

SCOPE

- I 1.1 This practice covers the design of power transformers.
- I 1.2 **An asterisk (*)** indicates that a decision by the Purchaser is required or that additional information is furnished by the Purchaser.

SUMMARY OF ADDITIONAL REQUIREMENTS

- I 2.1 **Table 1** lists the standards which shall be used for transformers purchased in the USA for use in the USA.

TABLE 1

STANDARDS FOR USE IN USA	
ANSI / IEEE Standards	
C57.12.00	General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
C57.12.90	Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers and Guide for Short-Circuit Testing of Distribution and Power Transformers
IEEE Standards	
C57.12.01	General Requirements for Dry Type Distribution and Power Transformers Including Those With Solid Cast and/or Resin-Encapsulated Windings
C57.12.91	Test Code for Dry-Type Distribution and Power Transformers

- I * 2.2 **Table 2** lists the main IEC standards which may be used for transformers purchased outside the USA. **For other conditions of purchase and use**, additional or equivalent standards of manufacture and test will be specified by the Purchaser.

TABLE 2

STANDARDS FOR USE OUTSIDE USA	
IEC Standards	
IEC 76 (1 - 5)	Power Transformers
IEC 354	Guide for Loading Oil-Immersed Transformers
IEC 726	Dry Insulated Transformers

- I * 2.3 **IP 20-1-1, Inspection of Equipment and Materials**, shall be used with this practice **as specified** by the Purchaser.

DOCUMENTATION

- I 3.1 **Typical transformer data** shall be furnished with all bid proposals as noted below. These data shall then be corrected to apply to the actual transformers purchased, and shall be furnished with the required final drawings and parts information.
 - a. Losses (watts):
 - 1. No load at 100 and 110 percent rated voltage.
 - 2. Total at 50, 75, 100 and 125 percent of self-cooled rating.
 - b. Exciting current at 100 and 110 percent rated voltage (amperes or percent).
 - c. Impedance at rated tap and self-cooled rating (percent).
 - d. Weight, lb (kg):
 - 1. Core and coils
 - 2. Tanks and fittings
 - 3. Total assembled transformer including liquid
 - e. Volume of liquid, gal.(L)
 - f. Type of oil furnished
 - * g. Outline drawings with dimensions, including motor information when fans are specified
 - h. X/R ratio at rated tap
 - i. Vector group
 - j. Paint Specifications

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(This practice is appropriate for attachment to Inquiry or Purchase Document)

- I * 3.2 When current transformers are supplied, the following information shall be provided for each CT:
- a. Ratio
 - b. Accuracy data (e.g., "C-100" per ANSI or "25 VA Class 10 P 20" per IEC)
 - c. Magnetizing curve
 - d. Internal resistance

- I 3.3 **Test reports** shall be submitted to the Purchaser for each transformer.

DEFINITIONS

- I 4.1 **Switch making capacity** is the maximum momentary current for which the switch can be closed onto a standing fault without self-opening and without sustaining damage. Momentary current may be defined in terms of peak or rms amperes.
- I 4.2 **A captive transformer** is defined as a transformer which supplies a single utilization device, usually a large motor. The transformer may be located at either the substation or close to the device it supplies.
- I 4.3 **Fully insulated bars** means bars fully coated or covered with solid insulating material, or individual bars fully surrounded by solid insulating material to prevent the propagation of arcs between phases or between phase and ground.

POWER TRANSFORMER DESIGN

COOLING CLASSES AND RATINGS

- O ♦ 5.1 **All liquid filled power transformers** 501 kVA and larger shall have provisions for increasing their continuous kVA rating by the use of cooling fans. Provisions shall include capacity in all current-carrying parts for the higher fan cooled rating, and bushing current-ratings conforming to the higher force-cooled rating.
- R ♦ 5.2 **If fans are specified, fan motors** shall be three-phase squirrel-cage induction type.
- E * 5.3 **When cooling fan clamping brackets are used**, an insulating material such as fiber pads or neoprene shall be used to eliminate any conductive contact between radiators and brackets.
- R * 5.4 When specified, **transformer design shall take into account the harmonic currents associated with the loads** and apply the appropriate deratings or other changes in design to accommodate these loads without any general or localized overheating in any component of the transformer.

TAPS

- O * 5.5 **Taps**, suitable for deenergized operation, shall be furnished if load-tap-changing is not specified. If not otherwise specified, these shall be four 2-1/2% full-capacity taps, two above two below rated voltage. Tap changer shall be externally operable; changer operating device shall not be located within terminal enclosures or enclosures housing transformer accessories.

CAPTIVE TRANSFORMERS

- O,R * 5.6 Purchaser shall specify **when a transformer is to be used as a captive transformer** and the characteristics of its load. When load is a motor, the Purchaser shall specify motor rating, type of starting, magnitude of starting current and frequency of starting. Transformer shall be designed and constructed to withstand the mechanical and thermal stresses of the duty specified.

ARRESTER GROUND LUG

- R * 5.7 If it is specified that **lightning arresters** are to be mounted on or within a few feet of the transformer, solderless connectors shall be provided on the tank for the grounding conductor of the arresters. The connectors shall be mounted as close to the arresters as possible and shall not be mounted on radiators or handhole covers. Location shall be such that the entire electrical path from connectors to ground pads can carry without damage the specified rated discharge current of the arrester.