

## § 431.191

*Commercial HVAC & WH product* means any small or large commercial package air-conditioning and heating equipment, packaged terminal air conditioner, packaged terminal heat pump, commercial packaged boiler, hot water supply boiler, commercial warm air furnace, instantaneous water heater, storage water heater, or unfired hot water storage tank.

*Flue loss* means the sum of the sensible heat and latent heat above room temperature of the flue gases leaving the appliance.

*Industrial equipment* means an article of equipment, regardless of whether it is in fact distributed in commerce for industrial or commercial use, of a type which:

(1) In operation consumes, or is designed to consume energy;

(2) To any significant extent, is distributed in commerce for industrial or commercial use; and

(3) Is not a "covered product" as defined in Section 321(2) of EPCA, 42 U.S.C. 6291(2), other than a component of a covered product with respect to which there is in effect a determination under Section 341(c) of EPCA, 42 U.S.C. 6312(c).

*Private labeler* means, with respect to a commercial HVAC & WH product, an owner of a brand or trade mark on the label of a product which bears a private label. A commercial HVAC & WH product bears a private label if:

(1) Such product (or its container) is labeled with the brand or trademark of a person other than a manufacturer of such product;

(2) The person with whose brand or trademark such product (or container) is labeled has authorized or caused such product to be so labeled; and

(3) The brand or trademark of a manufacturer of such product does not appear on such label.

### Subpart K—Distribution Transformers

SOURCE: 70 FR 60416, Oct. 18, 2005, unless otherwise noted.

#### § 431.191 Purpose and scope.

This subpart contains energy conservation requirements for distribution transformers, pursuant to Parts B and

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C of Title III of the Energy Policy and Conservation Act, as amended, 42 U.S.C. 6291–6317.

[71 FR 24995, Apr. 27, 2006]

#### § 431.192 Definitions.

The following definitions apply for purposes of this subpart:

*Autotransformer* means a transformer that:

(1) Has one physical winding that consists of a series winding part and a common winding part;

(2) Has no isolation between its primary and secondary circuits; and

(3) During step-down operation, has a primary voltage that is equal to the total of the series and common winding voltages, and a secondary voltage that is equal to the common winding voltage.

*Basic model* means a group of models of distribution transformers manufactured by a single manufacturer, that have the same insulation type (*i.e.*, liquid-immersed or dry-type), have the same number of phases (*i.e.*, single or three), have the same standard kVA rating, and do not have any differentiating electrical, physical or functional features that affect energy consumption. Differences in voltage and differences in basic impulse insulation level (BIL) rating are examples of differentiating electrical features that affect energy consumption.

*Distribution transformer* means a transformer that—

(1) Has an input voltage of 34.5 kV or less;

(2) Has an output voltage of 600 V or less;

(3) Is rated for operation at a frequency of 60 Hz; and

(4) Has a capacity of 10 kVA to 2500 kVA for liquid-immersed units and 15 kVA to 2500 kVA for dry-type units; but

(5) The term "distribution transformer" does not include a transformer that is an—

(i) Autotransformer;

(ii) Drive (isolation) transformer;

(iii) Grounding transformer;

(iv) Machine-tool (control) transformer;

(v) Nonventilated transformer;

(vi) Rectifier transformer;

(vii) Regulating transformer;

- (viii) Sealed transformer;
- (ix) Special-impedance transformer;
- (x) Testing transformer;
- (xi) Transformer with tap range of 20 percent or more;
- (xii) Uninterruptible power supply transformer; or
- (xiii) Welding transformer.

*Drive (isolation) transformer* means a transformer that:

- (1) Isolates an electric motor from the line;
- (2) Accommodates the added loads of drive-created harmonics; and
- (3) Is designed to withstand the additional mechanical stresses resulting from an alternating current adjustable frequency motor drive or a direct current motor drive.

*Efficiency* means the ratio of the useful power output to the total power input.

*Excitation current* or *no-load current* means the current that flows in any winding used to excite the transformer when all other windings are open-circuited.

*Grounding transformer* means a three-phase transformer intended primarily to provide a neutral point for system-grounding purposes, either by means of:

- (1) A grounded wye primary winding and a delta secondary winding; or
- (2) A transformer with its primary winding in a zig-zag winding arrangement, and with no secondary winding.

*Liquid-immersed distribution transformer* means a distribution transformer in which the core and coil assembly is immersed in an insulating liquid.

*Load loss* means, for a distribution transformer, those losses incident to a specified load carried by the transformer, including losses in the windings as well as stray losses in the conducting parts of the transformer.

*Low-voltage dry-type distribution transformer* means a distribution transformer that—

- (1) Has an input voltage of 600 volts or less;
- (2) Is air-cooled; and
- (3) Does not use oil as a coolant.

*Machine-tool (control) transformer* means a transformer that is equipped with a fuse or other over-current protection device, and is generally used

for the operation of a solenoid, contactor, relay, portable tool, or localized lighting.

*Medium-voltage dry-type distribution transformer* means a distribution transformer in which the core and coil assembly is immersed in a gaseous or dry-compound insulating medium, and which has a rated primary voltage between 601 V and 34.5 kV.

*No-load loss* means those losses that are incident to the excitation of the transformer.

*Nonventilated transformer* means a transformer constructed so as to prevent external air circulation through the coils of the transformer while operating at zero gauge pressure.

*Phase angle* means the angle between two phasors, where the two phasors represent progressions of periodic waves of either:

- (1) Two voltages;
- (2) Two currents; or
- (3) A voltage and a current of an alternating current circuit.

*Phase angle correction* means the adjustment (correction) of measurement data to negate the effects of phase angle error.

*Phase angle error* means incorrect displacement of the phase angle, introduced by the components of the test equipment.

*Rectifier transformer* means a transformer that operates at the fundamental frequency of an alternating-current system and that is designed to have one or more output windings connected to a rectifier.

*Reference temperature* means 20 °C for no-load loss, 55 °C for load loss of liquid-immersed distribution transformers at 50 percent load, and 75 °C for load loss of both low-voltage and medium-voltage dry-type distribution transformers, at 35 percent load and 50 percent load, respectively. It is the temperature at which the transformer losses must be determined, and to which such losses must be corrected if testing is done at a different point. (These temperatures are specified in the test method in Appendix A to this part.)

*Regulating transformer* means a transformer that varies the voltage, the phase angle, or both voltage and phase

angle, of an output circuit and compensates for fluctuation of load and input voltage, phase angle or both voltage and phase angle.

*Sealed transformer* means a transformer designed to remain hermetically sealed under specified conditions of temperature and pressure.

*Special-impedance transformer* means any transformer built to operate at an impedance outside of the normal impedance range for that transformer's kVA rating. The normal impedance range for each kVA rating for liquid-immersed and dry-type transformers is shown in Tables 1 and 2, respectively.

TABLE 1—NORMAL IMPEDANCE RANGES FOR LIQUID-IMMERSED TRANSFORMERS

Single-phase transformers		Three-phase transformers	
kVA	Impedance (%)	kVA	Impedance (%)
10 .....	1.0-4.5	15	1.0-4.5
15 .....	1.0-4.5	30	1.0-4.5
25 .....	1.0-4.5	45	1.0-4.5
37.5 .....	1.0-4.5	75	1.0-5.0
50 .....	1.5-4.5	112.5	1.2-6.0
75 .....	1.5-4.5	150	1.2-6.0
100 .....	1.5-4.5	225	1.2-6.0
167 .....	1.5-4.5	300	1.2-6.0
250 .....	1.5-6.0	500	1.5-7.0
333 .....	1.5-6.0	750	5.0-7.5
500 .....	1.5-7.0	1000	5.0-7.5
667 .....	5.0-7.5	1500	5.0-7.5
833 .....	5.0-7.5	2000	5.0-7.5
.....	.....	2500	5.0-7.5

TABLE 2—NORMAL IMPEDANCE RANGES FOR DRY-TYPE TRANSFORMERS

Single-phase transformers		Three-phase transformers	
kVA	Impedance (%)	kVA	Impedance (%)
15 .....	1.5-6.0	15	1.5-6.0
25 .....	1.5-6.0	30	1.5-6.0
37.5 .....	1.5-6.0	45	1.5-6.0
50 .....	1.5-6.0	75	1.5-6.0
75 .....	2.0-7.0	112.5	1.5-6.0
100 .....	2.0-7.0	150	1.5-6.0
167 .....	2.5-8.0	225	3.0-7.0
250 .....	3.5-8.0	300	3.0-7.0
333 .....	3.5-8.0	500	4.5-8.0
500 .....	3.5-8.0	750	5.0-8.0
667 .....	5.0-8.0	1000	5.0-8.0
833 .....	5.0-8.0	1500	5.0-8.0
.....	.....	2000	5.0-8.0
.....	.....	2500	5.0-8.0

*Temperature correction* means the mathematical correction(s) of measurement data, obtained when a transformer is tested at a temperature that is different from the reference temperature, to the value(s) that would

have been obtained if the transformer had been tested at the reference temperature.

*Test current* means the current of the electrical power supplied to the transformer under test.

*Test frequency* means the frequency of the electrical power supplied to the transformer under test.

*Test voltage* means the voltage of the electrical power supplied to the transformer under test.

*Testing transformer* means a transformer used in a circuit to produce a specific voltage or current for the purpose of testing electrical equipment.

*Total loss* means the sum of the no-load loss and the load loss for a transformer.

*Transformer* means a device consisting of 2 or more coils of insulated wire that transfers alternating current by electromagnetic induction from 1 coil to another to change the original voltage or current value.

*Transformer with tap range of 20 percent or more* means a transformer with multiple voltage taps, the highest of which equals at least 20 percent more than the lowest, computed based on the sum of the deviations of the voltages of these taps from the transformer's nominal voltage.

*Underground mining distribution transformer* means a medium-voltage dry-type distribution transformer that is built only for installation in an underground mine or inside equipment for use in an underground mine, and that has a nameplate which identifies the transformer as being for this use only.

*Uninterruptible power supply transformer* means a transformer that is used within an uninterruptible power system, which in turn supplies power to loads that are sensitive to power failure, power sags, over voltage, switching transients, line noise, and other power quality factors.

*Waveform correction* means the adjustment(s) (mathematical correction(s)) of measurement data obtained with a test voltage that is non-sinusoidal, to a value(s) that would have been obtained with a sinusoidal voltage.

*Welding transformer* means a transformer designed for use in arc welding

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equipment or resistance welding equipment.

[70 FR 60416, Oct. 18, 2005, as amended at 71 FR 24995, Apr. 27, 2006; 71 FR 60662, Oct. 16, 2006; 72 FR 58239, Oct. 12, 2007]

**TEST PROCEDURES**

**§431.193 Test procedures for measuring energy consumption of distribution transformers.**

The test procedures for measuring the energy efficiency of distribution transformers for purposes of EPCA are specified in Appendix A to this subpart.

[71 FR 24997, Apr. 27, 2006]

**ENERGY CONSERVATION STANDARDS**

**§ 431.196 Energy conservation standards and their effective dates.**

(a) *Low-Voltage Dry-Type Distribution Transformers.* The efficiency of a low-voltage dry-type distribution transformer manufactured on or after January 1, 2007, shall be no less than that required for their kVA rating in the table below. Low-voltage dry-type distribution transformers with kVA ratings not appearing in the table shall have their minimum efficiency level determined by linear interpolation of the kVA and efficiency values imme-

diately above and below that kVA rating.

Single phase		Three phase	
kVA	Efficiency (%) <sup>1</sup>	kVA	Efficiency (%) <sup>1</sup>
15	97.7	15	97.0
25	98.0	30	97.5
37.5	98.2	45	97.7
50	98.3	75	98.0
75	98.5	112.5	98.2
100	98.6	150	98.3
167	98.7	225	98.5
250	98.8	300	98.6
333	98.9	500	98.7
		750	98.8
		1000	98.9

<sup>1</sup> Efficiencies are determined at the following reference conditions: (1) for no-load losses, at the temperature of 20 °C, and (2) for load-losses, at the temperature of 75 °C and 35 percent of nameplate load.

(Source: Table 4-2 of National Electrical Manufacturers Association (NEMA) Standard TP-1-2002, "Guide for Determining Energy Efficiency for Distribution Transformers.")

(b) *Liquid-Immersed Distribution Transformers.* The efficiency of a liquid-immersed distribution transformer manufactured on or after January 1, 2010, shall be no less than that required for their kVA rating in the table below. Liquid-immersed distribution transformers with kVA ratings not appearing in the table shall have their minimum efficiency level determined by linear interpolation of the kVA and efficiency values immediately above and below that kVA rating.

Single-phase		Three-phase	
kVA	Efficiency (%)	kVA	Efficiency (%)
10	98.62	15	98.36
15	98.76	30	98.62
25	98.91	45	98.76
37.5	99.01	75	98.91
50	99.08	112.5	99.01
75	99.17	150	99.08
100	99.23	225	99.17
167	99.25	300	99.23
250	99.32	500	99.25
333	99.36	750	99.32
500	99.42	1000	99.36
667	99.46	1500	99.42
833	99.49	2000	99.46
	2500	99.49	

**Note:** All efficiency values are at 50 percent of nameplate-rated load, determined according to the DOE Test-Procedure. 10 CFR Part 431, Subpart K, Appendix A.

(c) *Medium-Voltage Dry-Type Distribution Transformers.* The efficiency of a medium-voltage dry-type distribution transformer manufactured on or after January 1, 2010, shall be no less than

that required for their kVA and BIL rating in the table below. Medium-voltage dry-type distribution transformers with kVA ratings not appearing in the