

PosiTest[®]

Pull-Off Adhesion Tester

INSTRUCTION MANUAL v. 4.0

PosiTest AT-M
(manual)



PosiTest AT-A
(automatic)

DeFelsko[®]

Introduction

The portable, hand-operated *PosiTest Pull-Off Adhesion Tester* measures the force required to pull a specified test diameter of coating away from its substrate using hydraulic pressure. The pressure is displayed on a digital LCD and represents the coating's strength of adhesion to the substrate.

In accordance with ASTM D4541, D7234, ISO 4624 and others, the *PosiTest* evaluates the adhesion (pull-off strength) of a coating by determining the greatest tensile pull-off force that it can bear before detaching. Breaking points, demonstrated by fractured surfaces, occur along the weakest plane within the system consisting of the dolly, adhesive, coating layers and substrate.

NOTE: Throughout this manual, the (W) symbol indicates more information about the particular topic or feature is available on our website.

Basic steps for testing coating adhesion with a PosiTest Adhesion Tester:

1. Dolly & Coating Preparation

The dolly and the coating are cleaned and abraded. (see pg. 4)

2. Adhesive & Dolly Application

The adhesive is prepared and applied to the dolly. The dolly is then adhered to the coated surface and the adhesive is allowed to cure. (see pg.4)

3. Test Area Separation - *Optional step*

The test area of the coating is separated from the area surrounding the dolly by cutting or drilling. (see pg. 5)

4. Pull-off Test

a) PosiTest AT-M (manual) (see pg. 6)

b) PosiTest AT-A (automatic) (see pg. 8)

5. Analysis of Test Results

The dolly and the coating are examined and evaluated to determine the nature of the coating failure. (see pg. 10)

6. Store Pull-Off Test Results - *Optional step*

The PosiTest's internal memory stores maximum pull pressure, pull rate, test duration and dolly size for up to 200 pulls. (see pg. 10)

Step 1: Dolly & Coating Preparation

Dolly Preparation

1. To remove oxidation and contaminants, place the included abrasive pad on a flat surface and rub the base of the dolly across the pad 4-5 times.
2. As required, remove residue left from the abrading process using a dry cloth or paper towel.

Coating Preparation

1. Lightly roughen the coating using the included abrasive pad.

NOTE: As coating abrasion may introduce flaws, it should only be used when necessary to remove surface contaminants, or when the bond strength between the adhesive and the coating is insufficient for pull testing.

2. To promote the bond between the dolly and the coating, degrease the area of the coating to be tested using alcohol or acetone to remove any oil, moisture or dust.

NOTE: Ensure that any alternative abrasion techniques, degreasers or adhesives do not alter the properties of the coating. Test by applying a small amount of degreaser or adhesive to a sample area and observing effects.

Step 2: Adhesive & Dolly Application

Adhesive Selection

The adhesive included in the PosiTest Adhesion Tester kit has been selected due to its versatility. This adhesive has minimal impact on a variety of coatings and has a tensile strength exceeding the maximum performance capabilities of the pressure system under ideal conditions. Other adhesives may be preferred based on requirements such as cure time, coating type, working temperature and pull-off strength. Quick curing one-part cyanoacrylates (super glues) may be sufficient for painted surfaces, but two-part epoxies are preferred for porous or rough coatings.

Dolly Application

1. Mix the adhesive per manufacturer's instructions and apply a uniform film of adhesive on the base of the dolly (approximately 2-4 mils or 50-100 microns for best results)
2. Attach the dolly to the prepared coating test area.

NOTE: If the coated surface to be tested is overhead or vertical, a means to hold the dolly in place during the cure time may be required, i.e. removable tape.

3. Gently push down on the dolly to squeeze out excess adhesive. Do not twist or slide the dolly back and forth on the coating as air bubbles may be generated.
4. Carefully remove excess adhesive from around the edges of the dolly with included cotton swabs.
5. Allow to cure per the adhesive manufacturer's instructions

NOTE: Many adhesives cure faster and provide a stronger bond when cured with heat. Similarly, cold environments may cause a longer cure time and weaker bond strength.

Step 3: Test Area Separation

The decision of when to cut around a dolly is dependent on the standard, specification or contractual agreement to which the test is to comply. The primary purpose for cutting through the coating is to isolate a specific diameter test area. When the decision to cut into the coating has been made, it is recommended to cut all the way through to the substrate. As a minimum, it is suggested to carefully cut away excess adhesive from the dolly application process. This typically prevents a larger area of coating from being pulled away from the substrate, resulting in a higher pull-off pressure.

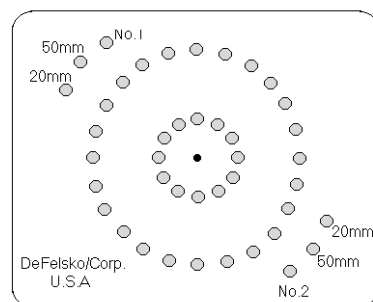
Cutting Instructions

1. Cut through the coating around the edges of the dolly with the included cutting tool, removing any excess adhesive.
2. Clear away any debris from the cutting process.

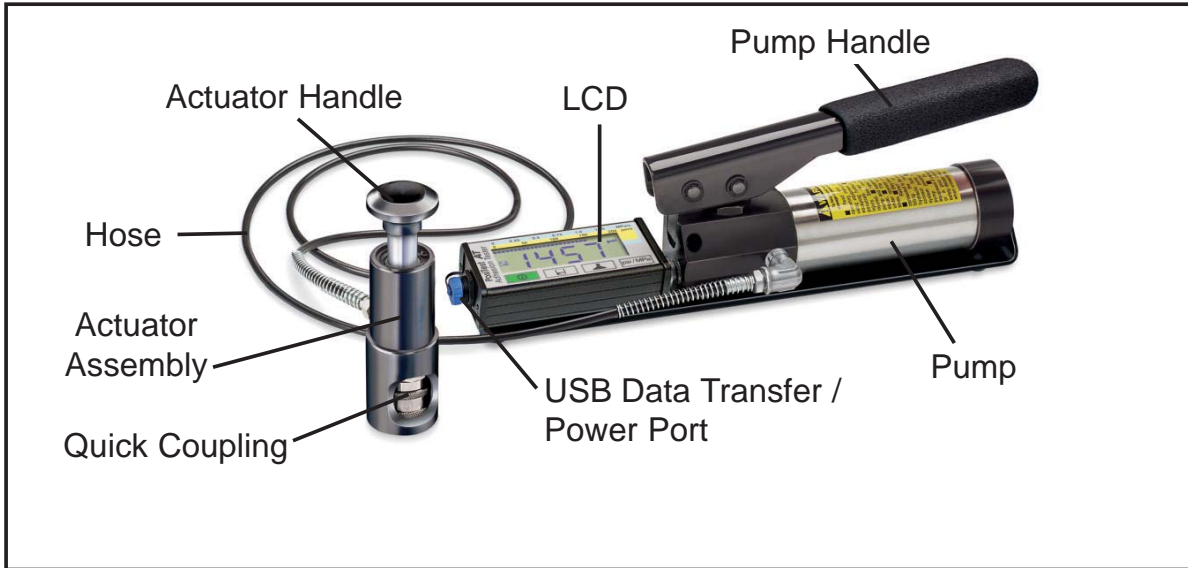
NOTE: - Cutting may induce coating surface flaws such as microcracking that may alter test results.
- For coatings with strong lateral bonding it is recommended to cut completely through the coating down to the substrate.


Drilling Template

When testing very thick coatings, an optional drilling template may be preferred.




Step 4a: Pull-Off Test *(PosiTest AT-M Manual)*

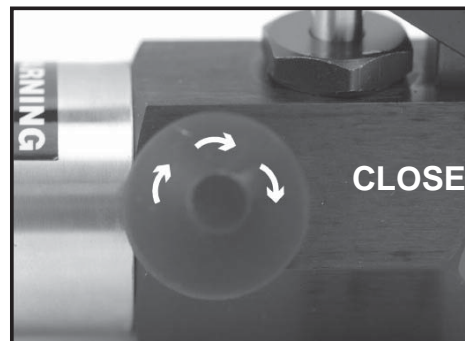
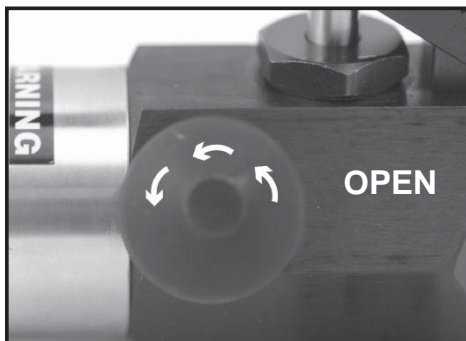


The *PosiTest AT-M* powers-up and displays dashes when the  button is pressed. To preserve battery life, the instrument powers down after 5 minutes of no activity.

Quick Guide




- (1) **Open** the pressure relief valve completely (turn counter clockwise)
- (2) **Connect** the actuator to the dolly
- (3) **Close** the pressure relief valve completely (turn clockwise)
- (4) **Zero** - Press the  Zero button.
- (5) **Pump** pressure into the system until the dolly pulls the coating away


1. Ensure the pressure relief valve on the pump is **completely open**. (turn counter clockwise)



2. Push the actuator handle completely down into the actuator assembly. Place the actuator assembly over the dolly head and attach the quick coupling to the dolly by reaching through the holes in the actuator assembly and lifting the quick coupling. Release the quick coupling when the dolly head is completely engaged.

3. Close the pressure relief valve on the pump **completely**. (turn clockwise)

NOTE: As required, verify and adjust the dolly size by pressing the  button. Select the pressure units by pressing the  button. The instrument will maintain these adjustments even after the  button is pressed.

4. Zero the instrument **BEFORE** pumping by pressing the  button. This prepares the instrument for the test by clearing the display, and zeroing the instrument.

5. Prime the pump slowly until the displayed reading approaches the priming pressure. The priming pressure is the point that the instrument begins calculating and displaying the pull rate. It is also the pressure at which the ability to store readings is enabled. Priming pressures for the various dolly diameters are:

10 mm	400 psi	2.8 MPa
14 mm	200 psi	1.4 MPa
20 mm	100 psi	0.7 MPa
50 mm	50 psi	0.4 MPa

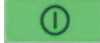
NOTE: For optimum results, prior to exceeding the priming pressure, return the pump handle to its full upright position and then complete a **single stroke** at the desired pull rate until the actuator separates the dolly from the coating.

6. Open the pressure relief valve and remove the dolly from the actuator assembly.

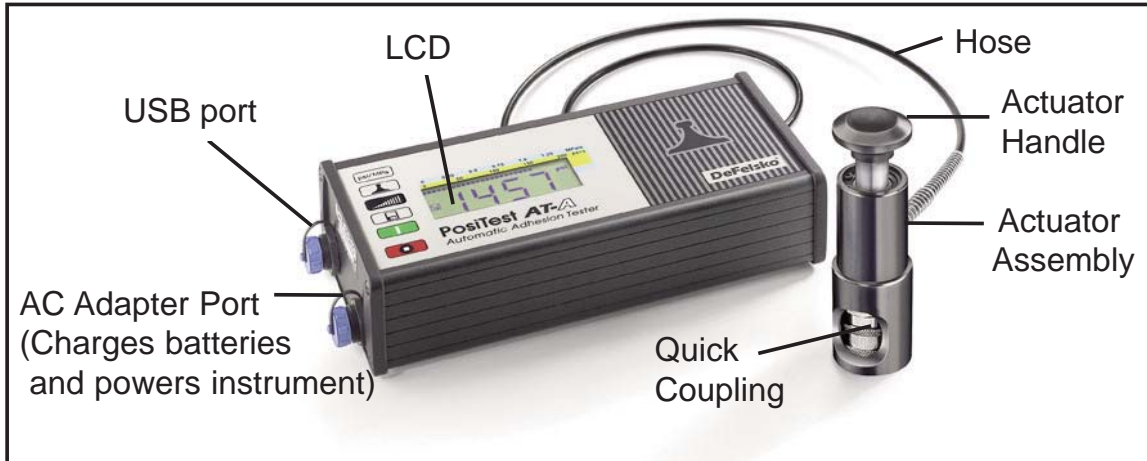
7. Readings may be stored into memory by pressing the  button (pg. 10).

Troubleshooting (PosiTest AT-M) (W)




Digital display “freezes” at a low value

The Tester uses a sudden drop in actuator pressure as an indication that the dolly has been pulled from the surface. The test stops and the highest pressure remains on the display for easy viewing and recording. Pumping up pressure too quickly at the beginning of a test can cause a sudden pressure pulse, fooling the Tester into thinking the test is complete. If this happens, restart the test by opening the pressure relief valve, closing it, then pressing the  button. For more information, see Step 5 above.



Step 4b: Pull-Off Test (PosiTest AT-A Automatic)




Quick Guide

- (1) **Connect** the actuator to the dolly
- (2) **Power-up** with the  button
- (3) **Verify** measurement units, dolly size and pull rate
- (4) **Ready** the instrument with the  button
- (5) **Test** with the  button


1. Place the actuator assembly over the dolly head and attach the quick coupling to the dolly by reaching through the holes in the actuator assembly and lifting the quick coupling. Release the quick coupling when the dolly head is completely engaged.

2. Press the  button to power-up the instrument if necessary. The instrument will power-down after 5 minutes of no activity or by holding the  button for 2 seconds.


3. Check settings:


(a) Verify displayed measurement units. Change with the  button if necessary.

(b) Verify dolly size with the  button and change if necessary.

(c) Verify pull rate with the  button and change if necessary. The following user selectable rates are available:


Dolly Size	PSI Rates	MPa Rates
10 mm	125, 200, 400, 600, 725	1.00, 2.00, 3.00, 4.00, 5.00
14 mm	60, 100, 200, 300, 360	0.40, 0.70, 1.40, 2.00, 2.50
20 mm	30, 50, 100, 150, 180	0.20, 0.30, 0.70, 1.00, 1.20
50 mm	5, 8, 16, 24, 30	0.04, 0.08, 0.12, 0.16, 0.20

4. Press the  button to ready the instrument. This prepares the PosiTest for the test by clearing the display and zeroing the instrument.

5. Press the  button again to start the test that consists of 4 stages that occur *automatically*:

Stage 1. Initiation - the display shows a blinking "0".

Stage 2. Priming - the pump applies initial pressure to the dolly.

Stage 3. Test - when the priming pressure has been achieved (see step 5 on pg. 7) the instrument begins calculating and displaying the pull rate established by the user. Pressure build-up stops when the dolly is pulled from the surface or when the  button is pressed.

Stage 4. Retraction - the maximum pull-off pressure value blinks on the display while the pump retracts the actuator. The buttons are locked during this stage.




CAUTION: *To avoid injury, keep fingers away from the quick coupling and actuator assembly until the pull test has completed and the actuator has been fully retracted. Press  to stop the pull test at any time.*

6. Remove the dolly from the actuator assembly.

7. Readings may be stored into memory by pressing the  button (pg. 10).

All settings and test results in memory are retained during power-down.

The red  button may be pressed to stop the pull test at any time. The maximum pressure value will remain on the display while the pump retracts the actuator. This value can be stored into memory and will be uniquely identified by the optional PosiSoft software. Stopping the pull test before destruction is handy when specifications allow the test to be stopped when required adhesion strengths have been exceeded. Uncouple the actuator from the dolly and then remove the dolly from the surface with a sharp, sideways hammer tap.

Troubleshooting (PosiTest AT-A) (W)

Instrument is unresponsive or will not power down



In the unlikely event that the PosiTest becomes unresponsive or will not power down, press and hold the  button, then press the  button. The instrument will power down.




Step 5: Analysis of Test Results



Test results can be considered 100% valid when the coating is completely removed from the substrate. When only a portion of the coating is removed, specific results should be noted including the fracture pattern to determine the cohesive properties of the coating and adhesion properties between the dolly and adhesive, adhesive and coating, distinct coating layers, and coating and substrate.

Step 6: Storing Pull-Off values into Memory

The PosiTest's internal memory stores maximum pull pressure, pull rate, test duration and dolly size for up to 200 pulls.

Press the  button upon completion of a test to store pull-off test results. The display will show the pull rate and alternate between the test number and the maximum pull pressure for that test. The  icon will appear to indicate that there are test results in memory.


Press the  button repeatedly to view previously stored test results. The *PosiTest AT-A* also displays dolly size  and pull rate  by pressing their respective buttons.

Complete information on all test results can be downloaded to a PC and viewed using the optional PosiSoft software. Test results are not erased from memory after downloading. Press  (*AT-M manual*) or  (*AT-A automatic*) to exit viewing mode.

To remove all stored test results from memory, press and hold the  or  button, then press the  button. The  icon will disappear from the display.

All settings and test results in memory are retained during power-down.


Available Options

A variety of accessories are available to help you get the most out of your PosiTest Pull-Off Adhesion Tester. 

Power Supply / Low Battery Indicator

PosiTest AT-M (manual)

Power Source: Built-in rechargeable NiMH battery (~60 hours continuous)


The built-in rechargeable NiMH batteries** are charged using the included USB AC power supply/charger. Ensure batteries are charged prior to use. The  symbol will blink while the instrument is recharging and disappear when fully charged. The charging process will take up to 14 hours depending on remaining battery power.

Alternatively, the AC power supply or any computer USB port can be used to power and charge the instrument.

PosiTest AT-A (automatic)

Power Source: Built-in rechargeable NiMH battery (>200 pulls with full charge)

The  symbol will appear when remaining battery power is below 35%.

The built-in rechargeable NiMH batteries** are charged using the included AC power supply/charger. Ensure batteries are charged prior to use. The  symbol will blink while the instrument is recharging and disappear when fully charged. The charging process will take 2-3 hours depending on remaining battery power. Alternatively, the AC power supply can be used to power the instrument.

NOTE: The USB port will not charge or power the *PosiTest AT-A*. The USB connection will drain battery power when connected for an extended period of time.

****Do not attempt to remove or replace the internal NiMH battery pack. In the unlikely event power issues are experienced, please contact our technical support for assistance.**

Technical Data

Conforms to: ASTM D 4541, ASTM D 7234, ISO 4624 and others.

Specifications: Resolution: 1 psi (0.01 MPa) Accuracy: ±1% Full Scale

	Dolly Size (mm)	Max Pull-Off Pressure
Adhesion Strength	10 mm	10,000 psi (70 MPa)
	14 mm	6,000 psi (40 MPa)
	20 mm	3,000 psi (20 MPa)
	50 mm*	500 psi (3.5 MPa)

*requires optional 50 mm accessory kit

Calibration

The PosiTest is shipped with a Certificate of Calibration showing traceability to a national standard. For organizations with re-certification requirements, the PosiTest may be returned at regular intervals for calibration. DeFelsko recommends that our customers establish the instrument calibration intervals based upon their own experience and work environment. Based on our product knowledge, data and customer feedback, a one year calibration interval from either the date of calibration, date of purchase, or date of receipt is a typical starting point.

Returning for Service

There are no user serviceable components. Any service must be performed by DeFelsko Corporation.

If you need to return the Instrument for service, describe the problem fully and include reading results, if any. Be sure to include contact information including your company name, company contact, telephone number and fax number or email address.

Limited Warranty, Sole Remedy and Limited Liability

DeFelsko's sole warranty, remedy, and liability are the express limited warranty, remedy, and limited liability that are set forth on its website:



© DeFelsko Corporation USA 2011. All Rights Reserved

This manual is copyrighted with all rights reserved and may not be reproduced or transmitted, in whole or part, by any means, without written permission from DeFelsko Corporation.

DeFelsko, PosiTector, PosiTest and PosiSoft are trademarks of DeFelsko Corporation registered in the U.S. and in other countries. Other brand or product names are trademarks or registered trademarks of their respective holders.

Protection provided by the equipment may be impaired if the equipment is used in a manner not specified by the manufacturer.

Every effort has been made to ensure that the information in this manual is accurate. DeFelsko is not responsible for printing or clerical errors.

DeFelsko®

Simple. Durable. Accurate.



© DeFelsko Corporation USA 2011
All Rights Reserved

This manual is copyrighted with all rights reserved and may not be reproduced or transmitted, in whole or part, by any means, without written permission from DeFelsko Corporation.

DeFelsko, PosiTector and PosiSoft are trademarks of DeFelsko Corporation registered in the U.S. and in other countries. Other brand or product names are trademarks or registered trademarks of their respective holders.

Every effort has been made to ensure that the information in this manual is accurate. DeFelsko is not responsible for printing or clerical errors.