International Association of Oil & Gas Producers

SPECIFICATION

IOGP S-713

August 2025

Version 2.0

Supplementary Specification to API Standard 613 for Special-purpose Gears

JIP33 JOINT INDUSTRY PROGRAMME

Revision history

VERSION	DATE	PURPOSE
2.0	August 2025	Second Edition
1.0	July 2020	First Edition

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).

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).

This second edition cancels and replaces the first edition published in July 2020. Due to technical writing requirements leading to extensive changes, this second edition should be treated as a new document.

Table of Contents

Foreword 1
Introduction 3
2 Normative References 5
3 Terms, Definitions, Acronyms, Abbreviations, and Symbols 5
3.2 Acronyms and Abbreviations 5
3.3 Symbols 5
6 Basic Design 6
6.1 General 6
6.2 Rating 6
6.3 Casings 7
6.4 Casing Connections 9
6.5 Gear Elements 9
6.6 Dynamics 11
6.7 Bearings and Bearing Housings 12
6.8 Lubrication 12
6.9 Materials 13
7 Accessories 13
7.2 Couplings and Guards 13
7.4 Controls and Instrumentation 13
8 Inspection, Testing, and Preparation for Shipment 14
8.1 General 14
8.2 Inspection 14
8.3 Testing 14
8.4 Preparation for Shipment 17
9 Vendor's Data 18
9.1 General 18
Annex A (informative) Special-purpose Gear Unit Datasheets 19
Annex E (normative) Vendor Drawing and Data Requirements 20
Annex G (informative) Gear Tooth Quality Inspection 21
Bibliography 22

List of Tables

Table 1—Symbols 5
Table 4—Minimum Gear Tooth Service Factors (C_{SF} and K_{SF}) 7

Introduction

The purpose of the IOGP S-713 specification documents is to define a minimum common set of requirements for the procurement of special-purpose gears in accordance with API Standard 613, Sixth Edition, July 2021, Special-purpose Gears for Petroleum, Chemical and Gas Industry Services, for application in the petroleum and natural gas industries.

The IOGP S-713 specification documents follow a common structure (as shown below) comprising a specification, also known as a technical requirements specification (TRS), a procurement data sheet (PDS), an information requirements specification (IRS) and a quality requirements specification (QRS). These four specification documents, together with the purchase order, define the overall technical specification for procurement.

JIP33 Specification for Procurement Documents
Supplementary Technical Requirements Specification (TRS)

This specification is to be applied in conjunction with the supporting PDS, IRS and QRS as follows.

IOGP S-713: Supplementary Specification to API Standard 613 for Special-purpose Gears

This specification defines technical requirements for the supply of the equipment and is written as an overlay to API 613, following the API 613 clause structure. Clauses from API 613 not amended by this specification apply as written. Modifications to API 613 defined in this specification are introduced by a description that includes the type of modification (i.e. *Add*, *Replace* or *Delete*) and the position of the modification within the clause.

NOTE Lists, notes, tables, figures, equations, examples and warnings are not counted as paragraphs.

IOGP S-713D: Procurement Data Sheet for Special-purpose Gears (API)

The PDS defines application-specific requirements. The PDS is applied during the procurement cycle only and does not replace the equipment data sheet. The PDS may also include fields for vendor-provided information required as part of the purchaser's technical evaluation. Additional purchaser-supplied documents may also be incorporated or referenced in the PDS to define scope and technical requirements for enquiry and purchase of the equipment.

IOGP S-713L: Information Requirements for Special-purpose Gears (API)

The IRS defines information requirements for the scope of supply. The IRS includes information content, format, timing and purpose to be provided by the supplier, and may also define specific conditions that invoke the information requirements.

IOGP S-713Q: Quality Requirements for Special-purpose Gears (API)

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 PDS or in the purchase order.

The specification documents follow the editorial format of API 613 and, where appropriate, the drafting principles and rules of ISO/IEC Directives Part 2.

The PDS and IRS are published as editable documents for the purchaser to specify application-specific requirements. The TRS and QRS are fixed documents.

The order of precedence of documents applicable to the supply of the equipment, with the highest authority listed first, shall be as follows:

a) regulatory requirements;

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

c) purchaser-defined requirements (e.g. PDS, IRS and QRS);

d) this specification;

e) API 613.

2 Normative References

Add to first paragraph

The following documents are referred to in this specification, the PDS (IOGP S-713D) or the IRS (IOGP S-713L) in such a way that some or all of their content constitutes requirements of these specification documents.

Add to section

API Recommended Practice 684, *Paragraphs Rotodynamic Tutorial: Lateral Critical Speeds, Unbalance Response, Stability, Train Torsionals, and Rotor Balancing, Second Edition, 2005*

3 Terms, Definitions, Acronyms, Abbreviations, and Symbols

3.2 Acronyms and Abbreviations

Add to section

CAS conformity assessment system

FEA finite element analysis

IRS information requirements specification

MRT mechanical running test

PDS procurement data sheet

QRS quality requirements specification

TRS technical requirements specification

3.3 Symbols

Table 1—Symbols

Add symbol "dw1"

Symbol	Term	SI Units	USC Units
d_{w1}	operating pitch diameter of pinion 2a/(u + 1)	mm	in.

Delete second occurrence of symbol "u"

Symbol	Term	SI Units	USC Units
~~u~~	~~helix angle at reference diameter~~	~~degrees~~	~~degrees~~

6 Basic Design

6.1 General

6.1.7 Sound Pressure Level

Add new section

6.1.7.6

The gear vendor shall provide the following values measured during the acceptance test run or calculated from the values measured during the acceptance test run:

— sound intensity level;

— sound power level;

— sound pressure level and its octave band spectrum at the measurement surface 1 m (3.28 ft) away from the gearbox casing;

— measurement surface identification.

6.1.14

Delete "If specified,"

Add new section

6.1.23

The limits of speed, torque and duration for reverse rotation of the gear unit shall be specified.

Add new section

6.1.24

Unless otherwise specified, gears shall be of the double-helical type.

6.2 Rating

6.2.1 Gear Unit Rated Power

Replace third sentence with

For gear units connected directly to the driver and gear units between two items of driven equipment, all modes of normal and transient operation shall be examined.

6.2.3 Minimum Gear Tooth Service Factor

Replace Table 4 title with

Table 4—Minimum Gear Tooth Service Factors (C_{SF} and K_{SF})

Add new table NOTE

Driven Equipment	Induction Motors	Synchronous and Variable Speed Motors	Steam and Gas Turbines	Reciprocating Engines
NOTE The applicable minimum gear tooth service factor value applies to both C_{SF} and K_{SF}.				

6.2.4 Minimum Tooth Hardness

Add to section

For rating purposes, the tooth hardness of through hardened gears shall not exceed 363 HBW.

6.2.5 Tooth Pitting Resistance Power Rating

6.2.5.5

In first paragraph, replace "Table 4, grade 2" with

Table 3, grade 2

6.3 Casings

6.3.1 Design Parameters

6.3.1.5

Add to section

Shimming shall be in accordance with API 686:2009, Chapter 7, 5.4.2.

Add to section

In accordance with API 686:2009, Chapter 7, 5.4.2.6, shimming shall not be allowed to correct for gear tooth contact.

6.3.1.6

Add to section

If specified, thermo-structural finite element analysis (FEA) of the gear casing shall be performed.

Add to section

FEA shall be required for new casing configurations or casing configurations on the experience list but not yet employed at the proposed power level.

6.3.1.8

Replace first sentence with

Internal piping material shall be 316L stainless steel and manufactured to ASTM A312/A312M welded or flanged.

Add after second sentence

The quantity of internal piping flanges shall be minimized and only permitted to facilitate maintenance.

In third sentence, in both instances, replace "stainless steel" with

316L stainless steel

6.3.1.13 Filter Breather

6.3.1.13.2

In both instances, replace "Series 300 stainless steel" with

316 stainless steel

6.3.1.14

Add to section

The top surface of the inspection opening shall be raised at least 25 mm (1 in.) from the gear casing.

Add new section

6.3.1.16

Shims shall not be used between the gear housing and the bearing shell.

Add new section

6.3.1.17

Gear casings shall have provision for two earthing connections at diagonally opposite locations.

6.3.3 Bolting

6.3.3.1

Replace section with

Case bolting shall use through-bolting.

Add to section

In locations where through-bolting is not practical, the use of studs shall require the purchaser's approval for each proposed location.

Add new section

6.3.3.7

Fasteners internal to the gearbox shall be positively locked or retained.

6.4 Casing Connections

6.4.9 Threaded Plugs

6.4.9.2

Replace section with

Plugs shall be of 316 stainless steel material.

6.4.11

Add to section

Socket-welded flanges and fittings shall not be permitted in lubricating oil service.

6.5 Gear Elements

6.5.2 Quality Assurance

6.5.2.2 Contact Checking

6.5.2.2.4

In second sentence, replace "a tooth" with

four or more teeth of the dry, degreased gear wheel at each of three locations, 120° apart (see 6.5.2.2.2)

Add new section

6.5.2.2.5

Unmodified leads shall have a minimum contact of 80 % across the tooth length.

Add new section

6.5.2.2.6

If profile and longitudinal tooth corrections are designed into the gear set, both loaded and unloaded tooth flanks shall be checked for contact.

6.5.3 Fabrication

6.5.3.2

Add to section

Double-helical gear wheels shall be machined from a single forging.

6.5.4 Shafts

6.5.4.1

Add new list section e)

e) the heat treatment of shaft forgings and hot-rolled barstock shall include stress relieving.

6.5.4.2 Shaft Ends

Add new section

6.5.4.2.4

If specified, the free end of the high-speed shaft shall have a square section or other suitable arrangement that can be used to turn the shaft manually after removing the bearing end cover.

6.5.4.3 Rotor Shaft Sensing Areas

6.5.4.3.6

Replace section (including equations (7a) and (7b)) with

For areas observed by radial vibration probes, the combined total electrical and mechanical runout shall not exceed 6.35 µm (0.25 mils).

6.5.4.3.9

Add to section

Records of electrical and mechanical runout, for the full 360° at each probe location, shall include the phase relationship of each probe with respect to a common reference signal or location (phase indicator probe).

6.5.4.4

Delete "If specified," from first sentence

6.5.4.6

Delete "If specified," from first sentence

6.5.5 Balancing

Add new section

6.5.5.8

When a direct-end drive balance machine is utilized, the requirements of API 684:2005, 5.3.4.2 shall apply.

6.6 Dynamics

6.6.1 General

6.6.1.3

Add to section

The damped lateral analysis report shall include the structural resonance, mode shapes and dynamic stiffnesses from the structural dynamic analysis calculations.

6.6.2 Lateral Analysis

6.6.2.1 General

6.6.2.1.2

In first sentence, replace "The location of all lateral critical speeds below the trip speed" with

The location and associated AF of all lateral critical speeds and critically damped speeds below the trip speed

6.6.2.2 Undamped Analysis

6.6.2.2.1

Delete "If specified,"

6.6.2.2.2

Add new list item c)

c) minimum and maximum bearing stiffnesses, as determined by the combined effect of the design bearing clearance range and the lube oil temperature range within the range of the alarm limits.

6.6.2.2.3

Add new list item c)

c) bearing dynamic stiffness curves for the 10 %, 50 % and 100 % power levels to be plotted as in Figure 5.

6.6.2.3 Damped Unbalanced Response Analysis

6.6.2.3.1

Add to list item e)

Damped rotor analysis shall include the normal operating point of the driven equipment and any other specified operating conditions (see 6.2.2).

6.6.2.3.5

Add new list section d)

d) If the AF of any rotor at a particular critical speed and at any given operating condition is greater than or equal to 2.5, the operating speed of any other gearbox rotor shall not be within ±10 % of that critical speed (cross talk between gear and pinions).

6.6.2.4 Stability Analysis

6.6.2.4.5

Delete "For some rotors," from second sentence

6.6.2.4.6

Replace "final log decrement greater than 0.1" with

log decrement greater than 0.1 for all conditions defined in 6.6.2.4

6.7 Bearings and Bearing Housings

6.7.1 General

6.7.1.3

In first sentence, replace "at rated speed" with

at all operating conditions

6.7.1.5

Delete "When specified," from first sentence

6.7.3 Thrust Bearings

6.7.3.2

Add new list section e)

e) be removable without the need to remove the gear rotor.

6.7.3.7

Add to section

For replaceable thrust collars, an interference fit shall be provided.

6.7.4 Bearing Housings

6.7.4.6

Replace list item c) with

c) two radial probes per radial bearing;

6.8 Lubrication

Add new section

6.8.7

Orifice sizes for bearing and spray nozzle lube oil supplies shall be indicated on the general arrangement drawing.

6.9 Materials

6.9.2 Welding

6.9.2.1

Add before first sentence

Welding of rotating parts shall not be permitted.

In first paragraph, replace "Welding of rotating parts and other highly stressed parts" with

Welding of highly stressed parts

6.9.2.3

Add to section

Weld repairs shall be defined as major when the depth of the cavity after the preparation for repair exceeds 20 % of the wall thickness or 25 mm (1 in.), whichever is smaller, or when the extent of the cavity exceeds 65 cm² (10 in.²).

6.9.3 Heat Treatment

6.9.3.1

Add to section

For each gear element, a plot of hardness versus case depth showing the following shall be provided:

a) hardness from the surface of the base metal through the case;

b) final tooth surface location after finish machining with measurement interval spacing depicting the hardness transition below the final tooth surface location.

7 Accessories

7.2 Couplings and Guards

7.2.7

Add to section

If an integral-flanged shaft end is not furnished and a complete unit test is not specified, the gear vendor shall trial fit the coupling hubs on the gear shafts.

7.4 Controls and Instrumentation

7.4.1 General

7.4.1.5

Add to section

Junction boxes shall not be mounted on the top half of the gearbox.

8 Inspection, Testing, and Preparation for Shipment

8.1 General

8.1.2 Purchaser's Participation in Inspection and Testing

8.1.2.5

Add after "After"

the specified

8.1.3

Replace third sentence with

The purchaser and the gear vendor shall establish the required time frame of notifications for witnessed and observed inspections and tests.

8.2 Inspection

8.2.2 Material Inspection

8.2.2.6 Rotating Elements

8.2.2.6.1

Delete section 8.2.2.6.1

Add new section

8.2.2.6.4

Plating repair of shafts shall be prohibited.

8.3 Testing

8.3.2 Mechanical Running Tests

8.3.2.1 Mechanical Test Requirements

Add new section 8.3.2.1.0 before section 8.3.2.1.1

8.3.2.1.0

The following records shall be made available before the start of the mechanical run test:

a) tooth contact check record;

b) plots of mechanical and electrical run out;

c) residual unbalance records;

d) test stand shaft alignment (face, rim and axial spacing) for each test setup;

e) as-built clearances;

f) results of the gear quality check as per 6.5.2.1.

8.3.2.1.6

Add to section

The lube oil supply pressure shall be a permissive prior to the start of the gear box.

Add to section

The gear shall be automatically shut down on low lube oil pressure.

8.3.2.2 Performing Running Tests

8.3.2.2.2

Replace first paragraph with

The gear unit shall be operated at maximum continuous speed for 4 hours uninterrupted.

In first sentence of second paragraph, replace "at any time during the test duration of 4 hours" with

at the end of the uninterrupted 4 hour test

8.3.2.2.3

Delete "for the first hour and every 30 minutes" from first sentence

8.3.2.2.7 Critical Speed Test Results

8.3.2.2.7.2

Replace section with

The following plots of data recorded during the coast down tests in 8.3.2.2.7.1 shall be provided:

a) Bode plots for radial vibration probes;

b) polar plots for radial vibration probes;

c) Bode plots for accelerometers;

d) waterfall plots for shaft vibration;

e) waterfall plots for casing vibration;

f) shaft centerline plots with bearing clearance and bearing temperature sensor locations indicated.

Add new section

8.3.2.2.7.3

The actual critical speeds determined on the mechanical running test shall not deviate from the corresponding critical speed ranges predicted by analysis (see 6.6.2.3.4) by more than ± 5 %.

If the actual critical speeds from the mechanical running test deviate by more than ± 5 % from the ranges predicted by analysis, the vendor and the purchaser shall agree on modifications to the rotor dynamic analysis.

NOTE Where the discrepancy is not tolerable, rotor and bearing modifications can be required.

8.3.2.2.8

Delete "If specified," from first sentence

8.3.2.2.15

Delete "If specified,"

Add to section

Real-time vibration data recordings shall start with the initial (internal) shop run, even if not witnessed or observed.

Add new section

8.3.2.2.18

The machine shall not be removed from the test stand until the test results have been accepted or otherwise agreed.

8.3.2.3 Inspection Following Test

8.3.2.3.2

Add to section

The gear contact pattern shall be photographed.

Add to section

A thin coat of hard bluing shall be reapplied for any subsequent testing.

Add to section

The contact area shall be at least 80 % of the expected value based on the test load.

8.3.4 Optional Tests

8.3.4.2 Full-speed/Full- or Part-load Test

8.3.4.2.1

Add after first paragraph

If full-speed/full-load or full-speed/part-load testing is specified, the vendor shall describe in the proposal the extent of compliance with this requirement.

In first sentence of second paragraph, replace "4 hour test" with

5 hour test

Replace second sentence of second paragraph with

Unless the gear unit is to be string tested or unless otherwise specified, the gear unit shall be tested as close as possible to field operating conditions by running full-speed/full-load tests in accordance with the following:

a) full-speed/full-load tests sequentially run at 10 % load (1 hour), 70 % load (1 hour), and 100 % load (3 hours) where 100 % load is equal to gear rated power.

b) when the gear cannot be tested at the gear vendor's shop at full-speed/full-load, full-speed/part-load test sequentially run at 10 % load for 1 hour, and the maximum load available for 4 hours.

8.3.4.4 Sound-level Test

Add to section

The sound-level test shall be mandatory.

Add new section

8.3.4.6 String Test

8.3.4.6.1

If the gear is string tested and is driven by a train with an adjustable speed drive, the gear shall be tested at speeds within the operating speed range where resonances are predicted by the torsional analysis.

8.3.4.6.2

This portion of the test shall identify the actual torsional and lateral resonant speed, and the vibratory response of the gear unit, including changes in non-synchronous vibration.

8.4 Preparation for Shipment

8.4.1

Delete "including blocking of the rotor if necessary" from first sentence

Add before list item a)

Gear rotors shall be locked in position for shipment to prevent damage from rotation or axial movement of shafts.

In list item a), replace "blocked" with

locked

Add new list item d)

d) a prominent warning sign identifying the presence of the locking device and including instructions for its safe removal shall be affixed to the outside of the gearbox.

9 Vendor's Data

9.1 General

9.1.2

Replace section with

The contents of IOGP S-713L shall be used to define requirements for proposals, contract documentation and vendor data content.

Annex A
(informative)

Special-purpose Gear Unit Datasheets

Add to start of Annex A

IOGP S-713D shall be used as the purchaser's datasheet during proposal stages.

Annex E
(normative)

Vendor Drawing and Data Requirements

Add to start of Annex E

Vendor drawings and data shall be provided in accordance with IOGP S-713L.

Annex G
(informative)

Gear Tooth Quality Inspection

G.3 Modified Tooth Flanks

G.3.1 Helix Modification (Lead Modification)

G.3.1.2

In NOTE, replace "Table 4" with

6.2.8.1

Bibliography

Add to start of Bibliography

The following documents are informatively cited in the text of this specification, API 613, the PDS (IOGP S-713D) or the IRS (IOGP S-713L).

Add to Bibliography

[49] API Technical Report 684-1 *, *API Standard Paragraphs Rotordynamic Tutorial: Lateral Critical Speeds, Unbalance Response, Stability, Train Torsionals, and Rotor Balancing, First Edition, 2019*

[50] IOGP S-615 *, *Supplementary Specification to API Standard 610 for Centrifugal Pumps*

[51] ISO 15664, *Acoustics — Noise control design procedures for open plant, First Edition, 2001*

[52] ISO/IEC Directives, Part 2, *Principles and rules for the structure and drafting of ISO and IEC documents*

[53] ISO 19901-5, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 5: Weight control during engineering and construction, Third Edition, 2021*

* Cited in IOGP S-713J only.

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