BS 3170:1972

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Specification for

Flexible couplings for power transmission

Co-operating organizations

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The scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard.

Association of British Correspondence Colleges
Council of British Manufacturers of Petroleum Equipment
Institute of Marine Engineers

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Amendments issued since publication

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Contents

Foreword

This standard makes reference to the following British Standards and Code of Practice.

BS 1649, *Guards for shaft couplings.*

BS 3692, *ISO metric precision hexagon bolts, screws and nuts.*

BS 3763, *The International System of units (SI).*

BS 4168, *Hexagon socket screws and wrench keys — metric series.*

BS 4183, *Machine screws and machine screw nuts — metric series.*

BS 4235, *Metric keys and keyways — Part 1: Parallel and taper keys.*

BS 4320, *Metal washers for general engineering purposes.*

BS 4464, *Spring washers for general engineering and automobile purposes (metric series).*

BS 4500, *ISO limits and fits.*

BS 4506, *Shaft ends.*

BS . . . ., *Shaft fitment bores*[1].

CP 3004, *Guarding of machinery.*

The first edition of this standard published in 1959 entitled "*Characteristics of flexible couplings for power transmission*" was prepared under the authority of the Mechanical Engineering Industry Standards Committee and related to mechanical devices for flexibly coupling a driving to a driven shaft other than those devices properly referred to as flexible shafts or universal joints.

The purpose of this standard, which is prepared under the same authority, is to bring together, under a more appropriate title, information of assistance to those engaged in choosing couplings.

It is not the intention to establish a dimensional standard for flexible shaft couplings.

The following related standard has also been published:

BS 3092, *Dimensions of main friction clutches, main power-take-off assemblies and associated attachments for i.c. engines.*

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Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 6 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

[1] In course of preparation.

1 Scope

This British Standard specifies some of the requirements for flexible couplings for power transmission and includes definitions; performance under operating conditions; dimensions of bores; references to necessary components, such as bolts, screws, keys and guarding. An appendix on alignment is included. This standard does not apply to flexible shafts or universal joints.

NOTE The titles of the British Standards referred to in this standard are listed on page ii.

2 Definitions

For the purposes of this British Standard, the following definitions apply.

2.1
rigid coupling

a device for connecting a driving to a driven shaft in such a manner that no displacement of the one relative to the other can occur, the two shafts behaving as one

2.2
flexible coupling

a flexible coupling, as distinct from a rigid coupling, possesses to a greater or lesser extent the ability to permit relative displacement of the driving and driven shafts in one or a combination of the forms illustrated in Figure 1

(information on particular types of flexible couplings can be obtained from individual manufacturers)

2.3 Misalignment

The condition in which the axes of the driving and driven shafts are not truly in line. Misalignment may be:

2.3.1
angular

angular misalignment is present when the shaft axes are inclined one to the other. Its magnitude is stated as the inclination of the shaft axes, measured at the coupling faces, in radians, in degrees, or in length units per unit length [Figure 1a(i) and Figure 1a(ii)]

2.3.2
parallel

parallel misalignment is present when the axes of the driving and driven shafts are parallel but are laterally displaced. Its magnitude is stated in length units (Figure 1b)

NOTE In practice misalignment of both angular and parallel forms can occur together.

2.4 End float

The ability to accommodate relative axial displacement (*f*) of the connected shafts (Figure 1c). It may result from the deformation of resilient materials, from the sliding of co-operating surfaces, or from a combination of the two. In coupling dimensional drawings the end float is often the sum of two separate dimensions. The end float is stated in length units.

2.4.1
limited end float

for some special applications in which the shaft of one machine, either driving or driven, is to be effectively axially located by the shaft system of the other machine a limitation of the coupling end float is necessary. This limitation may be inherent in the design or by mechanical stops. Such a coupling is described as a limited end float coupling

2.5 Torsional flexibility

The ability of a coupling to twist elastically under torque. It is stated as the angular displacement (radians or degrees) produced by unit torque: it is usually small and is frequently expressed as micro-radians, or micro-degrees, per unit of torque (Figure 1d).

2.5.1
torsional stiffness

the resistance to twisting of a coupling under torque. It is the reciprocal of the torsional flexibility and is expressed as torque per unit angular displacement (radians or degrees)

2.5.2
torsional resilience

the ability of a coupling to absorb and restore energy expressed in energy units, i.e. joules

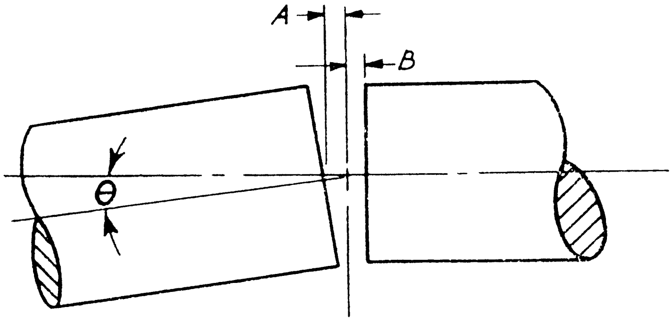
2.5.3
torsional backlash

free angular displacement. It is stated in radians or degrees

NOTE 1 Alternative expressions for **2.5.1** are "torsional rigidity" and "torsional spring rate".

NOTE 2 Depending on the type of coupling, **2.5** and **2.5.1** may be constant or may vary with increasing displacement.

NOTE 3 A torsionally flexible coupling may be used to modify the torsional vibration characteristics of a shaft system and also to absorb energy due to torsional shock.



(i) Symmetrical (*A* = *B*)
(ii) Non-symmetrical (*A*/*B*)

Figure 1a — Angular misalignment

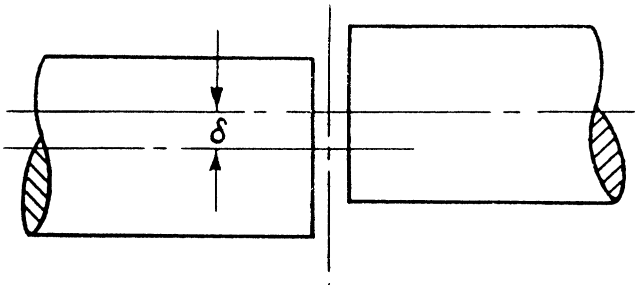


Figure 1b — Parallel misalignment

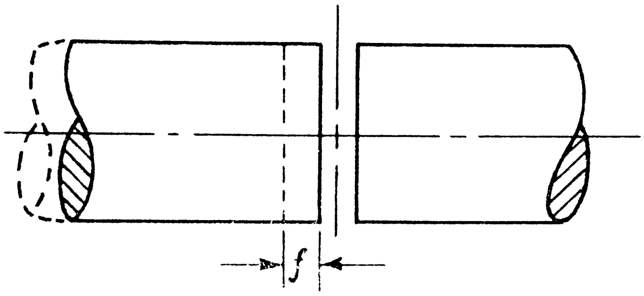


Figure 1c — End float

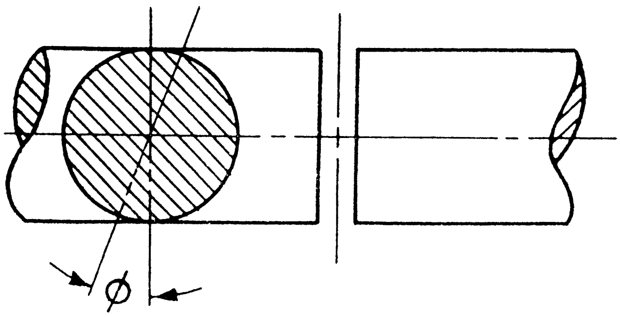


Figure 1d — Torsional flexibility

Figure 1 — Displacement forces

2.6
radial load carrying ability

radial load carrying ability is the property required of a coupling that is to support one end of a shaft which is at its other end supported by a similar coupling or a bearing. The coupling then sustains a proportion of the shaft weight

3 Performance under operating conditions

Displacements (angular, parallel, axial or torsional) in a flexible coupling are associated with forces external to the coupling.

Bending stresses in shafts and radial loads on bearings result from angular and parallel displacements of the coupling halves. The significance of these effects produced in the coupled machines is dependent on the magnitude of the displacement, the transmitted torque, the speed, and the design of the coupling employed.

Axial loads on bearings result from axial displacement of the coupling halves and may be transient (e.g. during the sliding of interacting surfaces) or permanent (e.g. when there is elastic deformation).

The torsional displacement between the coupled shafts results from the transmitted torque and has a magnitude dependent on the torque and the coupling design, e.g. relatively large when rubber or some similar substance is employed as the elastic medium, relatively small when steel is so employed.

3.1 Displacement forces. The following may require consideration at the design stage and may be used as an indication of the limits of performance of a particular coupling.

1) *Angular.* The force resisting angular misalignment shall be stated as the bending moment about the effective centre of resistance of the coupling or about the point of intersection of the shaft axes and shall be quoted in force-length units, i.e. newton metres.

2) *Parallel.* The force resisting parallel misalignment is a radial force acting in line with the displacement and shall be quoted in force units, i.e. newtons.

3) *End float (axial).* The force resisting end float is a force acting in the direction of axial displacement and shall be quoted in force units, i.e. newtons.

4) *Torsional.* The force resisting torsional displacement is a twisting moment about the shaft axis and shall be quoted in force-length units, i.e. newton metres.

The displacement forces may or may not be related directly to the magnitude of the displacement and when required to be specified they shall be associated with specific values of displacement, torque and speed. Within a specified and usually narrow range of operating conditions these displacement forces may often be quoted as a force per unit displacement.

4 Specification of operating conditions

It is recommended that the following particulars should be given to the coupling manufacturer or supplier for all applications. SI units should be utilized where applicable (see BS 3763).

4.1 Description of machines

1) Driving.

2) Driven.

3) Any associated transmission equipment.

4.2 Nature of duty

1) Continuous.

2) Intermittent (duty cycle).

3) Shock conditions.

4) Fluctuating or reversing conditions.

4.3 Power to be transmitted

1) Normal.

2) Maximum.

4.4 Speed of the shafts to be connected

1) At which normal power is transmitted.

2) At which maximum power is transmitted.

3) Maximum speed.

4.5 Dimensions of the shafts to be connected

1) Actual diameters or nominal diameters with limits.

2) Length of shaft ends.

3) Keyway details (type, number dimensions, etc.).

Alternatively, the finished bore diameters and keyways required in the coupling halves may be specified. The bores of the coupling halves may, as supplied, be required to be rough machined or finish machined.

The above information will suffice for the majority of applications where the shafts are nominally horizontal and in good alignment (see Appendix A). Where specific displacements must be accommodated these shall be stated using the definitions in **2** and the magnitudes shall be given.

NOTE It is customary for coupling manufacturers to give, in their technical literature, service factors applicable to their own products. The particulars quoted above are to be taken into consideration in the selection of a factor.

4.6 Additional information. It is recommended that the following additional information should be supplied when applicable:

1) Position of shafts to be connected (vertical, inclined, etc.).

2) Details of limitations in the space available for assembling and dismantling the coupling.

3) Details, including ratio, of any gearing on either of the shafts to be connected.

4) Inertia of rotating parts of the shaft system, such as flywheels.

5) If subject to braking forces, the time to come to rest.

6) Details of peak torques (driving, braking or shock).

7) Range of temperature conditions, atmospheric conditions, any other special conditions.

8) Position, number and size of any holes required for draw-off bolts or jacking-screws.

9) Dimensions of any recess in the face of a half coupling required for a retaining screw, nut or ring.

10) Position and size of any set screw required in the boss over the keyway(s).

11) Any other requirements.

5 Balancing of couplings

The inherent standard of balance of most types of flexible coupling is generally acceptable. When special attention to the balance of the combined equipment is required full particulars of the application should be given to the manufacturer or supplier of the coupling and there should be mutual agreement about the action to be taken.

6 Alignment of driving and driven shafts

Notes on the alignment of driving and driven shafts are given in Appendix A. Permissible errors in initial alignment shall be agreed between the purchaser and the coupling manufacturer.

7 Dimensions of bores, limits and fits

7.1 Bores

1) *Nominal diameters.* The nominal dimensions of cylindrical and conical bores shall correspond to those of the shaft ends in BS 4506.

2) *Tolerances.* Since the shaft to which a flexible coupling fits is generally part of the more complex component of the mating pair the fit is normally on a shaft basis. Where the coupling is supplied ready bored it is recommended that the limits shall be taken from BS 4500, with guidance from BS . . . .[2], "*Shaft fitment bores*".

7.2 Keyways. Keyways shall conform to the requirements of BS 4235-1. Where a parallel key is used, means may be provided to prevent axial movement of the coupling on the shaft by means of special spacing collars used in conjunction with retaining washers and set screws or nuts. BS 4506 specifies the sizes of the external or internal threading for this purpose.

8 Components

Bolts, nuts, washers, screws, keys, shall, where applicable, comply with the requirements of BS 3692, BS 4168, BS 4183, BS 4235, BS 4320 or BS 4464.

9 Marking for assembly

Where applicable the driving and driven portions of the couplings shall be clearly marked so as to ensure that they are assembled in the correct position relative to each other.

10 Guarding

Since couplings are part of rotating machinery they must be adequately guarded unless encased or safe by position at all times when the associated shafting is in motion. Attention is drawn to BS 1649 and CP 3004. Guarding for couplings and associated shafting is not normally provided by the coupling manufacturer.

[2] In course of preparation.

Appendix A Notes on methods of checking angular and parallel alignment of couplings

Although flexible couplings, as their name implies, are capable of accommodating some or all of the forms of relative displacements of the driving and driven shafts defined in **2**, many designs are not intended to deal with specific displacements greater than those displacements incidental to the operation of the equipment; even those that are designed to deal with some greater degree of displacement will benefit from good initial alignment. The following notes describe a recommended method of arriving at the agreed initial alignment of driving and driven shafts.

The following notes and associated figures describe briefly a method of checking angular and parallel alignment of couplings, see Figure 2, which is independent of the truth of the coupling or shaft and is not, therefore, affected by out-of-squareness (cant) of the coupling faces or eccentricity of the outside diameter of the coupling with its shaft axis. It is, however, necessary that the shaft axes should each be maintained in its true position throughout one revolution. To ensure this, the shaft journal must be truly circular, and care should be taken to ensure that no fouling affects the position of the shaft in the bearing.

Figure 2a and Figure 2b show the checking method using dial gauges. Although the use of dial gauges will give the necessary degree of accuracy[3)], it is possible to use other means of measuring the error, provided that this procedure is maintained. It should be clearly understood that the coupling halves must rotate together between successive readings. This can sometimes be arranged by linking the coupling halves together by a coupling pin or spring. If, however, the coupling pins or springs are so tight as to restrict free movement between the coupling halves or if this arrangement cannot be used then the coupling halves should be marked and the readings taken only when the marks are in line.

Figure 2a (Angular alignment). The procedure is to fix one gauge at the top and one at the bottom of the coupling with both pointers at zero. Turn the coupling bodily through 180° and recheck. If both gauges still give the same reading, but not necessarily zero, then the angular alignment so far is correct. Any constant difference in readings is produced by axial movement of one or both shafts. Repeat the procedure after advancing the position of the coupling by 90°.

Figure 2b (Parallel alignment). With the coupling still secured as for Figure 2a check for parallel alignment by using one gauge, as shown in Figure 2b. The initial reading is compared with the readings at each quarter revolution. Any variation in the readings indicates parallel misalignment and adjustments are required to height and lateral position until the readings are uniform. (The difference in gauge readings is twice the actual displacement.)

[3)] Care has to be taken that the gauges are rigidly supported.

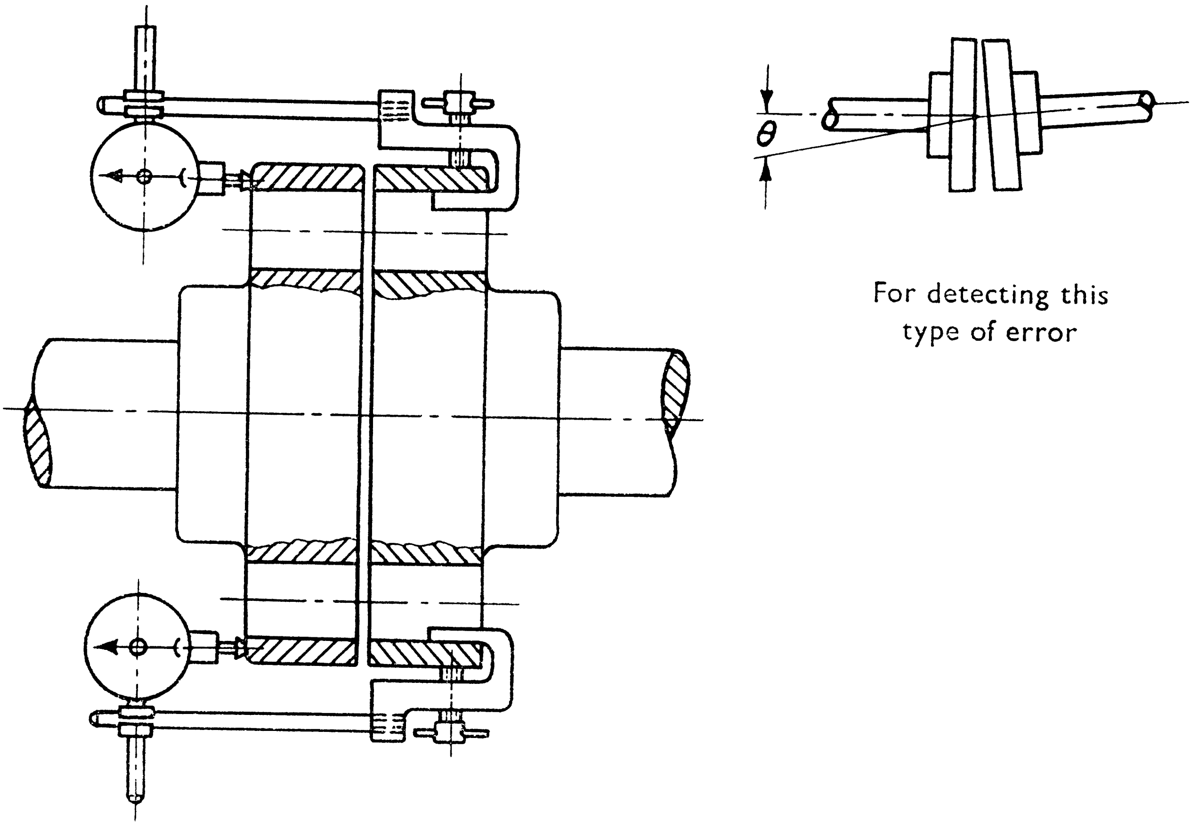


Figure 2a — To check angular alignment

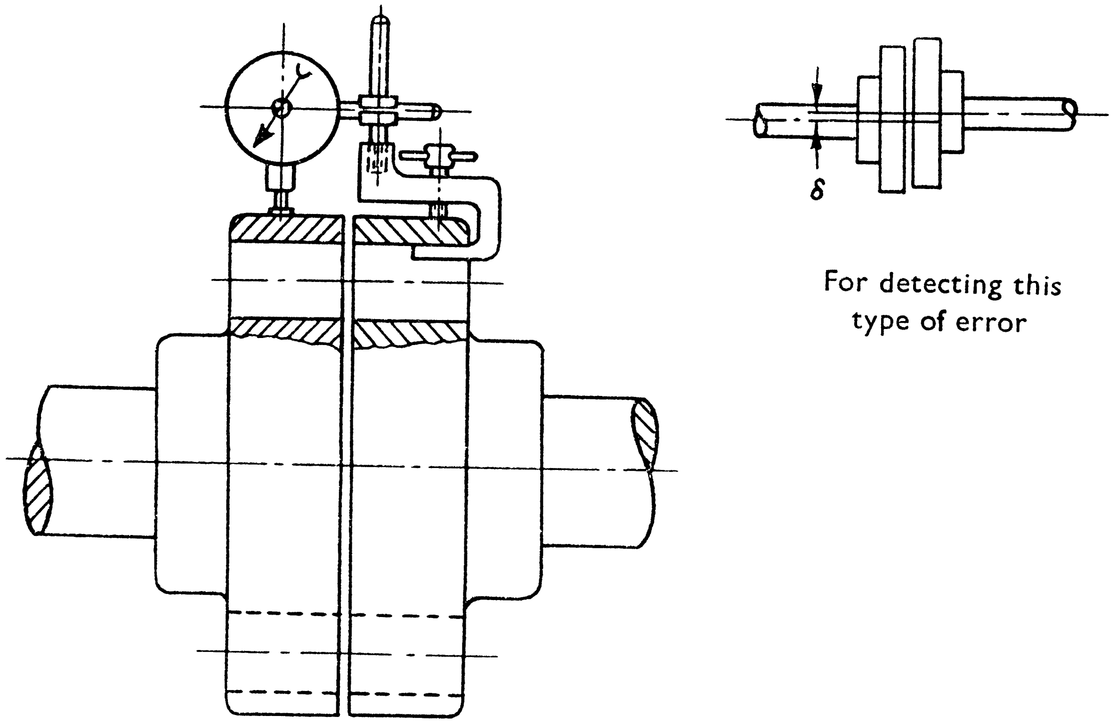


Figure 2b — To check parallel alignment

These illustrations are intended to be schematic only and do not relate to any particular design or make of coupling.

Figure 2 — Method of checking angular and parallel misalignment

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