> Specifications are formulated for different types of transformers depending on their application

ABSTRACT

Due to the wide use of transformers, their specification is very important. Transformer specification is a "common language" between manufacturers, suppliers, vendors, engineers, or any other parties that work with transformers on the technical level. That is the reason why the transformer specifications are well defined by standards.

KEYWORDS

EN, IEC, IEEE, specifications, standards

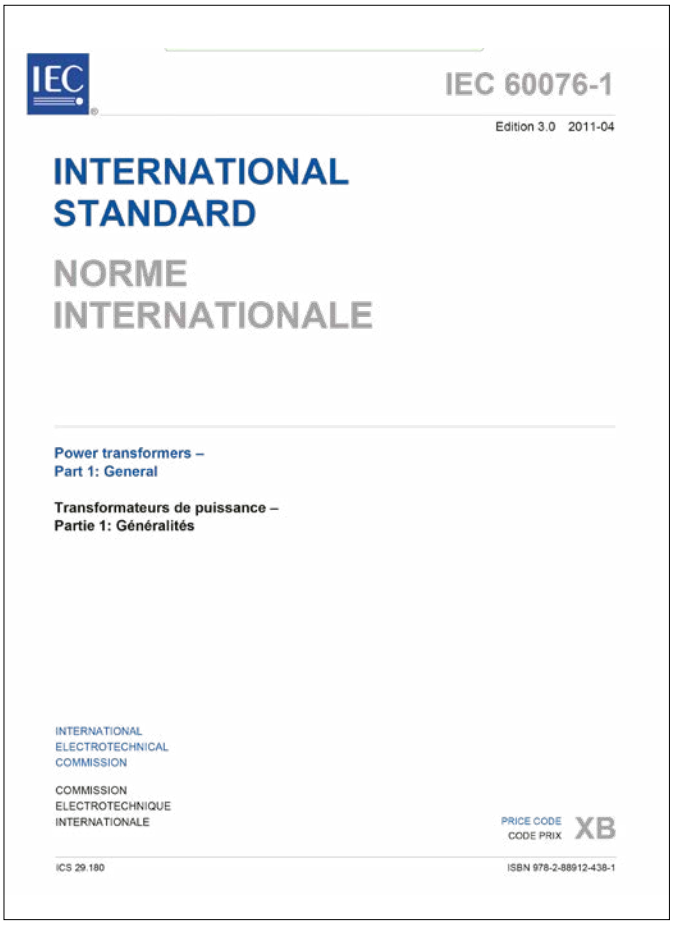
List contains transformer type and number of the standard if it exists among IEC, IEEE, or EN standards

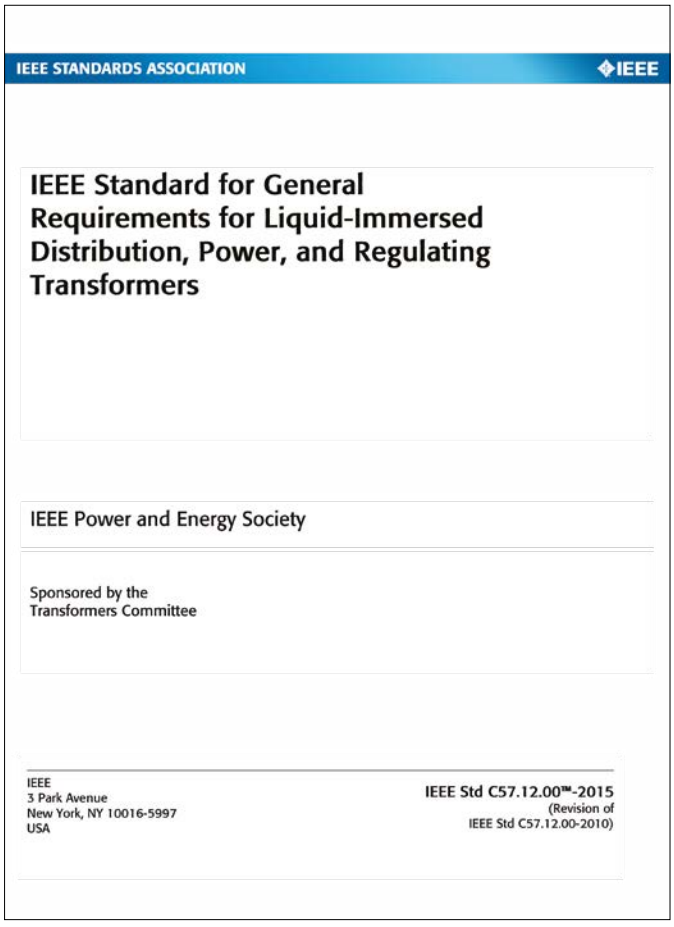
Standards relevant to transformers – Part VI

Transformer specifications

1. Introduction

In part V of this column, we had covered national standards available for the selection and application of transformers. In this part, we have compiled standards for transformer specifications required by power engineers when they order different types of transformers for the transmission and distribution of electric energy. Transformers and reactors required for electric transmission, distribution, railway traction, furnace, rectifier, solar, and wind power farms are covered. Standards are available for special application transformers such as HV DC converter transformers, phase shifting transformers, grounding transformers, voltage regulators, submersible transformers, and pad-mounted transformers. Transformers with different insulation structures like liquid immersed (mineral oil and ester), dry-type (cast resin or conventional), and SF-6 gas are covered by separate standards. Standards for minimum energy efficiency and loss capitalization formula help users to opt for appropriate efficiency levels (total losses).





2. Standards list

Transformer type	IEC standard / CIGRE TB	ANSI / IEEE standard	EN / Indian standard
Liquid immersed transformers	60076-1-Ed 3.0-2011 (2000)	C57.12.00 - 2015 (2010)	IS:2026 (Part 1)-2011 / IEC 60076-1(2000)
Transformers, step voltage regulators and reactors		NEMA TR 1 - 2013	
Standard requirements for liquid immersed Power transformers Distribution transformers		 C57.12.10 - 2017 (2010) C57.12.36 - 2017 (2007)	
Outdoor type, liquid immersed, DTs 2500 kVA, 33 kV Part 1 - Mineral oil immersed Part 2 - Ester fluid immersed			 IS:1180 (Part 1) - 2014 + Amend 4-2021 (1989) IS:1180 (Part 3) - 2021
Reactors - shunt	60076-6 Ed 1.0-2007 CIGRE TB 546-2013 Protection, monitoring and control of shunt reactors	C57.21 - 2008 (1990)	IS 2026 (Part 6) – 2017 / IEC 60076-6-2007
Grounding (earthing) transformers	60076-6 ed1.0-2007 Section 6 (60289-1968, 1988)	C57.32 - 2015 (IEEE 32-1972) C57.32a - 2020 Amendment 1	IS 2026 (Part 6) -2017 / IEC 60076-6-2007
Self-protected liquid filled transformer	60076-13 Ed 1.0 - 2006		
Liquid Immersed transformers, using high temperature insulation system	60076-14 Ed 1.0 - 2013	C57.154 - 2012	IS:2026 (Part 14) - 2018
Gas filled transformers	60076-15 Ed 2.0-2015 (2008)		IS-2026 (Part 15) - 2018
Transformers for wind turbine applications	IEC/IEEE 60076-16 Ed. 2.0 - 2018	IEC/IEEE 60076-16 Ed. 2.0 - 2018	IS-2026 (Part 16) - 2018
Dry transformers – general requirements	60076-11 Ed 2.0 - 2018 +ISH 1-2020 Interpretation sheet (Ed 1.0 - 2004) (60726 - 1982)	C57.12.01-2020 (2015) (solid-cast or resin-encapsulated) NEMA ST-20 -1 992 (R1997) Dry-type transformers for general applications	(IS:11171-1985 (R2016) IS:2026-11 - 2021
Converter (rectifier) transformers / reactors	60146-1-3 Ed 1.0 - 1991 61378-1 Ed 2.0 - 2011 (1997)	C57.18.10 - 1998 (R2003)	
HVDC Converter transformers	IEC/IEEE 60076-57-129-2017 Ed 1.0	C57.129 - 2008	
Reactors - HVDC smoothing reactors		1277 - 2000	
K-rated transformers		UL 1561 - 2011 UL 1562 - 1999 C57.110 - 2008	
Transformers for non-sinusoidal currents (loads with harmonics) - liquid immersed and dry	-	C57.110 - 2018 (2008)	
Traction transformers and inductors	60310 Ed 4.0 - 2016 (2004)		
Traction transformers for fixed installations	62695 Ed 1.0 - 2014	1653.1 - 2016 Traction power rectifier transformers for substations	EN 50329 - 2003
Arc furnace transformers		C57.17 - 2012	IS:12977 - 1990 (R2014)

Transformer type	IEC Standard / CIGRE TB	ANSI / IEEE standard	EN / Indian standard
Testing transformers			IS:13956 - 1990 (R2014)
Phase shifting transformer	62032 Ed 2.0-2012 IEC/IEEE 60076-57-1202-2017 Ed 1.0	C57.135-2011	
Step voltage regulators- Standard requirements, terminology and test code Automatic line voltage correctors (step type) for domestic use Dry type air core series reactors	60076-21 Ed 2.0-IEEE C57.15 -2018 (2011)	C 57.15-2009 (1999) (induction voltage regulators) C57.16 - 2011 (1996)	IS:8448 - 1989
Voltage Regulating Distribution Transformers (VRDT)	60076-24 - 2020 Ed 1.0		
Transformers for DPV (distributed photovoltaic) power generation system		C57.159 - 2016	
Transformers ≤ 230 kV, 1~10 MVA single phase, 0.8~100 MVA 3-phase		C 57.12.10 - 2017 (1997, 2010)	
Overhead distribution transformers ≤ 500 kVA 34.5/13.8 kV		C 57.12.20 - 2017 (2011)	
Submersible, single phase transformers ≤ 250 kVA, HV ≤ 34.5 kV, LV ≤ 600 V		C57.12.23 - 2018 (2009)	
Submersible, 3 phase Transformers ≤ 3.75 MVA, HV ≤ 34.5 kV LV ≤ 600V		C57.12.24 - 2016 (2009)	
Pad mounted 3-phase DT ≤ 5 MVA 34.5/0.48 kV		C57.12.34 - 2009	
Pad mounted single phase distribution transformers, ≤ 250 kVA, 34.5 kV		C57.12.38 – 2014 (2009)	
Bar coding for distribution transformers and step voltage regulators		C57.12.35 - 2013 (2007)	
Standard requirements for liquid immersed distribution substation transformers		C57.12.36 - 2017 (2007)	
Degrees of protection provided by enclosures (IP Code)	60529 Ed 2.2 - 2013		
Enclosure integrity - pad mounted equipment		C57.12.28 - 2014 (2005) C57.12.31 - 2020 (2010)	
Enclosure integrity - pad mounted, for coastal environments		C57.12.29 - 2014 (2005) C57.12.30 - 2020 (2010)	
Enclosure integrity-submersible equipment		C57.12.32 - 2019 (2002 (R2008))	
Electronics power transformers		IEEE Std 295 - 1969	
Requirements for distribution transformer tank pressure co-ordination		C57.12.39 - 2017	
Secondary network transformers – subway and vault type (liquid immersed) 2.5 MVA and less		C57.12.40 - 2017 (2011)	
Secondary network protectors - standard requirements		C57.12.44 - 2014 (2005)	
Ventilated dry type DT-500 kVA max 1~500 kVA single phase 15~500 kVA 3-phase		C57.12.50 – 1981 (R1998)	
Ventilated, dry type power transformers More than 500 kVA 3-phase 33 kV		C57.12.51 - 2019 (2008)	
Sealed, dry power transformers ≥ 0.5 MVA 3-phase 34.5 kV		C57.12.52 - 2012 (1981 (R1998))	
Dry type transformers used in unit substations		C57.12.55 - 1987	

Transformer type	IEC Standard / CIGRE TB	ANSI / IEEE standard	EN / Indian standard
Guide for dry type transformer through fault current duration		C57.12.59 - 2015	
Dry type transformers for general applications		NEMA ST 20	
Non-flame proof mining transformers for use below ground			IS:2772 - 1982 (R2016)
Energy efficiency of power transformers	60076-20 Ed 1.0 - 2017	C57.120 – 2017 Loss evaluation guide (1991 (R2006))	EN 50588-1-2015 - Medium power transformers ≤ 36 KV - general requirements EN 50629 - 2015 + A1 + A2 - 2018 Energy performance of large power transformers

Conclusion

Authors hope that this comprehensive list of various national standards covering specification, types, and energy efficiency of various types of transformers will be useful for consultants, users, and designers of transformers.

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