Instruction Manual
AVTM 55-Jd

For the use of the

TTR® Transformer Turn Ratio Test Sets

Catalog Number 550005 Series

Megger®

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Section A
INTRODUCTION

1. PURPOSE OF MANUAL

This Instruction Manual is published as a guide to the operation and maintenance of a Transformer Turn Ratio Test Set.

This Manual also presents a brief discussion (Section C) of the relation between turn ratio, voltage ratio and leakage flux, and their significance in transformer ratio measurements.

For further information concerning transformer ratio tests see: American National Standard Test Code for Distribution, Power and Regulating Transformers ANSI/IEEE C57.12.90.

RECEIVING INSTRUCTIONS

Your TTR instrument has been thoroughly tested and inspected to rigid specifications before being shipped and is ready for use after it is set up as indicated in the Installation section. Check the equipment received against the packing list. Notify BIDDLE Instruments, Blue Bell, Pa. 19422 of any shortage of materials. The TTR instrument should be examined for damage received in transit. If any damage is found, file a claim with the carrier at once and notify BIDDLE Instruments or its nearest representative, giving a detailed description of the damages observed.

WARRANTY

All products supplied by BIDDLE Instruments are warranted against all defects in material and workmanship for a period of one year following shipment. Our liability is specifically limited to replacing or repairing, at our option, defective equipment. Equipment returned to the factory for repair will be shipped Prepaid and Insured. The Warranty does not include batteries, lamps or tubes, where the original manufacturer's warranty shall apply. WE MAKE NO OTHER WARRANTY.

The Warranty is void in the event of abuse or failure by the customer to perform specified maintenance as indicated in the Instruction Manual.

REPAIR

BIDDLE Instruments maintains a complete instrument repair service. Should this instrument ever require repair, we recommend it be returned to the factory for repair by our instrument specialists. When returning instruments for repairs, either in or out of warranty, they should be shipped Prepaid and Insured, and marked for the attention of the Instrument Service Manager.

CAUTION! Test Sets energized with 220/240 volts input voltage!

These sets are intended to be exported. The sets are energized via an internal transformer which is used for voltage reduction. The black cord lead must be connected to the live pole of the line power source and the white cord lead must be connected to the neutral pole of the line power source. The green ground lead of the input supply cord *must* be connected to the protective ground (earth) contact of the input plug. These sets *must not* be energized from a power source where both poles are live.

2. DEFINITION OF TERMS

In order to describe the operation and theory of the Transformer Turn Ratio Test Set (the TTR Set) concisely, certain terms and abbreviations are used. These are defined in the Appendix, Section E.

3. PURPOSE OF THE TTR SET

The TTR Set is designed to measure accurately the turn ratio of rational transformers* which have a ratio of less than 130, and to give a direct reading of turn ratio when the low voltage winding is the primary during test. The set is so arranged that during ratio tests, polarity is determined and the detection of open or short-circuited turns is facilitated. Where the winding is accessible it offers a means of obtaining the actual turn count. Transformers having ratios as high as 330 may be measured with auxiliary equipment.

The set is used for field and shop testing of single and polyphase power, distribution and other rational transformers designed for 25 to 60 Hz operation, having a low-voltage winding rated at 8 volts or more and having a magnetizing current of less than 1.0 amperes at 8 volts. These ratings permit testing all types and ratings of power and distribution transformers in general use.

Where the low voltage winding cannot be used as the primary during test, because of excessive magnetizing current or low voltage rating, the high-voltage winding may be connected as primary. In this application, the TTR Set reads inverse turn ratio to three decimal places — fourth place interpolated.

The Set is also used for comparison tests on certain irrational and special transformers such as potential transformers, current transformers, and luminous tube transformers. It will give accurate results where the percent impedance and percent magnetizing current are

*See appendix page 50.

known and for which corrections can be made. It will also give reasonably accurate results without corrections if the transformer primary impedance drop at eight volts excitation is less than 0.1%. In some cases of specialty transformers it has been found that by winding a standard transformer in advance it could be used as a comparison standard for production line testing to cull out defectives as to inability to meet voltage output or ratio specifications. In this case only the no-load ratio test, which includes the effect of primary excitation drop, was required, not the exact turn ratio.

For cases where the magnetizing current of 1.0 ampere at 8 volts is exceeded, as is found in network transformers of 15000/115 volt class, the ammeter can be equipped with a shunt to extend the range to 5 amperes (× 5 range). Because it is inconvenient to crank the hand-powered generator for the higher output, the TTR is available in power-operated models, Cat. Nos. 550022 or 550027, capable of being operated from a 120 volt, 60 Hz supply.

4. ACCURACY

The no-load voltage ratio of the TTR Set reference transformer is approximately .9995 times the ratio indicated on the dials where the ratio indicated is greater than one. For inverse ratios (less than one) the no-load voltage ratio is equal to the dial reading plus or minus .0005.

The accuracy of turn ratio measured by the TTR Set is limited by the difference between no-load voltage ratio and the turn ratio of the transformer being measured.

For well-designed transformers properly tested, it is possible to determine turn ratio to an accuracy of 0.1% or better. Inverse turn ratio can be relied on to the third decimal place under the same conditions. No corrections are needed.

For less rational transformers the true turn ratio will be slightly larger than the indicated ratio. In such cases a correction can be applied if the percent impedance and percent magnetizing current are known approximately.

Discussion of this and other factors affecting accuracy will be found in Section C.

5. PRINCIPLE OF OPERATION

When a transformer is excited by its low voltage winding, the no-load voltage ratio is almost exactly equal to the turn ratio if the transformer is rational. The difference between the two ratios is caused by voltage drop in the primary that results from magnetizing current flowing through the primary. In practical transformers the difference is often less than 0.1%.

All electrical methods of measuring turn ratio are based on the above principle. The basic problem is that of measuring no-load voltage ratio.

The TTR Set is arranged so that the transformer to be tested and the adjustable ratio reference transformer in the TTR Set are excited from the same source of voltage. The secondary windings are connected in series opposing through a null detector. When the ratio of the reference transformer is adjusted so that no current flows in the secondary circuit (null), two conditions are fulfilled simultaneously. The voltage ratios of the two transformers are equal and there is no load on either secondary. The no-load voltage ratio of the reference transformer is known, therefore the voltage ratio of the transformer under test is known, and its turn ratio is also known, subject only to the errors mentioned above.

6. GENERAL DESCRIPTION

The TTR Set is entirely self-contained and self-powered. The following components are built into a case with cover and carrying strap as shown in Figure 1 on page 10. The case is approximately 10 inches high, 10 inches deep and 13 inches long overall. The approximate weight is 19 pounds.

a. Generator: The source of test power is a hand-cranked permanent magnet ac generator which provides 8 volts excitation at approximately 60 Hertz under normal conditions of operation. The generator also supplies a source of 8 volts to be used as a reference for the synchronous detector.

b. Reference Transformer: This is a tapped transformer having precise turn count at each tap and designed so that the primary voltage drop due to magnetizing current is negligible when excited at 8 volts.

c. Decade: Three tap switches are connected to secondary taps of the reference transformer. The shafts of these switches project through the instrument panel and are fitted with indicating plates and control knobs. Reading from left to right while facing the Set, the first switch changes the connected turn count ratio of the reference transformer in steps of 10; the second switch changes ratio in steps of 1, the third in steps of 0.1. The actual connected turn count ratio set up by any combinations of positions of these three switches is indicated by figures which appear in the windows located above the switch knobs.

d. Fourth Dial: A fourth dial in line with the three dials but with a larger window is located on the right. This is connected to a potentiometer across an auxiliary winding in the reference transformer. It provides a continuously variable voltage which is electrically equivalent to variable turn ratio. The dial is marked with 100 divisions each of which corresponds to a change in turn ratio of 0.001.

e. Detector: A phase-sensitive null-detector is used. It consists of a synchronous rectifier and a zero center, dc microammeter used as a detector. The latter is located in the upper right corner of the panel.

f. Meters: An ac voltmeter measures the excitation level. It is marked with a graduation at 8 volts and upper and lower limits which insure operation within the correct voltage range. There is also an ammeter which indicates the magnetizing current of the transformer under test. Both of these meters are mounted at the top of the instrument panel adjacent to the detector.

A divide-by-5 ammeter range, selected by a switch directly below the meter, increases resolution at low magnetizing currents.

g. Leads: Four leads are permanently connected to the set for connecting to the transformer under test. Two of these are 10 ft. long and provided with clamps for connection to the winding which is to be used as primary (generally the low-voltage winding). The other leads are 13 ft. long and are fitted with clips for connecting to the secondary for the test (usually the high-voltage winding). A compartment in the case is used to store the leads.