BS EN 4644-001:2012

BSI Standards Publication

Aerospace series — Connector, electrical and optical, rectangular, modular, rectangular inserts, operating temperature 175 °C (or 125 °C) continuous

Part 001: Technical specification

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National foreword

This British Standard is the UK implementation of EN 4644-001:2012.

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.

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Date	Text affected

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English Version

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Série aérospatiale - Connecteur, électrique et optique, rectangulaire, modulaire, à inserts rectangulaires, température de fonctionnement 175 °C (ou 125 °C) continu - Partie 001: Spécification technique

Luft- und Raumfahrt - Elektrische und optische Rechtecksteckverbinder, modular, rechteckige Kontakteinsätze, Dauerbetriebstemperatur 175 °C (oder 125 °C) konstant - Teil 001: Technische Lieferbedingungen

This European Standard was approved by CEN on 6 August 2011.

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EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document (EN 4644-001:2012) has been prepared by the Aerospace and Defence Industries Association of Europe - Standardization (ASD-STAN).

This standard was reviewed by the Domain Technical Coordinator of ASD-STAN's Electrical Domain.

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of an identical text or by endorsement, at the latest by November 2012, and conflicting national standards shall be withdrawn at the latest by November 2012.

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Introduction

The connectors defined by this standard are suitable for use on board of commercial and military aircraft for both disconnect panel and rack and panel applications in severe environmental conditions.

1 Scope

This European Standard specifies the required characteristics, the condition for qualification, acceptance and quality assurance for electrical and optical rectangular connectors with single or multiple removable rectangular inserts for use in a temperature range from – 65 °C to 175 °C continuous for electrical contact.

This family of connectors is particularly suitable for aeronautic use in zones of severe environmental conditions on board aircraft, applying EN 2282.

Inserts for fiber optic contacts or mixing fiber optic contacts and electrical contacts are described in EN 4639-002.

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 2266-003, *Aerospace series — Cables, electrical, for general purpose — Operating temperatures between − 55 °C and 200 °C — Part 003: Ink jet printable — Product standard*

EN 2282, *Aerospace series — Characteristics of aircraft electrical supplies*

EN 2591 (all parts), *Aerospace series — Elements of electrical and optical connection — Test methods*

EN 3155-001, *Aerospace series — Electrical contacts used in elements of connection — Part 001: Technical specification*

EN 3155-002, *Aerospace series — Electrical contacts used in elements of connection — Part 002: List and utilization of contacts*

EN 4530-002, *Aerospace series — Sealing sleeves used in elements of connection — Part 002: List and utilization of sealing sleeves*

EN 4639-002, *Aerospace series — Connectors, optical, rectangular, modular, multicontact, 1,25 diameter ferrule, with removable alignment sleeve holder — Part 002: List of product standards*

EN 4644-002, *Aerospace series — Connector, electrical and optical, rectangular, modular, rectangular inserts, operating temperature 175 °C (or 125 °C) continuous — Part 002: Specification of performance and contact arrangements*

EN 9100, *Quality Management Systems — Requirements for Aviation, Space and Defence Organizations*

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

MIL-HDBK-454B, *General guidelines for electronic equipment* [1)]

SAE AS31971, *Connectors, high reliability, space use, general specification for* [2)]

SAE AS39029/1, *Installing and removal tools, connector electrical contact, general specification for* [2)]

3 Terms and definitions

For the purposes of this document, the definitions given in EN 2591-100 apply.
The reference planes and axis used in this product standard are listed below:

Ap : shell bottoming reference plane on male housing.

Ar : shell bottoming reference plane on female housing.

Bp : vertical axis of male housing

Br : vertical axis of female housing

Cp : horizontal axis of male housing

Cr : horizontal axis of female housing

DAC: disconnect aligning housing cavity

DNC: disconnect non aligning housing cavity

N : extremity of insert retention clip reference plane

P : front face of hard insert

R : vertical axis of housing backshell interface

RAC: rack & panel aligning housing cavity

RNC: rack & panel non Aligning housing cavity

S : horizontal axis of housing backshell interface

T : backshell bottoming reference plane on housing

X : horizontal axis of insert

Y : vertical axis of insert

1) Published by: DoD National (US) Mil. Department of Defense http://www.defenselink.mil/

2) Published by: SAE National (US) Society of Automotive Engineers http://www.sae.org/

4 Description

4.1 General

This family of connectors is divided into two types of connectors which are the following:

— disconnect panel connectors;

— rack and panel connectors.

The current revision of this standard is describing two disconnect panel housing sizes and one rack and panel housing size. However, it is also providing a design rule to extend the current range described. The design rule is based on the description of housing aligning cavities, housing non aligning cavities and a clinging dimension line; see 4.2 and 4.3 for details.

These connectors have rectangular housings, removable rectangular inserts and contacts and can be fitted with rear accessories. Male and female inserts can be fitted either in the male or female housing.

Depending on the housing size, the disconnect panel connectors are mated and unmated either by using a centre coupling screw or two quarter turn fasteners.

The centre coupling screw and coupling nut can be installed either on the male or female housing.

The centre coupling mechanism shall provide a total of 12 polarization positions.

Housings having the quarter turn fasteners are polarized by using two polarizing posts and keys offering a total of 16 polarizing positions.

A size 1 housing has one insert cavity with one keyway, a quarter turn fastener and two polarizing posts or keys.

A size 2 housing has two insert cavities with one cavity having one keyway and the other having two keyways; a central coupling mechanism provides housing polarization.

There is two rack and panel (blind mate) connector housing sizes; it is a size three housing and a size four housing which have respectively three and four insert cavities all with one keyway, three polarizing posts or keys offering 64 polarizing positions and no locking mechanism.

In addition to this rack and panel use, the size four male connector can be mated with two size 2 female connectors in a disconnect application by using two centre coupling mechanisms.

These connectors use different types of contacts (signal, power, coaxial, triaxial, quadrax, etc.) see EN 3155-002 and optical contacts see EN 4639-002.

4.2 Female housing

4.2.1 General

Size 1 and 3 female housing shall be attached by rectangular flange with two mounting holes, size 3 housing has floating eyelet mounting holes or through holes. The size 3 housing has four pins, each of which can take two positions, to polarize the shell with the panel on which it is mounted.

Size 4 female housing shall be attached by rectangular flange with two or three mounting holes, Size 4 housing has four pins, each of which can take two positions, to polarize the shell with the panel on which it is mounted.

Size 2 female housing are either panel mount connector or cable connector. Panel mount receptacle connector shall be attached by rectangular flange with two mounting holes.

The insert cavities are identified on the female housing by letters A, B, C, D for size 4, letters A, B, C for size 3 letters, A, B for size 2 and no letter for size 1.

The insert cavities are polarized by either one (A polarizing position) or two keyways (B polarizing position) location. Housing size 1, 3 and 4 insert cavities have one keyway. Housing size 2 insert cavity identified with letter A has one keyway and insert cavity identified with letter B has two keyways.

Each insert cavity has two insert retaining devices allowing rear insertion and rear release of the insert.

Each female housing has a grounding device ensuring electrical continuity between housings before contact mating.

In addition, size 1 and 2 female housings are available with a grounding block (classes B and F) or without a grounding block (classes A, C and E) allowing grounding of a cable braid with a pigtail.

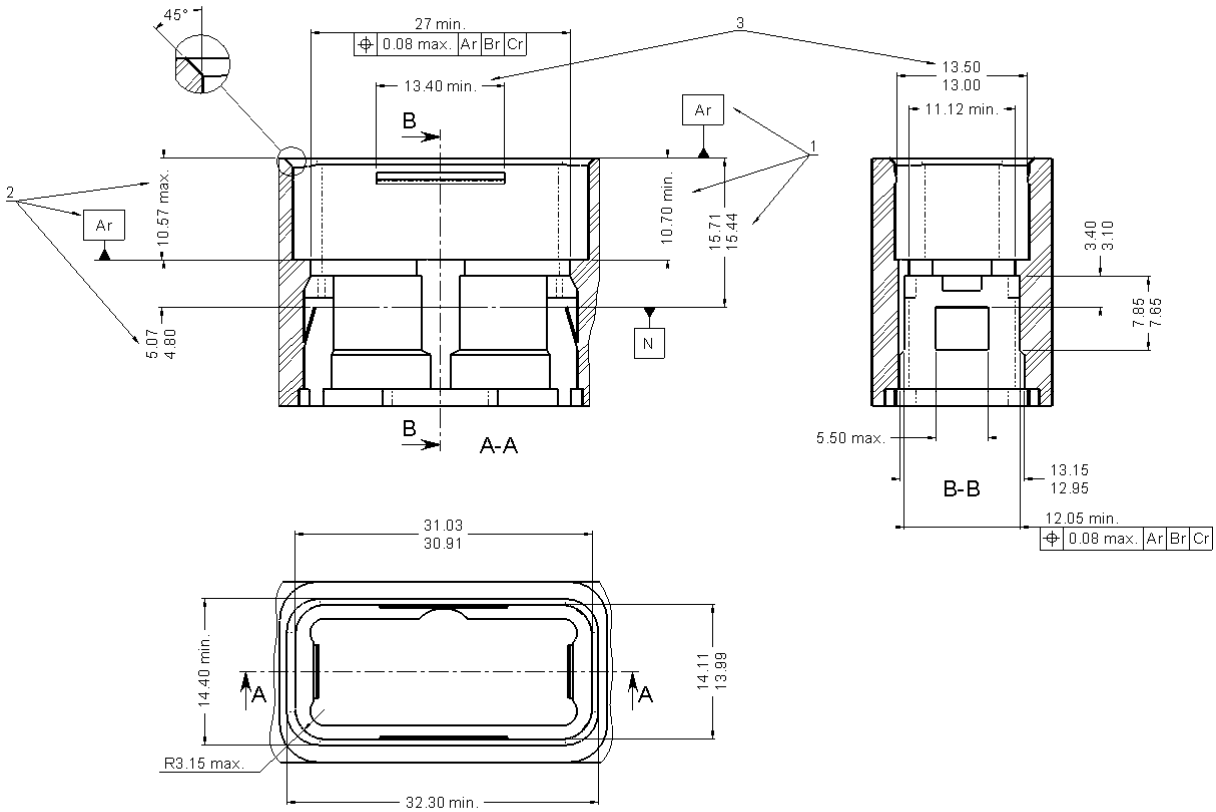
For each female housing, some cavities are aligning cavities and other cavities are non aligning.

Aligning cavities guaranty not only the alignment between male and female housing but also guarantee the shell to shell bottoming.

Non aligning female housing cavities have a circular location tolerance.

In order to define how alignment of the female and male housing is achieved a dimension line between the two housing aligning cavities is defined.

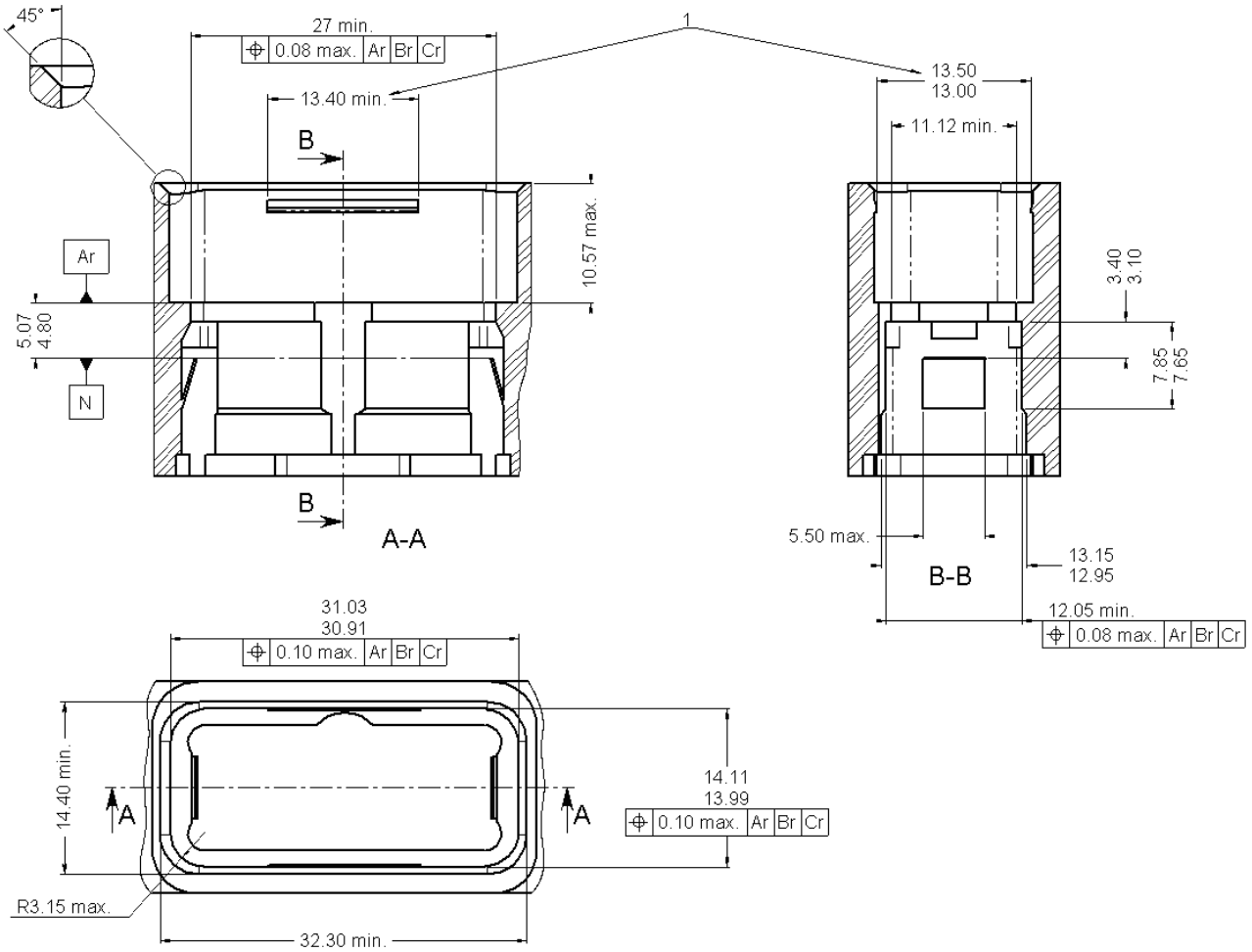
4.2.2 Disconnect panel female housing alignment



Key

1 Dimensions for housing size 1
2 Dimension for housing size n (n > 1)
3 Dimension of grounding device (optional)

Figure 1 – Disconnect panel female aligning cavity (DAC)

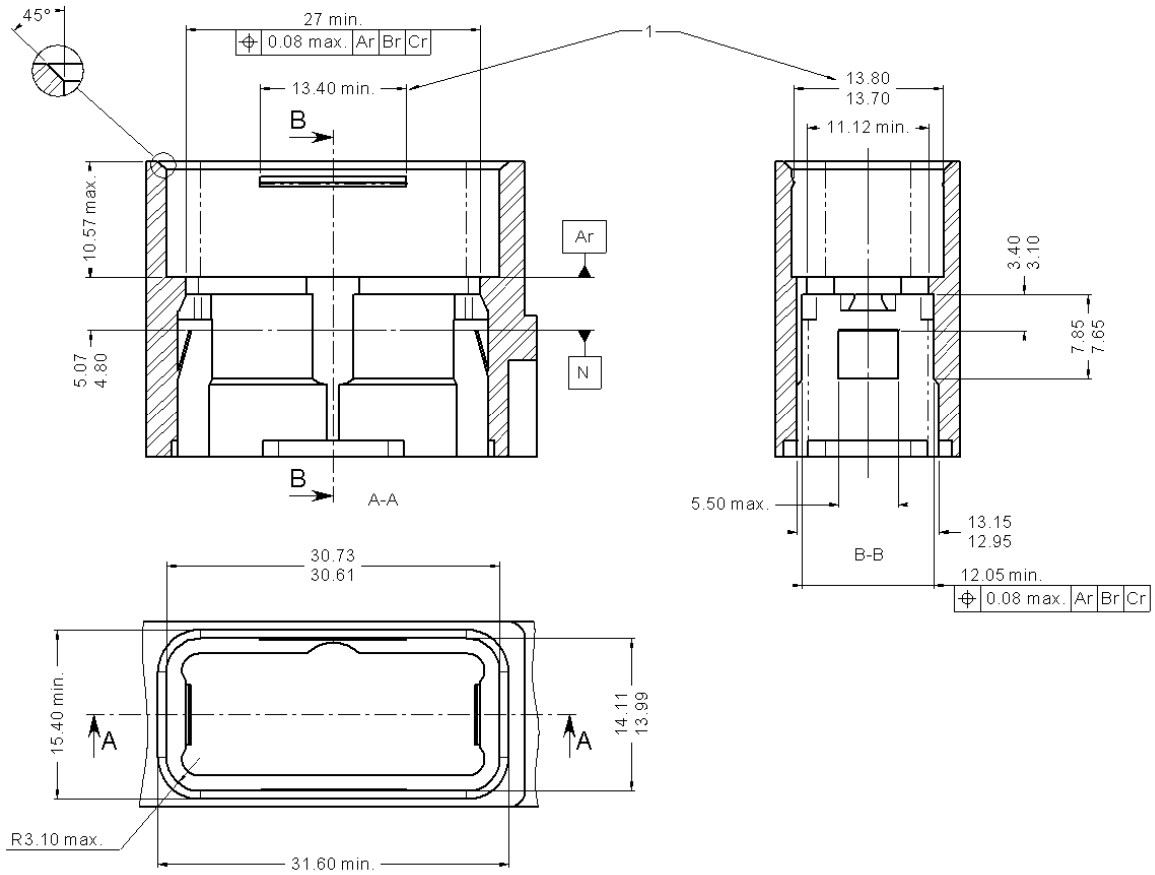


Key

1 Dimension of grounding device (optional)

Figure 2 — Disconnect panel female aligning cavity (DNC)

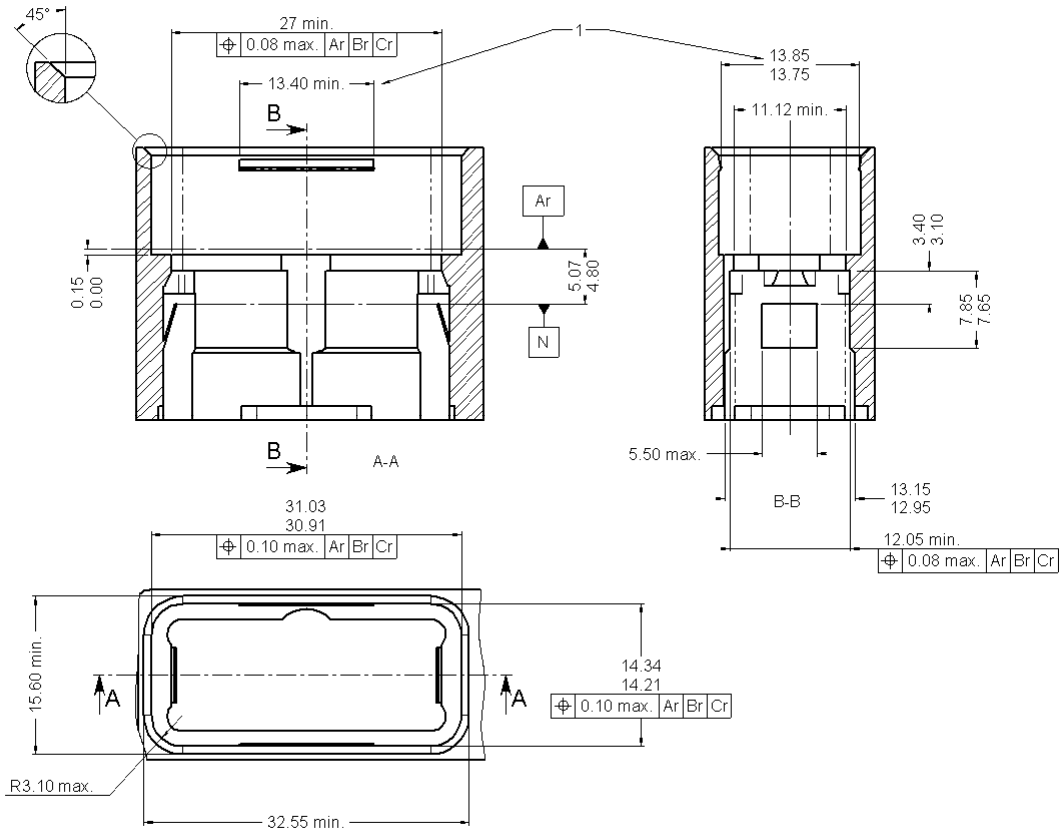
4.2.3 Rack and panel female housing



Key

1 Dimension for grounding device

Figure 3 — Rack and panel female aligning cavity (RAC)



Key

1 Dimension for grounding device (optional)

Figure 4 — Rack and panel female non aligning cavity (RNC)

4.3 Male housing

4.3.1 General

Size 1, 3 and 4 male housing shall be attached by rectangular flange with two mounting holes;

Size 2 male housing are either panel mount connector or cable connector. Panel mount connector shall be attached by rectangular flange with two mounting holes.

The insert cavities are identified on the male housing by letters A, B, C, D for size 4, letters A, B, C for size 3, letters A, B for size 2 and no letter for size 1.

The insert cavities are polarized by either one or two keyways location. Housing size 1, 3 and 4 insert cavities have one keyway. Housing size 2 insert cavity identified with letter A has one keyway and insert cavity identified with letter B has two keyways.

Each insert cavity has two insert retaining devices allowing rear insertion and rear release of the insert.

Size 1 and 2 male housings are available with (classes B and F) or without a grounding block (classes A, C and E) allowing grounding of a cable braid with a pigtail.

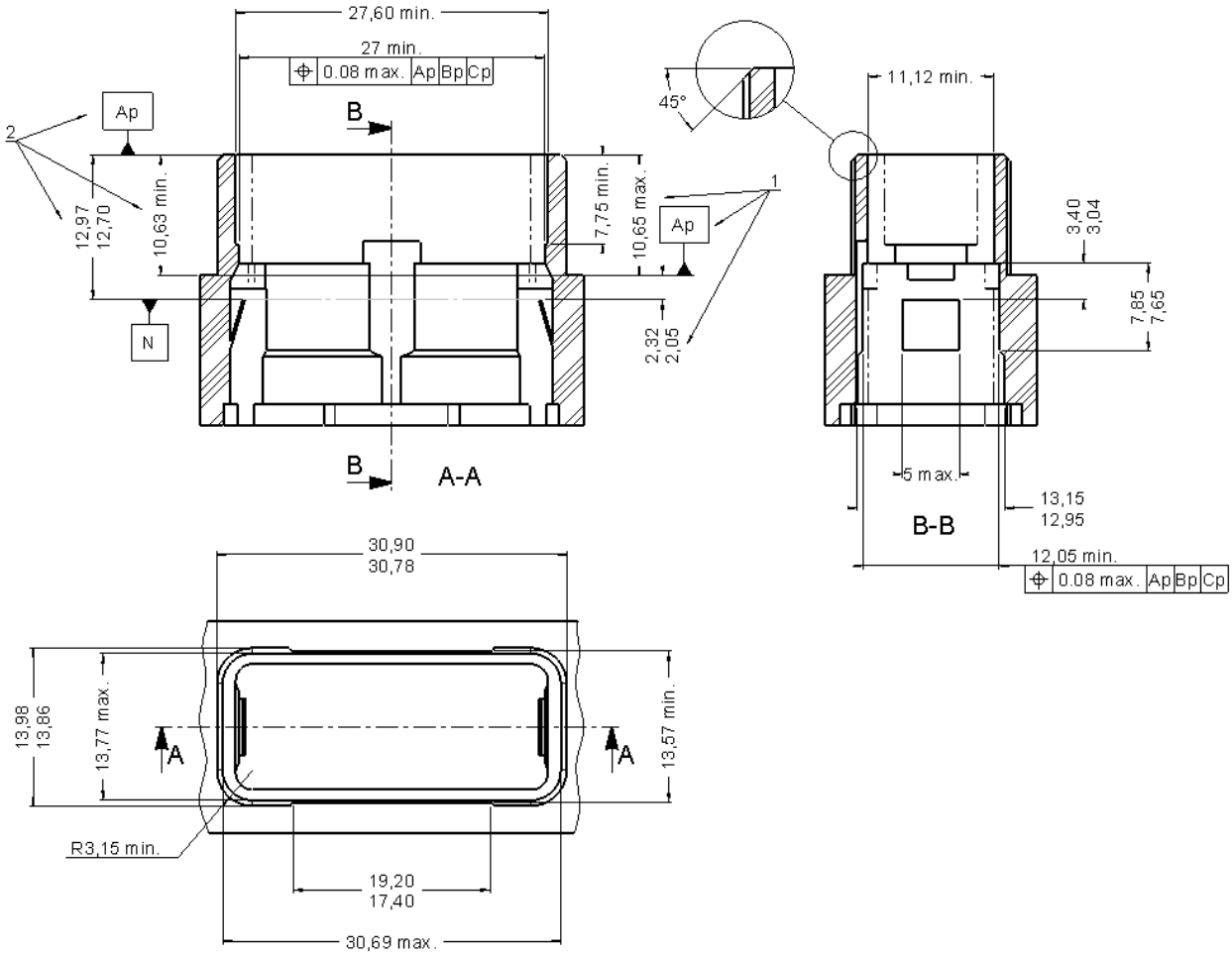
All male housing have a minimum of one (for single cavity connectors) and a maximum of two aligning housing cavities (see Figure 5 and Figure 7); the remaining housing cavities are non aligning cavities (see Figure 6 and Figure 8).

Aligning cavities guaranty not only the alignment between male and female housing but also guarantee the shell to shell bottoming.

Non aligning housing cavities have a circular location.

In order to define how alignment of the female and male housing is achieved a clinging dimension line between the two housing aligning cavities is defined.

4.3.2 Disconnect panel male housing



Key

1 Dimension for housing size 1

2 Dimension for housing size n (n > 1)

Figure 5 — Disconnect panel male aligning cavity (DAC)

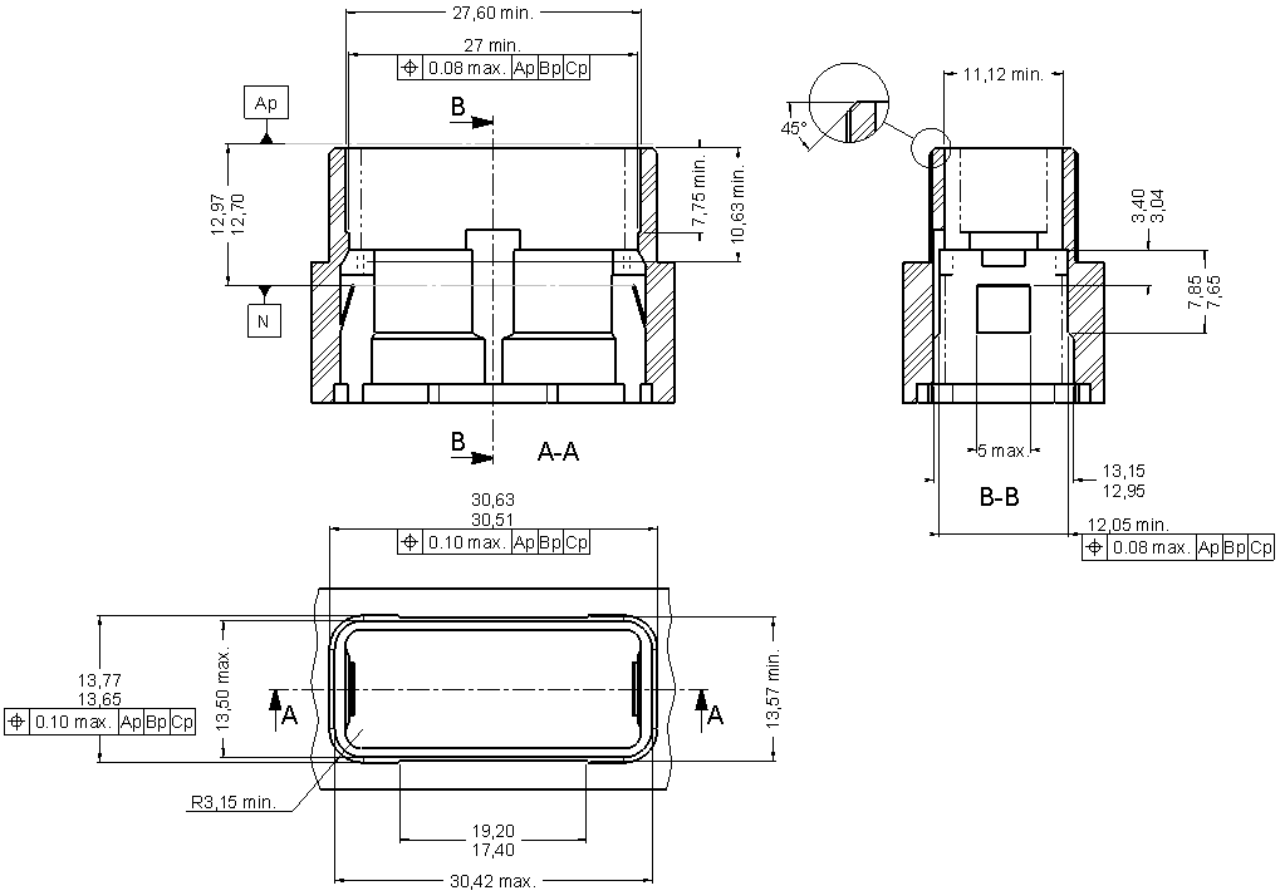


Figure 6 — Disconnect panel male non aligning cavity (DNC)

4.3.3 Rack and Panel male housing

See Figure 7 and Figure 8.

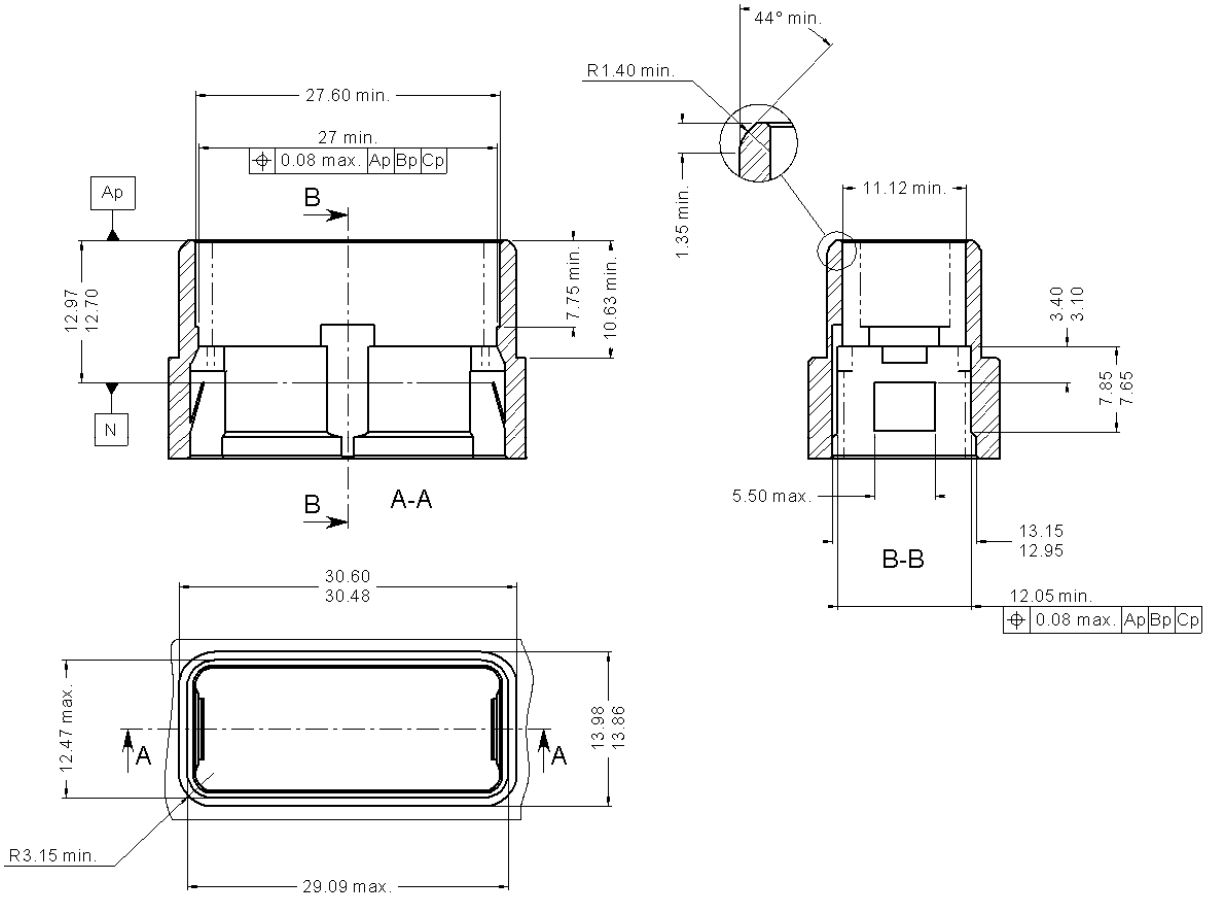


Figure 7 — Rack and panel male aligning cavity (RAC)

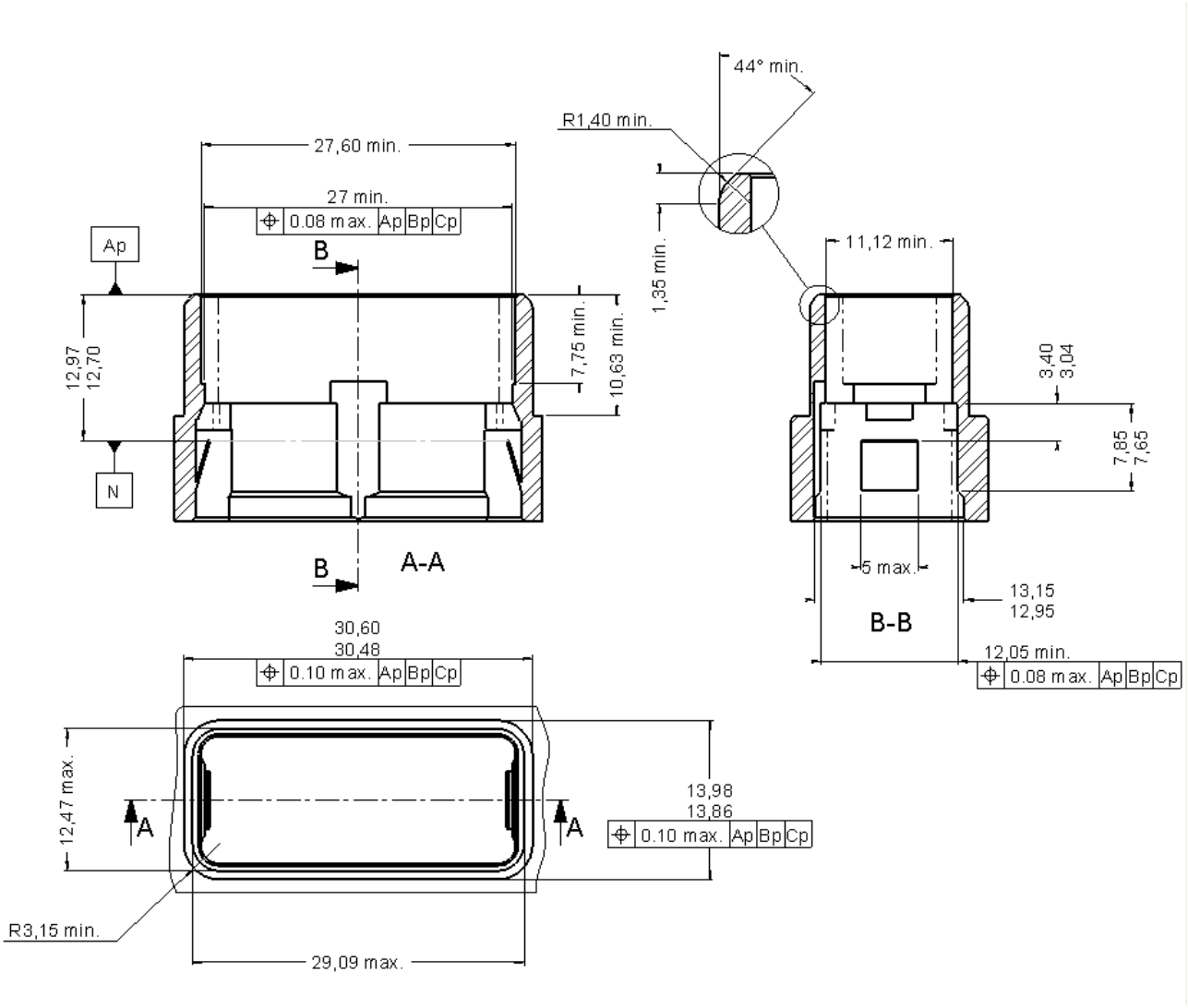


Figure 8 — Rack and panel male non aligning cavity (RNC)

4.4 Rear accessories

See EN 4644-002.

4.5 Inserts

The insert assembly shall be single-bloc type design complete with contact retention systems and appropriate seals.

The female inserts use female contacts and male inserts use male contacts. These inserts use contacts of size 22, 20, 16, 12, 8 and 5. The inserts are rear release rear removable from the housing. Male and female inserts can be installed either in the male or female housing.

There are inserts with one polarizing rib (A polarizing position) and inserts with two polarizing ribs (B polarizing position). This means that there are inserts dedicated to housing cavities with one keyway and inserts dedicated to housing cavities with two keyways. See Table 1 below.

Table 1

Shell size	**1**	**2**		**3**			**4**			
Shell cavity labeling	None	A	B	A	B	C	A	B	C	D
Insert polarization	A	A	B	A	A	A	A	A	A	A

A blank insert is installed in a housing cavity where no contact is required. This blank insert has no polarizing rib and the same dimensions as an insert for pin contacts. It can be installed in any male or female housing cavity. This blank insert can mate without causing any interference with an insert for male contacts or with an insert for female contacts. The blank insert does not provide sealing.

4.6 Keying mechanism

Size 1, 3 and 4 housings have a polarizing system using polarizing posts having a L shape cross section and polarizing keys having a L shape cavity to mate with the polarizing posts. Each polarizing post and key provides 4 polarizing positions. Each post and key is retained in the housing by a special shape which allowed them to be clipped in the housing.

Size 1 housings have two polarizing pins offering 16 polarizing positions.

Size 3 and 4 housings have three polarizing pins offering 64 polarizing positions.

The size 2 housing has either a centre coupling screw or coupling nut which ensure also the polarizing function. The coupling screw has a coding peg and the coupling nut has a coding slot. The centre coupling screw and nut have an hexagonal shoulder which slides in an hexagonal print in the housing, consequently, the coupling screw or nut can take 6 positions. The coding peg on the coupling screw and the slot on the coupling nut can be vertically aligned with an angle or a flat of the hexagonal shoulder. There are two types of coupling screw and coupling nut, those having the coding peg or the slot aligned with a flat and those for which it is aligned with an angle of the hexagonal shoulder. These two types of coupling screw and nut provide a total of 12 polarizing positions.

The size 4 male connector can have two centre coupling screw or coupling nut in order to be mated with two size 2 disconnect female connectors.

4.7 Dust caps

See EN 4644-002.

4.8 Materials and surface treatment

4.8.1 General

When dissimilar metals are in close contact, adequate protection against corrosion shall be used in order to make sure that the electromotive force of the cell shall not exceed 0,25 V.

4.8.2 Housings

The material of the housing shall be aluminium alloy or composite. When aluminium is used, it shall be protected with nickel plating or aluminium chromatation (see EN 4644-002). Composite housings are nickel plated.

4.8.3 Contacts

Removable contacts (see EN 3155-002).

4.8.4 Non-metallic materials

The material used for composite housings, polarizing posts and keys, inserts, seals, dust covers and grommets shall have mechanical characteristics consistent with the required use.

5 Design

5.1 Housings

The connector housing shall be a one piece construction. Each housing cavity shall be fitted with two retaining device to provide insert retention.

If the receptacle housing has a grounding device per housing cavity, it shall provide electrical contact between housings before probability of electrical contact.

The housing shall accommodate rear accessories. The accessories shall be fixed by screw on the rear side of the connector.

The quarter turn fasteners and the centre coupling mechanism shall be designed so that the connectors mate when it is rotated clockwise and unmate when it is rotated counter clockwise. The quarter turn fasteners and central jackscrew shall have a hexagonal socket head screw compatible with the coupling torque values defined in the product standard.

5.2 Inserts

Inserts shall be made of a rigid dielectric material or metallic when specified; elastomeric material for sealing parts. Cross sections and angle radii shall be sufficient to ensure that no cracking, chipping or breakage can occur in normal use.

There are two types of inserts:

— Inserts with one polarizing rib;

— Inserts with two polarizing ribs.

Inserts with one polarizing rib shall fit the cavities of housing size 1, 3, 4 and cavity A of housing size 2.

Inserts with two polarizing ribs shall fit the cavity B of housing size 2.

The inserts shall be rear removable from the housing and shall be mechanically retained in the housing. The removal of an insert shall be done by using the tool described in product standard (see EN 4644-002). An insert is installed in the housing by hand, it is a rear snap in insert.

The mating face of the insert shall ensure that sealing is provided when connectors are mated together. The interfacial seal shall be on the insert having male contacts and shall not be removable.

The rear grommet shall permit sealing for all cable diameters indicated in EN 4644-002 and shall not be removable.

For size 5 and height contacts, the insert contact cavity and the grommet shall accept the sealing boots described in EN 4530-002.

The mechanical contact retention system shall be integrated in the rigid part of the insert.

Connectors shall be designed to allow the insertion and removal of individual contacts without having to remove the insert from the housing. Inserts shall be designed for rear release rear removable contacts. Insertion, extraction tools are specified in EN 3155 product standards.

There are three environmental categories of inserts:

— environmental inserts (with grommet and interfacial seal);

— non environmental inserts (without grommet and interfacial seal);

— Semi environmental inserts (with an interfacial seal and without grommet).

5.3 Connector mating sequence

The mating sequence shall be the following:

— shell to shell engagement and ESD discharge;

— polarizing;

— locking system;

— grounding device system;

— electrical contacts;

— sealed interface compression;

— metal to metal or composite shell to shell bottoming.

6 Dimensions and masses

The general dimensions and masses are given in the product standard.

6.1 Disconnect panel connectors

6.1.1 Female and male mating dimensions

6.1.1.1 Size 1 disconnect panel connectors

See Figure 9 to Figure 11.

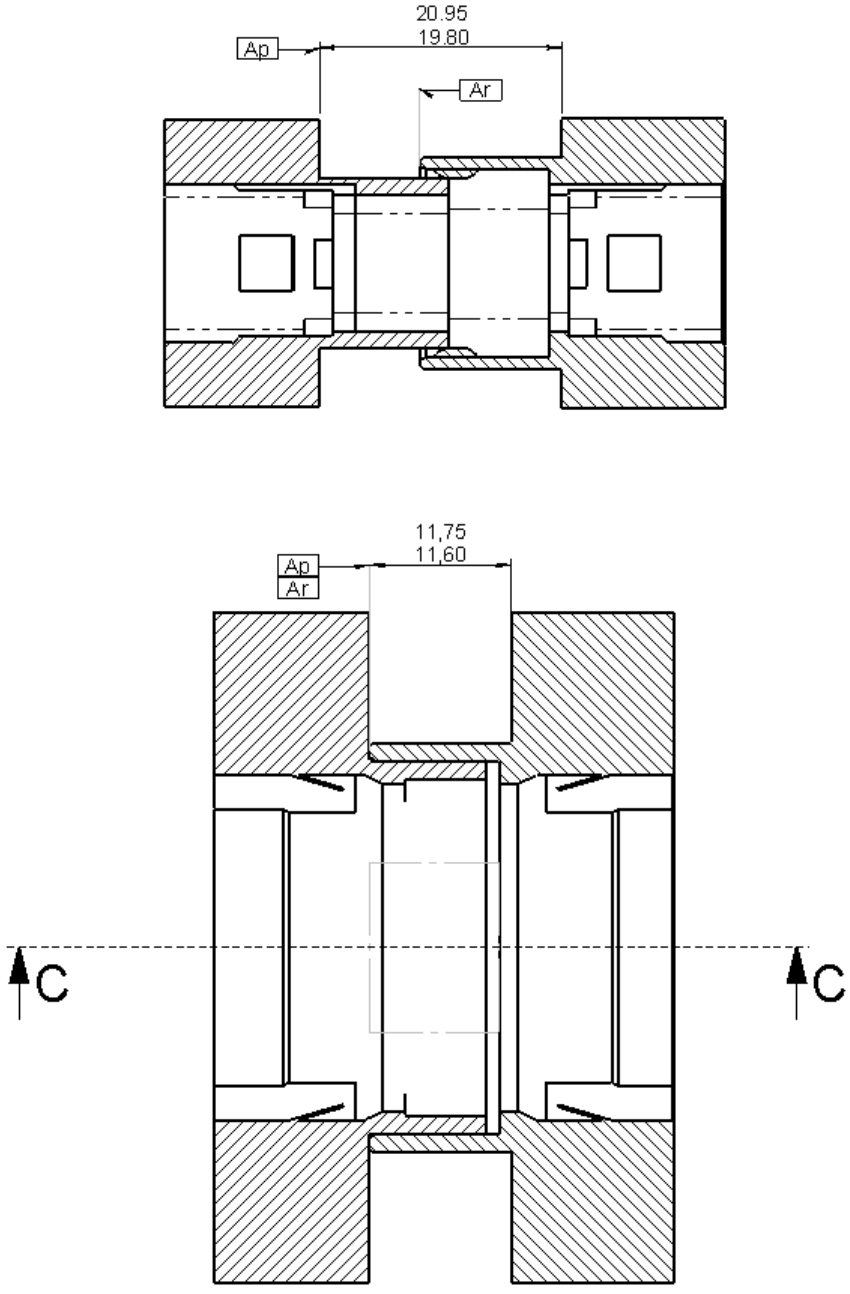
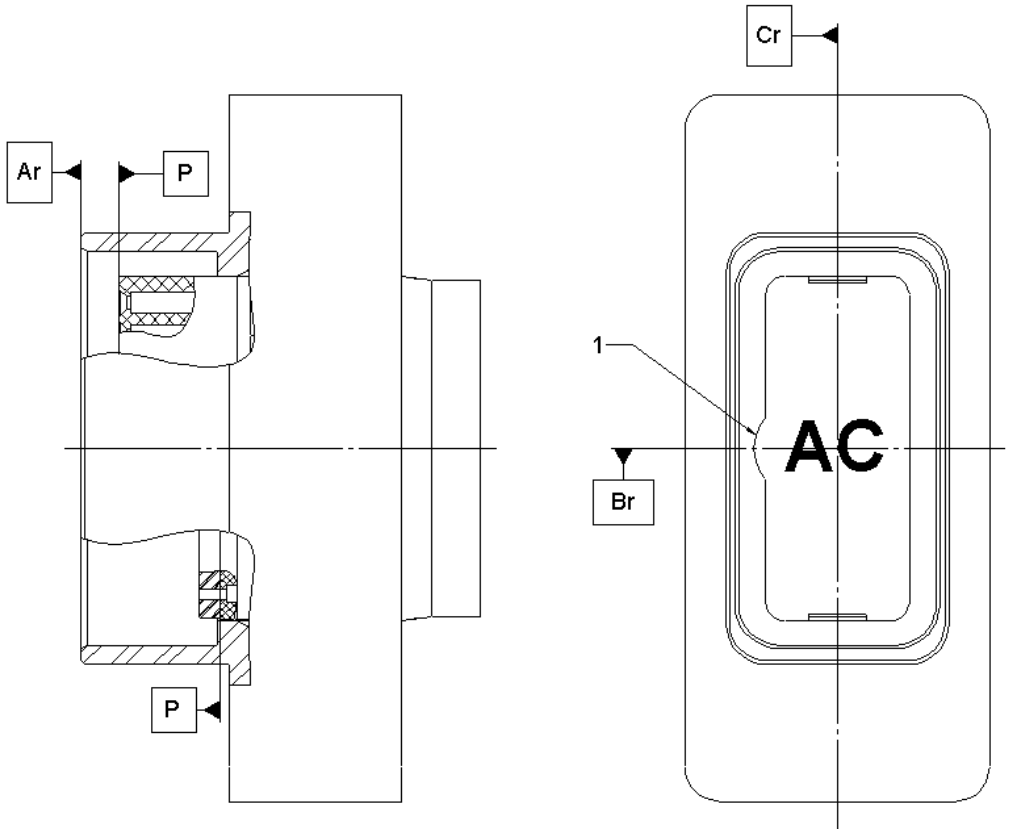


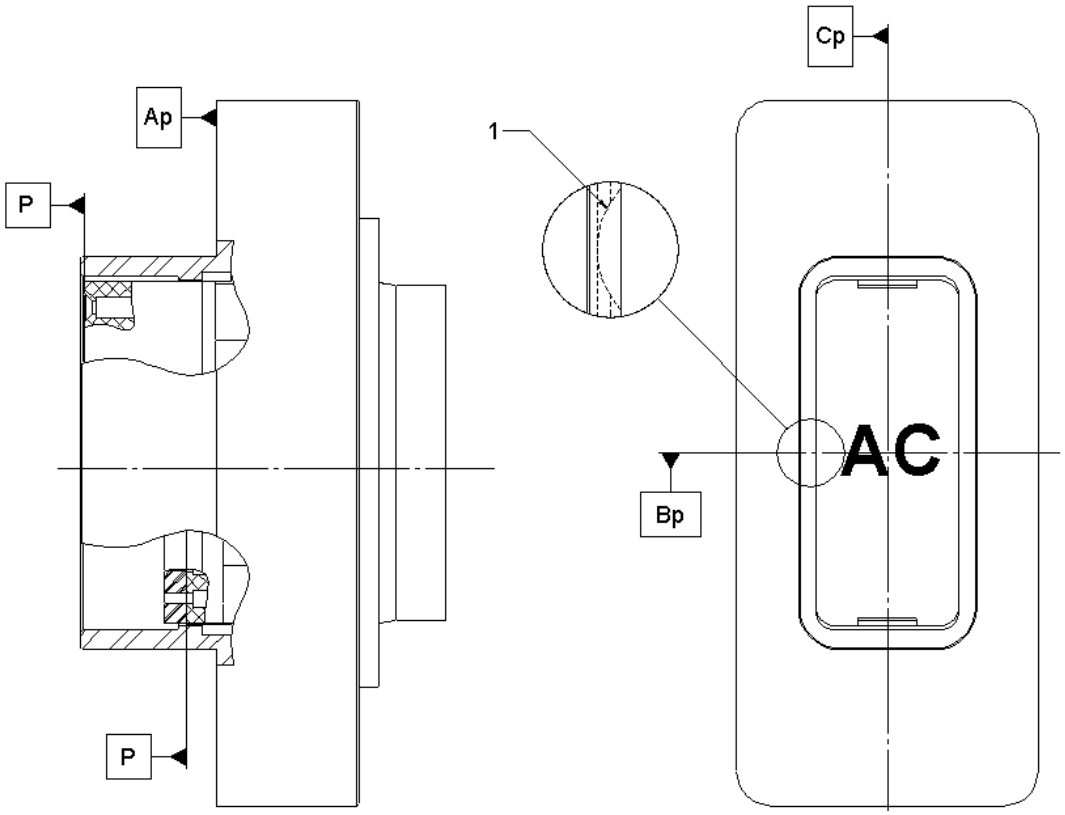
Figure 9 — Mating dimensions



Key

1 A keying

Figure 10 — Female housing



Key

1 A keying

Figure 11 — Male housing

6.1.1.2 Size 2 disconnect panel connectors

See Figure 12 to Figure 14.

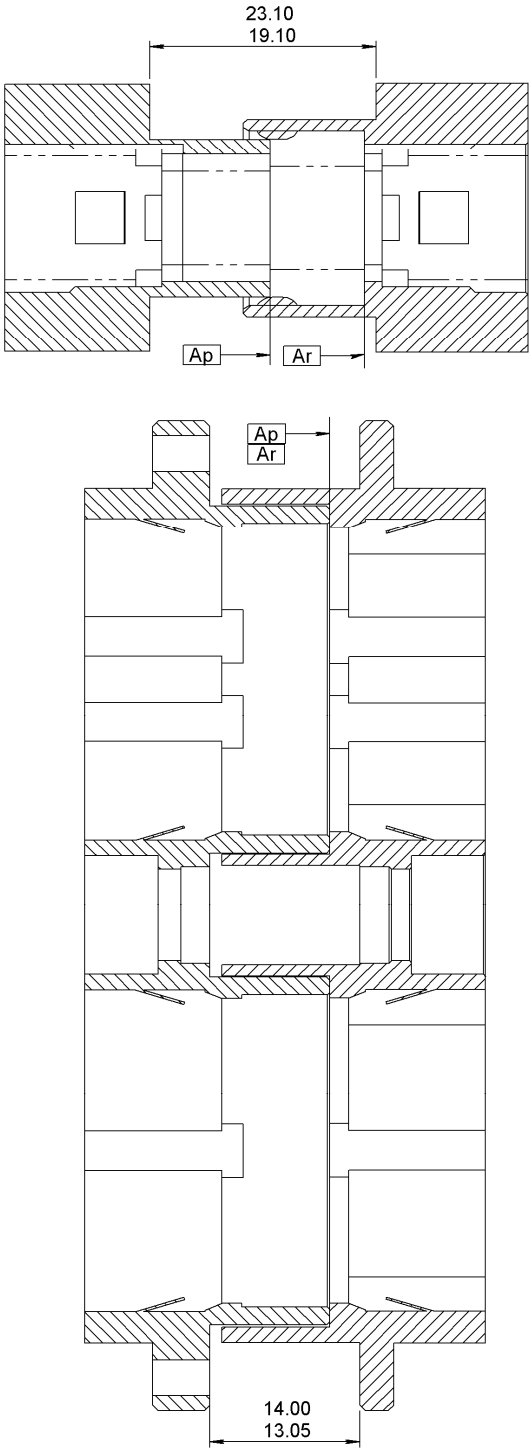
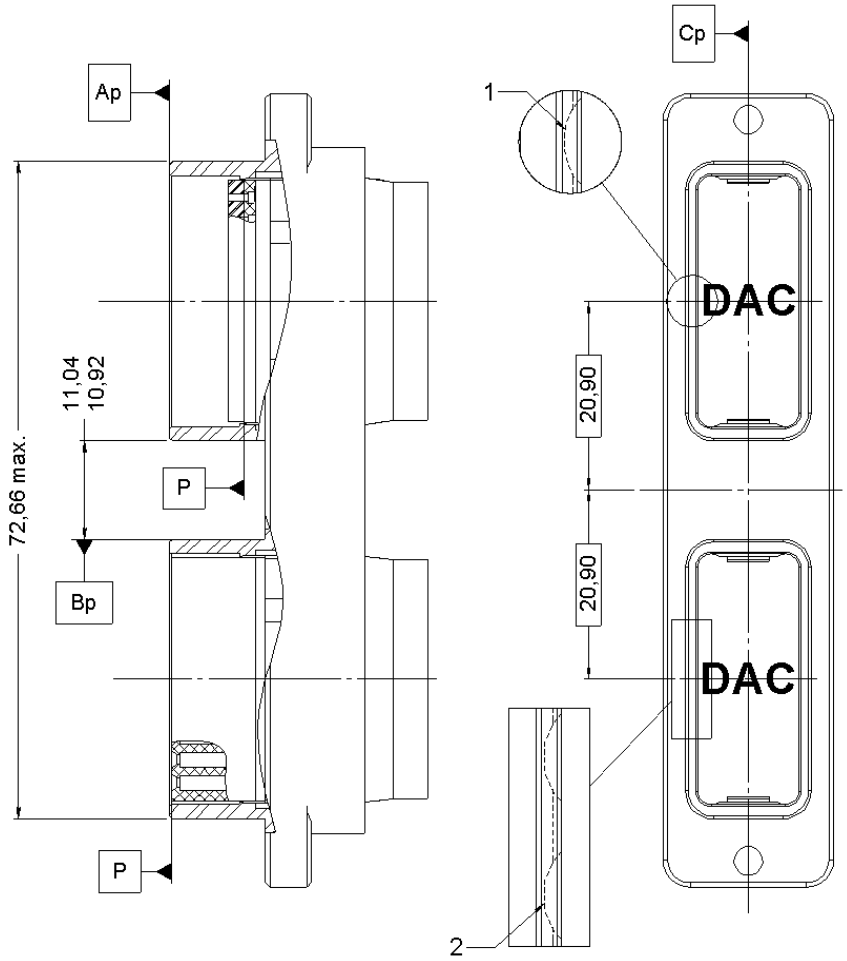


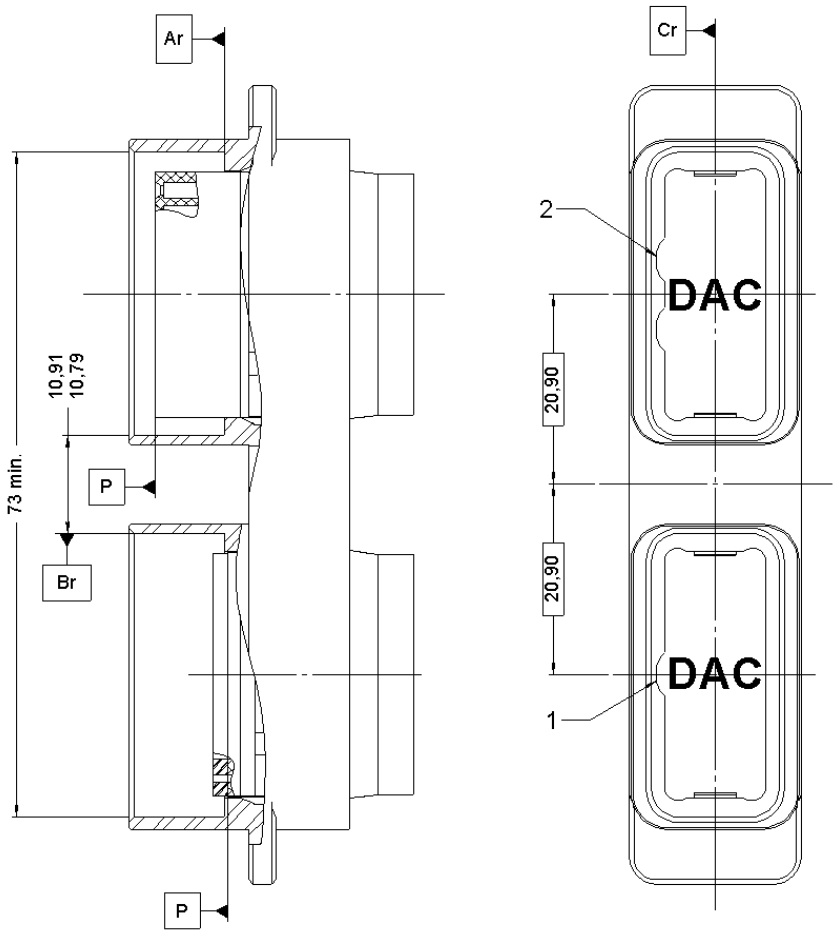
Figure 12 — Mating dimensions



Key

1 A keying
2 B keying

Figure 13 — Male housing



Key

1 A keying
2 B keying

Figure 14 — Female housing

6.1.1.3 Size 2 female disconnect connectors mated with size 4 male disconnect connectors

See Figure 15.

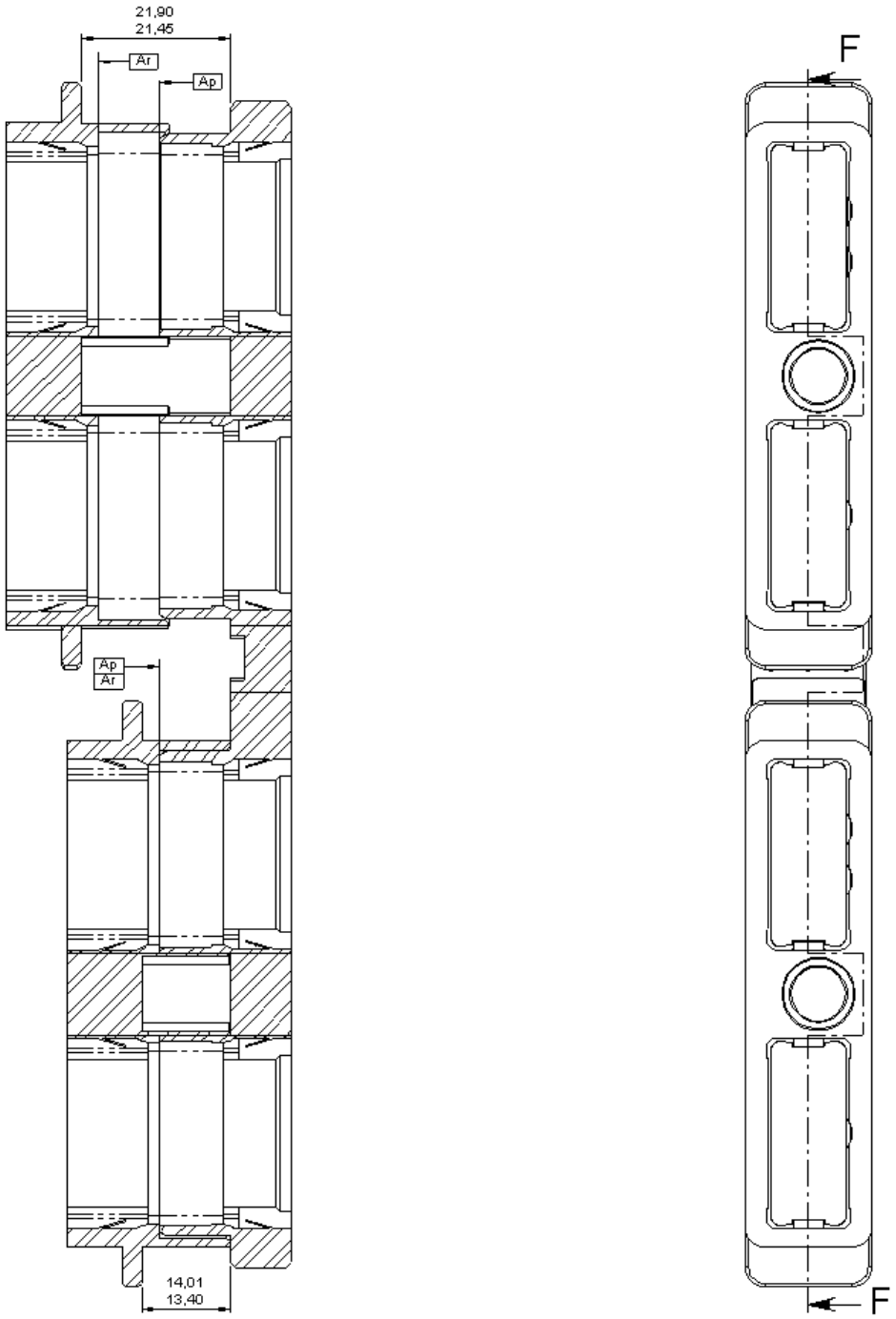
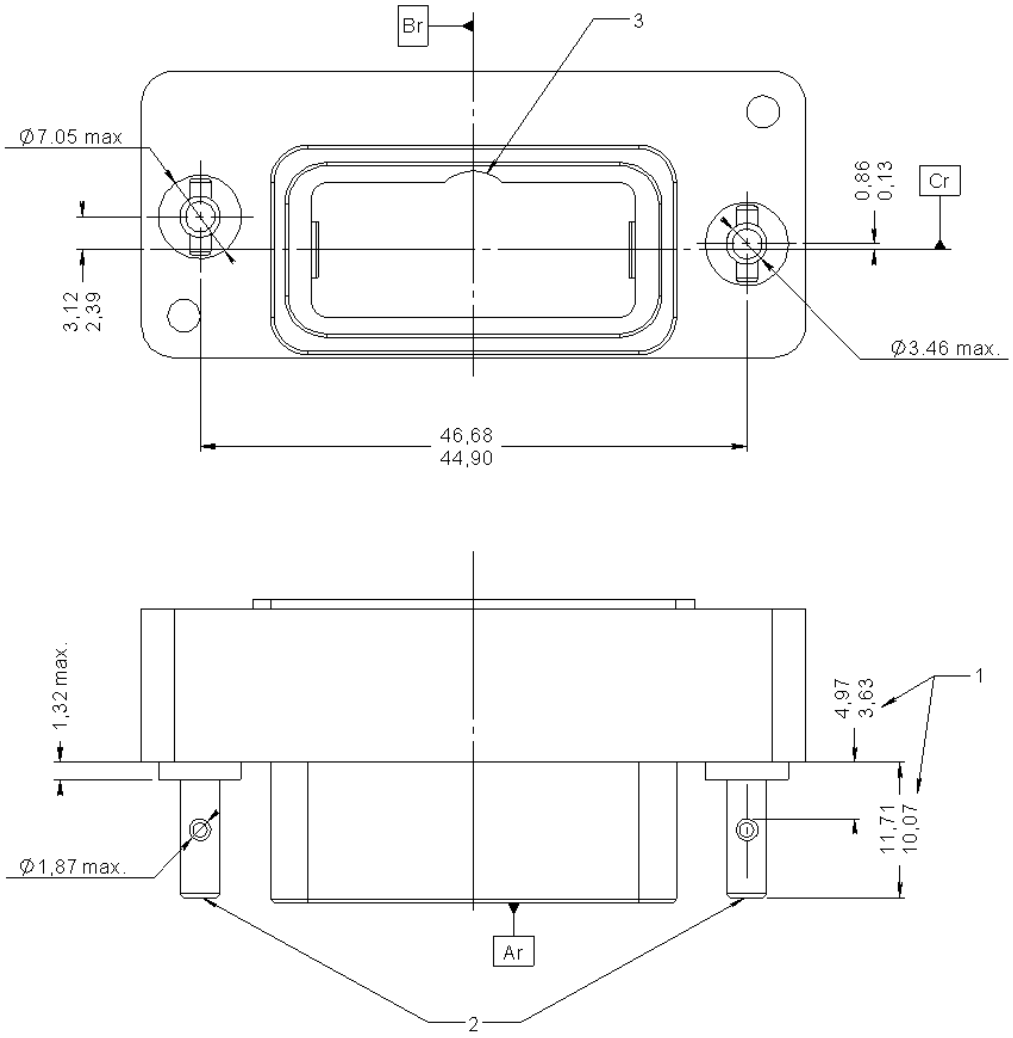


Figure 15 — Mating dimensions

6.1.2 Housing size 1 locking system

6.1.2.1 Female housing

See Figure 16.



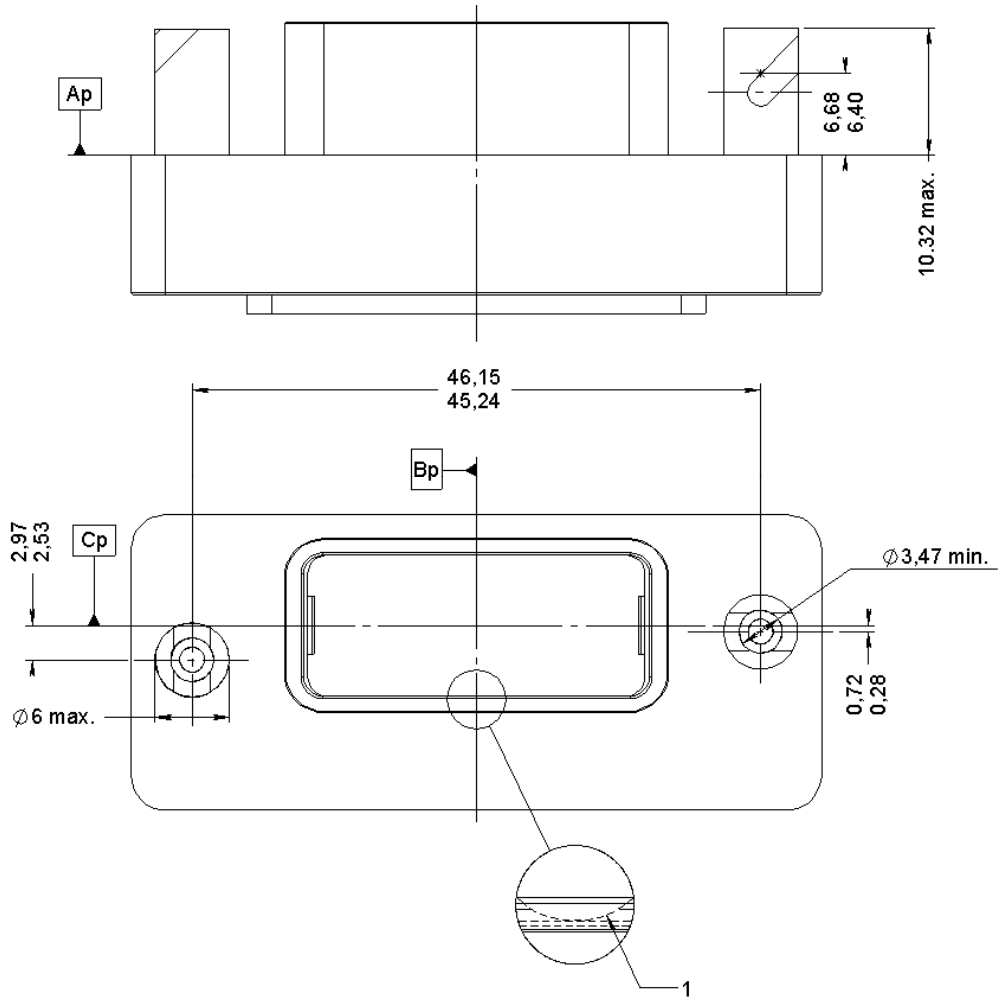
Key

1 Dimension when not under stress
2 Minimum spring compression force: 150 N. per axis
3 A keying

Figure 16

6.1.2.2 Male housing

See Figure 17 and Figure 18.



Key

1 A keying

Figure 17

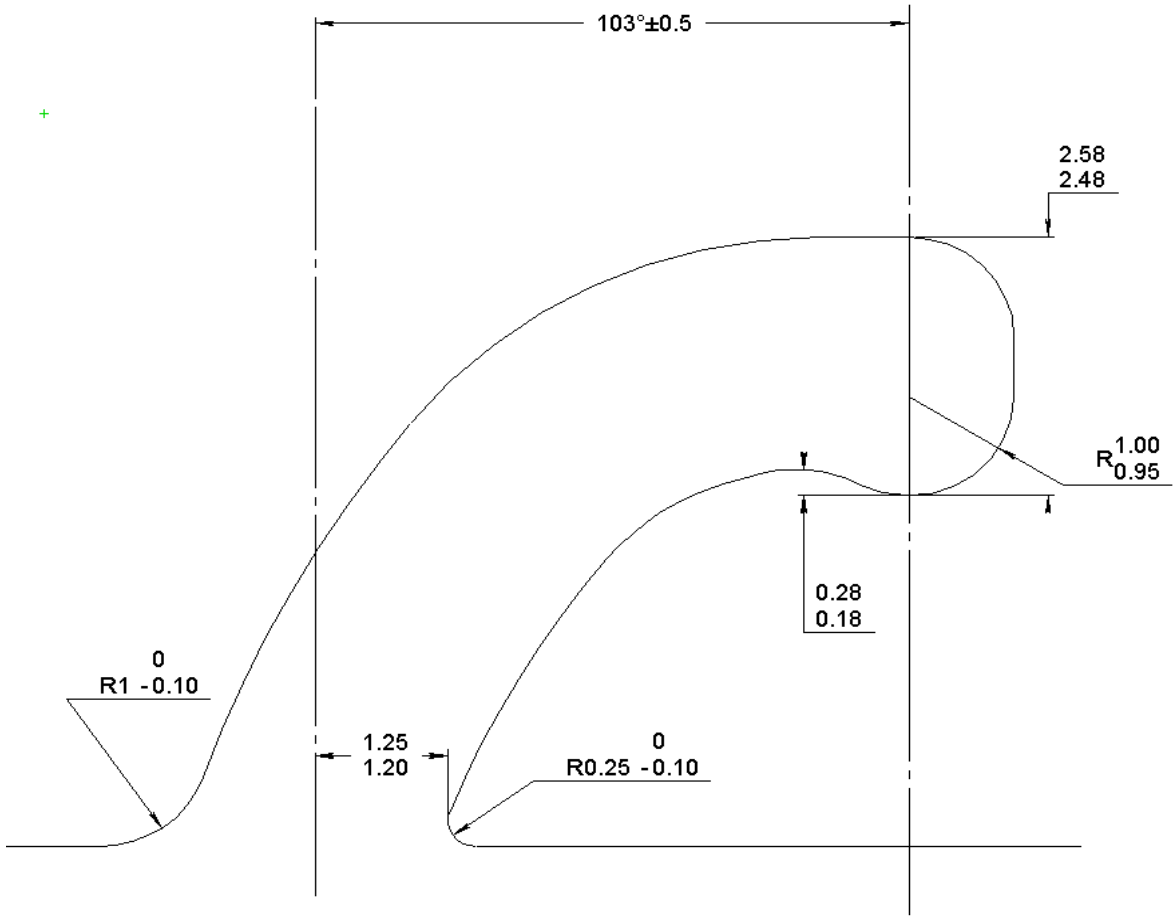
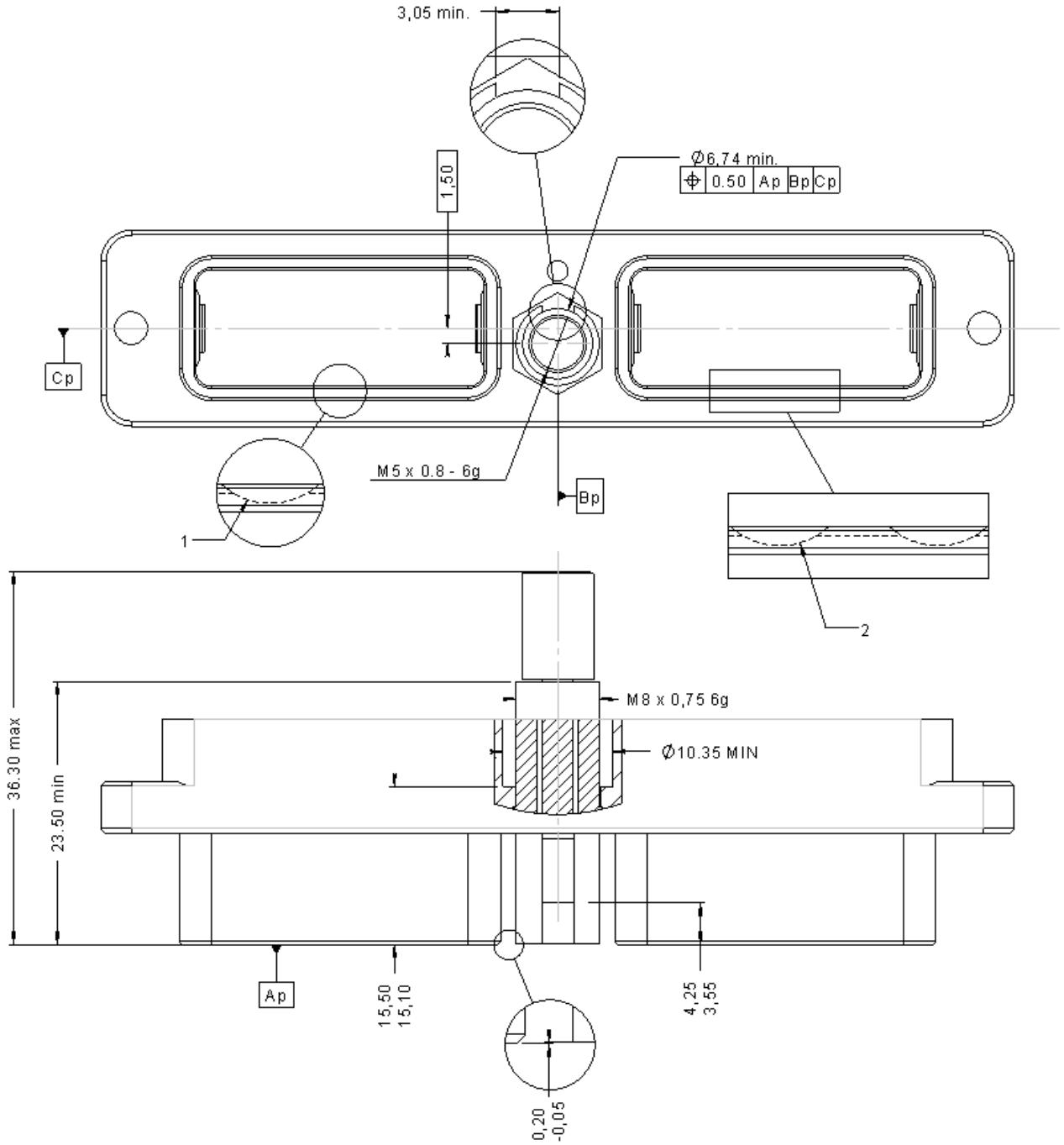


Figure 18

6.1.3 Size 2 locking system

6.1.3.1 Male housing with jackscrew

See Figure 19a.



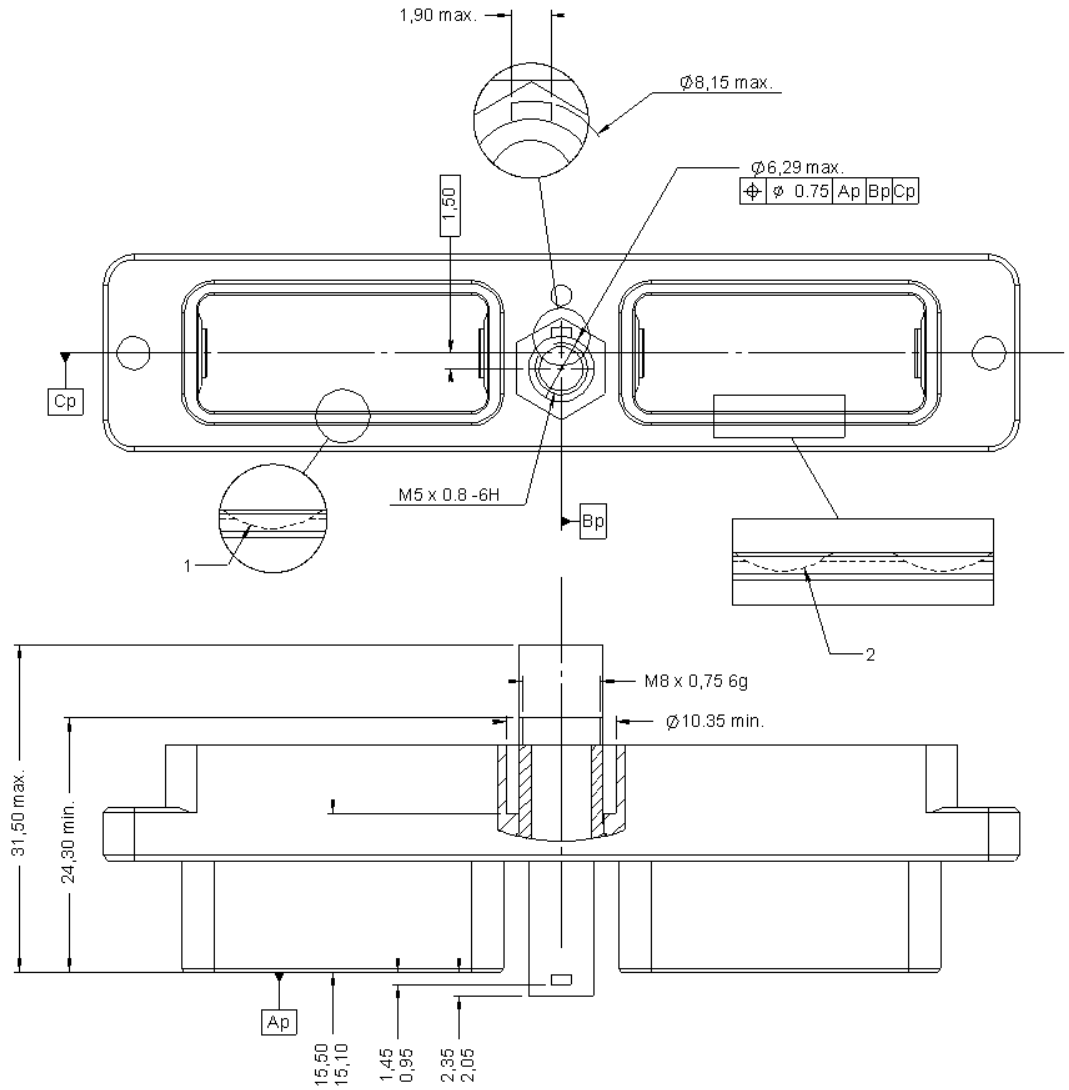
Key

1 A keying
2 B keying

Figure 19a

6.1.3.2 Male housing with jacknut

See Figure 19b.



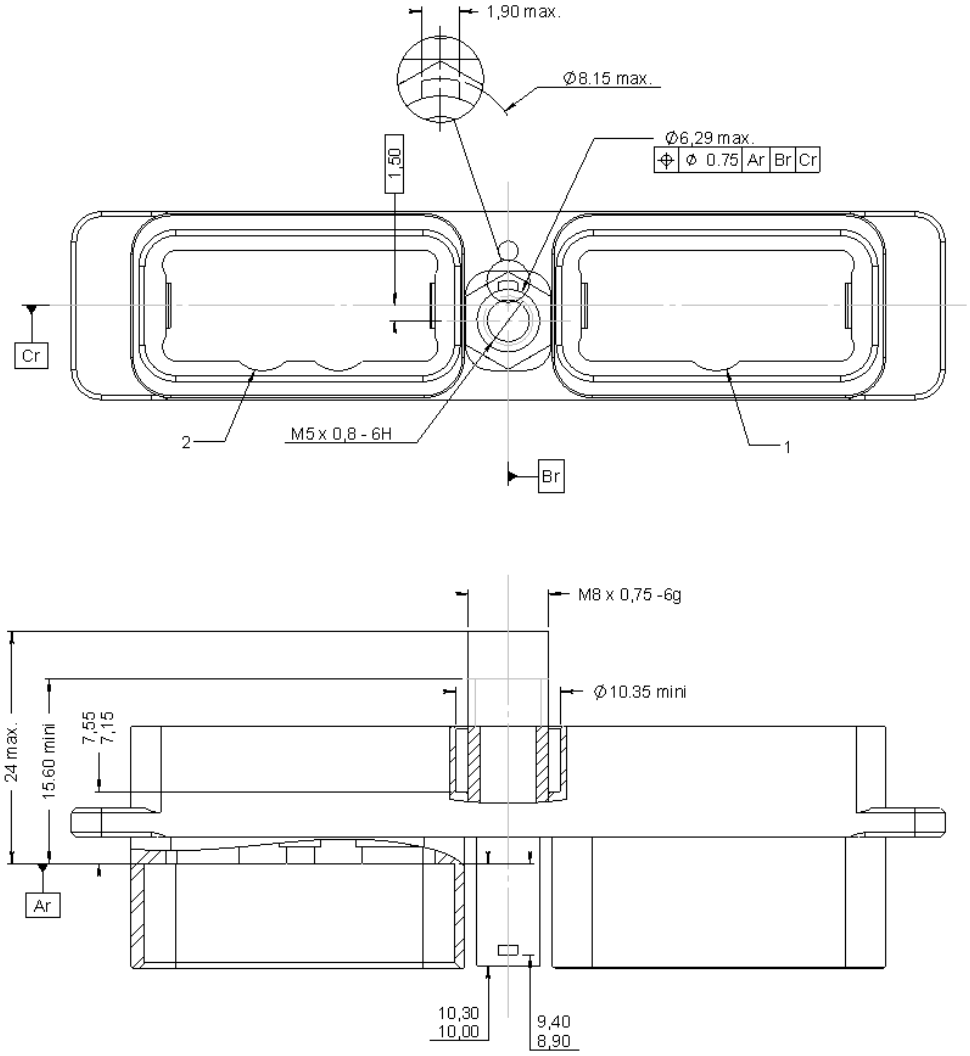
Key

1 A keying
2 B keying

Figure 19b

6.1.3.3 Female housing with jacknut

See Figure 20a.



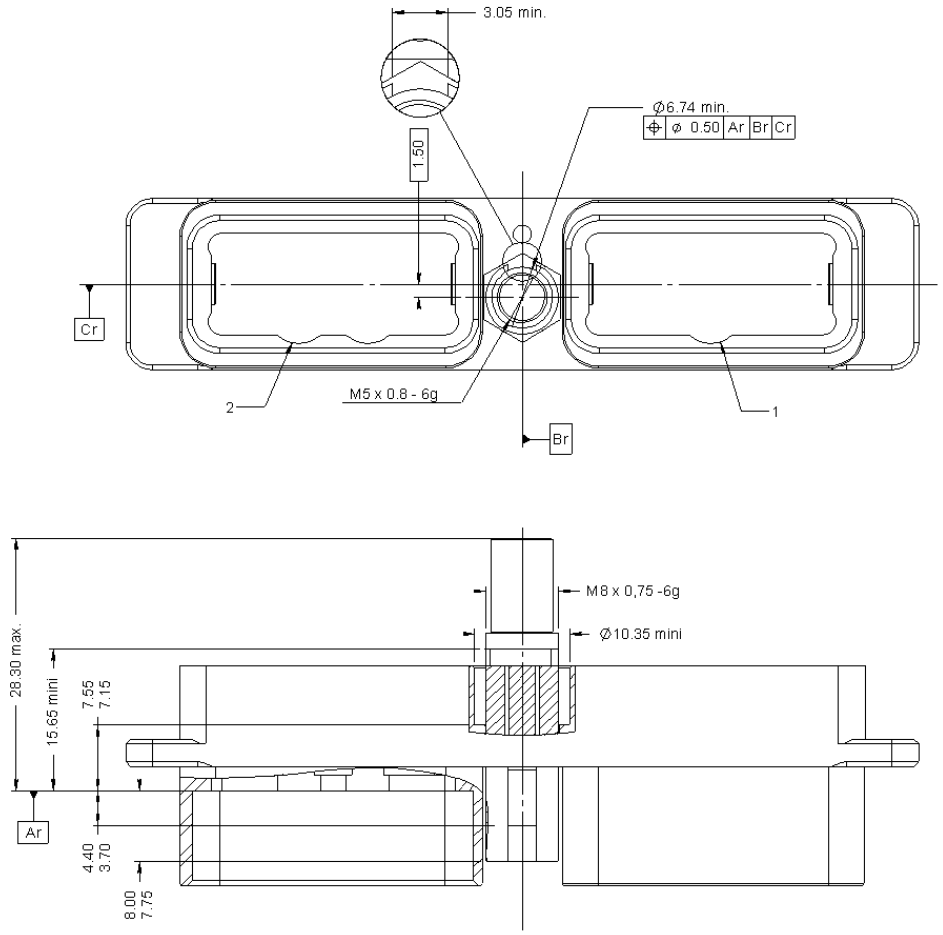
Key

1 A keying
2 B keying

Figure 20a

6.1.3.4 Female housing with jackscrew

See Figure 20b.



Key

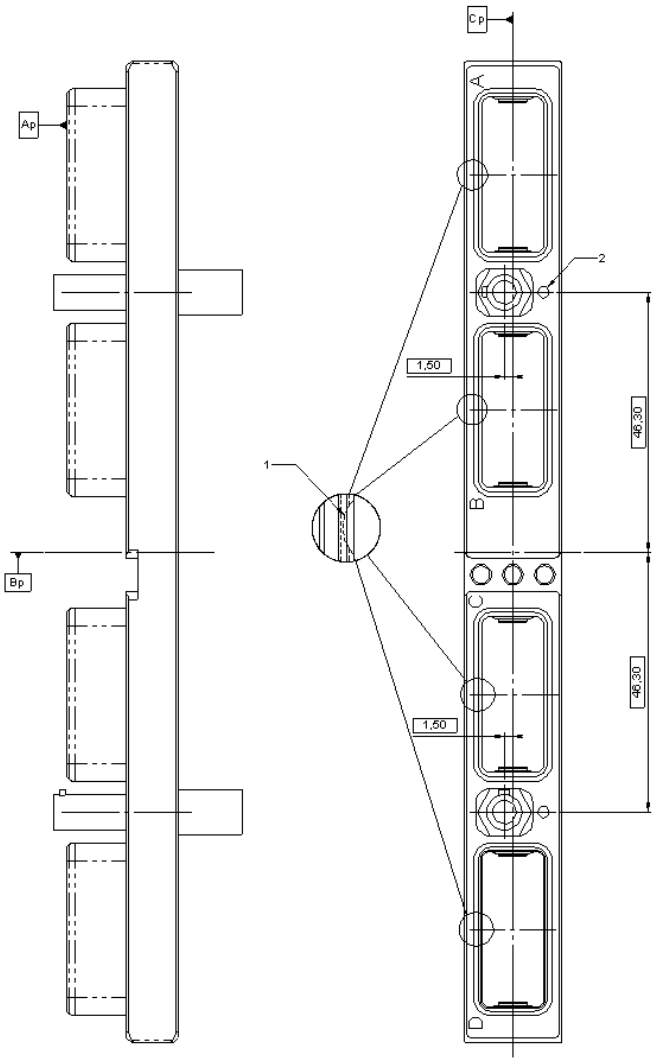
1 A keying
2 B keying

Figure 20b

6.1.4 Size 4 locking system for a mating with a size 2 locking system

6.1.4.1 Male housing

See Figure 21.



Key

1 A keying
2 Indexing point

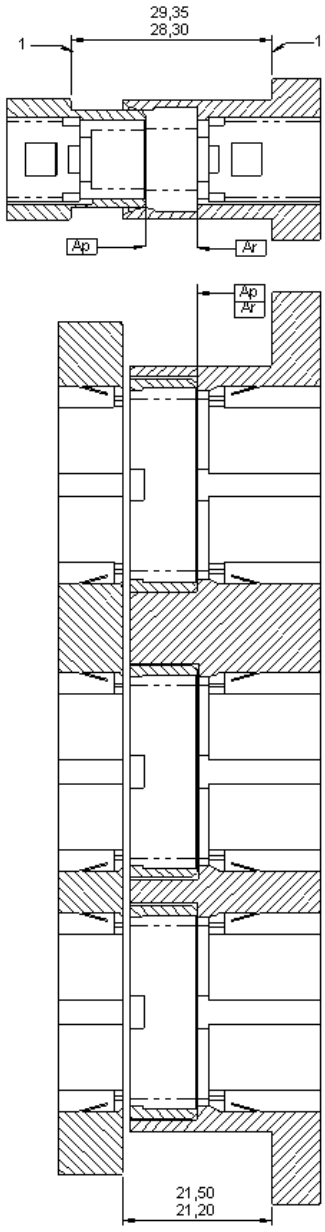
For others dimension on the locking device, see Figure 19a.

Figure 21

6.2 Rack and Panel connector

6.2.1 Size 3 connectors

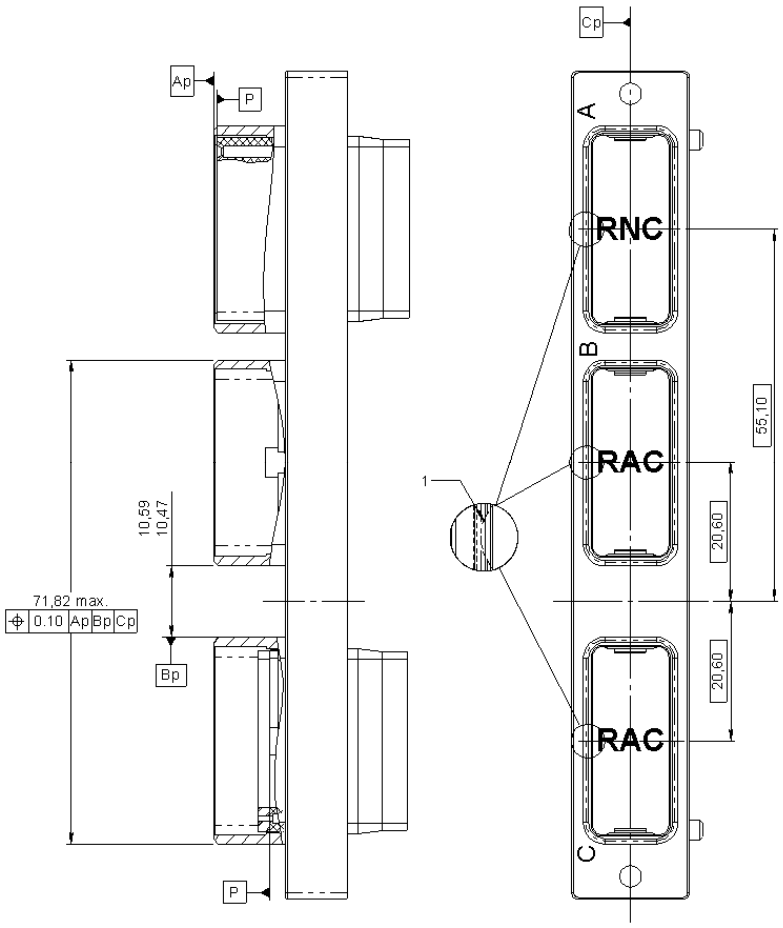
See Figure 22 to Figure 24.



Key

1 Panel mounting faces

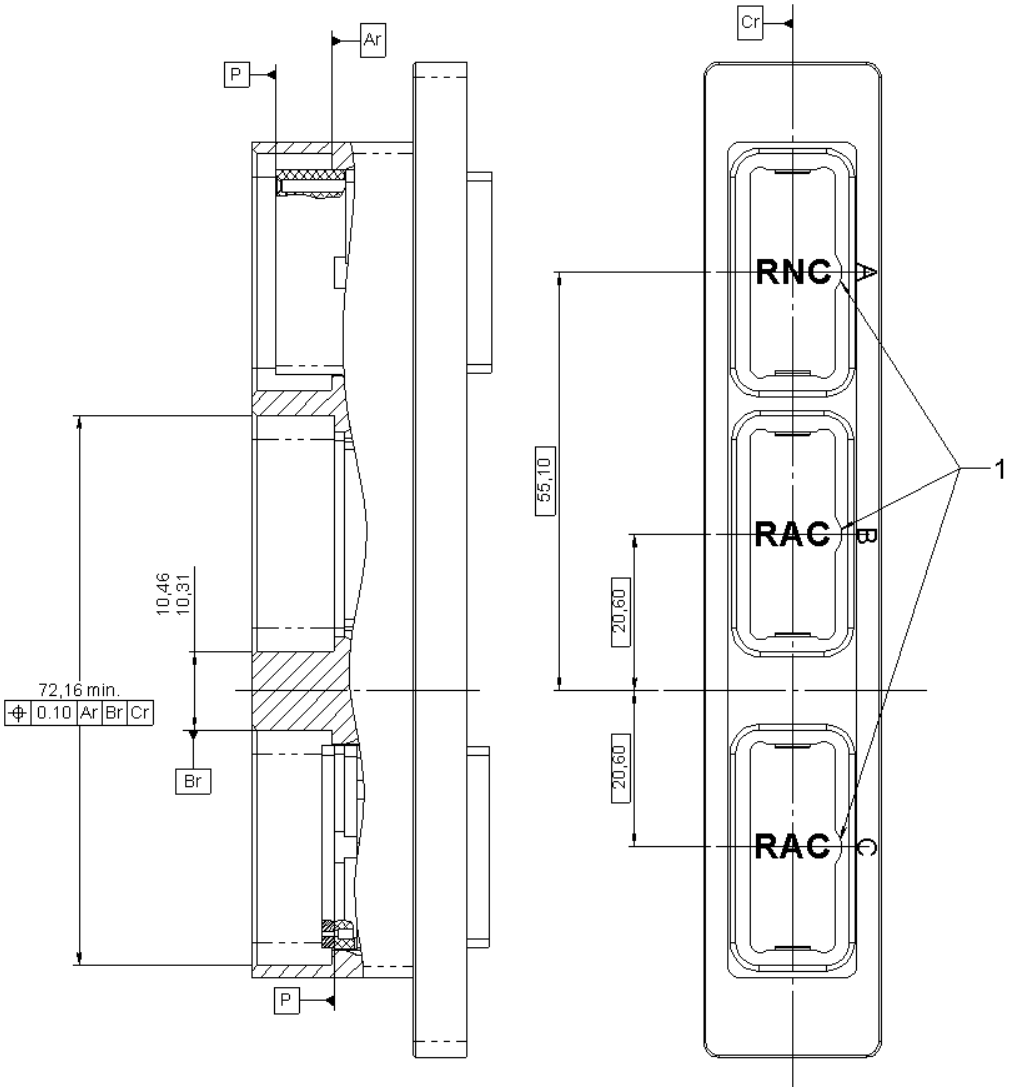
Figure 22 — Mating dimensions



Key

1 A keying

Figure 23 — Male housing



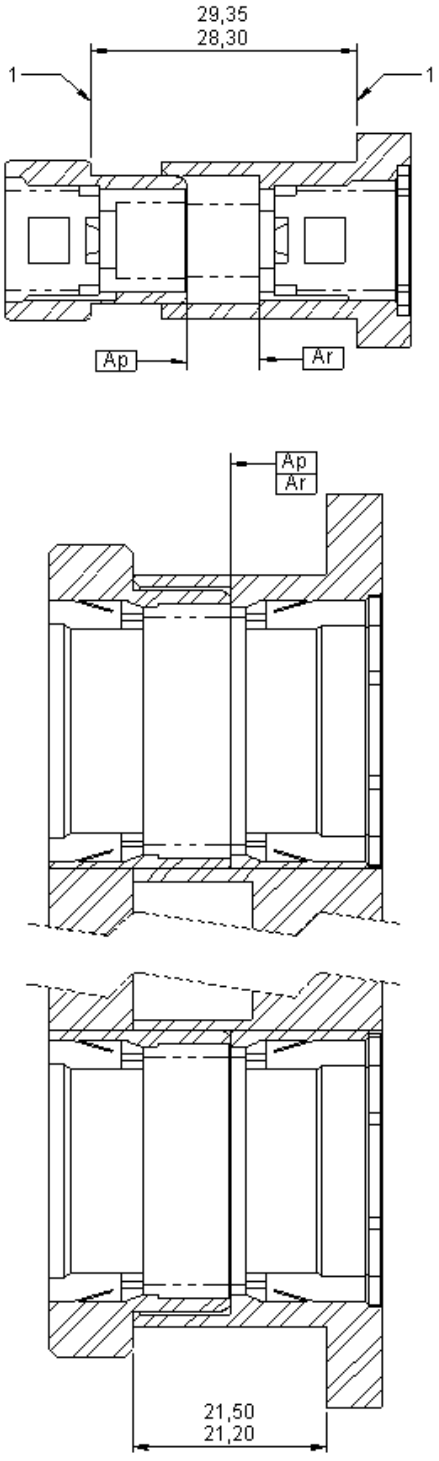
Key

1 A keying

Figure 24 — Female housing

6.2.2 Size 4 connectors

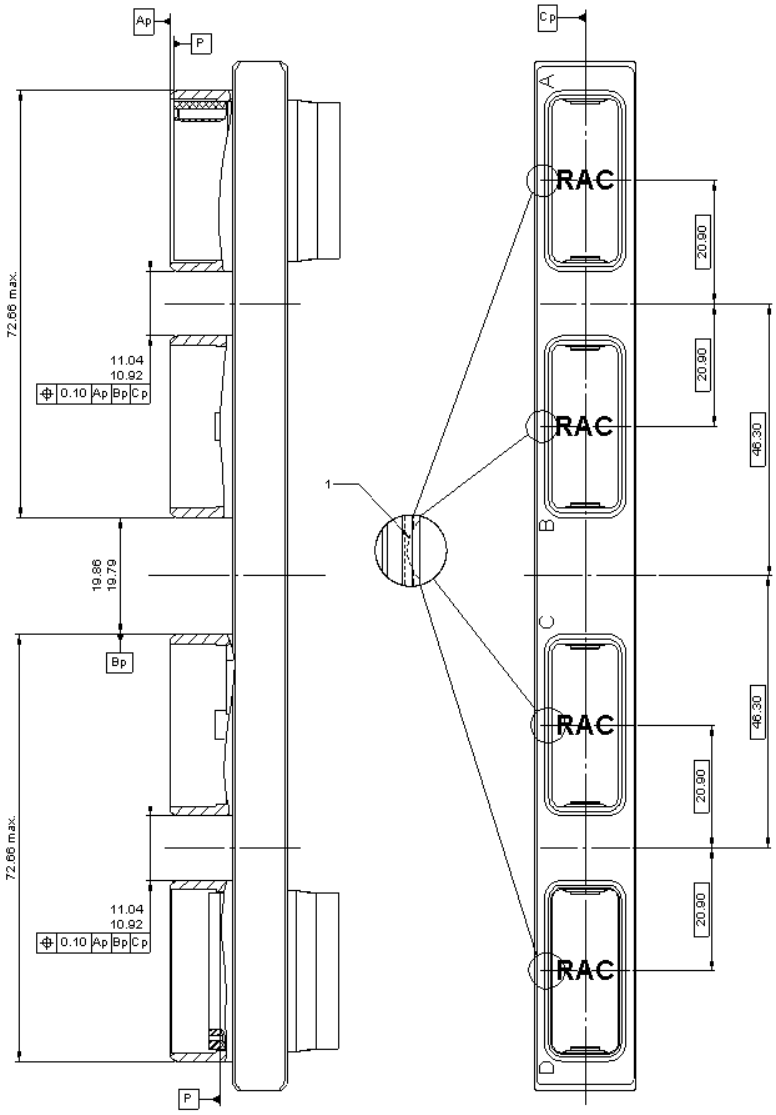
See Figure 25.



Key

1 Panel mounting faces

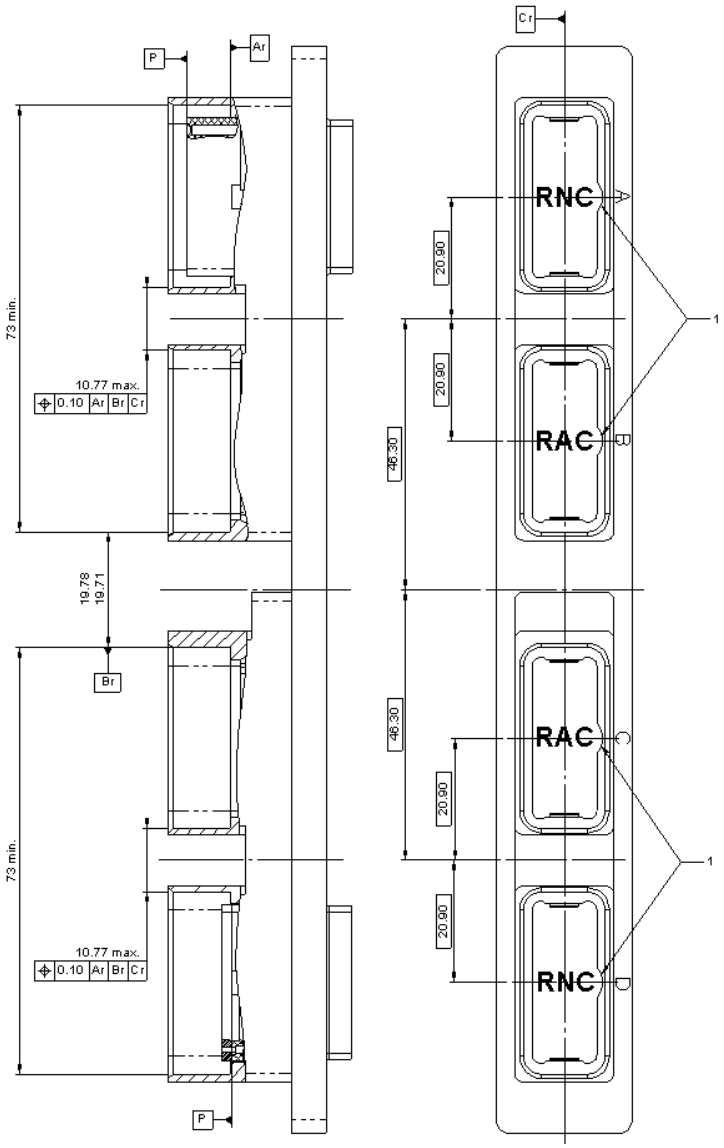
Figure 25 — Mating dimensions



Key

1 A keying

Figure 26 — Male housing



Key

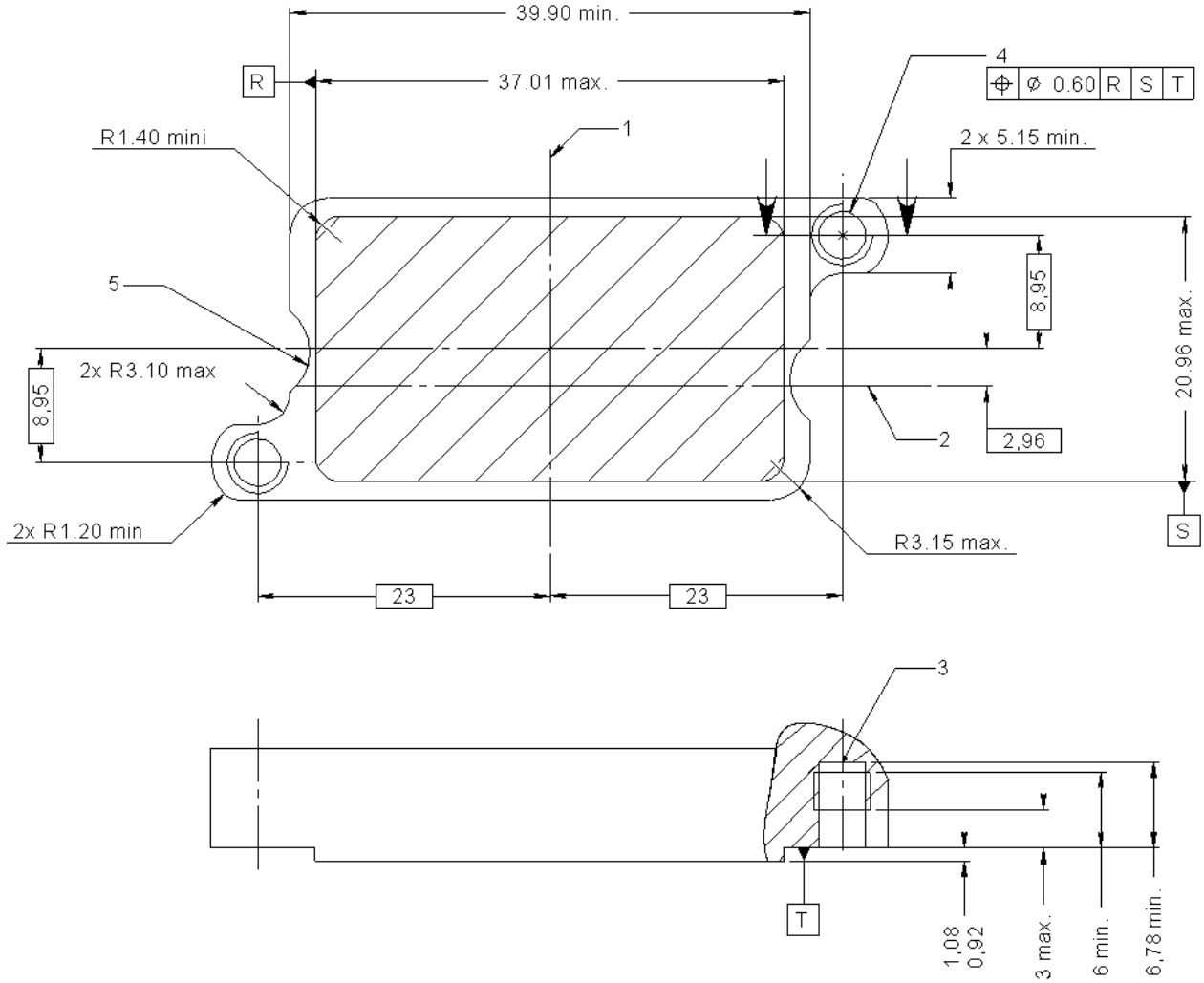
1 A keying

Figure 27 — Female housing

6.3 Rear accessory interface

6.3.1 Male and female size 1 rear accessory interface

See Figure 28.



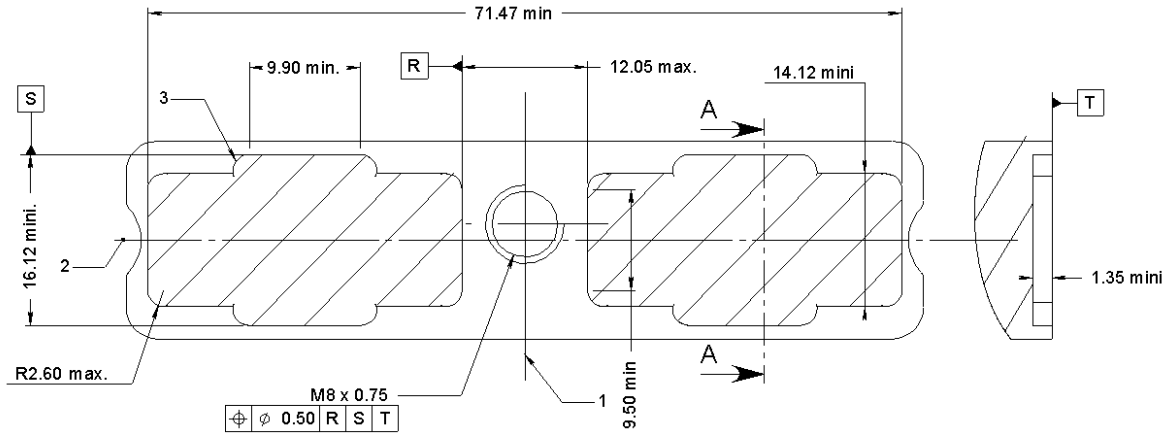
Key

1 Vertical reference axis of connector (Br or Bp)
2 Insert longitudinal axis (Cr or Cp)
3 Blind hole optional
4 Self-locking thread 4-40 UNC
5 Radius 3,60 max. optional

Figure 28

6.3.2 Male and female size 2 rear accessory interface

See Figure 29.



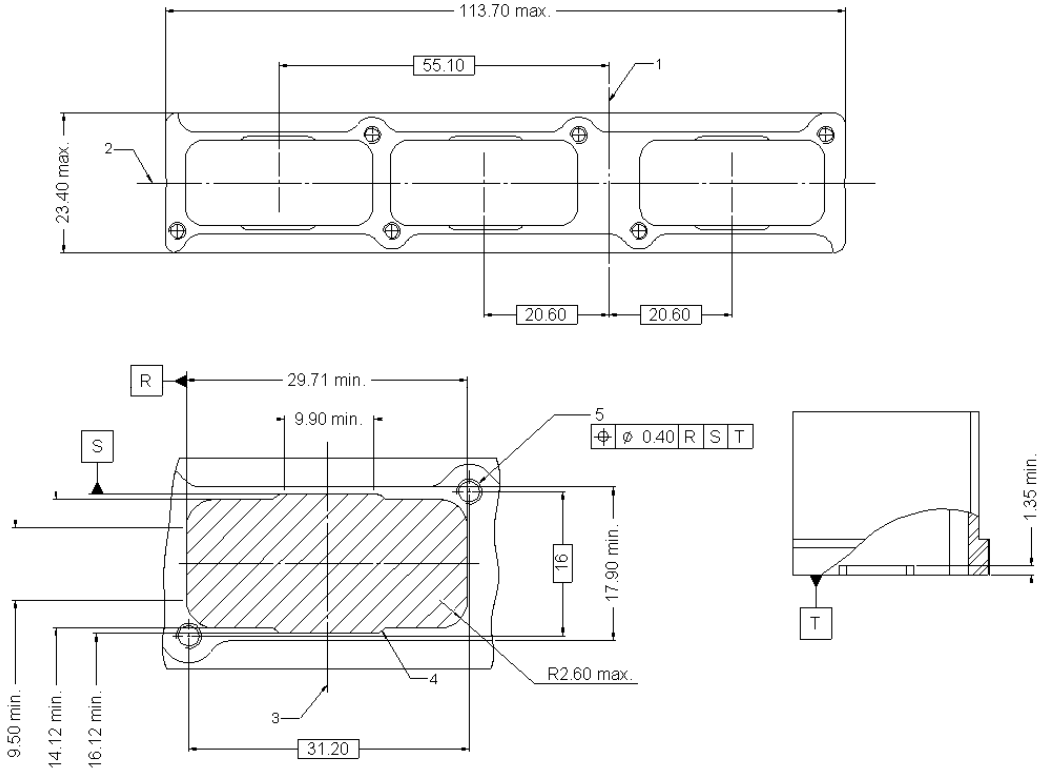
Key

1 Vertical reference axis of connector (Br or Bp)
2 Horizontal reference axis of connector (Cr or Cp)
3 Optional shape

Figure 29

6.3.3 Female size 3 rear accessory interface

See Figure 30.



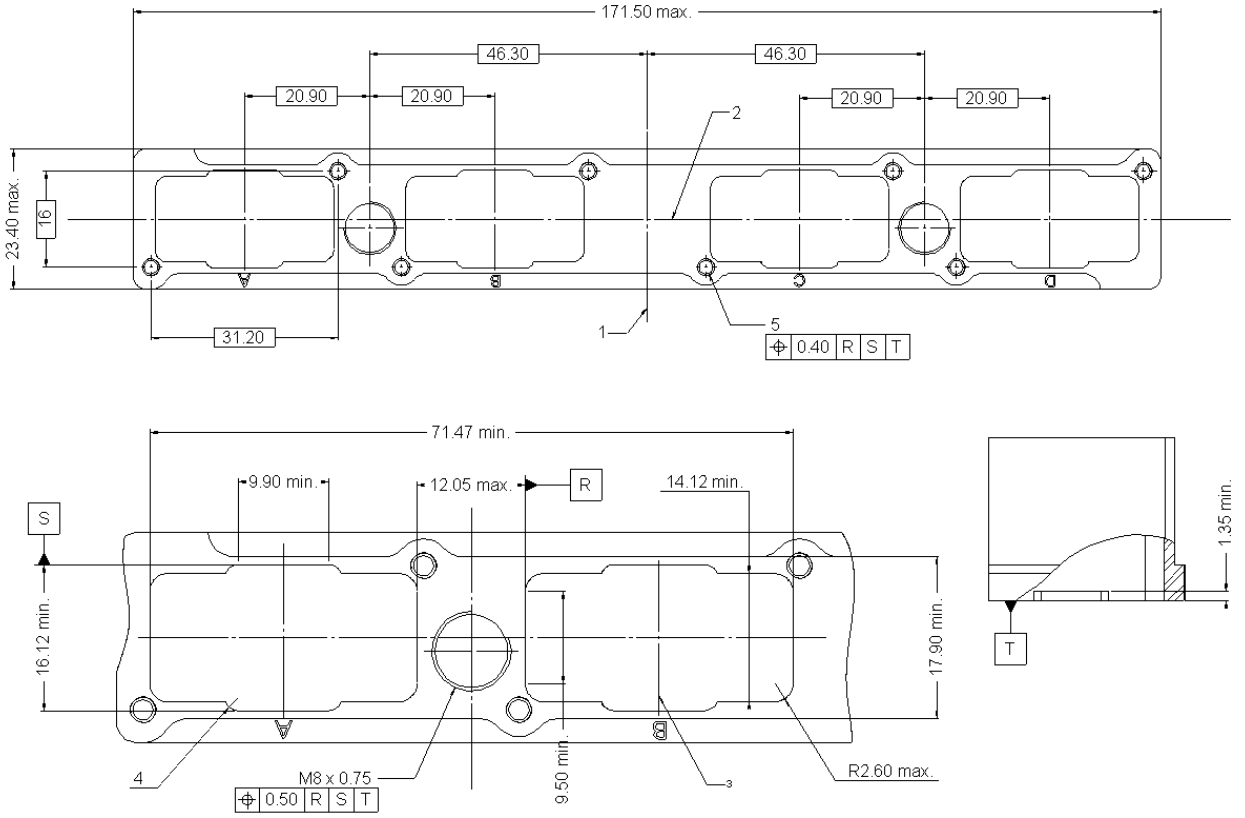
Key

1 Vertical reference axis of connector (Br)
2 Horizontal reference axis of connector (Cr)
3 Vertical axis of shell cavity
4 Optional shape
5 4-40 UNC 2B self-locking thread. Depth = 4,50 mm min.

Figure 30

6.3.4 Female size 4 rear accessory interface

See Figure 31.



Key

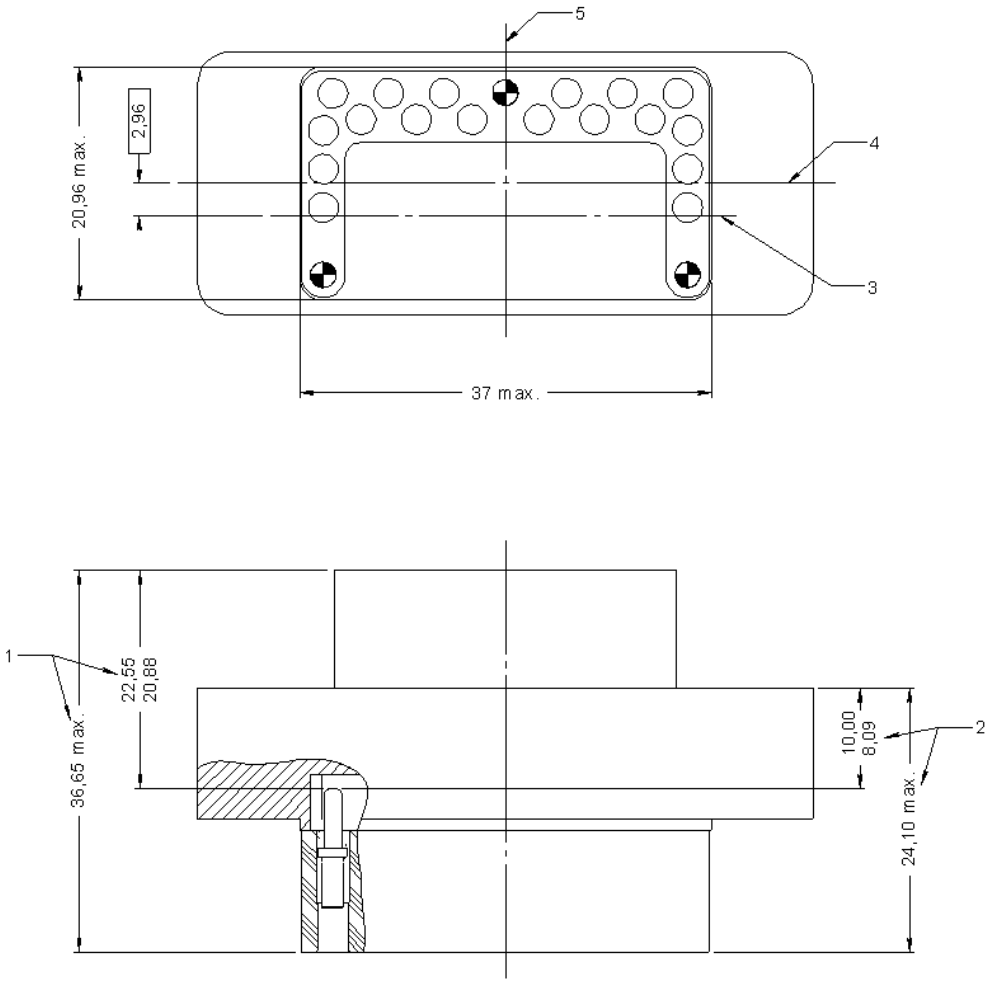
1 Vertical reference axis of connector (Br)
2 Horizontal reference axis of connector (Cr)
3 Vertical axis of shell cavity
4 Optional shape
5 4-40 UNC 2B self locking thread. Depth = 4,50 mm min.

Figure 31

6.4 Male and female ground block interface

6.4.1 Housing size 1

See Figure 32.



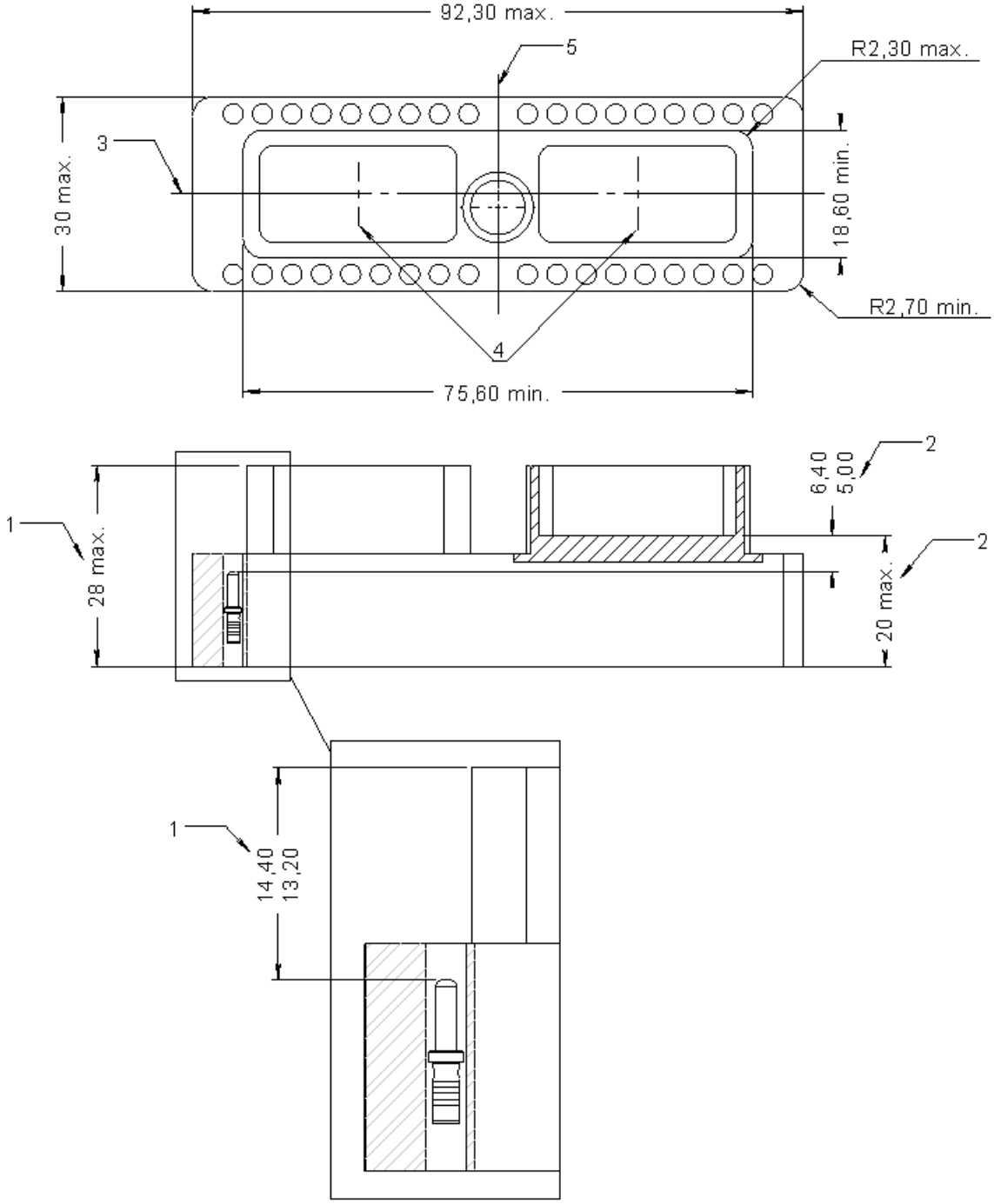
Key

1 M39029/1-101 extremity to female connector bottoming face
2 M39029/1-101 extremity to male connector bottoming face
3 Insert longitudinal axis
4 Horizontal axis of connector
5 Housing and insert vertical axis

Figure 32

6.4.2 Housing size 2

See Figure 33.



Key

1 Dimension applicable to male housing
2 Dimension applicable to female housing
3 Horizontal axis of connector
4 Vertical axis of housing cavities
5 Vertical axis of connector

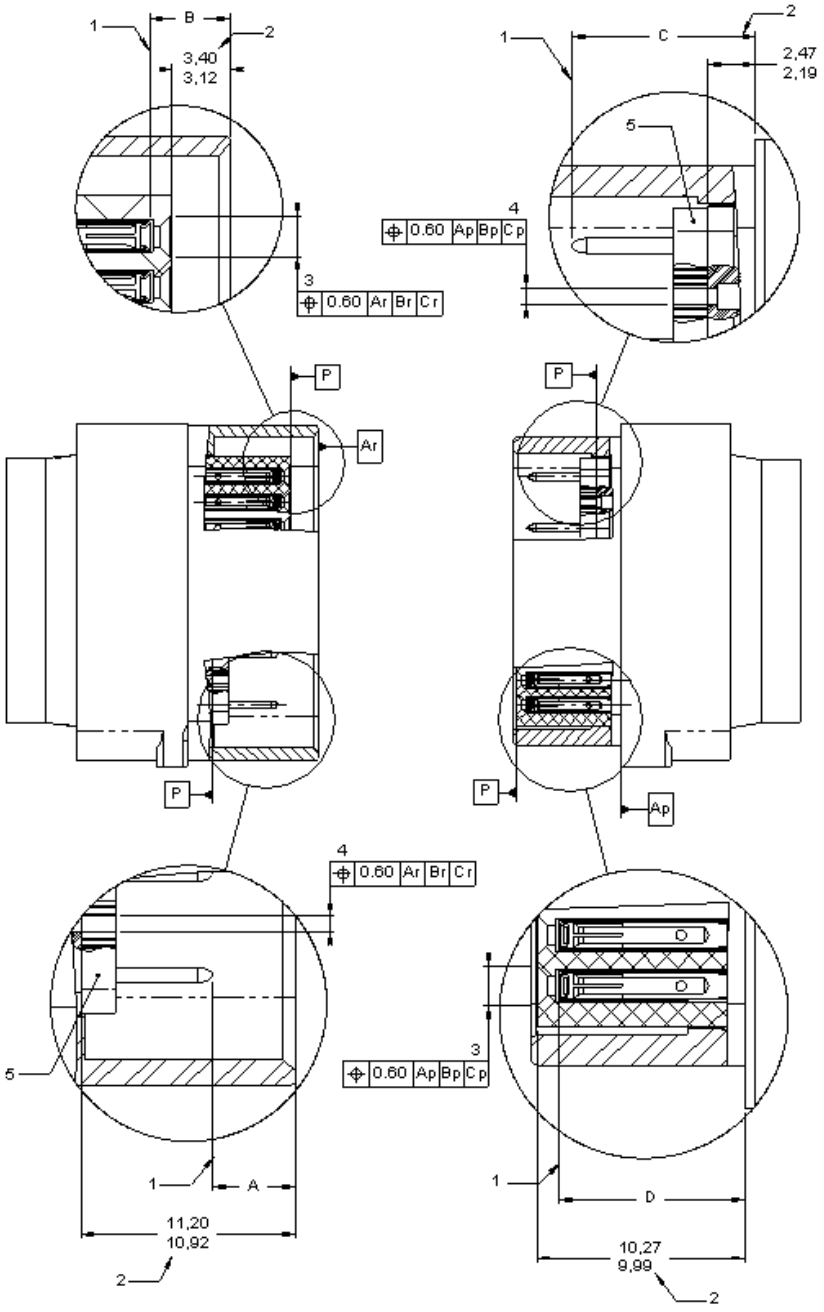
Figure 33

6.5 Insert to housing interface

6.5.1 Contact position

6.5.1.1 Contact position for connector size 1

See Figure 34 and Table 2.



Key

1 Contact extremity
2 Dimension when insert is butting in rear position
3 Female contact cavity position
4 Male contact cavity position

Figure 34

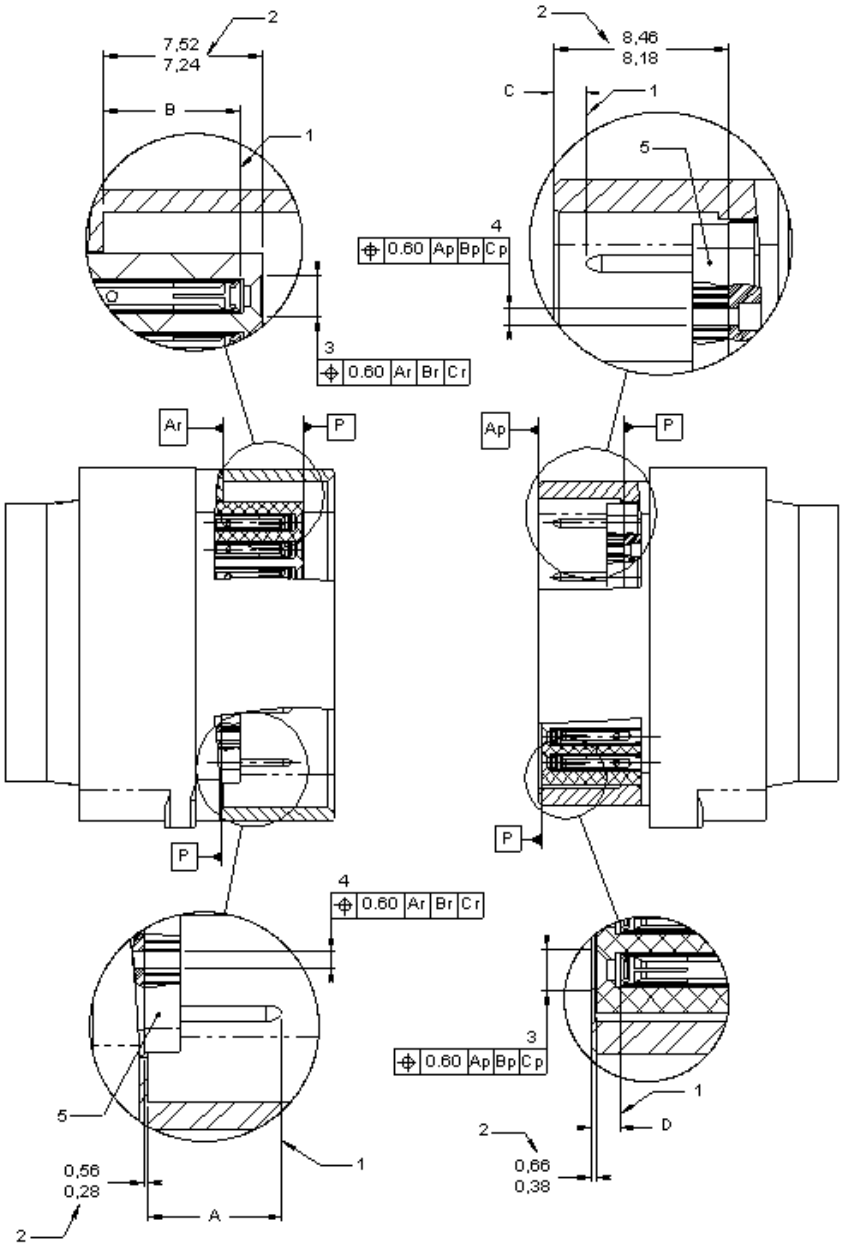
Table 2

Dimensions in millimetres

Contact size	*A*		*B*		*C*		*D*	
	min.	max.	min.	max.	min.	max.	min.	max.
22	4,04	5,17	3,78	5,02	8,21	9,35	8,38	9,61
20	3,54	4,70	3,78	4,93	8,68	9,85	8,47	9,61
16	2,87	4,10	3,83	5,02	9,28	10,52	8,38	9,56
12	2,87	4,12	3,83	5,04	9,26	10,52	8,36	9,56
8	2,30	3,47	4,23	5,39	9,92	11,09	8,00	9,16
8 quadrax	3,04	4,57	5,42	6,90	8,82	10,35	6,49	7,97
5	3,00	4,15	3,36	5,51	9,25	10,39	7,89	10,03

6.5.1.2 Contact position for connector size 2, 3 and 4

See Figure 35 and Table 3.



Key

1 Contact extremity
2 Dimension when insert is butting in rear position
3 Female contact cavity position
4 Male contact cavity position

Figure 35

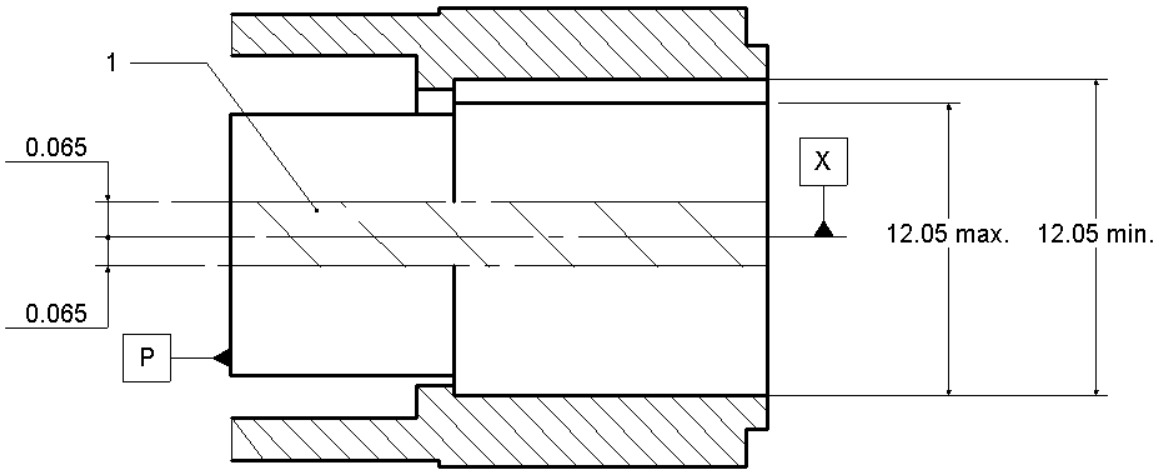
Table 3

Dimensions in millimetres

Contact size	*A*		*B*		*C*		*D*	
	min.	max.	min.	max.	min.	max.	min.	max.
22	5,45	6,60	5,62	6,86	1,30	2,44	1,04	2,26
20	5,90	7,10	5,69	6,86	0,80	1,99	1,04	2,20
16	6,52	7,77	5,62	6,81	0,13	1,37	1,09	2,27
12	6,50	7,76	5,60	6,81	0,14	1,39	1,09	2,29
8	7,17	8,31	5,24	6,41	-0,41	0,73	1,49	2,66
8 quadrax	6,07	7,57	3,74	5,22	0,33	1,83	2,68	4,16
5	6,49	7,64	5,13	7,28	0,26	1,40	0,62	2,76

6.5.1.3 Gap of inserts in housing cavity

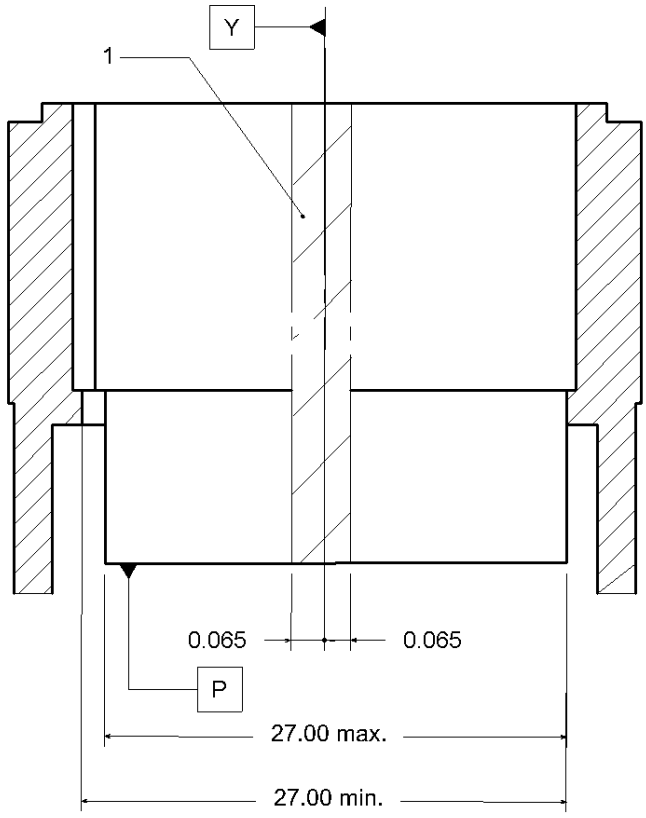
See Figure 36 and Figure 37.



Key

1 Area containing the insert symmetry axis (on ribs)

Figure 36 — Gap along X axis



Key

1 Area containing the insert symmetry axis (on ribs)

Figure 37 — Gap along the Y axis

6.5.1.4 Contact cavities details

6.5.1.4.1 Female contact cavity

See Figure 38 and Table 4.

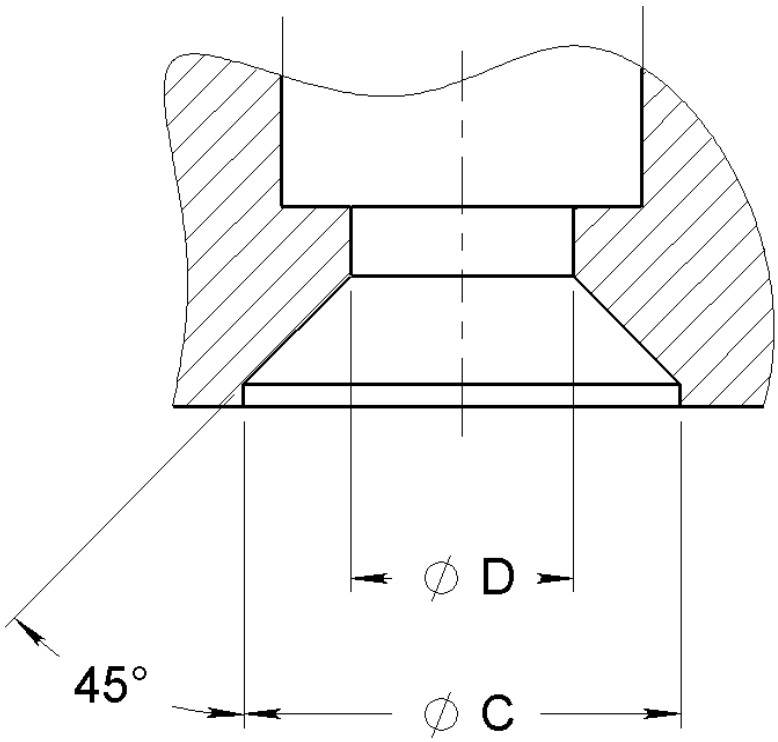


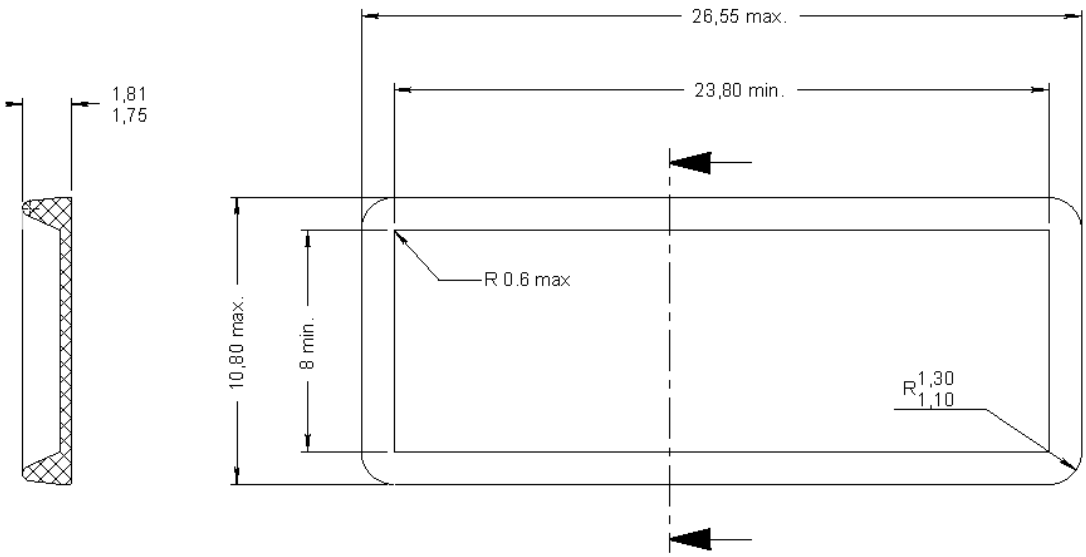
Figure 38

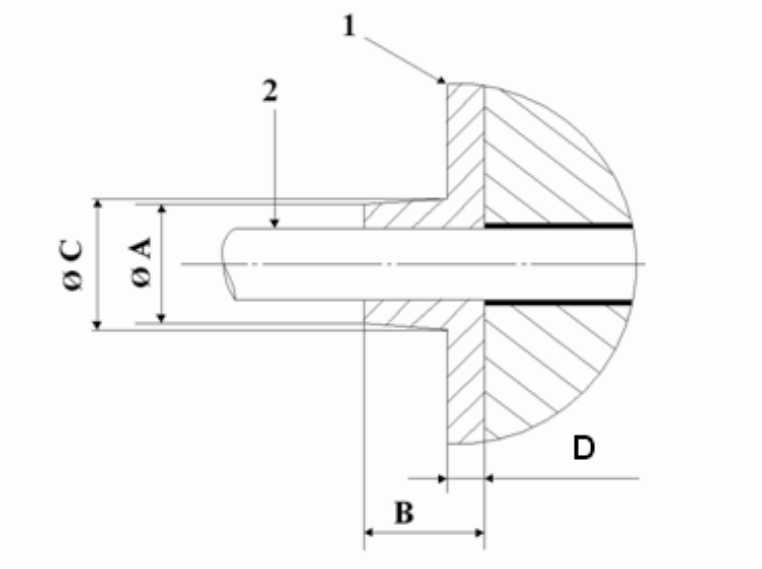
Table 4

Contact size	Ø *C*		Ø *D*	
	min.	max.	min.	max.
22	2,00	2,10	1,02	1,06
20	2,45	2,55	1,27	1,31
16	3,20	3,30	1,97	2,03
12	3,75	3,85	2,77	2,83
8	7,29	7,39	5,77	5,81
5	7,00	7,10	5,85	5,96

6.5.1.4.2 Male contact cavity

See Figure 39a and Table 5.





Key

1 Interfacial seal
2 Male contact

Figure 39a

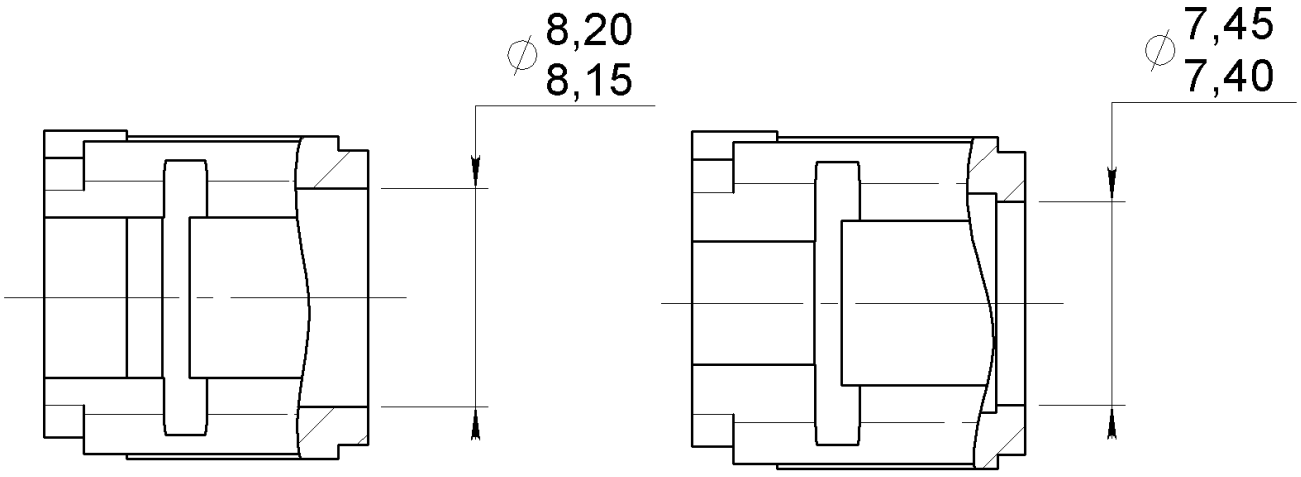
Table 5

Dimensions in millimetres

Contact size	Ø *A*		*B*		Ø *C*		*D*	
	max.	min.	max.	min.	max.	min.	max.	min.
22	1,13	1,03	2,1	1,9	1,81	1,61	0,43	0,37
20	1,57	1,47	2,1	1,9	2,25	2,05	0,43	0,37
16	2,32	2,22	2,1	1,9	3,00	2,80	0,43	0,37
12	2,87	2,77	2,1	1,9	3,55	3,35	0,43	0,37
8	6,41	6,31	2,1	1,9	7,09	6,89	0,43	0,37
5	6,12	6,02	2,1	1,9	6,80	6,60	0,43	0,37

6.5.1.4.3 Size 8 and 5 rear male cavity

See Figure 39b.



Size 8 cavity rear diameter **Size 5 cavity rear diameter**

Figure 39b

6.6 Masses

Connector masses are shown in grams in Table 6 below. It is the maximum mass of the connector housing together with its locking and polarizing hardware.

Table 6

Class	Male housing			Female housing		
	Size 1	Size 2	Size 3	Size 1	Size 2	Size 3
A	32	37	Not available	45	45	Not available
B	40	85	Not available	50	90	Not available
C	Not available	Not available	—	Not available	Not available	—
E	26	35	Not available	35	45	Not available
F	35	Not available	Not available	42	Not available	Not available

6.7 Contact arrangements

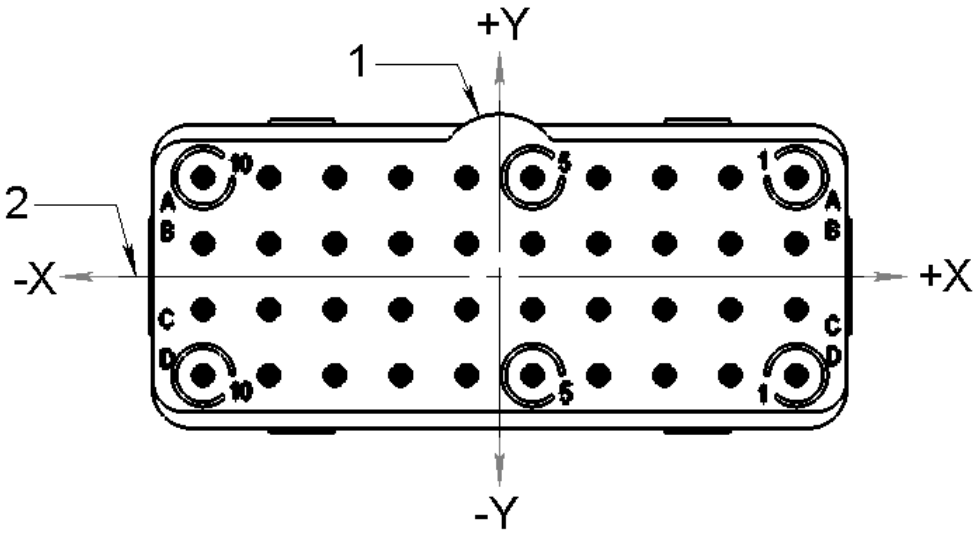
Contact arrangements in the insert are specified by Figure 40 to Figure 60 which show the mating face of the inserts for pin contacts.

The true positioning for contact cavities is defined in Table 7. Identification of the contact position shall be permanently marked in contrasting colour on the mating face of the insert (optional on interfacial seal) and on the rear face of the wire sealing grommet, identification shall not be recessed or raised on the sealing surfaces.

Table 7

Contact size	Contact position
22	⌖ Ø 0,23 P X Y
20	⌖ Ø 0,23 P X Y
16	⌖ Ø 0,23 P X Y
12	⌖ Ø 0,23 P X Y
8	⌖ Ø 0,27 P X Y
5	⌖ Ø 0,27 P X Y

Contact arrangement 40



Key

1 One or two polarization ribs
2 Centre line

Figure 40

Table 8

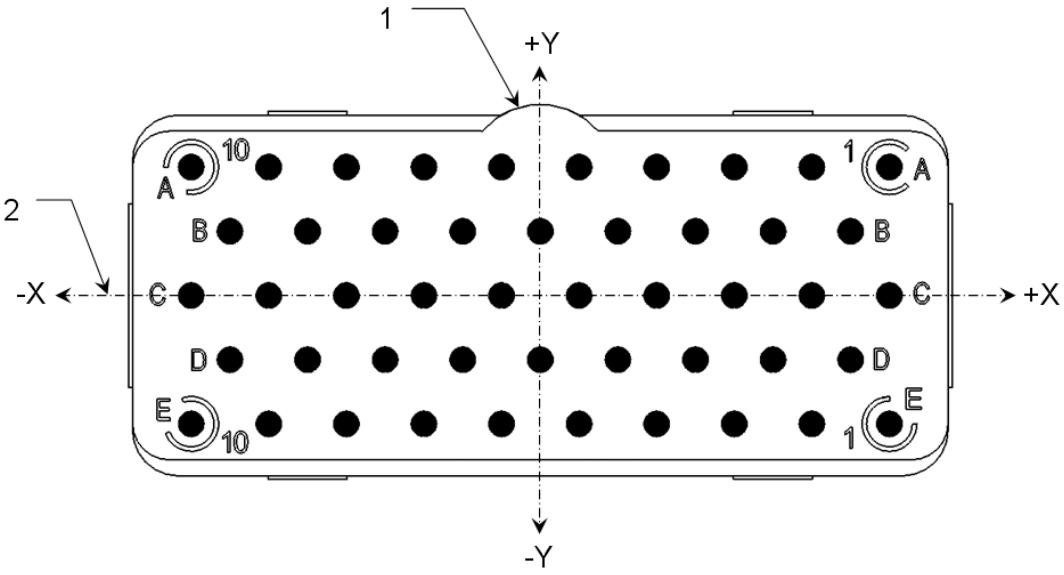
Dimensions in millimetres

Contact position										
Y	X									
	– 11,43	– 8,89	– 6,35	3,81	– 1,27	+ 1,27	+ 3,81	+ 6,35	+ 8,89	+ 11,43
+ 3,81	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1
+ 1,27	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1
– 1,27	C10	C9	C8	C7	C6	C5	C4	C3	C2	C1
– 3,81	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1

Table 9

Contacts		
Size	**Quantity**	**Location**
22	40	A1 to D10

Contact arrangement 48



Key

1 One or two polarization ribs
2 Centre line

Figure 41

Table 10

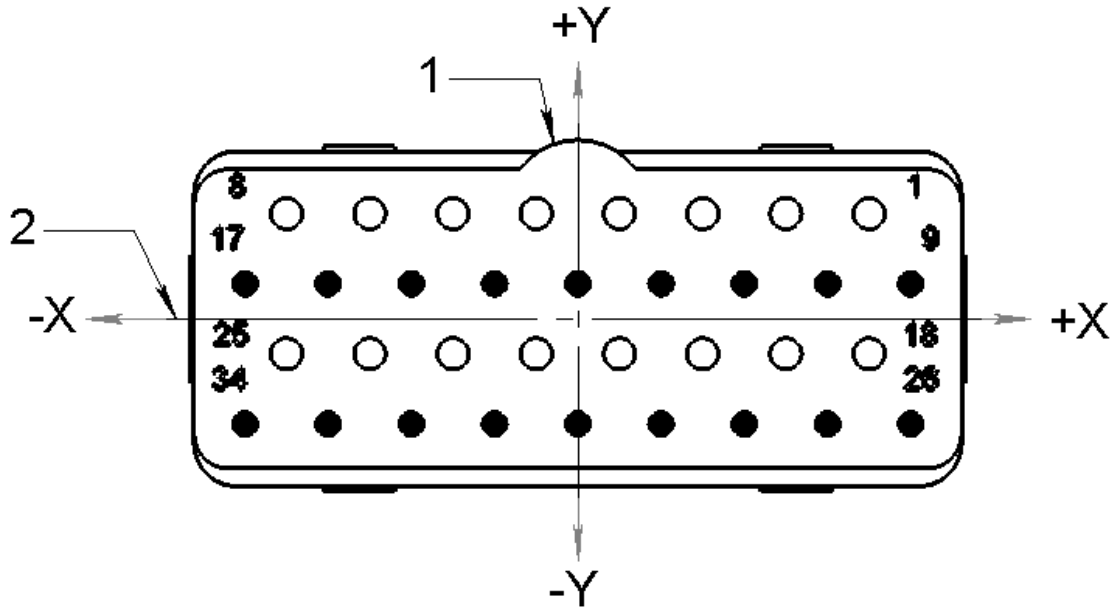
Dimensions in millimetres

Contact position																			
Y	X																		
	-11,43	-10,16	-8.,89	-7,62	-6,35	-5,08	-3,81	-2,54	-1,27	0	+1,27	+2,54	+3,81	+5,08	+6,35	+7,62	+8,89	+10,16	+11,43
+4.2	A10	–	A9	–	A8	–	A7	–	A6	–	A5	–	A4	–	A3	–	A2	–	A1
+2.1	–	B9	–	B8	–	B7	–	B6	–	B5	–	B4	–	B3	–	B2	–	B1	–
0	C10	–	C9	–	C8	–	C7	–	C6	–	C5	–	C4	–	C3	–	C2	–	C1
-2.1	–	D9	–	D8	–	D7	–	D6	–	D5	–	D4	–	D3	–	D2	–	D1	–
-4.2	E10	–	E9	–	E8	–	E7	–	E6	–	E5	–	E4	–	E3	–	E2	–	E1

Table 11

Contacts		
Size	**Quantity**	**Location**
22	48	A1 to E10

Contact arrangement 34



Key

1 One or two polarization ribs
2 Centre line

Figure 42

Table 12

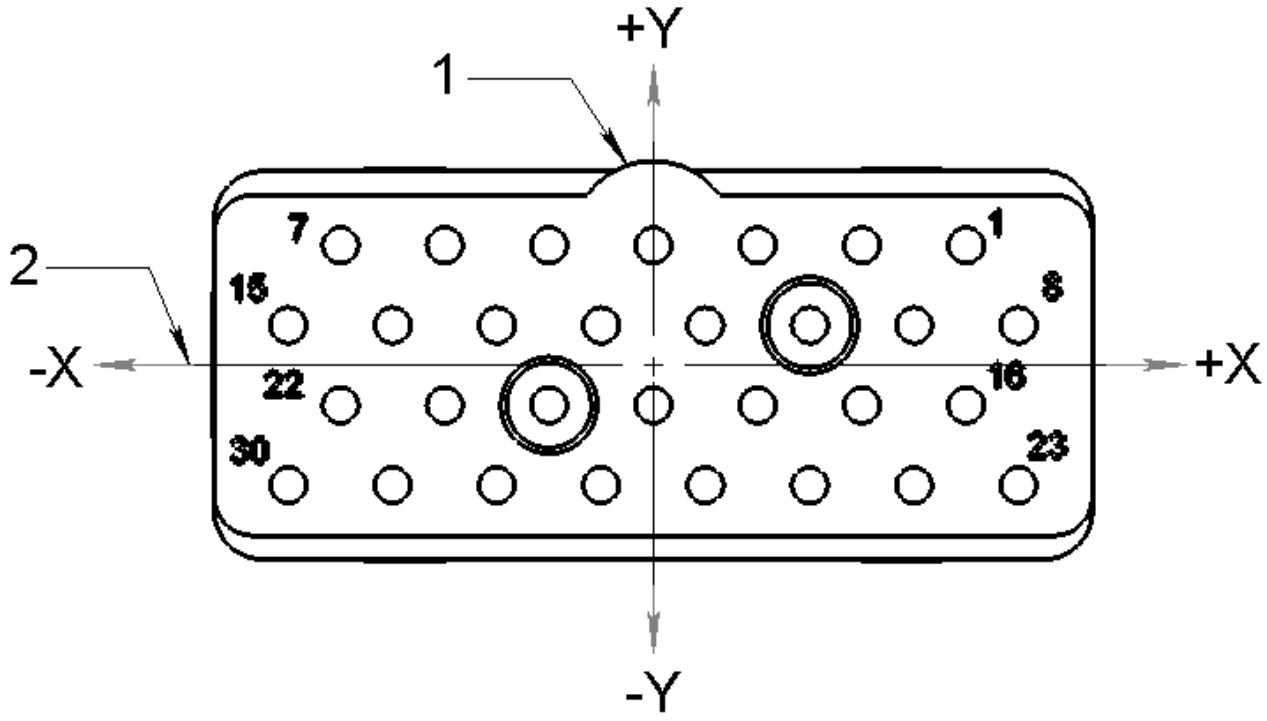
Dimensions in millimetres

Contact position																	
Y	X																
	-11,6	-10,15	-8,70	-7,25	-5,80	-4,35	-2,90	-1,45	0	+1,45	+2,90	+4,35	+5,80	+7,25	+8,70	+10,15	+11,60
+3,67	–	8	–	7	–	6	–	5	–	4	–	3	–	2	–	1	–
+1,225	17	–	16	–	15	–	14	–	13	–	12	–	11	–	10	–	9
-1,225	–	25	–	24	–	23	–	22	–	21	–	20	–	19	–	18	–
-3,68	34	–	33	–	32	–	31	–	30	–	29	–	28	–	27	–	26

Table 13

Contacts		
Size	**Quantity**	**Location**
22	18	9 to 17, 26 to 34
20	16	1 to 8, 18 to 25

Contact arrangement 30



Key

1 One or two polarization ribs

2 Centre line

Figure 43

Table 14

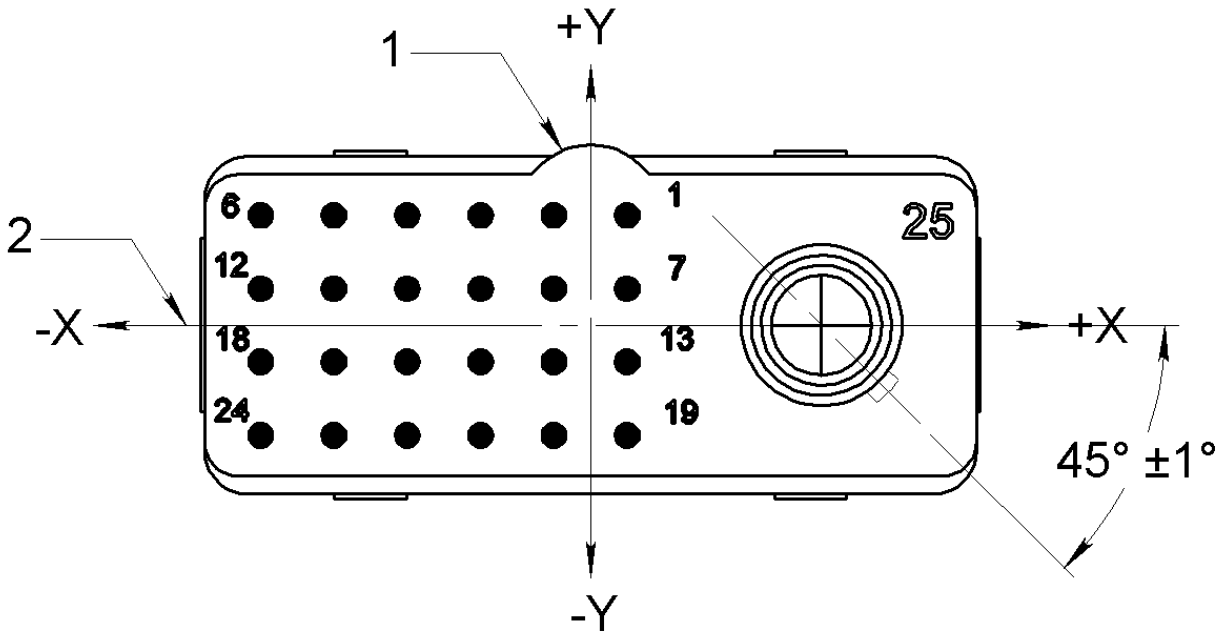
Dimensions in millimetres

Contact position															
Y	X														
	– 11,20	– 9,60	– 8,00	– 6,40	– 4,80	– 3,20	– 1,60	0	+ 1,60	+ 3,20	+ 4,80	+ 6,40	+ 8,00	+ 9,60	+ 11,20
+ 3,67	–	7	–	6	–	5	–	4	–	3	–	2	–	1	–
+ 1,225	15	–	14	–	13	–	12	–	11	–	10	–	9	–	8
– 1,225	–	22	–	21	–	20	–	19	–	18	–	17	–	16	–
– 3,68	30	–	29	–	28	–	27	–	26	–	25	–	24	–	23

Table 15

Contacts		
Size	**Quantity**	**Location**
20	30	1 to 30

Contact arrangement 25Q1



Key

1 One or two polarization ribs
2 Centre line

Figure 44

Table 16

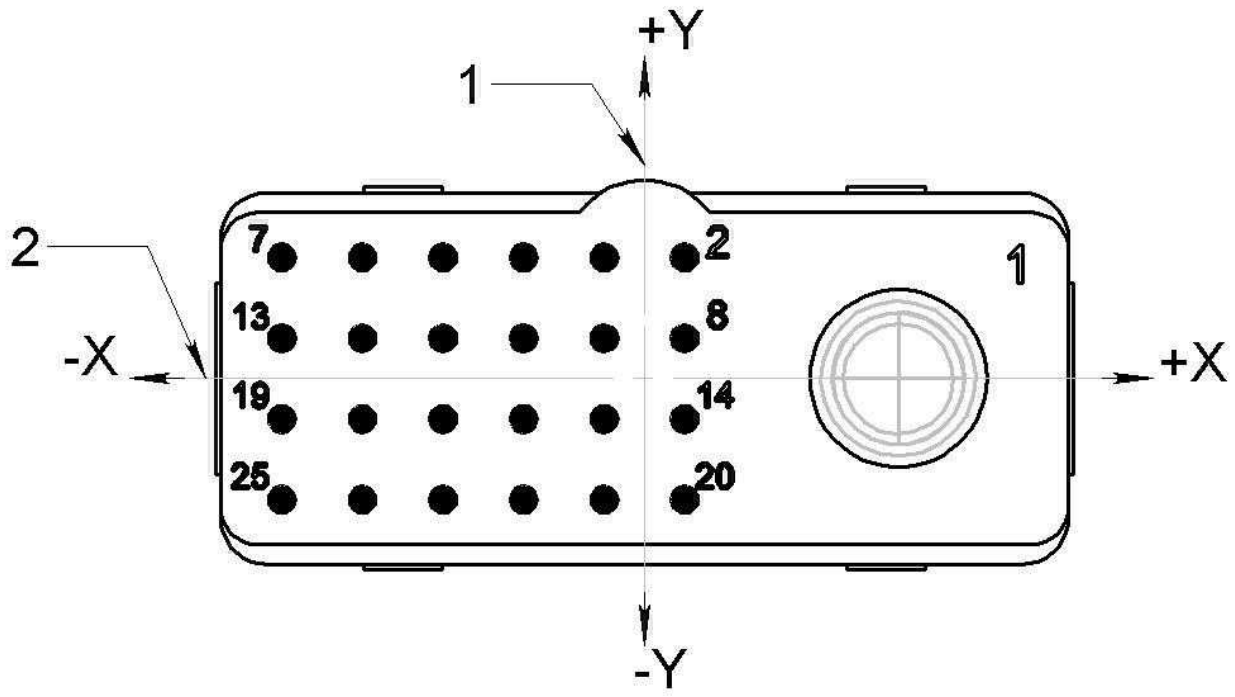
Dimensions in millimetres

Contact position							
Y	X						
	– 11,43	– 8,89	– 6,35	– 3,81	– 1,27	+ 1,27	+ 8,00
+ 3,81	6	5	4	3	2	1	–
+ 1,27	12	11	10	9	8	7	–
0	–	–	–	–	–	–	25
– 1,27	18	17	16	15	14	13	–
– 3,81	24	23	22	21	20	19	–

Table 17

Contacts		
Size	**Quantity**	**Location**
22	24	1 to 24
8 quadrax (not power)	1	25

Contact arrangement 25P1



Key

1 One or two polarization ribs
2 Centre line

Figure 45

Table 18

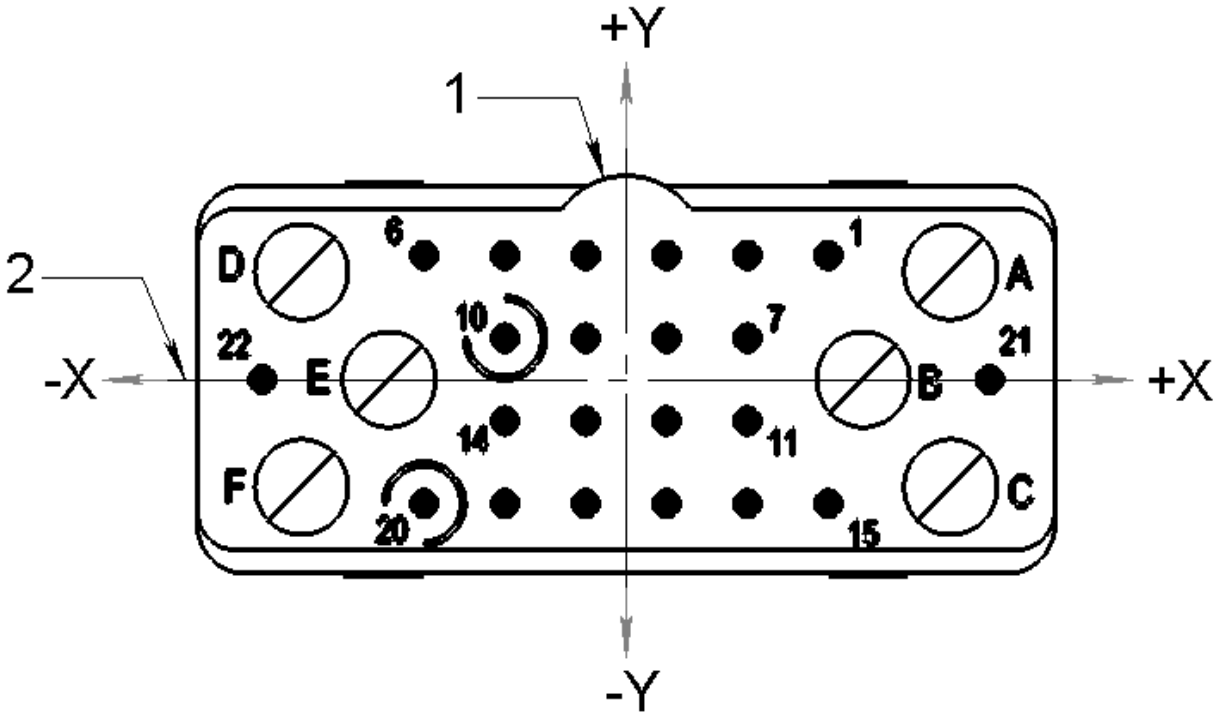
Dimensions in millimetres

Contact position							
Y	X						
	– 11,43	– 8,89	– 6,35	– 3,81	– 1,27	+ 1,27	+ 8,00
+ 3,81	7	6	5	4	3	2	–
+ 1,27	13	12	11	10	9	8	–
0	–	–	–	–	–	–	1
– 1,27	19	18	17	16	15	14	–
– 3,81	25	24	23	22	21	20	–

Table 19

Contacts		
Size	**Quantity**	**Location**
22	24	2 to 25
8 power	1	1

Contact arrangement 28



Key

1 One or two polarization ribs
2 Centre line

Figure 46

Table 20

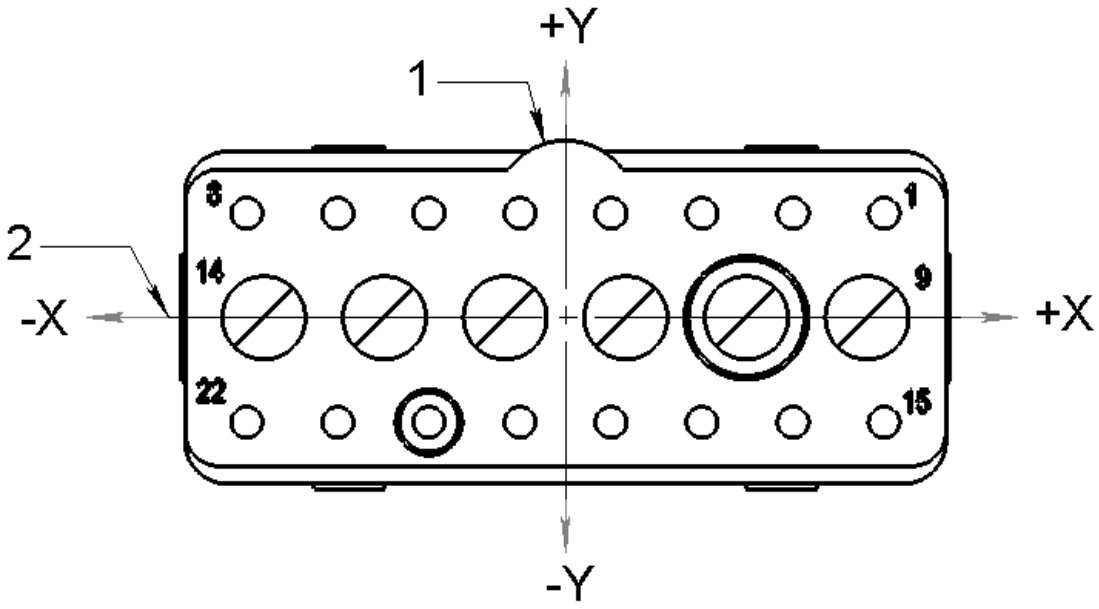
Dimensions in millimetres

Contact position												
Y	X											
	– 11,43	– 10,20	– 7,45	– 6,35	– 3,81	– 1,27	+ 1,27	+ 3,81	+ 6,35	+ 7,45	+ 10,20	+ 11,43
+ 3,81	–	–	–	6	5	4	3	2	1	–	–	–
+ 3,30	–	D	–	–	–	–	–	–	–	–	A	–
+ 1,27	–	–	–	–	10	9	8	7	–	–	–	–
0	22	–	E	–	–	–	–	–	–	B	–	21
– 1,27	–	–	–	–	14	13	12	11	–	–	–	–
+ 3,30	–	F	–	–	–	–	–	–	–	–	C	–
+ 3,81	–	–	–	20	19	18	17	16	15	–	–	–

Table 21

Contacts		
Size	**Quantity**	**Location**
22	22	1 to 22
16	6	A to F

Contact arrangement 22



Key

1 One or two polarization ribs

2 Centre line

Figure 47

Table 22

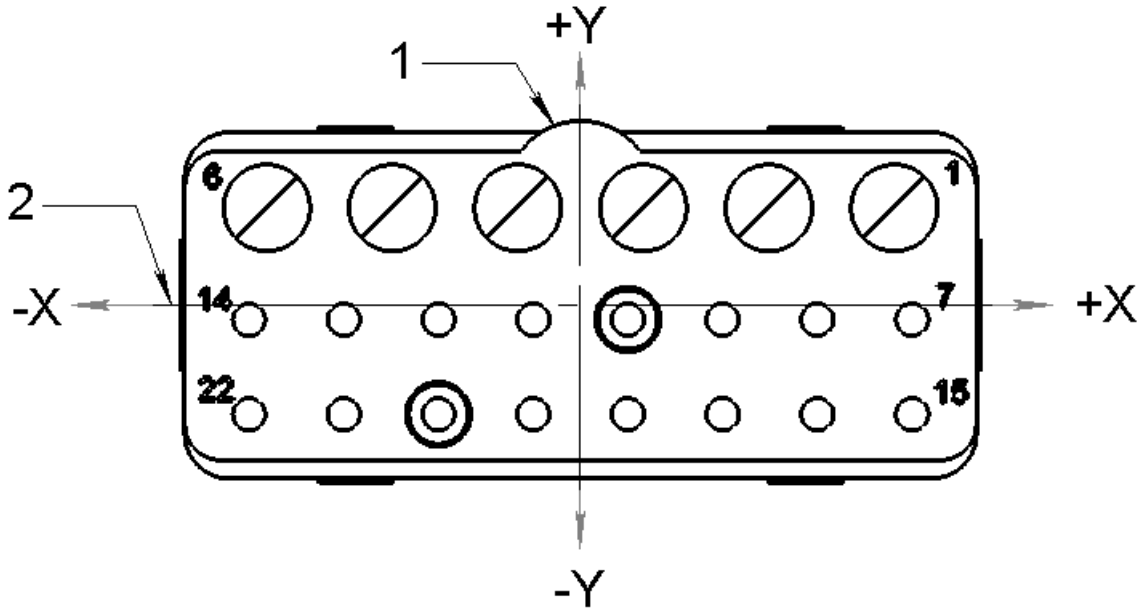
Dimensions in millimetres

Contact position													
Y	X												
	– 11,20	– 10,60	– 8,00	– 6,36	– 4,80	– 2,12	– 1,60	+ 1,60	+ 2,12	+ 4,80	+ 6,36	+ 8,00	+ 10,60	+ 11,20
+ 3,68	8	–	7	–	6	–	5	4	–	3	–	2	–	1
0	–	14	–	13	–	12	–	–	11	–	10	–	9	–
– 3,68	22	–	21	–	20	–	19	18	–	17	–	16	–	15

Table 23

Contacts		
Size	**Quantity**	**Location**
20	16	1 to 8, 15 to 22
16	6	9 to 14

Contact arrangement 22V



Key

1 One or two polarization ribs

2 Centre line

Figure 48

Table 24

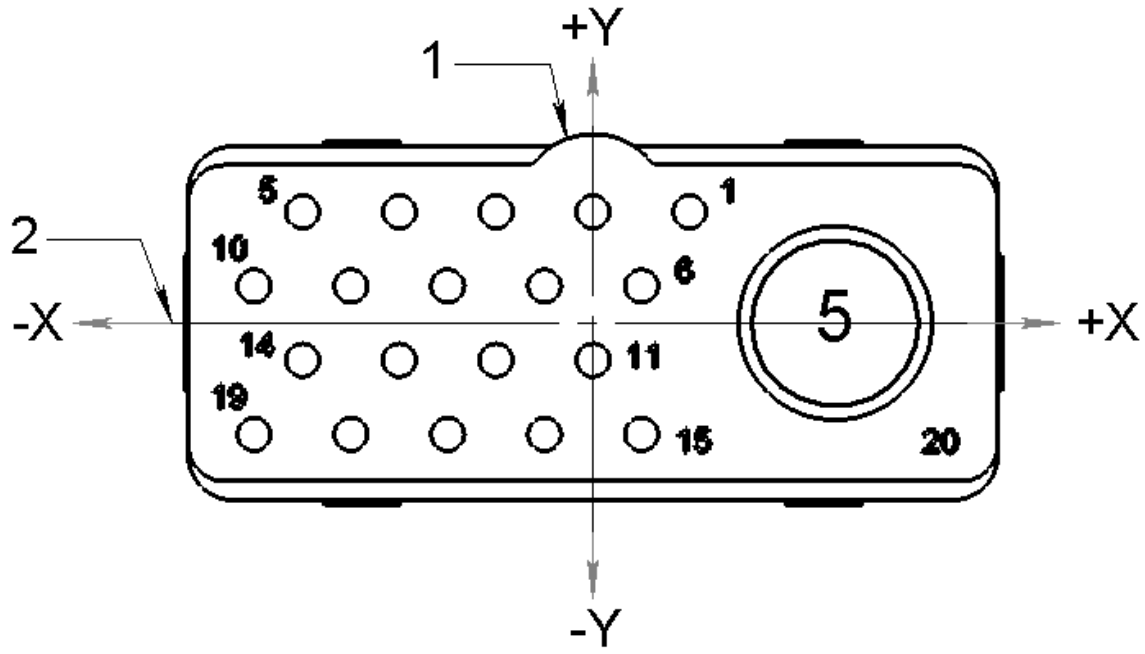
Dimensions in millimetres

Contact position														
Y	X													
	– 11,20	– 10,60	– 8,00	– 6,36	– 4,80	– 2,12	– 1,60	+ 1,60	+ 2,12	+ 4,80	+ 6,36	+ 8,00	+ 10,60	+ 11,20
+ 3,30	–	6	–	5	–	4	–	–	3	–	2	–	1	–
– 0,48	14	–	13	–	12	–	11	10	–	9	–	8	–	7
– 3,68	22	–	21	–	20	–	19	18	–	17	–	16	–	15

Table 25

Contacts		
Size	**Quantity**	**Location**
20	16	7 to 22
16	6	1 to 6

Contact arrangement 20C1



Key

1 One or two polarization ribs
2 Centre line

Figure 49

Table 26

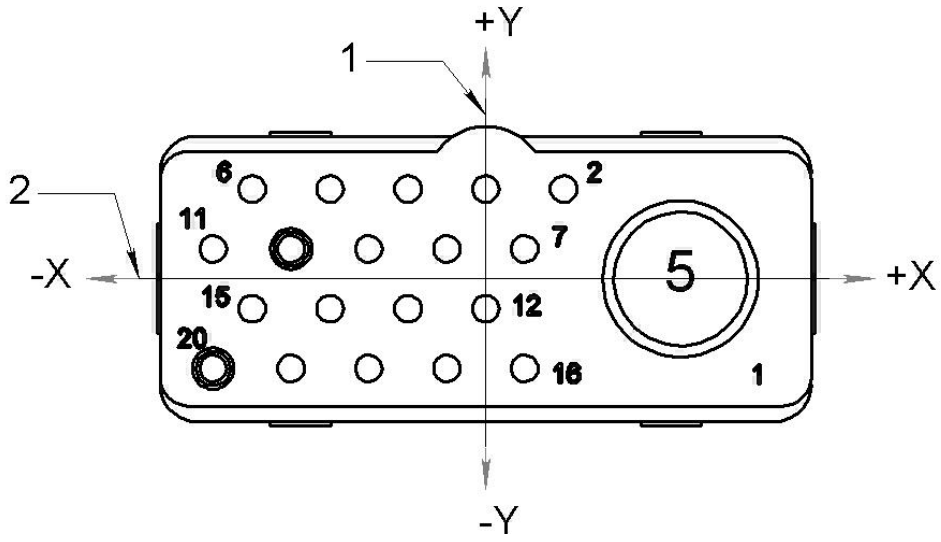
Dimensions in millimetres

Contact position											
Y	X										
	– 11,20	– 9,60	– 8,00	–6,40	– 4,80	– 3,20	– 1,60	0	+ 1,60	+ 3,2	+ 8,00
+ 3,675	–	5	–	4	–	3	–	2	–	1	–
+ 1,225	10	–	9	–	8	–	7	–	6	–	–
0	–	–	–	–	–	–	–	–	–	–	20
– 1,225	–	14	–	13	–	12	–	11	–	–	–
– 3,675	19	–	18	–	17	–	16	–	15	–	–

Table 27

Contacts		
Size	**Quantity**	**Location**
20	19	1 to 19
5 all except power	1	20

Contact arrangement 20P1



Key

1 One or two polarization ribs
2 Centre line

Figure 50

Table 28

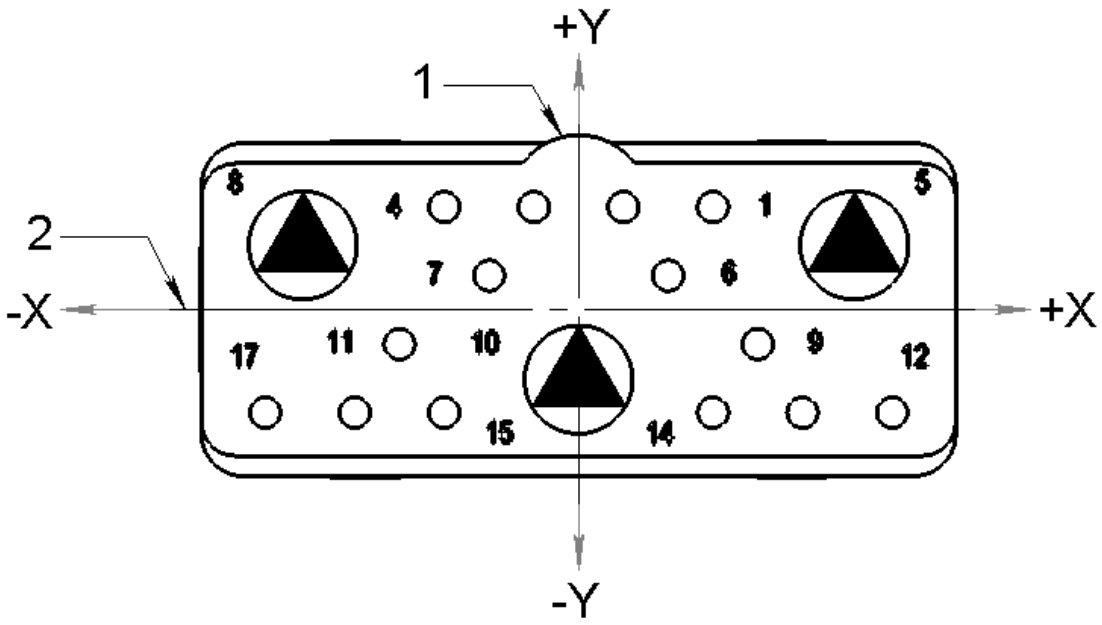
Dimensions in millimetres

Contact position											
Y	X										
	– 11,20	– 9,60	– 8,00	– 6,40	– 4,80	– 3,20	– 1,60	0	+ 1,60	+ 3,2	+ 8,00
+ 3,675	–	6	–	5	–	4	–	3	–	2	–
+ 1,225	11	–	10	–	9	–	8	–	7	–	–
0	–	–	–	–	–	–	–	–	–	–	1
– 1,225	–	15	–	14	–	13	–	12	–	–	–
– 3,675	20	–	19	–	18	–	17	–	16	–	–

Table 29

Contacts		
Size	**Quantity**	**Location**
20	19	1 to 20
5 power	1	1

Contact arrangement 17



Key

1 One or two polarization ribs
2 Centre line

Figure 51

Table 30

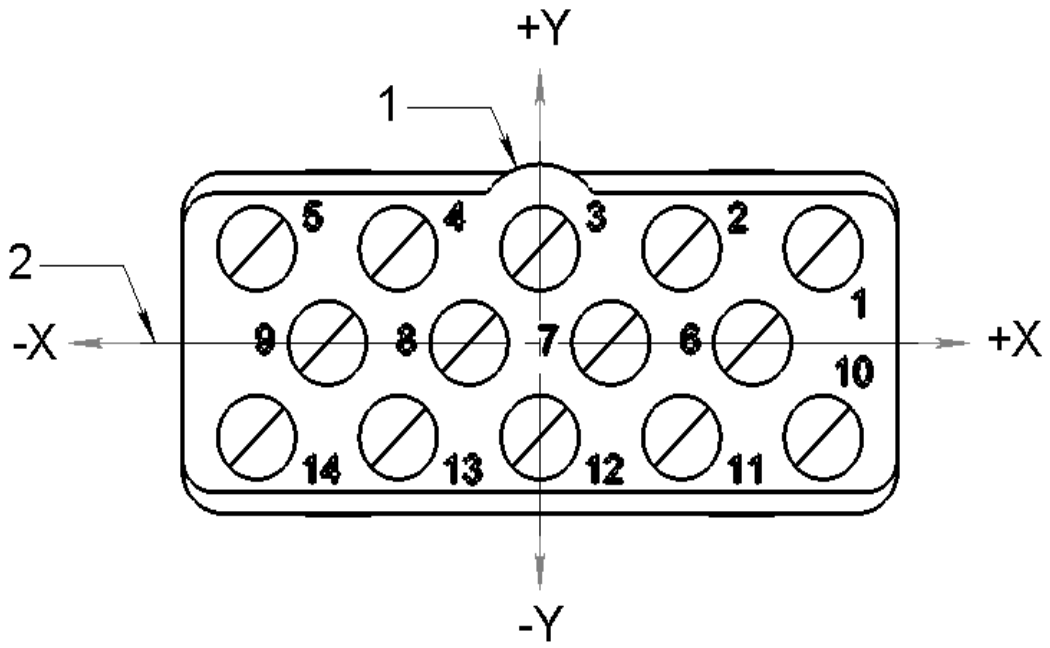
Dimensions in millimetres

Contact position															
Y	X														
	– 11,20	– 9,85	– 8,00	– 6,40	– 4,80	– 3,20	– 1,60	0	+ 1,60	+ 3,20	+ 4,80	+ 6,40	+ 8,00	+ 9,85	+ 11,20
+ 3,67	–	–	–	–	4	–	3	–	2	–	1	–	–	–	–
+ 2,30	–	8	–	–	–	–	–	–	–	–	–	–	–	5	–
+ 1,225	–	–	–	–	–	7	–	–	–	6	–	–	–	–	–
– 1,225	–	–	–	11	–	–	–	–	–	–	–	9	–	–	–
– 2,50	–	–	–	–	–	–	–	10	–	–	–	–	–	–	–
– 3,68	17	–	16	–	15	–	–	–	–	–	14	–	13	–	12

Table 31

Contacts		
Size	**Quantity**	**Location**
20	14	1 to 4, 6,7,9,11 to 14, 15 to 17
12	3	5, 8, 10

Contact arrangement 14



Key

1 One or two polarization ribs
2 Centre line

Figure 52

Table 32

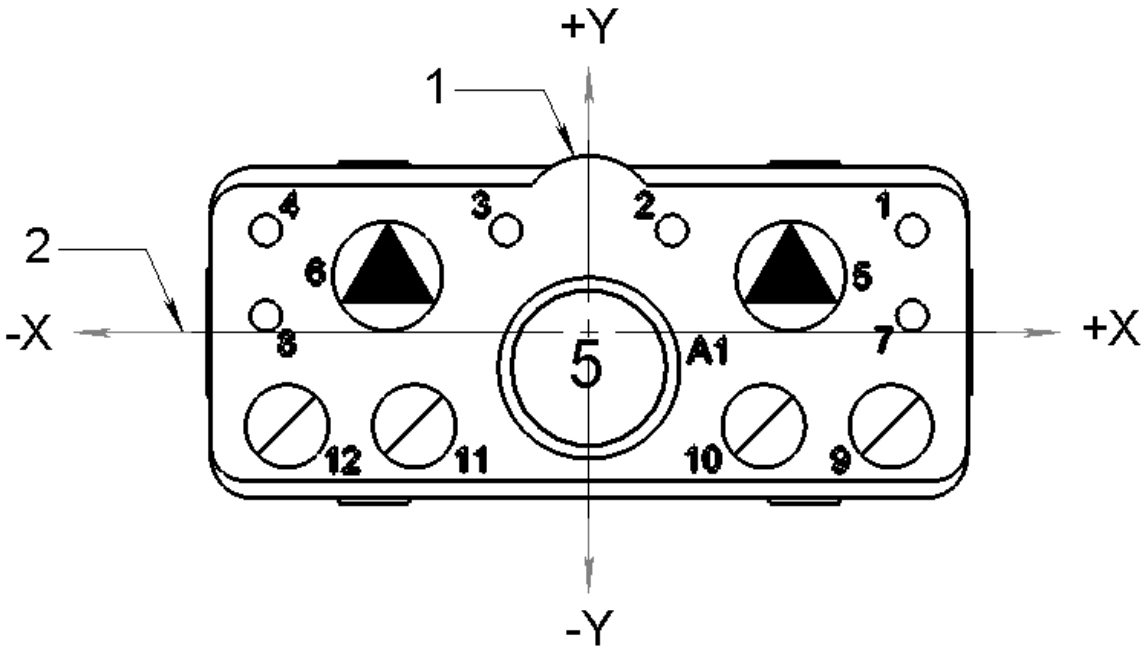
Dimensions in millimetres

Contact position									
Y	X								
	– 10,68	– 8,01	– 5,34	– 2,67	0	+ 2,67	+ 5,34	+ 8,01	+ 10,68
+ 3,30	5	–	4	–	3	–	2	–	1
0	–	9	–	8	–	7	–	6	–
– 3,30	14	–	13	–	12	–	11	–	10

Table 33

Contacts		
Size	**Quantity**	**Location**
16	14	1 to 14

Contact arrangement 13C1



Key

1 One or two polarization ribs
2 Centre line

Figure 53

Table 34

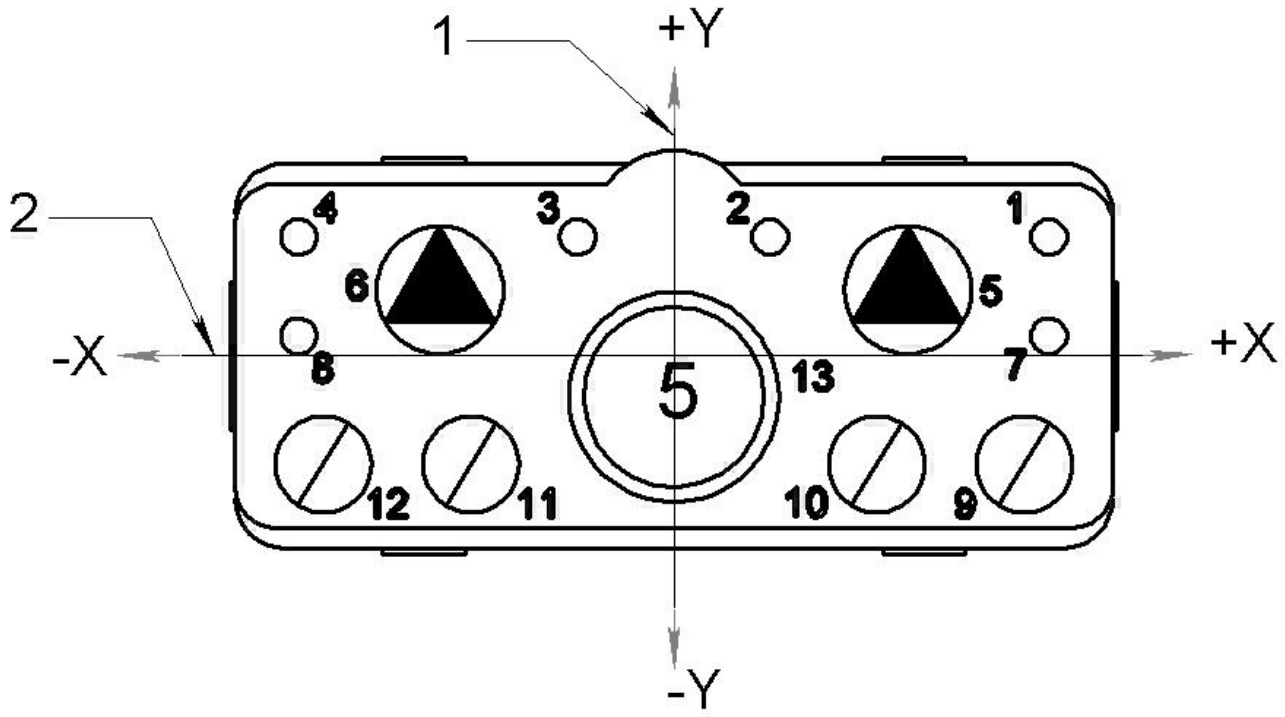
Dimensions in millimetres

Contact position											
Y	X										
	– 11,43	– 10,68	– 7,13	– 6,18	– 2,93	0	+ 2,93	+ 6,18	+ 7,13	+ 10,68	+ 11,43
+ 3,62	4	–	–	–	3	–	2	–	–	–	1
+ 2,00	–	–	6	–	–	–	–	–	5	–	–
+ 0,60	8	–	–	–	–	–	–	–	–	–	7
– 1,25	–	–	–	–	–	A1	–	–	–	–	–
– 3,30	–	12	–	11	–	–	–	10	–	9	–

Table 35

Contacts		
Size	**Quantity**	**Location**
20	6	1, 2, 3, 4, 7, 8
16	4	9, 10, 11, 12
12	2	5, 6
5 (all except power)	1	A1

Contact arrangement 13P1



Key

1 One or two polarization ribs
2 Centre line

Figure 54

Table 36

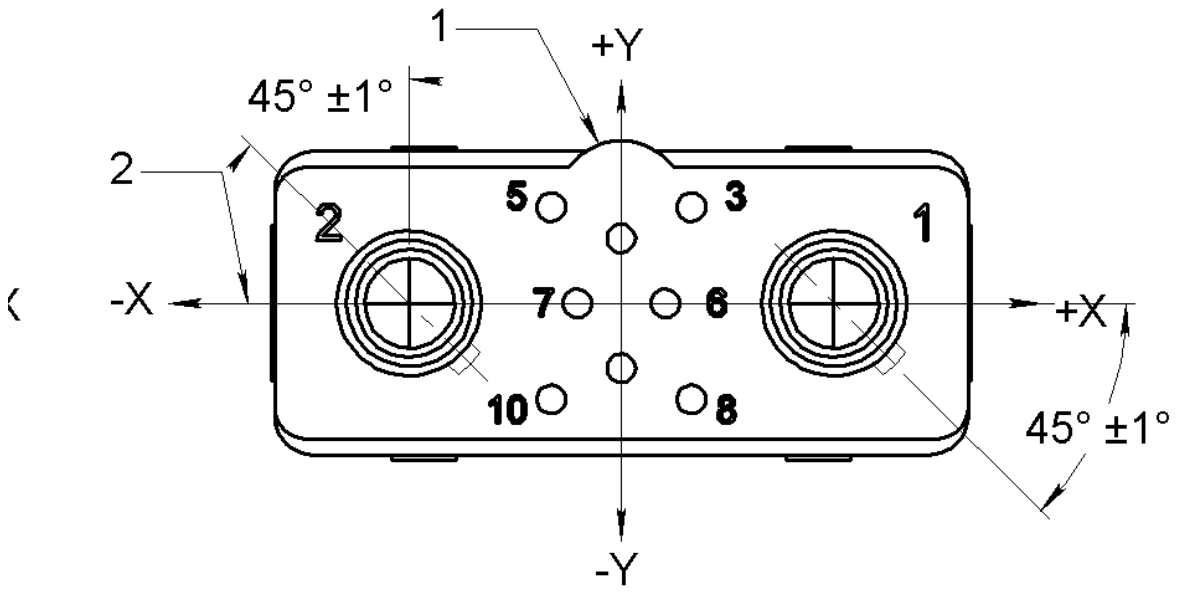
Dimensions in millimetres

Contact position											
Y	X										
	− 11,43	− 10,68	− 7,13	− 6,18	− 2,93	0	+ 2,93	+ 6,18	+ 7,13	+ 10,68	+ 11,43
+ 3,62	4	–	–	–	3	–	2	–	–	–	1
+ 2,00	–	–	6	–	–	–	–	–	5	–	–
+ 0,60	8	–	–	–	–	–	–	–	–	–	7
− 1,25	–	–	–	–	–	13	–	–	–	–	–
− 3,30	–	12	–	11	–	–	–	10	–	9	–

Table 37

Contacts		
Size	**Quantity**	**Location**
20	6	1, 2, 3, 4, 7, 8
16	4	9, 10, 11, 12
12	2	5, 6
5 power	1	13

Contact arrangement 10Q2



Key

1 One or two polarization ribs
2 Centre line

Figure 55

Table 38

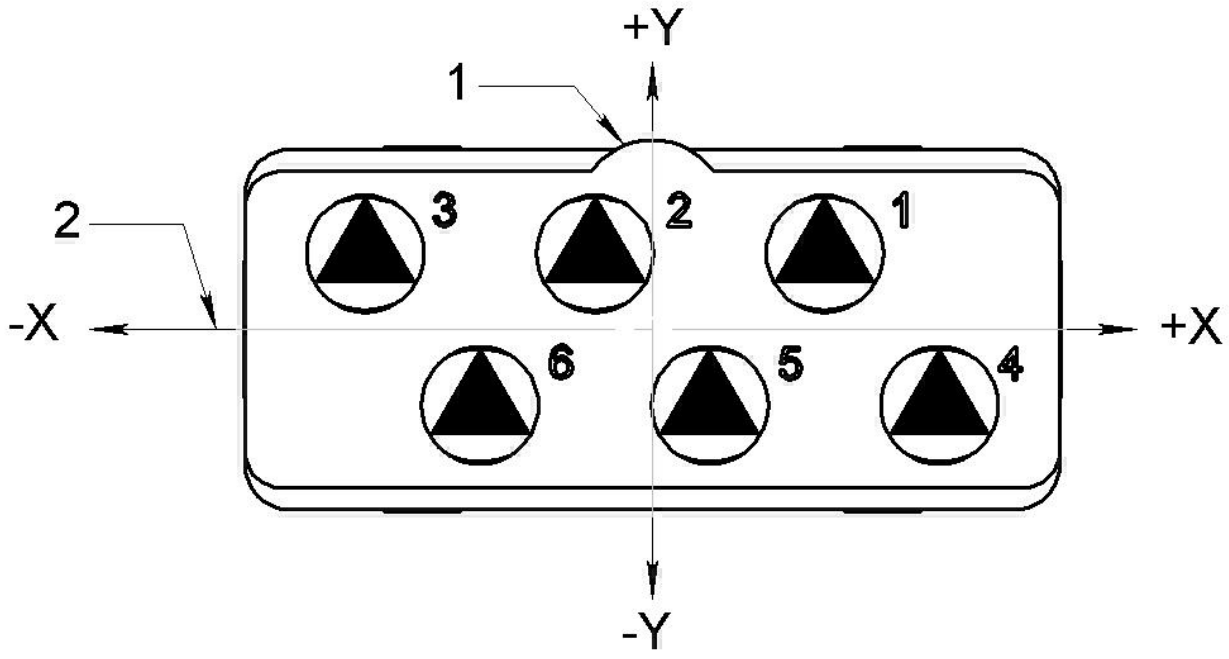
Dimensions in millimetres

Contact position							
Y	X						
	– 8,20	– 2,70	– 1,70	0	+ 1,70	+ 2,70	+ 8,20
+ 3,70	–	5	–	–	–	3	–
+ 2,50	–	–	–	4	–	–	–
0	2	–	7	–	6	–	1
– 2,50	–	–	–	9	–	–	–
– 3,70	–	10	–	–	–	8	–

Table 39

Contacts		
Size	**Quantity**	**Location**
20	8	3 to 10
8 quadrax	2	1 and 2

Contact arrangement 06



Key

1 One or two polarization ribs
2 Centre line

Figure 56

Table 40

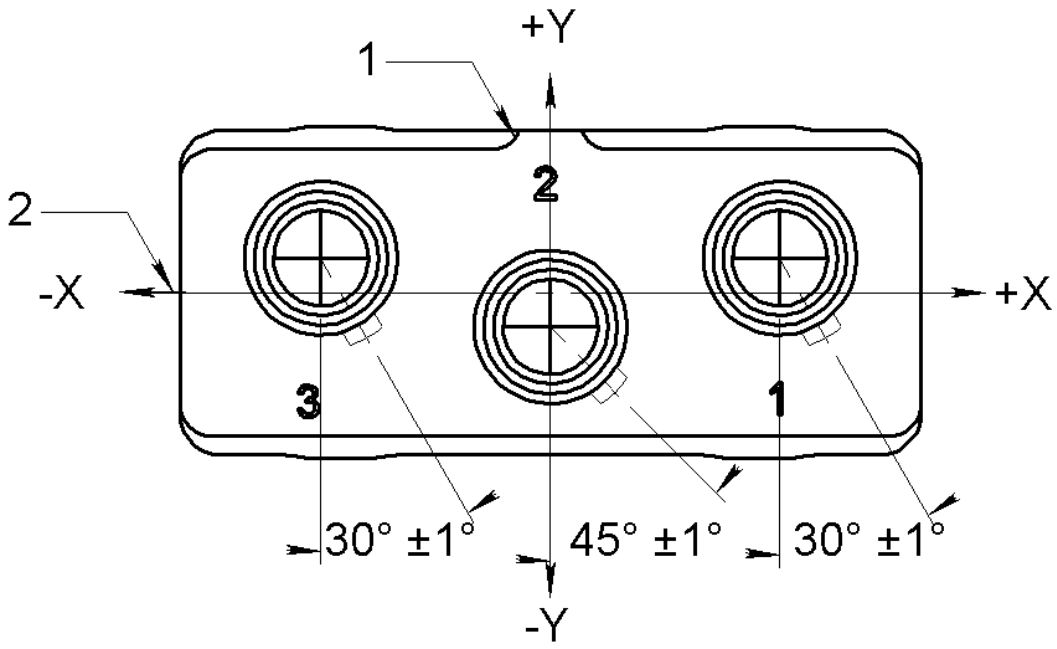
Dimensions in millimetres

Contact position						
Y	X					
	– 9,50	– 5,70	– 1,90	+ 1,90	+ 5,70	+ 9,50
+ 2,50	3	–	2	–	1	–
– 2,50	–	6	–	5	–	4

Table 41

Contacts		
Size	**Quantity**	**Location**
12	6	1 to 6

Contact arrangement 3Q3



Key

1 One or two polarization ribs

2 Centre line

Figure 57

Table 42

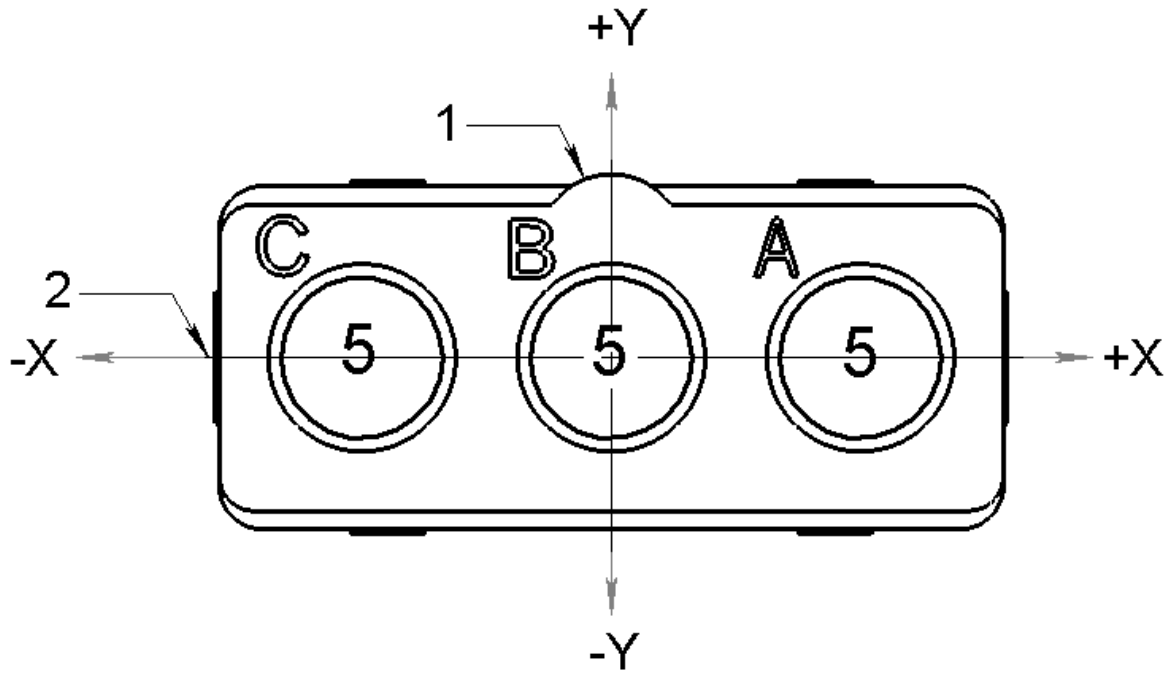
Dimensions in millimetres

Contacts position			
Y	**X**		
	− 8,36	0	+ 8,36
+ 1,25	3	–	1
− 1,25	–	2	–

Table 43

Contacts		
Size	**Quantity**	**Location**
8 quadrax	3	1 to 3

Contact arrangement C3



Key

1 One or two polarization ribs
2 Centre line

Figure 58

Table 44

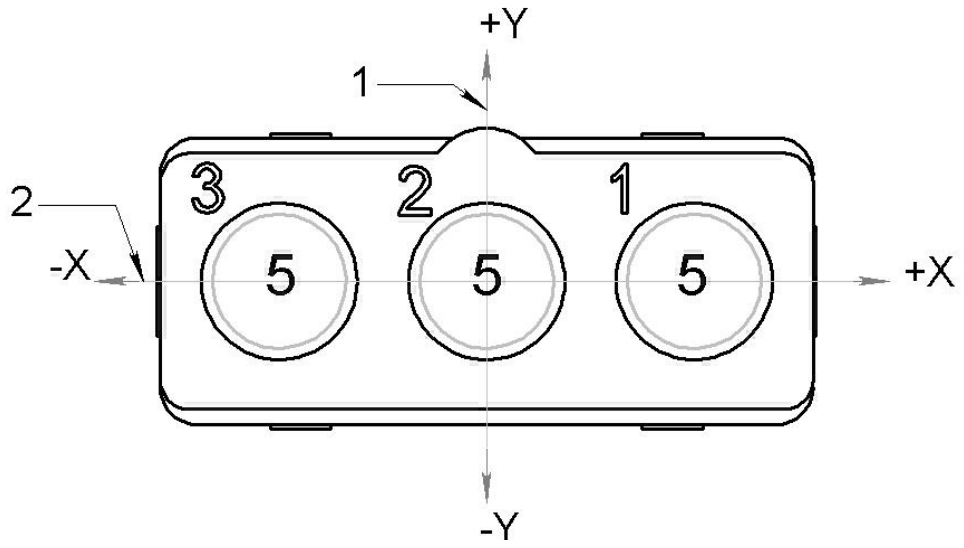
Dimensions in millimetres

Contact position			
Y	**X**		
	− 8,50	0	+ 8,50
0	C	B	A

Table 45

Contacts		
Size	**Quantity**	**Location**
5 all except power	3	A to C

Contact arrangement P3



Key

1 One or two polarization ribs
2 Centre line

Figure 59

Table 46

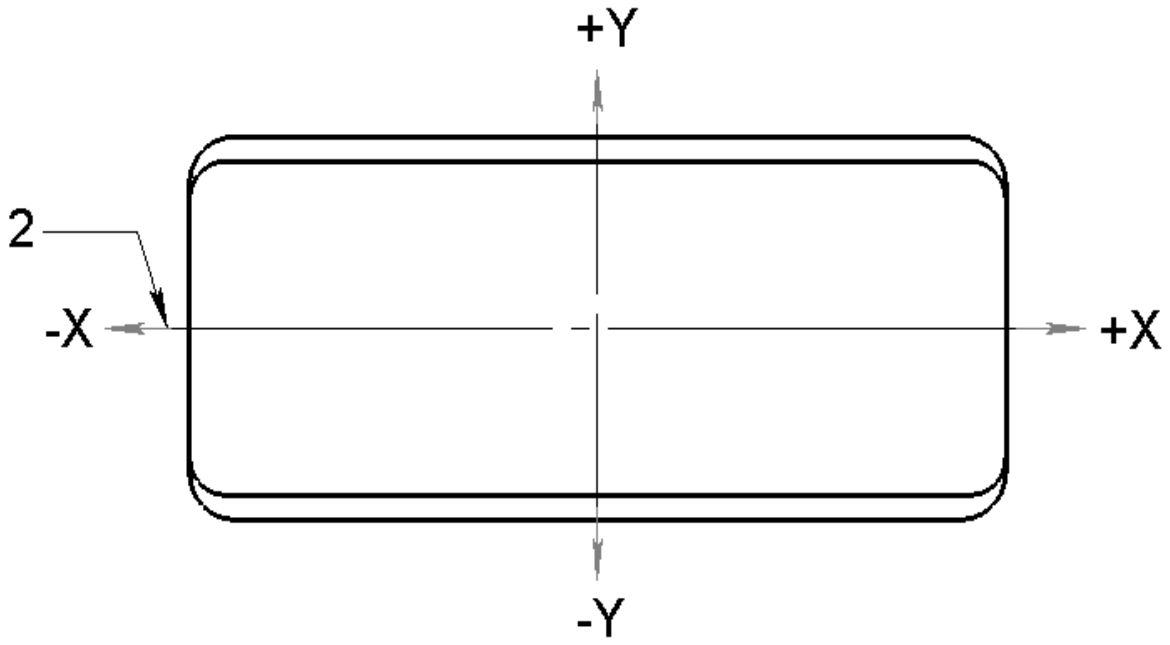
Dimensions in millimetres

Contact position			
Y	**X**		
	− 8,50	0	+ 8,50
0	3	2	1

Table 47

Contacts		
Size	**Quantity**	**Location**
5 power	3	1 to 3

Contact arrangement 0



Key

1 Center line

Figure 60

Table 48

Contacts		
Size	**Quantity**	**Location**
–	–	–

7 Tests

7.1 Tests according to EN 2591-100

The tests of EN 2591-100, applicable in the context of this standard as well as the details necessary for implementing them and for inspecting connector characteristics, are given in Table 49.

If a connector uses fibre optic contacts, an additional qualification should be done per the optical EN standard.

Table 49 *(1 of 10)*

<table>
<tr><th>EN 2591-</th><th>Designation of the test</th><th>Details</th></tr>
<tr><td>101</td><td>Visual examination</td><td>Applicable, naked eye</td></tr>
<tr><td>102</td><td>Examination of dimensions and mass</td><td>Applicable see product standard</td></tr>
<tr><td>201</td><td>Contact resistance - low level</td><td>Applicable
Defined by the standards for contacts specified in EN 4644-002.</td></tr>
<tr><td>202</td><td>Contact resistance at rated current</td><td>Applicable
Defined by the standards for contacts specified in EN 4644-002.
Contacts SAE AS39029/1-101 for grounding blocks of classes B and F connectors.
Measuring points at a distance of (75 ± 3) mm from the crimp barrel of each contact. The test shall be applied to a minimum of four pairs of contacts installed next to each other in the ground block and on a minimum of four pairs of contacts installed on the plug and the receptacle.
<table>
<tr><th rowspan="3">Wire size</th><th rowspan="3">Rated test current
A</th><th colspan="2">Max. contact resistance</th></tr>
<tr><th colspan="2">Contact to contact</th></tr>
<tr><th>Initial</th><th>After test</th></tr>
<tr><td>20</td><td>7,5</td><td>9</td><td>11</td></tr>
</table>
</td></tr>
<tr><td>203</td><td>Electrical continuity at microvolt level</td><td>Applicable to shielded contact.
Requirements defined by the standard for contacts specified in EN 4644-002.</td></tr>
<tr><td>204</td><td>Discontinuity of contacts in the microsecond range</td><td>Duration 1µs. Method B. Test time: throughout the duration of tests EN 2591-402, EN 2591-403.
Except 10 ns for quadrax contacts.</td></tr>
<tr><td>205</td><td>Housing (shell) electrical continuity</td><td>Measuring points: on the rear of the male housing and a point in the front face of the counterpart female housing flange.
a) between mated connectors:
Classes A, B, E and F: 2,5 mΩ max. before and after test.
Class C: 15 mΩ max. before and after test.
b) between shell and grounded contact
Measuring point on the outer contact, flush with the insert and on the body shell.
Maximum resistance:
Classes A, B, E and F: 10 mΩ max. before and after test.
Class C: 20 mΩ max. before and after test</td></tr>
</table>

Table 49 *(2 of 10)*

<table>
<tr><th>EN 2591-</th><th>Designation of the test</th><th>Details</th></tr>
<tr><td>205
(continued)</td><td>Housing (shell) electrical continuity</td><td>Rack and panel size 3 and 4 connectors have to be mated with a Fs compression force between shells. In order to take into account the reaction force exerted by the environmental inserts (interfacial seal compression) and of inserts for fibre optic contacts the following formula has to be used:
$F_m = x\,F_s + y\,F_i + z\,F_o$
where
F_m = maximum connector mating force;
F_s = maximum shell mating force per cavity = 150 N;
x = number of insert cavities;
F_i = interfacial seal counter reaction force = 300 N;
y = number of environmental inserts;
F_o = fibre optic counter reaction force (see the appropriate EN optical standard);
z = number of fibre optic contacts.</td></tr>
<tr><td>206</td><td>Measurement of insulation resistance</td><td>Method A on unmated connectors
$>$ 5 000 MΩ at ambient temperature
$>$ 200 MΩ at elevated temperature (175 °C)</td></tr>
<tr><td>207</td><td>Voltage proof test</td><td>Method A, connectors mated and unmated except after test EN 2591-314 where they shall be mated.
<table>
<tr><th>Max. leakage current</th><th>Pressure</th><th>Connector mated
V r.m.s</th><th>Connector unmated
V r.m.s</th></tr>
<tr><td colspan="4">Environmental connectors</td></tr>
<tr><td rowspan="3">1mA</td><td>Sea level</td><td>1 500</td><td>1 500</td></tr>
<tr><td>12,1 kPa (15 000 m)</td><td>800</td><td>600</td></tr>
<tr><td>4,7 kPa (21 000 m)</td><td>800</td><td>300</td></tr>
<tr><td colspan="4">Semi environmental connectors</td></tr>
<tr><td rowspan="3">1mA</td><td>Sea level</td><td>1 500</td><td>1 500</td></tr>
<tr><td>12,1 kPa (15 000 m)</td><td>600</td><td>600</td></tr>
<tr><td>4,7 kPa (21 000 m)</td><td>300</td><td>300</td></tr>
<tr><td colspan="4">Non environmental connectors</td></tr>
<tr><td rowspan="3">1mA</td><td>Sea level</td><td>1 500</td><td></td></tr>
<tr><td>12,1 kPa (15 000 m)</td><td>600</td><td></td></tr>
<tr><td>4,7 kPa (21 000 m)</td><td>400</td><td></td></tr>
</table></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 for qualification</td></tr>
</table>

Table 49 *(3 of 10)*

<table>
<tr><th>EN 2591-</th><th>Designation of the test</th><th>Details</th></tr>
<tr><td>210</td><td>Electrical overload</td><td>
<table>
<tr><th>Contact size</th><th>Current
A</th><th>Duration
S</th></tr>
<tr><td>22</td><td>10
50</td><td rowspan="4">40
0,6</td></tr>
<tr><td>20</td><td>15
75</td></tr>
<tr><td>16</td><td>26
130</td></tr>
<tr><td>12</td><td>46
230</td></tr>
</table>
</td></tr>
<tr><td>211</td><td>Capacitance</td><td>Not applicable</td></tr>
<tr><td>212</td><td>Surface transfer impedance
(10 k to 100 MHz)</td><td>Not applicable. 5 mΩ initial; 10 mΩ after tests</td></tr>
<tr><td>213</td><td>Shielding effectiveness
from 100 MHz to 1 GHz</td><td>
<table>
<tr><th rowspan="2">Frequency

MHz</th><th colspan="2">Leakage attenuation</th></tr>
<tr><th>Aligning cavities
dB</th><th>Non aligning cavities
dB</th></tr>
<tr><td>100</td><td>65</td><td>55</td></tr>
<tr><td>200</td><td rowspan="2">63</td><td>52</td></tr>
<tr><td>300</td><td>50</td></tr>
<tr><td>400</td><td>62</td><td rowspan="2">45</td></tr>
<tr><td>500</td><td>60</td></tr>
<tr><td>600</td><td>55</td><td rowspan="3">40</td></tr>
<tr><td>800</td><td rowspan="2">50</td></tr>
<tr><td>1 000</td></tr>
</table>
</td></tr>
<tr><td>214</td><td>Lightning strike, current and voltage pulse</td><td>Applicable to classes A and B connectors only.
Class 5 kA – 1 600 Volts – 10 pulses.
Class 3 kA – 1 600 Volts – for other classes.</td></tr>
<tr><td>216</td><td>Engagement of contacts</td><td>
<table>
<tr><th>Contact size</th><th>Minimal engagement
mm</th></tr>
<tr><td>22</td><td rowspan="2">1,27</td></tr>
<tr><td>20</td></tr>
<tr><td>16</td><td rowspan="4">1,50</td></tr>
<tr><td>12</td></tr>
<tr><td>8</td></tr>
<tr><td>5</td></tr>
</table>
</td></tr>
</table>

Table 49 *(4 of 10)*

EN 2591-	Designation of the test	Details
220	Contact /conductor joint ageing by current and temperature cycling	Not applicable
221	Voltage Standing Wave Ratio (VSWR)	Not applicable
222	Insertion Loss (I.L)	Not applicable
223	Measurement of characteristic impedance of a coaxial connector or contact	Not applicable
224	RF leakage	Not applicable
225	RF high potential withstanding voltage	Not applicable
226	Corona level	Not applicable
301	Endurance at temperature	Method B, no load. Temperature: (175 °C or 125 °C for class C connectors) Duration: 1 000 h
302	Climatic sequence	Not applicable to non environmental connectors. Connector mated Minimum temperature: (-65 ± 2) °C Maximum temperature: (175 ± 2) °C; (125 ± 2) °C for class C
303	Cold/low pressure and damp heat	Not applicable
304	Damp heat steady state	Not applicable
305	Rapid change of temperature	Connectors mated, five cycles Classes A, B, E and F $T_A = (175 \begin{smallmatrix}+0,5\\0\end{smallmatrix})$ °C $T_B = (-65 \begin{smallmatrix}0\\-0,5\end{smallmatrix})$ °C Class C connectors $T_A = (125 \begin{smallmatrix}+0,5\\0\end{smallmatrix})$ °C $T_B = (-65 \begin{smallmatrix}0\\-0,5\end{smallmatrix})$ °C
306	Mould growth	Test conducted on materials Method A Duration: 28 d Growth: 0 No prior washing No surface etching
307	Salt mist	The connectors shall be suspended in the test chamber with non-metallic cords, so that no accumulation of condensed saline solution can occur. The connectors unmated shall be exposed to the salt mist for 96 h except for class C connectors which shall be exposed to the salt mist for 48 h.
308	Sand and dust	The mated connectors shall be arranged so that their longitudinal axis is parallel t o the wind direction, with the rear of the plug facing into the wind. Wind velocity in the duct: $(3,5 \pm 0,5)$ m/s. Number of cycle: one
309	Dry heat	Not applicable

Table 49 *(5 of 10)*

EN 2591-	Designation of the test	Details
310	Cold	Not applicable
311	Low air pressure	Not applicable
312	Air leakage	Not applicable
313	Driving rain (artificial)	Not applicable
314	Immersion at low air pressure	Applicable to environmental connectors. Pressure : 12,1 KPa
315	Fluid resistance	Applicable, for types of fluids number of cycles, temperature and duration of immersion for the third phase: see Table 50.
316	Ozone resistance	Not applicable
317	Flammability	Applicable Method A
318	Fire-resistance	Not applicable
319	Gastightness of solderless wrapped connections	Not 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	The element of connection shall have all its contacts wired in series using cables according to EN 2267-003. The elements of connection fitted with appropriate cable clamps shall be mated and mounted on the shock apparatus using appropriate mounting systems. The elements of connection are not fitted with any accessories. The cables are clamped at a minimum of 200 mm from the rear of the connector. Size 2 disconnect connectors: coupling torque = 1,1/1,3 Nm Rack and panel connectors have to be mated with an F_s compression force between shells. In order to take into account the reaction force exerted by the environmental inserts (interfacial seal compression) and of inserts fibre optic contacts the following formula has to be used: $F_m = x\,F_s + y\,F_i + z\,F_o$ where F_m = maximum connector mating force; F_s = maximum shell mating force per cavity = 150 N; x = number of insert cavities; F_i = interfacial seal counter reaction force = 300 N; y = number of environmental inserts; F_o = fibre optic counter reaction force (see the appropriate EN optical standard); z = number of fibre optic contacts. Method A Severity 300 for size 2 classes A, B and C except for connectors fitted with quadrax contacts and rack and panel connectors where severity is 50. Severity 50 for the others connectors sizes and classes. Number of shocks: three shocks in each direction shall be applied along the three mutually perpendicular axes of the element of connection. EN 2591-204 throughout the test.

Table 49 *(6 of 10)*

EN 2591-	Designation of the test	Details
403	Sinusoidal and random vibration	The element of connection shall have all its contacts wired in series using cables according to EN 2266-003. The elements of connection fitted with appropriate cable clamps shall be mated and mounted on the shock apparatus using appropriate mounting systems. The elements of connection are not fitted with any accessories. The cables are clamped at a minimum of 200 mm from the rear of the connector. Size 2 disconnect connectors: coupling torque = 1,1/1,3 Nm Rack and panel connectors have to be mated with an F_s compression force between shells. In order to take into account the reaction force exerted by the environmental inserts (interfacial seal compression) and of inserts fibre optic contacts the following formula has to be used: $F_m = x\,F_s + y\,F_i + z\,F_o$ where F_m = maximum connector mating force; F_s = maximum shell mating force per cavity = 150 N; x = number of insert cavities; F_i = interfacial seal counter reaction force = 300 N; y = number of environmental inserts; F_o = fibre optic counter reaction force (see the appropriate EN optical standard); z = number of fibre optic contacts. Method B Test curves three, level G, height hours in each three directions for disconnect application connectors. Connectors size 1, 2, 3 and 4 fitted with quadrax contacts or for rack and panel application shall be tested according to Method B test curve 2 level E.
404	Transverse load (external Bending moment)	Applicable. The plug connector is mounted on a panel, 2,5 mm thick, made of steel or aluminium Vertical shear: 2 000 N Side shear: 2 000 N
405	Axial load	Applicable. The plug connector is mounted on a panel, 2,5 mm thick, made of steel or aluminium Axial load 3 000 N
406	Mechanical endurance	Number of mating and unmating operations: Size 1, 2, 3 and 4: 500 limited to 100 mating/unmating operation by locking mechanisms The rate shall not exceed five cycles/min.
407	Durability of contact retention system and seals (Maintenance ageing)	Applicable

Table 49 *(7 of 10)*

<table>
<tr><th>EN 2591-</th><th>Designation of the test</th><th>Details</th></tr>
<tr><td>408</td><td>Mating and unmating forces</td><td>Maximum mating forces
<u>Rack and panel connectors:</u>
$F_m = x\,F_s + y\,F_i + z\,F_o$
where
F_m = maximum connector mating force;
F_s = maximum shell mating force per cavity = 150 N;
x = number of insert cavities;
F_i = interfacial seal counter reaction force = 300 N;
y = number of environmental inserts;
F_o = fibre optic counter reaction force (see the appropriate EN optical standard);
z = number of fibre optic contacts.
<u>Disconnect panel connectors:</u>
Size 1 and 2 connectors :
Method A
Torques shall be within the limits indicated below with tolerances of ± 0,1 N.m
<table>
<tr><th rowspan="2">Coupling shell</th><th colspan="2">Initial</th><th colspan="2">After mechanical endurance</th></tr>
<tr><th>Coupling torque
N.m</th><th>Uncoupling torque
N.m</th><th>Coupling torque
N.m</th><th>Uncoupling torque
N.m</th></tr>
<tr><td>Connector size 2</td><td>1,2</td><td>1,2</td><td>1,2</td><td>1,2</td></tr>
<tr><td>Connector size 1</td><td>1,0</td><td>1,0</td><td>1,1</td><td>1,1</td></tr>
</table>
</td></tr>
<tr><td>409</td><td>Contact retention in insert</td><td>The contacts may be slightly preloaded (10 N max)
Axial displacement < 0,38 mm
<table>
<tr><th>Contact size</th><th>Axial load
N</th></tr>
<tr><td>22</td><td>53</td></tr>
<tr><td>20</td><td>89</td></tr>
<tr><td>16</td><td>111</td></tr>
<tr><td>12</td><td>133</td></tr>
<tr><td>8</td><td>156</td></tr>
<tr><td>5</td><td>133</td></tr>
</table>
</td></tr>
</table>

Table 49 *(8 of 10)*

<table>
<tr><th>EN 2591-</th><th>Designation of the test</th><th>Details</th></tr>
<tr><td>410</td><td>Insert retention in housing (axial)</td><td>Connector not fitted with contacts.
Prior to the insert retention test, the insert shall be subjected to 10 cycles of being inserted and extracted from the shell using the extraction tool specified.
The insert may be slightly preloaded (10 N max)
Mechanical pressure applied: 400 N on the front face of the insert.
The insert should retain its normal position in the connector displacement < 0,3 mm. At the completion of the test, insert shall be able to be removed using the standard removing tool. The retention mechanism shall be inspected and shall show no physical damage.</td></tr>
<tr><td>411</td><td>Insert retention in housing (torsional)</td><td>Not applicable</td></tr>
<tr><td>412</td><td>Contact insertion and extraction forces</td><td><table><tr><th rowspan="2">Contact size</th><th colspan="2">Axial load
N</th></tr><tr><th>Insertion</th><th>Removal</th></tr><tr><td>22</td><td>44</td><td>36</td></tr><tr><td>20</td><td>67</td><td>44</td></tr><tr><td>16</td><td>89</td><td>67</td></tr><tr><td>12</td><td>111</td><td>89</td></tr><tr><td>5</td><td>89</td><td>67</td></tr></table></td></tr>
<tr><td>413</td><td>Holding force of grounding spring system</td><td>Sizing gage as defined by Figure 53 and Figure 54.
Sizing gage weight = 180 g
The sizing gage shall be retained by the connector AC grounding device</td></tr>
<tr><td>414</td><td>Unmating of lanyard release connectors</td><td>Not applicable</td></tr>
<tr><td>415</td><td>Test probe damage (Grounding block contact)</td><td>Test applicable to the grounding block contacts.
The test probe shall conform to Figure 61 and Table 51.
Bending moment: 0,055 N.m.
After test the grounding block contact shall meet test EN 2591-202 requirements.</td></tr>
<tr><td>416</td><td>Contact bending strength</td><td>Not applicable</td></tr>
<tr><td>417</td><td>Tensile strength (crimped connection)</td><td>Not applicable</td></tr>
<tr><td>418</td><td>Gauge insertion/extraction forces (female contacts)</td><td>Grounding block contacts:
An oversized contact with the following characteristics shall be used :
Length: 25,4 mm minimum
Material: Gage-hardened steel
Finish: 15 µm to 25 µm
Diameter: $1{,}956\ ^{+0{,}005}_{-0}$
Tip radius: Full spherical radius
A minimum of four grounding clips shall be tested by attempting to insert the oversized contact with a force of (13,34 ± 0,55) N.</td></tr>
</table>

Table 49 *(9 of 10)*

<table>
<tr><th>EN 2591-</th><th>Designation of the test</th><th>Details</th></tr>
<tr><td>418
concluded</td><td>Gauge insertion/extraction forces (female contacts)</td><td>After performing the test, the grounding clips shall meet the requirements as described below.
The contact separation force shall be a minimum of 0,55 N when tested as specified.
The connector shall be mounted in a suitable fixture for applying gradually increasing loads for measuring the separation force of the contacts. Condition each contact by inserting and withdrawing a SAE AS31971 minimum size test pin for a size 16 contact one time. Insert the test pin to a depth of at least 70 % of the bore depth. Measure the minimum force required to remove the pin from the internal socket contact.</td></tr>
<tr><td>419</td><td>Stability of male contacts in insert</td><td>Test Probe for test: see Figure 1 and Table 2.
<table>
<tr><th>Contact size</th><th>Force
N</th><th>Max. permitted deflection
mm</th></tr>
<tr><td>22</td><td>0,60</td><td>1,32</td></tr>
<tr><td>20</td><td>2,50</td><td>1,40</td></tr>
<tr><td>16</td><td>5,00</td><td>1,53</td></tr>
<tr><td>12</td><td>5,00</td><td>1,58</td></tr>
<tr><td>5</td><td>5,50</td><td>1,58</td></tr>
</table></td></tr>
<tr><td>420</td><td>Mechanical strength of rear accessories</td><td>Phase A: 67N – In accordance with Figure 61.</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 strength</td><td>Not applicable</td></tr>
<tr><td>424</td><td>Stripping force, solderless wrapped connections</td><td>Not applicable</td></tr>
<tr><td>425</td><td>Unwrapping capability, solderless wrapped connections</td><td>Not applicable</td></tr>
<tr><td>426</td><td>Contact retention system effectiveness (removable contact walkout)</td><td>Multi-strand steel cable of a cross section which can fit in the contact crimp barrel.
Test applicable to size 22, 20, 16, 12 and 5 contacts and grounding block contacts.
Force = 13 N</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>Not applicable</td></tr>
</table>

Table 49 *(10 of 10)*

EN 2591-	Designation of the test	Details
502	Restricted entry	Not applicable
503	Contact deformation after crimping	Not applicable
505	Contact protection effectiveness (scoop-proof)	Not applicable
506	Use of tools	Not applicable
507	Plating porosity	Not applicable
508	Measurement of thickness of coating on contacts	Not applicable
509	Adhesion of coating on contacts	Not applicable
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	Not applicable
515	Hydrolytic stability	Applicable to classes E and F connectors Method A increase in weight < 0,75 %.

7.2 Special Tests

7.2.1 Fluids test

See Table 50.

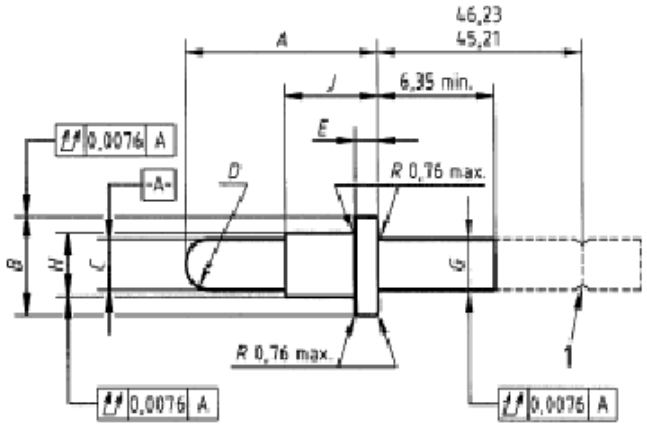
Table 50 — Resistance to fluids

Fluid		Immersion		Stoving	Number of cycles
Category	References see EN 3909	Duration min	Temp. C	Temp. °C	
Fuel for type 1 and 2 modules	2	5^{+2}_{0}	025	055	7
Mineral hydraulic fluid	5	5^{+2}_{0}	085	100	7
Synthetic hydraulic fluid	3	5^{+2}_{0}	085	100	7
Synthetic lubricant	9	5^{+2}_{0}	120	125	7
Cleaning products	11	5^{+2}_{0}	025	025	5
	12				5
	13	5^{+2}_{0}			2
De-icing fluid	15	5^{+2}_{0}	025	100	7
Cooling fluid	19	$1^{+0,1}_{0}$	050	025	1

Due to environmental concerns, the range of test fluids may vary. It is the responsibility of the Manufacturer and the Mandated Body to agree on the fluids used during the test. However, every effort shall be made to ensure that the fluids selected are representative of the fluids specified.

7.2.2 Male contact gauge

See Figure 61 and Table 51.



Key

1 Location where load supplied

Figure 61

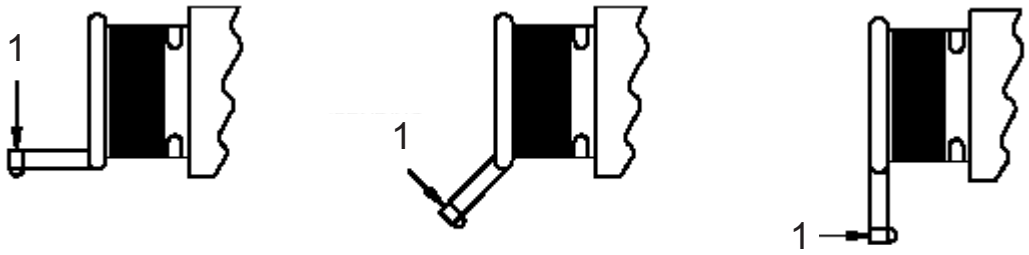
Table 51

Dimension in millimetres

Contact size	*A* + 0,013 0	∅ *B* + 0,005 0	∅ *C* + 0,005 0	*D* RAD	*E* 0 – 0,005	∅ *G* 0 – 0,005	∅ *H* + 0,005 0	*J* + 0,005 0
22	10,643	0,737	1,753	Spherical	0,813	1,270	1,245	3,429
20	11,151	0,991	2,083			1,676	1,803	3,556
16	12,116	1,575	3,302		1,168	2,718	2,870	3,912
12		2,337	4,724			3,937	3,810	
5		4,521	6,985			6,477	6,375	4,978

7.2.3 Mechanical strength of rear accessories

See Figure 62.



Style 1 — Straight **Style 2 — 45°** **Style 3 — 90°**

Key

1 Bending moment

Figure 62

7.2.4 Cavity gauges

See Figures 63 and 64.

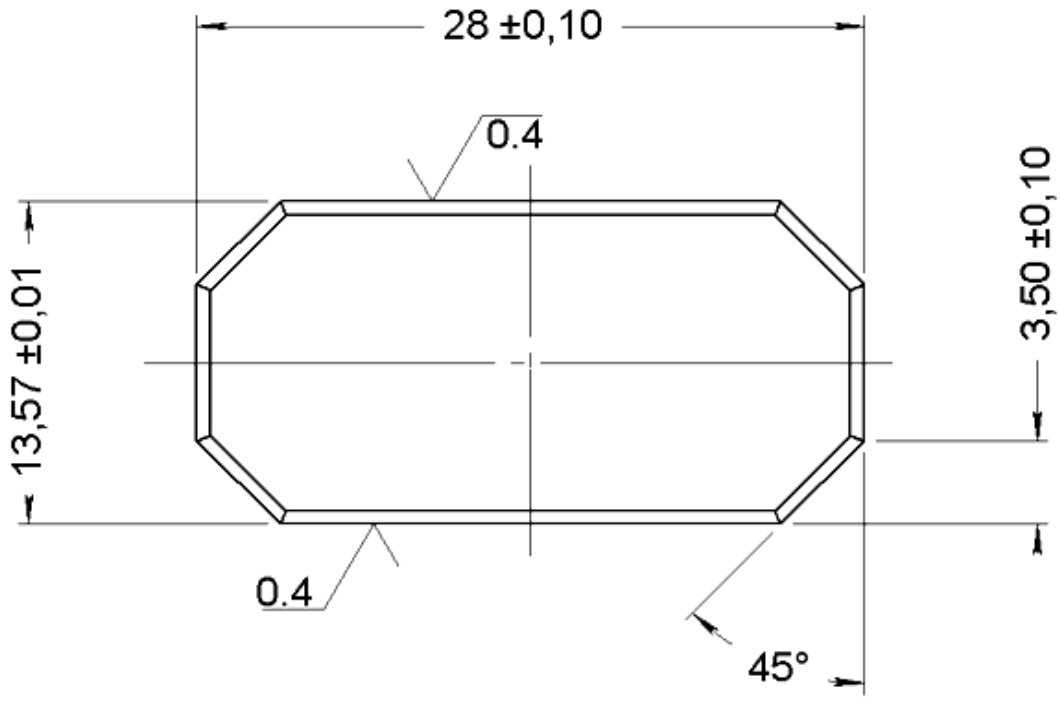


Figure 63 — Sizing gauge for disconnect panel AC connector cavities

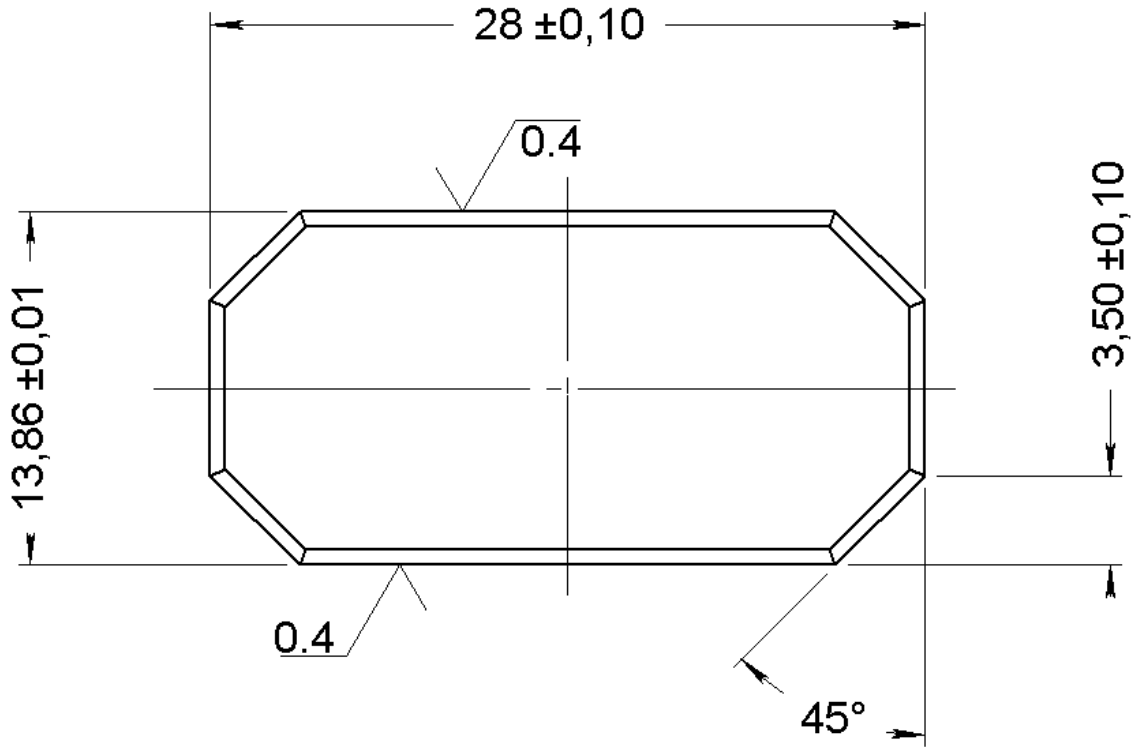


Figure 64 — Sizing gauge for rack and panel AC connector cavities

8 Quality assurance

8.1 General

Quality assurance shall conform to the requirements of EN 9133 and the manufacturer's quality system shall conform to EN 9100.

8.2 Qualification

8.2.1 Sampling and definition of specimens

The specimens to be qualified shall be as described in Table 52.

Contact sizes: Samples shall include suitable insert arrangements to demonstrate all contacts sizes within manufacturers current production range

Table 52

		Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7
Housing size 1	**Class A**	1	0	1	0	1	0	0
	Class B	0	1	0	1	0	0	0
	Class E	1	0	0	1	1	1	1
	Class F	0	1	1	0	0	1	0
	Class C	1	1	0	1	0	1	0
Housing size 2	**Class A**	0	1	1	1	1	0	0
	Class B	1	0	0	0	0	0	0
	Class E	0	1	0	0	1	1	0
	Class F	1	0	1	1	0	1	1
	Class C	1	1	0	1	0	1	0
Housing size 3	**Class A**	1	1	1	1	0	0	0
	Class C	1	1	1	1	0	0	0
Housing size 4	**Class A**	1	1	1	1	0	1	0
	Class C	1	1	1	1	0	1	1

8.2.2 Preparation of specimens

Unless otherwise specified in the tests, the specimens shall be wired with cables, the outside diameter of which is in accordance with the maximum indicated in EN 4644-002.

The connectors shall be wired with round cables free from any roughness likely to contribute to the penetration of humidity or liquid to the inside of the connector.

The specimens for test groups 1 and 4 shall be provided with cable gauges representing the largest permissible cable for each size of contact cavity (see EN 4644-002). The specimens for test groups 2 and 3 shall be provided with cable gauges representing the smallest permissible cable for each size of contact cavity (see EN 4644-002).

8.2.3 Programme of qualification test

The qualification tests are defined in Table 53 and shall be carried out in the sequence indicated.

Test EN 2591-306 is to be performed on material and is not included in the groups below. If the materials used comply with group 1 of MIL-HDBK-454B, Requirement 4, test EN 2591-306 is not performed.

Table 53 *(1 of 3)*

Designation of the test	EN 2591-	Remarks
Group 0 (initial for groups 1 and 2)		
Visual examination	101	—
Examination of dimensions and mass	102	—
Magnetic permeability	513	—
Contact retention in insert	409	—
Contact resistance at rated current	202	—
Test probe damage (female contacts)	415	—
Contact resistance at rated current	202	—
Gauge insertion/extraction forces (female contacts)	418	—
Housing (shell) electrical continuity	205	—
Mating and unmating forces	408	—
Visual examination	101	—
Group 1		
Electrical continuity at microvolt level	203	—
Measurement of insulation resistance	206	Ambient temperature
Voltage proof test	207	Sea level
Insert retention in housing (axial)	410	—
Contact retention in insert	409	—
Stability of male contacts in insert	419	—
Measurement of insulation resistance	206	at high temperature (175 °C)
Voltage proof test	207	in altitude (15 000 m and 21 000 m)
Contact resistance at rated current	202	—
Mechanical endurance	406	—
Durability of contact retention system and seals (maintenance ageing)	407	—
Rapid change of temperature	305	—
Immersion at low air pressure	314	12,1 KPa (15 000 m and 21 000 m)
Measurement of insulation resistance	206	Ambient
Voltage proof test	207	Sea level
Housing (shell) electrical continuity	205	—
Contact resistance at rated current	202	—
Salt mist	307	unmated

Table 53 *(2 of 3)*

Designation of the test	EN 2591-	Remarks
Group 1 *(continued)*		
Housing (shell) electrical continuity	205	—
Contact retention in insert	409	—
Contact resistance at rated current	202	—
Fluid resistance	315	Fluids 2, 3 and 5. One connector per fluid.
Voltage proof test	207	Sea level
Mating and unmating forces	408	—
Visual examination	101	—
Group 2		
Measurement of insulation resistance	206	Ambient
Voltage proof test	207	Sea level
Engagement of contacts	216	—
Stability of male contacts in insert	419	—
Sinusoidal and random vibration	403	—
Shock	402	—
Measurement of insulation resistance	206	—
Voltage proof test	207	Sea level
Housing (shell) electrical continuity	205	—
Contact resistance at rated current	202	—
Salt mist	307	unmated
Housing (shell) electrical continuity	205	—
Contact retention in insert	409	—
Contact resistance at rated current	202	—
Damp heat, cyclic test	321	—
Fluid resistance	315	Fluids 9, 11 and 12. One connector per fluid.
Voltage proof test	207	Sea level
Mating and unmating forces	408	—
Visual examination	101	—
Group 3		
Visual examination	101	—
Housing (shell) electrical continuity	205	—
Contact resistance at rated current	202	—
Measurement of insulation resistance	206	Ambient
Voltage proof test	207	Sea level
Measurement of insulation resistance	206	At high temperature
Rapid change of temperature	305	$^{+175}_{-\ 65}$ °C
Endurance at temperature	301	1 000 h at 175 °C
Contact retention system effectiveness	426	—

Table 53 *(3 of 3)*

Designation of the test	EN 2591-	Remarks
Measurement of insulation resistance	206	Ambient
Voltage proof test	207	Sea level
Contact resistance at rated current	202	—
Housing (shell) electrical continuity	205	—
Flammability	317	—
Visual examination	101	—
Group 4		
Visual examination	101	—
EMI shielding effectiveness	213	—
Visual examination	101	—
Group 5		
Visual examination	101	—
Hydrolytic stability	515	Classes E and F connectors only
Mating and unmating forces	408	—
Visual examination	101	—
Group 6		
Visual examination	101	—
Lightning strike, current and voltage pulse	214	—
Visual examination	101	—
Fluid resistance	315	Fluids 13, 15 and 19. One connector per fluid
Visual examination	101	—
Group 7		
Visual examination	101	—
Transverse load (external bending moment)	404	—
Axial load	405	—
Sand and dust	308	—
Visual examination	101	—

8.3 Maintenance of qualification

8.3.1 Tests

The tests shall be carried out every 36 months after qualification on specimen taken at random in accordance with EN 9133.

8.3.2 Sampling distribution

All housing sizes and classes taken shall be divided into the two groups of Table 54.

Table 54

Designation of the test	EN2591-
Group 1	
Visual examination	101
Examination of dimensions and mass	102
Insert retention in housing (axial)	410
Contact retention in insert	409
Voltage proof test	207
Housing (shell) electrical continuity	205
Immersion at low air pressure	314
Measurement of insulation resistance	206
Mating and unmating force	408
Salt mist	307
Contact resistance at rated current	202
Measurement of insulation resistance	206
Visual examination	101
Group 2	
Visual examination	101
Examination of dimensions and mass	102
Endurance at temperature	301
Mating and unmating forces	408
Contact retention system effectiveness (removable contact walkout)	426
Measurement of insulation resistance	206
Contact resistance at rated current	202
Visual examination	101

8.4 Routine test during production

The applicable tests shown in Table 55 shall be performed on all products prior to delivery. The contractor may use in process controls for this requirement.

All contacts delivered with the connector shall be from lots that have met the requirements of the appropriate product standards specified in EN 4644-002.

Table 55

Designation of the test	EN 2591-	Remarks
Visual examination	101	
Housing (shell) electrical continuity	205	Classes E and F only
Measurement of insulation resistance	206	

8.5 Quality control

Inspections which are intended to maintain the required quality level are in their entirety the responsibility of the manufacturer, ranging from materials through delivery of the product.

The quality department of the manufacturer shall be able to demonstrate, at any given time, that the product complies with the manufacturing documentation and with the product standard concerned.

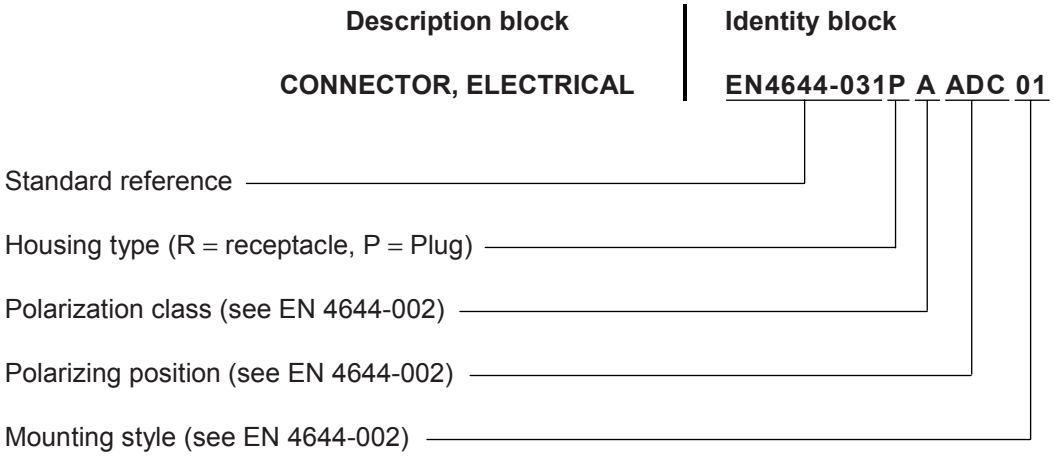
There shall be a monitoring system in place for the various inspection phases. This shall be evidenced by documents kept available by the manufacturer for a period of five years and submitted to the national official services on request.

9 Designation and marking

9.1 General principle of designation

9.1.1 Connectors

EXEMPLE



9.2 Marking

Marking shall be applied to the connectors.

This marking shall include:

— the identity block as defined in product standard;

— the date of manufacture (year - week);

— the manufacturer's name or trade mark.

10 Delivery conditions

Housings are delivered with or without polarizing hardware. Housings are always delivered without inserts and without contacts.

11 Packaging

The connectors shall be packed in transparent, inert plastic bags.

The designation required by the product standard shall be affixed on the packaging of connectors.

12 Storage

Storage shall be in a place free from ultra-violet rays.

Every five years, an inspection shall be made in accordance with EN 2591-101. The connector shall be repacked in accordance with 11 and the date of inspection shall be marked on the packaging.

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