

BS EN 50181:2010



BSI Standards Publication

# Plug-in type bushings above 1 kV up to 52 kV and from 250 A to 2,50 kA for equipment other than liquid filled transformers

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The UK participation in its preparation was entrusted to Technical Committee PEL/36, Insulators for power systems.

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

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English version

**Plug-in type bushings above 1 kV up to 52 kV and from 250 A to 2,50 kA  
for equipment other than liquid filled transformers**

Traversées embrochables de tensions supérieures à 1 kV jusqu'à 52 kV et de 250 A à 2,50 kA pour équipements autres que transformateurs à remplissage de liquide

Steckbare Durchführungen über 1 kV bis 52 kV und von 250 A bis 2,50 kA für Anlagen anders als flüssigkeitsgefüllte Transformatoren

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## Foreword

This European Standard was prepared by the Technical Committee CENELEC TC 36A, Insulated bushings.

It was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 50181 on 2010-07-01.

This document supersedes EN 50181:1997.

The main technical changes on the Plug-in type bushings are:

- Enlarge the scope of the voltage class from the plug-in bushings from 36 kV to 52 kV;
- Upgrading the current capacity of the existing defined bushings;
- Introduce a new bushing interface for 52 kV.

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The following dates were fixed:

- latest date by which the EN has to be implemented  
at national level by publication of an identical  
national standard or by endorsement (dop) 2011-07-01
  - latest date by which the national standards conflicting  
with the EN have to be withdrawn (dow) 2013-07-01
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## Introduction

The object of this European Standard is to specify the requirements to ensure interchangeability of bushings for maximum voltages above 1 kV up to 52 kV and rated currents from 250 A to 2 500 A for equipment other than insulating liquid filled transformers.

## 1 Scope

This European Standard is applicable to insulated bushings for maximum voltages above 1 kV up to 52 kV, rated currents from 250 A up to 2 500 A and frequencies from 15 Hz up to 60 Hz for equipment other than liquid filled transformers.

This European Standard establishes essential dimensions, to ensure adequate mounting and interchangeability of mating plug-in separable connectors of equivalent ratings.

## 2 Normative references

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

EN 60137, *Insulated bushings for alternating voltages above 1 000 V*

IEC Guide 109 and Cenelec TC 111X document <sup>1)</sup>, *Environmental aspects – Inclusion in electrotechnical product standards*

NOTE It is highly recommended to minimize the impact of bushings on the environment during all phases of their life (including manufacturing, operation during service life, dismantling after their end of life and disposal or recycling).

IEC Guide 109 and document by CENELEC TC 111X, *Environmental standardization for electrical and electronic products and systems* after finalization can be used as helpful reference.

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

### 3.1

#### **plug in type bushing**

bushing one end of which is immersed in an insulating medium which has customized dimensions according to insulation requirements for the specific application and the other end designed to receive a separable insulated cable connector without which the bushing cannot function

### 3.2

#### **separable connector**

fully insulated termination permitting the connection and disconnection of the cable to and from the mating plug-in type bushing

### 3.3

#### **interface type**

bushing dimensions that insure mechanical and electrical interchangeability of bushing and separable connector of similar rating and type

NOTE Each interface type is designed by a letter or a number.

### 3.4

#### **bail holder**

fixture which facilitates anchoring of an externally mounted device (called the bail) designed to prevent undesirable separation of a separable connector and a bushing

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<sup>1)</sup> Under development.

NOTE A bail holder may or may not be an integral part of a bushing and is an optional feature.

## 4 Requirements

### 4.1 Application

Bushings covered by this European Standard shall be suitable for operation with one end connected to a separable connector and the other end having customized dimensions according to the insulation requirements for the specific application.

### 4.2 Standard values of maximum voltage ( $U_m$ )

The value of  $U_m$  of a bushing shall be chosen from the standard values of the highest voltage for equipment, defined in IEC 60038 as given below in kilovolt:

12 – 24 – 36 – 52

### 4.3 Standard values of rated current ( $I_r$ )

The value  $I_r$  of a bushing shall be chosen from the standard values given below in ampere:

250 - 400 - 630 - 800 - 1 250 - 1 600 - 2 000 - 2 500

### 4.4 Compliance

Bushings which are supplied separately shall meet the requirements of EN 60137.

Customized bushings which are integrated directly in the equipment shall comply with the test requirements specified in the standard(s) relevant to that type of equipment.

### 4.5 Bushing mounting distance

The minimum distance between bushings shall take into account the outer dimensions of separable connectors and the optional bail holders.

### 4.6 Detail dimensions of plug-in type bushings

#### 4.6.1 General

The dimensions necessary to ensure adequate mounting and interchangeability of mating plug-in separable connectors shall be as specified in the following Figures and Tables.

#### 4.6.2 Outside cone type

The dimensions necessary for outside cone plug-in type bushings are specified in Figures 1 and 2 and in Tables 1 and 2.

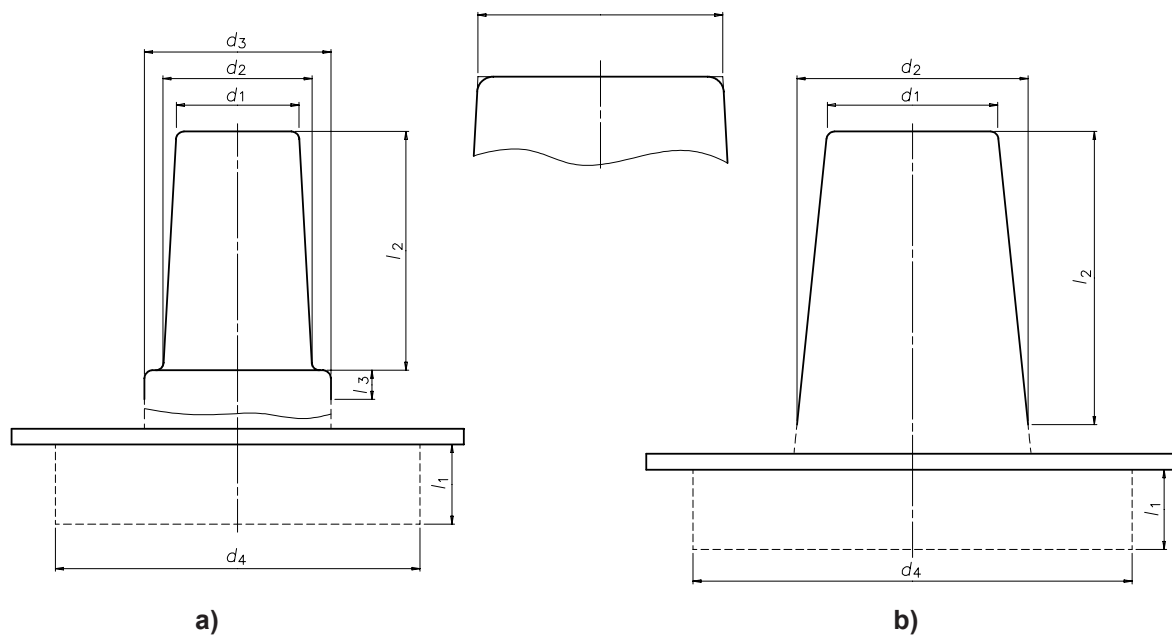


Figure 1 - Interface dimensions of outside cone plug-in type bushings

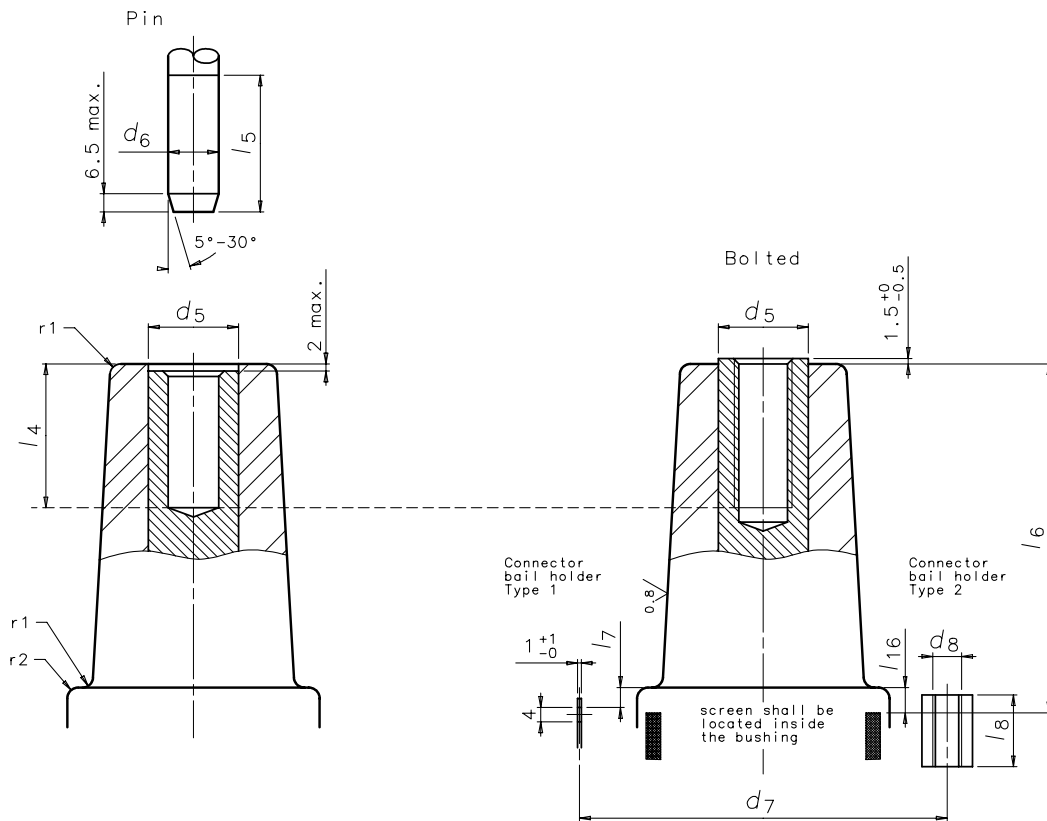
Table 1 - Interface dimensions

| $U_m$       | $I_r$              | $d_1$                              | $d_2^{+0,2}$ | $d_3^{+0,2}$ | $d_4$<br>max. | $l_1$<br>max. | $l_2$                           | $l_3$<br>min. | Contact<br>type | Interface<br>type | Figure |
|-------------|--------------------|------------------------------------|--------------|--------------|---------------|---------------|---------------------------------|---------------|-----------------|-------------------|--------|
| kV          | A                  | mm                                 | mm           | mm           | mm            | mm            | mm                              | mm            |                 |                   |        |
| 12-24       | 250                | 31 <sup>+0,1</sup> <sub>-0,3</sub> | 32,5         | 48,5         | 132           | 205           | 48 <sup>0</sup> <sub>-0,2</sub> | 9             | Sliding         | A                 | 1a)    |
| 12-24-36    | 250 - 400          | 46 ±0,2                            | 56           | 70           | 137           | 205           | 90 ±0,2                         | 11            | Sliding         | B                 | 1a)    |
| 12-24-36    | 630-1 250          | 46 ±0,2                            | 56           | 70           | 137           | 205           | 90 ±0,2                         | 11            | Bolted          | C                 | 1a)    |
| 12-24       | 800-1 250          | 39,9 ±0,2                          | 52,1         | 76,2         | 137           | 205           | 81 ±0,2                         | 14,8          | Bolted          | D                 | 1a)    |
| 36          |                    | 39,9 ±0,2                          | 61,5         | 76,2         | 165           | 240           | 103,7 ±0,2                      | 21            | Bolted          | E                 | 1a)    |
| 12-24-36    | 630-1 250<br>2 500 | 64 ±0,2                            | 86,8         |              | 165           | 240           | 110,5 ±0,2                      |               | Bolted          | F                 | 1b)    |
| 12-24-36-52 | 630-1 250          |                                    |              |              |               |               |                                 |               |                 |                   |        |

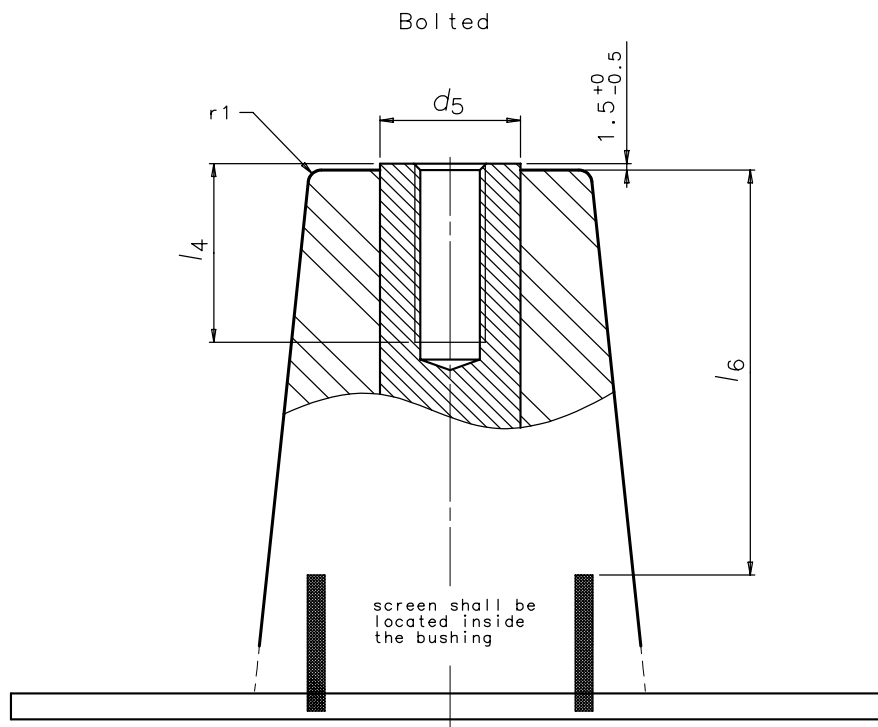
NOTE The envelope  $l_1 \times d_4$  represents the section of the plug-in type bushing inside the equipment.  
When bushings are an integral functional part of an equipment, the values  $l_1$  and  $d_4$  may differ from the table and shall be defined by the equipment manufacturer.



**Interface type: A to E**



**Interface type: F**



**Figure 2 - Bushing details of outside cone plug-in type bushings**

Table 2 - Bushing dimensions

| $U_m$<br>kV | $I_r$<br>A | Bushing contact |                       |                        |                                       |        |                     |                     | $l_5$<br>min.<br>mm | $l_6$<br>max.<br>mm | Radius              |                                      | Bail holder<br>Type 1 or 2 |                 |     | $l_7$<br>$\pm 2$<br>mm | $l_8$<br>min.<br>mm | $l_{16}$<br>$\pm 1$<br>mm | Interface<br>and<br>bushing<br>type |
|-------------|------------|-----------------|-----------------------|------------------------|---------------------------------------|--------|---------------------|---------------------|---------------------|---------------------|---------------------|--------------------------------------|----------------------------|-----------------|-----|------------------------|---------------------|---------------------------|-------------------------------------|
|             |            | Type            | Material <sup>a</sup> | $d_5$<br>nominal<br>mm | $d_6$<br>mm                           | Thread | $l_4$<br>min.<br>mm | $r_1$<br>max.<br>mm |                     |                     | $r_2$<br>max.<br>mm | Location<br>$d_7$<br>$\pm 0,5$<br>mm | Required<br>number<br>min. | $d_8$<br>Type 2 |     |                        |                     |                           |                                     |
| 12-24       | 250        | Sliding         | Cu                    | -                      | 7,9 <sup>+0,02</sup> <sub>-0,05</sub> | -      | 32                  | 30                  | 54                  | 1                   | 2x<br>45°           | 90                                   | 2                          | M6              | 3,5 | 8                      | 2                   | A1                        |                                     |
| 12-24-36    | 250        | Sliding         | Cu                    | -                      | 14 <sup>+0</sup> <sub>-0,04</sub>     | -      | 40                  | 38                  | 97                  | 3                   | 3                   | 102                                  | 2                          | M8              | 5,5 | 10                     | 2                   | B1                        |                                     |
| 12-24-36    | 400        | Sliding         | Cu                    | -                      | 14 <sup>+0</sup> <sub>-0,04</sub>     | -      | 40                  | 38                  | 97                  | 3                   | 3                   | 102                                  | 2                          | M8              | 5,5 | 10                     | 2                   | B2                        |                                     |
| 12-24-36    | 630        | Bolted          | Cu                    | 22<br>min.             | -                                     | M 16   | 29                  | -                   | 97                  | 3                   | 3                   | b<br>102                             | b<br>2                     | b<br>M8         | -   | 10                     | -                   | C1                        |                                     |
| 12-24-36    | 1 250      | Bolted          | Cu                    | 32                     | -                                     | M 16   | 29                  | -                   | 97                  | 3                   | 3                   | b<br>102                             | b<br>2                     | b<br>M8         | -   | 10                     | -                   | C2                        |                                     |
| 12-24       | 800        | Bolted          | Cu<br>or<br>Al        | 32                     | -                                     | M 16   | 29                  | -                   | 88                  | 3                   | 3                   | b<br>102                             | b<br>2                     | b<br>M8         | -   | 10                     | -                   | D1                        |                                     |
| 36          |            |                 |                       |                        |                                       |        |                     |                     | 111                 |                     |                     |                                      |                            |                 |     |                        |                     | E1                        |                                     |
| 12-24       | 1 250      | Bolted          | Cu                    | 32                     | -                                     | M 16   | 29                  | -                   | 88                  | 3                   | 3                   | b<br>123                             | b<br>2                     | b<br>M8         | -   | 10                     | -                   | D2                        |                                     |
| 36          |            |                 |                       |                        |                                       |        |                     |                     | 111                 |                     |                     |                                      |                            |                 |     |                        |                     | E2                        |                                     |
| 12-24-36    | 2 500      | Bolted          | Cu                    | 50                     | -                                     | M 16   | 29                  | -                   | 94                  | 3                   | -                   | -                                    | -                          | -               | -   | -                      | -                   | F1                        |                                     |
| 12-24-36-52 | 630        | Bolted          | Cu                    | 22<br>min.             | -                                     | M 16   | 29                  | -                   | 94                  | 3                   | -                   | -                                    | -                          | -               | -   | -                      | -                   | F2                        |                                     |
| 12-24-36-52 | 1 250      | Bolted          | Cu                    | 32                     | -                                     | M 16   | 29                  | -                   | 94                  | 3                   | -                   | -                                    | -                          | -               | -   | -                      | -                   | F3                        |                                     |

<sup>a</sup> In the connection of separable connectors to bushings, care must be taken in the matching of the materials of the cable conductors, the cable lugs and the bushing conductors. Where dissimilar metals are joined, appropriate precautions shall be taken. Where aluminium bushing conductors are used and screw threads are required, a suitable grade of aluminium or aluminium alloy shall be used.

<sup>b</sup> Bail holder is optional.

### 4.6.3 Inside cone type

The dimensions necessary for inside cone plug-in type bushings are specified in Figures 3 and 4 and in Tables 3 and 4.

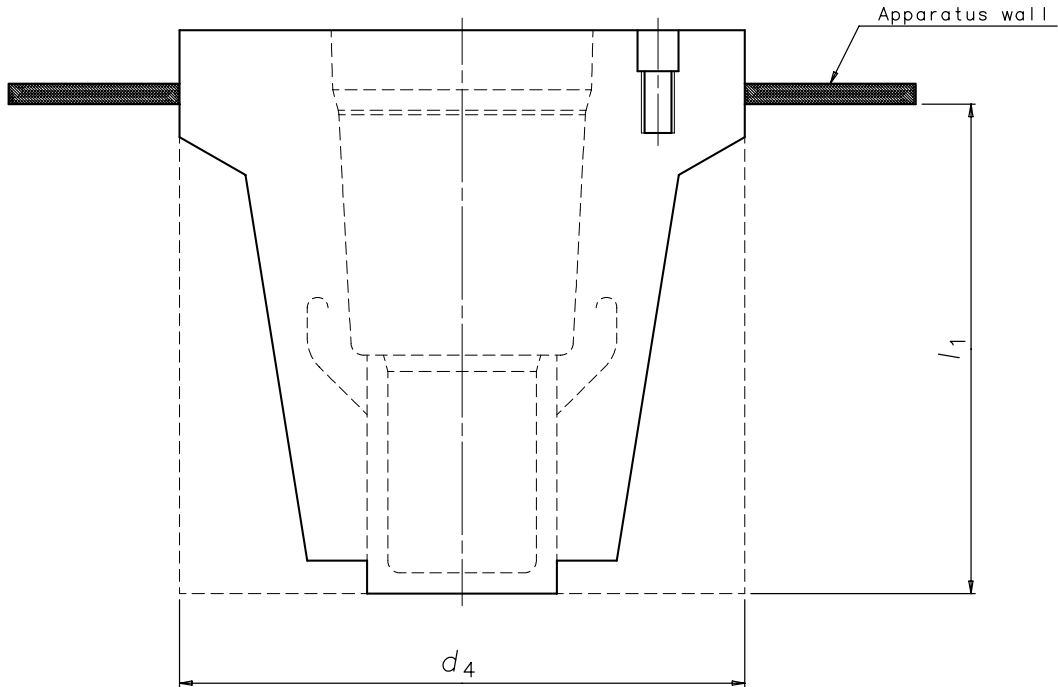


Figure 3 - Outer dimensions of inside cone plug-in type bushings

Table 3 - Bushing dimensions

| $U_m$<br>kV        | $I_r$<br>A       | $d_4$<br>max.<br>mm | $l_1$<br>max.<br>mm | Interface<br>type |
|--------------------|------------------|---------------------|---------------------|-------------------|
| <b>12-24</b>       | <b>250</b>       | 132                 | 205                 | 0                 |
| <b>12-24-36</b>    | <b>400 - 630</b> | 137                 | 205                 | 1                 |
| <b>12-24-36</b>    | <b>800</b>       | 137                 | 205                 | 2                 |
| <b>12-24-36-52</b> | <b>1 250</b>     | 185                 | 240                 | 3                 |

NOTE The envelope  $l_1 \times d_4$  represents the section of the plug-in type bushing inside the equipment. When bushings are an integral functional part of an equipment, the values  $l_1$  and  $d_4$  may differ from the table and shall be defined by the equipment manufacturer.

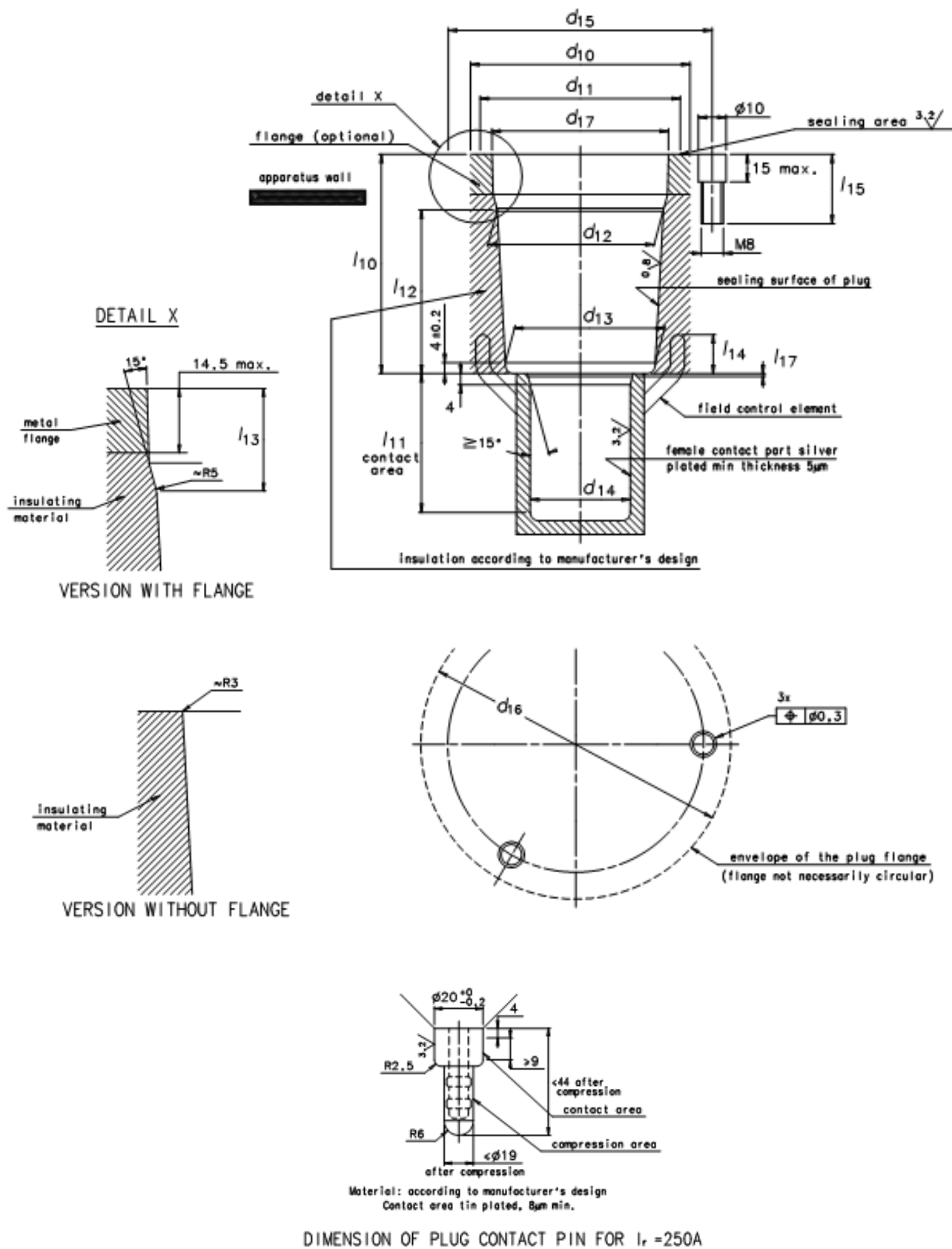


Figure 4 - Interface details of inside cone plug-in type bushings

**Table 4 - Interface dimensions**

| $U_m$<br>kV        | $I_r$<br>A               | $d_{10}$<br>mm | $d_{11}$<br>mm | $d_{12}$<br>$\pm 0,4$<br>mm | $d_{13}$<br>$\pm 0,4$<br>mm | $d_{14}$<br>$+0,1$<br>$0$<br>mm | $d_{15}$<br>mm | $d_{16}$<br>max.<br>mm | $d_{17}$<br>min.<br>mm | $h_{10}$<br>$\pm 1,3$<br>mm | $h_{11}$<br>min.<br>mm | $h_{12}$<br>$\pm 0,2$<br>mm | $h_{13}$<br>mm | $h_{14}$<br>$+2$<br>$-1$<br>mm | $h_{15}$<br>$+5$<br>$0$<br>mm | $h_{17}$<br>mm  | Contact<br>type | Interface<br>Type |
|--------------------|--------------------------|----------------|----------------|-----------------------------|-----------------------------|---------------------------------|----------------|------------------------|------------------------|-----------------------------|------------------------|-----------------------------|----------------|--------------------------------|-------------------------------|-----------------|-----------------|-------------------|
| <b>12-24</b>       | <b>250</b>               | min<br>69      | max<br>62      | 53,2                        | 47,5                        | <sup>a</sup>                    | 88             | 108                    | 59,5                   | 83                          | 44                     | 59                          | $20^{+1}_0$    | 14                             | 23                            | $1^{+1}_{-0,5}$ | Sliding         | 0                 |
| <b>12-24-36</b>    | <b>400</b><br><b>630</b> | min<br>79      | max<br>72      | 59,8                        | 54                          | 36                              | 95             | 115                    | 63,5                   | 83                          | 46,5                   | 59                          | $20^{+1}_0$    | 14                             | 23                            | 0               | Sliding         | 1                 |
| <b>12-24-36</b>    | <b>800</b>               | min<br>86      | max<br>79      | 65,8                        | 60                          | 39                              | 102            | 122                    | 69,5                   | 83                          | 46,5                   | 59                          | $20^{+1}_0$    | 14                             | 23                            | 0               | Sliding         | 2                 |
| <b>12-24-36-52</b> | <b>1 250</b>             | $115^0_{-18}$  | $95^0_{-1}$    | 87,8                        | 79,7                        | 55                              | 130            | 150                    | 92,5                   | 110                         | 82                     | 81                          | $24^{+1,5}_0$  | 19                             | 32                            | 0               | Sliding         | 3                 |

<sup>a</sup> The female part has to be designed according to the requirements of the separable connector contact pin detail.

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