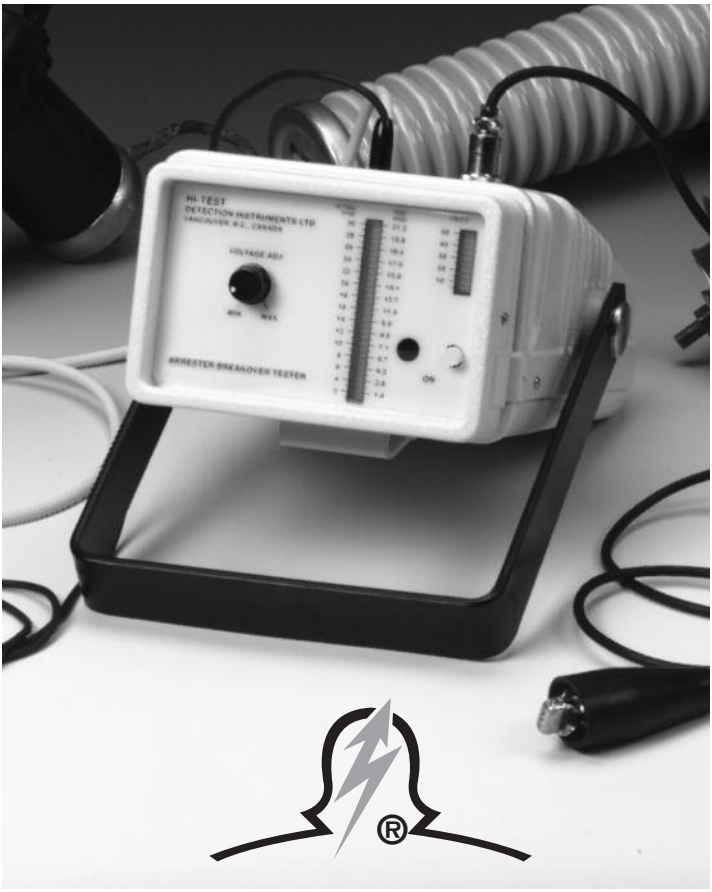
HISAT®-15

SURGE ARRESTER/BREAKOVER TESTER

Operating & Instruction Manual



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SURGE ARRESTER/BREAKOVER TESTER

Operating & Instruction Manual

MANUFACTURING LOCATION

HD Electric Company
Waukegan, IL. 60085, USA

SAFETY INFORMATION

Hi-Test Detection Instruments is now a part of HD Electric Company.

HD Electric Company, located in Waukegan, Illinois, USA is a manufacturer and provider of a wide range of electrical equipment. 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 your 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 or abuse of this product can lead to severe injury or death.

OPERATIONAL IMPAIRMENT - If the HiSat-15 is used in a manner not described in this instruction manual, the protection and effective operation of this equipment may be impaired.

CLEANING INSTRUCTIONS - To clean, wipe with a damp cloth with water. Do not use harsh chemicals or solvents.

SAFETY PRECAUTIONS

1) **DO NOT** use this tester on any part connected to an energized circuit. **FLASH OVER WILL OCCUR.**

2) **DO NOT** attempt to use the tester while it is connected to the battery recharging cable. This can result in destruction of the transformer on the recharging power cable.

3) **DO NOT** touch the bare end of the high voltage test lead when the tester is on, or for 15 seconds after it shuts off. The short circuit current of the tester is a maximum of 250 microamps.

4) **DO NOT** touch or otherwise contact any part being tested. If the part being tested has capacitance, it can store current well in excess of the maximum current output of the tester. Such parts should be shorted after testing to ensure that any current so stored is dissipated safely.

5) **DO NOT** bring the high voltage probe close to the front panel of the tester when it is ON (no closer than 3 inches / 7 centimeters).

6) **DO NOT** attach metallic decals of any kind to the tester. They can cause erroneous readings on the display due to their charged field, and the charged decals may present a source of static shocks.

7) **STATIC SHOCK:** The tester generates static electricity when it is on, particularly at high voltage outputs. Failure to use the Static Ground strap provided, will result in static shocks to the operator. Either ground the tester directly to earth ground or to the operator (ie. by a wrist strap), whichever is more convenient in the circumstances. If good grounding cannot be accomplished, light work gloves should be worn when using the tester to minimize the irritation associated with the static discharge.

8) **RE-ENERGIZING TESTED SURGE ARRESTERS:** Some energizing procedures and circumstances can cause tested good arresters to fail at initial energization.

ALL COMPANY SAFETY PRECAUTIONS AND PROCEDURES MUST CONTINUE TO BE FOLLOWED WHEN ENERGIZING ARRESTERS - EVEN ON THOSE ARRESTERS WHICH HAVE BEEN TESTED GOOD.

GENERAL OPERATING INSTRUCTIONS

Charging the Battery:

1) Fasten the wall rack to a wall near a 110/120 VAC outlet which has a non-interrupted power supply. Damage will result to the charger if it is subjected to power surges from an outlet which is being turned off and on at a main switch.
2) Remove test leads from the tester prior to recharging.
3) Remove the red plastic cap from the receptacle marked BAT. RECHARGE.
4) Plug the recharging cord into the wall outlet and the other end into the receptacle on the rear of the tester. The ON light will glow red.
5) Place the tester in its wall rack - recharge time from fully discharged to fully charged can take up to 12 hours. The recharge circuit will automatically shut off when the battery is fully charged.

NOTE: When not in use, the tester should be stored in charge mode to keep the battery fully charged. This will ensure consistency in test readings and will not affect the battery or its ability to deep discharge (the battery is not a NICAD type battery).

DO NOT ATTEMPT TO USE THE TESTER WHEN IT IS BEING RECHARGED.

Operation of the Tester:

1) Remove the tester from its wall rack and disconnect the battery recharging cable.
2) Plug the Static Ground strap into the receptacle marked STATIC GROUND on the top of the tester and ground the tester either directly to earth ground or to yourself (ie. by a wrist strap). Failure to ground the tester will result in the operator receiving static shocks from the Voltage Control knob on the front of the tester.
3) Plug the Ground Return lead into its receptacle.
4) Make sure the voltage adjust control is turned fully counter-clockwise.
5) Plug the High Voltage Test lead (the red test lead with the red handle) into its banana jack.
6) Turn the tester on by pressing the ON button. The green light beside the ON button will light to signify operation. The tester will run for approximately 30 seconds and automatically shut off. If you wish to extend the on time, every time you press the ON button it resets the 30 second ON duty cycle.
7) Turn the Voltage Adj. control clockwise to increase the voltage output of the tester.

NOTE:
a) The High Voltage Test Lead has a rounded metal end on the probe to minimize corona discharge. Modifications of this probe end will result in corona discharge which will reduce the test voltage available from the tester and can also produce erroneous current readings.
b) The Ground Test Lead is a shielded cable and should not be replaced or modified as this will affect the accuracy of readings displayed on the tester meters.
c) The clip on the underside of the tester can be used as a belt hook to allow the tester to be carried in a "hands free" way for use in the warehouse, stores yard, or field troubleshooting situations.

Internal Fuse:

1) The tester is internally fused and the fuse is changed as follows:
   a) Ensure the Voltage Adj. knob is set to MIN. (fully counterclockwise). Remove the test leads from the tester and turn the tester over;
   b) Remove the 4 screws from the bottom panel and remove the battery cover door;
   c) There are 2 fuses located in the battery compartment. The fuse closest to the belt clip is the power fuse, and the second fuse is a spare. You do not need to remove the battery to change the fuse;
   d) Replace the fuse with a 1 amp., 250 volt, AGC type quick blow fuse. Push the ON button and check that the ON light is glowing green. If the tester still does not work and the fuse is checked to be okay, return it to the factory for repair.
   e) Once the fuse is replaced and the tester works, replace the battery cover door and secure it in place with the 4 screws. Do not over-tighten the screws as they are small and capable of stripping the threads in the tester body;
   f) Turn the tester right side up and re-attach the tester leads. Push the ON button and resume testing as normal.

INSTRUCTIONS FOR TESTING MOV SURGE ARRESTERS

(Overhead and Molded Underground Types)

These arresters can be tested for partial internal shorts and open failures using the procedure set out below.

IF YOU ARE TROUBLESHOOTING IN THE FIELD, follow all company procedures and safety precautions and **DISCONNECT THE ARRESTER FROM THE CIRCUIT** before using the tester.

1) Ground the tester using the Static Ground strap provided (See Safety Precaution #7).
2) Connect the High Voltage and Ground Return leads to the tester.
3) Turn the voltage output of the tester to **MAX.** (Voltage Adj. knob fully clockwise) and push the ON button.
4) Place the tester leads in contact with the end studs of the arrester.
5) The voltage display (long center display) of the tester will immediately display the actual break over voltage of the arrester - provided the arrester is rated at 15 kVAC or less.

INTERPRETATION:

A) If the voltage displayed is at or higher than the rated break over voltage (duty cycle) of the arrester, then the arrester is functioning correctly with regard to its break over voltage.
B) If the voltage displayed is significantly below the rated break over voltage (duty cycle) of the arrester, then the arrester is shorted and should be discarded.
C) If no break over voltage can be achieved under test, then the arrester has failed open and should be discarded - provided the rated break over voltage (duty cycle) of the arrester is below 15 kVAC.

Arresters which fall into Category A above should then be subjected to the following test:

1) Ground the tester using the Static Ground strap provided.
2) Connect the High Voltage and Ground Return leads to the tester.
3) Place the tester leads in contact with the end studs of the arrester under test.
4) Turn the voltage output of the tester to MIN. and push the ON button.

5) Gradually increase the voltage imposed on the arrester by turning the Voltage Adj. knob clockwise until the voltage imposed on the arrester is at the MCOV rating of the arrester.
6) Read the current leakage displayed on the current meter (short display) of the tester.

INTERPRETATION:

A) If the current leakage through the arrester at MCOV voltage is minor (0 to 10 microamps) the arrester is functioning correctly with regard to leakage current at MCOV.
B) If the current leakage is significantly higher than 10 microamps at MCOV, then the arrester should be discarded. (NOTE: There will be variation in the performance of arresters from different manufacturers in this test - even with new arresters. Test several of each manufacturer's arresters which you use to observe this difference).
C) Arresters which fall in Category B above will typically be in full conduction slightly below their duty cycle rating.

NOTE: ARRESTERS RATED ABOVE 15 KVAC cannot be tested to their break over voltages if they are good, using the HiSat-15 Surge Arrester Tester. However, they can be tested for partial shorts as these will be indicated by the arrester breaking over at any voltage below its duty cycle rating.

INSTRUCTIONS FOR TESTING SILICON CARBIDE ARRESTERS

NOTE: This type of arrester generally cannot be tested to rated break over voltage using the HiSat-15 Surge Arrester Tester due to their gapped construction and the limited current available from the tester. **However, they can be tested for internal shorts.** Research on failed silicon carbide arresters collected in the field indicates that non-visible internal shorts are the most common form of failure in these arresters. The mechanism for such failure is moisture invasion past the rubber seals under the metal caps of the arrester.

IF YOU ARE TROUBLESHOOTING IN THE FIELD, follow all company procedures and safety precautions and **DISCONNECT THE ARRESTER FROM THE CIRCUIT** before using the tester.

1) Ground the tester using the Static Ground strap provided (See Safety Precaution #7).
2) Connect the High Voltage and Ground Return leads to the tester.
3) Place the tester leads in contact with the end studs of the arrester under test, ensuring that the High Voltage lead contacts the high voltage stud of the arrester and the Ground Return lead contacts the ground stud of the arrester.
4) Turn the voltage output of the tester to MIN. and push the ON button.
5) Gradually increase the voltage across the arrester to MAX. while watching the current meter on the tester. Note any current leakage which occurs and the voltage at which it occurs.

6) Repeat Steps 3 through 5 with three or four additional arresters that are the same manufacturer and same rated capacity as the first one. This is necessary to determine the "performance profile" of this particular arrester under test with the HiSat-15 Surge Arrester Tester.

NOTE: Differences in the performance of silicon carbide arresters when being tested are a function of differences in the gap structure among these arresters.

INTERPRETATION:

A) Once the typical "performance profile" has been established for the arrester under test, discard any arresters whose performance falls beneath the profile. Arresters which leak current and break over at voltages lower than the others in the set are partially shorted.

INSTRUCTIONS FOR TESTING INSULATORS

Important Points of Information

1) The HiSat-15 Surge Arrester Tester cannot be used to test insulators installed on the system. Insulators must be tested prior to installation or removed from the system for testing.

2) The types of physical damage typically seen in visual examination of porcelain insulators (cracks, chips, broken skirts, flash burns) are poor predictors of the dielectric condition of these insulators. Such types of damage affect the flashover withstand capability of the insulator but do not usually affect its resistance value.

   The type of physical damage which does affect an insulators resistance value is an **internal crack which in non-visible** or, at best, extremely difficult to see during a visual examination.

3) Insulators, by definition, should be nonconductive. If they are conductive, there are only two paths which the current can follow: a) across the surface of the insulator due to moisture on the surface (or because the surface has a conductive glaze, which is rare); and/or b) through the body of the insulator due to an internal crack which provides a conductive path.

4) Given these two conductive paths, the surface of an insulator must be dry at the time it is tested. Otherwise, the surface conductivity of the insulator will interfere with your attempt to test the internal conductivity of the insulator. If there is any question of surface conductivity at the time of test, this can be measured following the procedure set out on the following page.

5) There are a wide variety of insulator shapes, sizes, and materials. They can all be tested using the HiSat-15 tester, however, the following points should be used as guidelines on where to focus your efforts:

   a) **GLASS INSULATORS** - are all prestressed 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 type typically begins on the external surface and visible signs of potential trouble include extensive evidence of surface tracking and/or changes in the color/consistency of the skirt material. They can be tested using the procedure set out on the following page, 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. **They should all be routinely tested for such failures prior to being recycled.**

NOTE: Several types of porcelain insulators are assemblies of two or more pieces of porcelain bonded together with cement. Such insulators can be readily identified by turning the insulator upside down and looking for a cement bead between the skirts. If such a bead can be seen, each skirt must be tested separately (See test procedure on the following page).

6) There are two times when it is desirable to test insulators: a) immediately prior to their installation on the system, thereby ensuring they are good at that point; and b) recycled insulators which are being stored inside should be tested within a few hours of being brought inside (ie., after the external surfaces have dried but before the internal part of the insulator has had a chance to fully dry).

Procedures for Testing Insulators:

1) Ground the tester using the Static Ground Strap provided (See Safety Precaution #7).
2) Connect the High Voltage and Ground leads to the tester.
3) Push the ON button and set the Voltage Adj. at 10 to 15 kVDC - anywhere in this range is adequate to detect non-visible defects in insulators.
4) Impose the voltage output of the tester across the insulator to be tested by placing one of the test leads on the metal cap and the other test lead on the metal pin of the insulator (unless it is a multi-piece insulator, in which case, see Step 7 below). Watch the current leakage display on the tester. If no bars light up on the current display, then the insulator is good (ie., has infinite resistance value); if any bars light up, then the insulator is defective.
5) For those insulators which do not have a metal cap (such as tie top insulators), use a piece of aluminum foil molded into the area in which the conductor rests and around the area where the tie wire is installed to serve the purpose of the metal cap.
6) For those insulators which do not have a metal base (such as pin insulators), use a metal pin screwed into the insulator.
7) For multi-piece insulators, follow Steps 1 through 3 and then place one tester lead in contact with the metal cap on the top of the insulator and the other lead in contact with the cement bond on the underside of the top insulator skirt - this allows you to test the top skirt of the insulator. Then, move the lead from the metal cap on top of the insulator to the cement bond under the second skirt while keeping the other lead in contact with the cement bond it was originally placed on - this allows you to test the next skirt of the insulator. And so forth, for each skirt. The bottom skirt is tested from the cement bond immediately above it to the metal base plate or pin of the insulator.

Procedures for Testing Surface Conductivity:

1) Ground the tester using the Static Ground Strap provided (See Safety Precaution #7).
2) Connect the High Voltage and Ground leads to the tester.
3) Push the On button and set the Voltage Adj. at 10 - 15 kVDC.
4) Place both tester leads on the external surface of the insulator (whether porcelain, glass or non ceramic) three or four inches apart. Watch the current leakage display as you move the tester leads around on the surface of the insulator. If no bars light up in the current display, then the surface is not conductive and the insulator can be tested for non-visible defect. If any bars light up in the current display, then the surface is conductive and the insulator must be further dried prior to testing for non-visible defect.

TESTING INSULATED TRANSFORMER TANK LIDS

Pinhole punctures of the insulating coating on transformer tank lids are not unusual. Such punctures can be quickly located with the HiSat-15 Surge Arrester Tester using the following procedure.

IF YOU ARE TROUBLESHOOTING IN THE FIELD, follow all company procedures and safety precautions and **DISCONNECT THE TRANSFORMER FROM THE CIRCUIT** before using the tester.

1) Ground the tester using the Static Ground strap provided (See Safety Precaution #7).
2) Connect the High Voltage and Ground Return leads to the tester.
3) Connect the Ground Return lead of the tester to the ground contact on the side of the transformer tank.
4) Push the ON button and set the Voltage Adj. at 10 - 15 kVDC.
5) Move the High Voltage test lead of the tester across the surface of the insulated transformer tank lid.
6) Listen for the "snap" of current arcing through a pinhole puncture and watch the Current Display on the tester for any current leakage.

INTERPRETATION:

A) If no current leakage occurs, then there are no pinhole punctures.
B) If current leakage occurs, the High Voltage test lead can be used to locate the precise location of the pinhole puncture.

TESTING FUSES FOR CONTINUITY

Separation of a fuse causes service problems. Using the following procedures, the continuity of a fuse can be quickly checked.

IF YOU ARE TROUBLESHOOTING IN THE FIELD, follow all company procedures and safety precautions and **DISCONNECT THE FUSE FROM THE CIRCUIT** before using the tester.

1) Ground the tester using the Static Ground strap provided (See Safety Precaution #7).
2) Connect the High Voltage and Ground Return leads to the tester.
3) Push the ON button and set the Voltage Adj. at 10 - 15 kVDC.
4) Place the High Voltage and Ground Return leads in contact with the opposite ends of the fuse under test and watch the Current Display on the tester for leakage.

INTERPRETATION:

A) If current leakage occurs when the test leads are placed in contact with the fuse, then the fuse has continuity.
B) If no current leakage occurs when the test leads are placed in contact with the fuse, then the fuse has separated.

TROUBLESHOOTING COMMON PROBLEMS

1) Tester does not turn on when the ON button is pushed.
   Check the fuse inside the battery compartment of the tester.

2) Tester stays on past 30 seconds after the ON button is pushed.
   Check to see if the ON button is sticking.

3) Tester will not produce 21 kVDC output.
   Recharge the battery. If, after recharging the battery for 12 hours the tester still will not produce a 21 kVDC output, replace the battery. The battery is a 12 Volt, 1.2 Ah sealed lead acid (gel cell type) battery. Contact HD Electric Company to order a replacement battery.

4) Everything tested has current leakage.
   Check for surface conductivity.

   Check for conductivity of the surface on which the parts are laying when they are being tested (eg. are they laying on a metal table top or on a damp cardboard or wooden surface).

5) Operator is receiving static shock from the tester.
   Check to ensure that the Static Ground strap is connected to the tester and that it is well connected to ground.

   When testing any part which has capacitance, check that the test leads are connected so that the High Voltage lead is connected to the high voltage side of the part being tested and the Ground Return lead is connected to the ground side of the part being tested.

LIMITED WARRANTY AND LIMITATION OF LIABILITY

This warranty applies to all products sold by HD Electric Company (the "Products"); provided, however, that the term Products does not include any third party products purchased through HD Electric Company, for which no warranties are made (the "Third Party Products"). Third Party Products may be subject to a separate manufacturer's warranty; [should you have any question regarding whether a separate warranty applies, please contact HD Electric Company].

NOTICE: READ THIS LIMITATION OF WARRANTY AND LIABILITY BEFORE BUYING OR USING THE PRODUCTS CONTAINED HEREIN.

It is impossible to eliminate all risks associated with the use of the Products. Risks of serious injury or death, including risks associated with electrocution, arcing and thermal burns, are inherent in work in and around energized electrical systems. Such risks arise from the wide variety of electrical systems and equipment to which Products may be applied, the manner of use or application, weather and environmental conditions or other unknown factors, all of which are beyond the control of HD Electric Company.

HD Electric Company does not agree to be an insurer of these risks, and shall have no liability for any claims arising from such risks.

WHEN YOU BUY OR USE THESE PRODUCTS, YOU AGREE TO ACCEPT THESE RISKS.

HD Electric Company warrants to the original purchaser that the Products (excluding any third party products purchased through HD Electric Company, for which no warranties are made) will be free from defects in material and workmanship, under normal use and regular service, and preventative maintenance for a period of one (1) year (ten (10) years for HDE Capacitor Controls) from the date of shipment (the "Warranty Period"). Should any failure to conform with this warranty be found during the Warranty Period, you must notify HD Electric Company of your claim within thirty (30) days of discovery, and within the Warranty Period. Your failure to give notice of claims of breach of warranty within the Warranty Period shall be deemed an absolute and unconditional waiver of claims for such defects. HD Electric Company will have no responsibility to honor claims received after the date the applicable Warranty Period expires.

Upon notice of your claim, HD Electric Company will provide a return authorization number, and further instructions on how to return the product for service. You must follow HD Electric Company's instruction. You are responsible for all Product removal, handling, re-installation, and shipping (both to and from HD Electric Company). Products returned for repair, as well as repaired or replacement Products shall be sent postage / freight prepaid. After receipt of a product which HD Electric Company determines is defective, HD Electric will, at its option, either (1) repair (or authorize the repair of) the Product or (2) replace the Product, subject to the following: The Products are made using parts sourced from a variety of manufacturers. Due to the rapidly changing technology environment, parts may become obsolete / unavailable over time (end of life). In the event that a Product cannot be repaired or replaced due to unavailability of parts, HD Electric Company will use commercially reasonable efforts to obtain substitute parts or conduct work around design, but cannot guarantee its ability to do so.

Items not found defective will be returned at your expense, or failing receipt of instruction from you on return of such items within five (5) business days of our notice to you that the product is not defective, HD Electric may dispose of the product at its discretion and with no liability to you. HD Electric Company's determination of defects is final. Products repaired or replaced during the Warranty Period shall be covered by the foregoing warranties for the remainder of the original Warranty Period or ninety (90) days from the date of delivery of the repaired or replaced Products, whichever is longer.

LIMITATIONS:
This warranty is void in the event of misuse, alteration, faulty installation, or misapplication of the product.

This warranty does not cover failure of product or components due to any ACT OF NATURE; lightning, floods, hurricanes, tornadoes or any other such catastrophic events.

HD Electric Company does not warrant any third party products or associated hardware or their performance or suitability for use and application. Such items are provided "as-is".

All repairs must be authorized by HD Electric Company. Unauthorized repairs will not be reimbursed under any circumstances.

HD Electric Company is not required to make replacement or loaner equipment available while Products are being repaired or replaced, or to compensate you for any in/out labor charges or expenses associated with removal, handling or re-installation of the Products.

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IN NO EVENT SHALL HD ELECTRIC COMPANY HAVE ANY LIABILITY FOR ANY THIRD PARTY PRODUCTS OR ASSOCIATED HARDWARE, OR CUSTOMER-OWNED SYSTEMS, EQUIPMENT OR SOFTWARE.

HD Electric Company must have prompt notice of any claim so that an immediate product inspection and investigation can be made. Buyer and all users shall promptly notify HD Electric Company of any claims, whether based on contract, negligence, strict liability, or other tort or otherwise be barred from any remedy.

HD Electric Company is committed to ongoing review and improvement of its product lines, and thus reserves the right to modify product design and specifications without notice.

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