

Cleaning/aluminizing large telescope mirrors at ING

revised 14/5/2001

Removing the old coat

The first stage of cleaning is getting rid of all solid matter from the surface. The simplest way of removing the dust without touching the surface is to play the [fire hose](#) on to it, and to flood it until no solids remain.



To get rid of the contamination introduced by the fire hose, the mirror is then thoroughly rinsed with de-ionized water obtained from the de-ionization plant in the JKT (Jacobus Kapteyn Telescope).

The next step requires a solution of Caustic Soda (NaOH) made by adding 10-15% by volume of NaOH pellets to de-ionized water and stirring until fully dissolved. With pure cotton wool or soft paper (E-Tork, Molnlycke) soaked in this solution we [swab the surface](#) gently and continuously until there is no trace of aluminum on the surface.



It occasionally happens that an aluminum coat is slow to disappear using alkali. In this cases an acid solution is prepared of Hydrochloric acid (HCl), de-ionized water and Copper Sulphate.

When all the aluminum has gone we repeat the fire hose treatment and the de-ionized water rinse.

Now we dry the mirror with ISO-propyl alcohol. That is to say the water is

progressively replaced by alcohol, and the alcohol spread around until it evaporates, wiping the surface gently with pads of high quality absorbent paper (E-Tork, Molnlycke).

Final cleaning then continues with a linen cloth with a small amount of Balzers Substrate Cleaner No.2 on it.

Glow discharge

[Glow discharge](#) is started manually when the tank pressure has reached 8×10^{-6} mbar.



The diffusion pump plate valve is closed, a [bleed valve](#) causes the pressure to rise to 10^{-3} mbar and the voltage and the current will rise gradually to a peak of 2.8 kV and 1.3 A. This will last for a period of 7 minutes.



Meissner cooling

After glow discharge the tank pressure drops back quickly as the bleed valve is closed and the diffusion pump plate valve opened. Liquid Nitrogen will now start flowing through the [Meissner coils](#) just below of the filaments. It takes about 20 minutes to cool the coils down.



Tank pressure before evaporation

Before performing the evaporation the tank pressure is $6 - 8 \times 10^{-6}$ mbar.

Aluminum and filaments

There are 120 [filaments](#) in the tank, located in a ring of 4.2 m in diameter, 2.0 m above the target.



Each coils (10 turns) is 75 mm long and 7.5 mm in diameter and is loaded with two 55 mm long and 1.5 mm thick aluminum wires. They are clamped to the filament on one side to make sure they don't fall out just before evaporation. It happens sometimes that drops of aluminum form and fall down during evaporation.

Evaporation

For evaporation all coils are heated up together. The ramp up of the filament current is programmed and the maximum value of 7500 A (total current) is reached after 25-30 seconds and will settle to 6000 A afterwards. After about 60 sec. all aluminum has deposited on the target and after 90 sec. the filament current is switched off.

A total of 63 g of aluminum is evaporated, 3.5 g being deposited on the 13m² surface of the WHT primary mirror to create a reflective surface 100 nm thick.

Venting Procedure

Pumping continues while warming up the Meissner coils (20 minutes). Then the tank pressure is increased to 10-1 mbar. After two hours we vent to 100 mbar and leave it there for another 12 hours before venting to atmospheric pressure and opening.

Aluminizing small mirrors

Uniform coating thickness has been optimized for the 4.2m primary mirror. Smaller mirrors should be [supported on stands](#), such their surface is sitting approximately at the same level in the aluminizing tank as the surface of the 4.2m mirror.



I appreciate your comments, please contact Juerg Rey, juerg@ing.iac.es