Special-Purpose Couplings for Petroleum, Chemical, and Gas Industry Services

API STANDARD 671
THIRD EDITION, OCTOBER 1998

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Manufacturing, Distribution and Marketing Department

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CONTENTS

Special-Purpose Couplings for Petroleum, Chemical, and Gas Industry Services

1 General

1.1 SCOPE

1.1.1 This standard covers the minimum requirements for special-purpose couplings that transmit power between the rotating shafts of two pieces of equipment in the petroleum, chemical, and gas industries. In general, a special-purpose coupling is to be designed and constructed for a minimum service life of 5 years for flexible-element couplings, and 3 years for gear and torsionally damped and resilient couplings. The coupling is to operate continuously without interruption for this time period in an equipment train that is normally unspared and is critical to the continued operation of the installation.

1.1.2 These couplings are designed to accommodate misalignment and axial displacement of the shafts without imposing excessive mechanical loading on the coupled equipment. This equipment will usually dictate a coupling that is engineered and manufactured specifically to meet the operating conditions of the equipment train in which it will be installed.

1.1.3 Couplings covered in this standard include gear, flexible element, quill shaft, and selected types for torsional damping and torsional tuning in horizontal applications. All other couplings, including clutch, hydraulic, eddy-current, and general-purpose couplings are excluded from the scope of this standard. Additional requirements may be necessary if a coupling is to be used in a vertical position, or at any other angle significantly removed from the horizontal. In particular, provision may be necessary to support the mass of the spacer assembly.

1.1.4 This standard addresses design, materials of construction, manufacturing quality, inspection, and testing of special-purpose couplings. This standard does not define criteria for the selection of coupling types for specific applications.

Note: Consultation by the user with the original manufacturer of the drive and driven equipment is strongly recommended to assure proper application to this standard when coupling retrofits are planned.

Note: A bullet (●) at the beginning of a paragraph indicates that either a decision is required or further information is to be provided by the purchaser. This information should be indicated on the data sheets (see Appendix A); otherwise, it should be stated in the quotation request or in the order.

1.2 ALTERNATIVE DESIGNS

1.2.1 The vendor may offer alternative designs. Equivalent metric dimensions, fasteners, and flanges may be substituted as mutually agreed by the purchaser and the vendor.

1.2.2 The alternative design shall be at least equivalent and preferably superior to the specified design.

1.2.3 Deviations from the specified design shall be described completely, along with the justification for the deviations.

1.2.4 All information required by 5.1 shall be included.

1.3 CONFLICTING REQUIREMENTS

In case of conflict between this standard and the inquiry or order, the information included in the order shall govern.

1.4 DEFINITION OF TERMS

Terms used in this standard are defined in 1.4.1 through 1.4.64.

1.4.1 angular misalignment: For a double-engagement coupling, it is the minor angle between the axial centerline of the structure joining the two flexing elements and either of the shaft centerlines. Thus, there are two misalignment angles associated with a double-engagement coupling. These two angles are not necessarily equal, because they are the result of common parallel offset combined with the angular misalignment of the respective shaft end. AGMA 510 describes shaft parallel offset and shaft angular misalignment.

1.4.2 angular misalignment: For a single-engagement coupling, it is the minor angle between the two shaft centerlines.

1.4.3 anti-sludge: A design that minimizes sludge gathering pockets in continuously lubricated couplings.

1.4.4 assembly balance: A procedure in which a complete assembled coupling is balanced as a unit.

1.4.5 assembly check balance: A procedure in which an assembled coupling is placed on a balance machine and the potential unbalance is measured. This can be done to a component-balanced coupling, or to an assembly balanced coupling.

1.4.6 axial displacement: A change in the gap between the shaft ends of two coupled machines, usually caused by thermal expansion.

1.4.7 axial natural frequency (ANF): A cyclic response frequency determined by the mass of the flexible center element acting against the axial spring rate of the flexible elements. The spring rate may vary with the deflection of the flexible element; therefore, a frequency band corresponding to deflection amplitudes from zero to the maximum allowable amplitude must be considered.

1.4.8 axial reaction force: The axial force developed within the coupling imposed by the operating conditions (axial deflection, misalignment, speed, temperature, etc.) It is a function of the shape and stiffness of the flexible elements or the sliding friction between the elements of a gear coupling.

1.4.9 backlash: The gear tooth circumferential clearance that is necessary to provide angular misalignment capability.

1.4.10 batch-lube: A coupling that is designed to be lubricated by a periodically changed charge of grease or oil.

1.4.11 bending stiffness: A measure of how much force or bending moment is required to angularly misalign a coupling to a specified angle while under torque load.

1.4.12 between shaft ends (BSE): The distance from the face of one shaft (including any threaded end) to the face of the next shaft. For integral flanges, this measurement shall be from the mating face.

1.4.13 center of gravity: For a half coupling, it is the location at which the weight of that half coupling can be considered to be concentrated. The effective center of gravity of the half coupling is referenced from the equipment shaft end; with a positive location being beyond the shaft end and a negative location being within the shaft.

1.4.14 component balance: A procedure for achieving coupling balance in which the components, or factory-assembled subassemblies, are balanced separately before assembly of the coupling.

1.4.15 continuous-lube coupling: A coupling that is designed to be lubricated by a continuous external supply of oil directed at the gear mesh.

1.4.16 continuous-torque rating: For a coupling, it is the manufacturer's value of the torque capability of the coupling utilizing a combination of speed, angular misalignment, and axial displacement.

1.4.17 crown diameter: The major diameter of the external gear teeth.

1.4.18 diametral crown clearance: The clearance between the outside diameter of the coupling's external teeth (whether on a hub or on a marine spool piece) and the root diameter of the internal teeth in the sleeve, when the coupling is in perfect alignment.

1.4.19 diaphragm coupling: A coupling that consists of one or more flexible elements in the form of circular plates that are attached to one part of the coupling at their outer diameter, and the other part at their inner diameter.

1.4.20 disc coupling: A coupling that consists of one or more flexible elements that are alternately attached circumferentially to the two parts of the coupling; the attachment points being substantially at the same radial distance from the axial centerline.

1.4.21 double engagement: A coupling with two flexing planes. This type of coupling can accommodate parallel offset, angular misalignment, and axial displacement.

1.4.22 elastomeric element coupling: A coupling in which the torque is transmitted through one or several elastomeric elements. They can be categorized into two general types—compression and shear—depending on the way torque is transmitted through the flexible element.

1.4.23 electrically insulated coupling: Prevents the flow of electrical current from one shaft to the other through the coupling by inserting insulation between the flanges and around the flange bolts.

1.4.24 factor of safety (F.S.): Used to cover uncertainties in a coupling design; e.g., analytical assumptions in stress analysis, material unknowns, manufacturing tolerances, etc. Under given design conditions, the F.S. is the material yield strength divided by the calculated stress, where the stress is a function of torque, speed, misalignment, and axial displacement.

1.4.25 fatigue factor of safety: The factor of safety at the published rated conditions of torque, speed, misalignment and axial displacement. It is used by the manufacturer to establish the coupling rating. (See 2.1.2.1)

1.4.26 flex-hub coupling: A coupling with the external gear teeth on the hubs and the internal teeth in the sleeves.

1.4.27 flexible-element coupling: Describes both disc and diaphragm couplings. A flexible-element coupling obtains its flexibility from the flexing of thin discs or diaphragms.

1.4.28 flooded-mesh coupling: A continuously lubricated coupling in which the gear meshes are completely submerged in oil during normal operation.

1.4.29 gear couplings: Couplings that transmit torque and accommodate angular misalignment, parallel offset, and axial displacement by relative rocking and sliding motion between mating, profiled gear teeth.

1.4.30 half coupling: The composite of all of the components of the coupling attached to, and supported from, one shaft. Includes an appropriate portion of the spacer assembly in the case of a double-engagement coupling, or of the flexing elements of a single-engagement coupling.

1.4.31 high-speed coupling: A coupling that is designed to operate at speeds above 1800 revolutions per minute (rpm).

1.4.32 lateral (radial) stiffness: The ratio of the force to displacement while deflecting the coupling in a plane perpendicular to the coupling axis of rotation.

1.4.33 limited-end float coupling: A coupling that is designed to limit the axial movement of the coupled shaft ends with respect to each other where one shaft has no thrust bearing for centering. A limited-end float design is commonly used in couplings for sleeve-bearing motors.

1.4.34 low-speed coupling: A coupling that is designed to operate at speeds of 1800 rpm or less.

1.4.35 marine coupling: A coupling with the external gear teeth on the spacer and the internal teeth in the sleeves.

1.4.36 maximum allowable temperature: The maximum continuous temperature for which the manufacturer has designed the equipment.

1.4.37 maximum continuous angular misalignment: The maximum misalignment (both from the shaft angle and parallel offset) the coupling is able to tolerate for unlimited periods. Expressed either as a single value at the coupling-rated speed when transmitting the coupling continuous-rated torque, and simultaneously subject to the coupling maximum continuous axial displacement; or as an interrelated function of speed, torque, and axial displacement.

1.4.38 maximum continuous axial displacement: The maximum axial displacement the coupling is able to tolerate for unlimited periods expressed either as a single value at the coupling rated speed when transmitting the coupling continuous-rated torque, and simultaneously subject to the coupling maximum continuous angular misalignment; or as an interrelated function of speed, torque, and angular misalignment.

1.4.39 maximum continuous speed (in rpm): The speed at least equal to 105 percent of the highest speed required by any of the specified operating conditions.

1.4.40 mechanically flexible element: A form of flexible element that accommodates misalignment by the sliding of mating surfaces. These elements do not have a free-state position. They can be at rest in any combination of axial and angular positions within their flexible capability. Mechanically flexible elements resist change in the axial and angular direction. The resisting forces are mainly a function of shaft torque and coefficient of friction between the mating surfaces. Examples of mechanically flexible elements are gear, grid, and pin bushings.

1.4.41 minimum allowable speed (in rpm): The lowest speed at which the manufacturer's design will permit continuous operation.

1.4.42 moment simulator: An auxiliary device required to simulate the moment of the half coupling. A moment simulator may also be designed to serve as a solo plate.

1.4.43 momentary torque limit: That which corresponds to a factor of safety of 1.0 with respect to the component's material yield strength, using a combination of speed, angular misalignment, and axial displacement.

1.4.44 normal operating point: The point at which usual operation is expected and optimum efficiency of the driver or driven equipment is desired. This point is usually the point at which the vendor certifies that performance is within the tolerances stated in this standard.

1.4.45 peak torque rating: Corresponds to a factor of safety of 1.15 with respect to the component's material yield strength, using a combination of speed, angular misalignment, and axial displacement.

1.4.46 pilot (rabbet): A surface that positions a coupling component, subassembly, or assembly upon which another coupling component is mounted or located.

1.4.47 potential unbalance: The probable net unbalance of a coupling after installation. Potential unbalance results from a condition of the residual unbalance of individual components and subassemblies, and possible eccentricity of the components and subassemblies due to run-out, and tolerances of the various surfaces and registers. The numerical value of the potential unbalance is the square root of the sum of the squares of all the contributory unbalances. Typical contributory unbalances are:

a. The residual unbalance of each component or subassembly.

b. Errors in the balance of each component or subassembly resulting from eccentricity in the fixture used to mount the component or subassembly in the balance machine.

c. The unbalance of each component or subassembly due to eccentricity resulting from clearance or run-out of the relevant registers or fits.

1.4.48 quill-shaft couplings: Couplings that are both laterally and torsionally flexible. Angular misalignment, parallel offset, and torsional fluctuations are accommodated by elastic deformation of a relatively long, slender shaft. Quill-shaft couplings cannot accommodate axial displacement.

1.4.49 rated speed: The maximum speed at which the coupling is capable of transmitting the continuous-rated torque while simultaneously subjected to the rated angular misalignment and the coupling-rated axial displacement.

1.4.50 residual unbalance: The level of unbalance remaining in a component or assembly after it has been balanced to either the limit of the capability of the balancing machine or in accordance with the relevant standard.

1.4.51 root diameter: The diameter of the root circle of the internal gear teeth.

1.4.52 service factor: A factor to account for unusual and occasional loading conditions.

1.4.53 shaft penetration factor: The percentage of the shaft length within the confines of the coupling hub that is, for the purpose of calculating torsional rigidity, assumed to be free from restraint at the shaft-hub interface.

1.4.54 single engagement: A coupling with only one flexing plane. This type of coupling can accommodate angular misalignment and axial displacement. Certain types of single-engagement couplings can also accommodate offset misalignment.

1.4.55 sleeve: A component with internal teeth.

1.4.56 solo plate: An auxiliary device required to rigidly hold in alignment the floating sleeve at the drive end of a flex-hub coupling. This is to allow solo operation of the driver without the necessity of dismounting the coupling hub.

1.4.57 spacer gap length: The flange-to-flange dimension between coupling hubs or sleeves in which the coupling spacer is installed. Spacer gap length is not necessarily equal to the distance between the shaft ends.

1.4.58 torsional natural frequency: Any natural cyclic rotational oscillatory rate of a system composed of rotating mass inertias acting in combination with the restraining torsional rigidities of the connected shafts and couplings.

1.4.59 torsional stiffness: The ratio of the applied torque to the resilient angular displacement, either a complete coupling or part of the coupling, such as a spacer.

Note: With some types of couplings, the torsional stiffness may not be constant but may be a function of the magnitude of the torque and, with oscillating torques, also the frequency.

1.4.60 torsional tuning: The shifting of one or more torsional natural frequencies of a coupled system to avoid system resonance at a known excitation frequency. Torsional tuning is normally accomplished by varying the torsional stiffness of the coupling.

1.4.61 total indicator reading (TIR): The difference between the maximum and minimum readings of a dial indicator, or similar device, monitoring a face or cylindrical surface during one complete revolution of the monitored surface. With truly-flat or truly-circular surfaces, the indicator reading implies, respectively, an out-of-squareness equal to the reading or an eccentricity equal to half the reading.

Note: For a perfectly cylindrical surface, the indicator reading implies an eccentricity equal to half the reading. For a perfectly flat face, the indicator reading implies an out-of-squareness equal to the reading. If the surface in question is not perfectly cylindrical or flat, the interpretation of the meaning of TIR is more complex and may represent ovality or lobing.

1.4.62 transmitted axial force: The axial force transmitted through the coupling from one shaft to the other; and is a function of the resistance to deflection of the flexible element, or the sliding friction of the gear teeth.

1.4.63 trip speed (in rpm): The rotational speed of the coupling corresponding to the speed at which the independent emergency overspeed device operates to shut down a variable speed prime mover. If the term is used in relation to a machine train driven by a fixed-speed electric motor, the trip speed shall be assumed to be the coupling speed corresponding to the synchronous speed at the maximum supply frequency. See Table 1 for a definition of trip speed requirements for various drivers.

Table 1—Driver Trip Speeds

Driver Type	Trip Speed (% of maximum continuous speed)
Steam turbine	
NEMA Class A[a]	115
NEMA Class B,C,D[a]	110
Gas turbine	105
Variable speed motor	110
Constant speed motor	100
Reciprocating engine	110

[a]Indicates governor class as specified in NEMA SM 23.

1.4.64 unit responsibility: The responsibility for coordinating the technical aspects of the equipment and all auxiliary systems included in the scope of the order. The technical aspects to be considered include but are not limited to such factors as the power requirements, speed, rotation, general arrangement, dynamics, noise, lubrication, sealing system, material test reports, instrumentation, piping, conformance to specifications, and testing of components.

1.5 REFERENCED PUBLICATIONS

The editions of the following standards, codes, and specifications that are in effect at the time of publication of this standard shall, to the extent specified herein, form a part of this standard. The applicability of changes in standards, codes, and specifications that occur after the inquiry shall be mutually agreed upon by the purchaser and the vendor.

API

Std 614	*Lubrication, Shaft-Sealing, and Control-Oil Systems for Special-Purpose Applications*
RP 684	*Tutorial on the API Standard Paragraphs Covering Rotor Dynamics and Balancing: An Introduction to Lateral Critical and Train Torsional Analysis and Rotor Balancing*

AGMA[1]

510	*Nomenclature for Flexible Couplings*

[1]American Gear Manufacturers Association, 1500 King Street, Suite 201, Arlington, Virginia 22209.

9000	*Flexible Couplings—Potential Unbalance Classification*
9002	*Bores and Keyways for Flexible Couplings (Inch Series)*
9003	*Flexible Couplings—Keyless Fits*

ANSI[2]

Y14.2M	*Line Conventions and Lettering*

ISO[3]

262	*General Purpose Metric Screw Threads—Selected sizes for Screws, Bolts and Nuts*
4572	*Hydraulic Fluid Power—Multi-Pass Method for Evaluating Filtration Performance*
10441	*Petroleum and Natural Gas Industries—Flexible Couplings for Mechanical Power Transmission in Special Purpose Applications*

NEMA[4]

SM 23	*Steam Turbines for Mechanical Drive Service*

OSHA[5]

	29 *Code of Federal Regulations* Part 1910.219

SAE[6]

J 429	*Mechanical and Material Requirements for Externally Threaded Fasteners*

2 Basic Design

2.1 GENERAL

2.1.1 Coupling Selection

● **2.1.1.1** The purchaser will specify whether a flexible element, gear, quill shaft, or torsional-damping coupling shall be supplied. For torsional-damped couplings, see Appendix B for special instructions.

2.1.1.2 The coupling shall be selected based on the equipment loading, which consists of steady state and transient conditions of torque, angular misalignment, axial displacement, and speed.

a. Sections 2.1.1.3, 2.1.1.4, 2.1.1.5 and 2.1.1.6 define the minimum requirements for steady state torque and misalignment.

b. Where the service is well understood, Section 2.1.1.7 can be used in place of 2.1.1.3, 2.1.1.4, and 2.1.1.5; and sometimes results in a smaller, less expensive, coupling.

c. Section 2.1.1.8 defines the minimum transient torque requirements for coupling selection.

d. Regardless of which criteria is used to select the coupling, it shall be capable of transmitting the maximum steady state torques, continuous cyclic torques, and the maximum transient torques under all conditions of angular misalignment and axial displacement that it will be subjected to in service.

2.1.1.3 The steady state torque used to select couplings shall be based on the following equation:

In SI Units: $$TS = \frac{9{,}550 \times P\ \text{normal} \times SF}{N\ \text{normal}} \tag{1}$$

In US Units: $$TS = \frac{63{,}000 \times P\ \text{normal} \times SF}{N\ \text{normal}}$$

where

TS = Steady-state torque used to select the coupling in Newton-meters [Nm] (inch-pounds [in.-lb]),

P normal = Input power required by the driven machine at the specified normal operating point in kW (horsepower [hp]),

N normal = Speed corresponding to the normal power, in rpm,

SF = Service factor derived from various modes of off-design operation that may result from such factors as a change in the density of the fluid (molecular weight, temperature or pressure variation), unequal load sharing, fouling, or driver output at maximum conditions.

2.1.1.4 Unless otherwise specified, the coupling shall be rated using a service factor of 1.75 for gear couplings, 1.75 for elastomeric couplings, 1.5 for flexible-element couplings, and 1.5 for quill-shaft couplings.

Note: At the proposal stage for new equipment the final driver characteristics are often unknown. These factors are normally satisfactory to cover unknowns so that coupling sizes don't increase during engineering.

Note: Should reasonable attempts to achieve the specified service factor fail to result in a coupling weight and subsequent overhung moment commensurate with the requirement for rotor dynamics of the connected machines, a lower factor may be selected by mutual

[2]American National Standards Institute, 11 West 42nd Street, New York, New York 10018.
[3]International Organization for Standardization, ISO publications are available from the American National Standards Institute, 11 West 42nd Street, New York, New York 10036.
[4]National Electrical Manufacturers Association, 1300 North 17th Street, Suite 1847, Rosslyn, Virginia 22209.
[5]Occupational Safety and Health Administration, U.S. Department of Labor. The *Code of Federal Regulations* is available from the U.S. Government Printing Office, Washington, D.C. 20402.
[6]Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, Pennsylvania 15096.

agreement of the purchaser and the vendor. In such cases, the service factor used for coupling selection may be reduced to as little as 1.2.

2.1.1.5 Unless otherwise specified, the coupling-to-shaft juncture, and the machinery shafting shall be capable of operating at a steady-state torque determined by Equation 1 using a service factor of 1.75 (see 2.1.1.9).

2.1.1.6 Unless otherwise specified, the coupling selection shall, as a minimum, be based on $({}^{1}/_{5})°$ steady state angular misalignment capacity across each flexible element. The total minimum steady state axial deflection capacity shall be determined by the largest shaft diameter divided by 100.

● **2.1.1.7** When specified, and when the driver and driver characteristics are well-understood, the coupling may be sized on the basis of driver rating. In such cases, the service factor shall be no less than 1.2. The coupling size selection shall be submitted to the purchaser for approval.

Note: If the driver rating is large compared with the normal load, this requirement may result in an excessively conservative coupling selection.

● **2.1.1.8** The purchaser will specify the expected magnitude, nature and number of occurrences of transients to which the coupling will be subjected in service. The coupling, coupling-to-shaft juncture, and shafting shall be capable of transmitting a minimum of 115% of the purchaser-specified maximum transient torque without damage. This factor applies to well-known transient conditions, such as induction motor start-ups. The factor for situations, such as some synchronous motor start-ups, where the torque is large and cyclic or short circuits and breaker reclosures shall be mutually agreed upon by the purchaser and vendor.

2.1.1.9 The torque capacity of a coupling-to-shaft juncture which is hydraulically-fitted and keyless, shall be determined by using the methods and equations in AGMA 9003.

a. The coefficient of friction used shall be 0.15.
b. The length of hub engagement shall not include O-ring and oil distribution grooves in the hub or the shaft.

Note: Other methods of calculations may be used with approval of the purchaser.

2.1.1.10 The vendor shall state the relationship between the coupling continuous-torque, speed, the coupling continuous-angular misalignment, and the coupling continuous-axial displacement if the rated maximum values of each cannot be accepted simultaneously (see 5.2.3.2).

Note: With some types of couplings, particularly those with elastomeric elements or inserts, this relationship may also be a function of temperature, oscillatory torque, and its frequency.

2.1.2 Coupling Ratings

2.1.2.1 The fatigue factor of safety at the continuous-torque rating and any published combination of speed, angular misalignment, and axial displacement, shall be determined using either the proportional increase method of the Modified Goodman Diagram, or Constant Life Curves, together with the mean and cyclic stresses induced in the flexible element under the evaluated conditions. If the Modified Goodman method is used, the minimum fatigue factor of safety shall be 1.25. If the Constant Life method is used, the minimum fatigue factor of safety shall be 1.35. Regardless of the method used, data for material strength shall be drawn from MIL-HDBK-5, SAE, ASTM or other objective sources or test data. The coupling manufacturer shall state the source. See Appendix E.

Note: This paragraph defines (for the coupling manufacturers) the minimum fatigue factors of safety and the methods for applying them to recognized material properties. This definition standardizes the basis for continuous coupling ratings. Details of the design, such as formulas and analyses used to derive the stresses, are often considered proprietary and are not a point of documentation.

2.1.2.2 When the coupling is subjected simultaneously to its peak torque and rated conditions of speed, axial displacement and angular misalignment, all torque-transmitting coupling components shall have a minimum factor of safety of 1.15 with respect to the component's material yield strength. The manufacturer shall also state the momentary torque limit which corresponds to a factor of safety of 1.0, with respect to the component's yield strength.

Note: This section defines (for the coupling manufacturer) the minimum factor of safety for transient and momentary coupling limits.

2.1.3 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. The minimum spacer length shall therefore correspond to a between-shaft-ends (BSE) dimension of 460 mm (18 in.), unless otherwise specified by the purchaser.

● 2.1.4 Hub Type

The purchaser will specify whether integral flange(s) or removable hub(s) are to be used.

2.1.5 Machining of Integral Flanges

2.1.5.1 When the coupling is to be used with integrally flanged shaft end(s), the coupling vendor shall supply the flange geometry. The holes may be machined with computer numerical-controlled (CNC) equipment or a drill fixture (or template). In either case, inspection shall be performed to assure proper location of the mating coupling flanges. The coupling vendor shall furnish the drill fixture (or template), if required.

2.1.5.2 Unless otherwise specified, the coupling shall mate directly to the integral flange without an adapter.

Note: Addition of an adapter between the coupling and the integral flange adds another fit whose runout and clearance must be controlled to maintain balance. Further, the coordination issue of who is to supply the adapter (machine manufacturer or coupling manufacturer) must be completed for each order.

Note: For certain machines, particularly gas turbines, space limitations make it impractical to comply with this requirement.

2.1.6 Moment Simulator

● When specified, a moment simulator shall be supplied. The purchaser will supply the vendor with the measurement of the distance from the end of the shaft to the centerline of the first bearing.

2.1.7 Solo Plate

● If required for solo operation, the vendor shall supply a solo plate for the drive end of the coupling. The solo plate shall center and maintain the balance of the coupling.

2.1.8 Removable Hubs

● **2.1.8.1** Removable coupling hubs shall be secured to the shaft by means of an interference fit. The shaft end details and the degree of interference will be specified by the purchaser, and is subject to approval by the vendor.

Note: The following guidelines are recommended for hub-to-shaft fits:

a. The interference fit for straight bore keyed hubs should be from 0.00050 mm/mm to 0.00075 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 fit for tapered bore hydraulically fitted hubs should be at least 0.0015 mm/mm (in./in.) of bore diameter.
d. Some international machinery manufacturers may use preferred fits for shafts and bores. Refer to ANSI B4.2-1978.

● **2.1.8.1.1** For straight bore keyed hubs, shaft sizes and coupling bores shall conform to AGMA 9002.

● **2.1.8.1.2** For tapered bore keyed hubs, the inspection procedures shall be in accordance with AGMA 9002.

● **2.1.8.1.3** For tapered bore hydraulically fitted hubs, the inspection procedure shall be in accordance with AGMA 9003.

2.1.8.2 The surface finish, arithmetic average roughness (Ra), of hub bores shall not exceed:

a. 3.2 μm (125 μin.) for straight bored keyed hub.
b. 1.6 μm (63 μin.) for tapered keyed hubs.
c. 0.8 μm (32 μin.) for keyless hubs.

2.1.8.3 The roundness (eccentricity) of the hub bore, whether straight or tapered, shall not exceed 5.1 μm (0.0002 in.) TIR for bores less than, or equal to, 102 mm (4 in.) in diameter and shall not exceed 12.7 μm (0.0005 in.) TIR for hub bores greater than 102 mm (4 in.) in diameter. Roundness measurements shall be made before any keyways are cut.

2.1.9 Tapered Bore Hubs

2.1.9.1 General

● **2.1.9.1.1** When a taper-bored coupling is specified, the purchaser will select the taper (see Appendix C).

2.1.9.1.2 Keyless hydraulically fitted hubs shall have a taper of 1:24 on the diameter ($^1/_2$ diametral inch per foot [in./ft] of length).

2.1.9.1.3 Nonhydraulically fitted hubs shall have a taper of 1:16 on the diameter ($^3/_4$ diametral in./ft of length).

● **2.1.9.1.4** When specified, a matched set of plug and ring gages (see 3.5) shall be supplied.

● **2.1.9.1.5** When specified, a matching set of plug and ring lapping tools (see 3.5) shall be supplied.

2.1.9.1.6 Tapered bores shall be checked by using the plug gage from a matched plug and ring gage set furnished by the purchaser. A light coat of bluing shall be used for the check.

a. Tapered bores for keyless hydraulically fitted hubs shall have at least an 85% blued fit (surface contact) to the taper gage.
b. Tapered bores for keyed hubs shall have at least a 70% blued fit (surface contact) to the taper gage.

Note: AGMA 9002 specifies the bore check before cutting keyways.

2.1.9.1.7 The design of the tapered-bore hub shall provide for a shaft-end retaining nut, including the necessary wrench clearance.

Note: The direction of the thread on the retaining nut shall be such that rotation of the coupling hub relative to the shaft (attributable to slippage under load) will force the hub more tightly on the taper.

2.1.9.2 Additional Requirements for Keyed Hubs

2.1.9.2.1 The purchaser will specify the number and configuration of the keyways.

2.1.9.2.2 Keys, keyways, and inspection methods shall comply with AGMA 9002.

2.1.9.2.3 The bottom corners of all keyways shall be radiused with a smooth transition from the keyway walls. Corner radii shall comply with AGMA 9002.

2.1.9.2.4 Keyed coupling hubs shall have tapped puller holes. Puller holes for bores that are less than 64 mm ($2^1/_2$ in.) shall have a minimum nominal diameter of 6 mm ($^1/_4$ in.). Puller holes for bores that are greater than or equal to 64 mm ($2^1/_2$ in.) shall have a minimum nominal diameter of 10 mm ($^3/_8$ in.). Puller holes shall have standard coarse threads.

2.1.10 Component Fit Tolerances

2.1.10.1 Components of high-speed couplings shall be centered by means of piloted or rabbeted fits. The eccentricity of these fits shall not exceed 0.00008 mm/mm TIR (0.001 in./ft TIR) of diameter or 0.013 mm (0.0005 in.) TIR, whichever is greater. Fits that tighten under centrifugal loading are preferred. The fit shall range from a loose fit of 0.025 mm (0.001 in.) to an interference fit, with the actual fit determined by balancing requirements. For low-speed couplings, fits are only required to meet the balance tolerance.

2.1.10.2 The face runout of mating faces (except for flexible elements) shall not exceed 0.00008 mm/mm TIR (0.001 in./ft TIR) of diameter or 0.025 mm TIR (0.001 in. TIR), whichever is greater. For low-speed couplings, fits are only required to meet the balance tolerance.

2.1.10.3 For hubs, pilot fits at gear coupling teeth shall be concentric to the bore within 0.00008 mm/mm TIR (0.001 in./ft TIR) of diameter or 0.013 mm TIR (0.0005 in. TIR), whichever is greater. For low-speed couplings, fits are only required to meet the balance tolerance.

2.1.10.4 For sleeves, pilot fits at gear coupling teeth shall be concentric to the rabbet within 0.00008 mm/mm TIR (0.001 in./ft TIR) of diameter or 0.025 mm TIR (0.001 in. TIR), whichever is greater. Pilot fits shall be round within 0.00016 mm/mm TIR (0.002 in./ft TIR) of diameter or 0.038 mm TIR (0.0015 in. TIR), whichever is greater. For low-speed couplings, fits are only required to meet the balance tolerance.

2.1.11 Bolting Considerations

2.1.11.1 Bolting between coupling components shall be designed to transmit the required torque without dependence on flange-face friction.

2.1.11.2 Bolts for piloted flanges shall have a diametrical clearance of from 0 to 0.13 mm (0.005 in.) in the bolt holes of one flange. This requirement does not apply if fasteners thread into one flange. The hole location shall allow the balance requirements to be met.

2.1.11.3 For low-speed couplings, the location and the clearance between the bolt and the hole shall allow the balance requirements to be met.

2.1.11.4 Deformed thread self-locking fasteners shall be used. Castellated lock nuts are not acceptable. Lock washers shall not be used. The coupling vendor shall recommend the interval or the minimum prevailing torque at which fasteners should be replaced.

Note: The self-locking feature of the fasteners may lose effectiveness with each removal. Consideration should be given to maintaining a complete set of spare nuts because of repeated assembly and disassembly.

2.1.11.5 The coupling vendor shall specify the required bolt torque and shall state whether this value is for dry or lubricated torquing.

2.1.11.6 Bolts shall be held within tolerances, on both dimensions and weight, sufficient to permit interchange within the same set of bolts or substitution of a spare set of bolts, without affecting the coupling integrity or resulting in the balance being outside the prescribed limits. See also 2.5.

2.1.11.7 A minimum of 10% or, at least two, spare coupling bolts/nuts shall be supplied for installation with each coupling and/or each spare set of coupling bolts/nuts.

2.1.12 Electrical Insulation

● When specified, the coupling shall be electrically insulated.

Note: On couplings with electrical insulation, the nonmetallic insulating parts are exempt from the requirements of 2.1.10.

2.1.13 Machining

All coupling parts, other than fasteners and flexible discs, shall be machined all over to minimize inherent unbalance. All exposed surfaces shall be finished to 3.2 μm (125 μin.) or better.

2.2 GEAR COUPLINGS

2.2.1 All gear couplings shall be the double-engagement type.

● **2.2.2** The purchaser will specify if the coupling is to have the external teeth on the hub (constituting a flex-hub coupling) or on the spacer (constituting a marine coupling).

2.2.3 Unless otherwise specified, the coupling's assembly shall permit total axial displacement of at least 6 mm ($^1/_4$ in.). The purchaser will specify limited-end-float design if required by the equipment train.

2.2.4 The coupling design shall ensure that all components are positively centered. The gear meshes shall be centered at the crown diameter of the external teeth and at the root diameter of the internal teeth. The crown clearance of the tooth diameter shall be the maximum clearance possible that maintains the specified balance. On flex-hub couplings, the crown clearance shall allow for diametral growth that is attributable to the hub-to-shaft interference fit.

2.2.5 The involute tooth form shall be used. External teeth shall be relieved or chamfered at the tips and edges to provide the required misalignment capability and torque capacity. The amount of backlash in the mesh shall be held to the minimum value commensurate with the vendor's stated maximum permissible misalignment.

2.2.6 The hardness of the gear teeth shall be at least 45 on the Rockwell C scale (Rc). The hardness of the teeth with the greater face width (generally the sleeve teeth) shall be greater than or equal to the hardness of the mating teeth.

2.2.7 Couplings shall be designed for continuous lubrication, unless the purchaser specifies batch lubrication.

● **2.2.8** To minimize the accumulation of foreign material and excessive temperature rise, continuously lubricated couplings shall have a flooded-mesh and anti-sludge design. Each gear mesh shall be fed separately with filtered oil. The purchaser will specify the viscosity, pressure, temperature, and degree of filtration of the oil supply (to be furnished by others). The vendor shall state the rate of oil flow that the coupling requires.

2.3 METALLIC FLEXIBLE ELEMENT COUPLINGS

2.3.1 Flexible elements may be of any design acceptable to the purchaser. Unless otherwise specified, flexible elements shall be metallic.

2.3.2 If the flexible elements of a coupling are combined in a factory assembled disc pack, the coupling spacer shall be removable without disturbance of the factory assembly of the elements (discs).

● **2.3.3** If the coupling must operate within a close-fitting enclosed coupling guard, the purchaser will furnish 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 Appendix D for coupling guard.

2.3.4 If a tapered bore or integral hub is specified for one or both ends of the coupling, the vendor shall furnish spacer shims to adjust the spacer gap. The shims shall provide a variance of ±1.6 mm (±$^1/_{16}$ in.), 3.2 mm ($^1/_8$ in.) total for shafts with a nominal diameter of less than 102 mm (4 in.). For shafts with a nominal diameter of 102 mm (4 in.) or greater, the shims shall provide a variance of ±3.2 mm (±$^1/_8$ in.), 6.4 mm ($^1/_4$ in.) total.

2.3.5 Unless otherwise agreed, the design of the 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.

2.4 QUILL-SHAFT COUPLINGS

2.4.1 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 couplings to overcome the inherent limitations of axial displacement.

2.4.2 Unless otherwise specified, quill shafts shall have integral end flanges.

2.4.3 When a quill-shaft coupling is used, associated machine shafts having integral flanges are preferred.

2.5 DYNAMICS

2.5.1 Some flexible couplings, such as single element convoluted styles, exhibit an undamped response to external forced vibration. The axial natural frequencies (ANF) of these couplings shall not occur within 10 percent of the specified operating speed range. Vendor shall identify the ANF in the proposal.

Note: Multidisc, multidiaphragm, and nonconvoluted single element flexible couplings do not exhibit undamped vibration response.

2.5.2 The lateral natural frequency (Nc) of that portion of the coupling between and including the flex elements, assuming infinitely stiff supports, shall be at least 50 percent above the highest specified operating speed.

Note: The actual lateral frequency of the coupling will be affected by the stiffness of any flange adapter(s) and shaft extension(s). The calculation to achieve this actual number is complex. This paragraph establishes a default value to use when little else is known, such as in the proposal stages of a design. The purchaser and vendor shall mutually agree upon who will perform these calculations and the assumptions used.

2.6 BALANCE

2.6.1 General

The degree of balance required for a given coupling is a function of the unbalance responses of the coupled machines. Machines with a high degree of sensitivity to coupling unbalance require well-balanced couplings; machines with lower sensitivity require less precisely balanced couplings. There are three separate balance methods available. Table 2, Summary of Balancing Methods and Options, identifies the paragraphs pertinent to each balancing option.

a. Method 1 is standard for low-speed couplings.
b. Method 2 is standard for high-speed couplings with options as specified.
c. Method 3 is optional for high-speed couplings with options as specified.

2.6.2 Balancing Methods

2.6.2.1 Method 1—Component Balance Only

This balance method requires that all components be individually balanced. In addition, calculations must prove that the potential unbalance of all the coupling components when assembled shall not exceed an AGMA 9000 Class 9 residual mass center displacement (2000 µin.) for speeds of 1800 RPM or less. Refer to Figure 1.

Table 2—Summary of Balancing Methods

Methods 1	Methods 2	Methods 3	Reference Paragraph
R	N/A	N/A	2.6.2.1 Potential Unbalance Calculation
R	R	R	2.6.3.5 Component Balance
N/A	R	N/A	2.6.3.6 Assembly Check Balance
N/A	N/A	R	2.6.3.7 Assembly Balance
N/A	W.S.	W.S.	2.6.3.8 Residual Unbalance Verification
N/A	W.S.	W.S.	2.6.3.9 Repeatability Check

Note: R= Required, N/A= Not Applicable, W.S.= When Specified

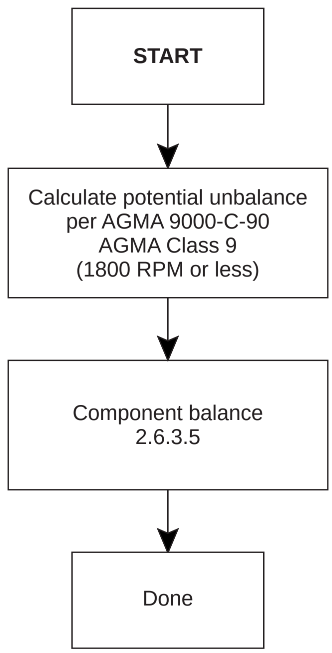

Figure 1—Method 1—Component Balance Only

2.6.2.2 Method 2—Component Balance With Assembly Check Balance—Standard Method

This balance method requires that all the components be balanced as per Method 1. Additionally, the components must be assembled and the balance verified. The assembled coupling residual unbalance per plane shall not exceed the balance level specified per 2.6.3.6. Additional options may be selected to require a residual unbalance verification (2.6.3.8) or Repeatability Check (2.6.3.9). Refer to Figure 2.

2.6.2.3 Method 3—Component Balance with Assembly Balance

This balance method requires that all the components be balanced as per Method 1, except for the component or subassembly that is to have the assembly balance correction made to it. Additionally, the components must be assembled and the residual unbalance per plane shall be corrected. The final residual unbalance of the assembled coupling is not to exceed the balance level specified per 2.6.3.7. Additional options may be selected to require a residual unbalance verification (2.6.3.8) and/or repeatability check (2.6.3.9). Refer to Figure 3.

2.6.3 Balance Criteria

2.6.3.1 Balancing shall be performed on balance machines that are capable of achieving the specified level of residual unbalance.

2.6.3.2 Material for the purpose of balancing shall be removed from low-stress areas of the components.

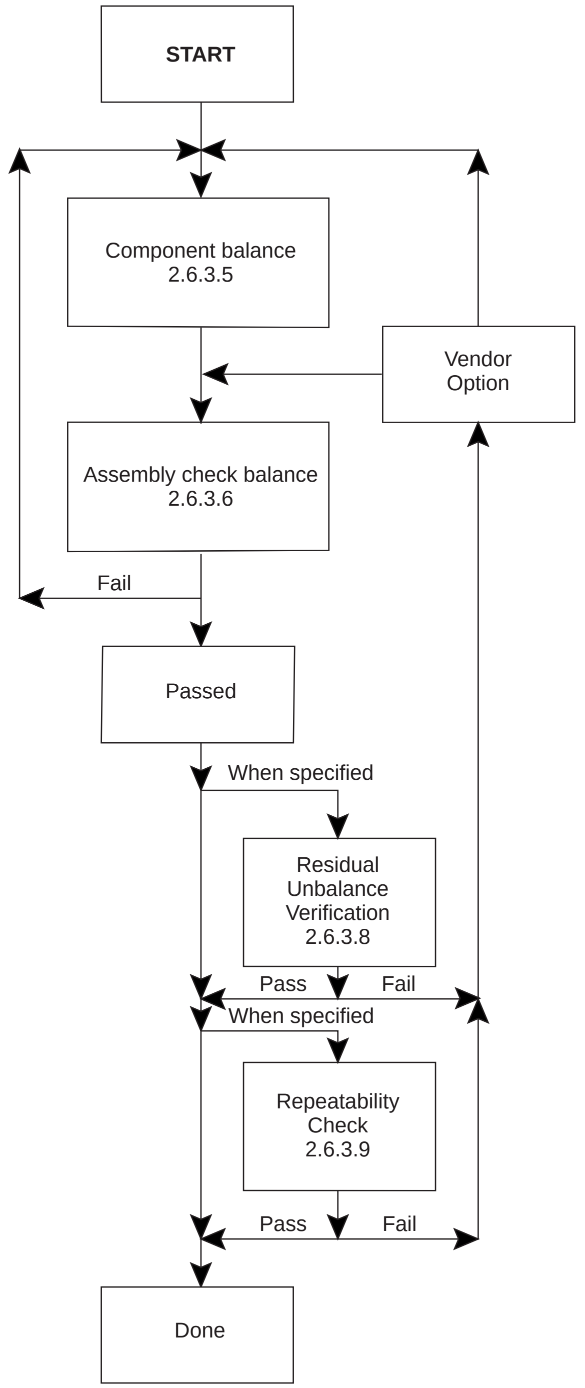

Figure 2—Method 2—Component Balance With Assembly Check Balance—Standard Method

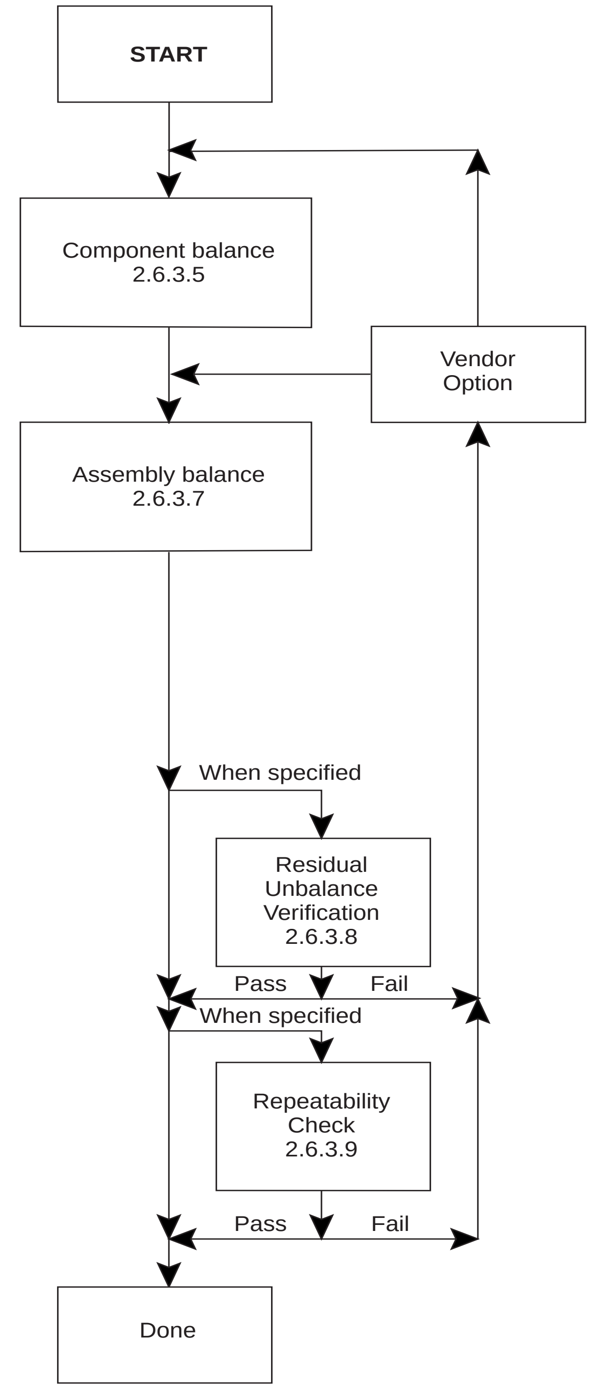

Figure 3—Method 3—Component Balance With Assembly Balance

2.6.3.3 Before balancing is started, the mounting surfaces of the component (the hub bore, sleeve pilot, and so forth) shall be aligned so that the component's geometric center is concentric with the center of rotation for balancing within 0.00004 mm/mm (in./in.) of mounting diameter, or 6.4 μm (0.00025 inch), whichever is greater.

Note: Determination of the geometric center of rotation requires that the roundness of the component be identified. Once the roundness is identified the geometric center is then determined. This procedure differs from a conventional TIR reading in that a TIR reading does not directly compensate for roundness variations (e.g., roundness variation due to jaw squeeze).

2.6.3.4 Each bolt, each nut, and other similar accessory components that must be removed for normal field disassembly of the coupling shall be weigh-balanced individually to a total tolerance of 0.05% of the component's weight or 0.1 g (0.0035 oz), whichever is greater.

2.6.3.5 Component Balance

Couplings shall be component balanced by rotation. Each component, such as the hubs, sleeves, flexible elements, spacer, factory assembled subassemblies, adapter plate(s), solo plate(s), and moment simulators shall be balanced individually (except for the component or subassembly that is to be corrected per 2.6.3.7). All machining of components, shall be completed before balancing, except for keyway(s). The machining of keyway(s) prior to balancing is optional. Two-plane balancing is preferred, but single-plane balancing may be used for components with a length to diameter (L/D) ratio of 1.0 or less. Each component shall be balanced so that the level of residual unbalance for each balance plane does not exceed the greatest value determined by the following expressions:

U = 6,350 (W/N), or
U = 1.27 (W), or
U = 7.2.

In US Customary units:

U = 4 (W/N), or
U = 0.0008 (W), or
U = 0.01.

where

U = Residual unbalance, in g/mm (oz/in.),

W = Weight of the component, in kg (lb), apportioned to the balance planes so that the sum of the weight apportionments for both planes equals the total weight of the component,

N = Maximum continuous operating speed, in rpm.

2.6.3.6 Assembly Check Balance

Couplings balanced in accordance with 2.6.2.2 shall be assembled, the balance verified, and the components shall be match marked. The residual unbalance for the randomly assembled coupling shall not exceed the greatest value determined by the following expressions:

U = 63,500 (W/N), or
U = 12.7 (W), or
U = 72.0.

In US Customary units:

U = 40 (W/N), or
U = 0.008 (W), or
U = 0.1.

where

U = Residual unbalance, in g/mm (oz/in.),

W = Weight of the coupling, in kg (lb), apportioned to the balance planes at the two coupling hubs so that the sum of the weight apportionments equals the total weight of the coupling,

N = Maximum continuous operating speed, in rpm.

Couplings that fail to meet these criteria shall be balance corrected by repeating the component balance, not by trim-balancing the assembly.

2.6.3.7 Assembly Balance

Couplings balanced in accordance with 2.6.2.3 shall be assembly balanced. For an assembly balance, coupling components or subassemblies shall be balanced in accordance with 2.6.3.5. The coupling shall then be match-marked and two-plane balanced, with corrections being made only to the component or subassembly 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 the following expressions:

U = 6,350 (W/N), or
U = 1.27 (W), or
U = 7.2.

In US Customary units:

U = 4 (W/N), or
U = 0.0008 (W), or
U = 0.01.

where

U = Residual unbalance, in g/mm (oz/in.),

W = Weight of the coupling, in kg (lb), apportioned to the balance planes so that the sum of the weight apportionments for both planes equals the total weight of the coupling,

N = Maximum continuous operating speed, in rpm.

Note: Assembly balancing corrects for overall coupling unbalance caused by eccentricities of the pilot fits that are used to center components during assembly. However, assembly balancing may prohibit the subsequent interchange of duplicate coupling components and may require that the entire coupling be maintained as a unit, except for the bolts and nuts.

2.6.3.8 Residual Unbalance Procedure

When specified, a residual unbalance check shall be performed on assembled couplings. 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. API RP 684, Appendix 3B, is to be referenced for a description of the procedure for a residual unbalance verification.

2.6.3.9 Repeatability Check

When 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, and the residual unbalance shall not exceed the greatest value determined by the following expressions:

U = 63,500 (W/N), or
U = 12.7 (W), or
U = 72.0.

In US Customary units:

U = 40 (W/N), or
U = 0.008 (W), or
U = 0.1.

where

U = residual unbalance, in g/mm (oz/in.),

W = weight of the coupling, in kg (lb), apportioned to the balance planes so that the sum of the weight apportionments for both planes equals the total weight of the coupling,

N = maximum continuous operating speed, in revolutions per minute.

2.6.4 Trim-Balance Holes

● When specified, tapped holes shall be provided in the coupling for trim balancing. The trim balance holes should be capable of correcting for an unbalance equal to:

U = 12.7 (W)

In US Customary units:

U = 0.008 (W)

where

U = residual unbalance, in g/mm (oz/in.),

W = weight of the coupling, in kg (lb), apportioned to the driver or driven equipment so that the sum of the weight apportionments for both planes equals the total weight of the coupling.

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 may be advisable. This practice normally precludes moving the hub to another rotor, unless balance is achieved by using balance holes as described in 2.6.4. 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.

2.7 MATERIALS

2.7.1 Construction materials shall be the manufacturer's standard for the specified operating conditions, except as required or prohibited by the data sheets or this standard. The metallurgy of all major components shall be clearly stated in the vendor's proposal.

2.7.2 Materials shall be identified in the proposal with their applicable ASTM, AISI, ASME, SAE or UNS numbers, including the material grade. If the designation is unavailable, the vendor's material specification, showing physical properties, chemical composition, and test requirements, shall be included in the proposal.

● **2.7.3** The purchaser will specify any corrosive agents present in the environment, including constituents that may cause stress corrosion cracking.

● **2.7.4** When coupling operation in a corrosive environment is specified, either oil mist, a suitable coating, or an inert-gas purge may be required. The vendor shall advise the purchaser when material limitations demand such protection for the coupling.

2.7.5 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.

● **2.7.6** When specified, all other parts not covered by 2.7.5 shall be made from corrosion-resistant material or suitably coated.

2.7.7 All fasteners shall be of heat-treated steel, SAE J 429, Grade 5, or better. The threads shall comply with ISO 262 (ANSI/ASME B1.1) Materials shall be corrosion-resistant to the specified environment. If plated bolts are required, they shall be treated properly to avoid cracking caused by hydrogen embrittlement. The quality of the nuts shall be at least equal to that of the bolts.

3 Accessories

● **3.1** The purchaser will specify who will furnish the necessary pumps, hoses and fittings, pressure gages, and other equipment required for the installation and removal of hydraulically fitted coupling hubs.

3.2 The vendor shall furnish all special tools required for assembly and disassembly of the coupling, including jackscrews and other special devices needed to separate closely piloted parts.

● **3.3** When specified, 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 to the shaft and shall be removed after the coupling is properly in place, whether it is installed in the shop or in the field.

● **3.4** When specified, the vendor shall provide a puller for keyed coupling hubs.

● **3.5** When specified, the vendor shall supply a matched set of plug and ring gages for each shaft-end taper. These gages shall meet the following requirements:

a. The material shall be harder than the shaft or coupling, Rockwell C 45 minimum.
b. This plug and ring gage set shall be verified with the machinery vendor master plug and master ring gages.
c. The plug and ring gages shall meet the roundness, surface finish and contact requirements of this standard for coupling tapers.
d. The length of the ring and plug gage 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 and be 12 mm ($^1/_2$ in.) longer than the taper.

Note: Equipment drawing shall be reviewed for possible interference.

e. The gages are to be marked “Gage” in a noncritical location.
f. The storage preservation of these gages is to satisfy the requirements of paragraph 4.5.4.

Note: This gage set is intended to become the master gage set for the owner for use in inspection of both shaft and coupling taper.

● **3.6** When specified, the vendor shall supply a set of lapping tools.

a. The lapping tools shall be softer than the shaft and hub.
b. Lapping tools shall overlap the taper at each end and be 12 mm ($^1/_2$ in.) longer than the taper.

Note: Equipment drawing shall be reviewed for possible interference.

c. The lapping tools are to be marked “Lapping Tool” in a noncritical location.
d. The storage preservation of these tools is to satisfy the requirements of paragraph 4.5.4.

4 Manufacturing Quality, Inspection, Testing, and Preparation for Shipment

4.1 MANUFACTURING QUALITY

4.1.1 The purchaser’s representative shall have access to the vendor’s quality program for review.

4.1.2 Repair of defects by welding or plating in the torque-transmitting path shall not be undertaken without written authorization from the purchaser. Repair of other defects that do not affect the performance, reliability, or safety of the coupling may be made at the vendor’s discretion.

4.1.3 Parts of duplicate couplings, except for meshing gear components, shall be manufactured within tolerances that permit interchangability or replacement of parts in the field with minimal fitting; however, the assembly may require rebalancing after interchange of component parts.

4.1.4 The vendor shall remove all sharp edges of parts and components, with the exception of the threads.

4.1.5 Manufacturer’s markings, such as identification or match marking, shall occur on a low-stress area that does not affect the performance or integrity of the coupling.

4.2 INSPECTION AND TESTING

4.2.1 After advance notification of the vendor by the purchaser, the purchaser’s representative shall have entry to all vendor and subvendor plants where manufacturing, testing, or inspection of the equipment is in progress.

4.2.2 The vendor shall notify subvendors of the purchaser’s inspection and testing requirements.

4.2.3 The vendor shall provide sufficient advance notice to the purchaser before conducting any inspection or test that the purchaser has specified to be witnessed or observed.

● **4.2.4** The purchaser will specify the extent of participation in the inspection and testing and the amount of advance notification required.

4.2.4.1 When shop inspection and testing have been specified by the purchaser, the purchaser and the vendor shall agree upon manufacturing hold points and inspector's visits.

4.2.4.2 *Witnessed* means that a hold shall be applied to the production schedule and that the inspection or test shall be carried out with the purchaser or his representative in attendance.

4.2.4.3 *Observed* means that the purchaser shall be notified of the timing of the inspection or test; however, the inspection or test shall be performed as scheduled, and if the purchaser or his representative is not present, the vendor shall proceed to the next step. (The purchaser should expect to be in the factory longer than for a witnessed test.)

4.2.5 Equipment for the specified inspection and tests shall be provided by the vendor.

4.3 INSPECTION

4.3.1 General

4.3.1.1 The vendor shall keep the following data available for at least 5 years for examination or reproduction by the purchaser or his representative upon request:

a. Necessary certification of materials, such as mill test reports for all torque transmitting components.

Note: Periodic testing of the mechanical properties (such as ultimate tensile strength, yield strength, percentage elongation, and percentage area reduction) of sample materials after heat treatment shall be performed at least twice annually, and the results shall be documented.

b. Results of nondestructive tests.
c. Results of documented tests and inspections, including fully identified records of all heat treatment and radiography.
d. Balance data in accordance with 2.6.

4.3.1.2 The vendor shall keep data available for at least 20 years, enabling the reproduction of a functionally equivalent coupling. The data may include a general arrangement drawing, parts list, material specification list, and application data.

4.3.1.3 After final machining, all metallic torque-transmitting components, bolts, and other major parts, with the exception of multiple membrane diaphragms and discs, manufactured from cold rolled strip, shall be inspected by wet magnetic particle, or liquid penetrant methods. Indications of cracks or other injurious defects shall be the basis for rejection of the affected part. Certification of conformance is required.

4.3.2 Welds

4.3.2.1 All welds shall receive 100% surface and subsurface inspection after final treatment. Magnetic particle or liquid penetrant methods shall be used for surface inspection. Ultrasonic or radiographic methods shall be used for subsurface inspection. All weld inspection procedures shall be mutually agreed upon by the purchaser and the vendor.

4.4 TESTING

● **4.4.1** When specified, couplings identified in 2.5.1 as having undamped response to external vibration shall be tested to verify the predicted natural frequency. The test technique shall be mutually agreed upon by the purchaser and the vendor.

4.4.2 The purchaser's acceptance of shop tests does not constitute a waiver of requirements to meet field performance standards under specified operating conditions, and inspection by the purchaser does not relieve the vendor of his responsibilities.

4.5 PREPARATION FOR SHIPMENT

4.5.1 Prior to assembly and shipment, all surfaces of the coupling shall be cleaned and coated to prevent corrosion. Adequate instructions covering preparation for operation shall be attached.

● **4.5.2** The purchaser will specify the expected storage time and whether the storage location is to be indoors or outdoors.

● **4.5.3** The purchaser will specify whether the packing provided is for domestic or export shipping.

4.5.4 Packing shall be adequate to prevent mechanical and corrosion damage during normal shipment and for the duration of the specified storage time.

4.5.5 Each coupling shall be properly identified by an item number and serial number stamped or etched on the coupling assembly (see 4.1.5). The container shall be marked with the information specified by the purchaser.

4.5.6 The vendor shall inscribe a serial number unique to the coupling on all of the coupling's 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.

5 Vendor's Data

5.1 GENERAL

5.1.1 The following paragraphs specify information to be furnished by the vendor. A detailed schedule for transmission of drawings, curves, and data as agreed to at the time of the order, as well as the number and type of copies required by the purchaser shall be furnished.

5.1.2 The data shall be identified on transmittal (cover) letters and in title blocks or pages with the following information:

a. The purchaser/user's corporate name.
b. The job/project number.
c. The equipment name and item number.
d. The purchase order number.
e. Any other identification specified in the purchase order.
f. The vendor's identifying shop order number, serial number, or other reference required to identify return correspondence completely.

● **5.1.3** If specified, the vendor shall attend the coordination meeting covering the connected equipment train and be prepared to discuss the following items:

a. The purchase order, scope of supply, and subvendor items.
b. The data sheets.
c. Schedules for transmittal of drawings, production, and testing.
d. Inspection, expediting, and testing.
e. Lube-oil and cooling system requirements for the coupling, when applicable.
f. A review of applicable specifications and previously agreed-upon exceptions to specifications.
g. Design data for the coupling housing (see 2.3.3).

5.2 PROPOSALS AND CONTRACT DATA

5.2.1 General

The vendor's proposal shall include the information specified in items a through f below:

a. A specific statement that the coupling and all its components are in strict accordance with this 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 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. When specified, a list of similar couplings installed and operating under analogous conditions.
f. Any start-up, shutdown, or operating restrictions required to protect the integrity of the coupling.

5.2.2 Drawings

● **5.2.2.1** In the inquiry and in the order, the purchaser will state the number of prints and/or reproducibles required and the timetable within which they are to be submitted by the vendor.

5.2.2.2 The purchaser will promptly review the vendor's drawings when received; however, this review shall not constitute permission to deviate from any requirements in the order unless specifically agreed on in writing. After the drawings have been reviewed, the vendor shall furnish certified copies of the approved drawings in the quantity specified. Drawings shall be clearly legible and in accordance with ANSI Y14.2M.

5.2.2.3 The following information shall be provided on the coupling drawing(s). A copy of the finalized drawing shall be included with the shipment of the coupling. (Typical drawings are not acceptable):

a. The purchaser's order number (on every drawing).
b. The purchaser's equipment item number (on every drawing).
c. The make, type, and size of the coupling.
d. The weight and $^1/_2$ weight of each part of the assembly and the weight of the entire assembly.
e. The location of the center of gravity of each half of the coupling.
f. All principal overall outline, interface, and other critical dimensions, including interface pilot diameters, gear pitch diameter, lengths, hub-to-hub and shaft-end spacing, hub bore details including keyways, hub-to-shaft interference fits, hub advances, and axial float.
g. The distance from centerline to centerline of the flexing elements.
h. When applicable, axial natural frequencies of flexible element couplings.
i. The polar mass moment of inertia or WR^2 for each coupling half (including half of the spacer).
j. The torsional spring constant.
k. Lateral natural frequency of the spacer, including assumptions that were used.
l. Tightening and minimum prevailing (2.1.11.4) torque of all normally removable fasteners.
m. Type and quantity of lubricant, and size and orientation of lubricant spray nozzles.
n. Thread dimensions and trim-balancing hole dimensions.
o. Materials of construction.
p. Materials and outline dimensions of solo plate and/or moment simulator when furnished.
q. Maximum permissible values of axial displacement and angular misalignment for continuous and transient operation.
r. Description of match-mark locations and nomenclature.
s. The continuous and peak torque rating and momentary torque limit.
t. For all hubs:
   1. Hub-to-shaft interference range.
   2. Hub draw-up range (for taper-bored fits).
   3. Torque capacity of hub shaft interface (for keyless only).
u. For flexible-element couplings:

1. Flexible-element lateral stiffness
2. Maximum axial force at maximum deflection or axial stiffness.
3. Maximum bending moment or bending stiffness.

v. For gear couplings:

1. Axial force at Normal operating torque at the assumed coefficient of friction.
2. Bending moment at Normal operating torque and rated misalignment at the assumed coefficient of friction.

Note: Determination of the torsional spring constant shall take into consideration the entire length of the coupling between the points where the shafts enter the coupling hub on each end and shall include a shaft penetration factor of $^1/_3$ (or an alternative value based on the vendor's test data).

5.2.3 Data

5.2.3.1 The vendor shall provide completed data sheets.

5.2.3.2 The vendor shall make the following information available to the purchaser:

a. Data required by mandate or purchaser decision in 4.3 and 4.4.
b. Certified balance records.
c. Relationships as described in paragraph 2.1.1.10 as required.

5.2.3.3 The maximum enclosure temperature at the maximum continuous speed shall be calculated. It shall be mutually agreed upon by the purchaser and the vendor who shall make these calculations. (Enclosure data and ambient temperature data at the coupling location will be supplied by the purchaser.)

5.2.3.4 The vendor shall furnish a parts list for all equipment supplied. The list shall include pattern, stock, or production drawing numbers and materials of construction. The list shall completely identify each part so that the purchaser may determine the interchangeability of the part with other couplings furnished by the same manufacturer. Standard purchased items shall be identified by the original vendor's name and part number. Materials shall be identified as specified in 2.7.2.

5.2.3.5 No more than 5 days after the actual shipment date, the vendor shall furnish the required number of instruction manuals for the coupling provided by the vendor. The manuals shall include legible drawings of the specific equipment included (typical drawings are not acceptable), a parts list, and completed data sheets. They shall include instructions covering installation, final tests and checks, start-up, shutdown, operating limits, and operating and maintenance procedures. For flexible-element couplings, the manuals shall include prestretch or precompression values and instructions regarding the application of spacer shims. Any devices, such as solo plates or moment simulators, shall include instructions for mounting or their usage.

5.2.3.6 The vendor shall submit a supplementary list of spare parts other than those included in the original proposal. This supplementary list shall include recommended spare parts, cross-sectional or assembly-type drawings, parts numbers, materials, prices, and delivery times. Parts numbers shall identify each part for purposes of interchangability. Standard purchased items shall be identified by the original manufacturer's numbers.

APPENDIX A—COUPLING DATA SHEETS

PAGE 1 OF 2

COUPLING DATA SHEET
API 671 THIRD EDITION
SI UNITS

JOB . NO. ______ ITEM NO. ______
PURCH. ORDER NO. ______ DATE ______
INQUIRY NO. ______ BY ______
REVISION ______ DATE ______

1 NOTE: INFORMATION TO BE COMPLETED ○ BY PURCHASER ☐ BY COUPLING MANUFACTURER
2 APPLICABLE TO: ○ PROPOSAL ○ PURCHASE ○ AS BUILT
3 ○ OWNER: ______ NO. REQUIRED ______
4 SITE: ______ SERVICE: ______
5 ○ DRIVER: TYPE ______ MANUFACTURER ______ MODEL ______
6 NAMEPLATE POWER (KW) ______ SERVICE FACTOR ______ SERIAL NO. ______ TAG. NO. ______
7 DRIVEN UNIT: ______ MANUFACTURER ______ MODEL ______
8 SERIAL NO. ______ TAG. NO. ______
9 COUPLING TYPE: ○ FLEXIBLE ELEMENT ○ GEAR ○ QUILL SHAFT ○ OTHER ______
10 ☐ MANUFACTURER: ______ MODEL ______ SIZE ______ ASS'Y. DWG. NO. ______
11 ○ **CONDITIONS CONSIDERED FOR COUPLING SELECTION** ☐ **RATINGS**

	CONDITIONS	TORQUE (N-m)	@ RPM		TORQUE (N-m)	@ RPM	SERVICE FACTOR
14	NORMAL (2.1.1.3)			NORMAL			
15	DRIVEN RATED LOAD			PEAK			
16	MAXIMUM STEADY STATE (2.1.1.2.d)			MOMENTARY			
17	MAXIMUM TRANSIENT (2.1.1.2.d)			SHAFT JUNCTURE DRIVING (2.1.1.9)			
18	TRIP CONDITION						
19	CONTINUOUS CYCLIC (2.1.1.2.d)			SHAFT JUNCTURE DRIVEN (2.1.1.9)			
20	OTHER:						

21 ○ FREQUENCY OF TRANSIENTS (EVENTS/TIME) (2.1.1.8) ______ ○ NON-SYNCHRONOUS EXCITING FREQUENCY (2.5.1) ______
22 ○ COUPLING MINIMUM REQUIRED SERVICE FACTOR, SF (2.1.1.4)(2.1.1.7) ______
23 ○ AMBIENT TEMPERATURE (ºC) MAXIMUM ______ MINIMUM ______
24 ENVIRONMENT (2.7.3) (2.7.4) ○ HYDROGEN CHLORIDE ○ HYDROGEN SULFIDE ○ OTHER: ______

25 **LUBRICATION**

26 ○ CONTINUOUS (2.2.7) (2.2.8) ○ BATCH (2.2.7) ○ NON-LUBRICATED
27 ○ VISCOSITY (cP) ______ @ ______ ºC ○ FILTRATION MICRONS ______
28 ○ PRESSURE (BAR) ______ ○ TEMPERATURE (ºC) ______ ☐ FLOW (m^3/h) ______

29 **COUPLING DATA**

30 ○ SHAFT SEPARATION (INCLUDING THERMAL GROWTHS) (mm B.S.E.):
31 @ AMBIENT TEMP. ______ @ NORMAL OPERATION ______ @ MAXIMUM TRANSIENT ______
32 ○ MOTOR ROTOR FLOAT (mm) ______ ○ LIMITED END FLOAT (mm) (2.2.3) ______
33 ○ MARINE TYPE REQUIRED (2.2.2) ○ FLEX-HUB TYPE REQUIRED (2.2.2) ○ ELECTRICALLY INSULATED (2.1.12)
34 ○ REQUIRED MISALIGNMENT CAPABILITY (2.1.1.6)
35 STEADY STATE: ANGULAR (DEG.) ______ PARALLEL OFFSET (mm) ______ AXIAL (mm) ______
36 TRANSIENT: ANGULAR (DEG.) ______ PARALLEL OFFSET (mm) ______ AXIAL (mm) ______
37 ☐ MAXIMUM ALLOWABLE MISALIGNMENT (5.2.2.3.q)
38 STEADY STATE: ANGULAR (DEG.) ______ PARALLEL OFFSET (mm) ______ AXIAL (mm) ______
39 TRANSIENT: ANGULAR (DEG.) ______ PARALLEL OFFSET (mm) ______ AXIAL (mm) ______
40 ○ COMPONENT BALANCE (2.6.2.1) (2.6.3.5) OR ○ COMPONENT BALANCE WITH ASSEMBLY CHECK BALANCE (2.6.2.2) (2.6.3.6)
41 OR ○ COMPONENT BALANCE WITH ASSEMBLY BALANCE(2.6.2.3) (2.6.3.7)
42 ○ RESIDUAL UNBALANCE CHECK OF ASSEMBLED COUPLINGS (2.6.3.8) ○ BALANCE REPEATABILITY CHECK (2.6.3.9)
43 ☐ MAXIMUM ALLOWABLE RESIDUAL UNBALANCE (g-mm) (2.6) DRIVER END ______ DRIVEN END ______
44 ☐ MAXIMUM ACTUAL RESIDUAL UNBALANCE (g-mm) (2.6) DRIVER END ______ DRIVEN END ______
45 ☐ TORSIONAL STIFFNESS (kg-mm/RAD) (5.2.2.3.j) ______
46 ☐ WR◊(kg-mm^2) (5.2.2.3.i) DRIVER END ______ DRIVEN END ______
47 ☐ SPACER LATERAL NATURAL FREQUENCY (2.5.2) (5.2.2.3.k) ______
48 ☐ TORQUE CAPACITY OF HUB/SHAFT INTERFACE FOR KEYLESS FITS (N-m) (5.2.2.3.t) ______

COUPLING DATA SHEET **API 671 THIRD EDITION** **SI UNITS**	PAGE 2 OF 2 JOB . NO. ____ ITEM NO. ____ PURCH. ORDER NO. ____ DATE ____ INQUIRY NO. ____ BY ____ REVISION ____ DATE ____

COUPLING DATA (CONTINUED)

FLEXIBLE-ELEMENT COUPLING :

☐ INITIAL DEFLECTION (mm) ____ ☐ PRESTRETCH ☐ COMPRESSION ☐ MAXIMUM AXIAL DEFLECTION (mm) ____

☐ CALCULATED AXIAL NATURAL FREQUENCY (5.2.2.3.h) ____ ○ TEST OF ANF (4.4.1) ☐ ACTUAL ANF ____

☐ MAXIMUM ENCLOSURE TEMPERATURE AT MAXIMUM CONTINUOUS SPEED (°C) (5.2.3.3) ____

MATERIALS (2.7)

	DRIVE END MATERIALS	DRIVEN END MATERIALS
HUB/FLANGE		
SPACER		
SLEEVE		
FLEXIBLE-ELEMENT		
FLEXIBLE-ELEMENT GUARD		
BOLTS		
NUTS		

○ PROTECTIVE COATING (2.7.6) ○ VENDOR STANDARD ○ ____

☐ INTERNAL TEETH HARDNESS (ROCKWELL C) (2.2.6) DRIVE END ACTUAL ____ DRIVEN END ACTUAL ____

☐ EXTERNAL TEETH HARDNESS (ROCKWELL C) (2.2.6) DRIVE END ACTUAL ____ DRIVEN END ACTUAL ____

COUPLING HUB MACHINING

	DRIVE END	DRIVEN END
○ TYPE (INTEGRAL, CYLINDRICAL, TAPER) (2.1.4) (2.1.8.1)		
○ KEYED OR HYDRAULICALLY FITTED (2.1.8.1)		
○ TAPER (1 DEG. I.A., 1/2 IN. PER FT., 3/4 IN. PER FT.)		
(2.1.9.1.1) (2.1.9.1.2) (2.1.9.1.3)		
☐ KEYWAY DIMENSIONS AND NUMBER (2.1.9.2)		
☐ NOMINAL BORE DIAMETER		
☐ INTERFERENCE FIT (mm) MAX./MIN. (2.1.8.1)	/	/
○ PULLER HOLES (2.1.9.2.4)		
○ TRIM BALANCE HOLES (2.6.4)		

COUPLING GUARD (APPENDIX D)

○ COORDINATOR (D.2.1) ____

○ FLANGED CYLINDRICAL (D.4) ○ BASE MOUNT (D.3)

○ AIR TIGHT (D.6.2) ○ OIL TIGHT (D.2.7)

○ SPARK RESISTANT (D.2.9)

○ TRANSPARENT WINDOW FOR EACH OIL SPRAY POINT (D.5.5)

○ VENT CONNECTION (D.4.3)

○ 1 INCH NPT WITH FILTER-BREATHER

○ 1 INCH FLANGED, RATING & FACING

○ PURGE GAS ____ ○ DRY AIR PURGE (D.4.4)

☐ PURGE CONNECTION SIZE & TYPE ____

☐ PURGE m^3/h REQUIRED ____

○ OIL MIST COOLING ○ GAS COOLING

○ CONTRACT GUARD TO BE USED DURING SHOP TEST (D.4.5)

○ ADDITIONAL GUARD DETAILS (2.3.3) ____

ACCESSORIES

○ PRIME EQUIPMENT SUPPLIER TO FURNISH ONE SET OF PLUG AND RING GAGES (3.5) ○ LAPPING TOOLS (3.6)

○ DRILL TEMPLATE FOR INTEGRAL FLANGED HUBS BY (2.1.5.1)

○ COUPLING MANUFACTURER ○ PURCHASER

○ TWO-PIECE STOP RINGS BY COUPLING MANUFACTURER (3.3)

○ HYDRAULIC INSTALLATION/REMOVAL TOOLING (TO INCLUDE HAND PUMP(S), PRESSURE GAUGE(S), FITTINGS AND HOSE(S)) BY (3.1)

○ PURCHASER ○ COUPLING MANUFACTURER

○ PULLER BY COUPLING MANUFACTURER (3.4)

○ MOMENT SIMULATOR (2.1.6) ○ SOLO PLATE (2.1.7)

APPLICABLE SPECIFICATIONS

○ API-671, SPECIAL PURPOSE COUPLINGS

○ ____

○ COORDINATION MEETING ATTENDANCE REQ'D (5.1.3)

PREPARATION FOR SHIPMENT

○ OUTDOORS STORAGE FOR MORE THAN 3 MONTHS (4.5.2)

○ EXPECTED STORAGE TIME ____

SHIPPING: (4.5.3) ○ DOMESTIC ○ EXPORT

STORAGE: (4.5.2) ○ INDOOR ○ OUTDOOR

○ SEE COUPLING PURCHASE ORDER FOR PRESERVATION, BOXING, AND SHIPPING INSTRUCTIONS

COUPLING DATA SHEET API 671 THIRD EDITION CUSTOMARY UNITS	PAGE 1 OF 2 JOB . NO. ______ ITEM NO. ______ PURCH. ORDER NO. ______ DATE ______ INQUIRY NO. ______ BY ______ REVISION ______ DATE ______

NOTE: INFORMATION TO BE COMPLETED ○ BY PURCHASER ☐ BY COUPLING MANUFACTURER

APPLICABLE TO: ○ PROPOSAL ○ PURCHASE ○ AS BUILT

○ OWNER: ______ NO. REQUIRED ______
SITE: ______ SERVICE: ______

○ DRIVER: TYPE ______ MANUFACTURER ______ MODEL ______
NAMEPLATE POWER (HP) ______ SERVICE FACTOR ______ SERIAL NO. ______ TAG. NO. ______
DRIVEN UNIT: ______ MANUFACTURER ______ MODEL ______
SERIAL NO. ______ TAG. NO. ______

COUPLING TYPE: ○ FLEXIBLE ELEMENT ○ GEAR ○ QUILL SHAFT ○ OTHER ______
☐ MANUFACTURER: ______ MODEL ______ SIZE ______ ASS'Y. DWG. NO. ______

○ **CONDITIONS CONSIDERED FOR COUPLING SELECTION**			☐ **RATINGS**			
CONDITIONS	TORQUE (IN-LB)	@ RPM		TORQUE (IN-LB)	@ RPM	SERVICE FACTOR
NORMAL (2.1.1.3)			NORMAL			
DRIVEN RATED LOAD			PEAK			
MAXIMUM STEADY STATE (2.1.1.2.d)			MOMENTARY			
MAXIMUM TRANSIENT (2.1.1.2.d)			SHAFT JUNCTURE DRIVING (2.1.1.9)			
TRIP CONDITION						
CONTINUOUS CYCLIC (2.1.1.2.d)			SHAFT JUNCTURE DRIVEN (2.1.1.9)			
OTHER:						

○ FREQUENCY OF TRANSIENTS (EVENTS/TIME) (2.1.1.8) ______ ○ NON-SYNCHRONOUS EXCITING FREQUENCY (2.5.1) ______
○ COUPLING MINIMUM REQUIRED SERVICE FACTOR, SF (2.1.1.4)(2.1.1.7) ______
○ AMBIENT TEMPERATURE (ºF) MAXIMUM ______ MINIMUM ______
ENVIRONMENT (2.7.3) (2.7.4) ○ HYDROGEN CHLORIDE ○ HYDROGEN SULFIDE ○ OTHER: ______

LUBRICATION

○ CONTINUOUS (2.2.7) (2.2.8) ○ BATCH (2.2.7) ○ NON-LUBRICATED
○ VISCOSITY (SSU) ______ @ ______ ºF ○ FILTRATION MICRONS ______
○ PRESSURE (PSIG) ______ ○ TEMPERATURE (ºF) ______ ☐ FLOW (GPM) ______

COUPLING DATA

○ SHAFT SEPARATION (INCLUDING THERMAL GROWTHS) (IN. B.S.E.):
@ AMBIENT TEMP. ______ @ NORMAL OPERATION ______ @ MAXIMUM TRANSIENT ______
○ MOTOR ROTOR FLOAT (IN.) ______ ○ LIMITED END FLOAT (IN.) (2.2.3) ______
○ MARINE TYPE REQUIRED (2.2.2) ○ FLEX-HUB TYPE REQUIRED (2.2.2) ○ ELECTRICALLY INSULATED (2.1.12)
○ REQUIRED MISALIGNMENT CAPABILITY (2.1.1.6)
STEADY STATE: ANGULAR (DEG.) ______ PARALLEL OFFSET (IN.) ______ AXIAL (IN.) ______
TRANSIENT: ANGULAR (DEG.) ______ PARALLEL OFFSET (IN.) ______ AXIAL (IN.) ______
☐ MAXIMUM ALLOWABLE MISALIGNMENT (5.2.2.3.q)
STEADY STATE: ANGULAR (DEG.) ______ PARALLEL OFFSET (IN.) ______ AXIAL (IN.) ______
TRANSIENT: ANGULAR (DEG.) ______ PARALLEL OFFSET (IN.) ______ AXIAL (IN.) ______
○ COMPONENT BALANCE (2.6.2.1) (2.6.3.5) OR ○ COMPONENT BALANCE WITH ASSEMBLY CHECK BALANCE (2.6.2.2) (2.6.3.6)
OR ○ COMPONENT BALANCE WITH ASSEMBLY BALANCE(2.6.2.3) (2.6.3.7)
○ RESIDUAL UNBALANCE CHECK OF ASSEMBLED COUPLINGS (2.6.3.8) ○ BALANCE REPEATABILITY CHECK (2.6.3.9)
☐ MAXIMUM ALLOWABLE RESIDUAL UNBALANCE (OZ-IN) (2.6) DRIVER END ______ DRIVEN END ______
☐ MAXIMUM ACTUAL RESIDUAL UNBALANCE (OZ-IN) (2.6) DRIVER END ______ DRIVEN END ______
☐ TORSIONAL STIFFNESS (LB-IN/RAD) (5.2.2.3.j) ______
☐ WR◊(LB-IN^2) (5.2.2.3.i) DRIVER END ______ DRIVEN END ______
☐ SPACER LATERAL NATURAL FREQUENCY (2.5.2) (5.2.2.3.k) ______
☐ TORQUE CAPACITY OF HUB/SHAFT INTERFACE FOR KEYLESS FITS (IN-LB) (5.2.2.3.t) ______

COUPLING DATA SHEET API 671 THIRD EDITION CUSTOMARY UNITS	JOB . NO. ______ ITEM NO. ______ PURCH. ORDER NO. ______ DATE ______ INQUIRY NO. ______ BY ______ REVISION ______ DATE ______

COUPLING DATA (CONTINUED)

FLEXIBLE-ELEMENT COUPLING :

☐ INITIAL DEFLECTION (IN.) ______ ☐ PRESTRETCH ☐ COMPRESSION ☐ MAXIMUM AXIAL DEFLECTION (IN.) ______

☐ CALCULATED AXIAL NATURAL FREQUENCY (5.2.2.3.h) ______ ○ TEST OF ANF (4.4.1) ☐ ACTUAL ANF ______

☐ MAXIMUM ENCLOSURE TEMPERATURE AT MAXIMUM CONTINUOUS SPEED (°F) (5.2.3.3) ______

MATERIALS (2.7)

	DRIVE END MATERIALS	DRIVEN END MATERIALS
HUB/FLANGE		
SPACER		
SLEEVE		
FLEXIBLE-ELEMENT		
FLEXIBLE-ELEMENT GUARD		
BOLTS		
NUTS		

○ PROTECTIVE COATING (2.7.6) ○ VENDOR STANDARD ○ ______

☐ INTERNAL TEETH HARDNESS (ROCKWELL C) (2.2.6) DRIVE END ACTUAL ______ DRIVEN END ACTUAL ______

☐ EXTERNAL TEETH HARDNESS (ROCKWELL C) (2.2.6) DRIVE END ACTUAL ______ DRIVEN END ACTUAL ______

COUPLING HUB MACHINING

	DRIVE END	DRIVEN END
○ TYPE (INTEGRAL, CYLINDRICAL, TAPER) (2.1.4) (2.1.8.1)		
○ KEYED OR HYDRAULICALLY FITTED (2.1.8.1)		
○ TAPER (1 DEG. I.A., 1/2 IN. PER FT., 3/4 IN. PER FT.) (2.1.9.1.1) (2.1.9.1.2) (2.1.9.1.3)		
☐ KEYWAY DIMENSIONS AND NUMBER (2.1.9.2)		
☐ NOMINAL BORE DIAMETER		
☐ INTERFERENCE FIT (IN.) MAX./MIN. (2.1.8.1)	/	/
○ PULLER HOLES (2.1.9.2.4)		
○ TRIM BALANCE HOLES (2.6.4)		

COUPLING GUARD (APPENDIX D)

○ COORDINATOR (D.2.1) ______

○ FLANGED CYLINDRICAL (D.4) ○ BASE MOUNT (D.3)

○ AIR TIGHT (D.6.2) ○ OIL TIGHT (D.2.7)

○ SPARK RESISTANT (D.2.9)

○ TRANSPARENT WINDOW FOR EACH OIL SPRAY POINT (D.5.5)

○ VENT CONNECTION (D.4.3)

○ 1 INCH NPT WITH FILTER-BREATHER

○ 1 INCH FLANGED, RATING & FACING

○ PURGE GAS ______ ○ DRY AIR PURGE (D.4.4)

☐ PURGE CONNECTION SIZE & TYPE ______

☐ PURGE SCFM REQUIRED ______

○ OIL MIST COOLING ○ GAS COOLING

○ CONTRACT GUARD TO BE USED DURING SHOP TEST (D.4.5)

○ ADDITIONAL GUARD DETAILS (2.3.3) ______

ACCESSORIES

○ PRIME EQUIPMENT SUPPLIER TO FURNISH ONE SET OF PLUG AND RING GAGES (3.5) ○ LAPPING TOOLS (3.6)

○ DRILL TEMPLATE FOR INTEGRAL FLANGED HUBS BY (2.1.5.1)

○ COUPLING MANUFACTURER ○ PURCHASER

○ TWO-PIECE STOP RINGS BY COUPLING MANUFACTURER (3.3)

○ HYDRAULIC INSTALLATION/REMOVAL TOOLING (TO INCLUDE HAND PUMP(S), PRESSURE GAUGE(S), FITTINGS AND HOSE(S)) BY (3.1)

○ PURCHASER ○ COUPLING MANUFACTURER

○ PULLER BY COUPLING MANUFACTURER (3.4)

○ MOMENT SIMULATOR (2.1.6) ○ SOLO PLATE (2.1.7)

APPLICABLE SPECIFICATIONS

○ API-671, SPECIAL PURPOSE COUPLINGS

○ ______

○ COORDINATION MEETING ATTENDANCE REQ'D (5.1.3)

PREPARATION FOR SHIPMENT

○ OUTDOORS STORAGE FOR MORE THAN 3 MONTHS (4.5.2)

○ EXPECTED STORAGE TIME ______

SHIPPING: (4.5.3) ○ DOMESTIC ○ EXPORT

STORAGE: (4.5.2) ○ INDOOR ○ OUTDOOR

○ SEE COUPLING PURCHASE ORDER FOR PRESERVATION, BOXING, AND SHIPPING INSTRUCTIONS

APPENDIX B—TORSIONAL-DAMPING COUPLINGS AND RESILIENT COUPLINGS

B.1 General

Torsional damping and resilient couplings are used in equipment trains in which potentially harmful torsional excitations occur during transient or continuous operation. They are treated in a tutorial manner in this appendix because of the unique, specialized nature of these couplings and the application for which they are suited.

B.2 Application

Torsional-damping couplings and resilient couplings limit torque oscillations of coupled machinery by dissipating energy into one or more flexing elements. Generally, these couplings are applied to the lowest speed shaft in an equipment train; therefore, the couplings are usually classified as low speed. When some of the torsional natural frequencies of an equipment train fall below the running speed of the train (a normal occurrence), the train must pass through these natural frequencies during start-up and again during normal or emergency shutdown.

B.3 Design

Torsional-damping couplings and resilient couplings are available with either metallic or elastomeric flexing elements. Some couplings with spring steel as the flexing element can be filled with oil to provide high degrees of viscous damping by oil displacement. Generally, couplings with elastomeric flexing elements exhibit lower torsional stiffness and higher damping capability than do those with metallic flexing elements. Torsional-damping couplings and resilient couplings are usually used on the low speed side of a drive-train and are often used in combination with another type of coupling (gear, disc, or diaphragm). This combination is used for several reasons: to accommodate axial movement, and to reduce the weight on the equipment (usually on the driven end of equipment).

B.3.1 The coupling damping shall be sufficient to reduce torsional vibration stresses in the machinery train to a safe level.

● **B.3.2** The purchaser will specify any material constraints regarding flexible elements.

● **B.3.3** The purchaser will specify minimum requirements for torsional damping, and the allowable range of torsional stiffness for the coupling.

● **B.3.3.1** The purchaser will specify any restrictions regarding the use of elastomers in shear.

B.3.3.2 Couplings that use elastomers in compression shall be designed to accommodate the resultant Poisson expansion in the axial direction.

B.3.3.3 Elastomeric elements shall be designed to dissipate the required vibrational energy without overheating.

● **B.3.4** The purchaser will specify whether the coupling is to be of the single- or double-engagement type, based on misalignment requirements.

● **B.3.5** The purchaser will specify whether the coupling is to be of the spacer or nonspacer type, taking the maintenance requirements of the coupled equipment into consideration.

B.3.6 The following sections of this standard shall apply:

a. Section 1.
b. Section 2—Only the parts specified below:
Subsection 2.1, with the following exceptions:
In 2.1.3, the spacer is not mandatory, except by purchaser specification. In 2.1.13, all-over machining is not mandatory.

B.4 Balance

B.4.1 Couplings shall be balanced by balancing the individual components to limits set in 2.6.3.5. Separate elastomeric flexible elements shall be weigh balanced to a tolerance of 0.1 g (0.0035 oz.).

● **B.4.2** When specified, the coupling shall be assembly balanced. Assembly balance limits shall be mutually agreed upon by the purchaser and the vendor.

B.5 Construction Materials

● **B.5.1** The construction materials, including elastomers, shall be mutually agreed upon by the purchaser and the vendor. The purchaser will specify pertinent operating conditions (including environmental conditions) such as temperature, corrosiveness of the atmosphere, and air-borne abrasives.

B.5.2 Hubs, sleeves, and spacers shall preferably be forged. Welded spacers are acceptable. Ductile iron construction is permissible, but cast iron is not acceptable.

B.5.3 Paragraph 2.7.6 of this standard shall apply.

B.6 Manufacturing Quality, Inspection Testing, and Preparation for Shipment

B.6.1 Section 4 of this standard shall apply.

B.7 Vendor's Data

B.7.1 For couplings with nonlinear torsional stiffness, the vendor shall furnish a curve or tabulation of deflection versus torque and instantaneous values of equivalent viscous damping. Where applicable, the effects of temperature, speed, and frequency of vibration shall be taken into consideration.

B.7.2 The vendor shall state the life expectancy of the elastomeric elements when they are operating at the specified conditions (including environmental conditions).

B.7.3 The vendor shall state the maximum allowable continuous operating misalignment and maximum allowable misalignment.

B.7.4 Section 5 of this standard shall apply.

APPENDIX C—COUPLING TAPERS

This document mandates shaft ends with a taper of 1:24 ($^1/_2$ diametrical in./ft length) for keyless hydraulically-fitted hubs and a taper of 1:16 ($^3/_4$ diametrical in/ft of length) for nonhydraulically fitted hubs. It is recognized that other tapers exist; however, these tapers are mandated as default standards to standardize for tooling purposes.

The greater the taper, the greater the accuracy that is demanded to position the hub axially on the shaft if stresses and contact pressures are to be maintained within given limits. Alternatively, the more shallow the taper, the less latitude one has in varying stresses and contact pressures because of the relatively large accompanying change in the spacer-gap dimension.

Table C-1 illustrates the axial hub advance required to achieve 0.025 mm (1 mil, 0.001 in.) of bore dilation for three standard shaft-end tapers.

Table C-1—Axial HUB Advance Required to Achieve 1 Mil of Bore Dilation

Taper	Axial Advance	
	Mm	In.
1 degree (included angle)	1.4	0.057
1:24 ($^1/_2$ inch per foot)	0.6	0.024
1:16 ($^3/_4$ inch per foot)	0.4	0.016

As a further illustration, consider the case of a 125 mm, 5-in., diameter bore that has an interference of 0.002 mm/mm, 0.002 in./in., of bore diameter. This bore will achieve a stress level of (4.14×10^8) Nm^2, 60,000 psi. The total bore dilation is 0.25 mm, 0.010 in., requiring an axial advance 10 times the values shown in the chart, that is, 14.5, 6.0, and 4.0 mm (0.57, 0.24, and 0.16 in.), respectively, for the three tapers.

APPENDIX D—COUPLING GUARDS

D.1 Scope

This section covers the minimum requirements for guards to be used with special-purpose couplings. This information is added as a convenience to the owner or the contractor in specifying the total requirements for the driving and driven equipment system. Coupling guards are usually furnished by the machinery vendor rather than by the manufacturer of the coupling. Therefore, this section does not pertain to the requirements for special-purpose couplings, as such.

D.2 General Requirements for All Guards

● **D.2.1** The purchaser will designate someone to coordinate and to be responsible for the supply of all coupling guards in the equipment train.

● **D.2.2** The purchaser will specify the required guard types.

D.2.3 Each coupling shall have a coupling guard that sufficiently encloses the coupling and shafts to prevent any personnel from accessing the danger zone during operation of the equipment train.

D.2.4 The guard shall be readily removable for inspection and maintenance of the coupling without disturbance of the coupled machines.

D.2.5 The guard shall be constructed to be rigid enough to withstand a 90 kg (200-lb) static load with a deflection of not more than 0.0005 times the unsupported length of the guard.

D.2.6 The guard shall comply with the requirements of OHSA Standard 1910.219.

● **D.2.7** When specified, the guard shall be oil tight.

D.2.8 The guard shall contain antiswirl baffles as required to minimize the effects of windage oil swirl.

● **D.2.9** When specified, the guard shall be fabricated from spark-resistant material. A description of the construction materials shall be submitted to the purchaser for approval.

D.3 Base-Mounted Guards

D.3.1 Guards that are fastened to the equipment foundation or baseplate shall be removable in one piece.

D.3.2 Base-mounted guards shall preferably be fabricated from a solid metal sheet or plate with no openings. Guards that are fabricated from expanded metal or perforated plate are acceptable, provided that the size of the opening is small enough to prevent entry by objects that are 10 mm ($^3/_8$ in.) or larger in diameter. Guards of woven wire are unacceptable.

D.4 Flanged Cylindrical-Shell Guards

D.4.1 Guards shall preferably be tubular in shape and shall be axially split with provision at each end for connection to the coupled equipment. If a slip joint is required at one end of the guard, the joint shall be provided with two O-rings. Alternatively, expansion may be accommodated by using a flexible diaphragm.

D.4.2 If adapting flanges are required to mate the guard to the associated components of the equipment train, the vendor designated in D.2.1 shall be responsible for their inclusion.

● **D.4.3** A baffled vent connection (1-in. NPT minimum) shall be provided. Unless otherwise specified, a threaded filter breather shall be supplied for attachment at this connection. When specified, the vent shall be flanged for connection to the bearing oil vent system of the equipment train, in which case, the filter breather is not required.

● **D.4.4** When specified, the guard shall be fitted with a connection for purging with dry air or an inert gas. (This is necessary when unusually corrosive conditions exist.)

● **D.4.5** When specified, the contract guard shall be used when the contract coupling is factory tested with the driver and driven equipment.

D.5 Guards for Continuously Lubricated Couplings

D.5.1 In addition to the requirements listed in D.4, the following shall apply to coupling guards for continuously lubricated couplings.

D.5.2 Each oil-spray nozzle shall be positively fastened to the guard in the proper orientation, and the mounting shall ensure that this orientation is easily reestablished if removal of the nozzle is required for maintenance. Friction clamping of nozzles or tubing in unacceptable.

D.5.3 Guards shall be designed to remain oil tight for at least 3 years of operation.

D.5.4 A flanged oil drain connection, 1 NPS or larger in size, shall be provided for each guard.

● **D.5.5** When specified, a transparent window shall be provided to permit safe inspection of each oil spray while the coupling is in service.

D.6 Guards for Flexible-Element Couplings

D.6.1 In addition to the requirements listed in D.4, the following shall apply to coupling guards for flexible-element couplings.

D.6.2 When specified, guards shall be designed to be essentially air tight at the radial and axial flanged joints and at the slip joint, if any. The design of the guards shall minimize the potential heating caused by windage.

D.6.3 A flanged oil drain connection, 1 NPS or larger in size, shall be provided to handle any oil carryover from the coupled equipment into the guard.

D.7 Guards for Instrumented Couplings

D.7.1 In addition to requirements noted above, guards containing instrumentation, such as torquemeters, shall be designed so that the internal temperature does not exceed the maximum allowable temperature of the enclosed instrumentation.

APPENDIX E—COUPLING FATIGUE FACTOR OF SAFETY

Paragraph 2.1.2.1 defines how a coupling manufacturer is to rate a coupling for continuous operation. It defines the minimum factor of safety and the methods for applying them to recognized material properties. This definition standardizes the basis for published continuous ratings, so that different manufacturer's ratings can be compared on a more equivalent basis.

This standard does not address the details of the design, such as formulas or analysis used to derive the stresses or how these stresses are combined. This information is often considered proprietary and are not a point of this document. As to how these stresses are derived and combined, a certain level of confidence is required for each coupling manufacturer based on experience with their product.

Below is a typical fatigue diagram incorporating a Modified Goodman line and a Constant Life Curve.

For this example coupling, the combined maximum constant stresses from the catalog rated speed, axial displacement, and torque on the flexible element is 92,500 psi. The alternating stress due to catalog rated angular misalignment is 20,000 psi. These two values define a point on the fatigue chart labeled "Combined stresses at catalog ratings".

The proportional increase factor of safety is the ratio of the distance of:

1. The line from the origin to either the Constant Life Curve or the Modified Goodman Line to;
2. The distance of the line from the origin to the Combined Stresses point.

Using the scale,

Constant Life Factor of Safety	= 23 units/16.5 units = 1.39
Modified Goodman Factor of Safety	= 21 units/16.5 units = 1.27

Since either one of these factors is greater than the minimum requirement outlined in 2.1.2.1, this flexible element meets the requirements of API 671.

Note: This factor of safety is not for a defined equipment operating point; it is for the combination of maximum ratings published in a catalog. The actual factor of safety for an equipment operating point will typically be much greater.

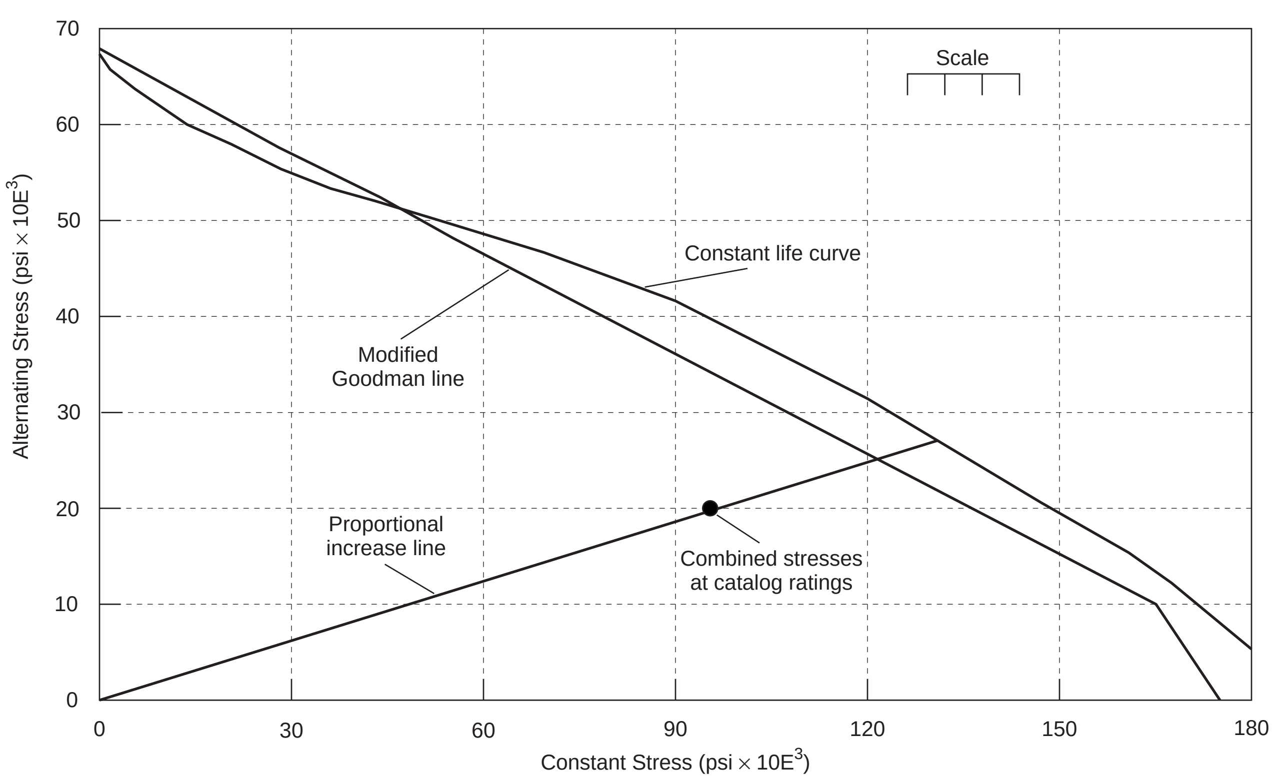

Figure E-1—Typical Flexible Element Fatigue Diagram

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