English

Elcometer 331

Concrete Covermeter

Model B • Model BH

Operating Instructions

The Elcometer 331 Concrete Covermeter has been tested in accordance with EU regulations governing Electro-magnetic compliance and it meets the required directives.

Note: *Readings may be affected if the unit is operated within a radio frequency electromagnetic strength of greater than 3 V/m.*

A copy of this Instruction Manual is available for download on our Website via www.elcometer.com/downloads.

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Thank you for your purchase of this Elcometer 331 Concrete Covermeter. Welcome to Elcometer.

Elcometer are world leaders in the design, manufacture and supply of inspection equipment for concrete and coatings.

Our concrete inspection products include a comprehensive range of concrete, and civil engineering inspection equipment. Our coatings products cover all aspects of coating inspection, from development through application to post application inspection.

The Elcometer 331 Concrete Covermeter is a world beating product. With the purchase of this Covermeter you now have access to the worldwide service and support network of Elcometer. For more information visit our website at www.elcometer.com

1 ABOUT YOUR COVERMETER

The Elcometer 331 Concrete Covermeter is a handheld Covermeter for fast and accurate location, orientation and measurement of concrete reinforcement bars (high tensile steel or stainless steel). Your Covermeter can also be used in half-cell mode[a] to help assess the potential for corrosion of the reinforcement bars.

Locate • Identify orientation

Measure depth of cover • Measure half-cell potential[a]

The Covermeter is available in five versions:

- Model B (entry level)
- Model BH (entry level with half-cell potential measurement)
- Model SH (intermediate level with half-cell potential measurement)
- Model TH (data logging with half-cell potential measurement)
- Model THD (data logging with half-cell potential measurement and stainless steel reinforcement bar detection)

This manual describes the operation of the **Elcometer 331 Model B and Model BH**.

All versions of the Covermeter feature an easy-to-use menu-driven graphical interface which guides the user during setup of the Covermeter and during measurement.

A range of fully interchangeable search heads and half-cell probes is available to suit your requirements. Search heads include a keypad which allows remote operation of the Covermeter. See “Search heads” on page 25 for full details.

Your Covermeter is packed in cardboard and plastic packaging. Please ensure that this packaging is disposed of in an environmentally sensitive manner. Consult your Local Environmental Authority for further guidance.

To maximise the benefits of your new Elcometer 331 Concrete Covermeter please take some time to read these Operating Instructions. Do not hesitate to contact Elcometer or your Elcometer supplier if you have any questions.

a. Half-cell mode is not included on the Elcometer 331 Model B.

1.1 Features

Feature	Elcometer 331 Model					Page
	B	BH	SH	TH	THD	
Menu-driven backlit graphical user interface	✓	✓	✓	✓	✓	9
3 sizes of search head + borehole probe	✓	✓	✓	✓	✓	25
Weather proof to IP65	✓	✓	✓	✓	✓	-
International standard bar size database in memory	✓	✓	✓	✓	✓	20
Multiple languages	✓	✓	✓	✓	✓	11
Automatic bar size estimate	×	×	✓	✓	✓	-
Additional orthogonal bar size calculation	×	×	✓	✓	✓	-
Locate mode	✓	✓	✓	✓	✓	-
Under Cover mode - alerts user when cover is below minimum	×	×	✓	✓	✓	-
Maxpip™ mode - for fast identification of reinforcement bar layout	×	×	✓	✓	✓	-
Memory - up to 10 linear batches, up to 1000 readings in each batch	×	×	✓	×	×	-
Memory - multiple linear and grid batches, up to 240 000 readings	×	×	×	✓	✓	-
Text fields for input of user data in each batch	×	×	✓	✓	✓	-
Date and time stamping	×	×	×	✓	✓	-
Statistical analysis of readings and batches	×	×	✓	✓	✓	-
Alarm if reading is outside limits	×	×	✓	✓	✓	-
Transfer readings and statistics to a computer	×	×	✓	✓	✓	-
CoverMaster® software for batch setup, data transfer and reporting	×	×	✓	✓	✓	-
Half-cell potential measurement	×	✓	✓	✓	✓	21
Plot mode	×	×	×	✓	✓	-
Stainless steel reinforcement bar detection and measurement	×	×	×	×	✓	-
Upgradeable	×	×	✓	×	×	-

Note: *Features described in these instructions apply to all models unless otherwise indicated in the text.*

1.2 What this box contains

- Elcometer 331 Model B or Model BH Concrete Covermeter
- Standard Search head[b] (Model B only)
- Search head connecting cable
- Rechargeable battery pack and battery charger
- Earphone
- Shoulder strap
- Plastic carrying case
- Operating instructions

b. Search head and half-cell kit for model BH must be ordered separately.

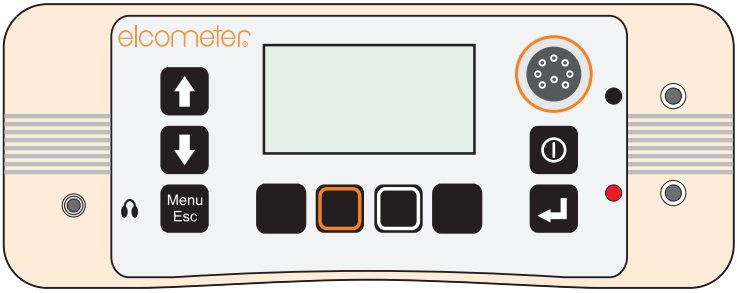


Figure 1. Elcometer 331 Concrete Covermeter (model BH shown)

1.3 Standards

The Elcometer 331 Concrete Covermeter can be used in accordance with the following National and International Standards: BS1881:204, ASTM C876, DGZfP:B2, DGZfP:B3, TR60, UN110174

1.4 Conventions in these instructions

A simple menu structure helps you get the most from your Covermeter - see “The menus” on page 12. There are many references to this menu structure in these instructions.

As an example, the LANGUAGE option which is in SETUP from the MAIN MENU would be shown in these instructions as:

MENU / SETUP / LANGUAGE

These instructions include images of Elcometer 331 screens with units set to millimetres (mm). Similar screens will be seen when the Covermeter is set to inches.

2 QUICK-START

To configure the Covermeter quickly and start taking readings:

1. Charge the batteries . . . . . see page 4
2. Fit search head . . . . . see page 5
   or Fit half-cell probe and cables . . . . . see page 7
3. Switch on. . . . . see page 9
4. Select language . . . . . see page 11
5. Zero the Covermeter . . . . . see page 12
6. To locate a bar. . . . . see page 14
7. To measure depth of a bar . . . . . see page 18
8. To measure half-cell potential . . . . . see page 21 (model BH only)

For an overview of your Covermeter menus and functions, see pages 12 to 13.

3 GETTING STARTED

This section of the instructions is intended for first-time users of the Covermeter. It contains essential information about batteries, assembling the Covermeter, the controls and the display. At the end of this section you will be ready to take readings.

3.1 The power supply

Your Covermeter is powered by a rechargeable Lithium-Ion[c] battery pack which can be charged inside or outside the Covermeter.

One battery pack is supplied with the Covermeter. To increase productivity on site, Elcometer recommends that you purchase a spare battery pack which can be charged while you are using your Covermeter. To order an additional battery pack (see “Accessories” on page 33), contact Elcometer or your local Elcometer supplier.

Charging the batteries

The rechargeable battery must be fully charged before using the Covermeter for the first time. Use only the charger supplied with your Covermeter to charge the battery. Use of any other type of charger is a potential hazard, may damage your Covermeter 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.

1. Referring to Figure 2, unscrew the retaining screw (1) and open the interface access cover (2) on the rear of the Covermeter.

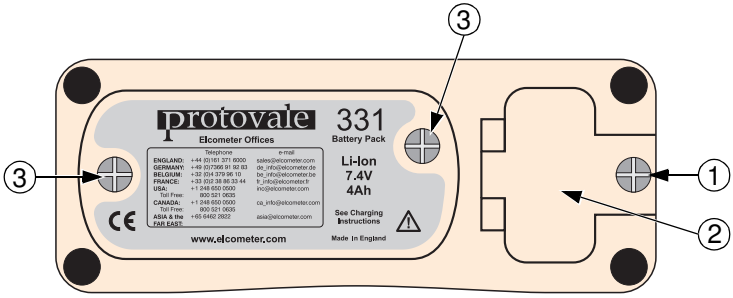


Figure 2. Covermeter rear panel

2. Connect the lead from the charger into the socket marked ‘Charger Input’ behind the interface access cover (Figure 3).

   The Covermeter will automatically switch off when the lead from the charger is connected.

(battery in the Covermeter)

(battery removed)

Figure 3. Charging the batteries

c. The Covermeter is **not** designed to operate using dry cell batteries.

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

To remove the battery pack for charging outside the Covermeter, unscrew the two battery pack retaining screws (Figure 2, item 3) at the rear of the Covermeter and slide out the battery pack. To charge the battery once it has been removed, connect the lead from the charger into the socket on the battery pack (Figure 3).

Warning: Do not allow metallic objects to come into contact with the battery terminals; this may cause a short circuit and result in permanent damage to the battery.

Warning: 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 Hz 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 warranty.

Battery condition indicator

The state of charge of the battery is shown by a symbol on the display:

Symbol	Battery charge/action required
	70% to 100%
	40% to 70%
	20% to 40%
	10% to 20%, charging recommended
	<10%, Covermeter beeps every 10 seconds and symbol flashes - immediate charging required
	5 loud beeps, Covermeter switches off automatically

3.2 Fitting search heads

The Covermeter **must be switched off** when search heads are fitted or removed.

Connect the search head to the Covermeter using the supplied connecting cable. The connecting cable is fitted with a metal screw-type connector at each end. To fit a connector, align the keyway, push the connector into place and then tighten the metal collar.

A range of search heads is available for your Covermeter - see “Search heads” on page 25 for full details. The search head icon on the reading screen indicates the type of search head connected to the Covermeter:

	Narrow pitch
	Standard
	Deep cover

Borehole probe - set to forward-looking operation

Borehole probe - set to sideways-looking operation

The Covermeter must be zeroed after a search head has been fitted and after changing between high-tensile and stainless modes - the display will show PLEASE ZERO and the ZERO softkey will flash to remind you.

The metal and plastic bracket on the outside of the main unit is a storage clip for standard and narrow pitch search heads. The bracket provides a convenient place to store the search head while the Covermeter is not in use.

Figure 4. Search head storage clip

3.3 Identifying search heads

The four search head types are one of two physical sizes. The Narrow Pitch and Standard heads are in a small package which fits in the rails on the top of the instrument. The Deep Cover and THD search heads are larger and do not fit in the rails. Each head is fitted with a label which identifies its type for ease of recognition. The software also shows an indication of the search head type as indicated in section 3.2.

3.4 Fitting half-cell probes

(This section applies to Elcometer 331 Model BH only)

Connect the probe and cables as shown in Figure 5. The search head can be left connected to the gauge at the same time as the half-cell probe, however for ease of use it is recommended that the search head is removed and stored in the carry case.

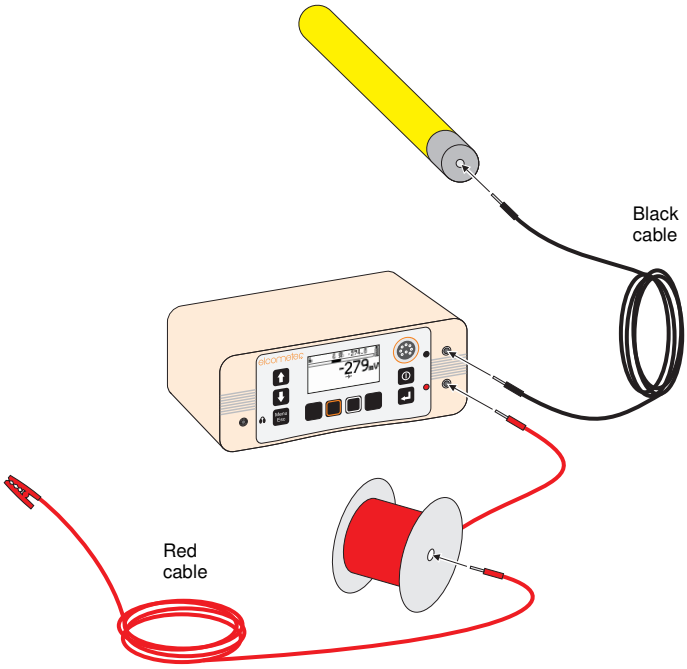


Figure 5. Fitting half-cell probe and cables

3.5 The controls

All functions of the Covermeter can be controlled using the keypad on the main unit. There are two types of keys on the keypad; fixed function keys and 'soft' keys (Figure 6)..

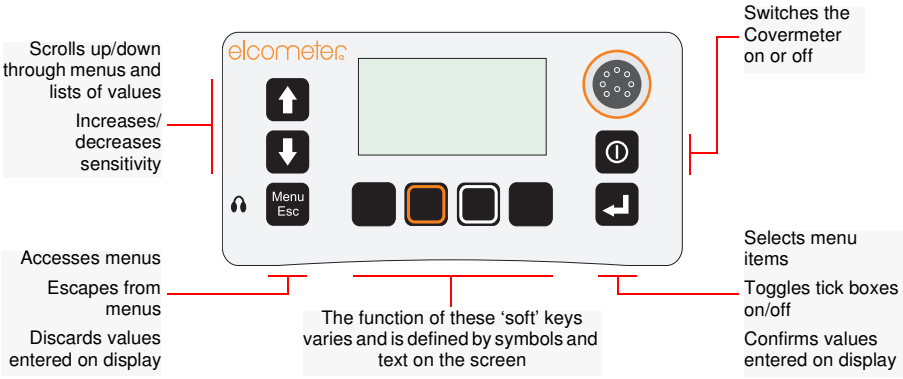


Figure 6. Covermeter main keypad (model BH shown)

Search head keypad

The keys on the search head mimic the functions of some of the keys on the main unit.

The function of the [enter ⏎] key and the [menu/esc] key is identical to the corresponding keys on the main unit.

The function of the [scroll up ↑ zero 0] and [scroll down ↓ size] keys depends upon whether the reading screen is displayed or not.

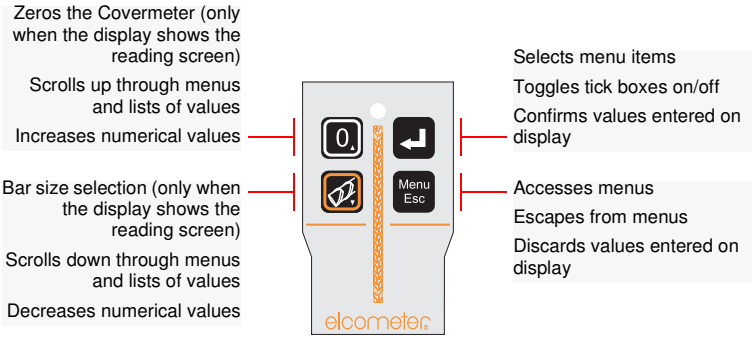


Figure 7. Search head keypad

3.6 Switching the Covermeter on and off

Note: *Before switching the Covermeter on for the first time read "Selecting a language" on page 11.*

To switch the Covermeter on, press [⏻].

To switch the Covermeter off, press and hold [⏻] for two seconds. The Covermeter will beep, two single tones followed by a double tone, and will then switch off.

The Covermeter includes an automatic switch off feature which will help to extend the battery life (time between charges). The automatic switch off time can be set to OFF, 5, 6, 7, 8, 9 or 10 minutes.
☜ MENU / SETUP / AUTO SWITCH OFF

A countdown timer is displayed on the screen 60 seconds before the Covermeter automatically switches off. The timer counts down from 60 to 0 to warn you that the Covermeter is about to switch off. Press any key while the countdown timer is displayed to cancel automatic switch off.

3.7 The display

Take some time to familiarise yourself with the information shown on the display of your Covermeter. The display shows:

- Welcome information
- Measurement information
- Menus to configure the Covermeter and control functions
- Help and miscellaneous information

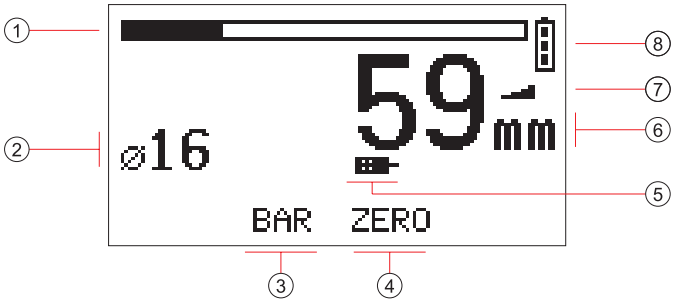
When the Covermeter is switched on an opening (welcome) information screen[d] may be displayed briefly before the main reading screen appears.

The information shown depends upon whether you are taking measurements, reviewing readings or setting up the Covermeter.

The main screen displayed (while you are taking measurements) is the Reading Screen.

d. The opening (welcome) screen can be disabled.
☜ MENU / SETUP / OPENING SCREEN.
Customised welcome screens can be created on a PC and downloaded into the gauge - see "Personalised welcome screen" on page 30.

Reading screen (when measuring depth of cover)



1. Signal strength indicator bar (14)
2. Bar size/number (20)
3. Bar softkey
4. Zero softkey
5. Search head type (5)
6. Depth of cover (18)
7. Sensitivity (22)
8. Battery condition indicator (5)

Refer to page numbers in brackets ( ) for more information.

Reading screen (when measuring half-cell potential)[e]

1. Half-cell potential - bar graph (zero at centre)
2. Half-cell reading indicator
3. Half-cell potential - numerical

Symbols

A wide range of symbols is used on the display. The meaning of all these symbols is stored in the Covermeter.

MENU / ABOUT / HELP

LCD contrast

Adjust the contrast of the display to suit lighting conditions.

MENU / SETUP / LCD CONTRAST

Backlight

The display includes a backlight which illuminates the display for 10 seconds after any key is pressed and during measurements. Switch the backlight on or off as required. Switching the

e. Half-cell mode is not included on the Elcometer 331 Model B.

backlight off will increase battery life.
MENU / BACKLIGHT

3.8 Selecting a language

Your Covermeter has a number of built-in languages. When the Covermeter is switched on for the first time after dispatch from the Elcometer factory the display will show the language selection screen (Figure 8).

Figure 8. Language selection screen

At first switch on

1. Press [⇧] or [⇩] to locate language required.
2. Press [⏎] to activate the selected language.

The Covermeter operates in the new language until changed.

At any time

1. Switch Covermeter off.
2. Press and hold left hand softkey.
3. Press [⏻] to switch on Covermeter.

   The display will show the language selection screen with the current language highlighted by the cursor.
4. Release left hand softkey.
5. Press [⇧] or [⇩] to locate language required.
6. Press [⏎] to activate the selected language.

Alternatively, select a language at any time.
MENU / SETUP / LANGUAGE

3.9 Computer interface

Your Covermeter is fitted with an RS232 interface. The interface is located under the interface access cover at the rear of the Covermeter - see Figure 2 and Figure 3 on page 4.

This 5-pin RS232 interface is used with the data transfer cable[f] to connect the Covermeter to the RS232 port[g] of a computer. When the Covermeter is connected to a computer you can:

- Download personalised screens to the Covermeter (see “Personalised welcome screen” on page 30).

3.10 Using the earphone

To use the earphone, plug the connector into the 3.5 mm socket marked 🎧 on the front of the Covermeter. Replacement earphones are available as an optional accessory - see “Accessories” on page 33.

f. The data transfer cable is not included with Elcometer 331 Model B or BH. For ordering information, see “Accessories” on page 33.
g. An RS232 to USB transfer cable is available which allows you to connect your Covermeter to a USB port on your computer. For ordering information, see “Accessories” on page 33.

3.11 Zeroing the Covermeter

This action is requested by the Covermeter whenever it is switched on with a search head attached, and periodically thereafter (at least once every 10 minutes). The user can choose to zero the instrument at any time.

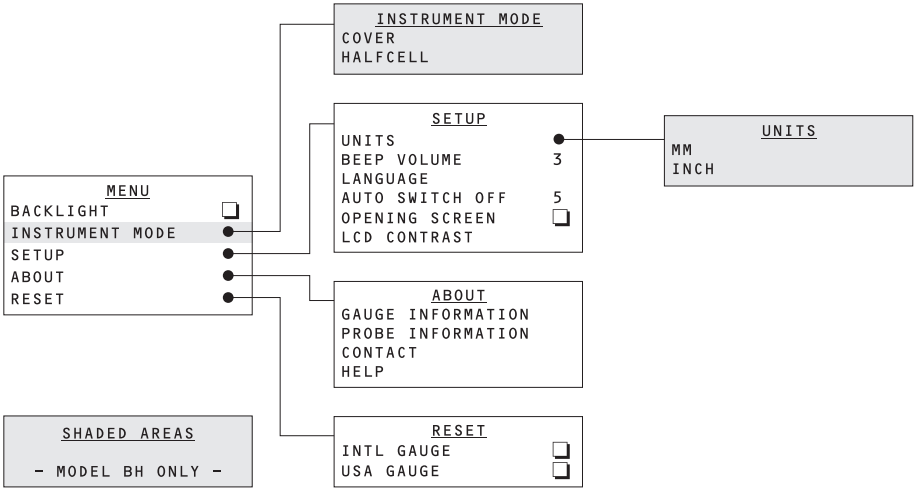
If zeroing is required, the cover display is blanked, the user is prompted, and no further readings can be entered until zeroing is completed.

To zero the Covermeter, hold the search head in the air well away from any metal and press the ZERO softkey. Zeroing is complete when the ZERO softkey indicator stops flashing. Sometimes more than one press of the ZERO softkey will be required; this is quite normal.

When a half-cell probe[h] is attached to the instrument, zeroing is not required.

4 THE MENUS

To access the menus press the MENU softkey. To return to the reading screen quickly, press and hold the MENU softkey.



4.1 MENU

BACKLIGHT . . . . . Toggles the display backlight on or off
INSTRUMENT MODE[i] . . . . . Opens Instrument mode menu . . . . See 4.2 INSTRUMENT MODE
SETUP . . . . . Opens Setup menu . . . . . See 4.3 SETUP
ABOUT . . . . . Opens About menu . . . . . See 4.4 ABOUT
RESET . . . . . Opens Reset menu . . . . . See 4.5 RESET

Note: *When Backlight is on, the display is illuminated for approximately 30 seconds after any key is pressed and during measurements.*

h. Half-cell probes cannot be fitted to the Elcometer 331 Model B.
i. 'Instrument mode' is not included on Elcometer Model B.

4.2 INSTRUMENT MODE[j]

COVER . . . . . Sets the instrument to measure depth of cover
HALFCELL . . . . . Sets the instrument to measure half-cell potential

4.3 SETUP

UNITS . . . . . Opens Units menu . . . . . See 4.6 UNITS
BEEP VOLUME. . . . . Use Scroll keys to select beep volume 0 (off) to 5 (maximum) and then press Enter
LANGUAGE. . . . . Use Scroll keys to select menu language and then press enter
AUTO SWITCH OFF . . . . . Use Scroll keys to select auto switch off time, 5 to 10 minutes or off and then press Enter
OPENING SCREEN . . . . . Press Enter to toggle the opening screen on or off
LCD CONTRAST. . . . . Use Scroll keys to select LCD contrast, 0 to 8 and then press Enter

4.4 ABOUT

GAUGE INFORMATION . . . . Press Enter to display technical information about the Covermeter
PROBE INFORMATION . . . . Press Enter to display technical information about the search head
CONTACT . . . . . Press Enter to display Elcometer offices worldwide and (if programmed) Supplier contact details
HELP . . . . . Press Enter to display an explanation of all the symbols used on the display

4.5 RESET

INTL GAUGE. . . . . Press Enter to Reset Covermeter to International settings[k] (DD/MM/YYYY date format, metric units, etc.)
USA GAUGE . . . . . Press Enter to Reset Covermeter to USA settings[l] (MM/DD/YYYY date format, imperial units, etc.)

Note: *The Covermeter will display a Yes/No confirmation screen before reset is activated.*

4.6 UNITS

MM. . . . . (Millimetres) Use Scroll keys to select units, then press Enter
INCH . . . . . (Inches) Use Scroll keys to select units, then press Enter

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j. 'Instrument mode' is not included on Elcometer Model B.
k. International settings can also be activated at switch on:
Press and hold third softkey ■■◉■ and switch on gauge.
l. USA settings can also be activated at switch on:
Press and hold fourth softkey ■■■◉ and switch on gauge.

5 LOCATING REINFORCEMENT BARS

This section describes how to set up and use your Covermeter to locate reinforcement bars.

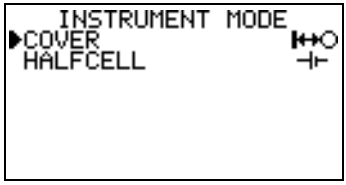
5.1 Before you start

- *Are you using the correct search head?*
  See “Search heads” on page 25.

5.2 To locate a single layer of reinforcement bars

1. Connect the search head to the Covermeter.
2. Switch on the Covermeter.
3. Ensure the instrument is set to Cover mode[m].

   MENU / INSTRUMENT MODE / COVER



4. Zero the Covermeter.
5. Adjust sensitivity - see “Adjusting sensitivity” on page 22.
6. Align the search head parallel to the reinforcement bars being sought.
7. Maintain the alignment of the search head and move the search head across the search area (Figure 9).

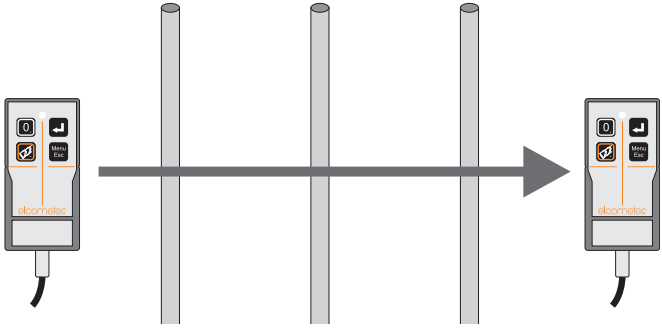


Figure 9. Align search head and scan across bars

When the search head is approaching a reinforcement bar:

- The Covermeter will start to emit a sound which will increase in pitch as the search head moves closer to the bar.
- The signal strength indicator bar on the display will increase in length.

m. ‘Instrument mode’ - available on Elcometer 331 Model BH only.

- The depth of cover on the display will show a number.
- The LED on the search head will start to glow.

The search head is aligned directly over a reinforcement bar when:

- The pitch of the sound is at its highest.
- The signal strength indicator bar is at its maximum.
- The depth of cover is at its minimum.
- The LED is glowing at its most intense.

8. Record the position of the reinforcement bar (using chalk or similar).

5.3 To locate two layers of reinforcement bars

Layers of reinforcement bars are typically orientated at right angles to each other. To locate individual layers of reinforcement bars, carry out the procedure in section 5.2 for each layer.

If the bars in the two layers are of similar size (Figure 10):

Search for the nearer layer first; it gives a stronger signal, and is least influenced by the other bars. Then search for the second layer, this time scanning the head in lanes between the previously located positions of the first layer of bars.

- The first scan locates the nearer (top) layer.
- The second scan locates the second (bottom) layer.

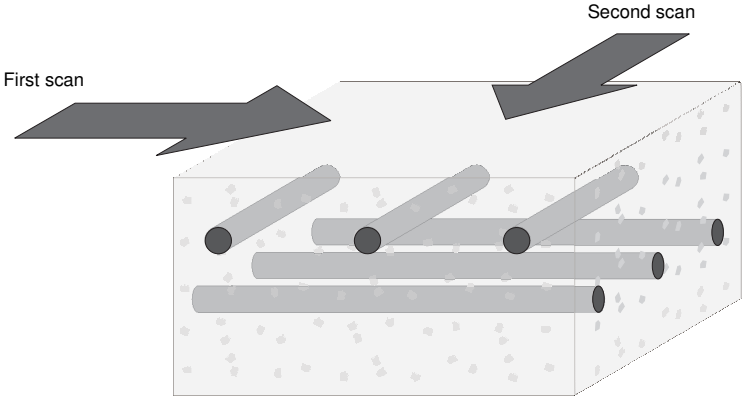


Figure 10. Scanning layers of bars of equal size

If the bars in the nearer layer are thin compared with those in the deeper layer (Figure 11):

Search for the deeper layer first; it gives a stronger signal, and is least influenced by the other bars. Then search for the nearer layer, this time scanning the head in lanes between the now-known positions of the deeper layer of bars.

- The first scan locates the second (bottom) layer.

- The second scan locates the nearer (top) layer.

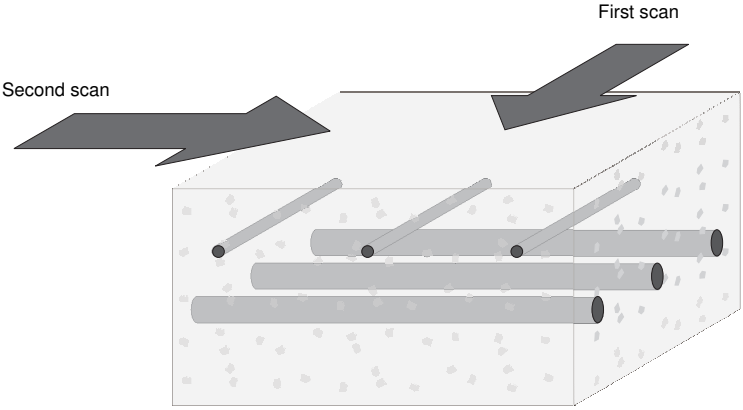


Figure 11. Scanning layers of bars of different size

(This situation is typical of a nearer layer consisting of relatively thin tie-wires or stirrups, and the deeper layer consisting of much larger main structural bars.)

5.4 To determine the orientation of a reinforcement bar

1. Locate the position of the reinforcement bar - see “To locate a single layer of reinforcement bars” on page 14.
2. Hold the search head over the bar. Move the search head side-to-side and rotate the head clockwise/anti-clockwise until the signal is at a maximum (Figure 12).

   When the signal is at its maximum, the search head is aligned parallel with the reinforcement bar.

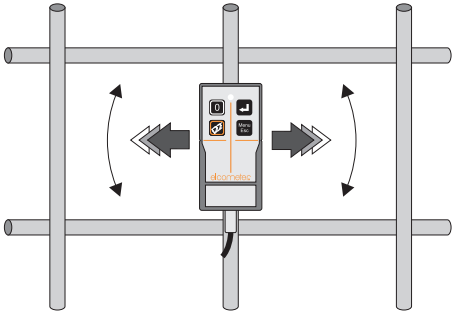


Figure 12. Determining orientation of a reinforcement bar

5.5 Practice

Because your Covermeter is unaffected by the nature of the material covering the reinforcing bars, the easiest way to practice location and orientation technique is to use uncovered bars which you

can see. A block of wood or plastic 20 mm to 45 mm thick can be held between the search head and the bars to simulate the depth of concrete cover.

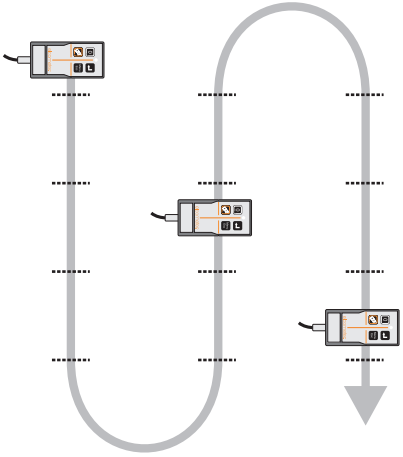
Start from the simplest situation, a single straight bar, and progress through parallel bars, lapped bars, and crossing bars. As you develop skill and confidence with uncovered bars, move on to locating bars in more realistic situations.

5.6 Surface mapping

When you are locating layers of reinforcement bars it is good practice to 'map' the concrete surface in a systematic manner. The following steps describe a mapping technique which can be used to locate two layers of reinforcement bars at right angles to each other.

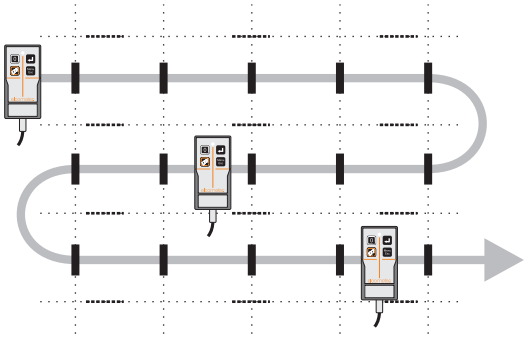
1. Hold search head horizontally.

   Scan up and down to locate (predominantly) horizontal bars.



2. Hold search head vertically.

   Scan from side to side between horizontal bars to locate vertical bars.



Note: *In some situations, it will be more appropriate to scan first for the vertical bars and then the horizontal bars.*

6 MEASURING DEPTH OF COVER

This section describes how to set up and use your Covermeter to measure the depth of cover over reinforcement bars.

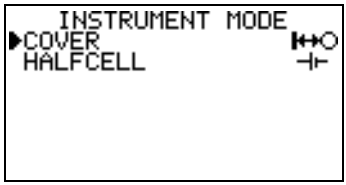
6.1 Before you start

- *Are you using the correct search head?*
  See “Search heads” on page 25.
- *What units of measurement do you want to use?*
  See “SETUP” on page 13.

6.2 Procedure

1. Connect the search head to the Covermeter.
2. Switch on the Covermeter.
3. Ensure the instrument is set to Cover mode[n].

   MENU / INSTRUMENT MODE / COVER



4. Select bar diameter - see “Selecting bar size” on page 20.
5. Zero the Covermeter.
6. Adjust sensitivity - see “Adjusting sensitivity” on page 22.
7. Locate the reinforcement bar using the sound, the LED and the display as indicators.
8. The reading of cover is continuously updated on the display in large digits. If you are satisfied that the search head is directly over the reinforcement bar, record the depth of cover reading and move on to the next bar.

n. ‘Instrument mode’ - available on Elcometer 331 Model BH only.

6.3 Accuracy

The reading of cover will only be accurate if all the following conditions are satisfied:

- The instrument has been zeroed.
- The search head is over the centre-line of the bar.
- The search head is parallel to the bar.
- The search head is not over, or near, any other bars which might affect the reading[o].

If the reinforcement bar is too deep to measure successfully (over-range), the depth of cover will be displayed as infinite (Figure 13).

Figure 13. Depth of cover over-range (infinite)

o. If reinforcement bars are too close together to measure with the standard search head, try using the narrow pitch search head. See “Accessories” on page 33 for ordering details.

7 SELECTING BAR SIZE

The dimensions of reinforcement bars are stored within the Covermeter. The dimensions are grouped into four standard series; Metric, Imperial, ASTM/Canadian and Japanese.

To select bar size, display the reading screen and press the BAR softkey to access Bar Size selection:

- To select bar size, press the SERIES softkey. Use [⇧] or [⇩] to select the appropriate series (Metric, Imperial, ASTM/Canadian or Japanese). Press [⏎] to accept the bar series and then use [⇧] or [⇩] to adjust the bar size. Press [⏎] to accept the bar size and return to the Reading Screen.

Metric	
Bar size	**Diam. (mm)**
5	5
5.5	5.5
6	6
7	7
8	8
9	9
10	10
11	11
12	12
14	14
16	16
18	18
20	20
22	22
25	25
28	28
32	32
36	36
40	40
44	44
50	50

Imperial	
Bar size	**Diam. (inch)**
#2	0.250
#3	0.375
#4	0.500
#5	0.625
#6	0.750
#7	0.875
#8	1.000
#9	1.125
#10	1.250
#11	1.375
#12	1.500
#13	1.625
#14	1.750
#15	1.875
#16	2.000
#18	2.250

ASTM/Canadian	
Bar size	**Area (mm^2)**
10M	100
15M	200
20M	300
25M	500
30M	700
35M	1000
45M	1500
55M	2500

Japanese	
Bar size	**Diam (mm)**
6	6
10	10
13	13
16	16
19	19
22	22
25	25
29	29
32	32
35	35
38	38
41	41
44	44
48	48
51	51
57	57

The bar sizing functions of the Covermeter will display any measured bar size to the nearest size in the selected series.

8 MEASURING HALF-CELL POTENTIAL

Your Covermeter[p] is capable of measuring half-cell potential - an electrochemical technique commonly used to assess the severity of corrosion in reinforced concrete structures. When set to half-cell mode, your Covermeter acts as a voltmeter which measures the potential difference between the steel reinforcement in the concrete structure and a reference electrode (the half-cell) placed on the surface of the concrete.

Half-cell readings can be stored in memory in batches in the same way as readings of cover.

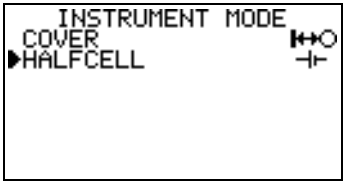
8.1 Before you start

- *Are you using the correct half-cell probe?*
  See “Half-cell probes” on page 28.

8.2 Procedure

1. Use the Covermeter to locate a reinforcing bar.
2. Expose the bar, e.g. by drilling through the cover using a large drill.
3. Drill a small diameter hole into the bar suitable for attachment of the positive (red) cable using a screw or lead plug.
4. Mark out a grid on the concrete. Measurements will be taken at the intersection points of the grid. Typical grid spacing is 1 m x 1 m, however this may be reduced if localised corrosion is suspected. If the measured half-cell potential between two adjacent positions differs by more than 100 mV, it is recommended that the grid spacing is reduced.
5. If necessary, use tap water to wet the whole of the test area, or just the measurement positions.
6. Connect the red cable and extension reel between the exposed reinforcing bar and the red terminal on the Covermeter (Figure 14). Connect the black cable between the probe and the black terminal on the Covermeter.
7. Switch on the Covermeter.
8. Ensure the instrument is set to Half-cell mode

   ☜ MENU / INSTRUMENT MODE / HALFCELL



9. Remove the end cap from the probe and store the cap safely.
10. Press the electrode against the concrete surface.
11. View the reading of half-cell potential on the display.
12. If you are satisfied with the reading, record the half-cell potential and then move on to the next measurement location.

p. Half-cell mode is not included on the Elcometer 331 Model B.

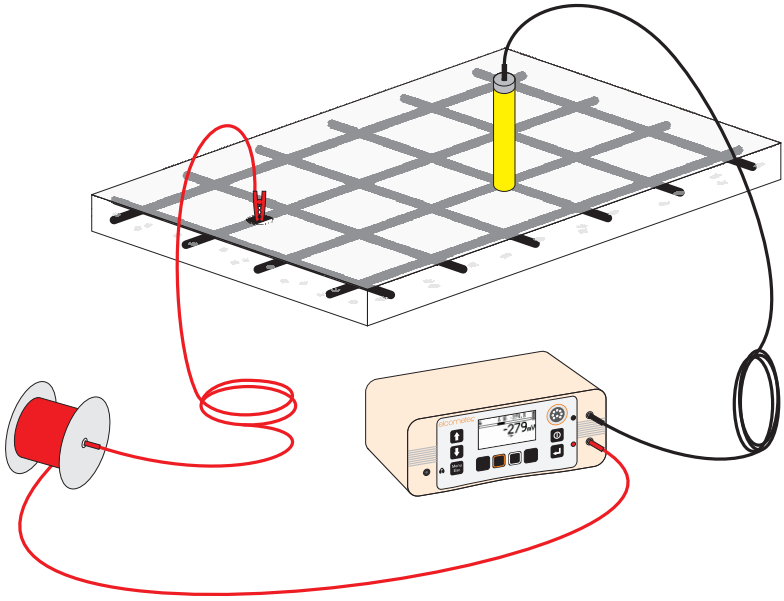


Figure 14. Typical instrument configuration for half-cell measurements

8.3 Measuring cell-to-cell rather than cell-to-bar

In some instances it will not be possible to make a direct connection to a reinforcing bar. In this situation it is common practice to use two half-cell probes connected to the inputs of the Covermeter. One probe is fixed in position on the concrete surface and the other probe is moved over the surface. In this way the surface can be 'mapped'.

Using this method, the absolute value of the reinforcing bar to concrete half-cell will not be measurable, however changes from one point on the surface to the next can be measured and interpreted.

9 ADJUSTING SENSITIVITY

The sensitivity setting is indicated by the variable wedge-shaped symbol on the display. To increase the sensitivity, press [⇧]. To decrease the sensitivity, press [⇩].

Typically, set the sensitivity to produce a slow 'clicking' sound in the absence of metal. With the sensitivity set at this level you will be able to differentiate quickly between bars of the same size located at different depths.

If the sensitivity is optimised, the pitch of the sound will consistently give a good guide to the extent of cover; shallower-than-average bars will produce a clearly noticeable, more intense sound, which will draw your attention to such bars. However, if the sensitivity has been adjusted to an arbitrary level, the necessary degree of consistency may not be achieved.

To improve audible resolution when locating closely spaced reinforcement bars it may be beneficial to reduce the sensitivity below the optimum level described in the previous paragraphs.

It is also possible to reduce sensitivity deliberately so that bars of adequate cover are not indicated, but bars of shallower cover are. Please note that this method will not confirm the presence of bars with adequate or deeper cover.

During a search the sound from the speaker and the brightness of the LED may reach their maximum level before the signal has reached its maximum. If this occurs, reduce the sensitivity until the sound and LED are again responding readily to changes.

Note: *Reducing the sensitivity does not reduce the overall sensitivity of the instrument, but will reduce the sound and LED indications to zero when the search head is removed from the region of high signal strength. This may cause deeply covered bars to be missed.*

If the sensitivity is reduced to the minimum setting, the locate sound is muted (indicated by a crossed-out loudspeaker symbol on the screen).

The sensitivity setting only affects the locate sound and the brightness of the LED on the search head; it does not affect the cover measurement.

10 MEASURING WELDED MESH AND JOINED BARS

The procedures for locating and measuring depth of cover of welded mesh and joined bars are similar to those for reinforcement bars as described in sections 5 and 6 (pages 14 to 19). This section highlights the additional factors which must be considered when measuring welded mesh or joined bars.

When searching for isolated reinforcing bars, the Covermeter induces eddy currents within the individual bars. Welded mesh reinforcements however create current loops which produce additional strong signals.

When searching for welded mesh reinforcements, it is common to encounter three levels of signal:

Very strong signals

Very strong signals are obtained when the search head is across the centre bar of a double or ‘figure-of-eight’ loop. These locations must not be used for cover measurements.

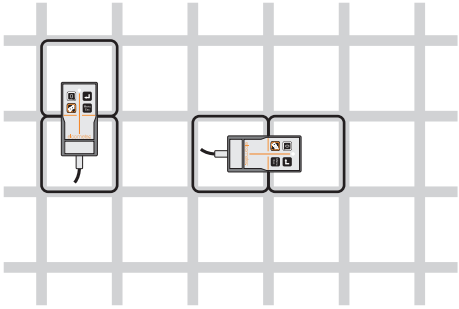


Figure 15. Strong signals at centre of ‘figure-of-eight’

Minimum strength signals

Minimum signals are obtained when the search head is over the centre of a single loop.

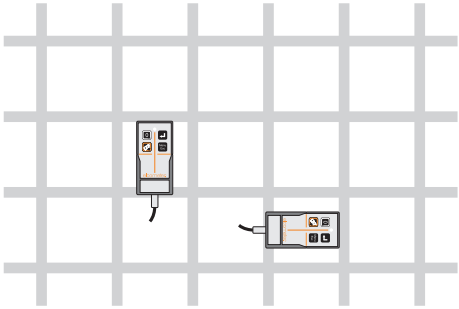


Figure 16. Minimum strength signals at centre of single loop

Ordinary strength signals

Ordinary strength signals are obtained when the head is accurately aligned with the middle of a side. Only this type of signal is suitable for measuring depth of cover.

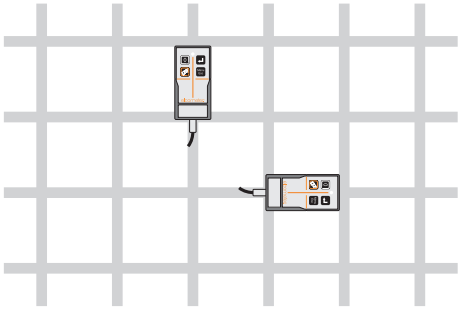


Figure 17. Ordinary strength signals from middle of one side of a loop

11 SEARCH HEADS

Four types of search head are available for your Covermeter; Standard, Narrow Pitch, Deep Cover and Borehole Probe. To order any of these search heads see “Accessories” on page 33.

All search heads are fully interchangeable. Changing from one type of search head to another is quick and easy; simply switch off the Covermeter, swap search heads, switch on again and zero the Covermeter.

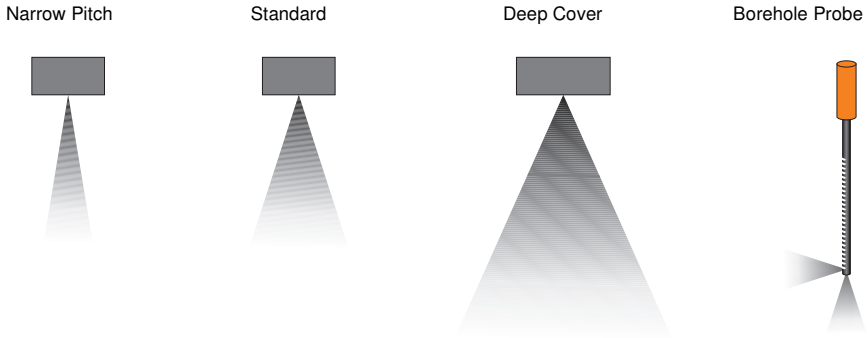


Figure 18. Search head search fields

Use the **Narrow Pitch** search head when the reinforcement bars are close together, i.e. when the pitch of the reinforcement bars is narrow.

Use the **Deep Cover** head to measure depth of cover over reinforcement bars deep within the structure. Because the Deep Cover search head only resolves bars if they are adequately spaced (centre-to-centre pitch more than about 1½ times their cover), for covers shallower than 70 mm, the Standard search head should be used in preference.

SEARCH HEADS

Borehole Probe

The Borehole Probe is used to locate reinforcement bars, tendon ducts and other metallic objects in the vicinity of holes drilled into concrete. The probe will also measure depth of cover over a limited range, making it ideal when attempting to drill through a structure without making contact with reinforcement bars or tendon ducts. The Borehole Probe is available in two lengths; 400 mm (16") and 1000 mm (40").

The Borehole Probe has two search fields; forwards looking and sideways looking. Readings can be taken looking forward from the end of the probe or looking sideways (at right angles to the axis of the probe) - Figure 19. A switch[q] on the handle controls which search field is active.

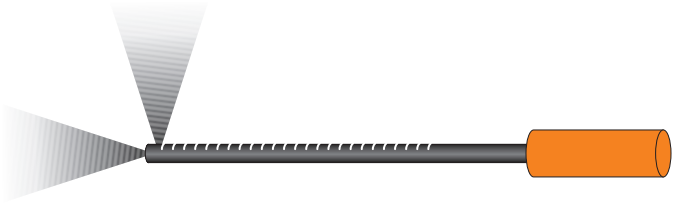


Figure 19. Borehole probe search fields

The body of the probe has a scale marked every 10 mm (0.5") along its length. Use this scale to measure the depth of reinforcement bars located to one side of the hole. The scale indicates distance from the centre of the sideways looking sensor in the probe. To measure the depth of the borehole, add 15 mm (0.6") to the reading taken from the scale.

The sideways looking search field is located on the side of the Borehole Probe marked with the scale.

To scan for reinforcement bars to the side of the borehole: Set the switch to the sideways looking position and move the Borehole Probe into the drilled hole, slowly rotating the probe through 360° (Figure 20 overleaf).

q. Whenever the position of the switch is changed, the Covermeter must be zeroed.

To scan for reinforcement bars or ducts in line with (in front of) the end of the borehole: Set the switch to the forward looking position and push the Borehole Probe into the drilled hole slowly.

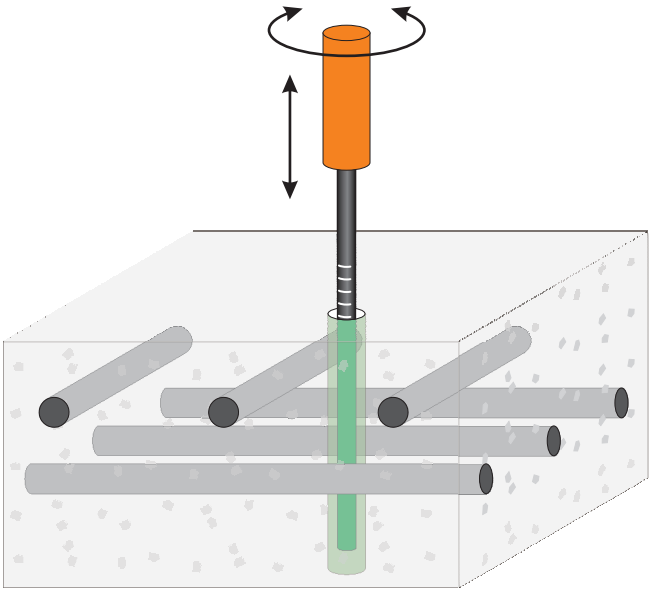


Figure 20. Scanning a borehole

11.1 Search head extension arm

This optional accessory allows the operator simple access to areas normally requiring ladders or scaffolding. The search head extension arm reduces the need to kneel down and allows the user to scan bridge decks and floor areas from a standing postion.

The extension arm is only suitable for use with the standard and narrow pitch search heads. See “Accessories” on page 33 for ordering information.

12 HALF-CELL PROBES

(This section applies to Elcometer 331 Model BH only)

Two types of half-cell probe are available for your Covermeter. The probes can be easily identified by colour:

- Copper-Copper Sulphate (Cu-$CuSO_4$): Yellow
- Silver-Silver Chloride (Ag-AgCl): Blue

12.1 Wetting your probe

For your probe to function properly the ceramic sensing end (the electrode) must be wet. To get a good wet electrode, just place the electrode in tap water for two to three minutes; this will usually be sufficient to keep the sensor going all day. Keeping the plastic end cap on the sensor when it is not being used will also help to keep the electrode wet. During periods of extended storage, place a small amount of water in the end cap before pushing the cap onto the probe.

12.2 Care of your probe and cables

The probes do not require any maintenance; they do not need recharging and are sealed for life. Any mud or grit should be removed from the electrode by swirling the electrode back and forth in a container of warm, soapy water and then brushing with a wet rag. The soapy water will not harm or contaminate the electrode.

Always check that the connecting cables are free of damage such as cuts and tears in the sheathing before use.

The Copper-Copper Sulphate half-cell probe is intentionally filled with a reserve of saturated Cupric Sulfate solution combined with solid Cupric Sulfate crystals to ensure a minimum 10-year design life.

Under certain circumstances a very small percentage of this reserve can leach out from the ceramic sensing tip of the half-cell producing crystals as shown in the photograph.

This does not affect the performance of the cell. The crystals should be removed by washing in distilled water.

12.3 Temperature

Do not allow the probe to freeze. Although freezing will not damage your probe, it will be impossible to obtain reliable measurements while in this state. All measurements are affected by temperature; if you take two readings in identical conditions, one in the summer at 29°C (85°F) and the other in the winter at 1°C (34°F), the half-cell potential readings will be different.

Each probe is tested at 25°C to be within ±10 mV of a standard Calomel reference cell. The following values relative to a standard Calomel cell are used as the test limits during manufacture:

	Lower limit	Reference value for Calomel	Upper limit
Copper-Copper Sulphate (Cu-$CuSO_4$)	+50 mV	+60 mV	+70 mV
Silver-Silver Chloride (Ag-AgCl)	-50 mV	-40 mV	-30 mV

12.4 Shelf life

Your probe does not degrade when stored.

13 ERROR MESSAGES

Under certain conditions the Covermeter will display error messages (Figure 21). These messages are normally cleared by pressing any one of the softkeys. The cause of the error will be indicated by the message and should be corrected before proceeding.

Table 1: Error messages

Error message	Causes	Action to take
#1 - PROBE	Search head-to-gauge communication failure.	Remove search head and refit. If error persists, return to Elcometer*.
#2 - PROBE	Corrupt data output from probe.	Try new search head. If error persists, return to Elcometer*.
#3 - PROBE	Internal error.	Return to Elcometer*.
#4 - PROBE	Search head power supply fault.	Remove probe. If error persists, the Covermeter is faulty. If error clears, the probe is faulty. Return faulty part to Elcometer*.
#5 - PROBE	Internal error.	Remove search head and refit. If error persists, return to Elcometer*.
PROBE UNSUPPORTED	Old Covermeter software does not support new search head.	Return to Elcometer* for software upgrade.
PROBE CHANGED	Probe has been changed and is not compatible with current batch.	Change to probe used when batch was created.
VALUE TOO LARGE	Numerical error.	Switch Covermeter off then on again. If error persists contact Elcometer.
CLOCK	Internal error.	Return to Elcometer*.
LANGUAGE MEMORY	Software error.	Return to Elcometer*.

* Contact Elcometer or your Elcometer Supplier to arrange return.

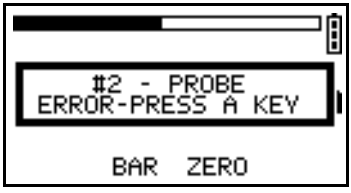


Figure 21. Example error message - search head not connected

14 PERSONALISED WELCOME SCREEN

A personalised welcome screen can be designed on a computer and then downloaded into the Covermeter.

Screen dimensions are 128 pixels x 64 pixels. The welcome screen is typically used to personalise the Covermeter with a logo, serial number, user name, etc. This is the first screen displayed when the Covermeter is switched on.

14.1 Creating the screen

1. Download Elcometer 'Welcome Screen Wizard' software. This software is available free of charge from the downloads section of the Elcometer website, www.elcometer.com
2. Connect Covermeter to PC using optional Data Transfer Cable - see "Accessories" on page 33.
3. Switch on the Covermeter.
4. Ensure that the reading screen is displayed.
5. Run 'Welcome Screen Wizard' software and follow the on-screen instructions.

14.2 Deleting the screen

1. Run the 'Welcome Screen Wizard' software.
2. Click 'Next'.
3. Select 'Create a new screen setup'.
4. Click 'Next'.
5. Select 'Disabled'.
6. Click 'Next'.

Follow the remaining on-screen instructions to delete the welcome screen.

15 STORAGE

This Covermeter incorporates a Liquid Crystal Display (LCD). If the display is heated above 50°C (120°F) it may be damaged. This can happen if the Covermeter is left in a car parked in strong sunlight.

Always store the Covermeter in its case when it is not being used.

16 MAINTENANCE

You own one of the finest covermeters in the world. If looked after, it will last a lifetime.

Regular calibration checks over the life of the Covermeter are a requirement of quality management procedures, e.g. ISO 9000, and other similar standards. For checks and certification contact Elcometer or your Elcometer supplier.

The Covermeter does not contain any user-serviceable components. In the unlikely event of a fault, the Covermeter should be returned to your Elcometer supplier or directly to Elcometer. The warranty will be invalidated if the gauge has been opened.

Contact details can be found:

- Stored in the Covermeter (MENU / ABOUT / CONTACT).
- On the outside cover of these operating instructions.

- At www.elcometer.com

17 TECHNICAL DATA

17.1 Performance[r]

Standard search head

Range:	40 mm (1.6") bar: 8 mm (0.3") bar:	17 mm to 100 mm (0.65" to 4") 9 mm to 75 mm (0.35" to 3")
Accuracy:	up to 65 mm (2.6") depth: over 70 mm (2.8") depth:	±2 mm (0.1") ±3%
Pitch resolution:	16 mm (#5) diameter bar at 50 mm (2") depth of cover; pitch ≥ 75 mm (3")	

Narrow Pitch search head

Range:	40 mm (1.6") bar: 8 mm (0.3") bar:	9 mm to 75 mm (0.35" to 3") 5 mm to 55 mm (0.2" to 2.2")
Accuracy:	up to 45 mm (1.75") depth: over 50 mm (2") depth:	±1 mm (0.05") ±2 mm (0.1")
Pitch resolution:	10 mm (#3) diameter bar at 30 mm (1.2") depth of cover; pitch ≥ 55 mm (2.15")	

Deep cover search head

Range:	40 mm (1.6") bar: 8 mm (0.3") bar:	50 mm to 200 mm (2" to 8") 25 mm to 150 mm (1" to 6")
Accuracy[s]:	up to 65 mm (2.6") depth: over 70 mm (2.8") depth:	±2 mm (0.1") ±3%
Pitch resolution:	16 mm (#5) diameter bar at 100 mm (4") depth of cover; pitch ≥ 125 mm (5")	

Half-cell mode[t]

Range:	-999 mV to +999 mV
Accuracy:	±5 mV

Half-cell probes

Stability:	10 mV with 3 µA load

17.2 Physical

Weight (including Deep head search head):	1.6 kg (3.5 lb)

r. All performance figures have been obtained when using Elcometer reference rebars of standard diameter at room temperature.
s. Accuracy figures for the deep cover search head are obtained once the operating temperature has stabilised (after 10 minutes continuous use of the search head).
t. Half-cell mode is not included on the Elcometer 331 Model B.

Dimensions (including search head and lead):	230 mm x 130 mm x 125 mm (9" x 5.1" x 4.9")
Operating temperature[u]:	0°C to 50°C (32°F to 120°F)
Case:	High impact ABS

17.3 Power supply

Internal rechargeable Lithium Ion battery[v].

Fuse rating of charger: 3 A

Battery life: Up to 32 hours continuous use without backlight. Up to 20 hours with backlight.

18 RELATED EQUIPMENT

Elcometer produces a wide range of concrete and coatings inspection equipment. Users of the Elcometer 331 Concrete Covermeter may also benefit from the following Elcometer products:

- Elcometer Adhesion and Bond Strength Testers
- Elcometer Concrete Crack Microscopes
- Elcometer Concrete Moisture Meters
- Elcometer Concrete Test Hammers

For further information contact Elcometer, your Elcometer supplier or visit www.elcometer.com

u. Operation outside these limits depends upon climatic conditions.

v. Battery packs must be disposed of carefully to avoid environmental contamination. Please consult your local environmental authority for information on disposal in your region. Do not dispose of the battery pack in a fire.

19 ACCESSORIES

Your Covermeter is complete with all the items required to get started.

The following optional accessories are available from Elcometer, or your Elcometer supplier. To place an order please quote the sales part number which follows the description of each accessory.

Rechargeable battery pack:	TW33119038
Search head - Standard:	TW33119124-1A
Search head - Narrow Pitch:	TW33119124-2A
Search head - Deep Cover:	TW33119171A
Search head - borehole probe, 400 mm (metric):	TW33119223-1A
Search head - borehole probe, 1000 mm (metric):	TW33119223-2A
Search head - borehole probe, 16" (imperial):	TW33119223-3A
Search head - borehole probe, 40" (imperial):	TW33119223-4A
Search head extension arm (for narrow pitch and standard search heads):	TW33119222
Search head connecting cable (for extension arm):	TW33119201
Search head connecting cable (curly)	TW33119199
Earphone:	TW99912220
Calibration check block:	TW33119218
Data transfer cable[w] (Covermeter to PC):	T99916217
RS232 to USB transfer cable:	T99916716
Half-cell probe kit, Copper-Copper Sulphate (Cu-CuSO4): (probe, 2 x connecting cables, 1 x 25 m cable reel, carry case)	TW331CUKIT
Half-cell probe kit, Silver-Silver Chloride (Ag-AgCl): (probe, 2 x connecting cables, 1 x 25 m cable reel, carry case)	TW331AGKIT
Half-cell probe cable reel, extendable to 100 m, with carry handle:	TW33119683

Calibration certificate

Certificates traceable to National Standards including UKAS and NIST are available on request.

Calibration Certificates are issued for a specific gauge/search head combination and are not interchangeable. Calibration Certificates must be requested at the time of order, or alternatively, the gauge and search head must be returned to Elcometer for certification.

Calibration Certificates cannot be issued retrospectively.

w. A 9-pin to 25-pin adapter may be required for certain PC RS232 ports.

20 INDEX