

English version

**Connecting devices -
Flat quick-connect terminations for electrical copper conductors -
Safety requirements
(IEC 61210:2010, modified)**

Dispositifs de connexion -
Bornes plates à connexion rapide pour
conducteurs électriques en cuivre -
Exigences de sécurité
(CEI 61210:2010, modifiée)

Verbindungsmaterial -
Flachsteckverbindungen für elektrische
Kupferleiter -
Sicherheitsanforderungen
(IEC 61210:2010, modifiziert)

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Management Centre: Avenue Marnix 17, B - 1000 Brussels

Foreword

The text of document 23F/200/FDIS, future edition 2 of IEC 61210, prepared by SC 23F, Connecting devices, of IEC TC 23, Electrical accessories, was submitted to the IEC-CENELEC parallel vote.

A draft amendment was prepared by the Technical Committee CENELEC SR 23F, Connecting devices and was submitted to formal vote.

The combined texts were approved by CENELEC as EN 61210 on 2010-11-01.

This European Standard supersedes EN 61210:1995.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN and CENELEC shall not be held responsible for identifying any or all such patent rights.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2011-11-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2013-11-01

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association.

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61210:2010 was approved by CENELEC as a European Standard with agreed common modifications as given below.

COMMON MODIFICATIONS

Delete Annex D.

Modify Annex E as follows:

Table E1: delete the last column containing the dimensions in "inches".

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60068-1	1988	Environmental testing - Part 1: General and guidance	EN 60068-1 ¹⁾	1994
IEC 60352-2	2006	Solderless connections - Part 2: Crimped connections - General requirements, test methods and practical guidance	EN 60352-2	2006
ISO 1456	2009	Metallic and other inorganic coatings - Electrodeposited coatings of nickel, nickel plus chromium, copper plus nickel and of copper plus nickel plus chromium	EN ISO 1456	2009
ISO 2081	2008	Metallic and other inorganic coatings - Electroplated coatings of zinc with supplementary treatments on iron or steel	EN ISO 2081	2008
ISO 2093	1986	Electroplated coatings of tin - Specification and test methods	-	-

¹⁾ EN 60068-1 includes A1 to IEC 60068-1 + corr. October 1988.

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Connecting devices – Flat quick-connect terminations for electrical copper conductors – Safety requirements

Dispositifs de connexion – Bornes plates à connexion rapide pour conducteurs électriques en cuivre – Exigences de sécurité

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**CONNECTING DEVICES –
FLAT QUICK-CONNECT TERMINATIONS
FOR ELECTRICAL COPPER CONDUCTORS –
SAFETY REQUIREMENTS**

FOREWORD

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International Standard IEC 61210 has been prepared by subcommittee 23F: Connecting devices, of IEC technical committee 23: Electrical accessories.

This second edition cancels and replaces the first edition published in 1993 and constitutes a merge between the first edition of IEC 61210 published by SC23F and IEC 60760 published in 1989 by SC48B. This second edition does not introduce major technical modifications.

The text of this standard is based on the following documents:

FDIS	Report on voting
23F/200/FDIS	23F/202/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

CONNECTING DEVICES – FLAT QUICK-CONNECT TERMINATIONS FOR ELECTRICAL COPPER CONDUCTORS – SAFETY REQUIREMENTS

1 Scope

This International Standard applies to non-insulated flat quick-connect terminations consisting of a male tab of size 2,8 mm, 4,8 mm, 6,3 mm or 9,5 mm with hole or dimple detents and a mating female connector for use as either an incorporated or an integrated part of an equipment or of a component, or as a separate entity. This standard establishes uniform requirements for the dimensions, performance characteristics and test program.

The connected electrical copper conductors shall be flexible or rigid stranded, having a cross-sectional area up to and including 6 mm² or rigid solid having a cross-sectional area up to and including 2,5 mm². This standard shall not be used for connecting aluminum conductors.

The rated voltage shall not exceed 1 000 V a.c. with a frequency up to and including 1 000 Hz, and 1 500 V d.c., and having the temperature limits applicable to materials used within this standard.

NOTE 1 This standard, where applicable, may be used for conductors made of material other than copper.

NOTE 2 For reasons of safety, it is recommended that flat quick-connect terminations beyond the scope of this standard should not be interchangeable with those of this standard.

NOTE 3 This standard does not apply to female connectors with positive locking means.

NOTE 4 The flat quick-connect terminations covered by this standard are not intended to be disconnected by pulling on the cable.

NOTE 5 Annex D provides additional information on non international units.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068-1:1988, *Environmental testing – Part 1: General and guidance*

IEC 60352-2:2006, *Solderless connections – Part 2: Crimped connections – General requirements, test methods and practical guidance*

ISO 1456:2009, *Metallic and other inorganic coatings – Electrodeposited coatings of nickel, nickel plus chromium, copper plus nickel and of copper plus nickel plus chromium*

ISO 2081:2008, *Metallic and other inorganic coatings – Electroplated coatings of zinc with supplementary treatments on iron or steel*

ISO 2093:1986, *Electroplated coatings of tin – Specification and test methods*

3 Terms and definitions

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

3.1

flat quick-connect termination

electrical connection consisting of a male tab and a female connector which can be inserted and withdrawn with or without the use of a tool

3.2

male tab

that portion of a flat quick-connect termination which receives the female connector

3.3

male test tab

male tab manufactured with tighter tolerances for the specific purpose of conducting mechanical tests with production female connectors

3.4

female connector

that portion of a flat quick-connect termination which is pushed onto the male tab

3.5

detent

dimple (depression) or hole in the male tab which engages a raised portion on the female connector to provide a latch for the mating parts

3.6

maximum permissible temperature

maximum service temperature

highest temperature which the flat quick-connect termination is allowed to attain in normal use

4 Main characteristics

4.1 Flat quick-connect terminations are classified into sizes according to the nominal width and thickness of the male tabs. This standard covers the following nominal sizes:

- 2,8 mm × 0,5 mm
- 2,8 mm × 0,8 mm
- 4,8 mm × 0,5 mm
- 4,8 mm × 0,8 mm
- 6,3 mm × 0,8 mm
- 9,5 mm × 1,2 mm

NOTE Relationship between millimetres and inches is shown in Table D.2.

4.2 The preferred conductor cross-sectional areas shall be 0,2 mm², 0,34 mm², 0,5 mm², 0,75 mm², 1,0 mm², 1,5 mm², 2,5 mm², 4,0 mm² and 6,0 mm².

NOTE The approximate equivalent relationship between cross-sectional area in mm² and AWG sizes is shown in Table D.3.

5 Marking and information

5.1 The manufacturer of male tabs and/or female connectors supplied separately and the manufacturer of the component with integral tabs and/or female connectors shall provide adequate information to ensure that the flat quick-connect termination can be applied in the intended manner and that the testing authority can perform the relevant tests in accordance with this standard.

5.2 This information shall be provided in the following methods, as detailed in 5.3:

- by marking (Ma)

The information shall be clearly and indelibly marked on the male tab and on the female connector.

NOTE In the case of integral tabs (e.g. in switches for appliances) the marking may be located on the switch itself.

- by documentation (Do)

The information shall be provided by a separate document, which may consist of a leaflet, label or a specification sheet, supplied with the smallest package unit or supplied separately. The content of the document shall be available to the end user or to the component or equipment manufacturer and to the testing authority, as appropriate, in any suitable format. The format in which this information is presented is not within the scope of this standard.

- by declaration (De)

This information shall be provided to the testing authority for the purpose of testing and in a manner agreed between the testing authority and the manufacturer.

5.3 The following information shall be supplied by the methods indicated.

- a) Manufacturer's name or trade mark Ma (see note 1)
- b) Type reference..... Do (see note 2)
- c) Nominal series designation (size: width and thickness, see 4.1).. Do (see note 2)
- d) Maximum permissible temperature if higher than 85 °C..... Do (see note 3)
- e) The most onerous combination of the tab and the female connectorDo
- f) Type of conductor(s) for which that part of the termination is suitable.....Do
- g) Conductor cross-sectional area for which that part of the termination is suitableDo
- h) The recommended method of attaching the conductor to the termination (i.e. tool, stripping length, any special preparation, etc.)Do
- i) The material(s) and type of coatingDe

NOTE 1 The information for integrated tabs or female connectors may be given together with the equipment or component.

NOTE 2 An appropriate code may be used for this information.

NOTE 3 The insulation of the cable and of the contact-carrying plastic parts should be compatible with the declared maximum permissible temperature.

NOTE 4 In Japan, tab thickness marking on the female connector is 5 for 0,5 mm and 8 for 0,8 mm.

6 Constructional requirements

6.1 Flat quick-connect terminations shall be so designed and constructed that in normal use their performance is reliable and without danger to the user or surroundings.

Compliance is checked by the tests of 8.1 to 8.6.

6.2 Male tabs and female connectors shall be of a metal having mechanical strength, electrical conductivity and resistance to corrosion adequate for their intended use.

Compliance is checked by inspection, by the tests of 8.1 to 8.6 and, if necessary, by chemical analysis.

Examples of suitable metals, when used within the permissible temperature range and under standard atmospheric conditions, are

- copper (for tabs only);
- an alloy containing at least 58 % copper for parts made from rolled sheet (in cold condition) or at least 50 % copper for other parts;
- stainless steel containing at least 13 % chromium and not more than 0,09 % carbon;
- steel provided with an electroplated coating of zinc (for earthing conductors only), according to ISO 2081;
- steel provided with an electroplated coating of nickel, according to ISO 1456;
- steel provided with an electroplated coating of tin, according to ISO 2093.

NOTE The choice of material and coating is left to the relevant product committees who should consider the pollution conditions occurring in the equipment or component where the flat quick-connect termination is mounted.

6.3 The dimensions of male tabs shall comply with those specified in Table 1 and Figures 1, 2, 3 and 4 where the dimensions *A*, *B*, *C*, *D*, *E*, *F*, *J*, *M*, *N* and *Q* are mandatory.

NOTE 1 The shapes of the various parts may deviate from those given in the figures, provided that the specified dimensions are not influenced and the test requirements are complied with, for example: corrugated tabs, folded tabs, etc.

NOTE 2 Dimensions of male tabs in inches are shown in Table D.4.

Compliance is checked by inspection and measurement.

6.4 The dimensions of female connectors shall comply with those specified in Table 2 and Figure 5 where L_2 , B_3 and 1,5 mm maximum are mandatory.

NOTE Dimensions of female connectors for tab size in inches are shown in Table D.5.

Compliance is checked by inspection and measurement.

6.5 Male tabs and female connectors shall be so designed and constructed as to allow the correct insertion and withdrawal of either the female connector or the tab without damage or loosening of other components.

Compliance is checked by the insertion and withdrawal force test of 8.1.

6.6 Male tabs and female connectors integral with equipment or components shall be securely retained.

Compliance is checked by the mechanical overload force test of 8.2.

6.7 Male tabs and female connectors shall be so designed and constructed that the temperature rise in normal use does not reach values likely to impair their further use.

Compliance is checked by the temperature rise test of 8.3.

6.8 Male tabs and female connectors shall be so designed and constructed that their electrical performances are reliable and their further use is not impaired.

Compliance is checked by the cyclic current loading test of 8.4.

6.9 Male tabs and female connectors having a maximum permissible temperature higher than 85 °C shall be so designed and constructed that in normal use their electrical performances are reliable and their further use is not impaired.

Compliance is checked by the elevated temperature test of 8.5.

Examples of maximum permissible temperatures of male tabs and female connectors, depending on materials and/or coating, are given as a guide in Annex A.

6.10 Crimped connections shall be such that they withstand the mechanical stresses likely to occur in normal use.

Compliance is checked by the tensile strength test of 8.6.

6.11 Male tabs and female connectors for solid conductors shall be so designed and constructed that any disturbance does not affect the crimped connection and their further use is not impaired.

Compliance is checked by the tests in 6.5 to 6.10.

7 General notes for tests

7.1 Tests according to this standard are type tests.

7.2 Unless otherwise specified, the samples shall be tested as delivered and connected as for normal use, at an ambient temperature of 20 °C ± 5 °C.

7.3 Unless otherwise specified, all tests shall be carried out under standard atmospheric conditions for testing as specified in IEC 60068-1.

7.4 Test specimens shall be preconditioned under standard atmospheric conditions for testing for a time sufficient to allow the entire component to reach thermal stability.

7.5 Temperature rise and cyclic current loading tests shall be conducted in still air, i.e. airflow less than 10 m/min at room temperature.

7.6 If samples are not delivered with conductors already assembled, the conductors shall be connected to the associated parts in accordance with the manufacturer's instructions and using the manufacturer's recommended tooling. If no specific manufacturer's instructions are provided, then refer to IEC 60352-2 for proper assembly instructions.

7.7 The tests shall be carried out on each set in the sequence as specified in Table 3, according to the most onerous combination of the tab and female connector according to item e) of 5.3.

7.8 Testing for integral tabs (see item D of Table 3) shall be performed using the test connectors in Annex C.

8 Type tests

8.1 Insertion and withdrawal force

Ten male test tabs and ten female connectors are required. The male tabs shall be special male test tabs manufactured to close tolerances for the specific purpose of conducting this test.

Male test tabs shall be of half-hard brass, having a hardness of (62 ± 7) HR30T and shall conform to Figures 1, 2, 3 and 4 and Table 1, except that the C dimension tolerance shall be as indicated in Table 4, and any raised plateau around the detent shall be limited to a total of 0,025 mm over the stock thickness (see Figure 1).

NOTE 1 Tolerances of nominal test tab thickness expressed in inches are shown in Table D.6.

The male test tabs shall not be coated.

NOTE 2 A male tab from the production line that complies with the dimensions for test tabs may also be suitable.

A new male test tab shall be used for each female connector tested. For each combination of male tab and female connector, the tab shall be slowly and steadily inserted and withdrawn six times at a rate of travel of approximately 1 mm/s.

Insertion and withdrawal force measurements shall be made with any suitable testing device providing accurate alignment and being capable of holding the reading. An example of a suitable device is shown in Annex B.

Compliance is checked as follows:

The insertion and withdrawal forces shall be within the limits as specified in Table 5.

NOTE 3 The insertion and withdrawal forces for sizes expressed in AWG are shown in Table D.7.

8.2 Mechanical overload force (for integral tabs or female connectors)

An axial force, equal to that shown in Table 6, is applied smoothly once only with a suitable test apparatus for a period of 1 min. No damage which could impair further use shall occur to the tab or to the female connector or to the equipment in which the tab is integrated.

NOTE Retention force for sizes expressed in inches is shown in Table D.8.

Compliance is checked by inspection after completion of the test.

8.3 Temperature rise

The temperature rise test shall be conducted using six double ended male test tabs (see Figure 6) and twelve female connectors connected to conductors of the same type and of the largest cross-sectional area.

The test tab material shall be

- uncoated half-hard brass having a hardness of (62 ± 7) HR30T for female connectors made from copper alloy (coated or bare);
- nickel coated steel for female connectors made of nickel coated steel or stainless steel.

The test shall be carried out with male tabs and female connectors as delivered. In no case shall the test samples be cleaned or otherwise prepared prior to test, unless explicitly required by the documentation.

Crimp terminations shall be crimped within 1 h after the removal of the insulation from the associated conductors. The terminations shall be crimped with an appropriate crimping tool which has been adjusted in accordance with the manufacturer's instructions.

All test samples are subjected to visual examination and dimensional measurement prior to connecting the conductor.

Test samples shall be connected on each end of 178 mm length of uncoated insulated copper conductors. The insulation of the conductor shall be as specified by the flat quick-connect termination manufacturer.

The test samples shall be fitted with fine wire thermocouples placed in such a way so as not to influence the contact or the connection area of the test sample. An example of placement is shown in Figure 7. A thermocouple shall be installed so as to obtain thermal and mechanical bonding with the surface of a connector and without causing an appreciable change in the temperature of the connector, for example by the use of small quantities of an adhesive.

During the test, the samples shall be arranged and connected as shown in Figure 8. The test current as specified in Table 7 is passed through the samples until thermal equilibrium has been established. The temperature of the samples and the ambient temperature are measured and recorded.

NOTE 1 With agreement between the testing facility and the manufacturer, the test current may be increased.

NOTE 2 Test current for temperature rise for sizes expressed in AWG is shown in Table D.9.

Compliance is checked as follows:

The temperature rise of any individual connection shall not exceed 30 K.

8.4 Current loading cyclic

The test shall be carried out on the samples already subjected to the temperature rise test of 8.3.

Cross-sectional areas, insulation of conductors and the test arrangement shall be as for 8.3. The twelve samples are subjected to 500 cycles. Each cycle consists of 45 min under the overload test current as specified in Table 8 and 15 min without current.

NOTE Test current for current loading cyclic for sizes expressed in AWG is shown in Table D.10.

Compliance is checked as follows:

The temperature rise Δt_1 of any individual connection shall be measured after the 24th cycle and the temperature rise Δt_2 of any individual connection shall be measured after the 500th cycle. The Δt_2 value shall not exceed the Δt_1 value by more than 15 K. Neither individual temperature rise, Δt_1 or Δt_2 , shall exceed 85 K.

8.5 Elevated temperature test

The test shall be performed in a heating cabinet at the declared maximum permissible temperature, decreased by 45 K, on samples having a maximum permissible temperature higher than 85 °C and already subjected to the tests of 8.3 and 8.4.

Cross-sectional areas, insulation of conductors and the test arrangement shall be as specified in 8.3.

Care shall be taken not to disturb the samples, the conductors or the test arrangement when placing them in the heating cabinet.

The samples are subjected to eight cycles of elevated temperature. Each cycle consists of 23 h applying the test current as specified in Table 7 and 1 h without current. After the first hour, the temperature of the heating cabinet is adjusted, if necessary, until the average temperature using all the samples under test equals the maximum permissible temperature.

After the last heating cycle, the samples are allowed to cool down to ambient temperature.

Compliance is checked as follows:

The temperature rise test of 8.3 shall be repeated using the current from Table 7, and the temperature rise for any connector shall not exceed 45 K.

NOTE Test current for temperature rise for sizes expressed in AWG is shown in Table D.9.

8.6 Tensile strength test for crimped connections

The test shall be conducted on 10 new samples, with any wire insulation support rendered mechanically ineffective.

The conductor shall be assembled to the connector using the manufacturer's instructions and with the specified crimping tool.

All declared cross-sectional areas of conductors shall be tested.

Additionally, when a combination of two or more conductors is declared, each conductor shall be tested individually, in turn, and in accordance with the pull force value of its cross-sectional area.

The pull force as specified in Table 9 shall be applied for 1 min without jerks, or applied with a tensile machine with the head traveling at a speed of between 25 mm and 50 mm per min.

Compliance is checked as follows:

The force required to separate the crimping area from its attached conductor shall not be less than the pull force of Table 9.

NOTE 1 Tensile strength values for other methods of connection of the conductor are under consideration.

NOTE 2 For conductor connection means other than crimping, a special test may be agreed upon between manufacturers and testing stations.

NOTE 3 The pull force for sizes expressed in AWG is shown in Table D.11.

Table 1 – Dimensions of male tabs in millimetres

(see 6.3)

Dimensions in millimetres

Nominal size	A	B min.	C	D	E	F	J	M	N	P	Q min.
2,8 × 0,5	0,6	7,0	0,54	2,90	1,8	1,3	12°	1,7	1,4	1,4	8,1
	0,3		0,47	2,70	1,3	1,1	8°	1,4		0,3	
2,8 × 0,8	0,6	7,0	0,54	2,90	1,8	1,3	12°	1,7	1,4	1,4	8,1
	0,3		0,47	2,70	1,3	1,1	8°	1,4		0,3	
4,8 × 0,5	0,6	7,0	0,84	2,90	1,8	1,3	12°			1,4	8,1
	0,3		0,77	2,70	1,3	1,1	8°			0,3	
4,8 × 0,8	0,9	6,2	0,54	4,80	2,8	1,5	12°	1,7	1,5	1,7	7,3
	0,6		0,47	4,60	2,3	1,3	8°	1,4	1,2	0,6	
4,8 × 0,8	0,9	6,2	0,54	4,90	3,4	1,5	12°	1,7	1,5	1,8	7,3
	0,6		0,47	4,67	3,0	1,3	8°	1,4	1,2	0,7	
6,3 × 0,8	1,0	7,8	0,84	4,80	2,8	1,5	12°	2,5	2,0	1,8	8,9
	0,7		0,77	4,60	2,3	1,3	8°	2,2	1,8	0,7	
9,5 × 1,2	1,0	7,8	0,84	4,90	3,4	1,5	12°			1,8	8,9
	0,5		0,77	4,67	3,0	1,3	8°			0,7	
9,5 × 1,2	1,3	12,0	1,23	9,60	5,5	2,0	14°			2,0	13,1
	0,7		1,17	9,40	4,5	1,7	6°			1,0	

Table 2 – Dimensions of female connectors

(see 6.4)

Tab size mm	mm	
	B_3 max.	L_2 max.
2,8 × 0,5	3,8	2,3
2,8 × 0,8	3,8	2,3
4,8 × 0,5	6,2	2,9
4,8 × 0,8	6,2	2,9
6,3 × 0,8	7,8	3,5
9,5 × 1,2	11,1	4,0

Table 3 – Test sequences and sets of samples

(see 7.7)

Sets	Number of new samples per set		Clauses and subclauses	Test sequence
	Tabs	Female connectors		
A	6 double- ended tabs	12	6.3, 6.4 6.7, 8.3 6.8, 8.4 6.9, 8.5	Measurement of dimensions Temperature rise test Cyclic current loading Elevated temperature test
B	10 (male test tabs)	10	6.3, 6.4 6.5, 8.1 6.10, 8.6	Measurement of dimensions Insertion and withdrawal force Tensile strength test for crimped connections
C (tabs)	10		6.3 6.10, 8.6	Measurement of dimensions Tensile strength test for crimped connections
D (integral tabs and female connectors)	12	12	6.3, 6.4 6.6, 8.2	Measurement of dimensions Mechanical overload force
E (integral female connectors)	12 (male test tabs)	12	6.4 6.5, 8.1 6.6, 8.2	Measurement of dimensions Insertion/withdrawal force Mechanical overload force

Table 4 – Tolerances of test tab thickness

(see 8.1)

Nominal test tab thickness mm	C Dimension Maximum and minimum values of thickness mm
0,5	0,516 0,500
0,8	0,820 0,805
1,2	1,201 1,186

Table 5 – Insertion and withdrawal forces

(see 8.1)

Size mm	Insertion force N	Sixth withdrawal force N
	Maximum	Minimum
2,8 mm	53	5
4,8 mm	67	9
6,3 mm	80	18
9,5 mm	100	20

Table 6 – Retention force

(see 8.2)

Size	Retention force N	
	Push	Pull
2,8 mm	64	58
4,8 mm	80	98 ^a
6,3 mm	96	88
9,5 mm	120	110

NOTE The relevant product committee may consider increasing these values to allow a safety margin.

^a This is higher than that of the next larger size, due to existing designs.

Table 7 – Test current for temperature rise

(see 8.3 and 8.5)

mm ²	0,2	0,34	0,5	0,75	1	1,5	2,5	4	6
Test current A	2	3	4	5,5	7,5	12	15	18	20

Table 8 – Test current for current loading, cyclic

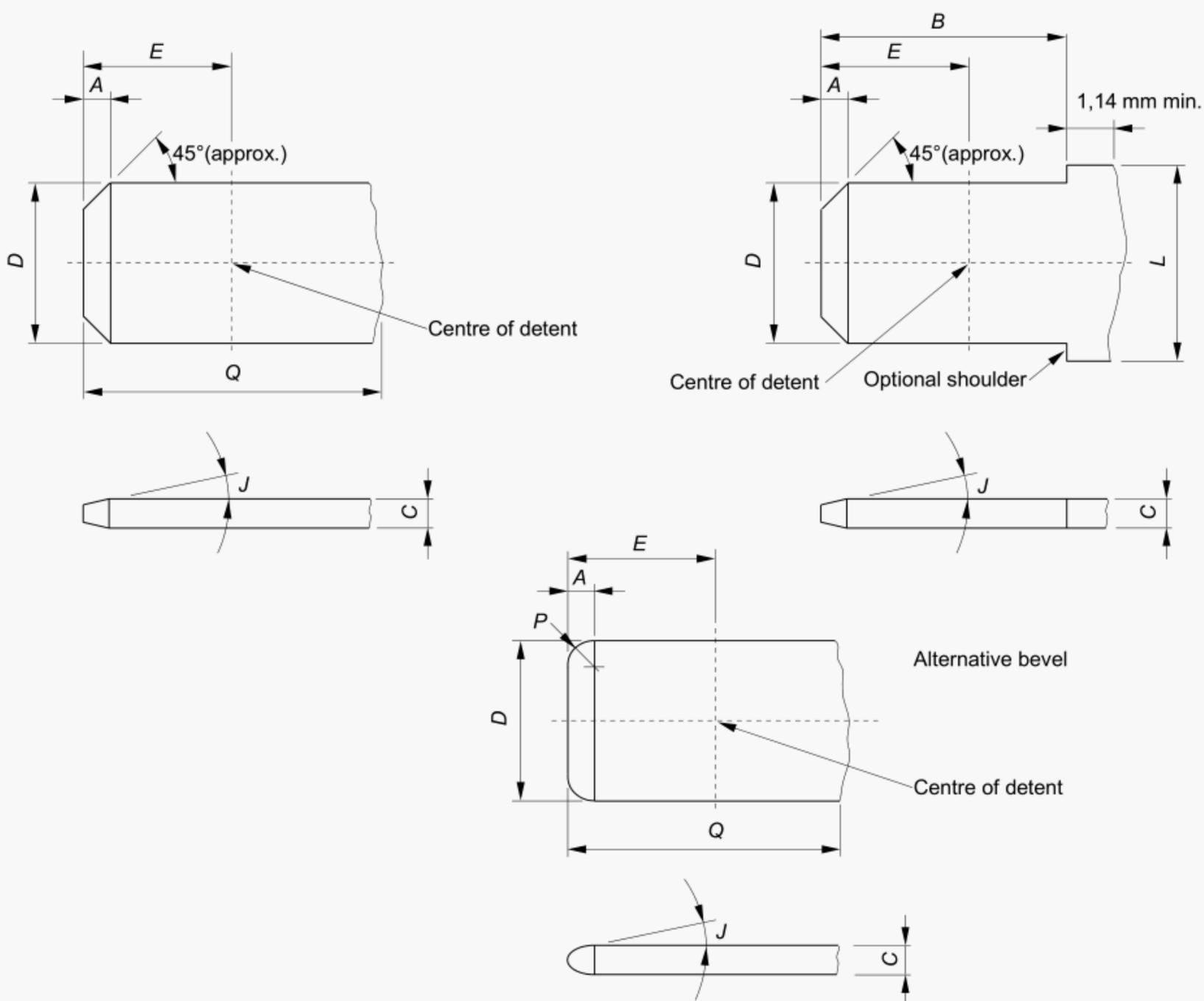
(see 8.4)

mm ²	0,2	0,34	0,5	0,75	1	1,5	2,5	4	6
Test current A	4	6	8	11	15	24	30	36	40

Table 9 – Pull force for testing the crimped connection

(see 8.6)

mm²	0,2	0,34	0,5	0,75	1	1,5	2,5	4	6
Pull force N	28	40	56	84	108	150	230	310	360



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NOTE 1 Bevel $A \times 45^\circ$ need not be a straight line if it is within the confines shown, or it may be a segment of a circle having a radius P and a segment altitude A .

NOTE 2 Dimension L is not specified and may vary by the application (e.g. fixing).

NOTE 3 Dimension C of tabs may be produced from more than one layer of material provided that the resulting tab complies in all respects with the requirements of this standard. A radius on the longitudinal edge of the tab is permissible.

NOTE 4 The sketches are not intended to govern the design except with regard to the dimensions shown.

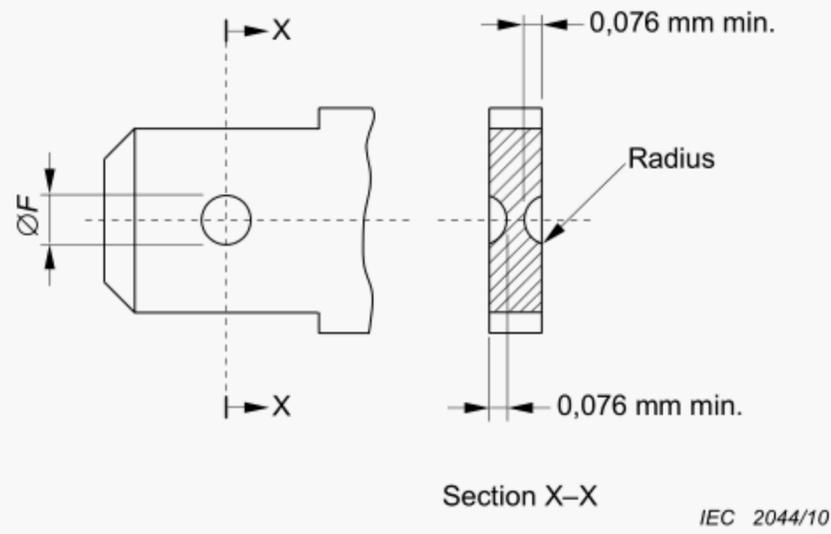
NOTE 5 The thickness C of the male tab may vary beyond Q or beyond $B + 1,14$ mm.

NOTE 6 All portions of the tabs should be flat and free of burrs or raised plateau, except that there may be a raised plateau over the stock thickness of 0,025 mm per side, in an area defined by a line surrounding the detent and distant from it by 1,3 mm.

NOTE 7 For detent and hole dimensions $\varnothing F$, M and N , see Figures 2, 3 and 4.

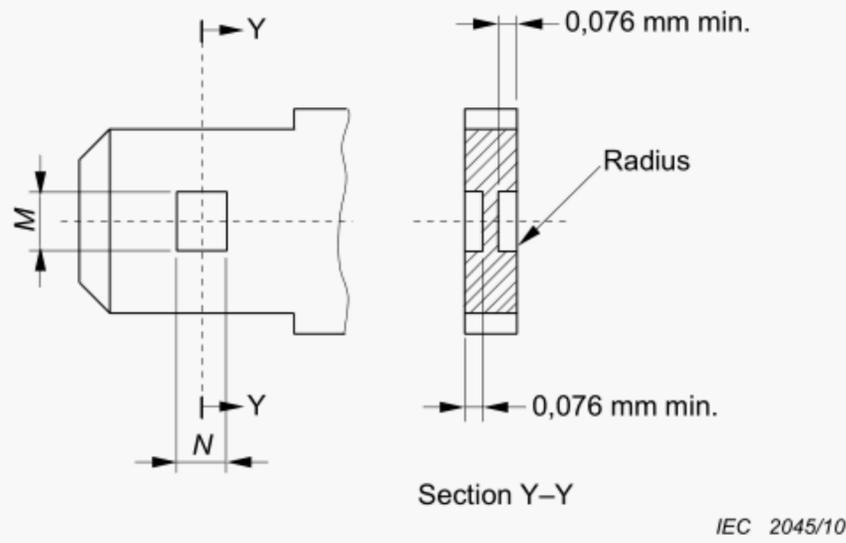
Figure 1 – Dimensions of male tabs

(see 6.3 and 8.1)



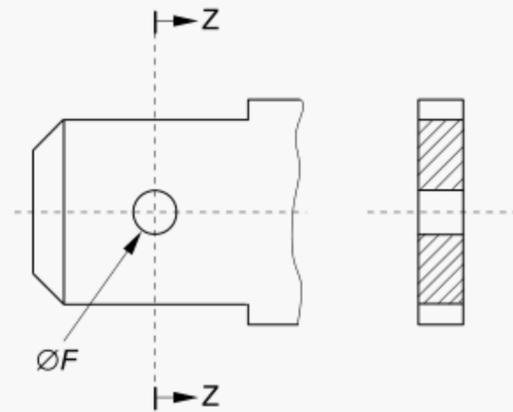
Detent shall be located within 0,076 mm of the centre-line of the tab.

Figure 2 – Dimensions of round dimple detents (see Figure 1)
(see 6.3 and 8.1)



Detent shall be located within 0,13 mm of the centre-line of the tab.

Figure 3 – Dimensions of rectangular dimple detents (see Figure 1)
(see 6.3 and 8.1)



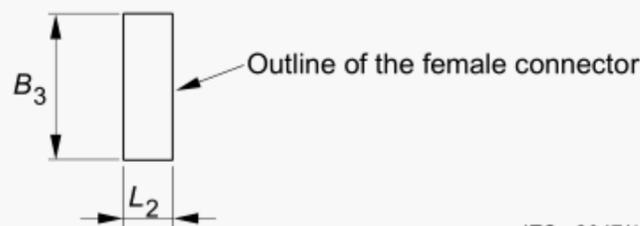
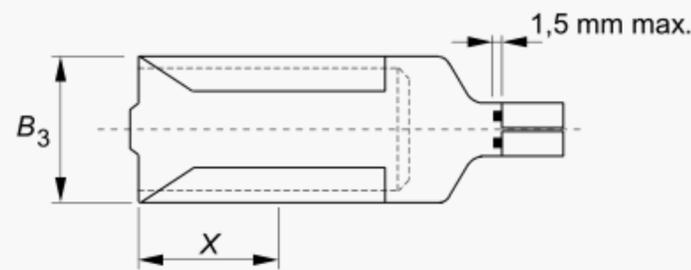
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Detent shall be located within 0,076 mm of the centre-line of the tab.

Figure 4 – Dimensions of hole detents (see Figure 1)

(see 6.3 and 8.1)



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B_3 and L_2 mandatory

NOTE 1 For determining female connector dimensions varying from B_3 and L_2 , it is necessary to refer to the tab dimensions in order to ensure that, in the most onerous conditions, engagement (and detent if fitted) between the tab and female connector is correct.

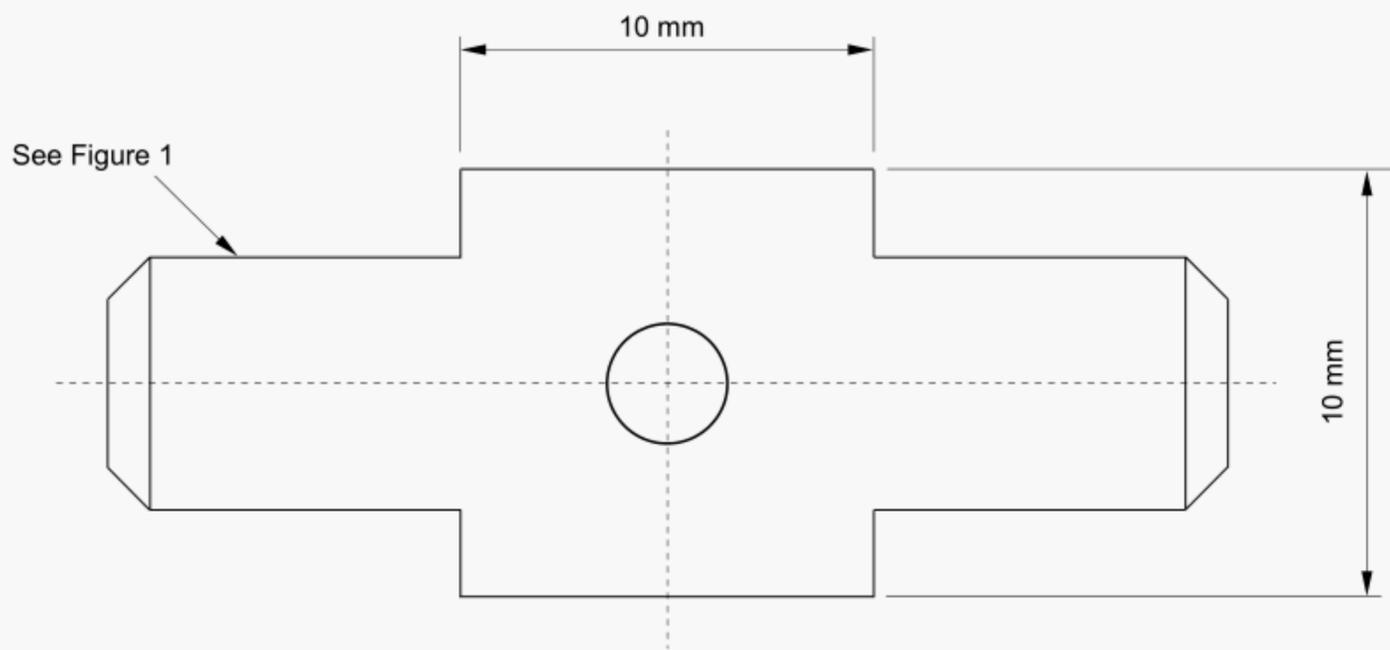
NOTE 2 If a detent is provided, the dimension X is at the manufacturer's discretion provided it meets the requirements of the performance clauses.

NOTE 3 Female connectors should be so designed that undue insertion of the conductor into the crimping area is visible or prevented by a stop in order to avoid any interference between the conductor and a fully inserted tab.

NOTE 4 The sketches are not intended to govern the design except with regard to the dimensions shown.

Figure 5 – Dimensions of female connectors

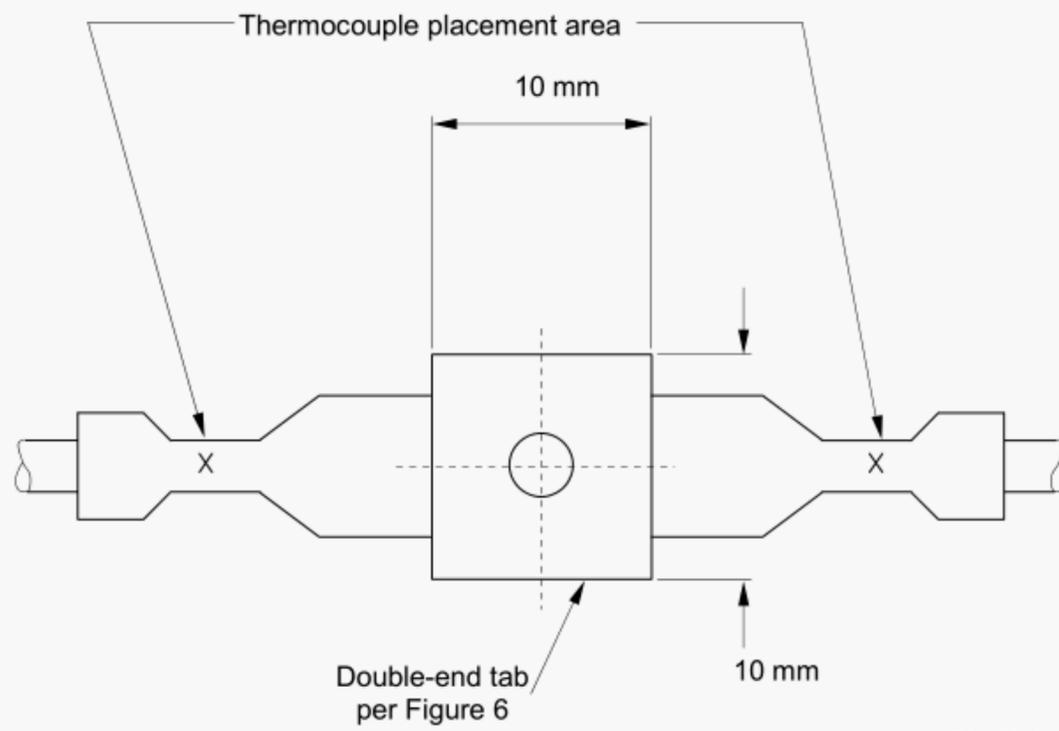
(see 6.4)



IEC 2048/10

Figure 6 – Double-ended tab

(see 8.3)



IEC 2049/10

Figure 7 – Location of thermocouples

(see 8.3)

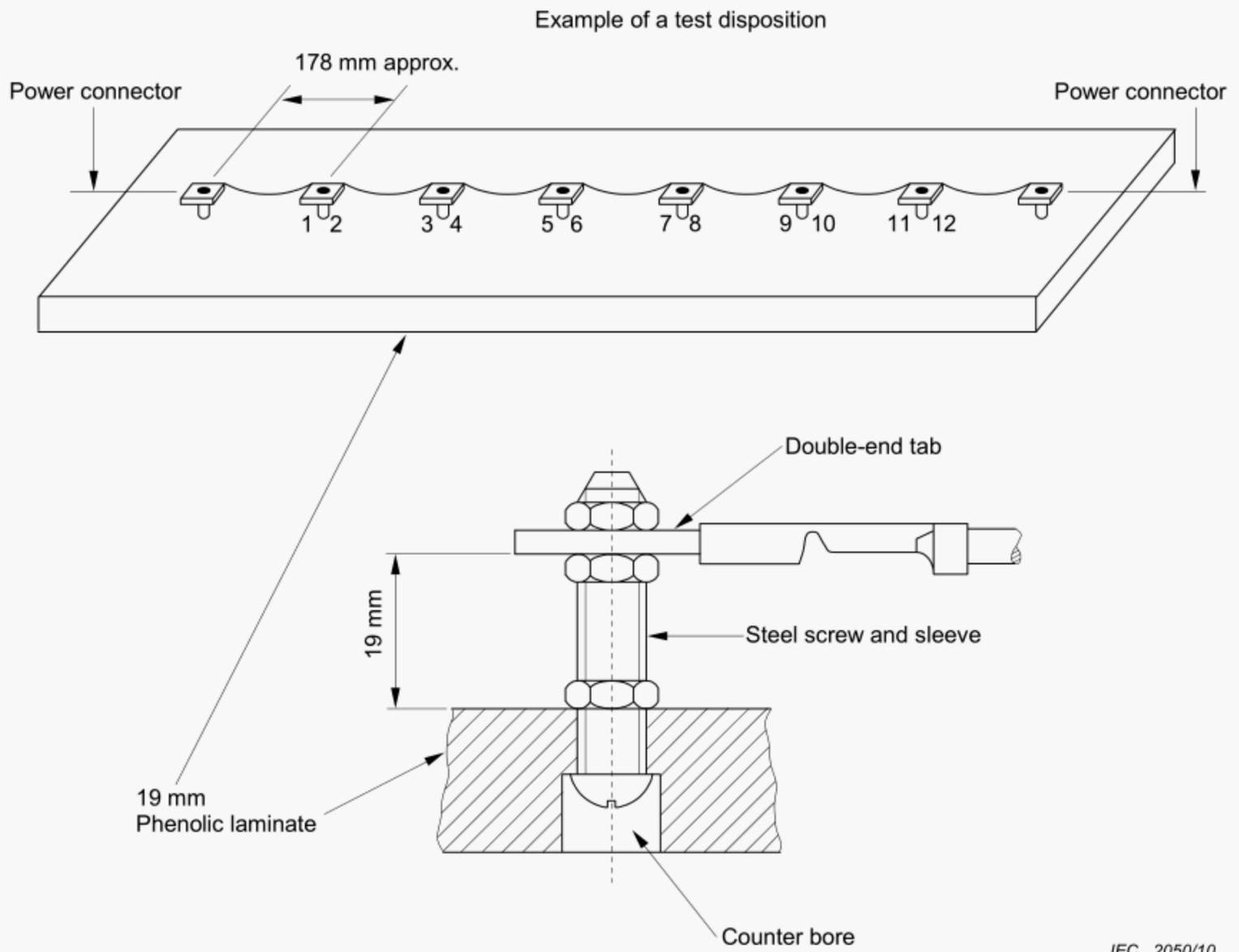


Figure 8 – Connections for electrical tests

(see 8.3)

Annex A (informative)

Maximum permissible temperature (maximum service temperature)

**Table A.1 – Maximum permissible temperature
(maximum service temperature)**

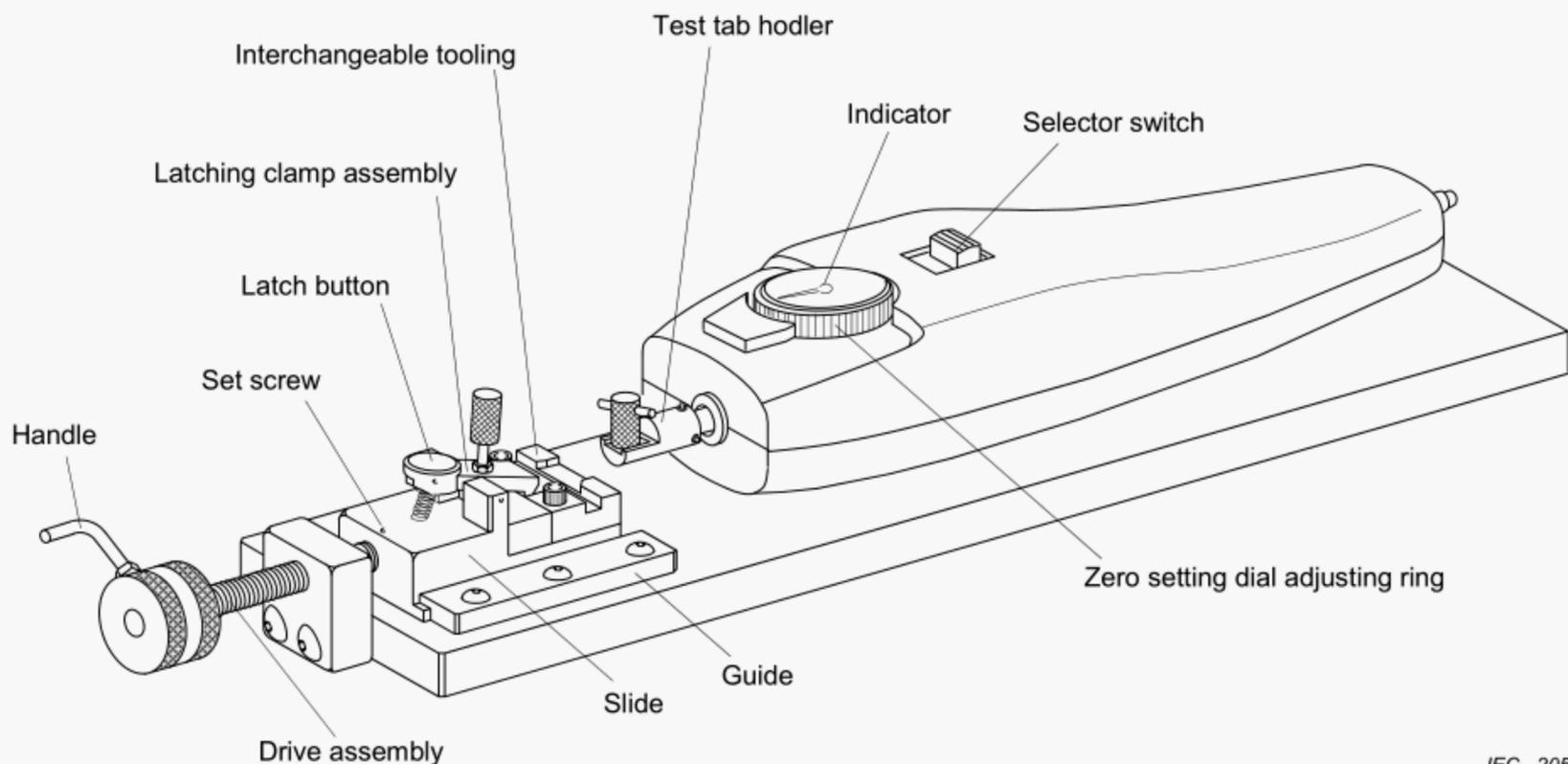
Materials and coating		Maximum permissible temperature °C		
Tabs	Female connectors	Tabs		Female connectors b
		Integrated a	In line b	
Bare copper		155	–	–
Bare brass	Bare brass	210	145	145
Tin coated copper and copper alloys	Tin coated copper alloys	160 ^a	160 ^c	160 ^c
Nickel coated copper and copper alloys		185	–	–
Silver coated copper alloys and copper	Silver coated copper alloys	205	–	205
Zinc coated steel		Only for earthing ^d	–	–
Nickel coated steel	Nickel coated steel	400	–	400
Stainless steel		400	–	400
<p>Other materials or coatings may be used, provided the electrical and mechanical properties are not less reliable, particularly with regard to resistance to corrosion and to mechanical strength.</p> <p>The temperature rise in normal use of flat quick-connect terminations designed and constructed under the guidance of this annex shall not make the temperature of their adjacent devices exceed their maximum permissible temperature.</p>				
<p>NOTE The values in the table represent material characteristics. The declared maximum permissible temperature from the manufacturer (item d) of 5.3) would generally be less than these values.</p>				
<p>^a Male tab integrated with the equipment.</p> <p>^b Tab or connector crimped onto the conductor.</p> <p>^c Temperature not higher than 160 °C because tin can melt at higher temperatures.</p> <p>^d Tabs as part of the frame or enclosure of equipment.</p>				

Annex B
(informative)

Force gauge for testing flat quick-connect female connectors

B.1 General

The following method is intended as an example only and its use is not mandatory. Figure B.1 depicts a typical fixture to be used.



IEC 2051/10

Figure B.1 – Force gauge fixture

An insertion/extraction force gauge is recommended for measuring the force necessary to insert and extract test tabs into and from flat quick-connect female connectors. Force gauges are available having test ranges of 45 N, 111 N and 222 N. The force gauge used depends on the known range of the female connector to be tested (for example a female connector having a known range between 22 N and 36 N would require a force gauge having a 45 N range, while a female connector having a known range between 36 N and 53 N would require a force gauge having 111 N range, etc.).

Interchangeable tooling, unique for each female connector series, is used to adapt the force gauge for any of the female connectors. In some cases, inserts for testing crimped female connectors can be used in the tooling specified for testing uncrimped female connectors.

It is recommended that the end of the brass male test tab, which is held in the test tab holder, be slotted to permit quick installation and removal of the test tabs. A new male test tab shall be used for testing each female connector to ensure an accurate reading.

The male tab and female connector holder dimensions and their location on the base plate shall provide a 0,051 mm alignment accuracy in both the vertical and horizontal directions with respect to the male tab centreline and the female connector slot centreline.

The retaining cavity of the female connector holder should allow the female connector a 0,127 mm lateral movement to provide for alignment during the insertion and extraction process.

B.2 Installation of tooling

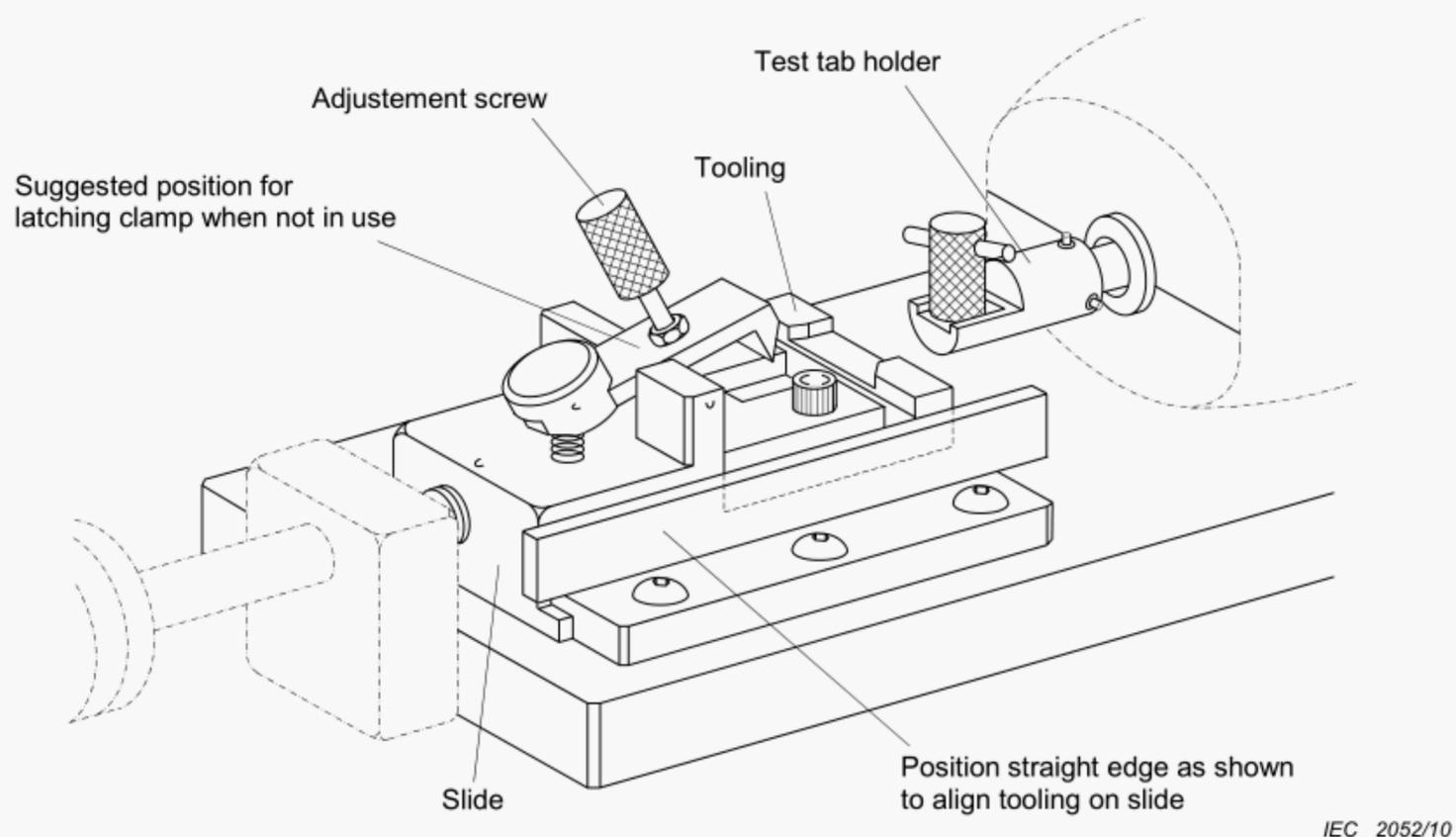
Check Figure B.1 and proceed as follows:

Remove the two socket head screws used to hold the tooling in place.

NOTE It may be necessary to back off the adjustment screw and depress the latch button to facilitate installation and removal of the tooling. Do not remove any of these components from the apparatus.

Place the tooling on the slide and align the holes in the tooling with those in the slide.

Install the socket head screws in the tooling. Make certain that the tooling is aligned with the test tab holder before securing the screws. This can be accomplished by placing a straight edge rule or an equivalent piece of flat stock material against the slide and tooling, and holding it in position until the screws are secured in the base. See Figure B.2.

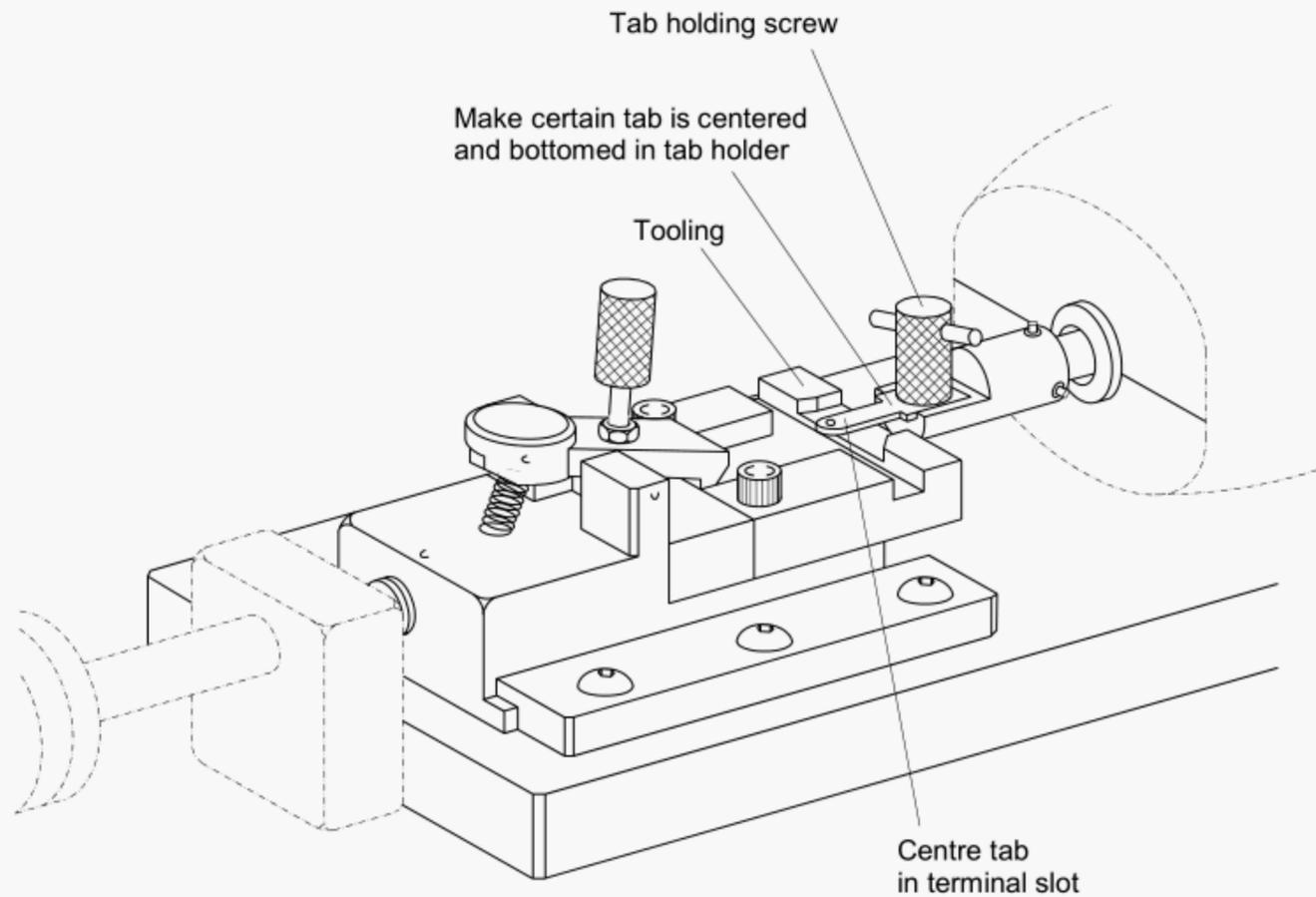


IEC 2052/10

Figure B.2 – Fixture adjustment

Check the alignment by placing a test tab in the tab holder. Advance the slide until the tooling is directly under the test tab. The test tab should be centered over the terminal slot in the tooling. Make certain that the test tab is bottomed and centered in the test tab holder before securing the test tab holding screw. See Figure B.3.

The apparatus is now ready for testing the female connector.



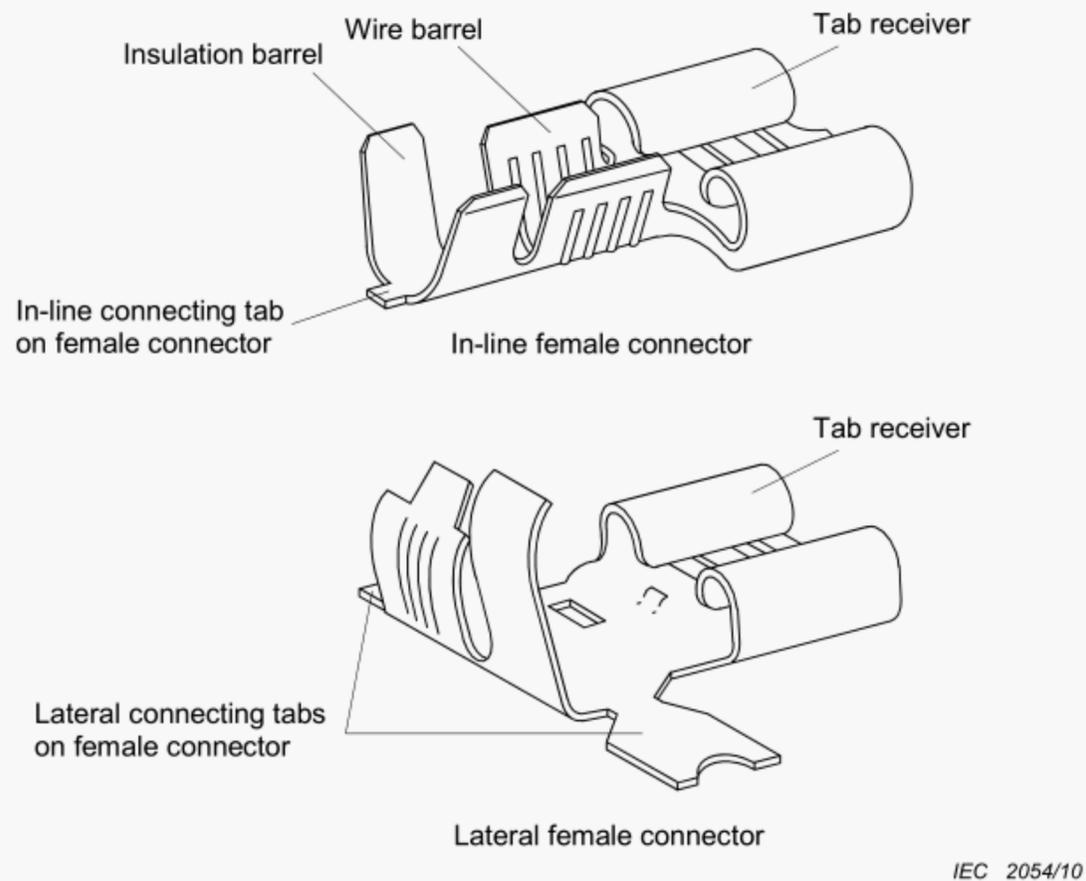
IEC 2053/10

Figure B.3 – Fixture test tab centering

B.3 Latching clamp

The latching clamp is primarily designed to hold female connectors having in-line connecting tabs (see Figure B.4) in the tooling during withdrawal tests. Generally, it is not necessary to use a latching clamp when testing female connectors having lateral connecting tabs. Adjust the clamp according to the following procedures.

NOTE 1 When the latching clamp is not in use, the adjustment screw can be positioned as shown in Figure B.2, to prevent interference during testing. When the tooling does not butt against the slide, a suitable piece of stock material can be positioned between the tooling and the slide to provide a resting surface for the adjustment screw (see Figure B.3). Do not remove the latching clamp assembly from the apparatus.



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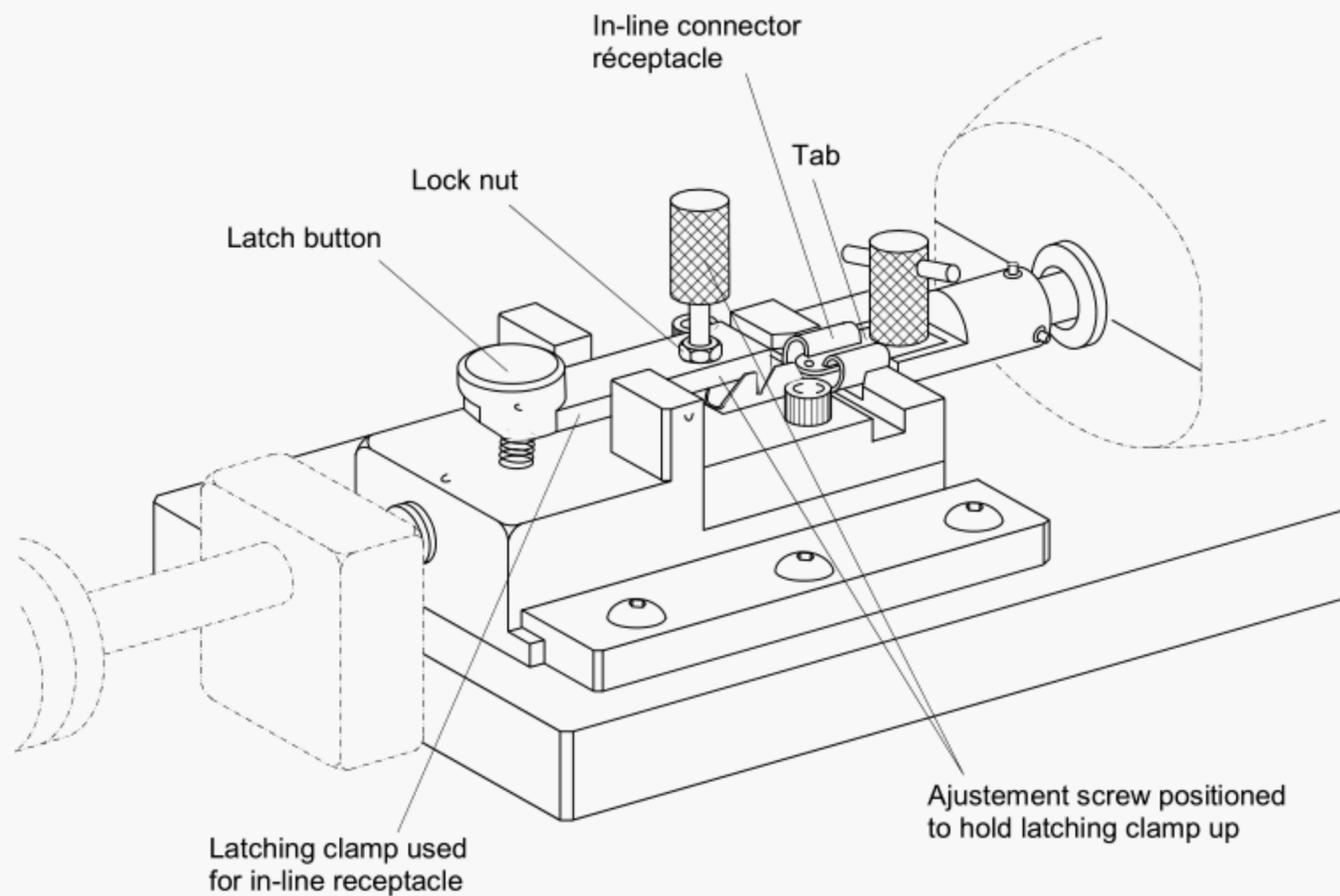
Figure B.4 – In-line and lateral female connectors

Place the in-line female connector in the appropriate tooling. Position the clamp between the insulation barrel and the wire barrel. (For female connectors without an insulation barrel, place the clamp between the tab receiver and the wire barrel.) Allow the clamp to bottom in the female connector.

NOTE 2 Remove in-line connecting tabs if they interfere with positioning the female connectors in the tooling. If possible, allow lateral connecting tabs to remain on the applicable terminal during the testing procedure. See Figure B.4.

Back-off the adjustment screw to release the pressure on the female connector. Use the locking nut to lock the screw in position. The adjustment should be such that the female connector is retained in the tooling, yet loose enough to facilitate self-alignment during the inserting test. See Figure B.5.

Depress the latch button to install and extract the female connector from the tooling.



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Figure B.5 – Fixtureing alignment

B.4 Testing procedure

Centre the selector switch and gently tap the side of the force gauge with a finger to ensure that the indicator is at rest. Turn the zero-setting dial adjusting ring until the indicator points to zero. Select the appropriate female connector and test tab and proceed as follows.

Place the test tab in the test tab holder and be sure that the test tab is fully inserted before tightening the test tab holding screw.

Place the female connector in the tooling and position the selector switch in the forward position. Advance the slide with a slow and uniform movement to ensure that the test tab and female connector mate properly.

NOTE If the female connector begins to lift up, apply light finger pressure to hold the components in line. Release the finger pressure when the test tab begins to penetrate the female connector. Be sure that the finger pressure does not affect the test reading.

Stop the slide when the dimples of the test tab and female connector have engaged. Do not over-insert the test tab into the female connector.

Record the force indicated on the dial, then reposition the selector switch to the rear position and back the slide away from the test tab holder to obtain the extraction value.

Install a new test tab for the next female connector and repeat test procedures.

Annex C (informative)

Female test connectors for testing with integral tabs

For the following connector designs, provide for uniform test connectors for performance testing of integral tabs on devices such as switches and the like.

The shape of the various parts may deviate from those given in Figures C.1 and C.2, provided that the specified dimensions in Tables C.1, C.2, C.3 and C.4 are not influenced.

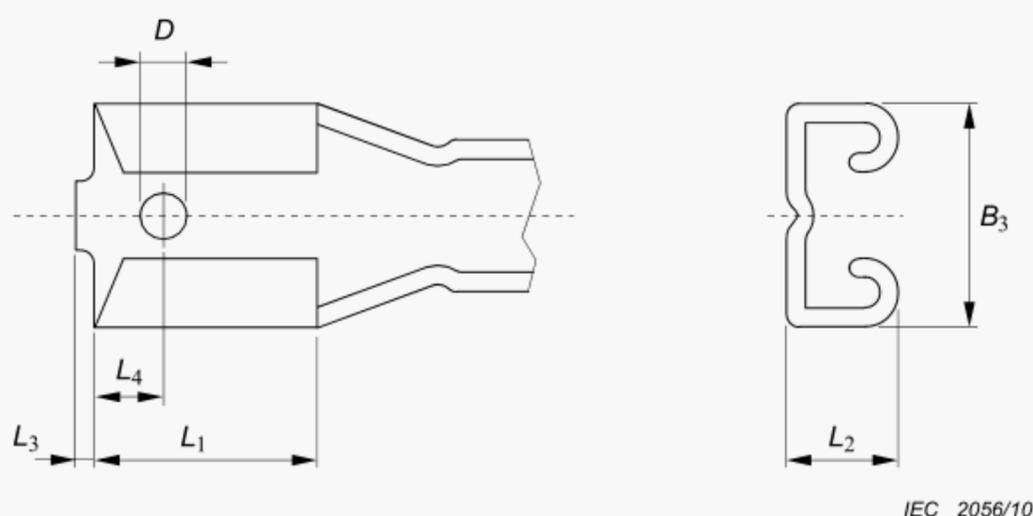


Figure C.1 – Dimensions of female connectors

Table C.1 – Dimensions of female connectors in millimetres (see Figure C.1)

Dimensions in millimetres

Connector for tab size	D (max.)	B_3 (max.)	L_1	L_2 (max.)	L_3 (max.)	L_4
2,8 × 0,5	1,2	3,8	6,6 6,0	2,3	0,5	a
2,8 × 0,8	1,2	3,8	6,6 6,0	2,3	0,5	a
4,8 × 0,5	1,2	6,0	6,6 6,0	2,9	0,5	a
4,8 × 0,8	1,2	6,0	6,6 6,0	2,9	0,5	a
6,3 × 0,8	1,6	7,8	8,1 7,5	3,5	0,5	a
9,5 × 1,2	1,6	11,1	12,2 10,9	4,0	0,5	a

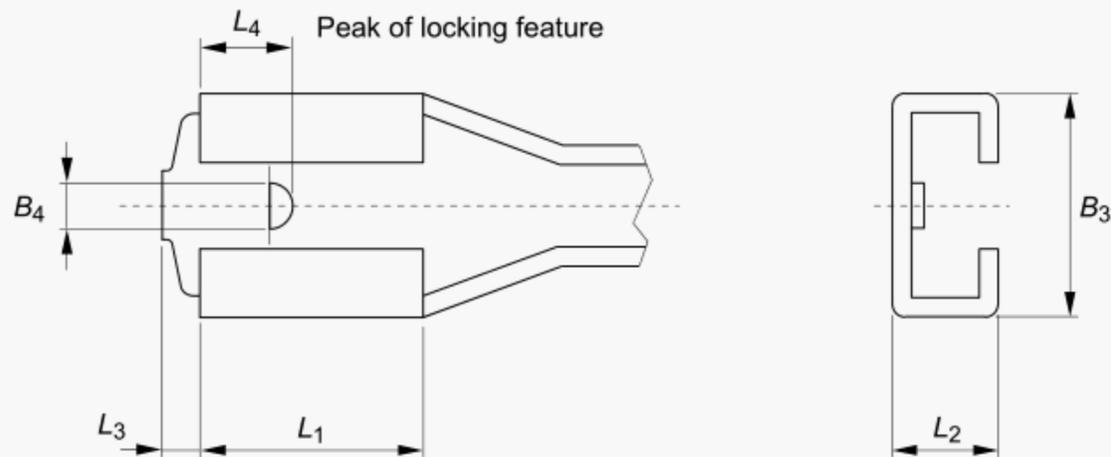
^a Dimension L_4 is at the manufacturer's discretion

Table C.2 – Dimensions of female connectors in inches (see Figure C.1)

Dimensions in inches

Connector for tab size	<i>D</i> (max.)	<i>B</i> ₃ (max.)	<i>L</i> ₁	<i>L</i> ₂ (max.)	<i>L</i> ₃ (max.)	<i>L</i> ₄
0,110 × 0,020	0,048	0,150	0,260 0,236	0,091	0,020	a
0,110 × 0,032	0,048	0,150	0,260 0,236	0,091	0,020	a
0,187 × 0,020	0,047	0,236	0,260 0,236	0,115	0,020	a
0,187 × 0,032	0,047	0,236	0,260 0,236	0,115	0,020	a
0,250 × 0,032	0,063	0,307	0,319 0,295	0,138	0,020	a
0,375 × 0,047	0,063	0,438	0,480 0,429	0,157	0,020	a

^a Dimension *L*₄ is at the manufacturer's discretion.



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Figure C.2 – Dimensions of female connectors, alternative design

Table C.3 – Dimensions of alternative design female connectors in millimetres (see Figure C.2)

Dimensions in millimetres

Connector for tab size	<i>B</i> ₃ (max.)	<i>B</i> ₄ (max.)	<i>L</i> ₁	<i>L</i> ₂ (max.)	<i>L</i> ₃ (max.)	<i>L</i> ₄
2,8 × 0,5			(under consideration)			
2,8 × 0,8			(under consideration)			
4,8 × 0,5	6,2	1,3	6,6 6,1	1,9	1,4	a
4,8 × 0,8	6,2	1,3	6,6 6,1	2,3	1,4	a
6,3 × 0,8	7,8	1,7	8,2 7,7	2,3	1,4	a
9,5 × 1,2			(under consideration)			

^a Dimension *L*₄ is at the manufacturer's discretion.

**Table C.4 – Dimensions of alternative design female connectors in inches
(see Figure C.2)**

Dimensions in inches

Connector for tab size	B_3 (max.)	B_4 (max.)	L_1	L_2 (max.)	L_3 (max.)	L_4
0,110 × 0,020			(under consideration)			
0,110 × 0,032			(under consideration)			
0,187 × 0,020	0,245	0,051	0,260 0,240	0,075	0,055	a
0,187 × 0,032	0,245	0,051	0,260 0,240	0,091	0,055	a
0,250 × 0,032	0,307	0,067	0,323 0,307	0,091	0,055	a
0,375 × 0,047			(under consideration)			
^a Dimension L_4 is at the manufacturer's discretion.						

Annex D
(informative)

Tables showing approximate relationships between mm and inches or cross-sectional areas in mm² and AWG sizes as used in North America allowing to use this standard

Table D.1 – Relationship between mm and inches or mm² and AWG within the scope

mm or mm ²	Inches or AWG
2,8 mm, 4,8 mm, 6,3 mm or 9,5 mm	0,110 in, 0,187 in, 0,250 in, or 0,375 in
6 mm ²	10 AWG and smaller
2,5 mm ²	14 AWG and smaller

Table D.2 Relationship between mm and inches in Subclause 4.1

mm	Inches
2,8 mm × 0,5	0,110 in × 0,020
2,8 mm × 0,8	0,110 in × 0,032
4,8 mm × 0,5	0,187 in × 0,020
4,8 mm × 0,8	0,187 in × 0,032
6,3 mm × 0,8	0,250 in × 0,032
9,5 mm × 1,2	0,375 in × 0,047

Table D.3 – Approximate relationship between cross-sectional area in mm² and AWG sizes in Subclause 4.2

Cross-sectional area mm ²	AWG	
	Size	Approximate equivalent metric area mm ²
0,20	24	0,21
0,34	22	0,32
0,50	20	0,5
0,75	18	0,8
1,00	–	–
1,50	16	1,3
2,50	14	2,1
4,00	12	3,3
6,00	10	5,3

Table D.4 – Dimensions of male tabs in inches applicable in Subclauses 6.3 and 8.1 (equivalent with Table 1)

Dimensions in inches

Nominal size	A	B min.	C	D	E	F	J	M	N	P	Q min.
0,110 × 0,020	dimple	0,024	0,021	0,114	0,071	0,051	12°	0,067	0,055	0,055	0,319
	hole	0,012	0,019	0,106	0,051	0,043	8°	0,055	0,039	0,012	0,319
0,110 × 0,032	dimple	0,024	0,021	0,114	0,071	0,051	12°	0,067	0,055	0,055	0,319
	hole	0,012	0,019	0,106	0,051	0,043	8°	0,055	0,039	0,012	0,319
0,187 × 0,020	dimple	0,035	0,021	0,190	0,110	0,060	12°	0,067	0,059	0,067	0,287
	hole	0,024	0,019	0,181	0,091	0,050	8°	0,055	0,047	0,024	0,287
0,187 × 0,032	dimple	0,040	0,033	0,190	0,110	0,060	12°	0,067	0,059	0,071	0,287
	hole	0,024	0,030	0,181	0,091	0,050	8°	0,055	0,047	0,027	0,287
0,250 × 0,032	dimple	0,040	0,033	0,193	0,134	0,060	12°	0,098	0,080	0,071	0,350
	hole	0,020	0,030	0,184	0,117	0,050	8°	0,086	0,070	0,027	0,350
0,375 × 0,047	dimple	0,040	0,033	0,253	0,161	0,080	12°	0,086	0,080	0,071	0,516
	hole	0,027	0,030	0,244	0,142	0,063	8°	0,086	0,070	0,027	0,516
0,375 × 0,047	dimple	0,051	0,048	0,379	0,217	0,080	14°	0,080	0,080	0,080	0,516
	hole	0,027	0,046	0,370	0,177	0,067	6°	0,067	0,039	0,039	0,516

Table D.5 – Dimensions of female connectors applicable in Subclause 6.4 (equivalent with Table 2)

Tab size Inches	mm	
	B_3 max.	L_2 max.
0,110 × 0,020	3,8	2,3
0,110 × 0,032	3,8	2,3
0,187 × 0,020	6,2	2,9
0,187 × 0,032	6,2	2,9
0,250 × 0,032	7,8	3,5
0,375 × 0,047	11,1	4,0

Table D.6 – Tolerances of test tab thickness applicable in Subclause 8.1 (equivalent with Table 4)

Nominal test tab thickness Inches	C Dimension maximum and minimum values of thickness mm
0,020	0,516 0,500
0,032	0,820 0,805
0,047	1,201 1,186

Table D.7 – Insertion and withdrawal forces applicable in Subclause 8.1 (equivalent with Table 5)

Size Inches	Insertion force N	Sixth withdrawal force N
	Maximum	Minimum
0,110	53	5
0,187	67	9
0,250	80	18
0,375	100	20

Table D.8 – Retention force applicable in Subclause 8.2 (equivalent with Table 6)

Size Inches	Retention force N	
	Push	Pull
0,110	64	58
0,187	80	98 ^a
0,250	96	88
0,375	120	110

NOTE The relevant product committee may consider increasing these values to allow a safety margin.

^a This is higher than that of the next larger size, due to existing designs.

**Table D.9 – Test current for temperature rise applicable in Subclauses 8.3 and 8.5
(equivalent with Table 7)**

AWG	24	22	20	18	–	16	14	12	10
Test current A	2	3	5	7	–	10	15	20	30

**Table D.10 – Test current for current loading, cyclic applicable in Subclause 8.4
(equivalent with Table 8)**

AWG	24	22	20	18	–	16	14	12	10
Test current A	4	6	10	14	–	20	30	40	60

**Table D.11 – Pull force for testing the crimped connection applicable in Subclause 8.6
(equivalent with Table 9)**

AWG	24	22	20	18	–	16	14	12	10
Pull force N	28	36	58	89	–	133	223	311	356

Annex E
(informative)

**Information relating to cross section of conductors
and dimensions of male tabs**

The values given within this annex are provided as general information only. They provide a general relationship between conductors and tabs and can help manufacturers during designing. This annex cannot be used in place of any normative part within this standard.

Table E.1 – Relationships between conductors and tabs

Cross-sectional area mm ²	Nominal width of male tabs	
	mm	Inches
0,50	2,8/4,8/6,3	0,110/0,187/0,250
0,75	2,8/4,8/6,3	0,110/0,187/0,250
1,00	2,8/4,8/6,3	0,110/0,187/0,250
1,50	4,8/6,3	0,187/0,250
2,50	4,8/6,3	0,187/0,250
4,00	6,3/9,5	0,250/0,375
6,00	6,3/9,5	0,250/0,375
