

Technical Specification for 12VM32C

The details of design, materials and workmanship of the diesel engine conform to the applicable Rules for Building and Classing Steel Vessels of the American Bureau of Shipping.

This equipment is entitled to become part of the machinery of a vessel with following ABS class notation: +A1(E), "Oil/Chemical Carrier ESP", CSR, CPS, VEC, +AMS, +ACCU, UWILD, ES, NIBS, +R2, CPP

3 MaK four-stroke marine main diesel engine as generator prime movers (diesel-electric propulsion)

Type: 12 VM32C

Design: 12 cylinders in vee-form, counter-clockwise rotation
compressed-air starting,
suitable for operation with HFO,
max. viscosity: 700 cSt/50 deg C,
quality requirements to CIMAC

Rated output: 5760 kW at 720 rpm
reference conditions to ISO 3046/1:

45 deg C (318 K) air temperature
38 deg C (311 K) cooling water inlet
temperature charge-air cooler
60 % humidity
1 bar (100 kPa) air pressure

The engine will be run at 110 % rated output on the test bed.
The fuel rack position will then be limited to 110 %. The engine

features

an intermittent overload capacity to ISO 3046/1.

Fuel consumption: 178 g/kWh at 100 % rated output
178 g/kWh at 85 % rated output
Tolerance: 5 %
Additional fuel consumption per engine
driven pump: +1 %
Reference conditions to ISO 3046/1:
calorific value LCV = 42,700 kJ/kg
air pressure 1 bar (100kPa)
intake-air temperature 25 deg C (298 K)

charge-air temperature
after cooler 45 deg C (318 K)
cooling water inlet
temperature charge-air
cooler 25 deg C (298 K)

In case of different reference conditions
conversion of fuel consumption according
to ISO 3046/1 Par. 10.4 and 13.2 shall be effected

**Lubricating oil
consumption
(related to
100 % engine
output) :**

0.6 g/kWh over the entire load range.
The tolerance is ± 0.3 g/kWh

Load increment:

The admissible load increment as per ISO 8528/5 and the IACS recommendations must be carried out in 4 steps. The customer promises to keep this admissible load increment in the design of the ship's network and to obtain the approval of the responsible classification society early enough before classification acceptance of the engine.

Exhaust Gas Emission :

Evidence about IMO II Marpol 73/78 Annex VI and NOx Technical Code emission compliance of the engine through EIAPP Certificate or EAPP Documents of Compliance or EIAPP Statement of Compliance according to the authorization by the flag state and related technical file. Proof of compliance with EPA TIER II regulations will be provided through an EPA Certificate of Compliance.

IMO SOLAS:

Additional equipment on engine as prerequisite for IMO SOLAS, Chapter II-2, Part A15 (new B4), Regulation 2.9 to 2.11 and 3:

- jacketed high pressure fuel pipes
- leak fuel collecting system with collecting tank and sensor for alarm
- exhaust lagging
- covers for indicator valve and safety valve
- covers for connections in the fuel system
- covers for connections in the lube oil system

Provided that other flammable media (i.e. hydraulic oil) could be concerned IMO SOLAS Chapter II-2, Part A15 (new B4), Regulation 4 has to be followed.

Acceptance test run :

Standard acceptance test run of the first engine with electrical load tests (cos phi = 1) via resistor.

The test run is carried out with the complete genset on the test bed at the discretion of the contractor with MDO or gas oil

Standard acceptance test run for the further engines at the water brake on the test bed at the discretion of the contractor with MDO or gas oil

Parallel operation on the test bed will not be carried out

Test cell will be conducted with test cell standard control cabinet.

Test:

Acceptance of the engine and the accessories subject to testing with certificate issued by **ABS**

Outside preservation:

Engine/genset painted to Cat Yellow according to Caterpillar Motoren-Standard N 576-4.3 Accessories as to maker standard.

Inside preservation:

According to Caterpillar Motoren-Standard N 576-3.3

Required kinds of current: (no changes can be made by the factory to voltage)

Three phase current	: 480 Volt / 60 Hz
Alternating current	: 115 V
Direct current	: 24 V DC

Engine interfaces:

Engine interfaces with screwed union, counter flange and gaskets as well as electric terminal box.

Scale:

Pressure in bar, temperature in deg C, speed in rpm

Lettering/plates:

Lettering and plates in English

Documents to be supplied:

- 5 sets of installation documents English
- 4 sets (2x as CD-ROM) of documents, consisting of:
 - operating instructions [book A] in English
 - tool and spare parts list and spare parts catalogue [book B] in German/English
 - supplement folder [book C] in English

Engine Components, General

- 3 motor-driven barring gear, fitted on engine, incl. reversing contactor and pushbutton switch with cable, with starting interlock when barring gear is engaged
- 3 electronic speed setting equipment, fitted on engine, consisting of:
Actuator (without mechanical back-up) and speed pick-up (Woodward)
- 3 emergency shut-down equipment, fitted on engine, with pushbutton, separate, for manual emergency stop

Indicators - Engine

- 3 gauge board, fitted on engine, with 1 set liquid damped pressure gauges each for fuel, lubricating oil, fresh water, starting air and charge air
- 3 set thermometers on the engine for fuel (in case of heavy fuel only), lubricating oil, fresh water and charge air

Electric remote speed indicator, consisting of:

- 3 rpm pick-up, fitted on engine
- 3 indicator, 96x96 mm, fitted in gauge board
- 6 indicator, separate, 144x144 mm, without interior illumination
- 6 turbocharger speed indicator, consisting of:
 - Pulse generator, fitted on engine
 - Indicator, 96x96 mm, fitted in gauge board
 - Indicator, separate, 96x96 mm
- 3 exhaust gas temperature indicator, with selector switch, fitted in gauge board

Control (engine mounted instrumentation and controls are wired to a common terminal box on engine)

- 3 manual control on engine, consisting of:
 - control panel with start/stop key,
 - speed setting device,
 - mechanical shut-down device,
 - change-over of control functions from engine to remote control

- 3 starting solenoid valve, 24 V DC, on engine

- 3 Control cabinet with housing for wall mounting consisting of:
 - Starter for prelubrication pump
 - Starter for lubrication pump of generator
 - Starter for electric water heater
 - Temperature controller for charge air temperature
 - Alternator space heater
 - AC load center with isolation breaker

- 3 electronic speed governor, separate
 - The electronic speed setting includes the isochronous load distribution of the engines.
 - The required output signal (4-20 mA) - proportional to the generator output - is not included in the MaK scope of supply.

Monitoring for Unattended Operation

(The monitoring is carried out with analogue and binary sensors. Analogue sensors are indicated specially.)

- 3 set of pressure switches, fitted on engine, for:
 - lube oil pressure at full load below danger level (alarm/reduction)
 - low lube oil pressure (alarm/analogue sensor)
 - lube oil pressure below danger level (alarm/engine stop)
 - lube oil pressure of pre lubrication failed (alarm)
 - low fresh water pressure at engine inlet (alarm/analogue sensor)
 - low fresh water pressure in LT circuit (alarm/analogue sensor)
 - low starting air pressure (alarm/analogue sensor)
 - low control air pressure engine/shutdown air pressure (alarm)
 - low fuel pressure at engine inlet (alarm/analogue sensor)

- 3 set of switches, fitted on engine, for:
 - high lube oil temperature at engine inlet (alarm/analogue sensor)
 - lube oil temperature at engine inlet above danger level (alarm/reduction or engine stop)
 - high fresh water temperature at engine outlet (alarm/analogue sensor)

-fresh water temperature at engine outlet above danger level (alarm/reduction or engine

stop)

-high charge-air temperature at engine inlet (alarm/analogue sensor)

-detection of water in charge-air duct (alarm)

-leak fuel level (alarm)

-alarm contact for high differential pressure at fuel filter (alarm)

pressure switch : make TRAFAG.

temperature switch : make SENSYCON.

3 set of thermocouples (Ni/CrNi, signals in mV) after each cylinder, before (not for M20) and after turbocharger

3 crankcase oil mist detector, fitted on engine (high smoke development - alarm/engine stop)

Equipment for oil detection in the cooling water is not included.

3 control cabinet, with housing for wall mounting, consisting of:

- Protection equipment, designed for:
automatic and manual stop input signals starting interlock input signals
all of the input signal units and the emergency shutdown solenoid are monitored for the wire break.
The equipment works according to the open-circuit system.
- speed recording system for over speed, firing speed and minimum speed (n-min)
- start/stop logic, controlled by the diesel start automatic not supplied by MaK
- service hour counter

Alarm system, not delivered by MaK

The alarm system must be equipped for analogue and binary inputs.
For pressure and temperature remote indicators analogue outputs are to be provided according to the requirements of classification societies.

Diesel start automatic and synchronizing unit, not delivered by MaK

Air Intake System

6 air intake filter, fitted on turbocharger

Exhaust System

- 6 turbocharger at free end, with transition nozzle,
Nozzle position: 0 degrees from the vertical and away from the engine,
with compressor cleaning device and washing connection (with connection fitting
for each shipset) for the turbine
- 6 expansion joint, separate
- 2 silencer and spark arrester, separate, unlagged, 35 dB(A) backpressure limited to 2.5
inches water

Fresh Cooling Water System

(designed for two-circuit cooling)

- 3 HT pump, fitted on engine
- 4 LT pump, separate, vertical design, electric motor driven (360m³/hr each)
- 3 HT thermostat, not powered, separate
- 2 LT thermostat, powered, separate
- 3 charge air temperature control unit to preheat the charge air at part load condition,
separate
- 3 engine preheating equipment, fitted on base frame, consisting of:
electric preheater, pump and switch box

Heavy Fuel System

- 3 duplex filter, fitted on engine, with differential pressure indication

Lubricating Oil System

- 3 force pump, fitted on engine
- 3 prelubrication pump, fitted on base frame, electric motor driven
- 3 pressure control valve, fitted

Nozzle Cooling System

The system is connected to the lube oil circulation system of the engine.

Connecting Parts – Engine

- 3 Siemens 1DK4543-8AL05-Z generators (Technical Specification, Siemens Alternator 4-24-07.pdf, attached separately)
- 3 flexible flange coupling between engine and generator
- 3 base frame with flywheel guard and incorporated lube oil sump tank, for engine and generator
- 3 mounting of engine and generator on the base frame
- 3 set of bonded rubber rails for resilient mounting of the base frame. The required transverse and longitudinal stoppers are not delivered by MaK.
- 3 set of flexible pipe connections

Tools

- 1 set tools for the engine (basic equipment) incl hydraulic tightening tools and nozzle tester
- 1 set of tools for turbocharger (basic equipment)
- 1 set of tools to DIN standards
- 1 valve reseating tool, manual
- 1 Maximator pump instead of hand pump for hydraulic tightening tools
- 1 crank web deflection dial gauge
- 1 electronic firing pressure measuring device, make Lemag

Spare Parts

- 1 set of engine spares for unrestricted voyage (See separate attachment, ABS Spares.pdf, for list of ABS required / recommended spares)
- 1 set of spare gearwheels for engine camshaft drive
- 1 set of spare flexible pipe connections

- 1 Lube Oil force pump
- 1 HT cooling water pump

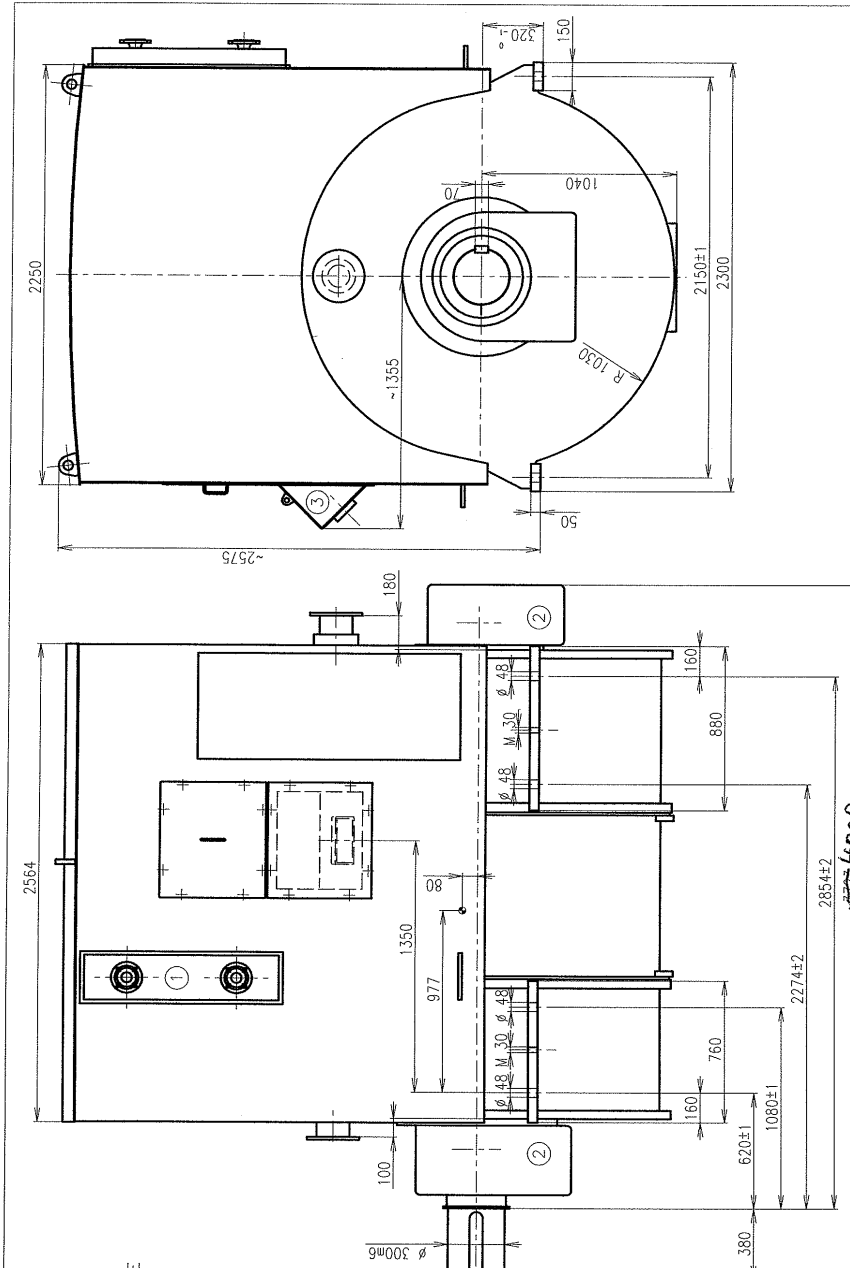
Technical Specification for Generators

SIEMENS

Alternator: 1DK 4543 - 8AL05 - Z

Quantity	3
Power output	6910 kVA;
Power factor	0,8
Voltage	6600 V
Frequency	60 Hz
Speed	720 r.p.m.
Classification	ABS
Excitation	self
Design:	brushless alternator with: ventilator, damper cage, stator connection in star
In accordance to	IEC 34, DIN EN 60034 (VDE 0530)
Enclosure	IP54
Cooling	IC 81W
Set-point adjustment	+/- 5%
Insulation class/temp. rise	F/F
Ambient temperature	50° C
Fresh water temperatur	38° C
Site elvation	up to 1000 m.a.s.l.
Design	IM 1101 - horizontal
Anti-condensation heating	2x250W/230V
Cable entry	plate undrilled
Temperature sensors	3 PT 100 on stator winding
Heating	1000W (240V)
Static unit	for parallel operation
Finish	prime
Regulation	AVR – Basler DECS 200
Bearings	sleeve

Nominal data			Type		1DK4543-8AL05-Z	
Rating	Sn	6910 kVA	cos φ		0,8	-
Voltage	Un	6600 V	Current In		604 A	
Frequency	fn	60 Hz	Speed		720 r.p.m	
The data are related to:		Ambient temperature			50 °C	
		Cooling water temperature			38 °C	
		Altitude at site			1000 m	
		Insulation class			F	
		Temperature rise			F	
Reactances and time constats						
	unsat.	sat.		unsat.	sat.	
X_d	93,1	85,9 %	X_q	58,3	%	T_{d0}' 3,089 s
X_d'	19,1	12,7 %	X_q'	58,3	%	T_d' 0,634 s
X_d''	11,2	9,9 %	X_q''	12,8	%	T_d'' 0,018 s
X_2	12,0	10,6 %	X_0	4,2	%	T_a 0,082 s
Efficiency						
S [%] of Sn		25	50	75	100	110
η [%] at cos φ	0,80	90,8	94,8	96,1	96,7	96,8
η [%] at cos φ	1,0	92,6	96,0	97,0	97,5	97,6
Short circuit data, transient data						
I_k'		6,13 kA				Initial short circuit current (3 ~)
I_s		15,57 kA				Max. peak current (3 ~)
I_k	>	1,81 kA				Sustained short circuit current
K_c		1,16				Short circuit ratio
M_{k2}		1208 kNm				Initial short circuit torque (2~)
Other data						
Moment of inertia		kgm ²	Weight			kg
Cooling air volume		m ³ /s	Total loses			190 kW
Water cooler		double tube	Loses to air			kW
Water flow		m ³ /h	Loses to water			kW
Max. pressure		Mpa	Bearing coolers			DE/NDE
Pressure drop		kPa	Water temp.			°C
Water temp. rise		K	Water flow			l/min
Remarks						
IC81W, IP54						
Class: ABS						
Winding pitch: 0,833						
VPI						



WELLE NACH DIN 748
 SCHAFTEND ACC. DIN 748
 UNVERBINDLICH/NON OBLIGATE
 KÜHLUNG ICW 81
 COOLING ICW 81
 SCHUTZART IP 54
 ENCLOSURE IP 54

- 1. WASSERKÜHLER
WATER COOLING
- 2. GLEITLAGER
SLIDE BEARINGS
- 3. KABELFÜHRUNG
CABLE GLAND

KUNDE/CLIENT		TYPE	
ANGEBOT/OFFER		1DK4537-8AL05	
PROJEKT/PROJECT		BEZEICHNUNG	
SSP-DRILLING		A 07 2357 0001-10A	
ZUS. ÄNDERUNG/CHANGE		BAUFORM/TYP OF CONSTRUCTION	
		IM B20	
DIMENSIONS, MABBILD			
SIEMENS			
DATUM/DATE	NAME/NAME	DATUM/DATE	NAME/NAME
05.04.06	Studeny		
BEARB. GEPR.			