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# LSST Painting Risk Evaluation Memo

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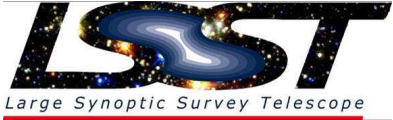
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## 1 Change History Log (Required)

Revision	Effective Date	Description of Changes
A		Initial release.

## 2 Contents (Required)

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## 3 Applicable Documents

LCA-52      Optics Specification

## 4 Executive Summary

The optics subsystem is required to paint the edges of optics black where possible. Due to the risks in applying the paint LSST requests a review of the impact of removing this requirement for the filters and L3.

## 5 Requirement

In LCA-52 the requirement for painting is given:

C-OPT-261: All non-optical surfaces of the lens and filter assemblies visible to the outside or inner light cones shall be painted with black paint where possible to minimize reflectance. Paint with a BRDF (Bidirectional reflectance distribution function) equal to or lower than the BRDF of LORD Aeroglaze Z306 (referred to as Z306 henceforth) coating is acceptable.

## 6 Filter Painting

It has been anticipated that the filter optic edges will be painted at Lawrence Livermore National Laboratory Paint Shop after application of the bandpass filters is complete. This is the facility that will be painting the filter frames. LLNL has developed a procedure for application of the LORD Aeroglaze Z306 to glass surfaces but has not performed it on precision optics.

While the LLNL paint shop is qualified for the application of Z306 and needed primers it is not intended or staffed for painting of high-precision, high-value optics. In our discussions with the paint shop managers and technicians it was both apparent and clearly stated that they are not experienced with dealing with parts like the LSST filters. The filter frames were considered highly technical and of much higher precision than their typical work pieces.



**Figure 1: Image of paint shop spray booth showing mechanical type environment and lack of clean-room conditions.**

The risk in the process is found in 2 areas:

- Handling of the optics
- Cleanliness/Contamination

#### 6.1.1.1 Risk 1: Handling

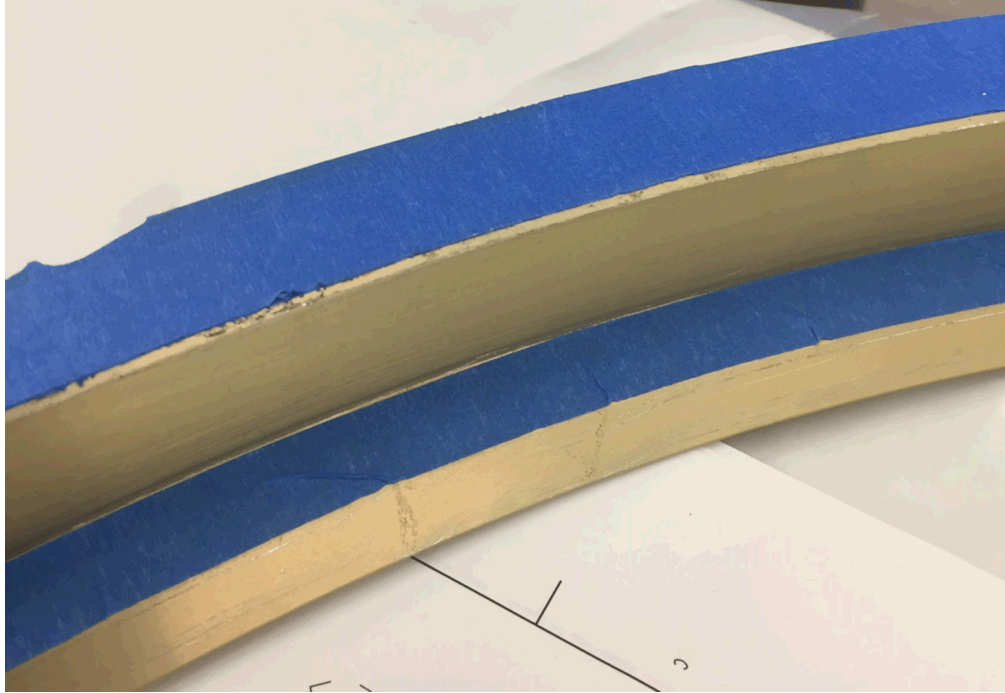
Though LLNL has a developed process for application of Z306 to glass surfaces our shops have never handled a finished optic of this size or value previously. The shops that the work must be done in are not designed or staffed with the intent of painting high value optics. The technicians in the paint shop have not been trained or given any experience in handling optics. As the optics will be completely finished at the time of painting, being fully coated, characterized and cleaned, this handling of the optics in this mechanical area will impart risk at the final processing step. This will be mitigated to the largest extent reasonable by high levels of supervision, custom tooling, and dry-runs, this risk will remain non-trivial.

#### 6.1.1.2 Risk 2: Cleanliness/Contamination

As noted, the facility that will be used for painting is not a clean facility. While utmost care will be taken to maintain cleanliness, there will be some contamination of the optic. In addition, the application of the paint to the edges presents a risk that the functional surfaces of the optic could be contaminated by the paint. Though careful masking will be done the risk of paint or residue on the clear aperture or seating surfaces remains non zero.



**Figure 2: Image of filter frame on preparation cart showing nature of paint shop cleanliness. The paint shop by it's nature is a non-clean envirmnt with high level of airborne particulate.**



**Figure 3: Image of masked filter frame. As can be seen the masking achieved by the paint shop is sufficient for mechanical components, but insufficient for precision optics.**

#### **6.1.1.3 Paths Forward**

Given the current status of the LLNL paint shop, if painting of the filter edges is required LSST will need to pursue one of two paths:

- Facilitize LLNL paint shop. Successful application of Z306 at LLNL to the filter edges would require installing temporary clean room to ensure cleanliness of the parts during the paint application. Clean carts, part holders and other mechanical components would need to be produced. A masking technique would need to be developed that is 100% effective in preventing overspray and contamination. To protect the part training of optics personnel to work in the paint shop and of paint shop personnel to work around optics would be required.

- Outsource painting. The filter edges could also be painted by an outside vendor if a qualified and cost-effective vendor is located. Discussions with potential coating vendors during the filter coating bid process indicated that they do not want to perform this work as they do not have experience with application of the Z306 to the edge of the parts. AOS and Ball Aerospace may be able to perform the work as they are painting the edges of L1 and L2 but likely at a high cost.

## **7 L3 Painting**

Thales SESO (TSESO) in Aix En Provence is currently required to paint the edges of the lens as part of supplying the L3 lens assembly. TSESO has requested that the requirement to paint the edge of the lens be removed several times as they view the risk of the activity to be higher than the value provided. TSESO has identified 5 risks. The key risks relating to the painting of the L3 edges as follows:

- There is no approved process for application of paints available to TSESO to glass substrates
- TSESO has not been able to find qualified applicators
- Handling of optics

#### *7.1.1.1 Risk 1: No approved process*

TSESO is unable to use Z306 as it is outlawed in Europe. The available alternative MAP AQ PUK or PU1 does not have a demonstrated history of application to glass substrates. When contacted MAP, the coating vendor, indicated that they may be able to develop a process, but it has not been previously done. It may be that the process can be quickly developed, but our experience with Z306 and application to glass for prevention of interior reflections indicates that there is a real risk that development will not be simple.

#### *7.1.1.2 Risk 2: Lack of qualified applicators*

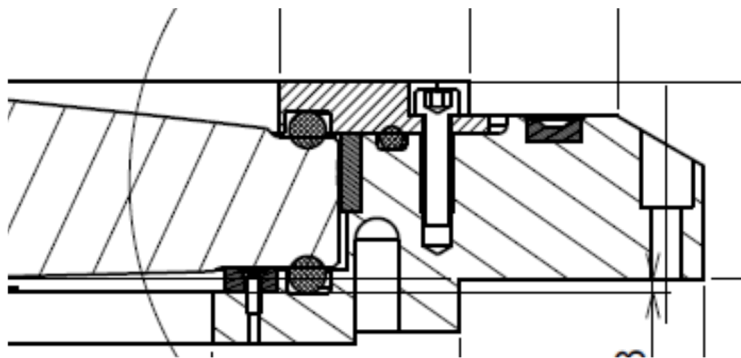
TSESO does not have the personnel internally to perform application of the paint. They have identified vendors willing and qualified to paint the barrel and other parts of the assembly, but have not been able to find a qualified vendor who is willing to perform application of the paint to glass.

#### *7.1.1.3 Risk 3: Handling of optics*

As previously noted, TSESO will be contracting the painting to an outside vendor. In the event they find a vendor willing to perform this work, it is highly unlikely that they will be experienced in optic handling and cleaning. The painting of the optic in this environment would carry real risk to the optic even when high levels of oversight are applied.

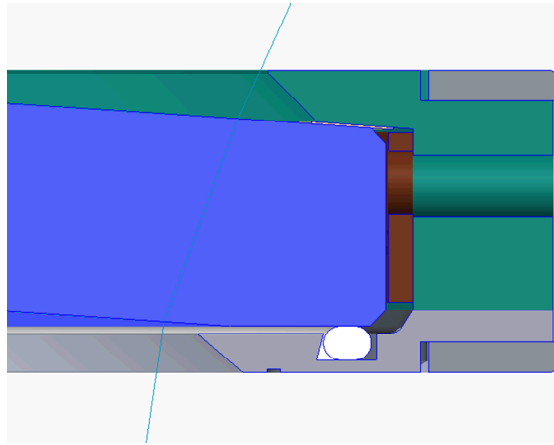
## **8 Stray Light Discussion**

L3 and the filters are all mounted in a continuous ring that extends inward from the edge a significant distance. Due to this frame, there are limited mechanisms whereby light reflected by the edge of the optic (where the paint would be applied) would be able to reach the detector plane.



**Figure 4: Cross section of L3 lens assembly showing edge of optic well enclosed in frame. In this diagram light would be incident from the top of page with the detector below the diagram.**





**Figure 5: Cross section of U-band filter assembly showing edge of optic well enclosed in frame. In this diagram light would be incident from the top of page with the detector below the diagram.**

## **9 Conclusion**

Given the risks inherent in painting of the edges of the filters and L3, the optics subsystem would request removing the requirement to paint the edges of the filter and L3 if there is negligible performance impact. At this time the performance impact is thought to be small to non-existent, however confirmation requires running the appropriate telescope level simulations.