HIGH VOLTAGE INSTRUMENTS LTD

T&R Test (Holdings) Ltd. Company

OPERATING AND MAINTENANCE MANUAL

Product: ***High Voltage Detector***

Type: ***HVD***

MANUFACTURED BY:

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CONTENTS

1. SAFETY RULES

1.1 Only personnel who are fully trained in the use of High Voltage Detectors should use this equipment. The systems that it will be used on are powered from high voltages which can be lethal.

1.2 Before use ensure that the detector and the accessories that are required for use are clean, free from cracks or deep scores, and are properly secured together.

1.3 Make certain that the HVD is properly rated for the voltage of the system under test.

1.4 Test the operation of the assembled HVD complete with accessories before and after each test (refer to Proving Section).

1.5 Do not allow a live high voltage conductor to come in contact with the HVD at a point below the limit mark.

1.6 The HVD must never be used without either a handle or insulating rods incorporating a handle.

1.7 Safe working distances must always be observed.

1.8 Never attempt to touch the viewing face or press the test button should the lamps go out when the contact electrode is touching, or is in the vicinity of, the conductor under test.

REMEMBER

SAFETY IS NO ACCIDENT!

THIS TESTER SHOULD ONLY BE USED BY A COMPETENT,

SUITABLY TRAINED PERSON.

6. Revision

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5.5 Periodic Maintenance

5.5.1 Battery Replacement

It is expected that the battery life will be many months of normal use. It is recommended therefore that the battery be replaced every six months whether it is found to be satisfactory when testing/arming the detector. The battery is located on the viewing face of the detector. Its position is clearly indicated by a distinctive label. Undo the two captive fixing screws and remove the battery compartment cover. Slide out the battery and unclip the battery connector. Fit a new battery type IEC 6LF22 in reverse order making sure that the fixing screws are properly tightened to ensure a good water seal. There are no other replaceable spares.

5.5.2 Recalibration and Proof Testing

Every twelve months the detector and accessories should be rechecked. This should include checking the threshold voltage and voltage proof testing of all the accessories. It is recommended that this rechecking be done by the manufacturer.

2. Description of High Voltage Detector

2.1. General

The HVIL range of capacitive high voltage detectors has been designed to meet the requirements of IEC standard 1243-1. They may be used indoors and outdoors in all weathers. The detector is intended for use on high voltage systems but not in switchgear. Models are available to cover a wide range of system voltages. The function of the detector is to determine whether a conductor is energised or de-energised so that it may be safely earthed before commencing work.

2.2. Principle of Operation

A cone shaped plastic moulding houses the detector. The inner wall of the cone has a metallic screen coating to which the earthy parts of the circuit are connected. This screen coating is capacitively coupled to the earth of the electric field and acts as a voltage divider with an internal sensing capacitor. In this manner, high voltage appearing at the electrode is divided down and the voltage across the sensing capacitor is proportional to the voltage at the electrode with respect to earth. This proportional signal voltage is fed to the electronic circuitry whose output drives an audible warning device and a system of indicating lamps.

2.3. Arming

The detector has a combined manual and a self-arming mode.

2.3.1 Manual Arming Mode

An arming/test button is mounted on the viewing face of the detector. When this button is pressed a red lamp flashes and an audible warning device sounds. This is the display for voltage PRESENT. When the button is released the display changes to a

green flashing lamp. This is the display for voltage NOT PRESENT. The detector is then armed and ready for use. This armed condition lasts for about 150 seconds. Arming the detector also functionally checks the internal circuitry but does not check the input protection resistor or contact electrode extension nor the internal sensing capacitor for an open circuit condition.

2.3.2 Self-Arming Mode

In this mode of operation, the Comparator automatically switches on when an A.C. voltage greater than the set threshold voltage is applied to the contact electrode.

2.4. Indicating Lamps

Two lamps are available and normally one is green for voltage NOT PRESENT, and the other is red for voltage PRESENT. However, in some self-arming models both lamps are red there is no lamp indication for voltage NOT PRESENT.

2.5. Limit Mark

At the narrow top end of the detector housing there is a red band which indicates the limit mark. By definition the limit mark indicates the physical limit to which the detector may be inserted between live components or may touch them. However, when the detector is used with a contact electrode extension the shroud of the extension covers the limit mark. In some models the shroud is clear, and the limit mark is still visible but in others it is coloured red and the shroud itself constitutes the limit mark.

5. Care and Maintenance

5.1 Storage

The detector and its accessories should be stored in the proprietary carrying case/ bag when not in use. If the equipment is not going to be used for an appreciable length of time (one month or more) then it is a wise precaution to remove the battery. Remember to replace the battery when the equipment is used again.

5.2 Transporting

When the equipment is in transit it should be stored in it carrying case/bag. Whilst the equipment has been designed for field use it should not be subjected to excessive bumps and shocks.

5.3 Cleanliness

Dirt can cause surface tracking and it is therefore necessary to keep the detector and its accessories clean by using a detergent solution. The detector and other plastic accessories should then be polished with the liquid polymer polish provided.

5.4 Mechanical Damage

If surface scratches or dents can be easily seen by the naked eye, then the equipment should be returned to the manufacturer for repair since these blemishes act as traps for dirt and moisture. Mechanical damage to stud or bush screw threads would also necessitate the return of the equipment to the manufacturer.

	directions. The frequency ranges from 10Hz to 500Hz and the duration of the sweep is set at 2hours for each direction. The test is considered passed if the comparator shows no apparent mechanical deterioration.
Drop Resistance	In accordance with (IEC 68-2-32 Test Ed). The voltage comparator is dropped from horizontal. and vertical positions from a height of 1m onto a test surface of concrete.
Shock Resistance	In accordance with IEC 1243-1 Test 6.4.5. Five mechanical shocks are performed on the most fragile parts of the indicator. The test is passed if the comparator shows no incipient fracture.
Cleaning Kit	Cloth and bottles of polymer liquid.

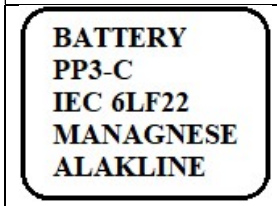
4.3 Environmental Specifications

Operating Temperature	-25°C to +55°C
Operating Humidity	20% to 96%
Cold	IEC 68-2-1 Test 2Ab
Dry Heat	IEC 68-2-2 Test 2Bd
Damp Heat	IEC 68-2-3 Test 2Ca
Change of Temperature	IEC 68-2-32 Test N
Precipitation	IEC 1243-1 Test 6.3.3

2.6. Labelling

The information shown is as follows:

	Read and understand the instruction manual before using the Comparators.
	Suitable for Live Working Designed and manufactured to meet the requirements of IEC 61481 phase comparators for voltages of 1kV to 36Kv AC.
	Meets EMC standards BS EN 50081-1 and BS EN 50082-2.
HVD TYPE XXXX	A unique identification for each model
VOLTAGE XX/XXkV	Indicates the system voltage or range been that the comparators can be used on
FREQUENCY 50/60Hz	The comparator will operate over the frequency range 50Hz/60Hz
SERIAL No. XXXXXXX	The year/month of production and a number are shown which gives traceability of features and threshold voltage

CLIMATIC CLASS	**Normal** The comparators will perform correctly over the temperature range -25°C to +55°C and in 20% to 96% humidity. **Outdoor** The comparators are suitable for use either indoor or outdoor and in wet conditions.
	Identifies the type of battery that is recommended for use with the comparators.

	Material: Acetal / Steel
Karl Pfisterer: (DDC5039)	Length: 85mm Diameter: 25mm Material: Acetal / Steel

4.2.5 Handles

TOP Handle with Bowthorpe adapter (DDM5018)	Length: 1200mm total (Bowthorpe Top) (Fixed 860mm insulating element length from hand guard) Material: Fibreglass/PVC
BOTTOM Handle with Bowthorpe (DM5022)	Length: 1200mm total (Bowthorpe Bottom) (Fixed 860mm insulating element length from hand guard) Material: Fibreglass/PVC
4-8 Foot operating pole (CMH5054)	Length: 2000mm total telescopic 450mm or 1050mm insulating element length Material: Fibreglass
Extension Poles	Length: 1200mm total Material: Fibreglass

4.2.6 Other:

Vibration Resistance	In accordance with (IEC 68-2-6 Test Fc). The indicator and contact electrode are subjected to sinusoidal vibrations in two perpendicular

	Diameter: 100mm Material: ABS

4.2.2 Electrodes

Straight	Length: 40mm Material: Stainless Steel
"Y"	Length: 35mm Width: 40mm Material: Stainless Steel
Hook	Diameter: 40, 60 or 100mm Material: Stainless Steel / Aluminium

4.2.3 Contact Electrode Extension

Contact Electrode Extensions	Length: 100, 250, 650, 1000mm Material: PVC / Stainless Steel

4.2.4 Pole Adaptors

Bowthorpe (DDC5025)	Length: 125mmm Diameter: 46mm Material: Acetal / Steel
Universal Star Wheel (DDC5054)	Length: 95mm Diameter: 27mm

3. Instructions For Use

This chapter describes how to use the different applications for the HVD. Details of testing specific types are given in this section of the manual.

3.1 Accessories

NAME	DESCRIPTION	PART No	USED ON SYSTEM VOLTAGES
CONTACT ELECTRODE EXTENSION	100mm RED SHROUD	DFH 5053	ALL
CONTACT ELECTRODE EXTENSION	250mm RED SHROUD	DFH 5039	ALL
CONTACT ELECTRODE EXTENSION	650mm RED SHROUD	DFH 5054	UP TO 33kV
CONTACT ELECTRODE EXTENSION	1000mm RED SHROUD	DFH 5034	UP TO 33kV
STRAIGHT CONTACT ELECTRODE		CMH 0110	ALL
"Y" CONTACT ELECTRODE		CMH 0111	ALL

HOOK CONTACT ELECTRODE	40mm	DDM 5009	ALL
HOOK CONTACT ELECTRODE	60mm	DDM 5008	ALL
HOOK CONTACT ELECTRODE	100mm	DDM 5010	ALL
PROVING UNIT		HVP 03	
POLE ADAPTOR	BOWTHORPE	DDC 5025	ALL
POLE ADAPTOR	UNIVERSAL STAR WHEEL	DDC 5054	ALL
POLE ADAPTOR	KARL PFISTERER	DDC 5039	ALL
POLE ADAPTOR	CHANCE	DDC 5055	ALL
*ADAPTORS FOR OTHER POLE SYSTEMS AVAILABLE TO ORDER			
EXTENSION POLES			
TOP BOWTHORPE	1200mm	CMH 5045	USED IN COMBINATIONS WORKING DISTANCES BEING OBSERVED
INTERMEDIATE BOWTHORPE	1200mm	CMH 5046	
BOTTOM BOWTHORPE	1200mm	CMH 5047	

Spark Protection	The comparators will not be damaged as a result of spark discharge while making contact with the conductor under test.
Bridging Protection	The comparators and their accessories will not cause flashover or breakdown between live parts of the installation or between live parts of the installation and earth.
Current Consumption	30mA maximum
Battery Low	8V nominal (Arming via the testing / arming button is inhibited at this voltage but self-arming from signals is maintained down to 6.5V.)
Battery	9 V manganese alkaline PP3-C IEC 6LF22
Visual Indication	Voltage Present: Red LED(s) flashes at 2.5Hz to 3.5Hz. No Voltage Present: Green LED (when fitted, and Manually Armed) flashes at 2.5Hz to 3.5kHz
Audible Indication	Voltage Present: Buzzer with 3.1kHz tone modulated at 2.5Hz to 3.5Hz >65dB at 5 metres.
EMC	Meets EN61326-1: 2006 (Cert No 3626TC2)

4.2 Mechanical Specifications

4.2.1 Detector

Detector	Length: 180mm

4 Specifications

4.1 Electrical Specifications

Threshold Voltage	For a single voltage detector (e.g., 11kV) the threshold voltage should be in the range 0.15 X system voltage to 0.4 X system voltage i.e., for 11kV, VTH is in the range 1.65kV to 4.4kV. For a detector with a two to one voltage range (e.g., 66kV to 132kV) the threshold voltage should be in the range 0.15 X system maximum voltage to 0.4 X system minimum voltage i.e., for 66kV/132kV, VTH is in the range 19.8kV to 26.4kV. For a detector with a three to one voltage range (e.g., 11kV to 33kV) the threshold voltage should be in the range 0.1 X system max. voltage to 0.45 X system min. voltage i.e., for 11kV/33kV, VTH is in the range 3.3kV to 4.95kV. Where none of the above rules can be applied the threshold may be set to a value agreed with the customer. Accuracy of threshold voltage: ±5% of set level.
Operating Time	150 seconds nominal with VOLTAGE NOT PRESENT display (only on detectors with red and green lamps) Continuous with VOLTAGE PRESENT display.
Response Time	Less than 1 second.

(FOAM FILLED) BOWTHORPE	1200mm	CMH 5051	FOR ALL VOLTAGES,
HANDLE - FIXED - (FOAM FILLED)	1200mm (860mm)	DDM5013	UP TO 33kV (1)
HANDLE - FIXED	1200mm (860mm)	DDM5018	UP TO 33kV (2)

3.2 Assembling the Equipment

3.2.1 For use on overhead lines and busbars up to 33kV

Select a contact electrode to suit the application and screw it to the detector. If the straight or “Y” electrode is selected it may be necessary to use a 100mm or 250mm contact electrode extension so that the contact electrode can be seen more easily from ground level. This short extension is screwed to the detector and the contact electrode screwed to it. Attach the required number of extension poles to the detector using an adaptor or handle. If tests are to be carried out on system voltages in areas where interference fields could affect the indications, then a contact electrode extension must be used. For 11kV and less use DFH5054 and above 11kV to 33kV use DFH 5034.

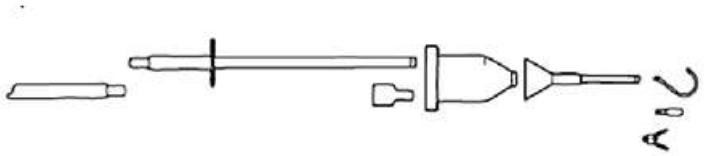


Fig 1a

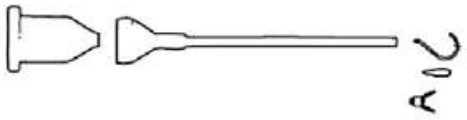


Fig 1b

Fig. 2 below shows the assembly of detector, handle DDM 5019 or 5020, contact electrode extension DFH 5039, or 5057 and straight contact electrode CMH 0110.

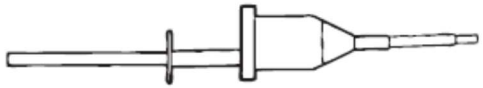


Fig. 2

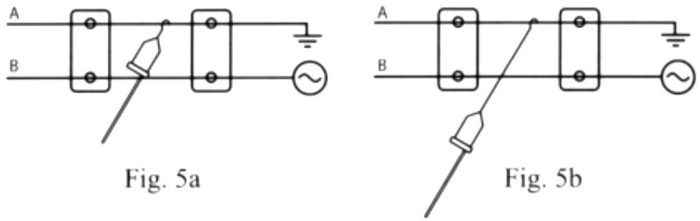


Fig. 5a

Fig. 5b

Fig. 5a shows two conductors A and B with A earthed and B energised. The detector is applied to conductor A and the field created by conductor B will cause the detector to indicate that conductor A is live. On system voltages up to 33kV the introduction of the appropriate contact electrode extension as in Fig. 5b, removes the detector from the interference field and the detector will indicate correctly.

Fig. 4

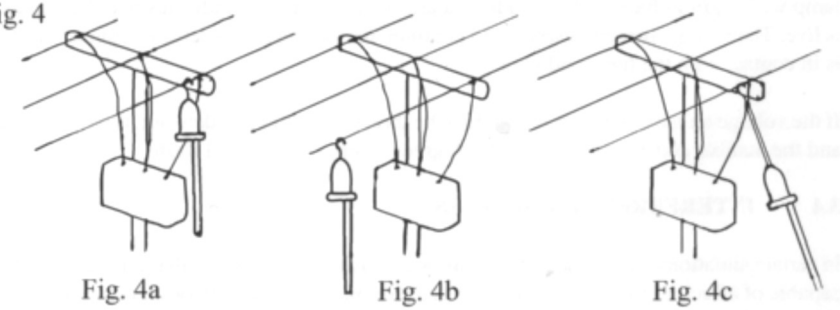


Fig. 4a Fig. 4b Fig. 4c

Fig. 4 shows an installation where there is a pole mounted transformer and the conductor coming down fom the cross arm to the transformer forms an approximate 90° bend. In Fig. 4a the detector is applied such that the field created by the down bend will interfere with the detector's return path to earth and it will not indicate. Moving the detector along from the bend as in Fig. 4b removes the detector from the interference field and it will indicate correctly. Another solution is to use the contact electrode extension which again moves the detector out of the interference field as in Fig. 4c.

3.4.2 Phase-Opposition Interference

If a conductor under test has adjacent conductors which are in phase opposition, then erroneous indication can occur. For instance, if the conductor under test is earthed and the detector came close to a live conductor then it is possible that the detector will indicate that the conductor under test is live. This, however, is a failsafe condition, although it is incorrect.

3.3 Using the Equipment

3.3.1 Arming/Testing

Press the arming/test button to check the function of the internal circuitry and the condition of the battery. The red lamp should flash and the audible alarm sound. When the button is released, the green lamp will flash for 150 seconds, if the green lamp goes off immediately, replace the battery (refer to Care and Maintenance Section). If the detector still does not arm correctly, then it is faulty and should be returned to the manufacturer for repair.

3.3.1.1 Manual Arming

Press the arming/test button and the red lamp and the audible alarm will flash and sound and on releasing the arming/test button the green lamp will flash. The detector is now in its armed state ready for use. This condition lasts for about 150 seconds.

3.3.1.2 Self-Arming

Some self-arming models have two sets of red lamps and no green lamp and when the test button is released the detector switches off immediately. Other self-arming models do have a green lamp and it will flash for about 150 seconds after the test button is released.

3.3.2 Proving Unit

The complete assembled equipment should now be checked using a high voltage proving unit or a known high voltage source. The proving unit consists of a high voltage generator which is housed in a handheld box, a flexible field coupler and two test leads. Wrap the field coupler around the main body of the detector. Plug the test leads into the proving unit and connect the lead with large clip to the contact electrode. Arm the detector if necessary and press the

proving unit test button. The red lamp should flash, and the audible alarm should sound. If a proving unit is not available, present the detector armed, if necessary to a high voltage source touching it with the contact electrode. The red lamp will flash, and the audible alarm will sound.

3.3.3 Testing

Now present the detector to the conductor under test, touching it with the contact electrode. If the voltage on the conductor is greater than the threshold voltage of the detector, then the red lamp will begin to flash, and the audible alarm will sound. This indicates that the conductor is live. The voltage present display will continue for as long as the detector contact electrode is in contact with the live conductor If the voltage on the conductor is less than the threshold voltage of detector, then the red lamp and the audible alarm will not operate. A green lamp, if fitted, will flash.

3.4 Interference Voltages

In certain situations, due to the dimensions or configuration of the installation, electrical fields capable of affecting the indication of the detector may occur. Erroneous indication will only occur if the body of the detector is situated within such a field. Correct indication can be achieved by applying the detector to horizontal conductors away from bends or connections. Unambiguous indication of the detector depends upon the capacitance of the detector to earth being unaffected by other fields. Some examples of interference situations are shown in sections 3.4.1 and 3.4.2. A long contact electrode extension must be used to overcome the problems created by interference voltages. See 3.2.1 Fig 1b page 7.

3.4.1 In-Phase Interference

This occurs when the conductor under test is adjacent to another conductor whose voltage is in-phase. The field which is then generated can act as a screen between the detector and earth, thereby reducing the effective capacitance of the detector to earth. This results in an increased threshold voltage which could mean that the detector will not indicate that a conductor is live.

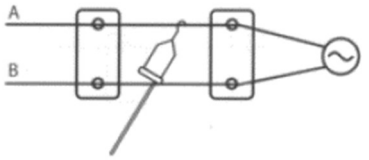


Fig. 3a

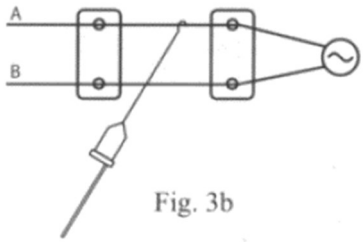


Fig. 3b

In Fig. 3a the detector is applied to conductor A which is above conductor B. Both conductors are energised from the same phase and the field created by conductor B screens the detector from earth. This increases the threshold voltage of the detector which may, therefore, not indicate. This is of course a dangerous situation on system voltages up to 33kV the introduction of the appropriate contact electrode extension in Fig. 3b removes the detector from the interference field so that it will indicate correctly.