

American National Standard

guide for loading liquid-immersed
step-voltage and induction-
voltage regulators

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**IEEE Guide for Loading Liquid-Immersed
Step-Voltage and Induction-Voltage Regulators**

Sponsor
**Transformers Committee
of the
IEEE Power Engineering Society**

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Foreword

(This Foreword is not a part of ANSI/IEEE C57.95-1984, IEEE Guide for Loading Liquid-Immersed Step-Voltage and Induction-Voltage Regulators.)

This guide is applicable to regulators described in ANSI/IEEE C57.15-1986, American National Standard Requirements, Terminology, and Test Code for Step-Voltage and Induction-Voltage Regulators.

This guide for loading liquid-immersed step-voltage and induction-voltage regulators has been developed to cover modern voltage regulators not to exceed 2500 kVA of regulation for 3-phase units and not to exceed 833 kVA of regulation for single-phase units. (The rating in kilovoltamperes of a 3-phase voltage regulator is the product of the rated-load amperes and the rated range of regulation in kilovolts multiplied by 1.732. The rating in kilovoltamperes of a single-phase voltage regulator is the product of the rated-load amperes and the rated range of regulation in kilovolts. The rated range of regulation of a voltage regulator is the amount that the regulator will raise *or* lower its rated voltage. If the rated raise and lower are unequal, the larger shall be used in determining the rating in kilovoltamperes.) As present-day production almost universally utilizes thermally upgraded paper that is rated for 65 °C rise, this information is included in the basic document. As there are still a number of units with 55 °C rise insulation systems still in service, information is provided for these units. In addition, as there are certain units available that have been designed on the 55 °C rise basis, but with 65 °C rise insulation systems, and are stated by the manufacturer to be equipped for operation with 65 °C rise, information is provided for loading these regulators also.

The 55 °C rise and the 65 °C rise systems meet the thermal evaluation criteria established in ANSI/IEEE C57.100-1986, IEEE Standard Test Procedure for Thermal Evaluation of Oil-Immersed Distribution Transformers. As these regulators covered by this guide are designed and manufactured basically the same as distribution transformers, and since the loss of life curve for these insulation systems has been based on data derived from functional life testing of full-sized distribution transformers, this regulator loading guide is based on this insulation-aging curve. Work completed by the IEEE Insulation Life Subcommittee, comprising life tests on production transformers, is the basis for the insulation-life-versus-temperature relationship and is designated as minimum life expectancy in ANSI/IEEE C57.100-1986. To avoid ambiguity, this guide will use the term *normal life expectancy* to indicate the minimum life to be expected at a given temperature. The normal life expectancy at 95 °C and 110 °C, hottest-spot temperatures for 55 °C and 65 °C rise insulation system regulators, respectively, is 20 years.

The load profile used in the preparation of the loading tables in this guide was chosen as the representative daily cycle. Loss of life was determined by computer computation of the hottest-spot profile for the load cycle and ambient conditions. This new method of calculation is more accurate and takes less time than previous methods. Hand calculation methods are illustrated in Section 5. The assumed characteristics were chosen by a consensus of users and manufacturers as the best typical characteristics for modern regulators.

Values of loss of life shown in the tables for loading capability are for normal life expectancy or for moderate sacrifice of life expectancy and are in addition to the loss of life for normal life expectancy. This is also true in ANSI/IEEE C57.91-1981, Guide for Loading Mineral-Oil-Immersed Overhead and Pad-Mounted Distribution Transformers and also ANSI/IEEE C57.92-1981, Guide for Loading Mineral-Oil-Immersed Power Transformers.

Text references to nameplate ratings in regard to loading are based on the normal full range of regulation nameplate rating. Where range limiting devices are utilized, the resultant increase in loading will conform to the supplementary continuous current ratings as stated in 5.4 of ANSI/IEEE C57.15-1986, and discussed in 3.2 of this guide and will be the base current used for computation of loading.

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