Taber® V-5 Stiffness Tester

Model 150-T

Operating Instructions

TABER® INDUSTRIES

ICONS

This instruction manual contains several notes and warnings that should be observed carefully by the user. The following icons denote these notes and warnings:

Indicates a ***NOTE*** that warrants careful attention. These notes may detail a step in the procedure or point out a unique feature of the instrument.

Indicates a ***WARNING*** that warrants careful attention. These warnings inform the user of any dangers that may cause injury to the operator and / or damage the instrument. It is imperative that you read and follow all warnings carefully.

The Waste Electrical and Electronic Equipment Directive (***WEEE Directive***) is the European Community Directive on electrical and electronic equipment waste which sets collection, recycling and recovery targets for all types of electrical goods.

Safety label – ***Shock hazard***

Safety label – ***Caution***

CE marking is a certification mark that indicates conformity with health, safety, and environmental protection standards for products sold within the European Economic Area (EEA).

SAFETY PRECAUTIONS

READ ALL SAFETY PRECAUTIONS BEFORE ATTEMPTING TO OPERATE.

Because of the design requirements, there are potential hazards that an operator should be aware of:

WARNING: *The rotating motion of the driving disc and pendulum creates an entanglement hazard. Do not place body parts or objects in the area surrounding pendulum as this may cause injury, damage to the equipment, or both.*

Below are general precautions that one should take when operating the equipment:

- Do not wear loose clothing or jewelry as they can become entangled in the moving parts.
- Do not attempt to handle or adjust the test specimen while the instrument is being operated.
- While mounting / removing test specimens, the instrument should be stopped and the pendulum and driving disc should be in the home position.

LIMITED WARRANTY

Taber Industries, ("Taber") warrants that its products are free from defects in material and workmanship. This Limited Warranty shall be applicable for a period of one year from the date of initial shipment of any product. The terms of this Limited Warranty do not in any way extend to parts of the product thereof which have a life, under normal usage, inherently shorter than the one year previously stated. Taber will, at its option, repair or replace the defective product if Taber determines it is defective within the warranty period and if it is returned, freight prepaid, to Taber. Replacement parts will be shipped F.O.B. Taber's plant. Taber is not obligated to furnish service under this Limited Warranty: a) to repair damage resulting from attempts by personnel other than Taber representatives to install, repair, or service the product; b) to repair damage resulting from improper use or from connecting the product to incompatible equipment; or c) if personnel other than Taber representatives, without Taber's prior permission, modify the product.

EXCEPT AS EXPRESSLY SET FORTH HEREIN, TABER MAKES NO OTHER REPRESENTATIONS, PROMISES, GUARANTEES OR WARRANTIES, EXPRESS OR IMPLIED, STATUTORY OR OTHERWISE, INCLUDING BUT NOT LIMITED TO, ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND TABER EXPRESSLY DISCLAIMS ALL WARRANTIES NOT EXPRESSLY STATED HEREIN. IN THE EVENT THE PRODUCT IS NOT FREE FROM DEFECTS AS WARRANTED ABOVE, A CUSTOMER'S SOLE REMEDY SHALL BE REPAIR OR REPLACEMENT AS PROVIDED ABOVE. UNDER NO CIRCUMSTANCES SHALL TABER BE LIABLE FOR ANY INJURIES, DAMAGE TO OR REPLACEMENT OF OTHER PRODUCTS OR PROPERTY, COSTS FOR RECOVERING, REPROGRAMMING, OR REPRODUCING ANY PROGRAM OR DATA USED WITH THE PRODUCT.

EXCEPT AS EXPRESSLY PROVIDED HEREIN, IN NO EVENT SHALL TABER BE LIABLE TO ANY CUSTOMER OR ANY THIRD PARTY FOR ANY INDIRECT, INCIDENTAL, CONSEQUENTIAL, SPECIAL OR PUNITIVE DAMAGES OF ANY KIND OR NATURE ARISING OUT OF OR RELATING TO THIS WARRANTY OR CONNECTED WITH OR RESULTING FROM THE MANUFACTURE, SALE, DELIVERY, RESALE, REPAIR, REPLACEMENT, OR USE OF ANY PRODUCT OR THE FURNISHING OF ANY SERVICE OR PART THEREOF, WHETHER SUCH LIABILITY IS BASED IN CONTRACT, TORT, NEGLIGENCE, STRICT LIABILITY OR OTHERWISE, EVEN IF WARNED OF THE POSSIBILITY OF ANY SUCH DAMAGES.

TABER IS NOT RESPONSIBLE FOR THE LOSS OF ANY DATA UNDER ANY CIRCUMSTANCES AND ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES THAT MAY RESULT THEREOF.

CLAIMS FOR SHORTAGES

We use extreme care during packaging to eliminate the possibility of error. If a shipping error is discovered:

1. Carefully examine the packing materials and ensure nothing was inadvertently overlooked when the shipment was unpacked.

2. Notify the company you purchased the product from and immediately report the shortage.

3. File any claim within 30 days from shipment.

CLAIMS FOR DAMAGES

Claims for loss or damage in transit should be made promptly and directly to the transportation company.

CONTENTS

Contents of the shipping container include the following:

- *150-T Stiffness Tester*
- *Calibration Specimen 62*
- *Compensator Range Weight (0 – 10 Taber Units)*
- *500 Taber Unit Range Weight*
- *1000 Taber Unit Range Weight*
- *2000 Taber Unit Range Weight*
- *Power Cord Kit 115/230 VAC*
- *Operating Instructions*

INTRODUCTION

The TABER V-5 Stiffness Tester Model 150-T is used to evaluate the resistance to bending of sheet materials including paper, paperboard, plastics, metals, nonwovens, textiles, rubber, and felts. It may also be used to test cylindrical objects such as wire or tubing. The instrument outputs the moment load applied to the test specimen in Taber Stiffness Units (g • cm) or mN • m when SI units are required.

Incorporated into the TABER V-5 Stiffness Tester is a bi-directional pendulum weighing system which provides an accurate and responsive method for measuring small load increments. The specimen clamp is mounted on the pendulum with the lower face of the jaws located on the center of rotation. This ensures a constant test length and deflection angle for accurate and repeatable results. Both jaws of the clamp are adjustable so the test specimen can be positioned exactly in the center of the clamp regardless of material thickness. The force is applied to the lower end of the specimen by rollers attached to the driving disc. Located directly behind the pendulum, the driving disc pushes the rollers at a constant rate (192.5° per minute) against the specimen which deflects it from its vertical position. The pendulum applies increasing torque to the specimen as it deflects further from the vertical. The test point reading occurs when the pendulum mark aligns with the appropriate driving disc mark (7.5° or 15°) which points to the stiffness reading on the dial plate (fixed annular disc) located around the periphery. The dial plate has a scale from 0 to 100 on both sides of the zero center line mark. Using the appropriate scaling multiplier, the scale is used to determine the bending moment required to bend the test piece for whichever test range is used.

The specimen is subjected to bending in both the left and right directions. The two test readings are recorded and automatically averaged to give the bending moment of the material. Note, when using the High Sensitivity Range Attachment, the test is conducted in one direction only (to the right).

Predetermined specimen length, deflection angle and rate of loading provide accurate and reproducible test results. This precision instrument provides accurate test measurement to 1.0% for specimens 0.10 mm to 7.54 mm (0.004” to 0.297”) thickness and up to 10,000 Taber Stiffness Units.

Nine (9) distinct testing ranges allow the operator to test materials that are extremely lightweight and flexible to materials that are very rigid. Each range is dependent on the roller position and the pendulum load, which is adjustable through supplemental weights. The test reading is automatically multiplied by an appropriate scaling factor based on the test range selected. The result is expressed in Taber Stiffness Units (gram-force centimeter) which is equal to 0.098066 millinewton meters (mN • m).

Range 1 is utilized for extremely lightweight or delicate materials that are between 0 to 1 Taber Stiffness units, and requires the optional High Sensitivity Attachment and compensator range weight. The attachment includes two parts, the Driven Pins Holder which is secured between the clamp jaws, and the Driving Pins Holder which is mounted to the studs in place of the left and right rollers. Both parts include precision pins that are oriented horizontal to the face of the V-5 Stiffness Tester. A specimen 38 mm x 38 mm (1.5 in. x 1.5 in.) is mounted such that the second and fourth pins from the left are above the specimen. As the driving disc rotates, the fourth pin of the Driving Pins Holder pushes down on the specimen while the first pin pushes up. As the sample is deflected, the Driven Pins Holder aligns the pendulum to the appropriate stiffness value. When using the High Sensitivity Attachment, the pendulum is only deflected to the right.

When testing lightweight materials or papers which are low in grammage, highly flexible, or both, Range 2 (0 to 10 Taber Stiffness units) is used. In this range, the rollers are inverted to reduce the bending length and a compensator range weight is mounted to the top of the pendulum. A specimen 38 mm x 38 mm (1.5 in. x 1.5 in.) is clamped vertically and the load is applied 10 mm (0.39 in.) away from the clamp.

For Ranges 3 to 9, the rollers are oriented in the down position. Range weights of 500, 1000 or 2000 Taber Units are used for stiffer materials and mounted to the bottom of the pendulum. The optional range weight set of 3000 or 5000 Taber units is required for test ranges 7, 8 and 9. A specimen 38 mm x 70 mm (1.5 in. x 2.75 in.) is clamped vertically and the load is applied 50 mm (1.97 in.) away from the clamp.

The Taber V-5 Stiffness Tester may also be used to evaluate wire and cable stiffness characteristics. The tester incorporates a "V-notch" in the clamps to accommodate this testing. Suggested specimens are between 3 mm – 8 mm in diameter and 70mm long which are centered in the clamp notch with care so as to not pinch or crimp the specimen. For specimens less than 3 mm diameter, it is recommended to secure the specimen at a location in the flat region of the clamp.

MANUAL / AUTO MODES

Prior to conducting tests, it is important to understand the different modes that are available with the Model 150-T. The MODE is displayed in the top left corner of the operator interface screen.

MANUAL MODE allows the operator to determine which test range should be used. While in Manual Mode, the operator has the ability to quickly change the following settings:

TEST RANGE (1 to 9)

Pendulum DIRECTION (both, left or right)

ANGLE OF DEFLECTION (15°, 7.5° or 5°)

The tests are automatically performed by the Model 150-T; however, test results are not recorded. Once the correct test range is determined, the operator can press the SAVE AS button and the test result can be saved by creating a NEW GROUP.

Similar to previous versions of the V-5 Stiffness Tester, Manual Mode also allows the operator to manually control the drive disc rotation using the ADVANCE left/right buttons as shown below:

AUTO MODE is used when the operator wishes to record test results. This mode allows the operator to create GROUPS which are easily accessed by pressing the MODE button. Each GROUP is specific to a particular test range, and the details are input by the operator according to their needs. For example, a GROUP may be created at the beginning of each production run to record test data for a particular lot. Or, the GROUP may represent tests over a specific period of time (e.g. quarter 1).

When in Auto Mode, individual tests can be displayed on a graph similar to Manual Mode. Or the last six tests can be displayed in a table along with the GROUP average & standard deviation. The STATISTICS button presents similar information, but includes the DATE (if activated). For further information, see page 12.

INSTRUMENT SET-UP

1. Place the Model 150-T Stiffness Tester on a flat, level surface.
2. This instrument includes an optional battery backup feature for the date/time function. To utilize, install two AAA batteries (not included) in the battery compartment found on the rear of the instrument.

3. Adjust leveling feet such that the pendulum alignment mark lines up with the zero centerline mark on the dial plate.
4. Connect the instrument to either a 115V or 230V, 50/60Hz cycle circuit.
5. Using the ON / OFF power switch located on the back of the instrument, turn the instrument on. The instrument is now ready to operate.

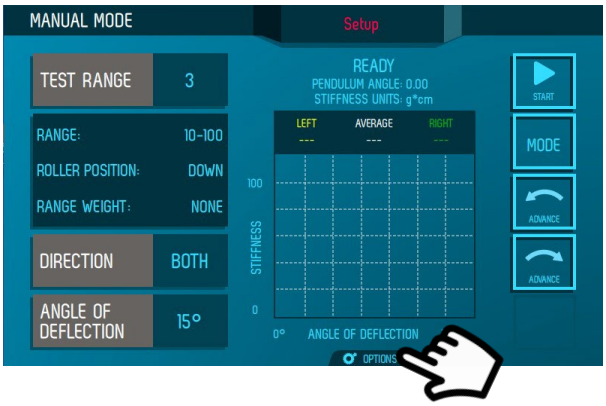
△ **WARNING:** *Failure to connect the 150-T Stiffness Tester to a surge protector or surge suppressor may result in damage to the instrument's electronic components.*

NOTE: To remove the fuse holder, slide it out of the power switch. A small screwdriver may be used to assist in the removal.

NOTE: Two power cords (NEMA Type 5-15P and "Schuko") are provided for your convenience. Discard the power cord not used.

SETTING PREFERENCES – *OPTIONS*

The Model 150-T Stiffness Tester allows you to set preferences on how information is displayed. After powering on, press the OPTIONS button and select the desired option. After making your selection, press OK.

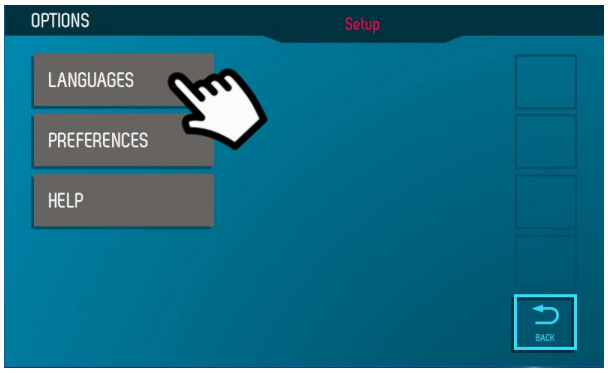


NOTE: Options shown below in bold text are factory default settings.

Language:	**English**, Mandarin, Japanese, Spanish, French, German, Italian or Dutch
Date Format:	None, **DD/MM/YYYY** or MM/DD/YYYY
Time Format:	12 Hour or **24 Hour**
Separator:	Comma or **Point**
Units:	**g • cm** or mN • m
Cycles:	**1**, 2, 3, 4, 5, 6, 7, 8, 9, 10, 100, 200 or 500

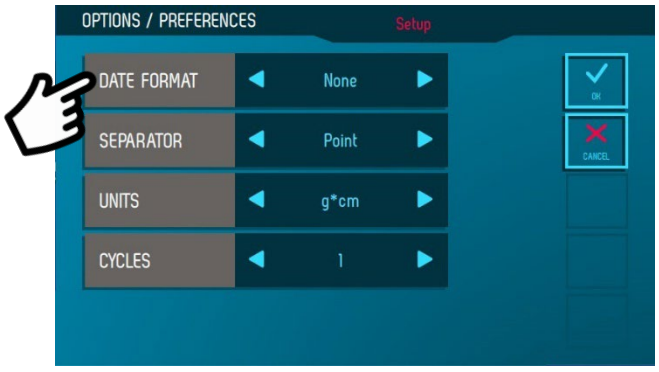
Language

To select a different language, press OPTIONS then LANGUAGES. Available languages include: *English, Mandarin, Japanese, Spanish, French, German, Italian* or *Dutch*.



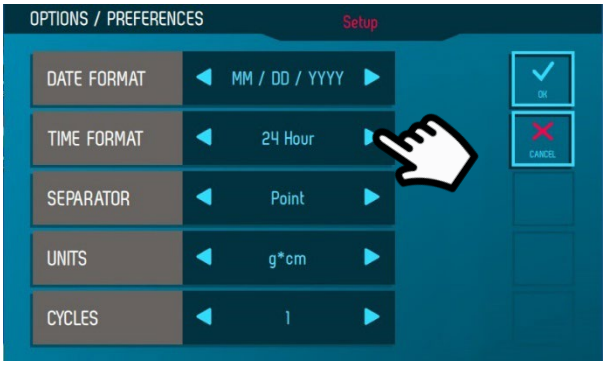
Preference – Date Format

To change the date or time format, press OPTIONS then PREFERENCES. From this screen, use the arrows to select the desired Date Format: *None, DD/MM/YYY* or *MM/DD/YYYY*.



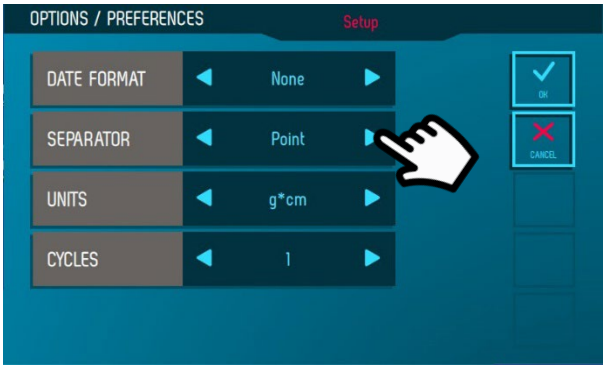
Preference – Time Format

Once the Date Format is activated, you can use the arrows to select the Time Format: *12 Hour* or *24 Hour*.



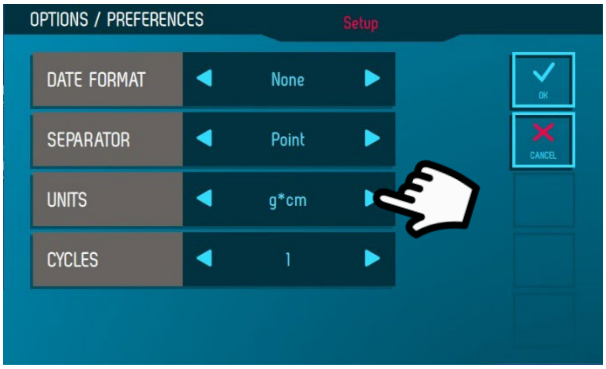
Preference – Separator

To change the separator, press OPTIONS then PREFERENCES. From this screen, use the arrows to select the desired separator: *Point* or *Comma*.



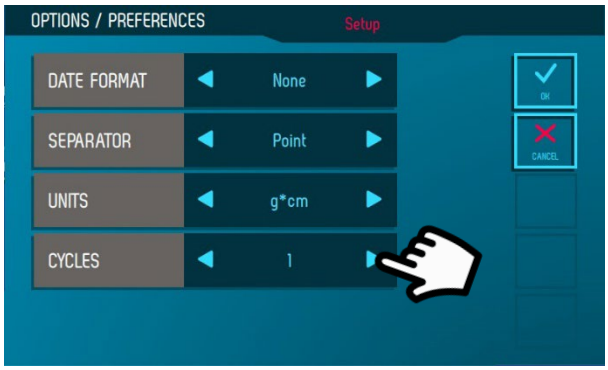
Preference – Units

To change the units, press OPTIONS then PREFERENCES. From this screen, use the arrows to select the desired unit: *g • cm* or *mN • m*.



Preference – Cycles

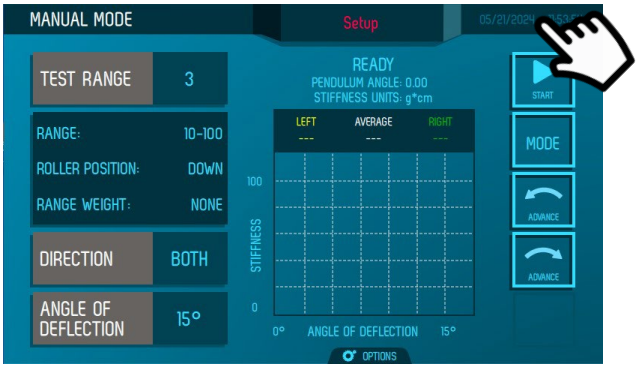
To change the number of test cycles, press OPTIONS then PREFERENCES. From this screen, use the arrows to select the desired test cycles: *1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 100, 200* or *500*.

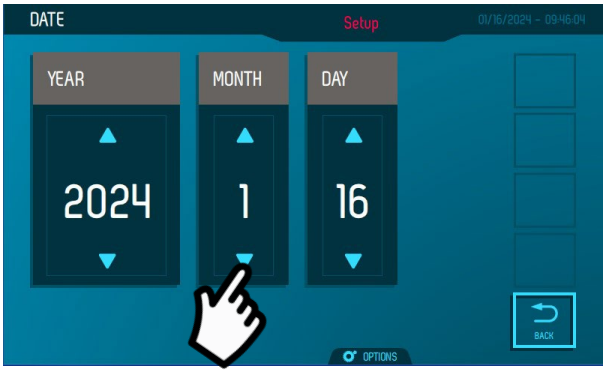


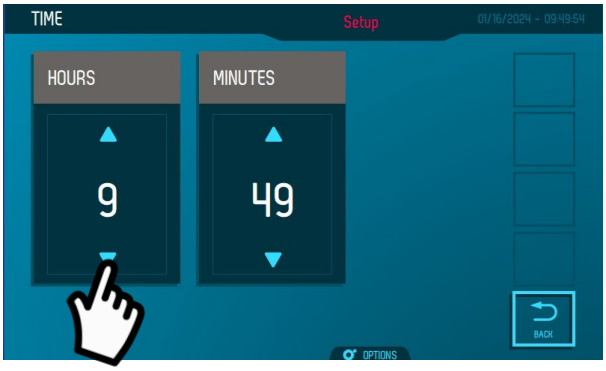
NOTE: Most test procedures require 1 cycle.

Updating Time and Date

(date format must be active – see page 5)



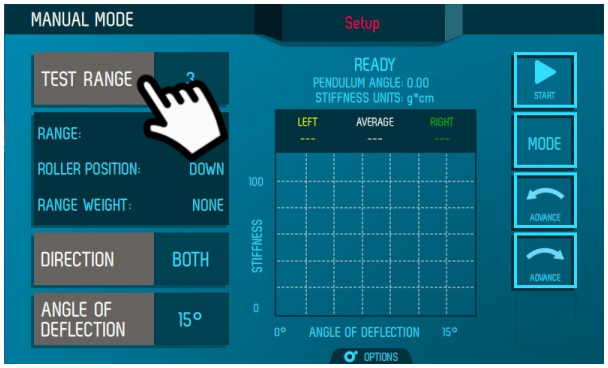


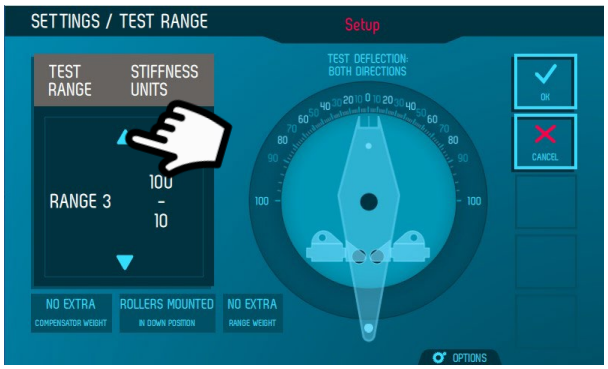


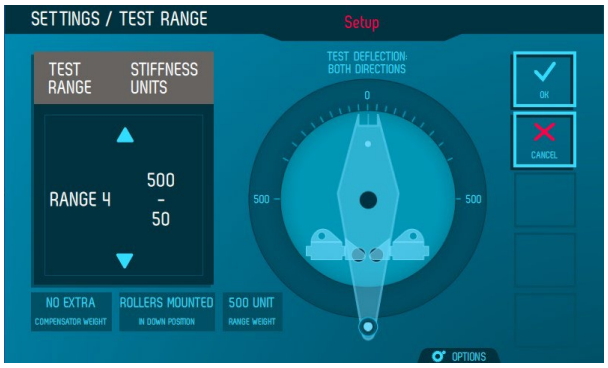
SETTING TEST PARAMETERS

Test Range

The test range can be changed by pressing TEST RANGE. Using the up or down arrows will allow you to scroll through the nine (9) standard ranges. Each range provides a graphic image of the set-up showing the correct position of the rollers and any required range weight. After making your selection, press OK.







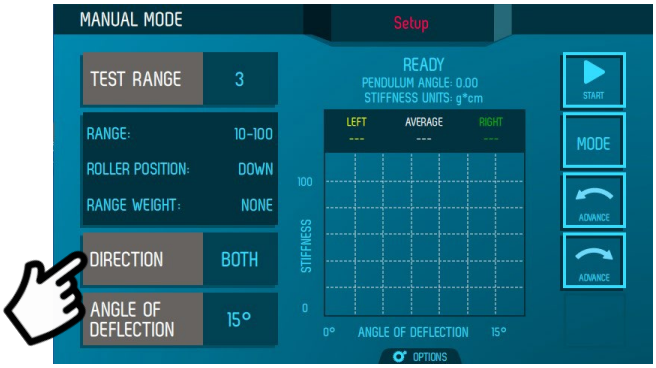
SPECIALIZED TESTING

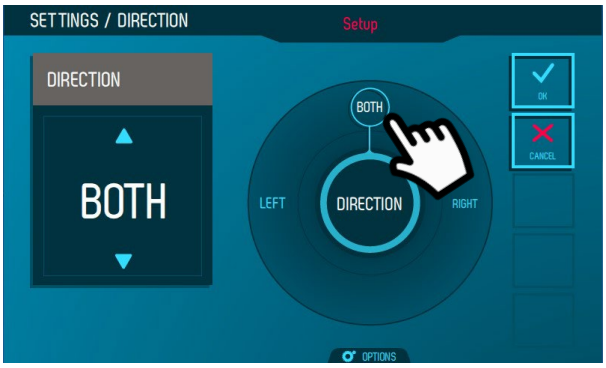
The Model 150-T allows you change the default test parameters to perform specialized testing. When the instrument is not operating, press the appropriate button and use the dial or arrows to set the value. To save your selection, press OK.

Direction

To determine the stiffness properties of most materials, the specimen should be deflected in both the left and right directions. For specialized testing, the direction of the test can be changed to only right or only left.

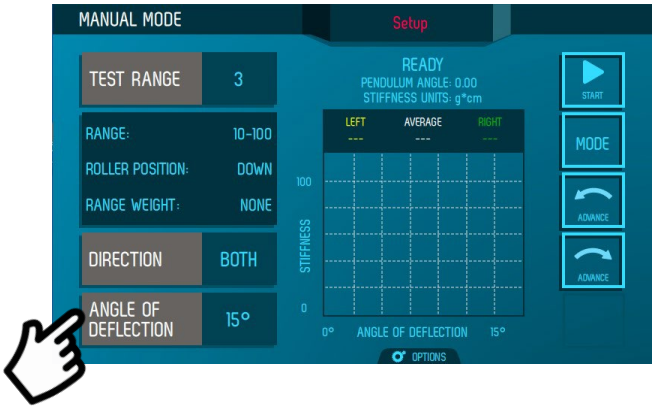
NOTE: The Model 150-T is programmed to test in only one direction for Range 1.

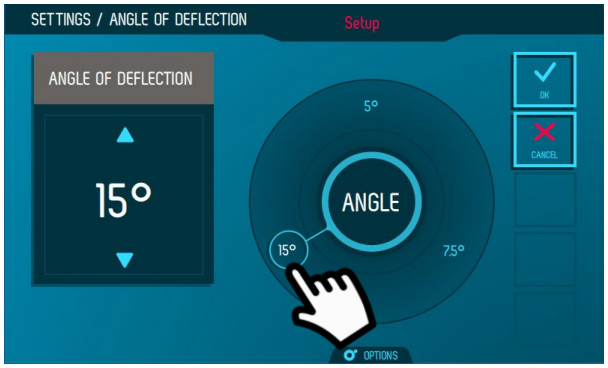




Angle of Deflection

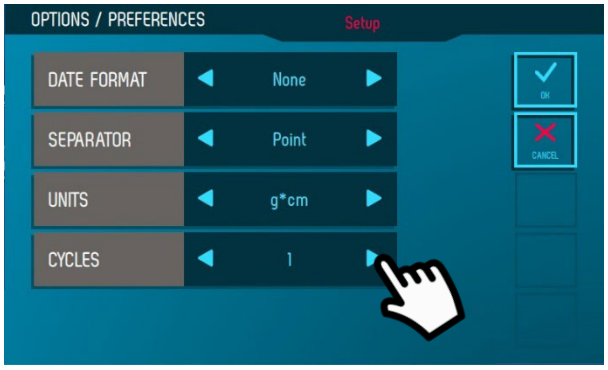
The standard angle of deflection for Ranges 1 – 8 is 15° and for Range 9 it is only 7.5°. For specialized testing in ranges 1 - 8, the Model 150-T provides the option to program the angle of deflection to 5°, 7.5° or 15°.





Cycles

The Model 150-T can be programmed to subject a specimen to multiple test cycles. Preset test cycles available include 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 100, 200 or 500.



SPECIMEN PREPARATION

For Ranges 1 or 2, specimens shall be 38 mm ± 0.3 mm wide by 38 mm ± 0.3 mm long. For Ranges 3 to 9, specimens shall be 38 mm ± 0.3 mm wide by 70 mm ± 1.0 mm long. The Triple Cut Specimen Shear is available to ensure uniform specimen size. Or a high-precision cutting board may be used.

Specimens should be prepared both with the length parallel to the machine direction and with the length parallel to the cross-direction. At the very edge of each test specimen, mark or in some other way identify the machine or cross direction, being careful not to damage the specimens. DO NOT affix a label with adhesive or tape.

Avoid folds, creases, visible cracks or other blemishes or defects in the area to be tested. If watermarks are present, this shall be noted in the test report.

Test readings of narrow samples representing the actual shape of the finished parts are directly comparable without recalculation to standard width. The stiffness of a flat rectangular material section is proportional to the cube of its thickness and directly proportional to its width. The stiffness of round sample (wire) is proportional to the fourth power of its radius.

Specimen Conditioning

Prior to testing, it is recommended that specimens be conditioned for at least 24 hours in a standard laboratory atmosphere of 23 °C ± 2 °C (73.4 °F ± 3.6 °F) with 50 ± 5% relative humidity. For materials that are susceptible to environmental influences, tests should be conducted in the same test atmosphere.

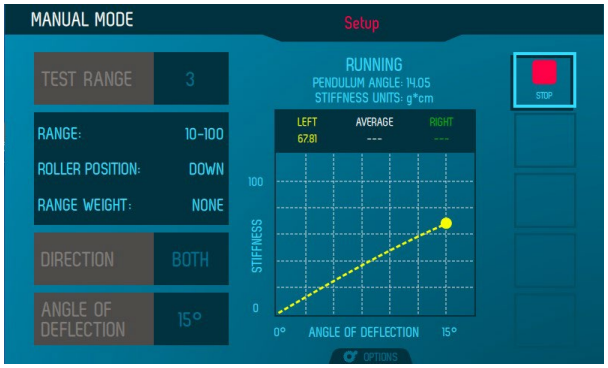
GENERAL TESTING INSTRUCTIONS

As you start your testing, use of these guidelines should assist you in developing a test procedure that will yield reproducible test results, accurate within the variations of quality inherent in the material itself.

The default screen when you first power on the instrument brings you to SETUP. This is to allow you to perform trials with your material to determine the correct test range.

NOTE: After powering the instrument off, it will return to the last MODE that was tested the next time the Model 150-T is turned on.

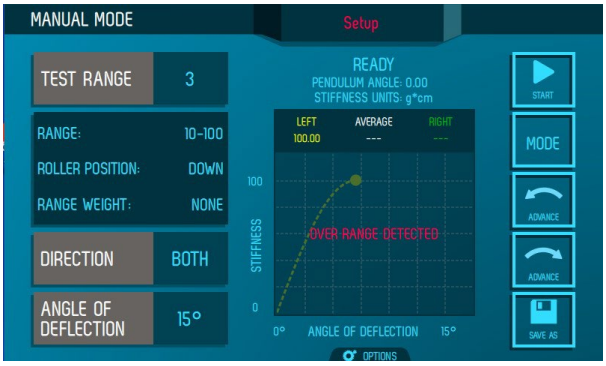
Test results of the Model 150-T are displayed on a graph that shows stiffness values as the specimen is deflected to 15° (or 7.5° for range 9). While the test is being performed the status RUNNING will be displayed above the graph along with the pendulum angle. Once the pendulum reaches the 15° (or 7.5°) mark, the instrument will record the scale reading on the dial plate and complete the test or return to the home position. The LEFT reading is displayed as a yellow line and the RIGHT reading as a green line. When both LEFT and RIGHT readings are captured, the instrument will average the readings and display the bending moment for that specimen.

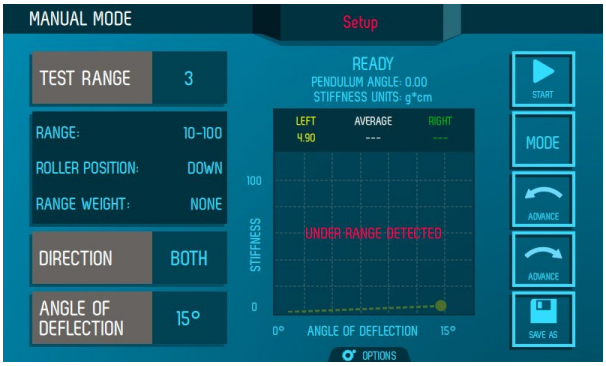


At the conclusion of the test, the status READY will be displayed above the graph. Note, if a test is stopped at any point, the status STOPPED, RETURNING HOME will be displayed.

To save the test result, press the SAVE AS button. Details for saving are discussed in the following section.

If a specimen is over (or under) the selected range, a message will appear on the screen. To continue testing this material, a different test range will need to be used.



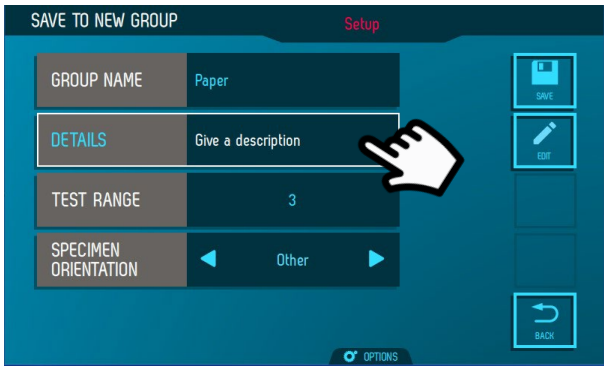


Enter a GROUP NAME to identify the product you will be testing (up to 16 characters).

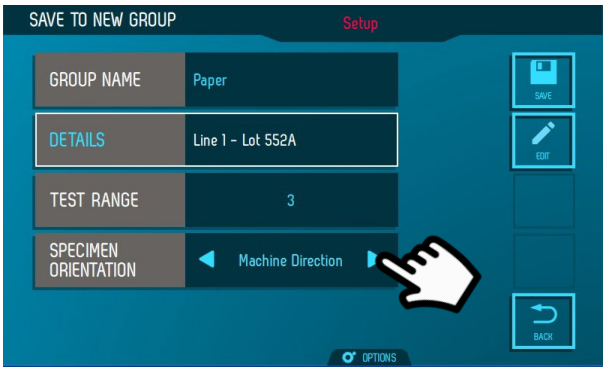
Setting up a NEW GROUP

Once you have identified the correct test range for your specimen or wish to save a test result, select SAVE AS which will bring you to the SAVE TO NEW GROUP screen.

Enter DETAILS about the product you will be testing (up to 32 characters).

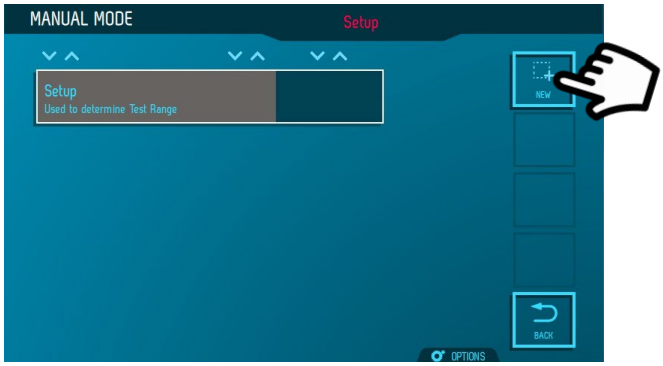


Select Test Range and Specimen Orientation, then press SAVE.



⚠ **WARNING:** *When changing specimen material or testing direction (e.g. cross or machine direction), you must start a new group. Failure to do so will result in the data being recorded in the wrong group.*

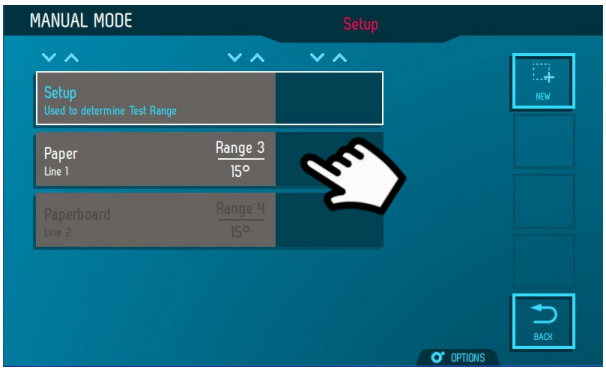
An alternate way to access the GROUPS screen is to press Setup at the top of the screen. Then select NEW.



Selecting a GROUP

To select a Group that has already been set up, ensure the instrument is in the same Test Range as the desired Group. Select the Group, then press OPEN to enter the AUTO MODE.

The arrows allow you to sort the rows in ascending or descending order based on the column that was selected.



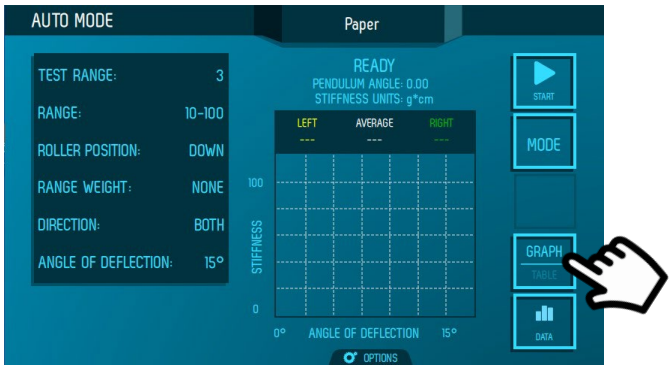
NOTE: Groups that are in different test ranges will not be selectable until the test range is changed.

Viewing GROUP Test Data

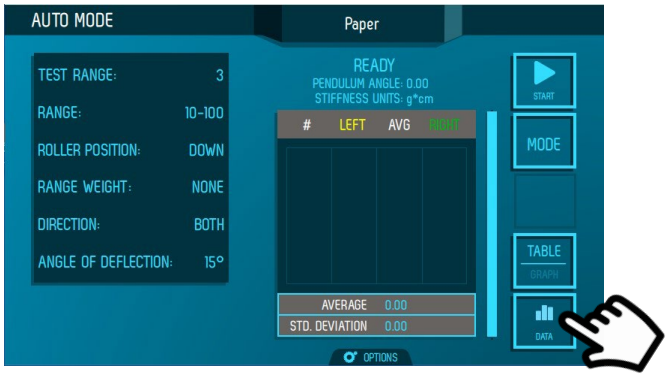
When in AUTO MODE, a summary chart of the test set-up is shown on the left hand side of the display (see below example). If the group name, details or specimen orientation need to be modified, return to the Group screen and select edit.

Two options are available for viewing the test data as testing is being performed:

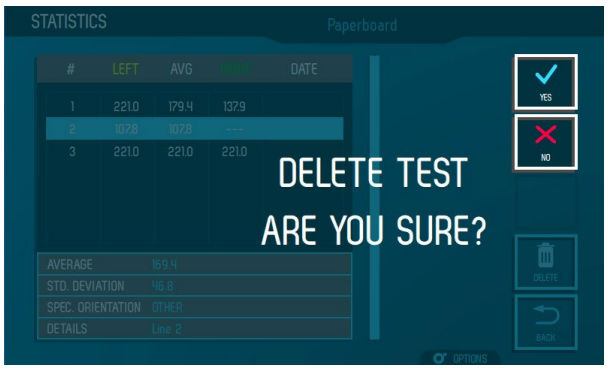
Option 1: Graph



Option 2: Table



Pressing the DATA button provides a summary list of all test results for that GROUP. The specimen orientation is shown along with the details entered during the GROUP setup. This screen also allows you to select and delete individual test results.

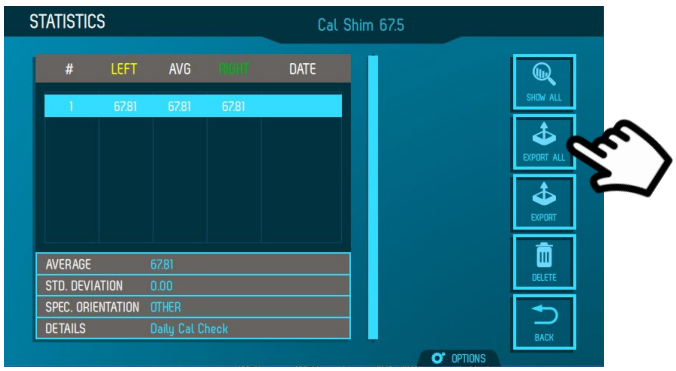


When performing tests with multiple cycles, select the desired test (or #) then press SHOW ALL to open the data points.

TRANSFERRING DATA

To transfer test results from the Model 150-T to a computer, insert a USB drive (not included) into the USB port found on the back of the instrument.

Once the USB drive is inserted, the operator will have the option to export all or just export the selected data grouping. A “CSV” file is sent to the USB drive which will allow the operator to transfer the data to a computer. Once this occurs, the CSV file can be opened by most spreadsheet applications.



TABER V-5 STIFFNESS TESTER SET-UP CHART

The below chart is used as a guide when setting up the instrument or determining which test range to use for the material being tested. Operating procedures for each Range are shown on the following pages.

Range	Stiffness Units	Sample Length	Roller Position	Sample Size	Range Weight	Angle of Deflection	Scaling Multiplier
1	0 – 1	20 mm	High Sensitivity Attachment*	38 mm x 38 mm	10 Unit Compensator	15°	0.01
2	0 – 10	10 mm	Up	38 mm x 38 mm	10 Unit Compensator	15°	0.1
3	10 – 100	50 mm	Down	38 mm x 70 mm	None	15°	1
4	50 – 500	50 mm	Down	38 mm x 70 mm	500 Unit	15°	5
5	100 – 1000	50 mm	Down	38 mm x 70 mm	1000 Unit	15°	10
6	200 – 2000	50 mm	Down	38 mm x 70 mm	2000 Unit	15°	20
7	300 – 3000	50 mm	Down	38 mm x 70 mm	3000 Unit*	15°	30
8	500 – 5000	50 mm	Down	38 mm x 70 mm	5000 Unit*	15°	50
9	1000 – 10000	50 mm	Down	38 mm x 70 mm	5000 Unit*	7 ½°	100

**Optional accessory sold separately*

The following WARNINGS and NOTES are applicable for all test ranges:

△ **WARNING:** *Do not overtighten the clamps as pressure of the clamping screws may affect the test results. The clamping pressure should be firm enough to hold the specimen, but not so firm as to compress or deform it.*

△ **WARNING:** *Do not flex a sample prior to testing or erroneous readings may result. Straightening curled or twisted samples may damage the material. Highly twisted and curled test pieces may give unreliable results.*

NOTE: The sensitivity of the Stiffness Tester may magnify variations in the material. Therefore, it is recommended that 5 or more samples be tested and the average result taken as the stiffness rating.

NOTE: Curvature of the specimen may prevent the pendulum from balancing at zero. This is acceptable as the results between the left and right readings will be averaged to give the stiffness of the specimen.

NOTE: If an environmentally controlled test laboratory is not available, test specimens should be conditioned and tested with a minimum lapse of time.

NOTE: If the pendulum reaches the maximum travel without bending the specimen to an angle of 15°, the wrong range has been used.

NOTE: To stop or cancel a test, press the STOP button.

NOTE: If a break, kink or crease is observed in the test specimen before the test piece has been bent through the bending angle 15°, the test result should be discarded. For materials that exhibit this behavior, a bending angle of 7.5° may be more appropriate.

NOTE: If your sample exhibits stiffness greater than the maximum 10,000 Taber Stiffness Units, another means of testing must be employed.

CONDUCTING TESTS

The steps for proper operation require minimal technical training, but must be followed to obtain consistently accurate readings. See below procedures or TABER V-5 STIFFNESS TESTER SET-UP CHART on page 14 for summary set-up information.

Both heat and moisture may affect the bending resistance of materials, therefore an environmentally controlled test room is strongly recommended. The standard atmosphere for testing paper and paperboard is 23 °C ± 1 °C (73.4 °F ± 1.8 °F) with 50 ± 2% relative humidity. If no time period is given, samples should be conditioned in the test atmosphere for at least 24 hours or more.

NOTE: See Warnings and Notes on page 14.

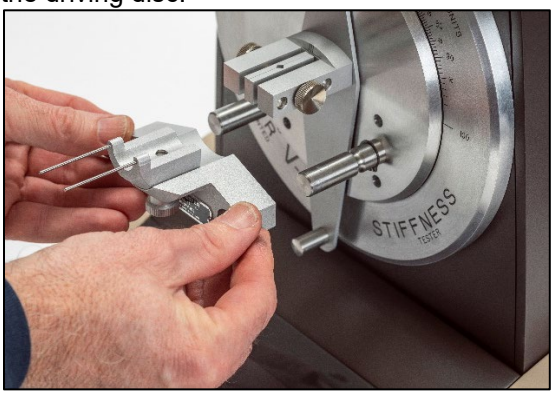
OPERATING PROCEDURE FOR RANGE 1

Range 1 is referred to as the high sensitivity range, and requires an optional High Sensitivity Attachment. It is used for extremely lightweight materials that test below 1.0 Taber Stiffness Unit on the 0-10 test range (Range 2). Some examples include cellophane, natural fibers and synthetic filaments, thin paper, metallic foils, and other lightweight materials. Specimen size is 38 mm x 38 mm.

To install the attachment, follow the procedure outlined below:

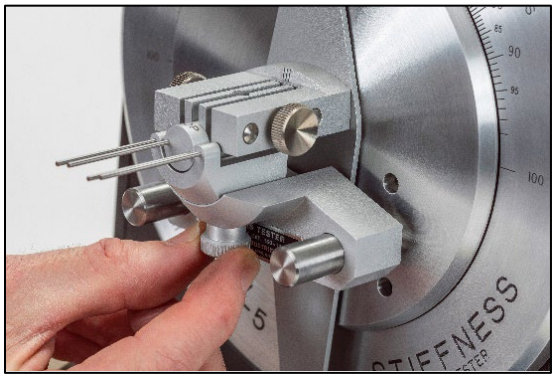
1. Remove the roller assemblies from the instrument by pulling them forward.

2. Place the *driving pin holder* on the two studs on the driving disc.

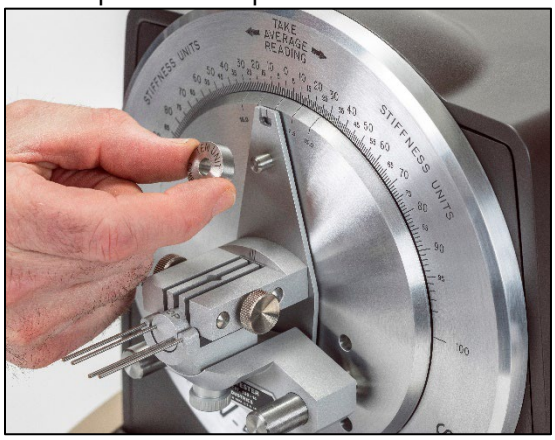


3. Open the jaws of the clamp fully by turning the clamp screws. Place the *driven pin holder* between the jaws of the clamp so "TOP" is facing upward and the positioning pins are in contact with the bottom surface of the clamp jaws. Tighten the clamp screws, ensuring the driven pin holder is centered in the clamp.

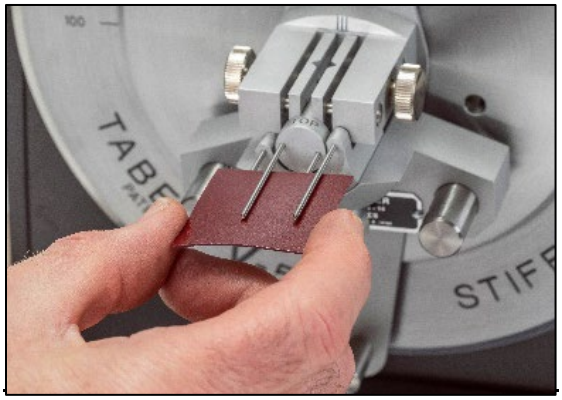
4. Loosen the knurled thumbscrew and slide it to the right. This will allow space for the specimen to be inserted between the pins.



5. Mount the 10 Unit Compensator Range Weight to the top stud of the pendulum.



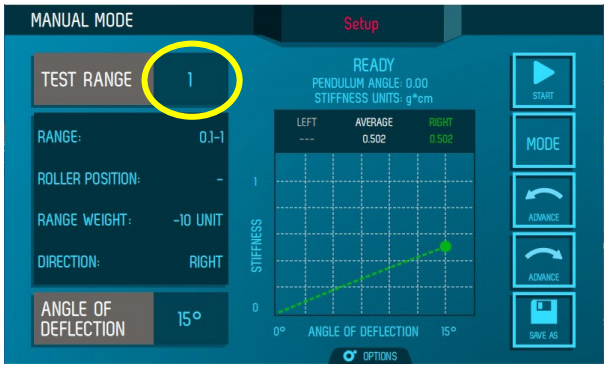
6. Place the specimen so it is above the second and fourth pins from the left and its back edge is parallel and about 1.5 mm from the pin holders.



Slide the thumbscrew to the left until the two upper pins contact the test specimen. The upper pins should contact the test material, but not exert pressure on the test specimen such that they cause the pendulum to be deflected.

7. Tighten the thumbscrew to lock the driving pins in this position.

8. Confirm the Test Range has been set to Range 1, then press START to commence testing.

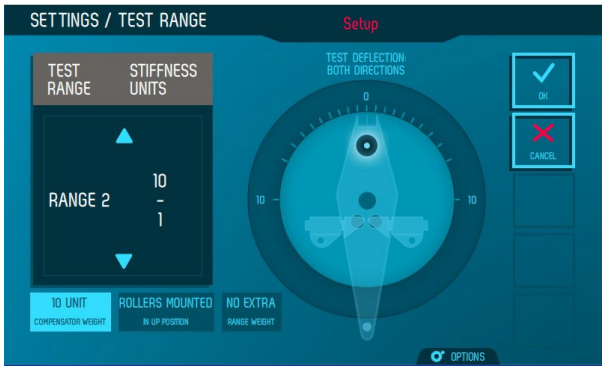


NOTE: When using the High-Sensitivity Attachment in Range 1, the pendulum is deflected to the right only.

NOTE: Specimen size for Range 1 is 38 mm x 38 mm.

OPERATING PROCEDURE FOR RANGE 2

Range 2 (0 to 10 Taber Stiffness units) is used to test lightweight materials or papers which are low in grammage, highly flexible, or both. Specimen size is 38 mm x 38 mm.



1. Remove the roller assemblies from the instrument by pulling them forward. Invert the rollers so that the ratchet-stop roller is on the left and the regular roller is on the right. Each should be positioned so the rollers are “up”.

2. Mount the 10 Unit Compensator Range Weight to the top stud of the pendulum.

3. Place the conditioned test specimen in the clamp jaws with one end approximately level with the top edge and the other between the rollers.

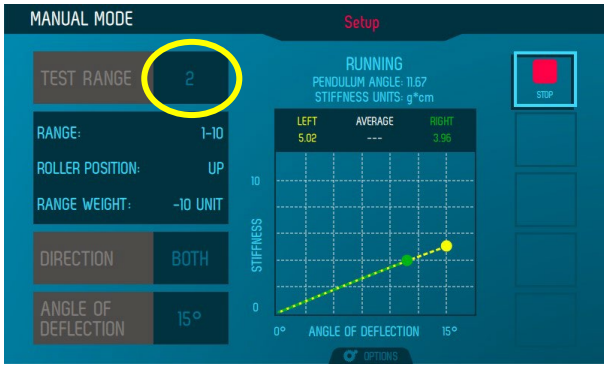
4. Use the two clamping screws, secure the specimen. Ensure the specimen is aligned with the center line indicated on the pendulum and the back edge of the test specimen is parallel to the face of the pendulum (but not touching).

5. When required, use the balance adjustment feet underneath the stiffness tester instrument to adjust the instrument until the black line on the pendulum window lines up with the zero line on the drive disc.

6. Adjust the right roller until it just makes contact but *does not* deflect the test specimen or pendulum. If the black line on the pendulum window has been moved from its zero position, slowly back off the right roller until the pendulum is re-zeroed.

7. Using the ratchet stop knob and a moderate turning speed, move the left roller toward the test specimen until the ratchet stop mechanism activates. Back off one-quarter turn which will set the distance between the rollers to 0.33 ± 0.03 mm greater than the thickness of the specimen.

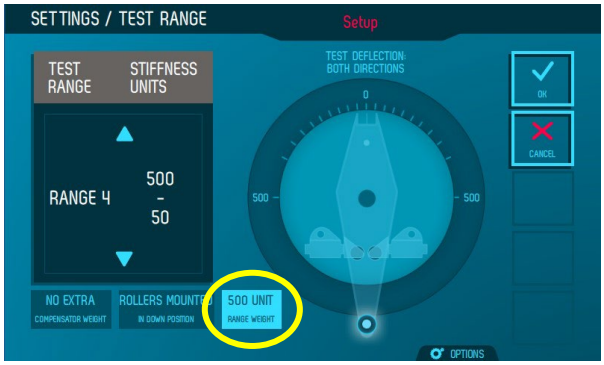
8. Confirm the Test Range has been set to Range 2, then press START to commence testing.



NOTE: Specimen size for Range 2 is 38 mm x 38 mm.

OPERATING PROCEDURE FOR RANGE 3 - 9

With no additional weights, the pendulum is calibrated for 10-100 Taber Stiffness Units (Range 3). Additional range weights are required when testing in ranges 4 – 9. Range weights are mounted on the lower pendulum stud. Reference the Range Weight column in the Set Up Chart (see page 14) or the Model 150-T Setup screen to determine which range weight should be used. Specimen size is 38 mm x 70 mm.

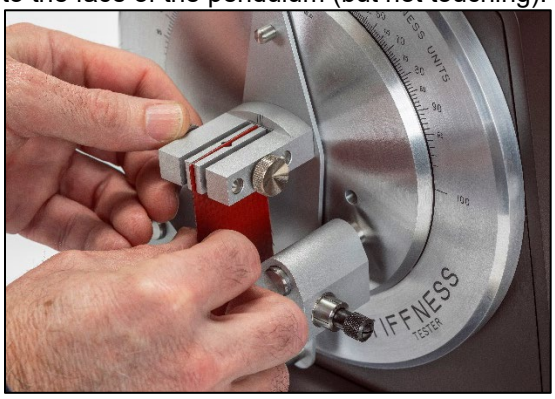


1. The roller assemblies should be mounted in the down position so the ratchet stop roller is on the right and the regular roller on left.

2. When required, mount the appropriate range weight to the bottom stud of the pendulum.

3. Place the conditioned test specimen in the clamp jaws with one end approximately level with the top edge and the other between the rollers.

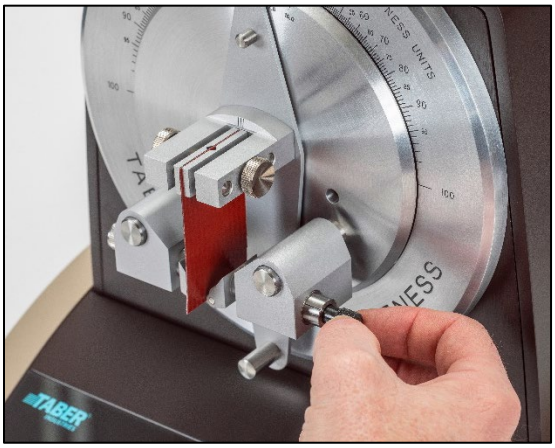
4. Use the two clamping screws to secure the specimen. Ensure the specimen is aligned with the center line indicated on the pendulum and the back edge of the test specimen is parallel to the face of the pendulum (but not touching).



5. When required, use the balance adjustment feet underneath the stiffness tester instrument to adjust the instrument until the black line on the pendulum window lines up with the zero line on the drive disc.

6. Adjust the left roller until it just makes contact but *does not* deflect the test specimen or pendulum. If the black line on the pendulum window has been moved from its zero position, slowly back off the left roller until the pendulum is re-zeroed.

7. Using the ratchet stop knob and a moderate turning speed, move the right roller toward the test specimen until the ratchet stop mechanism activates. Back off one-quarter turn which will set the distance between the rollers to 0.33 ± 0.03 mm greater than the thickness of the specimen.



8. Confirm the correct Test Range has been set, then press START to commence testing.

NOTE: Specimen size for Ranges 3 – 9 is 38 mm x 70 mm.

NOTE: Range weights are used with the standard ranges 4 through 9 only. DO NOT use them with test ranges 1 – 3.

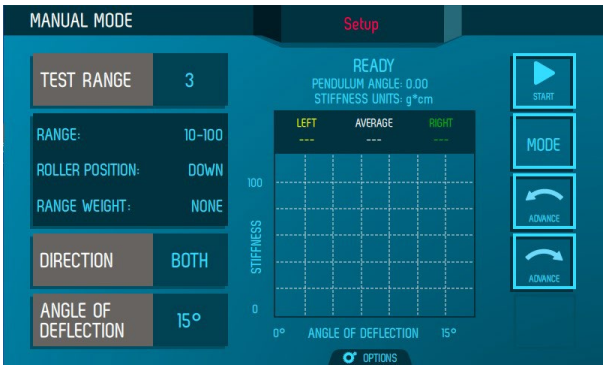
7.5° ANGULAR DEFLECTION

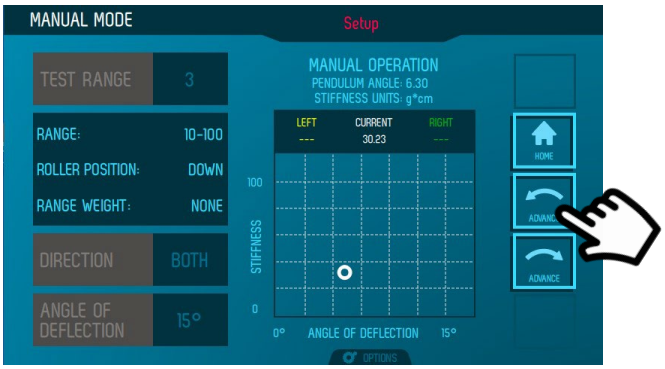
In addition to the two 15° marks on the driving disc there are two lines marked 7.5° on each side of zero. For materials or paperboard that would permanently deform or buckle if deflected to 15°, the half bending angle of 7.5° may be used.

In Range 9, the 7.5° deflection roughly doubles the instrument's range to a maximum of approximately 10,000 stiffness units when using the 5,000 unit range weight. The scale indication obtained is automatically multiplied by 100 to bring it into approximate relationship with those made at the 15° angle. The relationship is approximate due to the change in configuration of the specimen resulting from the difference in angular deflection.

MANUAL OPERATION

To operate the Model 150-T in manual mode, you must be in MANUAL MODE / Setup. This mode allows you to advance the pendulum to either the right or left manually. Press the ADVANCE left or right button until the desired pendulum angle is achieved.





To determine "basic stiffness" of a material, press the ADVANCE button (left or right) until the center line on the pendulum is aligned with the 15° line on the driving disc. When this occurs release your finger from the button. The angle of deflection (15°) is maintained until the reading has not changed for one minute. The final scale reading at the 15° mark is the basic stiffness.

CALCULATION OF RESULTS

After the test material has been deflected to the left and right, the average is calculated. The result is the moment load applied to the test specimen in Taber Stiffness Units (g • cm) or mN • m. Bending resistance is calculated as the mean bending moment from all readings for each specimen direction (machine direction or cross-direction).

Initial Stiffness can be recorded when the center line on the pendulum aligns with the 15° deflection line on the motor driven disc. The corresponding scale reading at the 15° mark represents the initial stiffness of the specimen and is generally used for comparison of stiffness quality.

NOTE: A test specimen held in a curved position for one minute or more may assume a temporary set which may produce a less accurate Initial Stiffness reading than would be obtained on a second test.

Basic Stiffness is the sustained deflection results in "elastic fatigue" and subsequent loss of stiffness due to "creeping" of the specimen structure. This continues until a state of comparative equilibrium has been reached and no measurable change takes place within a period of one minute. This reading is called the "basic stiffness" of the material and is obtained by aligning the center line on the pendulum with the 15° line on the driving disc, maintaining the angle of deflection (15°) until the reading has not changed for one minute. The final scale reading at the 15° mark is the basic stiffness. *This must be done in the manual mode.*

Resilience is the elastic or spring-like quality of materials and may be expressed as the ratio of BASIC STIFFNESS to INITIAL STIFFNESS, calculated as follows:

$$Resilience\ \% = \frac{Basic\ Stiffness\ \times 100}{Initial\ Stiffness}$$

Taber Stiffness Unit is defined as the bending moment of 1/5 of a gram applied to a 38 mm wide specimen at a 50 mm test length, flexing it to an angle of 15°.

$$E = \left(0.006832 \times \frac{1}{(w \times d^3 \times \theta)}\right) \times TSU$$

Where,
E = stiffness in flexure in pounds per square inch
w = specimen width in inches
d = specimen thickness in inches
Θ = deflection of specimen converted to radians
(15° = 0.2618 radians, 7.5° = 0.1309 radians)
TSU = bending moment reading in Taber Stiffness Units

Gurley Equivalency As reported in TAPPI Test Method T543, Taber Stiffness (S_t) can be converted to Gurley Stiffness (S_g) by the following equation:

$$S_t = 0.01419 S_g - 0.935$$

Millinewton Meters Where SI results are desired, the Model 150-T can be changed to report values as mN • m (see Units on page 6). To convert the value in Taber Stiffness Units to Millinewton Meters, multiple by 0.098066.

$$M = TSU \times 0.098066$$

Where,
M = bending moment, in millinewton meters
TSU = bending moment reading in Taber Stiffness Units

These conversions are for reference purposes only.

INFLUENCES ON RESULTS

The measurement of bending resistance is a complex phenomenon and may be influenced by a number of factors. If there are significant differences between reported test results for two laboratories (or more), it is often attributed to procedural errors or an instrument that is out of calibration.

It is important to recognize that the opposite surfaces of a test sheet may be different, such as one surface being coated. For multi-layer specimens, there may be a non-uniform internal structure which may not be visible to the eye. Variations in material surface and production lots influence the behavior of the test specimen. The most consistent test results are obtained from samples that are free of visible defects and flaws.

Other factors to consider include the conditions of the tests (temperature and humidity, conditioning of specimens, etc.). Materials affected by temperature or humidity have shown variation up to 50% and should be conditioned and tested in an environmentally controlled room.

For comparable and reproducible tests, it is recommended that all testing be performed under conditions covered by an established test procedure.

CALIBRATION CHECK

To determine if the Taber V-5 Stiffness Tester Model 150-T is operating correctly, a calibration check should be conducted prior to each use. Spring steel specimens (calibration specimens) with the average stiffness result scribed on them are used as the standard for this purpose and are available from Taber Industries. The scribed number represents the average stiffness result of the standard when flexed under load at 15° to the right and left of zero. If the stiffness reading of the standard varies more than plus or minus 1% of full scale, the instrument may need to be serviced or calibrated.

In terms of various stiffness ranges, the calibration should be within plus or minus 1% of full scale as shown below:

Range 3 (100 unit range) = ± 1 stiffness unit
Range 4 (500 unit range) = ± 5 stiffness units
Range 5 (1000 unit range) = ± 10 stiffness units
Range 6 (2000 unit range) = ± 20 stiffness units
Range 7 (3000 unit range) = ± 30 stiffness units
Range 8 (5000 unit range) = ± 50 stiffness units
Range 9 (10,000 unit range) = ± 100 stiffness units

During calibration checks, variations inevitably result from the way in which the sample is clamped or clearances are adjusted between rollers and specimens. Therefore, a HUMAN FACTOR is often introduced over which Taber Industries has no control. If the test results of several instruments operated by different technicians at different locations are to be compared, then a "correlation factor" may be determined using the formula below. This correlation factor can be used as a multiplier for actual results obtained with the instrument at the time of testing.

$$Correlation\ Factor = \frac{Calibration\ Value\ on\ Calibration\ Specimen}{Technician\ Averaged\ Test\ Readings}$$

Example:
Calibration Specimen value = 64 units
Avg. of technician's left & right readings = 63 units
Correlation Factor = 64/63 = 1.016

All test results of this particular instrument operated by this technician should be multiplied by 1.016 for a final value when they are to be correlated with the test results of other instruments.

MAINTENANCE

The Model 150-T Stiffness Tester is a precision instrument which if used and maintained properly, should give you many years of trouble-free service. Taber recommends annual factory calibration at which time the unit will be thoroughly checked.

General Care

- Lightly brush off any debris or paper fiber from the instrument, paying particular attention to the roller arms and clamp body.
- When not in operation, keep the instrument protected from dust and foreign matter.
- The bearings and other moving parts DO NOT require lubrication.
- When removing the roller arms, use a firm grip to pull straight out. Ball indents secure the roller arms in position.
- Do not test wet specimens.
- Take caution not to drop range weights onto the display screen.

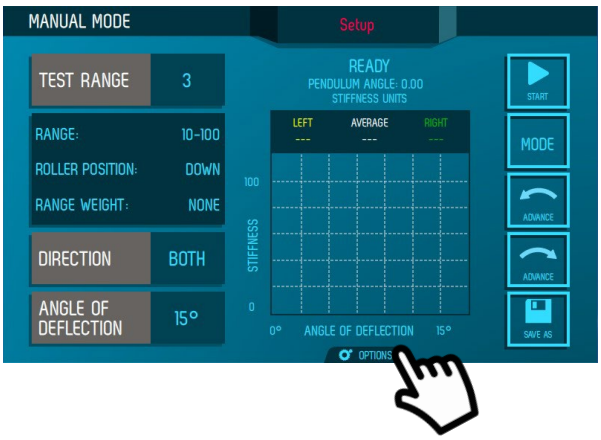
Fuse Replacement

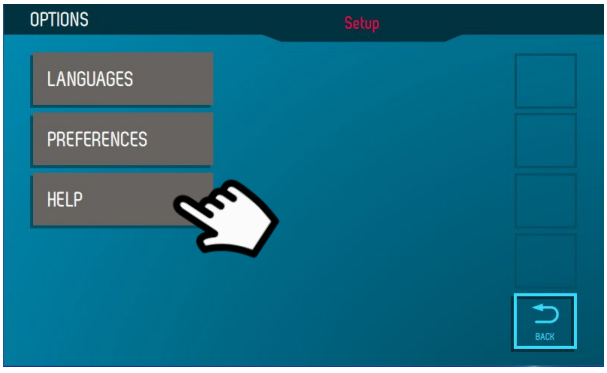
The fuse holder is encapsulated in orange plastic and located behind the On/Off rocker switch. There are 2 notches on the bottom side of the orange ring which are used to remove the fuse holder. Place the tip of a small flat head screwdriver in the left notch (if the screwdriver is too large, it can be rotated 90 degrees and inserted into the right notch). Gently push the screwdriver toward the bottom of the machine until the fuse holder disengages. Remove the fuse holder and replace the blown fuse(s) with a new T2A, 5 x 20mm fuse (p/n 132537). Reinsert the fuse holder.

⚠ **WARNING:** Before replacing fuses, ensure the power switch is toggled to the OFF position.

HELP

The HELP button provides information on the device details, including serial number and software version. It also provides details to contact Taber Industries. To access this information, press the OPTIONS button at the bottom of the home screen.





CALIBRATION / FACTORY SERVICE

Should your Model 150-T Stiffness Tester require repair or adjustment, carefully pack the instrument in the original packaging or in a rugged container with adequate cushioning material. After obtaining a return authorization number from the factory, the unit should be shipped, transportation charges prepaid, to Taber Industries.

TABER® Industries
455 Bryant Street
North Tonawanda, New York 14120
USA

Phone: *716.694.4000*
Fax: *716.694.1450*
E-mail: *sales@taberindustries.com*
WebSite: www.TaberIndustries.com
www.OrderTaber.com

Taber V-5 Stiffness Tester – Accessories

Part#	Model #	Description
125390-1	104-151-1	Calibration Specimen 62
125390-2	104-151-2	Calibration Specimen 225
125390-3	104-151-3	Calibration Specimen 440
125390-4	104-151-4	Calibration Specimen 565
125390-5	104-151-5	Calibration Specimen 1060
132850		Calibration Specimens, Set
980104-11	104-11	Triple Cut Specimen Shear
980150-14	150-14	Sensitivity Range Attachment
120815		Compensator Range Weight, replacement
120753		Range Weight (500 units), replacement
120752		Range Weight (1000 units), replacement
120751		Range Weight (2000 units), replacement
125656	104-10	Auxiliary Range Weight Set (3000 & 5000 units)