James Heal™

OPERATOR'S GUIDE

Martindale Abrasion and Pilling Testers
The 1600 Series - Including Special Applications
Featuring the NEW Intuitive Touchscreen User Interface

Covering all 1600 Series Martindale Instruments

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Setting the Standard

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JAMES H. HEAL & CO. LTD.
RICHMOND WORKS
HALIFAX
WEST YORKSHIRE
HX3 6EP
ENGLAND

TELEPHONE +44 (0) 1422 366355
FACSIMILE +44 (0) 1422 352440

E-mail info@james-heal.co.uk
Internet http://www.james-heal.co.uk

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Background

Thank you for investing in the **Martindale 1600 Series** from **James Heal**.

James Heal would like to assure you that we are committed to providing you with first class Instruments, Test Materials, excellent Customer Service and Support. You are part of a growing global community who consider **James Heal** products to be of the highest quality whilst offering excellent value for money.

We were the first to launch a feature-packed, six-station machine, incorporating a unique and patented hinged top plate. Later, we conceived and launched the very successful and versatile, single-station Mini-Martindale. Then the same award-winning team brought you the revolutionary Nu-Martindale 864, copied by many of our competitors worldwide.

Now we bring you the **1600 Series of Martindale Abrasion and Pilling Testers** which are the absolute ultimate for flexibility and ease-of-use, and feature our NEW intuitive touchscreen user interface.

Historical Background

The 1600 Series of Martindale Abrasion & Pilling Testers are the latest versions of the original Martindale Wear and Abrasion Tester developed by Dr. J.G. Martindale at the Wool Industries Research Association (WIRA) in 1942.

The principle of the Martindale test is that test specimens are rubbed against a standard abradant (a special woven worsted fabric; repp) in a continuously changing pattern, which ensures that the surface fibres of the specimens are flexed in every direction. The wear resistance of the specimens may be assessed by visual comparison after a predetermined number of rubbing cycles; or the test may be allowed to continue until, for example, two threads of the specimen have broken and the number of cycles to reach this point is recorded. Alternatively, the most objective method - but also the most laborious - is to remove the specimens at intervals, then condition and weigh them, so as to measure the rate of mass loss.

Discs of SM25 Abrasive Cloth, 140mm in diameter, are clamped tightly over the abrading tables, cushioned by standard felt backing pads. A test specimen of 38mm diameter is mounted in the sample holder and placed face down on the abrading surface. The weighted spindle is inserted through the top plate to engage with the sample holder below. The sample holder and abrasion table are driven by two reciprocating mechanisms acting at right angles to each other. The resulting relative complex motion carries the test specimens in a constantly changing pattern across the abrading surfaces. The pattern is known as a Lissajous figure.

Subsequently, the Martindale abrasion tester - suitably adapted - became the basis of the fabric pilling test developed in conjunction with the Eidgenoessiche Materialpruefungs- und Versuchsanstalt (EMPA) in Switzerland in 1987, now known as Swissatest. This method has now become very widely used for testing the pilling propensity of woven and knitted fabrics made from staple fibre yarns. Specimens are rubbed against each other, or abrasive cloth, and the degree of pilling is assessed by comparison with a written descriptive table assisted by photographs of standard fabrics, prepared by EMPA. The specimen is mounted on a holder that is much larger than that used for the Martindale abrasion test. The amplitude of the reciprocation is reduced in order to accommodate these larger sample holders.

The 1600 Series of Martindale Abrasion and Pilling Testers can also be used for testing socks (EN 13770). The smaller models can be modified for wet and damp testing, lacquers, wood, laminates, thick samples, liquids, sprays, powders, straps, ropes and shoelaces.

Safety

The 1600 Series Martindales have been specifically designed with operator health and safety in mind. These instruments ensure the minimum of operator stress and fatigue, and is virtually silent in operation to suit the laboratory environment.

	The instruments are very heavy, therefore do not attempt to lift without suitable lifting apparatus or use two or more able-bodied people. Mini-Martindale 1602 = 45 kg Midi-Martindale 1605 = 65 kg Maxi-Martindale 1609 & 1609W = 85 kg
	The 1600 Series Martindales comply with the CE regulations in full. See Compliance Statements.
	The operator is advised to conduct a dynamic risk assessment before using the instrument to take into account the use of PPE to: • Avoid grease contamination on clothing & skin • Ensure all operators are trained & competent in manual handling • Avoid incurring wood splinter injuries by wearing appropriate gloves (special Martindales where applicable) •
	Care should be taken when lifting the Top Plate.
	Care should be taken to prevent anything heavy (e.g., weights) from impacting on the Control Panel.
	Care should be taken to avoid placing the hand between the Abrading Stations and the Top Plate whilst in motion.
	Care should be taken to ensure any loose clothing or long hair doesn't get caught in the machine or clamp rings.
	Care should be taken to ensure the machine is switched off at the plug when dressing the machine, this will ensure the machine can't be switched on accidentally.
	Care should be taken as some fabrics can generate heat build-up during the abrading process due to friction.
	Sufficient space must be left around the instruments to allow unrestricted and safe operator access. See Installation section.
	Avoid grease contamination on skin

Emergency Stop

This switch is designed to bring the drive mechanism to an immediate halt in an emergency situation.

When pressed the switch will latch in the stop position.

To unlock the switch, twist the red cap in a clockwise direction.

Attempting to start a test with the switch in the stop position will result in a warning message being displayed.

Features and Benefits

A commitment to continuous investment in the latest design and manufacturing technology enables **James Heal** to bring superior quality and feature-rich instruments such as the 1600 Series of Martindale Abrasion and Pilling Testers within the reach of the whole Textile Testing Community.

Features and benefits include:

- NEW intuitive touchscreen user interface
- Model 1609 has a hinged lift-up top plate for easy access to abrading tables
- Suitable for fabric abrasion, fabric pilling, protective glove (PPE) abrasion, sock abrasion and leather (ball plate) testing
- Versatility - can be used for many other applications e.g. wood, laminates etc.
- Complies with known Martindale standards and test methods
- Individual station counters and totaliser
- Easy change of motion
- Comfortable and easy access to every station from the front, without removing the top plate
- Finger grips to facilitate (when required) removal of top plate
- Low power consumption
- Higher speed for accelerated testing (x1.5)
- Jog speed (slow speed) for positioning Top Plate
- “Quick lock” clamping rings
- UKAS Calibration by **James Heal Service & Calibration**
- Standard 18 months warranty
- Test Materials: abrasive cloth, woven and nonwoven felts and foam
- Real value for money

Standards

The 1600 Series of Martindale Abrasion and Pilling Testers comply with the following standards:

- ASTM D4966 (Abrasion)
- ASTM D4970 (Pilling)
- BS 5690:1991 (Superseded by EN ISO 12947)
- SFS 4328: 1979 (Superseded by EN ISO 12947)
- BS 3424: Part 24 (Method 27A)
- EN ISO 12947 series
- EN ISO 12945-2
- EN 15977
- SN 198 525 and SN 198 529
- IS 12673 (Plane Abrasion - Method 1)
- ISO 26082-1 (IUP 53-1)
- AWI TM 112 (Abrasion) and TM 196 (Pilling)
- IWTO TM 40
- JIS L 1096
- M&S P17 and P19
- Next TM18, TM18a and TM18b
- SATRA PM 31
- EN 388 (thick specimen holder available)
- and many more …

It is essential that reference be made to the appropriate standards as well as to performance specifications issued by your customers/buyers.

Unpacking

Do not dispose of any packaging material until all standard and optional accessories are accounted for. If there are any discrepancies, please contact your supplier or Local Agent immediately.

Remove any staples, wire strapping and adhesive tape.

Lift out the top box, containing the accessories.
Remove the adhesive tape and ensure that all accessories are present.

Using both hands remove the outer sleeve.
Carefully remove the instrument from its packing case and place it on a firm, flat surface.

The instrument weighs approximately 60 to 80 kg depending on the model, therefore do not attempt to lift without suitable lifting apparatus or use two or more able-bodied people.

Installation

Stand the instrument on a firm, level table or surface (Lifting equipment required).
Lower the top plate so that each of the three (3) Drive Pegs locates into the three (3) Drive Slots.
Ensure the Top Plate is resting on the three (3) Bearing Pads.

Connect the instrument to the correct electrical supply using the mains lead supplied.

Power Requirements	110-230 V ± 10%, 50/60 Hz, 60 W (mains electricity must be free from spikes and surges exceeding 10% of nominal voltage) (Universal Voltage & Frequency)

	Depth	Height	Width	Weight
Mini-Martindale 1602	730 mm	246 mm	500 mm	45 kg
Mini-Martindale 1602S	748mm	246mm	498mm	Dependent on application
Midi-Martindale 1605	637 mm	246 mm	674 mm	65 kg
Maxi-Martindale 1609	670 mm	309 mm	877 mm	85 kg
Maxi-Martindale 1609W	670 mm	309 mm	877 mm	85 kg

Please note: The Maxi-Martindale 1609W is a 'wet' Martindale for which the mains lead is wired directly into machine, with no on/off switch - this is to reduce risk of water ingress.
No plug is fitted to the 1609W to allow for the customer/agent to fit correct plug required.

Identification of Parts

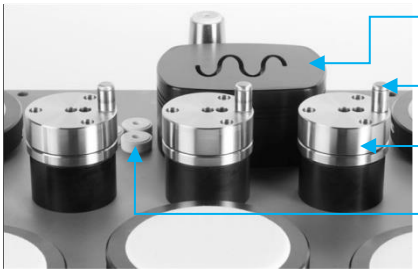
This illustration shows a Midi-Martindale 1605.
Parts on the Maxi-Martindale 1609 look identical.

Unscrew the two (2) Support Bars and screw into the rear of the instruments. In this way they act as spacers giving adequate clearance at the rear of the instrument.

Abrading Tables

Clamp Rings
Support Towers with Bearing Pads (support for Top Plate)

Touchscreen User Interface



Motor Housing (do not cover the ventilation slot)

Drive Pegs (position can changed to allow different types of motion)
Drive Towers

Spare Bearing Pads

Left-hand side view of instrument.

Base Plate

Emergency Stop Button (front left hand side)

Power Lead connection with Power Switch above

Instruments fully loaded with Sample Holders:
Loading Weight (on Spindle)
Finger Grips (to aid lifting Top Plate)

Top Plate with Perspex Guard Plate

Bearing Housing (Needle Bearing)

Sample Holder

Getting Started

In response to market demand, James Heal have designed and manufactured the Martindale 1600 Series of Abrasion and Pilling Testers. The 1600 Series comprises three (3) instruments:

- Model 1609 Maxi-Martindale Nine (9) station instrument
- Model 1605 Midi-Martindale Five (5) station instrument
- Model 1602 Mini-Martindale Two (2) station instrument for special applications

Model 1609 has a hinged lift-up top plate for easy access to abrading tables.

This Quick Start Guide describes the use of Model 1609, Model 1605 and Model 1602 which are primarily designed for the testing of textiles, leather and related materials. Other applications will be explained in more detail later in the guide.

The Martindale 1600 Series of Abrasion and Pilling Testers feature a NEW intuitive touchscreen user interface.

Block Spanner

The Martindale 1600 Series block spanner is supplied with the instrument, but unlike previous models, is not attached.

The block spanner has a "sticky" base for adhering to a bench, where it can be fixed in the most ergonomic position for the user.

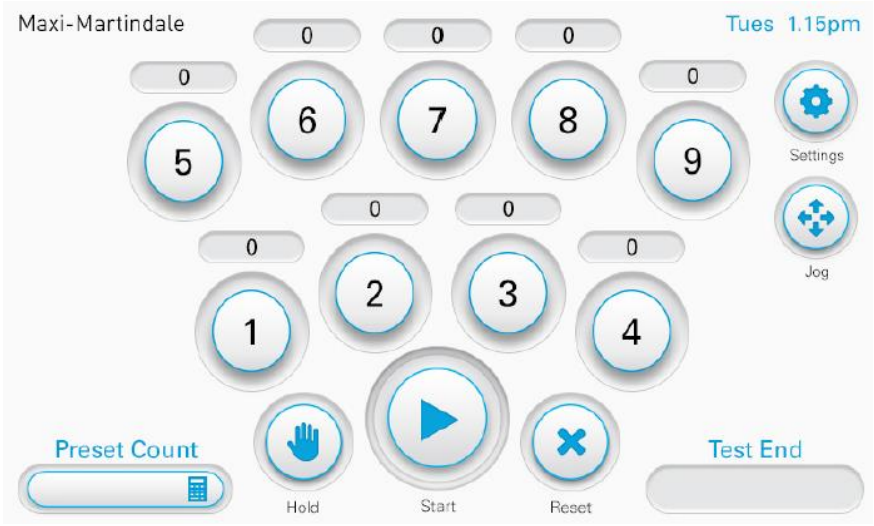
One of the changes proposed in ISO/DIS 12947-2 was the use of a 5.5 kg preparation weight to provide a more consistent method of mounting specimens in the sample holder.

If using this weight, place it onto the spindle and tighten the sample holder.

This weight is not supplied with the instrument.

Intuitive Touchscreen User Interface

The 1600 series Martindale features the NEW intuitive touchscreen user interface. The functions for the 1609, 1605 and 1602 are near-identical, the only difference being the number of stations.



1609 Home Screen

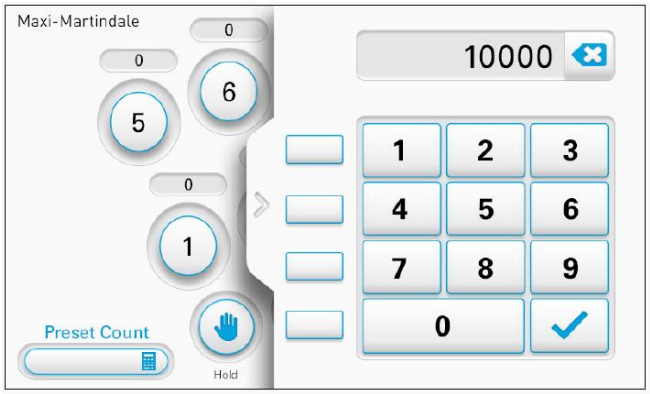
1605 Home Screen

1602 Home Screen

Using the Touchscreen User Interface

1. Home page

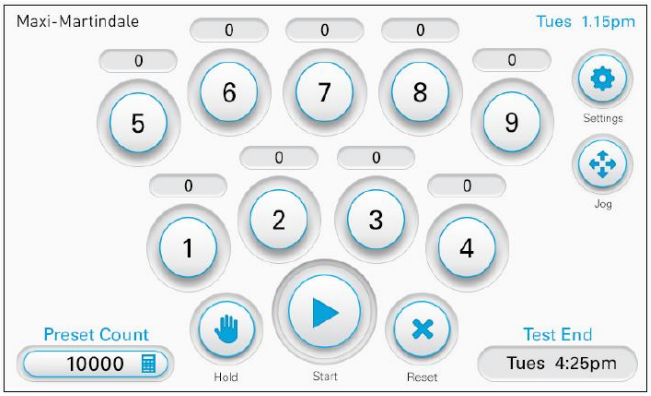
To start a test, press the Preset Count button with the keypad icon to input rubs required.



2. Keypad

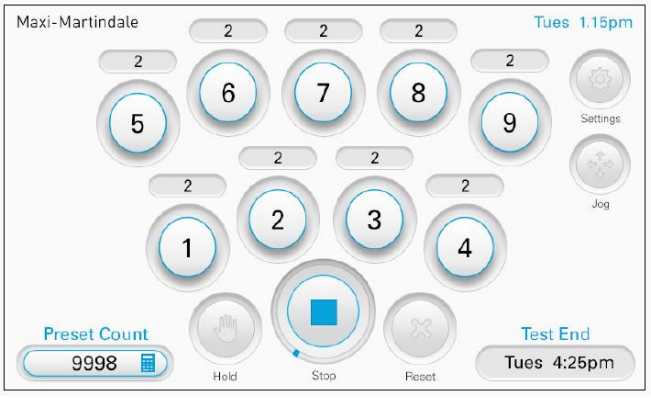
Enter the amount of rubs required using the keypad followed by pressing the button.

Favourites can be stored by entering the required number of rubs and holding down on one of the rectangular preset tabs to the left of the keypad. This can then be selected easily, followed by the tick.



3. Test is set up

Once the test has been set up, the Preset Count will display the amount of rubs and the Test End display will show when the test will be complete. The test can be started by pressing the button.

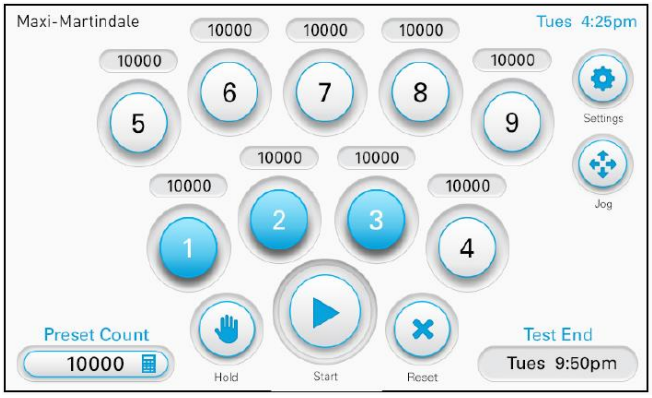


4. Test running

Whilst the test is running, the Preset Count will count down the rubs and the displays on each station will count up the number of rubs.
The hold, reset, settings and jog buttons will be greyed out once the test is running.
The Play button will also change to a stop button whilst running with a cyan ring around it to show the progress of the test.

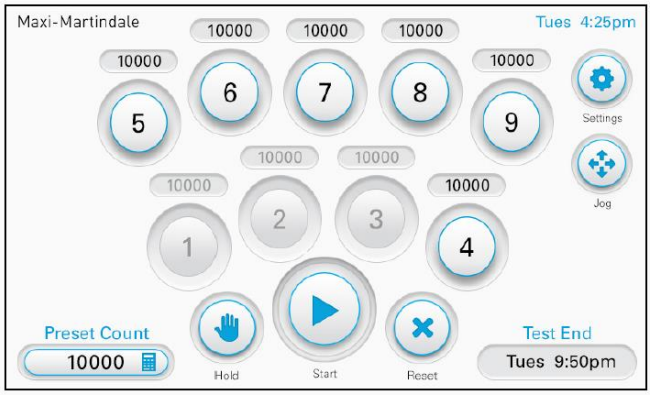
5. Test complete

Once the test has completed, the progress ring will glow and the Test End will show a tick symbol.
The buttons previously greyed out are now active and available for use.



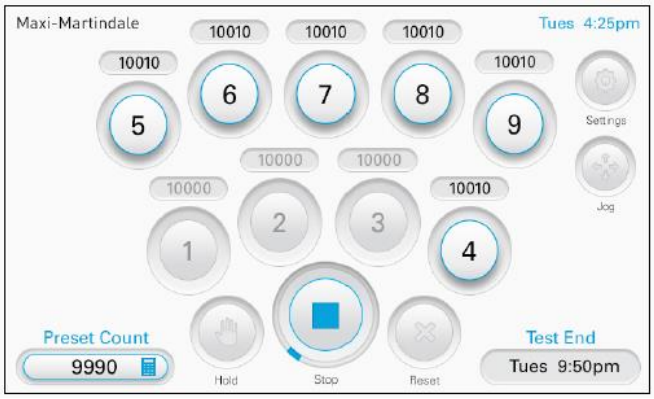
6. Hold stations

To hold stations, select the stations you wish to hold.
Once pressed, the stations light up to show they have been selected, then press the button.



7. Held stations

The stations on hold will grey out to show they are being held.
To start the test, press the button.



8. Test running

When the test is running, the stations on hold will still be greyed out and not increase in count.

9. Test complete

Once the test has completed, the held stations will stay held and greyed out.

10. Reset stations

Press the stations that you would like to select. The selected stations will light up cyan. Once you have made your selection press the  button.

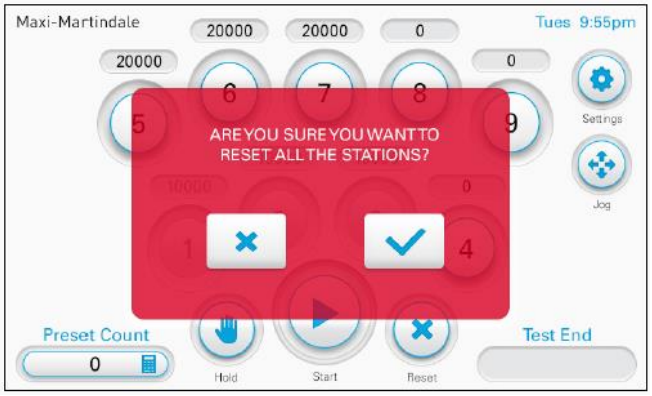
11. Reset selected stations

A warning box will appear to ensure you are wanting to reset the count on the selected stations.

To confirm the reset press the  button.

12. Reset stations

The reset stations will clear their counts back to zero.

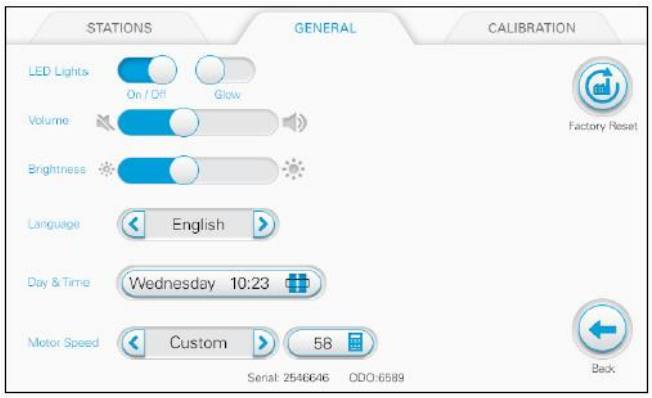


13. Reset all stations

To reset all stations hold and press the button for 2 seconds.
A warning box will appear to ensure you are wanting to reset the count on all the stations.
To confirm the reset press the button.

14. Reset stations

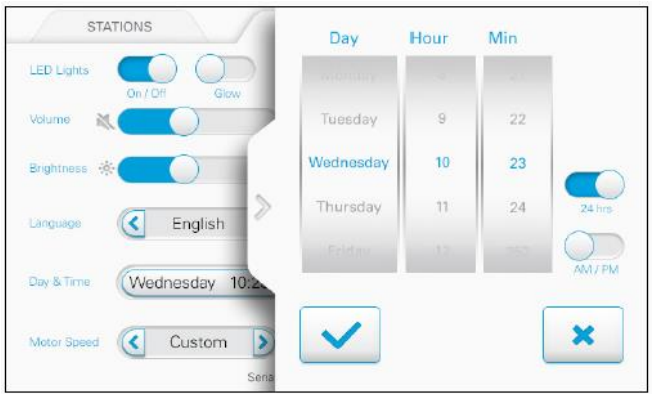
All the stations will clear their counts back to zero and any stations on hold will no longer be on hold.



15. Settings – General

The following settings can be controlled by pressing Settings on the home page and then the GENERAL tab:

- Lights
- Volume
- Brightness
- Language
- Day & Time
- Motor speed



16. Setting the day and time

A roller wheel controller will appear once the Day & Time button is pressed.
The day and time can be set by rolling the wheels around to the correct setting.
AM/PM or 24 hour clock can also be selected.
Once selected, press

Lifting the Top Plate on the Martindale 1609

The Martindale 1609 has an additional feature which is not present in the Martindale 902 and 905 – the top plate can be lifted on hinges, allowing easy access to all nine stations.

Rests for front top plate

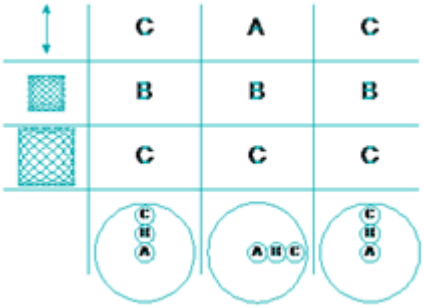
The Top Plate is in two parts and both parts can be removed.

The larger front part can be detached from the smaller back part, simply but carefully lift the front part and it will detach from the back part.

When detached, the front top plate can be stored by placing against the rests.

The smaller back part can be lifted away to allow access to the Drive Pins to change the motion of the Martindale.

Changing the Rubbing Motion



The instrument is supplied with the Drive Pegs in position C ready for abrasion testing. To change the motion, lift or remove the Top Plate and set the Drive Pegs as required: Straight Line, 24mm Lissajous or 60.5mm Lissajous.

Typically the 60.5mm Lissajous motion is used for abrasion tests and the 24mm Lissajous motion for pilling tests. However, there are some exceptions, e.g., ASTM D4970 for pilling uses 60.5mm, so please consult the test method.

It takes 16 rubs to make a complete Lissajous figure.

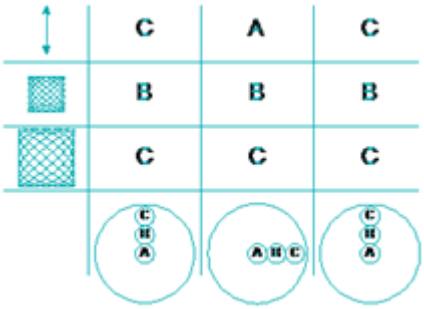
Introduction to Applications

This information is supplied to aid the user to carry out testing in conjunction with standards and test methods. Therefore it is not a replacement for these documents. The information and advice supplied is of a generic form and for more specific and detailed information the standards, test methods and specifications should be consulted. Information is provided for:

	Typical Standard
Abrasion Test	EN ISO 12947 parts 1 to 4
Pilling Test	EN ISO 12945-2
Sock Abrasion Test	EN 13770
Scratch Resistance	EN 16094

Some of the following application photographs were produced using an earlier model of the Martindale instrument – where the block spanner was attached - but the principle of the procedures is the same. See the block spanner section on page 10.

Abrasion Test



Set the motion to abrasion by setting all three (3) the Drive Pegs in position C, large lissajous.

Abrading Table Preparation:

Remove the top plate or use the jog key to provide easy access to the abrading table.

Remove any material such as yarn or fibrous debris from the abrading table.

Place a 140mm diameter piece of felt centrally on the Abrading Table.

The felt need only be replaced when damaged or excessively soiled.

Place a 140mm diameter piece of SM25 abrasive cloth, face up, and centrally on the felt.

If the SM25 abrasive cloth is creased it should not be used.

The SM25 abrasive cloth is replaced after each test. Some standards also state replacing the abrasive cloth after each 20000 or 50000 rubs if the test exceeds this number of rubs.

Carefully place the pressing weight centrally on to the SM25 abrasive cloth, taking care not to move the felt and SM25 abrasive cloth.

Place the Quick-Lock Clamp Ring onto the three (3) locking pins and twist in a clockwise manner and with a slight downward force.

Check the edge of the abrasive cloth is retained by the clamp ring. If the edge protrudes, reposition the felts and abrasive cloth centrally before re-clamping.

Remove the pressing weight.

Specimen Holder Preparation:

Place the sample holder nut in the block spanner.

Place the 38mm diameter specimen, face down, centrally into the sample holder nut.

Creased or damaged specimens should not be used.

Avoid excessive handling of the specimen.

Place the 38mm diameter piece of Polyetherurethane (PU) foam centrally into the sample holder nut on top of the specimen.

Carefully place the sample holder insert in to the specimen holder nut, on top of the PU foam.

Place the sample holder body on to the sample holder nut and carefully engage the screw threads.

With the screw threads engaged, apply a slight down ward force while at the same time turning the sample holder body in the clockwise direction until tight.

Check the specimen is securely held and none of its edge protrudes out of the sample holder nut.
Insert the spindle into the sample holder body. The end with an o-ring should be inserted.

Add the correct loading weight, either 9 kPa or 12 kPa, and tighten the grub screw using the tool provided.

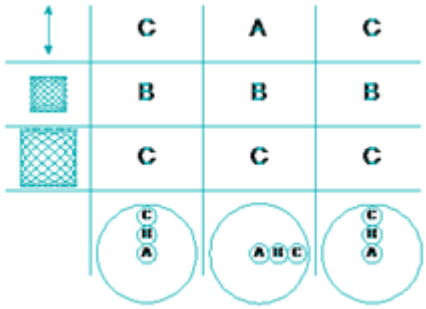
Place a loaded sample holder on each of the abrading tables.

Select the loading weight, 9 kPa or 12 kPa, appropriate to the test to be performed and insert the spindle through the bearing housing in the top plate. Locate the spindle in the sample holder bush and press the spindle down so it is fully located.

Midi-Martindale 1605.

Typically, an abrasion test requires four (4) specimens to be tested. The fifth (5^{th}) head is provided for additional assessments such as Colour Change or Change in Appearance, for example, Colour Change at 5000 rubs.

Pilling Test



Set the motion to pilling by setting all three (3) the drive pegs in position B, small lissajous.

Abrading Table Preparation:

Remove the top plate or use the jog key to provide easy access to the abrading table.

Remove any material such as yarn or fibrous debris from the abrading table.

Place a 140mm diameter piece of felt centrally on the abrading table.

The felt need only be replaced when damaged or excessively soiled.

The pilling test can be carried out in two (2) ways: with abrasive cloth or with another specimen from the test sample. In this case we are showing a pilling test for apparel fabric.

Place a 140mm diameter piece of the sample, free of creases, face up, and centrally on top of the felt.

Carefully place the pressing weight centrally on to the sample, taking care not to move felt and sample.

Place the Quick-Lock Clamp Ring onto the three (3) locking pins and twist in a clockwise manner and with a slight downward force.

Check the edge of the sample is retained by the clamp ring. If the edge protrudes, reposition the felt and sample centrally before re-clamping.

Remove the pressing weight.

Specimen Holder Preparation:

Place the specimen mounting mandrel in the black rubber retaining ring.

Place the specimen face down on the specimen mounting mandrel.

Place a piece of 90mm diameter felt centrally on the specimen.

Place the pilling sample holder centrally down on the specimen and felt.

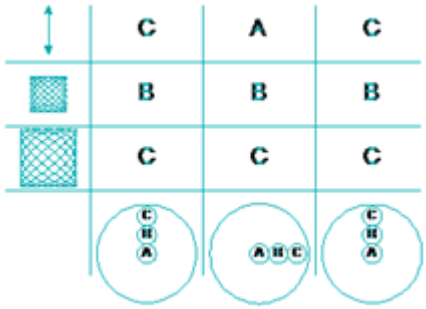
Gently press the sample holder against the specimen mounting mandrel (use your thumbs to do this) while at the same time rolling up the black rubber retaining ring until it grips the specimen on to the pilling sample holder.

This illustration also shows the additional mass, typically only used for testing upholstery fabrics.

Typically, a pilling test requires three (3) specimens to be tested.

The number of rubs is generally very much less than an abrasion test, usually in the range of 125 rubs to 7000 rubs.

Sock Abrasion Test



Set the motion to abrasion by setting all three (3) the drive pegs in position C, large lissajous.

Abrading Table Preparation:

Remove the top plate or use the jog key to provide easy access to the abrading table.

Remove any material such as yarn or fibrous debris from the abrading table.

Place a 140mm diameter piece of felt centrally on the abrading table.

The felt need only be replaced when damaged or excessively soiled.

Place a 140mm diameter piece of SM25 abrasive cloth, face up, and centrally on the felt.

If the SM25 abrasive cloth is creased it should not be used.

The SM25 abrasive cloth is replaced after each test.

Carefully place the pressing weight centrally on to the SM25 abrasive cloth, taking care not to move felt and SM25 abrasive cloth.

Place the Quick-Lock Clamp Ring onto the three (3) locking pins and twist in a clockwise manner and with a slight downward force.

Check the edge of the abrasive cloth is retained by the clamp ring. If the edge protrudes, reposition the felts and abrasive cloth centrally before re-clamping.

Remove the pressing weight.

Specimen Holder Preparation:

Place the block spanner adaptor on to the fixed block spanner.

This is a spring loaded device.

Place the modified sample holder nut on to the block spanner adaptor.

Place the 38mm diameter specimen, face down, centrally into the modified sample holder nut.

Creased or damaged specimens should not be used.

Avoid excessive handling of the specimen.

Place the pinned ring, needles first, down through the specimen into the holes in the modified sample holder nut.

PU foam is not used.

Place the hard rubber precision ball with the 20mm diameter end making contact with the specimen.

Place the sample holder body on to the sample holder nut and carefully engage the screw threads.

With the screw threads engaged, apply a slight down ward force while at the same turning the sample holder body in the clockwise direction until tight.

Check the specimen is securely held.
Note how the specimen protrudes out of the sample holder nut.

Mounted sample holder, complete with spindle and loading weight.

Typically only the loading weight marked “12 kPa” is used. This gives an actual pressure on the specimen of 24 kPa.

Test four (4) specimens.

Special Martindales

The smaller model Martindales can be modified for wet and damp testing, lacquers, wood, laminates, thick samples, liquids, sprays, powders, straps, ropes and shoelaces. These applications can be used in conjunction with standards where available, or for Research & Development.

Some combinations of the above applications are also available to order. Please consult your sales representative to discuss the options available and for the accompanying test materials that we can offer.

Scratch Resistance

The circular motion of the lissajous pattern provides multi directional scratching, offering results more representative of the actual end-use than other methods in the market which scratch the surface in a straight line only. The following scratch resistance standards can be performed on a range of materials including wood floors, high pressure laminates and furniture surfaces:

- EN 16094
- EN 438-2
- CEN/TS 16611
- IKEA

The information below describes two procedures from EN 16094, Procedure A for assessing changes in gloss, and Procedure B for assessing scratch resistance.

Test Parameter	**Procedure A**	**Procedure B**
Scrub Material 3M reference James Heal stock code	Very Fine Maroon SB 7447+ 789-672	Medium Fine Brown SB 7440 789-671
Holder for Scrub Material	Version 1 6N Holder + 6N ring weight	Version 2 4N Holder + 4N ring weight
Speed Factor	1	1
Assessment	Gloss change using a Reflectometer	Visual assessment to scheme in Annex B of EN 16094

Assemble the Martindale so that all three (3) of the drive pegs are in position C (see page 13) to create a large lissajous with a width of 60.5mm.

Ensure the abrading tables are free from adhesive residues, then replace the top plate.

Using double-sided adhesive tape, fix the specimen to the abrading table.

Attach the circular scrub material to the holder, also with double sided adhesive tape.

The chosen abradant rubs on the specimen with a predetermined load and number of rubs. The holder travels in a lissajous pattern and rotates around its own axis perpendicular to the horizontal plane. When the test is complete, any changes to the surface of the specimen are either assessed using a Glossmeter, or compared with the images contained in the standards.

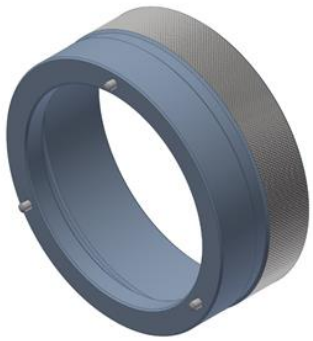
Microscratch reference black high gloss HPL (JH701-501) are available for checking every new lot of scrub materials.

Wet & Damp Testing

A special water bath allows for testing the abrasion resistance of properties or products which are required to resist the penetration of water. This includes footwear, and waterproof or water resistant garments.

This complies with ISO 20344 and also ISO 17704 when 2 dry and 2 wet stations are used.

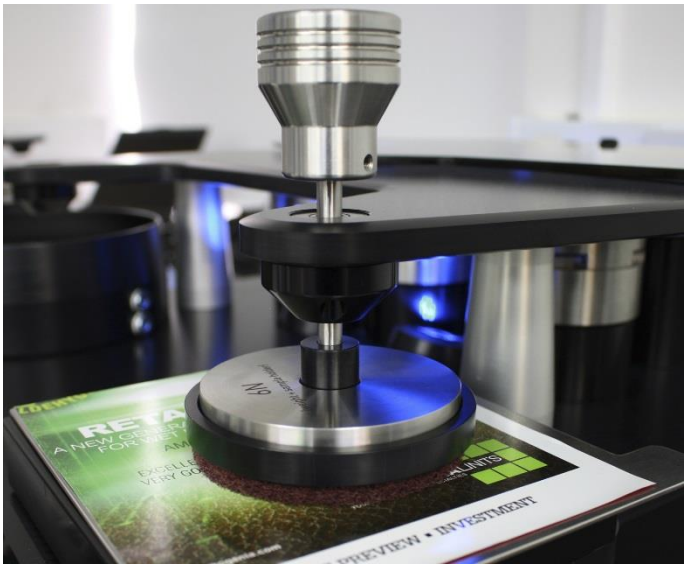
The abrading table inside the bath and the specimen in the holder can be fully submerged.



A clamp ring tool (black) is supplied for locking the bath into place. Locate the lugs into the corresponding holes and turn anti clockwise to loosen.

The bath is equipped with pipes which push on and pull off easily, and a tap for easy drainage of the bath after use.

Lacquers & Coatings



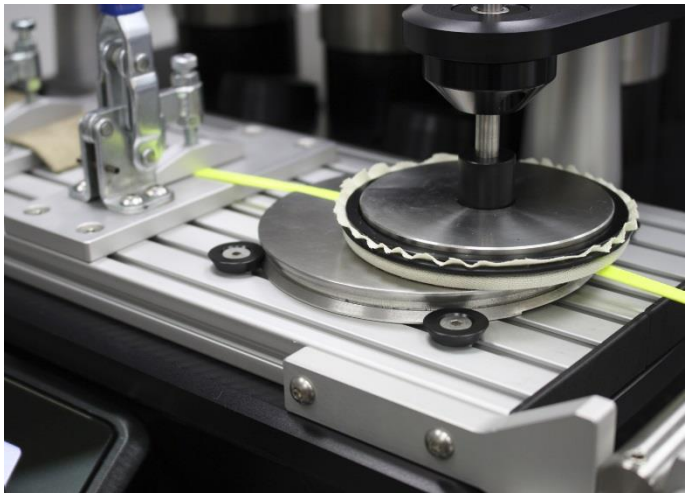
A removable specimen mounting plate allows for easy mounting and removal of printed matter on which a lacquer or coating has been applied e.g. brochures and flyers.

Once the mounting plate is removed from the instrument, the specimen can be evaluated for colour fastness and abrasion resistance.

Some automotive parts could also be tested in this manner.

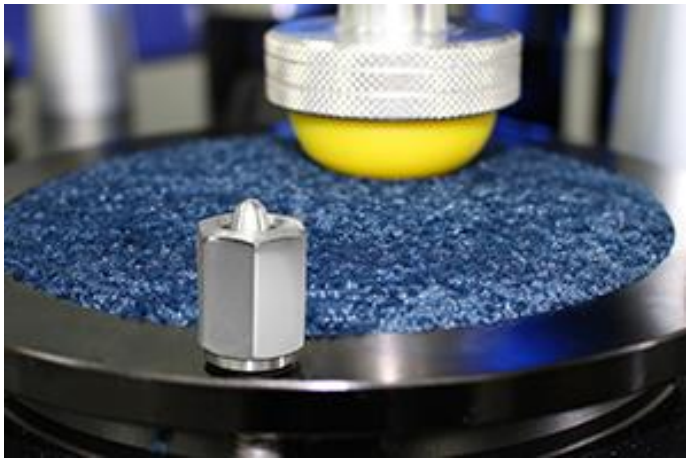
Weights are available to provide pressures of 4N and 6N.

Straps, Ropes & Shoelaces



This attachment for a 2 station Martindale is specifically designed to test the abrasive properties of multiple types of cord and belting. This includes products such as shoelaces, rope, cord, straps, cables, tape, webbing and belts.

Thick Specimens



The design of this table enables tests for the resistance to abrasion of thick samples to be undertaken on products such as carpets, leather, shoe components and vinyl.

We offer a choice of carpet abrasives such as rubber for use with a 55 kPa weight, or hexapod studs (ISO 11856).

A 100cm^2 sample cutter for carpets and thick material is available from James Heal.

Liquids, Sprays & Powders

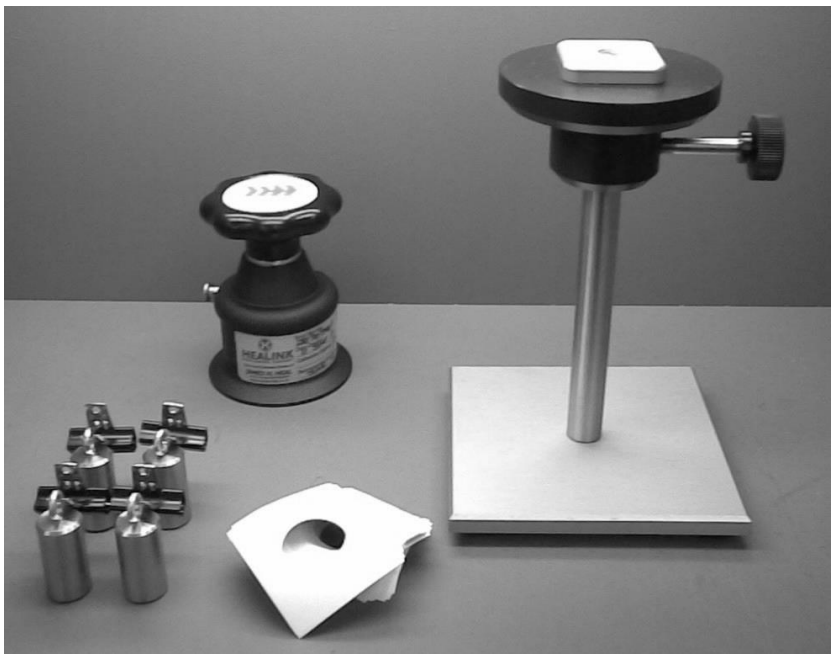
A removable abrading table offers the flexibility to apply liquid, sprays or powdered products onto the material, away from the instrument.

Mounting Easily Stretched Materials

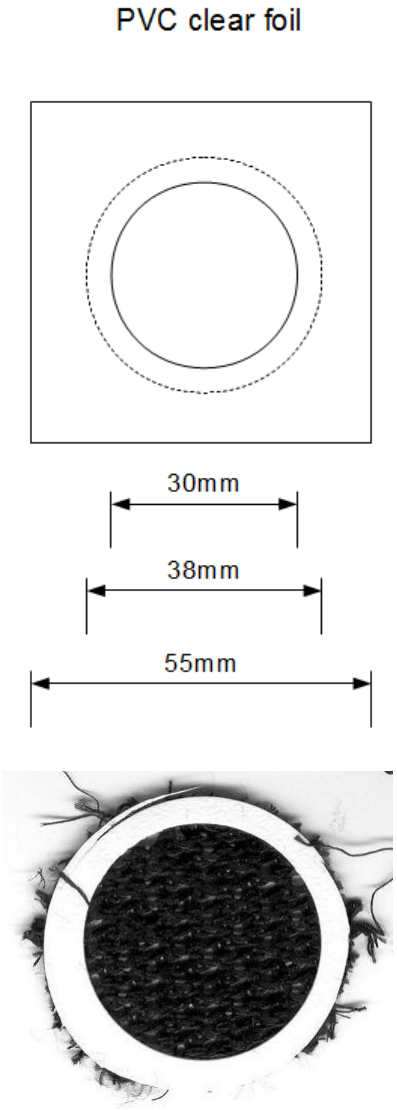
This device and procedure can be used to mount specimens which are easily stretched (and therefore easily distorted) and specimens which curl (or roll up) after cutting.

The device is specified in ISO 12947-2.

The test specimens of dimensions 60 x 60 mm are cut out or stamped in square shape parallel with the stitches or threads, conditioned and placed on the square table mount measuring 45 x 45 mm of the test bed with the side to be abraded facing downwards. A clip of 30 mm edge length is placed on each of the four sides of the test specimen hanging over the table, secured and a weight hung on each clip without stretching the specimen. The four weights are placed on the bracket that can be lowered. The mass of each weight complete with clamp is 100 g. The clamps and weights are then lowered and raised three times in quick succession so that the test specimen is subjected to loading (extended) three times by the four weights and the load released. The bracket is then lowered again with renewed loading (extension) of the test specimen. In this state a square foil measuring about 55 x 55 mm and which has a 30 mm diameter hole in the centre is pressed on to the extended test specimen and affixed to it by means of the adhesive. The bracket is then raised again. The weights are removed from the specimen, the specimen is removed from the mounting device and the test specimen size of 38 mm stamped or cut out for the abrasion test. Care is to be taken that the hole of 30 mm diameter stamped in the foil is precisely centred so that the stamped out specimen is held in the lightly extended state by a foil circle 4 mm wide. To prevent the circular adhesion area loosening, the test specimen is mounted in the specimen holder immediately after stamping or cutting.



794-512 Specimen Mounting Device and 902-222 Sample Cutter 38mm

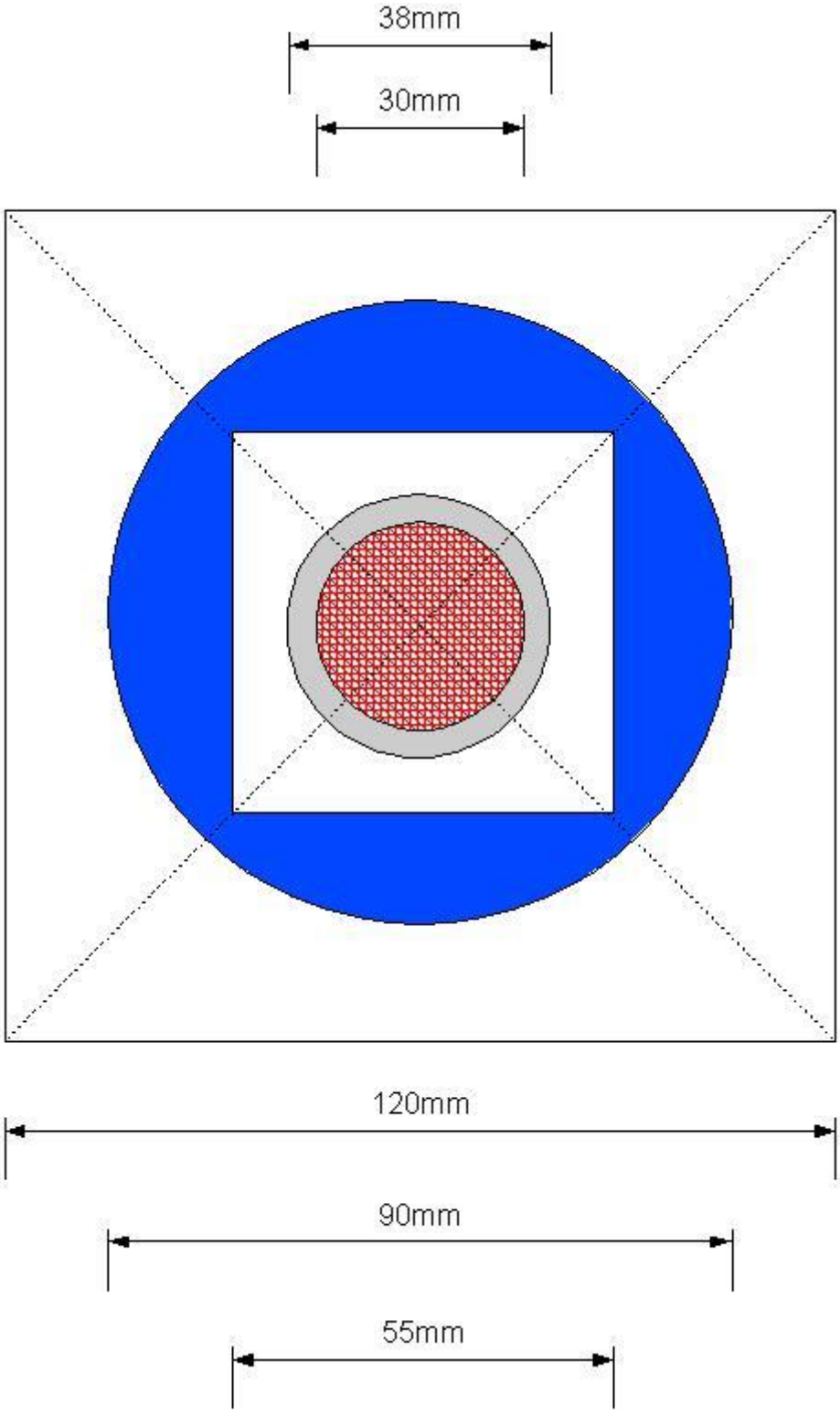


Example of prepared specimen

Cutting Template for Stretch Mounting Device

See next page for template for printing.

Paper Template 120mm x 120mm, with 90mm diameter circle surrounding a 55mm square about a common centre, drawn on it.
Outer case diameter of cutter is 90mm.
Inner diameter of foil 30mm.
Sticky foil square 55mmx55mm.


38mm
30mm
120mm
90mm
55mm

Accessories

Abrasion — EN ISO 12947

794-620 **Abrasion Station Kit**, comprising:
- 1 x Sample Holder
- 1 x 9 kPa Weight
- 1 x 12 kPa Weight
- 2 x Spindle

Recommended minimum order quantity: 4

902-222 **Circular Sample Cutter**, 38mm diameter
For the rapid and accurate preparation of 38mm diameter test specimens

766-200 **Grey Scale for Assessing Colour Change**, ISO 105-A02
For assessing the change in colour of test specimens during the abrasion test

788-761 **Lissajous Figure Marker Pen**
For checking the Lissajous Figure according to EN ISO 12947-1

788-760 Lissajous Figure Recording Paper - per pack (50)

794-512 **Mounting Device for Easily Stretched Fabrics**
Supplied complete with 4 weights and 50 foils

785-507 Additional Foils - per pack (50)

794-621 **Thick specimen holder for EN 388**

Pilling — EN ISO 12945-2

794-517 **Pilling station Kit**, comprising:
- 1 x Sample Holder
- 1 x Sample Retaining Ring
- 1 x Ring Weight
- 1 x Spindle

Recommended minimum order quantity: 3

525-256 **Specimen Mounting Mandrel**
This is an essential accessory for mounting specimens for the pilling test

766-451 **Full Set EMPA Photographic Standards**
This complete set contains 3 x 4 mounted photographs for woven fabrics and 3 x 4 for knitted fabrics

Sock Abrasion — EN 13770 Method 1

794-518 **Sock Abrasion Station Kit**, comprising:
- 1 x Sock Sample Holder
- 1 x Pinned Ring
- 1 x Precision Ball
- 1 x Spindle

Recommended minimum order quantity: 4

525-311 **Block Spanner Adaptor** (for Sock Abrasion – one per instrument)

526-547 **12 kPa Weight (one per kit)** – per weight

Scratch Resistance — EN 16094 / EN 438-2 / CEN/TS 16611 / IKEA

794-519 **4 x Station Kits (including weights for 4N loading)**

525-688 **4 x additional weights for 6N loading**

701-501 **Microscratch reference plates** for checking every new lot of scrub material

Abrasion & Pilling

902-221 **Sample Cutter**, 140mm diameter
For the rapid and accurate preparation of 140mm diameter upper and lower specimens for the pilling test, and for the SM25 abrasive cloth for abrasion.

Test Materials

Abrasion

701-202	Pack (5m) SM25 Abrasive Cloth
701-203	Roll (50m) SM25 Abrasive Cloth
701-207	Pack (100) Pre-cut Discs of SM25 Abrasive Cloth
714-602	Pack (20) Nonwoven Felt Pads (140mm diameter)
714-612	Pack (20) Woven Felt Pads (140mm diameter)
786-256	Pack (2000) Pre-cut Discs of Polyetherurethane Foam (38mm diameter)

Pilling

714-602	Pack (20) Nonwoven Felt Pads (140mm diameter)
714-612	Pack (20) Woven Felt Pads (140mm diameter)
714-601	Pack (20) Nonwoven Felt Pads (90mm diameter)
714-611	Pack (20) Woven Felt Pads (90mm diameter)
356-301	Pack (10) Sample Retaining Rings
701-202	Pack (5m) SM25 Abrasive Cloth

Sock Abrasion

393-254	Pack (2) Spare Precision Balls
701-202	Pack (5m) SM25 Abrasive Cloth
714-612	Pack (20) Woven Felt Pads (140mm diameter)

Scratch Resistance EN 16094 / EN 438-2 / CEN/TS 16611 / IKEA

789-674	Very fine maroon 7447+ (not IKEA)
789-671	Brown 7440 (not CEN/TS 16611)
789-678	Ultra-fine grey/brown 7448+ (for CEN/TS 16611 only)

Please enquire about any other accessories or test materials not listed here, that may be available from James Heal.

Calibration

Sock Abrasion

202-409	UKAS Certificate of Calibration for Martindale (up to 10 stations) - Textile
201-828	ISO Certificate of Calibration for Sock Abrasion Station Kit (up to 4 kits)
201-920	ISO Certificate of Calibration for Sock Abrasion Station Kit (up to 8 kits)

Abrasion & Pilling

202-409	UKAS Certificate of Calibration for Martindale (up to 10 positions) - Textiles
202-410	UKAS Certificate of Calibration for Martindale (up to 10 positions) - Textiles (with additional reference to paragraph 7.3.2 of EN ISO 12947-1)

Cleaning

- Periodically inspect Abrading Tables for indents. Damaged Abrading Tables should be replaced.
- Periodically inspect the Sample Holders and Spindles for signs of damage. Damaged or worn parts should be replaced.
- Keep the instrument scrupulously clean. Remove accumulated debris from all parts. Clean up oil and grease stains immediately.
- Keep the Spindles clean. A trace of light oil applied via a cloth is recommended in a high humidity environment.
- Keep the Drive Slots and the Drive Pegs free from debris.
- Use only a dry soft cloth when cleaning the Control Panel. DO NOT use any solvents or abrasive cleaning agents.

Service and Calibration

User Servicing

- At approximately monthly intervals, clean away any oxidised or contaminated grease from the Drive Pins, Bushes, Drive Slots and Wear Plates and re-apply fresh 1600 Series Martindale Grease to the same areas using the Plastic Spatula provided. See Replacement Parts (Spares), below.
- Mains electrical fuses are located in the power inlet socket, located at the left-hand side of the instrument.
- To replace the fuses, remove the mains cable from the power inlet. Open the fuse drawer to expose the fuse cartridge. Fit new 2A and 1A 20mm anti-surge fuses. The 2A fuse is fitted to the 110V side and the 1A is fitted to the 220V side of the carrier. NB – For 1609W the mains cable cannot be removed as it is wired directly into the instrument.

Service & Calibration Support

The Martindale 1600 Series of Martindale Abrasion and Pilling Testers are world-class products, fully supported by our world-leading Maintenance and Calibration Service - covering installation, operator training, regular maintenance, UKAS Calibration and on-line technical and applications support.

James Heal Service & Calibration is available Worldwide – Contact our Service & Calibration Support email for further details: support@james-heal.co.uk

Compliance Statements

Product End-of-Life Disassembly Instructions (WEEE)

The **Waste from Electric and Electronic Equipment (WEEE)** disassembly instructions are intended for use by end-of-life recyclers or treatment facilities. They provide the basic instructions for the disassembly of this product to remove the components and materials requiring selective treatment.

Items Requiring Selective Treatment

Models 1602, 1605 and 1609		
Item Description	**Notes**	**Qty. of Items included in Product**
Printed Circuit Boards (PCB) or Printed Circuit Assemblies (PCA)	With a surface area greater than $10cm^2$	3
Batteries	All types including standard alkaline and lithium coin or button style batteries	1
Mercury containing components	e.g. mercury in lamps, display backlights, switches, batteries	0

EU Conformity

- Machinery Directive 2006/42/EC
- Low Voltage Directive (LVD) 2014/35/EU
- Electromagnetic Compatibility (EMC) Directive 2014/30/EU
- Waste Electrical and Electronic Equipment recycling (WEEE) Directive 2012/19/EU
- Restriction of Hazardous Substances (RoHS) Directive 2011/65/EU

Specifications

Mode of Operation	**Abrasion**	**Pilling**	**Sock Abrasion**
Standard	EN ISO 12947	EN ISO 12945-2	EN 13770
Number of specimens	Model 1602 – up to 2 Model 1605 – up to 5 Model 1609 – up to 9		
Exposed area of test specimen	6.45 cm^2	64.5 cm^2	3.14 cm^2
Working pressure on test specimen	9 kPa (apparel) 12 kPa (upholstery)	2.5 cN/cm^2 (knitted) 6.5 cN/cm^2 (woven)	23.86 kPa
Rotational speed	47.5 ± 2.5 rpm (optional but non-standard x1.5 speed)		
Total stroke of drive units	60.5 ± 0.5 mm	24.0 ± 0.5 mm	60.5 ± 0.5 mm
Parallelism of top plate to abrading tables	0.05 mm		
Maximum circumferential parallelism of sample holders to abrading tables	0.05 mm		

Dimensions and Weights

	Depth	**Height**	**Width**	**Weight**
Mini-Martindale 1602	730 mm	246 mm	500 mm	45 kg
Mini-Martindale 1602S	748mm	246mm	498mm	Dependent on application
Midi-Martindale 1605	637 mm	246 mm	674 mm	65 kg
Maxi-Martindale 1609 & 1609W	670 mm	309 mm	877 mm	85 kg

Revision History

See front cover for publication number, e.g., 290-1600-1$A.
The letter following the dollar symbol shows the revision status of the document.

Rev	Date	Originator	Details of revision
A	02-09-16	CB	Inclusion of TS Interface onto 1300 series guide by PG
B	01.12.16	CB	'User' / EU Conformity
C	09.02.17	CB	Add special apps / reduce 5.5kg mounting weight info
D	19.02.19	SEW	1609W direct mains lead info, no switch & plug required note
E	28.10.19	LK	Safety advise updated following a full risk assessment on the machine
F	03.12.19	SEW	EOL Update