

GENERAL SPECIFICATION

ROTATING MACHINERY

GS EP MEC 240

**Special Purpose Couplings for Petroleum, Chemical,
and Gas Industry Services according to
API Standard 671**

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1. Scope

This specification clarifies how to use the recommendations of [API Std 671](#) for the supply to Company of couplings for the transmission of power between the rotating shafts of two machines in special purpose applications in the petroleum, petrochemical, and natural gas industries.

The purpose of this specification is to clarify the requirements of [API Std 671](#) standard fourth edition, August 2007.

This document modifies or complements some requirements of [API Std 671](#) standard, when deemed necessary considering Company experience.

The paragraph numbering is defined in the same way as in [API Std 671](#) except for additional requirements, which may be presented with new paragraph numbers. The summary sheet at front indicates where to find the information for each paragraph of [API Std 671](#) shown with a bullet.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
ANSI/AGMA 9003	Flexible Couplings - Keyless Fits
API Std 671	Special Purpose Couplings for Petroleum, Chemical and Gas Industry Services
DIN 7190	Interference fits - Calculation and design rules

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

Reference	Title
Not applicable	

3. Comments to API Std 671

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3. Terms and definitions	
For the purposes of this document, the following terms and definitions apply.	The terms and concepts defined in section 3 of API Std 671 shall be used, with the following amendments.
3.32 Purchaser Agency that issues the order and the specification to the Vendor. Note: the purchaser can be owner of the plant in which the equipment is to be installed, the owner's appointed agent or, frequently, the manufacturer of the driven machine.	Vendor is the coupling supplier. Purchaser is the supplier of the driven or driver machine having the complete responsibility of the shaft line. Company refers to TOTAL, its subsidiaries, agents or associates.
4. Statutory requirements	
The purchaser and the vendor shall mutually determine the measures to be taken to comply with any federal, state or local codes, regulations, ordinances or rules that are applicable to the equipment.	Codes and regulations that shall apply are listed in the Project Specification, including ATEX rules requirements.
5. Coupling selection	
5.1 The purchaser shall specify the type of coupling required. Unless otherwise specified, the coupling shall be a metallic flexible-element coupling. For torsional damping and resilient couplings, refer to Annex A; for gear couplings, refer to Annex B; and for quill-shaft couplings, refer to Annex C.	Couplings shall be metallic flexible-element type. Either metallic disc type or metallic diaphragm type are acceptable to Company. Any other coupling type, such as torsional damping couplings, shall be subject to a formal derogation by Company. Resilient couplings and gear couplings shall not be used. Quill-shaft couplings can be used only if Vendor can demonstrate sufficient experience with this type of coupling. Coupling Vendor shall provide quill-shaft assembly details, including cross sectional drawing, with the proposal. If quill-shaft coupling is used, the Purchaser shall provide a complete train lateral analysis.
5.3 If specified, the coupling, coupling-to-shaft juncture and shafting may be sized for a future condition.	Refer to Project Data Sheets and Specification.

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6. Coupling design	
• 6.1 The purchaser shall specify the following requirements, where applicable: a) type of train; b) normal power; c) normal speed and variations; d) maximum continuous speed; e) any defined overspeed; f) angular misalignment; g) axial displacements; h) shaft sizes and styles; i) distance between shaft-ends; j) temperature; k) type of driver; l) driver power rating (list and driver service factor); m) expected transient (peak) and cyclic torque conditions, including magnitude, nature and number of occurrences of transients to which the coupling will be subjected in service.	This paragraph is applicable.
• 6.2 The purchaser shall specify the maximum angular misalignments the coupling is expected to experience during start-up, normal operation and shut-down of the coupled machines, normally expressed as parallel (or lateral) offset and/or angular misalignment between the coupled shafts. These values shall allow for all the known effects on the machines from thermal, pressure and dynamic forces. Unless otherwise specified, the steady-state angular misalignment capability across each flexible element shall be not less than 0.2°.	This paragraph is fully applicable. In addition, the steady-state angular misalignment capability across each flexible element shall be not less than 0.2°.
• 6.3 The purchaser shall specify the maximum axial displacements the coupling is expected to experience, expressed as the amount and direction of the relative movement of the shaft ends toward or away from each other as the coupled machines go through their start-up, normal operation and shut-down cycle. These dimensions shall be	This paragraph is not applicable to quill-shaft couplings. For all other acceptable coupling designs, this paragraph is fully applicable. In addition, the minimum steady-state axial deflection (plus/minus) capability shall be determined by the largest shaft diameter

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given from the machine at ambient conditions, non-operating position. Unless otherwise specified, the minimum steady-state axial deflection (plus/minus) capability shall be determined by the largest shaft diameter divided by 125.	divided by 75.
• 6.4 The purchaser shall specify the speed range for the fully assembled coupling, moment simulator and solo plate for both continuous speed and any defined overspeed.	This paragraph is applicable.
6.5 The steady-state torque, T_n, expressed in newton-metres (inch-pounds force), shall be determined as given in Equation (1): $T_n = \frac{K_1 \times P_{\text{normal}}}{N_{\text{normal}}} \quad (1)$ Where: • K_1 is a constant, equal to 9,550 (63,000); • P_{normal} is the input power required by the driven machine at the specified normal operating point, expressed in kilowatts (horsepower); • N_{normal} is the speed corresponding to the normal power, expressed in revolutions per minute. • If specified by the purchaser, the steady-state torque shall be based on the power required by the driven machine at the rated operating point and the corresponding speed rather than that at the normal operating point. This can be appropriate if the power required by the driven machine at the rated point is significantly higher than that at the normal point. Note 1: This situation can occur, for example, in the case of a centrifugal compressor with a number of different specified operating duties. Note 2: Basing the coupling torque rating on the driven-machine-rated operating point rather than the normal point can result in a coupling that is undesirably large or heavy. This can be significant if one or both of the	Refer to paragraph 6.9.

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connected machines is sensitive to overhung mass. The purchaser should also consider possible future up-rating of the connected machines, for example augmentation of the power output of a gas turbine by water injection.	
6.6 Unless otherwise specified, the steady-state selection torque, T_s, expressed in newton-metres (inchpounds), used to select the coupling shall be as given in Equation (2): $T_s = T_n \times F_s \quad (2)$ Where: F_s is the service factor (as specified for the specific coupling type). Note: The service factor allows for various modes of off-design operation that can result from such factors as a change in density of the fluid (molar mass, temperature or pressure variation), unequal load sharing, fouling or driver output at maximum conditions.	Refer to paragraph 6.9.
6.7 Unless otherwise specified, the coupling shall have, as a minimum, a service factor of 1.5 for a metallic flexible-element coupling.	Refer to paragraph 6.9.
6.8 The service factor may be reduced by agreement between the purchaser and the vendor if - the characteristics of the driver and driven machines and the operating process are well understood, or - all reasonable attempts to achieve the specified steady-state torque service factor fail to result in a coupling mass and subsequent overhung moment commensurate with the requirement for rotor dynamics of the connected machines. In no case shall the service factor be reduced to a value lower than 1.2 based on the normal power.	Refer to paragraph 6.9.
6.9 If specified, for the steady-state conditions, the coupling shall be sized based	This paragraph is applicable. For the steady-state conditions, the coupling

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on the driver rating multiplied by 1.2 (typically, excluding the driver service factor). Note: If the driver rating is large compared with the normal load, this requirement can result in an excessively conservative coupling selection.	shall be sized based on the driver maximum available power at site conditions multiplied by 1.2. In particular, when the driver is a gas turbine, the driver maximum available power shall correspond to the most favorable ambient conditions (e.g. minimum ambient temperature). If more than one coupling is present in the shaft line, the couplings shall be sized based on the driver maximum available power at site conditions multiplied by 1.2, and prorated between the driven equipment on the basis of the power demand of each driven equipment.
• 6.12 If specified, the coupling shall be capable of transmitting a specified transient torque associated with a generator short circuit and/or a motor breaker re-closure without damage. Note: During these situations large torques can occur, which require that the total system be subsequently examined for possible damage.	This paragraph is applicable.
6.13 Unless otherwise specified, the coupling-to-shaft juncture and the machinery shafting shall be capable of operating at a steady-state torque determined in accordance with 6.6, substituting a service factor of 1.75.	The coupling-to-shaft juncture and the machinery shafting shall be capable of operating at a steady-state torque determined in accordance with 6.9, substituting a service factor of 1.75.
6.14 Unless otherwise agreed, the torque capacity of a coupling-to-shaft juncture that is hydraulically fitted and keyless shall be determined by using the methods and equations in ANSI/AGMA 9003 or DIN 7190. Other methods of calculation may be used with the approval of the purchaser. The coefficient of friction used shall be 0.15. The assumed length of hub engagement shall not include "O"-ring and oil-distribution grooves in the hub or the shaft.	This paragraph is fully applicable. In addition, the torque capacity of a coupling-to-shaft juncture that is hydraulically fitted and keyless shall be determined by using the methods and equations in ANSI/AGMA 9003 or DIN 7190. O-rings shall not be used.
6.15 Couplings may be designed to transmit torque through flange face friction. Unless otherwise agreed, a value of 0.15 shall be	This type of coupling shall not be used.

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assumed for the coefficient of friction. However, the fasteners for coupling flanges, including integral flanges, shall be not less than that required to transmit the specified torques, as identified in 6.9 through 6.12, in shear.	
7. Coupling ratings	
7.3 For applications where cyclic torques can occur (such as from synchronous motor, generator or reciprocating compressor), the coupling design shall be determined by completing a fatigue analysis. The analysis shall take into account the normal operating conditions in conjunction with the transient conditions (see 6.1). Depending on whether the cyclic loads are considered for a limited number of occurrences or considered to be infinite, either a low-cycle fatigue analysis or high-cycle fatigue analysis shall be performed for the various torque-transmitting components in the coupling. For low-cyclic fatigue analysis, the resultant mean and cyclic stresses plotted on a fatigue diagram shall fall under the applicable life curve (i.e. 10^4, 10^5, 10^6 or 10^7 cycles). • The life curve used shall be based on the purchaser specifying the number of occurrences of transients to which the coupling will be subjected in service. For high-cycle fatigue analysis, the analysis and safety factors shall be as specified in 7.1. Transient applications do not require the application of a service factor. In applications where potentially damaging, infrequent, maximum momentary or fault torques occur, the provision of an overload device may be considered to protect the coupling and equipment. Care should be taken that the overload device does not trip prematurely due to low- or high-cycle fatigue of any sacrificial elements. Precautions should also be taken to ensure that the device remains relatively intact after a trip until the connected equipment is brought to a stop.	This paragraph is fully applicable. In addition, overload devices shall not be used, and may be considered for very specific power generation applications only. As a minimum, couplings shall be able to withstand short circuit torques without any overload devices.

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8. Coupling requirements	
8.1 Metallic flexible-element couplings	
8.1.2 Unless otherwise specified, flexible elements shall be metallic.	Flexible elements shall be metallic.
• 8.1.4 If the coupling is required to operate within a close-fitting, enclosed coupling guard, the purchaser shall provide details of the guard for the vendor to inspect. The vendor shall determine and so advise if cooling is required and, if necessary, shall recommend a cooling system for the coupling. See Annex H for coupling guard requirements.	Forced cooling systems for the coupling shall not be used. In addition, anti-windage plates or guards shall be provided and installed on coupling hubs to limit losses and subsequent heat generation.
8.1.6 Unless otherwise agreed, the design of metallic flexible-element couplings shall be such that in the event of complete failure of the flexible element or elements in one plane of flexure, the spacer assembly is retained in approximately its normal position.	The design of metallic flexible-element couplings shall be such that in the event of complete failure of the flexible element or elements in one plane of flexure, the spacer assembly is retained in approximately its normal position.
• 8.1.7 When specified, couplings shall incorporate a feature that allows transmission of load for a limited period, in the event of a complete flexible element failure. This feature may be considered for turbine main-drive couplings to provide an additional safety factor to prevent turbine overspeed in the event of coupling failure and complete loss of load.	Features that allow transmission of load for a limited period, in the event of a complete flexible element failure shall not be used.
8.3 Spacer	
All couplings shall be of the spacer type. The spacer shall be of sufficient length to allow removal of coupling hubs and to allow for maintenance of adjacent bearings and seals without removal of the shaft or disturbance of the equipment alignment. Unless otherwise specified by the purchaser, the spacer length shall correspond to a distance between shaft-ends of 460 mm (18 in). Note: The spacer gap length is not necessarily the same as the spacer length.	This paragraph is fully applicable. In addition, the minimum spacer length shall correspond to a distance between shaft-ends of 460 mm (18 in). The spacer shall be equipped with appropriate devices such as slots inserted in the flanges connection to the coupling hubs or holes to evacuate potential oil accumulation.

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8.4 Hub type	
The purchaser shall specify whether the coupling shall be designed to fit to integral flange(s) or be provided with removable hub(s). Note: The two ends of the couplings are not necessarily the same.	This paragraph is applicable.
8.5 Integral flanges	
8.5.2 Unless otherwise specified, the coupling shall mate directly to the integral flange without an adapter. Note 1: Addition of an adapter between the coupling and the integral flange increases the overhung moment and adds another fit whose runout and clearance it is necessary to control in order to maintain balance. Further, the issue of who is responsible for supplying the adapter (machine manufacturer or coupling manufacturer) requires an agreement for each order. Note 2: For certain machines, particularly gas turbines, space limitations can make it impractical to comply with the requirement in 8.5.2.	The coupling shall mate directly to the integral flange without an adapter.
8.6 Hubs	
8.6.1 Removable hubs	
8.6.1.1 Removable coupling hubs shall be fitted to the shaft using an interference fit to positively locate and centre the hub, and therefore the rest of the coupling, on the shaft. These hubs may have a parallel or taper bore, with or without keyways, or may be splined with a major diameter fit, or splined with a side fit and fore and aft locating pilots, as specified by the purchaser. - The degree of interference shall be specified by the purchaser and is subject to approval by the vendor. The following guidelines are recommended for hub to shaft fits. a) The interference fit for straight-bore, keyed hubs should be from 0.000	Only the following arrangements are permitted: - Parallel or straight bore with keyways. The interference fit for straight-bore, keyed hubs shall be from 0.000 50 mm/mm (in/in) to 0.000 75 mm/mm (in/in) of bore diameter. This type of coupling hub is allowed only if after installation, the hub becomes an integral irremovable part of the shaft. - Taper bore without keyways. The interference rate for taper-bore, hydraulically fitted hubs shall be 0.0025 mm/mm (in/in) of bore diameter.

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50 mm/mm (in/in) to 0.000 75 mm/mm (in/in) of bore diameter. b) The interference fit for tapered-bore, keyed hubs should be at least 0.001 mm/mm (in/in) of bore diameter. c) The interference rate for taper-bore, hydraulically fitted hubs should be based upon the torque that is required to be transmitted. As a maximum, the interference rate should not exceed 0.003 mm/mm (in/in) of bore diameter to avoid potential bonding problems. d) Some international machinery manufacturers may use preferred fits for shafts and bores.	
● 8.6.1.2 If specified, for straight-bore, keyed hubs, shaft sizes and coupling bores shall be in accordance with ANSI/AGMA 9002, ANSI/AGMA 9112 or ISO 286-2.	This paragraph is applicable.
8.6.2 Tapered-bore hubs	
● 8.6.2.1 If a taper-bored coupling is specified, the purchaser shall specify the taper (see Annex G).	This paragraph is applicable. In addition, the hub taper bore shall be free of any o-ring grooves and of any sharp edges.
8.6.2.2 Unless otherwise specified, keyless hydraulically fitted hubs shall have a taper of 1:24.	Keyless hydraulically fitted hubs shall have a taper of 1:24.
8.6.2.3 Unless otherwise specified, non-hydraulically fitted hubs shall have a taper of 1:16.	This paragraph is not applicable, as this type of coupling hubs is not allowed (refer to 8.6.1.1).
● 8.6.2.4 If specified, a matched set of plug and ring gauges (see 11.5) shall be supplied.	A matched set of plug and ring gauges (see 11.5) is not required.
● 8.6.2.5 If specified, a matching set of plug and ring lapping tools (see 11.6) shall be supplied.	A matching set of plug and ring lapping tools (see 11.6) is not required.
8.6.2.6 Unless otherwise agreed, which can be the case if the shaft-ends and hubs are machined using modern CNC machines, tapered bores shall be checked by using the plug gauge from a matched plug-and-ring gauge set provided by the purchaser. A light coat of bluing shall be used for the check.	Tapered bores shall be checked by using blue coating between the respective coupling hubs and the relevant shaft cone ends. Tapered bores for keyless, hydraulically fitted hubs shall have at least an 85% blued fit (surface contact) to the taper shaft. Tapered bores for keyed hubs are not

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Tapered bores for keyless, hydraulically fitted hubs shall have at least an 85% blued fit (surface contact) to the taper gauge. Tapered bores for keyed hubs shall have at least a 70% blued fit (surface contact) to the taper gauge. Note 1: ANSI/AGMA 9003 provides guidance for checking the contact. Note 2: ANSI/AGMA 9002 specifies the bore check before cutting keyways.	allowed anymore.
8.6.3 Additional requirements for keyed hubs	
• 8.6.3.1 The purchaser shall specify the number and configuration of the keyways.	This paragraph is applicable.
8.7 Solo plate (idling adapter)	
• If uncoupled operation is specified, if necessary, the vendor shall supply a solo plate for the drive end of the coupling. The solo plate shall centre and maintain the balance of the coupling.	This paragraph is not applicable as this type of operation is not required.
8.8 Moment simulator	
• If specified, a moment simulator shall be supplied. The purchaser shall provide the vendor with the measurement of the distance from the end of the shaft to the centerline of the adjacent bearing. A moment simulator may be designed also to serve as a solo plate.	This paragraph is applicable. However, the solo plate is not required.
8.9 Component fit tolerances and potential unbalance calculations	
• 8.9.3 If specified, the coupling vendor shall perform calculations to verify the potential unbalance of the complete coupling, in the plane of the centre of mass of each half coupling. The calculation shall be for the coupling specified. The potential unbalance shall not exceed ANSI/AGMA 9000-C90, Class 9, potential mass centre displacement of 50 µm (2,000 microinches), for couplings operating at speeds 1,800 r/min or less. For couplings operating at speeds greater than 1,800 rev/m up to 5,000 rev/m, the	This paragraph is not applicable.

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potential unbalance shall not exceed ANSI/AGMA 9000-C90, Class 10, potential mass centre displacement of 27 μm (1,000 microinch). For couplings operating at speeds greater than 5,000 rev/m, the potential unbalance shall not exceed ANSI/AGMA 9000-C90, Class 11, potential mass centre displacement of 13 μm (500 microinch). The centre of mass is the location at which the mass of the half coupling can be considered to be concentrated and is normally referenced from the equipment shaft end, with a positive location being beyond the shaft end and a negative location being within the shaft. Note: An example of a potential unbalance calculation is given in Annex E.	
8.11 Electrical insulation	
• If specified, the coupling shall be electrically insulated to prevent the flow of electrical current from one shaft to the other through the coupling. Any non-metallic insulating parts are exempt from the requirements of 8.9.1 and 8.9.2. Note: Electrical insulation is normally achieved by the insertion of insulating material between the flanges and around the flange bolts.	This paragraph is not applicable.
9. Balance	
9.1 General	
The overall objective of coupling balance is to provide a coupling that is designed, manufactured, assembled and balanced such that it can be installed on the driving and driven machines and operated with machine vibrations within allowable limits. This requires that the machine shaft end eccentricity should be commensurate with the degree of balance required on the coupling. The degree of balance required for a given coupling is a function of the unbalance responses of the coupled machines.	Method 3 shall be used.

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Machines with a high degree of sensitivity to coupling unbalance require well balanced couplings; machines with lower sensitivity require less precisely balanced couplings. This International Standard provides three separate balancing methods. Certain specific applications can require tighter balancing criteria or methods to be specified by the purchaser. • Couplings shall be balanced by one of the following methods, as specified by the purchaser. • Method 1 is to separately balance each major component or factory-assembled sub-assembly. This method is the standard for couplings operating at 1,800 r/min or less. • Method 2 is as method 1 but with the addition of a check balance carried out on the completely assembled coupling. This method is the standard for couplings operating above 1,800 r/min, with options as specified. • Method 3 is an optional method for couplings operating above 1,800 r/min, with options as specified, and is based on the balancing of the completely assembled coupling as an entity. Table 1 identifies the paragraphs pertinent to each balancing method.	
9.2 Balancing methods	
9.2.2 Method 2 - Component balance with assembly check balance	
• All components shall be manufactured and balanced as for method 1, to achieve the required level of potential unbalance. The coupling shall then be assembled and the balance checked as an assembly with the limits stated and the technique described in 9.3.6. If specified, the coupling as mounted on the balance machine shall have the residual unbalance verified as described in 9.3.8. If specified, the coupling shall be subjected to a repeatability check as	This paragraph is not applicable (see 9.1).

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described in 9.3.9. The procedure for this method is illustrated in Figure 3.	
9.2.3 Method 3 - Component balance with assembly balance	
This balance method requires that all components be individually balanced to the limits stated using the technique described in 9.3.5, except for the component or sub-assembly that will have the assembly balance correction made to it. The coupling shall then be assembled and balanced in accordance with and to the limits stated in 9.3.7. If specified, the coupling as mounted on the balance machine shall have the residual unbalance verified as described in 9.3.8. If specified, the coupling shall be subjected to a repeatability check as described in 9.3.9. The procedure for this balancing method is illustrated in Figure 4.	This paragraph is fully applicable.
9.3 Balance criteria	
9.3.5 Component balance	
Couplings components shall be balanced by rotation. Each component, such as the hubs, sleeves, flexible elements, spacer, factory-assembled sub-assemblies, adapter plate(s), solo plate(s) and moment simulators, shall be balanced individually (except for the component or sub-assembly that is corrected as described in 9.3.7). All machining of components, except for keyway(s), shall be completed before balancing. The machining of keyway(s) prior to balancing is optional. Two-plane balancing is required for components or sub-assemblies with a length/diameter ratio greater than or equal to 1.0. Where the length/diameter ratio is less than 1.0, two-plane balancing is preferred but single-plane balancing is acceptable. Each component shall be balanced so that the level of residual unbalance, U, expressed in gram-millimetres (ounce-inches), for each balance plane does not exceed the greatest of the values determined by Equations (3) to	This paragraph is fully applicable. In addition, two-plane balancing is required independently from the length/diameter ratio of the component, and each component shall be balanced so that the level of residual unbalance, U, expressed in gram-millimetres (ounce-inches), for each balance plane does not exceed the value determined by Equation (3).

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(5): $U = \frac{K_2 \times m}{N} \quad (3)$ $U = K_3 \times m \quad (4)$ $U = K_4 \quad (5)$ Where: • K_2 is a constant, equal to 6350 (4); • K_3 is a constant; equal to 1.27 (0.0008); • K_4 is a constant; equal to 7.2 (0.01); • m is the mass, expressed in kilograms (pounds) of the component apportioned to one or the other of the balance planes so that the sum of the masses apportioned to the two planes equals the total mass of the component; • N is the maximum continuous operating speed, expressed in revolutions per minute.	
9.3.7 Assembly balance	
Couplings balanced in accordance with 9.2.3 (component balance with assembly balance) shall be assembly balanced. For an assembly balance, coupling components or sub-assemblies shall be balanced in accordance with 9.3.5. The assembled coupling shall then be match-marked and two-plane balanced, with corrections being made only to the component or sub-assembly that was not previously balanced. The final residual unbalance of the assembled coupling in each of the two correction planes shall not exceed the greatest value determined by Equations (3) to (5). Note: Assembly balancing corrects for overall coupling unbalance caused by eccentricities of the pilot fits that are used to centre components during assembly. However, assembly balancing can prohibit the subsequent interchange of duplicate coupling components and can require that the entire coupling be maintained as a unit, except for the bolts and nuts.	This paragraph is fully applicable. In addition, the final residual unbalance of the assembled coupling in each of the two correction planes shall not exceed the value determined by Equation (3) of paragraph 9.3.5.

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9.3.8 Residual unbalance check	
• If specified, a residual unbalance check shall be performed on the assembled coupling. The residual unbalance check shall be performed after assembly balancing or assembly check balancing is complete and before the assembled coupling is removed from the balancing machine. Note: A procedure for a residual unbalance check is given in Annex I.	This paragraph is applicable.
9.3.9 Repeatability check	
• If specified, the coupling shall be checked after the assembly balance or assembly check balance to ensure that the assembly balance can be repeated. The coupling shall be disassembled to the same extent required for normal field disassembly and remounted on the balance fixture or fixtures. The unbalance of the reassembled coupling shall then be measured on the balancing machine; the residual unbalance, U, expressed in gram-millimeters (ounce-inches), shall not exceed the greatest value determined by Equations (6) to (8).	This paragraph is applicable.
9.3.10 Component interchangeability check	
• If specified and where interchangeable spare parts are to be supplied with the original coupling, a component interchangeability test shall be performed. After the coupling has been match-marked following an assembly check balance, it shall be disassembled to the same extent required for normal field disassembly and a major component, to be selected by the purchaser, shall be substituted and the coupling reassembled and remounted on the balance machine. The unbalance of the coupling shall then be measured in the same manner and to the same criteria described in 9.3.9. The components shall be match-marked to identify proper positioning as applicable. A major component shall normally be a rigid	This paragraph is not applicable, as method 3 only is considered.

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adapter, a flexible element sub-assembly, a spacer or a centre section containing flexible elements.	
9.4 Trim balance holes	
• If specified, threaded holes shall be provided in the coupling for trim balancing. The trim-balance holes should be capable of correcting for an unbalance, U, as given by Equation (9): $U = K_6 \times m \text{ (9)}$ Where: m is the mass, expressed in kilograms (pounds), of the component apportioned to one or the other of the balance planes so that the sum of the masses apportioned to the two planes equals the total mass of the component; K_6 is a constant, equal to 12.7 (0.008). The number, size, depth and location of such holes shall be agreed upon by the purchaser and the vendor. The optimum hole location for keyed hubs is generally on the outboard faces of the hubs, midway between the inside and outside diameters of the hub barrel. The optimum location for keyless (hydraulically fitted) hubs is generally on the coupling flanges, between the bolt holes of the flange. Note: Because of eccentricity of the shaft end or incompletely filled keyways, trim balancing the rotor after the coupling hub has been mounted can be advisable. This practice normally precludes moving the hub to another rotor, unless balance is achieved by using balance holes as described in this subclause (9.4). When balance holes are used, the hub can always be returned to its original state of balance by removing the weights inserted into the holes.	This paragraph is fully applicable. In addition, the second sentence is replaced by the following: The trim-balance holes shall be capable of correcting for an unbalance, U as a minimum, as given by Equation (9).
10. Materials	
• 10.3 The purchaser shall specify any corrosive agents present in the environment, including constituents that can cause stress	Refer to Project Data Sheets and Specification.

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corrosion cracking.	
• 10.4 If a coupling operation in a corrosive environment is specified, either oil mist, a suitable coating or an inert gas purge can be required. The vendor shall advise the purchaser when material limitations demand such protection for the coupling.	This requirement has to be assessed on a case by case, and any kind of protection proposed by the Vendor shall be subject to Company approval.
10.5 Flexible elements shall be of corrosion-resistant material. If approved by the purchaser, flexible elements may be suitably coated to resist corrosion. The type of coating and its method of application shall be described by the vendor.	Flexible elements shall be of corrosion resistant material. The use of coating for flexible elements is prohibited.
• 10.6 If specified, all other parts not covered by 10.5 shall be made from corrosion-resistant material or suitably coated.	All other parts not covered by 10.5 shall be made from corrosion-resistant material.
11. Accessories	
• 11.1 The purchaser shall specify who is to supply the necessary pumps, hoses and fittings, pressure gauges and other equipment required for the installation and removal of hydraulically fitted coupling hubs.	The Purchaser shall supply the necessary pumps, hoses and fittings, pressure gauges and other equipment required for the installation and removal of hydraulically fitted coupling hubs.
• 11.3 If specified by the purchaser, a two-piece stop-ring shall be provided to locate the advance (draw) of the hydraulically fitted coupling hub during installation. This stop-ring shall be designed to be clamped onto the shaft and shall be removable after the coupling is properly in place, whether installed in the shop or the field.	Refer to paragraph 11.1.
• 11.4 If specified by the purchaser, the vendor shall provide a puller for keyed coupling hubs.	Refer to paragraph 11.1.
• 11.5 If specified, the vendor shall supply a matched set of plug-and-ring gauges for each shaft-end taper. These gauges shall meet the following requirements. a) The hardness of the material of the gauge shall be greater than that of the shaft or coupling and not less than 45 HRC. b) This plug-and-ring gauge set shall be	Refer to paragraph 8.6.2.4.

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verified with the machinery vendor's master plug and master ring gauges. c) The plug-and-ring gauges shall meet the roundness, surface finish and contact requirements of this International Standard for coupling tapers. d) The length of the ring-and-plug gauge shall at least be equal to the length of the coupling hub plus the advancement distance. The tools shall overlap the taper at each end. e) Equipment drawings shall be reviewed for possible interference. f) The gauges shall be marked "Gauge" in a non-critical location. g) The storage preservation of these gauges shall satisfy the requirements of 12.5.4. Note: This gauge set is intended to become the master gauge set for the owner for use in inspection of both shaft and coupling taper.	
• 11.6 If specified, the vendor shall supply a set of lapping tools in compliance with the following. a) The lapping tools shall be softer than the shaft and hub. b) Lapping tools shall overlap the taper at each end by a minimum of 12 mm. c) Equipment drawings shall be reviewed for possible interference. d) The lapping tools shall be marked "Lapping Tool" in a non-critical location. e) The storage preservation of these tools shall satisfy the requirements of 12.5.4.	Refer to paragraph 8.6.2.5.
12. Manufacturing quality, inspection, testing and preparation for shipment	
12.2 Inspection and testing	
• 12.2.1 The purchaser shall specify the extent of participation in the inspection and testing.	This paragraph is applicable.
• 12.2.5 The purchaser shall specify the amount of advanced notification required for a witnessed or observed inspection or test.	This paragraph is applicable.

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12.4 Testing	
● 12.4.1 If specified, couplings identified in 8.12.1 as having undamped response to external vibration shall be tested to verify the predicted natural frequency. The test technique shall be agreed by the purchaser and the vendor.	This paragraph is applicable.
12.5 Preparation for shipment	
● 12.5.2 The purchaser shall specify the expected storage time and whether the storage location is to be indoors or outdoors.	Refer to Project Data Sheets and Specification.
● 12.5.3 The purchaser shall specify whether the packing to be provided is for domestic or export shipping.	Refer to Project Data Sheets and Specification.
● 12.5.5 Each coupling shall be properly identified by an item number and serial number stamped or etched on the coupling assembly (see 12.1.5). The container shall be marked with the information specified by the purchaser.	This paragraph is applicable.
● 12.5.6 The vendor shall inscribe a serial number unique to the coupling on all of the coupling major separable parts. The vendor shall inscribe the recommended bolt torques on each flange. The purchaser may require the vendor to inscribe additional identifying markings, for example, markings to indicate equipment train or location of the coupling within the train.	This paragraph is applicable.
13. Vendor data	
13.1 General	
● 13.1.3 If specified, the vendor shall attend the co-ordination meeting covering the connected equipment train and be prepared to discuss the following items: a) purchase order, scope of supply and sub-vendor items; b) data sheets; c) schedules for transmittal of drawings, production and testing;	This paragraph is applicable.

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d) inspection, expediting and testing; e) review of applicable specifications and previously agreed exceptions to specifications; f) design data for the coupling guard.	
13.2 Proposal data	
13.2.1 General	
The vendor's proposal shall include the information specified in items a) through g): a) specific statement that the coupling and all its components are in strict accordance with this International Standard and the purchaser's specifications (if the system and its components are not in strict accordance, the vendor shall include a specific list of exceptions to the specifications that details and explains each deviation sufficiently to permit the purchaser to evaluate the offering); b) copies of the purchaser's data sheets with complete vendor's information entered thereon; c) typical cross-sectional drawings and literature; d) when necessary, an itemized list of the special tools included in the offering; e) any start-up, shut-down or operating restrictions required to protect the integrity of the coupling; f) potential unbalance calculations, if specified; see 8.9.3; • g) if specified, a list of similar couplings installed and operating under analogous conditions.	This paragraph is fully applicable including item g).
13.2.2 Drawings	
• 13.2.2.1 The purchaser shall state in the inquiry and in the order the number of prints and/or reproducible copies required and the timetable within which they are to be submitted by the vendor.	This paragraph is applicable. Refer also to Project Data Sheets and Specification.



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13.2.3 Data	
• 13.2.3.3 The maximum enclosure temperature at the maximum continuous speed shall be calculated. It shall be agreed by the purchaser and the vendor who shall make these calculations. Enclosure data and ambient temperature data at the coupling location shall be supplied by the purchaser.	This paragraph is applicable. In addition, the Purchaser shall be fully responsible for these calculations.

Annex A - Torsional damping couplings and resilient couplings

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A.1 General	
A.1.1 The requirements of this annex apply to torsional damping and resilient couplings and replace the requirements in 8.1, except that the requirements of 8.1.4, 8.1.5 and 8.1.6 shall apply.	Resilient couplings shall not be used. Torsional damping couplings shall be subject to Company approval.
• A.1.3 The purchaser shall specify if it is necessary to use a resilient coupling.	Resilient couplings shall not be used.
A.2 Basic Design	
A.2.3 Unless otherwise agreed, initial sizing shall be accomplished by multiplying the normal steady-state torque by 3.0 and comparing this to the peak capacity of the coupling. These couplings are usually sized based on transient/peak torques that are determined by doing a detailed system analysis. The peak capacity of the elastomeric flexible element of the coupling shall be greater than the calculated transient/peak torque by 1.15. The momentary torque limit of the elastomeric flexible element of the coupling shall be greater than the very infrequent high-transient torque. All other components (bolts, hubs, spacers) shall comply with the requirements of 7.2 and 7.3.	This paragraph is fully applicable. In addition, initial sizing shall be accomplished by multiplying the normal steady-state torque by 3.0 and comparing this to the peak capacity of the coupling.
• A.2.5 The purchaser shall specify any material constraints regarding flexible elements.	Refer to Project Data Sheets and Specification. In particular, site ambient conditions and corrosion possibility shall be considered. In any case, material selection shall be subject to Company approval.
• A.2.6 The purchaser shall specify minimum requirements for torsional damping and the allowable range of torsional stiffness for the coupling.	This paragraph is applicable.
• A.2.7 The purchaser shall specify any restrictions regarding the use of elastomers in shear.	This paragraph is applicable.
• A.2.10 The purchaser shall specify whether the coupling is a single- or double-	This paragraph is applicable.

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engagement type, based on misalignment requirements.	
• A.2.11 The purchaser shall specify whether the coupling is a spacer or non-spacer type, taking the maintenance requirements of the coupled equipment into consideration and shall specify the length of spacer, if required.	This paragraph is applicable.
A.3 Balance	
A.3.1 Unless otherwise specified, the resilient coupling, including any part of a metallic flexible-element coupling or a gear coupling, shall be balanced by balancing the individual components to limits set in 9.3.5. Separate elastomeric, flexible elements shall be mass-balanced to a tolerance of 0.1 g (0.003 5 oz).	Resilient couplings shall not be used.
• A.3.2 If specified, the coupling shall be check-balanced and/or assembly-balanced. Assembly-balance check limits and balance limits shall be agreed by the purchaser and the vendor.	The coupling shall be assembly-balanced. Assembly-balance limits shall be as per paragraph 9.3.7 as amended by Company.
A.4 Materials of construction	
• A.4.1 The materials of construction, including elastomers, shall be agreed by the purchaser and the vendor. The purchaser shall specify pertinent operating conditions (including environmental conditions), such as temperature, corrosiveness of the atmosphere and air-borne abrasives.	Refer to Project Data Sheets and Specification.
A.5 Vendor's data	
• A.5.3 If specified, the vendor shall state the life expectancy of the elastomeric elements when they are operating at the specified conditions (including environmental conditions).	This paragraph is applicable.

Annex C - Quill-shaft couplings

API	GS
C.1 General	
• C.1.2 The purchaser shall specify whether a quill-shaft coupling shall be supplied.	The use of quill-shaft couplings shall be subject to Company approval.
C.1.3 Quill-shaft couplings shall not be used between two shafts that are both constrained by thrust bearings. However, quill-shaft couplings may be combined with one of the other types of coupling to overcome the inherent inability to accommodate axial displacement.	Quill-shaft couplings shall not be combined with one of the other types of coupling.
C.2 Coupling selection and design	
• C.2.2 The purchaser shall specify the maximum misalignments the coupling is expected to experience during start-up, normal operation and shut-down of the coupled machines, normally expressed as parallel (or lateral) offset and/or angular misalignment between the coupled shafts. These values shall allow for all the known effects on the machines from thermal, pressure and dynamic forces.	This paragraph is applicable.
C.2.3 The lateral natural frequency (Nc) of the coupling, assuming infinitely stiff supports, shall be at least two times the highest specified operating speed for the uniform tube equation methodology as specified in ANSI/AGMA 9004 or ANSI/AGMA 9014 or at least 1.5 times the highest specified operating speed using a more rigorous analysis based on actual geometry (i.e. finite-element analysis). The purchaser and vendor shall agree who shall perform these calculations and the assumptions used. Note: The actual lateral frequency of the coupling is affected by the stiffness of any flange adapter(s) and shaft extension(s). The calculation to achieve this actual number is complex. This subclause (C.2.3) establishes a default value to use when little else is known, such as in the proposal stages of a	The Purchaser shall provide a complete train lateral analysis to validate the quill-shaft design.

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design.	
C.2.4 Unless otherwise specified, the quill-shaft coupling shall be rated using a service factor of 1.5 based on the steady-state torque. See 6.6.	Refer to 6.9.
C.2.5 Unless otherwise specified, quill shafts shall have integral end flanges.	Quill shafts shall have integral end flange on driven machine side. Integral end flange shall not be used on driver side, and the assembly design shall be submitted to Company for approval.

Annex H - Coupling guards

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H.2 General requirements for all guards	
• H.2.1 The purchaser shall designate who coordinates and who is responsible for the supply of all coupling guards in the equipment train.	The supplier of the driven or driver machine having the complete responsibility of the shaft line shall be responsible for the supply of all coupling guards in the equipment train.
• H.2.2 The purchaser shall specify the types of guards that are required.	Base-mounted guards shall not be used. Only fully enclosed guards are acceptable.
• H.2.7 If specified, the guard shall be oil-tight.	The guard shall be oil tight, including on the horizontal and vertical split flanges.
• H.2.9 If specified, the guard shall be fabricated from spark-resistant material, such as aluminium, aluminium alloys, copper or copper-based alloys. A description of the materials of construction shall be submitted to the purchaser for approval.	In all cases, the coupling guard shall be spark proof type fitted with drain and vent connections, designed to avoid windage effect. Marine environment resistant materials shall be used, and clearly specified by the Purchaser for Company approval. Furthermore, the coupling guard shall be sufficiently rigid to sustain the weight of an 80 kg operator.
H.2.10 The guard shall include features to minimize the heat generated by the rotating components and have, as a minimum, a 25 mm (1 in) radial clearance between the maximum coupling outside diameter and the guard inside diameter. The vendor supplying the guard shall confirm the expected surface temperature of the guard. It is recommended that the maximum guard temperature should not exceed 70°C (160°F). If the guard temperature exceeds this value consideration should be given to providing personnel protection from contact with the guard.	This paragraph is fully applicable. In addition, and in all cases, the maximum skin guard temperature shall not exceed 70°C.
H.4 Fully enclosed guards	
• H.4.3 Fully enclosed guards shall be oil-tight and provided with vent and drain connections. As a minimum, these vent and drain connections shall be DN 25 (NPS1) and, if specified, flanged.	This paragraph is applicable, and connections shall be flanged type.
• H.4.7 If specified, the guard shall be fitted with a connection for purging with dry air or an inert gas.	The guard shall not be fitted with a connection for purging with dry air or an inert gas.

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Note: This is necessary when unusually corrosive conditions exist.	
• H.4.8 If specified, the contract guard shall be used when the contract coupling is factory tested with the driver and driven equipment.	This paragraph is applicable.
H.5 Guards for continuously lubricated couplings	
• H.5.4 If specified, a transparent window shall be provided to permit safe inspection of each oil spray while the coupling is in service.	Lubricated couplings are prohibited.