LIGO Laboratory / LIGO Scientific Collaboration

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Enhanced LIGO Core Optic Drag Wipe Cleaning Procedure

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Core Optic Drag Wipe Cleaning Procedure:

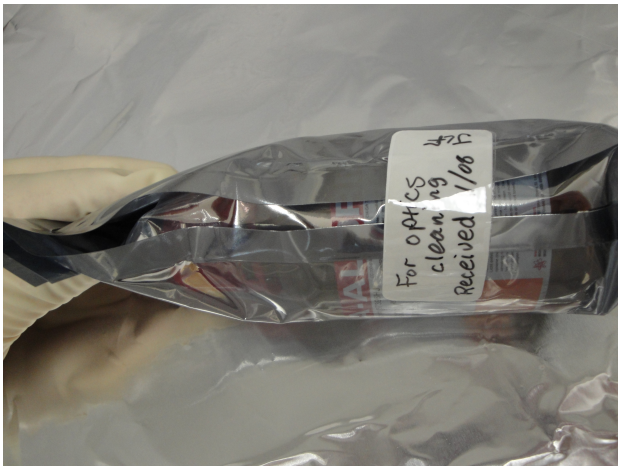
This procedure was develop at LHO by Doug Cook, and refined by Cheryl Vorvick and Justin Garafoli. Jodi Fauver provided instructions for cleaning and storing the glass bottles. Jeff Garcia snapped the pictures.

Materials List:

1) Methanol, CHROMASOLV®, gradient grade, for HPLC, 99.9%, Sigma-Aldrich, item number 34885: purchase 100ml bottles
2) Gloves: AccuTech Ultraclean, item number 91-300C
3) Tissue: Birkshire LENSX 90, 9"x9", item number LN90.0909.16
4) Glass bottles: Wheaton bottles from VWR
5) Ameristat Bags
6) Razor Blade: new (sharp), cleaned to class B
7) 12” Ruler: cleaned to class B
8) Bright flashlight: cleaned to class B (or as close as possible)

Material Handling and Purchasing:

Methanol:
Purchase high grade Methanol – specifically Chromasolv, gradient grade, for HPLC, item number 34885 from Sigma-Aldrich, in 100ml bottles. Chromasolv is hydroscopic, and will only be good for use on a core optic on the day that it is opened. The bottle’s airtight seal can be broken without breaking the red cap seal, so it’s important to ensure that the bottles have not been opened before use. To ensure they have not been opened, wrap the bottles in Ameristat bags, and staple shut (Figures 1 and 2).



Figures 1 and 2: Chromasolv wrapped and sealed in Ameristat, to ensure that the lid's airtight seal is not broken before use.

Glass Bottles:
Wash and class B a glass bottle, with stopper, to hold the Methanol

1. Obtain glass dropping bottles (clear, 50 mL or 100 mL).
    a. We use Wheaton bottles from VWR (http://vwrlabshop.com/glass-dropping-bottles-wheaton/p/0006780/bhcd2/1248379168/)
2. Clean and bake bottles according to E0960022.
    a. Liquinox/DI H_2O ultrasonic wash, triple DI H_2O rinse
    b. 24 hour air-bake

If the bottles are to be used at a later date:

3. Wrap each individual bottle in UHV foil.
4. Place each foil-wrapped bottle into a small zip-lock Ameristat bag w/ air removed.
5. Place each small Ameristat bag into a medium zip-lock Ameristat bag w/ top folded over and stapled. (Bags are stapled to make the packaging tamper-evident.)
6. Tag outer bags appropriately (Class B clean, Size of Bottle, Date cleaned, etc.)
7. Place bagged bottles into a storage container close to the flammables cupboard for the Chromasolv.

Procedure Overview:

Filling bottles on the day of optic cleaning:
Wear gloves, and maintain class B cleanliness, to open a new bottle of Chromasolv and fill a class B glass bottle. Wrap the filled glass bottle in an Ameristat bag for transport to the vacuum chamber.

Lens Tissue Preparation:
Cut the 9" x 9" lens tissue into 3" strips, using a Class B cleaned ruler and razor blade.

Lens Tissue Wipe Preparation:
Take 2 strips of tissue, fold in half once and crease the fold. Fold in half again and DO NOT CREASE. This round edge is what you'll use to clean the optic. Draw a line of methanol across this round edge, which should wet about a 1 cm line of tissue.

Drag Wiping The Optic:
Hold the lens tissue about half way down toward the wetted end. Touch the wetted part of the lens tissue to the optic surface, at the start of the area to be wiped, without touching your fingers to the optic.

Gently pull the lens tissue across the optic surface without letting the tissue separate from the surface, until you reach the end of the area to be wiped.

Discard the tissue and make a new one to use on the next wipe.

The optic surface can be drag wiped in a horizontal or vertical pattern.

Two people are needed for the drag wiping procedure, so that one person can hold the flashlight wile the other person works on drag wiping the optic surface.

Procedure Details with Pictures:

Lens Tissue Preparation:
Cut the 9” x 9” tissue into 3” widths with a razor blade and class B ruler (Figures 3, 4, and 5). This is to make sure the edges are very cleanly cut, so no lens tissue fibers are left behind on the optic or in vacuum.

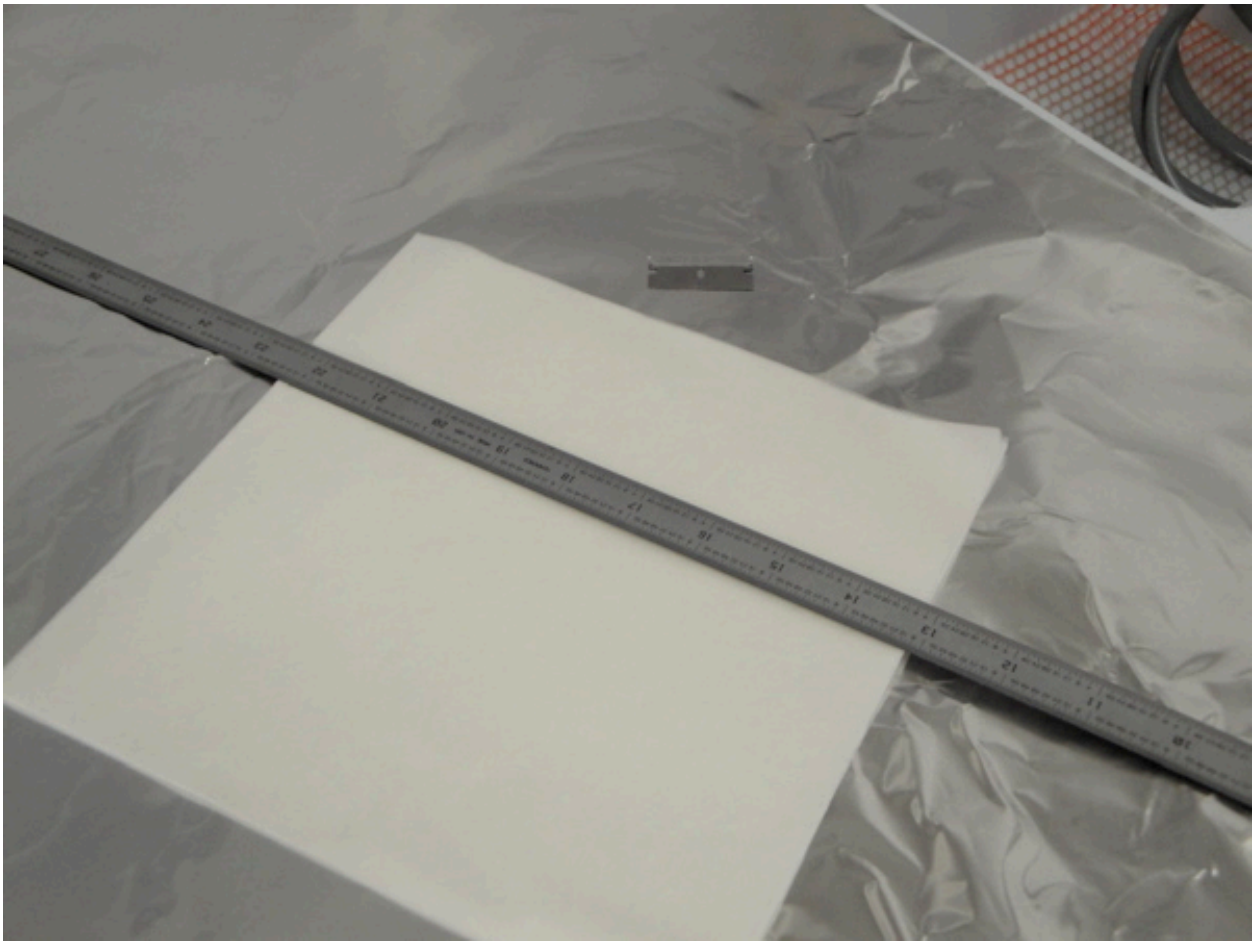


Figure 3: Preparing to cut lens tissue. Class B ruler and razor. Lens tissue on a clean sheet of foil.

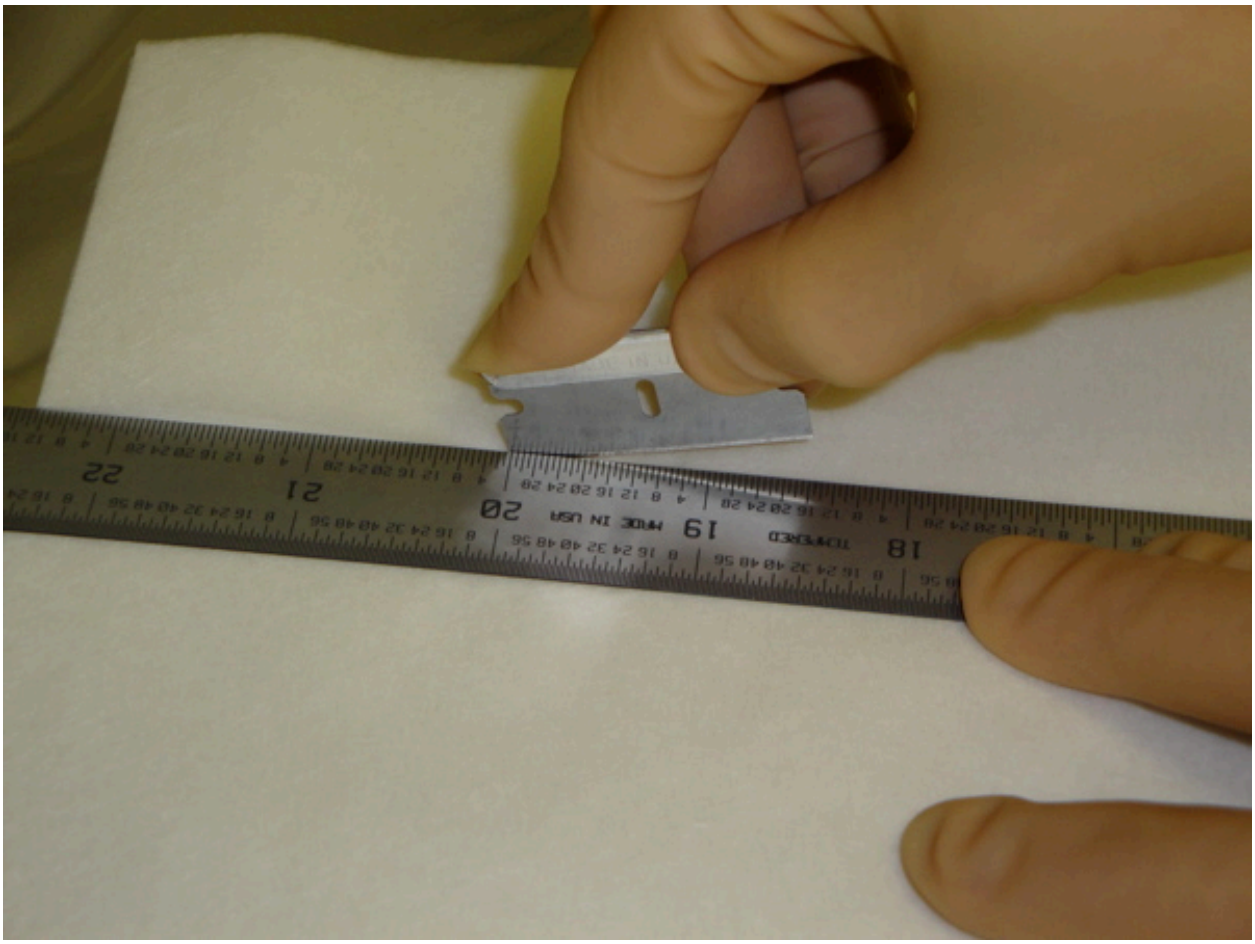


Figure 4: Cutting the tissue.

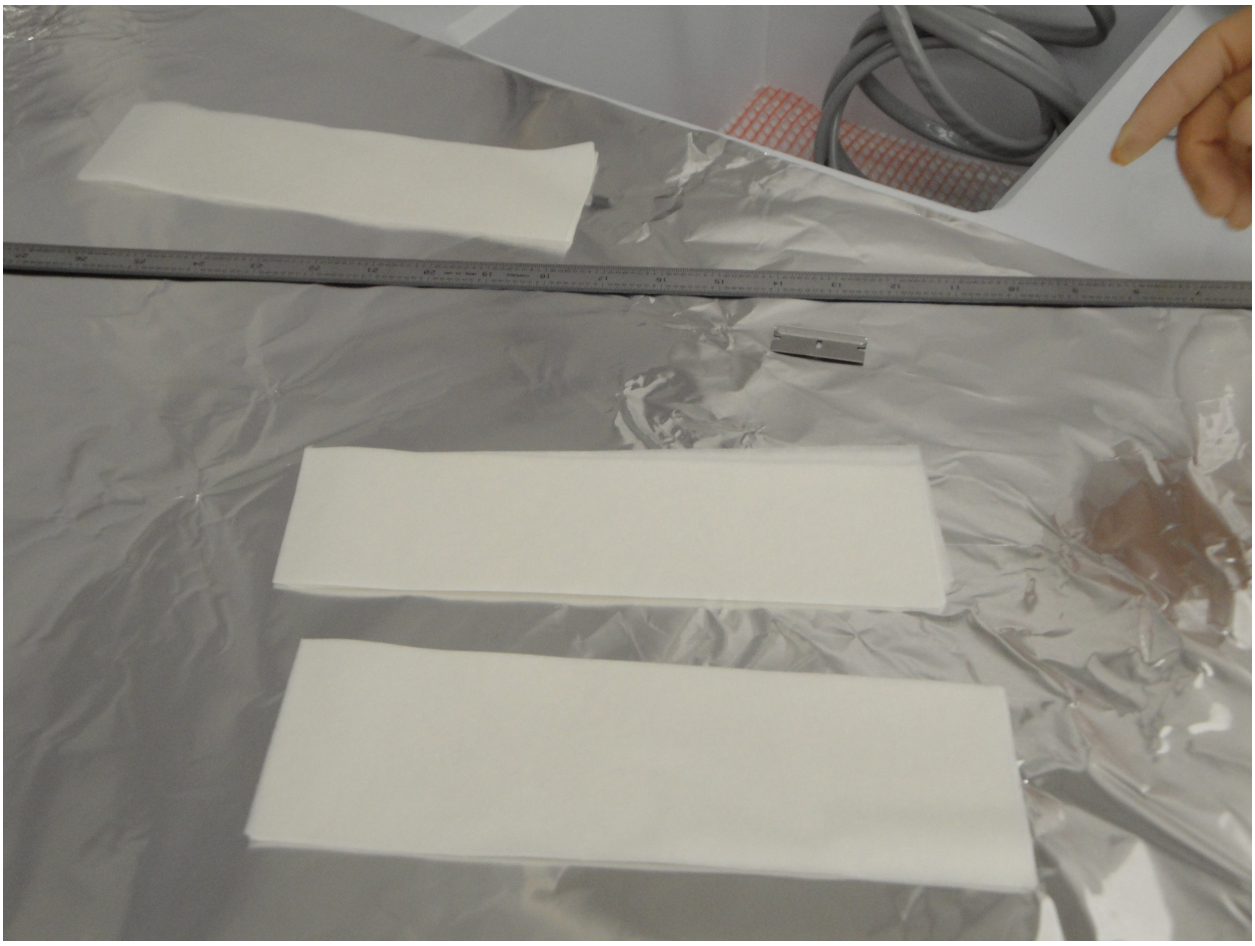


Figure 5: 9” x 9” lens tissue cut into 3” strips.

For transport to the vacuum chamber, construct a foil pouch where all the edges or the foil are concealed, so that no cut foil edge touches the tissue, gloves, or anything! Place the pouch in an Ameristat bag to keep it class B during transport.

Lens Tissue Wipe Preparation:
Take 2 strips of tissue (Figure 6), fold in half once and crease the fold (Figure 7).

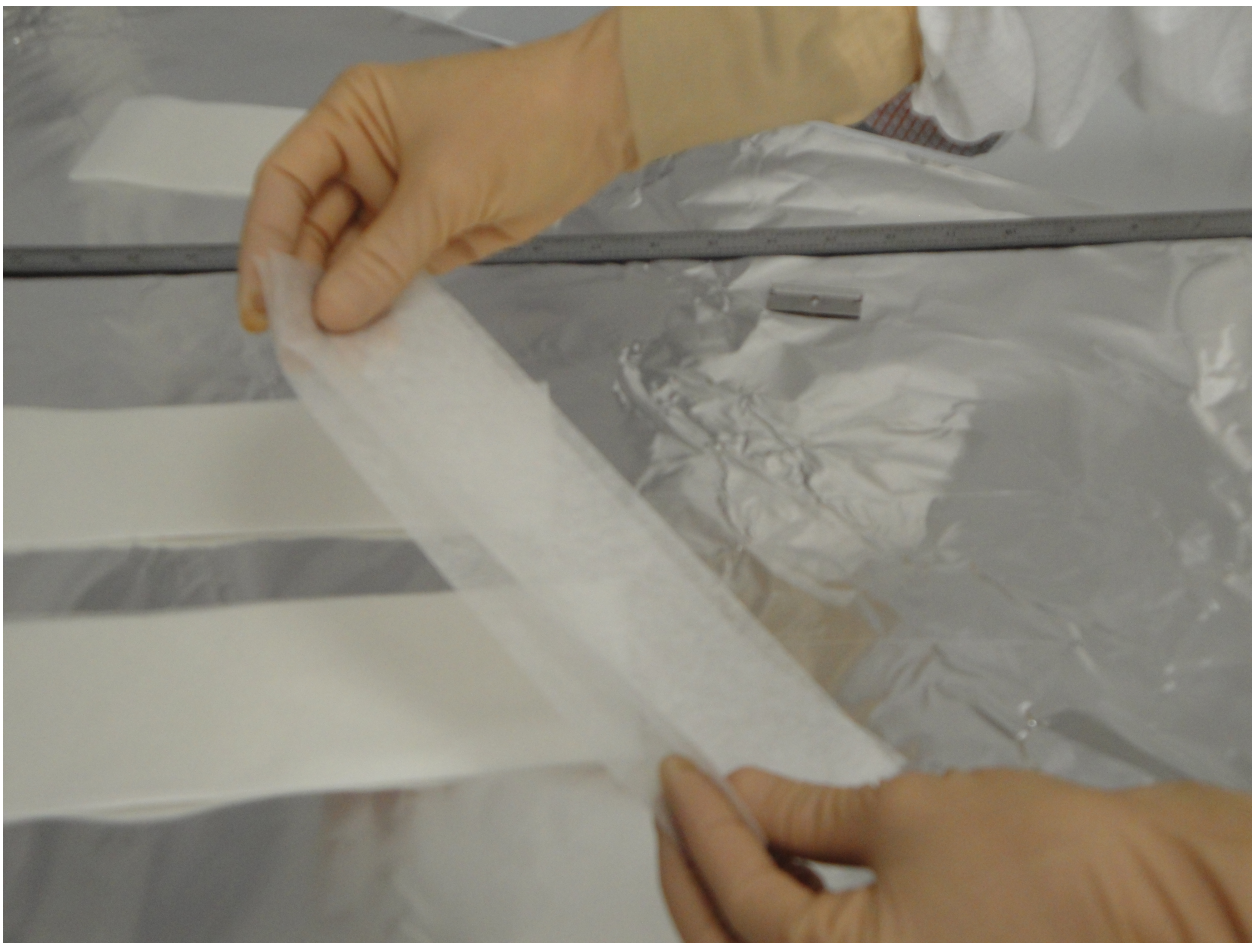


Figure 6: Two lens tissue strips.

Figure 7: Lens tissue strips folded in half.

Fold in half again and DO NOT CREASE (Figure 8). This round edge is what you'll use to clean the optic.

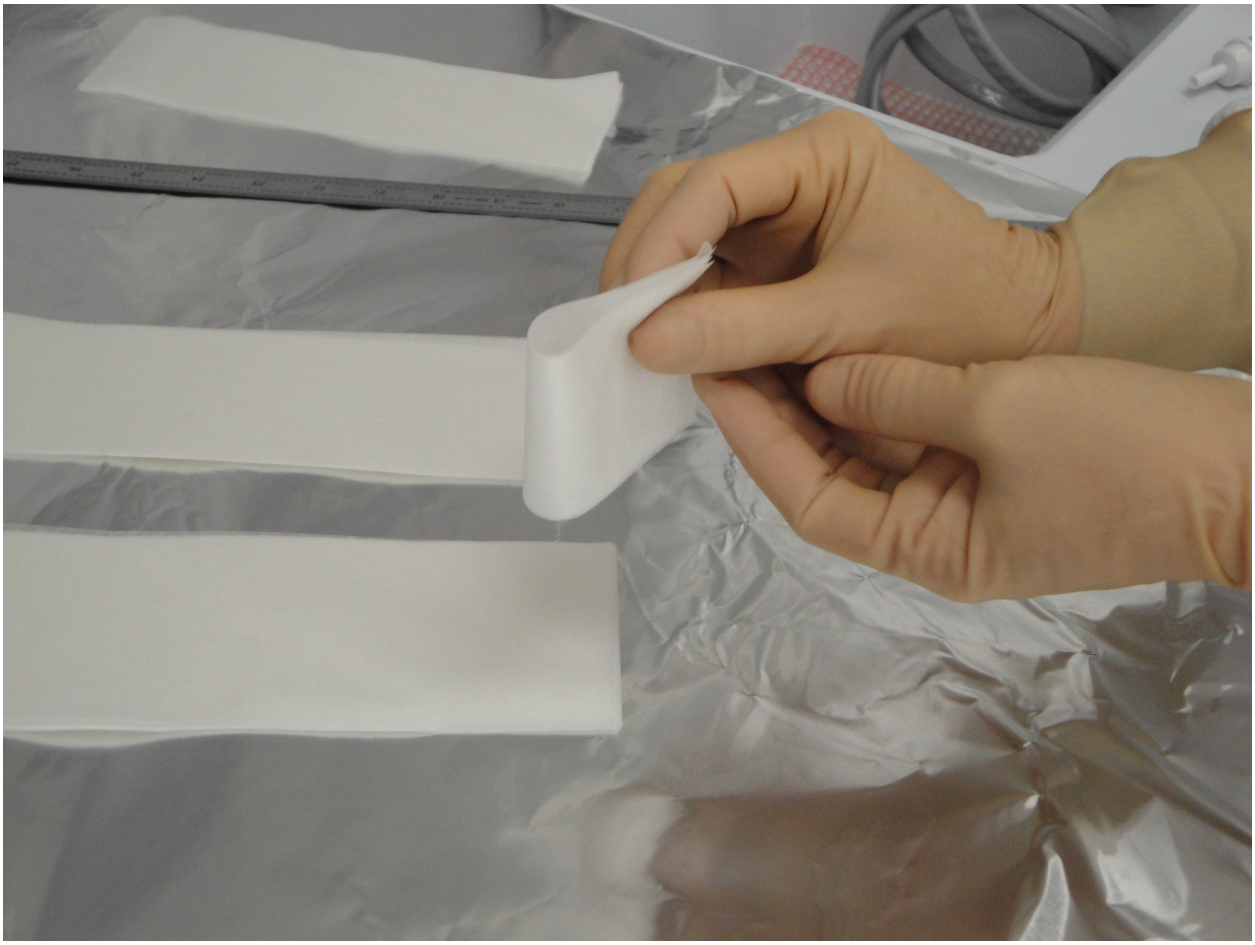


Figure 8: Tissue strips folded but NOT creased.

Draw a line of methanol across this round edge - the methanol should wet about a 1 cm line of tissue (Figures 9 and 10).

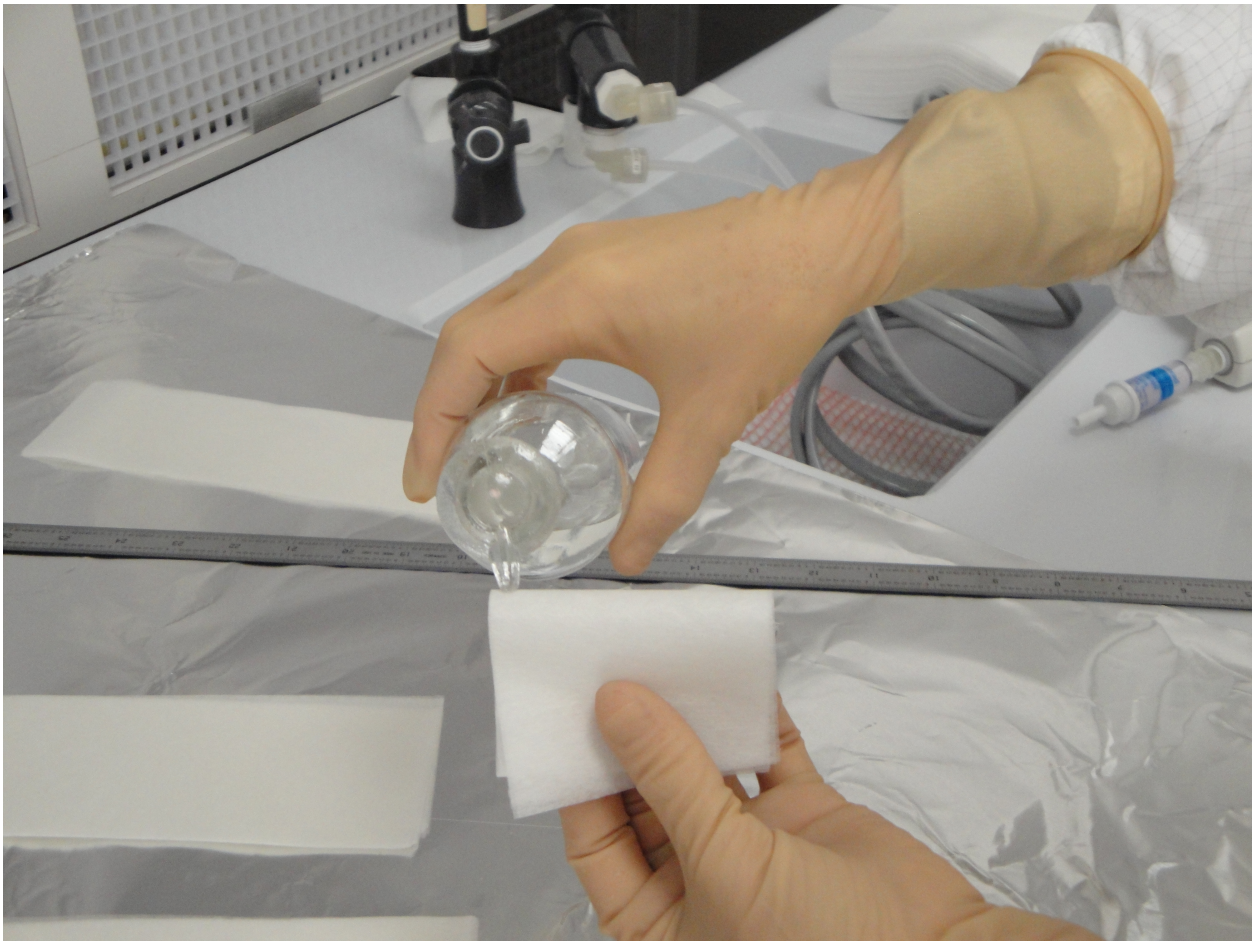


Figure 9: Wetting the rounded edge of the tissue with methanol.

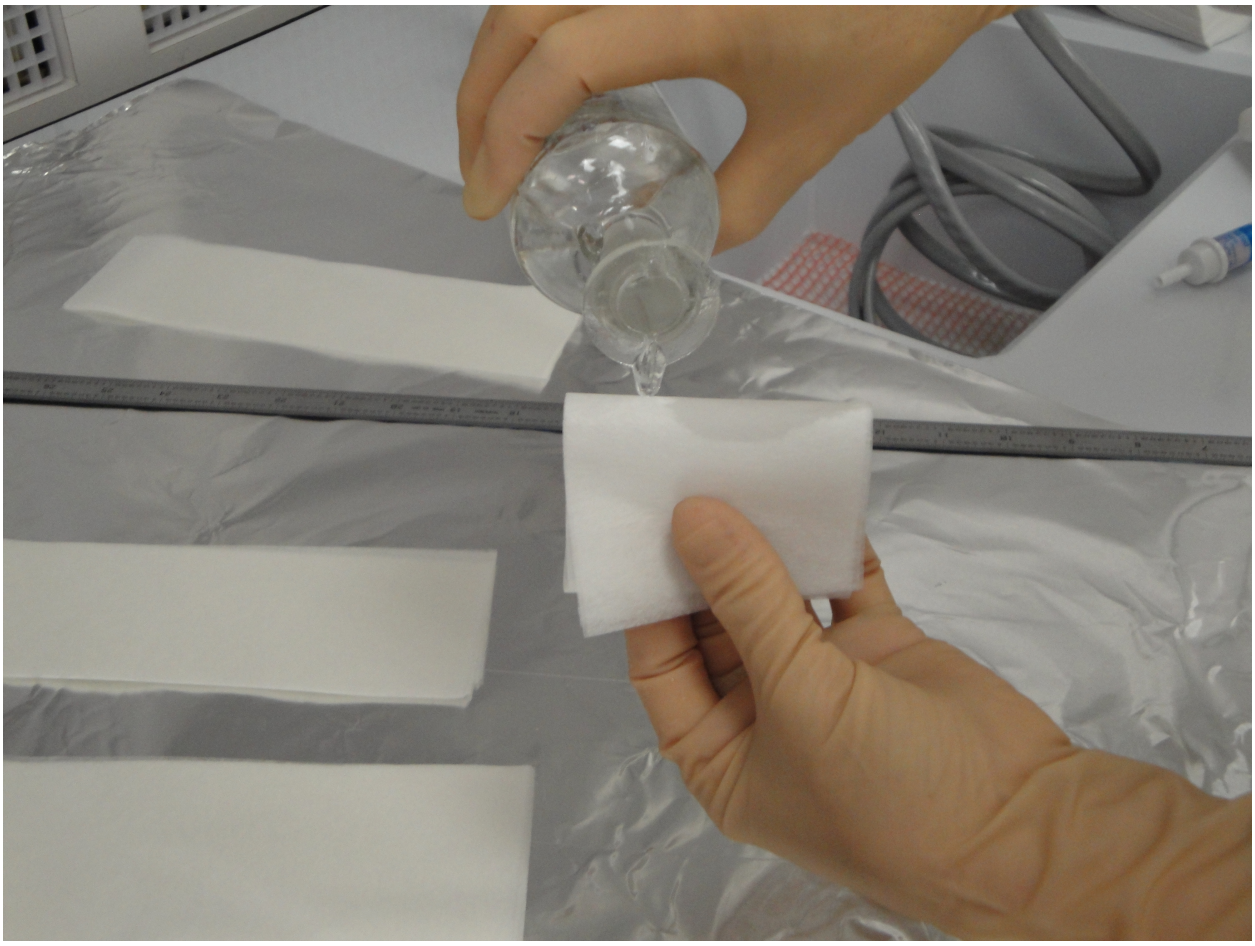


Figure 10: Wetting the rounded edge of the tissue – showing the wetted area.

Drag Wiping the Optic:
Contact the wetted part of the tissue with the optic surface. At no time do your fingers contact the optic surface (Figure 11).

Figure 11: Contacting the wetted edge of the tissue to the surface (in this case, using the aluminum covered table as the optic surface). Note that I am wearing rings under my gloves in this demonstration picture, but they should NEVER be worn during a real cleaning procedure.

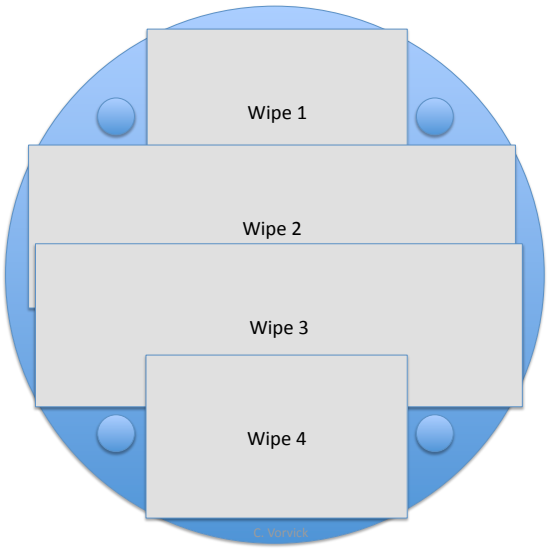
Gently pull the tissue across the optic surface, watching that the tissue remains adhered to the surface (Figures 12 and 13). Discard the tissue after each use.

Figure 12: Contacting the wetted edge of the tissue to the surface (in this case, using the aluminum covered table as the optic surface). This image shows that the tissue bends as it adheres to the surface and the tissue is gently pulled across the surface. Again, the rings, don't wear them in a real procedure!

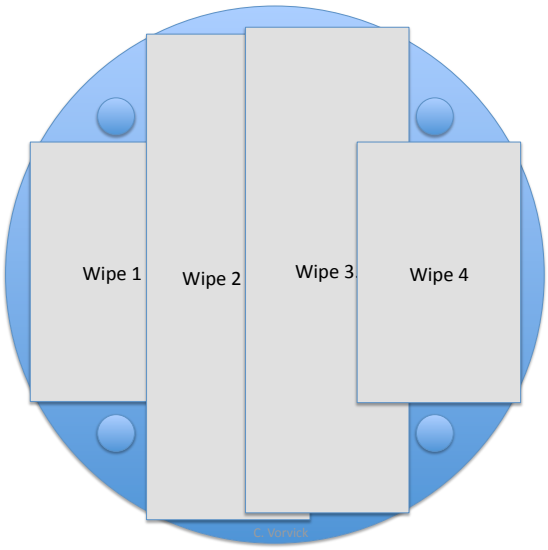
Figure 13: This shows that the only the wetted area of the tissue contacts the surface of the optic. The fingers do not contact the surface, and do not press the tissue directly onto the optic. Again, rings – don't wear them! This is just a demo picture.

Cleaning a LIGO Core Optic:

When cleaning a Enhanced LIGO core optic, both horizontal and vertical wiping patterns can be used (Figures 14 and 15). I prefer and use the horizontal wiping pattern. The optic surface should be examined with a bright flashlight after each wipe, and if additional wipes are necessary, pay special attention to the area around the edge of the tissue to ensure that no streaks are left behind. If streaks are found, go over them with additional wipes until they are gone, or you can verify that they are part of the optic surface.



Figures 14: Horizontal Drag Wiping Patterns for LIGO Core Optics.



Figures 15: Vertical Drag Wiping Patterns for LIGO Core Optics.