DeFelsko®

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Calibration Procedure

DeFelsko Corporation

PosiTest AT-M & AT-A

Pull-Off Adhesion Tester

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1 Introduction and UUC Performance Requirements

1.1 This procedure describes the calibration of DeFelsko Corporation PosiTest AT-M and AT-A Pull-Off Adhesion Testers with the following specifications:

Table 1-1 Measurement Ranges

Unit	Measurement Range
PosiTest AT-M & AT-A	3000 Psi Max.* (20 MPa Max.)

* when using 20mm dolly

1.2 The unit being calibrated will be referred to as the UUC (Unit-Under-Calibration).

2 Measurement Standards and Support Equipment Performance Requirements

2.1 The UUC accuracy requirements are based upon the published UUC performance specifications.

2.2 The test uncertainty ratio applied in this Calibration Procedure is 4:1 unless otherwise stated.

2.3 The Minimum-Use-Specifications are the minimum test equipment specifications required to meet all the UUC accuracy requirements and the test uncertainty ratio applied.

Table 2-1 UUC Accuracy Requirements and Description

UUC	Performance Specifications		Test Method
AT-M & AT-A	3000 Psi Max. (20 MPa Max.)	± 1% of Full Scale	Load Cell

Table 2-2 Minimum use specification

Range	Accuracy
0 – 3000 Psi (0 – 20 MPa)	± 7.5 Psi (± 0.05 MPa)

Table 2-3 Actual Equipment Specification

Equipment Generic Name	Range	Accuracy	Manufacturer / Model #'s Applicable
Load Cell and Display	0 – 10269 Psi (0 – 70 MPa)	± 6.53 Psi* (± 0.04 MPa)	Transducer Techniques Smart Sensor Indicator (SSI) and SB0-5K load cell

*See section 2.4 for determination of system accuracy

***Caution*:** The instructions in this Calibration Procedure relate specifically to the equipment and conditions listed in Section 2. If other equipment is substituted, the information and instructions must be interpreted accordingly.

Table 2-4 Calibration Environmental and Warm-Up Requirements

Measurement Standards & Support Equipment Environmental Requirements:	Temperature: 23 ± 5° C. Relative Humidity: Less than 95%
Measurement Standards & Support Equipment Warm-up and Stabilization Requirements:	Not Required

2.4 The uncertainty of the load cell and display is determined in the following manner:

2.4.1 Manufacturer's specifications for the maximum errors of the load cell are:
Non-linearity: 0.05 % FS (full scale)
Non-repeatability: 0.03 % FS
Hysteresis: 0.02 % FS

Full scale on the load cell is 5000 lbs and applying the surface area of the 20mm dolly (0.4869 in^2) this is equivalent to 10269 psi. With the 10269 psi FS value the load cell Non-linearity, Non-repeatability and Hysteresis errors become 5.1345, 3.0807 and 2.0538 psi respectively.

2.5 The error contributed to the measurement system by the SSI is determined as follows:

2.5.1 The manufacturer's calibration certificate indicates the load cell output when increasing in tension at 2500 lbs. This value varies for each load cell and is typically 1.5724 mV/V. The system uses a 3.0 V excitation so 3.0 V x 1.5724 mV/V = 4.7172 V at 2500 lbs.

2.5.2 Using the 20mm dolly surface area of 0.4869 in^2 and dividing the load, 2500 lbs, by the dolly surface area yields 5134 psi.

2.5.3 Therefore we have 5134 psi at 4.7172 V or 1088.3575 psi/V.

2.5.4 The SSI has a published accuracy of +/- 0.0015 V at 25^oC. So 1088.3575 psi/V x 0.0015 V = +/- 1.6325 psi.

2.6 Performing a sum of squares on the system to determine the combined uncertainty yields:

$$+/- (SSI^2 + \text{Non-linearity}^2 + \text{Non-repeatability}^2 + \text{Hysteresis}^2)^{1/2}$$
$$+/- (1.6325^2 + 5.1345^2 + 3.0807^2 + 2.0538^2)^{1/2}$$
$$+/- (42.7369)^{1/2}$$
+/- 6.5373 psi

3 Preliminary Operations

Note: Review the entire document before starting the calibration process.

3.1 Visual Inspection

3.1.1 Visually inspect the UUC for:

- damage to LCD readout, keypad, hose, enclosure, or quick disconnect coupling
- missing USB and/or power port covers
- proper identification

3.1.2 Damage or excess wear shall be repaired prior to beginning the calibration process.

3.2 Attach the quick disconnect from the UUC to the load cell dolly and ensure that there is no tension on the dolly and that the actuator is loose on the dolly. Zero the load cell by cycling the power to the SSI display unit. Press the Peak button on the SSI display to engage Peak reading mode. Make sure that the “FAST”, “Peak”, and “PSI” are all displayed on the SSI display unit.

3.3 Press the green button on the UUC twice, the gage will turn on and then display zero.

3.4 Press the dolly button until “20” is displayed.

3.5 Press the “psi/MPA” button until “psi” is displayed.

3.6 For AT-A only, press the rate button until “100” is displayed.

3.7 Review the Performance Requirements Table 6-1.

3.8 For AT-Ms, perform the calibration steps in Section 4. For AT-As, perform the calibration steps in Section 5.

4 AT-M Calibration Process

Note: Whenever the test requirement is not met, verify the results of each test and take corrective action before proceeding.

4.1 Turn the pressure release knob clockwise to close the valve.

4.2 Pump the handle a couple of times until the slack comes out of the quick disconnect/dolly assembly.

4.3 Pump at an even rate until the value displayed on the UUC approaches 500 +/-25 psi. As you approach the target value slow the rate of pressure until the value displayed on the UUC is within the range shown in Figure 4-1.

4.3.1 If you overshoot the target value you will need to turn the pressure release knob counter-clockwise to release all pressure and then return it to the closed position. Cycle the power on the SSI display unit to zero the load cell. Put the display unit back into Peak mode and retest the calibration point.

Figure 4-1

UUC target value (psi)		
Minimum	Nominal	Maximum
475	500	525
975	1000	1025
1475	1500	1525
1975	2000	2025
2475	2500	2525
2975	3000	3025

4.4 Record both the Target (load cell display) and Test Reading (UUC) values.

4.5 Repeat steps 4.3 and 4.4 for the remaining UUC target values shown in Figure 4-1.

4.6 Release the pressure in the UUC by fully rotating the knob counter-clockwise and then remove the UUC actuator from the load cell.

4.7 Determine the allowed range of readings for the UUC using the calculation methods shown in Table 6-1.

5. AT-A Calibration Process

Note: Whenever the test requirement is not met, verify the results of each test and take corrective action before proceeding.

5.1 Press the green start button on the UUC and let the unit build pressure until the value displayed on the UUC approaches 500 +/-25 psi. Press the red stop button once the UUC is at the nominal reading shown in Figure 5-1. The pressure will be released from the unit and the peak value will be displayed.

5.1.1 If you overshoot the target value you will need to press the red stop button and wait for the UUC to stop retracting. Cycle the power on the SSI display unit to zero the load cell. Put the display unit back into Peak mode and retest the calibration point.

Figure 5-1

UUC target value (psi)		
Minimum	Nominal	Maximum
475	500	525
975	1000	1025
1475	1500	1525
1975	2000	2025
2475	2500	2525
2975	3000	3025

5.2 Record both the Target (load cell display) and Test Reading (UUC) values.

5.3 Repeat steps 5.1 and 5.2 for the remaining UUC target values in Figure 5-1 as displayed on the UUC display.

5.4 Remove the UUC actuator from the load cell.

5.5 Determine the allowed range of readings for the UUC using the calculation methods shown in Table 6-1.

6. Performance Requirements

Table 6-1 Performance Requirements and Calibration Data for PosiTest AT-M & AT-A

Target Load Cell Value (psi)	Min. Reading Allowed❶ (psi)	Test Reading (UUC) (psi)	Max. Reading Allowed❷ (psi)
A			

❶Calculation (A – 30). Round up to the nearest 1 Psi increment
❷Calculation (A + 30). Round down to the nearest 1 Psi increment.