

## CHAPTER 3

## TRANSFORMERS

## 3-1. Small power transformers

Transformers referred to herein are limited to those having a primary voltage under 600V usually of dry-type construction and are used for lighting, control power, and small power applications. These small power transformers sometimes supply power to loads where continuity of service is critical and therefore a greater degree of attention is justified. While the percentage of transformer failures is low, failures that do occur are serious and result in extensive downtime and expense. The best assurance of continued high reliability is regular maintenance procedures. A transformer is a device usually used to transform, or step down a higher distribution level voltage to a lower utilization level. Although among the most reliable components in an electrical system, proper transformer maintenance is still a necessity. While removal of a transformer from service cannot always be accomplished, visual inspections and testing can be performed with the transformer in service. Transformers require very little attention when compared to most electrical apparatus. The extent of the inspection and maintenance will be governed by the size, the importance of service community, the location on the system, and operating conditions such as, ambient temperature and the surrounding atmosphere. In general, a two-year maintenance cycle is appropriate (see para 15-3 for transformers).

## 3-2. Dry-type transformers.

Dry-type transformers are of open-or-ventilated type construction with either air or gas serving as the insulation medium.

*a. Routine inspections.* All measurements should be taken at the time of peak load and recorded so that a means of comparing existing versus previous transformer conditions is available. Routine inspections of dry-type transformers should include load current readings, voltage readings and ambient temperature readings.

(1) *Load current readings.* If load current readings exceed the rated full load current of the transformer, then steps should be taken to reduce the load to within design limits.

(2) *Voltage readings.* Either undervoltages or overvoltages can be detrimental to a load and/or the transformer. If one of these conditions exists, then its cause should be determined and corrected to within nominal nameplate values.

(3) *Ambient temperature readings.* Dry-type transformers are cooled by free circulation of surrounding air over their surfaces. In a totally enclosed transformer, all heat is transferred by the exterior surfaces; an encased transformer depends upon air to enter the case at the bottom, flow upward over core and coil surfaces, and flow out of the case at the opening near the top. These transformers will perform satisfactorily at rated output when surrounding air does not exceed 40 degrees C (104 degrees F) and adjacent structures permit free movement of cooling air. Dry-type transformers are designed to reach rated temperature rise above ambient air temperature when operating continuously at rated voltage, frequency, or load. Serious overheating may result if the unit is operated for sustained periods at above rated voltage, above rated current, or at lower than rated frequency. Operating a transformer above the recommended temperature will shorten the life of the solid insulation and subsequently increase the risk of a failure. Therefore, it's important that ambient temperature readings be taken at the transformer to verify that it is within its design limits. If these limits are exceeded, simply moving the transformer to a cooler environment or providing additional ventilation or removing structures that prohibit the flow of cool air around the transformer may correct overtemperature conditions. If these changes are not feasible then the load on the transformer needs to be reduced or a higher rating transformer installed.

*b. Special inspections.* Before any work, more extensive than a visual inspection is performed on a transformer, it must be de-energized, tagged and locked-out (para 12-2). This is to ensure the safety of both personnel and equipment. In general, dry-type transformers have no moving parts (fig 3-1). The only maintenance required is periodic tightening of connections and removal of accumulated dust, dirt and lint as outlined below:

(1) Check for dirt accumulation on windings, internal leads and insulating surfaces.

(2) Check for dirt accumulation that impedes the flow of cool air.

(3) Check for tracking and carbonization over insulating surfaces.

(4) Check for cracked or loose insulators or coil spacers.

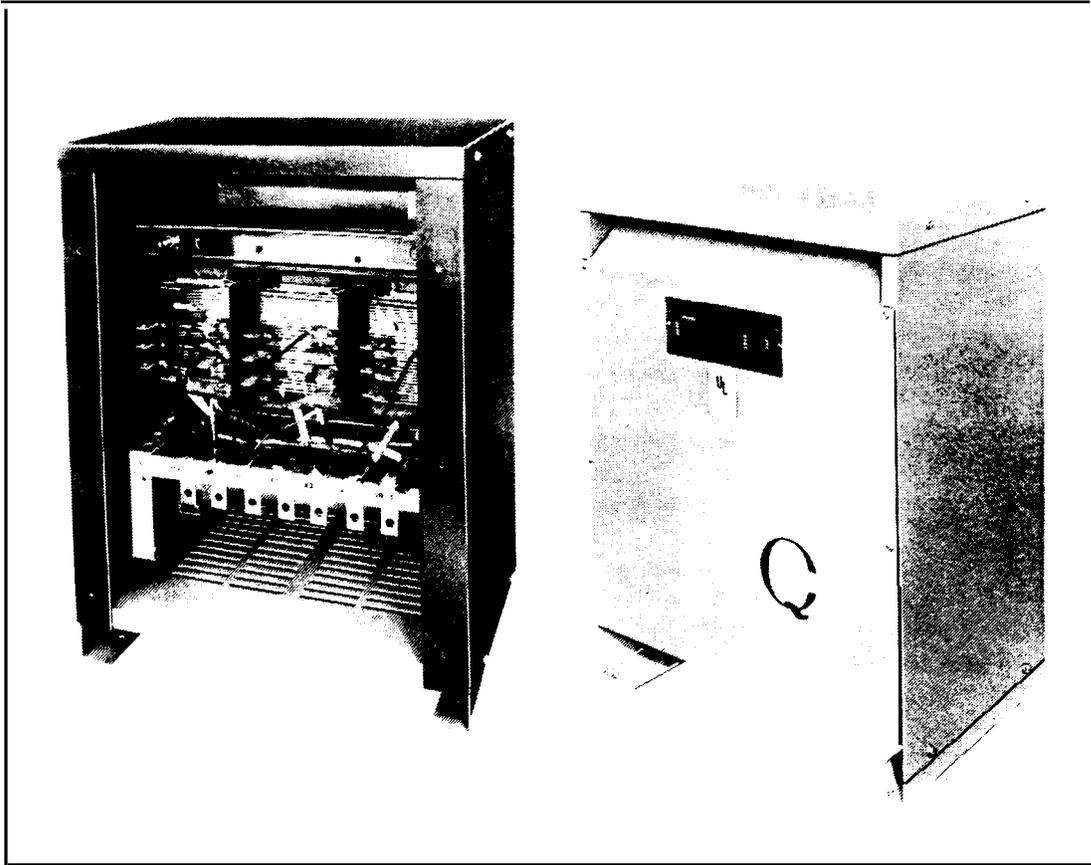
(5) Check deterioration of the turn insulation and barrier cylinders.

(6) Check for corrosion at all primary, secondary, tap, and ground connections.

(7) Check for loose connections at the coil clamps, primary, secondary, tap, and ground connections.

c. *Repairs.* A transformer should be cleaned of dirt and dust annually with a vacuum cleaner, blower or air compressor at less than or equal to 30 PSI. If moisture is evident by the appearance of

rust, the unit should be dried by placing it in an oven or by blowing heated air over it. Liquid cleaners may only be used if recommended by the manufacturer. It should be noted that if any inspection and/or repair that takes longer than 24 hours or allows the transformer to cool to ambient temperature, then special drying procedures outlined by the manufacturer should be adhered to before the transformer is re-energized.



*Figure 3-1. Dry-type transformers.*