BRITISH STANDARD

BS 4579-2: 1973

CONFIRMED DECEMBER 1990

Specification for

The performance of mechanical and compression joints in electric cable and wire connectors —

Part 2: Compression joints in nickel, iron and plated conductors

UDC 621.315.683.001.42: [621.317.33+620.172] + 621.315.683:621.315.55: [669.3 + 669.14 + 669.24]

Co-operating organizations

The Electrical Industry Standards Committee under whose supervision this British Standard was prepared consists of representatives from the following Government departments and scientific and industrial organizations:

Associated Offices Technical Committee
Association of Consulting Engineers
Association of Manufacturers of Domestic Electrical Appliances
Association of Mining Electrical and Mechanical Engineers
Association of Supervisory and Executive Engineers
British Electrical and Allied Manufacturers' Association
British Radio Equipment Manufacturers' Association
British Steel Corporation
British Railways Board
Crown Agents for Oversea Governments and Administrations
Department of Employment
Department of the Environment (H.M. Factory Inspectorate)
Department of Trade and Industry
Electric Cable Makers' Confederation*
Electrical Contractors' Association (Incorporated)*
Electrical Contractors' Association of Scotland
Electrical Research Association
Electricity Council, the Central Electricity Generating Board and the Area Boards in England and Wales*
Electronic Engineering Association
Engineering Equipment Users' Association
Institution of Electrical Engineers
Institution of Electrical and Electronics Technician Engineers
Lighting Industry Federation Limited
Ministry of Defence
National Inspection Council for Electrical Installation Contracting
National Physical Laboratory (Department of Trade and Industry)
Oil Companies Materials Association
Post Office
South of Scotland Electricity Board

The industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

Association of Manufacturers Allied to the Electrical and Electronic industry
British Ship Research Association
Electrical Installation Equipment Manufacturers' Association

This British Standard, having been approved by the Electrical Industry Standards Committee was published under the authority of the Executive Board on 17 October 1973

The following BSI references relate to the work on this standard:
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Draft for comment 68/32939

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Amendments issued since publication

Amd. No.	Date of issue	Comments
2048		Indicated by a sideline in the margin

Contents

Foreword

This British Standard has been prepared under the authority of the Electrical Industry Standards Committee. It is based on proposals submitted by the British Electrical and Allied Manufacturers' Association.

— *Part 2 of the standard is concerned with compression jointing of nickel, nickel alloy, iron, plated iron and plated copper conductors.*

— *Part 1 of the standard relates to copper conductors and a further part of the standard will apply to cable and wire connectors for use with aluminium conductors.*

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 part of the standard specifies requirements for the performance of compression joints in electric cable and wire connectors for use with conductors for normal continuous operation at elevated temperatures forming parts of factory-built electrical equipment and for associated site installation work.

The conductors for which the connectors are suitable may be stranded or solid and up to and including 1 000 mm^2 in plated copper or up to and including 6 mm^2 in nickel, nickel alloy, iron or plated iron. The copper conductors may be plated with tin, silver or nickel and the iron conductors with nickel.

For the purpose of this part of the British Standard, the range of joint operating temperature is divided into three classes.

Class 1 above 85 °C up to and including 130 °C

Class 2 above 130 °C up to and including 210 °C

Class 3 above 210 °C[1)]

This part of the British Standard does not apply to the following connectors or joints:

1) compression joints on copper conductors with an operating temperature up to 85 °C, for which reference should be made to BS 4579-1.

2) thermocouple cable joints;

3) joints conforming to the requirements of BS 2G 178;

4) fittings complying with the requirements of BS 3288.

NOTE The titles of the British Standards 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:

connector

a lug, tag, ferrule or other device with a barrel or socket at one or both ends to accommodate an electrical conductor with or without additional provision to secure the insulation

compression jointing

a method of firmly attaching a connector to a conductor by pressure forming or reshaping the barrel in association with the conductor to establish good electrical and mechanical contact

joint

the connector barrel and that portion of conductor which have been brought into intimate contact by the compression jointing process

test specimen

a length of uninsulated conductor terminated at both ends by means of joints of the same type. For the purposes of this definition, a ferrule is taken as having two joints

3 Test specimens

3.1 Preparation. The conductor shall be prepared and the joint shall be formed with the tools and in accordance with the instructions and drawings of the connector manufacturer.

In the case of ferrules, care shall be taken to ensure that the ends of the conductors are not in direct contact (see Figure 1).

3.2 Number. Six specimens shall be prepared for each type and size of joint and for each combination of conductor material and connector. When a connector has a barrel declared to accept a range of conductors, there shall be six specimens of both the smallest and largest sizes of conductors in the declared range for any particular compression tool or die.

3.3 Length. The shortest practicable free length of conductor should be used (see Figure 1), but shall be not less than that shown below.

Conductors up to but excluding 95 mm^2 cross sectional area	150 mm
Conductors of 95 mm^2 and up to and including 1 000 mm^2 cross sectional area	300 mm

4 Sequence of tests

Before the tests are made, the testing organization shall satisfy itself that the test specimens comply with the requirements of section 3.

Tests on each specimen shall be made in the following sequence:

1) initial resistance measurement by procedure stated in **5.1**;

2) temperature cycling (first 500 cycles) by procedure stated in **5.2**;

3) datum resistance measurement by procedure stated in **5.1**;

4) temperature cycling (second 500 cycles) by procedure stated in **5.2**;

[1)] Joints operating above 210 °C will require very special attention and the actual maximum temperature for testing particular joints will require knowledge of its applicability. For this reason, no specific value of maximum temperatures are given.

5) final resistance measurement by procedure stated in **5.1**;

6) tensile strength test by procedure stated in **5.3**.

5 Test procedure

5.1 Resistance measurement. The resistance of each specimen shall be ascertained by the use of two probes. In the case of a lug or tag, the probes shall be placed on the intersection of the palm and the barrel as shown in Figure 1(a). In the case of a ferrule, the probe shall be placed at the mid point as shown in Figure 1(b). In both cases, care shall be taken to ensure that the probes do not touch the ends of the conductor.

The resistance per unit length of the conductor to be used during the test shall be ascertained using as long a length as reasonably practicable.

For the purpose of the test, the joint resistance shall be regarded as that determined by subtracting from the specimen resistance the resistance of the free length of conductor between the joints and then dividing the result by two.

The devices and instruments used for resistance measurement shall have an error of 1 % or less, and the through-current used by the instrument shall be such that it does not materially affect the temperature of the test specimen.

All resistance measurements shall be taken at any convenient temperature between 15 °C and 25 °C.

5.2 Temperature cycling

5.2.1 All test specimens shall be subjected to temperature cycling, that is, a cycle comprising a "heat on" period followed by a "heat off" period.

5.2.2 During the "heat on" period, the temperature of the conductor in the specimen shall be raised to a minimum temperature corresponding to the appropriate classification as follows and held at or above this temperature for not less than 5 minutes.

Class 1	150 °C
Class 2	230 °C
Class 3	To be agreed between manufacturer and purchaser

5.2.3 The "heat off" period, during which the current is switched off, shall be of sufficient duration to allow the specimen to cool to a temperature of less than 30 °C.

Accelerated cooling by artificial means is permissible.

5.2.4 The required temperature may be attained by current heating or by current heating in association with oven heating. The minimum test current shall be that current sufficient to raise the conductor temperature to the value corresponding to the appropriate classification as follows.

Class 1	75 °C
Class 2	115 °C
Class 3	150 °C

This current shall be determined before commencing the test. The test current may be varied as required between 1 and 4 times the minimum test current.

Where the required conductor temperature is to be obtained by means of current plus oven heating, the heating attributable to the oven should not raise the conductor to a temperature greater than the value corresponding to the appropriate classification as follows.

Class 1	75 °C
Class 2	115 °C
Class 3	150 °C

The balance of heat required shall be produced by current heating.

5.2.5 All specimens shall be subjected to a minimum of 1 000 temperature cycles. Resistance measurements shall be taken at approximately 50 cycle intervals after 500 cycles have been completed.

5.3 Tensile strength test

5.3.1 The axial pull shall be applied by separating the jaws of the tensile testing machine at a steady rate between 25 mm/min and 50 mm/min. For the purpose of tensile tests on ferrules, it is permissible to carry out the test on an assembly of one ferrule joining two unterminated lengths of conductor (see Figure 2).

5.3.2 5.3.1 states that the load should be applied axially.

Alternatively, for terminations, it is permissible to apply a longitudinal pull on the palm of the connector.

6 Requirements

6.1 Joint resistance

6.1.1 *Initial value.* The initial value of resistance of any joint shall not exceed the resistance of a length of conductor equal to twice the length of the compression barrel (see dimension *l* in Figure 1).

6.1.2 *Datum value.* A datum level of resistance shall be established after the first 500 temperature cycles have been completed and shall not exceed the resistance of a length of conductor equal to three times the length of the compression barrel.

6.1.3 *Final value.* During the last 500 temperature cycles, resistance measurements shall show that stable conditions have been maintained. The final value of the joint resistance shall not differ from the datum value by more than ± 25 % or ± 5 μΩ whichever is the greater.

6.2 Tensile strength. For the purpose of this test the breaking load of the conductor shall be taken as either that stated by the conductor manufacturers or that established under laboratory conditions.

Specimens which withstand the appropriate test load, calculated from this conductor breaking load and the percentages given in Table 1 and Table 2, shall be deemed to have met the requirements.

Table 1 — Percentage of conductor breaking load. Copper conductors

Conductor cross-sectional area (mm^2)	Percentage of conductor breaking load
Up to and including 5.0	40
Above 5.0 up to and including 50	30
Above 50 up to and including 95	25
Above 95 up to and including 1 000	20

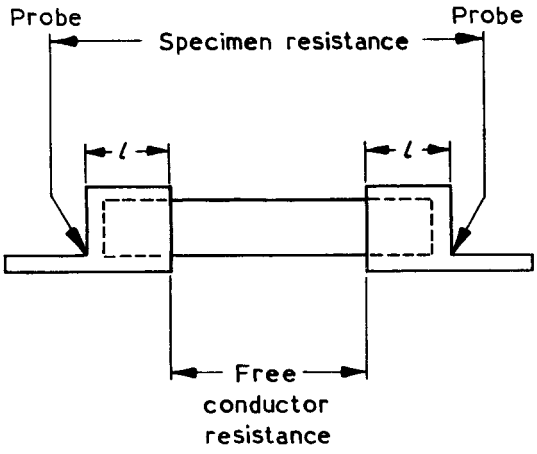
Table 2 — Percentage of conductor breaking load. Nickel, nickel alloy and iron conductors

Conductor cross sectional area (mm^2)	Percentage of conductor breaking load	
	Nickel and Nickel Alloy	Iron
Up to and including 6.0	16	20

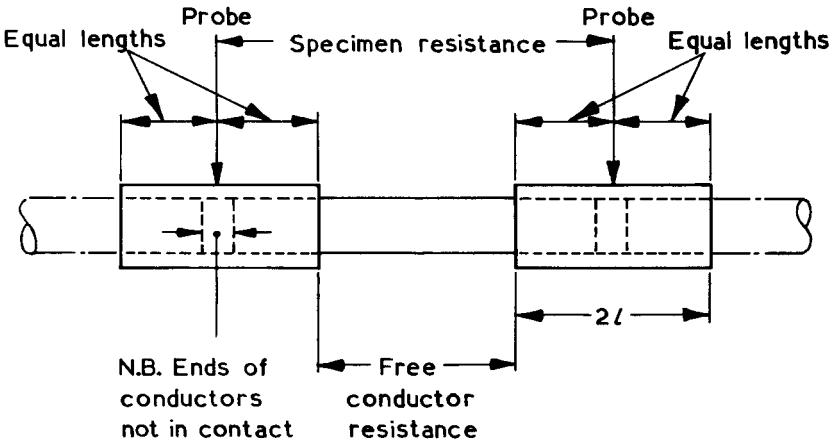
6.3 Retests. If, during the course of tests, one or more specimens fail, a further twelve similar specimens shall be tested. The connector is only considered to have passed the test if all twelve specimens pass.

7 Test certificates

The manufacturer shall, upon request, issue certificates as evidence that the type tests have been satisfactorily performed on connectors identical in all essential details with those to be supplied. Such certificates shall be accepted as evidence of compliance with the test requirements of this standard.



(a) Lug or tag



(b) Ferrules

$$\text{Joint resistance} = \frac{\text{specimen resistance} - \text{free conductor resistance}}{2}$$

Figure 1 — Method of determining joint resistance

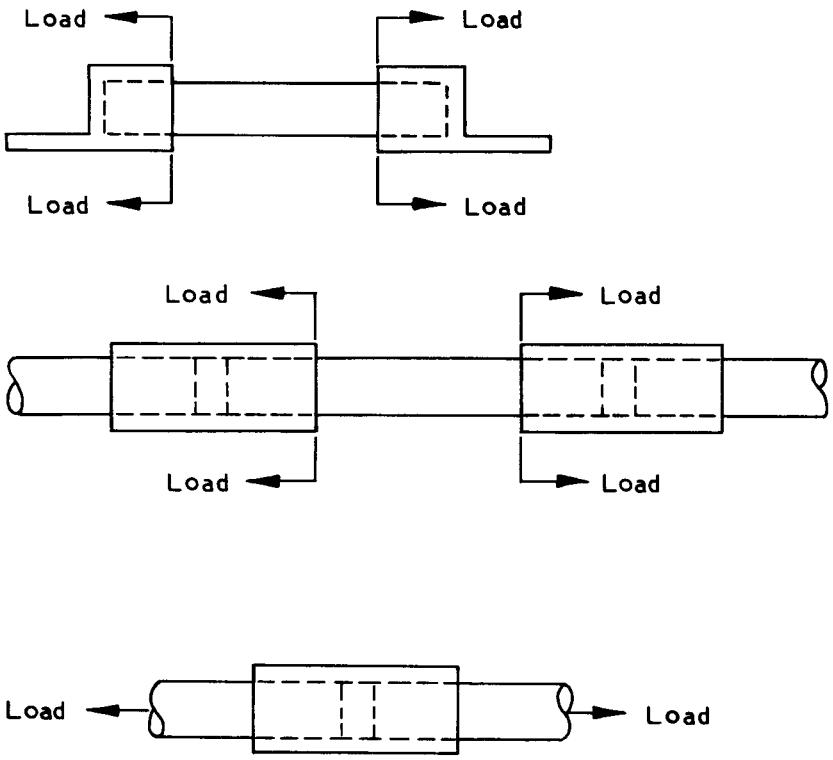


Figure 2 — Typical assemblies for tensile test

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Publications referred to

This standard makes reference to the following British Standards:
BS 3288, *Insulator and conductor fittings for overhead power lines.*
2G.178, *Crimped joints for aircraft electrical cables and wires.*

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