

Elcometer 510 Automatic Pull-Off Adhesion Tester

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 1542, EN 24624*,
ISO 16276-1, ISO 4624, JIS K 5600-5-7, NF T30-606, NF T30-062*



The Elcometer 510 Automatic Pull-Off Adhesion Gauge accurately measures the adhesion strength of coatings on a wide range of substrates.

Using an automatic hydraulic pump, the Elcometer 510 Pull-Off Adhesion Tester ensures smooth and continuous pressure application for consistent and repeatable results. Whilst the rate of pull is controlled manually for most pull-off adhesion testers, the Elcometer 510 Pull-Off Adhesion Gauge allows the rate of pull to be selected, and the gauge applies the pre-selected rate automatically.

The Elcometer 510 Pull-Off Adhesion Tester includes all the features that you have come to expect from an Elcometer designed and manufactured product, including ease of use, robust and ergonomic design, menu driven colour display, user selectable statistics and display modes.

As well as reducing inspection times, the Elcometer 510 Pull-Off Adhesion Gauge can also speed up inspection reporting. When out in the field or on site, users can instantly review their data using Elcometer's free data management software, ElcoMaster®. Each live reading can be transferred via Bluetooth® to a PC, or mobile devices and, at the click of a button; users are able to generate professional reports.

Recording Pull-Off Force to National and International Standards

(Click on the image to access the video)



Many Standards require you to record the nature of the failure (either adhesive or cohesive) as an estimated percentage to the nearest 10%, as well the pull-off force.

When the Elcometer 510 is set to Advanced Mode¹, the nature of the fracture can be recorded digitally against the reading.

You can also store any combination of two failures – whether it's up to two adhesive failures (a failure at the interface between layers), two cohesive failures (a failure within the body of a coating layer, or the substrate when testing on concrete), or a combination of both adhesive and cohesive failures.

¹ Model T only

* Standards not in bold have been superseded but are still recognised in some industries

Key features of the Elcometer 510 Pull-Off Adhesion Gauge include:



Efficient

- Ideal for laboratory and field use
- 10, 14.2, 20 & 50mm diameter reusable dollies
- Compatible with ElcoMaster® Software
- Range of substrate actuator skirts for thick, thin, flat or convex substrates

Powerful

- Smooth load application up to 100MPa
- USB and Bluetooth® data output to iOS or Android™ devices
- Stores up to 60,000 readings in 2,500 batches

Durable

- Sealed, heavy duty and impact resistant
- Dust and waterproof equivalent to IP64
- Suitable for use in harsh environments

Accurate

- Fully adjustable pull rates 0.1-1.4MPa/s
- Accuracy of ±1% of full scale
- Can be used in accordance with National & International Standards
- Interchangeable units: MPa, psi, Nmm2 and N

Reliable

- Repeatable and reproducible
- 2 year gauge warranty
- Batch date and time stamp facility

Easy

- Supplied in a robust plastic carry case for easy transportation
- USB and Bluetooth® data output to iPhone or Android™ devices
- Bright LCD colour screen

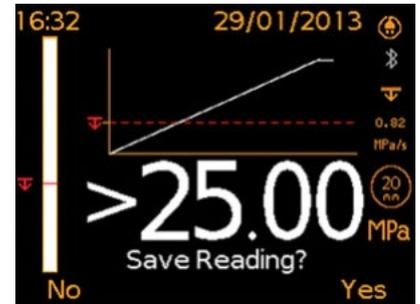
Elcometer 510 features explained:



Automatic adhesion tester with selectable pull rates for 10, 14.2, 20 & 50mm diameter dollies.



View adhesion trend graphs or live statistics alongside the reading value.



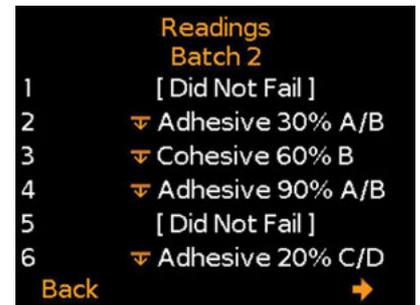
Individual user definable adhesion pull rate graphs can be saved with each reading.



Stores individual adhesion strength readings and pull rate graphs in up to 2,500 alpha numeric batches, together with date, time and attribute information.



Either pull to maximum or pull to preset limit. Unique time hold feature allows users to set a delay before pressure returns to zero.



Save cohesive and adhesive failure attributes alongside your adhesion pull data in accordance with National and International Standards.



Powered by either standard rechargeable batteries or AC mains*. Each battery charge performs up to 200 pulls. Battery recharge time less than 300 minutes.



Transfer data to your PC via USB or Bluetooth® for further analysis with ElcoMaster® software or view live pull rate graphs in ElcoMaster® during the test.



Using wireless Bluetooth® communication link the gauge to an Android™ or iPhone mobile device. Live GPS coordinates from your mobile device can be added to reports and emailed instantly



A range of standard and thin substrate actuator skirts allow each gauge to be use with 10, 14.2, 20 or 50mm diameter reusable dollies, ideal for testing coatings on thick, thin, flat or convex substrates



The optional magnetic anchor clamp ensures the actuator doesn't fall during tests on vertical surfaces or testing at height.



Supplied in a robust plastic carry case for easy transportation to and around the job site

Testing coatings on low bond strength substrates



When testing coatings on low bond strength substrates such as concrete, wood or other fibrous materials, a larger surface area of dolly (50mm) is required to provide accurate, repeatable and reproducible results. The Elcometer 510 is available as a Concrete Adhesion Tester Kit, or 50mm accessory items (skirt, dolly, cutter) can be added to existing Elcometer 510 adhesion kits

Technical Specifications

Part Number	Description	Certificate
F510-20S	Elcometer 510 Model S Automatic Adhesion Gauge; 20mm Kit	•
F510-20T	Elcometer 510 Model T Automatic Adhesion Gauge; 20mm Kit	•
F510-50S	Elcometer 510 Model S Automatic Adhesion Gauge; 50mm Concrete Kit	•
F510-50T	Elcometer 510 Model T Automatic Adhesion Gauge; 50mm Concrete Kit	•

• Calibration Certificate supplied as standard

Product Features

	Model S	Model T
Repeatable & reproducible measurements	■	■
Easy to use menu structure; multiple languages	■	■
Tough, impact, waterproof & dust resistant; equivalent to IP64	■	■
Bright LCD colour screen; with ambient light sensor	■	■
Scratch & solvent resistant display; 6cm (2.4") TFT	■	■
Calibration certificate	■	■
2 year gauge warranty	■	■
Automatic rotating display; 0°, 180°	■	■

Data output via USB (Live readings - and batch)	■	■
Data output via Bluetooth®		■
PC command; start & stop gauge from a PC with live readings (USB only)		■
Switchable Units (mPa, psi, N, Nmm-2)	■	■
On-Screen Statistics (η , x , σ , Hi, Lo, CV%, N>hi limit*)	■	■
Pull Rate Indicator	■	■
Trend Graph	■	■
Pull Rate Graph (Load v Time)		■
Interchangeable Dolly Selection; 10, 14.2, 20 & 50mm	■	■
User Selectable Pull Rates; (Model S & Model T Standard Mode)*		
10mm: 1.00, 2.00, 3.00, 4.00, 5.00 MPa/s	■	■
14.2mm: 0.4, 0.7, 1.4, 2.0, 2.5 MPa/s		
20mm: 0.2, 0.3, 0.7, 1.0, 1.2 MPa/s		
50mm: 0.04, 0.08, 0.12, 0.16, 0.20 MPa/s		
User Selectable Pull Rates; (Model T Advanced Mode)*		
10mm: 0.4 - 5.60 MPa/s		■
14.2mm: 0.2 - 2.80 MPa/s		
20mm: 0.1 - 1.40 MPa/s		
50mm: 0.02 - 0.22 MPa/s		
User Selectable Limit & Limit Hold Time		■
Gauge Memory; maximum number of readings	60	60,000*
Number of Batches (Alpha Numeric - Model T)	1	2.5
Attribute Modes to meet National & International Standards		■
Display Modes		
Readings, Selected Stats & Run Chart (last 20 readings)	■	■
Pull Rate Graphs		■
Batch Review		■
Power; Battery (B), AC Mains Power (M)	B	B, M
USB Cable & ElcoMaster® CD	■	■
Power Cable with Multi International Plug Adaptor (UK, EU, US, AUS)		■
Plastic Transit Case	■	■
Date & Time		■
In Field Adhesion Calibration Verification Mode	■	■

+ The Elcometer 510 is extendable within 60 days from date of purchase, free of charge, to 2 years

◆ Model T only

* When 'Rate Graph' is enabled, the number of readings which can be stored depends on the graph resolution selected

Technical Specifications

Pressure Accuracy	±1% of full scale			
Pressure Resolution	0.01MPa			
Pull Rate Accuracy	±(2.5% + 0.3 seconds)			
Pull Rate Resolution	0.01MPa			
Dolly Diameter	10mm	14.2mm	20mm	50mm
Operating Range	8 - 100 MPa	4 - 50 MPa	2 - 25 MPa	0.3 - 4 MPa
Pull Rate Range	0.4 - 5.6MPa/s	0.2 - 2.8MPa/s	0.1 - 1.4MPa/s	0.02 - 0.22MPa/s
Gauge Dimensions	260 x 100 x 66mm			
Actuator Height	85mm	85mm	85mm	110mm
Instrument Weight	2.9kg	2.9kg	2.9kg	3.1kg
Kit Weight	-	-	6.1kg	7.3kg
Power Supply	8 x AA NiMH/Alkaline batteries (16 rechargeable batteries supplied complete with charger) or AC mains power (Model T only)			
Battery Life	~200 pulls per charge up to 25MPa at 1MPa/s, recharge time less than 5 hours			

Packing List: 20mm Kit

Elcometer 510 Adhesion Tester with 20mm dollies (x10)
 Standard skirt for 20mm dollies
 20mm dolly cutter handle
 20mm dolly cutter
 Araldite standard two part epoxy adhesive (2 x 15ml tubes)
 Abrasive pad
 Shoulder harness
 Carry case
 16 x AA MiMH rechargeable batteries & charger
 Mains power supply (Model T)
 ElcoMaster® CD & USB cable
 Calibration certificate
 Operating instructions



Packing List: 50mm Kit

Elcometer 510 Adhesion Tester with 50mm dollies (x6)
 Standard skirt for 50mm dollies
 50mm dolly cutter arbor
 50mm dolly cutter
 Araldite standard two part epoxy adhesive (2 x 15ml tubes)
 Abrasive pad
 Shoulder harness
 Carry case
 16xAA MiMH rechargeable batteries & charger
 Mains power supply (Model T)
 ElcoMaster® CD & USB cable
 Calibration certificate
 Operating instructions



Create instant reports with ElcoMaster®

What you do with the collected data is just as important as taking the readings themselves.

ElcoMaster® is a fast, easy to use software solution for all your data management and quality assurance needs, preparing professional inspection reports at the click of a button.

Data transferred from the gauge to ElcoMaster® includes:

- Adhesion Measurements
- Date & Time
- Cohesive/Adhesive Failure Attributes
- Dolly size
- Pull rate graph
- Pull to Limit/Max
- Limit values
- Limit Hold Time
- Cutting Device
- Number of Layers
- Skirt Type/Support Ring Dimensions
- Batch Information & Statistics
- Calibration Information
- Calibration Verification Date/Time

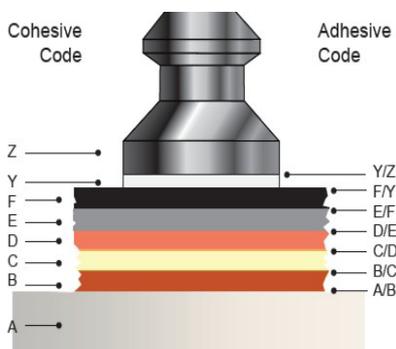
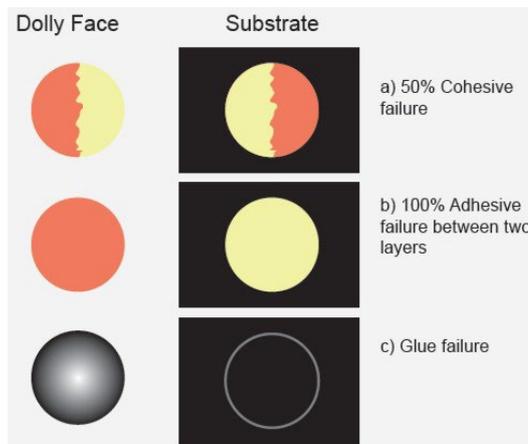


Assessing The Results - Failure Attributes

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 failure. This is done by examining the bottom of the dolly and assessing the failure. In 'Advanced' mode on the Elcometer 510 it is possible to select the 'Attributes' feature (Menu / Setup / Gauge Mode / Advanced) allowing the nature of the fracture to be recorded against each reading and stored within the batch.

Examining The Dolly

1. Cohesive Failure: The coating fails within the body of a coating layer leaving the same coating on the surface and on the dolly face.
2. Adhesive Failure: Failure occurs 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.
3. Glue Failure: When no coating is present on the dolly it must be recorded as a failure of the glue. This may be due to incorrect or insufficient mixing of the component parts of the adhesive, incompatibility between the adhesive / coating / dolly / test surface.



Cohesive Failure Layer^d

Code	Description
A	Substrate
B	Layer 1
C	Layer 2
D	Layer 3
E	Layer 4
F	Layer 5
Y	Glue

Adhesive Failure Layers

Code	Description
A/B	Substrate & Layer 1
B/C	Layer 1 & Layer 2
C/D	Layer 2 & Layer 3
D/E	Layer 3 & Layer 4
E/F	Layer 4 & Layer 5
F/Y	Layer 5 & Glue
Y/Z	Glue & Dolly

The data is saved in the batch and can be viewed at any time displayed as:

###.## MPa^e N% A M% A/B, where;

###.## MPa^e = Pull Force in MPa or other measurement units (psi, Newtons or Nmm-2)

N% = Cohesive failure percentage^f

A = Cohesive failure layer

M% = Adhesion failure percentage^f

A/B = Intercoat adhesive failure layers

^d 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.

^e Or equivalent units.

^f To the nearest 10%, in line with International Standards.

Accessories

Dollies



Dolly Diameter	Pack of 10*	Pack of 100
10mm	T5100014AL-10	T5100014AL-100
14.2mm	T9990014AL-10	T9990014AL-100
20mm	T9990020AL-10	T9990020AL-100
50mm	T9990050AL-4	-
50mm Stainless Steel	T9990050SS-4	-

*50mm dollies are supplied in packs of 4.

Dolly Skirts



Diameter	Standard Skirt	Thin Substrate Skirt
10mm	T999101420S	-
14.2mm	T999101420S	T9990014T
20mm	T999101420S	T9990020T
50mm	T9990050S	-
50mm Stainless Steel	-	-

Adhesion Verification Unit



Part Number	Description
T99923924	Elcometer AVU Adhesion Verification Unit
T99923924C	Elcometer AVU Adhesion Verification Unit - Certified

Dolly Cutters



Diameter	Dolly Cutter Handle	Dolly Cutter
10mm	-	-
14.2mm	T9991420H	T9990014CT
20mm	T9991420H	T9990020CT
50mm	T9990050H	T9990050CT
50mm Stainless Steel	-	-

Magnetic Anchor Clamp



Part Number	Description
T99923797	Magnetic Anchor Clamp - holds actuator securely during tests on vertical surfaces

Adhesive



Part Number	Description
T99912906	Araldite Standard Two Part Epoxy Adhesive, 2 x 15ml Tubes

Dolly Cleaning Heating Tong

Part Number	Description
T99923147	Dolly Cleaning Heating Tong - EUR 220V / UK 240V

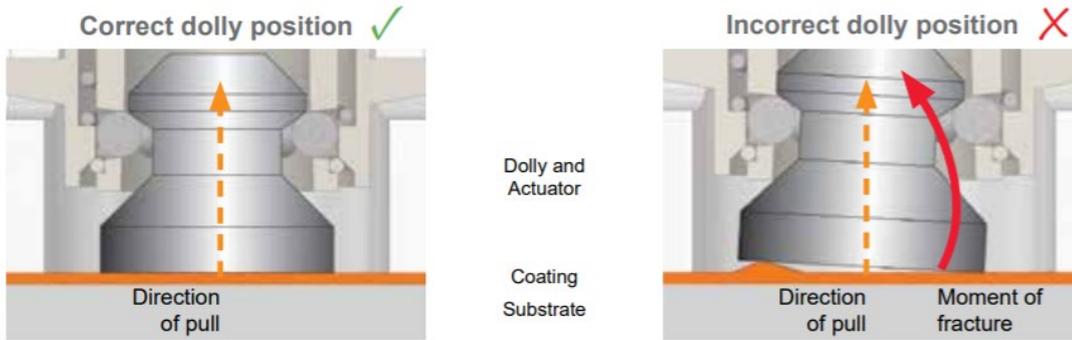
Pull-Off Adhesion Tests - Preventing Adhesive and Cohesive Failures

Preparing the surface and dolly

1. Select an appropriate test area which is flat and has sufficient area to attach the adhesion gauge.
2. Abrade the dolly and surface, clean both to remove any dust - minimising the risk of an 'adhesive' failure.

Fixing the dolly

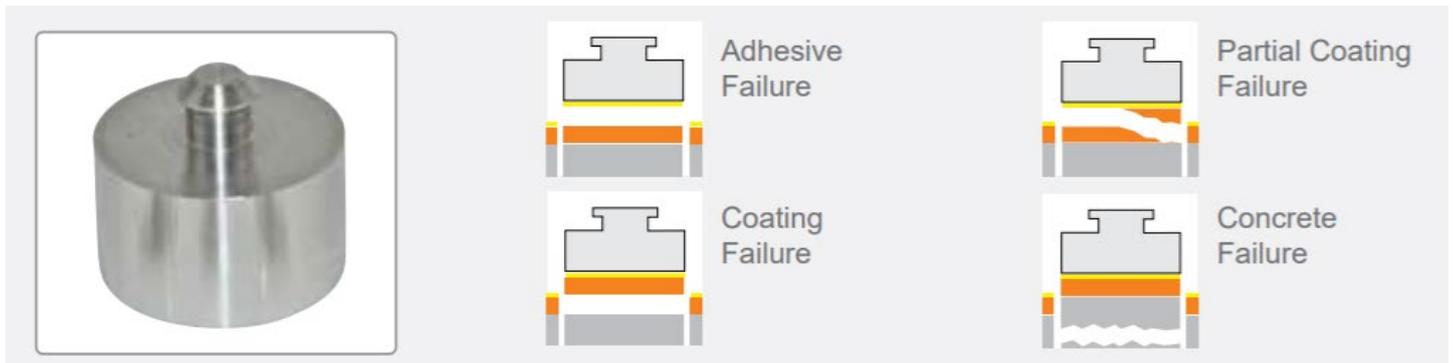
3. Mix the adhesive correctly and apply a uniform adhesive film over the entire dolly face.
4. Test Standards require that the dolly is pulled off perpendicularly to the test surface. The dolly must therefore be adhered on to a prepared flat test surface (see images below). Apply an even pressure to the dolly to ensure that the dolly face is parallel to the test surface.
5. Remove any excess adhesive from around the dolly and allow to fully cure. Tape maybe required when applying dollies to vertical surfaces during the cure process.
6. If required, once the dolly has fully cured, score the coating around the dolly using the dolly cutter provided.
7. Attach the gauge actuator to the dolly and begin test.



Assessment of the Adhesion Test

For a valid pull test the coating must cover at least 50% of the area of the dolly face. If the glue fails and no coating is present on the dolly, or it covers less than 50% of the dolly face area, the pull-test is invalid and should be repeated. When the coating has failed within the layer leaving the same coating on both the dolly and the test panel it is known as a 'cohesive failure'. 'Adhesive failures' occur when either the coating has failed at the interface with another coating (leaving a coating on the dolly and another coating on the substrate), or when the coating has failed at the substrate (leaving the coating on the dolly and the substrate bare). NOTE: If the glue fails at a value above the specification then it can be reported that the adhesion exceeded the specification for this individual test.

Coating Adhesion Testing on Concrete



Video



YouTube Video - An Introduction to Pull-Off Adhesion on Coated Surfaces (Click on the image to the left to view the video)

Adhesion testers are used to test how well a coating has adhered to a surface, as poor adhesion can lead to premature coating failures. The coating inspector has essentially three main methods to choose from - cross hatch, push off, and the most common, the pull-off adhesion test.