

Instruction Manual

Elcometer 280

Pulsed DC Holiday Detector

A copy of this Instruction Manual is available for download on our website www.elcometer.com. For the avoidance of doubt, please refer to the original English language version.



The Elcometer 280 is available in 2 models. This User Guide is written for the Model T. Where applicable the Model S is referenced.



The Elcometer 280 Models S and T, in standby, meet the Electromagnetic Compatibility Directive and the Low Voltage Directive. The product is Class A, Group 1 ISM equipment according to CISPR 11. Group 1 ISM product: A product in which there is intentionally generated and/or used conductively coupled radio-frequency energy which is necessary for the internal functioning of the equipment itself. Class A products are suitable for use in all establishments other than domestic and those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.



Note: Additional information is given in "Working safely" on page 4.
Product Description: Elcometer 280 Pulsed DC Holiday Detector
Manufactured by: Elcometer Limited, Manchester, England

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Gauge Dimensions (l x w x h): 60 x 17.3 x 19cm (23.6 x 6.8 x 7.5")

Gauge Weight: 3.0kg (6.6lb) including battery pack

Battery Type: Rechargeable lithium ion battery pack

Operating Temperature: 0°C to 50°C (32°F to 120°F)

Relative Humidity: 0 - 80% up to 31°C (87.8°F)

Pulsed DC High Voltage Range: 0.5 - 35kV, user adjustable in 100V steps & 10V below 1000V

High Voltage Accuracy: $\pm 5\%$ or $\pm 50V$ below 1000V. Maximum voltage may be reduced at extreme altitudes.

Applicable Standards: AS 3894.1, ANSI/AWWA C203, ANSI/AWWA C214, ASTM D4787, ASTM D5162, ISO 29601, JIS G 3491, JIS G 3492, NACE RP0274, NACE SP0188, NACE SP0490, NACE TM0186, NACE TM0384

Warranty: One year as standard. To extend the warranty to 2 years free of charge, register your gauge online within 60 days from date of purchase at www.elcometer.com

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CONTENTS

1	Box & Kit Contents	9	Manually Calculating the Test Voltage
2	Gauge Overview	10	The Safety Trigger Switch
3	Using the Gauge	11	Detecting a Holiday
4	Charging the Battery	12	Probe Accessories
5	Fitting the Battery Pack	13	Menu Structure - Model T
6	Connecting the Signal Return Lead	14	Menu Structure - Model S
7	Getting Started	15	Maintenance & Storage
8	Selecting a Voltage		

1 BOX & KIT CONTENTS

Elcometer 280 Contents:

- Pulsed DC Holiday Detector
- 5m (16') trailing signal return lead
- Rechargeable battery pack & battery charger with mains cables (UK, EUR & US)
- Shoulder strap
- Instruction manual

Inspection Kit Contents:

All items listed in the Elcometer 280 Contents, plus:

- Additional rechargeable battery pack (Model T only)
- Stainless steel rolling spring holder (Model T only)
- 250mm (9.8") probe extension piece
- Rugged wheeled transit case

WORKING SAFELY



The equipment should be used with extreme care. Follow the instructions given in these Operating Instructions. Caution - risk of electric shock.

The Elcometer 280 generates a voltage at the probe tip of up to 35,000 V. If the User makes contact with the probe, it is possible to experience a mild electric shock. Due to the current being very low, this is not normally dangerous, nevertheless Elcometer does not advise using this product if you are fitted with a pacemaker.

When in standby the Elcometer 280 will generate radio frequency emissions which are within the limits defined by the Electromagnetic Compatibility Directive. Due to its method of operation however, the Elcometer 280 will generate broadband RF emissions when the unit is generating high voltage or when a spark is produced at the probe. It is therefore recommended that the user does not activate the high voltage, or deliberately generate continuous sparks, within the vicinity of sensitive electronics or radio equipment.

In order to avoid injury and damage, the following should always be observed:

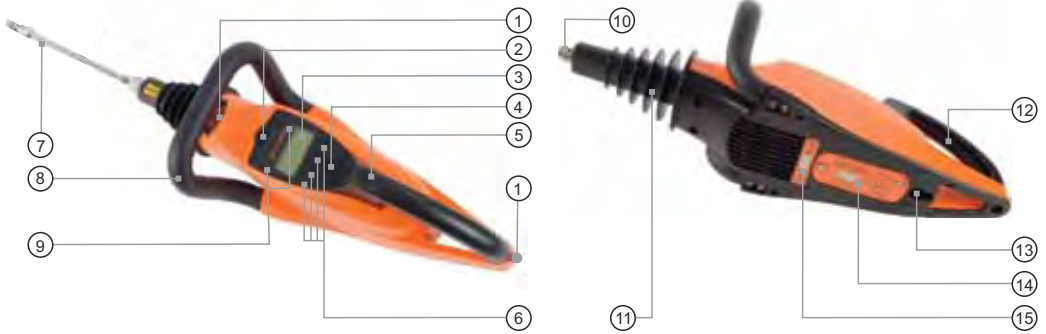
- × **DO NOT** use this instrument in hazardous situations and environments, e.g. an explosive atmosphere, as an electrical spark indicates detection of a coating flaw.
- × **DO NOT** carry out tests close to moving machinery.
- × **DO NOT** use the instrument in a precarious, unstable or elevated situation from which a fall may result, unless a suitable safety harness is used.
- × **DO NOT** use this product if you are fitted with a pacemaker.
- × **DO NOT** allow metallic objects to come into contact with the battery pack terminals; this may cause a short circuit and result in permanent damage to the battery.
- × **DO NOT** use this product when it is raining or the unit is wet.

WORKING SAFELY (continued)

- × **DO NOT** attempt to connect the supply side of the battery charger to generators or any other medium to high power source other than the single phase 50/60Hz AC mains outlet supplied from an approved and safe mains switchboard.
Connection to other supply sources such as generators or inverters may have the potential to damage the charger, the battery and/or the gauge invalidating the warranty.

- ✓ **DO** read and understand these instructions before using the equipment.
- ✓ **DO** charge the battery before the first use of the equipment. This will take approximately 4 hours.
- ✓ **DO** consult the plant or safety officer before carrying out the test procedure.
- ✓ **DO** undertake testing well clear of other personnel.
- ✓ **DO** work with an assistant to keep the test area clear and to help with the testing procedure.
- ✓ **DO** check that there are no solvents or other ignitable materials from the coating activities left in the test area, particularly in confined areas such as tanks.
- ✓ **DO** switch the instrument off and disconnect the leads when the work is finished and before leaving it unattended.
- ✓ **DO** ensure that the earth signal return cable is connected and extended before you switch on the instrument.
- ✓ **DO** only use on coatings that are cured, thickness tested and visually inspected and accepted.
- ✓ **DO** only use on coatings having a dry film thickness of at least 200µm (0.008"). For thicknesses between 200µm and 500µm (0.008" to 0.020"), ensure that an appropriately low voltage is applied (to prevent damage to the coating), or use the wet sponge method (using the Elcometer 270).
- ✓ **DO** take care when using this product with coatings that are damp or wet.
- ✓ **DO** dry the instrument if it gets wet, paying special attention to the ribbing area.

2 GAUGE OVERVIEW



- 1 Shoulder Strap Harness Point
- 2 Sealed, Waterproof Buzzer
- 3 LCD Display
- 4 Gauge On/Off Key
- 5 Voltage Activation Key
- 6 Multifunction Softkeys
- 7 Rolling Spring Holder
- 8 Handgrip
- 9 LED Indicators - Red (left), Blue (right)
- 10 Accessory Connection Point
- 11 Specialised Ribbing (for protection to EN61010)
- 12 Handle & Integrated Safety Trigger Switch
- 13 Earth Signal Voltage Return Connection Point
- 14 Quick Release Rechargeable Battery Pack
- 15 Gauge Model & Serial Number

3 USING THE GAUGE



- | | Model |
|--|--------------|
| a Red LED - indicates when high voltage is on | ST |
| b Earth signal return lead disconnected icon | ST |
| c Unit overheating icon - allow unit to cool | ST |
| d Porosity detector overload icon '■' accessory/coating combination or Voltage protection breakdown icon† '⚠' | ST |
| e Voltage calculator softkey (Model T), or Backlight On '☀' / Off '☁' (Model S) | T or S |
| f Voltage adjustment softkey | ST |
| g Sealed, waterproof buzzer | ST |
| h Blue LED - flashes when a holiday is detected | ST |
| i Holiday detected icon | ST |
| j Battery symbol indicating remaining charge
☹ 3 bars: 70 - 100%; 2 bars: 40 - 70%; 1 bar: 20 - 40%; 0 bars: 10 - 20%
⚡ Flashing icon & beep every 10 seconds: <10%, re-charge battery
0 bars & 5 loud beeps & auto power off: no charge, recharge required | ST |
| k Voltage selected | ST |
| l Standard in use (set via voltage calculator) | T |
| m Menu softkey (Model T), or buzzer volume softkey (Model S) | T or S |
| n Voltage level achieved at probe | ST |

† Overvoltage output has been prevented; restart test.

en 4 CHARGING THE BATTERY

- Upon receiving the Elcometer 280, the rechargeable battery supplied has a small amount of charge (for safety reasons) and should be fully charged before using the instrument for the first time.
- Use only the charger supplied with your instrument to charge the battery.
- Use of any other type of charger is a potential hazard, may damage your instrument and will invalidate the warranty.
- Do not attempt to charge any other batteries with the supplied charger. Always charge the battery indoors.
- To prevent overheating, ensure that the charger is not covered.
- Each re-chargeable battery can be recharged in approximately 4 hours.

- 1 Connect the lead from the charger into the socket on the battery.
- 2 Plug the charger supplied into the mains supply. The LED indicator on the charger will glow orange.
- 3 Leave the gauge charging for at least 4 hours. The LED indicator changes colour from orange to green when charging is complete.
- 4 When charging is complete, disconnect the charger from the mains supply before removing the lead from the instrument.



5 FITTING THE BATTERY PACK

The Elcometer 280 battery pack is designed so that it can only be attached in the correct manner. To connect the battery pack:

- 1 Turn the gauge onto its side
- 2 Push the battery pack into the battery housing
- 3 Tighten up the two battery pack retaining screws (a)



To remove the battery pack, unscrew the two battery pack retaining screws (a) at the rear of the instrument and slide out the battery pack.

6 CONNECTING THE SIGNAL RETURN LEAD

- 1 Ensure that the Elcometer 280 is off
- 2 Insert the signal return lead plug into the socket
- 3 Push the plug in and twist it ¼ turn to the right
- 4 Switch the gauge on
- 5 Make sure the signal return lead is uncoiled and extended. For the most ideal conditions, attach the signal return lead to an uncoated area of the substrate, using part number T28022750.
- 6 If '⚡' icon is displayed, the plug is not connected correctly, repeat steps 1-5.



If problem persists, please contact your Elcometer distributor.

To remove the lead, push the plug in and twist it ¼ turn to the left.

7 GETTING STARTED

- 1 Press the ON/OFF button until the Elcometer logo is displayed
- 2 Select your language using the $\uparrow\downarrow$ softkeys (Top models only) and press the OK softkey

If '🔌' icon is displayed, the return lead plug may not be connected, see Section 6

To access the language menu when in an alternate language:

- 1 Switch the gauge OFF
- 2 Press and hold the left softkey and switch the gauge ON
- 3 Select your language using the $\uparrow\downarrow$ softkeys



8 SELECTING A VOLTAGE

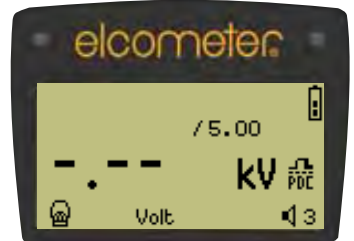
The voltage of the Elcometer 280 can either be set automatically using the gauge's internal voltage calculator (Model T) or adjusted manually (Models S & T).

Adjusting the voltage manually

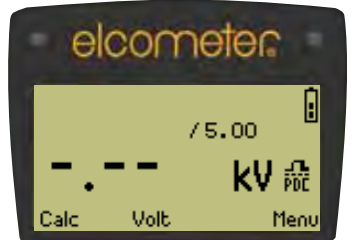
- 1 Switch the gauge ON
- 2 Press the 'Volt' softkey
- 3 Using the $\uparrow\downarrow$ softkeys, adjust the voltage to the required level
- 4 Press OK

The selected voltage appears above the kV symbol ('5.00' in the example images).

To determine the correct voltage to use see 'Calculating the test voltage' on page 12



Elcometer 280 Model S

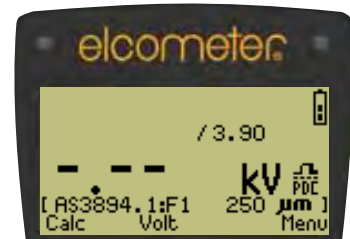
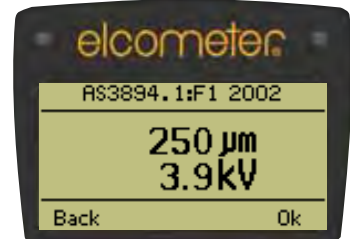
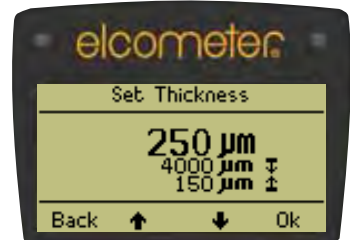
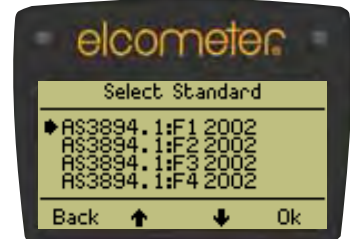
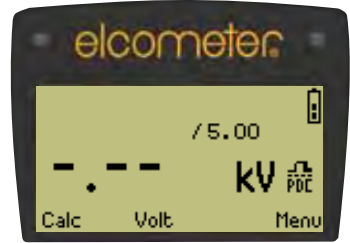


Elcometer 280 Model T

Setting the voltage using the Voltage Calculator

The voltage calculator function within the Elcometer 280 Model T gauge is designed to automatically calculate the test voltage according to a user selected test standard and the dry film thickness of the test sample.

- 1 Switch the gauge ON
- 2 Press the 'Calc' softkey
 - The gauge will display the standard currently selected. To change the standard:
 - i Press the 'Std' softkey
 - ii Using the $\uparrow\downarrow$ softkeys, select the relevant test standard
 - iii Press OK
- 3 If the standard currently selected is correct, press OK
- 4 Using the $\uparrow\downarrow$ softkeys adjust the dry film thickness to the required value and press OK[†]
- 5 A confirmation screen will now display the selected test standard, dry film thickness and calculated test voltage,
 - i Press OK to set the instrument voltage to the calculated value,
 - or
 - ii Press ESC to return to the reading screen without making changes



[†] The Set Thickness Screen will show the last used coating thickness and the upper and lower thickness values for the selected test standard

9 MANUALLY CALCULATING THE TEST VOLTAGE

When setting the voltage manually please follow the guidelines below which describe how a safe, but effective, test voltage may be determined.

Overview

For effective testing, the test voltage must lie between two limits - the upper and lower limits.

The upper voltage limit is that at which the coating itself would breakdown and be damaged at the thickness applied.

The lower limit is the voltage required to break down the thickness of air equivalent to the coating thickness. If the output voltage is not greater than this value, then a flaw will not be detected.

These two limits can be determined and a voltage approximately half way between them selected as the test voltage.

Dielectric Strength

Whatever the material, if a high enough voltage is applied, it will conduct electricity. For insulators such as paint, however, the level of voltage required to achieve a current flow usually results in irreversible material damage.

The voltage at which a particular thickness of material breaks down is termed the dielectric strength. This is usually expressed as the voltage per unit distance, e.g. kV/mm (kV/inch). Its value depends on the type of applied voltage (AC, DC or pulsed), temperature and thickness.

The dielectric strength of coating materials usually lies in the region of 10 kV/mm to 30 kV/mm (250kV/inch to 750kV/inch). The dielectric strength of air ranges from 1.3 kV/mm to 4 kV/mm (33kV/inch to 100kV/inch).

Establishing the lower voltage limit

The lower limit for effective operation is that required to breakdown the thickness of air equivalent to the coating thickness. The breakdown voltage of a given thickness of air varies with humidity, pressure and temperature.

If the coating thickness is known, or can be measured, the lower limit value can be determined from the breakdown voltage for air at that dry film thickness.

If the coating thickness is not known then the minimum value has to be established experimentally. Reduce the voltage setting to minimum and position the probe over an unprotected area of substrate at the normal height of the coating surface. Increase the voltage slowly and steadily until a spark is produced. Make a note of this voltage - it is the lower voltage limit.

Establishing the upper voltage limit

The upper voltage limit may be determined by:

The job specification - if available and a test voltage is stated.

The dielectric strength - if specified for the applied coating.

Measure the thickness of the layer and determine the voltage by multiplying the dry film thickness by the dielectric strength.

For example:

Metric: if you have 500 microns of coating (0.5mm) with a dielectric strength of 6kV/mm, the upper voltage will be 3kV.

Imperial: if you have 20 mils of coating (0.02inch) with a dielectric strength of 150kV/inch, the upper voltage would be 3kV.

Experiment

Touch the probe on an unimportant area of the work piece. Increase the voltage slowly and steadily until a spark passes through the coating. Make a note of this voltage - it is the upper voltage limit.

Note: The dielectric strength can be calculated by dividing this voltage by the coating thickness.

Tables and formulae

Alternatively, the correct voltage levels can be determined from established Codes of Practice, e.g. NACE and ASTM.

10 THE SAFETY TRIGGER SWITCH

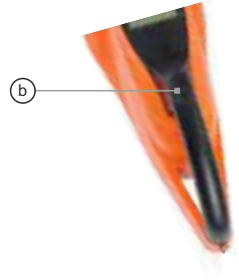
In order to minimise the possibility of accidentally switching the voltage on, the Elcometer 280 is fitted with both a safety trigger switch (a) and a voltage activation key (b).

The voltage will only be activated when:

- 1 The gauge is switched ON
- 2 The safety trigger switch (a) is held, and
- 3 The voltage activation key (b) is pressed
- 4 The signal return lead is fitted

If the safety trigger switch is released when the gauge is in operation, the voltage is immediately disconnected.

If the safety trigger switch is held again within 3 seconds, the voltage will automatically re-activate (without the need to press the voltage activation key).



11 DETECTING A HOLIDAY

The Elcometer 280 identifies the detection of a holiday in the following manner:

- 1 The blue LED flashes;
- 2 The buzzer alarms;
- 3 The holiday detection '⚡' icon is displayed;
- 4 The backlight and display flashes;
- 5 A spark is generated.

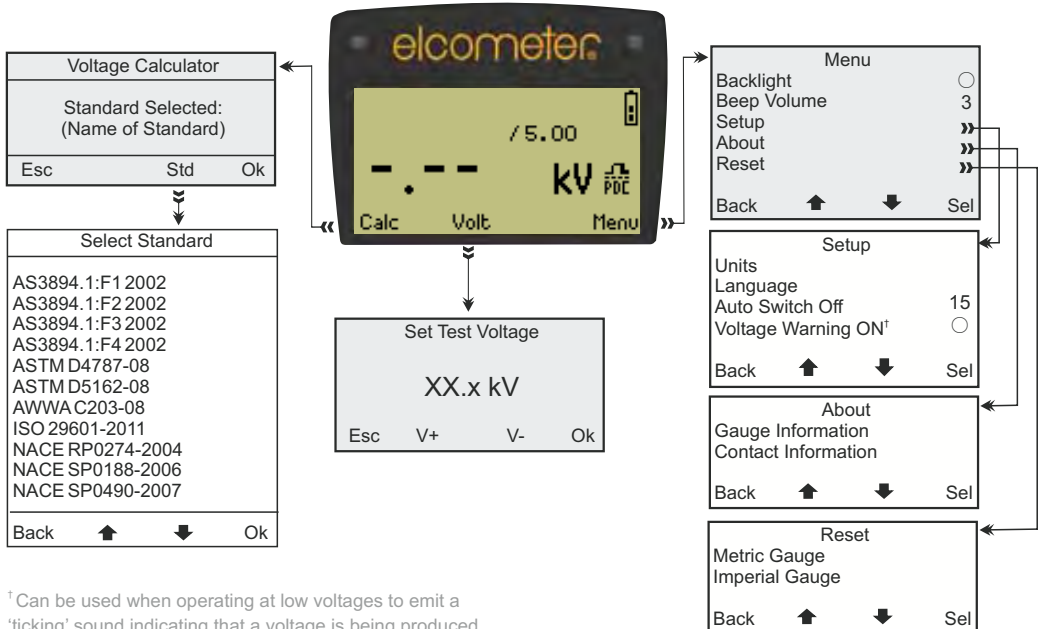
12 PROBE ACCESSORIES

The Elcometer 280 Pulsed DC Holiday detector has a wide range of electrodes available for testing a variety of structures and forms, these include:

- Wire brush probes
- Internal pipe brush probes
- External 'c-type' brush probes
- External pipe rolling springs
- Conductive rubber probes
- Grounding mats - ideal for testing ungrounded coated structures
- Accessory adaptors - allowing the Elcometer 280 to work with electrodes from other manufacturers

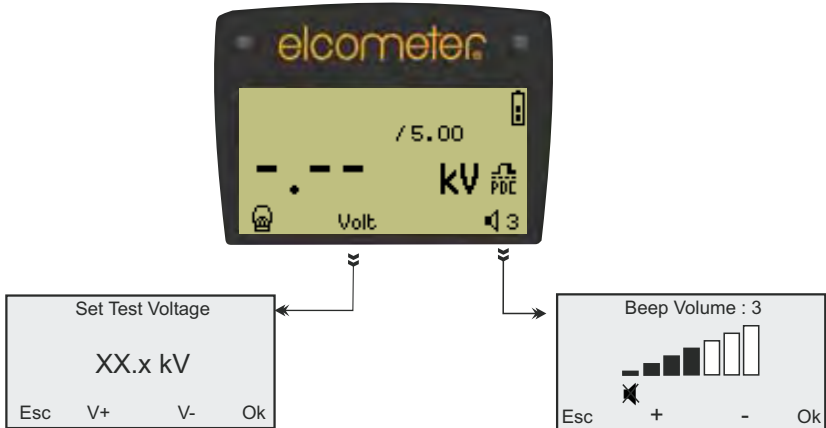
For more information on probe accessories for the Elcometer 280 please visit the Elcometer website or contact your nearest distributor.

13 THE ELCOMETER 280 MODEL T MENU STRUCTURE



[†] Can be used when operating at low voltages to emit a 'ticking' sound indicating that a voltage is being produced.

14 THE ELCOMETER 280 MODEL S MENU STRUCTURE



15 MAINTENANCE & STORAGE

The Elcometer 280 has a liquid crystal display (LCD). If the LCD is heated above 50°C (120°F) it may be damaged. This can happen if the instrument is left in a vehicle which is parked in strong sunlight.

To ensure the Elcometer 280 remains in good working order, keep the instrument, connecting cables and probe electrodes clean. Before cleaning, switch the instrument OFF and remove the battery and all cables.

To clean, wipe surfaces with a damp cloth and then allow sufficient time to air dry all components before use. Do not use any solvents to clean the instrument.

From time to time inspect the instrument and accessories for damage and replace or return the unit to Elcometer for repair.

Note: With the exception of probe electrodes and cables, the instrument does not have any components which can be serviced by the user. Please return the instrument to Elcometer for service.