

# SLOVENSKI STANDARD

## SIST-TS CLC/TS 50458:2006

01-oktober-2006

---

**Skoznjik za zunanjo montažo s porazdeljeno kapacitivnostjo za napetosti od 52 kV do 420 kV za transformatorje, potopljene v olje**

Capacitance graded outdoor bushing 52 kV up to 420 kV for oil immersed transformers

Kapazitiv gesteuerte Freiluftdurchführungen 52 kV bis 420 kV für ölgefüllte Transformatoren

Traversées à répartition capacitive immergées d'extérieur 52 kV à 420 kV pour transformateurs immergés dans l'huile

**Ta slovenski standard je istoveten z: CLC/TS 50458:2006**

---

**ICS:**

29.080.20	Skoznjiki	Bushings
29.180	Transformatorji. Dušilke	Transformers. Reactors

**SIST-TS CLC/TS 50458:2006**

**en**

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

SIST-TS CLC/TS 50458:2006

<https://standards.iteh.ai/catalog/standards/sist/803972bb-241a-4bb5-9ff0-6df892811441/sist-ts-clc-ts-50458-2006>

TECHNICAL SPECIFICATION  
SPÉCIFICATION TECHNIQUE  
TECHNISCHE SPEZIFIKATION

**CLC/TS 50458**

April 2006

ICS 29.080.20

English version

**Capacitance graded outdoor bushing 52 kV up to 420 kV  
for oil immersed transformers**

Traversées à répartition capacitive  
immergées d'extérieur, 52 kV à 420 kV  
pour transformateurs  
immergés dans l'huile

Kapazitiv gesteuerte  
Freiluftdurchführungen 52 kV bis 420 kV  
für ölgefüllte Transformatoren

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

This Technical Specification was approved by CENELEC on 2005-10-15.

CENELEC members are required to announce the existence of this TS in the same way as for an EN and to make the TS available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

**CENELEC**

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

**Central Secretariat: rue de Stassart 35, B - 1050 Brussels**

## Foreword

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

The text of the draft was submitted to vote in accordance with Subclause 11.3.3.3 of Part 2 of the CENELEC Internal Regulations and was approved by CENELEC as CLC/TS 50458 on 2005-10-15.

The following date was fixed:

- latest date by which the existence of the CLC/TS  
has to be announced at national level (doa) 2006-07-01

The purpose of this Technical Specification is to ensure the interchange ability between capacitance graded bushings, with comparable technical requirements, from different manufacturers.

The aim is, to reduce the multiplicity of the different designs, only regarding the interchange ability. The document gives recommendations for mounting flange dimensions, lower part details, current conductor connections and limits for the overall dimensions. This allows, on the one hand, the manufacturers of bushings to use normalised solutions within their own type series and on the other, the users to exchange bushings from different manufacturers and with different years of manufacture.

In the preparation of this Technical Specification information about existing types (especially details of the design and the dimensions taken mostly from catalogues of the European manufacturers) was the basis for discussion in WG 4 of TC 36A. The following restrictions were applied:

- technical aspects of the design of different manufacturers and the requirements of users must be considered for the values of the new Technical Specification regarding the state of art;
- there should be no single effort for one manufacturer or to the exclusion of another;
- no restriction for the technical evolution.

Conformance will require design changes for not only the manufacturer of the bushings but also transformers. Some changes may require significant modifications along with type tests which are time consuming and costly. Purchasers of transformers should also review its contents for its impact on their procurement process. For these reasons, this document will act as a guide or Technical Specification (TS) during a transitional period. During this period, the contents will act as a guide to manufacturers while allowing debate in the industry on its effectiveness and value. This transition period will not exceed ten years at which time its contents should be amended if necessary and submitted for approval as a European Standard.

## Contents

	Page
<b>Introduction</b>	<b>4</b>
<b>1 Scope</b>	<b>4</b>
<b>2 Normative references</b>	<b>4</b>
<b>3 Definitions</b>	<b>4</b>
3.1 Draw-lead conductor	4
3.2 Solid rod conductor	4
3.3 Bottom terminal - current connection	5
<b>4 Requirements</b>	<b>5</b>
4.1 Application	5
4.2 Standard values of highest voltage for equipment ( $U_m$ )	5
4.3 Standard values of rated current ( $I_r$ )	5
4.4 Compliance	5
4.4.1 Test tap	5
4.4.2 Creepage distance	5
4.4.3 Insulating level	5
4.4.4 Operating conditions, test requirements	5
4.5 Additional requirements	5
4.6 Designation	6
4.6.1 Electrical design of oil end	6
4.6.2 Conductor principles and mechanical design of oil end	6
4.6.3 Conductor arrangement	6
4.6.4 Complete bushing designation	7
4.7 Design details	8
<b>Annex A</b> (informative) Example of bushing documentation	<b>17</b>
Figure 1 – Bushing dimensions (general)	8
Figure 2 – Bushing oil end dimensions	9
Figure 3 – Examples of current leader principles and mechanical design of oil end	10
Figure 4 – Jointing of split rod conductor	15
Figure 5 – Example of bottom connection	16
Table 1 – Dimensions of air terminal stems according to IEC/TR 62271-301	8
Table 2 – Dimensions	11
Table 3 – Two examples of data for split rod type inside the bore	15

## Introduction

The object of this Technical Specification is to specify details and dimensions of capacitance graded outdoor bushings for highest voltages for equipment from 52 kV up to 420 kV as far as it is necessary to ensure the interchange ability of bushings with comparable technical requirements. Additionally, some technical items are site specific, and are rarely able to be standardised, e.g. airside length of a bushing which depends on the different air side material, shed profiles and pollution level. This Technical Specification defines additional data or information, which must be included, by the bushing or the transformer manufacturer, in the transformer manual for the purpose of interchange ability.

## 1 Scope

This Technical Specification is applicable to capacitance graded outdoor bushings with values of highest voltage for equipment ( $U_m$ ) from 52 kV up to 420 kV and with values of rated current ( $I_r$ ) up to 3 150 A and frequencies from 15 Hz up to 60 Hz for oil immersed transformers.

The major insulation of these bushings consists either of oil-impregnated or resin-impregnated paper or other suitable insulating systems.

This Technical Specification establishes essential details and dimensions to ensure interchange ability and adequate mounting of the bushings.

## 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 60059	1999	IEC standard currents (IEC 60059:1999)
EN 60076-3	2001	Power transformers – Part 3: Insulation levels and dielectric tests and external clearances in air (IEC 60076-3:2000 + corrigendum Dec. 2000)
EN 60137	2003	Insulated bushings for alternating voltages above 1 000 V (IEC 60137:2003)
EN 60296		Specification for unused mineral oil for transformers and switchgear (IEC 60296)
IEC 60038	1983	IEC standard voltages
IEC 60815	1986	Guide for the selection of insulators in respect of polluted conditions
IEC/TR 62271-301	2004	High-voltage switchgear and controlgear – Part 301: Dimensional standardization of terminals

## 3 Definitions

For the definitions of generally used terms in the present Technical Specification reference should be made to EN 60137.

For the purposes of this Technical Specification the following additional definitions apply:

### 3.1

#### **draw-lead conductor**

conductor consisting of one or more flexible leads in parallel drawn into the central tube of the major insulation body of the bushing (preferred up to 1 000 A)

### 3.2

#### **solid rod or tube conductor**

conductor consisting of a round rod either removable and drawn into the central tube of the major insulation body of the bushing or fixed rod or tube and not removable (preferred from 1 250 A up to 3 150 A)

### 3.3

#### bottom terminal – current connection

a device used to terminate the leads from the transformer at a position below and adjacent to the lower end of the bushing

The terminal may be removable or non-removable according to the following:

- removable bottom connections may be either attached to the lower end of the bushing or guided into position by a draw-rod through the center bore of the bushing and locked in position on the air side of the bushing. The draw-rod may also be pre-stressed to achieve a clamping force on the removable bottom connection. The draw-rod with these functions is not part of the current conducting path within the bushing.
- non-removable bottom connections usually consist of a terminal that is permanently attached to the lower end of the bushing.

NOTE 1 Where the solid rod conductor is drawn into the bushing the conductor should be split as shown in Figure 4.

NOTE 2 The rated currents corresponding to a cross section of the current conductors may differ for oil-impregnated or resin-impregnated paper bodies due to the different insulating materials and the geometrical bushing data.

NOTE 3 Due to handling problems solid rod conductors with masses above 30 kg should preferably be fixed and bottom connected (see 4.6.3).

## 4 Requirements

### 4.1 Application

The bushings covered by this Technical Specification shall be capacitance graded outdoor bushings suitable for operations with one end in air and the other end fully immersed in transformer oil according to EN 60296 or similar fluids.

### 4.2 Standard values of highest voltage for equipment ( $U_m$ )

The value of  $U_m$  of a bushing shall be chosen from the standard values (defined in IEC 60038), as given below, in kilovolts (kV):

<https://standards.iteh.ai/catalog/standards/sist/803972bb-241a-4bb5-9ff0-6d1892811441/sist-ts-clc-ts-50458-2006>  
52 - 72,5 - 100 - 123 - 145 - 170 - 245 - 300 - 420

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

The value of  $I_r$  of a bushing shall be chosen from the standard values (defined in EN 60059), as given below, in amperes (A):

630 - 800 - 1 000 - 1 250 - 1 600 - 2 000 - 2 500 - 3 150

NOTE Where the required bushing current rating does not appear in Table 2, the next higher value of standard current rating shall be used.

### 4.4 Compliance

The bushings according to this Technical Specification shall meet the requirements of EN 60137.

#### 4.4.1 Test tap

Each bushing covered by this Technical Specification must have a test tap as defined in EN 60137.

#### 4.4.2 Creepage distance

The required creepage distance of a bushing depends on the value of the pollution level, the reference minimum nominal specific creepage distance (EN 60137, IEC 60815) and the highest voltage for equipment  $U_m$ .

#### 4.4.3 Insulating level

The standard values of insulating levels are in accordance to EN 60076-3 and EN 60137 whichever is higher.

#### 4.4.4 Operating conditions, test requirements

Requirements and methods for operating conditions and tests are given in EN 60137 and EN 60076-3.

#### 4.5 Additional requirements

Additional electrical requirements, e.g.

- external clearances between phases or to earth,
- special overload conditions, etc.

and mechanical requirements, e.g.

- mounting with inclination angle exceeding 30° from the vertical,
- earthing eye of the flange,
- venting plug of the current lead tube and the flange,
- ceramic or other material for the outside insulator,
- oil level gauge,
- earthquake strength, etc.

are not considered in this Technical Specification. They depend on several other standards and must be defined in addition to this Technical Specification if necessary.

All dimensions described in Figures 1 up to 5 of this Technical Specification must, where relevant, be given in the bushing manual (drawings and data sheets from the bushing manufacturer). This bushing manual must be included in the transformer instruction manual. The information in the transformer instruction manual must give sufficient information for the interchange ability.

#### 4.6 Designation

The following designation by letters shall identify the main design details of the bushings according to this Technical Specification.

##### 4.6.1 Electrical design of oil end

**M** = oil end without shield (no special oil end)

**N** = oil end with embedded shield

**O** = oil end with attached shield (Shield may be removable, or an integrated non-removable part of the bushing; shield length is **not included in L5**. Dimensional and constructional details of the shield shall be stated in the bushing manual.)

##### 4.6.2 Conductor principles and mechanical design of oil end

**P** = removable conductor, bushing opening continuous cylindrical

**Q** = removable conductor, bushing opening conical

**R** = removable conductor, bushing opening stepped cylindrical or cylindrical / conical

**T** = fixed rod or tube

##### 4.6.3 Conductor arrangement

**U** = draw-lead conductor without split rod (soldered into the air side connecting bolt)

**V** = conductor with split inside the bushing tube <sup>1)</sup>

**W** = rod or tube end for removable bottom connection <sup>2)</sup>

**X** = rod or tube end for non-removable bottom connection <sup>3)</sup>

<sup>1)</sup> Dimensions of split rod conductor according to Figure 4.

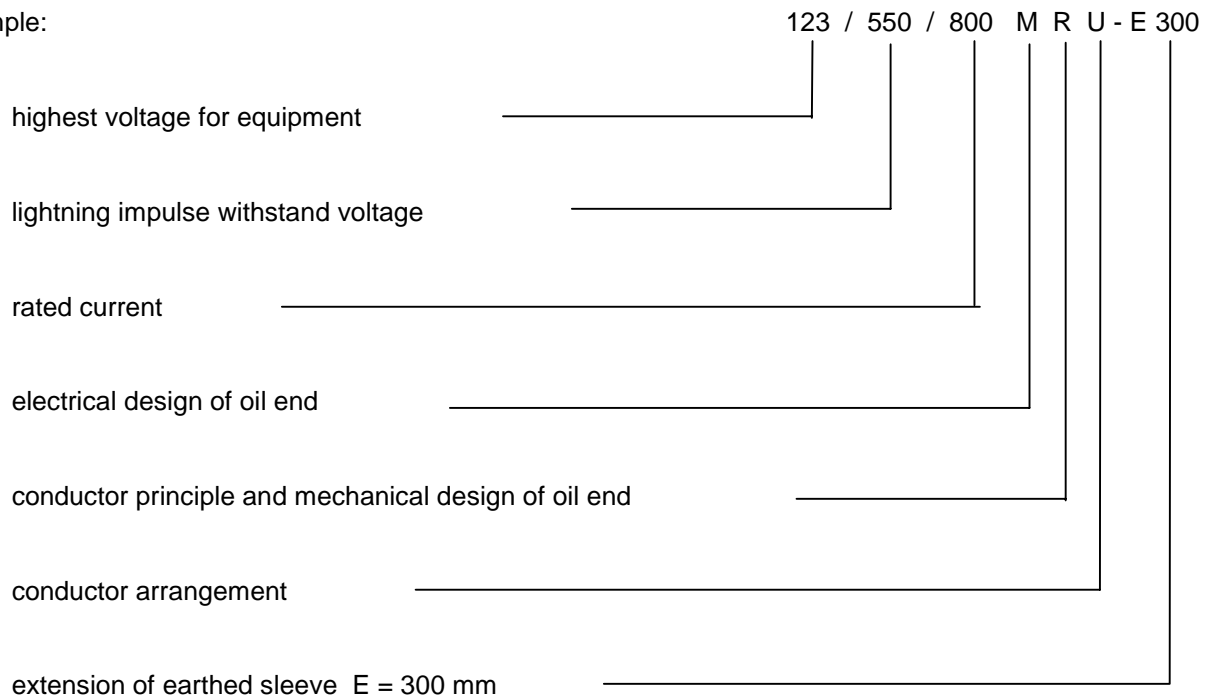
<sup>2)</sup> Figure 5 is only an example for required dimensions. The Figure shows a typical arrangement for an oil end terminal palm to be attached to the lower end of the bushing.

<sup>3)</sup> A non-removable bottom connection may consist of prepared threaded holes directly in the bulk of a solid conductor.



#### 4.6.4 Complete bushing designation

Example:



**iTeh STANDARD PREVIEW**  
 (standards.iteh.ai)

NOTE The complete designation including positions exemplified by "MRU" above, should be given in the bushing documentation, and not used by the purchaser during ordering stage.

SIST-TS CLC/TS 50458:2006  
<https://standards.iteh.ai/catalog/standards/sist/803972bb-241a-4bb5-9ff0-6df892811441/sist-ts-clc-ts-50458-2006>

## 4.7 Design details

Design details for interchange ability are given in Figures 1 and 2 and should be given in the bushing drawing included in the transformer manual.

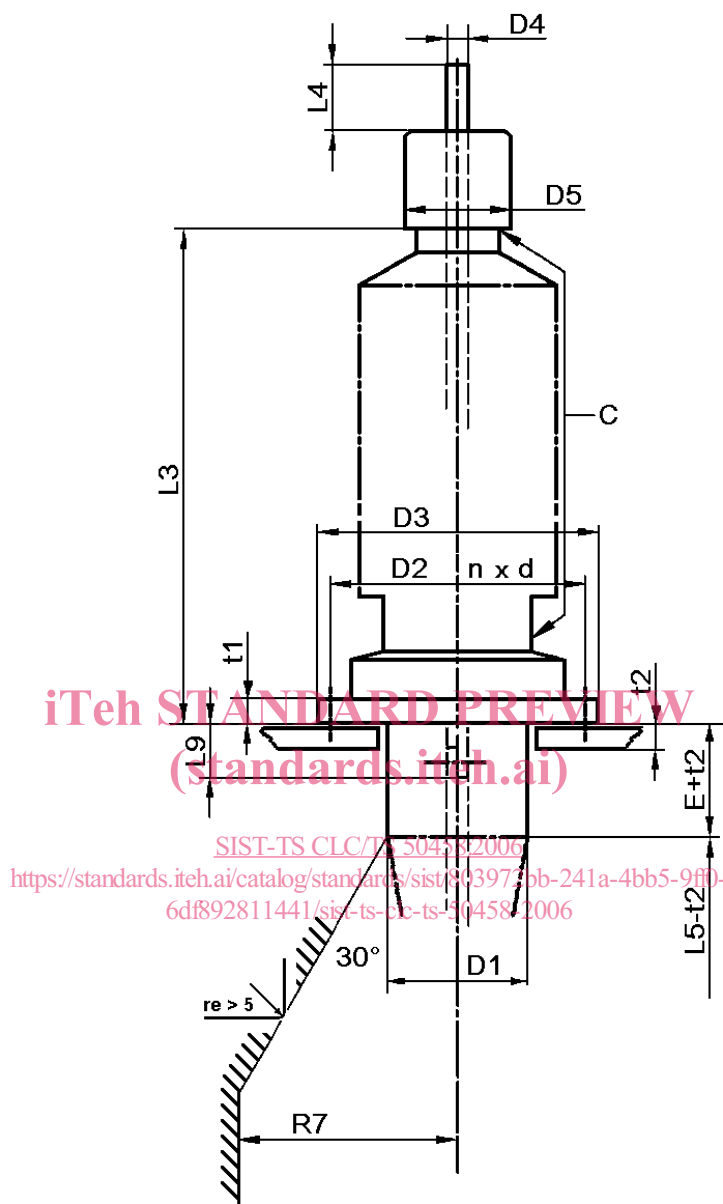


Figure 1 – Bushing dimensions (general)

Table 1 – Dimensions of air terminal stems according to IEC/TR 62271-301

Rated current A	D4 min.	L4 min.
≤ 1 250	30	80
>1 250 to ≤ 2 000	40	125
> 2 000	60	125

All dimensions in mm

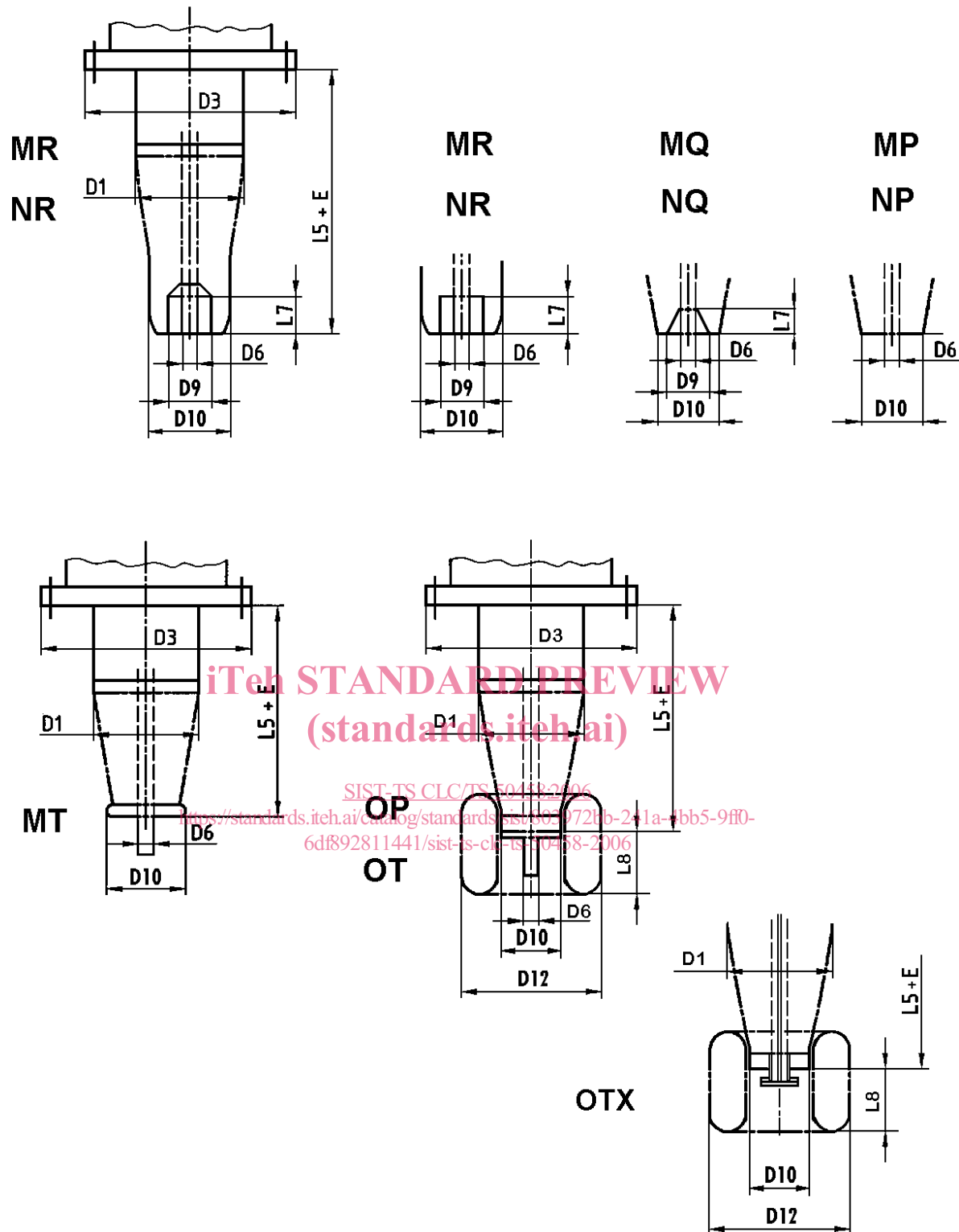


Figure 2 – Bushing oil end dimensions