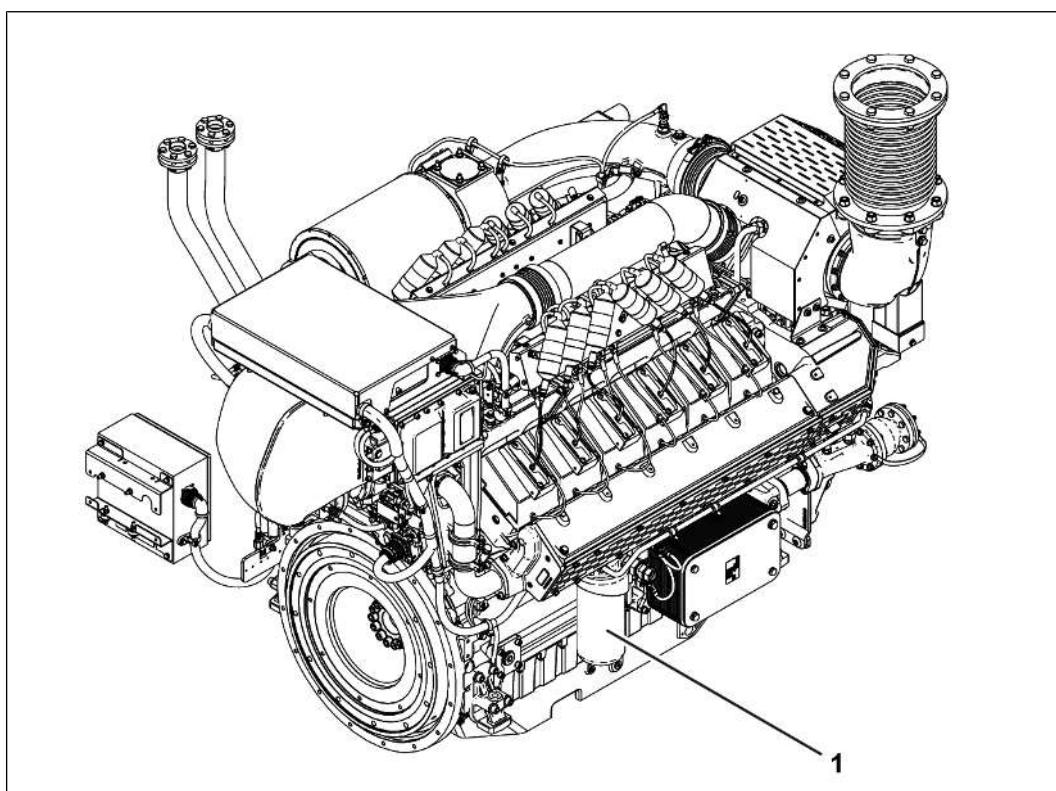
Auxiliary media:

- Binding agent

#### Procedure to follow:

- ✓ [Decommissioning the genset \[▶ 146\]](#).

1. Wait for re-lubrication procedure
2. Activate the emergency stop button
3. Place the collecting tray below the lube oil filter



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4. Unscrew lube oil filter (1) with the lube oil filter key

5. Dispose of the lube oil filter (1) properly
6. Dispose of the collected operating media properly

## Installing the lube oil filter

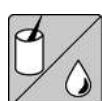
Valid for:

TCG 3016



Tools:

- Standard tools



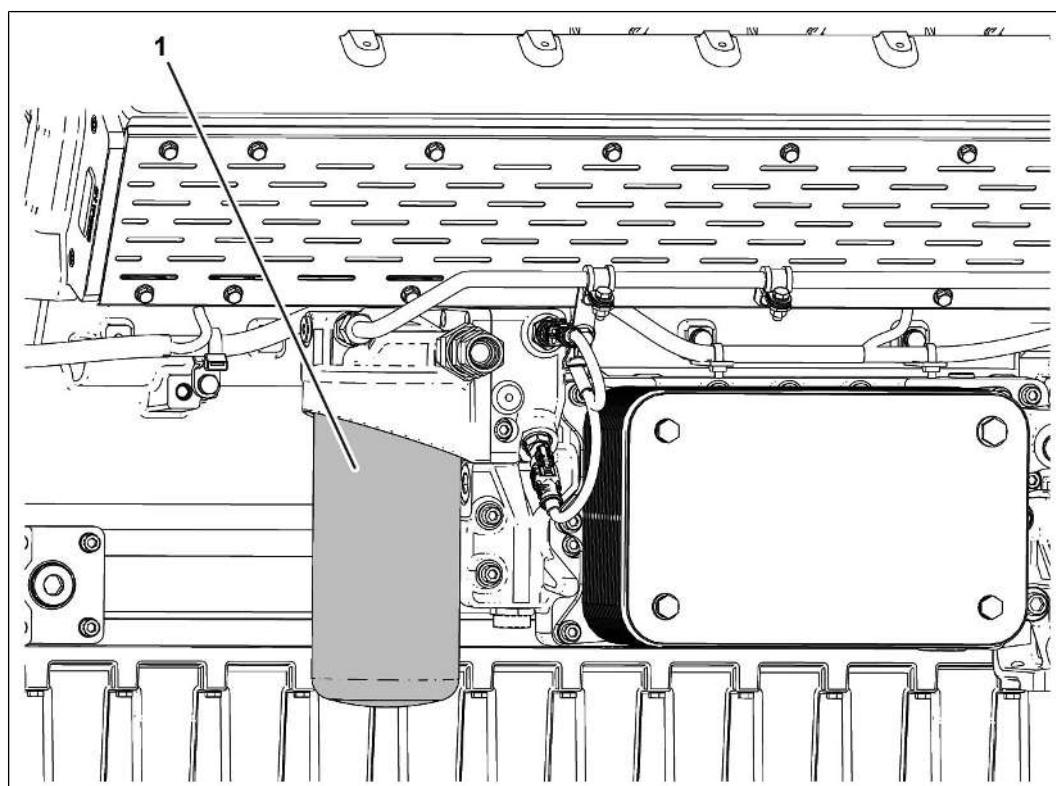
Auxiliary media:

- Binding agent



Spare parts:

- Lube oil filter

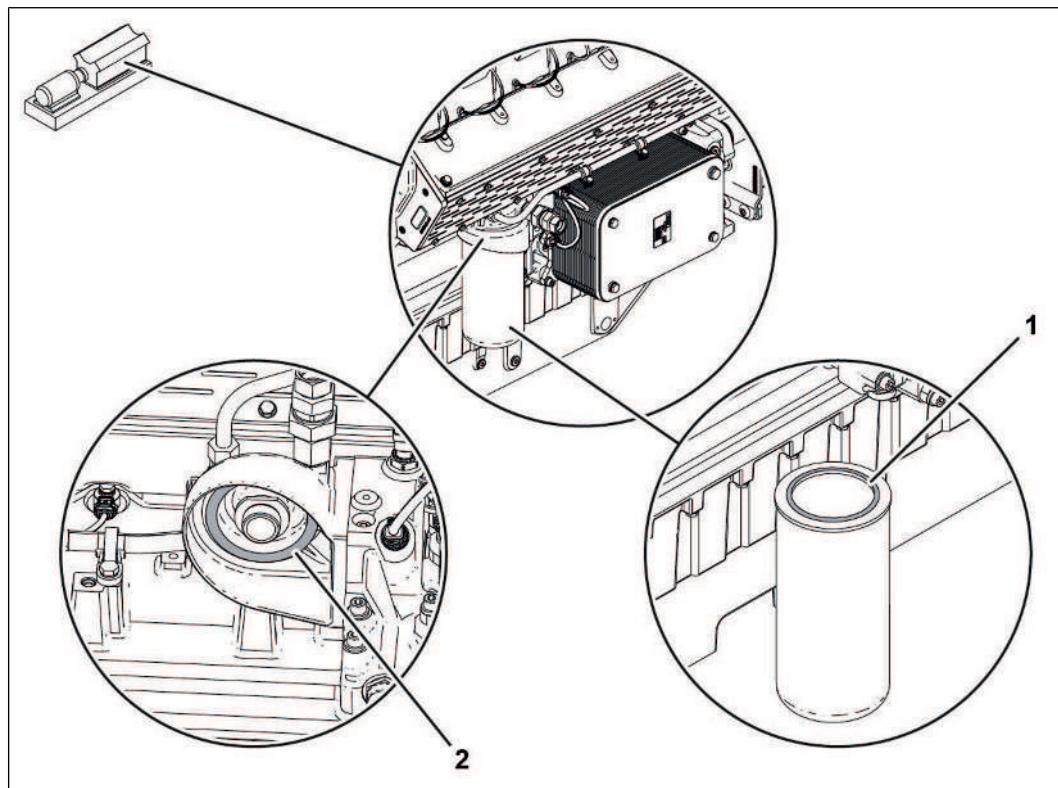


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Lube oil filter on lube oil filter console

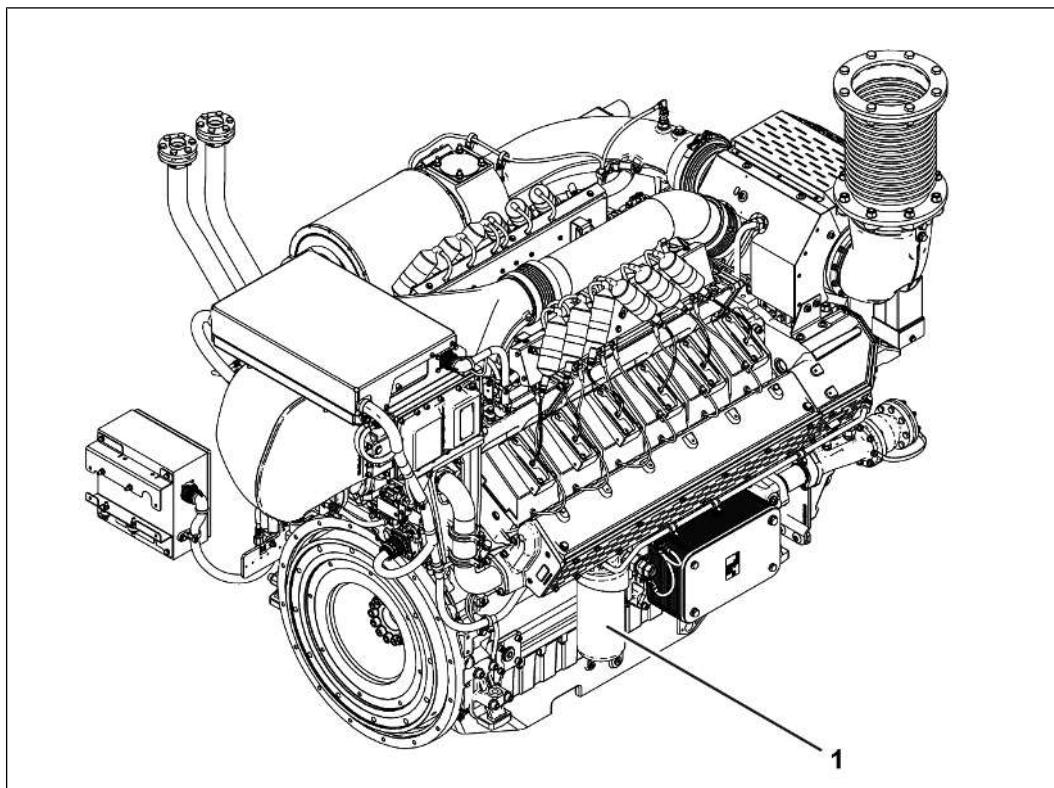
1

25 Nm

**Procedure to follow:**

308800395

1. Clean the sealing surface (2) on the lube oil filter console
2. Wet the seal (1) with lube oil on the new lube oil filter.



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3. Tighten the lube oil filter (1) in the lube oil filter console using the lube oil filter key
4. Reset the emergency stop button
  - Acknowledge the fault message in the control. See *Operating Manual, chapter "Control"*, section "*TPEM Operating manual*"
5. [Commissioning the genset \[▶ 143\]](#)
6. If necessary, see [Filling the lube oil system \[▶ 330\]](#)
7. [Prelubricating the engine \[▶ 336\]](#)
8. Visually inspect the lube oil filter (1) for leaks and tighten if necessary
  - To re-tighten the lube oil filter, stop the genset. See [Stopping the genset \[▶ 144\]](#)

## Removing and installing the intake air filter

### Dismantling the intake air filter

Valid for:

TCG 3016



Tools:

- Standard tools

#### Procedure to follow:



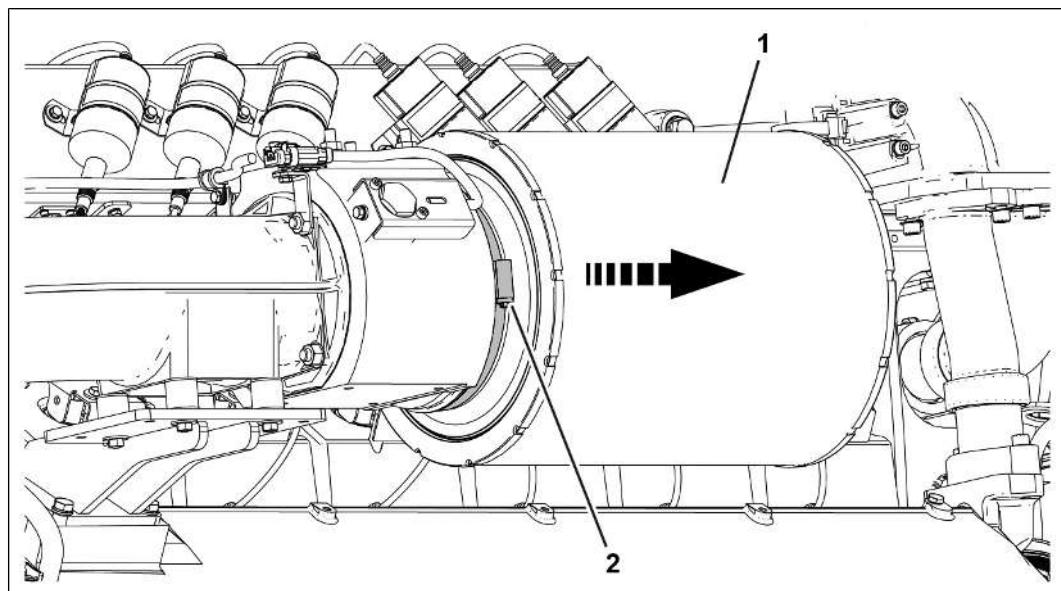
#### Risk of destruction of components

Damage to the Zeppelin and contamination of the gas-air mixer

Potential total loss of the gas-air mixer

- Immediately mount a new intake air filter to the gas-air mixer after dismantling.
- After dismantling the intake air filter, close the opening of the gas-air mixer (e.g. film) in case of a longer shutdown period.

#### ✓ Decommissioning the genset [▶ 146]



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1. Dismantle the intake air filter (1)
  - Open the clamping clip (2).
  - Remove the intake air filter (1) from the gas-air mixer (arrow).
  - Remove the clamping clip (2).

## Mounting the intake air filter

Valid for:

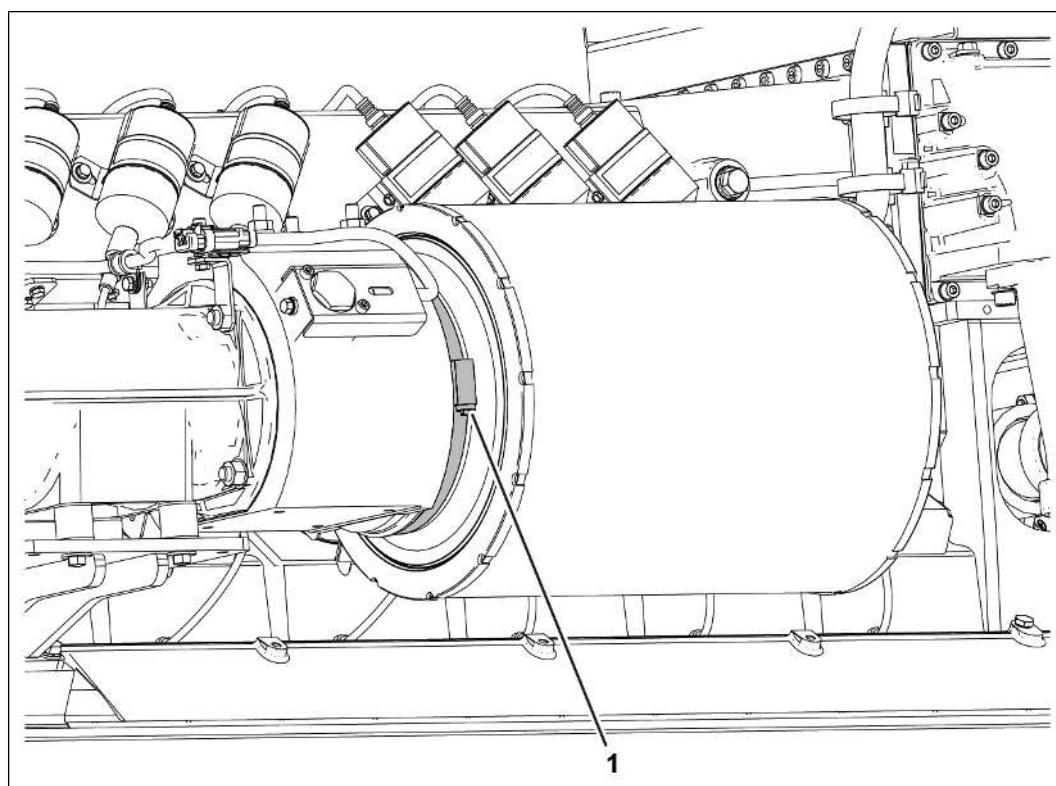
TCG 3016



Tools:

- Standard tools

### Technical data

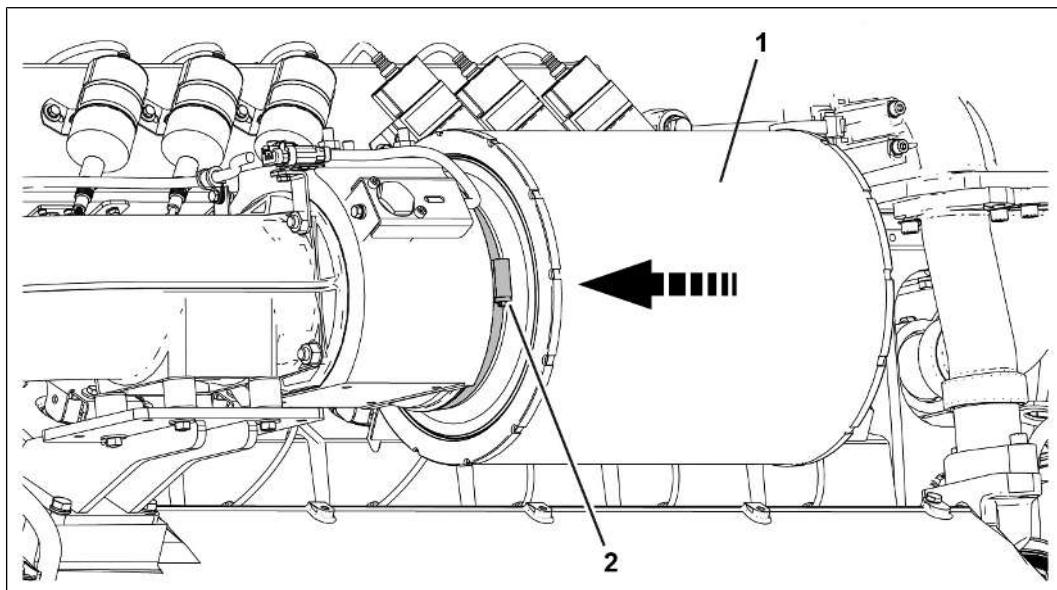


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Clamping clip on intake air filter
------------------------------------

1
---

Hand tight
------------

**Procedure to follow:**

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1. Mount the intake air filter (1)
  - Remove the cover from the gas-air mixer if necessary.
  - Push the intake air filter (1) with clamping clip (2) onto the connection piece on the gas-air mixer (arrow).
  - Close the clamping clip (1).
2. [Commissioning the genset \[▶ 134\]](#)

## Setting the global ignition angle

Valid for:

TCG 3016

### Technical Data for standard gases

Global ignition angles at 50 Hz for standard gases	
Configuration	Global ignition angle [° crankshaft before top dead center]
P	23
S	23
X	27

Global ignition angles at 60 Hz for standard gases	
Configuration	Global ignition angle [° crankshaft before top dead center]
P	27
S	----
X	29

### Technical data for natural gases with hydrogen

Global ignition angles at 50 Hz for natural gases with hydrogen (Configuration P+ and S+)	
Hydrogen content of natural gas [Vol. % H <sub>2</sub> ]	Global ignition angle [° crankshaft before top dead center]
0 %	23
up to 5 %	21
up to 10 %	19
up to 15 %	17
up to 20 %	16
up to 25 %	14

**Global ignition angles at 60 Hz for natural gases with hydrogen**
**(Configuration P+)**

<b>Hydrogen content of natural gas</b>	<b>Global ignition angle</b>
<b>[Vol. % H<sub>2</sub>]</b>	<b>[° crankshaft before top dead center]</b>
0 %	27
up to 5 %	25
up to 10 %	23
up to 15 %	21
up to 20 %	20
up to 25 %	18

**Technical data for biogases**
**Global ignition angles at 50 Hz for sewage gas, landfill gas and other biogases**
**(Configuration X)**

<b>Methane content of biogas</b>	<b>Global ignition angle</b>
<b>[Vol. % CH<sub>4</sub>]</b>	<b>[° crankshaft before top dead center]</b>
up to 55 %	28
up to 60 %	26
from 60 %	24

**Global ignition angles at 60 Hz for sewage gas, landfill gas and other biogases**
**(Configuration X)**

<b>Methane content of biogas</b>	<b>Global ignition angle</b>
<b>[Vol. % CH<sub>4</sub>]</b>	<b>[° crankshaft before top dead center]</b>
up to 55 %	30
up to 60 %	29
from 60 %	28

### Description

Compared to natural gas, **hydrogen** combusts more rapidly. You can compensate for the more rapid combustion by adjusting the global ignition angle towards the top dead center. To do this, set a global ignition angle for each possible hydrogen content in the engine control.

When **biogas** is used, the methane content of the biogas influences combustion. Setting a global ignition angle that is further before top dead center compensates for a lower methane content of the biogas. To do this, set a global ignition angle for each possible methane content in the engine control.

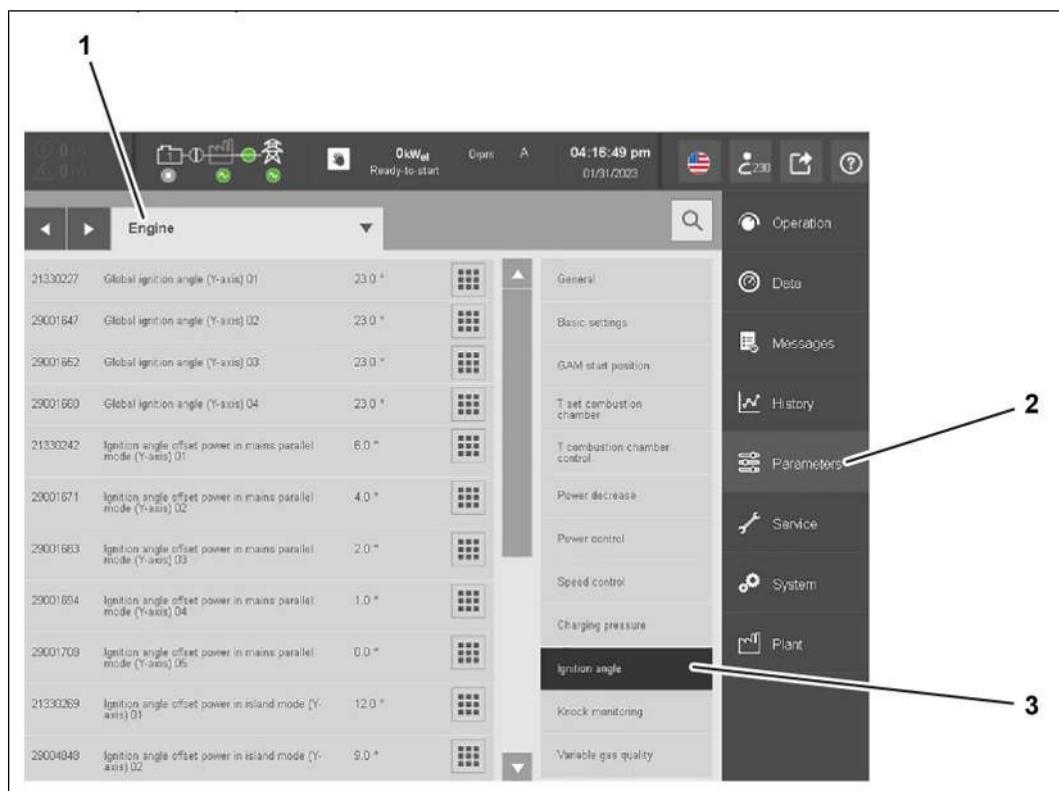
When commissioning the genset, the commissioning engineer will input the corresponding global ignition angle for hydrogen or biogas operation into the engine control. When the hydrogen content of the natural gas or the methane content of the biogas changes, you must adjust the global ignition angle. The specifications for the global ignition angle for each hydrogen or methane content level can be found in the tables above.

The control will additionally adjust the ignition angle to the actual combustion characteristic curves (balancing). To do this, the control starts with the global ignition angle and continuously calculates the required ignition angle adjustment. Depending on the ignition angle adjustment made, ignition takes place a few degrees earlier or later.

**NOTE! When you retrofit your genset for hydrogen operation, you must adjust the global ignition angle for hydrogen operation in the engine control yourself.** Input the global ignition angle in the Global ignition angle parameter. You must set the global ignition angle for operation as a function of the actual hydrogen content of the natural gas.

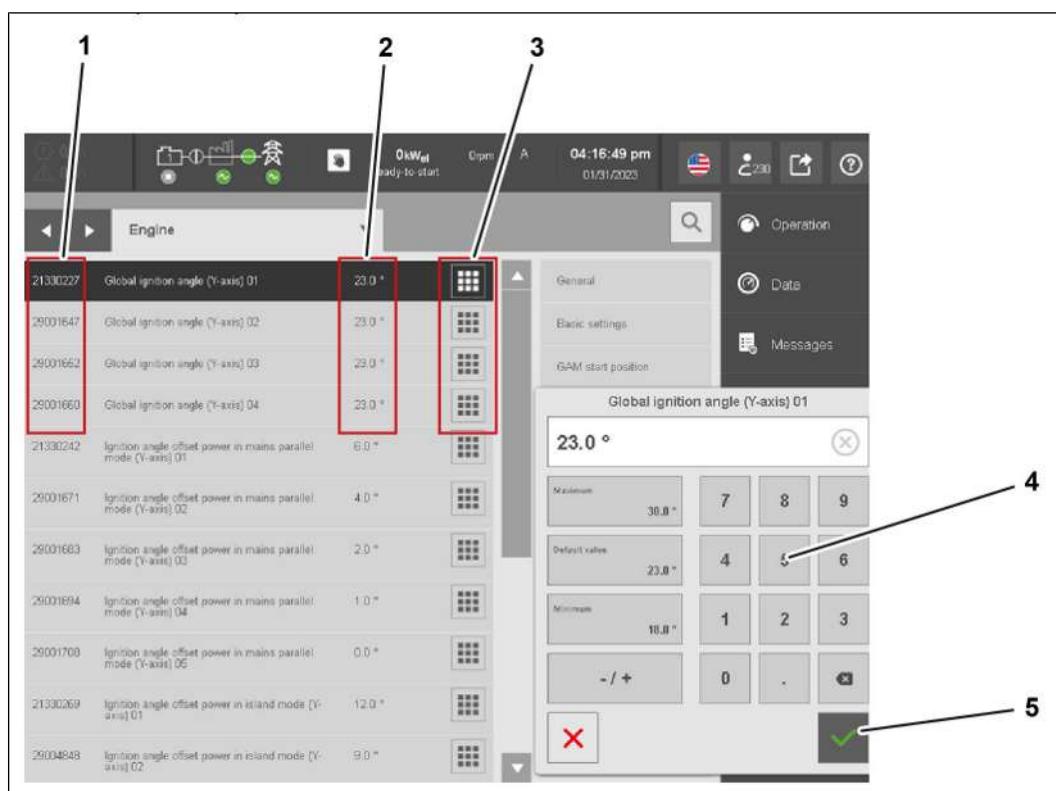
### Preparatory work:

- ✓ Engine control has been upgraded to TPEM version 1.8.2 or higher
- ✓ [Decommissioning the genset \[▶ 146\]](#)



1856877579

1. Open the functional group **Parameters** (2).
  - Open sub-group **Engine** (1).
  - Select the function **Ignition angle** (3).



1856876427

1. Adjust parameter 21330227 Global ignition angle (Y-axis) 01.
  - In the dialog area 21330227 Global ignition angle (Y-axis) 01 (1), select the symbol (3). The input mask opens.
  - Use the keypad (4) to enter the value for the respective hydrogen or methane content
  - Confirm entry by pressing the green checkmark (5).
  - The new ignition angle (2) appears in the dialog area 21330227 Global ignition angle (Y-axis) 01 (2).
2. **NOTE! Enter the same value for every parameter based on the hydrogen or methane content.** Repeat the procedure described above for the following parameters:
  - 29001647 Global ignition angle (Y-axis) 02
  - 29001652 Global ignition angle (Y-axis) 03
  - 29001660 Global ignition angle (Y-axis) 04
3. [Establishing operational readiness \[▶ 129\]](#)

## Removing and installing the spark plug

### Removing the spark plug

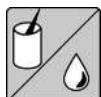
Valid for:

TCG 3016



Tools:

- Standard tools
- Special tool
  - Socket wrench insert for spark plug
  - Spark plug thread cleaner

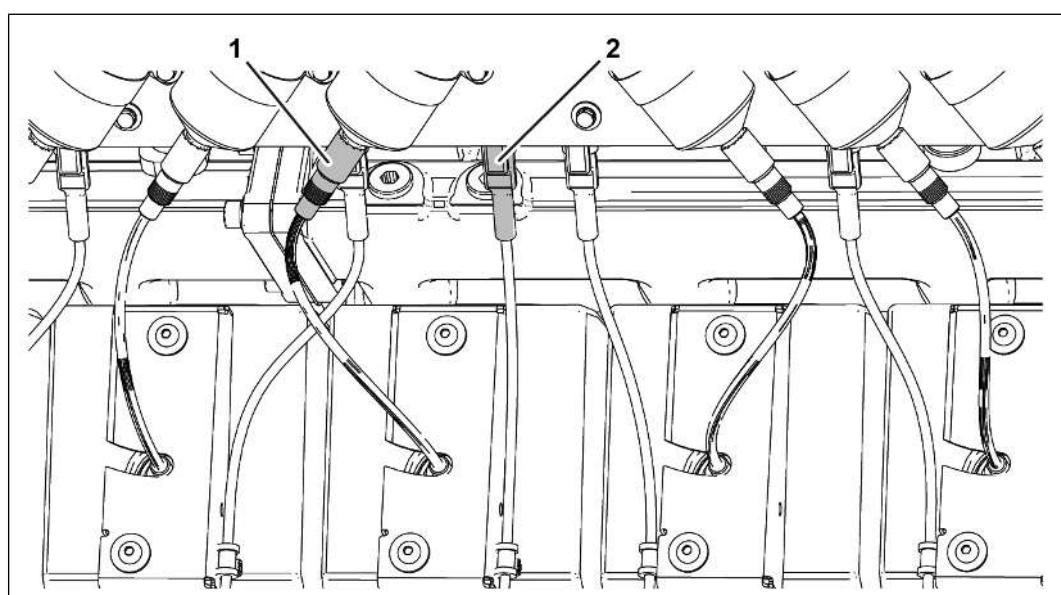


Auxiliary media:

- Compressed air

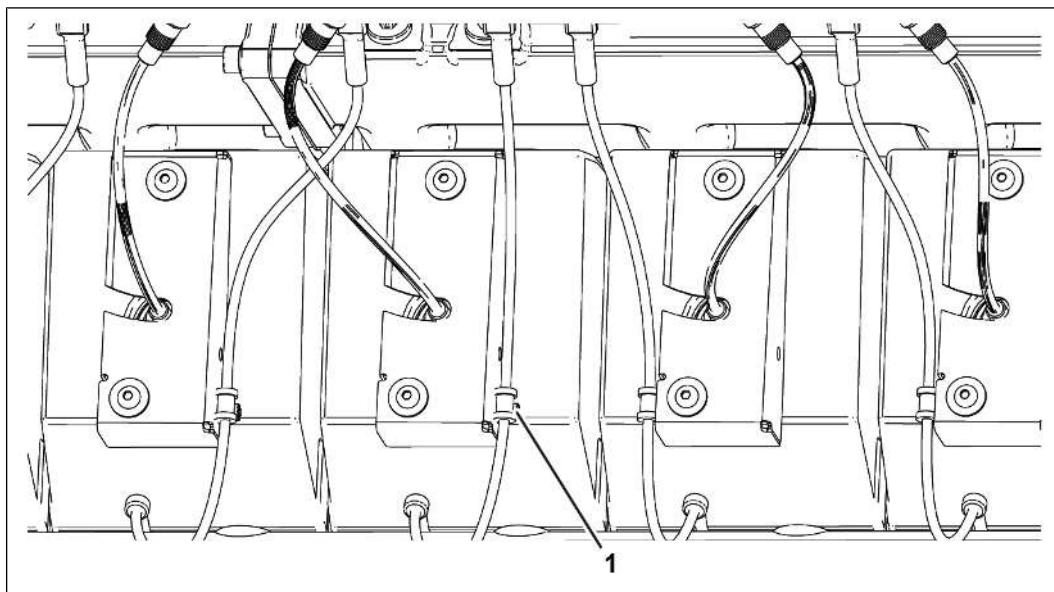
#### Removing the spark plug:

- ✓ [Decommissioning the genset \[▶ 146\]](#)



309635339

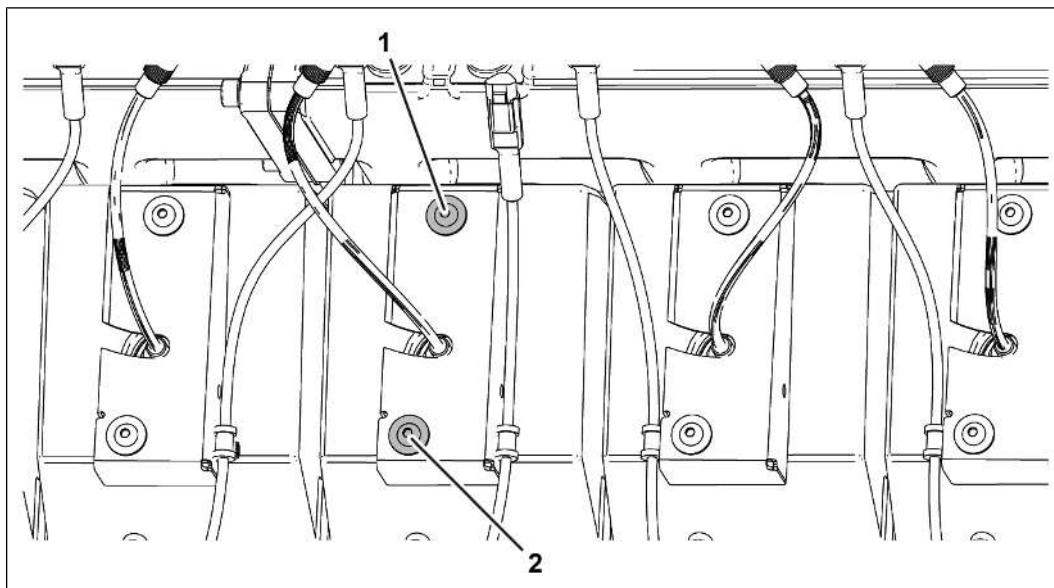
1. Disconnect the connector (1) from the ignition coil.
2. Disconnect the combustion chamber temperature sensor connector (2) from the ignition rail



309641355

3. Unscrew the cable holder (1)

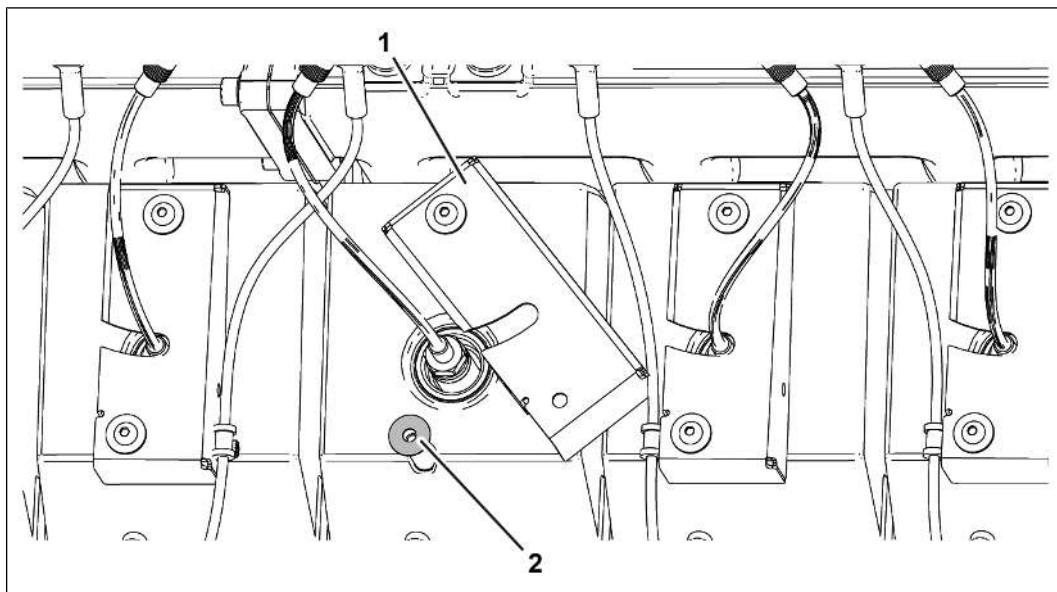
- Lay the combustion chamber temperature sensor cable in such a way that it does not obstruct further work.



309630475

4. Loosen the fall protection

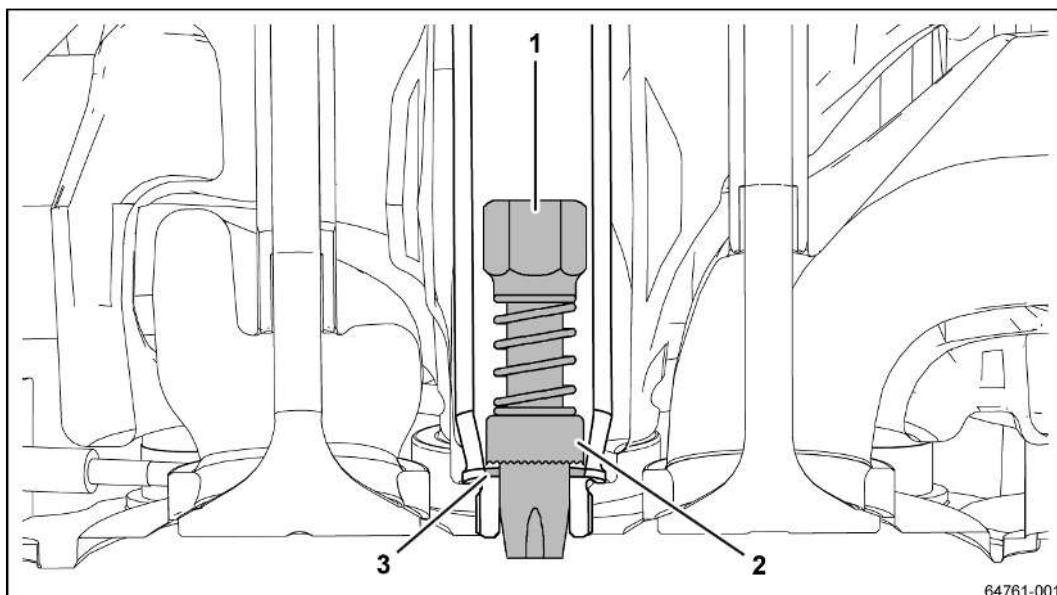
- Loosen the screw (1).
- Unscrew screw with washer (2).



309637771

5. When moving the fall protection (1), pay attention to the washer (2) underneath
6. **NOTE! Blow out spark plug shaft only with the spark plug installed. Otherwise the dirt present gets into the inside of the engine. This may damage the cylinder liners and can impair the combustion.** Blow out the spark plug shaft with compressed air
7. Unscrew the spark plug

#### Cleaning the screw thread and spark plug sleeve:



64761-001

309639435

1. Clean screw thread
  - Screw spark plug thread cleaner (1) hand tight into the screw thread with the socket wrench insert for spark plug.

- The cleaning bushing (2) of the spark plug thread cleaner (1) must be in contact with the seating surface (3).
  - To remove dirt on the seating surface (3), screw in spark plug thread cleaner (1) a further one to two turns.
  - Unscrew spark plug thread cleaner (1) until the cleaning bushing (2) is no longer in contact with the seating surface (3).
2. **NOTE! Only blow out the spark plug sleeve while the spark plug thread cleaner (1) is installed. Otherwise the dirt present gets into the inside of the engine. This may damage the cylinder liners and impair the combustion.** Clean the spark plug sleeve
- Blow out the spark plug sleeve with compressed air.
  - Unscrew the spark plug thread cleaner (1) with the socket wrench insert for spark plug.
  - Vacuum the clean spark plug sleeve using a suitable vacuum cleaner nozzle.

## Installing the spark plug

Valid for:

TCG 3016



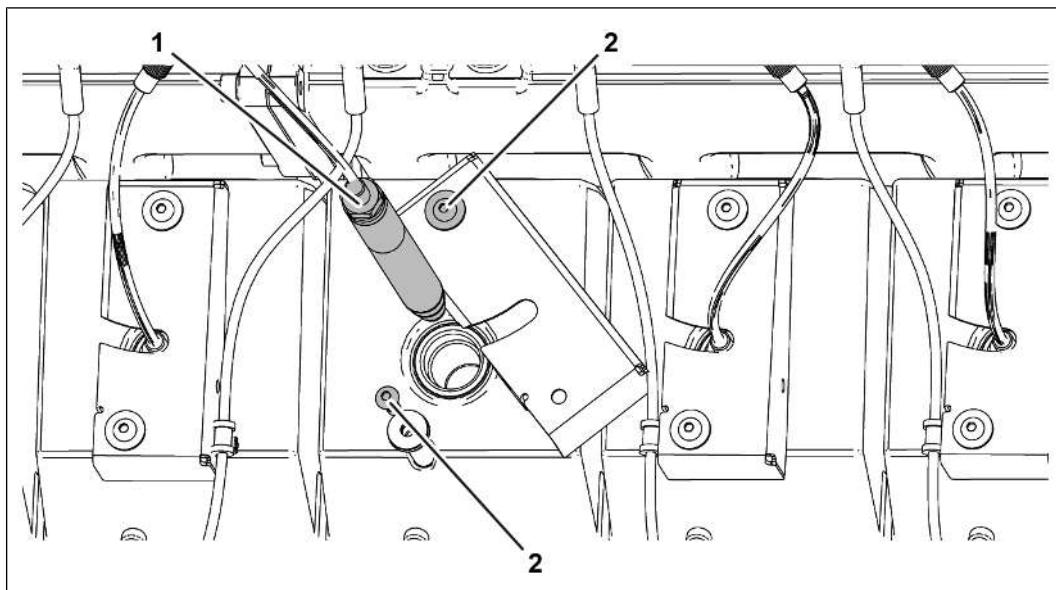
Tools:

- Standard tools
- Special tool
  - Socket wrench insert for spark plug



Spare parts:

- Spark plug
- Sealing ring



307281035

Spark plug in spark plug sleeve <sup>1)</sup>		
1	M18 x 1.5	50 Nm
Fall protection on cylinder head cover		
2	M8 x 25	12 Nm
<sup>1)</sup> Replace sealing ring.		

#### Procedure to follow:



#### Risk of destruction of components

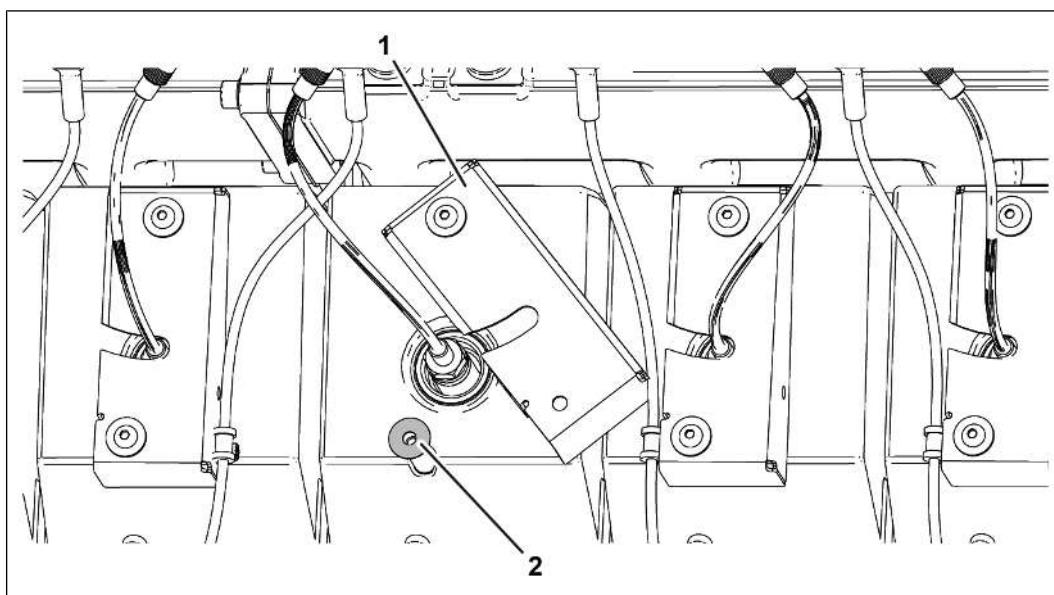
Incorrectly screwed in spark plugs

Components can be damaged or destroyed.

- Stop the engine after the test run and function run
- Tighten spark plugs with 50 Nm on the engine at operating temperature

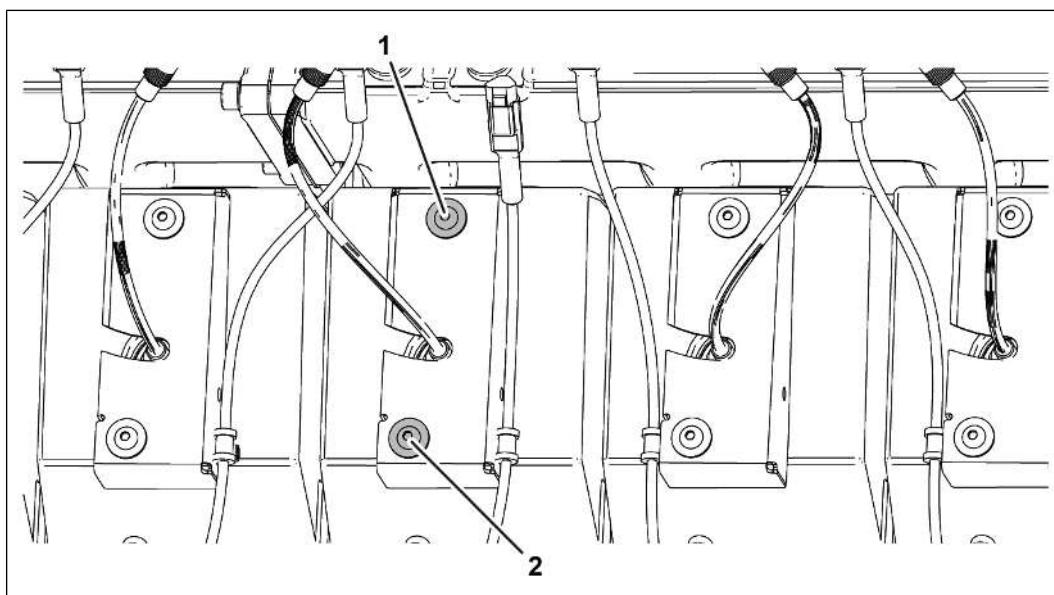
#### ✓ Checking the spark plug and ignition cable [► 374]

1. Screw in a spark plug with a new sealing ring in the spark plug sleeve
2. Use the socket wrench insert for spark plugs to tighten the spark plug
  - Place the spark plug cable such that it does not obstruct further work.
  - Tighten spark plug with 50 Nm.



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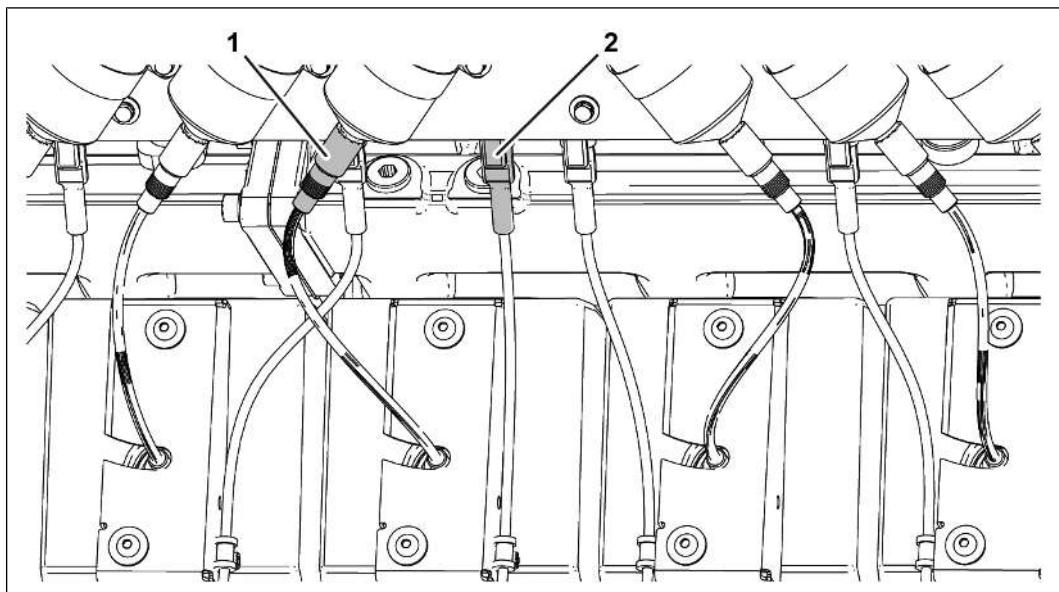
3. Position fall protection (1) with a washer (2) underneath on the cylinder head



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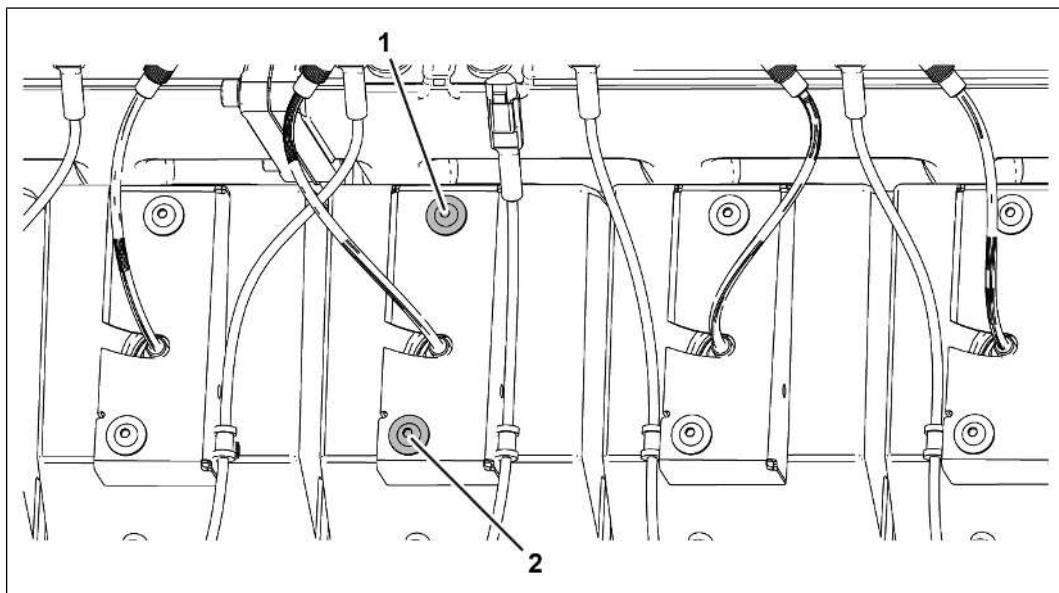
4. Mount fall protection

- Tighten screw with washer (2).
- Tighten the screw (1).



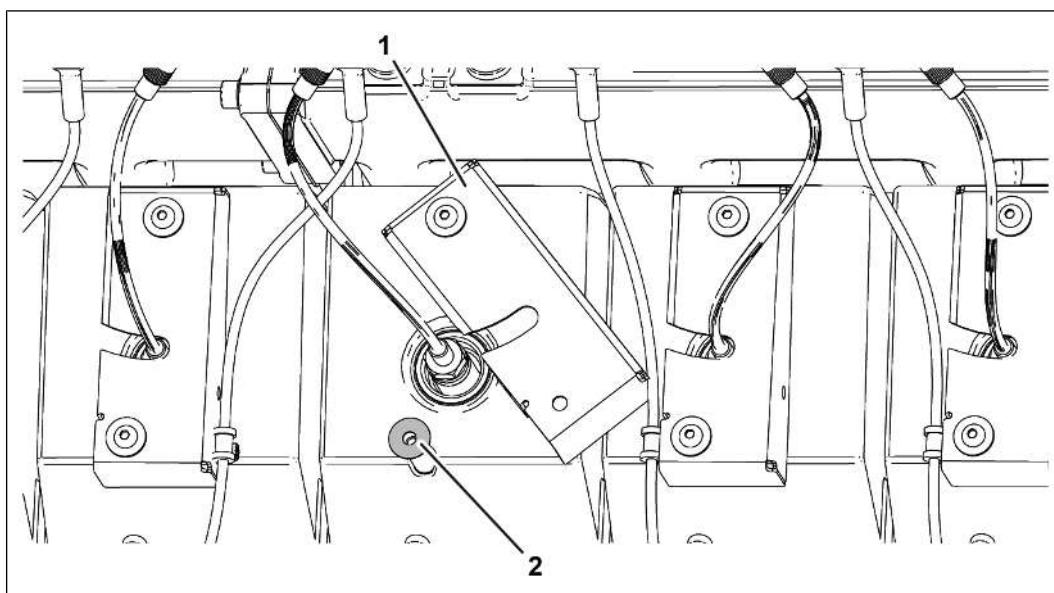
309635339

5. Insert connector (1) on the ignition coil
6. Insert the combustion chamber temperature sensor connector (2) on the ignition rail
7. [Commissioning the genset \[▶ 134\]](#)
8. [Performing test run and function run \[▶ 199\]](#)
9. [Decommissioning the genset \[▶ 146\]](#)



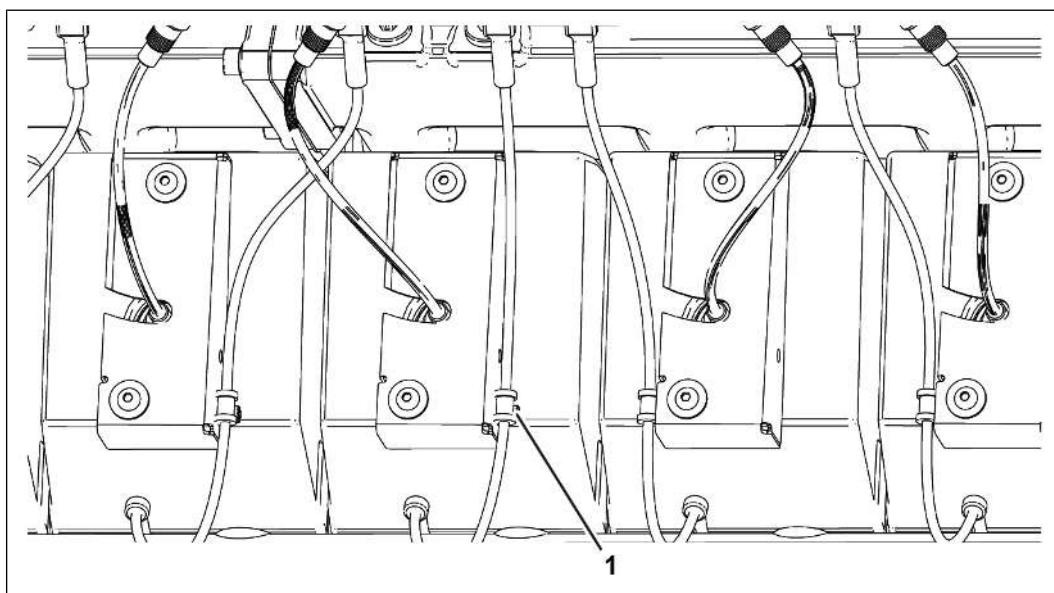
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10. Loosen fall protection
  - Loosen the screw (1).
  - Unscrew screw with washer (2).



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11. When moving the fall protection (1), pay attention to the washer (2) underneath
12. Tighten spark plugs with 50 Nm on the engine at operating temperature
13. Mount fall protection.



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14. Tighten cable holder (1)
15. [Commissioning the genset \[▶ 134\]](#)

## Checking the spark plug and ignition cable

Valid for:

TCG 3016



Tools:

- Standard tools
  - Measuring instrument (ohmmeter)
- Special tool
  - Socket wrench insert for spark plug
  - Torque wrench



Spare parts:

- If necessary, spark plug

### Spark plug (short-circuit test)

Spark plug socket against spark plug body	Infinite kOhm
Sealing ring	
Sealing ring thickness <sup>1)</sup>	1.9 mm

<sup>1)</sup> If the value is below the specified value, replace sealing ring.

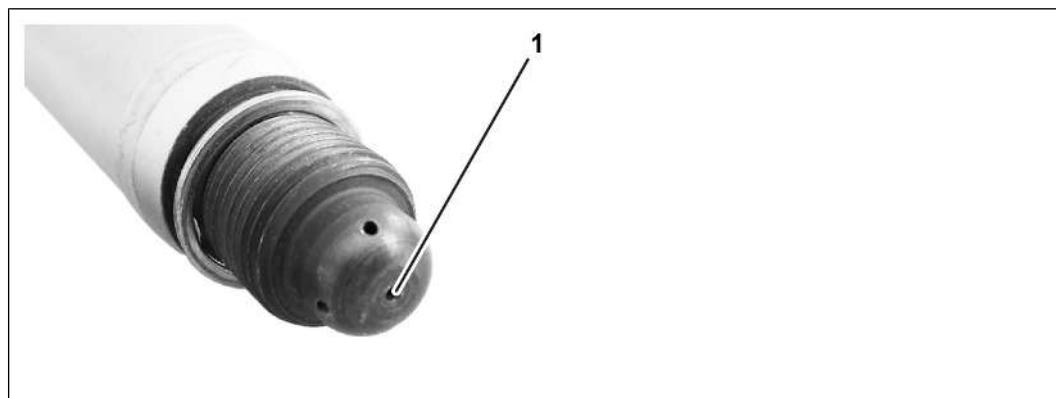
### Combustion residues on the spark plug

Combustion residues are deposited at the outlets of the spark plugs. This clogs the outlets. The flames no longer achieve the ignition energy required for the ignition. Poor ignition energy leads to faulty ignitions and ultimately to engine failure.

#### Procedure to follow:

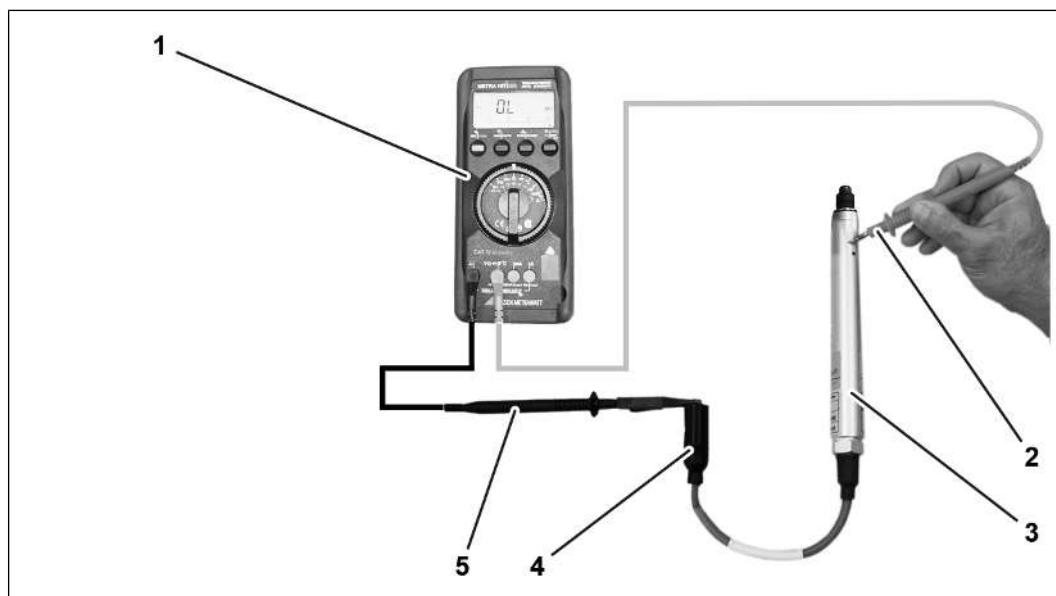
- ✓ [Removing the spark plug \[▶ 366\]](#)

1. Visually inspect the spark plug and ignition cable for mechanical damage



309997451

2. Visually inspect the bores (1) of the spark plug for deposits
  - Replace spark plugs with clogged bores (1).
3. Replace damaged spark plugs and spark plugs with damaged ignition cables.



309995019

4. Set the Ohm measuring range on the measuring instrument (1)
5. Connect the measuring device (1) to the spark plug (3) and switch it on
  - Connect the connector (5) of the measuring device to the connector (4) of the ignition cable.
  - For an accurate measured value, place the tip of the measuring sensor (2) on an electrically conductive point of the spark plug. If necessary, remove the protective coating from this point.
  - Compare measured value, see Table : Checking the spark plug and ignition cable [▶ 374]

- 
6. [Installing the spark plug \[▶ 369\]](#)
  7. Repeat the checking process for all the other spark plugs

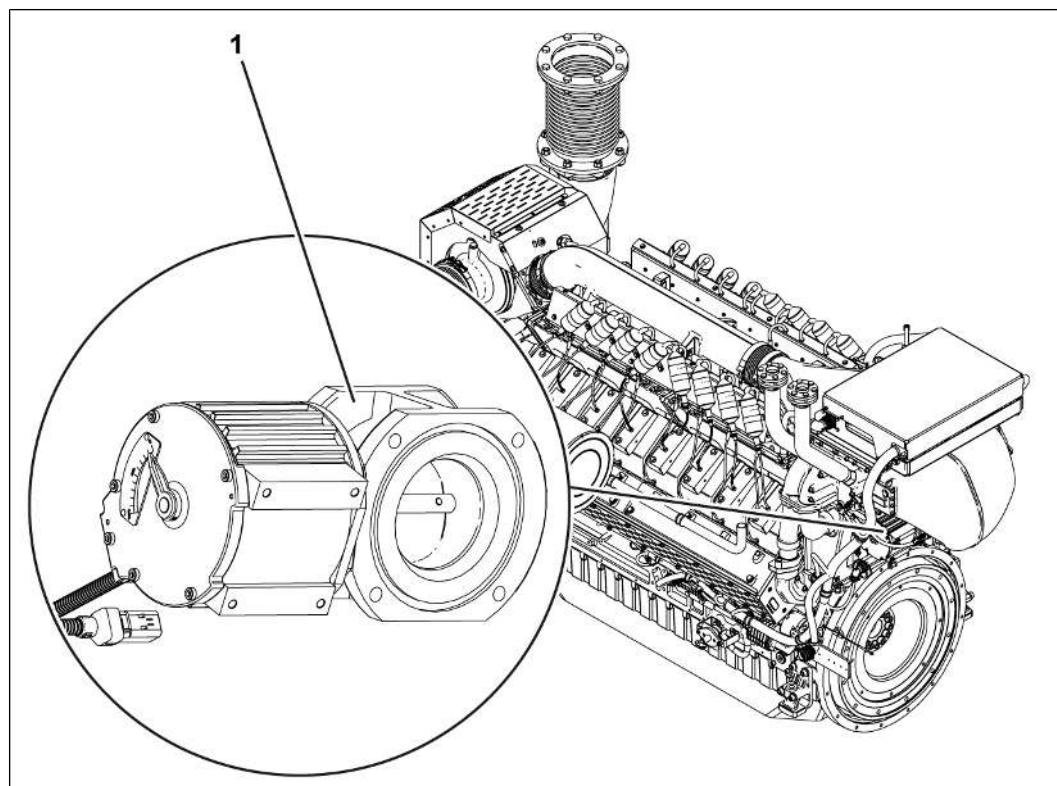
## Checking the throttle valve

Valid for:

TCG 3016

### Procedure:

- ✓ The genset has reached the operating temperature
- ✓ [Decommissioning the genset \[▶ 146\]](#)



308065547

1. Check the throttle valve (1) for leakages
  - If leakages are visible, contact service partner.
  - If the throttle valve has no leakages, [Commissioning the genset \[▶ 134\]](#)

## Detaching and attaching the torsional vibration damper guard

### Dismantling the torsional vibration damper guard

Valid for:

TCG 3016

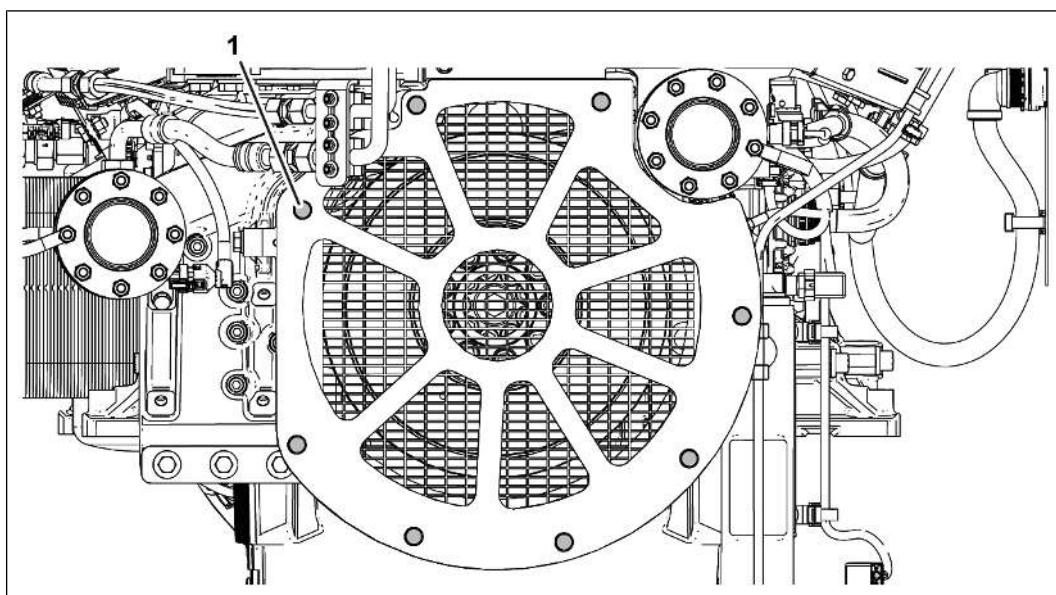


Tools:

- Standard tools

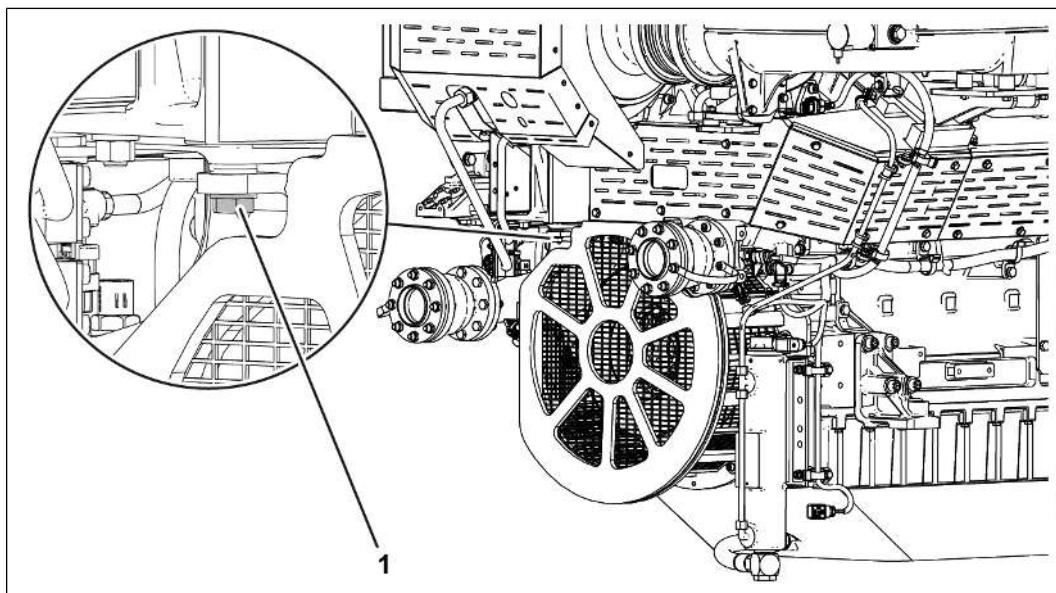
#### Implementation:

- ✓ Removing the fill level probe [▶ 438]



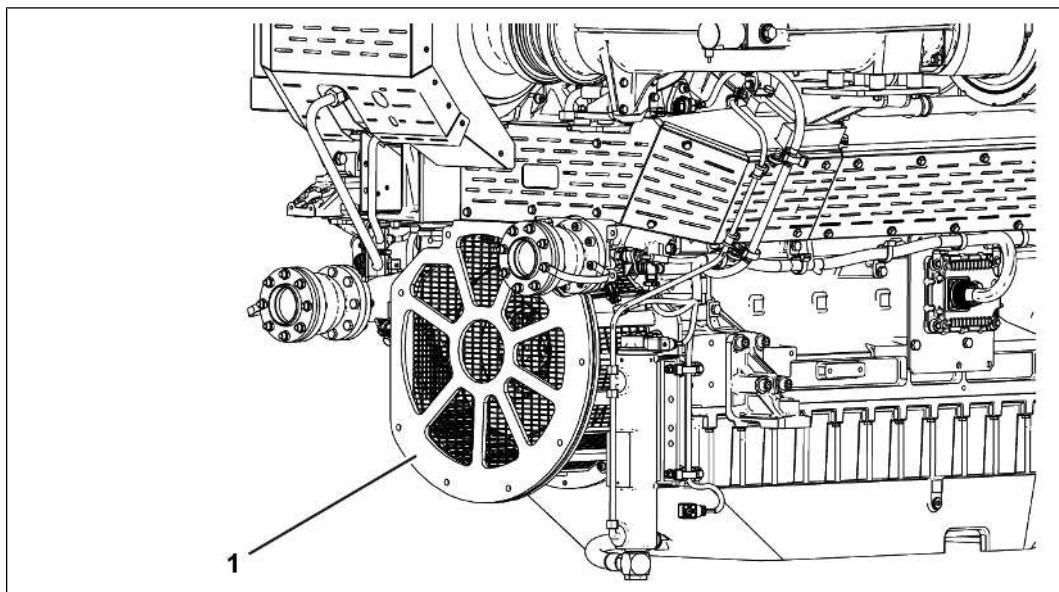
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1. Unscrew screws with washers (1)



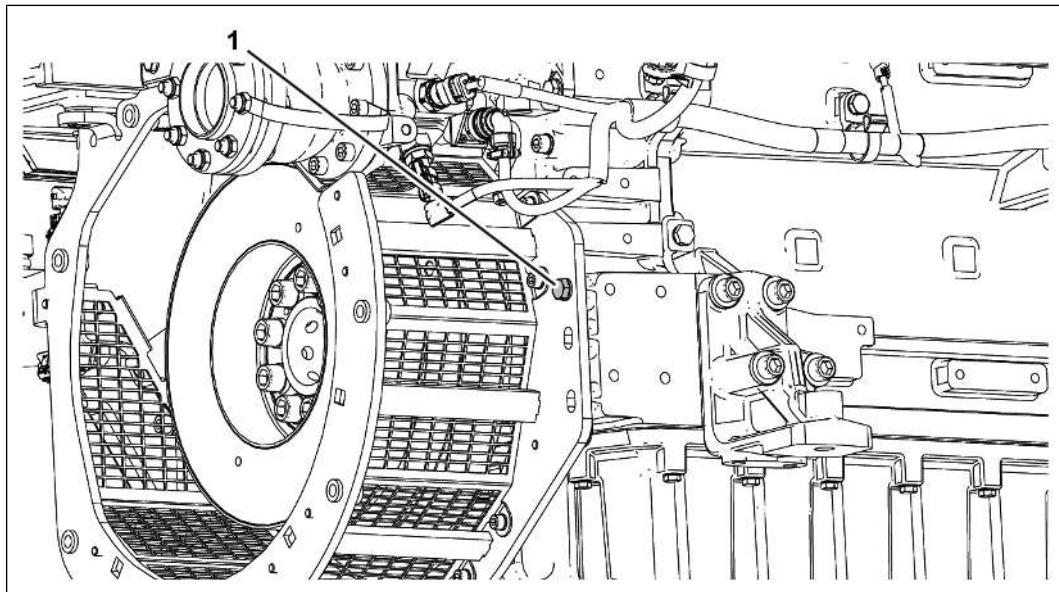
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2. Unscrew screw with washer (1)



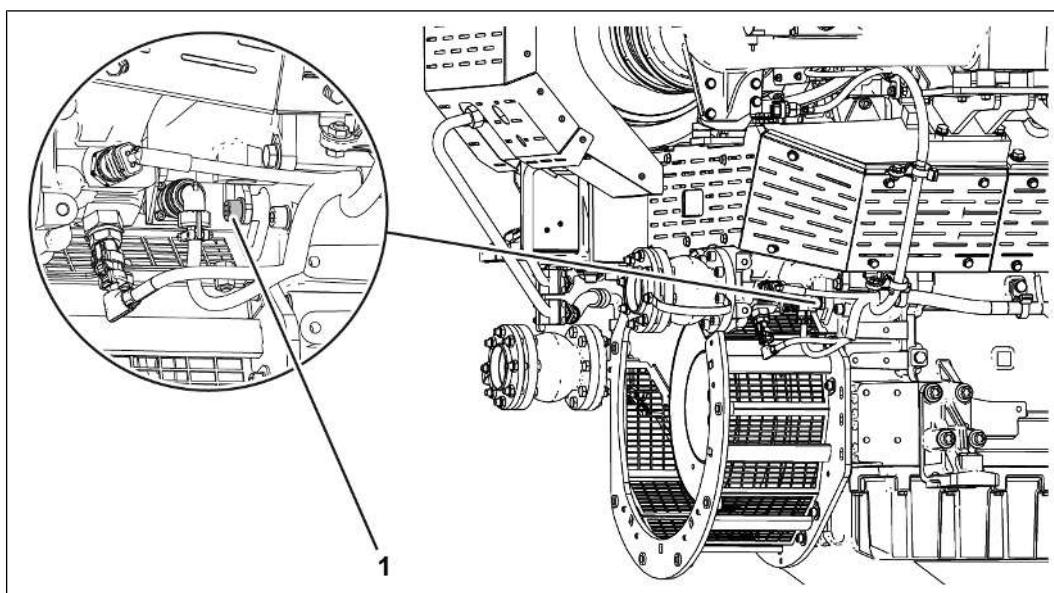
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## 3. Remove the contact protection (1)



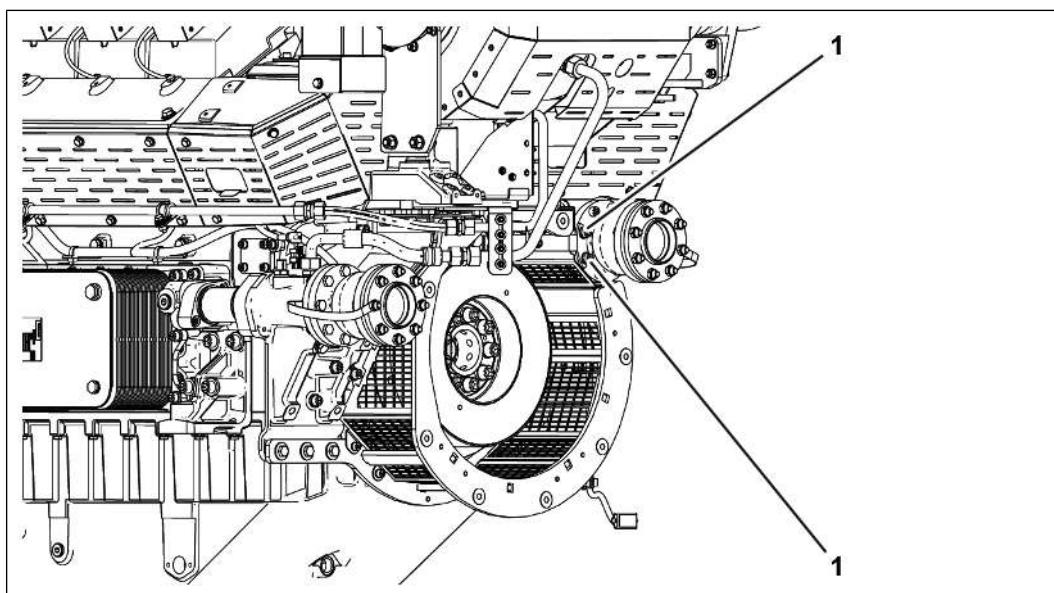
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## 4. Unscrew screw with washer (1)



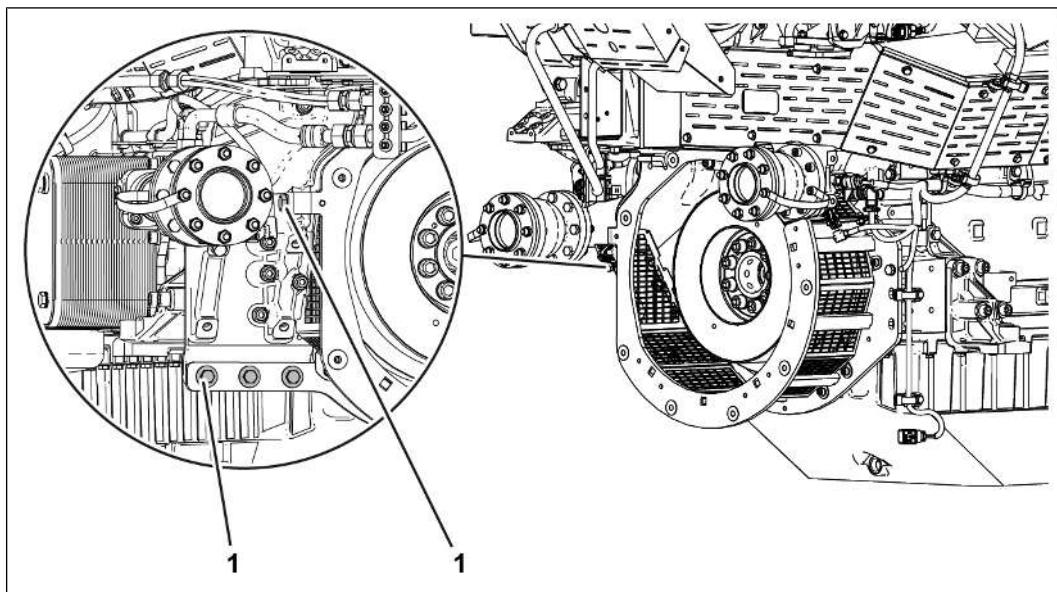
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## 5. Unscrew screw with washer (1)



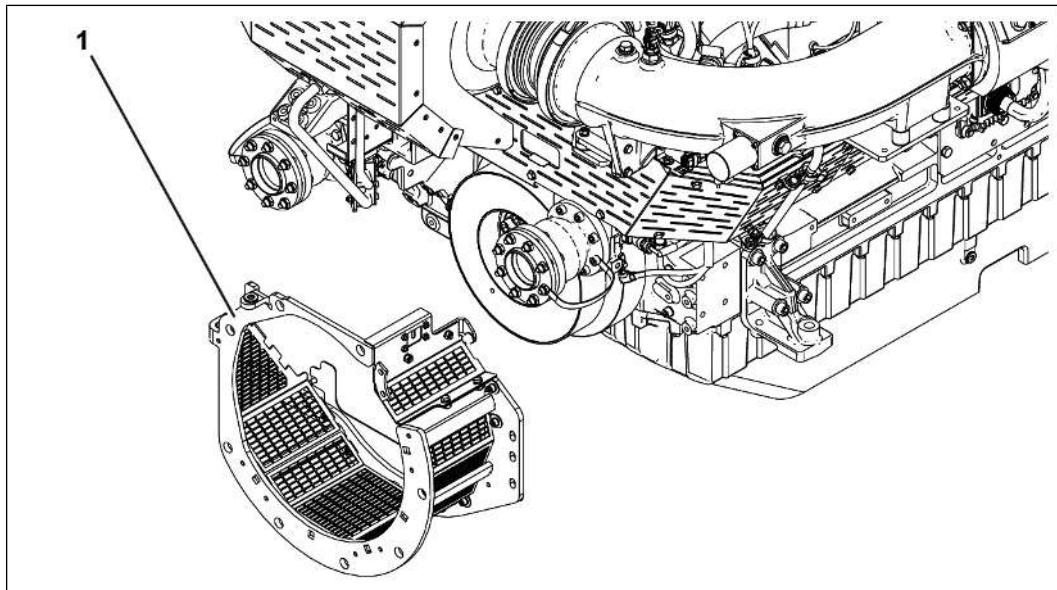
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## 6. Unscrew screws with washers (1)



9007199563990027

## 7. Unscrew screws with washers (1)



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## 8. Remove the torsional vibration damper guard (1)

**Mounting the torsional vibration damper guard**

Valid for:

TCG 3016



Tools:

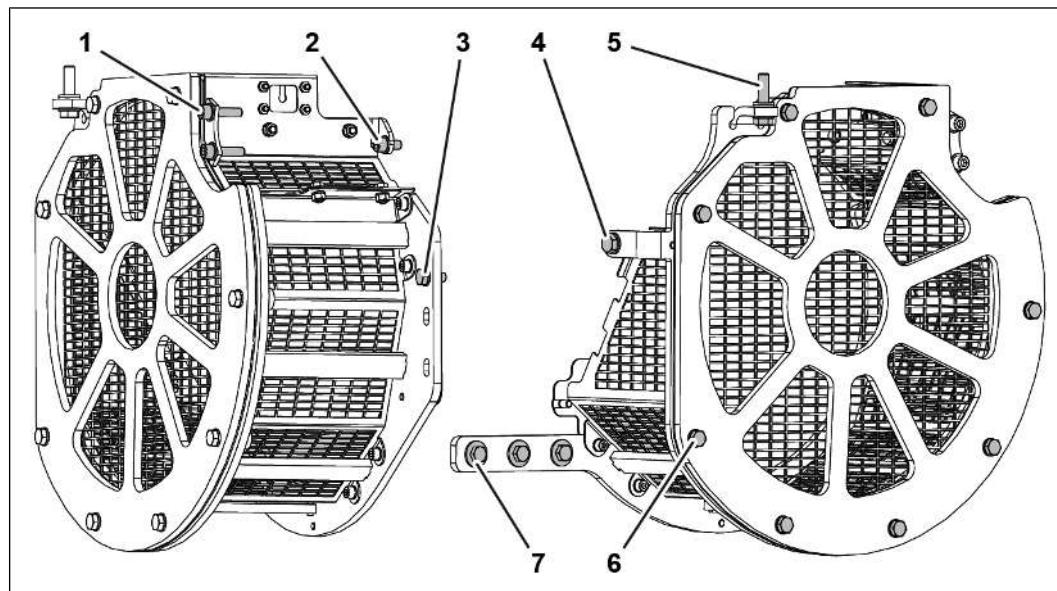
- Standard tools



Spare parts:

- Seals
- Sealing rings

#### Technical data



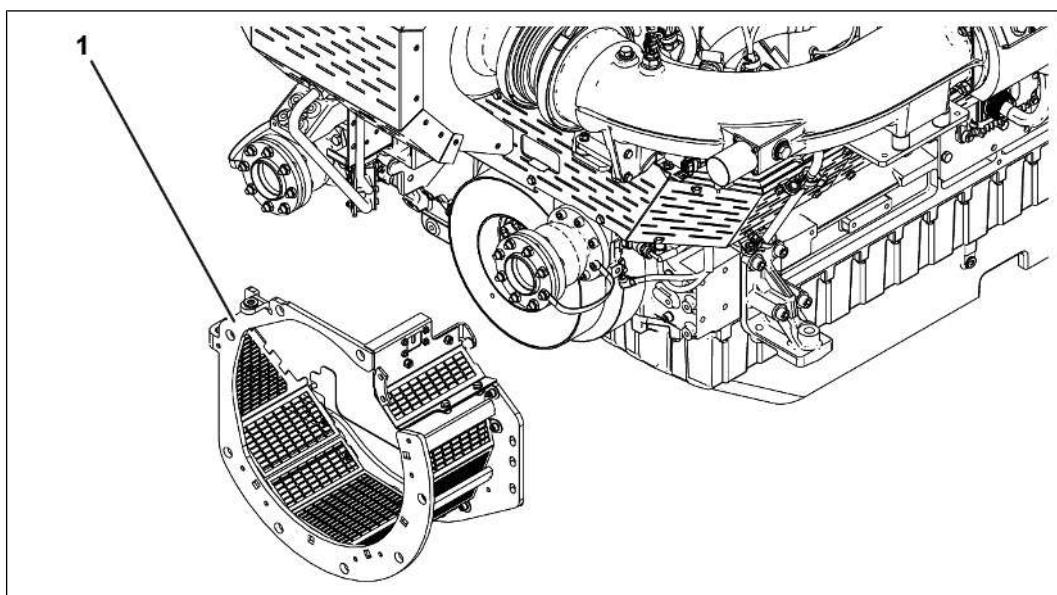
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#### Torsional vibration damper guard on crankcase

1	M10 x 40 – 10.9	60 Nm
2	M10 x 20 – 10.9	60 Nm
3	M10 x 25 – 10.9	60 Nm
4	M12 x 30 – 10.9	110 Nm
5	M12 x 50 – 10.9	110 Nm
6	M10 x 40 – 10.9	23 Nm
7	M10 x 30 – 10.9	60 Nm

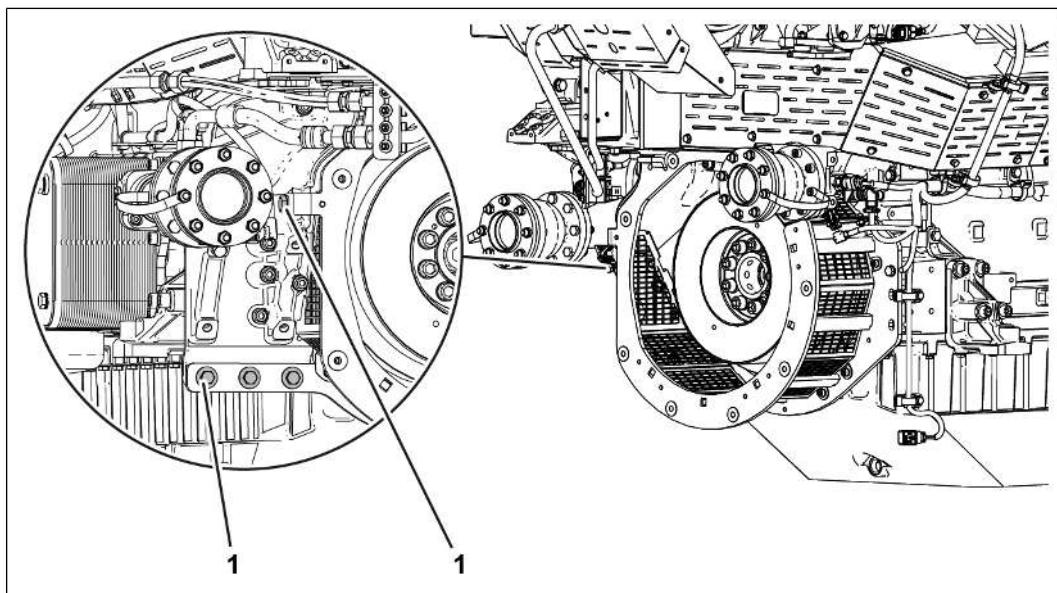
#### Procedure to follow:

- ✓ Decommissioning the genset [▶ 146]



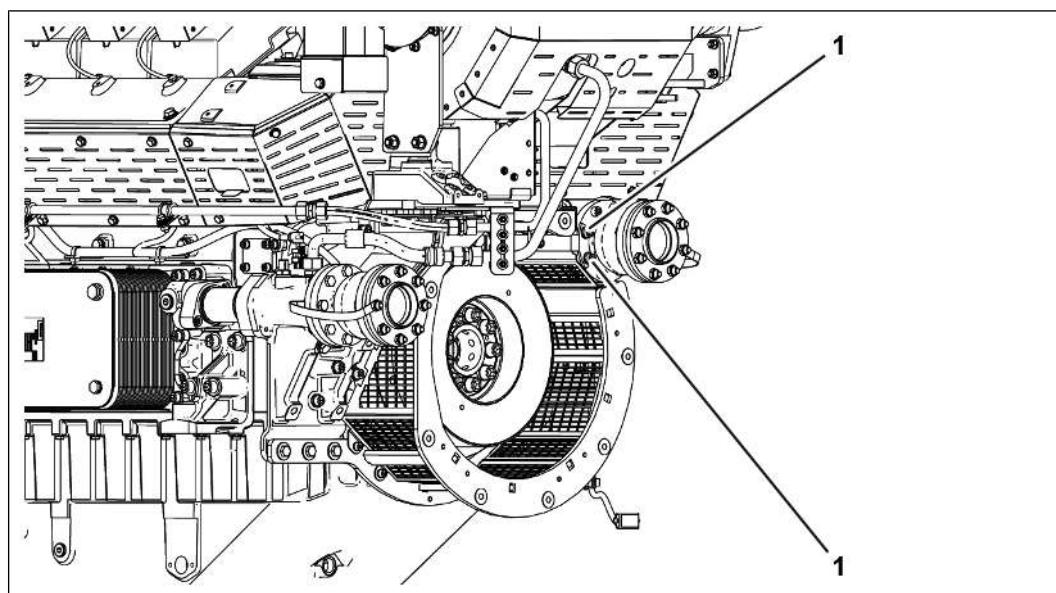
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1. Attach the torsional vibration damper guard (1), work in pairs if necessary



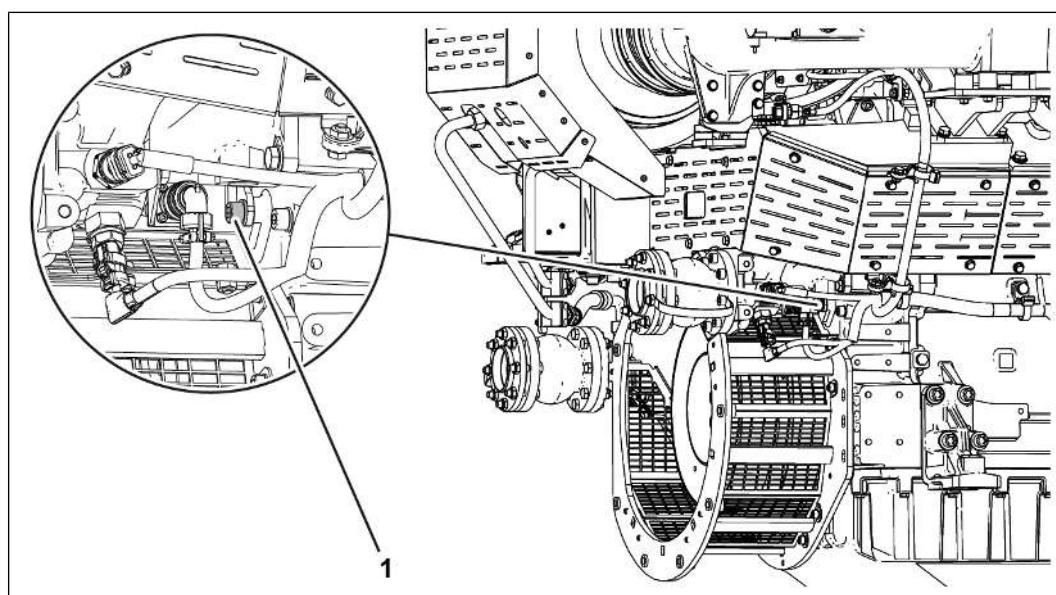
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2. Tighten screws with washers (1)



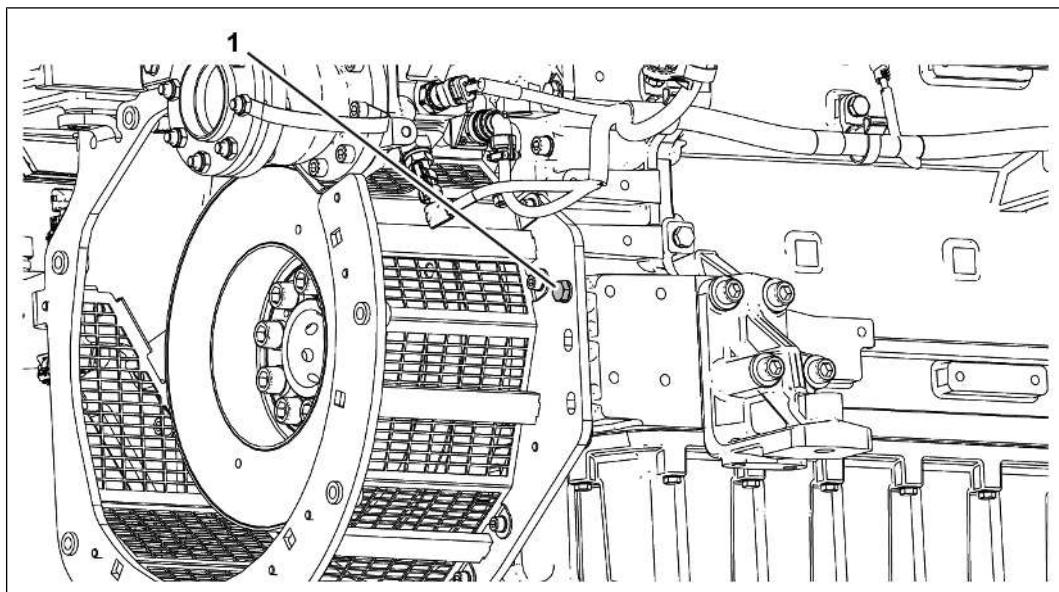
9007199563987595

## 3. Tighten screws with washers (1)



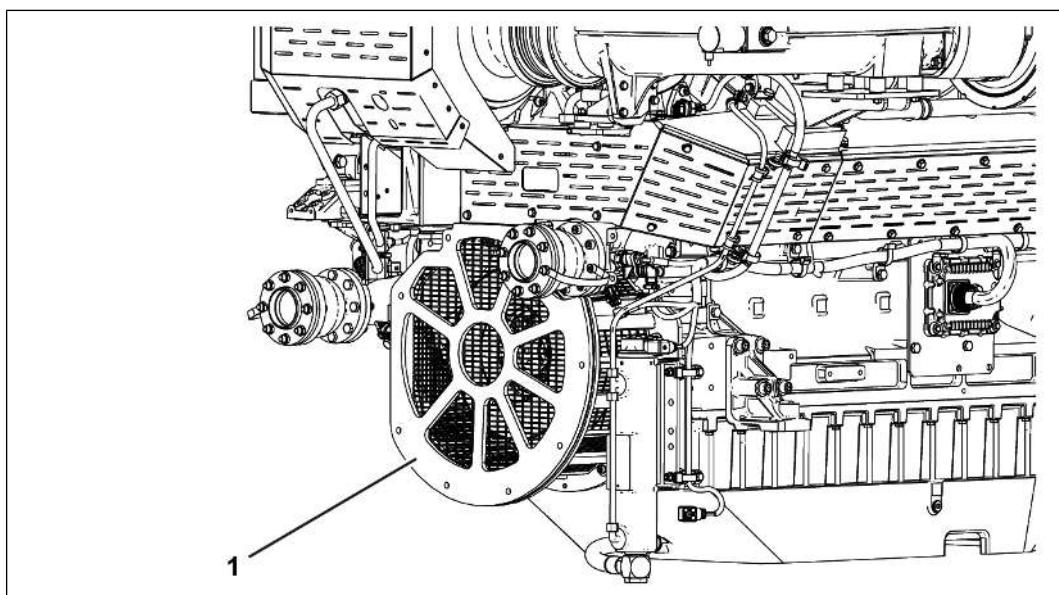
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## 4. Tighten screw with washer (1)



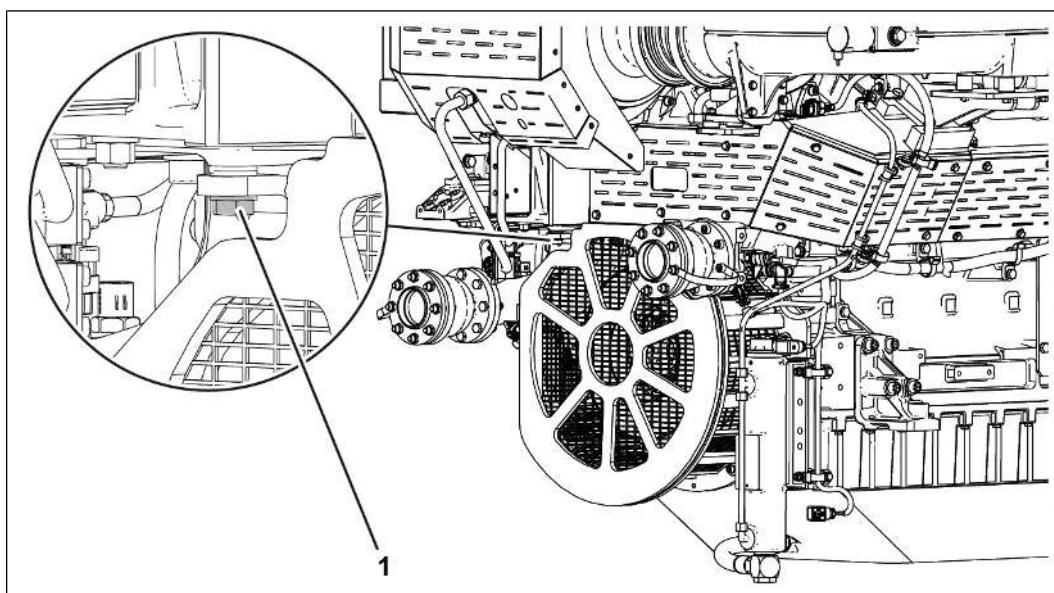
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## 5. Tighten screw with washer (1)



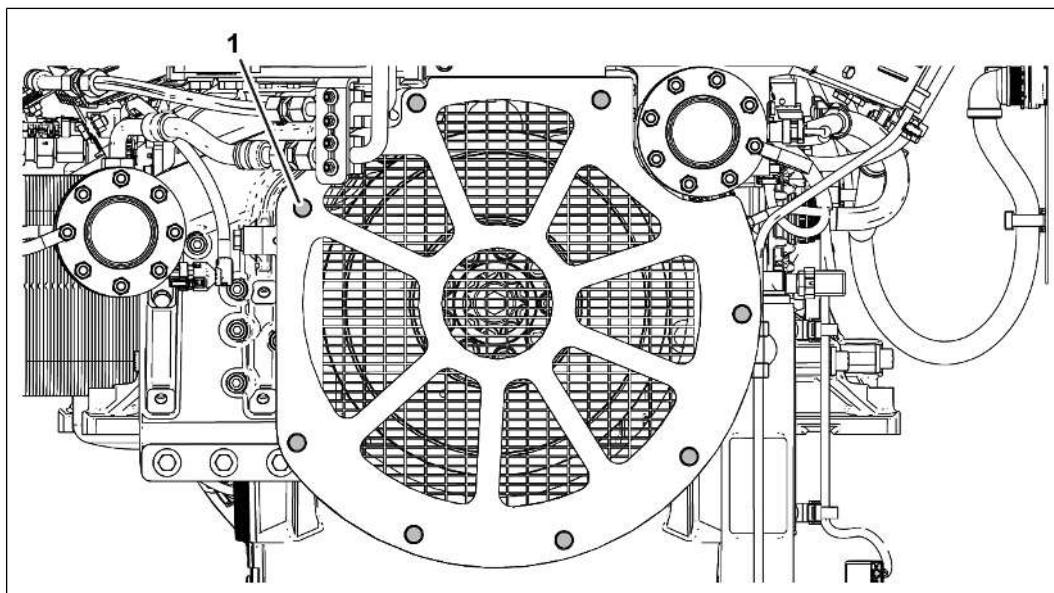
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## 6. Attach the contact protection (1)



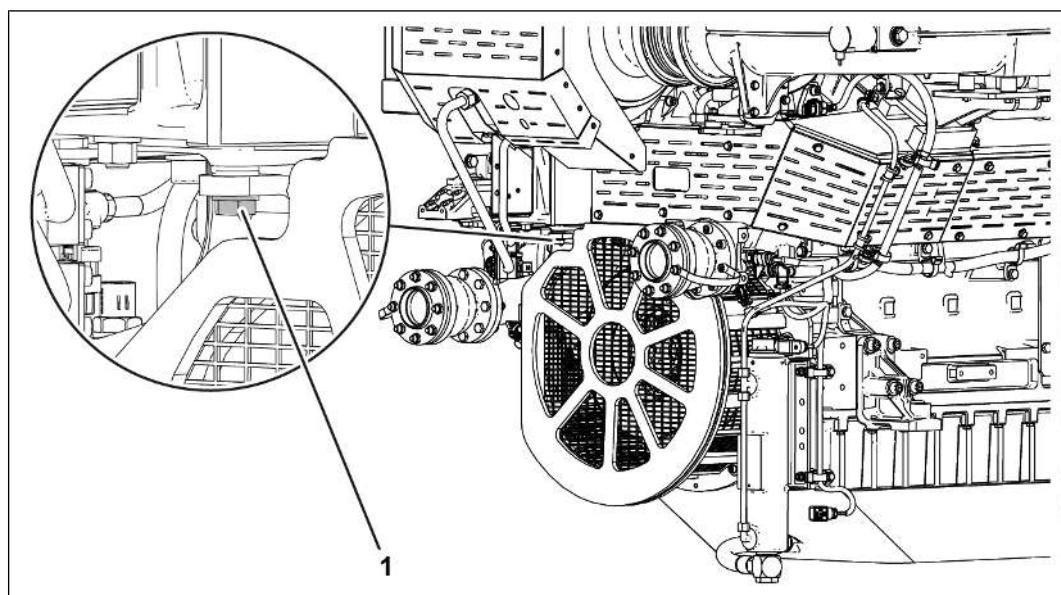
9007199563994891

7. Screw in screw with washer (1)



9007199563980299

8. Tighten screws with washers (1)



9007199563994891

9. Tighten the screw (1)
10. [Installing the fill level probe \[▶ 442\]](#)

## Emptying and filling the cooling system

### Emptying the cooling system

Valid for:

TCG 3016



Tools:

- Standard tools



Auxiliary media:

- Binding agent

#### Information on the cooling system

Mixture cooling circuit and engine cooling circuit are completely separated. You can empty the cooling circuits individually. For this purpose, there are multiple draining points on the engine.

When working on the engine the mixture cooling circuit may under some circumstances remain full.

When working on the plant, the engine cooling circuit may remain full under some circumstances.

#### Procedure to follow:

- ✓ [Checking the cooling system protection agent \[▶ 394\]](#)
- 1. Drain coolant from the mixture cooling circuit
  - Open the plant-side drain valve of the mixture cooling circuit and drain coolant.
- 2. Drain coolant from the engine cooling circuit
  - Open the plant-side drain valve of the engine cooling circuit and drain coolant.
- 3. Dispose of the coolant properly
- 4. Check the cooling system, clean if necessary. See [Specification for coolant](#)
- 5. [Filling the cooling system \[▶ 390\]](#)

#### See also

- ☰ [Decommissioning the genset \[▶ 146\]](#)

## Filling the cooling system

Valid for:

TCG 3016



Tools:

- Standard tools



Auxiliary media:

- Binding agent
- Coolant according to operating media regulations



Spare parts:

- Seals
- Sealing rings

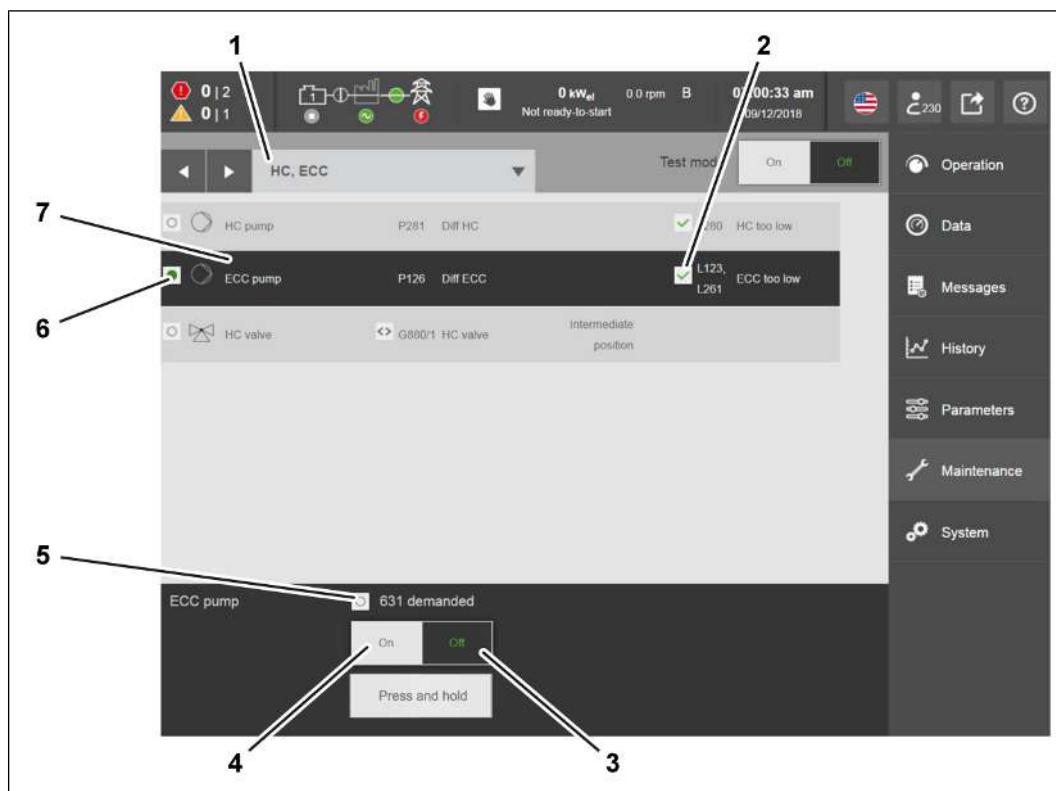
### Information on the cooling system

Mixture cooling circuit and engine cooling circuit are completely separated. You can fill the cooling circuits individually.

In certain circumstances you may only need to refill one cooling circuit. In this case, you must adjust the amount of coolant to the cooling circuit to be filled.

### Filling the cooling system:

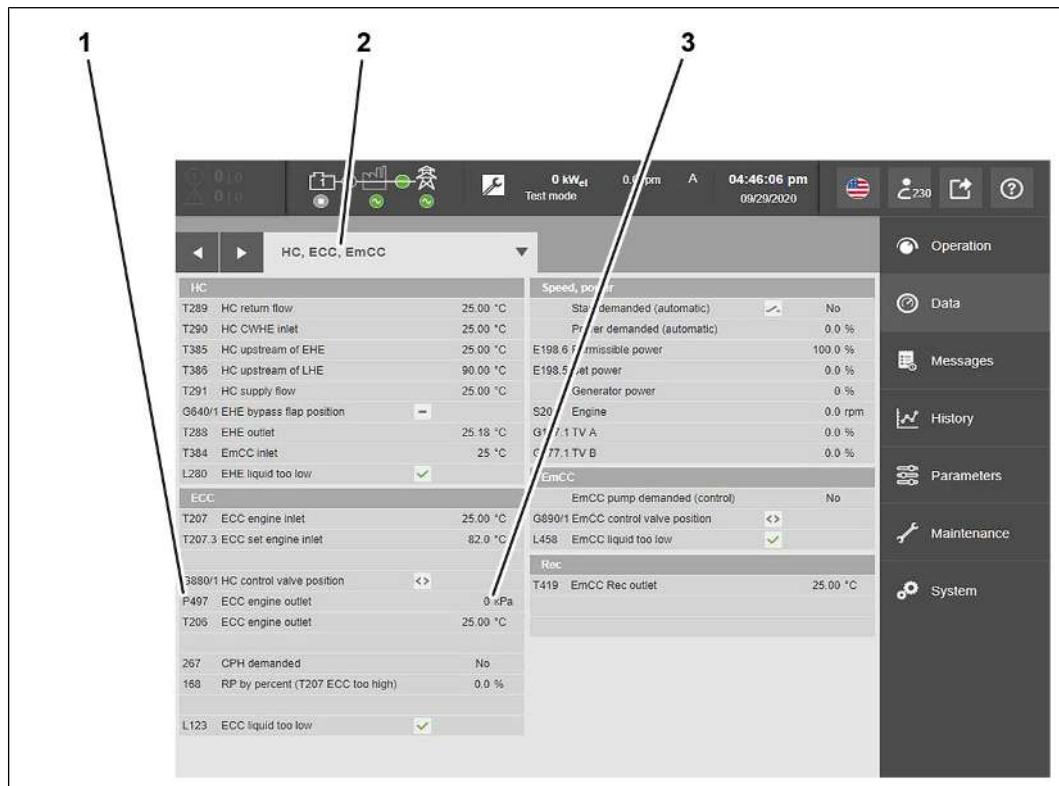
- ✓ Prepared or fresh coolant is available in sufficient quantity, see [Specification for coolant](#)
- ✓ Coolant lines from and to the engine are open.
- ✓ [Commissioning the genset \[▶ 134\]](#).



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1. Select and open the auxiliary drive subgroup HC, ECC (1)
2. Tap the ECC pump (7) line in the pull-down menu
  - A green check mark (2) appears in the P123, L261 ECC too low dialog area.
3. Start the coolant pumps
  - Tap the ON (4) button
  - A green dot (6) appears in the ECC pump dialog area.
  - A green dot (5) appears in the HC pump 631 demanded dialog area.
4. Let the coolant pumps run for approx. 10 minutes
5. Switch off the coolant pumps
  - Tap the OFF (4) button
  - The green point (6) disappears from the ECC pump dialog area.
6. Check the cooling system pressure

### Checking the coolant level and coolant system pressure:



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1. Select and open the data subgroup HC, ECC, DCC (2)
2. Read the value of the cooling system pressure in the P497 ECC engine outlet (1) dialog area
  - The value must be greater than 1.5 bar.
  - If necessary, verify the value on the pressure gauge in the plant.
3. If the value is too low, check the lines, connecting elements and engine for leaks
  - Replace defective components.
4. **NOTE! To top up the coolant, only run the coolant pump for a brief time. Press the coolant pump if necessary.** Top up the coolant and check the cooling system pressure again

**Switching off the coolant pumps:**

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1. Switch off the coolant pumps
  - Tap the OFF (3) button
  - The green dot (1) disappears from the ECC pump dialog area.
  - The green check mark (2) disappears from the L123, L261 ECC too low dialog area.
  - The green dot (4) disappears from the HC 631 demanded dialog area.

**Final work:**

1. [Starting the genset \[▶ 143\]](#)
2. Visually inspect the lines, connecting elements and engine for leaks
  - Replace defective components. For more information, see [Decommissioning the genset \[▶ 146\]](#).
  - Check cooling system pressure, top up coolant if necessary.
3. Dispose of the spent coolant properly

## Checking the cooling system protection agent

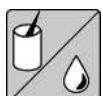
Valid for:

TCG 3016



Tools:

- Standard tools
- Special tool
  - Test set for the coolant
  - Closable collecting container (50 to 100 ml)



Auxiliary media:

- Binding agent

### Procedure:



#### Risk of destruction of components

Incorrect concentration of cooling system protection agent

Components can be damaged or destroyed.

- Always adhere to the mixing ratio of cooling water and cooling system protection agent as per the genset data sheet.
- Determine the current concentration of cooling system protection agent each time before topping up.

#### ✓ [Decommissioning the genset \[▶ 146\]](#)

1. Take a coolant sample from the mixture cooling circuit
  - Open the plant-side drain valve of the mixture cooling circuit and extract coolant.
  - Mark the collecting container accordingly.
2. Take a coolant sample from the engine cooling circuit
  - Open the plant-side drain valve of the engine cooling circuit and extract some coolant.
  - Mark the collecting container accordingly.
3. Check the quality of the coolant
  - **NOTE! The Technical Bulletin (TR) 2091 Specification for coolant specifies the limits for the coolant. These limits apply to the coolant in both cooling circuits.** Treat the coolant if necessary, see [Specification for coolant](#)
  - Adjust the cooling system protection agent to the system-specific value in accordance with the genset data sheet, see *Operating Manual, chapter General, section Specifications*

- 
- If the coolant no longer needs to be treated, empty the cooling system completely and refill it, see [Emptying and filling the cooling system \[▶ 389\]](#)
  - Dispose of the coolant sample properly.
4. [Commissioning the genset \[▶ 134\]](#)

## Removing and installing the rubber expansion joint

### Removing rubber expansion joint

Valid for:

TCG 3016



Tools:

- Standard tools



Auxiliary media:

- Binding agent
- Standard cleaning agents (e.g. soap)

### Information on handling rubber expansion joints

Rubber expansion joints compensate for vibrations, pressure fluctuations and thermal length changes in piping. The elastic rubber bellows balances mechanical movements. Only flawless rubber bellows ensure the balancing function of rubber expansion joints. Therefore, never use expansion joints with damaged rubber bellows. Replace damaged rubber expansion joints immediately.

To protect rubber bellows from damage, observe and comply with the following:

- Do not mechanically stress rubber expansion joints. Avoid rough impacts or blows.
- Do not throw rubber expansion joints.
- Never attach chains or ropes to the rubber bellows.
- Avoid all torsional stress (twisting) during dismantling or assembly, as well as in later operation.
- The surfaces of the rubber expansion joint flanges serve as seals. Therefore, all sealing surfaces must be level and clean.
- Never exceed the permissible test pressure during a leak test.
- Fasten all downstream piping in accordance with specifications.
- Always cover rubber bellows with non-conductive material when welding.
- Never paint rubber bellows with a coat of paint.
- Do not apply insulation to rubber bellows.

The following describes the dismantling process for a rubber expansion joint from the engine cooling circuit. Dismantle all other rubber expansion joints in accordance with the procedure described here.

---

**Procedure to follow:**

---

**CAUTION**

Risk of burns from touching hot operating media or hot components

This can lead to minor or severe injuries.

- Wear personal protective equipment.
  - Allow the operating media or components to cool down to ambient temperature.
- 

**Danger to the environment**

Due to escaping operating media that enter the environment.

Contamination of the environment.

- Collect escaping operating media.
  - Dispose of operating media properly.
- 

**Risk of destruction of components**

Risk of destruction of components

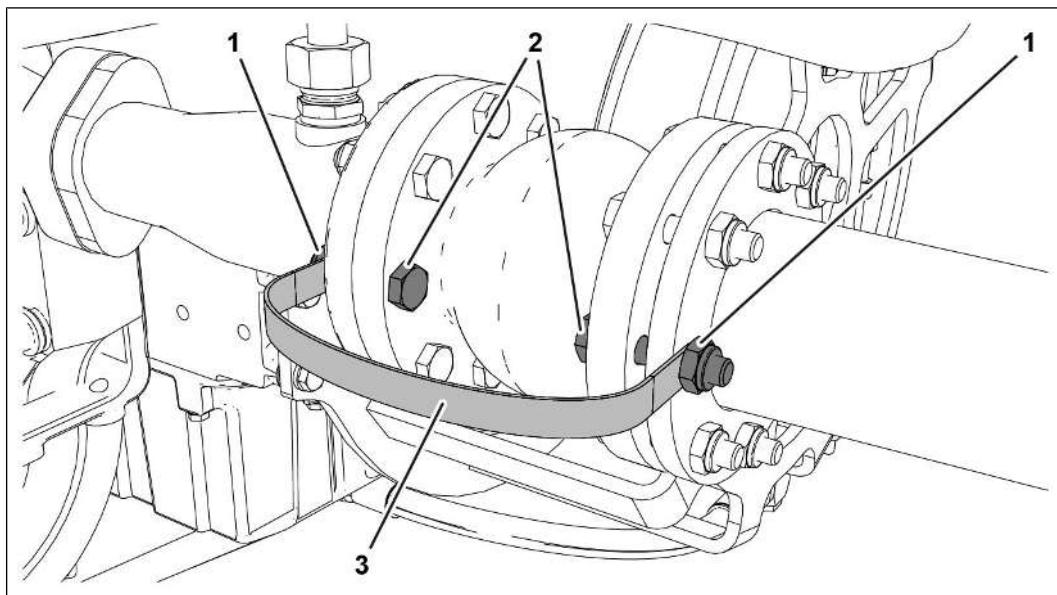
The rubber bellows can be damaged or destroyed due to incorrect cleaning.

- Do not use solvents.
  - Do not use sharp objects as cleaning aids.
    - Do not use wire brushes or sandpaper.
  - Use only soap and warm water for cleaning.
- 

✓ [Emptying the cooling system \[▶ 389\]](#)

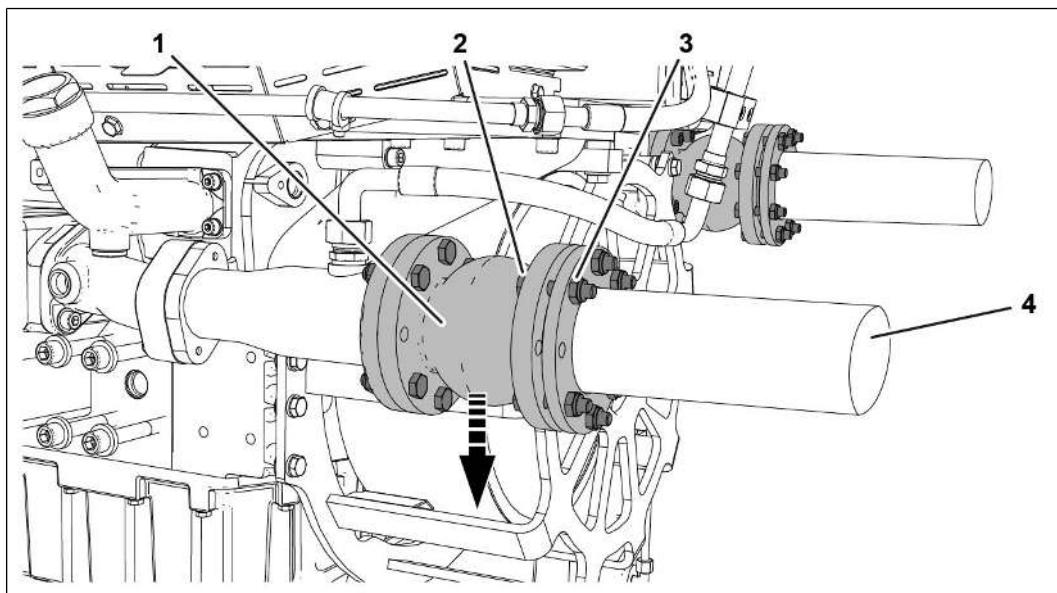
✓ [Perform a lube oil change \[▶ 314\]](#)

✓ [Decommissioning the genset \[▶ 146\]](#)



333853451

1. Dismantle the grounding cable (3) from the rubber expansion joint
  - Place the collecting tray underneath.
  - Unscrew nuts (1). While doing so, hold the screws (2) in place.
  - Remove the grounding cable (3).



333855883

2. Remove the rubber expansion joint (1)
  - Secure the rubber expansion joint (1) from falling down.
  - If necessary, support coolant line (4).
  - Unscrew the remaining nuts (3). While doing so, hold the screws (2) in place.
  - Catch any escaping operating media and dispose of them properly.
  - Remove screws with washers (2) on the flanges.

- Remove the rubber expansion joint (1) (arrow) and place it on a suitable surface to prevent it from rolling away.
3. Clean the rubber expansion joint
- [Visually inspecting the rubber expansion joints \[▶ 296\]](#).
  - Remove all foreign objects (e.g. dirt, insulating material) from the rubber bellows.
  - Clean rubber bellows outside and inside with a lint-free cloth.
  - Clean all sealing surfaces.

## Installing rubber expansion joint

Valid for:

TCG 3016



Tools:

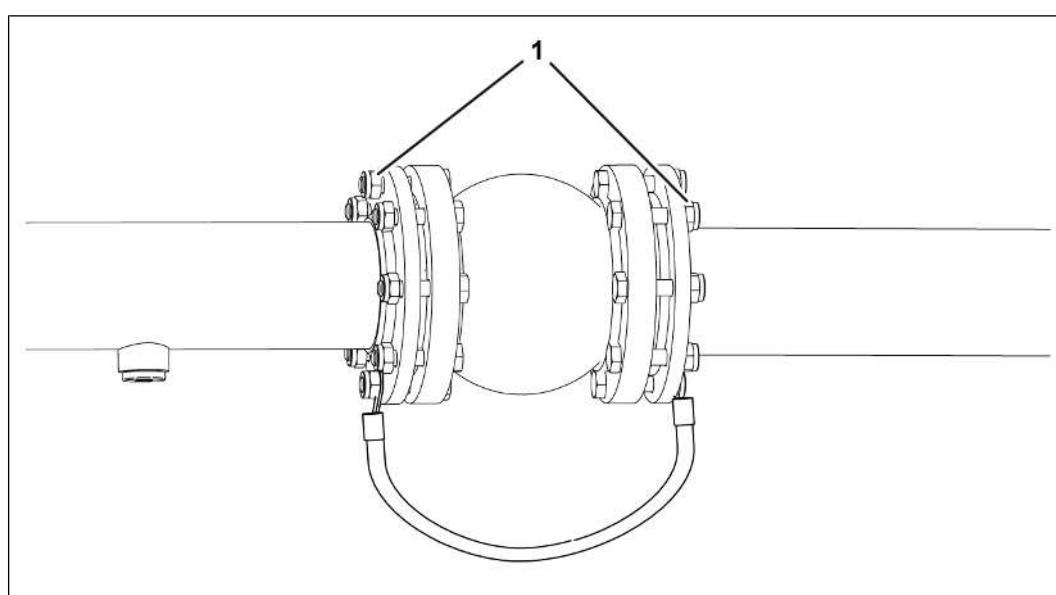
- Standard tools



Spare parts:

- Self-locking nuts

### Technical data



309646219

Rubber expansion joint on flange		
1	DN 40/50	15 Nm
	DN 65/80/100/125	20 Nm
	DN 150	25 Nm

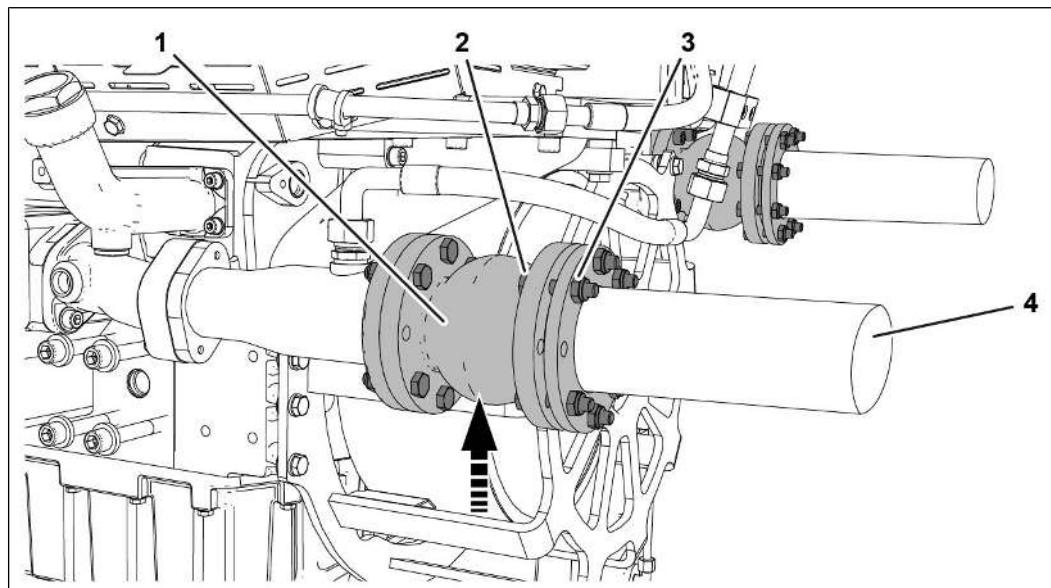
### Information on handling rubber expansion joints

Rubber expansion joints compensate for vibrations, pressure fluctuations and thermal length changes in piping. The movement compensation takes place mechanically via the elastic rubber bellows. Only flawless rubber bellows ensure the balancing function of rubber expansion joints. Therefore, expansion joints with damaged rubber bellows must not be used and must be replaced immediately.

To protect rubber bellows from damage, observe and comply with the following:

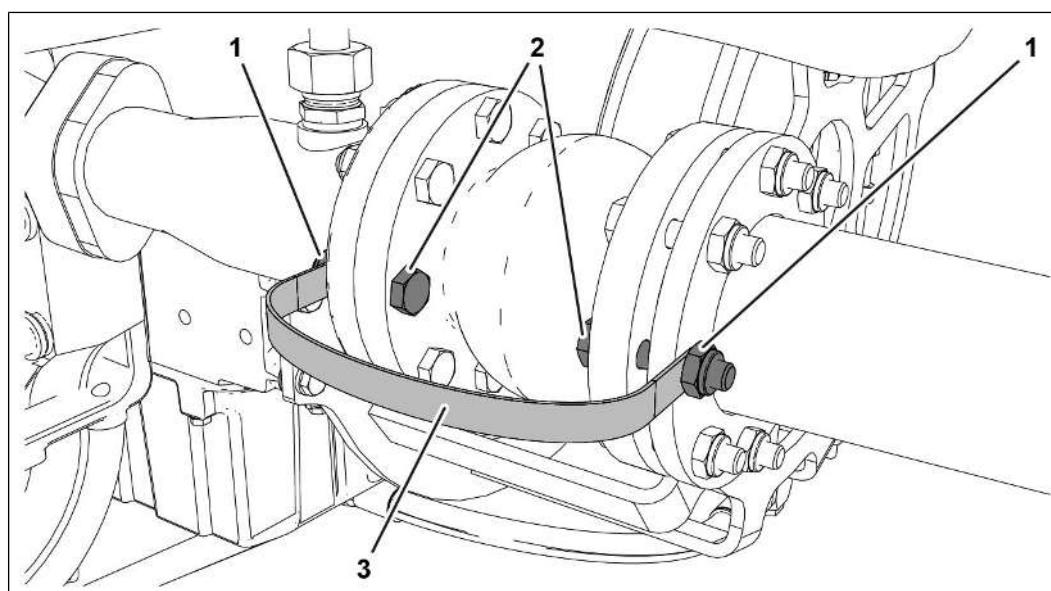
- Do not mechanically stress rubber expansion joints. Avoid rough impacts or blows.
- Do not throw rubber expansion joints.
- Never attach chains or ropes to the rubber bellows.
- Avoid all torsional stress (twisting) during dismantling or assembly, as well as in later operation.
- The surfaces of the rubber expansion joint flanges serve as seals. Therefore, all sealing surfaces must be level and clean.
- Never exceed the permissible test pressure during a leak test.
- Fasten all downstream piping in accordance with specifications.
- Always cover rubber bellows with non-conductive material when welding.
- Never paint rubber bellows with a coat of paint.
- Do not apply insulation to rubber bellows.

The following describes the assembly process for a rubber expansion joint from the engine cooling circuit. Assemble all other rubber expansion joints in accordance with the procedure described here.

**Implementation:**

333858315

1. Install rubber expansion joint (1)
  - Insert rubber expansion joint (1) into the coolant line (arrow) and secure against falling.
  - Insert screws (2) into the flanges.
  - Except for two nuts, tighten all nuts (3). While doing so, hold the screws (2) in place.
  - If necessary, remove the support of the coolant line (4).



333853451

2. Mounting the grounding cable (3) on the rubber expansion joint
  - Push one end of the grounding cable (3) onto each screw (2).

- 
- Tighten the corresponding nuts (1). While doing so, hold the screws (2) in place.
  - 3. Check all screw connections for tight fit
  - 4. [Commissioning the genset \[▶ 134\]](#)

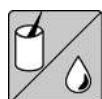
#### See also

-  [Removing rubber expansion joint \[▶ 396\]](#)

## Visually inspecting the wastegate

Valid for:

TCG 3016

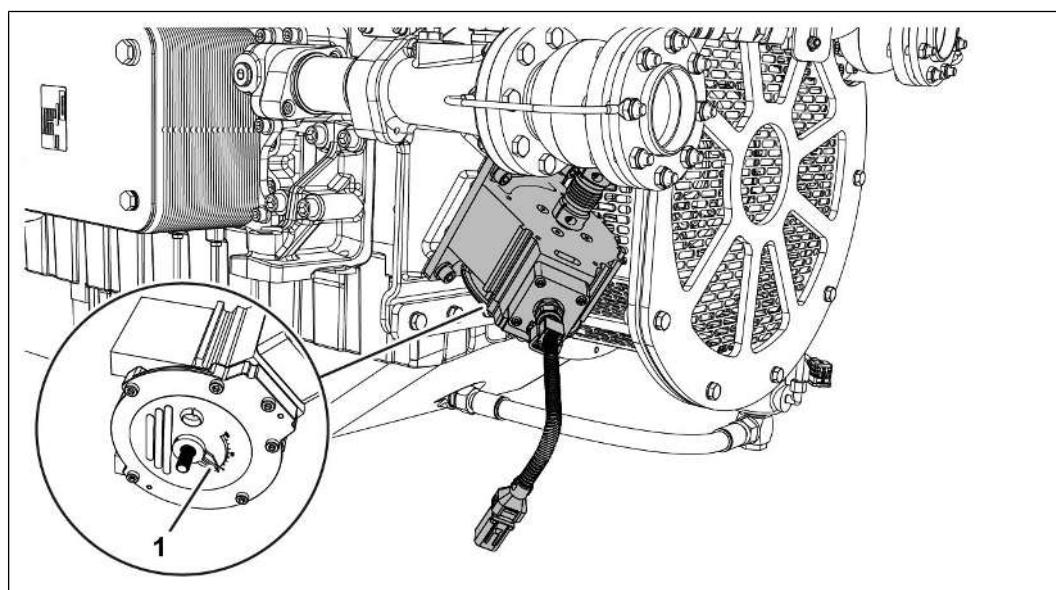


Auxiliary media:

- Cleaning agent
  - See Technical Bulletin (TR) 2147 [Specification for auxiliary media](#).

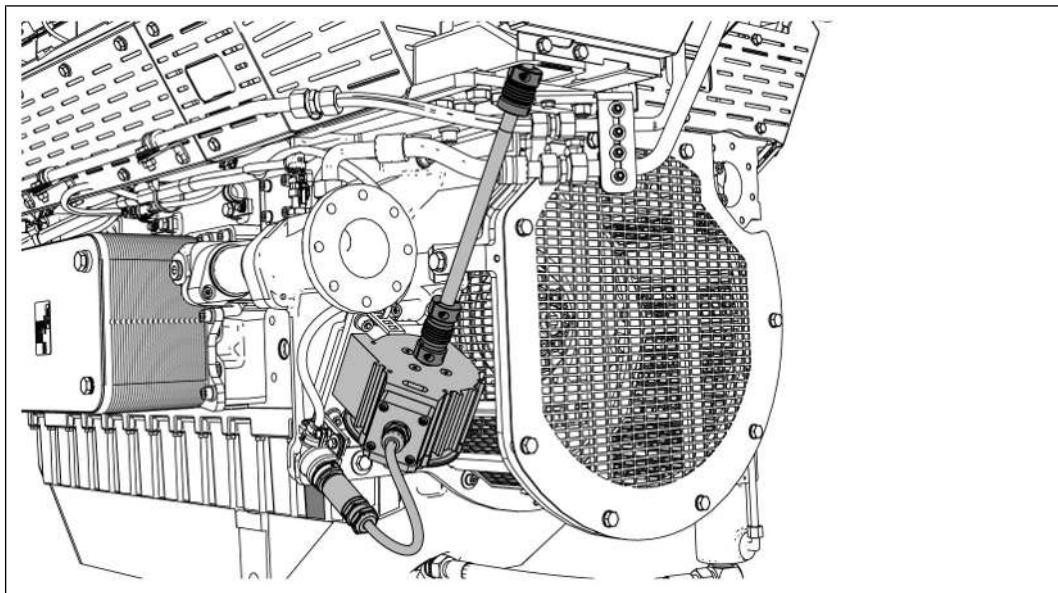
### Procedure to follow:

- ✓ [Decommissioning the genset](#) [▶ 146]



330709771

1. Check wastegate actuator for ease of movement.
  - Rotate needle (1) manually to the 100 percent limit stop and then back to the 0 percent limit stop.
  - It must be possible to rotate the controller output shaft against consistent resistance without jolting.
  - If the controller output shaft does not rotate without jolting, contact service partner.



9007199585302795

2. Visually inspect the wastegate.
  - Clean the wastegate connecting parts using a soft, lint-free cloth.
  - Visually inspect all components.
  - Check connection parts, drive shaft, couplings and plug-in connections.
  - Re-tighten screw connections if necessary.
  - Check the cable bundle and connectors.
  - Replace worn or damaged components, contact service partner.
3. --- FEHLENDER LINK ---

#### See also

- ▀ Commissioning the genset [▶ 134]

## Removing and installing the crankshaft sensor

### Removing the crankshaft sensor

Valid for:

TCG 3016

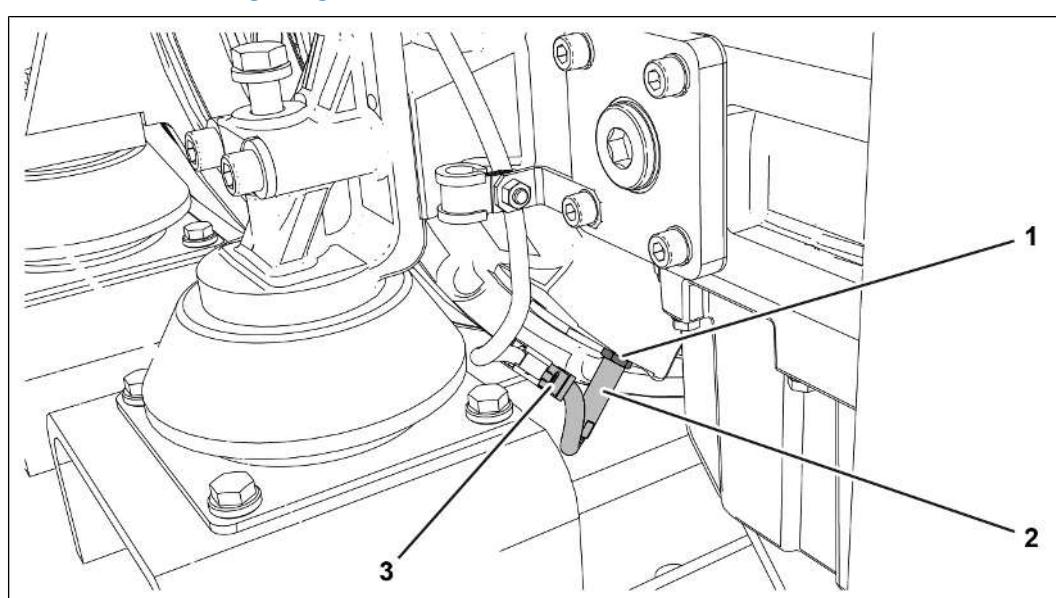


Tools:

- Standard tools

#### Procedure to follow:

- ✓ [Decommissioning the genset \[▶ 146\]](#)



9007199595250315

1. Remove the sensor (2) from the flywheel housing
  - Dismantle the connector (3).
  - Unscrew lock nut (1).
  - Unscrew sensor (2).
2. Clean the contaminated sensor (2) with a soft lint-free cloth
3. Replace the defective sensor.

### Installing the crankshaft sensor

Valid for:

TCG 3016



## Spare parts:

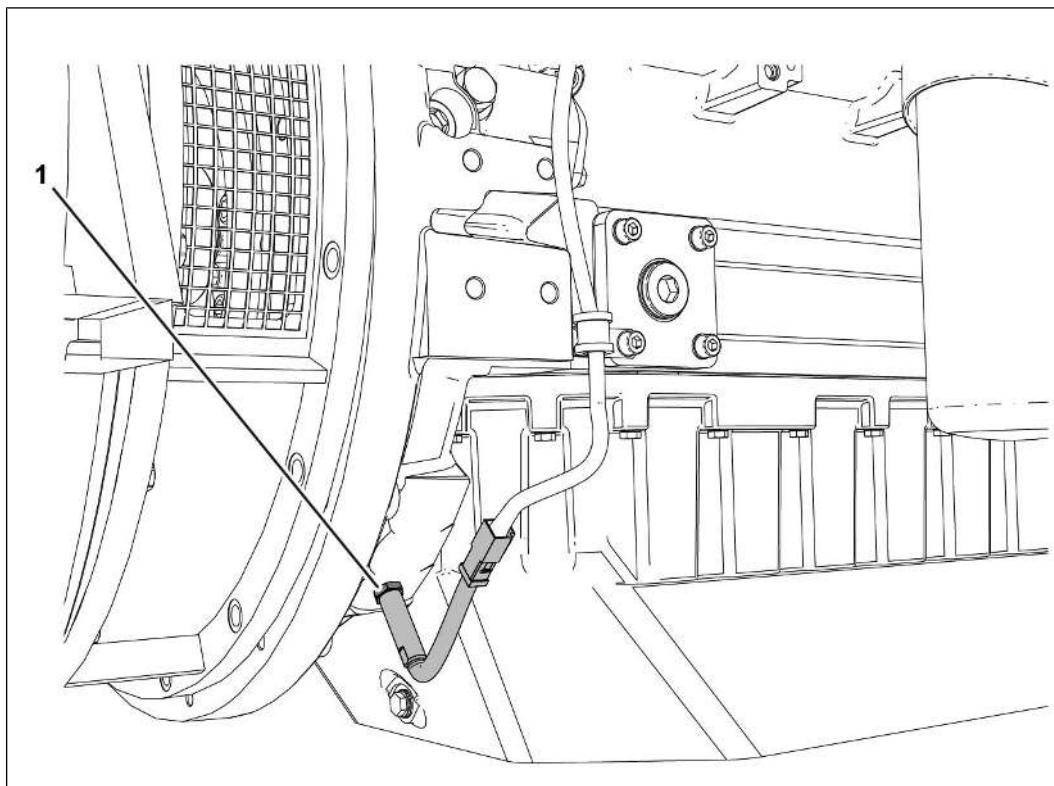
- Crankshaft sensor, if necessary

## Crank speed sensor (PN 1232 4043)

Start position	Screw in the crank speed sensor until it rests on the flywheel.
Setting or positioning	Unscrew by 0.75 of a turn (270°).
	The marking on the sensor is pointing in the direction of rotation of the flywheel.

## Crank speed sensor (PN 1232 4415)

Start position	Screw in the crank speed sensor until it rests on the flywheel.
Setting or positioning	Unscrew by 2/3 of a turn (240°). That is the equivalent of turning by 4 corners of the hexagon.
	The marking on the sensor is pointing in the direction of rotation of the flywheel.



9007199595252747

**Lock nut for crank speed sensor on flywheel housing**

1	M18 x 1 - A2K	Type Jaquet (PN 1232 4043)	30 Nm
---	---------------	-------------------------------	-------

G5/8 - 18 - 2A	Type FAH13 (PN 1232 4415)	25 Nm
----------------	------------------------------	-------

**Tools:**

- Standard tools

**Information on the crank speed sensor pulse emission**

The distance between the crank speed sensor and flywheel affects the pulse emission to the control. The genset manufacturer sets the crank speed sensor distance during initial installation and checks for the correct pulse emission to the control system.



### Risk of destruction of components

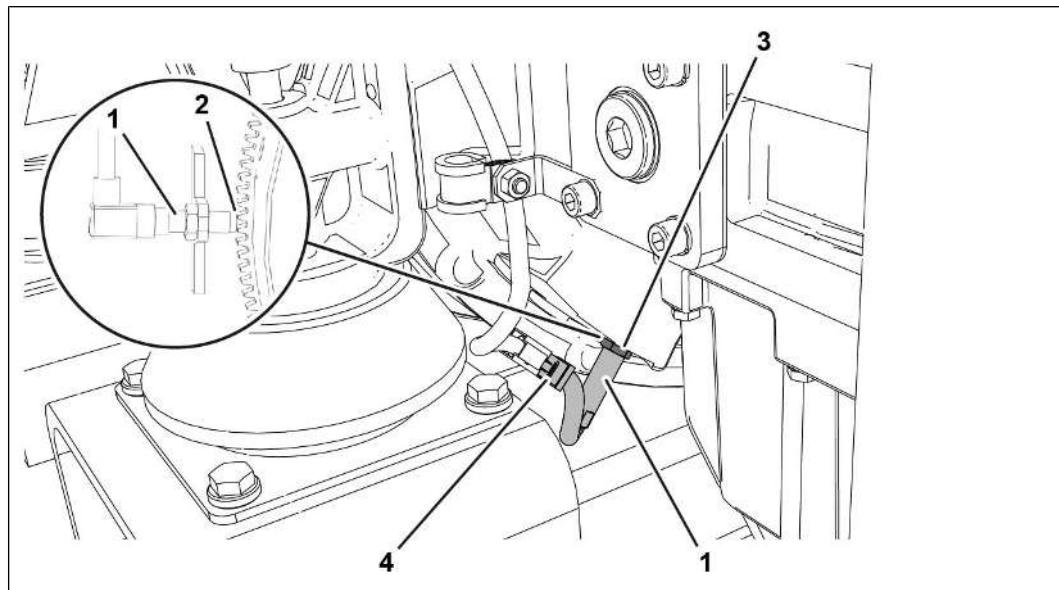
Due to incorrect crank speed sensor positioning

The incorrect positioning of the crank speed sensor leads to collision with the flywheel.

The crank speed sensor can be torn out, leading to engine failure.

- Ensure that the crank speed sensor is positioned correctly.
- If in doubt, do not start the genset
- Contact service partner.

### Procedure to follow:



18014398849996171

1. Install the sensor (1) in the flywheel housing
  - **NOTE! Check the position of the flywheel before screwing in. The flywheel must be positioned in such a way that the sensor is touching a flywheel tooth (2) when screwing in. The sensor must not be screwed between two flywheel teeth.** Screw in the sensor (1) by hand until it touches a flywheel tooth (2) (inset).
  - Unscrew the sensor (1) by the specified value, see [Installing the crankshaft sensor \[▶ 406\]](#).
  - **NOTE! Do not change the position of the sensor (1) when tightening the lock nut (3).** Fasten sensor (1) to the flywheel housing with lock nut (3). Counter-hold the sensor (1) during this.
  - Mount the connector (4).
2. [Commissioning the genset \[▶ 134\]](#)
3. Check the sensor (1) function, see [Engine auxiliary drive test \[▶ 206\]](#)

## Removing and installing the combustion chamber temperature sensor

### Removing the combustion chamber temperature sensor

Valid for:

TCG 3016

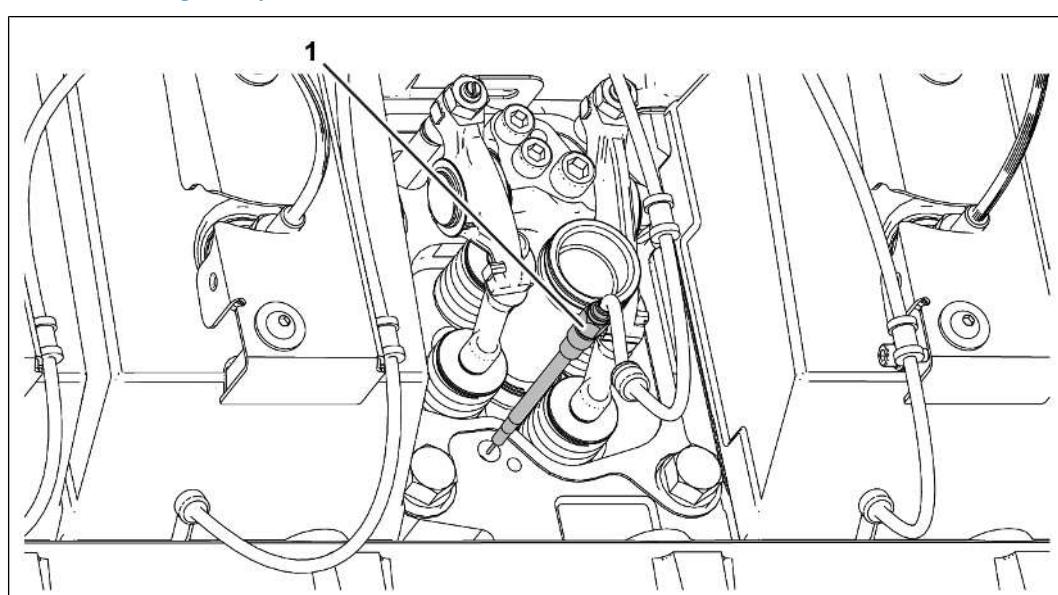


Tools:

- Standard tools

#### Procedure:

- ✓ Dismantling the cylinder head cover [▶ 348]



310871051

1. Unscrew sensor (1).
  - Remove sealing ring and dispose of.

### Installing the combustion chamber temperature sensor

Valid for:

TCG 3016



Tools:

- Standard tools



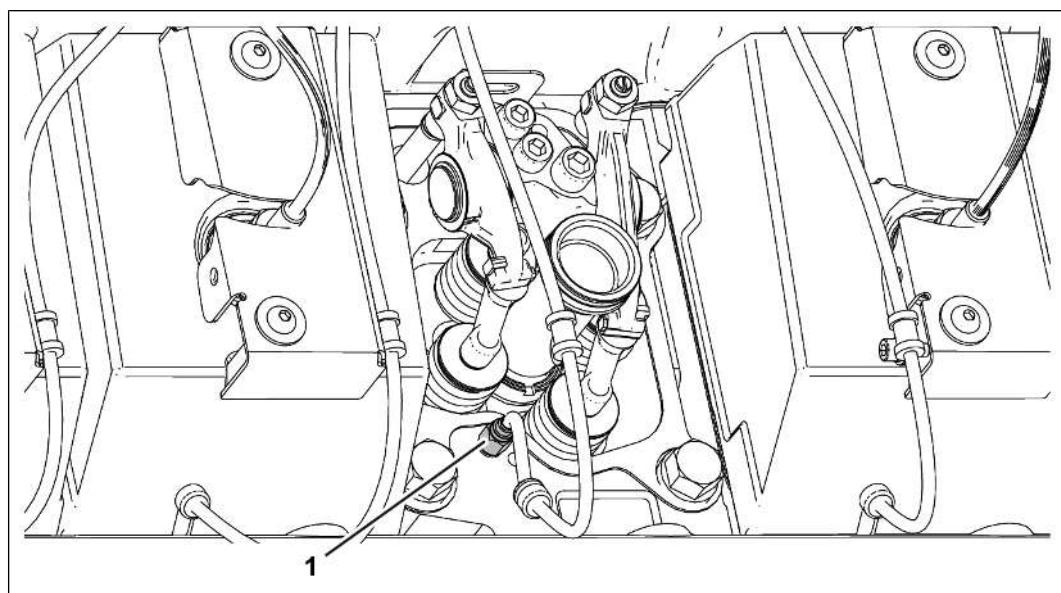
Auxiliary media:

- Assembly paste



Spare parts:

- Sealing ring
- Temperature sensor



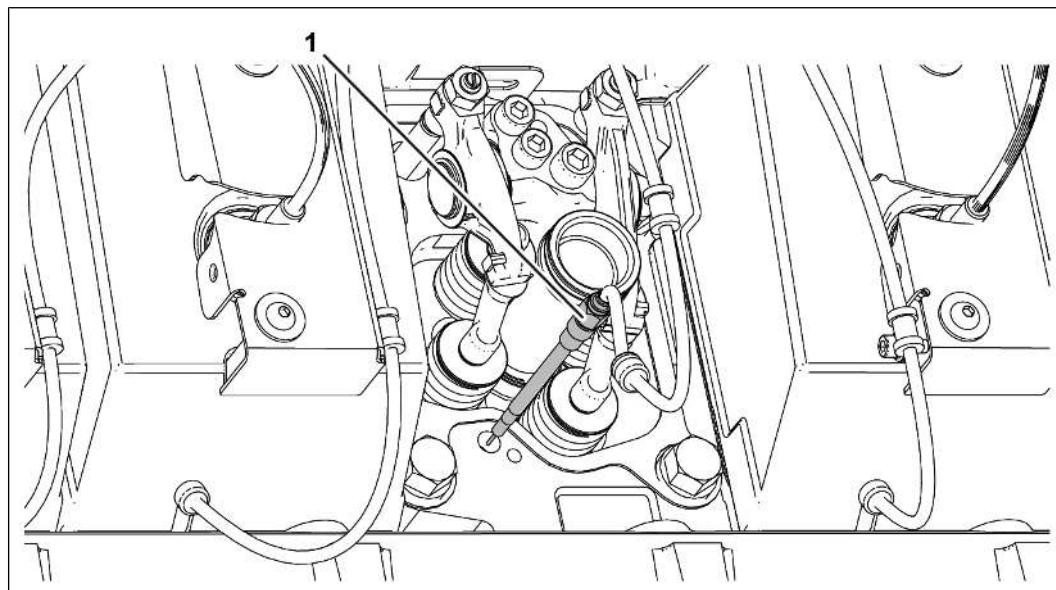
310873483

Combustion chamber temperature sensor<sup>1)</sup> on cylinder head

1 M12 x 1

10 Nm

<sup>1)</sup> Replace sealing ring.

**Procedure:**

310871051

1. Install sensor (1).
  - Visually inspect the connector.
  - Apply a thin coat of assembly paste to the sensor (1) thread.
  - Insert sensor (1) with new sealing ring and tighten
2. [Mounting the cylinder head cover \[▶ 349\]](#)

## Removing and installing the differential pressure sensor

### Removing the differential pressure sensor

Valid for:

TCG 3016

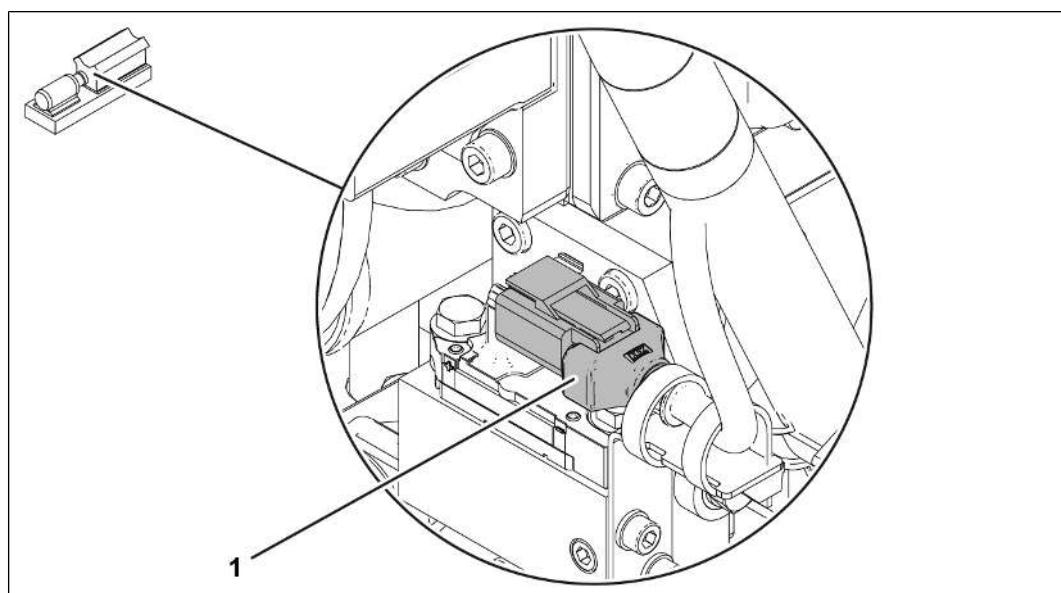


Tools:

- Standard tools

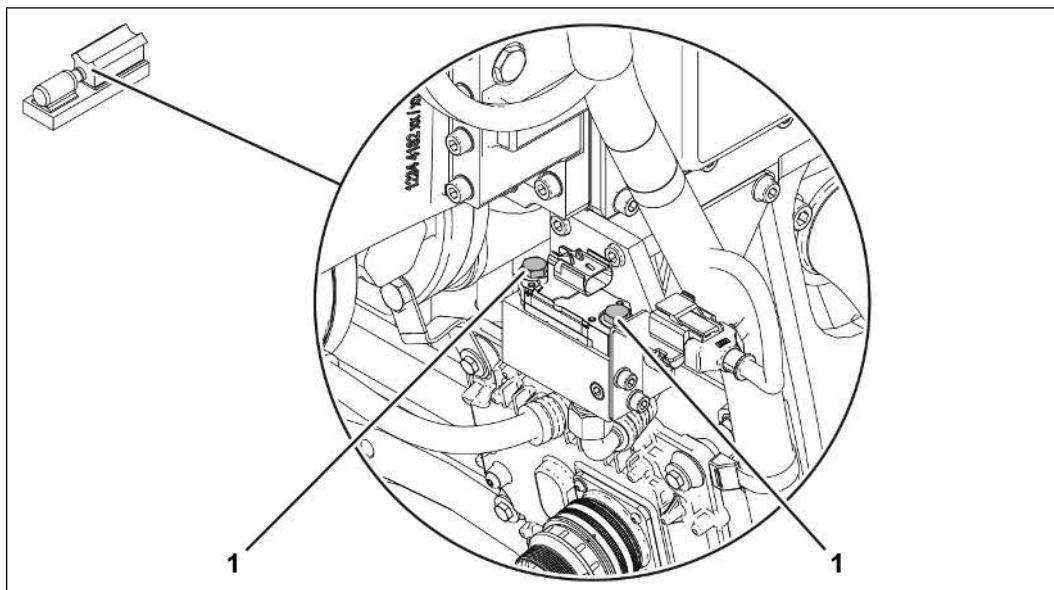
#### Implementation:

- ✓ [Decommissioning the genset \[▶ 146\]](#)



18014398821017355

1. Dismantle the connector (1) from the differential pressure sensor
  - If necessary, loosen the cable tie.



18014398821019787

2. Dismantle the differential pressure sensor
  - Unscrew screws with washers (1).
  - Remove the differential pressure sensor.

## Installing the differential pressure sensor

Valid for:

TCG 3016



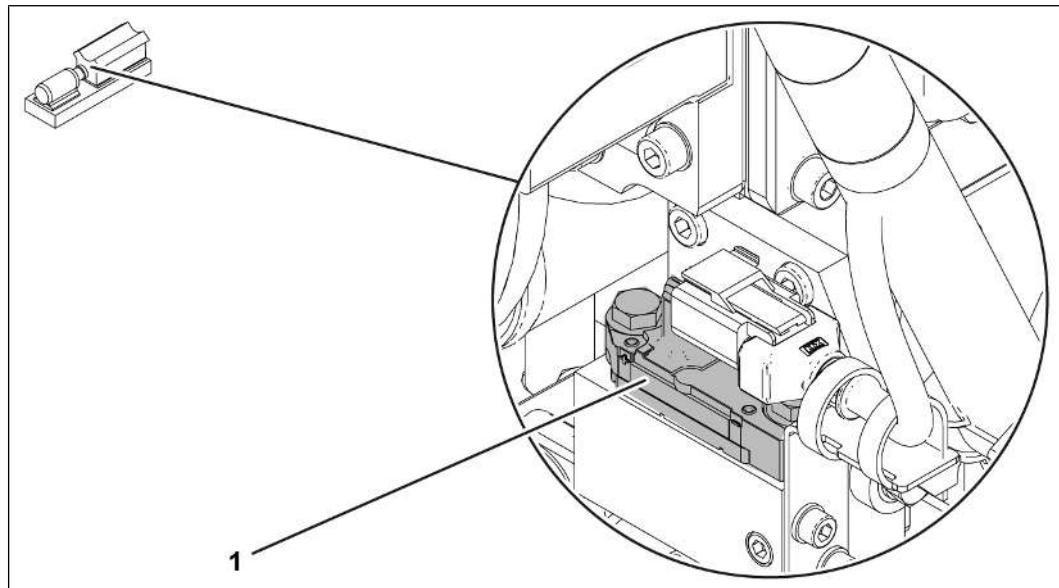
Tools:

- Standard tools



Spare parts:

- Differential pressure sensor

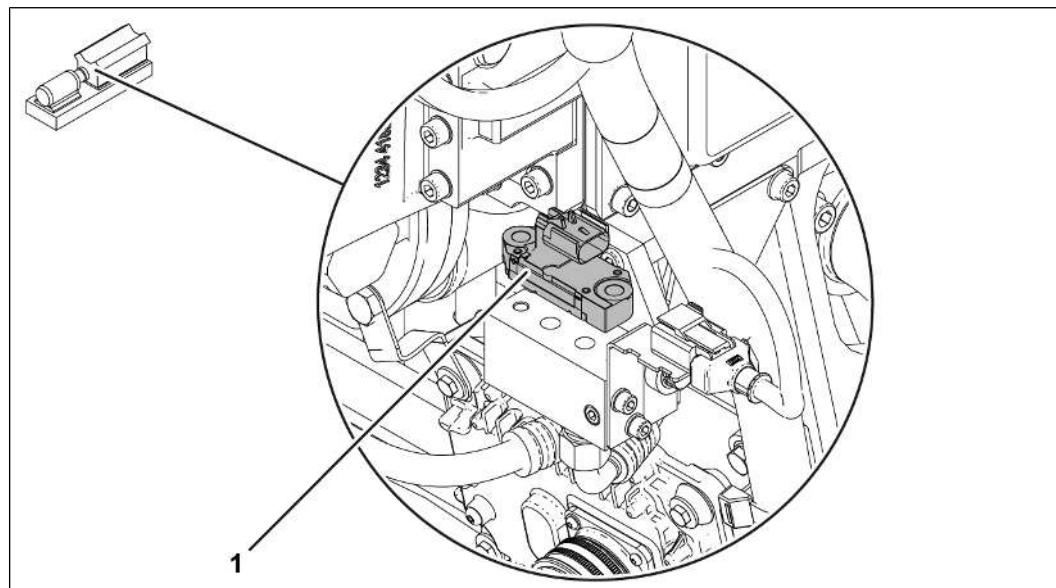
**Technical data**

18014398821024651

Differential pressure sensor on holder<sup>1)</sup>

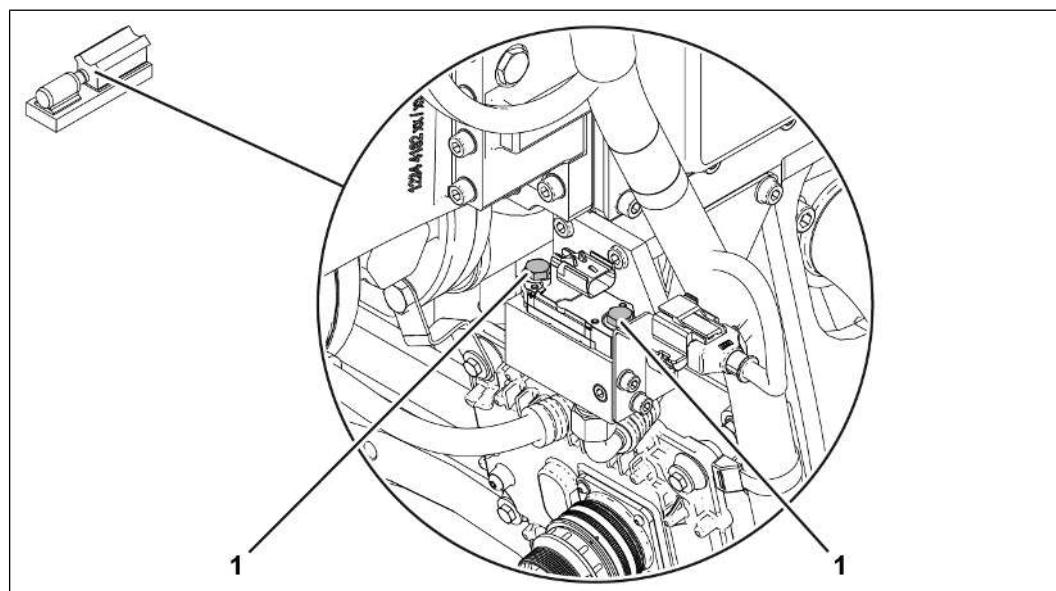
1	M8 x 25 – 10.9	20 Nm
---	----------------	-------

<sup>1)</sup> Replace sealing ring.

**Procedure to follow:**

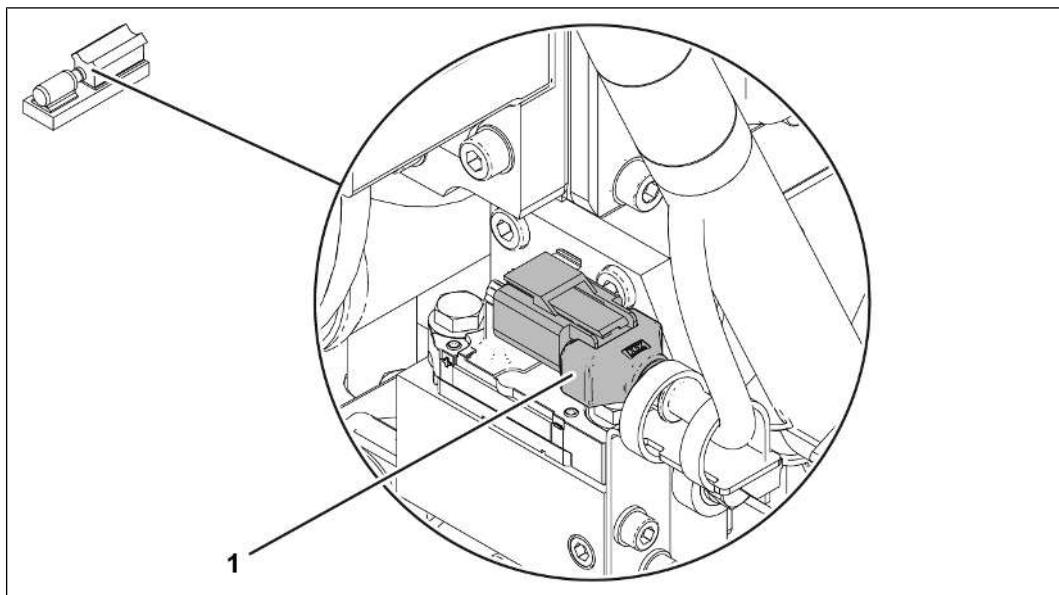
18014398821022219

1. Position the differential pressure sensor (1) on the holder



18014398821019787

2. Tighten screws with washers (1)



18014398821017355

3. Mount the connector (1) on the differential pressure sensor
  - Visually inspect the connector (1).
  - Lay the cable bundle so that it is free of tension and abrasion.
4. [Commissioning the genset \[▶ 134\]](#)

## Removing and installing the crankcase pressure sensor

### Removing the crankcase pressure sensor

Valid for:

TCG 3016



Tools:

- Standard tools

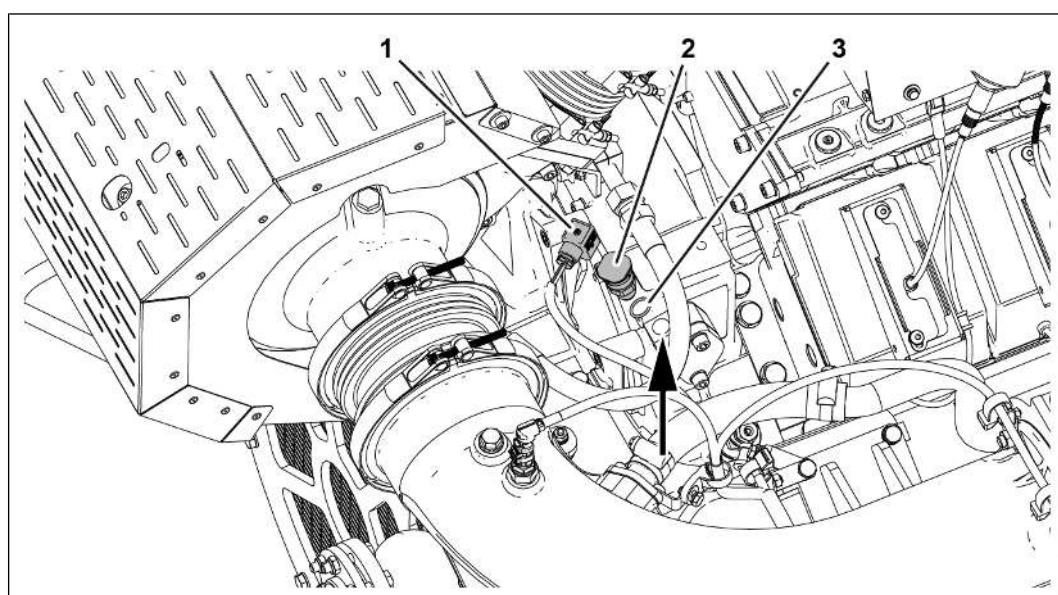


Auxiliary media:

- Binding agent

#### Implementation:

- ✓ [Decommissioning the genset \[▶ 146\]](#)



18014398820468235

#### 1. Remove sensor (2)

- Dismantle connector (1) from the sensor (2).
- Lay the cable bundle in such a way that the cable bundle does not obstruct further work.
- Unscrew sensor (2).
- Remove sealing ring (3) and dispose of (arrow).

## Installing the crankcase pressure sensor

Valid for:

TCG 3016



Tools:

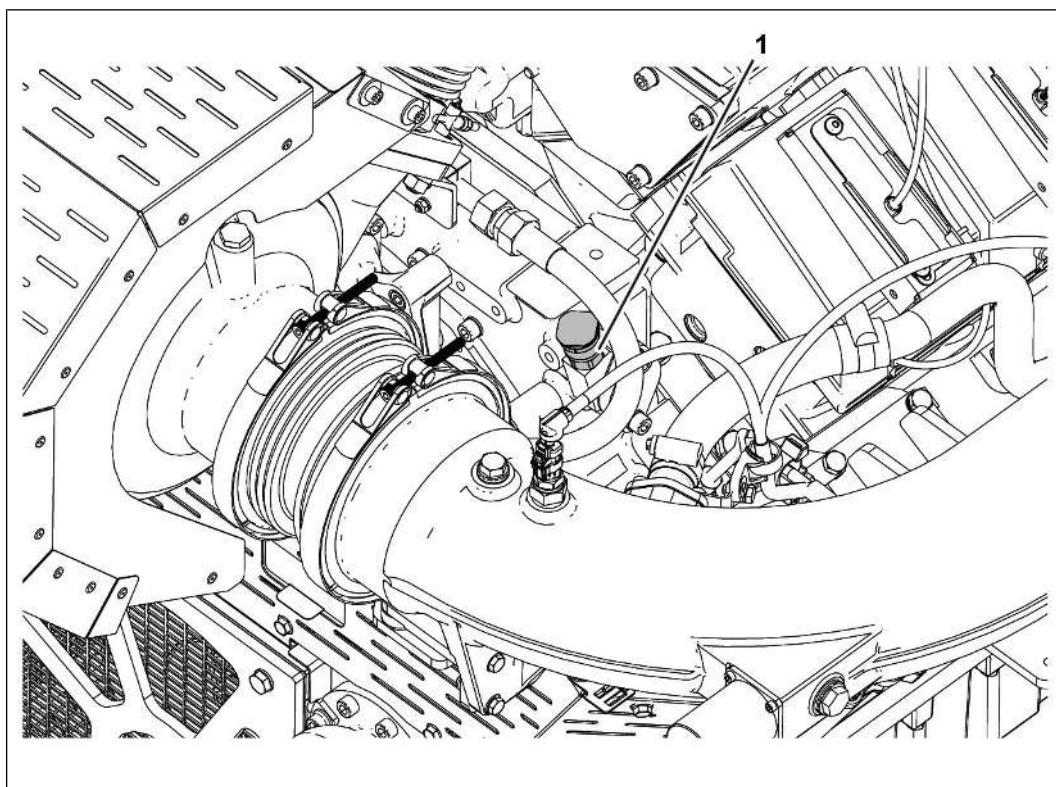
- Standard tools



Spare parts:

- Sealing ring
- Pressure sensor

### Technical data

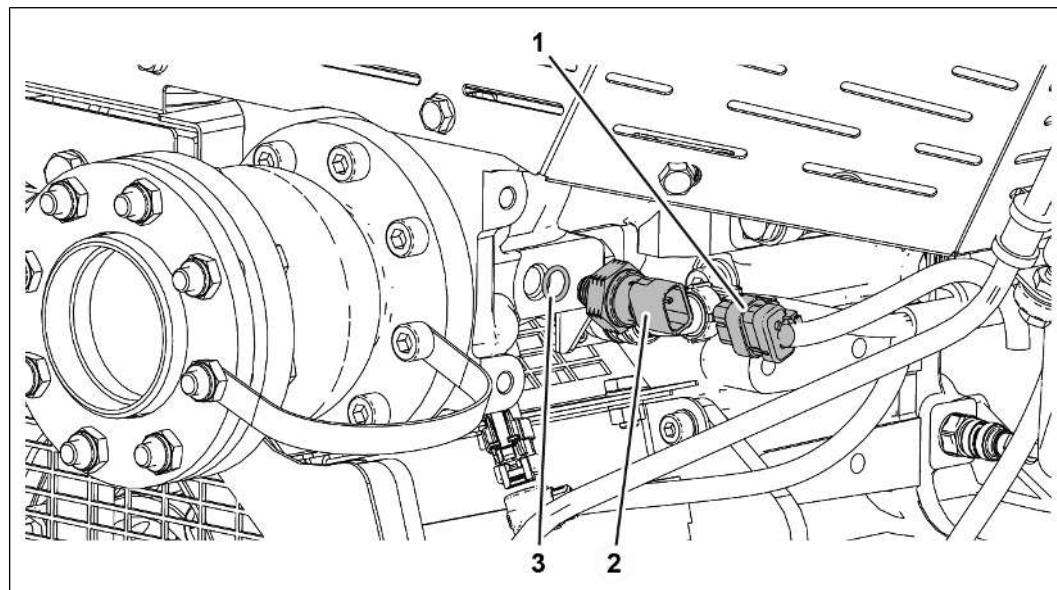


18014398820465803

Crankcase pressure sensor<sup>1)</sup> on face cover

1	1/2A	20 Nm
---	------	-------

<sup>1)</sup> Replace sealing ring.

**Procedure:**

18014398820104587

1. Insert sensor (2) with new sealing ring (3) and tighten
2. Mount the connector (1) onto the sensor (2)
  - Visually inspect the connector (1).
  - Lay the cable bundle free of tension and abrasion.
3. [Commissioning the genset \[▶ 134\]](#)
4. [Checking the crankcase chamber pressure \[▶ 302\]](#)

## Removing and installing the mixture temperature sensor (before exhaust turbocharger)

### Removing the mixture temperature sensor

*Upstream of exhaust turbocharger*

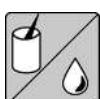
Valid for:

TCG 3016



Tools:

- Standard tools

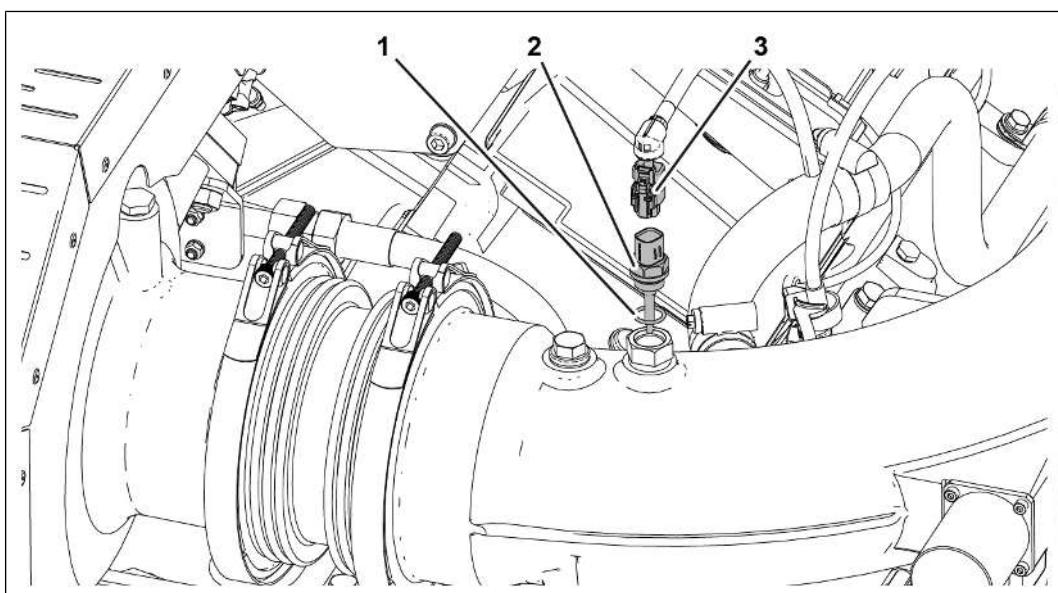


Auxiliary media:

- Binding agent

#### Procedure to follow:

- ✓ [Decommissioning the genset \[▶ 146\]](#)



310734475

1. Remove sensor (2)
  - Place the collecting tray below the sensor.
  - Dismantle connector (3) from the sensor (2).
  - Unscrew sensor (2).
  - Remove sealing ring (1) and dispose of it.

### Installing the mixture temperature sensor

*Before exhaust turbocharger*

Valid for:  
TCG 3016



Tools:

- Standard tools



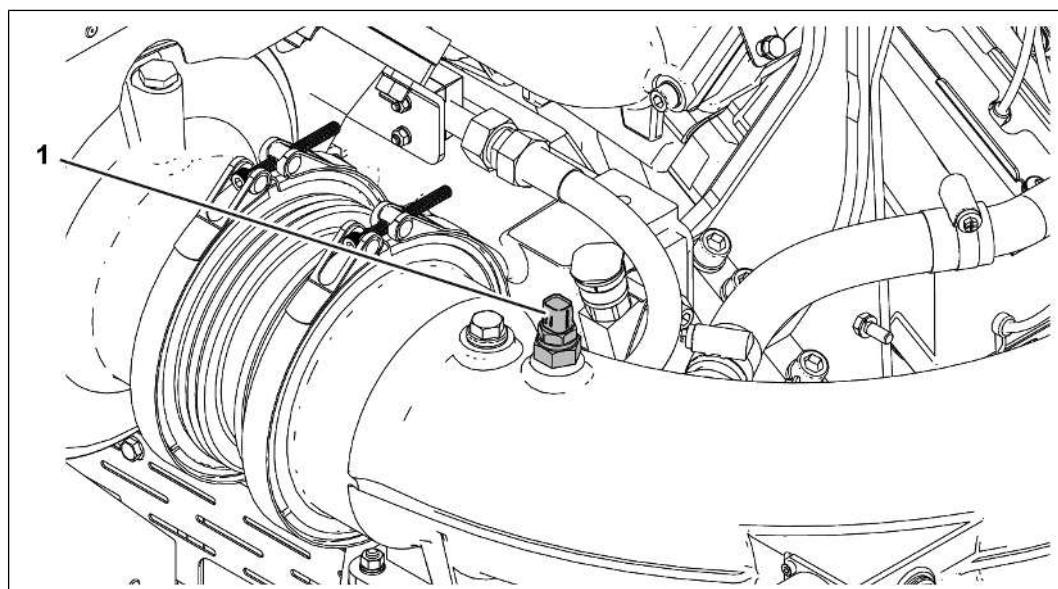
Auxiliary media:

- Binding agent
- Coolant according to operating media regulations



Spare parts:

- Sealing ring
- Temperature sensor

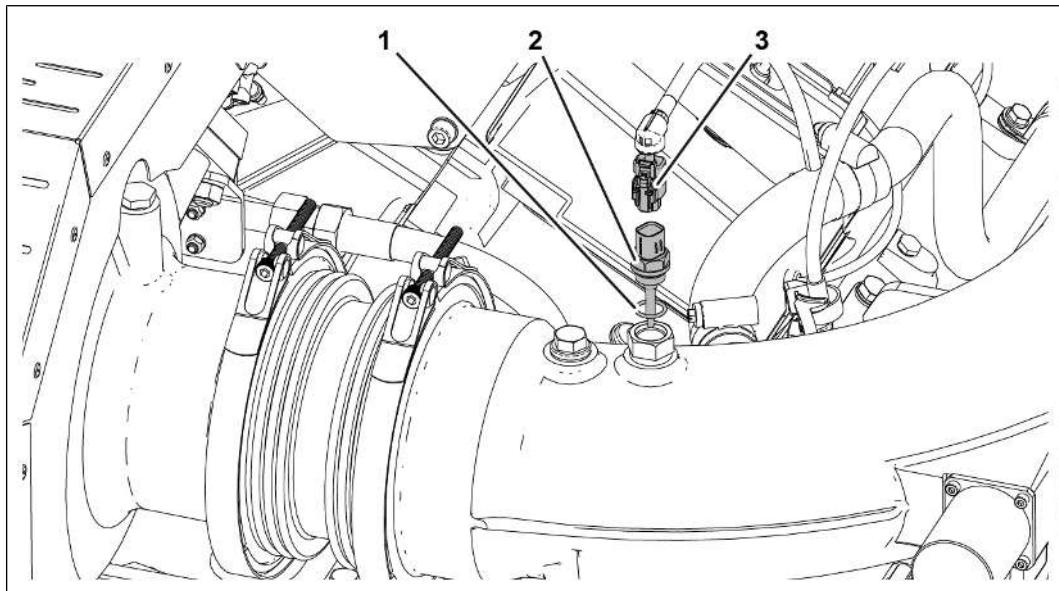


310736907

Mixture temperature sensor<sup>1)</sup> on mixture pipe

1	$\frac{3}{4}$ – 16 – 2A	20 Nm
---	-------------------------	-------

<sup>1)</sup> Replace sealing ring.

**Procedure:**

310734475

1. Insert sensor (2) with new sealing ring (1) and tighten
2. Mount the connector (3) onto the sensor (2)
  - Visually inspect the connector (3).
  - Lay the cable bundle free of tension and abrasion.
3. Remove the collecting tray
  - Properly dispose of collected operating medium
4. [Commissioning the genset \[▶ 134\]](#)

## Removing and installing the mixture temperature sensor (before mixture cooler)

### Removing the mixture temperature sensor

*Before mixture cooler*

Valid for:

TCG 3016

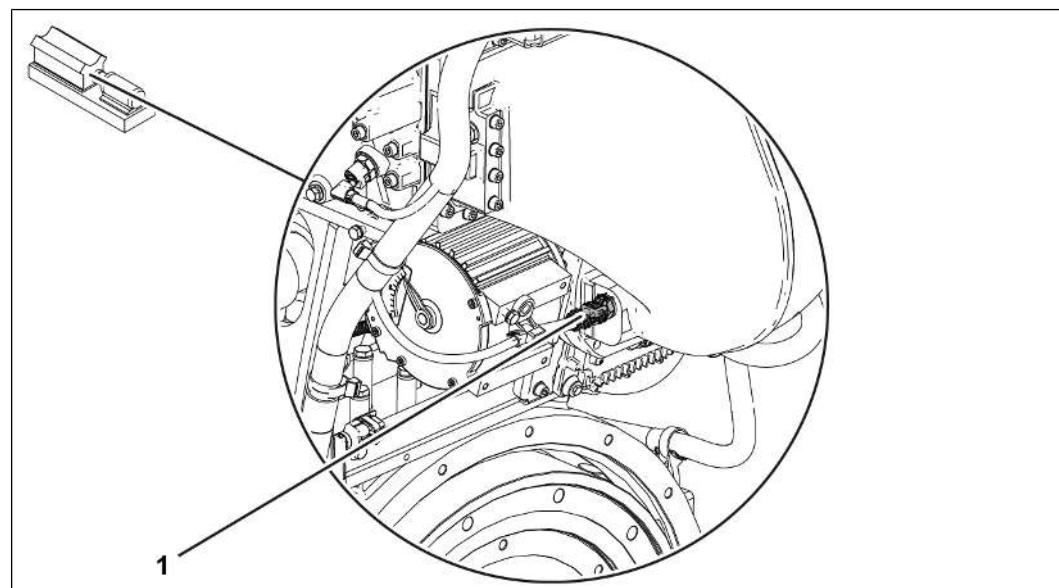


Tools:

- Standard tools

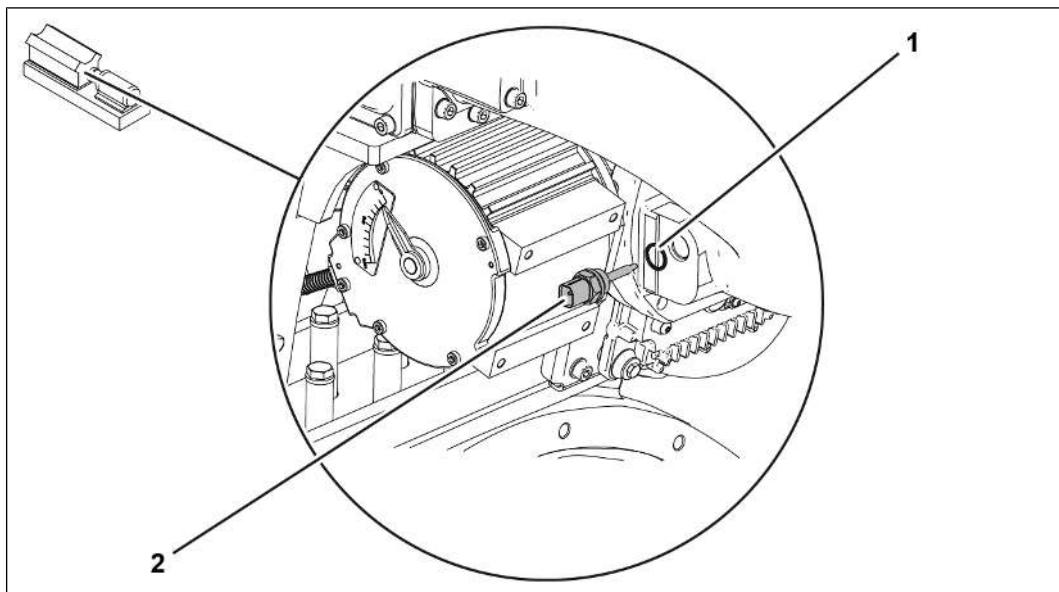
#### Implementation:

- ✓ [Decommissioning the genset \[▶ 146\]](#)



311263371

1. Dismantle connector (1) from the sensor
  - Lay the cable bundle in such a way that the cable bundle does not obstruct further work.



311265803

2. Unscrew sensor (2)
  - Remove sealing ring (1) and dispose of.

## Installing the mixture temperature sensor

*Before mixture cooler*

Valid for:

TCG 3016



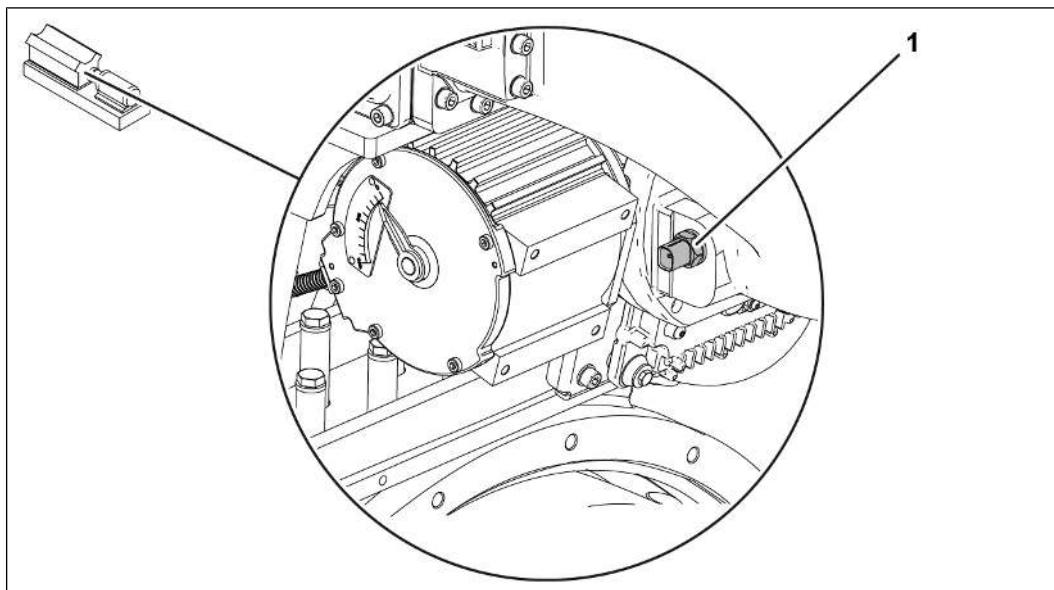
Tools:

- Standard tools

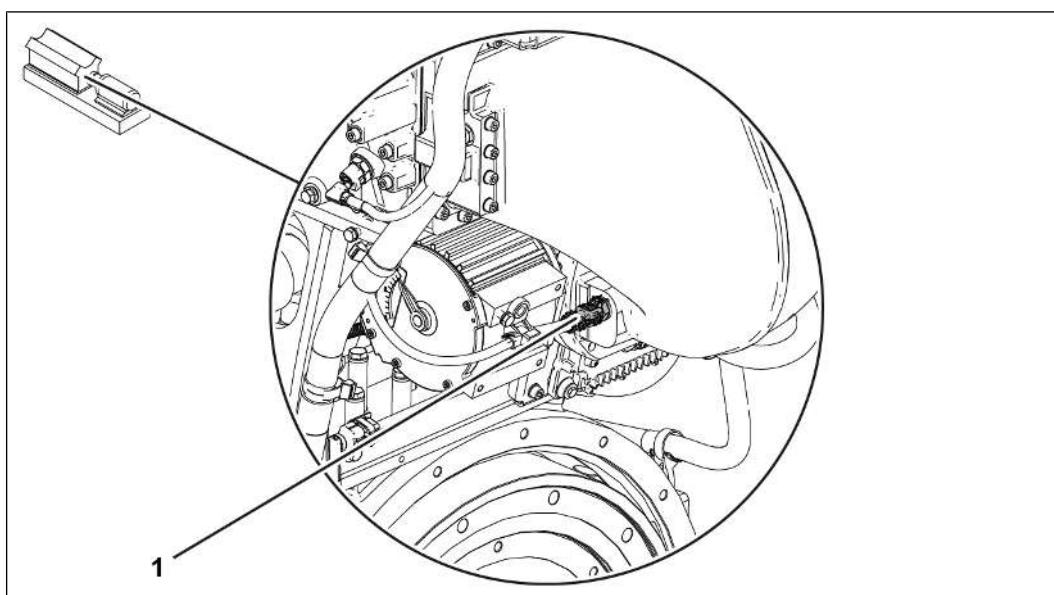


Spare parts:

- Sealing ring
- Temperature sensor

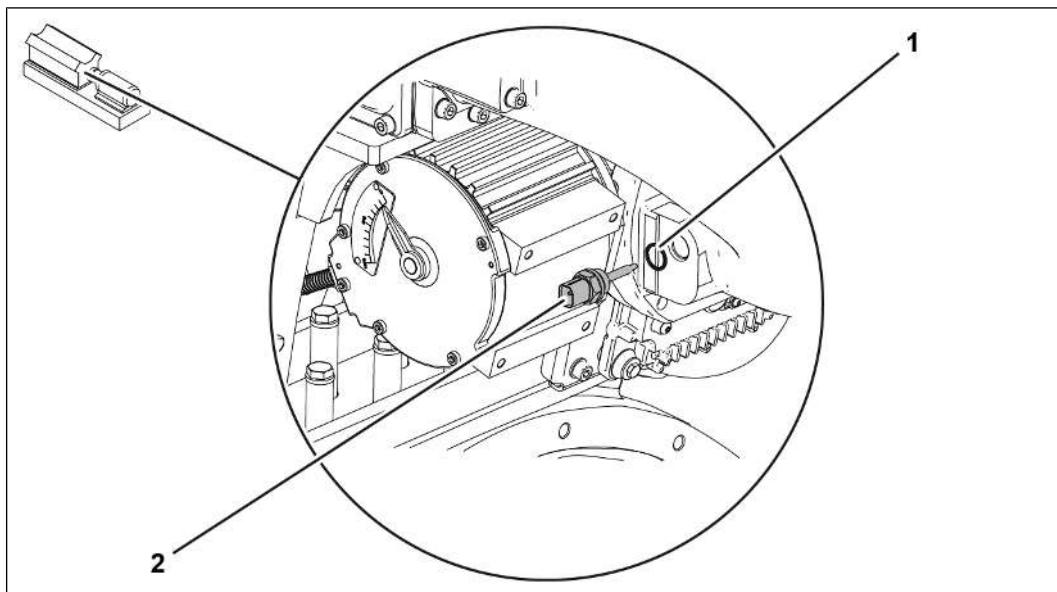


9007199566009227

Mixture temperature sensor<sup>1)</sup> on mixture cooler1       $\frac{3}{4}$  – 16 – 2A      20 Nm<sup>1)</sup> Replace sealing ring.**Procedure:**

311263371

1. Mount the connector (1)
  - Visually inspect the connector.
  - Lay the cable bundle free of tension and abrasion.



311265803

2. Install sensor (2)
  - Insert sensor (2) with new sealing ring (1) and tighten.
3. [Commissioning the genset \[▶ 134\]](#)

## Removing and installing the mixture pressure sensor (after mixture cooler)

### Removing the mixture pressure sensor (after mixture cooler)

Valid for:

TCG 3016

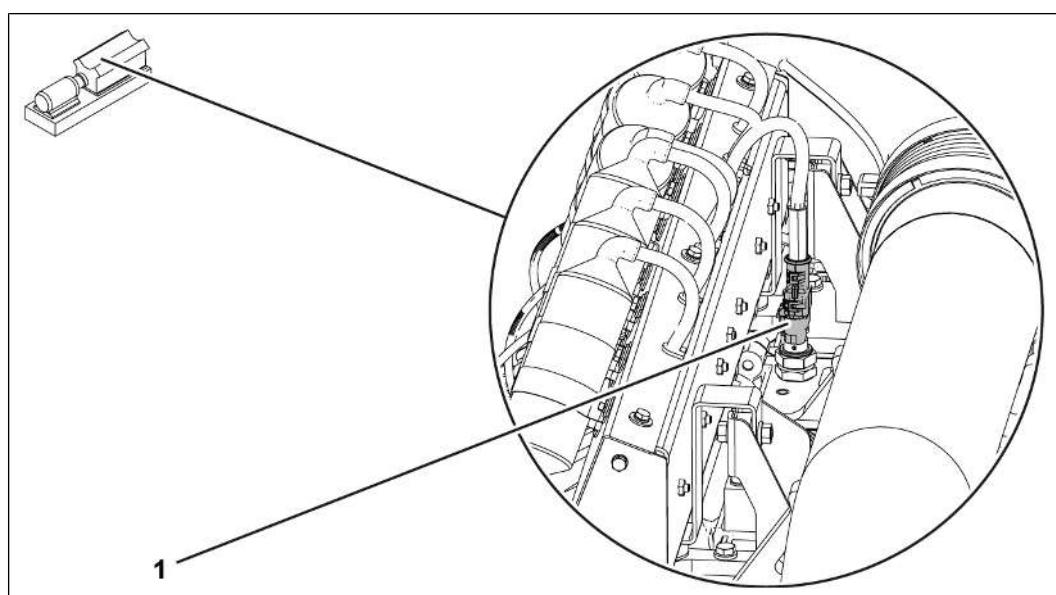


Tools:

- Standard tools

#### Implementation:

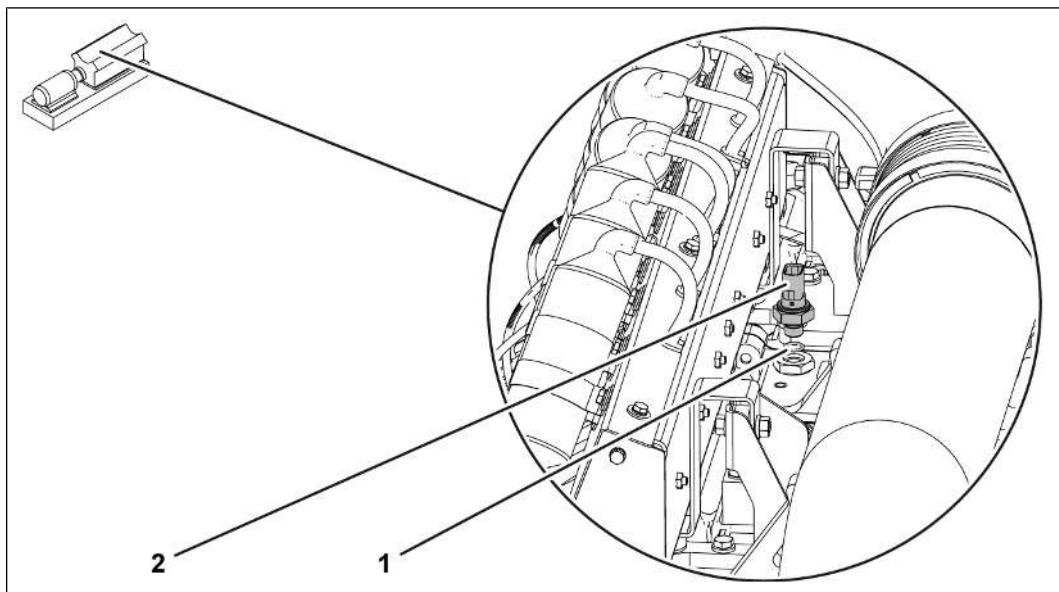
- ✓ [Decommissioning the genset \[▶ 146\]](#)



27021598075366411

#### 1. Dismantle connector (1) from the sensor

- Lay the cable bundle in such a way that the cable bundle does not obstruct further work.



18014398820570507

2. Remove sensor (2)
  - Unscrew sensor (2).
  - Remove sealing ring (1) and dispose of.

### Installing the mixture pressure sensor (after mixture cooler)

Valid for:

TCG 3016



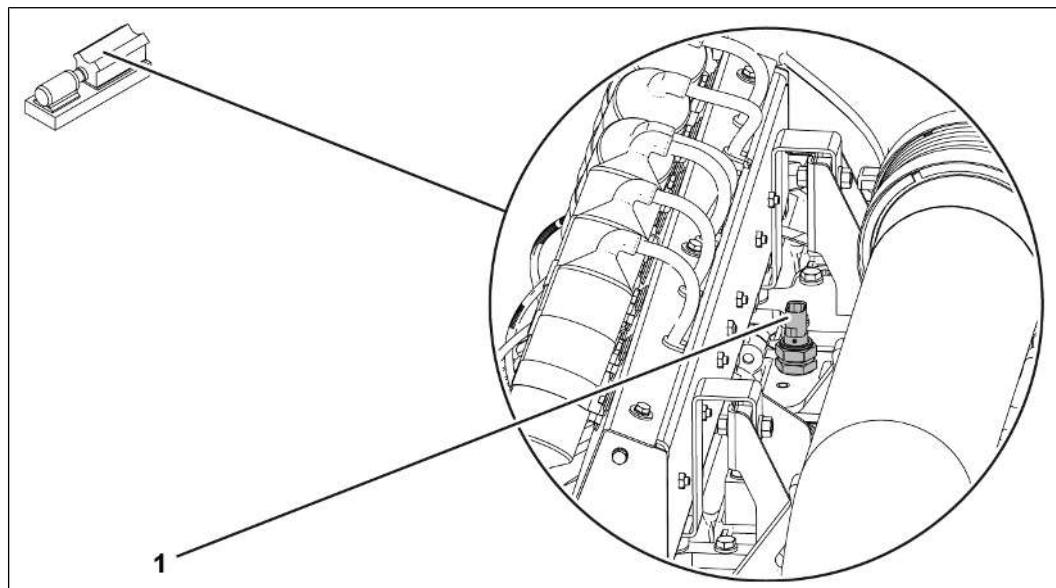
Tools:

- Standard tools



Spare parts:

- Sealing ring
- Pressure sensor

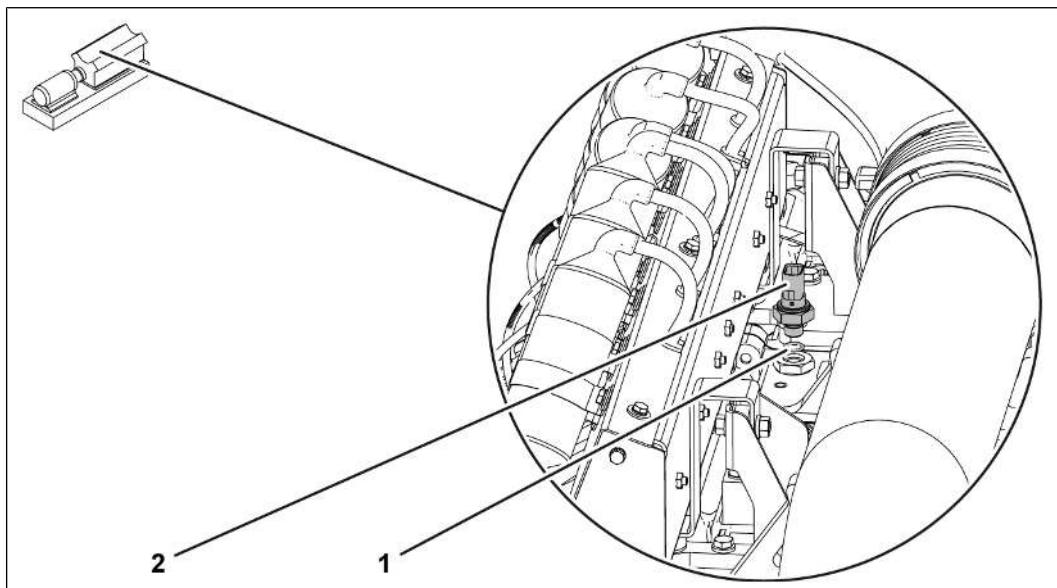
**Technical data**

18014398820568075

Mixture pressure sensor<sup>1)</sup> on mixture housing

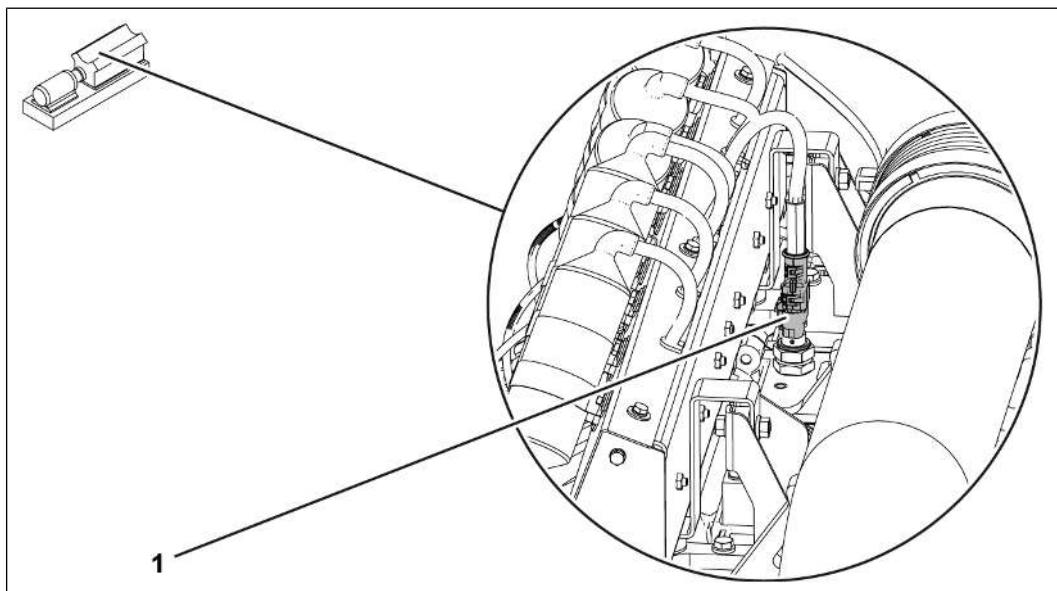
1 M14 x 1.5 10 Nm

<sup>1)</sup> Replace sealing ring.

**Procedure to follow:**

18014398820570507

1. Insert sensor (2) with new sealing ring (1) and tighten



27021598075366411

2. Mount the connector (1) onto the sensor
  - Visually inspect the connector (1).
  - Lay the cable bundle so that it is free of tension and abrasion.
3. [Commissioning the genset \[▶ 134\]](#)

## Removing and installing the lube oil temperature sensor

### Removing the lube oil temperature sensor

Valid for:

TCG 3016



Tools:

- Standard tools

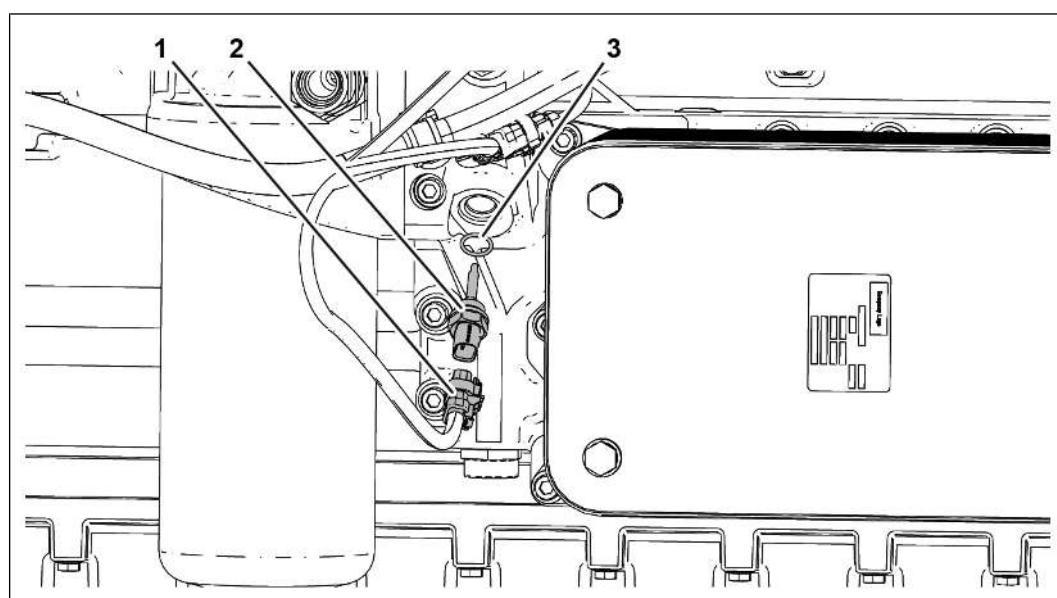


Auxiliary media:

- Binding agent

#### Procedure to follow:

- ✓ [Decommissioning the genset \[▶ 146\]](#)



310515595

1. Remove sensor (2)
  - Place the collecting tray below the sensor (2).
  - Dismantle connector (1) from the sensor (2)
  - Unscrew sensor (2).
  - Remove the sealing ring (3) and dispose of it.

## Installing the lube oil temperature sensor

Valid for:

TCG 3016



Tools:

- Standard tools



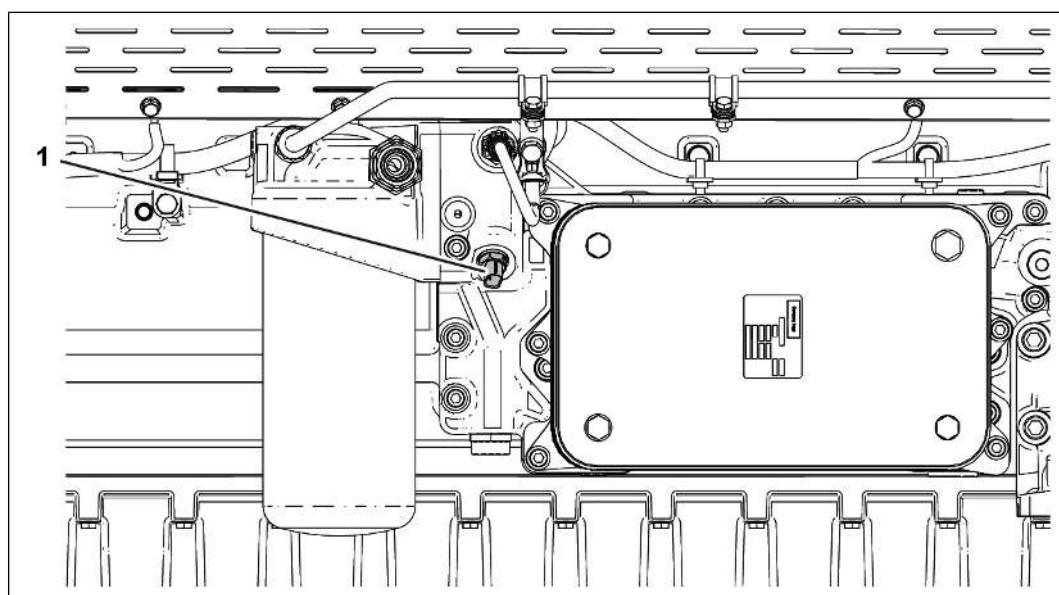
Auxiliary media:

- Binding agent
- Lube oil according to operating media regulations



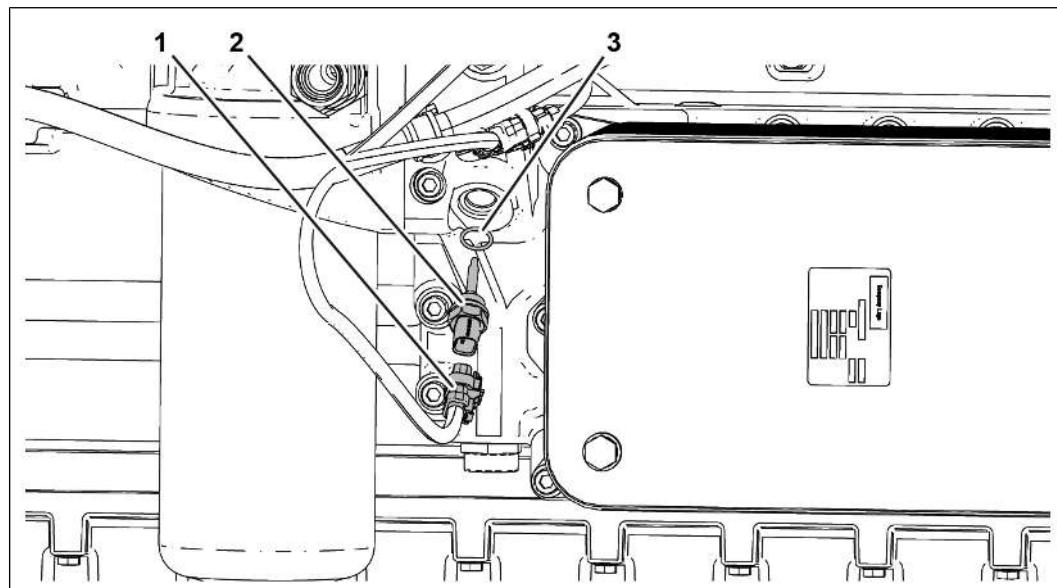
Spare parts:

- Sealing ring
- Temperature sensor



310518027

Lube oil temperature sensor <sup>1)</sup> on the lube oil filter console		
1	$\frac{3}{4}$ – 16 – 2A	20 Nm
<sup>1)</sup> Replace sealing ring.		

**Procedure:**

310515595

1. Insert sensor (2) with new sealing ring (3) and tighten
2. Mount the connector (3) onto the sensor (2)
  - Visually inspect the connector (3).
  - Lay the cable bundle free of tension and abrasion.
3. Remove the collecting tray
  - Properly dispose of collected operating medium
4. If necessary [Filling the lube oil system \[▶ 330\]](#)
5. [Commissioning the genset \[▶ 134\]](#)

## Removing and installing the lube oil pressure sensor

### Removing the lube oil pressure sensor

Valid for:

TCG 3016



Tools:

- Standard tools

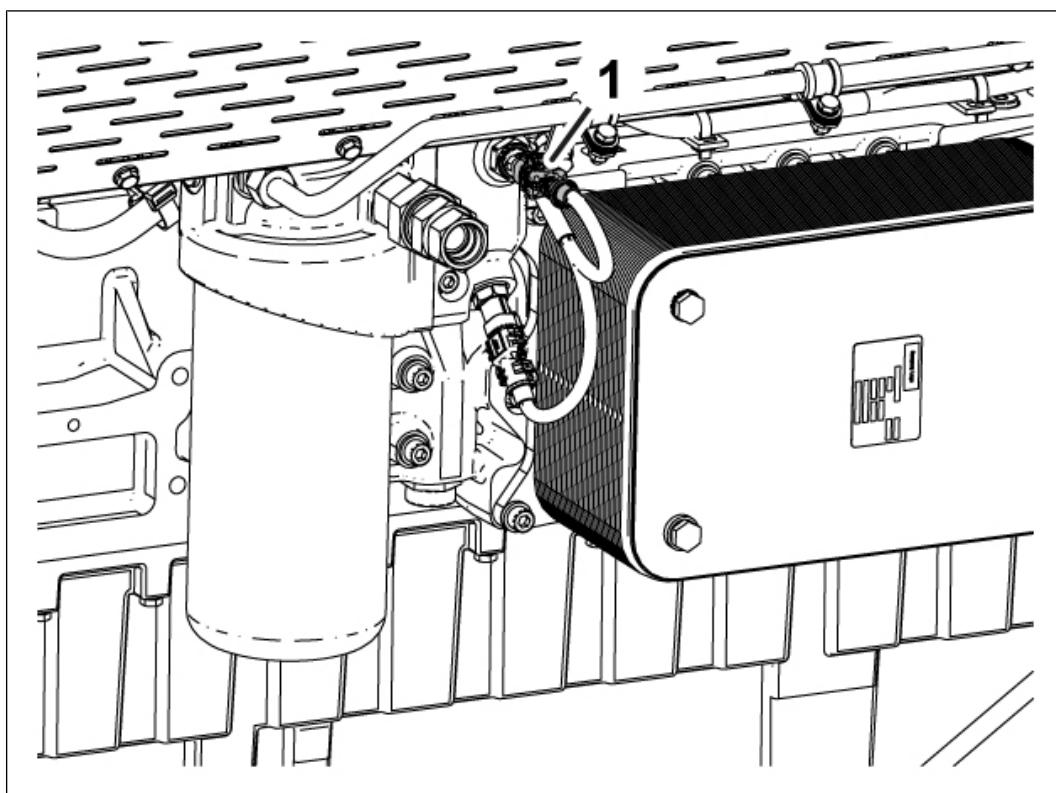


Auxiliary media:

- Binding agent

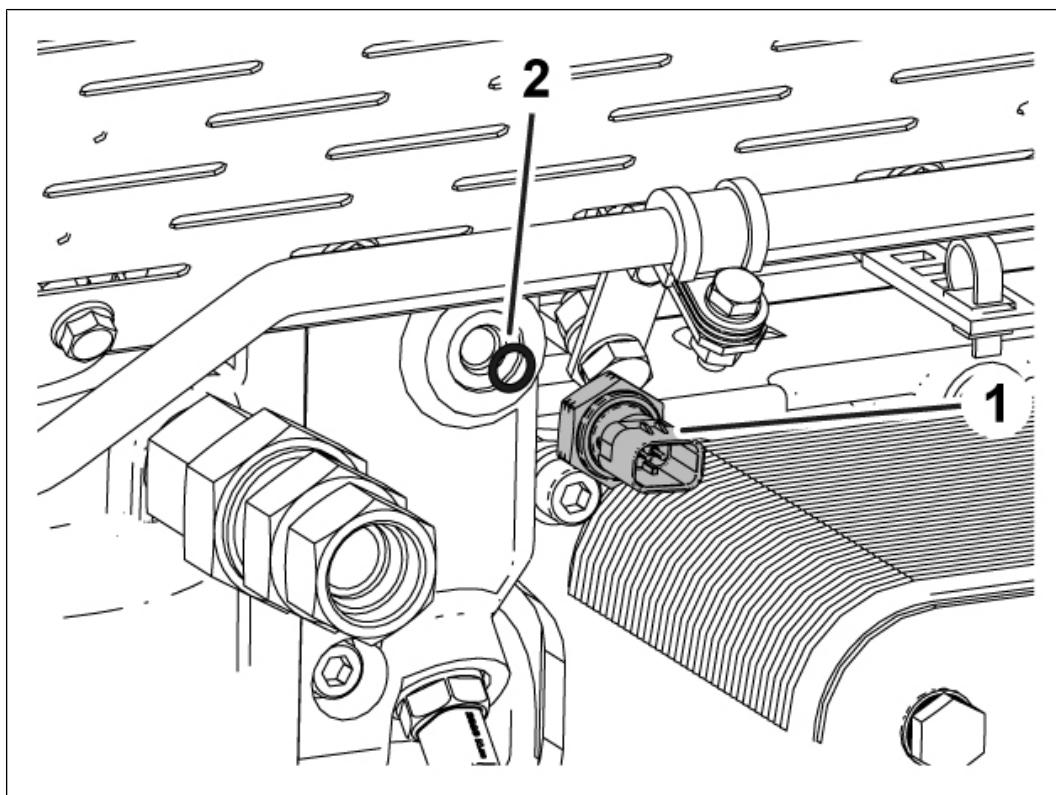
#### Procedure to follow:

- ✓ [Decommissioning the genset \[▶ 146\]](#)



27021598074620171

1. Dismantle connector (1) from the sensor



18014398819881611

2. Remove sensor (1)

- Place the collecting tray below the sensor.
- Unscrew the sensor (1).
- Remove the sealing ring (2) and dispose of it.

## Installing the lube oil pressure sensor

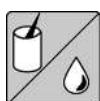
Valid for:

TCG 3016



Tools:

- Standard tools



Auxiliary media:

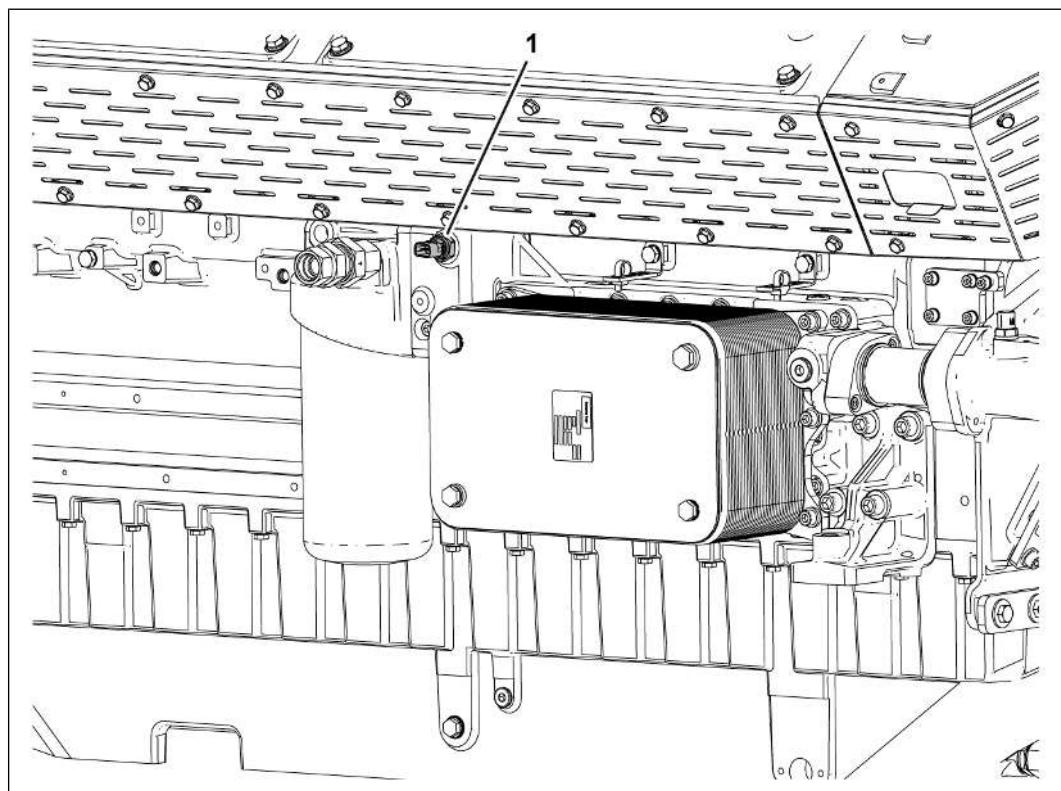
- Binding agent
- Lube oil according to operating media regulations



Spare parts:

- Sealing ring
- Pressure sensor

### Technical data



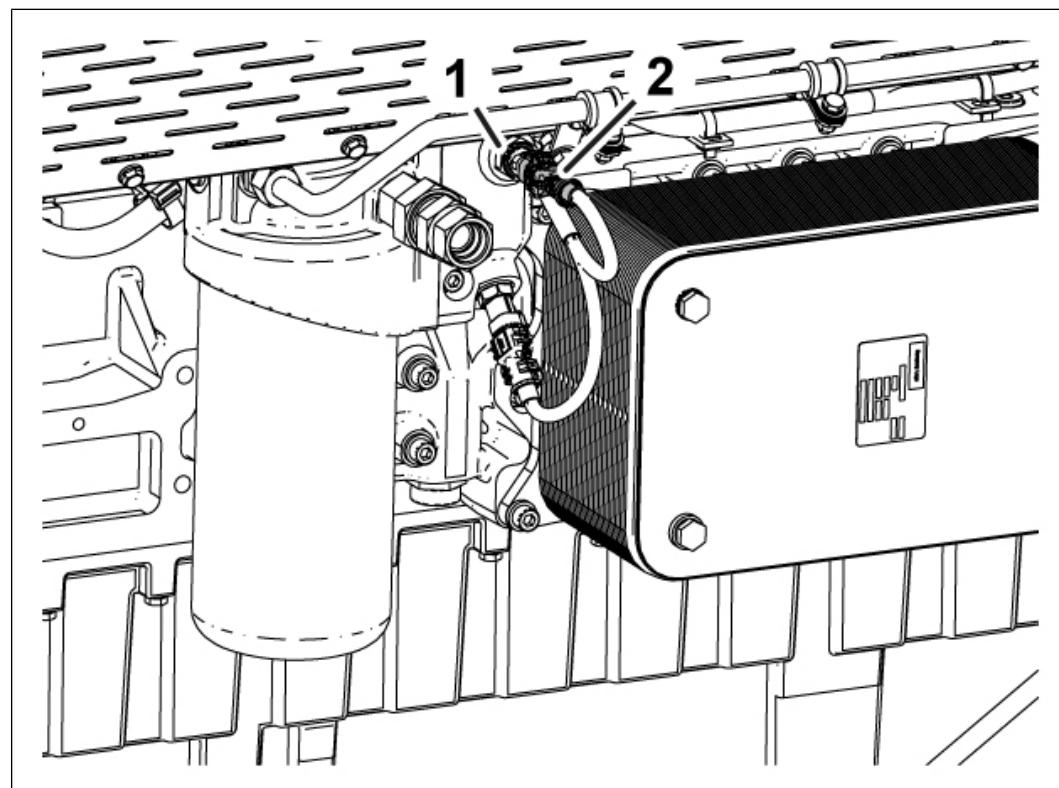
18014398819899275

Lube oil pressure sensor<sup>1)</sup> on crankcase

1	M12 x 1.5	10 Nm
---	-----------	-------

<sup>1)</sup> Replace sealing ring.

**Procedure to follow:**



18014398819896843

1. Insert sensor with new sealing ring (1) and tighten
2. Mount the connector (2) onto the sensor (1)
  - Visually inspect the connector (2).
  - Lay the cable bundle so that it is free of tension and abrasion.
3. Remove the collecting tray
  - Properly dispose of collected operating medium
4. [Commissioning the genset \[▶ 134\]](#)

## Removing and installing the fill level probe

### Removing the fill level probe

Valid for:

TCG 3016



Tools:

- Standard tools

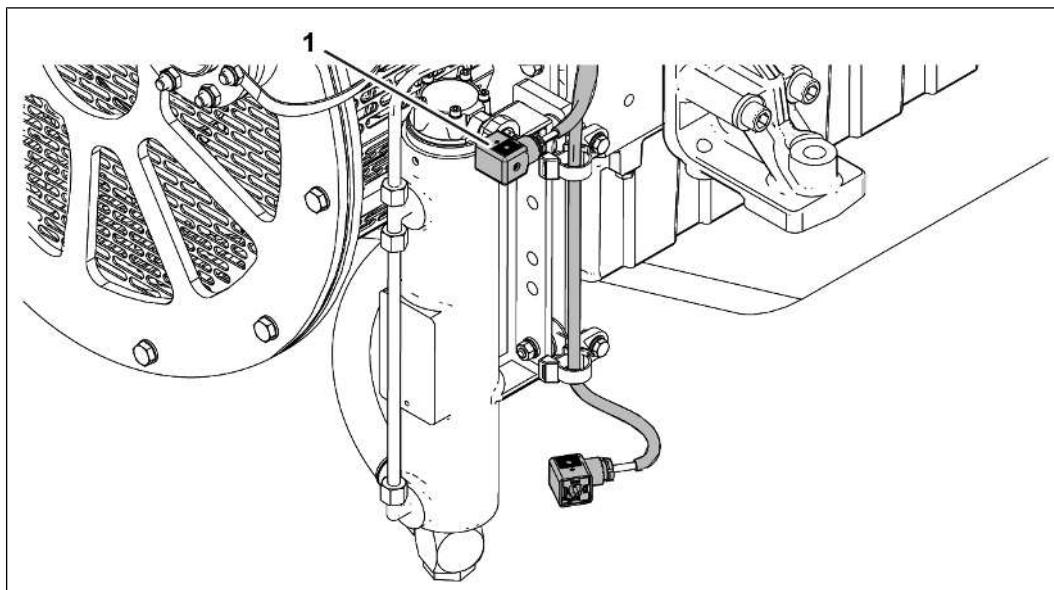


Auxiliary media:

- Binding agent
- Acid-free grease
- Lube oil according to operating media regulations

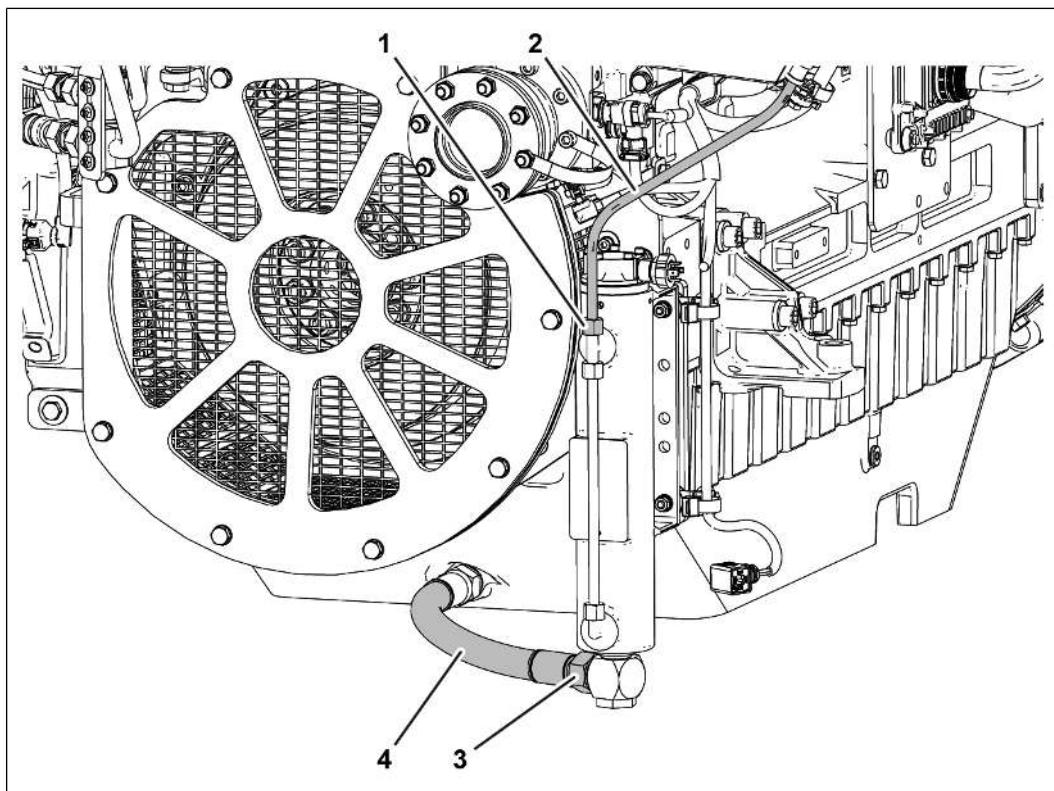
#### Dismantling the fill level probe:

- ✓ Pumping lube oil out of the lube oil sump [▶ 326]



9007199564887691

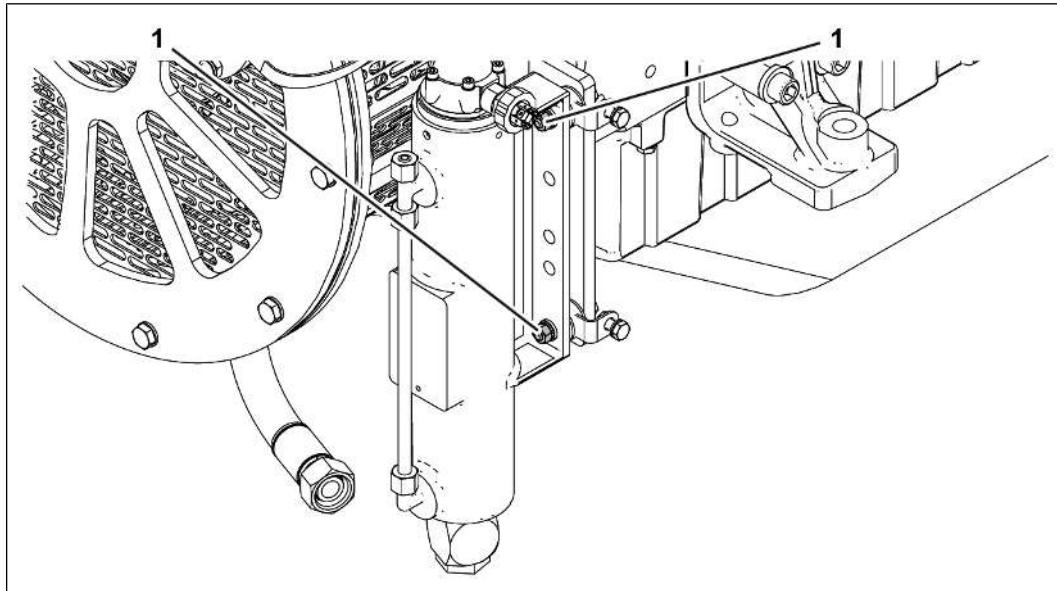
1. Dismantle connector (1) from the fill level probe



9007199564890123

2. Dismantle lube oil line (2) and (4) from the standpipe
  - Place the collecting tray below the standpipe.
  - Unscrew union nuts (1) and (3).
  - Remove lube oil lines (2) and (4).
  - Seal lube oil lines (2) and (4) tightly with blind plugs.

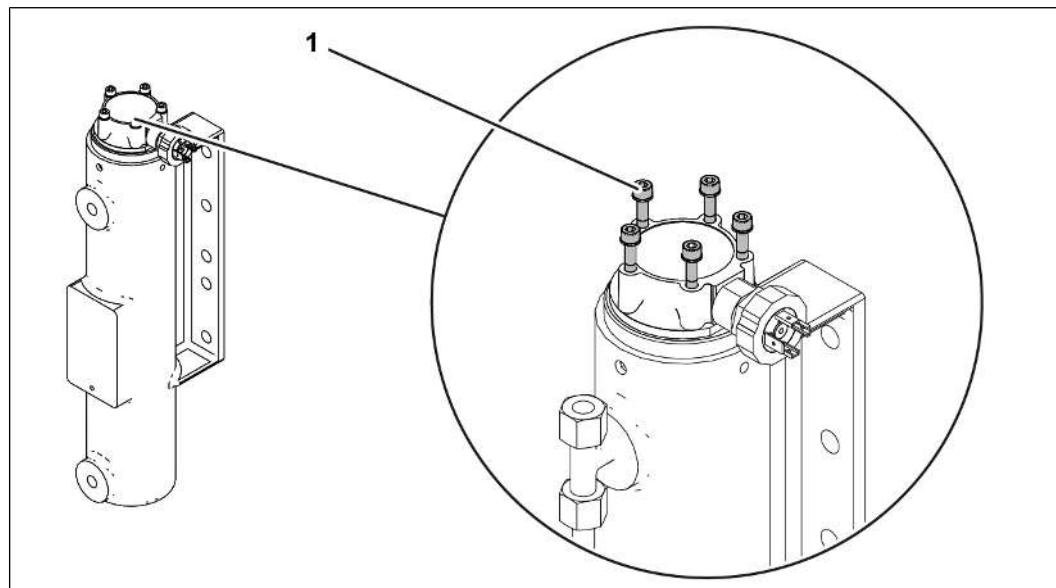
- Seal the lube oil connections on the standpipe and engine tightly with blind plugs.



9007199564892555

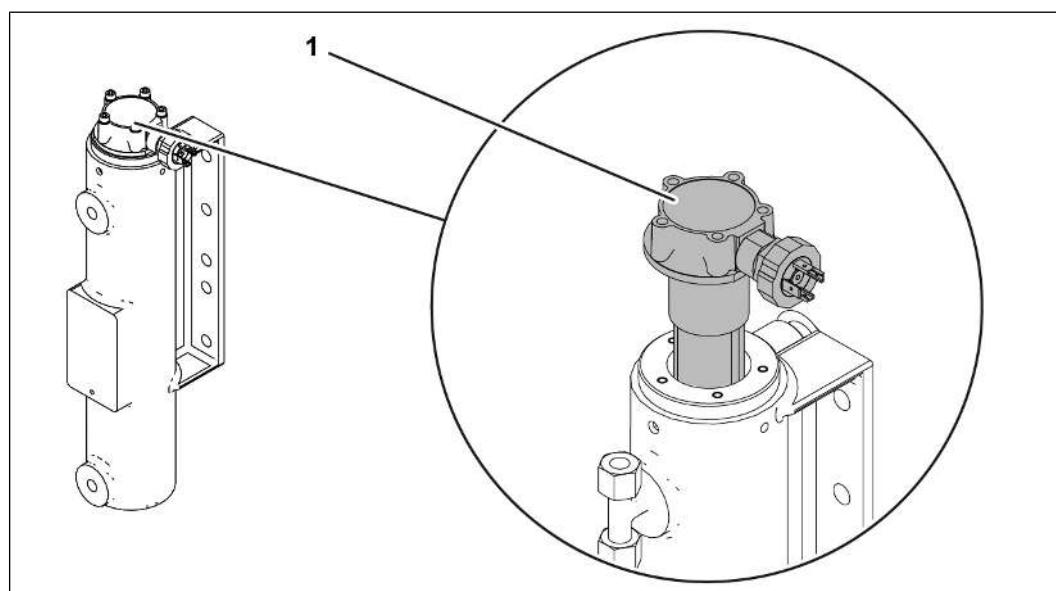
### 3. Remove the standpipe

- Secure the standpipe against falling down.
- Unscrew nuts with washers (1).
- Remove the holder from the sensor.

**Removing the fill level probe:**

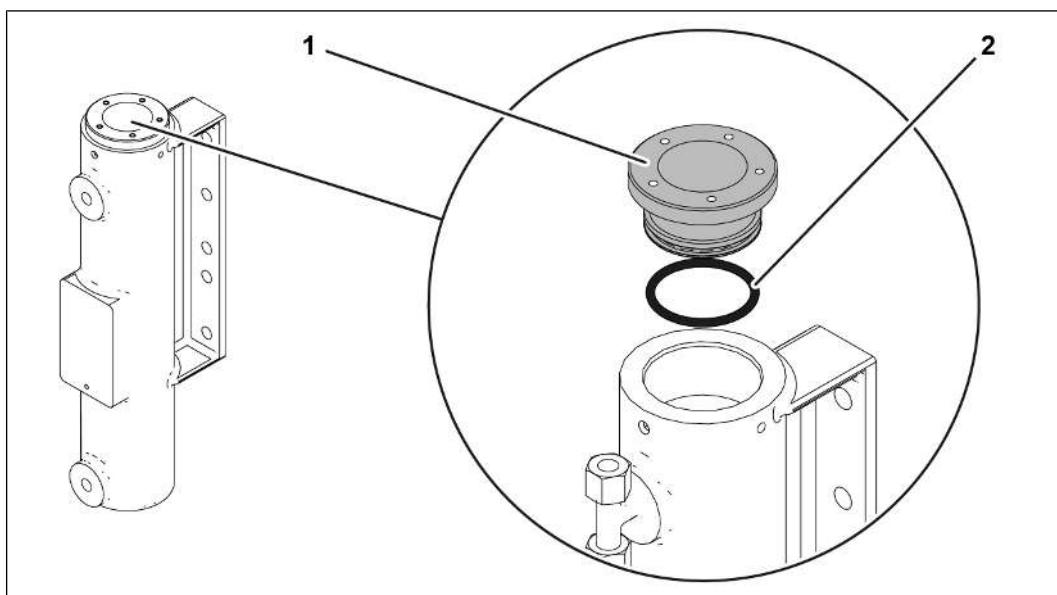
9007199564897419

1. Unscrew screws with washers (1)



9007199564925451

2. Pull the fill level probe (1) out of the standpipe



9007199564927883

3. Clean and visually inspect the spacer (1)
  - Remove the spacer (1).
  - Remove and dispose of the sealing ring (2).

## Installing the fill level probe

Valid for:

TCG 3016



Tools:

- Standard tools



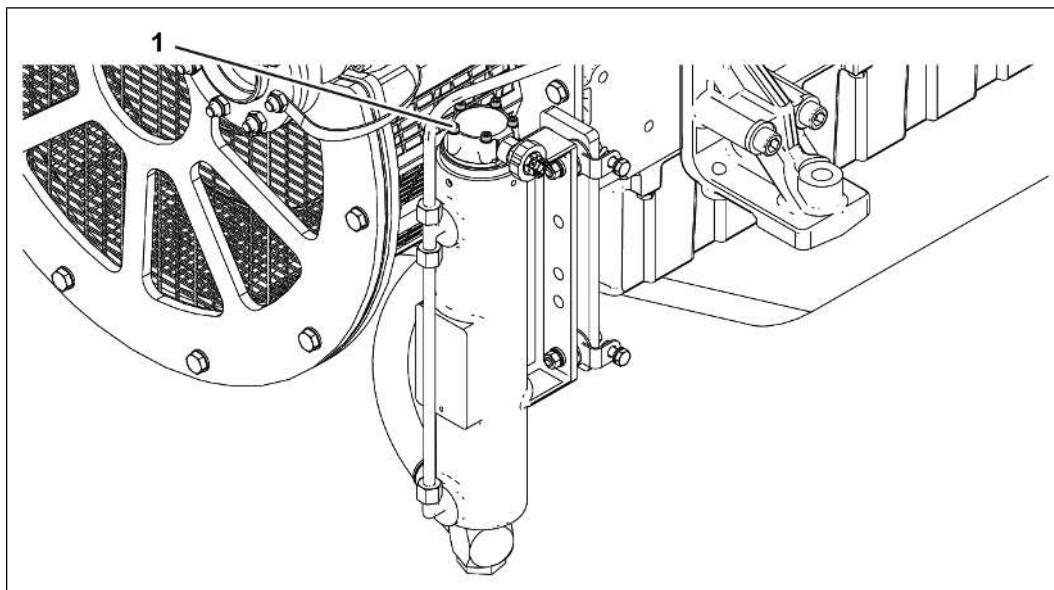
Auxiliary media:

- Binding agent
- Acid-free grease
- Lube oil according to operating media regulations



Spare parts:

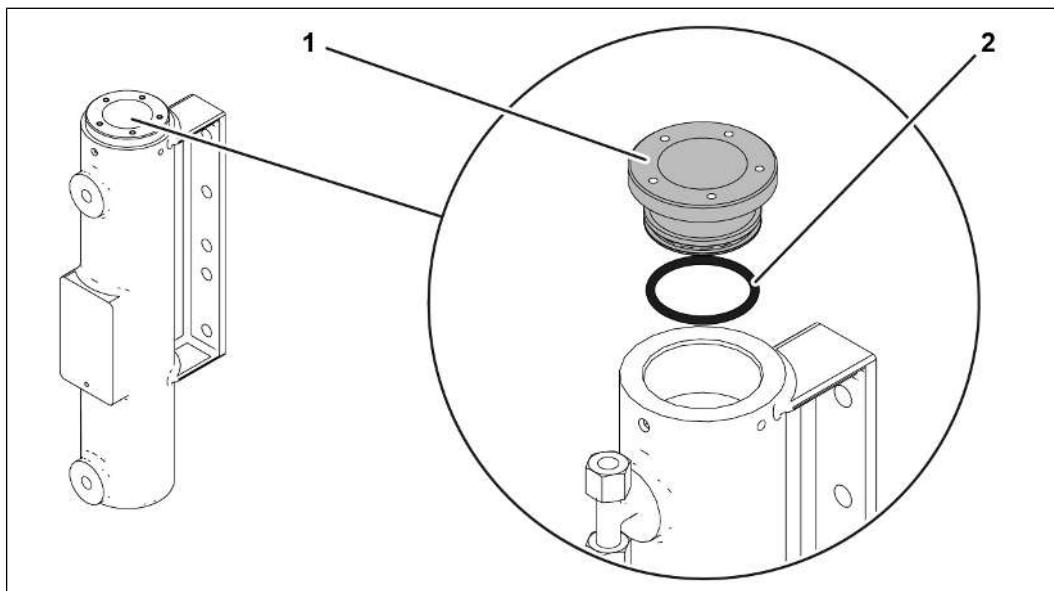
- Fill level sensor
- Sealing ring



9007199564930315

Fill level probe on spacer

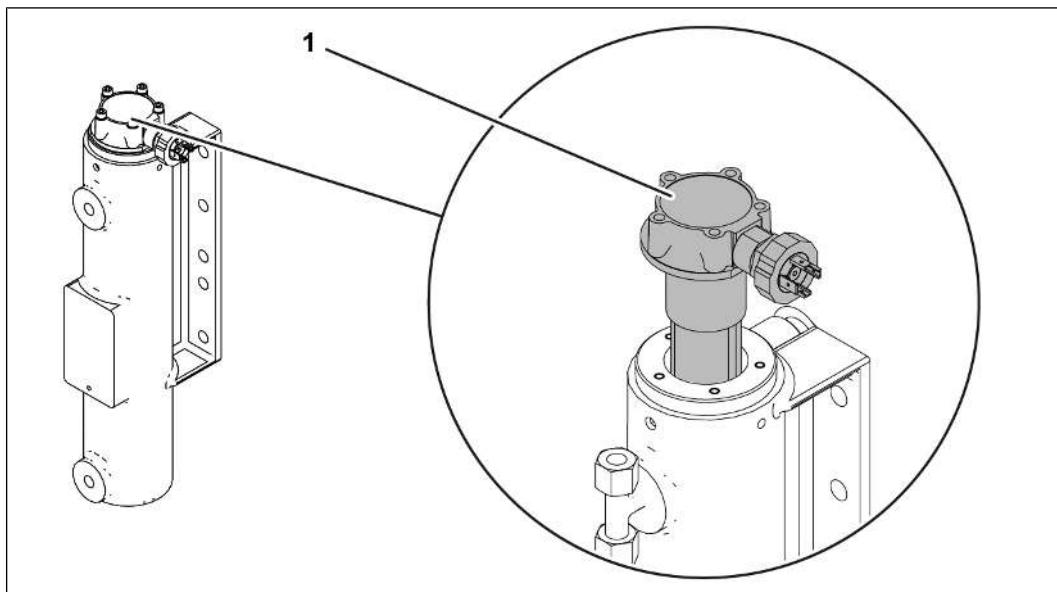
1 M5 x 35 – 10.9 1.5 Nm

**Installing the level sensor:**

9007199564927883

## 1. Install spacer (1)

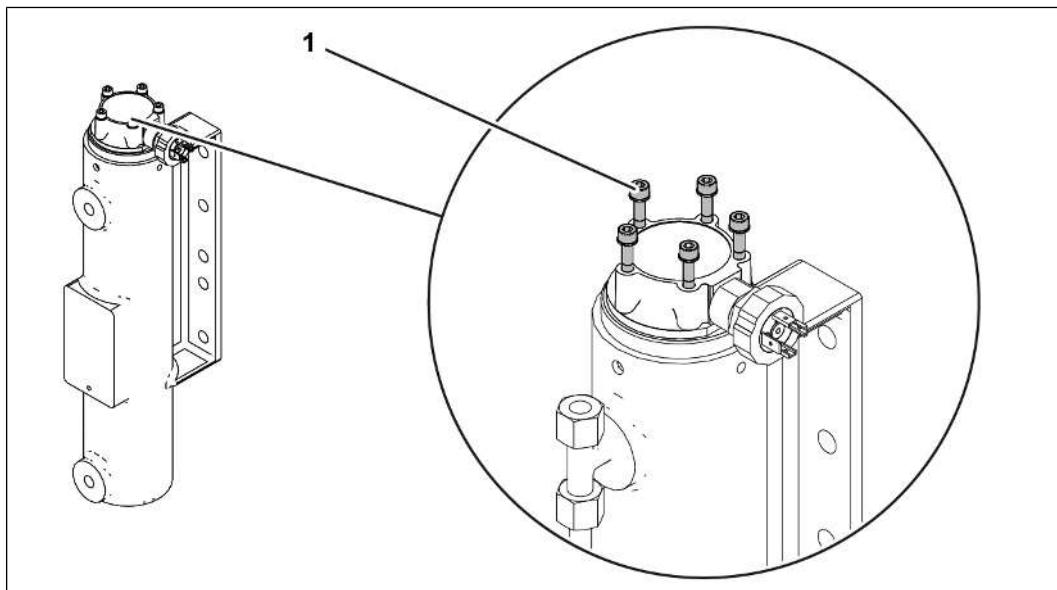
- Wet the new sealing ring (2) with acid-free grease.
- Fit the sealing ring (2) on the spacer (1).
- Insert spacer (1).



9007199564925451

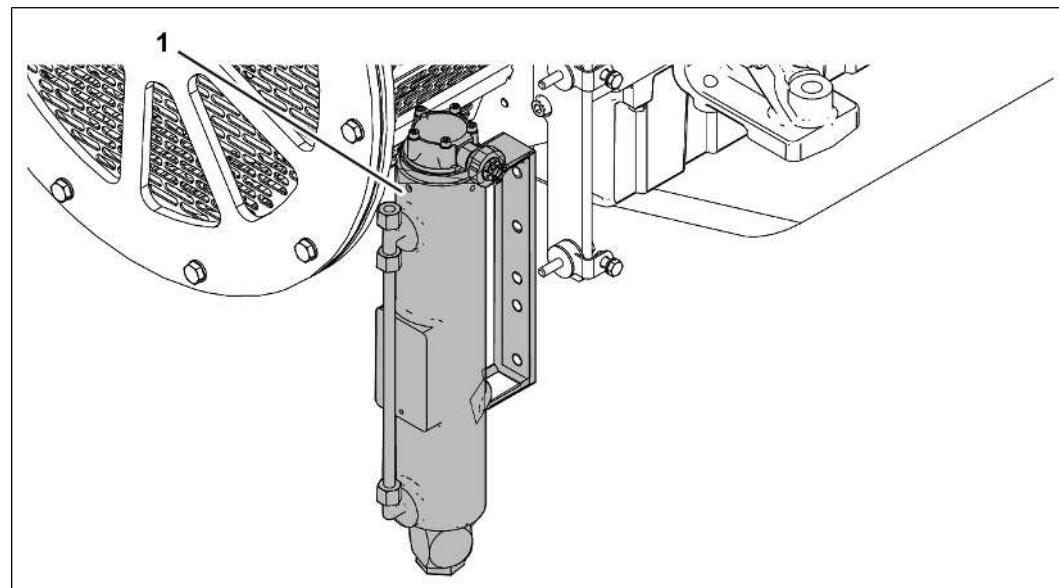
## 2. Install the level sensor (1)

- **NOTE! Ensure correct installation position of the level sensor. The electrical connection of the level sensor must point toward the connector.** Push the level sensor (1) completely into the standpipe.



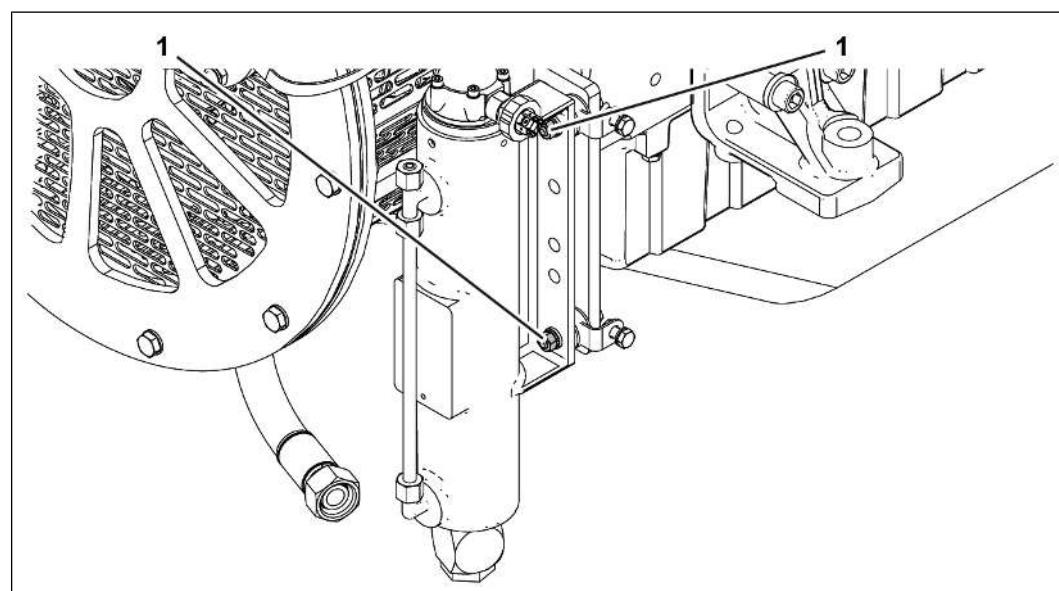
9007199564897419

## 3. Tighten screws with washers (1)

**Installing the level sensor:**

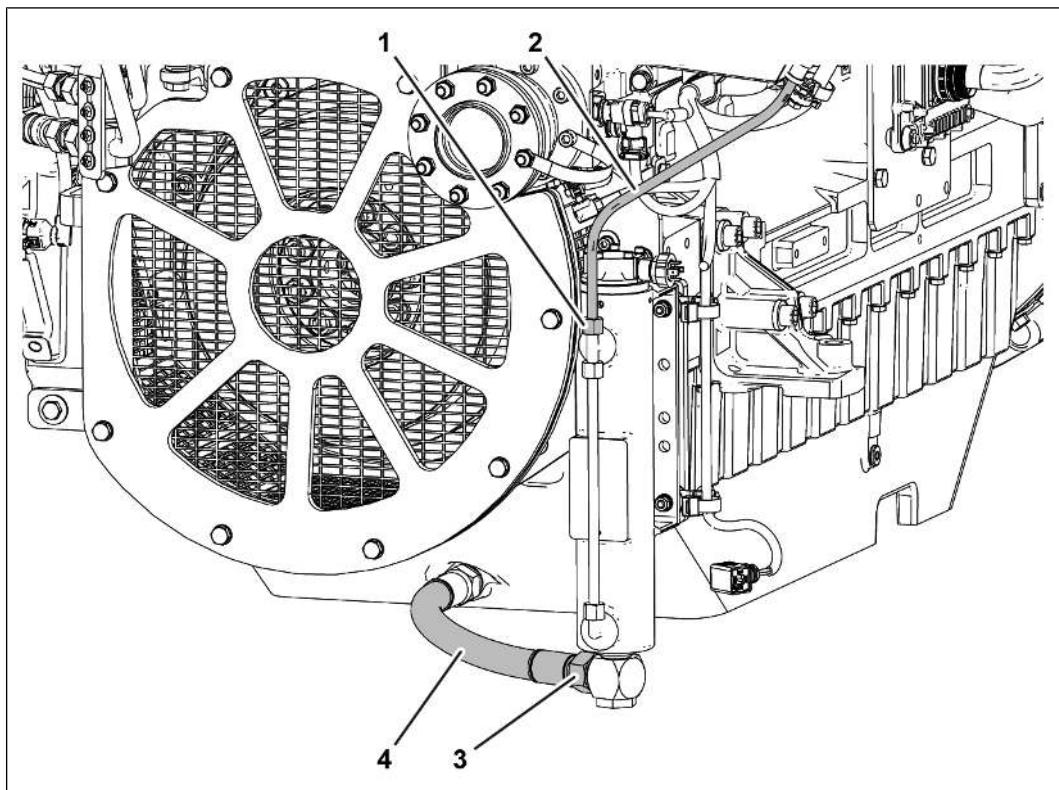
9007199564894987

1. Position the standpipe (1) on the holder
  - Secure the standpipe (1) against falling down.



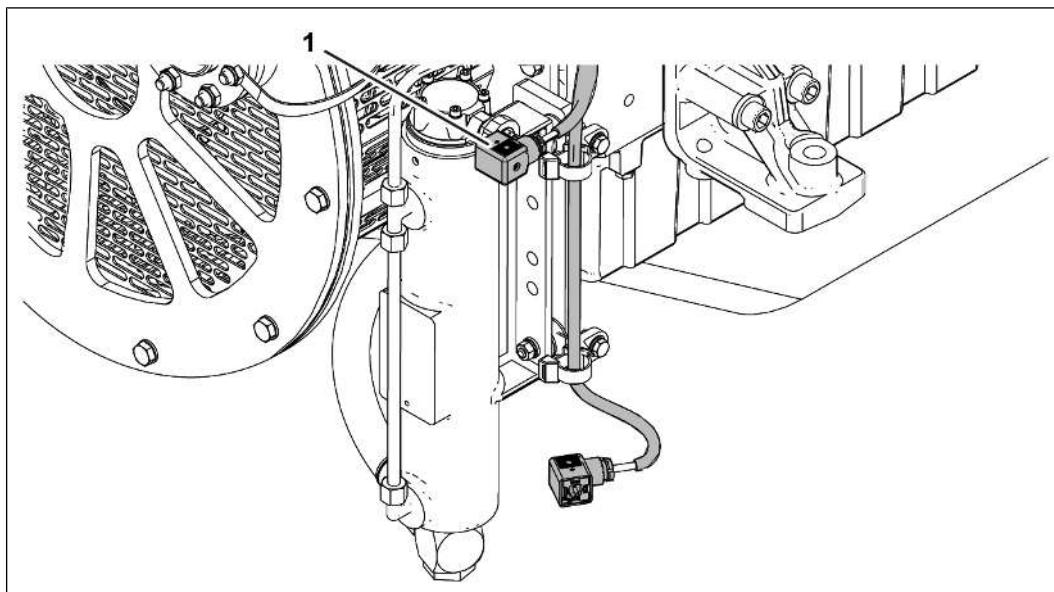
9007199564892555

2. Tighten nuts with washers (1)



9007199564890123

3. Mount the lube oil line (2) and (4) on the standpipe
  - Place the collecting tray below the standpipe.
  - Remove the blind plugs from the lube oil lines (2) and (4).
  - Remove the blind plugs from the lube oil connections on the standpipe and engine.
  - Push the lube oil lines (2) and (4) onto the lube oil connections on the standpipe and engine.
  - Tighten the union nuts (1) and (3).



9007199564887691

4. Mount the connector (1) on the level sensor.
  - Lay the cable bundle so that it is free of tension and abrasion.
5. Remove the collecting tray
  - Properly dispose of the collected lube oil.
6. Fill the lube oil sump, see [Filling the lube oil system \[▶ 330\]](#)
7. [Commissioning the genset \[▶ 134\]](#)
8. Visually inspect all the components and screw connections for leaks

## Removing and installing the coolant temperature sensor (mixture cooler)

### Removing the coolant temperature sensor

*Mixture cooler*

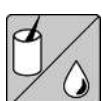
Valid for:

TCG 3016



Tools:

- Standard tools

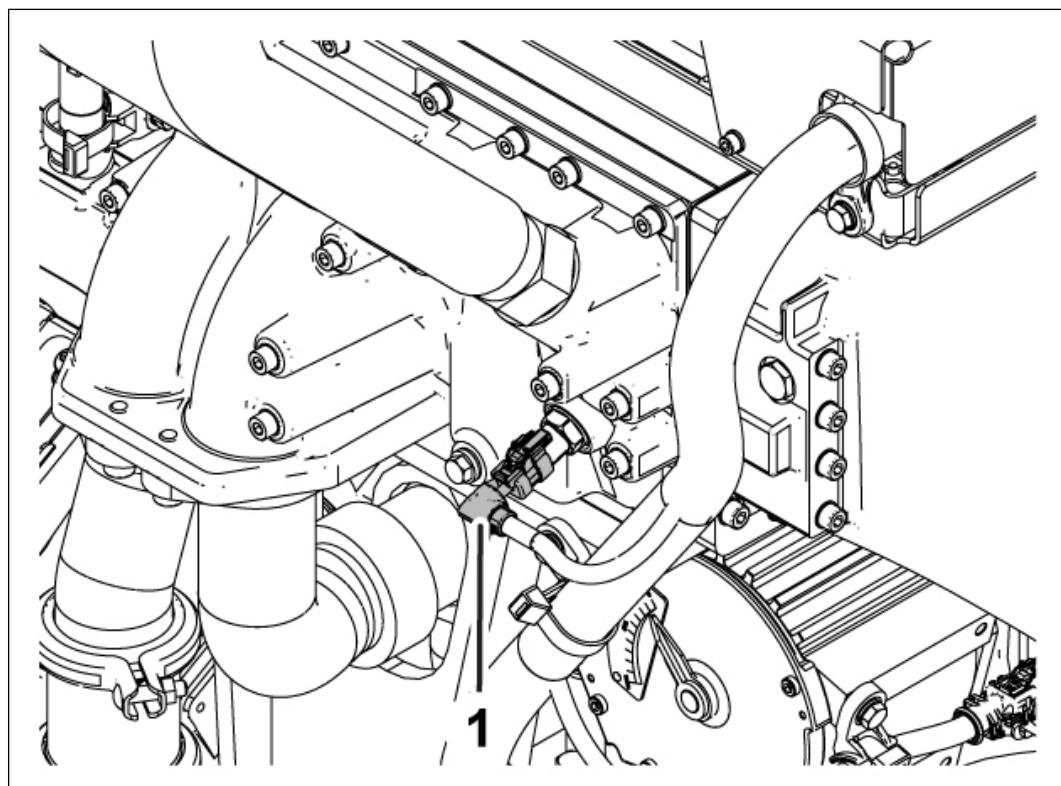


Auxiliary media:

- Binding agent

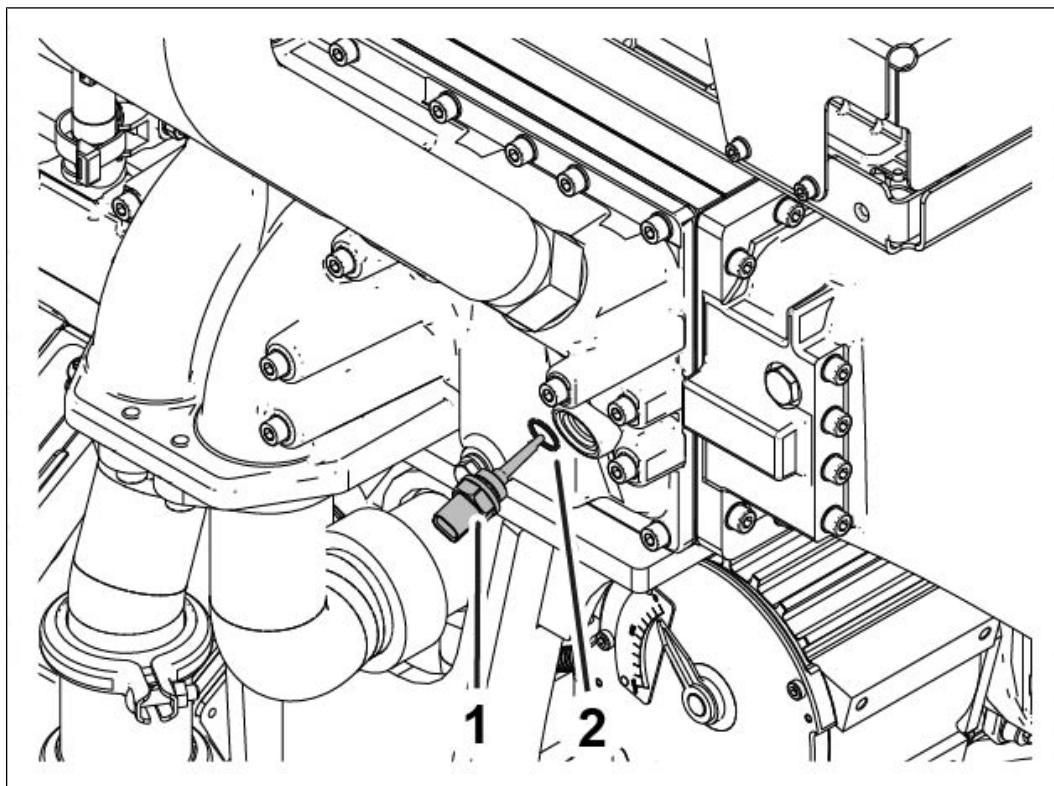
#### Procedure:

- ✓ [Decommissioning the genset \[▶ 146\]](#)
- ✓ Empty the mixture cooling circuit if necessary, see [Emptying the cooling system \[▶ 389\]](#)



327473931

1. Dismantle connector (1) from the sensor (2)
  - Lay the cable bundle in such a way that the cable bundle does not obstruct further work.



327476363

2. Remove sensor (1)
  - Place the collecting tray below the sensor (1).
  - Unscrew sensor (1).
  - Remove sealing ring (2) and dispose of.

## Installing the coolant temperature sensor

*Mixture cooler*

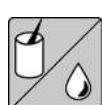
Valid for:

TCG 3016



Tools:

- Standard tools



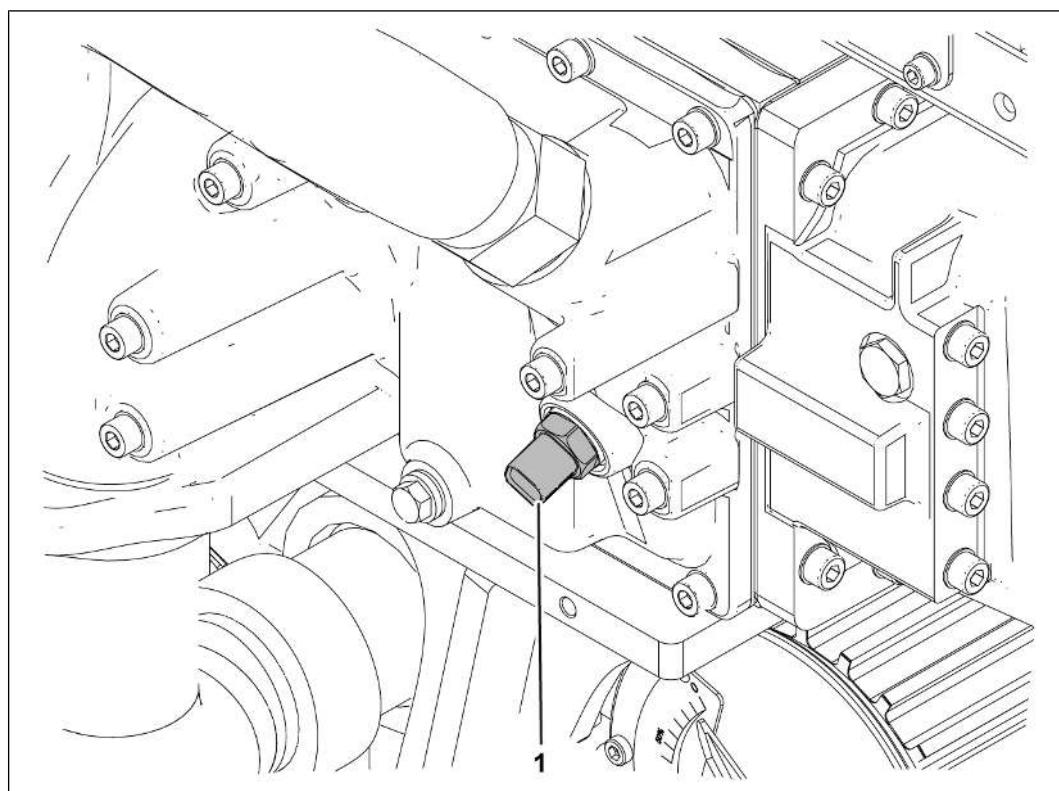
Auxiliary media:

- Binding agent



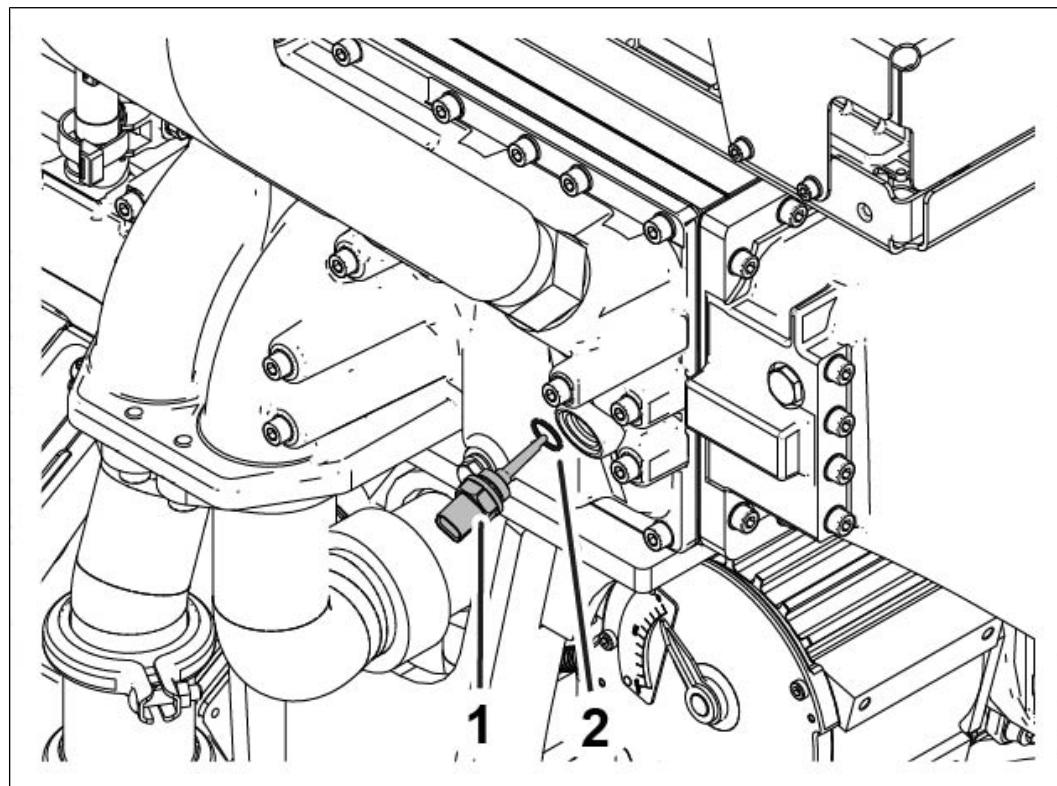
Spare parts:

- Sealing ring
- Temperature sensor



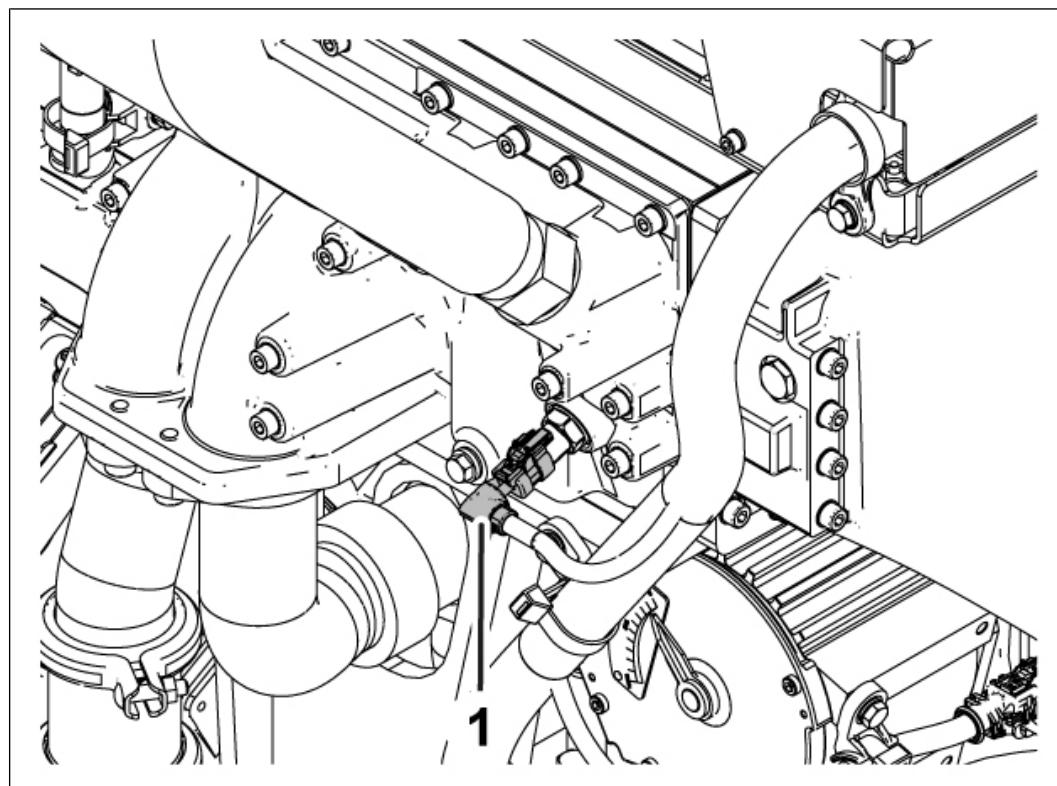
327482379

Coolant temperature sensor<sup>1)</sup> on mixture cooler1       $\frac{3}{4}$  – 16 – 2A      20 Nm<sup>1)</sup> Replace sealing ring.

**Procedure:**

327476363

1. Insert sensor (1) with new sealing ring (2) and tighten



327473931

2. Mount the connector (1) onto the sensor
  - Visually inspect the connector (1).
  - Lay the cable bundle free of tension and abrasion.
3. Remove the collecting tray.
  - Properly dispose of collected operating medium
  - Top up coolant if necessary, see [Filling the cooling system \[▶ 390\]](#)
4. [Commissioning the genset \[▶ 134\]](#)

## Removing and installing the coolant temperature sensor (engine outlet)

### Removing the coolant temperature sensor

*Engine outlet*

Valid for:

TCG 3016



Tools:

- Standard tools

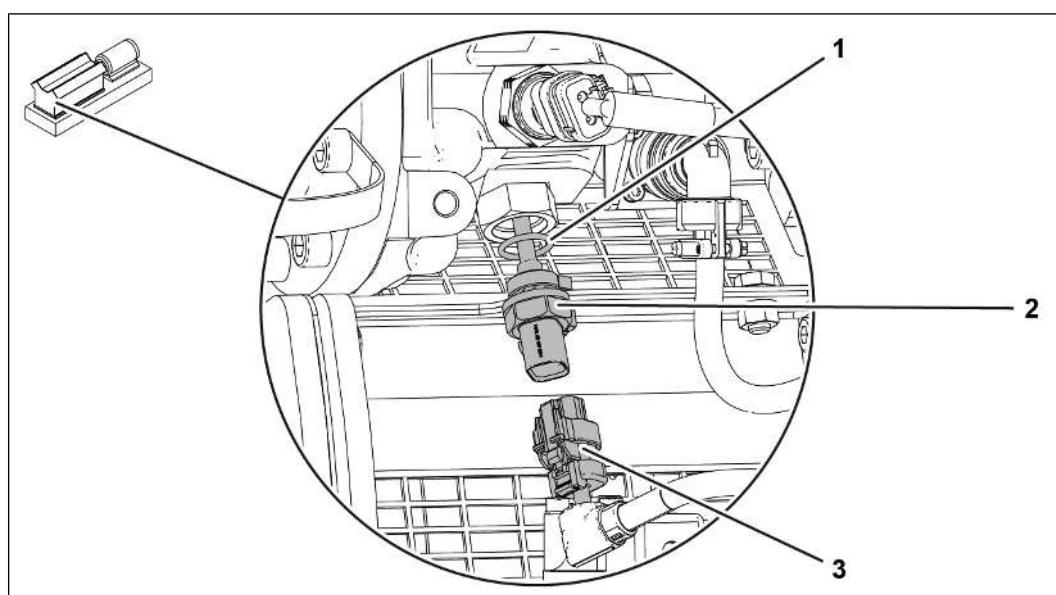


Auxiliary media:

- Binding agent

#### Procedure to follow:

- ✓ Decommissioning the genset [▶ 146]



311387915

1. Remove sensor (2)
  - Place the collecting tray below the sensor (2).
  - Dismantle connector (1) from the sensor (2)
  - Lay the cable bundle in such a way that the cable bundle does not obstruct further work.
  - Unscrew sensor (2).
  - Remove the sealing ring (3) and dispose of it.

## Installing the coolant temperature sensor

### *Engine outlet*

Valid for:

TCG 3016



Tools:

- Standard tools



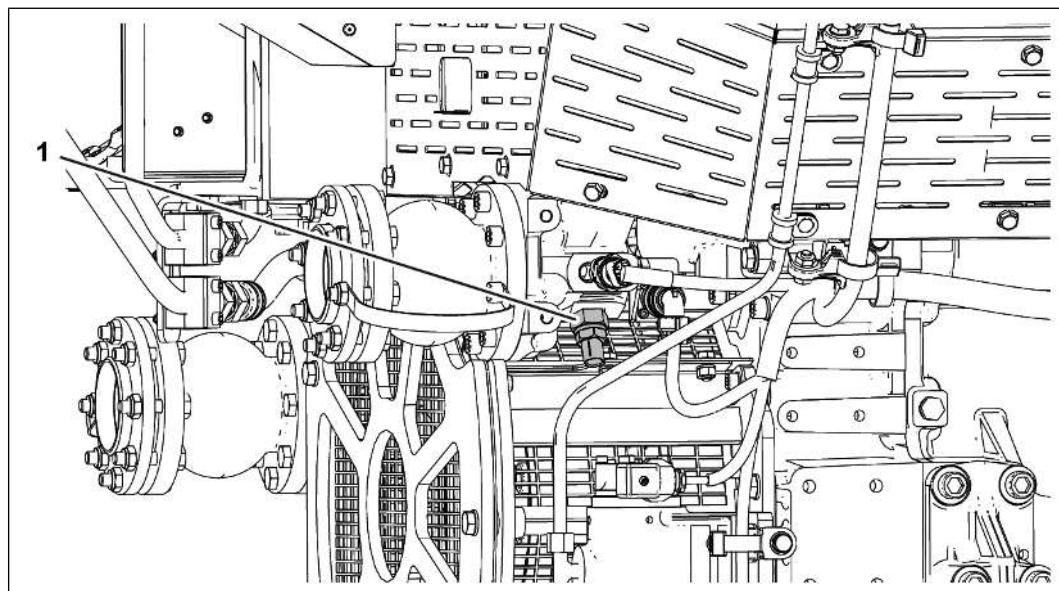
Auxiliary media:

- Binding agent
- Coolant according to operating media regulations



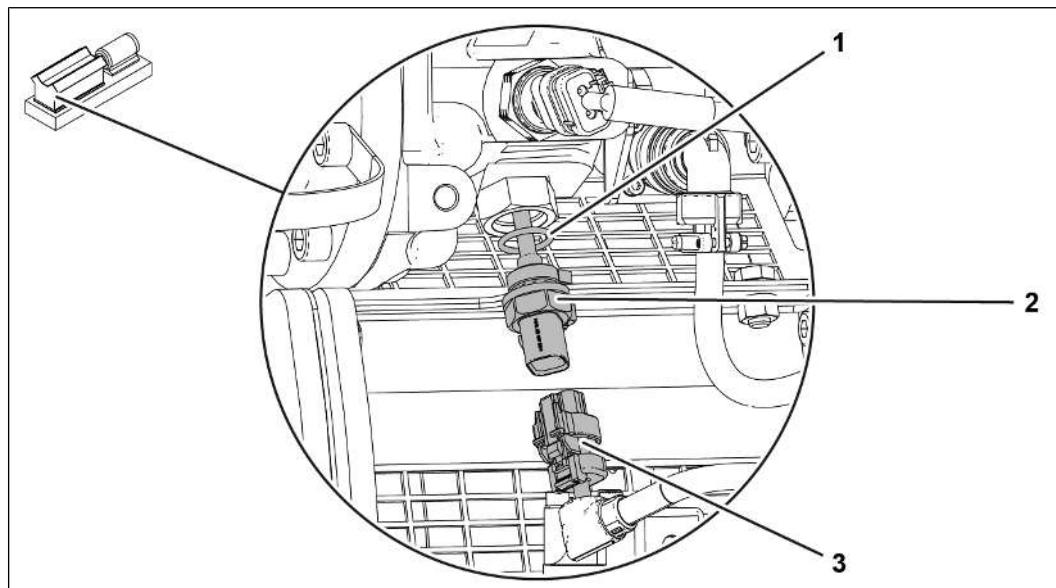
Spare parts:

- Sealing ring
- Temperature sensor



311390347

Coolant temperature sensor <sup>1)</sup> on coolant housing		
1	$\frac{3}{4}$ – 16 – 2A	20 Nm
<sup>1)</sup> Replace sealing ring.		

**Procedure:**

311387915

1. Insert sensor (2) with new sealing ring (1) and tighten
2. Mount the connector (3) onto the sensor (2)
  - Visually inspect the connector (3).
  - Lay the cable bundle free of tension and abrasion.
3. Remove the collecting tray
  - Properly dispose of collected operating medium
  - Top up coolant if necessary, see [Filling the cooling system \[▶ 390\]](#)
4. [Commissioning the genset \[▶ 134\]](#)

## Removing and installing the coolant temperature sensor (engine inlet)

### Removing the coolant temperature sensor

*Engine inlet*

Valid for:

TCG 3016



Tools:

- Standard tools

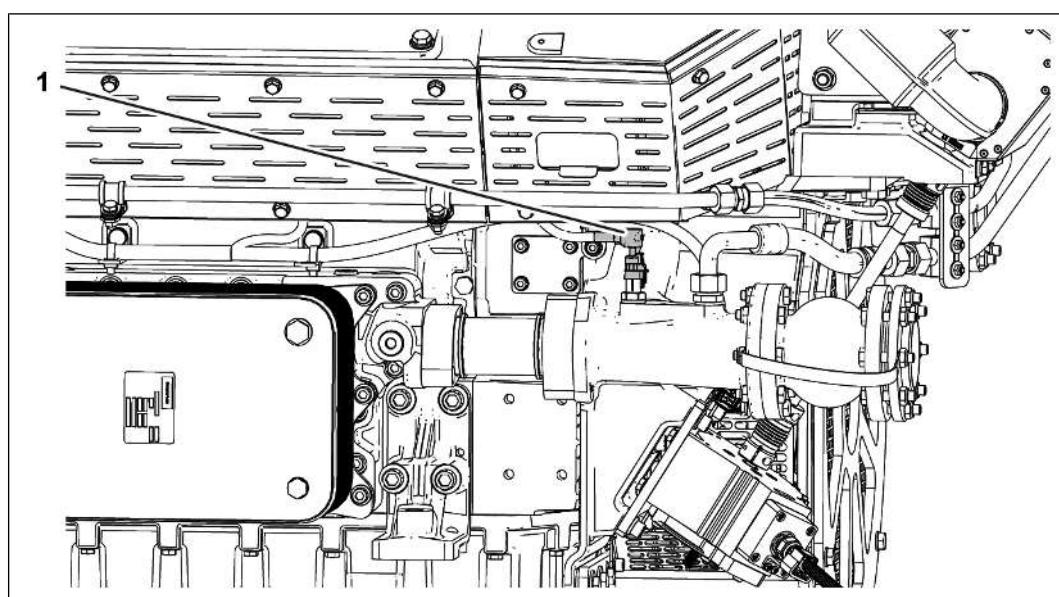


Auxiliary media:

- Binding agent

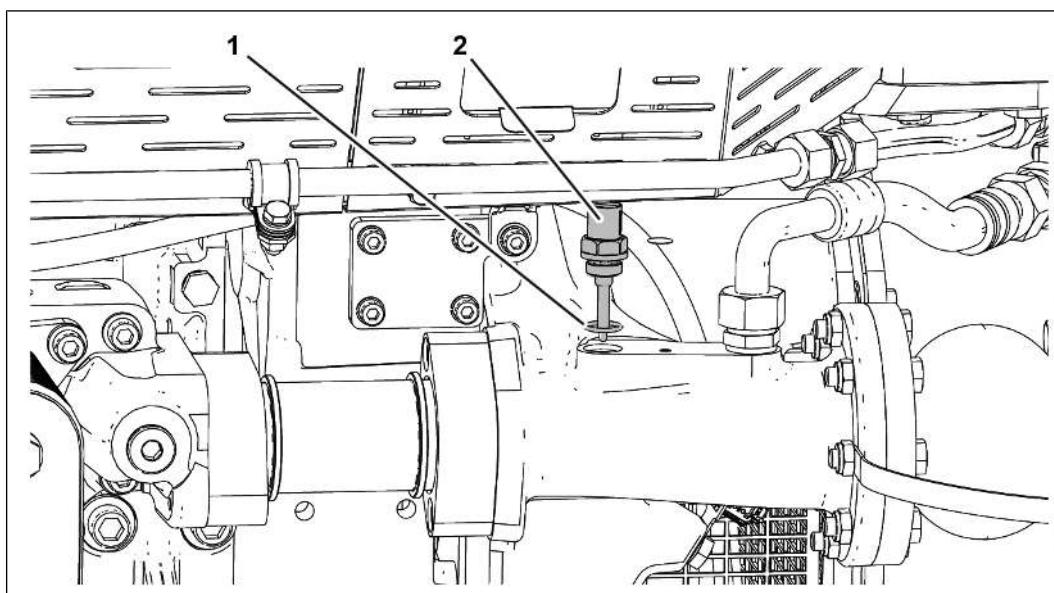
#### Implementation:

- ✓ [Decommissioning the genset \[▶ 146\]](#)



311505419

1. Dismantle connector (1) from the sensor.
  - Lay the cable bundle in such a way that the cable bundle does not obstruct further work.



311510283

2. Remove sensor (2)
  - Place the collecting tray below the sensor (2).
  - Unscrew sensor (2).
  - Remove sealing ring (1) and dispose of.

## Installing the coolant temperature sensor

### *Engine inlet*

Valid for:

TCG 3016



Tools:

- Standard tools



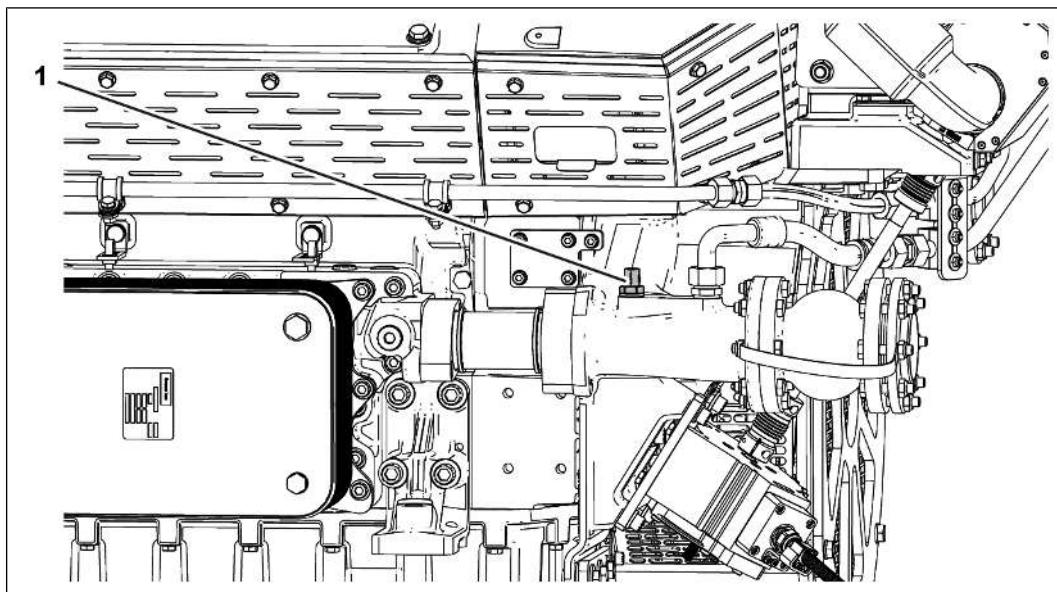
Auxiliary media:

- Binding agent
- Coolant according to operating media regulations



Spare parts:

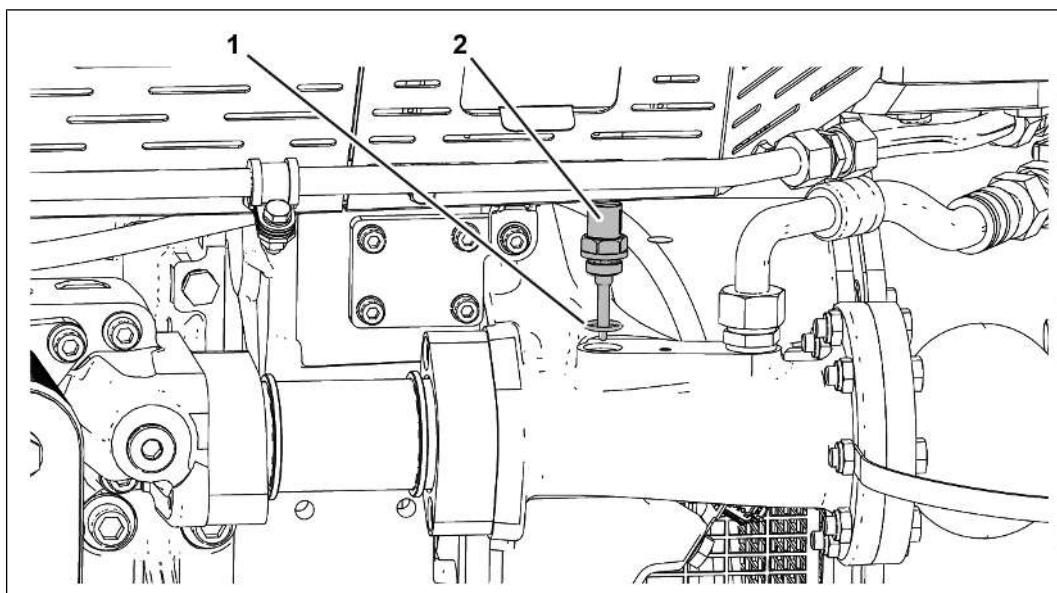
- Sealing ring
- Temperature sensor



311507851

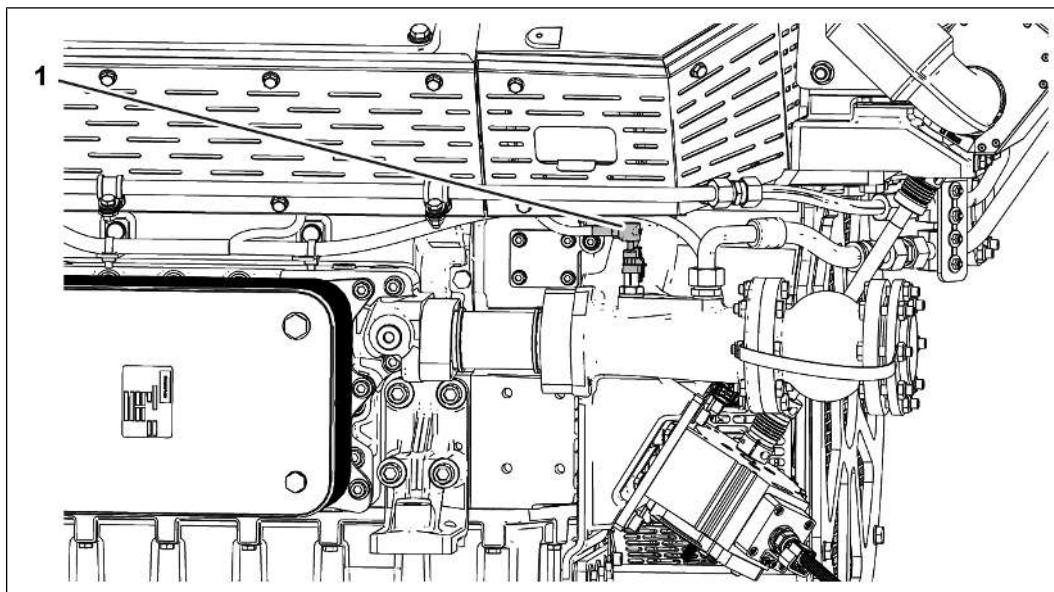
Coolant temperature sensor <sup>1)</sup> on coolant housing		
1	$\frac{3}{4}$ – 16 – 2A	20 Nm
<sup>1)</sup> Renew sealing ring		

**Procedure:**



311510283

1. Insert sensor (2) with new sealing ring (1) and tighten
2. Mount the connector (3) onto the sensor (2)



311505419

3. Mount the connector (1)
  - Visually inspect the connector (1).
  - Lay the cable bundle free of tension and abrasion.
4. Remove the collecting tray
  - Properly dispose of collected operating medium
  - Top up coolant if necessary, see [Filling the cooling system \[▶ 390\]](#)
5. [Commissioning the genset \[▶ 134\]](#)

## Removing and installing the coolant pressure sensor

### Removing the coolant pressure sensor

Valid for:

TCG 3016



Tools:

- Standard tools

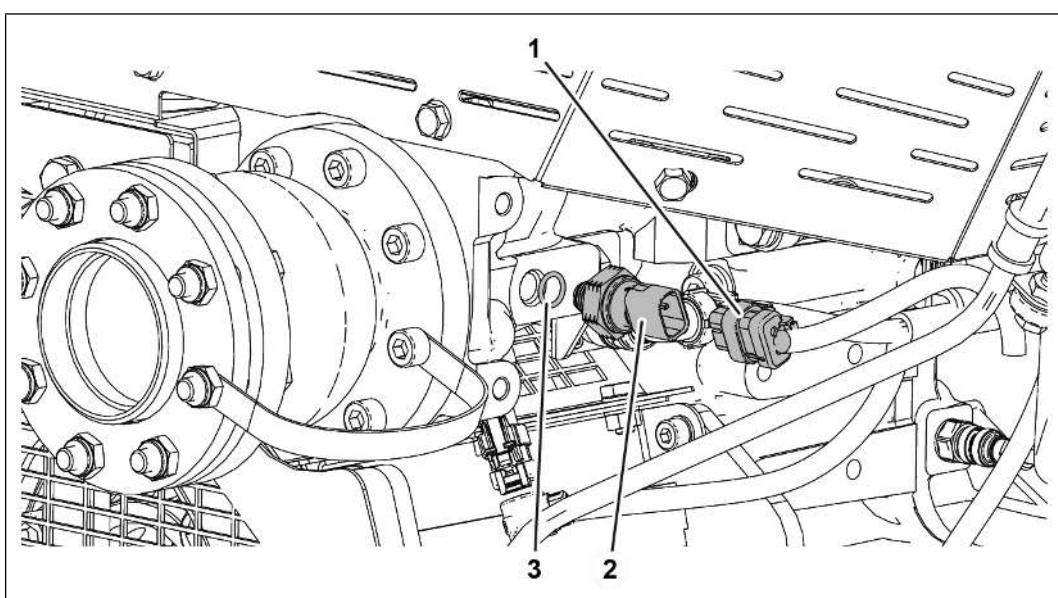


Auxiliary media:

- Binding agent

#### Implementation:

- ✓ [Decommissioning the genset \[▶ 146\]](#)



18014398820104587

#### 1. Remove sensor (2)

- Place the collecting tray below the sensor.
- Dismantle connector (1) from the sensor (2).
- Unscrew sensor (2).
- Remove sealing ring (3) and dispose of.

## Installing the coolant pressure sensor

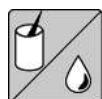
Valid for:

TCG 3016



Tools:

- Standard tools



Auxiliary media:

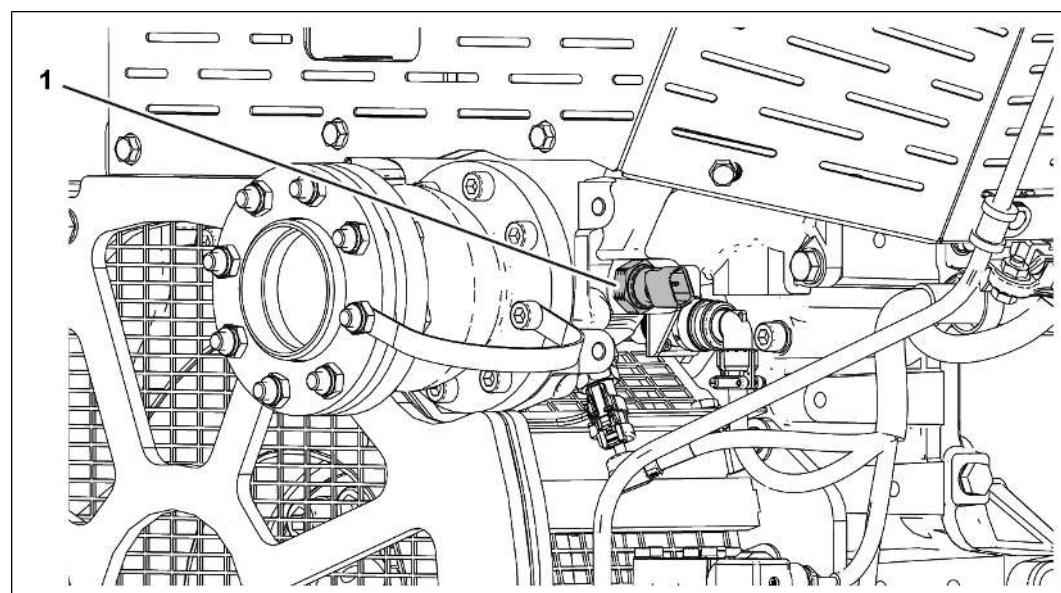
- Binding agent
- Coolant according to operating media regulations



Spare parts:

- Sealing ring
- Pressure sensor

### Technical data

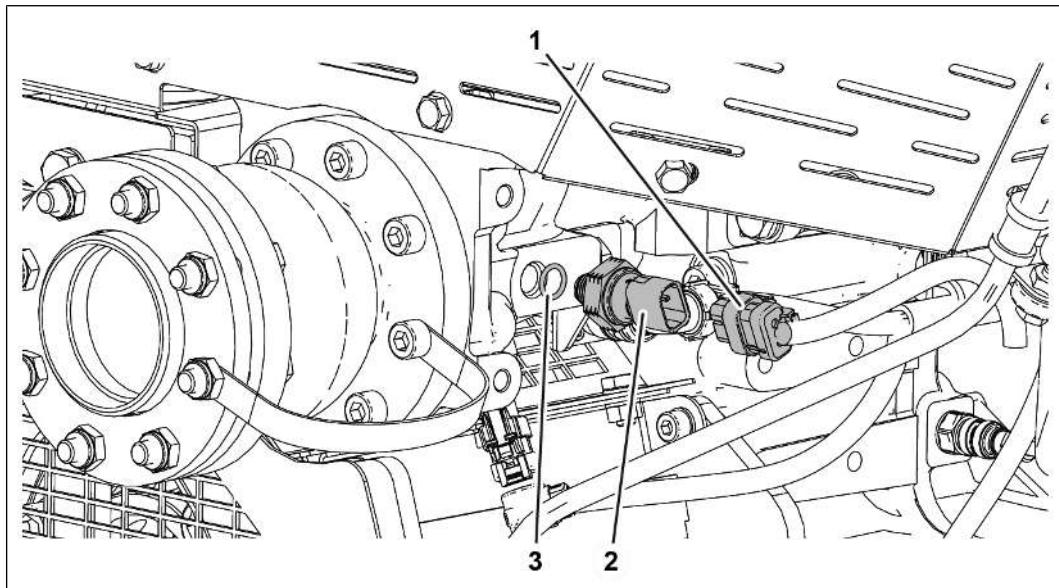


18014398820102155

Coolant pressure sensor<sup>1)</sup> on flange

1	M14 x 1.5	10 Nm
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<sup>1)</sup> Replace sealing ring.

**Procedure:**

18014398820104587

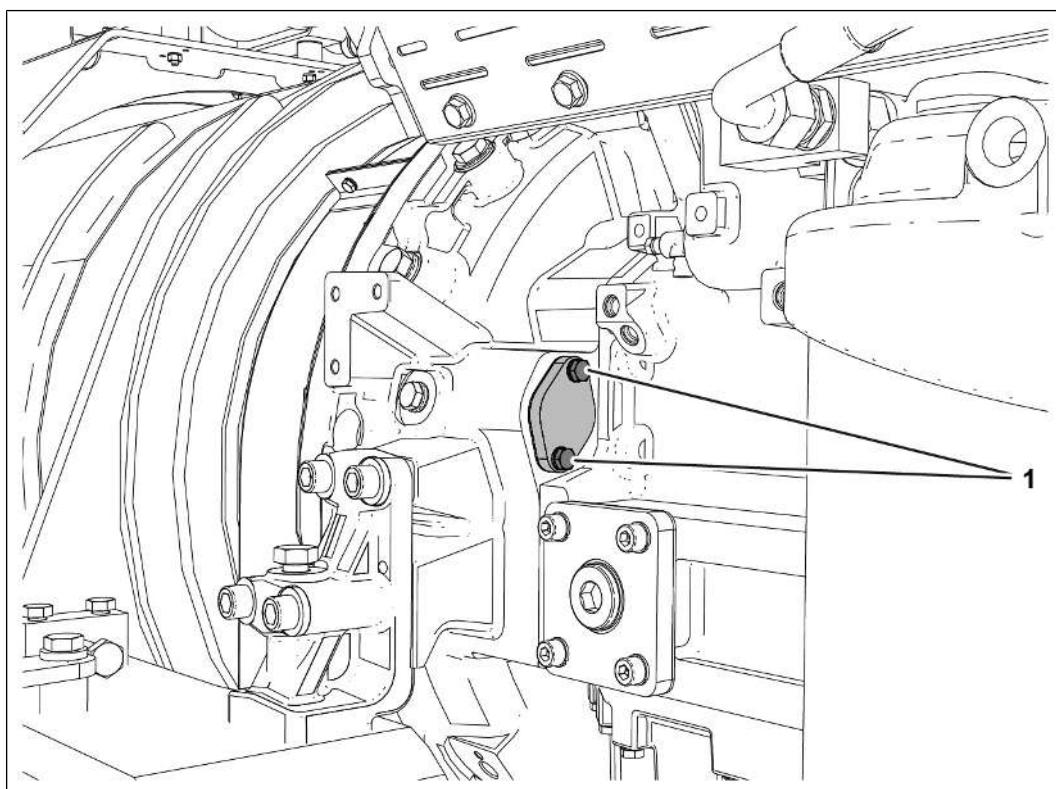
1. Insert sensor (2) with new sealing ring (3) and tighten
2. Mount the connector (1) onto the sensor (2)
  - Visually inspect the connector (1).
  - Lay the cable bundle free of tension and abrasion.
3. Remove the collecting tray
  - Properly dispose of collected operating medium
4. [Commissioning the genset \[▶ 134\]](#)

## Mounting and dismantling the engine turning gear

### Mounting the engine turning gear

Valid for:

TCG 3016



9007199562469387

#### Closing cover on crankcase

1	M10 x 35 – 10.9	47 Nm
	M10 x 70 – 8.8	47 Nm
	M10 x 130 – 8.8	47 Nm

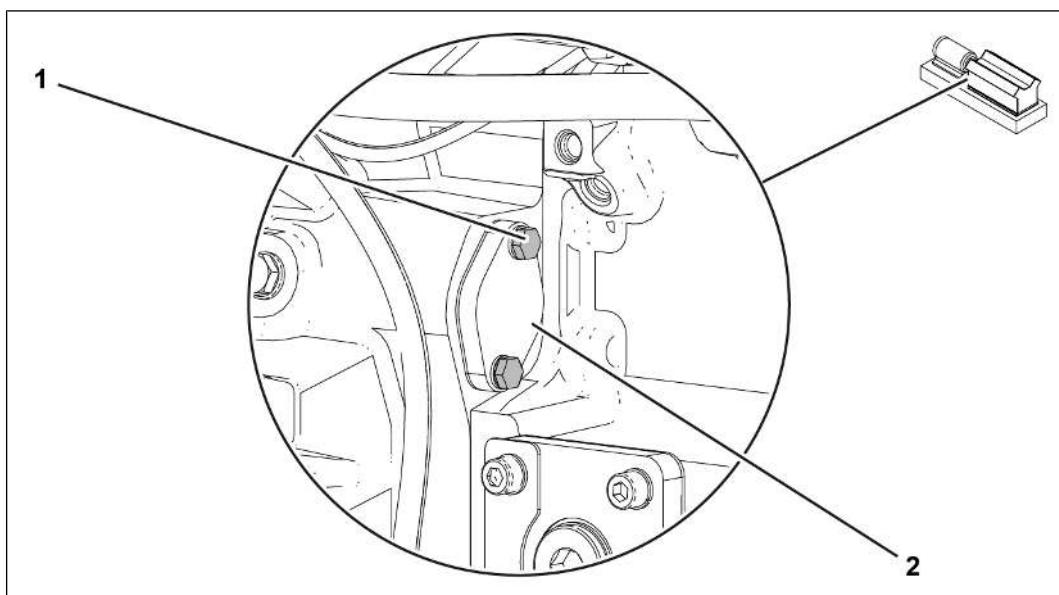


Tools:

- Standard tools

#### Procedure:

- ✓ [Removing the spark plug \[▶ 366\]](#)
- ✓ For V8 engines: [Removing the lube oil filter \[▶ 354\]](#)



9007199562466955

1. Unscrew screws with washers (1)
2. Remove sealing cap (2)
3. Mount the engine turning gear
  - Push the pinion of the engine turning gear into the opening.
  - Place the engine turning gear so that the bores are aligned.
  - Tighten the engine turning gear.

## Operating the engine turning gear

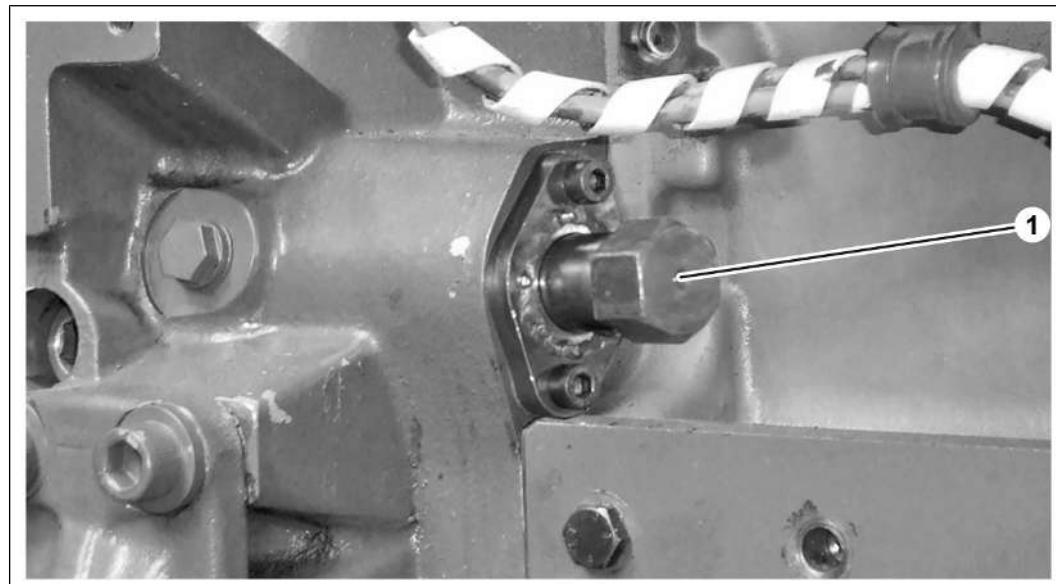
Valid for:

TCG 3016



Tools:

- Standard tools

**Procedure:**

319782283

1. To turn the engine, press in the hexagonal screw (1) and turn
  - Turn the hexagonal screw (1) until the desired position of the crankshaft is achieved.

**Dismantling the engine turning gear**

Valid for:

TCG 3016

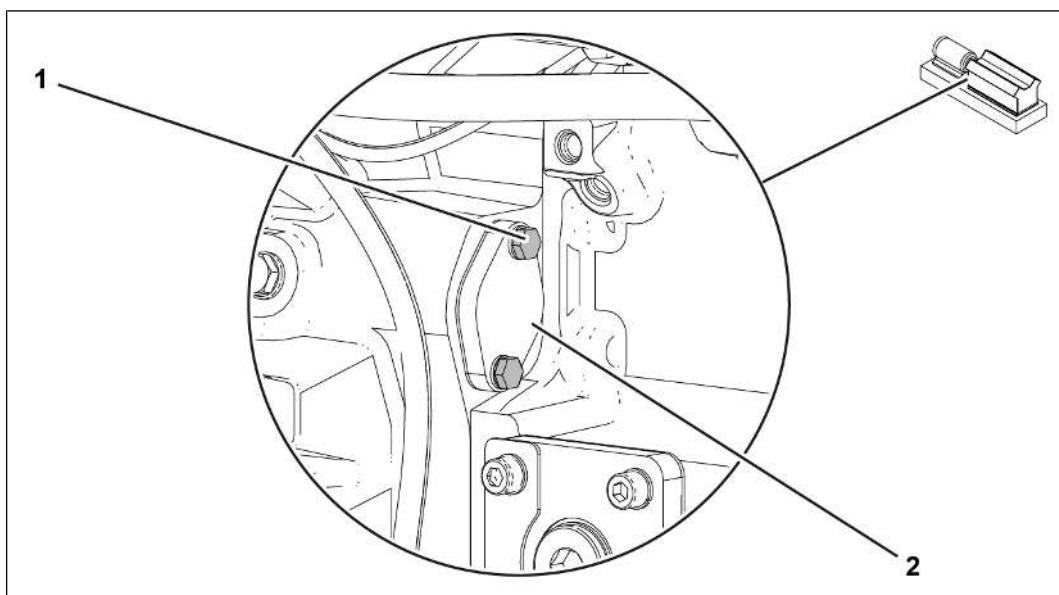


Tools:

- Standard tools

**Procedure to follow:**

1. Dismantle the engine turning gear
  - Unscrew the engine turning gear.
  - Pull the pinion of the engine turning gear out from the opening.



9007199562466955

2. Mount the cover (2)
  - If there are cracks or signs of wear on the seal, replace the seal.
  - Attach the sealing cap (2).
  - Tighten screws with washers (1).
3. For V8 engines: [Installing the lube oil filter \[► 355\]](#)
4. [Installing the spark plug \[► 369\]](#)

## Visually inspecting the coupling

Valid for:

TCG 3016

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### NOTE

- For all information on visually inspecting the elastic coupling, see *Operating Manual, chapter Maintenance information, section Genset add-on parts.*
-

## Dismantling and mounting the control device holder

### Dismantling the control device holder

Valid for:

TCG 3016

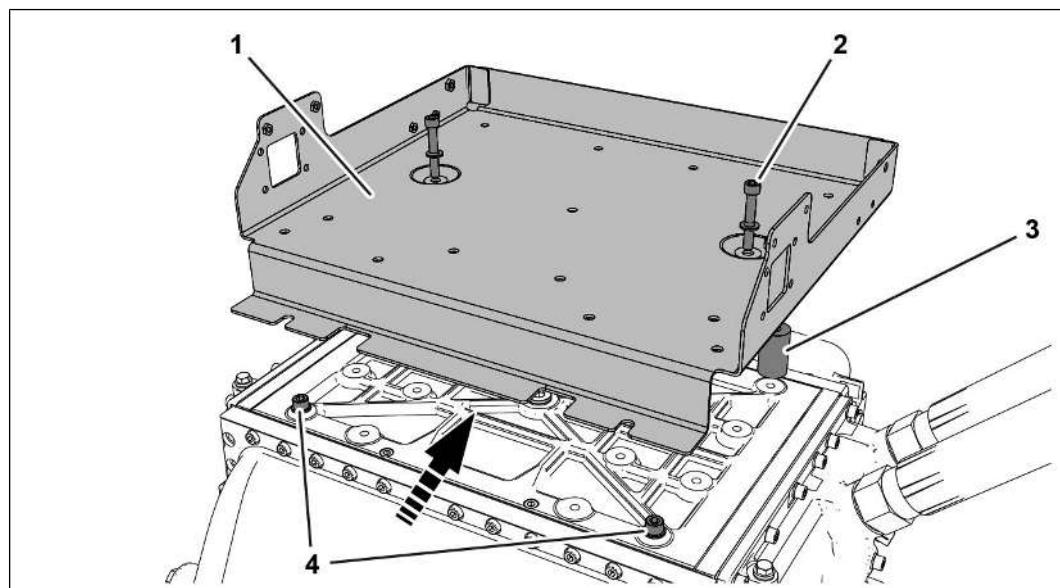


Tools:

- Standard tools

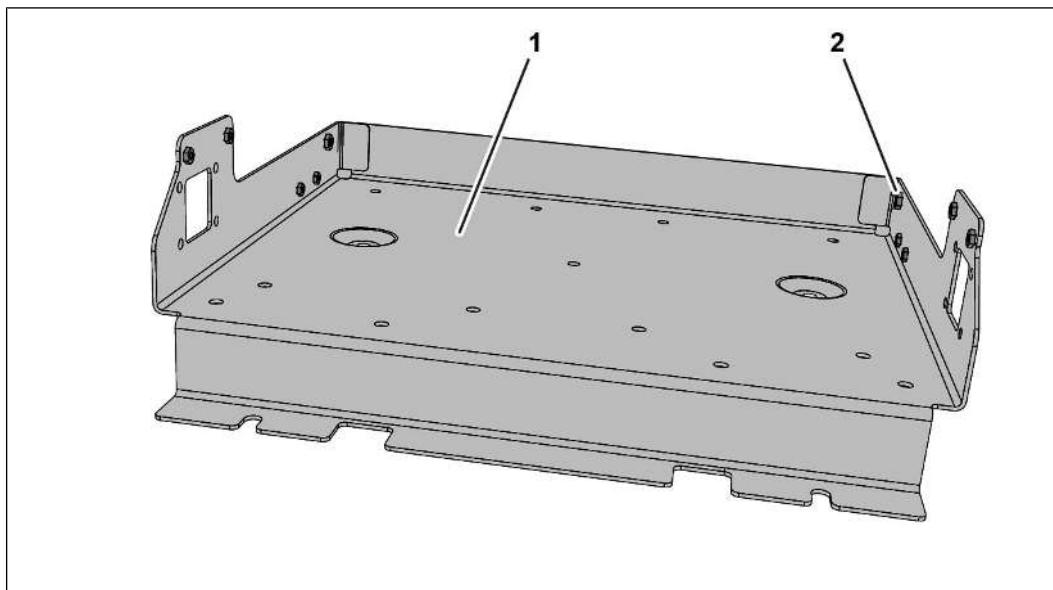
#### Dismantling the holder for main control device and auxiliary control device:

- ✓ Remove the main control device. Contact your service partner.
- ✓ Remove the auxiliary control device. Contact your service partner.



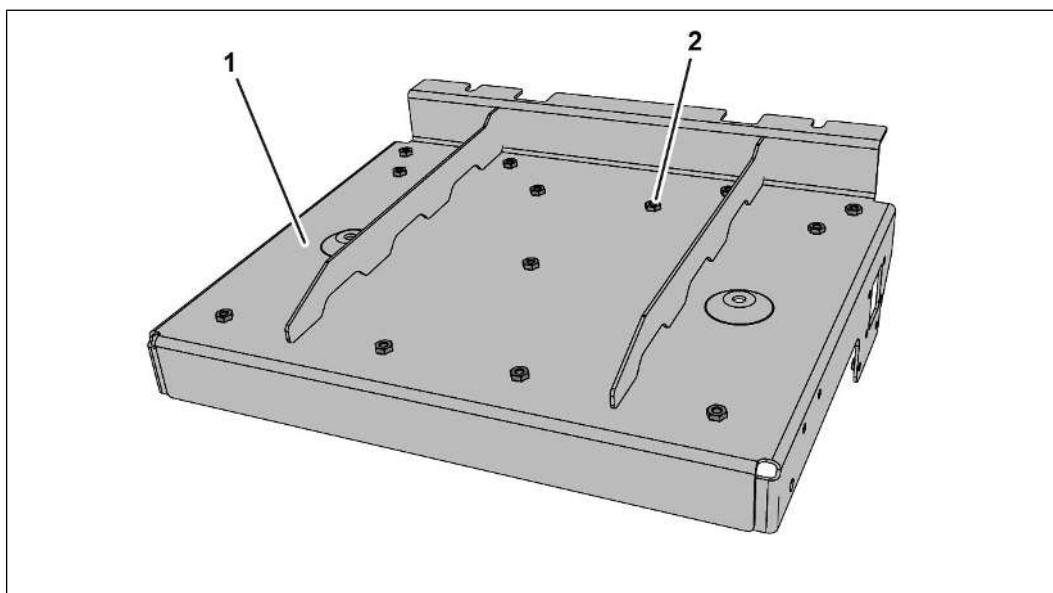
9007199594313483

1. Dismantle holder (1)
  - Unscrew screws with washers (2).
  - Loosen the screws (4).
  - Remove the spacer sleeves (3).
  - Remove the holder (1) to the front (arrow).



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2. On the upper side (1) of the holder, check the weld nuts (2) for completeness and tight fit
  - Replace loose and missing weld nuts (2).

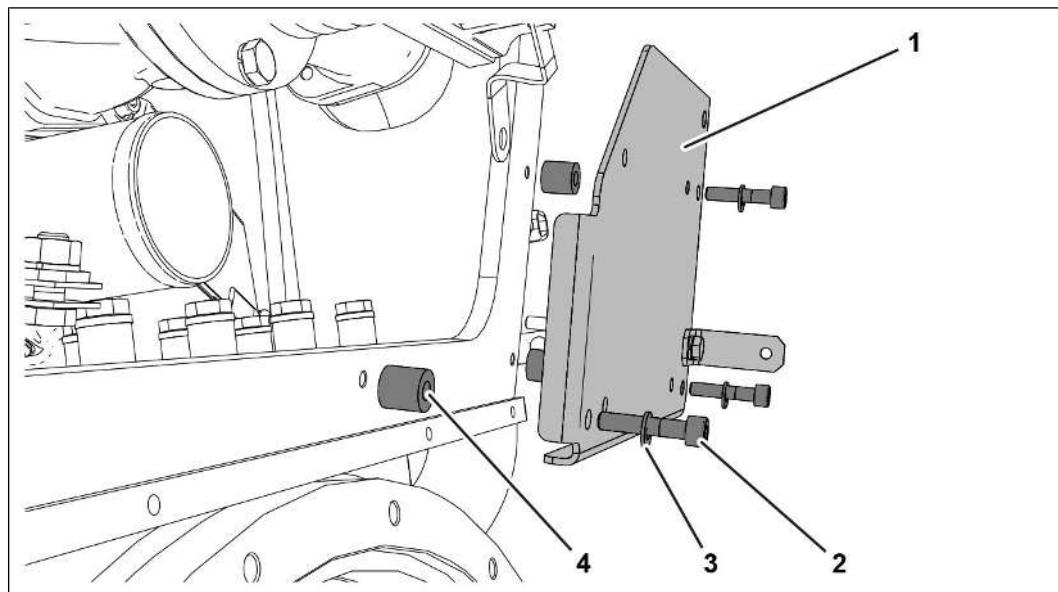


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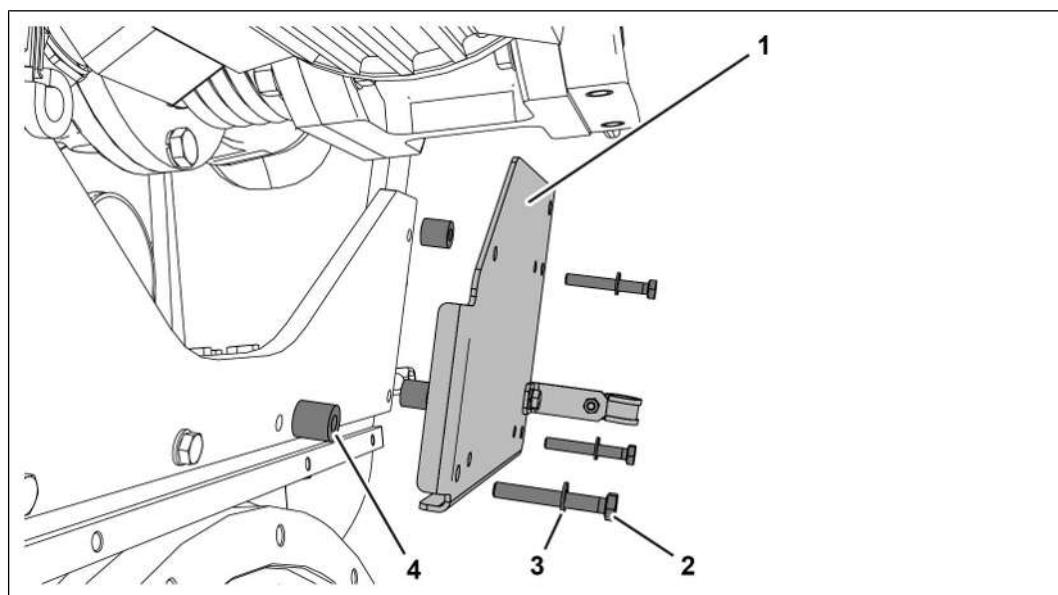
3. On the under side (1) of the holder, check the weld nuts (2) for completeness and tight fit
  - Replace loose and missing weld nuts (2).

#### **Dismantling the holder for the output stage control device (gas-air mixer):**

- ✓ Dismantle output stage control device. Contact your service partner.

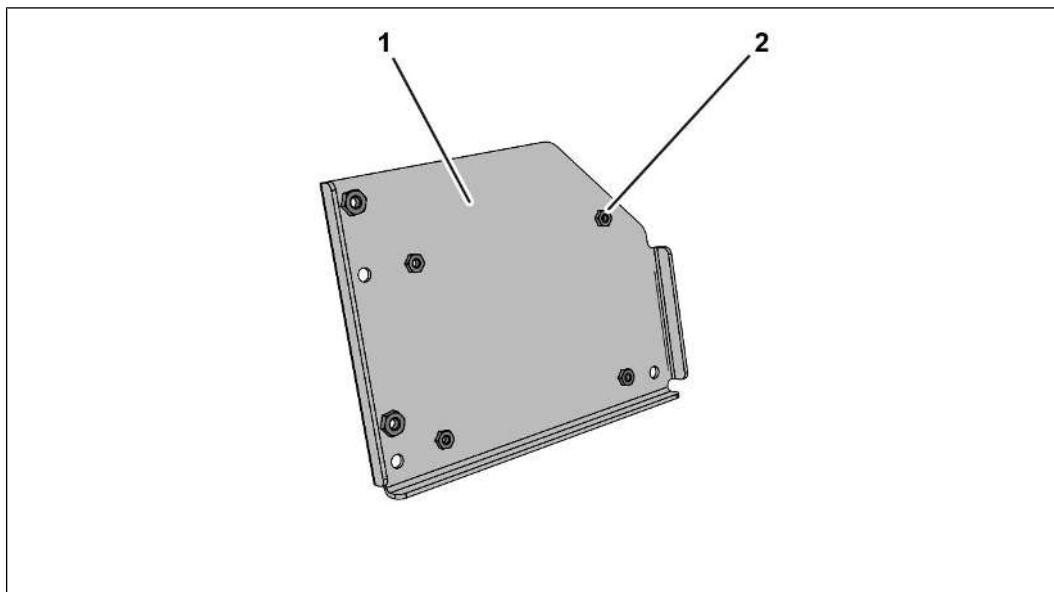


9007199594295819: All engine types; V8 engine only until manufacture date 08/2023



2836003723: V8 engine as of manufacturing date 08/2023

1. Dismantle holder (1)
  - Unscrew screws (2) with washers (3).
  - Remove the spacer sleeves (4).
  - Remove holder.

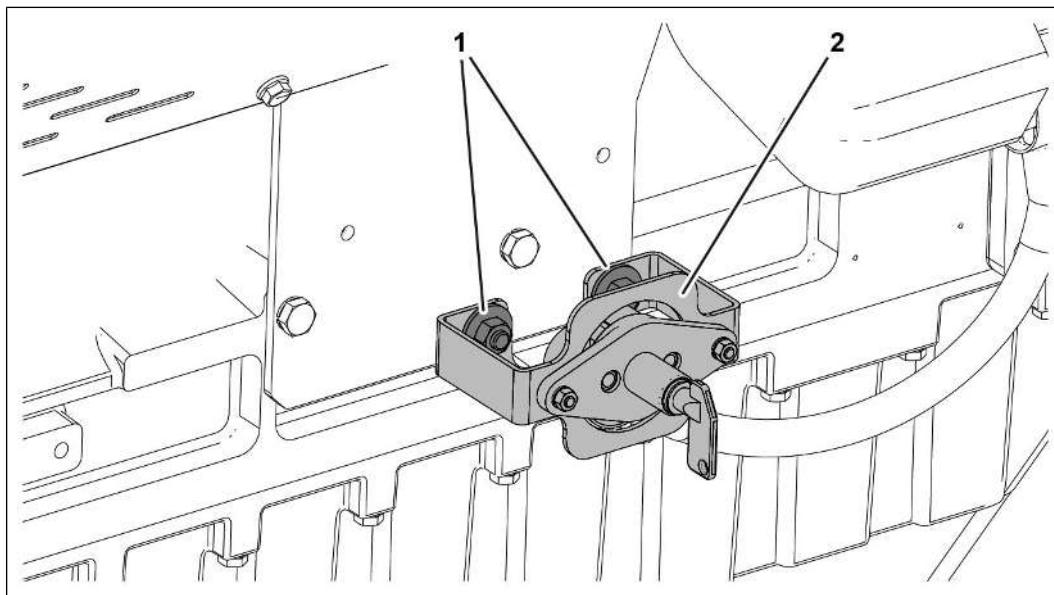


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2. On the rear (1) of the holder, check the weld nuts (2) for completeness and tight fit
  - Replace loose and missing weld nuts (2).

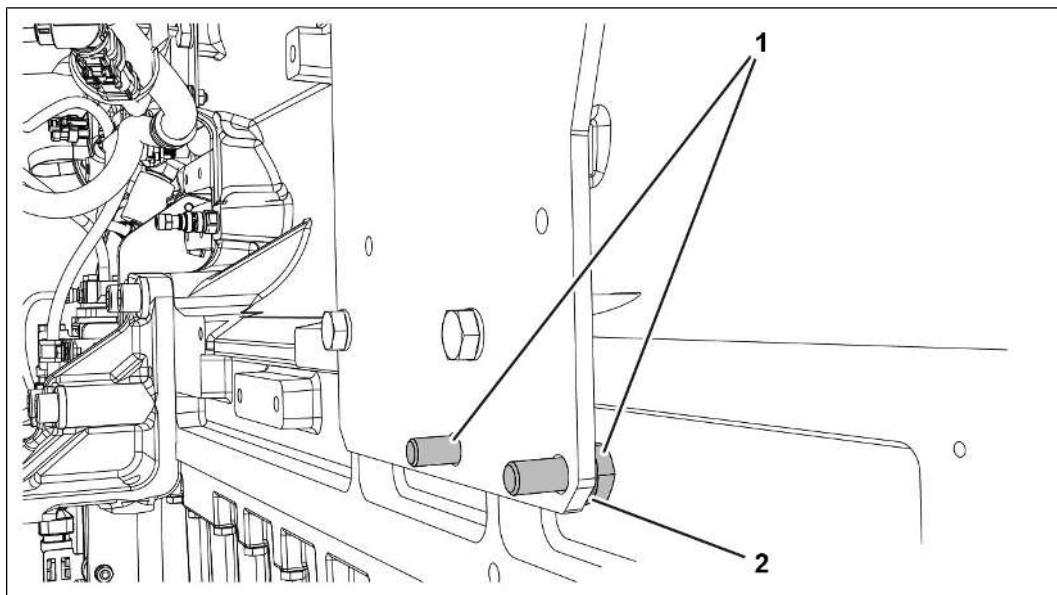
**Dismantling the holder for the output stage control device (throttle valve/wastegate):**

- ✓ Dismantle output stage control device. Contact your service partner.



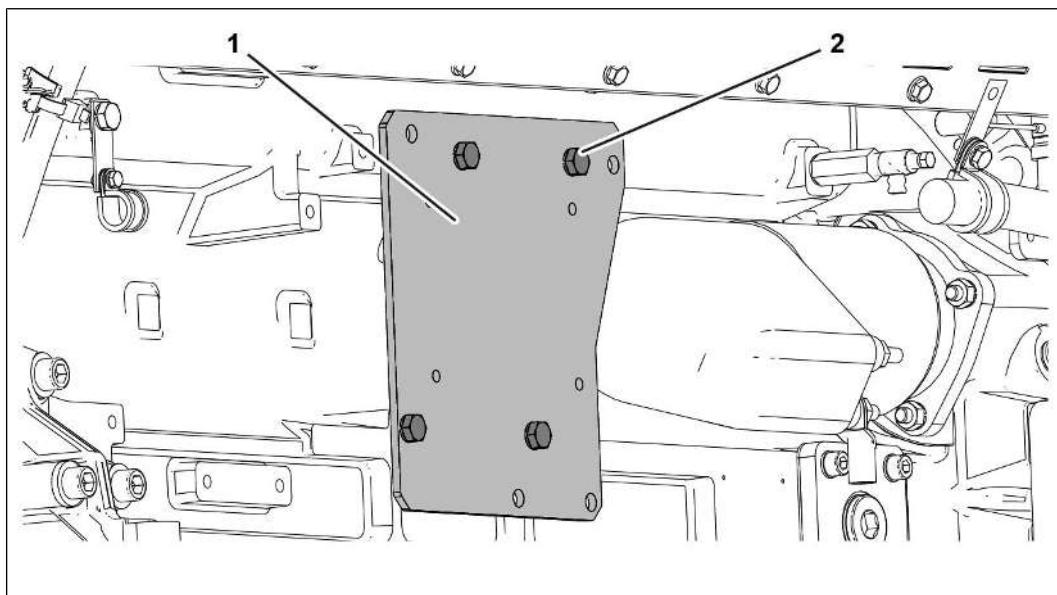
9007199594286091

1. If necessary, dismantle the battery disconnection switch (2)
  - Unscrew nuts with washers (1). While doing so, hold the screws in place.
  - Remove battery disconnection switch (2).



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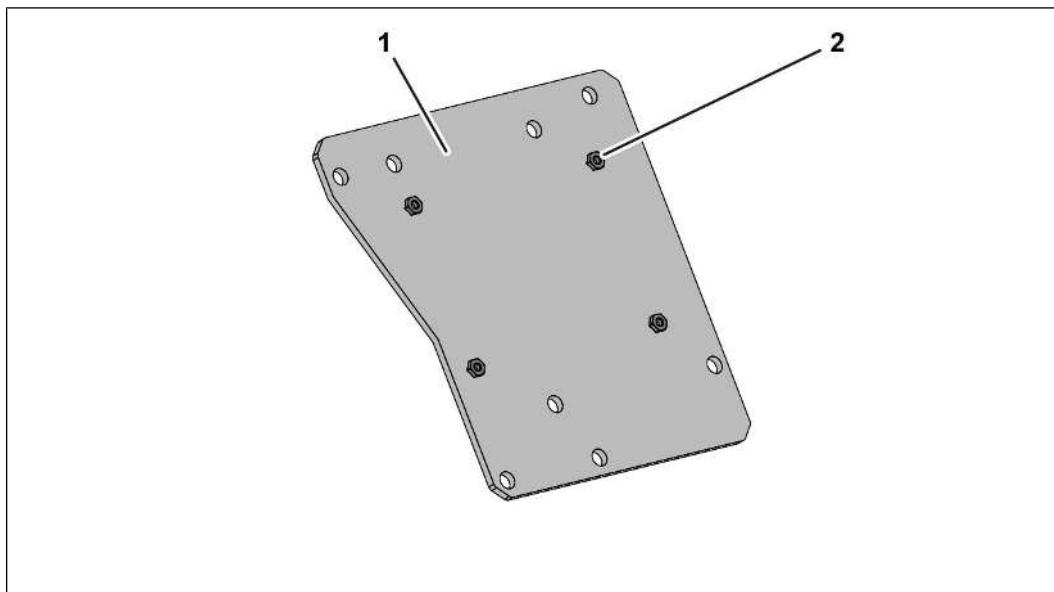
## 2. Remove screws (1) with washers (2)



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## 3. Dismantle holder (1)

- Unscrew screws with detent edged rings (2).



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4. On the rear (1) of the holder, check the weld nuts (2) for completeness and tight fit
  - Replace loose and missing weld nuts (2).

## Mounting the control device holder

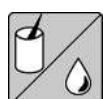
Valid for:

TCG 3016



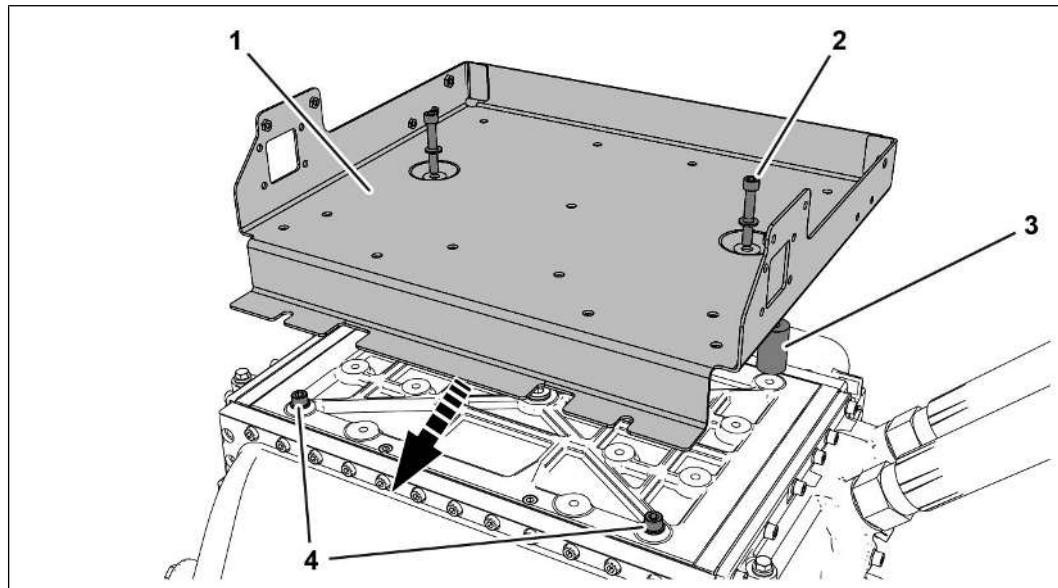
Tools:

- Standard tools



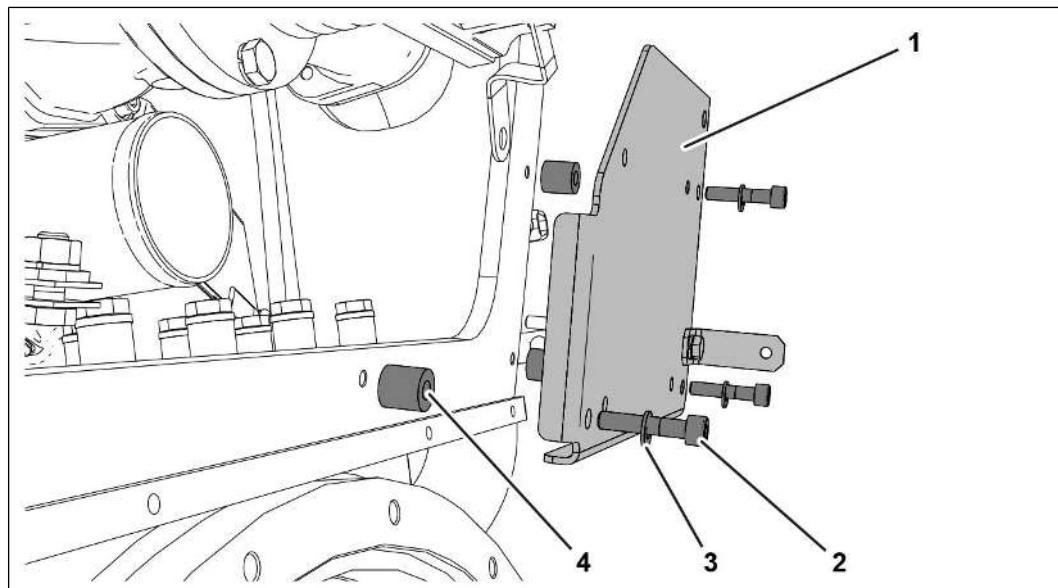
Auxiliary media:

- Sealing rings

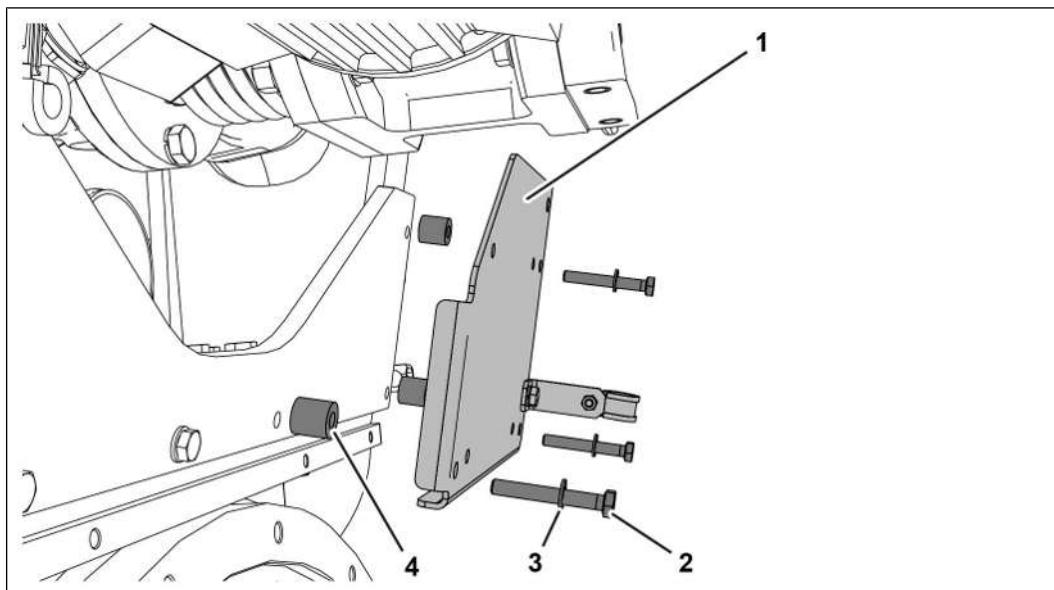
**Mounting the holder for main control device and auxiliary control device:**


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1. Mount holder (1).
  - Push holder (1) onto the screws (4) (arrow).
  - Position spacer sleeves (3).
  - Tighten the screws with washers (2).
  - Tighten screws (4).
2. Install main control device. Contact your service partner.
3. Install auxiliary control device. Contact your service partner.

**Mounting the holder for the output stage control device (gas-air mixer):**


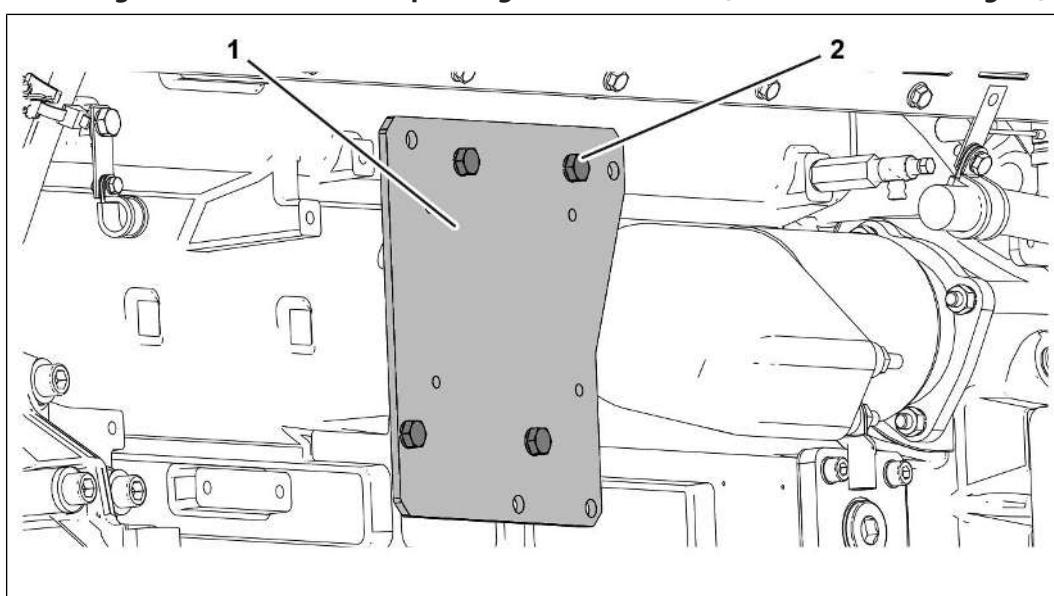
9007199594295819: All engine types; V8 engine only until manufacture date 08/2023



2836003723: V8 engine as of manufacturing date 08/2023

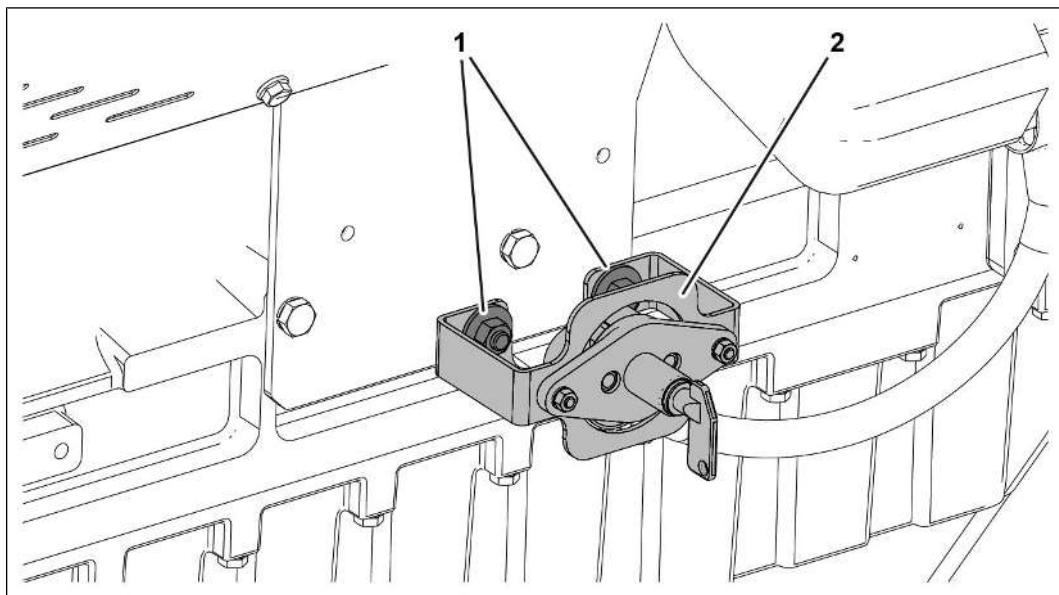
1. Mount holder (1)
  - Attach holder with spacer sleeves (4).
  - Tighten the screws (2) with washers (3).
2. Install output stage control device. Contact your service partner.

#### Mounting the holder for the output stage control device (throttle valve/wastegate):



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1. Mount holder (1).
  - Tighten the screws with detent edged rings (2).
2. For the installation of the battery disconnection switch, insert all screws (1) and nuts with washers (2) if necessary



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3. If necessary, mount the battery disconnection switch (2)
  - Mount battery disconnection switch (2).
  - Tighten the screws with washers (1). Counter-hold with the nuts while doing so.
4. Install output stage control device. Contact your service partner.

## 13 Dismantling and disposal

### 13.1 Genset

#### 13.1.1 Dismantling the genset



Tools:

- Crane
- Load securing devices
- Standard tools

#### Description

If the genset has reached the end of life, disassemble the genset and dispose of it in an environmentally sound manner.



#### Danger to the environment

Improper dismantling of the genset may cause environmental damage.

- When dismantling the genset, adhere to all the national and regional environmental protection regulations.
- Ensure that the auxiliary media and operating media do not leak.
- Drain off, collect, and dispose of the auxiliary media and operating media properly.
- Sort the reusable materials (e.g. plastics, metals) and recycle them.
- If necessary, commission a designated and certified specialist company to do this.

#### Procedure to follow:

- ✓ The genset has reached its end of life.
1. Shut down the genset and secure it against restarting
  2. Physically separate the complete energy supply from the genset and discharge the saved residual energies
  3. Remove the operating and auxiliary media as well as the residual processing material and dispose of it in an environmentally sound manner
  4. Dismantle the genset

#### 13.1.2 Disposing of the genset



Tools:

- Standard tools
- Welding device for cutting and welding work

### Description

Unless a return agreement or disposal agreement was concluded, recycle the disassembled genset components.

The local authority or specialist companies for disposal shall provide information on environmentally sound removal.



### Danger to the environment

Incorrect disposal of components and operating media may cause environmental damage.

- Electronic scrap, electronic components, lubricants and other auxiliary media are subject to the treatment of special refuse
- Electronic scrap, electronic components, lubricants and other auxiliary media may be disposed of only by designated and certified specialist companies

### Procedure:

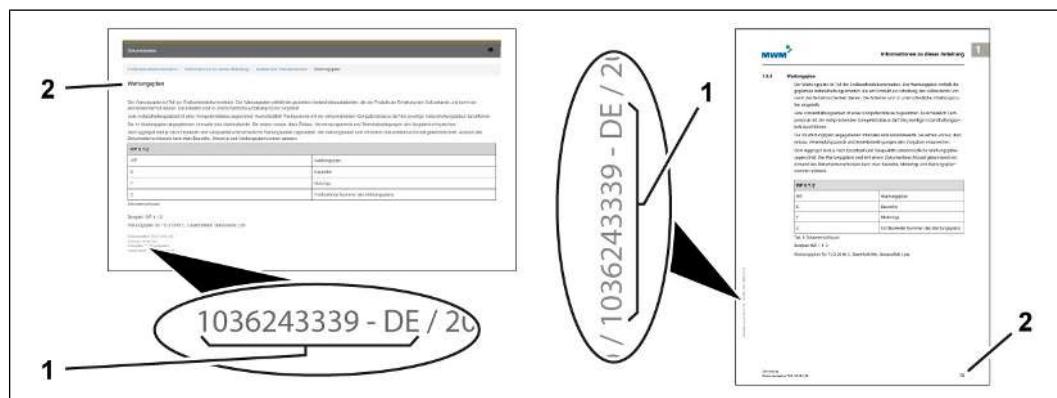
1. Scrap metals
2. Recycle plastic elements
3. Sort the remaining components as per the material properties and dispose of them properly

## 14 Feedback on documentation

**Do you have any praise, criticism or suggestions for improvement for this document?**

Send an e-mail to [techred@mwm.net](mailto:techred@mwm.net).

Describe your request as precisely as possible. So that we can categorize your feedback, please also provide the following information:



9007199541385227: Example document (HTML page in the Service Library on the left, and a PDF page on the right side)

- Document number and language (1)
- Page title or page number (2)
- Contact data (name, email) for potential further enquiries

Thank you for your support. We read all feedback carefully.

We look forward to hearing from you!

## Glossary

### AA-EN

Work instructions

### AKC

Anti-knock control

### BL

BOP Specialist Level: Competence level that enables a person to mount, inspect, service and repair components and assemblies of Caterpillar Energy Solutions products that require the manufacturer's special knowledge due to their complexity or their hazard potential or that require special experience and qualifications.

### CB

Circuit breaker: Circuit breaker designed for switching high currents.

### CPH

Coolant preheating: Coolant preheating ensures that the coolant at the engine inlet does not exceed a defined setpoint. This applies even when the engine is at a standstill.

### CV

Cabin air

### DCC

Dump cooling circuit

### DCC RDTR

Dump cooling circuit - radiator

### DCC RDTR/DCR FC

Dump cooling circuit radiator frequency converter

### DCR

Dual core radiator: Radiator with two hydraulically independent coolant flows.

### Diff GTR

Differential pressure gas train

### Diff HC

Differential pressure heating circuit

### ECC

Engine cooling circuit

### EHE

Exhaust heat exchanger: Heat exchanger that changes heat from exhaust gas to a different fluid.

### GAM

Gas-air mixer: The main task of a gas-air mixer is to mix the fuel (gas) and air in such a way that optimal combustion occurs in the engine.

### GCB

Generator circuit breaker: Circuit breaker that protects important systems in an energy supply plant by eliminating potentially harmful short-circuit faults within milliseconds, preventing serious damage and increasing the availability of the energy supply plant.

### GTR

Gas train

### HC

Heating circuit

### IAP

Intake air preheating: Functional unit used to heat the combustion air supplied to the engine.

**ML**

Maintenance Level: Competence level that enables a person to mount, inspect, service, repair and then recommission certain components and assemblies of Caterpillar Energy Solutions products.

**OL**

Operator Level: Competence level that enables a person to control and monitor energy supply plants produced by Caterpillar Energy Solutions.

**Para controller**

Parameterizable controllers

**Set speed CV FC**

Set speed cabin air frequency converter

**SL**

Service Level: Competence level that enables a person to mount, inspect, service, repair and then recommission all components and assemblies of Caterpillar Energy Solutions products for which Caterpillar Energy Solutions provides maintenance.

**TDC**

Top dead center

**TPEM**

TPEM system: Control system for a genset and some associated auxiliary systems in an energy supply plant.

**TPEM I/O**

TPEM I/O Controller

**TPEM MFR**

TPEM Multi Function Relay

**TPEM SaC**

TPEM Safety Chain

**TPEM TP**

TPEM Touch Panel

**TR**

Technical Bulletin

**TV**

Throttle valve

**WG**

Wastegate: The wastegate is a valve on the exhaust turbocharger. It is used to regulate the pressure. This valve is opened once a certain pressure is reached and it diverts the exhaust gas past the turbine directly into the exhaust tract.

