BRITISH STANDARD

BS 7166:1989

Specification for

Wedge and socket anchorages for wire ropes

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Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Mechanical Handling Standards Policy Committee (MHE/-) to Technical Committee MHE/1, upon which the following bodies were represented:

Associated Offices Technical Committee
British Chain Manufacturers' Association
British Forging Industry Association
British Ports Association and the National Association of Ports Employers
British Railways Board
British Steel Industry
Chain Testers Association of Great Britain
Corporation of Trinity House
Department of Trade and Industry (National Physical Laboratory)
Federation of Wire Rope Manufacturers of Great Britain
Health and Safety Executive
Lloyds Register of Shipping
Ministry of Defence

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

Association of Supervisory and Executive Engineers
British Coal
Drop Forging Research Association
Electricity Supply Industry in England and Wales
Engineering Equipment and Materials Users' Association
Federation of Manufacturers of Construction Equipment and Cranes
Independent Engineering Insurers' Committee
National Association of Lift Makers
Steel Castings Research and Trade Association

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Foreword

This British Standard has been prepared under the direction of the Mechanical Handling Standards Policy Committee. It covers requirements for wedge and socket anchorages which are among the simplest devices for the termination of wire ropes. Such anchorages consist of a flat, pear-shaped wedge which fits into a suitably tapered socket or body (see Figure 1). The wedge has a peripheral groove to take a wire rope and the socket is often of the clevis type with an eye and pin fitting.

Wedge and socket anchorages are intended for on-site attachment and can be used as a quick means of replacing and re-reeving wire ropes on cranes, excavators, lifts, etc.

This standard specifies type tests on the socket body and on the wedge and socket anchorage assembly. A proof test on each socket body is also required. In service, the performance of an assembly will depend upon the design of the wedge and socket anchorage and on the type and construction of the actual wire rope used. The in-service termination efficiency may therefore be less than the type performance. Where considered necessary, suitable additional testing should be carried out to establish the termination efficiency; attention is drawn to the testing requirements of Section 6(1)(b) of the Health and Safety at Work, etc. Act 1974.

Accidents involving wedge and socket anchorages are possible from causes such as the use of incompatible (mismatched) components and assembly where the wedge has not been properly and firmly seated in the body.

Purchasers ordering wedge and socket anchorages for wire ropes to BS 7166 are advised to specify in their purchasing contract that the manufacturer operates a quality system in compliance with the appropriate Part of BS 5750, or suitable equivalent, to ensure for themselves that products claimed to comply with BS 7166 consistently achieve the required level of quality.

Appendix B, Appendix C, Appendix D and Appendix E give guidance on storage of components, method of selection and fitting, method of assembly and inspection in use respectively.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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, 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 standard specifies the performance requirements for wedge and socket anchorages designed for use as terminal attachments with either one size or two adjacent nominal sizes of steel cored or fibre cored wire rope of tensile grade up to and including 1 960 N/mm^2 in the nominal diameter range of 8 mm to 96 mm.

This standard also applies to wedge and socket anchorages that are incorporated into the structure of a lifting appliance, e.g. a wire rope hoist block.

NOTE 1 Wedge and socket anchorages are not intended for use in the make-up of lifting slings for multi-purposes as defined in BS 6166-1.

NOTE 2 Steel ropes with independent wire rope core (IWRC) in the tensile strength range 1 960 N/mm^2 to 2 200 N/mm^2, which are outside the range specified in BS 302-1 to BS 302-8 inclusive, are used with wedge and socket anchorage terminations. Such anchorages are acceptable, provided they are tested with such ropes and comply with all the performance requirements of this standard.

NOTE 3 The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

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

2.1
socket body

a component having an internal tapered orifice in the form shown in Figure 1 suitable for housing a wedge (see **2.2**) and the rope(s) with which it is associated

NOTE The socket body is usually of the clevis type with eyes to accommodate a pin.

2.2
wedge

a flat pear-shaped component as shown in Figure 1 having a peripheral groove suitable for fitting into a tapered socket body (see **2.1**) to house a rope of matching nominal diameter

2.3
eyes

bosses on the lugs of the socket body having co-axial pinholes through which a pin can pass (see **2.4**)

2.4
pin

a cylindrical bar to be fitted through the eyes in the lugs of the socket body arranged so as to be secure when in position but which can be readily disassembled

2.5
wedge and socket anchorage

a component used as a terminal attachment for wire rope, comprising a socket body and matching wedge usually for on-site attachment and for quick rope replacement purposes

2.6
proof test force

the force applied to a socket body in a static tensile test (see **7.1**)

2.7
basic design size

the diameter of the largest wire rope with which the wedge and socket anchorage is designed to be used

2.8
competent person

a designated person qualified by knowledge and practical experience which would enable the testing and examination of wedge and socket anchorages as specified in **7.2** and **E.4** to be carried out and any defect to be located and evaluated in terms of possible detrimental effect

3 Designation and information to be supplied

3.1 A designation of a wedge and socket anchorage shall include the following:

a) the number of this British Standard, i.e. BS 7166;

b) the letters WSA;

c) basic design size;

d) the minimum breaking load of the strongest rope for which the wedge and socket anchorage is designed (in tonnes).

Example of designation: BS 7166, WSA, 16, 16.4 t.

3.2 The designation forms the minimum information to be supplied by the purchaser on his enquiry and/or order.

4 Constructional details

4.1 Socket body

If the form of the socket body is asymmetric as shown in Figure 1(a), it shall be arranged so that the axis of the live or loaded side of the rope aligns with the centre of the pinholes in the lugs.

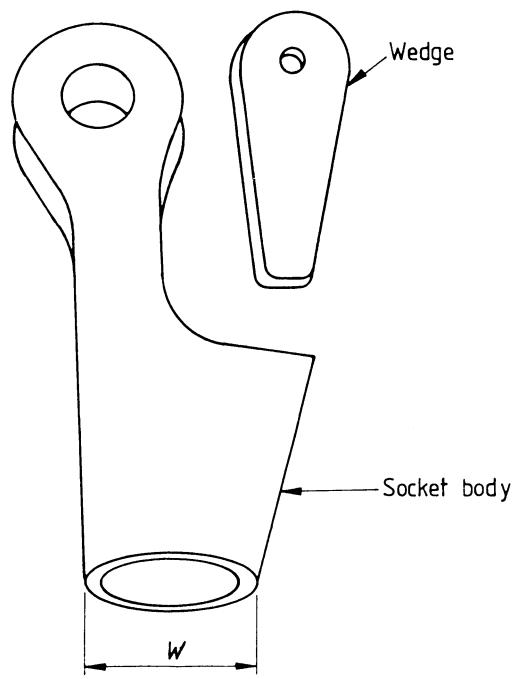
If the form of the socket body is symmetric as shown in Figure 1(b) it shall be used on lift applications only.

4.2 Wedge

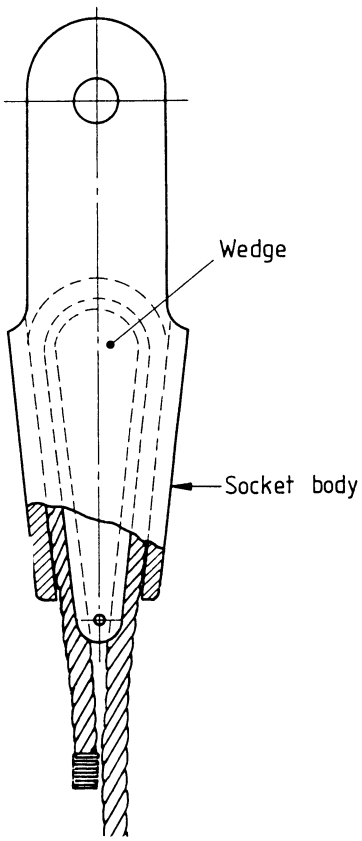
The wedge shall be flat and shall have a peripheral groove which shall be of radius profile to suit the size of wire rope(s) for which it is designed [see Figure 1(a)].

The wedge shall be of sufficient size to prevent it from passing right through the socket body, even when no rope is fitted.

NOTE It is recommended in Appendix B that a small hole be drilled in the wedge to enable it to be wired to the socket body for storage purposes.



(a) Asymmetric type shown disassembled



(b) Symmetric type shown assembled for use on lifts only

Figure 1 — Typical wedge and socket anchorage components: socket body and wedge

5 Workmanship

5.1 Socket body

5.1.1 *General.* The surfaces of socket bodies shall be clean and sharp edges shall be radiused. All flashes or fins produced in any casting process, if used, shall be removed.

NOTE 1 Surface defects may be removed by grinding, provided that the wall thicknesses are not reduced below the minimum wall thickness specified by the manufacturer.

NOTE 2 Other minor casting defects caused by the manufacturing processes where these are used may be rectified by removal and subsequent welding, provided that the thickness of sound material remaining at the effective point immediately before welding is at least 50 % of the original thickness. The method of repair should comply with the rectification of steel castings as specified in BS 4570.

5.1.2 *Pinholes.* The pinholes in the lugs of the socket body where provided shall be machined in one operation and the centre line of the holes shall be at right angles to the centre line of the socket body.

5.2 Wedge

The surfaces of the wedge shall be in a clean condition and sharp edges shall be radiused. The surface of the peripheral radiused groove shall be smooth.

6 Type tests

6.1 Socket body

6.1.1 *Purpose of tests.* The purpose of type tests is to prove the design, material and method of manufacture of the socket body.

NOTE Tests to prove complete wedge and socket anchorage assemblies with the associated wire rope are given in **6.2**.

6.1.2 *Tensile test*

6.1.2.1 *General.* Two tensile tests shall be carried out on each size of socket body of each design, material and method of manufacture.

6.1.2.2 *Force applied and requirement.* A force equal to 50 % of the minimum specified breaking load of the strongest rope for which the socket body is designed shall be applied and held for 2 min. On removing this force, the socket body shall be deemed to have satisfied the test requirement if, compared with their initial values, both the following apply:

a) the increase in the diameter of the pinholes in the lugs when measured in any position does not exceed 0.2 % or 0.1 mm, whichever is the greater;

b) the increase in dimension *W* [see Figure 1(a)] at the base of the socket body does not exceed 0.2 % or 0.1 mm, whichever is the greater.

6.2 Wedge and socket anchorage assemblies

6.2.1 *Purpose of tests.* The purpose of type tests is to assess the suitability of each design, material and method of manufacture of wedge and socket anchorage assembly including the socket body, wedge and associated wire rope for which the anchorage was designed.

If zinc coated wire ropes are to be used in a termination application, then the same type and finish of wire rope shall be used in the type tests.

NOTE This test may be carried out concurrently with that specified in **6.1** for socket bodies.

6.2.2 ***Tensile test***

6.2.2.1 *General.* Two tensile tests shall be carried out on each size of wedge and socket anchorage of each design, material and method of manufacture and for each nominal diameter of rope, *d*. When the sockets are tested in pairs, the distance between the inner faces of the sockets shall be at least 30*d*.

6.2.2.2 *Force applied and requirement.* A force equal to 80 % of the minimum specified breaking load of the strongest rope of each nominal diameter for which the wedge and socket anchorage is designed shall be applied. The force shall be applied quickly up to 60 % of the same minimum specified breaking load but increased slowly until the 80 % value has been reached. The force shall be held for 2 min. On removing the force the wedge and socket anchorage shall be deemed to have satisfied this test provided the load is retained.

Both wedge and socket anchorages shall pass the tests.

6.2.3 *Pulsatory fatigue test.* When a wedge and socket anchorage is to be subjected to fluctuating stress in service over an extended period, e.g. in a lift installation, the purchaser may require evidence that an additional prototype pulsatory fatigue test has been successfully carried out. This requirement, when necessary, is to be stated in the enquiry and/or order.

In such cases the test shall be carried out in accordance with **A.1** to **A.4** inclusive, and the anchorage shall comply with the requirement in **A.5**.

7 Proof tests on socket bodies

7.1 Proof test force

Each socket body shall be subjected to a proof force equivalent to 40 % of the minimum specified breaking load of the strongest rope for which the wedge and socket anchorage is designed.

7.2 Requirement

After removal of the proof load, each socket body shall be carefully examined by a competent person and shall be deemed to comply with the standard only if found free from visible flaw or defect.

8 Marking

8.1 Basic design size

Each socket body and wedge shall be legibly and permanently marked with the basic design size.

NOTE The marking of the socket body and the wedge with the basic design size is intended to ensure that the two components are kept together and used together. Mismatching is dangerous.

8.2 Identification

Each socket body and wedge shall be permanently marked with such marks or symbols as will provide identification with the manufacturer's certificate of test.

8.3 Care in marking

The marking shall not affect the performance of the socket body or the wedge.

9 Manufacturer's certificate

The manufacturer or supplier shall provide a certificate of test and examination with each consignment of wedge and socket anchorages giving the following information:

a) the name and address of the manufacturer or supplier;

b) basic design size;

c) the identification marks or symbols, as required by the marking clause (see **8.2**);

d) the proof test force applied (see **7.1**);

e) the highest minimum breaking load of the rope for which the wedge and socket anchorage is designed;

f) a statement of conformity with this British Standard, i.e. BS 7166[1)].

[1)] Marking BS 7166 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 Pulsatory fatigue test

A.1 This prototype test shall be carried out on a wedge and socket anchorage assembly comprising socket body, wedge and associated wire rope.

A.2 For lift applications the rope constructions used for the test shall be in accordance with BS 302-1 and BS 302-4.

A.3 For other applications the rope shall be the strongest specified by the wedge and socket anchorage manufacturer for that size of rope.

A.4 The tests shall be carried out on four test pieces of the required size of wedge and socket anchorage. Each assembly shall be subjected to a cyclic tension along the rope axis from 15 % to 30 % of the relevant minimum breaking load of the rope.

The machine frequency shall not exceed 4 Hz.

A.5 Each wedge and socket anchorage shall withstand 75 000 cycles and shall then satisfy the test specified in **6.2.2**.

Appendix B Storage of socket bodies and wedges

It is essential that a socket body and its mating wedge are kept together as a set. A small hole drilled in the wedge will enable the two components to be wired together for storage purposes.

Appendix C Information on the correct method of selection and fitting

Information and instruction on the correct method of selecting and fitting wedge and socket anchorages and on in-service inspection should be provided by the manufacturer or supplier.

An outline is given in Appendix D and Appendix E.

Appendix D Method of assembly

D.1 It is essential to use only a wedge and a socket body of the correct dimensions and strength for the particular steel wire rope. Failure to do so may result in the rope pulling through the fitting or in failure of the wire rope or the anchorage.

D.2 Socket bodies and wedges from different manufacturers are not interchangeable, even though they may be designed for the same size of wire rope. Components of different designs should not be mixed and the fit of the wedge (with the rope) in the socket body should always be checked at the time of assembly.

An oversized wedge, or a wedge of incorrect taper, will not enter the socket body sufficiently to give a secure termination; too small a wedge will protrude too far through the socket body and the high localized loading may cause the socket body to crack and open out, allowing the wedge to pull through.

D.3 The wire rope should be fitted so that the live or loaded part of the rope is not kinked where it leaves the socket body, but pulls directly in line with the point of attachment of the socket (see Figure 2). Incorrect fitting will result in premature failure of the rope.

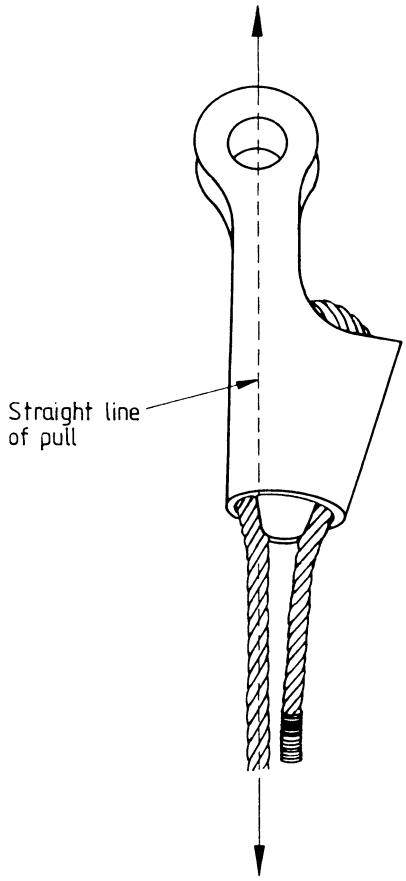


Figure 2 — Wire rope in line with pinholes (point of attachment)

D.4 When the termination is made up, the tail-end of the rope left protruding should be long enough for whatever securing method is to be used (see **D.8**).

D.5 Multi-strand ropes tend to show distortion when they are bent around small radii and may require temporary serving, e.g. with electrician's tape during fitting of the socket body. This serving should be subsequently removed, as far as possible, to allow for inspection of the wire rope.

D.6 After a wedge and socket anchorage termination has been made or re-made, it is essential that the wedge and the wire rope are properly seated in the socket body before the equipment is put into service. Failure to do so may allow the rope to pull through the fitting or, particularly when the wire rope is new, the wedge may be sprung out of the socket.

D.7 Initially the wedge should be hammered home. A wooden packer should be used to protect the fitting and wire rope against damage. Simultaneously a load should be applied to the ends of the wire rope. A substantial load should then be raised and left suspended, but not unattended, to seat the wedge and rope firmly into the socket body. The wedge should be properly seated before the assembly is put into service.

D.8 Two typical ways of dealing with the tail-end length of rope protruding from the socket, depending on the circumstances of use, are as follows.

a) The tail-end may be looped back on itself and secured by a wire rope grip (in accordance with BS 462) or clamped to form a loop. The loop should be lashed to the live or loaded part of the rope by suitable means, such as soft binding wire, to prevent flexing of the rope in service [see Figure 3(a)]. If this method is used, the tail-end length of rope should be about 15 times the diameter of the rope, e.g. 195 mm tail end length for a 13 mm diameter wire rope.

b) Where there is a possibility of the loop interfering with an obstruction, such as the working structure, which might cause the wedge to loosen and the rope to pull free, the tail-end length of the rope should not be looped back, but should be fitted with a simple clamp or wire rope grip (in accordance with BS 462) and laid parallel to the live or loaded part of the rope. If a wire rope grip is used, a distance piece, or a short length of rope of the same diameter, will be necessary to ensure that the rope is adequately gripped [see Figure 3(b)]. If necessary the tail-end may be lashed to the live part with soft binding wire.

In both a) and b), the clamp or wire rope grip is used to ensure that the rope cannot slip through the anchorage before the wedge has had a chance to seat adequately. The clamp or wire rope grip should not be allowed to encroach on the fused-end of the rope.

NOTE The lift industry has for many years used an alternative method of securing the tail end by applying a wire rope grip across the live rope and tail end. This method is not recommended in other than lift applications.

D.9 Special care is necessary when tension may be completely removed from the rope, e.g. when a load is set down and where there is a possibility that the wedge may become loosened.

Appendix E Inspection in use

E.1 Wedge and socket anchorages should be inspected at least once a week depending on usage.

NOTE Where this type of termination is used on suspension ropes of goods or passenger lifts, the wedge and socket anchorage should be inspected at every periodic examination; attention is drawn to HSE Guidance Note PM 7 (revision 1 June 1982) *Lifts: thorough examination and testing*[2)].

E.2 Particular attention should be paid to the following:

a) rope damage, e.g. broken wires, or deformation of the wire rope where it emerges from the socket body;

b) the condition of the socket body, e.g. cracks, particularly if the wedge is seen to protrude excessively. The lugs of the socket body should be examined for possible deformation, cracks or other defects;

c) the security and tightness of the wedge fitting;

d) condition of the pin including screw threads and presence of the split cotter pin correctly positioned and locked in.

E.3 The socket body and the wedge and the part of the wire rope lying inside the fitting should be examined each time the assembly is dismantled for any reason. A wedge or socket body found to be damaged should be replaced by another assembly.

E.4 When a rope is to be reterminated with a wedge and socket anchorage, this can be achieved by either of the following:

a) shortening the rope and resocketing in a new position; or

b) using the same position on the rope, provided that a competent person considers that any part of the previous flattening and/or damage to be acceptable.

No part of any previous flattening and/or damage should be on the live or loaded part of the rope.

[2)] Obtainable from Public Enquiry Point, HSE, St. Hugh's House, Stanley Precinct, Bootle, Merseyside L20 3QY.

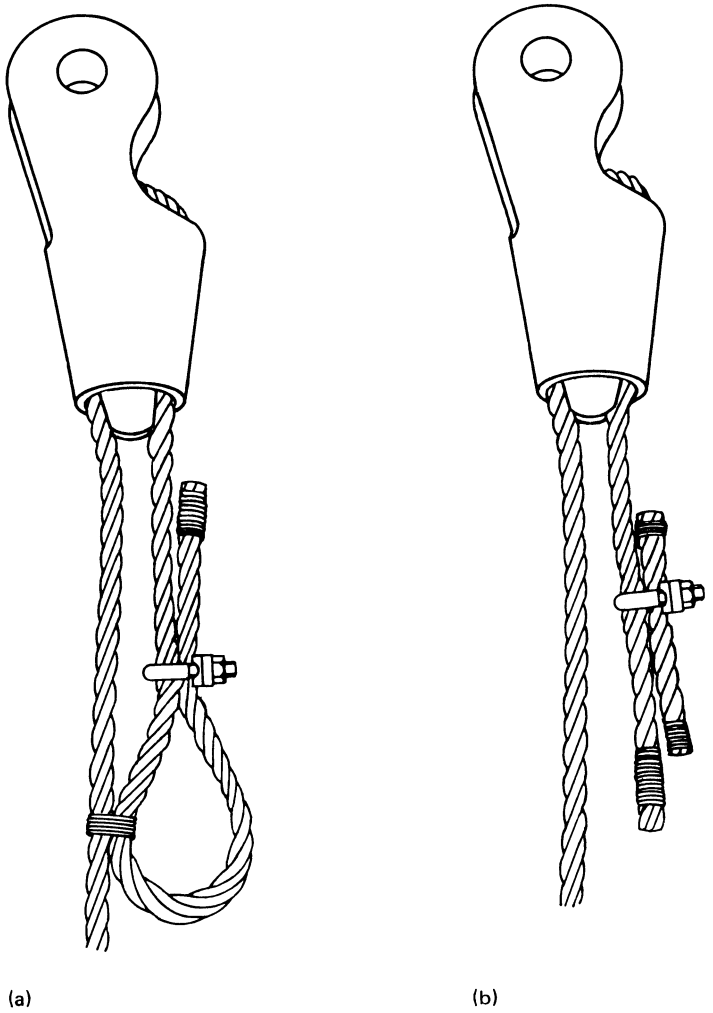


Figure 3 — Two methods of dealing with the tail-end of the wire rope

Publications referred to

BS 302, *Stranded steel wire ropes.*
BS 302-1, *Specification for general requirements.*
BS 302-2, *Specification for ropes for general purposes.*
BS 302-3, *Specification for zinc coated ropes for ships.*
BS 302-4, *Specification for ropes for lifts.*
BS 302-5, *Specification for ropes for hauling purposes.*
BS 302-6, *Specification for ropes for mine hoisting.*
BS 302-7, *Large diameter ropes*[3)].
BS 302-8, *Higher strength ropes*[3)].
BS 462, *Specification for wire rope grips.*
BS 4570, *Specification for fusion welding of steel castings.*
BS 5750, *Quality systems*[4)].
BS 6166, *Lifting slings.*
BS 6166-1, *Methods of rating.*
HSE Guidance Note PM7. Lifts: thorough examination and testing[5)].

[3)] In preparation.
[4)] Referred to in the foreword only.
[5)] Obtainable from Public Enquiry Point, HSE, St. Hugh's House, Stanley Precinct, Bootle, Merseyside L20 3QY.

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