BS EN 3155-001:2016

BSI Standards Publication

Aerospace series — Electrical contacts used in elements of connection

Part 001: Technical Specification

bsi.

National foreword

This British Standard is the UK implementation of EN 3155-001:2016. It supersedes BS EN 3155-001:2009 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee ACE/6, Aerospace avionic electrical and fibre optic technology.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Série aérospatiale - Contacts électriques utilisés dans les organes de connexion - Partie 001 : Spécification technique

Luft- und Raumfahrt - Elektrische Kontakte zur Verwendung in Verbindungselementen - Teil 001: Technische Lieferbedingungen

This European Standard was approved by CEN on 4 April 2016.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Contents

European foreword

This document (EN 3155-001:2016) has been prepared by the Aerospace and Defence Industries Association of Europe - Standardization (ASD-STAN).

After enquiries and votes carried out in accordance with the rules of this Association, this Standard has received the approval of the National Associations and the Official Services of the member countries of ASD, prior to its presentation to CEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2017, and conflicting national standards shall be withdrawn at the latest by March 2017.

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This document supersedes EN 3155-001:2009.

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1 Scope

This European Standard specifies:

— the electrical, mechanical, environmental and dimensional characteristics of electrical contacts used in elements of connection, including coaxial, triaxial and quadrax contacts;

— the conditions for qualification, acceptance testing and quality assurance;

— the test programs and groups.

It is applicable to removable crimp contacts, wrap contacts, solder contacts used in connectors or in other elements of electrical connection.

In case of conflict or missing information between the EN 3155-001 and the product standards, the product standard shall govern.

2 Normative references

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

EN 2083, *Aerospace series — Copper or copper alloy conductors for electrical cables — Product standard*

EN 2242, *Aerospace series — Crimping of electric cables with conductors defined by EN 2083, EN 4434 and EN 2346*

EN 2424, *Aerospace series — Marking of aerospace products*

EN 2591-100*, *Aerospace series — Elements of electrical and optical connection — Test methods — Part 100: General*

EN 3197, *Aerospace Series — Design and installation of aircraft electrical and optical interconnection systems*

EN 4434, *Aerospace series — Copper or copper alloy lightweight conductors for electrical cables — Product standard (Normal and tight tolerances)*

EN 9133, *Aerospace series — Quality management systems — Qualification procedure for aerospace standard parts*

EN ISO 1302, *Geometrical Product Specifications (GPS) — Indication of surface texture in technical product documentation* (ISO 1302)

EN ISO 27874, *Metallic and other inorganic coatings — Electrodeposited gold and gold alloy coatings for electrical, electronic and engineering purposes — Specification and test methods* (ISO 27874)

ISO 2859-1, *Sampling procedures for inspection by attributes — Part 1: Sampling plans indexed by acceptance quality level (AQL) for lot-by-lot inspection*

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* All parts quoted in this European Standard.

ISO 8843, *Aircraft — Crimp-removable contacts for electrical connectors — Identification system*

IEC 60352-1, *Solderless connections — Part 1: Wrapped connections — General requirements, test methods and practical guidance* [1)]

TR 3198, *Aerospace series — Manufacturers' identification monograms and marks for EN aerospace products* [2)]

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 2591-100 and the following apply.

3.1
LSP
Length of Selective Protection

3.2
point of electrical contact
position of point of application of the force which provides contact pressure

3.3
contact active area
part of the contact which allows current to pass between the contact male and female

3.4
contact transition area
all mechanical liaisons that contribute to electrical performance and which are different from contact active area defined in 3.3

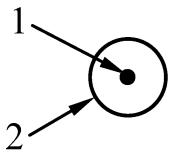
3.5
coaxial contact male or female
assembly of two contacts arranged coaxially enabling the connection of coaxial, shielded or bifilar cables

See Figure 1.

NOTE 1 Male coaxial contact where the outer contact is male; the central contact(s) may be male or female.

NOTE 2 Female coaxial contact where the outer contact is female; the central contact(s) may be male or female.

Coupling face



Key

1 Centre contact
2 Outer contact

Figure 1

1) Published by: IEC International Electrotechnical Commission. http://www.iec.ch/

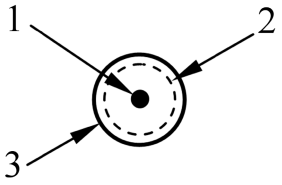
2) Published as ASD-STAN Technical Report at the date of publication of this European Standard. http://www.asd-stan.org/

3.6
triaxial contacts male or female
assembly of three contacts arranged coaxially, enabling the connection of shielded triaxial or bifilar cables

See Figure 2.

NOTE 1 Male triaxial contact where the outer contact is male; the central contact(s) may be male or female.

NOTE 2 Female triaxial contact where the outer contact is female; the central contact(s) may be male or female.



Key

1 Centre contact
2 Intermediate contact
3 Outer contact

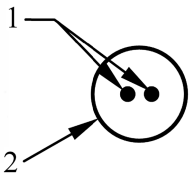
Figure 2

3.7
bifilar contact (twinax)
assembly of three contacts, two of which are parallel, the third being peripheral to these, enabling the connection of shielded bifilar cables

See Figure 3.

NOTE 1 Male twinax contact where the outer contact is male; the central contacts may be male or female.

NOTE 2 Female twinax contact where the outer contact is female; the central contacts may be male or female.



Key

1 Twin parallel contacts
2 Outer contact

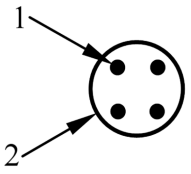
Figure 3

3.8
quadrax contact
assembly of five contacts, four of which are parallel, the fifth being peripheral to these, enabling the connection of shielded quadrax cables

See Figure 4.

NOTE 1 Male quadrax contact where the outer contact is male; the central contacts may be male or female.

NOTE 2 Female quadrax contact where the outer contact is female; the central contacts may be male or female.



Key

1 Four parallel contacts
2 Outer contact

Figure 4

4 Conditions of use

4.1 Types of contact

The contact specified shall be one of the following types:

— Type A: Removable contact for general application;

— Type B: Non-removable contact, See Note;

— Type C: Removable contact for thermocouple;

— Type D: Removable contact with screening feature (including the coaxial contacts, triaxial contacts and bifilar contacts). These have no characteristic impedance and are therefore not recommended for use at high frequency.

— Type E: Removable contact with screening feature, including coaxial, triaxial, bifilar and quadrax contacts. These have matched impedance.

NOTE Type B contacts are defined in the connector specifications.

4.2 Temperature classes

The contacts specified shall be from one of the classes specified below:

— class P: maximum operating temperature 125 °C;

— class R: maximum operating temperature 150 °C;

— class S: maximum operating temperature 200 °C;

— class T: maximum operating temperature 260 °C;

— class U: maximum operating temperature 350 °C.

The minimum operating temperature shall be – 65 °C, unless otherwise specified in the product standard.

4.3 Permissible wires and cables

4.3.1 The conductors which are acceptable in the crimping barrels and the coding by means of colour bands are specified in ISO 8843. The contact detail specification shall state the acceptable conductors for each size of contact.

4.3.2 The type of cable, coaxial, triaxial, etc. shall be specified in the product standard.

5 Design and description

5.1 Design

5.1.1 General

This standard covers male and female contacts of all types and technologies: cylindrical or rectangular entry contacts, flat contacts of the blade type, etc., stamped, formed or machined contacts.

Stamped and formed technology for body contact are not allowed.

5.1.2 Mating end of female contact, cylindrical contacts

Unless otherwise stated in the product standard, the mating end of female contacts from size 08 to 24, shall be of the restricted entry type and shall not permit the introduction of a gauge which has a diameter 0,13 mm greater than the maximum diameter of the male contact.

5.1.3 Mating end of male contacts, cylindrical contacts

Unless otherwise stated in the product standard, the mating end of the male contacts shall be approximately spherical. A flat is permitted at the end; its dimensions are given in Table 1.

Table 1 — Gauge dimensions for male contact

Contact size	Pin active area contact diameter mm	Diameter of flat at the mating end mm	Contact size	Pin active area Contact diameter mm	Diameter of flat at the mating end mm
28 [a]	0,394 0,368	0,19 max.	14	2,01 1,96	0,99 0,61
26 [a]	0,521 0,495	0,25 max.	12	2,41 2,36	1,57 1,19
24 [a]	0,65 0,62	0,30 max.	10	3,20 3,15	2,08 1,57
23	0,705 0,659	0,30 max.	8	3,63 3,58	2,18 1,68
22	0,775 0,750	0,35 max.	6	4,55 4,50	2,44 1,93
20	1,04 0,99	0,51 0,13	4	5,74 5,69	2,79 2,29
16	1,61 1,56	0,81 0,43	—	—	—

[a] Inner contact of type D or type E.

5.1.4 Solder buckets

The buckets shall be designed so that during soft soldering operations, the liquid solder cannot run towards the end of the contact.

5.1.5 Crimp barrels

Barrels shall be designed to accept the range of permissible conductors according to ISO 8843, EN 2083 and EN 4434.

The use of a reducing sleeve is not recommended; this remains the responsibility of the user and shall be subject to acceptance by the relevant OEMs.

5.1.6 Terminations for wrapped connections

The terminations for wrapped connections shall comply with IEC 60352-1.

5.1.7 Surface roughness (see EN ISO 1302)

The surface roughness after coating in the male contact zone shall not exceed R_a = 0,8 µm (or N6); in the other zones, it shall not exceed R_a = 1,6 µm (or N7).

5.1.8 Engagement sequence

The engagement sequence for coaxial and quadrax contacts shall be outer contact, then inner contacts. Unless otherwise specified in the product standard, the engagement sequence for triaxial contacts shall be: outer contact, intermediate contact, centre contact.

5.2 Materials

The materials used in the manufacture of contacts shall be consistent with those indicated in the definition document. When dissimilar metals are in close contact, the electromotive force of the galvanic couple shall not exceed 0,25 V, see EN 3197.

5.3 Metallic protective plating

Except contact type C contact.

5.3.1 General

The protective coating may be either uniform over the entire surface of the contact, or it may be selective. The entire contact shall have a nickel undercoat and gold overcoat, with the exception of fittings or retaining features such as springs or spring clips which shall be made of a corrosion resisting material.

Three functional areas are defined with their minimum gold plating thickness requirements as follows:

— Crimping area,

— Transition area,

— Active area,

— See description in paragraph from 5.3.1.1 to 5.3.1.3.

5.3.1.1 Crimping area

Crimping area shall be protected as follows:

Inside barrel: EN ISO 27874 Ni 0,76 µm min./Au(99,0) 0,1 µm minimum in crimping area (from the extremity of the crimp barrel to the inspection hole).

Inside barrel: EN ISO 27874 Ni 0,76 µm min./Au(99,0) 0,05 µm minimum after inspection hole up to the bottom of the drilled barrel.

Outside barrel: EN ISO 27874 Ni 0,76 µm min./Au(99,0) 0,1 µm minimum in crimping area.

5.3.1.2 Transition area

Transition area are defined in 3.4 and Figure 7 and shall be protected as follows:

EN ISO 27874 Ni 1,25 µm min./Au(99,0) 0,2 µm minimum (or 0,1 µm on each side of interfaces).

5.3.1.3 Active area

Active areas are defined in 3.3 and Figure 5, Figure 6 and shall be protected as follows:

EN ISO 27874 Ni 1,25 µm min./Au(99,0) 0,8 µm minimum.

As specified in the product standards, the gold plating on contact for the LSP areas shall be in accordance with the above requirements. In the other zones, the thickness of the protections is generally not specified, but the minimum shall be as per 5.3.1.1 and 5.3.1.2.

A change in colour of the gold plating is not a reason for rejection excepted in active areas Y [see Figure 5b), key 4, male active area] and X [see Figure 5c), key 6, female active area].

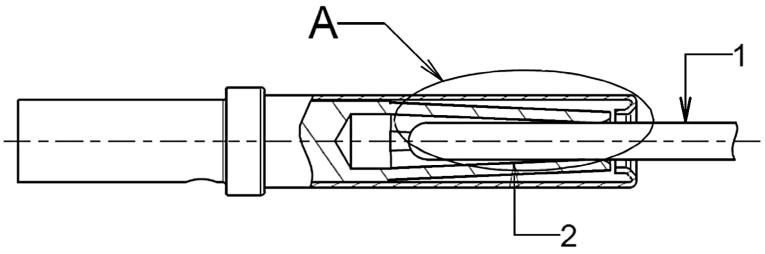
The gold plating thickness shall be sufficient to fulfil the performances required in this specification. However, and unless otherwise specified in the product standard, it shall never be lower than 0,8 µm.

It is a supplier responsibility to define the right gold thickness to meet the performances tests required in this technical specification if the 0,8 µm minimum are not sufficient to pass the expected requirements.

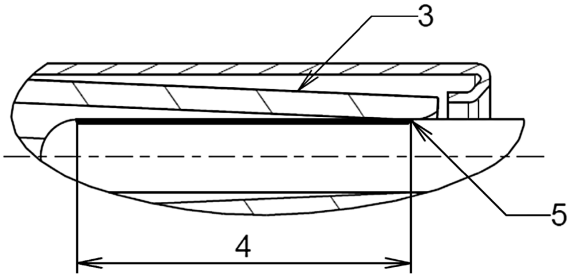
5.3.1.4 All other areas

All other areas shall be protected as follows:

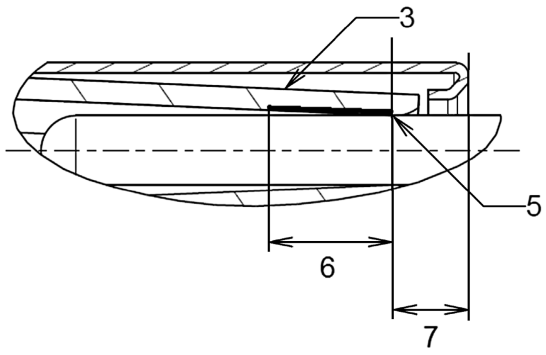
EN ISO 27874 Ni 0,76 µm min./Au(99,0) 0,1 µm minimum.



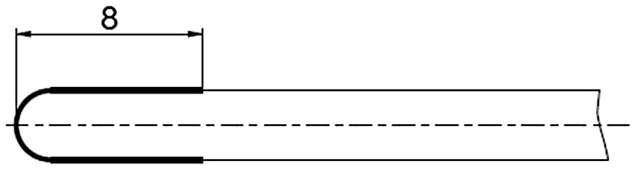
a) Engaged pin / socket contact



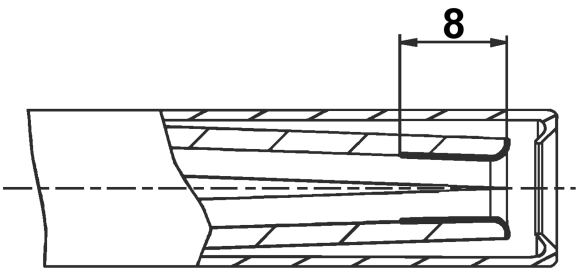
b) Detail A: male contact



c) Detail A: female contact



d)

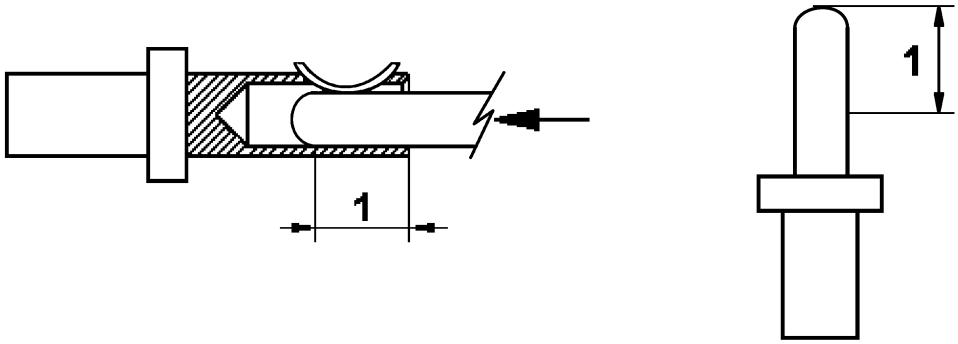


e)

Key

1 Male contact with maximum diameter
2 Pressure element
3 Engagement of contacts (given in connector technical specification)
4 Male active area (Y) see product standard
5 First point of electrical contact (Point at which a square ended minimum gauge pin of the same basic diameter as the mating contact first engages the female contact spring member).
6 Female active area (X = 1 mm length min. of gold plating)
7 Position of the first point and the maximum length of electrical contact (Point at which a square ended minimum gauge pin of the same basic diameter as the mating contact first engages the female contact spring member as defined in the contact product standard)
8 Length of Selective Protection "LSP" which shall include the length of the Key 4 (for male) or 6 (for female) and the radius/chamfer at the extremity.

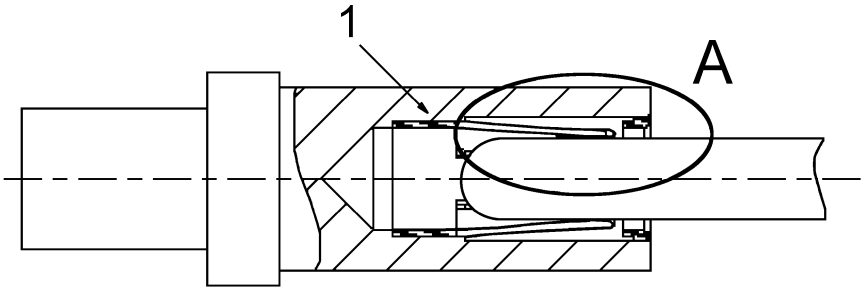
Figure 5 — Contact with integrated pressure element



Key

1 Contact active area X = contact active area Y

Figure 6 — Female contact with separate pressure elements



Key

1 Electrical contact transition area

NOTE See Figure 5 for Detail A.

Figure 7 — Contact with separate pressure element

For contacts types D and E.

Inner contact and outer contact bodies see Figure 5, Figure 6 and applicable standard products.

6 Dimensions and mass

The dimensions of the contacts and their mass are defined in the product standard.

7 Operation

The tools for connecting and installing the contacts are defined in the product standard.

8 Tests

See Table 2.

Table 2 — Qualification tests

<table>
<tr><th>EN 2591-</th><th>Test</th><th>Details</th></tr>
<tr><td>101</td><td>Visual examination</td><td>Initial examination: before and after wiring
Details to be examined and documented :
— identification of materials in accordance with definition document;
— identification;
— aspect before and after wiring (No breaking strand at the rear of the barrel);
— marking;
— surface roughness in accordance with 5.1.7.
For crimped terminations, after wiring, the crimp joint shall be examined (10 times magnification) for cracking exposing the base metal, except type C contact.
Intermediate and final examination:
Details to be examined and documented:
— gold plating shall be present at electrical contact point and transition area.
There shall be no crack, burr, peeling or blister.
No breaking strand at the rear of the barrel</td></tr>
<tr><td>102</td><td>Examination of dimensions and mass</td><td>In accordance with the product standard.</td></tr>
<tr><td>201</td><td>Contact resistance - low level

— Types A, D and E contacts</td><td>Applicable to type A contacts of size 20 and smaller and to types D and E contacts.
Unless otherwise specified in the product standard, the contact resistance shall not exceed the maximum values given below (in mΩ).
<table><tr><th rowspan="2">Contact size</th><th colspan="2">Type A</th></tr><tr><th>Initially</th><th>After tests</th></tr><tr><td>≤ 24</td><td>– [a]</td><td>– [a]</td></tr><tr><td>23</td><td>8</td><td>11</td></tr><tr><td>22</td><td>8</td><td>11</td></tr><tr><td>20</td><td>5</td><td>7</td></tr><tr><td colspan="3">[a] To be specified in the product standard.</td></tr></table>
The contact resistance values for types D and E shall be specified in the product standard.</td></tr>
</table>

<table>
<tr><th>EN 2591-</th><th>Test</th><th>Details</th></tr>
<tr><td>202</td><td>Contact resistance at rated current
— Types A, D and E contacts

— Type A</td><td>Applicable to types A, D and E contacts.
Unless otherwise specified in the product standard, the contact resistance shall not exceed the maximum values given below (in mΩ).</td></tr>
<tr><td></td><td colspan="2">
<table>
<tr><th rowspan="2">Contact size</th><th colspan="2">At ambient temperature</th><th colspan="5">At high temperature</th></tr>
<tr><th>Initially</th><th>After tests</th><th>Class P 125 °C</th><th>Class R 150 °C</th><th>Class S 200 °C</th><th>Class T 260 °C</th><th>Class U 350 °C</th></tr>
<tr><td>24</td><td>– [a]</td><td>– [a]</td><td>– [a]</td><td>– [a]</td><td>– [a]</td><td>– [a]</td><td>– [a]</td></tr>
<tr><td>23</td><td>8</td><td>11</td><td>[a]</td><td>[a]</td><td>14</td><td>[a]</td><td>[a]</td></tr>
<tr><td>22</td><td>8</td><td>11</td><td>12</td><td>12,8</td><td>13,6</td><td>14,4</td><td>– [a]</td></tr>
<tr><td>20</td><td>5</td><td>7</td><td>7,5</td><td>8</td><td>8,5</td><td>9</td><td>– [a]</td></tr>
<tr><td>16</td><td>3</td><td>5</td><td>4,5</td><td>4,8</td><td>5,1</td><td>5,4</td><td>– [a]</td></tr>
<tr><td>≥ 12</td><td>2</td><td>3</td><td>3</td><td>3,2</td><td>3,4</td><td>3,6</td><td>– [a]</td></tr>
<tr><td colspan="8">[a] To be specified in the product standard.</td></tr>
</table>
— Types D and E: The contact resistance values shall be specified in the product standard.
</td></tr>
<tr><td>203</td><td>Electrical continuity at microvolt level</td><td>See product standard.</td></tr>
<tr><td>204</td><td>Discontinuity of contacts in the microsecond range</td><td>No discontinuity ≥ 1 µs
For types D and E contacts: duration of discontinuity specified in the product standard.
Method B or Method A
Test duration: throughout the duration of tests EN 2591-402 (Shock) and EN 2591-403 (Vibrations).</td></tr>
<tr><td>205</td><td>Housing (shell) electrical continuity</td><td>Not applicable</td></tr>
<tr><td>206</td><td>Measurement of insulation resistance</td><td>Method C – Contact type D or E
Otherwise specified in the product standard, the value shall be:
— at room temperature ≥ 5 GΩ;
— at high temperature ≥ 2 GΩ at the maximum temperature specified.</td></tr>
<tr><td>207</td><td>Voltage proof test</td><td>Method C – Contact types D and E
The values for:
— voltage to apply;
— pressure;
— leakage current.
shall be defined in the product standard.</td></tr>
<tr><td>208</td><td>Temperature rise due to rated current</td><td>Not applicable</td></tr>
<tr><td>209</td><td>Current temperature derating</td><td>Not applicable</td></tr>
</table>

<table>
<tr><th>EN 2591-</th><th>Test</th><th>Details</th></tr>
<tr><td>210</td><td>Electrical overload</td><td>Contact wired and not fitted into the connector
Cylindrical contacts type A.

<table>
<tr><th>Contact size</th><th>Current
A</th><th>Duration
s</th><th>Contact size</th><th>Current
A</th><th>Duration
s</th></tr>
<tr><td>28</td><td colspan="2">Not applicable</td><td>10</td><td>66
330</td><td>40
0,6</td></tr>
<tr><td>26</td><td colspan="2">Not applicable</td><td>8</td><td>92
460</td><td>40
0,6</td></tr>
<tr><td>24</td><td>5
25</td><td>40
0,6</td><td>6</td><td>120
600</td><td>40
0,6</td></tr>
<tr><td>23</td><td>5
25</td><td>40
0,6</td><td>4</td><td>160
800</td><td>40
0,6</td></tr>
<tr><td>22</td><td>10
50</td><td>40
0,6</td><td>2</td><td>200
1 000</td><td>40
0,6</td></tr>
<tr><td>20</td><td>15
75</td><td>40
0,6</td><td>0</td><td>300
1 500</td><td>40
0,6</td></tr>
<tr><td>16</td><td>26
130</td><td>40
0,6</td><td>2/0</td><td>370
1 850</td><td>40
0,6</td></tr>
<tr><td>14</td><td>36
180</td><td>40
0,6</td><td>4/0</td><td>450
2 250</td><td>40
0,6</td></tr>
<tr><td>12</td><td>46
230</td><td>40
0,6</td><td>—</td><td>—</td><td>—</td></tr>
</table>
Other types of contacts: in accordance with the product standard.</td></tr>
<tr><td>211</td><td>Capacitance</td><td>Applicable to types D and E contacts unless otherwise specified in the product standard.</td></tr>
<tr><td>212</td><td>Surface transfer impedance</td><td>Types D and E, see product standard.</td></tr>
<tr><td>213</td><td>Shielding effectiveness from 100 MHz to 1 GHz</td><td>Types D and E, see product standard.</td></tr>
<tr><td>214</td><td>Lightning strike, current and voltage pulse</td><td>Not applicable</td></tr>
<tr><td>216</td><td>Engagement depth of contacts</td><td>Not applicable</td></tr>
<tr><td>217</td><td>Voltage drop under specified current for terminal lugs and in-line splices</td><td>Not applicable</td></tr>
<tr><td>218</td><td>Ageing of terminal lugs and in-line splices by temperature and current cycling</td><td>Not applicable</td></tr>
<tr><td>219</td><td>Voltage strength for insulated terminal lugs and in-line splices</td><td>Not applicable</td></tr>
<tr><td>220</td><td>Contact/conductor joint ageing by current and temperature cycling</td><td>See product standard.</td></tr>
<tr><td>221</td><td>Voltage Standing Wave Ratio (VSWR)</td><td>Type E, see product standard.</td></tr>
<tr><td>222</td><td>Insertion Loss (I.L.)</td><td>Type E, see product standard.</td></tr>
<tr><td>223</td><td>Measurement of characteristic impedance of a coaxial connector or contact</td><td>Type E, see product standard.</td></tr>
<tr><td>224</td><td>RF leakage</td><td>Not applicable</td></tr>
<tr><td>225</td><td>RF high potential withstanding voltage</td><td>Not applicable</td></tr>
</table>

EN 2591-	Test	Details
226	Corona level	Not applicable
301	Endurance at temperature	Method B, Except: Mated contact shall not be fitted into the connector. Contact shall not be wired in serial. Test under load not applicable Temperature: according to product standard. Duration: according to product standard.
302	Climatic sequence	Not applicable
303	Cold/low pressure and damp heat	Not applicable
304	Damp heat steady state	Not applicable
305	Rapid change of temperature	Contacts shall be wired and mated Mated contact shall not be fitted into the connector. Types A, C, D and E T_A = maximum temperature specified in the product standard T_B = minimum temperature specified in the product standard $T_1 = 15\,^{+5}_{0}$ min, 500 cycles applicable for test group 1 $T_1 = 30\,^{+5}_{0}$ min, 10 cycles applicable for test group 2
306	Mould growth	Types D and E contacts. Method A Duration: 28 d Nil growth. No prior washing. No surface etching.
307	Salt mist	Contacts wired and connector unmated Duration: 48 h Corrosion due to the cable is not taken into account.
308	Sand and dust	Not applicable
309	Dry heat	Not applicable
310	Cold	Not applicable
311	Low air pressure	Not applicable
312	Air leakage	Not applicable
313	Artificial rain	Not applicable
314	Immersion at low air pressure	Not applicable

EN 2591-	Test	Details
315	Fluid resistance	Types A and C contacts which have a plastic link between the cable and the contact. Types A, D and E contacts which are fitted with non-metallic elements. Fluids and test conditions in accordance with the product standard.
316	Ozone resistance	Types A, D and E contacts which are fitted with non-metallic elements.
317	Flammability	Not applicable
318	Fire-resistance	Not applicable
319	Gastightness of solderless wrapped connections	Applicable
320	Simulated solar radiation at ground level	Not applicable
321	Damp heat, cyclic test	Not applicable
322	Hermeticity	Not applicable
323	Thermal shock	Not applicable
324	Interfacial sealing	Not applicable
325	Ice resistance	Not applicable
401	Acceleration, steady state	Not applicable
402	Shock	Unless otherwise specified in the product standards, — The elements of connection fitted with appropriate backshell shall be mated and mounted on the vibration apparatus using appropriate mounting systems. — The cables are clamped on the shaker at a minimum of 200 mm from the rear of the backshell. Method A: 300 $g_{n.}$ or as specified in the product standard Two shocks in the three mutual perpendicular axis, one in each direction, Total: six shocks; or as specified in the product standard.
403	Sinusoidal and random vibration	Unless otherwise specified in the product standards, — The elements of connection fitted with appropriate backshell shall be mated and mounted on the vibration apparatus using appropriate mounting systems. — The cables are clamped on the shaker at a minimum of 200 mm from the rear of the backshell. Method, duration and temperature shall be according to the most severe and applicable connector as specified in product standards. After test and before unmating the connectors the EN 2591-202 shall be performed.

EN 2591-	Test	Details
404	Transverse load	Not applicable
405	Axial load	Not applicable
406	Mechanical endurance	Unless otherwise specified in the product standard, the contacts shall undergo 500 mating and unmating operations; the rate shall not exceed five cycles per minute.
407	Durability of contact retention system and seals	Not applicable
408	Mating and unmating forces	Not applicable
409	Contact retention in insert	Not applicable
410	Insert retention in housing (axial)	Not applicable
411	Insert retention in housing (torsional)	Not applicable
412	Contact insertion and extraction forces	Not applicable
413	Holding force of grounding spring system	Not applicable
414	Unmating of lanyard release connectors	Not applicable
415	Test probe damage (female contacts)	Contacts types A and C. Length of probe: ½ of depth A_1 in order to test the elastic portion of the female contacts under test fitted in a connector or in a representative assembly. Probe *B* diameter and value of bending moment unless otherwise specified in product standard:

Contact size	*B* ± 0,01 mm	**Moment** Nm	**Contact size**	*B* ± 0,01 mm	**Moment** Nm
24	0,64	0,014	8	3,61	0,454
23	0,69	0,014	6	4,52	0,454
22	0,76	0,014	4	5,72	0,454
20	1,02	0,057	2	7,19	0,454
16	1,59	0,227	0	9,07	0,908
14	1,98	0,227	2/0	10,31	0,908
12	2,39	0,227	4/0	12,70	0,908
10	3,18	0,227	—	—	—

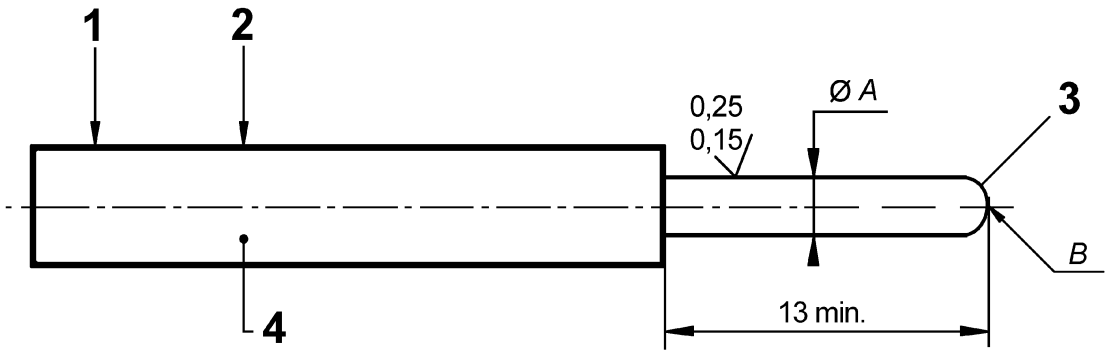
<table>
<tr><th>EN 2591-</th><th>Test</th><th>Details</th></tr>
<tr><td>416</td><td>Contact bending strength</td><td>Type A contacts.
Size 20 and smaller.

<table><tr><th>Contact size</th><th>Moment Nm</th></tr><tr><td>20</td><td>0,060</td></tr><tr><td>22</td><td>0,025</td></tr><tr><td>23</td><td>0,018</td></tr><tr><td>24</td><td>0,015</td></tr></table>
Maximum permitted permanent set: 0,13 mm.
For type C contacts the values shall be indicated in the product standard.</td></tr>
<tr><td>417</td><td>Tensile strength (crimped connection)</td><td>Crimping tool and wire gauge in accordance with the product standard.
Tension load: according to EN 2242.</td></tr>
<tr><td>418</td><td>Gauge insertion/extraction forces (female contacts)</td><td>Unless otherwise specified, the gauge used is that defined in Table 3.
Applicable to cylindrical contacts, types A and C.
For other types, see the product standard.
Maximum insertion and minimum extraction forces in N.

<table><tr><th rowspan="2">Contact size</th><th colspan="3">Initially</th><th colspan="3">After tests</th></tr><tr><th>Insertion
max.</th><th>Insertion average
max.</th><th>Extraction
min.</th><th>Insertion
max.</th><th>Insertion average
max.</th><th>Extraction
min.</th></tr><tr><td>24</td><td>2,5</td><td>1,64</td><td>0,14</td><td>2,8</td><td>2,01</td><td>0,11</td></tr><tr><td>23</td><td>2,27</td><td>1,93</td><td>0,14</td><td>2,83</td><td>2,30</td><td>0,11</td></tr><tr><td>22</td><td>3,4</td><td>2,64</td><td>0,20</td><td>4</td><td>3,16</td><td>0,17</td></tr><tr><td>20</td><td>5,1</td><td>3,33</td><td>0,20</td><td>6,2</td><td>3,89</td><td>0,17</td></tr><tr><td>16</td><td>8,5</td><td>6,67</td><td>0,60</td><td>10,2</td><td>8,06</td><td>0,425</td></tr><tr><td>14</td><td>8,5</td><td>NR</td><td>0,60</td><td>10,2</td><td>NR</td><td>0,425</td></tr><tr><td>12</td><td>8,5</td><td>6,67</td><td>0,85</td><td>10,2</td><td>8,06</td><td>0,70</td></tr><tr><td>10</td><td>17</td><td>NR</td><td>1,15</td><td>20,4</td><td>NR</td><td>0,85</td></tr><tr><td>8</td><td>45,4</td><td>NR</td><td>1,42</td><td>53,9</td><td>NR</td><td>1,15</td></tr><tr><td>6</td><td>45,4</td><td>NR</td><td>1,42</td><td>53,9</td><td>NR</td><td>1,15</td></tr><tr><td>4</td><td>68</td><td>NR</td><td>2,85</td><td>82,2</td><td>NR</td><td>2,30</td></tr><tr><td>2</td><td>68</td><td>NR</td><td>2,85</td><td>82,2</td><td>NR</td><td>2,30</td></tr><tr><td>0</td><td>90,7</td><td>NR</td><td>4,25</td><td>108</td><td>NR</td><td>3,40</td></tr><tr><td>2/0</td><td>90,7</td><td>NR</td><td>4,25</td><td>108</td><td>NR</td><td>3,40</td></tr><tr><td>4/0</td><td>90,7</td><td>NR</td><td>4,25</td><td>108</td><td>NR</td><td>3,40</td></tr><tr><td colspan="7">NR: no requirement.</td></tr></table></td></tr>
</table>

<table>
<tr><th>EN 2591-</th><th>Test</th><th>Details</th></tr>
<tr><td>419</td><td>Stability of male contacts in insert</td><td>Not applicable</td></tr>
<tr><td>420</td><td>Mechanical strength of rear accessories</td><td>Not applicable</td></tr>
<tr><td>421</td><td>Free fall</td><td>Not applicable</td></tr>
<tr><td>422</td><td>Locking wire hole strength</td><td>Not applicable</td></tr>
<tr><td>423</td><td>Connector rear accessories thread strenght</td><td>Not applicable</td></tr>
<tr><td>424</td><td>Stripping force, solderless wrapped connections</td><td>Applicable</td></tr>
<tr><td>425</td><td>Unwrapping capability, solderless wrapped connections</td><td>Applicable</td></tr>
<tr><td>426</td><td>Contact retention system effectiveness</td><td>Not applicable</td></tr>
<tr><td>427</td><td>Robustness of protective cover attachment</td><td>Not applicable</td></tr>
<tr><td>428</td><td>Sinusoidal vibrations with passage of current for crimped terminal lugs</td><td>Not applicable</td></tr>
<tr><td>501</td><td>Soft solderability</td><td>Applicable to solder contacts unless otherwise specified in the product standard.</td></tr>
<tr><td>502</td><td>Restricted entry</td><td>Female contacts (Applicable to cylindrical contacts type A and C – for other types, see product standard).
<table>
<tr><th>Contact size</th><th>Diameter of test pin
± 0,005
mm</th></tr>
<tr><td>24</td><td>0,78</td></tr>
<tr><td>23</td><td>0,82</td></tr>
<tr><td>22</td><td>0,90</td></tr>
<tr><td>20</td><td>1,17</td></tr>
<tr><td>16</td><td>1,73</td></tr>
<tr><td>14</td><td>2,13</td></tr>
<tr><td>12</td><td>2,54</td></tr>
</table></td></tr>
<tr><td>503</td><td>Contact deformation after crimping</td><td>Maximum and minimum cable sizes in accordance with product standard.
Axial deformation:
The eccentricity shall not exceed the following values:
— contact sizes 20 to 28 0,28 mm;
— contact sizes 12 to 16 0,30 mm;
— contact sizes 4/0 to 10 0,80 mm.
Expansion shall not exceed 0,15 mm in the crimping zone.</td></tr>
<tr><td>505</td><td>Contact protection effectiveness (scoop-proof)</td><td>Not applicable</td></tr>
<tr><td>506</td><td>Use of tools</td><td>Not applicable</td></tr>
<tr><td>507</td><td>Plating porosity</td><td>Applicable</td></tr>
</table>

EN 2591-	Test	Details
508	Measurement of thickness of coating on contacts	Uniform and selective plating. The nickel and gold coating thickness shall be checked in zones defined in 5.3 or by the product standard. After test The gold coating thickness shall be checked in zones defined in 5.3. Unless otherwise specified in the product standard, the gold plating thickness shall be greater than 0,1 µm on active areas and transition areas (on each face of interfaces) One of the following methods may be used: — X-ray spectrometry (EN ISO 27874), — Beta ray backscatter (EN ISO 27874).
509	Adhesion of coating on contacts	Unless otherwise specified in product standard, Bending test for male contact sizes 20 to 24. See EN ISO 27874. Burnishing test for female contact sizes 4/0 to 24. See EN ISO 27874. Burnishing test for male contact sizes 4/0 to 16. See EN ISO 27874.
512	Effectiveness of non-removable fixing of hermetically sealed connector shell	Not applicable
513	Magnetic permeability	≤ 2
514	Solderability of contacts with self-contained solder and flux	Applicable to solder contacts unless otherwise specified in the product standard.
515	Hydrolytic stability	Not applicable



Key

1 Example of handle
2 Recommended length 25 max. diameter two times *A* max.
3 Radius
4 Marking

Material: tool steel or carbide steel.

Figure 8 — Gauges for test EN 2591-418

Table 3 — Gauge dimensions

Dimensions in millimetres

Contact size [a]	*A*		*B*
	Minimum gauge + 0,003 0	**Maximum gauge** 0 − 0,003	**Maximum flat**
24	0,622	0,648	0,2
23	0,669	0,705	
22	0,749	0,775	
20	0,991	1,041	
16	1,562	1,613	0,4
14	1,956	2,007	
12	2,362	2,413	
10	3,150	3,200	0,8
8	3,581	3,632	
6	4,496	4,547	
4	5,690	5,740	
2	7,163	7,214	
0	9,042	9,093	1,54
2/0	10,287	10,338	
4/0	12,675	12,725	

[a] Other contact sizes: see product standard.

9 Quality assurance

9.1 General

Quality assurance shall comply with EN 9133.

9.2 Conditions for qualification

9.2.1 General

The contacts defined by this standard form an integral part of the connection device in which they are fitted.

When a test requires the contacts to be fitted in the connector, a qualified connection device shall be used.

In the event of a defect of contact, qualification approval of the connection device cannot be disputed.

Samples for Qualification and maintenance of Qualification (36 months) shall be manufactured to the lowest gold plating thickness specified by the manufacturer on the customer drawings.

The active area of samples for qualification shall be coated with gold thickness between XX and XX + 0,15 μm.

XX = minimum gold thickness defined in manufacturer process and drawing.

Demonstration by population analysis can be proposed by manufacturer.

9.2.2 Sampling and definition of specimens

See Table 4. To see in accordance with group sampling (Table is given for information only as the sample numbers are linked to connector and contact arrangements defined into the product standard).

Table 4 — Sampling of specimens

Type	Contact size	Number of specimens [a, b, c]		
		Male contact	Female contact	Female contact body [d]
A	16 and smaller	76	72	4
A	12 and 14	52	48	4
A	10 and larger	28	26	2
C	All	16	16	–
D [e]	All	30	26	4
E [e]	All	16	16	4

[a] In addition and, where applicable, one contact for each size and fluid tested (see EN 2591-315).

[b] Number of specimens for test EN 2591-220 not included (see EN 2591-220).

[c] The number of the specimens stated in Tables 8 to 15 override the requirements of EN 2591-100 test.

[d] Clips and, if applicable, spring systems and inserts shall not be fitted in the contact body.

[e] Internal and external contacts may be used for the tensile strength tests.

9.2.3 Preparation of specimens

25 spare unwired contacts shall be kept with the qualification samples (from the same manufacturing batch) for contacts size 12 and smaller.

10 spare unwired contacts shall be kept with the qualification samples (from the same manufacturing batch) for contacts size 10 and larger.

In group 1 and 3, contacts shall be crimped with all the crimping tools defined in the product standard.

All applicable crimping tools shall be used at GO/NO GO plus measurement of value of intender diameter once closed shall be given for information in the QTR.

Types D and E contacts.

The specimens shall be wired with cables as defined in the product standard.

Table 5 — Specimen configuration for contact type A

Group	Specimens configuration
0	Contact alone, not crimped
1, 3, 4, 5, 8 and 10	Contact crimped, not fitted in connector NOTE Contact engagement depth (except for EN 2591-415) shall be controlled and not greater than the maximum male active area length defined in product standard.
2	Contact to be crimped, for all tests Contacts to be fitted in connectors for test EN 2591-307, EN 2591-406, EN 2591-403 and EN 2591-402 **REMARK —** Before the test EN 2591-307 (Salt mist) 1/3 of the contacts shall be removed from the connector and tested in the unmated condition. **REMARK —** for test EN 2591-402, EN 2591-403 and EN 2591-406 connectors shall be fitted at 50 % of even contact at minimum AWG and 50 % of odd contact at maximum AWG acceptable by contact. In case of alphabetical identification of contact cavities, the following rule shall apply: (i.e.: A=1- odd; B=2-even).
6, 7 and 9	Contact not crimped, not fitted in connector (excepted for group 9 for EN 2591-406)

Table 6 — Specimen configuration for contact type C

Group	Specimens configuration
0	Contact alone, not crimped
1, 3 and 4	Contact crimped, not fitted in connector NOTE Contact engagement depth shall be controlled and not greater than the maximum male active area length defined in product standard.
2	Contact crimped, fitted in connectors for test EN 2591-307, EN 2591-406, EN 2591-403 and EN 2591-402 **REMARK —** Before the test EN 2591-307 (Salt mist) 1/3 of the contacts shall be removed from the connector and tested in the unmated condition. **REMARK —** for test EN 2591-402, EN 2591-403 and EN 2591-406 connectors shall be fitted at 50 % of even contact at minimum AWG and 50 % of odd contact at maximum AWG acceptable by contact. In case of alphabetical identification of contact cavities, the following rule shall apply. (i.e.: A=1- odd; B=2-even).

Table 7 — Specimen configuration for contact types D and E

Group	Specimens configuration
0	Refer to group 0 – Table 7
1, 3 and 5	Contact crimped, not fitted in connector NOTE Contact engagement depth shall be controlled and not greater than the maximum male active area length defined in product standard.
2	Contact to be crimped, for all tests Contacts to be fitted in connectors for test EN 2591-307, EN 2591-406, EN 2591-403 and EN 2591-402 **REMARK —** Before the test EN 2591-307 (Salt mist) 1/3 of the contacts shall be removed from the connector and tested in the unmated condition.
4, 6 and 7	Contact not crimped, not fitted in connector.

9.2.4 Test programme – Type A contacts

The qualification approval tests are defined in Table 8.

Table 8 — Qualification test for type A contacts

Tests	EN 2591-	Number of specimens per size		Breakdown of specimens wired with maximum gauge		Breakdown of specimens wired with minimum gauge	
		Size 12 and smaller	Size 10 and larger	Size 12 and smaller	Size 10 and larger	Size 12 and smaller	Size 10 and larger
GROUP 0							
Visual examination	101						
Examination of dimensions and mass	102	a	a	–	–	–	–
Magnetic permeability	513						
GROUP 1		12	12	6	6	6	6
Visual examination	101						
Contact deformation after crimping	503						
Contact resistance - low level	201						
Contact resistance at rated current [b]	202						
Gauge insertion/extraction forces (female contacts)	418						
Rapid change of temperature	305						
Gauge insertion/extraction forces (female contacts)	418						
Test probe damage (female contacts)	415						
Visual examination	101						
Gauge insertion/extraction forces (female contacts)	418						
Contact resistance at rated current [b]	202						
Tensile strength (crimped connection)	417	8	8	4	4	4	4
Stripping force, solderless wrapped connections	424						
GROUP 2		Number of contacts shall be in relation with the connector arrangements					
Visual examination	101						
Contact deformation after crimping	503						
Contact resistance - low level	201	See product standard or at least 16 [c] or 8 [d]	See product standard or at least 4	See product standard or at least 12 [c] or 6 [d]	See product standard or at least 3	See product standard or at least 4 [c] or 2 [d]	See product standard or at least 1
Contact resistance at rated current [b]	202						
Gauge insertion/extraction forces (female contacts)	418						
Rapid change of temperature	305						
Mechanical endurance	406						

Tests	EN 2591-	Number of specimens per size		Breakdown of specimens wired with maximum gauge		Breakdown of specimens wired with minimum gauge	
		Size 12 and smaller	Size 10 and larger	Size 12 and smaller	Size 10 and larger	Size 12 and smaller	Size 10 and larger
Visual examination	101						
Sinusoidal and random vibration [e]	403						
Shock [e]	402						
Salt mist [f]	307						
Contact resistance - low level [g]	201						
Contact resistance at rated current [b, h, g]	202						
Gauge insertion/extraction forces (female contacts)	418						
Visual examination	101						
Measurement of thickness of coating on contacts (except thermocouple contacts) [i]	508	3	3				
GROUP 3		16	16	8	8	8	8
Visual examination	101						
Contact deformation after crimping	503						
Contact resistance - low level	201						
Contact resistance at rated current [b]	202						
Gauge insertion/extraction forces (female contacts)	418						
Endurance at temperature [f]	301						
Contact resistance - low level	201						
Contact resistance at rated current [b]	202						
Visual examination	101						
Gauge insertion/extraction forces (female contacts)	418						
Tensile strength (crimped connection)	417	12	12	6	6	6	6
Stripping force, solderless wrapped connections	424						
GROUP 4 [b]		8	–	4	–	4	–
Visual examination	101						
Contact deformation after crimping	503						
Contact resistance - low level	201						
Contact resistance at rated current [j]	202						
Contact bending strength	416						
Visual examination	101						

Tests	EN 2591-	Number of specimens per size		Breakdown of specimens wired with maximum gauge		Breakdown of specimens wired with minimum gauge	
		Size 12 and smaller	Size 10 and larger	Size 12 and smaller	Size 10 and larger	Size 12 and smaller	Size 10 and larger
GROUP 5 [b]							
Visual examination	101						
Contact deformation after crimping	503						
Restricted entry	502						
Electrical overload	210						
Contact resistance at rated current	202	8	8	4	4	4	4
Tensile strength (crimped connection)	417						
Stripping force, solderless wrapped connections	424						
GROUP 6							
Unwrapping capability, solderless wrapped connections	425						
Soft solderability	501						
Solderability of contacts with self-contained solder and flux	514	4	4	–	–	–	–
Measurement of thickness of coating on contacts [i]	508						
Adhesion of coating on contacts [i]	509						
GROUP 7							
Fluid resistance	315	k	k	–	–	–	–
Visual examination	101						
GROUP 8							
Gastightness of solderless wrapped connections	319	3	3	2	2	1	1
GROUP 9		Number of contacts shall be in relation with the connector arrangements					
Mechanical endurance [l]	406						
Visual examination	101	See product standard or at least 8	See product standard or at least 8	–	–	–	–
Plating porosity	507						

Tests	EN 2591-	Number of specimens per size		Breakdown of specimens wired with			
				maximum gauge		minimum gauge	
		Size 12 and smaller	Size 10 and larger	Size 12 and smaller	Size 10 and larger	Size 12 and smaller	Size 10 and larger
GROUP 10							
Contact/conductor joint ageing by current and temperature cycling	220	m	m	–	–	–	–

[a] All specimens of groups 1 to 10, before wiring.

[b] At ambient temperature.

[c] Sizes 16 and smaller - The samples are divided into two equal lots. In the test programme, one lot is subjected to all tests, except EN 2591-201, the other is subjected to all tests, except EN 2591-202.

[d] Sizes 14 and 12.

[e] Not applicable to barrel size 28 and smaller.

[f] Integrity of colour bands after test is not a requirement.

[g] Contacts shall be fitted into the connector and connectors shall be mated.

[h] At maximum temperature.

[i] The test on female contacts shall be carried out on non-assembled parts of the contact.

[j] Sizes 16, 12 contacts only.

[k] One contact of each size shall be tested per fluid.

[l] Unwired contacts.

[m] Numbers of specimens, see EN 2591-220.

9.2.5 Programme of qualification approval tests – Type C contacts

See Table 9.

Table 9 — Qualification test for type C contacts

Group	EN 2591-	Number of specimens	Breakdown of specimens wired with	
			maximum gauge	minimum gauge
GROUP 0				
Visual examination	101			
Examination of dimensions and mass	102	a	a	a
GROUP 1		12	6	6
Visual examination	101			
Contact deformation after crimping	503			
Gauge insertion/extraction forces (female contacts)	418			
Rapid change of temperature	305			
Test probe damage (female contacts)	415			
Visual examination	101			
Gauge insertion/extraction forces (female contacts)	418			
Contact resistance - low level	201			
Contact bending strength	416			
Tensile strength (crimped connection)	417	8	4	4
GROUP 2		Number of contacts shall be in relation with the connector arrangements		
Visual examination	101	See product standard or at least 12	See product standard or at least 6	See product standard or at least 6
Contact deformation after crimping	503			
Gauge insertion/extraction forces (female contacts)	418			
Mechanical endurance	406			
Visual examination	101			
Sinusoidal and random vibration	403			
Shock	402			
Salt mist	307			
Gauge insertion/extraction forces (female contacts)	418			
Visual examination	101			

Group	EN 2591-	Number of specimens	Breakdown of specimens wired with	
			maximum gauge	minimum gauge
GROUP 3				
Visual examination	101			
Contact deformation after crimping	503	b	b	b
Contact/conductor joint ageing by current and temperature cycling	220			
GROUP 4		16	8	8
Visual examination	101			
Contact deformation after crimping	503			
Gauge insertion/extraction forces (female contacts)	418			
Endurance at temperature	301			
Visual examination	101			
Gauge insertion/extraction forces (female contacts)	418			
Restricted entry	502			
Tensile strength (crimped connection)	417	12	6	6

[a] All specimens of groups 1 to 4, before wiring.

[b] Numbers of specimens, see EN 2591-220.

9.2.6 Programme of qualification approval tests – Type D contacts

See Table 10.

Table 10 — Qualification test for type D contacts

Tests	EN 2591-	Number of specimens
GROUP 0		
Visual examination	101	[a]
Examination of dimensions and mass	102	"
Magnetic permeability	513	"
Preparation of specimens	–	[b]
Visual examination	101	
Contact deformation after crimping	503	
Contact resistance - low level [c]	201	"
Contact resistance at rated current	202	
Gauge insertion/extraction forces (female contacts) [d]	418	
Measurement of insulation resistance	206	

Tests	EN 2591-	Number of specimens
GROUP 1		8
Rapid change of temperature	305	
Visual examination	101	
Measurement of insulation resistance	206	
Voltage proof test	207	
Contact resistance - low level [c]	201	
Contact resistance at rated current [e]	202	
Gauge insertion/extraction forces (female contacts) [d]	418	
Visual examination	101	
Tensile strength (crimped connection)	417	4
GROUP 2		
Mechanical endurance	406	
Visual examination	101	
Sinusoidal and random vibration	403	
Shock	402	
Salt mist [f]	307	
Visual examination	101	8
Measurement of insulation resistance	206	
Voltage proof test	207	
Contact resistance - low level [c, g]	201	
Contact resistance at rated current [h, g]	202	
Gauge insertion/extraction forces (female contacts) [d]	418	
Visual examination	101	
GROUP 3		
Endurance at temperature [f]	301	8
Visual examination	101	
Measurement of insulation resistance [h]	206	
Voltage proof test	207	
Contact resistance - low level [c]	201	
Contact resistance at rated current [h]	202	
Visual examination	101	
Tensile strength (crimped connection)	417	4

Tests	EN 2591-	Number of specimens
GROUP 4		
Mould growth	306	4
Visual examination	101	
GROUP 5		
Surface transfer impedance [i]	212	2
Shielding effectiveness from 100 MHz to 1 GHz [i]	213	
GROUP 6		
Fluid resistance	315	j
Measurement of insulation resistance	206	
Visual examination	101	
Examination of dimensions and mass	102	
GROUP 7		
Soft solderability	501	4
Solderability of contacts with self-contained solder and flux	514	
Measurement of thickness of coating on contacts [k]	508	
Adhesion of coating on contacts [k]	509	

a All specimens of groups 1 to 7.

b All specimens of groups 1 to 6 (except group 4).

c Central and intermediate contacts only.

d Applicable to all inner, intermediate, outer female contacts.

e At ambient temperature.

f Integrity of colour bands after test is not a requirement.

g Contacts shall be fitted into the connector and connectors shall be mated.

h At maximum temperature.

i Contact to be wired.

k The test shall be carried out on non-assembled parts of the contact.

j One contact per fluid.

9.2.7 Programme of qualification approval tests – Type E contacts

See Table 11.

Table 11 — Qualification test for type E contacts

Tests	EN 2591-	Number of specimens
GROUP 0		
Visual examination	101	a
Examination of dimensions and mass	102	"
Magnetic permeability	513	"
Preparation of specimens	–	b
Visual examination	101	"
Contact deformation after crimping	503	
Contact resistance - low level [c]	201	
Contact resistance at rated current	202	
Gauge insertion/extraction forces (female contacts) [d]	418	
Measurement of insulation resistance	206	
Voltage Standing Wave Ratio (VSWR)	221	
Insertion Loss (I.L.)	222	
Measurement of characteristic impedance of a coaxial connector or contact	223	
GROUP 1		8
Rapid change of temperature	305	
Visual examination	101	
Measurement of insulation resistance	206	
Voltage proof test	207	
Contact resistance - low level [c]	201	
Contact resistance at rated current [e]	202	
Gauge insertion/extraction forces (female contacts) [d]	418	
Voltage Standing Wave Ratio (VSWR)	221	
Insertion Loss (I.L.)	222	
Measurement of characteristic impedance of a coaxial connector or contact	223	
Visual examination	101	
Tensile strength (crimped connection)	417	4

Tests	EN 2591-	Number of specimens
GROUP 2		
Mechanical endurance	406	
Visual examination	101	
Sinusoidal and random vibration	403	
Visual examination	101	
Shock	402	
Salt mist [f]	307	
Visual examination	101	
Measurement of insulation resistance	206	
Voltage proof test	207	8
Contact resistance - low level [c, g]	201	
Contact resistance at rated current [h, g]	202	
Gauge insertion/extraction forces (female contacts) [d]	418	
Voltage Standing Wave Ratio (VSWR)	221	
Insertion Loss (I.L.)	222	
Measurement of characteristic impedance of a coaxial connector or contact	223	
Visual examination	101	
GROUP 3		
Endurance at temperature [f]	301	8
Visual examination	101	
Measurement of insulation resistance [h]	206	
Voltage proof test	207	
Contact resistance - low level [c]	201	
Contact resistance at rated current [h]	202	
Voltage Standing Wave Ratio (VSWR)	221	
Insertion Loss (I.L.)	222	
Measurement of characteristic impedance of a coaxial connector or contact	223	
Visual examination	101	
Tensile strength (crimped connection)	417	4
GROUP 4		
Mould growth	306	4
Visual examination	101	

Tests	EN 2591-	Number of specimens
GROUP 5		
Surface transfer impedance [i]	212	2
Shielding effectiveness from 100 MHz to 1 GHz [i]	213	
GROUP 6		
Fluid resistance	315	j
Measurement of insulation resistance	206	
Visual examination	101	
Examination of dimensions and mass	102	
GROUP 7		
Soft solderability	501	4
Solderability of contacts with self-contained solder and flux	514	
Measurement of thickness of coating on contacts [k]	508	
Adhesion of coating on contacts [k]	509	

[a] All specimens of groups 1 to 7.
[b] All specimens of groups 1 to 6 (except group 4).
[c] Central and intermediate contacts only.
[d] Applicable to all inner, intermediate, outer female contacts.
[e] At ambient temperature.
[f] Integrity of colour bands after test is not a requirement.
[g] Contacts shall be fitted into the connector and connectors shall be mated.
[h] At maximum temperature.
[i] Contact to be wired.
[j] One contact per fluid.
[k] The test shall be carried out on non-assembled parts of the contact.

9.3 Inspection conditions for manufacturing lots

EN 2591-101 - Visual examination.

Sampling level: S3 (in accordance with ISO 2859-1).

Acceptable quality level: 1 %.

EN 2591-418 - Gauge insertion and extraction forces in and out of a female contact - limited to the extraction force and carried out at 100 % on female contacts, except type D contact. This clause can be discharged provided the contacts are subject to 100 % inspection according to the requirement of this test during production (in-process controls).

9.4 Maintenance of qualification

See EN 9133.

Providing no change has been made in the manufacturing processes and materials, the following applies:

The test shall be carried out every 36 months after qualification on specimen taken at random.

After two maintenance of qualification (renewal) (nine years) a full qualification shall be performed.

The manufacturer shall submit, to be mandated body, the results of tests which shall be carried out based on the below tables.

9.4.1 Type A contacts

See Table 12.

Table 12 — Test programme for maintenance of qualification type A contacts

Tests	EN 2591-	Number of specimens per size		Breakdown of specimens wired with			
				maximum gauge		minimum gauge	
		Size 12 and smaller	Size 10 and larger	Size 12 and smaller	Size 10 and larger	Size 12 and smaller	Size 10 and larger
GROUP 0							
Visual examination [a]	101						
Examination of dimensions and mass	102	[a]	[a]	–	–	–	–
Magnetic permeability	513						
Preparation of samples	–						
Visual examination	101						
Contact deformation after crimping	503						
Contact resistance — low level	201						
Contact resistance at rated current [b]	202						
Gauge insertion and extraction forces (female contacts)	418						

Tests	EN 2591-	Number of specimens per size		Breakdown of specimens wired with			
				maximum gauge		minimum gauge	
		Size 12 and smaller	Size 10 and larger	Size 12 and smaller	Size 10 and larger	Size 12 and smaller	Size 10 and larger
GROUP 1		12	12	6	6	6	6
Rapid change of temperature	305						
Gauge insertion and extraction forces (female contacts)	418						
Test probe damage (female contact)	415						
Visual examination	101						
Gauge insertion and extraction forces in and out of a female contact	418						
Contact resistance at rated current [b]	202						
Tensile strength (crimped connection)	417	8	8	4	4	4	4
Stripping force, solderless wrapped connections	424						
GROUP 2		Number of contacts shall be in relation with the connector arrangements					
Mechanical endurance	406	See product standard or at least 16 [c] or 8 [d]	See product standard or at least 4	See product standard or at least 12 [c] or 6 [d]	See product standard or at least 3	See product standard or at least 4 [c] or 2 [d]	See product standard or at least 1
Visual examination	101						
Sinusoidal and random vibration [e]	403						
Salt mist [f]	307						
Contact resistance - low level [g]	201						
Contact resistance at rated current [b, h, g]	202						
Visual examination	101						
Measurement of thickness of coating on contacts (except thermocouple contacts) [i]	508	3	3				
GROUP 3		2	2				
Unwrapping capability, solderless wrapped connections	425						
Soft solderability	501						
Solderability of contacts with self-contained solder and flux	514						
Measurement of thickness of contacts [i]	508						
Adhesion of coating on contacts [i]	509						

Tests	EN 2591-	Number of specimens per size		Breakdown of specimens wired with			
				maximum gauge		minimum gauge	
		Size 12 and smaller	Size 10 and larger	Size 12 and smaller	Size 10 and larger	Size 12 and smaller	Size 10 and larger
GROUP 4							
Mechanical endurance [j]	406			–	–	–	–
Plating porosity	507	4	4				

[a] All specimens of groups 1 to 10, before wiring.

[b] At ambient temperature.

[c] Sizes 16 and smaller - The samples are divided into two equal lots. In the test programme, one lot is subjected to all tests, except EN 2591-201, the other is subjected to all tests, except EN 2591-202.

[d] Sizes 14 and 12.

[e] Not applicable to barrel size 28 and smaller.

[f] Integrity of colour bands after test is not a requirement.

[g] Contacts shall be fitted into the connector and connectors shall be mated.

[h] At maximum temperature.

[i] The test on female contacts shall be carried out on non-assembled parts of the contact.

[j] Unwired contacts.

9.4.2 Type C contacts

See Table 13.

Table 13 — Qualification test for maintenance of qualification type C contacts

Group	EN 2591-	Number of specimens	Breakdown of specimens wired with	
			maximum gauge	minimum gauge
GROUP 0				
Visual examination	101	a	a	a
Examination of dimensions and mass	102			
GROUP 1				
Visual examination	101	12	6	6
Contact deformation after crimping	503			
Gauge insertion/extraction forces (female contacts)	418			
Rapid change of temperature	305			
Test probe damage (female contacts)	415			
Visual examination	101			
Gauge insertion/extraction forces (female contacts)	418			
Contact resistance - low level	201			
Contact bending strength	416			
Tensile strength (crimped connection)	417			
GROUP 2		Number of contacts shall be in relation with the connector arrangements		
Visual examination	101			
Contact deformation after crimping	503			
Gauge insertion/extraction forces (female contacts)	418			
Mechanical endurance	406			
Sinusoidal and random vibration	403			
Salt mist	307			
Gauge insertion/extraction forces (female contacts)	418			
Visual examination	101			
GROUP 3				
Contact/conductor joint ageing by current and temperature cycling	220	b	b	b

a All specimens of groups 1 and 3.

b Numbers of specimens, see EN 2591-220.

9.4.3 Type D contacts

See Table 14.

Table 14 — Qualification test for maintenance of qualification type D contacts

Tests	EN 2591-	Number of specimens
GROUP 0		
Visual examination	101	a
Examination of dimensions and mass	102	"
Magnetic permeability	513	"
Preparation of specimens	–	b
Visual examination	101	"
Contact deformation after crimping	503	
Contact resistance - low level [c]	201	
Contact resistance at rated current	202	
Gauge insertion/extraction forces (female contacts) [d]	418	
Measurement of insulation resistance	206	
GROUP 1		8
Rapid change of temperature	305	
Visual examination	101	
Measurement of insulation resistance	206	
Voltage proof test	207	
Contact resistance - low level [c]	201	
Contact resistance at rated current [e]	202	
Gauge insertion/extraction forces (female contacts) [d]	418	
Visual examination	101	
Tensile strength (crimped connection)	417	4
GROUP 2		8
Mechanical endurance	406	
Visual examination	101	
Sinusoidal and random vibration	403	
Salt mist [f]	307	
Visual examination	101	
Measurement of insulation resistance	206	
Voltage proof test	207	
Contact resistance - low level [c, g]	201	
Contact resistance at rated current [g, h]	202	
Gauge insertion/extraction forces (female contacts) [d]	418	
Visual examination	101	

Tests	EN 2591-	Number of specimens
GROUP 3		
Surface transfer impedance [i]	212	2
Shielding effectiveness from 100 MHz to 1 GHz [i]	213	
GROUP 4		
Soft solderability	501	4
Solderability of contacts with self-contained solder and flux	514	
Measurement of thickness of coating on contacts [j]	508	
Adhesion of coating on contacts [j]	509	

[a] All specimens of groups 1 to 4.
[b] All specimens of groups 1 to 3.
[c] Central and intermediate contacts only.
[d] Applicable to all inner, intermediate, outer female contacts.
[e] At ambient temperature.
[f] Integrity of colour bands after test is not a requirement.
[g] Contacts shall be fitted into the connector and connectors shall be mated.
[h] At maximum temperature.
[i] Contact to be wired.
[j] The test shall be carried out on non-assembled parts of the contact.

9.4.4 Type E contacts

See Table 15.

Table 15 — Qualification test for maintenance of qualification type E contacts

Tests	EN 2591-	Number of specimens
GROUP 0		
Visual examination	101	[a]
Examination of dimensions and mass	102	"
Magnetic permeability	513	"
Preparation of specimens	–	[b]
Visual examination	101	"
Contact deformation after crimping	503	
Contact resistance - low level [c]	201	
Contact resistance at rated current	202	
Gauge insertion/extraction forces (female contacts) [d]	418	
Measurement of insulation resistance	206	
Voltage Standing Wave Ratio (VSWR)	221	
Insertion Loss (I.L.)	222	
Measurement of characteristic impedance of a coaxial connector or contact	223	

Tests	EN 2591-	Number of specimens
GROUP 1		
Rapid change of temperature	305	
Visual examination	101	
Measurement of insulation resistance	206	
Voltage proof test	207	
Contact resistance - low level [c]	201	
Contact resistance at rated current [e]	202	8
Gauge insertion/extraction forces (female contacts) [d]	418	
Voltage Standing Wave Ratio (VSWR)	221	
Insertion Loss (I.L.)	222	
Measurement of characteristic impedance of a coaxial connector or contact	223	
Visual examination	101	
Tensile strength (crimped connection)	417	4
GROUP 2		
Mechanical endurance	406	
Visual examination	101	
Sinusoidal and random vibration	403	
Salt mist [f]	307	
Visual examination	101	
Measurement of insulation resistance	206	
Voltage proof test	207	
Contact resistance - low level [c, g]	201	8
Contact resistance at rated current [h, g]	202	
Gauge insertion/extraction forces (female contacts) [d]	418	
Voltage Standing Wave Ratio (VSWR)	221	
Insertion Loss (I.L.)	222	
Measurement of characteristic impedance of a coaxial connector or contact	223	
Visual examination	101	
GROUP 3		
Surface transfer impedance [i]	212	2
Shielding effectiveness from 100 MHz to 1 GHz [i]	213	

Tests	EN 2591-	Number of specimens
GROUP 4		4
Soft solderability	501	
Solderability of contacts with self-contained solder and flux	514	
Measurement of thickness of coating on contacts [j]	508	
Adhesion of coating on contacts [j]	509	

[a] All specimens of groups 1 to 4.

[b] All specimens of groups 1 to 3.

[c] Central and intermediate contacts only.

[d] Applicable to all inner, intermediate, outer female contacts.

[e] At ambient temperature.

[f] Integrity of colour bands after test is not a requirement.

[g] Contacts shall be fitted into the connector and connectors shall be mated.

[h] At maximum temperature.

[i] Contact to be wired

[j] The test shall be carried out on non-assembled parts of the contact.

10 Designation and marking

10.1 Designation

See product standards.

Contact size codes and barrel size codes, see Tables 16 and 17. Code and delivery conditions for contacts D and E, see Table 18.

Table 16 — Contact size codes

Contact size	Code
24	24
23	23
22	22
20	20
16	16
14	14
12	12
10	10
8	08
6	06
5	05
4	04
2	02
1	01
0	1A
2/0	2A
4/0	4A

Table 17 — Barrel size codes

Barrel size	Code
26	26
24	24
22	22
20	20
18	18
16	16
14	14
12	12
10	10
8	08
6	06
4	04

Table 18 — Code and delivery conditions for contacts D and E

Code	Delivery conditions
A	Without sleeve
B	With shrinkable sleeve
C	With sealing sleeve

10.2 Marking

See EN2424 style F.

The contacts shall be permanently and legibly marked with the manufacturer's symbol in a non-function area at a place chosen by the manufacturer and, in the case of cylindrical contacts, colour identification in accordance with ISO 8843, unless otherwise specified in the product standard. All markings shall remain legible after all tests. When specific identification is necessary, such as high temperature requirement, it shall be specified in the product standard.

The manufacturer's identifications are listed TR 3198.

11 Delivery conditions

The delivery conditions of types D and E contacts are indicated by the product standard.

12 Packaging

The contacts shall be packed in a rigid box to prevent damage. A label inserted in the box shall state the identification, date/code and quantity of contacts.

13 Storage

Storage shall be in a place free from ultraviolet rays.

Every five years, an inspection shall be made in accordance with test EN 2591-101.

The date of inspection shall be marked on the new packaging.

Contacts shall be stored under the following ambient conditions:

— Temperature: from 10 °C to 30 °C,

— Relative humidity: from 20 % to 80 %,

— Pressure: 950 mbar to 1 050 mbar.

Annex A
(normative)

Symbols of contact sizes in contact arrangement drawings

Table A.1

Contact size	Type of contact			
	Standard	Coaxial	Triaxial	Quadrax
23	—	—	—	—
22 [a]		—	—	—
20		—	—	—
16			—	—
14	—	—	—	—
12			—	—
10				—
8				
6		—	—	—
5	—		—	—
4		—	—	—
2		—	—	—
1			—	—
0		—	—	—
2/0		—	—	—
4/0		—	—	—

[a] Equivalent to US contact size 22D.

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