INTERNATIONAL STANDARD

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

Industries du pétrole et du gaz naturel — Accouplements flexibles pour transmission de puissance mécanique — Applications spéciales

ISO 10441:199 (E)

Contents

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

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Foreword

ISO (the International Organization for Standardization) is a worldwide 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 10441 was prepared by Technical Committee TC 67, *Materials, equipment and offshore structures for 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 used to couple large or critical machines in the petroleum and natural gas industries, but its use is not restricted to these industries.

This International Standard has been derived from the American Petroleum Institute, standard 671 but contains significant differences from that standard.

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 — Special 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 service in special purpose applications in the petroleum and natural gas industries. Such applications will typically be in large and/or high speed machines in services that may be required to operate continuously for extended periods, are often unspared and are critical to the continued operation of the installation. By agreement, it may be used to apply to other services.

NOTE Couplings for general purpose, less critical applications are covered in ISO 14691.

1.2 Couplings covered by this International Standard are designed to accommodate parallel (or lateral) offset, angular misalignment and axial displacement of the shafts without imposing unacceptable mechanical loading on the coupled machines. It is applicable to gear, metallic flexible-element, quillshaft and torsionally resilient-type couplings. It is not applicable to other types, such as clutch, hydraulic, eddy-current, rigid, radial spline, chain and bellows types.

1.3 This International Standard is applicable to the design, materials of construction, manufacturing quality, inspection and testing of couplings. It does not include criteria for the selection of coupling types for specific applications.

NOTE It is strongly recommended that, when users fit new couplings to existing equipment, which are different from those originally fitted, they consult the vendor who originally had unit responsibilty for the equipment train, to ensure proper application of this International Standard. It will generally be necessary to recalculate the rotor dynamics of the train.

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 IEC and ISO maintain registers of currently valid International Standards.

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 14691, *Petroleum and natural gas industries — Flexible couplings for mechanical power transmission — General purpose applications*.

3 Terms and definitions

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

3.1 Terms relating to 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 The contacting parts may be metallic or may be made of self-lubricating nonmetallic material.

3.1.11
gear coupling
type of mechanical contact coupling designed to transmit torque and accommodate misalignment and axial displacement by relative rocking and sliding motion between mating internal and external profiled gears

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

3.1.2.1
metallic diaphragm coupling
type of metallic flexible-element 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
type of metallic flexible-element 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 equidistant from the centreline

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

3.1.3.1
elastomeric shear coupling
type of elastomeric flexible-element coupling in which the torque is transmitted through an elastomeric element which is principally loaded in shear

NOTE 1 The element may be in the form of a tyre, a bellows (with one or more convolutions) or a diaphragm.

NOTE 2 A single such elastomeric element is usually able to accommodate angular misalignment, parallel offset and axial displacement.

3.1.3.2
elastomeric compression coupling
type of elastomeric flexible-element coupling in which elastomeric inserts are located between adjacent parts of the driving and driven halves of the coupling and are principally loaded in compression

NOTE 1 The inserts are often in the form of bushes or wedges, or one single insert.

NOTE 2 The ability of such couplings to accommodate misalignment, particularly of the parallel (or lateral) 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
quill-shaft coupling
coupling designed to accommodate angular misalignment, parallel (or lateral) offset and torsional fluctuations by elastic deformation of a relatively long slender shaft

NOTE Quill-shaft couplings cannot normally accommodate axial displacement.

3.1.6
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.

3.1.7
torsionally resilient coupling
flexible coupling incorporating increased torsional flexibility and/or torsional damping

NOTE A torsionally resilient coupling may or may not also be designed to accommodate misalignment and/or axial displacement.

3.2 Terms relating to coupling rating

3.2.1
coupling continuous rated torque
T_c
the coupling manufacturer's declared maximum torque which the coupling will transmit continuously, for unlimited periods

NOTE 1 The coupling continuous rated torque is expressed as either:

— a single value at the coupling rated speed, when simultaneously subjected to the coupling rated maximum continuous angular misalignment (at each plane of flexure) and the coupling rated maximum continuous axial displacement,

— or a range of values expressed 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.

3.2.2
coupling rated maximum continuous angular misalignment
maximum angular misalignment, at each plane of flexure, which the coupling is able to tolerate continuously for unlimited periods

NOTE It is expressed as either:

— a single value when transmitting the coupling continuous rated torque at the coupling rated speed, and simultaneously subjected to the coupling rated maximum continuous axial displacement

— or a range of values expressed as an interrelated function of speed, torque and axial displacement.

3.2.3
coupling rated maximum continuous axial displacement
maximum axial displacement the coupling is able to tolerate continuously for unlimited periods

NOTE It is expressed as either:

— a single value when transmitting the coupling continuous rated torque at the coupling rated speed, and simultaneously subjected to the coupling rated maximum continuous angular misalignment

— or a range of values expressed as an interrelated function of speed, torque and angular misalignment.

3.2.4
coupling rated speed
maximum rotational speed at which the coupling is capable of continuously transmitting the coupling continuous rated torque when simultaneously subjected to the coupling rated maximum continuous angular misalignment and the coupling rated maximum continuous axial displacement

3.2.5
maximum allowable speed
highest rotational speed at which the coupling design will permit transient operation

3.2.6
maximum allowable temperature
maximum ambient temperature in the immediate vicinity of the coupling for which the manufacturer has designed the coupling

3.3 Terms relating to coupling duty

3.3.1
application factor
K_a
factor by which the machine rated torque is multiplied 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 such machines are reciprocating engines or compressors.

3.3.2
experience factor
K_e
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 speed
highest rotational speed at which the machine rated torque is required to be transmitted continuously by the coupling

3.3.4
machine rated torque
T_m
maximum mean torque required to be transmitted continuously by the coupling

NOTE Mean torque is the average torque over a few revolutions and does not include cyclic variations such as those associated with reciprocating machines.

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

3.3.7
minimum continuous speed
lowest rotational speed at which the coupling is required to operate continuously

3.3.8
minimum operating temperature
lowest ambient temperature in the immediate vicinity of the coupling, at which the coupling is required to transmit torque and/or accommodate misalignment or axial displacement

3.3.9
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** (3.4.8).

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 distance is measured

3.4.4
coupling axial reaction force
axial force developed within the coupling which results from the imposed operating conditions

NOTE 1 Axial deflection, misalignment, speed, temperature, etc. are examples of imposed operating conditions.

NOTE 2 Coupling axial reaction 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.

3.4.5
coupling mass simulator
auxiliary device designed to correctly simulate both the effective mass and the effective location of the centre of mass of a half-coupling with respect to the shaft on which it is mounted

3.4.6
electrically insulated coupling
coupling designed to prevent the flow of electrical current from one shaft to the other through the coupling

3.4.7
flexing length
axial distance between the effective planes of flexure of a double-engagement coupling

3.4.8
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.

3.4.9
half-coupling
composite of all the components of the coupling attached to and supported from one shaft, including 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

3.4.10
hub
part of a coupling mounted directly onto the shaft of the driving or driven machine

3.4.11
idling adapter
solo plate
device designed to rigidly hold in alignment the floating parts at the drive end of certain types of coupling, to allow uncoupled operation of the driving machine without dismounting the coupling hub

3.4.12
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.

3.4.13
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

3.4.14
manufacturer
body responsible for the design and manufacture of the coupling

NOTE The manufacturer is not necessarily the vendor.

3.4.15
moment simulator
auxiliary device designed to simulate the effective moment of the mass of a half-coupling with respect to the centre of the adjacent bearing

3.4.16
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.

3.4.17
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. Since it may be assumed that the actual values of the various contributory unbalances are random in both magnitude and direction, the numerical value of the potential unbalance is the square root of the sum of the squares of the maximum likely values 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 2 The concept of potential unbalance is explained more fully and a worked example is given in annex B.

3.4.18
purchaser
body that issues the order and the specification for the coupling to the vendor

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

3.4.19
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

3.4.20
shaft-mounted assembly
total assembly of parts rigidly connected to the shaft of the driving or driven machine

NOTE This includes 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.

3.4.21
spacer
that 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.

3.4.22
spacer gap length
axial length of the free gap, after the removal of the spacer, that is available for the use of tools to remove the hubs or for other purposes

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

3.4.23
torsional damping
absorption or dissipation of oscillatory rotary energy

NOTE Torsional damping may be necessary to limit the build-up of transient or steady-state torsional resonant oscillations in a system.

3.4.24
torsional natural frequency
natural rotational oscillatory frequency of a system composed of rotating mass inertias acting in combination with the restraining torsional rigidities of the connected shafts and couplings

3.4.25
torsional stiffness
ratio of the applied torque to the resulting angular displacement of either a complete coupling or part of a coupling, such as the spacer

NOTE With some types of coupling, 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.

3.4.26
torsional tuning
changing of one or more torsional natural frequencies of a coupled system to avoid system resonance at a known excitation frequency

NOTE Torsional tuning may be accomplished by varying one or more of the torsional stiffnesses or mass inertias in the system.