BRITISH STANDARD

BS 3876-5: 1990

Rope rollers, pulleys, mountings and assemblies for colliery track haulage —

Part 5: Specification for suspended pulley assemblies and clamps

Confirmed January 2011

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Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Mining and Quarrying Requisites Standards Policy Committee (MQE/-) to Technical Committee MQE/18, upon which the following bodies were represented:

Association of British Mining Equipment Companies
British Foundry Association
British Steel Industry
Federation of Wire Rope Manufacturers of Great Britain
Health and Safety Executive
Institution of Mining Electrical and Mining Mechanical Engineers

This British Standard, having been prepared under the direction of the Mining and Quarrying Requisites Standards Policy Committee, was published under the authority of the Board of BSI and comes into effect on 30 June 1990

The following BSI references relate to the work on this standard:
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Contents

Foreword

This Part of BS 3876 has been prepared under the direction of the Mining and Quarrying Requisites Standards Policy Committee.

The other Parts in the revised edition of BS 3876, are as follows:

— *Part 1: Specification for parallel barrel rollers, mountings and assemblies;*

— *Part 2: Specification for vertical spindle pulleys, mountings and assemblies;*

— *Part 3:* (Withdrawn);

— *Part 4:* (Withdrawn).

In the revised Parts, the following points should be noted:

a) tapered rollers, which were covered in BS 3876-2:1965, are now omitted from the revised Part 2;

b) vertical rollers, which were included in the 1965 edition of Part 2, are now omitted as it is considered that the parallel barrel rollers specified in Part 1 can be used in the vertical mode;

c) horizontal spindle pulleys, covered in the 1965 edition of Part 2, are relocated in Part 5 of the revised edition;

d) Part 3:1965 has been withdrawn because there is no longer any requirement for rollers with non-metallic rope bearing surfaces;

e) the requirements for mountings for parallel barrel rollers, previously specified in BS 3876-4:1966, have been revised and incorporated into the expanded edition of Part 1; there is therefore no need for retention or revision of a separate Part 4.

During the preparation all dimensions have been metricated and these are not necessarily straight conversions from the imperial dimensions previously adopted.

Product certification. Users of this British Standard are advised to consider the desirability of third party certification of product conformity with this British Standard based on testing and continuing surveillance, which may be coupled with assessment of a supplier's quality systems against the appropriate Part of BS 5750.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 10, an inside back cover 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 Scope

This Part of BS 3876 specifies requirements for suspended pulley assemblies and clamps intended for use in colliery track haulage.

This Part applies to:

a) suspended pulleys, supplied and used with or without mountings, that are intended for the support of haulage ropes and which may be used in rope haulage ancilliary equipment, e.g. weight ropes on safety equipment, haulage rope tensioning equipment, etc.;

b) mountings;

c) suspended pulley assemblies that comprise the pulleys and mountings;

d) clamps for suspending assemblies from supporting members.

The suspended pulleys to which this Part applies are not intended to be used where rope deflections in excess of 10° across a single pulley are required. Where rope deflections in excess of 10° per pulley are required, pulleys in accordance with BS 4878 should be used.

NOTE 1 Appendix A gives the information which should be supplied by the purchaser, in his enquiry and/or order for pulleys, mountings and assemblies in accordance with this Part of BS 3876.

NOTE 2 Appendix B gives the information that will be required by the purchaser, to be provided by the supplier, prior to the supply of pulleys, mountings and assemblies in accordance with this Part of BS 3876.

NOTE 3 Appendix D gives general recommendations for the design and operating criteria for suspended pulleys.

NOTE 4 No inspection requirements are specified in this Part of BS 3876. However, a typical requirement that a purchaser may choose to write into his order or contract for pulleys, mountings and assemblies to this Part is given in Appendix E.

NOTE 5 The titles of the publications referred to in this Part of BS 3876 are listed on the inside back cover.

2 Definitions

For the purposes of this Part of BS 3876 the following definitions apply.

2.1
barrel

that part of the pulley on which the rope runs

2.2
pulley

a drum having a curved or U-shaped barrel, complete with spindle and bearings

2.3
mounting

the frame to which the pulley is, or is to be, attached

2.4
pulley assembly

the pulley and its mounting

2.5
clamp

means for securing the pulley assembly to a supporting member

NOTE The supporting member will typically be manufactured from a rolled steel joist to BS 4-1, having a flange width varying between 75 mm and 127 mm, as indicated in Figure 1.

3 General

The pulley components, mountings and clamps shall comply with the requirements specified in clauses **4** to **9** as appropriate.

The design of pulley shall be such that it is a fixture in the mounting, with the bearings being contained within the pulley.

4 Design considerations

The mounting shall not be supported by the clamping fastener [see Figure 1 b)].

The use of hooks, or "J" bolts for the clamping fasteners shall not be permitted.

The pulley assembly shall move freely within the minimum angular limits shown in Figure 1 when subjected to the safe working load of the pulley assembly [see clause **9** c)].

All screw threads shall be in accordance with BS 3643-1.

5 Dimensions and shape of pulley components and mountings

5.1 Dimensions

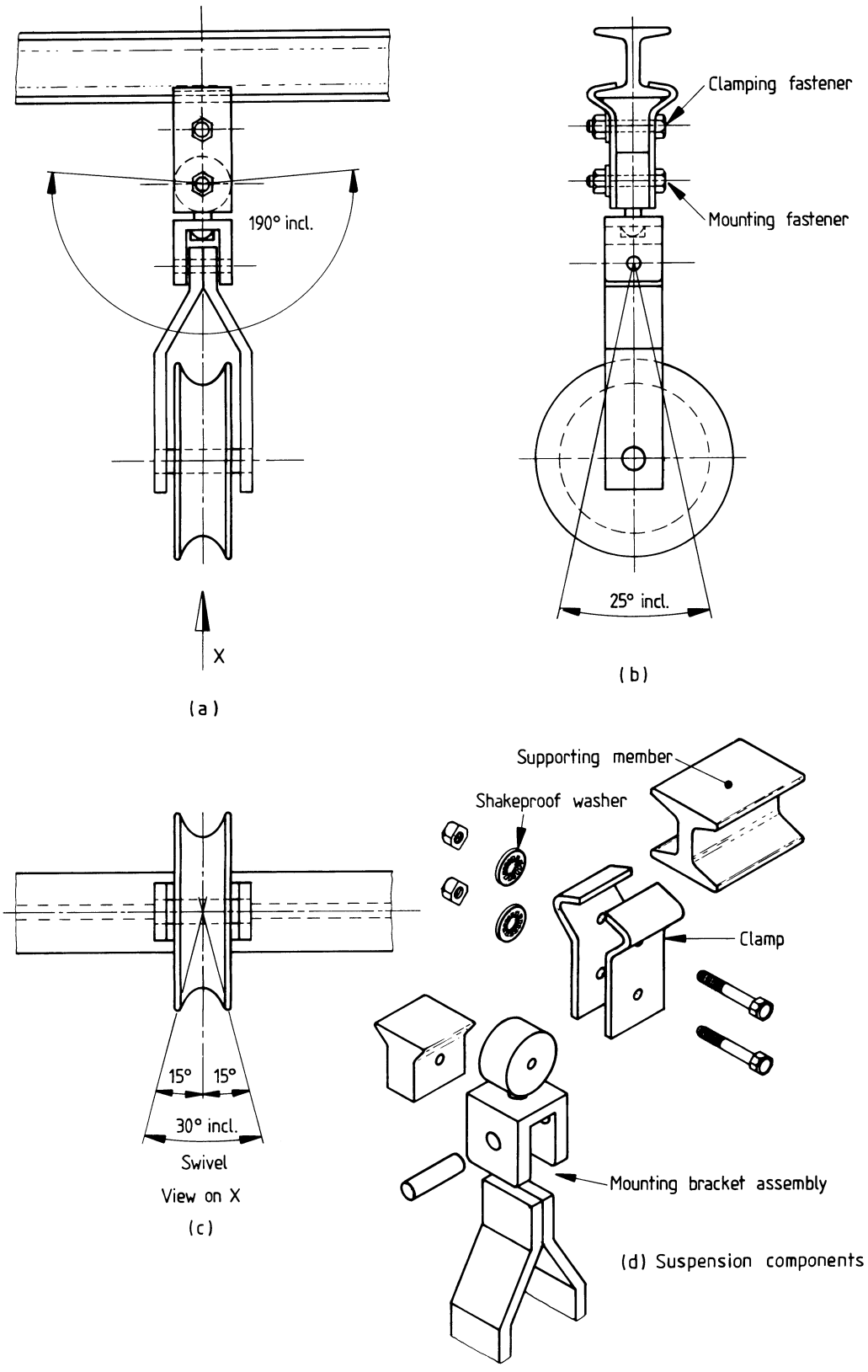
The dimensions of the pulleys shall be as given in Table 1.

NOTE 1 For convenience, a typical pulley is illustrated in Figure 2 which identifies the dimensions referred to in Table 1.

The profile of the pulley barrel shall be curved or U-shaped having a minimum depth d (see Figure 2) of 1.25 times the nominal diameter of the largest rope for which the pulley is designed to operate and have a radius at the barrel at least 1 mm greater than the nominal radius of that rope.

NOTE 2 Spindle ends may be plain, shouldered and threaded or otherwise machined to provide a suitable method of fixing the spindle in the pulley mounting.

Mountings shall be designed to accept pulleys which have been designed to the dimensions given in Table 1.



NOTE This figure does not purport to show design details.

Figure 1 — Permitted minimum angular movement of suspended pulley assemblies
(see clause 4)

Table 1 — Dimensions of horizontal spindle pulleys (see also Figure 2)

Pulley reference	Barrel tread diameter, *A* (± 10 mm)	Barrel width, *B* (max.)	Spindle length, *D* (max.)	Barrel outside diameter, *E* (max.)	Spindle[a] diameter, *C*	Boss diameter, G_1 (max.)	Boss diameter, G_2 (min.)
	mm	mm	mm	mm	mm	mm	mm
SP1	100	100	200	225	20	75	60
SP2	150	125	250	275	20	75	60
SP3	200	150	250	325	25	90	80
SP4	250	175	275	375	25	90	80
SP5	300	200	300	425	25	90	80

[a] For tolerances, see **7.3**.

5.2 Eccentricity of the pulley barrel

When a pulley supported on V blocks (see Figure 3) is rotated one revolution the radial run-out shall not exceed 2 mm for pulleys of nominal barrel diameter up to and including 150 mm and 2.5 mm for pulleys greater than 150 mm barrel diameter; the measurement being normal to the surface at any point between the limits Y-Y.

6 Materials

6.1 General

Subject to the requirements of **6.2** the materials used in the construction of the pulley assemblies and clamps shall be in accordance with **6.3** and **6.4** respectively.

6.2 Light metals

In the construction of the pulleys, assemblies and clamps no metal shall be used that contains more than:

a) 15 % (*m*/*m*) in total of aluminium, magnesium and titanium; and

b) 6 % (*m*/*m*) in total of magnesium and titanium.

Paint and coatings containing any of the metals aluminium, magnesium and titanium shall not be used.

6.3 Materials for pulleys

6.3.1 *Pulley barrels*

Pulley barrels shall be made from one of the following materials.

a) Spheroidal graphite iron having a minimum hardness of 200 HB throughout any section.

b) Carbon steel in accordance with BS 3100, steel A3.

c) Low alloy (1 % chromium) steel in accordance with BS 3100, steel BW4.

6.3.2 *Spindles*

Spindles shall be made from wrought steel in accordance with BS 970 grade 070 M20, with a minimum tensile strength of 430 N/mm^2.

6.3.3 *Bearings*

Bearings shall be double sealed, grease filled, single row radial ball beatings in accordance with BS 292-1.

NOTE 1 The use of seize-resistant bearings having polyamide cages is preferred.

The types of bearings to be used for each application shall be as given in Table 2.

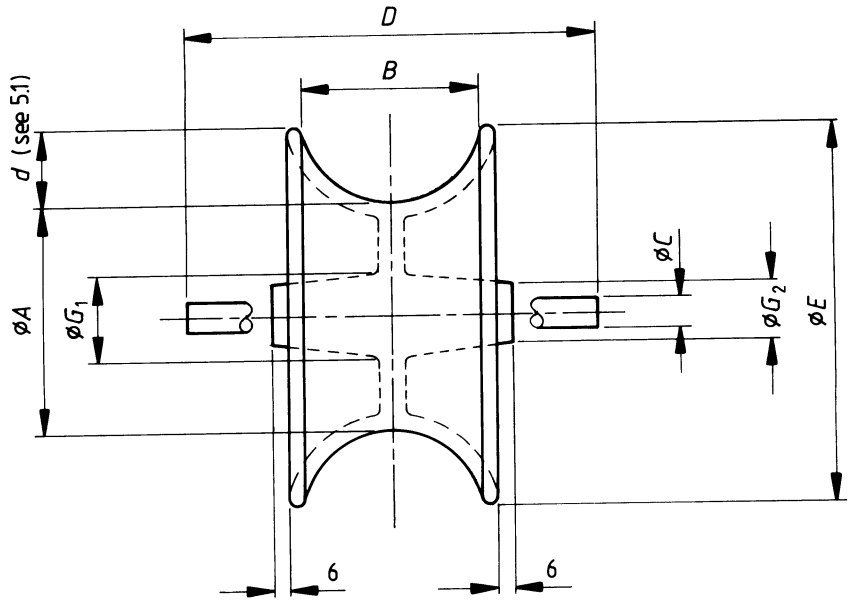
The bearings shall be sealed on both sides with an elastomeric material suitably reinforced.

NOTE 2 Plain metal covers are not sufficient.

The polyamide cages, where fitted, and the elastomeric sealing material shall meet the fire resistance requirements of BS 3790 and the antistatic requirements of BS 2050.

Table 2 — Bearing characteristics and designations

Pulley reference	Pulley speed	Bearing designation
	r/min	
SP1	up to 800	6204-2RS
SP2	over 800	6304-2RS
SP3	up to 800	6205-2RS
SP4		
SP5	over 800	6305-2RS



NOTE This figure does not purport to show design details.
All dimensions are in millimetres.

Figure 2 — Typical horizontal spindle pulley

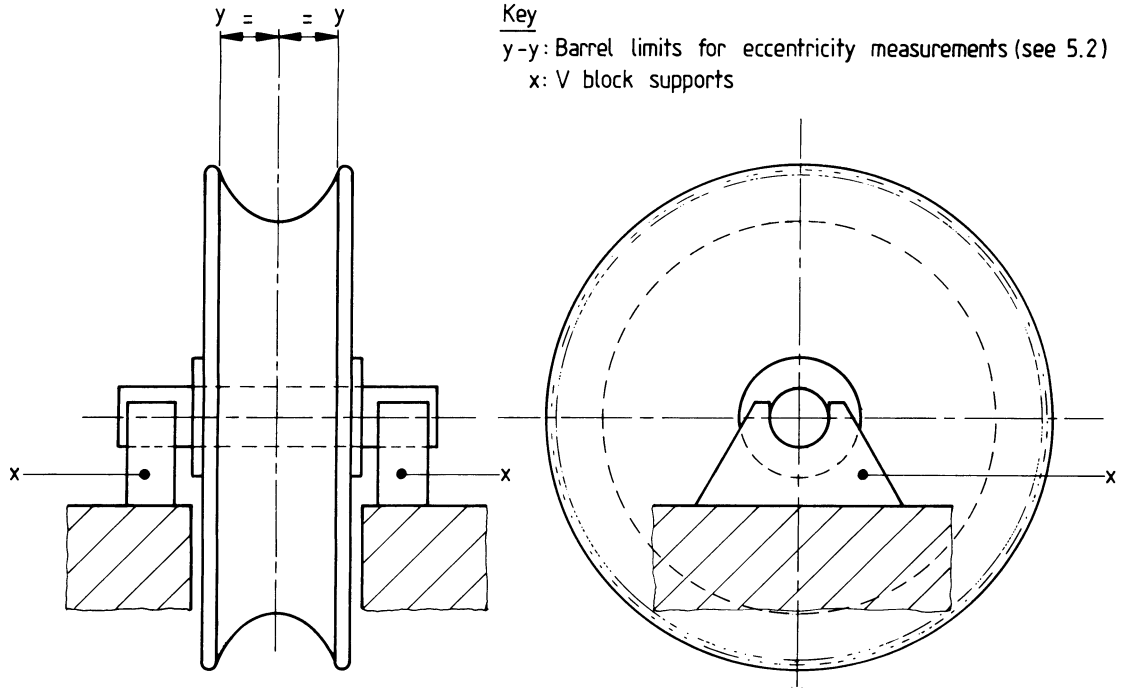


Figure 3 — Testing of a pulley for run-out

6.4 Materials for mountings and clamps

Mountings and clamps shall be fabricated from steel in accordance with either of the following:

a) carbon steel in accordance with BS 970, grade 070 M20; or

b) weldable structural steel in accordance with BS 4360, grade 43A.

7 Manufacture

7.1 General

The pulley assemblies and clamps shall comply with **7.2** and **7.3**.

NOTE It is important that:

a) all pulley assemblies and clamps should be free from harmful defects;

b) the barrels of pulleys should be smooth and free from all projections cross-jointing and defects that may be injurious to ropes;

c) all machined parts should be free from sharp corners, edges and undercuts, tool marks and scoring that are likely to cause excessive concentrations of stress;

d) all welds should be free from the imperfections described in section 6 of BS 499-1:1983 and all defects (e.g. rough edges, weld spatter) likely to be injurious to persons or equipment, or to interfere with mating parts, should be removed.

The attention of the supplier is drawn to the fact that the purchaser may reject pulleys, assemblies and clamps as being unsatisfactory on any of these grounds, notwithstanding that the requirements of this Part of BS 3876 are complied with, subject to discussion in accordance with normal commercial practice.

7.2 Welding

Welding techniques shall be in accordance with BS 5135.

NOTE 1 Details of each welded joint should be agreed between the supplier and the purchaser and shown in detailed drawings, copies of which are held by both the supplier and the purchaser [see Appendix B e)].

NOTE 2 Minor defects in castings, that will not affect the mechanical strength or performance of the pulley barrel, may be rectified by welding when the manufacturer is able by so doing to provide a satisfactory casting.

When repairs to cast steel are to be undertaken, then they shall be in accordance with BS 4570.

7.3 Machining tolerances

The machining tolerances for the outer diameter of the bearing shall be M7 and the machining tolerances on the spindle diameter shall be g6, as specified in BS 4500-1.

8 Type testing

Each type of pulley assembly, together with its corresponding clamps, shall be type tested in accordance with Appendix C.

9 Marking

Each pulley, mounting and clamp shall be marked with an etched, stamped or cast identity, giving the following information which shall be readily visible during normal operation:

a) the manufacturer's name, identification mark or trade mark;

b) the number of this Part of this British Standard, i.e. BS 3876-5[1)];

c) the safe working load (SWL) (see **C.2**);

d) in the case of mountings and clamps, the reference number of the pulley for which it is intended for use (see Table 1);

e) also in the case of clamps, the nominal flange width(s) in millimetres to which it can be fitted unless the design of such arrangements is such as to be capable of being fitted to all flange widths in the nominal size range 75 mm to 127 mm.

For the purpose of item c), SWLs of less than 1 000 kg shall be marked in kilograms to the nearest whole kilogram. SWLs of 1 000 kg or more shall be marked in tonnes (which may be abbreviated to "t"). Only one place of decimals shall be used; for integral values of SWL the "0" after the decimal point shall be omitted (e.g. 5 t not 5.0 t).

[1)] Marking BS 3876-5 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is therefore solely the responsibility of the person making the claim. Such a declaration is not to be confused with third party certification of conformity, which may also be desirable.

Appendix A Information to be supplied by the purchaser

The purchaser should supply the following items of information at the time of enquiry and/or order:

a) the number, Part and date of this British Standard, i.e. BS 3876-5:1990;

b) the type reference of the pulley required and SWL;

c) the material of the pulley barrel (see **6.3.1**);

d) whether castings are to be inspected and tested during manufacture (see Appendix E);

e) whether mountings and/or clamps are to be supplied;

f) where clamps are to be supplied, the flange width of the supporting member;

g) the type of mounting and clamp to be supplied, if required;

h) details of any tests which are required to be carried out on the pulley assembly (see Appendix C and Appendix E).

Appendix B Information to be provided by the supplier

Prior to supply, the supplier is to provide a detailed drawing, or drawings, including the following particulars.

a) *Pulley barrels*. Material specification and full dimensional details.

b) *Spindles*. Material specification and full dimensional details.

c) *Bearings*. Manufacturer and identification reference.

d) *Mountings and clamps*. Material specifications and full dimensional details.

e) *Welding*. Details of any welding, e.g. preparation, weld dimensions, the welding material and operation used.

f) Width (in mm) of flange to which the mounting can be fitted and perform as tested.

g) Maximum size of rope which can be used on the pulley.

h) Actual breaking force of pulley assembly (in kN).

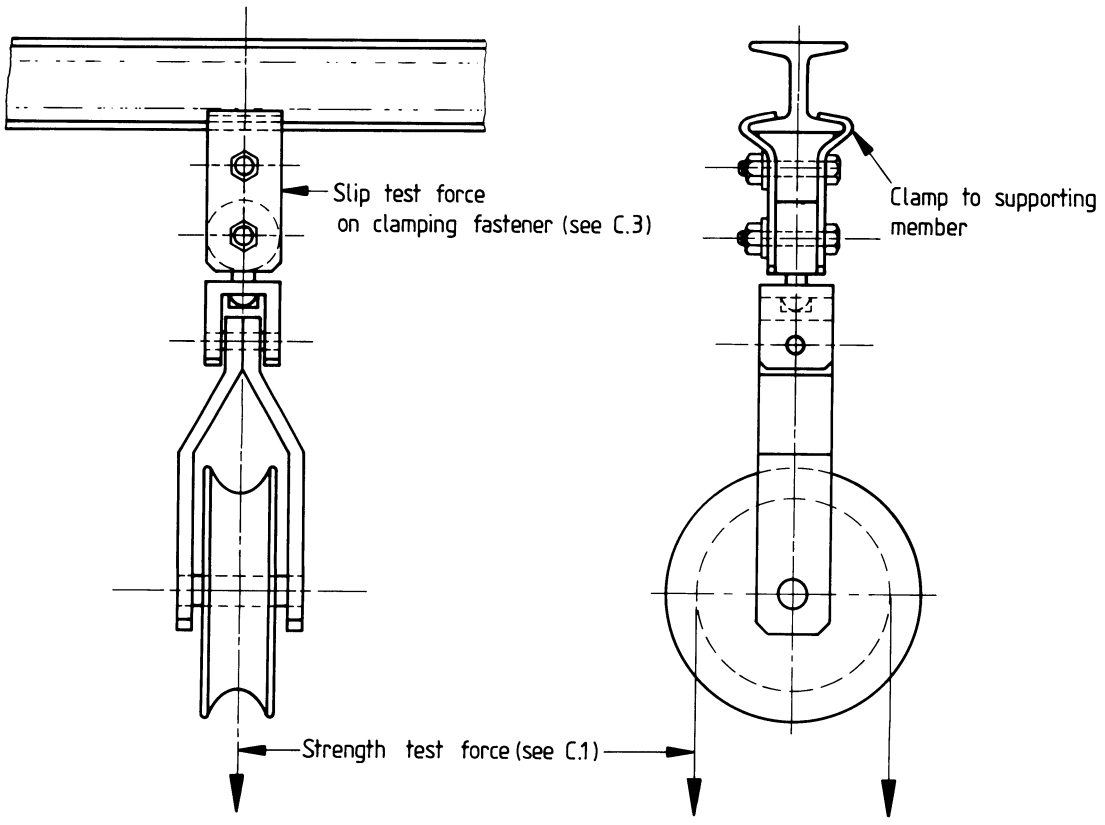


Figure 4 — Test forces for suspended pulley assemblies and clamps

i) Force required to cause pulley assembly and clamp to slip when tested in accordance with **C.3**.

j) The safe working load (see clause **9**).

k) The tightening torque for the clamping arrangements in (N · m).

Appendix C Methods of testing suspended pulley assemblies and clamps

C.1 Test for strength of the pulley assembly and clamp

Fix the pulley assembly and clamp to a supporting member which is of the correct specified section and which is relatively free from rust and scale. Tighten the clamp to the torque specified by the manufacturer. Apply an increasing force at a rate not exceeding 10 kN/min in the manner shown in Figure 4 until the assembly becomes detached from the supporting member or a component fails. Record the force applied when failure occurs. One-fifth of this value shall be taken as the SWL in order to meet the marking requirements of clause **9** c).

C.2 Test for freedom of movement of the pulley assembly

Secure the pulley assembly to a supporting member and, with a load equivalent to the SWL suspended from the pulley, check that it moves freely through the minimum angular limits specified in clause **4** and shown in Figure 1.

C.3 Slip test for the clamp

Fix the clamp to be tested together with its associated pulley assembly to a supporting member which is of the correct specified section and which is relatively free from rust and scale. Tighten the clamp to the torque specified by the manufacturer. Apply an increasing force to the clamp parallel to the supporting member, and through the clamping fastener at a rate not exceeding 10 kN/min until the clamp slips. Record the force applied to cause the clamp to slip. If the clamp does not slip but otherwise fails then record the applied load and the method of failure.

Appendix D General recommendations for the design and operating criteria of pulley assemblies

The design of suspended pulleys depends basically on the rope speed and the applied loading.

Several characteristics of the pulley itself affect the choice when considering a particular duty, as follows.

a) Eccentricity and ovality of pulley, since eccentricity results in a hammer blow being imparted to both rope and bearing.

b) Hardness and wear resistance.

c) Type of bearing.

d) Ease of and need for maintenance.

e) Pulley revolutions per minute.

f) Loading on the pulley.

The haulage system should be designed such that at the nominal speed of the haulage rope the pulley revolutions do not exceed 500 r/min. This should ensure that a pulley speed of 800 r/min is not exceeded due to rope surges which are usually experienced during system start up and acceleration.

Where, due to installation limitations, the recommended pulley speed of 500 r/min has to be exceeded on a continuous basis then consideration should be given to the use of the heavier duty bearing as specified in Table 2.

No system should be designed based on pulley speeds continously in excess of 800 r/min unless the appropriate bearings given in Table 2 are utilized. Figure 6 may be used to estimate quickly the r/min of pulleys where the rope speed and diameter are known. This, in conjunction with information in Appendix B, will aid in the selection of the correct pulley.

Higher stresses are introduced into the pulley assembly when the assembly is not positioned correctly in relation to the rope plane. This may be due to the original positioning of the pulley assembly and/or subsequent displacement, e.g. distortion of the supporting member. In these circumstances it is necessary to be aware of the higher stresses and to take appropriate action, e.g. re-position pulley assemblies, provide additional pulley assemblies, reduce maximum rope tension. Good alignment at installation and its maintenance together with proper matching of groove profile to the rope will give low loads on pulleys and ropes resulting in safe working and long life of both items.

The included angle of wrap between rope and pulley should not exceed 10° otherwise rope and pulley damage are likely to occur quickly and large resultant loads can be imposed on the pulley assembly and the supporting member to which the pulley assembly is attached. In normal haulage operations the combination of small angle of wrap and low tension in the rope means that the resultant force is low. However, if angles of wrap are high or rope tension increased, for example during holdfast situations, then the resultant force can be large. Figure 5 may be used to estimate quickly the resultant force from the rope tension and the included angle.

It is important to ensure that the supporting member to which the pulley assembly is attached is strong enough and firmly secured for example by packing, struts or masonry, such that if large resultant loads are applied the support will not be dislodged. If the pulley assembly is attached directly or indirectly to a strata support, account should be taken of the load applied by the strata and if stilts or similar yield devices are fitted to the support, note has to be taken of the values of yield.

The flanges of steel sections used in roadway supports, whilst having the same nominal width, may have different nominal thicknesses and angles of taper. If the assemblies are to be attached to other than rolled sections in accordance with BS 4-1, the suitability of fit should be examined.

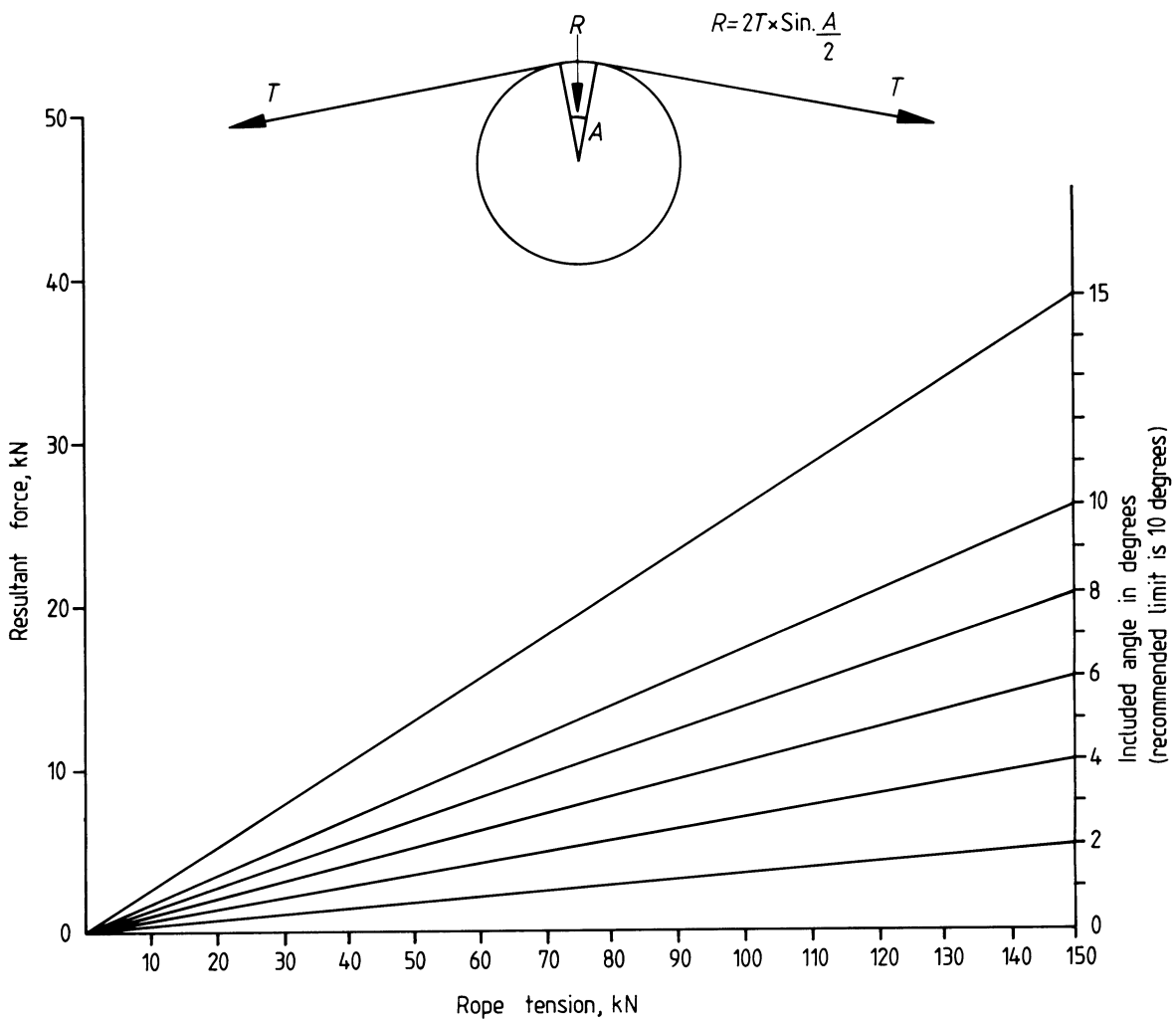


Figure 5 — Relationship between rope tension and resultant force on the pulley wheel

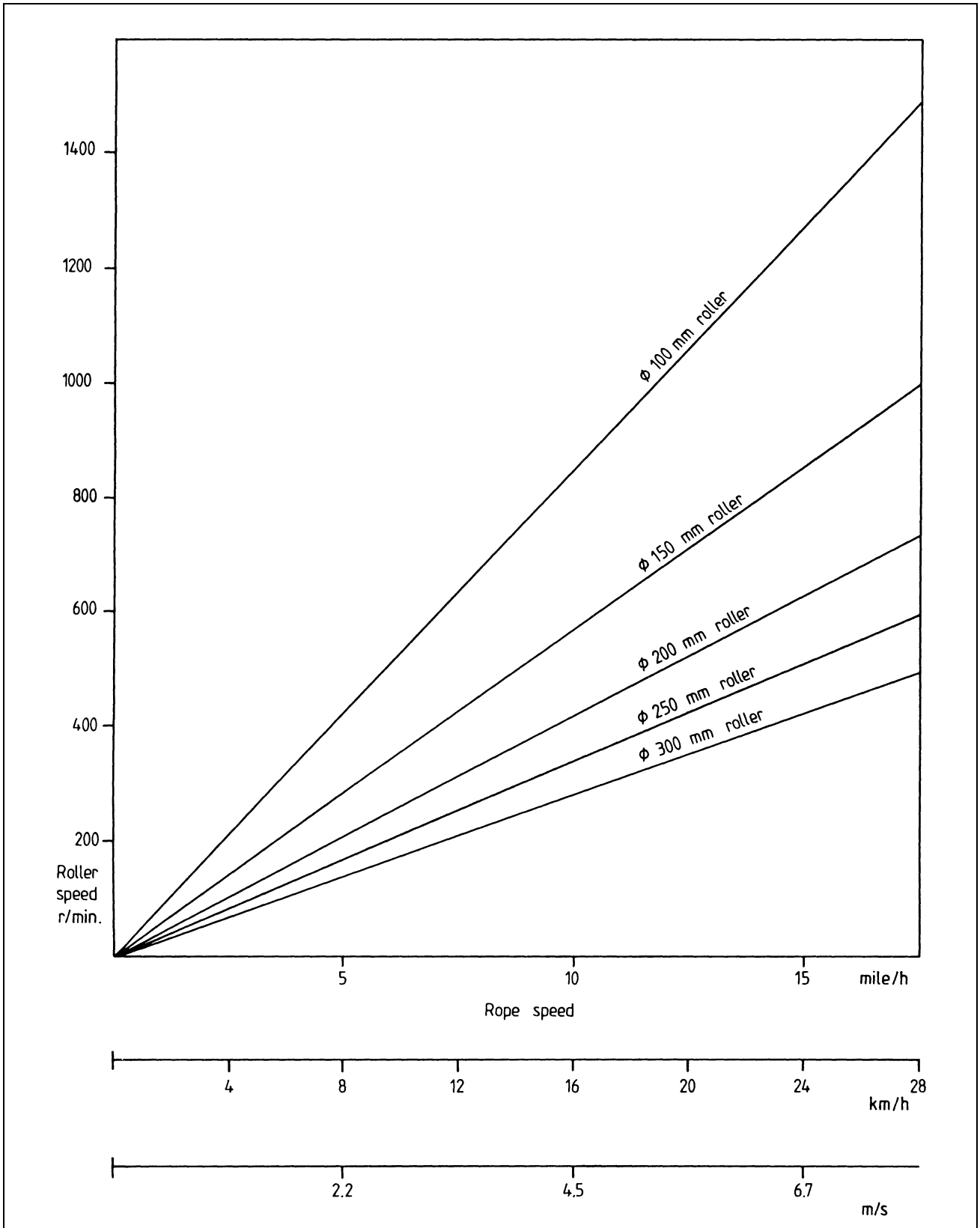


Figure 6 — Relationship between rope speed and roller speed (r/min)

Appendix E Typical clause relating to inspection that the purchaser may choose to write into his order or contract for the supply of pulley assemblies and clamps to this Part of BS 3876

(NOTE See also Appendix A.)

For inspection purposes, the purchaser may choose to include the following clause in his order or contract.

"The purchaser or his representative shall have access at all reasonable times to those parts of the manufacturer's works or the works of subcontractors engaged on the order; he shall be at liberty to inspect the manufacture at any stage to witness the required tests and to reject any material that does not comply with the relevant specification."

Publications referred to

BS 4, *Structural steel sections.*

BS 4-1, *Specification for hot-rolled sections.*

BS 292, *Rolling bearings: ball bearings, cylindrical and spherical roller bearings.*

BS 292-1, *Specification for dimensions of ball bearings, cylindrical and spherical roller bearings (metric series).*

BS 499, *Welding terms and symbols.*

BS 499-1, *Glossary for welding, brazing and thermal cutting.*

BS 970, *Specification for wrought steels for mechanical and allied engineering purposes.*

BS 970-1, *General inspection and testing procedures and specific requirements for carbon, carbon manganese, alloy and stainless steels.*

BS 2050, *Specification for electrical resistance of conducting and antistatic products made from flexible polymeric material.*

BS 3100, *Specification for steel castings for general engineering purposes.*

BS 3643, *ISO metric screw threads.*

BS 3643-1, *Principles and basic data.*

BS 3790, *Specification for endless wedge belt drives and endless V-belt drives.*

BS 3876, *Rope rollers, pulleys, mountings and assemblies for colliery track haulage.*

BS 3876-1, *Specification for parallel barrel rollers, mountings and assemblies*[2)].

BS 3876-2, *Specification for vertical spindle pulleys, mountings and assemblies*[2)].

BS 4360, *Specification for weldable structural steels.*

BS 4500, *ISO limits and fits.*

BS 4500-1, *General, tolerances and deviations.*

BS 4570, *Specification for fusion welding of steel castings.*

BS 4878, *Specification for large (vee-throated) haulage rope pulleys for mines and quarries.*

BS 5135, *Specification for arc welding of carbon and carbon manganese steels.*

BS 5750, *Quality systems*[2)].

[2)] Referred to in the foreword only.

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