

AS 3751:2022



Underground mining — Slope haulage — Couplings, drawbars, and safety chains



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Preface

This Standard was prepared by the Standards Australia Committee ME-018, Mining Equipment, to supersede AS 3751—2005.

The objective of this document is to facilitate the implementation and maintenance of functional and safe couplings, drawbars, and safety chains in underground mines and to facilitate clear communication in the trade and governance thereof.

The major changes in this edition are as follows:

- (a) Corrections to minor errors identified in the previous revision.
- (b) Addition of design guidelines for loaded holes and pins, chase blocks and chain links.

In the preparation of [Appendices C, F and G](#), cognizance was taken of the 1983 British Coal document *Design Guide for Cage Suspension Gear*.

The terms “normative” and “informative” are used in Standards to define the application of the appendices to which they apply. A “normative” appendix is an integral part of a Standard, whereas an “informative” appendix is only for information and guidance.

Contents

Preface	ii
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Materials	3
4.1 Component type designation	3
4.2 Type A components	3
4.3 Type B components	3
4.4 Type C components	3
4.5 Type D components	4
4.6 Safety chains	4
5 Design	4
5.1 Static factor of safety	4
5.2 Axially loaded threaded components	4
5.3 Safety chains	4
6 Manufacture	4
6.1 All components	4
6.2 Type A components	5
6.3 Safety chains	5
6.4 Threads and nut locking	5
6.5 Protective coatings	5
6.5.1 Type A and Type C component	5
6.5.2 Type B and Type D components	5
7 Testing	5
7.1 General	5
7.2 Proof load test	6
7.2.1 Procedure	6
7.2.2 Pass criterion	6
7.3 Non-destructive test	6
7.3.1 Purpose	6
7.3.2 Procedure	6
7.3.3 Welds	6
8 Test certificates	6
8.1 Certificates required	6
8.2 Component certificates	6
8.3 Assembly test certificate	7
9 Marking	7
10 Usage	7
11 Inspection and maintenance	12
Appendix A (normative) Inspection and maintenance	13
Appendix B (informative) Ruling section and equivalent section	16
Appendix C (informative) Design guidelines for threaded components	19
Appendix D (normative) Requirements for steel for Type A components	21
Appendix E (normative) Permissible imperfections for magnetic particle inspection	25
Appendix F (informative) Design guidelines for loaded holes and pins	30
Appendix G (informative) Design guidelines for chase blocks	33

Appendix H (informative) Design guidelines for safety chain end links.....36

Bibliography 38

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Underground mining — Slope haulage — Couplings, drawbars, and safety chains

1 Scope

This document specifies requirements for materials, design, manufacture and use of couplings, drawbars, and safety chains that connect slope haulage conveyances in underground mines.

NOTE 1 Inspection and maintenance are covered in [Appendix A](#).

NOTE 2 Information on ruling section and equivalent section is given in [Appendix B](#).

NOTE 3 The design of threaded components are covered in [Clause 5.2](#) and [Appendix C](#).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document.

NOTE Documents referenced for informative purposes are listed in the Bibliography.

AS 1065, *Non-destructive testing—Ultrasonic testing of carbon and low alloy steel forgings*

AS 1275, *Metric screw threads for fasteners*

AS 1391, *Metallic materials — Tensile testing — Method of test at room temperature*

AS 1442, *Carbon steels and carbon-manganese steels—Hot rolled bars and semi-finished products*

AS 1444, *Wrought alloy steels—Standard, hardenability (H) series and hardened and tempered to designated mechanical properties*

AS 1447, *Hot-rolled spring steels*

AS 1448, *Carbon steel and carbon-manganese steels—Forgings (ruling section 300 mm maximum)*

AS 1544.2, *Methods for impact tests on metals, Part 2: Charpy V-notch*

AS 1710, *Non-destructive testing—Ultrasonic testing of carbon and low alloy steel plate and universal sections—Test methods and quality classification*

AS 1733, *Methods for the determination of grain size in metals*

AS 2074, *Cast steels*

AS 2321, *Short-link chain for lifting purposes*

AS B199, *Undercuts and runouts for screw threads*

AS/NZS 1050 (all parts), *Methods for the analysis of iron and steel*

AS/NZS 1554.1, *Structural steel welding, Part 1: Welding of steel structures*

AS/NZS 3678, *Structural steel—Hot-rolled plates, floorplates and slabs*

AS/NZS 3679.1, *Structural steel, Part 1: Hot-rolled bars and sections*

AS ISO 1302, *Geometrical product specifications (GPS)—Indication of surface texture in technical product documentation*

ISO 9934-1, *Non-destructive testing — Magnetic particle testing — Part 1: General principles*

3 Terms and definitions

For the purpose of this document, the following terms and definitions apply.

3.1

competent person

person who has acquired, through education, training, qualification or experience or a combination of these, the knowledge and skill enabling that person to perform the task required

3.2

conveyance

rail-mounted car, carriage or trolley, in which persons, minerals or materials are hauled in underground mines

3.3

coupling

attachment used to connect conveyances together to form a train

Note 1 to entry: It is usually a male/female assembly and may be fixed or pivoted (see [Figures 1 to 8](#)).

3.4

coupling pin

pin that connects the couplings or drawbars together

3.5

drawbar

attachment used to connect conveyances together to create a greater distance between them than if a coupling alone is used

Note 1 to entry: See [Figures 9 to 12](#).

3.6

may

indicates the existence of an option

3.7

pivot pin

pin that attaches the pivoted type coupling to the chassis of the conveyance

3.8

working load limit

WLL

maximum static load permitted to be carried by the coupling or drawbar

3.9

safety chain

chain, consisting of chain links and end links, that prevents the conveyance from separating in the event of a coupling failure

3.10

shall

indicates that a statement is mandatory

3.11

should

indicates a recommendation

3.12

slope haulage

any grade of trackwork on which traction effort cannot be achieved practicably by friction

3.13**static factor of safety**

ratio of the ultimate load of the coupling or drawbar to the working load limit

3.14**ultimate load**

minimum tensile load that will produce a complete functional collapse of the component assembly when applied to a coupling or drawbar

4 Materials**4.1 Component type designation**

The components of couplings and drawbars shall be designated Type A, Type B, Type C or Type D, in accordance with [Table 1](#).

NOTE Other designs of couplings and drawbars may be permitted.

Table 1 — Coupling and drawbar component types

Component	Component type designation ^a
Coupling body	A
Coupling pin	A
Coupling housing	B
Safety pin/top lifter	B
Coupling bolts	C
Buffer beam	A
Thrust/follower block	B
Pivot pin	C
Spring	D
Drawbar body	A
^a Components not included are designated Type B	

4.2 Type A components

All Type A components shall be manufactured from steel made by the open hearth, basic oxygen, or an electric process. The steel shall conform to the requirements of [Appendix D](#).

NOTE Additional refining by vacuum-arc-remelt (VAR), electroslag refining (ESR), or vacuum degassing is permitted.

4.3 Type B components

All Type B components shall be manufactured from steel conforming to AS/NZS 3679.1 Grade 250, Grade 300 or Grade 350, AS 1442 Grade 53, or AS 2074 Grade C3, or from steel conforming to the requirements of [Appendix D](#) or equivalent.

4.4 Type C components

All Type C components shall be manufactured from steel conforming to AS 1444 or equivalent.

4.5 Type D components

All Type D components shall be manufactured from steel conforming to AS 1447 Grade XK 9258 S or equivalent.

4.6 Safety chains

Safety chains shall be made from suitable material to ensure conformance to the factor of safety specified in [Clause 5.3](#).

5 Design

5.1 Static factor of safety

The static factor of safety shall be not less than 10, except for axially loaded threaded components (see [Clause 5.2](#)) and safety chains (see [Clause 5.3](#)).

5.2 Axially loaded threaded components

All axially loaded threaded components, which may carry a suspended load, shall have a static factor of safety of not less than 15.

Design guidelines for threaded components are given in [Appendix C](#).

5.3 Safety chains

All coupled conveyances shall be fitted with two safety chains of equal length attached to each conveyance by means of a hook or clevis. Each of the chains shall have a factor of safety of 10 where the WLL of each chain is not less than half the load between the coupled conveyances.

Design guidelines for safety chain end links are given in [Appendix H](#).

NOTE The chains should be installed such that —

- (a) they do not interfere with the free movement of the coupling or drawbar; and
- (b) they are clear of the track during normal operations.

6 Manufacture

6.1 All components

All components shall conform to the following:

- (a) Machining or grinding shall be carried out where necessary to ensure —
 - (i) suitable operation of the components and assembly;
 - (ii) the removal of stress-raisers and decarburization from highly stressed regions; and
 - (iii) satisfactory surface for any subsequent non-destructive examination.
- (b) Where machining is required, surfaces shall —
 - (i) be fully machined and finished so that the roughness is $R_a = 1.6 \mu\text{m}$ for mating surfaces or $R_a = 3.2 \mu\text{m}$ for outside surfaces, measured in accordance with AS ISO 1302; and

- (ii) be free from harmful nicks, burrs, deep machining and grinding marks.
- (c) Surfaces not requiring machining shall have surface finish of $R_a = 3.2 \mu\text{m}$ or better.

NOTE Machining should be done, where possible, in the direction of the service tensile stress.

6.2 Type A components

All Type A components shall conform to the following:

- (a) Plates shall be laid out so that the direction of service tensile stress is within 5° of the direction of rolling for the material.
- (b) For the profiling of plates by a burning or fusion process, the surface shall be machined or ground to remove all nicks and burrs.
- (c) Where welding is carried out, it shall be done in accordance with the requirements for AS/NZS 1554.1 Category SP.

6.3 Safety chains

Safety chains shall be manufactured from Grade T material in accordance with AS 2321.

Oblong end links of Type A material shall be used to absorb energy in the event of coupling failure (see [Figure 13](#)).

6.4 Threads and nut locking

Screw threads shall conform to AS 1275.

The portion of the shank adjacent to the shoulder shall have an undercut and fillet in accordance with Form A, Grade 1 of AS B199. All nuts shall be secured against loosening by effective means. If locking plates are used, their orientation shall be such that any fixing bolts are located in low stress areas of the components.

6.5 Protective coatings

6.5.1 Type A and Type C component

Type A and Type C components may be covered by paint or other inorganic coating. Such coatings shall not restrict normal movement of components.

The application of coatings that could affect the heat treatment of the components, such as hot-dipped galvanizing, shall not be used.

6.5.2 Type B and Type D components

Type B and Type D components may be coated as desired.

7 Testing

7.1 General

Each coupling and drawbar assembly and each safety chain, after manufacture, shall be subject to the proof load test (see [Clause 7.2](#)). Subsequently, each Type A and Type C component shall be subject to a non-destructive test (see [Clause 7.3](#)).

7.2 Proof load test

7.2.1 Procedure

Each assembly, which may consist of only one Type A or Type C component, shall be held between connectors of the correct size and a tensile force equivalent to 2.5 times the working load limit applied. Similarly, a tensile force equivalent to 1.5 times the working load limit shall be applied to safety chains.

7.2.2 Pass criterion

No component shall have suffered any permanent deformation that could adversely affect the function or mechanical properties of the component or assembly.

7.3 Non-destructive test

7.3.1 Purpose

The non-destructive testing shall be carried out to ensure that each Type A or Type C component is free from defects that could affect the mechanical properties of the component.

7.3.2 Procedure

Components shall be examined for surface discontinuities by magnetic particle inspection in accordance with ISO 9934-1. The acceptance level shall be as defined in [Appendix E](#).

7.3.3 Welds

The entire weld shall be examined for imperfections in accordance with the requirements for AS/NZS 1554.1 Category SP.

8 Test certificates

8.1 Certificates required

The following certificates shall be provided:

- (a) A component certificate relating to each Type A and Type C component.
- (b) An assembly certificate where applicable.

Each certificate shall bear —

- (i) the name and address of the manufacturer and of the testing establishment;
- (ii) the name, qualification, and status of the signatory; and
- (iii) the date of test.

A copy of each certificate shall be retained by the manufacturer and the supplier.

8.2 Component certificates

The component certificate shall state the following information:

- (a) Serial number of component.
- (b) Description of component.

- (c) Conformance of material grade, heat treatment, and mechanical properties to this document.
- (d) Details of magnetic particle inspection as relevant.

The certificate shall declare that the component has been inspected by a responsible and competent person and conforms to the requirements of the non-destructive test.

8.3 Assembly test certificate

The assembly test certificate shall state the following information:

- (a) Type of equipment.
- (b) Working load limit, in tonnes.
- (c) Serial number of each component.
- (d) The proof load, in tonnes.
- (e) The total mass of the assembly, in kilograms.

The certificate shall declare that the assembly —

- (i) has been inspected by a responsible and competent person;
- (ii) conforms to the proof load test and any other test required by this document; and
- (iii) has a static factor of safety conforming to this document.

9 Marking

Each component shall be permanently and legibly marked with the serial number of the component. One prominent component of each assembly shall be marked with the following additional information:

- (a) Manufacturer's identification.
- (b) The working load limit, in tonnes.
- (c) Date of proof test.

The marks shall be neither too sharp nor too deep. The symbols shall be as large as practicable, but not less than 5 mm high.

Marking of a Type A or Type C component shall be in a low stress area.

NOTE Manufacturers making a statement of conformity with this Australian Standard on a product, or on packaging or promotional material related to that product, are advised to ensure that such conformance is capable of being verified.

10 Usage

Couplings and drawbars are generally used to connect conveyances in slope haulage rail systems. As well, couplings and drawbars may be used to connect conveyances for travel within the mine, in which case the drawbars (see [Figures 1, 6, 9, 10, 11 and 12](#)) should not be subjected to excessive compressive forces.



Figure 1 — Male coupling pivoting horizontally

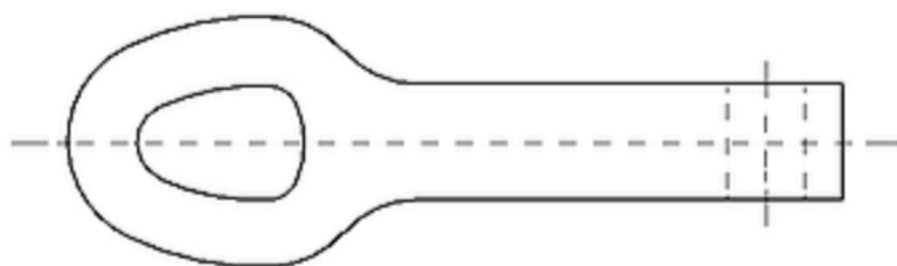


Figure 2 — Male coupling pivoting vertically

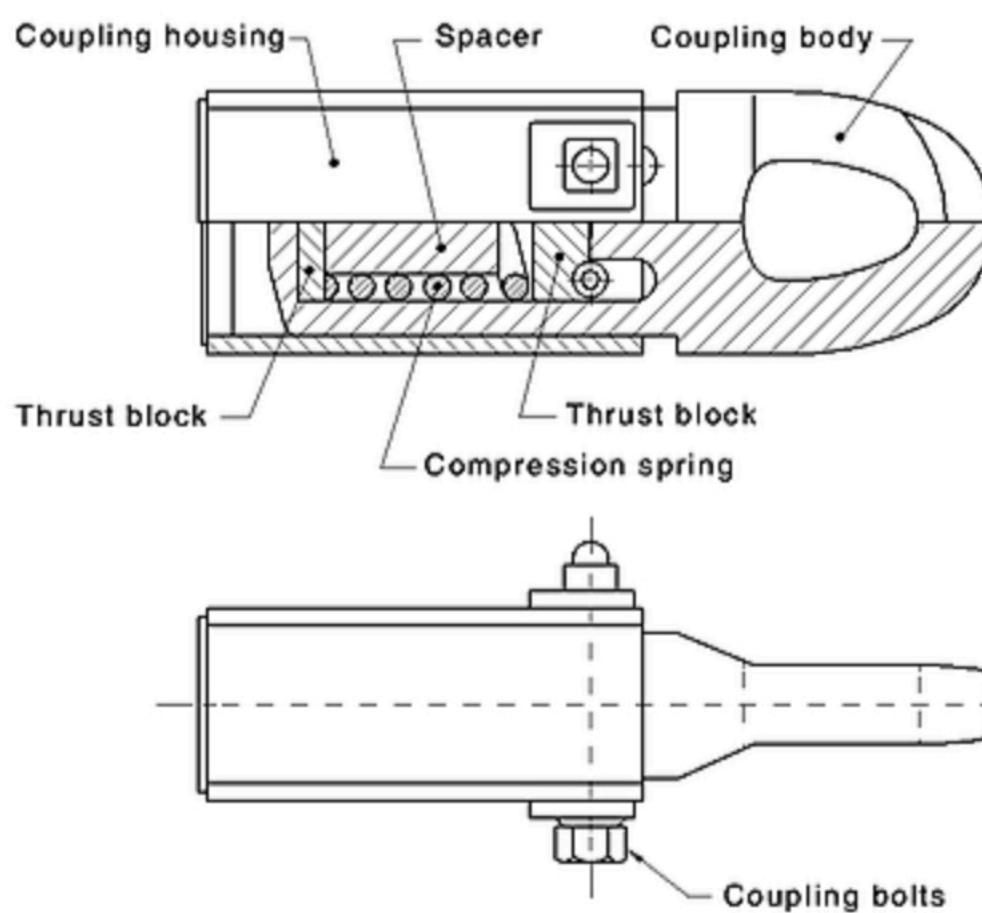


Figure 3 — Male coupling — Spring-cushioned, fixed