Currently active national standards are important for the transformer design, manufacturing and operation - they reflect today's transformer technology

ABSTRACT

Currently active transformer standards are of the utmost importance for the selection, design, manufacture, installation, operation and maintenance - they reflect today's modern transformer technology.

KEYWORDS

application, selection, standards, transformers

Standards relevant to transformers – Part V

Transformer selection and application

IEC 60076-8 Transformer application guide provides users with information on selection and characteristics of three phase transformer connections, zero sequence impedance characteristics, tapping selection and features, operational issues (parallel operation and fault currents) and measurement accuracy of losses

1 Introduction

In the previous four parts of this column, we have explained the evolution of transformer standards by IEC, IEEE, EN, plus technical brochures by CIGRE bodies. We have also noted the current standards available on transformer specifications. In this part of the series, national standards available for the selection and application of transformers are summarised. Numbers in the bracket next to the standard number indicates the previous edition of the particular standard.


NORME INTERNATIONALE
CEI
IEC
INTERNATIONAL STANDARD
60076-8
Première édition
First edition
1997-10
Transformateurs de puissance – Guide d'application
Power transformers – Application guide
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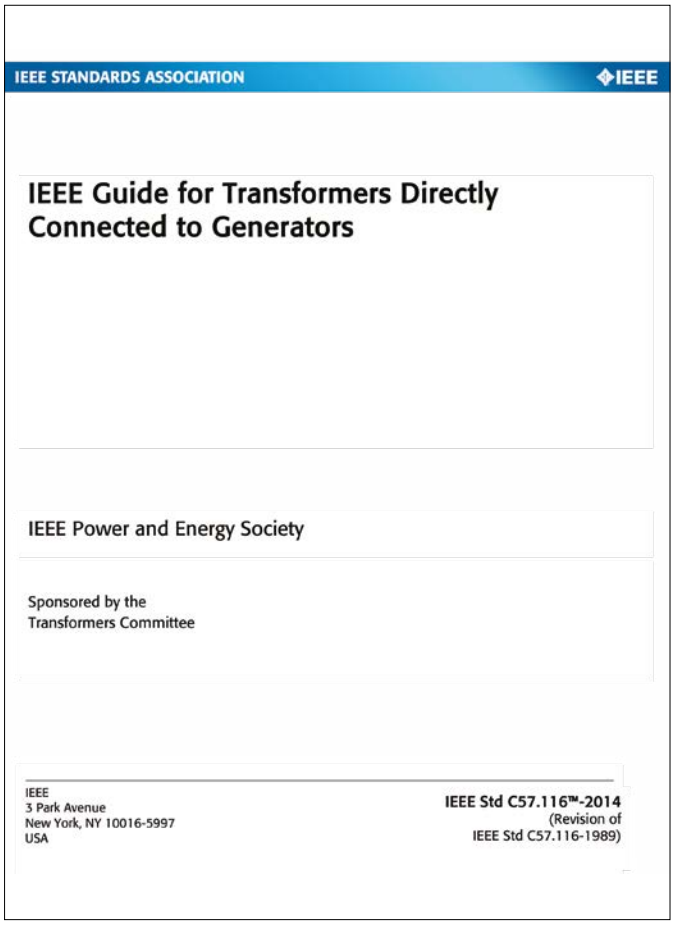
IEEE STANDARDS ASSOCIATION
IEEE
IEEE Guide for Transformers Directly Connected to Generators
IEEE Power and Energy Society
Sponsored by the
Transformers Committee
IEEE
3 Park Avenue
New York, NY 10016-5997
USA
IEEE Std C57.116™-2014
(Revision of
IEEE Std C57.116-1989)

2 Standards

Category	IEC Standard / CIGRE TB	ANSI / IEEE standard	EN / Indian standard
Standard terminology for transformers and reactors	60050-421, 1990	C57.12.80-2010 (2002)	
Transformers – application guide	60076-8, Ed. 1.0, 1997 (606-1978)	C57.94-2015 (dry-type) (1982)	IS 2026 (Part 8) 2009 / IEC 60076-8-1997 (IS10561-1983)
Converter transformers – application guide	61378-3, Ed. 2.0, 2015 (2006)		
Tap-changers – application guide	60214-2, Ed. 2.0, 2019 (dual std. with IEEE)	60214-2, Ed. 2.0, 2019 (dual std. with IEC)	
Transformers using high temperature insulation materials - design, testing and application	60076-14, Ed. 1.0, 2013	C57.154-2012	IS 2026 (Part 14) – 2018 / IEC 60076-14-2013
Guide for application of high temperature insulation materials in liquid immersed transformers		1276-2020 (1997)	
Guide for transformers directly connected to generators	-	C57.116-2014	
Phase-shifting transformer – application, specification, testing guide	(62032, Ed. 2., 2012) IEC / IEEE 60076-57-1202:2017	(C57.135-2012) Superseded	
Transformer capability for non-sinusoidal currents (loads with harmonics) – liquid filled and dry	-	C57.110-2018 (2008)	
Harmonic control in power systems		519-2014 (1992)	
Transformers for application in DPV (distributed photo voltaic) power generation system		C57.159-2016	
Transformer capability under geo-magnetic disturbances		C57.163-2015	
Transformer loss evaluation guide	-	C57.120- 2017 (1991)	
Terminal marking and connections	TR 60616, Ed. 1.0, 1978	C57.105-2019 (1978) (Transformer connections in three-phase electrical systems) C57.12.70-2020 (2011) (Terminal markings and connections for power and distribution)	IS 2026 (Part 4), 1977
Application of power apparatus bushings		C57.19.100-2012 (1995)	
Direct connection details between transformers and GIS	62271-211, Ed. 1.0, 2014 (TR 61639-1996)		
Cable connection for GIS	62271-209, Ed. 2.0, 2019 (2007)	1300-2011 (1996)	
Selection of insulators for polluted environments	60815, 1 to 3, Ed. 1.0, 2008 CIGRE brochures 158 and 361		
Selection guide for polymeric materials for outdoor use under HV stress	TR 62039, Ed. 1.0, 2007		
Cleaning of insulators		957-2005 (1995)	
Bushings – seismic qualification	TS 61463-2016 (2000)		
Seismic design of substations – recommended practice		693-2018 (2005) (1997) (C57.114-1990 Seismic guide for transformers and reactors)	
Seismic test methods	60068-3-3, Ed. 2.0, 2019 (1991)		
Insulation coordination – definitions, principles and rules	60071-1, Ed. 9.0, 2019	C62.82.1-2010 (1313.1-1996)	
Application guide	60071-2, Ed. 4.0, 2018	1313.2-1999	
Computational guide for insulation coordination and modelling of electrical networks	TR60071-4, Ed. 1.0, 2004		
Procedure for HVDC converter stations	TR 60071-5, Ed. 1.0, 2002		
Low voltage system	60664-1, Ed. 3.0, 2020		
Preferred voltage ratings	60038, Ed. 7.0, 2009 (1983)	1312-1993 ANSI C84.1, 2020 (2016)	

Category	IEC Standard / CIGRE TB	ANSI / IEEE standard	EN / Indian standard
Qualifications of Class 1E transformers for nuclear generating station		638-2013 (1992)	
Bar coding of distribution transformers		C57.12.35-2013 (2007)	
Sound level Determination of sound level Guide for sound abatement and determination	60076-10-1, Ed 2.0, 2016 (2005)	 C57.136-2000	IS 2026 (Part 10), Sec. 1-2018 / IEC 60076-10-1-2016
Occurrence and mitigation of switching transients induced by transformers	CIGRE brochure 577 A and B, 2014 569, 2014, ferroresonance	C57.142- 2010	
Guide for conducting a transient voltage analysis of dry-type transformer coil		C57.12.58-2017 (1991)	
Metric conversion of transformer standards		C57.144-2004	
Determination of hot spot temperature in windings in liquid filled transformers		1538-2000	
Temperature rise of LV switchgear and control gear assemblies by calculation	TR60890, Ed. 2.0, 2014 (1987)		
Electro-technical equipment – temperatures of touchable hot surfaces	Guide 117, 2010		
Safety of transformers – EMC requirements	62041, Ed. 3.0, 2017 (2010)		
Classification of environmental conditions Temperature and humidity	 60721-2-1, Ed. 2.0, 2013 1982)		
Application of neutral grounding in utility system Introduction Synchronous generator system Generator auxiliary system Distribution Transmission		 C62.92.1- 2016 (2000) C62.92.2-2017 (1989) C62.92.3-2012 (1993) C62.92.4-2014 (1991) C62.92.5-2020 (2009)	
Grounding Safety in substation grounding Guide for generating station grounding		 80-2013 (2000) 665-1995 (R2001)	
Arc flashover study Guide for arc flash hazard calculations Guide for the specifications of scope and deliverable requirements of a flash over study		1584 and NFPA 70 E 1584-2018 (2002) 1584.1-2013	
Short circuit currents in three phase AC systems Calculation of currents Factors for SC calculations Data of equipment for SC calculations Current during 2 Nos. LG fault Examples for SC calculations Calculation of thermally permissible short circuit currents Modal components in three-phase AC systems	 60909-0, Ed. 2.0, 2016 (2001) TR60909-1, Ed. 2.0, 2002 (1991) TR60909-2, Ed. 2.0, 2008 (1992) TR 60909-3, Ed. 3.0, 2009 (2003) TR60909-4, Ed. 1.0, 2000 60949, Ed. 1.0, 1988 AMD1-2008 62428, Ed. 1.0, 2008		

Category	IEC Standard / CIGRE TB	ANSI / IEEE standard	EN / Indian standard
Electrical installations of ships and mobile and fixed offshore units – Part 1 – procedure for calculation of short circuit current in three-phase AC	61363, Ed. 1.0, 1998		
Short circuit currents in DC auxiliary Installations	61660 (all parts)		
Short circuit currents – calculation of effects			Cahiers technique, Nos. 158 and 162
Definitions and calculation methods	60865-1, Ed. 3.0, 2011 (1993)		
Examples of calculations	TR 60865-2, Ed 2.0, 2015 (1994)		
Interconnection of distributed resources with electric power system		1547-2018 (2003) Interconnection and interoperability – 8 parts	
Recommended practice for industrial and commercial power system			
Application of power distribution apparatus		3001-5-2013	
Grounding and bonding		3003.2-2014	
Application of instrument transformers		3004.1-2013	
Application of LV breakers		3004.5-2014	
Determination of reliability of 7 x 24 continuous power system		3006-7-2013	
Collecting data		3006-9-2013	
Operation and management		3007.1-2010	
Maintenance		3007.2-2010	
Electrical safety		3007.3-2012	
Corrosion of metals and alloys			
Basic terms and definitions	ISO8044-2015 (1999)		
Corrosivity of atmospheres-classification, determination and estimation	ISO 9223-2012 (1992)		
Guiding corrosivity values for the corrosivity categories	ISO 9224-2012 (1992)		
Measurement of environmental parameters affecting corrosivity of atmosphere	ISO 9225-2012 (1992)		
Determination of corrosion rate on standard specimens	ISO 9226-2012 (1992)		
Salt spray tests	ISO 9227-2017 (2012)		
Classification of low corrosivity of indoor atmospheres	ISO 11844-2020, 1 (2006), 2 (2005), 3 (2006)		

Category	IEC Standard / CIGRE TB	ANSI / IEEE standard	EN / Indian standard
Corrosion protection of iron and steel			
Nickel electroplating	ISO 1456-2009 (2003)		
Hot-dip galvanizing – specs and test methods	ISO1461-2009 (1999)		
Metallic coating – thickness measurement	ISO 1463-2003 (1982)		
Thermal spraying – design considerations and quality requirements	ISO 2063-1-2019 (2017)		
Thermal spraying – execution	ISO 2063-2-2017 (2005)		
Surface treatment and metal coatings – vocabulary	ISO 2080-2008 (1981)		
Electroplated zinc coating	ISO 2081-2018 (2008)		
Tin coating	ISO 2093-1986 (1973)		
Chromate conversion coatings on zinc / cadmium electro plating – test methods	ISO 3613-2010 (2000)		
Fasteners – electroplated coating system	ISO 4042-2018 (1999)		
Chromate conversion coatings on zinc / cadmium electro plating – specifications	ISO 4520-1981		
Silver plating	ISO 4521-2008 (1985)		
Metallic coatings – CORR test	ISO 4541-1978		
Aluminium anodizing-specification	ISO 7599-2018 (2010)		
Aluminium anodizing – rating system for evaluation	ISO 8994-2018 (2011)		
Metallic coatings – pre-treatment of iron to reduce hydrogen embrittlement	ISO 9587-2007 (1999)		
Metallic coatings –post-coating treatment of iron to reduce hydrogen embrittlement	ISO 9588-2007 (1999)		
Metallic coating – review of porosity test	ISO 10308-2006 (1995)		
Fasteners – zinc flake coatings	ISO 10683-2018 (2014)		
Fasteners – hot dip galvanized coatings	ISO 10684-2004 + A1 2008		
Guidelines for selection of protection methods against corrosion	ISO 11303-2002		
Mechanically deposited coatings of zinc – specifications and test methods	ISO 12683-2004		
Mechanically deposited coatings – automated controlled shot peening of metallic articles prior to nickel, chromium plating	ISO 12 686-1999		
Zinc coatings – guidelines for protection of iron and steel structures			
General principles of design and corrosion resistance	ISO 14713-1-2017 (2009)		
Hot – dip galvanizing	ISO 14713-2-2019 (2009)		
Sherardising	ISO 14713-3-2017 (2009)		
Thermal spraying – terminology and classification	ISO 14917-2017 (1999)		
Zinc diffusion coatings – sherardising – specifications	ISO 17668-2016		
Metallic coatings – definitions and conventions concerning porosity	ISO 18332-2007		

Category	IEC Standard / CIGRE TB	ANSI / IEEE standard	EN / Indian standard
Corrosion protection of iron and steel – paints and varnishes			
Introduction	ISO 12944-1-2017 (1998)		
Classification of environment	ISO 12944-2-2017 (1998)		
Design considerations	ISO 12944-3-2017 (1998)		
Types of surface and surface preparation	ISO 12944-4-2017 (1998)		
Protective paint systems	ISO 12 944-5-2019 (2018)		
Laboratory performance test methods	ISO 12944-6-2018 (1998)		
Execution and supervision of paint work	ISO 12944-7-2017 (1998)		
Development of specifications for new work and maintenance	ISO 12944-8-2017 (1998)		
Paint system and tests for offshore structures	ISO12944-9-2018 (2009)		
Cross-cut test	ISO 2409-2020 (2013)		
Materials for use in H2S containing environment – Petroleum and gas industries			
General principles	ISO 15156-1-2020 (2015)		
Crack resistant carbon and low alloy steels	ISO 15156-2-2020 (2015)		
Crack resistant corrosion resistant alloys	ISO 15156-3-2020 (2015)		
Guide for development of specifications for turnkey substation projects		1267-2019 (1999)	
Guide for transformer specifications	CIGRE TB 528-2013/156-2000		
Guide for transformer design review	CIGRE TB 529-2013/204-2002		
Guide for transformer factory capability assessment	CIGRE TB 530-2013		

Conclusion

The authors hope that this comprehensive list of various national standards covering various aspects in the selection and application of transformers will be useful for consultants, users and designers of transformers.

IEEE C57.116 provides information on the selection and application considerations for the unit power transformer and unit auxiliaries power transformer

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