



Handling and Cleaning Procedures for Optical Components

Optical components require special methods be followed to maximise their performance and lifetime. Daily use of optics can cause them to be dirty due to dust, water and skin oils. These dirt increase scattering off the optical surface and absorb radiation which in turn will create hot spots on the surface leading to permanent damage. This guide talks about common handling and cleaning methods that are useful for optical components. As optical components vary in size, material etc. it is vital that one uses the right method to handle and clean the component.

Handling

Proper handling methods can decrease the frequency at which one cleans the optics and maximising their lifetime. Ensure that the unpacking procedure of the optical components is done in a clean and temperature-controlled surrounding. Avoid handling the components with bare hands as oil from your skin may damage the optical surface quality permanently. Alternatively, one may wear gloves and for smaller optical components, one may use optical tweezers. When holding the optical components, try to hold the components along the non-optical surfaces.

For holographic/ruled gratings, first surface unprotected metallic mirrors and pellicle beam splitters, one should never touch with his/her bare hands or optical handling instruments. These optical components are very sensitive and any form of physical contact will cause damage. Crystals are temperature sensitive and can break if exposed to thermal shock. Hence one should always allow the package to come into thermal equilibrium before unpacking. Crystals are also much softer, unlike conventional optics, and thus, requires more careful handling when cleaning.

Storage

As optics are easily scratched, contaminated and hygroscopic, proper storage is vital for preserving the optical components. Optics should always be wrapped in lens tissue and stored inside an optical storage box designed for optics. Never put optics on hard surfaces as it will cause the optic surface to receive contamination. Optical storage boxes should be kept in a temperature-controlled environment with low humidity and contaminant.

Inspection

Optical components should be inspected before and after cleaning and usage. If necessary, utilise a magnification device to aid in inspection as most of the contaminations and defects are small. In addition, one can shine a bright line onto the optical surface which will increase the intensity of the specular reflections from the contaminations and defects.

When inspecting an optical component whose surface is reflectively coated, the component should be held parallel to the inspector's line of sight. Looking parallelly across the surface will allow one to see the contaminations and not reflections. When inspecting an optical component whose surface is polished, the component should be held perpendicular to the inspector's line of sight which will enable him/her to look through the optics.

If there is a surface defect on a clean optical surface, utilising a scratch-dig paddle allows one to categorize the size of the defect by comparing the size of the calibrated defects on the scratch-dig paddle to the size of the defect on the optical surface. If the size of the defect is more than the manufacturer's scratch-dig specification, it may be required to replace the optic which will allow one to achieve the desired performance.

Cleaning Procedures

If available, one should always read the manufacturer's recommended cleaning and handling procedures. Before cleaning an optical component, inspect the component to determine the type/severity of the contaminants. One should not skip this inspection as the cleaning process involves solvents and physical contact with the optical surface. If the involvement of solvents and physical contact occurs too frequently, it may damage the optical surface. For optics with multiple contaminants, the order at which they are removed is important as the optical surface may be damaged by one contaminant when removing another contaminant.

Blowing Off the Surface of an Optic

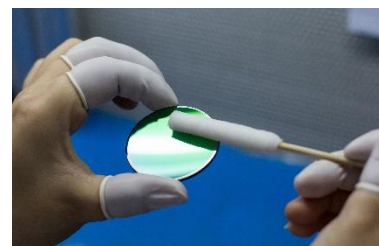
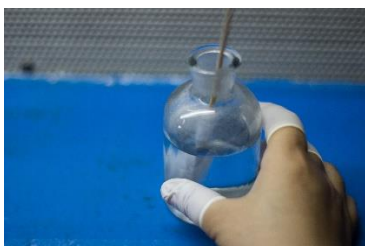
A canister of inert dusting gas or a blower bulb can be used to blow off dust or any other loose contaminants. One should not use his/her mouth to blow on the surface as droplets of saliva will be deposited onto the optical surface.

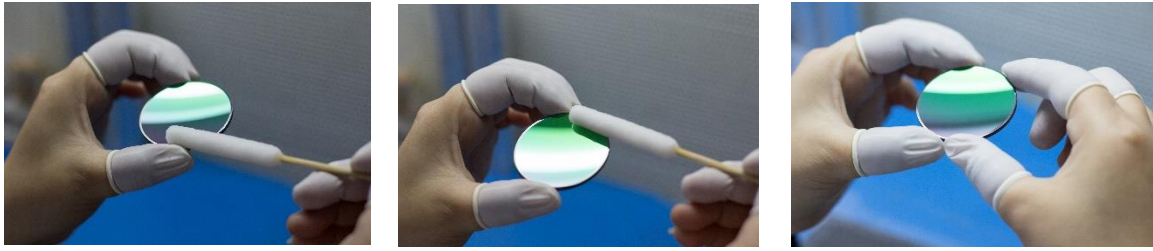
When using the inert dusting gas, do not shake the can prior/during the use. Hold the can upright and roughly 6" from the optical surface throughout the procedure and start the flow of gas with the spray pointed away from the optical component. This will help to ensure that the inert gas propellant do not get deposited on the optical surface. Wave the spray over the optical surface with the spray at a grazing angle to the optical surface. When spraying over a large surface, trace a figure of eight pattern over it.

This method of cleaning can be applied on almost all types of optics but for certain optics (holographic/rules gratings, calcite polarizers etc.) which can be damaged by physical contact, this is the only method for them to be cleaned.

Alternate Cleaning Procedures

There are alternate cleaning procedures if blowing off the surface of the optic is not sufficient. Optics should always be cleaned using clean wipes and optical grade solvents to avoid damage from contaminants. The wipes should always be moist with an approved solvent and never used dry. Some acceptable wipes are pure cotton, lens tissue and cotton-tipped applicators. Common solvents used are acetone, methanol and isopropyl alcohol. Solvents should be used with care as most of them are toxic, flammable or both.





Washing the Optic

Fingerprints and large dust particles on optical surfaces can be removed by immersing the optics in a mild solution of distilled water/optical soap if approved by the manufacturer. However, the optic should not remain immersed any longer than required to remove the contaminants. After immersing the optic, rinse it in clear distilled water. Depending on the type of optic, the drop and drag or lens tissue procedures can be used to apply a quick-drying solvent (acetone/methanol) to the optic to increase the speed of drying. Do not pool any cleaning solutions as the optic dries as it often leaves streaks on the surface.

Drag and Drop Method

For cleaning flat optical surfaces that are elevated above any surrounding surfaces, one can employ the drop and drag method. First, start by examining the optic to locate the contaminants. Locating the contaminants allows one to lift it from the surface as soon as possible rather than dragging it across the optical surface. After inspecting, place the optic such that even a weak lateral force on the surface will keep the optic stationary. Use a fresh new clean sheet of lens tissue and hold the optic above such that pulling the lens tissue will cause it to be drawn across the optical surface. Subsequently, drip about 1-2 drops of an approved quick drying solvent on the lens tissue being held above the optic. The weight of the solvent will result in the lens tissue meeting the optical surface. Drag the lens tissue slow and steadily across the optic until it is off the optical surface ensuring that the lens tissue does not leave the surface. A right amount of solvent will ensure that the lens tissue is damp throughout the entire drag yet not leave any visible trace of solvent on the optical surface. Examine the optic and repeat the step if needed but use each sheet of lens tissue only once. This is a preferred cleaning method as the lens tissue is only in minimal contact with the optical surface. This method can remove small particles and oil from the optical surface. Repeated treatments can be used to remove heavy concentrations of contaminants.

Lens Tissue with Forceps or Applicator Method

This method is commonly used for mounted/curved surface optics that require cleaning with a solvent. First, start by examining the optic to locate the contaminants. Plan a wiping path that will not cause the drag of any contaminants over the optical surface. If the lens tissue is used, it is vital that the tissue is folded in such a way that a portion of tissue that meets the optic is not touched. Hold the folded lens tissue with forceps in a way that a smooth wipe over the optical surface can be conducted. Next, apply a few drops of solvent to the lens tissue to make it damp (not dripping). The lens tissue should be able to wipe across the optical surface in a smooth motion.

When wiping, continuously rotate the lens tissue slowly. After the wipe, inspect the optic for any leftover contaminants or streaks and repeat the procedure with a new lens tissue if required. If streaks form at the edge of the lens tissue, use a larger applicator or apply a continuous wiping path that removes the wiped interface on the optical surface.

Cleaning with Webril Wipes

Webril wipes are soft cotton wipes that are recommended for cleaning most optics. They absorb solvent effectively, do not dry out as fast compared to lens tissue and do not fall apart quickly. The surrounding edges of the Webril wipes may leave some lint hence always use a folded edge when cleaning. During the entire of this process, always wear gloves or finger cots.

For smaller optics, roll the wipe into a cone shape with the folded edges at the point, moisten the tip and use the point as the wiping area. For bigger optics, cut the wipe into 3 parts that are roughly 2.6"x4". Fold the wipe length so that it measures 1.3"x4" and then make a fold roughly 1" from the end. Moisten the last folded edge with solvent and use the edge to clean the optical surface. Utilise a pump bottle to release the solvent will allow it to be easier to hold the optic in one hand while moistening the wipe with the other.

Pick up the optic with one hand and then wipe the optic lightly and slowly across the entire optical surface to avoid streaking. The amount of solvent, pressure applied to the wipe and speed of the wipe may have to be adjusted to avoid those streaks from appearing. Wiping duration may also vary with solvent. For example, acetone requires you to wipe faster than alcohol as acetone dries faster.

Optical Handling and Cleaning Tools

1. Gloves

Crucial when handling any optical component. Material of the gloves are either cotton or powder-free latex.

2. Tweezers

Optical/vacuum tweezers are commonly used to handle smaller optics. Optical tweezers are made to hold small hard objects in a secure manner. The uniquely designed optical tweezers' tip are made of a material that reduces the chances of scratching the optical component. Vacuum tweezers utilise a suction cup to hold the optical component. The tips are usually of a few variant that are specialised to hold certain shapes and sizes of optical components.

3. Webril Wipes

Webril Wipes are fabricated from pure cotton. These wipes can be used to clean optics or any surfaces. The edges leave lint particles, but this can be avoided if the wipes are folded and the folded edge is used to clean the optical component.

4. Lens Tissue

Used to handle and clean optics as it offers a soft surface that can safely touch many types of optical surfaces. Lens tissue is often used to wrap optical components.

5. Optical Storage Boxes

These boxes usually have foam or moulded plastic inserts. The inserts ensure that the optical components will be stationary in the box and the optical surfaces will not touch the hard surfaces.

6. Magnifiers

Small optics can be examined using magnifiers. Magnifiers are useful in checking the cleanliness and integrity of the optical surfaces which will determine the cleaning procedure being used.

7. Scratch-Dig Paddle

Most optics have specific scratch-dig tolerance which categorises the optical surface's optical quality. This paddle has a series of calibrated optical defects which will determine how deep or thick a scratch is.

8. Inert Dusting Gas

This gas is great for cleaning dust and other contaminants that are not adhered to the optical surfaces. An alternate source is a bulb blower. Inert dusting gas can provide a continuous stream of pressurised gas with which contaminants can be blown away from the optical surface. As the gas is released from a pressurized canister, it is often cooler than the surrounding which may cool the optical surface. The stream of pressurized gas may contain droplets of the propellant which may cause it to be deposited on the optical surface.

9. Forceps

Forceps are a small, lockable clamp that is frequently utilised to hold a lens tissue when it is used in certain cleaning procedures. Since forceps can easily scratch an optical surface, it is important to make sure forceps never touch the optical surface.

10. Cotton-Tipped Applicators

Cotton-tipped applicators are 6" wooden sticks with cotton on one end utilised as an applicator for different cleaning agents. These are useful for cleaning small optical surfaces. For larger optical surfaces, it is harder to get a streak free finish. Cotton-tipped applicators are not to be confused with Q-tips or other drugstore applicators. These applicators are optical graded which will not leave contaminants on optics and the material is free from abrasive fibres.

11. Optical Cleaning Solvents

Common optical cleaning solvents include acetone, distilled water, methanol and propanol. It is vital to use only optical grade solvents as contaminants may exist in the solvent which may result in the contaminants being deposited onto the optical surface during the cleaning procedure. Only use manufacturer approved solvents on optics to avoid possible damage to the surfaces.