



Secondary Mirror Handling Procedures

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Document number WODC 03-20

This document covers four phases of handling the secondary mirror:

Removing the mirror cell from the telescope

Removing the mirror from its cell

Installing the mirror into its cell

Installing the mirror cell on the telescope

Removing the mirror cell from the telescope.

This operation takes approximately one hour and can be done with two people.

Drawing list

NOAO #3501 0003994E Upper Cage & Secondary Assembly

NOAO #3501 0004698E Secondary Mirror & Cell Assembly

NOAO #3501 0004699E Secondary Mirror Assembly

Equipment

Secondary handling cart.
Small Hydraset
Small optics spreader bar.
Jib hoist control paddle.
Elevation horizon stay bar.
Allen driver set.

Procedure

1. Point telescope south (azimuth 180d°).
2. Place secondary handling cart on south side of telescope.
3. Bring telescope to horizon pointing while maneuvering the cart to clear the forward tubes. The cart should end up inside the tube assembly.
4. Release the elevation brakes and push the telescope as low as it will go.
5. Set the elevation horizon stay bars in place.
6. Position the jib hoist so that it traverses radially to or away from the telescope. Position over the secondary baffle.
7. Attach the baffle to the hoist with a single web of nylon strapping, and carefully take up the slack by raising the hoist.
8. Detach the secondary baffle. Move the hoist in (*towards the telescope*), then down. Remove the baffle and set aside.
9. Install the secondary mirror cover.
10. Attach Hydraset to the hoist.
11. Set the spreader bar arms to the secondary cell position and attach it to the Hydraset.
12. Detach the following cables at the back of the secondary cell:

Secondary air line (1/4" blue pvc tubing)

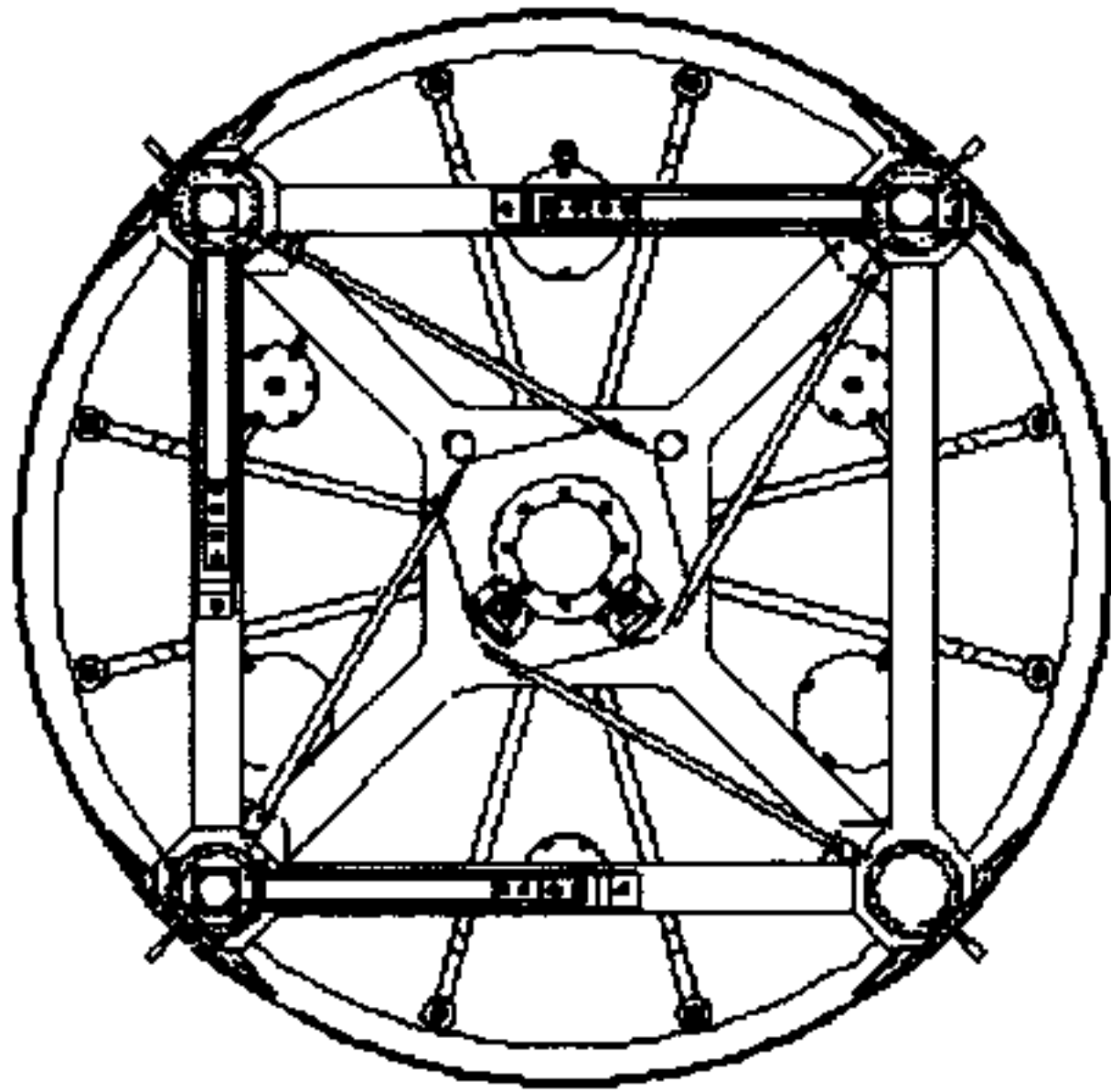
Load cell signal line

13. Retract the plunger on each of the three LVDT's and hold it back with a piece of tape.
14. Position the hoist over the secondary and maneuver the spreader bar to engage the lift trunnions at either side of the cell. Carefully take up most of the slack by raising the hoist. Be sure the hoist cable is precisely vertical over the secondary.
15. Take up the last of the slack using the Hydraset until the Hydraset scale reads 600 lbs (this is the full weight of the secondary cell assembly).

The next two steps detach the secondary. The jib hoist must support the full weight of the mirror cell before detaching from the telescope.

Be sure that one person is prepared to guide the secondary, as it may start to move.

16. Remove 8 5/16-18 bolts that hold a circular clamp plate on to the back of the back of the cell.



*View of the back of the secondary mirror cell.
The clamp plate with its 8 bolts is at the center.*

17. Remove three split clamps from the actuator pushrods. These are attached with 5/16 bolts. They may be difficult to remove. If so, try gently prying the split clamp apart with a screw driver. Set the split clamps aside.
18. Push the secondary cell towards the primary. If necessary, raise the Hydraset until the cell is free.
19. Move the hoist *in* (towards the primary).
20. When the secondary is clear of the cage, lower the hoist, rotate the secondary face up, and lower the cell onto its cart.
21. If the telescope must be rebalanced, attach the secondary dummy weight. See installing the cell in the telescope.

This completes the secondary cell removal procedure

Removing the secondary mirror from its cell

This procedure takes about 1.5 hours and can be done by two people with occasional help from a third hand.

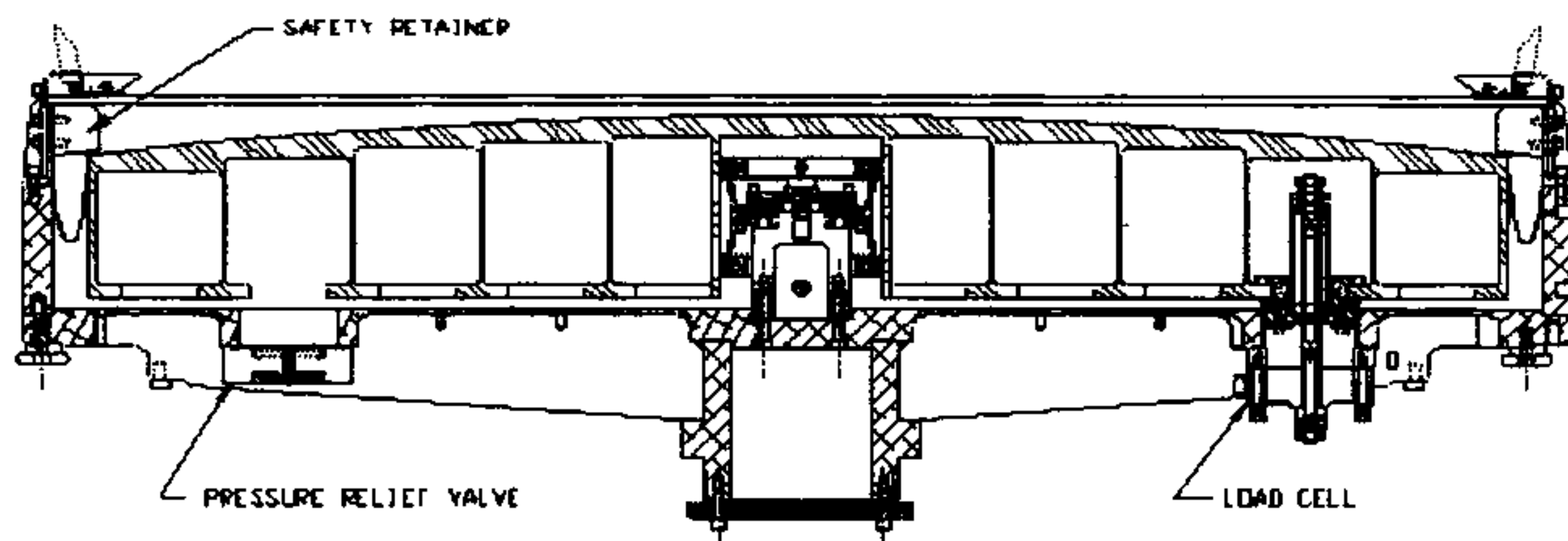
At the start of the procedure the mirror cell is in its cart.

Equipment

Small Hydraset
WIYN small optics spreader bar
Secondary removal tools kit
Secondary handling band

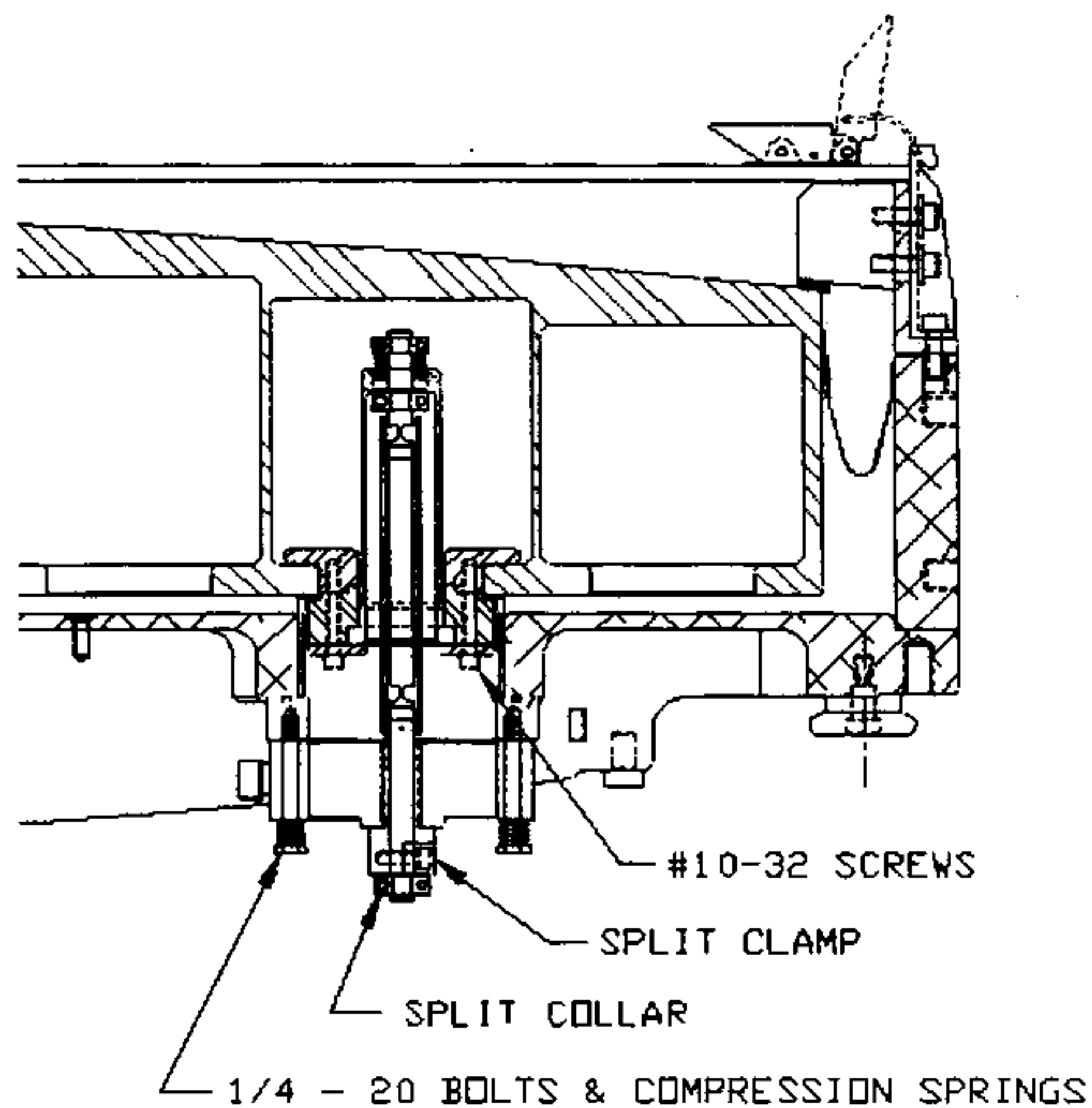
Procedure

1. Remove the mirror cell from the telescope and position zenith pointing on its cart with the load cells midway between the cart uprights.
2. Remove 24 1/4-20 machine screws and remove the safety ring.



Sectional view through the edge of the mirror cell.

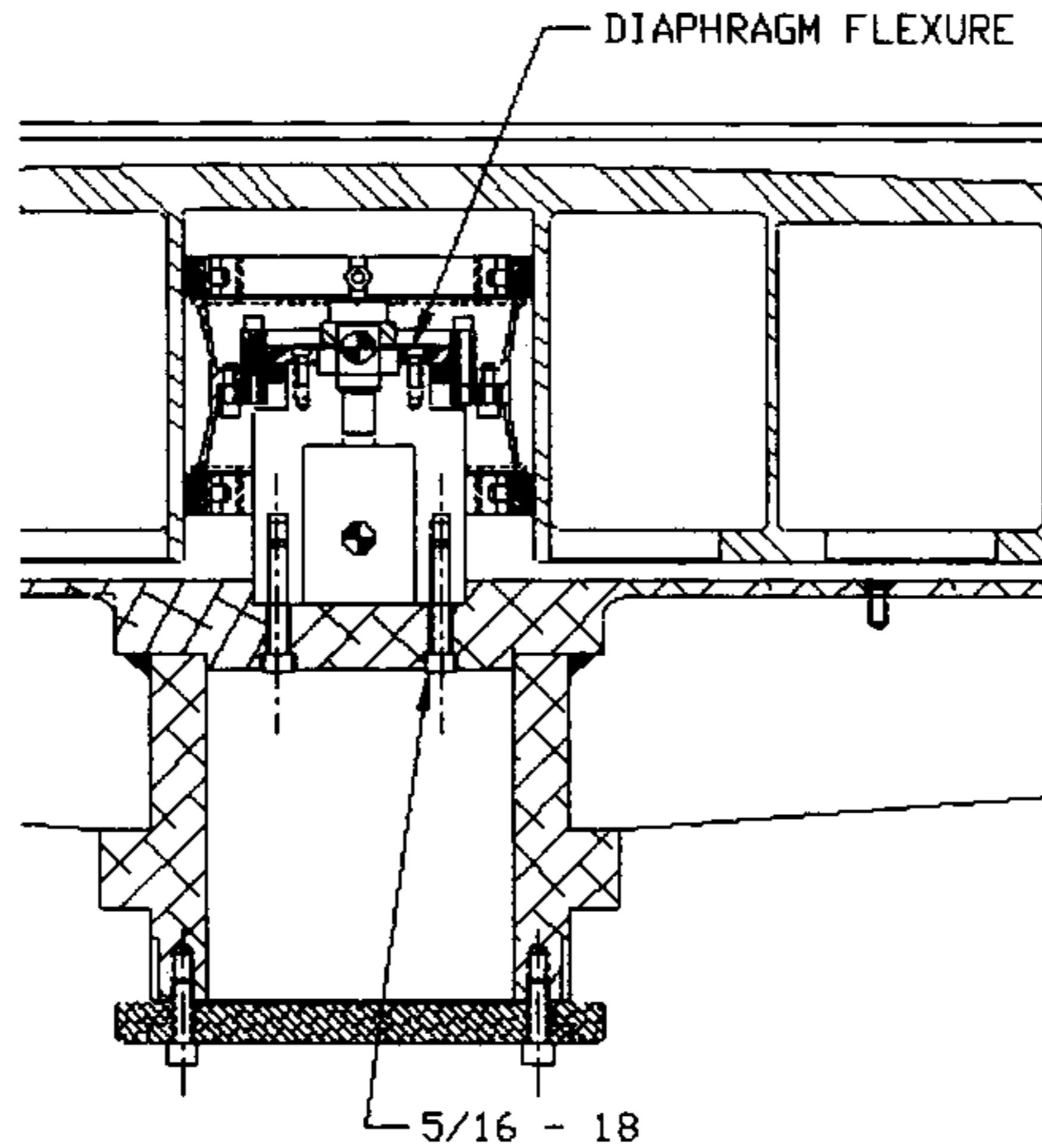
3. Detach the zip-lock edge seal from the glass. Tuck the seal back out of the way of the mirror.
4. Remove 24 3/8-16 x 1 1/4" long machine screws that attach the cell wall ring using a 5/16" allen driver on a socket wrench. With two or three people (or with the overhead), lift the ring over the glass and set aside.
5. Install the mirror handling band around the glass. Use a 3/4" socket and 3/4" box wrench to tighten the band.
6. Remove the view plate, pressure relief assembly, and pressure line attachment plates from the back of the cell using a 1/4" allen driver on a socket wrench.
7. Install the three delrin guide bushing onto the back of the cell.
8. Advance the guide bushings until they are touching the glass and "just snug".



Section view showing the load cell and flexure.

9. At the back of each load cell there is a split collar at the end of shaft protruding from the load cell. Remove these and set aside.

10. Remove eight 1/4-20 x 1 1/2" long machine screws and eight compression springs from each load cell.
11. Loosen two #10 screws in the split clamp at the back of the load cell and slide the load cell off of the 3/8" diameter shaft.
12. Remove six #10-32 screws from each flexure assembly and remove the assembly.
13. Remove eight 5/16-18 center post bolts from the back center of the cell.



Section view showing the center hub.

14. Rig an overhead crane with the hydraset and the WIYN spreader bar. Set the down bars to the m2 band position.
15. Attach the spreader to the mirror band trunnions.
16. Check to be sure all bolts have been removed and the mirror is free from the cell.
17. Lift the mirror about two inches above the cell. Install the safety clips on the mirror band. Lift the mirror clear of the cell and place it in its box.

This concludes the mirror removal procedure

Installing the mirror into its cell

This procedure can be done by two people and takes about two hours.

At the start of installation the secondary mirror will be in its shipping container, while the cell is supported zenith pointing on its handling cart with the circumferential ring and safety restraint removed and set aside.

1. Orient the cell on its support cart so that the load cell positions are midway between the cart uprights.
2. Install three delrin guide pins on the cell at the location of the safety relief valves. Turn the pins to the correct height using the guide pin setting tool.
3. Install the tangent strap into its channel in the cell.
4. Open the mirror box, remove the packing to expose the mirror. If the handling band is not already in place, install it around the mirror.
5. Rig the small Hydraset from the jib crane, and the WIYN spreader bar from the hydraset. Pick the mirror out of its box a few

inches and set the safety clips on the band. Raise the mirror the rest of the way.

6. If it has not been installed, set the center post lateral support flexure into the center of the mirror. Orient it according to the marks on the glass and on the post.
7. Clean the cell if needed. Be sure the 0.030" spacer is installed into the center post recess in the cell.
8. Locate the "top" mark on the mirror and the "top" mark on the cell. Position the cell under the mirror and lower the glass until the guide pins engage into the appropriate holes in the glass.
9. Using the Hydraset, lower the glass until the center post is about 1/8" clear of the cell.
10. Install two center post bolts to act as guides for the post.
11. Lower the glass taking care that the center post engages the cell correctly. Continue lowering until all the mirror weight is resting on the shoulders of the guide pins.
12. Check the rotational alignment of the mirror in its cell by installing a 10-32 machine screw through the end of the tangent flexure. It should align with a hole in the puck. Rotate the mirror in the cell to align.
13. Tighten the two center post bolts to seat the center post.
14. Check the position of the central diaphragm flexure. This flexure has plus or minus 0.025" of travel from its neutral position, so it is important to be sure it is set correctly. Insert a 9.000" long gage rod into either of the two gage holes in the back center of the cell. Use a depth mic to measure from the rim of the cell central boss to the end of the gage rod. This should read 0.630 +/- 0.005". If it does not, adjust the delrin guide pins as needed. Be sure that the mirror is level by measuring the distance to the glass at the load cell mounting holes.
15. Loosen the handling band (3/4" box end wrench and 3/4" socket driver). Remove it from the mirror and set aside.
16. Install all eight center post bolts and tighten with a socket driver with extension and TBD allen driver.
17. Insert flexure assemblies into the three pucks in the mirror. At position A be sure the tangent strap properly engages the cutout in the flexure assembly.
18. The load cells are marked A, B and C, or if these marks are missing they should be installed in the following positions:
 - Position A Load cell Serial # 69155
 - Position B Load cell Serial # 70150
 - Position C Load cell Serial # 69152
19. Install eight compression springs and eight 1/4-20 x 1 1/2" long bolts on each load cell and tighten.
20. Back off the delrin guide pins - this transfers the weight of the glass onto the flexures and load cells.
21. Remove the three guide pin plates (1/4" allen driver on a socket wrench).
22. Install the view plate, pressure relief valve assembly, and pressure line attachment plates.
23. With two or three people (or with the overhead), pick up the cell ring and position it over the glass. Rotate to align the "0" marks, and lower into place. Install 24 3/8-16 x 1 1/4" long bolts through the cell plate into the ring and tighten with a 1/4" allen driver on a socket wrench.
24. Close the zip lock pressure seal
25. Pressure test the seal with no more than 3 inches of water pressure (just blow into the pressure line). A little soapy water will reveal any leaks. Minor leaks can be sealed with vacuum grease, however, this should be used sparingly.
26. Install the safety keeper ring onto the cell with 24 1/4-20 machine screws. Check the location of the safety retainer clips - they should be 0.025 clear of the face of the glass. Adjust if necessary.
27. Adjust the spreader bar to pick up the cell from its trunnion fittings. Rotate the cell to point the mirror towards nadir. Check the clearance of the safety clip.
28. Check the location of the center flexure using the 9.000" gage rod. The end of the rod should be 0.630 ± 0.005 below the rim of the cell central boss.

29. Install two 5/16" screws into the gage rod holes.

The mirror and cell are now ready to install on the telescope.

Installing the mirror cell onto the telescope

This operation takes approximately one hour and can be done with two people.

At the start of the procedure the telescope is pointed south and at horizon pointing. If the secondary dummy weight is on the telescope, it should be removed following the removing the cell from the telescope procedure.

Secondary handling cart.
Small Hydraset
Small optics spreader bar.
Jib hoist control paddle.
Elevation horizon stay bar.
Allen driver set.

Procedure

1. Position the jib hoist so that it traverses radially to or away from the telescope. Position over the secondary cage.
2. Install the secondary mirror cover on the cell assembly.
3. Attach Hydraset to the hoist.
4. Set the spreader bar arms to the secondary cell position and attach it to the Hydraset.
5. Check to make sure the LVDT's are still retracted.
6. Position the hoist over the secondary and maneuver the spreader bar to engage the lift trunnions at either side of the cell.
7. lift the cell off its cart and rotate so the mirror is facing the primary.
8. Carefully maneuver the cell to engage the secondary cage.
9. Attach the clamp plate (8 5/16 bolts). Snug, but don't tighten the bolts.
10. Install the three split clamps between the secondary actuator push rods and the back of the cell. Don't over tighten. The bolts should be hand tight plus about a half turn.
11. Lower the Hydraset to slowly transfer the 600 lbs weight of the secondary cell to the telescope.
12. Tighten the clamp plate bolts.
13. Lower the hoist and disengage the spreader bar from the cell trunnions.
14. Re-attach the signal and pressure lines.
15. Remove the mirror cover.
16. Install the secondary baffle.
17. Remove the elevation horizon stow bar.

This completes the secondary cell installation procedure.

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