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MODEL IT-4

HI-TEST™

HI-TEST INSULATOR TESTER

DETAILED OPERATING INSTRUCTIONS

PLEASE READ ALL INSTRUCTIONS PRIOR TO USE

Welcome to the HD Electric Company family of electrical products.

Hi-Test Detection Instruments is now a part of the HD Electric Company group of Electrical Test and Measurement equipment.

HD Electric Company, located in Waukegan, Illinois, USA is a manufacturer and provider of a wide range of electrical equipment. We have been in business for over 65 years by providing proven products and reliable service. Our product offerings include Electrical Test & Measurement, Control Instrumentation & System Measurement, Lighting Products and Specialty Products. If you are already an HD Electric Company customer, we thank you for your valued business. If you are a new customer, we appreciate your business and look forward to meeting all of your needs.

At HD Electric Company, it is our goal to provide tools and equipment needed to perform the job in the safest and most efficient way possible. It is our intention to provide continuing service and support needed for all your Hi-Test equipment. Feel free to contact us regarding any aspect of the application or operation of this test equipment. We can be reached at:

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At HD Electric Company, we understand the special training and requirements for work on electrical power distribution systems. Please take a few moments to read this manual in its entirety before using the new equipment. Pay special attention to the warnings and cautions both in this manual and on the equipment itself.

NOTICE – This product is designed for use by professionals trained in its use and application in and around high voltage electrical equipment. If you are not trained in the work methods required for safe operation, do not proceed until you obtain training.

CAUTION – This product was tested before leaving the factory but it must be tested prior to and after each use for proper working operation. Be aware that dirt, moisture, mechanical fatigue and other factors reduce the dielectric strength of this product. If any defect of condition is noted, do not use this product. Remove from service and arrange for repair.

WARNINGS – Rigorous hot stick work precautions and OSHA and company work practices must be followed. Always wear approved cover-up and safety equipment. Read and understand instructions prior to use. Misuse and abuse of this product can lead to severe injury or death.

Unit Serial No.: _____
Manufacture Date: _____

LIMITATIONS TO THE USE OF THE HI-TEST INSULATOR TESTER

Three factors limit the use of the Hi-Test Insulator Tester under energized conditions and they **must** be understood prior to its use:

1) On a 69 kVAC phase-to-phase nominal circuit the phase-to-ground voltage is approximately 40 kVAC. The tester was designed and constructed to withstand 60 kVAC low impedance, phase-to-ground voltage across the probes of the tester. This gives an additional 50% safety margin above 40 kVAC before flashover will occur. **CAUTION:** The 60 kVAC flashover voltage was tested in clean, dry conditions. To further increase safety to the operator and to the tester, the tester is externally "shunted" on the back of the housing to limit the flashover voltage to 50 kVAC. This shunt ensures that should the tester be placed across a circuit in which the voltage exceeds 50 kVAC phase-to-ground, the tester will flash across it's external surface first. The shunt is located behind the **"DO NOT REMOVE"** label (*see Figure One below*). The flashover voltage may be reduced by the moisture and/or contamination on the tester surface. **ALWAYS** be sure the tester is clean and dry before use. This means the tester is capable of withstanding the phase-to-ground voltage on any circuit up to and including 69 kVAC phase-to-phase nominal while testing insulators (ie. the voltage on the line is directly across the probes of the tester with no other insulators in the string working).

Figure One

2) One side of any insulator under test must be isolated from the circuit in order to be able to test that insulator. If the user attempts to test an insulator going directly from phase-to-ground, the following situation arises: the probe placed in contact with the conductor side of the insulator will be common with all insulators connected to that conductor; the probe placed in contact with the ground side of the insulator will be common with all insulators on that circuit sharing ground. The tester will then try to test the resistance of all parallel insulation paths it can reach simultaneously.

   FURTHERMORE, placing the tester across a single insulator going directly from phase-to-ground at line voltages greater than 69 kVAC phase-to-phase nominal will result in externally flashing the tester and a line-to-ground fault!

   NOTE: Users of the tester report some success testing pin and cap insulators on distribution circuits when the insulators are mounted on wooden cross-arms, which are not bonded to ground and when the cross-arms are dry. In these circumstances, the cross-arms provide isolation of the insulator under test to the common ground side.

3) **WHEN TESTING INSULATORS IN SUB STATIONS**, such testing must be done **DE-ENERGIZED** unless the user recognizes and understands the limitations set out above and uses the tester in accordance with those limitations.

READ ALL OPERATING INSTRUCTIONS PRIOR TO USING THE TESTER

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SURFACE CONTAMINATION

Most contaminants that collect on the surface of insulators are only conductive in the presence of moisture. There are only a few wind blown contaminants that are conductive when dry and their occurrence in any area is generally well known to the utility company. As a result, these latter types of contaminants generally will not interfere with insulator testing activities.

For the more common wind blown contaminants, the visible amount of surface contamination on the insulator is a poor predictor of its surface conductivity for two reasons:

1) the actual visibility of contaminants varies greatly (eg. concrete dust versus salt spray); and
2) most wind blown contaminants are non-conductive until they are moistened - either by fog, heavy dew, light rainfall, or extremely high humidity.

This means that line crews testing insulators for dielectric condition must pay attention to the moisture at the time they are testing. Since rainfall normally precludes the performance of live-line work, the surface conductivity of insulators in this circumstance is typically not a problem in the testing of insulators.

However, early morning dew, fog, and extremely high humidity are conditions which will interfere with insulator testing. To avoid the problem of early morning dew, it is advisable not to begin testing insulators until the sun has had time to dry the surface of the insulators to be tested. To avoid the problem of fog, it is advisable not to attempt to test insulators under foggy weather conditions. To avoid the problem of extremely high humidity, it is advisable to avoid testing insulators if the relative humidity exceeds 85%.

Finally, if any question arises about the surface conductivity of insulators being tested, the test crew can measure the surface conductivity of several of the subject insulators using the test procedures described in the Operating Instructions.

DETAILED INSTRUCTIONS OF THE HI-TEST INSULATOR TESTER

FITTING THE TEST PROBES:

1) The probes can be fitted so that they project from either side of the tester.

2) The couplings on the tester to which the probes are fitted are notched in three locations on their outer edge to allow the longer probe to be fitted in three (3) configurations (*see Figure Two*). The longer probe can be fitted: i) to the top of the tester; ii) to project across the rear end of the tester; or iii) to project across the bottom of the tester (*see Figures Three, Four, and Five*).
The notches on the outside edge of the couplings on the tester are designed to receive a pin machined on the inside of the couplings on the end of the test probes. In order to fit the probes correctly to the tester, it may be necessary to rotate the probes slightly as they are being tightened onto the couplings on the tester. This will ensure that the pins fit into the notches.

Figure Two

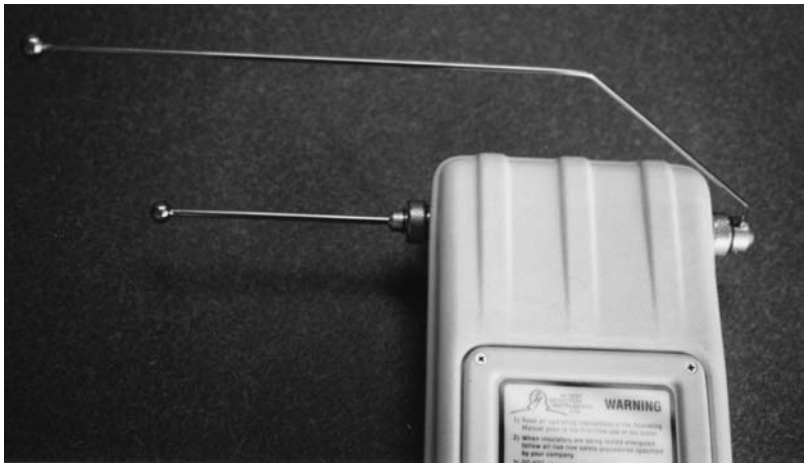

Figure Three

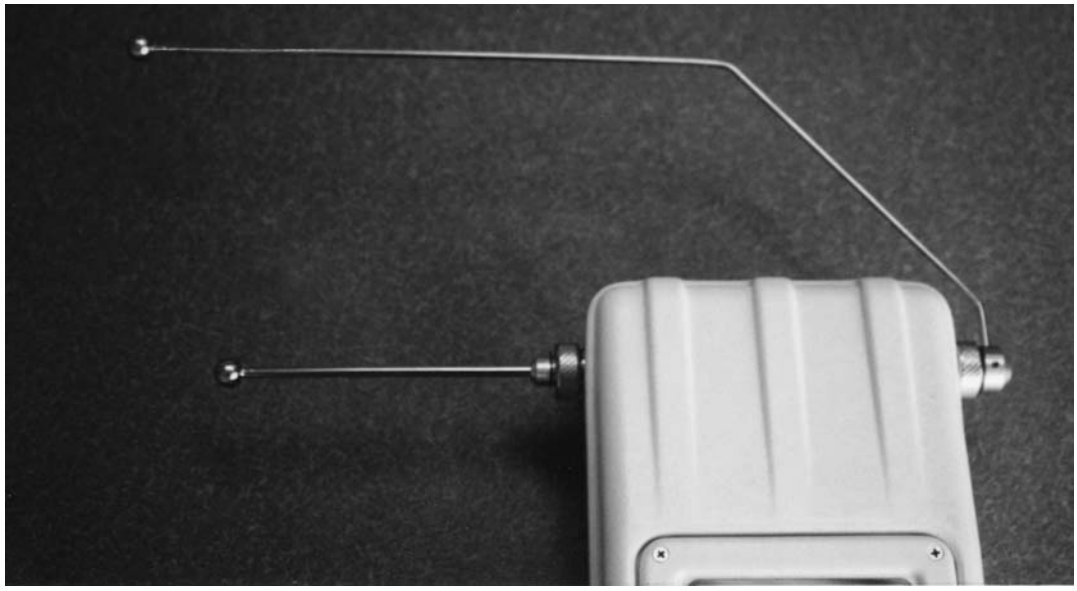

Figure Four

Figure Five

OPERATION OF THE TESTER:

1) Push ON button - green LED at far left of the LED display will light to indicate the instrument is ON.

   NOTE: When tester's ON electrical potential between the test probes is 10 kVDC with an approximate current output of 85 micro amps. **DO NOT** get in series with the test probes whether the tester is turned ON or turned OFF.

2) Bend the longer flexible probe to contact rigid probe - all LED's should light and the warning buzzer should sound. If this does not happen, the tester is not functioning correctly and should be returned for service.

3) When testing insulators, one probe must make contact with the metal cap on the top side of the insulator and the other probe must make contact with the pin, metal cap or concrete bead (depending upon the configuration of the insulator - *see next section INSTRUCTIONS FOR TESTING INSULATORS*).

4) When testing insulators installed on line, the probes should be shorted after completion of testing on each structure to ensure that the tester is functioning correctly. When testing insulators in a stores yard or warehouse, the probes should be shorted periodically to ensure that the tester is functioning correctly.

RECHARGING AND CARE OF THE BATTERY:

1) Make sure the tester is turned OFF.

2) Connect the recharging transformer to the power outlet and plug the recharging cable into the battery recharge receptacle on the bottom of the tester. Recharge indicator light should be lit green.

3) Recharge the tester overnight (at least 12 hours) after each use and at least once every two weeks during periods when the tester is not used regularly.

INSTRUCTIONS FOR TESTING INSULATORS

IMPORTANT POINTS OF INFORMATION:

1) Insulators can be tested energized at any line voltage or de-energized using the Hi-Test Insulator Tester, subject to the limitations described earlier in these instructions under the heading LIMITATIONS TO THE USE OF THE HI-TEST INSULATOR TESTER.

2) The types of physical damage usually seen during the visual examination of porcelain insulators (cracks, chips, broken skirts, flash burns, dried and flaking cement around the pins) are very poor predictors of the dielectric condition of these insulators. Such types of damage affect the flash over withstand capability and/or the gross mechanical strength of the insulators. However, they often do not affect the resistance value of the insulators. The type of damage that does affect resistance value is an internal crack, through the porcelain which is often non-visible (and, in the case of suspension insulators, always non-visible).

3) Insulators, by definition, should have infinite resistance. When they have less than infinite resistance there are only two paths for this loss of resistance: a) through the body of the insulator due to an internal crack which presents an opportunity for electric current to flow; and b) across the external surface of the insulator due to the presence of moisture on that surface. (NOTE: There are some insulators which are resistance graded and have conductive glazes making them surface conductive and the user should be aware of the possibility of their presence.)

4) There are a wide variety of insulator shapes, sizes, and materials. They can all be tested with the Hi-Test Insulator Tester. However, the following points should be used as a guideline on where to focus testing efforts and attention:

   a) **Glass Insulators** - are all pre-stressed when manufactured so that any failure of the glass results in the entire skirt being shed. In this way, they are self identifying for failure of their resistance value and do not need to be tested for non-visible defects.

   b) **Composite/Polymer/Non Ceramic Insulators** - failure of these types typically begins on the external surface and visible signs of potential failure include extensive evidence of surface tracking and/or color or consistency changes in the shed material. They can be tested using the procedure set out below for testing insulators, however, the visible signs described above rarely coincide with dielectric failure.

   c) **Porcelain Insulators** - virtually every shape and style is capable of sustaining non-visible failure and they should all be routinely tested for such failures prior to being recycled.

      NOTE: Several types of porcelain insulators appear to be single piece insulators but are, in fact, assemblies of two or more pieces of porcelain bonded together with cement. Such insulators can be readily identified by turning them upside down and looking for a cement bead between the skirts. If such a bead is located, each skirt must be tested separately (see test procedure below).

5) When to test insulators for non-visible defects:

   a) immediately prior to installation on the system, thereby ensuring they are not defective when installed;
   b) when insulators are recycled they should all be tested for non-visible defects prior to being placed in inventory;
   c) when trouble shooting RF/TVI and blinking light complaints as non-visible internal failures in insulators can be a source of such nuisance complaints;
   d) as part of a routine maintenance and emergency repair work on transmission circuits - particularly on dead-end structures - to identify non-visible defective insulators before they become a safety hazard to line crews. Testing on dead-end structures is emphasized because evidence from the field indicates that the vast majority of non-visible insulator failures on transmission circuits occur on dead-ends.

PROCEDURE FOR TESTING INSULATORS:

1) Follow all live line safety procedures when testing insulators energized.

2) When testing in close proximity to dead-end or cutout jumpers, take care to ensure that the tester probes do not shunt the jumper to the pole or cross arm.

3) When testing energized insulators: a) **DO NOT** test strings of insulators which are buzzing abnormally (this is an indication of possible extensive insulator failure) and b) when nominal voltage of the circuit is higher than 69 kVAC, **STOP TESTING** any string of insulators if the number of insulators identified as defective reaches one-half the total number of insulators in the string.

4) Keep the tester clean - particularly the area between the probes. This will prevent the possibility of erroneous tester readings due to surface creepage from one probe to the other across the dirty external surface of the tester. Clean unit with mild soap, rinse and dry thoroughly before using.

5) **If insulators are to be tested energized**, attach the tester to a hotstick appropriate for the line voltage and raise it to the lineman using a tie assist on the hotstick.
   If insulators are to be tested de-energized, the tester may be hand held.

6) Apply the tester probes briefly across the metal parts on either side of the insulator or from metal to concrete bead (depending upon insulator construction - see Section 4c of IMPORTANT POINTS OF INFORMATION above).

PROCEDURE FOR TESTING INSULATORS: (cont'd)

INTERPRETATION:

1) When the probes are first placed in contact with the insulator one or two yellow lights may come on briefly and then go off - this is normal and indicates that the tester is in contact with the insulator being tested.

2) **The insulator is good** when the probes are in contact with the insulator and the green LED and/or the first or second yellow LED are lit.

3) **The insulator is surface conductive** if some but not all red LED's are lit and the buzzer sounds - see Point 5 below.

4) **The insulator is defective or has very high surface conductivity** if the complete LED display is lit and the buzzer sounds - see Point 5 below.

5) **Readings produced by surface conductivity** can be isolated from those produced by non-visible defects by applying both tester probes directly to the external porcelain surface of the insulator or one probe to the metal cap and one probe to the external porcelain surface of the insulator in question (it may be necessary to reposition the flexible probe 90 degrees from its original position on the tester - see section on FITTING THE TEST PROBES above). With the probes in contact with the insulator as described in this step:
   a) **if the green LED and/or the first or second yellow LED are lit,** the insulator is not surface conductive and the reading produced by Step 3 or 4 above is the result of a defective insulator. Move the contact point on the porcelain skirt to different places to rule out a dry banding on the insulator;
   b) **if the complete LED display is lit and the buzzer sounds**, the insulator is surface conductive. It should be cleaned and dried prior to retesting or be tested at a time when the relative humidity is lower (see section on SURFACE CONTAMINATION above).

   NOTE: Test results on strings of insulators will tend to fall into one of two cases.

   In the first case, surface conductivity is generally present if EVERY one of the first several insulators tested indicates defective. If this pattern of defects occurs, the user should suspect surface conductivity and immediately test for this condition using the procedure in Point 5 above.

   In case two however, if MOST of the insulators tested are found to be good, then the few which are found to be defective are probably defective. This is because surface conductivity is not likely to happen on only a few insulators on any particular string or structure. Therefore, those insulators which indicate they are defective under these circumstances are almost certain to be defective.

For more information, refer to the page entitled "SURFACE CONTAMINATION" toward the front of the manual.

WARRANTY

The Hi-Test Insulator Tester (Model No. IT4) is warranted against defects in manufacture for a period of one year from date of purchase. The only exclusions to this warranty are:

1) the battery; and

2) if the tester and/or its carrying case are returned in a condition that indicates the tester has been tampered with or has been subjected to extreme physical damage, the warranty is void. Extreme physical damage includes cracks, breaks or dents in the plastic and/or fittings indicative of the tester having been dropped, crushed, run over, subjected to flash over, or otherwise abused.

This product is built to the highest quality standards. An extensive laboratory and field test program preceded its commercial introduction to ensure that it would withstand the rigors of field use. However, users should keep in mind that the tester is a piece of electronic test equipment which can be damaged if subjected to excessive mechanical force.

If the tester requires repair, it must be returned to HD Electric Company, or their agents; freight prepaid and properly packaged to protect it against damage in shipping. HD Electric Company and its agents will assume no liability for damaged instruments not properly packaged.

IF YOU HAVE ANY PROBLEMS, QUESTIONS, OR COMMENTS ABOUT THE TESTER, PHONE HD ELECTRIC COMPANY IN WAUKEGAN, ILLINOIS, USA AT 847-473-4980 OR FAX US AT 847-473-4981.