Comparing current ratings for buried cables from ampacity tables under application of correction factors with results from calculations according to IEC 60287

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ABSTRACT

This document describes the results of various comparison series of buried cables, applying the Australian standard AS/NZS 3008.1.1:2017 and calculating the cases using a commercially available software based on the analytical methods from IEC 60287.

The aim of this publication is to point out potential errors and the resulting risks of using ampacity tables versus analytically calculating the cable current ratings. The reason being that significant deviations can be found, especially when using more than one correction factor at the same time.

KEYWORDS

Cable rating, derating factors, IEC 60287, AS/NZS 3008.1.1

INTRODUCTION

Various international and national standards and regulations exist with ampacity tables for common installation practice. Some standards are applicable for low voltage such as the national standards [1], [2], [3] or the international standard [4]. Others are applicable for medium voltage such as [5] and [6].

All mentioned standards have in common that the values in the ampacity and correction factor tables have been derived in accordance with the methods given in the IEC 60287 series [7], except of special cable types (e.g. flat cables) or special laying conditions not covered by the IEC standard (e.g. cables partially or completely surrounded by thermal insulation). Therefore, a good agreement would be expected between values obtained from the tables and results of calculations according to the analytic methods provided by the IEC standard.

Methodology

The current-carrying capacities of a cable is dependent on the number of conductors and cross-section, the conductor material (typically copper or aluminium) and the permissible conductor temperature which depends on the insulation material. The current-carrying capacity of a cable is also dependent on the method of installation to maintain the temperature of the cable within its operating limits. Different methods of installation vary the rate at which the heat generated by the current flow is dissipated to the surrounding medium. Usually, different tables depending on these parameters are given in the standards, which provide the values of current ratings for a list of conductor cross-sections for a single cable or a single circuit.

In order to take into account dependence on the ambient temperature, type of laying and laying depth, as well as laying in enclosures and other parameters, further tables with correction factors exist in these standards.

Where a number of circuits are installed in the same group in free air, on a surface, buried direct in the ground or within the same sheath or wiring enclosure, in such a way that they are not independently cooled by the ambient air or the ground, further tables are provided with the appropriate derating factor to be used.

The load capacity is obtained by multiplying the load capacity at agreed service conditions by the linear product of all necessary correction factors.

$$I_{rated} = I_{table} \cdot f_{DR} = I_{table} \cdot f_1 \cdot f_2 \cdot f_3 \cdot f_4 \qquad [1]$$

With I_{table}, being the tabulated current value and f_1 to f_4 being the derating factors depending on burial depth, soil thermal resisivity, ambient temperature, and grouping.

AS/NZS 3008.1.1

The standard AS/NZS 3008.1.1:2017 is applicable to Australian installation conditions. The objective of this standard is to specify current-carrying capacity, voltage drop and short-circuit temperature rise of cables, to provide a method of selection for those types of electric cables and methods of installation that are in common use at working voltages up to and including 0.6/1 kV at 50 Hz a.c.

The current-carrying capacities given in the tables of this Standard are based on following standard conditions:

- Ambient air temperature of 40 °C and ambient soil temperature of 25 °C
- Depth of laying of 0.5 m (center of cable or group).
- Thermal resistivity of soil of 1.2 K.m/W.

Notes

This standard differs from the 2009 edition in several points, however, all the values used for this paper remained the same, including the current rating values in table 14.

The current ratings are noted as also applicable for d.c. installations as calculations will yield negligible difference or conservative results.

The soil thermal resistivity varies greatly with soil composition, moisture retention qualities and seasonal weather patterns as weil as the variation in load carried by the cable with values ranging between 0.8 to 2.5 K.m/W. The value of 1.2 K.m/W has been selected as an average figure on the basis of soil types and assumes maximum thermal resistivity at times of maximum load.

In Appendix A, Example 3, the product of correction factors was used.

Deviation to IEC 60287

The standard explicitly states in clause 3.1.2: *"The values for current ratings given in Tables 4 to 15 have been calculated using the method described in IEC 60287 […]"*.