SIDEBAR: Maintenance of Classical Lenses

As noted in Part III., historic lighthouse lenses are considered character-defining features of a lighthouse. Briefly, a classical Fresnel lens (also called the beacon or optic) is a large composite illumination device which can include hundreds of separate pieces of glass all organized to capture radiant light and create a directed beam. Glass segments are either secured to each other or to the brass superstructure. Segments are secured to each other by means of a beveled cut (along the edge) of a prism and a little litharge (white lead) glazing putty to hold them in place. Prisms are also secured directly into the brass framework with glazing putty and wood shims placed in between the glass and brass to position the prism. In addition, some lenses also have a series of brass or bronze retaining bars to help secure the sections.

The glass used in Fresnel lenses was manufactured in France and is quite hard and scratch resistant. It is also quite brittle, which lends itself to chipping and fracture. By comparison, more modern flint (which contains lead) glass is softer, quite clear, and comparatively easy to scratch. Litharge glazing putty was the standard glazing material of its time. It is composed of linseed oil, whiting (calcium carbonate), and either a lead oxide (yellow to reddish) or a lead carbonate (white) filler and dryer. The use of litharge is the source of many of our current preservation problems.

During the historic period of operation, maintenance practices were prevention oriented. Every effort was made to prevent inadvertent damage or scratches to the glass, corrosion of the brass, or loss of a prism through disintegration of the glazing putty. In addition, the turning mechanism, clockwork, and lantern room were kept meticulously clean. Condition assessments of numerous classical lenses reveal that most damage and deterioration encountered today occurred recently.

Recommendations for Maintenance

Historically Fresnel lenses were 1) dusted daily, 2) cleaned with "spirits of wine" or vinegar, and 3) polished with rouge once a year.

The goal of preventive care is to substantially reduce loss of original historic material to deterioration and inappropriate maintenance procedures. Preventive care aptly describes those activities which minimally trained personnel can utilize to keep a lens in a stable state. The introduction of new materials, preservatives, and/or coatings, as well as the removal of established corrosion layers, all constitute a degree of intervention which, in the absence of appropriate training and experience, are beyond the scope of preventive care.

Inspection

- Examine and document the condition of the classical lens before preventive care procedures are carried out. (If deteriorated glazing has resulted in prisms not being firmly seated, then the optic cannot be safely cleaned.)

Handling

- Pad the work area with sheets of expanded polyethylene foam.
- Remove jewelry such as rings, bracelets, and long necklaces, and belts that might scratch or chip the objects. Preferably, wear an apron to ensure the prisms will not be scratched.

- Moisture, oils, and acids left from fingerprints will disrupt and eventually etch these delicate surfaces. Use snug fitting latex gloves when handling these objects. (Handle classical lenses as little as possible.)
- Do not apply pressure to annular rings which are not supported in the brass, or bronze superstructure. Be especially careful not to apply pressure from the interior of the lens. This is a major cause of damage because unsupported annular rings and bullseye lenses can easily fall out.

Cleaning the brass

Historically, a form of calcium carbonate called whiting was used as a mild cleaning agent on the brass, and jeweller's rouge was used as a polishing compound. These materials maintained a clean and polished appearance on the copper; however, the practice needed to be repeated regularly to keep corrosion in check. Preventive care should shy away from a regime of repolishing because the brass is continually being sacrificed and lost to achieve a shiny appearance. If a polished appearance is desired, a more conservative approach would have the polished lens coated to isolate the copper alloy from the environmental agents which cause corrosion. Clear coatings are often used today, but their use can bring about a new set of associated problems. Their success is dependent upon surface preparation, the means of application, and the degree of exposure to ultraviolet light. A poorly applied protective coating may cause differential corrosion, and a mottled appearance will develop. If surface preparation has not been adequate, the coating is likely to peel, and the useful lifetime of clear coatings exposed to elevated levels of ultraviolet (especially when within a tower) is controversial. These problems are difficult to deal with because they require the complete removal of the coating in order to effect a remedy. What emerges here is the realization that although all classical lenses were historically treated in about the same way, today's decision to polish brass should be based on what technical expertise is available and at least some consideration of the following factors: 1) What kind and how much corrosion is present upon the brass? 2) Will the lens be in an urban environment? 3) Will the lens remain in the tower, or has it been relocated? 4) Is staffing sufficient to carry out scheduled maintenance?

Brass which has a well-established reddish brown cuprite corrosion layer is not considered to be actively corroding. The decision to polish brass in this condition is an aesthetic one. Once polished, the metal then needs to either be repolished periodically or it needs to be coated to preserve a polished appearance.

Cleaning the glass

The historic record indicates that the prisms were routinely washed with mild soap or "spirits of wine." Periodically, the prisms were also rubbed down with whiting, or a combination of whiting followed by rouge to polish the glass. Keepers were instructed to first brush the glass with a feather brush to remove surface dust. Before removing airborne particulates which have settled in, try to determine if in fact the deposit contains abrasive particulate. If the 'dust' is particularly abrasive, or if a large quantity of deposits is to be removed, then a vacuum aided by a soft mop-type artist's brush will be effective. Be sure that sufficient hose is available to avoid the vacuum endangering the lens, and that the hose attachments are nonmetallic to avoid scratching. If the deposits are light and nonabrasive, then it is suggested that the glass be wiped down with lint free cotton toweling moistened with distilled water. Small amounts of denatured alcohol can safely be added to form an alcohol and water solution, especially if the deposits are a combination of dust and oils. It is usually recommended that alcohol be added until the solution is an effective cleaning solution. The exact proportions will vary for each site because of such environmental factors

as proximity to industrial sites, freeways, or visitor contact. Be alert to the presence of a clouded glass surface. If noted, a conservator should be contacted. A clouded surface indicates that the glass is deteriorating.

Care for deteriorated putty

If human error in cleaning, handling, and/or moving is overall the most serious threat to classical lenses, then deteriorated glazing putty is the second most serious threat. The consolidation of

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Figures 37 and 38. Joe Cocking (above) and Nick Johnston (below) restore a classical lens at the U.S. Coast Guard Exhibit Center.

porous putty conforms to *The Secretary of Interior's Standards for Rehabilitation* by preserving as much original historic material as possible; the National Park Service, Division of Conservation, is currently evaluating a variety of synthetic resins to establish which is best suited as a consolidant for the preservation of historic glazing putty. Our approach had been to try and reconstitute the original putty. In addition, substantial cost savings are realized by consolidating the original putty both because it is a less expensive treatment option than reglazing, and because replacing a hazardous material requires proper abatement, control, and disposal procedures. Unfortunately, consolidation is only feasible if the original putty is porous and adsorbent enough to accept the introduction of a solvented resin. Preventive care as it applies to litharge glazing putty begins with establishing a monitoring program to determine if the putty has deteriorated. This is accomplished by the use of lead indicator test patches or strips. Indicators do not establish levels of lead containing compounds, only their presence. The relative rate of deterioration is established by a combination of condition assessment and monitoring. To monitor, wet clean the area and monitor periodically for additional lead particulate deposition. Working in the presence of lead oxide or lead carbonate particles requires that the worker wear appropriate protective clothing and a respirator rated for the removal of lead bearing particulate. Additional state or local regulations may also apply. If a lens is in your custodial care by means of a loan agreement, then only the owner is authorized to make decisions about the care and treatment of a lens. Because of the inherent health hazards, it is strongly advised here that only trained personnel attempt to address litharge glazing putty preservation issues. At present, and until a more satisfactory solution is found, both the National Park Service and the U.S. Coast Guard often stabilize loose lenses or prisms by the localized addition of a vinyl glazing compound.

A classical Fresnel lens with significant deterioration requires stabilization and perhaps restorative treatment and may require a professional conservator.

For more information on the maintenance of classical lenses, refer to the forthcoming NPS *TECH NOTE: Preventive Care for Classical Lighthouse Lenses.*