AS 1078—1984
UDC 621.314.212.016.3

Australian Standard®
1078—1984

GUIDE TO LOADING OF OIL-IMMERSED TRANSFORMERS

STANDARDS ASSOCIATION OF AUSTRALIA
Incorporated by Royal Charter

This Australian standard was prepared by Committee EL/8, Static Electrical Machinery. It was approved on behalf of the Council of the Standards Association of Australia on 6 August 1984 and published on 9 November 1984.

The following interests are represented on Committee EL/8:

Australian British Trade Association

Australian Electrical and Electronic Manufacturers Association Ltd

Confederation of Australian Industry

Defence Standardization Committee

Electrical Testing Laboratories

Electricity Supply Association of Australia

Institution of Engineers, Australia

Railways of Australia Committee

This standard was issued in draft form for comment as DR 82197.

AUSTRALIAN STANDARD

GUIDE TO LOADING OF OIL-IMMERSED TRANSFORMERS

AS 1078—1984

First published (as AS CC10) 1965
AS 1078, Part 1 first published 1972
AS 1078 first published 1984

PUBLISHED BY THE STANDARDS ASSOCIATION OF AUSTRALIA
STANDARDS HOUSE, 80 ARTHUR ST, NORTH SYDNEY, N.S.W.

ISBN 0 7262 3511 3

PREFACE

This standard was prepared by the Association's Committee on Static Electrical Machinery. It supersedes AS 1078, Guide to Loading of Oil-immersed Transformers, Part 1—1972, Transformers to AS C61—1963. This guide applies directly to transformers manufactured to AS C61—1970, Power Transformers, but may be used for transformers manufactured to AS 2374—1982, Power Transformers, and earlier editions of AS C61.

The guide is based on the revised 1969 Draft Loading Guide for Oil Immersed Transformers, prepared for the Electricity Supply Association of Australia (ESAA) by the Sydney County Council and acknowledgement is made of the assistance received therefrom.

It is stressed that the language used in this guide is much freer than is customary in a standard specification and for this reason no attempt has been made to give a list of defined terms.

The life-expectancy curve (see Fig. A2) used as a basis of the guide to arrive at the cyclic loading values given in Tables 2.4 to 2.15 inclusive, is based on the ageing curve used in IEC 354, Loading Guide for Oil-immersed Transformers.

CONTENTS

STANDARDS ASSOCIATION OF AUSTRALIA

Australian Standard
for
GUIDE TO LOADINGS OF OIL-IMMERSED TRANSFORMERS

SECTION 1. SCOPE AND GENERAL

1.1 SCOPE. This standard sets out a guide to the loading of oil-immersed transformers manufactured to comply with the requirements of the following standards:

(a) AS C61—1970—Applies directly.

(b) AS 2374—1982—Applies directly with acceptable accuracy.

(c) AS C61—1963—Applies subject to the following modifications—

(i) use temperature-rise test results directly, if available; or

(ii) if no temperature-rise test results are available, then take the continuous rating for a 55°C top-oil rise as 1.08 times the name plate rating and the corresponding hotspot to top-oil temperature gradient as 28°C for ONAN and ONAF transformers or 23°C for OFAN and OFAF transformers.

NOTE: The ratings obtained by this procedure are typically 10 percent greater than those which would have been obtained by the direct application of this standard.

It applies to transformers having ratings up to 132 kV and 75 000 kV.A. It does not apply to transformers equipped with low oil volume, compact heat exchangers, either oil to water or oil to air.

1.2 PURPOSE. The purpose of this standard is to give guidance for determining whether or not the proposed load cycle for a transformer of known rating is permissible, in terms of insulation deterioration and life expectancy. It may also be used to select the rating of a transformer for a known load cycle.

1.3 BASIS OF STANDARD. The load-carrying ability of a transformer depends principally on the effect of the load causing deterioration of winding insulation, deterioration being related both to temperature and to the duration of its application. As a result of laboratory and model tests by various investigators, a number of relationships between insulation life and temperature (which relationships may be conveniently referred to as 'ageing curves') have been adopted by different authorities. This standard is based on the ageing curve used in IEC 354. (See Paragraph A4.1 of Appendix A herein).

In the determination of transformer ratings based on insulation life, it is necessary to decide upon a suitable minimum life period for transformers. The cyclic loading tables in this guide are based on a suitable minimum life, nominated as 1.0 per unit. Typically 1.0 per unit life would be of the order of 30 years. In practice the transformer may continue to function satisfactorily for a much longer period until a fault or other occurrence of sufficient magnitude results in the physical disturbance of the windings. This standard can also be used to obtain ratings corresponding to an assumed life expectancy greater or less than 1.0 per unit.

The theoretical basis of the guide is explained in Appendix A.

1.4 APPLICATION.

1.4.1 Use of the standard. Section 2 describes methods for the determination of cyclic loadings for oil-immersed transformers such that an acceptable minimum life may be expected. Section 2 also includes corrections if the assigned normal life is varied.

Section 3 gives examples of the determination of cyclic loading which may be applied to a transformer of a given rating.

Section 4 describes the methods used to evaluate the temperature response and reduction of life expectancy due to the application of short-time emergency loading.

1.4.2 Limitations in the use of the standard.

1.4.2.1 *General.* In the preparation of the tables and graphs, no specific limitations were imposed. In the application of the standard, the cyclic loadings should be limited in accordance with Clauses 1.4.2.2 to 1.4.2.4.

1.4.2.2 *For day-to-day cyclic loading.* For day-to-day cyclic loading, the following limitations apply:

(a) The top-oil temperature should not exceed 115°C and allowance should be made for the effect on the oil in the transformer operating for long periods at high temperature (see AS 1883).

(b) The hotspot temperature in the windings should not exceed 140°C.

(c) The current in the windings should not exceed 1.5 times the rated current.

1.4.2.3 *For short-time emergency loading, and abnormal emergency cyclic loading.* For abnormal conditions, account should be taken of all abnormal loads (number and magnitude) that may be imposed on the transformer during its lifetime to cater for maintenance and/or failure of nearby substations or other parallel transformers.

Short-time emergency loadings are dealt with in Section 4.

For oil-immersed insulation, at temperatures above 140°C, the formation of deterioration products may become too fast, or a gaseous phase may develop sufficiently rapidly to start localized over-saturation of the oil and the formation of bubbles, which may endanger the dielectric strength.

1.4.2.4 *Other limitations.* Under all conditions the user should also ensure that the following do not impose restrictions on the transformer loading:

(a) Capabilities of tap changers.

(b) Oil expansion.