

*The*  
**ASO fine optics CLEANING SYSTEM: Part I**  
**PRECISION COATED OPTICAL Lenses, Corrector Plates and other**  
**REFRACTIVE GLASS**

**PREFACE:**

There are many, many variations of high precision, high reflectivity and high transmission coatings presently offered on the market for both amateur and professional scientists who use OPTICS in their respective lines of study. Smaller glass surfaces with high transmission coatings have always been seemingly easy to clean, since the smaller surface area is not as prone to spotting, streaking and streaking of the cleaner used. On the other hand, large optical surfaces such as telescope lenses, corrector plates and optical glass "windows" are very difficult to properly clean without some residue being left behind as a result of cleaning.

The ARKANSAS SKY OBSERVATORY's new protocol for cleaning optical surfaces includes:

- 1) judging carefully when cleaning is actually necessary;
- 2) preparation of the optical surface for proper cleaning;
- 3) a new solution that combines the attributes of all previous formulae and results in very fast, easy, and streak-free results if used properly;
- 4) the proper new technique that is highly recommended for cleaning.

**WHEN TO CLEAN OPTICS:**

Although we are attempting to obtain the best possible light transmission efficiency from our optics by cleaning them free of deposits, film and debris, lock firmly in your memory that ***cleaning coated optical surfaces is the single-most damaging*** action that will be done to them, short of actual physical damage or breakage. No matter how careful, how delicate, nor what cleaning solution is used.....every time cleaned will result in a microscopically-reduced optical performance than before cleaning. Note that the coatings themselves - regardless who makes them and from what they are made - are nothing more than molecule-thick deposits of a very delicate film left on the optical surface from a vacuum process in which air is evacuated and the gases of the coating materials are gently and uniformly distributed across the glass surface after the vacuum container is void of air.

This system is devoted to the cleaning of large astronomical refractive optics: lens, corrector, and other optical glass; however the techniques discussed here as well as the new ASO SuperPlus Solution is excellent for the cleaning of eyepieces, eyeglasses, binoculars, camera lenses and all other fine coated optical surface.

So....the ground rule here is: ***CLEAN ONLY WHEN ABSOLUTELY NECESSARY.*** In most cases, dusting alone will lead to tremendous improvement in performance and overall light transmission.

**PREPARATION TO CLEANING**

***DUSTING OPTICAL SURFACES:*** Large area optical surfaces are frequently plagued by DUST, POLLEN, GRIT, DEBRIS and even human skin and airborne hair. If the surface of the glass is allowed to be exposed at a temperature BELOW THE DEWPOINT, these particulates will stick to the glass and will be stubborn to remove. However, for optimum performance, it is essential to, indeed, remove debris from the optical surface. Your optical glass **MUST** be dusted when:

- 1) a flashlight held obliquely against the glass reveals a uniform and fairly thick layer of dust, etc;

- 2) when POLLEN is on the glass, as leaving pollen will result in "pollen sap" leaving a very difficult-to-remove stain on the surface;
- 3) ALWAYS prior to cleaning the glass with the solution and technique which follows.

### **Never clean optical glass without gently dusting first!**

You will find in 3 out of 5 cases that merely dusting off the glass is sufficient to greatly enhance your performance back to optimum and that further physical cleaning is NOT necessary after dust removal. There can be a lot of smudges, stains, flecks and streaks on the glass before it actually begins to degrade your optical performance for all but the most exacting (i.e., high resolution planetary imaging, CCD spectrography and photometry, etc.) demands put upon your telescope.

To dust, use a SQUARE-CUT (not a tip-cut) very soft brush that is about 2" (50mm) wide with tapered bristles. I have found several excellent such brushes at Lowe's and Home Depot and other stores where quality painting supplies are sold. Look for the very soft and flexible "touch up" and/or "delicate trim" brushes....most of these are short-handled and have the bristles as an angled radius cut. Make sure that the bristles are incredibly soft; I use the "cheek method" for testing softness: take the brush out of its package and push the tiny ends of the bristles hard against the cheek of your face....if they do not "prick" then they are fine for optical use. Another tip on selecting a brush is the number of bristles....the MORE bristles on brushes just described, usually the softer and better the quality.

I start dusting by dusting the METAL SURFACES that surround the optics, ridding them of all debris first; just whisk away. Then start at the top of your glass and gently swipe the surface IN ONE DIRECTION....do NOT move back-and-forth with the brush. Stroke in only one direction. Do NOT rub....merely "pull" the brush across the surface and apply no pressure; let the brush do the work for you. Any particles that do not come off with such brush will be removed in subsequent cleaning with liquid if necessary.

The object of your dusting is to essentially "move" all the particles to the bottom of the surface you are working on....once there you can brush them off the area and actually assist their removal by blowing gently against the areas being brushed.

*USING COMPRESSED AIR: DON'T. Period.* Dusting is easy, although it may take a little more time, and it is more effective. I have found that compressed air is virtually worthless for attempting to gently remove embedded particles on a glass surface and the chances of the liquid propellants within the can being expelled in liquid droplets against the glass is quite great.

### **The ASO SuperPlus Optical Cleaning Solution - how to mix it yourself!**

There is NOTHING magic about the new concoction developed over a period of about five weeks here at the Arkansas Sky Observatory. SuperPlus Solution is quite simple, and indeed, there are many familiar components that are being used that have been touted in cleaning solutions before. Nonetheless, after hundreds of elixirs and hours later, this combination - in exactly the proportions given below - results in near-perfect results every time!

In striving for the "perfect cleaner" the following criteria were evaluated:

- 1) Streaking - the solution was required to dry streak free with minimal "dry rubbing" which can damage optical surfaces;
- 2) Spotting - the solution must dry spot-free with minimal rubbing;
- 3) Safety - the solution was required in all respects to be totally impervious to the optical coatings and totally safe for all variations of them on the market;
- 4) Simplicity - it needed to be something that anyone could mix up when needed with over-the-counter inexpensive components;

5) Sure-fire - it must work every time the first time....the less rubbing the better.

Experiments on all types of optical glass surfaces were conducted with EVERY cleaner offered by all makers and groups; the following SuperPlus Solution was derived as the "best of all of them" since all had some attributes that were worthy, with some extreme cases omitted. Interestingly although some of the solutions that have been previously offered were deemed very hazardous to the quality of cleaning and even the surfaces themselves, some components used within those solutions did HAVE MERIT and have been incorporated! You will be surprised perhaps at the simplicity of this.

*HERE IS WHAT YOU WILL NEED:*

Nearly all components should be available locally; suggested outlets for obtaining these are in parenthesis.

- 1) distilled water (supermarkets)
- 2) "pure" isopropyl alcohol (pharmacies, drug stores....may have to be ordered)
- 3) coffee filters
- 4) "regular" Windex, the blue kind (supermarket)
- 5) Kodak PhotoFlo solution (camera and photo houses only)
- 6) Synthetic Cotton Replacement Pads (some finer pharmacies, medical supply companies....ask your local M.D.!!)
- 7) two "atomizers" or simple squirt bottles for dispensing liquids (Wal Mart or similar)
- 8) box of KLEENEX [only!] pure white, no additives tissue (supermarket)
- 9) quart mixing jars, very clean and sterile (try your cabinets!) 10) sterile eye dropper (drug store).

*NOTES ABOUT THE INGREDIENTS:*

What an how you combine these components, as well as HOW you use them will make or break your success in streak-free and perfect cleaning; please make note of the following:

*Pure Isopropyl Alcohol* - NEVER use "regular" isopropyl alcohol. Isopropyl is what you commonly see in stores as "Rubbing Alcohol." However, most on-the-shelf varieties is about 70% or less pure....the remaining 30% is impurities which WILL result in streaking and deposits on your glass. USE ONLY **91%** OR HIGHER proof isopropyl....this is found on the same shelf typically, in very large and well-stocked pharmacies. If not, simply ask your pharmacist to order some! Expect to pay about double the price of the "store brand."

*Windex* - Many cleaning formulae suggest Windex, indeed from one of the largest optical houses in the world. However, there has always been "something wrong" with Windex in that it leaves a ghostly film on optics. After much experimentation, I have found that it is the heavy impurities that are SUSPENDED in the solution that are responsible for the fog....you CAN get them out as you will see. NOTE that ONLY the **blue Windex** should be used. NEVER use any cleaner with vinegar on your optics.

*Kodak Photo-Flo* - If you have never used this before NOTE!!! This is extremely concentrated stuff and a tiny, tiny bit goes a very long way! We are talking DROPPER amounts here....NOT ounces. DO NOT USE MORE THAN RECOMMENDED....your results will be horrible.

*Kleenex* - ONLY USE pure white Kleenex, no other brands at all. Do not select Kleenex with "ultra softeners" or with scented oils. Only plain and simple pure white.

*HERE IS HOW TO MIX ALL THIS STUFF:*

You are making TWO solutions:

- 1) Solution 1 - Cleaning Solution: This is the active part of the cleaning and should be mixed very precisely in the quantities provided.
- 2) Solution 2 - Rinse Solution: This is ABSOLUTELY necessary for most cleaning session; however, you MAY find that you do NOT NEED the final solution if your optics dry streak-free (which likely they will!).

***SOLUTION ONE: Cleaning Solution.***

You are going to have much more solution of each component than need for one quart of final SuperPlus Cleaning Solution. Keep all left-over unused and unmixed components well sealed and marked for future use.

Step 1: FILTER THE WINDEX VIA THE COFFEE FILTER into a thoroughly washed and dried container; go ahead and filter the entire bottle as this is much simpler and more effective than attempting to filter one ounce.

Step 2: FILTER THE DISTILLED WATER using a second clean coffee filter into another jar. Yes, I know that distilled water is supposedly inclusion free, but trust me on this one.

Step 3: MIX..... In another quart jar, add the following (do NOT substitute nor change amounts!)  
a) the filtered and purified WINDEX - 1 ounce  
b) ALCOHOL - 1.5 ounce  
c) PHOTO-FLO - two drops...that's RIGHT, I said "two drops"....any more and you will be sorry. And I mean SMALL drops!! (about 1/16th ounce is pushing the limit)

Step 4: MIX together gently but do NOT shake.

Step 5: ADD 12 OUNCES OF Distilled water. I chose to mix my solution in empty quart plastic alcohol bottles; if doing so, merely fill the bottle to within 1" of the top.

Step 6: Pour liquid into your MARKED squirt bottle for use.

***SOLUTION TWO: Rinse Solution.***

In 12 ounces of filtered distilled water add TWO drops (only!!) of Photo-Flo solution. No more no less. Transfer liquid into SECOND MARKED squirt bottle.

You are now ready to CLEAN your optics.

**The ASO SuperPlus Cleaning Technique - You CAN do it right! The FIRST time!**

***\*\*tip #1\*\****

CLEAN OPTICS ONLY IN THE DAYTIME WITH THE OPTICAL SURFACE "LOOKING" OUT OF A WINDOW OR TOWARD A BRIGHT OPEN SKY

***\*\*tip #2\*\****

NEVER....NEVER...ATTEMPT TO SURFACE CLEAN LARGE OPTICS WHEN THE HUMIDITY IS ABOVE **65%** !! Streaking will result. If you attempt to clean your optics when the humidity is high, you will be very disappointed in the results.

***\*\*tip #3\*\****

PLAN TO USE AT LEAST **ONE TISSUE PER INCH APERTURE BEING CLEANED**....ALWAYS keep a dry tissue to the surface for best results!

There is no solution that will result in satisfactory cleaning if your technique is NOT good when cleaning. Unfortunately with cleaning large glass surfaces, you must normally move quickly, but gently in order to obtain a streak-free and spot-free result. If you follow this technique, you can move a bit more slowly and deliberately AND achieve the same results.

**\*\* MAKE SURE YOU HAVE DUSTED OFF THE PARTICLES FROM THE GLASS PRIOR TO FURTHER CLEANING! (see above) \*\***

STEP ONE - Turn your telescope so that you are FACING the corrector plate or lens head-on; you are NOT going to use so much liquid that you need to be worried about cleaning solution getting away from you and down inside the retaining rings of the optics. Make yourself comfortable....you may be here a while! I prefer placing the telescope if possible in a position where I can sit down to clean. You must have a small table or area within reach where you will have your Synthetic Cotton Replacement Pads, solutions and Kleenex waiting.

STEP TWO - Imagine your corrector plate or lens in QUADRANTS or quarters, like large sections of pie. You are going to begin at the TOP left and work your way down to the BOTTOM left piece of pie.

STEP THREE - Gently shake the container (Solution ONE - Cleaner) for just a brief moment and spray a generous amount of liquid onto the Synthetic Cotton Replacement Pad, NOT the glass surface. You want the Synthetic Cotton Replacement Pad WET, but not dripping; make sure you hold the pad only on ONE side and do not TURN to use the side where your fingers have been.

STEP FOUR - Begin in your upper left "quadrant" and gently daub (do NOT rub) this section until you have generously smeared the cleaning solution across the surface of ONLY that area. Never "push" the Synthetic Cotton Replacement Pad, only pull. Do NOT rub. The idea here is to ONLY move the liquid across the surface to break the adhesion of film and dirt deposits against the glass. **MOVE QUICKLY TO STEP 5.....**

STEP FIVE - Before the liquid begins to collect into large areas and before any drying takes place, immediately begin wiping the quadrant just soaked with KLEENEX tissue to dry it....to do this, you want to gently PULL the Kleenex across the surface in ONE DIRECTION ONLY...do NOT go back and forth as this will streak and will tear the tissue into endless amounts of clumps that will have to be removed from the surface. You will see the liquid rapidly drying behind you. Follow each swipe IMMEDIATELY with a DRY Kleenex tissue.  
[reminder: *keep changing to a dry tissue constantly!!*]

STEP SIX - When entire quadrant is reasonably dry, buff gently with a totally dry Kleenex; repeat a second time with another Kleenex while gently "puffing" a bit of your breath against the corrector plate or lens to expose possible areas of streaking.  
[reminder: *keep changing to a dry tissue constantly!!*]

STEP SEVEN - Repeat same procedure on remaining three quadrants with a bit of overlap on each.  
[reminder: *keep changing to a dry tissue constantly!!*]

STEP EIGHT - Check each point where areas overlapped during cleaning and "touch up" using a fresh Synthetic Cotton Replacement Pad sprayed with a VERY SMALL amount of cleaner....you want this swab nearly dry, but just enough moisture to touch up defects in cleaning.

STEP NINE - Using your breath as a guide, gently "puff" against the glass while using a Synthetic Cotton Replacement Pad to buff the final cleaned surface to a high luster with not streaking!

STEP TEN - [[OPTIONAL]] - *USING THE RINSE SOLUTION*

This step is likely NOT necessary and should ONLY be used if there is any streaking left after the careful cleaning procedure outlined above. If there are problem areas, you should rinse your cleaned corrector/lens as follows:

- spray a VERY SMALL amount of rinse solution onto the glass OR place some on a fresh Synthetic Cotton Replacement Pad.....you want only a tiny amount of liquid present to break the surface tension of the glass....remember, the glass is already cleaned from the CLEANING PROCEDURE. All you are attempting to do is to remove any streaks at this point.

- gently rub the Synthetic Cotton Replacement Pad across the entire glass area quickly but very lightly and follow WITH YOUR OTHER HAND a fresh dry Kleenex tissue to absorb any moisture remaining from the first pass. This should take care of streaking very quickly.

- again, buff the entire surface with a fresh and dry Synthetic Cotton Replacement Pad to finish.

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Best of luck and take your time.....this solution and technique will work on all coated glass surfaces (NOT MIRRORS) and the solution is ideal as well for your binocular, eyepieces and camera lenses.

The key to success is: 1) take your time; 2) work in small areas; 3) use LOTS of dry Kleenex; and, 4) use ONLY the materials and techniques described.

***Another quality service from your Arkansas Sky Observatory!***

Part II (coming soon...): ***"Cleaning Telescope Mirrors and Delicate First Surfaces"***

Part III (coming soon...): ***"Preventing the Need to Clean - Protecting your Telescope Optics"***

Dr. Clay

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