**JOB HAZARD ANALYSIS (JHA)**

**JHA Preparation Instructions:** JHAs are to be prepared by the Supervisor or Group Manager in charge of the work, with work group member participation. The goal of preparing a JHA is for those responsible for or performing any work to review the risks and possible complications of that work and to consider ways of mitigating those risks and complications. A JHA shall be completed for all work executed. The JHA## is to be incremented when a procedure requires more than one JHA form. “Standing” should be marked if job or task is performed regularly and work group members are always the same individuals. Supervisors are responsible for getting the work group members sign off completed and a copy sent to the safety officer for each JHA.

**JHA Change Instructions:** If changes to the content of this JHA are required, follow the KPNO ETS Engineering Change Process. The master copy of the document must be checked out of the Document Vault, an Engineering Change form must be completed, and the Revision Table (see last page) must be updated. Note that periodic reviews of this JHA that do not result in content changes require only entry of the review date and the name of the reviewer in the Revision Table; the document revision should not be advanced in this case.

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**Tammie Lavoie**

Tammie Lavoie, Safety Manager

Date 23 June 2017

<table>
<thead>
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<th>JHA Number:</th>
<th>3500-AD-015-0005-JHA</th>
<th>Rev: -</th>
<th>Standing:</th>
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<td>21 June 2017</td>
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<tr>
<td>Title of Job or Task:</td>
<td>WIYN Tertiary Mirror Removal and Installation Procedure</td>
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<td>Location/Facility:</td>
<td>KPNO WIYN Telescope</td>
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<td>Supervisor or Person Completing this JHA:</td>
<td>Miranda Saucedo</td>
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<tr>
<td>Person(s) Assisting with this JHA:</td>
<td>Emily Hunting, Rob Christensen, Tammie Lavoie</td>
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</table>

**Recommended Personal Protective Equipment (PPE):** select area above line to make entry

| Head Protection | X |
| Foot Protection | X |
| Eye Protection |
| Hearing Protection |
| Hand and body Protection | X |
| Respiratory Protection |
| Fall Protection |

**Special PPE:** N/A

**Notes:**
*Hard hats must be used whenever someone is working above you or at your head height, or when working with suspended loads.
**Safety Shoes are mandatory in the area during construction, maintenance, heavy or complex work.*

**Equipment or tools needed to perform the job:** tab or select to make entry in next location, only use if not listed in procedure.

| N/A | N/A | N/A | N/A |
HAZARD ANALYSIS

Hazard Analysis Instructions: Complete the table below with the basic job steps, stating the hazards present and safe procedures or precautions to control the hazards for each step. Tab will move to next column; to add rows place cursor outside table on the right, and press ENTER.

Basic Job Steps: Review the activity and divide it into basic steps.

Hazards Present in Each Job Step: Identify the hazards or the possible danger present for each basic job step.

Correct and Safe Procedures and Precautions: Decide what actions or procedures are necessary to control and minimize the hazards present.

Things to consider:
Do employees know how to do the job?
What are the hazards? Include people and equipment.
How can injuries or accidents occur?
How can injuries or accidents be prevented?
Are there obvious unsafe conditions?
Are special tools needed?
Do people need personal protective equipment?

How would we rescue people if something went wrong?
Do we have the equipment to rescue?

Use designations in the “Hazards Present” column:
AX – Asphyxiation
BR – Burn Hazard
CB – Caught Between
CBY – Contacted By
CI – Caught In
CO – Caught On
CW – Contact With
E – Exposure to Chemicals,
Noise, Vibration, Radiation
EL – Electrical
ER – Ergonomics
FB – Fall to Below
FH – Fire Hazard
HS – Heat stress
R – Repetitive Motion
SA – Struck Against
SB – Struck By
SE – Stored Energy
SL – Suspended Load
TH – Trip Hazard

<table>
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<th>Item No.</th>
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<th>HAZARDS PRESENT IN EACH JOB STEP</th>
<th>CORRECT AND SAFE PROCEDURES AND PRECAUTIONS</th>
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</table>
| 1        | Rig the tertiary baffle to the shop hoist and remove the baffle. | CO, FB, SB, SL, TH | -Examine straps for abnormal wear.  
-Use caution when walking around straps on the equipment, as there may be a low head clearance.  
-Ensure load is strapped securely.  
-Keep hands and feet clear of the suspended load. |
| 2        | Detach the air and load signal lines from the back of the mirror cell. | FB, SB, TH | -Inspect air and load signal lines for rust and wear to ensure a proper fit in the equipment. |
| 3        | Attach one 5’ strap through two shackles on one side of the mirror cell. Repeat rigging for opposite side of the cell. Rig the loops to the shop hoist crane hook. | CO, FB, SB, SL, TH | -Examine straps for abnormal wear.  
-Use caution when walking around straps on the equipment, as there may be a low head clearance.  
-Ensure load is strapped securely.  
-Keep hands and feet clear of the suspended load. |
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| 4       | Remove the rigging slack with the floor hoist and remove the tertiary mounting hardware. | CO, FB, SB, TH | -Examine straps for abnormal wear.  
-Use caution when walking around straps on the equipment, as there may be a low head clearance.  
-Ensure load is strapped securely.  
-Keep hands and feet clear of the suspended load. |
| 5       | Slowly lift the cell above the A-frame and pull away from the primary mirror. | CO, FB, SB, SL, TH | -Examine straps for abnormal wear.  
-Use caution when walking around straps on the equipment, as there may be a low head clearance.  
-Ensure load is strapped securely.  
-Keep hands and feet clear of the suspended load. |
| 6       | Lower it onto the cribbing positioned on the cart. | CO, FB, SB, SL, TH | -Examine straps for abnormal wear.  
-Use caution when walking around straps on the equipment, as there may be a low head clearance.  
-Ensure load is strapped securely.  
-Keep hands and feet clear of the suspended load. |
| 7       | Attach three, 5’ long lifting straps to the A-frame. | CO, FB, SB, TH | -Examine straps for abnormal wear.  
-Use caution when walking around straps on the equipment, as there may be a low head clearance. |
| 8       | Remove the bolts connecting the A-frame to the M1 mirror cell. | FB, SB, TH | -Inspect bolts for rust and wear to ensure a proper fit in the equipment. |
| 9       | Safely back the shop hoist and the A-frame away from the M1 mirror cell. | SB, TH | -Confirm no workers are standing underneath shop hoist as it is being moved. |
| 10      | Place the removal fixture on the cart, back off the six Delrin® pad adjustment screws, and lower the pads. | CO, FB, SB, TH | -Confirm no workers are standing underneath pads as they are being lowered. |
| 11      | Use an overhead hoist to pick the mirror up by its trunnion fixture, turn over the cell, and maneuver it onto the removal fixture. **Note:** Glass will be suspended from the cell. | CO, FB, SB, SL, TH | -Examine straps for abnormal wear.  
-Use caution when walking around straps on the equipment, as there may be a low head clearance.  
-Ensure load is strapped securely.  
-Keep hands and feet clear of the suspended load. |
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| 12      | Adjust the six Delrin® pads and advance the screws until they just barely touch the back of the mirror. **Note:** If advanced too far, the weight may transfer from the cell to the glass and potentially damage the support. | CO, FB, SB, SL, TH               | -Examine straps for abnormal wear.  
-Use caution when walking around straps on the equipment, as there may be a low head clearance.  
-Ensure load is strapped securely.  
-Keep hands and feet clear of the suspended load. |
| 13      | Remove the set screws and insert a ¼” x 5” long drift pin through the hole. | FB, SB, TH                       | -Inspect screws and drift pin for rust and wear to ensure a proper fit in the equipment. |
| 14      | Remove the ⅝-16 lock nut from the top of the loadcell.                          | FB, SB, TH                       | -Inspect lock nut for rust and wear to ensure a proper fit in the equipment. |
| 15      | Remove eight, ⅛-20 bolts that are holding the loadcell in place.               | FB, SB, TH                       | -Inspect bolts for rust and wear to ensure a proper fit in the equipment. |
| 16      | Remove the loadcells and unthread them, counterclockwise, from the end of the flexure. | CO, FB, SB, TH                  | -Inspect loadcells for rust and wear to ensure a proper fit in the equipment. |
| 17      | Insert the aluminum retainers around each flexure rod and remove the drift pins. | FB, SB, TH                       | -Inspect aluminum retainers for rust and wear to ensure a proper fit in the equipment. |
| 18      | Remove the six #10 screws, the washer, cup, and the flexure from the mirror.    | FB, SB, TH                       | -Inspect screws, washer, cup, and flexure for rust and wear to ensure a proper fit in the equipment. |
| **Note:** Do not drop the #10 screws.                                           |                                   |                                |
| 19      | Remove eight, ⅛-20 screws from each of the three lateral support assemblies.    | FB, SB, TH                       | -Inspect screws for rust and wear to ensure a proper fit in the equipment. |
| 20      | Rig the cell to be lifted at the four lifting points and hoist the cell away from the mirror. | CO, FB, SB, SL, TH               | -Examine straps for abnormal wear.  
-Use caution when walking around straps on the equipment, as there may be a low head clearance.  
-Ensure load is strapped securely.  
-Keep hands and feet clear of the suspended load. |
| 21      | Install the tertiary handling band, lift the mirror, rotate the mirror so that it is face-up, and place the mirror in its box. | CO, FB, SB, SL, TH               | -Examine straps for abnormal wear.  
-Use caution when walking around straps on the equipment, as there may be a low head clearance.  
-Ensure load is strapped securely.  
-Keep hands and feet clear of the suspended load. |
| 22      | Lift the mirror from its box using the mirror band. Place the mirror onto the removal/installation fixture. | CO, FB, SB, SL, TH               | -Examine straps for abnormal wear.  
-Use caution when walking around straps on the equipment, as there may be a low head clearance.  
-Ensure load is strapped securely.  
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| 23      | Rig the cell with two nylon straps, shackle them to the four lifting points, and lift using the overhead hoist. | CO, FB, SB, SL, TH | -Examine straps for abnormal wear.  
-Use caution when walking around straps on the equipment, as there may be a low head clearance.  
-Ensure load is strapped securely.  
-Keep hands and feet clear of the suspended load.  
-Examine straps for abnormal wear.  
-Use caution when walking around straps on the equipment, as there may be a low head clearance.  
-Ensure load is strapped securely.  
-Keep hands and feet clear of the suspended load.  
-Examine straps for abnormal wear.  
-Use caution when walking around straps on the equipment, as there may be a low head clearance.  
-Ensure load is strapped securely.  
-Keep hands and feet clear of the suspended load. |
| 24      | Carefully lower the cell over the mirror. | CO, FB, SB, SL, TH | -Examine straps for abnormal wear.  
-Use caution when walking around straps on the equipment, as there may be a low head clearance.  
-Ensure load is strapped securely.  
-Keep hands and feet clear of the suspended load.  
-Examine straps for abnormal wear.  
-Use caution when walking around straps on the equipment, as there may be a low head clearance.  
-Ensure load is strapped securely.  
-Keep hands and feet clear of the suspended load. |
| 25      | Lower the cell until it rests on the removal frame. | CO, FB, SB, SL, TH | -Examine straps for abnormal wear.  
-Use caution when walking around straps on the equipment, as there may be a low head clearance.  
-Ensure load is strapped securely.  
-Keep hands and feet clear of the suspended load.  
-Examine straps for abnormal wear.  
-Use caution when walking around straps on the equipment, as there may be a low head clearance.  
-Ensure load is strapped securely.  
-Keep hands and feet clear of the suspended load. |
| 26      | Insert the cup, flexure, and washer assemblies into their correct positions. | FB, SB, TH | -Inspect cup, flexure, and washer assemblies for rust and wear to ensure a proper fit in the equipment.  
-Examine straps for abnormal wear.  
-Use caution when walking around straps on the equipment, as there may be a low head clearance.  
-Ensure load is strapped securely.  
-Keep hands and feet clear of the suspended load.  
-Examine straps for abnormal wear.  
-Use caution when walking around straps on the equipment, as there may be a low head clearance.  
-Ensure load is strapped securely.  
-Keep hands and feet clear of the suspended load. |
| 27      | Carefully thread the loadcell onto the end of the rod. | CO | -Inspect loadcell for rust and wear to ensure a proper fit in the equipment.  
-Examine straps for abnormal wear.  
-Use caution when walking around straps on the equipment, as there may be a low head clearance.  
-Ensure load is strapped securely.  
-Keep hands and feet clear of the suspended load.  
-Examine straps for abnormal wear.  
-Use caution when walking around straps on the equipment, as there may be a low head clearance.  
-Ensure load is strapped securely.  
-Keep hands and feet clear of the suspended load. |
| 28      | Bolt down the loadcells with eight, ¼-20 screws that allow the loadcell to “float” to a stress-free position. Remove the drift pins and replace the filler screws in the drift pin holes. | FB, SB, TH | -Inspect bolts for rust and wear to ensure a proper fit in the equipment.  
-Examine straps for abnormal wear.  
-Use caution when walking around straps on the equipment, as there may be a low head clearance.  
-Ensure load is strapped securely.  
-Keep hands and feet clear of the suspended load.  
-Examine straps for abnormal wear.  
-Use caution when walking around straps on the equipment, as there may be a low head clearance.  
-Ensure load is strapped securely.  
-Keep hands and feet clear of the suspended load. |
| 29      | Back off each Delrin® pad and adjust the screw one full turn.  
**Note:** This transfers the support of the glass to the cell. | FB, SB, TH | -Inspect screws for rust and wear to ensure a proper fit in the equipment.  
-Examine straps for abnormal wear.  
-Use caution when walking around straps on the equipment, as there may be a low head clearance.  
-Ensure load is strapped securely.  
-Keep hands and feet clear of the suspended load.  
-Examine straps for abnormal wear.  
-Use caution when walking around straps on the equipment, as there may be a low head clearance.  
-Ensure load is strapped securely.  
-Keep hands and feet clear of the suspended load. |
| 30      | Insert the three rod flexures into their labeled locations. Let the rod base “float” to a stress-free position and bolt them in place. | FB, SB, TH | -Inspect rod flexures for rust and wear to ensure a proper fit in the equipment.  
-Examine straps for abnormal wear.  
-Use caution when walking around straps on the equipment, as there may be a low head clearance.  
-Ensure load is strapped securely.  
-Keep hands and feet clear of the suspended load.  
-Examine straps for abnormal wear.  
-Use caution when walking around straps on the equipment, as there may be a low head clearance.  
-Ensure load is strapped securely.  
-Keep hands and feet clear of the suspended load. |
| 31      | Install the mirror safety clips. | FB, SB, TH | -Inspect mirror safety clips for rust and wear to ensure a proper fit in the equipment.  
-Examine straps for abnormal wear.  
-Use caution when walking around straps on the equipment, as there may be a low head clearance.  
-Ensure load is strapped securely.  
-Keep hands and feet clear of the suspended load.  
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<td>32</td>
<td>Attach the trunnion fixture and lift the mirror and cell from the removal frame. Turn the mirror over, install the cover, and set the assembly mirror side up on the cribbing.</td>
<td>CO, FB, SB, SL, TH</td>
<td>-Examine straps for abnormal wear.</td>
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<td>-Use caution when walking around straps on the equipment, as there may be a low head clearance.</td>
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<td>-Keep hands and feet clear of the suspended load.</td>
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WIYN TERTIARY MIRROR REMOVAL AND INSTALLATION PROCEDURE

REVISION TABLE

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<tr>
<th>Rev</th>
<th>Date Approved</th>
<th>Remarks and/or Change Details</th>
<th>Reason for Change</th>
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<td>Feb. 17, 2015</td>
<td>Initiated</td>
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WORK GROUP MEMBERS FOR THIS JHA

I understand & will adhere to the steps, hazards & controls as described in this JHA. I understand that performing steps out of sequence may pose hazards that have not been evaluated, nor authorized. I will contact my supervisor prior to continuing work, if the scope of work changes or new hazards are introduced. I understand I have the authority and responsibility to stop work if I believe it to be unsafe.

<table>
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<tr>
<th>N°</th>
<th>NAME (print)</th>
<th>SIGNATURE</th>
<th>DATE</th>
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SUPERVISOR IN CHARGE

I have reviewed the steps, hazards & controls described in this JHA with all workers listed above and authorize them to perform the work. Workers are qualified (i.e. licensed or certified, as appropriate, & in full compliance with NOAO training requirement(s) to perform this activity.

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