



# FPT-H1

## Horizontal Friction, Peel, and Tear Tester

Assembly, Installation, and Operation



## **This manual**

This document illustrates the use of the Mecmesin FPT-H1 horizontal coefficient of friction tester. Please refer also to 431-398 *A Guide to Safe Use of Mecmesin Mains Powered Test Systems*.

For more information on running programs in Console mode, please refer to Manual 431-389, *Emperor™ Programming for Mecmesin-xt Force and Torque Test Systems*.

For writing, editing and running programs for the FPT-H1-i, please refer to Manual 431-382, *Emperor™ Force and Torque Testing Software: Operator Manual*.

## **Warranty**

The -xt console is pre-configured at Mecmesin. With the exception of the Advanced Builder Option, which requires a configuration change to the console, any unauthorised changes to the console configuration and set-up will invalidate the warranty.

The 24-month end-user warranty for the console itself is with a third party. Please contact your local Mecmesin agent for assistance with this warranty.

The Microsoft® Windows® 10 Enterprise 2016 operating system is pre-installed and licensed by Mecmesin and supplied with an End User License Agreement, and Certificate of Authenticity.

The console is supplied for the sole purpose of operating, and collecting data from, your Mecmesin system. Any use other than this is not recommended and may result in performance degradation and/or damage to your console. Although network and USB storage device connection is allowed, this is at the user's risk. No liability can be accepted by Mecmesin for virus, malware or ransomware contamination

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Part no. 431-449-04

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# 1. Parts Supplied With Your Tester

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## **FPT-H1**

1. FPT-H1 tester
2. Mains cable for the tester
3. FPT loadcell
4. Toolkit of Allen keys and Torx wrench
5. Fixture mounting block
6. Plane sample spring clamp
7. Friction test hook for loadcell
8. 2 × 8 mm QC mounting posts and retaining pins
9. Manual: *A Guide to Safe Use of Mecmesin Mains-powered Test Stands*
10. Emperor™ software CD-ROM, with library programs for a range of standard tests
11. Programming Manual for operating the Emperor™ software

## **Additional items with FPT-H1-xt**

12. Touch screen PC console with mounting bracket, preloaded with Emperor™ software
13. USB-serial data cable and power supply for the console

## **Additional items with FPT-H1-i**

14. PC data cable

## **Optional accessories include:**

### **Loadcell accuracy checking kits**

FPT-H1 loadcell calibration checking kit (part no. 432-635). Used with mass kits for a 10 N loadcell (5 N, part no. 432-655), or 100 N loadcell (50 N, part no. 432-656).

### **BS ISO 15359 coefficient of friction test fixture (factory-fitted version of FPT-H1)**

Motorised lift with set-down and guide rails, with 3 mm Allen key to attach rails.

### **Fixtures for peel testing and tear testing**

The FPT-H1 is suitable for certain peel testing standard methods (see section 16 'Fixtures for Peel and Tear Testing').

## 2. Suggested Test Standard Methods

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### 2.1 Suggested coefficient of friction test standards

BS EN ISO 8295	Plastics. Film and sheeting. Determination of the coefficients of friction
ASTM D1894	Standard Test Method for Static and Kinetic Coefficients of Friction of Plastic Film and Sheeting
BS ISO 15359	Paper and board – Determination of the static and kinetic coefficients of friction – Horizontal plane method
TAPPI T 549	Coefficients of static and kinetic friction of uncoated writing and printing paper by use of the horizontal plane method

### 2.2 Suggested peel test standards

AFERA 5001	Self Adhesive Tapes – Measurement of Peel Adhesion from Stainless Steel or from its own Backing
ASTM D3330	Standard Test Method for Peel Adhesion of Pressure-Sensitive Tape
ASTM D6252	Standard Test Method for Peel Adhesion of Pressure-Sensitive Label Stocks at a 90° Angle
PSTC 101	International Standard for Peel Adhesion of Pressure Sensitive Tape
BS EN 868-5	Packaging materials and systems for medical devices which are to be sterilized. Heat and self-sealable pouches and reels of paper and plastic film construction
BS EN 1895	Adhesives for paper and board, packaging and disposable sanitary products - 180°-‘T’ peel test for a flexible-to-flexible assembly
BS EN 1939	Self-adhesive tapes. Determination of peel adhesion properties
ASTM F88	Standard Test Method for Seal Strength of Flexible Barrier Materials
ISO 8510-2	Adhesives – Peel Test for a Flexible-bonded-to-rigid Test Specimen Assembly – Part 2: 180 degree peel
FINAT FTM-1	180° peel adhesion at 300 mm per minute (from application substrate)
FINAT FTM-2	90° peel adhesion at 300 mm per minute (from application substrate)
FINAT FTM-3	180° peel adhesion at 300 mm per minute (from backing)



## 2.3 Suggested tear test standards

ASTM D1004	Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting
ASTM D1938	Standard Test Method for Tear-Propagation Resistance (Trouser Tear) of Plastic Film and Thin Sheeting by a Single-Tear Method
BS EN ISO 6383-1	Plastics – Film and Sheeting – Determination of Tear Resistance – Part 1: Trouser Tear Method
BS EN ISO 12625-12	Tissue paper and tissue products – Part 12: Determination of tensile strength of perforated lines – Calculation of perforation efficiency

## 3. Installation

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### 3.1 Unpacking the tester

When you first receive your FPT-H1 please check that there is no obvious damage to the packaging. If there is any sign that the packaging or the test stand itself has been damaged, please contact Mecmesin or your authorised distributor immediately. Do not use the stand until you have confirmation that it is safe to use.

We strongly recommend that the packaging is kept, as this can be useful if the machine needs to be returned for any reason.

Section 1 lists items that should be included with your test stand. Please contact Mecmesin or your authorised distributor if any items are missing or damaged.

### 3.2 Lifting the tester

The unpackaged weight of the tester is given in the Specification table at the back of this manual. The tester should be lifted by two people.

### 3.3 Locating the tester

The tester should be positioned on a level, stable work surface, and levelled by using the adjustable feet as necessary.

### 3.4 Mains power supply

The FPT-H1 tester can be used on 110–120 or 220–240 V ac 50–60 Hz supplies. The rear fuse carrier will be set for your local requirement, but is reversible, so should you replace a fuse, the correct local voltage must read in an upright position (carrier and holder arrows align):



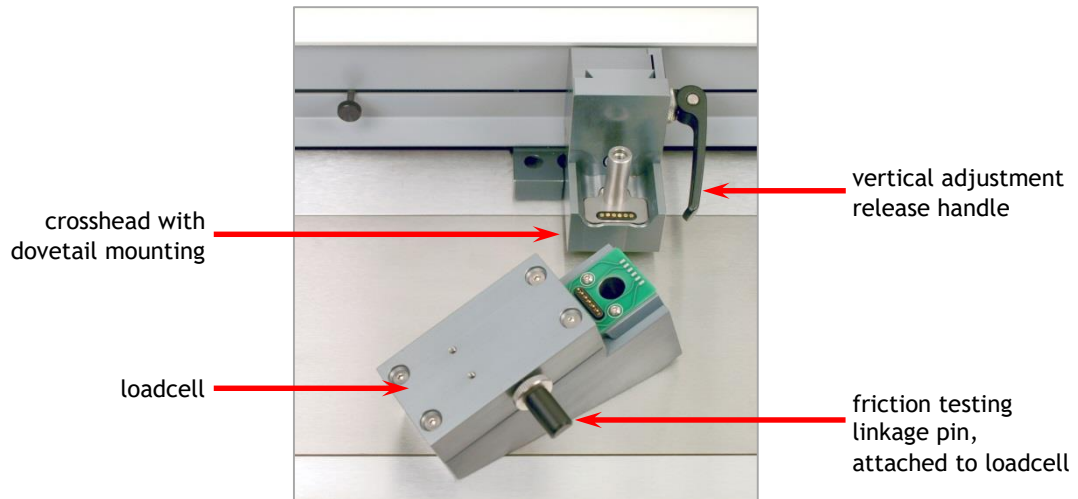
Fuse carrier

Carrier removal

## 4. Identification of Parts

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### 4.1 Crosshead and loadcell

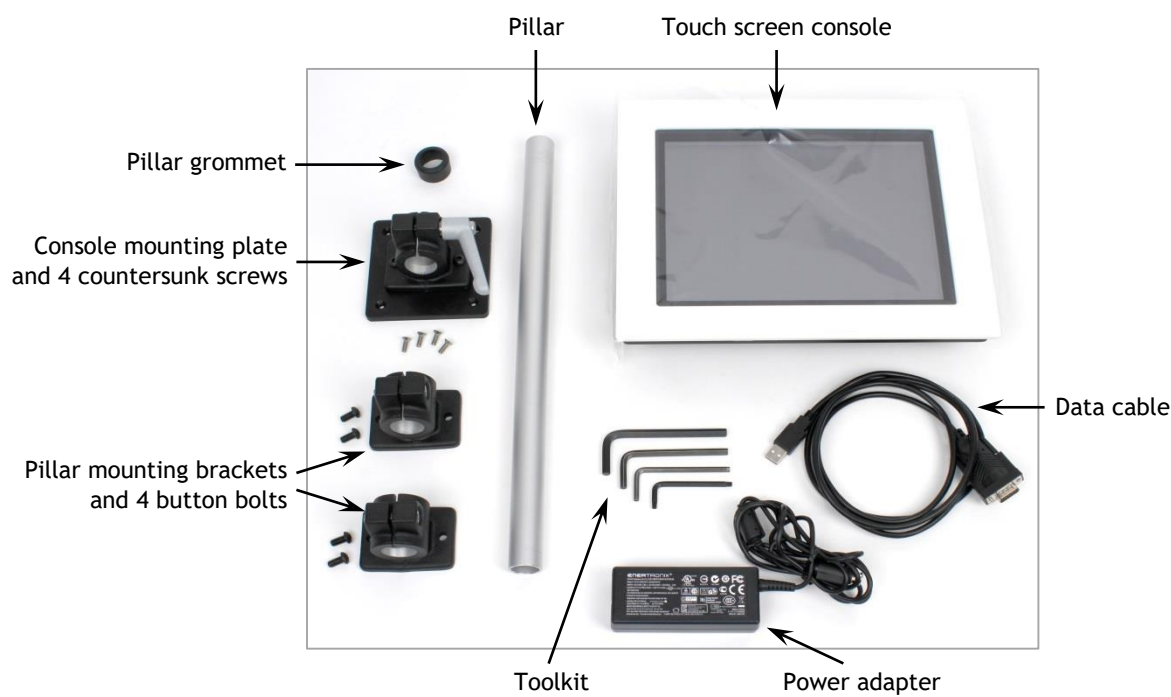


### 4.2 Rear panel connections



## 5. Assembly and Connection

### 5.1 Mounting the console (FPT-H1-xt)



#### 5.1.1 Bracket assembly

Attach the pillar brackets to the FPT-H1 back panel, using the 4 mm Allen key and four button bolts, but do not tighten:



Insert the pillar into the brackets and tighten the brackets very firmly onto the pillar, using the 6 mm Allen key, and then tighten the brackets to the FPT-H1 using the 4 mm Allen key:



At this stage you can pass the USB end of the data cable up through the pillar, to save a trailing cable (see right, below).

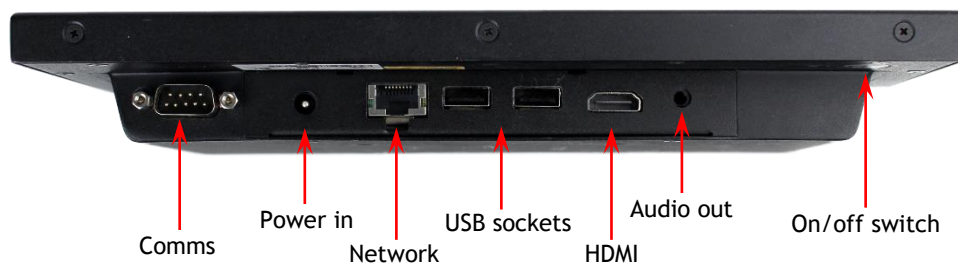
Secure the mounting plate to the back of the console using the four countersunk screws, using the Torx key, mount the bracket onto the pillar, and secure it using the grey handle:



Push the button on the grey handle to lift and turn it as required, and to leave it tidily.

### 5.1.2 Connecting the console

Data and power connections are on the underside of the console:



Pass the pillar grommet over the USB cable and push it onto the top of the pillar. Insert the USB plug into one of the available sockets on the underside of the console (circled):



The console is powered from a separate adaptor plugged into a mains socket.

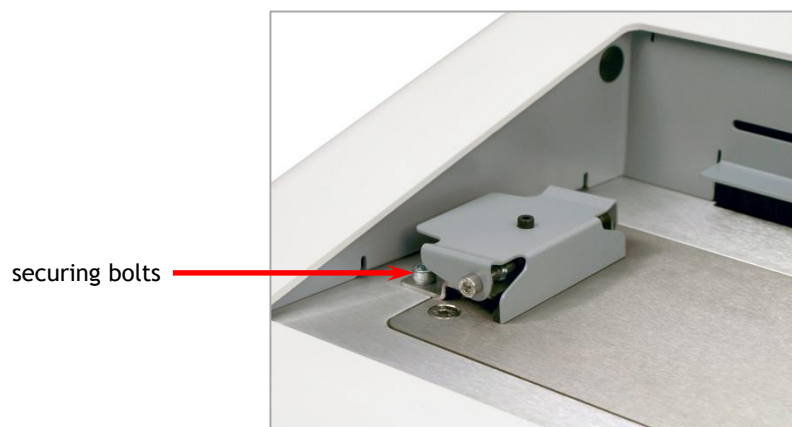
**Caution:** use only the mains adaptor supplied by Mecmesin, do not use any other type.

Ensure that the power lead and USB lead are firmly fitted to the console. Plug the power adaptor into a suitable mains supply socket. Plug the other end of the USB cable into the 9-way socket labelled 'PC-RS232' on the rear left of the FPT-H1. Normally it will not be necessary to remove the USB cable, but should this be required, return the Emperor software to the front screen display before disconnecting the data cable.

Connect printers or other device using the spare USB sockets.

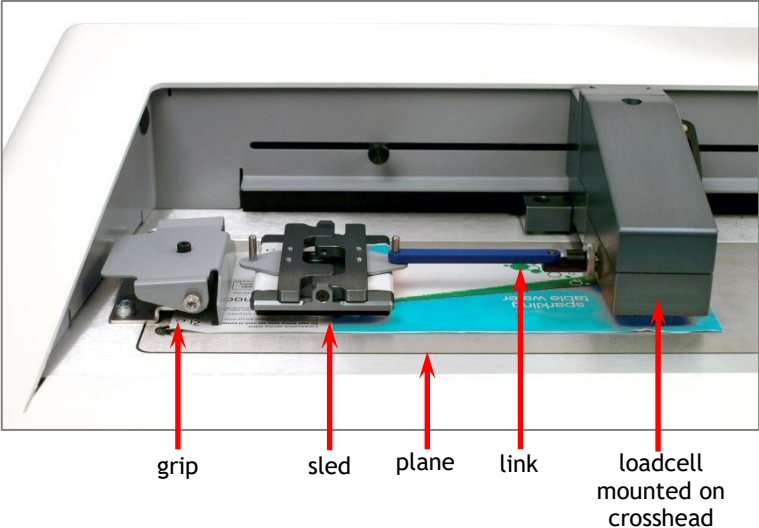
## 5.2 Coefficient of friction grips and fixtures

Samples for coefficient of friction testing on the plane bed are secured under the neoprene-edged spring clamp at the left-hand side. Advice on securing the sample free end and sides, to provide a completely flat sample, is given under each of the coefficient of friction test standards described in this manual.



The clamp is secured by means of two cap-head bolts (arrowed). Use a 5 mm Allen key to release the clamp and secure alternative fixtures for peel or tear testing.

The moving part of the tester is the sled, which is attached to the loadcell on the crosshead by a link (a rigid link is shown):



### 5.3 Coefficient of friction sleds

There are three sleds available for the FPT-H1, designed to comply with the testing standards in dimension, weight and sample facing. Be sure to select the correct sled:

Sled	Used for		Weight	Face dimensions	Facing material
A	BS EN ISO 8295 ASTM D1894	plastics, film and sheeting	200 g	63.5 mm × 63.5 mm	compressive foam
B	TAPPI T 549	uncoated writing and printing paper	200 g	63.5 mm × 63.5 mm	neoprene
C	BS ISO 15359	paper and board	800 g	65 mm × 65 mm	neoprene

### 5.4 Sled links for coefficient of friction testing

Rigid and elastic links of the same length are supplied. The supplied test programs are set for links of this length, so please use only these links, or suitable links of the same length.

The purpose of the elastic link is to damp the starting load of the crosshead when measuring static friction, especially of plastic films. The rigid link is required wherever stick-slip behaviour is observed, typically with paper samples (see Section 11, *Elements of Friction*).

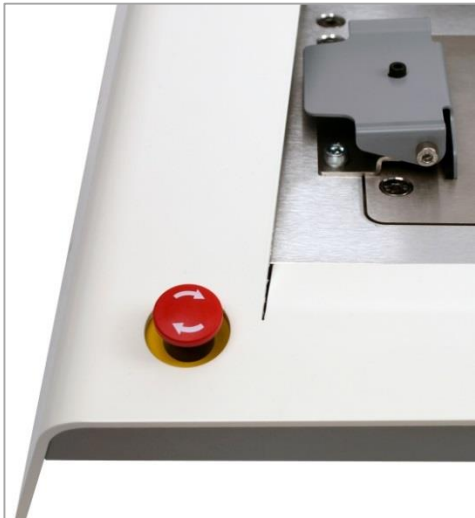


## 6. Working in the Test Area

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### 6.1 Emergency stop and jog buttons

On the front left of the tester, the red button is for an emergency stop. Pressing this will stop all movement of the crosshead and will override all other controls. Once pressed, the button stays latched down. To re-set the button, rotate it clockwise.



Emergency stop button



Crosshead jog buttons

Jog buttons are used to position the crosshead so that samples can be attached or removed. The blue-lit physical buttons move the crosshead at a factory-set fixed rate of around 100 mm/min when the console software is running. When the console software is not running, the jog buttons will only progress the crosshead by 10 mm for each press of a button.

Another pair of similar 'jog' buttons are on the software test screen. The two sets of buttons function in different ways.

- The hardware buttons move at a factory-set fixed speed.
- The software buttons can be user-set in Emperor (select Programmed Testing at logon, then *Setup > Preferences > [General]* to set a fixed speed, or variable speed (repeatedly pressing an onscreen jog button progressively changes the speed)).

### 6.2 Attaching and changing the loadcell



**Turn off the tester power before changing loadcells.**

You can swap loadcells by simply disconnecting one cell and fitting another. First, return to the Emperor software Main Screen and switch off the tester, before removing the loadcell. When the new loadcell has been fitted, switch the tester on again, and after a few



seconds the new loadcell will be automatically recognised. The tester will read in the new cell's range, serial number and calibration status.

Do not attempt to remove the crosshead itself. The loadcell is attached via a captive hex caphead bolt, secured and released with the 5 mm Allen key:

- lower the loadcell onto the mounting pillar
- support the loadcell with one hand
- insert the caphead bolt, and tighten using the Allen key.



**Do not overtighten. Low-capacity loadcells are delicate and require careful handling.**



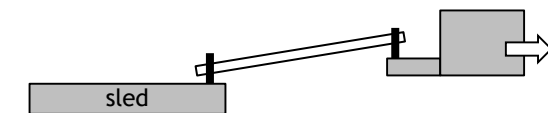
Attaching and removing the loadcell



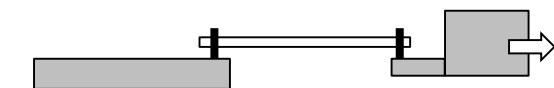
**Do not rest the loadcell with the stud down.**

### 6.3 Adjusting crosshead height

The height of the crosshead will need adjusting to ensure horizontal alignment when force is applied using different fixtures. For example, in friction testing:



Incorrect alignment



Correct alignment

- attach the required link or grips
- jog the crosshead left or right as required, to secure a sample with the link or grips
- support the loadcell with your left hand
- release the black lever on the right of the crosshead
- carefully position the crosshead vertically, so as to achieve sample alignment

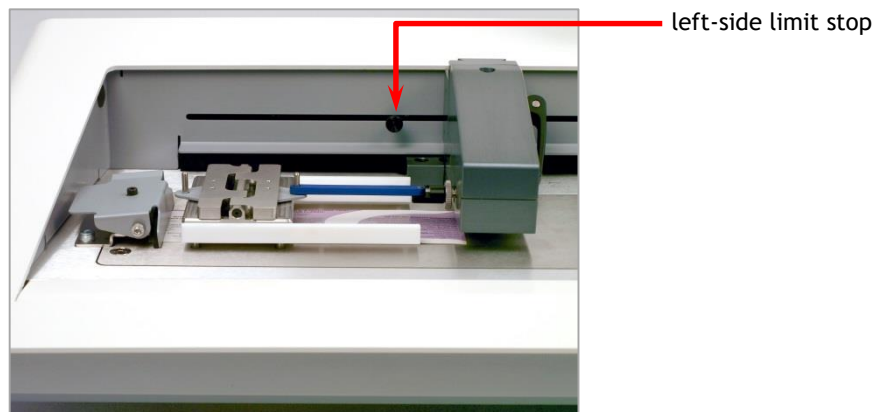
- tighten the black lever.



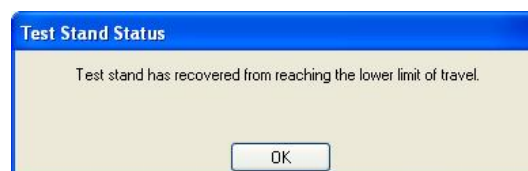
Adjusting crosshead height

## 6.4 Setting the limit stops

The system prevents the motor drive from overloading the loadcell. However, other parts may come into contact, undetected by the loadcell, such as between the crosshead and the BS ISO 15359 sled guide fixture when raised, or at maximum or minimum travel. Left- and right-side limit stops stop crosshead travel before physical over-travel limits are reached. The right-side limit stop will not normally need to be adjusted, but advice is given on positioning the left stop depending on the test being run.

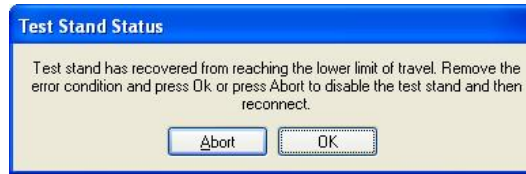


If the crosshead reaches a limit stop during a test, it will stop then reverse direction for approximately 5 mm, then stop again. A warning message is displayed:



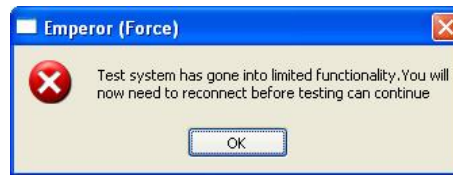
Press **OK** to acknowledge the warning and use the Jog buttons to move the crosshead so that you can then check the position of the limit stops and re-set if required.

If a limit stop is reached while pressing one of the Jog buttons on the front panel of the FPT-H1, a different warning message is displayed.



Pressing **OK** will allow you to correct the situation and continue.

Pressing **Abort** will disconnect the stand from the console, and display the following message:



Press **OK** then the toolbar Info. button: 

On the [Test Stand] Tab, press **Reconnect** then **OK**.

Limit stops should be adjusted after grips or holding accessories have been fitted so that the limit positions will prevent contact between moving and static parts (for example, the sled lifting rails for BS ISO 15359). To set the left-side limit stop, slacken the knurled knob by turning it anti-clockwise, then slide the stop to the desired position and re-tighten the knob. The right-side limit stop can be adjusted using a 2.5 mm Allen key.



**Remember to check** and, if necessary, adjust the position of the left-side limit stop if the grips are exchanged for a different holding accessory (e.g. peel tests).

## 6.5 FPT-H1 with mechanical sled lift

This is a factory-fitted variant of the FPT-H1.



**If you have an installed sled lift**, this must **never** be operated when any fixture is secured over the lift pins, e.g. the 180 degree peel table, or the heated plane. Doing so inadvertently may cause damage to the lifter mechanism.

## 7. Starting the Emperor Software

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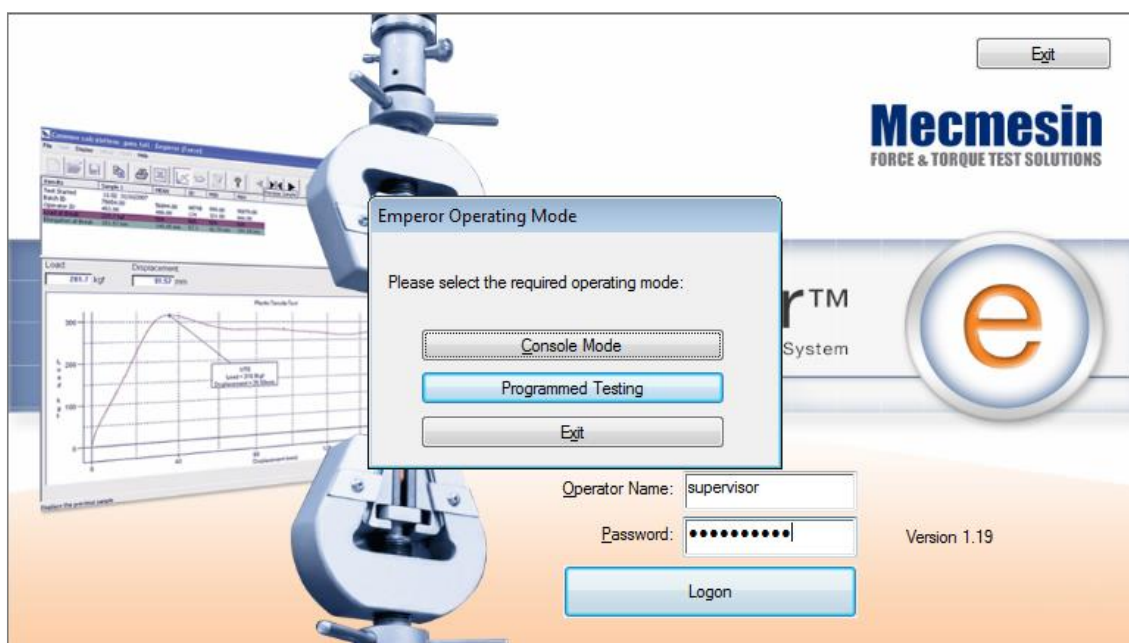
Start the program by using the Emperor icon on the Windows desktop – the splash screen is displayed.

Logon with a Master level username and password (for full access). If this is the first time you have started the program, you can use:

Default Username: supervisor

Default Password: supervisor

**Note:** both the username and password are case-sensitive.



### FPT-H1-xt

On the Operating Mode selection screen, click on **Console Mode** to use the system as described in this manual.

### FPT-H1-i

On the Operating Mode selection screen, click on **Programmed Testing** to use the system as described in the manual: 431-382 *Emperor™ Force and Torque Testing Software: Operator Manual*. See also Section 18, *Installing Emperor Software on a PC (FPT-H1-i)*.

#### 7.1.1 User accounts

To add user accounts, press **System Settings** and the [User Accounts] tab. Type in a new user's details, then **Add**. You will notice that for Operators, you choose only those permissions you wish to give.

New programs can only be written by Master users, using Programmed Testing mode.

For full information on using all aspects of the Emperor™ programming and analysis software, refer to manual 431-382 *Emperor™ Force and Torque Testing Software: Operator Manual*.

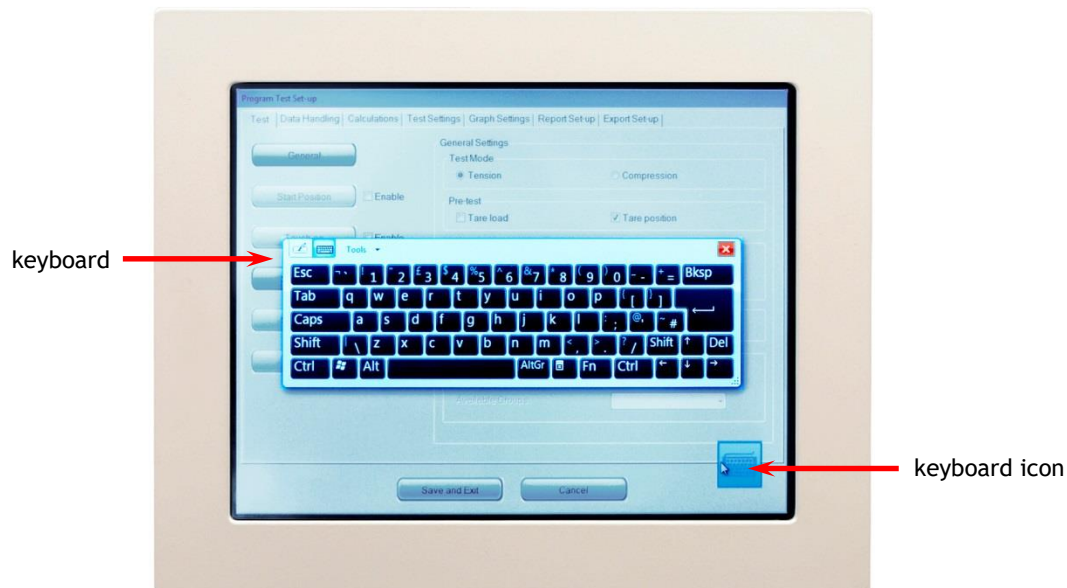
## 7.2 The touch screen console

The touch screen is used to control the FPT-H1-*xt* system. Please note that this Windows computer does not contain an internal battery. If power to the system is interrupted, any unsaved data will be lost.

You can select operations and options by pressing or tapping on the relevant button on the touch screen with a finger or a stylus. In the bottom right of any screen layout requiring typed entry, there is a keyboard icon. Touch this, and a floating keyboard appears so you can type in numbers or text.

If this obscures an entry field or control, just drag it out of the way by touching and dragging just above the icon.

Where a layout has no data entry, the keyboard will automatically slide out of sight to the left, but it does not appear automatically when data may be required. Simply tap the keyboard icon whenever you need it.



The FPT-H1-*xt* console showing the floating keyboard icon bottom right, and keyboard

- a single tap or press is the same as a left mouse button
- press-and-hold is the same as a right mouse button
- a double-tap is a double-click
- touch and drag a finger to select text

- combination keys such as Shift+ and Ctrl+ are used sequentially. For example, to select contents of a field, press Ctrl and then A. To copy, press Ctrl and then C. To paste, press Ctrl and then V.
- touch and drag a window element by its title bar – such as the floating keyboard itself
- to close Windows from the desktop, bring up the floating keyboard and touch the Windows button twice.

If preferred, a standard USB mouse and/or keyboard may be used.

## 8. Setting the Absolute Zero Crosshead Position



This process must be run prior to using the tester, or if ever there appears to be a change in programmed positioning.

All preset programs are written to position the crosshead at various stages to allow sample fixing, sled linking, and to slide the sled the correct distance within the plane sample length.

To achieve this, an absolute zero reference position is used. Before using a test program, you will need to establish this position and set it via the Emperor software. The tester will retain this position even when switched off.

### General setting

If you do *not* use the FPT-H1 for BS ISO 15359, follow these general settings. If you *do* use the FPT-H1 for BS ISO 15359, follow the specific instructions under the next heading.

1. Switch the tester and console on, and logon to the software in Console Mode.
2. Ensure the left-side limit stop is tightened in a position to the far left of the tester.
3. Place the sled to the left, close to the grip, where you will start each slide.
4. Drop a link onto the sled pin.
5. Jog the crosshead left towards the sled, using the blue buttons on the machine, until the link can be dropped freely on the loadcell pin.
6. Press the Quick Test button
7. Now just press **Run** and then the Zero button on the toolbar at the top of the screen.
8. Select the [Absolute Zero] tab, and touch to place the cursor in the Offset position box:



Using the onscreen keyboard, enter zero (0), press the **Set Absolute Position** button, then **Exit**.

9. Press Exit:

## Setting Absolute Zero for users of BS ISO 15359

If you use the FPT-H1 for BS ISO 15359, follow these more specific instructions.

1. With the sled rails fitted, ensure the crosshead is clear of the rails, to the right and raised above the rail height.




**Important! The crosshead must never be allowed to collide with the rails.**

2. Loosen the left-side limit stop.
3. Switch the tester and console on, and logon to the software in Console Mode.
4. From the Advanced Test Library, select the program: 'ISO 15359 sled position only'.
5. Press the green start button
6. This will raise the sled rails so that you can place the sled on the four locating pins, and then lower the sled into the correct starting position.
7. Drop a link onto the sled pin.
8. Jog the crosshead left towards the sled, using the blue buttons on the machine, until the link can be dropped freely onto the loadcell pin.
9. Now press the Zero button on the toolbar at the top of the screen.
10. Select the [Absolute Zero] tab, and touch to place the cursor in the Offset position box:



Using the onscreen keyboard, enter zero (0), press the **Set Absolute Position** button, then **Exit**.

11. Press Exit:  and discard the results (there are none).
12. Slide the left-side limit stop up to this crosshead position, and back off to the left by 1-2 mm, and retighten.



## 9. Running Supplied Test Programs



**Before running supplied programs for the first time**, you must set the absolute zero crosshead position, as described in Section 8 *Setting the Absolute Zero Crosshead Position*.

Programs supplied with the FPT-H1-*xt* have been written for the Advanced Program Builder (Emperor™) and appear under Advanced Test.

For more information on running programs in Console mode, please refer to Manual 431-389, *Emperor™ Programming for Mecmesin-xt Force and Torque Test Systems*.

For writing, editing and running programs for the FPT-H1-*i*, please refer to Manual 431-382, *Emperor™ Force and Torque Testing Software: Operator Manual*.

The FPT-H1 is supplied pre-programmed with key industry standard test programs. Up to five of these can be assigned to the 'favourites' buttons. Any number of other programs can be held in the libraries under Program Test or Advanced Test. Here five programs to coefficient of friction standard methods have been assigned:



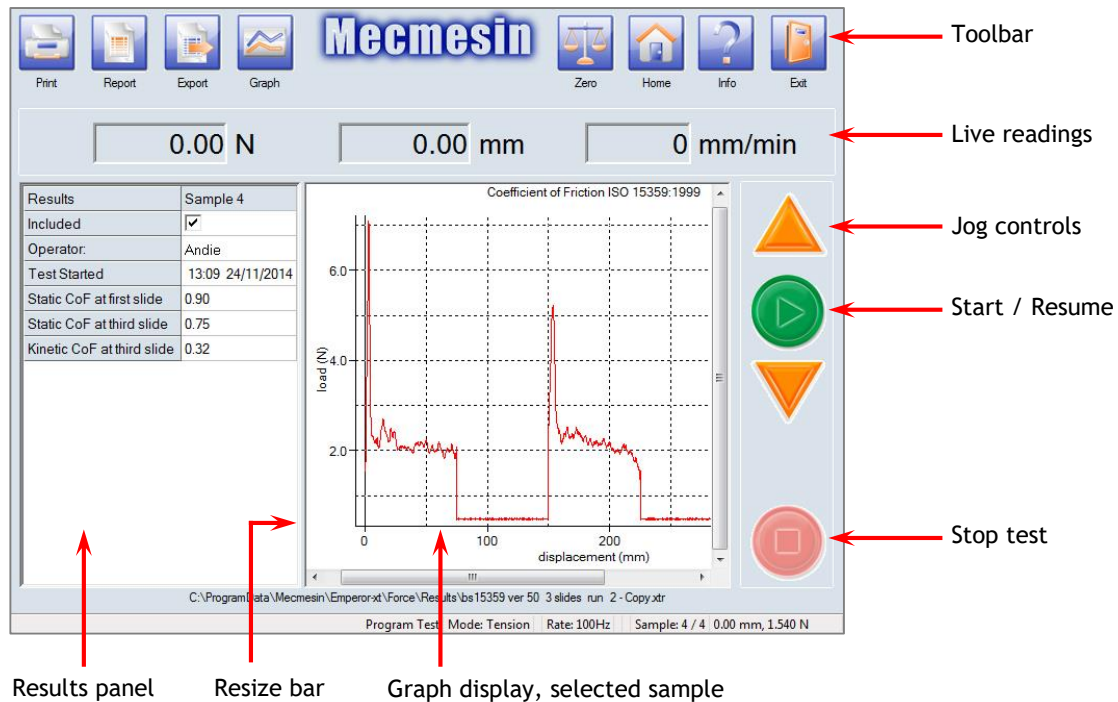
All supplied programs are listed under 'Advanced Test' in the Test Library, and any can be assigned to, or removed from, a Favourites position. (See the Emperor™ software manuals for full details.)

Any programs that you write in Console mode will be listed under 'Program Test'.

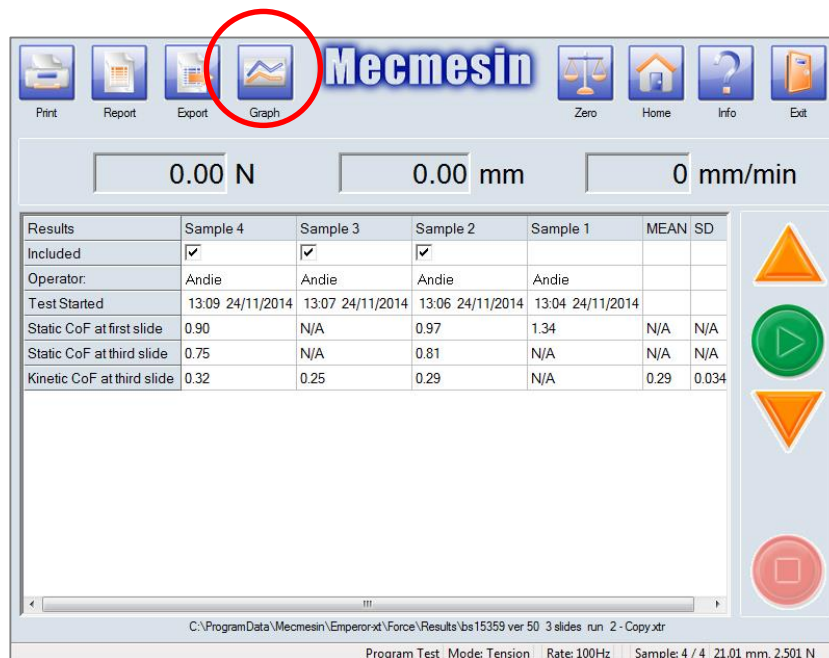
Please refer to the published test standards for complete details of sample preparation and conditioning, and to note any relevant changes that may be introduced from time to time by the relevant standards bodies.

## 9.1 Running programs: the test screen


You will probably want to run the test with the live graph on display:




Touch the Graph button to reveal all sample results instead, and compare results:




- Sample 1, Sample 2 ... etc. are default titles. Double click them to edit this text, using the onscreen keyboard.
- Select any sample and touch the graph button to examine the graph for that sample.

- Select any sample and touch the Info button  to access Sample Management, where individual samples can be deleted, and where additional descriptive information for the batch of samples can be added. This information will be included in printed reports.


## 9.2 Viewing and handling results

On completing any run of tests, touch Exit  and you will be prompted to save or discard the results. Results are saved in .for format, which can be opened in Emperor to be viewed and analysed again.

Results save to default folder C:\ProgramData\Mecmesin\Emperor\Force\Results.

Test results can also be exported to a delimited format file. Touch the Export button  and name the file, saved in C:\ProgramData\Mecmesin\Emperor\Force\Export.

'Results' format will save just the same information that you can see in the results grid on screen. 'Raw' data format will export all data points. Batch information is not saved in this format.

Touch the Report button  to generate a printout incorporating the results details for each sample, a results graph, and any batch information entered. This report can be saved as a PDF file, in default folder C:\ProgramData\Mecmesin\Emperor\Force\Reports. The Print button will just print this same report without the option to save it.

### 9.2.1 Excel

Results and raw data can be sent to Excel, via an export Scheme. For full explanation of the export file, its name and location, and export options in a Scheme, see the manual 431-382 *Emperor™ Force and Torque Testing Software: Operator Manual*.

Results can be sent to Excel only from Programmed Testing mode, not Console mode (Excel toolbar button, or *File > Send to Excel*).

Results, when sent to Excel, include the test batch notes fields.

## 10. Coefficient of Friction Testing

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### 10.1 Test programs

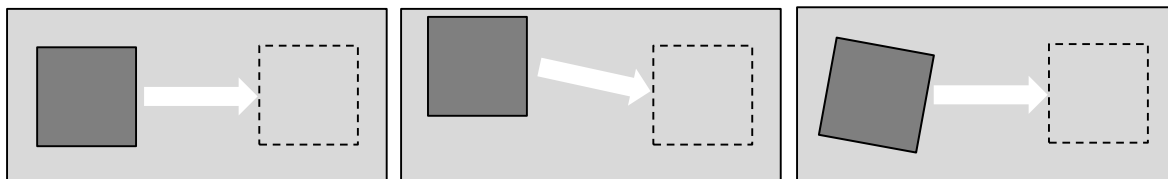
Standard programs are supplied preinstalled on the FPT-H1 Favourites menu (Console mode). They are also listed under the button: Advanced Test, Advanced Test Library.

### 10.2 Plane sample attachment

The FPT-H1 has a spring clamp for securing one end of the plane sample. Note that some standards permit further adhesive attachment to ensure the sample lies flat, especially for plastic films.

### 10.3 Alignments

Alignment of the sled is critical to accurate measurement, especially of static friction. For accurate measurement, the sled must not rotate or be pulled at an angle as movement begins. Throughout kinetic friction measurement, the travel of the sled must remain perpendicular to the travel of the loadcell.



Correct

Incorrect (causes drift)

Incorrect (causes rotation)

There must be full-area contact between the sled sample and the plane bed sample at all times, and no contact with any fixing tape attaching a sample.

### 10.4 Sled sample attachment

The purpose of the prescribed sleds by dimension and weight is to provide a consistent pressure between the two sample surfaces in the contact system being tested. It is essential, then, that despite any incidental lateral movement of the sled, full surface area contact is maintained.

For some tests (typically paper and card), the sample is cut to size and stuck to the sled surface.



Apply low-tack double-sided adhesive tape to secure the sample



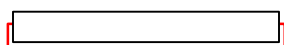
Sample not set square  
card edge projects, area not fully supported



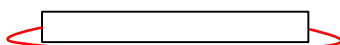
Sample set square  
no edge friction, whole sample supported

It is important that residues do not build up on the neoprene so as to create an uneven surface. Clean carefully with detergent or light application of a 'sticky stuff' remover.

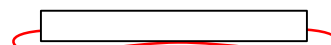
For other tests, the sample material is thin enough to wrap around the sled, secured by the magnetic grips. Wrapping must not lead to unevenness in the contact plane:



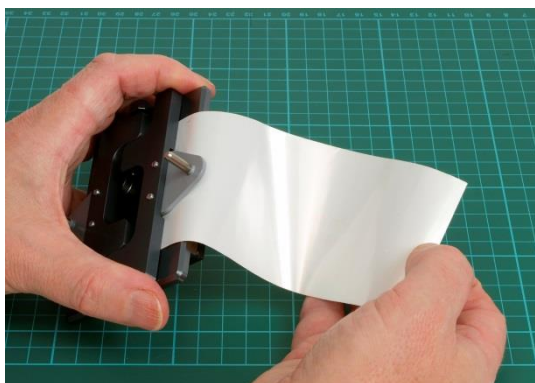
good fit



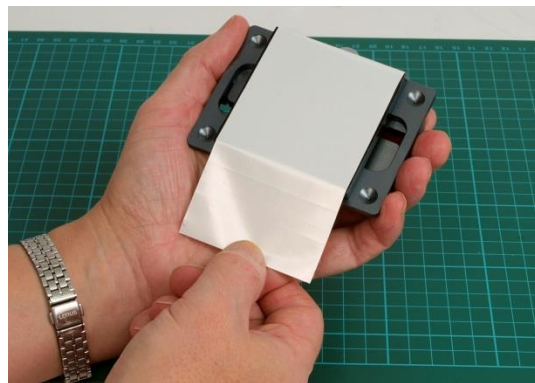
bad fit



bad fit

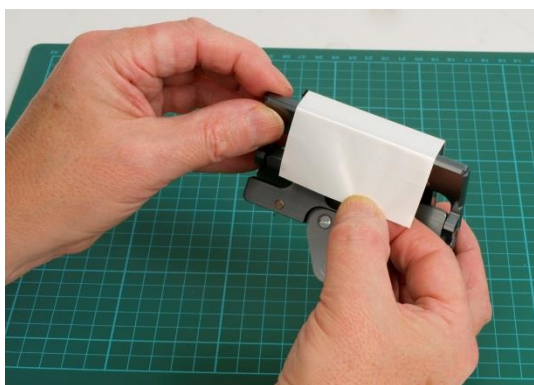


Clamp one end of the film sample  
being careful not to handle the contact area



Draw the film into place without stretching,  
maintaining alignment with the sled surface





Fold the film under the second magnetic catch



Hold in place and lower the catch



A correctly-prepared sled sample

## 10.5 Sled linking

Two kinds of link are provided, rigid and elastic. The requirement and use of each is described in the standards methods sections of this manual.

## 10.6 Crosshead positions during preset test programs

Preloaded programs use crosshead positions relative to a specific reference position (referred to as absolute zero). You may need to check, change or reset the absolute zero position depending on your use of the machine. See section 8 *Setting the Absolute Zero Crosshead Position*.

### Sample loading position

This is where the crosshead is driven to clear the plane area for attaching and removing samples, or cleaning.

### Test start position

This is where the crosshead is driven in order to attach a link between the sled and the loadcell, and from which each slide movement begins.

# 11. Elements of Friction

---

The FPT-H1 is designed for daily use of standard coefficient of friction tests for film and sheet materials. These typically produce figures for static coefficient of friction (the force overcome to initiate sliding movement) and the kinetic coefficient of friction (the force resisting continued sliding motion).

Friction is the product of a system, not a material. This may be paper sliding over a standardised steel surface, or two samples of the same plastic film sliding over each other. The value for coefficient of friction  $\mu$  is the ratio of the force required to move one object over another, divided by the normal force applied to press the surfaces together (mass  $\times$  acceleration due to gravity):

$$\mu = \frac{F}{mg}$$

- $F$  is directly proportional to the applied load. (*Amontons' First Law*)
- $F$  is independent of the apparent area of contact. (*Amontons' Second Law*)
- Kinetic friction is independent of the sliding velocity. (*Coulomb's Law of Friction*)

Static friction (sometimes called stiction) may be measured in a test by itself, or as an initial peak value in a sliding test from rest, through a sliding distance at a given speed, back to rest. Kinetic friction is typically measured as an average value over a sliding distance.

## 11.1 Practical considerations

Values for the coefficient of friction may seem stable, but can involve very small values for  $F$ , and are affected by environmental conditions of temperature and humidity, which may exacerbate potential surface changes. Surfaces are also altered by contact that may abrade, lubricate or polish, or create adhesion (blocking). This includes handling during sample preparation and mounting, and the amount of time one surface rests on another, during which volatile additives may accumulate to form a lubricating layer, inks and coatings may adhere, or where fibres compress to exclude air.

### Dwell, or resting time

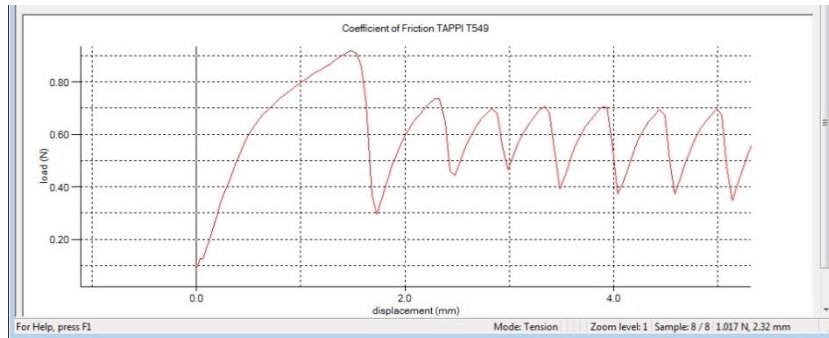
Some standard test methods include a resting time for the sled on the bed sample, but where they do not, consistency should nonetheless be maintained.

### Applying load for static friction measurement

In measuring the coefficient of friction, care must be taken not to apply an impact as the initial load is applied so as to affect the static friction value. This can be avoided by using a less-than-rigid link.

## Stick-slip

An elastic link can cause stick-slip behaviour during measurement of kinetic friction, where the relative motion between surfaces oscillates with a periodicity:



Where stick-slip is observed, a more rigid sled link should be used.

Sleds may tend to rotate or slew if friction properties across the width of a sample are variable. This will affect the average values for the coefficient of kinetic friction, but may have to be accepted as a characteristic of the material under test. Testing in different orientations can therefore be important.

In practice, surfaces moving in contact may not in any case be uniform, as with printed or embossed materials, so average values are sought by comparing friction in different orientations, with samples taken from different positions in a larger sample sheet. The requirement may simply be to make handling of sheet, or sheet-constructed packaging, predictable in order to optimise throughput.

## 11.2 International standard test methods

The most common coefficient of friction tests are provided as preloaded programs. The use of these is described in the following sections. Please refer to the latest standards themselves for the precise procedures, requirements and sample preparation for these test methods.

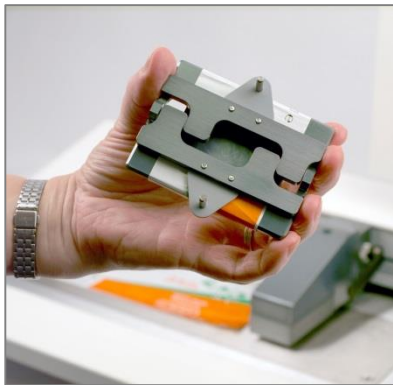


## 12. BS EN ISO 8295, Plastics, Film and Sheeting, Static and Kinetic Coefficients of Friction

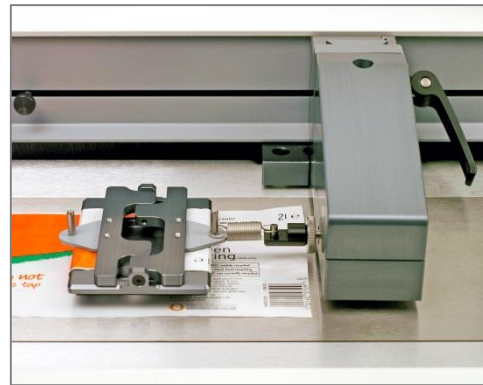
Replaces BS 2782-8 Method 824A

Sled dimensions:	63 mm × 63 mm
Sled weight:	200 g ±2 g
Plane sample dimensions:	200 mm × 80 mm
Linkage type:	Elastic link, unless stick-slip observed when measuring kinetic friction, in which case use rigid link.
Speed:	100 mm/min ±10 mm/min
Length of slide:	60 mm
Number of samples:	at least 3 sample pairs
Passes per sample:	1, and discard

Coefficient of friction may also be tested between different surfaces (e.g. film against stainless steel) where the film is applied to the sled. In this case the plane surface must be cleaned to a standard between tests.



Magnetic catches secure the sample ends



Use an elastic link to pull the sled

### 12.1 Process for static and kinetic friction (continuous test)

1. Ensure the tester is switched on, the software is running, and the test area is clear.
2. Load the BS EN ISO 8295 library program and press Start. This will move the crosshead to the sample loading position.
3. Prepare and attach both samples, and press Resume. This will move the crosshead to the test start position.

4. Attach the link to the sled pin and place the sled as gently as possible, such that the link drops into place over the loadcell pin.
5. Press the Start button. Note: this method begins by resting the sled for 15 seconds.
6. When the crosshead stops, the program will indicate that the sample test is complete.
7. Remove the sled and press Resume to clear the crosshead away to the sample loading position.
8. Discard both samples.

Press Start and repeat the test until at least three sample pairs have been tested.

If you require a report, press the Report button. This can then be saved and/or printed

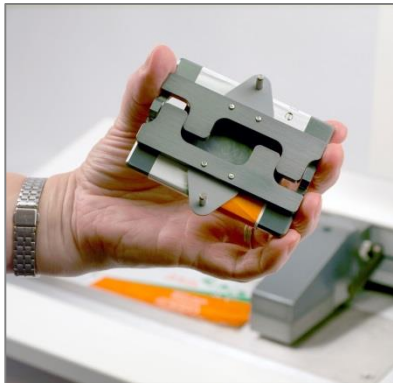
Press Exit and when prompted, Save the results to file.

## **12.2 Kinetic (dynamic) friction test when stick-slip is observed**

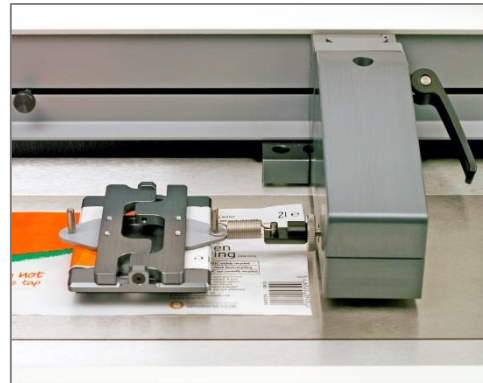
If you observe stick-slip occurring after the static friction point (see page 26), measure static and kinetic friction with separate samples, using the rigid link for kinetic friction testing. In each case use only the relevant part of the results.

## 13. ASTM D1894 Plastic film and sheeting

Sled dimensions:	63.5 mm × 63.5 mm
Sled weight:	200 g ±5 g
Sled sample dimensions:	63.5 mm × 63.5 mm
Plane sample dimensions:	250 mm × 130 mm (L × W)
Linkage type:	Elastic link, unless stick-slip observed when measuring kinetic friction, in which case use rigid link.
Speed:	150 mm/min ±30 mm/min
Length of slide:	130 mm
Number of samples:	5 sample pairs
Passes per sample:	1, and discard



Magnetic catches secure the sample ends



Use an elastic link to pull the sled

### 13.1 Process for static and kinetic friction (continuous test)

1. Ensure the tester is switched on, the console software is running, and the test area is clear.
2. Load the ASTM D1894 library program and press Start. This will move the crosshead to the sample loading position.
3. Prepare and attach both samples, and press Resume. This will move the crosshead to the test start position.
4. Attach the link to the sled pin and place the sled as gently as possible, such that the link drops into place over the loadcell pin.
5. Press the Start button.

Note that leaving samples in contact can alter the blocking or lubricating characteristics and therefore the static friction measurement.

6. When the crosshead stops, the program will indicate that the sample test is complete.
7. Remove the sled and press Resume to clear the crosshead away to the sample loading position.
8. Discard both samples.

Press Start and repeat the test until five sample pairs have been tested.

If you require a report, press the Report button. This can then be saved and/or printed

Press Exit and when prompted, Save the results to file.

## **13.2 Kinetic (dynamic) friction test when stick-slip is observed**

If you observe stick-slip occurring after the static friction point (see page 26), measure static and kinetic friction with separate samples, using the rigid link for kinetic friction testing. In each case use only the relevant part of the results.

## 14. TAPPI T 549, Uncoated Writing and Printing Paper, Static and Kinetic Coefficients of Friction

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Sled dimensions:	63.5 mm × 63.5 mm
Sled weight:	200 g ±5 g
Sled sample dimensions:	63.5 mm × 63.5 mm
Plane sample dimensions:	215 mm × 100 mm
Speed:	150 mm/min ±30 mm/min
Length of slide:	130 mm
Number of samples:	5 sample pairs
Passes per sample:	1, and discard

### 14.1 Process for static and kinetic friction (continuous test)

Observe sampling methods as described and referred to in the TAPPI standards. A rigid link may be used throughout, except for the lowest friction papers, where an elastic link may give a more accurate measurement for static friction.

1. Ensure the tester is switched on, the software is running, and the test area is clear.
2. Load the TAPPI T 549 library program and press Start. This will move the crosshead to the sample loading position.
3. Prepare and attach both samples, and press Resume. This will move the crosshead to the test start position.
4. Attach the link to the sled pin and place the sled as gently as possible, such that the link drops into place over the loadcell pin.
5. Press the Start button.
6. When the crosshead stops, the program will indicate that the sample test is complete.
7. Remove the sled and press Resume to clear the crosshead away to the sample loading position.
8. Discard both samples.

Press Start and repeat the test until five sample pairs have been tested.

If you require a report, press the Report button. This can then be saved and/or printed

Press Exit and when prompted, Save the results to file.

## 15.BS ISO 15359, Paper and Board, Static and Kinetic Coefficients of Friction

Required fixtures:	Sled raising and lowering rails (lifter mechanism is a factory installed option)
Sled dimensions:	60 mm × 60 mm ±5 mm
Sled weight:	800 g ±100 g
Plane sample dimensions:	≥ 60 mm × ≥ 70 mm + gripping length
Speed:	1200 mm/min ±120 mm/min
Number of samples:	6, two test methods for static only, or static and kinetic

### 15.1 Attaching the sled-lift rails

The rails have captive screws for attachment, and can be removed for alternative tests.

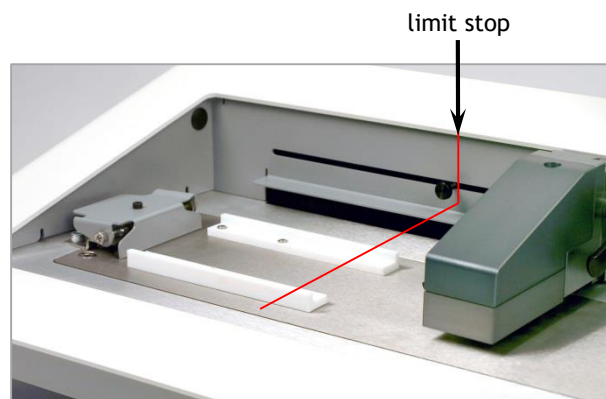


Secure the first rail; do not overtighten



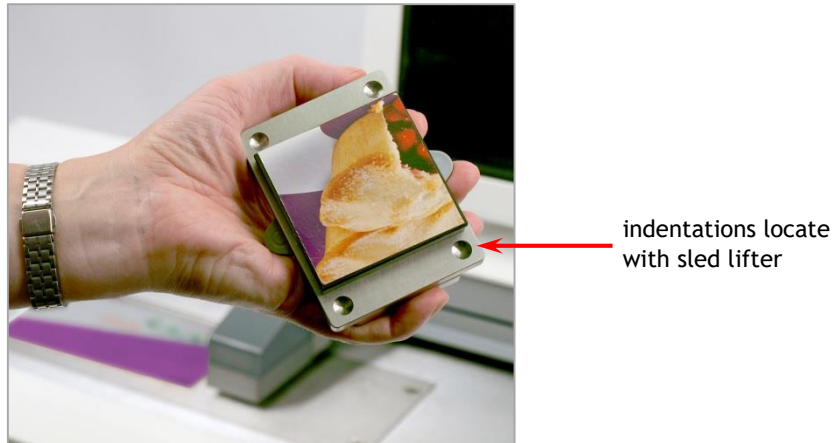
Secure the second rail, facing

The left-hand limit stop must be positioned to prevent any possible collision between the loadcell and the sled-lifting rails:



## Securing samples to the sled

Samples may be attached using low-tack double-sided tape or adhesive (see Section 10.4, *Sled sample attachment*). This must not leave a raised profile in the surface. Be especially careful to apply the cut sample square-on, so that edges do not protrude to touch the guide rails:



## 15.2 Static friction at first slide (BS ISO 15359, section 9.2)

Take 6 sample pairs, measure static friction only for each and discard. Use the non-rigid link provided. Follow the on-screen prompts.

For each sample pair:

1. Ensure the tester is switched on and the console software is running.
2. Load the library program and press Start. This raises the rails and sends the crosshead to the sample loading position.
3. Secure your prepared samples and position the sled on the four locating pins.
4. Press Resume. This sends the crosshead to the test starting position.
5. Link the sled to the loadcell.
6. Press Resume. This lowers the sled lift, rests it for 2 seconds, then slides it for 75 mm.
7. Remove the link and sled, discard the samples.

## 15.3 Static coefficient of friction at the first slide, static and kinetic at the third slide (BS ISO 15359, section 9.3)

Take 6 sample pairs, for each pair take three consecutive sets of measurements and discard. The supplied non-rigid link is suitable for damping the initial load.

Should you observe stick-slip (see page 26) within the measurement of kinetic friction, the rigid link should be used for measuring kinetic friction as a separate test, taking values for the third slides only.

For each sample pair:

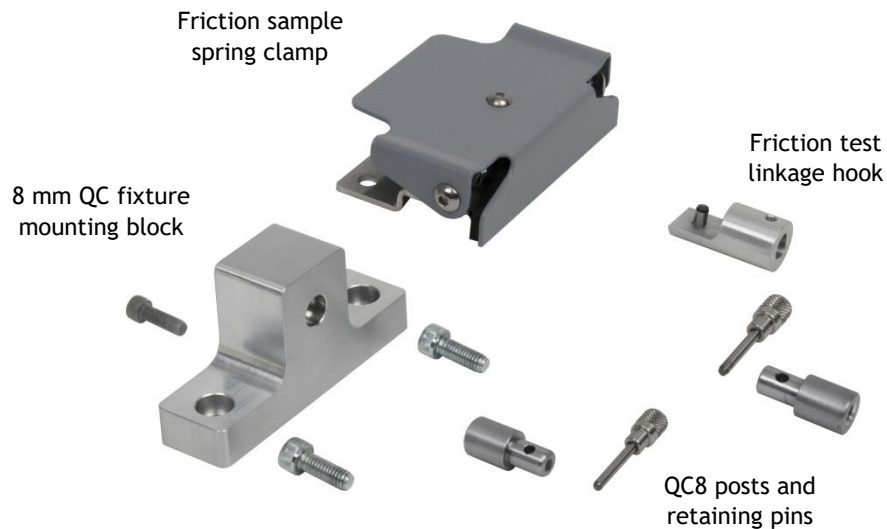
1. Ensure the tester is switched on and the software is running.
2. Load the library program and press Start. This raises the sled lift and sends the crosshead to the sample loading position.
3. Secure your prepared samples and position the sled on the four locating pins.
4. Press Resume. This sends the crosshead to the test starting position.
5. Link the sled to the loadcell.
6. Press Resume. This lowers the sled lift, rests it for 2 seconds, then slides it for 75 mm, raising the sled at the end.
7. Remove the link and replace the sled back on the locating pins.
8. Press Resume. This returns the crosshead to the test start position.
9. Link the sled and loadcell and press Resume. The test is repeated.
10. After three slides the test ends. Remove the sled and discard the samples.



## 16. Fixtures for Peel and Tear Testing

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The FPT-H1 can be fitted for alternative tests. Basic fixtures are included with the tester:



Additional fixtures include:

- 432-640     Heated platen for coefficient of friction at elevated temperatures
- 432-636     180 degree peel testing kit
- 432-670     90 degree assisted-table peel testing kit
- 432-654     50 mm peel grip (single), rubber-faced jaws, to use in place of the peel hook
- 432-642     T-peel jig, comprising 2 × 25 mm wide, rubber-faced vice grips
- 432-625     Lightweight tear grips, comprising 2 × 100 mm wide, rubber-faced vice grips

These enable a variety of peel and tear tests to be done, within the scope of a 10 N or 100 N loadcell, and the travel of the FPT-H1 crosshead.

### 16.1 Exchanging fixtures

Fixtures on the left-hand end of the FPT-H1 are secured with two cap-head hex-socket bolts, of a length to suit each fixture. The clamp is only used to secure sheet materials for friction testing. All other fixtures attach to the mounting block with its 8 mm QC post and retaining pin.

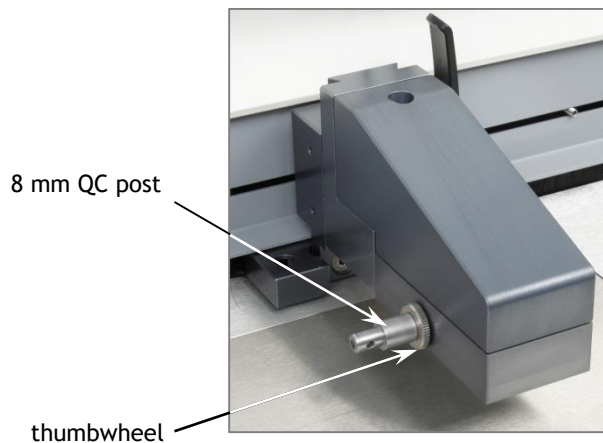
The friction test linkage hook is removed for the attachment of other grips, by releasing the thumbwheel and unscrewing the hook. This is then replaced by an 8 mm QC post and the thumbwheel retightened.

For both the mounting block and the loadcell, it is important to orient the QC post correctly before attaching a QC fixture. For example, the same hook is used in 90 and 180 degree peel tests, but in one it is horizontal and the other, vertical. Vice grips are used also in both orientations, depending on the test to be performed.

Do not twist a fixture attached to loadcell in order to align it.



Release the QC post in the mounting block to change its orientation, before refitting to the FPT-H1.



Release the thumbwheel on the loadcell to change the QC post orientation.

## 16.2 90 degree peel testing of PSAs

*Standards:* FINAT 2, AFERA5001, ASTM D3330 (F), ASTM D6252, PSTC 101 (F), BS EN 1939 (Annex B)

When fitting the 90 degree peel fixture (part no. 432-670), it is important that the limit stops are set to avoid potential damage.

See instruction sheet 431-457, *Fitting the FPT-H1 90° peel table*.

## 90 degree peel testing by delamination

Using the same peel kit, but with a 50 mm vice grip (part no. 432-654) in place of the test hook (jaw opening vertical), a non-PSA sample can be tested, for example to delaminate faced cardboard:



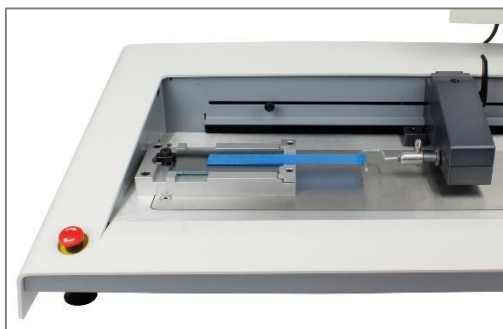
The sample is adhered to the sample plate according to the standard used, and a length of 190 mm is recommended when using this fixture. Separate the two layers back to 100 mm and trim the back layer off.

## 16.3 180 degree peel testing

*Standards:* FINAT 1 & 3, Afera 5001, ASTM D3330, BS EN 1939, PSTC 101

Stainless steel (part no. 432-652) or float glass (part no. 432-651) sample plates are required, depending on the test method being followed. Insert the provided aluminium spacer plate first, when using stainless steel sample plates.

The 180 degree peel table (part no. 432-636) raises the sample for precise alignment of a PSA tape test. After fitting the plate and mounted sample, the drawn end of a pressure sensitive adhesive (PSA) tape is folded under and around the test hook and stuck back on itself, with the crosshead at its starting position.



For self-adhesive labels, the end can be folded over onto itself, and a 50 mm vice grip used (part no. 432-654).

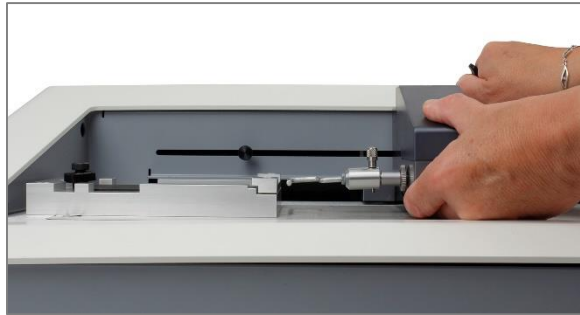
For gripping non-adhesive samples (e.g. the release backing for self-adhesive labels, as in FINAT FTM 3), a 50 mm grip (part no. 432-654) must be used in place of the hook.

A sample length of 280 mm is recommended when using this fixture.

When the peel test is complete, the crosshead should be restored to the starting position. When using the hook, remove the QC (quick change) pin, and take the hook from the loadcell, before removing the PSA sample. This will avoid accidentally overloading a 10 N loadcell.

### 16.3.1 Safe set-up

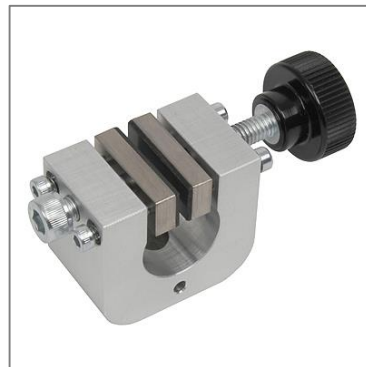
1. Position the crosshead to the right end of the FPT-H1 and fit the peel table.
2. Fit the test hook and raise the crosshead so that the hook is above the level of the table.
3. Bring the crosshead to the left until the test hook is about 10 mm from the end of the table.
4. Adjust the crosshead down so that the test hook neither raises the sample when pulled, nor adds friction by pulling down on the table edge:



## 16.4 T-peel testing

*Standard:* BS EN 868-5 Annex D

For T-peel testing, two 25 mm vice grips (part no. 432-642) are used with jaws vertically oriented:



Both vice grip jaws must be adjusted so that both ends of a sample are accurately aligned.

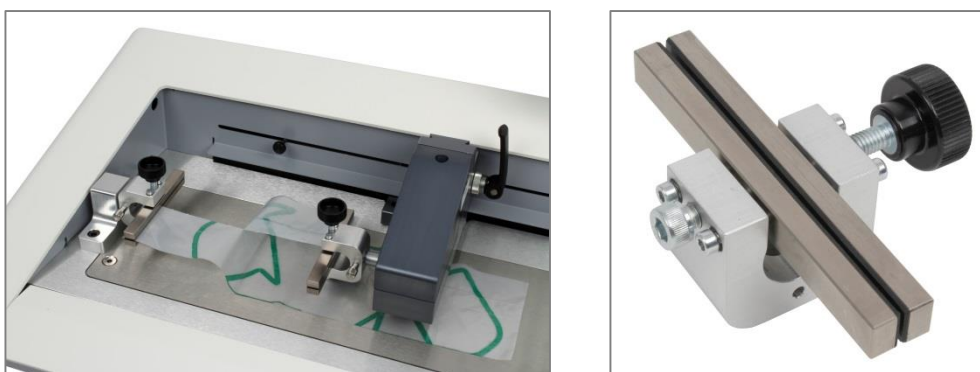
1. Raise the crosshead to its highest limit.
2. Fit the left-hand mounting block with the QC adapter adjusted to insert the pin vertically.
3. Fit both vice grips vertically as shown above.

4. Bring the grips close together and align their jaw closing position and height.

## 16.5 Single-rip 'trouser' tear

*Standard:* ASTM D1938, BS EN ISO 6383-1

For this test type, two 100 mm vice grips are used (part no. 432-650), with jaws horizontal:



The sample perforation or line of tear must be on the central axis of each grip. Adjust both vice grip jaws and the crosshead height so that they are accurately aligned. The FPT-H1 limit stops will need to be set at their widest limits.

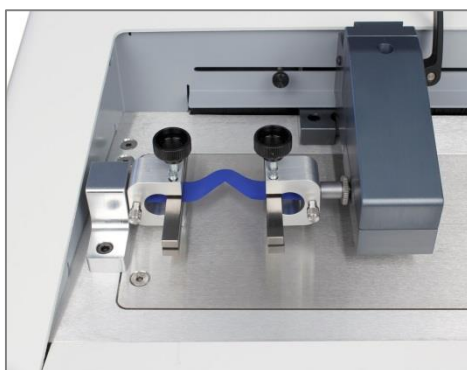
1. Raise the crosshead to its highest limit.
2. Fit the left-hand mounting block with the QC adapter adjusted to insert the pin horizontally.
3. Fit both vice grips horizontally as shown above.
4. Bring the grips close together and align their jaw closing position and height.

For this test, the grips should be set 50 mm apart before securing the sample to start the test.

## 16.6 Wing tear tests (Winkelmann / Graves)

*Standards:* ASTM D1004

Using a pair of vice grips (part no. 432-625 [100 mm] or 432-642 [25 mm]), a wing-type tear test can be performed up to the 100 N loadcell limit. Adjust the grip jaws as for a tear test, above, to align the grips:

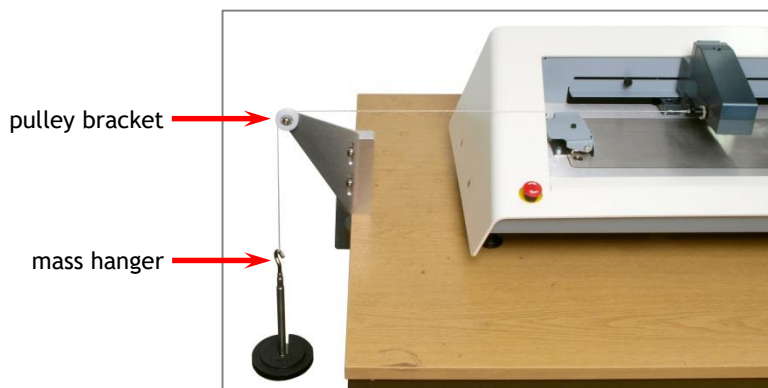


## 17. Loadcell Accuracy Verification

When a loadcell is beyond its calibration date, this will be indicated when you switch the system on. It should be returned to Mecmesin or your distributor, for recalibration. You can also periodically check your loadcell's accuracy, using the optional loadcell accuracy verification kit (part no. 432-635), with appropriate masses for a 10 N or 100 N loadcell.

Note that calibrated masses are certified at a given geographical location with a specific gravitational value of  $g$ . Divide the mass by this value of  $g$  and multiply by your local value of  $g$ , to obtain a true mass value. (Internet sources for values of  $g$  may not be reliable.)

*example:*  $5 \text{ N} \div 9.82 \text{ m/s}^2 \text{ (as calibrated)} \times 9.79 \text{ m/s}^2 \text{ (local)} = 4.98 \text{ N local mass value}$



Level the line horizontally ...



... and align centrally

### 17.1 Method



**Take care not to overload the loadcell. Only use a mass hanger and masses, with a total mass below the overload capacity of the loadcell.**

- Clamp the pulley bracket to the bench end.
- Position the crosshead towards the left side of its travel.
- Raise the loadcell to its upper stop position.
- Attach the loop of the line to a loadcell link pin (coefficient of friction fixture) and draw the line over the nylon pulley.
- Attach the other end of the line to the mass hanger.
- Level the line horizontally over the end of the tester, by adjusting the pulley bracket.
- Position tester and bracket so that the line runs over the centre of the spring grip.
- Zero (tare) the load via the Emperor software.
- Carefully add a calibrated slotted mass or masses of 5 N (for the 10 N loadcell) or 50 N (for the 100 N loadcell).
- Verify that the load measurement on the console is within 0.1% of the total applied load.

## 18. Installing Emperor Software on a PC (FPT-H1-i)

---

This section applies to users of the FPT-H1-i model, without the touch-screen console, driven by Emperor™ software installed on a separate PC (not supplied).

### 18.1 Minimum system requirements

**The minimum specification** for the Windows PC is 2 GB RAM and 60 GB free space on the hard drive, running Windows™ XP Pro with SP1, or above. A CD drive is required for installation. At least one USB port or RS232 port are required for connecting to the system.

**Note:** Emperor software is not available for Linux or Mac OS X operating systems.

### 18.2 Access to data folders

Emperor will need access to certain folders listed below. Before installing the program, please make sure that read and write access is granted for these folders. In particular if the computer is part of a centrally controlled Windows Domain system, it may be necessary to consult with your IT department to allow correct access to these locations.

Windows XP User Data location	
Emperor Force	C:\Documents and Settings\All Users\Application Data\Mecmesin\Emperor\Force
Windows Windows 7,8 or Windows 10 User Data location	
Emperor Force	C:\ProgramData\Mecmesin\Emperor\Force
All Windows versions Program files location	
Emperor Force	C:\Program Files\Emperor\Force

Insert the Emperor CD; Emperor should start automatically and ask if you wish to proceed with the installation of the software, and perform a custom installation to include FPT-H1 test library programs.

If the installation program does not start automatically or if you have other problems:

- On your computer desktop click the shortcut to 'My Computer'
- Click on the CD drive that contains the Emperor software CD
- Navigate to the Emperor folder
- Right click on the Set-up.exe file, and Run as Administrator

Emperor will begin the process of installing the program onto your hard-drive. Follow the instructions, and accept the license agreement. You can choose which languages are installed: English only, all languages, or custom, so you can select languages you need.



## 18.3 Start Emperor

Start the program by using the Emperor icon that was installed on your computer desktop – the splash screen is displayed.

Emperor software provides two levels of user, and a password is used to restrict access to either a simple choice of pre-defined tests or some limited functions, or to give access to the full capabilities of the Emperor system.

**Operators** can select from tests that are pre-defined, and for which reports have already been written, and some functions that can be assigned to each user account.

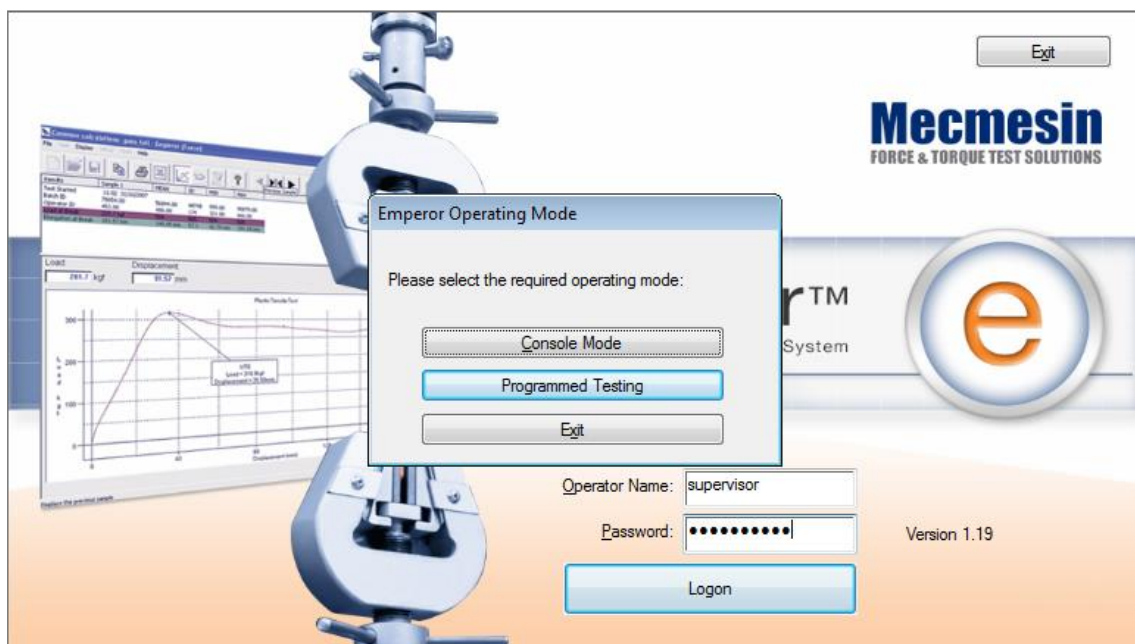
**Masters** have full access to all the functions of the Emperor system. The master user has control over which users are operators and masters.

Logon with a Master level username and password. If this is the first time you have started the program, you can use:

Default Username: supervisor

Default Password: supervisor

**Note:** both the username and password are case-sensitive.



On the Operating Mode selection screen, click on **Programmed Testing** for full programming access, or **Console Mode** to use as described in this manual.

This will start Emperor, and you can set your system preferences, user accounts, create and run test programs, review results, perform calculations for analysis, produce test reports and export data for use elsewhere. For full details, see the manual: *Emperor Programming for Mecmesin Test Systems* (Part no. 431-382).

## 18.4 Emperor file locations

Should you need to copy, move or reload any of the supplied files, this is where files go by default:

### Programs

C:\ProgramData\Mecmesin\Emperor\Force\Library

### Results

C:\ProgramData\Mecmesin\Emperor\Force\Results

### Report templates

C:\ProgramData\Mecmesin\Emperor\Force\Templates

File locations can also be customised in *Setup > System Setup > [File Locations]*.

### Favourite program bitmap images

Favourite program images can be attached to your programs when saving as favourites, by selection from:

C:\ProgramData\Mecmesin\Emperor\Force\Favourites

This location cannot be changed.

## 19. Creating Test Programs

---

You can program your FPT-H1 for many kinds of tensile or compression tests, with suitable fixtures, using the full scope of the Emperor™ software.

Refer to manual 431-382 *Emperor™ Force and Torque Testing Software: Operator Manual* for writing full programs.

Refer to manual 431-389 *Emperor™ Programming for Mecmesin-xt Force and Torque Test Systems* for writing or editing simpler console-mode test programs.

## 20. Specification

<b>Load measurement</b>	
Loadcell range	10 N, 100 N (2.2 lbf, 22.5 lbf). Contact Mecmesin for other loadcell capacities.
Load resolution	1:6500
Load accuracy	0.1% of full scale output
<b>Speed</b>	
Speed, continuously variable	0.016 mm/s (1.0 mm/min) or (0.039 in/min) to 20 mm/s (1200 mm/min) or (47.2 in/s) *
Speed accuracy	0.2% of indicated
<b>Test area</b>	
Sled lowering rate	3.0 mm/s $\pm$ 2.0 mm/s (0.12 in/s $\pm$ 0.079 in/s)
Crosshead height adjustment	30 mm (1.18")
Max. crosshead travel	275 mm (10.8")
Test surface	Stainless steel 304
<b>Dimensions</b>	
Height	226 mm (8.9") [console + 293 mm (11.5")]
Width	914 mm (36.0")
Depth	415 mm (16.3")
Weight	29.3 kg (64.6 lb) [25.6 kg (56.4 lb) without console]
<b>Communications</b>	
Digital I/O	6 input, 6 output
Ports	RS232 and USB
Network communications (FPT-H1-xt)	RJ45 USB for external wireless connectivity
<b>Power requirement</b>	
Maximum power consumption	120 W
Supply voltage	230 V AC 50 Hz, or 110 V AC 60 Hz
<b>Pneumatic connections (optional extra)</b>	
Crosshead	4 mm, 8 bar max. (116 psi)
Fixed	4 mm, 8 bar max. (116 psi)
<b>Environment</b>	
Recommended temperature range	+10° to +35° C (50° to 95°F)
Noise emissions	Less than 70 dbA

\* where mains voltage is unreliable (significantly under voltage) the machine may not run above 1000 mm/min

Mecmesin reserves the right to alter equipment specifications without prior notice. E & OE

## 21. Declaration of Conformance

<p style="text-align: center;"><b>EC DECLARATION OF CONFORMITY</b></p> <p style="text-align: center;">we,</p> <p style="text-align: center;"><b>Mecmesin Limited</b> Newton House, Spring Copse Business Park, Slinfold, West Sussex, RH13 0SZ</p> <p style="text-align: center;"><i>hereby declare that the product(s):</i></p> <p style="text-align: center;">MultiTest 0.5-i, MultiTest 1-i, MultiTest 2,5-i, MultiTest 5-i, MultiTest 10-i, MultiTest 25-i, MultiTest 50-i, Vortex-i, Helixa-i and FPT-H1-i Computer Controlled Test Stands</p> <p style="text-align: center;"><i>and associated and derivative product(s):</i></p> <p style="text-align: center;">MultiTest 0.5-xt, MultiTest 1-xt, MultiTest 2,5-xt, MultiTest 5-xt, MultiTest 10-xt, MultiTest 25-xt, MultiTest 50-xt, Vortex-xt, Helixa-xt and FPT-H1-xt Console Controlled Test Stands</p> <p style="text-align: center;"><i>to which this declaration relates. are in conformity with the essential requirements of the Council Directives:</i></p> <ul style="list-style-type: none"><li>• EMC Directive 2004/108/EEC</li><li>• Low Voltage Directive 2006/95/EEC</li><li>• Machinery Directive 2006/42/EEC</li></ul> <p style="text-align: center;"><i>and tested to the following standards and other normative documents:</i></p> <p style="text-align: center;">EN 61000-6-2, EN 61000-6-3, EN 60204-1, EN 60950-1</p> <p style="text-align: center;">Declaration Issue Date: 18 February 2015</p> <p style="text-align: center;"> _____ Technical Director, Mecmesin Limited: Dr Patrick Collins</p> <p style="text-align: right;">431-DoC08-03</p>
---

сертификат

Zertifikat

شهادة

Certificado



## CERTIFICATE OF COMPLIANCE

This is to certify that the product listed in follows was (were) tested in the BTL EMC Laboratory to comply with the required criteria levels of the follow-mentioned ETSI harmonized standard according to the essential conformity requirements of the R&TTE Directive of 1999/5/EC and related directives .

**Equipment** Panel PC  
**Model Name** SID-10W9; SID-10W9XXXXXXXXXX( Where "X" may be any alphanumeric character, or blank or "-" )  
**Brand Name** Avalue  
**Applicant** Avalue Technology Inc.  
**Address** 7F,228,Lian-cheng Road,Zhonghe Dist.,New Taipei City 235,Taiwan  
**Standard(s)** EN 301 489-1 V1.9.2 (2011-09)  
 EN 301 489-17 V2.2.1 (2012-09)  
 EN 61000-3-2: 2014 Class D  
 EN 61000-3-3: 2013  
 EN 300 328 V1.9.1 (2015-02)  
**Report(s)** BTL-ETSE-1-1611051  
 BTL-ETSP-1-1611051

The test data, data evaluation, and equipment configuration contained in our test report(s) above was (were) obtained utilizing the test procedures, test instruments, test sites that has been accredited by the Authority of TAF according to the ISO-17025 quality assessment standard and technical standard(s). The test data contained in the referenced test report relate only to the EUT sample and item(s) tested.

  
 Andy Chiu  
 Authorized Signatory

**BTL INC.**

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 TEL:+886-2-2657-3299  
 FAX:+886-2-2657-3331



# Appendix A

## Microsoft® Windows® 10 Enterprise 2016 LTSCB Licensing

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Each *-xt* system supplied with a console controller has Microsoft® Windows® 10 Enterprise 2016 Operating System pre-installed and licensed by Mecmesin. Each console is supplied with the following as proof of licensing:

- End User License Agreement (EULA)
- Certificate of Authentication (COA)

### End User License Agreement (EULA)

A multi-language EULA is enclosed with each system.

### Certificate of Authentication (COA)

The COA is supplied as a sticker located on the rear of each console supplied with a system, as proof of licensing.

This COA sticker lists the following:

- Microsoft® product title
- COA serial number
- Microsoft® SKU (stock keeping unit) number

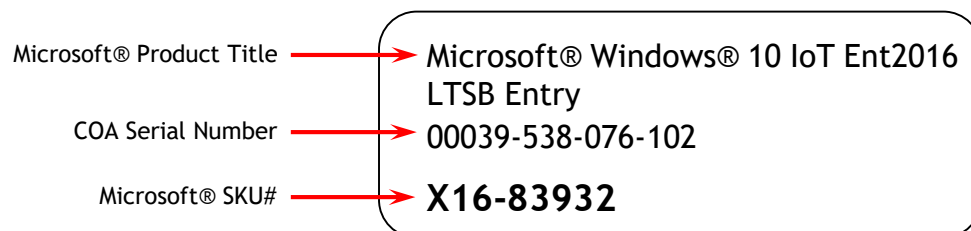


Figure 1: Certificate of Authentication

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