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Supplementary Specification to API Standard 613 for Special-purpose Gears

Public Review Draft



Revision history

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1.1	May 2024	Issued for Public Review
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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).

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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).

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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.

3 Terms, Definitions, Acronyms, Abbreviations, and Symbols

3.3 Symbols

Table 1—Symbols

Add symbol " d_{w1} "

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

6.1.7.4

Delete "If specified,"

6.1.7.5

Replace first paragraph with

During testing, the gear vendor shall measure the sound intensity level, the sound pressure level and relative sound spectrum.

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 provided.

Add new section

6.1.24

Unless otherwise specified, gears shall be double-helical.

6.2 Rating

6.2.1 Gear Unit Rated Power

Add to third sentence

for all configurations, i.e. whether the gear unit is connected directly to the driver or located between two items of the driven equipment.

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 NOTE

Driven Equipment	Induction Motors	Synchronous and Variable Speed Motors	Steam and Gas Turbines	Reciprocating Engines
NOTE Same value to be used for C_{SF} and K_{SF} .				

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

6.2.8 Pinion Length to Diameter Ratio

6.2.8.2

Add to section

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

6.3 Casings

6.3.1 Design Parameters

6.3.1.1

Add to section

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

6.3.1.5

Add to section

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

6.3.1.6

Add to section

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

6.3.1.8

In first sentence, replace "ASTM A312/A312M" with

316L stainless steel

In third sentence, replace "ASTM A269/A269M" with

316 stainless steel

6.3.1.13 Filter Breather

6.3.1.13.2

Replace "300 stainless steel" with

316 stainless steel

Add new section

6.3.1.13.4

The filter breather shall be flanged.

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.

6.3.3 Bolting

6.3.3.1

Replace section with

Case bolting shall use through-bolting or studs.

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 316 stainless steel.

6.5 Gear Elements

6.5.3 Fabrication

6.5.3.2

Add to section

Double-helical gear wheels shall be made 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.

6.6 Dynamics

6.6.1 General

6.6.1.3

Add to section

The structural dynamic analysis report shall include the calculation of structural resonance, mode shapes and dynamic stiffnesses.

6.6.2 Lateral Analysis

6.6.2.2 Undamped Analysis

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 operating point specified.

6.6.2.3.5

Add new list section d)

- d) If the AF at a particular critical speed is greater than or equal to 2.5, the operating speed of the gearbox rotor is not within (+/-) 10 % of the critical speed of the other rotors (cross talk between gear and pinion).

6.6.2.3.6

Add to section

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 $\pm 5\%$.

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 of first paragraph

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.

6.7.4 Bearing Housings**6.7.4.6**

Replace list item c) with

- c) two radial probes per radial bearing;

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).

8 Inspection, Testing, and Preparation for Shipment

8.2 Inspection

8.2.3 Mechanical Inspection

8.2.3.3

Add to section

Gear tooth and pinion tooth hardness tests (see 6.2.4), checks and associated documentation shall be mandatory.

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:

- tooth contact in both the checking stand and the gear casing;
- plots of mechanical and electrical run out;
- residual unbalance records;
- test stand shaft alignment (face, rim and axial spacing) for each test setup;
- as-built clearances;
- results of tooth profile, lead, pitch circle run out and tooth-to-tooth spacing tests.

8.3.2.2 Performing Running Tests

8.3.2.2.7 Critical Speed Test Results

8.3.2.2.7.2

Replace section with

The data in 8.3.2.2.7.1 shall be furnished in Bode plots for radial vibration probes, polar plots for radial vibration probes and Bode plots for accelerometers during run up and coast down.

8.3.2.2.8

Delete "If specified," from first sentence

8.3.2.2.12

In third sentence of first paragraph, replace "frequency exceeds 20 % of the allowable vibration amplitude" with

frequency exceeds 20 % of the allowable vibration amplitude or 6.5 μm (0.25 mil)

8.3.2.2.15

Delete "If specified,"

8.3.4 Optional Tests

8.3.4.4

Add to section

The sound-level test shall be mandatory.

Annex A (informative)

Special-purpose Gear Unit Datasheets

Replace Annex A with

IOGP S-713D shall be used as the special-purpose gear PDS.

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Annex E (normative)

Vendor Drawing and Data Requirements

Add to start of annex

The contents of IOGP S-713L shall be used to define vendor drawing and data requirements.

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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

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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 Specification Q1, *Specification for Quality Management System Requirements for Manufacturing Organizations for the Petroleum and Natural Gas Industry*
- [50] API Specification Q2, *Specification for Quality Management System Requirements for Service Supply Organizations for the Petroleum and Natural Gas Industries*
- [51] EN 10204, *Metallic products — Types of inspection documents*
- [52] IOGP S-615 *, *Supplementary Specification to API Standard 610 for Centrifugal Pumps*
- [53] ISO 9001, *Quality management systems — Requirements*
- [54] ISO 10005, *Quality management — Guidelines for quality plans*
- [55] ISO 10474, *Steel and steel products — Inspection documents*
- [56] ISO/IEC 17000, *Conformity assessment — Vocabulary and general principles*
- [57] ISO/IEC Directives, Part 2, *Principles and rules for the structure and drafting of ISO and IEC documents*

* Cited in IOGP S-713J only.

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