THORLABS

LDC401 & LDC401A

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

User Guide

vytran®

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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

CAUTION

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.

CAUTION

The Cleave Blade should never touch the fiber on the initial, fast move towards the fiber, or damage to the blade could result.

WARNING

Do not place your fingers between the left Fiber Holding Block and the ruler block during the cleaving process or they will be pinched!

CAUTION

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

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.

Chapter 3 Description

3.1. Introduction

Thank you for purchasing an LDC401 or LDC401A 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 LDC401A 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 produce both flat and angled (LDC401A only) cleaves with high-quality end face finishes. For detailed information on the Tension-and-Scribe technique please refer to Chapter 6.

Chapters 3 through 7 of this manual deal with the operation of the cleaver, including information on the Cleave Process and maintenance. Chapters 8 and 9 provide advanced Users additional information about the types of Cleave Processes and parameters that can be adjusted via the Tablet Controller. This manual also contains:

- Setup Tips (Section 9.10)
- Frequently Asked Questions (Section 12.2)
- Troubleshooting (Section 12.3)
- Specifications (Chapter 11)
- Accessories (Chapter 10)

3.2. Parts Checklist

When unpacking the LDC401 for the first time, verify that the box contents look like this:

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

Check to make sure that you have the following items:

- Cleaver12V Power Supply
- Line Cord
- Tablet Controller
- USB Cable (for tablet data)
- USB Cable (for tablet power)
- Stand for tablet
- Nylon brush
- 0.035″ Hex Key
- 0.050″ Hex Key
- 3/32″ Hex Key
- Top inserts (purchased separately)
- Bottom inserts (purchased separately)
- Canvas Bag

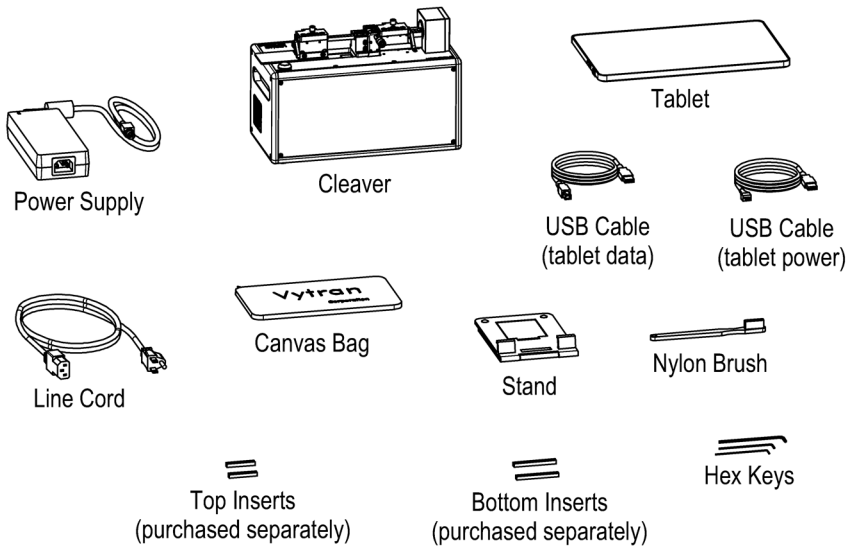


Figure 2 The LDC401A with Included Accessories

If you are missing any of the accessories or need replacements, please contact the distributor from whom you bought the cleaver. Visit **https://www.thorlabs.com/locations.com** 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 Packaging Materials Should be Saved

Both the LDC401 and LDC401A include a micrometer that can back up the fiber during cleaving, particularly useful for large-diameter fibers. The LDC401A 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 LDC401.

The illustrations below show the differences between the LDC401 and LDC401A.

Figure 4 LDC401 Cleaver with Micrometer Backstop

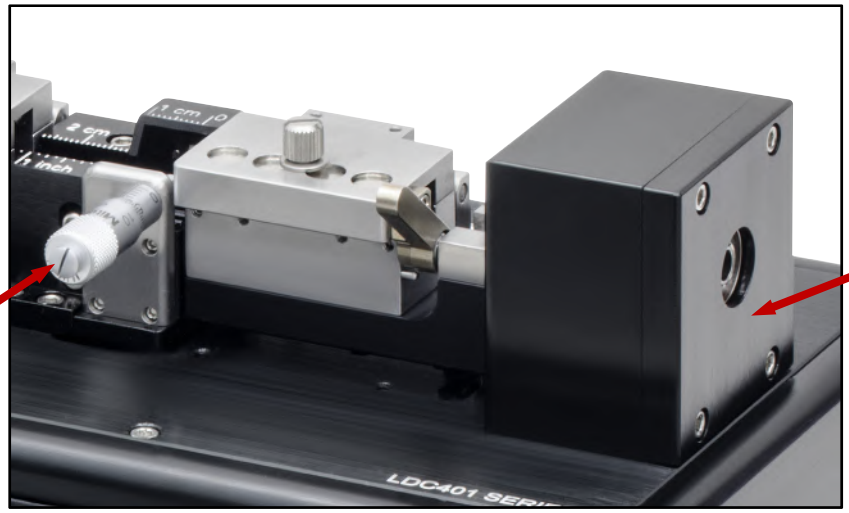


Figure 5 LDC401A Cleaver with Micrometer Backstop and Rotary Stage for Angled Cleaves

Chapter 4 Set-up

4.1. Initial Set-up

1. Plug in the AC power cord. The power supply accepts an AC input of 100 - 240 VAC; 47 - 63 Hz.

2. Connect the AC power cord to the external power supply.

3. Connect the DC power cable to the unit.

4. Locate the USB cable that has a microUSB Type B plug. Plug it into the power socket of the tablet.

5. The other USB cable has one end that is USB Type A. Plug that end of that cable into the USB socket of the tablet.

6. Plug the USB Type B plug into its socket on the back of the unit.

7. Plug the USB Type A plug (on the first USB cable) into its socket on the back of the unit.

4.2. Power-Up

1. Turn on the Cleaver using the ON/OFF Rocker Switch located on the back of the unit.
2. Turn on the Tablet Controller (press and hold the Power Button).

4.3. Shut-Down

Turn off the Cleaver using the on/off Rocker Switch located on the back of the Cleaver.

Chapter 5 The Tablet Controller

The Tablet Controller provides a simple, easy to use interface for configuring, controlling and monitoring LDC401 series cleavers.

Figure 6 Tablet Controller – LDC401 Main Screen

A status bar at the top of the screen indicates the machine connected, the file currently open (if any) and status icons for file, access security and USB connection.

At the bottom of the screen, a toolbar provides access to Tablet Controller settings, cleave files, LDC401 specific tools and fast security log-out.

Features of the Tablet Controller include:

- User Password setup,
- User accessibility control to safeguard against accidental changes to parameters and user files,
- Language selection,
- Voice notification,
- USB communications setup,
- Almost unlimited file storage and access with optional over-write protection,
- Fast security log-out,
- Easy parameter viewing/editing

Tool features specific to LDC401 series cleavers include:

- Motor control screens for manipulating Fiber Holding Block (FHB), Blade, and Rotation,
- Auto-Parameter screen, generates theoretical optimal parameters according to fiber/cleave angle,
- Blade Service screen for setting up blade position and usage counters,
- Insert Selection tool for choosing the optimum Insert combination,
- Terminal Client

For a more complete description of the Tablet Controller interface and parameters, please refer to Chapter 9.

Chapter 6 Theory of Cleaving

The LDC401 and LDC401A 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.

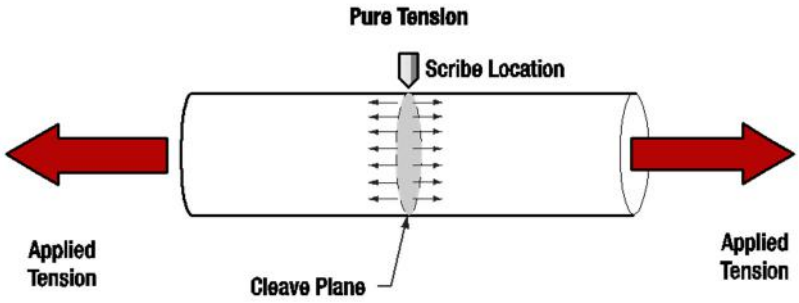


Figure 7 Pure Tension: Maximum Stress is in the Direction of the Fiber Axis and the Cleave is Perpendicular to the Axis

The LDC401A 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.

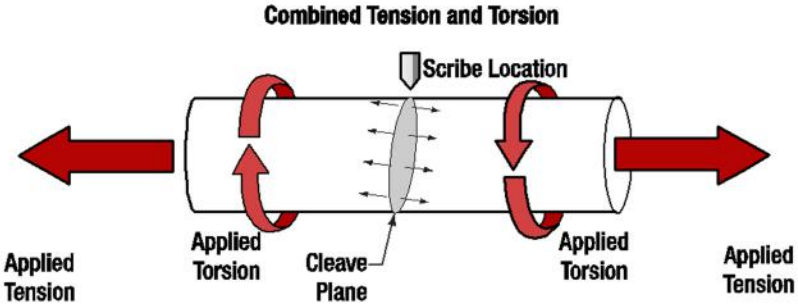


Figure 8 Combined Tension and Torsion: Maximum Resultant Stress is at an Angle between the Fiber Axis and 45° and the Cleave is Perpendicular to this Direction

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

6.1. Specialty Fiber Cleaving Processes

Two additional process capabilities are available on the LDC401 and LDC401A. 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 end face 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 Backstop

   The flat micrometer tip acts as a backstop for the fiber during the Cleave Process. When using the Micrometer Backstop, 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 7 Cleaving

7.1. Overview

The LDC401 and LDC401A 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 (LDC401A only).

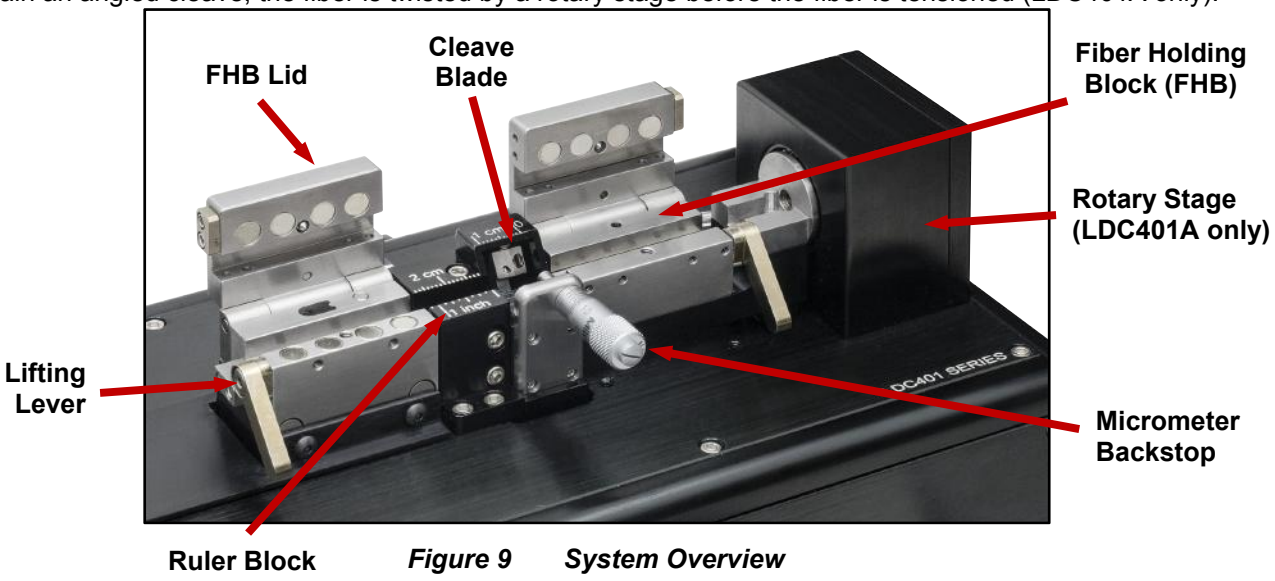


Figure 9 System Overview

This chapter provides an in-depth description of the manner in which fiber is cleaved using the LDC401 and LDC401A Fiber Cleavers.

7.2. 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 (LDC401) or outfitted with a rotary drive mechanism for twisting the fiber (LDC401A). A load cell is incorporated into the left FHB for monitoring fiber 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 Tablet Controller are in **bold**. Descriptions of these parameters are provided in Section 9.8. The majority of Users will only need to set the **Fiber Diameter** (cladding), **Cleave Tension**, and **Pre-Cleave Advance** 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 LDC401A, the right FHB will rotate to the specified **Cleave 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 **Blade Offset + 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 tension.

3. When the fiber is cleaved, the cleaver senses the drop in tension and immediately draws the Cleave Blade back, the left FHB pulls further left to draw the cleaved fiber away from the waste piece, and the rotary stage returns to a level position.

These cleavers are configured such that the cleave “discard” is on the right. Though it is possible to use the cleaver the ‘other way around’, such that the waste is on the LHS of the machine, it is less convenient to do this, and on the LDC401A this also necessitates that the cleaved fiber is drawn out through the rotational FHB, which carries an increased risk of contamination of the fresh cleave through unintentional mechanical contact.

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 fiber should be clamped working from one side of the machine to the other, that is to say, if the “non-discard” (left) side is clamped first, prior to the “discard” (right) side, then all operations should be carried out on the left side before securing the right side, to minimize the possibility of twisting the fiber during clamping, which would introduce torsion in to the fiber, and therefore uncontrolled angle.

Figure 10 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 flexes around the blade. If the **Cleave Tension** is set too high, the fiber may break at the clamping points prior to reaching the desired tension, or, if the cleave is successful, the end face may have excessive “misting”, fracturing and/or roughness.

7.3. 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, allowing safe easy handling, and also providing accurate registration/repeatable lengths of the cleaved parts. 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 10.1 to determine which inserts would be most suitable or use the Insert Selection tool in Tablet Controller.

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, possibly damaging it. After the lid comes to rest on its lifting lever cam, it can be closed gently by lifting the lever.

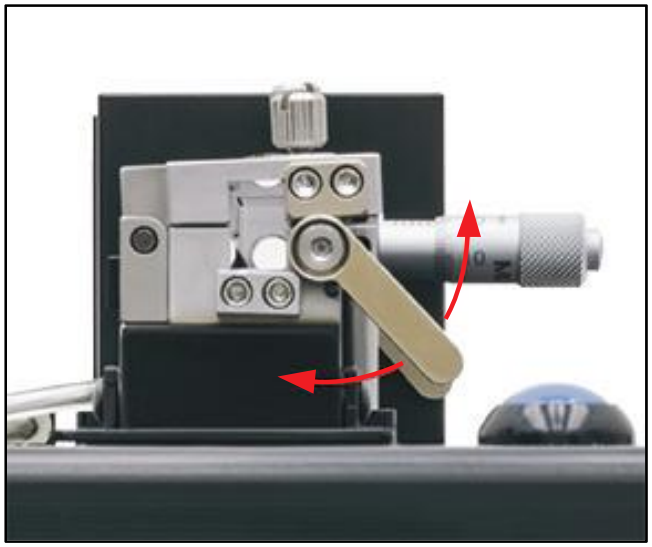


Figure 11 A Lifting Lever Propping up the FHB Lid

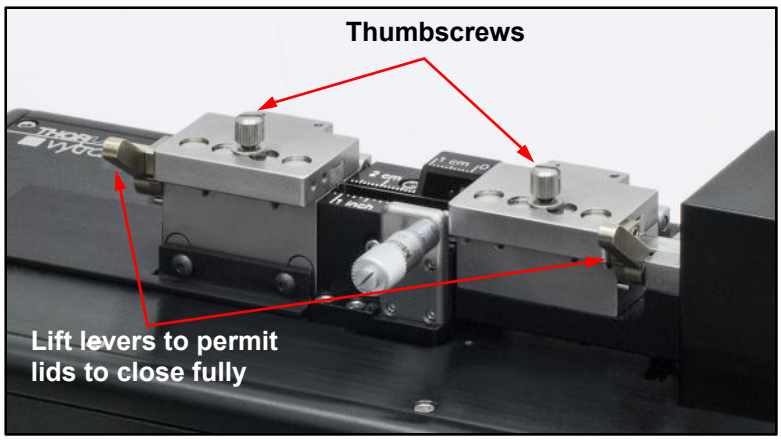


Figure 12 Lifting Levers and Thumb Screws

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.

Note that when the thumbscrews are used, the user should be sure that they are undone when operating the lifting levers to open the FHB Lid.

Also note that thumbscrews are not a substitute for correctly chosen and fitted FHB inserts!

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. It is prudent to mark one side of the magnets before removal so the orientation and position are easily identified. 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.

7.4. 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).

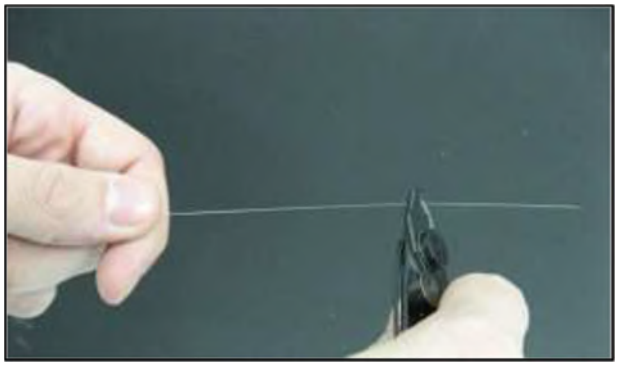


Figure 13 Stripping Fiber using a Miller Stripper

7.5. 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 9). In the first instance the critical parameters can be estimated using the Auto Parameter Tool in the Tablet Controller.
2. If the 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 up to 30 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.
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 14 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

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.

7.6. 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 Tablet Controller. The Cleave Process is fully automated as follows:
    a. If on, the internal Vacuum Pump will be turned off.
    b. If performing an Angled Cleave with the LDC401A, the right-hand FHB will rotate to the **Cleave Rotation Angle**.

WARNING

Do not place your fingers under the right Fiber Holding Block during the cleaving process or they will be pinched!

    c. The left-hand FHB will begin moving to the left, applying tension to the fiber.
    d. Once the **Cleave Tension** is reached, the left-hand FHB will stop moving.
    e. The Cleave Blade will move forward towards the fiber over the **Blade Offset + Pre-Cleave Advance** distance.

CAUTION

The Cleave Blade should never touch the fiber on the initial, fast move towards the fiber, 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. When the fiber is cleaved, the cleaver senses the drop in tension and immediately draws the Cleave Blade back, the left FHB pulls further left to draw the cleaved fiber away from the waste piece, and the rotary stage returns to a level position.

WARNING

Do not place your fingers between the left Fiber Holding Block and the ruler block during the cleaving process or they will be pinched!

Figure 15 Initiating a Cleave by Pressing the Blue Start Button

7.7. Unloading the Fiber

To unload the fiber after cleaving:

1. If the thumbscrews were secured, turn them counter-clockwise until they disengage from the FHB base.
2. 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).
3. Raise the left-hand FHB lid and carefully remove the cleaved fiber. Immediately the left FHB lid is opened, the internal vacuum pump will turn on for approximately 15 seconds to assist in holding the fiber during the unloading process.
4. Press down on the right-hand lifting lever to release the clamping force.
5. 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.
6. Check that no debris is left behind in the FHB V-grooves or on the lid clamping surfaces.

After the vacuum turns off, the Tablet Controller 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.

The Reset may be initiated as soon as the cleaved fiber is removed using the Start Button – it is not necessary to wait for the vacuum pump to time out.

If the Reset 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 16 Removing a Cleaved Fiber from the Left Fiber Holding Block

7.8. 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 10.1 or the Tablet Controller Insert Selection tool (Section 9.5.5). 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, 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″ hex 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. The top inserts are secured by re-tightening the set screws until they are snug. Do NOT over tighten. However see the note below regarding fitment of both Inserts in the FHB together.

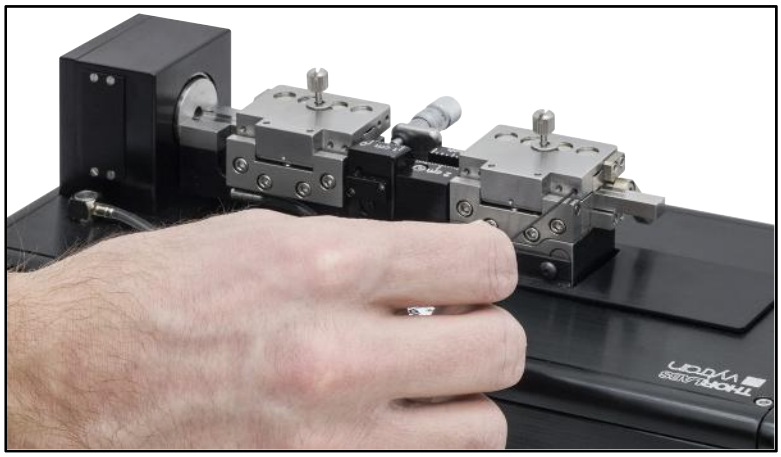


Figure 17 Changing the Top Inserts

To change the bottom V-groove insert:

1. Loosen the set screws accessible from the front of the FHB base using the 0.035” hex 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. The bottom inserts are secured by re-tightening the set screws until they are snug. Do NOT over tighten. However see the note below regarding fitment of both inserts in the FHB together. Re-tighten the set screws until they are snug. Do NOT over tighten.

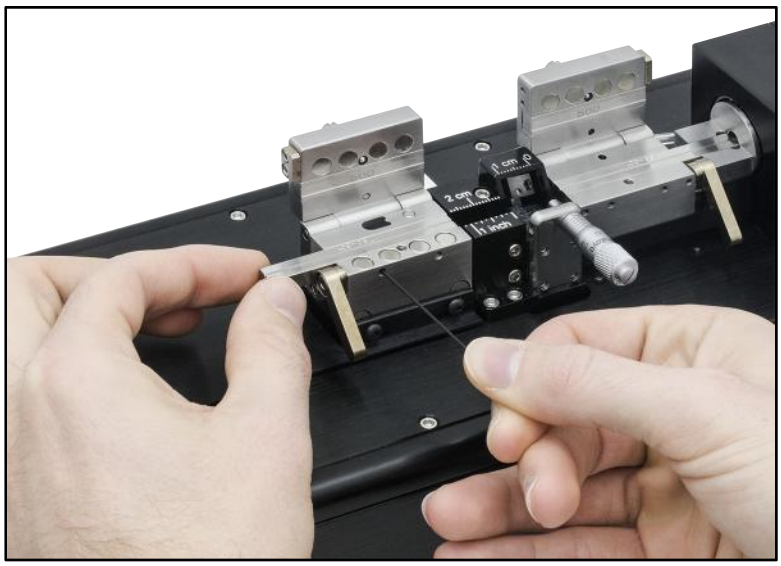


Figure 18 Changing the Bottom Inserts

It is important that both inserts in the FHBs fit together properly. It is better to have both inserts fitted loosely in the FHBs, and secure them both at the same time:

1. With the lid of the FHB closed only on to the lid lever, but all grub screws that secure both top and bottom inserts loose, the inserts should be free to move side to side.
2. Use a straight edge to set the ends of the inserts flush to one another on the side of the FHB that faces the Cleave Blade. It may be useful to use an hex key to push from the other end to get the inserts up against the straight edge.
3. When the inserts are set side to side, gently raise the lid lever to fully close the FHB Lid.
4. Secure the inserts with the grub screws.

Note: When using the VHF series lower inserts in the left FHB, the Top insert should be fitted differently, not such that the top and bottom inserts are flush at the inside end. The top insert should be pushed back towards the left, and 1-2mm clearance between this and the fitted Transfer Clamp allowed, so that the Transfer Clamp Lid may be easily raised and lowered.

7.9. Specialty Cleave Process

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 end face quality but require the execution of additional steps.

7.9.1. 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 that required for a regular 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, open the Parameter Select screen, select the Sub-Critical Cleave Process parameter and select Enable. When enabled, three additional parameter values must be specified. These parameters are Re-Tension Level, Post-Scribe Pause, and Re-Tension Pause. Please refer to Section 9.8 for a definition of these Parameters. In addition to specifying these new parameter values, two existing parameter values may require adjustment. These are Cleave Tension and Cleave Oscillation Counter (or 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 Parameter value and the Cleave Oscillation Counter 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 parameter settings are VERY fiber dependent.

7.9.2. Micrometer Backstop

The Micrometer Backstop may be helpful 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.

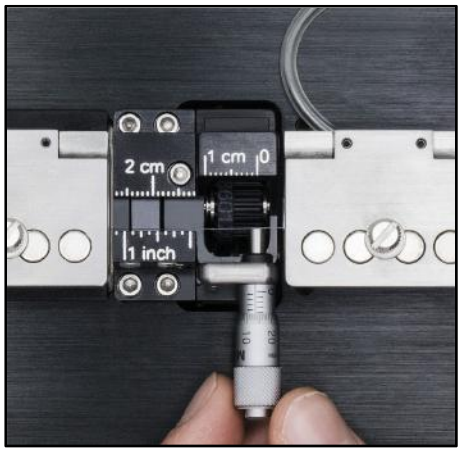


Figure 19 The Micrometer Backstop Acting as a Backstop to a Fiber

The Micrometer Backstop acts as a backing for the fiber during the Cleave Process. When using the Micrometer Backstop, it is possible to reduce the tension applied to the fiber because the Micrometer Backstop will prevent the fiber from flexing when struck by the blade to produce a longer initial scribe. The longer initial scribe causes the fiber to cleave, 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 Backstop may be used in conjunction with the "Subcritical Process" to produce cleaves with very good end face quality.

A general rule to follow when using the Micrometer Backstop is that the Cleave Tension should initially be lowered to 85% of the Auto Parameter value that Tablet Controller recommends for the diameter of the part. Adjust the tension based upon visual inspection of the end face. Increase the tension if there is no end face damage but the cleave has an angle. Decrease the tension if there is end face damage but no angle. **Do not go below 60% of the Auto Parameter value or severe blade damage may result.**

Figure 20 Using an Eye Loupe to Check that the Micrometer Backstop just Touches the Fiber

To use the Micrometer Backstop, load the fiber in to the unit in the normal way, but do not initiate a cleave immediately. 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 Backstop just barely touches the fiber (see Figure 20). After the Micrometer Backstop is set, initiate the cleave as per standard procedure. Be careful not to flex the fiber forwards, or the results will be poorer than not using the micrometer at all!

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.

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

Process Selection Chart

Fiber Type	Cleave Type	Standard Process	SubCritical Process	Micrometer Backstop
Cladding <Ø800 µm	Flat or Angled[1]	✓	-	-
Cladding ≥Ø800 µm	Flat or Angled[1]	✓	May be Necessary	Use if the Blade is Pushing the Fiber Forwards without Cleaving
Multimode	Flat	✓	-	-
	Angled[1]	-	✓	Use if Fiber Cladding is >Ø400 µm
Thick-Walled Capillary Tubing[2]	Flat or Angled[1]	-	-	✓
Thin-Walled Capillary Tubing[3]	Flat or Angled[1]	-	✓	✓
PM	Flat	Use if Fiber Cladding is ≤Ø400 µm	Use if Fiber Cladding is >Ø400 µm	✓
	Angled	-	✓	✓
PCF	Flat or Angled[1]	-	✓	✓

[1] *Only the LDC401A can be used to produce angled cleaves.*
[2] *Wall thickness is at least 10% of the diameter.*
[3] *Wall thickness is less than 10% of the diameter.*

Chapter 8 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.[4]
- Inspect and clean the Cleave Blade every day.[5]
- Reposition the Cleave Blade as needed (roughly every month).[5]
- Replace Cleave Blade as needed (roughly every six months).[5]
- Return the unit to Vytran for recalibration as needed (roughly once a year).[6]

8.1. 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!*

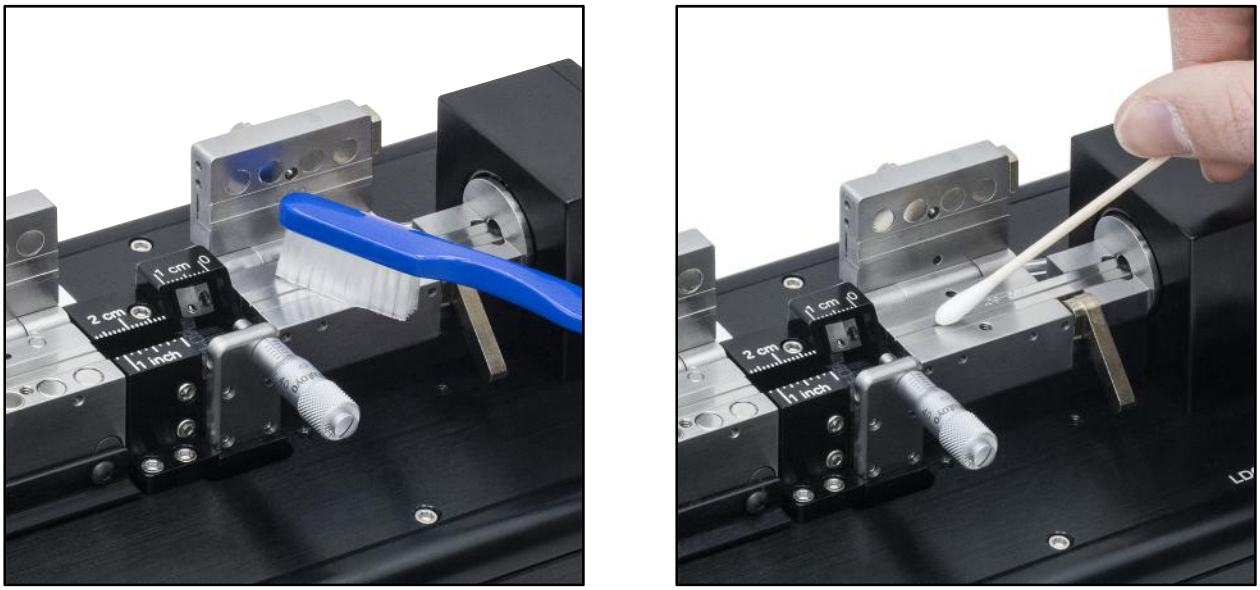


Figure 21 Removing Debris from the Fiber Holding Blocks and Oils from the Inserts

[4] *Maintenance operation can be performed by the operator.*
[5] *Maintenance operation can only be performed by trained maintenance personnel.*
[6] *Recalibration can only be performed by a Vytran-certified technician.*

8.2. 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 **Blade Service** tool may be selected from the Tablet Controller tools (Section 9.5.4). This function will move the Cleave Blade to the forward (cleave) position. **Note:** Before selecting **Blade Service**, make sure to remove any fiber or discard pieces from the FHBs to prevent possible damage to the Cleave Blade and retract the Micrometer Backstop.

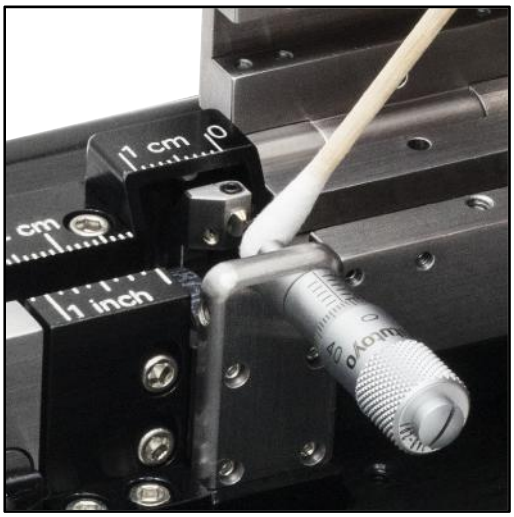


Figure 22 Cleaning the Cleave Blade

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.

Note: Closing the Blade Service tool will return the Cleave Blade to its home position.

8.3. 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 of 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″ hex key provided with the tool kit.
2. Loosen the two (2) clamping screws located at the front of the Cleave Blade Housing; 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. These should not be over-tightened.

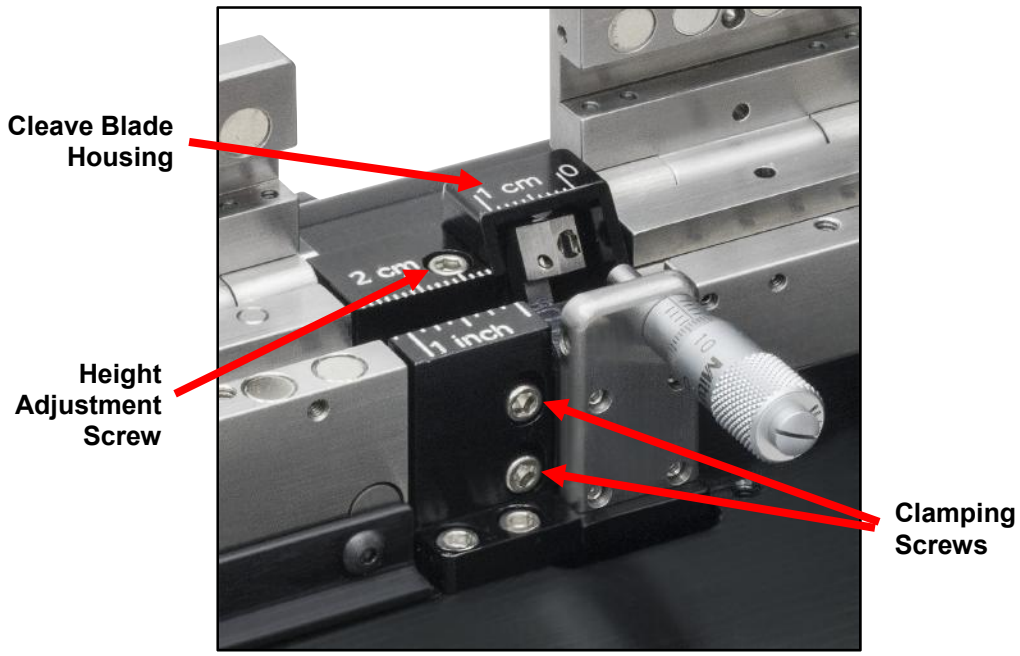


Figure 23 Screws Used in Height Adjustment

After adjusting the height of the Cleave Blade, perform a cleave to ensure proper operation. 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 Blade.

When cleaving, the blade performs an initial moves from its starting position to one that is close to, but not touching, the fiber. The distance of this initial move consists of the **Blade Offset + Pre-Cleave Advance**. Ensure that the Cleave Blade does not strike the fiber during the **Blade Offset + Pre-Cleave Advance** move, as this can easily damage the new section of diamond blade. After the **Blade Offset + Pre-Cleave Advance** move, 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 Tablet Controller. 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. In general, the **Blade Offset** is modified to account for variation in the blade dimensions and or position of the blade, the **Pre-Cleave Advance** is modified to account for fiber size (larger fibers being closer to the blade).

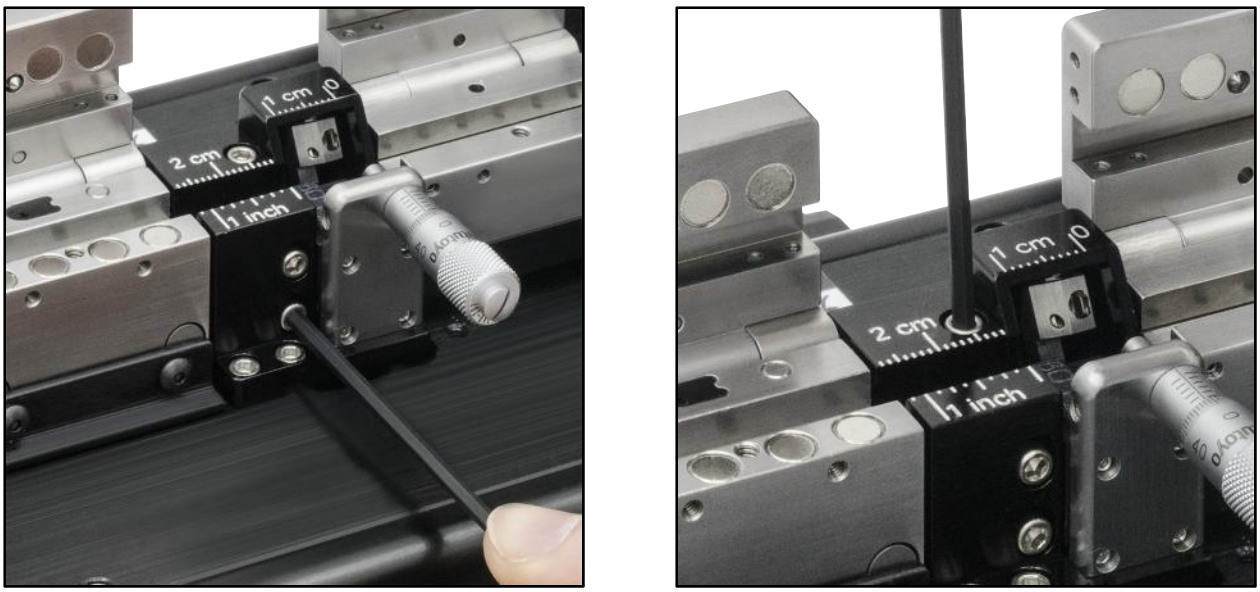


Figure 24 Adjusting the Height of the Cleave Blade

8.4. 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.

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.

To replace the Cleave Blade:

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

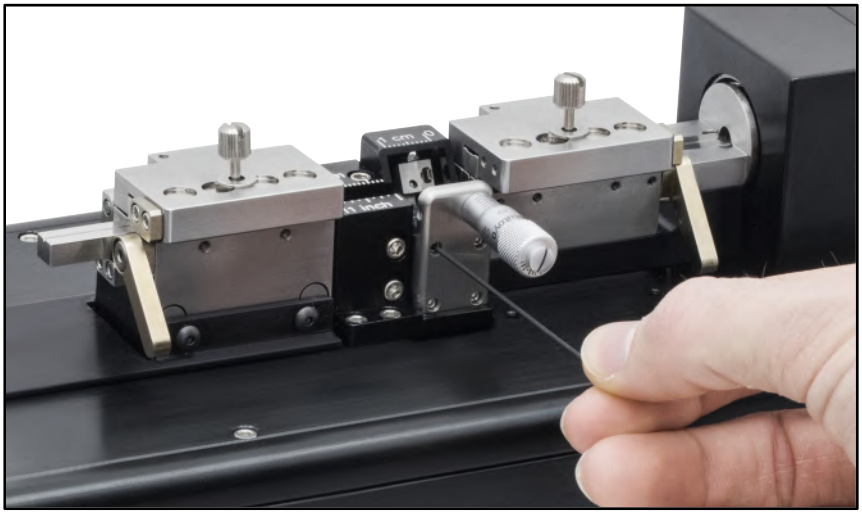


Figure 25 Removing the Micrometer Backstop

3. Select the **Blade Service** tool function in the Tablet 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″ hex key provided.

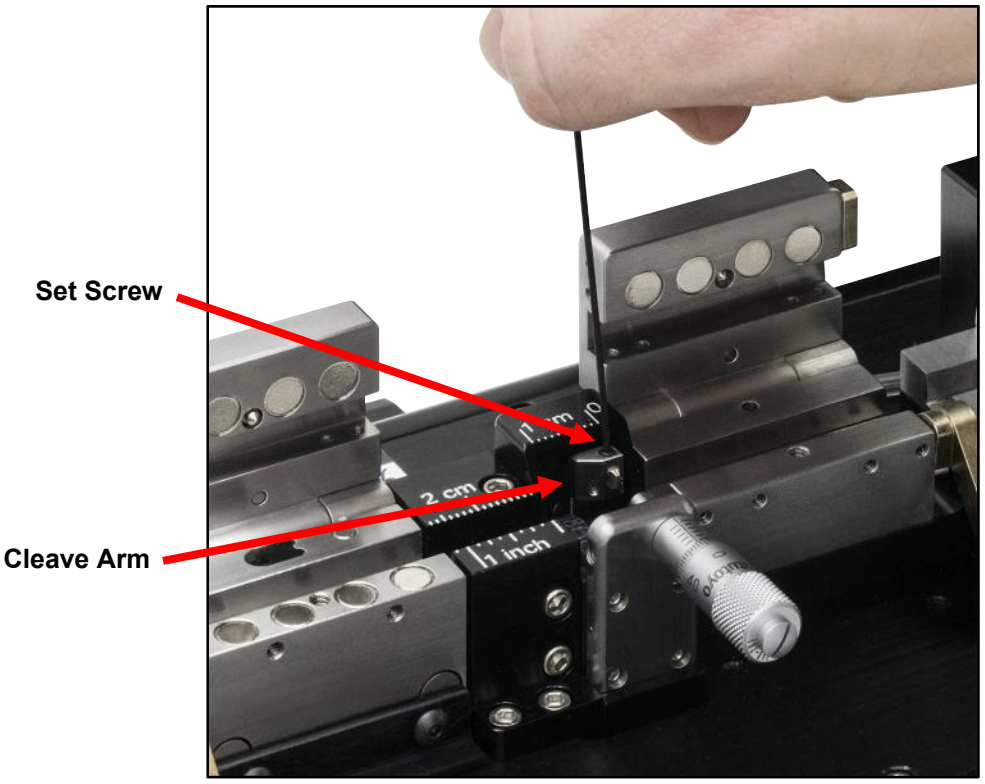
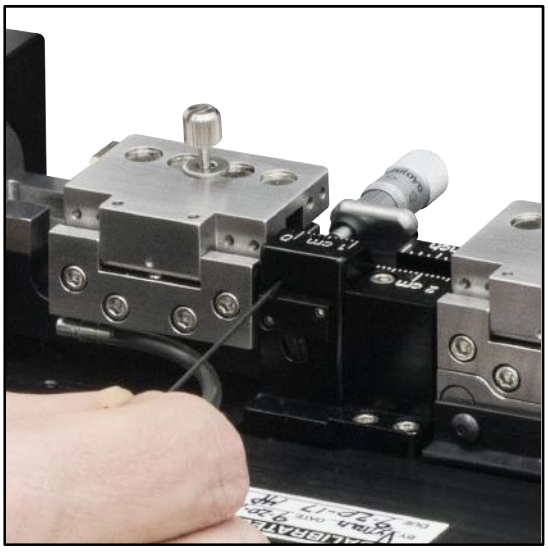


Figure 26 Set Screw and Cleave Arm

5. Insert the 0.035″ hex 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.



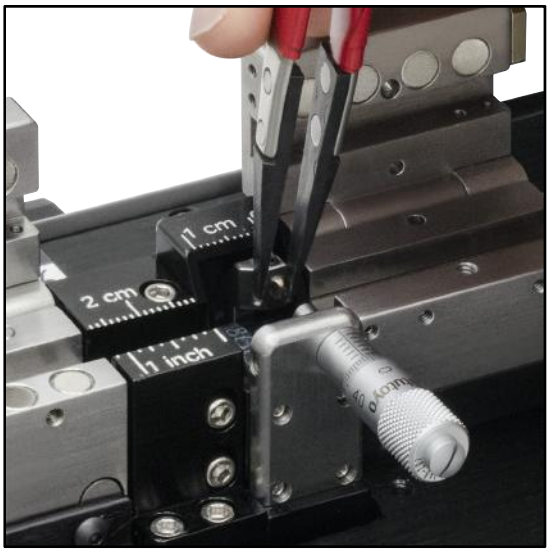


Figure 27 Replacing the Cleave Blade

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 the 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

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.

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 Blade Service screen or by closing the Blade Service screen.
11. Re-attach the Micrometer Backstop 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″ hex key 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 corner 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 8.3 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 **Blade Offset + Pre-Cleave Advance** move, 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 Tablet Controller). 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.

8.5. 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 Vytran Thorlabs-certified technician.

Chapter 9 Controlling the LDC401 and LDC401A

The Tablet Controller provides a simple, easy to use interface for configuring, controlling and monitoring LDC401 series cleavers. The following sections contain a quick start guide followed by a more detailed view of the features and capabilities of the Tablet Controller.

9.1. A Quick Start Guide to Cleaving with LDC401 and the Tablet Controller

Once the Tablet Controller has recognized an LDC401, the LDC Main Screen is displayed. From here the User can start a cleave, view / edit Parameters, select items on the toolbar.

A: Status Bar

B: Tool Bar

C: Start Button

D: Parameter View / Edit

E: LDC Widget

Figure 28 LDC Main Screen

To start a cleave, press ‘Start’ (C). This performs the same action as pressing the blue ‘Start’ button on the LDC. To view and or edit cleave Parameters, touch either the view/edit button (D) or the Cleave Widget (E). (If the User has insufficient access permission to edit Parameters, a view only icon is displayed.)

The cleave parameters (along with the current value) will be shown on the Parameter Select screen. Swipe the list to scroll up / down, touch a parameter to select it for editing.

Note: Yes, OK, Apply No, Cancel, Close

Figure 29 Parameter Select Screen

In the edit / viewing screen, touch the value to enable the On-Screen-Keyboard and edit the value. Touch ✓ or X to return to the Parameter Select Screen.

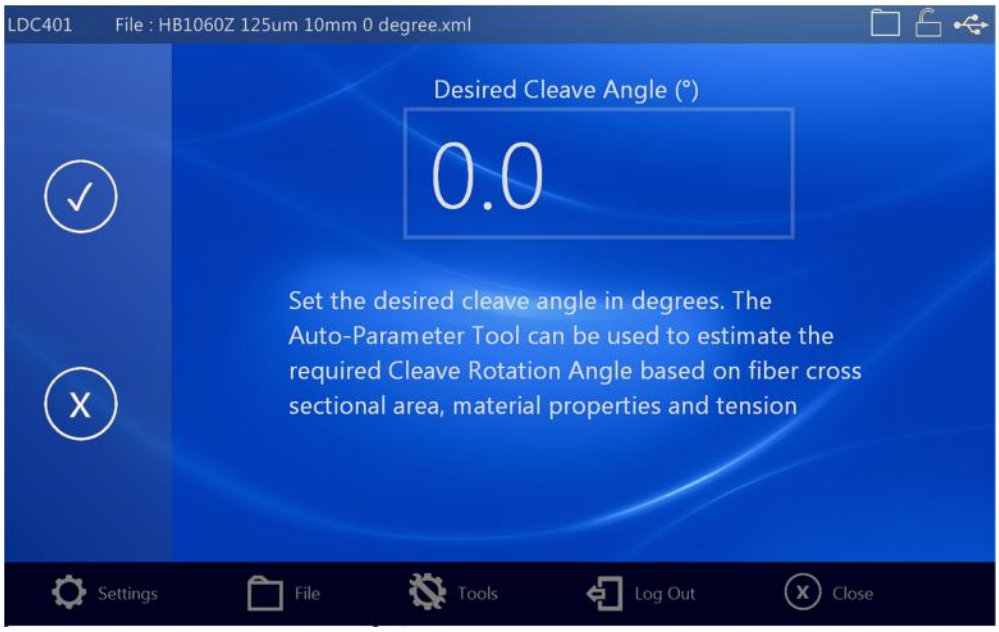


Figure 30 Parameter Edit Screen

The parameter list indicates that an item has been changed by displaying a different icon

.

The User must select ✓ when leaving the Parameter Select Screen in order for all changes to be committed to the LDC. Changing the FHB offset will require the motor to be re-homed after uploading. The controller will ask if it's "ok to home?". Be sure that there is no fiber clamped in the machine or any other obstruction that may cause the system to fail this move.

9.1.1. Cleave Screen

Once the cleave sequence has started (either by pressing 'Start' on the Tablet, on the LDC401 or by opening the left FHB lid), the Cleave Screen is displayed. This screen updates dynamically as the cleave sequence progresses. A typical sequence consists of loading the fiber, pulling tension, cleaving the fiber then unloading (although the user can go straight to the tension stage by pressing start when the left FHB lid is closed).

Figure 31 Cleave Screen – Load Fiber

Once the left FHB lid is closed, the user is given extra time to close the right FHB lid. Pressing 'Start' will advance the LDC401 to the tension stage.

Figure 32 Cleave Screen – Extended Vacuum

The LDC401 will wait until the user is ready to start the cleave or repeat load fiber. Note that the user can return to the LDC Main Screen at this point in order to modify parameters or access the toolbar.

Figure 33 Cleave Screen – Reload or Cleave

Cleave begins by tensioning fiber, displaying the measured tension.

Figure 34 Cleave Screen – Tension

Once tension is reached, the Cleave Peck Indicator is also displayed.

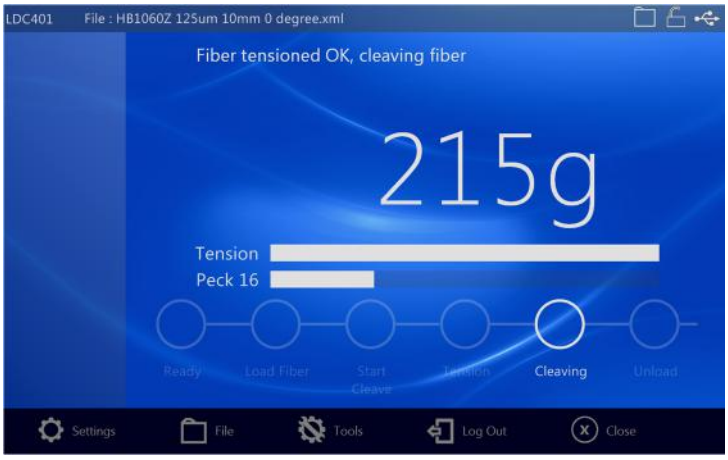


Figure 35 Cleave Screen – Tension and Peck

When the fiber is cleaved, the tension will drop to zero and the Cleave Peck Indicator remains on screen. The LDC will wait for the user to start unloading the fiber (raising the left FHB lid).

Figure 36 Cleave Screen – Cleave Complete

Figure 37 Cleave Screen – Unload

Figure 38 Cleave Screen – Homing

Once homing is complete, the Tablet Controller indicates it is ready to start the next cleave.

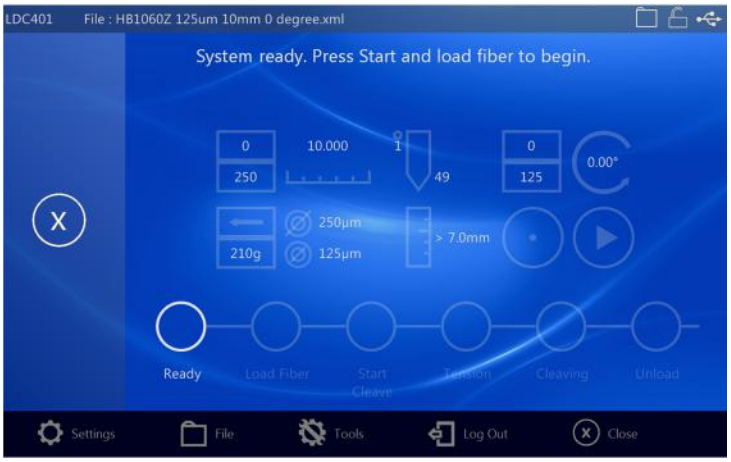


Figure 39 Cleave Screen – Ready

The Tablet Controller remains in the Cleave Screen for the convenience of the user. In most instances, the LDC is used in a repetitive manner with little or no need to access the toolbar or edit parameters between cleaves. To access parameters or the toolbar, the user must close the Cleave Screen and return to the LDC Main Screen.

9.2. Tablet Controller Online

The Tablet Controller is a fully featured Windows 8 (and in due course, Windows 10) Tablet. The controller application (VytranCX.exe) is launched automatically on Windows startup. After a few seconds of displaying a master Home Screen, a discovery process is launched which detects any Vytran LDC / PTR modules connected. If a module is found and recognized, the controller configures itself for that module, in this case the LDC401 / LDC401A.

It is recommended that the Tablet Controller remains connected to a single machine in order to benefit from machine status monitoring built into the controller. The LDC can, however, operate without the Tablet Controller attached, and through use of the Start Button will carry out cleaves using the last set of parameters that were uploaded to it.

At startup, Tablet Controller will always read parameters from the LDC401 meaning that the parameters that appear on the screen will always be the parameters that have been uploaded to the cleaver.

The Tablet Controller provides an 'offline' mode in which files can be modified and uploaded later.

9.2.1. LDC Main Screen

The LDC Main Screen, much like the Main Screen for any other Vytran PTR module, shares a common theme. It has a status bar, one or more control (action) buttons, a view / edit button to access parameters related to that control or action, a Widget (for displaying the most relevant current parameters) and a toolbar. During operation, runtime messages are displayed.

From left to right, the status bar indicates the type of module detected (in this case LDC400), the file currently open (blank if none) and three icons to indicate file status (unprotected or read-only), current user access status and USB connection.

Figure 40 LDC Main Screen – Status Bar

The control button on the LDC Main Screen will perform the same function as the Start button on the LDC401, invoking either a load or cleave operation depending on whether the left FHB lid is open or closed. The view / edit button will bring up the Parameter Select list. Since LDC401 has only one functional button, all parameters will appear in one single list. Note that touching the Widget on the main screen will also bring up the Parameter Select list.

Figure 41 LDC Main Screen – Start Button and Parameter View/Edit

The Widget provides an instant overview of the most relevant current parameters. From top left to top right it shows:

- Left FHB inserts
- FHB Offset in mm
- Cleave Blade index
- Cleave counter
- Right FHB inserts
- Right FHB inserts

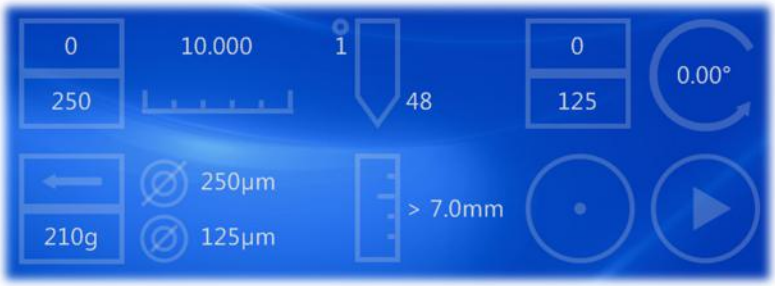


Figure 42 LDC Main Screen – Cleave Widget

From bottom left to bottom right:

- Target tension
- Fiber cladding and jacket diameter
- Micrometer Backstop position
- Regular cleave/Sub-critical cleave
- Ready/Busy indicator

Runtime messages are displayed on the LDC Home screen when something important is happening such as reading parameters from the LDC and uploading new parameters to the machine.

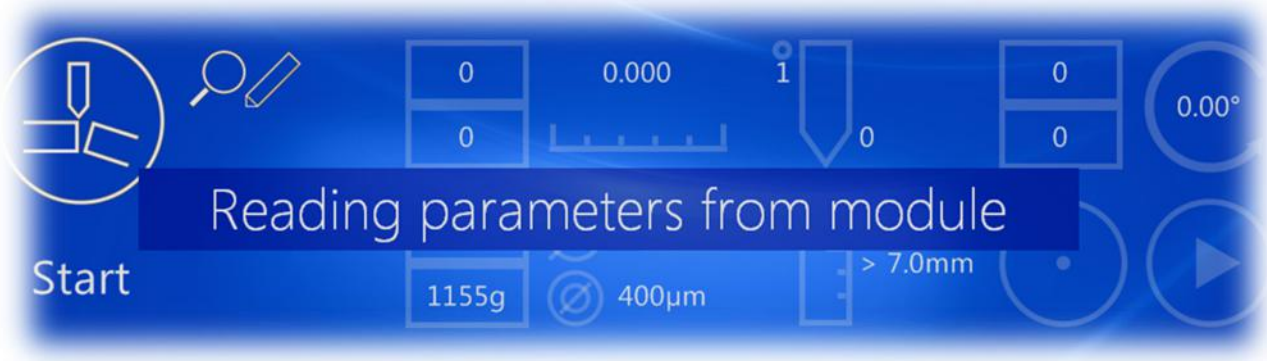


Figure 43 LDC Main Screen – Toast Messagers

The toolbar provides access to Tablet Controller settings, the file system, LDC specific tools, a fast Log-Out feature and a close button to allow the user to exit the LDC Main Screen.

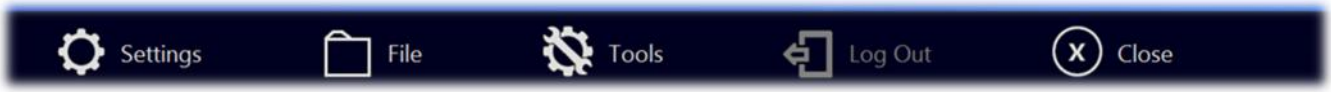


Figure 44 LDC Main Screen – Toolbar

9.3. Settings

Touch the toolbar Settings button to bring up the Settings Screen. These options are for configuring the Tablet Controller and are generally not PTR/LDC dependent.

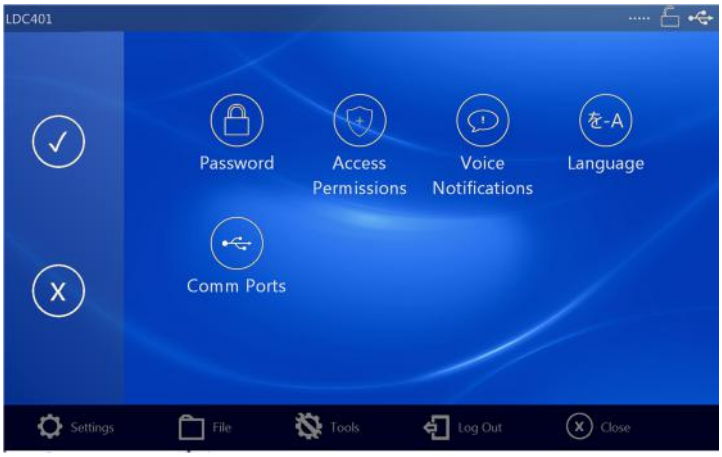


Figure 45 Toolbar – Settings Screen

From this screen the user can setup or enter a password, control user access permissions, enable or disable voice notifications, select the user interface language, view and manage communication ports.

9.3.1. Password

With a password, users can protect the controller and its files from unauthorized access / modification.

Passwords are recoverable from a configuration xml file so can be retrieved if lost or forgotten. The controller defaults to No Password, Full Permission enabled.

If a password has been setup and entered, the user can quickly log out using Log-Out from the toolbar.

A password is required (only if one has been set) to change Access Permissions. These permissions are the actual mechanism for protecting files and parameters.

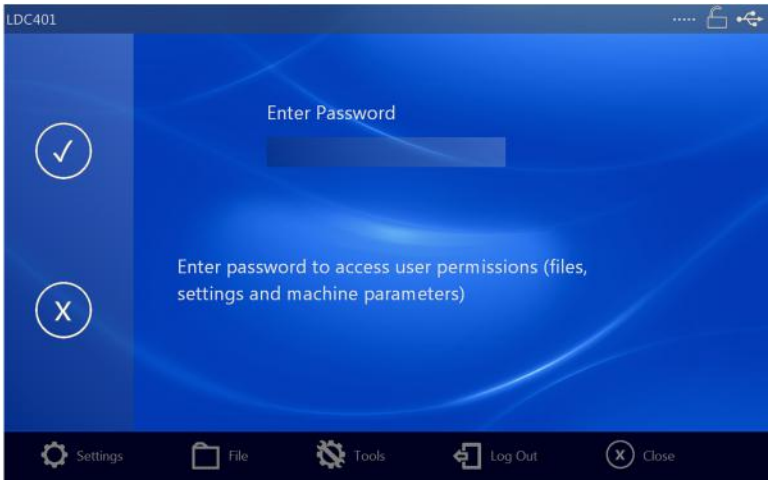


Figure 46 Toolbar – Password Screen

If no password has been setup yet, the password is effectively an empty string. Touch the password box and press the enter key to continue. If a password has been setup, enter the password. Passwords can be any characters, any length and are case sensitive. Whenever an incorrect password is entered, a message appears to inform the user. The Password is in effect until the user touches Toolbar-Log-Out.

Once the correct password has been entered (in this case 1234), it can be changed by touching the Change Password text to continue.

Figure 47 Toolbar – Change Password Option

Touch the Enter New Password box and enter the new password, repeat in the confirmation box.

The password is in effect until the user touches Toolbar-Log-Out.

Figure 48 Toolbar – New Password Screen

9.3.2. Access Permissions

Tablet Controller can be setup to prevent unauthorized access of files and parameters which can be read-only or read-write in any combination. In addition, files can be saved as read-only and can only be overwritten by a user with Full Access Permission. Tablet Controller will warn the user when attempting to overwrite a read-only file.

Tablet Controller defaults to No Password, Full Permission enabled. A password is required (if one has been set) to change Access Permissions.

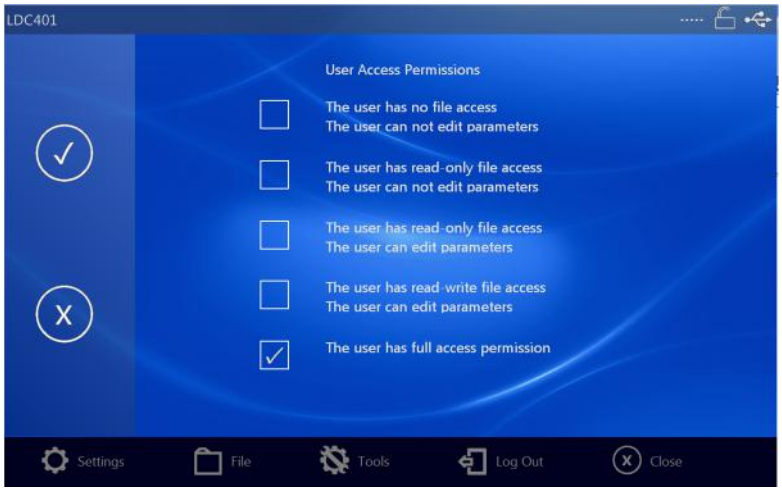


Figure 49 Toolbar – User Access Permissions Screen

The Access Permissions are self-explanatory except for Full Access Permission.

Full Access Permission allows full read-write access of parameters and files, the ability to change User Access Permissions and the ability to overwrite a file that has been saved as read-only. If a read-only file contains an error, it's possible to correct it. If a password has been setup, the user must enter it before being allowed to change User Access Permissions.

9.3.3. Voice Notifications

Enable audible notifications in spoken language when a process has begun and whether it completed successfully or failed. Voice notifications will attempt to load an appropriate Text-To-Speech (TTS) voice for the current language selection. This requires a suitable (TTS) Voice has been installed. Contact Thorlabs / Vytran for more details.

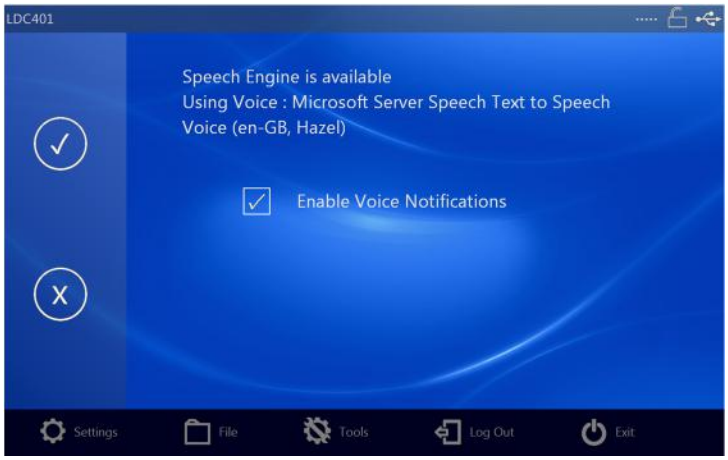


Figure 50 Toolbar – Voice Notifications (Current Language – English)

Figure 51 Toolbar – Voice Notifications (Current Language – Chinese)

9.3.4. Language

The user can select the preferred user-interface language. Language selection is independent of computer locale or computer language packs installed.

Complete translations are available in English, French and Russian and Chinese, more will be available in the future. In the event that a piece of translated text is missing, the controller will default to English for that text. Future translations are installed by simply copying a resource-only dll file into a sub-folder of VytranCX controller.

Figure 52 Toolbar – Language Selection

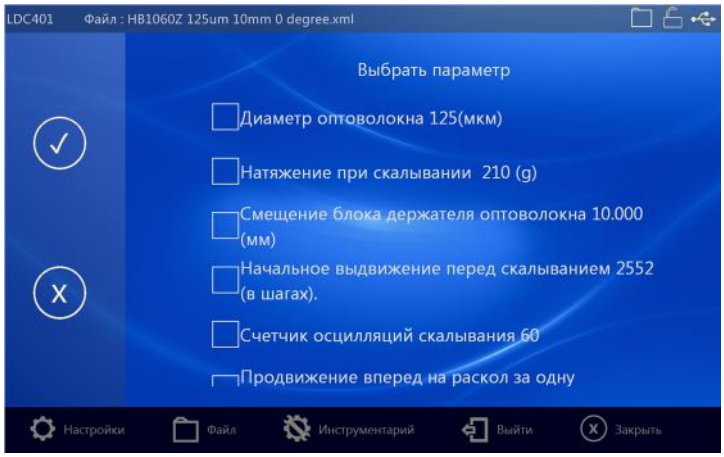


Figure 53 LDC Parameters Select in Russian

9.3.5. Comm Ports

The Comm Ports screen lists all communications ports detected by Tablet Controller which can be useful when fault-finding a missing connection. Tablet Controller will normally auto-detect the correct USB serial Comm Port to communicate with the LDC.

9.4. Files

Files are opened, saved or saved-as from Toolbar-File. The user is presented with those options. Note that if no file is open, selecting Save File will open the Save File As screen and the current machine parameters will be saved to the file specified. Open File and Save File As will open a file selection screen.

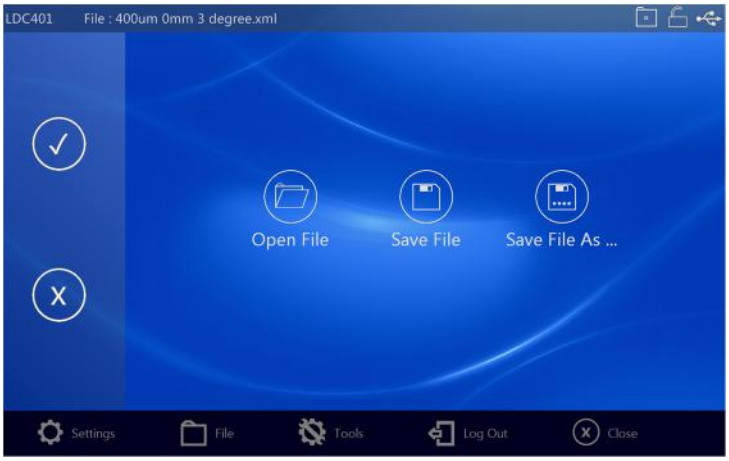


Figure 54 Toolbar – File Options Screen0.

9.4.1. Open File

Figure 55 Toolbar – File Open Screen

In both File Open and Save File As screens, the existing files are listed in order of Most Recently Used (MRU). Any file that has been saved as a read-only file will display the small lock symbol next to the file name.

Only files specific to a particular type of Vytran equipment are displayed in the list. E.g., if the User is working with an LDC-400, only LDC-400 files are accessible. Each machine type has its own dedicated folder and files can only be saved in that folder.

Touch the file in the list to select to it for opening. Swipe the list to scroll up or down.

9.4.2. Save File As

Figure 56 "Save File As" Screen

To select an existing file to overwrite, select it by touching it in the list. Alternatively, type in a filename to create a new file. Files can be saved as read-only. A read-only file can be overwritten but only if the user has Full Access Permission. It might at first seem strange to be able to overwrite a read-only file, consider how frustrating it would be if files contained errors that were impossible to correct. The current machine parameters can always be saved to file using Save File As.

Note: There is no File Save screen. File Save instantly saves the current open file to disk.

9.5. Tools

Each Vytran machine type has its own suite of tools, designed to simplify certain tasks. Some of the tools are common to multiple machine types, others are unique to just one. Touching Toolbar – Tools brings up the Tool Selection Screen.

Figure 57 Toolbar – Tool Selection Screen

The set of tools currently available include:

- Terminal Client (direct command language communication with LDC401)
- Motor Manipulation Tools (FHB, Cleave Blade, Rotation)
- Auto Parameter (recommendation of best theoretical parameter values for a given fiber / cleave angle)
- Blade Service T Insert Selector (automatic selection tool based on the insert selection guide tables given in Section 10.1)

9.5.1. Terminal

The Terminal Screen provides a box (top left) where a command can be entered for transmission. Below that is a list of the most recent commands sent. Touch a command in the list to select it for re-transmission. On the right is the received communications traffic.

Terminal is available for all module types (LDC, PTR-200 etc.)

Figure 58 Tools – Terminal Screen

9.5.2. Motor Control

The Motor Control window initially allows the user to select which motor to manipulate. On LDC401, these are left FHB, Cleave Blade and right rotation. On selecting one of these options, a generic motor control window opens.

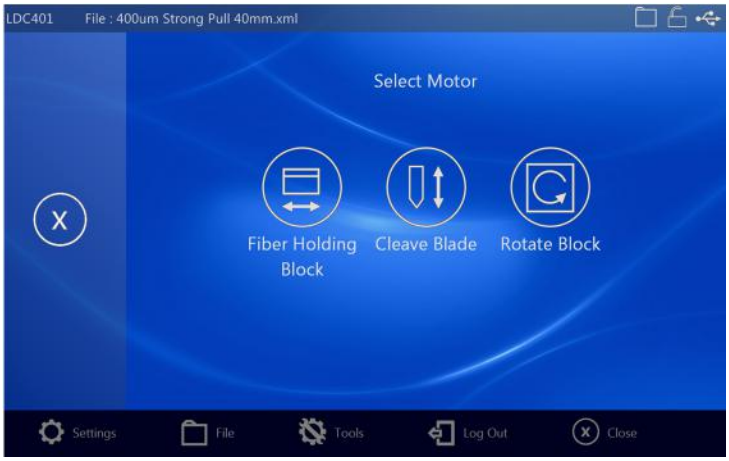


Figure 59 Tools – Motor Control (Select)

The Motor Control window provides a numeric window where the user can type in the desired motor position. After pressing Enter, the move is initiated. Below is a slider control that displays both target position and current position. The user can also touch and slide the slider button to move the motor. Below the slider are individual buttons for small step manipulation in either direction and a stop button.

In the case of the left FHB, the user is given a checkbox option to apply the current position to the FHB offset. When used to control the Cleave Blade motor, the user can optionally apply the position to the Pre-Cleave Advance parameter.

Figure 60 Tools – Motor Control (FHB)

9.5.3. Auto Parameter

Auto Parameter will generate a basic set of suggested theoretical values based on Fiber Diameter (and if required, Desired Cleave Angle). The user can touch the tick to use the suggested parameters. Touching any parameter in the list on the right will bring up the Parameter View/Edit Screen, allowing fast access to modify that parameter (provided the user has sufficient Access Permissions).

Note that distance between FHBs refers to the 'Clamping Distance' and the Fiber Modulus is its Young's Modulus of Elasticity - typically 28 for SMF28. 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). The modulus of rigidity of silica glass varies from 19 to 31 GPa.

Figure 61 Tools – Auto Parameter

9.5.4. Blade Service

Blade Service provides a window that allows the user to move the blade between its Service Position and its Home Position. The list on the right gives quick access to the parameters needed to manage blade setup. Touch an item in the list to edit (provided the user has sufficient Access Permissions).

When the blade is in its Service Position, the 'Home' button is displayed, when the blade is in the Home Position, the 'Service Position' button is displayed.

Whenever the user physically advances the registration of the Cleave Blade (to use a new part of the diamond blade), the index should also be incremented and the Cleave Counter reset to zero.

Figure 62 Tools – Blade Service

9.5.5. Insert Selector

The Insert Selection Tool provides the same functionality as the lookup tables provided in Chapter 13.1. Specifying the Coating (jacket) and Fiber (cladding) diameter provides a list of possible FHB insert combinations in order of preference (best choice at the top). The offset values are also given so the user can best match left and right inserts when a complete set is not available.

Figure 63 Tools – Insert Selector

9.6. Log Out

When the user enters a password, the user is considered 'logged in' with full access permission. The Log Out button provides a quick method of returning to the normal access permission level. If no password has been setup, the Toolbar-Log Out button is permanently greyed. If a password has been setup, the Toolbar-Log Out button is enabled whenever the user has 'logged in' by entering the password.

9.7. Exit/Close

In the default Home Screen, the final toolbar button displays Exit. This will close the Application. When the Tablet is connected to a Vytran module, the button displays Close, this allows the user to return to the default Main Screen so the Tablet can be connected to a different Vytran module.

9.8. Parameter Description

LDC401 / LDC401A 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.

Parameter	Description
Fiber Diameter	The diameter of the fiber cladding to be cleaved. Other recommended values are derived from this.
Cleave Tension (grams)	This parameter is the load, in grams, applied axially to the fiber prior to initiating the scribe. The Tablet Controller provides manual and **Auto Parameter** 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 Parameter** option will provide the appropriate Cleave Tension for silica fibers based on the Fiber Diameter currently specified in the file. These cleavers are calibrated using standard weights; the Cleave Tension settings are programmed into the Tablet Controller in grams. Possible settings correspond to a range of tensions from 9.8 mN (0.0022 lbs) to 63.7 N (14.3 lbs).
Cleave Rotation Angle (degrees, LDC401A Only)	This parameter is the Rotation Angle, in degrees, applied by the right side FHB prior to initiating the Tension Process. The optimal Rotation Angle for a specific resultant angled cleave is dependent upon the cross sectional area of the fiber, material properties of the glass, and the tension applied. The Tablet Controller has an **Auto Parameter** function to estimate this value for a user specified target Angle. See Section 9.5.3 for more information. Set the Rotation Angle to 0° for a perpendicular cleave.

Pre-Cleave Advance (Steps)	Pre-Cleave Advance + Blade Offset = the distance that the blade moves towards the fiber before entering the oscillation phase of its movement. The Tablet Controller provides both manual and **Auto Parameter** 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). See sections 8.3 and 8.4 for more information regarding Pre-Cleave Advance and Blade Offset.
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. This will effectively give a longer cleave where Transfer Clamps are used.
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 Sub-critical specialty process is enabled. One step corresponds to 0.00003125" (0.8 µm).
Cleave Oscillation Counter (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 Reverse Steps” parameter) may be beneficial for the “Micrometer Backstop” specialty process. The “Cleave Forward Steps” parameter must always be greater than the “Cleave Reverse Steps” parameter for the blade to oscillate toward the fiber. One step corresponds to 0.00006" (1.5 µm).
Cleave Reverse 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 Backstop” specialty process. The “Cleave Reverse 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 (ms)	This parameter is the delay, in milliseconds, between each of the Cleave Blade oscillations. Typically, the scribe delay is set to 250 ms. Larger fibers benefit from larger Scribe Delays. A safe ‘rule of thumb’, is to set Scribe Delay in ms, to the same value as the Fiber Diameter in µm. Increasing the scribe delay may also be beneficial for the subcritical and the Micrometer Backstop specialty processes.
Blade Offset	Blade Offset is used in Cleave Blade setup and is modified to account for variation in the blade dimensions and or position of the blade. Pre-Cleave Advance + Blade Offset = the distance that the blade moves towards the fiber before entering the oscillation phase of its movement. See sections 8.3 and 8.4 for more information regarding Pre-Cleave Advance and Blade Offset.
Sub-critical Cleave	This parameter is used to enable or disable the Sub-critical cleaving process. When disabled, the LDC will perform a regular ‘tension-and-scribe’ cleave.
Desired Cleave Angle	This parameter is used by the Auto Parameter tool to calculate the angular rotation required to achieve the desired angle.
Cleave Blade Index	This parameter can be set by the user to indicate the number of times the Cleave Blade height has been adjusted (see section 8.3). Typically, each blade can be positioned to use a new section of the diamond blade ~ 10 times.
Cleave Counter	This parameter is incremented by Tablet Controller after each cleave. The user should reset the counter value to zero after replacing/repositioning the blade height.
Insert Size	Four Insert Size parameters are stored, left hand side upper, left hand side lower, right hand side upper, right hand side lower. The insert sizes can be selected using the Insert Selection Tool or modified from the Parameter Select Screen where touching one of the four parameters brings up a list of possible insert sizes. The insert sizes are displayed in the Cleave Widget.

Coating Diameter	This parameter is used by the Insert Selection Tool to determine the optimum insert choice for the left FHB. The coating diameter is also displayed in the Cleave Widget.
Backstop Position	Backstop Position is displayed in the Cleave Widget and provides a visual clue that the backstop should be set and its approximate value. A value of 7mm is typically considered to mean 'unused'.

The following Parameters are required by the sub-critical process.

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 setting 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 settings are programmed into the Tablet Controller 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 (starting) tension that will be added to the original (starting) 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.

9.9. Parameter Limit

Minimum and maximum Parameter values permitted by the Tablet Controller are given below.

Parameter	Default	Min	Max
Fiber Diameter	Fiber Size Dependent	10 µm	1500 µm
Cleave Tension[7]	Fiber Size Dependent	1 g	6500 g
Pre-Cleave Advance	Fiber Size Dependent	200 Steps	400 Steps
FHB Offset	0 mm	0 mm	47 mm
Tension Velocity	60 Steps/s	4 Steps/s	200 Steps/s
Cleave Rotation Angle (LDC401A Only)	0°	0°	180°
Cleave Oscillation Counter	60	10	250
Cleave Forward Steps	81	40	400
Cleave Reverse 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			
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[8]	20% of Cleave Tension	1% of Cleave Tension	50% of Cleave Tension

[7] *These Cleavers are calibrated using standard weights, so the tension settings are programmed into the Tablet Controller in grams. This corresponds to a range of tensions from 9.8 mN (0.0022 lbs) to 63.7 N (14.3 lbs).*
[8] *These Cleavers are calibrated using standards weights so the tension settings are programmed into the Tablet Controller in grams. This corresponds to a range of tensions from 9.8 mN (0.0022 lbs) to 0.98 N (0.22 lbs).*

9.10. Setup Tips – Cleaving a New Fiber

The Tablet Controller comes configured with a number of default files and these may be adapted or reconfigured as necessary to meet your requirements. If a fiber of different dimensions is to be cleaved for the first time, the following procedure will get the system setup in the right way to give a good starting point.

1. Use the Insert Selection tool in Tablet Controller to choose appropriately sized inserts for the dimensions of the fiber and fit these in accordance with the Instructions in section 7.8.
2. Use the Auto Parameter tool in Tablet Controller to get the recommended **Cleave Tension**, **Pre-Cleave Advance** and **Scribe Delay**. Touching the tick will upload the Parameters to the LDC401.
3. Prepare the fiber and load it to the machine.
4. Start the cleave and **observe the blade**. Make sure that the blade completes its fast move forward (**Blade Offset + Pre-Cleave Advance**) before it goes in to the oscillation phase. If it strikes the fiber before it starts to oscillate, raise the RHS FHB Lid immediately to prevent damage to the blade, then check that **Blade Offset** is correctly setup (are different sized fibers cleaved properly when using the recommended **Pre-Cleave Advance**? If yes, adjust **Pre-Cleave Advance**, if not, adjust **Blade Offset**). In some cases it may be necessary to adjust Pre-Cleave Advance from that recommended by the machine to prevent the fiber being struck by the blade in this way, but typically this is not necessary.
5. If the blade strikes the fiber a number of times but otherwise the process proceeds normally, it may be necessary either to use the Micrometer Backstop (if the fiber is large - 800µm and up), or simply increase **Cleave Tension**, but speciality fibers require careful treatment as dealt with in other sections of this manual.
6. From the toolbar, touch File, Save As to save the parameters to file.

With ‘regular’ silica based fibers this procedure can get good results immediately, but more speciality fibers may require further work and the application of more advanced techniques. Technical assistance is available from Vytran Thorlabs.

If one is available, it is useful to observe the end face of the fiber with an Interferometer if developing a new process.

Chapter 10 Accessories

These Cleavers comes in two basic unit configurations:

- **LDC401:** Produce flat cleaves in fiber with a cladding between Ø80 µm and Ø1.25 mm.
- **LDC401A:** 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)

10.1. 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 in Section 10.1 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[9]	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

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 Holding 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 LDC401 can accept

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

Transfer Inserts, if desired, while the right Fiber Holding Block of the LDC401A 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 on the following page 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[10]		VHA05[10]		VHA10[10]		VHA15[10]		VHA20[10]		VHA25[10]	VHA30[10]
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[11]	80 µm	57/100 -23/21											
VHD125[11]	125 µm	88/161 -37/36											
VHD160[11] or VHF160[11,12]	160 µm	112/208 -49/48	-	-	-	-	-	-	-	-	-	-	-
VHD250[11] or VHF250[11,12]	250 µm	177/320 -73/69	275/323 25/74	-	-	-	-	-	-	-	-	-	-
VHD400[11] or VHF400[11,12]	400 µm	279/519 - 122/119	377/517 -23/117	410/519 -9/119	-	-	-	-	-	-	-	-	-
VHD500[11] or VHF500[11,12]	500 µm	346/592 -153/93	447/647 -53/147	476/711 -24/211	560/795 61/296	-	-	-	-	-	-	-	-
VHD750[11] or VHF750[11,12]	750 µm	516/759 -234/9	617/970 - 132/221	643/878 -107/128	728/963 -23/213	812/1047 62/297	-	-	-	-	-	-	-
VHE10[10]	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[10]	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[10]	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	2946/3198 -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.

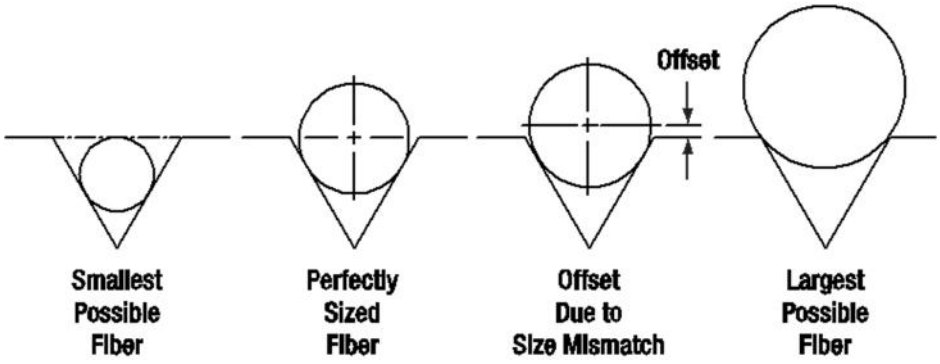


Figure 64 Each Insert Can Hold a Range of Fiber Sizes

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.**

[10] 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.
[11] These Bottom Inserts have vacuum holes to aid in aligning small fibers when used with the large-diameter fiber Cleavers.
[12] 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.

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 LDC401 and LDC401A 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:

- LDC401 Cleaving Stations
- 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 graphite tips 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 11 Specifications

Item #	LDC401	LDC401A
Cleave Type	Flat Cleave	Flat Cleave Angled[13] 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[14]	
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 5.30" x 5.15" (257.4 mm x 134.6 mm x 130.7 mm)	
Dimensions (L x W x H)	10.14" x 5.30" x 6.82" (257.4 mm x 134.6 mm x 173.3 mm)	10.14" x 5.30" x 6.96" (257.4 mm x 134.6 mm x 176.8 mm)
Weight	10.0 lbs (4.5 kg)	

[13] It may not be possible to create clean angled cleaves in specialty fibers with large "air-fill" fractions due to the structural properties of the fiber.

[14] These Cleavers are calibrated using standard weights, so the tension settings are programmed into the Tablet Controller in grams. This maximum tension corresponds to 6.5 kg.

Chapter 12 Servicing and Troubleshooting

12.1. Packaging

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 LDC401 or LDC401A. 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 65 Foam Support

Figure 66 Last Sheet of Foam Goes on Top

12.2. Frequently Asked Questions

Q: What is the micrometer used for?

The Micrometer Backstop process is primarily used for cleaving highly stressed (MM and PM) fibers and capillary tubing. The Micrometer Backstop 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 Backstop enables the use of a lowered Cleave Tension while improving the end face quality. A general rule is that the Cleave Tension should initially be lowered to 85% of the **Auto Parameter** value. Adjust the tension based upon visual inspection of the end face. If there is no end face damage but the cleave has an angle, increase tension. Decrease tension if there is end face damage but no angle. Do not go below 60% of the **Auto Parameter** value. Severe blade damage may result. To use the Micrometer Backstop load the fiber in the left FHB. Rotate the micrometer until it just contacts the fiber. Close the right FHB. Initiate the cleave as 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 the Process Selection Chart in Section 7.9.2.

Q: How many cleaves per Blade?

With proper parameters, typical blade life is about 5,000 cleaves per position, with ~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 it in the Parameter Select Screen, and set it to ‘**Enable**’. When enabled, three additional parameters values must be specified. These parameters are **Re-Tension Level, Post-Scribe Pause,** and **Re-Tension Pause**. Please refer to section 8.8 for a definition of these parameters. In addition to specifying these new parameter values, two existing parameter values may require adjustment. These are **Cleave Tension** and **Cleave Oscillation Counter** (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 Parameter** value and the Cleave Oscillation Counter 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 end face.

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 Auto Parameter tool built into the Tablet 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” (Section 10.1) or use the Insert Selection tool (Section 9.5.5).

Q: How do I figure out the meaning of all the Parameters referenced by the Tablet Controller?

Refer to Chapter 9: Controlling the LDC401.

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

Yes, refer to Section 7.9: Specialty Cleave Processes.

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

Refer to Section 12.3: Troubleshooting.

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

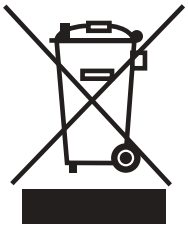
12.3. Toubleshooting

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 lower v-groove inserts and top inserts 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 FHB 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)	Set recommended Pre-cleave Advance for Fiber Diameter or adjust Blade Offset if blade has just been replaced or height changed.
	Blade reaches fiber but does not cleave it since it is chipped	Raise Cleave Blade Housing so that Cleave Blade strikes fiber at different location
	Blade passes below fiber	Raise Cleave Blade Housing
	Blade passes above fiber	Lower Cleave Blade Housing
	Blade reaches fiber but does not cleave it because fiber is large and FHB separation is large	Use Micrometer Backstop
Cleave angles are too large	Fiber is slipping in FHB's because of oil on inserts	Clean Lower 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 FHB lids.
	Fiber is twisting during loading due to debris in FHB's	Clean Lower 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
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)

Chapter 13 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.

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.

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.

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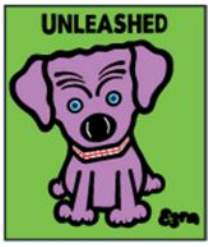
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