

AS/NZS 1747:2022



Australian/New Zealand Standard™

Reeling, trailing and feeder cables used for mining — Repair, testing and fitting of accessories



AS/NZS 1747:2022

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Australian/New Zealand Standard™

Reeling, trailing and feeder cables used for mining — Repair, testing and fitting of accessories

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Preface

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EL-023-03, Cables, Couplers and Receptacles, to supersede AS/NZS 1747:2003, *Reeling, trailing and feeder cables used for mining—Repair and testing*.

The objective of this document is to provide standard procedures for the repair and testing of reeling, trailing and feeder cables used in mining applications, and to establish requirements for the repair of cables which will ensure that the repaired cable is returned to a condition as near as possible to the original design. It also sets out requirements for the fitting of accessories to these cables.

This document differs from the previous edition in the following significant ways:

- (a) Reference to AS/NZS 60079 standards has been included.
- (b) Definitions for Competent Person, Responsible Person, Insulation Earth Screens, Insulation Stress Relief Screens and Twist Test have been included.
- (c) The reference to Spark test has been changed to Sheath Test throughout this standard.
- (d) *Details of cable to be recorded*, AS/NZS 1747:2003 section 2.3, has been deleted.
- (e) A new [Clause 2.5](#), *Inspection of cable accessories*, has been included.
- (f) A new [Clause 3.7](#), *Joining pilot conductors and control conductors other than reeling cables*, has been included.
- (g) A new [Clause 3.11](#), *Joining of PILSWA and XPLE armoured cables*, has been included.
- (h) A new [Clause 3.19](#), *Replacement of outer rubber sheath only*, has been included.
- (i) A new [Clause 3.20](#), *Replacement/repair of PVC outer sheath*, has been included.
- (j) Plug inspections have been divided into [Clauses 4.2](#), *Plug inspection external*, 4.3, *Plug inspection internal*, 4.4, *Flamepath inspection*, and 4.5, *Tail inspection*.
- (k) The phase rotation of power conductors in plugs has been defined.
- (l) Flameproofing has been changed to explosion protection.
- (m) A new [Clause 5.2](#), *HV Connections*, has been included.
- (n) The high voltage proof test voltage for 1.1kV cables has been increased from 3.5kV DC to 5kV DC.
- (o) A new [Clause 5.3](#), *Discharge times*, has been included.
- (p) The application of fault location pulses has been changed.
- (q) A test time has been included to the High voltage proof test table.
- (r) A new [Table 5.8](#) *Test voltages for high voltage proof test on PILSWA and XLPE cable*, has been included.
- (s) New connection diagrams have been included for insulation tests and proof testing.
- (t) The minimum insulation resistance value for 1.1kV cables has been increased to 250 mΩ.
- (u) Testing of pilot conductors now includes control cores.
- (v) Test times have been included to the minimum insulation resistance table.
- (w) The practicability of symmetrical load and Partial break testing has been included.

- (x) New marking codes for outer sheath repair, single ferrule and long hand splice have been included in [section 6](#).
- (y) AS/NZS 1747:2003 section 7, *Temporary sheath repairs*, has been deleted.
- (z) A new [Section 7](#), *Responsible person*, has been included.
- (aa) [Appendix A](#) has been expanded and a rating matrix has been included in [Appendix G](#).
- (bb) [Appendix F](#) has been amended.
- (cc) Discharge stick and earth bridging leads have been included in [Appendices H](#) and [I](#).
- (dd) AS/NZS 1747:2003 Appendix J, *Combined resistance of earth conductors*, has been deleted.
- (ee) New [Appendix J](#) has been included for measuring equipment.

The terms 'normative' and 'informative' have been used in this Standard to define the application of the appendix to which they apply. A 'normative' appendix is an integral part of a Standard, whereas an 'informative' appendix is only for information and guidance.

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Australian/New Zealand Standard

Reeling, trailing and feeder cables used for mining — Repair, testing and fitting of accessories

Section 1 Scope and general

1.1 Scope

This document sets out requirements for the repair and testing of reeling, trailing and feeder cables used in underground coal mines, metalliferous mines, open cut mines, tunnelling, quarries and dredges. This document also details the requirements for the inspection, fitting and replacement of plugs, couplers fitted to the cables and for the test equipment used for testing cables.

Where type or code numbers are referred to in this document for cables, the numbers are as specified in AS/NZS 1802, AS/NZS 2802 and AS/NZS 1972.

NOTE 1 The Standard applies particularly to reeling and trailing cables conforming to AS/NZS 1802 and AS/NZS 2802, and to cables with similar constructions conforming to AS/NZS 1972, but is not restricted in application to such cables.

NOTE 2 Where reference is made to “PVC”, in respect to the sheath of the cable, the reference is valid for any of the alternative thermoplastic sheath materials.

NOTE 3 Where reference is made to plugs in this standard, it also refers to receptacles, bolted couplers and adaptors.

1.2 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.

AS 1683.15.2, *Methods of test for elastomers, Method 15.2: Durometer hardness*

AS 1834.1, *Material for soldering, Part 1: Solder alloys*

AS/NZS 1299, *Electrical equipment for mines and quarries — Explosion-protected three-phase restrained plugs and receptacles for working voltages up to and including 3.3. kV*

AS/NZS 1300, *Electrical equipment for mines and quarries — Bolted explosion-protected three-phase cable coupling devices*

AS/NZS 1802, *Electric cables — Reeling and trailing — For underground coal mining*

AS/NZS 1972, *Electric cables — Underground coal mines — Other than reeling and trailing*

AS/NZS 2802, *Electric cables — Reeling and trailing — For mining and general use (other than underground coal mining)*

AS/NZS 60079.7, *Explosive atmospheres, Part 7: Equipment protection by increased safety ‘e’*

1.3 Terms and definitions

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

1.3.1

arduous flexing

cable under constant flexing up to but not exceeding its minimum bend radius

1.3.2**bunch**

number of wires all of which are twisted together in the same direction and with the same length of lay throughout

1.3.3**bolted coupler**

device consisting of a body and cable gland, together with means for connecting the cable conductors to insulated contact sockets within the body

Note 1 to entry: The full description in AS/NZS 1300 is 'bolted flame-proof cable coupling device'.

1.3.4**cable repair facility**

facility for carrying out cable repair and testing to recognized standards

1.3.5**competent person**

person who can demonstrate a combination of knowledge, skills and experience to effectively, efficiently and safely carry out all activities related to this document and provide supervision of operatives undertaking test and repair activities of trailing, reeling and feeder cables

1.3.6**composite screen**

screen comprising copper wires or stranded or bunched copper wires applied in one direction and interwoven in the opposite direction with polyethylene terephthalate yarn, or equivalent yarn

1.3.7**conductor screen**

layer of non-metallic semiconductive material applied directly over the power conductor for the purpose of equalising stress through the insulation layer

1.3.8**core**

assembly comprising a conductor and insulation and where applicable, including the conductor screen, insulation screen, metallic screen, and tape over the screen

1.3.9**cradle separator**

shaped section of elastomeric material designed to support the core assembly, fill the centre interstice and provide a specified separation between individual power cores

1.3.10**direction of lay**

slope direction of the conductor wire, bunch, core screen or armour strand, when the stranded conductor or cable is held vertically. It is right-hand when the slope is in the direction of the central part of the letter Z, and left-hand when the slope is in the direction of the central part of the letter S

1.3.11**earth conductor**

conductor, metallic or composite earth screen included in the cable for the purpose of providing earth continuity

1.3.12**feeder cable**

cable intended for use between a transportable substation and associated equipment

Note 1 to entry: For example, distribution control box or distribution centre

1.3.13**ferrule**

metal tube used for joining of earthing conductors, bunches, wires, strands and armour

1.3.14**history record**

record of all of the test and repair actions throughout the life of the cable

1.3.15**insulation screen**

insulation stress relief screen and/or an insulation earth screen

1.3.15.1**insulation earth screen**

layer applied directly over the power core insulation for the purpose of providing a fault current path to earth

1.3.15.2**insulation stress relief screen**

semiconductive layer applied directly over the power core insulation for the purpose of providing electrical stress relief through the insulation

1.3.16**length of lay**

axial length of one complete turn of the helix formed by a cable component, e.g.—

- (a) a bunch of a multiple stranded conductor;
- (b) a conductor of a laid-up core assembly; or
- (c) the strands of a pliable armour in a cable

1.3.17**multiple (or rope) strand**

group of bunches laid up helically and symmetrically so that within any one layer the length of lay of any given bunch is uniform

1.3.18**operative**

person who can demonstrate a combination of knowledge, skills and experience to effectively and safely carry out activities relevant to a specific task related to this document

1.3.19**partial break tester**

device used to locate broken wires in a cable

1.3.20**pilot/control core**

insulated conductor for use in conjunction with a protection or other control system

1.3.21**plastic welding**

process of creating a molecular bond between two compatible thermoplastics

1.3.22**power core**

conductor with insulation of the appropriate voltage grade including, where applicable, semiconductive and composite screens

1.3.23**proofed tape**

tape used under copper braids for cushioning against the power core insulation or for protection of interstitial insulation from abrasion against power core copper braids

1.3.24**reeling and trailing cable**

cable having flexible conductors, insulation incorporating conductor and insulation screens where appropriate, filling, reinforcement where appropriate, and protective coverings, and specially designed to provide a flexible electrical connection between portable or mobile equipment and a point of supply

1.3.24.1**reeling cable**

cable specially designed for continual reeling, unreeling, and flexing

1.3.24.2**trailing cable**

cable specially designed for being trailed behind a moving machine

1.3.25**replacement**

restoration of the equipment to meet its original specification by renewing missing, worn, broken or damaged parts

1.3.26**responsible person**

competent person who also assumes the responsibility for the management, review and accuracy of all information contained in inspections, reports and documents for a repaired cable

1.3.27**restrained plug**

that portion of a restrained plug and receptacle having contacts consisting of sockets and which is attached to a trailing cable and is designed for engagement within the receptacle

1.3.28**restrained receptacle**

that portion of a restrained plug and receptacle, having contacts consisting of pins, which is designed to receive the plug

1.3.29**screened cable**

cable in which the insulation of all conductors are collectively enclosed in a conductive layer or where the insulation of conductors are separately enclosed in a conducting layer, or both

1.3.30**semiconductive elastomer**

rubber-like material with conductive properties

1.3.31**sheath****1.3.31.1****inner sheath**

component of a cable which is applied immediately over the core assembly to protect the cores against mechanical damage from the armouring or collective metallic screen

1.3.31.2**outer sheath**

outermost component of a cable which encloses the underlying components and protects them against damage

1.3.32**sheath test**

test used to detect defects and damage such as pinholes in the outer sheath of a cable

1.3.33**strand**

assembly of wires laid up helically in one or more layers

1.3.34**vulcanizer**

device used to provide the necessary heat and pressure to effectively vulcanize and mould the raw core and sheath repair materials and bond them to the original material of the cable

1.3.35**wires**

metal drawn in a circular cross-section into the form of a thread or rod that make up bunches and strands

Section 2 Evaluation before repair and history record

2.1 Requirements

Prior to any testing or repair of a cable, the requirements of this Section shall be met.

2.2 History record

A history record shall be prepared and maintained for each cable in use, containing as a minimum all the information which is listed in [Appendix A](#). Every repair facility shall keep its own records of cable history. These shall be examined before any testing or repair is carried out.

2.3 Visual examination

A visual examination shall be made of the cable to be repaired and any obvious damage (e.g. cuts, severe abrasions, previous repair deterioration, extent of corkscrewing, etc) and general condition of the cable shall be noted.

2.4 Pre-repair tests

All appropriate tests detailed in [Clauses 5.5.1](#) to [5.5.2](#) inclusive shall be carried out before any repairs are performed.

2.5 Inspection of cable accessories

All appropriate inspections as detailed in [Clauses 4.1](#) to [4.4](#) shall be carried out before any repairs are performed.

2.6 Practicability of repair

If, at any stage during the visual examination and pre-repair tests, the cable is assessed as unfit for repair and further use, this assessment shall be recorded on the history record and reported to the owner of the cable.

NOTE Guidance for assessing a cables condition is given in [Appendix G](#).

Section 3 Repair procedures for cables

3.1 Compatibility of cables to be joined

Except for XLPE and PILSWA cable, cables of unlike cable type, manufacturer, materials, voltage rating, construction or conductor size shall not be joined to one another.

3.2 Use of cleaning solvents

A suitable residue free solvent may be employed to clean the cable during the repair and for removal of flux.

3.3 Joining by ferrules

3.3.1 Ferrules

Ferrules used for joining conductors, bunches in conductors, wires or strands in screens and armouring, shall conform to the requirements of [Appendix B](#).

Where a single bunch or strand is joined by a single ferrule (see [Figures 3.2, 3.6 and 3.7](#)) the ferrule shall be of cylindrical form. Where more than one bunch or strand is joined by a single ferrule (see [Figures 3.3, 3.4, 3.9 and 3.11](#)), the ferrule shall be shaped as illustrated in [Appendix B](#).

3.3.2 Solder and flux

The solder and flux shall conform to [Appendix C](#).

3.3.3 Technique

When in position the ferrules shall be soldered so that any solder migrating beyond either end of the ferrule is kept to a minimum and shall be confined to the joint being made. Solder shall not be allowed to run through to other bunches, strands or wires. Any excess solder on or around the ferrule shall be removed.

The application of flux shall be confined to the actual area being soldered. Avoid placing any flux, especially liquid corrosive flux, on the insulation, sheath or other non-metallic components of the cable. Any residue of flux which remains after soldering shall be carefully removed.

3.4 Joining by exothermic welding

The procedure for exothermic welding is given in [Appendix D](#).

3.5 Joining by hard soldering

A procedure for hard soldering is given in [Appendix E](#).

3.6 Joining pilot and control conductors (for reeling cables)

3.6.1 Single central (extensible) pilot conductors

Single central pilot conductors shall be joined in a manner which does not reduce its conductivity or mechanical strength and does not significantly reduce the extensibility and the flexibility of the conductor.

The methods of joining pilot conductors are by a sheet bend knot or soldered reef knot, as shown in [Figure 3.1](#).

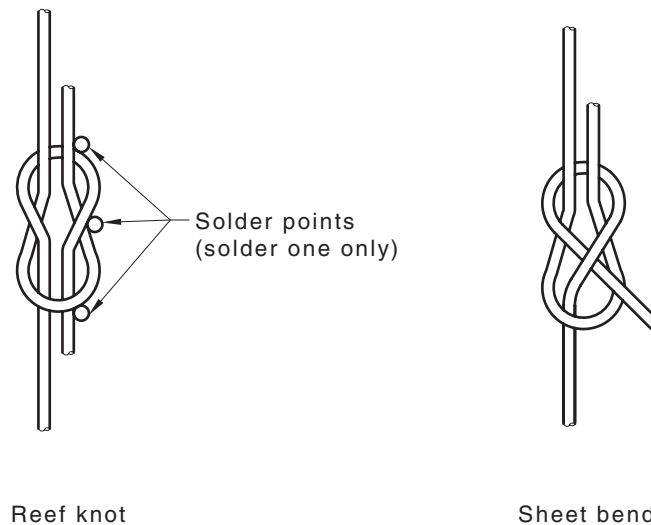


Figure 3.1 — Methods of joining central (extensible) pilot conductor

3.6.2 Multiple central pilot conductors

Each conductor may be joined by a single ferrule. The spacing between ferrules shall be at least 25 mm.

3.6.3 Interstitial pilot and control conductors

Interstitial pilot and control conductors shall be joined in the manner specified for earth conductors in [Clause 3.9](#).

3.7 Joining pilot and control conductors (other than reeling cables)

Single central pilot conductors shall be joined in a manner which does not reduce their conductivity or mechanical strength and does not significantly reduce the extensibility and the flexibility of the conductor.

Single central pilot conductors in cables can be joined as specified in [Clause 3.6.1](#) and can also be joined by use of a soldered ferrule. The ferrule shall conform to the requirements of [Appendix B](#). Solder shall conform to the requirements of [Appendix C](#).

3.8 Joining power conductors of all reeling and trailing cables

3.8.1 Power conductors having less than 19 bunches

Power conductors having less than 19 bunches shall be joined by ferrules conforming to [Appendix B](#) and be soldered in accordance with [Clause 3.3](#) or may be joined by hard soldering in accordance with [Clause 3.5](#).

The bunches of the conductor shall be joined individually, i.e. one ferrule per bunch.

Where there is a centre bunch, e.g. 7-bunch conductor, the ferrule for the centre bunch shall not be adjacent to a ferrule used for joining any bunch in the adjoining layer.

The centre to centre spacing between ferrules in the same layer be at least 50 mm. The following example is for a conductor comprising 7 bunches:

- (a) The centre single bunch is joined by one ferrule.

- (b) The outermost layer of six bunches is joined one ferrule per bunch, so that the six ferrules are approximately equally spaced. The ferrule of the centre bunch is somewhere between but not adjacent to these six ferrules.

3.8.2 Power conductors having 19 or more bunches

Power conductors having 19 or more bunches or a cross-sectional area greater than 50 mm² shall be joined by ferrules conforming to [Appendix B](#) and be soldered in accordance with [Clause 3.3](#) or may be joined by hard soldering in accordance with [Clause 3.5](#).

Where the centre consists of a single bunch it shall be joined individually, i.e. one ferrule for the centre bunch alone. In all other cases not more than two bunches may be joined in any one ferrule. No ferrule shall be adjacent to any other ferrule in any adjoining layer.

For joints having one or more bunches per ferrule in any layer, the centre to centre spacing between ferrules shall be at least 25 mm. The following example is for a conductor comprising 19 bunches:

- (a) The centre bunch is joined by one ferrule (see [Figure 3.2](#)).
- (b) The middle layer of six bunches is joined with one or two bunches per ferrule, so that the ferrules are approximately equally spaced. The ferrule of the centre bunch is somewhere between but not adjacent to these ferrules (see [Figure 3.3](#)).
- (c) The outermost 12 bunches are joined with one or two bunches per ferrule, so that the ferrules are approximately equally spaced. The ferrules in the middle layer of bunches are somewhere between but not adjacent to the ferrules in the outer layer (see [Figure 3.4](#)).

Power conductors equal to or greater than 50 mm², other than those for arduous flexing applications, may be joined by the method specified in [Clause 3.9](#).

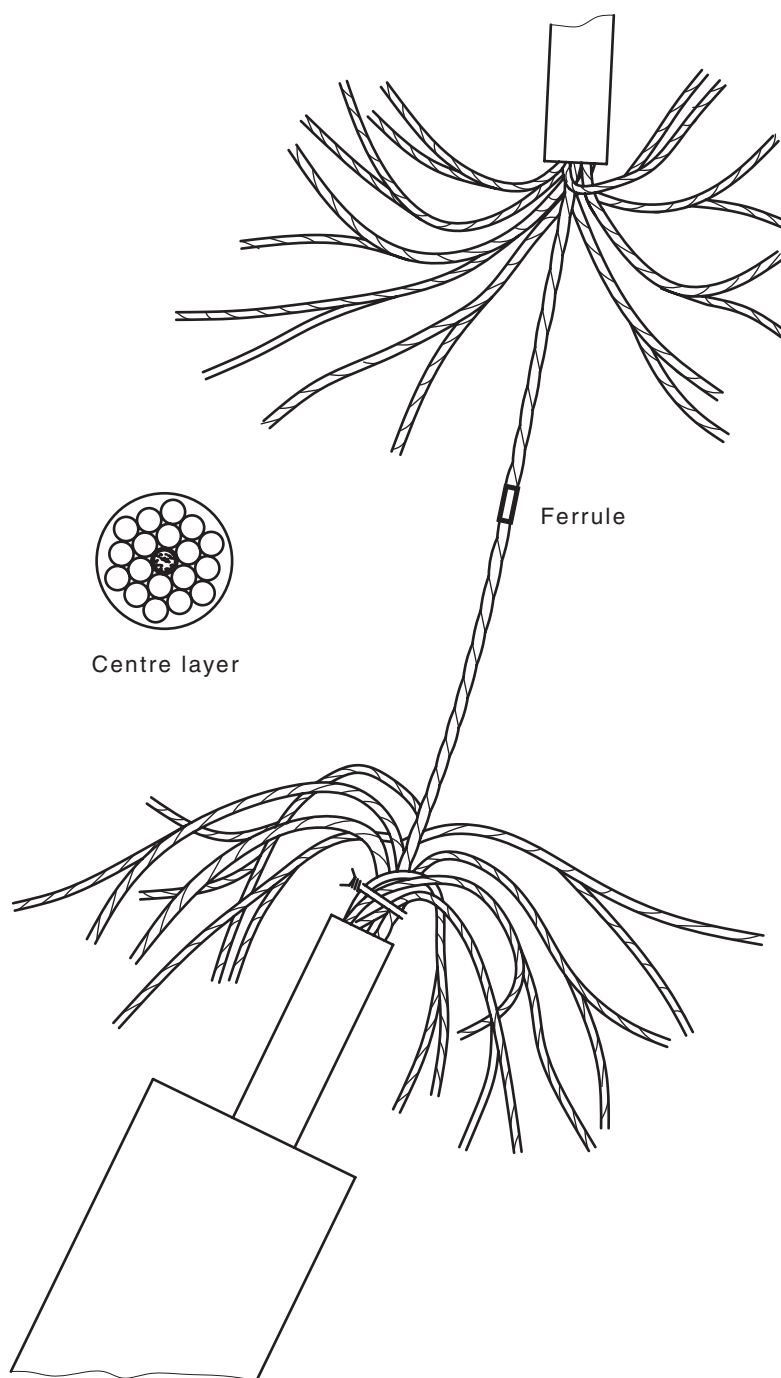


Figure 3.2 — Joining centre bunch of a 19-bunch power conductor

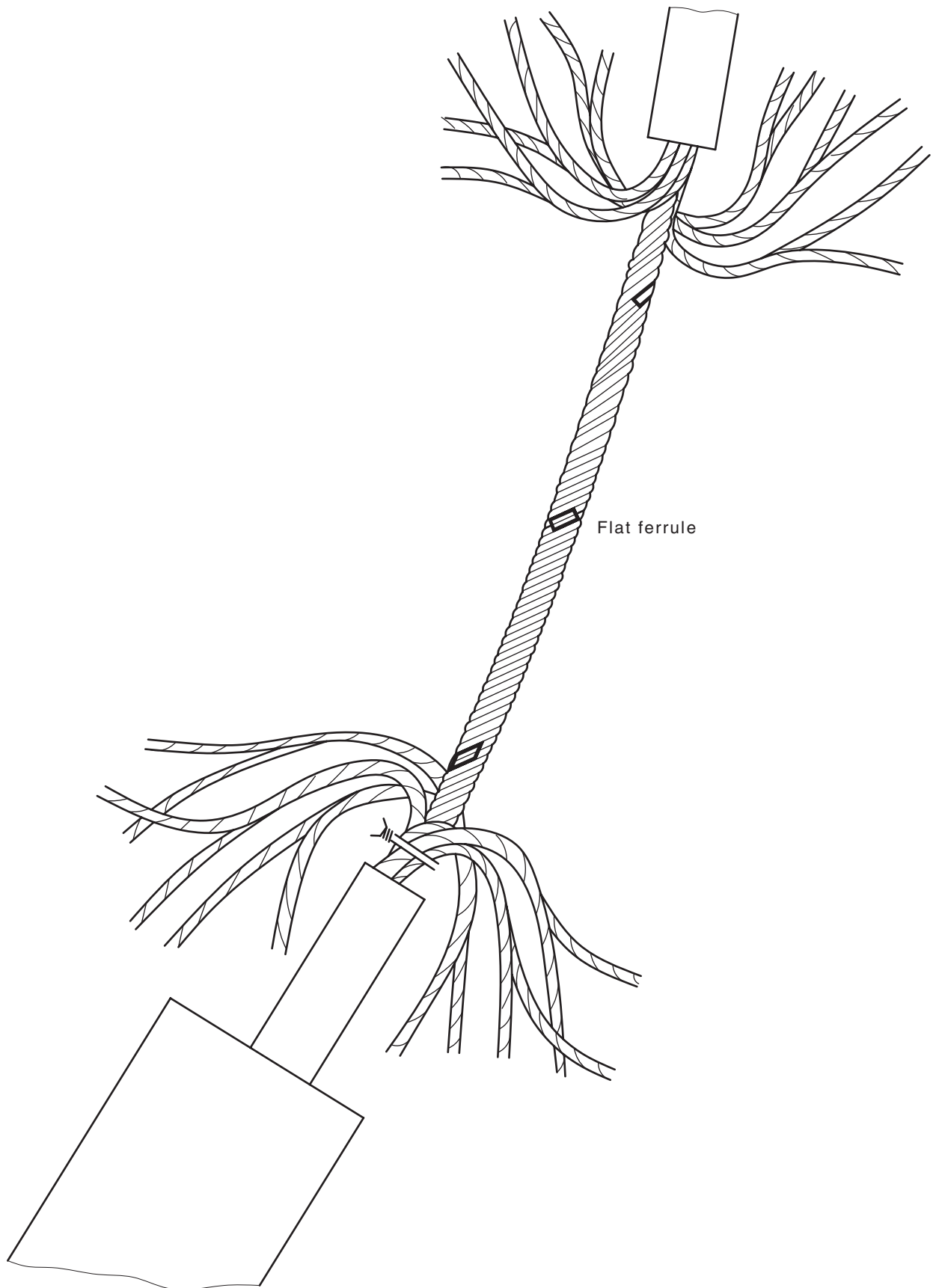


Figure 3.3 — Joining middle layer of six bunches of a 19-bunch power conductor

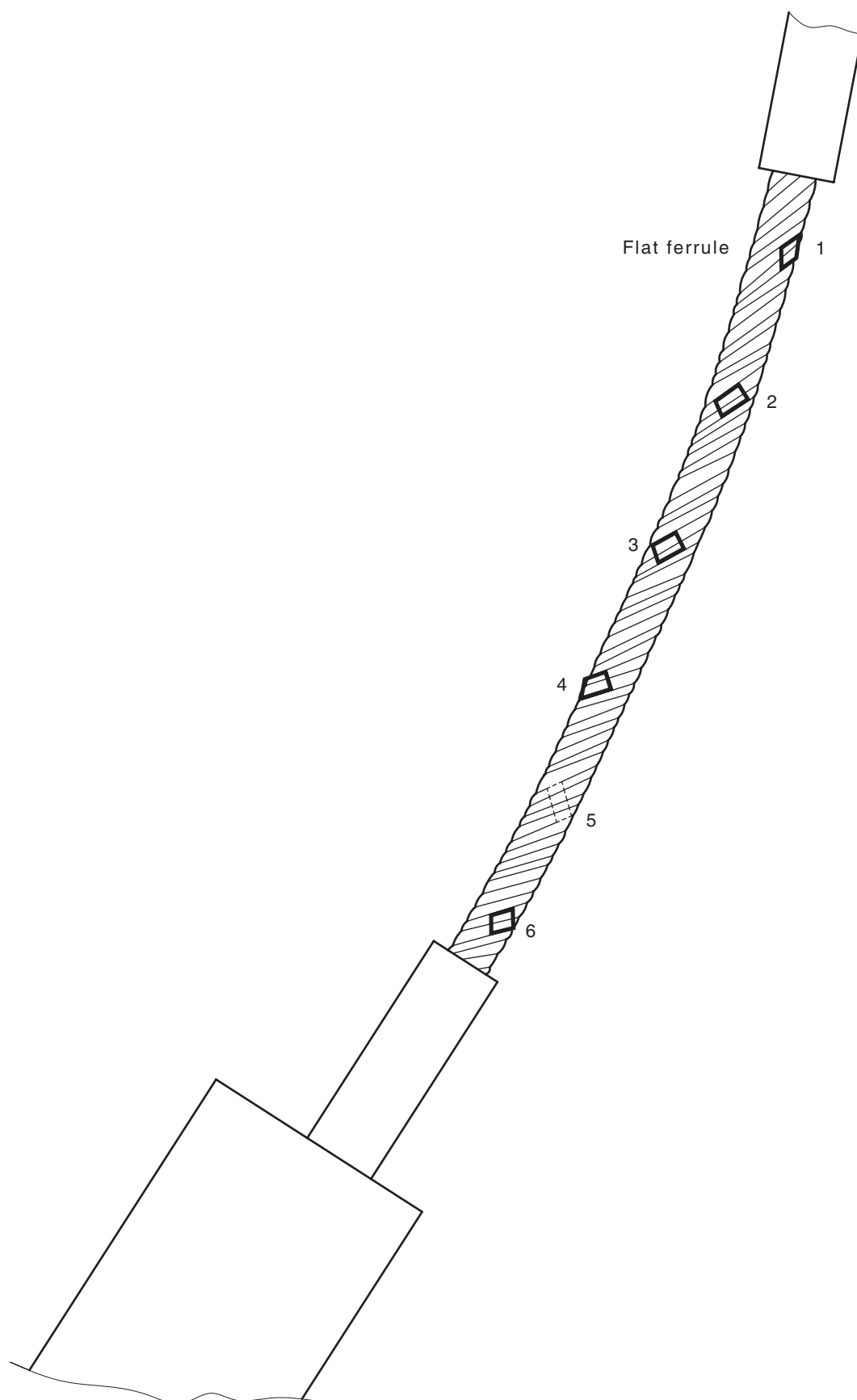


Figure 3.4 — Joining outermost 12 bunches of a 19-bunch power conductor

3.9 Joining power conductors of feeder cables

The power conductors of feeder cables may be joined in accordance with [Clause 3.3](#) (with the individual wires in the conductor representing the bunches) or the conductor may be joined as a whole by a single ferrule, as illustrated in [Figure 3.5](#), or by exothermic welding (see [Appendix D](#)).

For a joint having a single ferrule per conductor, the spacing of ferrules in each of the power conductors of the cable shall be such as will ensure that the distance between any two ferrules is at least equal to one-third of the length of lay of the power conductors.

Where exothermic welding method is used to join the conductor as a whole, the joint spacing specified above need not apply.

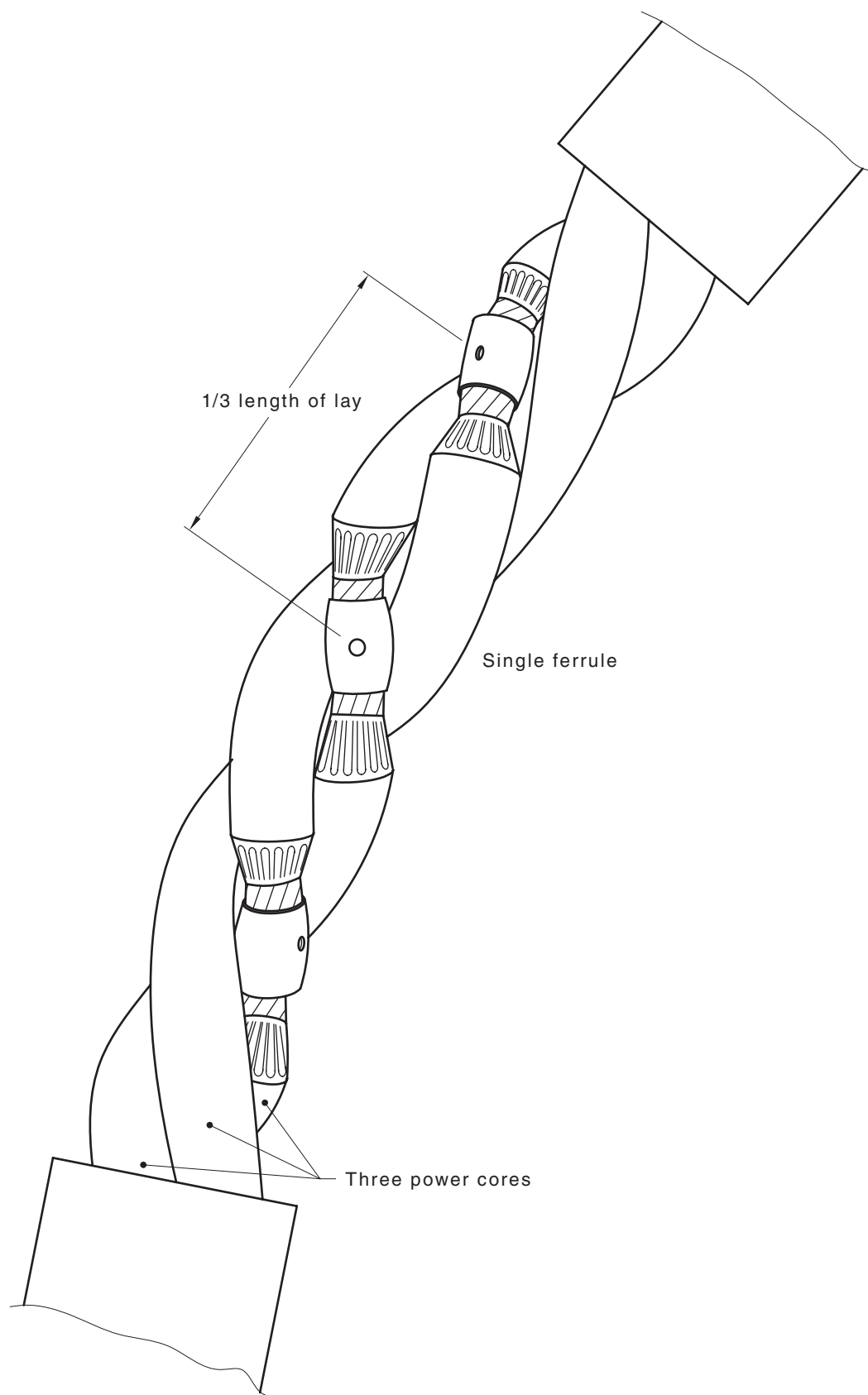


Figure 3.5 — Typical example of joining power conductors as a whole with ferrules

3.10 Joining earth conductors (excluding earth screens)

Earth conductors shall be joined by ferrules conforming to [Appendix B](#) and shall be soldered in accordance with [Clause 3.3](#).

Every bunch of the conductor shall be joined individually, i.e. one ferrule per bunch.

For 3 and 5 bunch earth conductors, the distance between any two ferrules shall be at least twice the length of lay of the conductor.

For earths with 7 bunches or more, no ferrule shall be adjacent to any other ferrule in any adjoining layer. The distance between any two ferrules shall be at least the length of lay of the conductor.

[Figure 3.6](#) shows a recommended method for joining a 3-bunch earth conductor and [Figure 3.7](#) shows that for a 7-bunch conductor.

For surface mining applications exothermic, hard soldering or single ferrule techniques may be used in accordance with [Clause 3.9](#).