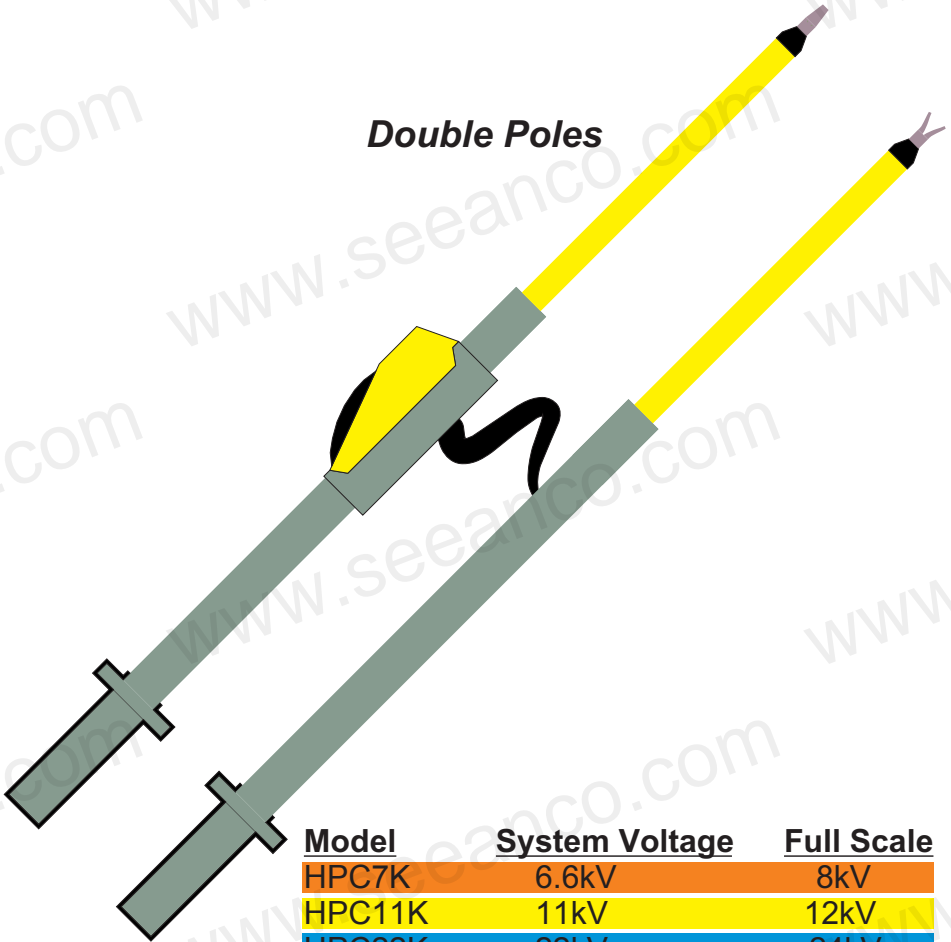


USER'S MANUAL for HIGH VOLTAGE PHASE COMPARATORS

Double Poles



<u>Model</u>	<u>System Voltage</u>	<u>Full Scale</u>
HPC7K	6.6kV	8kV
HPC11K	11kV	12kV
HPC22K	22kV	24kV
HPC33K	33kV	36kV
HPC44K	44kV	48kV

INDEX

PAGE

SAFETY RULES.....	1
GENERAL DESCRIPTION.....	2
PRINCIPLE OF OPERATION.....	2
PROVING THE PHASE COMPARATORS.....	3
LIMIT MARK.....	3
LABELS AND MARKING.....	4
RANGE OF MODELS.....	5
INSTRUCTION FOR USE.....	6
OPERATION.....	7
SPECIFICATIONS.....	8
SCALES.....	9
DIRECTIONS FOR USE.....	10
TESTING FOR PHASING PRESENCE.....	11
CARE AND MAINTENANCE.....	12
LIMITED WARRANTY.....	13
NOTES.....	14

SAFETY RULES

- Only Personnel who are fully **trained** in the use of High Voltage Phase Comparators should use this equipment.
- Be aware that the system that it will be used on are powered from high voltages which are **lethal**.
- Before use, ensure that the Phase Comparators and any accessories are **clean**, free from cracks or deep scores, and are properly secured together.
- Only the proper rated Phase Comparators must be used. Ensure that the Phase Comparator is **properly rated for the voltage** of the system under test.
- **Test** the operation of **the Phase Comparator before and after** each test.
- Do not allow any part of the Phase Comparator except the contact electrodes to come in contact with energized or earthed items.
- **Safe Working distance** must always be observed.
- **Safety insulated Gloves and protective clothing and glasses** must be wear when using the Phase comparator.
- The Phase Comparator must only be **handled by one person only**.
- Do **not** insert the Phase Comparator **beyond its limit mark** into the apparatus under test. **The Limit mark is the red band**.
- The Phase Comparator should **not be used as a synchronising Device or a voltage detector**.
- The Interconnecting **lead/cord must not** be allowed to **come within 4" (10cm)** of the hand guard and must not be touched while testing.
- Before using the Phase Comparator in the testing of factory assembled switchgear, the **manufacturer of the switchgear must be consulted** as the suitability of the Phase Comparator in such testing.
- **Always check for Phase Presence before testing between Phases. Ensure that voltage is present on both phases before testing between phases.**
- The Phase Comparators are not to be subjected to a constant voltage for a period longer than 1 minute in every five minutes.

GENERAL DESCRIPTION

- The range of high Voltage Phase Comparators have been designed to **comply and exceeds** the requirements of **VDE0681 Part 5**.
- The Phase Comparators are double poles devices which are **used to determine the correct Phase Relationship between two energized conductors of the Same nominal Voltage and Frequency**.
- Models are available to cover systems voltages from **1kV to 44kV** 50/60Hz.
- For other systems voltage, please contact the factory.
- All models may be used indoor and outdoors in **dry weather only**.

PRINCIPLE OF OPERATION

- The range of Phase Comparators is a resistive device which comprise mainly of resistors, a neon and a panel meter. The Phase Comparator draw current from the circuit or source under test.
- The Phase Comparator consist of two inter-connected poles (the master pole with the panel meter and the slave pole).
- The Master pole carries the panel meter with the color coded scale and the integral neon light indicator.
- The color coded scale indicates "in-phase/out-of-phase" band on the scale. (Green = in-phase; Red=out-of-phase).
- The Neon light lit up when the voltage between the poles is greater than $\pm 1.2kV \pm 1.5kV$.
- If two energized conductors are out-of-phase and a contact electrode is touched onto each pole, current will flow between the conductors through the resistors (resistors are inside the fiberglass front end in each pole) in the poles and the interconnecting lead/cord. This will cause the neon to lit and the panel meter's indicator to move into the out-of-phase area (Red).
- If two energized conductors are in-phase and a contact electrode is touched onto each pole, current will not flow between the conductors through the resistors in the poles and the interconnecting lead/cord. This should not cause the neon to lit and the panel meter's indicator to move. The indicator will stay into the in-phase area (Green).
- **Ensure that voltage is present on both phases before testing between phases.**

PROVING THE PHASE COMPARATORS

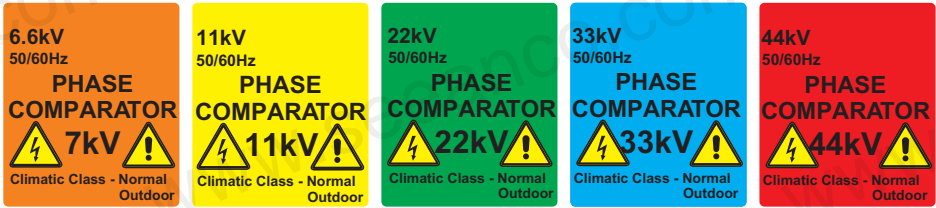
- **Before and after** using a Phase Comparator and accessories, a functional test should be performed on the Phase Comparator as it is to be used on the source or circuit to test.
- A **High Voltage Insulation tester can be used** for this purpose.
- When using a High Voltage Insulation tester, the Phase Comparator will indicate the voltage generated by that H.V. Insulation tester.
- Please note that H.V. Insulation testers are generating DC voltage and have polarity.
- The range of Phase Comparators are using a ½ bridge rectifier and current only pass one way into the panel meter. However, the neon must lit both ways.
- When proving with a DC source as with a H.V. Insulation tester, the poles must be tested for both polarity to confirm that the panel meter only show voltage in one way, but confirm that the neon indicates both polarity.
- The reading on the High Voltage Insulation tester also indicate the total value of the resistor chain and is also a good indication that the circuit is still correct and in good condition (See specifications).
- A **Proving Unit** can also be used if a High Voltage Insulation Meter is not available. The Proving unit does not indicate how many mega ohms are in the front end or if the circuit is still in good condition or not. The Proving unit only output a DC voltage of 5kVdc.

LIMIT MARK

- Each Phase Comparator has two poles.
- Each pole has a front end which is in Fiberglass tubing.
- Each pole has a handle section.
- At the junction between the handle section and the front end section, there is a **RED BAND** which **is the limit mark**.
- By definition, this mark, or the **Red Band, indicates the physical limit to which the poles of the Phase Comparators may be inserted between live components or may touch them.**

LABELS AND MARKING

- The following labels must be present on the Master Pole.



CONFORMS TO DIN VDE 0681/5

- The following labels must be present on BOTH Poles.

NOT FOR USE IN RAIN

CAN BE USED AS A VOLTAGE TESTER

<p>6.6kV DANGER: USE ON SYSTEMS UP TO 6.6kV ONLY AS PER INSTRUCTION MANUAL</p>	<p>11kV DANGER: USE ON SYSTEMS UP TO 11kV ONLY AS PER INSTRUCTION MANUAL</p>	<p>22kV DANGER: USE ON SYSTEMS UP TO 22kV ONLY AS PER INSTRUCTION MANUAL</p>	<p>33kV DANGER: USE ON SYSTEMS UP TO 33kV ONLY AS PER INSTRUCTION MANUAL</p>	<p>44kV DANGER: USE ON SYSTEMS UP TO 44kV ONLY AS PER INSTRUCTION MANUAL</p>
---	---	---	---	---

The Phase Comparator is designed to be used up to this voltage system only.

Voltage System for this Phase Comparator

The Phase Comparator will operate over the frequency range 50 to 60 Hz.

The Phase Comparator is designed for use on High Voltage Systems.

The Phase Comparator will perform correctly over the temperature range of -25°C to + 55°C.

The Phase Comparator is suitable for use either indoor or outdoor in dry condition

* Care must be taken to observe the attached labels, which must not be removed. The labels warn of danger and to use only up to the rated voltage, as per instruction manual. The Labels "Frequency Range", "Year of Manufacture", "not to be used in the rain", "not to be used as voltage tester" are self-explanatory and are to be strictly Observed.

Read and Understand the Instruction manual before using the Phase Comparator.

The user must keep hands and all parts of the body behind the hand guard to maintain safe working distances.

**WARNING
STAY BEHIND HAND GUARD**

RANGE OF MODELS

- Models are available to cover system voltages from 1kV to 44kV @50 or 60Hz.
- Contact the factory for information on models suitable for other voltages.
- The following models are available as standard instruments:

Model N°	System Voltage	Full Scale Voltage	Maximum Voltage	Display Type
HPC7K	6.6kV	8kV	9kV	Neon Panel Meter
HPC11K	11kV	12kV	15kV	Neon Panel Meter
HPC22K	22kV	24kV	30kV	Neon Panel Meter
HPC33K	33kV	36kV	40kV	Neon Panel Meter
HPC44K	44kV	48kV	55kV	Neon Panel Meter

INSTRUCTION FOR USE

- Before using the Phase Comparator, clean the Front End (FiberGlass) with a polymer polish.
- All models do not require batteries and are being signal driven (current taken from the source or circuit under test) and do not require arming. However, **it is recommended that a functional test be carried out using a High Voltage Insulation tester** or a proving unit.
- To prove the Phase Comparator, set the voltage on the Proving unit or on the High Voltage Insulation tester, to suit the model of Phase Comparator. Turn the test "ON" or the proving unit "ON". The Neon should lit (if the voltage is high enough) and the indicator should move nearest the voltage measured.
- Reverse the poles of the Phase Comparator and check that an out-of-phase indication is given.
- They are **no user serviceable parts** on our range of Phase Comparators. Should the Phase Comparator become damaged, please consult with your nearest distributor to return it to the factory.
- There must be galvanic contact between the test electrodes and the part of the installation under test and no other part of the phase Comparator, except the electrodes, should be in contact with energized or earthed parts, in order to ensure accuracy of the display.

OPERATION

To determine the correct phase relationship between two energized conductors, the following procedure should be followed:

- First, **Check that each Phase to be compared is individually energized.**
 1. With one handle held in each hand, touch one bare conductor (first phase which will be compared later) with one contact electrode and touch the earth with the other contact electrode.
 2. The Neon will operate and the meter pointer will indicate the Red out-of-phase band indication which indicate that this phase is energized. The voltage scale will indicate the voltage phase -to-Earth or/and the percentage of the full scale.
 3. Repeat the operation 1 and 2 with the other bare conductor (the other phase to be compared later) so that it is known that both Conductors are energized.
- Now, you should know if both conductors are energized because you will have read the voltage Phase-to-Earth of both conductors.
- If both phases are not energized, then, the remedial action will have to be carried out before proceeding to the next stage of the Test.
- **Compare the Phases.**
- If both Phases are energized (after checking between Phase and Earth that they are energized) proceed to compare between the phases.
- Now touch each bare conductor (each phase to compare) with a contact Electrode.
- If the conductors (Phases) are **in-phase**, the **neon will not lit** and the **meter pointer will not operate** or the meter pointer **will stay in the Green** band.
- If the conductors (Phases) are **out-of-phase**, the **neon will lit** and the **meter pointer will operate** or the meter pointer **will go in the Red** band.

SPECIFICATIONS

Safety Standard

IEC 61481

	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>
Total Resistance	4.48M ohm	6.78M ohm	10.82M ohm	19.68M ohm	26.8M ohm
Response time	<1Sec	<1Sec	<1Sec	<1Sec	<1Sec
Neon Threshold	1.2kV	1.2kV	1.2kV	1.2kV	1.2kV
Neon Lit Fully @	1.5kV	1.5kV	1.5kV	1.5kV	1.5kV

Mechanical

	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>
Length of Handle	30"	30"	30"	30"	30"
Length of Front End (Fiberglass)	15.75"	15.75"	19.7"	26.2"	32.3"
Total Length	46.25"	46.25"	50.2"	56.7"	62.8"
Total Weight	4.6lbs	4.6lbs	4.9lbs	5.3lbs	5.5lbs
Handle Material	Composite Material with Polyurethane				
Front End	Fiber Glass Wound Tubing				

Vibration Resistance: tested in accordance with IEC 68-2-6

Drop Resistance: tested in accordance with IEC 68-2-32

Bump: tested in accordance with IEC 68-2-2

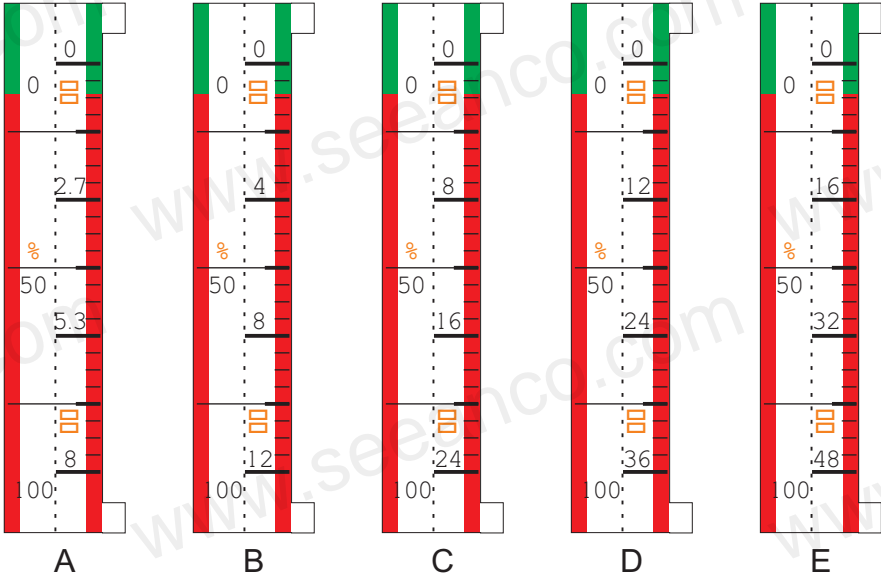
Impact: tested in accordance with IEC 1010 Clause 8.2

Environmental

Operating temperature: -25°C to +55°C

Operating Humidity: 20 to 96% RH.

SCALES



Special Scales and configuration can be manufactured on a case by case basis. Contact the factory with your requirements.

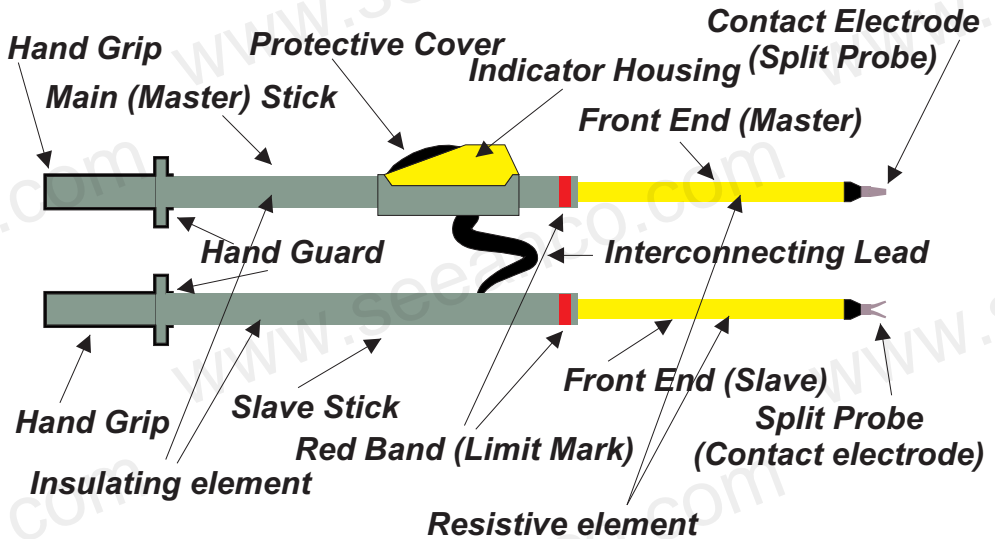
DIRECTIONS FOR USE

It is the user's responsibility to ensure that only competent personnel with the necessary knowledge and training use and handle this equipment.

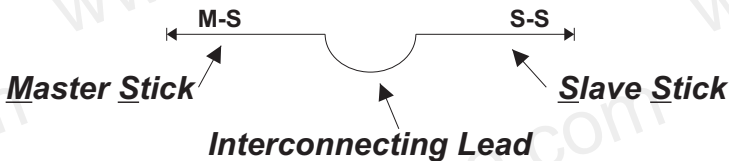
Before using the Phase Comparators, it is recommended to check them with an High Voltage Insulation tester.

For Phasing, it must be ensured that both feeders are in a live condition of the same voltage and in a stable state before commencing the phasing tests.

The Phase Comparators consist of two interconnected parts; these are the Master Stick, containing the indicator housing. The second stick is referred to as the slave.

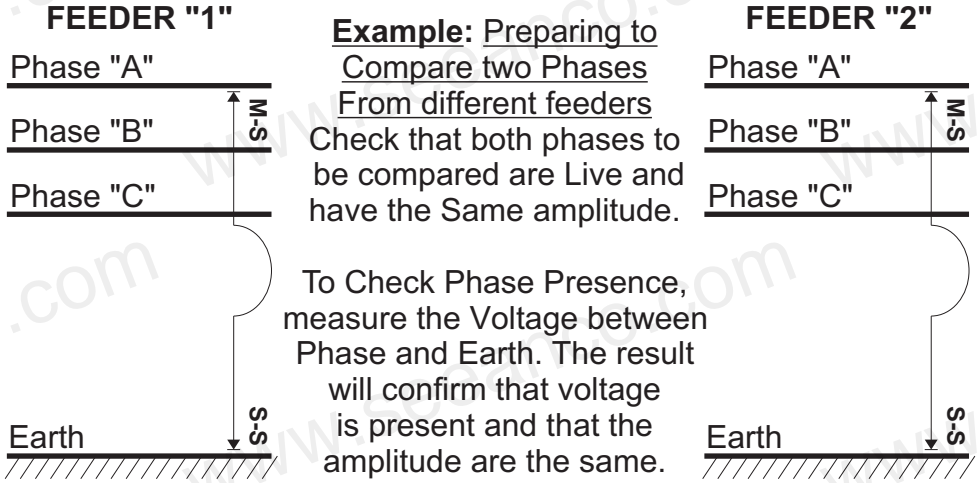


REPRESENTATION FOR EXPLANATION PURPOSE



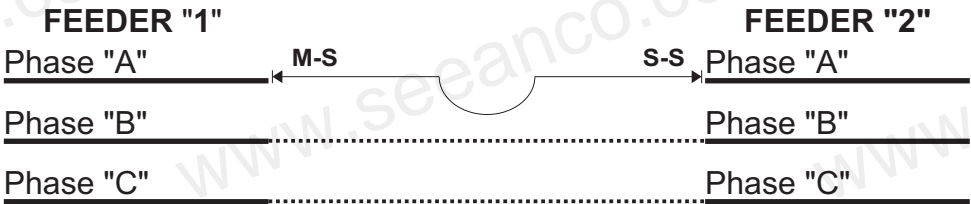
TESTING FOR PHASE PRESENCE

Before doing the Phase Comparison test, you must ensure that the feeders to be compared are live.

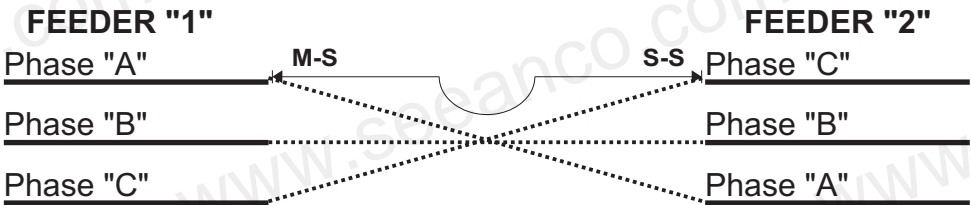


TESTING FOR PHASING

No Indication - Neon OFF (does not lit) = IN PHASE



Indication - Neon ON (does lit) = OUT OF PHASE



Note that the links must be arranged so that the phases are Connected in Phase, as indicated by the dotted lines.

Do Not Use Phasing Sticks unless you have been fully trained In High Voltage work and understand the system.

CARE AND MAINTENANCE

- **Storage:** The Phase Comparator and its accessories should be stored in the carrying case/bag when not in use.
- **Transporting:** When the equipment is in transit it should be stored in its carrying case/bag. While the equipment has been designed for field use it should not be subjected to excessive bumps and shocks.
- **Cleanliness:** Dirt can cause surface tracking and it's therefore necessary to keep the Phase Comparator and its accessories clean by washing them in mild detergent solution. All parts should be cleaned with the appropriate liquid.
- **Mechanical Damage:** If surface scratches or dents can easily be seen by the naked eye, then the equipment should be returned to the factory of your nearest distributor for repairs since these blemishes act as traps for dirt and moisture. Mechanical damage would also necessitate the return of the equipment to the manufacturer.
- **Recalibration and Proof Testing:** Every twelve months the Phase Comparator and its accessories should be rechecked. This would include checking the threshold level of the neon, voltage proof testing in factory or accredited laboratory and pressure testing of the panel meter housing.

Please note that there are no internal user replaceable parts.

The Phase comparator must always be clean and dry before use and during use.

Warranty and Service

Hoyt Electrical Instrument Works, Inc. (Hoyt) warrants its products to be free of defective materials and workmanship for a period of (2) years after shipment to the original purchaser. This warranty shall be limited to defective materials and workmanship. Hoyt will repair all warranty items at no charge.

Hoyt will not cover those products that have been damaged due to removal of warranty stickers, improper handling, storage, installation or operation by the purchaser or any third party. At Hoyt's discretion defective products may be repaired or replaced and the products returned to proper working condition. Upon this time you would be notified for approval of any charges.

All warranty claims must be made using the Hoyt RMA form available by calling the factory directly at 1-800-258-3652.

All products must be returned prepaid to:
Hoyt Electrical Instrument Works, Inc.
Attention: Returns
23 Meter Street
Penacook, NH 03303-1894

Return Shipments must be made in the original packaging or packaging of equal quality that will provide appropriate protection during shipping. Hoyt will not be responsible for warranty repair of products returned via inadequate containers and packaging, nor for missing components.

Hoyt shall not be liable for any special, punitive, incidental or consequential damages made by the buyer or any third party. This statement of warranty is in lieu of all other warranties, guarantees, liabilities, obligations, statutory or implied to the original purchaser or to any other party.

NOTES

We exceed the safety specifications wherever possible. However, we can't be held liable for misuse or bad manipulation.

We simplified the Phase Comparators by not having any parts to assemble on site. There is no user serviceable parts or user assembled part in our Phase Comparators.

Only the tip (contact electrode) has to be screwed on the Front end of each pole. They generally do not need to be removed by the user. For other kind of tips and contact electrodes, contact the factory or you nearest distributor.

Getting regular training on your High Voltage equipment and on the electrical network / grid you are working on is a good practice and will help in keep you safe.