



**1.15.1 Specific lubrication oil consumption**

SLOC: - \_\_\_\_\_ [g/kWh]

Breaking-in period: ☐ Finished  
☐ Not finished  
☐ Not applicable

**1.15.2 Cylinder liner lubrication**

☐ None  
☒ Yes, active at

☐ 100% Feed rate: \_\_\_\_\_ 5862 [g/h]  
☐ 75% Feed rate: \_\_\_\_\_ 4484 [g/h]  
☐ 50% Feed rate: \_\_\_\_\_ 3107 [g/h]  
☐ 25% Feed rate: \_\_\_\_\_ 1832 [g/h]  
☐ 10% Feed rate: \_\_\_\_\_ 914 [g/h]

Breaking-in period: ☒ Finished  
☐ Not finished  
☐ Not applicable

**1.15.3 Inlet valve seat lubrication**

☒ None  
☐ Yes, active at

☐ 100% Feed rate: \_\_\_\_\_ [g/h]  
☐ 75% Feed rate: \_\_\_\_\_ [g/h]  
☐ 50% Feed rate: \_\_\_\_\_ [g/h]  
☐ 25% Feed rate: \_\_\_\_\_ [g/h]  
☐ 10% Feed rate: \_\_\_\_\_ [g/h]

**1.16 Exhaust gas treatment device**

☐ None ☒ Yes

☒ SCR  
☐ Scrubber  
☐ EGR  
☐ Water injection  
☐ Others: \_\_\_\_\_

**2. Fuel****2.1 Fuel in use**

☐ ULSD ☐ DMX ☒ DMA ☐ DMZ ☐ DMB  
☐ RMA ☐ RMB ☐ RMD ☐ RME ☐ RMG ☐ RMK  
☐ Other: \_\_\_\_\_ acc. standard: \_\_\_\_\_  
☐ Natural Gas  
☐ Other gases acc. IGF: \_\_\_\_\_

☐ Liquid to gas fuel ratio as certified at mode point:

100% \_\_\_\_\_  
75% \_\_\_\_\_  
50% \_\_\_\_\_  
25% \_\_\_\_\_  
10% \_\_\_\_\_

## Fuel properties and composition (in use during testing)

### 2.2 Gas

Please fill in as far as possible  
most important marked with \*)

Property	Unit / Standard	Actual value	Remark
Methane number*)	[-] / DIN EN 16726		
Lower calorific value*)	[MJ/kg] / ISO 6976		
Higher calorific value	[MJ/kg] / ISO 6976		
Wobbe Indices Ws / Wi	[MJ/m <sup>3</sup> ] / ISO 6976		
Density*)	[kg/m <sup>3</sup> ] / ISO 6976		
Methane*)	wt.-% [kg/kg] / ISO 6974 or DIN 51894		
Ethane*)	wt.-% [kg/kg] / ISO 6974 or DIN 51894		
Propane*)	wt.-% [kg/kg] / DIN 51894		
Isobutane*)	wt.-% [kg/kg] / DIN 51894		
N-Butane*)	wt.-% [kg/kg] / DIN 51894		
Pentane	wt.-% [kg/kg] / DIN 51894		
Hexane	wt.-% [kg/kg] / DIN 51894		
Heptane	wt.-% [kg/kg] / DIN 51894		
Nitrogen	wt.-% [kg/kg] / ISO 6974		
Sulphur*)	wt.-% [kg/kg] / ISO 6326-5		
Hydrogen sulfide	wt.-% [kg/kg] / ISO 8819		
Carbon dioxide	wt.-% [kg/kg] / ISO 6974		
Hydrogen	wt.-% [kg/kg] / DIN 51894		
Others			

### 2.3 Liquid fuel

Please fill in as far as possible  
most important marked with \*)  
essential \*\*)

Property	Unit / Standard	Actual value	Remark
Type of fuel	Grade / ISO 8217	DMA	
Flash point*)	[°C] / ISO 2719	59.5	ISO 2719
Viscosity @ 40/50°C **)	[mm <sup>2</sup> /s] / ISO 3104	2.73	ISO 3104
Density @ 15°C *)	[kg/m <sup>3</sup> ] / ISO 3675 or 12185	848	ISO 12185
Net calorific value (Hu) *)	[J/g] / DIN 51900	45450	ASTM D 4809
Sulphur content*)	ppm [mg/kg] / ISO 8754 or 14596	878	ISO 20846
Ash content*)	ppm [mg/kg] / ISO 6245	<10	ISO 6245
Water content*)	ppm [mg/kg] / ISO 3733	-	-
Carbon content*)	wt.-% [kg/kg] / ASTM D5291	87.46	ASTM D5291
Hydrogen content*)	wt.-% [kg/kg] / ASTM D5291	12.75	ASTM D5291
Nitrogen content*)	wt.-% [kg/kg] / DIN 51444	-	-
Oxygen content*)	wt.-% [kg/kg] / DIN 51732		
Cetane index*)	ISO 4264	47.1	ISO 4264
CCAI*)			
FAME content*)	wt.-% [kg/kg] / EN 14078	0.05	EN 12916
Mono aromatic compounds*)	wt.-% [kg/kg] / EN 12916		
Poly aromatic compounds*)	wt.-% [kg/kg] / EN 12916		
Di aromatic compounds	wt.-% [kg/kg] / EN 12916		
Tri aromatic compounds	wt.-% [kg/kg] / EN 12916		
Inorganic constituents (V)	ppm [mg/kg] / ISO 14597 or 8691		
Inorganic constituents (Ni)	ICP		
Carbon residues*)	wt.-% [kg/kg] / ASTM D4530		
Others			

### 3. Lube oil properties and composition (in use during testing; Producers specification can be used)

#### 3.1 Circulation lubrication oil

Please fill in as far as possible

Property	Unit / Standard	Actual value	Remark
Lube oil	Brand / Type	BP Energol	
Grade	Multi / Mono	HT30	
BN	mg KOH/g / ISO 3771	8.14	
Ash content	wt.-% [kg/kg] / ISO 6245	-	
Viscosity	[mm <sup>2</sup> /s] / ASTM D7042	112.37	at 40°C
Sulphur content	wt.-% [kg/kg] / ISO 20884	0.054945	

#### 3.2 Cylinder oil

Please fill in as far as possible

Please fill in if applicable

Property	Unit / Standard	Actual value	Remark
Lube oil	Brand / Type	Mobilgard	
Grade	Multi / Mono	525	
BN	mg KOH/g / ISO 3771	25	
Ash content	wt.-% [kg/kg] / ISO 6245		
Viscosity	[mm <sup>2</sup> /s] / ASTM D7042		
Sulphur content	wt.-% [kg/kg] / ISO 20884		

#### 3.3 Valve seat lubrication oil

Please fill in as far as possible

Please fill in if applicable

Property	Unit / Standard	Actual value	Remark
Lube oil	Brand / Type		
Grade	multi / mono		
BN	mg KOH/g / ISO 3771		
Ash content	wt.-% [kg/kg] / ISO 6245		
Viscosity	[mm <sup>2</sup> /s] / ASTM D7042		
Sulphur content	wt.-% [kg/kg] / ISO 20884		

## 4. Measurement equipment information (to be completed before measurement) and parameters

### Measurement instrument

4.1 BC measurement instrument information      Make: AVL      Model: 415S

4.2 Measurement principle      ☐ LII      ☒ FSN      ☐ PAS      ☐ MAAP  
☐ Others: \_\_\_\_\_

4.3 Values reported as      ☐ EC (thermal)      Protocol acc.: \_\_\_\_\_  
☐ rBC  
☐ eBC  
☒ FSN  
☐ Others: \_\_\_\_\_

4.4 Values reported in unit      ☐  $\text{mg}/\text{m}_n^3$  (wet basis; act.  $\text{O}_2$ -concentration)       $\text{H}_2\text{O}$ -conc.: \_\_\_\_\_ [Vol.-%] (wet)  
☐  $\text{mg}/\text{m}_n^3$  (dry basis; act.  $\text{O}_2$ -concentration)  
☐  $\text{mg}/\text{m}_n^3$  (dry basis; Ref.  $\text{O}_2$ -concentration)       $\text{O}_2$ -conc.: \_\_\_\_\_ [Vol.-%] (dry)  
☐  $\text{mg}/\text{kWh}$  refer to 5.  
☒ FSN  
☐  $\text{mg}/\text{kg}$  fuel refer to 5.  
☐ Others: \_\_\_\_\_

4.5 Reference conditions      Norm temperature: \_\_\_\_\_ [°C]  
(only if 4.4 is referred to Norm-cubic meters [ $\text{m}_n^3$ ])      Norm pressure: \_\_\_\_\_ [mbar]

4.6 Sampling time / -number      Sampling time of each measurement: \_\_\_\_\_ 30 [s]  
If mean values are reported: Number of consecutive  
measurements at each mode point: \_\_\_\_\_ 5 [-]  
Acc. manufacturer specification:      ☒ Yes      ☐ No

4.7 BC instrument parameter      Temperature inside measuring cell: \_\_\_\_\_ 70 [°C]  
Pressure inside measuring cell: \_\_\_\_\_ Ambient [mbar]  
Wavelength(s) used: \_\_\_\_\_ 550 [nm]  
Mass absorption cross section(s) used: \_\_\_\_\_ 5 [ $\text{m}^2/\text{g}$ ]  
Conversion equation(s) used: \_\_\_\_\_ -  
Repeatability of the instrument used: \_\_\_\_\_  $\leq 0.005 \text{ FSN} + 3\%$  of measured value  
Reproducibility of the instrument used: \_\_\_\_\_  $\leq 0.005 \text{ FSN} + 6\%$  of measured value  
Acc. manufacturer specification:      ☒ Yes      ☐ No

Other parameters which could influence the measured values:

Parameter / Correction	Unit

#### 4.8 BC Instrument Calibration

Date of last calibration: \_\_\_\_\_ (dd.mm.yyyy)

Calibration procedure according manufacturer specification:

☐ Yes ☐ No ☐ Others: \_\_\_\_\_

Calibration including zero point: ☐ Yes ☐ No

Used medium for zero point calibration: \_\_\_\_\_

Used calibration standard: ☐ Synthetic flame soot  
☐ Printex-U  
☐ Graphite spark aerosol generator GfG soot  
☐ Soot with inorganic coatings  
☐ Soot without inorganic coatings  
☐ Reflectance standards  
☐ Others: \_\_\_\_\_

Remark: \_\_\_\_\_

Leakage test performed before or after calibration: ☒ Yes ☐ No ☐ Not applicable

#### 4.9 Sample gas pre-treatment

Please fill in if applicable

Exhaust gas dilution: ☐ Yes ☒ No

If yes, dilution ratio (1:x) \_\_\_\_\_ at mode point: \_\_\_\_\_ [%]

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Dilution medium: ☐ Ambient air ☐ Exhaust gas  
☐ Others: \_\_\_\_\_

Filtration of the dilution medium before dilution: ☐ Yes ☐ No

Temperature of the dilution medium: \_\_\_\_\_ [°C]

Temperature of the diluted exhaust gas: \_\_\_\_\_ [°C]

Evaporation tube ☐ Yes ☒ No  
Temperature \_\_\_\_\_ [°C] acc. manufacturer spec. ☐ Yes ☐ No

Catalytic stripper ☐ Yes ☒ No  
Temperature \_\_\_\_\_ [°C] acc. manufacturer spec. ☐ Yes ☐ No

Thermo-denuder ☐ Yes ☒ No  
Temperature \_\_\_\_\_ [°C] acc. manufacturer spec. ☐ Yes ☐ No

Others: \_\_\_\_\_

#### 4.10 Sample flow rate/volume

Acc. manufacturer specification: ☒ Yes ☐ No

Sample flow rate of the raw exhaust gas: \_\_\_\_\_ 10 [l/min]

Sample flow rate of the diluted exhaust gas: \_\_\_\_\_ [l/min]

Sample volume of the raw exhaust gas: \_\_\_\_\_ [l]

Sample volume of the diluted exhaust gas: \_\_\_\_\_ [l]

☐ Subkinetic ☐ Isokinetic ☐ Superkinetic ☐ Not applicable

## Sample line and probe

### 4.11 Sample/transfer line

Please fill in if applicable

Use of a sample line: ☒ Yes ☐ No (in situ,...)

Acc. manufacturer specification: ☒ Yes ☐ No

Length of the sample line: \_\_\_\_\_ [m]

Heated sample line: ☒ Yes ☐ No Temperature: 70 [°C]

Sample line material: Viton

Inner diameter of the sample line: 4 [mm]

Isolated or heated connections between sample line, measurement instrument and probe: ☒ Yes ☐ No

Electrical conductive (sample line material): ☐ Yes ☐ No

Grounded: ☐ Yes ☒ No

Grounding method: \_\_\_\_\_

Backflushing sample line between measurements: ☒ Yes ☐ No

### 4.12 Sample probe

Please fill in if applicable

Use of sample probe: ☒ Yes ☐ No (in situ,...)

Acc. manufacturer specification: ☒ Yes ☐ No

Material: ☒ Stainless steel ☐ Others: \_\_\_\_\_

Type/design:

☐ Probe with single hole at the end (pipe)

☒ Probe with single hole at the end (45° beveled)

☐ Multi-hole

☐ L-shaped pipe with single hole, opening shielded with preclassifier (e.g. hat)

☐ Others: \_\_\_\_\_

Direction of the probe opening relative to the exhaust gas flow:

☐ With flow ☒ Against flow

☐ Others: \_\_\_\_\_

Effective cross section of sample hole opening(s) 17.8 [mm<sup>2</sup>]

Backflushing sample probe between measurements: ☒ Yes ☐ No

## Sampling point and probe location

### 4.13 Sample point and probe location ■ Engine Outlet

☐ Downstream heat exchanger

☐ Downstream exhaust gas treatment device

Treatment device active during measurement ☐ Yes ☐ No

☐ Others: \_\_\_\_\_

Distance between engine outlet and sampling point: \_\_\_\_\_ 6 [m]

Diameter of the exhaust gas pipe: \_\_\_\_\_ 1.002 [m]

Type of exhaust gas pipe where the sample probe is located:

☐ Straight part of the exhaust gas pipe

☐ Bent part of the exhaust gas pipe

Immersion depth of the sample probe: \_\_\_\_\_ 0.2 [m]

Orientation of the exhaust gas pipe where the sample probe is located:

☐ Horizontal ☐ Vertical ☐ Others: \_\_\_\_\_ downward \_\_\_\_\_

Length of straight part of the exhaust gas pipe,

if sample probe is located at straight part of the exhaust gas pipe:

Upstream sample probe: \_\_\_\_\_ 4 [m]

Downstream sample probe: \_\_\_\_\_ 1 [m]

Exhaust gas pulsation at the sampling point during measurement:

■ No ☐ Yes \_\_\_\_\_ [mbar]

## 5. Determination of engine load, exhaust gas flow, exhaust water content, fuel mass flow, O<sub>2</sub> and CO<sub>2</sub> (if applicable)

5.1 Determination of values, instrument performance and calibration shall be in accordance with the requirements of NOx Technical Code 2008 (NTC 2008) and its applicable appendices

5.2.1 Method of load determination

Electrical WB Signal 4-20mA

5.2.2 Estimated accuracy of engine load determination

+/- 1 [%] of reading

5.3.1 Method of exhaust gas flow determination

Calculation

5.3.2 Estimated accuracy of exhaust gas flow determination

+/- 1 [%] of reading

5.4.1 Method of exhaust water content determination

Calculation

5.4.2 Estimated accuracy of exhaust water content determination

+/- 1 [%] of reading

5.5.1 Method of fuel mass flow determination

Load Cells

5.5.2 Estimated accuracy of fuel mass flow determination

+/- < 1 [%] of reading

5.6.1 Method of O<sub>2</sub> and CO<sub>2</sub> determination

Horiba 7170H

5.6.2 Estimated accuracy of O<sub>2</sub> and CO<sub>2</sub> determination

+/- < 1 [%] of reading

## 6. Measured values for BC determination (to be completed during measurement; measured values)

Date of measurement (dd.mm.yyyy)

31.03.2016	31.03.2016	31.03.2016	31.03.2016	31.03.2016
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Engine parameters

Measurement at mode points:

100	85	75	50	25
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 [%]

	↓	↓	↓	↓	↓	
<b>6.1 Stabilized mode point</b>						
Actual Speed	105.5	100.3	95.8	83.7	66.5	[rpm]
Speed variation during measuring	1	1	1	1	1	+/- [%]
Actual Load	6513	5604	4891	3247	1624	[kW]
Load variation during measuring	1	1	1	1	1	+/- [%]
<b>6.2 Charge air temperature</b>	35.7	37.2	36.2	29.8	32.6	[°C]
<b>6.3 Charge air pressure</b>	3590.000	3110.000	2770.000	1660.000	570.000	[mbar]
<b>6.4 Exhaust gas temp. at engine outlet</b>	264	243	229	226	253	[°C]
<b>6.5 Exh. gas temp. at sampling point</b>	254	237	224	217	235	[°C]
(only if there is a significant difference to the exhaust gas temperature at the engine outlet)						
<b>6.6 Exhaust gas back pressure</b>	35.53	31.46	28.65	18.88	9.46	[mbar]
<b>6.7 Exhaust gas mass flow</b>	47337.000	43180.000	40007.000	28452.000	14932.000	[kg/h]
<b>Ambient conditions</b>						
<b>6.8 Ambient temp. at engine inlet</b>	20.5	21.8	22	20.3	20.2	[°C]
<b>6.9 Ambient pressure at engine inlet</b>	954.65	954.09	953.41	952.68	952.43	[mbar]
<b>6.10 Absolute humidity of ambient air</b>	8.2	8.3	8.9	8.6	9.4	[g/kg]
<b>7. Black Carbon</b>	Reported as (see 4.3):		FSN		Unit (see 4.4): FSN	
<b>7.1 Estimated accuracy of measured value</b>	-	-	-	-	-	+/- [%]
<b>7.2 Black Carbon emission</b>	0.018	0.015	0.025	0.016	0.024	
Remark: _____						
<b>8. Measurement repeatability Indicators</b>						
<b>8.1 95% confidence interval</b> ( +/- unit measured)	-	-	-	-	-	
<b>8.2 Variance</b>	-	-	-	-	-	
<b>8.3 Sample size</b> (number of measurements taken)	5	5	5	5	5	