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Ampacities For
Single-Conductor Solid Dielectric Power Cable 15 kV Through 35 kV

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CONTENTS

TABLES AND CHARTS

Foreword

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Preface

The first industry ampacity tables were published in December 1943 by the Insulated Power Cable Engineers Association (IPCEA) under the title *Current Carrying Capacity of Impregnated Paper, Rubber and Varnished Cambric Insulated Cables*. These tables were based on the best available information at the time they were published and served the industry well for many years.

As a result of interest in this subject by the AIEE Insulated Conductors Committee and recognition of the fact that new techniques had been developed for making ampacity calculations through greater understanding of the thermal circuit, a joint AIEE-IPCEA Working Group was formed to prepare a new ampacity publication. In 1962 a completely new edition was published in two volumes for copper and aluminum conductor entitled *Power Cable Ampacities,* AIEE Pub. No. S-135, IPCEA Pub. No. P-46-426 [1]. (IPCEA was changed to ICEA in 1979, dropping the "P" for power when communications manufacturers joined the association) This publication covered several cable types including, for the first time, oil-filled and gas-filled impregnated paper insulated cables in a variety of installations. The ampacities in these tables are still considered appropriate for the designated installation conditions and parameters.

The 1962 tables do not adequately cover ampacities for single-conductor solid-dielectric cables with shields designed for stringent fault current conditions and directly buried concentric-neutral three-phase cables. The increasing use of these constructions prompted the Cable Characteristics Subcommittee of the IEEE Power Engineering Society to consider a supplement to these tables. A Task Group was formed to study the problems and to prepare this publication. In particular the Group considered the effect on ampacities of (1) shield losses in single-conductor cables and (2) temperatures in the earth surrounding buried cables and ducts. Subsequently, Tables 1 through 80 were approved on March 22, 1972 by IPCEA and NEMA as Authorized Engineering Information.

On May 17, 1976, IPCEA and NEMA approved the expansion of this publication to include 69 kV cables. This resulted in the revision of paragraphs A through E and Tables A and B and in the addition of Tables 81 through 128. On September 26, 1988, NEMA reaffirmed the ICEA P-53-426/NEMA WC50 standard
In 2008 the Utility Power Cable Standards Technical Advisory Committee (UPCSTAC) Task Group was formed to address the need for tables to cover ampacities for single-conductor cables with an extruded LLDPE jacket which had become the standard cable design for Utility distribution cables 15 kV through 35 kV. These tables are intended to compliment the IEEE 835 Standard Power Cable Ampacity Tables-1994. The following companies or persons have contributed to the computation of the ampacity tables for the new ICEA P-117-734 publication:

General Cable
Southwire
Nexans
Ritchie Harp - Oncor
Mike Smalley – We Energies
Greg Stano - WPS
Jeff Helzer – OG&E
Jon Erickson – San Diego G&E
Jason Fosse – SCE
Carl Wall – Southern Co.
Harry Hayes – Ameren

Section 1

General

1.1 INTRODUCTION

In recent years there has been an increase in the use of extruded Linear Low Density Polyethylene (LLDPE) jacketed single-conductor solid-dielectric 15 through 35 kV power cables for substation exit feeders and other three-phase distribution circuits. When shields are bonded and grounded at multiple points, circulating currents, dependent on shield impedance, will flow in the concentric shields with consequent I^2R losses and heating. These currents and associated losses may be appreciable when the cables are spaced.

This publication focuses attention in the form of published tables on the effect of circulating currents on ampacities of cables with bonded and grounded shields. These tables also provide the earth interface temperatures in order to recognize the risk of over-heating and possible thermal instability due to earth moisture migration.

Circulating current losses may be eliminated or minimized by bonding and grounding the shields at a single point or by special shield bonding techniques. A detailed treatment of shield bonding techniques is included in ANSI/IEEE Std 575 [10], Chapter 3 of the Underground Systems Reference Book [3] and in Section II of the Miller thesis [4] on sheath losses. Open-circuited or special shield bonding techniques result in voltages between shield and ground both under steady-state and transient operating conditions. In the case of single-point bonding, alternative means of through fault current return may need to be provided.

1.2 SCOPE

This publication presents calculated ampacities for single-conductor solid-dielectric 15 through 35 kV power cables with multiple bonded and grounded shields, copper or aluminum conductors, single or three phase operation, spaced or trefoil configurations, single or double circuits, directly buried or in buried ducts. Ampacities are given for three or four different shield resistances for each conductor size.

The ampacity calculations provided in this guide have been performed with the software program CYMCAP Ver. 5.3 Rev 2 from CYME International. The methodology used in the calculations is based on Neher-McGrath [6] and the international standard IEC 60287 [9]. Recognizing that both this IEC standard and the CYMCAP modeling program will undergo changes over time, the user may not get repeatable results with CYMCAP in the future from those shown in this guide. To minimize these potential differences, the values shown have been rounded to the nearest 5 amps and should not be considered as exact since it is generally accepted that there are many variables that influence the actual ampacity of an installation even beyond those of the calculation method.