

Strata reinforcement support system components used in coal mines —

Part 1: Specification for rockbolting

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Committees responsible for this British Standard

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- Association of British Mining Equipment Companies
- British Steel Industry
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Foreword

This Part of BS 7861 has been prepared by Subcommittee MRE/1/1.

It meets a need for specifying and verifying the quality and performance of components and assemblies for the rockbolt support of coal mine roadway roofs and sides.

Manufacturers are recommended to establish and maintain a quality assurance system in accordance with BS EN ISO 9001 or BS EN ISO 9002 as appropriate.

Attention is drawn to the Health and Safety at Work etc. Act of 1974 [1], and Regulations made under this Act, and also any other appropriate statutory requirements or byelaws. These place responsibility for complying with certain specific safety requirements on the manufacturer and the user.

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 to iv, pages 1 to 28, 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 7861 specifies dimensional, material and performance requirements for rockbolting support system components used in coal mines. Included are steel rockbolts, glass reinforced plastics (grp) rockbolts, resins, conical seats and domed washer plates.

This standard does not cover the assembly or installation of these components to form a rockbolting support system on site.

2 References

2.1 Normative references

This Part of BS 7861 incorporates, by dated or undated reference, provisions from other publications. These normative references are made at the appropriate places in the text and the cited publications are listed on the inside back cover. For dated references, only the edition cited applies; any subsequent amendments to or revisions of the cited publications apply to this Part of BS 7861 only when incorporated in the reference by amendment or revision. For undated references, the latest edition of the cited publication applies, together with any amendments.

2.2 Informative references

This Part of BS 7861 refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are listed on the inside back cover, but reference should be made to the latest editions.

3 Definitions

For the purposes of this Part of BS 7861, the following definitions apply.

3.1

bond strength

in a rockbolt/resin system, the load at which the system stiffness falls below 20 kN/mm

3.2

breakout facility

facility whereby the nut is held in position on the thread of the rockbolt enabling mixing of the resin to take place during rockbolt installation, but which, when a predetermined torque value is reached, allows the nut to be spun up the thread to tighten on the domed washer plate

3.3

conical seat

accessory which, when used in conjunction with a rockbolt, nut and domed washer plate, facilitates a degree of misalignment between the rockbolt and the strata surface

3.4

domed washer plate

accessory which, when used in conjunction with a rockbolt, nut and conical seat, facilitates load distribution, ensures correct alignment and reduces weathering around the mouth of the rockbolt hole

3.5

gel time

period during which a resin can be mixed with no appreciable change in viscosity, i.e. before it begins to turn from fluid to solid state

3.6

resin

encapsulating material used to achieve a bond between rockbolt and strata

3.7

rockbolt

ribbed bar used in conjunction with fully encapsulating resin to provide reinforcement of the mine roadway roof or side

3.8

rockbolt assembly

rockbolt with a threaded end fitted with a nut, conical seat and domed washer plate (see Figure 1)

3.9

rockbolting support system

rockbolt assemblies installed systematically to provide principal roof and/or side support for mine roadways

3.10

routine test

test conducted at a predetermined frequency to ensure continued conformance to specification of the item concerned

3.11

setting time

period, in addition to gel time, that is required for the resin to attain enough strength to resist the pull exerted on the rockbolt when the nut is tightened

3.12

system stiffness

slope of a load/extension curve obtained from a laboratory double embedment pull test. The unit of system stiffness is the kilonewton per millimetre (kN/mm)

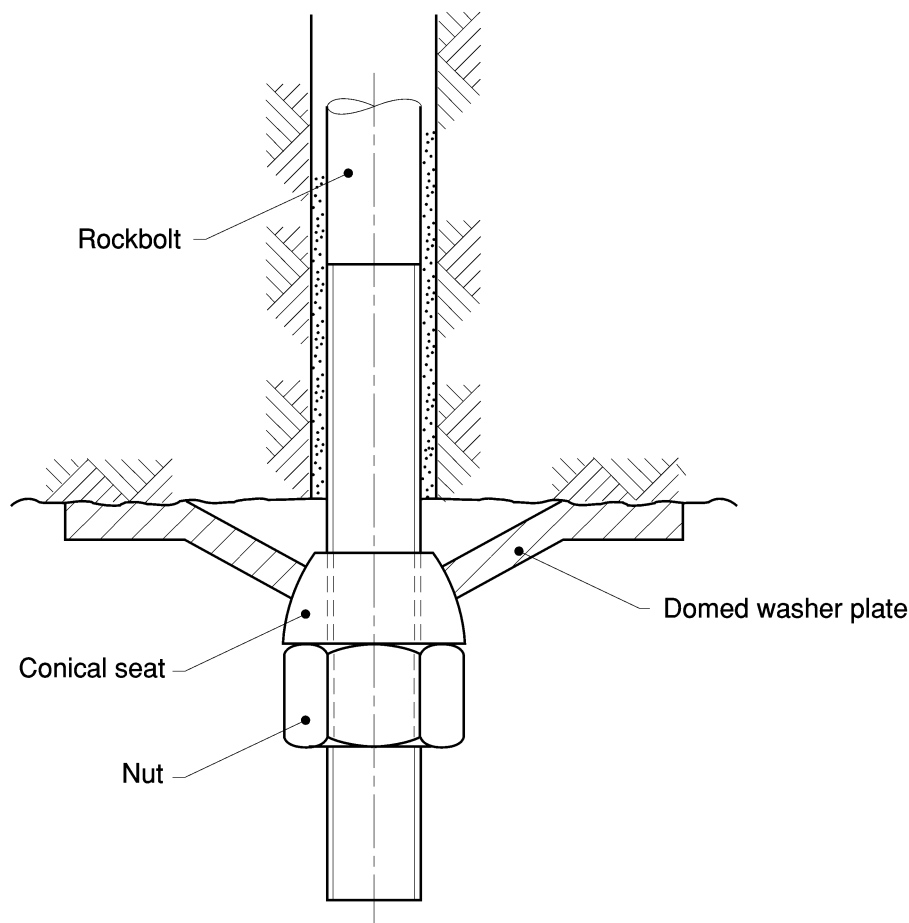


Figure 1 — Components of a steel rockbolt assembly in situ

3.13 type test

test on a component or assembly before regular production commences, to ensure the relevant mechanical and/or physical properties are achievable and which is conducted whenever any significant change in the process parameters occurs

4 Steel rockbolts and components

4.1 Rockbolt

4.1.1 Supplied bar

4.1.1.1 Composition

The bar shall be made from steel with a homogenous structure having a chemical composition of carbon 0.3 % max., manganese 1.6 % max., sulfur 0.05 % max. and phosphorus 0.05 % max.

4.1.1.2 Profile

The bar shall be rolled to a round section with raised ribbing. The nominal core diameter of the bar shall be 21.7 mm. The dimensions and profile shall conform to Figure 2.

4.1.1.3 Straightness

Straightness shall be 0.4 % of the length of the supplied bar.

4.1.1.4 Performance

When tested by a procedure conforming to BS EN 10002-1 and Annex A:

- a) the yield strength shall be within the range 640 N/mm^2 to 720 N/mm^2 ; ¹⁾
- b) the tensile strength shall be at least 20 % greater than the yield strength on each tensile test;

¹⁾ $1 \text{ Pa} = 10^{-6} \text{ N/mm}^2$

- c) the elongation after fracture (A) shall be a minimum of 18 % and the elongation at maximum force (A_{gt}) shall be a minimum of 8 %.

4.1.2 Manufacture

4.1.2.1 Threaded end

The thread shall be roll-formed conforming to BS 3643-1 M24 × 3, having a thread tolerance class designation of 8g. The minimum length of thread shall be 150 mm.

As a routine test, one thread in every 50 produced shall be checked using a go/no-go gauge.

4.1.2.2 Non-threaded end

The non-threaded end of the rockbolt shall be formed by cropping or sawing and shall be free from burrs and edges which protrude beyond the profile of the rockbolt.

As a routine, one rockbolt in every 200 produced shall be checked for straightness using a 25.4 mm bore cylinder gauge, having a minimum length of 450 mm.

4.1.2.3 Length

For use in roadway roofs, the minimum nominal length rockbolt shall be 1.8 m. For use in roadway sides, the minimum nominal length of rockbolt shall be 1.2 m. The tolerance on length shall be ± 5 mm.

As a routine test, the rockbolt lengths shall be checked at the end of every production shift and at every occasion when the cropping/sawing machine is reset.

NOTE The actual length of rockbolt used will be determined by the user by geotechnical appraisal.

Rockbolt lengths shall be identified by colour coding on the threaded end face as given in Table 1. Rockbolt lengths over 2.4 m shall be identified as such by colour(s) other than those listed in Table 1.

Table 1 — Colour coding of rockbolts

Nominal rockbolt length m	Colour code
2.4	Red
2.1	Green
1.8	Yellow
1.5	White (for side rockbolts only)
1.2	Blue (for side rockbolts only)

4.1.3 Type tests

4.1.3.1 Tensile test

When tested in accordance with Annex B, the threaded portion of the rockbolt or the thread of the assembled nut shall not fail at less than 295 kN load.

4.1.3.2 Shear test

When tested in accordance with Annex C, the rockbolt/resin system shall withstand a minimum shear force of 250 kN.

4.1.3.3 Bond strength and system stiffness

When tested in accordance with Annex D, the minimum bond strength between rockbolt and resin shall be 200 kN and the minimum system stiffness shall be 70 kN/mm measured between loads of 50 kN and 150 kN.

4.1.4 Supplier identification

Either the nut or conical seat supplied with the rockbolt shall be uniquely colour-coded by painting so as to identify the supplier.

4.2 Nut

4.2.1 General

The nut shall be black hexagon steel grade 8 conforming to BS EN 24034, except that its thickness shall be a minimum of 26 mm. The thread shall conform to BS 3643-1 M24 × 3, class designation 7H.

The nut shall have an installation feature allowing the rockbolt to be installed in the hole prior to torquing. The feature shall enable breakout at predetermined torque settings.

The nut shall be used in association with an anti-friction washer.

4.2.2 Test

4.2.2.1 Type test

When tested in accordance with Annex E, the nut breakout facility shall operate at torques in the ranges of:

- 95 N m to 175 N m for roof rockbolts;
- 40 N m to 125 N m for rib rockbolts; and
- 125 N m to 185 N m for high torque roof rockbolts.

4.2.2.2 Routine test

The test procedure of 4.2.2.1 shall be carried out on one nut in every 1 000.

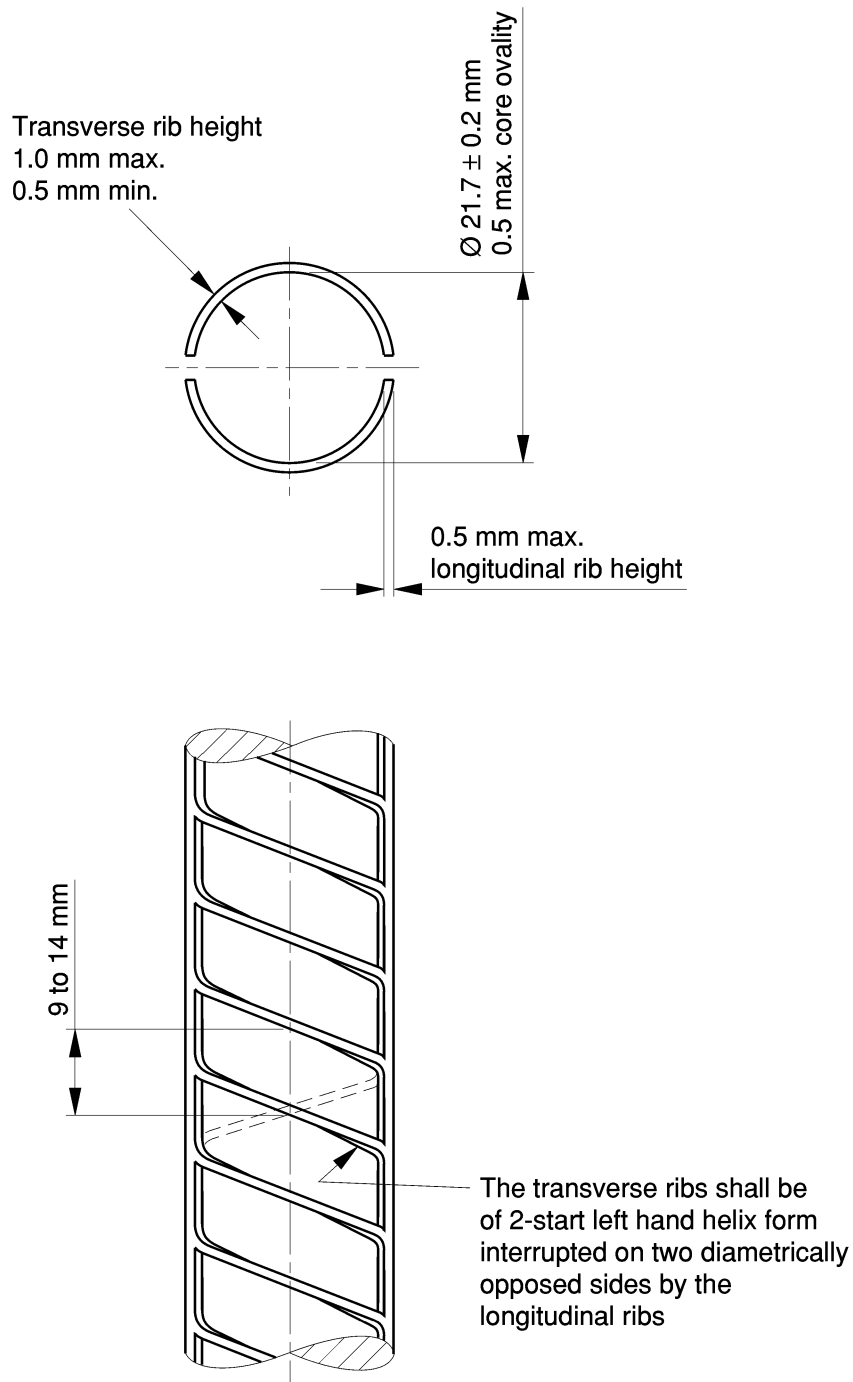
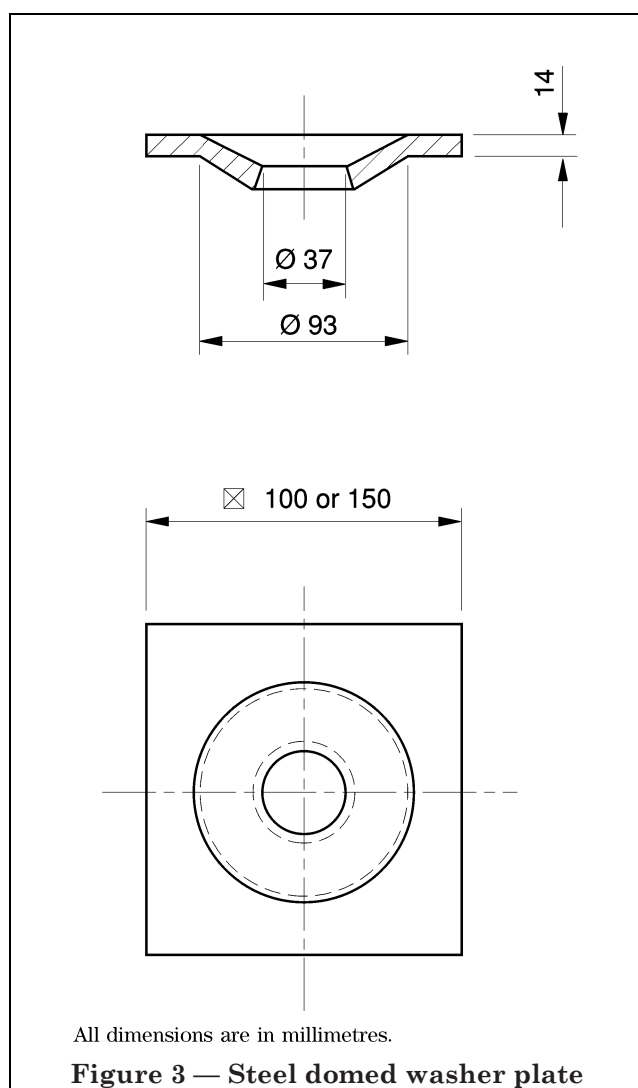


Figure 2 — Profile of 21.7 mm steel rockbolt

4.3 Steel domed washer plate

4.3.1 Material and dimensions

The domed washer plate shall be manufactured from 8 mm or 10 mm nominal steel flat bar conforming to grade S 275JR of BS 10025:1993. The plates shall be either 150 mm square or 100 mm square with a central hole and a domed central area in accordance with the nominal dimensions given in Figure 3.



4.3.2 Type test

When tested in accordance with Annex F, the domed washer plate shall

- firstly flatten under a load of 140 kN to 200 kN, and
- secondly allow pull-through of the rockbolt, nut and conical seat assembly under a load (the maximum tensile load or pull-through load) of 210 kN to 290 kN,

without failure of the rockbolt threaded end.

NOTE Failure of the plate should occur in a progressive manner.

4.3.3 Routine test

One plate in every 50 000 produced shall be tested to the requirements of 4.3.2.

4.3.4 Supplier identification

Each domed washer plate shall have a unique supplier identification mark.

4.4 Steel conical seats

4.4.1 Material

The conical seat shall be manufactured from a forged steel capable of withstanding the performance criteria specified in 4.4.4.

4.4.2 Dimensions

The nominal dimensions of the conical seat shall conform to Figure 4 and be compatible with the other components of the rockbolt assembly.

4.4.3 Supplier identification

Each conical seat shall have a unique supplier identification mark.

4.4.4 Mechanical performance criteria

4.4.4.1 Assembly load test

When the conical seat is tested as part of a rockbolt assembly as described in Annex F, it shall be capable of withstanding the maximum tensile load determined in that test without damage or cracking.

This test shall be routinely repeated at a frequency of 50 000 units of production.

4.4.4.2 Alignment test

When tested in accordance with Annex G, the conical seat shall allow a minimum misalignment between the rockbolt and the domed washer plate of $\pm 18^\circ$. This shall be verified by a routine test repeated at every change of tool batch.

5 Glass reinforced plastics (grp) rockbolts and components

5.1 Rockbolt

5.1.1 Installation feature

There shall be an installation feature that allows the rockbolt to be installed in the hole prior to torquing.

5.1.2 Dimensions

The minimum diameter shall be 21.5 mm and the minimum length shall be 1.2 m.

One end of the rockbolt shall have a standard engineering thread formed out of non-metallic material. The minimum length of thread shall be 150 mm.