LDC400 & LDC400A Automated Cleavers for Fibers with Ø80 µm to Ø1.25 mm Claddings

User Guide

Table of Contents

Chapter 1 Warning Symbol Definitions

Below is a list of warning symbols you may encounter in this manual or on your device.

Symbol	Description
	Direct Current
	Alternating Current
	Both Direct and Alternating Current
	Earth Ground Terminal
	Protective Conductor Terminal
	Frame or Chassis Terminal
	Equipotentiality
	On (Supply)
	Off (Supply)
	In Position of a Bi-Stable Push Control
	Out Position of a Bi-Stable Push Control
	Caution: Risk of Electric Shock
	Caution: Hot Surface
	Caution: Risk of Danger
	Warning: Laser Radiation
	Caution: Spinning Blades May Cause Harm

Chapter 2 Safety

WARNING

Do not place your fingers under the left and right fiber holding blocks when the blocks are moving or your fingers will be pinched!

WARNING

Do not place your fingers between the ruler block and the left fiber holding block when it is moving or your fingers will be pinched!

WARNING

Use great care when working near or handling the cleave blade, as the diamond tip is "knife edge" sharp and can very easily cut through skin. Do not push on the edge of the cleave blade with your finger or you will cut yourself.

Chapter 3 Introduction

Thank you for purchasing an LDC400 or LDC400A large diameter fiber cleaver. These cleavers are designed for cleaving optical fibers from Ø80 µm up to Ø1.25 mm. During standard operation, the cleavers use a tension-and-scribe cleave method, whereby an axial tension is first applied to the fiber followed by an automated scribe process utilizing a diamond cleave blade. The LDC400A can also produce angle cleaves by first applying a pre-programmed torsion, followed by axial tension and the automated scribe process. When configured and operated properly, the cleavers can product both flat and angled (LDC400A only) cleaves with high-quality end-face finishes. For detailed information on the tension-and-scribe technique please refer to Chapter 7: Theory of Cleaving.

Chapters 3 through 6 of this manual deal with the operation of the cleaver, including information on the cleave process and maintenance. Chapters 7 and 8 provide advanced users additional information about the types of cleave processes and parameters that can be adjusted via the handset. This manual also contains:

- Frequently Asked Questions (Chapter 9)
- Troubleshooting (Chapter 10)
- Specifications (Chapter 11)
- Accessories (Chapter 12)

3.1. Parts Checklist

When unpacking the LDC400 for the first time, verify that the box contents look like this:

Figure 1 Unit and Accessories in the Box with Top Foam Sheet and Documents Removed

Check to make sure that you have the following accessories in addition to the cleaver:

- 12.5 V Power Supply (PSU)
- AC Power Cord
- DC Power Cord
- 0.035″ Allen Key
- 0.050″ Allen Key
- 3/32″ Allen Key
- Handset Controller
- Two instructional documents including this manual. The other document is the **LDC400 & LDC400A Reference Sheet**.

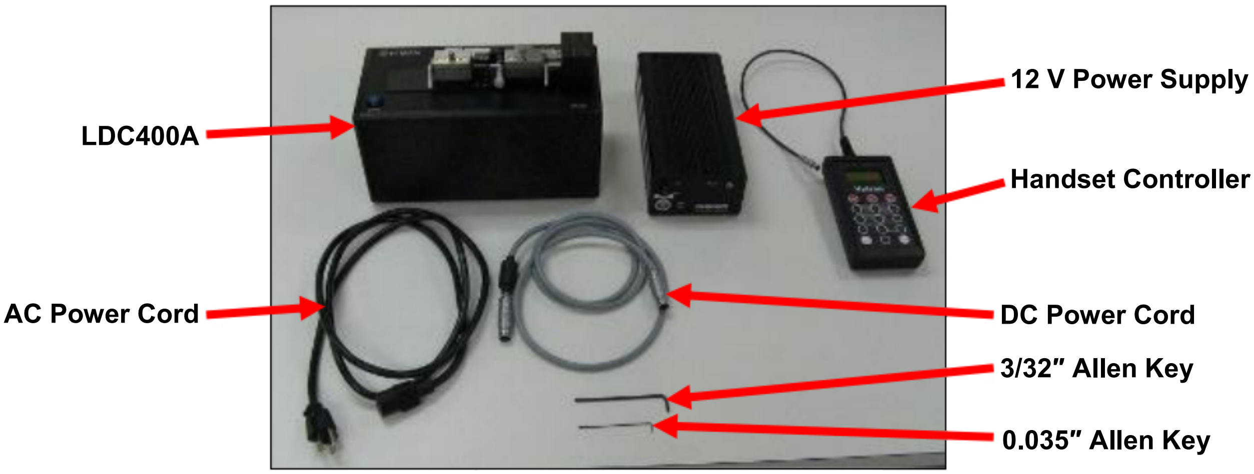

Figure 2 The LDC400A shown with Included Accessories

If you are missing any of the accessories or need replacements, please contact the distributor that you bought the cleaver from. Visit **https://www.thorlabs.com/locations.cfm** for contact information.

NOTE
Please save the packaging material and pink anti-static bag for returning the unit back to Vytran for service. This packaging will reduce the risk of damage during shipment.

Figure 3 These packing materials should be saved!

Both the LDC400 and LDC400A include a micrometer that can back up the fiber during cleaving, particularly useful for large-diameter fibers. The LDC400A incorporates a rotary stage that can rotate the right fiber holding block in order to twist the fiber and produce an angle cleave. Please note that it is not possible to add angle-cleaving capability to the LDC400.

The illustrations below show the differences between the LDC400 and LDC400A.

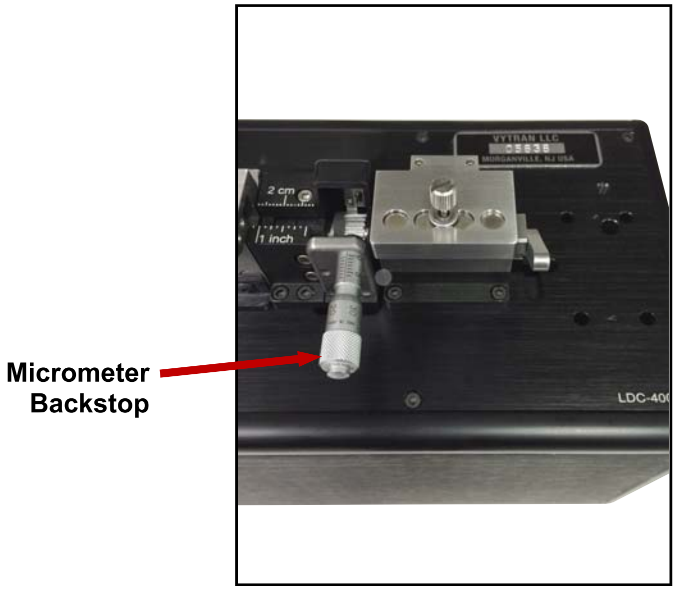

Figure 4 LDC400 Cleaver with Micrometer Backstop

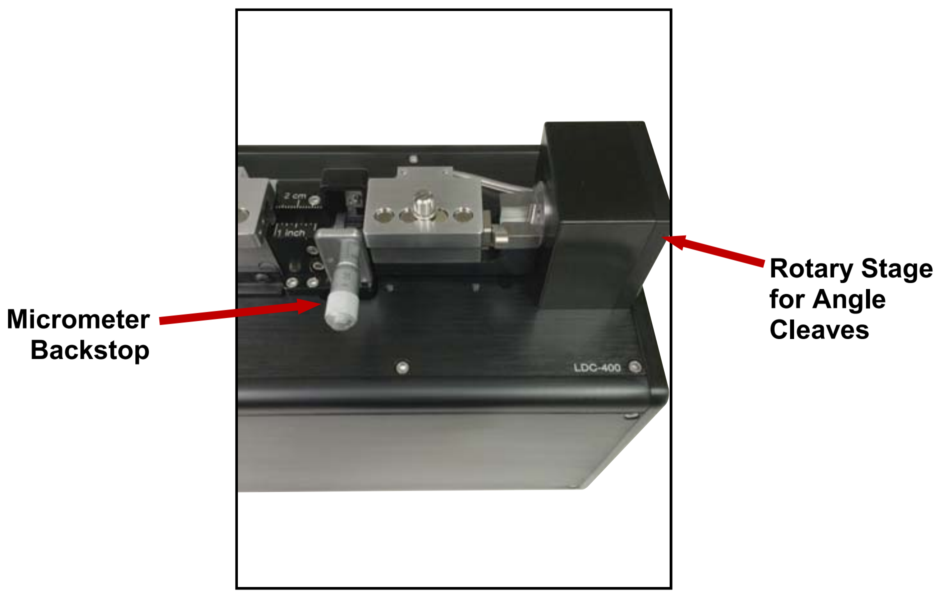

Figure 5 LDC400A Cleaver with Micrometer Backstop and Rotation Stage for Angled Cleaves

3.2. Set-up

1. Plug in the AC power cord. The power supply accepts an AC input of 90 - 260 VAC; 47 - 63 Hz.

2. Connect both the AC power cord and the DC power cable to the external power supply. The end of the DC power cord without the ferrite is the one that should be plugged into the power supply (see the photo below).

3. Connect the handset controller and the DC power cable to the LDC400 or LDC400A.

3.3. Power-up

1. Turn on the power supply.
2. Turn on the cleaver using the ON/OFF rocker switch located on the back of the unit.

3.4. Shut-down

1. Turn off the cleaver using the on/off rocker switch located on the back of the cleaver.
2. Turn off the power supply.

Chapter 4 The Handset Controller

These cleavers are configured and controlled from Vytran's handset controllers, which also provide feedback on the status of the units.

The handset controller can store up to fifty "fiber files," each of which contains the parameters for a specific cleave process. Fiber File (00) always contains the file currently in use and is stored on the handset until it is turned off. Files 1 to 50 are stored in the handset's non-volatile memory and can be configured and uploaded to the unit. The file name is composed of the cladding diameter in microns and the rotation angle, as shown below. The handset controller is shipped with fiber files for a range of common fiber diameters.

Figure 6 The Handset Controller

The **Main Menu** displays the fiber file currently in use. From this menu, press the "CFG" button to enter the Configuration Menu or press the "OPT" button to enter the Options Menu.

From the **Configuration Menu**, the fiber configuration parameters and the file name of the currently selected fiber file can be viewed, edited, and/or copied.

From the **Options Menu**, a new Fiber File can be selected and various system level configuration parameters and functions can be edited or executed.

For a fuller description of the menus and parameters, see Chapter 8.

Chapter 5 Cleaving

The LDC400 and LDC400A cleave fiber using the tension-and-scribe technique as follows:

1. A stripped fiber is secured in fiber holding blocks (FHBs).
2. The left FHB moves to the left, tensioning the fiber.
3. A diamond-coated blade approaches the fiber and makes a small scribe.
4. The tension causes the scribe to propagate through the fiber, resulting in a cleave

To obtain an angled cleave, the fiber is twisted by a rotary stage before the fiber is tensioned (LDC400A only).

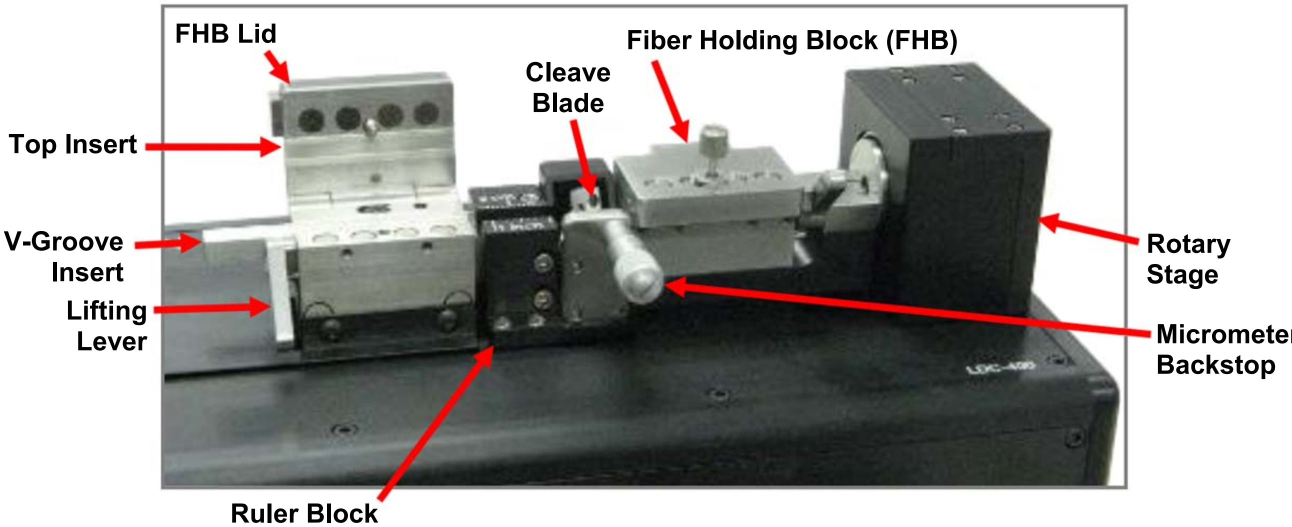

Figure 7 System Overview

This chapter provides an in-depth description of the manner in which fiber is cleaved using the LDC400 and LDC400A fiber cleavers.

5.1. The Cleave Process

The cleaver utilizes two fiber holding blocks (FHBs) to securely clamp and position the fiber prior to cleaving. The left FHB has a linear drive mechanism for applying tension to the fiber. The right FHB is either stationary (LDC400) or outfitted with a rotary drive mechanism for twisting the fiber (LDC400A). A load cell is incorporated into the left FHB for monitoring cleave tension. Once the fiber is positioned and securely clamped in the FHBs, an automated cleave process can be initiated by pressing the “Start” button.

Parameters that can be adjusted using the hand set controller are bolded; descriptions of these parameters are provided in Chapter 4: The Handset Controller. The majority of users will only need to set the **Fiber Diameter** (cladding), **Cleave Tension**, and **Pre-Cleave Advance** in the handset controller while leaving the rest of the parameters set to their default values.

The cleave process proceeds as follows:

1. For flat cleaves, the left FHB will slowly pull to the left until the specified cleave tension is reached. For angled cleaves performed with the LDC400A, the right FHB will rotate to the specified rotation angle, and then left FHB will slowly pull to the left until the specified cleave tension is reached.

2. While the fiber is held under tension (and rotated if performing an angled cleave), the diamond blade advances towards the fiber. After the blade has traveled the **Pre-Cleave Advance** distance, it begins oscillating towards the fiber in small back-and-forth steps. As soon as the diamond blade contacts the

fiber it creates a small scribe, which rapidly propagates through the fiber due to the pre-applied torsion (angled cleave only) and tension.

3. When the fiber is cleaved, the cleaver senses the drop in tension and immediately resets the positions of the cleave blade and (if using the LDC400A) rotary stage.

These cleavers are configured such that the cleave “discard” is on the right. While it is typically preferable to clamp directly on the cladding (bare glass) on the discard side, it is also possible to center-strip the fiber and to clamp on the buffer. This may be advantageous for certain types of non-circular fiber that would otherwise rotate uncontrollably during clamping. The “non-discard” side (passing through the left-hand FHB) should be clamped on the coating whenever possible to avoid potential damage to the glass. The “non-discard” (left) side should always be clamped prior to the “discard” (right) side to minimize the possibility of twisting the fiber during clamping.

Figure 8 Two Pieces of Fiber After a Cleave

It is critical that the cleave tension be set appropriately for the fiber being cleaved. If the tension is set too low, the fiber may not cleave and the diamond blade could be damaged due to excessive lateral stresses as the fiber slides along the blade. If the tension is set too high, the fiber may break at the clamping points prior to reaching the set tension, or, if the cleave is successful, the end face may have excessive “misting”, fracturing and/or roughness.

5.2. The Fiber Holding Blocks, Inserts, Lifting Levers and Thumbscrews

The Fiber Holding Blocks (FHBs) are designed to accommodate a wide range of fiber buffer and cladding sizes through the use of changeable top and bottom fiber holder inserts, which must be purchased separately. The bottom inserts feature V-grooves and are available in three varieties. Insert options are outlined in the table below. The VHD and VHF series of bottom inserts incorporate holes for a vacuum feed to assist in loading the fiber. The VHF series of transfer bottom inserts are designed to work with the VHT1 transfer clamps to aid in moving the fiber between compatible Vytran™ stations while maintaining coarse alignment. For large fibers that are too stiff to be sucked into place by the vacuum, the VHE series of inserts have long extensions that allow the fiber to be held in place by a user's finger while the FHB lid is closed. Both the bottom inserts and the top inserts (which feature flat clamping areas) must be sized according to the buffer/cladding diameter. Selecting the correct inserts ensures that full cleave tension can be applied without the fiber slipping. All inserts are labeled with a nominal accepted diameter in microns. In the event that you wish to use a fiber that is between insert sizes, refer to the chart in section 12.1 to determine which inserts would be most suitable.

Item #	Fiber Holder Insert Type	Side 1 Min/Max Accepted Diameter	Side 2 Min/Max Accepted Diameter	Vacuum Holes
VHA00	Top	57 µm / 759 µm	275 µm / 970 µm	N/A
VHA05	Top	410 µm / 1008 µm	560 µm / 1269 µm	N/A
VHA10	Top	812 µm / 1515 µm	1036 µm / 1770 µm	N/A
VHA15	Top	1288 µm / 2022 µm	1534 µm / 2268 µm	N/A
VHA20	Top	1772 µm / 2505 µm	2032 µm / 2944 µm	N/A
VHA25	Top	2278 µm / 3029 µm	N/A	N/A
VHA30	Top	2609 µm / 3198 µm	N/A	N/A
VHD080	Bottom	57 µm / 100 µm	N/A	Yes
VHD125	Bottom	88 µm / 161 µm	N/A	Yes
VHD160	Bottom	112 µm / 208 µm	N/A	Yes
VHF160	Transfer Bottom			
VHD250	Bottom	177 µm / 320 µm	N/A	Yes
VHF250	Transfer Bottom			
VHD400	Bottom	279 µm / 519 µm	N/A	Yes
VHF400	Transfer Bottom			
VHD500	Bottom	346 µm / 795 µm	N/A	Yes
VHF500	Transfer Bottom			
VHD750	Bottom	516 µm / 1047 µm	N/A	Yes
VHF750	Transfer Bottom			
VHE10	Bottom	773 µm / 1271 µm	1034 µm / 1523 µm	No
VHE15	Bottom	1280 µm / 1769 µm	1534 µm / 2007 µm	No
VHE20	Bottom	1787 µm / 2267 µm	2033 µm / 2513 µm	No
VHE25	Bottom	2270 µm / 2844 µm	N/A	No
VHE30	Bottom	2692 µm / 3198 µm	N/A	No

Lifting levers are used to overcome the very high clamping forces of the FHB magnets. To lift the FHB lid, press down on the lifting lever first, and then lift the lid. When closing an FHB lid, make sure that the lever is in the downward position: this will prevent the FHB lid from slamming down on the fiber and damaging it. After the lid comes to rest on its lifting lever cam, it can be closed gently by lifting the lever.

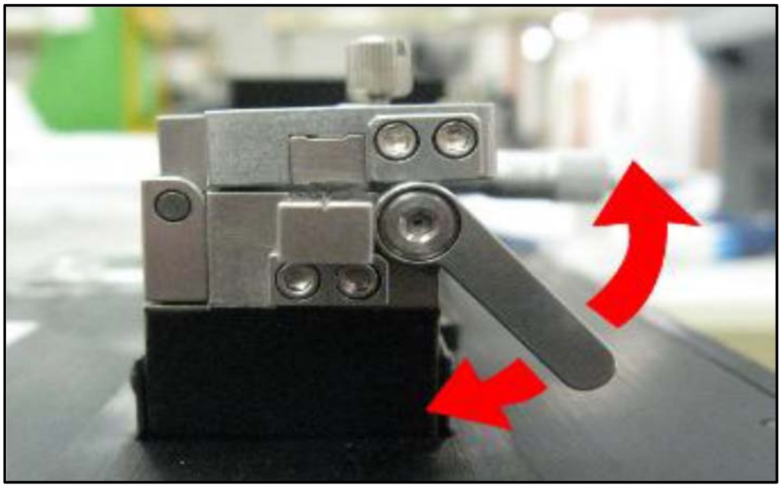

Figure 9 A Lifting Lever Propping Up the Holding Block Lid

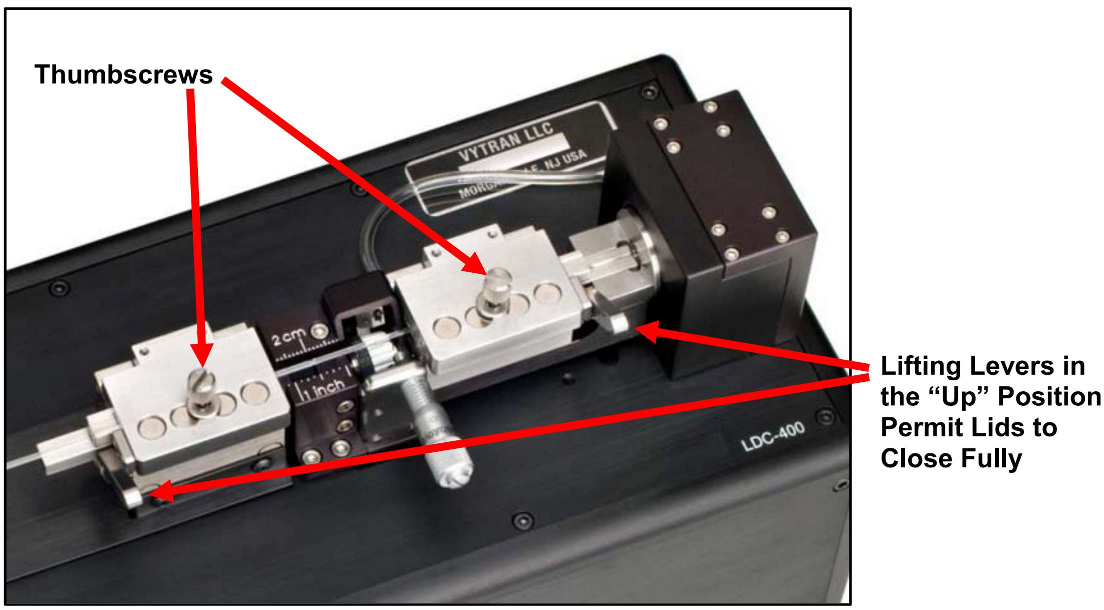

Figure 10 Lifting Levers and Thumb Screws

Thumbscrews on the FHB lids provide added clamping force for large diameter fibers (>400 µm) or for fibers with very slippery coatings requiring additional clamping force. If the thumbscrews are not required, they may be kept out of the way by threading them backwards into the lids or by removing them completely.

The normal clamping force created by the magnets may be excessive for some applications involving very delicate fiber (e.g. thin-walled capillary tubes and PCF). If the lids crush the fibers, it will be necessary to reduce the clamping force. This can be achieved by pushing out the magnets in the lids with a stick, or pulling them out with a rare-earth magnet. After completing work on the delicate fiber, remember to return the magnets to the lid holes *facing the correct direction*. They should all be attracted to, not repelled by, their counterparts in the FHB body. The polarity of these magnets alternates, and can most easily be determined by a rod-shaped magnet that is easy to hold between two fingers.

5.3. Stripping the Fiber

The fiber end should be stripped down to the cladding over a sufficient length to allow for the desired post cleave length plus the discard length. The discard length should ideally allow for full clamping in the FHB, and should therefore be 1.8″ (45 mm). A ruler block is provided for accurate positioning of the strip interface relative to the cleave point. The fiber must be stripped down to bare glass and thoroughly cleaned at the location where the diamond blade strikes the fiber (the cleave point).

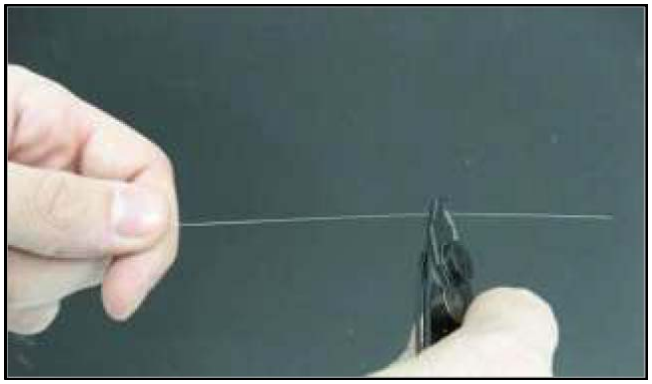

Figure 11 Stripping Fiber Using a Miller Stripper

5.4. Loading the Fiber

To load the fiber for cleaving:

1. Make sure that the correct cleave file (Fiber File) and/or process parameters are selected for the fiber to be cleaved (see Chapter 7). These values can be estimated using the Autocleave Calculator..

2. If the Fiber Holding Block (FHB) lids are closed, loosen the thumbscrews, press the lifting levers down to release the clamping force and open the lids. The internal vacuum pump will turn on for approximately 60 seconds to aid in loading fibers. If the FHB lids are already open, the internal vacuum pump can be initiated by either pressing the blue START button or by fully closing and then re-opening the left-hand FHB lid. See Section 8.3: Options Menu for information on enabling/disabling the internal vacuum pump.

3. Check that the correct FHB inserts (top and bottom) are installed and that they are free from fiber and/or coating debris. Position the fiber in the left-hand FHB V-groove with the stripped (discard) end positioned in the right-hand V-groove.

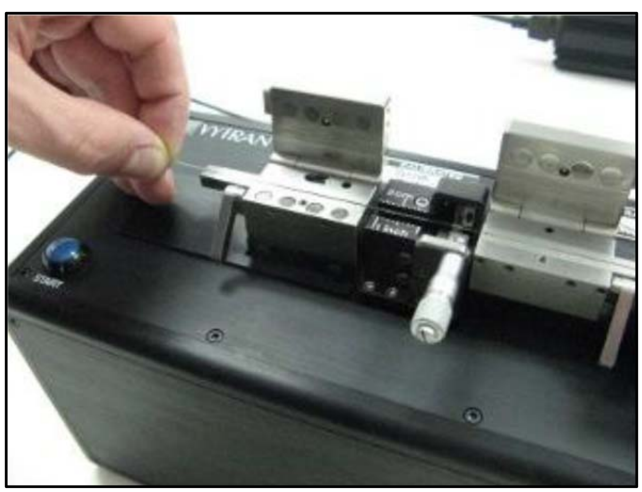

Figure 12 Positioning a Fiber in the Left-Hand FHB V-Groove

4. Check that the lifting levers are in the downward position and carefully lower the left-hand FHB lid.

5. With the lifting lever in the downward position the lid will not contact the fiber and the fiber is still free to move. Set the cleave length by positioning the fiber such that the coating-to-glass interface is aligned with the desired graduation on the Ruler Block. Once the fiber is positioned properly, raise the left-hand lever to clamp the fiber.

CAUTION

Note: Damage to the diamond blade may occur if an attempt is made to cleave a coated section of fiber. Make sure that the fiber is stripped down to bare glass and is cleaned thoroughly at the point where the blade will contact the fiber

6. With the fiber securely clamped in the left-hand FHB, check that the free end of the fiber is positioned in the right-hand V-groove, and then carefully lower the right-hand FHB lid. Raise the right-hand lever to clamp the fiber.

7. If cleaving fibers with cladding diameters larger than 400 µm or fibers with very slippery coatings, the thumbscrews on the FHB lids may need to be tightened for increased clamping force and reduced chance of fiber slippage during tensioning. If the thumbscrews are not required, they may be kept out of the way by threading them backwards into the lids or by removing them completely.

8. The fiber is now ready to be cleaved.

5.5. Cleaving the Fiber

To cleave the fiber:

1. Confirm that the fiber is loaded properly and that both levers are raised.

2. Initiate the cleave process by pressing the blue START button on the unit or the START button on the Handset Controller. The cleave process is fully automated as follows:

    a. If enabled, the internal vacuum pump will be turned off.

    b. If performing an Angled Cleave with the LDC400A, the right-hand FHB will rotate to the **Rotation Angle**.

WARNING

Do not place your fingers under the right fiber holding block during this step or they will be pinched!

    c. The left-hand Fiber Holding Block (FHB) will begin moving to the left, applying tension to the fiber.

    d. Once the **Cleave Tension** is reached, the left-hand block will stop moving.

    e. The cleave blade will move forward towards the fiber over the **Pre-Cleave Advance** distance.

CAUTION

Note: The cleave blade should never touch the fiber on the pre-cleave advance or damage to the blade could result.

f. The cleave blade will begin oscillating in a forward-and-back motion and will progressively advance towards the fiber.

g. Once the cleave blade contacts the fiber, a small scribe is generated and the fiber should cleave immediately.

h. As soon as the fiber is cleaved, the cleaver will sense the drop in the tension of the fiber and will immediately move the cleave blade back out of the way. If performing an Angled Cleave with the LDC400A, the right-hand FHB will rotate back to zero degrees.

WARNING

Do not place your fingers between the left fiber holding block and the ruler block during this step or they will be pinched!

Figure 13 Initiating a Cleave by Pressing the Blue Start Button

5.6. Unloading the Fiber

To unload the fiber after cleaving:

1. After the fiber is cleaved, the internal vacuum pump will turn on for approximately 15 seconds to assist in holding the fiber during the unloading process.
2. If the thumbscrews were secured, turn them counter-clockwise until they disengage from the FHB base.
3. Hold the fiber securely and press down on the left-hand lifting lever to release the clamping force. The fiber will be free to move after the lifting lever is lowered, so it is important to keep the fiber secured (the V-groove extension is ideal for this).
4. Raise the left-hand FHB lid and carefully remove the cleaved fiber.
5. Press down on the right-hand lifting lever to release the clamping force.
6. Raise the right-hand FHB lid and remove the cleave discard. Make sure to dispose of the cleave discard properly as these shards can be very sharp.
7. Check that no debris is left behind in the FHB V-grooves or on the lid clamping surfaces.

After a cleave is completed, the vacuum will turn on for 15 seconds to assist with unloading. After the vacuum turns off, the handset displays a message with instructions to “Close FHB or Press Start Button to Initiate Home Process.” Either action will trigger the homing routine, which re-sets the position of the left-hand FHB, the right-hand FHB if an angle cleave was performed, and the cleave blade.

If the homing process is interrupted or fails, all system functionality is disabled to prevent possible damage to the equipment. Remove any fibers and/or discards from the FHBs and cycle the power OFF then ON. The cleaver will initialize and attempt to run the homing process again. If any further difficulty is experienced, contact techsupport@thorlabs.com for assistance.

Figure 14 Removing a Cleaved Fiber from the Left Fiber Holding Block

5.7. Changing the Fiber Holding Block Inserts

Both the top and bottom FHB inserts must be selected according to the diameter of the fiber being clamped. It is common to have a set of inserts for larger diameters in the left-hand FHB for clamping on the coating, than those in the right-hand FHB, which typically clamps on the cladding. All inserts are labeled according to the optimum clamping diameter in microns. For guidance in selecting the proper inserts, see the *Insert Selection Guide* in Section 12.1. Instructions for changing the inserts are given below.

To change a top insert:

CAUTION
Do not change the top insert without a bottom insert in place, or the top insert can get stuck in the lower channel.

1. Loosen the four (4) set screws accessible from the back of the FHB lid using the 0.035″ Allen key included in the tool kit. Do NOT remove the set screws completely; one full turn counter-clockwise should be sufficient to release the insert.

2. Remove the FHB insert and replace with the desired size. For dual-sided inserts, the label for the desired size should face outward and be visible.

3. Raise the lever and make sure that the new insert is fully seated and flush with the inside face of the FHB. **Note**: The inside face of the FHB is the side closest to the cleave blade

4. Re-tighten the set screws until they are snug. Do NOT over tighten.

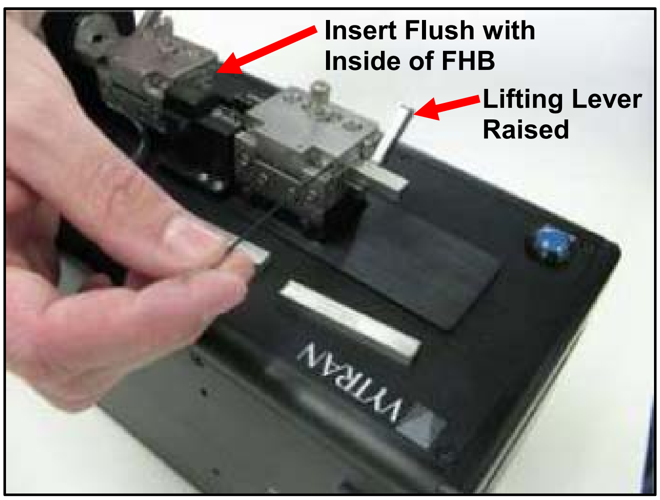

Figure 15 Changing the Top Inserts

To change the bottom V-groove insert:

1. Loosen the set screws accessible from the front of the FHB base using the 0.035” Allen key included in the tool kit. Do NOT remove the set screws completely; one full turn counterclockwise should be sufficient to release the insert.

2. Remove the FHB insert and replace with the desired size. For dual sided inserts, the label for the desired size should face outward and be visible. For vacuum V-groove inserts (VHD and VHF series), make sure that the vacuum feed ports are clear of debris by holding the insert up to a light and checking from behind to make sure light passes each of the ports. Clean if necessary.

3. Make sure that the new insert is fully seated and flush with the inside face of the FHB. **Note:** The inside face of the FHB is the side closest to the cleave blade.

4. Re-tighten the set screws until they are snug. Do NOT over tighten.

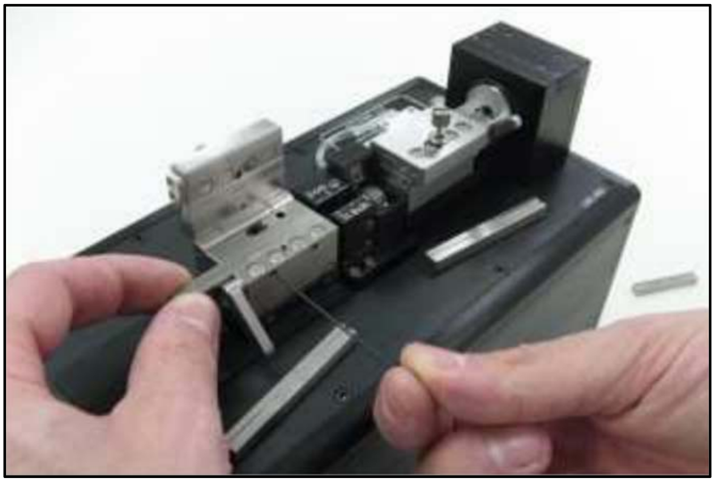

Figure 16 Changing the Bottom Inserts

5.8. Specialty Cleave Processes

Two additional process capabilities are available on these cleavers. These processes are primarily utilized for specialty fiber cleaving such as microstructured fiber, highly stressed fibers (usually PM), or capillary tubing. The specialty fiber processes are used to improve endface quality but require the execution of additional steps.

5.8.1. SubCritical Process

The SubCritical Process should be used in the following circumstances:

- When cleaving microstructured fiber such as PCF (photonic crystal fiber) or PBF (photonic band gap fiber).
- When cleaving capillary tubing whose wall thickness is less than 10% of its diameter.
- When cleaving PM fiber that has a cladding more than 400 µm in diameter.
- When angle cleaving multimode fiber or PM fiber.
- When cleaving fiber with a cladding diameter of 800 µm or larger and a high-quality end face is required.

The SubCritical Process applies a tension that is lower than required for a standard cleave. The blade then scribes the fiber, and the tension is incrementally increased to propagate the scribe and produce the cleave. Since the crack is allowed to propagate relatively slowly with little driving force, a smoother cleave surface is produced. To activate the subcritical process, select the Option Menu and scroll to the SubCritical Toggle menu. Select SubCritical Toggle and set the subcritical toggle to “Enable.” When enabled, three additional parameters are available in the Configuration Menu and their values must be specified. These parameters are Re-Tension Level, Post-Scribe Pause, and Re-Tension Pause. Please refer to the Section 8.2 for a definition of these parameters. In addition to specifying these new parameter values, two existing parameters values may require adjustment. These are Cleave Tension and Cleave Peck Cycles. Experimentation will be required in order to set these parameters. A general rule is that the cleave tension should be lowered to 60% of the autoset value and the cleave peck cycles should be set at 30. Optimal settings for these values are achieved when then the cleave blade will scribe the fiber in the last few oscillations without causing the cleave to propagate immediately or the fiber to bow significantly. Please note: all subcritical process parameters settings are VERY fiber dependant.

5.8.2. Micrometer Backstop

The optional micrometer backstop should be used in the following circumstances:

- When cleaving large fiber (cladding greater than 800 µm in diameter) if the cleave blade appears to be pushing the fiber forwards without cleaving it.
- When angle cleaving multimode fiber that is more than 250 µm in diameter.
- When cleaving capillary tubing.
- When cleaving PM fiber.
- When cleaving PCF or PBF.

Figure 17 The Micrometer Stop Acting as a Backstop to a Fiber

The micrometer stop acts as a backing for the fiber during the cleave process. When using the micrometer stop, it is possible to reduce the tension applied to the fiber because the micrometer stop will prevent the fiber from buckling when stuck by the blade to produce a longer initial scribe. The longer initial scribe cleaves the fiber, despite the relatively low tension. Since the tension is lower, the crack propagates slowly with little driving force, and a smoother cleave surface results. The micrometer stop may be used with the "SubCritical Process" to produce cleaves with very good endface quality.

A general rule to follow when using the micrometer stop is that the cleave tension should initially be lowered to 85% of the auto-set value. Adjust the tension based upon visual inspection of the endface. Increase the tension if there is no endface damage but the cleave has an angle. Decrease the tension if there is endface damage but no angle**. Do not go below 60% of the auto-set value or severe blade damage may result.**

Figure 18 Using an Eye Loupe to Check that the Micrometer Stop Just Touches Fiber

To use the micrometer stop, load the fiber in the left FHB and close the lid. Close the lid of the right FHB. Rotate the micrometer until it just contacts the fiber. It is a good idea to use a 10X eye loupe to make sure that the micrometer stop just barely touches the fiber (see Figure 18). After the micrometer stop is set, initiate the cleave per standard procedure.

After cleaving, back the micrometer away from the cleaved fiber prior to unloading. This will ensure that the fiber does not contact the micrometer during unloading.

Process Selection Chart

The following chart offers guidelines for when to use the SubCritical Process and the Micrometer Backstop.

Fiber Type	Cleave Type	Standard Process	SubCritical Process	Micrometer Backstop
Cladding <Ø800 µm	Flat or Angled[a]	✓	-	-
Cladding ≥Ø800 µm	Flat or Angled[a]	✓	May be Necessary	Use if the Blade is Pushing the Fiber Forwards without Cleaving
Multimode	Flat	✓	-	-
	Angled[a]	-	✓	Use if Fiber Cladding is ≥Ø400 µm
Thick-Walled Capillary Tubing[b]	Flat or Angled[a]	-	-	✓
Thin-Walled Capillary Tubing[c]	Flat or Angled[a]	-	✓	✓
PM	Flat	Use if Fiber Cladding is ≥Ø400 µm	Use if Fiber Cladding is ≥Ø400 µm	✓
	Angled	-	✓	✓
PCF	Flat or Angled[a]	-	✓	✓

a. Only the LDC400A can be used to produce angled cleaves.
b. Wall thickness is at least 10% of the diameter.
c. Wall thickness is less than 10% of the diameter.

Chapter 6 Maintenance

These cleavers are designed to provide trouble-free operation in a production environment provided that planned maintenance is performed as described below.

Planned Maintenance Schedule

- Inspect and clean the fiber holding blocks every shift. [1]
- Inspect and clean the cleave blade every day. [2]
- Reposition the cleave blade as needed (roughly every month). [2]
- Replace cleave blade as needed (roughly every six months). [2]
- Return the unit to Vytran for recalibration as needed (roughly once a year). [3]

[1] Maintenance operation can be performaned by the operator.
[2] Maintenance operation can only be performed by trained maintenance personnel.
[3] Recalibration can only be performed by a Vytran-certified technician.

6.1. Inspecting the Fiber Holding Blocks

The Fiber Holding Blocks (FHB's) should be inspected daily for debris and/or damage that may prevent the lids from closing properly and the fiber from being fully clamped. It is particularly important to make sure that the bottom insert V-groove surfaces and the top insert clamping surfaces are free of debris and oils. This will help to ensure that the fiber will not break or slip during tensioning. Remove debris using a nylon brush as shown below. Brush from the inside to the outside of the unit as shown (away from the cleave blade) so as to avoid getting debris inside the cleave assembly.

To remove oils from the inserts, use a cotton-tipped swab wetted with acetone or alcohol. *Never do this while the vacuum is turned on as the solvent will be sucked into the unit!*

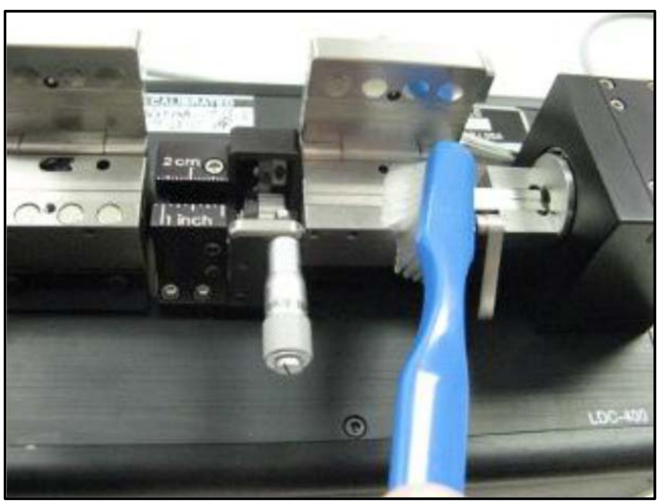

Figure 19 Removing Debris from the Fiber Holding Blocks

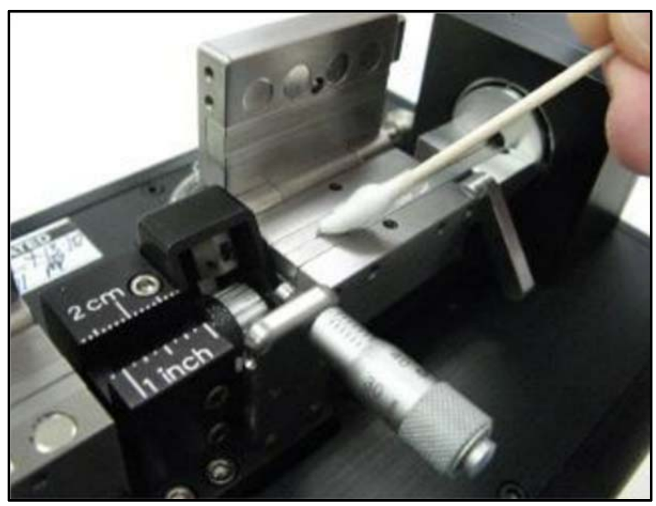

Figure 20 Removing Oils from the Inserts

6.2. Inspecting the Cleave Blade

The diamond edge of the cleave blade should be inspected daily for debris and/or damage which may result in sub-optimal cleave performance. For easier inspection and cleaning, the **Service Cleave Blade** function may be selected from the Handset Controller **Options** menu. This function will move the cleave blade to the forward (cleave) position. **Note:** Before selecting the **Service Cleave Blade** function, make sure to remove any fiber or discard pieces from the FHBs to prevent possible damage to the cleave blade and turn the micrometer knob to retract the backstop.

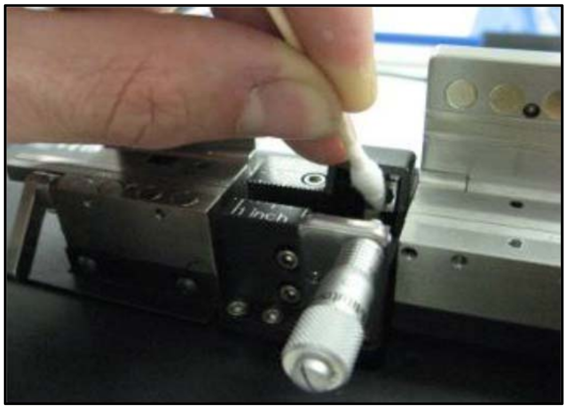

Figure 21 Cleaning the Cleave Blade

The cleave blade should be cleaned using a cotton-tipped swab wetted with acetone or isopropyl alcohol. Wipe both sides of the blade in a back-to-front direction, towards and over the diamond edge, using very light pressure only. Never touch the edge of the cleave blade with any hard or metal object. For very loose debris, the cleave blade may also be cleaned by blowing clean (canned) air across the edge.

WARNING

Use great care when working near or handling the cleave blade, as the diamond tip is "knife edge" sharp and can very easily cut through skin.

IMPORTANT

If the Service Cleave Blade function was selected, make sure to exit this function by selecting the Reset (Home) routine.

6.3. Re-Positioning the Cleave Blade

Only a small portion of the cleave blade edge is used to scribe the fiber. If this local portion of the edge gets damaged, the blade can be re-positioned to a new “un-used” section. While the lifetime of a given section of the blade can be very long (greater than 5,000 cleaves), it is also very easy to damage the blade due to excessive lateral stresses (stresses perpendicular to the edge of the blade). This can occur if the blade is in contact with the fiber and the fiber then moves sideways across the edge of the blade. The most common occurrence of this is a result the cleave tension being set so low that the fiber is unable to be cleaved. In this scenario, the fiber will slide along the edge of the blade and take a small semi-circular “bite” out of the current section. For small localized damage such as this, the blade can be re-positioned approximately 9 times.

To re-position the cleave blade:

1. Locate the 3/32″ Allen wrench provided with the tool kit.
2. Loosen the two (2) clamping screws” located at the front of the cleave block assembly; turning them counter-clockwise by ¼ to ½ turn is sufficient.
3. Turn the Height-Adjustment Screw exactly ¼ turn clockwise. This will raise the Cleave Blade Housing and re-position the blade to a new section of the diamond edge.
4. Re-tighten the Clamping Screws.

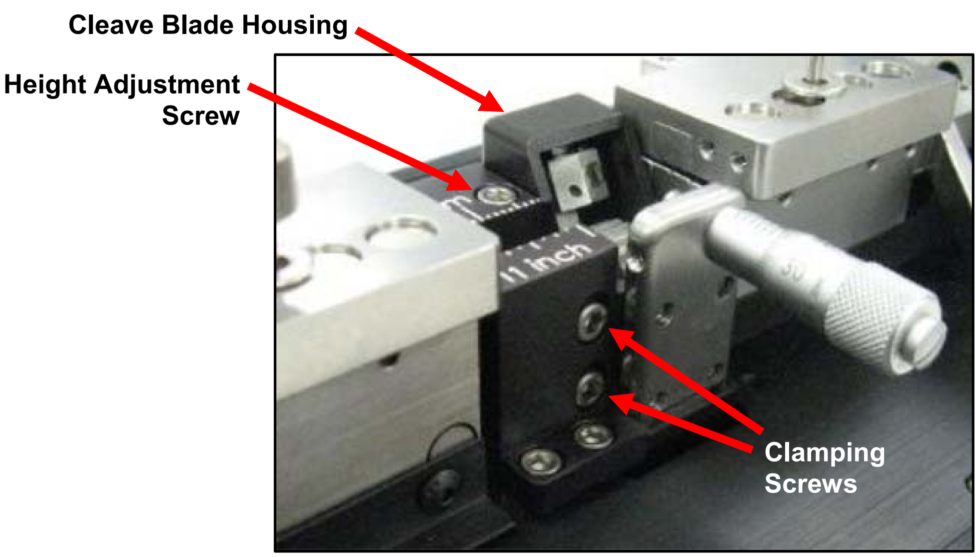

Figure 22 Screws Used in Height Adjustment

After adjusting the height of the cleave blade, perform a cleave to ensure proper operation of the equipment. Check to make sure that the cleave blade has not been raised so many times that the contact point is right at the bottom edge of the diamond blade, or that the diamond blade “misses” the fiber completely. If so, it is time to replace the cleave blade. Also ensure that the cleave blade does not strike the fiber during the **Pre-Cleave Advance**, as this can easily damage the new section of diamond blade. After the **Pre-Cleave Advance**, the blade should oscillate for approximately 3 seconds prior to striking and cleaving the fiber. If incorrect, the **Blade Offset** must be adjusted (in the handset controller **Options** menu). Every 10 step change in the Blade Offset will change the oscillation time by approximately 1 second. Reduce the **Blade Offset** for longer oscillation times. After adjusting the **Blade Offset**, it is necessary to re-home the unit using the “reset” command in the **Options** menu.

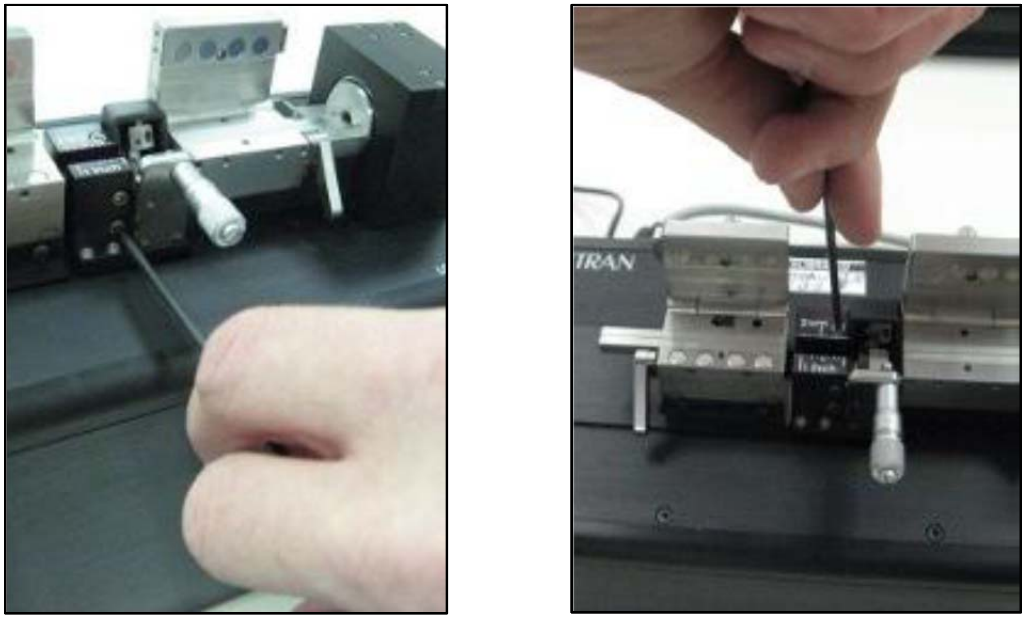

Figure 23 Adjusting the Height of the Cleave Blade

6.4. Replacing the Cleave Blade

If the cleave blade is sufficiently damaged along its edge such that it cannot be re-positioned to an “un-used” section, then replacement is required. The entire cleave blade is replaced as a unit, and consists of the diamond blade tip which is permanently mounted to a stainless steel base with a round, reduced diameter shank.

CAUTION
Use great care when working near or handling the cleave blade, as the diamond tip is “knife edge” sharp and can very easily cut through skin.

To replace the cleave blade:

1. Remove any fiber or discard pieces from the FHB’s.
2. Remove the micrometer stop by loosening the four socket head cap screws holding it in place (use the 0.05″ allen key supplied with the unit).

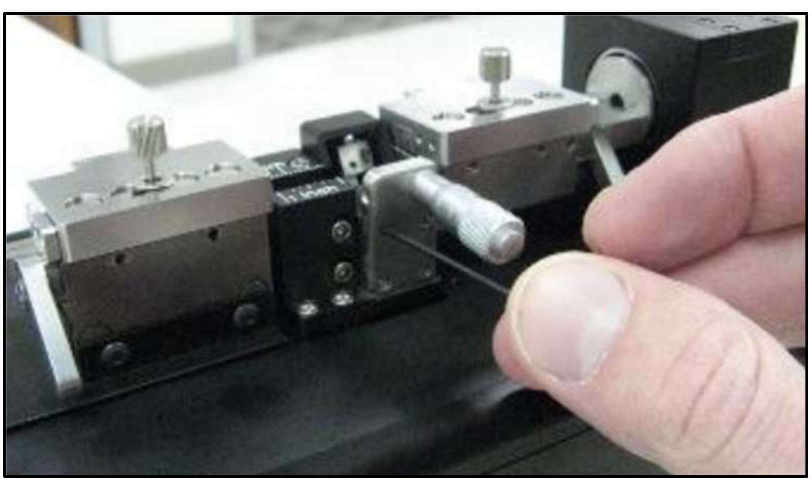

Figure 24 Removing the Micrometer Backstop

3. Select the **Service Cleave Blade** function under the **Options** menu on the Handset Controller. This function will move the cleave blade forward to the cleave position.
4. Loosen the set screw in the top of the cleave arm one full turn counter-clockwise, using the 0.035″ Allen key provided.
5. Insert the 0.035″ Allen key through the access hole in the back of the cleave blade housing and push the cleave blade out of the cleave arm. Remove the cleave blade with tweezers.

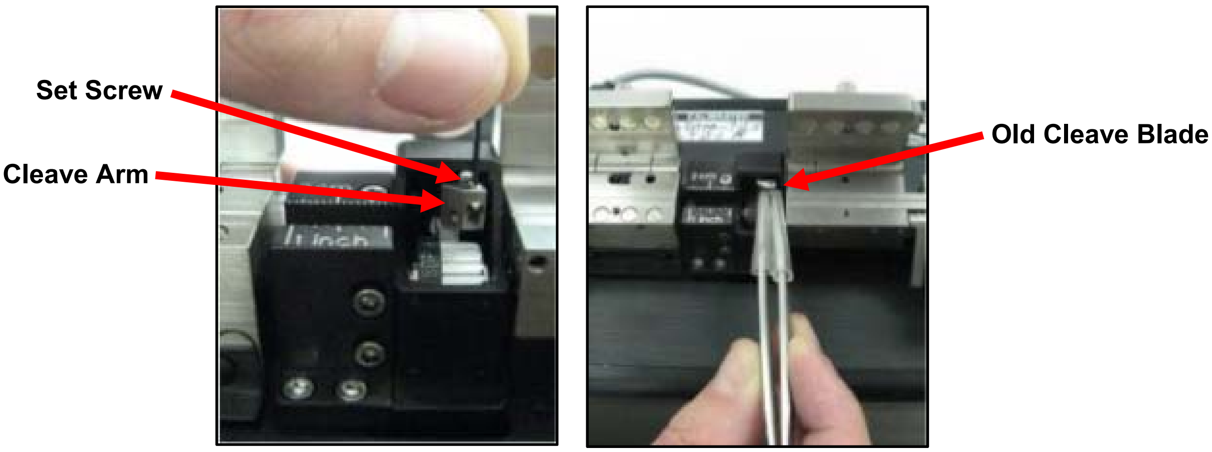

Figure 25   Replacing the Cleave Blade

Note: If the cleave blade does not push out easily from the cleave arm, attempt to provide some support to the front of the cleave arm to prevent it from rotating.

6. Select a new cleave blade and, with the protective plastic tube still in place over the front of the blade as a handle, insert the shank of the blade as far as possible into cleave arm.
7. Re-tighten the set screw until it is just snug and remove the protective tube from the front of the blade, exposing the diamond tip.
8. Check to see if the stainless steel cleave blade base is fully seated against the cleave arm and that the diamond blade is orientated perfectly vertically. If necessary, loosen the set screw and re-position the blade using a pair of flat-tipped tweezers to rotate and seat the stainless steel base. **Take great care not to touch the blade edge with the tweezers or any other hard objects or it will get damaged.**

WARNING

Do not push on the edge of the cleave blade with your finger or you will cut yourself.

9. Tighten the set screw and confirm the blade position.
10. Return the cleave blade assembly to the home position by selecting **Home** on the handset controller.
11. Reattach the micrometer stop assembly.

After replacing the cleave blade, the cleave blade housing should be moved to its lowest position. This will drop the cleave blade down so that the very top portion of the diamond blade will be the first section of the edge to be used.

To lower the cleave assembly:

1. Locate the 3/32″ Allen wrench provided with the tool kit.
2. Loosen the two clamping screws located at the front of the cleave block assembly; turning counter-clockwise one full turn.
3. Turn the height-adjustment screw counter-clockwise until it disengages.
4. Push down on the cleave blade housing until it is full seated at its lowest position.
5. Re-tighten the clamping screws.

6. Turn the height adjustment screw clockwise to re-engage, and, using very light force only, continue tightening until resistance is felt. Do not use excessive force tightening the height adjustment screw, or the cleave blade housing will be pulled upwards.

After lowering the cleave blade housing, perform a cleave to ensure proper operation of the equipment. Check to make sure that the cleave blade is not so low that the contact point is right at the top edge of the diamond blade, or that the diamond blade "misses" the fiber completely. If so, follow the instructions for Re-Positioning the Cleave Blade in Section 6.3 above, and repeat until the top portion of the blade hits the fiber during a cleave. It is also important to check the blade oscillation time after replacing the cleave blade. After the **Pre-Cleave Advance**, the blade should oscillate for approximately 3 seconds prior to striking and cleaving the fiber. If incorrect, the **Blade Offset** must be adjusted (in the handset controller **Options** menu). Every 10 step change in the **Blade Offset** will change the oscillation time by approximately 1 second. Increase the **Blade Offset** for shorter oscillation times.

6.5. Load Cell Calibration

The load cell calibration should be checked every year to ensure that accurate cleave tension is applied to the fiber and that optimal cleave angle and end-face quality is achieved. This task must be performed by a Thorlabs-certified technician.

Chapter 7 Theory of Cleaving

The LDC400 and LDC400A automated fiber cleavers are designed for cleaving optical fibers with claddings from Ø80 µm up to Ø1.25 mm. To produce a flat cleave, the cleavers use a “tension-and-scribe” method, whereby an axial tension is first applied to the fiber followed by an automated scribe process utilizing a diamond cleave blade.

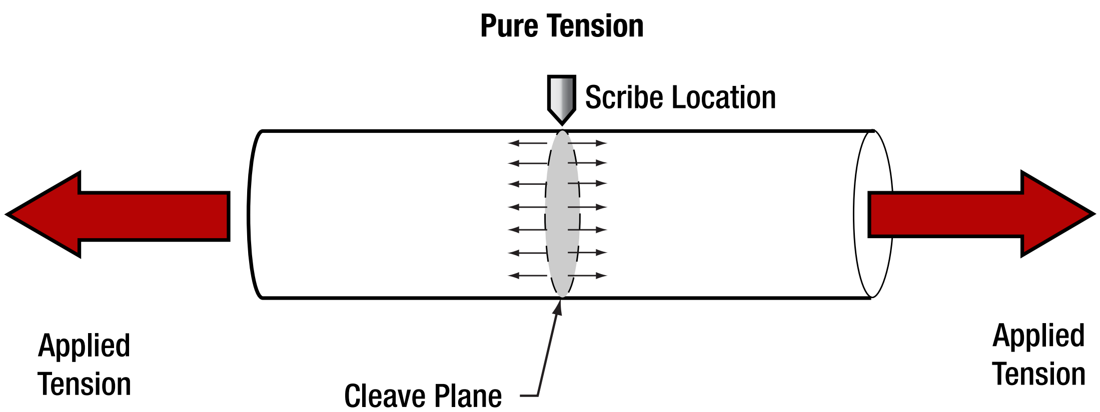

Figure 26 Pure Tension: Maximum stress is in the directon of the fiber axis and the cleave is perpendicular to the axis.

The LDC400A is also capable of producing angled cleaves. To accomplish this, a pre-programmed torsion is applied to the fiber first, followed by axial tension, and then the automated scribe process.

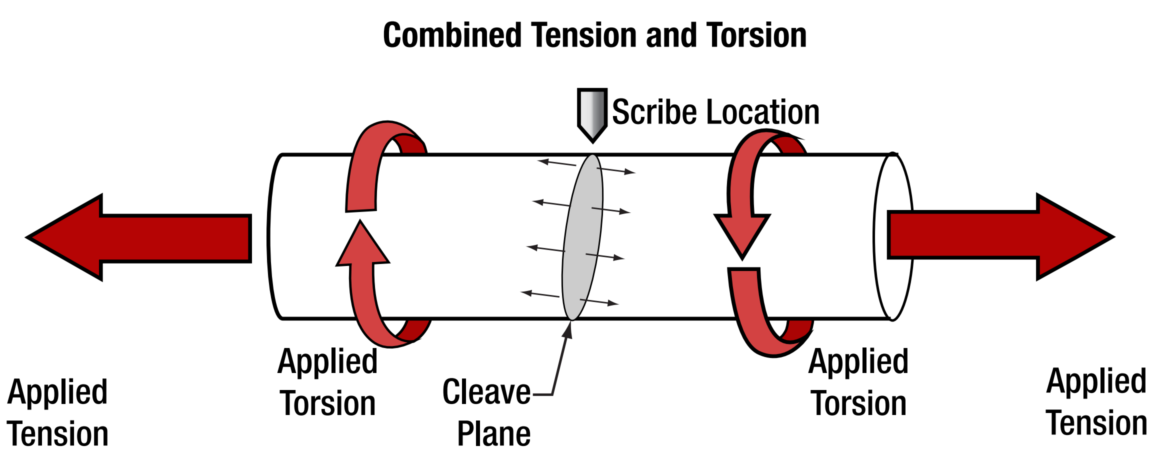

Figure 27 Combined Tension and Torsion: Maximum resultant stress is at an angle between the fiber axis and 45° and the cleave is perpendicular to this direction.

When configured and operated properly, both cleavers are capable of producing cleaves with high-quality end-face finishes.

7.1. Specialty Fiber Cleaving Processes

Two additional process capabilities are available on the LDC400 and LDC400A. These processes are primarily utilized for cleaving specialty fibers such as microstructured fiber, highly stressed fibers (MM and PM), or capillary tubing. The specialty fiber processes are used to produce flat cleaves and improve endface quality but require the execution of additional steps.

1. SubCritical Process

   The "SubCritical Process" applies a tension that is lower than required for a "standard" cleave. The blade then scribes the fiber, and the tension is slowly (and incrementally) increased to propagate the scribe and produce the cleave

2. Micrometer Stop

   The flat micrometer tip acts as a backstop for the fiber during the cleave process. When using the micrometer stop, it is possible to reduce the tension applied to the fiber.

Both of these processes will be described in greater detail in later in the manual.

Chapter 8 Controlling the LDC400 and LDC400A

This section provides an in-depth description of the LDC400 and LDC400A user interface. It has been written for users desiring a complete understanding of the handset controller's function.

Each LDC400 or LDC400A cleaver is configured and controlled from the included handset controller, which also provides feedback on the status of the unit. If the cleave parameters do not need to be changed, the handset controller can be removed and the unit operated simply by pressing the blue START button. However, removing the handset controller is not recommended, as it will eliminate the user's ability to monitor system status.

The handset controller can store up to fifty "fiber files" containing the parameters required for specifying a specific cleave process. The handset controller displays the fiber file currently in use. If power is cycled, the handset controller will pull the cleave parameters from the unit and refer to them as fiber file 00. Files 1 to 50 are stored in the handset's non-volatile memory and can be configured and uploaded to the unit. The file name is composed of the fiber diameter in microns and the rotation angle in degrees. The handset controller is shipped with fiber files for a range of common fiber diameters.

8.1. Main Menu

The main menu displays the fiber file currently in use. From this menu, press the "CFG" button to enter the configuration menu or press the "OPT" button to enter the options menu.

8.2. Configuration Menu

From the configuration menu, the fiber configuration parameters and the file name of the currently selected fiber file can be viewed, edited and/or copied.

These large-diameter fiber cleavers are designed to provide easy operation when performing simple cleaves but still support customized processing for more complicated cleaves involving specialty fibers. A complete list of modifiable parameters is listed below. The majority of users will only need to enter the Fiber Diameter (cladding), Cleave Tension, and Pre-Cleave Advance while leaving the rest of the parameters set to their default values. To further simplify the process, an autoset function in the handset will estimate an appropriate Cleave Tension and Pre-Cleave Advance based on the fiber diameter, although these values can be adjusted by the user if necessary.

Parameter	Description
Fiber Diameter	The diameter of the fiber cladding to be cleaved. This option allows for current file name to be changed by editing fiber cladding diameter and rotation angle.
Cleave Tension (grams)	This parameter is the load, in grams, applied axially to the fiber prior to initiating the scribe process. The configuration menu provides manual and auto-set options for setting the cleave tension. The optimal cleave tension depends on the cross sectional area of the fiber and its material properties. The **auto-set** option will provide the appropriate cleave tension for silica fibers based on the fiber diameter specified by the current fiber file. These cleavers are calibrated using standard weights that are hung off of a pulley, so the tension settings are programmed into the handset in grams. Possible settings correspond to a range of tensions from 9.8 mN (0.0022 lbs) to 63.7 N (14.3 lbs).
Rotation Angle (degrees, LDC400A Only)	This parameter is the rotation angle, in degrees, that the right end of the fiber is twisted prior to initiating the tension process. The optimal rotation angle for a specific angle cleave is dependent upon the cross sectional area of the fiber, material properties of the glass, and tension applied. The handset has an "Auto Cleave Angle" function to estimate this value for different fibers. See Section 0 for more information. Set the rotation angle to 0° for a perpendicular cleave.

Parameter	Description
Pre-Cleave Advance (Steps)	This parameter is the distance, in steps, that the cleave blade moves forward prior to initiating the scribe oscillation cycle. The configuration menu provides both manual and auto-set options for setting the pre-cleave advance. The ideal pre-cleave advance is dependent upon the fiber diameter, and must be reduced as the fiber diameter increases. One step corresponds to 0.00006" (1.5 µm).
Set FHB Offset	This parameter is the distance to the left that the left fiber holding block will move after homing (measured in millimeters). Increase this parameter if you want to hold the fiber farther from the cleave point.
Tension Velocity (Steps/sec)	This parameter is the velocity (in steps per second) of the motor tensioning the fiber prior to the scribe process. Typically, this value is set to 60 steps per second. Lower tension velocities may be beneficial when the subcritical specialty process is enabled. One step corresponds to 0.00003125" (0.8 µm).
Cleave Peck Cycles	This parameter is the maximum number of oscillations that the cleave blade will attempt during the scribe process. Because the cleave blade advances towards the fiber on each oscillation, this value will determine the maximum total distance that the blade can advance during the scribe. The default is 60.
Cleave Forward Steps	This parameter is the distance, in steps, that the cleave blade moves toward the fiber during each blade oscillation. Typically, this parameter is set to 81 steps. Increasing this parameter (and correspondingly the “cleave back steps” parameter) may be beneficial for the “micrometer stop” specialty process. The “cleave forward steps” parameter must always be greater than the “cleave back steps” parameter for the blade to oscillate toward the fiber. One step corresponds to 0.00006" (1.5 µm).
Cleave Back Steps	This parameter is the distance, in steps, that the cleave blade moves away from the fiber during each blade oscillation. Typically, this parameter is set to 80 steps. Increasing this parameter (and correspondingly the “cleave forward steps” parameter) may be beneficial for the “micrometer stop” specialty process. The “cleave back steps” parameter must always be less than the “cleave forward steps” parameter for the blade to oscillate toward the fiber. One step corresponds to 0.00006" (1.5 µm).
Scribe Delay (milliseconds)	This parameter is the delay, in milliseconds, between each of the cleave blade oscillations. Typically, the scribe delay is set to 250 ms. Increasing the scribe delay may be beneficial for the subcritical and the micrometer stop specialty processes.
Auto Cleave Angle	This is a calculator that suggests parameters to use when doing angle cleaves. It asks for the desired cleave angle, the distance between the fiber holding blocks, and the fiber modulus, and then outputs a recommended tension and rotation. Some experimentation may be required to fine-tune these parameters for the ideal angle cleave. See Section 0 for more information.

Note: The file name is defined by the diameter of the fiber cladding in microns and the rotation angle in degrees.

The following parameters are only visible when the **SubCritical Process** has been enabled in the Options Menu. When the subcritical process is disabled these parameters are hidden.

Parameter	Description
Re-Tension Level (grams)	This parameter is the additional load, in grams, applied axially to the fiber after the post-scribe pause and after successive re-tension pauses. The optimal re-tension level is dependent upon the effective cross sectional area, material properties and type of fiber as well as scribe size. Experimentation will be required to optimize the re-tension level but it will typically be less than 50 grams. The tension settings are programmed into the handset in grams. Possible settings correspond to a range of tensions from 9.8 mN (0.0022 lbs) to 0.98 N (0.22 lbs).
Re-Tension Limit	This parameter is the percentage of original tension that will be added to the original tension after the post-scribe pause through all the successive re-tensioning steps.
Post-Scribe Pause (seconds)	This parameter is the pause, in seconds, between the last blade oscillation and the first re-tension. Typically, the Post-Scribe Pause is set to 1 - 3 seconds. This is enough time for the scribe to propagate and cleave the fiber if the scribe was too large.
Re-Tension Pause (seconds)	This parameter is the pause in seconds between each re-tension. The optimal Re-Tension Pause is dependent upon the effective cross sectional area, material properties and type of fiber as well as scribe size. Experimentation will be required to optimize the Re-Tension Pause.

8.3. Options Menu

From the Options Menu, a new Fiber File can be selected and various system level configuration parameters and functions can be edited or executed.

Parameter	Description
Load Fiber File	This menu option is used to select and upload any of the fifty stored fiber files (fiber files 1 to 50) to the LDC400 or LDC400A. **Note:** Fiber File (00) always contains the parameters currently in use by the cleaver.
Save Fiber File As	This menu option is used to save the current parameters under another fiber file number.
Service Cleave Blade	This menu option is used to advance the cleave blade to cleave position to allow for easier inspection, cleaning, or replacement of the blade. When this option is selected, the system will perform a Reset (Home) before advancing the blade for service. Once service is completed, the system will prompt the user to perform another Reset (Home) to properly re-position the blade for cleaving.
Adjust Blade Offset (steps)	This menu option allows for a global correction of the Pre-Cleave Advance, and is used to compensate for machine specific variables. Increasing the blade offset will bring the blade farther forwards after homing.
SubCritical Toggle	This menu option provides the ability to enable or disable the **SubCritical Process**. The subcritical process is primarily used for cleaving microstructured fiber. When enabled, three additional parameters are available in the Configuration Menu and these values must be specified. These parameters are Re-Tension Level, Re-Tension Limit, Post-Scribe Pause, and Re-Tension Pause. See section 5.8.1 for more detail about the SubCritical Process.
Vacuum Pump Toggle	This menu option provides the ability to enable or disable the internal vacuum pump. Vacuum assist can be used with the VHF series of V-groove fiber holder transfer bottom inserts and the VHD series of V-Groove standard fiber holder bottom inserts.

8.4. Parameter Limits

Minimum and maximum parameter values permitted by the handset controller are given below.

Parameter	Default	Min	Max
Fiber Diameter	Fiber Size Dependent	10 µm	1500 µm
Cleave Tension[1]	Fiber Size Dependent	1 g	6500 g
Pre-Cleave Advance	Fiber Size Dependent	200 Steps	400 Steps
Set FHB Offset	0 mm	0 mm	47 mm
Tension Velocity	60 Steps/s	4 Steps/s	200 Steps/s
Rotation Angle (LDC400A Only)	0°	0°	180°
Cleave Peck Cycles	60	10	250
Cleave Forward Steps	81	40	400
Cleave Back Steps	80	39	399
Scribe Delay	250 ms	1 ms	5000 ms
Set Blade Offset	Unit Specific Value	100 Steps	2500 Steps
Sub-Critical Process Parameters[2]			
Re-Tension Level (grams)	10 g	1 g	100 g
Post-Scribe Pause (seconds)	1.0 s	0.1 s	30.0 s
Re-Tension Pause	1.0 s	0.1 s	30.0 s
Re-Tension Limit[3]	20% of Cleave Tension	1% of Cleave Tension	50% of Cleave Tension

[1] These cleavers are calibrated using standard weights that are hung off of a pulley, so the tension settings are programmed into the handset in grams. This corresponds to a range of tensions from 9.8 mN (0.0022 lbs) to 63.7 N (14.3 lbs).
[2] These parameters only appear in the controller when the subcritical process is enabled.
[3] These cleavers are calibrated using standards weights that are hung off of a pulley, so the tension settings are programmed into the handset in grams. This corresponds to a range of tensions from 9.8 mN (0.0022 lbs) to 0.98 N (0.22 lbs).

8.5. Angle Cleaving

As mentioned in Section 8.2, the handset controller has a built-in calculator which suggests parameters to use when performing angled cleaves. This section explains how it is used.

1. Open the cleave data file for correct fiber diameter. It is important to have the correct fiber diameter file loaded as this is used in calculation of the required rotation.

2. Press the **CFG** button on the handset and then scroll through the various options until you get to the tenth, and last, item in the configuration menu. This is called **AUTO CLEAVE ANGLE**. Click on the **Select** button.

3. The first item that the handset will ask for is the required cleave angle. This is to 1 decimal and requires two leading digits, so if you want to calculate for 8 degrees you need to type in "080", and then press the **CFG** button.

4. The next item is **Clamp Gap**. This is the distance between the left and right fiber holding blocks in millimeters - i.e., this is the overall length of fiber that the twist is applied to. Usually this distance is 34 mm, but you need to measure this to make sure that it is correct, since you may have applied a fiber holding block offset. **Clamp Gap** is entered in whole numbers and can be a value from 30 to 99. Enter two digits only. After you have entered the distance between the fiber holding blocks, press the **CFG** button.

5. The last item is **Fiber Modulus** in GPa. This is the shear modulus or modulus of rigidity. For SMF28 and similar fibers, this number is 28. However for softer glass, 28 will be too high, and you should look up the modulus of rigidity. A smaller number should also be used for photonic crystal fiber (PCF). Note that the modulus of rigidity of silica glass varies from 19 to 31 GPa. Press the **CFG** button.

6. The handset will display two results for you: the required tension and the rotation angle to apply to the fiber. You then have to manually change the cleave data file to enter new tension and the required cleave angle values.

   Example: To produce a cleave angle of 8° in SMF28 fiber (which has a shear modulus of 28 GPa) with a distance between the fiber holding blocks of 34 mm, the suggested parameters are:

Tension	206 g
Rotation Angle	26.2°

   These are theoretical settings. To fine tune the process, you will have to make some angled cleaves and measure them to see what these settings produce, but they will not be far off.

Chapter 9 Frequently Asked Questions

Q: What is the micrometer used for?

The micrometer stop process is primarily used for cleaving highly stressed (MM and PM) fibers and capillary tubing. The micrometer stop process utilizes a support or “backing” applied to the fiber during the fiber loading. Similar to the subcritical process, a tension lower than that required to cleave is applied and the blade scribes the fiber. The micrometer stop enables the use of a lowered cleave tension while improving the endface quality. A general rule is that the cleave tension should initially be lowered to 85% of the auto-set value. Adjust the tension based upon visual inspection of the endface. Increase tension if there is no endface damage but the cleave has an angle. Decrease tension if there is endface damage but no angle. Do not go below 60% of the auto-set value. Severe blade damage may result. To use the micrometer stop load the fiber in the left FHB. Rotate the micrometer until it just contacts the fiber. Close the right FHB. Initiate the cleave per standard procedure. After cleaving back the micrometer away from the cleaved fiber prior to unloading. This will ensure that the fiber does not contact the micrometer during unloading. For more information, refer to theProcess Selection Chart in Section 5.8.2.

Q: How many cleaves per blade?
With proper cleaving parameters, typical blade life is about 5,000 cleaves per position and there are ~10 positions per blade.

Q: How do I cleave Photonic Crystal Fiber?

The subcritical process is primarily used for cleaving microstructure fiber. The subcritical process applies a tension that is lower than required to cleave, the blade scribes the fiber, and the tension is incrementally increased to propagate the scribe and produce the cleave. To activate the subcritical process, select the **Option** menu and scroll to the **Subcritical Toggle** menu, select it, and set it to **Enable**. When enabled, three additional parameters are available in the **Configuration** menu and values must be specified. These parameters are **Re-Tension Level**, **Post-Scribe Pause**, and **Re-Tension Pause**. Please refer to Section 8.2: Configuration Menu for a definition of these parameters. In addition to specifying these new parameter values, two existing parameters values may require adjustment. These are **Cleave Tension** and **Cleave Peck Cycles**. Experimentation will be required in order to set these parameters. A general rule is that the cleave tension should be lowered to 60% of the auto-set value and the **Cleave Peck Cycles** should be set at 30. Optimal settings for these values are achieved when then the cleave blade will scribe the fiber in the last few oscillations without causing the cleave to propagate or the fiber to bow significantly. Please note: all subcritical process parameters settings are VERY fiber dependent.

Q: When do I use the thumbscrews?

The FHBs are designed to accommodate a wide range of fiber buffer and cladding sizes through the use of changeable, top and bottom, FHB inserts. Thumbscrews on the FHB tops provide added clamping force for large diameter fibers (>400 µm) or for fibers with very slippery coatings requiring additional clamping force. If the thumbscrews are not required, they may be kept out of the way by threading backwards into the tops or by removing completely.

Q: How can I check the quality of my cleaves?

One way to check cleave quality is to use an interferometric cleave checker. If you are working with a GPX3000, you can instead use the software included to measure the cleave angles and view the endface.

Q: How do I know how many degrees to twist the fiber to achieve an angle cleave?

Experimentation is required to determine the ideal parameters for an angle cleave of any particular fiber. The calculator built into the handset controller can provide a first estimate for the cleave parameters. If you have further questions, contact Thorlabs' tech support at techsupport@thorlabs.com.

Q: How do I know which inserts I need to use with my fiber?

Refer to the "Insert Selection Guide" in Section 12.1.

Q: How do I figure out the meaning of all the parameters referenced by the Handset Controller?

Refer to Chapter 8: Controlling the LDC400.

Q: Is there a way to neatly cleave highly stressed fibers and very delicate fibers?

Yes, refer to Section 5.8: Specialty Cleave Processes.

Q: What should I do if the unit does not seem to be working properly?

Refer to Chapter 10: Troubleshooting.

For other questions, contact the distributor you bought the cleaver from.

Chapter 10 Troubleshooting

Symptom	Possible Cause	Solution
Unit fails to reach cleave tension	Fiber is not actually being held because levers were not lifted	Lift levers
	Fiber is not actually being held because inserts are not appropriate for that fiber size	Replace inserts with appropriately-sized inserts
	Fiber is slipping in FHB's because of oil on inserts	Clean v-groove insert and top insert with cotton swab dipped in acetone when vacuum is off
	Magnetic clamping force is too weak for the fiber you are using	Use thumb screws
	Fiber is slipping because top inserts are not fully seated in slots (magnet force reduced)	Loosen top set screws, lower lids fully by lifting levers, re-tighten set-screws
The lids won't open	Levers still up, magnetic attraction still large	Press down on the levers to lift lids slightly, then try opening lids
	The last user tightened the thumbscrews	Rotate thumbscrews counterclockwise until they release
Unit fails to cleave fiber	Blade never reaches fiber (or barely reaches fiber)	Increase pre-cleave advance or blade offset in Configure menu
	Blade reaches fiber but does not cleave it since it is chipped	Raise cleave blade assembly so that cleave blade strikes fiber at different location
	Blade passes below fiber	Raise cleave blade assembly
	Blade passes above fiber	Lower cleave blade assembly
	Blade reaches fiber but does not cleave it because fiber is large and FHB separation is large	Use micrometer stop
Cleave angles are too large	Fiber is slipping in FHB's because of oil on inserts	Clean v-groove insert and top insert with cotton swab dipped in acetone when vacuum is off
	Fiber is slipping in FHB's because fiber is large and a large force is required to tension it.	Use thumb-screws to clamp lids down tightly
	Fiber is twisting during loading due to debris in FHB's	Clean v-groove insert and top insert with soft brush, brushing from the inside out
	Cleave tension too low	Raise cleave tension
	Fiber offset on left and right is mismatched due to insert selection	Use Insert Selection Guide to select inserts such that fiber offsets will be as close as possible
	Fiber is twisting when last FHB lid is closed.	After closing the first lid (the left lid), flip the discard end of the fiber up with a stick or a pair of tweezers to let it untwist before closing the lid of the second (right) FHB.
Capillary tube/PCF breaks when lids are lowered	Clamping force created by magnets is too high	Remove half of the top magnets in lid with a stick or magnet to lower clamping force
Fiber end-face appears shattered or rough when examined closely	Cleave tension too high	Lower cleave tension

Symptom	Possible Cause	Solution
Rotary stage fails to return to horizontal position	Unit lost power while stage was rotated forwards	Keep cycling power until rotary stage returns to the horizontal position (may be necessary to repeat several times)
Vacuum not turning on when lids are lifted	Vacuum was disabled by previous user	Enable vacuum in Options Menu

Chapter 11 Specifications

Item #	LDC400A	LDC400
Cleave Type	Flat Cleave	Flat Cleave Angled[4] Cleave up to 15°
Accepted Fiber Sizes	Cladding: Ø80 µm to Ø1.25 mm Buffer: Ø80 µm to Ø3.198 mm	
Accepted Fiber Types	SM, PM, MM, Specialty Fibers Including Photonic Crystal Fiber (PCF) and Non-Circular Fiber, Capillary Tubes	
Cleave Method	Tension and Scribe	
Cleave Tolerance	±0.5°	±0.5° (Flat) ±1.0° (Angled)
Rotation Stage	N/A	0.1° Resolution, Stepper Motor Controlled
Loading	Linear Tension, Stepper Motor Controlled	
Tension	63.7 N (14.3 lbs) Max, Programmable[5]	
Scribe	Diamond Blade, Stepper Motor Controlled	
Fiber Holding Blocks	Internal Vacuum Pump for Easier Loading, Up to 9 inHg (4.4 psi) of Pressure	
V-Groove Inserts	Available Separately Below	
Power	12.5 VDC, 5 A (Provided by External Power Supply)	
External Power Supply	100 - 120 / 200 - 240 VAC, 4.5 / 2.2 A, 47 - 63 Hz	
Dimension (L x W x H) without Holding Blocks or Rotation Stage	10.14" x 5.00" x 5.00" (258 mm x 127 mm x 127 mm)	
Dimensions (L x W x H)	10.14" x 5.00" x 6.88" (258 mm x 127 mm x 175 mm)	10.14" x 5.00" x 6.96" (258 mm x 127 mm x 177 mm)
Weight	10.0 lbs (4.5 kg)	

[4] It may not be possible to create clean angled cleaves in specialty fibers with large "air-fill" fractions due to the material properties of the fiber.
[5] These cleavers are calibrated using standard weights that are hung off of a pulley, so the tension settings are programmed into the handset in grams. This maximum tension corresponds to 6.5 kg.

Chapter 12 Accessories

These cleavers comes in two basic unit configurations:

- **LDC400:** Produce Flat Cleaves in fiber with a cladding between Ø80 µm and Ø1.25 mm.
- **LDC400A:** Produce Flat or Angled Cleaves in fiber with a cladding between Ø80 µm and Ø1.25 mm.

The following accessories are available separately for use with the cleavers:

- **Fiber Holder Top Inserts** (Two Required)
- **Fiber Holder Bottom Inserts** (Two Required)
- **VHT1 Transfer Clamp** (Optional, Compatible with VHF Series of Bottom Inserts)
- **Graphite V-Grooves** (Required when Using Fibers ≥Ø550 µm VHF Series of Bottom Inserts)

12.1. Fiber Holder Inserts

Fiber Holder Inserts, which are designed to hold various sized fibers within the cleaver, must be purchased separately. The bottom inserts have V-grooves to hold the fiber, while the top inserts each feature a recessed, flat surface that clamps the fiber against the V-groove in the bottom insert. Each top and bottom insert is sold individually, as the fiber diameter clamped by the left and right holding blocks may not be the same. Two top inserts and two bottom inserts are required to operate the cleaver. Available inserts are described below, and the Insert Selection Guide on page 42 should be used to select the appropriate inserts for each holding block.

Top Inserts

The table below summarizes the top Fiber Holder Inserts that are available from Thorlabs.

Item #	Side 1 Min/Max Accepted Diameter	Side 2 Min/Max Accepted Diameter
VHA00	57 µm / 759 µm[6]	275 µm / 970 µm
VHA05	410 µm / 1008 µm	560 µm / 1269 µm
VHA10	812 µm / 1515 µm	1036 µm / 1770 µm
VHA15	1288 µm / 2022 µm	1534 µm / 2268 µm
VHA20	1772 µm / 2505 µm	2032 µm / 2944 µm
VHA25	2278 µm / 3029 µm	N/A
VHA30	2609 µm / 3198 µm	N/A

[6] *This side of the VHA00 is flat to provide additional clamping force for fibers with very small diameters.*

Bottom Inserts

Bottom inserts are available in three varieties:

- The **VHD Series of Fiber Holder Inserts** are single-sided, have holes for vacuum suction that aid in positioning small fibers, and can accommodate fiber sizes up to Ø1.047 mm.
- The **VHF Series of Fiber Holder Transfer Inserts** are designed to work with the VHT1 transfer clamps that aid in moving the fiber between compatible Vytran™ stations while maintaining coarse alignment. They are also single-sided and have holes for vacuum suction that aid in positioning small fibers.
- The **VHE Series of Fiber Holder Inserts** are for fibers with claddings >Ø773 µm. They maybe single- or dual-sided.

Typically, the transfer inserts are only be used in the left fiber holder block, as the right fiber holding block usually clamps the side of the fiber that will be discarded. The right fiber holding block of the LDC400 can accept transfer inserts, if desired, while the right fiber holding block of the LDC400A is incompatible with the transfer inserts, due to the presence of the rotation stage.

Item #	Transfer Insert	Side 1 Min/Max Accepted Diameter	Side 2 Min/Max Accepted Diameter	Vacuum Holes
VHD080	No	57 µm / 100 µm	N/A	Yes
VHD125	No	88 µm / 161 µm	N/A	Yes
VHD160	No	112 µm / 208 µm	N/A	Yes
VHF160	Yes			
VHD250	No	177 µm / 320 µm	N/A	Yes
VHF250	Yes			
VHD400	No	279 µm / 519 µm	N/A	Yes
VHF400	Yes			
VHD500	No	346 µm / 795 µm	N/A	Yes
VHF500	Yes			
VHD750	No	516 µm / 1047 µm	N/A	Yes
VHF750	Yes			
VHE10	No	773 µm / 1271 µm	1034 µm / 1523 µm	No
VHE15	No	1280 µm / 1769 µm	1534 µm / 2007 µm	No
VHE20	No	1787 µm / 2267 µm	2033 µm / 2513 µm	No
VHE25	No	2270 µm / 2844 µm	N/A	No
VHE30	No	2692 µm / 3198 µm	N/A	No

Insert Selection Guide

The table below indicates the maximum and minimum diameters that can be accommodated by different combinations of top and bottom inserts. It also indicates how far offset the fiber will be for recommended combinations of top and bottom inserts. Note that the fiber outer diameter may be the fiber cladding, jacket, or buffer. If one side of the fiber is being discarded, it is preferable to clamp onto the cladding of this section except in special cases (such as non-circular fiber) where the coating or buffer may be preferable. Sections of fiber that are not being discarded should always be clamped on the coating or buffer in order to avoid damaging the glass. This may require different sets of fiber holder inserts to be used in the left and right holding blocks. In this case, it is important to minimize the difference in the offsets introduced by the left and right sets of inserts when attempting to produce perpendicular, flat cleaves.

Fiber Holder Insert Selection Chart

Top Insert Item #		**VHA00[7]**		**VHA05[7]**		**VHA10[7]**		**VHA15[7]**		**VHA20[7]**		**VHA25[7]**	**VHA30[7]**
Accepted Diameter (Nominal)		**≤320 µm**	**400 µm**	**500 µm**	**750 µm**	**1000 µm**	**1250 µm**	**1500 µm**	**1750 µm**	**2000 µm**	**2250 µm**	**2500 µm**	**3000 µm**
Bottom Insert Item #	**Accepted Diameter (Nominal)**	**Min/Max Accepted Diameter (µm) Min/Max Offset (µm)**											
VHD080[8]	**80 µm**	57/100 -23/21											
VHD125[8]	**125 µm**	88/161 -37/36											
VHD160[8] or VHF160[8,9]	**160 µm**	112/208 -49/48	-	-	-	-	-	-	-	-	-	-	-
VHD250[8] or VHF250[8,9]	**250 µm**	177/320 -73/69	275/323 25/74	-	-	-	-	-	-	-	-	-	-
VHD400[8] or VHF400[8,9]	**400 µm**	279/519 -122/119	377/517 -23/117	410/519 -9/119	-	-	-	-	-	-	-	-	-
VHD500[8] or VHF500[8,9]	**500 µm**	346/592 -153/93	447/647 -53/147	476/711 -24/211	560/795 61/296	-	-	-	-	-	-	-	-
VHD750[8] or VHF750[8,9]	**750 µm**	516/759 -234/9	617/970 -132/221	643/878 -107/128	728/963 -23/213	812/1047 62/297	-	-	-	-	-	-	-
VHE10[7]	**1000 µm**	-	-	773/1008 -172/63	858/1093 -88/147	943/1178 -3/232	1036/1271 90/325	-	-	-	-	-	-
	1250 µm	-	-	-	1034/1269 -176/59	1119/1354 -91/144	1212/1447 2/237	1288/1523 78/313	-	-	-	-	-
VHE15[7]	**1500 µm**	-	-	-	-	1280/1515 -172/63	1373/1608 -79/156	1449/1684 -2/233	1534/1769 82/314	-	-	-	-
	1750 µm	-	-	-	-	-	1534/1770 -159/76	1611/1846 -83/152	1695/1930 2/237	1772/2007 78/313	-	-	-
VHE20[7]	**2000 µm**	-	-	-	-	-	-	1787/2022 -171/64	1871/2106 -86/149	1947/2183 -10/225	2032/2267 74/309	-	-
	2250 µm	-	-	-	-	-	-	-	2033/2268 -167/68	2109/2344 -91/144	2193/2429 -6/229	2278/2513 78/313	-
VHE25	**2500 µm**	-	-	-	-	-	-	-	-	2270/2505 -172/64	2355/2590 -87/148	2439/2675 -2/233	2609/2844 167/402
VHE30	**3000 µm**	-	-	-	-	-	-	-	-	-	2692/2944 -256/-4	2777/3029 -171/81	2946/3918 -2/250

Legend

Best Fit	**Second Best Fit** Try these options if the best fit does not incorporate your fiber sizes.	**Third Best Fit** Try these options if the other two categories do not incorporate your fiber sizes.

[7] These inserts have two grooves, one on each side, that each accommodate a different range of fiber sizes, except for the VHA00, which has a flat surface on one side that can be used to clamp the smallest fiber sizes.
[8] These bottom inserts have vacuum holes to aid in aligning small fibers when used with the large-diameter fiber cleavers.
[9] These are transfer inserts. When used with the VHT1 transfer clamp, they allow the fiber to be transferred between compatible stripping, cleaning, cleaving, splicing, and tapering stations without losing registration of the fiber tip location relative to the edges of the fiber holding block.

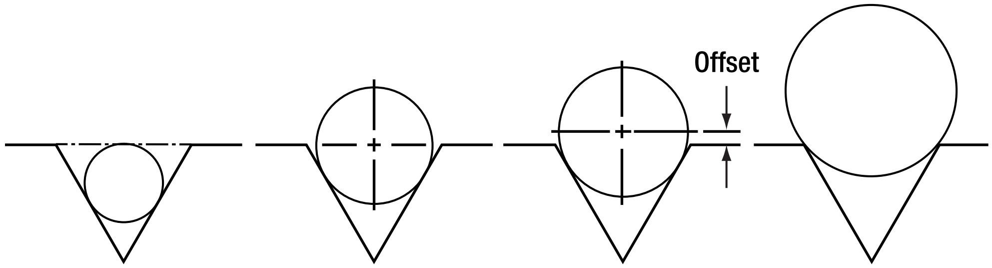

Figure 28 Each insert can hold a range of fiber sizes.

Here are instructions for using the charts on the previous page.

1. **First, select the bottom insert that matches your fiber size most closely.**
   Example: For an Ø800 µm fiber, the VHD750 insert is the closest match, since it is only 50 µm smaller.
2. **On the chart below, look to the right of your chosen bottom insert. Select a compatible top insert based on the fiber diameter size range shown in each cell.**
   Example: For the Ø800 µm example fiber from step 1, the green cell is in the 750 µm groove column for the VHA05 top insert which has two grooves. The numbers listed in the green cell indicate that this combination of inserts is good for fibers from 728 to 963 µm in diameter. Our Ø800 µm fiber is within this range, so this is a good choice. There are several other options as well that will accommodate an Ø800 µm fiber as well, but the green shading in the chart indicates that the 750 µm groove in the VHA05 provides the best fit.
3. **The second line of numbers in each cell shows the range of offsets that can be expected for any given combination of top and bottom inserts. When selecting inserts for the right and left fiber holding blocks, try to minimize the offsets between the pairs of inserts on each side.**
   Example: If we choose a VHD750 bottom insert and the Ø750 µm groove in the VHA05 top insert, we can use fiber as small as 728 µm, in which case the center of the fiber would sit 23 µm below the surface of the bottom insert. We could also clamp a fiber as large as 963 µm, in which case the center of the fiber would sit 213 µm above the surface of the bottom insert. We could interpolate to find the offset experienced by our hypothetical 800 µm fiber, but it turns out that in a 60° V-groove, the offset is equal to the diameter difference. So in our example, that means that the center of our fiber is going to sit 50 µm above the bottom insert surface, since it is 50 µm larger than the fiber that the bottom insert was designed for (800 - 750 = 50).
4. **Holding blocks designed for fibers less than Ø1000 µm have vacuum holes, designed to aid in aligning small fiber within the groove, while bottom inserts for fibers of Ø1000 µm or larger do not have these holes.** The LDC400 and LDC400A each have a vacuum pump that provides a small holding force via these holes, keeping small fibers in place as the clamps are lowered. Inserts with vacuum holes are indicated by a superscript "b" in the Fiber Holder Insert Selection Chart.

VHT1 Transfer Clamp and Graphite V-Grooves

The Fiber Holder Transfer Bottom Inserts are designed to be used with the VHT1 Transfer Clamp to allow small fibers to be easily transferred between compatible Vytran systems while maintaining rough alignment of the fiber tip location relative to the edges of the fiber holding blocks. Compatible systems are:

- FPS300 Cleaning and Stripping Station
- LFS4100 Splicer
- GPX3400 and GPX3600 Glass Fiber Processing Stations

The LFS4100 splicer and GPX series of glass processing stations require extra support for the fiber tips close to the heating filament for fibers with cladding diameters ≤550 µm. For this purpose, Thorlabs offers graphite tips with V-grooves that can be installed in the transfer inserts. Available inserts are outlined in the table below.

Item #	Accepted Diameter (Min / Max)
VHG125L	80 µm / 125 µm
VHG200	150 µm / 200 µm
VHG250	200 µm / 250 µm
VHG300	250 µm / 300 µm
VHG350	300 µm / 350 µm
VHG400	350 µm / 400 µm
VHG450	400 µm / 450 µm
VHG500	450 µm / 500 µm
VHG550	500 µm / 550 µm

Chapter 13 Maintenance and Service

NOTE

Please keep the original packaging and pink anti-static bag that the unit came in. Reuse it if your system needs to be returned to Thorlabs for service or evaluation.

The illustrations below show the correct way to re-pack the LDC400 or LDC400A. Please ensure that the bottom of the box is taped securely before re-packing the unit. If returning a malfunctioning unit for repair, we ask that you return the accessories with the unit in case one of the accessories happens to be the source of the problems.

Figure 29 Initial Placement of Foam

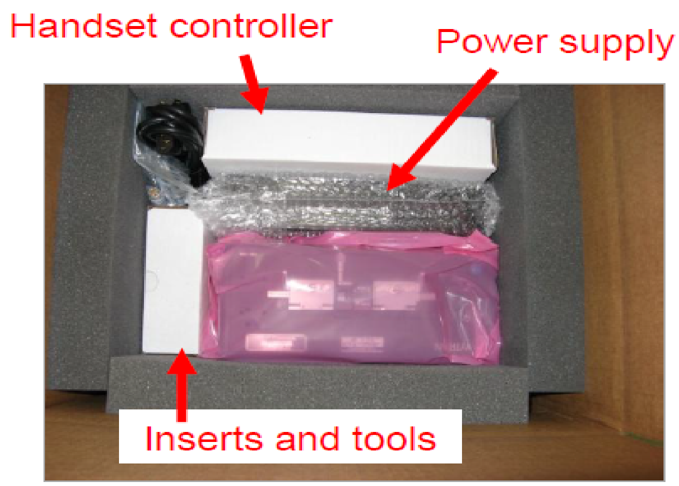

Figure 30 The Unit and its Accessories

Figure 31 Foam Supports

Figure 32 One Final Sheet of Foam on Top of Everything

Chapter 14 Regulatory

As required by the WEEE (Waste Electrical and Electronic Equipment Directive) of the European Community and the corresponding national laws, Thorlabs offers all end users in the EC the possibility to return “end of life” units without incurring disposal charges.

- This offer is valid for Thorlabs electrical and electronic equipment:
- Sold after August 13, 2005
- Marked correspondingly with the crossed out “wheelie bin” logo (see right)
- Sold to a company or institute within the EC
- Currently owned by a company or institute within the EC
- Still complete, not disassembled and not contaminated

Wheelie Bin Logo

As the WEEE directive applies to self-contained operational electrical and electronic products, this end of life take back service does not refer to other Thorlabs products, such as:

- Pure OEM products, that means assemblies to be built into a unit by the user (e. g. OEM laser driver cards)
- Components
- Mechanics and optics
- Left over parts of units disassembled by the user (PCB’s, housings etc.).

If you wish to return a Thorlabs unit for waste recovery, please contact Thorlabs or your nearest dealer for further information.

14.1. Waste Treatment is Your Own Responsibility

If you do not return an “end of life” unit to Thorlabs, you must hand it to a company specialized in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.

14.2. Ecological Background

It is well known that WEEE pollutes the environment by releasing toxic products during decomposition. The aim of the European RoHS directive is to reduce the content of toxic substances in electronic products in the future.

The intent of the WEEE directive is to enforce the recycling of WEEE. A controlled recycling of end of life products will thereby avoid negative impacts on the environment.

Chapter 15 Thorlabs Worldwide Contacts

For technical support or sales inquiries, please visit us at www.thorlabs.com/contact for our most up-to-date contact information.

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FACE
VALUE
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