SLOVENSKI STANDARD
SIST HD 528 S1:1998

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A method of temperature-rise assessment by extrapolation for partially type-tested assemblies (PTTA) of low-voltage switchgear and controlgear (IEC 890:1987)

A method of temperature-rise assessment by extrapolation for partially type-tested assemblies (PTTA) of low-voltage switchgear and controlgear

Verfahren zur Ermittlung der Erwärmung von partiell typgeprüften Niederspannungs-Schaltgerätekombinationen (PTSK) durch Extrapolation

Méthode de détermination par extrapolation des échauffements pour les ensembles d'appareillage à basse tension dérivés de séries (EDS)

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BODY OF THE HD

The Harmonization Document consists of:

- IEC 890 (1987) ed 1; IEC/SC 17D, not appended

This Harmonization Document was approved by CENELEC on 1989-06-12.

The English and French versions of this Harmonization Document are provided by the text of the IEC publication and the German version is the official translation of the IEC text.

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to announce the existence of this Harmonization Document at national level by or before 1989-12-01

to publish their new harmonized national standard by or before 1990-06-01

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Ing. Makar France

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

1) The formal decisions or agreements of the IEC on technical matters, prepared by Technical Committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjects dealt with.

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4) The IEC has not laid down any procedure concerning marking as an indication of approval and has no responsibility when an item of equipment is declared to comply with one of its recommendations.

PREFACE

This report has been prepared by Sub-Committee 17D: Low-voltage Switchgear and Controlgear Assemblies, of IEC Technical Committee No. 17: Switchgear and Controlgear.

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

Six Months' Rule	Report on Voting
17D(CO)31	17D(CO)32

Full information on the voting for the approval of this report can be found in the Voting Report indicated in the above table.

The following IEC publication is quoted in this report:

Publication No. 439-1 (1985): Low-voltage Switchgear and Controlgear Assemblies, Part 1: Requirements for Type-tested and Partially Type-tested Assemblies.

A METHOD OF TEMPERATURE-RISE ASSESSMENT BY EXTRAPOLATION FOR PARTIALLY TYPE-TESTED ASSEMBLIES (PTTA) OF LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR

1. Introduction

In IEC Publication 439-1, in the series of type tests, a temperature-rise test is specified. However, for certain types of assemblies for which the performance of a temperature-rise test is either not feasible or economically not justifiable a calculation of the temperature rise in the form of extrapolation from data found by tests on other assemblies may be made instead. Such assemblies are then called partially type-tested assemblies (PTTA).

Various methods of calculation can be conceived and are acceptable. The factors and coefficients set out in this report have been derived from measurements on numerous assemblies and the method has been verified by comparison with test results. The method described in this report is therefore one possible method and may for partially type-tested assemblies be used to prove compliance with the requirements of Sub-clause 8.2.1 of IEC Publication 439-1. This report applies to PTTAs only.

2. Scope

The following method is applicable to enclosed PTTA or partitioned sections of PTTA without forced ventilation.

Notes 1. — The influence of the materials and wall thicknesses usually used for enclosures are negligible on the steady state temperatures. The method is therefore applicable to enclosures made of sheet steel, sheet aluminium, cast iron, insulating material and the like.

2. — For open-type and dead-front PTTA, no temperature-rise assessment is needed if it is obvious that no excessive air temperatures are likely to arise.

3. Object

The proposed method is intended to determine the temperature rise of the air inside the enclosure.

Note. — The air temperature within the enclosure is equal to the ambient air temperature outside the enclosure plus the temperature rise of the air inside the enclosure caused by the power losses of the installed equipment.

Unless otherwise specified, the ambient air temperature outside the PTTA is the air temperature indicated for indoor installation of the PTTA (average value over 24 h) of 35 °C. If the ambient air temperature outside the PTTA at the place of use exceeds 35 °C, this higher temperature is deemed to be the ambient air temperature of the PTTA.

4. Conditions for application

This method of calculation is only applicable if the following conditions are fulfilled:

— there is an approximately even distribution of power losses inside the enclosure;

— the installed equipment is so arranged that air circulation is but little impeded;

— the equipment installed is designed for direct current or alternating current up to and including 60 Hz with the total of supply currents not exceeding 3 150 A;

- conductors carrying high currents and structural parts are so arranged that eddy-current losses are negligible;
- for enclosures with ventilating openings, the cross-section of the air outlet openings is at least 1.1 times the cross-section of the air inlet openings;
- there are no more than three horizontal partitions in the PTTA or a section of it;
- where enclosures with external ventilating openings have compartments, the surface of the ventilating openings in each horizontal partition shall be at least 50% of the horizontal cross-section of the compartment.

5. Calculation

5.1 *Necessary information*

The following data are needed to calculate the temperature rise of the air inside an enclosure:

- dimensions of the enclosure: height/width/depth;
- the type of installation of the enclosure according to Figure 4, page 25;
- design of enclosure, i.e. with or without ventilation openings;
- number of internal horizontal partitions;
- effective power loss of equipment installed in the enclosure.

Note. — The effective power losses of the equipment installed in the circuits of the PTTA used for this calculation are the power losses at the rated currents of the various circuits to be taken from information provided by the manufacturer. The power losses of the conductors are determined by calculation.

5.2 *Calculation procedure*

For the enclosures specified in columns 4 and 5 of Table I, the calculation of the temperature rise of the air inside the enclosures is carried out using the formulae laid down in columns 1 to 3 of Table I.

The pertinent factors and exponents (characteristics) are obtained from columns 6 to 10 of Table I.

The symbols, units and designations are to be taken from Table II.

For enclosures having more than one section with vertical partitions the temperature rise of the air inside the enclosure shall be determined separately for each section.

Where enclosures without vertical partitions or individual sections have an effective cooling surface greater than 11.5 m² or a width greater than about 1.5 m, they should be divided for the calculation into fictitious sections, whose dimensions approximate to the foregoing values.

Note. — The form shown on page 35 may be used as a calculation aid.

5.2.1 *Determination of the effective cooling surface A_e of the enclosure*

The calculation is carried out according to formula (1) in column 1 of Table I.

The effective cooling surface A_e of an enclosure is the sum of the individual surfaces A_0 multiplied by the surface factor b. This factor takes into account the heat dissipation of the individual surfaces according to the type of installation of the enclosure.

5.2.2 *Determination of the internal temperature rise $\Delta t_{0.5}$ of the air at mid-height of the enclosure*

The calculation is carried out according to formula (2) in column 2 of Table I.

In formula (2) the enclosure constant k allows for the size of the effective cooling surface for enclosures without ventilation openings and, in addition, for the cross-section of the air inlet openings for enclosures with ventilating openings.

The dependence of the temperature rises occurring in the enclosure on the effective power loss P is expressed by the exponent x.

The factor d allows for the dependence of the temperature rise on the number of internal horizontal partitions.

5.2.3 *Determination of the internal temperature rise $\Delta t_{1.0}$ of air at the top of the enclosure*

The calculation is made according to formula (3) in column 3 of Table I.

Factor c allows for the temperature distribution inside an enclosure. Its determination varies with the design and installation of the assembly as follows:

a) For enclosures without ventilation openings and with an effective cooling surface:

$$A_e > 1.25 \text{ m}^2$$

The factor c from Figure 4, page 25, depends on the type of installation and the height/base factor f, where:

$$f = \frac{h^{1.35}}{A_b}$$

b) For enclosures with ventilation openings and with an effective cooling surface:

$$A_e > 1.25 \text{ m}^2$$

The factor c from Figure 6, page 29, depends on the cross-section of air inlet openings and the height/base factor f, where:

$$f = \frac{h^{1.35}}{A_b}$$

c) For enclosures without ventilation openings and with an effective cooling surface:

$$A_e \leqslant 1.25 \text{ m}^2$$

The factor c from Figure 8, page 33, depends on the height/width factor g, where:

$$g = \frac{h}{w}$$

where:

h is the enclosure height, in metres
A_b is the surface area of the enclosure base, in square metres
w is the enclosure width, in metres

5.2.4 *Characteristic curve for temperature rise of air inside enclosure*

To evaluate the design according to Clause 6, it is necessary to apply the calculated results of Sub-Clauses 5.2.2 and 5.2.3 with the proper characteristic curve for temperature rise of air inside the enclosure as a function of the enclosure height. The air temperatures within horizontal levels are practically constant.

5.2.4.1 *Temperature-rise characteristic curve for enclosures with an effective cooling surface A_e exceeding 1.25 m²*

As a general rule, the characteristic curve of temperature rise is adequately well defined by a straight line which runs through the points $\Delta t_{1.0}$ and $\Delta t_{0.5}$ (see Figure 1).

The internal air temperature rise at the bottom of the enclosure is close to zero, i.e. the characteristic curve flattens out towards zero. (In practice, the dotted part of the characteristic curve is of secondary importance.)

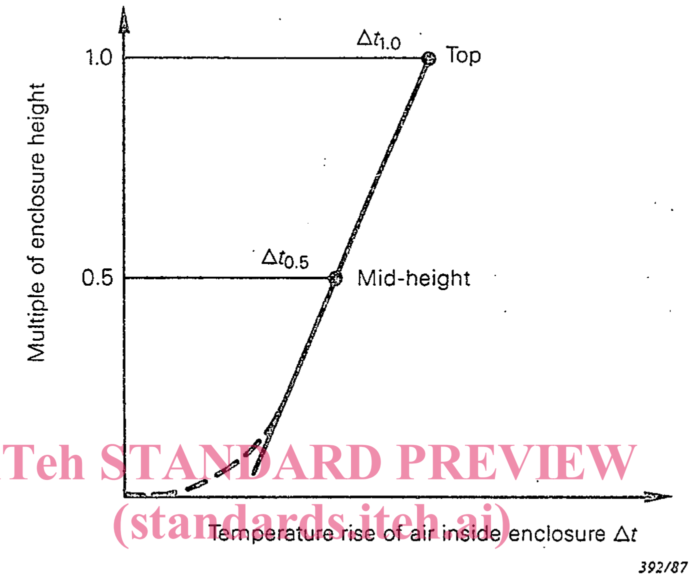

FIG. 1. — Temperature-rise characteristic curve for enclosures with A_e exceeding 1.25 m².