



ALL MIRRORS ARE EQUAL

Whether you use a tabletop reflector or a giant Dobsonian, all Newtonian reflector mirrors require a good cleaning eventually.

Nurture YOUR NEWT: Bathing Mirrors

Cleaning your reflector's optics ensures top performance.

Newtonian telescopes are amazingly robust devices. With two mirrors that need to be accurate to within $\frac{1}{4}$ -wavelength of light and aligned within millimeters, you might expect them to be fussy, temperamental beasts that require constant attention and adjustment. Some people do seem to fiddle with their scopes more or less continually, but others let them go for years without so much as a dusting or a twist of a collimation knob. The famous Edmund Astroscan, one of the best-selling Newtonian designs in history, wasn't even built to be adjustable.

Yet while it's true that the Newtonian is tolerant of

neglect and even some abuse, it's also true that a little care and fine-tuning can keep your scope operating at peak capacity. Two of the simplest and most effective maintenance tasks are surprisingly easy: keeping it clean and keeping it collimated. We'll talk about cleanliness here and collimation next month.

Dust Prevention

Regarding cleanliness, the main thing you need to concern yourself with is dust on the mirrors. It's surprising how much they can collect and still provide a decent view (by "surprising," I really mean "Holy, cow, you've got to be kidding!"), but there's a limit. Every speck of dust adds a little diffraction to the image, and eventually all that diffraction adds up to become a distraction.

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Unfortunately, when using the scope, its primary mirror is facing upward, so any dust in the air can settle on it. With closed-tube scope designs this isn't a big problem, but with open-truss scopes, whose primary mirrors are right next to your feet as you scuffle around in the dark, you can put on a hefty coat of dust in a single night. The trick, then, is to not kick up so much dust in the first place. That means setting up on grass or a hard surface if possible, or laying down a ground cloth if you can't.

It also means not letting the mirror dew up if you can help it. Dew moistens the dust particles and effectively glues them to the mirror so they can't simply be blown off later. It's not a disaster if the mirror dews up, but you'll need to clean it more often if it happens frequently.

How you store the scope will also have a big effect on how clean the mirrors stay. Obviously, use a dust cap, but also put a bag or a shower cap around the base of the scope so dust can't enter around the mirror cell. A full-length cover is even better. If possible, store solid-tube scopes sideways or top-down so no dust that does get inside can fall on the primary. Store any scope in as dust-free an environment as possible. In the shop next to the table saw is probably not the best place.

When your mirrors do become dusty, the first step is to gently blow them off with compressed air. Be careful when using mechanical air compressors; the air coming out of them can sometimes be oily or wet, which will make matters worse. Use a can of compressed air instead. Compressed air won't get everything off, especially if it was dew-glued on, but it'll help considerably. Eventually your mirrors will need cleaning, but with a little preventative care that won't happen for several years.

Figuring out when it's necessary is the real trick. Any telescope that's been used more than a couple of times will fail the flashlight test, in which you shine a light straight

down the tube and gasp at all the dust on that once-pristine surface. By the time it's truly ready to clean, the flashlight test will make you want to use a chisel.

Your best indicator isn't by examining the primary mirror at all, at least not directly. You're better off looking at a bright star through a clean medium-to high-power eyepiece. Is there a lot of flare around the star? If so, then that's probably from dust on the primary. (Be sure to check your eyepiece first — the view through a dirty eyepiece mimics that of a dirty mirror.) The scope may have a dirty secondary mirror, but since secondaries point downward most of the time, that's less likely. If so, though, the following procedure will work for cleaning a secondary just as well as a primary.

Hands-on Cleaning

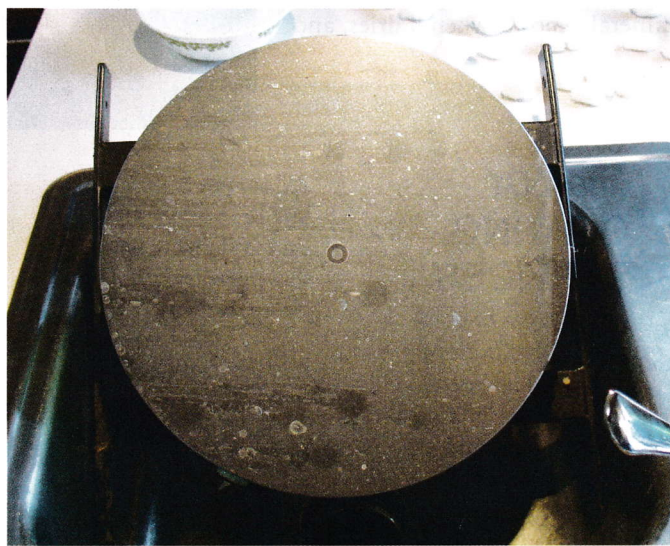
Many people (maybe even most) are afraid of their primary mirror. It is, after all, a precision instrument, and the coating is on the front surface where it can be easily scratched. While this is true, it's not as fragile as you might think. The aluminum coating is overcoated with a layer of silicon dioxide, which is basically glass.

I have a fond memory of Bill Atwood, owner of Uvira, Inc., holding my very first mirror casually in his hands as he admonished me not to be afraid of its shiny new surface. "It's coated with glass," he said. "I could clean it with my tie."



▲ **CELL PROTECTION** A simple shower cap prevents dust from entering through the bottom of the telescope around its mirror cell.

▼ **HAZY REVELATION** Left: When it's time to clean your Newtonian's primary mirror, be careful removing it from its sling or cell. Here, the author dons new gloves in order to avoid adding fingerprints and other contaminants to the coated surface. Right: This mirror is definitely ready for cleaning.



I've never had quite the courage to do that, but I believe he's right. I have cleaned mirrors with Glass Plus and Kleenex without harming them. But there's a tried-and-true method that's safer, and it's easy enough that it should be your standard method, too.

First, remove the mirror from its cell if possible. If you can't, then you'll have to clean it in the cell, as I've done in the illustrations here.

Next, blow off any dust that you can. Don't use a high-pressure air jet; just puff away whatever is loose.

Get a couple dozen cotton balls ready. You'll want to be able to pick them up one at a time with wet hands.

Have some distilled or deionized water ready, too.

Take off your rings.

Trim your fingernails. Seriously.

Prepare a bowl of warm, soapy water. Add just a couple drops of Dawn, Ivory, or some other gentle dish soap. Unscented is best (fewer additives), but that's not critical. Wash your hands first to get most of the oils off, then soak the fingertips of your dominant hand for a few minutes in the mirror-washing water. This will soften up your skin and get it squeaky clean.

Next, rinse the mirror under warm running water. From this point on, don't let any water dry on the mirror. Tap water leaves mineral deposits when it dries, and



those are hard to get off. Rinse off all the dirt you can. Use your sink sprayer if it has one. You might even soak the mirror for a while if you have stubborn spots.

Once you've gotten off everything you can with running water, start in with the cotton balls. Take a single cotton ball, dip it in the soapy water, and, starting at the top of the mirror, wipe it gently across the mirror in one steady, light swipe from one edge to the other. Now throw that cotton ball away. If the cotton picked up any grit, you don't want to be scraping it across the surface on your next pass.

Work your way down with overlapping horizontal motions, using one cotton ball per swipe. (Yes, if you're careful you can rotate the cotton ball and get a second clean swipe out of it.)

When you've done the entire mirror, rotate it 90° and do it again. Now take a deep breath and touch the mirror with your fingertips. (This is why you trimmed your fingernails — you just want the fleshy parts of your fingers to

Mirror COATING SERVICES

Here's a list of companies that currently provide aluminization services for amateurs in North America.

Aluminum Coating
807 Rutherford Ave.,
San Carlos, CA 94070
650-868-5035
alcoat.net

Evaporated Coatings Inc.
2365 Maryland Rd.,
Willow Grove, PA 19090
215-659-3080
evaporatedcoatings.com

Evaporated Metal Films
239 Cherry St.,
Ithaca, NY 14850
800-456-7070
dynasil.com

Galaxy Optics
P.O. Box 2045,
Buena Vista, CO 81211
719-395-8242
galaxyoptics.com

H. L. Clausing, Inc.
8038 N. Monticello Ave.,
Skokie, IL 60076
847-676-0330
clausing.com

North American Coating Laboratories
9450 Pineneedle Dr.,
Mentor, OH 44060
866-216-6225; nacl.com

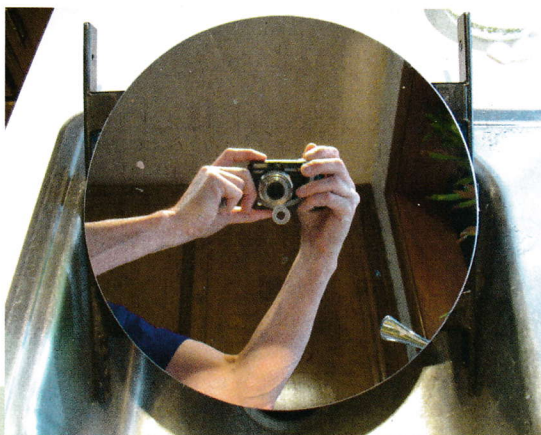
contact the surface.) This part is optional, but it's worth doing if you can work up the courage, because your fingertips are so sensitive that you can feel any grit particles that might still be stuck to the mirror. Gently feel around with your soapy, wet fingertips to make sure the mirror is truly clean. If you find a grit particle, gently knock it free and rinse it off the mirror so you won't drag it around. If you see a stubborn stain, it's okay to rub it a little — lightly — with your fingertips to clean it off. A fresh cotton ball would work, too, but unless you're a guitarist and you're using your fretting hand to wash the mirror, your fingertips are gentler than the cotton fibers.

When the mirror is clean to your satisfaction, rinse off all the soapy water with warm tap water, then rinse off all the tap water with distilled or deionized water. This last step ensures that no mineral deposits will be left on the mirror when it dries.

Water will sheet off a truly clean mirror, so odds are you'll only have a few drops remaining. You can dry these drops by blotting them with a soft towel, but there's no need. The distilled/deionized water will dry perfectly clean.

When to Recoat a Mirror

If you notice a lot of splotches on a clean mirror, it's possible that your



◀ **ROUND TWO** *Top:* Rinse off the soapy water with lots of warm tap water. *Middle:* Flood the mirror with distilled water to prevent mineral stains. *Bottom:* The cleaned mirror may still have some defects. This one is beginning to have coating issues but is still perfectly useable.

coating is going bad. Pinholes in the glass overcoating let oxygen and other contaminants reach the aluminum layer, and that can eventually lead to corrosion. These spots usually look like an irregular patch of algae on a rock or an ice cream cone splat on the pavement, and they won't clean off. When more than a small percentage of the mirror is affected with this corrosion, it's time to have it recoated. (See below for a list of coating vendors.)

Assuming your mirror is in good shape, though, you're done! Put it back in its cell, remembering not to overtighten the mirror clamps. You want them to *just* hold the mirror from tipping forward when the scope is tilted horizontal, not push down on it (not even a little bit). Too much pressure will pinch the optics.

Now reassemble the scope and collimate it. We'll cover the finer details of collimation in the next installment.

■ Contributing Editor **JERRY OLTION** loves cleaning mirrors, especially other people's.

Majestic Optical Coatings

152 Willow Way,
Clark, NJ 07066
888-278-8308

majestic-coatings.com

Optiques Fullum

1111 Rt. Harwood #6,
Vaudreuil-Dorion,
QC J7V 8P2 Canada
optiquesfullum.com

Optical Mechanics Inc.

2224 Heinz Rd.,
Iowa City, IA 52240
319-351-3960

opticalmechanics.com

Ostahowski Optics

P.O. Box 390440,
Anza, CA 92539
951-763-5959
ostahowskioptics.com

Precision Optical

320 Kalmus Dr.,
Costa Mesa, CA 92626
949-205-7346

precisionoptical.com

Reynard Corporation

1020 Calle Sombra,
San Clemente, CA 92673
949-366-8866
reynardcorp.com

Spectrum Thin Films

135 Marcus Blvd.,
Hauppauge, NY 11788
800-815-8184

spectrumthinfilms.com

Spectrum Coatings

1165 Ring St.,
Deltona, FL 32725
386-561-9779
spectrum-coatings.com