INTERNATIONAL STANDARD

IEC 61076-4-111

QC 480301XX0012

First edition
2002-02

Connectors for electronic equipment –

Part 4-111:
Printed board connectors with assessed quality – Detail specification for two-part power connector modules, for printed boards and backplanes having early mating features, and having a basic grid of 2,5 mm in accordance with IEC 60917-1

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International Electrotechnical Commission, 3, rue de Varembé, PO Box 131, CH-1211 Geneva 20, Switzerland
Telephone: +41 22 919 02 11 Telefax: +41 22 919 03 00 E-mail: inmail@iec.ch Web: www.iec.ch

Commission Electrotechnique Internationale
International Electrotechnical Commission
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

CONNECTORS FOR ELECTRONIC EQUIPMENT –

Part 4-111: Printed board connectors with assessed quality – Detail specification for two-part power connector modules, for printed boards and backplanes having early mating features, and having a basic grid of 2,5 mm in accordance with IEC 60917-1

FOREWORD

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International Standard IEC 61076-4-111 has been prepared by subcommittee 48B: Connectors, of IEC technical committee 48: Electromechanical components and mechanical structures for electronic equipment.

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

FDIS	Report on voting
48B/1123/FDIS	48B/1171/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 3.

Annex A forms an integral part of this standard.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated when a new edition is prepared.

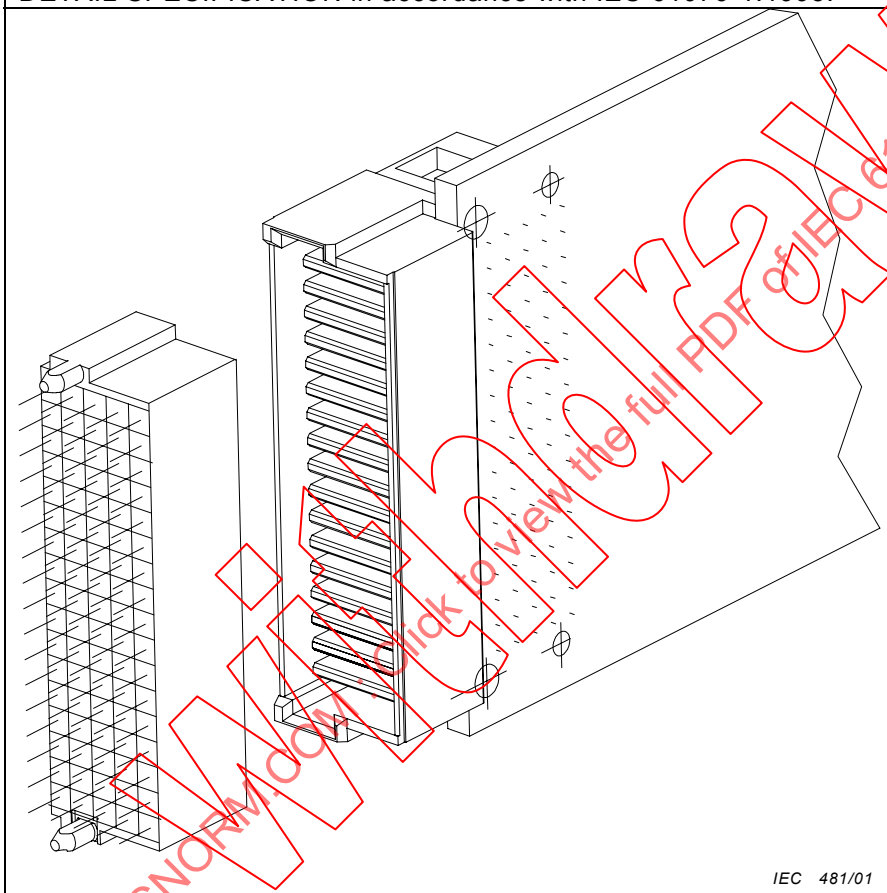
The QC number that appears on the front of cover of this publication is the specification number in the IEC Quality Assessment System for Electronic Components (IECQ).

The committee has decided that the contents of this publication will remain unchanged until 2004. At this date, the publication will be

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- withdrawn;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

CONNECTORS FOR ELECTRONIC EQUIPMENT –

Part 4-111: Printed board connectors with assessed quality – Detail specification for two-part power connector modules, for printed boards and backplanes having early mating features, and having a basic grid of 2,5 mm in accordance with IEC 60917-1

IEC SC 48B – Connectors Specification available from: IEC Central Office or from the addresses shown on the inside cover.	IEC 61076-4-111 QC 480301XX0012
ELECTRONIC COMPONENTS OF ASSESSED QUALITY DETAIL SPECIFICATION in accordance with IEC 61076-1:1995.	Blank detail specification number 61076-4-001.
 IEC 481/01	Modular two-part power connector for printed boards and backplanes having a basic grid of 2,5 mm in accordance with IEC 60917-1. Modular two part power connector having 15 mm mounting pitch and height multiple modules of n x 25 mm with n = 1 and 2. Female press-in connector on the backplane. Male press-in connector on the daughterboard. Performance levels (PL): 1, 2 Assessment level: B, G

Information on the availability of components qualified to this detail specification is given in the qualified products list.

1 General data

This specification contains modular two-part power connectors having a grid of 2,5 mm for printed boards and backplanes. The described modules are n x 25 mm with n = 1 and n = 2. The required board mounting spacing is 15 mm or more. The standard power contact has a first make / last break function in respect to the first make / last break signal contact described in IEC 61076-4-100. The connector is not intended for mating and unmating under heavy load (non-signal).

Throughout this specification, all dimensions are in millimetres.

1.1 Recommended method of mounting

The free board connector is provided with compliant press-in terminations. The mounting of the free board connector is achieved by press-in pivots; the terminations of the free board connector fit into holes in the printed board according to IEC 60352-5 located on a grid of 2,5 mm. Each contact has five press-in sections.

The fixed board connector is provided with compliant press-in terminations. The mounting of the fixed board connector is achieved by press-in pivots, the terminations of the fixed board connector fit into holes in the printed board according to IEC 60352-5 located on a grid of 2,5 mm. Each contact has five press-in sections. Care must be taken that the five terminations are connected to each other by traces adequate to bear the required current on the backplane, for it might be that, on multispring designs, there are no internal connections within the connector.

For the press-in operation, the tooling recommended by the connector supplier should be used.

See annex A for guidance on the application of these connectors in mechanical structures according to IEC 60917-1.

1.1.1 Number of contacts

Style	A	B
Number of contacts	7	17

1.2 Ratings and characteristics

Rated voltage:	500 V r.m.s. for pollution degree 1 (according to IEC 60664-1, table 4)
	100 V r.m.s. for pollution degree 2 (according to IEC 60664-1, table 4)
Impulse withstand voltage:	2 kV for pollution degrees 1 and 2 (according to IEC 60664-1, table 2)
Current rating:	15 A at 70 °C
Insulation resistance:	10^4 MΩ
Climatic category:	PL1: 55/125/56
	PL2: 55/125/21
Printed board:	Hole diameter: plated-through hole 0,94 mm to 1,09 mm according to IEC 60352-5.
	Board thickness: 1,4 mm min.
Backplane:	Hole diameter: plated-through hole 0,94 mm to 1,09 mm according to IEC 60352-5.
	Board thickness: 1,4 mm min.
Contact spacing:	2,5 mm

1.3 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 61076. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 61076 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

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

IEC 60326-3:1991, *Printed boards – Part 3: Design and use of printed boards*

IEC 60352-5:1995, *Solderless connections – Part 5: Solderless press-in connections – General requirements, test methods and practical guidance*

IEC 60410:1973, *Sampling plans and procedures for inspection by attributes*

IEC 60512 (all parts), *Connectors for electronic equipment – Tests and measurements*

IEC 60512-1-100:2001, *Connectors for electronic equipment – Tests and measurements – Part 1-100: General – Applicable publications*

IEC 60664-1:1992, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60917-1:1998, *Modular order for the development of mechanical structures for electronic equipment practices – Part 2: Generic standard*

IEC 60917-2-2:1994, *Modular order for the development of mechanical structures for electronic equipment practices – Part 2: Sectional specification – Interface co-ordination dimensions for the 25 mm equipment practice – Section 2: Detail specification – Dimensions for subracks, chassis, backplanes, front panels and plug-in units*

IEC 61076-1:1995, *Connectors with assessed quality for use in d.c., low frequency analogue and in digital high speed data applications – Part 1: Generic specification*

IEC 61076-4:1995, *Connectors with assessed quality for use in d.c., low frequency analogue and in digital high speed data applications – Part 4: Sectional specification – Printed board connectors*

IEC 61076-4-001:1996, *Connectors with assessed quality, for use in d.c., low-frequency analogue and in digital high-speed data application – Part 4: Printed board connectors – Section 001: Blank detail specification.*

IEC 61076-4-100:2001, *Connectors for electronic equipment – Part 4-100: Printed board connectors with assessed quality – Detail specification for two-part connector modules having a grid of 2,5 mm, for printed boards and backplanes.*

IEC 61076-4-102:1997, *Connectors with assessed quality for use in d.c., low frequency analogue and in digital high speed data applications – Part 4: Printed board connectors – Section 102: Detail specification for two-part single-pole connectors, for multiple uses on plug-in units, with pre-centring, coding and early mating features, having a metric grid in accordance with IEC 60917*

ISO 1302:1992, *Technical drawings – Method of indicating surface texture*

1.4 Marking

The marking of the connector and the package shall be in accordance with 2.6 of IEC 61076-4.

1.5 IEC type designation

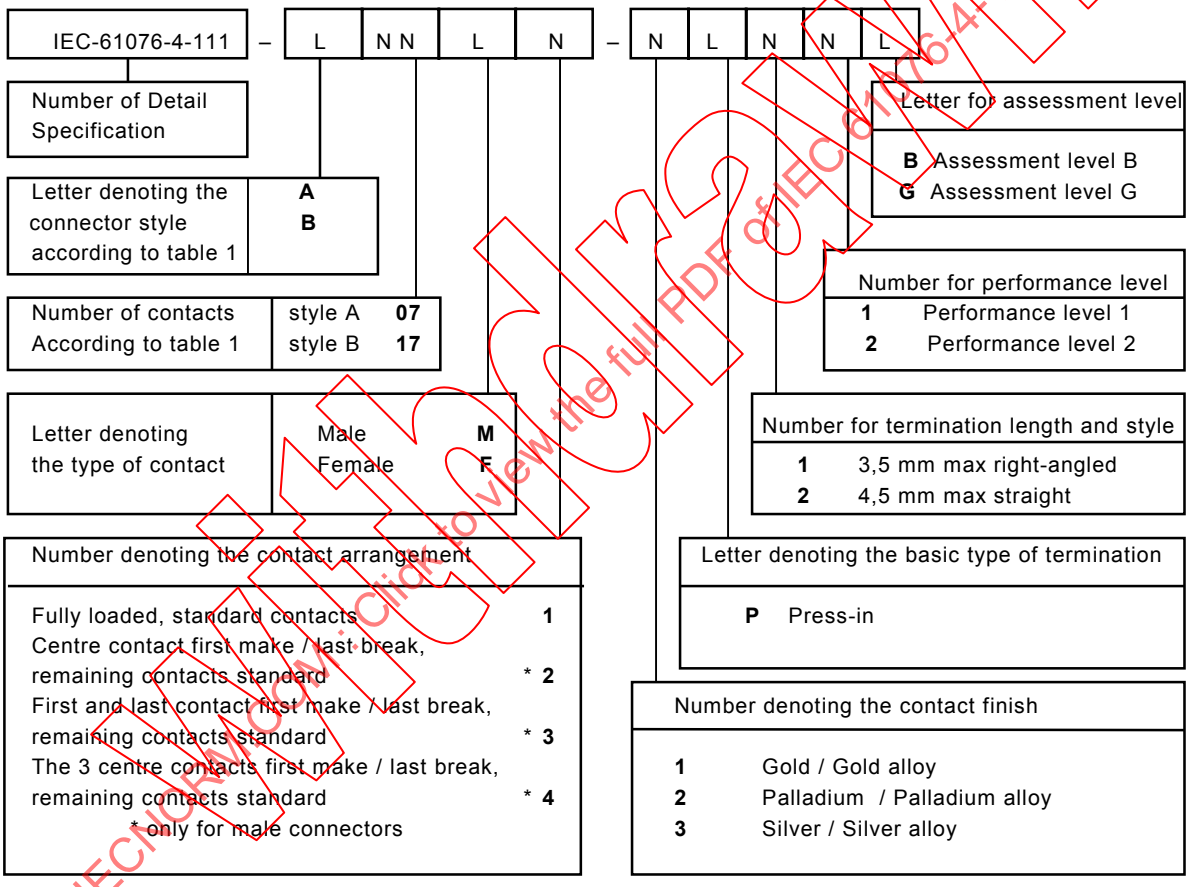
See 2.1 for definitions and 2.2 for designation of styles and variants.

L stands for letter, N stands for number.

Connectors shall be designated by the following system.

Example for connector:

A style A male connector, right-angled 3,5 mm press-in terminations, fully loaded, with first make / last break contacts in the first and last position, having silver or silver alloy plating meeting performance level 2, assessment level B is designated as follows: IEC-61076-4-111-A07M3-3P12B.



1.6 Ordering information

For ordering connectors according to this detail specification, the IEC type designation described in 1.5 shall be used.

2 Technical information

2.1 Definitions

For the purpose of this part of IEC 61076, the following definitions apply.

contact range

the minimum to maximum distance between the reference planes of the fixed and free board connectors, within which the specified contact resistance is met

contact level

group of contacts which engages/separates simultaneously, within the limits required by a secure engaging sequence

first reliable contact point

point on the female contact, from where the specified contact resistance with the incoming male contact is met

first make / last break contact

contact or group of contacts which engage prior and separate later than standard contacts.

2.2 Survey of styles and variants

Table 1 – Styles

Style reference letter	A	B
Height of styles	25 mm	50 mm
Number of contacts	7	17

2.3 Information on application

2.3.1 Complete connectors (pairs)

Based on the multi-module of 25 mm, the connector may be used in any combination with connectors according to IEC 61076-4-100. The arrangement of the free board connectors is the same as the arrangement of the fixed board connectors.

2.3.2 Fixed board connectors

The fixed board connector shall be pressed into the backplane, the contacts have compliant press-in terminations, the housing has two plastic pivots to ensure the proper positioning and mechanical fixation.

2.3.3 Free board connectors

The free board connector shall be pressed into the printed board. The contacts have compliant press-in terminations, the housing has four plastic pivots to ensure the proper positioning and mechanical fixation.

2.4 Contact arrangements

Contact arrangements according to 1.5.

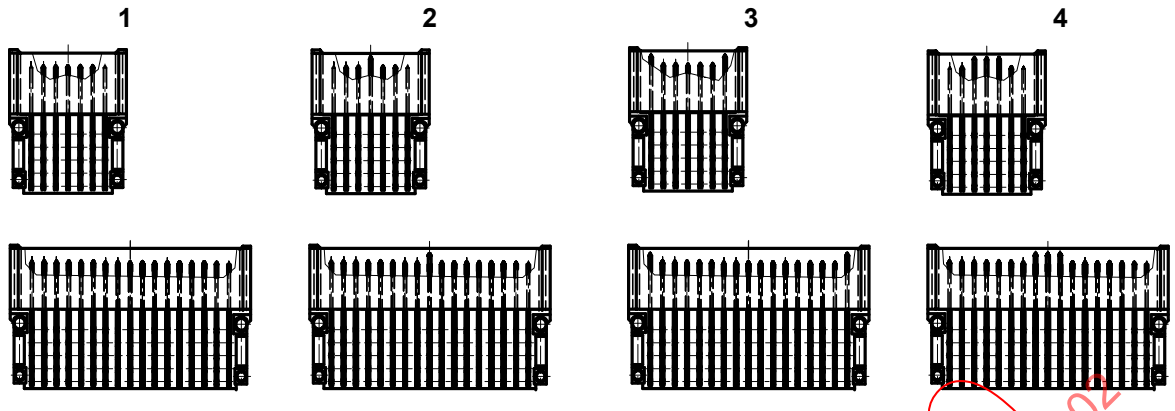


Figure 1 – Contact arrangements

3 Drawings and dimensions

3.1 General

All drawings are shown in first angle projection. The shape of the connectors may deviate from that given in the following drawings, as long as the specified dimensions and function are not influenced.

Dimensions not specified may be chosen according to common characteristics and intended use.

3.2 Isometric view and common features

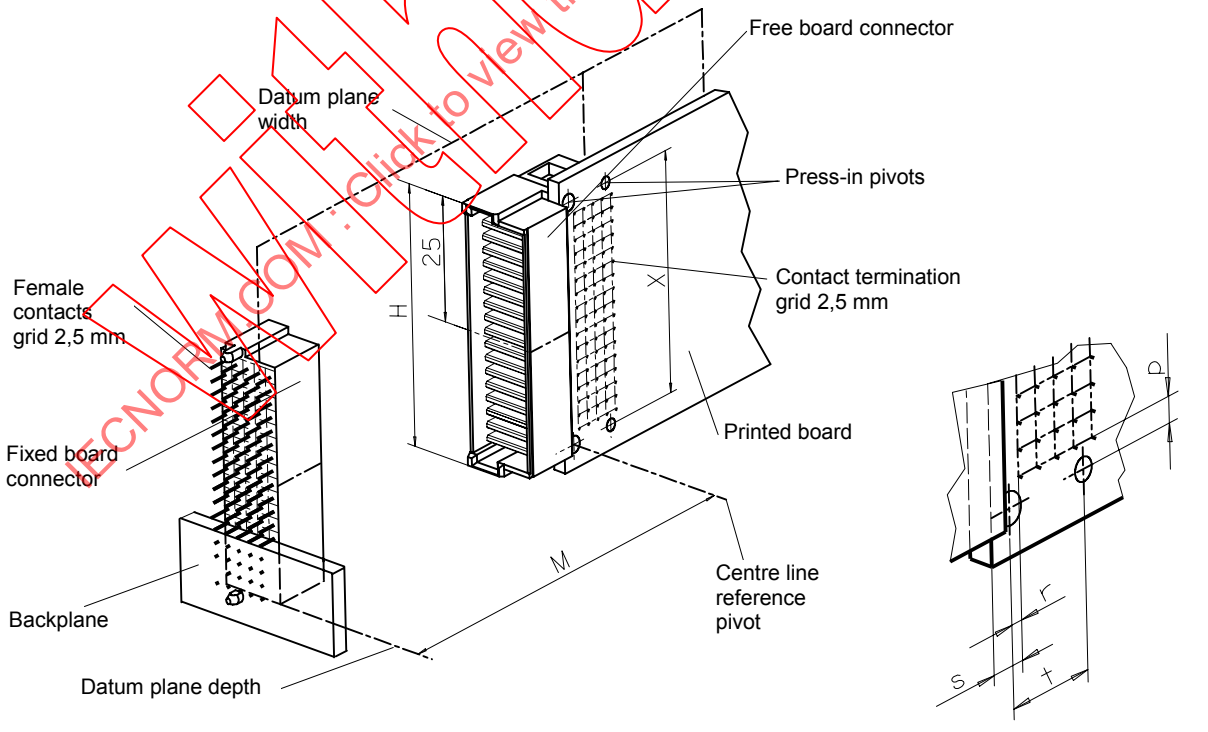


Figure 2 – Isometric view

3.2.1 Common features

Table 2 – Coordination dimensions and common features in the metric equipment practice

Reference	Dimension mm	Feature description
M	15 to 21	Contact range in engaging direction (see figure 6) for standard power contact
	15 to 22,75	Contact range in engaging direction (see figure 6) for first make / last break power contact
H	n x 25	Height of connector
r	1,25	Distance between the centre line of press-in pivots (first row) and the first row of terminations
s	3,75	Distance between the edge of the printed board and centre lines of the first row of holes for terminations of the free board connector
t	10	Distance between the centre lines of the press-in pivots of the free board connector
p	2,5	Distance between the centre line of press-in pivots and the first row of holes for terminations. Free board connector
X	H – 5	Distance between centre lines of press-in pivots of the free boad connector

3.2.2 Reference system

Coordination dimensions are dimensions without tolerances and indicate the maximum dimensions to guarantee the modular arrangement.

All coordination dimensions are based upon the 0,5 mm base pitch and the 2,5 mm and 25 mm multiple pitches specified in IEC 60917-1.

3.2.3 Height dimensions

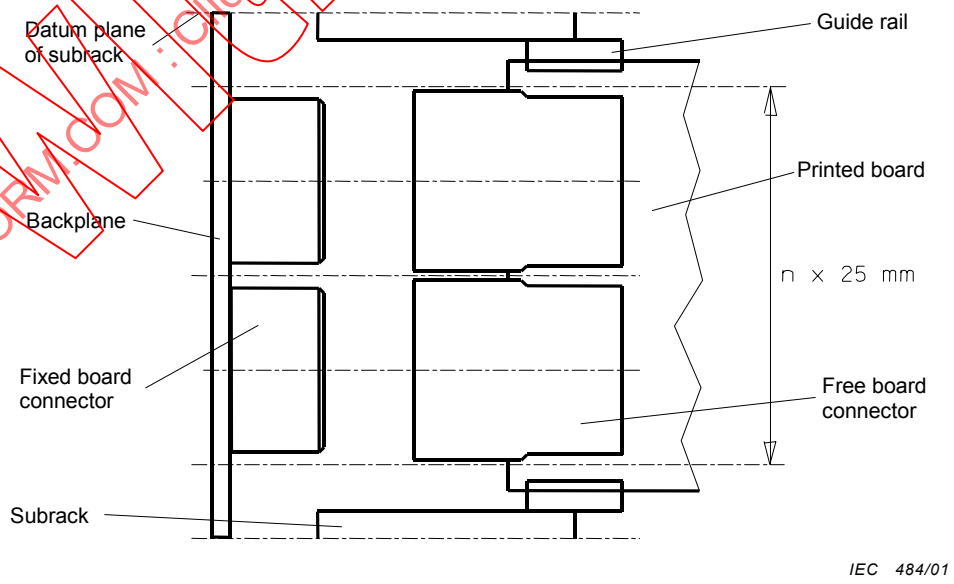


Figure 3 – Height dimensions

3.2.4 Width dimensions

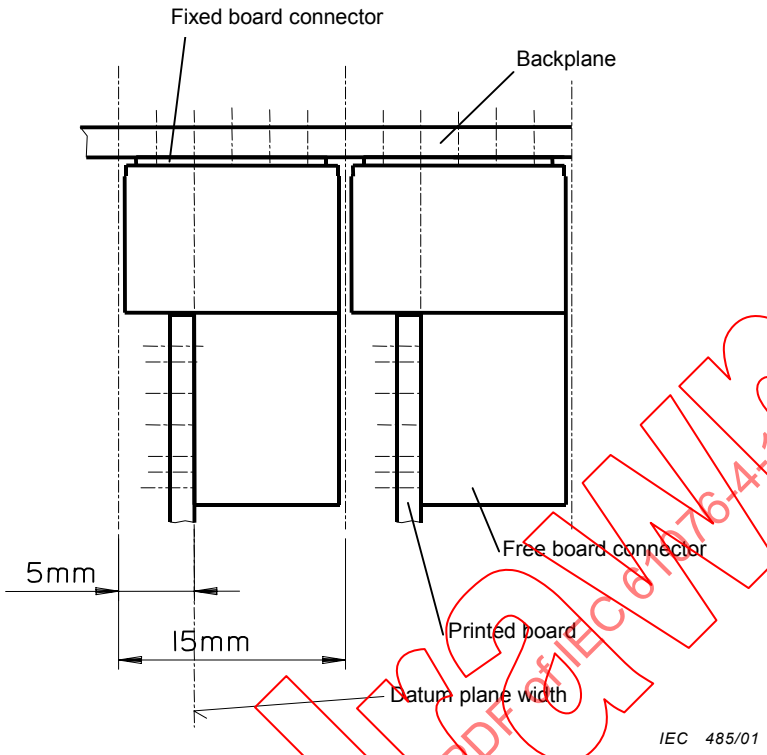
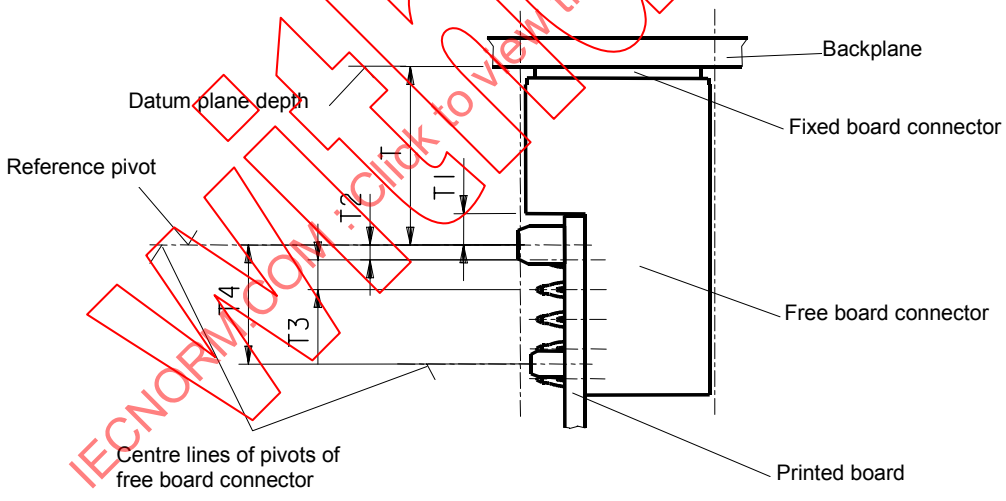


Figure 4 – Width dimensions

3.2.5 Depth dimensions



T	Centre line of the press-in pivots (first row) of the free board connector to the mounting plane of the fixed connector	15 mm
T_1	Distance between the edge of the printed board and the centre line of the press-in pivots (first row). Free board connector	2,5 mm
T_2	Distance between the centre line of the press-in pivots (first line) and the first row of terminations. Free board connector	1,25 mm
T_3	Spacing of terminations. Free board connector	2,5 mm
T_4	Distance between centre lines of the press-in pivots. Free board connector	10 mm

Figure 5 – Depth dimensions

3.3 Mating information

3.3.1 Electrical engagement length

Contact range

The specified contact resistance shall be maintained on a mated pair of connectors within a range of: **M** = 15 mm to **M** = 21 mm for standard power contacts and within: **M** = 15 mm to **M** = 22,75 mm for first make / last break power contacts.

The connector, manufactured to the maximum dimensions within its tolerances, shall allow insertion to **M** = 15 mm. When manufactured to its minimum dimensions it will be smaller, and will allow insertion below **M** = 15 mm. In that case, the specified contact resistance shall still be met.

The common requirements for first make / last break contacts are also included in this specification. The first make / last break contact shown in figure 6 has no safety contact function, it is intended to switch adapted electrical potentials, it is not intended to be mated and unmated under heavy load.

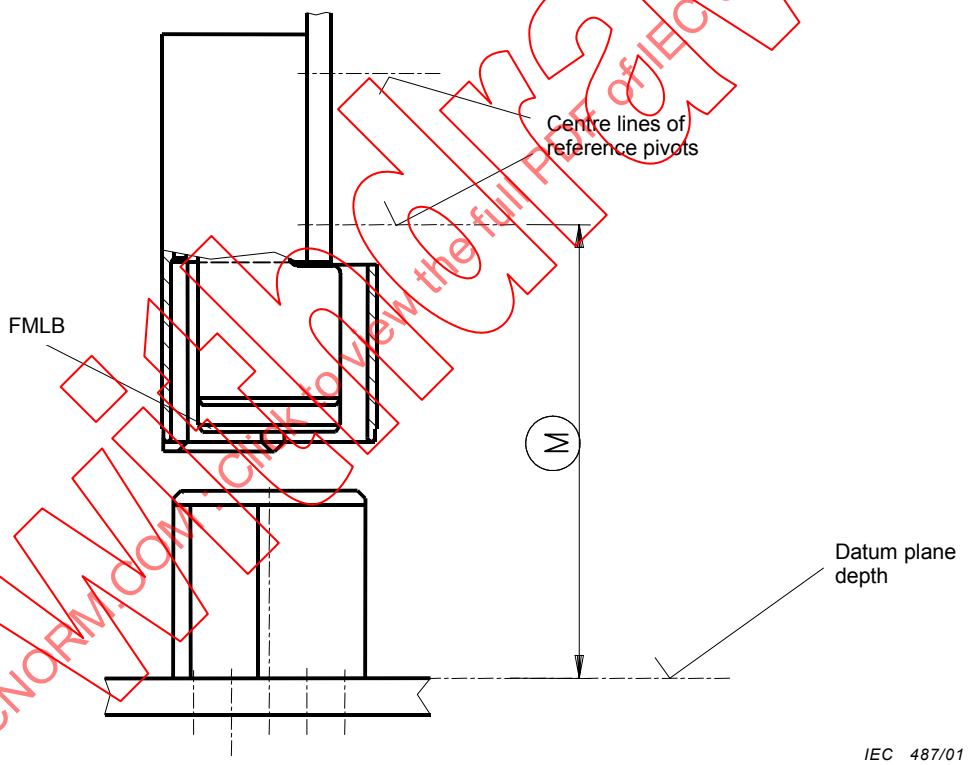


Figure 6 – Contact range

3.3.2 Perpendicular to engaging direction

The design of the free and the fixed connector shall accept a misalignment of at least 1 mm in the transversal and longitudinal directions of the connectors. To achieve the necessary alignment of both parts, one part of the connector pair is floating mounted.

For fixed mounted connector pairs, the mounting tolerances shall be kept within a sufficiently small range.

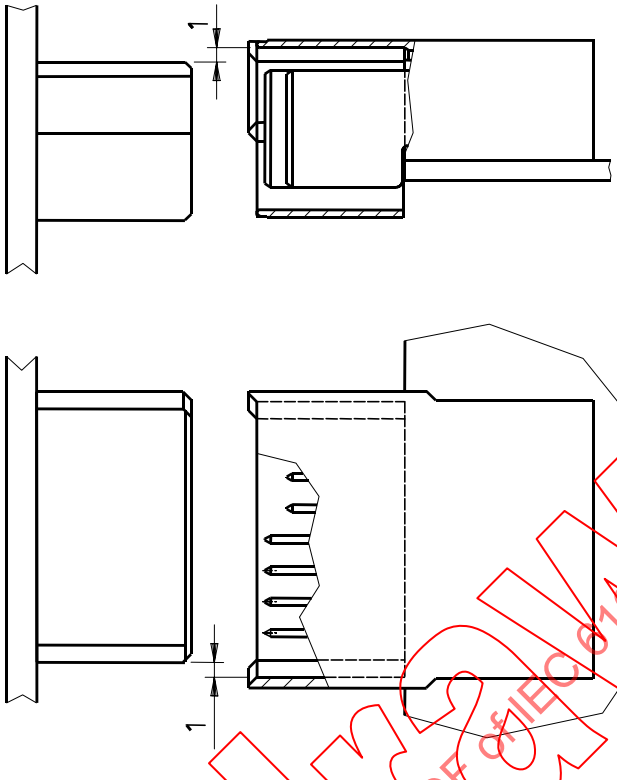


Figure 7 – Allowed misalignment in height and width directions

3.3.3 Inclination

The design of the free and fixed connector shall accept an initial angular misalignment of ±0,5° in the longitudinal and transversal axes.

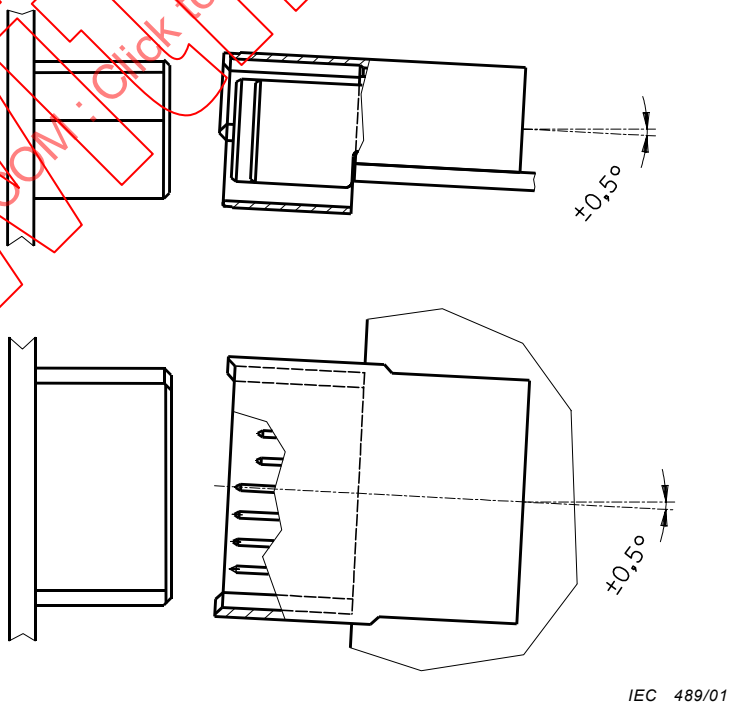
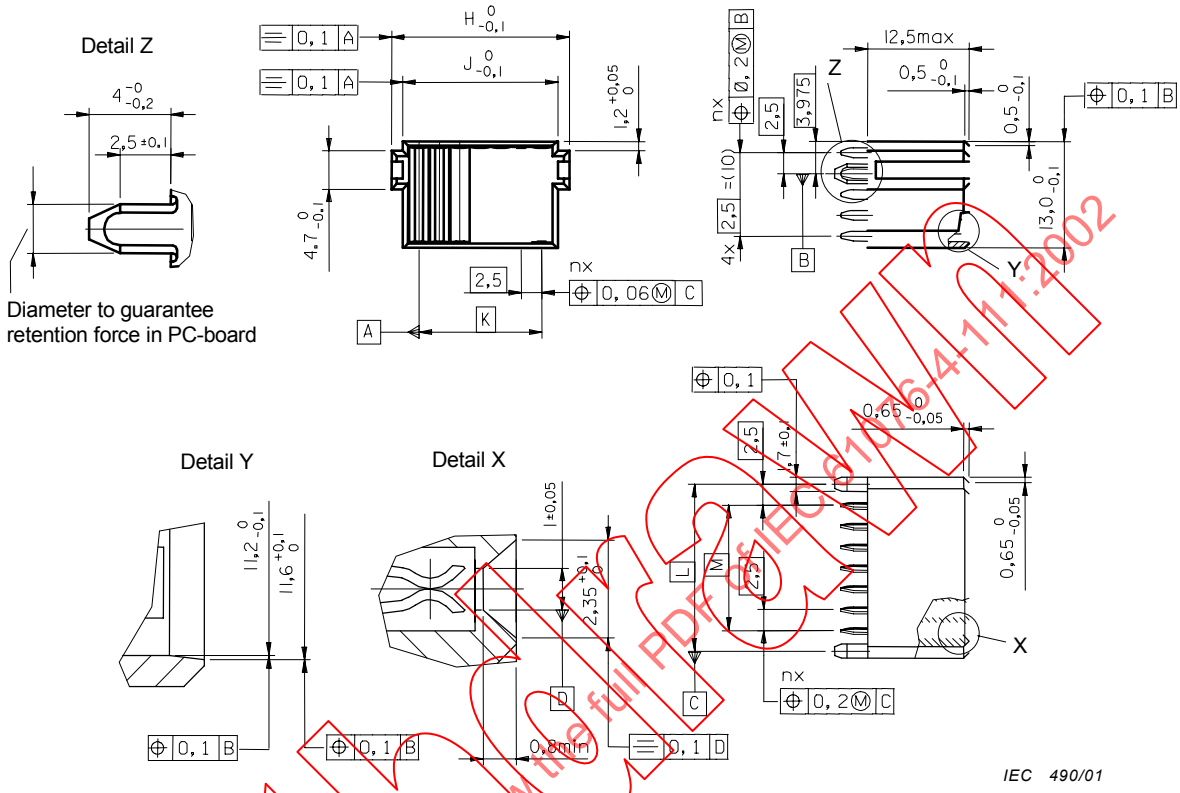


Figure 8 – Allowed inclination in height and width directions

3.4 Fixed board connectors

3.4.1 Dimensions



	Dim. H	Dim. J	Dim. K	Dim. L	Dim. M
Style A	21,9	19,05	6 × 2,5 = 15	20,0	6 × 2,5 = 15
Style B	46,8	44,05	16 × 2,5 = 40	45,0	16 × 2,5 = 40

Figure 9 – Fixed board connector

3.4.2 Terminations

Compliant press-in terminations according to IEC 60352-5.

3.4.3 Dimensions of contacts

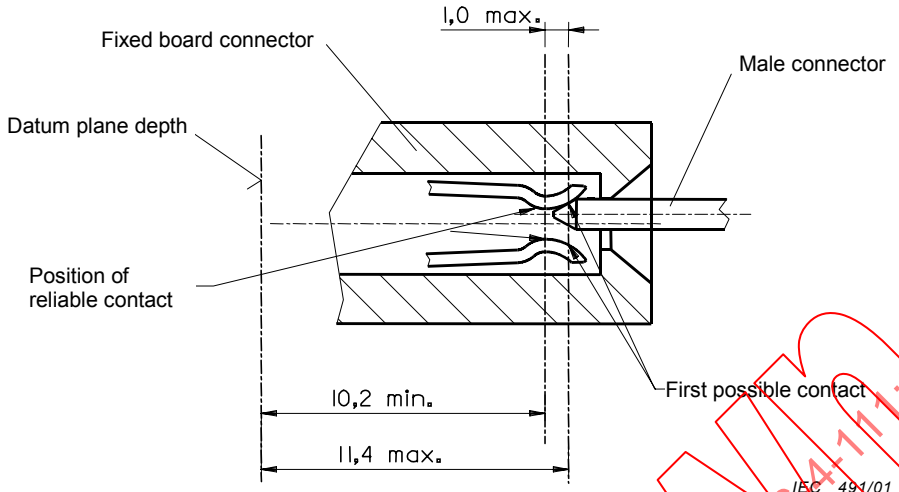
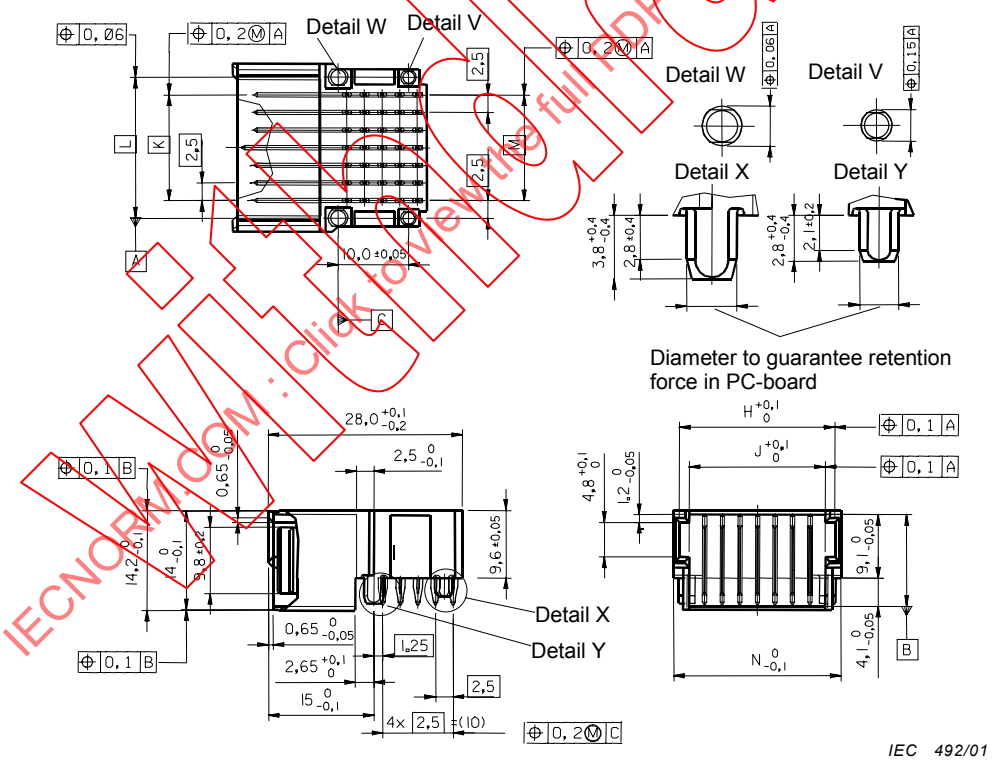


Figure 10 – Dimensions of contacts

3.5 Free board connectors

3.5.1 Dimensions



	Dim. H	Dim. J	Dim. K	Dim. L	Dim. M	Dim. N
Style A	22,0	19,25	6 × 2,5 = 15	8 × 2,5 = 20	6 × 2,5 = 15	23,8
Style B	47,0	44,25	16 × 2,5 = 40	18 × 2,5= 45	16 × 2,5 = 40	48,8

Figure 11 – Free board connector

3.5.2 Terminations

Compliant press-in terminations according to IEC 60352-5.

3.5.3 Dimensions of contacts

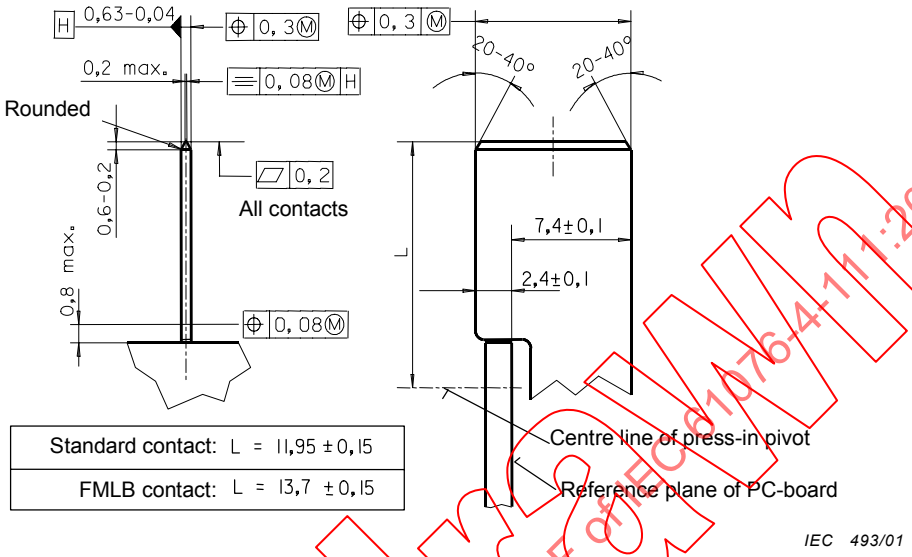


Figure 12 – Dimension of contacts

3.6 Accessories

Coding may be achieved by additional modules according to IEC 61076-4-102 on one or both ends of the connector.

3.7 Mounting information for fixed board connectors

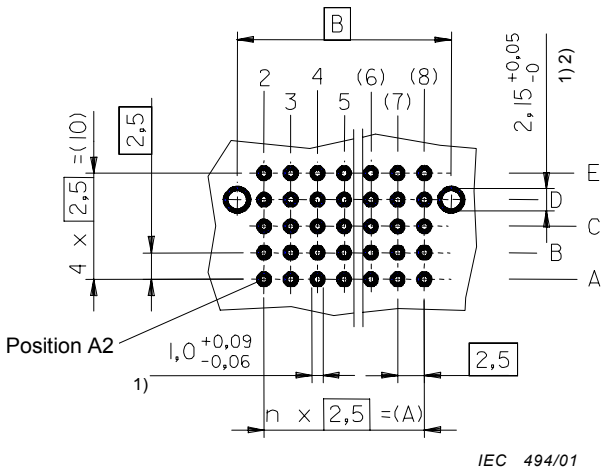
3.7.1 Hole pattern on backplane

Drawings: View of component side of panel

The letters on the right-hand side designate the termination row. (Each contact has one termination on rows A, B, C, D and E.)

The numbers above designate the position of the contact.

For contacts, use plated-through holes according to IEC 60352-5. For plastic pivots, use unplated holes.



	Dimension A	Dimension B
Style A	6 × 2,5 = 15	20
Style B	16 × 2,5 = 40	45

NOTE 1 ⌖ Ø 0,1 All holes.

NOTE 2 Holes not through metallized.

Figure 13 – Example of hole pattern on backplane in the 25 mm equipment practice

3.8 Mounting information for free board connectors

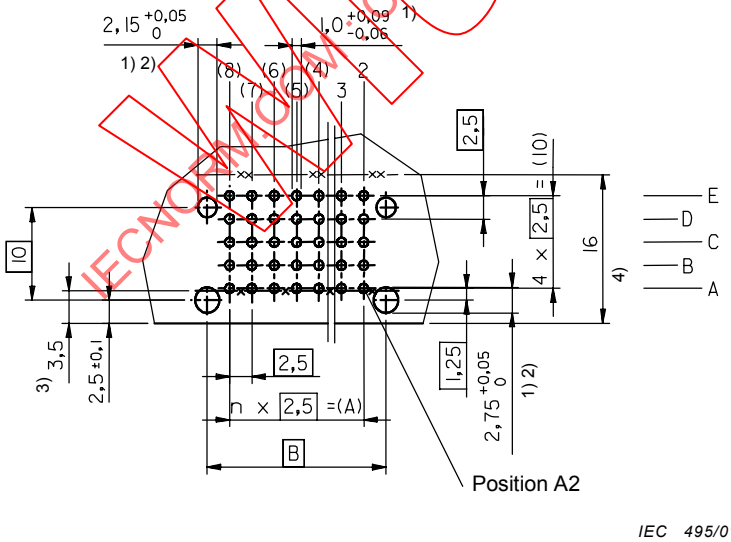
3.8.1 Hole pattern on printed boards

Drawings: View of component side of printed circuit board

The letters on the right-hand side designate the termination row. (Each contact has one termination on rows A, B, C, D and E.)

The numbers above designate the position of the contact.

For contacts, use plated-through holes according to IEC 60352-5. For plastic pivots, use unplated holes.



	Dimension A	Dimension B
Style A	6 × 2,5 = 15	20
Style B	16 × 2,5 = 40	45

NOTE 1 ⌖ Ø 0,1 All holes.

NOTE 2 Holes not through metallized.

NOTE 3 No conductors permitted (-x).

NOTE 4 Connector area, no other components permitted (-xx-).

Figure 14 – Example of hole pattern on printed board in the 25 mm equipment practice

3.9 Gauges

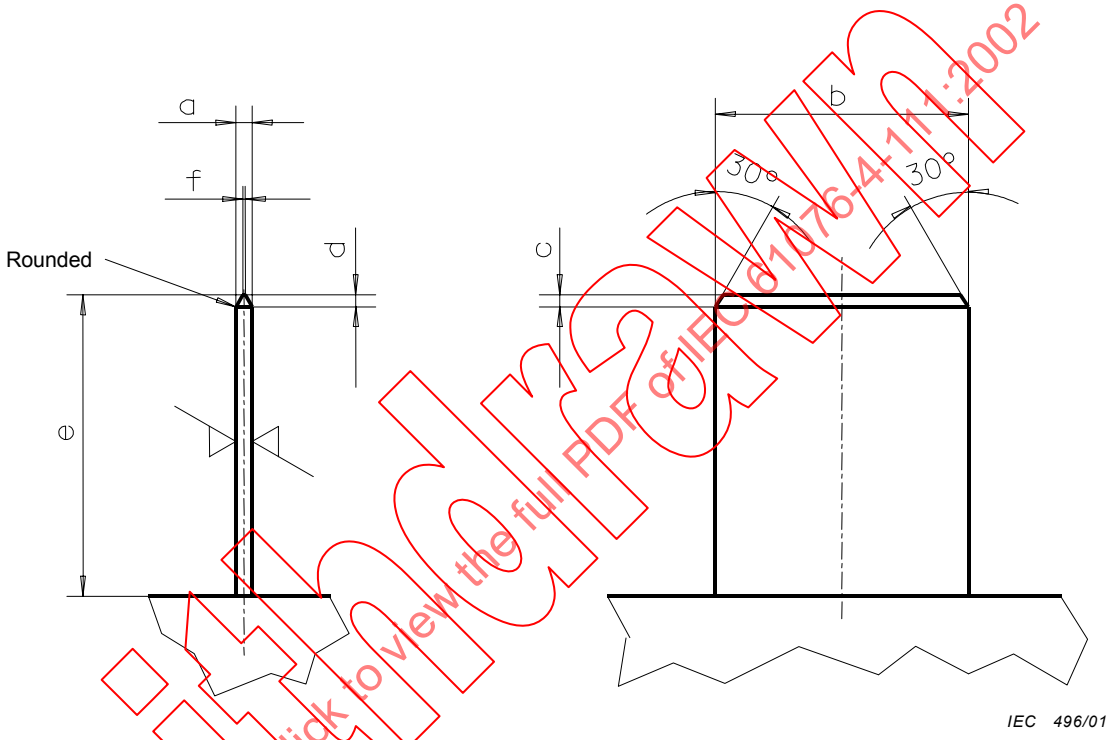
3.9.1 Sizing gauge and retention force gauge

Material: Tooling steel, hardened

Surface roughness: According to ISO 1302

Ra = 0,25 µm max.

Ra = 0,15 µm min.



Gauge	Application	Mass g	*a*	*b*	*c*	*d*	*e*	*f*
PA **PM**	Sizing Retention force	– 50^{+1}	0,63 to 0,64 0,58 to 0,59	9,8	0,5	0,5	11	0,2

Figure 15 – Sizing and retention force gauges for female contacts

4 Characteristics

4.1 Climatic category

Table 3 – Climatic category

Performance level	Climatic category	Temperature		Damp heat, steady state
		Lower °C	Upper °C	Days
1	55/125/56	–55	125	56
2	55/125/21	–55	125	21

4.2 Electrical

4.2.1 Creepage and clearance distances

The minimum creepage and clearance distance between contacts is 1,4 mm.

Application information – The permissible rated voltage depends on the application or specified safety requirement. Reductions in clearance or creepage distance may occur due to the printed board or wiring used, and shall be duly taken into account.

4.2.2 Voltage proof

Conditions: IEC 60512, Test 4a, Method B, standard atmospheric conditions, mated connectors contact to contact: 1 400 V r.m.s.

4.2.3 Current-carrying capacity

Conditions: IEC 60512, Test 5b

All contacts

At 70 °C ambient temperature: 15 A, for other ambient temperatures, see graph.

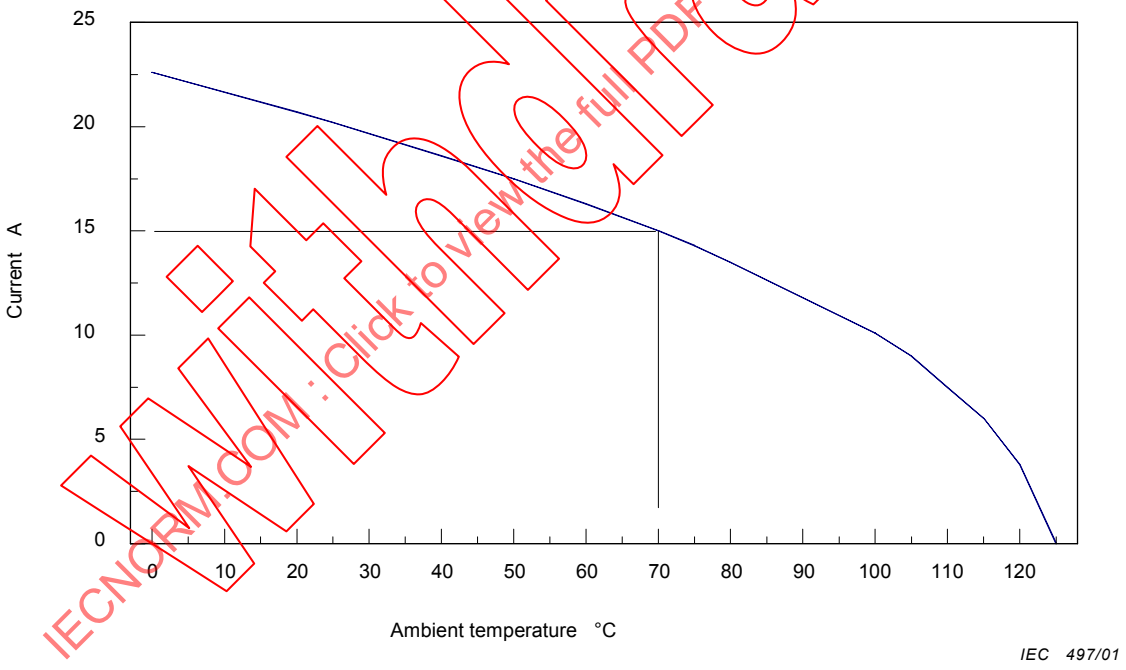


Figure 16 – Current-carrying curve capacity – derating curve

4.2.4 Contact resistance

Conditions: IEC 60512, Test 2a

Standard atmospheric conditions

Mated connectors, connecting points as specified in 5.1.1, test board see 5.1.4

Requirement: 4 mΩ maximum

4.2.5 Insulation resistance

Conditions: IEC 60512, Test 3a, Method B, mated connectors,
test voltage: d.c. 100 V ± 15 V

Standard atmospheric conditions. Test board see 5.1.4

Requirement: 10^4 MΩ minimum

4.3 Mechanical

4.3.1 Mechanical operation

Conditions: IEC 60512, Test 9a

Standard atmospheric conditions

Speed of operations: 10 mm/s maximum

Rest 30 s (unmated)

Table 4 – Number of mechanical operations

Performance level	1	2
Operations	500	250

4.3.2 Engaging and separating forces

Conditions: IEC 60512, Test 13b

Standard atmospheric conditions

Rate of engagement and separation: 10 mm/s

Requirement: Engaging force n x 5 N max. Separating force n x 3,5 N maximum

n = number of contacts

4.3.3 Contact retention in insert

Not applicable

4.3.4 Polarizing method

Conditions: IEC 60512, Test 13e

Standard atmospheric conditions

Requirement: 150 N

4.3.5 Gauge retention force

Conditions: IEC 60512, Test 16e

Gauge see 3.9.1.

Requirement: The gauge shall be retained.

5 Test schedule

5.1 General

This test schedule shows the tests and the order in which they shall be carried out, as well as the requirements to be met.

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

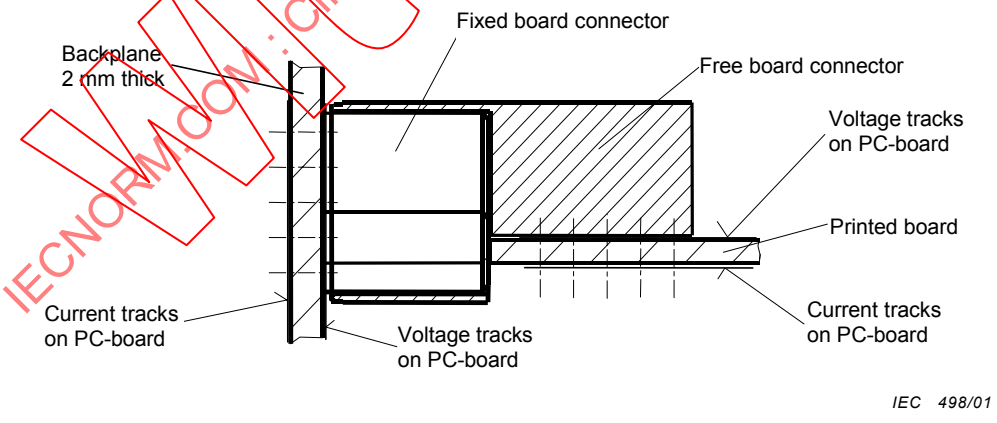
Unless otherwise specified, mated sets of connectors shall be tested. Care shall be taken to keep a particular combination of connectors together during the complete test sequence, i.e. when unmating is necessary for a certain test, the same connectors as before shall be mated for the subsequent tests.

In the following, a mated set of connectors is called a specimen.

Table 5 – Number of specimens necessary for the entire inspection and test sequence

Test groups		P	AP	BP	CP	DP	EP	FP	GP
Performance level	1	26+x**	5+1*	7+1*	3+1*	3+1*	0+4*	–	x**
	2	20+x**	3+1*	3+1*	3+1*	3+1*	0+4*	–	x**
* n+m means: n+m in total, m:= number of specimens wired according to 5.1.4, layout a. n: = number of specimens wired according to 5.1.4, layout b. ** Number of specimens and tests according to IEC 60352-5.									

5.1.1 Arrangement for contact resistance measurement

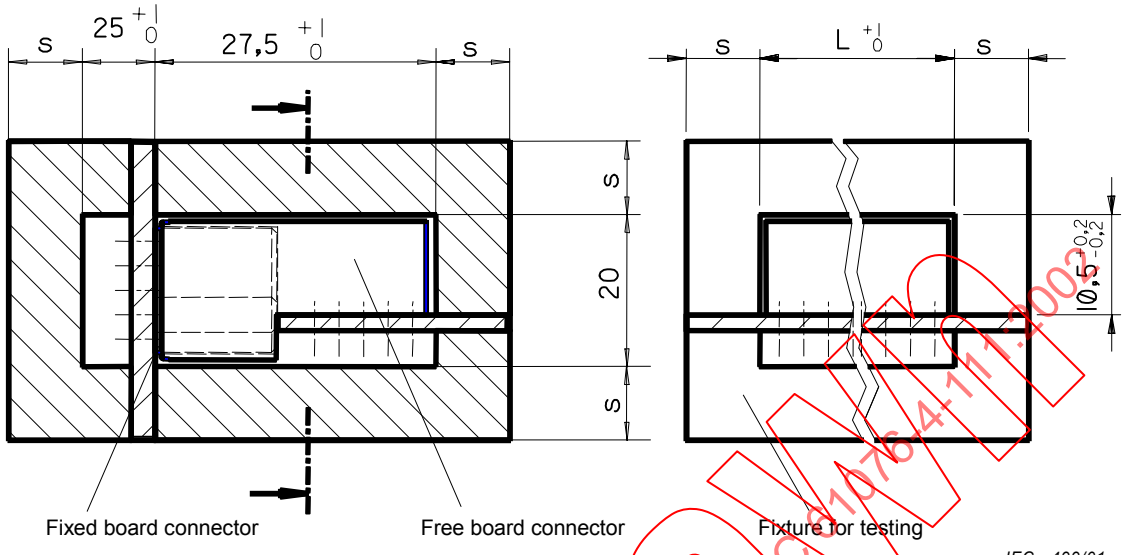


Conditions: IEC 60512, Test 2a

Figure 17 – Points of connection for contact resistance measurement

5.1.2 Arrangement for dynamic stress tests

Conditions: IEC 60512, Tests 6a, 6c and 6d



	Style A	Style B
L	27	52
s	>25	>25

Figure 18 – Arrangement for dynamic stress test

5.1.3 Arrangement for static load, axial

Not applicable.

5.1.4 Wiring of specimens

The printed circuit boards for the tests shall be manufactured according to IEC 60326-3, with a minimum thickness of 1,4 mm, and connection holes according to IEC 60352-5.

The mechanical and electrical characteristics of the test boards shall exceed the requirements of this specification, in order for them not to interfere with the results of the tests (e.g. insulation resistance and electrical load).

Layout a for IEC 60512, Tests 2a, 5b (min 70 µm copper) Layout b for IEC 60512, Tests 4a, 3a

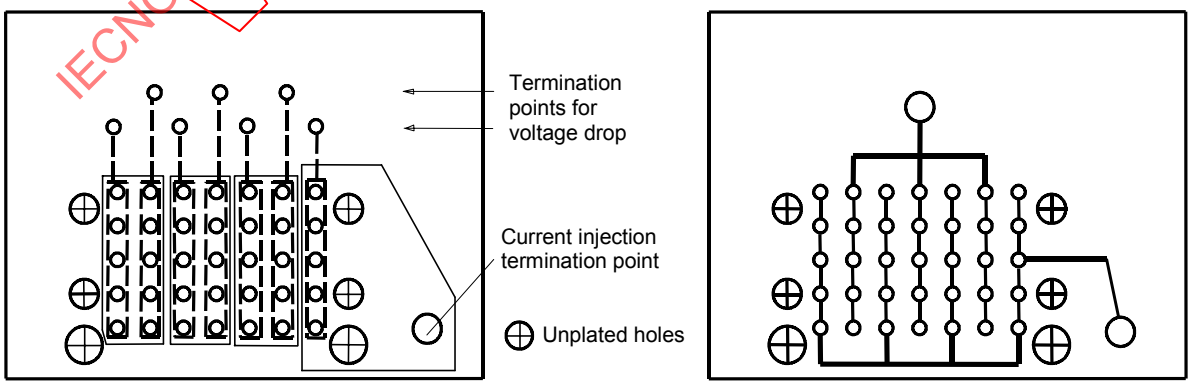


Figure 19 – Printed circuit boards for test

5.1.5 Arrangement for flammability test

Conditions: IEC 60512, Test 20a

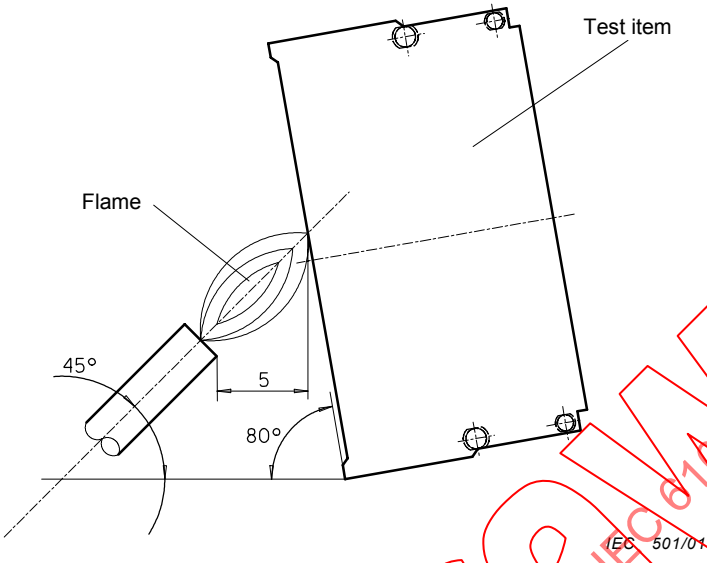


Figure 20 – Arrangement for flammability test

5.1.6 Arrangement to measure the holding force of the connector housing on the PC board

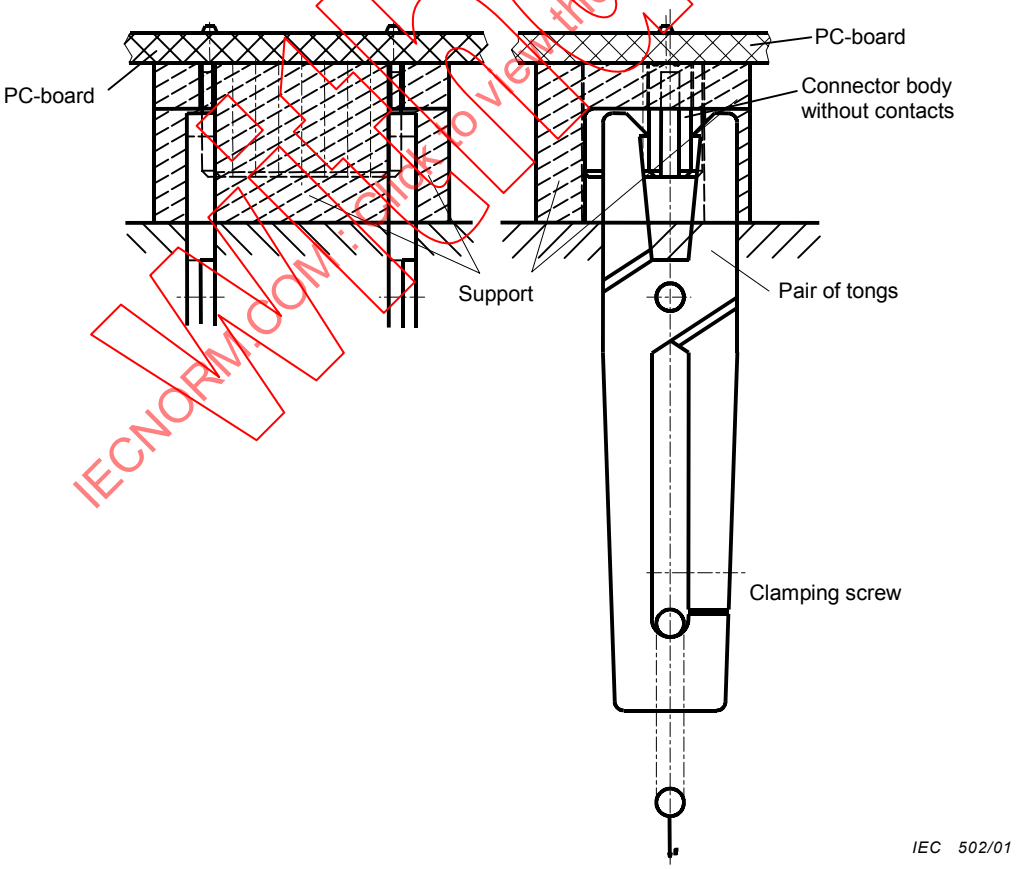


Figure 21 – Arrangement for the retention force of female connector housing

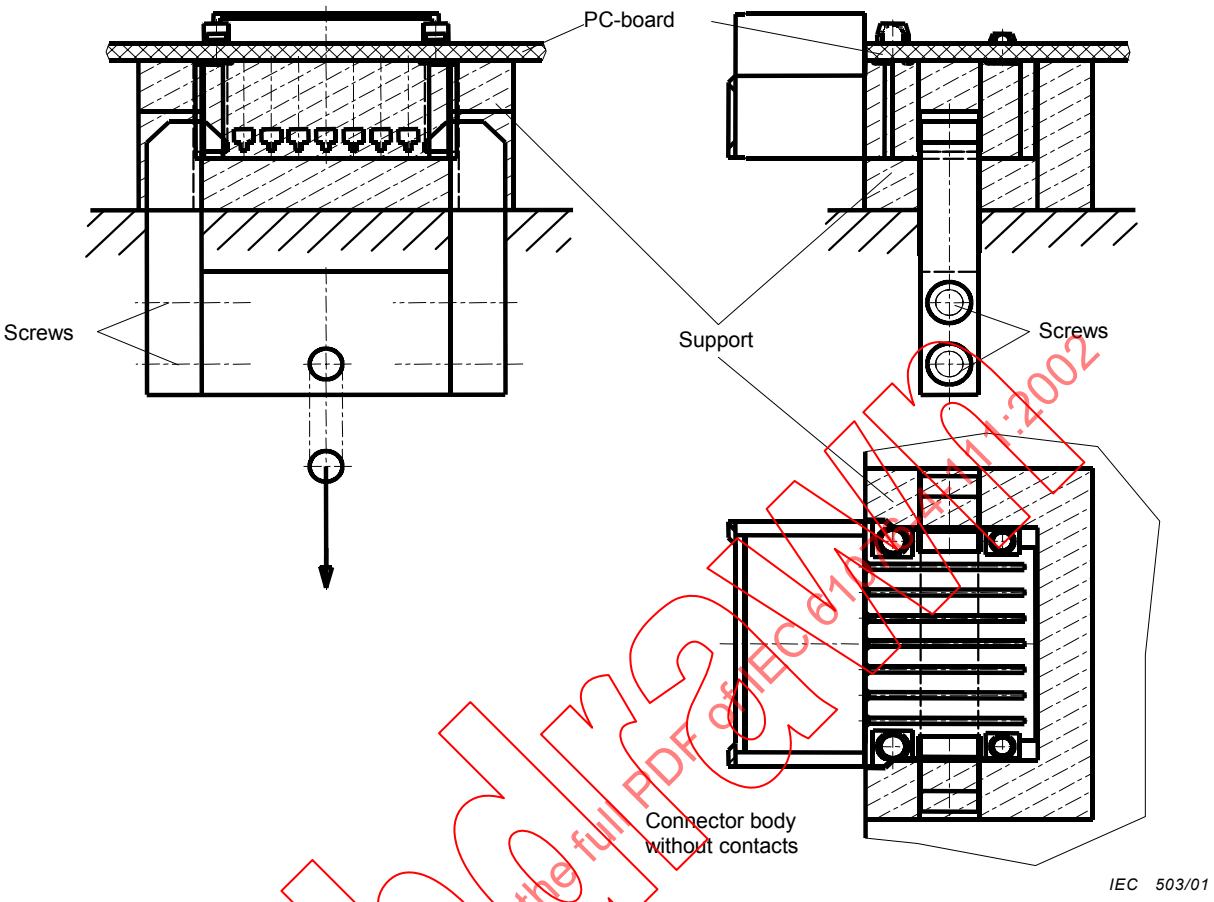


Figure 22 – Arrangement for the retention force of male connector housing

5.2 Test schedule tables

5.2.1 Basic test schedule

Table 6 – Basic tests

Test phase	Test			Measurement to be performed		PL	Requirements
	Title	IEC 60512 Test No.	Severity or condition of test	Title	IEC 60512 Test No.		
1	General examination		Unmated connectors	Visual examination	1a	All	There shall be no defect that would impair normal operation
				Examination of dimensions and mass	1b	All	The dimensions shall comply with those specified in clause 3, including creepage and clearance distances as specified in 4.2
2			See 4.3.2	Engaging and separating forces	13a	All	See 4.3.2
3			Connecting points as in 5.1.1	Contact resistance	2a	All	4 mΩ max.
4			Test voltage 100 V ± 15 V d.c. Method B	Insulation resistance	3a	All	10^4 MΩ min.
5			Method B, 1 400 V r.m.s	Voltage proof	4a	All	There shall be no breakdown or flashover

5.2.2 Full test schedule

5.2.2.1 Test group P – Preliminary

All specimens shall be subject to the following tests:

Table 7 – Test group P: Preliminary testing sequence

Test phase	Test			Measurement to be performed		Requirements	
	Title	IEC 60512 Test No.	Severity or condition of test	Title	IEC 60512 Test No.	PL	
P1	General examination		Unmated connectors	Visual examination	1a	All	There shall be no defect that would impair normal operation
				Examination of dimensions and mass	1b	All	The dimensions shall comply with those specified in clause 3, including creepage and clearance distances as specified in 4.2
P2	Polarizing method	13e	Conditions see 4.3.4 Force to be applied: 150 N	Visual examination	1a	All	There shall be no defect that would impair normal operation
P3			Connecting points as in 5.1.1	Contact resistance	2a	All	4 mΩ max.
P4			Test voltage 100 V ± 15 V d.c. Method B	Insulation resistance	3a	All	10^4 MΩ min.
P5			Method B, 1 400 V r.m.s.	Voltage proof	4a	All	There shall be no breakdown or flashover

5.2.2.2 Test group AP – Dynamic / climatic

Table 8 – Test group AP

Test phase	Test			Measurement to be performed		Requirements	
	Title	IEC 60512 Test No.	Severity or condition of test	Title	IEC 60512 Test No.	PL	
AP1			See 4.3.2	Engaging and separating forces	13a	All	See 4.3.2
AP2			Method A Gauges according to 3.9.1	Gauge retention force	16e	All	The gauge according to 3.9.1 shall be retained
AP3	Solderability	12a	Not applicable				
AP4			Method B, 1 400 V r.m.s.	Voltage proof	4a	All	There shall be no breakdown or flashover
AP5	Contact retention in insert	15a	Not applicable				
AP6	Bump	6b	Not applicable				

Test phase	Test			Measurement to be performed		Requirements	
	Title	IEC 60512 Test No.	Severity or condition of test	Title	IEC 60512 Test No.	PL	
AP7	Vibration	6d	Arrangement according to 5.1.2. Frequency 10 Hz to 2 000 Hz Amplitude 1,5 mm or 200 m/s^2 Sweep cycles: 10 Full duration: 7,5 h	Contact disturbance	2e	1	Duration of disturbance 1 µs max.
			Frequency range 10 Hz to 500 Hz Amplitude 0,35 mm or 50 m/s^2 Sweep cycles: 10 Full duration: 6 h			2	
				Visual examination	1a	All	See test phase 1
			Connecting points according to 5.1.1	Contact resistance	2a	All	4 mΩ max.
AP8	Shock	6c	Arrangement according to 5.1.2 Half sine, shock acceleration 490 m/s^2 (50 *g*). Duration of impact 10 ms. Five shocks in two directions per axis, in three axis.	Contact disturbance	2e	All	Duration of disturbance 1 µs max.
				Visual examination	1a	All	See test phase 1
			Connecting points according to 5.1.1	Contact resistance	2a	All	4 mΩ max.
AP9	Acceleration, steady state	6a	Arrangement according to 5.1.2 Acceleration 980 m/s^2 (100 *g*) Duration: 4 min. per axis Both directions of the 3 major axis	Contact disturbance Visual examination Contact resistance	2e 1a 2a	All All All	1 µs max. See test phase 1 4 mΩ max.
AP10	Rapid change of temperature	11d	–55 °C to 125 °C t1 = 30 min., 5 cycles Mated connectors	Insulation resistance	3a	All	10^4 MΩ min
			Method B, 1 400 V r.m.s.	Voltage proof	4a	All	There shall be no breakdown or flashover
				Visual examination	1a	All	See test phase 1
AP11	Climatic sequence	11a	Mated connectors				
AP11.1	Dry heat	11i	125 °C, Duration 16 h, Method B, test voltage 100 V ± 15 V d.c.	Insulation resistance at high temperature	3a	All	10^4 MΩ min.
AP11.2	Damp heat cyclic, first cycle	11m	PL1: 55 °C, PL2: 40 °C variant 1, recovery time 2 h	Visual examination	1a	All	See test phase 1
AP11.3	Cold	11j	–55 °C, duration 2 h, recovery time 2 h	Visual examination	1a	All	See test phase 1
AP11.4	Low air pressure	11k	Not applicable				
AP11.5	Damp heat cyclic, remaining cycles	11m	Conditions according to AP11.2 PL1: 5 cycles PL2: 1 cycle	Insulation resistance	3a	All	10^4 MΩ min.
			Method B, 1 400 V r.m.s.	Voltage proof	4a	All	There shall be no breakdown or flashover
			Connecting points according to 5.1.1	Contact resistance	2a	All	4 mΩ max.
AP12			See 4.3.2	Engaging and separating forces	13a	All	See 4.3.2
AP13			Unmated connectors	Visual examination	1a	All	See test phase 1