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TWO-POINT BEND TESTER

USER'S MANUAL

For Software:

2POINT™ Pro II for Windows version 2.00d

and

2POINT™ II for Windows version 2.00d

Document Version 2.00b, December 2021

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Introduction

2POINT II Pro for Windows
2POINT II for Windows

Software Version 2.00d

Warning: Protective Eyewear Must Be Worn While Operating This Instrument

This is the help file for 2POINT™ for Windows software which comes in two versions:

2POINT Pro II

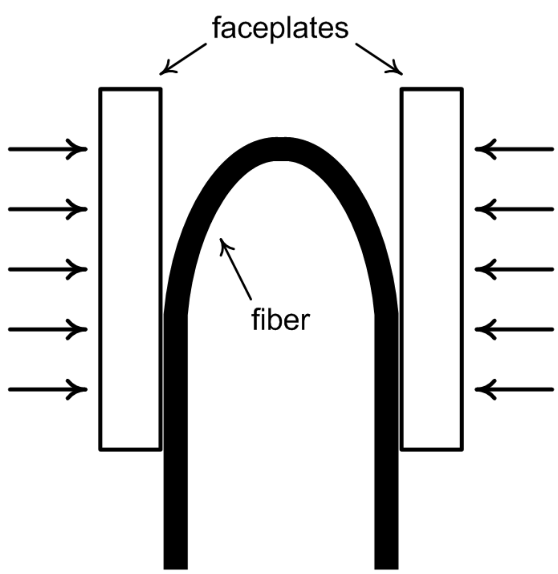
The two-point bend apparatus is connected to a controller, System Controller II, which incorporates a high performance microcontroller which handles the real-time control of the system. System Controller II is connected to the PC via a USB port.

2POINT II

This version uses a less powerful microcontroller and so is unable to operate certain measurements modes that require extensive real time calculations. The system connects to the controlling PC via a USB port. Constant stress rate, constant strain rate and cyclic stress modes require 2POINT Pro II software and System Controller II.

This manual primarily describes the functioning of 2POINT Pro II - it will be noted where the standard 2POINT II version differs.

Two-Point Bending



Two-point bending is a very convenient method for measuring the strength and fatigue of brittle fibers, such as optical fibers. It involves bending a fiber through 180° and inserting it between two faceplates. The faceplates are brought together until the fiber breaks at or very near the tip of the bend. The failure stress and strain can be calculated from the faceplate separation at failure.

The method is implemented in the Fiber Sigma Two-Point Bend Tester using a precision translation stage which is driven by a computer controlled stepper motor; the default is that the translation stage moves one micron per step of the stepper motor. One faceplate it attached to the frame of the stage and remains stationary during testing. The other faceplate is connected to the translating table. The zero position for the faceplate separation is determined by bringing the faceplates together (without a fiber) until they are in electrical contact.

The fiber is held between the faceplates by precision machined grooves in each plate. The total groove depth must be accounted for when calculating the failure stress and all faceplates supplied by Fiber Sigma include detailed information on the groove depths. The apparatus comes with a pair of single V-groove faceplates. V-groove faceplates can accommodate optical fibers with outer (coating) diameter up to about 1 mm. Also we supply multi-groove faceplates (12 and 30 grooves) which permit many specimens to be broken in one measurement. This is particularly useful for the low loading rates used when making fatigue measurements (*i.e.* when determining the stress corrosion parameter, *n*).

When the fiber breaks it makes a small noise, mostly in the ultrasound range. An piezo acoustic transducer is fixed to one faceplate and connects to electronic circuitry which triggers when a break is detected. The trigger pulse is passed to the computer which stops the stepper motor and calculates the failure stress from the faceplate position.

2POINT™ Pro II for Windows Software Installation

Run Windows Update to get the latest Windows patches *before* attempting to install 2POINT Pro II for Windows

Run the SETUP program obtained from the Fiber Sigma website (*http://www.fibersigma.com/downloads*) or from the distribution CD with file name Setup_2POINT_Pro_II_*nnn*.exe where *nnn* is the version number (or Setup_2POINT_II_*nnn*.exe for the standard version).

Running the Software for the First Time

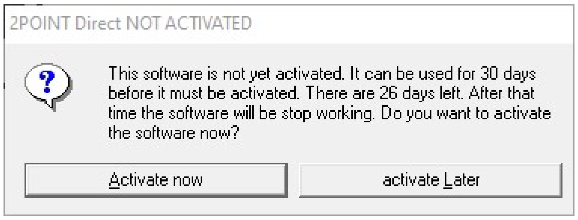
Software Activation

2POINT can be used for 30 days before it will require activation – activation requires a license number supplied by Fiber Sigma. You do not need to activate the software immediately, but it will stop a nagging message that appears when the program is started. The software can be activated automatically if the computer has an Internet connection, or manually if it does not. If you select manual activation, 2POINT provides an Installation Code which is needed together with the license number to get an Activation Key which can be obtained by filling in the form at:

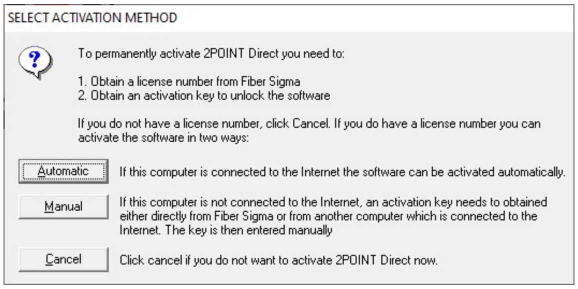
http://www.fibersigma.com/activate.html.

This key permanently activates 2POINT. Note that the Installation Code ***must*** be generated by running 2POINT on the ***same*** computer on which 2POINT will be used. Please contact us at support@fibersigma.com if you have any problems with the activation process.

Here are more details on activation since it is a common source of confusion. The example below is for 2POINT Direct which is an older version, but the process is the same for all Fiber Sigma licensed software including 2POINT Pro II.

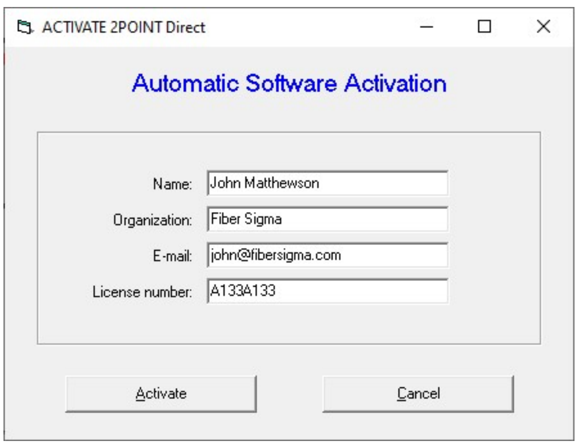


If you click activate Later, nagging reminder messages will appear each time you start 2POINT until the 30 day trial expires, at which point you will be unable to use 2POINT. Click Activate now to proceed with activation.



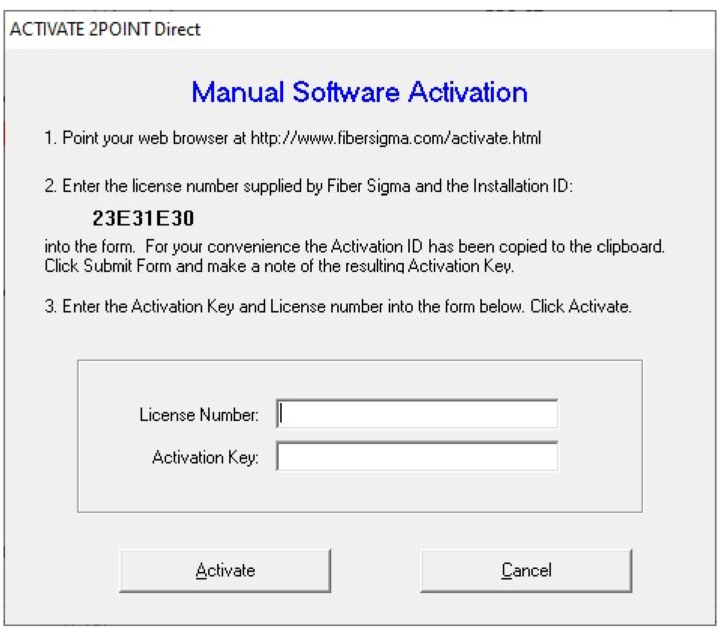
Select Automatic if your computer has an internet connection. Select Manual if your computer does not have an internet connection or if you company's network restricts access to certain external connections. The automatic method requires that a Perl script can be run on a remote server. If the automatic method fails, try the manual method.

Automatic Software Activation

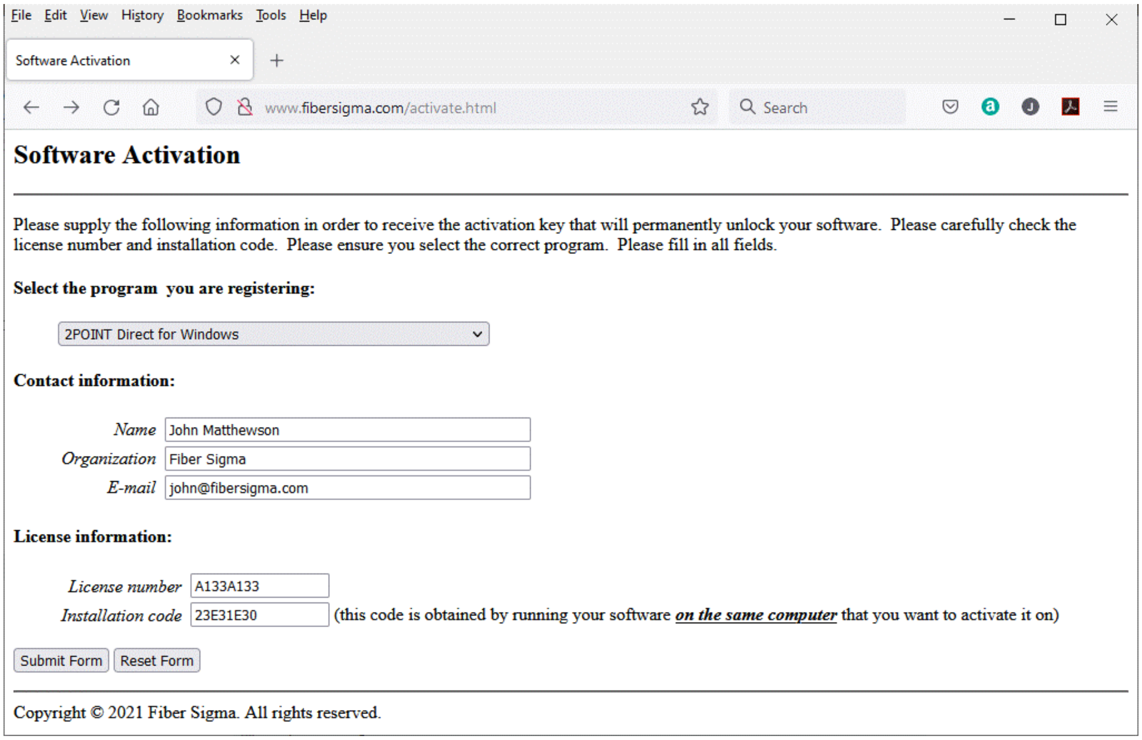


If you select automatic software activation, this form appears. Fill out the form completely. If you don't want to enter your email address for reasons of privacy, you can enter anything into the email field but it must look like a valid email address: "x@y.z". The license number field must be filled with the exact license number provided by Fiber Sigma. It can be found on labels inside the front cover of the printed manual provided with the instrument. It is suggested that you save the license number in a safe place.

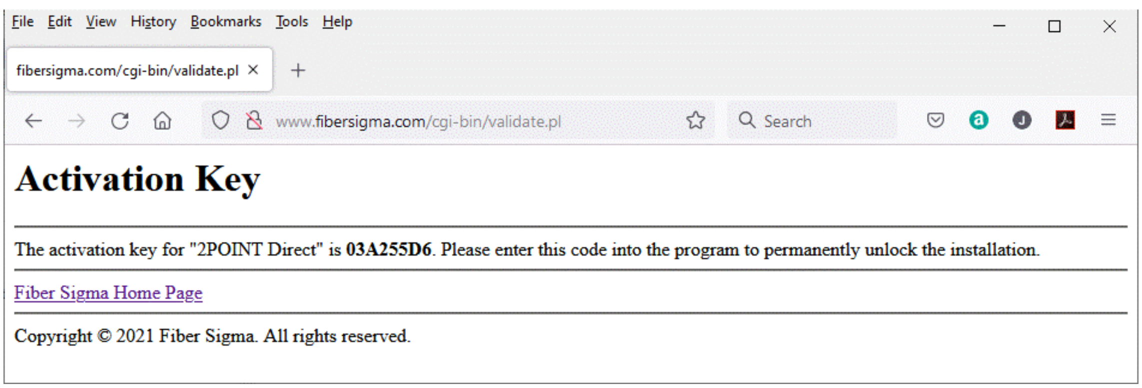
Manual Software Activation



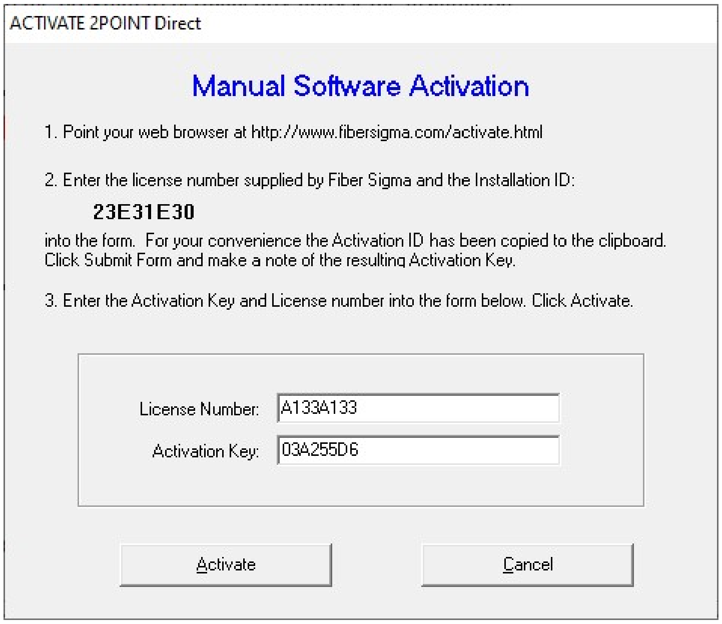
If you select manual software activation, this form appears. Note the installation ID ("23E31E30" in this example) which is needed for the next step. For your convenience the installation ID is copied to the clipboard when this form opens. ***Leave this form open.*** Open http://www.fibersigma.com/activate.html in your web browser on a ***different*** computer with ***both*** internet access ***and*** the ability to run server-side scripts.



Completely fill out the form on the Software Activation web page above. Make sure you select the correct software name from the drop down list (if you are not sure, the program name is in all the 2POINT window captions). If you don't want to enter your email address for reasons of privacy, you can enter anything into the email field but it must look like a valid email address: "x@y.z". The license number is supplied by Fiber Sigma. The installation code was generated in the 2POINT program and was copied to the clipboard so you can paste it straight into the Installation Code field. Click Submit Form:



The next window in the browser shows the activation key ("03A255D6" in this example) which you now copy and take back to the 2POINT Manual Software Activation window you left open on the 2POINT installation computer.



Now fill out the two fields in the form. Again, the license number is provided by Fiber Sigma. Paste the Activation Key, that you just obtained in your web browser on the other computer, into the second field. Click Activate and you should get a confirming message.

Troubleshooting

The **License Number** is a unique code supplied to you by Fiber Sigma that gives you the right to install a limited number of copies of the licensed software on different PCs. The license code is related to a specific Fiber Sigma instrument. Do not share your license code with anyone for use on a different instrument.

The **Installation Code** is a unique code that links your software license to the specific PC you are using for the installation.

The Installation Code is used to generate a unique **Activation Code** on the license server which is then used to activate the software.

Note that the Installation and Activate codes are hashes of the license number, the program name and a unique identifier related to your PC. They can only be used for activating a specific program on a specific PC. Note that if you change the hard drive on the computer you will need to reactivate the 2POINT program.

The License Number, Installation Code and Activation Code are all 8 digit hexadecimal numbers. They may contain the number zero, but never the letter oh (“o” or “O”). The letters are not case sensitive – “03A255D6” and “03a255d6” are equivalent.

Our apologies! The manual activation method is tedious and causes confusion. Originally our software did not require activation. However we felt forced to add this software protection after we found that our software was being widely used within a group of people who did not have a right to use of the software.

Software Startup

Whenever the 2POINT Pro II software is started (not just on the first occasion) two additional steps must be taken before accessing the Main Window of the program:

1. You need to synchronize the position of the faceplates with the position indicated by the Bend System Controller II and the position indicated by the 2POINT Pro II software. This is done in the Synchronize Positions Window.

   Warning: Do not select Run to contact before you have checked that faceplate contact detection is functioning correctly. To do this connect something metallic between the faceplates and make sure that the contact detection LED illuminates.

2. The software must be connected to a data file used to save all measurements as they are made. By default the same file used the last time the program was run is used, if it can be found. If not you are prompted to specify a file. After specifying the file, the data file name is displayed in the data area of the Main Window.

Updating 2POINT Pro II for Windows

2POINT Pro II can automatically link to the Fiber Sigma web site to determine if a newer version of the software is available. If it is, the new version can be downloaded and installed manually. To access this feature, select Help/Check for updates in the menu bar in the main window. Note that the older version does ***not*** need to be uninstalled before updating. If your computer does not have internet access, you can check for updates at http://www.fibersigma.com/downloads.htm.

Uninstalling 2POINT Pro II for Windows

2POINT Pro II for Windows can be uninstalled using either one of two methods:

1. Run the Uninstall icon in the Fiber Sigma program folder (Start | Programs | Fiber Sigma).
2. Go to Start | Settings | Control Panel | Add or Remove Software and select 2POINT Pro II and click Change/Remove**.**

Updating the System Controller II Firmware

When a new version of the 2POINT Pro II software is released it is sometimes necessary to update the System Controller II firmware at the same time. 2POINT Pro II will give an error message and halt if the System Controller II firmware is not up-to-date.

Close the 2POINT Pro II program. Open a DOS window in the C:\Program Files\FiberSigma\2POINT_Pro_II or C:\Program Files (x86)\FiberSigma\2POINT_Pro_II folder. The folder contains a bootloader program (SC2-BL.exe) and the firmware file named SC2-*nnn*.HEX where *nnn* is the firmware version. Run the command “SC2-BL upload SC2-*nnn*.HEX”.

Quick Start

The Two-Point Bend apparatus is supplied ready assembled and it is only necessary to install the control software and to make connections between the various components of the system. Note that all cables are color coded or have unique connectors. Provided the color coding there is only one way to make all the connections.

1. Make sure the Bend System Controller is turned off – the switch is on the back panel next to the power receptacle.
2. Connect the 24 VDC power supply to the 2.1mm P5 connector on the Bend System Controller rear panel.
3. Connect a D25 male-female cable between the Bend System Controller and the System Controller II (or the USB Adapter II for the standard version of 2POINT II).
4. Connect the BNC cable between the BNC socket on the rear of the black junction box attached to the two-point bend apparatus and the BNC socket labeled ‘sensor’ on the front of the Bend System Controller.
5. Plug the 3 mm cable in the socket on the rear of the black junction box attached to the two-point bend apparatus and the socket in the contact detection section of the front of the Bend System Controller.
6. Connect the translation stage to the Bend System Controller using the black cable with circular connectors on the ends. The plug of each connector should be gently pushed into the corresponding receptacle and rotated until the mating notches align – the plug will then move further into the

receptacle housing. Then rotate the locking ring clockwise until it clicks. This cable carries the power to the stepper motor and well as the signals for the hard limit switches in the translation stage which stop the stage being moved too far. ***Never connect or disconnect this cable while power is applied to the stepper motor.***

7. Put all switches on the Bend System Controller to their default positions:

   Motor Current to remote
   Local Control to remote
   Contact Detection selector switch up (*i.e.* not set to disable)
   Break Detection source switch down, Acoustic Detection
   Acoustic Detection sensitivity knob to about the 9 o'clock position

Now install the 2POINT Pro II for Windows software.

Checking Hardware Operation

Before attempting to break any fibers, go to the Hardware Setup Window and make sure that all input and output functions are operating correctly.

Breaking Your First Fiber

1. Check that the fiber and coating diameters are correctly set in the Main Window.
2. Click Load fibers and wait until the faceplates have opened to the Loading Gap.
3. Bend a fiber double and slide it into the grooves in the faceplates. Check that the fiber is properly seated in the grooves.
4. Click Break fibers and wait until the break is detected. Click OK and the strength will be displayed in the Results Table. If the break is not detected, refer to the Troubleshooting section.

Hardware Installation

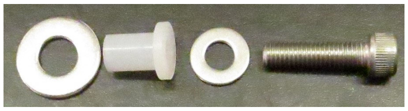
The two-point bend apparatus comes ready assembled but below are detailed instructions on how to assemble the various components, should they be dismantled. However, it is very much easier to describe the assembly process by action than words, so when you dismantle the apparatus note how it was assembled.

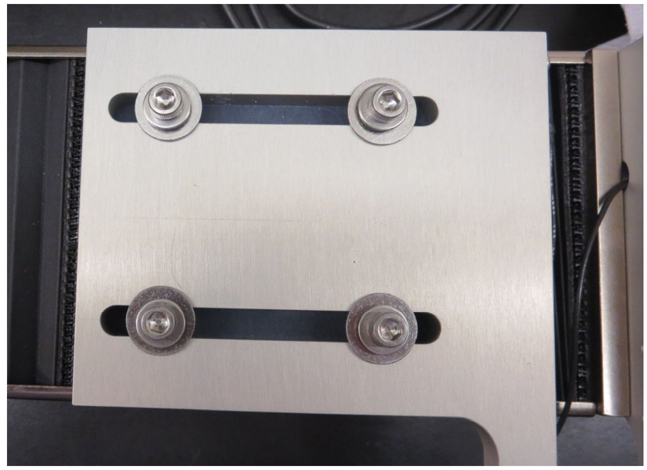
Faceplate Supports

1) The faceplates are supported by attachment to arms projecting from the top and end mounting plates. The faceplate separation is zeroed by checking for electrical contact between them. For this to function properly, the support plates must be electrically insulated from the translation stage. They are mounted with a thin sheet of "fish paper" installed between the mounting plates and the stage. The screws fastening the mounting plates are insulated from the plates using nylon shoulder washers.

2) The end mounting plate is attached by four #6-32×⅞" socket head screws which have placed on them, in order, a #6 stainless steel flat washer, a #6 nylon shoulder washer and a #8 stainless steel flat washer. Screw the end plate to the end of the stage using these four screws, tightening them only finger tight.

3) The top mounting plate is attached by four #10-32×¾" socket head screws which have placed on them, in order, a #10 stainless steel flat washer, a #10 nylon shoulder washer and a #12 or ¼" stainless steel flat washer. Use these screws to attach the top plate to the top of the translation stage with a sheet of insulating material separating the two. Do not tighten these screws yet.





4) To align the plates move the translation stage in manual mode in the “closed” direction until the motor stops with the yellow “closed” limit LED illuminated. Back off the stage in the “open” direction by 200 to 300 μm.

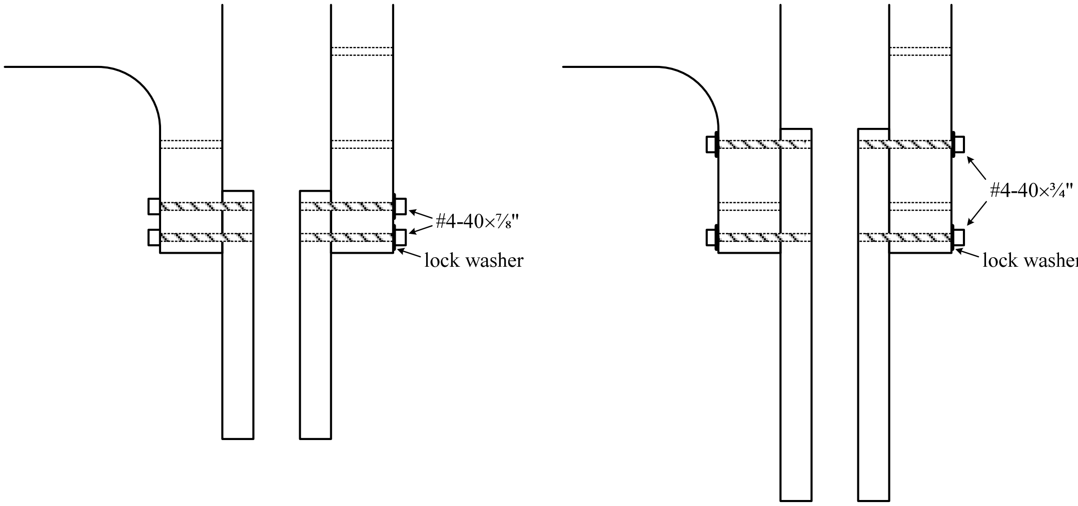
5) Remove the two #10 screws nearest to the motor which are holding down the top mounting plate. Slide the top mounting plate until it comes into contact with the end mounting plate. (If the black contact detect wire is attached to the top plate, disconnect it by removing the #6-32×¼" button head screw.) Two stainless steel precision rods (#33 wire size) are supplied in the toolbox that is shipped with the system. Insert these rods into the outer two holes on the arms projecting from the mounting plates – this will cause rough alignment of the holes. Now let’s align them more accurately. The screws holding down the mounting plates should be loose enough so that you can adjust the position of the plates. Adjust them so that the top surfaces of both plates are co planar. Progressively tighten the four #6 screws on the end plate by going around them in order tightening them a little more each time. Keep going until all four screws are tight. Then using the L-shaped hex wrench, tighten them firmly.

6) Make sure the end mounting plate is electrically isolated from the translation stage.

7) Now clamp the two faceplates together face to face, using the black fold-back clip in the tool box. Make sure the grooves are accurately aligned and that the screw holes align. Using two #4-40×¾" socket head screws with internal tooth lock washers, mount the pair of faceplates to the end mounting plate. Make sure that the top of the plates are coplanar with the top of the end plate, firmly tighten both #4 screws. See the schematic below.

8) Using two more #4-40×¾" socket head screws with internal tooth lock washers, attach the top mounting plate to the left faceplate. Let the screws slowly and gently pull the top mounting plate to the correct position - tapping the top plate occasionally permits it to move. Now firmly tighten the faceplates. Now progressively tighten the four #10 screws holding down the top plate - go around the screws in turn progressively tightening them until all are tight. Note that if one screw is fully tightened before the others it will tend to pull the top plate out of alignment.

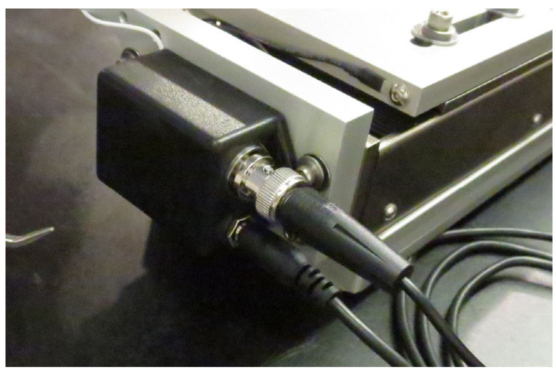
9) The above description is used to attach single groove, 10 or 12 groove faceplates or the polished faceplates. The 30 groove faceplates are mounted a little differently to provide additional support to these long faceplates. See the schematic on the right below for the correct mounting screw positions.



Schematic showing faceplate mounting positions for (left) single, ten or 12 groove faceplates and polished faceplates, and (right) 30 groove faceplates.

Faceplate Contact Detection

1) Using the 3mm jack plug cable (contact detection cable), put one end in the jack socket of the contact detection section of the front panel of the Bend System Controller, and put the other end in the jack socket on the rear of the black box attached to the end plate.



2) Using the local control section of the, put the Bend System Controller into local mode and move the faceplates apart. Make sure that in the contact detection section of the Bend System Controller the disable switch is not set to disable and check that the disable LED is off and not blinking.
3) Connect the faceplates together with a piece of conductive metal. Make sure the red contact detection LED in contact detection section of the Bend System Controller turns on when the faceplates are connected together and turns off when they are not connected.

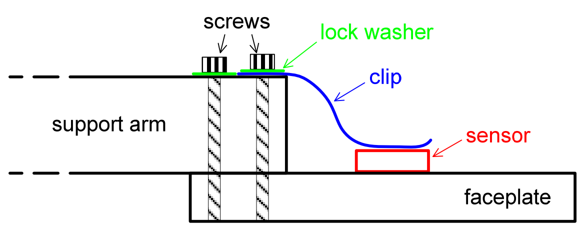
Warning: Do not proceed further until the contact lamp can be lighted by electrically connecting the faceplates. Attempting to zero the faceplates could damage the faceplates and stepper motor if the circuitry cannot detect faceplate contact.

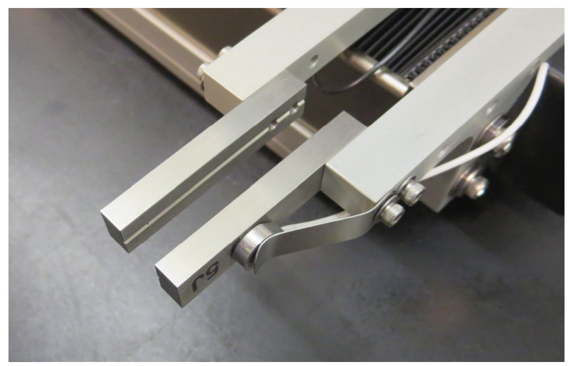
4) Put the locale/remote switch in local control section of the Bend System Controller is turned to remote. In the 2POINT software, click the set Zero position button then the Run to contact button so that the faceplates are moved into contact to detect the zero position.
5) In the 2POINT software, click the set Zero position button the click on check Zero - make sure the zero position is detected reliably. The contact position should not vary by more than about one motor step (1 µm). If it is unreliable, open the faceplates and carefully clean them of dirt and dust.

Warning: Do not connect any electrical device to the faceplates (such as temperature probes *etc*.). This, at worst, could damage the electronics of the Bend System Controller, or at best could cause difficulties with contact detection. While such damage would be avoided if contact detection were disabled, it would be unwise to rely on this since contact detection could be inadvertently enabled.

Acoustic Break Detection

1) Attach the spring clip to the support arm of the end plate using the outer screw that mounts the faceplate (see the schematic and photograph below).
2) Apply a small amount of grease (such as Vaseline) to the ceramic face of the acoustic sensor. Carefully pull up the spring clip and slide the senor under it. ***The edges of the spring clip are a little sharp so be careful not to cut yourself.*** Make sure the ceramic face of the sensor is flat again the faceplate. Reposition under the clip until it is.
3) Use the BNC acoustic detection cable to connect the "sensor in" BNC socket in the acoustic detection section of the front panel of the Bend System Controller to the BNC socket on the rear of the black box attached to the end plate.
4) Gently tap the faceplate using a small piece of metal and make sure the taps are detected by the acoustic detection system.





Groove Depth Measurement

Fiber Sigma supplies measurements of the groove depths with each set of faceplates. The results are provided on a sheet that can be found either with the faceplates or in the rear of the manual.

The depths are measured for the single groove faceplates at five positions along their length. For the most accurate measurements, these measurements should be interpolated to provide the depth where the fiber contacts the groove bottoms.

For the multi groove faceplates the groove depths are determined at their center. Detailed statistics are provided since there is some variability in the groove depths. Of particular interest is the Weibull analysis that predicts what the apparent Weibull modulus would be assuming the fiber has a single unique strength and all the scatter is derived from the scatter in groove depth. The results are presented for several representative fiber strengths. *E.g.* for the 10 groove faceplates the results are presented for all ten grooves, for the best nine, and for the best eight. Since the Weibull modulus is typically up to 50 or so, any value over 50 means that the groove depth scatter is not significant. Since the Weibull modulus is an inverse measure of scatter, the Weibull modulus determined in an experiment, m_e, is given (to a good approximation) by

$$\frac{1}{m_e^2} = \frac{1}{m_f^2} + \frac{1}{m_g^2}$$

where m_f is the Weibull modulus of scatter in the fiber strength, and m_g is the Weibull modulus of scatter in the groove depth. This equation is derived from the mathematical result that the variance of the sum is the sum of the variances of uncorrelated variables. This equation may be used to determine the fiber Weibull modulus from the measured value.

The printout of groove depths also shows a measure of the flatness of the multi-groove faceplates. This is found by analyzing the several heights of the plate surface on either side of the grooves. All the raw measurements have some systematic behavior because of tilt of the measurement system, but this is removed by fitting a straight line to the raw data. The flatness is the standard deviation of the deviations of the measurements from this straight line.

Polished Faceplates

"Polished faceplates" is actually a misnomer since, as supplied, these faceplates have a ground rather than polished surface. However, with use the plates will require polishing - see hint 1 below.

Alignment of the polished faceplates is particularly important since any misalignment will cause the fiber under test to twist and slip out of the faceplates. For bare fiber, this slipping will cause premature failure and will not be readily detectable. If this is happening it may be detectable if the scatter in the strength results is too high.

1) Screw the polished faceplate without tapped holes in one end to the end plate using two #4-40×¾" screws making sure the top of the plate is coplanar with the top of the end plate (see Figure 1). Check that there is electrical contact between the faceplate and the contact detection wire on the end plate. If there is not a connection replace one of the two screws with a #4 toothed lock washer on it. If there is still no electrical contact scrape a small amount of the anodizing from under the head of one of the screws.
2) Screw the bottom clamp plate to the end of the other faceplate using the two #2-24×½" socket head screws with ground down heads. Tighten the screws making sure the clamp plate is accurately perpendicular to the faceplate. Next screw the top clamp plate to the end of the faceplate using one #2-24×½" socket head screw. Make sure that this top clamp plate can rotate freely without too much wobble. If the screw tends to loosen when the clamp plate is lifted, replace the screw with a small quantity of thread locking agent (such as Locktite®). Place a #2 nut on the #2-24×¼" socket head screw and screw the screw into the end of the top clamp plate. This screw is used to set a space between the clamp plates equal to the diameter of the fiber to be tested. The screw is locked in position by tightening down the nut. Make sure that when the screw is correctly set that there is enough play in the pivot of the top clamp plate to give an equal gap at the pivot end as well.
3) Screw the faceplate assembly to the top plate using two #4-40×¾" socket head screws. Squeezing the two faceplates together, tighten these screws making sure the two faceplates have parallel sides. Also make sure that the two clamp plates are not in contact with the faceplate mounted first, giving special attention to the top clamp plate which should be slightly loose to operate properly. Check that there is electrical contact between the faceplate and the contact detection wire on the top plate. If there is not a connection replace one of the two screws holding on the faceplate with a #4 crimp washer on it. If there is still no electrical contact scrape a small amount of the anodizing from under the head of one of the screws. Again, squeezing the faceplates firmly together, progressively tighten the four screws clamping the top plate to the translation stage.
4) Make sure that the contact detection LED on the Bend Control System lights when the facesplate are shorted by a conductor.

Warning: Do not proceed further until the contact lamp can be lighted by electrically connecting the faceplates. Attempting to zero the faceplates could damage the faceplates and stepper motor if the circuitry cannot detect faceplate contact.

5) Make sure that there is no dirt between the faceplates. Run the 2POINT program and go to the Synchronize Positions window and select check Zero. Now view the gap between the faceplates by placing a bright lamp behind them. By looking down on the faceplates make sure that they are parallel. If they are not then the top mounting plate will require realignment (step 3). Next, looking down the length of the faceplates, make sure that they are in contact both top and bottom. Very small displacements can be made by differentially tightening pairs of the four #10 screws clamping the top plate. If this produces insufficient adjustment then a thin shim may be needed between one end of the top plate and the translation stage. While making adjustments, reselect the Check current zero menu item in the 2POINT program. The two faceplates should now be accurately parallel.

6) The lower clamp plate can now be accurately aligned with the translation axis by making a mark next to the plate on the end of the stationary faceplate. By sighting the mark against the edge of the clamp while moving the faceplates apart it can be seen whether the motion is parallel to the clamp. If it is not, loosen the two #2-24 screws, realign the plate and retighten the screws.

7) The last alignment is not needed on the apparatus as supplied due to the high precision of the machining of the parts. However, if the alignment is required due to damage to the hardware, it is very difficult to both detect and correct. While the faceplates should now be parallel they might not be accurately perpendicular to the motion axis. This can be detected by breaking plastic coated fiber. If the faceplates are misaligned or the fiber is not carefully positioned between the faceplates it will tend to twist out of the gap before breaking. The fiber can twist in either clockwise or anticlockwise directions but if the above alignment is poor it will preferentially twist in one direction. Poor positioning of the fiber would give an equal tendency to twist in either direction. Therefore misalignment is detected by analyzing the statistics for twist direction. Misalignment is corrected by rotating both the end and top plates by placing shims between the top plate and the translation stage and between the end plate and the spacer block.

Hints For Using Polished Faceplates

1) Debris from breaking fibers impacts the faceplates at high speeds and after only a few fibers are broken a careful examination will reveal slight roughening of the polished surfaces (despite them being made of a high grade impact resistant steel). Eventually this roughness will perturb the zero position due to high spots forming. It is therefore advisable to avoid re-zeroing the faceplates whenever possible to avoid cumulative systematic error. This rough area can also damage bare fibers and cause premature failure. Eventually the roughness will need to be removed by refinishing the plates but this will require complete realignment of the system. Any polishing should be done very carefully to avoid beveling of the surfaces:

   - To remove the roughened area use an abrasive metal polish such as Brasso. Place a small puddle of polish on a glass plate and then gently rub the faceplate in one direction – slide in one direction, lift off, move back and slide again in the same direction. The purpose is **not** to polish the faceplate but only to remove the roughness. If burnished/polished areas appear at edges or corners you have gone too far! After refinishing the faceplates place them together, face to face, and make sure tha slide smoothly against each other without rocking. If they do rock then they have been beveled by over polishing. In this case the surfaces need regrinding which can be carried out by any well equipped machine shop. Specify to that machinist that the faceplates must have front and rear faces parallel to 0.001 inch TIR (0.025 mm)

2) Debris between the faces plates can be a major problem, especially when taking a zero after each fiber break. However the following procedure can help. First, zero the system. Next, at least one of the holes in one of the faceplates goes completely through the plate. Remove the screw in this hole and replace it with a longer one that protrudes slightly (½ mm) and check the zero position. The offset caused by the protruding screw becomes the `ZeroOffset` (equivalent to the groove depth for the grooved plates). Reestablish the zero position.

3) Very strong fibers, giving very small gaps at fracture, have a correspondingly high probability of slipping out of the faceplates. "Grooves" can be modeled by placing two parallel strips of adhesive tape on each faceplate with a small gap between the strips. The gap forms a groove in which the fiber is positioned. The faceplates cannot now be zeroed as they are insulated by the tape but the protruding screw trick above can be used to overcome that.

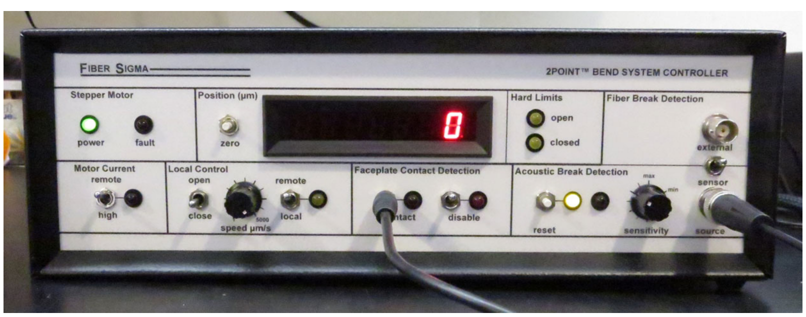
4) When the apparatus is tilted at extreme angles the top clamp plate can fall open and release the fiber. A small strip of self-adhesive magnetic plastic is supplied with the apparatus and two small pieces of this material can be stuck on the ends of the clamp plates. If the pieces are correctly aligned they will attract each other and keep the top clamp in position.

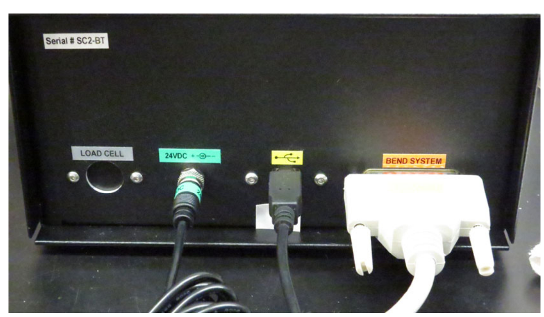
Electrical Connections

Most of the cables used to connect the various parts of the two-point bend apparatus are color coded – make sure that the color of the marker on the cable matches the color of the receptacle to which you connect it. Cables that are not color coded can usually only be connected in one place.

1. Connect the BNC cable between the “in” BNC receptacle on the front of the Bend System Controller and the BNC receptacle on the rear side of the black junction box on the end support plate.
2. Connect the 3 mm jack cable between contact detect socket on the front of the Bend System Controller and the socket on the rear side of the black junction box on the end support plate.
3. Connect the black cable with circular connectors to the motor housing on the translation stage and the circular connector on the rear of the Bend System Controller.
4. Connect the D25 male-female cable (yellow markers) between the male connector on the System Controller II to the female connector on the Bend System Controller.
5. Make sure the Bend System Controller is turned off – the switch is on the rear panel. Press the side of the switch marked “0” to turn off the power and “1” to turn on the power.
6. Connect power to the Bend System Controller using 2.1 mm P5 power connector on the power supply.
7. Install the USB cable between the rear panel of the System Controller II and the USB port on the PC.

Check that the connections resemble those in the following pictures (details of your units might differ slightly from these pictures):



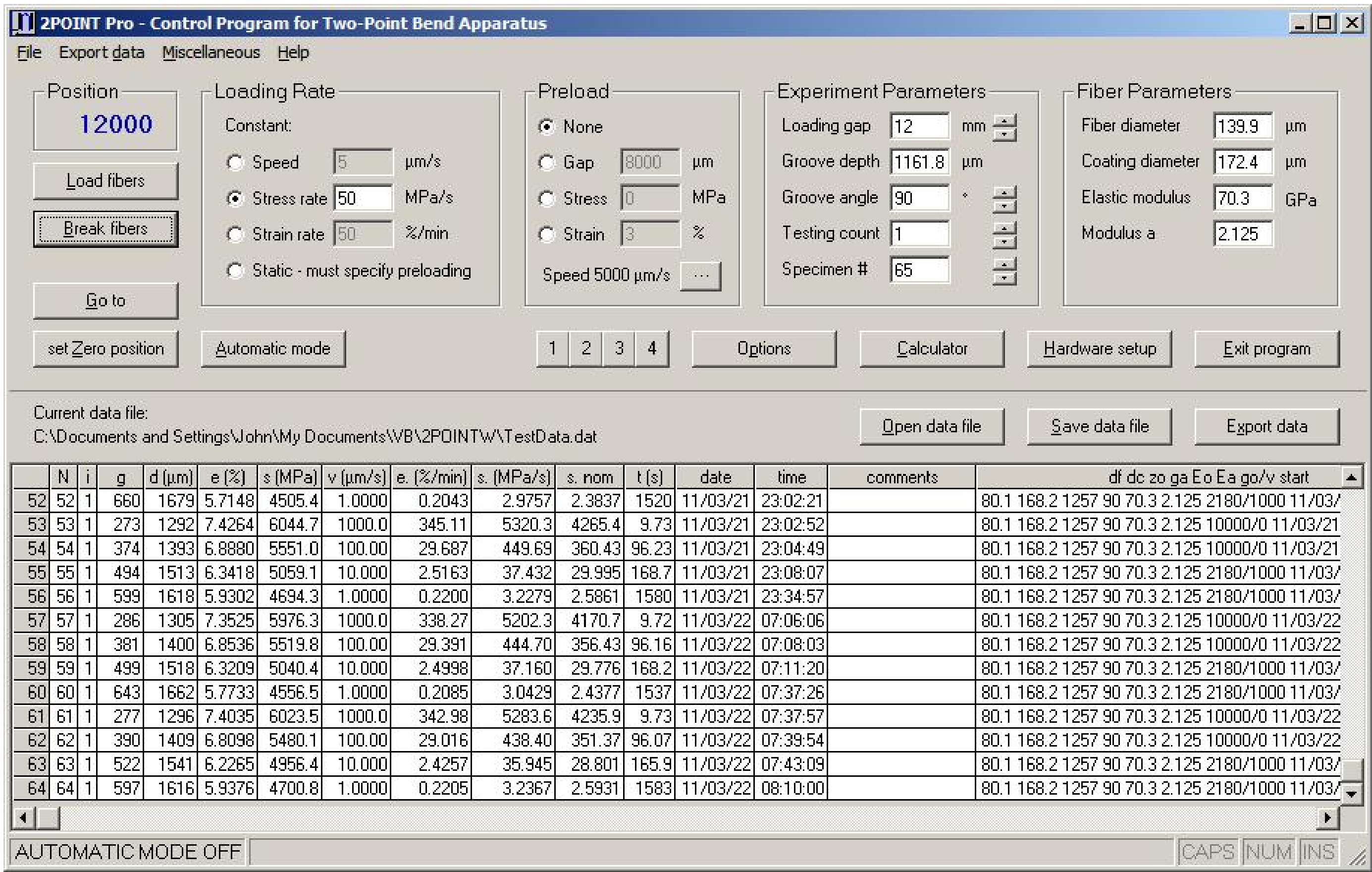


Front and rear panel connections for the Bend System Controller (left) and System Controller II (right.

The 2POINT Pro II Windows

This section describes all the windows in the 2POINT Pro II program:

The Main Window



This window is at the heart of the program. Experiments are run from this window and other windows are all accessed from here. The main window displays all key experimental parameters. The various sections of the main window are described below:

Performing an Experiment

Load fibers

The faceplates open until their separation is at least the Loading gap. If the separation is already greater then the loading gap then the faceplates do not close.

Break fibers

The faceplates are closed until the fiber(s) break. If preloading is specified the faceplates move at their maximum speed to the preload position and then continue at the rate specified by the loading rate parameters. The faceplates will continue to come together until all the fiber breaks are detected or until a small separation is reached at which point it can be assumed that one or more of the breaks were missed.

Go to

Specify a faceplate separation in microns. The faceplates will move to that separation at the maximum speed.

Set Zero position

Opens the Set Zero Position Window. This is used to reset or check the zero position, *i.e.* the position at which the faceplates are in contact.

Automatic mode

Opens the Automatic Mode Window for automatic, unattended operation.

Quick Parameter Changes

The main window contains a group of four buttons:

Clicking one of these buttons attempts to load a file containing configuration parameters. The folder containing the current data file is searched for configuration files called VarSet1.ini, VarSet2.ini, VarSet3.ini, and VarSet4.ini.

Loading Rate Parameters

Note: Constant Stress Rate and Constant Strain Rate modes are only available in 2POINT Pro II, but not in 2POINT II. These modes will be grayed out and will be unelectable for 2POINT II

Four types of experiment can be run; three dynamic fatigue (constant faceplate speed, constant stress rate or constant strain rate) and one static fatigue (constant stress/strain).

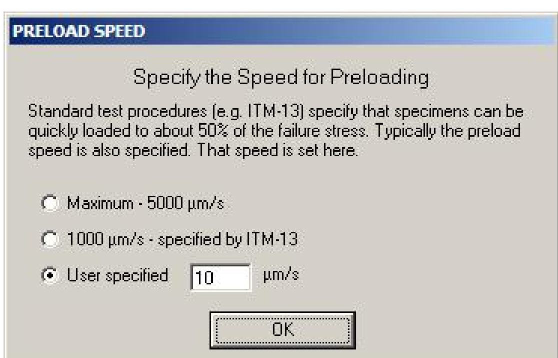
If the constant stress rate or strain rate is set too high, the initial speed of the faceplates is limited to the maximum available; the faceplates will close at that maximum speed until the requested stressor strain rate can be achieved at which point the faceplates will continuously slow to maintain the requested rate.

Preload Parameters

For very slow loading rates the experiment can be shortened by rapidly loading the fiber to some specified level, after which the rate drops to the needed slow value. Preloading can dramatically shorten experiment duration without affecting the results since little fatigue occurs at low stress. Both ITM-13 and IEC 60793 permit preloading.

Clicking the button at the bottom of the Preload Parameters section opens the Preload Speed window.

Preload Speed Window



This window is used to specify the faceplate speed for preloading the fiber. The speed may be explicitly specified ("User specified") or for convenience the maximum available speed or 1000 µm/s can be quickly selected. ITM-13 specifies preloading at 1000 µm/s while IEC 60793 specifies a rate equal to the next highest rate for a fatigue measurement.

Experiment Parameters

Loading gap

Specifies the faceplate separation for inserting fibers.

Groove depth

This is the total depth of both grooves. Grooved faceplates supplied by Fiber Sigma include a sheet detailing the combined groove depths.

Groove angle

This is the included angle of the base of the grooves. For standard U-grooves this is 180°, for V-grooves it is 90°.

Testing count

Specifies the number of specimens being tested simultaneously.

Specimen number

This is the index number for the ***next*** specimen to be broken. This index number is the parameter "N" in the first column of the Results Table.

Fiber Parameters

Fiber diameter

Set the fiber diameter in µm. This is the diameter of the glass in the fiber.

Coating diameter

This is the coating outer diameter in µm. This is the overall diameter of the fiber including all coating material.

Modulus

This is the elastic modulus of the glass in the limit of zero strain, E_0, in GPa. The default value is 72 GPa for silica.

Modulus a

This is the coefficient which describes the strain dependence of the elastic modulus. The default value is 2.125 for silica.

The elastic modulus (Young's modulus) of silica, E, varies with strain, e, according to the equation:

$$E = E_0 (1 + a e).$$

The accepted value for a is 3, but the elastic modulus is asymmetric for tensile and compressive strains so the neutral axis of the bent fiber is shifted and the value of 2.125 corrects for this (see reference 1). (Note that ITM-13 specifies that a should be 1.125 – this is a typographical error.) 2POINT calculates the stress in the fiber surface, s, using this strain dependent modulus:

$$s = E e = E_0 (e + a e^2).$$

Data Display Area

When fibers are broken the results are displayed in the Results Table. They are also saved to the current data file. This section of the Main Window shows the name of the current output file for the results. The file name includes the full path to the file – if the result is too long to fit in the available space part of the path may be replaced by ellipses. In that case, simply hover the mouse over the file name and the complete path and name will be displayed in the "tool tip" which appears when hovering.

The Results Table

The Results Table lists all results currently stored in the data file. The table can be configured to your liking and the display can be manipulated in various ways. The Results Table contains the following:

The first column is grayed out and can not be edited. This contains the line number in the data file for each row/measurement. Note that even if the table is sorted, the data file contains the data in order of this line number.

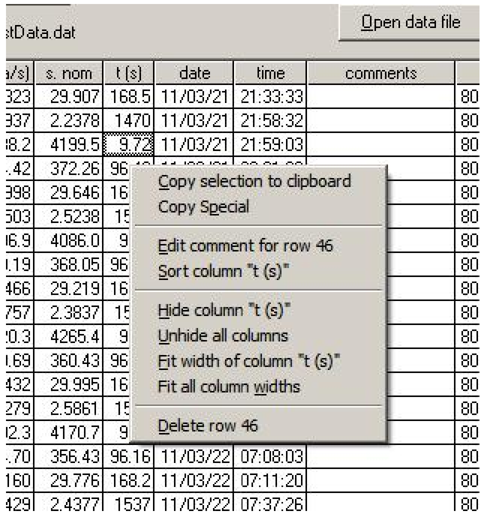
N	sequence number of the break
i	index of the break – when breaking multiple fibers this is the index of that break.
g	faceplate separation when the fiber breaks (µm)
d	distance between the axes of the two ends of the fiber at failure. For U-groove faceplates this is (g + groove depth – coating diameter) (µm)
e	failure strain (%)
s	failure stress (MPa)
v	faceplate speed at failure (µm/s)
e.	strain rate at failure, $d\varepsilon/dt$ (%/min)
s.	stress rate at failure, $d\sigma/dt$ (MPa/s)
s. nom	nominal stress rate, $d\sigma/dt$ (MPa/s), averaged over the top 20% of the stressing cycle (see the discussion on the ITM-13 standard)
t	time to failure; time from start of experiment to failure (s)
date	date at failure, format is year/month/day so that sorting in alphanumerically also sorts in date order
time	time at failure
comment	comments can be inserted in this column

df dc zo ga Eo Ea go/v start

This single column contains a variety of parameters that are not normally needed themselves for later data analysis. However, they are included because they are all parameters that might affect the results – they are included so you can check you used the right values for them. Their meaning:

df	fiber diameter (µm)
dc	coating diameter (µm)
zo	zero offset or groove depth (µm)
ga	groove angle
Eo	zero strain elastic modulus (72 GPa for silica)
Ea	first order strain correction to the elastic modulus (2.125 for silica)
go	gap origin – the faceplate separation when the experiment starts (the loading gap or the gap corresponding to the preload)
v	preload faceplate speed (µm/s); zero if no preloading
start	date and time the measurement is started

Results Table Actions



Several actions can be used to customize the data display, export the data or add comments. Many of these actions can be performed by right clicking anywhere in the table. The above context sensitive menu is shown. The contents of the menu depend on the cell that was right clicked on. Some of these actions can be performed in other ways, such as using the keyboard or the menu.

Sort data

Double click a column header to sort the table by that column. To sort descending, double click the column header again. Alternatively, right click anywhere in the column and select Sort column nnn. Repeat to sort descending. Sorting the date column co-sorts with the time column so that the results are sorted into strict chronological order.

Resize a column

Hover the mouse over the vertical bar on the right of the column title. When the mouse cursor turns into two vertical lines, the bar can be dragged to select any column width.

Resize one or all columns to fit

Right click anywhere in the column and select Fit width of column nnn and the column width will be set to a minimum that still makes all data in that column visible. Select Fit all column widths to perform the same action on all columns of the table.

Hide a column

Resize the column to its minimum width or right click in the column and select Hide column nnn.

Make all columns visible

To make all hidden columns visible, right click anywhere in the table and select Unhide all columns.

Select a block or column

To select a single column click in the column header.

To select multiple columns click in the left column header and drag the mouse and release it in the right column header (or *vice versa*).

Note: when a column or columns are selected, ***all*** cells in those columns are selected even if some rows are not visible because the table is scrolled.

Note: when multiple columns are selected, hidden columns between them are ***not*** selected.

To select a block of cells in the table click in one corner of the block, drag the mouse and release it in the opposite corner of the block.

Copy data to clipboard

The selected block or column of data can be copied to the clipboard by typing Ctrl-C, by right-clicking anywhere in the Results Table and selecting Copy selection to clipboard, or by clicking the Export data button (which opens the Export Data Window) and setting the data destination to the clipboard. For the first two methods the items within a selected row are separated by tab characters and rows are separated by new line characters (carriage returns). Any item, such as a comment, containing a space or comma is wrapped in double quotes. This format is suitable for immediately pasting into, *e.g.* Excel.

Copy Special

Selecting this item from the context sensitive menu or the Eport data menu item opens the Copy Special window. This can be used to quickly copy selected data to the clipboard in the selected order.

Add/edit comment

To add or edit a comment in a row, click in the comment cell and start typing or right click anywhere in the row and select Edit comment for row nn.

Delete row

A row can be deleted from the Results Table by right-clicking on the row and then selecting Delete row. Deleting data is not a great idea because all record of it is lost. It is better to add a comment to the row reminding you to ignore that measurement for data reduction. However, if you really want to delete a row you can, although you will need to click the appropriate buttons on two nagging dialogs before 2POINT will oblige!

Data File Functions

Open data file

Use this to change the file being used to save results. If the file does not exist already, a new one is created.

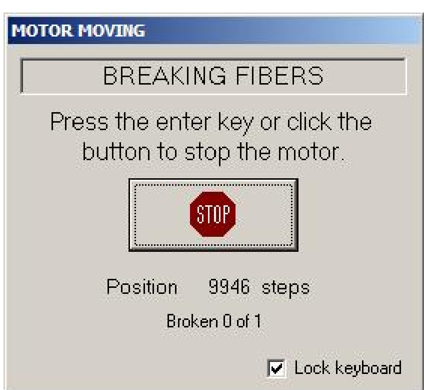
Save data file

Saves the contents of the current results to a file. That file becomes the new file for saving results.

Export data

Opens the Export Data Window.

The Motor Moving Window



Stopping the Motor

This window is shown whenever the motor is moving. It is also shown during a static fatigue experiment. The motor can be stopped by clicking on the stop button or by pressing any key on the keyboard.

If the Lock keyboard box is checked all keystrokes are ignored except the Enter key. The motor can only be stopped by clicking the stop button or pressing enter. This feature is useful for long duration experiments when it would be most inconvenient to accidentally interrupt a measurement.

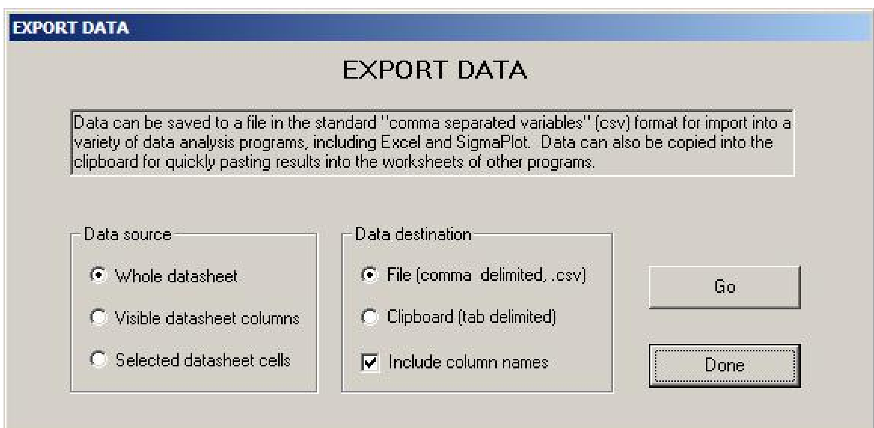
Whenever the motor is stopped in this way a dialogue asks you whether you really want to stop or whether you want to continue.

The motor movement can also be interrupted for 2POINT Pro by pressing the red “Stop Motor” button on the System Controller II.

Repositioning the Motor Moving Window

The window sometimes gets in the way since it hides parts of the main window. This can be particularly annoying when operating the equipment in Automatic Mode. The Motor Moving Window can be repositioned by clicking on its title bar and dragging. The window will remember this and reopen at the same position until either the 2POINT program is restarted or the window is dragged so that any part of it is outside the screen area. The window will then jump back to its default position centered in the main window.

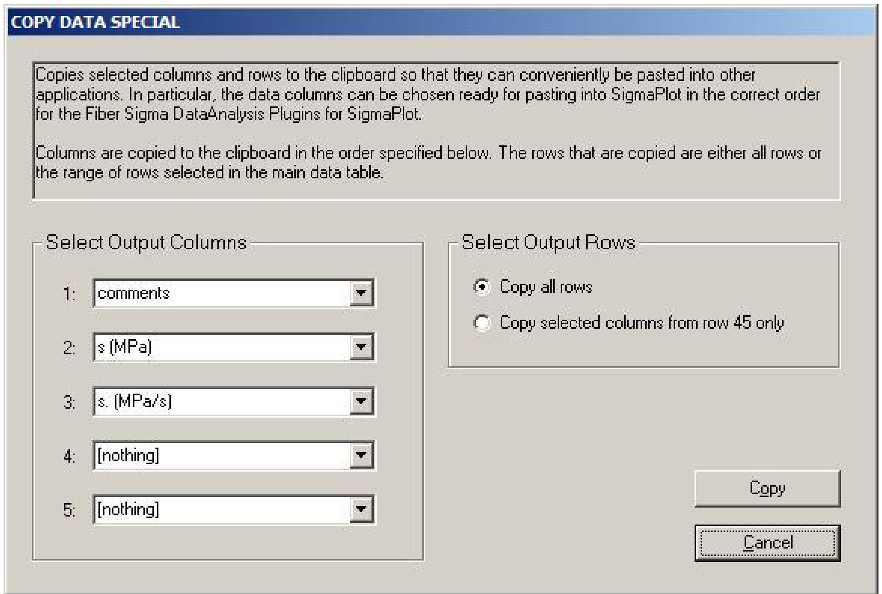
Export Data Window



This window permits results contained in the Results Table to be exported from the 2POINT program. The whole results sheet can be exported, or only the visible columns (*i.e.* all unhidden columns; columns that are scrolled outside the results box are considered visible), or cells that have been selected with the mouse. Output can either be sent to a comma delimited text file where each row of the results table is a line in the output file and each cell in a row is separated by commas. This is a standard format that can be recognized by and imported into many programs. Alternatively, the results can be placed in the clipboard, delimited by tabs characters between cells, and pasted directly into many applications, such as Excel or SigmaPlot. The column headers can be included in the output if Include column names is checked.

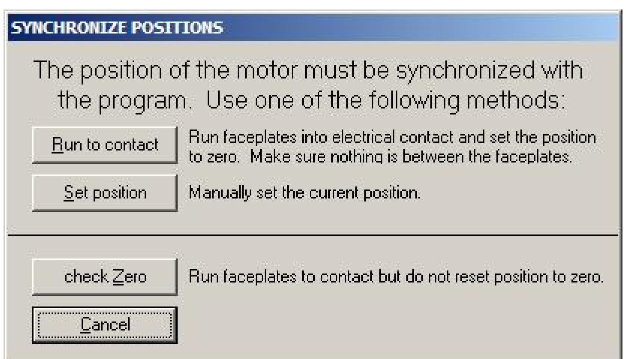
The same data export functions are available from the menu bar in the Main Window under Export data. Also right clicking anywhere in the results table brings up a context sensitive menu, one option of which copies the selected cells to the clipboard.

Copy Data Special Window



This window permits results contained in the Results Table to be copied to the clipboard in a user-defined order. Up to 5 columns of data in any order can be selected. The data are copied to the clipboard with each column separated by a tab character – this format is suitable for directly pasting into other applications such as Excell or SigmaPlot. This feature makes it fast and easy to export data directly to other applications. In paritcular, the column order shown above is suitable for pasting into SigmaPlot in the right order for manipulation by the Fiber Sigma Dynamic Fatigue or Weibull analysis Plugins for SigmaPlot.

Synchronize Positions Window



The position of the faceplates must be synchronized with the Bend System Controller and with the 2POINT software. This is normally done by moving the faceplates together until they are in electrical contact.

Warning: If the faceplates are run together but contact can not be detected, at best the faceplates could lose their alignment, at worst the support pates and/or faceplate could be damaged. To avoid these problems:

1. Always check that contact can be detected by the Bend Control Unit. To do this connect the faceplates together and make sure that the red contact LED illuminates in the Contact Detection section of the Bend System Controller.
2. Make sure that the faceplates are completely clean and that there is no debris between them. Do not use tissue to clean the faceplates since it can leave fibers behind. Experience shows that the best cleaning procedure is to gently wipe both faceplates with a clean "pinky" finger! If there is not enough space for your finger between the faceplates they can be opened by temporarily selecting local control on the Bend System Controller and using the open switch.

<u>S</u>et position

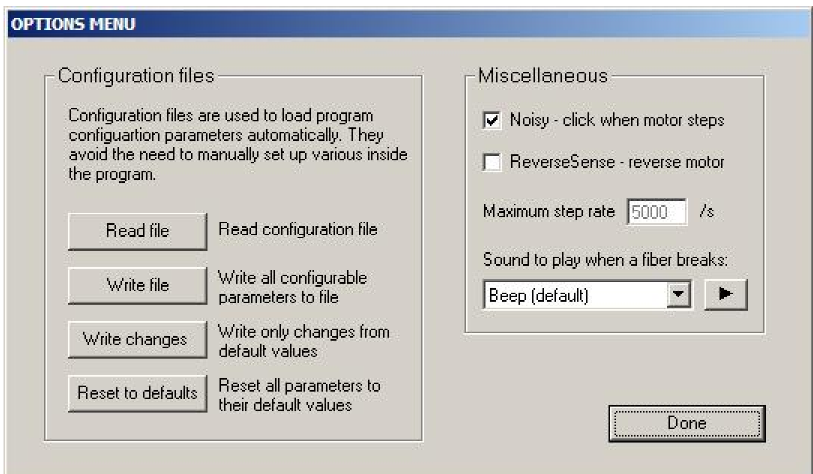
If the software is stopped it loses information on the faceplate position. If the position is known (the position displayed on the Bend System Controller is known to be correct) use this option to enter the current position of the faceplates.

check <u>Z</u>ero

It is good practice to check the zero position from time to time. Click this button to detect faceplate contact without forcing the position to read zero. Typically, the zero position drifts by a ***few*** microns. If the drift of more than about 5 µm the zero position should be reestablished by selecting Run to contact.

Note that the check Zero option is not available when the software starts. It is shown above grayed out. However, once a zero position has been established (by Run to contact or Set position) this button will be enabled.

Options Window



This window is used to set various options:

Configuration Files

Configuration files are plain text files that contain settings for various program parameters. Reading a configuration file will automatically set the values for the defined parameters. They can be used to quickly set several parameters at once. For example, you could create a file BARE.INI which should be read before using the polished faceplates for bare fibers. Such a file might contain:

```
GrooveDepth 0
CoatingDiameter 125
FiberDiameter 125
TestingCount 1
```

For V-groove faceplates:

```
GrooveDepth 1221
GrooveAngle 90
```

The configuration files can be constructed using a plain text editor such as NotePad. As a starting template, you can create a file containing all available configuration parameters using the write configuration file option. You can then delete irrelevant parameters and adjust others as necessary.

Configuration Parameters

The available configuration parameters are listed below, together with their default values. Note however, that many parameters are saved when the 2POINT program is closed.

`ExptType 0`	This parameter specifies what type of measurement should be made: 0 – constant faceplate speed 1 – constant stress rate 2 – constant strain rate 3 – constant stress (static fatigue)
`ExptSpeed 5000` `ExptSpeed 2000`	Specifies the faceplate speed in µm/s for a constant speed experiment. The default is 5000 µm/s for 2POINT Pro and 2000 µm/s for 2POINT Direct.
`ExptStressRate 60`	Specifies the stress rate in MPa/s for a constant stress rate experiment.
`ExptStrainRate 50`	Specifies the strain rate in %/min for a constant strain rate experiment.
`PreloadType 0`	Specifies how the preloading is defined: 0 – no preloading 1 – faceplate gap 2 – stress 3 – strain
`PreloadGap 0`	Specifies the preload faceplate gap in µm.
`PreloadStress 0`	Specifies the preload stress in MPa.
`PreloadStrain 0`	Specifies the preload strain in %.
`PreloadSpeedMode 0`	Specifies the speed at which the faceplates move to preload the fiber: 0 – maximum available faceplate speed 1 – 1000 µm/s, as specified by ITM-13 2 – user specified speed
`PreloadUserSpeed ?`	Specifies explicitly the speed to be used for preloading. It is used for `PreloadSpeedMode 2`. The default value is the maximum available speed (5000 µm/s for 2POINT Pro).
`LoadGap 10`	Specifies the faceplate gap for loading fibers in mm.
`GrooveAngle 180`	Specifies the included angle of the bottom of the grooves in grooved faceplates – use 180 for U-groove faceplates or 90 for "V"-groove faceplates.
`TestingCount 1`	Specifies how many specimens will be tested simultaneously.
`SpecimenCount 1`	Sets the index number of the next fiber to be broken.
`WaitBeforeBreak 0`	Not yet implemented.
`FiberDiameter 125`	Diameter of the fiber in µm. This is the diameter of the glass – it is the diameter at the position where the fracture initiates.
`CoatingDiameter 250`	Outer diameter of the fiber in µm. This is the coating diameter for a normal optical fiber. It should be set to the same value as `FiberDiameter` for bare fiber.
`Modulus 72`	Elastic modulus of the glass in the limit of zero strain in GPa. The value of 72 is appropriate for fused silica. See the Fiber Parameters section for more information.
`ModulusA 2.125`	This dimensionless parameters describes how the elastic modulus of the

fiber varies with strain. The value of 2.125 is appropriate for silica being deformed in bending. See the Fiber Parameters section for more information.

`GrooveDepth 0`	This is the total depth of both grooves. Grooved faceplates supplied by Fiber Sigma include a sheet detailing the combined groove depths.
`Noisy True`	If this option is checked, then the PC speaker (2POINT Direct) or System Controller II (2POINT Pro II) clicks when each step is taken by the motor. This provides auditory feedback on the progress of an experiment. If the clicking/buzzing is annoying, set this parameter to false.
`HiCurrRate 10`	When the translation stage is moved at a speed (µm/s) greater than the value defined by this parameter then the motor current is increased for the move. If the speed is less than this value, 2POINT will drop the current to the lower standby current to avoid heating effects in slow, long-duration tests. The motor current will only be low if the Motor Current switch on the Bend System Controller is set to remote.
`ReverseSense False`	Set to false for normal operation. When set to true the sense of the translation stage/motor rotation are reversed. This can be used if custom faceplates are mounted at the motor end of the translation stage instead of the other end. Note that the position displayed by the Bend System Controller will be the negative of the value shown by 2POINT.
`MaxStepRate 2000`	2POINT Direct only. This parameter specifies the maximum stepping rate of the motor in steps per second. If this value is set too high the stepper motor might not run smoothly. This parameter can be set higher on faster computers.

`CopySpecialColumn1`
`CopySpecialColumn2`
`CopySpecialColumn3`
`CopySpecialColumn4`
`CopySpecialColumn5`
	These parameters specify which main window data grid columns are copied to the clipboard in the Copy Data Special operation. The defaults are 14, 6, 9, 0, 0 – 0 corresponds to no selection.

`KeyBoardLocked False`	If set to true the lock keyboard option in the Motor Moving window is selected to reduce the chance of accidentally interrupting an experiment.
`RepeatSounds 0`	Normally when a break is detected 2POINT plays a sound to announce the occurrence. It does this only once if `RepeatSounds` is zero. However, if the value of is `RepeatSounds` is non-zero, the break sound is repeated after the specified number of seconds. Note that this can get annoying awfully fast!

Automatic Mode Parameters

`InsertLength 100`	Specifies how much fiber is fed into the faceplates using the Automatic Fiber Loader. See the section on the Automatic Mode Window for more information.
`SlackenLength 10`	After the Automatic Fiber Loader inserts fiber between the faceplate, the faceplates are brought together to a gap of 10 mm (20 mm for the wide loader option). A further length of fiber is then inserted which provides some slack so that as the faceplates come together to break the fiber, the fiber is not dragged on the corner of the left-hand faceplate. The `SlackenLength` parameter specifies how much extra fiber (mm) should be inserted for slackening. The default of 10 mm is suitable for the standard loader; approximately 15 to 20 mm might be needed for the wide loader.

This parameter can only be set using a configuration parameter file or in an Automatic Mode script. It is suggested that this parameter be specified in the header section of the script.

`AutoLoopCount 1` — Specifies how many times the program will loop through the sequence of measurements in the automatic mode. See the section on the Automatic Mode Window for more information.

`AutoLoopCount 1` — Specifies how many times the program will loop through the sequence of measurements in the automatic mode. See the section on the Automatic Mode Window for more information.

`AutoIndex 1` — Specifies the index (sequence number in the control scipt) for the next measurement. See the section on the Automatic Mode Window for more information.

`WideLoader False` — Set this parameter to True if the Wide Automatic Loader option is in use. It causes the fiber transport lengths to be adjusted correctly for this option. See the section on the Automatic Mode Window for more information.

`ExtraWideLoader False` — Set this parameter to True if the Extra Wide Automatic Loader option is in use. It causes the fiber transport lengths to be adjusted correctly for this option. See the section on the Automatic Mode Window for more information.

Email Configuration Parameters

`EmailSend False` — If set to true this parameter causes email messages to be sent when experiments end, on errors and periodically while in Automatic Mode.

`EmailSendEvery 0` — While in Automatic Mode, email messages are sent after this many breaks have been completed. Set to zero for no email messages.

`EmailSMTPServer ""` — Name of your SMTP (simple mail transfer protocol) server which you use for sending email.

`EmailUsername ""` — Your username for authentication on your SMTP server which you use for sending.

`EmailPassword ""` — Your password for authentication on your SMTP server which you use for sending. Note that your password is saved in an encrypted form so you can not specify the actual password using this parameter – only its encrypted form. The password should be specified unencrypted in the Email Configuration window.

`EmailSMTPPort 25` — Port to be used when accessing your SMTP server.

`EmailUseTLS False` — Specifies whether TLS (transport layer security) should be used when accessing your SMTP server.

`EmailFrom ""` — Specifies the email address that will be shown as the sender of the email. This can be a bare email address (such as `support@fibersigma.com`) or it can also contain a nickname:

"FS support" <support@fibersigma.com>

`EmailTo ""` — Specifies the email address to which status messages should be sent. As for `EmailFrom`, the address can be a bare address or can include a nickname. While the Email Configuration window permits multiple addresses to be specified, currently only a single address can be set using this parameter.

Configuration File Actions

Read file

A file containing configuration parameters can be read.

Write file

All configuration parameters can be written to a disc file.

Write changes

All configuration parameters that do not have their default value can be written to a disc file.

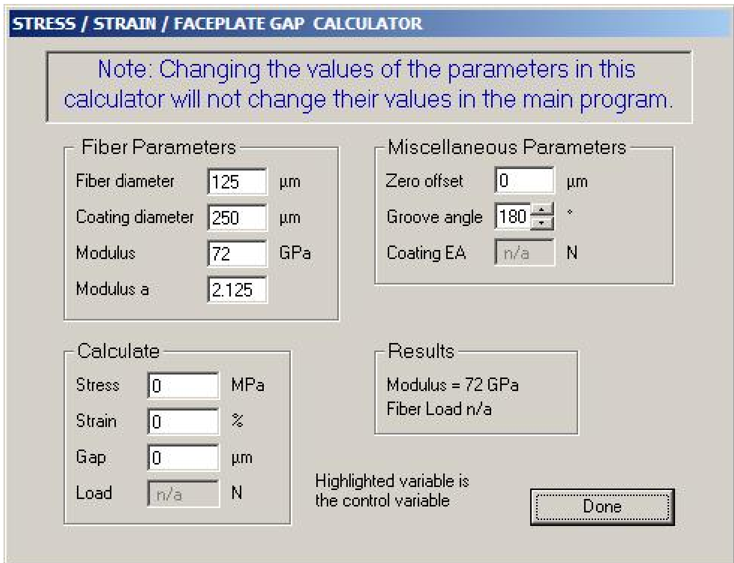
Reset to defaults

All configuration parameters are reset to their default values. This can significantly change the operation of the 2POINT program. It is advisable to stop and then restart the program after this action.

Miscellaneous Options

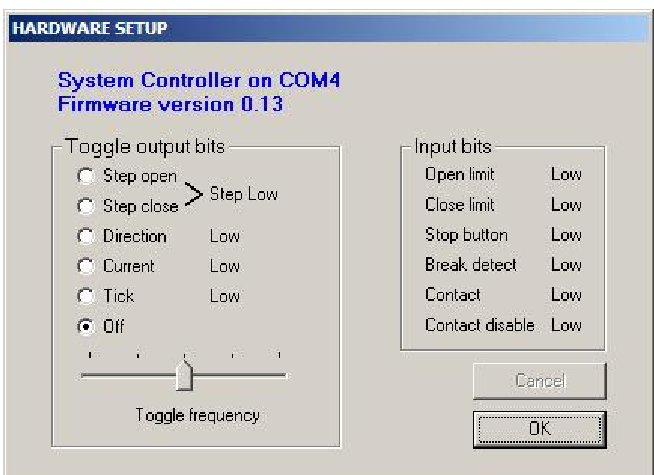
Noisy	If this option is checked, then the PC speaker (2POINT Direct) or System Controller II (2POINT Pro) clicks when each step is taken by the motor. This provides auditory feedback on the progress of an experiment. If the clicking/buzzing is annoying, clear this box.
ReverseSense reverse motor	When checked the sense of the translation stage/motor rotation are reversed. This can be used if custom faceplates are mounted at the motor end of the translation stage instead of the other end. Note that the position displayed by the Bend System Controller will be the negative of the value shown by 2POINT.
Maximum step rate	This parameter is available and only relevant for 2POINT Direct. It specifies the maximum step rate for the stepper motor. If the PC is too slow then the stepper motor movement might be uneven and “lumpy”. If this is the case, reduce this value – see the Troubleshooting section for more information.
Sound to play when fiber breaks	A custom sound can be played when a fiber breaks. Select the sound file from the drop-down list. Click the button to the right to play the selected sound. The sound files can be found in the Sounds folder in the program folder (C:\Program Files\FiberSigma\2POINT Pro or C:\Program Files\FiberSigma\2POINT Direct by default). If you want to use you own sound file it must be a wave file (.WAV). Copy the file to the Sounds folder and it will be available for selection.

Calculator



A calculator is built into the program for making a variety of calculations for two-point bending. Set the fiber and miscellaneous parameters appropriately and then enter one of the three parameters, stress, strain, or faceplate gap. The other two parameters will then be calculated. Note the dependent parameter will be highlighted in yellow. The calculator is useful, for example, when planning static fatigue experiments, checking results, *etc.*

Hardware Setup Window



This window is useful for checking the operation of the two-point bend interface electronics. The apparatus is controlled by several digital input and output lines (either directly from the parallel printer port for 2POINT Direct or from the controller for 2POINT Pro). Output bits can be toggled:

Step open — the position counter should count up

Step close — the position counter should count down

Direction — should have no noticeable effect

Current — the current high LED on the Bend System Controller should blink on and off (make sure the motor current selector switch is set to “remote”)

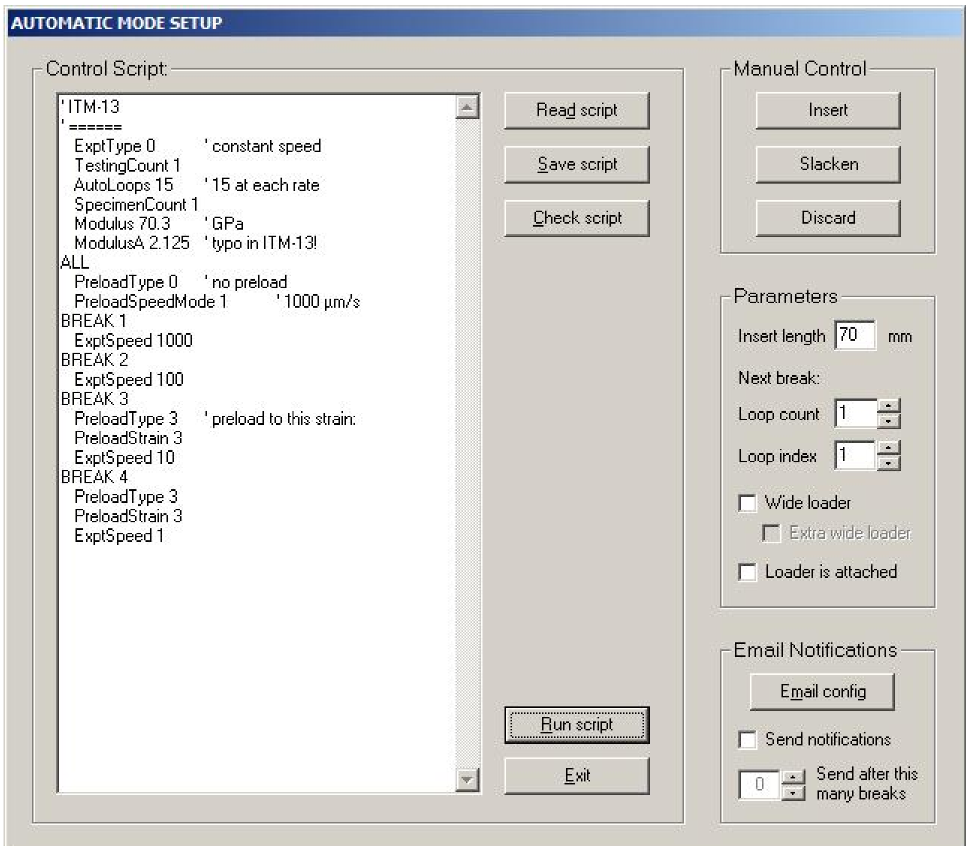
Tick — auses the speaker in the System Controller II to tick

The status of the input bits can be monitored:

Open limit — is high when either the open limit is active or the Bend System Controller is in local mode

Close limit	is high when either the close limit is active or the Bend System Controller is in local mode
Stop button	shows the state of the red emergency stop button on the System Controller front panel
Break detect	is high when the break detection circuitry is active – tap the sensor to check operation
Contact	is high when the faceplates are in electrical contact and the contact disable switch is ***not*** at “disable”
Contact disable	is high when the contact disable switch is at “disable”

Automatic Mode Window



This window set parameters for using the Automatic Fiber Loader, permits testing of the loader and starts an experiment under automatic control. See the Automatic Mode section for more information.

Control Script

The editable window contains a script which is used to control the Automatic Mode. You can edit the script by typing, copying, cutting and pasting using the standard keyboard sequences. Blank lines, text preceded by a single quote (') or semi-colon (;) are treated as comments and are ignored. The case of letters does not matter. Leading white space is ignored. In the example above, upper case letters and leading spaces are used for clarity.

Read script, Save script

The contents of the script window can be read from a file or saved to a file.

Check script

The contents of the script window are checked for any errors, such as unrecognized parameters names or invalid parameter values. If an error is found, checking stops and the offending line is highlighted ready for editing.

Run script

Starts an Automatic Mode experiment controlled by the displayed script. However, before execution, the script is checked so don't worry if it has an error – you are required to fix all errors before automatic mode proceeds.

Manual Control

The three buttons permit manual operation of the Automatic Fiber Loader. Use with caution since feeding excess fiber might cause a tangle.

Insert length

Defines the length of fiber to be inserted between the faceplates by the Automatic Fiber Loader. (Can be defined using the `InsertLength` configuration parameter.)

Loop count and Index Count

Defines the number of times the automatic control cycles through the sequence of measurements. (Can be defined using the `AutoLoops` and `LoopIndex` configuration parameters.)

Wide loader

When checked the program is configured to operate with the Wide Automatic Loader option that is used for thicker fibers. When the wide loader option is checked, the extra wide loader option can also be checked. (Can be defined using the `WideLoader` and `ExtraWideLoader` configuration parameters.)

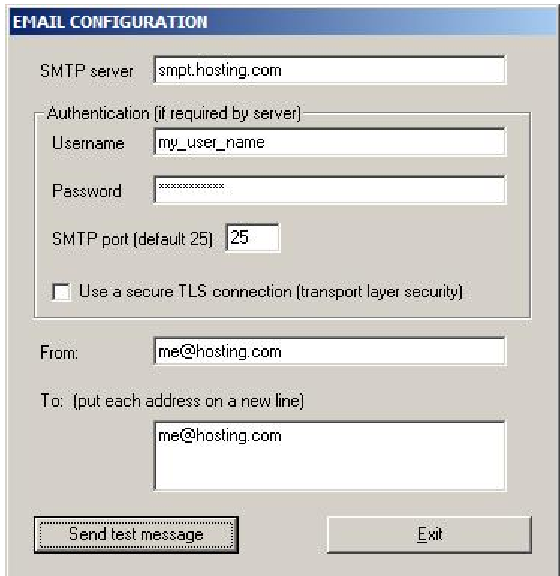
Loader is attached

Automatic mode is primarily designed for use with the automatic fiber loader. However, it can also be used when no load is attached to set the various test parameters automatically. It is then only necessary for the user to manually insert the fiber(s) into the faceplates. (Can be defined using the `LoaderAttached` configuration parameter.)

Email notifications

Automatic mode can be monitored remotely by sending email messages with status information. Messages are sent when a measurement is finished and can optionally be sent after the specified number of the specified number of breaks. This behavior can also be defined by the `EmailSend` and `EmailSendEvery` configuration parameters. Click the Email config button to open the Email Configuration window.

Email Configuration Window



This window is used to configure the various parameters needed to send email notifications while in automatic mode. Note that messages can be sent to multiple recipients. If you are not sure what to use for these parameters, check your email program (which will already be set for sending mail in the same way) or with your IT support department. `EmailSMTPServer`, `EmailUsername`, `EmailPassword`, `EmailSMTPPort`, `EmailUseTLS`, `EmailFrom`, and `EmailTo` configuration parameters. See the Automatic Mode section for more information.

Automatic Mode

The two-point bend apparatus can be run automatically without operator intervention using the Automatic Fiber Loader. Refer to the printed manual for the loader for information on the mechanical setup. Note that single V-groove faceplates are used with the loader. The correct parameters should be set in the Experiment Parameters section of the Main Window including the groove depth and the groove angle (90° for the V-groove faceplates). The faceplate loading gap should be set to 18 to 20 mm for the standard loader or 40 mm for the wide loader option or 60 mm for the extra wide loader. The testing count should be set to one. If any of these parameters do not have their required value, the program will ask if you want it to set the parameters appropriately.

The automatic mode is controlled by a script which can be viewed and edited in the Automatic Mode Window. The script contains a sequence of configuration parameters which are implemented between each measurement. The form of the script file is best described by example. The Loader subfolder of the program folder contains sample scripts that can be used directly or edited for your particular application. One file is called “ITM-13.LDR” and contains a script for measurements compliant with ITM-13:

```
'ITM-13
'======
   ExptType 0            ' constant speed
   TestingCount 1
   AutoLoops 15          ' 15 at each rate
   SpecimenCount 1
   Modulus 70.3          ' GPa
   ModulusA 2.125        ' typo in ITM-13!
ALL
   PreloadType 0         ' no preload
   PreloadSpeedMode 1    ' 1000 µm/s
```

```
BREAK 1
   ExptSpeed 1000
BREAK 2
   ExptSpeed 100
BREAK 3
   PreloadType 3         ' preload to this strain:
   PreloadStrain 3
   ExptSpeed 10
BREAK 4
   PreloadType 3
   PreloadStrain 3
   ExptSpeed 1
```

The script contains several blocks of configuration parameters.

The Header Block

The header block starts at the beginning of the script and continues up until the first "ALL" or "BREAK" label. In the example above, the header block starts with the comment `'ITM-13` and ends with the parameter `ModulusA 2.125`. The header block is read once at the start of an automatic experiment. It should be used for setting up global parameters that do not change from one measurement to the next.

The ALL Block

The ALL block starts with a line starting with "ALL" and continues until a BREAK block of the end of the script. In the above example the ALL block contains the parameters `PreloadType 0` (no preloading) and `PreloadSpeedMode 1` (if preloading, use a faceplate speed of 1000 µm/s). The ALL block may be placed anywhere in the script after the header block; immediately after the header is a good position for readability. The ALL block is optional and can be omitted. If more than one ALL block is in the script all but the first one are ignored.

The ALL block is read before each measurement is made and is used to reset parameters that might have been changed by individual measurements. In the example, `PreloadType 0` is used to reset preloading to "none" which is the default setting for ITM-13 measurements. However, it is changed for some of the measurements so the ALL block sets it back to the default before the next measurement.

The BREAK Blocks

The script must contain one or more BREAK blocks. A BREAK block starts with a line starting with "BREAK" and continues until an ALL block, or a BREAK block or the end of the script is encountered. A BREAK block is read before a measurement is made. For each pass through the script each BREAK block is read in turn and a measurement made. The BREAK blocks are read in the order in which they appear in the script (notwithstanding the numbers after "BREAK" in the example). The automatic sequencing then repeats `AutoLoops` times, as specified by the `AutoLoops` parameter or in the text box in the Automatic Mode Window. So, the automatic sequencing performs actions in the following order:

read Header block
<top>
read ALL block
read first BREAK block then break a fiber
read ALL block
read second BREAK block then break a fiber
read ALL block
read third BREAK block then break a fiber
…..
…..
read ALL block

read last BREAK block then break a fiber
go back to <top> repeating a total of `AutoLoops` times.

The example script above therefore sets the appropriate parameters for ITM-13 measurements in the header block. It then makes strength measurements at constant faceplate speeds (`ExptType 0`) of 1000, 100, 10 and 1 µm/s. The two slower speeds are preloaded to a strain (`PreloadType 3`) of 3% (`PreloadStrain 3`). Preloading is done at a faceplate speed of 1000 µm/s (`PreloadSpeedType 1` in the ALL block). The four measurements are repeated a total of 15 times (`AutoLoops 15` in the header block) giving a total of 60 measurements!

So, the operator just needs to insert the end of the fiber into the loader and click the Run script button. S/he can then get a coffee, have a chat with colleagues and later come back to retrieve all 60 measurements from the Results Table. Not bad! Of course, automatic mode can be left running overnight so that the equipment can in principal be in use 24 hours a day, every day!

Notes

Letter Case: the case of letters in the script is not significant. ALL and BREAK have been capitalized in the example for clarity.

Comments: blank lines and any text after single quote and semicolon are ignored and are used as comments. Any text after the BREAK and ALL tags is also ignored and may be used for comments. Leading spaces are ignored and the indentation in the above example is used for clarity.

Stopping Automatic Mode: Automatic mode can be interrupted by clicking the Stop button in the Motor Moving window or pressing any key. If automatic mode is restarted after being interrupted you are asked if you want to continue the previous sequence or start again from the beginning of the script. Automatic mode will also stop if an error is detected. For example, if no break is detected in the loading sequence (perhaps due to running out of fiber or a fiber jam) automatic mode is stopped. While automatic load is running everything in the Main Window but one button is disabled so that you can not change any parameters "under the feet" of the automatic mode sequencing. If automatic mode is interrupted the Main Window might be left in the disabled state. This can be remedied by clicking the Stop auto mode button.

Status: status information is displayed in the status bar at the bottom of the Main Window. Information includes what the automatic loader is doing and the progress through the sequence; current loop number and current BREAK block number.

Systematic *vs.* Random Error: The example script is a particularly good way to make a fatigue measurement. Cycling through the loading rates, rather than making all the faster measurements, than the next fastest and so on until the slowest, avoids introducing systematic error that are hard or impossible to detect and assess. If the testing environment varies during the test the resulting variation in strength will be distributed amongst the various loading rates, increasing the scatter and so increasing the confidence interval in the fatigue parameter, n. In contrast, if the measurements at different speeds are grouped together, variations in the environment will produce systematic changes in the apparent variation of strength with rate, so giving erroneous and misleading results for n. It is always better to make the influence of some unwanted parameter a random factor, rather than a systematic factor, since it can, to some extent, be removed by averaging.

"Manual" Automatic Mode

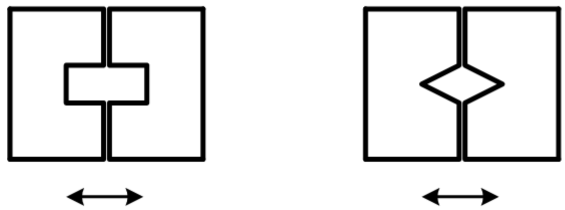
The automatic mode is very useful for setting the testing parameters appropriate to each measurement rate. It is better to interleave measurements at different speeds in order to randomize the effect of drift in the testing environment. If you do not have an automatic loader you can still make use of the automatic mode. Just uncheck the `Loader connected` box in the Automatic Mode window. The script will be used to specify the measurements and you will be prompted to load new fiber(s) at the appropriate time.

Miscellaneous Topics

Following are miscellaneous help topics that are accessed by the 2POINT program by pressing F1, the help key.

Groove Depth

The groove depth is the total depth of both grooves. It is the gap between the faceplates where the fiber is gripped when the faceplates are in contact. The depth is the whole depth whether using U- or V-groove faceplates:



Calibration

The only calibration necessary on the two-point bend system is setting the faceplate zero position where the faceplates are in electrical contact. This should be checked at least daily when in use or more often if drift in the position is noticed. Also, if the position shown by the computer and the Bend System Controller differ, zeroing should be repeated to determine which is correct. The zero position should be repeatable to within about 5 µm over a period of hours in a thermal stable environment. ***Note*** that it is ***very important*** to open the faceplates and clean any dust or debris off them before attempting to check the zero position.

No other calibration is necessary since the system is operated by a stepper motor which is digital and not subject to error or drift in position other than the step size which is 1 µm.

The two-point bend tester uses a precision lead screw with a precise thread spacing. It is driven by a stepper motor giving overall one micron movement per step. For positional *changes* the precision is good to a step or two (mostly "torque error" if the motor is under load). The motion does not need calibration because positioning is digital and deterministic. Most error is associated with determining the zero position which is found by faceplate contact. This depends on the faceplate alignment and on taking the zero position. Once the faceplates are fixed, the zero position should be checked at least daily and more often if there is significant drift in the zero. The ***apparent*** zero position can be changed by debris on the faceplates so they must be cleaned carefully.

Standard Test Procedures

The 2POINT Bend Apparatus is designed to be compliant with standard testing techniques. This section provides information on the two most well known standards. Please let us know if you use other standards and need features added to the 2POINT software.

TIA/EIA TSB62-13 (ITM-13)

ITM-13 “Measuring dynamic strength and fatigue parameters of optical fibers by two-point bending” is widely used in the USA. It is an “informative” document, not formal standard and so only makes suggestions on how measurements should be made. There follows a summary of the main requirements and how they can be implemented by the 2POINT software:

1. **Loading Rates**. ITM-13 suggests using the constant faceplate mode although constant strain rate or constant stress rate modes are permitted. A faceplate speed of 100 µm/s should be used for strength measurements and speeds of 1, 10, 100 and 1000 µm/s should be used for dynamic fatigue measurements. The speeds should be accurate to within 10%; the Fiber Sigma equipment controls the speed to better than 0.1%. See loading rate parameters section of the Main Window.

2. **Preloading**. At slower loading rates the fibers may be preloaded at a speed of 1000 µm/s up to about 50% of the failure strain. The 2POINT software implements three preloading modes with a user selectable faceplate speed for the preload. See the Preload Parameters section of the Main Window.

3. **Break Detection**. ITM-13 suggests three methods for break detection. The Fiber Sigma equipment uses the first method – acoustic emission. The other two techniques (force measurement or optical transmission) can be implemented by building suitable signal conditioning equipment which provides a TTL 5V pulse when the fiber breaks. This signal should be connected to the "external" BNC connector on the Bend Control Unit.

4. **Fiber Insertion**. The fiber should be loaded between the faceplates with a separation of 10 to 15 mm, including the groove depths. Both the faceplate loading gap and the groove depth can be specified in the Experiment Parameters section of the Main Window.

5. **Stress Rate Characterization**. For fatigue measurements the stress rate used for calculations is defined as the average loading rate as the applied stress increases from 80% to 100% of the failure stress. In my opinion this is an odd choice since for a constant faceplate speed measurement the actual stress varies continuously over the loading cycle. This average stress rate can be shown to be approximately 80% of the instantaneous stress rate at failure (the approximation is good – the relationship is not exact because for the strain dependence of elastic modulus). A simpler method is to calculate the stress corrosion parameter from the faceplate speed. However, the Results Table lists all three parameters; faceplate speed, "v", instantaneous stress rate at failure, "s.", and the nominal or average stress rate required for ITM-13, "s. nom". It may be shown mathematically that any of the three measures of rate give essentially the same value for *n* provided the appropriate equation is used to relate *n* to the slope of the dynamic fatigue plot.

6. **Zero Position**. The zero position should be repeatable to ± 5 µm. See the Set Zero Position Window for information on setting the zero position. If the faceplates are carefully cleaned and aligned, 5 µm repeatability is easily achieved.

7. **Fiber Elastic Modulus**. The failure stress is calculated from the faceplate separation at failure using an equation that involves the elastic modulus of the glass. The Young's modulus is "typically" 70.3 GPa for silica. The strain dependence of the elastic modulus should also be taken into account. ITM-13 specifies a correction factor of 1.125. However, this must be a typographical error because it is well known that this value should be 2.125 (see reference 1). The elastic modulus and strain dependence parameter can be specified in the Fiber Parameters section of the Main Window.

A suitable script file for use with the Automatic Loader, "ITM-13.LDR," can be found in the "Loader" subfolder of the 2POINT program folder (usually "C:\Program Files\FiberSigma\2POINT Pro" or "C:\Program Files\FiberSigma\2POINT Direct").

IEC 60793-1-33

The European specification, IEC 60793-1-33 "Measurement methods and test procedures – stress corrosion susceptibility," contains instructions for making both static and dynamic fatigue measurements in two-point bending.

Annex B: Dynamic *n* value by two-point bending

The specification is very similar to the ITM-13 requirements with the following differences:

1. **Preloading**. At slower faceplate speeds the fiber can be preloaded to less than or equal to 80% (*c.f.* 50% for ITM-13) of the lowest failure stress found for fibers at the next highest rate. The faceplate speed for preloading should be the next highest loading rate (*c.f.* 1000 µm/s for ITM-13). For example, for a faceplate speed of 1 µm/s, the preloading speed should be set to 10 µm/s. See the Preload Parameters section of the Main Window.

2. **Fiber Elastic Modulus**. The failure stress is calculated from the faceplate separation at failure using an equation that involves the elastic modulus of the glass. The Young's modulus is 72 GPa for silica (*c.f.*

70.3 for ITM-13). The strain dependence of the elastic modulus should be 2.125 (*c.f.* the erroneous value of 1.125 in ITM-13) (see reference 1). The elastic modulus and strain dependence parameter can be specified in the Fiber Parameters section of the Main Window.

A suitable script file for use with the Automatic Loader, "IEC60793.LDR," can be found in the "Loader" subfolder of the 2POINT program folder (usually "C:\Program Files\FiberSigma\2POINT Pro" or "C:\Program Files\FiberSigma\2POINT Direct").

Annex D: Static *n* value by two-point bending

Static fatigue measurements in bending normally involve long experimental durations and so it is not normally suitable to use the two-point bending equipment. Fiber Sigma can supply equipment specifically for making these measurements. However, the two-point bend strength measurement equipment can be used in a static fatigue mode and can make measurements compliant with IEC 60793-1-33.

1. **Fiber Loading**. IEC 60793-1-33 suggests using either parallel grooved plates or precision bore tubes for placing the fiber under a bending stress. The faceplates used with the two-point bending equipment satisfy the first method.
2. **Fiber Fracture Detection**. The requirement of measuring the time to failure within 1% is readily satisfied since the resolution of the 2POINT software is better than 1 ms! The precision is limited by the PC's system clock.

Troubleshooting

This section lists some common problems encountered by users, and how to overcome them. If you have any suggestions for this section, we will be glad to include them. The following topics are addressed:

Problems with Installation

Symptoms: Running the Setup program sometimes causes Windows to crash or the installation fails.

Cause: Setup attempts to update some system files making some other system files incompatible.

Solution: Run Windows Update to get all the latest patches and fixes. Then run Setup.

Unreliable and Variable Zero Position

Symptom: When checking the zero position by running the faceplates to contact, the position readout is variable and/or deviates significantly from zero.

Cause: Usually caused by dirt on the faceplates.

Solution: Thoroughly clean the faceplates and reestablish a reliable zero position that only varies by a few microns.

The faceplates must be extremely clean and dry before attempting to find the zero position. If you take a zero when there is a fragment on one faceplate, that fragment can become strongly adhering. So, first I suggest you wipe the faceplates with a cotton bud soaked in alcohol or acetone to loosen any debris. In particular, coating material can adhere to the faceplates quite strongly and the solvent breaks that adhesion. Then brush the faceplates with the small brush included in the parts box. The brush does not do a good job of completely removing debris but does loosen it. Finally, wipe the faceplates with a clean finger! Wipe gently to avoid scraping off skin cells. A clean finger does a very good job of picking up particles, perhaps because they are caught within the finger print skin ridges. Cloth or tissues are ***not*** good for the final clean since they tend to leave behind lint or fibers.

Once you have the faceplates clean, you should not need to use the solvent on a regular basis - just a brush and finger. When you check the zero position, use the "Check zero" option repeatedly. If the zero position jumps around by more than one or two microns, there is definitely debris on the faceplates. Then check the zero every ten or so measurements (check the zero, not actually set it unless you are really sure that it has changed). If things behave properly you can check the zero less frequently. However, I check it at least once a day and after each batch of measurements. The zero might move around by 5 microns or so over a day, but if it is 10 or more microns out, then the faceplates need better cleaning. Often the drift in the zero over the course of the day is not real – it can be caused by thermal changes or by roughness developing on the faceplates caused by impact of debris when the fibers break. If the zero position is only a few microns out, ***do not*** reset the zero position – it will probably drift back towards a zero readout later.

Another thing you can do is move the faceplates to the contact position then shine a very bright light on one side of the faceplates and view from the other. If clean and aligned, no light will pass between the faceplates. If misaligned you will see a gap at one end or at one corner. If there is dirt you will see a uniform gap but with one spot that is dark.

First always use "check zero" rather than "run to zero". You should not need to actually reset the zero - just check that it has not moved much. Sometimes I find the zero off by, say, minus 15 microns so reset the zero. Then, perhaps the next day, the zero is suddenly at plus 15 microns! This is clearly caused by a piece of dirt. If the zero is reset then all measurements during that period will be wrong by 15 microns.

Another problem you might see sometimes is that the position in the 2POINT program differs a little from the position displayed by the stepper motor controller. This is caused by external interference - for example when some very high power piece of equipment is turned on and off such as a big motor or air conditioner. Also, some equipment can put noise on the AC power supply. If you suspect this then connect the two-point bend system to the AC via a good quality battery backup power supply. The cheaper units pass AC power to the equipment, except when there is a failure when it generates the AC from the battery. A better solution is the kind of backup unit that always provides power to your instrument from the battery, and uses the AC supply to continually recharge the battery - this type does a much better job of removing spikes and noise from the power lines.

Problems Registering the 2POINT Software

Symptom: The registration procedure fails with a message such as invalid license.

Cause: Confusion about the meaning of the various codes used in the registration procedure.

Solution: The three different codes encountered in the registration process all look the same – they each consist of a string of eight letters or numbers. The case of the letters in unimportant although the software displays them in upper case. The three codes are:

1. The “license number” provided by Fiber Sigma: you can find this on a label inside the front cover of the manual or on the software CD or it might have been provided by Fiber Sigma via e-mail – contact us if you can not locate it. This license number permits the 2POINT software to be installed on a limited number of computers. The license if for a particular customer to use the software with a single two-point bend instrument. That software can be installed on a limited number of machines.

2. The “installation ID”. This code is generated by the 2POINT program after it has been given the license number. The installation ID is generated from both the license number and some information on the PC that uniquely identifies that PC (the information is not private and is related to hardware serial number codes). The installation ID is unique to that PC and will not permit the 2POINT software to be activated on any other PC.

3. The “activation key”. This key is generated by the on-line license server. The license server first checks that you have provided a valid license number. It then checks whether the installation ID has been used before – if it has it provides the activation key. If it has not seen that installation ID it means you are installing 2POINT on a PC for the first time. The license server then checks that you have not exceeded the permitted number of installations, and if you have not, it provides the activation key. The activation key is unique to the PC that generated the installation ID – it will not activate 2POINT on any other computer.

The activation key is then given to 2POINT. 2POINT checks that the activation key is consistent with both the license number and the installation ID. If it is, 2POINT is activated and the licensing process does not need to be repeated again. Note that installing a newer version of 2POINT on a PC that has already been activated, does not need to be activated again.

The activation process will be described for the manual mode of activation which makes the steps clearer:

1. You give 2POINT the license number. It generates the installation ID unique to that PC.
2. You give the license server at www.fibersigma.com/activate.html both the license number and the installation ID. After checking the validity of the license number, the server gives you the activation key.
3. You give 2POINT the activation key and 2POINT unlocks itself so that it can bypass the activation process each time it is run.

This is a somewhat onerous procedure, but one which should only need to be performed once. It has advantages for us:

1. It permits us to make the fully functioning trial version freely available for download for anyone.
2. It protects our intellectual property and investment bound up in the development of 2POINT for Windows – it was a long task!

We did not develop the licensing system on a whim. It was provoked when some of our software was bootlegged and used by several people who simply had to no right to use it – they then distributed it to some of their colleagues. When you consider the large effort required to develop our software, and divide that by the small number of people who use these very specialized tools, I hope you agree that the licenses are very reasonably priced?

Missed Breaks

Symptom: When making a measurement the fiber(s) break but one or more breaks are not detected.

Cause: Missed breaks can be caused by several things.

Solution: Consider some of the following:

1. Increase the sensitivity of the break detection system by rotating the sensitivity control in a clockwise direction. If you turn it too far the red LED will illuminate continuously. Rotate the knob counterclockwise until the LED goes out. If the sensitivity is set too high false breaks might be detected when the motor starts moving. In that case rotate the knob a little more counterclockwise.
2. Make sure that the acoustic sensor is solidly attached to the mounting plate with its ceramic face flat against the side of the mounting plate. Use a little grease between the two to improve acoustic coupling. There are too mounting positions available for the sensor – use the one nearer the faceplate.
3. For weak fibers tested in air the acoustic signal is very weak. It might be necessary to attach the sensor directly on the faceplate.
4. If the acoustic signal is still too weak to be detected then the break can be signaled manually. Set the break detection selection switch to "external." When you observe a break short circuit the "external" BNC to signal to 2POINT that a break is detected.
5. If using constant stress or constant strain loading rates, or using the preload option, a fiber might break before the faceplates reach the start position for the specified loading rate. The software does not look for breaks until the specified loading rate is started. To avoid this problem, do not use such high stress or strain rates and do not preload to such a high stress.
6. When testing multiple specimens the acoustic signals used to detect the breaks might overlap if fibers are breaking at similar times. This will occur when testing too many specimens for the testing speed. The problem is solved by simply testing fewer specimens at that speed. As a rough guide, no more than

one fiber should be tested at a time for faceplate speeds above about 100 µm/s, 2 above 10 µm/s or 5 above 1 µm/s. Note: if is not wise to test more fibers that you need and then simply take the detected breaks since this will cause some bias in the results. For example, if two specimens are tested simultaneously and most of the time only one is detected, you are systematically getting measuring the strength of the weaker of each pair of specimens.

Unable to Set Zero Position Due to Limits

Symptom: The closed limit light illuminates while attempting to set the faceplate zero position and the faceplates for not come into contact.

Cause: The faceplates have been improperly installed – one pair of faceplates has been replaced by a thinner pair. As a result the hard limit is encountered before the faceplates are in contact.

Solution: Faceplates must be installed using the instructions in the printed manual. The support plates should be repositioned so that contact is detected before the hard limit. However, the support plates should be positioned so that the limits are encountered only a couple of hundred microns beyond contact. This is a safety feature so that if contact detection fails, the faceplates and support plates are not pushed out of alignment or damaged.

Missing Features and Known Bugs

Missing Features

Automatic zero after each break; faceplate cleaning gap.
Automated updating of System Controller II firmware (2POINT Pro II).
Wait before break.

Known Bugs

Please report any bugs, errors, spelling mistakes, undesirable behaviors or nasty "features"! Please also suggest any way in which the software can be improved. Send reports and suggestions to support@fibersigma.com.

References

1. W. Griffioen, "Effect of nonlinear elasticity on measured fatigue data and lifetime estimations of optical fibers" *J. Am. Ceram. Soc.* **75** [10] 2692-2696 (1992).

History

Version 2.00d

- Work around for Microsoft component bug - 2POINT now works with Window 10.

Version 2.00

- First version supporting the newly designed System Controller II.