UL 1562

STANDARD FOR SAFETY

Transformers, Distribution, Dry-Type – Over 600 Volts

UL Standard for Safety for Transformers, Distribution, Dry-Type – Over 600 Volts, UL 1562

Fourth Edition, Dated January 25, 2013

Summary of Topics

This revision of UL 1562 dated August 11, 2020 was issued to update requirements for Insulation Systems; 8.1, 8.1.1, and Table 8.1.

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

The revised requirements are substantially in accordance with Proposal(s) on this subject dated June 8, 2020.

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UL 1562

Standard for Transformers, Distribution, Dry-Type – Over 600 Volts

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Fourth Edition

January 25, 2013

This UL Standard for Safety consists of the Fourth Edition including revisions through August 11, 2020.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at https://csds.ul.com.

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INTRODUCTION

1 Scope

1.1 These requirements cover single-phase or three-phase, dry-type, distribution transformers, including solid cast and resin encapsulated transformers. The transformers are provided with either ventilated or non-ventilated enclosures and are rated for a primary or secondary voltage from 601 to 35000 V.

1.2 These transformers are intended for installation in accordance with the National Electrical Code, ANSI/NFPA 70.

1.3 These requirements do not cover the following transformers:

a) Instrument transformers

b) Step-voltage and induction voltage regulators

c) Current regulators

d) Arc furnace transformers

e) Rectifier transformers

f) Specialty transformers (such as rectifier, ignition, gas tube sign transformers, and the like)

g) Mining transformers

h) Motor-starting reactors and transformers

1.4 These requirements do not cover transformers under the exclusive control of electrical utilities utilized for communication, metering, generation, control, transformation, transmission, and distribution of electric energy regardless of whether such transformers are located indoors, in buildings and rooms used exclusively by utilities for such purposes; or outdoors on property owned, leased, established rights on private property or on public rights of way (highways, streets, roads, and the like).

2 Components

2.1 Except as indicated in 2.2, a component of a product covered by this Standard shall comply with the requirements for that component.

2.2 A component is not required to comply with a specific requirement that:

a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard, or

b) Is superseded by a requirement in this standard.

2.3 A component shall be used in accordance with its rating established for the intended conditions of use.

2.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

3 Units

3.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

4 References

4.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

CONSTRUCTION

5 Mechanical Assembly

5.1 A transformer shall be so formed and assembled that it will have the strength and rigidity necessary to resist the abuses to which it is likely to be subjected, without increasing the risk of electric shock, fire, or injury to persons due to total or partial collapse with resulting reduction of spacings, loosening or displacement of parts, or other serious defects.

6 Enclosures

6.1 The enclosure shall comply with the requirements in Section 4 of the American National Standard for Transformers – Used in Unit Installations, Including Unit Substations – Conformance Standard, ANSI C57.12.55.

7 Guarding and Accessibility of Live Parts

7.1 When access is required to a compartment that contains energized high voltage parts, barriers shall be provided to reduce the risk of:

a) Unintentional contact with energized parts.

b) Dropping tools or other equipment on energized parts.

7.2 Low-voltage energized uninsulated live parts mounted on doors shall be effectively guarded or enclosed to reduce the risk of unintentional contact if and when the door must be opened for maintenance of equipment.

7.3 Any barrier intended to be removed during routine maintenance or servicing shall be marked to indicate that it is to be replaced.

8 Insulation Systems

8.1 The insulation system used in the transformer shall be one that has been evaluated in accordance with the thermal aging procedure described in the IEEE Standard Test Procedure for Thermal Evaluation of Insulation Systems for Dry-Type Power and Distribution Transformers, IEEE C57.12.60, and has been found to comply with the temperatures and voltages involved. Modifications to existing Electrical Insulation Systems (EIS) shall also follow the latest revision of IEEE C57.12.60.

8.1.1 *Deleted*

Table 8.1
Temperature and exposure time guide
Table deleted

8.2 Material substitutions in the insulation system shall be in accordance with the requirements in the Standard for Systems of Insulating Materials – General, UL 1446.

9 Spacings

9.1 The minimum spacings at field wiring terminals involving voltages of 600 volts or less shall be as indicated in Table 9.1.

Table 9.1
Minimum spacings at field wiring terminals

Voltage involved	Minimum spacings between uninsulated live parts of opposite polarity and between an uninsulated live part and a grounded part of a conductive material[a]			
	Through air[b]		Over surface[b]	
	inch	(mm)	inch	(mm)
0 – 50	1/8	(3.2)	1/4	(6.4)
51 – 250	1/2	(12.7)	1/2	(12.7)
251 – 600	1	(25.4)	1	(25.4)

[a] An isolated part of conductive material (such as a screw head or washer) interposed between uninsulated live parts of opposite polarity or between an uninsulated live part and grounded dead metal is considered to reduce the spacing by an amount equal to the dimension of the interposed part along the path of measurement.

[b] A minimum spacing of 1 inch (25.4 mm) is required between a live part and a metal enclosure.

9.2 The minimum spacings at a point other than a field wiring terminal involving voltages of 600 volts or less shall be as indicated in Table 9.2.

Table 9.2
Minimum spacings at points other than field wiring terminals

Voltage involved	Minimum spacings between uninsulated live parts of opposite polarity and between an uninsulated live part and a grounded part of a conductive material[a]			
	Through air		Over surface	
	inch	(mm)	inch	(mm)
0 – 50	1/16	(1.6)	1/16	(1.6)
51 – 125	1/8	(3.2)	1/4	(6.4)
126 – 250	1/4	(6.4)	3/8	(9.5)
251 – 600	3/8	(9.5)	1/2	(12.5)

[a] An isolated part of conductive material (such as a screw head or washer) interposed between uninsulated live parts of opposite polarity or between an uninsulated live part and grounded dead metal is considered to reduce the spacing by an amount equal to the dimension of the interposed part along the path of measurement.

10 Transformers Supplied With a K-Factor Rating

10.1 K-FACTOR – A rating optionally applied to a transformer indicating its suitability for use with loads that draw nonsinusoidal currents. The k-factor equals:

$$\sum_{h=1}^{\infty} I_h(pu)^2 h^2$$

in which:

I_h(pu) = the rms current at harmonic "h" (per unit of rated rms load current) and

h = the harmonic order.

K-factor rated transformers have not been evaluated for use with harmonic loads where the rms current of any singular harmonic greater than the tenth harmonic is greater than 1/h of the fundamental rms current.

10.2 If a pressure terminal connector for field wiring of the neutral conductor on a transformer marked with a K-factor rating in accordance with 17.3 is factory-installed, the connector shall accommodate a conductor sized for at least 200 percent of the line current based on the transformer full load rating and Table 10.1.

Table 10.1
Ampacities of insulated conductors rated 0 – 2000 volts[a]

Wire size		60°C (140°F)		75°C (167°)	
AWG	(mm^2)	Copper	Aluminum	Copper	Aluminum
14	(2.1)	15	–	15	–
12	(3.3)	20	15	20	15
10	(5.3)	30	25	20	25
8	(8.4)	40	30	50	40
6	(13.3)	55	40	65	50
4	(21.2)	70	55	85	65
3	(26.7)	85	65	100	75
2	(33.6)	95	75	115	90
1	(42.4)	110	85	130	100
1/0	(53.5)			150	120
2/0	(67.4)			175	135
3/0	(85.0)			200	155
4/0	(107.2)			230	180
kcmil					
250	(127)			255	205
300	(152)			285	230
350	(177)			310	250
400	(203)			335	270
500	(253)			380	310
600	(304)			420	340
700	(355)			460	375
750	(380)			475	385
800	(405)			490	395
900	(456)			520	425

Table 10.1 Continued on Next Page

Table 10.1 Continued

Wire size		60°C (140°F)		75°C (167°)	
AWG	(mm^2)	Copper	Aluminum	Copper	Aluminum
1000	(506)			545	445
1250	(633)			590	485
1500	(760)			625	520
1750	(887)			650	545
2000	(1013)			665	560

[a] These values of ampacity apply only where a maximum of three current-carrying conductors will be field installed in a single conduit. If more than three conductors are to be installed, it is assumed that multiple conduits will be used. For ampacities exceeding those shown in this Table, it is assumed that multiple conductors within the range of 1/0 AWG to 500 kcmil will be used. For multiple conductors, the ampacity value of each conductor is to be multiplied by the number of conductors.

10.3 The neutral bus bar and a terminal pad provided for securing the neutral pressure terminal connector on a transformer marked with a K-factor rating in accordance with 17.3 shall be sized based on the transformer full load current and the following maximum current densities:

a) Five-hundred amperes per square inch (77.5 A/cm^2) of cross section for solid copper;

b) Three-hundred and seventy-five ampere per square inch (58 A/cm^2) of cross section for solid aluminum having a conductivity of at least 55 percent that of the International Annealed Copper Standard;

c) One-hundred amperes per square inch (15.5 A/cm^2) of contact area at bolted contacts between copper bus bars and connecting straps or connectors. In determining the contact area of a bolted or riveted connection, no additions or subtractions shall be made for the area of screws, bolts, or rivets; and

d) Seventy-five amperes per square inch (11.6 A/cm^2) of contact area at bolted contacts between aluminum bus bars and connecting straps or connectors. In determining the contact area of a bolted or riveted connection, no additions or subtractions shall be made for the area of screws, bolts, or rivets.

Exception No. 1: The current densities of the neutral bus bar and terminal pad may be greater that the specified values if the transformer is found to comply with the temperature test requirements specified in the IEEE Standard Test Code for Dry-Type Distribution and Power Transformers, C57.12.91, while the neutral bus bar and terminal pad are carrying 200 percent of the transformer full load current.

Exception No. 2: The current densities of the neutral bus bar and terminal pad may be greater than the specified values if the cross sectional area of the neutral bus bar and terminal pad is no less than 200 percent of the cross sectional area of the phase bus bar and terminal pad, respectively.

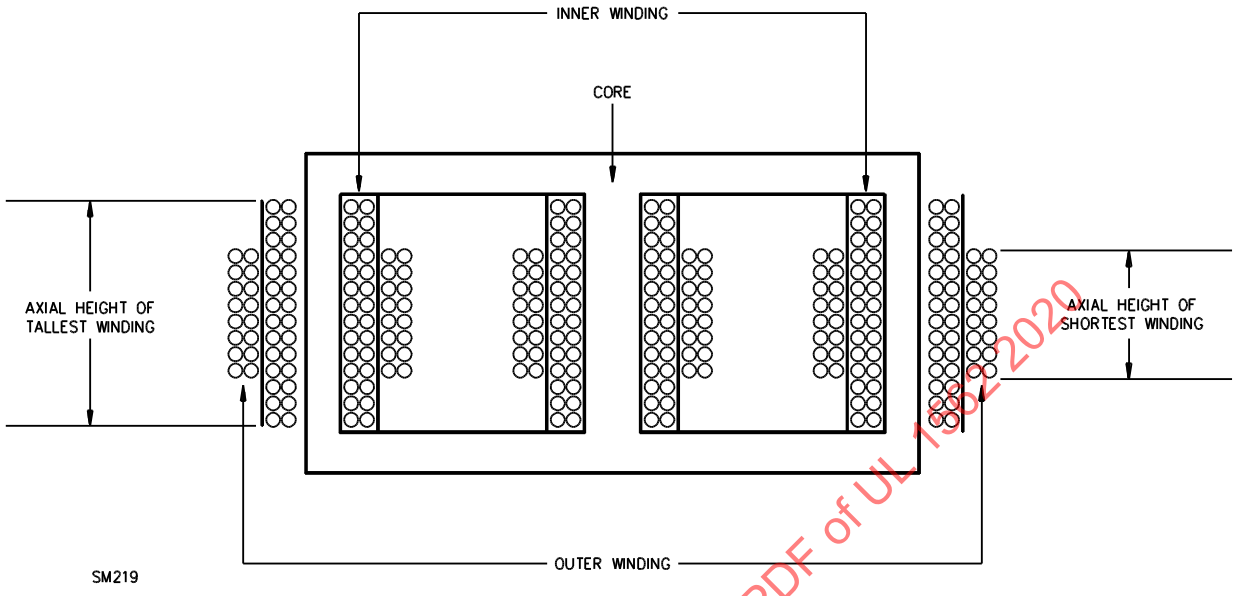
10.4 The cross section of a bus bar as specified in 10.3 may be reduced by no more that 5 percent due to rounding, shaping, or dimensional tolerances.

11 Coil Details

11.1 An isolation transformer marked with a K-factor rating in accordance with 17.3 shall be constructed such that the axial height of the tallest of the input and output windings does not exceed the height of the shortest winding by more that 15 percent. Figure 11.1 shows a typical transformer construction.

Figure 11.1

Typical transformer construction



Shortest winding = X inches

Tallest winding = No more than 1.15 X inches

PERFORMANCE

12 General

12.1 The certification guidelines specified in Section 10 of the American National Standard for Transformers – Used in Unit Installations, Including Unit Substations – Conformance Standard, ANSI C57.12.55 are to be allowed.

13 Conformance Tests

13.1 The transformers shall comply with the test requirements listed in Table 9 of the American National Standard for Transformers – Used in Unit Installations, Including Unit Substations – Conformance Standard, ANSI C57.12.55.

14 Transient Voltage Analysis Test

14.1 The insulation of a transformer shall be capable of withstanding the voltage stress imposed under impulse conditions.

14.2 In order to identify the points of maximum stress, the nonlinear distribution of the wave shape from turn to turn, layer to layer, section to section, and the like, is to be determined using differential measurements while a 1.2 × 50 microsecond low voltage wave shape is established across the winding.

14.3 Testing shall be performed per IEEE Guide for Conducting a Transient Voltage Analysis of a Dry-Type Transformer Coil, IEEE C57.12.58