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## Cleaning Lenses and Optics Part I: Best Practices

Dust happens. As does debris, fingerprints, and occasionally the nasty products of a sneeze. When it does, it might be time to clean your system optics such as lenses, mirrors and windows.

The FIRST STEP, writ large, is to blow off as much stuff as you can using clean, dry air from an empty squeeze bottle. Then do it again -- seriously. The idea is to remove as much abrasive material as possible before you start in with lens tissue and solvent, otherwise you risk scratching something you shouldn't.

When it comes to cleaning there are several rules to follow. I'll call these "Best Practice" rules while wearing an optical engineer's hat. Later, we'll talk about field expediency advice.

- 1) Use clean, soft, lint free tissue. I highly recommend a product called Pec\*Pads from Photographic Solutions. [<http://www.photosol.com/store/pc/home.asp>] In twenty-five years I've found no better product. You can also get it from other vendors via Amazon.
- 2) Wear powder free latex, nitrile or PVC gloves. (Use ONLY latex for acetone.)
- 3) Use the purest solvent possible. For alcohols or acetone use reagent grade or better. Don't use pharmacy or paint store solvents!
- 4) Use the mildest solvent that still does the job.
- 5) Use a solvent that dries very quickly. (Otherwise, it picks up contaminants from the air and leaves a residue when it finally does dry.)

Those last items are contradictory. Distilled or de-ionized water is as mild as it gets, but is poor for oil and grease and takes a long time to dry. Acetone dries quickly, is effective on many contaminants, but can attack certain older coatings and more importantly adjacent paint or plastic. Even the vapor can cause damage. Isopropanol and methanol are good mid-range candidates. Light Works prefers Eclipse brand of ultra pure methanol which is also available from Photographic Solutions or via Amazon. It's pricey, but worth it!

Never squirt or spray the solvent; it's too difficult to control where it goes. Place a few drops on the tissue to moisten it – don't soak. At this point you can follow one of the two classic cleaning methods.

Spiral: Start at the center of the optic and gently wipe in a single, continuous spiral to the outer edge.

Drag: Start at one end and gently drag the moist tissue across the surface. This is preferred, but can be difficult for mounted lenses.

For either case, only make one pass per tissue. Otherwise, you'll just redistribute the dirt. Repeat until clean.

## Cleaning Lenses and Optics Part II: Field Shortcuts

(To my fellow optical engineers: Avert your eyes!)

So it's late at night in Borneo and you're servicing a vision system. The protective windows are covered in grease, but all you have to work with is your shirt sleeves and your lunch debris. What do you do? Pack it in and go back to your hotel room!

If you insist on working, however, there are a few field expedients you can try. The following are actually some general tips for cleaning when you don't have all the right materials. You needn't be desperate in Borneo.

**Spit isn't so bad!** I made a strong point in Part I that blowing off dust and debris is the essential first step in cleaning optics. This will always be true, but if you don't have a squeeze bottle, blowing on the optics with your mouth is acceptable. Cleaning up stray spit is better than scratching mirrors.

**"Duster" cans work.** Sometimes they're great, \*as long as you keep them vertical and don't shake them\*. Otherwise, liquid difluoroethane can land on your optics. Best case is staining. Worst case is fracturing a lens from thermal shock.

**Soap and water.** If you can remove the window, mirror, or un-mounted lens, swishing warm tap water and liquid soap isn't a bad option. Be sure to rinse well, and shake off any excess water. This is also an excellent way to remove dust and debris prior to "real" cleaning.

**Ketchup.** Seriously. The vinegar will do a decent job dissolving grease and oil, allowing you to then wipe away the ketchup with water. Your Borneo lunch debris is useful after all!

**Do nothing.** Sometimes this really is the best choice. Light from a single target point diverges toward and eventually fills the entrance pupil of the lens. A speck of dirt on a window or mirror *between* the target and the lens entrance pupil will likely be very defocused. It's also often too small to block more than 0.001% of the light. Even if there are a thousand specks of dust or dirt, their total contribution to image degradation amounts to almost nothing. Not a great thought for the self-esteem of the speck, but good for you. Small particles far from an object or image plane are very often best left alone, especially when field cleaning might make things worse.

An exception to the above is when you operate the lens at a very high F-stop, or small aperture. The cones of light are quite skinny, and a small speck might block a lot of light.

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