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Petroleum and natural gas industries — Flexible couplings for mechanical power transmission — General purpose applications

Industries du pétrole et du gaz naturel — Accouplements flexibles pour transmission de puissance mécanique — Applications d'usage général

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International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet iso@iso.ch

Printed in Switzerland

Foreword

ISO (the International Organization for Standardization) is a world-wide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 14691 was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for the petroleum and natural gas industries*, Subcommittee SC 6, *Processing equipment and systems*.

Annexes A, B and C of this International Standard are for information only.

Introduction

This International Standard is based on the accumulated knowledge and experience of manufacturers and users of power transmission couplings in the petroleum and natural gas industries, but its use is not restricted to these industries.

Users of this International Standard should be aware that further or differing requirements may be needed for individual applications. This International Standard is not intended to inhibit a vendor from offering, or the purchaser from accepting, alternative equipment or engineering solutions for the individual application. This may be particularly appropriate where there is innovative or developing technology. Where an alternative is offered, the vendor should identify any variations from this International Standard and provide details.

This International Standard requires the purchaser to specify certain details and features.

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

Petroleum and natural gas industries — Flexible couplings for mechanical power transmission — General purpose applications

1 Scope

1.1 This International Standard specifies the requirements for couplings for the transmission of power between the rotating shafts of two machines for general purpose applications in the petroleum and natural gas industries. Such applications typically require couplings to transmit power at speeds not exceeding 4 000 r/min, between machines in which the first lateral critical speed is above the running speed range (stiff-shaft machines). It may, by agreement, be used for applications outside these limits.

1.2 This International Standard is applicable to couplings designed to accommodate parallel (or lateral) offset, angular misalignment and axial displacement of the shafts without imposing excessive mechanical loading on the coupled machines. Couplings covered include gear (and other mechanical contact types), metallic flexible-element and various elastomeric types. Special types such as clutch, hydraulic, eddy-current, rigid, radial spline and universal joint types, are not covered.

1.3 This International Standard covers design, materials of construction, inspection and testing of couplings and methods of attachment of the coupling to the shafts (including tapered sleeve and other proprietary devices). This International Standard does not define criteria for the selection of coupling types for specific applications.

1.4 It is recommended that, when users fit new couplings to existing equipment which are different from those originally fitted, they consult the manufacturers of the driving or driven equipment.

NOTE 1 In many cases, couplings covered by this International Standard are manufacturer's catalogue items.

NOTE 2 For the following applications, the use of ISO 10441 is recommended :

— large or high-speed machines that may be required to operate continuously for extended periods, are often unspared and are critical to the continued operation of the installation (special purpose applications);

— machines in which the first lateral critical speed is less than the maximum required operating speed (flexible-shaft machines);

— machines where the rotor dynamics are particularly sensitive to coupling unbalance.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid international standards.

ISO 286-2, *ISO system of limits and fits — Part 2: Tables of standard tolerance grades, and limit deviations for holes and shafts*.

ISO 1940-1:1986, *Mechanical vibration — Balance quality requirements of rigid rotors — Part 1: Determination of permissible residual unbalance.*

ISO 8821, *Mechanical vibration — Balancing — Shaft and fitment key convention*.

ISO 10441, *Petroleum and natural gas industries — Flexible couplings for mechanical power transmission — Special purpose applications.*

AGMA 9002 - A86, March 1986, *Bores and keyways for flexible couplings (Inch series) Annex A*.

3 Terms and definitions

For the purposes of this International Standard, the following terms and definitions apply.

3.1 Definitions of coupling types

3.1.1
mechanical contact coupling
coupling designed to transmit torque by direct mechanical contact between mating parts and accommodate misalignment and axial displacement by relative rocking and sliding motion between the parts in contact

NOTE 1 The contacting parts may be metallic or may be made of self-lubricating non-metallic material.

NOTE 2 This category includes gear couplings (see 3.1.1.1).

3.1.1.1
gear coupling
coupling designed to transmit torque and accommodate angular misalignment, parallel offset and axial displacement by relative rocking and sliding motion between mating profiled gears

3.1.2
metallic flexible-element coupling
coupling that obtains its flexibility from the flexing of thin metallic discs, diaphragms or links

NOTE This category includes the two types given in 3.1.2.1 and 3.1.2.2.

3.1.2.1
metallic diaphragm coupling
coupling consisting of one or more metallic flexible elements in the form of thin circular plates that are attached to one part of the coupling at their outer diameter and the other part at their inner diameter

3.1.2.2
metallic disc coupling
coupling consisting of one or more metallic flexible elements that are alternately attached to the two parts of the coupling, the attachment points being essentially the same distance from the centreline

3.1.3
elastomeric flexible-element coupling
a coupling in which the torque is transmitted through one or several elastomeric elements

NOTE This category includes elastomeric shear (3.1.3.1) and elastomeric compression (3.1.3.2) couplings.

3.1.3.1
elastomeric shear coupling
coupling in which the torque is transmitted through an elastomeric element which is principally loaded in shear

NOTE The element may be in the form of a tyre, a bellows (with one or more convolutions) or a diaphragm. A single such elastomeric element is usually able to accommodate angular misalignment, parallel offset and axial displacement.

3.1.3.2
elastomeric compression coupling
coupling in which elastomeric inserts, often in the form of bushes or wedges or one single insert, are located between adjacent parts of the driving and driven halves of the coupling and are principally loaded in compression

NOTE The ability of such couplings to accommodate misalignment, particularly of the parallel offset type, is limited.

3.1.4
double-engagement coupling
coupling with two planes of flexure

NOTE This arrangement enables couplings of certain types, notably gear and metallic flexible-element types, which cannot normally accommodate parallel (or lateral) offset, to do so.

3.1.5
single-engagement coupling
coupling with only one plane of flexure

NOTE Single-engagement couplings of some types, notably gear and metallic flexible-element types, will not normally accommodate parallel (or lateral) offset misalignment.

3.2 Terms relating to coupling rating

3.2.1
coupling axial reaction force
axial force developed within the coupling resulting from the imposed operating conditions

NOTE 1 Examples of imposed operating conditions are axial deflection, misalignment, speed, temperature, etc.

NOTE 2 The force is a function of the shape and stiffness of the flexible-elements or the sliding friction between the elements of a mechanical contact coupling.

3.2.2
coupling continuous rated torque
T_c
coupling manufacturer's declared maximum torque that the coupling will transmit continuously for not less than 25 000 h

NOTE 1 It is expressed either as a single value at the coupling rated speed, when simultaneously subjected to the coupling rated maximum continuous misalignment (both angular misalignment and parallel or lateral offset) and the coupling rated maximum continuous axial displacement, or as an interrelated function of speed, misalignment and axial displacement.

NOTE 2 For certain types of coupling, particularly those with elastomeric elements or inserts, the coupling continuous rated torque may also be a function of the operating temperature.

3.2.3
coupling rated maximum continuous misalignment
maximum misalignment (both angular misalignment and parallel or lateral offset) the coupling is able to tolerate continuously for not less than 25 000 h at the coupling rated speed, when transmitting the coupling continuous rated torque and simultaneously subjected to the coupling rated maximum continuous axial displacement

3.2.4
coupling rated maximum continuous axial displacement
maximum axial displacement the coupling is able to tolerate continuously for not less than 25 000 h at the coupling rated speed, when transmitting the coupling continuous rated torque and simultaneously subjected to the coupling rated maximum continuous misalignment

3.2.5
coupling rated speed
maximum speed at which the coupling is capable of continuously transmitting the coupling continuous rated torque when simultaneously subjected to the coupling rated maximum continuous misalignment and the coupling rated maximum continuous axial displacement

3.2.6
maximum allowable speed
highest rotational speed at which the coupling design will permit transient operation

3.3 Terms relating to coupling duty

3.3.1
application factor
K_a
factor by which the machine rated torque is increased to allow for the fact that the torque required to be transmitted with certain types of driving or driven machines is not constant but varies in a cyclic manner

NOTE Examples of application are with reciprocating engines or compressors.

3.3.2
confidence factor
K_c
factor by which the machine rated torque is increased to allow for uncertainties in the determination of the machine rated torque and possible future changes to the application

3.3.3
machine rated torque
T_m
maximum mean torque required to be transmitted continuously by the coupling

NOTE Mean torque is the short-time average torque and does not include cyclic variations such as those associated with reciprocating machines.

3.3.4
machine rated speed
highest rotational speed at which the machine rated torque is required to be transmitted continuously by the coupling

3.3.5
maximum continuous speed
maximum rotational speed at which the coupling is required to operate continuously but not necessarily transmitting the machine rated torque

NOTE In most cases, the machine rated speed and the maximum continuous speed are the same. In some applications, however, the coupling may be required to operate at speeds above the speed at which it is required to transmit its rated torque.

3.3.6
trip speed
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

NOTE Where the term is used in relation to a machine train driven by a constant-speed, alternating-current electric motor, the trip speed is assumed to be the coupling speed corresponding to the motor synchronous speed at the maximum supply frequency.

3.4 General terms

3.4.1
angular misalignment
minor angle between the centrelines of two shafts that intersect at a point or, where the shafts do not intersect, the minor angle between the centreline of one shaft and an intersecting line parallel to the centreline of the other shaft

See Figure C.2.

NOTE With double-engagement couplings, the term also applies to the minor angle between the centreline of one shaft and the effective centreline of the **floating shaft** (3.4.6).

3.4.2
axial displacement
change in the relative axial position of the adjacent shaft ends of two coupled machines

3.4.3
axial reference point
axial position on the shaft of the driving or driven machine (normally the extreme end of the shaft) from which axial distances are measured

3.4.4
electrically insulated coupling
coupling designed to prevent the flow of electrical current from one shaft to the other through the coupling

3.4.5
flexing length
axial distance between the effective flexing planes of a double-engagement coupling

3.4.6
floating shaft
floating part, or assembly, of a double-engagement coupling that connects and is flexibly supported from the shaft mounted assemblies and through which the power is transmitted

NOTE The floating shaft may include the spacer or may be only part of the spacer.

3.4.7
hub
part of a coupling mounted directly onto the shaft of the driving or driven machine

3.4.8
lateral offset
lateral distance between the centrelines of two coupled shafts that are not parallel, measured at the axial reference point of the driving machine shaft

See Figures C.3 and C.4.

3.4.9
limited-end-float coupling
coupling designed to limit the axial movement of the coupled shaft ends with respect to each other and transmit an axial force of a prescribed magnitude

3.4.10
manufacturer
body responsible for the design and manufacture of the coupling

NOTE The manufacturer is not necessarily the vendor.

3.4.11
maximum allowable temperature
maximum temperature, in the immediate vicinity of the coupling, for which the manufacturer has designed the coupling

3.4.12
maximum continuous temperature
maximum temperature, in the immediate vicinity of the coupling, at which the coupling will continuously transmit the coupling continuous rated torque at the specified operating conditions of speed and misalignment

3.4.13
minimum operating temperature
lowest temperature, in the immediate vicinity of the coupling, at which the coupling is required to transmit torque and/or accommodate misalignment or axial displacement

3.4.14
parallel offset
lateral distance between the centrelines of two coupled shafts that are parallel but not in the same straight line

See Figure C.1.

3.4.15
purchaser
body that issues the order and the specification to the vendor

NOTE The purchaser may be the end user or the end user's agent or the vendor of the driving or driven machine.

3.4.16
potential unbalance
maximum probable net unbalance of a complete coupling after installation

NOTE 1 Potential unbalance results from a combination 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 locating surfaces and registers.

NOTE 2 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:

— the measured residual unbalance of each component or subassembly;

— errors in the balance of each component or subassembly resulting from eccentricity in the fixture used to mount the component or subassembly in the balancing machine;

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

NOTE 3 The concept of potential unbalance is explained more fully and a worked example is given in annex B.

3.4.17
residual unbalance
level of unbalance remaining in a component or assembly after it has been balanced either to the limit of the capability of the balancing machine or in accordance with the relevant standard

3.4.18
shaft-mounted assembly
total assembly of parts rigidly connected to the shaft of the driving or driven machine, including the hub, where supplied, and all other components up to the flexible-element(s) of a metallic or elastomeric flexible-element coupling or one of the pair of contacting parts in a mechanical contact type coupling

3.4.19
spacer
part of a coupling that is removable to provide space and give access for the use of tools to remove the coupling hubs or for other purposes

NOTE The spacer may be a single component or an assembly.

3.4.20
spacer gap length
axial length of the free gap, after the removal of the spacer assembly, that is available for the use of tools to remove the hubs or for other purposes

NOTE The spacer gap length may be less than the distance between the shaft ends.

3.4.21
torsional stiffness
torque required to produce unit angular displacement between the coupled shafts

NOTE Couplings with elastomeric flexible-elements may exhibit a dynamic torsional stiffness which is significantly different from the static value.

3.4.22
unit responsibility
responsibility for coordinating the technical aspects of the complete machine train and the associated auxiliary systems

NOTE 1 The technical aspects to be considered include, but are not limited to, such factors as the power requirements, speed, rotation, general arrangement, couplings and coupling guards, dynamics, noise, lubrication, sealing system, instrumentation, piping, conformance to specifications and testing of components.

NOTE 2 Unit responsibility normally resides with the vendor of the driven machine.

3.4.23
vendor
body that supplies the coupling in reponse to an order from the purchaser

NOTE The vendor may be the manufacturer of the coupling or the manufacturer's agent and is normally responsible for service support.

3.5 Terms relating to gear couplings

The terms defined in 3.5.1 and 3.5.2 are applicable only to gear-type couplings.

3.5.1
batch-lubricated coupling
coupling designed to be lubricated by a periodically changed charge of oil or grease

3.5.2
neutral state
<gear coupling> state when the meshing pairs of gear teeth are axially centrally located with respect to each other, that is with equal scope for axial displacement in each direction

3.6 Terms relating to flexible-element couplings

The terms defined in 3.6.1 and 3.6.2 are applicable to metallic flexible-element couplings and elastomeric flexible-element couplings.

3.6.1
axial natural frequency
natural frequency of the mass of the spacer assembly supported by the flexible elements acting as axial springs

NOTE 1 The spring rate of certain designs of flexible elements may be non-linear, varying in relation to the axial deflection. With such designs, a range of axial natural frequencies exists within a band corresponding to deflection amplitudes from zero to the maximum allowable.

NOTE 2 Some types of coupling which have significantly non-linear axial stiffness and/or internal damping may not exhibit an axial natural frequency.

3.6.2
neutral state
<flexible-element coupling> state in which there is no net axial force imposed on the coupling

4 Purchaser's specification

4.1 It is recommended that the information required to be specified by the purchaser be entered on a suitable data sheet, a typical form of which is given in annex A. Where appropriate, the information required should be provided in the form of sketches or diagrams.

● **4.2** The purchaser may require the vendor to select the coupling based on the information provided or may select the coupling from the vendor's catalogue. In the latter case, the purchaser may require the vendor to confirm the suitability of the coupling selected.

● **4.3** The purchaser shall provide the following information:

a) the make and type of driving and driven machine, and a description of the whole machine train if this comprises more than two coupled units;

b) the type of coupling (gear, flexible-element, etc.) required and the method of attachment to the shafts (7.2);

c) the machine rated speed (3.3.4), the equipment's operating speed range and the trip speed (3.3.6);

The machine rated speed should normally be the maximum continuous speed.

d) the machine rated torque (3.3.3);

The machine rated torque should be not less than the maximum continuous torque required to be transmitted under any operating conditions. Where one single machine is driven from a driver, the machine rated torque should generally be the maximum continuous torque of the driver. Where two or more machines are driven from one driver, either in tandem, through a multishaft gearbox or from both ends of the driver, care should be taken in determining the machine rated torque for each coupling. Generally this should be based on the most adverse possible split of power consumption between the driven machines.

e) the environment in which the coupling is required to operate, including the maximum and minimum temperatures and the presence of atmospheric contaminants likely to attack the components of the coupling.

● **4.4** If the coupling vendor is required to select the coupling, in addition to the information required by 4.3, the purchaser shall provide the following information:

a) the value to be used for the application factor (K_a) as defined in 3.3.1.

The value of the application factor (K_a) should be selected to allow for cyclic variation in the continuous torque to be transmitted. Where the purchaser has no reason to use a specific value, the manufacturer's catalogue values should be used. In no case, when the prime mover is a turbine or an induction (asynchronous) electric motor, should the value of K_a be less than the values in Table 1.

Table 1 — Application factors for electric motor and turbine prime movers

Driven machine	Value of K_a
Generator	1,0
Centrifugal pump or compressor	1,2
Fan or screw compressor	1,5
Reciprocating pump or compressor with 4 or more cylinders	1,75
Reciprocating pump or compressor with less than 4 cylinders	2,5