

W, RK, EH, JL, FP  
ARRIVE 8:00AM

12-7-92

BARRY ST @ 7:00  
MIKE + DARREN 7:30

### SHANE TELESCOPE

### 120-INCH PRIMARY ALUMINIZING PROCEDURE

Corrected Copy 10-1-92

### FIRST DAY

Try to avoid working on Sunday

CREW: 9 — 9 hours

\*Do in advance

hook dec bar to telescope first then remove east mezzanine handrail to fork

- ✓ 1. Remove Cassegrain spectrograph and store by main console. (1)
- ✓ 2. Move coude third mirror or stand onto west mezzanine. (5-8)
- ✓ 3. Disconnect 5 ton hook (9-12), and hook up 15 ton hook. (13-16) (Do not rereave bridge crane.)
- 8:25 ✓ 4. Install (3) support arms to lock telescope in position. Make sure telescope is perfectly located at zenith. (2-4)
- 8:25 ✓ 5. Remove trim weights + store on east curb.
- 8:45 ✓ 6. Remove dial indicators until tub and counterweights have been removed. Record readings. (17)

NE	NW	S
.7515	.5605	.765
.762	.572	.698

BACK IN

DE PW S  
650 460 600

— push rod BENT

- 8:35 ✓ 7. Install mirror handling platform extensions: north-1, south-2. (18-20)  
L-ALREADY ON
- ✓ 8. Remove cable takeup turning block — tie up to north side of telescope. (21-22)  
(Do not remove cable trough.)
- 9:15 ✓ 9. Remove tub with standard rigging and store on east mezzanine — (lifting bar, NNE-SSW) Tools — 1-1/8 ratcheting box wrench). NOTE: Use tub fixture and leave electronic chassis and TV in place. (23-27) Use locating fixture of [redacted] aids for re-installation of tub.

Attach tub fixture to platform and drive under tub. Bolt tub to fixture

\* DONE BY BARRY @ 7:00AM

2" & 1-7/8" & extensions

WRENCH SIZE? ~~2" & 1-7/8" & EXTENSIONS~~

10. Remove telescope counterweight assemblies with mirror handling platform and store block E+W with 2x4 S on east mezzanine. (Remove N-E-W first.) (28-32)

~~BREAK~~  
11. Reinstall dial indicators and jack mirror .100 inches. Remove indicators. (17 and 33)  
Make sure to have one person on each indicator for verification of travel.

10:50  
12. Remove flooring on mirror handling platform and install 3/8 shim on east track. (34)

13. Position platform under cell. (34-36)

14. Remove micrometers and hold down springs. CAUTION: RECORD READINGS: DO NOT CHANGE SETTINGS. Lift on counterweights to install allen wrench. (37)

1-1/4" wrench for 3/4, 15/16" for 5/8

NE	NW	S
.415	.516	.525

15. Bolt cell to platform using 8-3/4 inches x 2 inches bolts and nuts. Use 5/8-inch bolts where required.

11:30  
16. Remove (16) bolts and nuts (nut size — 2 3/16 inch and bolt — 2 1/4 inch) attaching cell to telescope. (38-39)

12:00  
REMOVE N. THERMISTOR

12:00  
17. Lower cell to down limit. (41)  
LUNCH

1:00  
18. Move platform to north limit.

19. Start testing mirror at this point, prepare area and chemicals and remove cardboard, tape, and foil. (50-51)

20. PREPARE to remove support assemblies. Leave defining units in place. (42)

1:15  
21. Install support arms for mirror spreader bar on south end of mirror handling platform while work on mirror continues. (43)

2:00  
22. Remove (2) aluminum clips from under 2-1/2 inch socket head spring-loaded guide pins. (45-a) If the heads do not bottom out, take hold of (2) or (3) rectangular shaped counterweights and push up on one while rattling the other back and forth until bolts drop in place. (46-e)

2:10  
23. Install split PVC keepers (screws down) around 1-inch shaft supporting large 70 pound counterweight and push up into hold in place. (49-a)

See following page

WRENCH SETUP

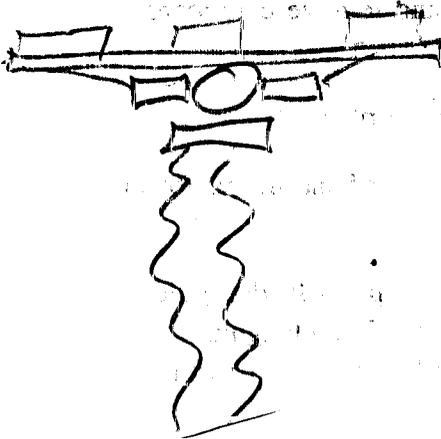
~~SLUGGER 2-3/16~~

~~RATCHETING EXT 1" DRIVE BREAKER BAR~~  
~~AND FINISH WHICH HAS CLEARANCE~~  
~~PROBLEM~~

Sluggers 2-3/16  
Ratcheting ext 1"  
drive breaker bar  
for E-W, which has  
clearance problem

1 TEAM DO E-W, 1 TEAM DO N-S.

LOOK IN AND SEE IF JACK BALL  
IS CENTERED ON SCREW



NEW 3 SPRINGS  
INSTALLED  
BALL CLEARANCE  
BROKE UP

SW INDICATOR PUSH ROD WAS BEND

DURING JACK-BALL PROBLEM - INDICATOR  
READING WILL PROBABLY BE WRONG

✓ 24. Remove (3) round counterweights from each support with 7/8 inch open end wrench at the cast iron lever arm bracket. (Don't move weight on shaft.) They are all match marked. (44-c) Keep counterweights in sets and in sequence.

2:25 ✓ 25. Loosen (2) of (4) radial set screws on large circular flange (THOSE NOT PAINTED RED). Use "L" shaped 1/4-inch allen-wrench. Don't touch radial centering screws in triangular grey casting (45-f) **NO!** 

3 capscrews are hidden above rectangular weights - remove with standard allen wrench

26. Remove all socket head cap screws holding large round flange *except* the second one (Leave (3) clockwise of the triangular point of the center plate. (45-b) **3 CAPSCREWS SA**

27. Remove (3) socket head cap screws, one from each point of the triangle shaped plate supporting the counterweight. (45-e)

28. Install (3) short hex-shaped and relieved extension screws and triangular push plate for jack. Use (3) holes in triangle casting. (46-b)

29. Install (3) long 1/2 inch extension in first hole clockwise of triangular plate. NOTE: Center support has no triangle plate. (48-d)

30. Install jack and align screw push plate by adjusting (3) nuts supporting jack; screw pilot and bearing to engagement with push plate. (48-b and c)

DINNER 5:00-5:45  
31. Remove (3) remaining cap screws from counterweight assembly flange. (47-a)

32. Wiggle jack gently while removing counterweight assembly until flange and radial set screws are no longer engaged.

33. Lower flange down 2 inches below mirror cell and install (3) clamps with slotted studs hanging down through (3) easily accessible holes and add bent bracket and nut. **NOTE:**

Note: center hole uses 3 special clamps

34. Raise flange till flush with mirror cell; using screwdriver rotate slotted studs (3) to engage clamps with outer diameter of hole and tighten with 15/16 inch open end wrench. (47-b)

6:15 35. Remove all jack equipment and proceed to next support assembly until completed.

36. Have team strip and clean mirror this night. ~~REMOVE TEMP SENSORS~~

Remove temp sensors from front of mirror

37. Test mirror surface with reflectometer. (52-53)

38. Prepare mirror for stripping and cleaning:

A. Apply (1) wrap of single face 2-inch masking tape in place of cardboard

Hard to remove after stripping mirror. Duct tape might be better (web)

Hard to remove after stripping mirror. Duct tape might be better.

- ✓ B. Apply (1) wrap of double face 2-inch masking tape over above
- ✓ C. Apply (1) wrap of 48-inch wide vinyl sheeting draped over edge of cell
- ✓ D. Apply (2) wrap of single face 2-inch masking tape
- ✓ E. Build a dam around the mirror by folding 2-inch duct tape 1/2 inch

- ✓ 39. Tie balls of cotton on end of PVC tubing and lucite rods (2-feet long). (59)
- ✓ 40. Install PVC drain plug in center of mirror form bottom and inflate inner tube and connect (3) hangers. (57-58) Make sure top of inner tube is approximately 1-inch below mirror surface.
- ✓ 41. Optician and (2) technicians proceed with stripping. Follow Lick Observatory procedure. (60-62)
- ✓ 42. Carefully cover with strips of cellophane and tape to side of glass. (64) Stow under telescope. *Finish @ 9:00 PM*

**SECOND DAY**

*7:45 AM START*

- ✓ 1. Idle technicians remove floor covers over aluminizing tank. (63)
- ✓ 2. Remove draping and all tape.
- ✓ 3. Match mark mirror to cell with masking tape (2 places — NE and NW). (65)
- ✓ 4. Slip sling around mirror. (66)
- ✓ 5. With use of bridge crane, install (2) edge arcs on mirror cell (NE-NW) and bolt down. (67) Install aluminum sling supports (68) + block up hook end so sling is parallel.
- ✓ 6. Use long 2-inch cable stinger to install lifting bar. (69-70)
- ✓ 7. Install ball screw jacks and attach to sling (71) (#1 in west).
- 9:08 ✓ 8. Install top U-shaped safety bracket on spreader bar (marked) and (2) safety brackets on sling. (72) Make sure that top bracket does not touch aluminum dial indicator push rod.
- 7:50 ✓ 9. Install trim weights on north of platform (40 weights).
- ✓ 10. Remove defining units after completing steps A and B; (NOTE settings). (42)
- 9:45 A. Turn (4) socket head graduated screws counter-clockwise on the NS defining units (36) turns to release the crowns. (CAUTION! Turn 2 EW screws 20 turns only) (73-a) (NOTE: Orange match marks)
- B. Remove (6) flat head screws and install 2-1/2-inch jack screws to push out assembly. (73-b and c)

BALLS PULLED OUT OF SW JACKING UNIT.

NW 2 1/2 TURNS

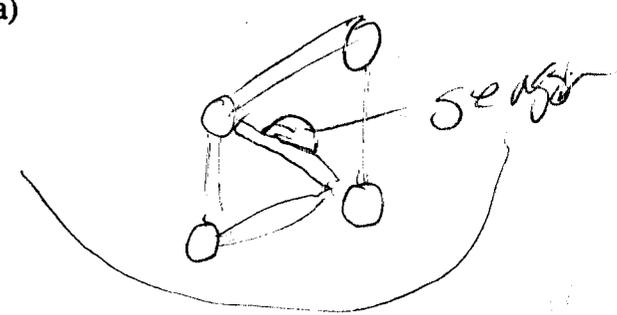
EAST  
7/8

WEST  
15/16

- 10:24 ✓ 11 Take up sling ball screw jacks until mirror starts to move. (74) Tilt a little first. Record dimension from stop to top of ball nut.
- ✓ 12. Attach a rope to either side of sling. (76)
- ✓ 13. Open aluminizing tank and remove all small mirror brackets from inside the tank.
- ✓ 14. Install Tuggit hoist from bottom of platform to frame for safety. (74)
- ✓ 15. Remove North Platform Extension
- ✓ 16. As platform is tilted, keep bridge crane hook snug on lifting bar and back off Tuggit hoist. (75)
- ✓ 17. After mirror is in vertical position, lift mirror 3/4 inch off edge arcs so that lifting bar clears support arms. (76)
- 11:00 ✓ 18. Roll platform south away from mirror to just clear telescope.
- ✓ 19. Disconnect power cable to mirror handling platform and store on floor. (77-a, 76)
- ✓ 20. Rotate dome and position mirror over tank. (77)
- ✓ 21. Position (2) technicians on tank to guide mirror sling into position.
- ✓ 22. Lower mirror enough to clear support arms and slide west into position; place weight on tank supports. (78-79)
- 11:30 ✓ 23. Do not slack lifting screws until top center support has been bolted to tank. (80)
- ✓ 24. Slack lifting screws and disconnect from sling; stow bar above floor opening. (79)
- ✓ 25. Remove (2) safety brackets and connect (2) bottom safety straps between sling and tank. (80-b)
- BREAK FOR LUNCH
- 12:40 ✓ 26. Remove all cellophane and allow coating technician to do final cleaning and inspection of mirror.
- 2:05 ✓ 27. Close tank and start roughing pump.
- ✓ 28. Rope off observing floor opening for safety.
- ✓ 29. Thoroughly inspect all crowns for damage; clean supports and cell as required. (82)
- ✓ 30. Bring (3) 1/4-inch push screws just into contact with crowns. This keeps them straight during reinstallation of mirror supports. (44a)

~~with hook~~ with hook

Remove bottom temp sensor



FIRED @ 5:30 BILL GO HOME  
31. Vacuum coat the mirror.

THIRD DAY

CREW: Same — 8 hours ST @ 7:30

JIM ARRIVE AM

1. Open tank, inspect mirror + test and cover surface of mirror with cellophane. (81)
- 8:30 2. Lower spreader bar and jacks over mirror and connect to sling. (79)
3. Disconnect (2) safety brackets at bottom of sling. (80-b) Also remove (A). *BOLTS AFTER ATTACHING SAFETY CLIP AT TOP OF SPREADER BAR*
4. Take up jacks equally about one turn (do not rotate mirror); lift mirror about 3 inches and outhaul to disengagement of tank supports. *7/8 W 15/16 E*
5. Install temperature sensors on front and back of mirror.
- 10:00 6. Inspect 18 Invar bearing races inside mirror support pockets for loose "O" rings and set screws.
7. Lift straight up while guiding with (2) attached ropes at bottom of sling and (2) technicians on tank. (83)
8. Rotate dome and center mirror in North; connect platform power.
- 10:45 9. Drive platform north and carefully guide mirror past edge arcs (84).
10. Make sure mirror cell is parallel to back side of mirror; override limits if necessary. (85)
11. Check rotation and center line of mirror with cell. Make adjustments with jacks after lifting bar is resting on supports.
12. Slack crane hook just a bit and start tilting platform down. Follow with hook and tuggit.
13. Level platform with machinist level on cell flange.
14. Remove trim weights.
15. DO NOT move platform until (3) mirror supports have been installed (center, east, west).
16. Remove lifting bar and brackets only after #15 is completed.
17. Install north platform extension.
18. Remove mirror sling. (68 and 86) + REMOVE

~~REMOVE EDGE ARCS #21~~

Remove edge arcs #21

1:45

19. Close aluminizing tank and floor over tank while mirror supports are being installed.

4:30 DONE

20. Install all mirror supports:

**IMPORTANT TO DO THE FOLLOWING STEPS IN SEQUENCE**

- A. Carefully jack supports until crowns are engaged. Rattle large round weights. (48)
- B. Lightly screw in radial set screws (2 unpainted set screws). (45f)
- C. Lightly tighten (3) cap screws and remove jacks. (45-b) 6
- D. Release (3) 1/4 inch slotted fillister head screws 1/2 turns (crown supports). (44-a)
- E. Finish installing cap screws on large flange and tighten radial set screws (2 unpainted set screws). (45-b)
- F. Install (2) aluminum clips on guide pins (install pull wire in hole in screw head). (45-a)
- G. Reinstall 3 radial weights (49-c)
- H. Remove split PVC blocks. (49-a)

21. Remove edge arcs.

4:35 22. Install both defining units: (42)

4:40 A. Turn graduated screws clockwise on NS (36) turns to previous setting; on EW 20 turns only. (73-a) (One of the N-S screws may only turn 35-1/2 turns.)

5:00 23. Drive mirror handling platform under telescope.

**FOURTH DAY**

CREW: Same — 8 hours

DID WHILE INS. 5:00 PM '75

1. Carefully remove cellophane from mirror surface.

2. Insulate mirror blank:

- A. Install 1 inch black masking tape to 1/4 inch inside mirror surface of radius edge.
- B. One wrap of single face 2 inch masking tape.
- C. One wrap of double face 2 inch masking tape.
- D. One wrap of 3 inch corrugated cardboard.
- E. ~~One wrap of single face 2 inch masking tape.~~ LEAVE OUT
- F. One wrap of double face 2 inch masking tape.
- G. One wrap of 3 inch corrugated cardboard
- H. ~~One wrap of single face 2 inch masking tape.~~ - LEAVE OUT
- J. One wrap of double face 2 inch masking tape.

FOR TEST

END OF

- J. One wrap of 18 inch wide aluminum foil.
- K. Install top hat light shield in 8 inch center hole.

END OF DAY 5:00 PM

- 8:00 12-10-92 L3. Install (6) washer-spacers at W-S-E bolt pattern on cell and raise mirror.
- L4. Install cap screws in down position (nuts down).

5. Remove most of cell/platform bolts if necessary for alignment.

8:35 L6. Install (4) bolts at N-S-E-W position and torque with (2) man power. Use tubing extension on flex handle. (38)

8:35 L7. Remove (8) tie down bolts between platform and cell. 1-1/4 end wrenches for 3/4

8:35 L8. Lower platform. 15/16 for 5/8

L9. Lower mirror jacks to their stops.

L10. Stow platform in north and replace wood flooring. Remove ramp and shim from east track.

9:00 L11. Install (3) micrometers and check readings: install springs between counterweights and brackets. (37) *S, N, E, W*

9:25 L12. Check to make certain round counterweights are level; adjust by turning turnbuckles; counter-clockwise raises weights.

L13. Install dial indicators and reset, if required, by rotating turnbuckles above micrometers. Do not change 0-settings on dial gauges. (17) Do after tub is on

L14. Check that all <sup>SUPPORT</sup> counterweights are free and floating.

9:20 L15. Install (4) <sup>TELESCOPE</sup> counterweights on telescope with platform. South first; then E, N, W together. Support E, W on 2x4 S. *2 MEN AT EACH WEIGHT*

9:45 L16. Position tub on platform and center under telescope. (26-24)

9:50 L17. Lift carefully aligning taper guide pins by moving the tub ~~laterally~~ hydraulic jacks.

L18. Bolt tub to cell: (23)

- L19A. Screw in and torque (12) insulated hex head screws (1-1/8 inch ratcheting box wrench).
- L19B. Position and bolt on cable turning block assemblies.

10:50 install dial indicators (see #13)

11:00 unbolt tub fixture from tub and lower platform. Travel to North limit.

11:15

Remove tub fixture with crane

~~REMOVE TUB FIXTURE WITH CRANE~~

11:30

19. Remove (2) south-platform extensions.
20. Remove (3) support bars from fork and store in north mezzanine. Remove hand rails from mirror handling platform.
21. Test telescope controls for proper operation.
22. Collimate primary mirror (if asked for):
  - A. Prime focus and Direct Camera
  - B. Collimate by adjusting micrometers.

Replace trimweights per balance specs

MAKE SURE SLING IS PARALLEL TO MIRROR CELL!

## MANPOWER REQUIRED FROM SANTA CRUZ

DATE	NAME	BREAKFAST	LUNCH	DINNER	ROOM
2-12-84	CANTRELL	⊖	X	⊖	⊖
2-12-84	HORN	⊖	X	X	X
2-12-84	LEWIS	⊖	X	X	X
2-12-84	OSBORNE	⊖	X	X	X
2-12-84	JERN	⊖	X	X	X
2-13-84	HORN	X	X	X	X
2-13-84	LEWIS	X	X	X	X
2-13-84	OSBORNE	X	X	X	⊖
2-13-84	JERN	X	X	X	X
2-13-84	HORN	X	X	X	X
2-14-84	LEWIS	X	X	X	X
2-14-84	JERN	X	X	X	X
2-14-84	HEPBURN	⊖	X	X	⊖
2-14-84	BROWN	⊖	X	X	⊖
2-15-84	HORN	X	X	X	X
2-15-84	LEWIS	X	X	X	X
2-15-84	JERN	X	X	X	X
2-16-84	HORN	X	X	X	?
2-16-84	LEWIS	X	X	X	?
2-16-84	JERN	X	X	X	?

ALUMINIZING 1987  
March 15-19

Crew:

RL	Ron Laub	JL	Jeff Lewis
DS	Darrel Severinsen	EH	Erich Horn
MO	Mike Owens	TP	Terry Pfister
BA	Barry Alcott	BB	Bill Brown
NJ	Neal Jern	TA	Telescope Assistant
TC	Ted Cantrall		

Sunday 3-15: ~~RL, DS, MO, BA, NJ, TC, JL, EH, TP~~ + WAYNE E

Lunch: NJ, TC, JL, EH, TP  
Dinner: NJ, NL, EH, TP, TC?  
Room: NJ, JL, EH, TP

Monday 3-16: RL, DS, MO, NJ, JL, EH, TP, BB UP IN ~~AM~~ (BA on call) <sup>AM KB</sup> CABLE)

Breakfast: NJ, JL, EH, TP  
Lunch: NJ, JL, EH, TP  
Dinner: NJ, JL, EH, TP, BB  
Room: NJ, JL, EH, TP, BB

Tuesday 3-17: ~~RL, DS, MO, NJ, BB, JL, EH, TP, TA~~ BA KB WE

Breakfast: NJ, JL, EH, TP, BB  
Lunch: NJ, JL, EH, TP, BB  
Dinner: NJ, JL, EH, BB  
Room: NJ, JL, EH, (BB?)

Wednesday 3-18: ~~RL, DS, MO, NJ, JL, EH, TP, TA~~ BA <sup>WE</sup>

Breakfast: NJ, JL, EH, TP, (BB?)  
Lunch: NJ, JL, EH, TP  
Dinner: ~~NJ, JL, EH, TP~~  
Room: ~~NJ, JL, EH, TP~~

~~Thursday 3-19: RL, DS, MO, NJ, JL, EH, TP, BA and TA~~

~~Breakfast: NJ, JL, EH, TP  
Lunch: NJ, JL, EH, TP  
Dinner: NJ, JL, EH, TP -?  
Room: -0-~~

This schedule is my best estimate based on a good coat the first time. We may need to work Friday 3-20, which would require rooms and meals to suit.

