

Shutter Opening Problem Correction

June 4, 2004

Introduction

On some domes, the process of opening or closing the shutter may result in an improper disconnect of the shutters, and a fall of the top shutter to the rear. This note outlines the likely causes and cures of the problem (See instruction manual for further discussion).

Discussion

When the shutter is opened the first few times after the observatory is constructed, you should make several observations as the shutter moves up the first foot:

- watch that the top shutter moves back as the front shutter is slid upward
- look up inside to check that the rear latch has disengaged
- look up inside to check that the front latch is still partially engaged (i.e., still in the hole)

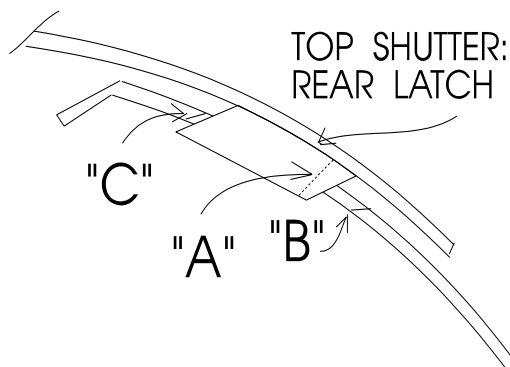
Shutter opening problems

Top shutter drops to back because it did not move. When opening, the front latch is supposed to stay engaged, while the rear latch disengages—then the two shutters move back together. However, if the front latch disengages while the rear latch remains engaged (the opposite of what should happen), then the front shutter will move toward the back under the top shutter while the top shutter stays in place. When the rear of the front shutter reaches the latch it will force a disengagement of the top shutter, which will then slide to the back OUT OF CONTROL and will usually break the shutter catchers. This can damage the shutter, and is dangerous and must be corrected.

The cause of this behavior may be one or both of the following:

- some condition at the **rear** latch **or** hole prevents easy disengagement of the rear latch
- some condition allows the **front** latch to disengage **too** easily.

The top shutter rear latch should disengage **very easily** as the top shutter is pushed back. Difficulty can be caused by:



- The rear latch may be excessively rounded at the ends of the rear face with a perpendicular bevel ("A" in drawing). Because the rear edge of the hole is triangular, the **ends** of the latch will initially contact the rear of the hole, and a perpendicular face will not slide up over the edge. Correction is to cut off the ends, or modify the bevel from perpendicular to sloped (as is the remainder of the rear face)
- The rear of the rear latch hole may be beveled too sharply ("B" in drawing). This can cause grooves or cuts in the rear face of the latch which worsen the problem. Correction is to sand the face ("B") to under 45 deg with smooth edges. If the rear face of the latch is grooved, sand or shave it smooth.

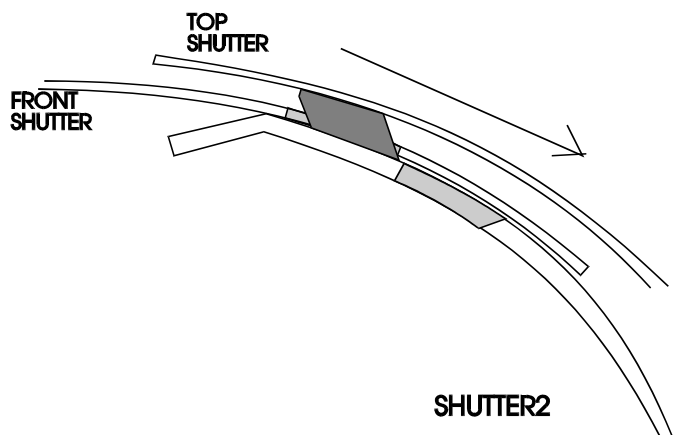
- The front of the hole may be beveled too sharply, causing the latch to jam in place ("C" in drawing). Sand the front of the hole ("C") to a more vertical face, and smooth the edges.

Top shutter drops to back because its latch did not hold properly. The front latch should NOT disengage until the rear of the top shutter has reached the shutter catchers. Too easy disengagement can be caused by lack of proper vertical bevel on front face of latch. In the initial delatching, the front of the front shutter hole may not push against the vertical part of the latch, but will instead push the shutter back so that when the top shutter weight shifts to the rear of the dome, it's latch will barely hang on the rear of the front shutter hole (rather than fully latched). Then when the latch reaches the rear cover as it moves back, it will bump out of the hole and the top shutter will fall to the rear.. Correction is same as the previous problem which is to create a vertical bevel on the front of the front latch about 1/4 in. high (sand, plane, or cut).

Top shutter does not delatch at rear. When the shutter is about half way open, sometimes there may be excessive force required to disengage the front latch even when the shutters are back in the correct position in the shutter catcher and ready for final disengagement. The symptom is usually that the front shutter will bow outward (because it is still trying to push the top shutter that is already in the shutter catchers) which lifts the top shutter off the slot edge. After a few seconds, the shutters delatch with a bang, the shutters drop down, and the front shutter continues back. As you might guess, this is bad.

This problem may be caused by warped shutters, excessive electric shutter tension, or other problems that lift the front of the top shutter and/or the rear of the front shutter away from the dome (this keeps the front latch fully engaged with the front shutter hole against the vertical bevel rather than the sloped part of the latch). Shutter cable tension should follow the instruction manual. In 6/10 foot domes, about 2-3 inches of spring tension is desirable. In 15 ft. dome, you should have at least several loose coils of cable on the multisheave pulley.

To check latch operation, while opening, watch the top shutter front latch as it rides up over the lip, and as it passes by the rear latch hole. When opening, once the front latch is back over the lip, the front shutter should be sliding on the rear cover, i.e., not still up against the top shutter blue surface. The front edge of the front shutter latch hole should be ready to slide under the beveled edge of the latch. You will probably see that this edge is instead still pushing on the flat forward part of the latch, so that disengagement will be hard.



The cure may be to reduce an excessive front latch vertical bevel, or to make vertical the **front** edge of the **front** hole (if it is incorrectly beveled).

Shutter Closing Problem Corrections

The most common problem is that the front latch will not fall square into the front shutter latch hole: when closing the shutters the first few times, observe carefully to see that the front latch is fully engaged as the front shutter moves forward.

In the worst case, the front shutter may simply move out from under the top shutter, leaving it behind. More typically, the front latch will fall only partway into the latch hole, with the result being that the top shutter literally hangs on only a small edge of the front latch (this can be seen by looking up inside as the latch moves forward past the rear cover latch hole). When this partial latching occurs, the top shutter will frequently

detach as it moves past the lip of the rear cover, causing the top shutter to crash back into the shutter catchers. This is dangerous, and must be corrected.

Different causes may contribute to this. These include top shutter too heavy and stiff, scored rear edge of the front latch, scored rear edge of the latch hole, error in cutting the hole or mounting the latch, or forward right and left corners of the rear cover not equally down against the slot edges. If the dome halves are out of alignment (ie., one forward from the other), or if the shutter catchers are not even, the rear cover, top shutter, and/or front shutter may be twisted causing a poor alignment of the front latch and latch hole: surprisingly small misalignments can sometimes combine to cause this shutter symptom.

Although the causes can be subtle, the cure is usually simple:

- use a large square to check that the latch and hole are perpendicular to their adjacent flanges and correct if necessary
- smooth the edges of the latch and hole (sanding or cutting)
- enlarge the latch hole to at least 2 3/4 in.. If the closed dome has at least 1/4 in. clearance between the inside shutter handle and the DSR, you can enlarge the hole at its rear, otherwise, enlarge by removing material from the front of the hole while maintaining the existing bevel.

These changes allow the latch to fall into place even if there is substantial misalignment of the parts.

Shutter Sequence

In identifying the cause of shutter problems, it is useful to see exactly when and where in the process the problem seems to occur. Here are the major steps in the shutter opening sequence:

1. The front shutter starts back
2. After moving about one inch it starts to push back the top shutter
3. Both shutters move back about one inch, then the rear latch of the top shutter slides up and out of the rear latch hole, taking about an inch more to do so
4. Both shutters move back until the top shutter is past midway. The top shutter moves about 1 inch sliding down the back until its front latch hooks onto the rear of the front shutter hole where it "hangs" as the shutters continue to move.
5. The front latch rides up over the rear cover lip
6. Both shutters move back until the rear of the front shutter reaches and slides over the front of the rear cover.
7. Both shutters move back until the rear of the top shutter reaches the shutter catcher. The top shutter stops moving, while the front shutter continues toward the rear sliding under the top shutter with the top shutter front latch sliding up out of the front shutter hole.
8. The front shutter continues back until it reaches end of travel.