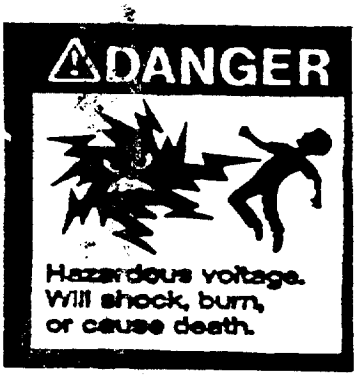
For Technical Assistance Outside of Illinois 1-800-858-TEST

HIGH POTENTIAL

DIELECTRIC WITHSTAND TESTING

WITH

MODEL 4045AI AC/DC JR. HYPOT®



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MANUAL 35956

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INTRODUCTION

This manual discusses the reasons why dielectric withstand tests are required, the precautions necessary to ensure that the tests are done safely, and how such tests are accomplished on various classes of materials, components and products.

In later chapters, the features of this Associated Research Model Hypot® are explained, along with a step by step guide to its proper use. Finally, technical data is presented.

SAFETY PRECAUTIONS REQUIRED FOR HIGH VOLTAGE TESTING

WARNING: This Model - - Hypot® produces voltages and currents which can cause harmful or fatal electric shock. Respect for this is essential when handling and using the test instrument:

1. Plug in the high voltage test lead only when it is being used. Handle its clip only by the insulator --- never touch the clip directly. Never touch the item being tested. When you are not actively performing tests, and before leaving the test station, unplug the high voltage test lead from the Hypot®.

2. Perform tests on a non-conducting table or workbench, if possible. If you must use a conductive surface, be certain that it is securely grounded to a good earth ground and properly insulate the high voltage connection from the grounded surface.

3. DO NOT perform hipot testing in a combustible atmosphere or in an area where combustible materials are present.

4. Never handle the test leads while the high voltage circuit is energized. This would present an undue shock hazard. This unit will shock burn, or cause death if mishandled.

5. Always operate this and all other electrical equipment from a grounded AC outlet. Operating this unit from an ungrounded outlet will expose the operator to undue shock hazard.

6. Never attempt to hipot test energized circuitry or equipment.

WHY PERFORM DIELECTRIC WITHSTAND TESTS?

A dielectric withstand test is a deliberate application of a higher-than-normal potential across some insulating material or the entire insulation system of a component or device. This stresses the insulation and the intent is to verify that the insulation can take this stress without breaking down and allowing arcing, and without drawing excessive current. If the insulation passes the test, it is assumed that it will withstand the lesser stress of its intended application. The test can uncover defects in material or workmanship which would render the insulation system ineffective if not corrected.

The items most commonly subjected to dielectric withstand tests fall into four categories:

I. Insulating raw materials: solids, liquids, gases.

II. Components: switches, relays, transformers, circuit breakers, potentiometers, wire, cable, connectors, etc.

III. End Products: appliances, motors, instruments, office machines, the control equipment of aircraft, machine tools, etc.

IV. Repaired or rebuilt products: rewound motors, generators, transformers, repaired appliances and entertainment devices, etc.

The majority of the tests performed can be grouped into the following categories:

I. Design Tests: A manufacturer desiring to verify the insulation provided by a supplier or designed into his product may run tests in a laboratory environment. Such tests may be designed to stress insulation or insulation systems against either the supplier's or the manufacturer's own specifications, or during component selection to gauge the relative insulation quality of competing products.

II. Routine Production tests: A manufacturer may conduct tests at various points in the production of his products to uncover defects in material or workmanship and prevent the defective product from receiving further processing. Often a regulatory agency or independent testing lab will require specific tests on completed products immediately prior to packaging for shipment. The products must pass these tests as a condition for "listing" or "recognition" or "certification" or even for permission to offer the product for sale.

III. Acceptance Tests: A purchaser may conduct tests on purchased components to prove that they meet minimum insulation specifications, to prevent faulty components from being incorporated into his own products.

IV. Service or Maintenance Tests: The owner of a piece of equipment may wish to periodically verify the integrity of its insulation system, to determine whether or not deterioration has taken place, and to what extent. A rebuilder of motors, etc., may wish to verify that his work was done properly by performing tests on the rebuilt equipment. A repairer of appliances, entertainment devices, etc., may wish to verify that he has not degraded the insulation system of any item he has repaired and to give the owner some minimum assurance of safety.

TYPICAL APPLICATIONS

To insure that the insulation or insulation system is properly stressed during a dielectric withstand test, the voltage must be applied across the insulation. This would not be the same connection as is normally used to power up the device being tested. For each of the categories of items mentioned earlier, we will discuss the usual application of the test potential:

I. Insulating raw materials: In general, the test voltage is applied to the test sample by placing the sample between two metallic electrodes connected to the Hypot® output. Of course, the size and shape of the electrodes must be proper for the type and amount of material being tested, and for testing liquids or gases, suitable containers must also be used.

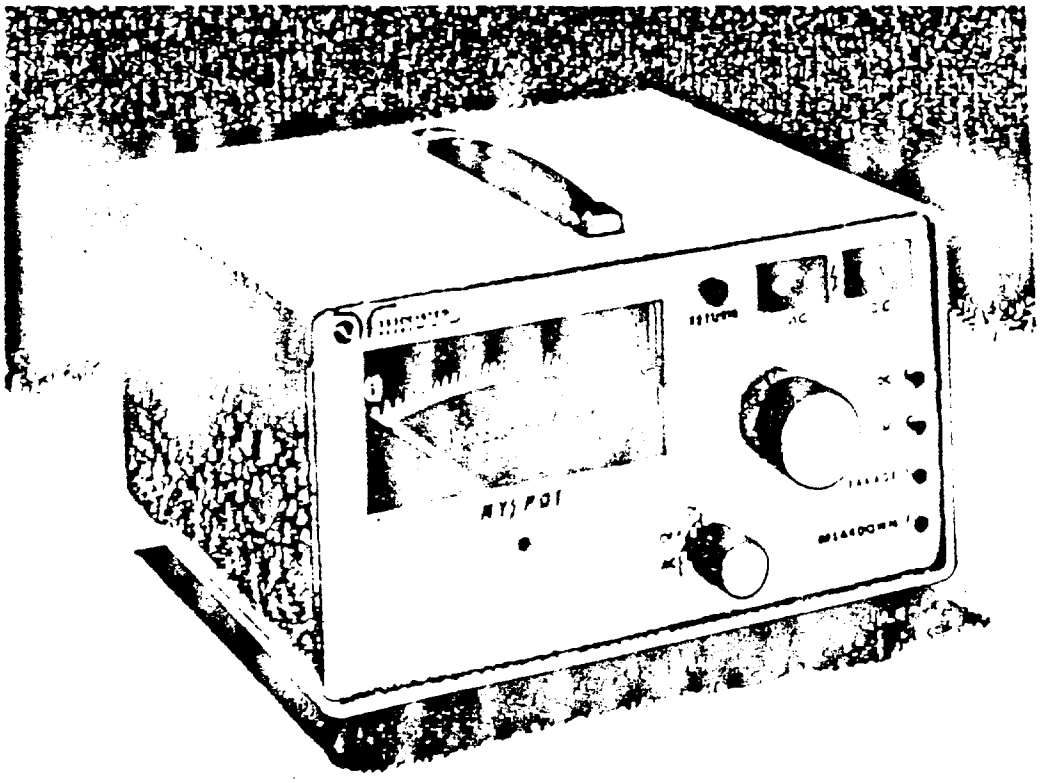
II. Components: Most often the tests required for components test the insulation between parts which are normally conducting and parts which are normally isolated and non-conducting or grounded. For example, in testing a potentiometer, the three potentiometer terminals would normally be shorted together and connected to the high voltage lead, and the case of the potentiometer would be connected to the ground lead. Sometimes, as in the case of transformers and motors, additional tests are required between normally conducting parts which must be kept insulated from each other. A simple transformer, for example, would receive three tests: primary to frame, secondary to frame, and primary to secondary. When testing transformers, it is common and recommended practice to tie both ends of a winding together before applying one side of the nigh voltage. It is not the continuity of the winding which is being tested, but the insulation

from every part of the winding to other components of the transformer. Similar treatment is usually given any winding, coil or heating element in a component, because over-voltaging these parts is not generally part of the Hypot® test.
Switches and relays, in addition to being tested from conducting parts to dead parts, are often also tested across open contacts. A special electrode may be required to test resistors, capacitors and similar items when it is desired to test the insulation provided by a coating or molded case. The special electrode, touching the outside of the case, is one connection point. The other is the leads of the device, all shorted together.

III. End products: These are typically cord-connected finisned products. The double-insulated variety must be tested with special electrodes touching the outside of the case connected to one side of the Hypot® and both blades of the line cord connected together and to the other side of the Hypot®. Any device with metal parts on its exterior should have the return (ground) lead connected to those metal parts (all connected together at once, or sequentially) and the high voltage applied to both blades of the line cord shorted together. For any testing of cord-connected end products, always leave the power switch(es) on so that the entire line circuit will be tested. If the device does not have a neutral connection, and the ground connection normally carries current, it will fail a Hypot® test from line to ground unless the connection from the internal wiring to ground is temporarily lifted during the test. Combination 240-120V appliances are often of this nature.

IV. Repaired or rebuilt products: The same techniques are generally used as on new equipment, except that the test voltage or time is sometimes reduced.

The voltage used and the time for which it is applied are sometimes specified by the manufacturer of an insulating material or by a regulatory or testing agency. When they are not, the following "rule of thumb" is often used: determine the voltage(s) in the circuit(s) being tested, under normal operating conditions. For a circuit to circuit test, as in a transformer, the voltage will depend on the degree of isolation required between circuits. For a circuit to ground or circuit to dead metal test, use two times the normal voltage plus 1000V. For example, a household iron rated at 120V would normally be tested at 1240V.



1. Wide, easily read 4-1/2 inch AC/DC kilovoltmeter with 2% of full scale accuracy.

2. Detachable 5 foot return (ground) lead. This lead is always used in performing tests and is grounded for safety.

3. Detachable 5 foot high voltage lead with flexible rubber insulation for easy handling. Control panel jacks are well recessed for safety.

4. Lighted AC and DC indicators on the control panel which show that the High Voltage circuit is enabled ("Power On") and indicate which mode of operation was selected by rotating the power switch to either the AC or DC position.

5. Lighted Breakdown and Leakage indication. If excessive current is drawn during the Hypot® test, the yellow leakage indicator will illuminate and an audio alarm will sound. Should any arcing occur during the Hypot® test, both the yellow leakage indicator and the orange breakdown indicators will illuminate. To reset the unit, simply decrease the output voltage to zero, place the power switch into the "Off" position and remove whatever is causing the failure from the output leads.

6. Voltage adjust knob. This control varies the high voltage from near zero to the full 5000 volts AC or 5000 volts DC. The voltage can be adjusted only when the high voltage circuit is energized. It is recommended that the voltage control be returned to zero at the end of each test.

7. Detachable 7-1/2 foot power cord with standard connector.

8. Line fuse accessible from the rear. "Shock safe" fuseholder.

9. Separate AC and DC Current Trip (sensitivity) adjustments. The current at which the Failure alarm will trip is adjustable from approximately .3 mA to 5 mA AC or 3 mA DC. Turn the controls counterclockwise to decrease the current setting and increase sensitivity. Turn them clockwise to increase the current setting and decrease sensitivity.

OPERATING INSTRUCTIONS

WARNING: DANGER - HIGH VOLTAGE - improper grounding or careless handling of the test set could result in dangerous shock hazard. Use extrem caution when operating.

1. Locate the Junior Hypot® in a suitable area for performing tests. There should be adequate light and power available. Allow sufficient room for the devices to be tested in such a way that the connections to them will be straightforward and uncrowded and all personnel will be able to stay clear during the tests. The surface upon which the tests will occur should be of a non-conductive material. If a conductive surface must be used, it should be securely electrically tied to a good earth ground and the high voltage connection will need to be properly insulated from ground.

2. Be sure the power switch is in the "Off" position.

3. Install and connect the line cord.

4. Connect the return lead to the Junior Hypot® and to the item to be tested.

5. Connect the high voltage lead to either the AC or DC high voltage output of the Junior Hypot® as required and to the item to be tested.

6. Rotate the Voltage Control of the Junior Hypot® fully counterclockwise. This adjusts the high voltage output to near zero when the test set is energized.

7. Place the power switch into either the AC or DC positions as required to energize the high voltage circuit. Do not handle the test leads or touch the item under test once the high voltage circuit is energized.

8. Rotate the voltage control of the test set clockwise while observing the kilovoltmeter until the desired test voltage is indicated. Start timing when the proper voltage is reached. If there has been no failure indication at the end of the timing period, the item under test has passed.

9. Rotate the voltage control fully counterclockwise.

10. Place the power switch into the "Off" position.

11. By observing the kilovoltmeter, verify that the high voltage has dropped to zero before disconnecting the item under test. NOTE: When DC testing items of a capacitive nature allow extra time for the item to discharge through the metering system of the Junior Hypot®. When the kilovoltmeter of the test set reads zero, the item under test should be discharged and safe to handle.

12. If the total test voltage can be applied instantaneously, the voltage control may be left at the proper setting and testing can be accomplished by turning the power switch to the "AC" or "DC" position as required after the connections to the item under test have been made and the test

area is clear. Monitor the voltage on the kilovoltmeter as high voltage will energize instantly and remain on until turned off by the operator. If the voltage must be applied gradually, steps 8 and 9 must be repeated.

13. If a test item failure occurs (excessive leakage current or break down [arcing]), the failure detection system will instantly indicate the nature of the failure by illuminating either the leakage or breakdown lamps and activating an audible alarm. Both the visual and audible indications will remain active and conspicuous until the failure conditions are removed from the output of the Junior Hypot®.

14. Always place the power switch into the "Off" position before connecting or disconnecting a test item. WARNING: FAILURE TO DO SO MAY RESULT IN A DANGEROUS SHOCK HAZARD. WILL SHOCK, BURN OR CAUSE DEATH.

CURRENT TRIP (SENSITIVITY) ADJUSTMENT AC AND DC

(0.3mA to 5mA range)

The failure detection systems for both the AC and DC modes have been preset so that at 1 mA, or more of output current, the alarm will sound and the leakage lamp will illuminate. If this factory setting is not appropriate for the intended application, it can be reset as follows:

1. Select a value of resistance which must trigger the failure circuit of the Junior Hypot®. The value of the resistance may be determined using the following formula:

   $$\frac{\text{Voltage at which the test is being made}}{\text{Minimum current which must trigger failure.}} = \text{Value of Resistance}$$

2. Place the power switch of the Junior Hypot® into the "Off" position and rotate the voltage control to its extreme counterclockwise position.

3. Connect the test leads to the Junior Hypot® output receptacles.

4. Connect the resistance chosen in step #1 across the test leads of the Junior Hypot®. The surface on which the test set is located should be non-conductive. If conductive, the surface must be grounded securely and the test leads isolated from ground.

5. Place the power switch of the Junior Hypot® into the "On" position.

6. Rotate the voltage control of the test set clockwise while observing the kilovoltmeter until it indicates the voltage used in selecting the resistance value in step #1. If the Junior Hypot® indicates a failure before the test voltage is reached, the current sensitivity setting is too low. Choose either the AC or DC current trip adjustment located on the rear panel as required and rotate it either clockwise to decrease the sensitivity, or counterclockwise to increase the sensitivity setting.

7. When the failure detection system is activated, rotate the voltage control counterclockwise until the failure is automatically cancelled.

8. Recheck the setting of the failure detector by slowly rotating the voltage control clockwise while observing the kilovoltmeter. The failure detector should be activatged when the proper test voltage is reached. If not, repeat steps #6 through 8.

9. Return the voltage control to its extreme counterclockwise position and place the power switch into the "Off" position before diconnecting the test leads.

S P E C I F I C A T I O N S :

MODEL NUMBER: 04045AI

DESCRIPTION: AC/DC Junior Hypot

PRIMARY
APPLICATION: Laboratory evaluation of dielectric strength of components, insulation systems, etc.

INPUT:
- Voltage: 115 Volts AC
- Frequency: 50/60 Hz
- Phase: Single
- Current: 1 A

OUTPUT:
- Voltage: 0-5KV AC/DC.
- KVA: .0125
- Frequency: 60 Hz and DC
- Current: 5 Milliamperes AC 3 Milliamperes DC
- Duty Cycle: Continuous
- Failure Detector: Current and arc sensitive failure system in return side of output. Continuously adjustable current sensitivity from .3-5 milliamperes. Factory set at 1 mA.

VOLTAGE CONTROL: Manually operated, continuously adjustable from zero to maximum output.

METERING
KILOVOLTMETER: Analog -- 0-5 KV AC/DC with 100 volts reading resolution.

TERMINATION:
- Input: Detachable 7-1/2 foot 3 conductor power cable terminated in 3 prong grounding type plug.

HIGH VOLTAGE: Detachable five foot silicon rubber insulated cable terminated in clip with rubber insulation.

RETURN: Detachable five foot cable terminated in clip with rubber insulation.

CABINETRY: Portable type with handle - 10.825"x9"x5.825" (274.95 mm x 228.60 mm x144.95 mm)

WEIGHT: 13.0 lbs. (5.9 Kg)