INTERNATIONAL STANDARD

ISO 14691

Second edition
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Petroleum, petrochemical and natural gas industries — Flexible couplings for mechanical power transmission — General-purpose applications

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

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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 2.

The main task of technical committees is to prepare International Standards. 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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

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

This second edition cancels and replaces the first edition (ISO 14691:1999), which has been technically revised.

Introduction

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.

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 in which the rotor dynamics are particularly sensitive to coupling unbalance.

This International Standard requires the purchaser to specify certain details and features. A bullet (●) at the beginning of a subclause or paragraph indicates that either a decision is required or that further information is to be provided by the purchaser. This information should be indicated on the datasheet(s), typical examples of which are included as Annex E, otherwise it should be stated in the quotation request or in the order.

The coupling vendor is not normally required to supply the coupling guard or guards. However, for completeness and for the information of the user of this International Standard, Annex D, which provides requirements for guards, has been added.

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

1 Scope

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, petrochemical 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 can, by agreement, be used for applications outside these limits.

NOTE 1 Recommendations are included in the Introduction as to when the use of ISO 10441 should be considered.

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 by this International Standard include gear (and other mechanical contact types), metallic flexible-element and various elastomeric types. Such couplings can be of all metal construction or can include components of non-metallic materials, such as composites.

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 apply to special types of couplings, such as clutch, hydraulic, eddy-current, rigid and radial-spline types.

This International Standard does not define criteria for the selection of coupling types for specific applications.

NOTE 2 In many cases, couplings covered by this International Standard are manufacturers' catalogue items.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 286-2:1988, *ISO system of limits and fits — Part 2: Tables of standard tolerance grades and limit deviations for holes and shafts*

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

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

ANSI/AGMA 9002, *Bores and Keyways for Flexible Couplings (Inch Series)*

ANSI/AGMA 9003, *Flexible Couplings — Keyless Fits*

ANSI/AGMA 9112, *Bores and Keyways for Flexible Couplings (Metric Series)*

DIN 7190, *Interference fits — Calculation and design rules*[1)]

3 Terms and definitions

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

3.1
angular misalignment
⟨double-engagement couplings⟩ two minor angles between the extension of each machine shaft centre-line and the centre-line of the structure joining the two flexible elements

3.2
angular misalignment
⟨single-engagement couplings⟩ minor angle between the extensions of the shaft centre-lines of the two coupled machines

3.3
axial displacement
change in the relative axial position of the adjacent shaft ends of two coupled machines, usually caused by thermal expansion

3.4
continuous torque rating
coupling manufacturer's declared maximum torque that the coupling can transmit continuously for the specified life

3.5
distance between shaft ends
DBSE
distance from the extreme end of one shaft (including any threaded end) to the extreme end of the next shaft or, in the case of integral flanges, the distance from the mating faces

3.6
double-engagement coupling
coupling with two planes of flexure

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

3.7
gear coupling
coupling of the mechanical contact type that transmits torque and accommodates misalignment and axial displacement by relative rocking and sliding motion between mating, profiled gear teeth

3.8
lateral offset
lateral distance between the centre-lines of two shafts that are not parallel, measured perpendicularly to the centre-line and in the plane of the shaft end of the driving machine

See Annex A.

3.9
manufacturer
agency responsible for the design and fabrication of the coupling

NOTE The manufacturer is not necessarily the vendor.

1) Deutsches Institut für Normung, Burggrafenstraße 6, Berlin, Germany D-10787.

3.10
maximum allowable speed
maximum speed for which the manufacturer has designed the coupling

3.11
maximum allowable temperature
maximum continuous temperature for which the manufacturer has designed the coupling

3.12
maximum continuous angular misalignment
maximum angular misalignment at each plane of flexure that the coupling is able to tolerate for the specified life (5.1.3) when transmitting the coupling continuous torque rating at the coupling rated speed, and when simultaneously subjected to the coupling maximum continuous axial displacement

3.13
maximum continuous axial displacement
maximum axial displacement the coupling is able to tolerate for the specified life (5.1.3) when transmitting the coupling continuous torque rating at the coupling rated speed and when simultaneously subjected to the coupling maximum continuous angular misalignment

3.14
maximum continuous speed
highest rotational speed at which the coupling, as made and tested, is capable of continuous operation

3.15
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 Examples of mechanical contact couplings are gear, grid, and pin-bushing couplings.

NOTE 2 The contacting parts can be metallic or can be made of self-lubricating non-metallic material.

NOTE 3 These couplings do not have a free-state position but resist change in the axial and angular direction, mainly as a function of transmitted torque and the coefficient of friction between the contacting parts.

3.16
metallic flexible-element coupling
coupling that obtains its flexibility from the flexing of thin metallic discs, diaphragms or links

3.17
momentary torque limit
maximum instantaneous torque that the coupling can tolerate without suffering immediate failure

3.18
owner
final recipient of the equipment who may delegate another agent as the purchaser of the equipment

3.19
parallel offset
distance between the centre-lines of two coupled shafts that are parallel but not in the same straight line

See Annex A.

3.20
peak torque rating
maximum torque the coupling can tolerate for short periods

3.21
pilot
rabbet
register
spigot
surface that positions a coupling component, sub-assembly, or assembly radially with respect to another coupling component

3.22
potential unbalance
probable net unbalance of a complete coupling

NOTE 1 Potential unbalance results from a combination of the residual unbalance of individual components and sub-assemblies and possible eccentricity of the components and sub-assemblies due to run-out and tolerances of the various surfaces and registers. Since it can 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 all the contributory unbalances. Typical contributory unbalances are

a) the residual unbalance of each component or sub-assembly,

b) errors in the balance of each component or sub-assembly resulting from eccentricity in the fixture used to mount the component or sub-assembly in the balance machine,

c) the unbalance of each component or sub-assembly 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 provided, in Annex B.

3.23
purchaser
agency that issues the order and the specification to the vendor

NOTE The purchaser can be the owner of the plant in which the equipment is being installed, the owner's appointed agent or, frequently, the manufacturer of the driven machine.

3.24
rated speed
highest rotational speed at which the coupling is required to be capable of transmitting the continuous torque rating while simultaneously subjected to the coupling rated axial displacement and the rated angular misalignment (or the rated parallel or lateral offset in the case of a single-engagement coupling)

3.25
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

3.26
service factor
factor applied to the steady-state torque in order to allow for off-design conditions, cyclic and other variations as well as equipment variations resulting in a torque higher than that at the equipment normal operating point

3.27
single-engagement coupling
coupling with only one plane of flexure

NOTE This type of coupling can accommodate angular misalignment and axial displacement. Single-engagement couplings of some types, notably gear and metallic flexible-element types, do not normally accommodate parallel (or lateral) offset. Certain types of single-engagement couplings can accommodate offset misalignment to a limited extent.

3.28
spacer
part of a coupling that is removable to give access for maintenance and/or removal of the coupling hubs

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

3.29
spacer gap length
distance between coupling hubs or sleeves in which the coupling spacer is installed

NOTE Spacer gap length is not necessarily equal to the distance between the shaft ends.

3.30
torsional stiffness
rate of change of the angular deflection with respect to the applied torque about the axis of rotation

NOTE With some types of couplings, the torsional stiffness is not constant but is a function of the magnitude of the torque and, with oscillating torques, also the frequency.

3.31
trip speed
rotational speed at which the independent emergency overspeed device operates to shut down a variable-speed prime mover or, for the purposes of this International Standard, in the case of alternating current electric motors, the speed corresponding to the synchronous speed of the motor at line frequency or, in the case of variable-frequency drives, at maximum supply frequency

3.32
unit responsibility
responsibility for co-ordinating the delivery and technical aspects of the equipment and all auxiliary systems included in the scope of the order

NOTE The technical aspects for consideration 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.

3.33
vendor
supplier
agency that supplies the equipment

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

4 Statutory requirements

The purchaser and the vendor shall mutually determine the measures taken to comply with any federal, state or local codes, regulations, ordinances or rules that are applicable to the equipment.

5 Coupling selection

5.1 General

5.1.1 The coupling type, size and rating supplied in accordance with this International Standard may be selected by one of the following methods.

— Method A: The coupling is selected by the purchaser from the manufacturer's catalogue.

— Method B: The coupling is selected by the purchaser from the manufacturer's catalogue and the selection is agreed and approved by the vendor based on data supplied by the purchaser.

— Method C: The coupling is recommended by the vendor based on data supplied by the purchaser.

5.1.2 In the case of method A, before accepting an order, the vendor shall advise the purchaser if, based on the information he has, he believes the coupling selected is not suitable for the application.

5.1.3 Unless otherwise agreed, couplings shall be designed, constructed and selected for a life of not less than 5 years' continuous operation transmitting the continuous torque rating, at the rated speed and subjected to the maximum continuous misalignment and axial displacement.

NOTE This requirement relates to the design of the coupling and does not imply a guaranteed life.

- If specified, the vendor shall provide evidence to demonstrate that this required life can be expected to be achieved. This may be by providing details for the purchaser's inspection of one of the following:

  — at least three similar couplings in similar applications that have achieved a satisfactory life of at least 5 years in continuous service;

  — extended laboratory tests on similar complete couplings or on the highly stressed components;

  — fatigue analysis of the flexible elements and other highly stressed components where these are of a form that is capable of precise stress analysis.

5.2 Compliance

5.2.1 To facilitate selection in methods A and B, the vendor's catalogue should clearly state that the couplings described fully comply with the requirements of this International Standard or should clearly identify the extent to which any particular type or model does not comply.

5.2.2 Where the necessary information is not included in the vendor's catalogue, and for selection method C, the vendor shall state that the offered/recommended coupling complies with the requirements of this International Standard or shall clearly identify the extent to which it does not comply.

6 Purchaser's specification

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

- **6.2** If the purchaser makes his own selection from the vendor's catalogue, he should specify the type, model and size of coupling required taking into account a suitable value for the service factor, K_s, and the required misalignment and axial deflection capability.

The value of the service factor, K_s, should be selected to allow for torque variations due to the type of driving and driven machines and possible future changes in the duty and should not generally be less than the values in Table 1.

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

Driven machine	K_s
Generator	1,2
Dynamic (centrifugal or axial) pump or compressor	1,25
Fan or rotary displacement pump or compressor	1,5
Reciprocating pump or compressor with four or more cylinders	1,75
Reciprocating pump or compressor with fewer than four cylinders	2,5

- **6.3** If the coupling vendor is required to recommend a coupling (selection method C) or approve the purchaser's selection (selection method B), the purchaser shall provide the following information:

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

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

  c) rated speed (3.24), the equipment's operating speed range and the trip speed (3.31);

  NOTE The rated speed is normally the maximum continuous speed.

  d) maximum torque, T_m, that it is required to transmit;

  NOTE The required continuous torque rating is not less than the maximum continuous torque that it is required to transmit under any operating condition. Where one single machine is driven from a driver, the maximum continuous torque is generally the maximum continuous torque of the driver. Where two or more machines are driven from one driver, either in tandem through a multi-shaft gearbox or from both ends of the driver, the maximum continuous torque for each coupling is generally based on the most adverse possible split of power consumption between the driven machines.

  e) value used for the service factor, K_s, as defined in 3.26;

  f) required misalignment capability, in terms of the angular misalignment and the parallel or lateral offset, and the axial displacement that the coupling is required to accommodate;

  g) expected magnitude, nature and number of occurrences of torsional transients that the coupling is required to tolerate in service, without damage;

  NOTE Torsional transients include start-up and shut-down effects, particularly those associated with synchronous motors and variable-frequency drive systems.

  h) 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.

- **6.4** The purchaser may specify the axial distance between the extreme ends of the shafts of the two machines being coupled, in the cold static condition. Alternatively, the purchaser may accept the vendor's standard or proposed coupling length.

- **6.5** If relevant, the purchaser should also specify the expected magnitude of momentary torques, resulting from fault conditions, which the coupling is required to survive but possibly with some damage. In particular, in the case of a generator drive, the purchaser should specify the short-circuit torque.

  NOTE It is accepted that, after such an event, the coupling will be need to be inspected and components replaced as necessary.

- **6.6** The purchaser may state if any properties of the coupling are considered important from consideration of the rotor dynamics of the driving or driven machines, or for any other reason, and may specify the range of acceptable values. Such properties may, for example, include

  — overhung mass,

  — torsional stiffness,

  — coupling axial reaction force (8.1.4),

  — coupling lateral stiffness, that is, the transverse load on the shafts resulting from unit parallel offset,