International Association of Oil & Gas Producers

SPECIFICATION
S-711

January
2020

Specification for Diesel Engines

JIP33
JOINT INDUSTRY PROGRAMME

Revision history

VERSION	DATE	PURPOSE
0.1	January 2020	Issued for Public Review

Acknowledgements

This IOGP Specification was prepared by a Joint Industry Project 33 Standardization of Equipment Specifications for Procurement organized by IOGP with support by the World Economic Forum (WEF).

Foreword

This specification was prepared under Joint Industry Programme 33 (JIP33) "Standardization of Equipment Specifications for Procurement" organized by the International Oil & Gas Producers Association (IOGP) with the support from the World Economic Forum (WEF). Companies from the IOGP membership participated in developing this specification to leverage and improve industry level standardization globally in the oil and gas sector. The work has developed a minimized set of supplementary requirements for procurement, with life cycle cost in mind, resulting in a common and jointly agreed specification, building on recognized industry and international standards.

Recent trends in oil and gas projects have demonstrated substantial budget and schedule overruns. The Oil and Gas Community within the World Economic Forum (WEF) has implemented a Capital Project Complexity (CPC) initiative which seeks to drive a structural reduction in upstream project costs with a focus on industry-wide, non-competitive collaboration and standardization. The CPC vision is to standardize specifications for global procurement for equipment and packages. JIP33 provides the oil and gas sector with the opportunity to move from internally to externally focused standardization initiatives and provide step change benefits in the sector's capital projects performance.

This specification has been developed in consultation with a broad user and supplier base to realize benefits from standardization and achieve significant project and schedule cost reductions.

The JIP33 work groups performed their activities in accordance with IOGP's Competition Law Guidelines (November 2014).

Table of Contents

List of Tables

Introduction

The purpose of this specification is to define a minimum common set of specification requirements for the procurement of diesel engines for application in the petroleum and natural gas industries.

This JIP33 standardized procurement specification follows a common document structure comprising the four documents as shown below, which together with the purchase order define the overall technical specification for procurement.

JIP33 Specification for Procurement Documents
Supplementary Technical Specification

It is required to use all of these documents in conjunction with each other when applying this specification, as follows.

S-711: Specification for Diesel Engines

This specification is written as a set of minimum requirements for the procurement of diesel engines. The terminology used within this specification is in accordance with ISO/IEC Directives, Part 2.

S-711D: Data sheet for Diesel Engines

This document provides project specific requirements where this specification requires the purchaser to define an application specific requirement. It also includes information required by the purchaser for technical evaluation. Additional purchaser supplied documents are also listed in the data sheet, to define scope and technical requirements for enquiry and purchase of the equipment.

S-711L: Information requirements for Diesel Engines

This document defines the information requirements, including format, timing and purpose, for information to be provided by the vendor. It also defines the specific conditions which must be met for conditional information requirements to become mandatory. The information requirements listed in the IRS have references to the source of the requirement.

S-711Q: Quality requirements for Diesel Engines

This document includes a conformity assessment system (CAS) which specifies standardized user interventions against quality management activities at four different levels. The applicable CAS level is specified by the purchaser in the data sheet.

The data sheet and IRS are published as editable documents for the purchaser to specify application specific requirements. The supplementary specification and QRS are fixed documents.

Unless defined otherwise in the purchase order, the order of precedence (highest authority listed first) of the documents shall be:

a) regulatory requirements;

b) contract documentation (e.g. purchase order);

c) purchaser defined requirements (data sheet, IRS, QRS);

d) this specification.

1 Scope

This specification covers the minimum requirements for four-stroke industrial diesel engines in offshore/onshore oil and gas applications. The requirements include:

– basic design,

– materials,

– fabrication,

– assembly,

– inspection, testing and documentation for diesel engines with related air inlet and exhaust,

– lubrication,

– fuel and coolant system,

– controls,

– auxiliary equipment and accessories.

This specification includes diesel engines for the following applications:

a) power generation:

  – emergency generator packages,

  – diesel-electric generator for firewater pump packages,

  – main, stand-by and essential power generation.

b) mechanical drive:

  – firewater pump packages,

  – prime mover for rotating equipment,

  – drivers for offshore pedestal and land based cranes.

This specification does not cover the following applications:

– diesel engine drivers for temporary service,

– diesel engines for marine propulsion,

– two-stroke diesel engines,

– dual fuel engines,

– engines burning crude, bio-fuels and distillate.

2 Normative references

ISO 15550	Internal combustion engines - Determination and method for the measurement of engine power – General requirements
ISO 3046-1	Reciprocating internal combustion engines- Performance - Part 1: Declarations of power, fuel and lubricating oil consumptions, and test Methods- Additional Requirements for Engines for General Use
ISO 3046-3	Reciprocating internal combustion engines - Performance - Part 3: Test Measurements
ISO 3046-4	Reciprocating internal combustion engines - Performance - Part 4: Speed Governing
ISO 3046-5	Reciprocating internal combustion engines - Performance - Part 5: Torsional vibrations
ISO 3046-6	Reciprocating internal combustion engines - Performance - Part 6: Overspeed protection
ISO 1204	Reciprocating internal combustion engines - Designation of the direction of rotation and of cylinder and valves in cylinder heads, and definition of right-hand and left-hand in-line engines and locations on an engine
ISO 2710	Reciprocating internal combustion engines - Vocabulary
ISO 5011	Inlet air cleaning equipment for international combustion engines and compressors- Performance testing
ISO 6798	Reciprocating internal combustion engines - Measurement of emitted airborne noise- Engineering method and survey method
ISO 7967	Reciprocating internal combustion engines - Vocabulary of components and systems – Part 7: Governing system
ISO 10816-6	Mechanical vibration - Evaluation of machine vibration by measurements on non-rotating parts- Part 6: Reciprocating machines with power rating above 100 kW
IEC 60079	Explosives Atmospheres
ASME PTC 17	Performance test code- Reciprocating internal combustion engines
IEC 61892	Mobile & fixed offshore units- Electrical installation
ISO 8528-2	Reciprocating internal combustion engine driven alternating current generator sets – Part 2: Engine
ISO 8528-9	Reciprocating internal combustion engine driven alternating current generator sets – Part 9: Measurement and evaluation of mechanical vibrations
EN1834-1	Reciprocating internal combustion engines - Safety requirements for design and construction of engines for use in potentially explosives atmospheres - Part 1: Group II Engines for use in flammable gas and vapour atmospheres
ISO 14396	Reciprocating internal combustion engines – Determination and method for the measurement of engine power- Additional requirements for exhaust emission Tests in Accordance with ISO 8178
ISO 16890-1	Air filters for general ventilation- Part 1: Technical specifications, requirements and classification system based upon particulate matter efficiency (ePM)
IEC 60529	Degrees of protection provided by enclosures (IP Code)
NFPA 20	Standard for the Installation of Stationary Pumps for Fire Protection
ASME PTC17	Performance test code- Reciprocating internal combustion engines
ISO 10474	Steel and steel products- inspection documents
ISO 8178	Reciprocating internal combustion engines- Exhaust emission measurement

NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
ISO 21457	Material selection and corrosion control for oil and gas production systems

3 Terms and definitions

3.1.1 continuous power

Power which an engine is capable of delivering continuously, between normal maintenance intervals stated by manufacturer, at the stated speed and under stated ambient conditions, the maintenance prescribed by the manufacturer having been carried out.

(based on ISO 15550)

3.1.2 ISO standard power

Continuous brake power that the engine manufacturer declares that an engine is capable of delivering with only the essential dependent auxiliaries fitted, between the normal maintenance intervals as stated by the manufacturer, and under the following conditions:

– at a stated speed and operating conditions of the engine manufacturer's test bed,

– with the declared power adjusted or corrected as determined by the manufacturer to the standard reference conditions specified in ISO 14396,

– with the maintenance prescribed by the engine manufacturer having been carried out.

(based on ISO 15550)

3.1.3 brake power

Power or sum of the powers delivered at the end of the crankshaft or its equivalent, with the equipment and auxiliaries fitted as required by the relevant "satellite" standard.

(based on ISO 15550)

3.1.4 prime power

Maximum power which a generating set is capable of delivering continuously while supplying a variable electrical load when operated for an unlimited number of hours per year under the agreed operating conditions with the maintenance intervals and procedures being carried out as prescribed by the manufacturer.

(based on ISO 8528-1)

3.1.5 safety critical service

Service where unavailability of equipment causes an unsafe situation leading to potential for personnel injury, fatality or damage to, or loss of, equipment or property. These include services such as firewater pumps, emergency generators and emergency air compressors.

3.1.6 package

Complete assembly of the diesel engine with driven equipment, auxiliary system, instrumentation and control mounted on a baseplate or sole plate, ready to be hooked up to the purchaser's utilities and power, and perform the intended duty.

3.1.7 maximum continuous rating (MCR)

Maximum power output that an engine can produce while running continuously at safe limits and conditions. Defined by the International Association of Classification Societies (IACS), and specified on the nameplate and in the technical file of the marine diesel engine.

3.1.8 package supplier

Supplier who has the overall responsibility of design, manufacture, assembly, integration of all sub-supplier equipment and testing of the package.

3.1.9 engine supplier

Party or agency that supplies the diesel engine either as a direct diesel engine manufacturer or manufacturer's authorized representative for installation and integration into a package.

3.1.10 dual fuel engine

Engine which accepts both liquid fuel and gaseous fuel for combustion, and has a mechanism to easily switch between the two fuels.

3.2 Acronyms, abbreviations and symbols

BHP	brake horse power
BICERA	British Internal Combustion Engine Research Association
BMEP	brake mean effective pressure
BSFC	brake specific fuel consumption
ECP	engine control panel
ESD	emergency shutdown
F & G	fire and gas
IACS	International Association of Classification Societies
IMO	International Maritime Organization
JW	jacket water
MCR	maximum continuous rating
MCS	marine classification society
OEM	original equipment manufacturer
UL	Underwriters Laboratories

4 General requirements

4.1 Service life

4.1.1

The diesel engine, including all auxiliaries, shall be designed and constructed for a minimum service life of 20 years.

NOTE This requirement is a design criterion. Service or duty severity, maloperation, or improper maintenance can result in the machine failing to meet this criterion.

4.1.2

The supplier shall specify in the proposal the minimum period of uninterrupted operation for the purchaser's acceptance.

4.1.3

The supplier shall advise the recommended maintenance program to define maintenance intervals and identify the wear and tear components that limit the period of uninterrupted operation.

4.2 Base scope

The base scope of diesel engines shall include:

– an inlet air filter,

– a turbocharger (if applicable),

– an engine mounted fuel system,

– an engine lube oil system,

– an engine mounted cooling system,

– a starting system,

– a speed governor,

– overspeed protection,

– an engine control panel,

– an air shut-off valve (if applicable),

– a barring device,

– lifting provisions for maintainable components,

– special tools.

4.3 Performance

4.3.1 Engine power rating

The engine power rating type shall be based on the power rating categories defined in ISO 8528-1.

4.3.2 Performance criteria

4.3.2.1

The engine performance test shall be carried out in accordance with ISO 15550, ISO 14396 and ISO 3046-3.

4.3.2.2

The brake power shall be corrected for site ambient temperature and altitude based on the brake power at standard reference, in accordance with the power correction method for compression-ignition engines as defined in Section 7 of ISO 15550.

4.4 Certification authority and Classification Society approval

4.4.1

Diesel engines, including auxiliaries installed on-board marine installations, shall comply with the rules of Classification Society, member of the IACS in the area of operation.

4.4.2

Diesel engines, including auxiliaries for safety critical services installed in offshore and marine installations, shall be subjected to approval of a third-party certification authority.

4.4.3

Diesel engines in marine applications shall be certified for compliance with International Maritime Organization (IMO) and Regulation 13 of Annex VI of MARPOL 73/78 and ISO 8178 for measuring exhaust emissions.

4.4.4

Emissions shall meet the local authority / regulatory requirements.

5 Technical requirements

5.1 Engine design

5.1.1 Cylinder liners

Diesel engines shall be provided with removable cylinder liners.

5.1.2 Direction of rotation

As per the designation of ISO 1204, the direction of rotation of the diesel engine shall be permanently marked on the engine in a visible location.

5.1.3 Crankcase ventilation system

5.1.3.1

Diesel engines shall be provided with a crankcase breather.

5.1.3.2

The diesel engine crankcase breather outlet shall be routed to safe location.

5.1.3.3

The vent from the fume filter shall be connected to downstream of the air inlet filter.

5.1.3.4

If required, an explosion relief device with flame arrestor shall be provided.

5.1.4 Engine barring device

5.1.4.1

Diesel engine crankshafts shall have provision for a barring device.

5.1.4.2

The barring device shall be one of the following types:

– manual,

– pneumatic,

– electric.

5.1.4.3

When proven by the supplier that manual barring is not feasible, a pneumatically operated or electrically actuated barring device shall be provided.

5.1.4.4

The barring device shall be interlocked with the diesel engine starting system.

5.1.5 Mechanical handling

All components over 25 kg and requiring onsite removal for maintenance shall be provided with lifting lugs or provisions for lifting eyebolts.

5.1.6 Personnel protection

Hot surfaces above 70 °C (158 °F) shall be provided with personnel protection either by suitable insulation or screening.

5.1.7 Emissions data

The diesel engine supplier shall provide emission data including NOx, CO, SOx and UHC for the operating range.

5.1.8 Emissions control

The package supplier shall provide details in their proposal regarding emission control and monitoring system to reduce exhaust emissions.

5.2 Starting system

5.2.1 General

5.2.1.1

Diesel engines in firewater pump applications shall be able to start-up and accelerate to rated speed within 20 seconds of initiating the start signal.

5.2.1.2

Diesel engines in emergency power generation applications shall be able to start-up and accept the rated load within 45 seconds of initiating the start signal.

5.2.1.3

Starting systems shall be rated for handling a minimum of six consecutive cranking cycles, each of 15 seconds duration, without recharging the battery or pressurizing the air vessel or hydraulic oil accumulator.

5.2.1.4

Diesel engines in safety critical services shall be provided with two independent starting systems.

5.2.1.5

If the engine fails to start after the specified number of cranking attempts, the starting sequence shall be aborted with a "failure to start" indication in the engine control panel or the unit control panel.

5.2.2 Electric starting system

5.2.2.1

Electric starting systems shall include:

– a 24V DC electric starter motor,

– a set of batteries,

– a battery charger,

– a starter control,

– a motor overspeed limit switch.

5.2.2.2

If the application requires two sets of batteries, a battery changeover facility shall be provided.

5.2.2.3

If specified, battery isolators shall be provided.

5.2.2.4

Batteries other than nickel cadmium or lead-acid types shall require the purchaser's approval.

5.2.2.5

For safety critical services other than firewater pumps, each set of batteries shall be rated for a minimum of six consecutive start attempts of 15 seconds cranking followed by 15 seconds rest.

5.2.2.6

Batteries shall have allowance to cover for capacity loss over a five-year period.

5.2.2.7

Batteries located in a compartment shall be ventilated to prevent the accumulation of hydrogen.

5.2.2.8

Battery chargers shall be of constant voltage float charge type with a current limiting feature to match the battery characteristics.

5.2.3 Pneumatic starting system

5.2.3.1

Pneumatic starting systems shall be diesel engine mounted air-starter motor type or direct injection type.

5.2.3.2

Diesel engine mounted air starter motors shall include control and overpressure protection.

5.2.3.3

Direct injection starting systems shall be provided with double check valve and relief valve.

5.2.3.4

For safety critical services, a starting air compressor and an air receiver shall be provided.

5.2.3.5

Starting air compressors shall be sized to recharge the air receiver within 15 minutes to the required starting air pressure.

5.2.3.6

The air receiver shall be designed in accordance with ASME Section VIII Division 1 or equivalent.

5.2.3.7

When required by the purchaser or the local authorities, air receivers shall be ASME code stamped or compliant with the essential safety requirements of the Pressure Equipment Directive (PED 2014/68/EU).

5.2.4 Hydraulic starting system

5.2.4.1

The hydraulic starting system shall include:

– a hydraulic starter motor,

– a hydraulic oil reservoir,

– accumulators as required,

– an engine driven hydraulic oil pump,

– a manual charge pump,

– oil filters,

– control and overpressure protection.

5.2.4.2

If a hydraulic starting system is provided as the only means of starting, an electric motor driven hydraulic oil pump shall be provided.

5.2.4.3

Hydraulic oil pumps shall be sized to recharge accumulators within 15 minutes.

5.2.4.4

Accumulators shall be sized to facilitate a minimum of six starts.

5.3 Air inlet and exhaust system

5.3.1 Air inlet system

5.3.1.1

If the combustion air is taken from inside the ventilated engine room, a single stage air filter mounted on the diesel engine frame shall be provided.

5.3.1.2

If the combustion air is taken from outside atmosphere, a two-stage air filtration system shall be provided.

5.3.1.3

Two-stage air filtration systems shall consist of weather hood, inertial type pre-filter followed by a dry media fine filter.

5.3.1.4

Pre-filters shall be rated for a filtration efficiency class of ISO ePM10 50 % or higher, in accordance with ISO 16890.

5.3.1.5

Engine air filters shall have a nominal particle rating of 5 µ with a filtration efficiency of 99.5 %.

5.3.1.7

For continuous operation in high humidity environment, coalescing filters shall be provided.

5.3.1.8

For diesel engines in hazardous area applications, air inlet shut-off valves shall be provided.

5.3.1.9

Air inlet shut-off valves shall be electrically actuated with a manual reset.

5.3.1.10

Diesel engine air filters shall be provided with a service indicator to monitor the condition of the air filter.

5.3.1.11

Differential pressure indicators shall be provided for two-stage air filters**.**

5.3.1.12

Condensate drainage shall be provided for diesel engines with charge-air cooler.

5.3.1.13

If required to meet the specified noise level, air inlet silencers shall be provided.

5.3.1.14

An expansion bellow shall be provided for engines with air inlet ducting.

5.3.2 Exhaust

5.3.2.1

Engine exhausts shall be provided with exhaust silencers.

5.3.2.2

In hazardous service, the exhaust shall be fitted with a spark arrester.

5.3.2.3

For diesel engines located in an enclosed container, an exhaust silencer shall be installed outside the container.

5.3.2.4

Exhaust expansion bellows shall be provided.

5.3.2.5

If required, water cooled exhaust manifolds or air-shielded water-cooled exhaust manifolds shall be provided to limit surface temperature within the specified temperature class limit.

5.4 Engine fuel system

5.4.1

A standard fuel system shall include:

– an engine driven fuel circulation pump,

– a manual priming pump,

– fuel injectors as required,

– a duplex main filter with manual change-over valve,

– a pre-filter pressure regulator,

– a fuel tank,

– a fuel shut-off valve.

5.4.2

A common rail fuel system shall include:

– an engine driven high pressure fuel pump,

– accumulators as required,

– a fuel injectors,

– high pressure lines with common rail and engine control unit,

– a duplex main filter,

– a pre-filter,

– a fuel pressure regulator,

– a fuel tank,

– a fuel shut-off valve.

5.4.3

The fuel tank capacity shall be determined by prevailing conditions, requirements for specific application or classification society requirements.

5.4.4

Electric priming pumps shall be provided for unattended operations.

5.4.5

If required to maintain the specified fuel tank and fuel supply temperature, a fuel cooler shall be provided in the return line to the fuel tank.

5.4.6

Main filters and pre-filters shall be provided with a differential pressure indicator.

5.4.7

A differential pressure transmitter with "high" differential pressure alarm shall be provided for diesel engines in continuous service.

5.4.8

The fuel tank shall be fitted with:

– a vent connection,

– a dip pipe,

– a level indicator,

– a drain connection.

5.5 Engine lubrication system

5.5.1

The lubrication system shall include:

– a lubrication oil sump,

– an engine driven main lubrication oil pump,

– a duplex lubrication oil filters with change-over valve,

– a lubrication oil cooler,

– a lubrication oil heaters,

– a lubrication oil temperature control valve,

– a lubrication oil pressure regulator,

– overpressure protection.

5.5.2

If the diesel engine requires to run pre-lubrication and post-lubrication cycles, an electric motor driven pre-lubrication pump shall be provided.

5.5.3

The pre-lubrication pump shall be provided with a discharge check valve.

5.5.4

For safety critical services, lubrication oil filters shall be provided with a pressure relief bypass valve.

5.5.5

A differential pressure indicator shall be provided for lubrication oil filters.

5.5.6

A differential pressure transmitter with a "high" differential pressure alarm shall be provided for diesel engines in continuous service.

5.5.7

The oil side pressure of the lubrication oil cooler shall be higher than the water side pressure.

5.6 Engine cooling system

5.6.1

The cooling system shall include:

– engine driven coolant pumps,

– radiator coolers or external air or water cooled heat exchangers,

– a temperature regulating device,

– an expansion tank.

5.6.2

If required, jacket water heaters shall be provided.

5.6.3

Radiators or external air coolers shall be designed for 110 % of the heat load at the engine rated power, at maximum ambient temperature.

5.6.4

Water cooled heat exchangers shall be designed for 110 % of the rated heat load at the maximum cooling medium inlet temperature, if an external cooling medium is used.

5.6.5

If located on the engine baseplate, radiator cooler fans shall be driven from the engine drive shaft through the direct drive, the V-belt drive or the toothed belt drive.

5.6.6

If located separately from the engine baseplate, radiator cooler fans shall be electric motor driven through a belt drive or a flexible coupling.

5.6.7

If required, separate high temperature (jacket water and lubrication oil coolers) and low temperature (charge-air cooler) cooling water circuits shall be provided as two independent systems.

5.6.8

A high point vent and a low point drain shall be provided for the cooling system.

5.6.9

Expansion tanks shall be provided with a level gauge.

5.6.10

Expansion tanks shall be provided with a level transmitter for diesel engines in safety critical or unattended services.

5.7 Vibration, rotordynamics and noise

5.7.1

The diesel engine manufacturer shall provide all relevant information related to torsional vibration calculations in accordance with ISO 3046-5 for completing train torsional analysis by the package supplier.

5.7.2

Vibration measurement points and direction shall be as defined in ISO 8528-9 and ISO 10816-6.

5.7.3

For diesel engines driving generator sets with power rating 100 kW and above, the vibration limits shall be in accordance with Table C.1 of ISO 8528-9.

5.7.4

For diesel engines in mechanical drive applications, the vibration limits shall be in accordance with Table A.1 of ISO 10816-6.

5.7.5

The diesel engine manufacturer shall provide sound pressure level and the sound power level at individual octave band frequencies at full load power for use by the package supplier to calculate the overall noise level.

5.8 Control, monitoring and protection

5.8.1 General

5.8.1.1

Instruments and controls, monitoring, and protective devices necessary for safe and reliable operation of the diesel engine shall be provided.

5.8.1.2

An engine control panel (ECP) mounted on the diesel engine, containing essential safety protection and control, shall be provided.

5.8.1.3

Electronic instruments e.g. transmitters and control valves shall be provided with a requisite communication protocol, as defined in the data sheet, to facilitate communication, remote monitoring and diagnostics from the purchaser's control system.

5.8.1.4

For onshore outdoor installations, control and instrumentation shall conform to a minimum ingress protection class IP55 as per IEC 60529 or NEMA 3 as per NEMA 250.

5.8.1.5

For offshore outdoor installation, control and instrumentation shall conform to ingress protection class IP65 as per IEC 60529 or NEMA 4 as per NEMA 250.

5.8.2 Engine Control Panel (ECP)

5.8.2.1

The ECP shall be provided with communication interface to the package supplier's local control panel and the purchaser's control system for remote operation and control, data monitoring and retrieval.

5.8.2.2

As a minimum, the ECP shall have the following:

– an auto/manual selector switch,

– emergency stop function,

– overspeed trip indication,

– a trip reset following ESD or overspeed trip.

5.8.2.3

The ECP shall have provision for remote indication and monitoring of the following functions, in the supplier's local control panel or remote control panel for the facility:

– engine available for automatic start,

– engine running,

– engine failed to start,

– common alarm and trip,

– engine lock-out.

5.8.2.4

All safety critical signals shall have hardwired signal interfaces.

5.8.3 Overspeed and emergency shutdown

5.8.3.1

Diesel engines shall be provided with an independent overspeed trip device.

5.8.3.2

The ECP shall have provision for manual reset following an overspeed trip or emergency shutdown, prior to re-start.

5.8.3.3

The air inlet shut-off valve, where provided, shall be latched in "closed" position following an emergency shutdown (ESD) or overspeed trip.

5.8.3.4

For diesel engines provided with a post lubrication system, the post lubrication system cycle shall be bypassed on receipt of an ESD signal or overspeed trip signal to ECU or activation of emergency stop push button in the ECU or field.

5.8.4 Alarms and Trips

5.8.4.1

As a minimum, diesel engines shall include monitoring, alarm and trip functions in accordance with Table 1.

Table 1 – Monitoring, alarm and trip functions

Condition	Indication	Alarm	Trip
Engine speed (H, HH)	X	X	X
Engine vibration (H, HH)	X	X	X [a]
Lube oil supply temperature (H, HH)	X	X	X [a]
Lube oil supply pressure (L, LL)	X	X	X [a]
Lube oil filter differential pressure	X	X	
Jacket water temperature (H, HH)	X	X	X [a]
Lube oil filter differential pressure (H)	X	X	
Lube oil sump level (L)	X	X	X [a]
Main fuel filter differential pressure (H)	X	X	
Fuel pre-filter differential pressure across (H)	X	X	
Engine service-hours meter	X		
Radiator Cooler Fan Vibration High	X	X	

[a] Refer to 5.8.4.2

5.8.4.2

For diesel engines in safety critical services, while on "auto" or "remote" mode, all trip interlocks except overspeed trip shall be bypassed.

5.8.4.3

All trip interlocks shall be active while on "test" mode.

5.8.4.4

An emergency stop push button shall be provided locally to the diesel engine.

5.9 Speed governor and overspeed protection device

5.9.1

Speed governors shall be provided in accordance with ISO 3046-4.

5.9.2

In electric generator applications, speed governors shall additionally meet the requirements of 6.3 of ISO 8528-2.

5.9.3

Speed governors for diesel engines in firewater pump service shall comply with the requirements of NFPA 20.

5.9.4

For diesel engine driven generator sets, the speed governor accuracy class shall be in accordance with performance class G2 as defined in Table 4 of ISO 8528-5.

5.9.5

Overspeed trip devices shall be in accordance with ISO 3046-6.

5.9.6

The overspeed trip set point for diesel engines shall be in the range of 110 % to 120 % of the rated speed.

5.10 Coupling and guard

5.10.1

The supplier with the overall responsibility for the package shall supply the coupling between the diesel engine and the driven equipment.

5.10.2

Shrink-fit coupling hubs shall not be used.

5.10.3

Coupling adapters shall not be used for crank shafts with integrally forged shaft end for flywheel assembly.

5.10.4

A minimum service factor of 1.75 shall be used for the selection of couplings.

5.10.5

The coupling-to-shaft juncture shall be designed for the same service factor as defined for the coupling.

5.10.6

The maximum tolerances on parallel and angular misalignments shall be specified by the manufacturer/ supplier.

5.10.7

Coupling guards shall be provided.

5.11 Mounting plate

5.11.1

Diesel engines supplied with a sub-baseplate for mounting on a package shall be designed to be bolted and doweled to the package baseplate.

5.11.2

The diesel engine manufacturer/supplier shall provide details in the proposal for levelling of the engine and alignment with the driven equipment.

5.11.3

For diesel engines resiliently mounted on the baseplate or the foundation, the diesel engine manufacturer/supplier shall provide flexible mounts to reduce vibrations transmitted to the baseplate or foundation.

5.11.4

As a minimum, the diesel engine sub-baseplate shall be provided as a minimum with four lifting lugs designed for a single-point lift.

5.11.5

The diesel engine sub-baseplate shall be single fabricated structural steel units with continuous welding for all load bearing structures.

5.11.6

Machinery mounting plates shall be machined flat and parallel after fabrication.

5.11.7

Machinery mounting plates shall extend at least 25 mm (1 in.) beyond outer three sides of the equipment feet.

5.11.8

Shim plates for alignment shall be made of stainless steel.

5.12 Hazardous area requirements

5.12.1

Diesel engines and auxiliaries installed in a hazardous area shall comply with the requirements of EN 1834-1.

5.12.2

The maximum surface temperature shall be based on peak engine power at worst operating conditions, in accordance with EN 1834-1.

5.12.3

Permeable dry insulation shall not be utilized to reduce surface temperature.

5.12.4

Radiator fan blades shall be made of non-sparking material.

5.12.5

Crankcases shall be provided with an explosion relief device and a flame arrestor.

5.12.6

Coupling guards shall be made of non-sparking material.

5.12.7

Diesel engine exhausts shall be fitted with a spark arrestor.

6 Materials

6.1

Material selection shall follow the recommendations of ISO 21457.

6.2

Materials for specific items shall be in accordance with Table 2 and the data sheet.

6.3

The manufacturer's standard materials shall be reviewed and approved by the purchaser.

6.4

Cast iron, carbon steel and low alloy steel external surfaces shall always be coated.

6.5

Coating for “harsh” environments with atmospheric corrosivity category C4, C5 and CX to ISO 12944-2, including coating for offshore service, shall be qualified in accordance with ISO 12944-9.

6.6

Coating system for environments with atmospheric corrosivity category C1 to C3 to ISO 12944-2 shall be selected in accordance with ISO12944-5, corrosivity category C3, durability high.

Coating system qualification shall be in accordance with ISO 12944-6.

Table 2 – Material selection

Item	Material of construction (base case)[a]	Material of construction (harsh environment)[b]
Engine block	Manufacturer's standard	Manufacturer's standard
Air inlet and exhaust		
Inlet air filter	Carbon steel (coated)[c]	Carbon steel (coated)[d] or 316 stainless steel
Exhaust pipe and bellow	321 stainless steel or 316 stainless steel	321 stainless steel or 316 stainless steel
Exhaust silencer housing	316 stainless steel	316 stainless steel
Engine lubrication oil system		
Lubrication oil sump	Manufacturer's standard	Manufacturer's standard
Lubrication oil pump	Manufacturer's standard	Manufacturer's standard
Lubrication oil filters (housing)	Manufacturer's standard	Manufacturer's standard
Lubrication oil cooler	Manufacturer's standard	Manufacturer's standard
Lubrication oil piping[f]	Manufacturer's standard	Manufacturer's standard
Engine fuel system		
Fuel oil pump	Manufacturer's standard	Manufacturer's standard
Fuel filter (housing)	Manufacturer's standard	Manufacturer's standard
Fuel oil piping[f]	Carbon steel (coated)[c], 304[e] or 316[e] stainless steel downstream of main fuel filter	316[e] stainless steel
Engine cooling system (closed cooling water system)		
Cooling water pump	Manufacturer's standard	Manufacturer's standard
Charge air cooler	Manufacturer's standard	Manufacturer's standard
Jacket water cooler	Manufacturer's standard	Manufacturer's standard
Jacket water pre-heater	Manufacturer's standard	Manufacturer's standard
Cooling water piping[f]	Manufacturer's standard	Manufacturer's standard
Expansion tank	Carbon steel (coated)[c]	Carbon steel (coated)[d]
Miscellaneous		
Engine control panel	Carbon steel (coated)[c]	Carbon steel (coated)[d] or 316 stainless steel
Tubing	316 stainless steel[f]	316 stainless steel[f]

[a] Base case requirements shall apply to diesel engines located in dry indoor environment (engine room/ container) or outdoor environment with atmospheric corrosivity category C1 to C3 (low to medium corrosivity to ISO 12944-2).

[b] Harsh environments shall apply to diesel engines located in an outdoor environment with atmospheric corrosivity category C4 to CX (high to extreme corrosivity to ISO 12944-2).

[c] Coating system shall comply with atmospheric corrosivity category C3 (high durability to ISO 12944-5).

[d] Coating system for 'harsh' environment.

[e] Austenitic stainless steel grade 304 and 316 shall be dual certified to meet the requirements of both 304/304L and 316/316L respectively.

[f] ISO 21457 temperature limits shall apply to stainless steels to prevent external and internal corrosion and cracking.

7 Inspection, testing and preparation for shipment

7.1 General

7.1.1

Inspection, testing, and certification of equipment and auxiliaries shall be carried out in accordance with the relevant design standards, regulatory and Classification Society requirements, this specification and the data sheet.

7.1.2

Hydrostatic testing shall be performed for all engine mounted pressure containing components and the pressure equipment parts of off-engine package auxiliaries.

7.1.3

An emission test or type approval as per ISO 8178 shall be carried out.

7.2 Mechanical and performance test

7.2.1

The diesel engine shall be subjected to an acceptance test in accordance with ISO 15550 or ASME PTC 17 or, when available, a type test certificate.

7.2.2

The diesel engine overspeed testing shall be carried out at the specified overspeed limit at the diesel engine manufacturer's premises.

7.2.3

During complete unit testing with the driven machinery, the diesel engine static load test shall be carried out at 50 %, 75 %, 100 % and 110 % of load to determine the performance of the engine.

7.2.4

A diesel engine vibration test shall be performed and the vibration data recorded for verification within the specified limit, as stated in 5.7.4 and 5.7.5.

7.2.5

Measurement of the sound pressure level and the sound power level test shall be carried out in accordance with ISO 3744 or ISO 9614-2.

7.3 Functional test

7.3.1

The diesel engine manufacturer / package supplier shall carry out a functional test of the starting system to verify the diesel engine starting time in compliance to 5.2.1.2.

7.3.2

The diesel engine manufacturer / package supplier shall carry out a test to demonstrate the cranking cycle sequence and the cranking period duration during start-up, in accordance with 5.2.1.3.

7.3.3

Overspeed trip functionalities shall be tested.

7.3.4

All functionalities of the ECP shall be verified for correct functioning of:

– the visual display,

– the control switch,

– the control logic,

– the alarm and the trip set points,

– the communication interface.

7.4 Preparation for shipment

7.4.1

A final inspection shall be performed prior to shipment, and include dimensional inspection, completeness of scope and documentation review.

7.4.2

The diesel engine manufacturer/supplier shall apply initial preservation upon completion of all inspection and testing activities, for a period of minimum six months of outdoor storage from the time of shipment.

7.4.3

All exposed machined and un-painted surfaces shall be coated with vapour proof corrosion inhibitor.

7.4.4

All visible display units and the control panel front face shall be protected during transportation and handling.

7.4.5

Open piping connections shall be blanked-off or capped and be sealed.

7.4.6

Lifting lugs shall be clearly identified on the equipment package.

7.4.7

The recommended lifting arrangements shall be identified with the boxed equipment and a set of lifting instructions enclosed with the shipment.

7.4.8

The equipment shall be identified, as defined in the purchase order, with:

– the tag number,

– the serial number,

– a label with shipping information.

7.4.9

All ship loose materials and spare parts shall be identified with:

– the spare part tag number,

– the spare part serial number,

– the equipment tag number.

8 Spare parts, operation and maintenance

8.1

The supplier shall submit separate lists for capital spare parts, commissioning spare parts, and two years' operating and maintenance spare parts, and include:

– the diesel engine supplier’s part number,

– the tag number or engine serial number (if applicable),

– the manufacturer and model number,

– the original equipment manufacturer (OEM) part number,
– the recommended stocking quantity,
– the unit price,
– the delivery time.

8.2

The list of spare parts shall include:

– diesel engine service kits,
– special gaskets for exhaust set,
– an air shut-off valve set,
– a fuel filter element set,
– a lubrication oil filter element set,
– an air-inlet filter set,
– an engine controller,
– a speed governor,
– a jacket water heater set,
– an oil priming pump set,
– lubrication oil pumps (main and pre-lubrication) set,
– a starter motor set,
– a turbocharger set.

8.3

Spare parts shall comply with all applicable requirements as for the original component.

9 Vendor drawing and data requirement

9.1 General

The data shall identify:

– the purchaser's name,
– the project name,
– the project number,

– the equipment tag number,
– the service name,
– the enquiry or purchase order number.

9.2 Proposal

The proposal shall include:

– a data sheet for the diesel engine and auxiliaries,
– a general arrangement drawing for the diesel engine and auxiliaries,
– a foundation loading diagram with support details,
– a piping and instrumentation diagram for the lubrication oil system,
– a piping and instrumentation diagram for the fuel system,
– a piping and instrumentation diagram for the cooling water system,
– a piping and instrumentation diagram for the air inlet and exhaust system,
– preliminary utilities data for process utilities and electrical load,
– a proposed inspection and test plan,
– a preliminary supplier master information register (SMIR),
– a list of capital spares,
– a list of commissioning spares.

9.3 Contract data

9.3.1

For sub-supplied items and components, the manufacturer's data sheet shall be provided.

9.3.2

The installation, operation and maintenance manual shall be prepared for the equipment covered by the purchase order. Typical manuals are not acceptable.

Registered Office
City Tower
40 Basinghall Street
14th Floor
London EC2V 5DE
United Kingdom

T +44 (0)20 3763 9700
F +44 (0)20 3763 9701
reception@iogp.org

Brussels Office
Bd du Souverain,165
4th Floor
B-1160 Brussels
Belgium

T +32 (0)2 566 9150
F +32 (0)2 566 9159
reception@iogp.org

Houston Office
10777 Westheimer Road
Suite 1100
Houston, Texas 77042
United States

T +1 (713) 470 0315
reception@iogp.org

www.iogp.org