# AvL TECHNOLOGIES

designs for ultimate performance

# Model 2460 HW 9-Piece Reflector Antenna System Operation and Maintenance Manual

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# 1 Chapter 1: Technical Descriptions and Specifications

## 1.1 Description of System

The Model 2460 HW antenna system is comprised of the following major components:

- AvL Model 2460 HW two-axis positioner
- 9-pc carbon fiber reflector with C-band feed and feed boom
- RCI Controller

The completed system weighs less than 900lbs without cases.

## 1.2 General

The 2.4M antenna system is an elevation over azimuth positioner featuring the simple, rugged AvL azimuth cable drive system that produces very low backlash, high stiffness, and high reliability. It is driven by low backlash gearboxes with DC motors. All drive components are high-strength steel encased in lubricated-for-life housings, resulting in the most reliable, maintenance free system with minimum weight.

The reflector is an offset, prime focus, 9-sector carbon fiber reflector illuminated by a top-boom mounted corrugated horn. Hand-crank access is provided on each axis – Az and El to allow antenna positioning if there is a power failure or a controller malfunction.

The antenna system is packaged in eleven cases. These include:

Case 1 - Foot Pads (4) and Corner Jacks (4)
Case 2 - Horizontal Tubes (4), Feed Boom (1), Dampeners (2), and Reflector Braces (2)
Case 3 - Diagonal Tube Structures (4)
Case 4 - Azimuth Positioner (1)
Case 5 - Actuator Assembly (1) and Motors (2)
Case 6 - Elevation Frame (1)
Case 7 - Reflector Hub Panel (1), Reflector Panels (3/4), Reflector Panels (5/6)
Case 8 - Reflector Top Panel (1), Reflector Panel (2), Reflector Panels (7/8)
Case 9 - RCI Controller (1), Amplifier (1), and Feed (1)
Case 10 - Feed Struts (2), Lightening Protection (1), and Ground Anchoring Kit (1)
Case 11 - Assorted Cables

With the added weight of the cases, the system weights less than 1500lbs. The AL power distribution is housed in a case to be supplied by the customer unless otherwise specified.

## 1.3 RF System

The offset reflector/feed system produces co-polarization patterns that easily meet the 29-25 Log $\theta$ requirement. The 0.8 f/d optics reduce off-axis cross-pol in the azimuth plane.

## 1.4 AvL Cable Drive System

The AvL cable drive system utilizes highly reliable aircraft control cables in a redundant configuration to achieve a lightweight, very stiff drive system with zero backlash. This high-tech performance is achieved using low-tech components - by simply wrapping the cable around the drive capstan several times before wrapping the larger drive drum. This method results in a minimum free-length of cable. The load cable on the main drum is exponentially reduced as it is wrapped around the drum. Therefore, the total elongation of the cable under load is minimized. The AvL cable drive system has up to 10 times less backlash than that of comparable gear systems. The cables are pre-tensioned and spring-loaded at the main drum attachment point, which eliminates backlash at installation and any unexpected cable stretch in the future. The elevation axis features a 3-ton machine screw jack with a factory set anti-backlash feature. The jack has stop collars at each end of travel. Limit switches are adjusted to prevent contact with the stop collars.

## 1.5 Secondary Drive Systems

The Az AvL cable drive is driven by a low backlash worm gear set with a 40:1 ratio. The low backlash of the worm gear drive is reduced further by the axis drive ratios. This results in a backlash equivalent of only .1° in azimuth as seen by the reflector system. The gear set is encased in a sealed housing that allows them to be continuously lubricated in synthetic oil, which maximizes gear efficiency and minimizes wear.

Elevation is driven by a lead screw set with a 6:1 ratio. The gear set is also encased in a sealed housing that allows them to be continuously lubricated in synthetic oil, which maximizes gear efficiency and minimizes wear.

## 1.6 Motor Drives

Lightweight, reliable, DC motors with integral gearbox are used for the Az, El and pol drives. These motors were selected because they provide the best torque-to-weight ratio as well as allowing dual speed operation for slewing and peaking. These motors produce constant torque over the speed range with no cogging at low speeds which ensures smooth operation when peaking the antenna. The 75V DC design provides current limiting torque control and will allow vehicle battery operation if necessary. The Az and El motors are rated at 75V and the Pol is 24V rated.

## 1.7 Controller

The antenna control unit (ACU) is an RC4000, manufactured by Research Concepts, Inc. The RC4000 ACU is integrated into the leg assembly. The RC4000 ACU is used to establish and maintain pointing at the user's satellite of interest. This unit provides automatic azimuth and elevation pointing solution calculation, automatic polarization control, and automatic repositioning to user-stored satellite positions. The ACU provides continuous monitoring of antenna drive status and interfaces via ICP/TCP connection and standard COTS web browser application.

The RC4000 performs its functions via digital and analog electronic equipment interfaced to the antenna's motor drive and position feedback systems. The positioner is controlled through embedded software algorithms run by the RC4000's microcontroller.

The RC4000 allows easy antenna operation via a menu-based user interface. Menus provided to the user are based on the current controller mode. Two modes are provided to the user: operational and programming. The operational mode provides for normal operation of the antenna. The programming mode provides access for initial configuration of the controller and is not typically used on a day-to-day basis. A separate manufacturer's technical manual is provided for this unit.

## 1.8 Construction

Except for the drive components and bearings, all metal components are aluminum or stainless steel.

# AvL TECHNOLOGIES
## MODEL 2460 High Wind Flyaway
### 2.4M Quad-Band Portable Auto-Acquisition Antenna

| | |
|---|---|
| Reflector | 2.4 Meter, 9 piece Carbon Fiber |
| Optics | Offset, Prime Focus, 0.8 f/D |
| Interchangeable Feeds | C-LP, C-CP, X-CP, Ku-LP, DBS, Ka-CP, Ka-LP 2-Port Feeds |
| Positioner Type | Case-based Quad-Pod |
| Drive System | AvL Cable Drive Azimuth Positioner with Elevation Machine screw |
| Mount Geometry | Elevation over Azimuth |
| Polarization | Rotation of Feed |

Mechanical

| | |
|---|---|
| Travel | |
| Azimuth | ± 90° |
| Elevation | 0° to 90° of reflector boresight from calibrated inclinometer |
| Polarization | ± 95° |
| Speed | |
| Slewing/Deploying | 1°/second Az, 0.3°/second El |
| Peaking | 0.2°/second |
| Motors | 75V DC variable speed, constant torque |
| Emergency Axes Drives | Handcranks on Az and El; Knob on Pol |
| Stowed/Transit Configuration | Weather-resistant cases |
| Positioner/Base Structure | 6 cases, less than 40x" x 40" x 70", 174 lbs. or less each |
| Feed Boom and one feed | 71" x 18" x 19", 110 lbs. (includes Ku or Ka feed) |
| Reflector (2) | 38" x 38" x 22", 120 lbs. |
| Additional Feeds | 43" x 28" x 21", 70 lbs. typical, dependent on feed options selected |
| Set-up Time | Less than 30 minutes |
| RF Interface | |
| BUC Mounting | Feed boom or behind reflector (additional case required) |
| Coax | Two connectors at positioner base |
| Electrical Interface | Connector at positioner base |

Environmental

| | |
|---|---|
| Wind | |
| Operational | |
| Without anchoring | 35 mph gusting to 45 mph |
| With anchoring | 60 mph gusting to 80 mph |
| Survival (anchored) | 100 mph in 90° elevation position |
| Pointing Loss in Wind, Operational winds | |
| Ku-band Receive | 0.5 dB typical, 1.0 dB max |
| Ka-band Receive | 1.2 dB typical, 2.0 dB max |
| Temperature | |
| Operational | -22° to 125° F (-30° to 52° C) |
| Survival | -40° to 140° F (-40° to 60° C) |

Options

- BUC/HPA mounting
- Waveguide interconnect options
- Feed boom options
- Controller options- see below
- Beacon receiver – inclined orbit tracking – resolvers/upgrade
- Ground Anchor Kit
- Grounding options (lightning conductor)

| C-Band | Receive | | Transmit | |
|---|---|---|---|---|
| Polarization | Standard (LP or CP) | INSAT (LP) | Standard (LP or CP) | INSAT (LP) |
| Frequency (GHz) (extended band available on request) | 3.625 - 4.20 | 4.50 - 4.80 | 5.85 - 6.425 | 6.725 - 7.025 |
| Gain (Midband) (dBi) | 38.0 | 39.2 | 41.8 | 42.6 |
| VSWR | 1.30:1 | | 1.30:1 | |
| Beamwidth (-3 dB) | 2.2˚ | 1.9˚ | 1.4˚ | 1.3˚ |
| Radiation Pattern Compliance (beyond mainbeam) | FCC 25.209, ITU-R S.580-6 IESS 207 | ITU-R S.580-6 | FCC 25.209, ITU-R S.580-6 IESS 207 | ITU-R S.580-6 |
| Ant Noise Temperature @ 20° El, midband | 49° K | 48° K | - | - |
| G/T with 20˚ LNB, midband, clear horizon | 19.5 dB/˚ K | | | |
| Axial Ratio (CP only, within pointing cone) | 2.3 dB | - | 1.3 dB | - |
| Cross Pol Isolation (on-axis/within pointing cone) | 35 dB / 30 dB | 35 dB / 30 dB | 35 dB / 30 dB | 35 dB / 30 dB |
| Feed Port Isolation – TX to RX (dB) | 65 | 35 | 105 (includes filter) | 70 |
| Power Handling Capability | | | 1000 watts per port | 1000 w per port |

| X-Band | Receive | Transmit |
|---|---|---|
| Polarization | RHCP or LHCP | LHCP or RHCP |
| Frequency Range (GHz) | 7.25 - 7.75 | 7.90 - 8.40 |
| Gain (Midband) (dBi) | 43.3 | 44.1 |
| VSWR | 1.30:1 | 1.30:1 |
| Beamwidth (-3 dB) | 1.2˚ | 1.1˚ |
| Radiation Pattern Compliance (beyond mainbeam) | MIL-STD-188-164A | MIL-STD-188-164A |
| Ant Noise Temperature @ 20° El, midband | 59° K | |
| G/T with 55˚ LNB, midband, clear horizon | 22.7 dB/˚ K | |
| Axial Ratio (CP only, within pointing cone) | 1.21 dB | 2 dB |
| Feed Port Isolation – TX to RX (dB) | 115 (includes optional filter) | 115 (includes optional filter) |
| Power Handling Capability | | 1000 watts per port |

| Ku-Band (DBS bands available on request) | Receive | Transmit |
|---|---|---|
| Polarization | Linear orthogonal standard, optional co-pol | |
| Frequency Range (GHz) | 10.95 - 12.75 | 13.75-14.50 |
| Gain (Midband) (dBi) | 47.0 | 48.8 |
| VSWR | 1.30:1 | 1.30:1 |
| Beamwidth (-3 dB) | 0.7˚ | 0.6˚ |
| Radiation Pattern Compliance | FCC 25.209, ITU-R S.580-6, IESS 208 | FCC 25.209, ITU-R S.580-6, IESS 208 |
| Ant Noise Temperature @ 20° El, midband | 61° K | |
| G/T with 50˚ LNB, midband, clear horizon | 26.5 dB/˚ K | |
| Cross Pol Isolation, on-axis | 35 dB | 35 dB |
| Cross Pol Isolation, within pointing cone | 28 dB standard, 25dB optional MM feed | 30 dB standard, 35 optional MM feed |
| Feed Port Isolation – TX to RX (dB) | 35 | 80 (includes filter) |
| Power Handling Capability | | 500 watts per port |

| Ka-Band | Receive | Transmit |
|---|---|---|
| Polarization | Circular or Linear | |
| Frequency Range (GHz) | 20.2 - 21.2 (military) or 17.7 - 20.2 (commercial) | 30.0 - 31.0 (military) or 27.5 - 30.0 (commercial) |
| Gain (Midband military) (dBi) | 52.1 | 55.0 |
| VSWR | 1.30:1 | 1.30:1 |
| Beamwidth (-3 dB ) | 0.4˚ | 0.3˚ |
| Radiation Pattern Compliance | FCC 25.209, MIL-STD-188-164A | FCC 25.209, MIL-STD-188-164A |
| Ant Noise Temperature @ 20° El, midband | 104° K | |
| G/T with 100˚ LNB, midband, clear horizon | 29.0 dB/˚ K | |
| Axial Ratio (CP only, within pointing cone) | 1.5 dB | 1.0 dB |
| Feed Port Isolation – TX to RX (dB) | 30 | 80 (includes filter) |
| Power Handling Capability | | 250 watts per port |

| | |
|---|---|
| Controller | Fully Automatic Satellite Acquisition, Peaking, and Cross-Pol Adjustment with GPS, Compass, Level Inputs and auto compensation with Entry of Desired Satellite. Embedded Outdoor Controller with either AC input or 1 RU DC Power supply options. Other options include Ethernet Remote interface, inclined orbit step tracking, TLE tracking, Differential GPS Compass, remote GUI, waveguide switch control. |
| Positioning Accuracy ±0.2˚ | ±0.2˚ |
| Input Power | 115 VAC, 1 phase, 50/60 Hz, 15 A Service required |

# 2 Chapter 2: Azimuth Positioning System

## 2.1 Azimuth Bearing

The azimuth includes a 4 point contact ball bearing platform with a dynamic and static moment capacity of over four times the worst-case wind-load specification. It is surrounded by double seals to protect the bearing, which is permanently lubricated. This rests on the azimuth drum and the azimuth cables wrap around the drum and capstan.

Because of the excess capacity, low rpm and low number of cycles compared to the bearing's B10 design life, no wear is expected. No maintenance should be required over the life of the positioner.

## 2.2 Azimuth Gearbox

The azimuth gearbox is a low backlash worm gear box. The worm gear drive isolates any backlash in the motor drive from the system. In addition, since it is a 40:1 ratio, it will not back drive, thus eliminating any need for a brake on the drive train.

The motor drives the input worm via a quill/female hole and square key. The worm shaft is extended providing a manual hand crank that can be used in the event of a loss of electrical power. The azimuth capstan is secured to the output shaft with a square key and zero backlash hub.

The gearbox contains synthetic lubricant filled half way to the level plugs. Because of the design capacity of the gearbox, low rpm and comparatively limited cycles experienced by a 2460 HW system, no wear or maintenance is expected.

## 2.3 Azimuth Motor

The azimuth drive motor is a servo quality 75V DC motor with integral 55:1 gear train.

The rated gearbox output speed is 51 rpm. The output shaft has a special adapter with a slot for a square key.

Since the low backlash worm gear drive isolates the backlash from the motor, any backlash between the shaft adapter, square key, or motor gear train will never be seen by the antenna beam. Any backlash at any of these points is of no consequence to the system performance.

No maintenance or wear of the motor is expected.

## 2.4 Azimuth AvL Cable Drive

The azimuth AvL cable drive produces a drive system with zero backlash, high stiffness, no wear, no lubrication, and maximum reliability. The system consists of four stainless steel aircraft control cables, reverse-wrapped three times around the capstan with solid connections on one end and Belleville springs on the other end to maintain the initial pre-load force that is imparted to the cables. One cable has the approximate capacity to withstand the rated load. The additional cables are used to provide increased stiffness and drive redundancy. If a cable

becomes damaged during usage, merely cut off the cable and continue to use the positioner. You can replace the cable at your maintenance facility whenever time permits.

The cables are sized to last the life of the positioner. No replacement from wear is expected. The spring package at one end will automatically compensate for any elongation of the cable.

At installation, the Belleville springs are collapsed until no light is seen between the springs. This condition should be checked yearly since there may be slow settling of the cable strands. Use pliers to hold the stud and 3/8" box-end wrench to tighten the nut. Be sure not to over tighten.

## 2.5 Azimuth Position Feedback

The azimuth position feedback is produced by an on axis resolver. Since the AvL cable drive has no backlash, the position feedback is as accurate as the resolution and accuracy of the resolver.

The azimuth stow clockwise and counter clockwise switches are mounted in the Az databox along with the Az resolver.

The azimuth drive has the mechanical capability of ±90° from the stow position.

# 3 Chapter 3: Elevation Positioning System

## 3.1 Elevation Pivot Assembly

The elevation pivot assembly consists of an elevation frame surrounding a linear actuator. No wear or maintenance is expected.

## 3.2 Elevation Drive

The elevation drive is a low backlash 3-ton machine screw jack assembly. The drive is assembled with .001" minimum backlash.

Because of the design capacity of the drive, low rpm and comparatively limited cycles experienced by a 2460 HW system, no wear or maintenance is expected.

## 3.3 Elevation Motor

The elevation drive motor is a servo quality 75V DC motor with integral 55:1 gear train.

The rated gearbox output speed is 51 rpm. The output shaft has a special adapter with a slot for a square key.

Since the low backlash worm gear drive isolates the backlash from the motor, any backlash between the shaft adapter, square key, or motor gear train will never be seen by the antenna beam. Any backlash at any of these points is of no consequence to the system performance.

No maintenance or wear of the motor is expected.

## 3.4 Elevation Position Feedback

The elevation position feedback is produced by an electronic inclinometer and an on axis resolver. Since the AvL cable drive has no backlash, the position feedback is as accurate as the resolution and accuracy of the inclinometer and resolver. The inclinometer has a resolution of 0.1° with the accuracy/linearity of 1% of the ±0° - 45° range and monotonic in the ±45° - 90° range. The inclinometer is rated for an outdoor environment. The resolver also provides precise feedback on elevation position during operation. The up and down limit switches are mounted in the El databox along with the El resolver.

The inclinometer is mounted on the feed boom and is encased in a plastic housing to protect it from mechanical damage and to provide additional weather protection.

# 4 Chapter 4: Feed Polarization

## 4.1 General

The positioner allows the antenna to be pointed at the satellite of interest. Once the axis of the antenna is pointed towards the satellite, it is necessary to align the feed such that it is aligned with the polarization drive consisting of non-back driving worm gear set, 24 V DC motor, and potentiometer for position feedback. The overall view of the feed system with the C-band feed horn is shown in Figure 1.

**Figure 1. 2460 HW Feed System with Circular Polarization**

## 4.2 Feed

The 2460 HW is normally equipped with a boom that will accommodate interchangeable feeds for a C-band, X-band, Ku-band, DBS-band, and KA-band. This feed is supported by the feed boom such that it is located precisely at the focal point of the parabolic reflector. The feed shown in Figure 2 is a C-band receive only feed and has its major components identified.

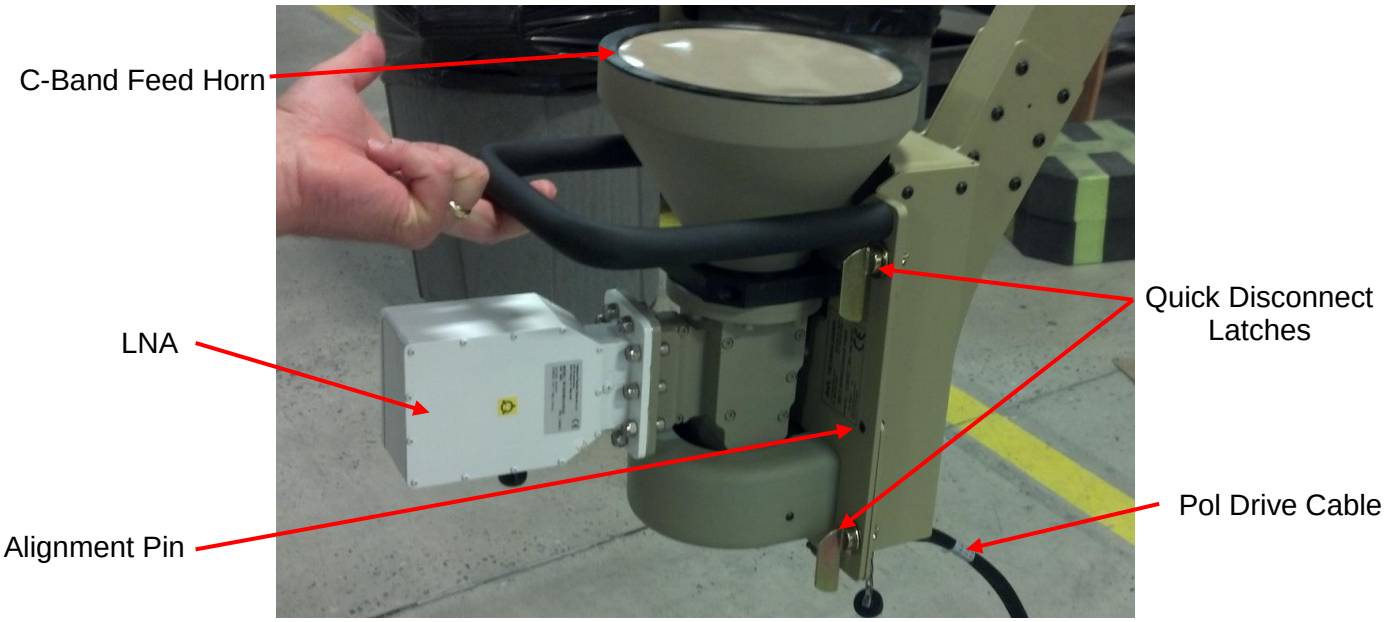



**Figure 2. Feed Assembly with Components Described**

# 5 Chapter 5: 2460HW General Deployment & Assembly Instructions

## 5.1 General

The Model 2460 HW 9-piece reflector antenna system is shown in Figures 3 and 4 in its stored and deployed state respectively. The antenna system packs into eleven individual cases for transportation. Each case has been designed for a two-person lift with a maximum weight of 174lbs per case. The Model 2460 HW is controlled via an RC4000 ACU, which is included in the cases. Each antenna system has been fully tested with the RCI controller prior to shipment. All position feedback, limit sensing, limit switches, and motor speeds have also been calibrated or set prior to delivery. The positioner needs only to be deployed, the antenna installed, and the coax and control cables connected to the controller.


**Figure 3. Individual Unit Cases**

**Figure 4. 2460 HW in Deployed State**

The eleven individual cases for antenna system are designed to fit on two 3.5' x 3.5' x 6.0' (42" x 42" x 72") transport pallets. Figure 5 on page 16 illustrates the correct orientation of the unit's cases during transit. This diagram can also be found labeled on each case's lid section. These cases are hard-sided, lightweight, and protect antenna components from shock, vibration, and environmental conditions during both transportation and storage. All cases have stacking features to assist in arranging the cases for transportation.

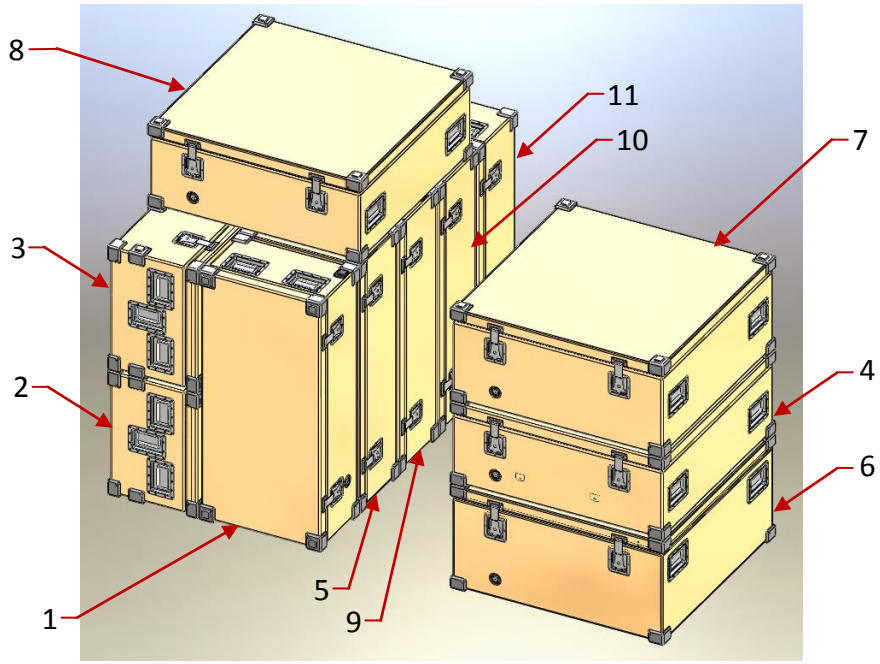


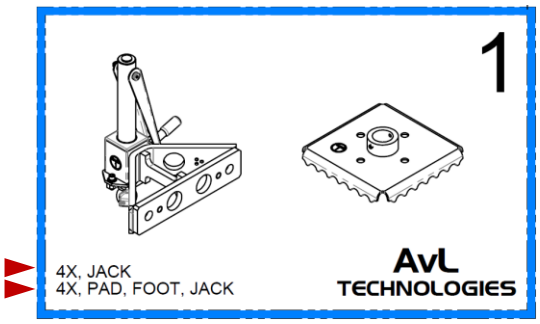

**Figure 5. Case Organization for Pallets**

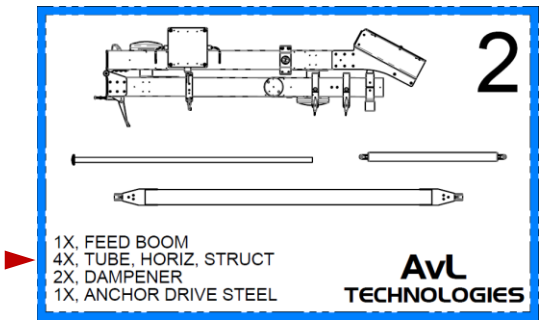
## 5.2 Quad-Pod Assembly Instructions

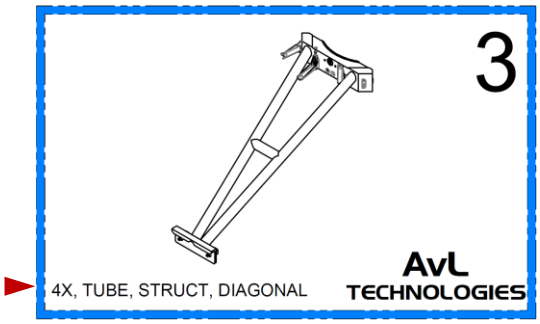
Each of the antenna system's eleven cases contains various components required for proper assembly of the unit. Note that the content of each case has been labeled on the sides and lid of each individual case. These labels will be referenced for ease of assembly throughout this documentation.

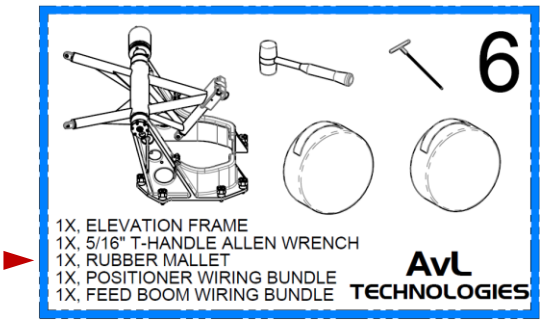
The following steps are to be used to install the 2460 HW antenna system:

1. To begin, assemble the base quad-pod structure using the components listed below from their respective cases.



**Note: The antenna system should be positioned so the front faces the Equator. Attempt to locate a relatively flat area on solid ground.**

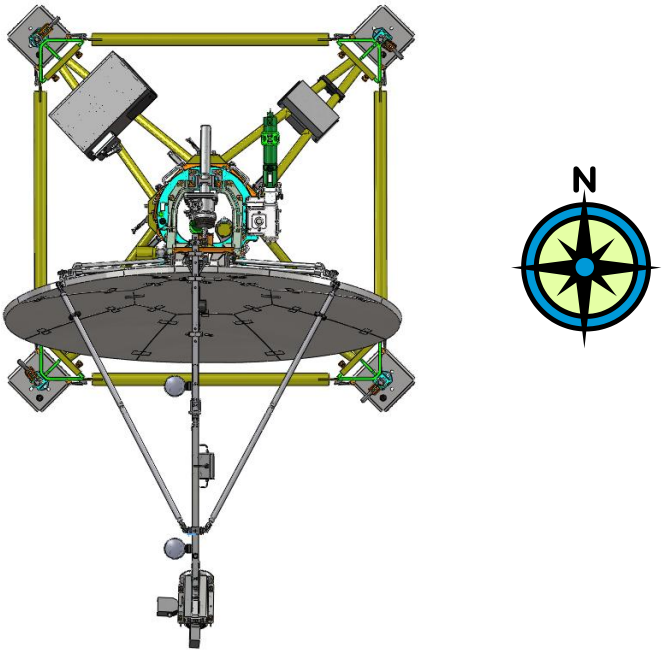



**Figure 6. Direction of Unit Deployment for Northern Hemisphere**

2. Place the four foot pads (Case 1) approximately 7 feet (84 inches) from one another forming a square.
3. Set a corner jack (Case 1) onto each foot pad.
4. Locate the horizontal tubes (Case 2).
5. Assemble corner jacks and horizontal tubes per Figure 7.
6. Use the latches to attach the corner jacks to one another as shown in Figure 7.
7. Level base assembly using the provided torpedo level.

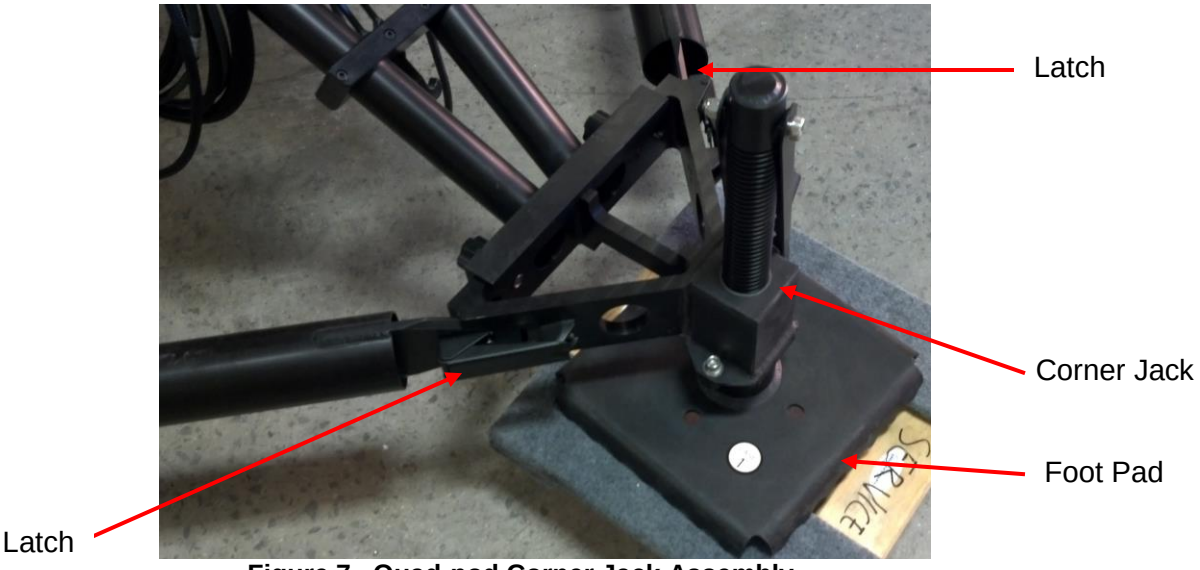



**Figure 7. Quad-pod Corner Jack Assembly**

8. Drive duckbill anchors (Case 10) centered on the each leg, 2 feet from the corner assembly. Duckbill anchors are to be driven using drive steel (Case 2) and the sledge hammer. See Appendix E: Interface Drawing for precise location of anchors.
9. Attach the diagonal tube structures (Case 3) to each corner jack using hand-knobs located on the diagonal tube structures as shown in Figure 8. A rubber mallet (Case 6) can be used to fit sections together should there be resistance.

**Note: Two of the diagonal tube structures have brackets for the connection of electrical equipment. Ensure these sections are connected to the rear of the unit.**

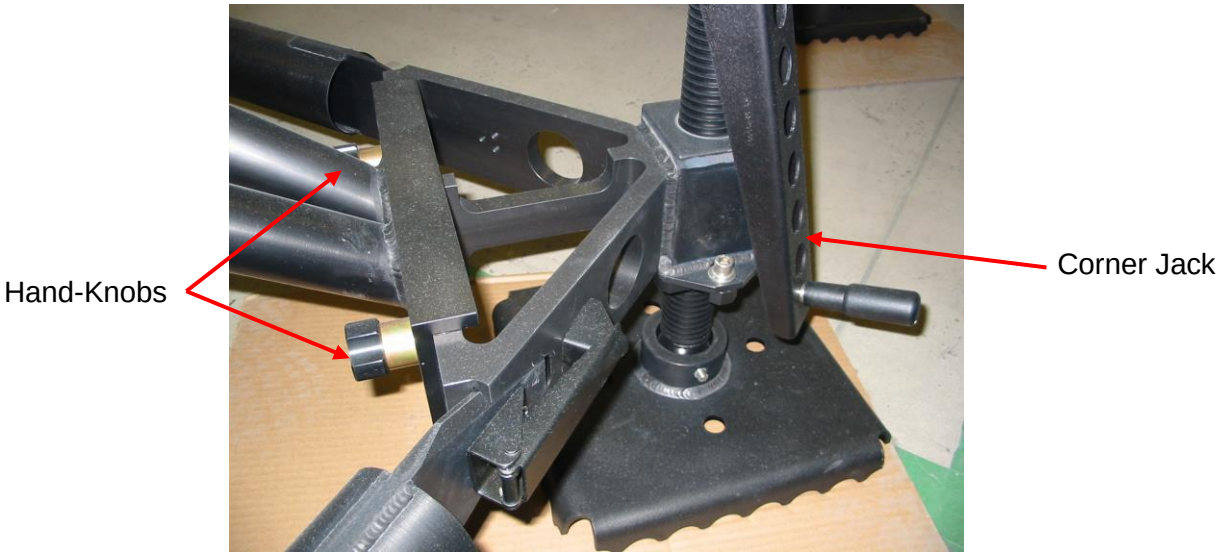



**Figure 8. Diagonal Structure Attachment to Corner Jack**

**Note: The top of the diagonal tube structures have a pin and a grove that must be aligned.**

10. Connect the four diagonal tube structures via the four horizontal latches as shown in Figure 9.

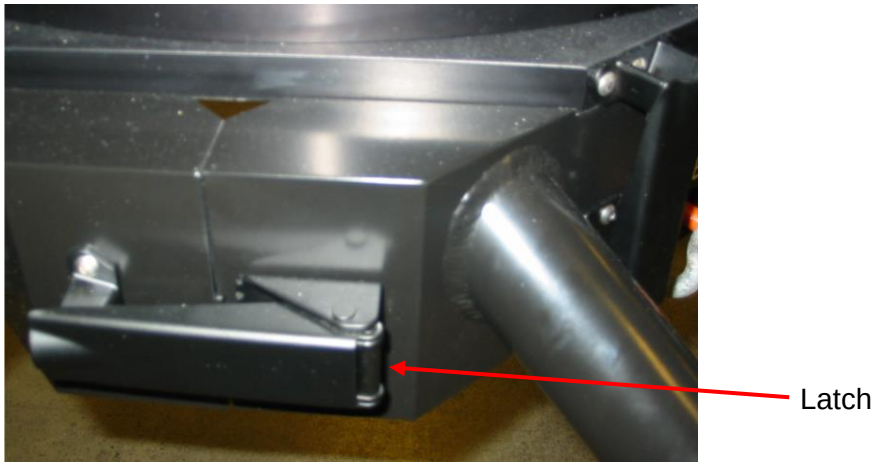
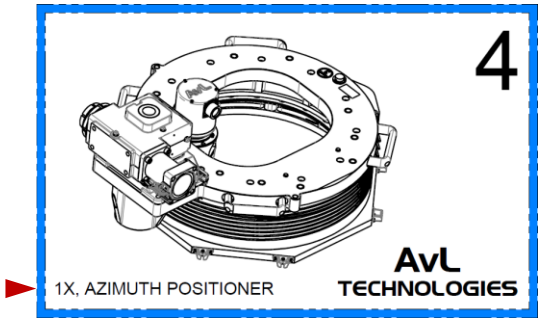



**Figure 9. Diagonal Tube Structure Latch Connection**




11. Install azimuth positioner (Case 4) on the quad-pod assembly so that the azimuth gear box is located on the left side of the antenna while looking towards the equator.
12. Secure the eight vertical latches to the azimuth positioner assembly as shown in Figure 10.


**Figure 10. Attaching the Azimuth Positioner**

**Note: Verify the Quad-pod is level using the bubble level located on the azimuth positioner. Adjust Corner Jacks as needed.**

13. Attach anchors to turnbuckles found in the ground anchor kit. Tighten turnbuckles as needed to secure unit.

**Note: Check using bubble level to ensure unit is still level after installing the Anchors as shown in Figure 11 on page 20.**

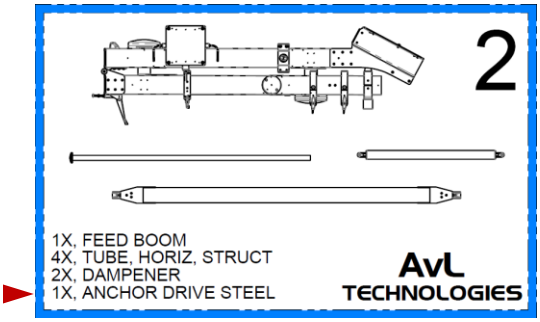

**Figure 11. Bubble Level Location on Azimuth Positioner**

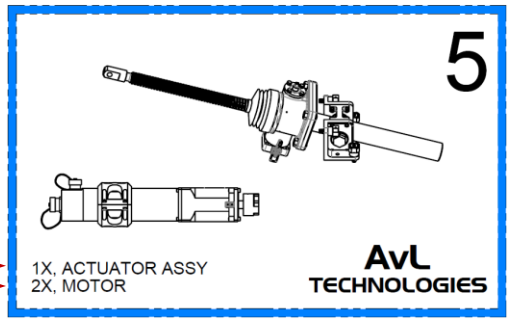
14. Completed quad-pod assembly should appear as in Figure 12 below.

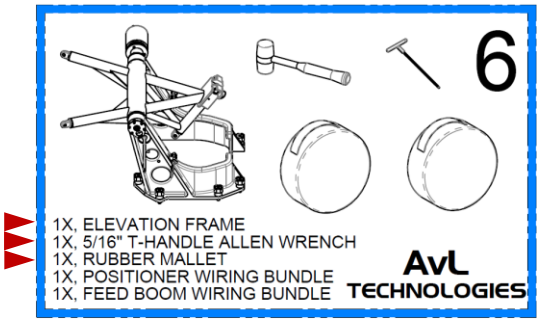

**Figure 12. Completed Quad-Pod Assembly**

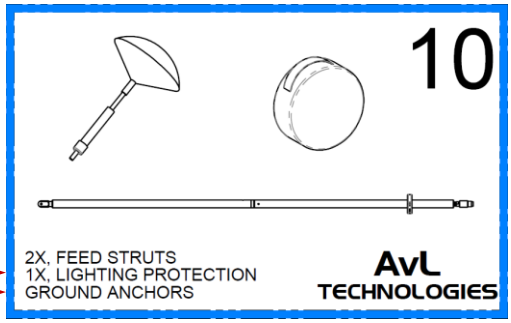
## 5.3 Positioner Assembly Instructions

1. The following components are required for assembling the positioner section of the antenna system.




2. Place elevation frame onto the azimuth positioner (Case 6) in direction as shown in Figure 13a on page 22. Secure the elevation frame using the eight hand-knobs. Arrows on both the elevation frame and the azimuth positioner should match showing proper alignment as shown in Figure 13b on page 22.

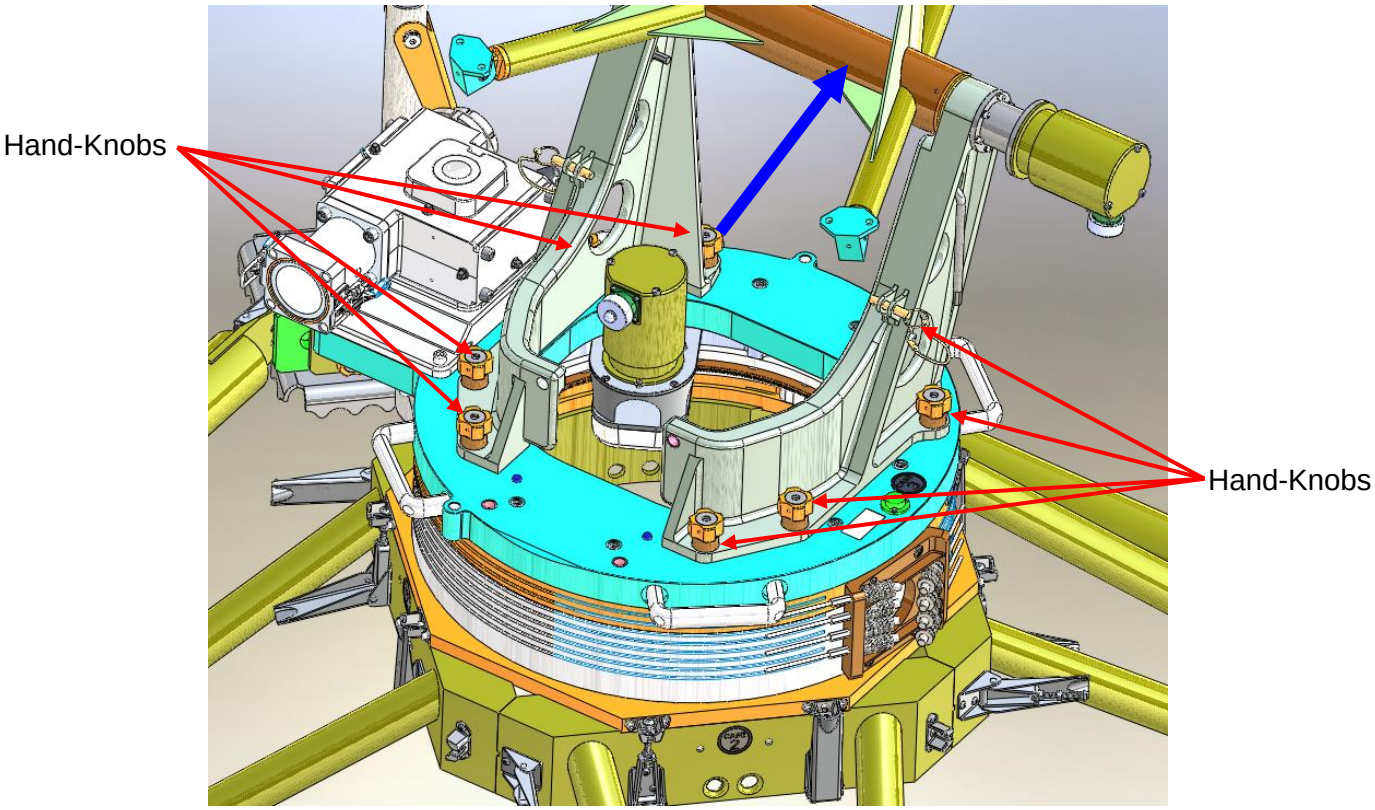



**Figure 13a. Attachment of Elevation Frame**

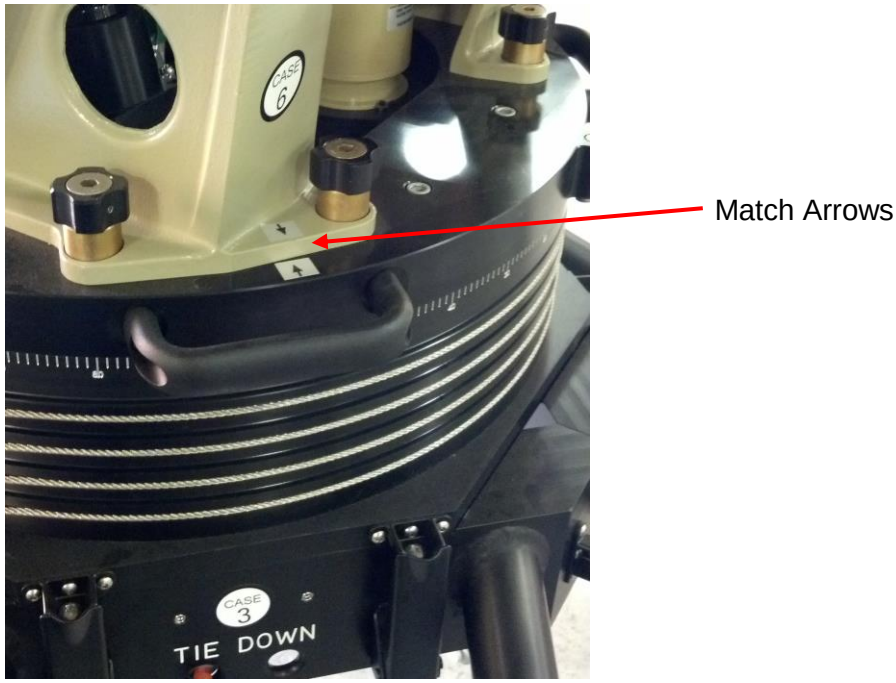



**Figure 13b. Attachment of Elevation Frame Arrows**

3. Place the elevation actuator (Case 5) onto the assembly (align pins) as shown in Figure 14 using the compression pin and the hand-knobs.

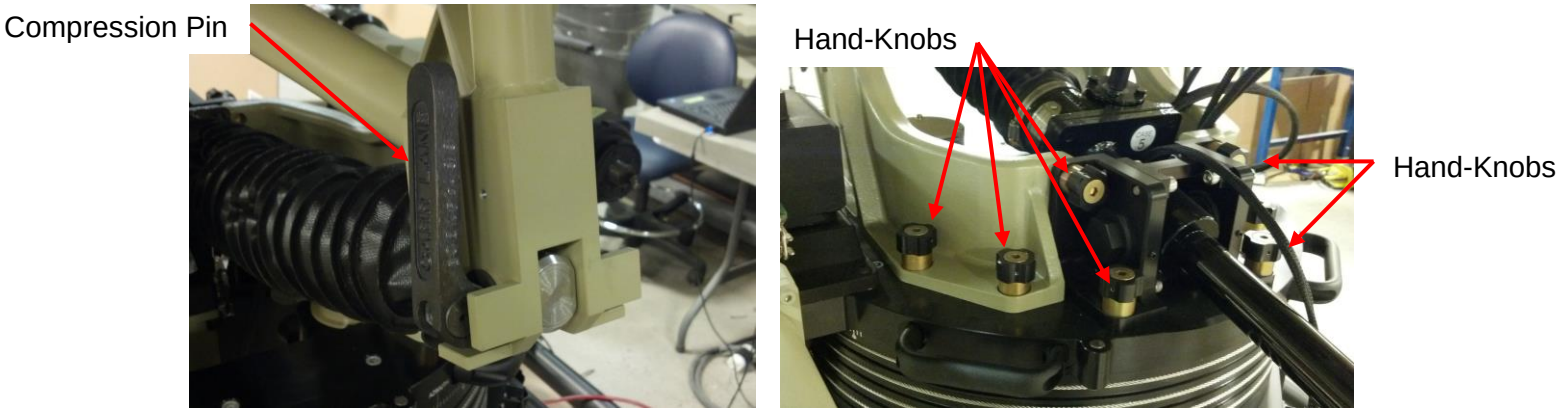



**Figure 14. Attaching the Elevation Actuator Assembly**

**Note: Allen wrenches are stored in the side of the elevation frame using rubber grommets as seen in Figure 15 and in Case 6 (Figure 16) on page 24.**

4. Tighten the hand-knobs on the elevation frame, elevation actuator assembly, and corner jacks using 5/16” Allen wrenches.

**Note: Return Allen wrench to storage locations.**

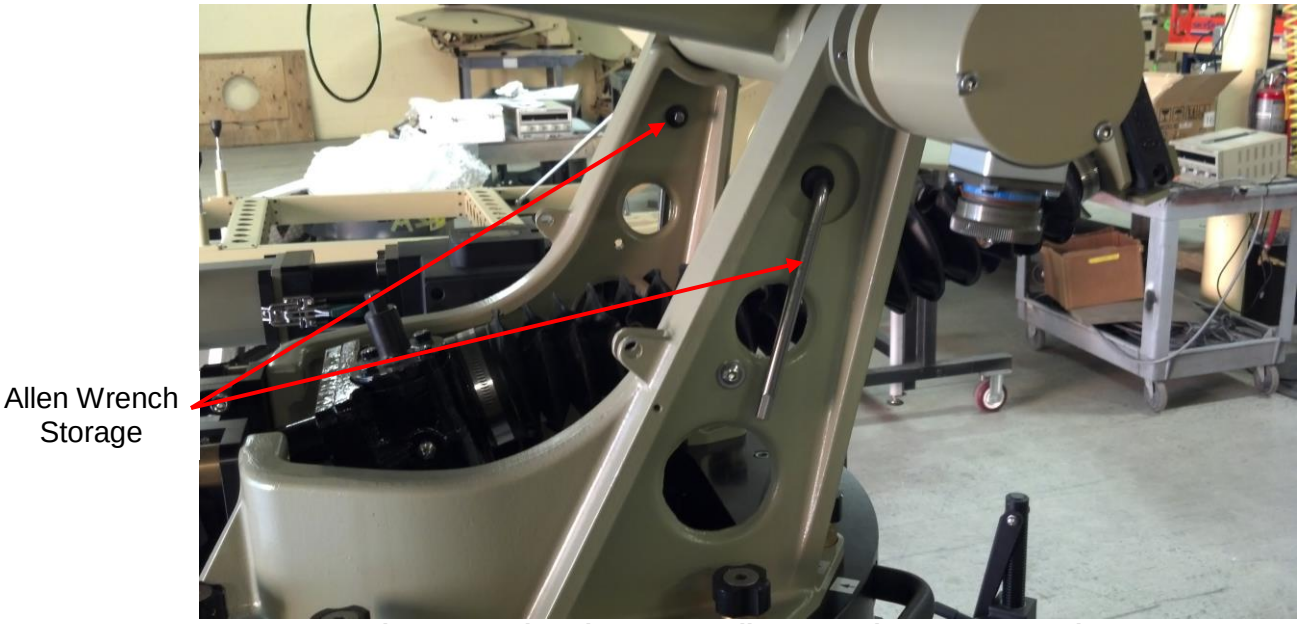



**Figure 15. Elevation Frame Allen Wrench Storage Locations**

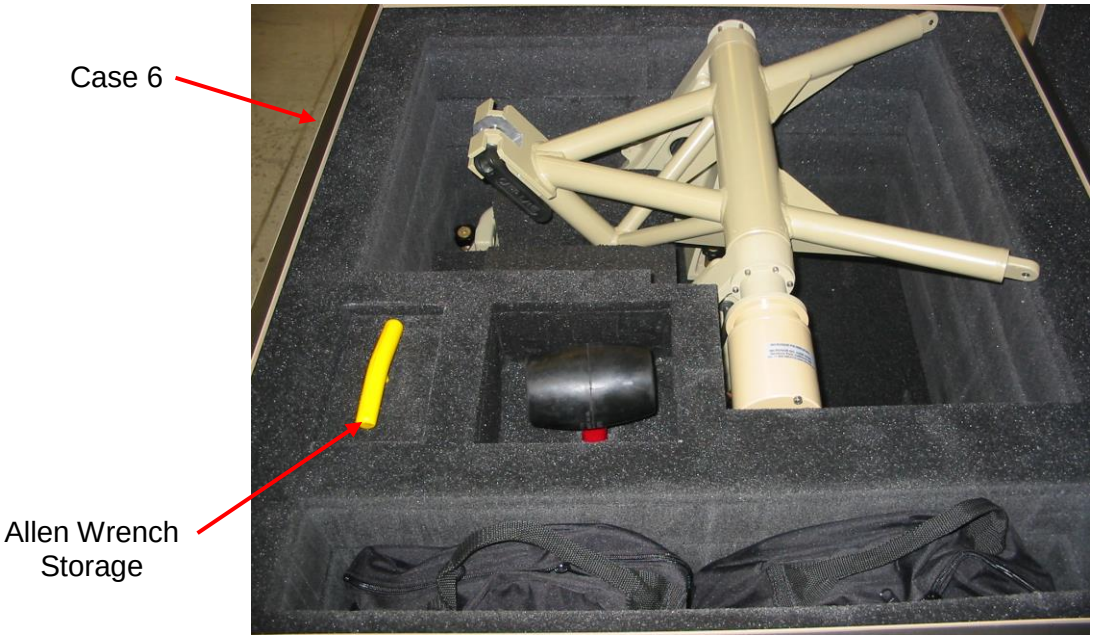



**Figure 16. Case 6 Allen Wrench Location**

5. Locate azimuth and elevation motors (Case 5).

**Note: Plastic couplers MUST be installed between motor and gearbox. Ensure the motor and gearbox connection is flush.**

6. Attach each motor to their respective gearboxes using the two draw latches as shown in Figure 17 (shown below) and Figure 18 (on page 25).

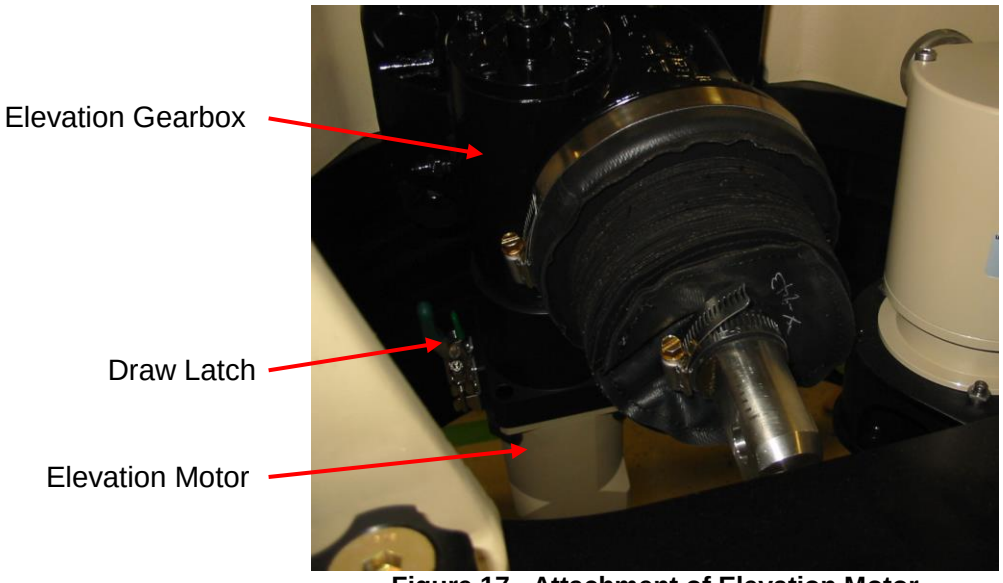



**Figure 17. Attachment of Elevation Motor**

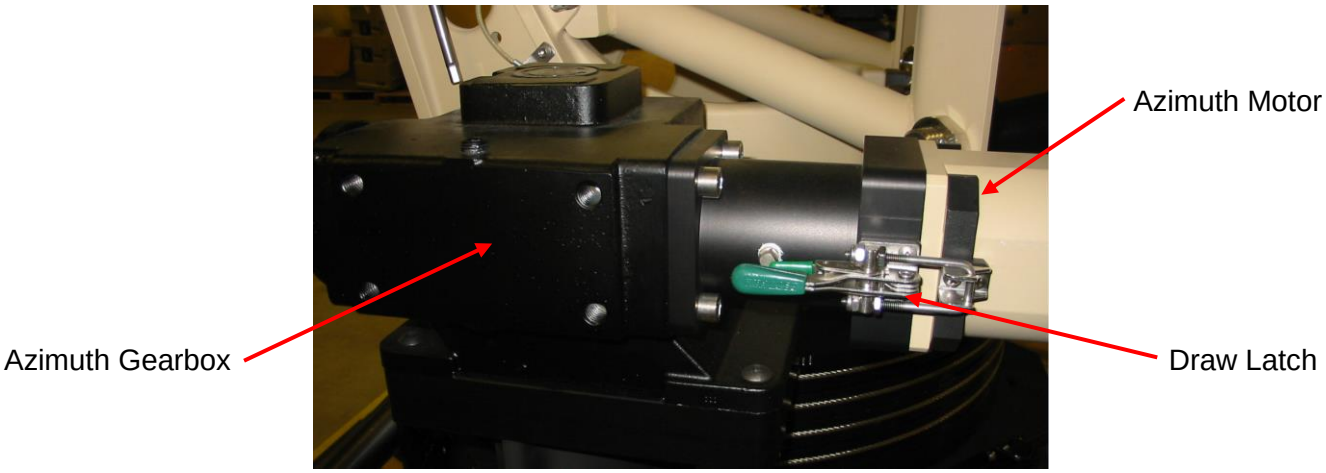



**Figure 18. Attachment of Azimuth Motor**

7. Connect ground rods together (Case 10). Drive ground rods within 5 feet of the quad-pod assembly near the corner unit at the rear of the antenna.

**Note: The three individual ground rods thread together to form a singular rod. For proper earth grounding, the grounding rod should be driven at least 12" into the neighboring soil.**

8. Completed positioner assembly should appear as in Figure 19.

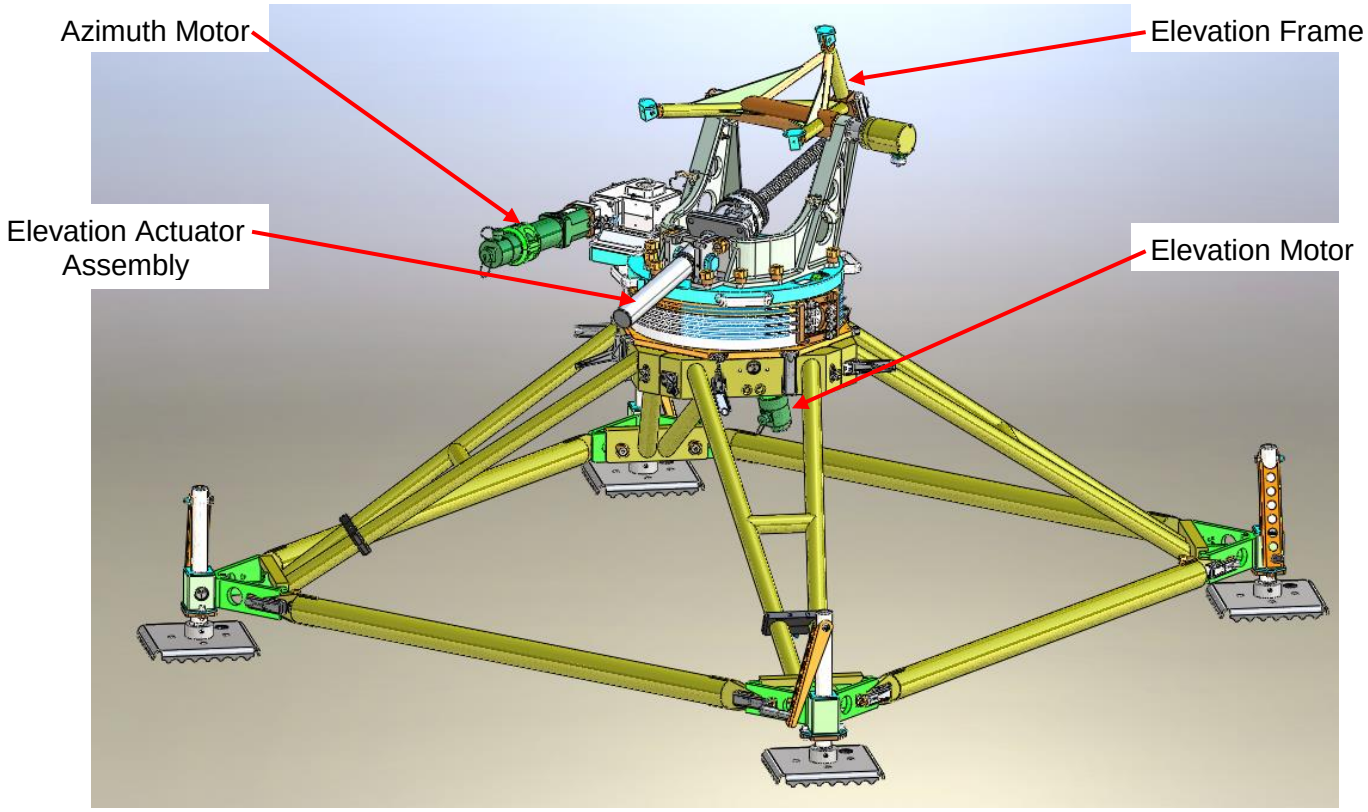
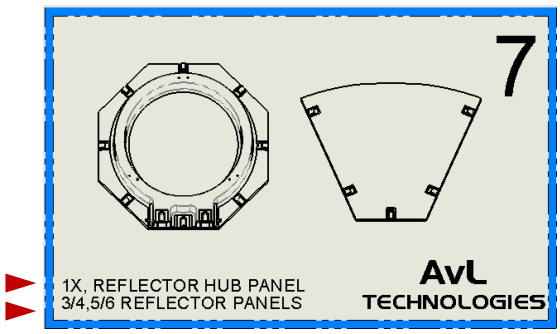
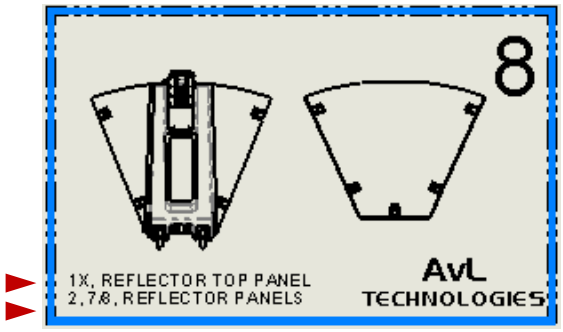


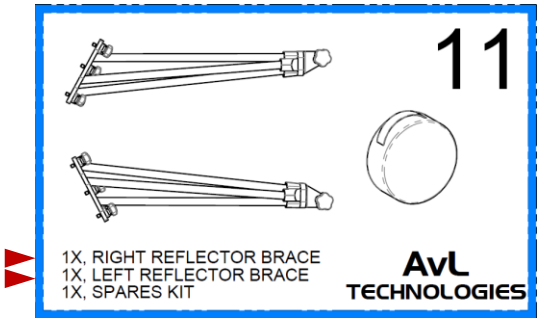

**Figure 19. Assembly of Quad-Pod and Positioner**

## 5.4 Reflector Assembly Instructions

1. The following components are required for assembling the reflector section of the antenna system.




2. Locate the reflector's center hub panel (Case 7).
3. Connect the hub to the the elevation frame assembly using the three connection points on the underside of the hub panel with the captive ball detent pins as shown in Figure 20 on page 27.

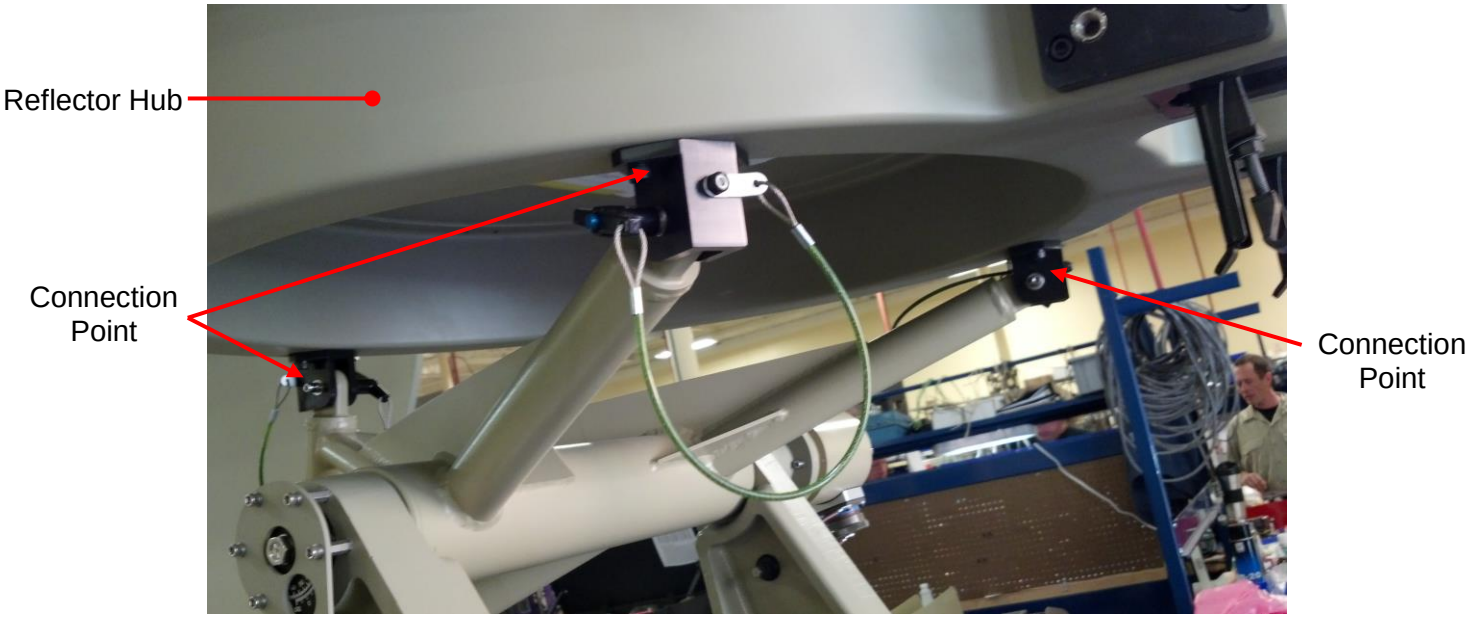



**Figure 20. Attachment of Reflector Center Hub Panel**

4. Locate panel 1 (Case 8) and attach to the center hub.

**Note: Pins on center hub will ensure panel 1 is aligned properly.**

5. Close the three draw latches to firmly secure the panel in place as shown in Figures 21a, 21b, & 21c on page 28.

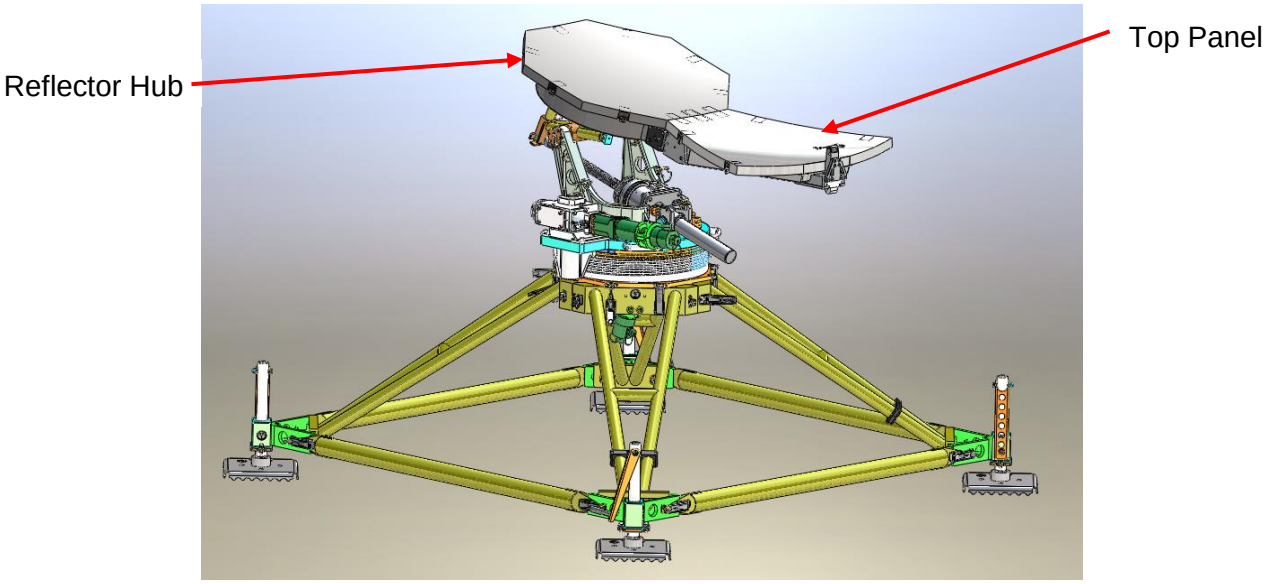



**Figure 21a. Attachment of Reflector Panel 1 Diagram**

**Figure 21b & 21c. Attachment of Reflector Panel 1**

**Note: Panels 2 & 8 have hardware for mounting the feed struts and reflector supports. Panels 2 through 8 self-align with the installed panels and are secured with three draw latches each.**

5. Attach panel 2 and 8 (Case 8) to both the reflector's center hub and top panel (1) using all three latches as shown in Figures 22a, 22b, & 22c on page 29.

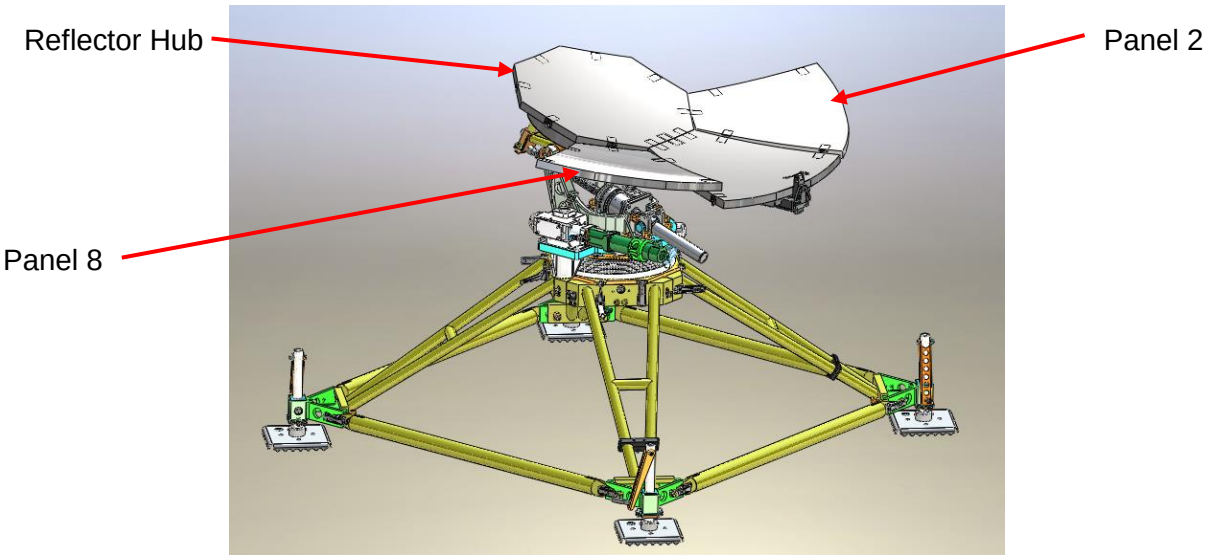



**Figure 22a. Attachment of Reflector Panels 2 and 8 Diagram**

**Figure 22b & 22c. Attachment of Reflector Panels 2 and 8**

6. Attach panels 3 (Case 7) and 7 (Case 8) to reflector assembly using only the center hub draw latch as shown in Figures 23a, 23b, & 23c.

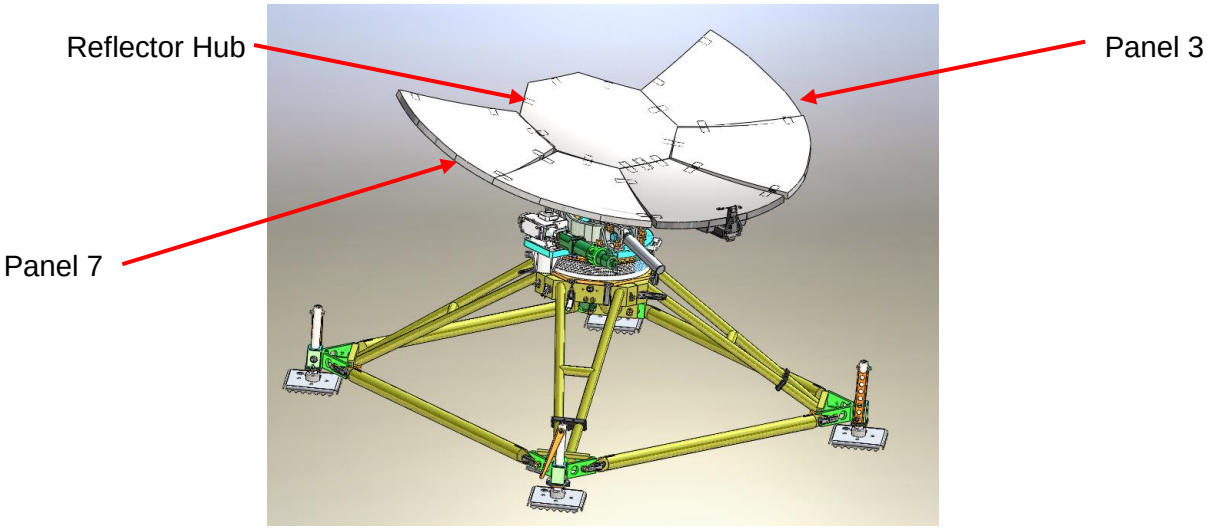



**Figure 23a. Attachment of Reflector Panels 3 and 7 Diagram**

**Figure 23b & 23c. Attachment of Reflector Panels 3 and 7**

7. Install panel 4 to the reflector in the same manner as panels 3 and 7.

**Note: Panels 5 and 6 must be installed together. Only the top latch should be used for this connection to allow the panels to self-locate within the overall reflector assembly.**

8. Connect panels 5 and 6 (Case 7) as shown in Figures 24a, 24b, & 24c.

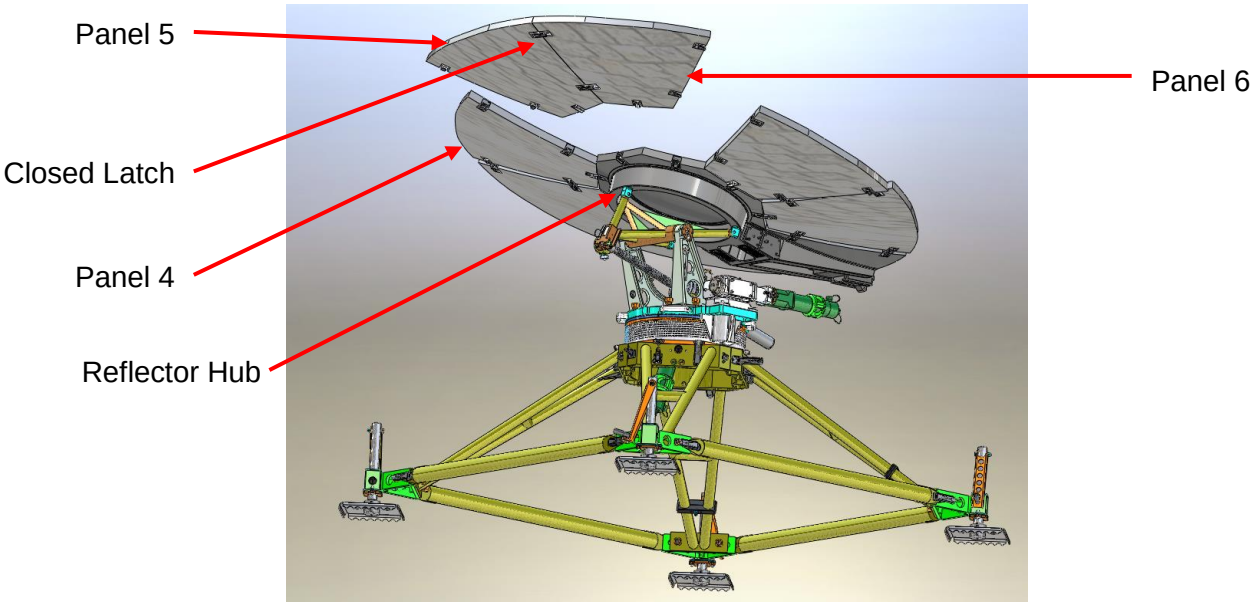



**Figure 24a. Attachment of Panels 4, 5, and 6 Diagram**

**Figure 24b & 24c. Attachment of Panels 4, 5, and 6**

9. Ensure all remaining reflector latches are closed.

10. Locate both the left and right reflector braces (Case 11).

**Note: Keying features are used to initially locate to these plates while hand-knobs are then tightened to secure the reflector braces to the assembly as seen in Figure 25 on first generation design. Second generation reflector braces employ a third hand knob in place of keying features. Each design will function suitably.**

11. Attach each brace to its corresponding pair of mounting plates located on the center hub and the reflector panels shown in Figures 25a, 25b and 26. Figure 25b is the updated design with no shoulder bolts and three knobs.
12. Check and tighten all hand-knobs.

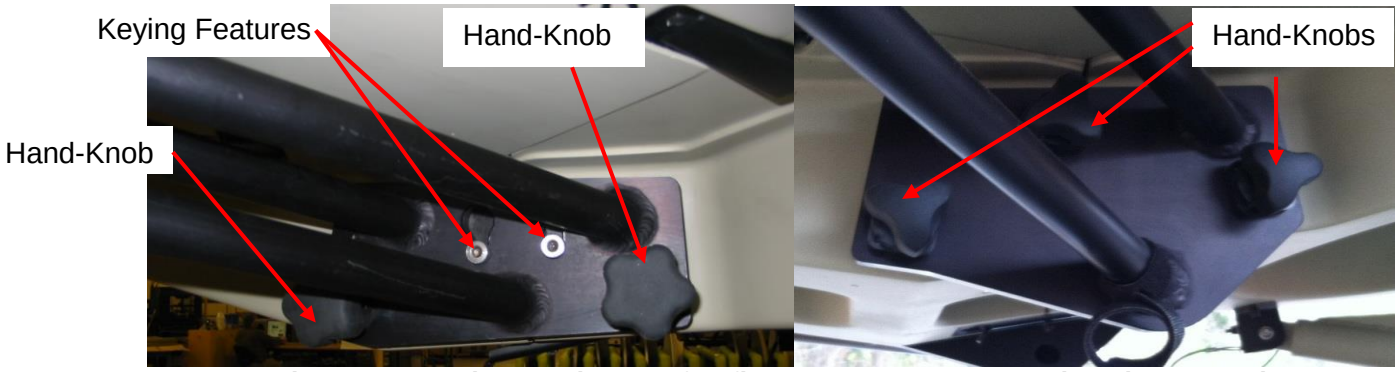



**Figure 25a & 25b. Attachment of Reflector Brace to Center Hub and Top Panel**


**Figure 26. Attachment of Reflector Brace to Panel 2**

13. The reflector is complete and should resemble Figures 27a and 27b.

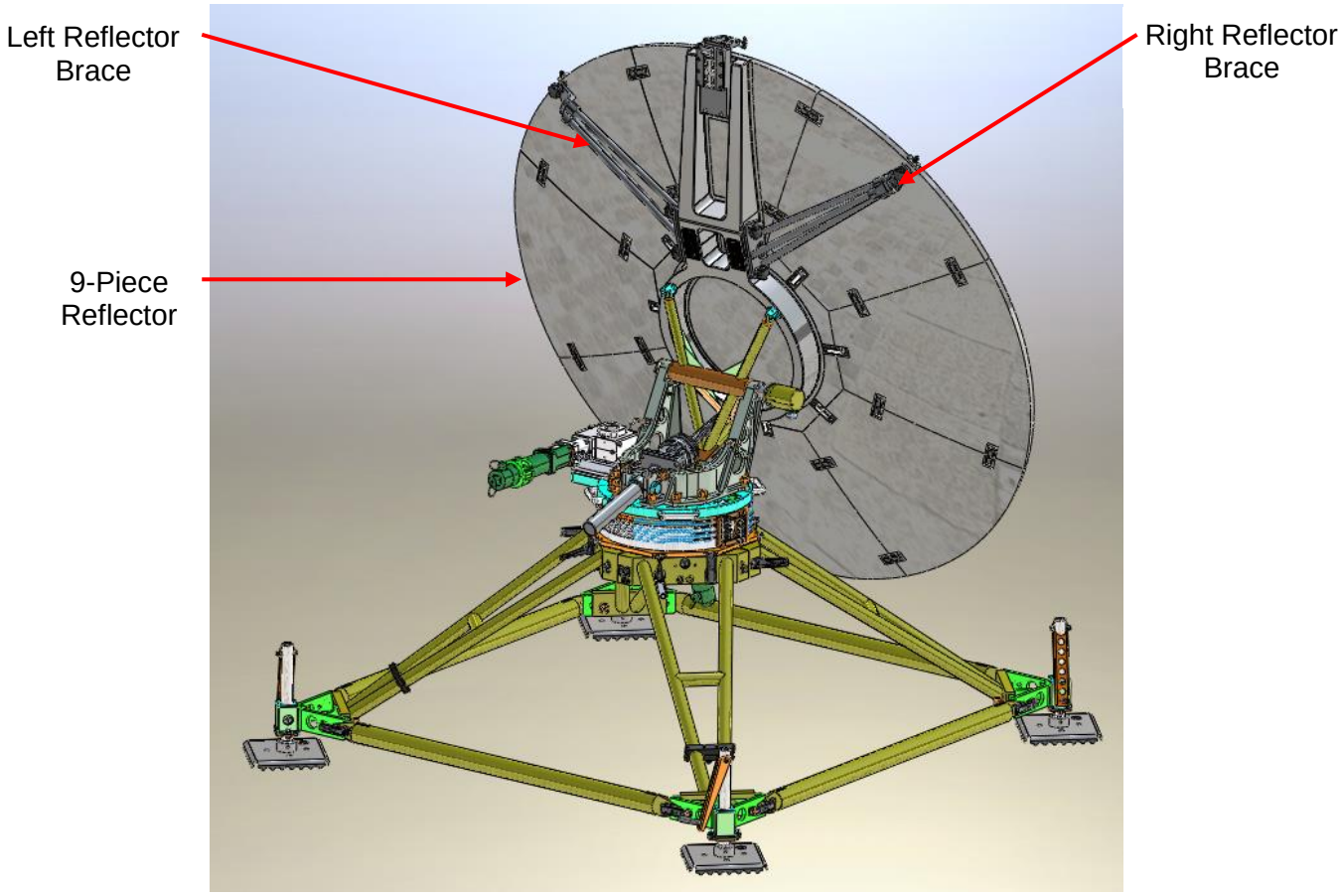
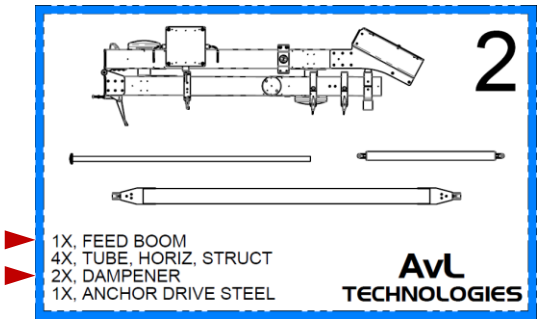


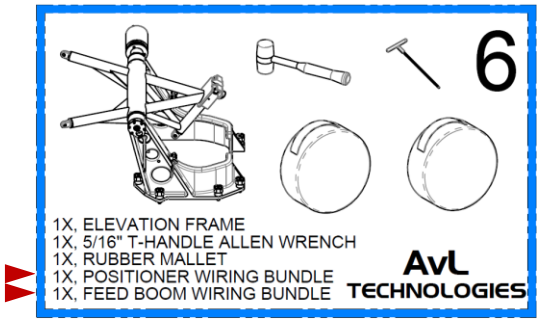

**Figure 27a. Assembly of Quad-Pod, Positioner, and Reflector Diagram**

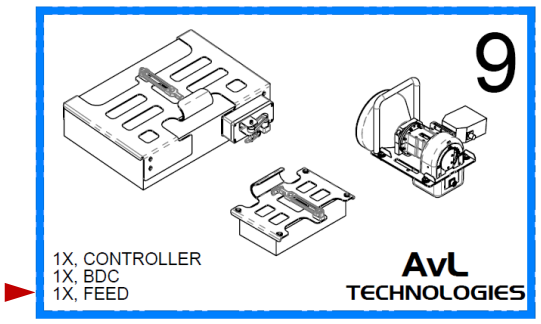
**Figure 27b. Assembly of Positioner and Reflector**

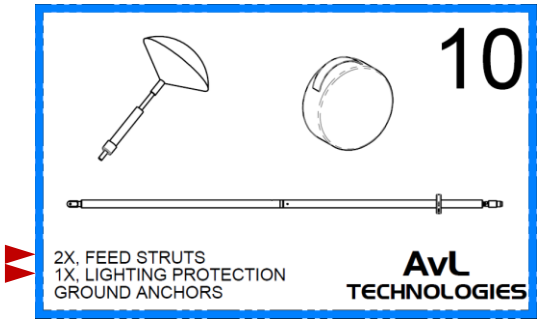
## 5.5 Feed Assembly Instructions

1. The following components are required for assembling the feed section of the antenna system.




2. Locate the feed boom (Case 2).

**Warning: The feed boom is hinged midway to allow for pack-up and includes various electrical connectors. Failure to support the boom may result in equipment damage and/or personnel injury.**

3. Remove the rear most pin from the feed boom and attach to the reflector as shown in Figure 28.

**Note: The feed bumper will rest against the top panel.**

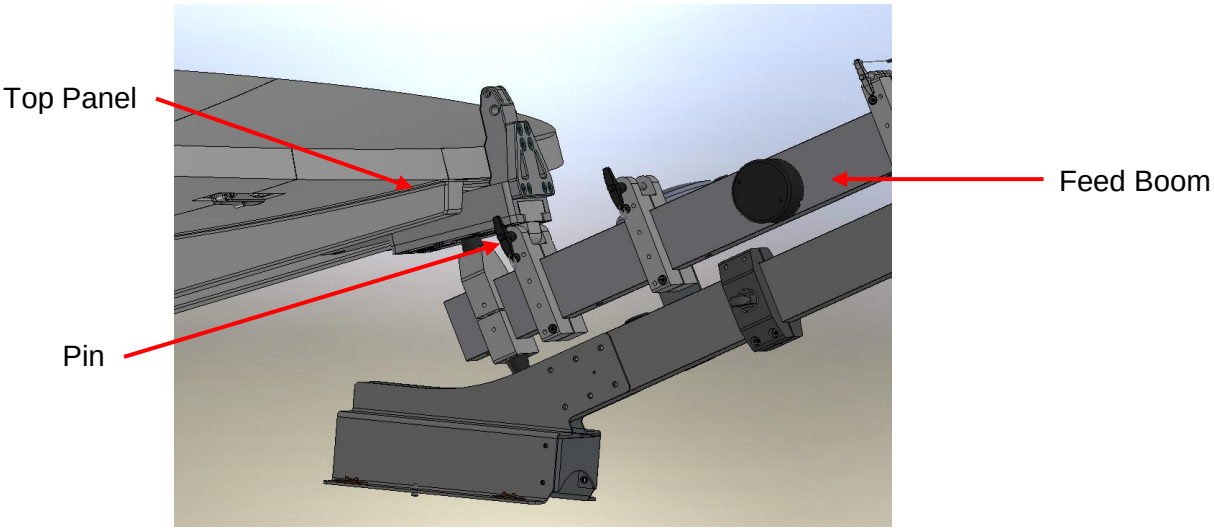



**Figure 28. Attachment of Feed Boom to Top Panel**

4. Locate the two feed boom dampeners (Case 2).

**Note: The dampeners will be used to support the feed boom during both deployment and pack-up. The dampeners should be installed so both are facing the same direction.**

5. Attach the dampeners using holes located on both ends via captive ball detent pins as shown in Figure 29.

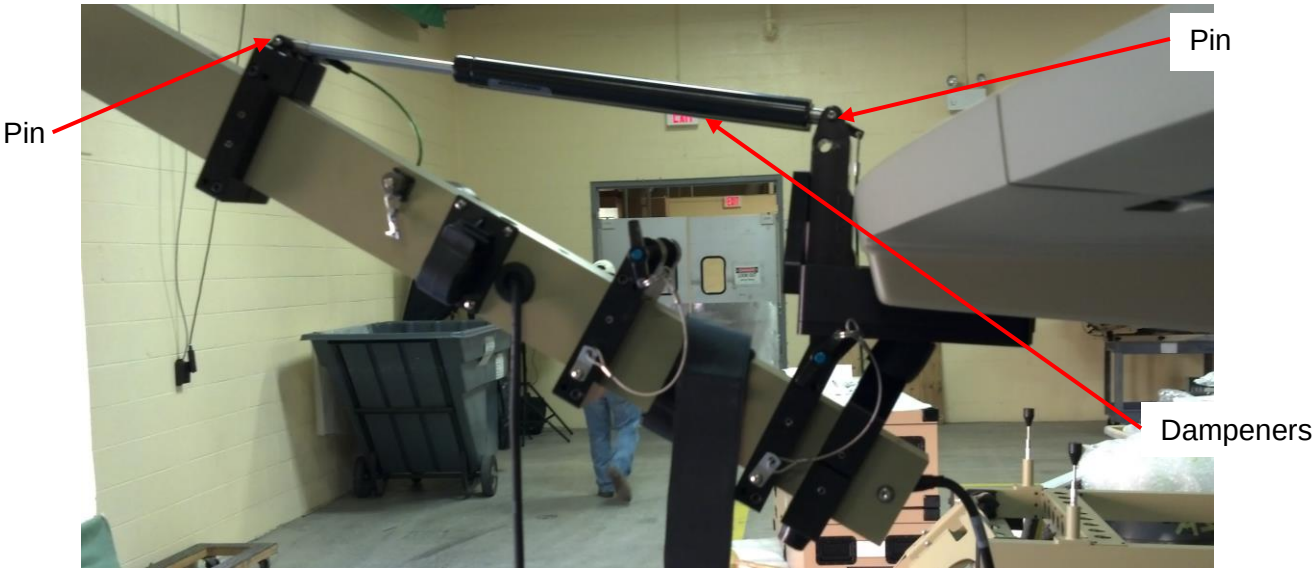



**Figure 29. Attachment of Dampeners**

6. Straighten the feed boom and close the draw latch located at the hinge point.
7. Locate the feed assembly (Case 9).
8. Attach the feed assembly to the end of the feed boom using 4 quarter-turn latches as shown in Figure 30.

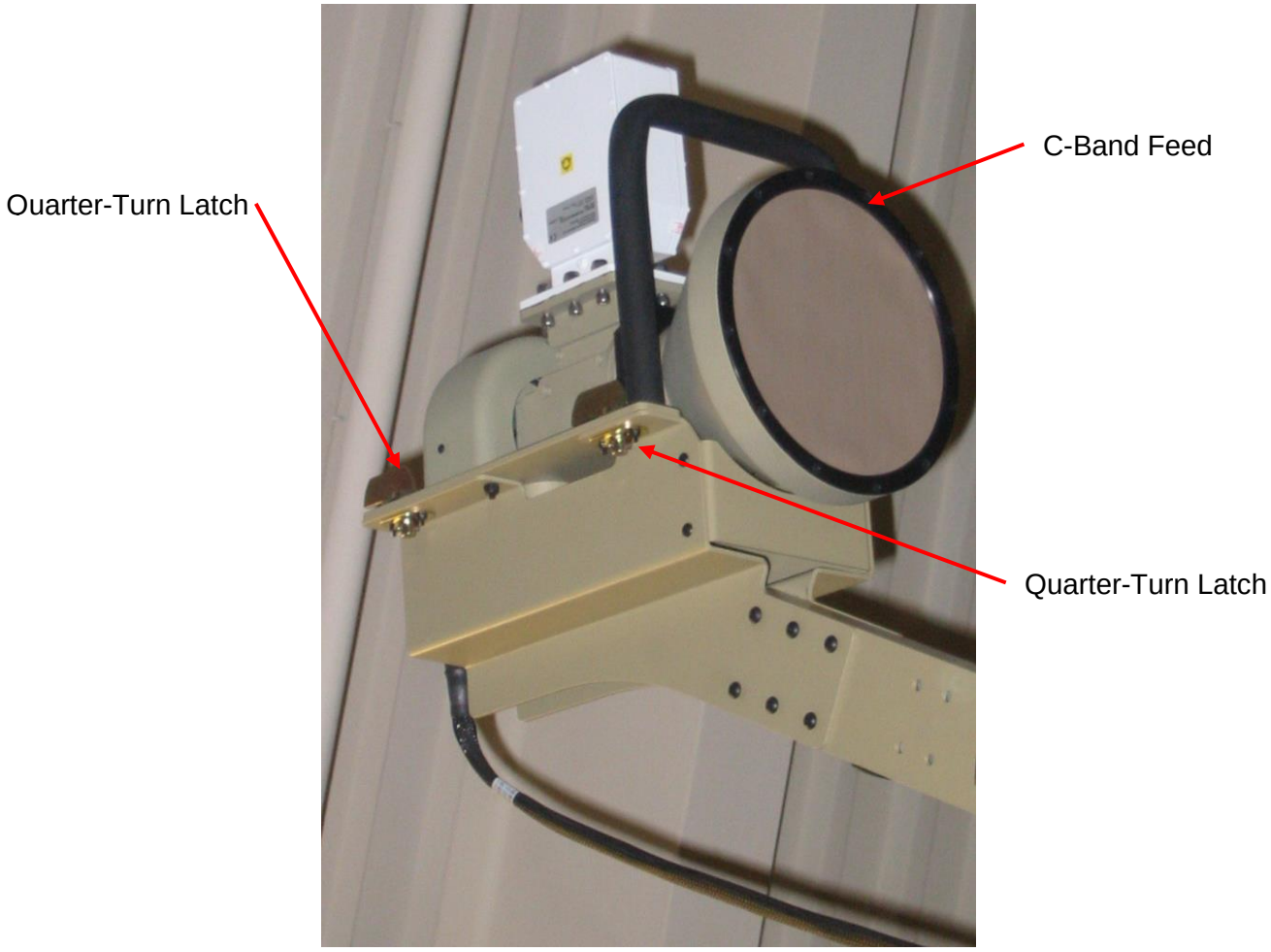



**Figure 30. Attachment of C-Band Feed to Feed Boom**

9. Locate the feed boom wiring bundle (Case 6).
10. Secure the feed boom wiring bundle using clips attached to the feed boom.
11. Connect the individual cables to their respective connector per the labels on each cable.
12. Locate 2 GPS TNC jumper cables (Case 6).
13. Connect the cables from the GPS junction box to the GPS antenna. Route the cables under the feed boom when in the lowered position. See Figure 31.

**Note: Ensure that GPS cables leading to the compasses do not snag on other components.**

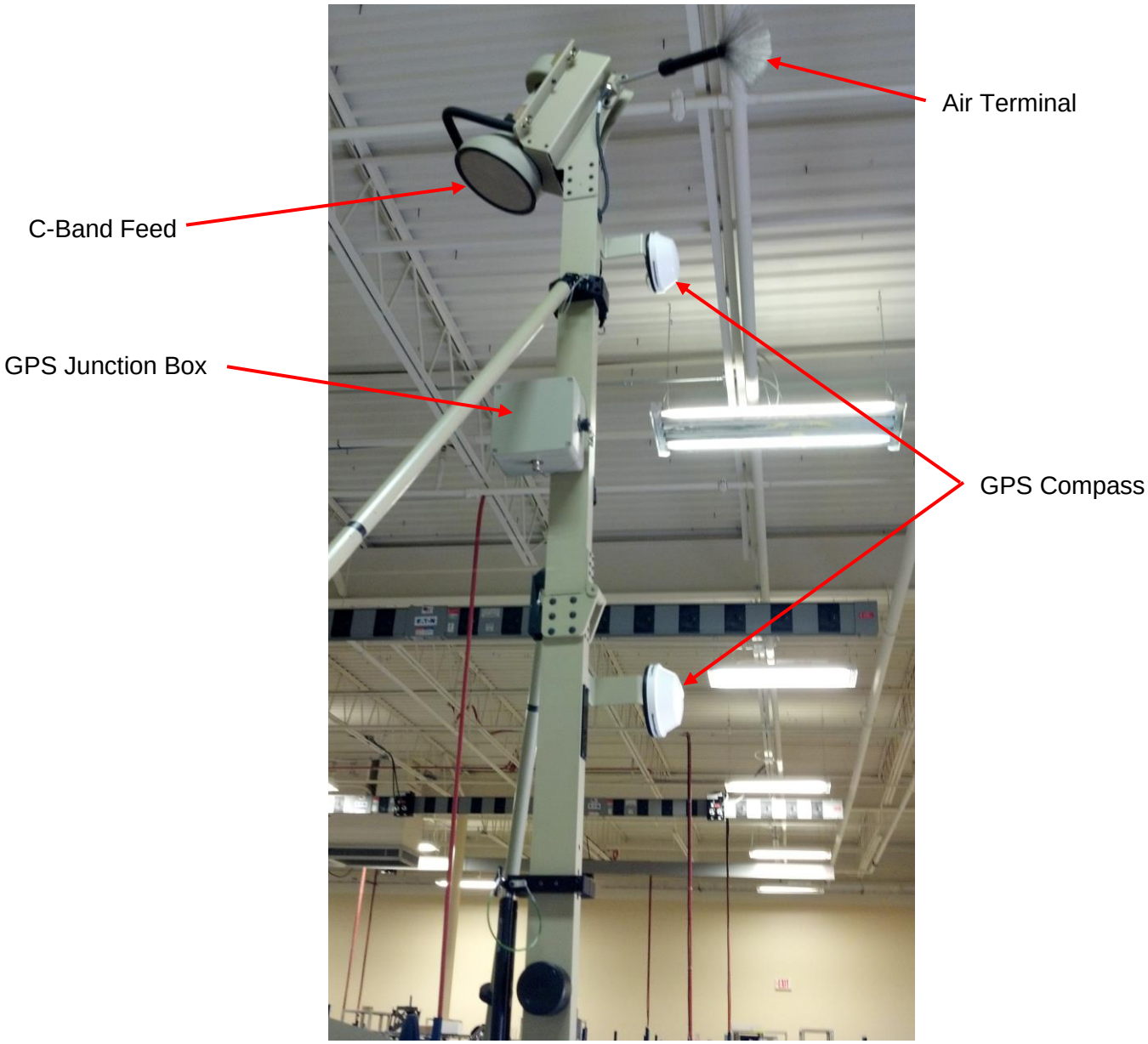



**Figure 31. Connecting Feed Boom Cables**

14. Locate the air terminal from the Lightning Protection Assembly (LPA) (Case 10).
15. Attach the air terminal to the connection point located on the feed end of the boom assembly as shown in Figure 32.
16. The LPA ground cable feeds through the feed boom and exits at the rear of the feed boom. Route the LPA ground cable through the center of the azimuth positioner.
17. Connect the ground cable to the ground rod.

**Note: Before raising the feed boom assembly, slide LPA air terminal cover to expose the lightning dissipater. The ground cable needs to be attached to the ground rod assembly before operation.**

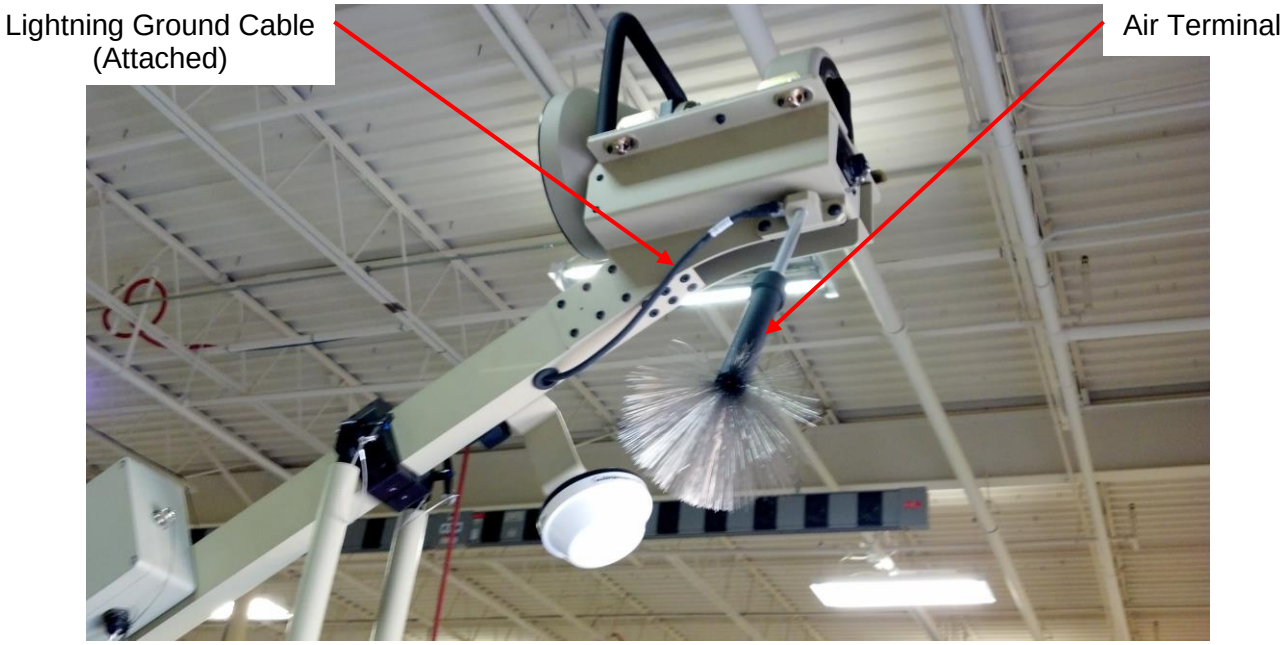



**Figure 32. Attaching the Lightning Air Terminal**

18. Locate the feed struts (Case 10) and screw the halves together.
19. Attach feed struts to the feed boom using captive ball detent pins as shown in Figure 33.
20. Remove captive ball detent pin as shown in Figure 33 before lifting feed boom.

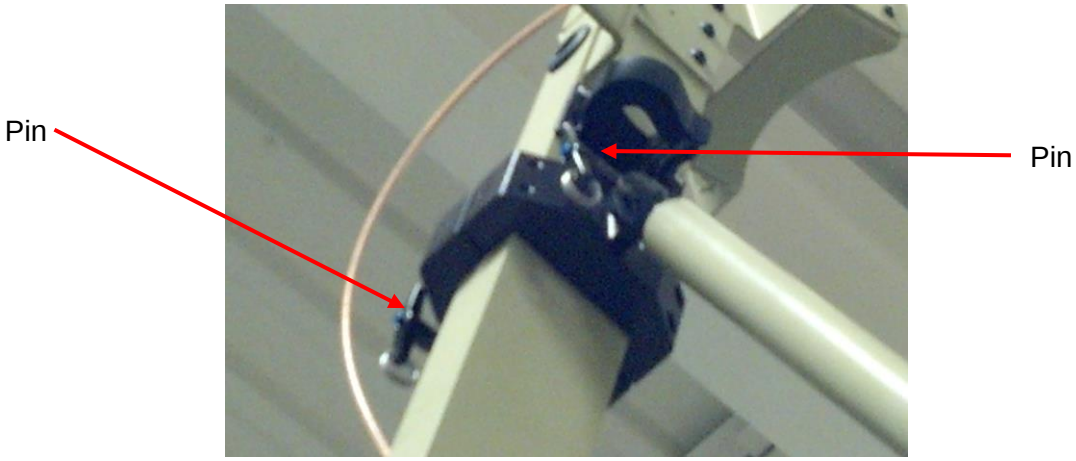



**Figure 33. Attaching Feed Struts to Feed Boom**

**Warning: Two person lift REQUIRED to prevent damage to equipment and/or injury to personnel. Remove equipment and/or personnel from below the feed boom prior to lift.**

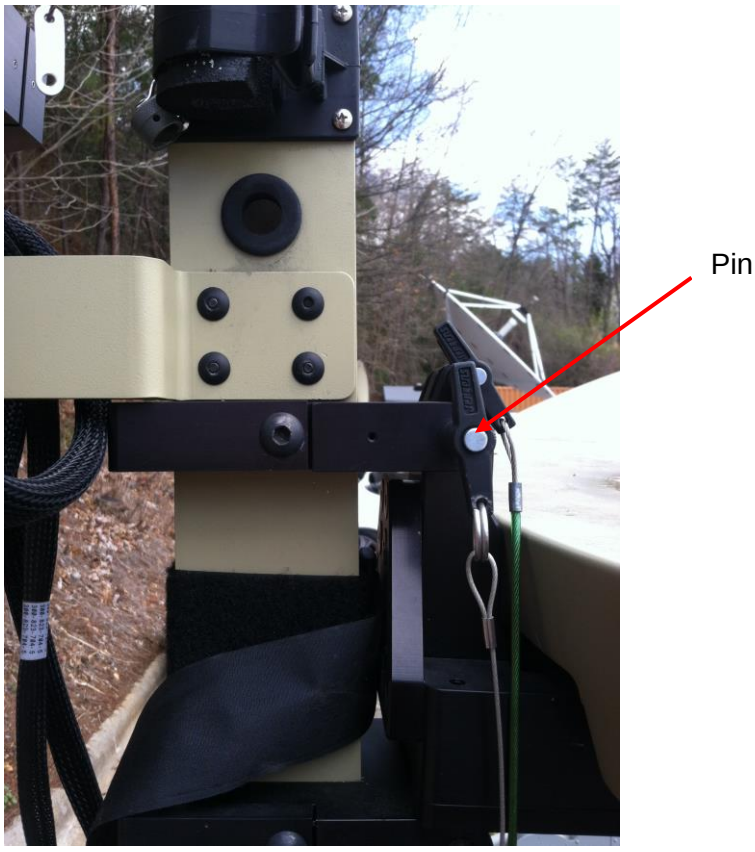



**Figure 34. Pin For Lifting the Feed Boom**

21. Lift feed boom assembly via the feed struts as shown in Figures 35a and 35b.

**Figure 35a. Lifting the Feed Boom**

**Figure 35b. Feed Boom in Deployed State**

22. Replace the final captive ball detent pin on the feed boom to secure the feed boom to panel 1 as shown in Figure 36.

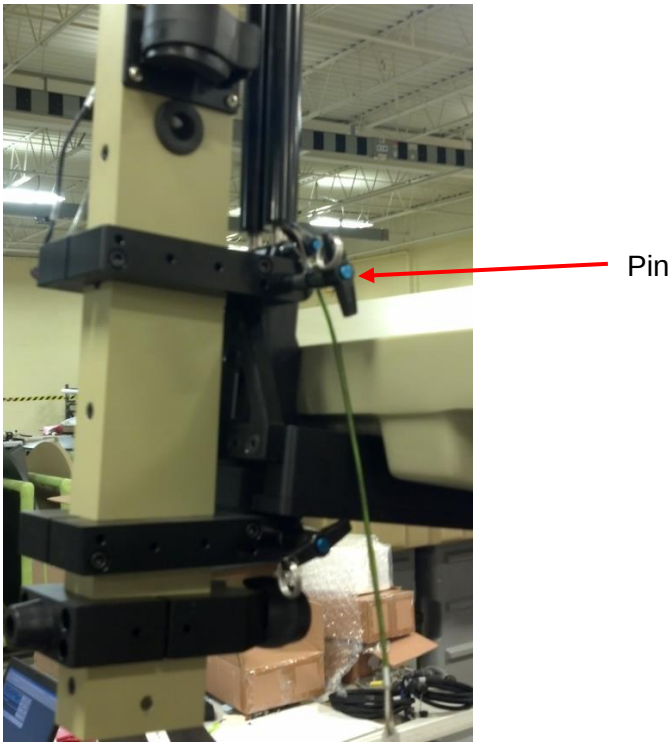



**Figure 36. Locking the Feed Boom in Deployed State**

23. Attach the struts to reflector panels 2 and 8 using ball joints found on the outer edge of the panels as shown in Figures 37.

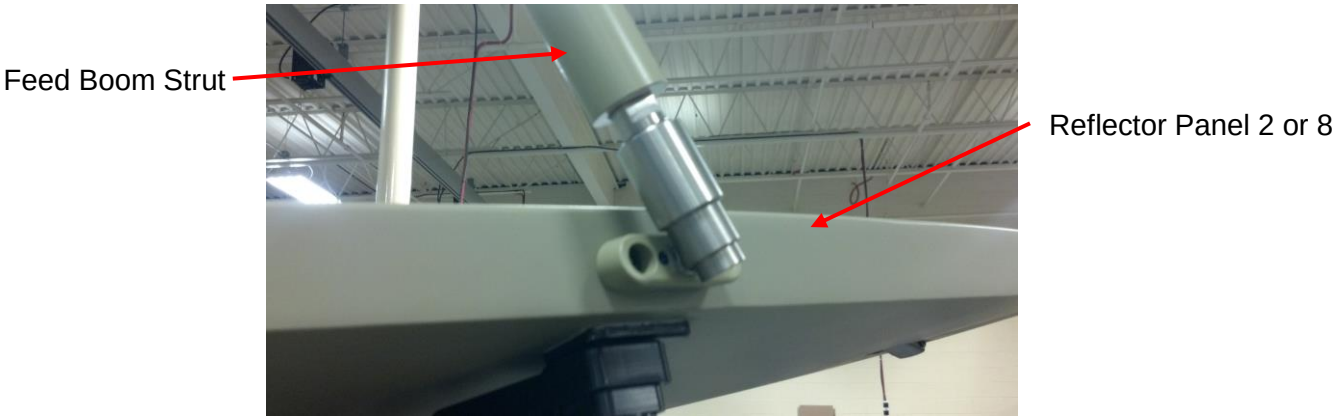


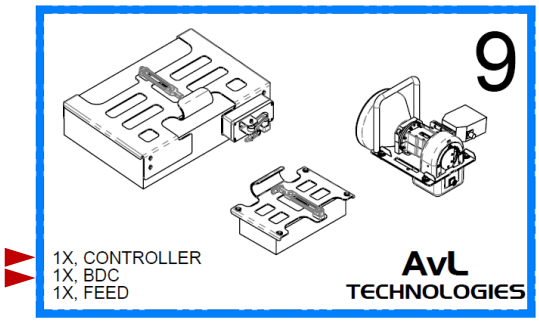

**Figure 37. Attaching Feed Struts to Reflector**

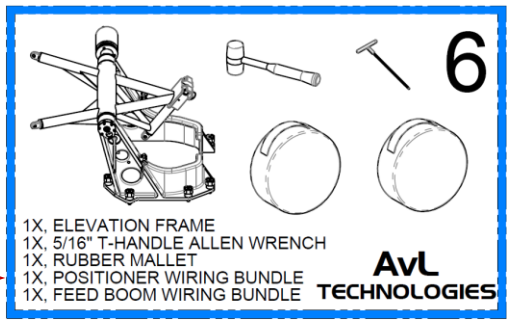
24. At this point, the feed section should be deployed as shown in Figure 38.


**Figure 38. Assembly of Quad-Pod, Positioner, Reflector, and Feed**

## 5.6 Electronic Component Assembly Instructions

1. The following section details the mounting and connecting of electrical components required for controlling the antenna system.




2. Locate the RC4000 Controller and Block Down Converter (BDC) (Case 9).
3. Hook the RC4000 bracket over the center brace on the right diagonal tube assembly and connect the flex handle to corresponding attachment point as shown in Figure 39.
4. Hook BDC bracket over the center brace on the left diagonal tube assembly and connect flex handle to corresponding attachment point as shown in Figure 39.

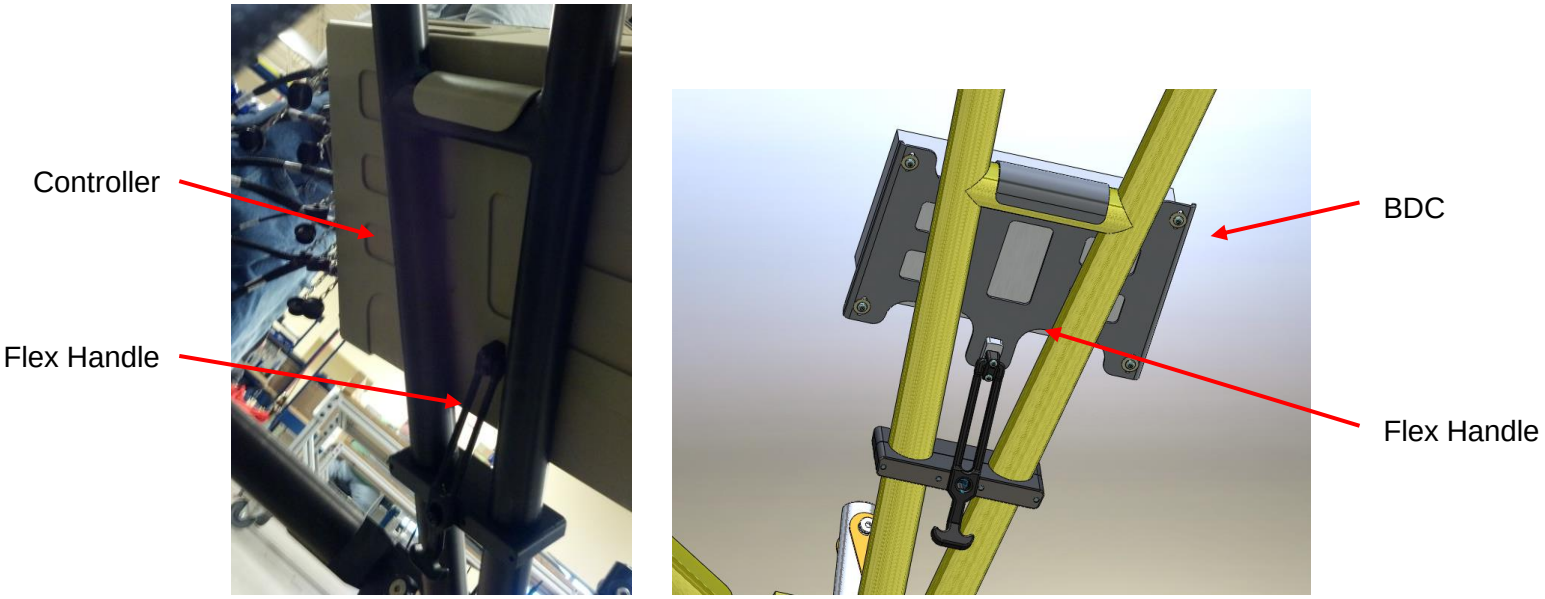



**Figure 39. Attachment of the RC4000 and BDC**

5. Connect all cables to the RC4000, BDC, and feed boom cabling bundle via the corresponding cable labels.

**Note: Attached to the top of the RC4000 controller is a junction box and manual crank handle. The junction box and the RC4000 must connected via the cable. If this cable and hand crank handle are not installed, the antenna will not move as shown in Figure 40.**

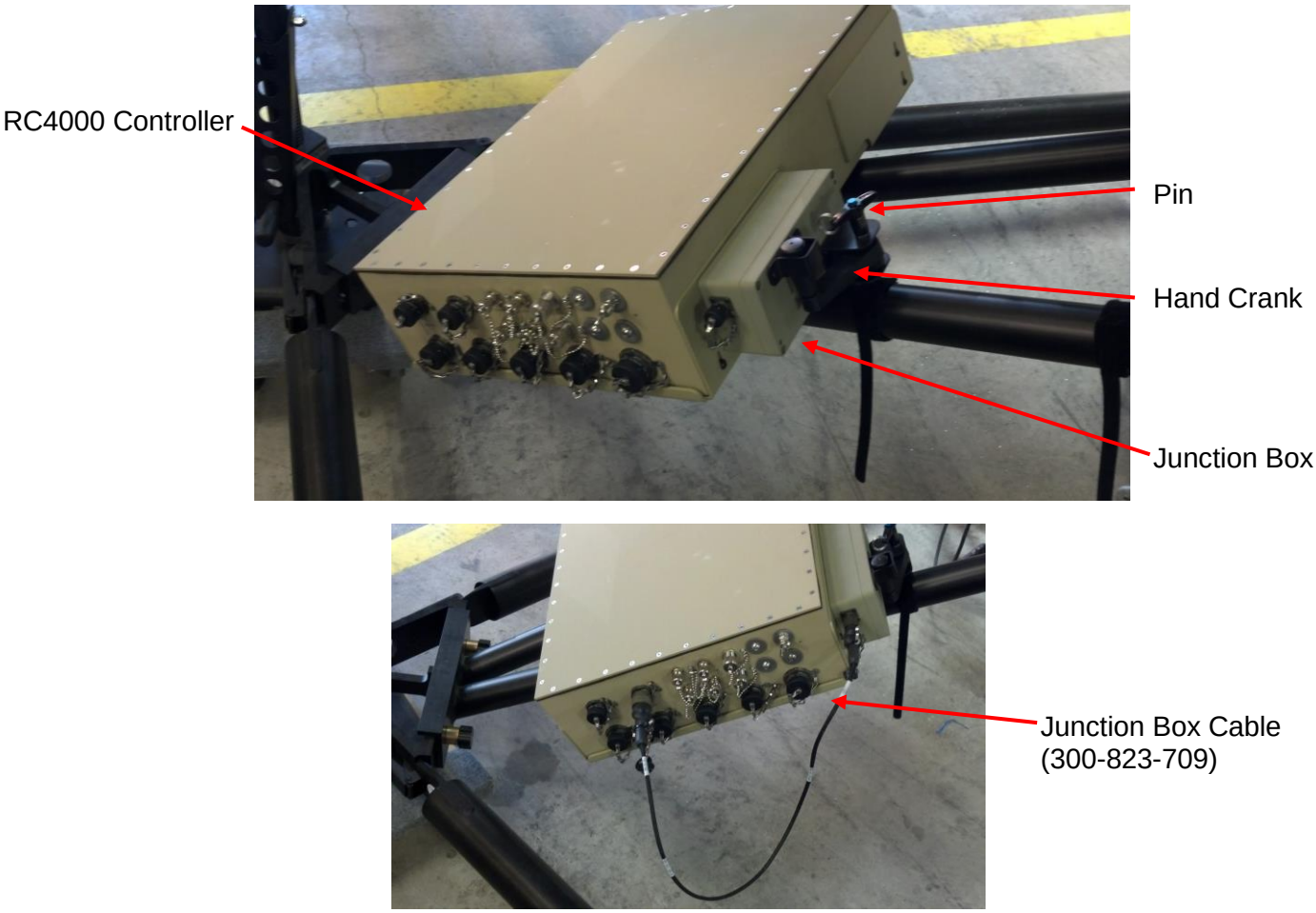



**Figure 40. Diagram of RC4000 Controller Bracket**

6. Connect the grounding cables found in both the feed boom and positioner wiring bundles to the elevation frame using the wing nut shown in Figure 41.

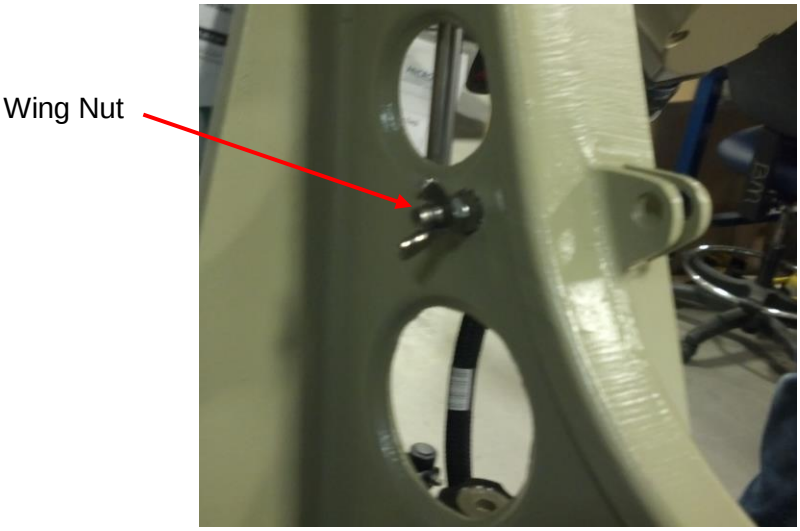



**Figure 41. Grounding Wing Nut on Elevation Frame**

7. Attach the remaining terminal on the positioner wiring bundle grounding cable to the positioner using the wing nut shown in Figure 42.

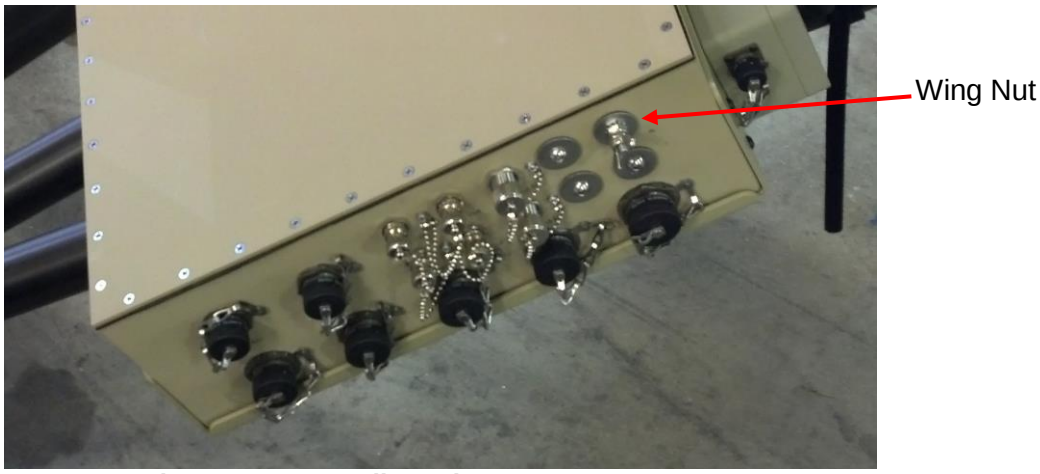



**Figure 42. Grounding Wing Nut on RC4000**

**Note: Confirm all electrical connections have been properly made.**

# 6 Chapter 6: 2460HW General Disassembly & Pack-Up Instructions

## 6.1 Disassembling the Model 2460 HW

**Note: Stow antenna before disassembly.**

1. Disconnect all cables to the RC4000, BDC, and feed boom cabling bundle.
2. Unhook the flex handle and remove the BDC bracket assembly.
3. Place the BDC assembly in Case 9 as shown in Figure 43.
4. Unhook the flex handle and remove the RC4000 bracket assembly.
5. Place the RC4000 Controller assembly in Case 9 as shown in Figure 43.

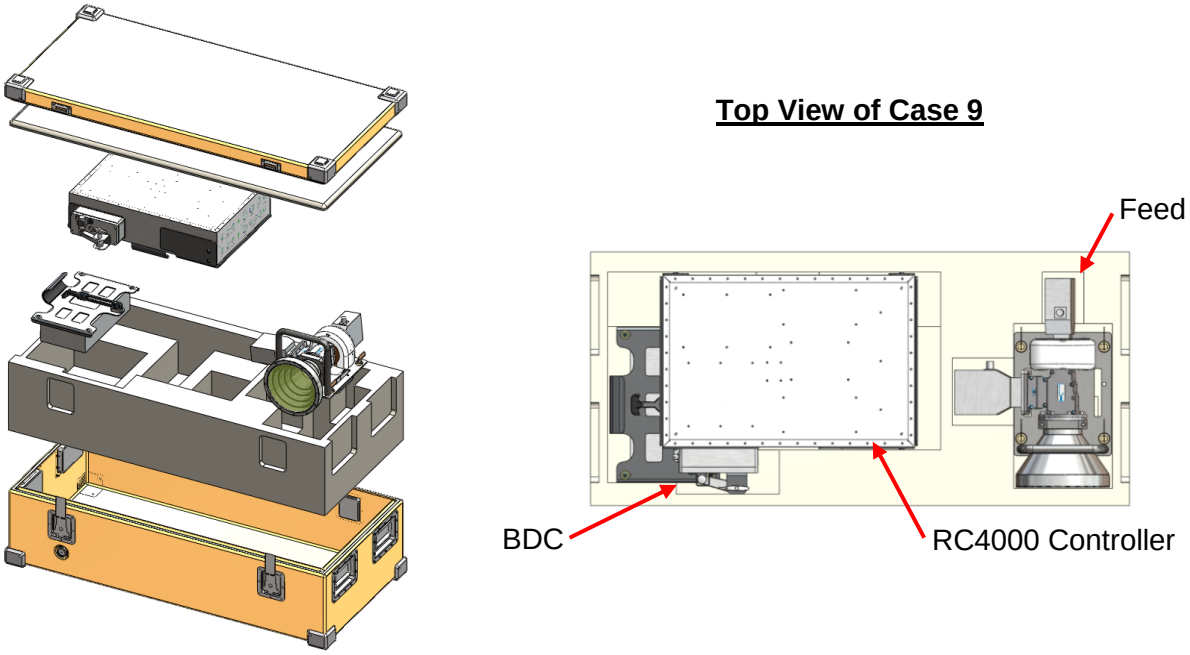



**Figure 43. Case No. 9 Pack-Up**

6. Detach the struts from panels 2 and 8.
7. Pull the top capative ball detent pin on the feed boom assembly connected to panel 1.

**Warning: Two person lift REQUIRED to prevent damage to equipment and/or injury to personnel. Remove equipment and/or personnel from below the feed boom prior to lowering.**

8. Lower the feed boom assembly via the struts.
9. Disconnect the struts from the feed boom.
10. Unscrew the two pieces and place in Case 10 as shown in Figure 44 on page 47.

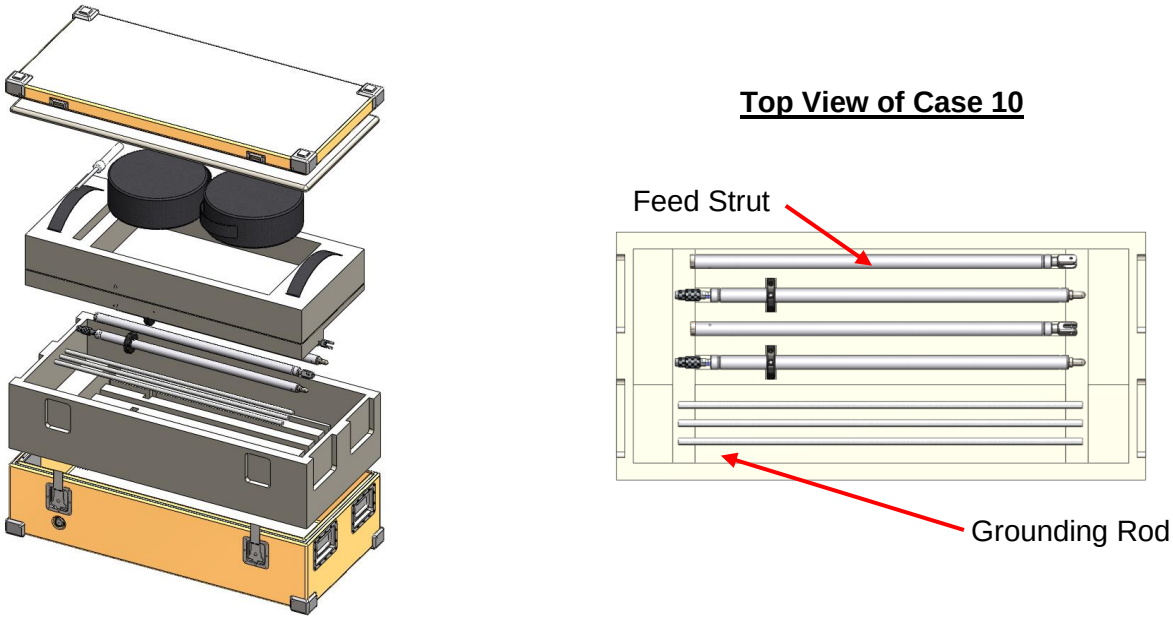



**Figure 44. Case No. 10 Pack-Up**

11. Disconnect the LPA ground cable from the ground rod.
12. Pull LPA ground cable and wire bundle through the top of the azimuth positioner.
13. Slide the LPA air terminal cover over the lightning dissipater.
14. Unscrew the LPA from the feed boom assembly and place in Case 10 as shown in Figure 45.

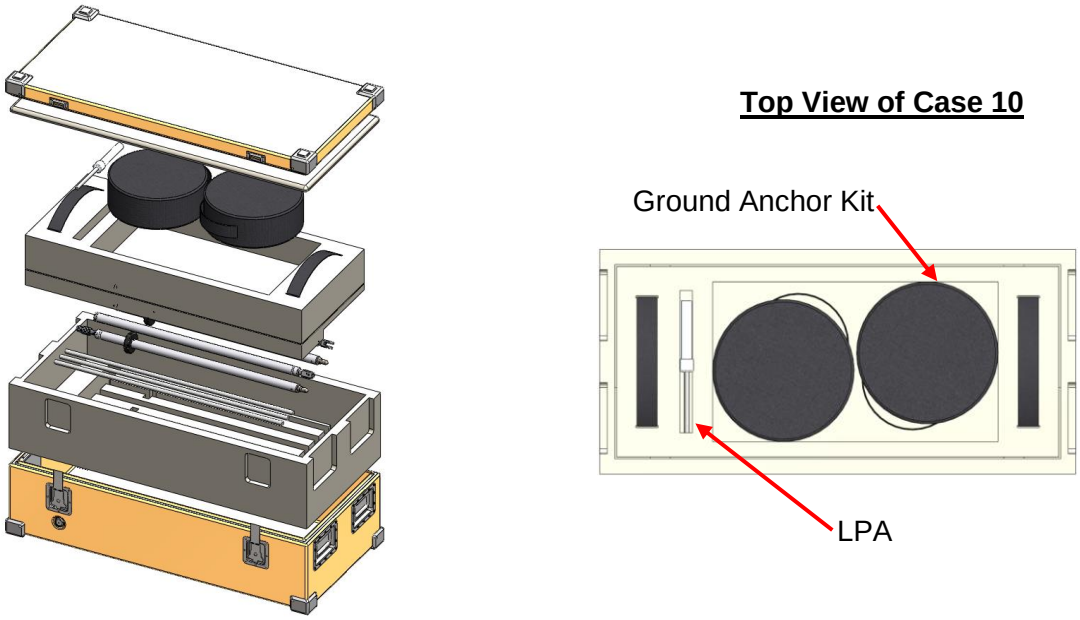



**Figure 45. Case No. 10 Pack-Up**

15. Disconnect the GPS cable (feed wiring bundle) from the GPS junction box .
16. Disconnect the two GPS TNC jumper cables form the GPS antennas and place in Case 6 cable bags as shown in Figure 46.
17. Disconnect cables from the feed assembly and cable connection point.
18. Remove the feed wiring bundle from clips attached to the feed boom and place in Case 6 cable bags as shown in Figure 46.

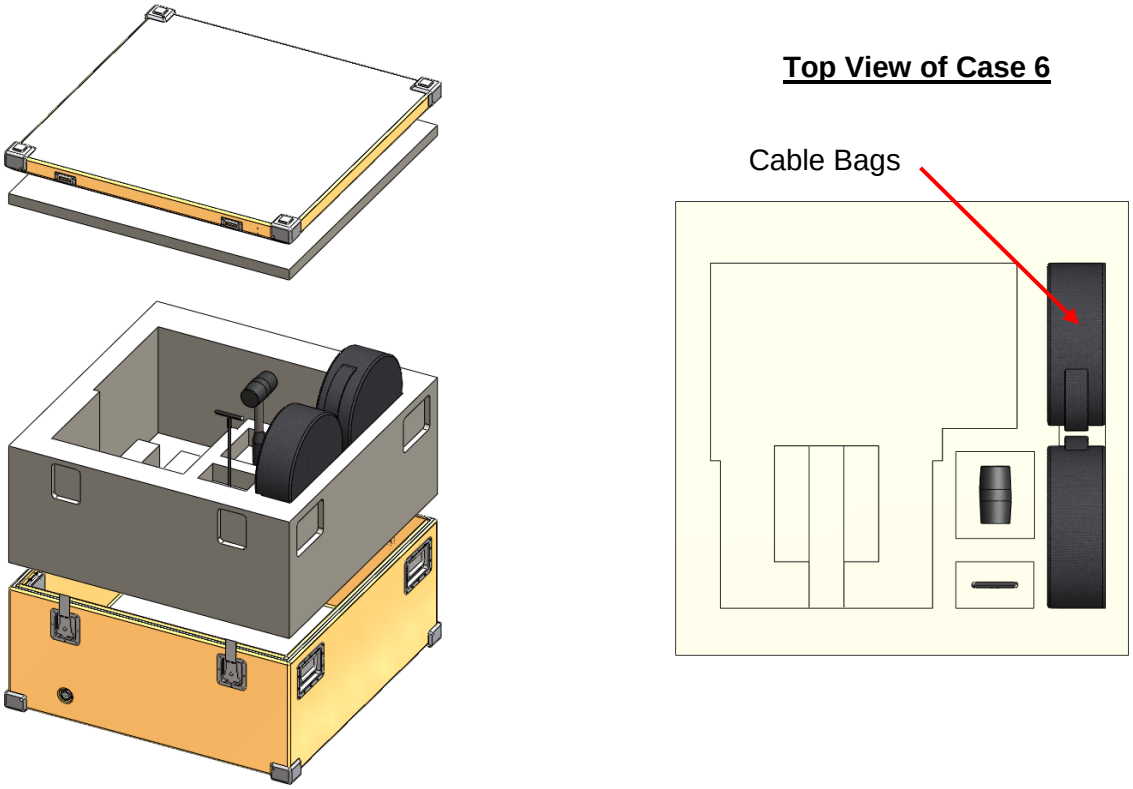



**Figure 46. Case No. 6 Pack-Up, Cable Bags**

19. Detach the four quarter-turn latches and remove the feed assembly and place in Case 9 as shown in Figure 43 on page 46.
20. Unlatch the draw latch located midway up the feed boom and fold boom in half.

**Warning: Feed boom must be supported by one person to prevent damage to equipment and/or personnel.**

21. Reattach straps to hold feed in folded position.

22. Detach the dampeners by removing two captive ball detent pins and place in Case 2 as shown in Figure 47.
23. Remove the bottom captive ball detent pin to remove feed boom assembly and place in Case 2 as shown in Figure 47.

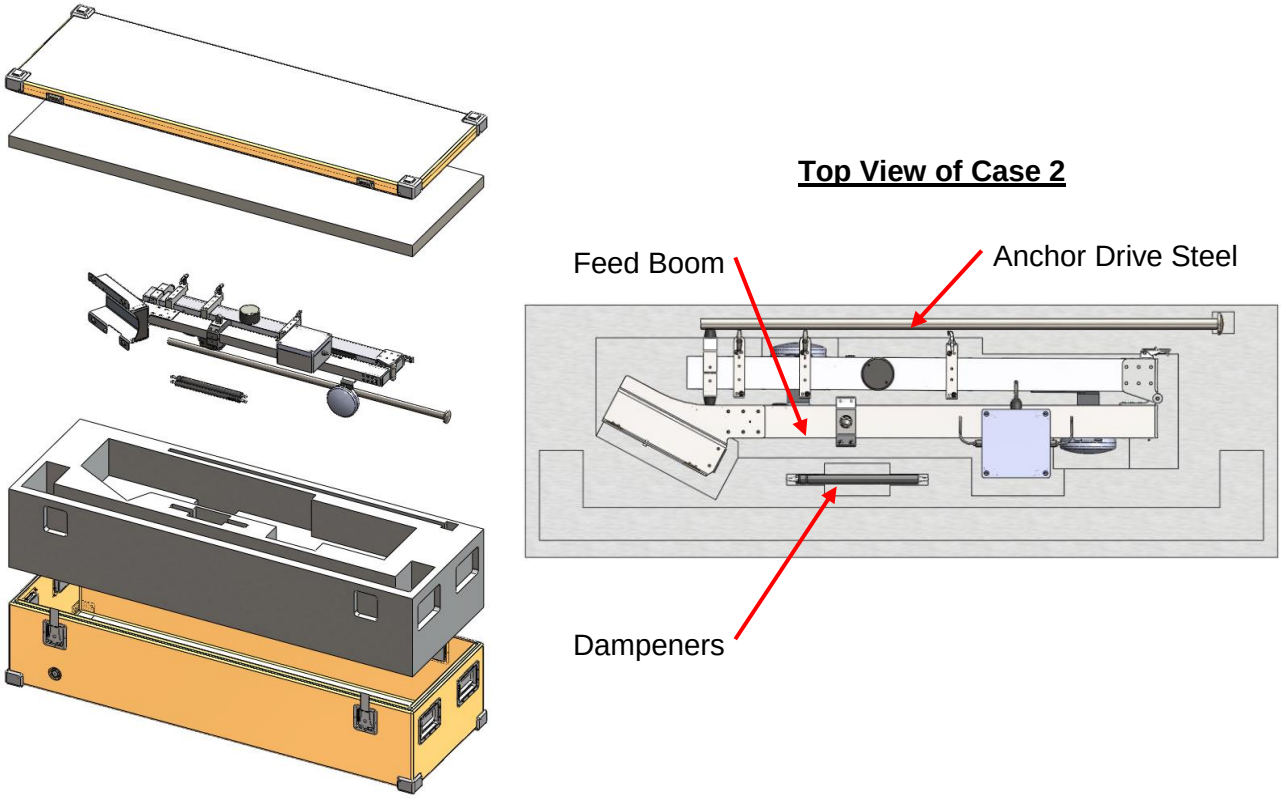



**Figure 47. Case No. 2 Pack-Up, Feed Components**

24. Loosen hand-knobs on the two reflector supports.
25. Remove reflector supports and place in Case 11 as shown in Figure 48 below.

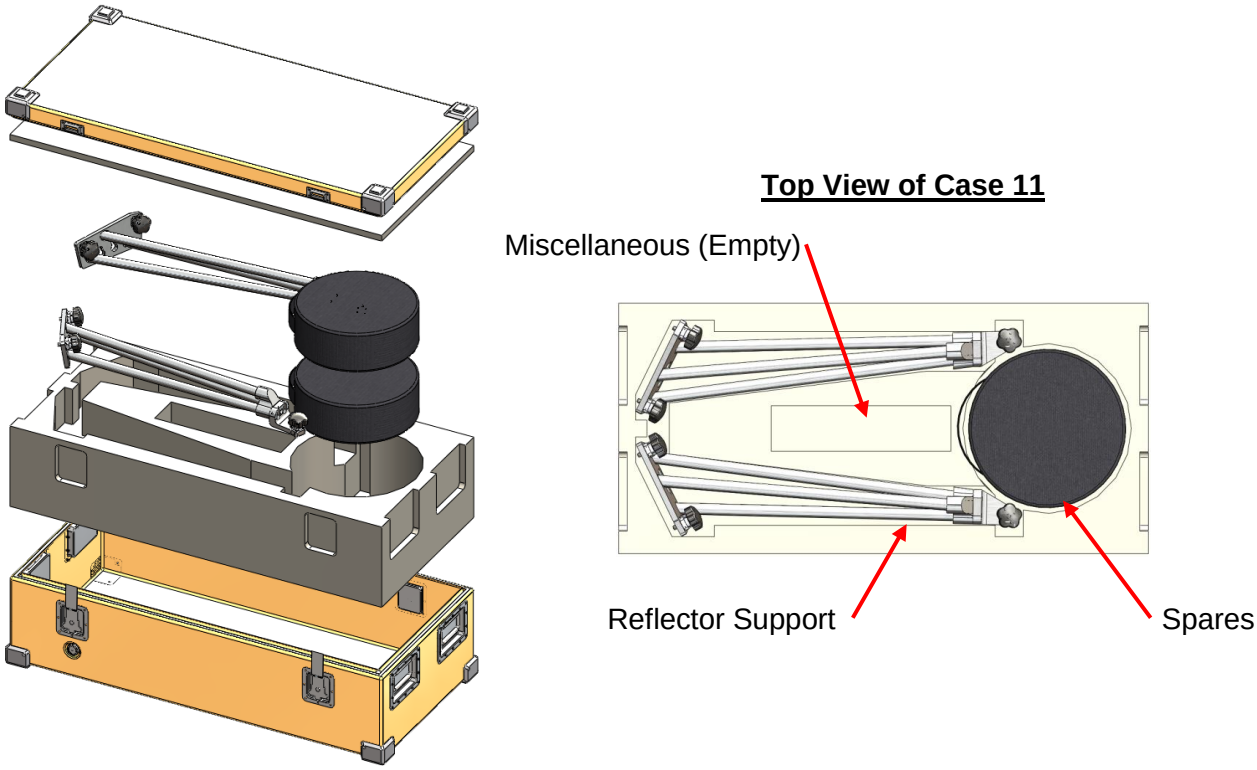



**Figure 48. Case No. 11 Pack-Up**

26. Unlatch horizontal latches that connect panels 4 through 7.
27. Remove panels 5 & 6 by removing center hub vertical latch.
28. Place panels 5 & 6 in appropiate bag located in Case 7 as shown in Figure 49 on page 51.
29. Remove panels 3 & 4 by removing center hub vertical latch.
30. Place panels 3 & 4 in appropriate bag located in Case 7 as shown in Figure 49 on page 51.
31. Remove remaing panels; HOWEVER, panel 1 must be removed last.
32. Place panels 1, 2, 7 & 8 in appropriate bag located in Case 8 as shown in Figure 50 on page 51.
33. Remove the three captive ball detent pins from center hub and place center hub in appropriate bag in Case 7 as shown in Figure 49 on page 51.

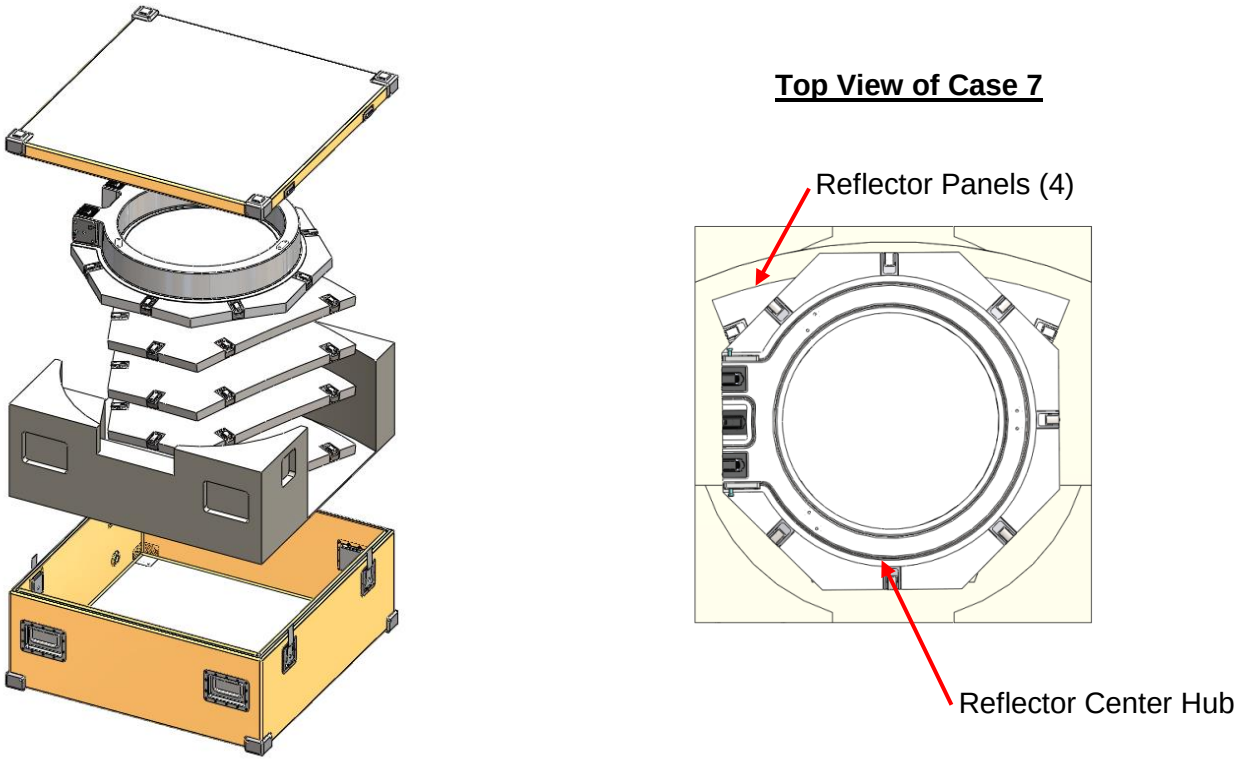



**Figure 49. Case No. 7 Pack-Up**

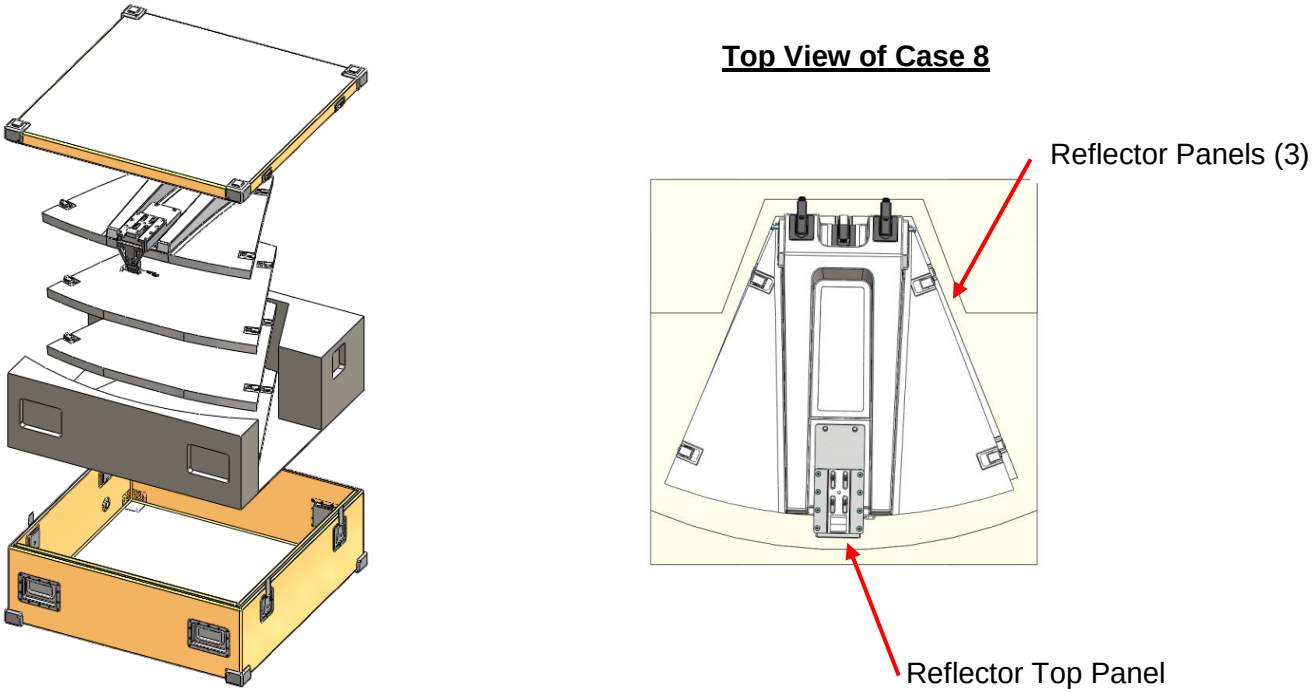



**Figure 50. Case No. 8 Pack-Up**

34. Unlatch the two draw latches and remove each motor.
35. Place motors in Case 5 as shown in Figure 51.
36. Loosen the hand-knobs on elevation actuator assembly using 5/16” Allen wrenches.
37. Remove the compression pin from elevation actuator assembly and place elevation actuator assembly in Case 5 as shown in Figure 51.

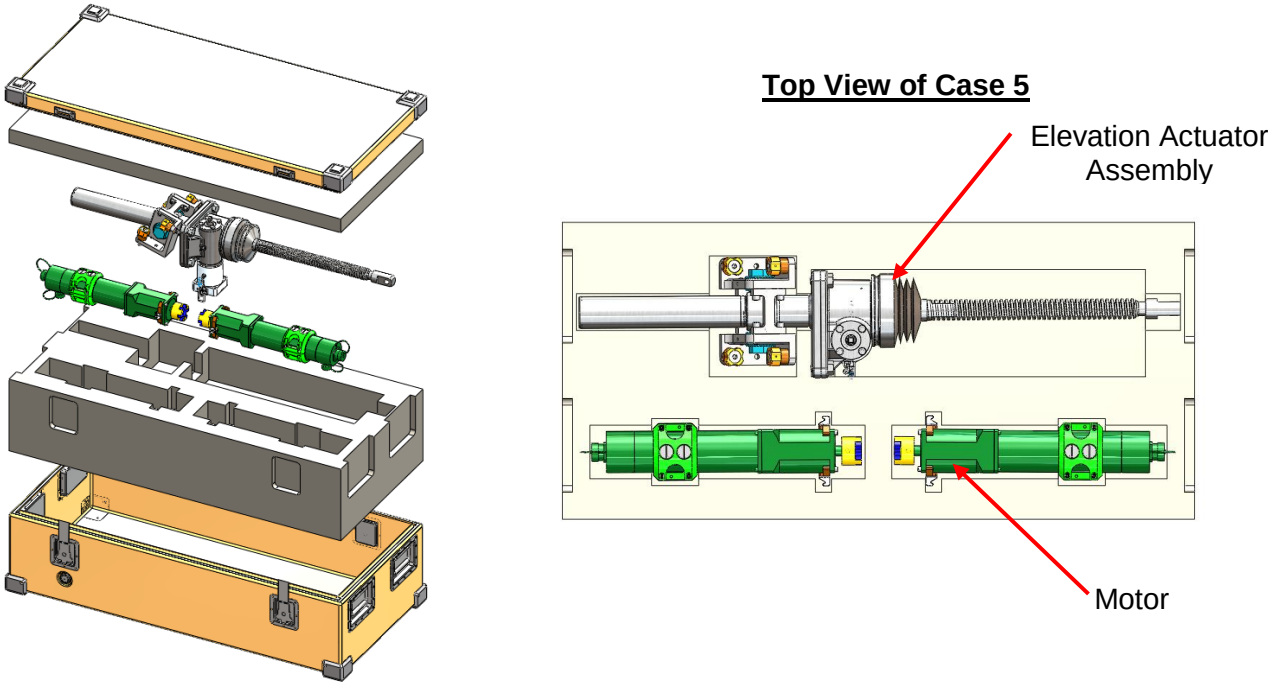



**Figure 51. Case No. 5 Pack-Up**

38. Loosen the hand-knobs on the elevation frame and corner jacks using the 5/16” Allen wrenches.
39. Place Allen wrenches back in storage position located on the elevation frame and in Case 6 as shown in Figure 52.
40. Remove elevation frame from the azimuth positioner and place in Case 6 as shown in Figure 52.

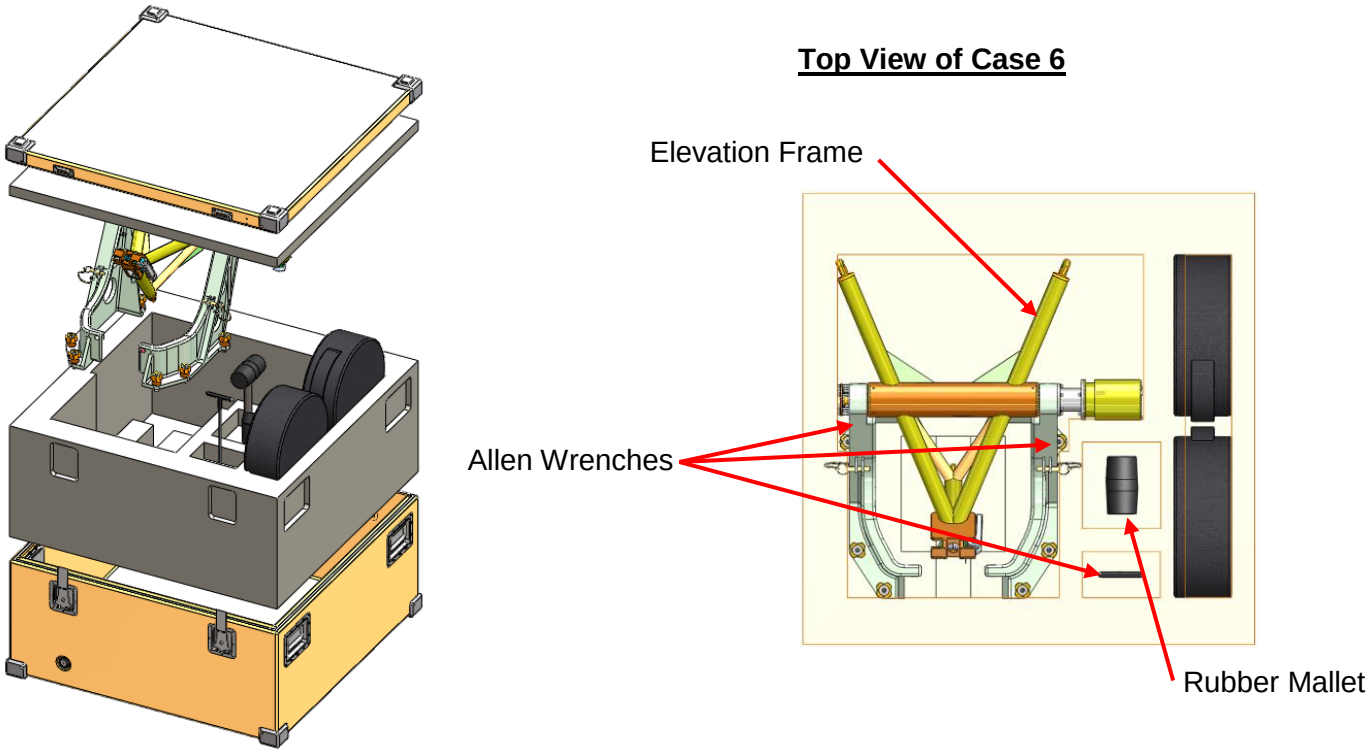



**Figure 52. Case No. 6 Pack-Up**

41. Disconnect duckbill anchors and remove turnbuckles from the Quad-pod assembly.
42. Return the turnbuckles and any other ground anchor related components to Case 10 as shown in Figures 44 & 45 on page 47.

43. Unlatch the eight vertical latches securing the azimuth positioner assembly to the Quad-Pod assembly.
44. Remove the azimuth positioner assembly and place in Case 4 as shown in Figure 53.
45. Secure the azimuth positioner to the case using case straps. Do not over tighten straps.

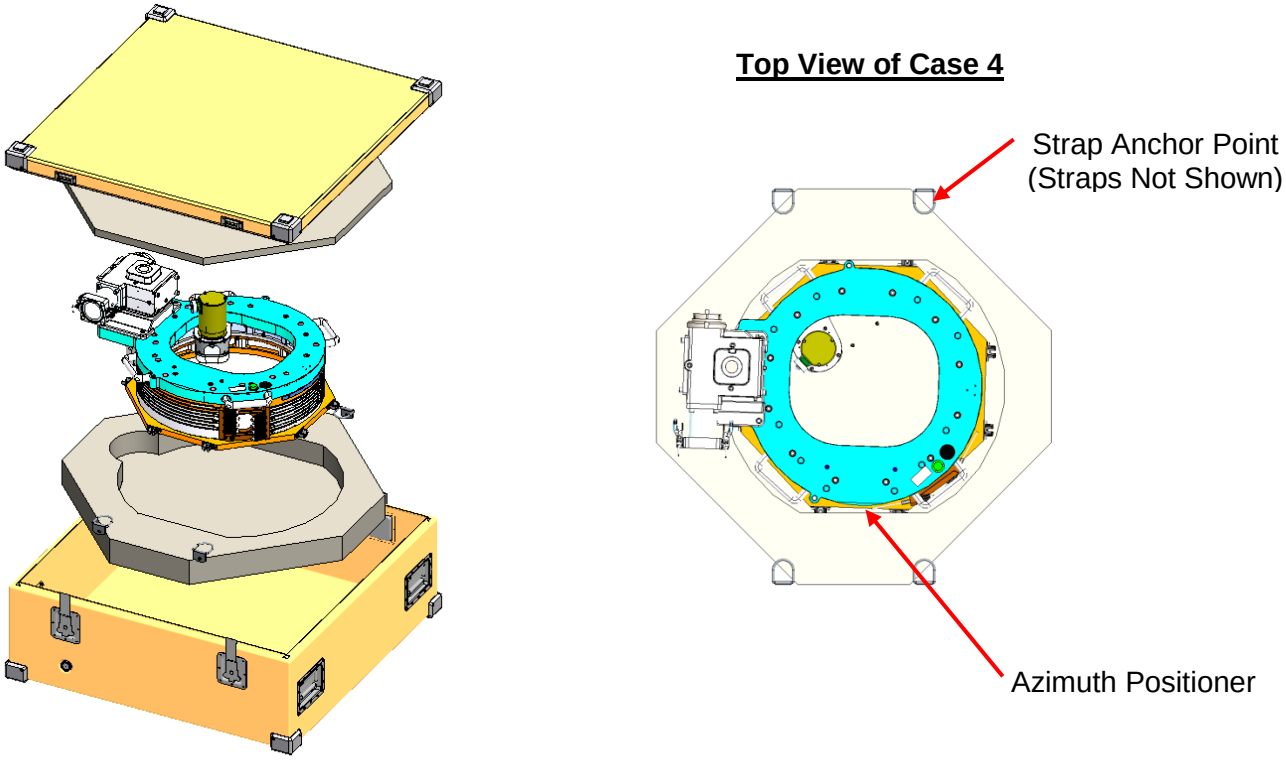



**Figure 53. Case No. 4 Pack-Up**

46. Unlatch the four horizontal latches that connect the diagonal tube structures.
47. Loosen the hand-knobs located on the corner jacks.

**Warning: One person must hold the center of the diagonal tube structure while the other person disassembles and stores each diagonal tube structure to prevent equipment damage and/or injury to personnel.**

48. Remove each diagonal tube structure (one at a time) and place in Case 3 as shown in Figure 54.
49. Secure the diagonal tube structures to the case using case straps. Do not over tighten straps.

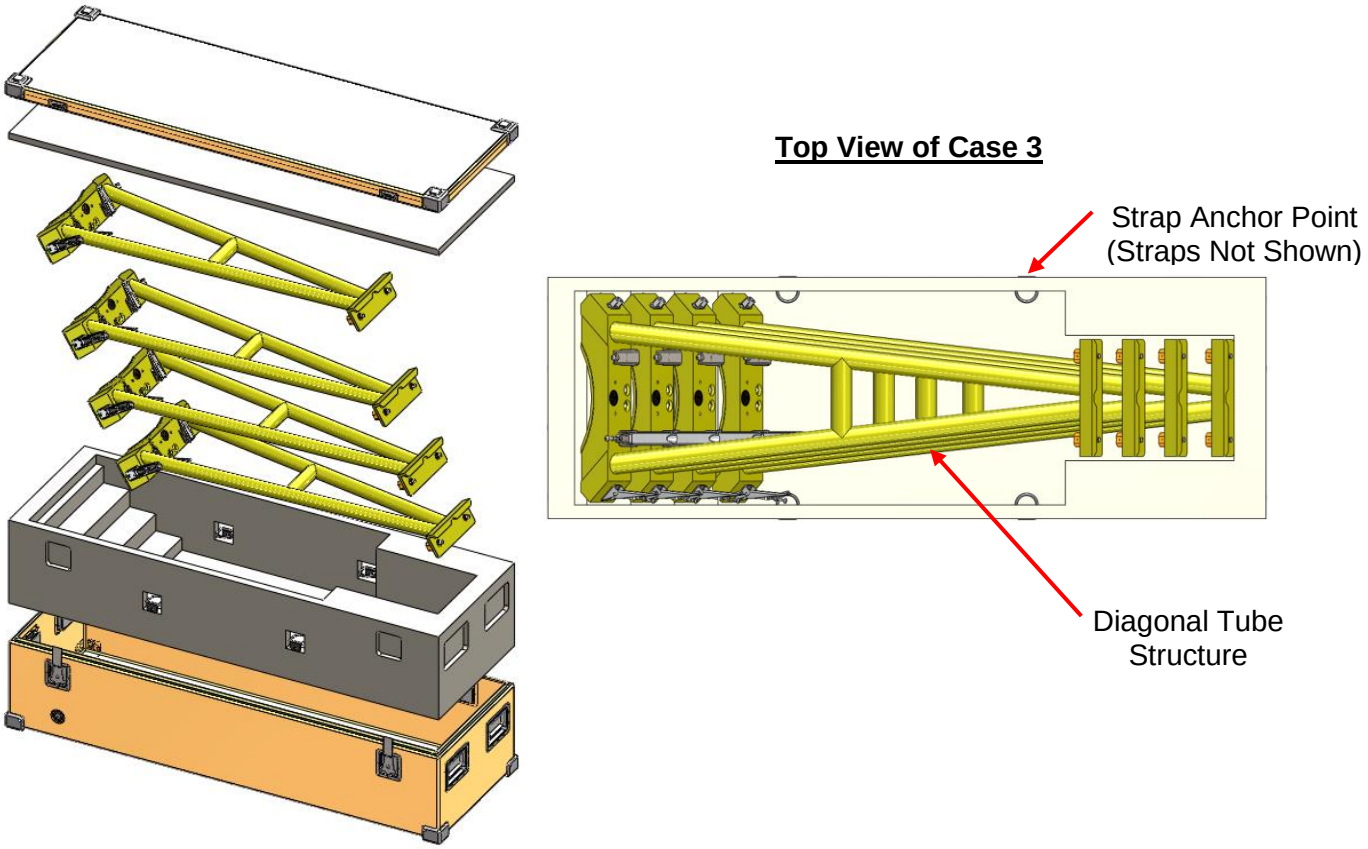
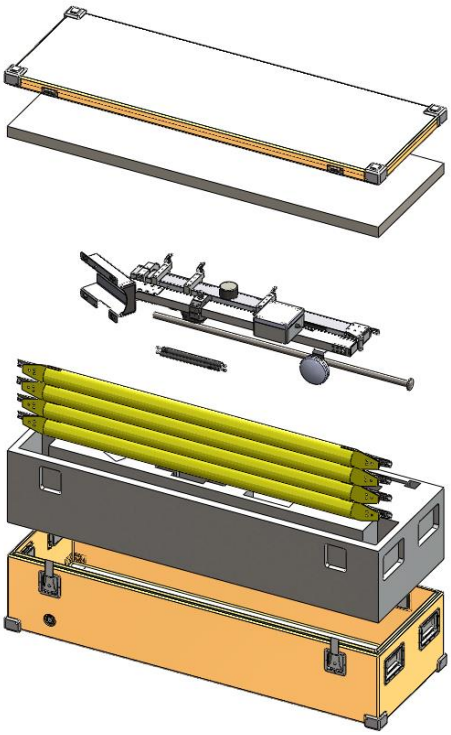



**Figure 54. Case No. 3 Pack-Up**

50. Lower each corner jack assembly to the lowest point.

**Note: Retrieve the rubber mallet from Case 6 to aid in disassembly of the horizontal tubes from the corner jack assembly.**

51. Unlatch horizontal tube and remove from corner jack assembly.
52. Place horizontal tube in Case 2 as shown in Figure 55.
53. Repeat for remaining three tubes.



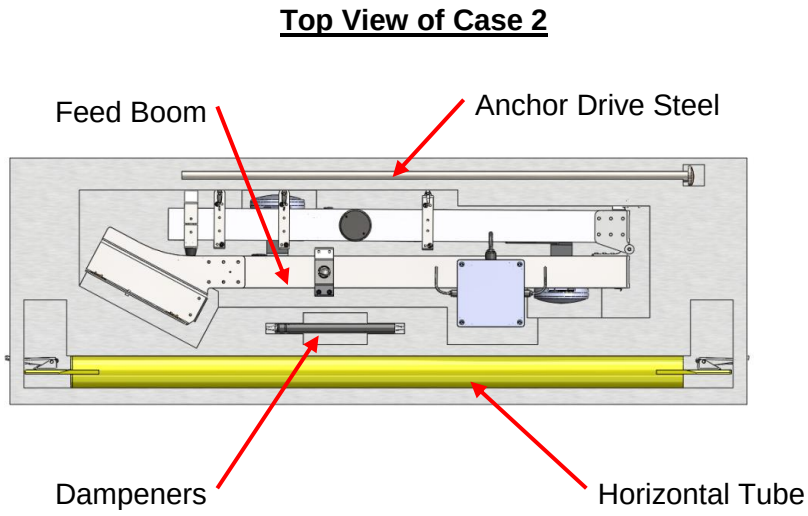



**Figure 55. Case No. 2 Pack-Up**

54. Remove corner jack from foot plate and place in Case 1 as shown in Figure 56.
55. Repeat for remaining three jacks.
56. Place the four foot pads in Case 1 as shown in Figure 56.

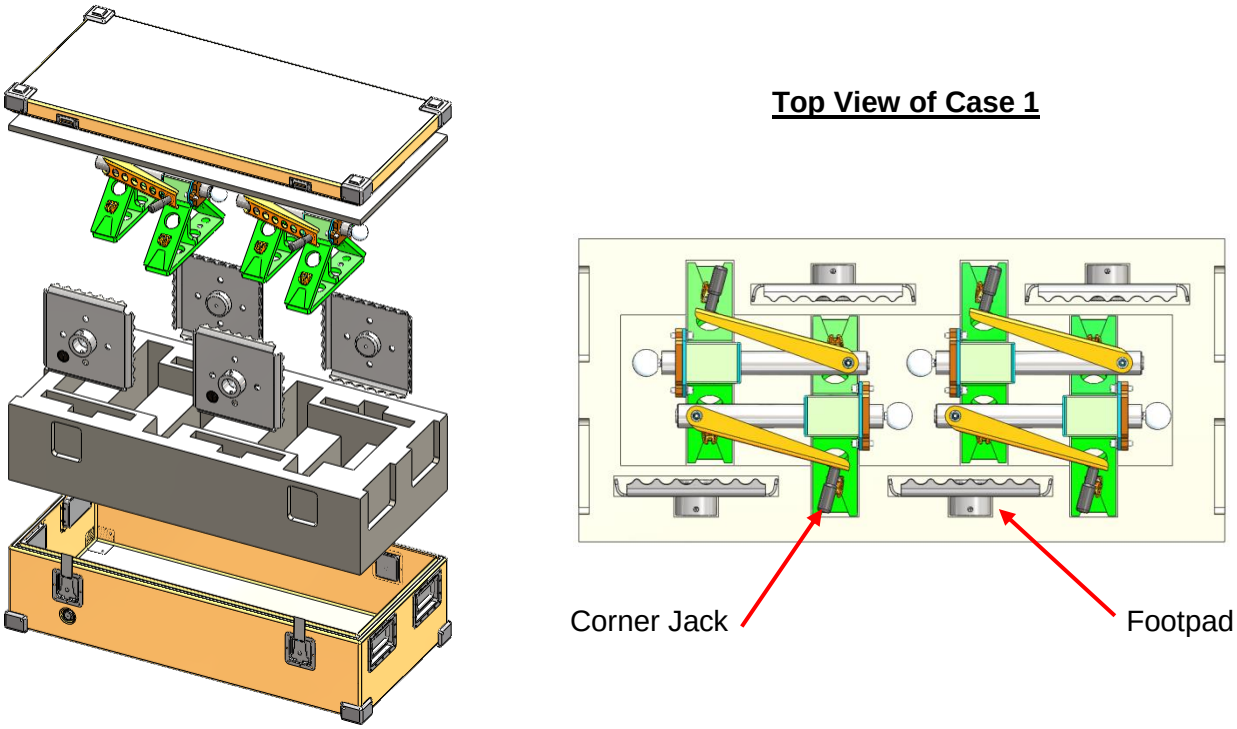



**Figure 56. Case No. 1 Pack-Up**

**Note: Consult Figure 5 on page 16 for shipping configuration.**

# 7 Chapter 7: Preventative Maintenance

## 7.1 General

The AvL Model 2460 HW is constructed to require a minimum amount of regular maintenance. The following checks should be undertaken on a regular basis and can be rectified in the field:

## 7.2 Monthly Maintenance

System:

1. Clean exterior surfaces with a mild non-abrasive cleaner and soft cloth.
2. Check for missing hardware. Replace as required
3. Check conditions of all cables (cuts, cracks and abrasions. Replace as required.
4. The feed horn, including protective face cover, should be checked for cracks or damage. Replace if damaged.
5. Any small chips on the reflector front surface should be noted and report to Depot

## 7.3 Annual Maintenance

Azimuth:

6. Disconnect controller and crank by hand in azimuth
7. Unit should hand-crank easily
8. Check for unusual noise in the azimuth bearing, azimuth gearbox, and azimuth motor
9. Run in azimuth and check for unusual noise in azimuth motor
10. Check position of azimuth drive cables on capstan at $0° \leq Az$
11. Check drive cables for damage
12. Run to both Az limits and observe cable tracking
13. Check for excessive backlash in gearbox using the hand crank
14. Remove cable termination block covers and inspect cable terminations.
15. Tighten springs if more than .010” gap exists
16. Inspect Az potentiometer for damage

Elevation:

1. Hand crank in elevation
2. Unit should hand crank with approximately 50-75 in-lbs. torque
3. Check for unusual noise in elevation pivot bushings and elevation gearbox
4. Run in elevation and check for unusual noise in elevation motor
5. Run up to limit
6. Check tracking of elevation drive cables
7. Check drive cables for damage
8. Check for excessive backlash in gearbox using the hand crank
9. Tighten springs if more than 0.010” gap between sets of springs exists

# APPENDICES

Appendix A: Hemisphere GPS Compass Quick Start Guide for use with RC3000
*(Optional on various models)*

Appendix B: Depot Repair Parts List

Appendix C: Spare Kit Parts List

Appendix D: Optional Anchoring and Weighting Instructions

Appendix E: Interface Drawing

# Appendix A:

## Hemisphere GPS Compass Quick Start Guide for use with RC4000

*(Optional on various models)*

*For a more detailed operation of the RC4000 and GPS Compass, see the RC4000 User's Manual and Appendix HGPS.*

### 1. Antenna (Pedestal) Positioning

The feed boom should be raised so that the GPS antennas are parallel to the ground. This may be done automatically within the "System Definition" menu. When set to Antenna Mounted Compass, the RC4000 will move the antenna to the "Deploy" position before reading the compass heading.

1. Power ON the RC4000
2. Press the "BKSP" button to clear current saved position.
3. Press and hold the "Mode" button for approximately 5 seconds**.**
4. Press and release the "Mode" button until "Config" is displayed in the upper right.
5. Press the "Scroll Up or Down" button until "System Definition" is displayed.
6. Press the "Enter" button to access the "System Definition" menu.
7. Press the "Enter" button until the "Compass" parameter is highlighted.
8. Enter "2" to select antenna mounted compass.
9. Press the "Enter" button to set.
10. Press and release the "Mode" button to exit.

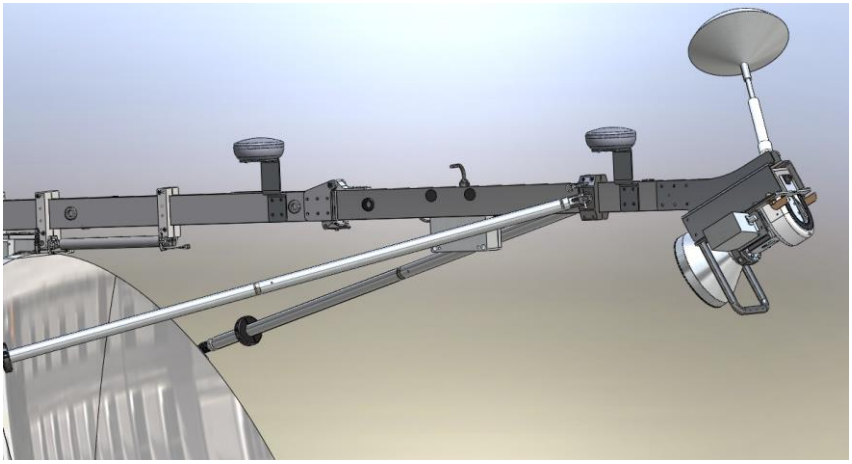


**Figure 57. GPS Antennas Attached to Feed Boom**

## 2. Compass Calibration

There are several parameters that must be set in the RC4000 for proper GPS Compass operation.

1. The distance between the GPS antennas must be entered into the Antenna Separation parameter at the Compass Calibration screen.

   1.1 Press and release the “Mode” button until “Main” is displayed in the upper right.
   1.2 Press “9” to enter in to the Compass Cal screen, “CSI CAL” in upper right.
   1.3 Press the “1” button to access the Antenna Separation parameter.
   1.4 Enter “1000” as the Antenna Separation distance.
   1.5 Press the “Enter” button to set.

2. If the GPS antennas are NOT within 10 degrees of parallel to ground, then the Level Op parameter must be changed.

   2.1 Press the “2” button to access the Level Operation parameter.
   2.2 Enter “0” to indicate that the GPS antennas are NOT within 10 degrees of level.
   2.3 Press the “Enter” button to set.

3. Tilt Aid should remain “0” or off.
4. If the unobstructed view of the sky to the horizon is NOT 10 degrees, then the El Mask parameter may be changed. It is NOT recommended to change this parameter above 10, which is the default. The recommendation is to reposition the antenna so to have an unobstructed view of the sky. Masking more of the sky decreases the number of GPS satellites and increases the chance of an inaccurate or even no heading.
5. Press and release the “Mode” button to exit.

## 3. Azimuth Calibration

The relationship of the GPS antennas and the pedestal’s azimuth must be configured. As viewed from the rear of the pedestal in figure 1, the primary GPS antenna is to the right. The true heading will be represented by the vector from the primary GPS antenna to the secondary GPS antenna. In this application, azimuth zero is 180 degrees clockwise from the direction of the GPS heading vector. A plus 180 degree fluxgate offset must be entered in the “Azimuth Calibration” menu.

1. Press and release the “Mode” button until “Config” is displayed in the upper right.
2. Press the “Scroll Up or Down” button until “Azimuth Calibration” is displayed.
3. Press the “Enter” button to access the “Azimuth Calibration” menu.
4. Press the “Enter” button until the “FG” parameter is highlighted.
5. Enter “90” to indicate a 180 degree offset.
6. Press the “Enter” button to set.
7. Press the “Mode” button to exit.

## 4. GPS Compass Initialization

The GPS Compass will need to calculate a new heading before satellite operation of the pedestal.

**WARNING: WHILE THE COMPASS INITIALIZATION IS IN PROCESS, IT IS RECOMMENDED TO STAY CLEAR OF THE GPS ANTENNAS BY 15 FEET**

1. Power cycle the RC4000.
2. Press the “BKSP” button to clear current saved position, if applicable.
3. Press and release the “Mode” button until “Menu” is displayed in the upper right.
4. Press the “3” to select “Locate”.
5. Allow the GPS Compass to acquire location and heading.

# Appendix B:

## Depot Repair Parts List

### 1. General System Assembly Views

The following are CAD generated exploded views of the antenna system. See parts list below for detailed information on individual parts.

### Parts List

| Item Number | AvL Item Number | Description | Quantity Per Unit | Associated Hardware (per item) |
|---|---|---|---|---|
| 1 | 245-043-301 | AMP BRACKET; 2460 HW | 1 | (4) ¼-20 UNC x .625 BHCS<br>(2) 10-32 UNF x 1 BHCS<br>(2) 10-32 UNF x .375 FHCS<br>(4) ¼ FLAT WASHER |
| 2 | 3191352-104 | TUBE ASSY; STRUCTRUAL UP | 4 | |
| 3 | 3191353-104 | TUBE ASSY; HORIZONTAL | 4 | |
| 4 | 3191357-104 | ASSEMBLY; CORNER JACK | 4 | (1) MCM#97345A723<br>(4) 3/8-16 UNC x 1.625 SHCS<br>(1) 3/8-16 LOCKNUT<br>(1) 3/8 FLAT WASHER<br>(2) 3/8 LOCK WASHER |
| 5 | 3192782-101 | FOOT; JACK | 4 | |
| 6 | 91-99-258-15 | LATCH; DRAW | 21 | (3) 10-32 UNF x ½ SHCS |
| 7 | 91-99-261-25 | BRACKET; LATCH | 21 | (3) 10-32 UNF x ½ SHCS |
| 8 | 245-044-001 | CLAMP; CRUTCH; BRACKETS; TOP | 2 | (4) 10-32 UNF x 1-¼ SHCS |
| 9 | 245-044-003 | CLAM; CRUCTH; BRACKETS; BOTTOM | 2 | (1) 10-32 UNF x 1-¼ SHCS |
| 10 | 3191337-101 | HAND KNOB; 3.8 POSITIONER | 18 | |
| 11 | P0334 | LATCH & KEEPER LONG FLEXIBLE T-HANDLE | 2 | (2) 10-32 UNF x 1 BHCS |
| 12 | 245-042-301 | CONTROLLER BRACKET; 2460 HW | 1 | (8) 10-32 UNF x ½ BHCS<br>(2) 10-32 UNF x 1 BHCS<br>(2) 10-32 UNF x .375 FHCS<br>(8) ¼ FLAT WASHER |
| 13 | 700-121-771 | 2460HW RC4000 Controller | 1 | |
| 14 | 245-046-301 | J-BOX; HANDLE DISCONNECT; 2460 HW | 1 | (1) ¼-20 UNC x ½ BHCS<br>(6) 6-32 UNC x ¼ BHCS |
| 15 | P0134 | QUICK RELEASE T-PIN 3/8 DIA. 1.50 | 1 | |
| 16 | 3VB94 | HANDCRANK; 3/8” SQ DRIVE; ALUM | 1 | |
| 17 | CL-100-LPA-S | CLAMP, TOGGLE | 4 | (4) 10-32 UNF x ½ BHCS |

| | | | | |
|---|---|---|---|---|
| 18 | 685144-25310 | COUPLER, SPIDER | 2 | |
| 19 | 685144-17852 | COUPLING, HUB | 2 | |
| 20 | 3208641-102 | MOTOR | 2 | |
| 21 | 26W132B80K | ALUMINUM HANDLE | 4 | (2) ¼-20 UNC x 1 SHCS |
| 22 | 3192769-HW KIT | HARRIS POSITIONER ASSY HARDWARE KIT | 1 | |
| 23 | 2-12038 | LEVEL; CIRCULAR | 1 | (3) 4-40 UNC x ¼ SHCS |
| 24 | 3192766-101 | ACTUATOR ASSY; MAQA TCV | 1 | |
| 25 | CL-100-PA-S-L | PLATE, LATCH | 1 | (2) 10-32 UNF x ½ BHCS |
| 26 | P0134 | QUICK RELEASE T-PIN 3/8 DIA. 1.50 | 3 | |
| 27 | 3219078-HW | HARRIS EL-ASSY HARDWARE KIT MAMBA | 1 | |
| 28 | 11981/1VHT1 | TOOLS INDL; HEX | 2 | |
| 29 | 9307K91 | GROMMET | 2 | |
| 30 | CL-10-EXP-2.00 | EXPANDING PIN; 5/8 DIA X 2”; CARR LANE | 1 | |
| 31 | 92001A330 | WING NUT 5/16-18 | 1 | |
| 32 | 120-636-001 | STUD; 13MM BALL | 2 | |
| 33 | P0235 | T-PINS 1.75 GRIP S/S WITH CL-4-BLPT | 1 | |
| 34 | 203-581-001 | LATCH SPRING CLIP | 3 | |
| 35 | 245-033-302 | FLYING BUTTRESS; MAMBA; LEFT | 1 | (3) 3/8-16 UNC x 1 SHCS<br>(12) 6-32 UNC x ¾ SHCS |
| 36 | 245-033-301 | FLYING BUTTRESS; MAMBA; RIGHT | 1 | (3) 3/8-16 UNC x 1 SHCS<br>(12) 6-32 UNC x ¾ SHCS |
| 37 | 91-522-52 | UNDER-CENTER DRAW LATCH | 23 | (3) 6-32 UNC x 3/8 BHCS |
| 38 | K4-2338-52 | EXPOSED LATCH KEEPER | 23 | (2) 6-32 UNC x 3/8 BHCS |
| 39 | P0368 | QK. REL. T-PIN 1/4 DIA. 1.25 LG. | 2 | |
| 40 | 245-017-303 | FEED STRUT; 2460HW | 2 | (2) ¼-20 UNC x 1-1/8 SHCS<br>(1) ¼-20 UNC x 1-1/4 SHCS<br>(1) ¼-20 LOCK NUT |
| 41 | GDE63-E | DAMPER; GUDEN; 19.65 EXT. 12.65 COMP. | 2 | |
| 42 | 245-000-502 | FEED ASSY, RX ONLY, C BAND, MAMBA | 1 | |
| 43 | 3192787-101 | LTG DISSIPATOR ASSY;MAQA | 1 | |
| 44 | 93750A320 | T-PIN WITH LANYARD; 1/4 DIA; 2-1/4 LONG | 1 | |
| 45 | P0422 | GROMMET | 1 | |
| 46 | 9540K2 | BUMPER | 1 | (1) 10-32 x 3/4 SHSS |
| 47 | 93750A525 | QK. REL. T-PIN 3/8 DIA. 4.00 LG. | 2 | |

| | | | | |
|---|---|---|---|---|
| 48 | 6912K581 | STRAP, VELCRO | 1 | (2) ¼" ALUM. RIVET |
| 49 | P0276 | CLAMP, CABLE | 3 | (4) 6-32 UNC X 3/8 BHCS |
| 50 | 9307K79 | GROMMET | 4 | |
| 51 | 85985K24 | PLUG | 2 | |
| 52 | 9405K61 | BUMPER | 1 | (1) 10-32 UNF X 1 BHCS |
| 53 | 300-823-710 | HARNESS, BDC TO FB | 1 | |
| 54 | 300-823-711 | HARNESS, FB | 1 | |
| 55 | 300-823-712 | HARNESS, ACU | 1 | |
| 56 | 3192791-101 | LIGHTING GROUNDING CABLE | 1 | |

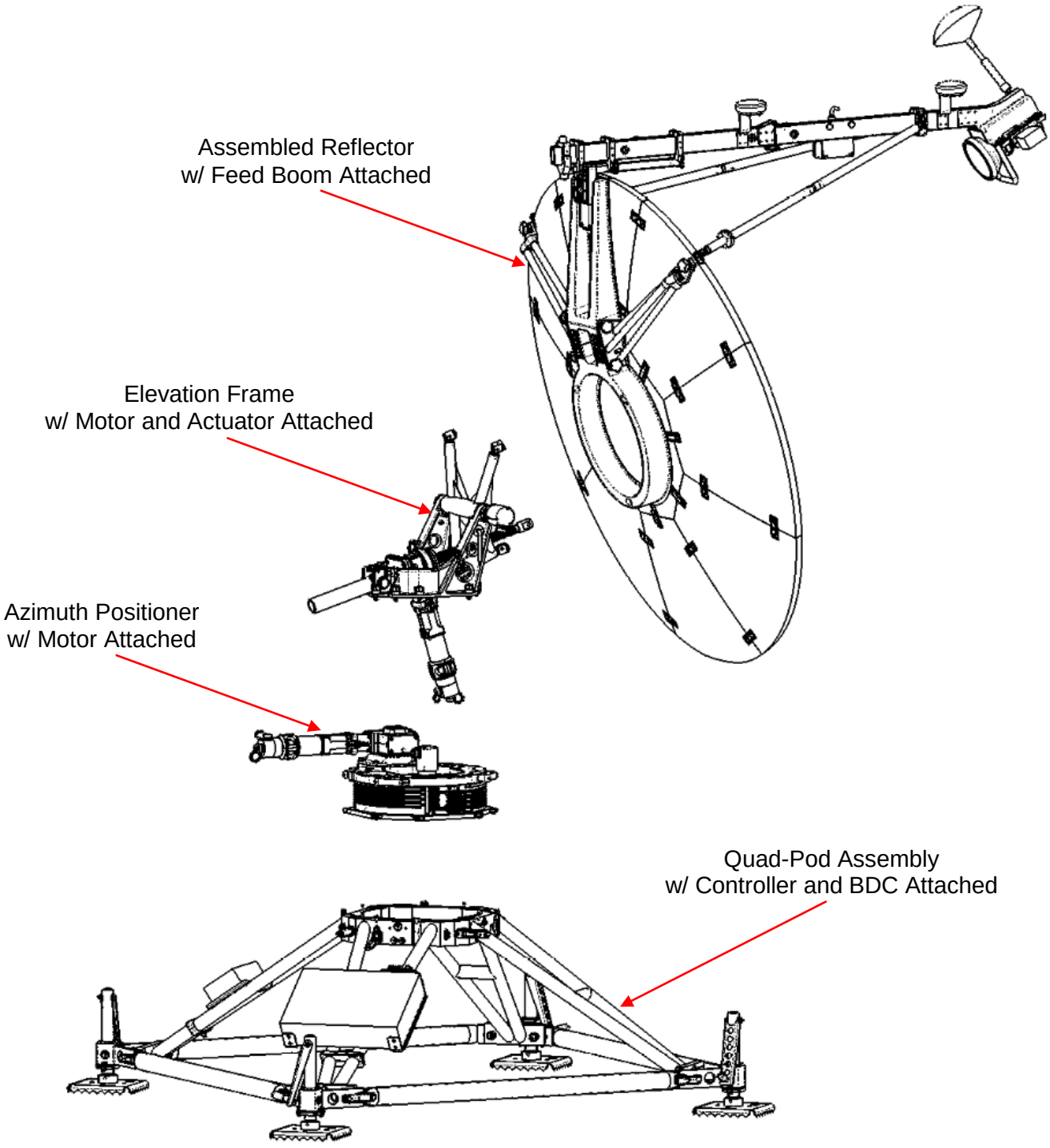



**Figure 58. Explosion View of Overall System**

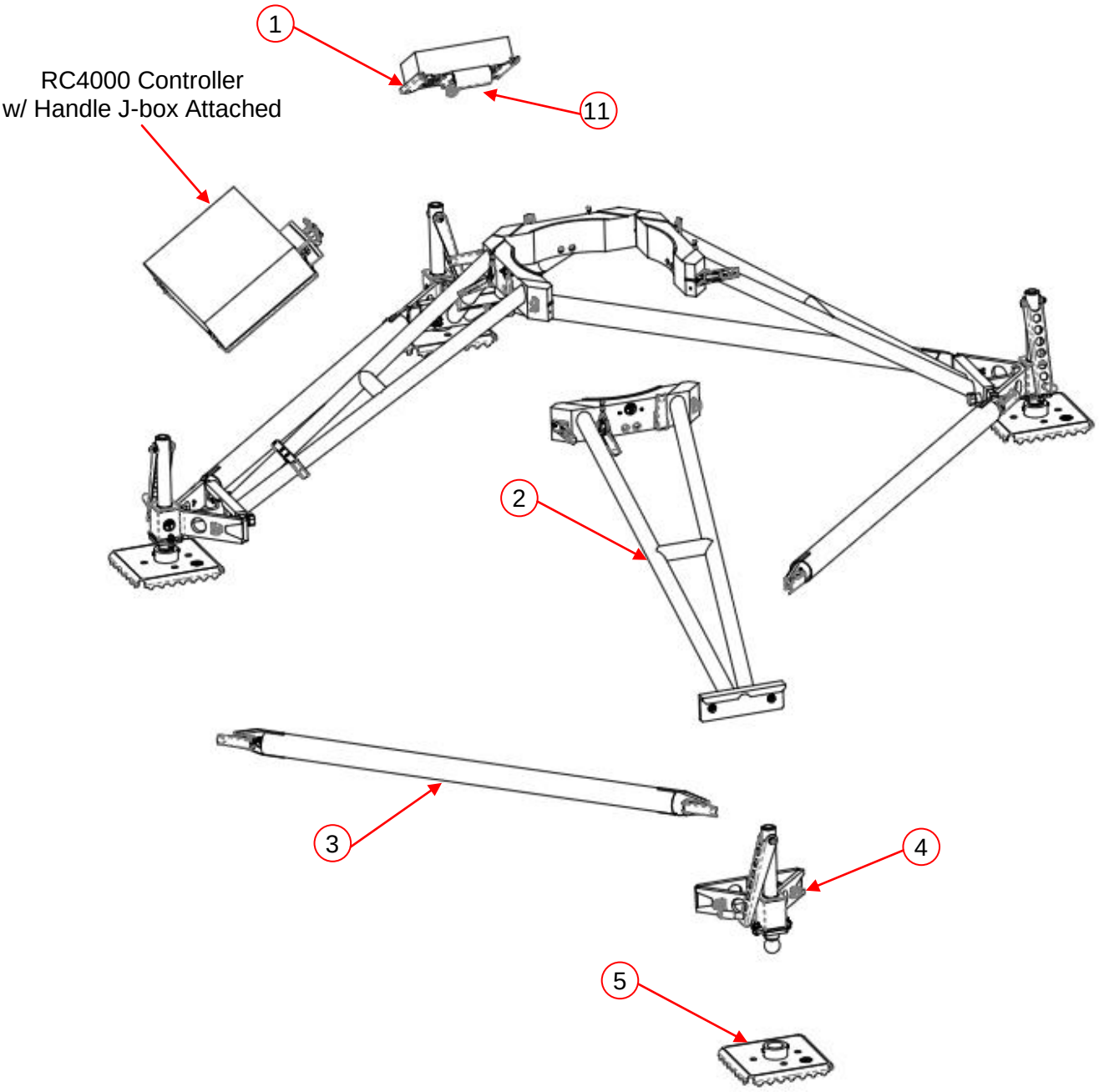



**Figure 59. Explosion View of Quad-Pod**

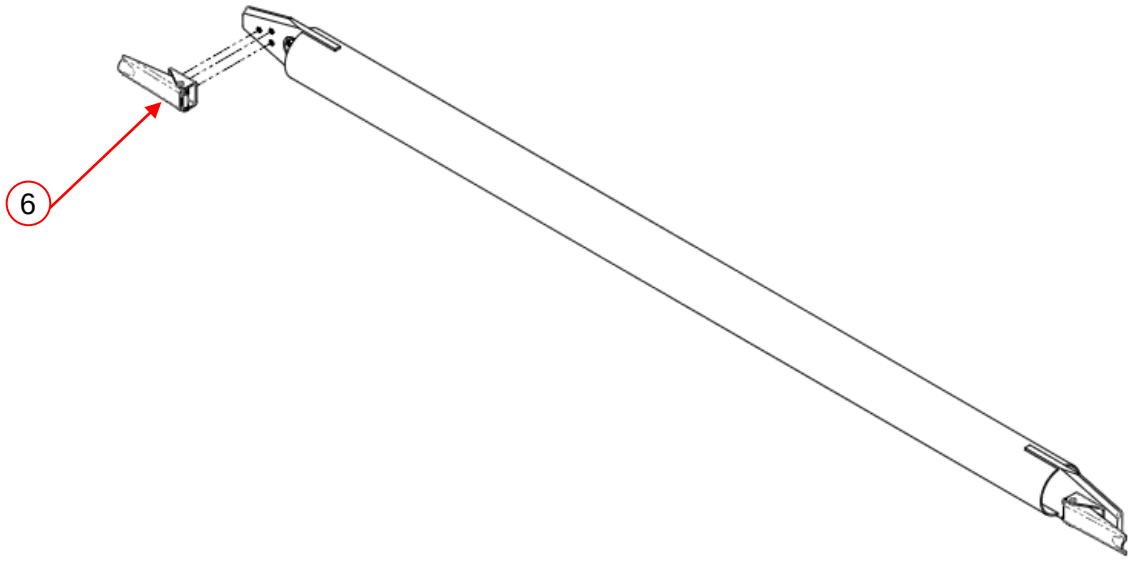



**Figure 60. Explosion View of Horizontal Tube**

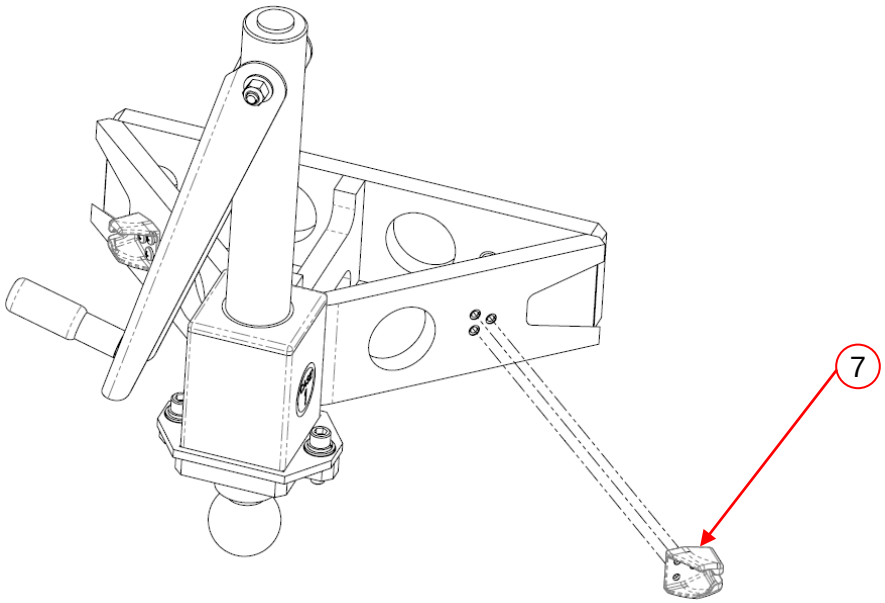



**Figure 61. Explosion View of Corner Jack**

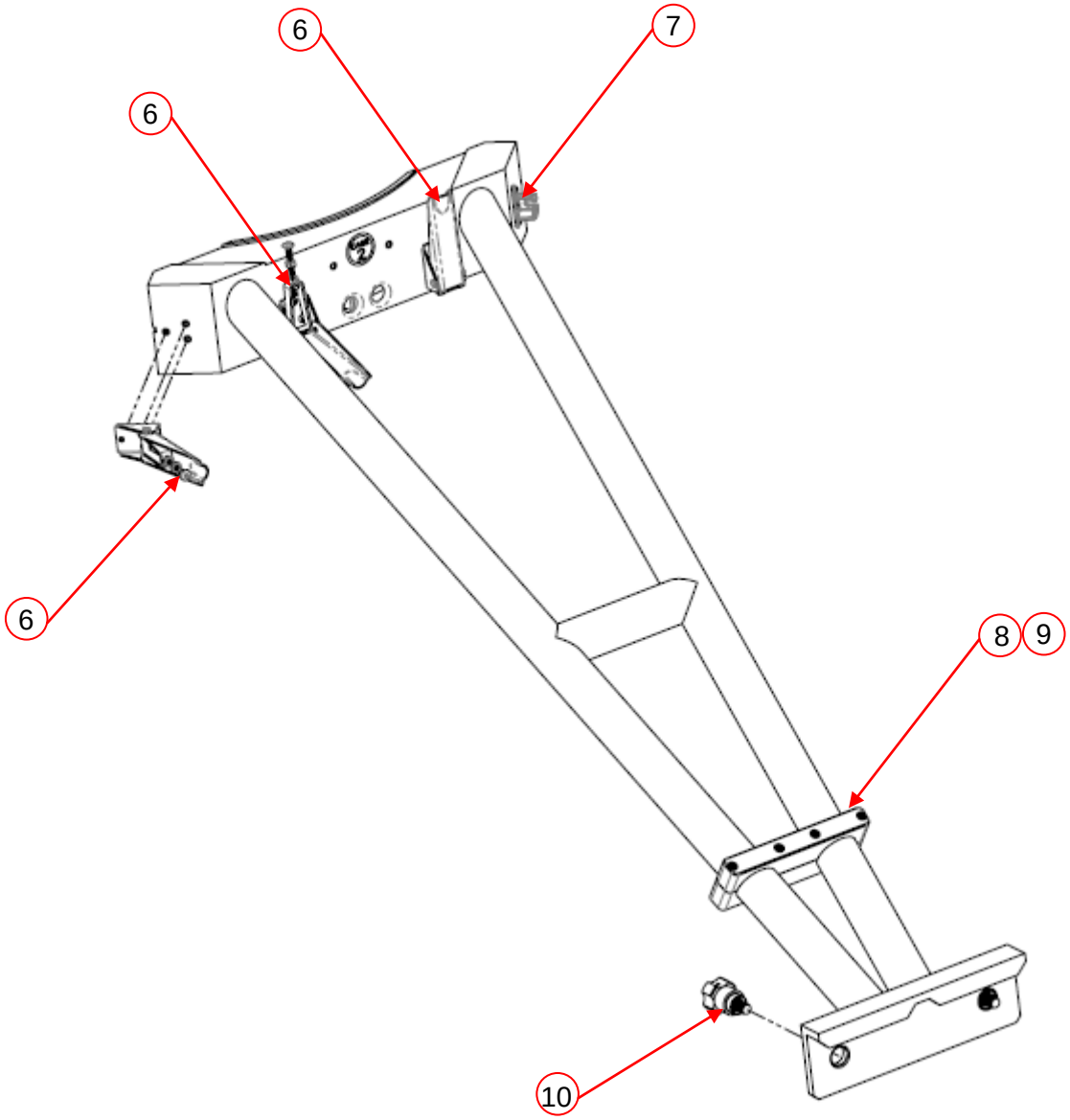



**Figure 62. Explosion View of Diagonal Tube Structure**

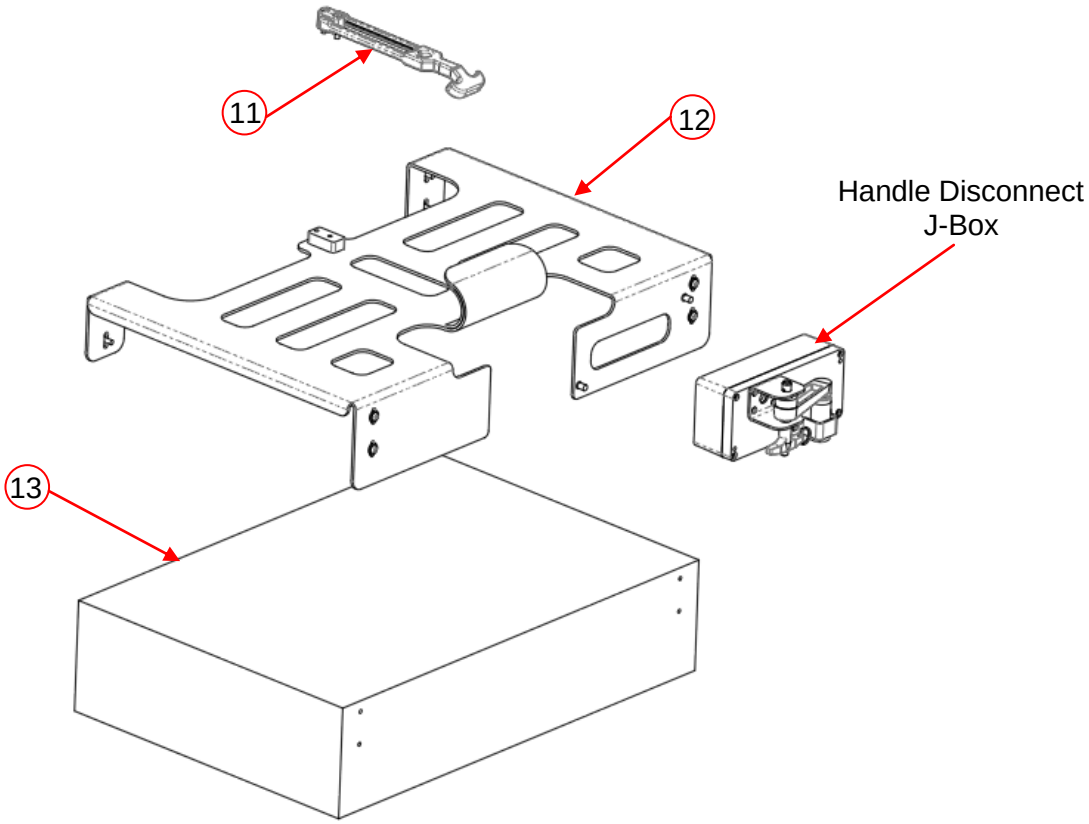



**Figure 63. Explosion View of RC4000 Controller Bracket**

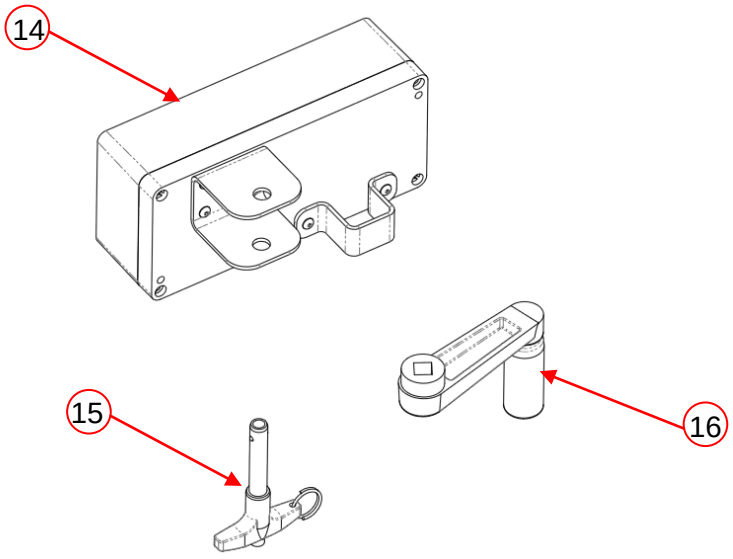



**Figure 64. Explosion View of Handle Disconnect J-Box**

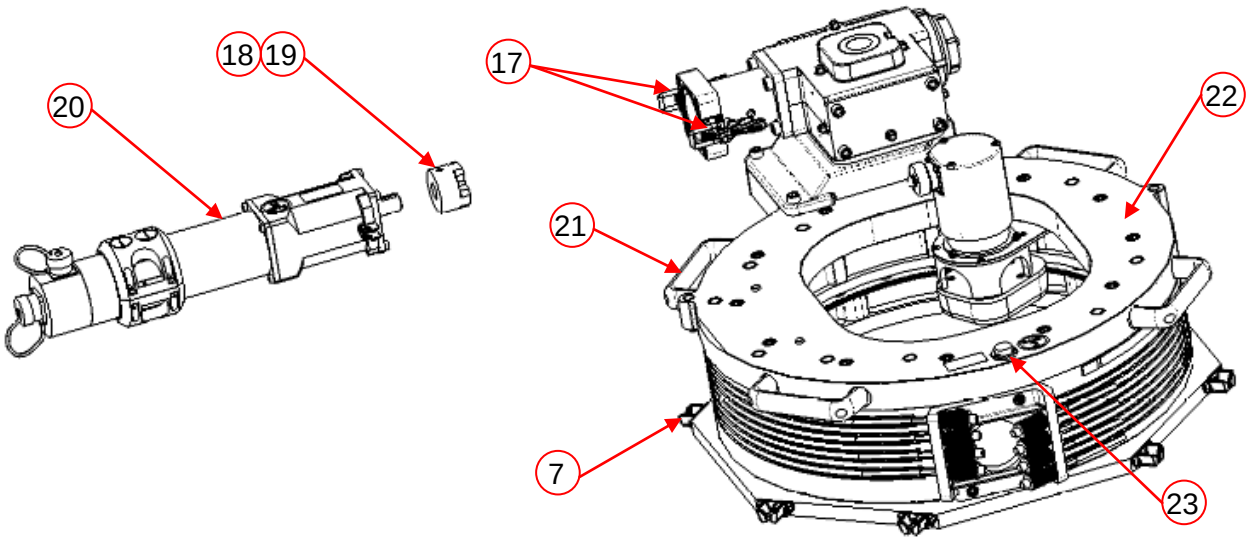



**Figure 65. Explosion View of Azimuth Positioner**

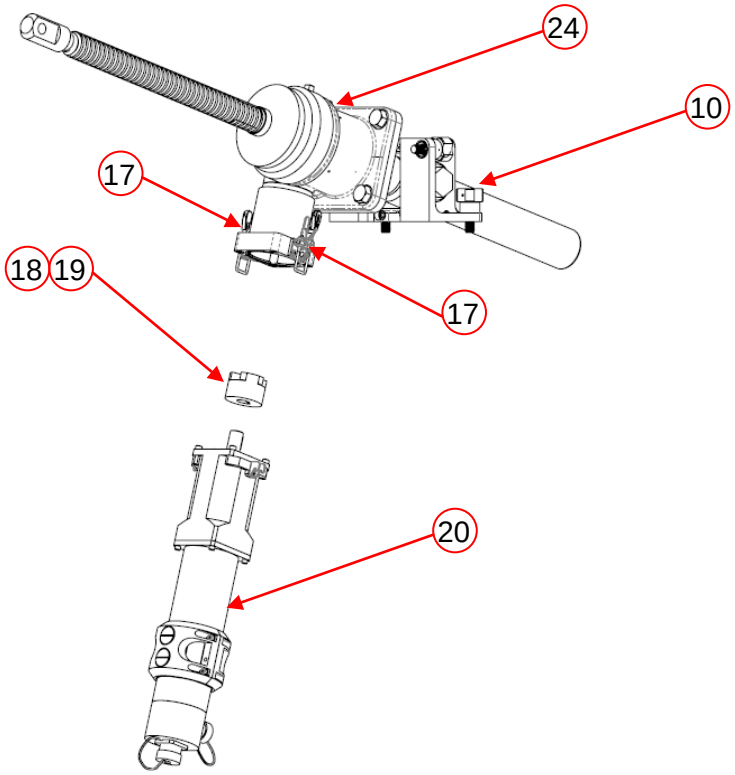



**Figure 66. Explosion View of Elevation Actuator Assembly**

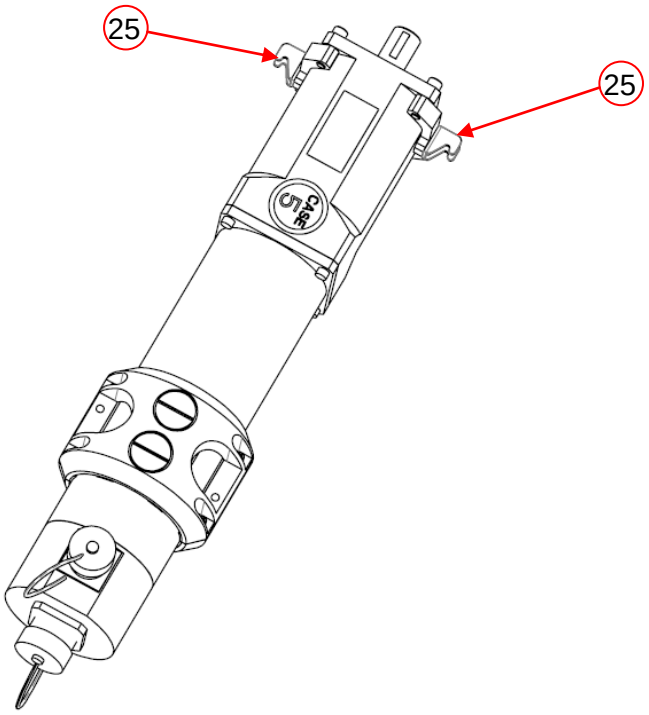



**Figure 67. Explosion View of Motor**

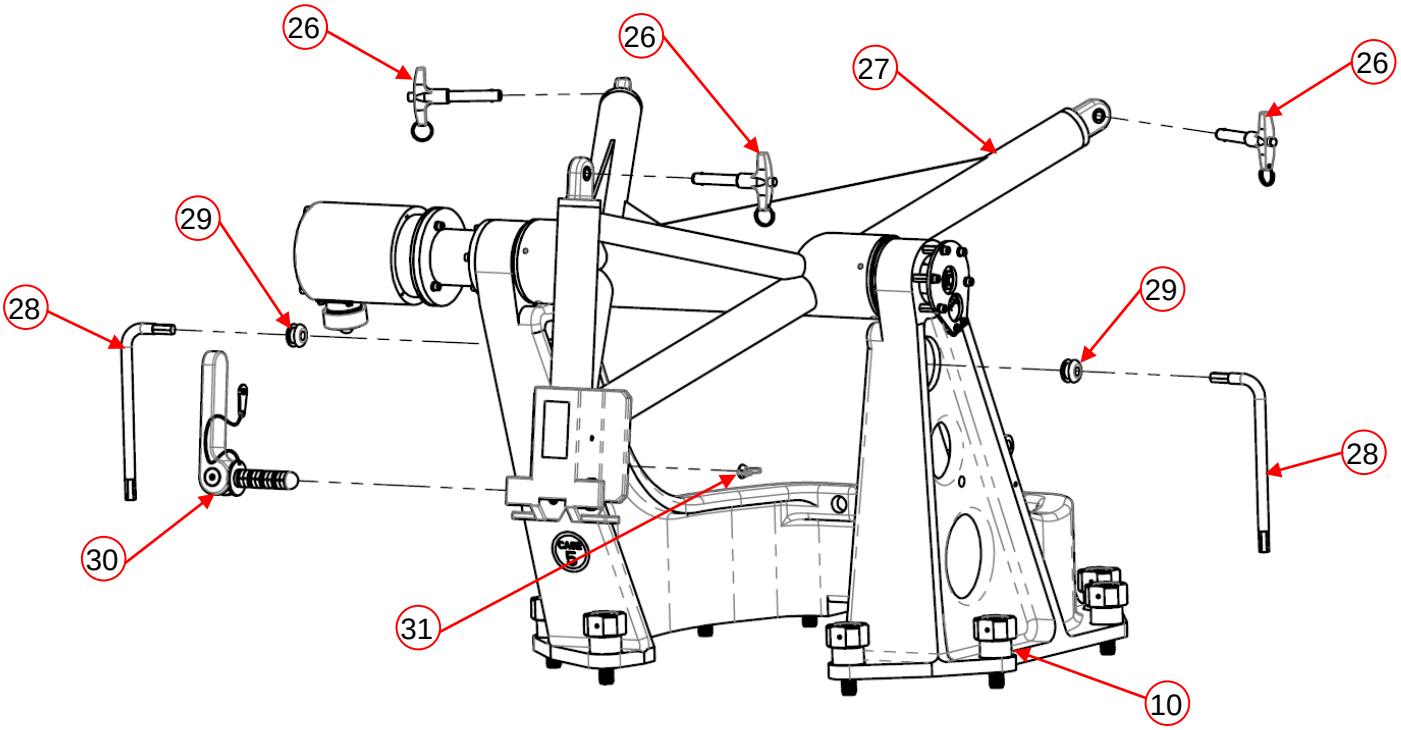



**Figure 68. Explosion View of Elevation Frame**

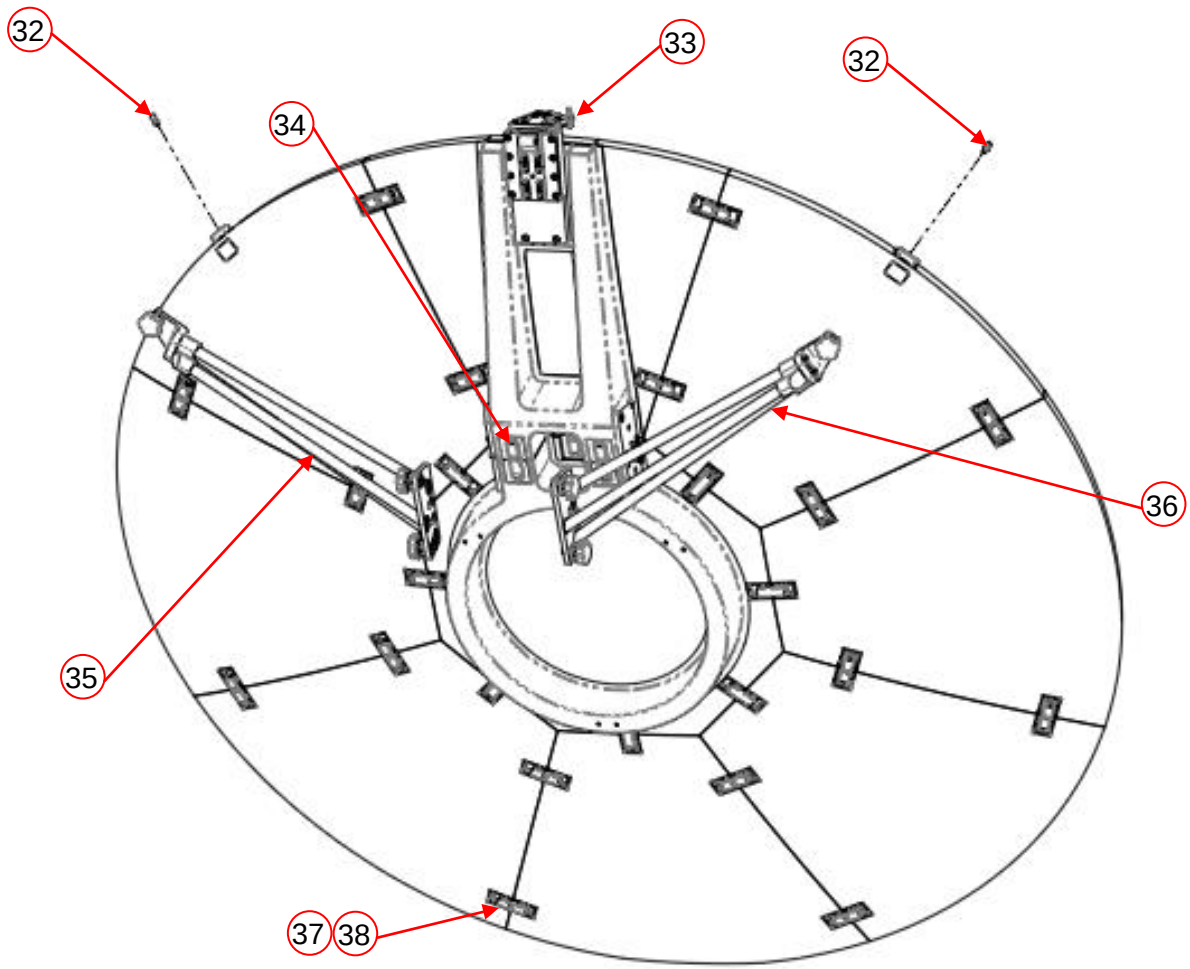



**Figure 69. Explosion View of Reflector**

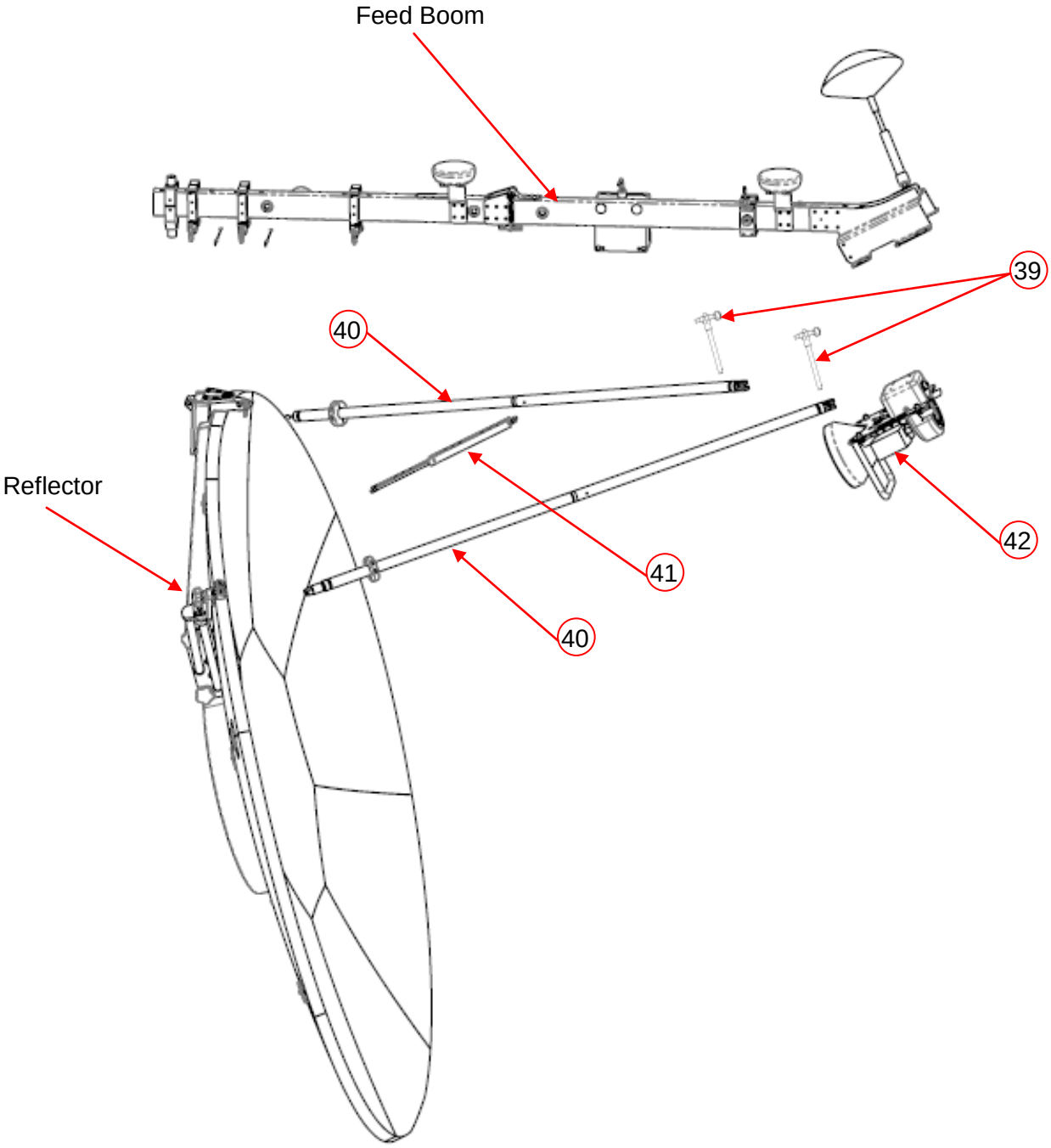



**Figure 70. Explosion View of Reflector and Feed Boom**

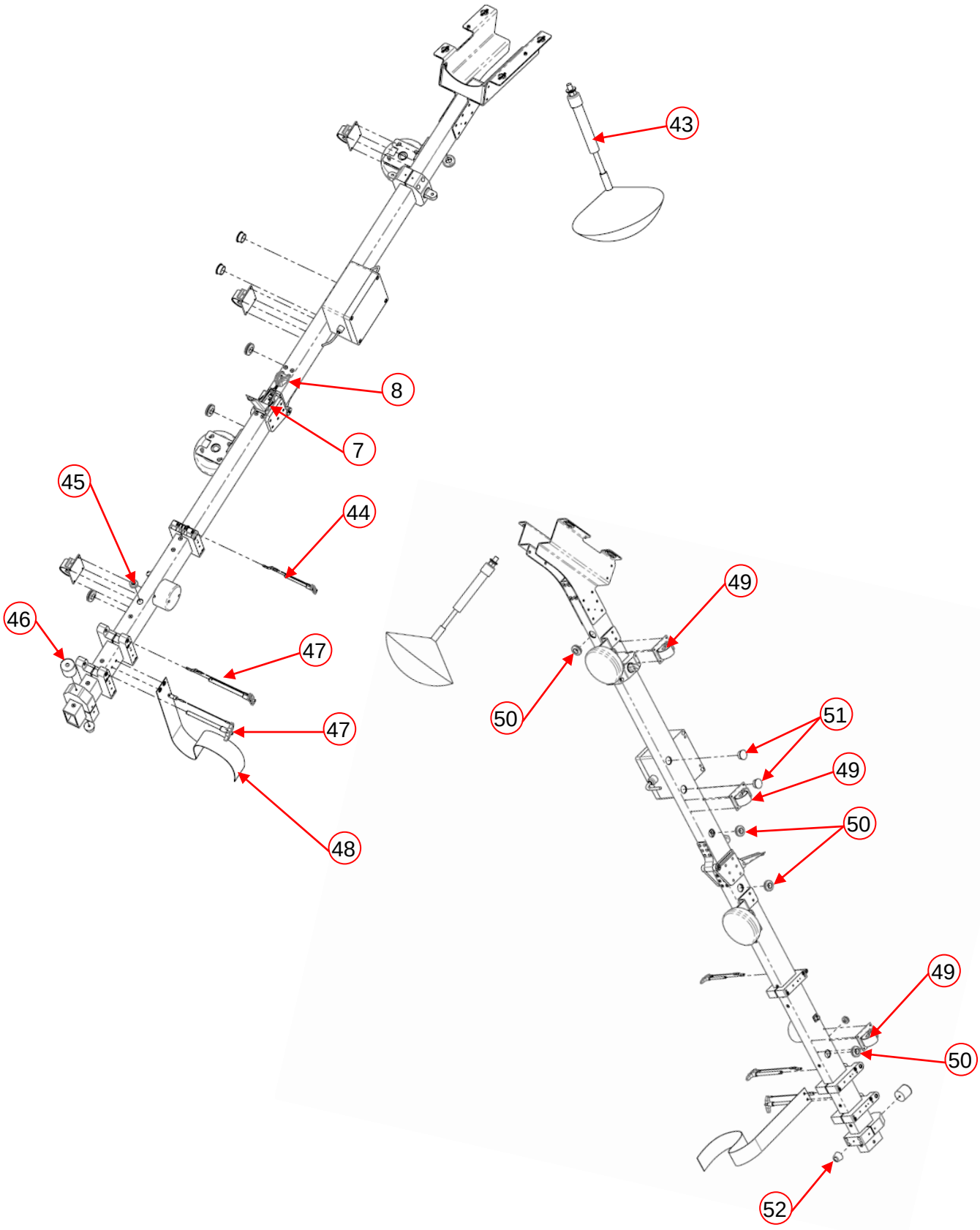



**Figure 71. Explosion View of Feed Boom**

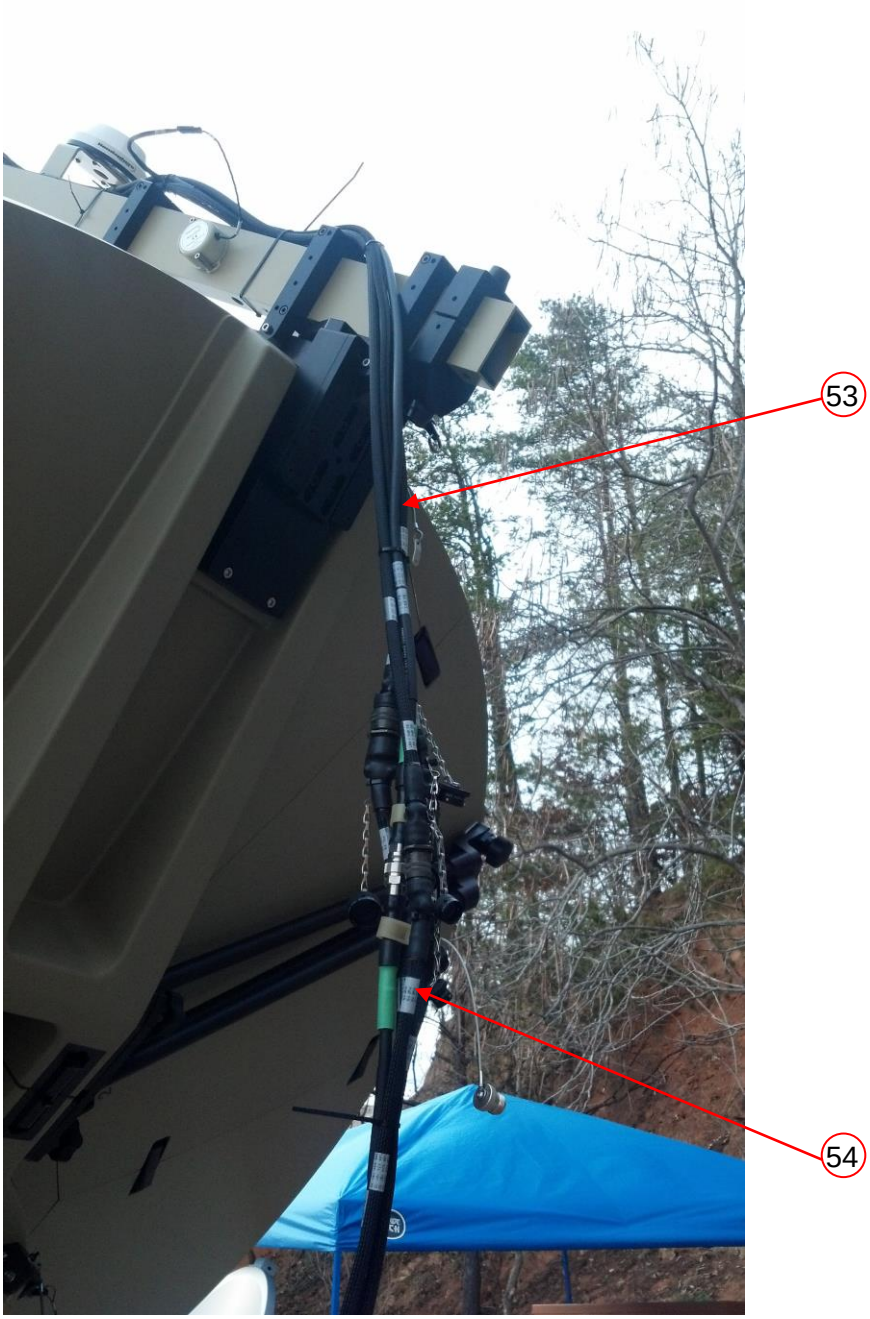



**Figure 72. Wiring Bundles on 2460 HW**


**Figure 73. Wiring Bundles on 2460 HW Cont.**

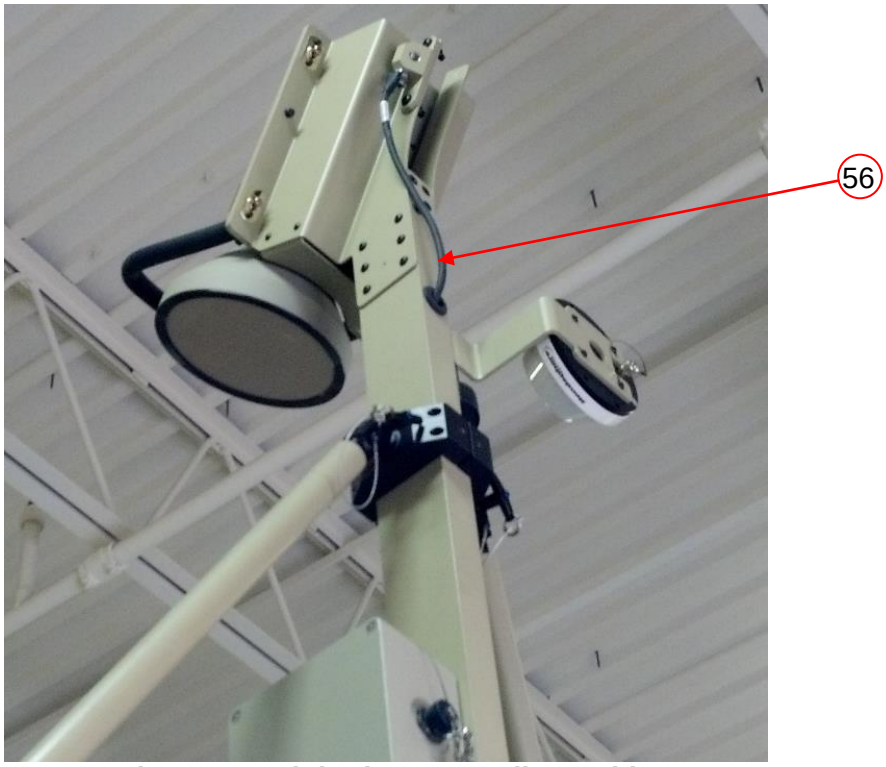


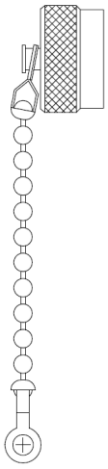

**Figure 74. Lightning Grounding Cable**

# Appendix C:

## Spare Kit Parts List
## (AvL Part Number: 245-076-301)

### 1. Item Reference

The following list represents parts included within the supplied Spare Parts kit for each 2460 HW 9-Pc. Ref. Antenna System. All images are approximate.



AvL Part Number: 172306
Part Description: DUST CAP, RC4K N
Quantity per Unit: 4
Amount in Kit: 2
Associated Hardware: N/A

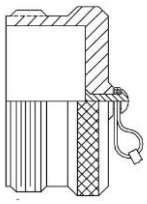
AvL Part Number: 031-6-RFX
Part Description: DUST CAP, RC4K BNC
Quantity per Unit: 5
Amount in Kit: 2
Associated Hardware: N/A

AvL Part Number: 2008618-1
Part Description: DUST CAP, RC4K RJ45
Quantity per Unit: 1
Amount in Kit: 1
Associated Hardware: N/A

AvL Part Number: MS3181-12NA
Part Description: DUST CAP, RC4K RJ45, 12
Quantity per Unit: 5
Amount in Kit: 2
Associated Hardware: N/A

AvL Part Number: MS3181-14NA
Part Description: DUST CAP, RC4K RJ45, 14
Quantity per Unit: 5
Amount in Kit: 2
Associated Hardware: N/A

AvL Part Number: MS3181-16NA
Part Description: DUST CAP, RC4K RJ45, 16
Quantity per Unit: 5
Amount in Kit: 2
Associated Hardware: N/A



AvL Part Number: MS25042-16DA
Part Description: DUST CAP
Quantity per Unit: 1
Amount in Kit: 1
Associated Hardware: N/A

AvL Part Number: MS3180-12CA
Part Description: DUST CAP
Quantity per Unit: 5
Amount in Kit: 2
Associated Hardware: N/A

AvL Part Number: MS3181-12CA
Part Description: DUST CAP
Quantity per Unit: 2
Amount in Kit: 1
Associated Hardware: N/A

AvL Part Number: MS3180-8CA
Part Description: DUST CAP
Quantity per Unit: 2
Amount in Kit: 1
Associated Hardware: N/A

AvL Part Number: MS3181-14CA
Part Description: DUST CAP
Quantity per Unit: 1
Amount in Kit: 1
Associated Hardware: N/A

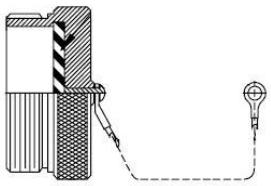
AvL Part Number: MS3180-16CA
Part Description: DUST CAP
Quantity per Unit: 1
Amount in Kit: 1
Associated Hardware: N/A

AvL Part Number: MS3180-14CA
Part Description: DUST CAP
Quantity per Unit: 5
Amount in Kit: 2
Associated Hardware: N/A

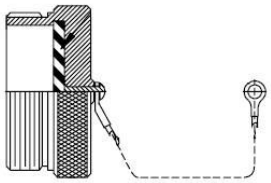
AvL Part Number: MS3180-10CA
Part Description: DUST CAP
Quantity per Unit: 3
Amount in Kit: 2
Associated Hardware: N/A

AvL Part Number: 1828740-1
Part Description: DUST CAP
Quantity per Unit: 1
Amount in Kit: 1
Associated Hardware: N/A

AvL Part Number: MS3181-10CA
Part Description: DUST CAP
Quantity per Unit: 1
Amount in Kit: 1
Associated Hardware: N/A



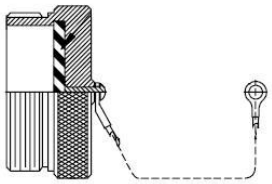
AvL Part Number: D38999/32W15N
Part Description: DUST CAP
Quantity per Unit: 2
Amount in Kit: 1
Associated Hardware: N/A



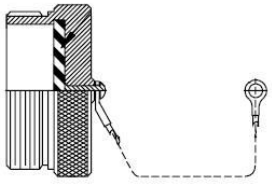
AvL Part Number: D38999/32W21N
Part Description: DUST CAP
Quantity per Unit: 2
Amount in Kit: 1
Associated Hardware: N/A

AvL Part Number: MS3181-8CA
Part Description: DUST CAP
Quantity per Unit: 1
Amount in Kit: 1
Associated Hardware: N/A

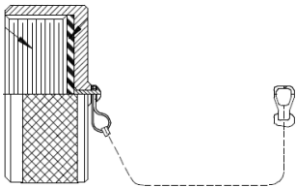
AvL Part Number: MS3181-8C
Part Description: DUST CAP
Quantity per Unit: 1
Amount in Kit: 1
Associated Hardware: N/A



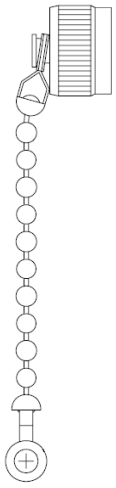
AvL Part Number: D38999/33W21R
Part Description: DUST CAP
Quantity per Unit: 2
Amount in Kit: 1
Associated Hardware: N/A



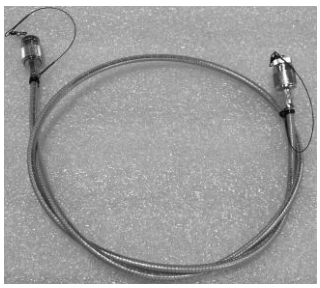
AvL Part Number: D38999/33W15R
Part Description: DUST CAP
Quantity per Unit: 2
Amount in Kit: 1
Associated Hardware: N/A



AvL Part Number: 660-005B20H5-05
Part Description: DUST CAP
Quantity per Unit: 2
Amount in Kit: 1
Associated Hardware: N/A

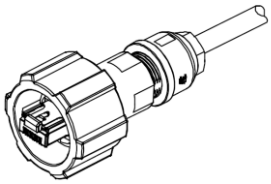


AvL Part Number: PE6023
Part Description: DUST CAP
Quantity per Unit: 4
Amount in Kit: 2
Associated Hardware: N/A

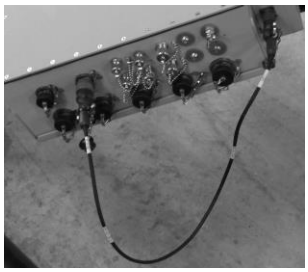


AvL Part Number: 300-892-701
Part Description: GPS COAX WITH COVERS
Quantity per Unit: 2
Amount in Kit: 1
Associated Hardware: N/A

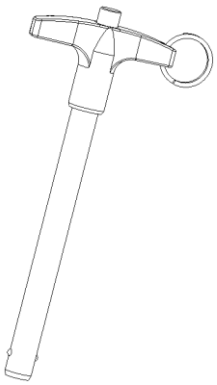
AvL Part Number: 300-823-701
Part Description: CABLE, RC4K POWER
Quantity per Unit: 1
Amount in Kit: 1
Associated Hardware: N/A



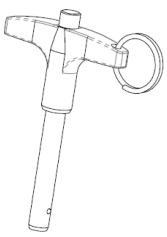
AvL Part Number: 300-823-702
Part Description: CABLE, RC4K ETHERNET
Quantity per Unit: 1
Amount in Kit: 1
Associated Hardware: N/A



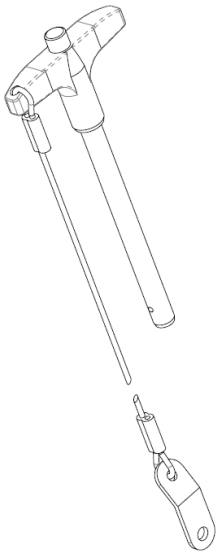
AvL Part Number: 300-823-709
Part Description: CABLE, RC4K TX IND
Quantity per Unit: 1
Amount in Kit: 1
Associated Hardware: N/A



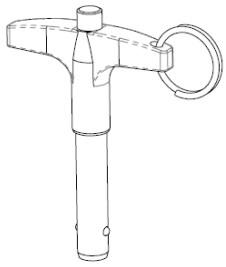
AvL Part Number: P0031
Part Description: QUICK RELEASE T-PIN 3/8" DIA. X 3.50" LG.
Quantity per Unit: 2
Amount in Kit: 1
Associated Hardware: N/A



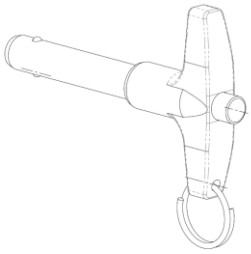
AvL Part Number: P0368
Part Description: QUICK RELEASE T-PIN 1/4" DIA. X 1.25" LG.
Quantity per Unit: 1
Amount in Kit: 1
Associated Hardware: N/A



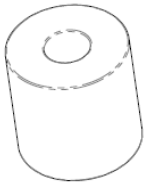
AvL Part Number: 93750A320
Part Description: QUICK RELEASE T-PIN 1/4" DIA. X 2.25" LG.
Quantity per Unit: 1
Amount in Kit: 1
Associated Hardware: N/A



AvL Part Number: P0302
Part Description: QUICK RELEASE T-PIN 5/16" DIA. X 1.00" LG.
Quantity per Unit: 1
Amount in Kit: 1
Associated Hardware: N/A

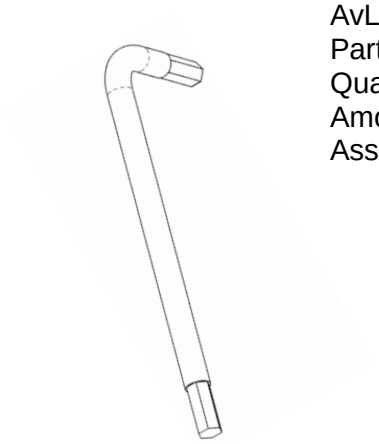


AvL Part Number: P0134
Part Description: QUICK RELEASE T-PIN 5/16" DIA. X 1.00" LG.
Quantity per Unit: 3
Amount in Kit: 2
Associated Hardware: N/A

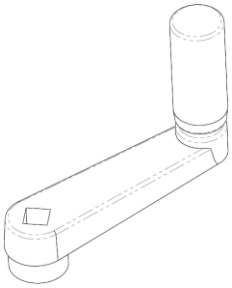


AvL Part Number: 9540K2
Part Description: RUBBER BUMPER
Quantity per Unit: 1
Amount in Kit: 1
Associated Hardware: (1) 10-32 UNF X 1 BHCS

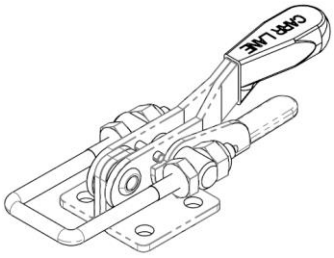
AvL Part Number: 9405K61
Part Description: PLASTIC BUMPER
Quantity per Unit: 1
Amount in Kit: 1
Associated Hardware: (1) 10-32 UNF X 1 BHCS



AvL Part Number: 11981/1VHT1
Part Description: TOOL; 5/16” HEX KEY
Quantity per Unit: 2
Amount in Kit: 1
Associated Hardware: N/A

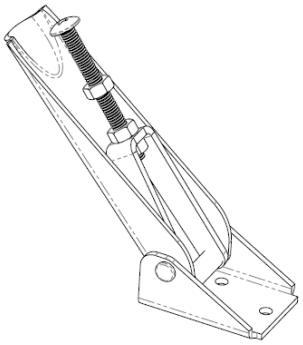


AvL Part Number: 3VB94
Part Description: HANDCRANK; 3/8" SQ DRIVE; ALUM
Quantity per Unit: 1
Amount in Kit: 1
Associated Hardware: N/A

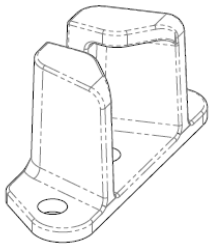



AvL Part Number: CL-100-LPA-S
Part Description: CLAMP, TOGGLE
Quantity per Unit: 4
Amount in Kit: 2
Associated Hardware: N/A

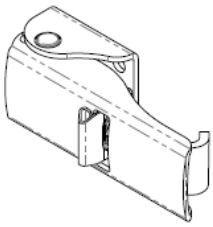
AvL Part Number: CL-100-PA-S-L
Part Description: PLATE, LATCH
Quantity per Unit: 4
Amount in Kit: 2
Associated Hardware: N/A



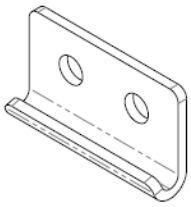
AvL Part Number: 91-99-258-15
Part Description: LATCH; DRAW
Quantity per Unit: 21
Amount in Kit: 6
Associated Hardware: (3) 10-32 UNF x ½ SHCS



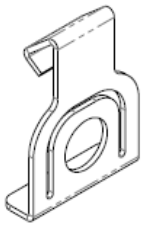
AvL Part Number: 91-99-261-25
Part Description: BRACKET; LATCH
Quantity per Unit: 21
Amount in Kit: 6
Associated Hardware: (3) 10-32 UNF x ½ SHCS



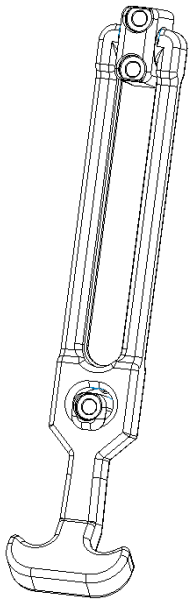
AvL Part Number: 91-522-52
Part Description: UNDER-CENTER DRAW LATCH
Quantity per Unit: 23
Amount in Kit: 6
Associated Hardware: (3) 6-32 UNC x 3/8 BHCS



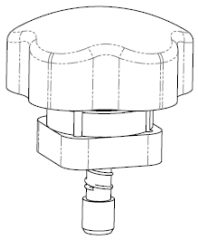
AvL Part Number: K4-2338-52
Part Description: EXPOSED LATCH KEEPER
Quantity per Unit: 23
Amount in Kit: 6
Associated Hardware: (2) 6-32 UNC x 3/8 BHCS



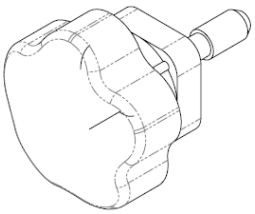
AvL Part Number: 203-581-001
Part Description: LATCH SPRING CLIP
Quantity per Unit: 3
Amount in Kit: 1
Associated Hardware: N/A



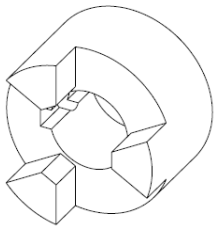
AvL Part Number: P0334
Part Description: LATCH; LARGE FLEXIBLE T-HANDLE
Quantity per Unit: 2
Amount in Kit: 1
Associated Hardware: N/A



AvL Part Number: 103-376-303
Part Description: KNOB ASSEMBLY; 3/8-16 X 2.25
Quantity per Unit: 4
Amount in Kit: 2
Associated Hardware: (4) 6-32 UNC x ¾ SHCS

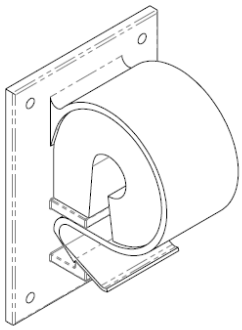


AvL Part Number: 103-376-305
Part Description: KNOB ASSEMBLY; 3/8-16 X 2.62
Quantity per Unit: 2
Amount in Kit: 1
Associated Hardware: (4) 6-32 UNC x ¾ SHCS



AvL Part Number: 17856
Part Description: COUPLING, HUB
Quantity per Unit: 2
Amount in Kit: 1
Associated Hardware: N/A

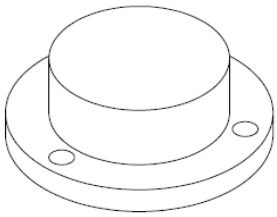

AvL Part Number: 6912K581
Part Description: STRAP; VELCO
Quantity per Unit: 1
Amount in Kit: 1
Associated Hardware: (2) ¼" ALUM. RIVET



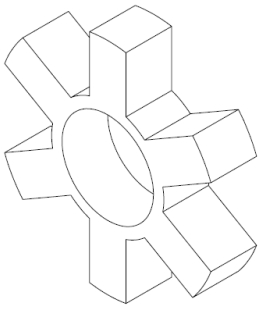
AvL Part Number: P0276
Part Description: CLAMP; CABLE
Quantity per Unit: 3
Amount in Kit: 1
Associated Hardware: (4) 6-32 UNC X 3/8 BHCS

AvL Part Number: 93575A029
Part Description: WING NUT; ¼"-20
Quantity per Unit: 1
Amount in Kit: 1
Associated Hardware: N/A

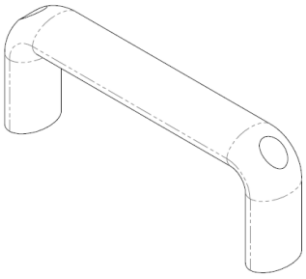
AvL Part Number: 92001A330
Part Description: WING NUT; 5/16-18
Quantity per Unit: 1
Amount in Kit: 1
Associated Hardware: N/A



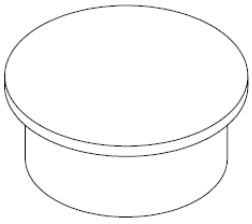
AvL Part Number: 2-12050
Part Description: LEVEL; CIRCULAR
Quantity per Unit: 1
Amount in Kit: 1
Associated Hardware: (3) 4-40 UNC x ¼ SHCS



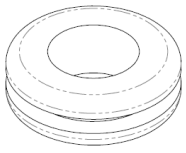
AvL Part Number: 685144-25310
Part Description: COUPLER, SPIDER
Quantity per Unit: 2
Amount in Kit: 1
Associated Hardware: N/A



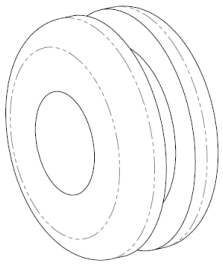
AvL Part Number: 26W132B80K
Part Description: ALUMINUM HANDLE
Quantity per Unit: 4
Amount in Kit: 2
Associated Hardware: (2) ¼-20 UNC x 1 SHCS



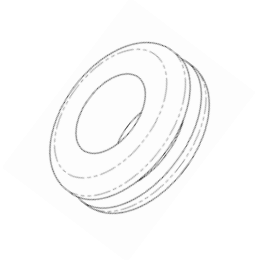
AvL Part Number: 85985K24
Part Description: PLUG
Quantity per Unit: 2
Amount in Kit: 1
Associated Hardware: N/A



AvL Part Number: P0422
Part Description: GROMMET
Quantity per Unit: 1
Amount in Kit: 1
Associated Hardware: N/A



AvL Part Number: 9307K79
Part Description: GROMMET
Quantity per Unit: 4
Amount in Kit: 2
Associated Hardware: N/A



AvL Part Number: 9307K91
Part Description: GROMMET
Quantity per Unit: 2
Amount in Kit: 1
Associated Hardware: N/A

# Appendix D:

## Optional Anchoring and Weighting Instructions

### 1. Introduction

The following section details the two most common methods of stabilizing the antenna system for high wind applications, the use of external weights and the use of external anchors such as earth anchors installed during deployment or permanent tie-downs provided at the site. For all stabilizing methods, the following steps should be performed to insure the antenna system has been properly deployed.

1. First, deploy the unit as stated within the main section of this manual (see Section 5: 2460 HW General Deployment and Assembly Instructions). Insure the unit's feet rest in good contact on relatively flat ground.

2. After assembling the unit, adjust the corner jacks so that each is in good contact with the ground.

3. Next, using the corner jacks, adjust the unit so that a relatively level platform is achieved. While leveling the unit is not critical as the ACU performs a tilt compensation, it is preferred the unit is adjusted as needed until a level platform is achieved. This is to reduce inaccuracies within the tilt sensors.

In all deployments of the unit, proper judgment should be used as to what external stabilization is best suited to the current situation. All situations are unique and should be treated as such. The following sections serve only to illustrate general occurrences and recommendations.

### 2. Stabilizing with Weights

Typical Terrain Types:

- Rooftops
- Concrete
- Asphalt
- Soils, varying from hard packed to loose sand

Many terrains, such as rooftops or concreted areas, often do not afford the option of using anchoring devices such as ground stakes. In these instances, additional weights can be applied to the unit to provide higher stability in wind. Sandbags are common in this application, but any dense fill material such as gravel and soil can be used equally.

When applying weights to the unit, insure they are placed on the corner jacks or horizontal tubes if possible. This location should allow for proper rotation of the reflector. However, interference in all axes of motions should be checked prior to use. The following Figure 75 illustrates the proper locations to apply weights to the unit.

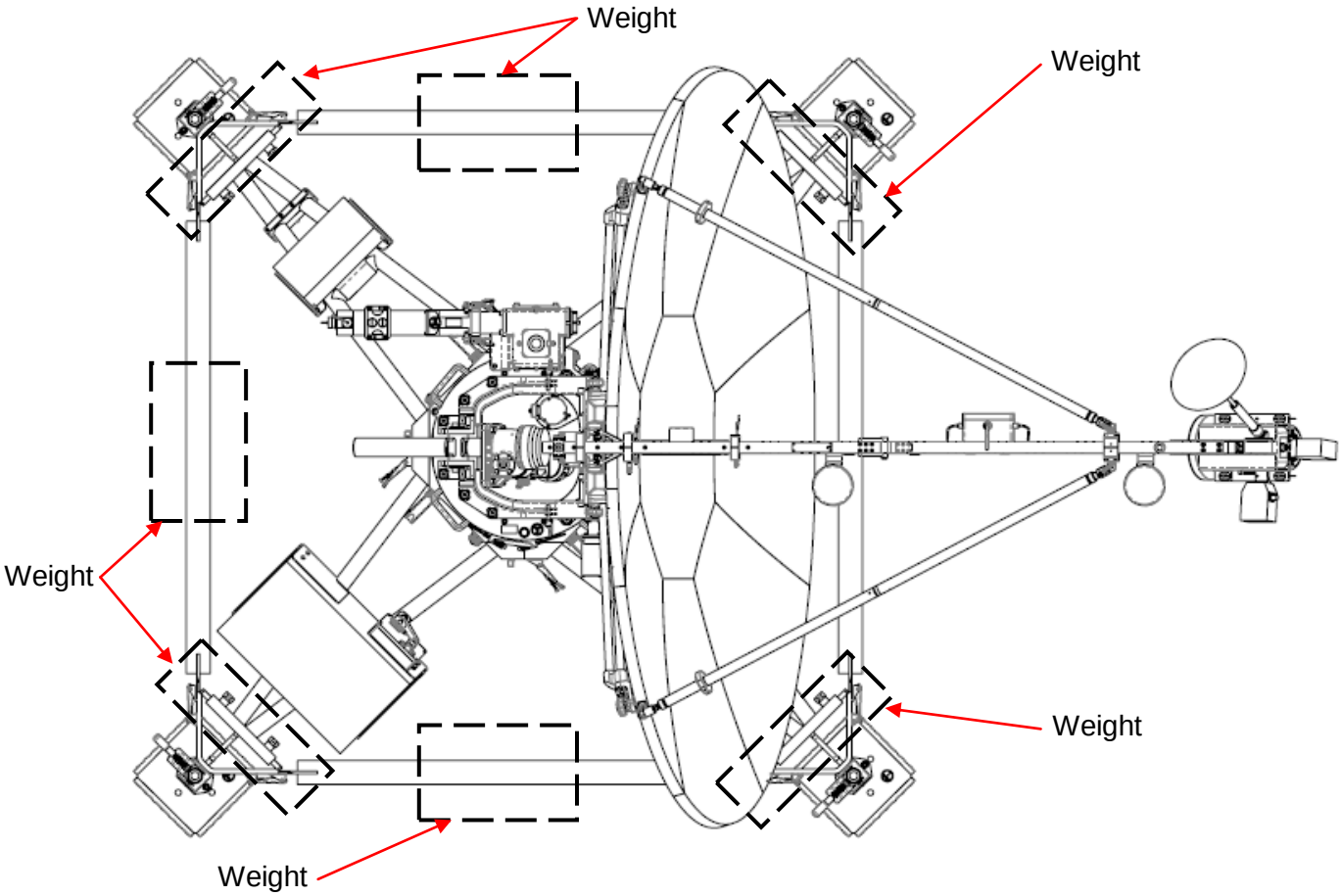



**Figure 75. Application of Weights to Unit**

## 3. Stabilizing with Anchors

**WARNING: MINIMUM OF 4 MODEL 88-DBL OR EQUIVALENT ANCHORS ARE REQUIRED TO PROPERLY ANCHOR UNIT.**

Typical Terrain Types:

- Soil (Grass, Clay, Hard Pack)
- Compacted Sand
- Asphalt
- Concrete with Cast Anchors

Utilizing fixed point anchors, such as earth anchors or equivalent tie-downs, to secure the unit may be used when the terrain allows. Typically, turnbuckles or ratcheting straps are associated with the application of anchors to firmly secure the unit to the ground. For this use, galvanized steel turnbuckles (supplied in Case 10) may be utilized to secure the unit using tie down locations on the diagonal tube structures. Additional hardware may also be necessary to secure the selected strapping method to the chosen earth anchor.

Figure 76 shows the location of the specified tie down areas on the diagonal tube structures. Reference Appendix B: Interface Drawing for suggested earth anchor locations.

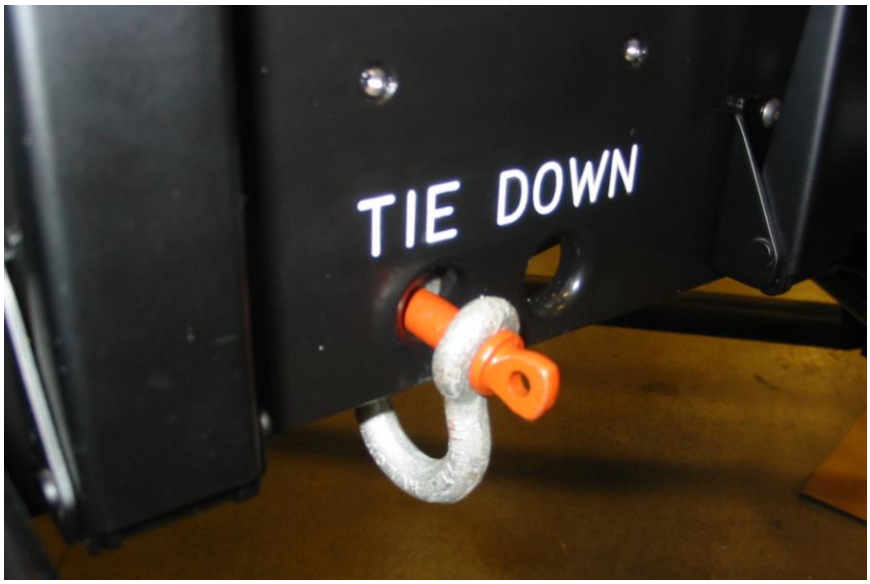



**Figure 76. Tie Down Location on Diagonal Tube Structures**

Consult the manufacturer's instructions as a guide for pull out strength and terrain conditions. If in doubt, consult a locally licensed civil engineer.

For this application, Foresight® Products' Duckbill® model 88 earth anchors (or equivalent) may be used. Make sure to review any manufacture's technical specifications and literature before use. Anchoring devices may vary according to soil types. Installation of the Duckbill® earth anchor is described in Figure 77 on page 94. The following text and figures have been taken from Foresight® Products' instruction material:

The patented Duckbill® earth anchor works like a toggle bolt in soil. It is "driven" into the ground (no holes or digging required). This can be accomplished with a sledge hammer and drive steel. Once driven to the proper depth, the drive steel is removed, and the anchor tendon is pulled upon to rotate the anchor into a perpendicular locked position in undisturbed soil. The anchors can then be load tested if required.


**Figure 77. Foresight® Products' Duckbill® Instillation**

FORESIGHT® PRODUCTS, LLC
There's a Foresight Earth Anchor for Every Application.
World Headquarters
6430 East 49th Drive
Commerce City, Colorado 80022 USA
800-325-5360 / 303-286-8955
FAX 303-287-3866



# DUCKBILL PERFORMANCE REVOLUTIONIZES ANCHORING TECHNOLOGY

***DUCKBILL** Anchors*

Driving the **DUCKBILL** Anchor.

The **DUCKBILL** anchor works like a toggle bolt when rotated in undisturbed soil.

## THE DUCKBILL PRINCIPLE:

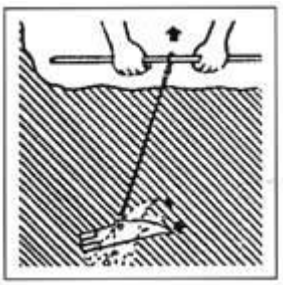
**DUCKBILL** anchors, a patented labor and time saving device, work like a toggle bolt in soil. **DUCKBILLS** are driven into the ground (with no holes, no digging and no concrete), providing a safe and environmentally sensitive installation. An upward pull on the anchor tendon rotates the **DUCKBILL** into a perpendicular "anchor lock" position in undisturbed soil. The result: superb holding capacities. **DUCKBILL** anchor systems offer the most effective, lightweight and economical solutions to any anchoring application, large or small.

### 1. DRIVE ANCHOR TO DESIRED DEPTH:

**DUCKBILL** anchors are driven into the soil using a hammer and drive steel. As the anchor is being driven, it is actually compacting the soil around the anchor head.

### 2. SETTING ANCHORS IN THE SOIL:

To set the anchor in normal soil, wrap the wire rope around the drive steel or insert rod through loop in wire rope and pull upward a distance slightly longer than the length of the anchor body. The upward pull on the wire rope rotates the anchor into a perpendicular anchor locking position in undisturbed soil.



### 3. LARGER DUCKBILL ANCHORS:

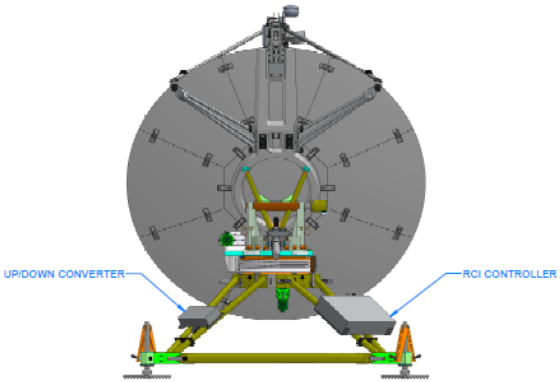
To set larger anchors, use the fulcrum (lever) principle, manual or hydraulic jack, winch or post puller.

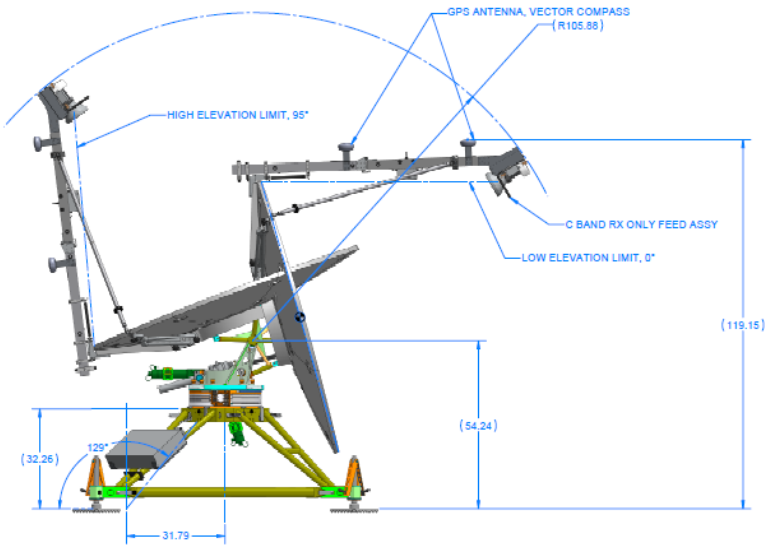
# Appendix E:

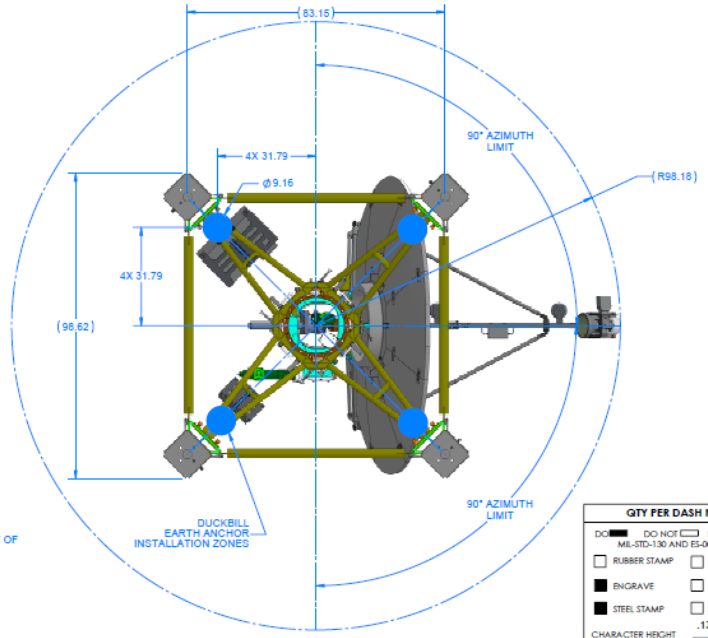
## Interface Drawing

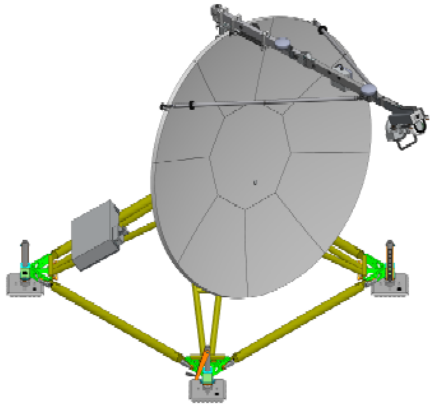
For further information contact AvL Technologies, engineering department.

| REVISIONS | | | | |
|---|---|---|---|---|
| REV. | ECN | DESCRIPTION | APPROVED | DATE |



NOTES:
1. ANCHORING KIT MUST BE INSTALLED IN WINDS EXCEEDING 40 MPH.
2. EARTH ANCHORS MUST RESIST 1100 LB PULLOUT FORCE.
3. PROOF-LOADING THE ANCHORS IS THE ONLY WAY TO INSURE THE EXACT CAPACITY OF EACH INSTALLATION.

| QTY PER DASH NO. | PARTS LIST | AvL CONFIDENTIAL AND PROPRIETARY |
|---|---|---|
| DO ■ DO NOT □ IDENTIFY PER MIL-STD-130 AND ES-001/013 | UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: FRACTIONS ± .03 DECIMALS .XX± .02 .XXX± .005 ANGLES ± 1/2° | CONTRACT NUMBER |
| ☐ RUBBER STAMP ☐ BAG/TAG | MATERIAL: SEE P/L | DRAWN EDL 1/10/2012 |
| ■ ENGRAVE ☐ SILK SCREEN | | CHECKED DATE |
| ■ STEEL STAMP ☐ SEE NOTE | FINISH: N/A | MECH DESIGN EDL 1/10/2012 |
| CHARACTER HEIGHT .13 | | ELEC DESIGN DATE |
| CHARACTER COLOR BLK | | MFG/QA ENGR DATE |
| LOCATE APPROX AS SHOWN | | |

AvL TECHNOLOGIES
ASHEVILLE, NC

TITLE: FLY AWAY, HIGH WIND, 2.4M SI INTERNATIONAL, RECEIVE ONLY, C BAND

| SIZE | CAGE CODE | DRAWING NO. | REV |
|---|---|---|---|
| D | 43WN8 | 245-000-504 | |

SCALE 1:20 WEIGHT 1409.340 LB SHEET 1 OF 1

DATE PRINTED: 2/27/2012

FILE: C:\pdm working\245-000-504

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