



## 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). Look in Section 4 for applying to vertical Advanced LIGO optics in situ, in Section 5 for applying to large horizontal optics, and in Section 5.1 for small optics.

### 2 Applicable Documents

- E1000128 First Contact FTIR, 2010
- T0900438 LIGO vacuum qualification of First Contact
- T1000137 Drag Wiping and First Contact Tests
- T1000425 First Contact Hazard Analysis
- T060161 FTIR and Residue tests, 2006
- T070280 Photonic Cleaning Technologies Technical Information
- T0900351 FC Peeling and Charging Tests

### 3 Materials

List of required materials, manufacturer and part number:

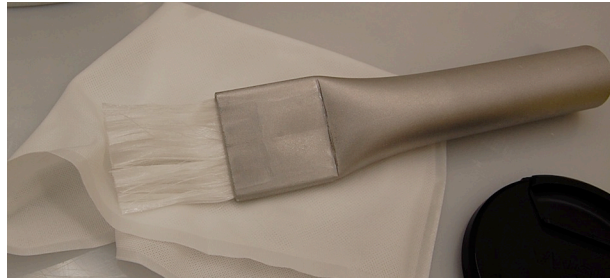
1. First Contact, Photonic Cleaning Technologies Part# FCL for 1 Liter
2. First Contact thinner, Photonic Cleaning Technologies Part#TFCL for 1 Liter
3. Clean room gloves, VWR Part #79999-xxx
4. Fine PEEK mesh, McMaster Carr Part# 9289T11
5. Custom nylon brushes from Gordon Brush [www.gordonbrush.com](http://www.gordonbrush.com) (ordered by COC)
6. Flashlight like Coast G45 LED flashlight from Lights and Knives(in techmart) OR barlight from Fiber Optic Systems, Illuminator Part# FSI-1060-250 and light part # 50-3077
7. Kapton tape, McMaster Carr part#7639A75
8. Ion gun, Terra Univeral Part#2005-55 or equivalent
9. Lint-free Berkshire lenswipes, 9’’x9’’. VWR part number 52847-150

### 4 Vertical Optic Application

This procedure requires at least 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 horizontal application explained in Section 5 is easier, faster and only requires one person.

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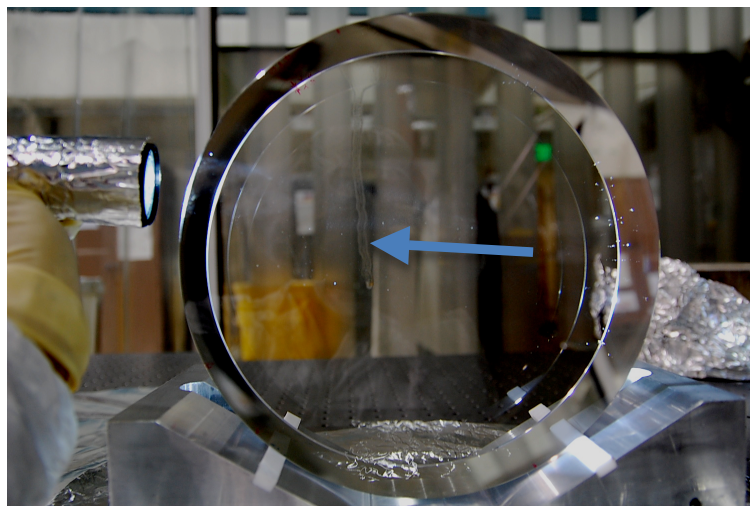
1. Both people put on [gloves](#) (LIGO approved kind for cleanroom use, see Materials item #3)  
NOTE: If any FC solution gets on your gloves at any point, **immediately change gloves.**
2. Pour some First Contact(Materials item #1) into a small beaker.(Fig.1)
3. Pour thinner (Materials item #2) into a second small beaker. Use acetone if you don't have thinner.



**Figure 1: aluminum handled nylon brush from Gordon 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 that do not contain adhesive, or the custom nylon brushes from GordonBrush that were ordered by COC.

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 possible. Brush FC on in a circle that starts at least 14mm away from the optic's edge, taking special



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care that the FC does not drip or run off the optic face near the bottom. Doing a circle first helps keep dripping to a minimum.

Keeping the film 14mm(0.55'') from the edge all the way around allows the Ergo-Arm to lift the optic without touching the FC film. **This is only necessary for Core optics.** For all other optics, FC can be painted all the way out to the edge.

7. After you complete the initial circle, 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, for a minimum of 4 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 a 340mm diameter optic(test mass size).

1. Put on gloves. NOTE: If any FC solution gets on your gloves at any point, **immediately change gloves.**

2. Pour the FC onto the optic's surface straight from its plastic bottle. Wrapping a clean wipe around the bottle cuts down on drips from the bottle. If you want to measure out exact quantities pour the FC into a 50mL clean glass beaker and use this to pour onto the optic. Be sure to keep a tight hold on the glass beaker though.

4. Make a pool of solvent right in the middle of the optic, ~20mL to start and then let it spread out a bit. If it is flowing all to on side or another pour the remaining quantity off center to compensate.

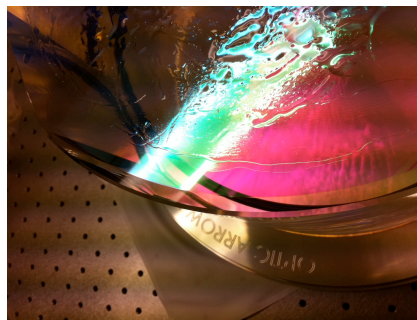


Figure 3: FC layer 14mm from edge of ETM02

5. Fold a lens tissue so that you have a rounded edge as in Fig. 4.



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6. Gently push the solvent around with the rounded edge of a Berkshire lens tissue until you get a fairly uniform coating. Use your lens tissue like a “crepe spreader”, and spread the solvent around in a radial motion for a more uniform coating. Push down with as little force as necessary to spread the solvent, let the solvent touch the optic and not the tissue.

7. Spread FC out to no more than 14mm from the edge of core optics, to allow for lifting the optic with the ErgoArm without touching the film.

8. Remove the same way as vertically applied FC.

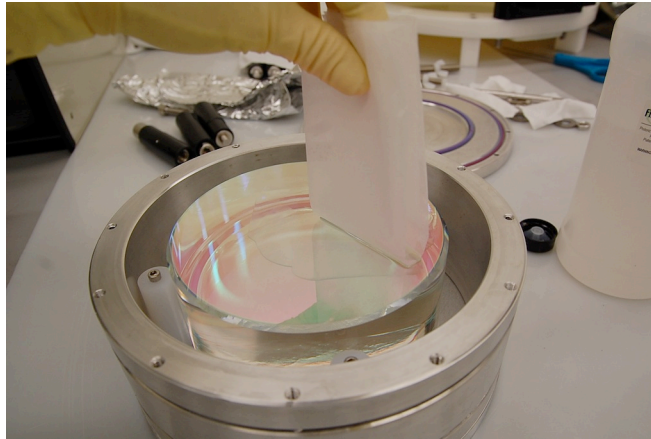


Figure 4: Spreading FC onto an input optic with a Berkshire lens tissue

### 5.1 Application on a Small Optic ( $\leq 1''$ diameter)

1. Put on gloves
2. Liberally apply FC using the small applicator bottle (Fig. 5) and brush. Can apply all the way out to the edge.
3. Remove the same way as for large optics, using a very small piece of PEEK mesh.



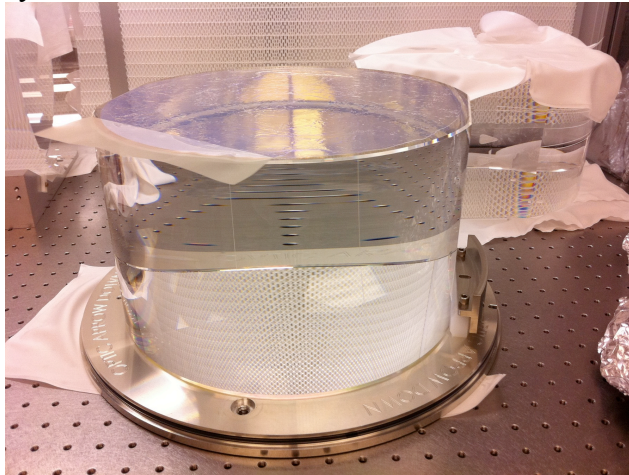
Figure 5: Small FC applicator bottle and two refill bottles



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### 6 Removal

1. Cut a strip of PEEK mesh. 1''x 3'' is a good size for a test mass size optic. The PEEK mesh is shown attached to the top of the optic in Fig.6 is even bigger than necessary, there is enough as long as there is mesh sticking out that you are able to grip and pull.
2. Hold mesh against the top of the optic. Leave about half the strip sticking up off the top of the optic (Fig.6).
3. With one hand hold the PEEK mesh strip, and with your other hand dab FC onto the part of the mesh that is on the optic using the small applicator brush. The PEEK mesh can be applied to an already dry film, the dry FC will dissolve in the solvent and recombine into one new layer.



**Figure 6: 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 break when pulled.
5. Holding the ion gun in one hand, 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 detaching from the optical surface, 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.

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**Figure 6: Keep a steady stream of nitrogen while peeling.**

6. Shine the flashlight around the outer surface of the optic face to check for any stray dried First Contact. Remove any last bits by dragwiping an acetone soaked lens tissue around the edge in a circular fashion. The middle of the optic will be the cleanest part so wiping from edge to middle to edge will drag any contaminants you have into the center, and is not recommended. If latex gloves touch the wet acetone, the tissue may leave some latex residue on the optic. To avoid doing this, either grip the tissue by the dry part only, OR use roundtip forceps to hold the tissue. Acetone has also been seen to dissolve cleanroom wipes enough so that wiping them on optics leaves wipe fibers and polymer. For this reason, use lint-free Berkshire lens tissue instead, in materials list #9.
7. Done!

### 7 Additional Information

First Contact has an expiration date of 1 year from the date of purchase.

DO NOT use methanol to drag wipe an optic that has been cleaned with first contact. See 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 yet.

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.



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