

Supplementary Specification to ANSI/API Standard 613 Special Purpose Gear Units for Petroleum, Chemical and Gas Industry Services

Public Review Draft

Revision history

VERSION	DATE	PURPOSE
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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).

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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 for projects 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 approved specification, building on recognized industry and/or 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, facilitating improved standardization of major projects across the globe. 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

	Foreword	1
	Introduction.....	3
1	General	5
	1.2 APPLICATIONS	5
	1.3 ALTERNATIVE DESIGNS.....	5
	1.7 STANDARDS	5
	1.8 UNITS OF MEASURE.....	5
2	Basic Design	5
	2.1 GENERAL	5
	2.2 RATING.....	6
	2.3 CASINGS	6
	2.4 CASING CONNECTIONS	7
	2.5 GEAR ELEMENTS.....	8
	2.6 DYNAMICS	9
	2.7 BEARINGS AND BEARING HOUSINGS	10
	2.9 MATERIALS.....	10
4	Inspection, Testing, and Preparation for Shipment.....	11
	4.3 TESTING.....	11
	4.4 PREPARATION FOR SHIPMENT.....	12
5	Vendor's Data.....	12
	5.2 PROPOSALS	12
	APPENDIX A—SPECIAL PURPOSE GEAR UNITS DATA SHEETS	13
	APPENDIX F—VENDOR DRAWING AND DATA REQUIREMENTS	14

Introduction

The purpose of this specification is to define a minimum common set of specification requirements for the procurement of special purpose gear units in accordance with API Standard 613, 5th Edition, February 2003, 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-713: Specification for Special Purpose Gear Units

This specification is written as an overlay to API Standard 613, following the clause structure of the parent standard, to assist in cross-referencing the requirements. Where clauses from the parent standard API Standard 613 are not covered in this specification, there are no supplementary requirements or modifications to the respective clause. The terminology used within this specification follows that of the parent standard and otherwise is in accordance with ISO/IEC Directives, Part 2.

Modifications to the parent standard defined in this specification are identified as Add (add to clause or add new clause), Replace (part of or entire clause) or Delete.

S-713D: Data Sheet for Special Purpose Gear Units

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 datasheet, to define scope and technical requirements for enquiry and purchase of the equipment.

S-713L: Information Requirements for Special Purpose Gear Units

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-713Q: Quality Requirements for Special Purpose Gear Units

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 (datasheet, IRS, QRS);
- d) this specification;
- e) the parent standard.

1 General

1.2 APPLICATIONS

Add to section

Applications with variable frequency drive electric motors shall be identified in the data sheet by the purchaser, when applicable.

1.3 ALTERNATIVE DESIGNS

Add to section

Alternative design proposals shall have equal or greater operating reliability based on proven experience. Acceptance of alternative design proposals shall be subject to the purchaser's approval.

1.7 STANDARDS

Replace section with

Applicable US standards shall be used for gear rating and design.

1.8 UNITS OF MEASURE

Replace section with

The purchaser shall specify whether data, drawings, gear unit name plate, hardware (including fasteners) and equipment supplied to this standard shall use the SI or U.S. Customary system of units.

2 Basic Design

2.1 GENERAL

2.1.4

Add to section

The purchaser shall specify the driven equipment's operating envelope covering all operating points in addition to the rated operating point, including minimum and maximum speed, and minimum and maximum torque.

Add new section

2.1.20.4

Limitations on reverse rotation of the gear unit shall be stated in the data sheet including any limits for speed, torque and duration.

Add new section

2.1.21

Gears shall be double-helical, unless specified otherwise in the data sheet.

2.2 RATING

2.2.3 Gear Service Factor

2.2.3.1

Add to section

Minimum SF for gas turbine generators shall be 1.3.

2.3 CASINGS

2.3.1 Design Parameters

2.3.1.2

Add to section

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

2.3.1.5

Add to section

Shimming between housing and the bearing is not permitted.

2.3.1.6

Add to section

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

2.3.1.8

Add to section

The material of construction for internal piping and tubing shall be 316L stainless steel minimum.

2.3.1.12

Add to section

The filter-breather shall comply with the following requirements:

- a. The filter-breather shall be flanged.
- b. The material of construction shall be 316 stainless steel minimum.

2.3.1.13

Add to section

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

2.3.1.15

Add new section

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

A single lube-oil supply connection for the gear casing shall be provided.

2.4.2

Replace first sentence with

A single lube-oil drain connection from the gear casing shall be provided.

2.4.5

Add to section

If a noise cover is provided, connections (including instrument connections) shall be extended to the outside of the noise cover.

2.4.6

Add to section

Oil supply and drain connections shall be flanged.

Oil supply and drain connections shall be arranged on the same side of the gear casing by the vendor.

2.4.10

Replace second sentence with

The material of construction for plugs shall be 316 stainless steel minimum.

2.5 GEAR ELEMENTS

2.5.2 Quality Assurance

2.5.2.2

Replace seventh sentence with

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

Add to section

The contact across the tooth length for modified leads shall not be less than 65%.

2.5.3 Fabrication

2.5.3.2

Add to section

Fabricated gears shall not be offered.

2.5.4 Shafts

2.5.4.1

Add to section

The heat-treatment process of shaft forgings and hot-rolled bar stocks 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 new list item c.

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

2.6.2.6

Add to section

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 section

The stability analysis of gear unit rotors shall be carried out for all the operating points specified in the data sheets and shop test conditions.

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 the following:
 - 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 an agreed criteria.

2.7 BEARINGS AND BEARING HOUSINGS

2.7.3 Thrust Bearings

2.7.3.2

Add to section

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

2.7.4 Bearing Housings

2.7.4.6

Replace section with

Following items shall be provided:

- a. 1 off one event per revolution probe at input and output, (total = 2)
- b. 2 off axial probes at each thrust bearing (total = 2 for double helical gear, 4 for single helical gear)
- c. 2 off radial probes shall be provided at each bearing, (total = 8)
- d. 1 off accelerometer shall be installed on the gear casing to monitor gear mesh at a mutually agreed location between the purchaser and the vendor.

The probe installation shall be as specified in API Std 670.

Note: The number and position of axial probes should consider the type of gear (double or single helical) and thrust bearing location.

2.9 MATERIALS

Replace section 2.9.2 heading with

2.9.2 Welding

2.9.2.1

Add to section

Welding of rotating elements is not permitted.

2.9.2.3

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 actual wall thickness, or 25 mm (1 in.), whichever is smaller, or when the extent of the cavity exceeds approximately 65 cm² (10 in.²). All other weld repairs shall be considered minor.

2.9.3 Heat Treatment

2.9.3.1

Add to section

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 section

The following records shall be made available to the purchaser before 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.

4.3.2.2.12

Add to section

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 from section

"If specified,"

4.3.3 Optional Tests

Add new section

4.3.3.1.2

If a complete unit test (i.e. test of the complete package comprising driver, gear and driven equipment) is specified, vibration limits applicable to the gear unit during the test shall be 125% of the limits specified in 2.6.6.5.

4.4 PREPARATION FOR SHIPMENT

4.4.3

4.4.3.1

Add to section

Exterior surfaces of the gear unit shall be coated for corrosion protection in conformance to a mutually agreed procedure.

5 Vendor's Data

5.2 PROPOSALS

5.2.3 Technical Data

Replace list item 1. with

- I. Vendor shall furnish a list of the user's installations of gears similar to the proposed unit, operating under conditions of equal or more severe services. The list of installations shall include the following information:
 1. Gear unit rated power.
 2. Single/double helical.
 3. Input speed.
 4. Gear ratio.
 5. Pitch line velocity.
 6. Bending stress number.
 7. Gear teeth hardening - through hardened/carburized/nitrided.
 8. Gear manufacturing location.
 9. Operation - onshore/offshore.
 10. Country of installation.
 11. Year of supply.
 12. Year of start operation.
 13. Purchaser / end user.

APPENDIX A—SPECIAL PURPOSE GEAR UNITS DATA SHEETS

SPECIAL PURPOSE GEAR UNITS API 613 FIFTH EDITION DATA SHEET SI UNITS

Replace data sheet with

The purchaser shall use IOGP S-713D.

SPECIAL PURPOSE GEAR UNITS API 613 FIFTH EDITION DATA SHEET CUSTOMARY UNITS

Replace data sheet with

The purchaser shall use IOGP S-713D.

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APPENDIX F—VENDOR DRAWING AND DATA REQUIREMENTS

Replace appendix with

The purchaser shall use S-713L.

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