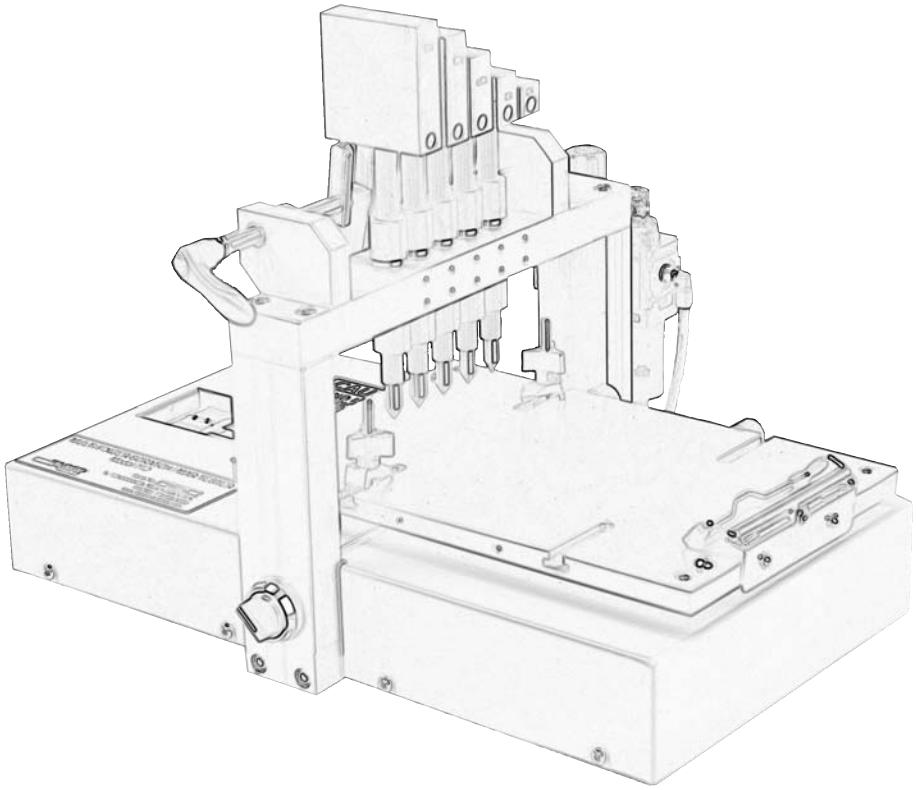
Multi-Finger Scratch/Mar Tester

Model 710



Operating Instructions

TABER®
INDUSTRIES
ISO 9001:2000 CERTIFIED

WARRANTY

Any product or part which, under normal operating conditions in the facility of the original purchaser, proves defective in material or workmanship within one year from the date of shipment by the company, as determined by an inspection by Taber® Industries, will be repaired or replaced free of charge provided you promptly return the defective material. All claims must be sent to Taber Industries with transportation charges prepaid, notice of the defect and verification the product has been properly installed, maintained and operated within the limits of rated and normal usage.

Replacement parts will be shipped FOB our plant. The terms of this warranty do not in any way extend to any product or part thereof that has a life, under normal usage, inherently shorter than the one-year indicated above. Said warranty in respect of replacement of defective parts and any such additional warranty or representation expressly made, are in lieu of all other warranties expressed or implied, including any implied warranty of merchantability, or fitness for any particular purpose.

Taber Industries reserves the right to make changes without notice at any time in colors, material, specifications, and models, and to discontinue models.

CLAIMS FOR SHORTAGES

We use extreme care in selection, checking, and packing 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. The materials are packed at the factory, and should be complete if the box has not been opened.
3. Claims should be filed 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 should include the following:

- *Multi-Finger Scratch / Mar Tester*
- *Spline Shaft Finger Assembly (5 each)*
- *Scratch Tip, 1.0mm Diameter Hemisphere (5 each)*
- *Mar Tip, 7.0mm Diameter Hemisphere (5 each)*
- *9 Piece Weight Set - 2N, 3N, 4.5N, 5N, 6N, 7N, 10N, 15N, 20N*
- *Electronic Timer with Digital Display*
- *Specimen Clamp with T-Slot Nut, Stud and Thumb Nut (set of 2)*
- *Quick Disconnect Socket for Air Supply, with female ¼" NPT thread*
- *3/32" Hex Wrench*
- *Operating Instructions*

INTRODUCTION

The Taber® Multi-Finger Scratch /Mar Tester is used to measure the relative resistance or susceptibility of a material surface to scratching, marring, gouging, scraping and other similar physical damage not classified as ordinary wear.

Useful in quality control, materials development and product development, applications for this instrument are diverse. They include plastics; rigid organic materials; paints and coatings; soft metals; linoleum, plus many others. The most common usage has been in the automotive industry, including smooth or grained plastics used in ornamentation or trim.

PRODUCT DESCRIPTION

The design of the Multi-Finger Scratch / Mar Tester is based on the five-finger (five-arm) scratching device described in popular automotive test methods.

The instrument includes a pneumatically driven, moveable platform to which the test sample is mounted. The platform moves in a linear fashion and is operated by a control knob, for one or multiple pass testing. An electronic timer displays the rate of speed, which is controlled by reducing or increasing air pressure.

A gantry supports five independent spline-shaft fingers, which provide a constant, vertical load on interchangeable scratch tips (1.0mm or 7.0mm diameter hemisphere). Offering a stable platform to ensure the rigidity for the scratch tips, the gantry system includes a handle to raise and lower the spline-shaft fingers. In addition, five support rests are incorporated to allow one or more fingers to be moved to an upright, rest position such that the scratch pin does not contact the specimen during testing.

Individual weights of varying loads mount to the top of each spline-shaft finger to exert a standard force on the surface of the test material. The standard 9-piece weight set includes loads that range from 2N to 20N. Optional weights are available to test up to 25N.

After lowering the scratch tips onto the specimen surface, compressed air drives the platform under the scratch tips to generate the damage on the specimen surface.

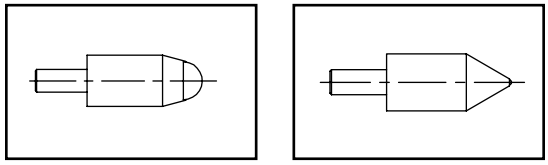
Interchangeable scratch tips include a precision tungsten carbide ball mounted to the contact end. The tips are 1.0mm diameter hemisphere for scratch testing and 7.0mm diameter hemisphere for mar testing. An optional holder permits testing with a conical diamond scratch tool.

The distance between the bottom of the gantry and specimen table permits testing of flat specimens up to 22mm in thickness. Or, the 'free-floating' feature of the spline-shaft fingers enables you to evaluate slightly contoured specimens provided they are rigid or adequately supported. A spring-loaded specimen holder is standard and can be mounted to the end or side of the moveable platform. For narrow and odd shaped parts, adjustable hold-down clamps are available.

INSTRUMENT SET-UP

Remove all contents from the shipping container and verify that you have all the components.

1. Set the instrument on a flat, level surface. Four suction cup feet will secure the instrument to the surface.
2. Install the appropriate tips (scratch or mar) into the end of each spline-shaft finger. Do not over-tighten.



Mar Tip Scratch Tip

3. Insert the spline-shaft fingers into the guide bearings, by matching the pattern on the shaft and bearing. Each bearing has been pre-adjusted at the factory. If a shaft DOES NOT slide easily through the bearings, see MAINTENANCE - Spline Shaft Finger Adjustment.

4. Select the weights to be used for testing, and mount to the top of the spline-shaft finger. Align so there is not any contact with the adjacent weight(s) and tighten in place using the hex wrench. Weights should be mounted from lowest to highest load, to permit ease of evaluation.

▶ **WARNING**: To prevent damage to the scratch tips, turn the handle to raise the spline-shaft fingers after the weights are assembled.

5. Attach the quick disconnect socket (sleeve-lock, with female ¼" NPT thread) to the air supply hose, using Teflon tape to seal the threads. If a local air supply is not available, it is acceptable to use a compressor that provides 80 to 100 PSI pressure and has at least a 2 gallon tank capacity. Fasten the hose to the Multi-Finger Scratch / Mar Tester air intake.

6. Connect the electronic timer, matching the green and black cables to their respective sockets (the red socket is not utilized). Insert one AA battery, ensuring the correct polarity.

SPECIMEN SIZE

To provide for an accurate assessment, specimens should be flat panel or regions cut from a sufficiently flat part. The recommended specimen size is 125mm x 300mm, with a thickness no greater than 22mm. If taken from finished parts, smaller or slightly contoured samples may be used.

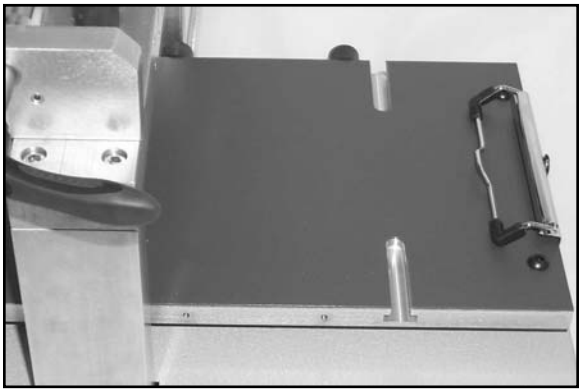
To test specimens that exceed the 22mm thickness, spacer blocks may be inserted into the support arms of the gantry.

OPERATING PROCEDURES

Prior to testing, it is recommended that all samples be preconditioned in a controlled atmosphere (such as 23 ±2° C and 50 ±5% relative humidity) for not less than 24 hours. Samples should be tested under the same conditions.

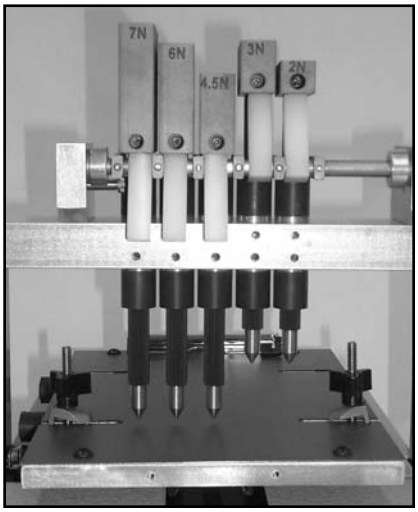
Conducting a Test

- Using the handle, raise the 'fingers' to the upright position.
- Place a sample on the platform so the surface to be tested is facing upward and is located under the spline-shaft fingers. Taking care not to deform the specimen, secure it using the spring clamp or other specimen clamps.



▶ **WARNING**: To prevent movement of the specimen during testing, ensure the specimen contacts a 'stop plate'. The spring clamp can serve this purpose when mounted on the end of the platform. The stop plate should be located on the opposite side of travel.

- If not already done, install the appropriate scratch (mar) tips and weights.
- Using the red button reset the electronic timer.
- Lower the scratch (mar) tips onto the specimen surface and actuate the moveable platform by turning the control knob in the direction the table will travel. If one or more scratch fingers are not required, a rest block is provided to raise the finger out of position.



SUGGESTION: For soft materials, it is recommended to test within 3 seconds after lowering the scratch pins onto the specimen surface.

- Mark the direction of movement of the scratching device on the panels, taking care not to mark the surface just tested.
- To remove the specimen, raise the spline-shaft fingers using the handle and release the clamping.
- Evaluate the extent of the damage on the sample.

Speed Adjustment

Prior to conducting any tests, you will need to adjust the speed of the platform. A sliding velocity of approximately 100mm per second (± 10) is normally recommended.

- Turn the knob on the air regulator/lubricator to an air pressure between 80 - 100 psi. To increase air pressure, turn the knob clockwise (to decrease turn counterclockwise).
- Using the handle, raise the 'fingers' to the upright position.
- Press the red button to reset the electronic timer.
- Actuate the moveable platform by turning the control knob in the direction the table will travel. The number displayed on the timer, indicates the time in seconds it takes the platform to travel 100mm.
- To adjust platform speed, turn the flow control valves found on the right hand side of the instrument. Turning the valve counter-clockwise will increase the speed, while turning it clockwise will decrease the speed. If you are testing in both directions, ensure the platform travels at the same rate. The valve toward the front of the instrument controls the speed when the platform is moving to the left. The valve toward the back, controls the speed when the platform is moving to the right.

- After adjusting the flow control valve, lock in place by tightening the lock thumbnut.
- Lower the scratch (mar) tips onto a 'dummy' test specimen, and verify the speed adjustment.

To calculate the platform speed, divide 100mm by the time shown on the display

▶ **WARNING**: It is possible for the speed of the platform to exceed the capacity of the automatic Start/Stop of the electronic timer. Should this occur, disconnect the timer and operate electronic timer by hand using the Green button to Start and Stop.

Weight Adjustment

If you are not following a test method that indicates which weights are required, start with 3N, 5N, 7N, 10N, and 15N. Loads can be increased or decreased accordingly.

CALCULATION OF RESULTS

Depending on the type of material under evaluation, the visual appearance of a scratch normally involves changes in surface topography, color, or brightness. Three methods are normally used:

Method A - Visual Evaluation:

Using a controlled light source, hold the sample such that the scratch lines are in a horizontal position to the observer. The scratch line caused by the highest weight should be at the upper position.

Rotate the sample, so the angle of observation changes. The observer should be checking each scratch line individually, and noting the point at which the scratch lines emerge at the clearest visibility. Do not use the starting and ending point of the scratch lines (approx. 10mm) in this evaluation.

Examine all scratch lines and rate according to a Rating Scale 1 to 5 (1 = no scratch line at all; 5 = severe scratch line). For plastic materials, indicate if the line exhibits signs of whitening.

Report the tip diameter, stylus loading level, and Rating Number for each line on the surface of the sample.

SUGGESTION: A lightbooth with North Sky Daylight (D65) has been recommend as a lighting source for automotive specifications.

Method B - Width/Depth:

Measure the width or depth of the scratch (grooves) using an optical measuring device.

Method C - Image Analysis:

The scratch mark intensity may also be evaluated by using Image Analysis techniques.

NOTE: Detailed descriptions are recommended when depicting scratch or mar damage. Items that might be described include surface topography, material deformation, material removal, and color changes. The following examples have been used to describe damage in plastics:

- *scratch is shallow (or deep)*
- *scratch is smooth, with a well defined shape (or rough and deformed)*
- *scratch includes plastic flow of the material (or cutting, tearing, cracking, chipping, crazing)*
- *scratch includes visible ripple marks at the bottom (i.e. chevron or parabolic shaped)*
- *strain whitening is visible (or no change in color)*

INFLUENCES ON RESULTS

For comparable and reproducible tests, it is recommended the operations be performed under conditions covered by an established test procedure. The following factors are known to affect the scratch resistance of materials, and could potentially impact your test results:

- ♦ Test methodology
- ♦ Test conditions (i.e. temperature or humidity)
- ♦ Scratching speed
- ♦ Geometry and condition of scratch tip or indenter tool
- ♦ Applied load
- ♦ Material (i.e. filler type; additives; lubricant; polymer type)
- ♦ Surface roughness and grain direction
- ♦ Type and thickness of surface treatment
- ♦ Elastic properties of the specimen
- ♦ Method of scratch assessment
- ♦ Length of time between scratch and evaluation

Plastics

The properties of plastic materials can greatly influence the evaluation of scratch and mar resistance. It is important to be aware of the following factors and take them into consideration:

1. Many plastics have elastic recovery upon removal of applied stress.
2. Many plastics have visco-elastic properties and the stresses in the plastics may relax during loading.
3. Plastics may change structure during material flow, which can also change the mechanical properties of plastics.

Irregular Surfaces

The existence of 'chatter' in a scratch path may indicate a non-uniform composition or the presence of surface irregularities. An irregular surface may also cause a scratch pin to 'bounce' on the specimen surface, resulting in additional impact force at landing points and additional damage to the surface.

MAINTENANCE

Taber recommends annual factory calibration at which time the unit will be thoroughly checked.

Care of the Scratch Tips

The precision cutting edge of the scratch (mar) tips is fragile, and must be handled with care. Depending on the material being tested, tips can provide months of satisfactory service.

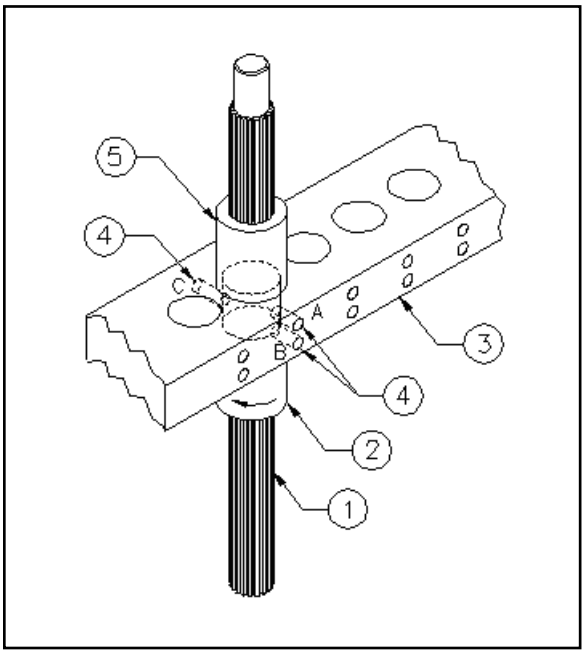
» Do not scrape the cutting edge of the scratch tip against a hard surface, such as steel. Doing so may prematurely dull the tool.

» The spline-shaft fingers must not be allowed to drop against the specimen or platform. Carefully lower them against the specimen just prior to making a test.

The scratch tip will eventually become dull through use. It is recommended that several spare tips be kept on hand for replacement and standardization purposes.

Spline Shaft Finger - Adjustment

The following procedure describes the correct way to adjust the spline-shaft fingers.



1. Using hex wrench supplied, loosen set screw and remove weight from spline-shaft finger.
2. If upper bearing (#5) is assembled tightly in gantry and locked with bottom set screw (#4), continue with step 3. Otherwise,
   a. Remove spline shaft (#1) from bearing assembly.
   b. Hand-tighten upper bearing (#5) and lock with bottom set screw (#4A).
   c. Adjust lower bearing (#2) into beam until shoulder of bearing is in contact with gantry.
   d. Slide spline shaft (#1) into upper bearing until shaft stops against lower bearing. Lightly twist lower bearing clockwise until spline grooves align into lower bearing and slide freely.
3. Loosen two adjustment set screws (#4B & C) approximately ½ to ¾ turn.
4. Apply light tension between spline shaft and lower bearing by slightly twisting lower bearing counter-clockwise.
5. Using hex wrench, apply a light tightening force to top set screw (#4B) locking lower bearing into place. **WARNING**, **DO NOT OVER TIGHTEN SET SCREW**. Spline shaft will no longer move freely through bearings.
6. Tighten set screw (#4C) on the opposite side of the gantry until spline shaft moves freely.
7. Re-attach weight and tighten set screws.

Load on Specimen Surface

To check the loading forces, measure directly under the scratch (mar) tip, using a spring balance or equivalent. If necessary, adjust the weight(s) to meet the required scratch force(s) on the surface of the sample.

Lubricator / Regulator

The maximum inlet pressures and temperatures are as follows:

150 psig (10.3 bar)
125° F (51.7° C)

Given normal operating conditions this unit will be trouble-free. It is recommended that you service the unit at least every six months.

CLEANING:

To clean bowl assembly:

a. Depressurize unit.
b. Remove bowl and bowl guard assembly by turning counterclockwise.
c. Inspect bowl daily for damaged or deteriorated seals. Replace with original manufacturers approved seals and bowls.
d. If bowl becomes dirty, replace it or clean it by wiping the bowl with a soft dry cloth or a mild detergent.
e. Before returning to service, ensure that all seals have been reinstalled or replaced.

f. Reinstall bowl and bowl guard assembly and rotate bowl guard clockwise to securely lock in place. Align arrow on bowl guard with arrow on lubricator body.

Occasionally, liquid water will get trapped in the lubricator bowl. Since water is denser than oil, the water will migrate to the bottom of the bowl. Periodically clean bowl to remove the liquid water.

ADDING OIL: Use clean oil, preferably SAE 10 or lighter. Do not use phosphate ester or diestor based fluids in lubricators.

The lubricator can be filled under pressure by removing the fill-plug slowly, allowing the pressure in the bowl to vent to atmosphere. After the pressure is bled off, the fill plug may be removed completely and oil poured into the fill port. When the fill plug is removed, a small amount of air will be venting from the fill port. This is to serve as an audible signal denoting that the unit is in fact under pressure. If faster filling is desired, slowly remove the fill plug to vent the bowl pressure to atmosphere. Then remove the bowl and bowl guard assembly by turning counterclockwise. Fill the bowl, reposition the bowl o-ring seal and reinstall the bowl into the body and turn clockwise to securely lock in place. Reinstall the fill plug. The unit is ready for use.

ADJUSTING DELIVERY RATE: The oil delivery rate will change automatically to deliver more oil during increase airflow demand and less oil for airflow lower than the original setting. To adjust and set oil delivery rate, the unit must be pressurized and flowing air. Turn the transparent sight dome counter-clockwise to initiate/increase oil delivery. Turn the sight dome clockwise to decrease/stop oil delivery.

If the oil delivery rate should drop, the lubricator should be inspected and cleaned to remove contaminates.

Electronic Timer

The electronic timer has been designed to offer accurate time measurement over a long period provided the following cautionary steps are maintained,

- It should not be used in environments, which are very hot or humid.
- Do not use abrasive or corrosive substances to clean.
- It should not be dropped or shaken vigorously.

FACTORY SERVICE

Should your Multi-Finger Scratch / Mar Tester require repair or adjustment, carefully pack it in a rugged container with plenty of cushioning material. After obtaining a return authorization number from the factory, the unit should be shipped, transportation charges prepaid, to:

TABER Industries

455 Bryant Street
North Tonawanda, New York 14120
USA

CONSUMABLES / ACCESSORIES

Description	Model Number	Part Number
Scratch Tip, 1.0 mm diameter hemisphere (each)		132347
Scratch Tip, 1.0 mm diameter hemisphere (set of 5)		132532
Mar Tip, 7.0 mm diameter hemisphere (each)		132348
Mar Tip, 7.0 mm diameter hemisphere (set of 5)		132533
Diamond Tool Holder, includes 121006 conical diamond tool w/90° 3 mil (0.003”) radius point		132892
Diamond Tool Holder, includes 121006-1 conical diamond tool w/90° 3.5 mil (0.0035”) radius point		132891
Conical Diamond Tool, with 90° 3 mil (0.003”)	139-55	121006
Conical Diamond Tool, with 90° 3.5 mil (0.0035”)	139-56	121006-1
Precision Weight Kit (Used to achieve 0.6N)		132740
Optional Weight Set (8N, 13N, 18N)		132401
Optional Weight (25N)		132352-5
Standard Specimen Hold-Down Clamp Kit (each)		132455
Oversized 'EZY' Specimen Hold-Down Clamp (each)		132399
Specimen Platform Protective Guard, Replacement		132451
3/32" Hex Wrench, Replacement		130808

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NOTES: