



First Contact Application and Removal Procedure

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see LIGO DCC record Status

1 Objective

This document explains the procedure that was developed for applying and removing First Contact(FC). Section 4 explains the procedure for vertical Advanced LIGO optics in situ, and in Section 5 is the procedure for horizontal optics.

2 Applicable Documents

E1000128 Phelps, M. FTIR indicates no residue, 2010.

T1000137 Phelps, M. Drag Wiping and First Contact

T060161 Armandula, H. FTIR and scatter measurements indicate FC leaves no residue on clean optics.

T070280 Technical information from Photonic Cleaning Technologies.

T0900351 Dannenburg, R. FC Peeling and Charging Tests

3 Materials

List of required materials, manufacturer and part number:

1. First Contact, Photonic Cleaning Technologies Part# FCL for 1 Liter
2. First Contact thinner, Photonic Cleaning Technologies Part#TFCL for 1 Liter
3. Clean room gloves, VWR Part #79999-xxx
4. Fine PEEK mesh, McMaster Carr Part# 9289T11
5. custom PEEK brushes from Gordon Brush www.gordonbrush.com
6. Flashlight, Stinger from Copquest Part#10-1552-000 OR barlight from Fiber Optic Systems, Part# FSI-060-250
7. Kapton tape, McMaster Carr part#7639A75
8. Ion gun, Terra Univeral Part#2005-55

4 Vertical Optic Application

This procedure requires two people and was designed to allow the users to apply FC in the chamber at the observatories. It can be used on optics outside the chamber as well, however the procedure explained in Section 5 is easier, faster and only requires one person.

1. Both people put on [gloves](#) (LIGO approved kind for cleanroom use, see Materials item #3)
2. Pour some First Contact(Materials item #1) into a small beaker.(Fig.1)

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3. Pour thinner (Materials item #2) into a second small beaker. Use acetone if you don't have thinner.



Figure 1: Small beaker with FC solvent and a PEEK/aluminum brush.

4. Person 1 is in charge of holding the flashlight, passing the solvents in and out of the chamber, and watching for drips. Angle the flashlight (see Materials item #6 for the [flashlight](#)) so that Person 2 can see the FC they are applying. Resituate flashlight throughout procedure if Person 2 cannot see what they are doing. This is to avoid getting FC too close to the barrel of the optic, and to avoid drips.

5. Immerse brush into First Contact. Wipe off excess against side of beaker. Use pure un-dyed nylon paintbrushes, or custom PEEK brushes from GordonBrush.

NOTE: If the optic is vertical it is important that the brush does not drip FC onto the barrel, or let it run down to the bottom edge. If there is not too much on the brush, this should not be a problem.

Person 1 should watch for drips.

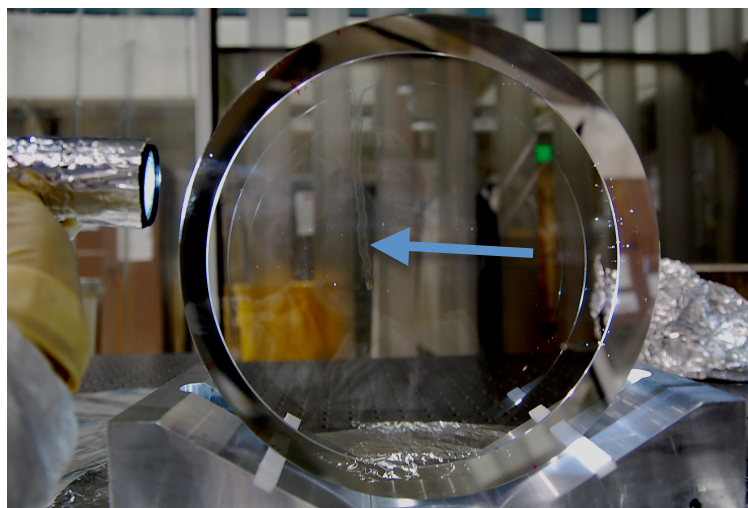


Figure 2: Avoid drips like this one. If it reaches the edge it will be hard to remove.

6. Begin brushing the FC. Start at the top of the optic, so that any excess solvent can be caught before it reaches the bottom. Brush slowly and lightly, avoiding as much bristle to optic contact as



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possible. Brush FC on in a circle that starts at least 5mm from the optic's edge, taking special care that the FC does not drip or run off the optic face near the bottom. A circle helps keep dripping to a minimum.

7. After you complete the initial circle of FC, go back in and fill in the rest using slow, uniform horizontal sweeps across the face.

8. Now that one layer is done set your brush in acetone/thinner and pass it back out of the chamber. Wait 20 minutes. First Contact includes acetone, so it is ok to use acetone as a thinner to keep your brush from stiffening. However the thinner sold by Photonic Cleaning works better. Do NOT use methanol as thinner.

9. Repeat twice for a total of 3 layers.

10. Leave to dry for as long as possible before removing, minimum 8 hours.

5 Horizontal Optic Application

It is easiest to apply first contact when an optic is horizontal. In this orientation drips aren't such a problem, and it also takes much less time, requiring one thick layer instead of three thin ones. This application reduces possible scratching from particulates being dragged along the surface, as there is no painting involved. It usually takes around 45mL of solvent for an ITM diameter optic.

1. Put on gloves.

2. Pour ~50mL of First Contact into a small beaker.

3. Pour the FC straight on to the optic's surface from a glass beaker (Fig. 3). Take care not to drop the beaker, if you feel uncomfortable holding the beaker over the optic, pour straight from the plastic FC bottle. Pouring straight from the bottle has less flow control.



Figure 3: Pouring FC onto horizontal optic

4. Make a pool of solvent right in the middle of the optic, ~20mL to start. Let it spread out a bit.

5. Pour more on, until you have a thick layer but none that might go over the edge. Gently push the solvent around with a clean room wipe until you get a thick, uniform coating. Use your wipe like a

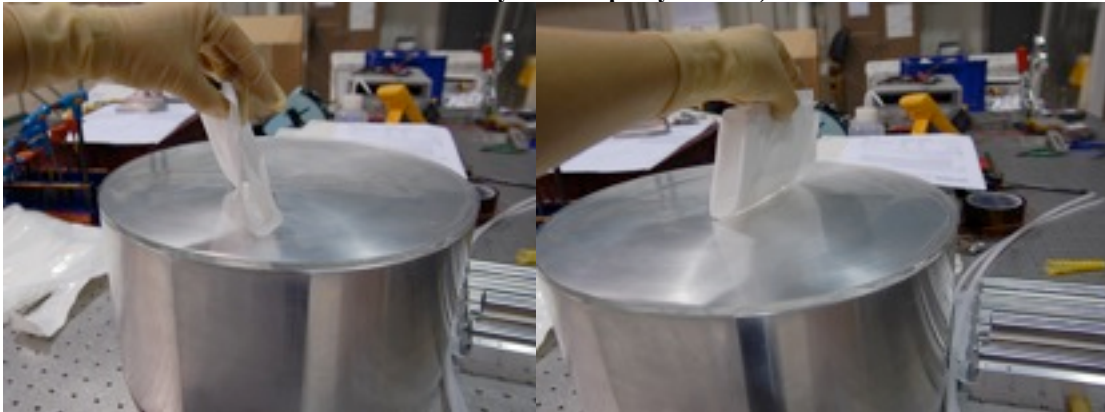


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“crepe spreader”, and spread the solvent around in a radial motion. Push down with as little force as necessary to spread the solvent, let the solvent touch the optic and not the wipe.

6. Spread FC out far enough to the edge of the optic so that if the ergo-arm is used to lift the optic, its o-ring will only contact FC, not half optic and half FC(this will not pull vacuum).
7. Remove the same way as vertically applied FC.

Figure 4: Picture on left is starting wipe position, picture on right is ending position(Doesn't matter where exactly on the optic you start)



6 Removal

1. Cut a strip of PEEK mesh about 2''x 12''. The PEEK mesh is shown attached to the top of the optic in Fig.5. On this optic, the mesh had to be taped back so that it did not interfere with the suspension structure. This can be avoided by cutting the mesh to follow the contour of the optic.
2. Hold mesh against the top of the optic. Leave about half the strip sticking up off the top of the optic (Fig.5).
3. With one hand hold the PEEK mesh strip, and with your other hand dip your brush into FC and spread a thin layer over the part of the mesh that is on the optic. Be careful to only brush FC onto the layer that is already there. Try not to spread FC all the way to the barrel! It may form a very thin layer, which will be hard to get off. Small strips that get left on near the edge by accident can be wiped off with acetone. Do not use methanol.

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Figure 5: Mesh in first contact layer at top, ready for removal.

4. Let the mesh dry for at least an hour. If the FC film is really stretchy and breaks when you try to remove it, wait longer until it does not stretch to breaking when pulled.
5. Holding the ion gun in position, begin to peel the PEEK mesh off from the surface. If the dried FC does not come off in one piece STOP, reapply a thicker layer if it has broken apart. As soon as the dry FC film starts coming off, start blowing nitrogen from the [ion gun](#) (Materials item #8) onto the optic. Hold the gun parallel to the optic face, focusing most on the area where the film is detaching itself from the optic. Use the flashlight and pay close attention to the edges when peeling it off to make sure nothing is left behind on the optic.



Figure 5: Keep a steady stream of nitrogen while peeling.

6. Once the film is off completely continue blowing off the optic for about 30 seconds to ensure the surface charge is zero. Try to keep the gun at the same angle and avoid waving your arm around, as you want to avoid disturbing the surrounding particles in the air. You can also point the ion gun towards your gloves before removal, they tend to accumulate some charge.
7. Shine the flashlight around the outer surface of the optic face to check for any stray dried First Contact. Remove any last bits by wiping a clean lens wipe around the edge in a circular fashion.



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The middle of the optic will be the cleanest part so wiping from edge to middle to edge will probably drag any contaminants you have into the center.

8. Done!

7 Alternative Removal(not allowed in vacuum chamber)

1. Stick a piece of kapton tape (Materials item #7) against the dried first contact.
2. Wait a few seconds, and then pull towards you, the film should come with the tape.
3. Do not use this to remove FC in a vacuum chamber where tape is not allowed. Try to avoid getting tape adhesive on the optic, if it does get on it, it can be taken off with more FC.

8 Additional Information

DO NOT use methanol to drag wipe an optic that has been cleaned with first contact. See [First Contact wiki](#) or LIGO #T1000137 for reasons why.

Each layer of FC will take about 20 minutes to “set”, ie to be dry enough to allow for the next layer to be applied. For three layers it is good to leave them overnight to ensure it is completely dry.

Dry time is longer at cooler temperatures.

If the layer sticks or stretches enough to break while removing it is not dry.

The dried film must leave the optic in one single INTACT piece.

If the dried film is too thin it will break while peeling. If this happens, stop peeling and brush another layer over the dry layer to make a thicker coating and allow re-drying before peeling off again.

When brushing on polymer with a brush do not allow bristles to scour the optic surface.