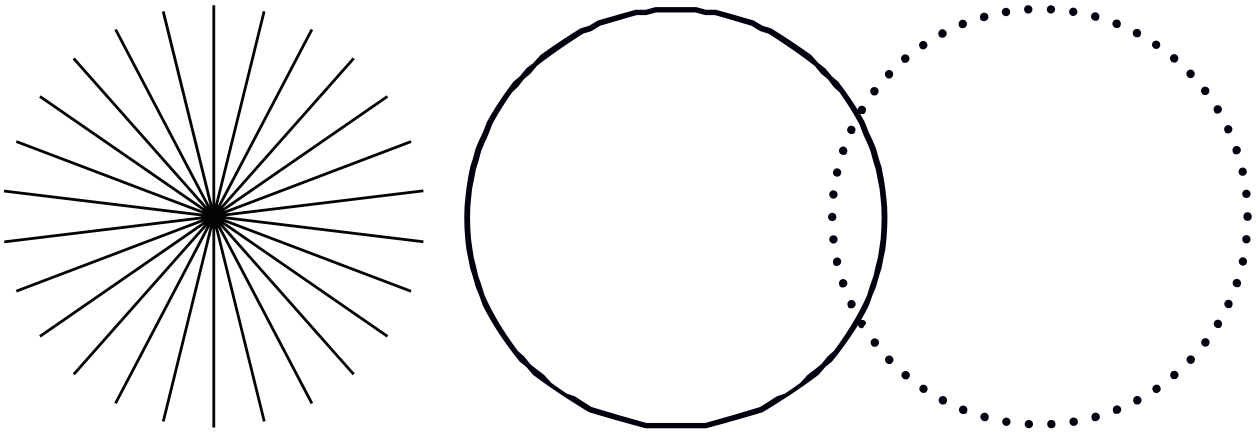
SureLock™ LMX Laser Diode Module

Operator's Manual



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Technical Support

In the U.S.:
Should you experience any difficulties with your laser or need any technical information, please go to our web site www.Coherent.com. Should you need further assistance, please contact Coherent Technical Support by e-mail customer.support@coherent.com or telephone, +1-734-456-3100. Please be prepared to supply the model and laser head serial number of your laser system, the description of the problem, and any attempted corrective steps to the Product Support Engineer responding to your request. Telephone coverage is available Monday through Friday (except U.S. holidays and company shutdowns). Inquiries received outside of normal office hours will be captured by our automatic answering system and will be quickly returned the next business day.

Outside the U.S.:
If you are located outside the U.S., please visit www.Coherent.com for technical assistance, or contact your local Service Representative. Service Representative telephone numbers and addresses can be found on the Coherent web site.
Coherent provides telephone and web-based technical assistance as a service to its customers and assumes no liability for any injury or damage that can occur at the same time with such services. Under no conditions do these support services affect the terms of any warranty agreement between Coherent and the buyer. Operation of any Coherent laser with any of its interlocks defeated is always at the operator's own risk.

Table of Contents

1 Safety Precautions

This instruction manual explains how to use the LMX Laser Module.

Before use, please thoroughly read this manual. After reading, keep it together with the product for reference when necessary. Please retain packaging material in the event the unit is stored or shipped in the future.

CAUTION – ***Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure. The body of the unit contains labels specifying wavelength and maximum emitted power.***

We recommend following user requirements for Class 3B products according to latest ANSI Z136.1 Standard for the Safe Use of Lasers. Use protective eyewear when engineering or other procedural and administrative controls are inadequate to eliminate potential exposure in excess of the maximum permissible exposure levels as stated in either ANSI Z136.1 or IEC-60825-1

WARNING! – ***To prevent permanent damage, observe these precautions:***

1. Protect against electrostatic discharge.
2. Take care in handling fiber. Inspect & clean fiber tip before connecting fiber.
3. Avoid external damage to the board and fiber.
4. Use supplied power supply or power supply meeting specifications.
5. Instrument is vibration sensitive. Handle with care. Permanent damage is possible.
6. Do not drop the module or operate it at extreme temperatures or humidity.

1.1 Explanation of Warning Symbols

This documentation may contain sections in which particular hazards are defined or special attention is drawn to particular conditions. These sections are indicated with signal words in accordance with ANSI Z-535.6 and safety symbols (pictorial hazard alerts) in accordance with ANSI Z-535.3 and ISO 7010.

Warning messages are intended to prevent accidents to operating personnel such as burns and electrical shocks.

1.2 Signal Words

Three signal words with color coded call-outs are used in this documentation:
WARNING!, **CAUTION**, and ***NOTICE***.

The signal words **WARNING** and **CAUTION** designate the degree or level of a hazard when there is a risk of user injury:

WARNING!
Indicates a hazardous situation that, if not avoided, could result in serious injury to eyes and/or skin.

CAUTION
Indicates a hazardous situation that, if not avoided, could result in minor to moderate injury to eyes and/or skin.

The signal word **NOTICE** is used when there is the risk of product or property damage:

NOTICE
Indicates information important to take special note of, but is not hazard-related.

1.3 Symbols

The signal words **WARNING**, and **CAUTION** are always emphasized with a safety symbol that indicates a special hazard, regardless of the hazard level:

This symbol is intended to alert the operator to the presence of highly-important operating and maintenance instructions.

This symbol is intended to alert the operator to the danger of exposure to hazardous visible and invisible laser radiation.

This symbol is intended to alert the operator to the danger of Electro-Static Discharge (ESD) susceptibility.

This symbol is intended to alert the operator to the presence of additional important information.

1.4 Safety Features For Compliance

The required Classification, Warning Logotype, Aperture, and Information labels are permanently affixed to (or screen-printed on) the housing, along with the Model Number, a unique Serial Number, Date Manufactured, and the units' maximum Output Power and Wavelength. Additionally, the wavelength is also found in the Model Number.

	Visible and/or invisible Class 3B laser radiation. Avoid direct exposure to beam. Wear suitable protective eyewear whenever laser is in operation.
	Laser output location warning.

2 Features

- Plug & Play Operation
- ESD Protection
- Adjustable Output Power
- Temperature and Wavelength Stabilized
- Compact Size

3 Specifications

OPTICAL	
Laser Class	Class 3B (maximum power and wavelength listed on warning labels of the unit)
Laser Operation	CW
Warm-up Time	< 5 min

ELECTRICAL AND THERMAL	
Operating Current	3 A
Operating Voltage	12V DC
Operating Temperature	+15ºC to +30°C
Storage Temperature	-20ºC to +50°C

MECHANICAL	
Laser Dimensions	120 mm x 40 mm x 42 mm
Weight	< 400 grams

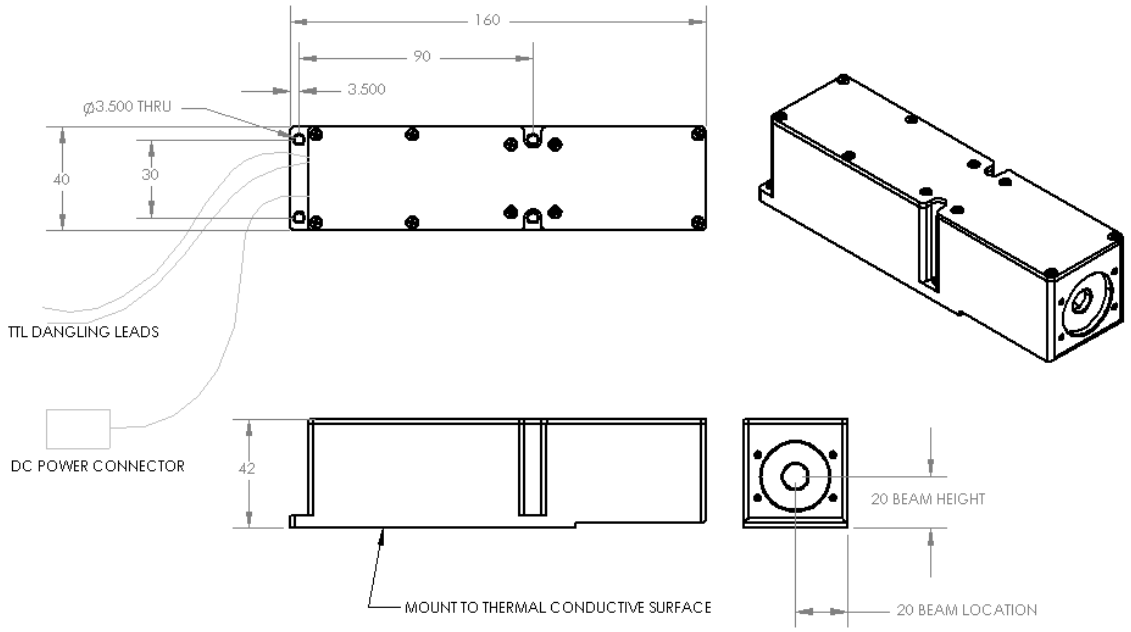

Figure 1: Mechanical Drawing

- Power Connection: 2.1 x 5.5mm Center Positive Standard Jack for supplying operating voltage and current. Transient 100% voltage input drop off per IEC 61326-1:2020 may cause unit to shut down and return back to its default power on operating condition.

- TTL Connection: DF13-2S-1.25C Connector

  Supplied with leads for TTL laser On/Off

  Default Open: Laser On

  To Turn Laser Off: Connect TTL, white wire, to ground, black wire.

4 Operating Procedures

4.1 Standard CW Operation

Laser module can be operated with or without USB communication port.

User Startup Procedure:

- Properly mount laser module on a heat sink
- If necessary, connect mini-USB interface cable
- Connect power supply

Laser Module Startup Process:

- Laser module controller will follow/indicate the following process after power on:
- Setpoints for current and temperature are saved aboard the laser diode module. Upon receiving power, temperature of the laser diode will be set after a few seconds.
- The LED at the rear end indicates the unit status. There is an approximate 40 second wait period before emission of radiation.
- Laser will operate with the saved state

WARNING! – Laser module will emit light, 20-60 seconds after providing power.

4.2 Operation via USB Communications Port:

The laser system includes complete remote-control capability through USB.

When the mini-USB cable is plugged into a PC for the first time, allow time for drivers to install. Virtual COM port (serial) drivers will install to allow the device to appear as an additional COM port. Application software can access the laser diode module similar to a standard COM port.

4.2.1 Baud rates and serial port settings

Each controller is shipped from the factory with a fixed 9600 baud, which cannot be changed.

The other serial port parameters are: 8 data bits, 1 stop bit and no parity. A hardware flow control is not supported.

4.2.2 Command formatting and termination characters

Each command to the controller must be terminated by a carriage return/line feed pair (ASCII 13 followed by ASCII 10).

All commands are case-sensitive.

Command arguments must be delimited by a single colon ':' character (ASCII 58).

4.2.3 Handshaking

Under no circumstances will the controller initiate communication. It only transmits characters in response to a message. Every message to the controller generates a response, either a numerical value or the acknowledgment string "OK". In the event that the controller receives a message that it cannot interpret, it responds: "ERROR". Every controller response is terminated by a carriage return/line feed pair (ASCII 13 followed by ASCII 10).

4.2.4 Commands

Commands	Argument	Response	Function
rli	No	**.*	Return the present operating current of the laser diode in mA
rtt	No	**.*	Return the TEC present measured temperature of laser diode in degrees Celsius
rti	No	**.*	Return the TEC present operating current in mA
stt:	**.*	OK	Set the TEC temperature in degrees Celsius(Default:25 Degree)
slc:	**.*	OK	Set ACC driver current in mA
ton	No	OK	Enable TEC control
tof	No	OK	Shut down TEC control
rsv	No	******	Return the laser system firmware version
rst	No	**.*	Return the TEC setpoint temperature in degree Celsius

rsi	No	**.*	Return the ACC setpoint current in mA
ssc	No	OK	Save the setting to the flash memory so the laser system can operate in the same setting after repower it
rcm	No	**.*	Read the maximum laser current in mA
rsn	No	*******	Return the laser controller serial number
con	No	OK	Turn on ACC laser driver
cof	No	OK	Turn off ACC laser driver

5 Maintenance

Routine maintenance is not required

6 Service

6.1 Repair

Defective modules will be repaired at cost, if possible. An RMA must be requested before sending it to Coherent. When shipping, please use original packaging materials, or a box at least five times as large as the module with enough packaging material to prevent any movement of the module within the box.

6.2 For Information or Enquiries

If you need information regarding purchase or repair, or for any other Sales related questions, please contact the distributor or selling agent from whom the module was purchased.

6.3 Coherent Limited Warranty

Coherent warrants that all **Benchtop** laser modules will be free from defects in material and workmanship for 12 months from the date of shipment. This limited warranty covers only those defects that arise as a result of normal use of the product, and does not cover any other problems, including those that arise as a result of: (i) improper handling, maintenance or modification, (ii) operation outside the product's specifications; or (iii) unauthorized modification or misuse.

If Coherent receives, during the applicable warranty period, notice of a defect in any product which is covered by this warranty, Coherent shall either repair or replace the product, at Coherent's option. Coherent shall have no obligation to repair, replace or refund until the customer returns the defective product to Coherent. Any replacement product may be either new or like-new, provided that it has functionality at least equal to that of the product being replaced. Coherent products may contain remanufactured parts, components, or materials equivalent to new in performance.

6.4 Coherent Limited Warranty

Coherent warrants that all SureBlock™ TR-Probe THz-Raman systems will be free from defects in material and workmanship for 12 months from the date of shipment. This limited warranty covers only those defects that arise as a result of normal use of the product, and does not cover any other problems, including those that arise as a result of: (i) improper handling, maintenance or modification, (ii) operation outside the product's specifications; or (iii) unauthorized modification or misuse.

If Coherent receives, during the applicable warranty period, notice of a defect in any product which is covered by this warranty, Coherent shall either repair or replace the product, at Coherent's option. Coherent shall have no obligation to repair, replace or refund until the customer returns the defective product to Coherent. Any replacement product may be either new or like-new, provided that it has functionality at least equal to that of the product being replaced. Coherent products may contain remanufactured parts, components, or materials equivalent to new in performance.

Responsibilities of the Buyer

The Buyer is responsible for providing the appropriate utilities and an operating environment as outlined in the product literature. Damage to the system caused by failure of Buyer's utilities or failure to maintain an appropriate operating environment, is solely the responsibility of the Buyer and is specifically excluded from any warranty, warranty extension, or service agreement.

The Buyer is responsible for prompt notification to Coherent of any claims made under warranty. In no event will Coherent be responsible for warranty claims made later than seven (7) days after the expiration of warranty.

Limitations of Warranty

The foregoing warranty shall not apply to defects resulting from any of the following conditions:

- Components and accessories manufactured by companies other than Coherent, which have separate warranties
- Improper or inadequate maintenance by the Buyer
- Buyer-supplied interfacing
- Operation outside the environmental specifications of the product
- Unauthorized modification or misuse
- Improper site preparation and maintenance
- Opening the housing
- Fiber tip and fiber damage due to mishandling and cleaniness

Coherent assumes no responsibility for customer-supplied material. The obligations of Coherent are limited to repairing or replacing, without charge, equipment that proves to be defective during the warranty period. Replacement sub-assemblies may contain reconditioned parts. Repaired or replaced parts are warranted for the duration of the original warranty period only. The warranty on parts purchased after expiration of system warranty is ninety (90) days.

This warranty does not cover damage due to misuse, negligence, or accidents; or damage due to installations, repairs or adjustments not authorized specifically by Coherent.

This warranty applies only to the original purchaser at the initial installation point in the country of purchase, unless otherwise specified in the sales contract. The warranty is transferable to another location or to another customer only by special agreement, which will include additional inspection or installation at the new site. Coherent disclaims any responsibility to provide product warranty, technical or service support to a customer that acquires products from someone other than Coherent or an authorized representative.

THIS WARRANTY IS EXCLUSIVE IN LIEU OF ALL OTHER WARRANTIES, WHETHER WRITTEN, ORAL OR IMPLIED, AND DOES NOT COVER INCIDENTAL OR CONSEQUENTIAL LOSS. COHERENT SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

6.5 Contacting Coherent

Coherent, Inc.
850 E. Duarte Rd.
Monrovia, CA 91016
Tel: 626-357-9600
Fax: 626-357-9321
Web: http://www.coherent.com
Email: customer.support@coherent.com
Technical Support: service.monrovia@coherent.com

7 Appendix

7.1 Importance Of Maintaining Clean Fiber-Connections

To ensure optimal performance of the laser system, it is crucial to maintain a pristine FC/PC connector on the unit and at the tips of the delivery fiber. Any contamination on the ends of the fiber connections can lead to undesirable performance outcomes and, if not addressed, may ultimately result in the failure of components or the entire system. There are also less apparent or even invisible contaminants that can cause unwanted attenuation, optical noise, or subpar performance. Examples include oils (e.g., from fingerprints), film coatings (e.g., condensates from vapors in a test chamber), and other residues (e.g., after the evaporation of water or solvents, dust, etc.). Furthermore, the laser output intensity at the very end of a fiber tip is so high that an small contaminant can be burned onto the end if it obstructs the core during operation at higher powers. This burn can damage the optical surface to the extent that it cannot be adequately cleaned, necessitating the replacement of the delivery fiber.

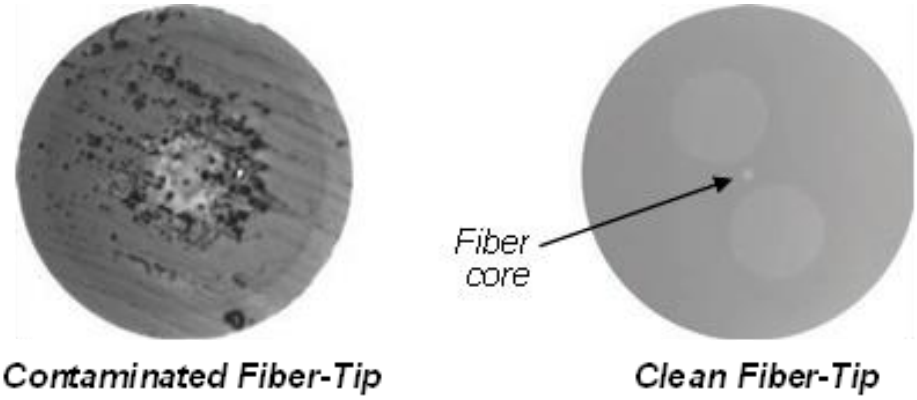

Figure 9.1-1: Contrast between a contaminated and clean Fiber-tip, as-viewed under magnification

NOTICE *- When cleaning fiber components, always complete the steps carefully, and wear nitrile gloves when handling fiber-ends. NEVER touch the fiber end-face with bare fingertips, even if "clean". The goal is to remove all dust and contamination to provide the cleanest mating surfaces possible for the optical connections. Remember that inspection, cleaning and re-inspection are very important steps which must be done before you make any fiber connections.*

WARNING! *– Always turn the unit OFF before you inspect a connected-fiber tip and/or clean the unit FC/PC connector:*

Never look into a fiber-end or the output aperture , while the Laser Enable keyswitch is in the ON position, even if the 'E-Stop' and/or other safety-interlocks are open and laser emission is not occurring.

Never attempt to inspect a fiber-end with a fiberscope while the laser is ON or operating.

Never use the eyes to verify laser emission, gauge power levels, or evaluate fiber-tip cleanliness' once the laser is ON and operating.

7.2 Cleaning the Fiber Connector

NOTE *- The product recommendations presented here are provided for convenience and reference purposes only. Coherent explicitly disclaims any responsibility or implication of warranty or guarantee regarding the performance, durability, or availability of these products. Moreover, the instructions given herein are intended as general guidelines and should not be considered exhaustive or comprehensive. It is important to note that fiber-cleaning methods and recommendations may vary between manufacturers and tools. As Coherent cannot dictate the choice of cleaning products or tools a customer may select, it is strongly advised to carefully adhere to the fiber tip cleaning instructions outlined in the User Manual for each specific product.*

Coherent recommends use of either the US Conec IBC™ Brand Model 9392 (or, alternatively, Model M250) 'one-click' style FC/PC connector-cleaners each time before freshly-mating a new delivery-fiber to the unit

Figure 9.2-1: US Conec IBC™ Brand Model 9392 and M250 FC-connector cleaning tools

NOTICE *- No known cleaning method is absolutely 100% effective. Thus, it is imperative that inspection is included as an 'integral part' of your cleaning process and protocol. Incorrect cleaning can damage the fiber, and/or the laser internally.*

7.3 Inspecting And Cleaning Delivery-Fiber Ends

Inspection of delivery-fiber ends are done with either a desktop video-fiberscope or a hand-held fiberscope. Both tools are specialized microscopes used for inspecting optical fibers. Any scope chosen should provide at least 200x total magnification. ***Specific adapters may be needed for FC/PC connectors*** to properly inspect the Fiber-tip. Figure 9.3-1 provides examples of popular scopes.

Handheld Fiber-Optic Inspection Scope

Desktop Video-Microscope Fiber Inspection Scope

Fiber-Optic Inspection-Scope Adapters

E-2000 Service Adapter 1019034 to hold spring loaded cap open

Figure 9.3-1: Examples of Fiber-tip inspection scopes and tools

To inspect a delivery-fiber tip:

1. Make certain that the laser is turned OFF before starting inspection.
2. Put the applicable inspection adapter or probe on your equipment.
3. Unscrew and remove the delivery-fibers' dust cap.
4. Insert the delivery-fiber connector into the fiberscope adapter and adjust the focus ring until you see a clear fiber tip image.
5. Clean the fiber tip and re-inspect, as necessary. See below for an overview on fiber tip cleaning.
6. Immediately plug the clean connector into the connector it will be mating-to decrease the risk of re-contamination.

Dry Cleaning Technique

The recommended dry-cleaning technique utilizes a 'cartridge' cleaning tool. Coherent recommends use of the following cartridge cleaning tools and associated techniques. (source-websites, valid as-of the time of this writing).

Figure 9.3-2 shows examples of these tools

OPTIPOP R, P/N ATC-RE-02

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http://www.ntt-at.com/product/optipop/

CLETOP-S TYPE A, P/N 14110501

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http://www.cletop.com/html/products.html

Figure 9.3-2: Examples of recommended Cartridge Fiber-tip cleaning tools

NOTE ***– Since fiber-cleaning techniques and advice can vary from manufacturer-to-manufacturer (and tool-tool), and Coherent cannot 'control' what cleaning product or tool a customer may choose to purchase, it is simply recommended to closely follow the Fiber-tip cleaning instructions provided in each products' User Manual.***

Wet Cleaning Technique

1. Make certain that the laser is turned OFF before starting cleaning.
2. Carefully remove the delivery-fibers' dust cap.
3. Inspect the fiber-tips with a fiberscope. (See Figure 9.2-1, above)
4. If a tip is dirty, clean with a cartridge cleaner, as-per the manufacturer's instructions – or – follow a simple 'Wet-to-Dry wipe' technique, as-follows: (Also see Figure 9.3-3, below)

CAUTION ***– Follow all safety instructions when using isopropyl alcohol and/or methanol (used for wet cleaning of the fiber tip). If you do not have a copy of the safety instructions and MSDS sheets for using IPA or methanol, contact your Industrial Safety Dept. before following the cleaning information described in this document.***

1. Start with a fresh sheet of lint-free, optical-grade lens paper, folded 3 times, to yield a cleaning surface with ‘8 layers’ of folded material. Be
2. careful not to touch or contaminate this cleaning ‘pad’.
3. Carefully drop spectroscopic-grade isopropyl alcohol (‘IPA’) or methanol onto the pad, until the ‘wet area’ is approximately the size of a penny.
4. Ensure that an area of the cleaning pad remains dry.
5. Place the ‘pad’ just created on a clean, smooth work-surface, and bring the fiber tip to a perpendicular-angle to the pad, and lightly contact it against the surface of the pad.
6. With very light pressure, and holding the tip to the cloth, ‘wipe’ the fiber tip lightly across the Wet area of the pad, using a ‘scalloped Figure 8’ motion. Do Not ‘scrub’ back and forth! At the same time, gently rotate the fiber-tip 90 – 180 degrees, maximum.
7. Immediately repeat this same action on a clean, dry-section of the pad to remove any traces of solvent. Again, Do Not ‘scrub’ back and forth!

NOTICE ***- Improper ‘Wet’ techniques can complicate fiber tip cleaning and should only be used when all dry, ‘cartridge-tool based’ techniques have failed to clean the tip sufficiently. The primary concern with using solvents is if it is not removed completely from the tip, residual liquid acts as a transport mechanism for loose debris elsewhere on the end-face. If the solvent is simply allowed to evaporate slowly off the end, it can leave residual contaminant on the fiber core. This is extremely difficult to clean off without another Wet cleaning and usually more difficult to remove than the original contaminant. Excess solvent can also remain in tiny ‘surface-pits’ where it can re-emerge upon fiber connection.***

Additionally, ‘scrubbing’ the fiber back-and-forth on the pad or wiping over the same area more than once can re-contaminate or damage the Fiber-tip.

(See technique-steps illustrated in Figure 9.3-3, next-page)

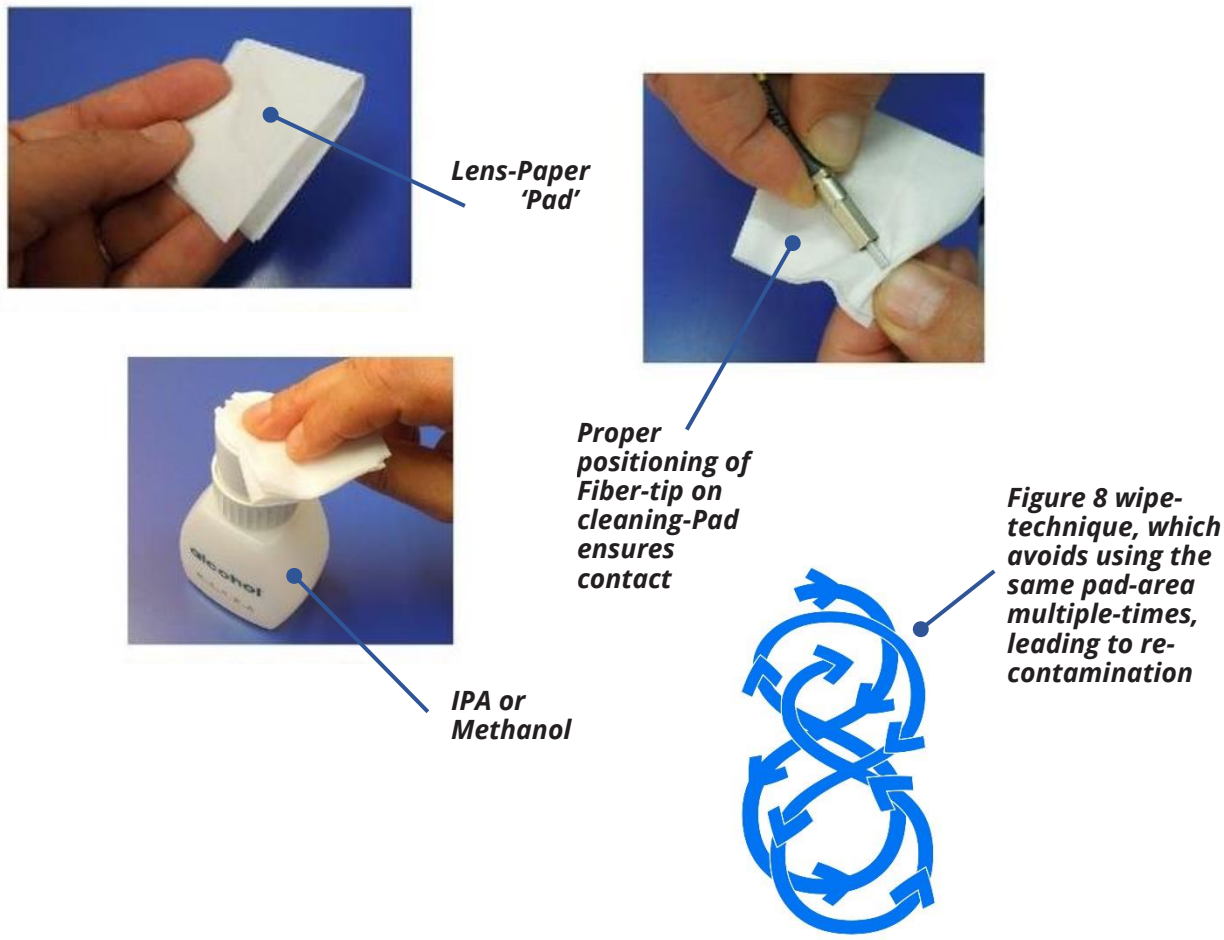

Figure 9.3-3: 'Figure 8' Wet-cleaning a fiber-tip with a 'cleaning pad' made from optical-grade lens paper.

Summary:

1. Inspect the delivery-fiber tip with a fiberscope or microscope, as per the instructions above. If the tip is dirty, use the Dry-cleaning technique to clean it, as-per the instructions above.
2. Re-inspect the fiber tip. If the connector is still dirty, repeat the Dry-cleaning technique, as-per above, a second time.
3. Re-inspect the fiber tip again. If the connector is *still* contaminated, clean it with the Wet cleaning technique, as per the instructions above.
4. Re-inspect the fiber tip again. If the contaminate is still present, repeat the Wet cleaning process, as per above, until the fiber tip is clean.

If the delivery-fiber tip is *still* contaminated after several cleaning attempts using both the Dry and Wet cleaning techniques, contact your technical support

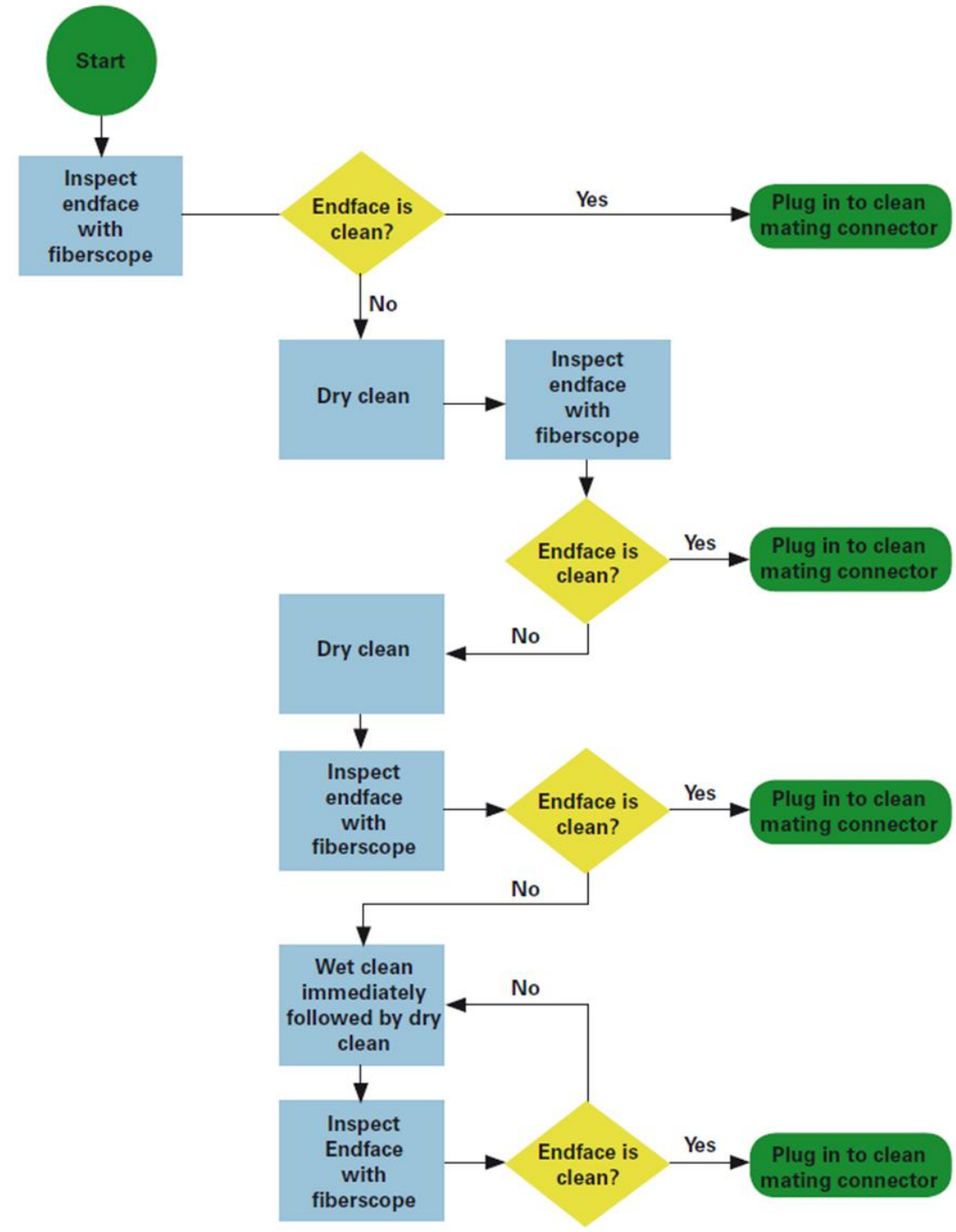

Figure 9.3-4: An example of a fiber cleaning process

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