International Association of Oil & Gas Producers

SPECIFICATION
S-713

July
2020

Supplementary Specification to ANSI/API Standard 613 Special Purpose Gear Units

JIP33
JOINT INDUSTRY PROGRAMME

Revision history

VERSION	DATE	PURPOSE
1.0	July 2020	Issued for Use

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 2014).

Table of Contents

Introduction

The purpose of this specification is to define a minimum common set of requirements for the procurement of special purpose gear units in accordance with ANSI/API Standard 613, Fifth Edition, August 2007, Special Purpose Gear Units for Petroleum, Chemical and Gas Industry Services for application in the petroleum and natural gas industries.

This JIP33 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

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

IOGP S-712: Supplementary Specification to API Standard 613 Special Purpose Gear Units

This specification defines the technical requirements for the supply of the equipment and is written as an overlay to API Standard 613, following the API Standard 613 clause structure. Clauses from API Standard 613 not amended by this specification apply as written to the extent applicable to the scope of supply

Modifications to API Standard 613 defined in this specification are identified as *Add* (add to clause or add new clause), *Replace* (part of or entire clause) or *Delete*.

IOGP S-712D: Data Sheet for Special Purpose Gear Units

The data sheet defines application specific requirements, attributes and options specified by the purchaser for the supply of equipment to the technical specification. The 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 data sheet to define scope and technical requirements for enquiry and purchase of the equipment.

IOGP S-712Q: Quality Requirements for Special Purpose Gear Units

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.

IOGP S-712L: Information Requirements for Special Purpose Gear Units

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.

The terminology used within this specification and the supporting data sheet, QRS and IRS follows that of API Standard 613 and is in accordance with ISO/IEC Directives, Part 2 as appropriate.

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.

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, QRS, IRS,);

d) this specification;

e) API Standard 613.

1 General

1.2 APPLICATIONS

Add to clause

The driver type shall be specified.

1.3 ALTERNATIVE DESIGNS

Add to clause

Alternative design proposals shall have equal or greater operating reliability based on proven experience.

Add to clause

Acceptance of alternative design proposals shall be subject to the purchaser's approval.

1.7 STANDARDS

Replace clause with

US standards shall be used for gear rating and design.

2 Basic Design

2.1 GENERAL

2.1.4

Add to clause

The purchaser shall specify the driven equipment's operating envelope covering all operating points.

Add new clause

2.1.20.4

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

Add new clause

2.1.21

Gears shall be double-helical.

2.3 CASINGS

2.3.1 Design Parameters

2.3.1.2

Add to clause

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

2.3.1.5

Add to clause

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

2.3.1.6

Add to clause

The vendor shall perform thermo-structural finite element analysis (FEA) of the gear casing, if specified.

2.3.1.8

Add to clause

Internal piping and tubing shall be 316L stainless steel.

2.3.1.12

Add after first sentence

The filter-breather shall be flanged.

In second sentence of first paragraph, replace "Series 300 stainless steel" with

316 stainless steel

2.3.1.13

Add to clause

The top-surface of the inspection opening shall be raised at least 25 mm (1 in.) to protect internals from dirt and water.

Add new clause

2.3.1.15

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

Note: The use of a thread-locking compound alone is not considered positive locking.

2.3.3 Bolting

2.3.3.1

Replace last sentence with

Cap screws shall not be used for the gear casing bolting.

2.4 CASING CONNECTIONS

2.4.1

Replace clause with

The gear casing shall have a single lube-oil supply connection.

2.4.2

Replace first sentence with

The gear casing shall have a single lube-oil drain connection.

2.4.5

Add to clause

If a noise cover is provided, connections shall extend to the outside of the noise cover.

2.4.10

Replace second sentence with

Plugs shall be 316 stainless steel.

2.5 GEAR ELEMENTS

2.5.2 Quality Assurance

2.5.2.2

Replace eighth sentence with

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

2.5.3 Fabrication

2.5.3.2

Replace third sentence with

Separate gear wheels shall be single forgings.

Add to clause before fourth sentence

Separate gear wheels shall be assembled on shafts with an interference fit.

2.5.4 Shafts

2.5.4.1

Add to clause

The heat-treatment of shaft forgings and hot-rolled barstock shall include stress-relieving.

2.6 DYNAMICS

2.6.1 General

2.6.1.3

Add to section

The vendor shall submit the dynamic characteristics and the basis for these values (e.g. analytical calculation of natural frequencies and mode shapes, modal tests of similar rotor structure systems or calculated structure stiffness values) to the purchaser for review.

2.6.2 Lateral Analysis

2.6.2.3

Add item c. to list

c. Bearing dynamic loads and characteristic curves for all the power levels specified in 2.6.2.2.

2.6.2.6

Add to clause

Damped rotor response analysis shall include the following conditions:

a. Load conditions as per API 613 2.6.2.2 a.
b. Supplier factory acceptance testing conditions.
c. Normal operating point of the driven equipment.
d. Any other operating point specified in the datasheets.

2.6.2.12

Add new clause

The stability analysis of gear unit rotors shall be performed for the specified operating points and shop test conditions.

2.6.2.13

Add new clause

The calculated log decrement of the stability analysis shall be greater than 0.1.

2.6.5 Torsional Analysis

2.6.5.3

Replace list item h. with

h. For equipment trains using variable frequency drive (VFD), torsional analysis shall include:
    1. Excitations from integer orders of the driver output frequency.
    2. Sidebands of the pulse width modulation.

3. Performance of a steady state response analysis from 0 to 125% of trip speed to quantify the effects of the VFD excitations.
4. Analysis showing that all shaft sections, couplings, and gear mesh have infinite life using agreed criteria.

2.7 BEARINGS AND BEARING HOUSINGS

2.7.3 Thrust Bearings

2.7.3.2

Add to clause

The thrust bearing shall be removable without needing to remove the gear rotor.

2.7.4 Bearing Housings

2.7.4.6

Delete "Unless otherwise specified" from first sentence

Replace "2 radial probes per radial bearing, coupling ends only (Total =)" with

2 radial probes at each bearing, (total = 8)

Replace "2 accelerometers - 1 per coupling end (Total =)" with

1 accelerometer installed on the gear casing to monitor gear mesh at a mutually agreed location between the purchaser and the vendor.

2.9 MATERIALS

Replace section heading with

2.9.2 Welding

2.9.2.1

Add to clause

Welding of rotating elements is not permitted.

2.9.2.3

Add to clause

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

Add to clause

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

2.9.3 Heat Treatment

2.9.3.1

Add to clause

Test coupons shall have approximately the same shape as the gear teeth and demonstrate hardness consistency across the full tooth face width after final machining.

4 Inspection, Testing, and Preparation for Shipment

4.3 TESTING

4.3.2 Mechanical Running Tests

4.3.2.1

Add to clause

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

a. Tooth contact both in the checking stand and gear casing.
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 tooth profile, lead, pitch circle run out and tooth-to-tooth spacing tests, if specified by 4.2.2.8.

4.3.2.2

Add to section

The sequence of steps for mechanical running tests as listed in 4.3.2.2.5 through 4.3.2.2.7 shall be followed.

4.3.2.2.8

Add to clause

The amplitude of discrete, nonsynchronous vibrations shall be less than 20 % of the allowable vibration or 6.5 µm (0.25 mil), whichever is greater.

4.3.2.2.12

Add to clause

The following information shall be provided during run up and coast down:

a. Bode plots for radial vibration probes.
b. Polar plots for radial vibration probes.
c. Bode plots for accelerometers.

4.3.2.2.13

Delete "if specified"

4.3.3 Optional Tests

Add new clause

4.3.3.1.2

If a complete unit test is specified, vibration limits applicable to the gear unit during the test shall be 125 % of the limits specified in 2.6.6.5.

Add new clause

4.3.3.1.3

Non-synchronous vibration limits for gear unit shall be 125 % of the limits specified in 4.3.2.2.8 during full load full speed test.

4.4 PREPARATION FOR SHIPMENT

4.4.3.3

Replace clause with

Internal surfaces of bearing housings and carbon steel oil system components shall be coated with a oil-soluble rust preventive that is compatible with the lubricating oil.

5 Vendor's Data

5.2 PROPOSALS

5.2.3 Technical Data

Replace list item l. with

l. A list of the user's installations of gears similar to the proposed unit, operating under conditions of equal or more severe services.

APPENDIX A SPECIAL PURPOSE GEAR UNITS DATA SHEETS

Replace APPENDIX A with IOGP S-713D

APPENDIX F VENDOR DRAWING AND DATA REQUIREMENTS

Replace APPENDIX F with IOGP S-713L

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