

1. Ambient Request & Examination

- 1.1 Lab condition, Temperature $23 \pm 2^{\circ}\text{C}$, Humidity $50 \pm 10\%RH$. Difference of temperature and humidity will result in obvious influence on test results. Especially in high-humidity condition, not only the test results, but also the service life of the instrument will be influenced. Therefore the lab condition should comply with corresponding standards or related specifications of ISO 291.
- 1.2 The power must be single-phase AC 220V 50Hz, the instant fluctuation of peak voltage should be less than 3V. It should be connected to earth reliably. Do not misuse the "N" (Naught) and "E" (Earth), and do not connect "N" with "E". Normally the voltage between "N"&"E" should be 1~5V.
- 1.3 This instrument should not be operated in intense corrosive, combustible, explosive condition or interference of electromagnetic wave. The worktable should be stable with no vibration.

2. Peripheral Equipment Requirement

The essential configuration of PC is as follows:

CPU: P4 2.0G or higher

RAM: 128MB

Free hard disk : 40G

CD-ROM

VGA: 1024x768 75Hz

OS: Windows98 or higher

3. Brief Introduction

3.1 Standards & Purpose

MXD-02 Coefficient of Friction (COF) tester is designed according to ASTM D1894, ISO 8295, GB 10006. It is applicable in static and kinetic coefficient of friction test for plastic films, foils, paper and other materials. Users can control the quality technique data by testing smoothness of the materials, such as usual pack-fill property of packages, the speed of packing machines, and so on.

3.2 Test principle

The speed of relative motion between two tested surfaces is controlled by specially designed control circuit, high accuracy load cell will measure the friction force produced by relative motion, and calculate the COF of sample by frictional force and mass of sled. The final results could be displayed, printed or output to the computer via RS232 port.

3.3 Technical Data

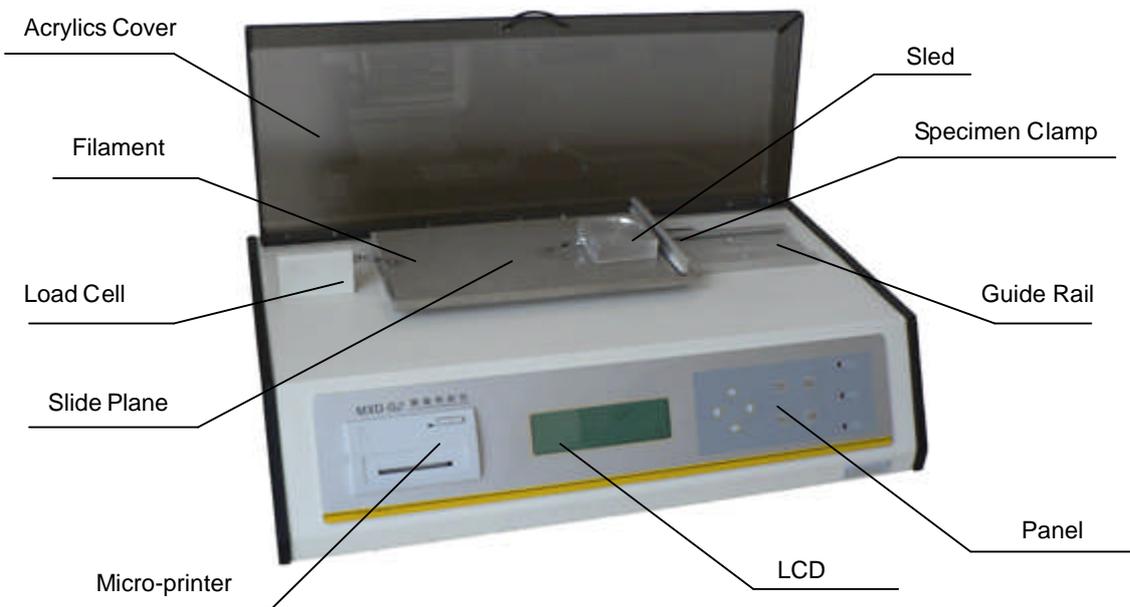
Model: MXD-02

Range: 0~5N

Mass of sled:	200g (standard)	
Accuracy:	±0.5% of force reading	
Test speed:	100mm/min (GB 10006、ISO 8295)	150mm/min (ASTM D 1894)
Stroke:	10mm+60mm (GB 10006、ISO 8295)	150mm (ASTM D 1894)
Power consumption:	6W	
Power supply:	single-phase AC 220V/50Hz	
Dimension:	630(L)mm × 360(B)mm × 230(H)mm	
Net weight:	33 kg	

4. Instrument Structure

4.1 Main frame



Acrylics Cover	-----Protect the load cell, slide plane and the sled.
Filament	-----Connect the load cell with the sled.
Load Cell	-----Measure the friction force during testing process.
Slide Plane	-----Clamp the specimen, perform uniform motion as specified in the standard
Panel	-----Membrane switch key panel
Micro-printer	-----Print out the test results.
Sled	-----Apply certain pressure on the film specimen.
Specimen Clamp	-----Used to clamp the specimen on the slide plane.
Guide Rail	-----The plane will run on the guide rail.

Power Jack:	-----in the left rear of instrument body
Safety fuse	-----in the left rear of instrument body
Main power switch	-----in the left rear of instrument body
RS232 port (serial port)	-----in the right rear of instrument body

5. Instrument Setup

- 5.1 Open the wooden case, take out the shock absorption stuff, then take out Acrylics cover and other accessories carefully.
- 5.2 Take the instrument out from the case, put it on a stable worktable carefully and remove the packaging.
- 5.3 Check up the accessories and materials according to the packing list and purchase contract. If there' s anything missing, please contact with LABTHINK within 7 days.
- 5.4 Install the Acrylics cover onto the mainframe using the screws attached.
- 5.5 Take out the attached power cord, and connect one end to the mainframe, and the other end to the power socket, which should be in accordant with item 1.2
- 5.6 Connect one end of the attached communication cable to the COM port on the back of the instrument. Connect the other end to the COM1 port (RS232 9 pins) of the computer.
- 5.7 Connect the computer and display, connect the printer to the computer and turn on the power, install the driver on the printer.

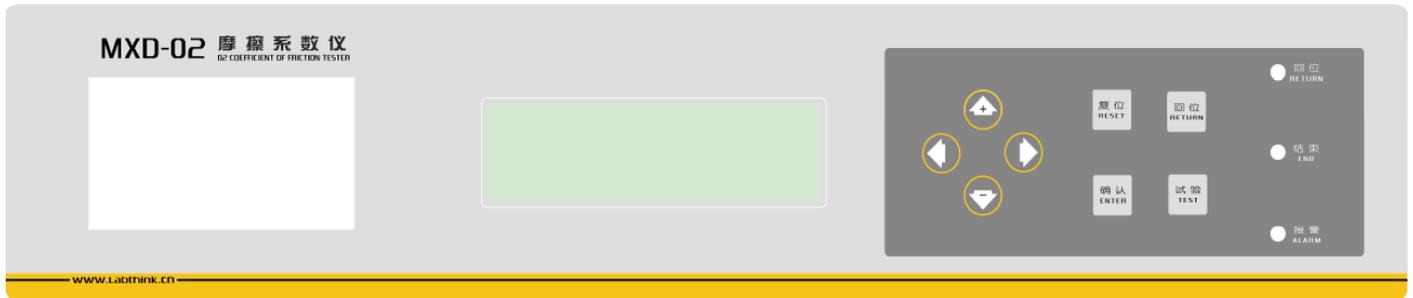
Notice: According to manual book, several important notices and warnings are included. Read carefully before operation.

6. Software Setup

- 6.1 Start the computer, exit from other programs.
- 6.2 Put the software CD of MXD-02 COF tester into CDRom
- 6.3 Double click "My computer" icon on desktop, and find the CD. Enter folder "MXD-02". Double click "Setup" to start the installation of the MXD-02 COF tester program.
- 6.4 Follow the installation guide. Choose "I accept the terms in the license agreement". Input "User Name" and "Organization", and choose the application message, choose "Complete" setup type.
- 6.5 After the setup of the program, there will be a shortcut on the desktop, and a shortcut of "MXD-02" in the "Start" menu of Windows. Double click to start the program.

7. Interface & Parameter Setting

- 7.1 Instrument's key function & interface
 - 7.1.1 Key function



“Reset”: After printing out the report, or if system is in confusion, alarm, or other abnormal status, please press this key to restart the program.

“Return”: Make the slide plane return to start position during test. When you want to do the next test, please press “Return” key firstly, and start the next test after the “Return” light is on. In the other screens besides Test screen, press “Return” to get back to the superior menu.

“Enter”: Enter the submenu by pressing this key when the cursor is on certain option. Save the modified values of parameters in “Preset” screen or in Calibration process.

“Test”: Press this key to start a test when the “Return” light is on.

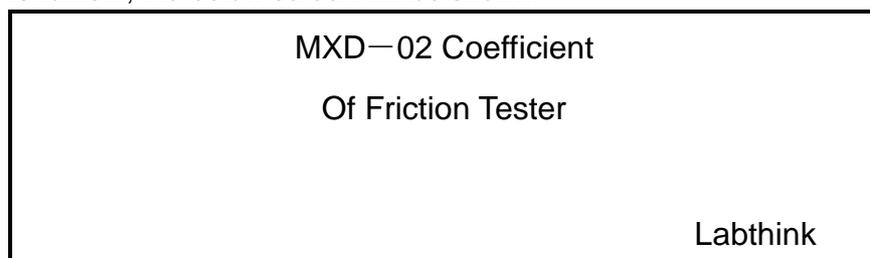
“Arrow”: Move the cursor among the options. Change the value or choice of parameters by “” or “”.

Notice: It is recommended to operate using your thumb to protect the panel.

7.1.2 LCD

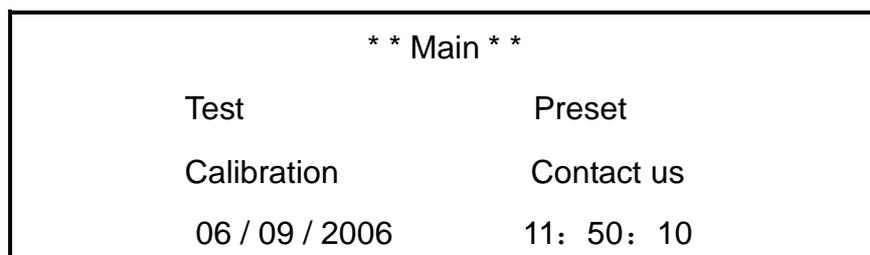
7.1.2.1 Welcome Screen

Turn on the instrument, the below screen will be shown.



7.1.2.2 Main menu

Press any key except “Reset” to enter the Main menu.



7.1.2.3 Preset screen

Press “” and “” to choose “Preset” in the Main menu, press “Enter” key to enter Preset screen.

** Preset **		
Standard: ASTM D1894 ▲▼	Amount: 05	
Sled: 200g	Band: 80%	Print: Y
06 / 09 / 2006	11: 50: 10	

Amount : From 1to 10 (the amount of specimens to be tested)

Sled : The mass of the metal block, the mass of which is 200g or 500g.

Band : Normally set to 80%

Print : “Y” Switch on the print function of the micro-printer. When a batch of tests are finished, press “Test” key to print out the results

“N” Don’t print after all tests are finished.

Standard : Press “↩” and “⏪” key to select “Standard”, then press “⏩” or “⏮” to switch from GB10006, ISO 8295 and ASTM D1894. Choose any one as you need and press “Enter” key to enter corresponding interface.

* * ASTM D1894 * *	
Rest Time : 15S	Us Time : 06S
Speed : 150mm / min	

Users can change “Rest time” and “Us Time” by “⏩”key and “⏮” key. When GB 10006 or ISO 8295 is chosen, the whole time scope is 42s, with the first 6 seconds to be Us time, and the rest 36s to be Ud time. As for ASTM D1894, the whole time scope is 60s.

7.1.2.4 Test screen

Choose “Test” in the Main menu, press “Enter” key to enter the Test screen.

TEST	A S T M D 1894
F=0.004N	
T=00 (S)	
N=00/01	
M=200g	
V =150	
13:37:24	

F : Force, T : Time, N : Test number and Preset amount, M : Mass of sled, V : Speed

7.1.2.5 Calibration screen

Choose "Calibration" in the Main menu, press "Enter" key to enter the Calibration screen.

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          * * Calibration * *
Zero : -0.001          K:6.5296
End : -0.001          B: -00001
N N : 0000            AD: -00384
    
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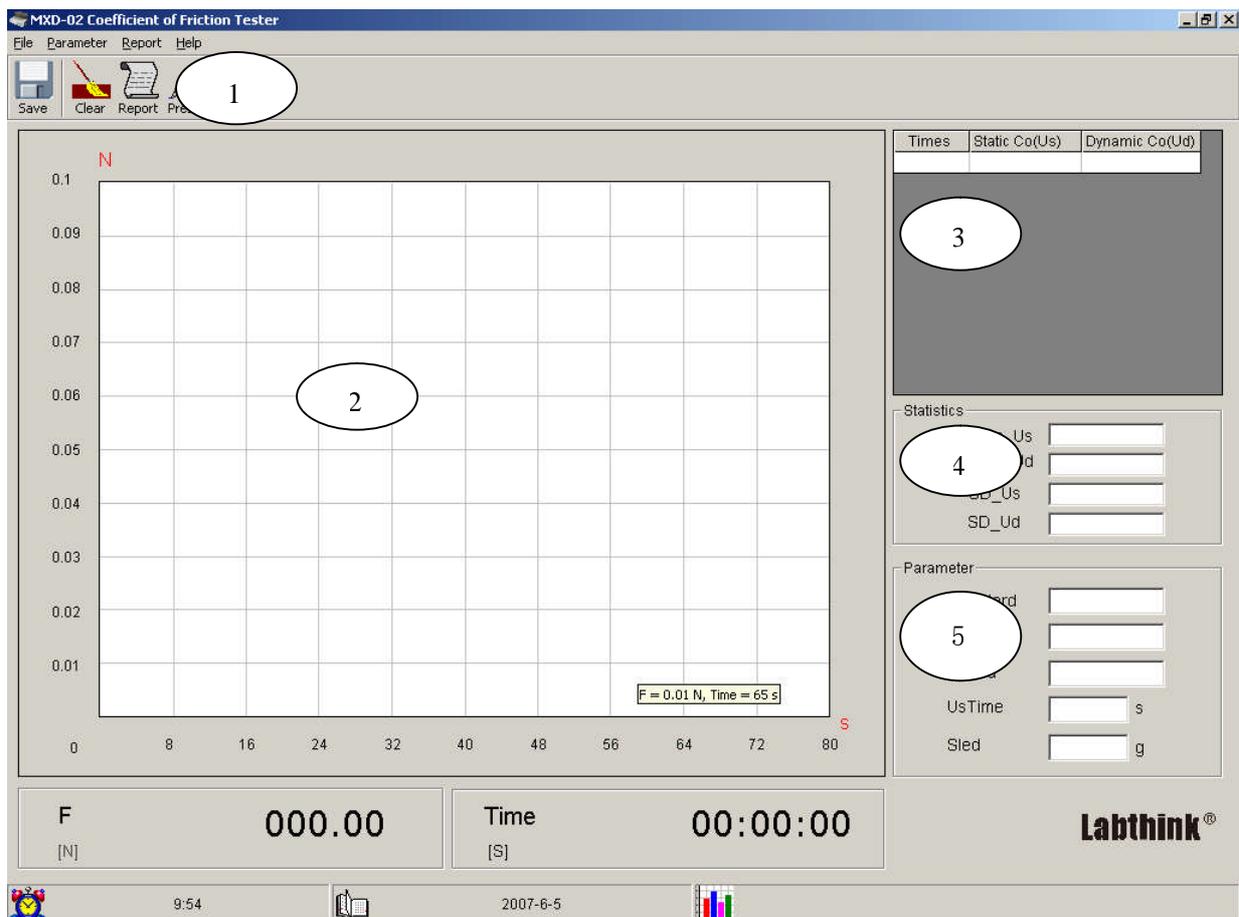
System Calibration requires precise operation, don't enter this screen unless it is necessary. Regarding the meaning and detailed procedure of calibration, refer to item 10.2 and 11.

7.2 Software interface introduction and usage

7.2.1 Run

Double click the short cut of MXD-02 on desktop, also users could click the "Start" menu, and find "MXD-02" in the "Program" to run the software.

7.2.2 Main interface



The main interface is made up of 5 parts:

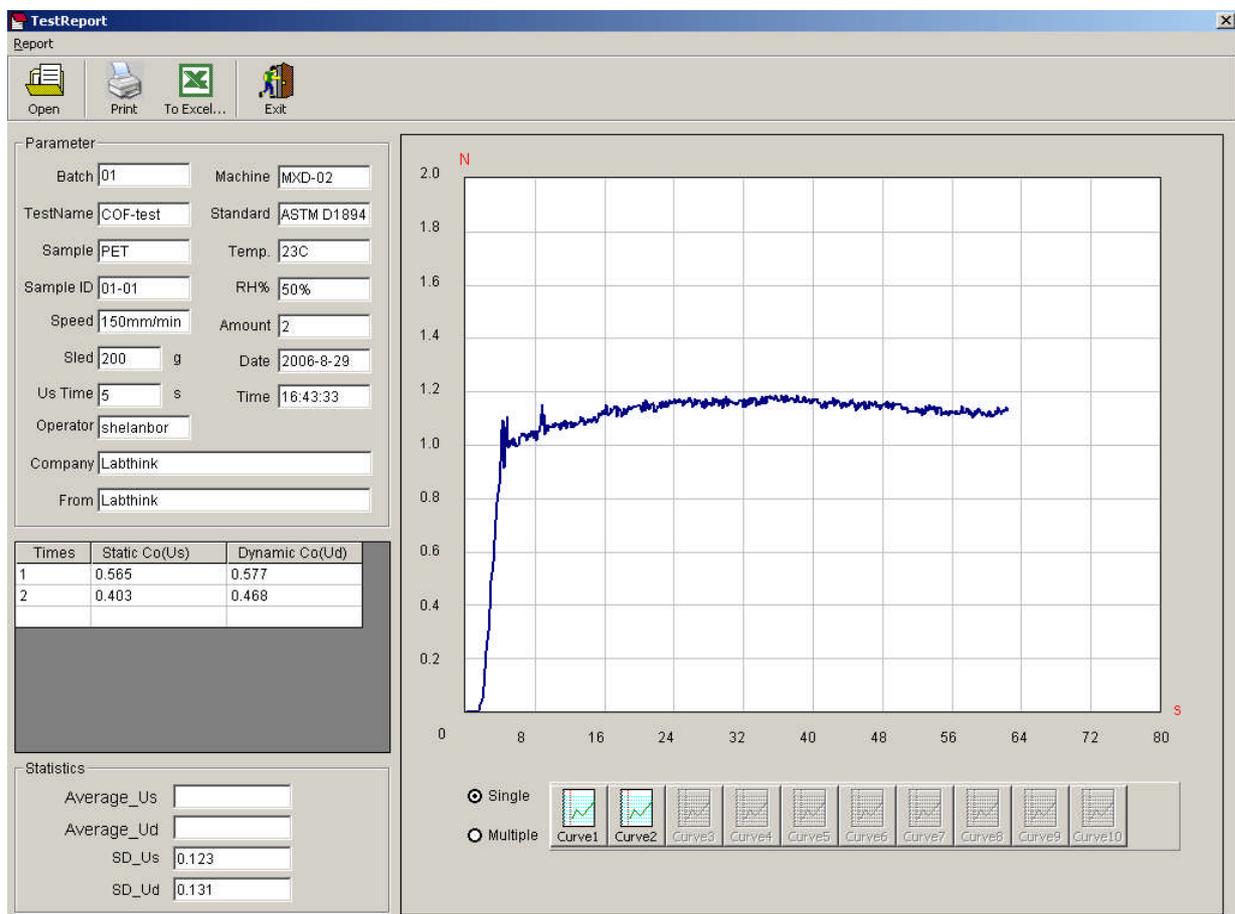
1. Toolbar: There are shortcuts of save, cancel, report, etc.

2. Data Curve Section: Plot the curve of testing force and testing time.
3. Result of Simple Test: Include the sequence number of current test, the static and kinetic coefficients of friction (COF).
4. Test Result: The average static COF and average kinetic COF of a batch of specimens, and the standard deviation of them (test time needs to be more than twice).
5. Test Parameters: Parameters correlative with test.

Before start, click "  " to open the preset interface, input user parameters. After a batch of tests are finished, click "  " to save the current test results. To query history test data, click "  " to enter test report interface, and open corresponding test report. Click "  " to clear current test results. Click "  " to quit.

7.2.3 Test report interface

The test report includes the test results, test curves of force value and friction coefficient in details which is convenient to check the history data. When "Single" is chosen, the last selected test curve will be shown only. When "Multiple" is chosen, all the test curves selected will be shown in the graph area. In the printed test report, the curve or curves will be the same as it was selected.



8. Sampling and Mounting

8.1 Pre-selection and sampling.

The sample should be flat without creases, dust, fingerprint or any other defects on the surface. Put the sample test side up, cut specimens according to the required direction into two kinds of size 130mm×250mm, 63.5mm×75mm, at least 5 specimens for each size, sampling evenly on the entire sample. In the case of thick specimen, cut it into 63.5mm×63.5mm instead of 63.5mm×75mm.

Don't touch the area to be tested by your hand while sampling.

8.2 Mounting

Put the 130mm×250mm specimen on the slide plane, with test side up. Then lift the specimen clamp on the right end lightly, and put the right end of the specimen under the clamp to fix it. Make sure the specimen is parallel to the direction of slide plane. If the specimen is curly, attach its left end to the plane.

Attach double side tape to the front and back of the sled, put the 63.5mm×75mm specimen test side out, and attach one end to the front of sled, be careful to make the specimen parallel to the sled edge. Press the sled onto specimen lightly, and attach the other end to the back of sled. In the case of thick specimen, attach the 63.5mm×63.5mm specimen directly to the sled by double side tape.

9. Test procedure

9.1 Procedure

9.1.1 Control the circumstance according to instrument demand and interrelated test item standard.

9.1.2 Condition the sample before test according to interrelated test item standard.

9.1.3 Connect the power cord and communication cable of the instrument and computer, refer to 5.5 and 5.6

9.1.4 Run the software on the computer, turn on the instrument and preset the interrelated parameters and standards.

9.1.5 Enter "Test" screen, press "Return" key, the slide plane will come back to the left end and stop with Return LED lighting. Refer to 7.1.2.4.

9.1.6 Sampling referring to the procedure in 8.1, then mount the specimens referring to the procedure in 8.2

9.1.7 Put the sled attached with specimen on the slide plane. When ISO 8295 or GB 10006 is applied, connect on end of the steel string with the sled, and the other end with the load cell. Make sure the string is a little loose to avoid extra force on the load cell. When ASTM D1894 is applied, dismantle the spring setting on the load cell, install it back with the spring facing out. Connect the sled and load cell with Nylon string, avoid extra force in the same way.

9.1.8 Press "Test" key to start testing, the sled will stay still at first for a while. The time scope can be changed in "Rest time". Then the slide plan starts to move at uniform speed, and result in the relative motion and friction between two pieces of specimen. The curve of friction force will be shown on the display, in the meanwhile, the test data is being transmitted to the computer through communication cable. At

the end of test, the plane will stop. In the case of a successful test, system will calculate the static and kinetic COF, then display and transmit the results to the computer,

9.1.9 Take off the sled and string, press “Return” key to let the slide plane back to position, the plane will move until the “return” LED is light. When “Print” is set to “Y”, press “Test” to print out the test results if the “Amount” is 1. If the “Amount” is 2 or else, change the specimens and test again, users could print out the results when finished.

9.2 Test results processing and judgment

9.2.1 Test results processing

9.2.1.1 Save the test report on the software referring to 7.2.2

9.2.1.2 Open the test report to look up history data or print it out, refer to 7.2.2 and 7.2.3

9.2.2 Test results judgment

9.2.2.1 Test results repeatability of one batch of sample

Check whether the repeatability is well for the same sample. When you do the repeatability analysis, if the result is not good, firstly, you may consider whether the sample has a wonderful stability. That's to say, whether the sample itself can has its own repeatability property. 2nd, when perform test in different condition (temperature, humidity etc.), we will have different results. 3rd, users may consider if the mounting operation, parameter presetting is correct, all these factors will influence the analysis. 4th, users may do verification or calibration according to procedure said in 10 and 11.

9.2.2.2 Test result comparison with reference value

When the comparison shows great difference, firstly, consider if the reference value is appropriate for the sample. Then, consider whether the way of mounting operation or the test condition will influence the test result. Or users may do verification or calibration according to the procedure in 10 or 11.

10. Veracity Verification

10.1 Test result veracity verification

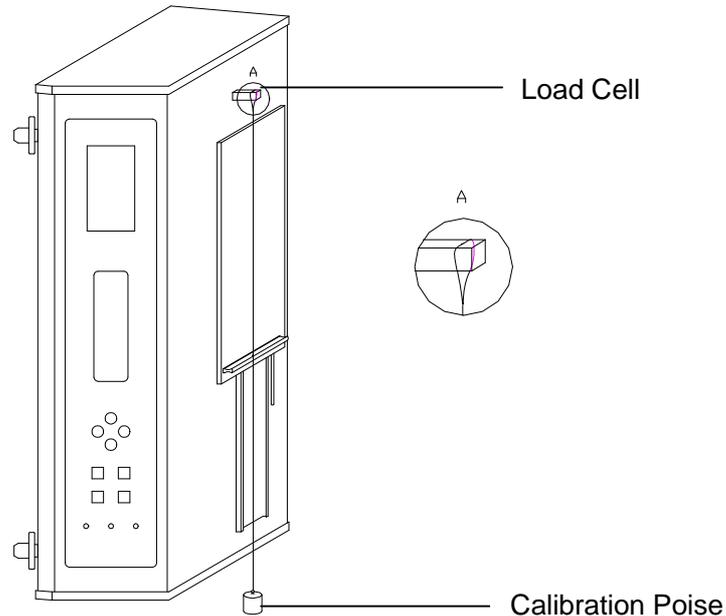
The coefficient of friction is the result of friction force divided by the weight of sled, thus the preset mass of sled must be accordant with the actual value. If the mass is set correctly, specimen and instrument status are the other two possible reasons, which will influence the results. Users could check the force reading veracity according to the procedure in 10.2

10.2 Force reading veracity verification

10.2.1 Take off the spring and tow rod from the load cell system.

10.2.2 Set the instrument upright on a stable work table as shown below, the instrument must be vertical. Otherwise, the calibration will be less accurate.

10.2.3 Enter “Test” screen refer to 7.1.2.4(do not start to test)



10.2.4 Note down the F value (F1) on the LCD, hang a 200g poise on the load cell with inelastic filament, Note down the F value (F2), Check if the difference value (F2-F1) is accordant with the weight of the poise (mass<g> * 9.8 * 0.001), the acceptable range is $\pm 0.5\%$.

Instance: When users use a poise of 2N, F2-F1 should be $2 \pm 2 \times 0.5\%$ (it is 1.99~2.01N). If so, it means the instrument is working properly, any question about test results could be caused by sample condition, or the test condition. If the value isn't in acceptable range, users should repeat this procedure to make a confirmation, then calibrate the instrument according to the procedure in item 11.

11. Calibration

11.1 Calibration Method

11.1.1 Calibration tools

One poise or a set of poises (M1 grade), the weight of which should be 50% of the testing range. When it is hard to find such tools, users can use a poise that closes to 50% testing range.

11.1.2 Calibration procedure

11.1.2.1 Warm up the instrument for 30min

11.1.2.2 Take off the spring and tow rod from the load cell system. Set the instrument upright on a stable work table as shown above, the instrument must be vertical, otherwise the calibration will be less accurate.

11.1.2.3 Enter Calibration screen, refer to 7.1.2.5

11.1.2.4 Press “”, “” to move the cursor to “NN”, then input “555” using “” and “” key. Make sure there is nothing on the load cell, then press “” and “” key to adjust the value of “Zero” to be 0.000, press “Enter” to save.

11.1.2.5 Press “” to choose “End”, hang the standard poise onto the load cell, make the poise at rest. Either the filament is too heavy or the poise is shaking, could result in inaccurate calibration. When the poise is steady, press “” and “” key to adjust the value of “End” according to the mass of the poise, then press “Enter” to save.

11.1.2.6 Press “Return” to exit from calibration screen.

11.2 The verification of calibration

Check up the results referring to item 10.2

12. Maintenance

12.1 When finish testing, turn off the instrument.

12.2 Take off the specimen from the sled, clear all the double side tape on the sled.

12.3 Make everything clear and arranged after test, keep the instrument clean and neat, then cover it with a dust cloak

12.4 Users should read the operation manual with solid understanding before start to operate. Service personnel should only perform maintenance with the guidance of Labthink staff or technical materials from Labthink. Maintenance or dismantlement is forbidden with power supply connected.

12.5 Calibrate periodically the instrument referring to interrelated standard. (Recommended to calibrate every year or 6 month)

12.6 Operate carefully and gently to avoid damage during testing process.

13. Troubleshooting

13.1 If there is creepage, check up the power and earth connection.

13.2 It is normal phenomenon if LCD display turns lighter in low-temperature or contrast turns deeper in high-temperature.

13.3 When the testing system is in confusion, press “Reset”.

13.4 If alarm occurred with “AD ALARM” on the LCD, it means the load cell is bearing a force larger than its test range. Check the force system referring to 10.2, if you get inaccurate force, it means the load cell is broken down, please contact with Labthink in time.

13.5 If alarm occurred with “HW ALARM” on the LCD, it means the return limit switch is operating. Press “” long enough to let the slide plane move to the right side, then press “Reset”. If alarm still exists after reset, it means the return limit switch is damaged. If not, enter “Test” screen to let the plane return back using “Return” key. If the alarm persists, we need to take off the rear cover to examine the return limit switch, and contact with Labthink in time.

13.6 If there is no backlight or display, check the following items in turn: power switch, fuse, power cord and power connection.