



# Supplementary Specification to API Standard 671 for Special-purpose Couplings

**NOTE** This version (S-700J) of the specification document provides the justification statements for each technical requirement, but is otherwise identical in content to S-700.

## Revision history

VERSION	DATE	PURPOSE
1.1	July 2023	Issued for Public Review
1.0	May 2020	First Edition

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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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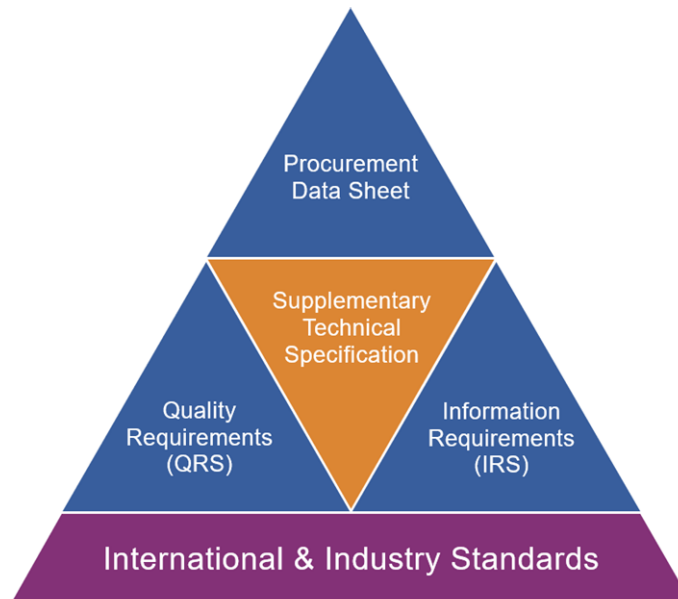
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## Introduction

The purpose of this specification is to define a minimum common set of requirements for the procurement of special-purpose couplings in accordance with API Standard 671, Fifth Edition, August 2020, Special-purpose Couplings for Petroleum, Chemical and Gas Industry Services, 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 Supplementary 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-700: Supplementary Specification to API Standard 671 for Special-purpose Couplings**

This specification defines the technical requirements for the supply of the equipment and is written as an overlay to API Standard 671, following the API Standard 671 clause structure. Clauses from API Standard 671 not amended by this specification apply as written to the extent applicable to the scope of supply. Modifications to API Standard 671 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-700D: Procurement Data Sheet for Special-purpose Couplings (API)**

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-700L: Information Requirements for Special-purpose Couplings (API)**

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-700Q: Quality Requirements for Special-purpose Couplings (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 data sheet or in the purchase order.

The terminology used within this specification and the supporting procurement data sheet, IRS and QRS follows that of API Standard 671 and is in accordance with ISO/IEC Directives, Part 2 as appropriate.

The procurement 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 (procurement data sheet, IRS, QRS);
- d) this specification;
- e) API Standard 671.

## 1 Scope

Replace second sentence of second paragraph with

This specification modifies only content applicable to metallic flexible element type couplings.

### **Justification**

*This statement is written to clarify what content of API 671 has been modified by this specification.*

## 2 Normative references

Add to first paragraph

The following documents are referred to in the text of this specification, the procurement data sheet (IOGP S-700D) or the IRS (IOGP S-700L) in such a way that some or all of their content constitutes requirements of this specification.

Add to section

IEC 60079 (all parts), *Explosive atmospheres*

IOGP S-715, *Supplementary Specification to NORSOK M-501 Coating and Painting for Offshore, Marine, Coastal and Subsea Environments*

ISO 80079-36, *Explosive atmospheres — Part 36: Non-electrical equipment for explosive atmospheres — Basic method and requirements*

ISO 9712, *Non-destructive testing — Qualification and certification of NDT personnel*

NFPA 70, *National Electrical Code*

## 4 Requirements

### 4.1 Units of Measure

Replace first sentence of first paragraph with

The specified units of measurement (SI or USC) shall be used in all data, drawings and maintenance dimensions.

### **Justification**

*This requirement describes how the specified unit of measurement is to be used.*

Delete second sentence

### **Justification**

*The modification made to (4.1 paragraph 1 sentence 1) describes how the unit of measurement is specified for both SI and USC units, to which this sentence is contradictory. It has therefore been deleted.*

## 5 Coupling Selection

### 5.2

Add new section

#### 5.2.3

Metallic flexible-element special-purpose couplings shall have a minimum service life of 20 years.

#### **Justification**

*This requirement aligns this specification with other API major driven equipment standards in specifying a 20-year minimum service life.*

Add new section

#### 5.2.4

The design life calculations of the coupling and coupling-to-shaft juncture shall take into account the frequency of starts per unit of time.

#### **Justification**

*This requirement ensures that the coupling selection process accounts for the number of starts per unit of time for which the coupling is to be designed, as this can have a direct bearing on its service life.*

## 6 Coupling Design

### 6.7

In first sentence of first paragraph, replace "the rated operating point and the corresponding speed" with

all operating points and the corresponding speeds

#### **Justification**

*There are multiple operating points for most upstream applications. This amendment ensures that the coupling vendor evaluates all of them and finds the highest torque rating that is to be used to calculate the service factor.*

### 6.13

Delete "If specified" from first sentence

#### **Justification**

*This deletion removes a repetitive instruction to the vendor. Possible transient events are specified in the data sheet and the coupling is therefore required to be compliant with this section.*

Add after first paragraph

For motor driven units and generators, transient events shall include the following:

- phase to phase short circuit;
- phase to ground short circuit;



- motor breaker re-closure;
- faulty synchronization to the grid.

### **Justification**

*This requirement ensures that the coupling is rated for all potential sources of transient torque that it may encounter in order to prevent damage to the coupling and possibly to the driver and/or driven equipment.*

## **8 Coupling Requirements**

### **8.1 Metallic Flexible-element Couplings**

#### **8.1.6**

##### **8.1.6.2**

Delete list item d)

### **Justification**

*This requirement conflicts with 8.1.7 which prohibits the use of an external cooling system for the coupling and coupling guard.*

Add new section

#### **8.1.7**

The coupling and coupling guard shall not use an external cooling system.

### **Justification**

*This amendment minimizes the complexity associated with the coupling guard requiring a cooling system.*

### **8.6 Hubs**

#### **8.6.4 Alternate Hub Design**

Delete section 8.6.4

### **Justification**

*Alternative coupling-to-shaft juncture methods may present an unquantified risk. The deletion of this requirement, prohibiting their use, removes any such risks.*

### **8.12 Dynamics**

#### **8.12.1**

Delete NOTE

### **Justification**

*This deletion removes a note that is technically incorrect. The axial frequency can be low enough to be an issue if the spool piece is sufficiently long.*

## 8.12.2

Delete ", or at least 1.5 times using a more rigorous analysis based on actual geometry (for example, finite-element analysis)" from first sentence

### **Justification**

*This deletion sets the default to 2 times the highest operating speed. 1.5 times the operating speed is considered inadequate because, at lower speeds, the likelihood of the occurrence of resonance is a higher risk. The term "more rigorous analysis" is vague and leaves the interpretation of what constitutes a more rigorous analysis method to the vendor.*

Delete second sentence

### **Justification**

*The fatigue analysis information requirement requires that the vendor performs these calculations and includes details of any assumptions.*

## 9 Balance

### 9.3 Balance Criteria

#### 9.3.5 Component Balance

##### 9.3.5.4

In first sentence, replace "except for" with

including

### **Justification**

*This amendment ensures the accuracy of the balancing of all coupling components. Additional unbalance may be introduced if the keyways are machined after balancing.*

Delete second sentence

### **Justification**

*The amendment made to (9.3.5.4 paragraph 1 sentence 1) requires that the machining of all components, including keyways, is to be completed before balancing. This requirement is in contradiction with that amendment so it is deleted.*

##### 9.3.5.6

In first sentence, replace "or" with

and

### **Justification**

*The criterion given in the later part of the requirement (10 % of the allowable rotor unbalance) is applicable to a heavy coupling with a lighter rotor, which is not a common condition. If the rotor is heavy and the coupling is light (such as in the typical refinery set-up), the 10 % allowable rotor unbalance would never be necessary. It applies when the rotor weight is less than 10 % of the coupling weight.*

In first sentence, replace "shaft" with

rotor

**Justification**

*This amendment corrects the nomenclature from "shaft" to "rotor" as is common in other API standards. Unbalance is caused not only by the shaft but due to the rotor assembly of which the shaft is a component.*

**9.3.6 Assembly Check Balance**

In second sentence of first paragraph, replace "or" with

and

**Justification**

*The criterion given in the later part of the requirement to not exceed the allowable shaft unbalance at the closest journal location is applicable for a heavy coupling with a lighter rotor, which is not a common condition. If the rotor is heavy and the coupling is light (such as in the typical refinery set-up), the allowable rotor unbalance would never be necessary.*

In second sentence of first paragraph, replace "shaft" with

rotor

**Justification**

*This amendment corrects the nomenclature from "shaft" to "rotor" as is common in other API standards. Unbalance is caused not only by the shaft but due to the rotor assembly of which the shaft is a component.*

**9.3.7 Assembly Balance**

**9.3.7.4**

In first sentence, replace "or" with

and

**Justification**

*The criterion given in the later part of the requirement to not exceed the allowable shaft unbalance at the closest journal location is applicable for a heavy coupling with a lighter rotor, which is not a common condition. If the rotor is heavy and the coupling is light (such as in the typical refinery set-up), the allowable rotor unbalance would never be necessary.*

In first sentence, replace "shaft" with

rotor

**Justification**

*This amendment corrects the nomenclature from "shaft" to "rotor" as is common in other API standards. Unbalance is caused not only by the shaft but due to the rotor assembly of which the shaft is a component.*

### 9.3.7.5

Delete section 9.3.7.5

#### **Justification**

*This deletion clarifies that the balancing of couplings should not be achieved by making corrections on the hub but rather by the use of balancing nuts at different phases.*

### 9.3.11 Balance Mandrels

#### 9.3.11.4

Replace "should" with

shall

#### **Justification**

*This amendment clarifies that, with heavier mandrels, when determining the coupling component residual unbalance, the residual unbalance of the mandrel has to be taken into account first.*

#### 9.3.11.6

In second paragraph, replace "should" with

shall

#### **Justification**

*Making this recommendation a requirement ensures that the location of TIR readings is consistent for comparison purposes.*

### 9.4 Trim Balance Holes

#### 9.4.1

Delete "If specified," from first sentence

#### **Justification**

*Threaded holes are required for the trim-balance holes to be capable of correcting the coupling component unbalance. This amendment makes the provision of such holes mandatory.*

## 10 Materials

### 10.5

Delete second sentence

#### **Justification**

*This change minimizes the risk of fretting and atmospheric corrosion, to the metallic flexible elements, which could lead to premature failure of the coupling. This in turn reduces OpEx and loss of production.*

Delete third sentence

**Justification**

*The use of coated non-corrosion-resistant materials for the flexible element is prohibited by the deletion of 10.5, second sentence, so this requirement pertaining to the details of such coating is no longer relevant.*

## 11 Accessories

Add new section

### 11.4

The hydraulic pump shall be rated for at least the hydraulic pressures required for installation and removal of hydraulically fitted hubs.

**Justification**

*This requirement ensures that the pressurized components of the hydraulic hub installation and removal tools are fit for purpose and safe to use.*

Add new section

### 11.5

The pressure rating of hoses and fittings shall be equal to or greater than the rating pressure of the hydraulic pump.

**Justification**

*This requirement confirms the minimum allowable pressure rating for the pump hoses and fittings associated with hydraulically fitted hubs.*

## 12 Manufacturing Quality, Inspection, Testing, and Preparation for Shipment

### 12.1 Manufacturing Quality

#### 12.1.2

Replace first sentence with

Repair of defects by welding or plating shall not be allowed.

**Justification**

*This amendment prohibits the repair of any coupling parts by welding and plating as the fatigue performance of such repairs can be unpredictable.*

Delete second sentence

**Justification**

*(12.1.2 paragraph 1 sentence 1) prohibits the repair of any coupling parts using welding or plating. With this amendment, there are no defects or parts that could be considered repairable at the vendor's discretion so this sentence is made superfluous.*

## 12.3 Inspection

### 12.3.5

Delete fourth sentence

#### **Justification**

*This deletion removes possibly contradictory instructions. The purpose of information requirements (for information or acceptance) is specified in IOGP S-700L.*

## 12.5 Preparation for Shipment

### 12.5.5

Replace second sentence with

The packing container shall be marked with the tag number, shipping weight and purchase order number.

#### **Justification**

*This requirement provides the minimum requirements for the marking of the coupling container.*

Add to section

The markings on the packing container shall be 75 mm (3 in.) minimum character height.

#### **Justification**

*This requirement provides the minimum requirements for the marking of the coupling container.*

Add new section

### 12.5.10

Markings shall be included in the detailed coupling drawing.

#### **Justification**

*The inclusion of markings in the detailed coupling drawing enables the purchaser to verify that the markings are correct before they are added to the coupling.*

## Annex G (informative)

### Example of the Determination of Potential Unbalance

#### G.3 Balancing

In list item a), replace "ISO 1940-1:2003" with

ISO 21940-11:2016

#### **Justification**

*ISO 1940-1:2003 has been withdrawn and replaced with ISO 21940-11:2016.*

In list item b), replace "ISO 1940-1:2003" with

ISO 21940-11:2016

#### **Justification**

*ISO 1940-1:2003 has been withdrawn and replaced with ISO 21940-11:2016.*

In list item c), replace "ISO 1940-1:2003" with

ISO 21940-11:2016

#### **Justification**

*ISO 1940-1:2003 has been withdrawn and replaced with ISO 21940-11:2016.*

In NOTE, replace "ISO 1940-1:2003" with

ISO 21940-11:2016

#### **Justification**

*ISO 1940-1:2003 has been withdrawn and replaced with ISO 21940-11:2016.*

## Annex H (normative)

### Coupling Guards

#### H.2 General Requirements for All Guards

##### H.2.12

Add to first paragraph

If specified, the guard shall be provided with protection preventing personnel from contact with the guard when the maximum enclosure/guard surface temperature at maximum continuous speed is greater than 60 °C (140 °F).

##### **Justification**

*In cases when the maximum enclosure/guard surface temperature at maximum continuous speed is greater than 60 °C (140 °F) and a temperature below this cannot be achieved, this requirement allows the purchaser to specify whether protection preventing personnel from contact with the guard is required.*

##### H.2.13

In first sentence, replace "H.2.13" with

H.2.12

##### **Justification**

*H.2.13 referred to in this sentence is incorrect. The requirement to calculate the maximum coupling guard surface temperature at the maximum continuous speed is covered by H.2.12 rather than H.2.13 which covers the maximum internal enclosure temperature.*

Delete second sentence

##### **Justification**

*There is already an information requirement 'Maximum enclosure temperature calculations at the maximum continuous speed' requiring these calculations from the vendor, therefore, keeping this requirement will lead to ambiguity. The removal of this sentence requires these calculations to be performed by the vendor.*

##### H.2.17

Delete section H.2.17

##### **Justification**

*IOGP S-700, 1<sup>st</sup> Edition (overlay to API 671, 4<sup>th</sup> Edition) included an amendment to 8.1.4 stating that "The coupling and coupling guard shall be designed to eliminate the need for an external cooling system". The requirements contained in 8.1.4 have been deleted in API 671, 5<sup>th</sup> Edition, however, the requirement for the coupling and coupling guard to be designed to not require an external cooling system is retained. As such, a new section **Error! Reference source not found.** has been added to reinstate this requirement. This requirement is in conflict with external cooling systems being prohibited, hence its deletion.*



## Annex K (normative)

### Procedure for Residual Unbalance Check

#### K.4 Residual Unbalance Check

##### K.4.1 General

###### K.4.1.1

Delete NOTE

###### *Justification*

*This note is incorrect. Calibration of the balancing machine is performed before the balancing process starts. The residual unbalance check is performed after the final correction of unbalance is performed.*

##### K.4.2 Procedure

###### K.4.2.1

Delete NOTE

###### *Justification*

*This note provides an example for identifying the trial weight magnitude as per Table K.1, however, the example calculation is not a requirement nor best practice. It also contains an error (it should state "MCS = 7500 rpm" not "MCS £ 7500rpm"). Furthermore, Figure K.2 already provides an example calculation.*

###### K.4.2.3

Replace section (including NOTE) with

Before starting the residual unbalance check, the balancing machine's readings shall be stable with no faulty sensors or displays.

###### *Justification*

*This ensures the correct functioning of sensors and displays before the residual unbalance check starts. In addition, the note is technically incorrect. The balancing tolerance or balancing machine calibration is checked prior to, rather than during, the balancing activity.*

## Annex L (normative)

### Torque Measuring System

#### L.2 Cyclic Torque (Torsional) Monitoring Capability (If Specified)

Replace list item b) with

- b) accuracy of torsional measurement;

##### **Justification**

*Cyclic loading and static/steady state torque have different ranges of amplitude so the use of different units should be a standard requirement.*

Replace list item c) with

- c) units of measurement;

##### **Justification**

*Cyclic loading and static/steady state torque have different ranges of amplitude so the use of different units should be a standard requirement.*

#### L.4 Accuracy

Replace second sentence of fourth paragraph with

The degradation in accuracy of the torque measuring system with respect to time shall be provided.

##### **Justification**

*This requirement ensures that if the accuracy of the torque measuring system is expected to degrade over time, information regarding the rate of expected degradation is provided in order to allow the purchaser to account for this.*

Add to section

If specified, the torque measuring system shall have a self-test feature to assist in determining the degradation of the accuracy of the torque measuring system.

##### **Justification**

*L.4, NOTE 1 states that some torque measuring systems include a self-test feature. This requirement and the corresponding data sheet element enable the purchaser to specify when this feature is required.*

Delete NOTE 1

##### **Justification**

*L.4 paragraph 5 sentence 1 and a corresponding data sheet element have been added to allow the purchaser to specify if a self-test feature is required. This requirement contains the information contained within this note, so it has been deleted to avoid duplication.*

## L.5 Effect of Rotordynamics

### Replace section with

Changes to the mass elastic properties of the coupling resulting from the incorporation of the torque meter shall be included in the system rotordynamics.

### **Justification**

*If the coupling design changes are mass elastic due to the incorporation of the torque meter, the rotor dynamics analysis is no longer valid and needs to be repeated to account for the changes. This is a mandatory requirement as failure to do this could result in imbalance. This amendment also clarifies the interpretation of the requirement. The addition of a torque meter always causes physical changes to the coupling, however, there may not be any mass elastic properties changes. Only changes in the mass elastic properties have an effect on the rotor dynamics of the drive train.*

## L.10 Additional Information

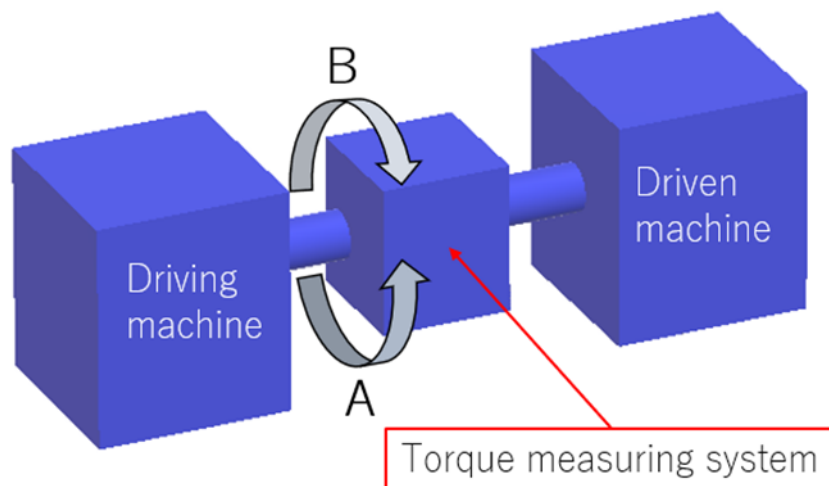
### Add to list item e)

in accordance with Figure L.1

### **Justification**

*Figure L.1 provides a reference to allow the direction of rotation and power flow to be specified.*

### Add new Figure L.1



**Figure L.1—Coupling Direction of Rotation and Power Flow**

### **Justification**

*Figure L.1 provides a reference to allow the direction of rotation and power flow to be specified.*

## Bibliography

### Add to start of Bibliography

The following documents are informatively cited in the text of this specification, the procurement data sheet (IOGP S-700D) or the IRS (IOGP S-700L).

### Add to Bibliography

- [6] EN 10204, *Metallic products - Types of inspection documents*
- [7] ISO 9001, *Quality management systems — Requirements*
- [8] ISO 10005, *Quality management — Guidelines for quality plans*
- [9] ISO 10474, *Steel and steel products — Inspection documents*
- [10] ISO 21940-11:2016, *Mechanical vibration — Rotor balancing — Part 11: Procedures and tolerances for rotors with rigid behaviour*
- [11] ISO/IEC 17000, *Conformity assessment — Vocabulary and general principles*

### Delete from Bibliography

- [1] ISO 1940-1:2003, *Mechanical vibration — Balance quality requirements for rotors in a constant (rigid) state — Part 1: Specification and verification of balance tolerances*

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