GENSETS: 4 x (7L21/31+1FC5 636-8) and
1 x (8L21/31+1FC5 636-8)

OUTPUT : 4 x 1460 kWe + 1 x 1672 kWe

SPEED : 60Hz / 900 RPM

Appenix:

- General arrangement 7 L21/31 Dwg.2190340-1.0 (pages 1;2)
- General arrangement 8 L21/31 Dwg.2190349-8.1 (pages 1;2)

1 GENERAL

1.1 This Technical Specification comprises:

Four (4) GenSets consist of:

- engine type **7 L21/31Tier II** foreseen to run on Heavy Fuel Oil (HFO) *Max. 700 cst. at 50 dgr. C (7000 sec. Redwood I/100 dgr.F) According to: ISO 8217-2012 and CIMAC-2003.* and Marine Gas Oil (MGO) *according to DIN EN 590 and ISO 8217-2012 (Class DMA or DMZ) standards.*, with an output per engine **1540 kWm** at 900 rpm
- and generator type **1FC5 636-8** with an output power of **1460 kWe, 60 Hz**

One (1) GenSet consist of:

-engine type **8 L21/31Tier II** foreseen to run on Heavy Fuel Oil (HFO) *Max. 700 cst. at 50 dgr. C (7000 sec. Redwood I/100 dgr.F) According to: ISO 8217-2012 and CIMAC-2003.* and Marine Gas Oil (MGO) *according to DIN EN 590 and ISO 8217-2012 (Class DMA or DMZ) standards.*, with an output per engine**1760 kWm** at 900 rpm
- and generator type **1FC5 636-8** with an output power of **1672 kWe, 60 Hz**

1.2 The engines are of . make, manufactured under license of the MAN Diesel & Turbo. All parts installed are exchangeable to parts manufactured by MAN Diesel & Turbo

1.3 The engines will be auxiliary marine engines for alternator drive and arranged to run parallel. Parallel running test will be performed with at least 3 engines on board. They are coupled to two bearing alternators by a flexible coupling.

1.4 The engine and alternator are mounted on a common base frame, which acts as lube oil sump for engine.

1.5 Direction of rotation is RH, i.e. clockwise as viewed from the flywheel.

1.6 The engines are started by means of a built on air starter. The air starter is activated by remote controlled solenoid valve or by emergency starting valve. The engines are stopped by energizing the governor solenoid and emergency stop solenoid valve.

1.7 The elastically mounted "engine-to-alternator-to-built-on-equipment" design will be so constructed as to allow for stable run of the system under torsional and linear vibrations, and will comply to the Register rules.

1.8 The engine with offered equipment by this technical specification will be in compliance with rules and requirements of the RINA for Class UMS.
Survey over erection, assembly and testing of engines and equipment will performed by RINA.
Engines will be coupled to the alternators at the test bed, and tested in accordance with Register rules conforming to auxiliary marine engines.

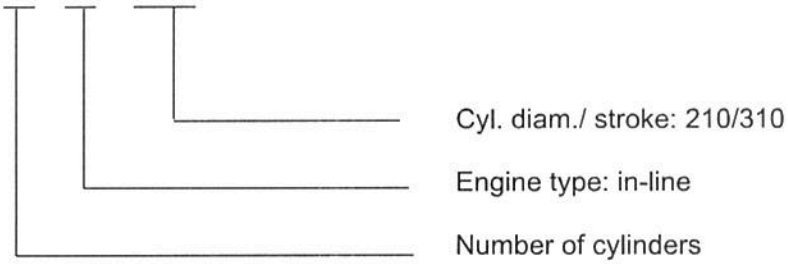
1.9 Nameplates of non-ferrous material on GenSets will be in English language. Preservation for 6 months.

1.10 The engines should comply with IMO, MARPOL, Annex VI – 2008, Reg. 13 (4) / NOx-Tier II,

2.1 TECHNICAL DATA OF ENGINE 7 L21/31Tier II

2.1.1 Designation of engine:

7 L 21/31 Tier II



2.1.2 Main characteristics of the engine:

2.2.1 Cylinders vertical, in line
2.2.2 Single-acting
2.2.3 4-stroke
2.2.4 Non-reversing
2.2.5 With direct injection of fuel
2.2.6 Two - piece pistons cooled by oil
2.2.7 Precharged by a turbocharger driven by exhaust gases.

2.1.3	The maximum continuous rating of engine:	1540 kW
	for the following climatic conditions:	
	- ambient air temperature	45 ° C
	- cooling water temp. at air cooler inlet	38 ° C
	- relative humidity	60 %
	- Barometric pressure	100 kPa
2.1.4	Mean effective pressure for conditions in point 2.3:	27,3 bar
2.1.5	Nominal speed	900 rpm
2.1.6	Number of cylinders	7
2.1.7	Cylinder diameter	210 mm
2.1.8	Cylinder stroke	310 mm
2.1.9	Cylinder volume	10,7 dm^3
2.1.10	Mean piston speed	9,3 m/s
2.1.11	Brake specific fuel consumption:	
	- at 100% load	192 g/kWh+5%
	- at 75% load (approx. value)	189 g/kWh
	- at 50% load (approx. value)	193 g/kWh
	Corrections to the fuel consumption, as related to built-on engine pumps:	
	- at 100% load	5,0 g/kWh
	- at 75% load	6,4 g/kWh
	- at 50% load	9,2 g/kWh
	Total fuel consumption with added values for the built-on pumps:	
	- at 100 % load	197,0 g/kWh+5%
	- at 75 % load (approximation)	195,4 g/kWh
	- at 50 % load (approximation)	202,2 g/kWh

NOTE:

The engine is designed and equipped for start/stop and running with HFO 380 cSt at 50°C with protection against fuel oil leakages. Possibility for start/stop with Diesel fuel oil too. Viscosity before the HP fuel pumps must be approx. 12-18 cSt.
Fuel consumption at the test bed is based on a net calorific DFO value (lower value) of HD = 42707 kJ/kg (10200 kcal/kg) and the ISO 3046-1: 2002 standard reference conditions:

- Barometric pressure	1.0 bar
- Inlet air temperature	25°C
- Air cooler cooling water temperature	25°C
- Relative humidity	30 %
For operation with MGO SFOC will be increased by 2g/kWh.	
2.1.12 Consumption of lube oil, after the running in of engine:	0,4 – 0,8 g/kWh
2.1.13 Quantity of lubricating oil in engine (**SAE 40**)	1178 dm^3
2.1.14 Quantity of water in engine:	150 dm^3
2.1.15 Exhaust gas flow for 100% load	
- ISO conditions	12100 kg/h
- Tropical conditions	11500 kg/h
2.1.16 Exhaust gas temperature after turbine for 100 % load	
- ISO conditions	311°C
- Tropical conditions	357°C
2.1.17 Air flow	
- ISO conditions	11781 kg/h
- Tropical conditions	11211 kg/h
2.1.18 Heat radiation of engine at 100% load and 45°C ambient temperature	86 kW
2.1.19 Allowed counterpressure at exhaust after compensator on engine	0,030 bar
2.1.20 Dry weight GenSet (without lube oil and cooling water)	cca 29,5 t

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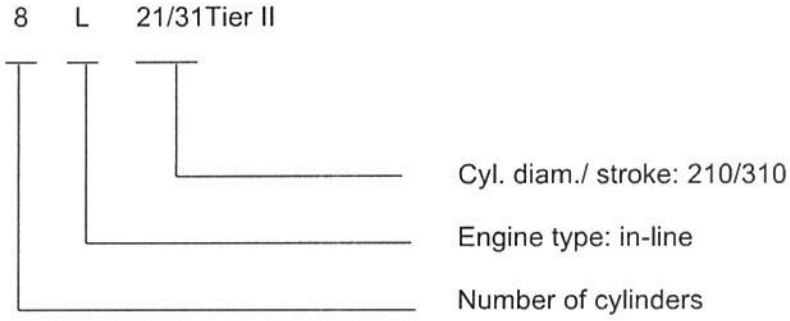
2.2 TECHNICAL DATA OF ENGINE 8 L21/31 Tier II

2.2.1 Designation of engine:



2.2.2 Main characteristics of the engine:

2.2.1 Cylinders vertical, in line
2.2.2 Single-acting
2.2.3 4-stroke
2.2.4 Non-reversing
2.2.5 With direct injection of fuel
2.2.6 Two - piece pistons cooled by oil
2.2.7 Precharged by a turbocharger driven by exhaust gases.

2.2.3	The maximum continuous rating of engine:	1760 kW
	for the following climatic conditions:	
	- ambient air temperature	45 ° C
	- cooling water temp. at air cooler inlet	38 ° C
	- relative humidity	60 %
	- Barometric pressure	100 kPa
2.2.4	Mean effective pressure for conditions in point 2.3:	27,3 bar
2.2.5	Nominal speed	900 rpm
2.2.6	Number of cylinders	8
2.2.7	Cylinder diameter	210 mm
2.2.8	Cylinder stroke	310 mm
2.2.9	Cylinder volume	10,7 dm^3
2.2.10	Mean piston speed	9,3 m/s
2.2.11	Brake specific fuel consumption:	
	- at 100% load	192,1 g/kWh+5%
	- at 75% load (approx. value)	189 g/kWh
	- at 50% load (approx. value)	193 g/kWh
	Corrections to the fuel consumption, as related to built-on engine pumps:	
	- at 100% load	5,0 g/kWh
	- at 75% load	6,4 g/kWh
	- at 50% load	9,2 g/kWh
	Total fuel consumption with added values for the built-on pumps:	
	- at 100 % load	197,1 g/kWh+5%
	- at 75 % load (approximation)	195,4 g/kWh
	- at 50 % load (approximation)	202,2 g/kWh

NOTE:

The engine is designed and equipped for start/stop and running with HFO 380 cSt at 50°C with protection against fuel oil leakages. Possibility for start/stop with Diesel fuel oil too. Viscosity before the HP fuel pumps must be approx. 12-14 cSt.
Fuel consumption at the test bed is based on a net calorific DFO value (lower value) of HD = 42707 kJ/kg (10200 kcal/kg) and the ISO 3046-1: 2002 standard reference conditions:

- Barometric pressure	1.0 bar
- Inlet air temperature	25°C
- Air cooler cooling water temperature	25°C
- Relative humidity	30 %

For operation with MGO SFOC will be increased by 2g/kWh.

2.2.12	Consumption of lube oil, after the running in of engine:	0,4 – 0,8 g/kWh
2.2.13	Quantity of lubricating oil in engine (**SAE 40**)	1303 dm^3
2.2.14	Quantity of water in engine:	170 dm^3
2.2.15	Exhaust gas flow for 100% load	
	- ISO conditions	13800 kg/h
	- Tropical conditions	13200 kg/h
2.2.16	Exhaust gas temperature after turbine for 100 % load	
	- ISO conditions	313°C
	- Tropical conditions	359°C
2.2.17	Air flow	
	- ISO conditions	13464 kg/h
	- Tropical conditions	12812 kg/h
2.2.18	Heat radiation of engine at 100% load and 45°C ambient temperature	98 kW
2.2.19	Allowed counterpressure at exhaust after compensator on engine	0,030 bar
2.2.20	Dry weight GenSet (without lube oil and cooling water)	cca 33,0 t
	Dwg.2190349-8.1	