

Table 1: GC panel and operating conditions

Property	Specifications
Carrier gas	Helium, 83Kpa (split ratio 50:1)
GC column	BPX70, capillary type (30.0 m x 0.25 μ m x 0.32 mm, inner diameter)
GC column flow rate	1.10ml/min
Injector	Split/split less (type 1177) with EFC control
Injection volume	1 μ L
Detector type	Flame ionization detector (FID), 250.0 °C
Operating temperatures	
Oven	140.0 °C
Injector	240.0 °C
Detector ports	260.0 °C
Initial hold	140.0 °C (hold for 2 minutes)
Temperature ramp	8°C/min to 165.0 °C
(after initial hold)	3°C/min to 192.0 °C
	8°C/min to 220.0 °C

Table 2: Equipment for Fuel property testing

Properties	Equipment	Manufact urer	Standard method	ASTM D6751	Accuracy
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				limit	
Kinematic viscosity	SVM 3000-automatic	Anton Paar, UK	D445	1.9-6.0	± 0.35%
Density	SVM 3000-automatic	Anton Paar, UK		Not specified	± 0.1 kg/m ³
Flash point	Pensky-martens flash point-automatic NPM 440	Normalab, France	D93	130 min	± 0.1°C
Calorific value	C2000 basic calorimeter-automatic	IKA, UK	D240	D6371	± 0.1 % of reading
Oxidation stability	873 Rancimat—automatic	Metrohm, Switzerland	D675	3 hour	±0.01 hour
Cloud point	Cloud and Pour point tester—automatic NTE 450	Normalab, France	D2500	Report	±0.1°C
Pour point	Cloud and Pour point tester—automatic NTE 450	Normalab, France	D2500	Not specified	±0.1°C
CFPP	Cold filter plugging point—automatic NTL 450	Normalab, France	D6371	Not specified	±0.1°C
Acid value	G-20 Rondolino automated titration system	Mettler Toledo, Switzerland	D664	0.5 max	±0.001 mg KOH/g

Table 3: Engine Specification

Engine type	4 Stroke diesel engine
Number of cylinders	4 in-line, longitudinal

Cylinder bore * stroke	91.1 x 95 mm
Displacement	2477 cc
Compression ratio	21:1
Combustion chamber	Swirl type
Rated Power	65 kW at 4200 rpm
Torque	185 Nm, at 2,000 rpm
Valve mechanism	Single overhead camshaft (SOHC)
Injection pressure (kg/cm²)	157 bar
Aspiration	Turbo charged
Fuel system	Distributor type injection pump
Cooling system	Radiator cooling
Lubrication system	Pressure feed, full flow filtration

Table 4 : Specification of Exhaust Gas Analyzer

	Method	Measured component	Range	Resolution
AVL Exhaust Gas Analyser	Non-dispersive infrared	CO	0.10% vol.	0.01 vol.%
	Non-dispersive infrared	Unburned HC	0-20000 ppm Vol	1 ppm
	Electrochemical	NO _x	0-5000 ppm Vol	1 ppm
Smoke opacimeter	Photodiode detector	Opacity %	0-100%	0.10%

Table 5: List of the accuracy of measuring component and the uncertainty

Measured components	Measurement techniques	Measuring range	Accuracy	Uncertainty
Load	Strain gauge type load cell	0-600 N m	±0.1 N m	
Speed	Magnetic pick up type	0-6000 rpm	±1 rpm	
Time	-	-	±0.1 s	

Fuel flow measurement	Positive displacement gear wheel flow meter	0.5–36 liter /hr.	±0.04 liter /hr.	
Pressure sensor	Piezoelectric crystal type	0-25,000 kPa	±10 kPa	±0.5
Crank angle encoder	Incremental optical encoder	0-12,000 rpm	±0.125°	±0.03
CO	Non-dispersive infrared	0–10% by vol.	0.01 vol.%	±0.01 vol.%
HC	Non-dispersive infrared	0-20000 ppm	±1 ppm vol.	±1 ppm
NO _x	Electrochemical	0-5000 ppm	±1 ppm vol.	±1 ppm
Smoke opacity	Photodiode detector	0–100%	0.1%	±0.5%
BSFC				± 0.33 g /kW-hr