

# User Guide

## Elcometer 510 Model T Automatic Adhesion Tester

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For the avoidance of doubt, please refer to the original English language version.

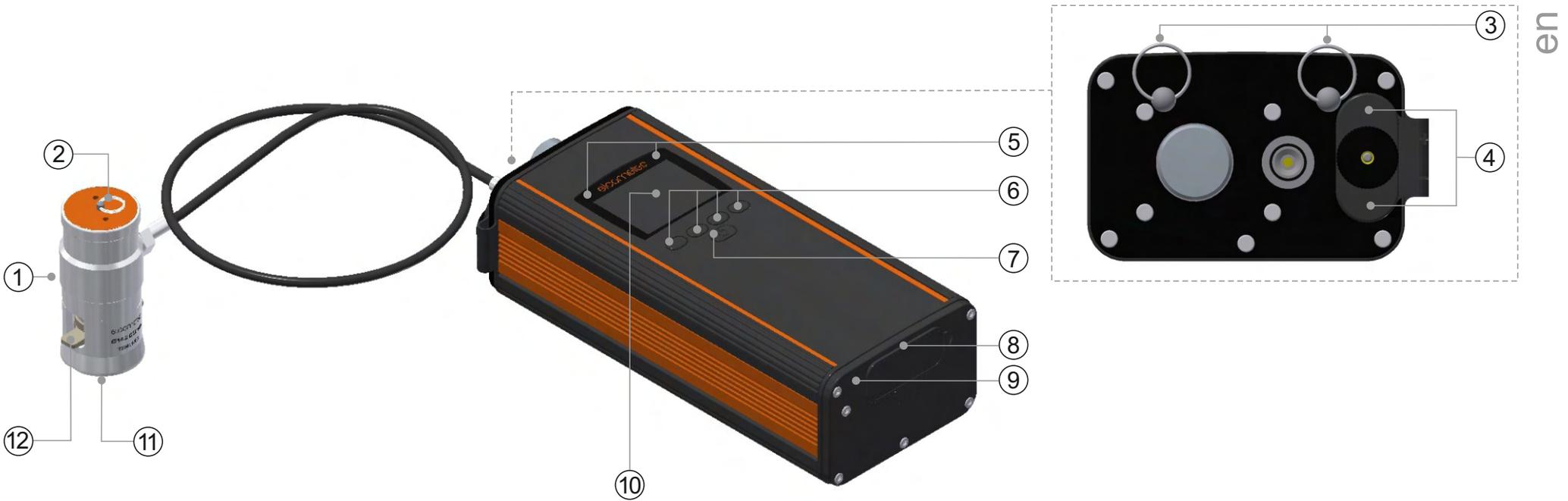
Gauge Dimensions: 260 x 100 x 66mm (10.3 x 3.9 x 2.6").

Gauge Weight: With 10mm, 14.2mm & 20mm Standard Dolly Skirt: 2.9kgs (6.4lbs); With 50mm Standard Dolly Skirt: 3.1kgs (8.3lbs)

**Note: Compliance can only be assured if approved accessories are used with this product.**

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# 1 GAUGE OVERVIEW



- |   |  |    |                                      |
|---|--|----|--------------------------------------|
| 1 | Actuator                                   | 7  | On/Off Key                           |
| 2 | Lanyard Ring                               | 8  | USB Data Output Socket (below cover) |
| 3 | Shoulder Strap Connections                 | 9  | Power Socket (below cover)           |
| 4 | Battery Compartment                        | 10 | LCD Display                          |
| 5 | LED Indicators - Red (left), Green (right) | 11 | Actuator Skirt <sup>a</sup>          |
| 6 | Multifunction Softkeys                     | 12 | Quick Connect Coupling               |

<sup>a</sup> The Standard Actuator Skirt for 20mm dollies is illustrated above. Skirts for other dolly sizes and thin substrates are also available - see Section 16.3 - "Dolly Skirts" on page 31 for details.

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## 2 BOX CONTENTS

- Elcometer 510 Adhesion Tester
- Standard Epoxy Adhesive (2x15ml tubes)
- Abrasive Pad
- 16 x AA Rechargeable Batteries
- 8 Cell Battery Charger
- Mains Power Supply: UK, EU, US & AUS

### *Additional items in 20mm Kit:*

- 20mm Dollies (x10)
- 20mm Dolly Standard Skirt
- 20mm Dolly Cutter & Handle

- Shoulder Harness
- Actuator Lanyard
- ElcoMaster™ 2.0 Software & USB Cable
- Carry Case
- Calibration Certificate
- User Guide

### *Additional items in 50mm Kit:*

- 50mm Dollies (x6)
- 50mm Dolly Standard Skirt
- 50mm Dolly Cutter with Drill Arbor

## 3 USING THE GAUGE



- a Red LED
- b Green LED
- c Power: Mains Power
- d Pull Rate - MPa/s, psi/s, N/s, Nmm<sup>2</sup>/s
- e Dolly Size - 10mm, 14.2mm, 20mm, 50mm
- f Measurement Units - MPa, psi, Newtons, N/mm<sup>2</sup>
- g Start Test (▶)<sup>b</sup>; Stop Test (■)<sup>b</sup>; Menu Softkey
- h Softkeys
- i Load Bar
- j Date & Time (when enabled and not in batching)

<sup>b</sup> ◀ is displayed when the gauge is rewinding.

### 3 USING THE GAUGE (continued)

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- k Bluetooth On - Grey: Not Paired; Orange: Paired
- l Limit Set & 'Pull to Limit' Selected
- m Batching On
- n Last Reading (> [greater than] symbolizes 'Did Not Fail')
- o Actuator Load Value
- p Limit Indicator (if set and enabled)
- q User Selectable Statistics - 4 rows

- r Batch Name (when in batching)
- s Pull Rate Graph (user selectable)
- t Power: Batteries (including battery life indicator & number of pulls remaining)
- u Limit Set & 'Pull to Maximum' Selected
- v Run Chart - last 20 readings (user selectable)
- w Power: USB

## 4 GETTING STARTED

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### 4.1 FITTING THE BATTERIES

Each gauge is supplied with 16 x AA NiMH rechargeable batteries and battery charger.

#### To insert or replace the batteries:

- 1 Unscrew the battery cap (turning anti-clockwise) and remove the battery cover.
- 2 Insert 8 batteries taking care to ensure correct polarity.
- 3 Refit the cover and tighten the battery cap.

Each fully charged set of batteries will last for approximately 200 pulls up to 25MPa (3600psi) at 1MPa/s (145psi/s) using a 20mm dolly.



The battery charger supplied can re-charge a set of 8 cells in approximately 5 hours. Care should be taken to ensure the correct polarity when fitting the batteries into the charger.

The battery condition is indicated by the battery symbol (☐■) at the top right of the display. When there is insufficient charge remaining to perform >100 tests, an indication of the approximate number of tests remaining - based on pulls to 25MPa (3600psi), using a 20mm dolly - is also displayed below the battery symbol.

The Elcometer 510 Model T can also be powered via mains power. When connected, the mains power symbol (⏻) is displayed at the top right of the display. If charged batteries are fitted and the mains power supply is connected, ⏻ is displayed to indicate that tests will be performed using mains power.

*Note: Mains power does not re-charge batteries in the gauge, use the battery charger supplied.*

## 4 GETTING STARTED (continued)

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The LCD display can be powered via USB. When connected, **USB** is displayed at the top right of the display allowing various functions to be undertaken including batch setup, review and transfer of data to PC or mobile device. Pull tests can not be performed using USB as it does not provide sufficient power to run the adhesion gauge motor.

### 4.2 SELECTING YOUR LANGUAGE

- 1 Press and hold the ON/OFF button until the Elcometer logo is displayed.
- 2 Press Menu/Setup/Language and select your language using the **↑↓** softkeys.
- 3 Follow the on screen menus.

To access the language menu when in a foreign language:

- 1 Switch the gauge OFF.
- 2 Press and hold the left softkey and switch the gauge ON.
- 3 Select your language using the **↑↓** softkeys.

### 4.3 SETTING UP THE DISPLAY

A number of screen settings can be defined by the user via Menu/Setup/Screen Settings including:

- **Screen Brightness;** This can be set to 'Manual' or 'Auto' - the brightness is adjusted automatically using the gauge's ambient light sensor.
- **Screen Timeout;** The display will dim if inactive for more than 15 seconds and will go 'black' if inactive for the period defined. Press any key, or tap the gauge to awaken it. The gauge can also be set to switch off automatically after a user defined period of inactivity via Menu/Setup/Gauge Auto Off. The default setting is 5 minutes.

## 4 GETTING STARTED (continued)

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- **Screen Rotation;** Using the internal accelerometer, the gauge rotates the display to allow the user to easily read the pressure value at 0° or 180° orientation ('Auto Display Rotation').

The colour LCD display is split into two halves; Top Display and Bottom Display. The user can define what information is displayed in each half including:

- **Selected Statistics;** As defined by the user via Display/Statistics/Select Statistics. The user can choose to view only those selected or view all.
- **Rate Graph;** A graphical representation of the increase in pressure applied over time of test, based on the pull rate set for the individual test or batch, drawn in real-time.
- **Run Chart;** A line trend graph of the last 20 measurements which is updated automatically after each reading.
- **Readings;** The last reading is displayed under the current pressure reading and is only updated when the current reading is saved.

### To setup the display:

- 1 Press Display/Setup Display/Top Display (or Bottom Display as required).
- 2 Use the **↑↓** softkeys to highlight the required option and press 'Select'.

If 'None' is selected for one half and 'Readings' or 'Run Chart' for the other half, the readings or run chart will fill the whole the screen. If any other combination of options is selected; the data will be shown in the top or bottom display as specified.

## 4 GETTING STARTED (continued)

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### 4.4 SELECTING THE GAUGE MODE

The Elcometer 510 Model T has two gauge modes; 'Standard' and 'Advanced'. Enabling 'Advanced' mode switches on additional functions including:

- **User Definable Pull-Rates;** in 'Standard' mode pre-defined pull rates are available for selection. In 'Advanced' mode users can set any pull-rate within the range available for the dolly size selected. (See Section 4.6 - 'Selecting the Dolly Size & Pull Rate'.)
- **Attribute Data;** test attribute information required by International Standards can be recorded against each reading. (See Section 9 - 'Recording Attribute Data' on page 16.)
- **Test Equipment Data;** details of the test equipment used can be recorded for each individual batch. (See Section 10 - 'Batching' on page 18.)

### 4.5 SELECTING THE MEASUREMENT UNITS

The Elcometer 510 Model T can display pull test results in MPa, psi, Newtons or N/mm<sup>2</sup>. To select the measurement units, press Menu/Setup/Units.

### 4.6 SELECTING THE DOLLY SIZE & PULL RATE

Prior to performing an adhesion test, the appropriate dolly size and pull rate must be selected. The Elcometer 510 can be used with 10mm, 14.2mm, 20mm and 50mm dollies. As the pull rate is determined by the dolly size, the dolly size must be selected first - refer to the 'Dolly Size & Pull Rates' tables on page 9.

**4 GETTING STARTED (continued)**

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**To set the dolly size and pull rate:**

- 1 Press Menu/Dolly Size & Pull Rate.
- 2 Use the **↑↓** softkeys to highlight the required dolly size and press 'Select'. The 'Pull Rate' screen will now appear.
- 3 Use the **↑↓** softkeys to set the pull rate as required and press 'Ok' to set.

Dolly Size	<b>ADVANCED MODE: Pull Rate Range</b> <i>(The user can select any pull rate within the range indicated)</i>			
	MPa/s	psi/s	N/s	Nmm <sup>2</sup> /s
10mm	0.40 - 5.60	58 - 812	31 - 440	0.40 - 5.60
14.2mm	0.20 - 2.80	29 - 403	31 - 440	0.20 - 2.80
20mm	0.10 - 1.40	15 - 203	31 - 440	0.10 - 1.40
50mm	0.02 - 0.22	2 - 32	31 - 440	0.02 - 0.22

Dolly Size	<b>STANDARD MODE: Pre-defined Pull Rates</b> <i>(Only the pull-rates listed below are available for selection)</i>			
	MPa/s	psi/s	N/s	Nmm <sup>2</sup> /s
10mm	1.00, 2.00, 3.00, 4.00, 5.00	125, 200, 400, 600, 725	80, 160, 235, 315, 395	1.00, 2.00, 3.00, 4.00, 5.00
14.2mm	0.40, 0.70, 1.40, 2.00, 2.50	60, 100, 200, 300, 360	65, 110, 220, 315, 395	0.40, 0.70, 1.40, 2.00, 2.50
20mm	0.20, 0.30, 0.70, 1.00, 1.20	30, 50, 100, 150, 180	65, 95, 220, 315, 380	0.20, 0.30, 0.70, 1.00, 1.20
50mm	0.04, 0.08, 0.12, 0.16, 0.20	5, 8, 16, 24, 30	80, 160, 235, 315, 400	0.04, 0.08, 0.12, 0.16, 0.20

## 4 GETTING STARTED (continued)

### 4.7 SETTING A LIMIT & LIMIT HOLD TIME

Some specifications require coatings to be tested to a maximum pull-off strength. Users can set a limit value and a limit hold time (how long pressure is maintained at the limit value until the gauge rewinds to zero) and then select:

- ‘Pull to Limit’** (⊕): the gauge will increase the pressure at the defined pull rate until the limit has been reached and maintained for the set hold time or the dolly pulls off, whichever occurs first after which, the gauge re-winds to ‘zero’; or
- ‘Pull to Maximum’** (⊖): the gauge will increase the pressure until the maximum pressure rate for the selected dolly size / pull rate combination has been reached or the dolly pulls off, whichever occurs first, at which point the gauge automatically re-winds to ‘zero’.

A limit can be set for individual readings (when in Immediate mode) or individual limits can be set for each batch (when in Batching).

#### To set a limit in Immediate (non Batching) mode:

- 1 Press Menu/Limit/Set Limit/Set Limit Value.
- 2 Use the **↑↓** softkeys to set the required value and press ‘Ok’. The ‘Set Hold Time’ screen will appear.
  - ▶ The maximum limit available is determined by the dolly diameter selected via Menu/Dolly Size & Pull Rate/Dolly Size.
  - ▶ Ensure the ‘Enable Limit’ radio button is checked; Menu/Limit/Set Limit/Enable Limit
- 3 Use the **↑↓** softkeys to set the required hold time and press ‘Ok’.

## 4 GETTING STARTED (continued)

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### To set a limit when in Batching:

A limit can be set when a new batch is created. Once a reading is saved into the batch the limit cannot be amended nor can one be added.

- 1 Press Batch/New Batch/Batch Limit/Set Limit/Set Limit Value.
- 2 Use the  $\uparrow\downarrow$  softkeys to set the required value and press 'Ok'. The 'Set Hold Time' screen will appear.
  - ▶ The maximum limit available is determined by the dolly diameter selected via Batch/New Batch/Dolly Size & Pull Rate/Dolly Size.
  - ▶ Ensure the 'Enable Limit' radio button is checked; Batch/New Batch/Batch Limit/Set Limit/Enable Limit
- 3 Use the  $\uparrow\downarrow$  softkeys to set the required hold time and press 'Ok'.

During a pull test, the limit icon ( $\nabla$ ), load bar and reading are red if a limit has been set (Fig. 1). The load bar and reading turn white when the limit is exceeded (Fig. 2). If no limit has been set, the limit icon is not displayed and the load bar and pressure reading are white (Fig. 3).



Fig. 1



Fig. 2



Fig. 3

## 5 SECURING THE DOLLY

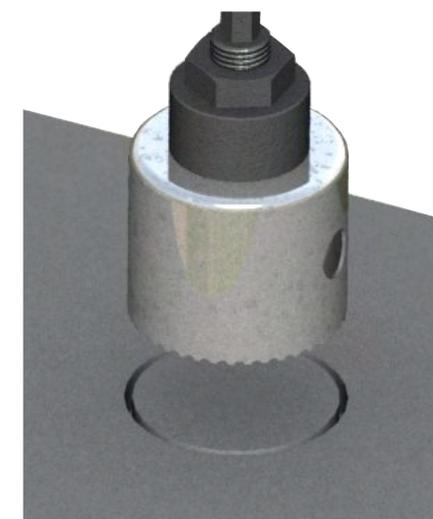
### 5.1 USING 10mm, 14.2mm OR 20mm DOLLIES

- 1 Prepare the surface of the dolly and the coating where the dolly is to be applied by roughening with the abrasive pad. Then de-grease and clean both surfaces using a suitable solvent and allow to dry.
- 2 Mix equal quantities of the two part Araldite® adhesive and apply a thin, even layer to the prepared surface of the dolly.
  - ▶ Araldite® adhesive is supplied by Elcometer however, other adhesives can be used - see Section 17 'Adhesives' on page 33.
- 3 Press the dolly firmly onto the prepared test surface and apply pressure to squeeze out excess adhesive which should then be wiped clean.
- 4 Allow the adhesive to cure - see Section 17 'Adhesives' on page 33.
  - ▶ If testing on vertical surfaces, you may wish to tape the dolly in place during cure.
- 5 If required, score the coating around the dolly using the dolly cutter provided.

### 5.2 TESTING COATINGS ON CONCRETE USING 50mm DOLLIES

When testing coatings on concrete using 50mm dollies, scoring of the coating down to, or into, the surface of the concrete may be required.

- 1 If testing on coatings thicker than 0.5 mm (20 mils) use the 50mm dolly cutter and arbor (mounted in a drill press or hand drill) to cut a "ring" into the concrete.
  - ▶ Ensure that the scoring is perpendicular to the coating and that the test area is not subjected to twisting or torque. To minimise heat and suppress dust, water lubrication may be required.
- 2 Follow steps 1-4 in Section 5.1, making sure the dolly is positioned inside the cut "ring".



Concrete Substrate

To score coatings thinner than 0.5 mm (20 mils), a sharp knife may be sufficient to carefully score around the dolly once it has been secured in place by adhesive.

## 6 ATTACHING THE GAUGE TO THE DOLLY

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- 1 Ensure the quick connect coupling is fully depressed.
- 2 Pull up the quick connect coupling, place the actuator (with skirt fitted<sup>°</sup>) over the dolly then release the coupling to grip the dolly.
  - ▶ The quick connect coupling is not a bayonet fitting. Do not attempt to push the actuator on to the dolly without lifting the quick connect coupling.



When testing at height or on vertical surfaces, in order to prevent damage to the surrounding coating or harm to the user, it may be necessary to use the Magnetic Anchor Clamp accessory, part number T99923797. This connects to the lanyard ring on the top of the actuator to prevent the actuator from falling when the dolly is pulled from the substrate.

<sup>°</sup> Skirts for 10mm, 14.2mm, 20mm and 50mm dollies and thin substrates are available - see Section 16.3 'Dolly Skirts' on page 31 for details.



## 7 PERFORMING THE TEST

- 1 Press and hold the ON/OFF button to switch the gauge on.
- 2 Ensure that the measurement units, dolly size and pull rate are set as required, see section 4.
- 3 Press the start softkey ( ▶ ) to begin the test. Load is applied at the rate defined, displayed numerically on the screen and illustrated on the load bar.
- 4 The load continues to increase at the defined rate until either:
  - a) the dolly pulls off;
  - b) the defined limit is reached (if set);
  - c) the gauge maximum pull load / pressure has been reached (eg. 25MPa for a 20mm dolly)
 At this point, the gauge re-winds to 'zero' and the user is asked if they wish to save the reading and when in 'Advanced Mode', define any attributes - if the dolly pulled off.
  - ▶ '---' indicates a reading outside of range
  - ▶ The gauge will not re-wind until the set hold time has elapsed; the 0.5 seconds default if 'Pull to Maximum' or as defined by the user if 'Pull to Limit'.
  - ▶ The gauge re-winds to 'zero' at a set rate of 1.5MPa/s or equivalent.

## 7 PERFORMING THE TEST (continued)

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5 Pull up the quick connect coupling to release the dolly and assess the results, see Section 8.

The stop softkey ( ■ ) can be pressed at any time during the test. If pressed, the user is asked if they wish to save the reading and the gauge re-winds to 'zero'. If saved, the "stopped" reading is included in the statistics.

Dollies can be reused after cleaning until either the top of the dolly (where it is held in position by the quick connect coupling) is severely deformed or the dolly surface is no longer flat. Additional dollies are available from Elcometer or your local supplier - see Section 16.1 - 'Dollies' on page 30 for details.

## 8 ASSESSING THE RESULTS

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Many National and International Standards including ISO 4624 & ASTM D4541, require the user to record not only the pull-off force but also the nature of the fracture by examining the bottom of the dolly and assessing the adhesive / cohesive failure.

The 'Attributes' feature in 'Advanced' mode (Menu/Setup/Gauge Mode/Advanced) allows the nature of the fracture to be recorded against each reading and stored within the batch - see Section 9 - 'Recording Attribute Data' on page 16 for further details.

Data can then be transferred to ElcoMaster™ 2.0 or ElcoMaster™ Mobile Apps for automatic reporting and archiving. For further information on ElcoMaster™ 2.0 or ElcoMaster™ Mobile Apps, visit [www.elcometer.com](http://www.elcometer.com)

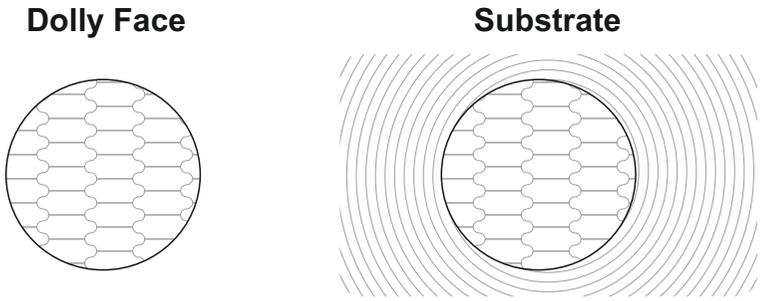
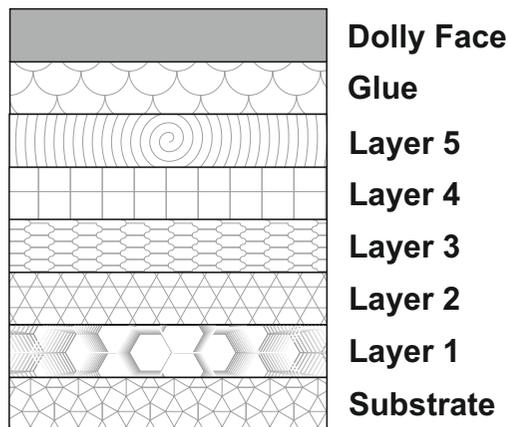
## 8 ASSESSING THE RESULTS (continued)

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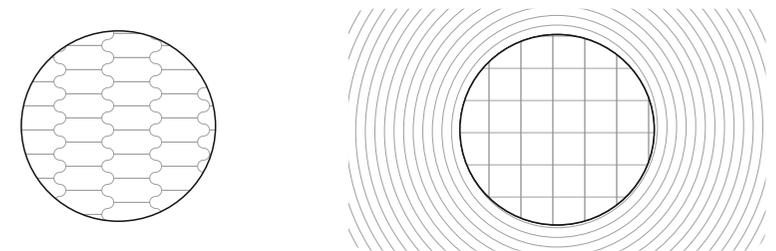
### 8.1 EXAMINING THE DOLLY

- a) **Cohesive Failure:** The coating fails within the body of a coating layer leaving the same coating on the surface and on the dolly face.
- b) **Adhesive failure:** Is a failure at the interface between layers (intercoat) where one pulls away from the other. The “coating” on the dolly face will not be the same as that on the test area.
- c) **Glue failure:** When no coating is present on the dolly it must be recorded as a failure of the glue. This is normally due to incorrect or insufficient mixing of the component parts of the adhesive, incompatibility between the adhesive, the coating, the dolly, and / or the test surface - see Section 5 - ‘Securing the Dolly’ on page 12 for more information.

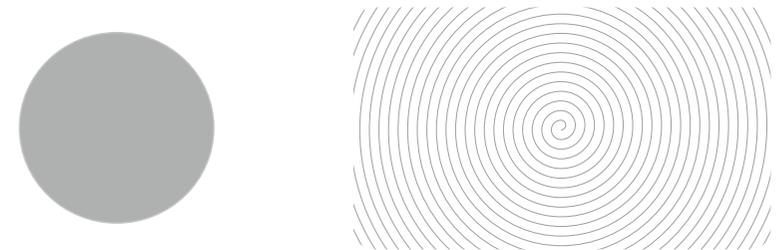
**Key**



**a) 100% Cohesive Failure**



**b) 100% Adhesive Failure Between Two Layers**



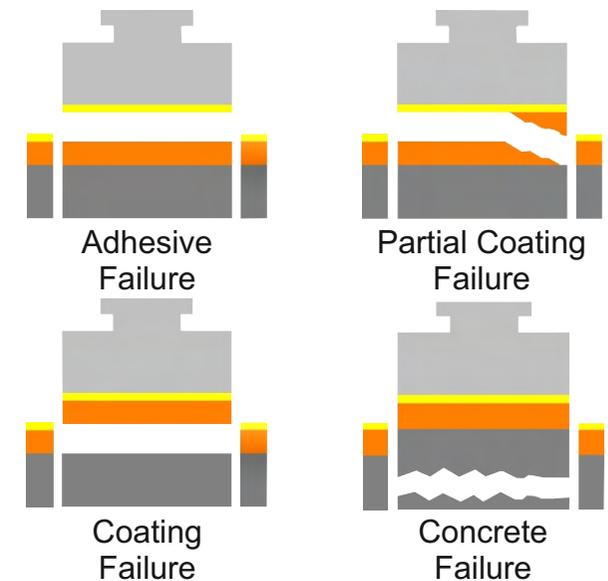
**c) Glue Failure**

## 8 ASSESSING THE RESULTS (continued)

### 8.2 EXAMINING THE DOLLY (COATINGS ON CONCRETE)

When testing coatings on concrete it is common for the adhesive bond between the coating and the concrete to exceed the strength of the concrete itself. In this case concrete will be removed from the surface and will be seen on the coating on the dolly face.

Observing the test area will give additional information about the type of failure; adhesion and cohesion between different layers of the coating.



## 9 RECORDING ATTRIBUTE DATA

Using the 'Attributes' feature available in 'Advanced' mode (Menu/Setup/Gauge Mode/Advanced), the nature of the fracture can be recorded against each reading and stored within the batch.

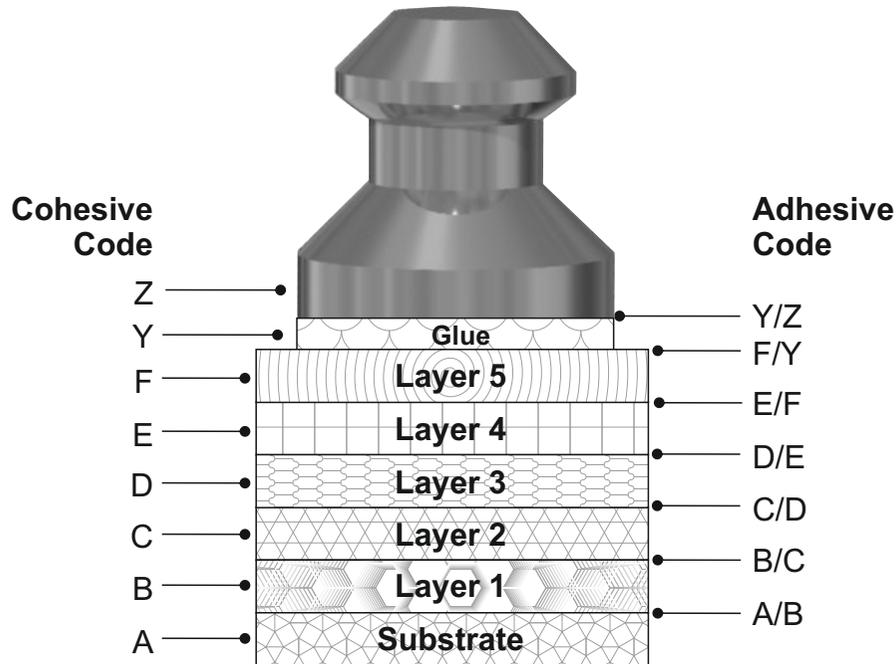
When prompted (after the reading has been saved), select 'Yes' to record the attribute data as follows:

- 1 Use the **↑↓** softkeys to set the 'Cohesive Failure %' to the nearest 10%; press 'Ok' to set.
- 2 Use the **↑↓** softkeys to select the cohesive failure layer<sup>d</sup>; see table on page 17 for an explanation of the options, press 'Select'.
- 3 Use the **↑↓** softkeys to set the 'Adhesive Failure %' to the nearest 10%; press 'Ok' to set.
- 4 Use the **↑↓** softkeys to select the intercoat adhesive failure layers; see table on page 17 for an explanation of the options, press 'Ok' to set.
- 5 Press 'Save' to confirm the data entered or 'Escape' to cancel and re-enter.

<sup>d</sup> The number of layers can be user defined for each batch via Batch/New Batch/Number of Layers. This will affect the number of layers available to select from during attribute recording. The maximum number of layers available is five, excluding the substrate and glue.

## 9 RECORDING ATTRIBUTE DATA (continued)

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Cohesive Failure Layer <sup>d</sup>		Adhesive Failure Layers	
Code	Description	Code	Description
A	Substrate	A/B	Substrate & Layer 1
B	Layer 1	B/C	Layer 1 & Layer 2
C	Layer 2	C/D	Layer 2 & Layer 3
D	Layer 3	D/E	Layer 3 & Layer 4
E	Layer 4	E/F	Layer 4 & Layer 5
F	Layer 5	F/Y	Layer 5 & Glue
Y	Glue	Y/Z	Glue & Dolly

The data is saved in the batch and can be viewed at any time via Batch/Review Batch/Readings; displayed as

**##.## MPa<sup>e</sup> N% A M% A/B**, where;  
**##.## MPa<sup>e</sup>** = Pull Force in MPa  
*(or other measurement units; psi, Newtons; Nmm<sup>-2</sup>)*  
**N%** = Cohesive failure percentage<sup>f</sup>  
**A** = Cohesive failure layer  
**M%** = Adhesion failure percentage<sup>f</sup>  
**A/B** = Intercoat adhesive failure layers



<sup>d</sup> The number of layers can be user defined for each batch via Batch/New Batch/Number of Layers. This will affect the number of layers available for selection during attribute recording. The maximum number of layers available is five, excluding the substrate and glue.

<sup>e</sup> Or equivalent units.

<sup>f</sup> To the nearest 10%, in line with International Standards.

## 9 RECORDING ATTRIBUTE DATA (continued)

For example: 14.26 MPa 40% B 30% B/C;

the coating fractured at a pull force of 14.26 MPa, with 40% of the dolly area associated with cohesive failure of layer 1 and 30% of the dolly area associated with intercoat adhesive failure between layers 1 and 2.

- ▶ The cohesive failure percentage plus the adhesive failure percentage does not have to equal 100% but cannot exceed 100%.

If the gauge reaches either a defined limit or the maximum pull load of the gauge for the dolly size selected; or is manually stopped by the user and the dolly has not “pulled off” from the surface, the gauge stores this reading into memory as ‘>###.## MPa<sup>e</sup>’ followed by [Did Not Fail], signifying that the adhesion value is greater than ###.## MPa<sup>e</sup>. ###.## MPa<sup>e</sup> is used to calculate the statistics within the batch.

If the dolly “pulled off” from the surface but the user has chosen not to enter attribute data; [None Set] is recorded against the reading.

## 10 BATCHING

### 10.1 BATCH FUNCTIONS

Readings in up to 2,500 batches and has the following batching functions:

- **Batch/New Batch;** Create a new batch - see Section 10.2 for further information.
- **Batch/New Batch/Fixed Batch Size;** Pre-define the number of readings which are stored in a batch. The gauge will notify the user when the batch is complete and ask if another batch is to be opened, these batches are then linked when transferred to ElcoMaster.

<sup>e</sup> Or equivalent units.

<sup>g</sup> When ‘Rate Graph’ is enabled, the number of readings which can be stored is reduced depending on the graph resolution selected. See Section 18 “Technical Specification” on page 34 for further details.

## 10 BATCHING (continued)

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- **Batch/Open Existing Batch;** Open an existing batch.
- **Batch/Rename Batch;** Rename an existing batch.
- **Batch/Copy Batch;** Copy a batch including the batch header information; dolly size & pull rate, cutting device, number of layers, skirt type, rate graph resolution.
- **Batch/Edit Batch/Clear Batch;** Clear all readings within a batch - but leaving all batch header information.
- **Batch/Review Batch;** Review the readings, statistics, batch information, a graph of all readings or a pull rate graph for each individual reading - see Section 11 for further information.
- **Batch/Edit Batch/Delete Batch;** Delete a batch or all batches entirely from the gauge.
- **Batch/Deleted Reading/Delete without Tag;** Delete the last reading entirely.
- **Batch/Deleted Reading/Delete with Tag;** Delete the last reading but mark it as deleted in the batch memory.
- **Batch/New Batch/Rate Graph;** Determine the pull rate graph resolution or switch off the storing of a pull rate graph against each reading<sup>9</sup>.

### 10.2 CREATING A NEW BATCH

Many Standards require the user to record not only the pull-off force and the nature of the fracture but also details of the test equipment used; if a support ring was used and its dimensions, if, and by what means, the coating was cut around the dolly.

Using the Elcometer 510 in 'Advanced' mode (Menu/Setup/Gauge Mode/Advanced), this additional information is recorded within the batch header and transferred to PC or mobile device and can be included on any report within ElcoMaster. For further information on ElcoMaster™ 2.0 or ElcoMaster Mobile Apps, visit [www.elcometer.com](http://www.elcometer.com).

<sup>9</sup> When 'Rate Graph' is enabled, the number of readings which can be stored is reduced depending on the graph resolution selected. See Section 18 "Technical Specification" on page 34 for further details.

## 10 BATCHING (continued)

To create a new batch select Batch/New Batch and add the following criteria as required:

- Dolly Size & Pull Rate; (*Batch/New Batch/Dolly Size & Pull Rate*)
- Cutting Device; the type of cutting device used, if any, to score the coating around the dolly; (*Batch/New Batch/Cutting Device*)
- Limit Value; if set, and whether 'Pull to Limit' or 'Pull To Maximum' was selected; (*Batch/New Batch/Batch Limit*)
- The numbers of layers on the test surface; (*Batch/New Batch/Number of Layers*)
- The dolly skirt type; (*Batch/New Batch/Skirt Type*)
  - Select '20mm Standard' for Standard Skirt for 10, 14.2 and 20mm dollies;
  - Select '50mm Standard' for Standard Skirt for 50mm dollies;
  - Select '14.2mm Thin Substrate' for Thin Substrate Skirt for 14.2mm dollies;
  - Select '20mm Thin Substrate' for Thin Substrate Skirt for 20mm dollies;

*Note: The Elcometer 510 dolly skirt has an integrated support ring, therefore identifying the dolly skirt used records the use of a support / bearing ring as required by some standards, together with the support ring dimensions - see Section 16.3 'Dolly Skirts' on page 31 for dimensions.*

Batch Information	
Batch n	
Created	15:31 28/11/2013
Limit	12.00 MPa
Date Last Verified	25/11/2013
Time Last Verified	12:49
Pull Rate	1.00 MPa/s
Dolly Size	20 mm
Back	↑ ↓

Batch Information	
Batch n	
Pull To	LIMIT
Hold Time	0.5 s
Cutting Device	Dolly Cutter
Number of Layers	2
Skirt Type	20 STD
Graph Resolution	2
Back	↑ ↓

These details can be added and amended until the first reading has been stored in the batch after which no changes can be made.

This information is saved in the batch header and can be viewed at any time via Batch/Review Batch/Batch Information.

## 11 REVIEWING BATCH DATA

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### 11.1 BATCH STATISTICS (Batch/Review Batch/Statistics)

Displays statistical information for the batch including:

- Number of readings in the batch ( $n$ ;) )
- Average reading for the batch ( $\bar{x}$ ;) )
- Lowest reading in the batch ( $L_o$ ;) )
- Highest reading in the batch ( $H_i$ ;) )
- Range ( $\bar{l}$ ;) ) the difference between the highest and lowest reading in the batch
- Standard Deviation ( $\sigma$ ;) )
- Coefficient of Variation ( $cv\%$ ;) )
- Batch Limit ( $\bar{v}$ ;) ) if set
- Number of readings below limit ( $\bar{v}_n$ ;) ) if set

Statistics		Batch 7	
$n$ :	6	$\bar{x}$ :	7.592
$L_o$ :	4.01	$H_i$ :	10.00
$\bar{l}$ :	5.99	$\sigma$ :	2.498
$cv\%$ :	32.9	$\bar{v}$ :	10.00
$\bar{v}_n$ :	4		
Back			Zoom+

*Note: The calculation of standard deviation is based on the distribution of individual fracture strength values being normal, that is forming a normal curve when plotted as a frequency chart. If adhesion values for pulls that are not completed are included in the calculation, i.e. pulled to a limit value or maximum and not to fracture, the distribution will not be normal and the standard deviation calculation will not be mathematically correct. For the purpose of assessing the distribution of values in this case, however, the calculation will be included as though all the dollies were pulled to coating failure and it should be noted that the resulting calculation is for guidance only.*

## 11 REVIEWING BATCH DATA (continued)

### 11.2 BATCH READINGS (Batch/Review Batch/Readings)

Displays all measurement data for each individual reading within the batch including:

- The reading value;
- Attribute data (see Section 9 - 'Recording Attribute Data' on page 16 for further details);
- Date and time stamp for each test;
- Test duration.

*Note: The test duration includes the hold time but does not include the time it takes for the gauge to re-wind to 'zero'.*

Press the **↑↓** softkeys to scroll through the readings and **→** to move to the next information screen.

The figure shows four screenshots of the 'Readings Batch 7' screen, each displaying a list of 6 readings with navigation controls at the bottom.

Reading	Value
1	>10.00 MPa
2	5.17 MPa
3	7.86 MPa
4	4.01 MPa
5	8.51 MPa
6	10.00 MPa

Reading	Value
1	[ Did Not Fail ]
2	[ None Set ]
3	40% B 60% B/C
4	30% A 70% A/B
5	20% C 80% C/D
6	[ Did Not Fail ]

Reading	Time	Date
1	14:00:39	10/01/14
2	14:01:06	10/01/14
3	14:02:05	10/01/14
4	14:03:57	10/01/14
5	14:06:33	10/01/14
6	14:08:41	10/01/14

Reading	Duration
1	31.25 Seconds (s)
2	31.42 Seconds (s)
3	30.90 Seconds (s)
4	32.14 Seconds (s)
5	31.83 Seconds (s)
6	31.19 Seconds (s)

## 11 REVIEWING BATCH DATA (continued)

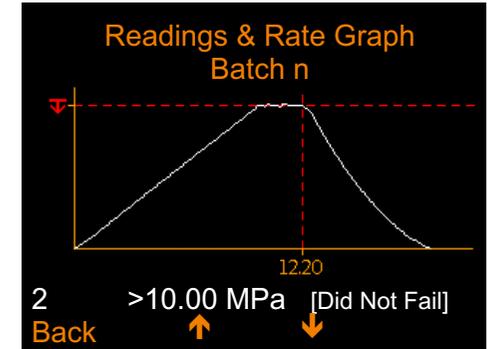
en

### 11.3 RATE GRAPH (Batch/Review Batch/Readings & Rate Graph)

A graphical representation of the increase in pressure applied over time of test, based on the pull rate and dolly diameter set for the batch.

The graph is displayed on screen above the pressure reading and attribute data (if set) using the resolution defined by the user via Batch/New Batch/Rate Graph.

Press the  $\uparrow\downarrow$  softkeys to scroll through the readings and display the rate graph for the reading selected.

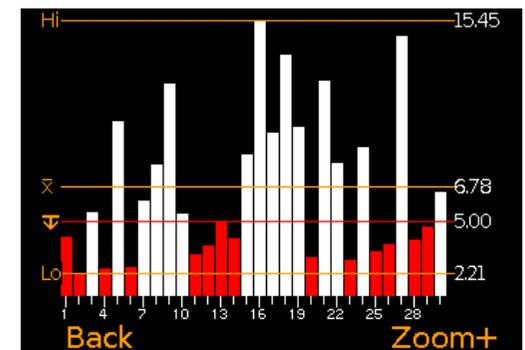


*Note: The rate graph is only available if enabled when the batch was created via Batch/New Batch/Rate Graph. It can not be added once a reading has been taken and saved in the batch. The resolution selected affects the gauge memory; the higher the resolution the fewer readings can be stored, see Section 18 - 'Technical Specification' on page 34 for further details.*

### 11.4 BATCH GRAPH (Batch/Review Batch/Batch Graph)

Allows the users to view the readings within the batch as a column bar graph. Up to four horizontal axes are displayed representing different values / statistics as follows:

- Highest reading in the batch (Hi:)
- Lowest reading in the batch (Lo:) (for batches of more than one reading)
- Average reading for the batch ( $\bar{x}$ :) (for batches of more than one reading)
- Batch Limit ( $\nabla$ :) (when set and enabled)
  - If not set: Readings are displayed as white vertical bars.
  - If set and enabled: Readings are displayed as red bars if below the set limit (the dolly pulled before the limit was reached) or white; if the set limit was exceeded and the coating did not fracture.



## 11 REVIEWING BATCH DATA (continued)

If there are more readings in the batch than can be displayed on a single screen, multiple readings will be combined into one bar. Should a single reading within the 'combined bar' be below the set limit, the whole bar will be red.

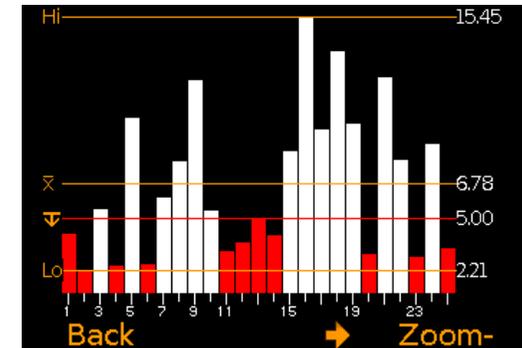
Pressing the 'Zoom+' softkey, allows each individual reading to be displayed, thereby showing the individual readings below the set limit.

When zoomed in, the graph will always display the first 25 readings. Pressing the ← softkey will display the last 25 readings taken.

Subsequent presses of the ← softkey will scroll backwards, pressing the → softkey will scroll forwards through the readings, 25 readings at a time.

Pressing the 'Zoom-' softkey returns to the original overview graph of all readings in the batch.

Pressing the 'Back' softkey returns the gauge to the Batch Review menu.



**12 PIN LOCK**

The 'PIN Lock' feature prevents the user from accidentally adjusting the gauge settings.

**To set a PIN code:**

- 1 Press the Menu softkey and select Setup/PIN Lock.
- 2 Set the four digit PIN Code using the **↑↓** softkeys to select 0 to 9 and the **→** softkey to move from the first to the fourth digit<sup>h</sup>.
- 3 Press 'Ok' to set, 'Escape' to cancel or 'Amend' to amend the PIN code.



When enabled, the following features are disabled and can not be adjusted

Menu/Dolly Size/Pull Rate	Batch/New Batch/Dolly Size/Pull Rate
Menu/Limit	Batch/New Batch/Batch Limit
Menu/Reset	Batch/New Batch/Cutting Device
Menu/Setup/Gauge Mode	Batch/New Batch/Number of Layers
Batch/Edit Batch	Batch/New Batch/Skirt Type

**To unlock the PIN code:**

- 1 Press the Menu softkey and select Setup/PIN Lock
  - 2 Enter the four digit PIN Code, using the **↑↓** softkeys to select 0 to 9 and the **→** softkey to move from the first to the fourth digit<sup>h</sup>
  - 3 Press 'Ok' or 'Escape' to cancel
- ▶ Should the user forget or lose the PIN Code, it can be disabled via ElcoMaster™ 2.0. Using the USB cable, simply connect the gauge to a PC with ElcoMaster™ 2.0 Version 2.0.45 or higher installed and select Edit/Clear PIN

<sup>h</sup> The **→** softkey will appear when the "X" changes to a number.

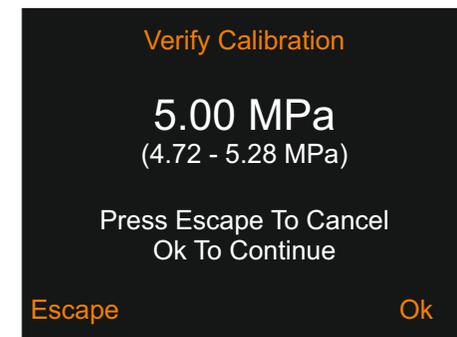
## 13 VERIFYING THE GAUGE CALIBRATION

The Elcometer 510 is factory calibrated. The calibration of the gauge can be verified in the field using the Elcometer Adhesion Verification Unit (AVU), part number T99923924C and the Elcometer 510 Verify Calibration wizard, Menu/Verify Calibration.



### To verify the calibration:

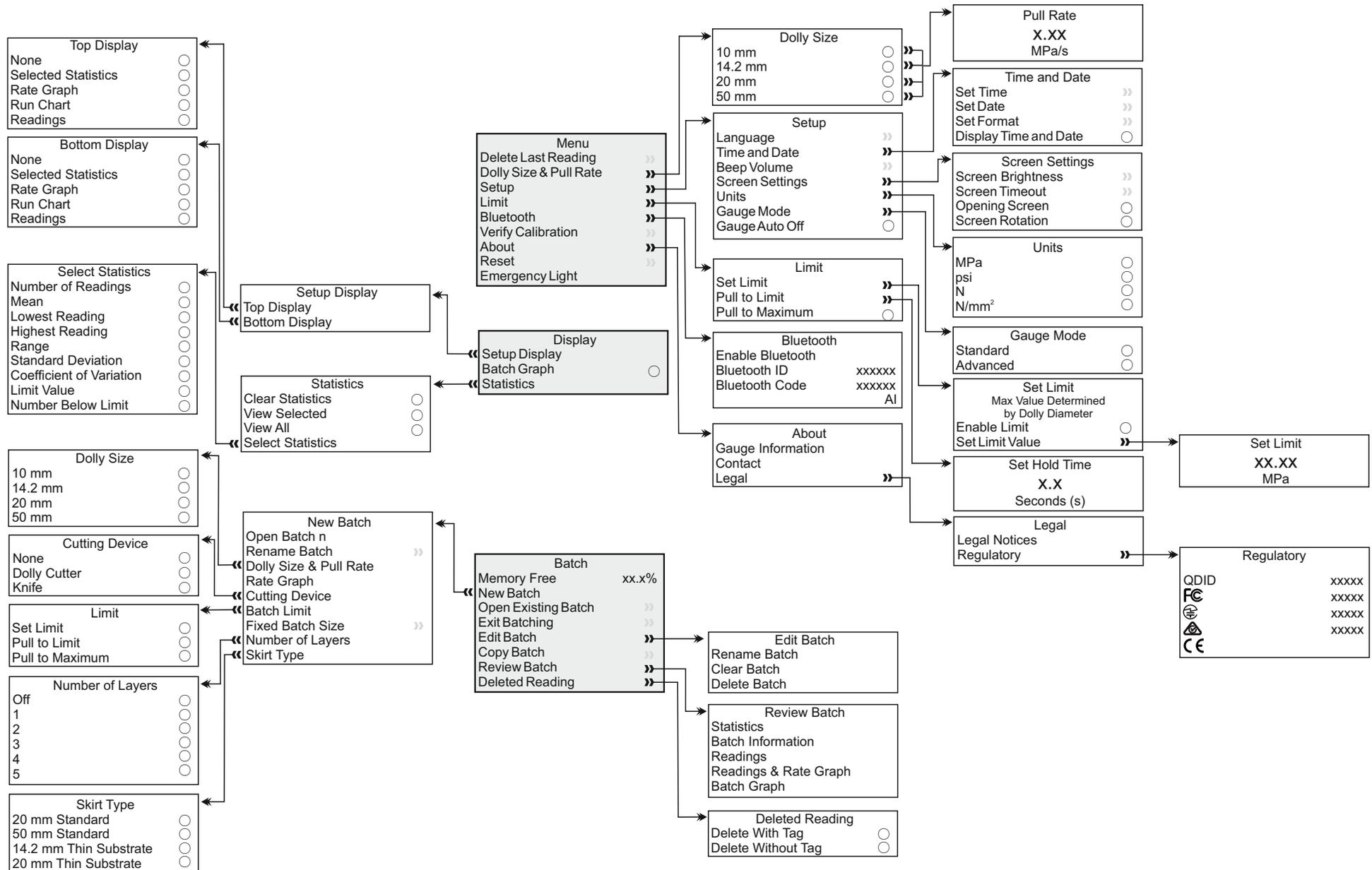
- 1 Select Menu/Verify Calibration and use the  $\uparrow\downarrow$  softkeys to highlight the required the dolly size; 20mm or 50mm. Press 'Ok' to select.
- 2 Switch on the Elcometer AVU and ensure that the appropriate dolly adaptor is fitted and the measurement units are the same as the Elcometer 510 (*refer to the instructions supplied with the Elcometer AVU*).
- 3 Connect the Elcometer 510 actuator (with skirt fitted) to the Elcometer AVU dolly adaptor.
- 4 Press 'Ok' on the Elcometer 510 when connected. The Elcometer 510 automatically starts to apply pressure until the first test load is reached.
- 5 Compare the test load with the reading on the Elcometer AVU display. If the Elcometer AVU reading is within the acceptable range, displayed in brackets underneath the test load, press 'Ok' to proceed to the next test pressure and repeat step 4. (If outside the acceptable range, re-calibration is recommended. Press 'Escape' to exit the calibration verification procedure and contact Elcometer or your local supplier for further information).
- 6 When the final test load has been reached, if it is within the acceptable range, press 'Verify' to update the gauge or 'Escape' to cancel. The date and time of the last verification procedure is recorded against each batch and can be viewed via Batch/Review Batch/Batch Information.



*Note: The acceptable range is based on the 'system' accuracy - the accuracy of the Elcometer 510 and Elcometer AVU unit combined. Measurement verification points: 20mm Dolly; 5, 15 & 25MPa, 50mm Dolly; 0.8, 2.4 & 4.0MPa (or equivalent units)*

# 14 MENU STRUCTURE

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## 15 DOWNLOADING DATA & UPGRADING YOUR GAUGE

### 15.1 DOWNLOADING DATA USING ELCOMASTER™ 2.0

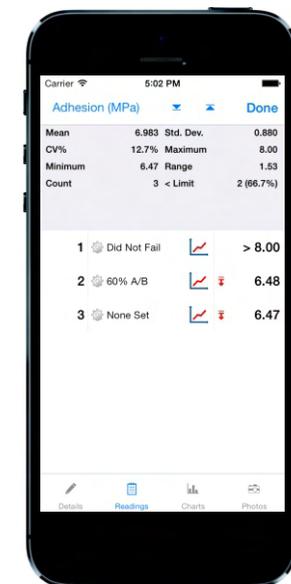
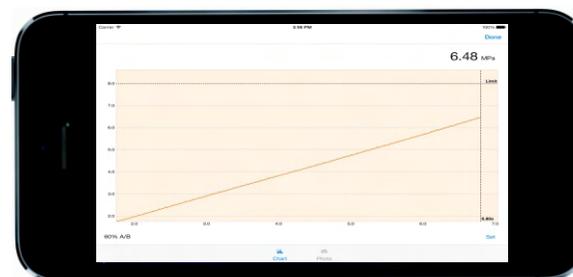
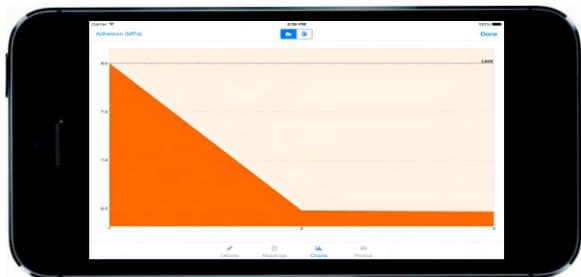
Using ElcoMaster™ 2.0 - supplied with each gauge, and available as a free download at [elcometer.com](http://elcometer.com) - gauges can transmit readings to a PC for archiving and report generation. Data can be transferred via USB or Bluetooth®. For more information on ElcoMaster™ 2.0 visit [www.elcometer.com](http://www.elcometer.com)

### 15.2 DOWNLOADING DATA USING ELCOMASTER™ MOBILE APPS

Ideal when out in the field or on-site, using the ElcoMaster™ Mobile Apps users can;

- Store live readings directly onto a mobile device and save them into batches together with GPS coordinates.
- View the pull rate graph in real-time for the duration of the test.
- Add attribute data to each individual batch reading.
- Add photographs of the dolly and test surface to each individual batch reading at the click of a button.
- Map readings on to a map, photograph or diagram.
- Inspection data can be transferred from mobile to PC for further analysis and reporting.

For more information on ElcoMaster™ Mobile Apps visit [www.elcometer.com](http://www.elcometer.com)



## 15 DOWNLOADING DATA & UPGRADING YOUR GAUGE (continued)

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Compatible with smart phones and tablets running Android 2.1 or above. To install, download via [www.elcometer.com](http://www.elcometer.com) or using the Google Play™ Store app, and follow the on screen instructions.



Made for iPhone 5S, iPhone 5C, iPhone 5, iPhone 4S, iPhone 4, iPad (4th generation), iPad mini, iPad 2, and iPod touch (4th and 5th generation). To install, download via [www.elcometer.com](http://www.elcometer.com) or the App Store, and follow the on screen instructions.

### 15.3 UPGRADING YOUR GAUGE

Gauge firmware can be upgraded to the latest version by the User via ElcoMaster™ 2.0, as they become available. ElcoMaster™ 2.0 will inform the User of any updates when the gauge is connected to the PC with an internet connection.

## 16 SPARES & ACCESSORIES

### 16.1 DOLLIES

The Elcometer 510 can be used with a range of dollies, also referred to as test elements or stubs. 10, 14.2, 20 and 50mm diameter dollies are available to purchase as an optional accessory<sup>i</sup>.

10mm: ideal for testing up to 100MPa (14400psi) on very small surface areas.

14.2mm: ideal for testing on small surface areas, for measurements over 25MPa (3600psi) and suitable for use on some curved surfaces.

20mm: suitable for use on a variety of coatings / substrates.

50mm: Coatings on concrete, cementitious layers and uneven surfaces can be tested more effectively with the larger 50mm dolly. Our 50mm dollies are also available in stainless steel as required for testing in accordance with DIN 1048 part 2 and BS EN 12636.

#### Description

Aluminium Dolly 10mm (x10)

Aluminium Dolly 10mm (x100)

Aluminium Dolly 14.2mm (x10)

Aluminium Dolly 14.2mm (x100)

Aluminium Dolly 20mm (x10)

Aluminium Dolly 20mm (x100)

Aluminium Dolly 50mm (x4)

Stainless Steel Dolly 50mm (x4)

#### Sales Part Number

T5100010AL-10

T5100010AL-100

T9990014AL-10

T9990014AL-100

T9990020AL-10

T9990020AL-100

T9990050AL-4

T9990050SS-4

<sup>i</sup> Please ensure the appropriate dolly skirt is fitted. See Section 6 - 'Attaching the Gauge to the Dolly' and Section 16.3 - 'Dolly Skirts' on pages 13 and 31 for further information.

**16 SPARES & ACCESSORIES (continued)**

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**16.2 DOLLY CUTTERS**

Standards or test methods will determine if the Inspector should cut / score around the dolly prior to test to separate the test area from the rest of the coating; information which should be recorded with the results.

The Elcometer 510 is supplied with a dolly cutter and handle appropriate for the dolly size included in the kit. Spare / replacement cutters are available to purchase using the sales part numbers below.

<b>Description</b>	<b>For Dolly Sizes (mm)</b>	<b>Sales Part Number</b>
Dolly Cutter	14.2mm	T9990014CT
Dolly Cutter	20mm	T9990020CT
Dolly Cutter	50mm	T9990050CT

Dolly cutter handles must be ordered separately - a handle is not supplied with the dolly cutter accessory.

<b>Description</b>	<b>For Dolly Cutter</b>	<b>Sales Part Number</b>
Dolly Cutter Handle	T9990014CT / T9990020CT	T9991420H
Dolly Cutter Arbor	T9990050CT	T9990050H

**16.3 DOLLY SKIRTS**

Standard skirts are available for 10mm, 14.2mm and 20mm dollies as well as 50mm dollies. Special skirts are also available for testing on thin substrate to even out the load, as using a standard skirt on a thin substrate may cause the substrate to bend or flex during test.

## 16 SPARES & ACCESSORIES (continued)

Description	For Dolly Sizes (mm)	Integrated Support Ring Dimensions		Sales Part Number
		I/D <sup>†</sup>	O/D <sup>‡</sup>	
Standard Skirt	10mm, 14.2mm & 20mm	30mm	40.4mm	T999101420S
Thin Substrate Skirt	14.2mm	16.3mm	40.4mm	T9990014T
Thin Substrate Skirt	20mm	21mm	40.4mm	T9990020T
Standard Skirt	50mm	52mm	72mm	T9990050S

### 16.4 MAGNETIC ANCHOR CLAMP

Ideal when testing at height or on vertical surfaces to prevent damage to the surrounding coating or harm to the user, the magnetic anchor clamp connects to the lanyard ring on the top of the actuator to prevent the actuator from falling when the dolly is pulled from the substrate.

#### Description

Magnetic Anchor Clamp Accessory

#### Sales Part Number

T99923797



<sup>†</sup> I/D: Inner Diameter    <sup>‡</sup> O/D: Outer Diameter

The adhesive supplied with the Elcometer 510 is Araldite® Standard, a two-pack epoxy paste which is mixed from approximately equal volumes of the two components. Measurement by eye is sufficient. When mixed it should be used within one hour. Curing Times: 24 hours at 25°C (77°F); 3 hours at 60°C (140°F)

Araldite® is suitable for warm and hot environments. Lower temperatures can require extended curing times of up to 3 days or more. The expiry date of the adhesive should be checked before use. Adhesive which has expired should not be used.

Unused adhesive must be disposed of as special waste unless it has been fully cured. To dispose of excess adhesive at the end of its shelf life simply mix the remaining material and allow it to cure before disposal.

**Description**

Araldite® Standard Two Part Epoxy Adhesive; 2x15ml Tubes

**Sales Part Number**

T99912906

A Material Safety Data Sheet for adhesive supplied by Elcometer can be downloaded via our website:  
Araldite® Standard Two Part Epoxy Adhesive: [www.elcometer.com/images/MSDS/araldite\\_epoxy\\_adhesive.pdf](http://www.elcometer.com/images/MSDS/araldite_epoxy_adhesive.pdf)

*Note: Other suitable adhesives include Loctite® Hysol® 907 and 3M™ Scotch-Weld™ Epoxy Adhesive.*

*The suitability of any adhesive should be determined by the user. Some coatings can be adversely affected by adhesives. Some adhesives can be contaminated by coating environments, solvents etc.*

**18 TECHNICAL SPECIFICATION**

<b>Dolly Diameter</b>	<b>10mm</b>	<b>14.2mm</b>	<b>20mm</b>	<b>50mm</b>
<b>Operating Range</b>	8 - 100MPa (1200 - 14400psi)	4 - 50MPa (600 - 7200psi)	2 - 25MPa (300 - 3600psi)	0.3 - 4.0MPa (50 - 580psi)
<b>Operating Temperature Range</b>	Elcometer 510: -10 to 50°C (14 to 122°F); Humidity: 0 - 95% RH PSU: 0 - 40°C (32 to 104°F); Humidity: 5 - 95% RH (non condensing)			
<b>Pressure Rating</b>	26MPa (3800psi)			
<b>Pressure Resolution</b>	0.01MPa (1psi)			
<b>Pressure Accuracy</b>	±1% of full scale			
<b>Pull Rate Range</b>	0.4 - 5.6MPa/s (58 - 812psi/s)	0.2 - 2.8MPa/s (29 - 403psi/s)	0.1 - 1.4MPa/s (15 - 203psi/s)	0.02 - 0.22MPa/s (2 - 32psi/s)
<b>Pull Rate Setting Resolution</b>	0.1MPa/s (1psi/s)	0.1MPa/s (1psi/s)	0.1MPa/s (1psi/s)	0.01MPa/s (0.1psi/s)
<b>Pull Rate Display Resolution</b>	0.01MPa (1psi)			
<b>Pull Rate Accuracy</b>	± (2.5% + 0.3 seconds) over time of test			

## 18 TECHNICAL SPECIFICATION (continued)

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Dolly Diameter	10mm	14.2mm	20mm	50mm
<b>Gauge Memory</b> <i>(Rate Graph Disabled)</i>	>60,000 readings in up to 2,500 batches			
<b>Gauge Memory</b> <i>(Rate Graph Enabled)</i>	>10,000 readings in up to 2,500 batches; Graph Resolution: 1 value per second >1,000 readings in up to 2,500 batches; Graph Resolution: 10 values per second			
<b>Power Supply</b>	8 x AA NiMH batteries <sup>j</sup> or mains power (input 80 - 264Vac, 47 - 63Hz)			
<b>Battery Life</b>	200 pulls per charge up to 25MPa (3600psi) at 1MPa/s (150psi/s)			
<b>Instrument Weight</b>	2.9kg (6.4lb)	2.9kg (6.4lb)	2.9kg (6.4lb)	3.1kg (8.3lb)
<b>Kit Weight</b>	n/a	n/a	6.1kg (13.5lb)	7.3kg (16.1lb)
<b>Instrument Length</b>	260mm (10.3")			
<b>Actuator Height</b>	85mm (3.4") <i>(10mm skirt fitted)</i>	85mm (3.4") <i>(14.2mm skirt fitted)</i>	85mm (3.4") <i>(20mm skirt fitted)</i>	110mm (4.3") <i>(50mm skirt fitted)</i>
Can be used in accordance with: ASTM C1583, ASTM D4541, ASTM D7234-12, AS/NZS 1580.408.5, BS 1881-207, DIN 1048-2, EN 1015-12, EN 12636, EN 13144, EN 1348, EN 1542, EN 24624, ISO 16276-1, ISO 4624, JIS K 5600-5-7, NF T30-606, NF T30-062				

<sup>j</sup> The number of pulls remaining with a battery charge is calculated using the NiMH batteries supplied. Alternative AA batteries (alkaline for example), can be used but will affect battery performance and the accuracy of the "pulls remaining" indication.

## 19 LEGAL NOTICES & REGULATORY INFORMATION

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The Elcometer 510 Model T meets the Radio and Telecommunications Terminal Equipment Directive.

The USB is for data transfer only and is not to be connected to the mains via a USB mains adapter.

The ACMA compliance mark can be accessed via: Menu/About/Legal/Regulatory

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

The Giteki mark, its ordinance number, the FCC ID and Bluetooth SIG QDID can be accessed via: Menu/About/Legal/Regulatory

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help.

To satisfy FCC RF Exposure requirements for mobile and base station transmission devices, a separation distance of 20 cm or more should be maintained between the antenna of this device and persons during operation. To ensure compliance, operation at closer than this distance is not recommended. The antenna(s) used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Modifications not expressly approved by Elcometer Limited could void the user's authority to operate the equipment under FCC rules.

This device complies with Industry Canada license exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This Class B digital apparatus complies with Canadian ICES-003.

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Made for iPhone 5S, iPhone 5C, iPhone 5, iPhone 4S, iPhone 4, iPad (4th generation), iPad mini, iPad 2, and iPod touch (4th, and 5th generation).

“Made for iPod,” “Made for iPhone,” and “Made for iPad” mean that an electronic accessory has been designed to connect specifically to iPod, iPhone, or iPad, respectively, and has been certified by the developer to meet Apple performance standards. Apple is not responsible for the operation of this device or its compliance with safety and regulatory standards. Please note that the use of this accessory with iPod, iPhone, or iPad may affect wireless performance.

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App Store is a trademark of Apple Inc., registered in the U.S. and other countries.

Google Play is a trademark of Google Inc.

All other trademarks acknowledged.

