

Specification for Diesel Generator Package (ISO/IEC Offshore)

Public Review Draft

Revision history

VERSION	DATE	PURPOSE
0.1	September 2022	Issued for Public Review

Acknowledgements

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

Disclaimer

Whilst every effort has been made to ensure the accuracy of the information contained in this publication, neither IOGP nor any of its Members past present or future warrants its accuracy or will, regardless of its or their negligence, assume liability for any foreseeable or unforeseeable use made thereof, which liability is hereby excluded. Consequently, such use is at the recipient's own risk on the basis that any use by the recipient constitutes agreement to the terms of this disclaimer. The recipient is obliged to inform any subsequent recipient of such terms.

Please note that this publication is provided for informational purposes and adoption of any of its recommendations is at the discretion of the user. Except as explicitly stated otherwise, this publication must not be considered as a substitute for government policies or decisions or reference to the relevant legislation relating to information contained in it.

Where the publication contains a statement that it is to be used as an industry standard, IOGP and its Members past, present, and future expressly disclaim all liability in respect of all claims, losses or damages arising from the use or application of the information contained in this publication in any industrial application.

Any reference to third party names is for appropriate acknowledgement of their ownership and does not constitute a sponsorship or endorsement.

Copyright notice

The contents of these pages are © International Association of Oil & Gas Producers. Permission is given to reproduce this report in whole or in part provided (i) that the copyright of IOGP and (ii) the sources are acknowledged. All other rights are reserved. Any other use requires the prior written permission of IOGP.

These Terms and Conditions shall be governed by and construed in accordance with the laws of England and Wales. Disputes arising here from shall be exclusively subject to the jurisdiction of the courts of England and Wales.

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 2020).

Table of Contents

	Foreword	1
	Introduction	4
1	Scope	6
	1.1 Scope definition	6
	1.2 Scope boundaries	6
	1.3 Exclusions from scope	6
2	Normative references	6
3	Terms, definitions and acronyms	7
	3.1 Terms and definitions	7
	3.2 Acronyms	7
4	Application, ratings, performance and testing of diesel generator packages	8
	4.1 Compliance	8
	4.2 Interfaces	8
	4.3 Interface termination	8
	4.4 Cable entries	8
	4.5 Cables	8
	4.6 Fire and gas detection	8
	4.7 Baseplate	8
	4.8 Flanged openings	9
	4.9 Provision for removal	9
	4.10 Testing	9
5	Engines	9
	5.1 Starting systems	9
	5.2 Overspeed detection	9
	5.3 Batteries and chargers	10
	5.4 Inlet and exhaust systems	10
	5.5 Cooling systems	10
	5.6 Crankcase	11
	5.7 Vibration	11
	5.8 Personnel protection	11
	5.9 Guards	11
	5.10 General	11
6	Alternating current generators	12
	6.1 Generator excitation	12
	6.2 Neutral conductor size	12
	6.3 Generator winding insulation type	12
	6.4 Insulated bearings	12

6.5	Anti-condensation heater	12
6.6	RTD junction box.....	12
7	Control panel	12
7.1	Operation mode selector switch.....	12
7.2	Parallel operation	13
7.3	Control panel earthing design	13
7.4	Electromagnetic compatibility.....	13
7.5	Communication interface	13
7.6	Interfaces for shutdown.....	13
7.7	Control panel alarms, trips and shutdown functions	13
7.8	Diesel engine monitoring, alarm and trip functions	13
	Bibliography.....	16

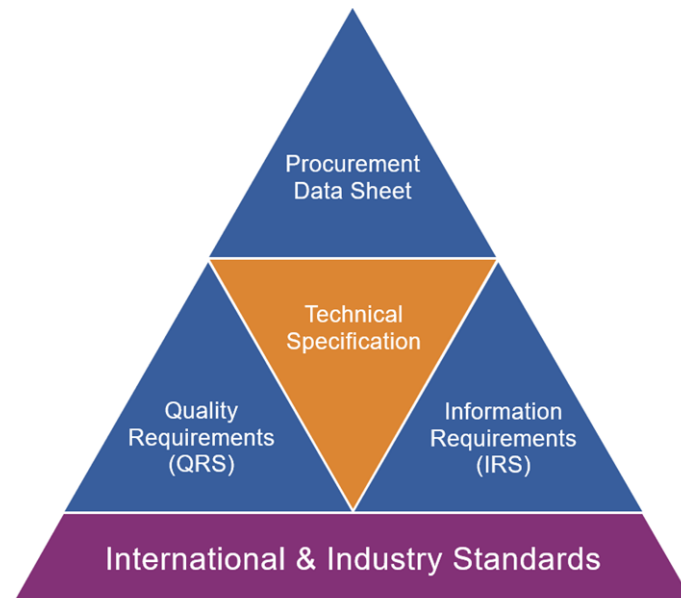
List of Tables

Table 1 — Generator status, alarm, trip and shutdown functions	14
Table 2 — Monitoring, alarm and trip functions.....	15

Introduction

The purpose of this specification is to define a minimum common set of requirements for the procurement of diesel generator package (ISO/IEC Offshore) for application in the petroleum and natural gas industries.

This 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 Technical Specification

This specification is to be applied in conjunction with the supporting procurement data sheet, information requirements specification (IRS) and quality requirements specification (QRS) as follows.

IOGP S-714-1: Diesel Generator Package (ISO/IEC Offshore)

This specification defines the technical requirements for the supply of the equipment.

IOGP S-714-1D: Procurement Data Sheets for Diesel Generator Package (ISO/IEC Offshore)

The procurement data sheet defines application specific requirements, attributes and options specified by the purchaser for the supply of equipment to the technical specification. The procurement data sheet may also include fields for supplier provided information attributes subject to purchaser's technical evaluation. Additional purchaser supplied documents may also be incorporated or referenced in the procurement data sheet to define scope and technical requirements for enquiry and purchase of the equipment.

IOGP S-714-1L: Information Requirements for Diesel Generator Package (ISO/IEC Offshore)

The IRS defines the information requirements, including contents, format, timing and purpose to be provided by the supplier. It may also define specific conditions which invoke information requirements.

IOGP S-714-1Q: Quality Requirements for Diesel Generator Package (ISO/IEC Offshore)

The QRS defines quality management system requirements and the proposed extent of purchaser conformity assessment activities for the scope of supply. Purchaser conformity assessment activities are defined through the selection of one of four generic conformity assessment system (CAS) levels on the basis of evaluation of the associated service and supply chain risks. The applicable CAS level is specified by the purchaser in the data sheet or in the purchase order.

The terminology used within this specification and the supporting procurement data sheet, IRS and QRS is in accordance with ISO/IEC Directives, Part 2.

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

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 (procurement data sheet, IRS, QRS);
- d) this specification.

1 Scope

1.1 Scope definition

This specification provides technical requirements for the supply of diesel generator packages for use in offshore fixed and floating production facilities using ISO and IEC standards.

1.2 Scope boundaries

This specification is applicable to:

- emergency generators;
- essential generators;
- main generators.

NOTE 1 Emergency generators are intended to supply the emergency system in the event of failure of the supply from the main source of electrical power [SOURCE: IEC 61892-2:2019, 3.1.33.1, modified – the term has been truncated to “emergency” and domain added].

NOTE 2 Essential generators are intended to supply the services necessary to maintain the plant in a habitable condition and the equipment necessary for asset preservation, standby and restarting [SOURCE: IEC 61892-2:2019, 3.1.33.2, modified – the term has been truncated to “emergency” and domain added].

NOTE 3 Main generators are intended to supply all services necessary for maintaining the plant in a normal operational and habitable condition [SOURCE: IEC 61892-2:2019, 3.1.33.3, modified – the term has been truncated to “emergency” and domain added].

1.3 Exclusions from scope

This specification does not apply to:

- diesel generators for supplying power to a firewater pump drive motors;
- diesel generators installed in hazardous area.

2 Normative references

The following publications are referred to in this document, the procurement data sheet (IOGP S-714-1D) or the IRS (IOGP S-714-1L) in such a way that some or all of their content constitutes requirements of this specification. For dated references, only the edition cited applies. For undated references, the latest edition of the references document (including any amendments) applies.

ASME BPVC, Section VIII, Division 1, *Rules for Construction of Pressure Vessels*

ASTM D975, *Standard Specification for Diesel Fuel*

EN 590, *Automotive fuel – Diesel – Requirements and test methods*

EN 13445, *Unfired pressure vessels*

IEC 61000-6-2, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments*

IEC 61000-6-4, *Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments*

IEC 61892-3:2019, *Mobile and fixed offshore units – Electrical installations – Part 3: Equipment*

IEEE C37.2, *IEEE Standard Electrical Power System Device Function Numbers, Acronyms, and Contact Designations*

ISO 8528-1, *Reciprocating internal combustion engine driven alternating current generating sets — Part 1: Application, ratings and performance:*

ISO 8528-2, *Reciprocating internal combustion engine driven alternating current generating sets — Part 2: Engines*

ISO 8528-3, *Reciprocating internal combustion engine driven alternating current generating sets — Part 3: Alternating current generators for generating sets*

ISO 8528-4:2005, *Reciprocating internal combustion engine driven alternating current generating sets — Part 4: Controlgear and switchgear*

ISO 8528-5:2018, *Reciprocating internal combustion engine driven alternating current generating sets — Part 5: Generating sets*

ISO 8528-6:2005, *Reciprocating internal combustion engine driven alternating current generating sets — Part 6: Test methods*

ISO 10816-6:1995, *Mechanical vibration — Evaluation of machine vibration by measurements on non-rotating parts — Part 6: Reciprocating machines with power ratings above 100 kW*

ISO 12944-1, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 1: General introduction*

ISO 12944-2, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 2: Classification of environments*

ISO 16890-1:2016, *Air filters for general ventilation — Part 1: Technical specifications, requirements and classification system based upon particulate matter efficiency (ePM)*

3 Terms, definitions and acronyms

3.1 Terms and definitions

3.1.1

control panel

panel of a diesel generator package that provides system monitoring, controls and protections for the diesel engine and the a.c. generator in one location

3.2 Acronyms

a.c. alternating current

RTD resistance temperature device

4 Application, ratings, performance and testing of diesel generator packages

4.1 Compliance

The diesel generator package shall comply with ISO 8528-1 to -6.

4.2 Interfaces

Utility and service interfaces shall be singular at the diesel generator package skids.

4.3 Interface termination

Utility and service interfaces shall terminate at skid edge flanges, at junction boxes or at the control panel.

4.4 Cable entries

Open cable entries shall be fitted with sealing plugs.

4.5 Cables

Power and instrument cables shall be flame retardant, low smoke and low halogen type.

4.6 Fire and gas detection

4.6.1

The release of fire suppressant shall be activated from the facility fire and gas system via a hard-wired signal to the supplier control panel.

4.6.2

Fire and gas detectors shall be installed and wired inside the diesel generator package enclosure.

4.7 Baseplate

4.7.1

The baseplate shall be designed for a single-point lift.

4.7.2

The baseplate shall be continuously welded.

4.7.3

The baseplate shall have a continuously welded secondary containment with a flanged drain.

4.7.4

Baseplate mounting pads shall be flat and parallel with each other to within 0,15 mm/m (0,002 in/ft).

4.7.5

The surface finish of baseplate mounting areas shall not exceed Ra 3,2 µm (125 µin).

4.8 Flanged openings

Flanged openings shall be provided with sealed protective covers made of weatherproof material.

4.9 Provision for removal

The diesel generator enclosure shall have provision for the removal of the generator and the diesel engine.

4.10 Testing

The diesel generator package shall be tested in accordance with ISO 8528-6:2005, Clause 5.

5 Engines

5.1 Starting systems

5.1.1

Diesel engines in emergency generator service shall have two independent starting systems.

5.1.2

Diesel engines with two independent starting systems shall have an automatic changeover device.

5.1.3

Starting systems shall be rated for handling three consecutive cranking cycles, each of 15 s of cranking and 15 s of rest, without recharging the battery or pressurizing the air vessel or hydraulic oil accumulator.

5.1.4

If the diesel engine fails to start after a complete cycle of cranking attempts, the starting sequence shall be aborted with a "failure to start" indication in the control panel.

5.1.5

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

5.1.6

Air and hydraulic starting systems shall be provided with system isolation valves.

5.1.7

Direct injection starting systems shall have double check valves between the air source and the engine.

5.2 Overspeed detection

Diesel engines shall have two independent speed sensors with shutdown of the engine occurring when one of the sensors detects an over-speed.

5.3 Batteries and chargers

5.3.1

Batteries shall be located in a naturally ventilated compartment.

5.3.2

Batteries shall be provided with two-pole isolators.

5.3.3

The battery charger shall have output surge protection.

5.4 Inlet and exhaust systems

5.4.1

Diesel engine air pre-filters shall be rated for a filtration efficiency class of ISO ePM10 50 % or higher, in accordance with ISO 16890-1:2016, Table 4.

5.4.2

Diesel engine air filters shall have a service indicator.

5.4.3

Diesel engines with air inlet ducting shall be provided with expansion bellows.

5.4.4

The exhaust silencer of a diesel engine in an enclosure or container shall be located outside the enclosure or container.

5.5 Cooling systems

5.5.1

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

5.5.2

Water-cooled heat exchangers shall be designed for 110 % of the maximum heat load at the maximum cooling medium inlet temperature.

5.5.3

The cooling system shall have a high-point vent.

5.5.4

The cooling system shall have a low-point drain.

5.5.5

Charge air coolers shall have a condensate draining feature.

5.5.6

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

5.6 Crankcase

5.6.1

The diesel engine crankcase shall have an explosion relief device with a flame arrestor.

5.6.2

When not routed to the engine air intake, the diesel engine crankcase breather outlet shall be flanged at the skid edge.

5.7 Vibration

5.7.1

Vibration points, direction and limits shall be in accordance with ISO 10816-6:1995.

5.7.2

Data and vibration calculations for torsional analysis shall be in accordance with ISO 8528-5:2018, 14.10.

5.8 Personnel protection

5.8.1

In areas that are accessible during operation and inspection, protection against potential injury from surfaces exceeding 60 °C (140 °F) shall be provided.

5.8.2

Insulation used to reduce surface temperature shall be impermeable.

5.9 Guards

5.9.1

Couplings and flywheels shall have guards.

5.9.2

Coupling guards shall be made of a non-sparking material.

5.10 General

5.10.1

The direction of rotation shall be permanently marked on the drive end of the engine.

5.10.2

Components over 25 kg (55 lb) requiring removal for maintenance shall have lifting lugs or provisions for lifting eyebolts.

5.10.3

The fuel system filter element shall remove water and solids.

5.10.4

Coupling adapters shall not be used for flywheel assembly when the crank shaft has an integrally-forged shaft end.

6 Alternating current generators

6.1 Generator excitation

6.1.1

The synchronous generator exciter shall be a brushless type with a rotating rectifier bridge circuit.

6.1.2

The excitation system field forcing capability shall be 300 % of the rated current for 7,5 s and 150 % of the rated current for 30 s.

6.2 Neutral conductor size

The neutral conductor of three-phase, four-wire systems of electrical power shall be equal to the phase conductor specification and size.

6.3 Generator winding insulation type

Generator stator windings shall be insulated using the vacuum pressure impregnation technique.

6.4 Insulated bearings

Bearing insulation shall be provided for generators with shaft voltage greater than 350 mV RMS value.

6.5 Anti-condensation heater

Anti-condensation heaters shall be provided for the generator and the control panel.

6.6 RTD junction box

Generator stator winding and bearing RTDs shall be wired to a dedicated junction box.

7 Control panel

7.1 Operation mode selector switch

The control panel shall have a "Manual-Test-Auto-Off" operation mode selector switch for a diesel generator in emergency service.

NOTE 1 The manual mode starts the diesel engine if a "start inhibit" condition does not exist.

NOTE 2 The test mode simulates an undervoltage signal to start the diesel engine and generate specified voltage and frequency, either manually or automatically, and initiates a "close" signal to the circuit breaker. The test mode allows the operator to load and unload the diesel generator package, open the circuit breaker and stop the generator to complete the test cycle.

NOTE 3 The auto mode selection starts the diesel engine automatically upon receipt of an undervoltage signal from the switchgear, generates specified frequency and voltage, synchronizes with the grid, and initiates a "close" signal to the circuit breaker.

7.2 Parallel operation

Generator sets specified for parallel operation shall have a control system and instrumentation in accordance with ISO 8528-4:2005, 6.12.

7.3 Control panel earthing design

Control panel earthing shall comply with IEC 61892-3:2019, 4.14.

7.4 Electromagnetic compatibility

The electromagnetic compatibility of electrical equipment and instrumentation shall comply with IEC 61000-6-2 for immunity and IEC 61000-6-4 for emissions.

7.5 Communication interface

7.5.1

The package control and monitoring system shall be time-synchronized with the facility control system.

7.5.2

The diesel generator package shall continue to operate when the communication interface fails.

7.6 Interfaces for shutdown

The control panel shall have terminations for hardwired external signals.

7.7 Control panel alarms, trips and shutdown functions

The generator status, alarm, trip and shutdown functions shall be in accordance with Table 1.

7.8 Diesel engine monitoring, alarm and trip functions

Diesel engines shall have monitoring, alarm and trip functions in accordance with Table 2.

Table 1 — Generator status, alarm, trip and shutdown functions

Function	Status	Alarm	Trips for essential and main generator	Trips for emergency generator
Overcurrent – voltage restraint (51V)			X	X
Overcurrent (50/51)			X	X
Stator earth/ground fault ^a (51G)			X ^c	X ^c
Under voltage (27)		X	X	
Over voltage (59)		X	X ^c	
Under frequency (81U)		X	X	
Over frequency (81O)		X	X ^c	
Reverse power ^b (32R)			X ^c	X ^c
Negative phase sequence (46)			X	
Loss of excitation (40)			X	
Differential protection (87G) ^d			X	
Pole slipping (78)			X	
Overload (49)		X		
Overexcitation (24)			X	
Stator winding temperature high (49S)		X	X	
Diode failure (58)		X	X	
Rotor earth/ground fault (64)			X ^c	
Bearing temperature high (49B)		X	X ^c	
Local emergency shutdown (command)			X ^c	X ^c
Remote emergency shutdown (command)			X ^c	X ^c
External shutdown override status for generator	X			
Automatic voltage regulator failure		X		
Control panel common alarm		X		
Lock out general			X	
Generator circuit breaker "OPEN"	X			
Generator circuit breaker "CLOSED"	X			
Control/trip supply "ON"	X			
Generator "Not in Auto"	X			
Generator "Unavailable"	X			
Generator "Fail to start"	X			

Key

X: required

NOTE Device numbers are as per IEEE C37.2 and can also be used in IEC standard projects also.

^a Where a restricted earth/ground fault relay is used for generator differential protection, the separate stator earth/ground relay may be omitted.

^b Applicable only when parallel operation of the generator is specified.

^c Shutdown of the engine is required in addition to generator trip.

^d The generator supplier shall make mounting provision and termination of purchaser's supplied differential protection current transformers in the generator neutral terminal box.

Table 2 — Monitoring, alarm and trip functions

Condition	Indication	Alarm	Trip
Engine speed (H, HH) ^c	X	X	X
Engine vibration (H, HH)	X	X	
Lube oil supply temperature (H, HH)	X	X	
Lube oil supply pressure (L, LL)	X	X	X
Lube oil filter differential pressure (H)	X	X ^a	
Lube oil sump level (L, LL)	X	X	X
Jacket water temperature (H, HH)	X	X	X
Expansion tank level (L)	X	X	
Inlet air filter differential pressure (H)	X	X ^a	
Temperature of charge-air downstream of cooler (H)	X	X ^a	
Main fuel filter differential pressure (H)	X	X ^a	
Fuel pre-filter differential pressure across (H)	X	X ^a	
Day tank fuel level (L)	X	X	
Engine service-hours meter	X		
Radiator cooler fan vibration high (H)	X	X	
Emergency stop (HH)	X		X ^b
Abort of engine starting	X		
Key X: required			
^a Continuous operation only. ^b Diesel engines in emergency diesel generator service shall have trip interlocks bypassed while in "Auto" mode of operation, except for overspeed trip and emergency stop. ^c Overspeed trip system shall be provided in accordance with ISO 8528-6:2005.			

Bibliography

- [1] API Specification Q1, *Specification for Quality Management System Requirements for Manufacturing Organizations for the Petroleum and Natural Gas Industry*
- [2] API Specification Q2, *Specification for Quality Management System Requirements for Service Supply Organizations for the Petroleum and Natural Gas Industries*
- [3] IEC 60034-1:2022, *Rotating Electrical Machines – Part 1: Rating and Performance*
- [4] IEC 60034-6, *Rotating electrical machines Part 6: Methods of cooling (IC Code)*
- [5] IEC 60034-7:2020, *Rotating electrical machines – Part 7: Classification of types of construction, mounting arrangements and terminal box position (IM Code)*
- [6] IEC 60085, *Electrical insulation – Thermal evaluation and designation*
- [7] IEC 61355-1, *Classification and designation of documents for plants, systems and equipment – Part 1: Rules and classification tables*
- [8] IEC 61892-2, *Mobile and fixed offshore units – Electrical installations – Part 2: System design*
- [9] ISO 9001, *Quality management systems — Requirements*
- [10] ISO 10005, *Quality management — Guidelines for quality plans*
- [11] ISO 13702, *Requirements and guidelines for the control and mitigation of fires and explosion on offshore oil and gas installations*
- [12] ISO 13880:1999, *Petroleum and natural gas industries — Content and drafting of a technical specification*
- [13] ISO 15664, *Acoustics — Noise control design procedures for open plant*

Registered Office

City Tower
Level 14
40 Basinghall Street
London EC2V 5DE
United Kingdom
T +44 (0)20 3763 9700
reception@iogp.org

Brussels Office

Avenue de Tervuren 188A
B-1150 Brussels
Belgium
T +32 (0)2 790 7762
reception-europe@iogp.org

Houston Office

15377 Memorial Drive
Suite 250
Houston, TX 77079
USA
T +1 (713) 261 0411
reception-americas@iogp.org

www.iogp.org

Draft