

Strata reinforcement support system components used in coal mines —

Part 2: Specification for birdcaged cablebolting

ICS 73.100.10

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Committees responsible for this British Standard

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- Association of British Mining Equipment Companies
- British Aggregate Construction Materials Industries
- British Drilling Association
- British Foundry Association
- British Geological Survey
- Confederation of United Kingdom Coal Producers
- Gypsum Association
- Health and Safety Executive
- Institution of Mining and Metallurgy
- UK Steel Association
- Union of Democratic Mineworkers

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Foreword

This Part of BS 7861 has been prepared by Technical Subcommittee MRE/1/1. It meets a need for specifying and verifying the quality and performance of components and assemblies for the birdcaged type of cablebolt support of mine roadway roofs and sides.

Cablebolts for strata reinforcement are generally used in addition to rockbolts and are usually installed when monitoring indicates that reinforcement is required through horizons higher than accessible with conventional rockbolts. Because, necessarily, they need to be considerably longer than rockbolts and may be longer than the height of the roadway, cablebolts are flexible to facilitate installation in drilled holes. Typically they may be 5 m to 10 m in length, having capacities of 300 kN for a single-strand cablebolt and 600 kN for a two-strand cablebolt, and are usually grouted in place using a cementitious material.

A birdcaged cablebolt is formed by unwinding steel strand and then rewinding the strand in the opposite direction without placing the wires under tension so that a loose matrix structure is produced, known as a “birdcage”. This structure may be formed by means of a special purpose “birdcaging” machine, particularly where two strands are to be combined into one cablebolt.

Manufacturers are recommended to establish and maintain a quality assurance system conforming to BS EN ISO 9000, BS EN ISO 9001 or BS EN ISO 9002, as appropriate.

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.

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

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 18, 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 birdcaged cablebolting support system components used in coal mines.

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

NOTE All references to cablebolts imply the birdcaged type.

2 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 publication 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.

3 Definitions

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

3.1

birdcaged cablebolt

partially rewound steel wire strand used in conjunction with fully encapsulating grout to provide reinforcement to the roof or side of a mine excavation

a cablebolt formed from a single strand is known as a single birdcaged cablebolt. A cablebolt formed from two strands is known as a double birdcaged cablebolt

3.2

cablebolt assembly

cablebolt complete with anchorage assembly comprising a strand gripping feature and bearing plate

3.3

grout

fluid mixture of binder, fine aggregate and water that hardens after application

3.4

routine test

test conducted at predetermined intervals or at a predetermined frequency to ensure conformity to the specification of the item concerned

3.5

setting time

the period taken for fluid grout to achieve a solid state when tested in accordance with BS EN 196-3

3.6

type test

tests on a component or assembly before regular production commences, to ensure that the relevant mechanical and/or physical properties are achievable. This test would be conducted whenever any significant change in the process parameters occurs

4 Steel cablebolts and components

4.1 Material

4.1.1 Cablebolts shall be formed from one or two 7-wire strands.

4.1.2 The strand shall conform to BS 5896-3 drawn strand-1820-15.2-relax 2.

4.1.3 The cablebolt structure shall be secured using swaged-on clamps or ties placed along the cable at intervals sufficient to maintain its structural integrity during transport and installation.

NOTE A securing device should be fitted to prevent slippage during installation.

4.2 Dimensions

4.2.1 The birdcage structure shall consist of cages or bulbs of wire groups nominally pitched at 200 mm. The nominal sizes of the cages or bulbs shall be 38 mm diameter for a single strand cablebolt and 48 mm diameter for a two-strand cablebolt (typical arrangements and dimensions are shown in Figure 1).

The tolerance on length of a finished cablebolt shall be ± 50 mm.

4.2.2 The un-birdcaged length of strand shall be as specified by the purchaser.

NOTE This length should be sufficient to ensure the efficient sealing of the hole prior to grouting and for fitting a strand gripping anchorage, and for identification purposes.

4.2.3 Those cablebolt lengths listed in Table 1 shall be identified by colour coding the tail.

Additionally one white ring shall be applied to identify a single-strand cable and two white rings shall be applied to identify a two-strand cable.

4.3 Anchorage assemblies

4.3.1 Bearing plate dimensions

The bearing plate shall be not less than 150 mm square.

Table 1 — Colour coding

Cablebolt length m	Colour code
5	Black
6	Red
7	Green
8	Blue
10	Orange
12	Yellow

4.3.2 Anchor assembly testing

When type tested in accordance with Annex A, the bearing plate shall conform to the values given in Table 2.

Routine testing shall be undertaken in accordance with Annex A for every 5 000 plates, or for every production batch, whichever is the smaller. Anchorage assemblies tested shall conform to the values given in Table 2.

Table 2 — Anchorage assembly test

Number of strands	Minimum failure load kN	Maximum plate deflection mm	Maximum strand draw-in mm
Single	279	10	15
Double	558	10	15

5 Grout**5.1 General**

All grouts shall be supplied in a form in which they can be readily transported, mixed and pumped, in order fully to encapsulate a cablebolt installed in a pre-drilled hole underground.

The manufacturer shall demonstrate by routine tests that the grout supplied has properties comparable to those achieved at type testing in accordance with Annex B, Annex C and Annex E.

NOTE At the present time all grouts used are cement based products and as such the test procedures and the performance values are associated with this type of product.

5.2 Storage life

When stored off the ground and under dry conditions, the storage life of grout in an unopened pack shall be at least three months.

5.3 Packaging

All materials supplied in containers shall be capable of withstanding transportation, handling and storage consistent with a mining environment.

The tolerance on material weight shall be $\pm 1\%$. The weight shall be stated on the container.

Containers shall include detailed instructions for mixing and use.

Attention is drawn to the Chemical (Hazard Information and Packaging) Regulations 1995 [1].

5.4 Mixing and pumping

The grout shall be mixed in accordance with the information supplied by the manufacturer, and shall be compatible with mixer/pump units approved for underground use.

When tested in accordance with Annex B, the grout shall fully fill the vertical tube.

5.5 Uniaxial compressive strength (UCS)

When tested in accordance with Annex C, the grout shall have the minimum UCS values given in Table 3. The value quoted for a particular grout shall be the mean of the three tests with no one test result being below the minimum specified value.

Table 3 — Uniaxial compressive strength

Curing period Days	Minimum uniaxial compressive strength N/mm ²
1	30
3	50
7	60
14	70
28	80

5.6 Elastic modulus

The Young's modulus shall be greater than 15.5 GPa when measured after a 14 day curing period. The value shall be derived from the results of three tests conducted in accordance with Annex D. The value quoted for a particular grout shall be the mean of the three tests with no one test result being below the minimum specified value.

5.7 Expansion

When tested in accordance with Annex E, the grout shall demonstrate a minimum positive expansion after setting of 0.05 %.

The test procedure specified in Annex E shall be performed not less than once for every 18 tonnes of grout produced.

6 System performance**6.1 System stiffness and load capacity****6.1.1 Single birdcaged cablebolt system**

The system stiffness and load capacity shall be tested in accordance with Annex F. The system stiffness shall be greater than 50 kN/mm when measured between loads of 150 kN and 200 kN. The load capacity of the system shall exceed 280 kN.

6.1.2 Double birdcaged cablebolt system

The system stiffness and load capacity shall be tested in accordance with Annex F. The system stiffness shall be greater than 100 kN/mm when measured between loads of 200 kN and 400 kN. The load capacity of the system shall exceed 560 kN.

6.2 Shear strength**6.2.1 Single birdcaged cablebolt system**

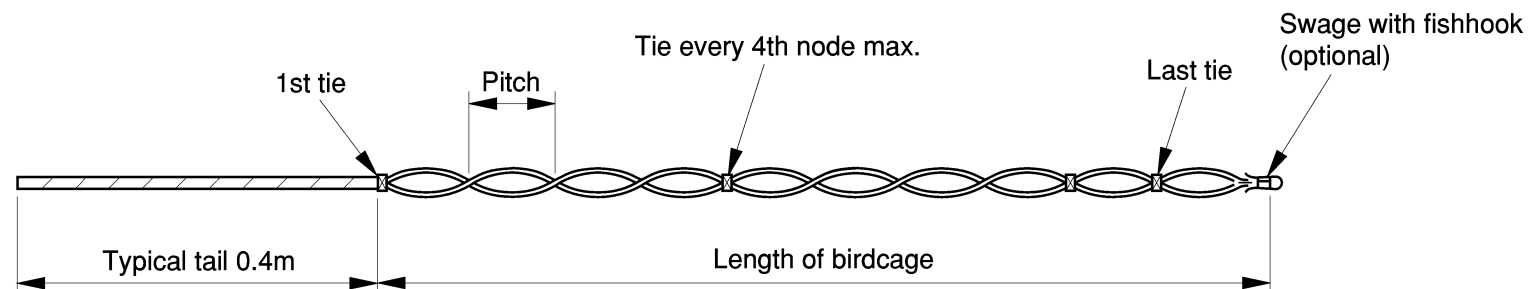
The system shall be tested for shear strength in accordance with Annex G. The shear strength shall exceed 200 kN.

6.2.2 Double birdcaged cablebolt system

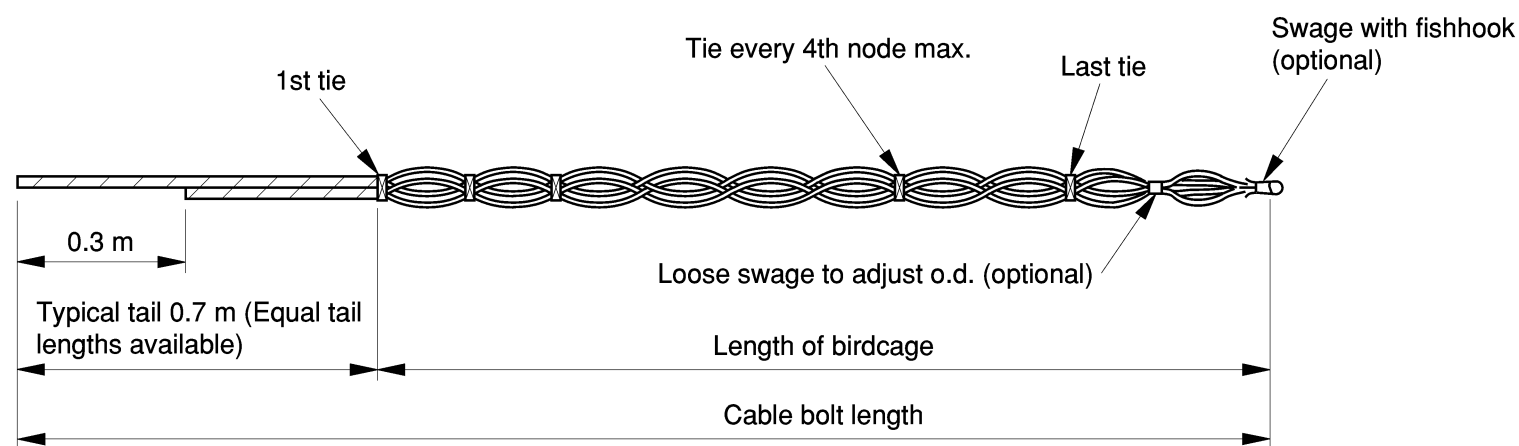
The system shall be tested for shear strength in accordance with Annex G. The shear strength shall exceed 350 kN.

7 Mechanical performance criteria

Type tests shall demonstrate that the mechanical performance criteria specified in 4.3.2, 5.4, 5.5, 5.6, 5.7, 6.1 and 6.2 can be achieved. The tests specified in 4.3.2, 5.5 and 5.7, together with the flow test specified in 5.4, shall also be performed on a routine basis.



a) Single birdcage



b) Double birdcage

c) Enlarged detail of swage & fishhook

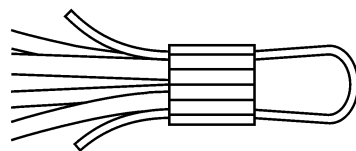


Figure 1 — Typical cablebolt arrangements