

Specification for

**Removable contacts of
assessed quality for
electrical connectors as
defined by BS 9520:
generic data, methods
of test and rules for the
preparation of detail
specifications**

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- Electricity Supply Industry in England and Wales
- Electronic Components' Industry Federation*
- Electronic Engineering Association*
- Institution of Electronic and Radio Engineers
- Ministry of Defence*
- National Supervising Inspectorate*
- Post Office*
- Society of British Aerospace Companies Limited*
- Telecommunication Engineering and Manufacturing Association (TEMA)*

The organizations marked with an asterisk in the above list were directly represented on the Technical Committee entrusted with the preparation of this British Standard.

This British Standard, having been prepared under the direction of the Electronic Components Standards Committee, was published under the authority of the Board of BSI and comes into effect on 31 May 1983

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Foreword

This British Standard has been prepared under the direction of the Electronic Components Standards Committee and is the generic specification for removable contacts for electrical connectors defined by BS 9520 in a system of standards for electronic components of assessed quality. This British Standard calls for the use of substances and/or test procedures that may be injurious to health if adequate precautions are not taken. It refers only to technical suitability and in no way absolves either the supplier or the user from statutory obligations relating to health and safety at any stage of manufacture or use.

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 35 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.

Section 1. Principles and mandatory procedures

1.1 General matters

1.1.1 Scope

This British Standard is applicable to contacts intended for insertion and removal by the user and suitable mainly for connectors specified in BS 9520. It is intended primarily for use on telecommunication and allied electronic equipment. It gives appropriate terminology and definitions, specifies requirements for general data and test procedures and includes rules for the preparation of detail specifications, an example of which is given in Appendix A. Requirements for quality assessment procedures, inspection and the preparation of certified test records are also specified.

This standard is to be read in conjunction with the relevant standards in the BS 9000 series. All general details and definitions in these standards that are appropriate to this specification apply, unless otherwise stated herein.

1.1.2 Related documents

This British Standard makes reference to the following documents:

BS 89, *Specification for direct acting indicating electrical measuring instruments and their accessories*.

BS 308, *Engineering drawing practice*.

BS 1991, *Letter symbols, signs and abbreviations*.

BS 2011, (IEC 68) *Basic environmental testing procedures*.

BS 3763, (ISO/R 1000) *The International System of units (SI)*.

BS 3939, (IEC 117) *Graphical symbols for electrical power, telecommunications and electronics diagrams*.

BS 4000, (ISO/R 101) *Sizes of paper and board*.

BS 4727, *Glossary of electrotechnical, power, telecommunication, electronics, lighting and colour terms*.

BS 4808, *L.F. cables and wires with PVC insulation and PVC sheath for telecommunication*.

BS 5310, *Hand crimping tools for the termination of electrical cables and wires for low frequency and radio frequency applications — Part 1: General requirements and tests — Part 3: Hand crimping tools for contacts of electrical connectors*¹⁾.

BS 6001, *Sampling procedures and tables for inspection by attributes*.

BS 9000, *General requirements for electronic components of assessed quality*.

BS 9520, *Electrical connectors of assessed quality for frequencies below 3 MHz: generic data and methods of test*.

BS G 178, *Crimped joints for aircraft electrical cables and wires*.

BS G 210, *PTFE insulated equipment wires (with silver plated copper conductors)*.

IEC 287, *Calculation of the continuous current rating of cables (100 % load factor)*.

PD 9002, *BS 9000 Component selection guide*.

NOTE When reference to an IEC Publication or ISO standard is given in parentheses, the British Standard is identical in technical content with the IEC Publication or ISO standard except where deviation(s) are indicated in the British Standard.

1.1.3 Terminology

For the purposes of this British Standard the general electrical and telecommunication terms and definitions given in the appropriate part of BS 4727 apply.

In addition the following specific terms and their definitions are applicable to removable contacts covered by this generic specification.

1.1.3.1 Contact and connection terms

1.1.3.1.1

barrel, conductor

the section of the contact which accommodates the conductor (normally applies to crimp contacts)

1.1.3.1.2

bucket

see *solder bucket* (1.1.3.1.49)

1.1.3.1.3

colour coding

a system of colour marking to aid identification of contact size and conductor accommodation

1.1.3.1.4

conductor pull-off force

the tensile force necessary to separate a conductor from a contact or terminal

¹⁾ In course of preparation.

1.1.3.1.5**connection**

a physical interface between conductors and/or contacts to provide an electrical path

1.1.3.1.6**connection, crimp**

a connection made by crimping

1.1.3.1.7**contact**

the conductive element in a connector which mates with a corresponding element in another connector to provide an electrical path

1.1.3.1.8**contact, co-axial**

a multipole contact with conductors having a common axis and insulated from each other. See also *contact, shielded* (1.1.3.1.30)

1.1.3.1.9**contact, crimp**

a contact having a conductor barrel designed to be crimped. See also *crimping* (1.1.3.1.38)

1.1.3.1.10**contact cross hole**

a vent near the bottom of a contact barrel or bucket. (See also *contact inspection hole* (1.1.3.1.18))

1.1.3.1.11**contact engaging and separating force**

see *force, contact insertion and withdrawal* (1.1.3.1.44)

1.1.3.1.12**contact, female**

a contact intended to make electrical connection on its inner surface and which will accept entry of a male contact

1.1.3.1.13**contact, filter**

a contact incorporating a passive filter network, typically comprising a ceramic capacitor and a ferrite inductor, intended to prevent the onward passage of high-frequency currents

1.1.3.1.14**contact force**

see *force, contact* (1.1.3.1.40)

1.1.3.1.15**contact, front-release**

a removable contact which is released via the mating face of the connector

1.1.3.1.16**contact, hermaphroditic**

a contact which mates with another contact of the same design

1.1.3.1.17**contact holding force**

see *force, contact holding* (1.1.3.1.43)

1.1.3.1.18**contact inspection hole**

a hole provided in the barrel to permit visual inspection, to ensure that the conductor has been inserted to the correct depth

1.1.3.1.19**contact lead-in**

a chamfered or flared portion of a contact to facilitate engagement

1.1.3.1.20**contact, low-frequency (LF)**

a single pole unshielded contact

1.1.3.1.21**contact, male**

a contact intended to make electrical connection on its outer surface and which will enter a female contact

1.1.3.1.22**contact, pin**

see *contact, male* (1.1.3.1.21)

1.1.3.1.23**contact, power**

a contact primarily intended for use in circuits carrying electrical power, as distinct from signal currents

1.1.3.1.24**contact, rear-release**

a removable contact which is released via the rear of the connector

1.1.3.1.25**contact, resilient**

a contact having split or spring sides

1.1.3.1.26**contact resistance**

the electrical resistance of a pair of mated contacts under specified conditions

1.1.3.1.27**contact, restricted entry**

see *restricted entry* (1.1.3.1.47)

1.1.3.1.28**contact retainer**

see *retainer, contact* (1.1.3.1.48)

1.1.3.1.29**contact retention force**

see *force, contact retention* (1.1.3.1.45)

1.1.3.1.30**contact, shielded**

a coaxial contact intended to prevent the transfer of electromagnetic or other interference to and from the internal conductor

1.1.3.1.31**contact size**

a number indicating the size of the mating element of a contact or its current-carrying capacity

1.1.3.1.32**contact, socket**

see *contact, female* (1.1.3.1.12)

1.1.3.1.33**contact, spring**

see *contact, resilient* (1.1.3.1.25)

1.1.3.1.34**contact style**

the mating end form of a contact, i.e. male, female or hermaphroditic. See 1.1.3.1.21, 1.1.3.1.12 or 1.1.3.1.16

1.1.3.1.35**contact, thermocouple**

a contact employed in thermocouple applications. Materials commonly used are iron, constantan, copper, chromel and alumel

1.1.3.1.36**contact wipe**

see *electrical engagement length* (1.1.3.1.39)

1.1.3.1.37**crimp**

a connection made by crimping

1.1.3.1.38**crimping**

a method of permanently attaching a termination point to a conductor by pressure deformation, or by reshaping the barrel around the conductor

1.1.3.1.39**electrical engagement length**

the distance a contact travels on the surface of its mating contact during engagement or separation

1.1.3.1.40**force, contact**

the normal force which exists between engaged contact surfaces at 90° to the axis of engagement

1.1.3.1.41**force, contact engaging and separating**

see *force, contact insertion and withdrawal* (1.1.3.1.44)

1.1.3.1.42**force, contact extraction**

the axial force required to extract a removable contact from a connector

1.1.3.1.43**force, contact holding**

the force required to keep a pair of resilient contacts fully engaged

1.1.3.1.44**force, contact insertion and withdrawal**

the force required to fully insert or withdraw a pair of mating contacts

1.1.3.1.45**force, contact retention**

the axial load in either direction which a contact can withstand without being displaced from its intended position within an insert

1.1.3.1.46**insulation support**

the part of a termination point which accommodates but does not secure the cable insulation

1.1.3.1.47**restricted entry**

a design feature incorporated in a female contact or in the insulator to prevent the entry of an oversized male contact, or test prod

1.1.3.1.48**retainer, contact**

a device either on the contact or in the insulator to retain the contact in the insulator

1.1.3.1.49**solder bucket**

the section of contact which accommodates the conductor for soldering

1.1.3.1.50**termination**

a permanent connection

1.1.3.1.51**test probe proof**

a design feature incorporated in a female contact to prevent damage by the insertion of a test probe

1.1.3.1.52**wire range, contact**

the sizes of conductors accommodated by a particular conductor barrel. See also *contact size* (1.1.3.1.31)

1.1.3.1.53**contact, concentric twinax**

a multipole contact with three conductors having a common axis and insulated from each other, generally used for data bus applications

1.1.3.2 Tool and gauge terms

1.1.3.2.1

gauge, contact holding force

a gauge of specified mass simulating a minimum size male contact

1.1.3.2.2

gauge, sizing

a gauge simulating a specified maximum size male contact or a specified minimum size female contact

1.1.3.2.3

tool, crimping

a mechanical device used to make a crimp

1.1.3.2.4

tool, extraction

a device for extracting removable contacts from a connector

1.1.3.2.5

tool, insertion

a device for inserting contacts into a connector

1.1.3.2.6

tool, removal

see *tool, extraction* (1.1.3.2.4)

1.1.4 Letter symbols, signs and abbreviations

The letter symbols, signs and abbreviations which are employed in all documents applicable to electronic parts covered by this standard shall either be in conformity with BS 1991 or be derived in accordance with the principles of that standard.

1.1.5 Graphic symbols

The graphical symbols which are employed in all documents applicable to electronic parts covered by this standard shall either be in conformity within BS 3939 or be derived in accordance with the principles of that standard.

1.1.6 Marking of component and package

1.1.6.1 Marking of the contact. When required by the detail specification, copper alloy contacts shall be legibly and durably marked with two coloured bands in accordance with the colour code in Appendix B. Omission or variation of this marking is permissible if such a requirement is stated when ordering.

Thermocouple contacts shall be marked, unless otherwise stated in the detail specification, with code letters as in Appendix B to identify a particular contact material.

The manufacturer's trade mark or symbol shall also be shown on the contacts unless otherwise stated in the detail specification.

1.1.6.2 Marking of the package. The following information shall be marked on the package, or if a transparent package is used, it shall be marked on a label which can be read without opening the package:

- a) manufacturer's name, code or trade mark;
- b) date code;
- c) contact identification number;
- d) BS contact detail specification number;
- e) any additional marking as required in the relevant detail specification, and/or the customer's order.

1.1.7 Eligibility for qualification approval

For the purpose of this standard, all processes subsequent to the manufacture of finished piece parts and sub-assemblies shall be subject to direct surveillance by the chief inspector or quality manager. A sub-assembly is defined as the permanent assembly of two or more piece parts. The subsequent process of surface finishing, if applicable, may be sub-contracted under the terms of 14.3.2 of BS 9000. It is conditional that the manufacturer is approved to BS 9000 and BS 9520 or BS 9521 in order to comply with the requirements of this clause.

1.1.8 Structurally similar components

Not applicable.

1.1.9 Delayed delivery

Contacts held for a period exceeding thirty-six months following acceptance inspection shall be re-examined for group A inspection. It is permissible for a detail specification to prescribe certain functional tests, e.g. solderability.

1.1.10 Supplementary procedures for qualification approval

Not applicable.

1.1.11 Certified test records

Certified test records (CTRs) shall be prepared by the manufacturer in the form shown in Appendix C of BS 9000, and they shall be printed on international size A4 paper complying with the requirements of BS 4000.

When the test schedule of the detail specification requires that attributes information shall be recorded, the total number of rejected contacts shall be recorded with reference to the parameter for which the rejection was made.

1.1.12 Standard ratings and characteristics

As in the relevant connector detail specification.

1.1.13 Unchecked parameters

The manufacturer may quote additional parameters to those given in the detail specification. Such parameters shall not be used for inspection purposes and no guarantee can be given as to their accuracy.

1.1.14 Procedure to be followed in the event of failure at group C or group D inspection

See 20.11 of BS 9000-1.

1.1.15 Ordering information

The following information is to be given when ordering contacts to this specification:

- BS contact detail specification number;
- contact identification number;
- details of any special requirements, e.g. contact colour code omission (LF contacts);
- requirement for assembly instructions including wire preparation, crimping and contact insertion details.

1.1.16 Release before completion of group B tests

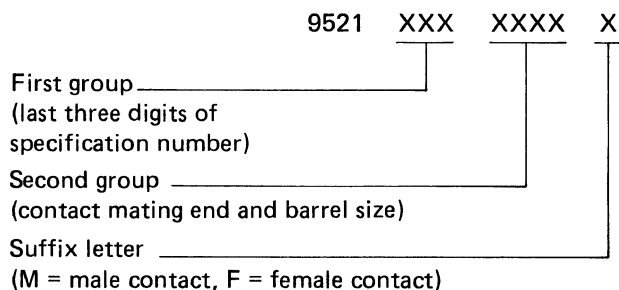
When the conditions for reduced inspection described in BS 6001 have been satisfied for all group B tests, the manufacturer is permitted to release components before the completion of such tests.

1.1.17 Drawings

The detail specification shall contain drawings which control dimensions ensuring intermateability and interchangeability, and these drawings shall be approved by the National Supervising Inspectorate (NSI) for this purpose. Those dimensions which, for inspection purposes, are classified as outline dimensions shall be designated accordingly on the same drawings.

1.1.18 Contact identification numbers

1.1.18.1 LF contacts. The contact identification number consists of two groups of digits and a letter suffix to identify an individual contact as follows.



The second group comprises four digits/letters in combination denoting contact size. The first pair of characters in the group are digits indicating mating and size, e.g. 1620, 0812.

The second pair are digits or a combination of letter and digit indicating contact bucket size, e.g. 2026, 1620.

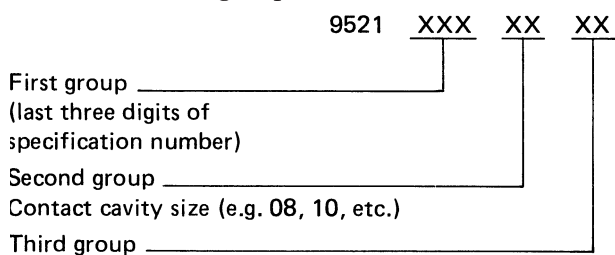
The numeral "0" is used where otherwise a blank would occur, e.g. 22M0.

When mating end bucket sizes are the same the bucket size is indicated by "00", e.g. 2000, 1600.

Example contact identification numbers:

9521	004	1620	M
9521	004	1620	M
9521	004	22M0	P

1.1.18.2 Co-axial and concentric twinax contacts. The contact identification number consists of three groups as follows.



The first letter indicates the cable description or code, required when alternative cables may be applicable for use with the contact (see note). Where no alternative cable is appropriate this letter may be omitted.

The second letter M = male contact, F = female contact.

When it is necessary to invoke the first letter of the third group the detail specification shall make its purpose clear. It is permissible for this to be by means of a table, e.g.

	Contact (cavity) size		RG	URM	Other
BS 9521 XXX	16	A B	83M —	— XXX	XXX —
BS 9521 XXX	12	A B	XXX XXX	XXX —	— —

Example contact identification numbers are as follows:

9521 029 08 AM
9521 029 10 F

All contact identification numbers relating to a particular detail specification are listed on the drawings in Appendix A of that specification.

1.2 Test procedures

NOTE Where contacts are required to be fitted in connectors for test purposes, mating specimens of BS 9000 approved patterns of connectors with which the contacts are primarily intended for use, shall be used.

1.2.1 Measurement conditions

Unless otherwise specified, all tests shall be carried out under standard atmospheric conditions for testing as specified in BS 2011.

For the subsequent recovery periods, specimens shall remain mated or unmated as they were during the conditioning cycle(s). Where measurements are to be completed within a specified period, it is permissible for specimens measured early and failing to meet the requirements to be measured again before the expiry of the period.

The use of sharp probes to make contact for testing purposes shall be avoided. The test conditions shall simulate the normal engagement of the mating contact.

Tests involving successive measurements shall be made on the same contacts throughout the series.

Where an approved mating component is specified for engagement with the component under test, the dimensions of the mating component shall be in accordance with the appropriate drawings.

Before commencing qualification tests on crimp-type contacts, the manufacturer shall satisfy the NSI that the combinations of contact, conductor and crimp tooling to be used for the tests are in accordance with those listed in the contact detail specification, and have been tested in accordance with Appendix E.

The following tests have been listed under the headings of electrical, mechanical, environmental and endurance for convenience of reference. It is not intended that they shall be applied in the order listed, but as shown in the test schedule in section 3.

1.2.2 Visual examination

The specimens shall be examined visually, using a device having a magnification of two to four diameters.

The following features shall be examined:

- correct identification and finish;
- marking, which shall be in accordance with the requirements of **1.1.7**;
- materials;
- surface finish (e.g. burrs, scratches, flash, etc., traces of corrosion);
- loosened or detached parts such as would impair operation.

1.2.3 Dimensioning and gauging procedures

The following features shall be checked.

- Outline dimensions.* Dimensions shall be checked and shall be in accordance with the drawings in the relevant contact detail specification.
- Detailed dimensions.* When required by the relevant contact detail specification, detailed dimensions of the contacts supplied shall be checked and shall be in accordance with the manufacturing drawings.
- Mass.* The mass shall be checked and shall be in accordance with the relevant contact detail specification.
- Gauging procedure.* Where gauging procedures are specified by the relevant contact detail specification, the relevant specimens shall be accepted or rejected by the gauges, as appropriate.
 - Mechanical compatibility gauging.* Where compatibility gauges are prescribed in the detail specification the relevant specimens shall accept the gauges.
 - Mechanical compatibility assurance.* Where compatibility gauges are not prescribed, a compatibility assurance test shall be applied. For this test the specimens shall be checked by a method approved by the NSI. The specimens shall comply with the requirements of the test schedule in section 3.

1.2.4 Electrical test procedures

1.2.4.1 Contact resistance. Unless otherwise stated in the detail specification contacts shall be fitted to connectors (see the note at the beginning of 1.2) and tested as mated pairs. Measurements shall be carried out with d.c. or a.c., and the measuring apparatus shall be such as to ensure an accuracy of $\pm 10\%$. For a.c. measurements, the frequency shall not exceed 2 kHz. In cases of dispute the d.c. measurement shall govern. The contact resistance shall normally be derived from the voltage drop measured between the points intended for connection of the wiring to the contacts or as specified in the relevant detail specification. Contact shall not be made or broken while the measuring voltage is applied.

Where the termination end of the contact is not directly accessible, the conductor resistance of the wire or cable used shall be measured and taken into consideration in deriving the contact resistance.

NOTE Ambient temperature variations should also be considered.

When measured with d.c., one measuring cycle consists of:

- switching on the controlled current in one direction;
- measuring the voltage drop;
- switching the controlled current in the opposite direction;
- measuring the voltage drop;
- switching off.

The contact resistance value shall then be determined by averaging the two measurements.

Unless otherwise specified, the mated contact pair shall not be disturbed between the end of the preceding test and the application of voltage in this test, or between successive test cycles.

When measured with a.c., one measuring cycle consists of:

- switching on the controlled current;
- measuring the voltage drop;
- switching off.

Where more than one cycle is prescribed in the detail specification they shall be carried out in immediate succession.

For contacts intended for use in the microvolt range, modifications of the measuring method and/or special requirements shall be specified in the detail specification.

a) *Light current.* Normally applicable to contacts size 12 and smaller. Contact resistance shall be measured with alternating or direct current not exceeding 50 mA. During the measurements the open circuit e.m.f. of the source shall not exceed 20 mV d.c. or a.c. peak. The contact resistance shall be not greater than that specified for each mated pair of contacts.

b) *Rated current.* Normally applicable to contacts size 8 and larger. Contact resistance shall be measured with the alternating or direct current specified in the detail specification. During the measurements the open circuit e.m.f. of the source shall not exceed 2.5 V d.c. or a.c. peak. The contact resistance shall be not greater than that specified for each mated pair of contacts.

When measurement of contact resistance is prescribed the following details shall be given in the detail specification:

- 1) the point on the terminations of a mated contact pair at which the voltage drop shall be measured;
- 2) the number of mated pairs of contacts to be measured and also the number of measuring cycles if more than one;
- 3) maximum current and maximum e.m.f. values of the source;
- 4) any necessary gauges;
- 5) maximum value for contact resistance.

1.2.4.2 Insulation resistance. This test is applicable only to co-axial and concentric twinax contacts. Contacts need not be fitted to connectors, and the normal method of mounting shall be simulated.

The insulation resistance shall be measured with a d.c. voltage of 500 ± 50 V, and after an electrification time of 1 min or earlier if a stable reading is achieved.

In cases of dispute, the reading taken at the 1 min period shall govern. The value shall be not less than that specified in the detail specification.

1.2.4.3 Voltage proof. This test is applicable only to co-axial and concentric twinax contacts. The normal method of mounting shall be simulated. Specimens having a rating in excess of 1 kV shall be rated for the purpose of this test.