

PTR-200-MRL

Operator's Manual

Version 2.2

This manual is currently being reviewed. An updated version in Thorlabs' template will be available in the coming weeks. Please refer to the website for the most up-to-date specifications.



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1 Introduction

The PTR-200-MRL is a combination optical fiber recoater and proof tester/tension tester that provides a convenient, portable unit. The recoat station applies a flexible UV acrylate coating to a fusion spliced section of fiber, while the proof test/tension test station ensures that a fiber or fusion splice meets a minimum strength requirement.

1.1 Accessories Parts Checklist

When unpacking the PTR-200 for the first time, check to make sure that you have the following:

- PTR-200-MRL Proof Tester / Recoater
- 12.5V Power Supply
- AC power cord
- DC power cable
- RS-232 communication cable
- Tool kit containing:
 - UV curable acrylate
 - Cotton swabs
 - Lens tissue
 - Quartz mold cleaning brush
 - Injection syringes and caps (for units without automatic or manual injection)
 - 5/64" Allen wrench
 - 3/32" Allen wrench
 - 0.035" Allen wrench
 - Two (2) replacement UV lamps
- Display controller options:
 - VYT-200C-MRL Integrated Module Controller
 - PTR-200-CX-MRL Handset Controller
 - MCM-200-MRL Mini Controller

If you are missing any of the above or need replacements, please contact Vytran.

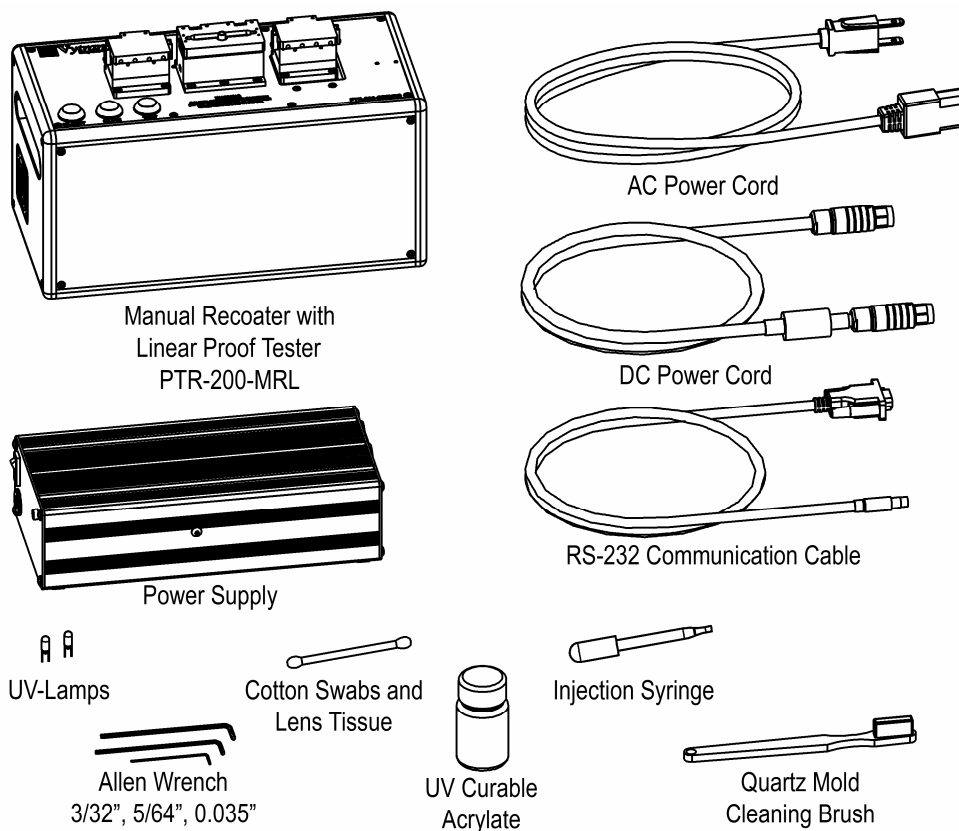


Figure 1: System Components

1.2 Setting Up the PTR-200-MRL

1. Connect the DC power cable from the "DC Out" connector on the power supply to the connector labeled "POWER 12.5V" on the back of the PTR-200-MRL. Plug the power supply into an AC source of 85-264 volts, 47-63 Hertz, using the power cord provided.
2. Determine which display controller option is provided and proceed to the appropriate section of chapter 2 for further set-up.

2 Controlling the PTR-200

The PTR-200-MRL can be operated using either the three (3) buttons on the unit, or via a display controller.

There are three (3) options of display controllers:

- an Integrated Module Controller (VYT-200C) that provides system status, programming and servicing capabilities. The Integrated Module Controller attaches to the back of the PTR-200 and incorporates a touch screen display for easy parameter set-up and machine service.
- a Handset Controller (PTR-200-Cx) that can be used to control the PTR-200 in place of an Integrated Module Controller, or to reprogram process parameters stored in a Mini Controller. The Handset Controller is a convenient option for temporarily connecting to a PTR-200 or Mini Controller for service or parameter changes.
- a Mini Controller (MCM-200) that provides system status only. The Mini Controller is a common option for repetitive production applications where the operator does not need to change process parameters. A Mini Controller can not be used to set-up or service a PTR-200, and can only be re-programmed with an Integrated Module Controller or a Handset Controller.

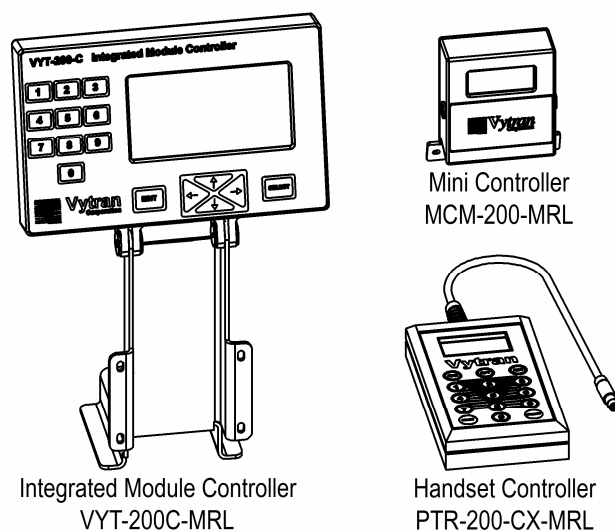


Figure 2: Controller Options

2.1 Unit Control Buttons

The PTR-200-MRL has three Unit Control Buttons that enable the user to inject and cure recoat material as well as test the strength of a fusion splice. The inject button is only enabled if an optional Automatic Injection System is purchased with the PTR-200-MRL. All parameters are preset and cannot be changed without an optional controller in conjunction with the Unit Control Buttons (see below for control options). An optional controller is also necessary for readout of the proof test values.

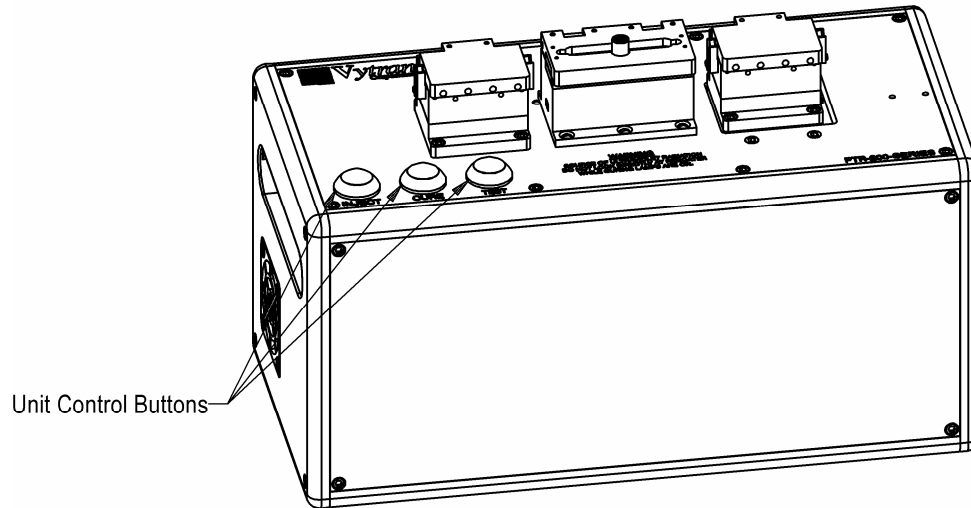


Figure 3: Unit Control Buttons

- Inject Button:** Inject a preset amount of recoat material into the mold (for units with built-in Automatic Injection System only). As an option, the Inject Button can be configured by Vytran to inject recoat material while it is pressed.
- Cure Button:** If the recoat mold is closed, pressing the Cure Button turns on full power to the UV lamps for the preset cure time. If the recoat mold is open, holding down the Cure Button will illuminate the UV lamps at low power (no UV output). This allows for a visual inspection of the lamps.
- Test Button:** Activates a Proof Test with the current parameter settings stored within the main unit. The right-hand fiber holding block will move linearly to the right to apply the set tension to the fiber. The load will be held for a set “hold time”, after which the fiber holding block will move back left to the home position.

2.2 Integrated Module Controller

2.2.1 Set-up

Make sure power to the MRL is turned off. Attach the Integrated Module Controller (VYT-200-C), by removing the four mounting screws and washers from the back of the MRL. Place the MRL and Controller on a flat work surface and secure the controller bracket to the back of the MRL as shown in Figure 4. Make sure the feet on the bottom of the bracket sit flush on the work surface. Connect the interface cable from the bottom of the Integrated Module Controller to the connector on the back of the MRL labeled "DISPLAY/SERIAL".

Note: The tension of the tilt display can be adjusted by loosening or tightening the left-hand (front view) pivot screw with the 5/64" Allen wrench provided in the tool kit.

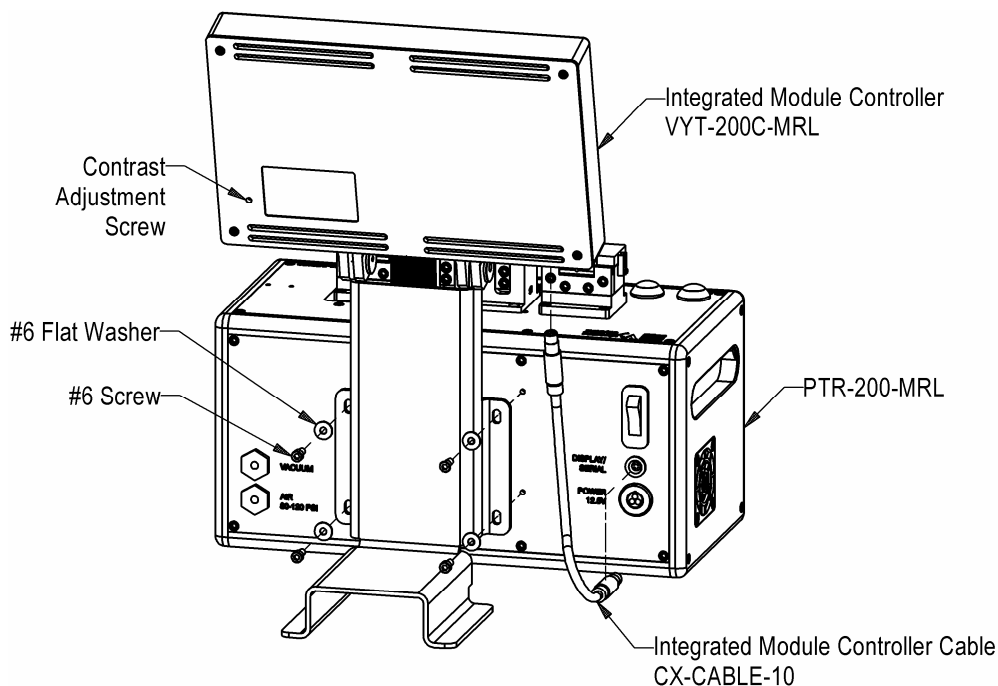



Figure 4: Attaching an Integrated Module Controller.

2.2.2 Power Up





With the Integrated Module Controller properly attached and connected to the MRL:

- Turn on the external power supply using the switch above the output cable.
- Turn on the MRL using the switch located at the back of the unit.

The system will go through an initialization process that takes from 15 to 90 seconds, during which time it will home and fill the internal recoat pump (if so equipped) and home the linear proof tester. During initialization the serial number of the Integrated Module Controller and version of code in the Controller will be displayed. The display will also indicate what Model PTR-200 the Integrated Module Controller is programmed for. Confirm that it is configured for a PTR-200-MRL. After initialization, you will be prompted to "Press Start to Continue". Press the highlighted start icon  to proceed to the Main Menu.


Note: It may take 5-10 minutes for the Integrated Module Controller to warm-up and achieve good display contrast. The contrast can be adjusted by turning an adjustment screw, which is accessible through a hole in the back of the controller (see Figure 4.)

2.2.3 User Parameter Files

The Integrated Module Controller provides three user definable parameter files, designated , , and . The selected User file can be checked or changed by pressing the open icon . The current User file will be highlighted. To change files, press the desired User file to highlight, then any icon to proceed. Any changes to the recoat parameters are stored in the selected User file.



The Integrated Module Controller will always start-up with the User file that was open prior to shut-down.

2.2.4 Recoating Menu

The recoat parameters can be checked or changed by selecting the edit recoat icon  from the Main Menu. The parameters are defined as follows:

- Quantity*:** The volume of recoat material in microliters (μl) injected into the mold.
- Rate*:** The speed at which recoat material is injected into the mold in microliters per second ($\mu\text{l}/\text{sec}$). The maximum inject rate is $1.8\mu\text{l}/\text{sec}$.
- Add*:** The amount of recoat material that can be added after activating a recoat. The specified amount is a percent value of the specified inject Quantity.
- Lamp Time*:** The amount of time in seconds that the curing lamps are on.

* Applicable only to units with automatic injection system

To change a recoat parameter, press the desired parameter to highlight the parameter box. Type in the desired value using the keypad. Make sure to enter leading zeros. Press the  icon to accept the new value, or the  icon to cancel.

Recommended recoat parameters are preset at time of shipment. Typical values for recoating a 30mm long stripped section of fiber in a 280 micron mold are listed below:

Quantity (μl):	2.5
Rate ($\mu\text{l}/\text{sec}$):	0.2
Add (%):	10
Lamp time (sec):	15

The valid range of recoat values is as follow:

Quantity (μl):	0,01 - 88
Rate ($\mu\text{l}/\text{sec}$):	0,01 - 1.8
Add (%):	0 - 99
Lamp time (sec):	0 - 60

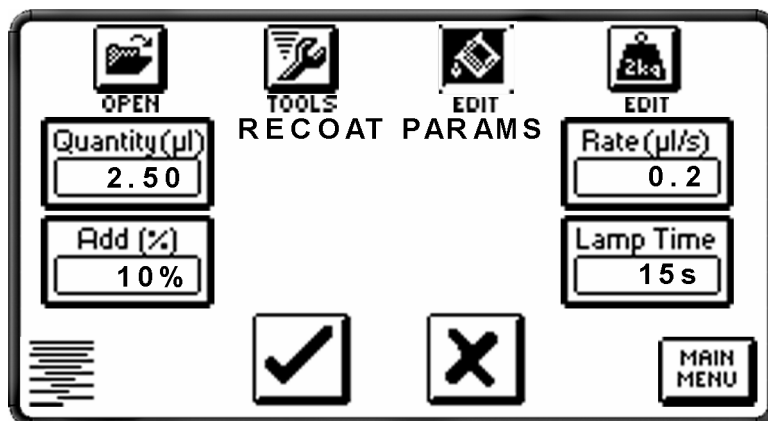


Figure 5: Recoat Parameter Screen

From the recoat parameter screen, select the  icon to return to the main process screen. The inject process can be initiated from the Main Menu by pressing the  icon.

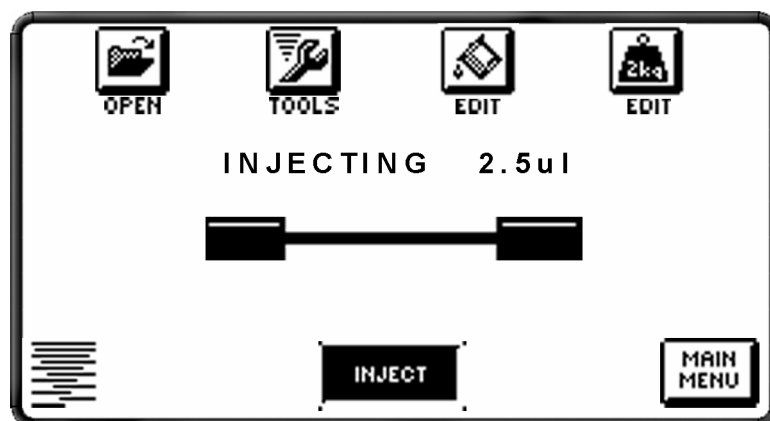




Figure 6: Inject Screen

If more recoat material is required select the  icon to add additional recoat material. Recoat material can be added multiple times.



Figure 7: Completed Injection

Select the  icon to initiate the cure process. After the cure process is finished return to the main menu by selecting the  icon.

2.2.5 Proof Testing

The proof test parameters can be checked or changed by selecting the edit proof test icon from the main menu. The parameters are defined as follows:

- Fiber Dia:** The diameter of the fiber in microns (μm). This diameter is required to calculate units of tension (kpsi, GPa). **Note:** Make sure to enter the diameter of the fiber, not the diameter of the coating.
- Peak Tension:** The load or tension to which the fiber is to be proof tested. The units of measure correspond to the highlighted display (grams, GPa, kpsi, lb, or N).
- Ramp Time:** The approximate time in seconds required to reach the Peak Tension.
- Hold Time:** The amount of time in seconds that the Peak Tension is held for.

To change a proof test parameter, press the desired parameter to highlight the parameter box. Type in the desired value using the keypad. Make sure to enter leading zeros. Press the icon to accept the new value, or the icon to cancel. The units for Peak Tension correspond to the highlighted units icon. To change units, press and highlight the desired units.

Note: For units of tension (kpsi and GPa) the fiber diameter (not the coating diameter) must be entered correctly for the system to calculate the applied load over area. Switching between units does not automatically convert the peak tension values.

Note: It is possible to enter parameters that will be out of range and cause the system to lock-up. If this occurs, re-start the unit and re-enter correct values.

Select the icon to return to the Main Menu, or any other icon to proceed.

The valid range of proof test values is as follows:

Fiber Dia (μm):	40 -160
Peak Tension (g):	1 - 2500
(N):	0.01 - 25
(kpsi):	1 - 341*
(Gpa):	0.01 - 2.35*
(lb):	0 - 5.5
Ramp Time (sec):	1 - 60
Hold Time (sec):	0 - 9.99

* Based on a 125 μm fiber.

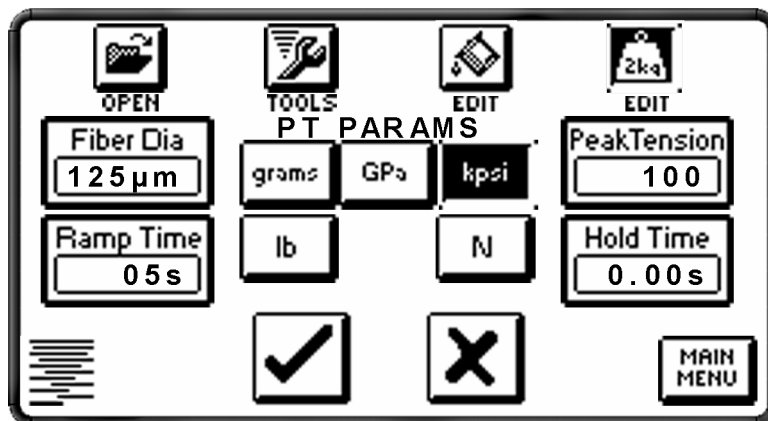




Figure 8: Integrated Module Controller Proof Test Parameters

From the proof test parameter screen, select the  icon to return to the main process screen. The proof test process can be initiated from the Main Menu by pressing the  icon. A display will indicate the current load being applied to the fiber. After the proof test is complete, the peak tension achieved will be displayed. If the fiber broke during proof test, the breaking strength will be displayed, as shown in Figure 9.

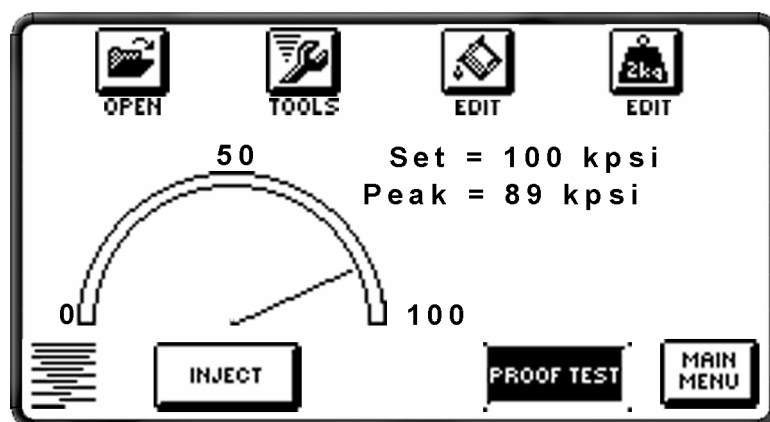






Figure 9: Proof Test Value

2.2.6 Tools/Options

The Tools Menu provides individual process commands for set-up and service of the MRL. It can be accessed through the tools  icon. A command is executed by highlighting one of the available options, entering a value through the keypad if applicable, and confirming it through the  icon. The  icon will remain highlighted until the process is completed. A process cannot be aborted once it is confirmed. Highlighted values can be reset with the  icon.

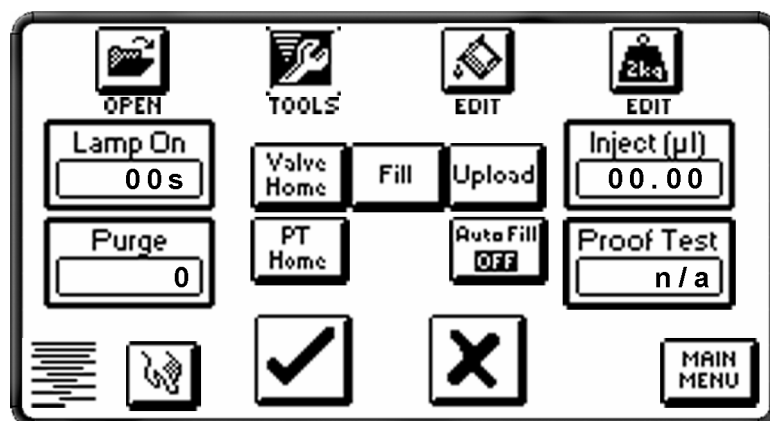



Figure 10: Tools Menu Screen

Lamp On	<p>The Lamp On command is used to manually turn on the lamps. Highlight the “Lamp On” box and enter the time in seconds that the lamps will be activated for. Make sure that the mold is closed</p> <p>WARNING: Do not look directly at the recoat assembly while the recoat lamps are on. The recoat lamps emit ultra-violet radiation which can cause damage to the eyes. The mold must be closed during recoat lamp operation.</p>
Purge*	The Purge command initiates a process that cycles recoat material through the recoat injection pump. Highlight the “Purge” box and enter in the desired number of purge cycles. Each purge cycle will empty the contents of the pump back into the top of the recoat bottle, and then draw 100 microliters of fresh recoat material from the bottom of the bottle back into the pump.
Inject (μl)*	The Inject command will inject a specified volume of recoat material out through the mold inject port. Highlight “Inject (μl)”, and enter the amount of recoat material, in microliters, to be injected.
Proof Test	The Proof Test function is not applicable to the PTR-200-MRL.
Valve (Position)*	<p>The Valve function can be used to position the distribution valve of the recoat injection pump to one of four positions: Home, Purge, Inject, or Fill. Toggle the Valve box to switch between positions. Once the desired position is displayed, press the <input checked="" type="checkbox"/> icon to initiate.</p>
Fill*	The Fill command initiates a process that fills the recoat injection pump.
Upload	The Upload function will transfer all parameters from the currently selected User file of the Integrated Module Controller to the MRL (and Mini Controller if attached in series). This function is useful for ensuring that the parameters in the Integrated Module Controller match those in the MRL.
PT Home	The PT Home function initiates a process that positions the right-hand fiber holding block to its home (innermost) position.
Auto Fill*	The Auto Fill icon toggles the automatic fill option ON/OFF. Automatic Fill checks if the Automatic Injection System has sufficient recoat material for one recoat and starts a fill command if necessary. The fill command will start after 30 seconds of system inactivity.
Touchpad Calibration	<p>The Touchpad Calibration is initiated through the  icon in the Tools menu. Chose either “Finger” of “Stylus” by toggling the first icon, then select “Cal”. You will be prompted to touch two “targets” on the screen to complete the calibration.</p>

* Applicable only to units with automatic injection system.

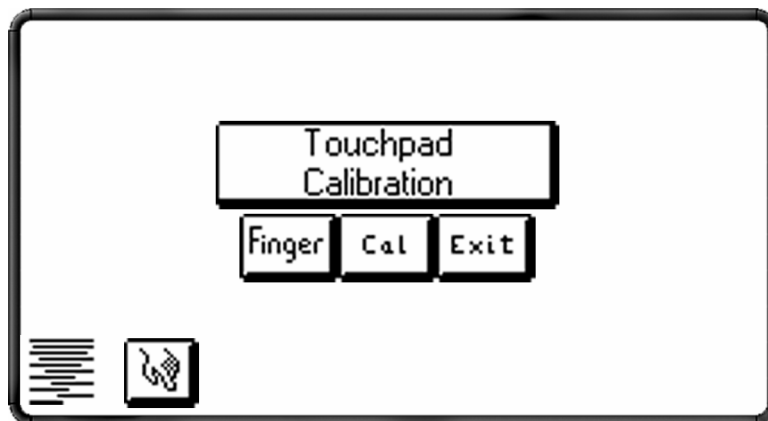


Figure 11: Touchpad Calibration

2.3 Handset Controller

2.3.1 Set-up

Make sure power to the MRL is turned off. Connect the cable of the Handset Controller (PTR-200-Cx) to the connector on the back of the MRL labeled “Display/Serial”.

2.3.2 Power Up

With the Handset Controller properly connected to the MRL:

- Turn on the external power supply using the switch above the output cable.
- Turn on the MRL using the switch located at the back of the unit.

The system will go through an initialization process that takes from 15 to 90 seconds, during which time it will home and fill the internal recoat pump (if so equipped) and home the linear proof tester. During initialization the serial number of the Handset Controller and version of code in the Controller will be displayed. Once initialization is complete, the display will switch to the Main Menu screen.

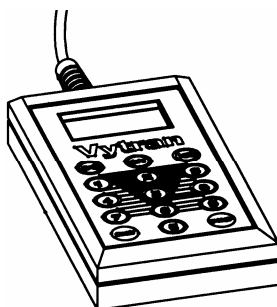


Figure 12: Handset Controller

2.3.3 Mode of Operation

The Handset Controller has two different “Modes” of operation, which provide different levels of functionality. These are defined as follows:

- Operator Mode:** This Mode of operation provides full display and status capabilities, but only very basic recoat and proof test execution capabilities. Process parameters can not be changed when in Operator Mode.
- Engineer Mode:** This Mode of operation provides full editing capabilities of all process parameter, as well as access to all process and service functions.

The default mode of operation when the Handset Controller is first turned on is Operator Mode. To access Engineering Mode a password must be entered as follows:

- At the Main Menu screen, press ‘8’ to display the Password Screen.
- Enter the 6-digit password using the keypad. All leading zeros must be entered as shown.

Mode	Password
Operator Mode	No Password
Engineer Mode	036465

- Press the “CFG” button to submit the password.
- The system will validate the entered password and indicate the result as follows:

Accepted: The accepted message is displayed briefly and then the system returns to the Main Screen with Engineering Mode indicated.

Rejected: If an incorrect password is entered, the reject message is displayed briefly and then the system returns to the Main Menu in Operator Mode.

2.3.4 User Parameter Files

The Handset Controller provides three user definable parameter files, designated as “User1”, “User2”, and “User3”. The User file can only be checked or changed from Engineering Mode. To select a User file:

- At the Main Menu screen, press ‘0’ to display the Select Set-Up screen.
- Press ‘1’ to scroll through the list of User files until the desired file is displayed.
- Press ‘0’ to select the displayed User file.

The Handset Controller will always start up with the User file that was open prior to shut down.

2.3.5 Recoat Parameters

The recoat parameters are defined as follows:

Quantity:	The volume of recoat material in microliters (μl) injected into the mold.
Rate:	The speed at which recoat material is injected into the mold in microliters per second ($\mu\text{l}/\text{sec}$). The maximum inject rate is $1.8\mu\text{l}/\text{sec}$.
Delay Time:	The amount of time in seconds between the end of the injection process and the start of the curing process. (Not applicable for PTR-200-MRL.)
Lamp Time:	The amount of time in seconds that the curing lamps are on.

Recoat parameters can be checked or changed only from Engineering Mode. Any changes made to the recoat parameters affect only the currently selected User file. To configure the recoat parameters, follow the menu sequence given in Figure 13.

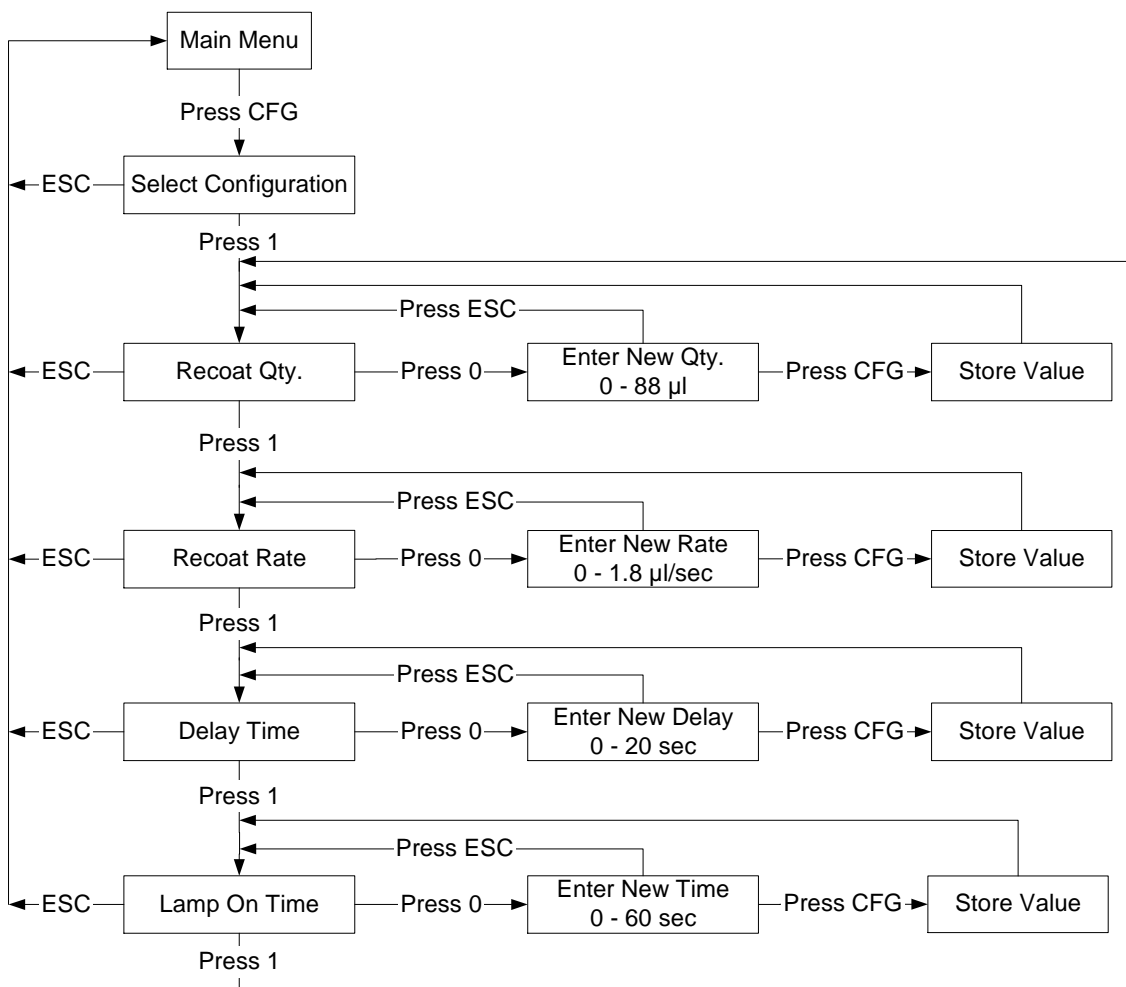


Figure 13: Recoat Configuration Menu

2.3.6 Proof Test Parameters

The Proof Test parameters are defined as follows:

- Fiber Dia:** The diameter of the fiber in microns (μm). This diameter is required to calculate units of tension (kpsi, GPa). **Note:** Make sure to enter the diameter of the fiber, not the diameter of the coating.
- Peak Tension:** The load or tension to which the fiber is to be proof tested. The units of measure must be selected from the following choices: grams, GPa, kpsi, lb, or N.
- Ramp Time:** The approximate time in seconds required to reach the Peak Tension.
- Dwell Time:** The amount of time in seconds that the Peak Tension is held for.

Proof test parameters can be checked or changed only from Engineering Mode. Any changes made to the proof test parameters affect only the currently selected User file. To configure the proof test parameters, follow the menu sequence given in.

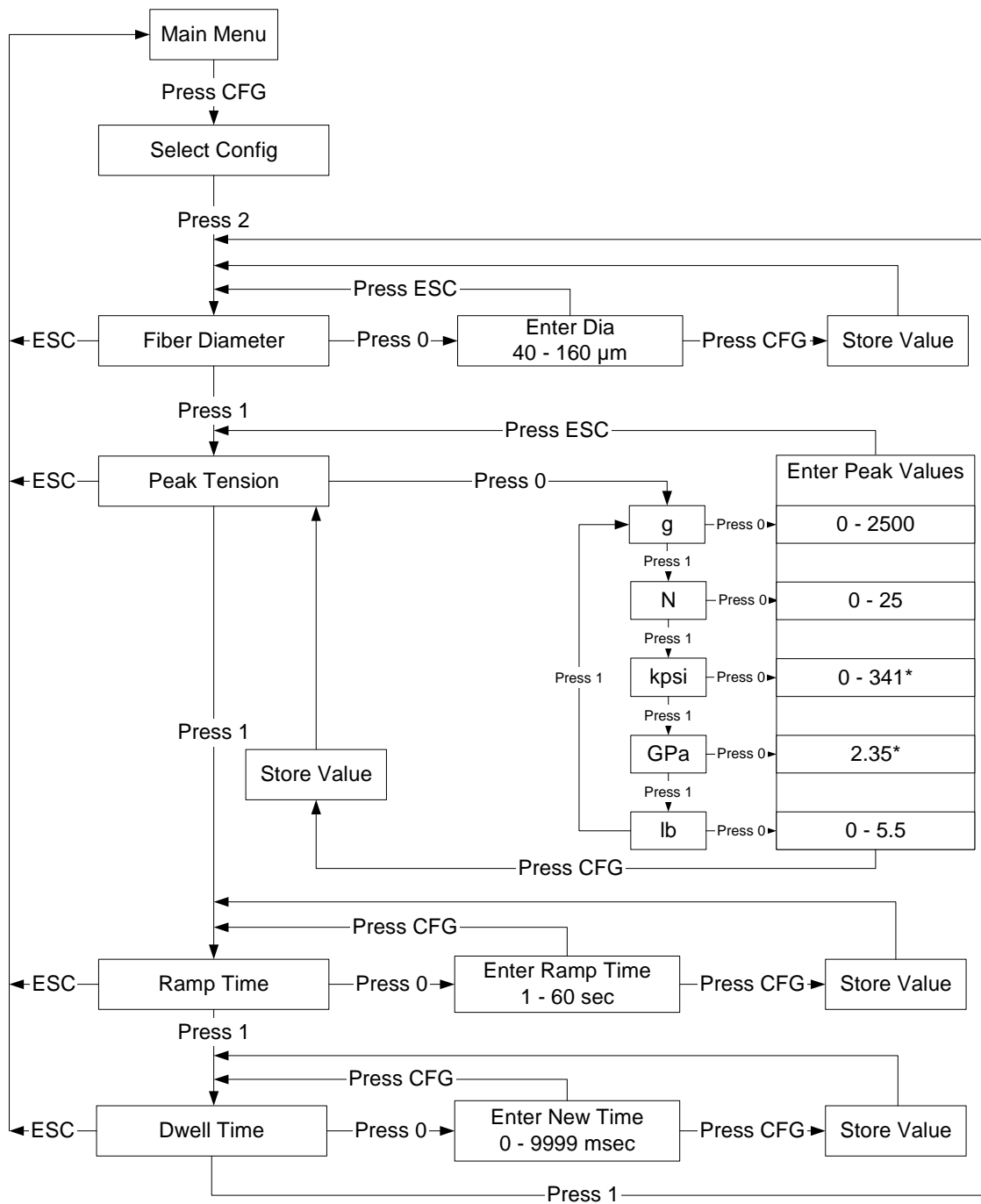


Figure 14: Proof Test Configuration Menu

2.3.7 Function Selection

Note: Process execution on PTR-200-MRL models is limited to the Proof Test function.

The Start button on the Handset Controller will execute one of three processes: Recoat, Proof Test, or Recoat plus Proof Test. The combination process will initiate a proof test immediately after the recoat is completed. The Start button can be programmed by following the menu given in Figure 15. The Handset Controller must be in Engineering Mode to access the Select Menu.

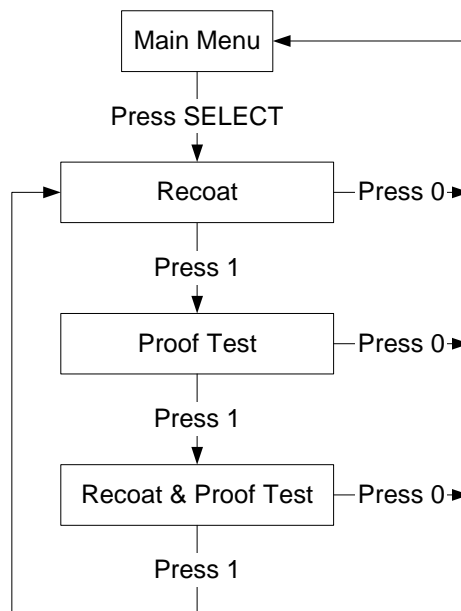


Figure 15: Start Button Process Selection Menu

2.3.8 Options

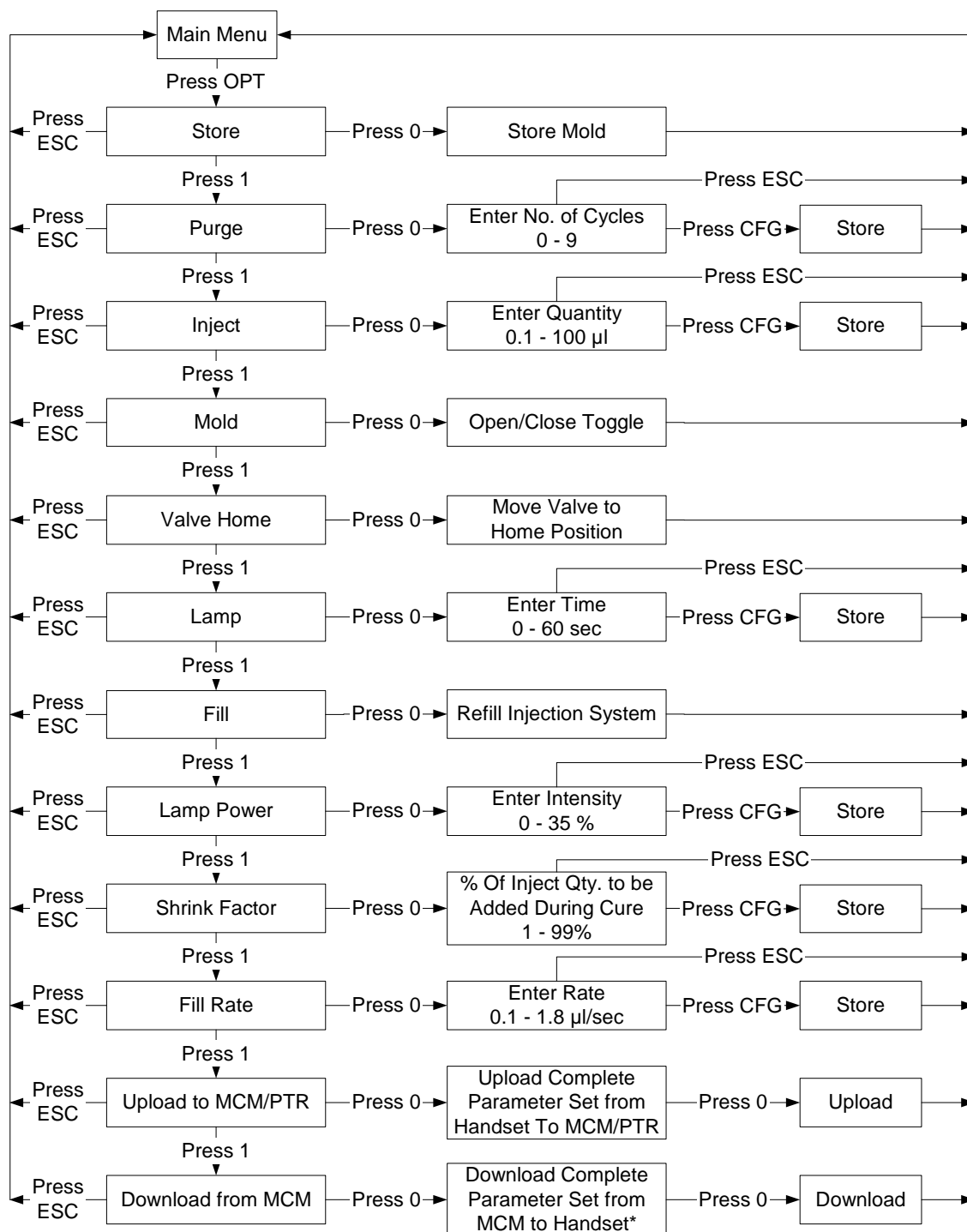
The Options Menu provides individual process commands for set-up and service of the MRL, as well as access to some system level process parameters. A flowchart for the Options Menu for Engineering Mode is given in Figure 16. If the Handset Controller is in Operator Mode, only the Store and Mold commands are accessible. A description of all commands and parameter available in the Options Menu is give below.

Store	The Store function closes the recoat mold and releases pressure from the pneumatic gripper. (Not applicable to PTR-200-MRL.)
Purge*	The Purge command initiates a process that cycles recoat material through the recoat injection pump. Enter the desired number of purge cycles. Each purge cycle will empty the contents of the pump back into the top of the recoat bottle, and then draw 100 microliters of fresh recoat material from the bottom of the bottle back into the pump.
Inject (µl)*	The Inject command will inject a specified volume of recoat material out through the mold inject port. Enter the desired amount of recoat material, in microliters, to be injected.
Mold	The Mold function can be used to open or close the recoat mold. (Not applicable to PTR-200-MRL.)
Valve Home*	The Valve Home function can be used to position the distribution valve of the recoat injection pump to its Home location.
Lamp	The Lamp On command is used to manually turn on the lamps. Highlight the "Lamp On" box and enter the time in seconds that the lamps will be activated for. Make sure that the mold is closed

WARNING: Do not look directly at the recoat assembly while the recoat lamps

	are on. The recoat lamps emit ultra-violet radiation which can cause damage to the eyes. The mold must be closed during recoat lamp operation.
Fill*	The Fill command initiates a process that fills the recoat injection pump.
Lamp Power	The Lamp Power command sets the intensity of the two center curing lamps. For MRL systems this should be set for 35%.
Shrink Factor*	The Shrink Factor is the amount of material injected into the recoat mold during the early stages of curing. This is entered as a percentage of the initial Inject volume, and is intended to compensate for material shrinkage during cure. Typical values for Shrink Factor are 3 to 6%.
Fill Rate*	The Fill Rate command sets the speed at which the pump draws material from the recoat bottle. This is typically set at the highest possible speed of 1.8 microliters/second.
Upload to MCM/PTR	The Upload function will transfer all parameters from the currently selected User file of the Handset Controller to both the MRL and, if attached in series, to the currently selected User file of a Mini Controller. This command is useful for re-programming a Mini Controller and/or MRL with a known parameter set and for ensuring that the parameters in a Mini Controller match those in the MRL.
Download from MCM	The Download function will transfer all parameters from the currently selected User file of a Mini Controller to the currently selected User file of the Handset Controller. This function is useful for confirming parameters that are stored in a Mini Controller. Note: Executing this command will overwrite all parameter in the currently selected User file of the Handset Controller.

* Applicable only to units with Automatic Recoat Injection System.



* Values in Handset will be overwritten when downloading

Figure 16: Engineering Mode option menu

2.4 Mini-Controller (MCM-200)

2.4.1 Set-Up

Make sure power to the MRL is turned off. Use the 3/32" Allen wrench from the tool kit to remove the two (2) socket head cap screws from the top right of the MRL backplate, as shown in Figure 17. Attach the two stand-off in place of the two screws removed from the unit. Line up the mounting holes on the MCM-200 with the stand-offs and attach using the two socket head cap screws removed from the unit. Connect the interface cable from the connector on the right-hand side (front view) of the Mini Controller to the connector on the back of the MRL labeled "DISPLAY/SERIAL".

Note: Make sure to use the correct connector on the Mini Controller. The Mini Controller has a connector on both the right and left-hand sides of the display. If the display side of the Mini Controller is facing you, the right-hand connector is used to connect the controller to the MRL. The left-hand connector is used to reprogram the Mini Controller, through the connection of an Integrated Module Controller or Handset controller. The Mini Controller will not function properly if connected to the MRL through the left-hand connector.

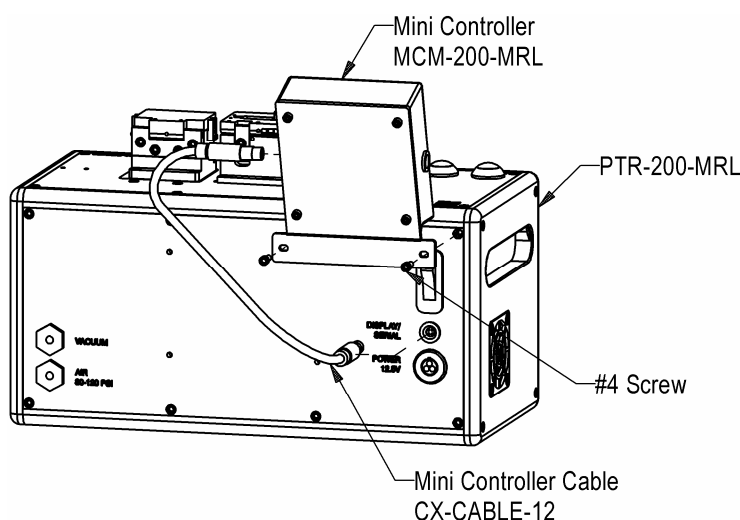


Figure 17: Attaching a Mini Controller

2.4.2 Power Up

With the Mini Display properly attached and connected to the MRL:

- Turn on the external power supply using the switch above the output cable.
- Turn on the MRL using the switch located at the back of the unit.

The system will go through an initialization process that will home and fill the internal recoat pump (if so equipped). During initialization the serial number of the Handset Controller and version of code in the Controller will be displayed. Once initialization is complete the display will switch to the "Select Function" screen.

Note: The flashing red light on the Mini Controller indicates that the microprocessor is active. This is not an error message.

2.4.3 Programming

The Mini Controller can be programmed with an Integrated Module Controller (VYT-200C) or Handset Controller (PTR-200-Cx). The Mini Controller remains connected normally to the MRL, and the programming device is connected into the left-hand side of the Mini Controller, as shown in Figure 18. Because the Mini Controller remains attached to the MRL, both the Mini Controller and MRL will get reprogrammed together. This is important to ensure that the program parameters stored in the Mini Controller match those on the MRL.

Note: If a Mini Controller has been programmed on a different unit and is then attached to a new MRL, it is very possible that the program parameters in the Mini Controller will not match those in the MRL. To avoid this situation, always make sure to reprogram the Mini Controller after attaching to a new unit.

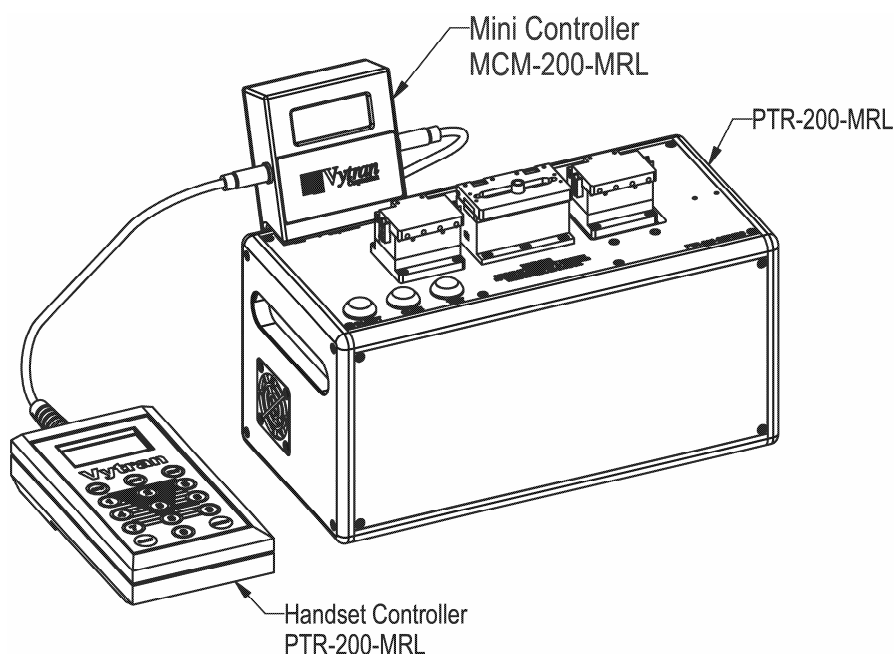


Figure 18: Programming the Mini Controller through a Handset Controller

The programming procedure is as follows:

1. Turn off power to the MRL.
2. Connect either a Handset Controller or an Integrated Module Controller to the connector on the left side (front view) of the Mini Controller.
3. Make sure that the cable from the right side (front view) of the Mini Controller is connected normally to the back panel of the MRL.
4. Turn on power to the MRL and wait for the system to initialize. During initialization, both the Mini Controller and the programming Controller will display their normal start-up information.
5. If using a Handset Controller, enter the password to access Engineering Mode (see 2.3.3).
6. Programming the Mini Controller is performed by using the Handset Controller or Integrated Module Controller as if they were directly connected to the MRL. To change the setting of an individual parameter, select the desired parameter and enter the desired value. The Mini Controller will emit an audible beep to indicate the data transfer. To transfer an entire User file, select the desired User file on the programming Controller, then execute an Upload command. Multiple audible beeps will be heard as all data parameters are transferred.
7. Turn off power to the MRL.
8. Disconnect the programming controller.

Note: Do not attempt to execute process commands with a programming controller attached to the Mini Controller. A Handset Controller or Integrated Module Controller will only execute commands if connected directly to the MRL.

3 Priming the PTR-200

3.1 Cleaning Recoat Mold

The recoat mold assembly contains two very flat quartz plates, each with a semi-circular channel running longitudinally down the center of their mating surfaces. One plate is mounted in the hinged top which, when closed, forms a circular mold cavity with the bottom plate. In order for the top and bottom plates to mate flush together, they must be cleaned of all dirt and/or coating particles.

The quartz mold plates can be cleaned with a cotton swab wetted with acetone or isopropyl alcohol. Acetone cleans more thoroughly than alcohol and will also soften and lift away any cured recoat material. Do not use excessive scrubbing or scraping action to clean the mold plates. Typically a single wipe from left to right across both top and bottom mold plate is sufficient to clean the plates.

If the recoat mold does have an accumulation of cured recoat material stuck to the plates, allow the cleaning solution (preferably acetone) time (60-90 seconds) to soften and lift any cured material. The soft Vytran "toothbrush" provided can be used occasionally to clean the mold channels of any cured coating particles.

Note: The top surface of the bottom mold plate has an optical coating that blocks UV light. Great care must be taken not to scratch or abrade this coating. Do not rub any hard objects across the surface of the plates as this could scratch the optical coating or chip the edges of the mold channel and degrade the quality of the recoat.

3.2 Priming the Injection System

The PTR-200-MRL can be configured with one of three recoat injection systems:

- Manual Injector
- Remote Manual Injector
- Automatic Injector

For priming the injection system go to the appropriate chapter below.

WARNING

Prior to handling the UV acrylate material, be sure to read the Material Safety Data Sheet provided in the Appendix B: Material Data Safety Sheet

3.2.1 Manual Injection System

The top quartz plate contains an injection port, which must be filled with UV acrylate material prior to placing the fiber in the recoat mold. The injection port can be filled by using a syringe (supplied) to dispense the UV material. Care must be taken to prevent the formation of bubbles in the UV material when loading both the syringe and the injection port.

To load the injection port, use the following procedures (see Figure 19):

1. Fill the syringe by inserting the tip into the bottle of UV material. Make sure that the tip is immersed in the material and slowly draw out the plunger.
2. If an air bubble gets trapped within the syringe, turn the syringe upside down for several minutes to allow the bubble to rise to the tip. Gently push in on the plunger to force out the air bubble.
3. Remove the threaded plunger from the injection port.

4. Slowly dispense material from the syringe into the injection port. Make sure not to trap or inject air bubbles in the port. A good procedure is to dispense a small drop of recoat material at the tip of the syringe and then touch the drop to the inside back surface of the injection port. Give the material time to flow down into the inject port – repeating with additional drops until material almost reaches the top. Some room should be left at the top in order to insert the o-ring plunger. If too much material is dispensed into the port such that it protrudes above the top, insert a small scrap piece of fiber into the port to remove some material.
5. Raise the recoat top slightly and press the o-ring of the injection plunger into the port.
6. Rotate the plunger clockwise until the threads just catch.
7. Raise the recoat top and wipe away any excess UV material that may have injected out through the top. Once the recoat port has been filled, it should contain enough UV material for several recoats.
8. Clean the mold plates of all excess recoat material.

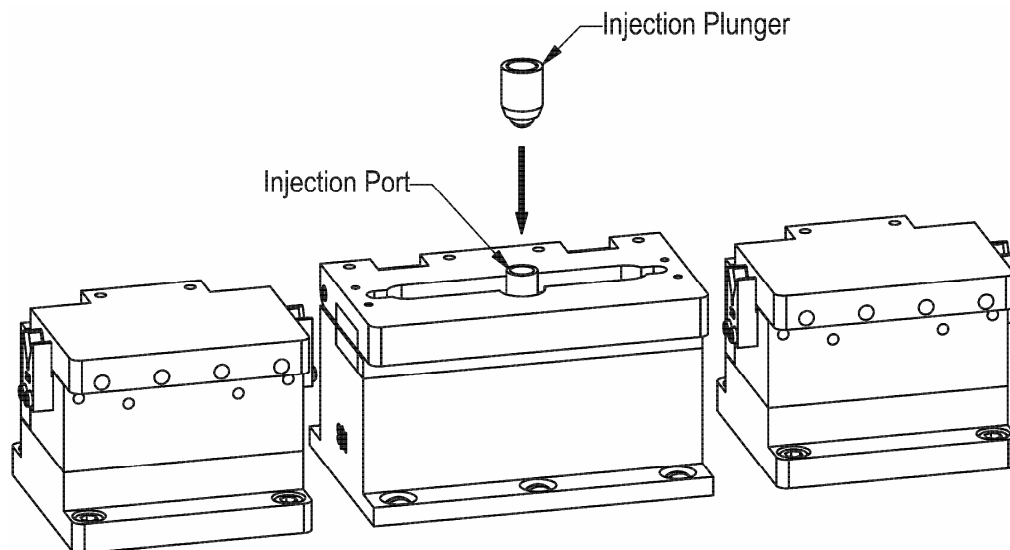


Figure 19: Loading the manual injection port

3.3 Remote Manual Injection System

The PTR-200-MRL is available with an optional remote manual recoat injector that can be fitted to the right side of the unit. This option provides a method of manually dispensing recoat material directly from the recoat bottle into the injection port. This system consists of a syringe with a knurled dispensing screw, which is fitted to a distribution valve with a two-position selection lever. The lever can be positioned downward (toward the recoat bottle) to draw up material from the recoat bottle, or horizontally (toward the syringe) to inject material into the mold. The knurled syringe screw is unscrewed (turned counter-clockwise) to fill the syringe, and screwed in (turned clockwise) to inject material. The selection lever must always be in the correct position for the desired operation (see table below).

OPERATION	LEVER POSITION	TURN SYRINGE SCREW
Fill syringe with recoat material	Down (toward recoat bottle)	Counter-clockwise (unscrew)
Inject recoat material into mold	Horizontal (toward syringe)	Clockwise (screw in)

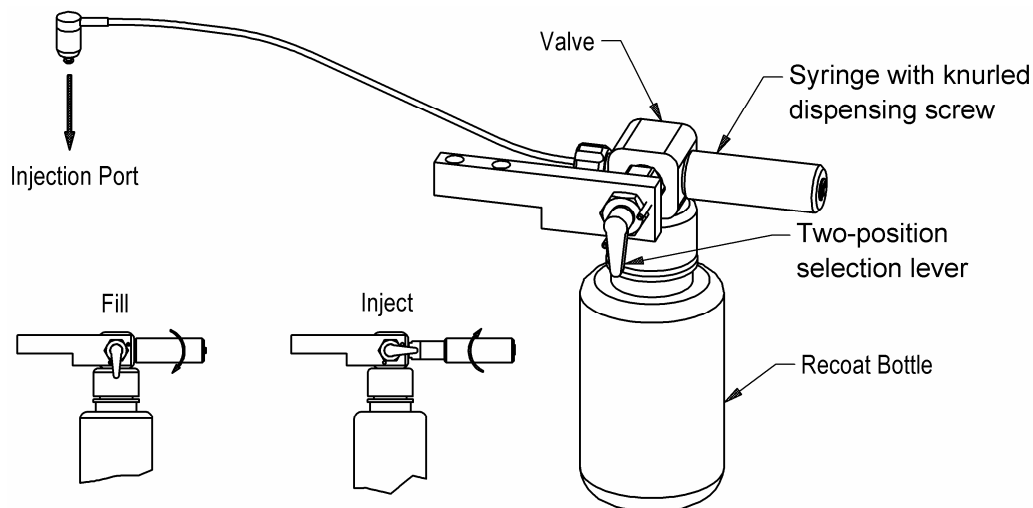


Figure 20: Remote Manual Injector

Prior to first use, the following steps must be followed to load the system with recoat material and purge all air from lines.

WARNING

Prior to handling the UV acrylate material, be sure to read the Material Safety Data Sheet provided in the Appendix B: Material Data Safety Sheet.

1. Make sure to have lens tissue and cleaning solution (acetone or alcohol) available prior to proceeding.
2. Raise the recoater top.
3. Position the selection lever to the Inject position (lever horizontal) and screw in (turn clockwise) the knurled syringe screw until a slight resistance is felt at the end of travel. Do not use excessive force when turning in the screw once the end of travel is reached. The end of travel point is reached when the leading edge of the syringe screw is approximately level with the step in the syringe body.
4. Fit a recoat bottle with fresh recoat material to the system. The red inject tube should be long enough to just reach the bottom of the recoat bottle. If using a short (30ml) recoat bottle the red tube may need to be trimmed to length.
5. Turn the selection lever to the Fill position (lever down). Unscrew (turn counter-clockwise) the knurled syringe screw to draw recoat material from the bottle into the syringe. Continue unscrewing the syringe screw approximately $\frac{3}{4}$ inches or until it is felt to spin freely. Do not pull on the syringe screw once the end of travel is reached; this will pull the plunger out from the syringe body.
6. Turn the selection lever to the Inject position (lever horizontal) and screw in (turn clockwise) the syringe screw until the inject end of travel point is reached.
Note: If the syringe screw was fully unscrewed until it spun freely, a slight forward pressure may initially be required to re-engage the threads.
7. Watch the injection port for signs of recoat material. Make sure to collect the recoat material as it comes out of the mold injection port. Do not allow recoat material to run down the face of the mold and under the mold plate.
8. The above steps of filling and injecting the syringe must be repeated several times to fully displace air from the system. Recoat material should run freely from the mold without bubbles. If bubbles are still present, run additional fill-inject sequences. It may help to turn the recoat plunger back and forth several times during the inject sequence in order to remove air trapped at the o-ring seal. It is also sometimes helpful to fill the syringe and then lift the left side of the unit such as to angle the syringe approximately 45 degrees. Leave the unit angled in this position for approximately 15 minutes. This will allow any air trapped in the syringe to rise up towards the distribution valve such that it can then be injected out.
9. Once the system runs free of air bubbles, clean the mold plates of any excess recoat material.

3.3.1 Automatic Injection System

The PTR-200-MRL is available with an optional automatic recoat injection pump fitted inside the unit. If equipped with this option, it is very important to remove all air from the recoat injection system prior to performing a recoat. When operating the system for the first time, the pump must be filled with recoat material and cleared of all air in the pump and tubing. In order to clear the inject tube, recoat material must be injected out through the mold inject port and collected and disposed of. Make sure to have cotton swabs and acetone or isopropyl alcohol available for this purpose prior to starting this procedure. An integrated Module Controller or Handset Controller is required to perform this procedure.

WARNING

Prior to handling the UV acrylate material, be sure to read the Material Safety Data Sheet provided in the Appendix B: Material Data Safety Sheet.

To prime the recoat injection system:

1. Turn off power to the MRL.
2. Remove the front plate of the MRL by using the 3/32 Allen wrench provided in the tool kit to remove the four (4) black socket-head cap screws located at the corners of the plate.
3. The recoat pump is located on the left side of the MRL as shown in Figure 21. Unscrew the brown recoat bottle located at the front of the pump and remove by angling out through the front opening. The red Fill tube will flex to allow removal.
4. For new systems, replace the empty recoat bottle shipped with the unit with a new bottle of recoat material. For systems that have previously been run with recoat material, the recoat injection system should be flushed clean prior to adding new material (see section 6.3.5).
5. Screw the new recoat bottle into place and replace the front panel and the four (4) socket head cap screws.

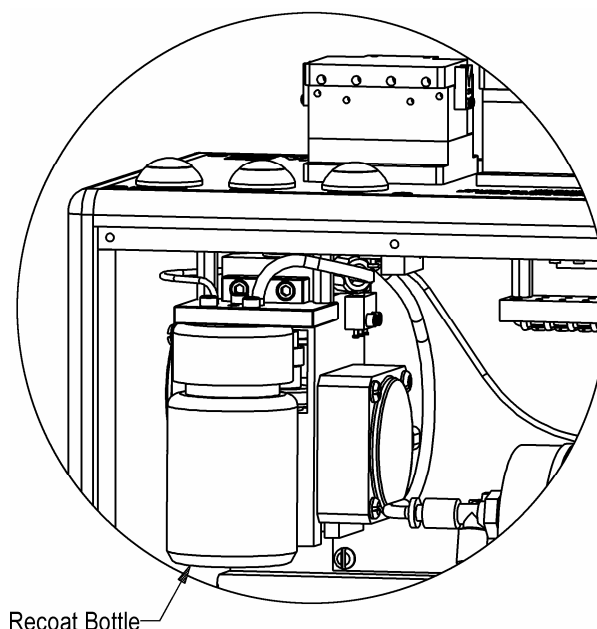


Figure 21: Recoat bottle access

6. Connect an Integrated Module Controller or Handset Controller directly to the back of the MRL. If the system is set-up with a Mini Controller it will need to be disconnected from the back of the MRL.
7. Turn on power to the MRL and wait for the system to initialize.
8. Execute five (5) Purge cycles (Options menu on Handset Controller or Tools menu on Integrated Module Controller). Each purge cycle will draw 100 microliters of recoat material from the bottom of the recoat bottle through the red Fill tube and inject material back into the top of the recoat bottle through the green Purge tube (see Figure 22). Five (5) Purge cycles are required to fill the pump with recoat material and force any air out of the pump system. This will take approximately 15 minutes to complete.

9. After the pump has completed its Purge cycles, the Inject tube that runs from the pump to the mold must also be filled with recoat material and purged of air. Raise the recoat mold top and make sure to have cotton swabs and cleaning solution (alcohol or acetone) available prior to proceeding.

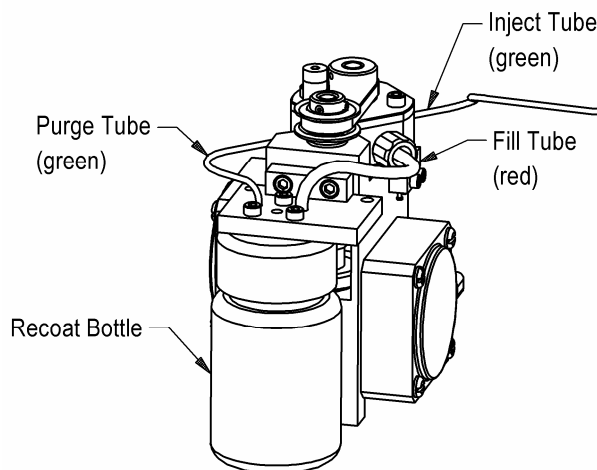


Figure 22: Recoat material flow

10. Set the recoat inject Rate to 1.8 μ l/sec (Recoat parameters menu). Make sure to take note of the original inject rate as this will need to be set back after this process is completed.
11. Set the inject quantity to 50 μ l (Options menu on Handset Controller or Tools menu on Integrated Module Controller).
12. Execute the inject command (press "CFG" on the Handset Controller or the icon on the Integrated Module Controller).
13. Watch for recoat material to emerge from the mold inject port. Make sure to collect the recoat material with a cotton swab as it comes out of the mold injection port. Do not allow recoat material to run down the face of the mold and under the mold plate.
14. Execute three (3) additional "Inject 50" sequences to purge air completely from the inject tube.
Note: Because the injection pump holds 100 μ l of recoat material, there will be a delay of approximately one minute between the second and third inject sequences while the pump refills.
15. After purging the inject tube, the recoat material should run freely from the mold without bubbles. If bubbles are still present, run additional inject sequences.
16. Once the pump and the inject tube are purged, clean the mold plates of all excess recoat material (see Section 6.2.1).
17. Reset the inject Rate to its original setting.

Note: Because the syringe in the recoat pump is mounted vertically, it is possible that an air bubble may still be trapped at the tip of the syringe after the above priming process. This air bubble will very slowly rise to the top of the syringe after which time it can be Purged out. It is therefore recommended that at least one (1) additional Purge cycle is run the next day after the initial priming of the system.

4 Recoat Process

The purpose of the recoat is to maintain the strength and flexibility of the fiber or fusion splice by protecting the glass surface from damage. It should be noted that recoating a splice does not make the splice stronger.

To recoat fusion splice, the section of exposed fiber is placed in a quartz recoat mold assembly. External holding fixtures secure the fiber, centering it within the recoat assembly. To allow for tolerance variations from fiber manufacturers, the diameter of the recoat mold cavity is generally specified to be slightly larger than the nominal outside coating diameter (e.g. 280 μm for a nominal 250 μm coating).

The recoat process maintains a near original fiber diameter and delivers a flexible fusion splice that can be handled or tightly coiled as if no splice were present. The integral fiber holding fixtures ensure that the fiber strength is not degraded by the recoat process.

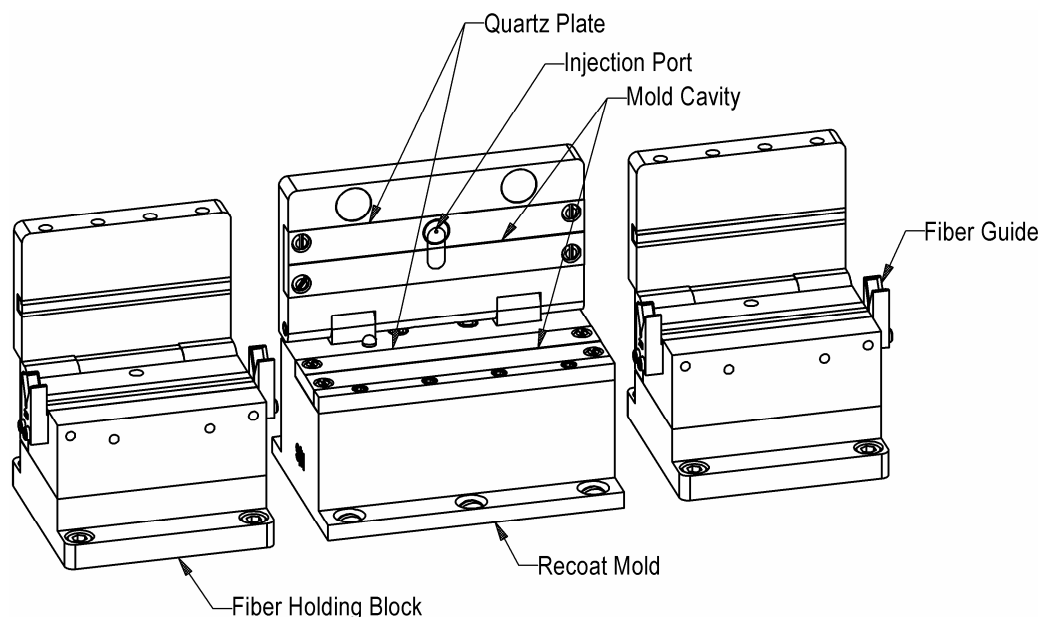


Figure 23: Recoat and Proof Test Components

4.1 Loading the Fiber

Fiber guides are mounted on each side of the fiber holding block inserts to aid in loading the fiber into the fiber folding blocks. Vacuum to the fiber holding blocks is automatically turned on when one of the holding tops is raised. Make sure that the fiber holding block inserts are sized correctly for the fiber to be recoated. The size, in microns, is labeled on the outside surface of the fiber guides.

To position a fiber for recoating, use the following procedures:

1. Raise the recoat top and both holding block tops.
2. Make sure both quartz plates are clean and that the injection port has enough UV material for the recoat (Manual Injection System) or that the injection system is purged (Automatic Injection System or Remote Manual Injector).
3. Hold the section of fiber to be recoated straight between two hands, making sure not to touch the exposed section of fiber (a total separation of approximately 8 inches is a convenient distance).
4. Lower the fiber into both sets of fiber guides until the fiber sits on the rubber inserts.
5. Make sure the stripped section of fiber is centered left-to-right in the recoat mold and close one of the fiber holding block tops. A free finger can be used to flip the top closed as the rubber inserts will not damage the coating.

6. Make sure that the fiber is taut between the holding fixtures and lower the second holding top. The fiber should be held in line with the recoat mold channel.
7. Lower the recoat top gently to capture the fiber within the mold cavity.

It is important to keep the fiber taut between the holding fixtures to prevent the fiber from bowing at the recoat. It is also important to avoid touching the exposed glass surface as this could significantly lower the strength of the fiber. Care should therefore be taken when positioning the fiber in the holding blocks to avoid rubbing the exposed section of fiber against the mold assembly. If proper care is taken when positioning the fiber, the recoat process will not degrade the strength of the fiber.

4.2 Recoating

4.2.1 Manual Injection System

Once the fiber has been captured in the recoat mold assembly, the injection plunger should be turned clockwise to inject the UV acrylate material into the mold cavity. The material will flow from the injection port, down a shallow channel, into the recoat cavity. The plunger should be turned slowly to give the material time to flow smoothly along the injection path.

Use the viewport in the recoat top to watch the material flow into the mold. Continue turning the plunger until the acrylate material reaches both coating interfaces of the exposed section of fiber. A slight migration of the acrylate material outside of the injection path between the two mold plates can be expected. The bottom mold plate has an optical coating that prevents this material from curing and forming a characteristic mold flashing. Excessive flashing flow indicates that the plates did not mate flush together. This is generally caused by dirt particles on the mold plates and/or by trying to recoat a fiber that has a larger coating diameter than the recoat mold.

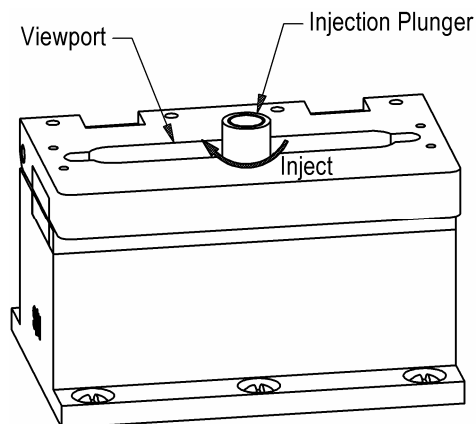


Figure 24: Manual Recoat Injection

4.2.2 Manual Remote Injection System

Make sure that the selection lever is in the inject position (lever up). Once the fiber has been captured in the recoat mold assembly, the injection syringe should be screwed in (turned clockwise) to inject the UV acrylate material into the mold cavity. The material will flow from the injection port, down a shallow channel, into the recoat cavity. The syringe should be turned slowly to give the material time to flow smoothly along the injection path.

Use the viewport in the recoat top to watch the material flow into the mold. Continue turning the injection syringe until the acrylate material reaches both coating interfaces of the exposed section of fiber. A slight migration of the acrylate material outside of the injection path between the two mold plates can be expected. The bottom mold plate has an optical coating that prevents this material from curing and forming a characteristic mold flashing. Excessive flashing flow indicates that the plates did not mate flush together. This is generally caused by dirt particles on the mold plates and/or by trying to recoat a fiber that has a larger coating diameter than the recoat mold.

Note: If the syringe end of travel is reached during the injection process, the syringe can be re-filled mid-process by positioning the selection lever to the fill position (lever down) and un-screwing (turn counter-clockwise) the syringe screw. Once filled, re-position the selection lever to the inject position (lever horizontal) and continue injecting material into the mold.

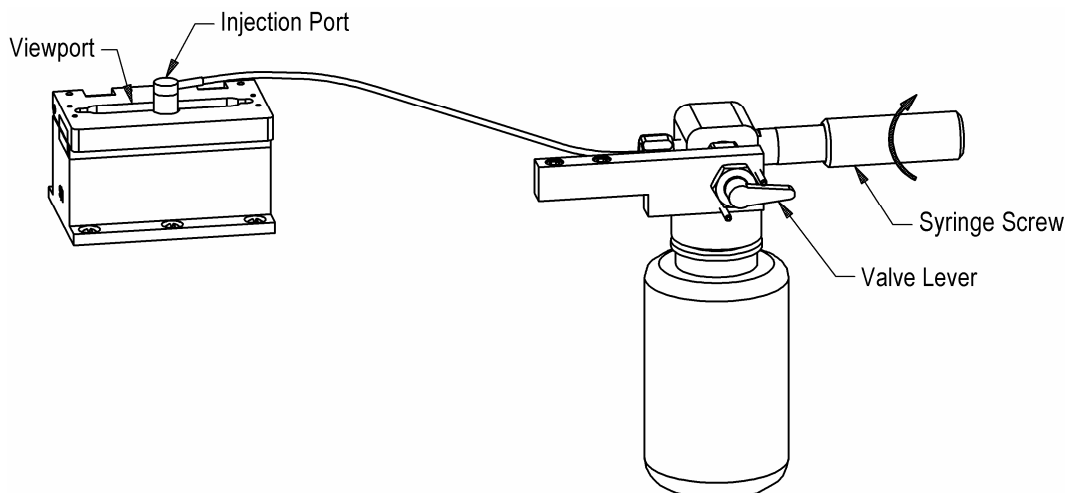


Figure 25: Remote Manual Recoat Injection

4.2.3 Automatic Injection System

Once the fiber has been captured in the recoat mold assembly, activate the injection process with one of the available controllers. This will activate the injection pump and dispense the specified amount of recoat material.

Use the viewport in the recoat top to watch the material flow into the mold. If the flow of recoat material does not reach the existing coating interface, inject additional material until the recoat material has reached the coating interface.

A slight migration of the acrylate material outside of the injection path between the two mold plates can be expected. The bottom mold plate has an optical coating that prevents this material from curing and forming a characteristic mold flashing. Excessive flashing flow indicates that the plates did not mate flush together. This is generally caused by dirt particles on the mold plates and/or by trying to recoat a fiber that has a larger coating diameter than the recoat mold.

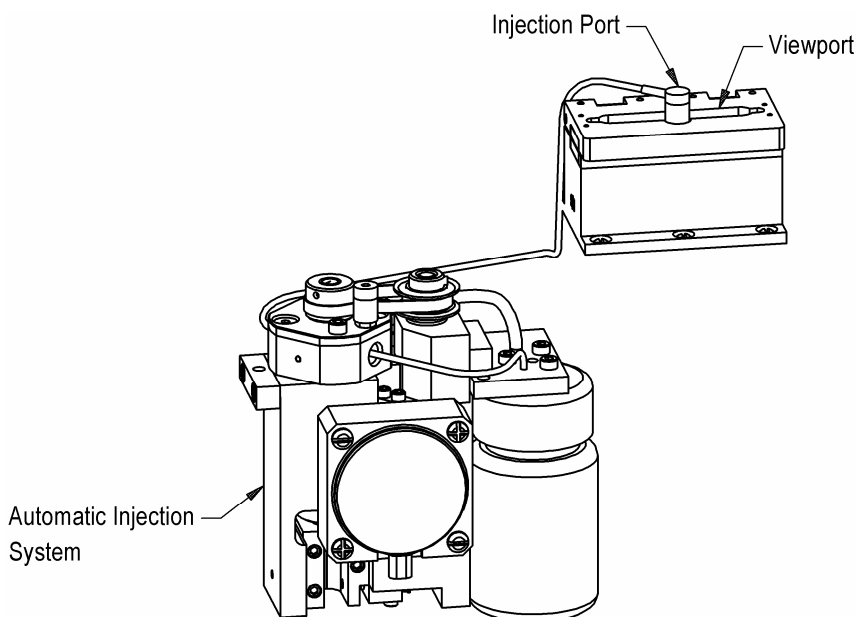


Figure 26: Automatic Recoat Injection

4.2.4 Curing the Coating

The liquid UV acrylate material cures to a solid state when exposed to ultra-violet light. The necessary UV radiation is provided by four tungsten-halogen lamps located below the bottom mold plate. The optical coating on the bottom plate ensures that any material which flows between the two plates will not cure and form a flashing on the recoated section of the fiber.

WARNING

Do not look directly at the recoat assembly while the recoat lamps are on. The recoat lamps emit ultra-violet radiation which can cause damage to the eyes. The mold top must be closed during recoat lamp operation.

To cure the fiber coating, use the following procedures:

1. Make sure recoat material has been injected up to or beyond the coating interfaces.
2. Activate the cure process to turn on the UV lamps. The recoat lamps will shut off automatically after the set cure time.
3. Raise both fiber holding block tops.
4. Raise the recoat mold top by lifting straight up at the two outside corners of the top. A slight force is typically required to “pop” the top free.

Note: Do not lift by or exert any force on the injection port.

5. The fiber may remain tacked to either the top or bottom mold plate. In this case, it may be necessary to gently pull on the fiber to release it. Try to avoid inducing any sharp bend to the fiber.
6. Visually inspect the recoated fiber to make sure the recoat reached both interfaces and that there are no voids or air bubbles in the recoat. The recoat can be gently wiped with a dry lens tissue to remove any uncured recoat material or light flashing. Do not wipe the recoat with acetone.
7. Clean both top and bottom mold plates with a soft lint-free lens tissue and/or cotton swab soaked in cleaning solution.

Note: Acetone is the preferred solution for cleaning the mold plates. Acetone cleans more thoroughly than alcohol and will also soften and remove cured recoat material. The mold plates can typically be cleaned of excess uncured recoat material with a single wipe from left to right across both top and bottom plates. Take care to avoid contact with the uncured recoat material (read “Appendix B: Material Data Safety Sheet” before working with recoat material).

Note: The top surface of the bottom mold plate has an optical coating that blocks the UV light. Great care must be taken not to scratch or abrade this coating. Do not rub any hard objects across the surface of the plates as this could scratch the optical coating or chip the edges of the mold channel and degrade the quality of the recoat.

4.3 Recoat Diagnostics

Problem	Possible Cause	Solution
Fiber snaps when mold top lowered.	Fiber not loaded properly.	See "4.1 Loading the Fiber"
	Recoat mold not properly aligned to fiber.	Refer to 6.3.7 Replace and Align Mold Assembly section for instructions on realigning the recoat mold assembly.
	Channels of recoat mold plate are misaligned.	Contact Vytran for recoater servicing.
Material flows excessively outside of mold cavity or does not flow down mold cavity ("puddling").	Recoat mold plates are dirty.	Dirt between quartz mold plates will not allow them to lay flush, causing the acrylate to flow excessively outside the mold cavity. The recoat mold plates should be cleaned as described in 6.2.1 Clean Mold.
	Channels of recoat mold plate are misaligned.	Contact Vytran for recoater servicing.
Plunger turns excessively when injecting acrylate.	Bubbles in injector port.	Empty the recoat injector port (refer to the Maintenance section for instructions) and reload.
Flashing forms along the length of the recoat.	Cure time too long.	This will increase the modulus of the coating and make it stiffer. In the future, decrease the cure time. This flashing can generally be removed by wiping the recoated section with a dry lens tissue. Do not use a solvent! For very tough flashing, it may be necessary to use the gray abrasive square (provided) to gently rub off the flashing material.
Recoat feels tacky or can be easily rubbed off by pulling the fiber between fingers.	Cure time too short.	Increase the cure time.
	Recoat lamp(s) burned out or old.	Replace the recoat bulb (refer to 6.3.8 Replace Tungsten Halogen Lamps).
Fiber sticks to recoat mold consistently.	Recoat mold plates are dirty.	Clean the recoat mold plates as described in 6.2.1 Clean Mold.
Fiber snaps when lifting the recoat mold top.	Failed to first release the holding fixture tops before lifting the recoat mold top.	If the recoat mold top is lifted with the holding fixture tops closed, the fiber may stick to the recoat mold top and snap or degrade the strength of the fiber. Always open the holding fixtures before lifting the recoat mold top.

5 Proof Test Process

A predefined load is automatically applied to the fiber by pulling on the fiber with a predefined force of the right fiber holding block as shown in Figure 27. The peak value reached during a proof test should be identical to the preset “Peak Tension” value, if the fiber doesn’t fail.

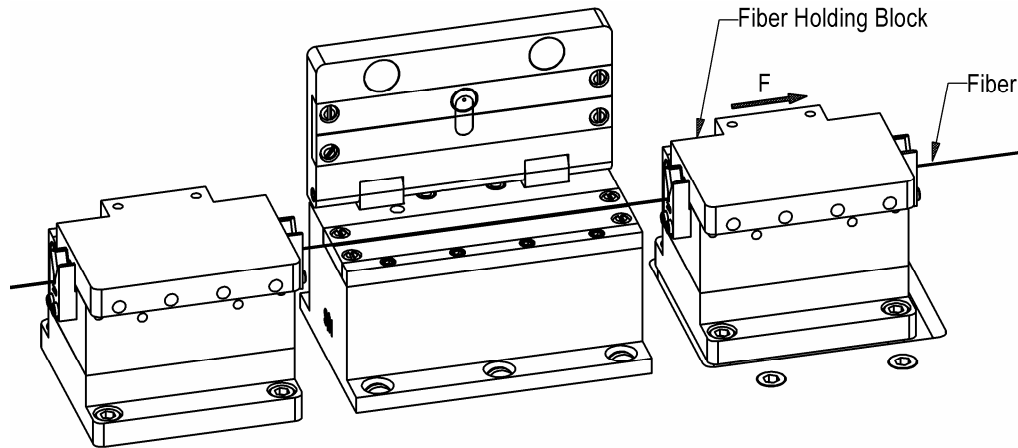


Figure 27: Proof Testing

5.1 Proof Testing

Configure the PTR-200 to proof test to the desired level as described in chapter 2.

WARNING

Always wear safety glasses when proof or tension testing fiber. The fiber under test can shatter and send glass particles flying.

The procedures for the automatic proof test are as follows:

1. Set the Proof Test parameters.
2. Load the fiber to be tested if not already loaded.
3. Make sure the mold cover is open.
Note: Anyone observing the test should also take precautions against flying glass particles.
4. Press the “TEST” button to initiate the proof test cycle.

The maximum tension applied to the fiber will be recorded and displayed. If the fiber breaks prior to reaching the Automatic Proof Test level, the breaking strength will be displayed

5.2 Proof Test Diagnostics

Problem	Possible Cause	Solution
Peak proof test value does not reach preset value.	Fiber slipped in fiber holding block	Clean fiber holding block inserts as described in 6.2.2 Check/Clean FHB Inserts.
Fiber slips at very high tension levels.	Fiber holding block inserts are dirty.	Clean fiber holding block inserts as described in 6.2.2 Check/Clean FHB Inserts.
	Fiber holding block inserts are worn out.	Replace fiber holding block inserts as described in "6.4.2"
Tension levels appear unusually high or low for the particular fiber being tested.	Wrong fiber diameter entered.	The fiber diameter is used in the tension level calculation. Check the setting for the current fiber diameter as described in "2 Controlling the PTR-200"

6 Maintenance

The purpose of the maintenance section is to define the planned maintenance requirements of the PTR-200-MRL. Where appropriate maintenance procedures are included.

6.1 Planned Maintenance

The PTR-200 series machines are designed for a production environment to give trouble free operation provided normal planned maintenance is adhered to. Maintenance and repair procedures should only be performed by trained personnel. Improper service and/or repair could result in the safety features being disabled and can also lead to damage that will not be covered under warranty.

Planned Maintenance Schedule

	Every Cycle	Every Shift	Daily	Monthly	3 Months	6 Months
Check Mold ¹	√	√	√	√	√	√
Check/clean FHB Inserts ¹		√	√	√	√	√
Check UV Lamps ¹			√	√	√	√
Run Purge (5 cycles)				√	√	√
Replace UV Lamps ²				√	√	√
Flush Recoat System						√
Replace Recoat Material						√
Check Proof Test Calibration / Re-Cal						√

¹ Maintenance operations can be performed by the operator.

² Lamp replacement based schedule based on 2,000 recoats/month at 15 sec/recoat.

6.2 Cleaning

6.2.1 Clean Mold

Keeping the mold plates clean is vitally important for proper recoat performance and quality. The mold plates should be cleaned of dirt, dust or excessive recoat material before each use. Clean the mold plates only with a soft cotton swab soaked in cleaning solution. Acetone is the preferred solution for cleaning the mold plates. Acetone cleans more thoroughly than alcohol and will also soften and lift away any cured recoat material. Do not use excessive scrubbing or scraping action to clean the plates. Give the cleaning solution time (60-90 seconds) to soften and lift any cured material. Excessive cleaning can shorten the life of the mold through damage to the coatings on the mold plates or chipping of the mold channel.

6.2.2 Check/Clean FHB Inserts

The fiber holding block inserts have a rubber insert that grips the fiber for proof testing. These should be checked for damage and cleanliness prior to each shift. If the rubber insert is damaged or dirty, the fiber may slip prior to reaching the maximum proof test level. If required, clean the rubber insert with a cotton swab or lens tissue soaked in isopropyl alcohol. If rubber insert is damaged it should be replaced.

Note: Do not use acetone to clean the rubber inserts. Repeated cleaning with acetone will damage the rubber.

Note: Do not clean the insert with alcohol when the PTR-200 is turned ON. The alcohol could be drawn into the vacuum system, causing damage.

6.3 Recoat System Maintenance

6.3.1 Check Recoat Bulb

The MRL uses tungsten halogen lamps as the UV source for curing the recoat material. These lamps have a useful lifetime of 500 minutes (30,000 seconds) and degrade linearly to 50% of their initial output over this period. For a standard cure time of 15 seconds on a 280 micron mold, this is a useful life of 2,000 recoats. If the lamps collect dirt and/or recoat material due to improper use and/or cleaning, this lifetime can be even further reduced. For production environments, it is recommended that a fixed lamp replacement schedule of 1500 recoats be implemented (shorter if using longer recoat cure times for larger mold). Also note that during this period the cure time will need to be increased to compensate for reduced lamp output.

To check the recoat lamps, open the top of the recoat mold assembly. Press and hold the CURE button on the PTR-200. This applies low power to the UV lamps for visual inspection. Look through the bottom recoat mold plates and check to make sure that all four recoat lamps are visibly illuminated. Because the lamps are powered in two series pairs, if one lamp burns out, only two will remain illuminated.

WARNING

Don't inspect the UV lamps while the top of the recoat mold assembly is closed, as the UV lamps will be powered for a cure process when pressing the CURE button.

If a lamp is burned out, remove the recoat assembly (see 6.3.7) and replace the burned out lamp (see 6.3.8). Replace the recoat assembly and re-align.

6.3.2 Empty the Manual Injection System

If the recoat mold assembly is stored for any length of time, the acrylate injector port must be emptied, particularly if it is stored near a fluorescent light source. If it is stored when not empty, the material may cure (harden) in the port. To empty the injector, open the recoat mold top. Turn the injection plunger clockwise to force the UV acrylate material out of the injection port and onto the recoat mold plate. Wipe up the acrylate as it is ejected with a soft lint-free cloth. Clean the mold thoroughly and store with several layers of soft lens tissue between the plates.

6.3.3 Flush the Manual Remote Injection System

The recoat pumping system should be flushed clean every 6 months as part of the recoat material replacement procedure. Before flushing the system, make sure to have lens tissue and cleaning solution (acetone or alcohol) available prior to proceeding. To flush the system:

1. Raise the recoater top.
2. Position the selection lever to the Inject position (lever horizontal).
3. Screw in (turn clockwise) the knurled syringe screw until a slight resistance is felt at the end of travel. Do not use excessive force when turning in the screw once the end of travel is reached. The end of travel point is reached when the leading edge of the syringe screw is approximately level with the step in the syringe body.

Note: Make sure to collect the recoat material as it comes out of the mold injection port. Do not allow recoat material to run down the face of the mold and under the mold plate.

4. Replace the recoat bottle with one containing clean solvent
5. Turn the selection lever to the Fill position (lever down).
6. Unscrew (turn counter-clockwise) the knurled syringe screw to draw the solvent from the bottle into the syringe. Continue unscrewing the syringe screw approximately $\frac{3}{4}$ inches or until it is felt to spin freely.

Note: Do not pull on the syringe screw once the end of travel is reached; this will pull the plunger out from the syringe body.

7. Turn the selection lever to the Inject position (lever horizontal) and screw in (turn clockwise) the syringe screw until the inject end of travel point is reached.
- Note:** If the syringe screw was fully unscrewed until it spun freely, a slight forward pressure may initially be required to re-catch the threads.)
8. Watch the injection port for signs of solvent.
 9. The above steps of filling and injecting the syringe must be repeated several times to fully displace recoat material from the system. Repeat until clean solvent flows from the injection port.
 10. Clean the mold plates of all excess solvent and recoat material.
 11. Remove the bottle containing the solvent and dispose of the solvent according to proper handling guidelines.
 12. Repeat step 5-7 with no bottle present to purge any solvent from the injection system.
 13. Prime the system by following the instructions in 3.3

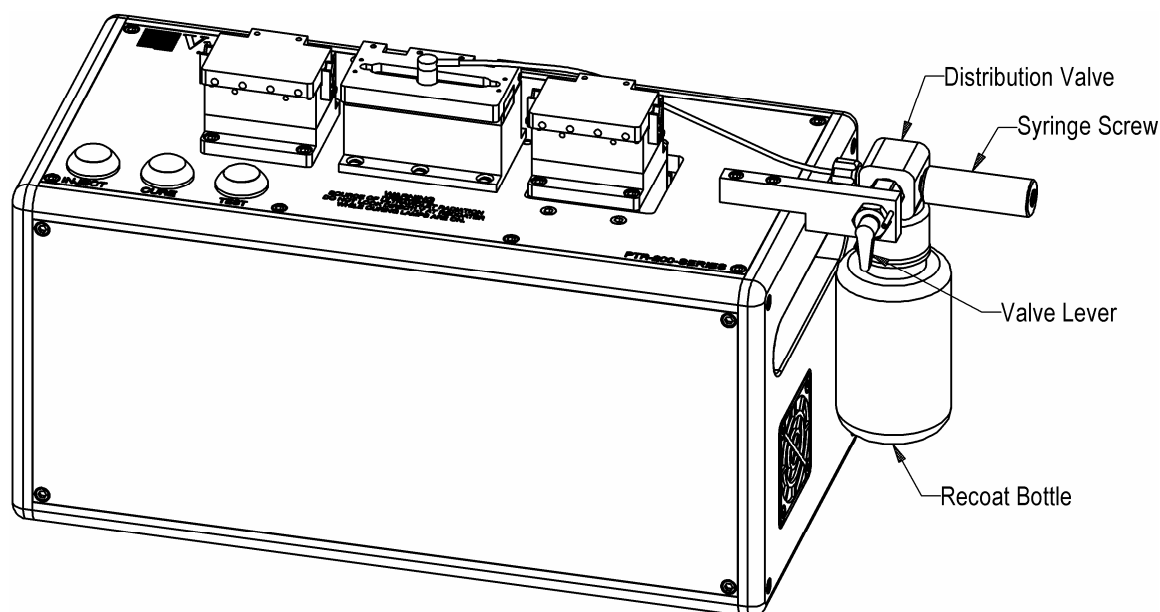


Figure 28: Remote Injection System

6.3.4 Purge the Automatic Injection System

The purge cycle is a process of emptying the recoat material of the Automatic Injector back into the recoat material bottle and refilling the pump with fresh recoat material drawn from the bottom of the bottle.

If the recoater is not used in a high volume application (less than 200 recoats per month), it is recommended that the system be purged monthly in order to circulate fresh recoat material into the pump. Running 5 purge cycles is sufficient to entirely fill the pump with fresh recoat material.

6.3.5 Flush Automatic Injection System

The recoat pumping system should be flushed clean every 6 months as part of the recoat material replacement procedure. Before flushing the system, make sure to have lens tissue and cleaning solution (acetone or alcohol) available prior to proceeding. To flush the system:

1. Remove the internal recoat bottle and clean all exposed tubing and fittings with acetone.
2. Install a bottle filled $\frac{3}{4}$ full with acetone on the pump.
3. Run 5 purge cycles.
4. Remove the bottle and fill with clean acetone.
5. Run 5 more purge cycles.
6. Make sure the recoat mold is open.
7. Run several inject 50 sequences until acetone runs clear from the mold inject port.

Note: Make sure to collect material as it comes out of the inject port. Do not allow any material to run under the mold plates.

8. Remove the bottle of acetone from the pump.
9. Run several more inject 50 sequences until no more acetone exits the injection port.
10. Run one purge cycle. Make sure to collect any acetone that comes out of the green purge tube at the top of the bottle fitting.
11. Clean all bottle tubing and fittings with acetone.
12. Prime the system by following the instructions in 3.3.1

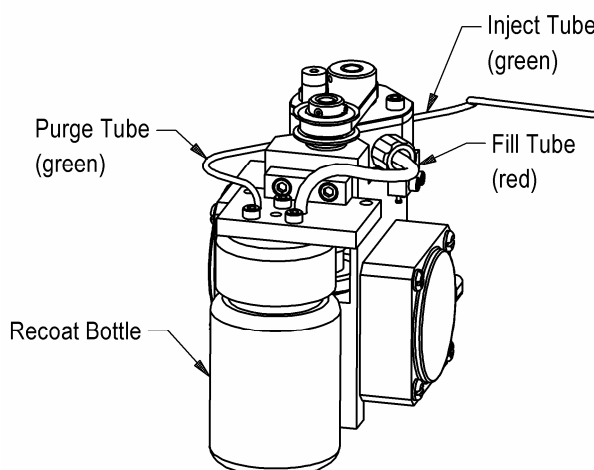


Figure 29: Recoat System

6.3.6 Replace Recoat Material

Recoat material has a finite shelf life and should be replaced every 6 months. To replace the recoat material first flush the system as outlined above. Once the system is flushed, fill a clean recoat bottle $\frac{3}{4}$ full with fresh recoat material and follow the procedures in chapter 3.2.

Note: The one-ounce internal recoat bottle holds approximately 30,000 micro-liters when $\frac{3}{4}$ full. The number of recoats per fill and the approximate time before the material needs to be refilled can be determined based on the volume of material per recoat (typically 2.5 micro-liter for a 280 micron mold) and the number of recoats per month. For most applications the material will need to be replaced before it runs out. Even if fresh material is added to the internal bottle prior to the 6-month Preventive Maintenance (PM) schedule, the material should still be replaced since mixing of the old and new materials occurs.

6.3.7 Replace and Align Mold Assembly

To remove the recoat assembly, remove the six (6) flange screws at the base of the assembly. Lift the recoat assembly straight up until it clears the recoat lamps. Keep track of the micro switch actuating post which may slide free of the assembly.

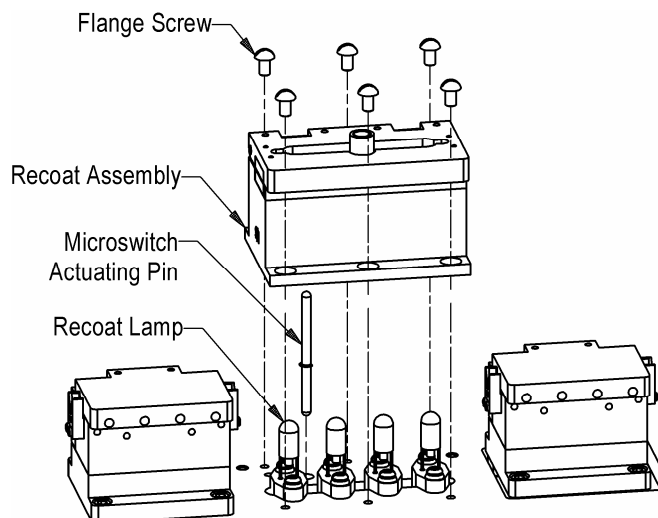


Figure 30: Remove Recoat Assembly

Before replacing the recoat assembly, make sure that the base plate, bottom of the mold assembly and micro switch actuating post are cleaned of any dirt particles. Replace the micro switch actuating post by inserting the long end into the recoat assembly. Verify that the post moves up and down freely.

Lower the assembly straight down over the recoat lamps and replace the six (6) flange screws. Lightly tighten two diagonal screws only to allow for adjustment of the recoat assembly. Open the recoat station top and the tops of the fiber holding blocks. Clamp a length of coated fiber between the holding blocks such that the fiber is under slight tension. (A fiber nominally smaller than that of the diameter of the recoat mold should be used). Using a 10X magnifying loupe, view the fiber straight down at the right-hand edge of the recoat station, as shown in the Figure 31. Adjust the recoat assembly such that the fiber is centered in the bottom recoat groove. Repeat this procedure while viewing the fiber at the left edge of the recoat station. Tighten the recoat flange screws and re-check the fiber alignment.

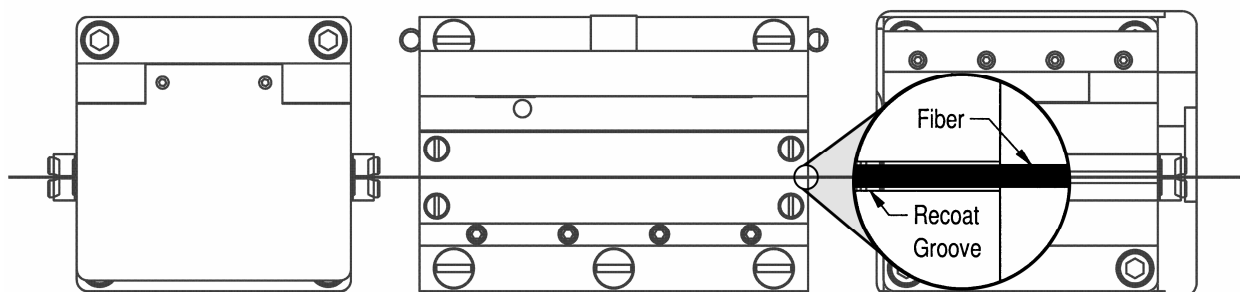


Figure 31: Align Recoat Mold

6.3.8 Replace Tungsten Halogen Lamps

In order to gain access to the lamps remove the recoat assembly as shown in chapter 6.3.7. Remove the lamp by pulling it out of the lamp socket and replacing it with a new one. Avoid handling the glass envelope. Fingerprints left on the envelope could shorten the lamp life. If you do touch the lamp, be sure to clean it with a soft lens tissue wetted with alcohol or acetone. Make sure all of the bulbs are positioned in a straight line. Replace and align the recoat mold assembly.

6.4 Proof Test System Maintenance

6.4.1 Check Proof Test Calibration/Re-Cal

The proof test calibration must be periodically checked to ensure that the correct load is being applied to the fiber. If the proof tester is applying a greater load than expected, the process yield may be adversely affected due to excessive proof test failures. If the proof tester is applying a load less than expected, the proof tested section of the fiber may be weaker than required and could fail at a later time.

Checking and re-calibrating the proof tester requires special equipment and training. Contact an authorized Vytran representative to learn more about calibration options.

6.4.2 Replace Fiber Holding Block Inserts

Replace the top or bottom insert by loosening the four (4) set screws securing them in place with a 0.035 Allen wrench. (One full turn counter-clockwise should be sufficient.) Remove the insert and clean the slot of the fiber holding block. Refit the new insert into the slot and center it within the fiber holding block. Lightly tighten the set screws while applying downward pressure on the insert. Excessive force is not required to hold the inserts in place - do not over tighten.

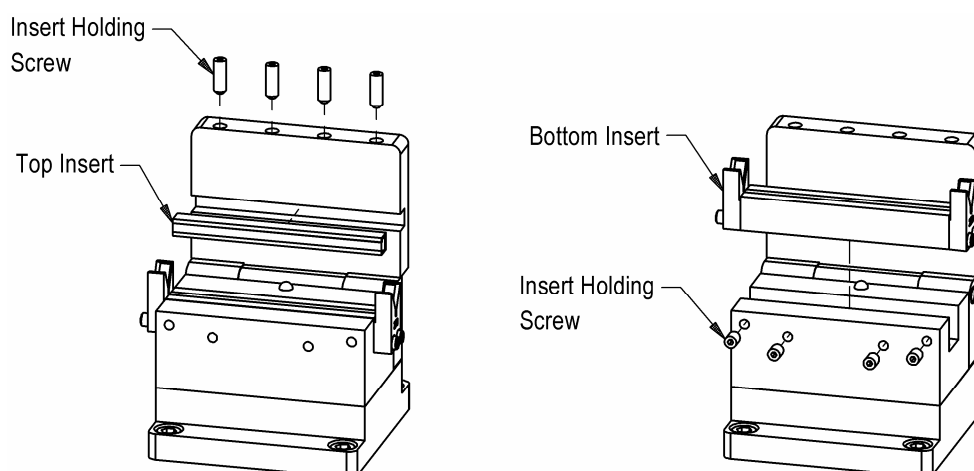


Figure 32: Replace FHB Inserts

Appendix A: Process Parameters

Table 1 gives the approximate injection quantity in micro liters for different length recoats and different mold sizes. A 125µm fiber diameter is assumed for all mold sizes except 160µm, which is calculated based on an 80µm fiber diameter. The formula for calculating injection volumes is also given.

Recoat Length	Mold Size				
	160 µm	260 µm	280 µm	430 µm	900 µm
5 mm	0.08µl + P.V.	0.20µl + P.V.	0.25µl + P.V.	0.66µl + P.V.	3.12µl + P.V.
10 mm	0.15µl + P.V.	0.41µl + P.V.	0.49µl + P.V.	1.33µl + P.V.	6.24µl + P.V.
15 mm	0.23µl + P.V.	0.61µl + P.V.	0.74µl + P.V.	1.99µl + P.V.	9.36µl + P.V.
20 mm	0.30µl + P.V.	0.82µl + P.V.	0.99µl + P.V.	2.66µl + P.V.	12.48µl + P.V.
25 mm	0.38µl + P.V.	1.02µl + P.V.	1.23µl + P.V.	3.32µl + P.V.	15.60µl + P.V.
30 mm	0.45µl + P.V.	1.22µl + P.V.	1.48µl + P.V.	3.99µl + P.V.	18.72µl + P.V.
40 mm	0.60µl + P.V.	1.63µl + P.V.	1.97µl + P.V.	5.32µl + P.V.	24.96µl + P.V.

P.V. = Plate Volume (typical value 2 to 5 µl)

Table 1: Approximate injection quantity in micro liters (µl) required for different length recoats

The volume of recoat material required can be calculated as follows:

$$Vol(\mu l) = \left(\frac{\pi D_{Mold}^2}{4} - \frac{\pi D_{Fiber}^2}{4} \right) \cdot Length_{Recoat} + PlateVolume$$

Diameter and length of recoat in millimeters.

Appendix B: Material Data Safety Sheet



950-200 from AngströmBond®
Page 1 of 3

Adhesives

The only adhesive line developed exclusively for fiber optics

1. MATERIAL IDENTIFICATION

Product Name:

950-200 from ANGSTRÖMBOND®

Emergency Phone:

For product emergencies involving spill, leak, fire, exposure, or accident call CHEMTREC at (800) 424-9300. For all other inquiries call **Fiber Optic Center™, Inc.** at (800) 473-4237.

2. COMPOSITION

Hazardous Components	CAS No.	Percent	Exposure Limits	
			ACGIH TLV-TWA	OSHA PEL
Multifunctional acrylate(s)		20-80	NE	NE
Monomers		20-80	NE	NE
Photoinitiator(s)		1-10	NE	NE
Additive(s)		0.01-10	ne	NE
Glycol Ether acrylate		28.5	NE	NE
Abbreviations: N.E. = Not Established				

3. HEALTH HAZARDS IDENTIFICATION

Primary Routes of Exposure:

Eyes: yes

Skin: Yes

Inhalation: Yes

Eye Contact: Contact may cause irritation. Inflammation of the eye is characterized by redness, watering, and itching.

Skin Contact: Avoid prolonged or repeated contact with skin. May cause skin irritation or sensitization.

Inhalation: Irritating to respiratory tract, coughing shortness of breath. Vapors and aerosol can produce mucous membrane, nose and throat irritation.

Ingestion: May cause mild gastric irritation, abdominal spasms, nausea and faintness.

4. FIRST AID MEASURES

Eyes: Flush eyes thoroughly with water for 15 minutes while holding eyelids open. Seek medical attention.

Skin: Wipe excess from skin, and flush the affected area with water. Follow by washing with soap and water. Wash contaminated clothing thoroughly before reuse. If irritation persists obtain medical attention.

Inhalation: Remove to fresh air, and provide oxygen or artificial respiration if needed. Obtain medical attention.

Ingestion: Do Not Induce Vomiting. Obtain immediate medical attention.

5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES

Flash Point:	higher than 93.3°C
Explosive Limits:	Not determined
Auto – Ignition Temperature:	Not determined
Hazardous Decomposition Products:	Carbon oxides, nitrogen oxides

EXTINGUISHING MEDIA and FIRE FIGHTING INSTRUCTIONS

When sufficiently large quantities are present, firefighters should be equipped with full bunker gear, including a positive pressure, NIOSH approved, self-contained breathing apparatus. Fire-exposed containers may be cooled with water.

Extinguishing Media: Use water spray, fog, dry chemical powder, or an appropriate foam.

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Rev. A 10/2002

Fiber Optic Center™, Inc., 23 Centre Street, New Bedford, MA, 02740-6322, USA

E-mail: sales@focenter.com

Toll Free: (800) IS-FIBER or (800) 473-4237 • Phone: (508) 992-6464 • Fax: (508) 991-8876 • Website: www.focenter.com

**Adhesives**

THE ONLY ADHESIVE LINE DEVELOPED EXCLUSIVELY FOR FIBER OPTICS

6. ACCIDENTAL RELEASE MEASURES

Ventilate the spill area, and evacuate if necessary. Shut off the source of the leak if it is safe to do so. Remove all ignition sources. Dike and contain large spills. Absorb with clay, sand, or another suitable material, and dispose of properly.

Clean-up personnel should use adequate protective equipment.

7. HANDLING AND STORAGE

Store between 16-27°C, away from ignition sources and high temperatures. Avoid contact with incompatible materials. Wear protective eyewear, chemical-resistant gloves, and other protective clothing as appropriate. Do not breathe fumes. Avoid contact with eyes skin and clothing. After handling always wash hands thoroughly with soap and water.

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

Engineering / Ventilation Controls: General ventilation may be acceptable under most conditions, although local ventilation is required to control exposure whenever vapors, mists, or dusts are generated.

Respiratory Protection: When local ventilation is unavailable and airborne limits are exceeded, a NIOSH-approved respirator for organic vapors, a supplied-air respirator, or a self-contained breathing apparatus is required.

Skin Protection: Chemical resistant (nitrile) gloves. Lab coat

Eye Protection: Chemical splash goggles or safety glasses with side shields should be worn as appropriate.

9. STABILITY AND REACTIVITY

Chemical Stability: Stable under normal conditions and use.

Conditions and Materials to Avoid: Keep away from direct sunlight or strong incandescent light. Keep away from heat. Incompatible With peroxides, and oxidizing agents.

Hazardous Decomposition Products: Carbon oxides, nitrogen oxides

Hazardous Polymerization: Not likely under normal conditions.

10. PHYSICAL AND CHEMICAL PROPERTIES

Appearance / State: Clear viscous liquid

Odor: not determined

pH: Not determined

Vap. Pressure (mmHG): Not determined

Vap. Density (air = 1): > 1

Boiling Point: Not determined

Freezing Point: Not determined

Specific Gravity: Not determined

Solubility in Water: Not determined

Evaporation Rate: <1 compared to Butyl acetate

11. DISPOSAL CONSIDERATIONS

Keep out of surface waters, sewers, and waterways entering or leading to surface waters. Notify authorities if any exposure to the environment occurs or is likely to occur. Utilize an appropriate disposal facility, in compliance with applicable federal, state, and local environmental control regulations.

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Adhesives

THE ONLY ADHESIVE LINE DEVELOPED EXCLUSIVELY FOR FIBER OPTICS

12. TOXICOLOGICAL INFORMATION**Toxicity to Animals:**

Acute Oral toxicity (LD50): >5000mg/kg[rat] (Multifunctional acrylate)

Acute Dermal toxicity(LD50): >5000mg/kg[Rabbit] (Multifunctional acrylate)

Multifunctional acrylate: chronic health effects information:

This component has been reported to be mutagenic in the mouse lymphoma (in vitro) assay, but negative in the Ames test. A dermal carcinogenicity study was also negative.

WEEL = 1mg/m³, skin 8 hours

Based upon physical and chemical properties and the manner in which this product will be used, considering foreseeable emergencies, airborne exposure at or approaching the WEEL is unlikely to occur. Skin contact is possible. Users should take appropriate precautions to prevent skin contact.

Chronic exposure:

Chronic effects to humans:

None classified by IARC, none by NTP, None by OSHA

Acute Effects on humans:

May cause irritation to skin, eyes, and respiratory tract.

13. TRANSPORTATION INFORMATION

DOT/IATA Proper Shipping Name: Not regulated.

14. REGULATORY INFORMATION**TSCA**

The chemical components of this product are included in the TSCA Chemical Substance Inventory, as required.

SARA TITLE IIISection 313 – Toxic Chemicals

Pursuant to Section 313, this product contains Glycol Ether 28.5%

HMIS Hazards: Health: 2 Flammability: 1 Reactivity: 1

Fiber Optic Center™, Inc. urges each customer or recipient of this MSDS to study it carefully in order to become aware of and understand the hazards associated with the product. The reader should consider consulting reference works or individuals who are experts in ventilation, toxicology, and/or fire prevention, as necessary to use and understand the data contained in this MSDS.

To promote safe handling, customers and recipients should: 1 – notify their employees, agents, contractors, and others whom they know or suspect will use this material or the information in this MSDS and any other information regarding hazards or safety; 2 – furnish this same information to each of their customers for the product; and 3 – request their customers to notify their employees, customers and other users of the product of this information.

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