



LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY

LIGO Laboratory / LIGO Scientific Collaboration

LIGO-T1600251-v1

LIGO

June 28, 2016

First Contact Application and Removal Procedure for LIDT
Vacuum System Optics

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1. Introduction

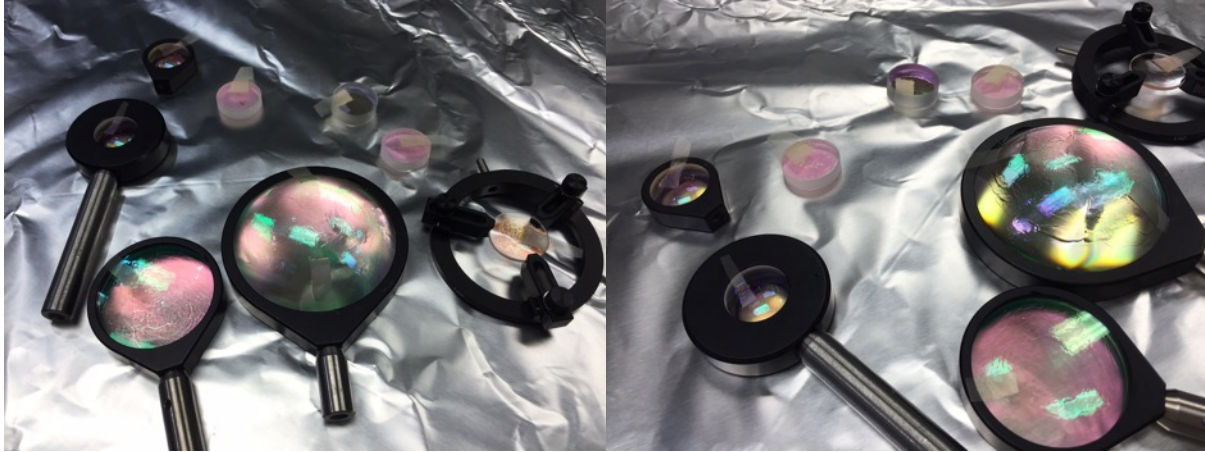
The purpose of this technical note is to describe in detail the procedure conducted to clean the [number] optics composed of both mirrors and lenses which are used in the LIDT (Laser Induced Damage Test) System. Five lenses and three mirrors were used in the cleaning procedure; all three mirrors were identical, and the lenses were of both the convex and concave variety. Further information on the specific lenses can be found on the LIDT DCC document portal page. The lenses and mirrors are cleaned with First Contact to remove dust particles on the lenses and mirrors for two main reasons. 1) When the laser comes in contact with the dust particulates, the dust may melt or combust resulting in the damaging of the delicate outer coating on the optics which gives the optics their precision. 2) Dust coating on the lenses and mirrors can interfere with the laser's signal and can be integrated in to the raw data as unnecessary and unwanted noise. A thorough cleaning of the lenses and mirrors will produce more accurate results in the LIDT experiment.



Figures 1 and 2: An example of the before and after effects of the First Contact cleaning procedure. The picture of the large convex lens on the left has many dust particles that are easily illuminated with the light of a small flashlight; however, after the procedure, the lens has little to no visible dust when illuminated with a flashlight.

2. Application

The cleaning process took place in a clean room on a stainless steel table covered in UHV (ultra high vacuum) aluminum foil. Participating researchers donned half-garb including gloves, hairnets, face-masks, full-body coats, safety glasses, and shoe-covers. The lenses and mirrors were laid out on the aluminum-covered SS table and covered in the First Contact one at a time using the brush and the occasional careful drop by hand. Manual drop techniques were increasingly employed as the First Contact bottle became more and more empty. Drops or brushstrokes started in the center of the optic and applied in a circular pattern. For the optics that were not attached to a base structure, the First Contact was applied to the edges whereas the optics attached to a base had a buffer space between the edge of the optic connected to the structure and the circular layer of First Contact in the center.



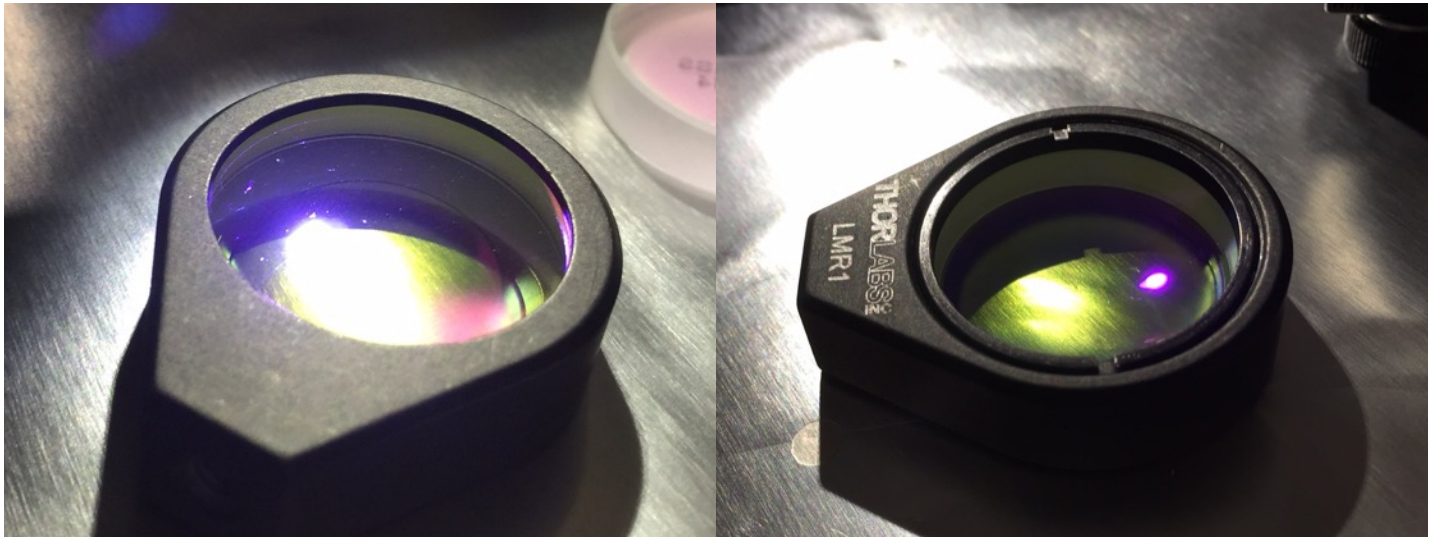
Figures 3 and 4: The eight fully covered mirrors and lenses, cleaned with First Contact, in the procedure. Note the buffer space left in-between the First Contact layers and the mount edges in order to keep the procedure clean and contained.

Before the application of the First Contact, one should cut small 2-3 cm long and 1cm wide strips of PEEK mesh and place them to the side after the first layer of the First Contact is done, one should dab the PEEK mesh in one corner with First Contact and dab one spot on the corner of the layered optic as well. After the PEEK mesh is placed on top of the optic and brushed and held down to stay gripped to the optic as it dries, the second and optional third layer of First Contact should be applied. The other edge of the PEEK mesh should be left free for the removal process.

First Contact layers should be applied uniformly across any one optic. Uneven layers could result in the tearing of the First Contact in the dry phase which would require a manual removal technique which is not recommended due to the unpredictable cleanliness of the laboratory gloves. The large convex lens required multiple application processes due to this issue of uneven First Contact layering as well as three applications of the PEEK mesh due to the shape of the lens.

3. Removal

After one hour of drying time in the clean room, the First Contact layer can be removed to reveal the clean optic underneath. Carefully pinch the exposed and free end of the PEEK mesh and slowly peel the First Contact off. One should be cognizant of any potential areas of uneven First Contact layering as to avoid isolating a section of the dried FC layer from that attached to the PEEK mesh. Once the optic has been removed of the FC, look closely on each optic for remaining dots or specks of First Contact. These dots can be removed by a gloved hand that has been cleaned with an alcohol wipe (after the alcohol has been dried since the alcohol can damage the optic) or with a dry wipe as was used for the large convex lens.



Figures 5 and 6: A before(left) and after(right) example of one of the lenses used in the First Contact cleaning procedure.



Figures 7 and 8: A clean lens(left) and the three clean mirrors (right) following the First Contact procedure.