



Adelaide Testing Machines Inc.
61 Advance Road Units 5 and 6
Toronto, Ontario, Canada M8Z 2S6
Phone No. Canada and U.S.A.: 1-800-665-8817
Local and International: 1-416-234-0786
Fax No.: 1-416-234-1369
E-mail: atmnc@on.aibn.com
Website: www.adelaidetesting.com

Model TO-15
Tensile/Compression/Torsion Testing Machine
Specification Sheets

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1.0 Introduction to the Model TO-15 Testing Machine

The Model TO-15 is a computer controlled bench mounted testing machine for performing both rotational torsion, tensile, and compression testing. The test machine was originally designed for performing rotational torque rupture testing on small diameter steel wire with the capability of maintaining a constant axial load on the wire as the rotations were applied. The Model TT-100 software was designed to perform this type of test. The flexibility of the software also allows the machine to be used for a wide variety of applications in both Quality Control and Research and Development testing of other products and components. Additional software packages are also available for performing tensile/compression, constant load creep, and low cyclic fatigue tests (ie. < 1 Hz.). Axial testing may be performed up to 200 lb (1 kN) with tension/compression rated load cells. The Model TO15B-x series biaxial type load cells used with the TO-15 are rated for 11 lb (50 N) maximum axial loads.

The mechanical design of the TO-15 consists of a torsion output shaft protruding through the platen of the testing machine which is connected to the lower torsion loading grip. The drive motor is a DC servo electric motor with encoder feedback operating in a closed loop control mode for accurate speed control. The vertical position of the axial loading platform is controlled by a second DC servo motor with encoder feedback. Figure 1 shows an overall view of the testing machine complete with a computer control system.



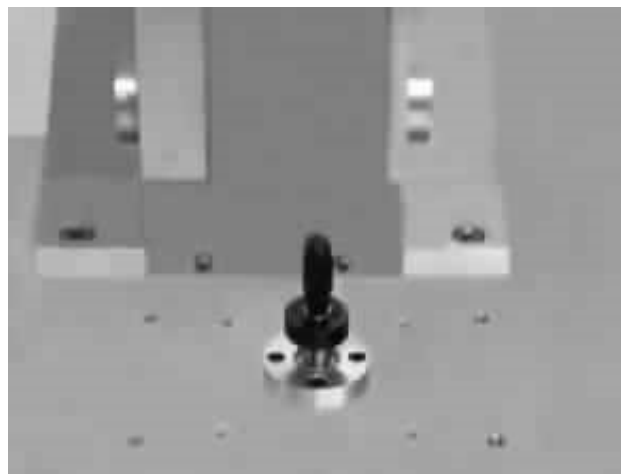
Figure 1
Overall View of the Model
TO-15 Tension/Torsion
Testing Machine and
Computer Control System

Views of the biaxial load cell and grips used on the TO-15 for performing torque testing on wire are shown in Figures 2 and 3. Figure 2 shows a Model T015B-x type biaxial load cell mounted on the axial loading platform with the upper collet attached. The collet grips come complete with three different sizes of collets for gripping round wire in the range from 0.0 - 2.5 mm (0.000 - 0.098 in) diameter. Figure 3 shows a view of the lower collet grip which is mounted in the center of the rotary output shaft using a split type collar.



Figure 2
Close up View of the
Load Cell with the Upper
Collet Grip Attached

Figure 3
View of the Rotary Output
Shaft with the Lower Collet
Grip in Place



2.0 Mechanical Specifications

A summary of the mechanical specifications of the TO-15 given as follows:

1. Rotational Test Speed Range: 0.05 - 100 RPM at 15 lb*in torque
(0.30 - 630 rad/s at 1,700 N*mm torque)

Axial Loading Range: 0.002 - 2.000 in/min at 200 lb load
(0.05 - 50 mm/min at 1 kN load)
0.020 - 20 in/min at 50 lb load
(0.50 - 500 mm/min at 250 N load)

2. 30 in (76 cm) maximum specimen length. Other lengths available on special order.
3. Machine Stiffness: 20,000 lb/in measured at 18 in height position
(3 kN/mm measured at 46 cm height position)
4. Loading mechanism consists of a mechanically speed reduced output shaft protruding through the platen of the test machine which is connected to the torsion loading collet grip. The axial loading platform is positioned vertically along a rigid linear bearing by a ball screw mechanically coupled to a driving motor. The load cell is mounted on the lower surface of the axial loading platform.
5. The two drive motors are DC servo motors with rear shaft mounted encoders. The encoders are used for output shaft angular position and angular speed calculations for the rotary shaft and axial loading platform position and linear speed calculations for axial loading.
6. Overall Dimensions of Test Machine Base:
16 in wide x 18 in deep x 8 in height
(40.6 cm wide x 45.7 cm deep x 20.3 cm height)
Overall Machine Height: 53.5 in (136 cm)
7. Weight/Mass of Test Machine:
Net: 120 lb (55 kg)
Gross Shipping: Approx. 200 lb (90 kg)
8. Power Supply Requirements:
60 Hz Model: 110 - 120 VAC at 5 A, 1 phase
50 Hz Model: 220 - 240 VAC at 2.5 A, 1 phase
Other power supply versions available upon request.

**All Specifications and Dimensions are Subject to
Modifications without prior Notice**

3.0 Computer Requirements and Motor Control System

The Model TO-15 requires an IBM compatible Pentium type PC system with a color display, hard drive, read/writable CD or DVD drive, and a Windows compatible printer for printing test reports. One unused PCI slot must be available on the PC for the servo controller / data acquisition card. The ATM software requires Microsoft Windows2000 or the WindowsXP operating system. The motor control and data acquisition hardware consists of the PCI card, a motor control electronics system, and a combined DC and AC conditioners system. The PCI card features include a combination of 12 bits resolution A/D channels and 2 channel servo motor controller capability. A 16 bits A/D resolution is available as an Option. The PCI card uses the encoder feedback signals from the torsion and axial drive motors and software commands to produce the motor control system command signals for the axial and torsion motors. The motor control system consists of a DC power supply for powering the DC servo motors and individual DC servo amplifiers for amplification of the servo controller card command signals.

Note: A 4 channel DC conditioner board is available as an option with the TO-15 as a substitute for the standard 2 channel AC / 2 channel DC conditioner board. The 4 channel DC conditioner board is recommended in systems that may require additional load cells and extensometers for the tests to be performed on the system.

Two selector switches mounted on the front panel of the test machine base are used for Manual Control positioning of the axial loading platform and rotary output control. The loading platform and rotary axis is moved using the left spring loaded selector switch labelled Down/Rev / Up/Fwd. The right selector switch labelled Slow/Fast is used to select the speeds of the manual positioning motion. The speeds corresponding to the Slow/Fast positions are set from within the software. Two DC and two AC conditioners are provided in the base of the testing machine on a single circuit board. All of the input connections from the rear panel and front mounted Manual Control switches are made to this board through connectors. The DC conditioners can be used for excitation and amplification of the ATM line of full Wheatstone bridge type load cells. The AC conditioners are used for excitation and amplification of LVDT type devices including certain types of extensometers and other position feedback transducers. Provision is made on the base rear panel for monitoring the conditioner output signals through female type BNC connectors. The 15 turn potentiometers accessible through a slot in the base right side panel are used for the 2 DC conditioners for electrical adjustment of the Gain, Input Offset (In OS), and Output Offset (Out OS) adjust. The AC conditioners have potentiometers for adjustment of the + Offset (+OS), - Offset (-OS), and Gain. In addition, the DC conditioners have a push button Calibration Check (Cal Chk) switch for a quick check of correct DC conditioner calibration. In a typical setup, the DC conditioner 1 is used with the axial load cell signal and DC conditioner 2 is used for the torsion load cell signal.

4.0 Computer Software Description

The TT-100 Torsion/Constant Axial Load software is the standard torsion testing software included with the Model TO-15. The software features a user friendly environment to perform the tasks necessary to run the system. The various features are available through use of the Function keys or clicking on the associated boxes. A brief description of the software is given as follows.

The Main Screen of the TT-100 software is shown in Figure 4. When the software is started, the data set and test parameters which are displayed on the X-Y graph are those which were current at the previous software shutdown. This data set and test parameters are stored in the TESTBAK.000 file. The present maximum and minimum torsional loads for the data set are displayed in the Present Data box in the upper left hand screen.

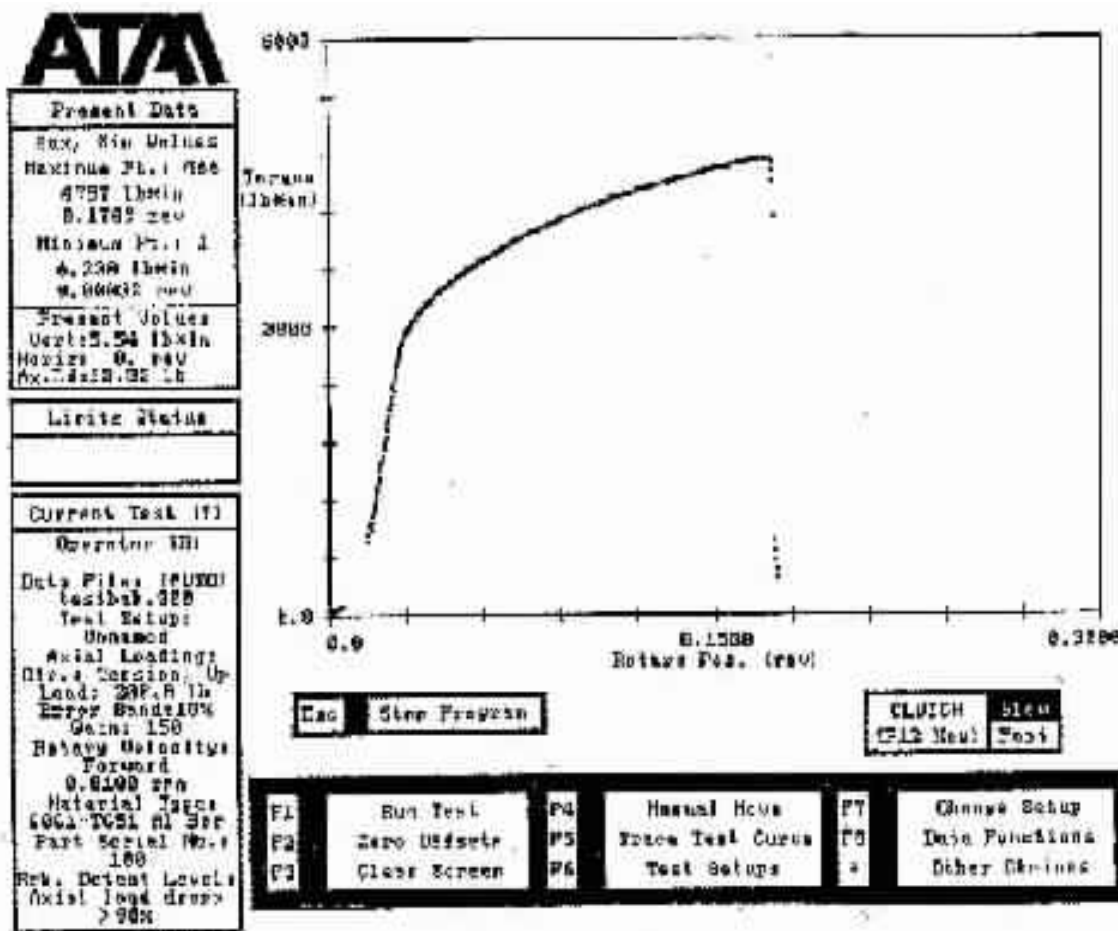


Figure 4
Main Screen Display of the TT-100 Software

The main screen display of the optional TC-100 Tensile/Compression software package for use with the Model TO-15 is shown in Figure 5. The TT-100 and TC-100 are very similar in their operations. When the TC-100 software is started, the data set and test parameters which are displayed on the X-Y graph are those which were current at the previous software shutdown. The present Tensile/Compressive and Yield Strengths for the data set are displayed in the Present Data box in the upper left hand screen.

Note: The Yield Strength will only be shown if the test was performed with an extensometer or actuator position on the horizontal axis which is required to calculate the strain or the elongation in the specimen.

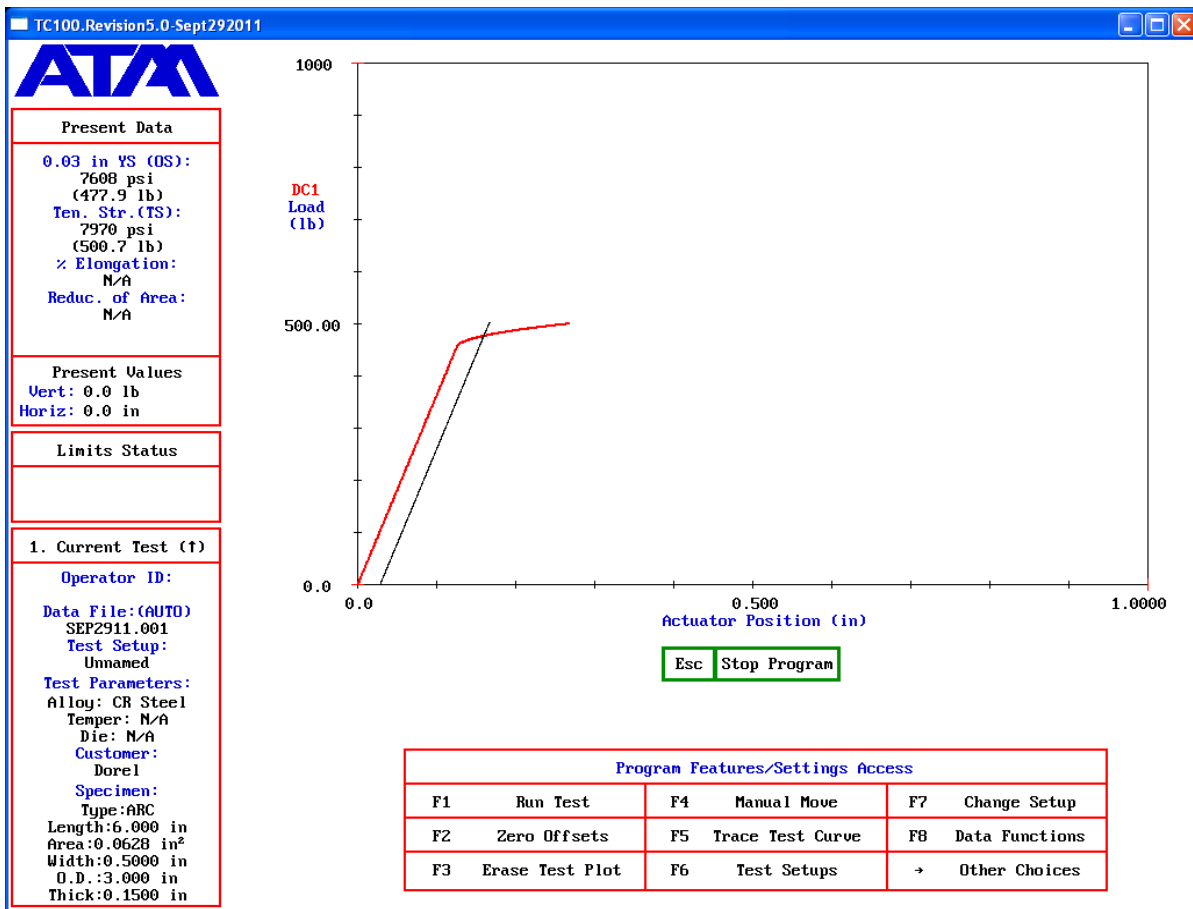


Figure 5
Model TC-100 Main Screen Display

Below the Present Values box, the Limits Status box will show if any axial load, torsional load, axial or rotary position, strain, or time limits are being exceeded. The Current Test box shows test setup parameters such as testing speed, data sampling rate, specimen type, specimen dimensions, etc. Additional screens for the Current Test box are accessed in the Main Screen configuration using the <UP ARROW> key or clicking in this box. The lower

right portion of the screen displays the command descriptions of the keyboard function keys F1 to F8 and the <RIGHT ARROW> key box. The <RIGHT ARROW> key box is selected to display a second set of command descriptions for additional features.

The software design allows a high degree of Operator control of the testing configuration. The Operator can make changes to the display screen with the F7 Change Setup box with minimum disruption of the background display. Up to 1000 data sets can be stored at any given time in the directory which contains the software. The data file named TESTS.NAM contains a listing of the data sets that are available for display. The data set generated during a test can be stored to the hard drive with a filename which the Operator either enters or is automatically generated by the software. An additional archive copy can also be made of the data file to another specified folder. The resulting data files may be reloaded or erased from within the program.

Performing replicate tests is easily accomplished with a minimum number of Operator inputs. The system features the F2 Zero Offsets command for performing a software zeroing of an existing offset load resulting from changes in the test grips or test setup. A Crosshead Return and Rotary Return feature in the TT-100 package which can be activated at test completion will automatically or after an Operator key input return the loading platform and/or rotary shaft to their positions at the start of the test.

During a test, the results are displayed in Real-Time to the monitor on an X-Y plot. The current value of the individual point being displayed is updated during the test in the Present Data box. The test is stopped at a preselected end point determined by such parameters as maximum time limit, axial or torsional load limit, after sample breakage, % load or torsion drop after maximum value, or by pressing/clicking the <Esc> key. In the TC-100 package, values of the Tensile/Compressive Strength, % Elongation, and % RA (ie. Reduction of Area) are calculated and displayed after test completion. The TT-100 package will indicate the maximum and minimum torsion loads at the end of a test. If an extensometer or crosshead position is used for the X axis, in the TC-100 package, the Yield Strength (Y.S.) may also be displayed. At test completion, the individual data points may be scrolled with the F5 Trace Test Curve function using the <LEFT ARROW> and <RIGHT ARROW> keys or by inputting of the number of the data point to be displayed. Also, the data may be replotted by changing the axes scales or with different Engineering Units and the resultant data stored under a different filename. The F8 Data Functions key may be used to display multiple data sets for comparison, storing data sets, or erasing stored data sets.

For simplifying multiple test setup requirements, up to 100 test setups may be stored using the F6 Test Setups feature. These are listed in the SETUP.NAM file. When a test setup is loaded, the current data on the screen is automatically reconfigured for the new test setup X and Y axes and Engineering Units.

Other software features include the capability of printing a test report to any Windows printer. Figure 6 shows an example of the one page test report format for the TC-100 Tensile/Compression software package. The Operator may change the axes scales of the graph and view the results on the monitor before printout. The test report contains information such as the Test Parameter descriptions which may be preset by the Operator to include such parameters as Order No., Alloy, etc. In addition, the Test Date/Time and the Test Operator are also included in the report.

Adelaide Testing Machines Inc. Test Report

Customer Name: ABC Manufacturing Inc. Test Date/Time: Oct. 25, 2011 at 9:50 pm Test Number: 12
Order No.: 1-2321 Color: Black
Alloy Type: 6061 Temper No.: T651
Test File Name: testbak.000 Operator: Patrick Sooley
Testing Machine - Model No.: TCA-5KNBS Serial No.: A100119

Transducers (Axis)	Type	Model No.	Serial No.
Vertical	DC1.CAL	LF-5KN(RSC-1K)	4587799A
Horizontal	ACTUATOR	N/A	N/A

Test Result Summary: 182 Data Points

Tensile Yield Point (0.050 in - OS): 5795.7 psi (Load: 362.23 lb)
Ultimate Tensile Strength: 6275.3 psi (Load: 392.21 lb)
Actuator Position at: Max. Load: 0.6170 in Break Load: 0.6170 in
% Elongation: 21.600% (2.0000 in Gage Length) % Reduction of Area: N/A
Test Speed: 1.0000 in/min (Tension)
Points Sampling Interval: 0.20000 s A/D Averaging Sample Size: 30 Points
Specimen - Type: SQ Length: 6.0000 in
Width: 0.25000 in
Area: 0.062500 in²

Test Comments:

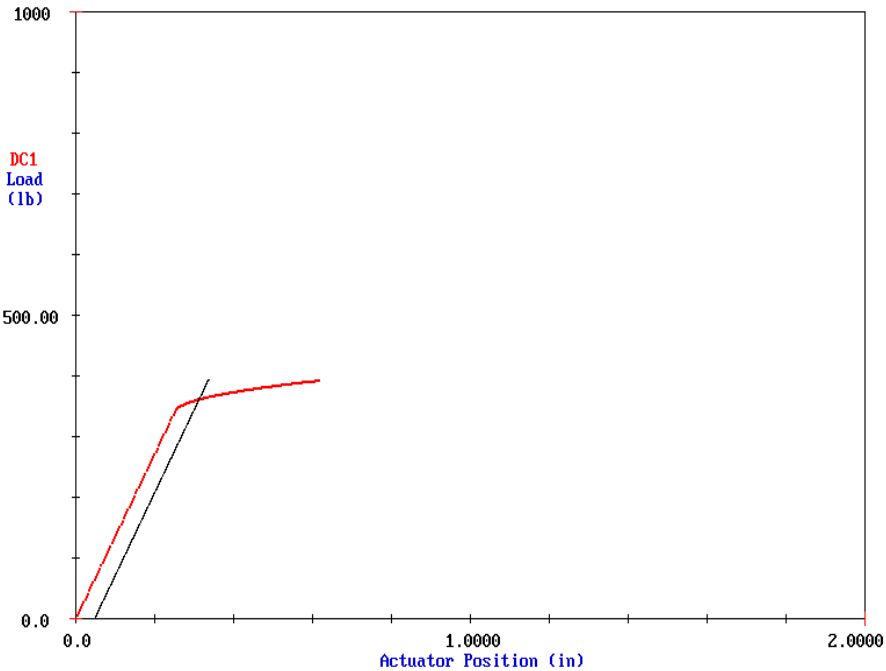


Figure 6
Test report for the TC-100 Tension/Compression Software

Other software packages are available for performing creep tests and low cycle fatigue cycling tests in both the axial and rotary modes. In addition, existing software packages can be customized for unique testing requirements which can not be handled by the standard software packages. Please contact Adelaide Testing Machines if you have requirements which may require customization of features in our standard software packages.

5.0 Options and Accessories

Various options and accessories are available for use with the Model TO-15 testing machine. Some of these are listed as follows:

A. Dust Enclosure for Ball Screw and Linear Track (Part No. TO15.DEBS)

This package consists of modifying the TO-15 to include a sliding enclosure on the front of the loading column and a full height panel enclosure on the rear of the loading column. The design minimizes exposure of the ball screw and linear bearing track to dust contamination. This option is recommended if the machine is to be used in a factory environment where there is a high level of metallic or nonmetallic dust in the air.

Note: This is a factory modification which requires extensive changes for mounting the dust enclosure components.

B. Biaxial Load Cells (Torque/Tension/Compression)

The recommended torque load cells for the TO-15 are the ATM model TO15B-x type. These are currently available in 3 torque capacities. The axial load capacity is 50 N (11 lb) for all three types.

- 15 lb*in (1675 N*mm) Capacity - Part No. TO15B-15
- 10 lb*in (1100 N*mm) Capacity - Part No. TO15B-10
- 5 lb*in (550 N*mm) Capacity - Part No. TO15B-5

C. Clear Enclosure around Wire Sample

The clear enclosure consists of sections of split acrylic tubing 4" (10 cm) outside diameter and 3/16" (4.8 mm) wall thickness which are hinged along their lengths. They are available in different lengths and may be stacked together to form longer enclosures. One of the base units must be ordered as part of a set.

i) Base Protective Clear Enclosure (Part No. TO15.BENC)

Figure 7 shows a view of the base enclosure mounted on the TO-15. The opening at the top allows some adjustment for the wire length to be tested. The base unit includes the end mount which bolts to the top surface of the base of the TO-15. Overall length is 10.2" (26 cm).

ii) Additional Lengths of Hinged Protective Enclosure

- 4" (10 cm) length - Part No. TO15.IOENC
- 8" (20 cm) length - Part No. TO15.20ENC
- 12" (30 cm) length - Part No. TO15.30ENC

Figure 8 shows the three additional lengths available which may be stacked on top of the base unit for testing longer lengths of wire or other type of test specimen. The individual lengths of protective enclosures may also be stacked on top of each other for very long wire length testing.



Figure 8
Extension Clear
Enclosures

Figure 7
Clear Protective
Base Enclosure



D. Torque Calibration System (Part No. T015.TCS)

Figure 9 shows the main component of the torque calibration system mounted on the upright tower of the T0-15. The base of the load cell is mounted against the upright tower and the torque calibration arm is mounted on the load cell in place of the upper collet grip assembly. The system contains all the necessary equipment for performing calibration of the torque load cell. The TT-100 software includes a function to create a new calibration file when used with the torque calibration system. Included with the torque calibration system are the following components:

i. Torque Calibration Arm

The torque calibration arm attaches to the end of the torque load cell. It contains machined slots at 1 cm steps from the centerline of the load cell for locating the torque calibration masses.

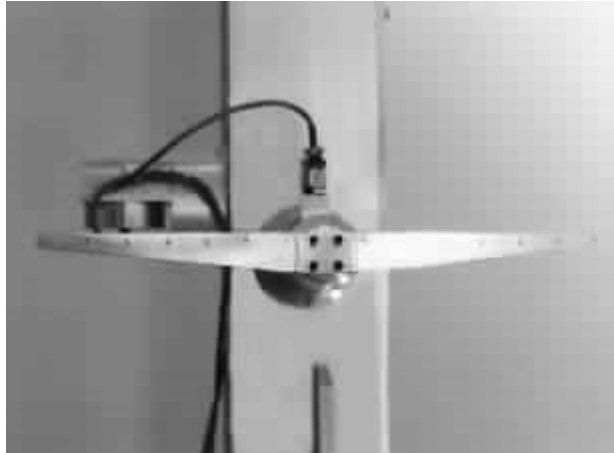


Figure 9
Torque Calibration Arm

ii. Torque Calibration Masses (ASTM Class 1 masses)

Consist of 1 each of the following sizes:

Weight (g)	Class 1 mass tolerance (mg)
1000	2.5
500	1.2
300	0.75
100	0.25

Combinations of these masses will give sufficient capacity increments to calibrate the available torque load cells between 5 lb*in (550 N*mm) to 15 lb*in (1675 N*mm) capacity.

iii. Digital Inclinator

Digital level for aligning torque calibration arm accurately to the horizontal. Digital level reads in degrees to +/- 0.1.

E. Axial Load Calibration Post (Part No. T015.AXCAL)

Figure 10 shows the axial load calibration post. The post mounts on the lower surface of the Model T015B-x types of load cells. The calibration post has a machined V groove to locate the center of the load cell to apply string on which calibration weights can be attached. Calibration weights are not included.

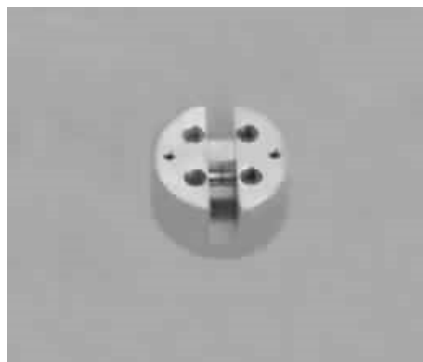


Figure 10
Axial Load
Calibration Post

F. Axial Load Calibration Weights

Weights are of solid stainless steel design and are manufactured and calibrated to Class 4 of ASTM E617-91 Standard Specification for Laboratory Weights and Precision Mass Standards. They have a highly buffed satin finished surface and come complete with a case.

- i) 5 kg - Part No. 13282
- ii) 3 kg - Part No. 13278
- iii) 2 kg - Part No. 13276
- iv) 1 kg - Part No. 13295
- v) 500 g - Part No. 13274
- vi) 200 g - Part No. 13272
- vii) 100 g - Part No. 13270

G. Additional Collet Package Set for Gripping wire (Part No. T015.CSET)

This package includes the pin type collet grip and three interchangeable collets for different filament diameters. One set is required for each end of wire.

H. High Temperature Test Ovens and Environmental Chambers

ATM can supply two different lines of split tubular or box type testing ovens with a range of temperatures to 1200 F and a very high temperature line for materials testing up to a maximum temperature capability of 2800 F. These models mount on swing arms which attach directly to upright posts on the ATM line of load frames. When not in use, the swing arms permit the oven to be moved completely out of the way of the load train. Lower temperature environmental chambers with temperature and/or humidity control are also available. These chambers are of mainly stainless steel construction and are designed with the same accessibility as the test ovens. They are also designed for mounting on the ATM load frames by use of swivel arms.

I. Extensometers

ATM can provide linear, diametral, biaxial, and elevated extensometry equipment for most applications. Please contact ATM with your requirements.

J. Optional 4 Channel DC Conditioner (Part No. T015.4CHDC)

This amplifier board replaces the 2 Channel DC, 2 Channel AC Conditioner amplifier on the standard system. The additional 2 channels of DC conditioners are useful for systems utilizing multiple load cells and extensometers.