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# *CERTIFIED TEST REPORT*

## *High Ampere*
## *DUAL VOLTAGE & TAP CHANGING SWITCHES*

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# *Design Tests for the High Ampere Dual Voltage & Tap Changing Switches*

## CERTIFICATION

*Statements made and data shown are, to the best of our knowledge and belief, correct and within the usual limits of commercial testing practice.*

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# INTRODUCTION

This report will detail design tests conducted to verify performance of the RTE high current Dual Voltage and Tap Changing Switches. All testing followed standard commercial test methods and practices. Switches tested were installed per RTE Installation Instruction Sheet 5000050064.

***Thermal***

• Switches must withstand temperatures between -30ºC and +130ºC, and rapid transitions between these limits.

***Seal***

• Switches must not leak oil or air at pressures up to 10 PSIG.

***Current Carrying***

• These switches must carry rated current with less than a 15ºC temperature rise over top oil. This requirement is derived from ANSI C57.12.00, Section 5.11.1.1.

• Ratings:
  Dual Voltage Switch 300 Amperes in Series Position (600 Amperes in Parallel)
  Tap Changer 300 Amperes

***Dielectric***

• Nominal Voltage Class: 35 kV

• Per ANSI C57.12.00, Table 4, specimens withstood levels of:
  150 kV with a 1.2x50 Microsecond Wave, Both Polarities
  50 kV for 1 Minute of 60 Hertz Voltage

## *THERMAL TESTING*

### *REQUIREMENTS*

These switches are used in oil-filled distribution transformers where ambient temperatures can be as low as -30ºC. They can also reach +130ºC when high ambient temperatures are combined with heating caused by transformer losses.

### *OBJECT*

To evaluate the switch's ability to withstand extreme temperatures and cycling between extremes without damage.

### *PROCEDURE*

Samples were mounted in air, in a thermal cycle chamber. The chamber was cycled between -30ºC and +130ºC ten times. Initially the samples were cooled. When they reached the lower extreme, the temperature was held for at least 20 minutes after stability was reached. At this point heating was begun.

The heating cycle was continued until stability at the high extreme (130ºC) was reached and held for at least 20 minutes. At this point cooling to -30ºC began again. A total of ten complete cold-hot-cold thermal cycles were run.

Other samples were placed in a 130ºC oven and held at that temperature for 24 hours to simulate core/coil dryout cycles.

Before and after cycling, the switches were leak tested and operated to determine if they were affected by the thermal cycling.

### *RESULTS*

All switches tested were unaffected by the cycling. There was no observable leaking of either oil or air before or after the test. There was no noticeable change in operation before or after the thermal tests.

### *CONCLUSIONS*

The switches tested met extreme thermal conditions which might be placed on them during installation and application.

# *SEAL REQUIREMENTS*

## *REQUIREMENTS*

These switches are used in oil-filled distribution transformers, where positive and negative pressures of 10 PSIG can be encountered. They must seal to prevent oil leakage from inside the tank and air leakage into the tank.

The gasket system consists of a double O-ring shaft seal and a flat gasket placed on the shoulder of a threaded flange tightened by a conduit lock nut.

## *OBJECT*

The test is done to demonstrate that these switches can create and maintain an oil seal.

## *PROCEDURE*

Samples were mounted into a pressurized vessel using normal hardware and installation methods. The vessel was then pressurized to 30 PSIG and placed into water. Samples were observed for bubbles and other signs of leakage. Samples were tested both before and after they were cycled ten times between -30ºC and +130ºC.

## *RESULTS*

All samples tested did not leak, before or after thermal cycling.

## *CONCLUSIONS*

All switches tested sealed satisfactorily.

# *CURRENT CARRYING*

## *REQUIREMENTS*

ANSI C57 transformer standards require hottest spot temperatures to be less than 15ºC higher than top oil temperatures. This forms the base current carrying requirement. It is also expected that the switch carry at least a 50% overload without thermal runaway.

## *OBJECT*

These tests were done in transformer oil to measure the temperature rise of the contacts of these switches above that of the oil, while they were carrying rated and overload current. The resultant temperature rises were then compared to the maximum allowable 15ºC hottest spot temperature rise over oil temperature.

## *PROCEDURE*

Samples were mounted in an oil-filled tank using normal methods and materials, except the coils normally connected to the contacts were replaced with cables. Each contact was wired with a cable segment and thermocouples were attached. Thermocouples were also placed on contact rollers and jumpers.

Switch contacts were connected in the normal manner; either in the series position, the parallel position, or between contacts for the tap switch.

Constant current was passed through the contacts until thermal stability was reached; at this point the temperature rise was recorded.

## *RESULTS*

All switches tested met or exceeded the requirement that the temperature rise is to be less than or equal to 15ºC at 100% rated current. Even hottest spot rises were less than 35ºC at 50% overload.

## *CONCLUSIONS*

All samples tested were within the required level. The tested switches had current carrying capability to justify their present rating.

# *DIELECTRIC STRENGTH*

## *REQUIREMENTS*

These switches are used in oil-filled distribution transformers. ANSI C57.12.00 requires that units of this type, used on systems of up to 35 kV, must be able to withstand at least three applications of a 1.2x50 μs 150 kV simulated lightning impulse voltage wave.

The same samples should withstand 50 kV rms for one minute at 60 Hertz.

## *OBJECT*

To demonstrate that the switches meet the dielectric requirements described above.

## *PROCEDURE*

Sample switches were mounted into an oil-filled tank. The contacts were connected together with wires. The required voltage stress was applied as specified by the standards. The samples were monitored with oscilloscopes, by sight, and by listening for any sign of breakdown. Breakdown voltages were recorded.

## *RESULTS*

All samples withstood at least 150 kV at both polarities. They also withstood more than 50 kV rms of a 60 Hertz voltage for one minute or more.

## *CONCLUSIONS*

The switches tested met all the dielectric withstand requirements described above for use in oil-filled distribution transformers.