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MAN Gensets – 18v32/40 Technical specifications

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Section 1 - Design data and performance guarantees

1 Design data and performance guarantees

Our offer is based on MDT standard designs and does not consider any special requirements of RFQs and tenders other than mentioned herein.

1.1 Design data

1.1.1 Site conditions

Site conditions

All offered equipment is designed to operate within the following ambient conditions:

– Altitude above sea level	200 m
– Maximum Wet bulb temperature	25 °C
– Minimum ambient air temperature	5 °C
– Maximum ambient air temperature	45 °C

Operation outside of these limits is withoutguarantee.

1.1.2 Generating sets

Generating sets

In response to your request, this quotation is for 6 generating sets based on the MAN 18V32/40 engine.

– Number of generating sets	6
– Engine type	18V32/40
– Engine speed	750 min^{-1}
– Lube oil pump	engine driven
– HT cooling water pump	engine driven
– LT cooling water pump	engine driven

Electrical system

The offered equipment is based on the following electrical values:

– Operation mode	island mode / grid parallel
– Frequency	50 Hz
– Power factor Cos φ (lagging)	0,8
– Medium voltage	11 kV
– Low voltage	400 V

1.1.3 Other design data

Foundation	Design parameter for foundations:	
	– Soil bearing capacity[1]	> 200 kN/m^2
	Earthquake design:	
	– Code	DIN-EN-1998-1
	– Peak Ground Acceleration (PGA)[2]	0.04 g
	– Soil type	D and E
	– Importance factor	1.0
Lube oil	Engine lube oil has to be in accordance with the requirements as stated in section 9.1.1	
	Requirements for viscosity:	
	− Viscosity class (40°)	SAE40

Cooling method

The cooling system of the engine is designed for cooling water in accordance with the requirements as stated in section 9.1.2.

Engine cooling water circuits with glycol content of 0 % considered. Features of the cooling water system:

- Type of cooling system radiator

Fuel system

The engine fuel oil system is designed based on heavy fuel oil in accordance with the requirements as stated in section 9.1.5.

Alternatively the engines can be operated on diesel fuel oil in accordance with the requirements as stated in section 9.1.4 for up to 72 hours at a time.

Intake air

Ambient air free of dust, salt and sand, aspirated from outside power house

Intake air has to be in accordance with the requirements as stated in section 9.1.6.

Permissible frequency limits in grid parallel operation

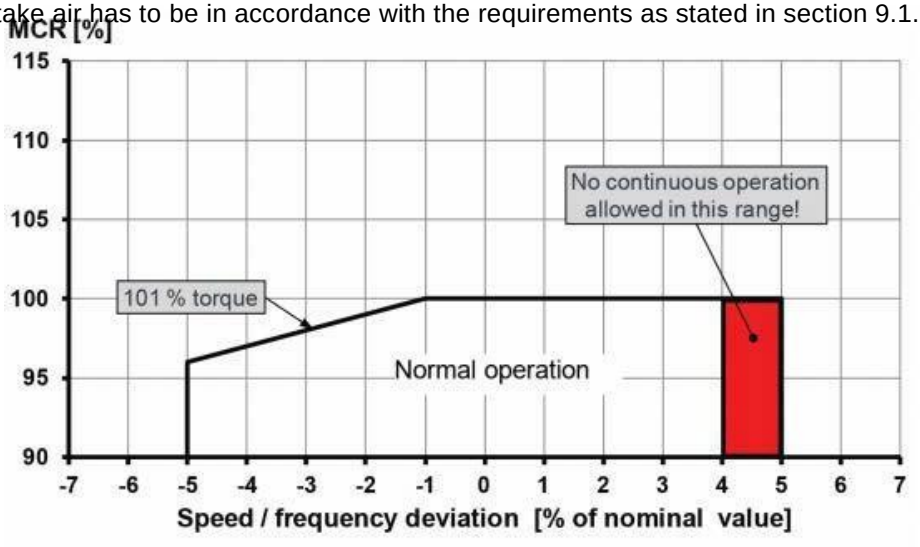


Figure 1: Diagram of permissible frequency and load limits

Figure 1 show that the maximum continuous engine output is ensured at a mains grid frequency exceeding up to max. +4%, whereas at a frequency drop to max. -5%, the power output is continuously reduced to 96% MCR. We permit operation of the engines up to +5% frequency fluctuations for maximum
120 seconds. In any case, the maximum permissible mains grid frequency deviation is ±5%.

In grid parallel operation, the frequency of the grid varies according to the cur- rent consumer load and the input from power suppliers. The plant responds as described above.

Load application in island operation

When load is suddenly applied to a generating set there will be a transient deviation in voltage and frequency. The permissible load increase is depending on the actual load of the generating sets in operation.

Permissible load increase in one step is max. 20% of the actual load, engines equipped with Jet Assist can handle load steps of up to 25%.

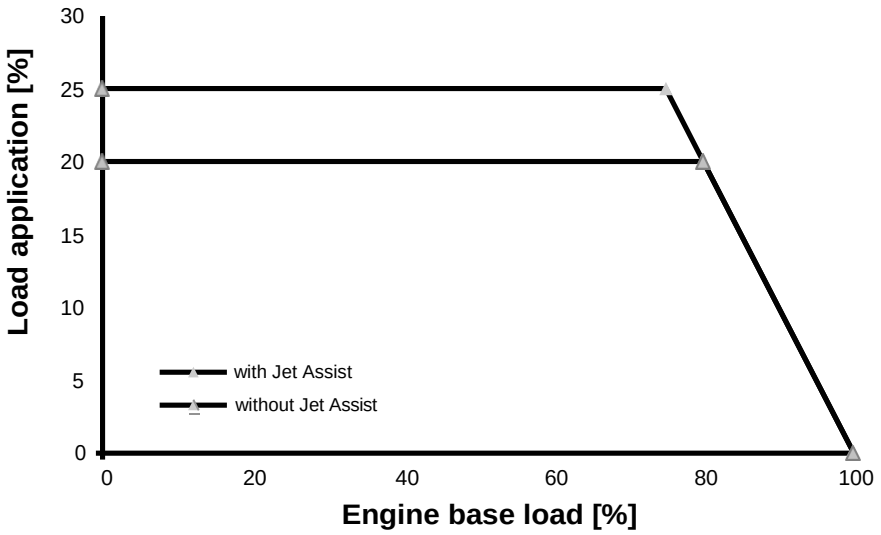


Figure 2: Load application

Further details can be found in our Project Guide of the 18V32/40 engine.

The offered generating sets comply with ISO 8528-5 class G2.

Power fluctuations

It is an intrinsic property of the power train of a generating set that it acts as a torsional vibration system. This complex system consists of the engine, coupling and generator (within scope of MAN Diesel & Turbo), the plant's electric network, consisting of further power producers and consumers, transformers, bus bars or circuit breakers and the power grid (not within scope of MAN Diesel & Turbo). The reciprocating engine, as well as the power grid or the other consumers and producers excite the system. As a consequence, the active power at the generator terminals is not completely constant with respect to time and some additional power oscillations so-called power fluctuations occur.

These power fluctuations do not affect the operational safety of the generating set. In addition, this behavior is in accordance with ISO 8528-5 and does as per MDT experience not affect net stability in an unacceptable range. In general, it is expected that power fluctuations are higher in net-parallel operation than in island-mode.

Please note that MAN Diesel & Turbo quotations do not consider any specific limitations regarding power fluctuations.

1.2 Performance data

Site Reference conditions

The below performance values are for information only and without guarantee. The stated performance data is based on the design data as per section 1.1 and calculated for the following reference conditions:

– Air Inlet temperature (before air inlet filter)	25 °C
– Wet bulb temperature	14.5 °C
– Relative humidity	30 %
– Air Inlet pressure (before air inlet filter)	1000 mbar
– Charge air temperature before cylinder	--- °C
– Exhaust gas back pressure	≤ 30 mbar
– Intake air pressure loss	≤ 20 mbar

In case the site conditions / technical parameters at performance test are different from the site reference conditions defined above, the performance guarantees will be adapted in accordance with MAN standard procedure.

Measuring tolerances

Tolerances in the measuring equipment shall be considered additionally and are not included in the guarantee figures stated below. Tests will be done according to ISO 15550:2002 (ISO 3046-1:2002).

1.2.1 Continuous power of the generatingset

The continuous power of one generating set 18V32/40 at above defined reference conditions is:

Continuous power of the generating set 8748 kW_{el}

The abovementioned power is the electrical output of the generating set as measured at the generator terminals.

Applicable standard is ISO 3046.

1.2.2 Specific fuel oil consumption (SFOC)

The specific fuel oil consumption at continuous power as per section 1.2.1 and at above defined reference conditions will not exceed the following value:

Specific fuel oil consumption 190.4 g/kWh_{el}

+ 5 % tolerance.

The specific fuel oil consumption is related to a Net Calorific Value (NCV) of 42700 kJ/kg. Separation and leakage losses are not included in the above consumption rates.

The stated guaranteed value is based on ISO 3046-1:2002. Corrections due to site conditions differing from the site reference conditions stated above must be executed according to the MAN standard procedure. The value stated above is the average of all generating sets.

1.2.3 Lubricating oil consumption

The lube oil consumption of one generating set at reference conditions as defined above will not exceed the following value:

Lube oil consumption 4.5 kg/h

+ 20 % tolerance.

The value stated above is without any losses due to cleaning of filter and centrifuge or lube oil charge replacement.

The stated guaranteed value is based on ISO 3046-1:2002. Corrections due to site conditions differing from the site reference conditions stated above must be executed according to the MAN standard procedure. The value stated above is the average of all generating sets.

2 Diesel engine 32/40

General description

The MAN engine 18V32/40 is a four-stroke, medium-speed diesel engine, turbocharged and charge air-cooled. The engine is prepared for operation on heavy fuel oil.
Compared to other medium-speed engines, within the same power range, the 18V32/40 produces high power from a compact, efficient design.

Technical data

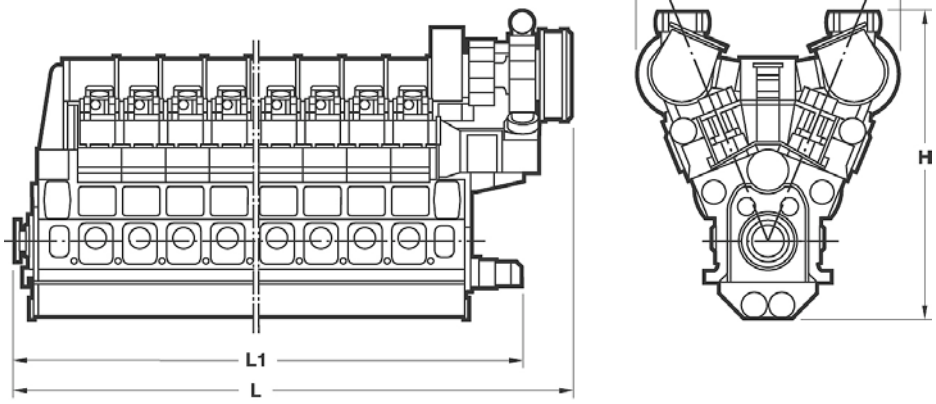
The technical data of the engine at ISO conditions[3] is summarized in the following table:

– Cylinder bore	320 mm
– Piston stroke	400 mm
– Engine speed	750 min^{-1}
– Piston speed	10 m/s
– Mean effective pressure	24,9 bar

Continuous development

The engine family has a well-proven service record in marine propulsion, marine auxiliary genset and stationary power generation. 32/40 engines from MAN have been in service since 1994 and are subject to continuous development to ensure reliability under the most severe service conditions.

Outline dimensions



Dimensions and weight[4] of the engine 18V32/40:

– Height (H)	4230 mm
– Length (L)	8300 mm
– Width (B)	3500 mm
– Weight (dry)	85000 kg

Item	Q'ty	Description
		2.1 Engine system
		2.1.1 Engine system
010 MJ	6	Engines 18V32/40, suitable for operation on heavy fuel oil or Diesel fuel oil, as per following detailed Technical Specification.
		2.1.2 Lubrication system
010.220.010 MJV01AP010	6	Engine attached lube oil pump(s)
		2.1.3 Cooling water system
010.230.010 MJG01 AP020	6	Engine attached HT cooling water pump
010.230.020 MJG02 AP010	6	Engine attached LT cooling water pump
		2.1.4 Special equipment of the engine
010.250.030	6	Slow-turn facility on the engine

2.2 Detailed Technical Specification of one engine 32/40

Design features	One-part crankcase with safety valves on crankcase covers
	Welded sheet-steel dry oil sump
	Crankshaft made of forged steel with torsion vibration damper at free end
	Main bearings and big-end bearings with two-part thin-walled bearing shells and main bearings cross-braced by tie-rods
	Connecting rod (split with flange) drop-forged from steel
	Piston with forged steel crown and nodular cast-iron skirt
	Cast-iron cylinder liners with fire land ring
	Nodular cast-iron cylinder head with armor-plated inlet and exhaust valves, valve seat rings for the inlet and exhaust valves. Valve rotators on the inlet and exhaust valves. Indicator valve on each cylinder
	Individual camshafts (multi-part) for injection pumps and valve timing
	Pipes on the engine with counter flanges or connecting screws
Fuel injection system	Injection pump on each cylinder
	Variable injection timing (VIT), with automatic adjustment
	Injection pipes with casing
	2 buffer pistons at the fuel admission and return pipes
Speed control	Electronic speed governor with actuator
	Electric speed transmitter for engine speed and turbocharger speed
	Electro-pneumatic emergency shutdown device on the engine for manual remote emergency stop and for automatic stop at over speed and other stop criteria within the safety system
Turbo charging and charge-air cooling	2 Exhaust gas turbocharger, type NR34/S mounted at the free end. Washing device (wet) for the exhaust gas turbine and compressor. Additional dry cleaning device for the turbine.
	2 Charge air cooler in fresh water and two-stage design; with counter flanges
	Exhaust gas piping on the engine, un-cooled, thermally insulated and lagged
Operation and control	Supplemental parts for engine control panel (ECP) The following equipment is included: – Control unit for speed governor, – Control for splash oil monitoring system – EDS-data box for collection and record of engine operating data The abovementioned equipment to be mounted in the engine control panel (ECP).
	Oil mist detector Schaller VN115
Temperature measuring	Thermocouples for measuring the exhaust gas temperature after each cylinder, before and after turbocharger, with terminal box and cabling on the engine.
Start and stop equipment	Compressed air starting equipment with main starting valve and with starting valve on each cylinder of one cylinder bank
Lubricating and cooling	Cylinder lubrication oil pump with attached electrical motor (IP 44)
	Forced-feed lubrication for all bearing points of running gear, camshaft, timing gear and turbocharger
	Cylinders, cylinder heads, fuel injection valves, and charge-air cooler are water-cooled, pistons are oil cooled

Flywheel and turning gear	Flywheel with teeth for turning gear Bolts connecting the flywheel with the crankshaft Turning gear for the running gear, with electric motor (reversible; IP 54) Push button switching equipment, control cable Starting interlock when turning gear engaged, with limit switch (not cabled; 24 V DC; IP 65) for display
Engine painting	The exterior surface of the engine is painted with two component paint system in color W HITE ALUMINUM (RAL9006).
Acceptance	Works acceptance / factory approval.
Calculation	Torsion vibration calculation

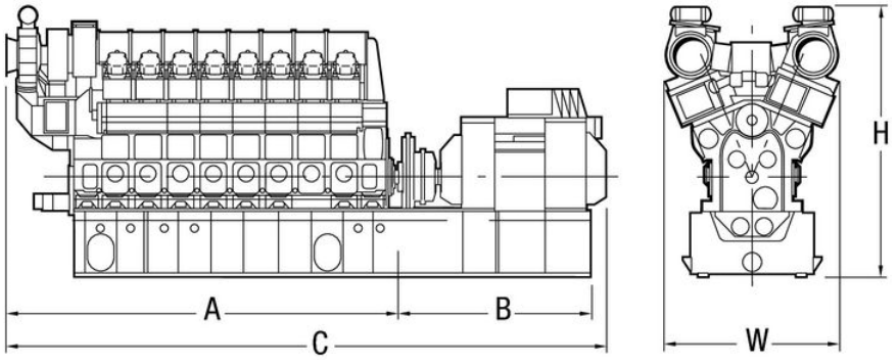
3 Generating set

General description

Our generating sets are designed for power generation in continuous, durable and safe operation. The area of application comprises ranges from supplies of basic loads in public mains or coverage of peak loads to isolated applications for industrial consumers.

Engine and alternator are mounted on a common steel foundation frame. The engine is resiliently mounted on the frame by rubber elements, whereas the alternator is rigidly mounted. Engine and alternator are flexibly coupled. The steel foundation frame is placed rigidly and grouted on a simple concrete foundation plate.

Outline dimensions



Dimensions and weight[5] of the generating set:

– Height (H)	5240 mm
– Length (C)	12750 mm
– Width (W)	3500 mm
– Weight (dry)	139000 kg

Item	Q'ty	Description
3.1		**Generating Set**
3.1.1		**Coupling arrangement**
	6	Flexible coupling
	6	Flywheel cover
3.1.2		**Engine seating**
	6	Engine seating
	6	Jacking bolts for engine alignment
3.1.3		**Pipe adapters**
	6	Flexible pipe connections for the engine
	12	Rubber expansion joint for intake air duct
	6	Adapter for exhaust gas duct
3.2		**Genset**
3.2.1		**Alternator system**
	6	Three phase synchronous alternator
	1	Automatic voltage regulator (AVR)
3.2.2		**Foundation system**
	6	Common base frame
	6	Set of foundation bolts for alternator
	6	Foundation frame seating
	Q'ty	Description
3.2.3		**Genset add-ons**
	6	Frame auxiliaries and assembly
	6	Lube oil tank level monitoring

4 Mechanical scope

Item	Q'ty	Description

4.1 Auxiliary systems, engine related

4.1.1 Engine exhaust gas system

	6	Expansion joint downstream of turbo charger

5 Electrical scope

Item	Q'ty	Description

5.1 Control and monitoring system

5.1.1 Genset Interface Panel (GIP)

	6	Engine control panel (ECP)

5.1.2 Genset control panel (GCP)

	6	Genset control panel (GCP)

6 Miscellaneous

Item	Q'ty	Description

6.1 Documentation

6.1.1 Basic plant technical documentation

	3	Engine, turbocharger and plant documentation

7 Tools, spare and wear parts

Item	Q'ty	Description

7.1 Tools and spares

7.1.1 Engine tools

1	Set of standard and special tools for the engine
1	Crank web deflection measuring device
1	Electric valve cone grinder
1	Electric valve seat grinder
1	Electronic firing pressure gauge
1	Manual programming unit for speed governor
1	Assembly and reversing device for cylinder heads
1	Set of tools for turbocharger

7.1.2 Engine spare and wear parts

2	Set of spare parts for turbocharger
1	Set of strategic engine spare parts
1	Spare parts for control and monitoring
1	MAN spare parts for external monitoring system
1	Spares for oil mist detector (010.290.330)

8 Services

Item	Q'ty	Description
8.1		**Quality Management, Quality Assurance**
	1	Quality Planning
8.1.1		**Health, Safety, Security and Environment**
	1	HSE Planning
8.2		**Project engineering**
8.2.1		**Design of the genset foundation base**
	1	Design of the genset foundation base
8.3		**Logistics**
8.3.1		**Transportation of equipment**
	6	Delivery of engine and alternators to Ex-works Mannheim, Germany
	1	Engine lifting device (on loan basis)

9 Requirements and limitations

9.1 Quality requirements for operating media

MAN engines are designed for continuous operation on the operation media as listed below. Project-specific system layouts for the respective operating media are mentioned in the respective chapters of our offer.

9.1.1 Lube oil

Use of engine lube oils according to the Approval List for heavy fuel oil operation of MAN Diesel & Turbo. More detailed information on the lube oils approved by MAN Diesel & Turbo is available in the engine manuals.

Requirements for viscosity:

- Viscosity-class (40°) SAE40

Requirements for Base Number (BN):

- TBN (Total Base Number),
  - if sulfur concentration < 1.5% wt. ~30 mg KOH/g oil
  - if Sulfur concentration > 1.5% wt. ~40 mg KOH/g oil

Please note that our cooling systems are designed to operate with the above-mentioned lube oil class SAE40 only. Operation of the plant with other lube oils requires a detailed modification in the cooling systems and additional equipment cost.

9.1.2 Engine cooling water

The engine cooling water must be carefully selected, treated and controlled. The treatment with an anti-corrosion agent has to be effected before the first commissioning of the plant. During subsequent operation the concentration specified by the engine manufacturer must always be ensured. The approved cooling water additives are defined in the operating instructions.

The characteristics of the water used for engine cooling must be within the following limits:

- Type of water: Distillate or freshwater, free from foreign matter
- Total hardness[7]: max. 10 °dH
- pH-value: 6.5 – 8.0
- Chloride (Cl): max. 50 mg/l

Engine cooling water will be used for cleaning of the turbo charger as well as for separators.

Seawater, brackish water, brines, industrial waste water and rain water cannot to be used without treatment.

9.1.3 Diesel fuel oil

9.1.3.1 Fuel system related characteristicvalues

Diesel fuel oil (DFO) based on ISO F- DMB. (ISO 8217-2012). The usability of the DFO depends on its conformity with the key properties listed below:

- Net Calorific Value (NCV) 42,250 kJ/kg
- Density at 15° C 900 kg/m^3
- Kinematic viscosity at 40°C 2.0 … 11 mm^2/s
- Pour Point, winter quality < 0 °C
- Pour Point, summer quality < 6 °C
- Flash point (Pensky Martens) > 60 °C
- Total sediment fraction 0.10 % wt.
- Water content < 0.3 % vol.
- Sulfur content ≤ 2.0% wt.
- Ash content < 0.01 % wt.
- Coke residue (MCR) < 0.3 % wt.
- Cetane number or cetane index > 35
- Hydrogen sulfide < 2 mg/kg
- Total acid number < 0.5 mg KOH/g
- Oxidation stability < 25 g/m^3
- Lubricity (wear scar diameter) < 520 µm
- Copper-strip test < 1

If the abovementioned fuel oil specification is not met, it can only be used in case of fuel treatment.

9.1.3.2 Diesel fuel oil properties related to site conditions

The following fuel specification must be met at engine inlet:

- Kinematic viscosity: 1.9 … 14 mm^2/s

To meet the diesel oil requirements at engine inlet the diesel oil provided must be in a range between minimum viscosity and maximum viscosity as specified below, considering project-specific ambient conditions (minimum air temperature $T_{amb\ min.}$ / maximum air temperature $T_{amb\ max.}$ plus ΔT = 10 K):

- Min. kinematic viscosity 1.9 mm^2/s at 55 °C
- Max. kinematic viscosity 14 mm^2/s at 5 °C

MDT is recommending a fuel management suitable for seasonally occurring temperatures, i.e. subsequently to the requirements above it might be necessary to provide two different diesel oil qualities for summer season and winter season.

In case the viscosity limits as stated above cannot be met, a special diesel oil cooling system respectively a diesel oil heating system is required and can be offered upon request.

9.1.4 Heavy fuel oil

The following HFO specification has been used as the basis for the design of the auxiliaries and fuel handling systems. W orse fuels may be possible for the engines, however additional or modified equipment may be required.

9.1.4.1 Fuel system related characteristicvalues

The fuel system is designed to operate based on the following fuel oil specification based on ISO 8217-2012:

− Net Calorific Value (NCV)	40230 kJ/kg
− Kinematic viscosity at 50°C	up to 380 mm^2/s
− Density at 15°C	max. 1,010 kg/m^3
− Sulfur content	up to 3.4%-wt.
− Ash content	up to 0.15%-wt.
− Flash point	min. 60 °C
− Pour point	max. 30 °C
− Carbon residue (Conradson)	max. 20 % wt.
− Vanadium	max. 450 mg/kg
− Water	max. 0.5 % vol.
− Sediment (potential)	max. 0.1 % wt.
− Aluminum and silicon (total)	max. 60 mg/kg
− Total acid number	max. 2.5 mg KOH/g
− Hydrogen sulfide	max. 2 mg/kg
− Asphaltene content	max. 2/3 of coke residue % wt (Conradson)
− Sodium	Sodium < 1/3 vanadium, Sodium < 100 mg/kg
− CCAI number	max. 870

Current fuel oil characteristics are not sufficient for estimating the combustion properties of the fuel oil. This means that service results depend on oil properties which cannot be known beforehand. This especially applies to the tendency of the oil to form deposits in the combustion chamber, gas passages and turbines. It may, therefore, be necessary to rule out some oils that cause difficulties ties.

The fuel must be free of admixtures not based on mineral oil, such as coal oil or vegetable oils, free of tar oil and lubricating oil, free of any chemical waste, solvents and polymers.

9.1.4.2 Treated heavy fuel oil at engine inlet

The following fuel specification must be met at engine inlet:

− Inorganic foreign particles (incl. catalyst residues)	<20 mg/kg (aluminum + silicon content < 15mg/kg) particle size: < 5 µm
− Water	< 0.2% vol.

9.1.5 Intake air

The quality and condition of intake air (combustion air) have a significant effect on the power output of the engine output as well as on the engine's lifetime. In this regard, not only the atmospheric conditions are extremely important, but also contamination by solid and gaseous foreign matter. Mineral dust in the intake air increases wear, chemicals and gases promote corrosion.

The concentrations before the turbocharger inlet must not exceed the following limiting values:

– Particle size	90% ≤ 5 µm; 98% ≤ 10 µm
– Dust (sand, cement, CaO, Al_2O_3 etc.)	max. 5 mg/Nm³
– Chlorine	max.1.5 mg/Nm³
– Sulfur dioxide (SO2)	max.1.25 mg/Nm³
– Hydrogen sulfide (H_2S)	max.5 mg/Nm³
– Salt (NaCl)	max.1 mg/Nm³

If combustion air is drawn from inside the powerhouse, the minimum required filter class is G3 according to EN779 or equivalent. Gas engines or dual-fuel engines must be equipped with a dry filter. If the combustion air is drawn from outside, there is a risk of higher air contamination (e.g. due to sand storms, loading and unloading of grain cargo vessels or a cement plant). In this case additional measures need to be taken. This includes the use of pre-separators, pulse filter systems and an increased filter efficiency class of M5 according to EN779.

During operation, effective cleaning of the intake air and regular maintenance of the air filters are required to stick within the abovementioned limits.

Intake air shall not contain any flammable gases. Make sure that the combustion air is not explosive.

9.1.6 Compressed air

The compressed air systems are divided into a starting air system -- used to start the engines, a control air system -- for auxiliary systems and a service air system – used for tools and working equipment.

Requirements for starting air:

– Pressure	30 bar(g)

Requirements for control air:

– Water	ISO 8573-1 – Class 3
– Particles	ISO 8573-1 – Class 3
– Oil	ISO 8573-1 – Class 2
– Pressure	7 bar(g)

Requirements for service air:

– Water	ISO 8573-1 – Class 4
– Particles	ISO 8573-1 – Class 4
– Oil	ISO 8573-1 – Class 4
– Pressure	6 bar(g)

Requirements for soot blowing air for waste heat recovery boiler:

– Water	ISO 8573-1 – Class 5
– Particles	ISO 8573-1 – Class 4
– Oil	ISO 8573-1 – Class 4
– Pressure	12 – 16 bar(g)

9.2 Limits of supply

9.2.1 General remark

The limits of supply are to be read in connection with the offered scope of supply as per the technical specification.

All equipment is supplied largely modularized. Necessary bolts, studs or screws to install the equipment on the foundations or elevated platforms / walkways are included.

Any steel supporting structures, steel mounting elements, etc. necessary to install the equipment / modules / auxiliaries are not included in the scope of supply of MAN Diesel & Turbo.

9.2.2 Generating sets

Mechanical:

- Pipe connection terminal on the engine to connect the engine to various pipes

Electrical:

- Terminal box of the alternator

Exhaust gas:

- Outlet flange with counter flange of the adapter and expansion joint for exhaust duct inside the powerhouse

Intake air:

- Flange and counter flanges of the turbochargerof the engine

Civil:

- Steel foundation frame with frame stoppers and leveling screws; grouting material (Pagel)

9.2.3 Electrical equipment / Engine and plant control system

- Engine Control Panel connectors for data transfer
- Engine Control Panel connectors for power supply
- Connectors on Genset Interface Panel (GIP) and Genset Control Panel (GCP) for bus cables (Profibus)
- Connectors for power supply on GIP and GCP

10 Standards and Guidelines

10.1 Applicable standards

All materials, equipment and services mentioned in this quotation comply with the respective standards and codes of the country of manufacture.

In particular, equipment supplied from EU countries complies, as far as applicable, with the following standards and codes:

- ISO International Standards Organization
- IEC International Electro technical Commission
- EN standard - European Institute for Standardization
- Manufacturer's QA/QC System
- Manufacturer's standards

MAN Diesel & Turbo advises that national and/or local regulations may differ from the abovementioned standards or guidelines. The national and/or local standards are not considered in our bid. Compliance to national regulations and standards are the sole responsibility of the customer or operator of the plant.

10.2 General guidelines

10.2.1 Heat exchangers for engine cooling

The heat exchangers offered are suitable for non-aggressive raw water (fresh water). If aggressive raw water is used (e.g. brackish water, industrial waste water) we are unable to accept any warranty for the heat exchangers, pumps, pipes and other units in contact with such water.

Mains water supply and water treatment

For the first filling of the system, water used in the cooling system has to meet the requirements listed in chapter 9. The treatment, kind and amount of added chemicals are related to the water quality available at site.

The water shall be available at the plant premises with a pressure of 4-6 bar.

10.2.2 Painting of the supplied equipment

Auxiliary equipment is delivered in the original color as supplied by the sub supplier, unless otherwise specified in this document.

10.2.3 Miscellaneous

Anything not specifically mentioned in the quoted scope is not included.

Minor changes due to technical development, design and output are reserved.

Other than the performances guarantees, all figures stated in this specification such as pressures, capacities, flows etc. are preliminary only and subject to change during detailed engineering phase.

10.2.5 Minimum requirements for personnelon site

The customer as well as MDT needs to ensure that adequately qualified per- sonnel will be available for the site activities.

The customer shall send engineers/technicians to site who are well conversant with the English language to avoid difficulties in communication with MDT engi- neers/technicians

11 Sub suppliers

MAN Diesel & Turbo is one of the leading manufacturers of large diesel engines and is working worldwide with established sub-suppliers for auxiliaries and sys- tem components for various power plant projects.

Our quality rules have to be followed by our sub-suppliers. The product quality is examined by MAN Diesel & Turbo in detail before suppliers are released and certified.

In case of order the engine power plant is engineered based on the design parameters of your site, details for specific projects are defined and fixed. Auxiliary equipment will finally be defined in detail and can be ordered after detail engineering.

MAN Diesel & Turbo at any time reserves the right to select the vendor who is the most favorable one with respect to technology, quality, delivery time, reliability or price in any individual case. Further vendors may be included in the list following the completion of a vendor assessment.

In any case, MAN Diesel & Turbo reserves the right to choose the sub-suppliers at its discretion