

EVA Checklist

STS-115 Flight Supplement

**Mission Operations Directorate
EVA, Robotics, and Crew Systems
Operations Division**

**Final, Rev C
August 16, 2006**

NOTE

This supplement is to be integrated into the generic edition to provide a complete document for the specific flight. Some pages in the generic edition may be replaced with supplemental pages identified as 'TEMP'. These generic pages, if any, must be retained for use on future flights.

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
Houston, Texas

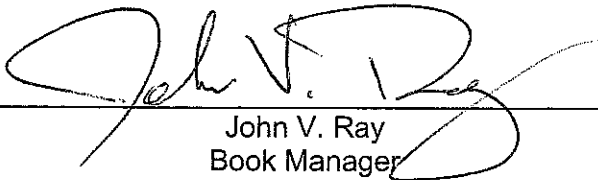


MISSION OPERATIONS DIRECTORATE

**EVA CHECKLIST
STS-115 FLIGHT SUPPLEMENT**

FINAL, REVISION C
August 16, 2006

PREPARED BY:




John V. Ray
Book Manager

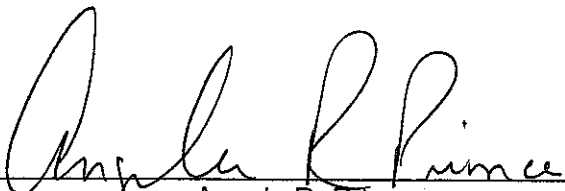
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Incorporates the following:		
482#:	EVA-1545A	EVA-1703A
	EVA-1687	EVA-1704A
	EVA-1691A	EVA-1705
	EVA-1692	EVA-1706
	EVA-1693	EVA-1707B
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	EVA-1700A	EVA-1714
	EVA-1701A	EVA-1715
	EVA-1702	

AREAS OF TECHNICAL RESPONSIBILITY

Book Manager

DX32/J. Ray

281-483-7068

EVA CHECKLIST
STS-115 FLIGHT SUPPLEMENT

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FINAL 04/30/03
REV C 08/16/06

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			FS 7-13	115/FIN C

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FS 18-12	115/FIN C	19-11	generic
FS 18-13	115/FIN C	19-12	generic
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FS 18-15	115/FIN C	20-2	* generic
FS 18-16	115/FIN C		
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* – Omit from flight book

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AIRLOCK CONFIG

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AIRLOCK
CONFIG

AIRLOCK PREP (50 min)

	Retrieve or unstow following equipment:
MF28G	3/8-in breaker bar, 4-in ext w/3/8-in drive
IFM Tool Kit	1/2-in socket w/3/8-in drive
Vol H	EMU Equipment Bag – attach to middeck wall
	Helmet Lights
	EVA Bag
	Contamination Detection Kit (location flight specific)
<hr/> FDF Locker	Cuff Checklists (2) – stow in EMU Equipment Bag
	<u>DEPRESS/REPRESS</u> Cue Card

- AW18A
1. ✓ Inner hatch Equal vlv (two) – OFF
 2. LTG FLOOD (four) – ON
 3. Remove from airlock, as reqd:
 - Airlock Stowage Bag
 - Airlock Floor Pallet using 3/8-in breaker bar, 4-in ext w/3/8-in drive, and 1/2-in socket w/3/8-in drive
 4. Stow Vol H Bags in Vol H
 5. Transfer to airlock:
 - EVA Bag – install on airlock wall
 - DEPRESS/REPRESS Cue Card
 - Helmet Lights
 - Contamination Detection Kit – install on airlock wall
 6. Install IVA foot restraint, as reqd
 7. Unbuckle SCU straps, Velcro SCU to wall
 8. Install EMU lights on helmets (EMU 1, EMU 2)
 9. Disconnect helmets from Airlock EMUs, temp stow
 10. Remove comm caps from LTA Restraint Bags and connect to electrical harnesses
 11. Install helmets (not reqd if proceeding directly to EMU Checkout)
 12. Remove LTA Restraint Bags
 13. Disconnect waist rings; remove and stow any equipment stowed in HUT/LTA
 14. Stow LTA Restraint Bags on AAPs
 15. ✓ Thermal cover clear of waist ring
 16. Waist ring – engage posn
 17. Connect LTA to HUT, lock
 18. Remove 20-g Crash Bag from middeck EMU, as reqd

EVA PREP FOR TRANSFER TO ISS (120 min)

- BOTH EMUs/
DCM
1. √PWR – SCU
 2. √PURGE vlv – op (up)
 3. √WATER – OFF, switch guard installed
 4. √O2 ACT – OFF
 5. Configure/verify items according to table below:

For stowage locations refer to EMU EQUIPMENT SORTED BY
LOCATION (TOOLS AND STOWAGE)

<p><u>EMU 3004 (Ta):</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> DIDB (in Restraint Bag) <input type="checkbox"/> LCVG (disconnected from MWC) <input type="checkbox"/> Wrist Mirror (2) <input type="checkbox"/> ISS EVA Cuff Checklist (w/12A notes) <input type="checkbox"/> CCA <input type="checkbox"/> Helmet (with cover) <input type="checkbox"/> TA1 Gloves <input type="checkbox"/> EMU Battery (S/N 2031) <input type="checkbox"/> LiOH Cartridge (S/N 2002) <input type="checkbox"/> <u>Mesh Bag (TA)</u> <ul style="list-style-type: none"> <input type="checkbox"/> EMU Equip Bag Crew Compartments <ul style="list-style-type: none"> <input type="checkbox"/> Comfort Gloves <input type="checkbox"/> Croakie <input type="checkbox"/> EVA 1,3 Ziplock Bags (TA)(2) <ul style="list-style-type: none"> <input type="checkbox"/> MAG <input type="checkbox"/> TCUs (top, bottom) <input type="checkbox"/> Socks <input type="checkbox"/> LTA (Ta) <input type="checkbox"/> LTA Restraint Strap and Bag 	<p><u>EMU 3017 (Pp):</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> DIDB (in Restraint Bag) <input type="checkbox"/> LCVG (disconnected from MWC) <input type="checkbox"/> Wrist Mirror (2) <input type="checkbox"/> ISS EVA Cuff Checklist (w/12A notes) <input type="checkbox"/> CCA <input type="checkbox"/> Helmet (with cover) <input type="checkbox"/> PP1 Gloves <input type="checkbox"/> EMU Battery (S/N 2036) <input type="checkbox"/> LiOH Cartridge (S/N 2003) <input type="checkbox"/> <u>Mesh Bag (PP)</u> <ul style="list-style-type: none"> <input type="checkbox"/> EMU Equip Bag Crew Compartment <ul style="list-style-type: none"> <input type="checkbox"/> Wristlets <input type="checkbox"/> Comfort Gloves <input type="checkbox"/> EVA 1,3 Ziplock Bags (PP)(2) <ul style="list-style-type: none"> <input type="checkbox"/> MAG <input type="checkbox"/> TCUs (tops, bottom) <input type="checkbox"/> Mole Skin <input type="checkbox"/> Socks <input type="checkbox"/> LTA (Pp) <input type="checkbox"/> LTA Restraint Strap and Bag
<p><u>Mesh Bag (EVA Systems)</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> FDF: EVA FS Checklist (1 of 2) <input type="checkbox"/> EMU/Airlock Consumables Cue Card (FDF) <input type="checkbox"/> PGT batteries (2) <input type="checkbox"/> HL battery (for IR Camera) <input type="checkbox"/> Film Cassette (35mm 100Cneg for F5 camera) <input type="checkbox"/> IV 6" adjustable wrench <input type="checkbox"/> <u>Mesh LEH Helmet Bag (CEVIS Hdw):</u> <ul style="list-style-type: none"> <input type="checkbox"/> Ergometer shoes (3 pairs) <input type="checkbox"/> Exercise Prebreathe Cue Card <input type="checkbox"/> HR Monitor Wristwatch (1) <input type="checkbox"/> HR Monitor Chest Straps (2) 	<p><u>Mesh Bag (EVA Systems)</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> CSA-O2 (2) <input type="checkbox"/> EVA Wire Ties <input type="checkbox"/> C-Lk Depress/Repress Cue Card (2) <input type="checkbox"/> ISS EVA Sys Checklist (1 of 2 = Red Stripe w/115 crew notes) <input type="checkbox"/> EMU Servicing Kit (labeled "Transfer after last EVA")
<p><u>Mesh Bag (BB)</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> ISS EVA Cuff Checklist (w/12A notes) <input type="checkbox"/> BB1 gloves (1 pair) <input type="checkbox"/> BB1 LCVG (w/biomed) <input type="checkbox"/> BB1 CCA <input type="checkbox"/> EV3 (red broken) ID stripes, mission patch, USA flag <input type="checkbox"/> EVA 2, 4 Ziplock Bags (BB)(2) <ul style="list-style-type: none"> <input type="checkbox"/> MAG <input type="checkbox"/> TCUs (top, bottom) <input type="checkbox"/> Comfort Gloves <input type="checkbox"/> Wristlets <input type="checkbox"/> Socks <input type="checkbox"/> Mole Skin <input type="checkbox"/> Croakies 	<p><u>Mesh Bag (MN)</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> ISS EVA Cuff Checklist (w/12A notes) <input type="checkbox"/> MN1 gloves (1 pair) <input type="checkbox"/> MN1 CCA <input type="checkbox"/> MN1 LCVG (w/biomed) <input type="checkbox"/> EV4 (bp) ID stripes, mission patch, Can. flag <input type="checkbox"/> EVA 2, 4 Ziplock Bags (MN)(2) <ul style="list-style-type: none"> <input type="checkbox"/> MAG <input type="checkbox"/> TCUs (top, bottom) <input type="checkbox"/> Comfort Gloves <input type="checkbox"/> Wristlets <input type="checkbox"/> Socks <input type="checkbox"/> Mole Skin <input type="checkbox"/> Croakies <input type="checkbox"/> Tegaderm

POST-DOCKING EVA TRANSFER/RECONFIG (75 min)

NOTE

This procedure assumes that transfer items were reconfigured per EVA PREP FOR ISS TRANSFER

EMU/TOOL TRANSFER TO ISS (10 min/2 crew)

1. Transfer following EMU equipment to ISS per table, report status:

Items Needed Before EVA 1:		
Item	Destination	Transfer Status
EMU 1 (s/n 3004, Ta)	Aft EDDA	
EMU 2 (s/n 3017, Pp)	Fwd EDDA	
Mesh Bag (EVA Systems)	E-Lk	
Items Needed Before EVA 2:		
Item	Destination	Transfer Status
Mesh Bag (Bb)	Node 1	
Mesh Bag (Mn)	Node 1	

- A/L1O1 2. Verify spare EMU (3015, L) w/0.5" Arm sizing rings in airlock

LiOH/METOX SWAP FOR TANNER/PIPER (15 min/2 crew)

- Mesh Bag (EVA Sys) 3. Unstow SODF: ISS EVA SYS C/L, DEPRESS/REPRESS Cue Cards

Place one cue card in C-lk, other in E-lk

- EMU 1,2 4. Unstow EMU/AIRLOCK CONSUMABLES cue card for reference
 5. Rotate EDDA open
 6. Unzip PLSS thermal cover and Velcro to top
 7. Remove and cap LiOH canisters, temp stow
 8. Install EVA1 Metox canisters per EMU/AIRLOCK CONSUMABLES Cue Card

CAUTION
 Do NOT install Metox in the Airlock CO2 Removal Box at this point in the timeline

- MO2 Bag (EVA Prep and Ops) 9. Locate and pre-position as desired the follow items:
 (Note EVA1 items per EMU/AIRLOCK CONSUMABLES Cue Card)
- 2.0 CTB Sn 1060 (Regenerated Metox)
 - Mesh Bag (Expended Metox – empty)
 - 0.5 CTB Sn 1205 (EMU and HL Batteries)
 - Helmet Light Batteries (4 – loose in bag or installed on Lights)
 - PGT Batteries (3 – loose in bag or with PGTs)
 - Old ISS EMU Servicing Kit (loose in bag or attached to wall)
 - REBA Batteries (2 – loose in bag or staged for installation)
 - REBA BSA cable Sn 1001 (loose in bag)

POST-DOCKING EVA TRANSFER/RECONFIG (75 min) (Cont)

EMU 3006 RECONFIG FOR MACLEAN (25 min)

NOTE

The following steps can be performed
as late as during EVA 1

10. Reconfig EMU Equipment Bag crew compartment (1 of 4) with MN items:
- Comfort Gloves MN1 gloves
 - Wristlets MN1 CCA
- EMU 4 11. Install EMU (s/n 3006, L, Mn) in EDDA, as required
12. Install ISS EVA Cuff Checklist
13. Install STS-115 mission patch, bp ID stripes, Canadian flag
14. Verify cam configurations per EMU NOMINAL SIZING (STS-115/12A) (EMU CONT PROCS)
15. Retrieve EVA 2 LiOH canister per EMU/AIRLOCK CONSUMABLES Cue Card
16. Rotate EDDA open, as required
17. Unzip PLSS thermal cover and Velcro to top
18. Verify EMU battery installed
19. Remove PLSS vent port plugs, temp stow in EMU Equipment Bag

CAUTION

Limit exposure time of uncapped canister
ports and avoid contact with seals

20. Remove caps, $\sqrt{\text{LiOH}}$ canister O-ring seals for damage
21. Holding LiOH cartridge with aluminum plate serial number facing self, install LiOH into PLSS vent ports
22. Attach Velcro retainer strap, rotate canister into place
23. Lock latches and close thermal cover zipper

EMU 3008 RECONFIG FOR BURBANK (25 min)

24. Reconfig EMU Equipment Bag crew compartment (1 of 4) with BB items:
- Comfort Gloves BB1 gloves
 - Wristlets BB1 CCA
- EMU 3 25. Install EMU (s/n 3008, XL, Bb) in EDDA, as required
26. Install ISS EVA Cuff Checklist
27. Install STS-115 mission patch, EV3 (red, broken) ID stripes, USA flag
28. Verify cam configurations per EMU NOMINAL SIZING (STS-115/12A) (EMU CONT PROCS)
29. Retrieve EVA 2 LiOH canister per EMU/AIRLOCK CONSUMABLES Cue Card
30. Rotate EDDA open, as required
31. Unzip PLSS thermal cover and Velcro to top
32. Verify EMU battery installed
33. Remove PLSS vent port plugs, temp stow in EMU Equipment Bag

CAUTION

Limit exposure time of uncapped canister
ports and avoid contact with seals

34. Remove caps, $\sqrt{\text{LiOH}}$ canister O-ring seals for damage
35. Holding LiOH cartridge with aluminum plate serial number facing self, install LiOH into PLSS vent ports
36. Attach Velcro retainer strap, rotate canister into place
37. Lock latches and close thermal cover zipper
38. As comm permits, report to MCC-H completion of EMU reconfig and LiOH install

EVA PREP FOR TRANSFER TO SHUTTLE

I

ISS AIRLOCK/EMU CLEANUP

- ISS EMUs/ DCM
1. √SCUs disconnected
√PWR – SCU
√PURGE vlv – op (up)
√O2 ACT – OFF
√WATER – OFF, switch guard installed
 2. Disconnect BB and MN CCAs from HUT
Remove valsalva devices from Helmets
Install Helmets, lock
 3. Install Helmet Light/EMU TV assys on ISS Helmets
Install Helmet covers
- EMU 3
4. Remove STS-115 mission patch, EV3 ID (red, broken) stripes, USA flag
Stow in Mesh Bag (Bb Prime)
- EMU 4
5. Remove STS-115 mission patch, EV4 (bp) ID stripes, Canadian flag
Stow in Mesh Bag (Mn Prime)
 6. Remove BB and MN items from ISS EMU Equipment Bag crew compartments
Reconnect crew compartments to ISS EMU Equipment Bag, as required
 7. Stow all BB and MN EMU items in crew specific Mesh bags (BB, MN) per below table
 8. Remove Flight Specific Cuff pages from 3 of 4 new ISS cuff checklists, stow in ISS EMU Equipment Bag; stow 4th ISS cuff in BB mesh bag for xfer/return

STS EMU RE-PACK

- STS EMUs
9. √REBA, EMU TVs, Helmet lights, Metox removed
- DCM
10. √SCUs disconnected
√PWR – SCU
√PURGE vlv – op (up)
√O2 ACT – OFF
√WATER – OFF, switch guard installed
 11. Check that old ISS EMU Servicing Kit contains only one ISS biomed signal conditioner sn _____
 12. Configure/install all items for transfer per table:
(NOTE: **bolded** items differ from the pre-docking config)

EVA PREP FOR TRANSFER TO SHUTTLE (Cont)

<p>EMU 3004 (Ta):</p> <ul style="list-style-type: none"> <input type="checkbox"/> DIDB Restraint Bag <input type="checkbox"/> LCVG (disconnected from MWC) <input type="checkbox"/> Wrist Mirror (2) <input type="checkbox"/> No ISS EVA Cuff Checklist <input type="checkbox"/> CCA <input type="checkbox"/> Helmet (with cover) <input type="checkbox"/> TA1 Gloves <input type="checkbox"/> EMU Battery (S/N 2031) <input type="checkbox"/> LiOH Cartridge (S/N 2002) <input type="checkbox"/> LTA (Ta) <input type="checkbox"/> LTA Restraint Strap and Bag <input type="checkbox"/> <u>Mesh Bag (TA)</u> <ul style="list-style-type: none"> <input type="checkbox"/> EMU Equip Bag Crew Compartments <ul style="list-style-type: none"> <input type="checkbox"/> Comfort Gloves <input type="checkbox"/> Croakie <input type="checkbox"/> EVA 1,3 Ziplock Bags (TA)(2) <ul style="list-style-type: none"> <input type="checkbox"/> MAG (less used items) <input type="checkbox"/> TCUs (top, bottom) <input type="checkbox"/> Socks 	<p>EMU 3017 (Pp):</p> <ul style="list-style-type: none"> <input type="checkbox"/> DIDB Restraint Bag <input type="checkbox"/> LCVG (disconnected from MWC) <input type="checkbox"/> Wrist Mirror (2) <input type="checkbox"/> No ISS EVA Cuff Checklist <input type="checkbox"/> CCA <input type="checkbox"/> Helmet (with cover) <input type="checkbox"/> PP1 Gloves <input type="checkbox"/> EMU Battery (S/N 2036) <input type="checkbox"/> LiOH Cartridge (S/N 2003) <input type="checkbox"/> LTA (Pp) <input type="checkbox"/> LTA Restraint Strap and Bag <input type="checkbox"/> <u>Mesh Bag (PP)</u> <ul style="list-style-type: none"> <input type="checkbox"/> EMU Equip Bag Crew Compartment <ul style="list-style-type: none"> <input type="checkbox"/> Wristlets <input type="checkbox"/> Comfort Gloves <input type="checkbox"/> EVA 1,3 Ziplock Bags (PP)(2) <ul style="list-style-type: none"> <input type="checkbox"/> MAG (less used items) <input type="checkbox"/> TCUs (tops, bottom) <input type="checkbox"/> Mole Skin (less used items) <input type="checkbox"/> Socks
<p><u>Mesh Bag (EVA Systems)</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> FDF: EVA FS Checklist (1 of 2) <input type="checkbox"/> EMU/Airlock Consumables Cue Card (FDF) <input type="checkbox"/> PGT batteries (2) <input type="checkbox"/> HL battery (for IR Camera) <input type="checkbox"/> Film Cassette (35mm 100Cneg for F5 camera) <input type="checkbox"/> IV 6" adjustable wrench <input type="checkbox"/> <u>Mesh LEH Helmet Bag (CEVIS Hdw):</u> <ul style="list-style-type: none"> <input type="checkbox"/> Ergometer shoes (3 pairs) <input type="checkbox"/> Exercise Prebreathe Cue Card <input type="checkbox"/> HR Monitor Wristwatch (1) <input type="checkbox"/> HR Monitor Chest Straps (2) 	<p><u>Mesh Bag (EVA Systems)</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> No CSA-O2s <input type="checkbox"/> No EVA Wire Ties <input type="checkbox"/> Old ISS EMU Servicing Kit <input type="checkbox"/> ISS EVA Sys Checklist (1 of 2 = Red Stripe w/115 crew notes)
<p><u>Mesh Bag (BB)</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> ISS EVA Cuff Checklist (only one returning) <input type="checkbox"/> BB1 gloves (1 pair) <input type="checkbox"/> BB1 LCVG (w/biomed) <input type="checkbox"/> BB1 CCA <input type="checkbox"/> EV3 (red broken) ID stripes, mission patch, USA flag <input type="checkbox"/> EVA 2, 4 Ziplock Bags (BB)(2) <ul style="list-style-type: none"> <input type="checkbox"/> MAG (less used items) <input type="checkbox"/> TCUs (top, bottom) <input type="checkbox"/> Comfort Gloves <input type="checkbox"/> Wristlets <input type="checkbox"/> Socks <input type="checkbox"/> Mole Skin (less used items) <input type="checkbox"/> Croakies 	<p><u>Mesh Bag (MN)</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> No ISS EVA Cuff Checklist <input type="checkbox"/> MN1 gloves (1 pair) <input type="checkbox"/> MN1 CCA <input type="checkbox"/> MN1 LCVG (w/biomed) <input type="checkbox"/> EV4 (bp) ID stripes, mission patch, Can. flag <input type="checkbox"/> EVA 2, 4 Ziplock Bags (MN)(2) <ul style="list-style-type: none"> <input type="checkbox"/> MAG (less used items) <input type="checkbox"/> TCUs (top, bottom) <input type="checkbox"/> Comfort Gloves <input type="checkbox"/> Wristlets <input type="checkbox"/> Socks <input type="checkbox"/> Mole Skin (less used items) <input type="checkbox"/> Croakies <input type="checkbox"/> Tegaderm (less used items)

PRE-UNDOCKING EVA TRANSFER

I

EMU/TOOL TRANSFER TO SHUTTLE

1. Transfer the following items to shuttle per table:

Item	Destination	Status
Mesh Bag (Mn)	Temp stow in Airlock	
Mesh Bag (Bb)	Temp stow in Airlock	
Mesh Bag (EVA Systems)	Temp stow in Middeck	
EMU 3004 (Ta)	Airlock Stbd AAP	
EMU 3017 (Pp)	Airlock Port AAP	

EMU/TOOL TRANSFER TO ISS

2. Transfer the following item to ISS:
ISS EVA SYS Checklist (No stripe = ISS Copy)
 - a. Report transfer status to MCC-H

POST TRANSFER STOW

NOTE

Steps 3 and 4 can be performed post-undock if desired

3. Stow tools per SHUTTLE EVA TOOLS SORTED BY TOOL NAME (TOOLS AND STOWAGE)
4. Stow all EMU items in for entry per EMU EQUIPMENT SORTED BY ITEM (TOOLS AND STOWAGE)

TIMELINES

I

EVA 1
12A EVA 1 FS 7-3
PRE EVA 1 TOOL CONFIG FS 7-5
EVA BRIEFING CARD FS 7-6
EVA 1 INHIBIT PAD FS 7-7
NOTES, CAUTIONS, AND WARNINGS FS 7-8
A/L EGRESS/SETUP FS 7-10
CONNECT P1 TO P3 LOWER TRAY UTILITIES FS 7-11
RELEASE SABB RESTRAINTS FS 7-14
RELEASE SAW BETA GIMBAL RESTRAINTS AND IEA KEEL PIN FS 7-17
UNSTOW SABB FS 7-20
SARJ PREPARATION FS 7-23
CONNECT P1 TO P3 UPPER TRAY UTILITIES FS 7-31
EVA 1 CLEANUP/INGRESS FS 7-34
POST EVA 1 TOOL CONFIG FS 7-35

EVA 2
12A EVA 2 FS 7-37
PRE EVA 2 TOOL CONFIG FS 7-39
EVA BRIEFING CARD FS 7-40
EVA 2 INHIBIT PAD FS 7-41
NOTES, CAUTIONS, AND WARNINGS FS 7-42
EVA 2 EGRESS/SETUP FS 7-44
SARJ PREPARATION FS 7-45
DEPLOY SARJ BRACES FS 7-50
EVA 2 CLEANUP/INGRESS FS 7-53
POST EVA 2 TOOL CONFIG FS 7-54

EVA 3
12A EVA 3 FS 7-55
PRE EVA 3 TOOL CONFIG FS 7-57
EVA BRIEFING CARD FS 7-58
EVA 3 INHIBIT PAD FS 7-59
NOTES, CAUTIONS, AND WARNINGS FS 7-61
EVA 3 EGRESS/SETUP FS 7-63
INSTALL P6 SHOULDER BOLT RETAINERS/SASA R&R PREP FS 7-64
RELEASE P4 PV RADIATOR CINCHES/WINCH FS 7-66
REMOVE AND STOW P3 KEEL BEAM AND DRAG LINK FS 7-69
P3 CLEANUP FS 7-73
S1 SASA R&R FS 7-74
S1 S-BAND BSP AND XPDR REMOVE AND REPLACE FS 7-78
INSTALL SGANT AGIT HEAT SHIELD FS 7-81
MISSE 5 RETRIEVE FS 7-82
EVA 3 CLEANUP/INGRESS FS 7-84
POST EVA 3 TOOL CONFIG FS 7-85

GET AHEADS
Z1-M5 VENT TOOL REMOVAL FS 7-86
DTO 851 IR CAMERA – WLE IMAGERY FS 7-87
EWIS ANTENNA INSTALLATION FS 7-89
RELEASE IEA MMOD COVER BOLTS, RELOCATE 12A.1 APFRs, P1-P3
FLUID JUMPER CONNECT FS 7-93

TIMELINES

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TIME (HR : MIN)	IV	12A EVA 1 EV1	EV2
00:00 ---		POST DEPRESS (00:05) A/L EGRESS AND SETUP (00:35) • Translation to P3	POST DEPRESS (00:05) A/L EGRESS AND SETUP (00:35) • Translation to P3
01:00 ---	√ MCC-H Go for P1-P3 connector mate	CONNECT P1 TO P3 UMB – LOWER TRAY (01:00)	RELEASE AFT SABB (4A) RESTRAINTS (01:00)
02:00 ---	Notify MCC-H P1 to P3 Lower Tray umbilicals mated Notify MCC-H S0 CID 7 Closed	• Close S0 CID 7 RELEASE AFT WING (4A) BGA RESTRAINTS (00:45)	RELEASE FWD SABB (2A) RESTRAINTS (01:00)
03:00 ---		ROTATE P4 KEEL PIN (00:10) UNSTOW AFT WING (4A) SABB (00:30)	RELEASE FWD WING (2A) BGA RESTRAINTS (00:45)
04:00 ---	√ MCC-H Go for P3 MDM Thermal Blanket Remove √ MCC-H Go for DLA Deploy Notify MCC-H DLA #2 Deploy Complete √ MCC-H Go for P1-P3 connector mate	SARJ PREPARATION (00:35) • Remove P3 MDM Thermal Blanket • Remove DLA Covers (2) • Deploy DLA #2 Face 2 CONNECT P1 TO P3 UMB – UPPER TRAY (01:15)	UNSTOW FWD WING (2A) SABB (00:30)
05:00 ---	Notify MCC-H P1 to P3 Upper Tray umbilicals mated	• Remove S0 CID 6 & 8	SARJ PREPARATION (01:50) • Deploy AJIS Struts (4) • Deploy DLA #1 Face 6
06:00 ---	Notify MCC-H S0 CID 6 & 8 Removed Notify MCC-H DLA #1 Deploy Complete	SARJ PREPARATION (00:50) • Release spring clamps • Inspect DLA • Reinstall DLA #1 and DLA #2 MLI Covers	• Release spring clamps • Inspect DLA • Reinstall DLA #1 and DLA #2 MLI Covers
		EVA 1 CLEANUP AND INGRESS (00:40)	EVA 1 CLEANUP AND INGRESS (00:40)
		PRE REPRESS (00:05)	PRE REPRESS (00:05)

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PRE EVA 1 TOOL CONFIG

Prior to EVA, inspect:
 RET cord for damage
 BRT for loose fittings/screws
 Safety & waist tether load alleviating straps

- EV 1**
- MWS
 - BRT (L)
 - RET (eq-eq)
 - Wire Ties (3)
 - T-Bar
 - RET (eq-eq)
 - RET (eq-eq) w/PIP pin
 - Adj Equip Tethers (2)
 - Wire Tie
 - Shuttle Small Trash Bag
 - Swing Arm (R)
 - RET (eq-eq)
 - ESC w/28mm lens
 - Waist Tether (R)
 - D-Ring Extender (R)
 - Safety Tether (85 ft)
 - SAFER
 - WVS

- EV 2**
- MWS
 - BRT (L)
 - RET (eq-eq)
 - Wire Ties (2)
 - T-Bar
 - RETs (eq-eq) w/PIP pin (2)
 - Adj Equip Tethers (2)
 - Wire Tie
 - Shuttle Small Trash Bag
 - 5/8 (rigid) Socket-7.8 ext (on RET PIP pin)
 - Swing Arm (R)
 - PGT [B7 25.5ft-lb, CAL, MTL 30.5] S/N _____
 - PGT Battery S/N _____
 - Round Torque Multiplier
 - Rd TM Socket – 5/8 PRD
 - RETs (eq-eq) (2)
 - Waist Tether (L)
 - D-ring Extender (R)
 - Safety Tether (85 ft)
 - SAFER
 - WVS

- AIRLOCK CONFIG**
- Staging Bag
 - Fuse Tethers (2)
 - F5 camera w/28mm lens
 - PGT S/N _____
 - PGT Battery S/N _____
 - Wire Tie Caddy
 - Locking Strut Aids (4)
 - BRS Pin Contingency Tool
 - GP Caddy
 - SSAS Contingency Bolts (4)
 - RAD S/N _____
 - ISS Torque Wrench Bag
 - ISS Torque Wrench (preset to 34 ft-lb)
 - WIF Adapter w/PIP pin
 - Connector Cleaner Tool Kit
 - Connector Pin Straightener
 - Spare Safety Tethers (2)
 - Probe
 - Prybar

- Large ORU Transfer Bag**
- Fuse Tether
 - Large Trash Bag
 - PGT [B7 25.5 ft-lb, CAL, MTL 30.5] S/N _____
 - PGT Battery S/N _____
 - 7/16 (wobble) socket-6 ext
 - Ratchet Wrench
 - 5/8 (rigid) socket-7.8 ext
 - EVA Crewlock Bag (inside ORU transfer bag)
 - Vise Grips
 - Socket Caddy
 - DPT Adapter
 - 3/8-in IVA Tool Stack
 - 7/16 (wobble) Socket-6 ext
 - PGT Battery S/N _____
 - Adj Equip Tether (outside of bag)
 - RET (eq-lg) (outside of bag)

- CETA CART 1 (Stbd of MT)**
- APFR WIF 4 [3,TT, F, 12]

- AIRLOCK EXTERIOR**
- Safety Tethers (2)

- S0 TRUSS**
- Safety Tether – HH 3529
 - Safety Tether – HH 3530
 - APFR S0-42 [10,PP,F, 12]

Highlight indicates location change during EVA

EVA BRIEFING CARD

EV 1/3 _____	EV 2/4 _____	IV 1 _____	IV 2 _____
Exercise			Campout
Wake-up (GMT) _____	_____ : _____	_____	Wake-up (GMT)
EVA Prep start _____	_____ : _____	_____	Repress for hygiene
Depress to 10.2 _____	_____ : _____	_____	Depress to 10.2
Start purge _____	_____ : _____	_____	Start purge
PET 00:00 _____	_____ : _____	_____	PET 00:00

EVA Prep

- Get-up plan – clothing and EMU equip bag, Hygiene break
- Exercise protocol review, if required
- Equipment lock activities – IV responsibilities
- Suit donning plan – special requests
- SAFER, MWS, tools, CL positions and bag stowage
- Airlock depress review
- EV/IV comm protocol
- SRMS/SSRMS initial position

EV Crew Procedure Review

- Egress Plan
- Translations – tether swaps
- Order of tasks
- Ingress Plan

General Procedure Review

- Get ahead tasks
- Constraints – ground and flight
- Cautions and warnings review
- RMS operations – comm protocol/clearances
- Contingency procedures – crib sheet

Emergencies review

- Lost comm
- EMU malfunctions
- Lost tools
- Lost crewmember
- DCS

Post EVA

- Suit doffing responsibilities
- Post EVA plan

Lessons learned from previous EVAs and general motherhood

EVA 1 INHIBIT PAD

ORBITER

RCS	
	If EV crew < 27 ft from FRCS:
IV	1. √DAP: FREE, LO Z
O14,15,16	2. √RJDF F1, F2, F3, F4 MANF DRIVER (four) – OFF LOGIC (four) – OFF
MCC-H	3. √Above RCS config
IV	4. √RCS F – ITEM 1 EXEC (*) √JET DES F1U – ITEM 17 (*) F3U – ITEM 19 (*) F2U – ITEM 21 (*)
TCS	
IV	L12 1. √TCS POWER – OFF
S-Band	
	<u>NOTE</u> Possible loss of comm when forced to S-Band LL FWD antenna
	When EV crew on Lab forward area:
IV	If EV crew ≤ 1.6 ft from upper S-Band antenna:
A1R	1. S-BAND FM ANT – XMTR LOWER/RCVR UPPER
	2. √MCC, lower antenna selected
	If no comm, or on MCC call:
C3	3. S-BAND PM ANT – LL FWD
	When EV crewmember at least 1.6 ft away from all S-band upper antennas:
C3	4. S-BAND ANT – GPC
KU-Band	
MCC-H	1. √KU-BAND EVA Mask – active 2. √KU-BAND EVA Protect Box – active

RSOS

FGB Antennas	
MCC-M	1. √FGB KURS P [Kurs] – Deactivate
	2. ARISS – Deactivate
Soyuz Antennas	
MCC-M	3. √Soyuz KURS A [Kurs] – Deactivate
SM Antennas	
MCC-M	4. Global Timing Sys 1 (400.1MHz) [GTS] – Deactivate
	5. ARISS – Deactivate

USOS

PCU	
	<u>NOTE</u> PCUs may require up to 1 hr warm-up period before they are operational. No further action is reqd in the event of one or two PCU failures
MCC-H	1. √PCUs (two) operational in discharge mode
Lab Window	
IV	1. Close window shutter if EV crew less than 10 ft/3.5m from window
MISSE PEC 5	
MCC-H	1. √MISSE PEC 5 – RESET, record timer information
Ground Radar	
MCC-H	1. √TOPO/RIO & FDO console, ground radar restrictions in place for EVA

NOTES, CAUTIONS, AND WARNINGS

NOTES

1. For bolt install: report good/nominal torque and turns
2. For bolt release: report torque and turns if different from published range
3. EVA connectors: after disconnection and prior to connection; verify pin and EMI band integrity; verify connector free of FOD
4. Mast Tip fasteners will pop-up when disengaged
5. MLI handholds are not rated for crewmember translation loads
6. Toolbox doors must be closed with one latch per door when EV crew not in immediate vicinity

CAUTION

Flight Specific

A. Electrical cables:

1. Avoid bend radii < 10 times cable diameter

B. Fiber optic cable handling:

1. Avoid bend radius less than 10 times cable diameter
2. Avoid pulling on harness during connector mate/demate

C. Release SABB restraints:

1. Unfasten jack bolt #6 (nearest tether point) last

D. Release SAW BGA restraints:

1. IEA Keel Pin must be rotated prior to release of Fwd BGA restraints

E. Unstow SABB:

1. Deploy rate of SABB must not exceed 6 degrees/sec (15 sec for full deploy)
2. Four-bar linkage must be deployed and locked and SABBs rotated into deploy position before Mast Canister Tip Fitting restraints can be disengaged

F. SARJ prep:

1. During re-installation of MLI covers, do not re-install outboard spring clamps on MLI covers
2. Avoid impacting the race ring with the DLA when the DLA is unconstrained
3. DLA must be held against the outer side of the SARJ race ring during follower arm deploy to avoid interference with structure

CAUTION (Cont)

Flight Specific (Cont)

G. PV radiators [P4,P6]:

1. Avoid contact with radiator bellows and thermal outer coating

ISS Constraints

H. Avoid inadvertent contact with:

1. Grapple fixture shafts (drylube)
2. PIP pins
3. Deployed MISSEs [A/L,P6]
4. Passive UMAs
5. MBS VDU, MCU, CRPCMs and Cameras (tape radiative surfaces, silver Teflon)
6. Deployed TUS cable
7. GPS Antenna (S13 paint) [S0]
8. UHF Antennas [LAB,P1]
9. ETCS Radiators [S1,P1]

I. For structural reasons:

1. Avoid vigorous body motions, quick grabs and kickoffs against tether restraints
 2. Avoid performing shaking motions (sinusoidal functions) more than four cycles
 3. Avoid kicking S1/P1 radiator beam
- If any of these occur, wait 2 to 5 min to allow structural response to dissipate

J. Other:

1. ITT Cannon connector: do not turn collar from WHITE to BLACK without a mating half attached
2. WIS Antennas: do not use as handholds [Z1,P4]

WARNING

Flight Specific

A. Electrical connectors:

1. NZGL connector linkage is pinch hazard. Use caution when mating/locking
2. Power must be turned off to electrical connectors prior to mating/demating to preclude arcing/sparking
3. Sharp edge – mating surfaces of EVA connectors. Avoid side loads during connector mating

B. Release SABB restraints:

1. Sharp edge – avoid contact with exposed threads on jack bolt #6 after SABB clam shell restraint released

C. Release SAW beta gimbal restraints:

1. Entire area behind IEA bulkhead, beta gimbal/solar array wing must be clear prior to fastener disengagement
2. Verify beta gimbal/solar array motion has stopped before exiting worksite
3. Sharp edge – exposed threads on keel pin fastener

D. Unstow SABB:

1. Pinch point – pivot fitting and lockout arm during SABB rotation

E. SARJ prep

1. Sharp edge – spring loaded captive EVA fasteners (eg SARJ MLI covers); end of spring may protrude

ISS Constraints

F. Avoid inadvertent contact with:

1. Grapple fixture targets and target pins
2. Stay 2 ft from S1/P1 radiator beam rotational envelope when beam is free to rotate
3. Stay 5 ft from moving MT on face 1

Cont next page

NOTES, CAUTIONS, AND WARNINGS (Cont)

WARNING (Cont)

ISS Constraints (Cont)

G. Handrails:

1. Handrails previously used for MISSE attachment may not be used as a safety tether point [A/L endcone 566, A/L Tank 2 nad/fwd, P6 5389]

H. Pinch:

1. ITT Cannon connector rotating housing
2. EV side of IV hatch during hatch operations (also snag hazard) [A/L]

I. RF radiation exposure:

1. Stay 1 ft from UHF antenna when powered [Lab,P1]

J. Sharp edges:

1. Inner edges of WIF sockets
2. Nickel coated braided copper ground straps may contain frayed wires [P6,P4]
3. Keep hands away from SSRMS LEE opening and snares

K. Thermal:

1. EVA connectors with booties may become hot if left uncovered
2. Turn off glove heaters when comfortable temp reached to prevent bladder damage. Do not pull fingers out of gloves when heaters are on
3. Uncovered trunnion pins may be hot
4. Do not touch EMU protective visor if temp has been, -134 for > 15 min
5. No EMU boot contact with foot restraint when temp < -120 deg F or > 200 deg F

A/L EGRESS/SETUP (00:35)

IV	EV1	EV2
	<p>Initial Condition: Waist Tether (R) to A/L D-ring</p> <p><u>EGRESS</u></p> <ol style="list-style-type: none"> 1. Open A/L thermal cover 2. Egress airlock 3. Inspect A/L Safety Tethers (2) and verify hooks on external D-rings locked 4. Attach Safety Tether to D-ring extender (R); verify hook locked 5. √SAFER man isol vlv – open (down) 6. √SAFER HCM – closed (down) 7. Receive ORU transfer bag; attach to BRT 8. Give A/L Safety Tether to EV2 9. Give EV2 GO for egress <p><u>SETUP</u></p> <ol style="list-style-type: none"> 10. Translate to S0 port end, face 6 11. Inspect S0 safety tether 12. Tether swap to Safety Tether at S0 HH 3529; verify hook locked 13. Translate to P3 - route safety tether under APFR in S0 WIF 42 14. Attach 85 ft safety tether to P1 HH 3690; verify hook locked 15. Tether swap to P3 safety tether; verify hook locked 16. Temp stow ORU transfer bag on SARJ struts (face 2) 17. Retrieve EVA Crewlock Bag from ORU Transfer bag 18. Temp stow EVA Crewlock Bag on P4 HH 5112 19. Stow ESC in ORU bag 	<p>Initial Condition: Waist Tether (L) to UIA D-ring</p> <p><u>EGRESS</u></p> <ol style="list-style-type: none"> 1. Hand off ORU transfer bag 2. Attach Safety Tether to D-ring extender (R); verify hook locked 3. Egress A/L 4. √SAFER man isol vlv – open (down) 5. √SAFER HCM – closed (down) 6. Close A/L thermal cover <p><u>SETUP</u></p> <ol style="list-style-type: none"> 7. Translate to S0 port end, face 6; perform translation adaptation 8. Inspect S0 safety tether 9. Tether swap to Safety Tether at S0 HH 3530; verify hook locked 10. Retrieve APFR from S0 WIF 42 (P4 settings [NN,E,12]) 11. Translate to P3 12. Attach 85 ft safety tether to P3 HH 3811; verify hook locked 13. Tether swap to P3 tether; verify hook locked; route tether under EV1's safety tether

CONNECT P1 TO P3 LOWER TRAY UTILITIES (01:00)

IV	EV1	EV2
<p>MCC-H 1. Verify DEACTIVATING DDCU LA2A (AND GIVE "GO" FOR LOWER TRAY UTILITY CONNECTIONS) step 13 complete (SODF: ASSY OPS: P3 ACTIVATION AND S0, S1, P1 POWER DOWN/POWER UP)</p> <p>2. Inform MCC – P3 Lower Tray Utilities complete</p> <p>3. Inform MCC – S0 CID 7 CLOSED</p>	<p><u>CONNECT P1 TO P3 UTILITIES</u></p> <ol style="list-style-type: none"> 1. APFR: From CETA Cart 1 WIF 4 to P3- 01 [6, TT, F, 12] 2. Open P1 Utility tray shroud to access connector panel A50 3. Open TA clamps 4. On MCC GO, demate from panel A50 and mate to panel A89 Lower Tray Utilities as follows and transfer caps: <ul style="list-style-type: none"> <input type="checkbox"/> Demate P6 (fiber optic) <input type="checkbox"/> P5 to J5 <input type="checkbox"/> P6 to J6 (fiber optic) <input type="checkbox"/> P4 to J4 <input type="checkbox"/> P3 to J3 <input type="checkbox"/> Demate P2 <input type="checkbox"/> Demate P1 <input type="checkbox"/> P2 to J2 <input type="checkbox"/> P1 to J1 5. If possible, Close P1 TA clamps 6. Reattach P1 utility tray shroud 7. Translate to S0 CIDs : CID 7 – CLOSE (ON) <ul style="list-style-type: none"> <input type="checkbox"/> 8. APFR: From P3-01 to P3- 31 [7,PP,F,12] (for DLA 1) 9. Retrieve PGT and Ratchet Wrench w/ 5/8 socket 7.8-ext from ORU transfer bag 	

CONNECT P1 TO P3 LOWER TRAY UTILITIES – TASK DATA

Estimated Task Duration:

	With RMS	Without RMS
One EV Crew	NA	1:00
Two EV Crew	NA	NA

Tools:

EV1 (FF)	EV2 (FF)
APFR	NA

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
NA								

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
W5001 (EO)	P1 (A50J21)	J1 (A89)	1	37	*Primary Power 2A
W5003 (EO)	P2 (A50J22)	J2 (A89)	1	37	Primary Power 2B
W5101 (EO)	P3 (A50J23)	J3 (A89)	1	25	*Secondary Power 2B
W5103 (EO)	P4 (A50J24)	J4 (A89)	1	33	*Secondary Power 3A
W5259 (RF)	P5 (A50J1)	J5 (A89)	1	25	*Data / 1553 A
W5451 (FO)	P6 (A50J26)	J6 (A89)	1	15	High Rate Data Link (UCCSA-1)
P1/P3 FLUID (1/4 INCH) JUMPER L40	F186/P1-A503-M2	F186/P1-A503-M3	1	1/4 inch	Ammonia line
P1/P3 FLUID (1/4 INCH) JUMPER L40	F187/P1-A504-M1	F187/P3-A501-M1		1/4 inch	Ammonia line

* denotes connection required for channel activation

Foot Restraints:

Task	WIF	APFR Setting
Mate P1 to P3 Lower Tray Umbilicals	P3-01	6, TT, F, 12
Mate P1 to P3 Fluid Line	P3-01	6, TT, F, 12

Note:

- Internal P1 TA clamps (3) were released during 11A
- No shroud exists on the P3 side utility tray

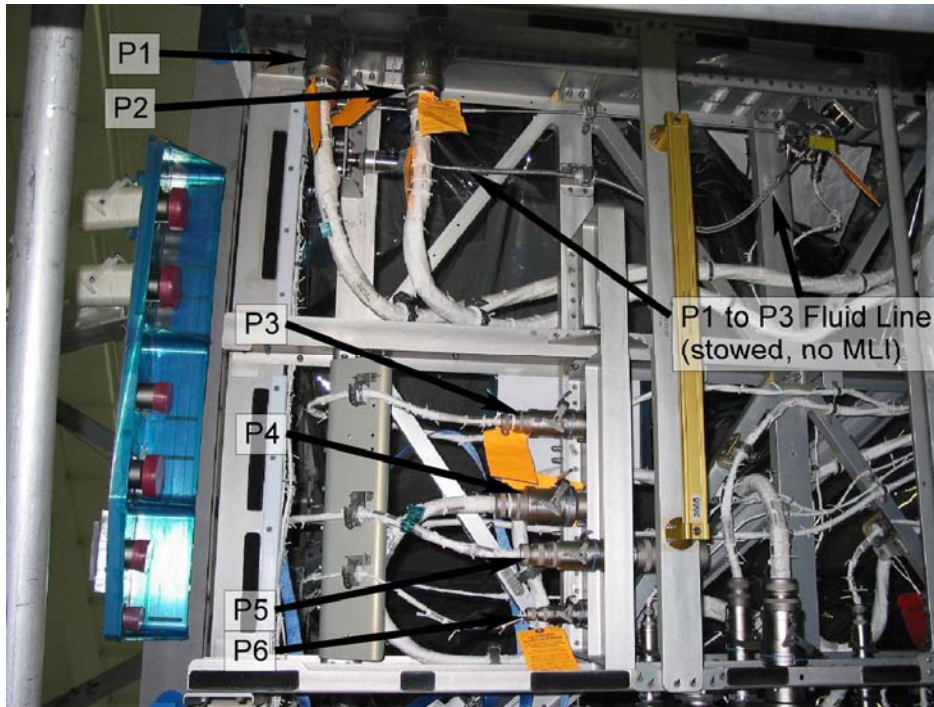
Cautions:

- Power should be restored as quickly as possible after the power umbilicals have been connected
- Fiber optic cable harness P6 shall be firmly supported during installation to prevent damage due to excessive bending, kinking, tension, torsional loading or other excessive strain. Avoid a bend radii of less than 10 times the diameter of the wire harness
- P3 MDM thermal shroud must be removed no earlier than 1 hour prior or no later than 3 hours after ORU activation to avoid violation of thermal constraints

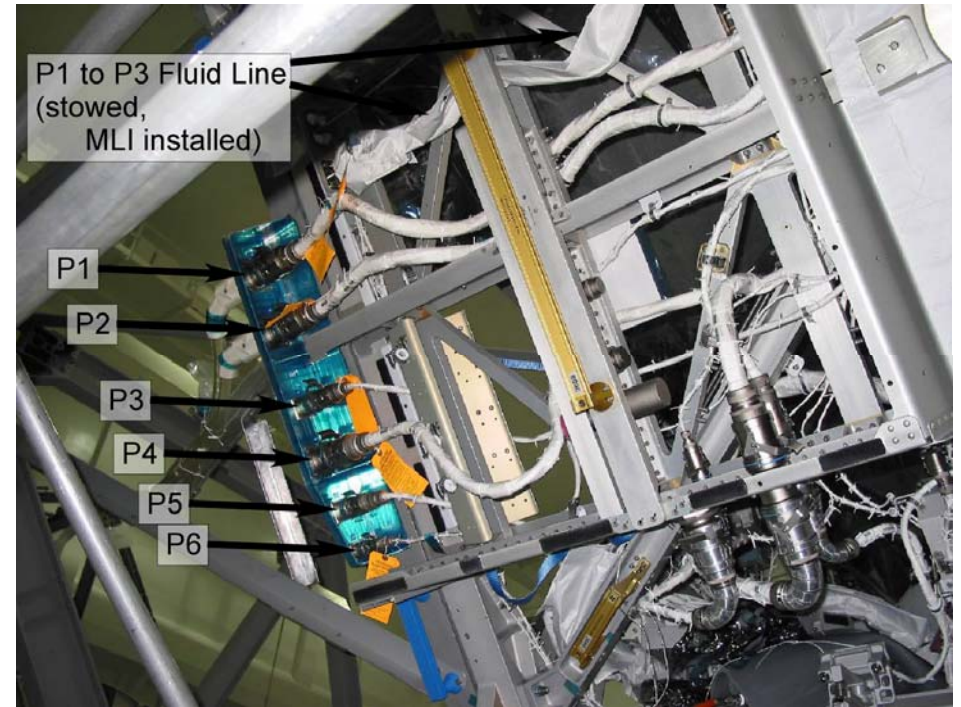
Warnings:

- Power must be turned off to connectors P1, P2, P3, and P4 being mated/demated to preclude arcing/sparking

CONNECT P1 TO P3 LOWER TRAY UTILITIES – TASK DATA (Cont)







P1 Lower Tray Umbilicals (Face 6) prior to mating to P3



P1 Lower Tray Umbilicals (Face 6) after mating to P3

RELEASE SABB RESTRAINTS (02:00)

IV	EV2
	<p><u>RELEASE AFT SABB (4A) RESTRAINTS</u></p> <ol style="list-style-type: none"> 1. APFR: P4-15 [9, NN, E, 12] <p><u>RELEASE AFT INBOARD RESTRAINTS</u></p> <ol style="list-style-type: none"> 2. PGT[B7 25.5 ft-lb, CCW3 60RPM, MTL 30.5]-Rd TM with 5/8: √Anti-Backlash Neutral: Break torque on Inboard SABB fasteners (2) (~5 turns) 3. PGT[B7 25.5 ft-lb, CCW2 30RPM, MTL 30.5]-5/8 socket 7.8-ext: Release Inboard SABB fasteners (2) (~9 turns) 4. Open clam shell until soft dock detent engages  <p><u>RELEASE AFT OUTBOARD RESTRAINT</u></p> <ol style="list-style-type: none"> 5. APFR: P4-15 [2, NN, E, 11] 6. Remove Beta Gimbal Restraint PIP pins (2) 7. PGT[B7 25.5 ft-lb, CCW3 60RPM, MTL 30.5]- Rd TM with 5/8: √Anti-Backlash Neutral: Break torque on Fwd Wing Beta Gimbal Restraints (2), (~5 turns) each 8. PGT[B7 25.5 ft-lb, CCW3 60RPM, MTL 30.5]- Rd TM with 5/8: √Anti-Backlash Neutral: Break torque on Outboard SABB fasteners (6), (~5 turns) each <div style="border: 2px solid black; padding: 5px; text-align: center;"> <p>WARNING Sharp edge hazard. Avoid contact with exposed threads on jack bolt #6 after SABB clam shell restraint released</p> </div> <div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>CAUTION Unfasten jack bolt (#6) last</p> </div> <ol style="list-style-type: none"> 9. PGT[B7 25.5 ft-lb, CCW2 30RPM, MTL 30.5]-7.8ext-5/8: Release Outboard SABB fasteners (6), (~9 turns) each  10. Temp stow clam shell on P4 HH 5149 using Adjustable Equip tether
	<p><u>RELEASE FWD SABB (2A) RESTRAINTS</u></p> <p><u>RELEASE FORWARD INBOARD RESTRAINTS</u></p> <ol style="list-style-type: none"> 1. APFR: From P4-15 to P4-13 [9, NN, E, 12] 2. PGT[B7 25.5 ft-lb, CCW3 60RPM, MTL 30.5]-Rd TM with 5/8: √Anti-Backlash Neutral: Break torque on Inboard SABB fasteners (2) (~5 turn) 3. PGT[B7 25.5 ft-lb, CCW2 30RPM, MTL 30.5]-5/8 socket 7.8-ext: Release Inboard SABB fasteners (2) (~9 turns) 4. Open clam shell until soft dock detent engages  <p><u>RELEASE FORWARD OUTBOARD RESTRAINTS</u></p> <ol style="list-style-type: none"> 5. APFR: P4-13 [2, NN, E, 11] 6. PGT[B7 25.5 ft-lb, CCW3 60RPM, MTL 30.5]- Rd TM with 5/8: √Anti-Backlash Neutral: Break torque on Outboard SABB fasteners (6), (~5 turns) each <div style="border: 2px solid black; padding: 5px; text-align: center;"> <p>WARNING Sharp edge hazard. Avoid contact with exposed threads on jack bolt #6 after SABB clam shell restraint released</p> </div> <div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>CAUTION Unfasten jack bolt (#6) last</p> </div> <ol style="list-style-type: none"> 7. PGT[B7 25.5 ft-lb, CCW2 30RPM, MTL 30.5]-7.8ext-5/8: Release Outboard SABB fasteners (6), (~9 turns) each  8. Stow clam shell in ORU transfer bag and TM in crewlock bag w/ spare RET from swingarm 9. Retrieve 7/16 socket 6-ext from crewlock bag 10. APFR: From P4-13 to P4-04 [6,PP,L,1](for DLA 2)

RELEASE SABB RESTRAINTS – TASK DATA

Estimated Task Duration:

	With RMS	Without RMS
One EV Crew	NA	2:00
Two EV Crew	NA	NA

Tools:

EV1 (FF)	EV2 (FF)
NA	PGT
	Rd TM with 5/8 PRD socket
	5/8 (rigid) Socket-7.8 ext
	APFR

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
Inboard SABB Launch Restraint	NA	5/8	2	98	119	389	10 [1]	30
Outboard SABB Launch Restraint	1-6	5/8	6	97	118	390	10 [1]	30

[1] - Turn count measured on flight hardware 5/27/03

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
NA					

Foot Restraints:

Task	WIF	APFR Setting
Release aft inboard SABB Launch Restraint	P4-15 4A P6-15 (P4-03)	[9, NN, E, 12] 4A [12, UU, C, 1]
Release aft outboard SABB Launch Restraint	P4-15 4A P6-35 (P4-23)	[2, NN, E, 11] 4A [12, JJ, F, 12]
Release forward inboard SABB Launch Restraint	P4-13 4A P6-13 (P4-01)	[9, NN, E, 12] 4A [12, TT, D, 1]
Release forward outboard SABB Launch Restraint	P4-13 4A P6-25 (P4-13)	[2, NN, E, 11] 4A [2, NN, F, 12]

4A APFR positions listed for reference only

Notes:

1. If outboard SABB launch restraint tether point is not accessible prior to removal, Rd TM may be installed and locked onto a bolt to provide a tether point until the launch restraint is removed and the tether point is better accessible

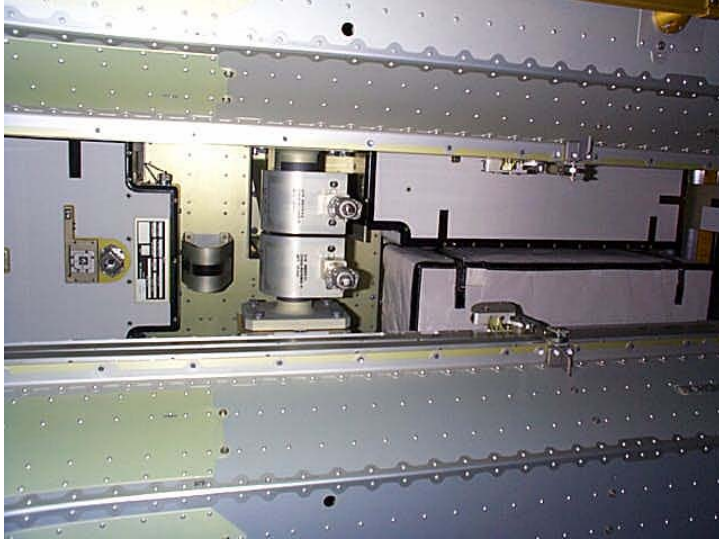
Cautions:

1. Unfasten Jack bolt #6 (nearest the tether point) last. Fasteners #1 – 5 can be released in any order

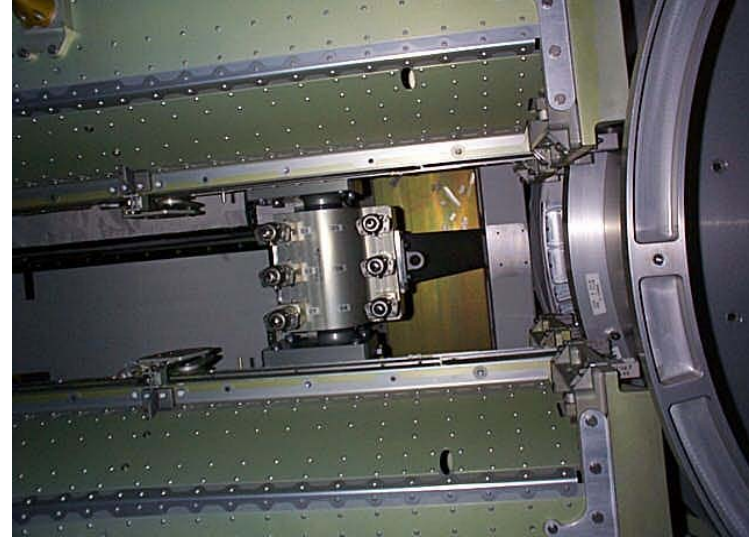
Warnings:

1. Sharp edge hazard. Avoid contact with exposed threads on jack bolt #6 after SABB clam shell restraint released

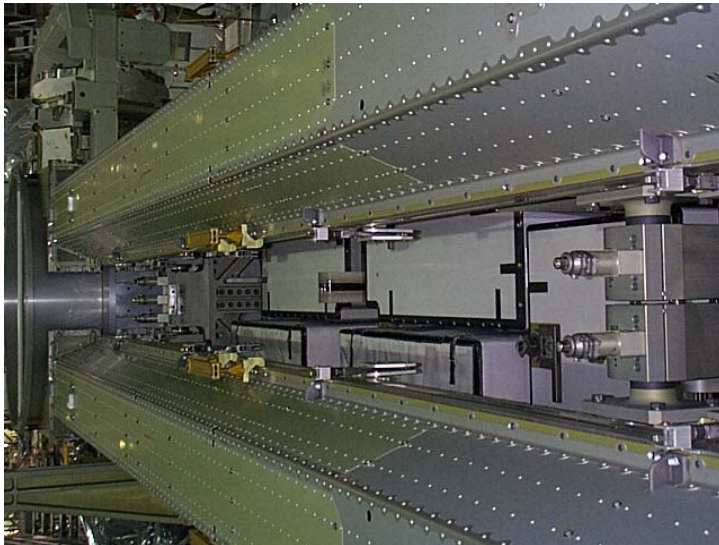
RELEASE SABB RESTRAINTS – TASK DATA (Cont)



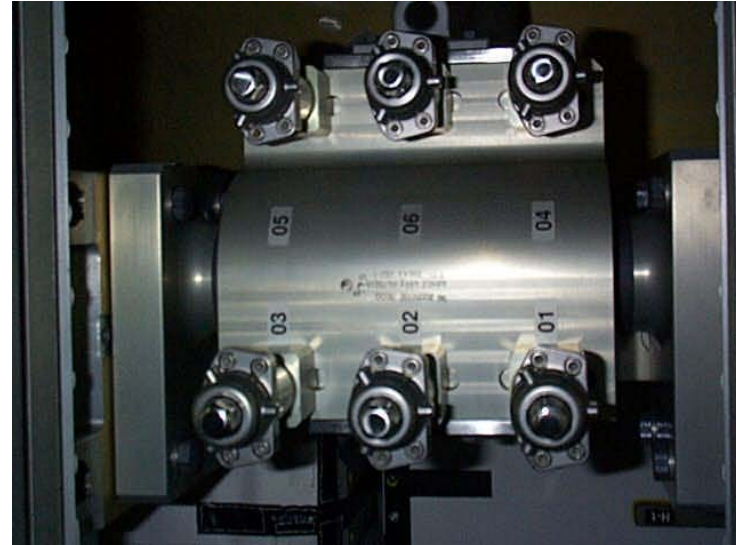
SABB Inboard Launch Restraint



SABB Outboard Launch Restraint

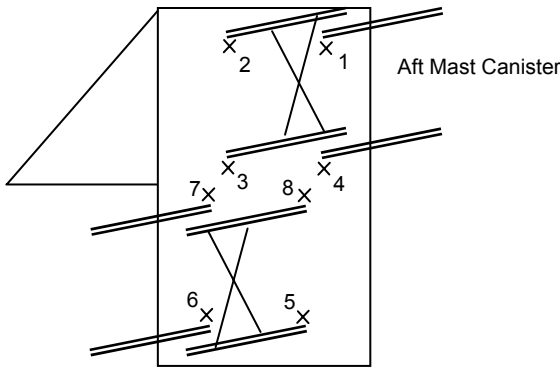




SABB Outboard and Inboard Restraints (left to right in view)



SABB Outboard Launch Restraint

RELEASE SAW BETA GIMBAL RESTRAINTS AND IEA KEEL PIN (00:55)

IV	EV1	EV2
 <p>Aft Mast Canister</p> <p>IEA Bulkhead looking inboard</p> <p>X - denotes side of 4-bar hinge to inspect for lock indicator</p>	<div style="border: 2px solid black; padding: 5px; margin-bottom: 10px;"> <p style="text-align: center;">WARNING</p> <p>Stored energy and collision hazard. Entire area behind the IEA bulkhead, Beta Gimbal/Solar Array Wing must be clear prior to Beta Gimbal Restraint disengagement</p> <hr/> <p>Verify that Beta Gimbal/Solar Array motion has stopped before exiting worksite</p> </div> <p><u>RELEASE AFT WING (4A) BETA GIMBAL RESTRAINTS</u></p> <ol style="list-style-type: none"> 1. Release Primary Power cable TA clamps (3) 2. Remove PIP pins from launch restraint assembly (2) 3. Verify EV2 is clear of stored energy hazard 4. Ratchet Wrench - 7.8ext-5/8: Release Aft Wing Beta Gimbal restraints (2), (~10 turns) <p>If PGT w/Rd TM required to break torque: PGT[B7 25.5 ft-lb, CCW3 60RPM, MTL 30.5]- Rd TM with 5/8: √Anti-Backlash Neutral: 5 turns</p> <ol style="list-style-type: none"> 5. Re-insert Beta Gimbal Restraint PIP pins (2) 6. Inspect to verify 4-Bar linkages have been fully deployed and locked (minimum of 3 of 4 locks) <div style="border: 2px solid black; padding: 5px; margin-top: 10px;"> <p style="text-align: center;">WARNING</p> <p>Sharp edge. The Keel fastener has exposed bolt threads when removed from the Keel body</p> </div> <p><u>ROTATE IEA KEEL PIN</u></p> <ol style="list-style-type: none"> 1. BRT to keel structure handrail 2. PGT[B7 25.5 ft-lb, CCW3 60RPM, MTL 30.5]-6 ext 7/16: Release fastener (~43 turns) 3. Remove the keel fastener completely from keel body 4. Rotate keel pin until hard dock detent capture 5. Verify alignment marks 6. Insert keel fastener into keel body 7. PGT[B7 25.5 ft-lb, CW2 30RPM, MTL 30.5]-6 ext 7/16: Engage fastener 10 turns 8. Stow Ratchet Wrench in C/L bag; retrieve EVA camera 	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p style="text-align: center;">CAUTION</p> <p>IEA Keel Pin must be rotated prior to the release of the Forward Beta Gimbal Restraints</p> </div> <div style="border: 2px solid black; padding: 5px; margin-bottom: 10px;"> <p style="text-align: center;">WARNING</p> <p>Stored energy and collision hazard. Entire area behind the IEA bulkhead, Beta Gimbal/Solar Array Wing must be clear prior to Beta Gimbal Restraint disengagement</p> <hr/> <p>Verify that Beta Gimbal/Solar Array motion has stopped before exiting worksite</p> </div> <p><u>RELEASE FWD WING (2A) BETA GIMBAL RESTRAINTS</u></p> <ol style="list-style-type: none"> 1. Rotate nadir P5 softdock mechanisms (2) to CAPTURE position and check RTAS interface for FOD  2. Release Primary Power cable TA clamps (3) 3. Verify EV1 is clear of stored energy hazard 4. PGT[B7 25.5 ft-lb, CCW3 60RPM, MTL 30.5]- 7.8ext-5/8: Release fasteners (2), (~10 turns) 5. Reconfigure PGT w/ 6 ext 7/16, stow 5/8 socket in small trash bag 6. Re-insert Beta Gimbal Restraint PIP pins (2) 7. Retrieve camera from P4 HH 5152 8. Inspect to verify 4-Bar linkages have been fully deployed and locked (minimum of 3 of 4 locks) <p></p>

RELEASE SAW BETA GIMBAL RESTRAINTS AND IEA KEEL PIN – TASK DATA

Estimated Task Duration:

	With RMS	Without RMS
One EV Crew	NA	1:40
Two EV Crew	NA	0:55

Tools:

EV1 (FF)	EV2 (FF)
PGT	PGT
Rd TM with 5/8	Rd TM with 5/8
5/8 (rigid) Socket-7.8 ext (backup)	5/8 (rigid) Socket-7.8 ext (backup)
7/16 (wobble) Socket-6 ext	

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
Beta Gimbal Launch Restraint Bolts	NA	5/8	2	60 (grnd)	60 @70°F 118 @200°F	495	10 [1]	60
IEA Keel Pin Restraint Bolt	NA	7/16	1	4	34	135	43	60

[1] - Turn count measured on flight hardware 5/27/03

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
NA					

Foot Restraints:

Task	WIF	APFR Setting
Release Aft Wing Beta Gimbal Restraints	P4-16	(1, PP, L, 12)
Release Forward Wing Beta Gimbal Restraints	P4-14	(12, PP, K, 12)
Optional P4 Keel Pin worksite	P4-28	(12, PP, G, 12)

Note:

1. Maintain a constant force to disengage the fastener anti-rotation locking sleeve when driving the IEA Keel fastener

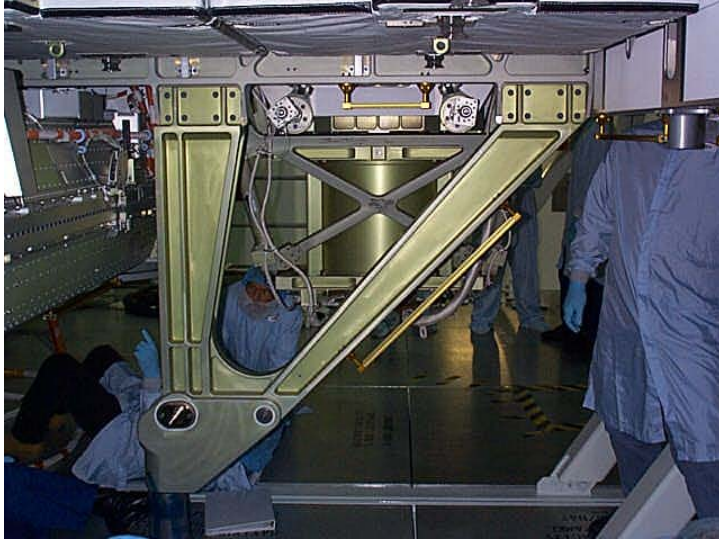
Cautions:

1. SABB launch restraints must be disengaged prior to release of Beta Gimbal Restraints
2. The IEA Keel Pin must be rotated prior to the release of the Forward Beta Gimbal Restraints

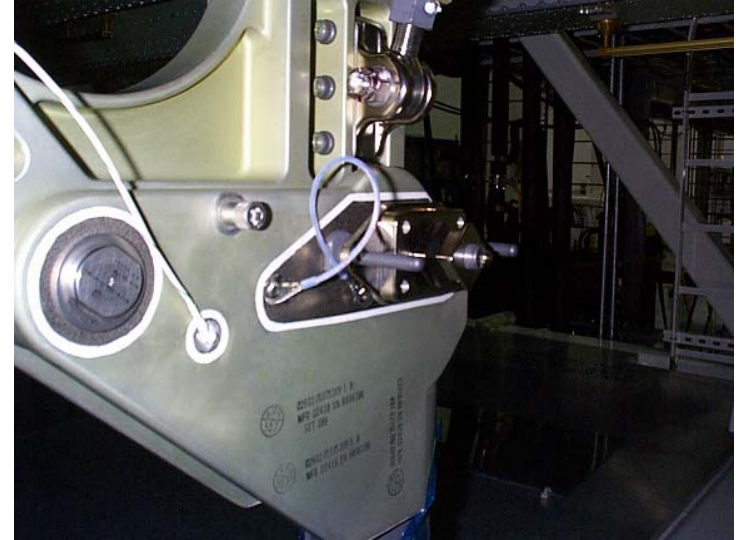
Warnings:

1. Entire area behind the IEA bulkhead, Beta Gimbal/Solar Array wing, must be clear prior to fastener disengagement
2. Verify that Beta Gimbal/Solar Array wing motion has stopped before exiting worksite
3. Sharp edge hazard – The Keel fastener once removed from the Keel body has exposed bolt threads

RELEASE SAW BETA GIMBAL RESTRAINTS AND IEA KEEL PIN – TASK DATA (Cont)








Aft Beta Gimbal Restraints and IEA Keel Structure



Keel Pin Bolt

UNSTOW SABB (00:30)

IV	EV1	EV2																		
<table border="1"> <thead> <tr> <th colspan="3">P5 Soft Dock Engage and RTAS Inspect</th> </tr> <tr> <th>Location</th> <th>Soft Dock</th> <th>RTAS</th> </tr> </thead> <tbody> <tr> <td>Fwd/Zenith</td> <td></td> <td></td> </tr> <tr> <td>Aft/Zenith</td> <td></td> <td></td> </tr> <tr> <td>Fwd/Nadir</td> <td></td> <td></td> </tr> <tr> <td>Aft/Nadir</td> <td></td> <td></td> </tr> </tbody> </table>	P5 Soft Dock Engage and RTAS Inspect			Location	Soft Dock	RTAS	Fwd/Zenith			Aft/Zenith			Fwd/Nadir			Aft/Nadir			<div style="border: 3px double black; padding: 5px; text-align: center;"> <p>WARNING Pinch Point – Stay clear of pivot fitting and lockout arm during SABB rotation</p> </div> <p><u>UNSTOW AFT WING (4A) SABB</u></p> <ol style="list-style-type: none"> Close TA clamps (3) Remove PIP pin from Lockout arm Rotate blanket box to deploy position Verify pivot arm is locked with locking sleeve over joint Install PIP pin through the Lockout arm Repeat step 2-5 for other blanket box  PGT[A6 8.3 ft-lb, CCW2 30RPM, MTL 30.5]-6 ext 7/16: Release Mast Tip fasteners (x3) (~14 turns) Verify Mast Tip fasteners are released  Release ECU strap on HH 5162, stow on Velcro near ECU shroud tether point Verify BGA rotation interface clear Transfer camera to EV2 or temp stow on P4 HH 5152 Rotate zenith P5 softdock mechanisms (2) to CAPTURE position and check RTAS interface for FOD  Retrieve Aft SABB Launch Restraint and adjustable tether from P4 HH 5149 Stow SABB Launch Restraint in ORU transfer bag 	<div style="border: 3px double black; padding: 5px; text-align: center;"> <p>WARNING Pinch Point – Stay clear of pivot fitting and lockout arm during SABB rotation</p> </div> <p><u>UNSTOW FWD WING (2A) SABB</u></p> <ol style="list-style-type: none"> Close TA clamps (3) Remove PIP pin from Lockout arm Rotate blanket box to deploy position Verify pivot arm is locked with locking sleeve over joint Install PIP pin through the Lockout arm Repeat step 2-5 for other blanket box  PGT[A6 8.3 ft-lb, CCW2 30RPM, MTL 30.5]-6 ext 7/16: Release Mast Tip fasteners (x3) (~14 turns) Verify Mast Tip fasteners are released  Release ECU strap on HH 5172, stow on Velcro near ECU shroud tether point Verify BGA rotation interface clear
P5 Soft Dock Engage and RTAS Inspect																				
Location	Soft Dock	RTAS																		
Fwd/Zenith																				
Aft/Zenith																				
Fwd/Nadir																				
Aft/Nadir																				

UNSTOW SABB – TASK DATA

Estimated Task Duration:

	With RMS	Without RMS
One EV Crew	NA	1:00
Two EV Crew	NA	0:30

Tools:

EV1 (RMS)	EV2 (FF)
PGT	PGT
7/16 (wobble) Socket-6 ext	7/16 (wobble) Socket-6 ext

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
Mast Canister Tip Fitting	Yes	7/16	3	7	7.5	9.8	14	30

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
NA					

Foot Restraints:

Task	WIF	APFR Setting
NA		

Note:

1. Mast Tip Fasteners will pop-up when disengaged

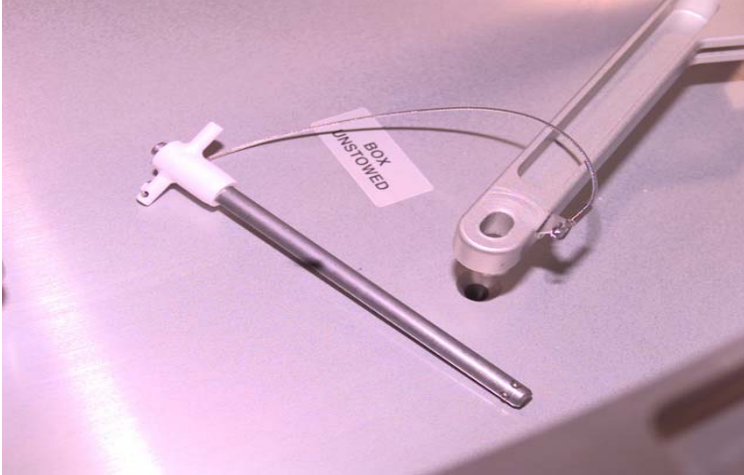
Cautions:

1. Deploy SABB no faster than 6 degrees/second (15 seconds min for 90 degree deploy)
2. 4-bar linkage must be deployed and SABBs rotated into the deployed position before Mast Canister Tip Fitting restraints can be disengaged

Warnings:

1. Pinch point hazard – Stay clear of pivot fitting and lockout arm during SABB rotation

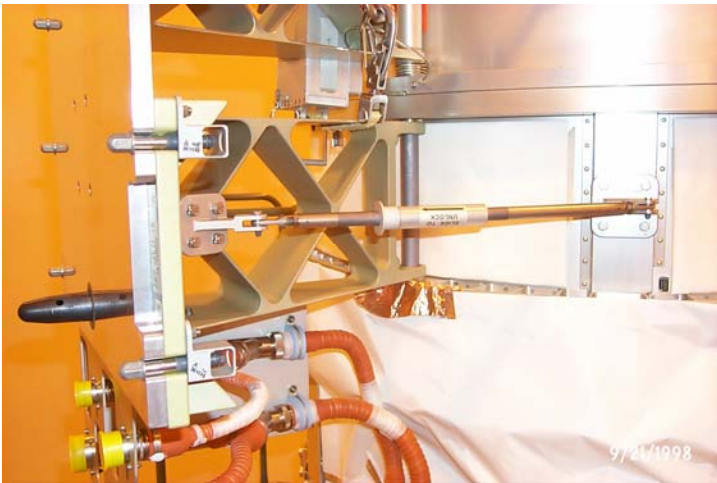
UNSTOW SABB – TASK DATA (Cont)



SABB Lockout Arm and PIP Pin




Mast Canister Tip Fitting Fastener

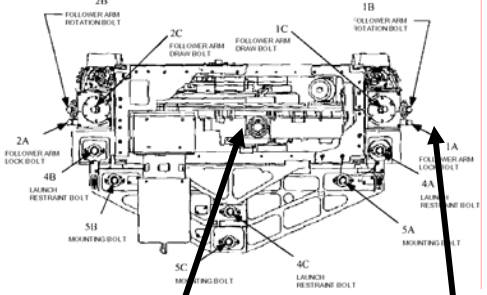



Pivot Arm and Locking Sleeve

SARJ PREPARATION (01:50)

IV	EV1	EV2
	<p>Execute the steps below for either deploying a DLA or MLI Cover removal/installation:</p> <ul style="list-style-type: none"> A. <input type="checkbox"/> ON MCC GO: REMOVE P3 MDM SHROUD: Stow shroud in large ORU bag B. <input type="checkbox"/> RELEASE OUTBOARD MLI COVER FASTENERS: Cover 20 Face 2 DLA 2 C. <input type="checkbox"/> REMOVE DLA MLI COVER: Cover 20 (Face 2 DLA 2) D. <input type="checkbox"/> DEPLOY SARJ DLA: DLA 2 (Face 2 Cover 20) APFR P4-04 [6, PP, L, 1] E. <input type="checkbox"/> APFR P4-04 TO P3-04 [6, TT, F, 12] FOR UPPER TRAY UMBILICALS F. <input type="checkbox"/> RELEASE OUTBOARD MLI COVER FASTENERS: Cover 5 (Face 6 DLA 1) G. <input type="checkbox"/> INSPECT DLA: DLA 2 H. <input type="checkbox"/> REINSTALL DLA2 MLI COVER: Cover 20 (Face 2 DLA 2) I. <input type="checkbox"/> RELOCATE APFR FROM P3-31 TO P3-29 [9, QQ, E, 12] (EVA 2 Get Ahead for Cover 7) J. <input type="checkbox"/> RELOCATE APFR FROM P3-04 TO P3-30 [9, QQ, E, 12] (EVA 2 Get Ahead for Cover 19) <p>RELEASE OUTBOARD MLI COVER FASTENERS</p> <ul style="list-style-type: none"> 1. PGT[A2 3.8 ft-lb, CCW3 60RPM, MTL 30.5]-6 ext 7/16: Release outboard MLI cover fasteners (1 to 4) ~9 turns 2. Verify fasteners swing open <p>REMOVE DLA MLI COVER</p> <ul style="list-style-type: none"> 3. Ingress APFR 4. PGT[A2 3.8 ft-lb, CCW3 60RPM, MTL 30.5]-6 ext 7/16: Release inboard MLI cover fasteners (4) ~8 turns 5. Remove MLI cover and temp stow 	<p>Execute the steps below for either the release of spring clamp bolts or MLI Cover removal/installation:</p> <ul style="list-style-type: none"> A. <input type="checkbox"/> STOW CAMERA IN CREWLOCK BAG B. <input type="checkbox"/> RIGIDIZE AJIS STRUT: Aft Nadir (#4) C. <input type="checkbox"/> RIGIDIZE AJIS STRUT: Aft Zenith (#1) D. <input type="checkbox"/> RIGIDIZE AJIS STRUT: Fwd Nadir (#3) E. <input type="checkbox"/> RIGIDIZE AJIS STRUT: Fwd Zenith (#2) F. <input type="checkbox"/> INSTALL TETHERS ON DLA1 MLI COVER: Cover 5 (Face 6 DLA1) G. <input type="checkbox"/> REMOVE DLA1 MLI COVER: Cover 5 (Face 6 DLA 1) H. <input type="checkbox"/> DEPLOY SARJ DLA: DLA 1 (Face 6 Cover 5) APFR P3-31 [7, PP, F, 12] I. <input type="checkbox"/> INSPECT DLA: DLA1 J. <input type="checkbox"/> REINSTALL DLA1 MLI COVER: Cover 5 (Face 6 DLA) K. <input type="checkbox"/> RELEASE OUTBOARD MLI COVER FASTENERS L. <input type="checkbox"/> ON MCC GO - REMOVE ECU SHROUDS (2) AND FWD (2A) SSU SHROUD (1): Stow in ORU bag <p>RIGIDIZE AJIS STRUT</p> <ul style="list-style-type: none"> 1. Open thermal cover 2. Remove tether loop 3. Remove PIP pin 4. Remove Hitch Pin 5. Remove and stow Strut Launch Restraint 6. Verify anti-rotation tabs on cones and ground wire attach point are pointing "out" of cups and are visible 7. Position fastener into mating bulkhead bracket 8. PGT[B5 22.0 ft-lb, CW3 60RPM, MTL 30.5]-6 ext 7/16: Engage fastener (~40 turns)  9. Secure thermal cover 10. Stow Strut Launch Restraints in large trash bag

SARJ PREPARATION (01:50) (Cont)

IV	EV1 OR EV2																																		
<p>MCC-H 1. Verify DLA in NEUTRAL position</p>   <p style="text-align: center;">DLA Bolts & Labels</p> <table border="1"> <thead> <tr> <th rowspan="2">1C</th> <th colspan="2">Torque</th> <th colspan="2">Turns</th> </tr> <tr> <th>DLA1</th> <th>DLA2</th> <th>DLA1</th> <th>DLA2</th> </tr> </thead> <tbody> <tr> <td>Initial (step 17)</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Final (step 18)</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <th>2C</th> <th colspan="2">Torque</th> <th colspan="2">Turns</th> </tr> <tr> <td>Initial (step 14)</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Final (step 19)</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>IV 2. Inform MCC - DLA Deploy Complete, GO for ENGAGE</p>	1C	Torque		Turns		DLA1	DLA2	DLA1	DLA2	Initial (step 17)					Final (step 18)					2C	Torque		Turns		Initial (step 14)					Final (step 19)					<p>DEPLOY SARJ DLA</p> <p><input type="checkbox"/> 2 <input type="checkbox"/> 1</p> <p>6. BOLT 1C: PGT[A3 4.8 ft-lb, CW2 30RPM, MTL 30.5]-6 ext 7/16: Rotate draw bolt 1C 2 turns (this decreases friction between the pivot fork and the follower bracket)</p> <p><input type="checkbox"/></p> <p>7. BOLT 2C: PGT[A3 4.8 ft-lb, CCW2 30RPM, MTL 30.5]-6 ext 7/16: Rotate draw bolt 2C 2 turns</p> <p><input type="checkbox"/></p> <p>BACK OFF DLA LOCK BOLTS (1A AND 2A)</p> <p>8. BOLTS 1A, 2A: PGT[A7 9.2 ft-lb, CCW3 60RPM, MTL 30.5]-6 ext 7/16: Release lock bolts 1A and 2A fasteners (2) 6 turns (retracts lock tip bolt from follower bracket)</p> <p><input type="checkbox"/></p> <p>RELEASE 3 DLA LAUNCH RESTRAINT BOLTS (4A, 4B, AND 4C)</p> <p>9. ON MCC GO: BOLTS 4A, 4B, 4C: PGT[B7 25.5 ft-lb, CCW2 30RPM, MTL 30.5]-6 ext 7/16: Release launch restraint bolts 4A, 4B, and 4C ~8 turns (this allows the DLA frame to move relative to the launch bracket)</p> <p>10. PGT[A3 6.3 ft-lb, CW1 10RPM, MTL 30.5]</p> <p><input type="checkbox"/></p> <p>REPOSITION DLA AND ROTATE FOLLOWER ARMS</p> <p>11. Reposition DLA onto race ring (approx. 1/2-inch radially in, 3/8 inch outboard, 1 inch radially in)</p> <p>12. Verify and maintain fixed bearing in contact with race ring</p> <p>13. BOLT 2B - PGT[A3 4.8 ft-lb, CW1 10RPM, MTL 30.5]-6 ext 7/16: Rotate follower arm rotation bolt 2B 5/8 turn to hardstop</p> <p>14. BOLT 2C - PGT[A3 4.8 ft-lb, CCW2 30RPM, MTL 30.5]-6 ext 7/16: Rotate follower arm draw bolt 2C to torque (~32 turns)</p> <p>15. Verify and maintain fixed bearing in contact with race ring</p> <p>16. BOLT 1B - PGT[A3 4.8 ft-lb, CCW1 10RPM, MTL 30.5]-6 ext 7/16: Rotate follower arm rotation bolt 1B 5/8 turn to hardstop</p> <p>17. BOLT 1C - PGT[A3 4.8 ft-lb, CW2 30RPM, MTL 30.5]-6 ext 7/16: Rotate draw bolt 1C to torque (~32 turns)</p> <p>18. BOLT 1C - PGT[B4 19.4 ft-lb, CW2 30RPM, MTL 30.5]-6 ext 7/16: Final installation torque on follower arm draw bolt 1C ~4 turns to final torque</p> <p>19. BOLT 2C - PGT[B4 19.4 ft-lb, CCW2 30RPM, MTL 30.5]-6 ext 7/16: Final installation torque on follower arm draw bolt 2C ~4 turns to final torque <input type="checkbox"/></p>
1C		Torque		Turns																															
	DLA1	DLA2	DLA1	DLA2																															
Initial (step 17)																																			
Final (step 18)																																			
2C	Torque		Turns																																
Initial (step 14)																																			
Final (step 19)																																			

SARJ PREPARATION (01:50) (Cont)

IV	EV1	EV2									
<p>MCC 3. Verify DLA in ENGAGE position</p> <table border="1"> <thead> <tr> <th>DLA</th> <th>1</th> <th>2</th> </tr> </thead> <tbody> <tr> <td>Engaged</td> <td></td> <td></td> </tr> <tr> <td>Cover Installed</td> <td></td> <td></td> </tr> </tbody> </table>	DLA	1	2	Engaged			Cover Installed			<p><u>INSPECT DLA</u></p> <p>20. ON MCC GO: EV2 stand by for DLA MLI cover re-install</p> <p>21. Verify DLA pinion gear teeth fully engaged to SARJ race ring teeth <input type="checkbox"/></p> <p><u>REINSTALL DLA MLI COVER</u></p> <p>22. PGT[A2 3.8 ft-lb, CW2 30RPM, MTL 30.5]-6 ext 7/16: Engage inboard MLI cover fasteners (4) (~8 turns) <input type="checkbox"/></p>	<p><u>REINSTALL DLA MLI COVER</u></p> <p>1. Assist EV1 with DLA cover install</p>
DLA	1	2									
Engaged											
Cover Installed											

SARJ PREPARATION – TASK DATA

Estimated Task Duration:

	With RMS	Without RMS
One EV Crew	NA	NA
Two EV Crew	NA	1:50

Tools:

EV1 (FF)	EV2 (FF)
PGT	PGT
6 Ext 7/16	6 Ext 7/16
APFR	Large ORU transfer bag
	Ratchet wrench
	6 Ext 7/16

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
MLI Cover Spring Clamps	NA	7/16	1-4 per cover	2.2	3.0	3.9	9	60
MLI Cover Inboard Fasteners	NA	7/16	4-6 per cover	3.2	3.6	5.3	8	60
SARJ Launch Lock Fasteners	NA	7/16	4 per lock	23.7	24.8	62.5	13	60
SARJ Launch Restraint Fastener	NA	7/16	2 per	56.3	50	134.1	18	60
SARJ Launch Restraint Jack Bolt	NA	7/16	1 per	12.5	25	139.3	9 max	60
DLA 1A and 2A Lock bolts	Yes	7/16	2 per	3.3 – 6.3	9.2	42.2	6	60
DLA 1C and 2C Draw Bolts	Yes	7/16	2 per	4.8 initial 19.4 final	0.8	38.9	38	20
DLA 4A, 4B, and 4C Launch Restraint Bolts	Yes	7/16	3 per	20 – 21.7	25	50	4 – A&B 8 – C	30
DLA 1B and 2B Follower arm rotation Bolts	Yes	7/16	2 per	NA	4.8	10.6	5/8	20

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
NA					

Foot Restraints:

Task	WIF	APFR Setting
Cover 1 Launch Lock (#8) Face 1	P4-08	2, NN, F, 12
Cover 2 Launch Lock (#9) Face 1	P3-31	5, QQ, F, 1
Launch Restraint 6 B	P3-31	5, QQ, E, 1
Cover 3 MLI Cover Latch Face 1 – 6	P3-31	5, QQ, E, 1
Cover 4 Launch Lock (#10) Face 6	P3-31	5, QQ, C, 12
Cover 5 DLA 1 Face 6	P3-31	7, PP, F, 12
Cover 6 Launch Lock (#11) Face 6	P3-28	9, QQ, G, 12
Launch Restraint 5	P3-28	9, QQ, F, 12
Cover 7 Launch Lock (#12) Face 5	P3-29	9, QQ, E, 12
Cover 8 Launch Lock (#13) Face 5	P3-29	10, QQ, F, 11
Cover 9 Launch Lock (#14) Face 5	P3-33	6, UU, G, 12
Cover 10 Launch Lock (#15) Face 5	P3-33	6, UU, G, 12
Launch Restraint 4 B	P4-06	1, NN, E, 12
Cover 11 MLI Cover Latch Face 4 – 5	P4-06	1, NN, E, 12
Cover 12 Launch Lock (#16) Face 4	P4-06	1, NN, E, 12
Cover 13 Launch Lock (#1) Face 4	P4-07	7, NN, F, 12
Launch Restraint 3 B	P4-07	7, NN, F, 12
Cover 14 MLI Cover Latch Face 3 – 4	P4-07	7, NN, F, 12
Cover 15 Launch Lock (#2) Face 3	P3-34	12, QQ, D, 12
Cover 16 Launch Lock (#3) Face 3	P3-34	12, QQ, D, 12
Cover 17 Launch Lock (#4) Face 3	P3-30	9, QQ, H, 1
Cover 18 Launch Lock (#5) Face 3	P3-30	9, QQ, F, 12
Launch Restraint 2	P3-30	9, QQ, F, 12
Cover 19 Launch Lock (#6) Face 2	P3-30	9, QQ, E, 12
Cover 20 DLA 2 Face 2	P4-04	6, PP, L, 1
Cover 21 Launch Lock (#7) Face 2	P4-08	2, NN, C, 11
Launch Restraint 1 B	P4-08	2, NN, C, 11
Cover 22 MLI Face 1-2	P4-08	2, NN, C, 11

SARJ PREPARATION – TASK DATA (Cont)

General Notes:

1. If any latch assembly fails to snap completely out of the way, a gentle nudge may be required
2. All launch locks should be removed prior to breaking torque on launch restraint bolts
3. It is preferred to remove launch restraint 2 or 5 last
4. The outboard SARJ race ring side MLI cover bolts (spring clamp bolts) should be released prior to the inboard MLI cover bolts
5. The SARJ Launch Restraint (SLR) comes off in three attached pieces via lanyards. The SLR consists of two clam shell halves retained by two (2) captive EVA bolts on the outer edges, with a central EVA jackscrew and a EVA tether loop on the upper half of the clamshell assembly

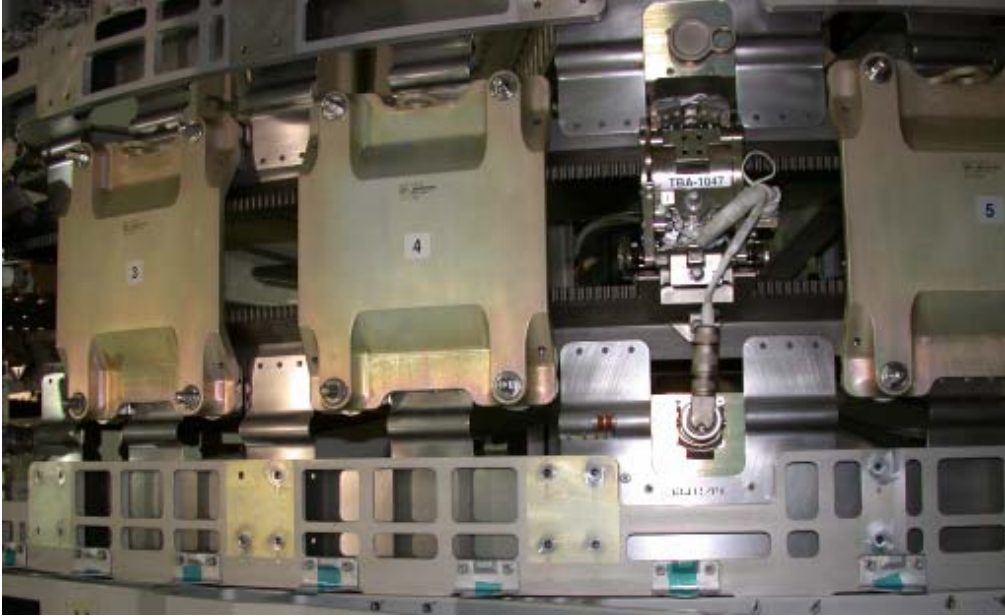
Cautions:

1. During re-installation of MLI covers, do not re-install Latch assemblies on the outboard SARJ race ring side (spring clamp bolts). This will preclude SARJ rotation
2. Prior to the removal of the last launch structure (launch lock or launch restraint), power must be off to the RJMCs and both deployed DLA pinion gears must be engaged to prevent free rotation of the SARJ
3. When using the jackscrew to release the launch restraint, do not exceed 9 turns. Half “moon-shaped” nuts on jackscrew may become detached if turned more than 9 times
4. Any single failure of bolts/latch assemblies will prevent SARJ activation
5. Avoid impacting the race ring with the DLA when the DLA is unconstrained
6. During follower arm rotation (90 deg turn) when the DLA is still unconstrained, interference with structure may occur. The DLA must be held against the outer side of the SARJ race ring for the follower arm to rotate fully – clearing obstruction
7. After removal of the last launch lock or launch restraint, crewmembers cannot translate outboard of SARJ until one DLA is in LOCK

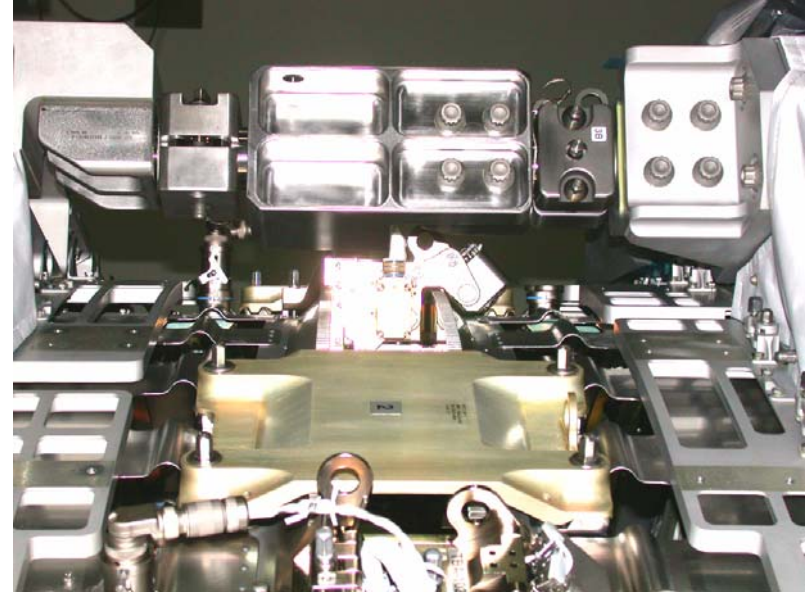
Warnings:

None

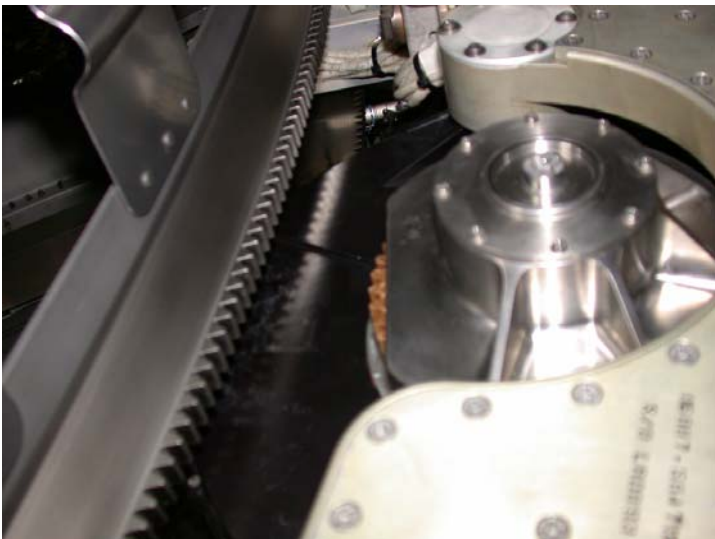
SARJ PREPARATION – TASK DATA (Cont)



SARJ Launch Locks



SARJ Launch Restraints

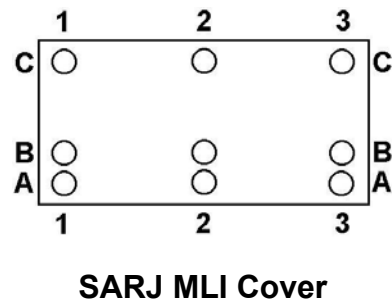
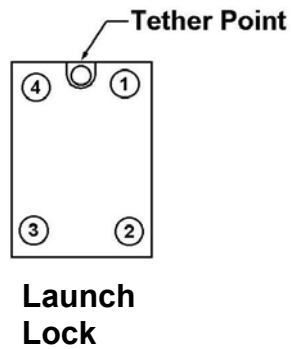
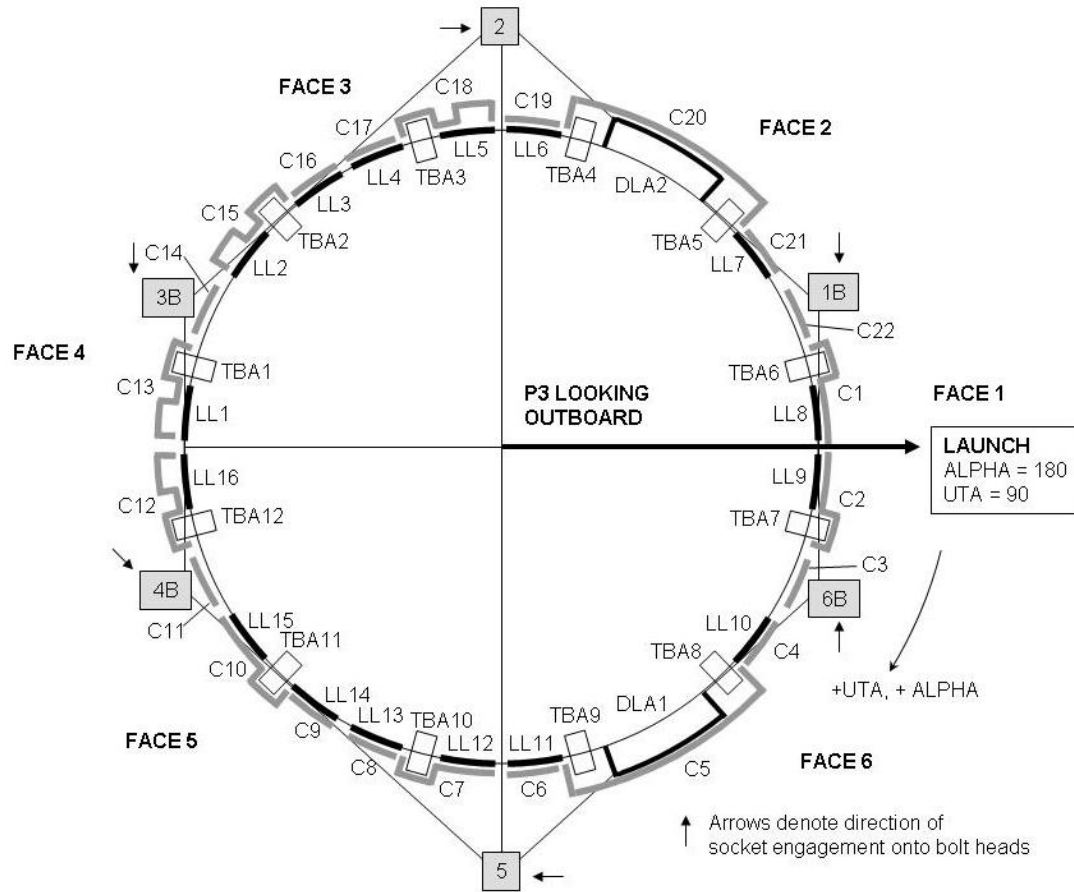


SARJ Race Ring and DLA Pinion Gear (gold)



DLA

SARJ PREPARATION – TASK DATA (Cont)



Cover (# Bolts Inbrd/Outbrd)	Outboard MLI cover fasteners	Launch Lock/ DLA Complete (GMT)	Item
22 (4/1)			
21 (4/2)			LL 7
20 (4/4)			DLA 2
19 (4/2)			LL 6
18 (6/3)			LL 5
17 (4/2)			LL 4
16 (4/2)			LL 3
15 (6/3)			LL 2
14 (4/1)			
13 (6/3)			LL 1
12 (6/3)			LL 16
11 (4/1)			
10 (6/3)			LL 15
9 (4/2)			LL 14
8 (4/2)			LL 13
7 (6/2)			LL 12
6 (4/2)			LL 11
5 (4/4)			DLA 1
4 (4/2)			LL 10
3 (4/1)			
2 (6/3)			LL 9
1 (6/3)			LL 8

LL = Launch Lock
DLA = Drive Lock Assembly

Launch Restraints	Released (GMT)	Launch Restraints	Released (GMT)
1B		4B	
2		5	
3B		6B	

SARJ Brace	Torque	Turns	Completed (GMT)
Face 2			
Face 3			
Face 5			
Face 6			

AJIS Strut	Torque	Turns	Completed (GMT)
#4 (Aft Nadir)			
#1 (Aft Zenith)			
#3 (Fwd Nadir)			
#2 (Fwd Zenith)			

SARJ PREPARATION – TASK DATA (Cont)

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CONNECT P1 TO P3 UPPER TRAY UTILITIES (01:15)

IV	EV1	
<p>MCC-H 1. Verify DEACTIVATING DDCU LA4A (AND GIVE "GO" FOR UPPER TRAY UTILITY CONNECTIONS) step 44 complete (SODF: ASSY OPS: P3 ACTIVATION AND S0, S1, P1 POWER DOWN/POWER UP)</p> <p>2. Inform MCC – P3 Upper Tray Utilities complete</p> <p>MCC-H 3. Verify PERFORMING P6 4B POWERDOWN - PART 2 step 45 complete (SODF: ASSY OPS: P3 ACTIVATION AND S0, S1, P1 POWER DOWN/POWER UP)</p> <p>4. Inform MCC – CIDs 6 & 8 REMOVED</p>	<p><u>CONNECT P1 TO P3 UTILITIES</u></p> <ol style="list-style-type: none"> 1. APFR P3-04 [6,TT,F,12] 2. Open P1 Utility tray shroud to access connector panel A51 3. Open all TA clamps except P17 4. On MCC GO, demate from panel A51 and mate to panel A88 Upper Tray Utilities as follows and transfer caps: <ul style="list-style-type: none"> <input type="checkbox"/> Demate P17 (leave in TA clamp) <input type="checkbox"/> P16 to J16 (fiber optic) <input type="checkbox"/> P15 to J15 <input type="checkbox"/> P14 to J14 <input type="checkbox"/> P13 to J13 <input type="checkbox"/> Release TA clamp on P17 <input type="checkbox"/> P17 to J17 <input type="checkbox"/> P12 to J12 <input type="checkbox"/> P11 to J11 5. If possible, close P1 TA clamps 6. Reattach P1 utility tray shroud 7. Translate to Z1 tray, port side (CID 6) 8. ON MCC GO: Perform the following steps to remove CID 6: <ul style="list-style-type: none"> <input type="checkbox"/> Demate S0 P230 from CID 6 J430; temp stow <input type="checkbox"/> Demate CID 6 P230 from Z1 tray J430 <input type="checkbox"/> Mate S0 P230 to Z1 tray J430 <input type="checkbox"/> Retrieve CID 6 9. Translate to S0; temp stow CID 6 on fwd, port S0 10. Ingress S0 bay 4 (CID 8). Perform the following steps to remove CID 8: <ul style="list-style-type: none"> <input type="checkbox"/> Demate S0 P485 from CID 8 J484; temp stow <input type="checkbox"/> Demate CID 8 P485 from S0 J484 <input type="checkbox"/> Mate S0 P485 to S0 J484 <input type="checkbox"/> Retrieve CID 8 11. Temp stow CID 8 with CID 6 	

CONNECT P1 TO P3 UPPER TRAY UTILITIES – TASK DATA

Estimated Task Duration:

	With RMS	Without RMS
One EV Crew	NA	1:15
Two EV Crew	NA	NA

Tools:

EV1	EV2
APFR	NA

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
NA								

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
W5002 (EO)	P11 (A51J31)	J11 (A88)	1	37	*Primary Power 4A
W5004 (EO)	P12 (A51J32)	J12 (A88)	1	37	Primary Power 4B
W5104 (EO)	P13 (A51J33)	J13 (A88)	1	25	*Secondary Power 1A
W5102 (EO)	P14 (A51J34)	J14 (A88)	1	33	*Secondary Power 4B
W5260 (RF)	P15 (A51AJ1)	J15 (A88)	1	25	*Data / 1553 B
W5452 (FO)	P16 (A51J36)	J16 (A88)	1	15	Video/Sync-3, High Rate Data Link (UCCAS-2)
W5354 (ML)	P17 (A51J37)	J17 (A88)	1	25	INSTM (Strain Gage/Accelerometer)
W4035 (EO)	S0 P230 (CID 6 J430)	Z1 J430	0	33	*Primary Power 4B-4A
W4005 (EO)	S0 P485 (CID 8 J484)	S0 J484 (A200)	0	37	*Primary Power 4B-4A

* denotes connection required for channel activation

Foot Restraints:

Task	WIF	APFR Setting
Mate P1 to P3 Upper Tray Umbilicals	P3-04	6, TT, F, 12

Note:

1. Internal P1 TA clamps (4) were released during 11A
2. No shroud exists on the P3 side utility tray

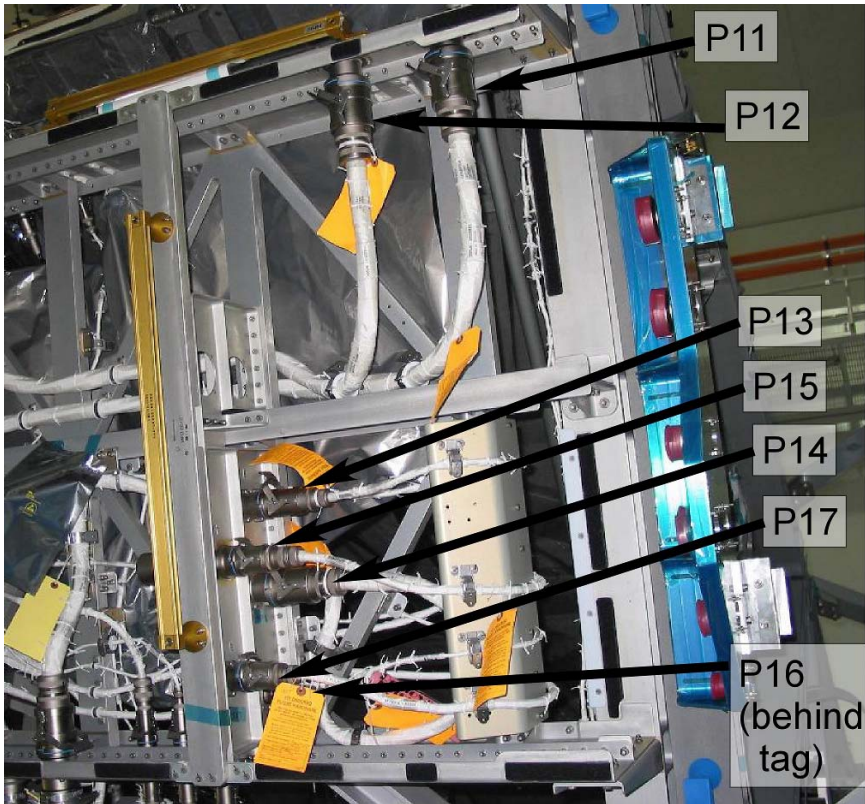
Cautions:

1. Power should be restored as quickly as possible after the power umbilicals have been connected
2. Fiber optic cable harness P16 shall be firmly supported during installation to prevent damage due to excessive bending, kinking, tension, torsional loading or other excessive strain. Avoid bend radii of less than 10 times the diameter of the wire harness

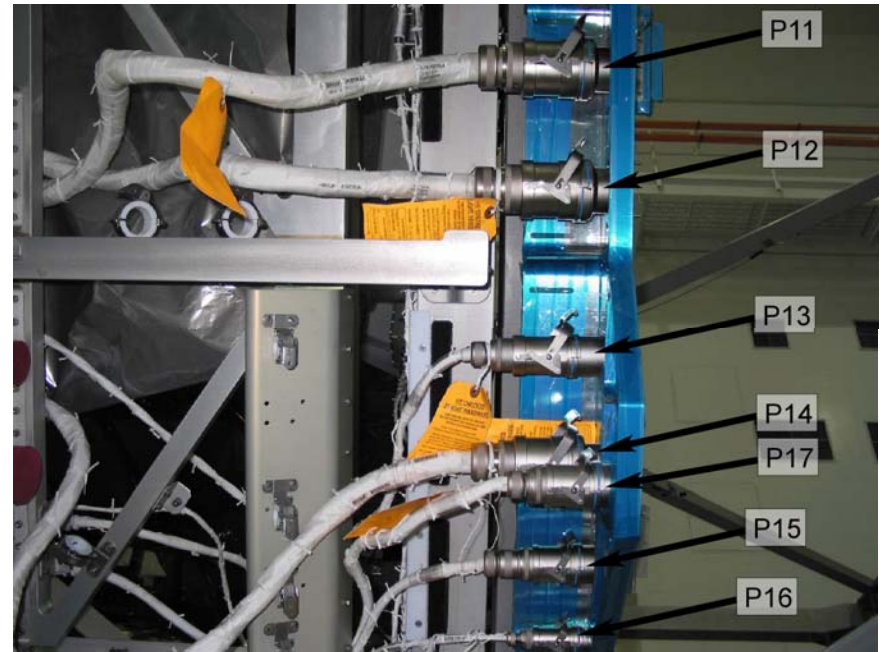
Warnings:

1. Power must be turned off to connectors P1, P11, P12, P13 and P14; Z1 J430 and S0 J484 while being mated/demated to preclude arcing/sparking

CONNECT P1 TO P3 UPPER TRAY UTILITIES – TASK DATA (Cont)



P1 Upper Tray Umbilicals (Face 2) before mating to P3



P1 Upper Tray

EVA 1 CLEANUP/INGRESS (00:40)

IV	EV1	EV2
	<p><u>CLEANUP</u></p> <ol style="list-style-type: none"> 1. Perform tool and bag inventory 2. Stow and retrieve ORU transfer bag and attach to BRT 3. Tether swap to S0 safety tether; verify hook locked 4. Stow P3 safety tether on HH P1 3690, verify reel unlocked 5. Translate to Airlock 6. Fairlead S0 safety tethers on A/L HH 0535 <p><u>INGRESS</u></p> <ol style="list-style-type: none"> 7. Hand in ORU transfer bag 8. Stow EV2 Safety tether A/L HH 0506, verify reel unlocked 9. Attach Waist Tether (R) to A/L D-ring; verify hook locked 10. Stow Safety Tether on A/L HH 0506; verify reel unlocked 11. Ingress A/L 12. Remove SCU from stowage pouch 13. Remove DCM cover, Velcro to DCM 14. SCU-> <-DCM, √SCU locked 15. Water – OFF <div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>CAUTION Do not close hatch until EMU WATER – OFF for 2 min</p> </div> <ol style="list-style-type: none"> 16. Close thermal cover, attach Velcro strap 17. Verify no hardware blocking hatch 18. EV Hatch – close and lock 19. Go to PRE REPRESS portion of {CREWLOCK DEPRESS/REPRESS CUE CARD} (SODF:ISS EVA SYS: EVA PREP/POST) 	<p><u>CLEANUP</u></p> <ol style="list-style-type: none"> 1. Perform tool inventory 2. Retrieve EVA Crewlock bag 3. Tether swap to S0 safety tether; verify hook locked 4. Stow P3 safety tether on HH P3 3811, verify reel unlocked 5. Translate to S0 and retrieve CIDs 6 & 8 6. Pickup airlock safety tethers at S0 HH 3530 7. Translate to Airlock 8. Stow airlock safety tethers on HH 0554, verify reel unlocked <p><u>INGRESS</u></p> <ol style="list-style-type: none"> 9. Open A/L Thermal Cover 10. Ingress A/L 11. Attach Waist Tether (L) to UIA D-ring, verify hook locked 12. Stow Crewlock Bag & CIDs 13. Stow ORU transfer bag 14. Release Safety tether, hand to EV1 15. Give EV1 GO for Ingress 16. Remove SCU from stowage pouch 17. Remove DCM cover, Velcro to DCM 18. SCU-> <-DCM, √SCU locked 19. Water – OFF <div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>CAUTION Do not close hatch until EMU WATER – OFF for 2 min</p> </div>

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TIME (HR : MIN)	IV	12A EVA 2 EV3	EV4
00:00		POST DEPRESS (00:05)	POST DEPRESS (00:05)
		EVA 2 EGRESS/SETUP (00:40) • Translation to P3	EVA 2 SETUP (00:40) • Translation to P3
		•Stow Bag #2 Face 4	•Stow Bag #1 Face 1
01:00		REMOVE AFT (4A) SSU SHROUD (00:20)	SARJ PREPARATION (04:30) • Release Spring Clamps SARJ Cover #22 – Face 2 • Remove SARJ Cover #21 – Face 2
		SARJ PREPARATION (04:10) • Remove SARJ Cover #15 – Face 3	• Remove SARJ Cover #19 – Face 2
		• Release Spring Clamps SARJ Cover #14 – Face 3 • Remove SARJ Cover #13 – Face 4	• Remove SARJ Cover #18 – Face 3
02:00		• Remove SARJ Cover #12 – Face 4	• Remove SARJ Cover #17 – Face 3
		• Release Spring Clamps SARJ Cover #11 – Face 5 • Remove SARJ Cover #10 – Face 5	• Remove SARJ Cover #16 – Face 3
03:00		• Remove SARJ Cover #4 – Face 1	• Remove SARJ Cover #9 – Face 5
		• Release Spring Clamps SARJ Cover #3 – Face 6 • Remove SARJ Cover #2 – Face 6	• Remove SARJ Cover #8 – Face 5
		• Remove SARJ Cover #1 – Face 6	• Remove SARJ Cover #7 – Face 5
04:00		• Remove SARJ Launch Restraint 1B	• Remove SARJ Cover #6 – Face 6
		• Remove SARJ Launch Restraint 6B	• Remove SARJ Launch Restraint 3 B
		• Remove SARJ Launch Restraint 2	• Remove SARJ Launch Restraint 4 B
05:00	√ MCC-H GO Prior to Removing Last Launch Restraint MCC-H – DLA to LOCK	• Remove SARJ Launch Restraint 5	• Relocate ORU transfer bag #2
		DEPLOY SARJ BRACE (00:30) • SARJ Brace - Face 6 • SARJ Brace - Face 5	DEPLOY SARJ BRACE (00:30) • SARJ Brace - Face 2 • SARJ Brace - Face 3
06:00		EVA 2 CLEANUP/INGRESS (00:40)	EVA 2 CLEANUP/INGRESS (00:40)
		PRE REPRESS (00:05)	PRE REPRESS (00:05)

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PRE EVA 2 TOOL CONFIG

<u>Prior to EVA, inspect:</u>	
<input type="checkbox"/>	RET cord for damage
<input type="checkbox"/>	BRT for loose fittings/screws
<input type="checkbox"/>	Waist tether load alleviating straps

<u>EV3</u>	
<input type="checkbox"/>	MWS
<input type="checkbox"/>	BRT (L)
<input type="checkbox"/>	RET (eq-eq)
<input type="checkbox"/>	Wire Tie
<input type="checkbox"/>	T-Bar
<input type="checkbox"/>	RET (eq-eq)
<input type="checkbox"/>	RET (eq-eq) w/PIP pin
<input type="checkbox"/>	Adj Equip Tethers (2)
<input type="checkbox"/>	Wire Ties (2)
<input type="checkbox"/>	Small Shuttle Trash Bag
<input type="checkbox"/>	Swing Arm (R)
<input type="checkbox"/>	PGT [A2 3.8 ft-lb, CAL, MTL 30.5] S/N _____
<input type="checkbox"/>	PGT Battery S/N _____
<input type="checkbox"/>	7/16 (wobble) Socket-6 ext
<input type="checkbox"/>	RET (eq-eq)
<input type="checkbox"/>	Waist Tether (R)
<input type="checkbox"/>	D-ring Extender (R)
<input type="checkbox"/>	SAFER
<input type="checkbox"/>	WVS

<u>EV4</u>	
<input type="checkbox"/>	MWS
<input type="checkbox"/>	BRT (L)
<input type="checkbox"/>	RETs (eq-eq) (2)
<input type="checkbox"/>	Wire Tie
<input type="checkbox"/>	T-Bar
<input type="checkbox"/>	RET (eq-eq)
<input type="checkbox"/>	RET (eq-eq) w/PIP pin
<input type="checkbox"/>	Wire Tie
<input type="checkbox"/>	Small Shuttle Trash Bag
<input type="checkbox"/>	Swing Arm (R)
<input type="checkbox"/>	PGT [A2 3.8 ft-lb, CAL, MTL 30.5] S/N _____
<input type="checkbox"/>	PGT Battery S/N _____
<input type="checkbox"/>	7/16 (wobble) Socket-6 ext
<input type="checkbox"/>	RET (eq-eq)
<input type="checkbox"/>	Waist Tether (R)
<input type="checkbox"/>	D-ring Extender (R)
<input type="checkbox"/>	SAFER
<input type="checkbox"/>	WVS

<u>AIRLOCK CONFIG</u>	
<input type="checkbox"/>	Staging Bag
<input type="checkbox"/>	Fuse Tethers (2)
<input type="checkbox"/>	F5 camera w/28mm lens
<input type="checkbox"/>	PGT S/N _____
<input type="checkbox"/>	PGT Battery S/N _____
<input type="checkbox"/>	Wire Tie Caddy
<input type="checkbox"/>	RAD S/N _____
<input type="checkbox"/>	WIF Adapter w/PIP pin
<input type="checkbox"/>	Connector Cleaner Tool Kit
<input type="checkbox"/>	Spare safety tethers (2)
<input type="checkbox"/>	Prybar

<input type="checkbox"/>	Medium ORU Transfer Bag #1 (SARJ Face 1)
<input type="checkbox"/>	Launch Lock Stowage Insert (6 LL) (verify secure)
<input type="checkbox"/>	ESC
<input type="checkbox"/>	Adj Equip Tether
<input type="checkbox"/>	Large trash bag
<input type="checkbox"/>	Fuse Tether
<input type="checkbox"/>	Vise Grips
<input type="checkbox"/>	Socket Caddy
<input type="checkbox"/>	DPT Adapter
<input type="checkbox"/>	3/8-in IVA Tool Stack
<input type="checkbox"/>	PGT Battery S/N _____
<input type="checkbox"/>	PGT Battery S/N _____
<input type="checkbox"/>	Ratchet Wrench w/o palm wheel
<input type="checkbox"/>	7/16 (wobble) Socket-6 ext
<input type="checkbox"/>	Adj Equip Tether on outside of bag
<input type="checkbox"/>	RET (Lg-eq) (on outside of bag, in A/L)

<input type="checkbox"/>	Medium ORU Transfer Bag #2 (mark w/tape) (SARJ Face 4)
<input type="checkbox"/>	Launch Lock Stowage Insert (10 LL) (verify secure)
<input type="checkbox"/>	Adj Equip Tethers (2)
<input type="checkbox"/>	RET (eq-eq)
<input type="checkbox"/>	Ratchet Wrench w/ palm wheel
<input type="checkbox"/>	7/16 (wobble) Socket-6 ext
<input type="checkbox"/>	Adj Equip Tethers (2) (on outside of bag)
<input type="checkbox"/>	RET (Lg-eq) (on outside of bag, in A/L)

<u>AIRLOCK EXTERIOR</u>	
<input type="checkbox"/>	Safety Tether HH 0506
<input type="checkbox"/>	(attached to S0 HH 3529)
<input type="checkbox"/>	Safety Tether HH 0506
<input type="checkbox"/>	(attached to S0 HH 3530)
<input type="checkbox"/>	Safety Tethers (2) HH 0554

<u>P3 TRUSS</u>	
<input type="checkbox"/>	APFR WIF 29 [9, QQ, E, 12]
<input type="checkbox"/>	APFR WIF 30 [9, QQ, E, 12]
<input type="checkbox"/>	Safety Tethers 85 ft (2)

Highlight indicates location change during EVA

EVA BRIEFING CARD

EV 1/3 _____	EV 2/4 _____	IV 1 _____	IV 2 _____
Exercise			Campout
Wake-up (GMT) _____	_____ : _____	_____	Wake-up (GMT)
EVA Prep start _____	_____ : _____	_____	Repress for hygiene
Depress to 10.2 _____	_____ : _____	_____	Depress to 10.2
Start purge _____	_____ : _____	_____	Start purge
PET 00:00 _____	_____ : _____	_____	PET 00:00

EVA Prep

- Get-up plan – clothing and EMU equip bag, Hygiene break
- Exercise protocol review, if required
- Equipment lock activities – IV responsibilities
- Suit donning plan – special requests
- SAFER, MWS, tools, CL positions and bag stowage
- Airlock depress review
- EV/IV comm protocol
- SRMS/SSRMS initial position

EV Crew Procedure Review

- Egress Plan
- Translations – tether swaps
- Order of tasks
- Ingress Plan

General Procedure Review

- Get ahead tasks
- Constraints – ground and flight
- Cautions and warnings review
- RMS operations – comm protocol/clearances
- Contingency procedures – crib sheet

Emergencies review

- Lost comm
- EMU malfunctions
- Lost tools
- Lost crewmember
- DCS

Post EVA

- Suit doffing responsibilities
- Post EVA plan

Lessons learned from previous EVAs and general motherhood

EVA 2 INHIBIT PAD

ORBITER

RCS	
	If EV crew < 27 ft from FRCS:
IV	1. √DAP: FREE, LO Z
O14,15,16	2. √RJDF F1, F2, F3, F4 MANF DRIVER (four) – OFF LOGIC (four) – OFF
MCC-H	3. √Above RCS config
IV	4. √RCS F – ITEM 1 EXEC (*) √JET DES F1U – ITEM 17 (*) F3U – ITEM 19 (*) F2U – ITEM 21 (*)
TCS	
IV	L12 1. √TCS POWER – OFF
S-Band	
	<u>NOTE</u> Possible loss of comm when forced to S-Band LL FWD antenna
	When EV crew on Lab forward area:
IV	If EV crew ≤ 1.6 ft from upper S-Band antenna:
A1R	1. S-BAND FM ANT – XMTR LOWER/RCVR UPPER 2. √MCC, lower antenna selected
	If no comm, or on MCC call:
C3	3. S-BAND PM ANT – LL FWD
	When EV crewmember at least 1.6 ft away from all S-band upper antennas:
C3	4. S-BAND ANT – GPC
KU-Band	
MCC-H	1. √KU-BAND EVA Mask – active 2. √KU-BAND EVA Protect Box – active

RSOS

FGB Antennas	
MCC-M	1. √FGB KURS P [Kurs] – Deactivate
	2. ARISS – Deactivate
Soyuz Antennas	
MCC-M	3. √Soyuz KURS A [Kurs] – Deactivate
SM Antennas	
MCC-M	4. Global Timing Sys 1 (400.1MHz) [GTS] – Deactivate
	5. ARISS – Deactivate

USOS

PCU	
	<u>NOTE</u> PCUs may require up to 1 hr warm-up period before they are operational. No further action is reqd in the event of one or two PCU failures
MCC-H	1. √PCUs (two) operational in discharge mode
Lab Window	
IV	1. Close window shutter if EV crew less than 10 ft/3.5m from window
MISSE PEC 5	
MCC-H	1. √MISSE PEC 5 – RESET, record timer information
Ground Radar	
MCC-H	1. √TOPO/RIO & FDO console, ground radar restrictions in place for EVA

NOTES, CAUTIONS, AND WARNINGS

NOTES

1. For bolt install: report good/nominal torque and turns
2. For bolt release: report torque and turns if different from published range
3. EVA connectors: after disconnection and prior to connection; verify pin and EMI band integrity; verify connector free of FOD
4. MLI handholds are not rated for crewmember translation loads
5. Toolbox doors must be closed with one latch per door when EV crew not in immediate vicinity

CAUTION

Flight Specific

A. SARJ prep:

1. During re-installation of MLI covers, do not re-install outboard spring clamps on MLI covers

B. SARJ launch restraint:

1. When using jackscrew, do not exceed 9 turns
2. Prior to removal of the last launch restraint, both DLAs must be engaged and both RJMCs must be powered off
3. After removal of last launch restraint, crewmembers cannot translate outboard of SARJ until the SARJ is locked

C. PV radiators [P4,P6]:

1. Avoid contact with radiator bellows and thermal outer coating

CAUTION (Cont)

ISS Constraints

D. Avoid inadvertent contact with:

1. Grapple fixture shafts (drylube)
2. PIP pins
3. Deployed MISSEs [A/L,P6]
4. Passive UMAs
5. MBS VDU, MCU, CRPCMs and Cameras (tape radiative surfaces, silver Teflon)
6. Deployed TUS cable
7. GPS Antenna (S13 paint) [S0]
8. UHF Antennas [Lab,P1]

E. Electrical cables:

1. Avoid bend radii < 10 times cable diameter

F. For structural reasons:

1. Avoid vigorous body motions, quick grabs and kickoffs against tether restraints
2. Avoid performing shaking motions (sinusoidal functions) more than four cycles
3. Avoid kicking S1/P1 radiator beam
If any of these occur, wait 2 to 5 min to allow structural response to dissipate

G. Other:

1. ITT Cannon connector: do not turn collar from WHITE to BLACK without a mating half attached
2. WIS Antennas: do not use as handholds [Z1,P4]

WARNING

Flight Specific

A. Electrical connectors:

1. NZGL connector linkage is pinch hazard. Use caution when mating/locking
2. Power must be turned off to electrical connectors prior to mating/demating to preclude arcing/sparking
3. Sharp edge – mating surfaces of EVA connectors. Avoid side loads during connector mating

B. SARJ prep:

1. Sharp edge – spring loaded captive EVA fasteners (e.g., SARJ MLI covers); end of spring may protrude

ISS Constraints

C. Avoid inadvertent contact with:

1. Grapple fixture targets and target pins
2. Stay 2 ft from S1/P1 radiator beam rotational envelope when beam is free to rotate
3. Stay 5 ft from moving MT on face 1

D. Handrails:

1. Handrails previously used for MISSE attachment may not be used as a safety tether point [A/L endcone 566, A/L Tank 2 nad/fwd, P6 5389]

E. Pinch:

1. ITT Cannon connector rotating housing
2. EV side of IV hatch during hatch operations (also snag hazard) [A/L]

F. RF radiation exposure:

1. Stay 1 ft from UHF antenna when powered [Lab,P1]

Cont next page

NOTES, CAUTIONS, AND WARNINGS (Cont)

WARNING (Cont)

ISS Constraints (Cont)

G. Sharp edges:

1. Inner edges of WIF sockets
2. Nickel coated braided copper ground straps may contain frayed wires [P6,P4]
3. Keep hands away from SSRMS LEE opening and snares

H. Thermal:

1. EVA connectors with booties may become hot if left uncovered
2. Turn off glove heaters when comfortable temp reached to prevent bladder damage. Do not pull fingers out of gloves when heaters are on
3. Uncovered trunnion pins may be hot
4. Do not touch EMU protective visor if temp has been, -134 for > 15 min
5. No EMU boot contact with foot restraint when temp < -120 deg F or > 200 deg F




EVA 2 EGRESS/SETUP (00:40)

IV	EV3 (FF)	EV4 (FF)
	<p>Initial Condition: Waist Tether (R) to A/L D-ring</p> <p><u>EGRESS</u></p> <ol style="list-style-type: none"> 1. Open A/L thermal cover 2. Egress airlock 3. Inspect S0 safety tethers (2) 4. Attach S0 safety tether (HH 0506) to D-ring extender (R); verify hook locked 5. √SAFER man isol vlv – open (down) 6. √SAFER HCM – closed (down) <p><u>SETUP</u></p> <ol style="list-style-type: none"> 7. Attach ORU transfer bag #2 to BRT 8. Release S0 Safety Tether (HH 0506) and give to EV4 9. Give EV4 GO for egress 10. Translate to P3, perform translation adaptation 11. Inspect P3 safety tether 12. Tether swap to P3 safety tether on HH 3811; verify hook locked 13. Stow ORU transfer bag #2 at SARJ face 4 <p><u>REMOVE AFT (4A) SSU SHROUD (00:20)</u></p> <ol style="list-style-type: none"> 1. Remove aft (4A) SSU shroud (1): Stow near ORU bag #2 	<p>Initial Condition: Waist Tether (R) to UIA D-ring</p> <p><u>EGRESS</u></p> <ol style="list-style-type: none"> 1. Hand off ORU transfer bag #2 2. Attach S0 safety tether to D-ring extender (R) and lock hook 3. Attach ORU transfer bag #1 to BRT 4. ON EV3 GO, Egress A/L w/ORU transfer bag #1 5. √SAFER man isol vlv – open (down) 6. √SAFER HCM – closed (down) 7. Close A/L thermal cover <p><u>SETUP</u></p> <ol style="list-style-type: none"> 8. Translate to P3, perform translation adaptation 9. Inspect P3 safety tether 10. Tether swap to P3 safety tether HH 3690; verify hook locked 11. Stow ORU transfer bag #1 on P3 face 1

SARJ PREPARATION (04:30)

IV	EV3 (FF)	EV4 (FF)
<p>1. Verify all SARJ hardware removed/released except Launch Restraint 5</p> <p>MCC-H 2. Verify last launch restraint; step 24 complete (SODF: ASSY OPS: SARJ INITIAL ACTIVATION AND CHECKOUT)</p> <p>3. Inform MCC-H – all launch restraints/locks removed</p> <p>MCC-H 4. Notify EV crew when DLA locked, step 29 complete (SODF: ASSY OPS: SARJ INITIAL ACTIVATION AND CHECKOUT)</p>	<p>Execute the steps below for either the removal of Launch locks or Launch Restraints or MLI Cover Release in the following order:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Cover 15, Face 3, Launch Lock #2 [Bag #2] APFR P3-34 (12, QQ, D, 12) <input type="checkbox"/> Cover 14, Face 3, release spring clamp (1) <input type="checkbox"/> Cover 13, Face 4, Launch Lock #1 [Bag #2] APFR P4-07 (7, NN, F, 12) <input type="checkbox"/> Cover 12, Face 4, Launch Lock #16 [Bag #2] APFR P4-06 (1, NN, E, 12) <input type="checkbox"/> Cover 11, Face 5, release spring clamp (1) <input type="checkbox"/> Cover 10, Face 5 Launch Lock #15 [Bag #2] APFR P3-33 (6, UU, G, 12) <input type="checkbox"/> Cover 4, Face 6, Launch Lock #10 [Bag #1] APFR P3-31 (5, QQ, C, 12) <input type="checkbox"/> Cover 3, Face 6, release spring clamp (1) <input type="checkbox"/> Cover 2, Face 1, Launch Lock #9 [Bag #1] APFR P3-31 (5, QQ, F, 1) <input type="checkbox"/> Cover 1, Face 1, Launch Lock #8 [Bag #1] APFR P4-08 (2, NN, F, 12) <ul style="list-style-type: none"> <input type="checkbox"/> Break torque (CCW) on 6B retaining bolts <input type="checkbox"/> Break torque (CCW) on 1B retaining bolts <input type="checkbox"/> Launch Restraint 1B, APFR P4-08 (2, NN, C, 11) <input type="checkbox"/> Launch Restraint 6B APFR P3-31 (5, QQ, E, 1) <input type="checkbox"/> Launch Restraint 2, APFR P3-30 (3, QQ, F, 12) <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> <p style="text-align: center;">CAUTION</p> <p style="text-align: center;">After removal of last launch restraint, remain inboard of SARJ until 1 DLA in LOCK</p> </div> <ul style="list-style-type: none"> <input type="checkbox"/> ON MCC GO: Launch Restraint 5, APFR P3-29 (9, QQ, F, 12) <ul style="list-style-type: none"> <input type="checkbox"/> Stow bag #1 	<p>Execute the steps below for either the removal of Launch locks or Launch Restraints or MLI Cover Release in the following order:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Cover 22, Face 2, release spring clamp (1) <input type="checkbox"/> PreStage Tethers for Cover 21 <input type="checkbox"/> Cover 21, Face 2, Launch Lock #7 [Bag #1] <input type="checkbox"/> Cover 19, Face 2, Launch Lock #6 [Bag #2] APFR P3-30 (9, QQ, E, 12) <input type="checkbox"/> Cover 18, Face 3, Launch Lock #5 [Bag #2] APFR P3-30 (9, QQ, F, 12) <input type="checkbox"/> Cover 17, Face 3, Launch Lock #4 [Bag #2] APFR P3-30 (9, QQ, H, 1) <input type="checkbox"/> Cover 16, Face 3, Launch Lock #3 [Bag #2] APFR P3-34 (12, QQ, D, 12) <input type="checkbox"/> Tether Inventory <input type="checkbox"/> Cover 9, Face 5, Launch Lock #14 [Bag #2] APFR P3-33 (6, UU, G, 12) <input type="checkbox"/> Cover 8, Face 5, Launch Lock #13 [Bag #2] APFR P3-29 (10, QQ, F, 11) <input type="checkbox"/> Cover 7, Face 5, Launch Lock #12 [Bag #1] APFR P3-29 (9, QQ, E, 12) <input type="checkbox"/> Cover 6, Face 6, Launch Lock #11 [Bag #1] APFR P3-29 (9, QQ, G, 12) <input type="checkbox"/> Tether Inventory <input type="checkbox"/> Launch Restraint 3B, APFR P4-07 (7, NN, F, 12) <input type="checkbox"/> Launch Restraint 4B, APFR P4-06 (1, NN, E, 12) <input type="checkbox"/> Inventory & stow ORU transfer bag #2 to P3 Face 1 <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> <p style="text-align: center;">CAUTION</p> <p style="text-align: center;">After removal of last launch restraint, remain inboard of SARJ until 1 DLA in LOCK</p> </div>

SARJ PREPARATION (04:30) (Cont)

IV	EV3 (FF)	EV4 (FF)
	<p><u>REMOVE SARJ LAUNCH RESTRAINT</u></p> <ol style="list-style-type: none"> 1. Ratchet wrench-6 ext7/16: Break torque on retaining bolts (2) (46 ft-lb) 2. PGT[B7 25.5 ft-lb, CCW3 60 RPM, MTL 30.5]-6 ext 7/16: Release retaining bolts (2) 9 turns <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> <p style="text-align: center;"><u>CAUTION</u> Do not exceed 9 turns on clam shell jack bolt</p> </div> <ol style="list-style-type: none"> 3. If both clamshells not loosened on “mushroom-shaped” fittings – PGT[B7 25.5ft-lb, CCW3 60 RPM, MTL 30.5]-6 ext 7/16: Release jack bolt (1) up to 3 turns 4. PGT[B7 25.5 ft-lb, CCW3 60 RPM, MTL 30.5]-6 ext 7/16: Release retaining bolts (2) (~9 turns) 5. Remove clamshell from “mushroom-shaped” fitting  6. Stow clamshell in Large Trash bag 	<p><u>REMOVE SARJ LAUNCH LOCK</u></p> <ol style="list-style-type: none"> 1. PGT[A2 3.8 ft-lb, CCW3 60 RPM, MTL 30.5]-6 ext 7/16: Release outboard MLI cover fasteners (1 to 4) (~9 turns) 2. Verify fasteners swing open  3. PGT[A2 3.8 ft-lb, CCW3 60 RPM, MTL 30.5]-6 ext 7/16: Release inboard MLI cover fasteners (4-6) (~8 turns) 4. Remove MLI cover and temp stow 5. PGT[B7 25.5 ft-lb, CCW3 60 RPM, MTL 30.5]-6 ext 7/16: Release SARJ Launch Lock fasteners (4) (~13 turns) 6. Remove launch lock and stow  7. Re-position MLI cover 8. PGT[A2 3.8 ft-lb, CW2 30 RPM, MTL 30.5]-6 ext 7/16: Engage inboard MLI cover fasteners (4-6) (~8 turns)

SARJ PREPARATION – TASK DATA

Estimated Task Duration:

	With RMS	Without RMS
One EV Crew	NA	NA
Two EV Crew	NA	4:20

Tools:

EV3 (FF)	EV4 (FF)
PGT	PGT
6 Ext 7/16	6 Ext 7/16
APFR	APFR
Medium ORU transfer bag	Medium ORU transfer bag
Large trash bag	Ratchet wrench
Ratchet wrench	

EVA Fasteners:

Fastener Name	Label	Head	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
MLI Cover Spring Clamps	NA	7/16	1-4 per cover	2.2	3.0	3.9	9	60
MLI Cover Inboard Fasteners	NA	7/16	4-6 per cover	3.2	3.6	5.3	8	60
SARJ Launch Lock Fasteners	NA	7/16	4 per lock	23.7	24.8	62.5	13	60
SARJ Launch Restraint Fastener	NA	7/16	2 per	56.3	50	134.1	18	60
SARJ Launch Restraint Jack Bolt	NA	7/16	1 per	12.5	25	139.3	9 max	60

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
NA					

Foot Restraints:

Task	WIF	APFR Setting
Cover 1 Launch Lock (#8) Face 1	P4-08	2, NN, F, 12
Cover 2 Launch Lock (#9) Face 1	P3-31	5, QQ, F, 1
Launch Restraint 6 B	P3-31	5, QQ, E, 1
Cover 3 MLI Cover Latch Face 1 – 6	P3-31	5, QQ, E, 1
Cover 4 Launch Lock (#10) Face 6	P3-31	5, QQ, C, 12
Cover 5 DLA 1 Face 6	P3-31	7, PP, F, 12
Cover 6 Launch Lock (#11) Face 6	P3-29	9, QQ, G, 12
Launch Restraint 5	P3-29	9, QQ, F, 12
Cover 7 Launch Lock (#12) Face 5	P3-29	9, QQ, E, 12
Cover 8 Launch Lock (#13) Face 5	P3-29	10, QQ, F, 11
Cover 9 Launch Lock (#14) Face 5	P3-33	6, UU, G, 12
Cover 10 Launch Lock (#15) Face 5	P3-33	6, UU, G, 12
Launch Restraint 4 B	P4-06	1, NN, E, 12
Cover 11 MLI Cover Latch Face 4 – 5	P4-06	1, NN, E, 12
Cover 12 Launch Lock (#16) Face 4	P4-06	1, NN, E, 12
Cover 13 Launch Lock (#1) Face 4	P4-07	7, NN, F, 12
Launch Restraint 3 B	P4-07	7, NN, F, 12
Cover 14 MLI Cover Latch Face 3 – 4	P4-07	7, NN, F, 12
Cover 15 Launch Lock (#2) Face 3	P3-34	12, QQ, D, 12
Cover 16 Launch Lock (#3) Face 3	P3-34	12, QQ, D, 12
Cover 17 Launch Lock (#4) Face 3	P3-30	9, QQ, H, 1
Cover 18 Launch Lock (#5) Face 3	P3-30	9, QQ, F, 12
Launch Restraint 2	P3-30	9, QQ, F, 12
Cover 19 Launch Lock (#6) Face 2	P3-30	9, QQ, E, 12
Cover 20 DLA 2 Face 2	P4-04	6, PP, L, 1
Cover 21 Launch Lock (#7) Face 2	P4-08	2, NN, C, 11
Launch Restraint 1 B	P4-08	2, NN, C, 11
Cover 22 MLI Face 1 – 2	P4-08	2, NN, C, 11

SARJ PREPARATION – TASK DATA (Cont)

General Notes:

1. If any outboard MLI cover fastener assembly fails to snap completely out of the way, a gentle nudge may be required
2. All launch locks should be removed prior to breaking torque on launch restraints
3. It is preferred to remove launch restraint 2 or 5 last
4. The outboard SARJ race ring side MLI cover bolts (spring clamp bolts) should be released prior to the inboard MLI cover bolts
5. The SARJ Launch Restraint (SLR) comes off in three attached pieces via lanyards. The SLR consists of two clam shell halves retained by two (2) captive EVA bolts on the outer edges, with a central EVA jackscrew and a EVA tether loop on the upper half of the clamshell assembly

Cautions:

1. During re-installation of MLI covers, do not re-install outboard MLI cover fasteners (spring clamp bolts) to the outboard SARJ race ring. This will preclude SARJ rotation
2. Prior to the removal of the last launch restraint, power must be off to the RJMCs and both deployed DLA pinion gears must be engaged to prevent free rotation of the SARJ
3. When using the jackscrew to release the launch restraint, do not exceed 9 turns. Half "moon-shaped" nuts on jackscrew are not captive and may become detached if turned more than 9 turns
4. Any single failure of bolts/latch assemblies will prevent SARJ activation
5. After removal of the last launch restraint, crewmembers cannot translate outboard of SARJ until one DLA is in LOCK

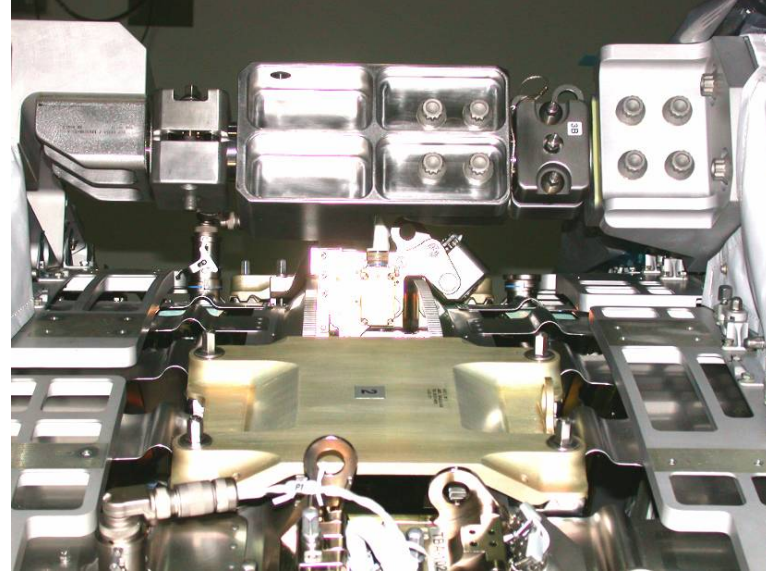
Warnings:

None

SARJ PREPARATION – TASK DATA (Cont)



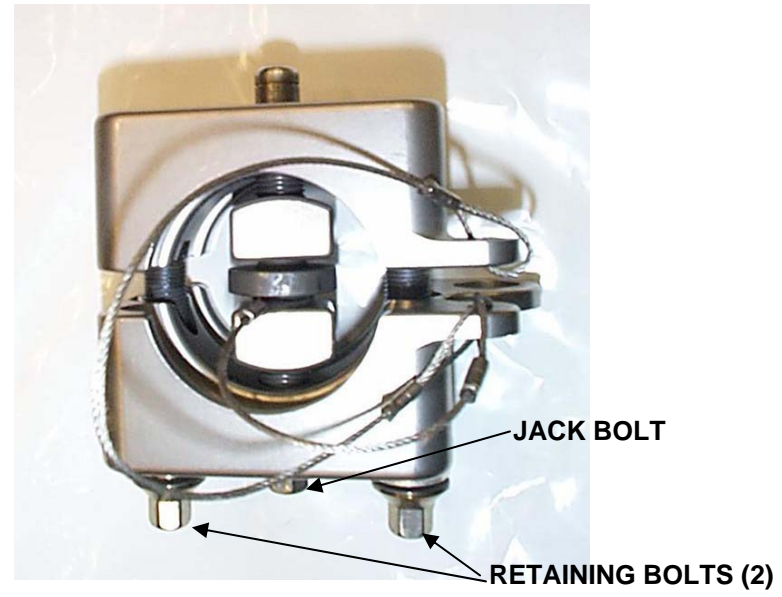
SARJ Launch Locks – Face 1



SARJ Launch Restraints – Face 1




SARJ Mushroom Fitting



SARJ Launch Restraint

DEPLOY SARJ BRACES (00:30)

IV	EV3	EV4
	<p>Execute the steps below for deploying each of the SARJ braces on Faces 3, 2, 6, and 5 (no specific order required):</p> <ul style="list-style-type: none"> <input type="checkbox"/> SARJ Brace Face 6 <input type="checkbox"/> SARJ Brace Face 5 <p><u>DEPLOY SARJ BRACE</u></p> <ol style="list-style-type: none"> 1. If Face 3 or 5, detach Velcro-straps (4) on X-POP shroud and partially peel back shroud to gain access to the SARJ brace on diagonal beam 2. PGT[B7 25.5 ft-lb, CCW3 60 RPM, MTL 30.5]-6 ext 7/16: Release brace launch restraint fastener (~11 turns) 3. Rotate brace and insert the double cone assembly into the SARJ bulkhead cup feature 4. PGT[B5 22.0 ft-lb, CW3 60 RPM, MTL 30.5]-6 ext 7/16: Engage brace cone fastener ~40 turns  5. Re-insert launch restraint bolt ~1 turn 6. If Face 3 or 5, re-attach X-POP thermal shroud Velcro straps (4) 	<p>Execute the steps below for deploying each of the SARJ braces on Faces 3, 2, 6, and 5 (no specific order required):</p> <ul style="list-style-type: none"> <input type="checkbox"/> SARJ Brace Face 2 <input type="checkbox"/> SARJ Brace Face 3

DEPLOY SARJ BRACES – TASK DATA

Estimated Task Duration:

	With RMS	Without RMS
One EV Crew	NA	1:00
Two EV Crew	NA	0:30

Tools:

EV3 (FF)	EV4 (FF)
PGT	PGT
7/16 (wobble) Socket-6 ext	7/16 (wobble) Socket-6 ext

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
Brace cone fastener	No	7/16	4	21.5	N/A	30.3	39-40	60
Brace launch restraint fastener	No	7/16	4	14.2	15.0	32.3	10-11 release 9 install	60

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
NA					

Foot Restraints:

Task	WIF	APFR Setting
Backup SARJ Brace Face 2	P3-27	12, PP, J, 12
Backup SARJ Brace Face 3	P3-30	12, TT, C, 12 (roll to D after ingress)
Backup SARJ Brace Face 5	P3-29	12, TT, J, 12 (roll to H after ingress)
Backup SARJ Brace Face 6	P3-28	12, PP, C, 12

Note:

- SARJ Braces lay longitudinally against the diagonal beam in a launch/stowed position ready for deployment. The SARJ brace is attached at one end to the diagonal beam with a rod and bearing allowing rotation and restrained at the opposite end. Brace restraint bolt is attached to diagonal beam via lanyard
- SARJ braces on P3 face 3 & 5 are covered by the X-POP thermal shroud. The thermal shroud must be peeled back to access the SARJ Brace
- Deployment of SARJ Braces is required prior to mating P6 to P5

Cautions:

- DLA must be in lock OR both DLA pinion gears engaged with power off to RJMCs OR a minimum of one launch restraint in place on the SARJ during this procedure

Warnings:

None

DEPLOY SARJ BRACES – TASK DATA (Cont)



SARJ Brace Face 5 (Launch position)



SARJ Brace Cup Cone Placed in On-orbit Position



SARJ Brace Launch Restraint Bolt (re-inserted into housing after brace release)

EVA 2 CLEANUP/INGRESS (00:40)

IV	EV3	EV4
	<ol style="list-style-type: none"> 1. APFR: P3-29 to P3-31 (1,OO,F,12) (Get Ahead for EVA 3 Keel Pin) 2. Perform tool inventory 3. Inventory and retrieve ORU transfer bag #1; attach to BRT 4. Tether swap to S0 safety tether on HH 3811; verify hook locked 5. Stow P3 safety tether, verify reel unlocked 6. Translate to Airlock 7. Fairlead at A/L HH 0535 <p><u>INGRESS</u></p> <ol style="list-style-type: none"> 8. Stow EV4's Safety Tether on A/L HH 0506, verify reel unlocked 9. Hand in ORU transfer bag #1 10. Ingress A/L 11. Attach Waist Tether (R) to A/L D-ring; verify hook locked 12. Stow Safety Tether on A/L HH 0506, verify reel unlocked 13. Remove SCU from stowage pouch 14. Remove DCM cover, Velcro to DCM 15. SCU-> <-DCM, √SCU locked 16. Water – OFF <div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>CAUTION Do not close hatch until EMU WATER – OFF for 2 min</p> </div> <ol style="list-style-type: none"> 17. Close thermal cover, attach Velcro strap 18. Verify no hardware blocking hatch 19. EV Hatch – close and lock 20. Go to PRE REPRESS portion of {CREWLOCK DEPRESS/REPRESS CUE CARD} (SODF:ISS EVA SYS: EVA PREP/POST) 	<ol style="list-style-type: none"> 1. APFR: P3-30 to P3-06 (6,PP,A,2) (Get Ahead for EVA 3 Keel Pin) 2. Perform tool inventory 3. Retrieve ORU transfer bag #2; attach to BRT 4. Tether swap to S0 safety tether on HH 3690; verify hook locked 5. Stow P3 safety tether, verify reel unlocked 6. Translate to Airlock 7. Fairlead at A/L HH 0535 <p><u>INGRESS</u></p> <ol style="list-style-type: none"> 8. Open A/L Thermal Cover 9. Stow ORU transfer bag #2 in airlock 10. Ingress airlock 11. Attach Waist Tether (R) to UIA D-ring; verify hook locked 12. Disconnect safety tether and hand out to EV3 13. Receive ORU transfer bag #1 and stow 14. Give EV3 GO for Ingress 15. Remove SCU from stowage pouch 16. Remove DCM cover, Velcro to DCM 17. SCU-> <-DCM, √SCU locked 18. Water – OFF <div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>CAUTION Do not close hatch until EMU WATER – OFF for 2 min</p> </div>

TIME (HR : MIN)	IV	12A EVA 3 EV1	EV2
00:00	ISS: LOCK 2B (STBD) & 4B(PORT) SAWS ISS: P6 S-BAND DEACT	POST DEPRESS (00:05)	POST DEPRESS (00:05)
		EVA 3 EGRESS/SETUP (00:15)	EVA 3 EGRESS/SETUP (00:15)
		INSTALL P6 BGA SHOULDER BOLT RETAINERS (00:55) • Engage P6 4-bar hinge lock • BGA Bolt Retainer Installation	SASA R&R PREP (00:30) • SASA R&R Prep activities
01:00			RELEASE PVR CINCHES/WINCH (00:50) • Translate to P3 & stow ORU bag
	ISS: P6 S-BAND ACT ISS: UNLOCK 2B & 4B SAWS SHUTTLE: THRUSTER INHIBIT ISS: DESAT INHIBIT SHUTTLE & ISS: RESUME NOM ATT CTRL	RELEASE PVR CINCHES/WINCH (00:25)	
		REMOVE AND STOW P3 KEEL PIN AND DRAG LINK (00:45)	REMOVE AND STOW P3 KEEL PIN AND DRAG LINK (00:45)
02:00		• Remove P3 SVS Target • Rotate P3 MT Stop	• Rotate P1 MT Stop • Install ETRS • Rotate P3 Tether Shuttle Stop
		P3 CLEANUP (00:45) • Remove RPDA Thermal Shroud • APFR P3-06 to P4 WIF	P3 CLEANUP (00:45) • Remove RPDA Thermal Shroud • APFR P3-31 to P4 WIF
03:00	ISS: Z1 SASA DEACT		
	ISS: S1 S-BAND DEACT	SASA R&R (02:00) • Spare SASA Z1 to S1	SASA R&R (01:50) • Spare SASA Z1 to S1
	ISS: S1 SASA HTR DEACT	• Remove failed SASA & temp stow	• Remove failed SASA & temp stow
04:00	ISS: S1 SASA HTR ACT	• Install spare SASA on S1	• Install spare SASA on S1
		• Failed SASA S1 to Z1	• Failed SASA S1 to Z1
	ISS: Z1 SASA ACT	• Install shrouds on failed SASA	• Install shrouds on failed SASA
05:00	ISS: S1 HTR (BSP/XPDR) DEACT ISS: KU-BAND ANT - PARK	• Cleanup	
		INSTALL SGANT AGIT HEAT SHIELD (00:20)	S1 S-BAND BSP & XPDR R&R (01:00)
	ISS: KU-BAND ANT - UNPARK	MISSE 5 RETRIEVE (00:30)	
06:00	ISS: ISS S1 S-BAND ACT	EVA 3 CLEANUP/INGRESS (00:25)	EVA 3 CLEANUP/INGRESS (00:25)
		PRE REPRESS (00:05)	PRE REPRESS (00:05)

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PRE EVA 3 TOOL CONFIG

Prior to EVA, inspect:	
<input type="checkbox"/>	RET cord for damage
<input type="checkbox"/>	BRT for loose fittings/screws
<input type="checkbox"/>	Waist tether load alleviating straps

- EV1**
- MWS
 - BRT (L)
 - RET (eq-eq)
 - Wire Ties (2)
 - T-Bar
 - RET (eq-eq)
 - RET (eq-eq) w/PIP-pin
 - Adj Equip Tether
 - Wire Ties (2)
 - Shuttle Small Trash Bag
 - Swing Arm (R)
 - PGT [B7 25.5 ft-lb, CAL, MTL 30.5] S/N _____
 - PGT Battery S/N _____
 - 7/16 (wobble) Socket-6 ext
 - RET (eq-eq)
 - Waist Tether (R)
 - D-Ring Extender (R)
 - SAFER
 - WVS

- EV2**
- MWS
 - BRT (L)
 - RET (eq-eq)
 - Wire Ties (2)
 - T-Bar
 - RET (eq-eq)
 - RET (eq-eq) w/PIP-pin
 - Adj Equip Tethers (2)
 - Wire Tie
 - Shuttle Small Trash Bag
 - Swing Arm (R)
 - PGT [B7 25.5 ft-lb, CAL, MTL 30.5] S/N _____
 - PGT Battery S/N _____
 - 7/16 (rigid) Socket-2 ext
 - RET (eq-eq)
 - Waist Tether (L)
 - D-ring Extender (R)
 - SAFER
 - WVS

- AIRLOCK CONFIG**
- Staging Bag
 - Fuse Tether
 - PGT S/N _____
 - PGT Battery S/N _____
 - PGT Battery S/N _____
 - Connector Cleaner Tool Kit
 - F5 Camera
 - Camera Bracket
 - Wire Tie Caddy
 - WIF Adapter w/PIP pin
 - RAD S/N _____
 - Probe
 - EVA Scraper
 - Spare Safety Tethers (2)

- P3 Med ORU Transfer Bag**
- Fuse Tether
 - Ratchet Wrench
 - EVA Temporary Rail Stop (ETRS)
 - Vise Grips
 - ESC
 - Adj Equip Tether (outside of bag)
 - RET (Lg-eq) (outside of bag in A/L)
 - MUT-Ballstack-MUT (attached to bag handhold)
 - Adj Equip Tether

- P6 Crewlock Bag**
- Adjustable Equip Tether
 - BGA Bolt Retainers (8)
 - ISS GP Caddy
 - IV Adjustable Wrench
 - AGIT Heat Shield

- S1 S-Band Large ORU Transfer Bag**
- BSP S/N _____
 - Protective Cover
 - RET
 - XPDR S/N _____
 - Protective Cover
 - RET
 - RET (Lg-eq) (outside of bag in A/L)
 - IR Camera Crewlock Bag
 - IR Camera
 - EHIP Battery S/N _____

- AIRLOCK EXTERIOR**
- Safety Tether – HH 0506
(attached to S0 HH 3529)
 - Safety Tether – HH 0506
(attached to S0 HH 3530)
 - Safety Tether – HH 0554
 - Safety Tether – HH 0554

- P3 TRUSS**
- APFR P3-06 [6, PP, A, 2]
 - APFR P3-31 [1, OO, F, 12]
 - 85' Safety Tether – P3 HH 3811
 - 85' Safety Tether – P1 HH 3690

- SO TRUSS**
- APFR S0-07 [5, NN, L, 12]

- Z1 TRUSS**
- IAPFR Z1-01 [3, RR, F, 12]
 - APFR w/AIA Z1-11 [2, TT, H, 11]

Highlight indicates location change during EVA

EVA BRIEFING CARD

EV 1/3 _____	EV 2/4 _____	IV 1 _____	IV 2 _____
Exercise			Campout
Wake-up (GMT) _____	_____	_____	Wake-up (GMT) _____
EVA Prep start _____	_____	_____	Repress for hygiene _____
Depress to 10.2 _____	_____	_____	Depress to 10.2 _____
Start purge _____	_____	_____	Start purge _____
PET 00:00 _____	_____	_____	PET 00:00 _____

EVA Prep

- Get-up plan – clothing and EMU equip bag, Hygiene break
- Exercise protocol review, if required
- Equipment lock activities – IV responsibilities
- Suit donning plan – special requests
- SAFER, MWS, tools, CL positions and bag stowage
- Airlock depress review
- EV/IV comm protocol
- SRMS/SSRMS initial position

EV Crew Procedure Review

- Egress Plan
- Translations – tether swaps
- Order of tasks
- Ingress Plan

General Procedure Review

- Get ahead tasks
- Constraints – ground and flight
- Cautions and warnings review
- RMS operations – comm protocol/clearances
- Contingency procedures – crib sheet

Emergencies review

- Lost comm
- EMU malfunctions
- Lost tools
- Lost crewmember
- DCS

Post EVA

- Suit doffing responsibilities
- Post EVA plan

Lessons learned from previous EVAs and general motherhood

EVA 3 INHIBIT PAD

ORBITER

RCS	
	If EV crew < 27 ft from FRCS:
IV	1. √DAP: FREE, LO Z
O14,15,16	2. √RJDF F1, F2, F3, F4 MANF DRIVER (four) – OFF LOGIC (four) – OFF
MCC-H	3. √Above RCS config
IV	4. √RCS F – ITEM 1 EXEC (*) √JET DES F1U – ITEM 17 (*) F3U – ITEM 19 (*) F2U – ITEM 21 (*)
TCS	
IV	L12 1. √TCS POWER – OFF
S-Band	
	<u>NOTE</u>
	Possible loss of comm when forced to S-Band LL FWD antenna
	When EV crew on Lab forward area:
IV	If EV crew ≤ 1.6 ft from upper S-Band antenna:
A1R	1. S-BAND FM ANT – XMTR LOWER/RCVR UPPER
	2. √MCC, lower antenna selected
	If no comm, or on MCC call:
C3	3. S-BAND PM ANT – LL FWD
	When EV crewmember at least 1.6 ft away from all S-band upper antennas:
C3	4. S-BAND ANT – GPC
KU-Band	
MCC-H	1. √KU-BAND EVA Mask – active
	2. √KU-BAND EVA Protect Box – active

RSOS

FGB Antennas	
MCC-M	1. √FGB KURS P [Kurs] – Deactivate
	2. ARISS – Deactivate
Soyuz Antennas	
MCC-M	3. √Soyuz KURS A [Kurs] – Deactivate
SM Antennas	
MCC-M	4. Global Timing Sys 1 (400.1MHz) [GTS] – Deactivate
	5. ARISS – Deactivate

Cont next page

EVA 3 INHIBIT PAD (Cont)

USOS

PCU	
	<u>NOTE</u>
	PCUs may require up to 1 hr warm-up period before they are operational
MCC-H	<ol style="list-style-type: none">1. √PCUs (two) operational in discharge mode and one of the following:<ol style="list-style-type: none">a. CCS PCU EVA Hazard Control enabledb. No more than two arrays unshuntedc. No more than two arrays pointed < 90 degrees from velocity vector2. One or no PCUs operational in discharge mode and one of the following:<ol style="list-style-type: none">a. No more than two arrays unshuntedb. No more than two arrays pointed < 90 degrees from velocity vector
Lab Window	
IV	<ol style="list-style-type: none">1. Close window shutter if EV crew less than 10 ft/3.5m from window
SARJ	
MCC-H	<ol style="list-style-type: none">1. √DLA (1) – LOCKED2. All motor setpoints set to zero3. All motors deselected
OR	<ol style="list-style-type: none">4. Both DLAs – LOCKED
MISSE PEC 5	
MCC-H	<ol style="list-style-type: none">1. √MISSE PEC 5 – RESET, record timer information
Ground Radar	
MCC-H	<ol style="list-style-type: none">1. √TOPO/RIO & FDO console, ground radar restrictions in place for EVA

NOTES, CAUTIONS, AND WARNINGS

NOTES

Flight Specific

A. PV Radiators

1. During cinch fastener release, apply 5 lb push force to disengage cinch bolt lock
2. Release cinches H11 & H12 (inboard & outboard) prior to H13 thru H16 to prevent excessive loads to cinches H11 and H12 (smaller diameter cable)
3. Based on past operations, one crewmember may need to compress panels so other crewmember can remove cinch

B. NPV

1. If NPV will not install due to thermally induced misalignment, leave soft docked to mounting plate for up to 15 min and retry

Generic Notes

1. For bolt install: report good/nominal torque and turns
2. For bolt release: report torque and turns if different from published range
3. EVA connectors – after disconnection and prior to connection: verify pin and EMI band integrity; verify connector free of FOD
4. Inspect QDs for damage prior to mating
5. MLI handholds are not rated for crewmember translation loads
6. Toolbox doors must be closed with one latch per door when EV crew not in immediate vicinity

CAUTION

Flight Specific

A. Electrical cables:

1. Avoid bend radii < 10 times cable diameter

B. PV Radiator [P4, P6]:

1. Avoid contact with radiator bellows and thermal outer coating

C. ETRS [P3]:

1. Do not back off ETRS bolts (CCW) prior to installation – non captive
2. Prevent inadvertent contact of tether shuttle with ETRS when tether shuttle stop is raised

D. SASA [S1,Z1,P6]:

1. Avoid contact with SASA RF Group

E. BSP & XPDR [S1]:

1. Avoid contact with lower surface of 6B boxes (Cho-Therm coating)

F. AGIT Heat Shield [Z1]:

1. Avoid contact with Ku-band Antenna (SGANT) dish
2. Lubricant from Ku-band SGANT gimbals can contaminate EMU

G. Orbit Installed Handrail (EWIS) [Lab]:

1. EVA crewmember shall be rigidly restrained during installation or removal of OIH via APFR or rigidized BRT
2. EVA crewmember shall not be rigidly restrained to OIH that is being installed or removed
3. Do not use WIS antennas as handholds

H. CETA Lights [Lab,S1,Node1]:

1. Avoid contact with white surfaces (Z-93 paint)

CAUTION (Cont)

ISS Constraints

I. Avoid inadvertent contact with:

1. Grapple fixture shafts (drylube)
2. PIP pins
3. TCS Reflectors [PMA2, PMA3]
4. APAS Hardware [PMA2, PMA3]
5. Passive UMAs
6. MBS VDU, MCU, CRPCMs and Cameras (tape radiative surfaces, silver Teflon)
7. Deployed TUS cable
8. S0 aft face radiator
9. GPS Antenna (S13 paint) [S0]
10. UHF Antennas [Lab,P1]
11. ETCs Radiators [S1,P1]
12. Heat pipe radiators [Z1]
13. PCU cathode and HCA ports [Z1]
14. CMG cover/shells [Z1]

J. Fluid line flex hoses and QDs:

1. Avoid bend radii < 5 in for hoses with diameter < 1 in on Lab,S0,S1,P1 and < 10 in for hoses with diameter < 1 in on all other elements
2. Avoid bend radii < 14 in for hoses with diameter ≥ 1 in
3. Additional care should be taken to not exceed bend radii when applying loads at the flexible hose to rigid tube stub interface
4. Ensure fluid QD booties are fully closed prior to leaving worksite, wire tie if required

K. For structural reasons:

1. Avoid vigorous body motions, quick grabs and kickoffs against tether restraints
2. Avoid performing shaking motions (sinusoidal functions) more than four cycles
3. Avoid kicking S1/P1 radiator beam
If any of these occur, wait 2 to 5 min to allow structural response to dissipate

L. Other:

1. ITT Cannon connector: do not turn collar from WHITE to BLACK without a mating half attached

NOTES, CAUTIONS, AND WARNINGS (Cont)

WARNING

Flight Specific

A. Electrical connectors:

1. NZGL connector linkage is pinch hazard. Use caution when mating/locking
2. Power must be turned off to electrical connectors prior to mating/demating to preclude arcing/sparking
3. Sharp edge – mating surfaces of EVA connectors. Avoid side loads during connector mating

B. P6 Zenith Worksite:

1. MISSE 5 does not meet kickload requirements. Avoid contact with payload
2. Remain clear of rotation plane of solar arrays when BGA not locked
3. Nickel coated braided copper ground straps may contain frayed wires

C. SASA [P6, S1]:

1. Stay 3.6 ft from S-band (SASA) high gain antenna when powered
2. Stay 1.3 ft from S-Band (SASA) low gain antenna when powered

D. PV Radiator [P4,P6]:

1. Moving hardware hazard. PV radiator panels are free to move after winch release

E. AGIT Heat Shield [Z1]:

1. Potential sharp edge – Z1 handrail 6061 between approx 17 in and 12 in from outboard end of handrail

WARNING

Flight Specific (Cont)

F. EWIS Worksite [Lab]:

1. Sharp edge – Back side of MMOD shield fasteners
2. Sharp edge – PMA umbilical launch restraints – exposed threads
3. PMA handrails may be hot. Handling may need to be limited
4. Stay > 1 ft away from PMAs and MMOD shields > 270 deg F if EMU sun visor up
5. Stay > 0.5 ft away from PMAs and MMOD shields > 325 deg F
6. No EMU TMG contact with PMAs or MMOD shields when temp > 320 deg F

G. QDs:

1. If pressurized QD is in FID when valve is opened (bail fwd), QD will leak and fluid line may whip
2. Do not rotate if in mated/valve open config

ISS Constraints

H. Avoid inadvertent contact with:

1. Grapple fixture targets and target pins
2. Stay 2 ft from S1/P1 radiator beam rotational envelope when beam is free to rotate
3. Stay 5 ft from moving MT on face 1

I. Handrails:

1. Handrails previously used for MISSE attachment may not be used as a safety tether point [A/L endcone 566, A/L Tank 2 nad/fwd, P6 5389]

J. Pinch:

1. ITT Cannon connector rotating housing
2. EV side of IV hatch during hatch operations (also snag hazard) [A/L]
3. Lab window shutter during operation

WARNING

ISS Constraints (Cont)

K. RF radiation exposure:

1. Stay 1 ft from UHF antenna when powered [Lab,P1]

L. Sharp edges:

1. Inner edges of WIF sockets
2. Spring loaded captive EVA fasteners; end of spring may protrude
3. Adjustable fuse tether buckles stowed in Node bag
4. Keep hands away from SSRMS LEE opening and snares

M. Thermal:

1. EVA connectors with booties may become hot if left uncovered
2. Turn off glove heaters when comfortable temp reached to prevent bladder damage. Do not pull fingers out of gloves when heaters are on
3. Uncovered trunnion pins may be hot
4. Do not touch EMU protective visor if temp has been – 134 for > 15 min
5. No EMU boot contact with foot restraint when temp < -120 deg F or > 200 deg F

EVA 3 EGRESS/SETUP (00:15)

IV	EV1 (FF)	EV2 (FF)
<p>MCC-H 1. Verify P6 BGAs locked and P6 S-Band Antenna inhibited</p>	<p>Initial Condition: Waist Tether (R) to UIA D-ring</p> <p><u>EGRESS</u></p> <ol style="list-style-type: none"> 1. Hand off P3 ORU bag to EV2 2. Attach S0 Safety Tether to D-ring extender (R); verify hook locked 3. Egress A/L w/ P6 crewlock bag 4. √SAFER man isol vlv – open (down) 5. √SAFER HCM – closed (down) 6. Close A/L thermal cover 7. Inspect airlock safety tether 8. Retrieve airlock safety tether <p><u>SETUP</u></p> <ol style="list-style-type: none"> 9. Translate to P6 Long Spacer HH 5312 10. Install airlock safety tether, verify hook locked 11. Tether swap to airlock safety tether; verify hook locked <div style="border: 3px double black; padding: 5px; margin: 10px 0;"> <p style="text-align: center;"><u>WARNING</u></p> <p>P6 trunnion pin may exceed touch temperature</p> <p>MISSE 5 does not meet kickload requirements. Avoid contact with payload</p> </div> <ol style="list-style-type: none"> 12. Translate to P6 zenith bulkhead 	<p>Initial Condition: Waist Tether (L) to A/L D-ring</p> <p><u>EGRESS</u></p> <ol style="list-style-type: none"> 1. Open A/L thermal cover 2. Egress airlock 3. Inspect S0 safety tethers (2) 4. Attach S0 Safety Tether to D-ring extender (R); verify hook locked 5. √SAFER man isol vlv – open (down) 6. √SAFER HCM – closed (down) 7. Receive P3 ORU bag from EV1 8. Stow P3 ORU bag on aft side of A/L-HR-0506 9. Release S0 Safety Tether and give to EV1 <ol style="list-style-type: none"> 10. Give EV1 GO for egress

INSTALL P6 SHOULDER BOLT RETAINERS/SASA R&R PREP (00:55)

IV	EV1 (FF)																																									
<p>BGA Bolts</p> <table border="1"> <thead> <tr> <th>2B (stbd)</th> <th>Turns</th> <th>Torque</th> <th>Retainer Installed</th> </tr> </thead> <tbody> <tr> <td>Fwd/Stbd</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Fwd/Port</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Aft/Stbd</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Aft/Port</td> <td></td> <td></td> <td></td> </tr> <tr> <th>4B (port)</th> <th>Turns</th> <th>Torque</th> <th></th> </tr> <tr> <td>Fwd/Stbd</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Fwd/Port</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Aft/Stbd</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Aft/Port</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	2B (stbd)	Turns	Torque	Retainer Installed	Fwd/Stbd				Fwd/Port				Aft/Stbd				Aft/Port				4B (port)	Turns	Torque		Fwd/Stbd				Fwd/Port				Aft/Stbd				Aft/Port				<p>4-BAR ENGAGEMENT (00:05)</p> <ol style="list-style-type: none"> Stow P6 Crewlock bag on 4B (port) 4 bar Retrieve IV adjustable wrench from crewlock bag On BGA 2B 4-bar, rotate port fwd 4-bar lock until lock engages Stow IV wrench in crewlock bag <p>BGA BOLT TORQUE/BGA RETAINER RETAINERS (00:50)</p> <ol style="list-style-type: none"> Starting with 2B (stbd) BGA, install BGA shoulder bolt retainers (8) per the following steps: <ol style="list-style-type: none"> PGT[B7 (25.5 ft-lb), CW2 30 RPM, MTL 30.5]-6 ext7/16 : Torque BGA shoulder bolt Install retainer For retainer installed near mast canister platform, wrap lanyard around adjacent handrail stanchion 2 times to keep clear of BGA rotational plane Tool inventory 	<p>The diagram shows a top-down view of the P6 Zenith Face. At the top is MISSE 5. Below it are two BGA units: 4B (port) BGA on the right and 2B (stbd) BGA on the left. At the bottom is the SASA component. A downward arrow labeled 'FWD' indicates the direction of the zenith face. The text 'P6 ZENITH FACE (LOOKING NADIR)' is at the bottom.</p>
2B (stbd)	Turns	Torque	Retainer Installed																																							
Fwd/Stbd																																										
Fwd/Port																																										
Aft/Stbd																																										
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Fwd/Stbd																																										
Fwd/Port																																										
Aft/Stbd																																										
Aft/Port																																										
<p>IV</p> <ol style="list-style-type: none"> When EV1 and EV 2 clear of P6 zenith bulkhead: Give MCC-H GO for P6 SASA power up & P6 BGA unlock 	<ol style="list-style-type: none"> Retrieve P6 crewlock bag Translate to P6 LS HH 5312 Tether swap to S0 safety tether; verify hook locked Retrieve airlock safety tether Translate to airlock Stow P6 crewlock bag on airlock toolbox 																																									

INSTALL P6 SHOULDER BOLT RETAINERS – TASK DATA

Estimated Task Duration:

	With RMS	Without RMS
One EV Crew	NA	0:55
Two EV Crew	NA	NA

Tools:

EV1 (FF)	EV2 (FF)
PGT	
7/16 (wobble) Socket-6 ext	
IV 6-in adjustable Wrench	

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
BGA Shoulder Bolt	na	7/16	4 per BGA	25.5	na	TBD	as reqd	30

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
NA					

Foot Restraints:

Task	WIF	APFR Setting
NA		

Note:

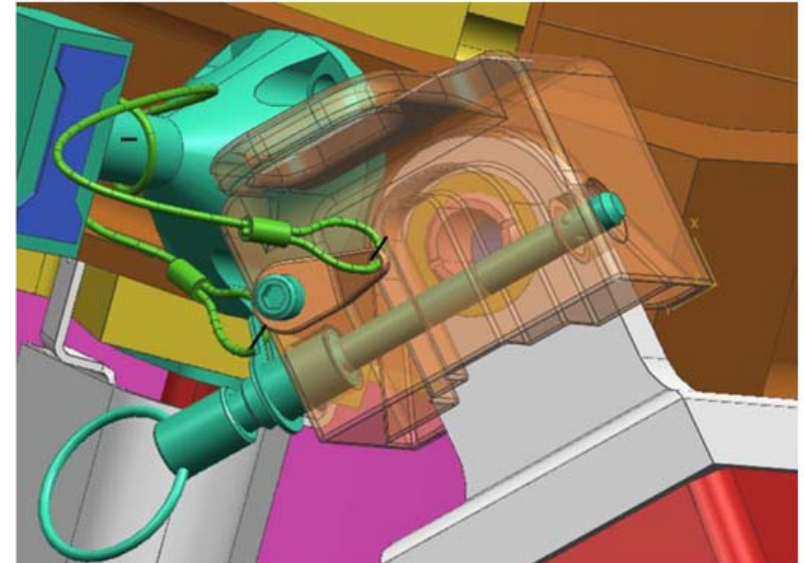
1. Locking of 2B port fwd 4-bar lock is desired to extend life of P6 structure
2. BGA bolt retainers correct design defect in P6 BGA that could allow shoulder bolts to back out with thermal cycling
3. Tightening of shoulder bolt is not required if retainer can be installed and no gap exists between 4-bar and BGA structure

Cautions:

1. Avoid contact with SASA RF Group





Warnings:

1. P6 trunnion pin may exceed touch temperature
2. MISSE 5 does not meet kickload requirements. Avoid contact with payload



BGA Shoulder Bolt Retainer Installed

RELEASE P4 PV RADIATOR CINCHES/WINCH (00:50)

IV	EV1 (FF)	EV2 (FF)
<div> </div> <div style="border: 2px solid black; padding: 5px;"> <p align="center">WARNING Free Drift or CMG Control with Thrusters Disabled is required when winch PIP pins are released and crew is in vicinity of unrestrained radiator</p> </div> <div> <p>IV 1. Verify MCC-H: THRUSTER DESAT REQUEST - INH</p> <p>IV 2. On EV GO – MCC-H Command THRUSTER DESAT REQUEST - ENABLE</p> </div>	<div> <ol style="list-style-type: none"> 1. Install airlock safety tether on external airlock D-ring; verify hook locked 2. Retrieve airlock safety tethers 3. Translate to S0 HH 3529; stow airlock safety tethers; verify retract control lever UNLOCKED 4. Translate to P3 5. Inspect P3 safety tether 6. Tether swap to P3 safety tether; verify hook locked 7. Translate to P4 PV radiator </div> <div style="border: 1px solid black; padding: 5px;"> <p align="center">CAUTION Avoid contact with radiator bellows and thermal outer coating</p> </div> <div> <p>Release PV radiator cinches using the procedure below (Release Cinches H11 and H12 prior to other cinches)</p> </div> <div> <ul style="list-style-type: none"> <input type="checkbox"/> Cinch H16 inboard aft <input type="checkbox"/> Cinch H14 outboard aft </div> <div> <p>RELEASE PVR CINCHES</p> </div> <div> <ol style="list-style-type: none"> 8. PGT[B7 25.5 ft-lb, CCW2 30 RPM, MTL 30.5]-6 ext 7/16: Release cinch 8-14 turns each, as required to disengage 9. Stow cinch in cinch clip, verify positive retention  </div> <div style="border: 2px solid black; padding: 5px;"> <p align="center">WARNING Moving hardware hazard. PV radiator panels are free to move after winch release</p> </div> <div> <p>RELEASE OUTBOARD PVR WINCH PIP PIN</p> </div> <div> <ol style="list-style-type: none"> 10. On IV GO – Release winch bar PIP pin from radiator, re-insert into winch bar 11. Verify PIP pin, lanyard and winch bar clear of radiator deploy envelope  </div>	<div> <ol style="list-style-type: none"> 1. Retrieve P3 ORU bag 2. Translate to S0 3. Stow MUT-MUT with adj equip tether on S0-HH-3413 4. Translate to P3 5. Inspect P3 safety tether 6. Tether swap to P3 safety tether; verify hook locked 7. Stow P3 ORU bag on P3 face 1 8. Translate to P4 PV radiator </div> <div style="border: 1px solid black; padding: 5px;"> <p align="center">CAUTION Avoid contact with radiator bellows and thermal outer coating</p> </div> <div> <p>Release PV radiator cinches using the procedure below (Release Cinches H11 and H12 prior to other cinches)</p> </div> <div> <ul style="list-style-type: none"> <input type="checkbox"/> Cinch H11 inboard <input type="checkbox"/> Cinch H12 outboard <input type="checkbox"/> Cinch H15 outboard fwd <input type="checkbox"/> Cinch H13 inboard fwd </div> <div> <p>RELEASE PVR CINCHES</p> </div> <div> <ol style="list-style-type: none"> 9. PGT[B7 25.5 ft-lb, CCW2 30 RPM, MTL 30.5]-2 ext 7/16: Release cinch 8-14 turns each, as required to disengage 10. Stow cinch in cinch clip, verify positive retention  </div> <div style="border: 2px solid black; padding: 5px;"> <p align="center">WARNING Moving hardware hazard. PV radiator panels are free to move after winch release</p> </div> <div> <p>RELEASE INBOARD PVR WINCH PIP PIN</p> </div> <div> <ol style="list-style-type: none"> 11. On IV GO – Release winch bar PIP pin from radiator, re-insert into winch bar 12. Verify PIP pin, lanyard and winch bar clear of radiator deploy envelope  </div>

RELEASE P4 PV RADIATOR CINCHES/WINCH – TASK DATA

Estimated Task Duration:

	With RMS	Without RMS
One EV Crew	NA	1:10*
Two EV Crew	NA	0:35*

* see note 1

Tools:

EV1 (FF)	EV2 (FF)
PGT	PGT
7/16 (wobble) Socket-6 ext	7/16 (wobble) Socket-2 ext

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
Cinch	Yes	7/16	6	32	25	35	8-14	30

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
NA					

Foot Restraints:

Task	WIF	APFR Setting
Cinch H11 worksite	P4-08	(6, WW, G, 1)
Cinch H12 worksite	P4-19	(6, VV, G, 1)
Cinch H13 worksite	P4-07	(5, SS, H, 11)
Cinch H14 worksite	P4-21	(7, PP, L, 9)
Cinch H15 worksite	P4-23	(7, PP, C, 3)
Cinch H16 worksite	P4-08	(7, SS, E, 1)

Note:

1. Task durations in task data sheets are estimates based on 1 crewmember alone or two crewmembers in parallel through the entire task with no additional tasks. Times do not match published task time due to extra steps and staggered arrival of EV crew
2. During Cinch fastener release, apply 5 lbs push force to disengage cinch bolt lock
3. Release cinches H11 and H12 prior to cinches H13 thru H16 to prevent excessive loads to cinches H11 and H12 (smaller diameter cable)
4. Based upon past operations, one crewmember may need to compress panels so that the other crewmember can remove the cinch
5. Optional APFR worksites are available if required

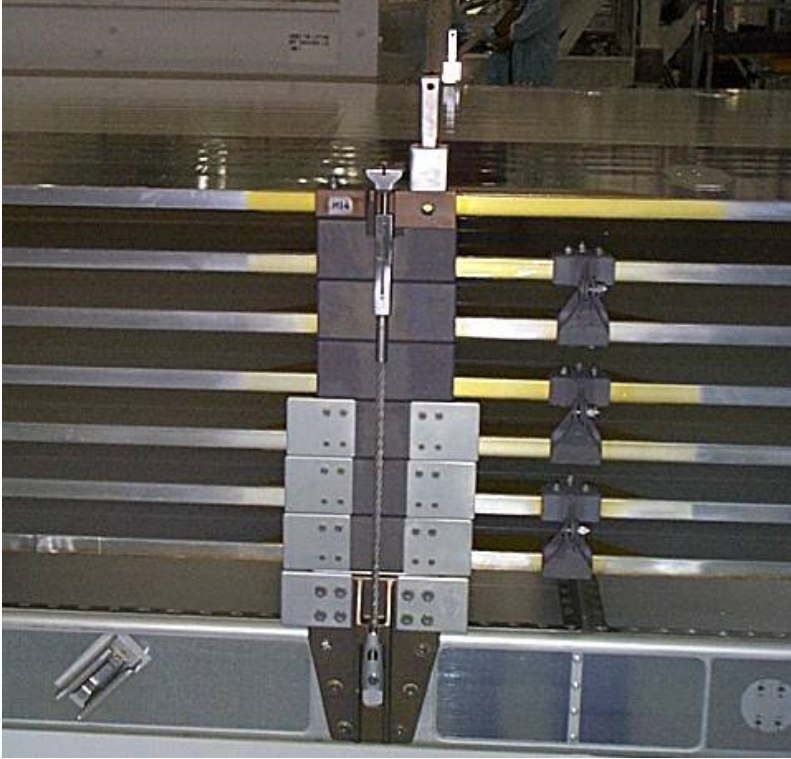
Cautions:

1. Avoid contact with radiator bellows and thermal outer coating

Warnings:

1. Moving hardware hazard. PV radiator panels are free to move after winch release

RELEASE P4 PV RADIATOR CINCHES/WINCH – TASK DATA (Cont)





PV Radiator Cinch Mechanism






PV Radiator Winch Bar & Cinch

REMOVE AND STOW P3 KEEL BEAM AND DRAG LINK (00:45)

IV	EV1 (FF)	EV2 (FF)
<p style="text-align: center;"><u>NOTE</u></p> <p>MT Stop, Tether Shuttle, ETRS, Nut Clamp and SVS target tasks may be performed by either crewmember in any order, as time permits, to maximize efficiency</p>	<p style="text-align: center;"><u>REMOVE P3 SVS TARGET</u></p> <ol style="list-style-type: none"> 1. PGT[A3 4.8 ft-lb, CCW3 60 RPM, MTL 30.5]-6 ext 7/16: Release SVS target fasteners (4) (~12 turns) 2. Remove SVS target and stow in ORU transfer bag  <p style="text-align: center;"><u>REMOVE AND STOW DRAG LINK</u></p> <ol style="list-style-type: none"> 3. Ingress APFR P3-06 [6, PP, A, 2] 4. Tether to outboard drag link bolt 5. PGT[B2 16.0 ft-lb, CCW2 30 RPM, MTL 30.5]-6 ext 7/16: Release outboard drag link fastener (~11 turns) 6. Remove drag link fastener, remove drag link from clevis, reinstall fastener a few turns by hand <ol style="list-style-type: none"> 7. Position drag link through face 1 and insert into retention/spring bracket 8. Engage other end of drag link onto the eye end of attach/tie-down bracket on zenith longeron 9. Remove outboard drag link fastener; engage drag link onto stowage clevis; reinstall bolt 3-4 turns 	<p style="text-align: center;"><u>TIGHTEN KEEL PIN NUT CLAMPS</u></p> <ol style="list-style-type: none"> 1. PGT[A2 3.8 ft-lb, CW2 30 RPM, MTL 30.5]-6 ext 7/16: Tighten zenith nut clamp bolt (~6 turns) 2. PGT[A2 3.8 ft-lb, CW2 30 RPM, MTL 30.5]-2 ext 7/16: Tighten nadir nut clamp bolt (~6 turns) <p style="text-align: center;"><u>ROTATE P1 MOBILE TRANSPORTER (MT) STOP</u></p> <ol style="list-style-type: none"> 3. Translate to ISS Bay 16, Face 1, outboard end bulkhead of P1 4. Remove PIP pin from bulkhead 5. Push MT stop assembly away from bulkhead notch 6. Rotate MT stop assembly 180 degrees 7. MT stop will re-engage bulkhead notch 8. Reinstall PIP pin in bulkhead; verify fully inserted  <p style="text-align: center;"><u>REMOVE AND STOW DRAG LINK</u></p> <ol style="list-style-type: none"> 9. PGT[B2 16.0 ft-lb, CCW2 30 RPM, MTL 30.5]-2 ext 7/16: Release inboard drag link fastener (~11 turns) 10. Remove inboard drag link fastener and stow in trash bag 11. Ingress APFR P3-31 [1, OO, F, 12]

REMOVE AND STOW P3 KEEL BEAM AND DRAG LINK (00:45) (Cont)

IV	EV1 (FF)	EV2 (FF)																					
<p>Keel Pin/Drag Link Bolts</p> <table border="1"> <thead> <tr> <th>Bolt</th> <th>Turns</th> <th>Torque</th> </tr> </thead> <tbody> <tr> <td>Clevis Bolt #2</td> <td></td> <td></td> </tr> <tr> <td>Clevis Bolt #1</td> <td></td> <td></td> </tr> <tr> <td>Outbrd Drag Link</td> <td></td> <td></td> </tr> </tbody> </table> <p>ETRS Bolts</p> <table border="1"> <thead> <tr> <th>Bolt</th> <th>Turns</th> <th>Torque</th> </tr> </thead> <tbody> <tr> <td>Inboard</td> <td></td> <td></td> </tr> <tr> <td>Outboard</td> <td></td> <td></td> </tr> </tbody> </table>	Bolt	Turns	Torque	Clevis Bolt #2			Clevis Bolt #1			Outbrd Drag Link			Bolt	Turns	Torque	Inboard			Outboard			<p><u>REMOVE AND STOW KEEL BEAM</u></p> <ol style="list-style-type: none"> 10. PGT[B2] 16.0 ft-lb, CW2 30 RPM, MTL 30.5]-6 ext 7/16: Release zenith clevis bolt (#2)(~22 turns) 11. Rotate keel beam 12. PGT[A4] 6.3 ft-lb, CW2 30 RPM, MTL 30.5]-6 ext 7/16: Reinstall zenith clevis bolt (#2)(~22 turns) 13. Handoff PGT to EV2 14. Rotate keel beam 180 deg so that the keel captive nuts face closest to bulkhead with keel pin pointing into face 1 15. Position keel pin into the center retention ring and secure clevis bolt inside the truss with nadir soft dock retention keel fitting. 16. Engage the zenith end of the keel onto the eye end of attach/tie-down bracket and reinstall clevis bolt; release tether 17. PGT[A4] 6.3 ft-lb, CW2 30 RPM, MTL 30.5]-6 ext 7/16: Engage zenith clevis bolt (#1)(~22 turns) 18. PGT[A2] 3.8 ft-lb, CW2 30 RPM, MTL 30.5]- 6 ext 7/16: Tighten outboard drag link fastener (~11 turns total)  	<p><u>REMOVE AND STOW KEEL BEAM</u></p> <ol style="list-style-type: none"> 12. Tether to keel beam 13. PGT[B2] 16.0 ft-lb, CW2 30 RPM, MTL 30.5]-6 ext 7/16: Release nadir clevis bolt (#1)(~22 turns) 14. Return PGT to EV1 15. Remove keel beam from clevis and reinstall nadir clevis bolt, 1 turn 16. Egress APFR <p><u>INSTALL ETRS</u></p> <ol style="list-style-type: none"> 17. Retrieve ETRS from ORU bag 18. Install ETRS on nadir SARJ rail segment 19. PGT[A1] 2.5 ft-lb, CW2 30 RPM, MTL 30.5]-2 ext 7/16: Tighten ETRS fasteners (2) (4-6 turns)  <p><u>ROTATE P3 TETHER SHUTTLE STOP</u></p> <ol style="list-style-type: none"> 20. Remove PIP pins (2) from tether shuttle stop; stow in trash bag 21. Push tether shuttle stop inboard and rotate 90 degrees away from CETA rail 22. Tether shuttle stop will detent in the stowed position 23. Verify marks on inboard lug and clevis of tether shuttle are aligned 
Bolt	Turns	Torque																					
Clevis Bolt #2																							
Clevis Bolt #1																							
Outbrd Drag Link																							
Bolt	Turns	Torque																					
Inboard																							
Outboard																							

REMOVE AND STOW P3 KEEL BEAM AND DRAG LINK – TASK DATA

Estimated Task Duration:

	With RMS	Without RMS
One EV Crew	NA	NA
Two EV Crew	NA	0:45

Tools:

EV1 (FF)	EV2 (FF)
PGT	PGT
6 Ext 7/16	6 Ext 7/16
APFR	APFR

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
Keel Nut Clamp Bolt	No	7/16	2	3.3	N/A	5.4	6	30
Keel Pin Structural Bolt	Yes	7/16	2	5.8	14	22.2 remove 11.8 install	22	30
Keel Pin Drag Link Bolts	No	7/16	2	3.3	12.8	32.3 remove 23.9 install	10.5	30

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
NA					

Foot Restraints:

Task	WIF	APFR Setting
EV1 Inboard Position	P3-06	(6, PP, A, 2)
EV2 Keel Position	P3-31	(1, OO, F, 12)

Note:

1. The P1 MT stop prevents the MT/CETA from moving past the P1/P3 interface plane when the P3 segment is not attached
2. The P3 MT stop prevents the MT/CETA from moving past P3 bay 18 when CETA rails are not installed outboard of the SARJ
3. The ETRS serves as a temporary stop for the MT and/or CETA Cart during assembly operations. The ETRS allows the MT to reach worksite 8 on P3 with one CETA Cart port, thereby reducing the number of CETA Cart relocations required during assembly

Cautions:

1. Verify PGT clockwise (CW) setting prior to tightening nut clamp assembly. Opposite direction (CCW) beyond 6 rotations can unscrew EVA bolt threads from the barrel nut which would disable the nut assembly. This means the loss of MT operations outboard of the keel location
2. Do not back off ETRS bolts (CCW) prior to installation – non captive (15 turn max)
3. Prevent inadvertent contact of tether shuttle with ETRS when tether shuttle stop is raised (damage to MT rail)

Warnings:

None

REMOVE AND STOW P3 KEEL BEAM AND DRAG LINK – TASK DATA (Cont)



P1 MT Stop PIP Pin (fully inserted)



P3 Drag Link



P3 Keel Pin

P3 CLEANUP (00:45)

IV	EV1 (FF)	EV2 (FF)
<p>Verify the following tasks complete prior to EV crew departing P3:</p> <ul style="list-style-type: none"> <input type="checkbox"/> P1 MT Stop <input type="checkbox"/> P3 SVS Target <input type="checkbox"/> P3 Drag Link & Keel Pin <input type="checkbox"/> P3 MT Stop <input type="checkbox"/> Install ETRS <input type="checkbox"/> P3 RPDA Thermal Shrouds (2) <input type="checkbox"/> P3 Tether Shuttle Stop <input type="checkbox"/> APFRs (2) clear of P3 face 1 	<p><u>REMOVE RPDA THERMAL SHROUDS</u></p> <ol style="list-style-type: none"> 1. Remove zenith RPDA shroud; stow in ORU transfer bag <p><u>APFR RELOCATION</u></p> <ol style="list-style-type: none"> 2. APFR P3-06 to P4-02 [6,PP,A,2] <p><u>TRANSLATE TO S0</u></p> <ol style="list-style-type: none"> 3. Retrieve ESC 4. Tool inventory 5. Retrieve P3 ORU bag 6. Tether swap to S0 safety tether; verify hook locked 7. Retrieve 85 ft P3 safety tether 8. Translate to S0 port, tether swap to airlock safety tether at S0 HH-3529; verify hook locked 9. Translate to airlock 10. Temp stow ESC 11. Stow P3 ORU bag near airlock 12. Install 85 ft safety tether on A/L external D-Ring; verify hook locked 13. Tether swap to 85 ft safety tether; verify hook locked 	<p><u>REMOVE RPDA THERMAL SHROUDS</u></p> <ol style="list-style-type: none"> 1. Remove nadir RPDA shroud; stow in ORU transfer bag 2. Inventory P3 ORU bag 3. Close P3 ORU bag <p><u>APFR RELOCATION (12A.1 GET-AHEAD)</u></p> <ol style="list-style-type: none"> 4. APFR P3-31 to P4-03 [7,OO,F,12] <p><u>TRANSLATE TO S0</u></p> <ol style="list-style-type: none"> 5. Tool inventory 6. Tether swap to S0 safety tether; verify hook locked 7. Retrieve 85 ft safety tether 8. Translate to S0 port; tether swap to airlock safety tether at HH-3530; verify hook locked 9. Translate to airlock 10. Temp stow 85 ft tether near airlock

S1 SASA R&R (02:00)

IV	EV1 (FF)	EV2 (FF)															
<p>1. MCC-H: Verify inhibits for Z1 SASA in place</p> <ul style="list-style-type: none"> <input type="checkbox"/> RPCM Z14B B RPC1 – OPEN, CLOSE CMD INH <p>2. MCC-H: Verify inhibits in place for disconnect of S1 SASA</p> <ul style="list-style-type: none"> <input type="checkbox"/> RPCM S11A B RPC12 – OPEN, CLOSE CMD INH <input type="checkbox"/> RPCM S11A B RPC16 – OPEN, CLOSE CMD INH <p>Gimbal Lock Bolts</p> <table border="1"> <thead> <tr> <th>Bolt</th> <th>Turns</th> <th>Torque</th> </tr> </thead> <tbody> <tr> <td>Bkt/Zenith</td> <td></td> <td></td> </tr> <tr> <td>Bkt/Nadir</td> <td></td> <td></td> </tr> <tr> <td>Non-Bkt/Zenith</td> <td></td> <td></td> </tr> <tr> <td>Non-Bkt/Nadir</td> <td></td> <td></td> </tr> </tbody> </table> <p>3. MCC-H: Verify: THRUSTER DESAT REQUEST – INH</p>	Bolt	Turns	Torque	Bkt/Zenith			Bkt/Nadir			Non-Bkt/Zenith			Non-Bkt/Nadir			<p><u>REMOVE SPARE SASA FROM Z1</u></p> <ol style="list-style-type: none"> 1. Remove scarf and shirt shrouds from Z1 SASA, temp stow 2. Ingress IAPFR Z1-01[3,RR,F,12] 3. ON EV2 GO: PGT [B7 25.5 ft-lb, CCW3 60 RPM, 30.5]-6 ext7/16: Release SASA stanchion storage bolts (2) (~9 turns) 4. Remove SASA stanchion from soft dock 5. GIVE EV2 GO to raise SASA to allow access to cables 6. ON MCC GO: Demate: <ul style="list-style-type: none"> <input type="checkbox"/> W200A-P33 from SASA J3; temp stow 7. GIVE EV2 GO to mnvr SASA clear of Z1; monitor clearance 8. Fairlead to S0-HH-3418 9. Ingress APFR S0-07 [5,NN,L,12] 10. Receive SASA from EV2 11. Hand off SASA to EV2 <p><u>RELEASE FAILED S1 SASA</u></p> <ol style="list-style-type: none"> 12. Translate to S1 HH 3278 13. Rotate SASA gimbal locks (4) toward high gain antenna (100°) into engaged position 14. PGT [TBD ft-lb, CW2 30 RPM, 30.5]-6 ext7/16: Tighten gimbal locks (4) (~4.5 turns) 15. Temp stow PGT on S1-HH 3277 16. BRT to S1-HH-3278 17. Receive SASA from EV2 	<p><u>REMOVE SPARE SASA FROM Z1</u></p> <ol style="list-style-type: none"> 1. Remove scarf and shirt shrouds from Z1 SASA, temp stow 2. Ingress APFR Z1-11[2,TT,H,11] 3. Tether to SASA 4. Hold spare SASA by handholds on RF group 5. GIVE EV1 GO to release attach bolts 6. ON EV1 GO: Raise SASA 7. ON EV1 GO: Mnvr SASA clear of Z1 8. Hand off SASA to EV1 9. Translate to EV1's APFR, roll to B 10. Retrieve MUT-MUT from S0-HH-3413 11. Stow MUT-MUT on S1-HH-3274 12. BRT to S1 HH 3289 13. Receive SASA from EV1 <p><u>RELEASE FAILED S1 SASA</u></p> <ol style="list-style-type: none"> 14. Handoff SASA to EV1 15. ON MCC GO: Demate the following connectors from SASA pnl A98; temp stow <ul style="list-style-type: none"> <input type="checkbox"/> Demate P2 from J2 <input type="checkbox"/> Demate P3 from J3 <input type="checkbox"/> Demate P4 from J4 16. Tether to failed SASA 17. PGT [B7 25.5 ft-lb, CCW3 60 RPM, 30.5]-6 ext7/16: Release S1 SASA stanchion attach bolt (~ 17 turns) 18. Remove S1 SASA stanchion from soft dock
Bolt	Turns	Torque															
Bkt/Zenith																	
Bkt/Nadir																	
Non-Bkt/Zenith																	
Non-Bkt/Nadir																	

S1 SASA R&R (02:00) (Cont)

IV	EV1 (FF)	EV2 (FF)						
<p>S1 Stanchion Bolt (turns engaged into attach fitting)</p> <table border="1"> <thead> <tr> <th>Bolt</th> <th>Turns</th> <th>Torque</th> </tr> </thead> <tbody> <tr> <td>S1 SASA Stanchion</td> <td></td> <td></td> </tr> </tbody> </table> <p>4. IV: Give MCC GO for S1 SASA power up</p> <p>5. IV On EV GO – MCC-H Command THRUSTER DESAT REQUEST – ENABLE</p> <p>6. IV: Give MCC GO for Z1 SASA power up</p>	Bolt	Turns	Torque	S1 SASA Stanchion			<p><u>INSTALL SPARE SASA</u></p> <p>18. Install spare SASA on S1</p> <p>19. Retrieve PGT</p> <p>20. PGT [B3 18.4 ft-lb, CCW2 30 RPM, 30.5]-6 ext7/16: Loosen gimbal lock bolts (4) (~4.5 turns)</p> <p>21. Rotate gimbal bolts (4) away from high gain antenna (100°)</p> <p>22. Release old SASA from MUT-MUT</p> <p>23. Pass failed SASA to EV2</p> <p>24. Verify fairlead to S0-HH-3418</p> <p>25. Ingress APFR S0-07 [5,NN,B,12]</p> <p>26. Receive SASA from EV2</p> <p>27. Handoff SASA to EV2</p> <p>28. Ingress IAPFR Z1-01 [3,RR,F,12]</p> <p>29. GIVE EV2 GO for SASA reposition for connector installation</p> <p>30. Mate:</p> <ul style="list-style-type: none"> <input type="checkbox"/> EAS W200A-P33 to SASA J3 <p>31. Install SASA on stowage bracket</p>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p style="text-align: center;">CAUTION</p> <p style="text-align: center;">Avoid contact with SASA while temp stowed on MUT EE-ballstack-MUT EE</p> </div> <p>19. Temp stow S1 SASA on MUT-MUT and adjustable tether</p> <p><u>INSTALL SPARE SASA</u></p> <p>20. Assist EV1 with installation of spare SASA</p> <p>21. PGT [B7 25.5 ft-lb, CW2 30 RPM, 30.5]-6 ext7/16: Install spare SASA stanchion bolt (~10 turns out of launch threads, ~16.5 turns to engage attach fitting)</p> <p>22. Mate the following connectors to spare SASA pnl A98:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Cap from spare SASA J2 <input type="checkbox"/> Cap from spare SASA J4 <input type="checkbox"/> S1 P4 to J4 <input type="checkbox"/> S1 P3 to J3 <input type="checkbox"/> S1 P2 to J2 <input type="checkbox"/> Install caps on failed SASA J2 and J4 <p>23. Position to receive failed SASA</p> <p>24. Receive failed SASA from EV1</p> <p>25. Handoff SASA to EV1</p> <p>26. Translate to EV1's APFR, roll to L</p> <p>27. Ingress APFR Z1-11 [2,TT,H,11]</p> <p>28. Receive failed SASA from EV1</p> <p>29. ON EV1 GO: Reposition SASA for connector installation</p>
Bolt	Turns	Torque						
S1 SASA Stanchion								

S1 SASA R&R (02:00) (Cont)

IV			EV1 (FF)	EV2 (FF)
SASA Stanchion Stowage Bolts			32. PGT [B1 12.0 ft-lb, CW2 30 RPM, 30.5]-6 ext7/16: Install stanchion stowage bolts (2) (~8.5 turns) 33. Reinstall shirt and scarf thermal covers 34. IAPFR: Z1-01 [12,PP,F,12]	30. Reinstall shirt and scarf thermal covers 31. Translate to airlock
Bolt	Turns	Torque		
Aft				
Zenith				

SASA R&R – TASK DATA

Estimated Task Duration:

	With RMS	Without RMS
One EV Crew	NA	NA
Two EV Crew	NA	2:00

Tools:

EV1 (FF)	EV2 (FF)
PGT	PGT
6 Ext 7/16	6 Ext 7/16
APFR	APFR
MUT EE (2)	
Ballstack	

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
Stanchion Storage Bolt	na	7/16	2 per	12.0	TBD	26.6	9	30
Gimbal Lock	na	7/16	4 per	TBD	16.7	21.8	4.5	30
Stanchion Attach Bolt	na	7/16	1 per	23.0	TBD	37.5	10 (launch restraint) 16.5 (install)	30

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
P2	na	J2	na	21	RF
P3	na	J3	na	17	Htr Pwr/1553 Ch B
P4	na	J4	na	15	Ops Pwr/1153 Ch A

Foot Restraints:

Task	WIF	APFR Setting
Z1 IAPFR for Stowage Bolt Access	Z1-01	(3,RR,F,12)
Z1 Handoff	Z1-11	(2,TT,H,11)
S0 Handoff – Z1 Handoff Config	S0-07	(5,NN,L,12)
S0 Handoff – S1 Handoff Config	S0-07	(5,NN,B,12)

Note:

1. Preflight plan uses APFR with AIA at Z1-11. AIA is not required for task
2. Reinstallation of thermal shroud at Z1 location is required to extend SASA thermal clock during power reconfigurations on 12A.1

Cautions:

1. Pre-flight thermal clock for SASA (both Z1 and S1) is 3.5 hours. Starts when heater or operational power or shroud removed, stops when heater or operational power restored
2. Avoid contact with SASA RF Group

Warnings:

1. Stay 3.6 ft from S-band (SASA) high gain antenna when powered
2. Stay 1.3 ft from S-Band (SASA) low gain antenna when powered

S1 S-BAND BSP AND XPDR REMOVE AND REPLACE (01:00)

IV	EV2 (FF)																											
<p>1. Verify w/MCC-H: S1 BSP/XPDR Inhibits in place (HTR DEACT)</p> <p>BSP</p> <ul style="list-style-type: none"> <input type="checkbox"/> RPCM S11A B RPC11 – OPEN, CLOSE CMD INH <input type="checkbox"/> RPCM S11A B RPC2 – OPEN, CLOSE CMD INH <p>XPDR</p> <ul style="list-style-type: none"> <input type="checkbox"/> RPCM S11A B RPC10 OPEN – CLOSE CMD INH <input type="checkbox"/> RPCM S11A B RPC15 OPEN – CLOSE CMD INH 	<ol style="list-style-type: none"> 1. Retrieve S1 S Band ORU bag 2. Translate to S1 S-Band ORU worksite (bay 5, face 1) 3. Temp stow S1 S-Band ORU bag on S1 face 1 <div style="border: 1px solid black; padding: 5px; margin: 10px 0; text-align: center;"> <p>CAUTION Avoid contact with lower surface of 6B boxes (Cho-Therm coating)</p> </div> <ol style="list-style-type: none"> 4. Confirm GO to remove BSP (nadir box) 5. PGT[A6 (8.3 ft-lb), CCW2 30 RPM, MTL 30.5]-6 ext7/16: Release left and right captive fasteners 16 turns 6. Release center jack screw 33 turns 7. Remove old BSP by sliding it along guide pins 8. Temp stow old BSP 9. Inspect BSP mounting location, verify no residual pieces Cho-Therm film 10. Remove protective cover from new BSP; temp stow 11. Install new BSP on the radiator plate support structure by sliding it along two guide pins into soft dock position 12. PGT[A6 {7.5 ft-lb}, CW2 30 RPM, MTL 30.5]-6 ext7/16: Push in and engage center jack to torque (~TBD turns) 13. Visually check for contact between BSP front wedge and radiator plate 14. PGT[A3 {5 ft-lb}, CW2 30 RPM, MTL 30.5]-6 ext7/16: Push in and engage left and right fasteners to torque (~TBD turns) 15. PGT[A3 {5 ft-lb}, CW2 30 RPM, MTL 30.5]-6 ext7/16: Torque jack screw to torque (~TBD turns) 16. Install protective cover on old BSP 17. Stow old BSP in S1 ORU bag <ol style="list-style-type: none"> 18. Confirm GO to remove XPDR (zenith box) 19. PGT[A6 (8.3 ft-lb), CCW2 30 RPM, MTL 30.5]-6 ext7/16: Release left and right captive fasteners 16 turns 20. Release center jack screw 33 turns 21. Remove old XPDR by sliding it along guide pins 22. Temp stow old XPDR 23. Inspect XPDR mounting location, verify no residual pieces Cho-Therm film 24. Remove protective cover from new XPDR 25. Install new XPDR on the radiator plate support structure by sliding it along two guide pins into soft dock position 26. PGT[A6 {7.5 ft-lb}, CW2 30 RPM, MTL 30.5]-6 ext7/16: Push in and engage center jack to torque (~TBD turns) 27. Visually check for contact between XPDR front wedge and radiator plate 28. PGT[A3 {5 ft-lb}, CW2 30 RPM, MTL 30.5]-6 ext7/16: Push in and engage left and right fasteners to torque (~TBD turns) 29. PGT[A3 {5 ft-lb}, CW2 30 RPM, MTL 30.5]-6 ext7/16: Torque jack screw to torque (~TBD turns) 30. Give IV GO: for S1 BSP and XPDR power up 31. Install protective cover on old XPDR 32. Stow old XPDR in S1 ORU bag <div style="border: 1px solid black; padding: 2px; margin: 5px 0;"> <p><input type="checkbox"/> <input type="checkbox"/></p> </div> <ol style="list-style-type: none"> 33. Retrieve MUT/MUT 34. Tool inventory 35. Retrieve S1 ORU bag 36. Translate to airlock 																											
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="3">S1 SBAND ORUS</th> </tr> <tr> <th>BSP</th> <th>Turns</th> <th>Torque</th> </tr> </thead> <tbody> <tr> <td>Center</td> <td></td> <td></td> </tr> <tr> <td>Outer #1</td> <td></td> <td></td> </tr> <tr> <td>Outer #2</td> <td></td> <td></td> </tr> <tr> <th>XPDR</th> <th>Turns</th> <th>Torque</th> </tr> <tr> <td>Center</td> <td></td> <td></td> </tr> <tr> <td>Outer #1</td> <td></td> <td></td> </tr> <tr> <td>Outer #2</td> <td></td> <td></td> </tr> </tbody> </table>	S1 SBAND ORUS			BSP	Turns	Torque	Center			Outer #1			Outer #2			XPDR	Turns	Torque	Center			Outer #1			Outer #2			
S1 SBAND ORUS																												
BSP	Turns	Torque																										
Center																												
Outer #1																												
Outer #2																												
XPDR	Turns	Torque																										
Center																												
Outer #1																												
Outer #2																												
<p>2. On EV GO – Notify MCC-H: Go for S1 BSP and XPDR power up</p>																												

S1 S-BAND BSP & XPDR REMOVE AND REPLACE – TASK DATA

Estimated Task Duration:

	With RMS	Without RMS
One EV Crew	NA	1:00
Two EV Crew	NA	NA

Tools:

EV1 (FF)	EV2 (FF)
	PGT
	6 Ext 7/16
	6B Box Protective Cover (2)
	Large ORU Transfer Bag

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
Primary Fastener (center)	na	7/16	1 per	TBD	TBD	TBD	TBD	30
Secondary Fastener (outer)	na	7/16	2 per	TBD	TBD	TBD	TBD	30

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
NA					

Foot Restraints:

Task	WIF	APFR Setting
NA		

Note:

1. Old BSP and XPDR ORUs require return to ground for upgrade to support S-Band string 2 relocation from P6 to P1

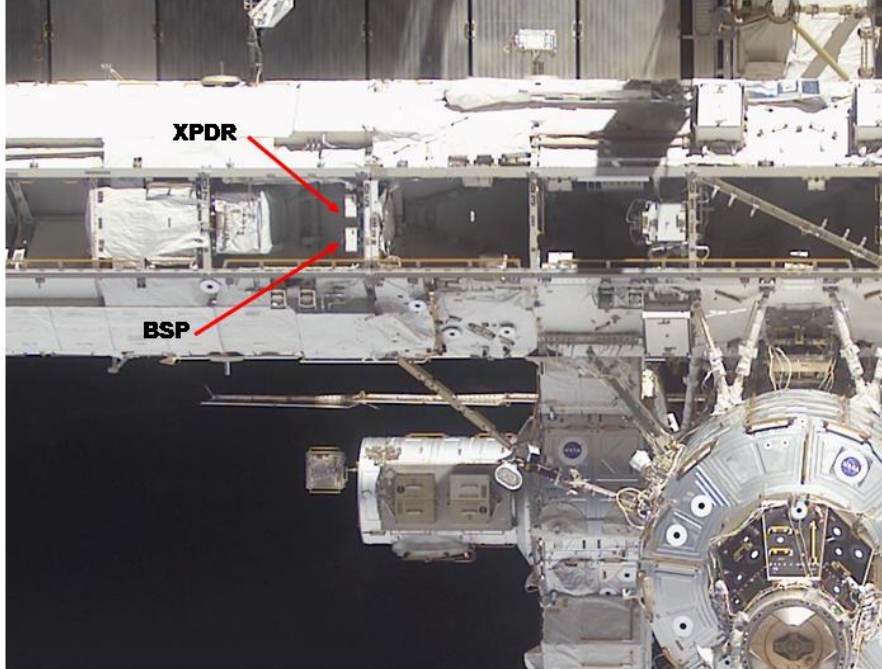
Cautions:

1. Avoid contact with lower surface of 6B boxes (Cho-Therm coating)

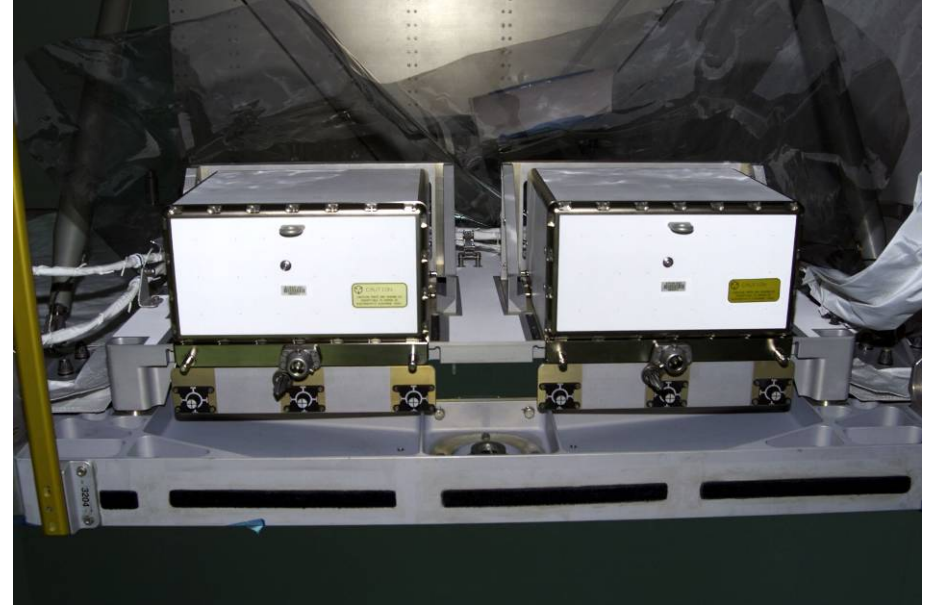
Warnings:

None

S1 S-BAND BSP & XPDR REMOVE AND REPLACE – TASK DATA (Cont)





BSP and XPDR locations on S1


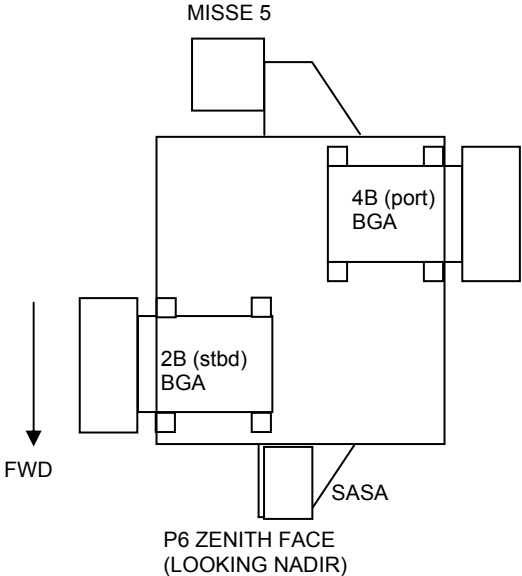


BSP (left) and XPDR (right)

INSTALL SGANT AGIT HEAT SHIELD (00:20)

IV	EV1 (FF)
<p>1. Verify w/MCC-H: Ku band Antenna PARKED in AGIT Heat Shield install position EI = 0 deg, XEL = 0 deg</p> <ul style="list-style-type: none"> <input type="checkbox"/> Autotrack Continuous Retry Inhibited <input type="checkbox"/> TRC PLC reset <input type="checkbox"/> TRC pointing mode inhibited <p>2. Inform MCC-H: When EV1 clear of AGIT</p>	<p>1. Temp stow PGT on P3 ORU transfer bag</p> <p>2. Retrieve AGIT Heat Shield and ESC from crewlock bag stowed at airlock toolbox</p> <div style="border: 3px double black; padding: 5px; text-align: center;"> <p><u>WARNING</u> Potential sharp edge ~5 inch long located approx 17 in to 12 in from outboard end of Z1 HR 6061. Avoid contact with this area</p> </div> <p>3. Translate to Z1 port Ku antenna boom HR 6061(long)</p> <p>4. Inspect discolored area near antenna; report condition </p> <p>5. BRT to Ku boom handrail HH 6062</p> <p>6. Install AGIT Heat Shield, secure with 2 quarter turn fasteners </p>

MISSE 5 RETRIEVE (00:30)

IV	EV1 (FF)	
	<p style="text-align: center;">WARNING</p> <p>Maintain at least 3.6 ft of separation to SASA antenna</p> <p>P6 trunnion pin may exceed touch temperature</p> <p>Remain clear of rotation planes of solar arrays</p> <p>MISSE 5 does not meet kickload requirements. Avoid contact with payload</p> <p>MISSE 5 RETURN (00:30)</p> <ol style="list-style-type: none">1. Translate to P6 MISSE 5 (P6 zenith/aft)2. Photograph both sides of MISSE 5 w/ESC 3. Electronics switch – OFF4. Swap MISSE safe and arm plugs5. Stow antennas (2) in Velcro restraints6. Release grounding strap from handrail standoff7. Release PIP pins (2) securing MISSE open8. Close MISSE; reinsert PIP pins (2) to secure MISSE closed9. Press lever lock tab and push clamp lever to UNLOCK10. Pull capture plate release PIP pin (1) to release clamp from handrail11. Re-engage capture plate and insert PIP pin12. Stow MISSE 5 on BRT13. Translate to airlock	 <p>The diagram illustrates the MISSE 5 hardware configuration. It shows a central rectangular unit with several components labeled: 'MISSE 5' at the top, '4B (port) BGA' on the right side, '2B (stbd) BGA' on the left side, and 'SASA' at the bottom. A downward-pointing arrow labeled 'FWD' is positioned to the left of the unit. Below the unit, the text 'P6 ZENITH FACE (LOOKING NADIR)' is written.</p>

MISSE 5 RETRIEVE – TASK DATA

Estimated Task Duration:

	With RMS	Without RMS
One EV Crew	NA	0:30
Two EV Crew	NA	NA

Tools:

EV1 (FF)
BRT

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
MISSE Stem Contingency Bolt	na	7/16	2	1.7	2.1	6.0	16	30

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
NA					

Foot Restraints:

Task	WIF	APFR Setting
NA		

Note:

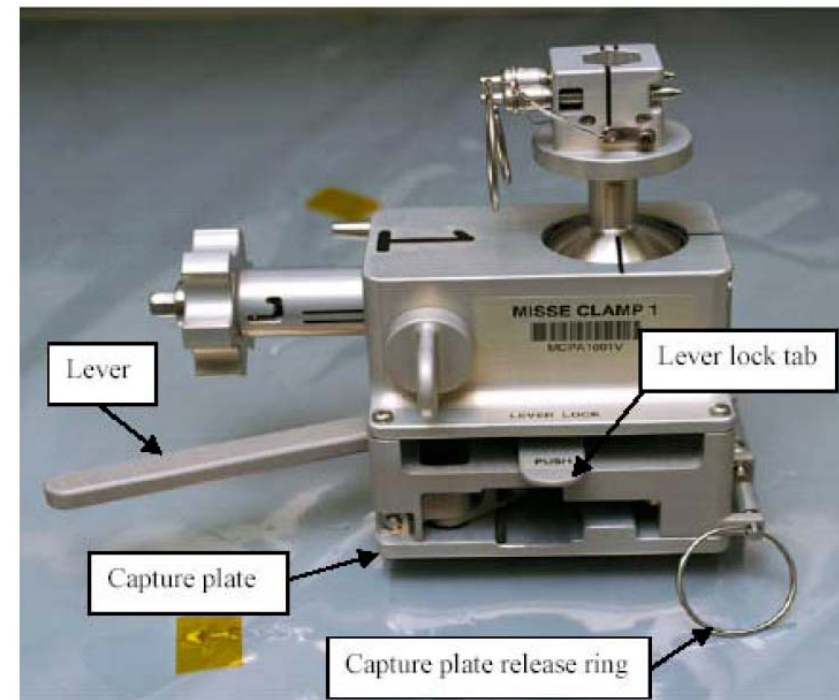
None

Cautions:

None

Warnings:

1. Maintain at least 3.6 ft of separation to SASA antenna
2. P6 trunnion pin may exceed touch temperature
3. Remain clear of rotation planes of solar arrays
4. MISSE 5 does not meet kickload requirements. Avoid contact with payload



EVA 3 CLEANUP/INGRESS (00:25)

IV	EV1 (FF)	EV2 (FF)
	<ol style="list-style-type: none"> 1. Open A/L Thermal Cover 2. Stow MISSE 5 in airlock 3. Retrieve P6 crewlock bag; stow in airlock 4. Stow S1 ORU bag w/MUT-MUT 5. Stow P3 ORU bag w/PGT and 85 ft safety tether 6. APFR: S0-07 to A/L Toolbox WIF 01 (stbd) [12,MM][9,MM,F,12] 7. Tool inventory 8. Translate to crewlock hatch 9. Ingress A/L 10. Attach Waist Tether (R) to UIA D-ring, verify hook locked 11. Give EV2 GO to release 85 ft safety tether 12. Remove SCU from stowage pouch 13. Remove DCM cover, Velcro to DCM 14. SCU-> <-DCM, √SCU locked 15. Water – OFF 16. Give EV2 GO for Ingress <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> <p style="text-align: center;">CAUTION Do not close hatch until EMU WATER – OFF for 2 min</p> </div>	<ol style="list-style-type: none"> 1. Hand S1 ORU bag w/MUT-MUT to EV1 2. Retrieve P3 ORU bag and 85 ft safety tether; hand to EV1 3. On EV1 GO: Release 85 ft safety tether 4. ON EV1 GO: Ingress A/L 5. Attach Waist Tether (R) to A/L D-ring, verify hook locked 6. Stow safety tether on A/L HH 0506; verify reel unlocked 7. Remove SCU from stowage pouch 8. Remove DCM cover, Velcro to DCM 9. SCU-> <-DCM, √SCU locked 10. Water – OFF 11. Close thermal cover, attach Velcro strap 12. Verify no hardware blocking hatch 13. EV Hatch – close and lock 14. Go to PRE REPRESS portion of {CREWLOCK DEPRESS/REPRESS CUE CARD} (SODF: ISS EVA SYS: EVA PREP/POST) <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> <p style="text-align: center;">CAUTION Do not close hatch until EMU WATER – OFF for 2 min</p> </div>

POST EVA 3 TOOL CONFIG

P6 P3 S1 **EV 1**
MWS

BRT (L)
RET (eq-eq)
Wire Ties (2)

T-Bar
RET (eq-eq)
RET (eq-eq) w/pip pin
Adj Equip Tethers (2)
Wire Ties (2)
Shuttle Small Trash Bag
Swing Arm (R)
PGT
7/16 (wobble) Socket-6 ext

RET (eq-eq)
ESC

Waist Tether (R)

P3 S1 **EV 2**
MWS

BRT (L)
RET (eq-eq)
Wire Ties (2)

T-Bar
RET (eq-eq)
RET (eq-eq) w/PIP pin
Adj Equip Tethers (2)
Wire Tie
Shuttle Small Trash Bag
Swing Arm (R)

PGT
7/16 (rigid) Socket-2 ext
RET (eq-eq)
Waist Tether (L)

AIRLOCK CONFIG

Staging Bag
Fuse Tether
PGT
PGT Battery
PGT Battery
Connector Cleaner Tool Kit
Wire Tie Caddy
WIF Adapter w/PIP pin
RAD
Probe
EVA Scraper
Spare Safety Tethers (2)

P3

P3 Med ORU Transfer Bag
Fuse Tether
Ratchet Wrench
SVS Target
RPDA Shrouds (2)
Vise Grips
Adj Equip Tether (outside of bag)

P6 A/L

P6 Crewlock Bag
ISS GP Caddy
IV Adjustable Wrench
AGIT Heat Shield

A/L

MISSE 5 w/Clamp
85 ft safety tethers (2)

S1 Large ORU Transfer Bag

Old BSP
Protective Cover
RET
Old XPDR
Protective Cover
RET
MUT-MUT (on outside of bag)
Adj Equip Tether

IR Camera Crewlock Bag

IR Camera
EHIP Battery

AIRLOCK EXTERIOR

A/L TOOLBOX #1 APFR [12,MM][9,MM,F,12]
Safety Tether – HH 0506
Safety Tether – HH 0506

S0 TRUSS

Safety Tether – S0 HH 3529
Safety Tether – S0 HH 3530

Z1 TRUSS

APFR w/AIA Z1-11 [2,TT,H,11]
IAPFR Z1-01 [12, PP, F, 12]

P4 TRUSS

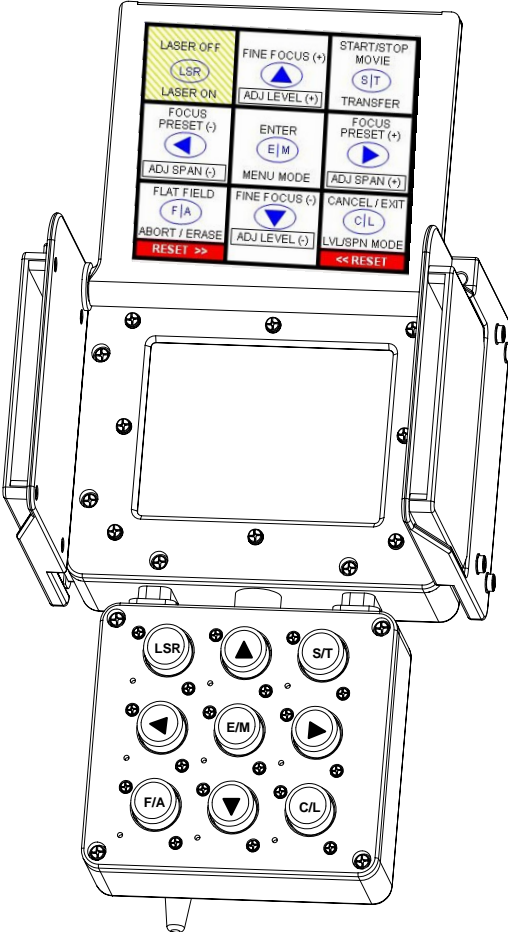
APFR P4-02 [6,PP,A,2]
APFR P4-03 [7,OO,F,12]

Highlight indicates location change during EVA

Z1-M5 VENT TOOL REMOVAL (00:20)

IV	EV1 (FF)	
	<p><u>Get Aheads</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> Z1-M5 Vent Tool Retrieval <input type="checkbox"/> DTO 851 – IR Camera WLE Imagery <input type="checkbox"/> EWIS Antenna Installation <input type="checkbox"/> Lab NPV Install <input type="checkbox"/> Release IEA MMOD Cover Bolts <input type="checkbox"/> 12A.1 APFR Relocation <input type="checkbox"/> P1-P3 Fluid Jumper Connect <p><u>Z1-M5 VENT TOOL RETRIEVAL</u></p> <ol style="list-style-type: none"> 1. Retrieve QRT, bail drive lever tool, cap removal tool, and ratchet wrench from crewlock 2. Remove Vent tool from Z1-M5 <ol style="list-style-type: none"> a. Verify button fully installed b. Close QD valve on vent tool <ul style="list-style-type: none"> <input type="checkbox"/> √Aft white band and button up <input type="checkbox"/> √Button can be depressed <input type="checkbox"/> Push bail toward open position (unstick male sleeve seals) <input type="checkbox"/> Push button and pull bail aft <input type="checkbox"/> √Fwd white band and button up c. Pull back release ring and demate QD 3. Inspect Z1-M5 male 4. Remove QD cap from Z1-M5 lower and install on Z1-M5 upper 5. Release wire tie from Z1 HR 6008 6. Release eq hook on Z1 HR 6010 7. Retrieve vent tool 	

DTO 851 IR CAMERA – WLE IMAGERY (00:30)

IV	EV1 OR EV2 (FF)	
<p>Day 1 Port WLE Panels: Camera Time: _____ Start Time: _____ Stop Time: _____</p> <p>Day 2 Port WLE Panels: Camera Time: _____ Start Time: _____ Stop Time: _____</p>	<p style="text-align: center;"><u>NOTE</u></p> <ol style="list-style-type: none"> IR Camera requires 5-min warm up after power up and prior to use IR camera should be put in standby when not in use to preserve battery power It is acceptable to have some portions of the wing shaded Different movies can show different portions of WLE Movies must be transferred to flash card prior to putting IR camera into standby <p style="text-align: center;"><u>Record 20-sec movies of the following objectives:</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> Daytime 1 WLE (any panels) Lighting: Any time during daylight <input type="checkbox"/> Daytime 2 WLE (any panels) Lighting: Any time during daylight <ol style="list-style-type: none"> Retrieve IR camera crewlock bag from airlock √sw MASTER – ON, √LED – Off Press and release ENABLE switch to initiate camera warmup (IV start 5-min timer), √LED – On Restow camera in crewlock bag Translate to S1 face 6 midpoint Retrieve IR camera from crewlock bag Remove camera lens cover Set camera focus using arrow keys (can be done during warm up) <ol style="list-style-type: none"> Right arrow Course Focus (+) Left arrow Course Focus (-) Up arrow Fine Focus (+) Down arrow Fine Focus (-) Press and hold LSR button for laser on Verify with IV 5-min camera warmup complete Report to IV the panels to be imaged Report time displayed on IR camera viewfinder Perform Flat Field correction (Press and release bottom left button) Record 20-sec movie, call start and stop times to IV Transfer movie to flash card (Press and hold upper right button) If opportunity available for additional movies, repeat steps 10-14 Press and hold ENABLE switch for 3 sec to put IR camera in Standby mode (LED-OFF) Close lens cover and LCD cover Stow IR camera in crewlock bag 	 <p style="text-align: center;"><u>NOTE</u> Press and release for top function. Press and hold for bottom function</p>

DTO 851 IR CAMERA – TASK DATA

Estimated Task Duration:

	With RMS	Without RMS
One EV Crew	NA	0:30
Two EV Crew	NA	NA

Tools:

EV1 (FF)
IR Camera
BRT

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
None	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
NA					

Foot Restraints:

Task	WIF	APFR Setting
N/A		

Notes:

1. Enable Switch: Top
2. Master Switch: Bottom
3. Battery Life: 5 hr full power, 15-16 hr in standby
4. IR camera requires 5 min warm up after power up and prior to use
5. LED will blink red/green for 25-30 sec after power up while camera is booting up. LED solid green after boot up
6. Camera has to complete boot up (solid green LED) prior to being put in standby
7. Camera is put in standby by pressing and holding the ENABLE switch for 3 sec. LED will go OFF when camera in standby
8. IR camera should be put in standby when not in use to preserve battery power
9. It is acceptable to have some portions of the wing shaded
10. Different movies can show different portions of WLE
11. Movies must be transferred to flash card prior to putting IR camera into standby

Cautions:

1. Do not touch IR camera lens, install lens cover when not in use
2. Tether camera body, remote control unit or connecting cable to camera bracket or MWS

Warnings:

None



EWIS ANTENNA INSTALLATION (01:30)

IV	EV1 (FF)	EV2 (FF)																		
<p><u>NOTE:</u> Due to Big Loop reconfigurations, if comm required between ISS IV crew and EV crew, recommend IV crew use drag-thru BPSMU (Shuttle ATU configured to A/G1)</p> <p>IV 1. Notify MCC-H when ready to reconfigure ISS SSSR (UHF) Big Loop communication</p> <p>MCC-H 2. Deactivate SSSR (UHF)</p> <p>IV 3. ON MCC-H GO: A1R AUD CTR SL A/G-1 – ON</p> <p><u>NOTE:</u> BIG LOOP COMM IS VIA HARDLINE</p> <table border="1"> <thead> <tr> <th colspan="3">EWIS Handrails</th> </tr> <tr> <th>Bolt</th> <th>Turns</th> <th>Torque</th> </tr> </thead> <tbody> <tr> <td>HH 0298 stbd</td> <td></td> <td></td> </tr> <tr> <td>HH 0298 port</td> <td></td> <td></td> </tr> <tr> <td>HH 0297 stbd</td> <td></td> <td></td> </tr> <tr> <td>HH 0297 port</td> <td></td> <td></td> </tr> </tbody> </table>	EWIS Handrails			Bolt	Turns	Torque	HH 0298 stbd			HH 0298 port			HH 0297 stbd			HH 0297 port			<ol style="list-style-type: none"> 1. Retrieve EWIS bag from airlock 2. Translate to Lab forward end cone OIH 0278; fairlead on Lab 0219 with adjustable tether 3. Stow EWIS bag between Lab HH 0206/0207 and 0266 <p><u>INSTALL EWIS OIH ANTENNA OIH</u></p> <ol style="list-style-type: none"> 4. Retrieve ANT 11 (OIH 0298) 5. Translate to Lab OIH 0278 6. Attach BRT and rigidize 7. PGT[B7 25.0 ft-lb, CCW2 30 RPM, MTL 30.5]-6 ext 7/16: Release OIH 0278 fasteners (2) (8 turns) 8. Install EWIS LAB OIH ANT 11 (HH 0298), antenna pointing nadir 9. PGT[A2 3.8 ft-lb, CW2 30 RPM, MTL 30.5]-6 ext 7/16: Install EWIS OIH ANT 11 fasteners (2) (8 turns) 10. Stow OIH 0278 in EWIS bag 11. Retrieve ANT 12 (OIH 0297) 12. Translate to Lab OIH 0276 13. Attach BRT and rigidize 14. PGT[B7 25.0 ft-lb, CCW2 30 RPM, MTL 30.5]-6 ext 7/16: Release OIH 0276 fasteners (2) (8 turns) 15. Install EWIS LAB OIH ANT 12 HH (0297), antenna pointing nadir 16. PGT[A2 3.8 ft-lb, CW2 30 RPM, MTL 30.5]-6 ext 7/16: Install EWIS LAB OIH ANT 12 (HH 0297) fasteners (2) (8 turns) 17. Remove caps from ANT 12 J1 and ANT 11 J1 18. Stow OIH 0276 in EWIS bag 19. Stow caps in ISS trash bag <p><u>ROUTE CABLE TO ANTENNAS</u></p> <ol style="list-style-type: none"> 20. Retrieve EWIS cable P2; release wire ties as required 21. Remove cap from EWIS cable P2; stow in ISS trash bag 22. Translate to EWIS LAB OIH ANT 12 with P2 23. Mate EWIS cable P2 to ANT 12 J1 24. Route cable to ANT 11; wire tie as required 25. Remove remaining caps (3) from EWIS cable; stow in ISS trash bag 	
EWIS Handrails																				
Bolt	Turns	Torque																		
HH 0298 stbd																				
HH 0298 port																				
HH 0297 stbd																				
HH 0297 port																				

EWIS ANTENNA INSTALLATION (01:30) (Cont)

IV	EV1 (FF)	EV2 (FF)
<p>WHEN EWIS CONNECTOR MATES COMPLETE:</p> <p>IV 4. ON MCC-H GO: A1R AUD CTR SL A/G-1 – OFF MCC-H 5. Activate SSSR (UHF)</p> <p><u>NOTE:</u> BIG LOOP COMM IS VIA UHF</p>	<p><u>MATE EWIS CABLE TO LAB</u></p> <p>26. Attach MMOD T-handle tool to shield 27. BRT to Lab HH 0206 28. Remove MMOD shield using MMOD T-handle tool and temp stow</p> <p>29. Re-install MMOD shield 30. Install MMOD shield center fastener 31. Install remaining MMOD shield fasteners 32. Inventory EWIS ORU bag 33. Retrieve EWIS bag; translate to airlock 34. Stow EWIS bag</p>	<p><u>MATE EWIS CABLE TO LAB</u></p> <p>1. Assist EV1 with removal of MMOD shield using MMOD T-handle tool 2. Release MLI fastener and peel back MLI to expose electrical connector P16 3. ON MCC-H GO – Demate Lab P16 connector from Lab J16 4. Mate P16A to J16 5. Mate J16A to P16 6. Feed cable to MMOD shield exit point 7. Re-install MLI and MLI fastener</p> <p>8. Mate EWIS cable P1 to ANT11 J1</p>

EWIS ANTENNA INSTALLATION – TASK DATA

Estimated Task Duration:

	With RMS	Without RMS
One EV Crew	NA	NA
Two EV Crew	NA	1:30

Tools:

EV1 (FF)	EV2 (FF)
MMOD Shield Tools (2)	PGT
BRT	6 Ext 7/16
	BRT

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
OIH Fastener	None	7/16	2 per	3.8	-	-	9.5	30

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
EWIS Cable P1	NA	ANT 11 J1	NA	21	
EWIS Cable P2	NA	ANT 12 J1	NA	21	
EWIS Cable P16A	NA	LAB J16	NA	25	
Lab P16	LAB J16	EWIS Cable J16A	NA	25	

Foot Restraints:

Task	WIF	APFR Setting
N/A		

Note:

None

Cautions:

1. EVA crewmember shall be rigidly restrained during handrail installation or removal of OIH via APFR or rigidized BRT
2. EVA crewmember shall not be rigidly restrained to OIH that is being installed or removed
3. Do not use WIS antennas as handholds
4. Avoid contact with grapple fixture shafts (drylube)

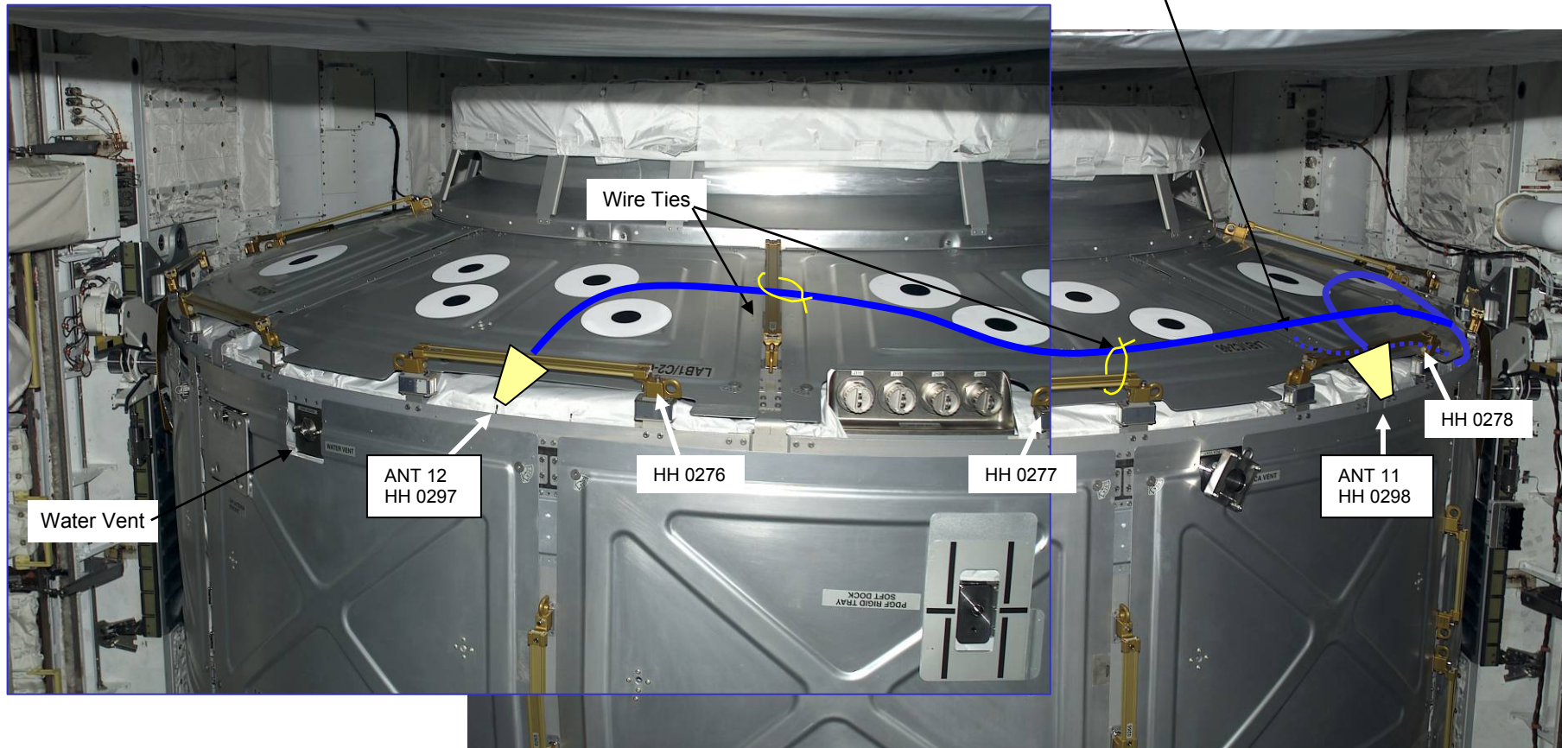
Warnings:

1. Sharp edge – Back side of MMOD shield fasteners
2. Sharp edge – PMA umbilical launch restraints – exposed threads
3. Avoid inadvertent contact with grapple fixture targets and target pins
4. PMA handrails may be hot. Handling may need to be limited
5. Stay > 1 ft away from PMAs and MMOD shields > 270 deg F if EMU sun visor up
6. Stay > 0.5 ft away from PMAs and MMOD shields > 325 deg F
7. No EMU TMG contact with PMAs or MMOD shields when temp > 320 deg F

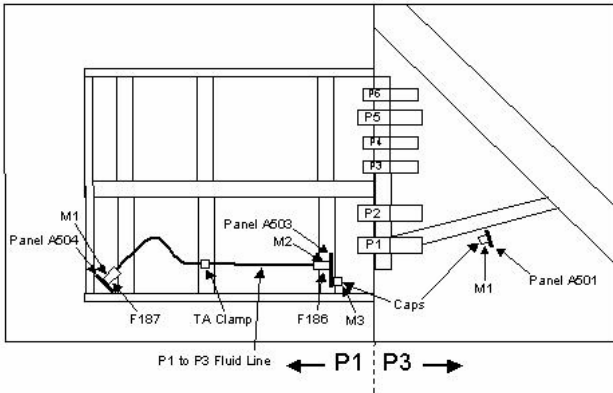
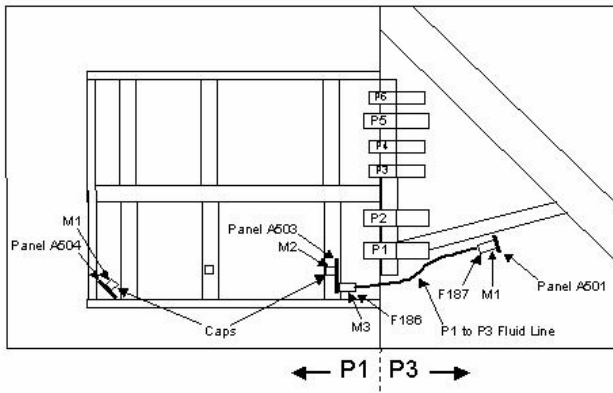
EWIS ANTENNA INSTALLATION – TASK DATA (Cont)

Lab Fwd End Cone – Nadir

J16 Feedthru
(underneath)



RELEASE IEA MMOD COVER BOLTS, RELOCATE 12A.1 APFRs, P1-P3 FLUID JUMPER CONNECT

IV	EV1 (FF)	EV2 (FF)
<p>QD MATE/DEMATE STEPS</p> <p><u>DEMATE QD</u></p> <ol style="list-style-type: none"> √Fwd band and button up Demate QD <p><u>MATE QD</u></p> <ol style="list-style-type: none"> Inspect QDs for FOD, button up, FID Mate QD – √Fwd band Snapback, pull and gap tests <p><u>OPEN QD VALVE</u></p> <ol style="list-style-type: none"> Press button and open valve √Aft band and button up 	<p><u>RELEASE IEA MMOD COVER BOLTS</u></p> <ol style="list-style-type: none"> PGT[B7 (25.5 ft-lb), CCW1 10 RPM, MTL 30.5]-2 ext 7/16: Unfasten IEA MMOD Cover bolts (4), 1 turn <ul style="list-style-type: none"> <input type="checkbox"/> Bolt #1 <input type="checkbox"/> Bolt #2 <input type="checkbox"/> Bolt #3 <input type="checkbox"/> Bolt #4 <p><u>12A. 1 APFR RELOCATIONS</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> APFR P3-06 to P4 WIF 17 [5,RR,J,12] (zenith,aft) <input type="checkbox"/> APFR P3-31 to P4 WIF 20 [6,WW,A,10] (nadir,aft) <p><u>CONNECT P1 TO P3 FLUID LINE</u></p> <ol style="list-style-type: none"> Open TA clamp Demate fluid jumper female QD F186 and QD 187 Close TA clamp Remove QD cap from panel P1-A503-M3 Mate QD F186 to P1-A503-M3 Mate QD cap to panel P1-A503-M2 Remove QD cap from panel P3-A501-M1 Mate QD F187 to P3-A501-M1 Mate QD cap to panel P1-A504-M1 	<p>P1 to P3 Fluid Line – Stowed Config</p> <p>↑ FACE 1</p>  <p>P1 to P3 Fluid Line – Deployed Config</p> <p>↑ FACE 1</p> 

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TOOLS AND STOWAGE

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TOOLS AND
STOWAGE

**TOOLS AND
STOWAGE**

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STS-115 PGT SETTINGS TABLE

TORQUE SETTINGS:

SETTING	TORQUE SETPOINT (FT-LB)	TORQUE WINDOW	TORQUE THRESHOLD	TURN LIMIT
A1	2.5	±1.0	±1.0	Infinite
A2	3.8	±1.0	±1.0	Infinite
A3	4.8	±1.0	±1.0	Infinite
A4	6.3	±1.0	±1.0	Infinite
A5	7.0	±1.0	±1.0	Infinite
A6	8.3	±1.0	±1.0	Infinite
A7	9.2	±1.0	±1.0	Infinite
B1	12.0	±1.0	±1.0	Infinite
B2	16.0	±1.2	±1.0	Infinite
B3	18.4	±1.7	±1.0	Infinite
B4	19.4	±1.9	±1.0	Infinite
B5	22.0	±2.0	±1.0	Infinite
B6	24.0	±2.0	±1.0	Infinite
B7	25.5	±2.0	±1.0	Infinite

SPEED SETTINGS:

SETTING	RPM
CW1	10
CW2	30
CW3	60
CCW1	10
CCW2	30
CCW3	60

POWER MANAGEMENT:

FUNCTION	MIN
Auto Sleep	15
Auto Off	30

MULTI-SETTING TORQUE LIMITER (MTL) SETTINGS

(ft-lb)
2.5
5.5
10.5
15.5
23.5
30.5

APFR MANAGEMENT – STS-115 (12A)

EVA 1	APFR 1 8A pitch knob problem, 9A & INC 12 no problem	APFR 2	APFR 3 S/N 1005 8A pitch knob problem, 9A & INC 12 no problem Ingress aid	APFR 4 TS, old ORU tether; safety tether Heat shield	APFR 5 TS, old ORU tether Heat shield	APFR 6 Heat shield	APFR 7 S/N 1008	IAPFR 1	IAPFR 2	CRANE ballstack	TS	WIF EXT
Pre-EVA 1	CETA 1 WIF 4 (3,GG) [12,WW,F,12]	S0 WIF 42 [10,PP,F,12]	Z1 WIF 11 [2,TT,H,11] Ingress aid flat against bootplate	Node WIF 05 [6,PP,B,12]	PMA1 WIF 02 [12,KK,F,6] TS pointed along node 1, zenith/Stbd dir	PMA1 WIF 04 [4,PP,A,6]	S0 WIF 07 [5,NN,L,12]	Z1 WIF 01 [3,PP,F,12]	Z1 WIF 04 [6,PP,F,12]	PMA1 WIF 05	S0 port wedge face	ESP-2 WIF 3 CL=9 P-90 (M) Ext = 1
P1 to P3 Lower Tray Umbilicals	P3 WIF 01 [6,TT,F,12]											
Release SABB Inbrd Aft Restraints		P4 WIF 15 [9,NN,E,12]										
Release SABB Outbrd Aft Restraints		P4 WIF 15 [2,NN,E,11]										
Release SABB Inbrd Fwd Restraints		P4 WIF 13 [9,NN,E,12]										
Release SABB Outbrd Fwd Restraints		P4 WIF 13 [2,NN,E,11]										
Deploy SARJ DLA 2		P4 WIF 04 [6,PP,L,1]										
Deploy SARJ DLA 1	P3 WIF 31 [7,PP,F,12]											
P1 to P3 Upper Tray Umbilicals		P3 WIF 04 [6,TT,F,12]										
EVA 2 Get Ahead	P3 WIF 29 [9,QQ,E,12]	P3 WIF 30 [9,QQ,E,12]										
EVA 2	P3 WIF 29 [9,QQ,E,12]	P3 WIF 30 [9,QQ,E,12]	Z1 WIF 11 [2,TT,H,11]	Node WIF 05 [6,PP,B,12]	PMA1 WIF 02 [12,KK,F,6] TS pointed along node 1, zenith/Stbd dir	PMA1 WIF 04 [4,PP,A,6]	S0 WIF 07 [5,NN,L,12]	Z1 WIF 01 [3,PP,F,12]	Z1 WIF 04 [6,PP,F,12]	PMA1 WIF 05	S0 port wedge face	ESP-2 WIF 3 CL=9 P-90 (M) Ext = 1
EVA 3 Get Ahead	P3 WIF 31 [1,OO,F,12]	P3 WIF 06 [6,PP,A,2]										

APFR MANAGEMENT – STS-115 (12A) (Cont)

EVA 3	APFR 1 P3 WIF 31 [1,OO,F,12]	APFR 2 P3 WIF 06 [6,PP,A,2]	APFR 3 Z1 WIF 11 [2,TT,H,11] Ingress aid flat against bootplate	APFR 4 Node WIF 05 [6,PP,B,12]	APFR 5 PMA1 WIF 2 [12,KK,F,6] TS pointed along node 1, zenith/Stbd dir	APFR 6 PMA1 WIF 04 [4,PP,A,6]	APFR 7 S0 WIF 07 [5,NN,L,12]	IAPFR 1 Z1 WIF 01 [3,PP,F,12]	IAPFR 2 Z1 WIF 04 [6,PP,F,12]	CRANE ballstack PMA1 WIF 5	TS S0 port wedge face	WIF EXT ESP-2 WIF 3 CL=9 P-90 (M) Ext = 1
SASA R&R Prep			Z1 WIF 11 [2,TT,H,11]				S0 WIF 07 [5,NN,L,12]	Z1 WIF 01 [3,RR,F,12]				
Remove & Stow P3 Keel Pin & Drag Link	P3 WIF 31 [1,OO,F,12]	P3 WIF 06 [6,PP,A,2]										
P3 Cleanup	P4 WIF 03 [7,OO,F,12]	P4 WIF 02 [6,PP,A,2]										
S1 SASA R&R								Z1 WIF 01 [12,PP,F,12]				
EVA 3 Cleanup							A/L Toolbox 1 (STBD) [12,MM] [9,MM,F,12]					
Post EVA 3	P4 WIF 03 [7,OO,F,12]	P4 WIF 02 [6,PP,A,2]	Z1 WIF 11 [2,TT,H,11]	Node WIF 05 [6,PP,B,12]	PMA1 WIF 2 [12,KK,F,6] TS pointed along node 1, zenith/Stbd dir	PMA1 WIF 04 [4,PP,A,6]	A/L Toolbox 1 (STBD) [12,MM] [9,MM,F,12]	Z1 WIF 01 [12,PP,F,12]	Z1 WIF 04 [6,PP,F,12]	PMA1 WIF 5	S0 port wedge face	ESP-2 WIF 3 CL=9 P-90 (M) Ext = 1

SAFETY TETHER CURRENT CONFIGURATION

I

	#59 SN 1007 Sm-sm Locking hooks	#72 SN 1022 Lg-sm Locking hooks	#73 SN 1023 (or 1015) Locking hooks	#60 or #70 SN 1008 or 1020 Lg-sm Locking hooks	#60 or #70 SN 1008 or 1020 Lg-sm Locking hooks	#71 SN 1021 Lg-sm Locking hooks	#66 SN 1016 Sm-sm Locking hooks	#22 SN 1002 85-ft Tehter Sm-sm Locking hooks	#26 SN 1006 85-ft Tehter Lg-sm Locking hooks	#25 SN 1005 85-ft	#28 SN 1008 85-ft
Pre EVA 1	A/L Interior	A/L Interior	A/L Interior	S0 HH 3529	S0 HH 3530 Note: this tether had some retraction issues	A/L Ext D- ring and A/L HH 0506	A/L Ext D- ring and A/L HH 0506	A/L Interior	A/L Interior	Shuttle Middeck	Shuttle Middeck
Post EVA 1				Reel @ A/L HH 0506, anchored to S0 HR 3529 (fairlead- HR 535)	Reel @ A/L HH 0506, anchored to S0 HR 3530 (fairlead- HR 535)	Reel @ A/L HH 0554. anchored at A/L Ext D-ring	Reel @ A/L HH 0554. anchored at A/L Ext D-ring	Reel and Anchor @ P1 HH 3690	Reel and Anchor @ P1 HH 3811		
Post EVA 2				Reel @ A/L HH 0506, anchored to S0 HR 3529 (fairlead- HR 535)	Reel @ A/L HH 0506, anchored to S0 HR 3530 (fairlead- HR 535)	Reel @ A/L HH 0554. anchored at A/L Ext D-ring	Reel @ A/L HH 0554. anchored at A/L Ext D-ring	Reel and Anchor @ P1 HH 3690	Reel and Anchor @ P1 HH 3811		
Post EVA 3	A/L Interior	A/L Interior	A/L Interior	S0 HH 3529	S0 HH 3530	A/L Ext D- ring and A/L HH 0506	A/L Ext D- ring and A/L HH 0506	Shuttle Middeck	A/L Interior	One of these will be transferred to ISS the other will return in the middeck	
Post 12A	A/L Interior	A/L Interior	A/L Interior	S0 HH 3529	S0 HH 3530	A/L Ext D- ring and A/L HH 0506	A/L Ext D- ring and A/L HH 0506	Shuttle Middeck	A/L Interior		
Cert expiration	8/10	8/10	8/10	8/10	8/10	8/10	8/10				

EMU EQUIPMENT SORTED BY ITEM

I

ITEM	LOCATION	QTY	S/N
3/8 Drive Ratchet w/7/16 Socket	Shuttle EVA Bag	1	
Bends Treatment Adapter (BTA)	MF43M	1	1006
BSC Contingency Tool	EMU Equip Bag Assy	1	
C/L, 115 EVA	MF57K – FDF	2	
C/L, ISS EVA Systems (No stripe; ISS copy)	MF57K – SODF	1	xfer
C/L, ISS EVA Systems (Red striped w/115 Crew notes)	MF57K	1	
CCC Cartridge, EMU LiOH	EMU 3017 (Pp)	1	2003
CCC Cartridge, EMU LiOH	EMU 3004 (Ta)	1	2002
CCC Cartridge, EMU LiOH	MD Ceiling (PORT2)	4	2012 2006 2005 2004
Comfort Gloves – Spectra (pr)	ECOK (Ta)	2	LN727513
Comfort Gloves – Spectra (pr)	ECOK (Bb)	2	LN727513
Comfort Gloves – Spectra (pr)	ECOK (Mn)	2	Mn special
Comfort Gloves (pr)	ECOK (Pp)	2	328 L/R 329 L/R
Comm Cap Assy (CCA) – Bb Prime	MD Ceiling (STBD1)	1	1181
Comm Cap Assy (CCA) – Mn Prime	MD Ceiling (STBD1)	1	1160
Comm Cap Assy (CCA) – Pp Prime	EMU 3017 (Pp)	1	1175
Comm Cap Assy (CCA) – Ta Prime	EMU 3004 (Ta)	1	1180
Croakie – Bb	ECOK (Bb)	2	
Croakie, Elastic Glasses Retention Device – Mn	ECOK (Mn)	2	
Croakie, Elastic Glasses Retention Device – Ta	ECOK (Ta)	2	LN0505
CSA-O2	MA9F	2	
Cue Card, Crewlock Depress/Repress	MF57K – SODF	2	xfer
Cue Card, Depress/Repress (Shuttle Conting)	MF57K – FDF	1	
Cue Card, EMU/Airlock Consumables Tracking	MF57K – SODF	1	
Cue Card, Exercise Prebreathe (for ISS Crew)	MF57K	1	xfer
Cue Card, Exercise Prebreathe (for Shuttle Crew)	MF57K	1	
Cuff C/L, ISS EVA	MF57K – SODF	4	xfer 3 of 4
Cuff C/L, Shuttle (Contingency)	MF57K – FDF	2	
DCM Plug	Shuttle EVA Bag	1	

EMU EQUIPMENT SORTED BY ITEM (Cont)

ITEM	LOCATION	QTY	S/N
DIDB Restraint Bag	EMU 3017 (Pp)	1	
DIDB Restraint Bag	EMU 3004 (Ta)	1	
Drink Bags (DIDB)	MA16D	14	LN 8100-59228-1
EMU – Pp	Ext A/L Port	1	3017
EMU – Ta	Ext A/L Starboard	1	3004
EMU 3-Micron Filters	MD Floor (PORT1)	4 return 2	Xfer 1018 1019 1020 1021 return 1014 1015 (qty 2)
EMU Battery (ICB)	EMU 3017 (Pp)	1	2036
EMU Battery (ICB)	EMU 3004 (Ta)	1	2031
EMU Battery (ICB)	MA9L	1	2061
EMU Equip Bag Crew Specific Compartment	Volume H, OTBD	2	1032 1027
EMU Equip Bag Trash Bag	EMU Equip Bag Assy	1	1030
EMU Equip Bag Trash Liner	EMU Equip Bag Assy	1	
EMU Equipment Bag Assy – Shared Compartment	Volume H, INBD	1	1025
EMU Mirror Assy	EMU 3017 (Pp)	2	
EMU Mirror Assy	EMU 3004 (Ta)	2	
EMU Servicing Kit	Volume H, INBD	1	xfer 5005 retrn 5004
Ergometer Shoe Bag	MD Ceiling (STBD2)	1	
EV Crew Options Kit (ECOK) – Bb	MD Ceiling (STBD1)	1	
EV Crew Options Kit (ECOK) – Mn	MD Ceiling (STBD1)	1	
EV Crew Options Kit (ECOK) – Pp	EMU 3017 (Pp)	1	
EV Crew Options Kit (ECOK) – Ta	EMU 3004 (Ta)	1	
EVA Adjustable Wrench	Shuttle EVA Bag	1	
EVA Bag (Shuttle)	Volume H, OTBD	1	

EMU EQUIPMENT SORTED BY ITEM (Cont)

ITEM	LOCATION	QTY	S/N
F5 Camera Film	A16 Locker (Flight Deck)	3	
General Purpose Tool Caddy	Shuttle EVA Bag	1	
Gloves (pr) – (Bb b/u)	MD Ceiling (STBD1)	1	6219
Gloves (pr) – (Bb prime)	MD Ceiling (STBD1)	1	6210
Gloves (pr) – (Mn b/u)	MD Ceiling (STBD1)	1	6183
Gloves (pr) – (Mn prime)	MD Ceiling (STBD1)	1	6184
Gloves (pr) – (Pp b/u)	MD Ceiling (STBD1)	1	6177
Gloves (pr) – (Pp prime)	EMU 3017 (Pp)	2	6178
Gloves (pr) – (Ta b/u)	MD Ceiling (STBD1)	1	6043
Gloves (pr) – (Ta prime)	EMU 3004 (Ta)	2	6044
Heartrate Monitor and Band	MA16G	6	
Helmet Light (EHIP)	Volume H, INBD	1	
Helmet Light (EHIP)	Volume H, OTBD	1	
Helmet Light (EHIP) Battery Pack	Volume H, INBD	2	
Helmet Light (EHIP) Battery Pack	Volume H, OTBD	2	
Helmet Light (EHIP) Battery Pack – IR Camera	MD Ceiling (STBD1)	1	
Helmet/EVVA Cover	EMU 3017 (Pp)	1	1071
Helmet/EVVA Cover	EMU 3004 (Ta)	1	1062
LCVG w/Biomed Hdwr – (Bb prime)	MD Ceiling (STBD1)	1	3173
LCVG w/Biomed Hdwr – (Mn prime)	MD Ceiling (STBD1)	1	3167
LCVG w/Biomed Hdwr – (Pp prime)	EMU 3017 (Pp)	1	3127
LCVG w/Biomed Hdwr – (Ta Prime)	EMU 3004 (Ta)	1	3111
LCVG w/no Biomed Hdwr – (Pp Backup)	MD Ceiling (STBD1)	1	3155
Leg Assy – (Bb Backup)	MD Ceiling (STBD1)	2	131
Leg Assy – (Mn Backup)	MD Ceiling (STBD1)	2	157
Leg Sizing Ring, 0.5" (pr) – b/u	MD Ceiling (STBD1)	1	127/128
Leg Sizing Ring, 1.5" (pr)	MD Ceiling (STBD1)	1	xfer 125/126
LTA Restraint Bag	EMU 3004 (Ta)	1	
LTA Donning Handle (pair)	EMU Equip Bag Assy	1	
LTA Restraint Bag	EMU 3017 (Pp)	1	
MAG	ECOK (Pp)	8	

EMU EQUIPMENT SORTED BY ITEM (Cont)

ITEM	LOCATION	QTY	S/N
MAG	ECOK (Ta)	7	
MAG	ECOK (Bb)	4	
MAG	ECOK (Mn)	4	
Moleskin	ECOK (Pp)	24	
Moleskin	ECOK (Bb)	9	
Moleskin	ECOK (Mn)	27	
MWC Flight Cover Jumper	EMU Equip Bag Assy	2	
PGT Battery	MD Ceiling (STBD1)	2	5017 5018
REBA	MD Ceiling (STBD2)	1	1009
SAFER HC Hardmount	MD Ceiling (STBD1)	1	8
Scissors	EMU Equip Bag Assy	1	
Scissors with tether	EMU 3017 (Pp)	1	
Scissors with tether	EMU 3004 (Ta)	1	
Signal Conditioner, Biomed – Bb backup	MF28H – OBS Kit	1	122
Signal Conditioner, Biomed – Mn backup (LA prime)	EMU Servicing Kit (sn 5005)	1	114
Signal Conditioner, Biomed – Pp/Ta backup	EMU Servicing Kit (sn 5005)	1	117
Sock Liners, Thermax (pr) – Bb	ECOK (Bb)	2	
Sock Liners, Thermax (pr) – Mn	ECOK (Mn)	3	
Sock Liners, Thermax (pr) – Pp	ECOK (Pp)	4	
Sock Liners, Thermax (pr) – Mn	ECOK (Mn)	2	
Sock Liners, Woodsman (pr) – Ta	ECOK (Ta)	2	
Socks, Thermal 'poly' (pr) – Mn	ECOK (Mn)	1	
SOP Checkout Fixture	EMU Equip Bag Assy	2	
Sports Bra	ECOK (Pp)	2	
TCU (Top and Bottom) – Bb	ECOK (Bb)	2	
TCU (Top and Bottom) – Mn	ECOK (Mn)	2	
TCU (Top and Bottom) – Pp	ECOK (Pp)	2	
TCU (Top and Bottom) – Ta	ECOK (Ta)	2	
Tegaderm Dressing	ECOK (Mn)	9	
Wristlets (pr) – Bb	ECOK (Bb)	2	
Wristlets (pr) – Mn	ECOK (Mn)	2	
Wristlets (pr) – Pp	ECOK (Pp)	2	

EMU EQUIPMENT SORTED BY LOCATION

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LOCATION	ITEM	QTY	S/N
A16 Locker (Flight Deck)	F5 Camera Film	3	
ECOK (Bb)	Comfort Gloves – Spectra (pr)	2	LN727513
	Croakie – Bb	2	
	MAG	4	
	Moleskin	9	
	Sock Liners, Thermax (pr) – Bb	2	
	TCU (Top and Bottom) – Bb	2	
	Wristlets (pr) – Bb	2	
ECOK (Mn)	Comfort Gloves – Spectra (pr)	2	Mn special
	Croakie, Elastic Glasses Retention Device – Mn	2	
	MAG	4	
	Moleskin	27	
	Sock Liners, Thermax (pr) – Mn	3	
	Sock Liners, Thermax (pr) – Mn	2	
	Socks, Thermal 'poly' (pr) – Mn	1	
	TCU (Top and Bottom) – Mn	2	
	Tegaderm Dressing	9	
	Wristlets (pr) – Mn	2	
ECOK (Pp)	Comfort Gloves (pr)	2	328 L/R 329 L/R
	MAG	8	
	Moleskin	24	
	Sock Liners, Thermax (pr) – Pp	4	
	Sports Bra	2	
	TCU (Top and Bottom) – Pp	2	
	Wristlets (pr) – Pp	2	
ECOK (Ta)	Comfort Gloves – Spectra (pr)	2	LN727513
	Croakie, Elastic Glasses Retention Device – Ta	2	LN0505
	MAG	7	
	Sock Liners, Woodsman (pr) – Ta	2	
	TCU (Top and Bottom) – Ta	2	

EMU EQUIPMENT SORTED BY LOCATION (Cont)

LOCATION	ITEM	QTY	S/N
EMU 3004 (Ta)	CCC Cartridge, EMU LiOH	1	2002
	Comm Cap Assy (CCA) – Ta Prime	1	1180
	DIDB Restraint Bag	1	
	EMU Battery (ICB)	1	2031
	EMU Mirror Assy	2	
	EV Crew Options Kit (ECOK) – Ta	1	
	Gloves (pr) – (Ta prime)	2	6044
	Helmet/EVVA Cover	1	1062
	LCVG w/Biomed Hdwr – (Ta Prime)	1	3111
	LTA Restraint Bag	1	
	Scissors with tether	1	
EMU 3017 (Pp)	CCC Cartridge, EMU LiOH	1	2003
	Comm Cap Assy (CCA) – Pp Prime	1	1175
	DIDB Restraint Bag	1	
	EMU Battery (ICB)	1	2036
	EMU Mirror Assy	2	
	EV Crew Options Kit (ECOK) – Pp	1	
	Gloves (pr) – (Pp prime)	2	6178
	Helmet/EVVA Cover	1	1071
	LCVG w/Biomed Hdwr – (Pp prime)	1	3127
	LTA Restraint Bag	1	
	Scissors with tether	1	
EMU Equip Bag Assy	BSC Contingency Tool	1	
	EMU Equip Bag Trash Bag	1	1030
	EMU Equip Bag Trash Liner	1	
	LTA Donning Handle (pair)	1	
	MWC Flight Cover Jumper	2	
	Scissors	1	
	SOP Checkout Fixture	2	
EMU Servicing Kit (sn 5005)	Signal Conditioner, Biomed – Mn backup (LA prime)	1	114
	Signal Conditioner, Biomed – Pp/Ta backup	1	117
Ext A/L Port	EMU – Pp	1	3017
Ext A/L Starboard	EMU – Ta	1	3004

EMU EQUIPMENT SORTED BY LOCATION (Cont)

LOCATION	ITEM	QTY	S/N
MA16D	Drink Bags (DIDB)	14	LN 8100-59228-1
MA16G	Heartrate Monitor and Band	6	
MA9F	CSA-O2	2	
MA9L	EMU Battery (ICB)	1	2061
MD Ceiling (PORT2)	CCC Cartridge, EMU LiOH	4	2012 2006 2005 2004
MD Ceiling (STBD1)	Comm Cap Assy (CCA) – Bb Prime	1	1181
	Comm Cap Assy (CCA) – Mn Prime	1	1160
	EV Crew Options Kit (ECOK) – Bb	1	
	EV Crew Options Kit (ECOK) – Mn	1	
	Gloves (pr) – (Bb b/u)	1	6219
	Gloves (pr) – (Bb prime)	1	6210
	Gloves (pr) – (Mn b/u)	1	6183
	Gloves (pr) – (Mn prime)	1	6184
	Gloves (pr) – (Pp b/u)	1	6177
	Gloves (pr) – (Ta b/u)	1	6043
	Helmet Light (EHIP) Battery Pack – IR Camera	1	
	LCVG w/Biomed Hdwr – (Bb prime)	1	3173
	LCVG w/Biomed Hdwr – (Mn prime)	1	3167
	LCVG w/no Biomed Hdwr – (Pp Backup)	1	3155
	Leg Assy – (Bb Backup)	2	131
	Leg Assy – (Mn Backup)	2	157
	Leg Sizing Ring, 0.5" (pr) – b/u	1	127/128
	Leg Sizing Ring, 1.5" (pr)	1	Xfer 125/126
	PGT Battery	2	5017 5018
	SAFER HC Hardmount	1	8
MD Ceiling (STBD2)	Ergometer Shoe Bag	1	
	REBA	1	1009

EMU EQUIPMENT SORTED BY LOCATION (Cont)

LOCATION	ITEM	QTY	S/N
MD Floor (PORT1)	EMU 3-Micron Filters	4 return 2	Xfer 1018 1019 1020 1021 return 1014 1015 (qty 2)
MF28H – OBS Kit	Signal Conditioner, Biomed – Bb backup	1	122
MF43M	Bends Treatment Adapter (BTA)	1	1006
MF57K – FDF	C/L, 115 EVA	2	
MF57K – FDF	Cue Card, Depress/Repress (Shuttle Conting)	1	
MF57K – FDF	Cuff C/L, Shuttle (Contingency)	2	
MF57K – SODF	C/L, ISS EVA Systems (Red striped w/115 Crew notes)	1	
	Cue Card, Exercise Prebreathe (for ISS Crew)	1	xfer
	Cue Card, Exercise Prebreathe (for Shuttle Crew)	1	
	C/L, ISS EVA Systems (No stripe; ISS copy)	1	xfer
	Cue Card, Crewlock Depress/Repress	2	xfer
	Cue Card, EMU/Airlock Consumables Tracking	1	
	Cuff C/L, ISS EVA	4	xfer 3 of 4
Shuttle EVA Bag	3/8 Drive Ratchet w/7/16 Socket	1	
	DCM Plug	1	
	EVA Adjustable Wrench	1	
	General Purpose Tool Caddy	1	
Volume H, INBD	EMU Equipment Bag Assy – Shared Compartment	1	1025
	EMU Servicing Kit	1	xfer 5005 retrn 5004
	Helmet Light (EHIP)	1	
	Helmet Light (EHIP) Battery Pack	2	
Volume H, OTBD	EMU Equip Bag Crew Specific Compartment	2	1032 1027
	EVA Bag (Shuttle)	1	
	Helmet Light (EHIP)	1	
	Helmet Light (EHIP) Battery Pack	2	

SHUTTLE EVA TOOLS SORTED BY TOOL NAME

Item	Part Number	Up	Down	Location	Comments
1/2-IN BOX RATCHET TOOL CADDY	V632-669200-022	1	1	VOLUME D	
1/2-IN BOX SOCKET WRENCH	V628-650885-004	1	1	VOLUME D	
1/4-IN HEX, RADIATOR EXTENSION	V628-650896-004	1	1	VOLUME D	
3 POINT LATCH TOOL	SED33101327-313	2	2	VOLUME D	
3 POINT LATCH TOOL STOWAGE BAG	V633-669300-033	1	1	VOLUME D	
3/8-IN RATCHET, 4-IN EXTENSION, 7/16-IN SOCKET	V628-650860-003	1	1	VOLUME D	
3/8-IN DRIVE RATCHET	V628-650881-004	1	1	MD CEIL E (PORT 1)	
3/8-IN RATCHET WITH 7/16-IN SOCKET	V628-650860-001	1	1	VOLUME H OUTBOARD	
5/32-IN SHORT BALL END ALLEN DRIVER	SEG33108851-303	1	1	MD CEIL E (PORT 1)	
85 FT SAFETY TETHER	SED33116109-301	0	1	MD CEIL E (PORT 1)	s/n 1002
85 FT SAFETY TETHER	SED33116109-307	2	1	MD CEIL E (PORT 1)	s/n 1008 xfer to ISS
ADJUSTABLE EQUIPMENT TETHER (EQ-EQ W/SLIDE LOCK)	SEG33106945-307	3	3	MD CEIL E (PORT 1)	
ADJUSTABLE EQUIPMENT TETHER (EQ-EQ W/SLIDE LOCK)	SEG33106945-307	2	2	MD CEIL H (STBD 2)	
ADJUSTABLE EQUIPMENT TETHER (SM-SM)	SED33104175-301	2	2	VOLUME D	
ADJUSTABLE FUSE TETHER	SED39127200-701	1	1	MD CEIL H (STBD 2)	
ADJUSTABLE FUSE TETHER (EQ HKS W/SLIDE LOCK)	SED39127200-705	2	2	MD CEIL G (STBD 1)	
ADJUSTABLE FUSE TETHERS	SED39127200	0	2	MD CEIL E (PORT 1)	
ADJUSTABLE THERMAL MITTEN	0106-811540-03	2	2	VOLUME D	
ADJUSTABLE THERMAL MITTEN	0106-811540-04	2	2	VOLUME D	
BATTERY ASSY, NI – METAL HYDRIDE PGT	SEG33110979-305	2	2	MD CEIL G (STBD 1)	
BGA BOLT RETAINER ASSY	1F15786-1	8	0	EXT A/L FLR	
BODY RESTRAINT TETHER (BRT)	SEG33110400-305	1	0	MD CEIL E (PORT 1)	s/n 1003
BODY RESTRAINT TETHER (BRT)	SEG33110400-305	0	1	MD CEIL E (PORT 1)	s/n 1002
BOLT PULLER	V628-650880-009	1	1	VOLUME D	
BOLT PULLER/WISE GRIP PLIERS TOOL CADDY	V632-669200-018	1	1	VOLUME D	
CENTERLINE LATCH TOOL	SED33101621-307	2	2	VOLUME D	
CENTERLINE LATCH TOOL BAG	V633-669310-037	1	1	VOLUME D	
CIPAA CONTAINMENT BAG ASSY	SED33117980-701	1	1	ML60J (8943-301)	
CIPAA SACK ASSY (TRAD SACK)	SED33119106-309	2	2	ML60J (8943-301)	

SHUTTLE EVA TOOLS SORTED BY TOOL NAME (Cont)

Item	Part Number	Up	Down	Location	Comments
COMPOUND CUTTER (SMALLCUTTER)	SED33104404-305	1	1	VOLUME D	
COMPOUND CUTTER/NEEDLE NOSE PLIERS TOOL CADDY	V632-669200-025	1	1	VOLUME D	
CRACK REPAIR BAG	SED33118750-301	1	1	MD CEIL F (PORT 2)	
CRACK REPAIR PALETTE ASSY	SED33118670-301	2	2	MD CEIL E (PORT 1)	
E.T. UMBILICAL DOOR TOOL	SED39118691-303	1	1	VOLUME D	
EHIP BATTERY PACK ASSY	SEG39130223-302	1	1	MD CEIL G (STBD 1)	
EHIP BATTERY PACK ASSY	SEG39130223-302	2	2	VOLUME H INBOARD	
EHIP BATTERY PACK ASSY	SEG39130223-302	2	2	VOLUME H OUTBOARD	
EMITTANCE WASH APPLICATOR KIT	SJD33116880-301	2	2	MD CEIL E (PORT 1)	
EMU CUFF CHECKLIST BAND	SEB33100302-604	6	6	VOLUME D	
EMU RF CAMERA ASSEMBLY (ERCA)	SED33111710-307	1	0	EXT A/L FLR	
EMU RF CAMERA ASSEMBLY (ERCA)	SED33111710-307	0	1	EXT A/L FLR	s/n 1011
EVA ACCESSORY BAG	10108-10081-01	1	1	VOLUME H OUTBOARD	
EVA ADJUSTABLE WRENCH	V628-650892-005	1	1	VOLUME D	
EVA ADJUSTABLE WRENCH	V628-650892-005	1	1	VOLUME H OUTBOARD	
EVA ADJUSTABLE WRENCH/4-IN RATCHET EXTENSION TOOL CADDY	V632-669200-016	1	1	VOLUME D	
EVA DIGITAL CAMERA MOUNT	SED33113695-302	1	1	CAMERA BAG	
EVA FORCEPS	V628-650877-001	1	1	VOLUME D	
EVA HELMET INTERCHANGEABLE PORTABLE (EHIP) LIGHT	SEG39130226-305	1	1	VOLUME H INBOARD	
EVA HELMET INTERCHANGEABLE PORTABLE (EHIP) LIGHT	SEG39130226-305	1	1	VOLUME H OUTBOARD	
EVA PUNCH TOOL ASSY	SED33118730-301	1	1	MD CEIL E (PORT 1)	
EVA THERMAL SENSOR (W/GOOSE NECK PROBE)	SED33118700-303	1	1	MD CEIL E (PORT 1)	
EVA TRASH BAG	10165-10065-03	2	2	VOLUME D	
EWIS CABLE ASSY	1F15448-1	1	0	EXT A/L FLR	
EWIS HANDRAIL/ANTENNA ASSY	1F15742-1	1	0	EXT A/L FLR	
EWIS HANDRAIL/ANTENNA ASSY	1F15742-501	1	0	EXT A/L FLR	
FILLED CARTRIDGE ASSEMBLY (MANUAL CRACK REPAIR GUN CARTRIDGE KIT)	SED33119444-301	2	2	MA9D	
FLOW SHUT-OFF VALVE ASSEMBLY	SED33119448-301	2	2	MD CEIL E (PORT 1)	

SHUTTLE EVA TOOLS SORTED BY TOOL NAME (Cont)

Item	Part Number	Up	Down	Location	Comments
GEL BRUSH KIT (FULL GEL BRUSH COMPLIMENT)	SJD33117200-301	1	1	MD CEIL E (PORT 1)	
GEL BRUSH KIT (HALF GEL/HALF FOAM BRUSH COMPLIMENT)	SJD33117200-302	1	1	MD CEIL E (PORT 1)	
GENERAL PURPOSE CUTTER	SEG33106915-303	1	1	VOLUME D	
GENERAL PURPOSE TOOL CADDY (GP TOOL CADDY)	SED33104089-301	1	1	VOLUME D	
GENERAL PURPOSE TOOL CADDY (GP TOOL CADDY)	SED33104089-301	1	1	VOLUME H INBOARD	
GENERAL PURPOSE TOOL CADDY (GP TOOL CADDY)	SED33104089-301	1	1	VOLUME H OUTBOARD	
HAMMER	V628-650875-004	1	1	VOLUME D	
HAMMER/CHISEL LONG PROBE TOOL CADDY	V632-669200-017	1	1	VOLUME D	
IVA 6" ADJUSTABLE WRENCH	SED33117898-301	1	1	MD CEIL G (STBD 1)	
LOOP PIN EXTRACTOR PULLER	V628-650998-001	1	1	VOLUME D	
MANUAL CRACK REPAIR GUN W/THERMAL COVER (LAUNCH CONFIG)	SED33119446-301	2	2	MD CEIL E (PORT 1)	
MMWS TOOL STOWAGE CADDY	GD2051000-301	1	1	MD CEIL H (STBD 2)	
MODULAR MINI-WORKSTATION KEY STRAP ASSY	SEG33110812-301	1	1	MD CEIL H (STBD 2)	
MODULAR MINI-WORKSTATION KEY STRAP ASSY	SEG33110812-301	1	0	EXT A/L FLR	s/n 1007
MODULAR MWS BASEPLATE ASSY	SEG33110490-303	2	2	MD CEIL H (STBD 2)	
MODULAR MWS GIMBAL ASSY	SEG33110493-305	2	1	MD CEIL H (STBD 2)	s/n 1031 xfer to ISS
MODULAR MWS GIMBAL ASSY	SEG33110493-305	0	1	MD CEIL H (STBD 2)	s/n 1007
MODULAR MWS RH SWINGARM ASSY	SEG33110491-307	1	1	MD CEIL H (STBD 2)	
MPM RATCHET WRENCH	SDD33102355-001	1	1	VOLUME D	
NEEDLE NOSE PLIERS	SEG33106921-301	1	1	VOLUME D	
ORU TRANSFER BAG (MEDIUM)	SEG33114494-303	0	1	EXT A/L FLR	s/n 1003
PAYLOAD RETENTION DEVICE (PRD)	10163-10063-03	2	2	VOLUME D	
PB ARTICULATING SOCKET	SED33105422-313	1	1	VOLUME D	
PDU DISC/LOOP PIN PULLER TOOL CADDY	V632-669200-013	1	1	VOLUME D	
PDU DISCONNECT TOOL	V628-651001-001	1	1	VOLUME D	
PFR ATTACHMENT DEVICE (PAD-UNPAINTED)	10159-10053-02	1	1	VOLUME D	
PROBE	V628-650879-005	1	1	VOLUME D	
PRY BAR	V628-650990-006	1	1	VOLUME D	
PRYBAR/EVA FORCEPS TOOL CADDY	V632-669200-014	1	1	VOLUME D	

SHUTTLE EVA TOOLS SORTED BY TOOL NAME (Cont)

Item	Part Number	Up	Down	Location	Comments
RADIATOR EXTENSION/DRIVE RATCHET TOOL CADDY	V632-669200-015	1	1	VOLUME D	
RCC CRM SCRAPER, 2-IN STIFF (2" SCRAPER)	SED33118187-301	4	4	MD CEIL E (PORT 1)	
RCC CRM SCRAPER, 5-IN WIDE (5" SCRAPER)	SED33118187-302	2	2	MD CEIL E (PORT 1)	
REBA	SEG33112213-301	1	1	MD CEIL H (STBD 2)	
RETRACTABLE EQUIPMENT TETHER (EQ-EQ W/SLIDE LOCK)	SEG33106164-381	8	11	MD CEIL E (PORT 1)	
RETRACTABLE EQUIPMENT TETHER (EQ-EQ W/SLIDE LOCK)	SEG33106164-381	2	2	MD CEIL G (STBD 1)	
RETRACTABLE EQUIPMENT TETHER (EQ-EQ W/SLIDE LOCK)	SEG33106164-381	0	1	MD CEIL E (PORT 1)	s/n 4073
RETRACTABLE EQUIPMENT TETHER (LG-EQ W/SLIDE LOCK)	SEG33106164-385	0	1	MD CEIL E (PORT 1)	s/n 4257
RMS SHOULDER BRACE RELEASE HAND TOOL	71140E271-3	1	1	VOLUME D	
RULER AND PROTUBERANCE GAUGE	SED33118222-001	1	1	MD CEIL E (PORT 1)	
SGANT AGIT KU BAND ANTENNA HEAT SHIELD	SEG33119869-301	1	0	EXT A/L FLR	
SNATCH BLOCK	SED33102357-305	2	2	VOLUME D	
SSU SHUNT PLUG ADAPTER ASSY	1F15798-1	1	0	EXT A/L FLR	
SSU SHUNT PLUG ASSY	1F15797-1	2	0	EXT A/L FLR	
TETHER RING EXTENDER	SED33105382-309	2	2	MD CEIL E (PORT 1)	
TETHER, WAIST (W/SLIDE LOCK)	SEG33106943-305	4	4	MD CEIL G (STBD 1)	
THERMAL BLANKET, EVA CAMERA MOUNTING ASSY	SED33117417-301	1	1	CAMERA BAG	
TILE REPAIR ABLATOR DISPENSER (TRAD)	SGD39137698-401	1	1	ML60J (8943-301)	
TRASH BAG, LARGE	SEG33106937-301	1	1	MD CEIL E (PORT 1)	
TUBE CUTTER	SED33101368-303	1	1	VOLUME D	
VELCRO/TAPE CADDY	SED33104207-301	1	1	VOLUME D	
WISE GRIP PLIERS	V628-650876-001	1	1	VOLUME D	
VOLUME H CONTAINER ASSY, INBOARD	V669-000947-037	1	1	VOLUME H (8068-306)	
VOLUME H CONTAINER ASSY, OUTBOARD	V669-000947-038	1	1	VOLUME H (8065-306)	
WINCH HOOK ADAPTER (RMS ROPE REEL)	SED33102348-307	1	1	VOLUME D	
WIPE, EVA	SED33116397-703	5	5	MD CEIL E (PORT 1)	
WIRE TIE	SDG33108130-001	42	0	EXT A/L FLR	does not incl 3 wire ties on EWIS cable

SHUTTLE EVA TOOLS SORTED BY LOCATION

Item	Part Number	Up	Down	Location	Comments
EVA DIGITAL CAMERA MOUNT	SED33113695-302	1	1	CAMERA BAG	
THERMAL BLANKET, EVA CAMERA MOUNTING ASSY	SED33117417-301	1	1	CAMERA BAG	
BGA BOLT RETAINER ASSY	1F15786-1	8	0	EXT A/L FLR	
EMU RF CAMERA ASSEMBLY (ERCA)	SED33111710-307	1	0	EXT A/L FLR	s/n 1007
EMU RF CAMERA ASSEMBLY (ERCA)	SED33111710-307	0	1	EXT A/L FLR	s/n 1011
EWIS CABLE ASSY	1F15448-1	1	0	EXT A/L FLR	
EWIS HANDRAIL/ANTENNA ASSY	1F15742-1	1	0	EXT A/L FLR	
EWIS HANDRAIL/ANTENNA ASSY	1F15742-501	1	0	EXT A/L FLR	
MODULAR MINI-WORKSTATION KEY STRAP ASSY	SEG33110812-301	1	0	EXT A/L FLR	s/n 1007
ORU TRANSFER BAG (MEDIUM)	SEG33114494-303	0	1	EXT A/L FLR	s/n 1003
SGANT AGIT KU BAND ANTENNA HEAT SHIELD	SEG33119869-301	1	0	EXT A/L FLR	
SSU SHUNT PLUG ADAPTER ASSY	1F15798-1	1	0	EXT A/L FLR	
SSU SHUNT PLUG ASSY	1F15797-1	2	0	EXT A/L FLR	
FILLED CARTRIDGE ASSEMBLY (MANUAL CRACK REPAIR GUN CARTRIDGE KIT)	SED33119444-301	2	2	MA9D	
3/8-IN DRIVE RATCHET	V628-650881-004	1	1	MD CEIL E (PORT 1)	
5/32-IN SHORT BALL END ALLEN DRIVER	SEG33108851-303	1	1	MD CEIL E (PORT 1)	
85 FT SAFETY TETHER	SED33116109-301	0	1	MD CEIL E (PORT 1)	s/n 1002
85 FT SAFETY TETHER	SED33116109-307	2	1	MD CEIL E (PORT 1)	s/n 1008 xfer to ISS
ADJUSTABLE EQUIPMENT TETHER (EQ-EQ W/SLIDE LOCK)	SEG33106945-307	3	3	MD CEIL E (PORT 1)	
ADJUSTABLE FUSE TETHERS	SED39127200	0	2	MD CEIL E (PORT 1)	
BODY RESTRAINT TETHER (BRT)	SEG33110400-305	1	0	MD CEIL E (PORT 1)	s/n 1003
BODY RESTRAINT TETHER (BRT)	SEG33110400-305	0	1	MD CEIL E (PORT 1)	s/n 1002
CRACK REPAIR PALETTE ASSY	SED33118670-301	2	2	MD CEIL E (PORT 1)	
EMITTANCE WASH APPLICATOR KIT	SJD33116880-301	2	2	MD CEIL E (PORT 1)	
EVA PUNCH TOOL ASSY	SED33118730-301	1	1	MD CEIL E (PORT 1)	
EVA THERMAL SENSOR (W/GOOSE NECK PROBE)	SED33118700-303	1	1	MD CEIL E (PORT 1)	
FLOW SHUT-OFF VALVE ASSEMBLY	SED33119448-301	2	2	MD CEIL E (PORT 1)	
GEL BRUSH KIT (FULL GEL BRUSH COMPLIMENT)	SJD33117200-301	1	1	MD CEIL E (PORT 1)	

SHUTTLE EVA TOOLS SORTED BY LOCATION (Cont)

Item	Part Number	Up	Down	Location	Comments
GEL BRUSH KIT (HALF GEL/HALF FOAM BRUSH COMPLIMENT)	SJD33117200-302	1	1	MD CEIL E (PORT 1)	
MANUAL CRACK REPAIR GUN W/THERMAL COVER (LAUNCH CONFIG)	SED33119446-301	2	2	MD CEIL E (PORT 1)	
RCC CRM SCRAPER, 2-IN STIFF (2" SCRAPER)	SED33118187-301	4	4	MD CEIL E (PORT 1)	
RCC CRM SCRAPER, 5-IN WIDE (5" SCRAPER)	SED33118187-302	2	2	MD CEIL E (PORT 1)	
RETRACTABLE EQUIPMENT TETHER (EQ-EQ W/SLIDE LOCK)	SEG33106164-381	8	11	MD CEIL E (PORT 1)	
RETRACTABLE EQUIPMENT TETHER (EQ-EQ W/SLIDE LOCK)	SEG33106164-381	0	1	MD CEIL E (PORT 1)	s/n 4073
RETRACTABLE EQUIPMENT TETHER (LG-EQ W/SLIDE LOCK)	SEG33106164-385	0	1	MD CEIL E (PORT 1)	s/n 4257
RULER AND PROTUBERANCE GAUGE	SED33118222-001	1	1	MD CEIL E (PORT 1)	
TRASH BAG, LARGE	SEG33106937-301	1	1	MD CEIL E (PORT 1)	
WIPE, EVA	SED33116397-703	5	5	MD CEIL E (PORT 1)	
CRACK REPAIR BAG	SED33118750-301	1	1	MD CEIL F (PORT 2)	
ADJUSTABLE FUSE TETHER (EQ HKS W/SLIDE LOCK)	SED39127200-705	2	2	MD CEIL G (STBD 1)	
BATTERY ASSY, NI – METAL HYDRIDE PGT	SEG33110979-305	2	2	MD CEIL G (STBD 1)	
EHIP BATTERY PACK ASSY	SEG39130223-302	1	1	MD CEIL G (STBD 1)	
IVA 6" ADJUSTABLE WRENCH	SED33117898-301	1	1	MD CEIL G (STBD 1)	
RETRACTABLE EQUIPMENT TETHER (EQ-EQ W/SLIDE LOCK)	SEG33106164-381	2	2	MD CEIL G (STBD 1)	
TETHER, WAIST (W/SLIDE LOCK)	SEG33106943-305	4	4	MD CEIL G (STBD 1)	
ADJUSTABLE EQUIPMENT TETHER (EQ-EQ W/SLIDE LOCK)	SEG33106945-307	2	2	MD CEIL H (STBD 2)	
ADJUSTABLE FUSE TETHER	SED39127200-701	1	1	MD CEIL H (STBD 2)	
MMWS TOOL STOWAGE CADDY	GD2051000-301	1	1	MD CEIL H (STBD 2)	
MODULAR MINI-WORKSTATION KEY STRAP ASSY	SEG33110812-301	1	1	MD CEIL H (STBD 2)	
MODULAR MWS BASEPLATE ASSY	SEG33110490-303	2	2	MD CEIL H (STBD 2)	
MODULAR MWS GIMBAL ASSY	SEG33110493-305	2	1	MD CEIL H (STBD 2)	s/n 1031 xfer to ISS
MODULAR MWS GIMBAL ASSY	SEG33110493-305	0	1	MD CEIL H (STBD 2)	s/n 1007
MODULAR MWS RH SWINGARM ASSY	SEG33110491-307	1	1	MD CEIL H (STBD 2)	
REBA	SEG33112213-301	1	1	MD CEIL H (STBD 2)	
CIPAA CONTAINMENT BAG ASSY	SED33117980-701	1	1	ML60J (8943-301)	
CIPAA SACK ASSY (TRAD SACK)	SED33119106-309	2	2	ML60J (8943-301)	

SHUTTLE EVA TOOLS SORTED BY LOCATION (Cont)

Item	Part Number	Up	Down	Location	Comments
TILE REPAIR ABLATOR DISPENSER (TRAD)	SGD39137698-401	1	1	ML60J (8943-301)	
TETHER RING EXTENDER	SED33105382-309	2	2	MD CEIL E (PORT 1)	
WIRE TIE	SDG33108130-001	42	0	EXT A/L FLR	does not incl 3 wire ties on EWIS cable
1/2-IN BOX RATCHET TOOL CADDY	V632-669200-022	1	1	VOLUME D	
1/2-IN BOX SOCKET WRENCH	V628-650885-004	1	1	VOLUME D	
1/4-IN HEX, RADIATOR EXTENSION	V628-650896-004	1	1	VOLUME D	
3 POINT LATCH TOOL	SED33101327-313	2	2	VOLUME D	
3 POINT LATCH TOOL STOWAGE BAG	V633-669300-033	1	1	VOLUME D	
3/8-IN RATCHET, 4-IN EXTENSION, 7/16-IN SOCKET	V628-650860-003	1	1	VOLUME D	
ADJUSTABLE EQUIPMENT TETHER (SM-SM)	SED33104175-301	2	2	VOLUME D	
ADJUSTABLE THERMAL MITTEN	0106-811540-03	2	2	VOLUME D	
ADJUSTABLE THERMAL MITTEN	0106-811540-04	2	2	VOLUME D	
BOLT PULLER	V628-650880-009	1	1	VOLUME D	
BOLT PULLER/WISE GRIP PLIERS TOOL CADDY	V632-669200-018	1	1	VOLUME D	
CENTERLINE LATCH TOOL	SED33101621-307	2	2	VOLUME D	
CENTERLINE LATCH TOOL BAG	V633-669310-037	1	1	VOLUME D	
COMPOUND CUTTER (SMALLCUTTER)	SED33104404-305	1	1	VOLUME D	
COMPOUND CUTTER/NEEDLE NOSE PLIERS TOOL CADDY	V632-669200-025	1	1	VOLUME D	
E.T. UMBILICAL DOOR TOOL	SED39118691-303	1	1	VOLUME D	
EMU CUFF CHECKLIST BAND	SEB33100302-604	6	6	VOLUME D	
EVA ADJUSTABLE WRENCH	V628-650892-005	1	1	VOLUME D	
EVA ADJUSTABLE WRENCH/4-IN RATCHET EXTENSION TOOL CADDY	V632-669200-016	1	1	VOLUME D	
EVA FORCEPS	V628-650877-001	1	1	VOLUME D	
EVA TRASH BAG	10165-10065-03	2	2	VOLUME D	
GENERAL PURPOSE CUTTER	SEG33106915-303	1	1	VOLUME D	
GENERAL PURPOSE TOOL CADDY (GP TOOL CADDY)	SED33104089-301	1	1	VOLUME D	
HAMMER	V628-650875-004	1	1	VOLUME D	
HAMMER/CHISEL LONG PROBE TOOL CADDY	V632-669200-017	1	1	VOLUME D	

SHUTTLE EVA TOOLS SORTED BY LOCATION (Cont)

Item	Part Number	Up	Down	Location	Comments
LOOP PIN EXTRACTOR PULLER	V628-650998-001	1	1	VOLUME D	
MPM RATCHET WRENCH	SDD33102355-001	1	1	VOLUME D	
NEEDLE NOSE PLIERS	SEG33106921-301	1	1	VOLUME D	
PAYLOAD RETENTION DEVICE (PRD)	10163-10063-03	2	2	VOLUME D	
PB ARTICULATING SOCKET	SED33105422-313	1	1	VOLUME D	
PDU DISC/LOOP PIN PULLER TOOL CADDY	V632-669200-013	1	1	VOLUME D	
PDU DISCONNECT TOOL	V628-651001-001	1	1	VOLUME D	
PFR ATTACHMENT DEVICE (PAD-UNPAINTED)	10159-10053-02	1	1	VOLUME D	
PROBE	V628-650879-005	1	1	VOLUME D	
PRY BAR	V628-650990-006	1	1	VOLUME D	
PRYBAR/EVA FORCEPS TOOL CADDY	V632-669200-014	1	1	VOLUME D	
RADIATOR EXTENSION/DRIVE RATCHET TOOL CADDY	V632-669200-015	1	1	VOLUME D	
RMS SHOULDER BRACE RELEASE HAND TOOL	71140E271-3	1	1	VOLUME D	
SNATCH BLOCK	SED33102357-305	2	2	VOLUME D	
TUBE CUTTER	SED33101368-303	1	1	VOLUME D	
VELCRO/TAPE CADDY	SED33104207-301	1	1	VOLUME D	
WISE GRIP PLIERS	V628-650876-001	1	1	VOLUME D	
WINCH HOOK ADAPTER (RMS ROPE REEL)	SED33102348-307	1	1	VOLUME D	
VOLUME H CONTAINER ASSY, OUTBOARD	V669-000947-038	1	1	VOLUME H (8065-306)	
VOLUME H CONTAINER ASSY, INBOARD	V669-000947-037	1	1	VOLUME H (8068-306)	
EHIP BATTERY PACK ASSY	SEG39130223-302	2	2	VOLUME H INBOARD	
EVA HELMET INTERCHANGEABLE PORTABLE (EHIP) LIGHT	SEG39130226-305	1	1	VOLUME H INBOARD	
GENERAL PURPOSE TOOL CADDY (GP TOOL CADDY)	SED33104089-301	1	1	VOLUME H INBOARD	
3/8-IN RATCHET WITH 7/16-IN SOCKET	V628-650860-001	1	1	VOLUME H OUTBOARD	
EHIP BATTERY PACK ASSY	SEG39130223-302	2	2	VOLUME H OUTBOARD	
EVA ACCESSORY BAG	10108-10081-01	1	1	VOLUME H OUTBOARD	
EVA ADJUSTABLE WRENCH	V628-650892-005	1	1	VOLUME H OUTBOARD	
EVA HELMET INTERCHANGEABLE PORTABLE (EHIP) LIGHT	SEG39130226-305	1	1	VOLUME H OUTBOARD	
GENERAL PURPOSE TOOL CADDY (GP TOOL CADDY)	SED33104089-301	1	1	VOLUME H OUTBOARD	

EMU MAINT/RECHARGE

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EMU POWERUP.....	TEMP FS	10-2
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WATER RECHARGE

IF EMU NOT ALREADY POWERED UP:

EMU POWERUP

- BOTH DCM 1. Retrieve, position SCUs; remove DCM covers
 2. Connect SCUs to DCM, √locked
 3. PWR – BATT

CAUTION

EMU must be on BATT pwr when
 airlock pwr supply is turned on

- AW18H 4. PWR/BATT CHGR EMU 1,2 MODE (two) – PWR
 BUS SEL (two) – MNA(MNB)
 MD(flir) 5. √EMU O2 ISOL VLV – OP
 AW82B 6. EV1,2 O2 vlv (two) – OP
 DCM 7. PWR – SCU

WATER FILL

- MO13Q 8. √ARLK H2O S/O VLV – OPEN (tb-OP)
 R11L 9. √SPLY H2O TKA OUTLET – CL (tb-CL)

SM 60 TABLE MAINT

- CRT 10. Use TKB quantity:
 PARAM ID – ITEM 1 +0 6 2 0 4 2 0 EXEC
 11. Log value before recharge

Recharge #	H2O TKB %
1	
2	
3	
4	
5	

- AW82D 12. √EMU 1,2 H2O WASTE tb (two) – CL
 SPLY (two) – OP (tb-OP)
 13. √H2O TKB quantity decreasing

NOTE

Full charge requires ~15 min

WATER FILL VERIFICATION

- DCM 14. √STATUS: H2O WP 8-15 psi and stable for ~30 sec (indicates charging complete)

SM 60 TABLE MAINT

- CRT 15. Use TKB quantity:
 PARAM ID – ITEM 1 +0 6 2 0 4 2 0 EXEC
 16. Log value after recharge

Recharge #	H2O TKB %
1	
2	
3	
4	
5	

EMU MAINT/
 RECHARGE

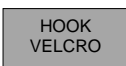
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TEMP FS 10-2

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EVA/ALL/FIN C

TOP



12A EMU/AIRLOCK CONSUMABLES CUE CARD

SAFERs Usage: SAFER sn 1005 & 1003 prime – NOTE: SAFER sn 1007 has failed latch; prime latches to be taped						
Consumable	LiOH/Metox (Sn or barcode)	EMU Battery (Sn or barcode)	HL Battery (Sn)	PGT Battery (Sn)	REBA (Sn)	PWR (Sn)
Activity						
EVA 1	007794J (Mtx) in EMU1 Sn 012 (Mtx) in EMU2 007792J (Mtx) for campout 007802J (Mtx) for campout	Sn 2031 in EMU1 (launched) Sn 2036 in EMU2 (launched)	1011, 1012 in EMU1 1013, 1014 in EMU2	5015, 5014 in prime PGTs 5013 in C-1k Staging Bag	1003 in EMU1 1005 in EMU2	NOTE: Use CWC Sn 1026 for ullage dumps during all EMU H2O recharges
If not Back-to-Back EVAs	Regen #0 007792J, 007802J (Post EVA 1)	Recharge on PSA during EVA 2 (below)	Recharge EVA 1 Batts (above) in BSA	Recharge EVA 1 Batts in BSA	Recharge EVA 1 Batts on BSA	EMU1,2 Recharge deferred to FD 6
EVA 2	Sn 2002 (LiOH) in EMU3 Sn 2003 (LiOH) in EMU4 007686J (Mtx) for campout 007796J (Mtx) for campout	Sn 2059 in EMU3 Sn 2060 in EMU4 Charge on ISS EMU Charger (PSA) Sn 2031, Sn 2036	1015, 1017 in EMU3 1019, 1021 in EMU4	5011, 5012 in prime PGTs 5017, 5018 in ORU Bag 5013 in C-1k Staging Bag	1011 in EMU3 1004 in EMU4	(Post EVA2) EMU 3, 4 with 1005 If reqd, also use 1011 IRU QTY (lbs): (if reqd) ----- lbs 2nd PWR: _____ lbs
Post EVA 2 + Flight Day 6	(Post EVA 2) Regen #1 007686J, 007796J		(Post EVA 2) Recharge in BSA <See reverse for serial #s & slot assignments>	(Post EVA2) Recharge in BSA <See reverse for serial #s & slot assignments>	(Post EVA 2) Recharge on BSA <See reverse for serial #s & slot assignments>	(FD 6) EMU 1, 2 with 1005 If reqd, also use 1011 IRU QTY (lbs): (if reqd) _____ lbs 2nd PWR: _____ lbs
EVA 3	007811J (Mtx) in EMU1 007795J (Mtx) in EMU2 007807J (Mtx) for campout 007814J (Mtx) for campout	Sn 2057 in EMU1 Sn 2058 in EMU2	1015, 1017 in EMU1 1019, 1021 in EMU2	5015, 5014 in prime PGTs 5013 in C-1k Staging Bag	1003 in EMU1 1005 in EMU2	
Post EVA 3	Regen #2 007807J, 007814J		Recharge in BSA <See reverse for serial #s & slot assignments>	Recharge in BSA <See reverse for serial #s & slot assignments>	If EVA 4 is reqd and Back-to-Back, REBA recharge is not possible; chrgd spare (1) Middeck	EMU 1, 2 with 1011 If reqd, also use 1012 IRU QTY (lbs): (if reqd) _____ lbs 2nd PWR: _____ lbs
If contingency EVA 4	007686J in EMU____ 007796J in EMU____ 007792J for campout 007802J for campout	Sn 2031 in EMU____ Sn 2036 in EMU____	1011, 1012 in EMU____ 1013, 1014 in EMU____	5011 in PGT1 5012 in PGT2 5013 in C-1k Staging Bag	____ in EMU____ ____ in EMU____	EMU Water Recharge per MCC-H direction
Pre-Undock Notes: (per Nominal Timeline)	(4) Metox Canisters are left fully regenerated; (6) spent ISS EMUs left w/spent Metox installed; STS EMUs return w/spent EVA 2 LiOH	(4) partial chrg on ISS (2) EVA 1 batts (up/down) return in STS EMUs charged (1) STS spare up/dn	Xfer chrgd back to ISS (4) left chrgd on ISS; (4) left partial chrg (1) IR Camera up/down (4) STS contig up/down	(4) left chrgd on ISS; 5th potentially only partial chrg (2) shuttle spares up/down	(2) Fully Charged in ISS EMUs (2) ISS stowed (1) Spare Middeck up/down	(4) filled while docked

EVA-4a/115/O/B

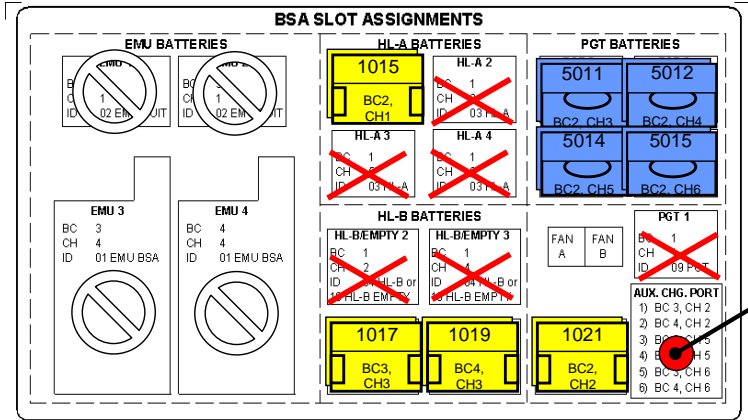
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HOOK
VELCRO

12A BSA BATTERY RECHARGE SLOT ASSIGNMENTS CUE CARD

POST EVA 2

KEY: = No Battery Installed = BC1 Slots (Failed) = On MCC-H GO



Cable:
"FROM BC3
TO REBA1"

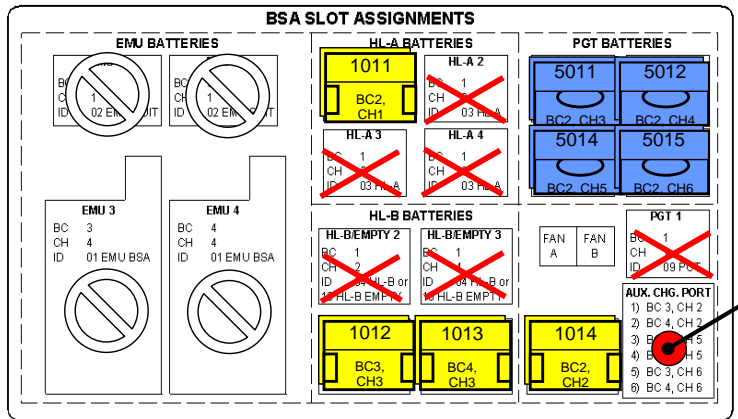
Recharge in
EMUs 1 & 2

1003

1004

Cable:
"FROM BC4
TO REBA2"

POST EVA 3



On MCC-H GO:

Cable:
"FROM BC3
TO REBA1"

Recharge in
EMUs 3 & 4

1011

1005

Cable:
"FROM BC4
TO REBA2"

EVA-4b/115/O/B

(reduced copy)

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EMU CONT
PROCS

DISPLAY LOSS DURING POWER TRANSFER (WARM RESTART)

- DCM If PWR – BATT and SCU connected:
 AW18H 1. √PWR/BATT CHGR EMU 1(2) BUS SEL – OFF
 DCM If PWR – SCU:
 2. PWR – BATT
 AW18H 3. PWR/BATT CHGR EMU 1(2) BUS SEL – OFF

WARNING

Fan will be off from steps 4 to 9 during which time CO2 buildup is a concern

NOTE

Affected EMU will be without comm after step 6. Steps 6 and 7 should be read together before step 6 is performed

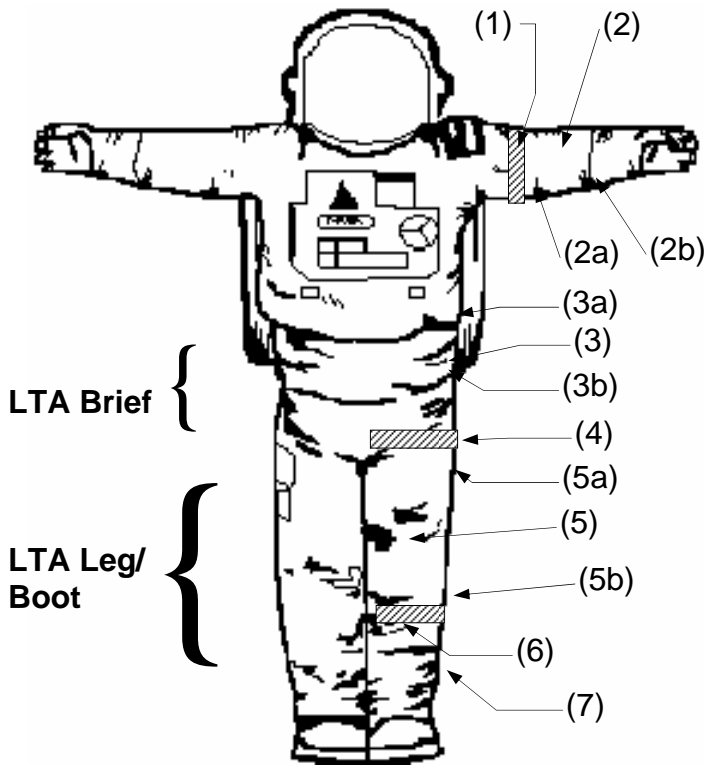
- DCM 4. FAN – OFF (expect **FAN SW OFF** msg, DISP – PRO)
 IV 5. Inform affected EV crewmember of impending comm loss
 DCM 6. PWR – SCU (7 sec)
 7. PWR – BATT
 When power restart complete:
 8. √Display – **O2 POS XX**, expect **FAN SW OFF** msg, DISP – PRO
 9. As reqd, FAN – ON
 If display blank or locked up:
 10. Contact MCC
 If SCU power desired:
 11. √SCU connected to DCM
 AW18H 12. PWR/BATT CHGR EMU 1(2) MODE – PWR
 BUS SEL – MNA(MNB)
 13. √EMU INPUT 1(2) Volts = 18.0 – 20.0
 DCM 14. PWR – SCU
 DCM 15. √Display – **O2 POS XX**

VACUUM H2O RECHARGE (MANNED)**WARNING**

Procedure should be used only if performing a contingency EVA

- EV 1. Perform AIRLOCK INGRESS, Cuff C/L, 30 (Close hatch, partially engage latches)
 2. √Helmet purge vlv – cl, locked
 DCM 3. √PURGE vlv – cl (dn)
 4. √WATER – OFF
 IV MO13Q 5. √ARLK H2O S/O VLV – OPEN (tb-OP)
 MD(flr) 6. √EMU O2 ISOL VLV – OP
 ML86B:C 7. √cb MNC EXT ARLK HTR LINE ZN 1,2 (two) – op
 AW82B 8. √EV-1(EV-2) O2 vlv – OP
 EV AW18H 9. PWR/BATT CHGR EMU 1(2) BUS SEL – MNA(MNB)
 DCM 10. PWR – SCU (fwd), WARN TONE
 IV R11L If SPLY H2O XOVR VLV closed (tb-CL or bp) (water transfer config):
 11. SPLY H2O TKA OUTLET – CL (tb-CL)
 If SPLY H2O XOVR VLV open (tb-OP) (nominal config):
 L1 12. √RAD CNTLR OUT TEMP – NORM
 13. √FLASH EVAP CNTLR PRI A,B (two) – OFF
 ML31C 14. SPLY H2O TKD OUTLET – CL (tb-CL)
 R11L 15. SPLY H2O TKB OUTLET – CL (tb-CL)
 √TKA OUTLET – CL (tb-CL)
 TKC INLET – CL (tb-CL)
 TKC OUTLET – OP (tb-OP)

EMU NOMINAL SIZING (STS-115/12A)



EMU SIZE MATRIX (STS-115/12A)

SEMU	(1) Arm Sizing Ring	(2a) Arm Cam	(2) Lower Arm	(2b) Wrist Cam	HUT (All ORU)
Tanner (3004 / L)	0.5	Long	04	Long	03
Piper (3017 / M)	0.5	Short	03	Long	02
Burbank (3008 / XL)	--	Short	04	Long	04
MacLean (3006 / L)	--	Short	04	Long	03
Piper – Backup (L)	--	Short	03	Long	03
Burbank – Backup (L)	0.5	Short	04	Short	03

LTA	(3a) Brief Upper Cam	(3) Adjust. Waist Brief	(3b) Brief Lower Cam	(4) Thigh Sizing Ring	(5a) Thigh Cam	(5) Leg Segment	(5b) Leg Cam	(6) Leg Sizing Ring	(7) Boot/Insert-Type
Tanner	Short	02	Long	--	Short	03	Long	1.5	02 / TS 07
Piper	Short	01	Long	--	Short	03	Long	1.5	01 / TS 04
Burbank	Short	01	Short	--	Short	04	Long	0.5	02 / TS 07
MacLean	Short	02	Long	--	Short	02	Long	0.5	02 / TS 07

Misc	LCVG/BLVD	TCU top/ bottom/MAG	Prime Gloves/SN	BU Glove/SN	New EEH	CCA/CCEM
Tanner	06 / 07	L / L / 711	6TA / 6044	6TA /6043	YES	03 / 327
Piper	03 / 04	M / M / 709	6PP / 6178	6PP /6177	YES	02 / 321
Burbank	05 / 07	XL / L / 709	6BB / 6210	6BB /6219	YES	04 / 327
MacLean	05 / 05	L / M / 711	6MN / 6184	6MN/6183	YES	04 / 327

12A EMU CONTINGENCY RESIZE MATRIX

FOR LOSS OF:	EV1 – Tanner				EV2 – Piper				EV3 – Burbank				EV4 – MacLean			
HUT/PLSS	(3004, Large) On EMU3015, REI Large 1. Verify Arm sizing ring installed 2. Remove glove/arm assys from rings 3. Use TA gloves/arms 4. √Arm red disconnect to right, √locks, √cams 5. Use primary LTA 6. Swap EMU PLSS identifier stripes, national flag				(3017, Medium) On EMU3015, REI Large 1. Remove ring/glove/arm assys 2. Use PP gloves/arms 3. √ No Arm sizing rings 4. √Arm red disconnect to right, √locks, √cams 5. Use primary LTA 6. Swap EMU PLSS identifier stripes, national flag				(3008, XLarge) On EMU3015, REI Large 1. Verify Arm sizing ring installed 2. Remove glove/arm assys from rings 3. Use BB gloves/arms 4. √Arm red disconnect to right, √locks 5. Adjust cams (bolded below) 6. Use primary LTA 7. Swap EMU PLSS identifier stripes, national flag				(3006, Large) On EMU3015, REI Large 1. Remove ring/glove/arm assys from EMU3015 2. Use MN gloves/arms 3. √Arm red disconnect to right, √locks, √cams 4. Use primary LTA 5. Swap EMU PLSS identifier stripes, national flag			
Arm cams:	2a-L	2b-L	2a-S	2b-L	2a-S	2b-L	2a-S	2b-S	2a-S	2b-L	2a-S	2b-L	2a-S	2b-L		
Waist Brief	(Sn 2050, 02 S-L) 1. Use MN 02 waist brief (√cams) 2. Use Ta prime 03 legs, 1.5-in leg rings, and 02 boots 3. Swap EMU brief identifier stripes 4. Verify locks				(Sn 2084, 01 S-L) 1. Use WI 01 waist brief Sn 018 (√cams) 2. Use Pp prime 03 legs, 1.5-in leg rings, and 01 boots 3. Swap EMU brief identifier stripes 4. Verify locks				(Sn 2053, 01 S-L) 1. Use WI 01 waist brief Sn 018 (√cams) 2. Use Bb prime 04 legs, 0.5-in leg rings, and 02 boots 3. Swap EMU identifier stripes 4. Verify locks				(Sn 2056, 02 S-L) 1. Use TA 02 waist brief (√cams) 2. Use Mn prime 02 legs, 0.5-in leg rings, and 02 boots 3. Swap EMU identifier stripes 4. Verify locks			
	3a-S	3b-L	5a-S	5b-L	3a-S	3b-L	5a-S	5b-L	3a-S	3b-L	5a-S	5b-L	3a-S	3b-L	5a-S	5b-L
Gloves	(6TA) Use backup (Middeck)				(6PP) Use backup (Middeck)				(6BB) Use backup (Middeck)				(6MN) Use backup (Middeck)			
LCVG	(06, 07-Therm Slipper) 1. Use Bb prime LCVG 2. Transfer biomed, dosimeter				(03, 04-Therm Slipper) 1. Use Pp backup LCVG 2. Transfer biomed, dosimeter				(05, 07-Therm slipper) 1. Use Ta prime LCVG 2. Transfer biomed, dosimeter				(05, 07-Therm slipper) 1. Use La prime LCVG (Sn 3034) 2. Transfer biomed, dosimeter			
CCA	(03/317) Use Sn 1177 (03/317 – Sellers' b/u)				(02/311) Use Sn 1176 (Reiter's prime)				(04/317) Use Sn 1198 (04/327 – Fossom's b/u)				(03/311) Use Sn 1198 (04/327 – Fossom's b/u)			
Lower Arm Segment	(04) 1. Use BB 04 arm (√red disconnect = right, blue = left) 2. Verify locks, cams				(03) 1. Use REI 03 arm Sn 141 or 142 (√red = right, blue = left) 2. Verify locks, cams				(04) 1. Use TA 04 arm (√red disconnect = right, blue = left) 2. Configure cams (bolded below) 3. Verify locks				(04) 1. Use TA 04 arm (√red disconnect = right, blue = left) 2. Configure cams (bolded below) 3. Verify locks			
	2a-L	2b-L	2a-S	2b-L	2a-S	2b-L	2a-S	2b-L	2a-S	2b-L	2a-S	2b-L	2a-S	2b-L		
Leg Segment	(03) 1. Use REI 03 leg Sn 173 or Sn 174 2. Verify locks, cams				(03) 1. Use REI 03 leg Sn 173 or Sn 174 2. Verify locks, cams				(04) 1. Use BB spare 04 leg segment (Middeck) 2. Verify locks, cams				(02) 1. Use MN spare 02 leg segment (Middeck) 2. Verify locks, cams			
	5a-S	5b-L	5a-S	5b-L	5a-S	5b-L	5a-S	5b-L	5a-S	5b-L	5a-S	5b-L	5a-S	5b-L		
Boot	(02) 1. Use REI 02 boot Sn 214 2. Remove BSI				(01) Use PP spare Sn 222 (on ISS; STS-121 xfer)				(02) 1. Use REI 02 boot Sn 214 2. Remove BSI				(02) 1. Use REI 02 boot Sn 214 2. Remove BSI			
Sizing Rings	<ul style="list-style-type: none"> ▪ <u>0.5 Arm</u>: Use REI's ring Sn 138 or 139 ▪ <u>1.5 Leg</u>: Use REI's ring Sn 141 or 142 				<ul style="list-style-type: none"> ▪ <u>0.5 Arm</u>: Use REI's ring Sn 138 or 139 ▪ <u>1.5 Leg</u>: Use REI's ring Sn 141 or 142 				<ul style="list-style-type: none"> ▪ 0.5 Leg: Use up-down spare (Middeck) 				<ul style="list-style-type: none"> ▪ 0.5 Leg: Use up-down spare (Middeck) 			

TPS REPAIR

I

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BOOM POINT INSPECTION SUMMARY TIMELINE

PET TIME (HR : MIN)	IV/SRMS	EV1 (BOOM)	EV2
00:00		POST DEPRESS AND A/L EGRESS (00:15)	POST DEPRESS AND A/L EGRESS (00:15)
		EVA SETUP (00:30) <ul style="list-style-type: none"> Translate to Lab/PMA2; perform safety tether swap (00:20) 	EVA SETUP (00:30) <ul style="list-style-type: none"> Retrieve ingress aid w/APFR from CETA cart; stow on BRT (00:10) Translate to Lab/PMA2; perform safety tether swap
01:00	IV: Give GO to reposition SRMS/Boom SRMS: Mnv to EE INGRESS posn (EE tip to sill)	BOOM SETUP AND INGRESS (01:00) <ul style="list-style-type: none"> Translate to SRMS EE (Orbiter port/aft sill) (00:10) Perform safety tether swap onto EE with 85' tether Install PAD and APFR (00:20) Tool setup (00:15) Boom Tip/APFR ingress (00:15) 	BOOM SETUP AND INGRESS (01:00) <ul style="list-style-type: none"> Translate to SRMS EE (Orbiter port/aft sill) (00:10) Install PAD and APFR Tool setup
02:00			
	SRMS: TPS DAMAGE 1 posn	POINT INSPECTION (02:30) <ul style="list-style-type: none"> Mnv to TPS Damage 1 (00:20) Perform Photogrammetry steps (00:15) If reqd, GCA in and perform IR video (RCC only) (00:15) 	POINT INSPECTION (02:30) <ul style="list-style-type: none"> Assist EV1 as capable from Orbiter sill
03:00	SRMS: TPS DAMAGE 2 posn	<ul style="list-style-type: none"> Mnv to TPS Damage 1 (00:20) Perform Photogrammetry steps (00:15) If reqd, GCA in and perform IR video (RCC only) (00:15) 	
04:00	SRMS: TPS DAMAGE 3 posn	<ul style="list-style-type: none"> Mnv to TPS Damage 1 (00:20) Perform Photogrammetry steps (00:15) If reqd, GCA in and perform IR video (RCC only) (00:15) 	
	SRMS: Boom tip EGRESS posn	BOOM EGRESS AND CLEANUP (01:00) <ul style="list-style-type: none"> Mnv to sill for egress (00:20) Egress APFR and remove APFR/PAD (00:20) Tether swap onto PMA tether, retrieve 85' tether (00:10) Tool cleanup (00:10) 	BOOM EGRESS AND CLEANUP (01:00) <ul style="list-style-type: none"> Assist EV1 Assist EV1
05:00	IV: Give GO to reposition SRMS/Boom SRMS: Mnv to SRMS EE tether removal posn (Boom tip to sill)		
		EVA CLEANUP (00:30) <ul style="list-style-type: none"> Translate to Lab/PMA2, tether swap (00:20) 	EVA CLEANUP (00:30) <ul style="list-style-type: none"> Translate to Lab/PMA2, tether swap Stow APFR and ingress aid (00:10)
06:00		A/L INGRESS AND PRE REPRESS (00:15)	A/L INGRESS AND PRE REPRESS (00:15)
07:00	EVA TIME: 06:00		

BOOM TPS INSPECTION

BOOM POINT INSPECTION TOOL CONFIG

Pre EVA Tool Config

AIRLOCK

Point Inspection

- Med ORU Bag, 1 Lg-sm RET
- Fish Stringer
- Digital Camera (2) – 50 mm lens
 - √remote shutter stowed
 - √remote shutter slider not in LOCK posn
 - √flash installed on both cameras
- PAD w/WIF adapter

- If RCC Inspection, IR Camera

EV1

- MWS
- Rt swing arm
- T-bar
- Adj tether (3)
- sm-sm RET (3)
- sm trash bag
- BRT
- RET
- Waist tether (2) (Lock)
- Spare safety tether – 85' (Lock)
- Spare safety tether – 55' (Lock)
- D-ring extender (2)
- SAFER

EV2

- MWS
- Rt swing arm
- T-bar
- Adj tether (3)
- sm-sm RET (3)
- sm trash bag
- BRT
- RET
- Waist tether (2) (Lock)
- Spare safety tether – 85' (Lock)
- Spare safety tether – 55' (Lock)
- D-ring extender (2)
- SAFER

Post EVA Tool Config

AIRLOCK

Point Inspection

- Med ORU Bag, 1 Lg-sm RET
- Fish Stringer
- Digital Camera (2) – 50 mm lens
- PAD w/WIF adapter

- If RCC Inspection, IR Camera

EV1

- MWS
- Rt swing arm
- T-bar
- Adj tether (3)
- sm-sm RET (3)
- sm trash bag
- BRT
- RET
- Waist tether (2) (Lock)
- Spare safety tether – 85' (Lock)
- Spare safety tether – 55' (Lock)
- D-ring extender (2)
- SAFER

EV2

- MWS
- Rt swing arm
- T-bar
- Adj tether (3)
- sm-sm RET (3)
- sm trash bag
- BRT
- RET
- Waist tether (2) (Lock)
- Spare safety tether – 85' (Lock)
- Spare safety tether – 55' (Lock)
- D-ring extender (2)
- SAFER

BOOM POINT INSPECTION

PET TIME (HR : MIN)	IV/SRMS	EV1 (BOOM)	EV2 (FF)
	<p>1. SRMS: To BOOM SETUP posn (SRMS EE close to port sill for safety tether setup)</p>	<p><u>A/L EGRESS (00:15)</u></p> <p>√Right waist tether to airlock internal D-ring extender Slide lock – L</p> <ol style="list-style-type: none"> 1. Thermal cover – open 2. Egress airlock 3. Retrieve airlock fwd safety tether, attach to D-ring extender, take slide lock – L, √reel unlocked 4. Release waist tether from airlock internal D-ring extender 5. Receive med ORU bag from EV2, attach to BRT 6. Retrieve airlock aft safety tether, transfer to EV2 <p>7. √EV2's SAFER MAN ISOL vlv – OP (dn) and HCM (dn)</p> <p><u>EVA SETUP (00:30)</u></p> <ol style="list-style-type: none"> 1. Translate to PMA2 HR 0402 (due nadir); perform safety tether swap onto spare 55' safety tether, take slide lock – L, fairlead tether as reqd (translate on Lab stbd HRs to endcone, go nadir around endcone to PMA2 nadir) 	<p><u>A/L EGRESS (00:15)</u></p> <p>√Right waist tether to UIA panel fwd D-ring Slide lock – L</p> <ol style="list-style-type: none"> 1. Transfer med ORU bag to EV1 2. Receive airlock safety tether from EV1, attach to D-ring extender, take slide lock – L, √reel unlocked 3. Release waist tether from UIA panel D-ring 4. Egress airlock 5. √EV1's SAFER MAN ISOL vlv – OP (dn) and HCM (dn) 6. Close thermal cover <p><u>EVA SETUP (00:30)</u></p> <ol style="list-style-type: none"> 1. Retrieve APFR and ingress aid from <u>TBD</u>, attach to BRT 2. Translate to PMA2 HR 0416 (nadir/port); perform safety tether swap onto spare 55' tether, take slide lock – L, fairlead tether as reqd (translate on Lab stbd HRs to endcone, go nadir around endcone to PMA2 nadir)

BOOM POINT INSPECTION (Cont)

PET TIME (HR : MIN)	IV/SRMS	EV1 (BOOM)	EV2 (FF)
	<p>2. <u>Verify LDRI and LCS inhibits in place</u></p> <p>3. SRMS: MnvR Boom tip to port sill for APFR setup and ingress</p>	<p style="text-align: center;">← □</p> <p><u>BOOM SETUP AND INGRESS (01:00)</u></p> <ol style="list-style-type: none"> Translate to SRMS EE (Orbiter port sill) Temp stow med ORU bag on sill HRs <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: 80%; text-align: center;"> <p>CAUTION</p> <p>Avoid contact with Boom Keep Alive Contacts and striker bar dry lube</p> </div> <ol style="list-style-type: none"> Perform safety tether swap onto SRMS EE black D-ring with 85' safety tether, take slide lock – L Stow 55' safety tether on Orbiter sill HR Clear the area for SRMS mnvr <p style="text-align: center;">← □</p> <ol style="list-style-type: none"> Position body near Boom tip opposite of EV2 <div style="border: 3px double black; padding: 5px; margin: 10px auto; width: 80%; text-align: center;"> <p>WARNING</p> <p>Minimize Boom loads. Minor loads can cause SRMS joint brake slip and joint backdrive allowing contact between EMU and Orbiter structure</p> </div> <ol style="list-style-type: none"> Retrieve PAD and WIF adapter from med ORU bag <div style="border: 3px double black; padding: 5px; margin: 10px auto; width: 80%; text-align: center;"> <p>WARNING</p> <p>Do not touch LDRI baffles. They pose both a sharp edge and entrapment hazard</p> </div>	<p><u>BOOM SETUP AND INGRESS (01:00)</u></p> <ol style="list-style-type: none"> Translate to SRMS EE (Orbiter port sill) If necessary, temp stow APFR <ol style="list-style-type: none"> Position body near Boom tip opposite of EV1

BOOM POINT INSPECTION (Cont)

PET TIME (HR : MIN)	IV/SRMS	EV1 (BOOM)	EV2 (FF)
	<p>4. SRMS: To INSPECTION AREA #1</p>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p style="text-align: center;"><u>CAUTION</u></p> <ul style="list-style-type: none"> Avoid contact with LDRI, LCS, IDC, and ITVC housings due to silver teflon tape and gold foil thermal coatings Avoid contact with all camera lenses, scratches degrade sensor performance Avoid contact with LCS sensor window Avoid contact with LDRI diffuser Avoid contact with striker bars (dry lube) </div> <p>8. Install PAD and WIF adapter onto Boom tip striker bar; PFR socket faces Boom tip</p> <p>9. Retrieve APFR from Orbiter sill</p> <p>10. Install APFR into WIF adapter</p> <p>11. Configure APFR to: <u>TBD</u> (see task data sheet)</p> <p>12. <u>If RCC Inspection</u>, retrieve IR camera from ORU bag, stow on MWS</p> <p>13. Retrieve 1 digital camera from ORU bag, stow on BRT</p> <p>14. Attach local waist tether to APFR/ingress aid tether point</p> <p>15. Perform soft APFR ingress</p> <p>16. Give SRMS operator GO to mnvr to worksite</p> <p><u>POINT INSPECTION (02:30)</u></p> <p>1. Mnvr to inspection area #1</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p style="text-align: center;"><u>WARNING</u></p> <p>Minimize boom loads. Minor loads can cause SRMS joint brake slip and joint backdrive allowing contact between EMU and Orbiter structure</p> </div>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p style="text-align: center;"><u>POINT INSPECTION (02:30)</u></p> </div> <p>4. React PAD install loads by holding sill HR and Boom/APFR structure (LCS T-handle)</p> <p>5. React APFR install & reconfig loads by holding sill HR and Boom/APFR structure</p> <p>6. Assist EV1</p> <p>7. Hold Boom/APFR structure and sill HR to react EV1's ingress loads</p> <p>1. Remain on Orbiter sill</p>

BOOM POINT INSPECTION (Cont)

PET TIME (HR : MIN)	IV/SRMS	EV1 (BOOM)	EV2 (FF)
		<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p style="text-align: center;"><u>CAUTION</u></p> <p>Damaged RCG can cut glove RTV; does not damage underlying layers</p> <hr/> <p>Loss of UHF comm between EV and IV may occur during mnvrs under payload bay doors. Be prepared to give ALL STOP hand signals in WVS camera if voice comm lost. MCC-H may issue ALL STOP if EMU biomed signal lost</p> </div> <p style="text-align: center;"><u>NOTE</u></p> <p style="text-align: center;">Allow boom motion to dampen prior to using MCG and taking photos.</p> <p style="text-align: center;">Wait until orbit day prior to beginning Photogrammetry steps</p> <ol style="list-style-type: none"> 2. GCA SRMS as reqd 3. Characterize damage cavity: <ul style="list-style-type: none"> • Estimate length, width, and depth • Whole or partial tiles missing? • Densification layer or SIP exposed? • Adjacent tile damage, including RCG and substrate? 4. Retrieve digital camera from BRT 5. Verify camera flash is off 6. Take a minimum of ten photographs of damaged area with the following criteria: <ul style="list-style-type: none"> <input type="checkbox"/> Ensure slight camera off-set between photos <input type="checkbox"/> Ensure whole adjacent healthy tile in every photo 	

BOOM POINT INSPECTION (Cont)

PET <small>TIME (HR : MIN)</small>	IV/SRMS	EV1 (BOOM)	EV2 (FF)
		<ul style="list-style-type: none"> ❑ Ensure max separation of 20" and min separation of 10" ❑ Take photos in pairs from different angles <p><u>If lighting conditions are not ideal for Photogrammetry,</u> (i.e., too much shading or insufficient light), perform steps 7-10</p> <ol style="list-style-type: none"> 7. Turn camera flash on 8. Photograph cavity 9. Verify ingress aid stowed 10. GCA SRMS as reqd for photography <p><u>If RCC Inspection,</u> perform steps 11 through 18</p> <p style="text-align: center;"><u>NOTE</u> 5 MIN must elapse between turning camera on and performing flat field correction</p> <ol style="list-style-type: none"> 11. Open IR camera lens cover 12. Turn ENABLE sw - ON 13. Press and hold (3 sec) IR camera LSR button 14. Press FOCUS PRESET (+) until "INF" displayed 15. Press FINE FOCUS (+ or -) as necessary 16. Perform IR recording of RCC as reqd; limit movie durations to 1 min segments to allow for quick transfers to memory 17. When in viewing posn, notify IV/SSRMS "Stop Motion" 18. <u>TBD flight specific steps</u> <p>If reqd to inspect additional damage sites, complete steps 19-23</p>	

BOOM POINT INSPECTION (Cont)

PET TIME (HR : MIN)	IV/SRMS	EV1 (BOOM)	EV2 (FF)
	<p>5. SRMS: To Boom tip EGRESS posn</p> <p>6. SRMS: To Boom tip EGRESS posn</p> <p>7. IV: Give SRMS operator GO to reposition SRMS/BOOM (present EE for safety tether removal)</p>	<p style="text-align: center;"><u>NOTE</u> Depending on location of additional damage sites, an APFR reconfig may not be required. If this is the case, proceed to next worksite</p> <p>19. Mnvr Boom tip to port sill 20. Soft egress APFR 21. Reconfigure APFR to <u>TBD</u>, see task data sheet 22. Perform soft APFR ingress 23. Repeat steps 1-6 and "If statements" for additional damage sites</p> <p><u>BOOM EGRESS AND CLEANUP (01:00)</u></p> <p>1. Mnvr Boom tip to sill for egress 2. Soft egress APFR 3. Remove APFR from Boom tip, transfer to EV2</p> <p>4. Stow camera and IR Camera (if reqd) in ORU bag 5. Release PAD and WIF adapter from Boom tip; stow on MWS or in ORU bag 6. Clear area for SRMS/boom mnvr ← <input type="checkbox"/></p> <p style="text-align: center;"><u>CAUTION</u> Avoid contact with Boom Keep Alive Contacts</p> <p>7. Perform safety tether swap back onto 55' safety tether, slide lock – L, retrieve 85' from SRMS 8. Attach med ORU bag to BRT</p>	<p>2. React egress loads 3. React APFR reconfigure loads 4. React ingress loads</p> <p><u>BOOM EGRESS AND CLEANUP (01:00)</u></p> <p>1. Assist EV1 with egress, react loads 2. Assist EV2 with APFR removal, stow APFR on BRT 3. Assist EV1 as reqd 4. Assist EV1 if necessary</p>

BOOM POINT INSPECTION (Cont)

PET <small>TIME (HR : MIN)</small>	IV/SRMS	EV1 (BOOM)	EV2 (FF)
		<p><u>EVA CLEANUP (00:30)</u></p> <ol style="list-style-type: none"> 1. Translate to PMA2 HR 0402; perform safety tether swap onto airlock tether, take slide lock to – L, retrieve spare tether 2. Translate to airlock 	<p><u>EVA CLEANUP (00:30)</u></p> <ol style="list-style-type: none"> 1. Translate to PMA2 HR 0416; perform safety tether swap onto airlock tether, take slide lock to – L, retrieve spare tether 2. Translate to airlock 3. Remove APFR from BRT and install in TBD toolbox WIF

BOOM POINT INSPECTION (Cont)

PET TIME (HR : MIN)	IV/SRMS	EV1 (BOOM)	EV2 (FF)
		<p><u>A/L INGRESS (00:15)</u></p> <ol style="list-style-type: none"> 1. Receive EV2's safety tether; stow on airlock aft D-ring, take slide lock – L 2. Transfer med ORU bag to EV2 3. Connect right waist tether to D-ring extender on airlock internal D-ring, take slide lock – L 4. Disconnect from airlock safety tether, stow on airlock fwd D-ring, take slide lock – L 5. Ingress airlock 6. Retrieve SCU, remove DCM cover 7. Connect SCU to DCM, √locked 8. DCM: Water – OFF 9. Hatch thermal cover – close, attach Velcro strap <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> <p style="text-align: center;"><u>CAUTION</u> Do not close hatch until EMU water – OFF for 2 min</p> </div> <ol style="list-style-type: none"> 10. Hatch – close and lock 11. Go to PRE REPRESS 	<p><u>A/L INGRESS (00:15)</u></p> <ol style="list-style-type: none"> 1. Ingress airlock 2. Connect right waist tether UIA panel fwd D-ring, take slide lock – L 3. Disconnect from airlock safety tether, hand to EV1 4. Receive med ORU bag from EV1 <ol style="list-style-type: none"> 5. Retrieve SCU, remove DCM cover 6. Connect SCU to DCM, √locked 7. DCM: Water – OFF <ol style="list-style-type: none"> 8. Go to PRE REPRESS

BOOM POINT INSPECTION/WLE MAPPING – TASK DATA

Point Inspection:

	SRMS w/Boom	SRMS	SSRMS
Two EV Crew (Assumes 3 damage areas)	6:00	TBD	TBD

WLE Mapping:

	SRMS w/ Boom	SRMS*	SSRMS
Two EV Crew - both (Port and Stbd WLE mapped)	7:40	TBD	TBD

* For EV crew on SRMS, only partial WLE coverage can be acquired

Tools:

Tool	Usage
Digital Camera	Point Insp, WLE mapping (tile and RCC)
IR Camera	Point Insp (RCC only)

APFR Settings:

(WLE Mapping with SRMS and Boom)

Task	WIF	APFR Setting
Boom Ingress	Boom mid	9, HH, E, 6
Stbd Apex RCC (5-13)	Boom mid	9, HH, E, 6
Stbd Lower RCC (1-22)	Boom tip	11, FF, A, 6
Stbd Apex RCC (1-4, 14-22)	Boom tip	4, FF, L, 12
Port Apex RCC (17-22)	Boom tip	1, MM, H, 12
Port Lower RCC (17-22)	Boom tip	1, MM, H, 9

APFR Settings (these may be updated real-time per RMS analysis)

(Point Inspection with SRMS and Boom)

Task	WIF	WIF Ext.	APFR Setting
Belly Acreage & Body Flap	Boom tip	N/A	[12,QQ,F,12]
OMS pod/Vert Stabilizer	Boom tip	N/A	[1,MM,H,1-3] [1,MM,F,5]
Nose	Boom tip	N/A	[9,MM,H,1-2] [9,MM,K,3] [9,MM,L,3] [3,ZZ,L,2] [10,TT,G,7]
Crew Cabin	SRMS only	N/A	TBD

Notes:

1. Allow boom motion to dampen prior to taking photos
2. EVA Inspection procedures are written for areas that require SRMS with Boom. Areas that can be reached with either the SSRMS or SRMS alone shall be worked real-time
3. The following criteria should be followed regarding RCC panel photo requirements:
 - For camera focusing purposes, photos must be centered on one edge of the T-seal. Slip side (aft) is easier to see versus lock side (fwd)
 - One photo should be taken perpendicular to surface of panel, and one off-center

Cautions:

1. Damaged tile RCG can cut glove RTV. It does not damage underlying protective layers
2. Loss of UHF communication between EV and IV may occur during mnvrs under payload bay doors. Be prepared to give ALL STOP hand signals in WVS camera if voice comm lost. MCC-H may issue ALL STOP if EMU biomed signal lost
3. Avoid contact with Boom Keep Alive Contacts, and striker bars (new dry lube)
4. Avoid contact with LDRI, LCS, and ITVC housings due to silver teflon tape and gold foil thermal coatings
 - Avoid contact with all camera lenses, scratches degrade sensor performance
 - Avoid contact with LCS sensor window and LDRI diffuser

Warnings:

1. Minimize boom loads. Minor loads can cause SRMS joint brake slip and SRMS joint backdrive allowing contact between EMU and Orbiter structure
2. Do not touch LDRI baffles. They pose both a sharp edge and entrapment hazard
3. EFGF SPEE connector (boom base end) will be "hot" when boom is in MPMs (2 ft KOZ)
4. The fwd MPM saddle contacts have a 2 ft KOZ. Although power to the MPM will be removed when the Boom is unberthed, there is only a single inhibit in place and no direct way to verify power is removed (molten metal hazard)

Timeline Considerations:

1. Time predictions for point inspection are only estimates as the number of inspection sites and extent of damage cannot be predicted
2. Current timelines assume EV2 is not needed on SRMS EE from comm relay. If EV2 is needed for comm relay, times will increase
3. The boom will be pre-positioned at the ingress location before EVA arrives

ICs & Assumptions:

1. Crewmember doing inspection may be on boom tip or mid striker bar depending upon location being inspected. If reqd, WIF extender can be used to get a little more reach
2. 85-foot tether should be used for all cases (with crew on Boom) to ensure enough line length from SRMS to EV crew on tip, and enough length for an emergency A/L ingress
3. Safety tethers with slide locks are available; double tethering is not reqd
4. If reqd, EV2 can ride on the SRMS EE/boom base in order to provide relay communication and situational awareness for both EV1 and robotic operator
5. The 50mm lens is used for both WLE mapping and Point Inspection (Photogrammetry)

Open Work:

1. Verify which arm, boom, or other hardware reqd for access (See Reach and Access Diagrams for Point Inspection (quick look only)), verify RCC or tile inspection
2. Verify APFR and Ingress Aid locations and APFR settings
3. For Point Inspection: Verify camera lens to be used (50 mm for majority of cases)
4. For Point Inspection: Verify whether WIF extender needed
5. For SRMS and Boom: Verify APFR at Boom tip or mid location
6. For SRMS and Boom: Verify whether EV2 needed for comm relay

BOOM POINT INSPECTION/WLE MAPPING – TASK DATA (Cont)

Minimum Number of Photos Required (WLE mapping):

- 2 photos per location (64 total)

Panels	Panel Numbers	Number of Photos
Stbd Apex	5-13	20
Stbd Lower	1-22	28
Stbd Apex	1-4, 14-22	8
Port Apex	17-22	4
Port Lower	17-22	4

Digital Camera Inspection Requirements:

1. For WLE Mapping, verify Flash light is ON and "Card Busy" light is OFF before next picture is taken (photo location and count is very important for RCC)
2. For Point Inspection, it is not necessary to verify card busy light OFF prior to taking next photo. For general photography, ensure flash is on prior to taking photos; for Photogrammetry, ensure flash is off
3. Object being photographed should be oriented in center alignment marks of camera for proper focus
4. Photogrammetry Requirements Include:
 - Crew must be between 5-10 ft from TPS in order to meet resolution reqts
 - A minimum of 10 photographs is reqd, with a slight off-set between shots
 - Each damage photograph must have an adjacent healthy tile in the FOV
 - Photos must be taken with a max separation of 20" & min separation of 10"
 - Photos must be taken during orbit day, without flash, within a 2.5 min window

Digital Camera Specifications:

1. Digital camera will take minimum of 50 photographs (when using flash)
2. Minimum focal distance for camera lenses shown below:

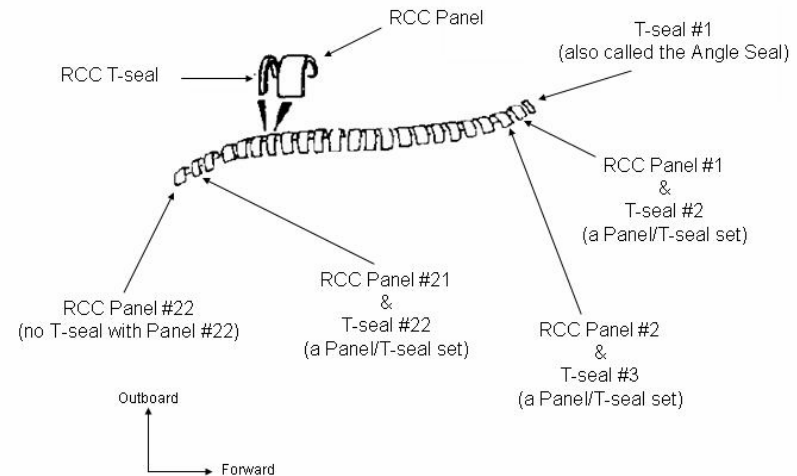
Lens (mm)	TASK	Min Focus Distance (ft)	Max Angle
35	NA	0.9	
50	WLE map & Point	1.5	35
85	NA	3.0	
105	NA	1.0	
180	NA	5.0	
70-200	NA	6.0	

Boom Constraints:

To minimize EV loads into the boom:

- React loads during PAD install, APFR install, APFR reconfiguration, ingress and egress
- When practical, tool and/or bag reconfig should be performed prior to APFR ingress to minimize boom loads. Minimize loads while reaching for tools and performing operations
- Soft APFR ingress and egress are required.
- Avoid harsh or sudden body movements while on boom

Detailed RCC Diagram:



RCC Panel Inspection Requirements (for EVA Mapping):

- The EVA WLE Mapping procedure does not acquire data that meets current RCC resolution reqts. The following table lists the resolution EVA is capable of obtaining:

RCC Panels	Diameter (inches)
Lower/Apex WLE, panels 5-13	0.25
Lower WLE, panels 1-4 and 14-22	1.0
Upper WLE (not currently in procedures)	1.0

(√MCC FOR ADDITIONAL TPS INSPECTION CRITERIA REFERENCES)

BOOM WLE MAPPING SUMMARY TIMELINE

PET TIME (HR : MIN)	IV/SRMS	EV1	EV2
00:00 ---	SRMS: EE at stbd aft sill tether position	<u>POST DEPRESS AND A/L EGRESS</u> (00:15)	<u>POST DEPRESS AND A/L EGRESS</u> (00:15)
		<u>EVA SETUP</u> (00:30) <ul style="list-style-type: none"> Translate to Lab/PMA2; perform safety tether swap (00:20) 	<u>EVA SETUP</u> (00:30) <ul style="list-style-type: none"> Retrieve ingress aid w/APFR from CETA cart; stow on BRT (00:10) Translate to Lab/PMA2; perform safety tether swap
01:00 ---	SRMS: Mnvtr to mid striker bar ingress position	<u>BOOM SETUP AND INGRESS</u> (01:00) <ul style="list-style-type: none"> Translate to SRMS EE (Orbiter stbd/aft sill) (00:10) Performe safety tether swap onto EE with 85' tether Install PAD and APFR (00:20) Tool setup (00:15) Boom mid/APFR ingress [9, HH, E, 6] (00:15) 	<u>BOOM SETUP AND INGRESS</u> (01:00) <ul style="list-style-type: none"> Translate to stbd/aft sill Install PAD and APFR Tool setup
02:00 ---	SRMS: Mnvtr to First Photo Pass starting position	<u>WLE MAPPING</u> (04:10) <ul style="list-style-type: none"> FIRST PHOTO PASS: STBD APEX 5-13 (20 photos taken, 5 RMS positions) 	<u>WLE MAPPING</u> (04:10) <ul style="list-style-type: none"> Assist EV1 with reacting Boom loads and tool config
03:00 ---	SRMS: Mnvtr to Second Photo Pass starting position SRMS: EE EGRESS posn	<ul style="list-style-type: none"> SECOND PHOTO PASS: STBD LOWER 22-1 (28 photos taken, 12 RMS positions) 	
04:00 ---	SRMS: Mnvtr to Third Photo Pass starting position SRMS: EE EGRESS posn	<ul style="list-style-type: none"> THIRD PHOTO PASS: STBD APEX 22-14 & 1-4 (8 photos taken, 4 RMS positions) 	
05:00 ---	SRMS: Mnvtr to Fourth Photo Pass starting position SRMS: EE EGRESS posn	<ul style="list-style-type: none"> FOURTH PHOTO PASS: PORT APEX 17-22 (4 photos taken, 2 RMS positions) 	
	SRMS: Mnvtr to Fifth Photo Pass starting position	<ul style="list-style-type: none"> FIFTH PHOTO PASS: PORT LOWER 17-22 (4 photos taken, 1 RMS position) 	
06:00 ---			

BOOM WLE MAPPING SUMMARY TIMELINE (Cont)

PET TIME (HR : MIN)	IV/SRMS	EV1	EV2
07:00	SRMS: EE EGRESS posn SRMS: Re posn for tether swap (00:10)	<u>BOOM EGRESS AND CLEANUP</u> (01:00) <ul style="list-style-type: none"> ▪ Mnvr to sill for egress (00:20) ▪ Egress APFR and remove APFR/PAD (00:20) ▪ Tool cleanup (00:10) <u>EVA CLEANUP</u> (00:30) <ul style="list-style-type: none"> ▪ Translate to Lab/PMA2, tether swap (00:20) <u>A/L INGRESS AND PRE REPRESS</u> (00:15)	<u>BOOM EGRESS AND CLEANUP</u> (01:00) <ul style="list-style-type: none"> ▪ Tool cleanup <u>EVA CLEANUP</u> (00:30) <ul style="list-style-type: none"> ▪ Translate to Lab/PMA2, tether swap ▪ Stow APFR and ingress aid (00:10) <u>A/L INGRESS AND PRE REPRESS</u> (00:15)
08:00			
	EVA TIME: 07:40		

BOOM WLE MAPPING TOOL CONFIG

Pre EVA Tool Config

AIRLOCK

Point Inspection

- Med ORU Bag, 1 Lg-sm RET
- Fish Stringer
- Digital Camera (3) – 50 mm lens
 - √remote shutter stowed
 - √remote shutter slider not in LOCK posn
 - √flash installed on both cameras
- PAD w/WIF adapter

EV1

- MWS
- Rt swing arm
- T-bar
- Adj tether (3)
- sm-sm RET (3)
- sm trash bag
- BRT
- RET
- Waist tether (2) (Lock)
- Spare safety tether – 85' (Lock)
- Spare safety tether – 55' (Lock)
- D-ring extender (2)
- SAFER

EV2

- MWS
- Rt swing arm
- T-bar
- Adj tether (3)
- sm-sm RET (3)
- sm trash bag
- BRT
- RET
- Waist tether (2) (Lock)
- Spare safety tether – 85' (Lock)
- Spare safety tether – 55' (Lock)
- D-ring extender (2)
- SAFER

Post EVA Tool Config

AIRLOCK

Point Inspection

- Med ORU Bag, 1 Lg-sm RET
- Fish Stringer
- Digital Camera (3) – 50 mm lens
- PAD w/WIF adapter

EV1

- MWS
- Rt swing arm
- T-bar
- Adj tether (3)
- sm-sm RET (3)
- sm trash bag
- BRT
- RET
- Waist tether (2) (Lock)
- Spare safety tether – 85' (Lock)
- Spare safety tether – 55' (Lock)
- D-ring extender (2)
- SAFER

EV2

- MWS
- Rt swing arm
- T-bar
- Adj tether (3)
- sm-sm RET (3)
- sm trash bag
- BRT
- RET
- Waist tether (2) (Lock)
- Spare safety tether – 85' (Lock)
- Spare safety tether – 55' (Lock)
- D-ring extender (2)
- SAFER

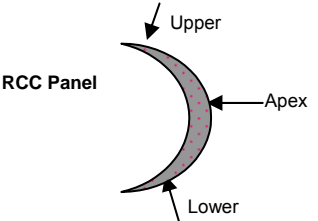
BOOM WLE MAPPING

PET TIME (HR : MIN)	IV/SRMS	EV1 (BOOM)	EV2 (FF)
	<p>1. SRMS: Maneuver to Tether posn (SRMS EE close to stbd sill)</p>	<p><u>A/L EGRESS (00:15)</u></p> <p>√Right waist tether to airlock internal D-ring extender Slide lock – L</p> <ol style="list-style-type: none"> 1. Thermal cover – open 2. Egress airlock 3. Retrieve airlock fwd safety tether, attach to D-ring extender, take slide lock – L, √reel unlocked 4. Release waist tether from airlock internal D-ring extender 5. Receive med ORU bag from EV2, attach to BRT 6. Retrieve airlock aft safety tether, transfer to EV2 <p>7. √EV2's SAFER MAN ISOL vlv – OP (dn) and HCM (dn)</p> <p><u>EVA SETUP (00:30)</u></p> <ol style="list-style-type: none"> 1. Translate to PMA2 HR 0402 (nadir); perform safety tether swap onto spare 55' safety tether, take slide lock – L, fairlead tether as reqd 	<p><u>A/L EGRESS (00:15)</u></p> <p>√Right waist tether to UIA panel fwd D-ring Slide lock – L</p> <ol style="list-style-type: none"> 1. Transfer med ORU bag to EV1 2. Receive airlock safety tether from EV1, attach to D-ring extender, take slide lock – L, √reel unlocked 3. Release waist tether from UIA panel D-ring 4. Egress airlock 5. √EV1's SAFER MAN ISOL vlv – OP (dn) and HCM (dn) 6. Close thermal cover <p><u>EVA SETUP (00:30)</u></p> <ol style="list-style-type: none"> 1. Retrieve APFR and ingress aide from <u>TBD</u>, attach to BRT 2. Translate to PMA2 HR 0401 (nadir); perform safety tether swap onto spare 55' tether, take slide lock – L, fairlead tether as reqd

BOOM WLE MAPPING (Cont)

PET TIME (HR : MIN)	IV/SRMS	EV1 (BOOM)	EV2 (FF)
	<p>2. Verify LDRI and LCS inhibits in place</p> <p>3. SRMS: Maneuver to EV1 INGRESS posn (mid striker bar at stbd sill)</p>	<p style="text-align: center;">← □</p> <p><u>BOOM SETUP AND INGRESS (01:00)</u></p> <ol style="list-style-type: none"> 1. Translate to SRMS EE (orbiter stbd/aft sill) 2. Temp stow med ORU bag on sill HRs <div style="border: 1px solid black; padding: 5px; margin: 5px auto; width: 80%;"> <p style="text-align: center;"><u>CAUTION</u> Avoid contact with Boom Keep Alive contacts and striker bar dry lube</p> </div> <ol style="list-style-type: none"> 3. Perform safety tether swap onto SRMS EE black D-ring with 85' safety tether, take slide lock – L 4. Stow 55' safety tether on Orbiter sill HR 5. Clear the area for SRMS mnvr <p style="text-align: center;">← □</p> <ol style="list-style-type: none"> 6. Position body near Boom mid opposite EV2 <div style="border: 2px solid black; padding: 5px; margin: 5px auto; width: 80%;"> <p style="text-align: center;"><u>WARNING</u> Minimize boom loads. Minor loads can cause SRMS joint brake slip and joint backdrive allowing contact between EMU and orbiter structure</p> </div> <ol style="list-style-type: none"> 7. Retrieve PAD and WIF adapter from med ORU bag 8. Install PAD and WIF adapter onto Boom mid striker bar, PFR socket faces Boom tip 9. Install APFR into WIF adapter 10. Config APFR to: [9,HH,E,6] 11. Receive digital camera, stow on BRT 12. Attach local waist tether to APFR/ingress aid tether point 	<p><u>BOOM SETUP AND INGRESS (01:00)</u></p> <ol style="list-style-type: none"> 1. Translate to SRMS EE (orbiter stbd/aft sill) 2. If necessary, temp stow APFR <ol style="list-style-type: none"> 3. Position body near Boom mid opposite EV1 <ol style="list-style-type: none"> 4. React PAD install loads by holding sill HR and Boom/APFR structure (LCS handle) 5. React APFR install & reconfig loads by holding sill HR and Boom/APFR structure 6. Retrieve 1 digital camera, pass to EV1

BOOM WLE MAPPING (Cont)

PET TIME (HR : MIN)	IV/SRMS	EV1 (BOOM)	EV2 (FF)
	 <p>RCC LOCATION MAP</p> <p>4. SRMS: To STBD APEX 5-8 posn 5. Perform <u>FIRST PHOTO PASS:</u> STBD APEX 5-13 6. SRMS: Maneuver to EV1 EGRESS posn (mid striker bar at sill)</p>	<p>13. Perform soft APFR ingress 14. Receive 2nd digital camera, stow on MWS T-bar 15. Give SRMS operator GO to mnvr to first worksite</p> <p><u>WLE MAPPING (04:10)</u></p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p align="center">WARNING</p> <p>Minimize boom loads. Minor loads can cause SRMS joint brake slip and joint backdrive allowing contact between EMU and orbiter structure</p> </div> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p align="center">CAUTION</p> <p>Loss of UHF comm between EV and IV may occur during mnvrs under payload bay doors. Be prepared to give ALL STOP hand signals in WVS camera if voice comm lost. MCC-H may issue ALL STOP if EMU biomed signal lost</p> </div> <p align="center">NOTE</p> <p>Allow boom motion to dampen prior to taking photos.</p> <p>Verify camera flash light illuminated and card busy light off prior to taking each photo</p> <p>1. SRMS mnvr to stbd apex 5-8 posn 2. Perform <u>FIRST PHOTO PASS: STBD APEX 5-13</u> 3. Mnvr to APFR Egress posn 4. Hand digital camera(s) to EV2 5. Soft egress boom APFR 6. Remove APFR from WIF adapter; temp stow 7. Remove PAD and WIF adapter; temp stow</p>	<p>7. Hold Boom/APFR structure and sill HR to react EV1's ingress loads 8. Retrieve 2nd digital camera, pass to EV1</p> <p><u>WLE MAPPING (04:10)</u></p> <p>1. Position body accordingly for clearance assist 2. Translate to orbiter stbd aft egress position 3. Receive digital camera(s), temp stow 4. React egress loads 5. React PAD and APFR removal loads</p>

BOOM WLE MAPPING (Cont)

PET TIME (HR : MIN)	IV/SRMS	EV1 (BOOM)	EV2 (FF)
	<p>7. SRMS: To BOOM TIP INGRESS posn</p> <p>8. SRMS: To STBD Lower 22-1 posn</p> <p>9. Perform <u>SECOND PHOTO PASS: STBD LOWER 22-1</u></p> <p>10. SRMS: Maneuver to EV1 EGRESS posn (tip striker bar at stbd sill)</p> <p>11. Perform <u>THIRD PHOTO PASS: STBD LOWER 22-14 & 1-4</u></p>	<p>8. Mnv'r boom tip to sill</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p style="text-align: center;"><u>WARNING</u></p> <p style="text-align: center;">Do not touch LDRI baffles. They pose both a sharp edge and entrapment hazard</p> </div> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p style="text-align: center;"><u>CAUTION</u></p> <ul style="list-style-type: none"> Avoid contact with LDRI, LCS, IDC, and ITVC housings due to silver teflon tape and gold foil thermal coatings Avoid contact with all camera lenses, scratches degrade sensor performance Avoid contact with LCS sensor window Avoid contact with LDRI diffusor </div> <p>9. Install PAD/WIF adapter onto tip striker bar, PFR socket faces towards boom tip</p> <p>10. Install APFR, configure to [11,FF,A,6]</p> <p>11. Receive digital camera, stow on BRT</p> <p>12. Attach local waist tether to APFR/ingress aide tether point</p> <p>13. Perform soft APFR ingress</p> <p>14. Receive 2nd digital camera, stow on MWS T-bar</p> <p>15. Give SRMS operator GO to mnvr to next photo pass worksite</p> <p>16. Perform <u>SECOND PHOTO PASS: STBD LOWER 22-1</u></p> <p>17. Mnv'r to APFR Egress</p> <p>18. Repeat steps 4-14, no PAD removal required</p> <p>19. Perform <u>THIRD PHOTO PASS: STBD APEX 22-14 & 1-4</u></p>	<p>6. React PAD install loads</p> <p>7. React APFR install loads</p> <p>8. Retrieve 1 digital camera, pass to EV1</p> <p>9. Hold Boom/APFR structure and sill HR to react EV1's ingress loads</p> <p>10. Retrieve 2nd digital camera, pass to EV1</p> <p>11. Translate to orbiter stbd aft egress position</p> <p>12. Repeat steps 3-11, configure APFR to [4, FF, L, 12]</p>

BOOM WLE MAPPING (Cont)

PET TIME (HR : MIN)	IV/SRMS	EV1 (BOOM)	EV2 (FF)
	<p>12. SRMS: To tip EGRESS posn</p> <p>13. Perform <u>FOURTH PHOTO PASS: PORT APEX 17-22</u></p> <p>14. SRMS: To tip EGRESS posn</p> <p>15. Perform <u>FIFTH PHOTO PASS: PORT LOWER 17-22</u></p> <p>16. SRMS: To tip EGRESS posn</p> <p>17. SRMS: To Tether posn (EE near stbd sill)</p>	<p>20. Mnvr to APFR Egress</p> <p>21. Repeat steps 4-14, no PAD removal required</p> <p>22. Perform <u>FOURTH PHOTO PASS: PORT APEX 17-22</u></p> <p>23. Mnvr to APFR Egress</p> <p>24. Repeat steps 4-14, no PAD removal required</p> <p>25. Perform <u>FIFTH PHOTO PASS: PORT LOWER 17-22</u></p> <p><u>BOOM EGRESS AND CLEANUP (01:00)</u></p> <ol style="list-style-type: none"> 1. Mnvr Boom tip to stbd sill for egress 2. Hand digital cameras to EV2 3. Egress APFR 4. Remove APFR, transfer to EV2 5. Remove PAD/WIFadapter, stow in Med ORU bag 6. Give IV GO for SRMS/boom mnvr to RMS EE <div style="border: 1px solid black; padding: 5px; text-align: center;"> <p><u>CAUTION</u> Avoid contact with Boom Keep Alive Contacts</p> </div> <ol style="list-style-type: none"> 7. Perform safety tether swap to 55' safety tether 8. Retrieve Med ORU bag, attach to BRT 	<p>13. Translate to orbiter stbd aft egress position</p> <p>14. Repeat steps 3-11, configure APFR to [1, MM, H, 2]</p> <p>15. Translate to orbiter stbd aft egress position</p> <p>16. Repeat steps 3-11, configure APFR to [1, MM, H, 9]</p> <p><u>BOOM EGRESS AND CLEANUP (01:00)</u></p> <ol style="list-style-type: none"> 1. Translate to orbiter stbd aft egress position 2. Stow digital cameras in Med ORU bag 3. React egress Loads 4. Receive APFR, attach to BRT

BOOM WLE MAPPING (Cont)

PET <small>TIME (HR : MIN)</small>	IV/SRMS	EV1 (BOOM)	EV2 (FF)
		<p><u>EVA CLEANUP</u> (00:30)</p> <ol style="list-style-type: none"> 1. Translate to PMA2 HR 0402; perform safety tether swap onto airlock tether, take slide lock to – L 2. Translate to airlock <p><u>A/L INGRESS</u> (00:15)</p> <ol style="list-style-type: none"> 1. Receive EV2's safety tether; stow on airlock aft D-ring, take slide lock – L 2. Transfer med ORU bag to EV2 3. Connect right waist tether to D-ring extender on airlock internal D-ring, take slide lock – L 4. Disconnect from airlock safety tether, stow on airlock fwd D-ring, take slide lock – L 5. Ingress airlock 6. Retrieve SCU, remove DCM cover 7. Connect SCU to DCM, √locked 8. DCM: Water – OFF <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> <p style="text-align: center;"><u>CAUTION</u> Do not close hatch until EMU water – OFF for 2 min</p> </div> <ol style="list-style-type: none"> 9. Hatch thermal cover – close, attach Velcro strap 10. Hatch – close and lock 11. Go to PRE REPRESS 	<p><u>EVA CLEANUP</u> (00:30)</p> <ol style="list-style-type: none"> 1. Translate to PMA2 HR 0401; perform safety tether swap onto airlock tether, take slide lock to – L 2. Translate to airlock 3. Remove APFR from BRT and install in <u>TBD</u> toolbox WIF <p><u>A/L INGRESS</u> (00:15)</p> <ol style="list-style-type: none"> 1. Ingress airlock 2. Connect right waist tether UIA panel fwd D-ring, take slide lock – L 3. Disconnect from airlock safety tether, hand to EV1 4. Receive med ORU bag from EV1, stow <ol style="list-style-type: none"> 5. Retrieve SCU, remove DCM cover 6. Connect SCU to DCM, √locked 7. DCM: Water – OFF <ol style="list-style-type: none"> 8. Go to PRE REPRESS

EVA WLE MAPPING INSPECTION

FIRST PHOTO PASS: STBD APEX 5-13 (FROM MID STRIKER BAR)

IV PHOTO COUNT RECORD			
#	#	Focus on T-seal	½ Panels in photo
		5	4-5
		6	5-6
		7	6-7
		8	7-8
RMS Maneuver			
		9	8-9
		10	9-10
RMS Maneuver			
		11	10-11
RMS Maneuver			
		12	11-12
RMS Maneuver			
		13	12-13
		14	13-14
RMS Maneuver to APFR Reconfig posn			

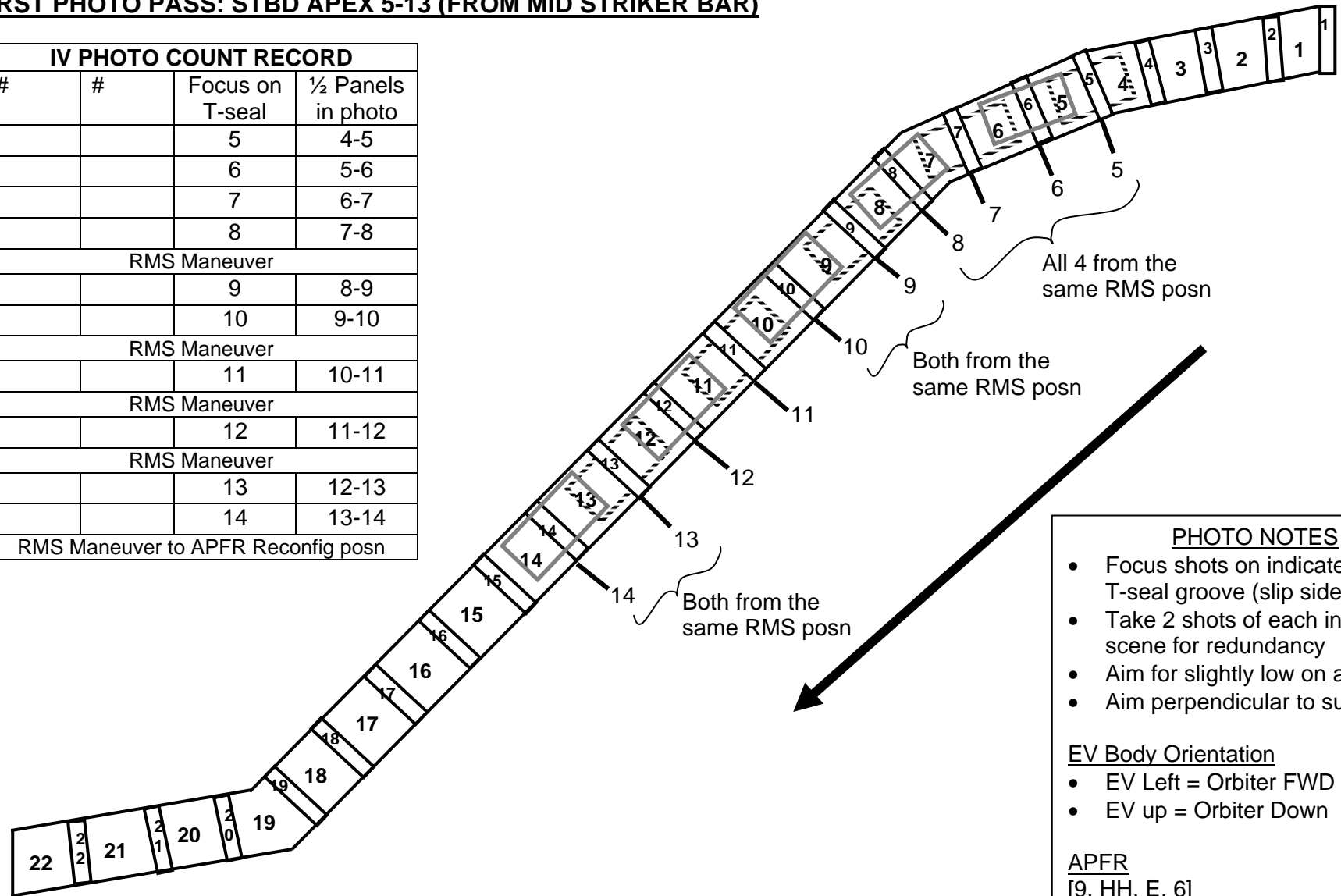


PHOTO NOTES

- Focus shots on indicated Aft T-seal groove (slip side)
- Take 2 shots of each indicated scene for redundancy
- Aim for slightly low on apex
- Aim perpendicular to surface

EV Body Orientation

- EV Left = Orbiter FWD
- EV up = Orbiter Down

APFR
[9, HH, E, 6]

EVA WLE MAPPING INSPECTION (Cont)

SECOND PHOTO PASS: STBD LOWER 22-1 (FROM TIP STRIKER BAR)

IV PHOTO COUNT RECORD			
#	#	Focus on T-seal	Panels in photo
		21	19-22
		RMS Maneuver	
		18	16-19
		RMS Maneuver	
		16	14-17
		RMS Maneuver	
		14	13-14
		RMS Maneuver	
		13	12-13
		RMS Maneuver	
		12	11-12
		RMS Maneuver	
		11	10-11
		RMS Maneuver	
		10	9-10
		RMS Maneuver	
		9	8-9
		RMS Maneuver	
		8	7-8
		RMS Maneuver	
		7	6-7
		RMS Maneuver	
		6	5-6
		RMS Maneuver	
		5	4-5
		RMS Maneuver	
		3	1-4
		RMS Maneuver to APFR Reconfig posn	

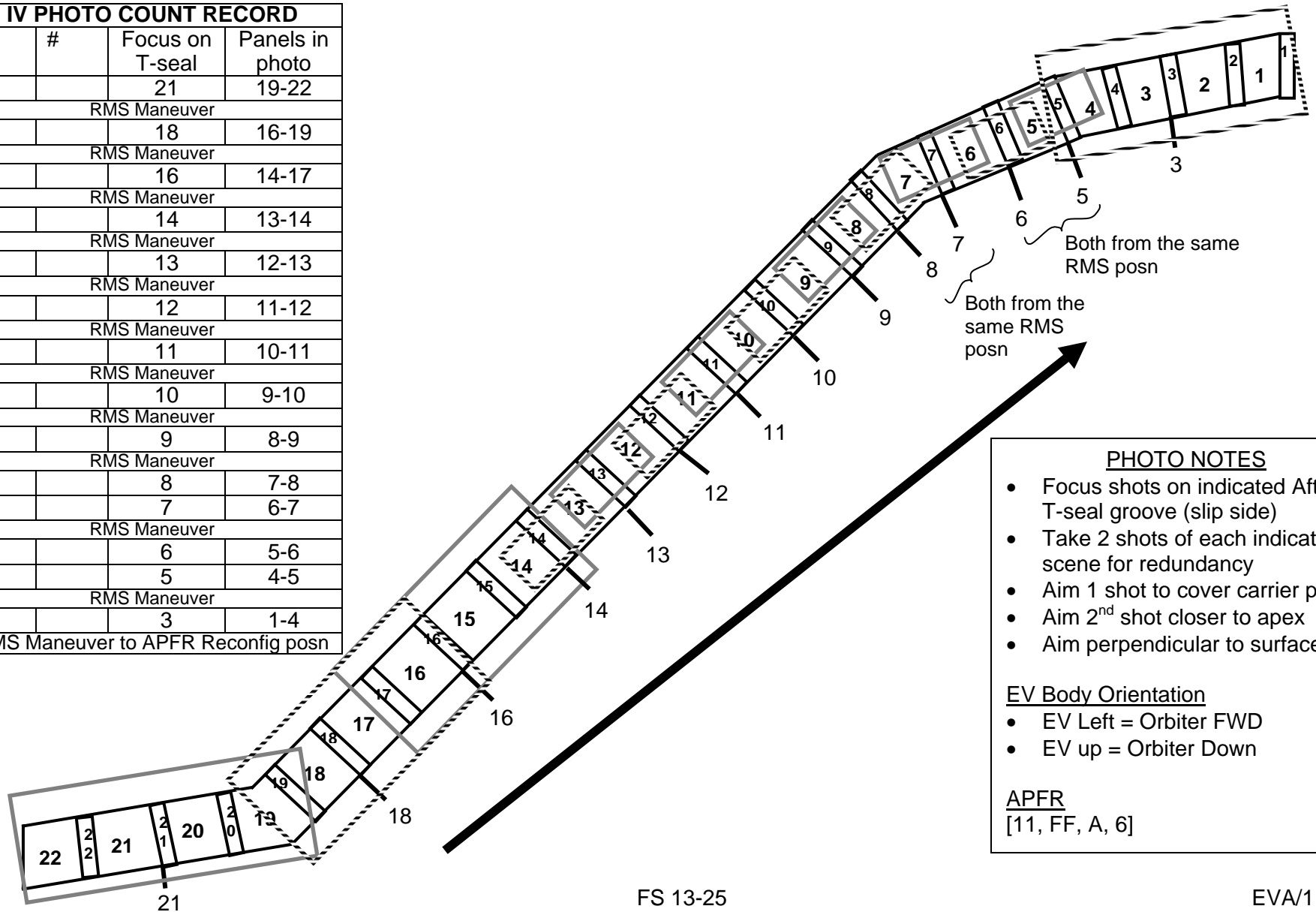


PHOTO NOTES

- Focus shots on indicated Aft T-seal groove (slip side)
- Take 2 shots of each indicated scene for redundancy
- Aim 1 shot to cover carrier panel
- Aim 2nd shot closer to apex
- Aim perpendicular to surface

EV Body Orientation

- EV Left = Orbiter FWD
- EV up = Orbiter Down

APFR
[11, FF, A, 6]

EVA WLE MAPPING INSPECTION (Cont)

THIRD PHOTO PASS: STBD APEX 22-14 & 1-4 (FROM TIP STRIKER BAR)

IV PHOTO COUNT RECORD			
#	#	Focus on T-seal	Panels in photo
		21	19-22
RMS Maneuver			
		19	17-20
RMS Maneuver			
		17	15-18
		15	13-16
RMS Maneuver			
		3	1-4
RMS Maneuver to APFR Reconfig posn			

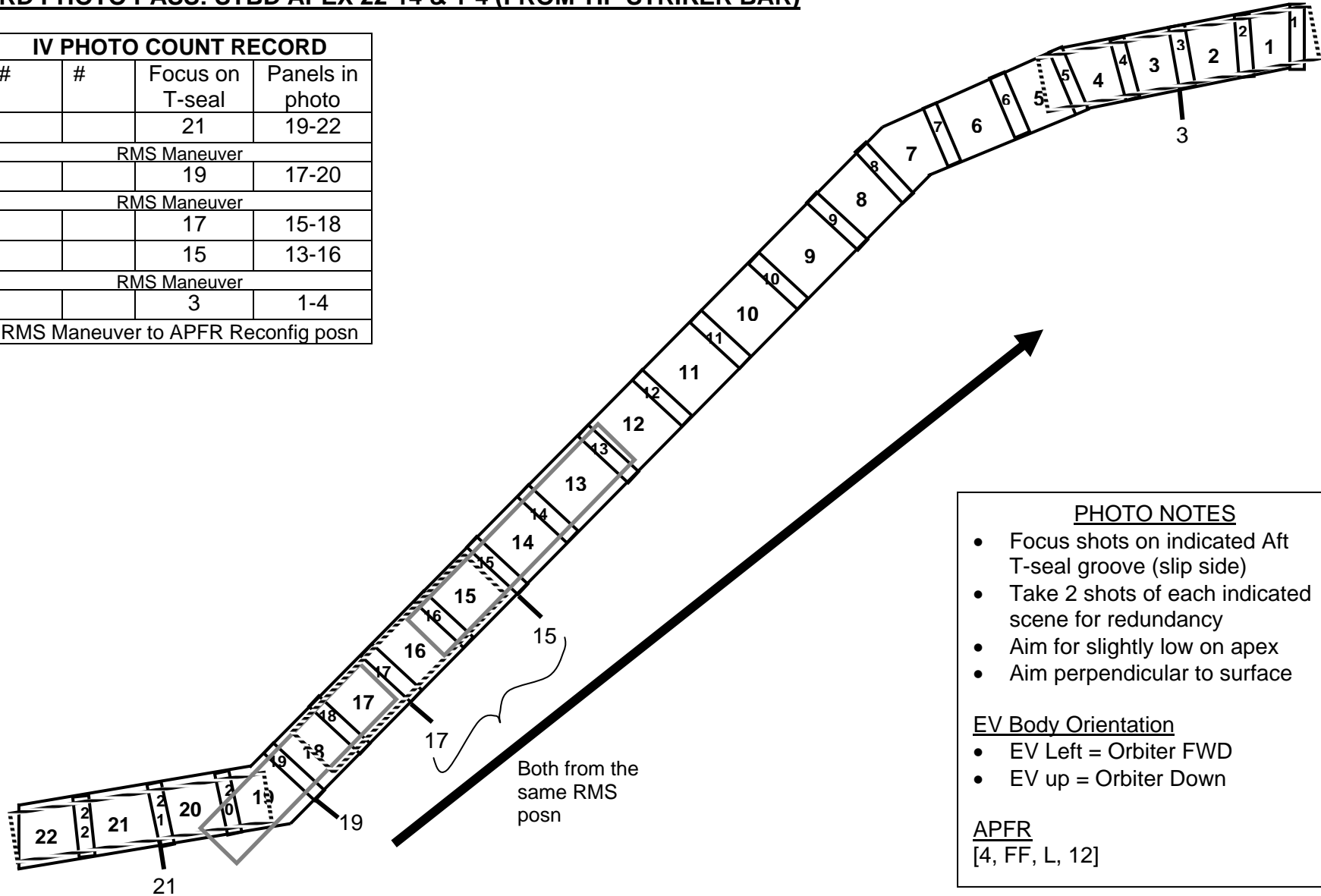


PHOTO NOTES

- Focus shots on indicated Aft T-seal groove (slip side)
- Take 2 shots of each indicated scene for redundancy
- Aim for slightly low on apex
- Aim perpendicular to surface

EV Body Orientation

- EV Left = Orbiter FWD
- EV up = Orbiter Down

APFR
[4, FF, L, 12]

EVA WLE MAPPING INSPECTION (Cont)

FOURTH PHOTO PASS: PORT APEX 17-22 (FROM TIP STRIKER BAR)

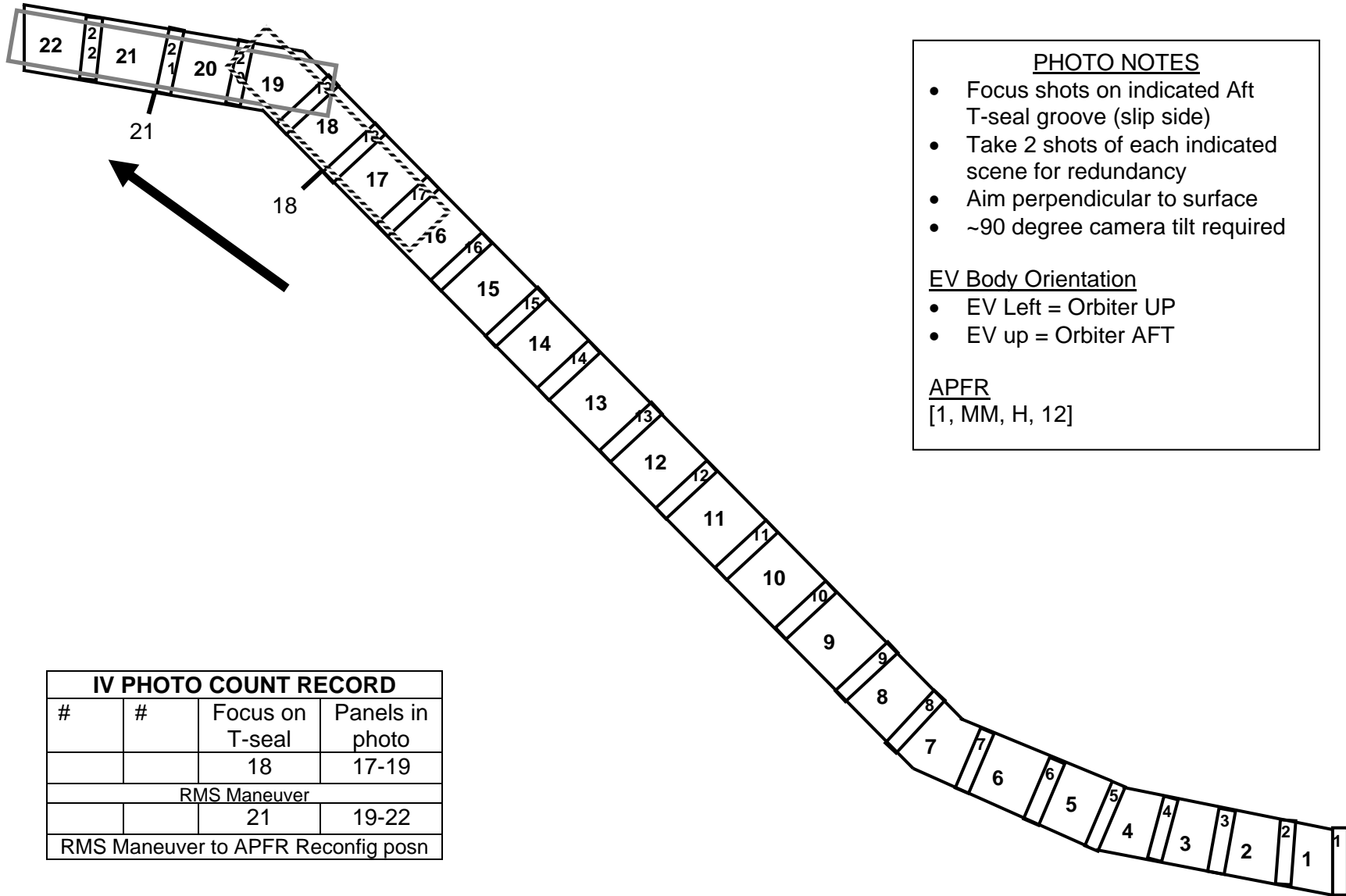


PHOTO NOTES

- Focus shots on indicated Aft T-seal groove (slip side)
- Take 2 shots of each indicated scene for redundancy
- Aim perpendicular to surface
- ~90 degree camera tilt required

EV Body Orientation

- EV Left = Orbiter UP
- EV up = Orbiter AFT

APFR
[1, MM, H, 12]

IV PHOTO COUNT RECORD			
#	#	Focus on T-seal	Panels in photo
		18	17-19
RMS Maneuver			
		21	19-22
RMS Maneuver to APFR Reconfig posn			

EVA WLE MAPPING INSPECTION (Cont)

FIFTH PHOTO PASS: PORT LOWER 17-22 (FROM TIP STRIKER BAR)

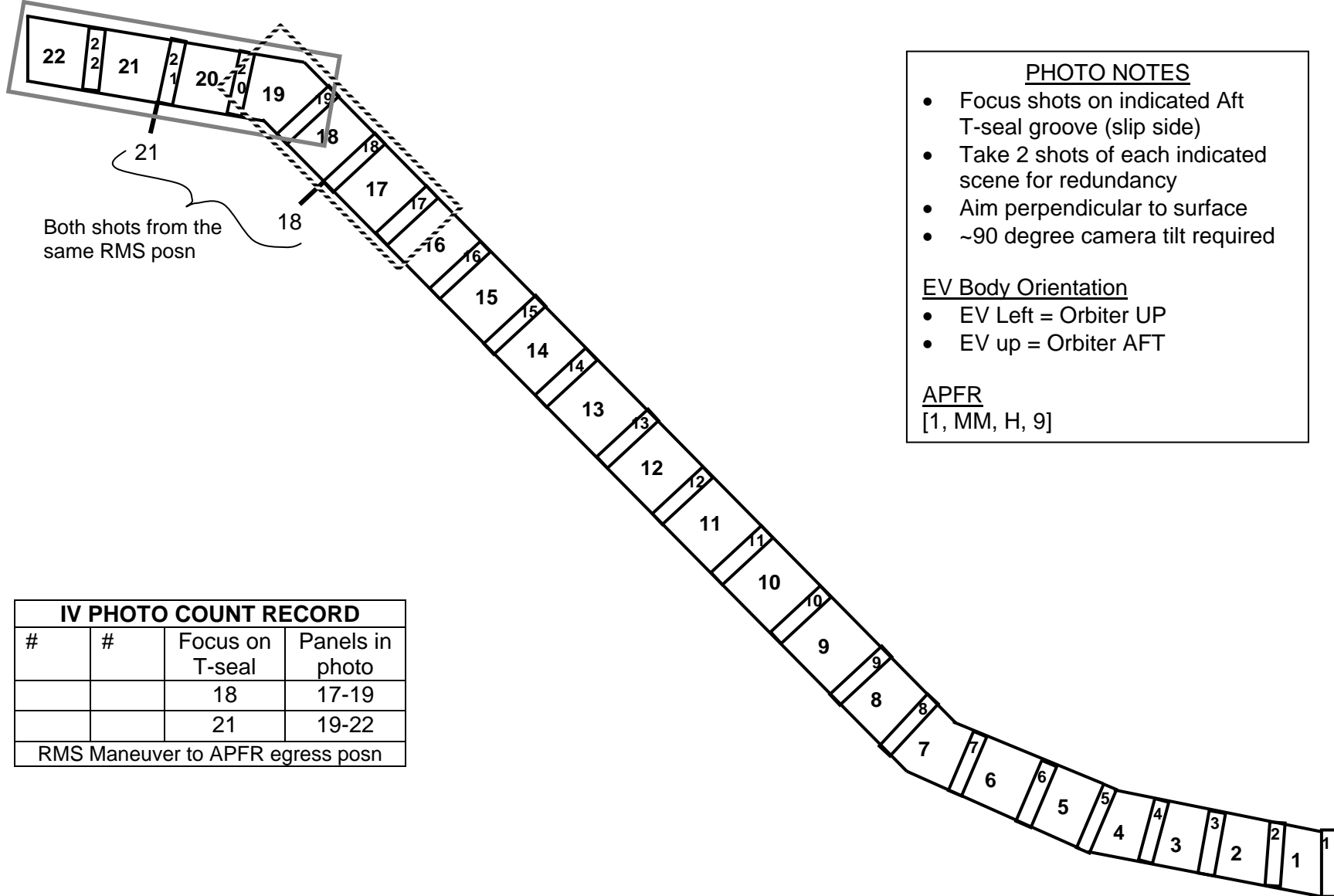


PHOTO NOTES

- Focus shots on indicated Aft T-seal groove (slip side)
- Take 2 shots of each indicated scene for redundancy
- Aim perpendicular to surface
- ~90 degree camera tilt required

EV Body Orientation

- EV Left = Orbiter UP
- EV up = Orbiter AFT

APFR
[1, MM, H, 9]

IV PHOTO COUNT RECORD			
#	#	Focus on T-seal	Panels in photo
		18	17-19
		21	19-22
RMS Maneuver to APFR egress posn			

SAFER TPS INSPECTION SUMMARY TIMELINE

PET TIME (HR : MIN)	IV/SRMS	EV1 (SAFER)	EV2 (SSRMS)
00:00	SSRMS: CETA CART posn	POST DEPRESS (00:05) EGRESS/SETUP (00:20)	POST DEPRESS (00:15) EGRESS/SETUP (00:20)
01:00	SSRMS: Mnv to INSPECTION posn	SSRMS SETUP (01:00) <ul style="list-style-type: none"> ▪ Translate to SSRMS at APFR location ▪ Perform safety tether swap to SSRMS ▪ Hold SSRMS during maneuver 	SSRMS SETUP (01:00) <ul style="list-style-type: none"> ▪ Translate to SSRMS at APFR location ▪ Retrieve APFR w/IA, install on SSRMS ▪ Perform safety tether swap to SSRMS ▪ Ingress APFR
02:00		SAFER INSPECTION (01:00) <ul style="list-style-type: none"> ▪ Power on SAFER; perform checkout ▪ SAFER flight to damage site 1: photo doc ▪ SAFER flight to damage site 2: photo doc (if required) ▪ SAFER flight to damage site 3: photo doc (if required) ▪ SAFER flight to SSRMS; power off SAFER 	SAFER INSPECTION (01:00) <ul style="list-style-type: none"> ▪ Stabilize EV1 ▪ Tend EV1 safety tether; provide GCA and comm relay if required
03:00	SSRMS: Mnv to CETA CART posn	EVA CLEANUP (01:00) <ul style="list-style-type: none"> ▪ Hold SSRMS during maneuver ▪ Stow APFR ▪ Perform safety tether swap; translate to A/L 	EVA CLEANUP (01:00) <ul style="list-style-type: none"> ▪ Egress APFR ▪ Perform safety tether swap; translate to A/L
04:00		A/L INGRESS (00:15) PRE REPRESS (00:05)	A/L INGRESS (00:15) PRE REPRESS (00:05)
05:00			
06:00			

SAFER TPS INSPECTION

SAFER TPS INSPECTION TOOL CONFIG

AIRLOCK

- Fish Stringer
- Digital Camera (2) – 50 mm lens
 - √Remote shutter stowed
 - √Remote shutter slider not in LOCK posn

EV1

- MWS
- T-bar
- SAFER Hardmount
- sm-sm RET (3) – 2 on SAFER Hardmount key and bracket lanyard
- Adj Tether
- WIF Adapter
- sm trash bag
- BRT
- Spare safety tether – 85' (Lock)
- Waist Tether (2) – Daisy-chained to short strap, MWS EE to restrain tether loop
- D-ring extender (right)
- Waist Tether (right)
- SAFER

EV2

- MWS
- T-bar
- SAFER Hardmount
- sm-sm RET (3) – 2 on SAFER Hardmount key and bracket lanyard
- Adj Tether (2)
- sm trash bag
- BRT
- Spare safety tether – 85' (Lock)
- D-ring extender (right)
- Waist Tether (right)
- SAFER

AIRLOCK

- Fish Stringer
- Digital Camera (2) – 50 mm lens
 - √Remote shutter stowed
 - √Remote shutter slider not in LOCK posn

EV1

- MWS
- T-bar
- SAFER Hardmount
- sm-sm RET (3) – 2 on SAFER Hardmount key and bracket lanyard
- Adj Tether
- sm trash bag
- BRT
- Spare safety tether – 85' (Lock)
- Waist Tether (2) – Daisy-chained to short strap, MWS EE to restrain tether loop
- D-ring extender (right)
- Waist Tether (right)
- SAFER

EV2

- MWS
- T-bar
- SAFER Hardmount
- sm-sm RET (3) – 2 on SAFER Hardmount key and bracket lanyard
- Adj Tether (2)
- WIF Adapter
- sm trash bag
- BRT
- Spare safety tether – 85' (Lock)
- D-ring extender (right)
- Waist Tether (right)
- SAFER

SAFER TPS INSPECTION (03:40)

TASK TIME (PET TIME) HR : MIN	IV/SSRMS	EV1 (SAFER)	EV2 (SSRMS)
00:05	1. SSRMS: To APFR posn	<p><u>Initial Config:</u> Right waist tether to airlock D-ring. 85-ft safety tether on left EMU D-ring (reverse configuration with waist tethers (2) daisy-chained on short strap; use MWS EE to restrain tether loop)</p> <p><u>A/L EGRESS/SETUP (00:20)</u></p> <ol style="list-style-type: none"> 1. Open thermal cover 2. Egress airlock 3. Retrieve fwd airlock safety tether; inspect load alleviating strap for damage 4. Attach fwd airlock safety tether to right D-ring ext 5. Engage safety tether crew hook slide lock – L 6. √Safety tether reel unlocked 7. Release right waist tether; stow 8. Retrieve aft airlock safety tether; inspect load alleviating strap for damage 9. Transfer safety tether to EV2 10. Install SAFER Hardmount on DCM; √locked with 2 RETs on key and bracket lanyards 11. Receive digital camera from EV2; stow on BRT 12. √SAFER MAN ISOL vlv – Open (dn) 13. √SAFER HCM – Closed (dn) 	<p><u>Initial Config:</u> Right waist tether to airlock D-ring. 85-ft safety tether on left EMU D-ring</p> <p><u>A/L EGRESS/SETUP (00:20)</u></p> <ol style="list-style-type: none"> 1. Receive safety tether from EV1 2. Attach safety tether to right D-ring ext 3. Engage safety tether crew hook slide lock – L 4. √Safety tether reel unlocked 5. Release right waist tether; stow 6. Transfer digital camera to EV1 7. Egress airlock 8. Retrieve digital camera; stow on BRT 9. Close thermal cover 10. √SAFER MAN ISOL vlv – Open (dn) 11. √SAFER HCM – Closed (dn)
00:25		<p><u>SSRMS SETUP (01:00)</u></p> <ol style="list-style-type: none"> 1. Translate to APFR/Ingress aid location 2. Attach waist tether chain of 85-ft tether to SSRMS fwd tether point 3. Engage waist tether crew hook slide lock – L 4. √All crew hook slide locks on waist tether chain and 85-ft safety tether – L 	<p><u>SSRMS SETUP (01:00)</u></p> <ol style="list-style-type: none"> 1. Translate to APFR/Ingress aid location 2. Retrieve APFR and ingress aid

SAFER TPS INSPECTION (03:40) (Cont)

TASK TIME (PET TIME) HR : MIN	IV/SSRMS	EV1 (SAFER)	EV2 (SSRMS)
	<p>2. SSRMS: To INSPECTION posn</p>	<p>5. ✓85-ft safety tether reel unlocked 6. Remove and temp stow airlock safety tether reel on ISS handrail 7. Install WIF adapter (tether point toward EE) 8. Assist EV2 with APFR installation</p> <p>9. Transfer EV1 safety tether reel to EV2</p> <p>10. Hold SSRMS for translation</p> <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> <p style="text-align: center;">CAUTION</p> <p>Loss of UHF communication between EV and IV may occur during maneuvers under payload bay doors. Be prepared to give ALL STOP hand signal in WVS camera if voice communication lost. MCC may issue ALL STOP if EMU biomed signal lost</p> </div> <p>11. Mnvr to inspection posn</p>	<p>3. Install APFR on end effector; configure APFR:</p> <p>4. Verify locking collar black-on-black 5. Perform pull test 6. Attach 85-ft tether to SSRMS aft tether point 7. ✓All crew hook slide locks on 85-ft safety tether – L 8. ✓85-ft safety tether reel unlocked 9. Remove and temp stow airlock safety tether reel on ISS handrail 10. Connect right waist tether and adj tether to APFR Yaw pedal 11. Ingress APFR 12. Receive safety tether reel from EV1</p> <div style="border: 3px double black; padding: 5px; margin: 10px auto; width: fit-content;"> <p style="text-align: center;">WARNING</p> <p>Breakaway Velcro loop is only allowable tether point on 85-ft safety tether reel</p> </div> <p>13. Tether to breakaway Velcro loop with adjustable tether</p> <p>14. Mnvr to inspection posn</p>

SAFER TPS INSPECTION (03:40) (Cont)

TASK TIME (PET TIME) HR : MIN	IV/SSRMS	EV1 (SAFER)	EV2 (SSRMS)
01:25	3. √End effector light – ON 4. √End effector camera provides good view of damage site 5. Read notes and star blocks to EV crewmembers	<p><u>SAFER INSPECTION (01:00)</u></p> <ol style="list-style-type: none"> 1. Helmet lights (two) – OFF 2. Rotate T-bar down to hardstop 3. Verify reach and access to digital camera <p style="text-align: center;"><u>NOTE</u></p> <p>EV1 may not have direct communication with IV or MCC. EV2 may need to relay voice communications.</p> <p>Unlock EV1’s safety tether reel as necessary to manage slack.</p> <p>Report GN2% and PWR% to MCC when convenient</p> <p>* Immediately return to SSRMS for any of: *</p> <ul style="list-style-type: none"> * GN2% < 30 * * PWR% < 34 * * Power-on PET > 32 min * <p>* The following steps should be performed only if a SAFER failure causes loss of control *</p> <p>* <u>CONTINGENCY TETHER RETRIEVAL</u> *</p> <ol style="list-style-type: none"> 1. MAN ISOL vlv – CLOSED (Up) <div style="border: 2px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> <p style="text-align: center;"><u>WARNING</u></p> <p style="text-align: center;">Do not retract safety tether cable if tangential velocity present</p> </div> <ol style="list-style-type: none"> 2. Use tether cable to face structure 3. Use hands to absorb kinetic energy during contact with structure 4. Lightly pull cable to initiate motion towards EV2 <p>Within 5 min of sunrise:</p> <ol style="list-style-type: none"> 4. Deploy SAFER HCM 5. Install HCM on SAFER Hardmount 6. Verify one-handed operation of camera and SAFER HCM joystick 7. Configure glove heaters and visors as 	<p><u>SAFER INSPECTION (01:00)</u></p> <ol style="list-style-type: none"> 1. Helmet lights (two) – ON (spot) <ol style="list-style-type: none"> 1. Unlock EV1’s safety tether reel 2. Prevent cable extension until tangential velocity eliminated or EV1 secure on structure 3. Tend cable slack

SAFER TPS INSPECTION (03:40) (Cont)

TASK TIME (PET TIME) HR : MIN	IV/SSRMS	EV1 (SAFER)	EV2 (SSRMS)
	<p>6. Start Power-on PET timer; record MET; inform MCC (___ / ___ : ___)</p>	<p>reqd for orbit day</p> <p style="text-align: center;"><u>NOTE</u> Attitude hold will attempt to stabilize SAFER until TST/ON switch position is seen twice. Avoid unnecessary motion during this time to reduce propellant waste</p> <p>8. SAFER PWR switch – TST/ON ← <input type="checkbox"/></p> <p>9. Wait until <input type="text" value="GN2 XX% PWR XX%"/> displayed</p> <p>10. √AAH LED – On</p> <p>11. MAN ISOL vlv – Closed (up)</p> <p>12. SAFER PWR switch – ON</p> <p>13. SAFER PWR switch – TST/ON</p> <p>14. √<input type="text" value="NSI CIRCUIT OPEN"/> message displayed; press DISP switch to resume test</p> <p>15. Count 24 thruster clicks and thruster LED flashes</p> <p>16. Follow displayed instructions</p> <p>17. Inform EV2 when <input type="text" value="RATE CHECK"/> displayed</p>	<p>2. Stabilize EV1</p> <p>3. When <input type="text" value="RATE CHECK"/> displayed, rotate EV1 in all rotational axes</p>
		<p>When <input type="text" value="FAILED TEST"/> displayed:</p> <p>18. SAFER PWR switch – ON; report to MCC:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Any failure messages <input type="checkbox"/> GN2% (Go if > 45) <input type="checkbox"/> PWR% (Go if > 45) <input type="checkbox"/> NO LEAK status present <p>When proper alignment achieved:</p> <p>19. MAN ISOL vlv – Open (dn)</p> <p>20. √SAFER Mode switch – TRAN</p>	<p>4. Lock EV1's safety tether reel</p> <p>5. Align EV1's +Y axis (right side) toward damage site and +X (fwd) toward vehicle</p> <p>6. Verify EV1's tether clear of tools</p>

SAFER TPS INSPECTION (03:40) (Cont)

TASK TIME (PET TIME) HR : MIN	IV/SSRMS	EV1 (SAFER)	EV2 (SSRMS)
		<ol style="list-style-type: none"> 21. Enable AAH, √AAH LED – On 22. Slowly translate to stable hover 5 to 10 ft above damage 23. Retrieve digital camera 24. Photograph damage (ten shots minimum with slight camera offset between shots) 25. Stow camera 	<ol style="list-style-type: none"> 7. Release EV1 (do not push) 8. Tend EV1 safety tether slack 9. Provide GCA support for EV1
02:25	<p>GN2% _____ PWR% _____ MET (____/____)</p> <p>7. SSRMS: To APFR posn</p>	<p>If additional damage site to be inspected:</p> <ol style="list-style-type: none"> 26. Verify GN2% > 45 27. Verify PWR% > 34 28. Verify Power-on PET < 23 min 29. Repeat steps 22 thru 25 30. Rotate to face EV2 31. Fly to EV2 32. Report GN2%, PWR% to IV 33. SAFER PWR – OFF ← <input type="checkbox"/> 34. Connect right waist tether to APFR 35. Remove HCM from SAFER Hardmount using key; stow in tray 36. Rotate T-bar up <p><u>EVA CLEANUP (01:00)</u></p> <ol style="list-style-type: none"> 1. Mnvr to APFR posn 2. Transfer APFR and ingress aid to WIF 3. Configure APFR in low profile setting; report setting to MCC 4. Verify locking collar black-on-black 5. Perform pull test 6. Perform safety tether swap to airlock safety tether 7. Translate to airlock 	<p>10. Grab EV1</p> <ol style="list-style-type: none"> 11. Route SAFER umbilical for stowage 12. Stow SAFER HCM in garage <p><u>EVA CLEANUP (01:00)</u></p> <ol style="list-style-type: none"> 1. Mnvr to APFR posn 2. Egress APFR 3. Remove WIF adapter 4. Perform safety tether swap to airlock safety tether 5. Translate to airlock

SAFER TPS INSPECTION (03:40) (Cont)

TASK TIME (PET TIME) HR : MIN	IV/SSRMS	EV1 (SAFER)	EV2 (SSRMS)
03:25		<p><u>A/L INGRESS</u> (00:15)</p> <ol style="list-style-type: none"> 1. Disconnect SAFER Hardmount from DCM 2. Receive EV2's safety tether; stow on airlock circular handrail, verify tether unlocked 3. Attach right waist tether to airlock D-ring 4. Release safety tether; stow on airlock circular handrail, verify tether unlocked 	<p><u>A/L INGRESS</u> (00:15)</p> <ol style="list-style-type: none"> 1. Disconnect SAFER Hardmount from DCM 2. Attach right waist tether to airlock D-ring 3. Ingress airlock 4. Release airlock safety tether; transfer to EV1
03:40		<ol style="list-style-type: none"> 5. Ingress airlock 6. Retrieve SCU, remove DCM cover 7. Connect SCU to DCM, √locked 8. DCM: Water – OFF 9. Hatch thermal cover – close, attach Velcro strap <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> <p style="text-align: center;">CAUTION Do not close hatch until EMU water – OFF for 2 min</p> </div> <ol style="list-style-type: none"> 10. Verify outer hatch clear of hardware, hatch – close and lock 11. Go to PRE REPRESS 	<ol style="list-style-type: none"> 5. Retrieve SCU, remove DCM cover 6. Connect SCU to DCM, √locked 7. DCM: Water – OFF <ol style="list-style-type: none"> 8. Go to PRE REPRESS

BOOM FRGF SHAFT RELEASE

Tools Required:

<u>Tool Name</u>	<u>Stowage Location</u>	<u>Used With</u>
<input type="checkbox"/> Ratchet w/7/16" Socket w/4" Ext	TSA	FRGF
<input type="checkbox"/> Velcro/Tape Caddy	TSA	SRMS
<input type="checkbox"/> Jettison Stowage Bag	Shuttle	SRMS
<input type="checkbox"/> Small Trash Bag	TSA	SSRMS
<input type="checkbox"/> PDGF Grapple Shaft Cover	ISS	Grapple shaft
<input type="checkbox"/> FRGF Stub Shaft	TBD	FRGF
<input type="checkbox"/> Probe	TSA	FRGF

CAUTION

Grapple fixture target sensitive - avoid contact, including tether hooks on OBSS handrails

1. If SRMS/SSRMS not grappled, install grapple shaft cover "Top End" on shaft
2. Rotate non-target side release rod ccw 9 turns to hard stop

WARNING

Beware of potential SRMS/SSRMS movement due to stored energy, shaft will release from grapple fixture

3. Rotate target side release rod cw 8 turns to hard stop
 - If no SRMS/SSRMS grappled:**
 - Gripping cover, remove shaft from grapple fixture
 - Close cover around bottom end of released grapple shaft; stow
 - If SRMS grappled:**
 - After SRMS cradle and powerdown:
 - Tape end of shaft to restrain slug
 - Cover EE with jettison stowage bag to restrain grapple shaft
 - If SSRMS grappled:**
 - Use probe to release slug from grapple shaft
 - Stow slug in small trash bag
4. Align FRGF Stub Shaft alignment slot with pin in grapple shaft mounting flange; insert FSE (~5 lb to overcome ball detent)
 - * If slug dislodged in FRGF housing and preventing shaft insertion, *
 - * use probe to push slug back into ball detents in cavity (toward *
 - * non-target side release rod) *
5. Rotate target side release rod ccw 8 turns to hard stop
6. Rotate non-target side release rod cw 9 turns to hard stop

BOOM FRGF SHAFT INSTALLATION

Tools Required:

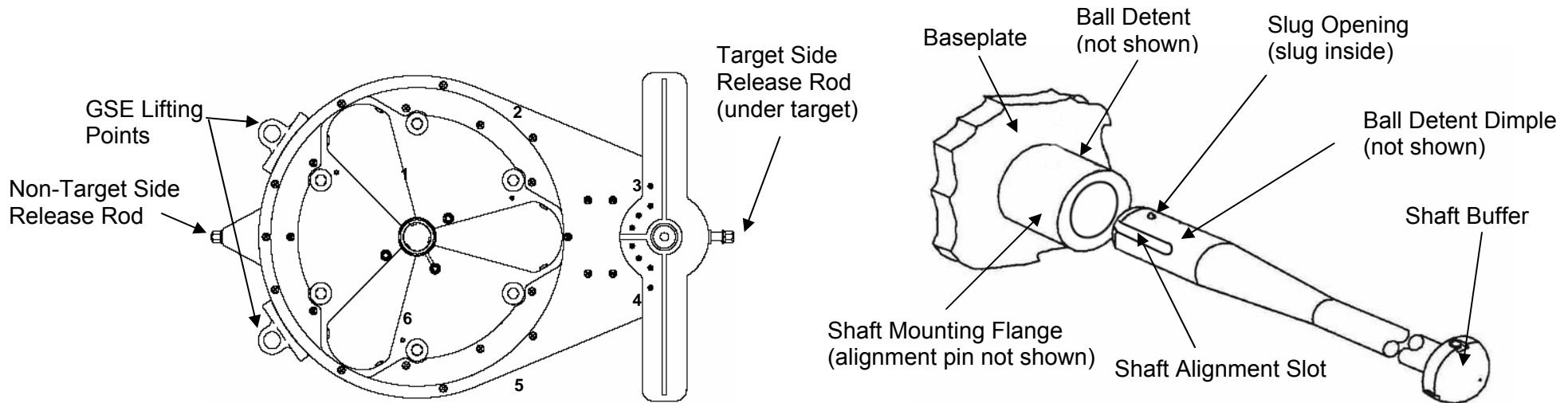
<u>Tool Name</u>	<u>Stowage Location</u>	<u>Used With</u>
<input type="checkbox"/> Ratchet w/7/16" Socket w/4" Ext	TSA	FRGF
<input type="checkbox"/> PDGF Grapple Shaft Cover w/grapple shaft restrained inside	ISS	Grapple shaft
<input type="checkbox"/> Probe	TSA	FRGF

CAUTION

Grapple fixture target sensitive - avoid contact, including tether hooks on OBSS handrails

1. Remove FRGF Stub Shaft from FRGF:
Rotate non-target side release rod ccw 9 turns to hard stop
Rotate target side release rod cw 8 turns to hard stop
Remove Boom FRGF Stub Shaft; stow
2. Open bottom half of grapple shaft cover to expose shaft
3. Align slot in grapple shaft with receptacle guide pin, insert shaft into FRGF (~5 lb to overcome ball detent)
 - * If slug dislodged in FRGF housing and preventing shaft insertion,*
 - * use probe to push slug back into ball detents in cavity (toward *
 - * non-target side release rod) *
4. Rotate target side release rod ccw 8 turns to hard stop
5. Rotate non-target side release rod cw 9 turns to hard stop, at least 10 ft-lb applied
6. Remove grapple shaft cover from grapple shaft

BOOM FRGF – TASK DATA

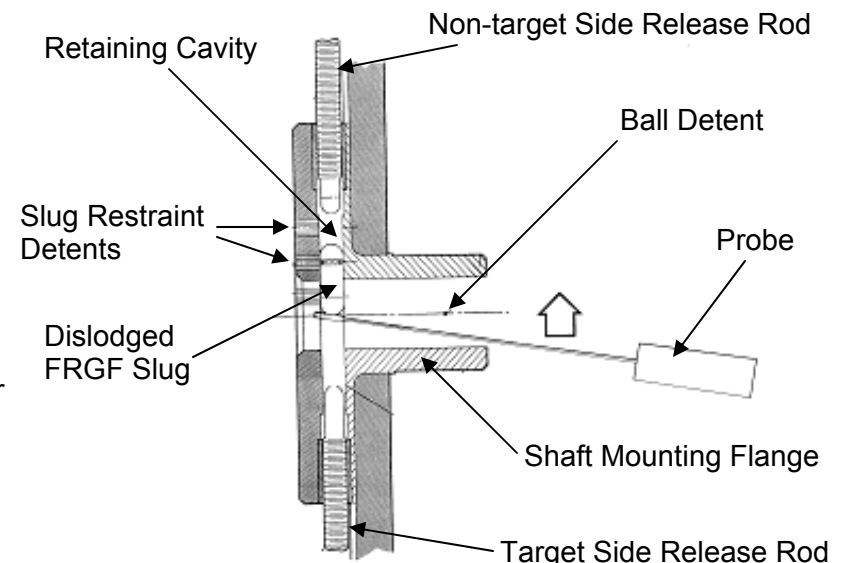


EVA Fastener Torque Data:

Fastener Name	Head Size	Qty	Release Torque (ft-lb)	Running Torque (ft-lb)	Failure Torque (ft-lb)	Turns
Non-target side Release Rod	7/16	1	7.5	3.8	~ 50	9
Target side Release Rod	7/16	1	7.5	3.8	~ 50	8
FRGF to Boom Bolts [4]	7/16	6	TBD	TBD	TBD	TBD

Notes:

1. PGT not recommended due to over-torque concerns. 150 in-lb MAX
2. FRGF shaft is too short for PDGF shaft cover. If FRGF shaft must be re-installed in FRGF, shaft must be restrained from slipping too far inside cover
3. Refer to BOOM POINT INSPECTION TASK DATA SHEET for additional Notes, Cautions, and Warnings
4. FRGF removal is not fully certified for RTF. EVA bolts have no pop-up feature, grounding wires (2) must be cut
5. GSE lifting points are not certified as tether points, but may be acceptable following real-time analysis



BOOM EFGF SHAFT RELEASE

Tools Required:

<u>Tool Name</u>	<u>Stowage Location</u>	<u>Used With</u>
<input type="checkbox"/> Jettison Stowage Bag	Shuttle	SRMS
<input type="checkbox"/> 1/2" Box Ratchet	TSA	EFGF
<input type="checkbox"/> Probe	TSA	EFGF

NOTE

Steps 1-5 remove all power from OBSS sensors and start a 90 min thermal clock on the LDRI Pan/Tilt unit

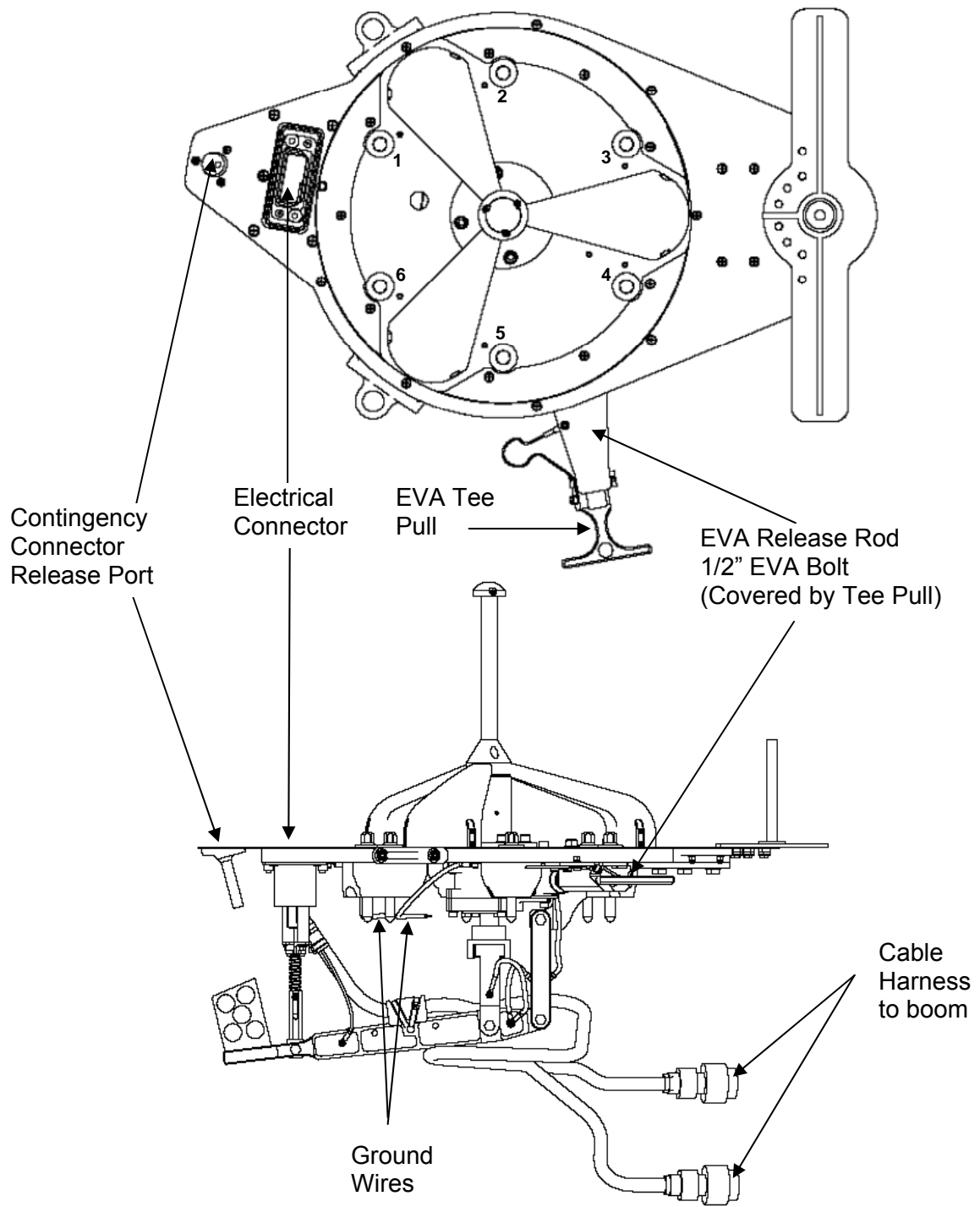
- IV
1. √LDRI Deactivation complete (LDRI/ITVC Cue Card, PHOTO/TV)
 2. √LCC Deactivation complete (LCS Cue Card, PHOTO/TV)
 3. √LCH Deactivation complete (LCS Cue Card, PHOTO/TV)
- SSP1
4. √APCU1, 2 CONV – OFF
 5. √APCU 2 OUTPUT RLY – op (tb-bp)

CAUTION

Grapple Fixture target sensitive – avoid contact, including tether hooks on OBSS handrails

- EV
6. Perform general visual inspection of EE/GF interface
 7. Remove tee pull (9-20 lb) to expose release rod bolt head
 8. Rotate release rod cw 19-23 turns to hard stop
 9. Verify electrical connector disconnected by inserting EVA probe into hole in abutment plate – it should insert 5.2 inches before the hard stop
 - * If electrical connector not disconnected, insert probe *
 - * into connector release port, push ~ 5.2 inches for full *
 - * release (~ 28 lb force required to release connector) *
 10. After SRMS cradle and powerdown, cover EE with jettison stowage bag to restrain grapple shaft

BOOM EFGF – TASK DATA



EVA Fastener Torque Data

Fastener Name	Head Size	Qty	Release Torque (ft-lb)	Running Torque (ft-lb)	Install Torque (ft-lb)	Failure Torque (ft-lb)	Turns
EVA Release Rod	1/2	1	< 20	< 11	TBD	TBD	19-23

BOOM MPM STOW/DEPLOY

Tools Required:

<u>Tool Name</u>	<u>Stowage Location</u>	<u>Used With</u>
□ MPM Wrench	TSA	MPM torque shaft

EV 1. Rotate torque shaft 8 turns until MPMs are stowed/deployed, $X_0 = 693$

IV A8L 2. When MPMs in stow(deploy) position:

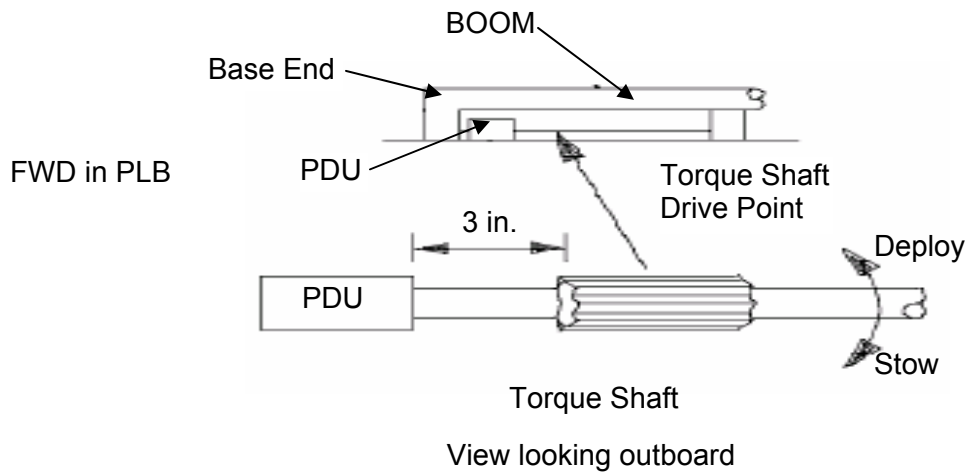
√STBD RMS tb – STO(DPY)

or

SM 94 PDRS CONTROL

RMS STBD – ITEM 2 EXEC (*)

√STBD MPM (STO)DPLY (two) = 1



BOOM ASSISTED LATCHING

Tools Required:

<u>Tool Name</u>	<u>Stowage Location</u>
<input type="checkbox"/> PRD	TSA
<input type="checkbox"/> Wire tie	BRT

- IV 1. Position MPMs to mid or inboard position as required
- EV 2. Feed PRD hook under MPM between pivot points (use wire tie as required to assist in feed-through)
3. Reposition strap under MPM (avoid sharp edges on connectors and limit switches)
4. Route strap over Boom and attach back to PRD (hook to hook). (Figure 8 routing not required)
- BASE END – PRD strap aft of Grapple Fixture
- MIDSECTION – PRD strap forward of Grapple Fixture
- TIP – PRD strap between LCS (forward) and LDRI (aft)
5. Take up strap slack on storage reel
6. Ratchet PRD as required to receive IVA Ready to Latch indication
- IV 7. Close MPM Latches
- EV 8. Remove PRD

EMU PREP FOR TPS REPAIR

TILE
REPAIR

DCM O2 ACTUATOR COVER INSTALLATION (5 min)

1. Remove O2 Actuator Cover, location _____
2. Open two snaps on right side of DCM TMG (See picture below)
3. Place two holes in O2 Actuator Cover over open snaps
4. Close snaps
5. Velcro cover to self in open position exposing O2 actuator and volume knobs
6. If reqd, repeat steps 1-5 for other EMU

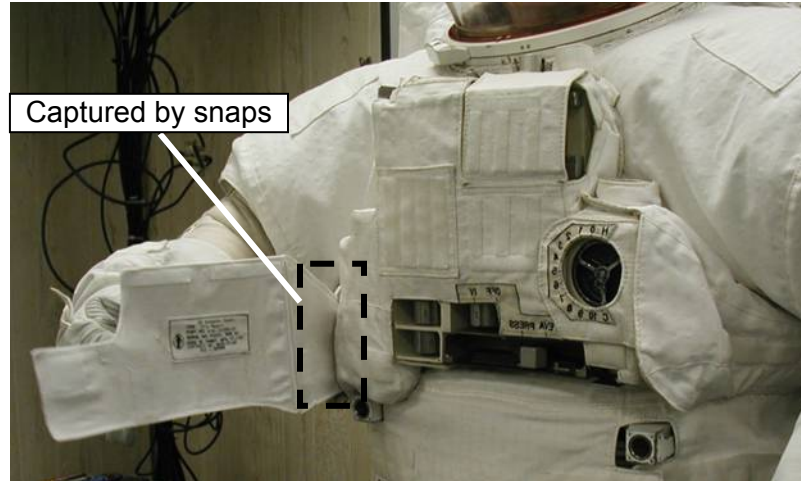


Figure 1 – O2 Actuator Attachment Point

EMU TV (ERCA) LENSE COVERING INSTALLATION (10 min)

NOTE

Repair scenario may require lense covering removal during EVA if IV or MCC determines that visibility for repair verification is degraded

1. Retrieve Teflon squares and Kapton tape from EMU ORU Tool Kit, location _____
2. Retrieve scissors from the EMU Servicing Kit
3. Cut Teflon squares to size for covering the ERCA lenses, overlapping by ~1/4"
4. See figure 2, using Kapton tape, tape down 2 opposite sides of the Teflon squares covering the lenses
5. Fold tape over onto itself to make a handle for removing the coverings while EVA, if necessary



Figure 2 – ERCA lense covered with Teflon squares and Kapton tape

POST TPS REPAIR DOFFING

- DCM O2 ACTUATOR COVER REMOVAL (3 min)
1. Remove O2 Actuator cover from DCM TMG
 2. Close snaps on right side of DCM TMG
 3. Stow O2 Actuator cover, location _____

- EMU TV (ERCA) LENSE COVERING REMOVAL (2 min)
1. Peel Kapton tape and Teflon squares off of ERCA lenses
 2. Dispose in trash
 3. Inspect lenses for any foreign debris, inform MCC-H

EWA MATERIAL MIXING (00:10)

CAUTION

1. Do not touch foam tip and minimize exposure time (cover open). This prevents foam tip contamination
2. Do not open main valve. This prevents air ingestion (material foaming)
3. Do not rotate EWA preload knob

1. Unstow EWA caddy
2. Remove EWA from caddy; record S/N _____

CAUTION

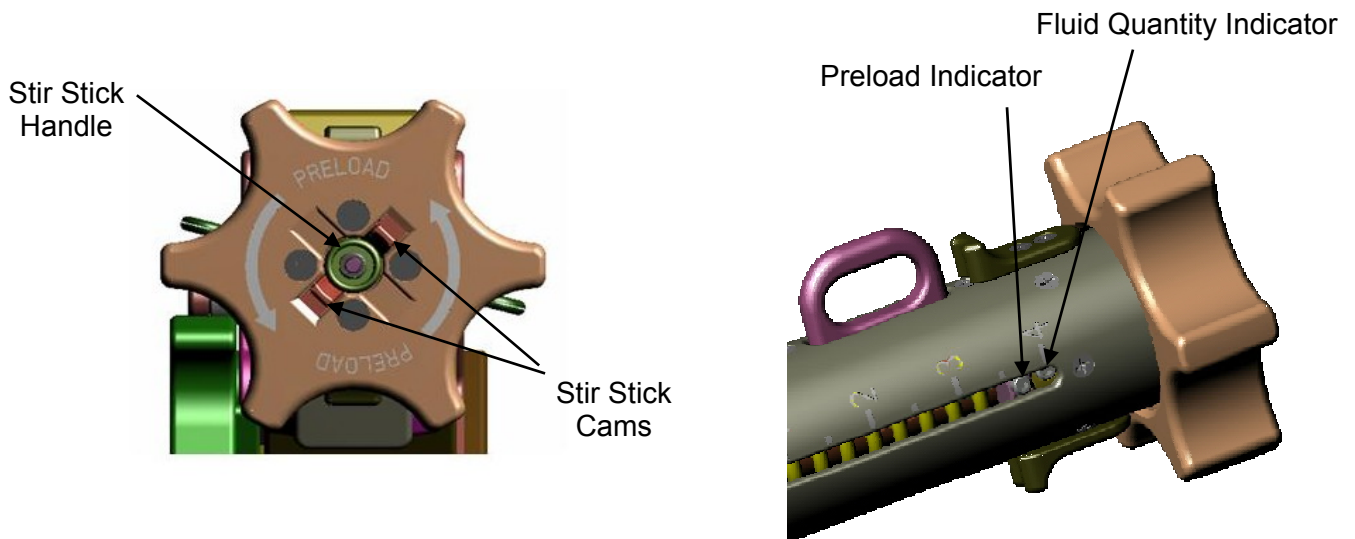
Do not side load stir stick handle during mixing

3. Release stir stick cams in preload knob; pull out stir stick handle
4. Pump stir stick vigorously 20 full cycles
5. Reseat stir stick handle in preload knob
6. ✓Stir stick cams re-engaged
7. ✓Trigger safety locked

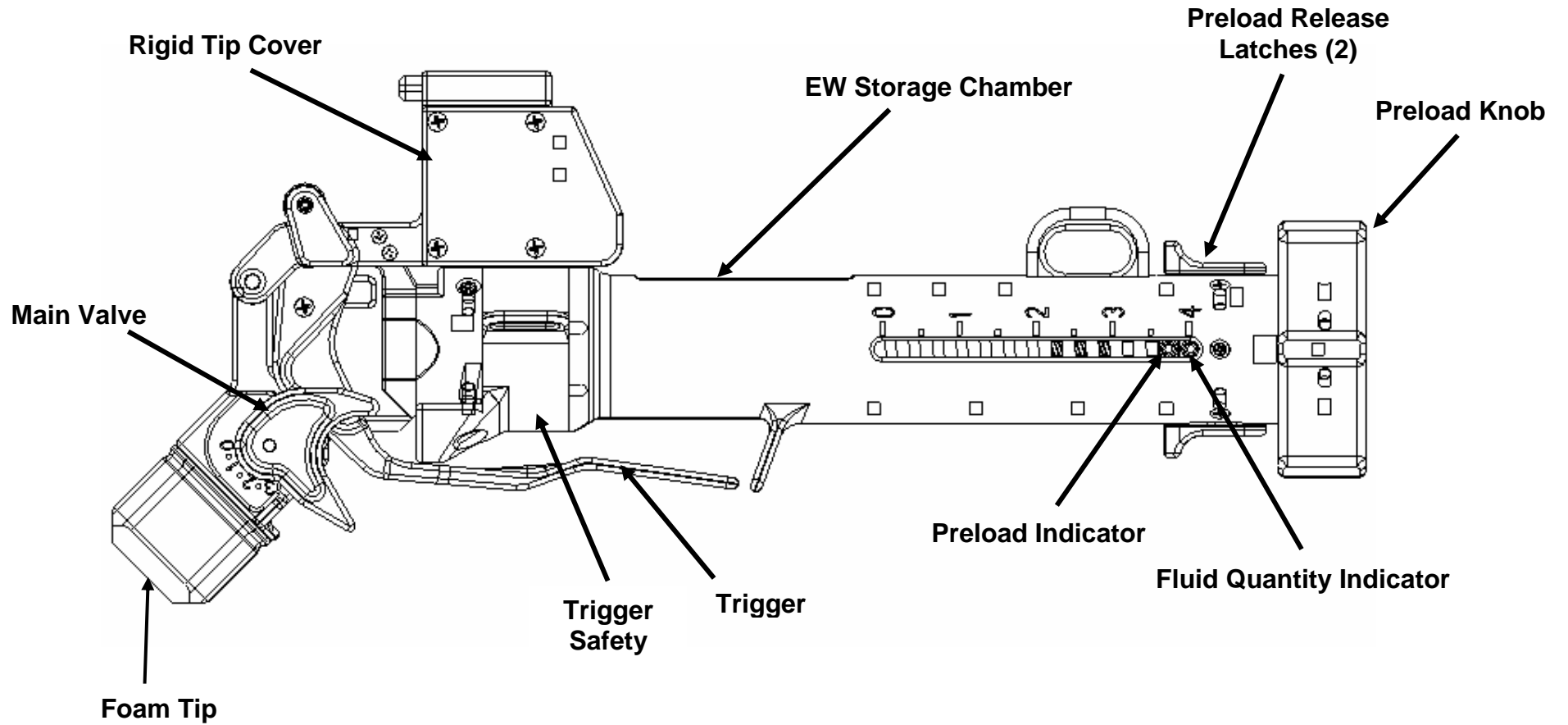
NOTE

With rigid tip cover open, risk of bumping main valve open is increased

8. Open tip cover, secure in detents
9. Inspect foam tip for debris or tearing
10. Close tip cover
11. Record fluid quantity _____
12. ✓Fluid quantity and preload indicators touching (no preload)
13. Stow EWA in caddy
14. ✓Integral RET connected to EWA tether point
15. Temp stow EWA caddy
16. Report EWA S/N, fluid quantity and any anomalies



EWA REF DATA



Emittance Wash Applicator (Tip Cover Open)

EWA TILE REPAIR – DOCKED/ORM SUMMARY TIMELINE

PET TIME (HR : MIN)	IV/SSRMS	EV1	EV2
00:00	SSRMS: EGRESS posn	POST DEPRESS and A/L EGRESS (00:15)	POST DEPRESS and A/L EGRESS (00:15)
		SSRMS SETUP (00:55) <ul style="list-style-type: none"> Receive and stow Med ORU bag on SSRMS (00:10) Install WIF adapter, extender, and APFR (00:25) Retrieve and install TS onto APFR (00:20) 	SSRMS SETUP (00:55) <ul style="list-style-type: none"> Retrieve WIF extender and APFR Retrieve and install TS onto APFR
01:00	SSRMS: Mnv to REPAIR SITE posn	TOOL SETUP (00:55) <ul style="list-style-type: none"> Configure safety tether; ingress APFR (00:10) Configure tool stanchion and tools (00:25) Mnv to repair site (00:20) 	TOOL SETUP (00:55) <ul style="list-style-type: none"> Retrieve tools from ORU bag
02:00		REPAIR (01:30) <ul style="list-style-type: none"> Cavity assessment (00:10) Cavity cleaning (00:20) EWA repair (01:00) 	REPAIR (01:30) <ul style="list-style-type: none"> Assist EV1 as reqd
03:00			
04:00	SSRMS: Mnv to CLEANUP posn	SSRMS CLEANUP (01:05) <ul style="list-style-type: none"> Mnv to CETA cart (00:20) Transfer tools to EV2 for stowage (00:20) Stow APFR, TS, and WIF extender (00:25) 	SSRMS CLEANUP (01:05) <ul style="list-style-type: none"> Receive tools and stow in ORU bag Stow APFR, TS, and WIF extender
05:00	SSRMS: Mnv to INGRESS posn	EVA CLEANUP (00:35) <ul style="list-style-type: none"> Mnv for ingress (00:20) Transfer Med ORU bag (00:10) Perform tool inventory (00:05) 	EVA CLEANUP (00:35) <ul style="list-style-type: none"> Receive hardware; stow in airlock Perform tool inventory
	EVA Time 5:30	A/L INGRESS and PRE REPRESS (00:15)	A/L INGRESS and PRE REPRESS (00:15)

EWA TILE REPAIR – DOCKED/ORM TOOL CONFIG

AIRLOCK

- Medium ORU Bag
- Adj tethers on exterior (4) (to strap bag to sill)
- Lg-sm RET on exterior (A/L tether)
- EWA caddy w/RET
- 1" foam brush with netting (integral RET)
- EWA (integral RET)
- EVA wipes (3 per caddy)
- EWA caddy w/RET (attached to other EWA caddy)
- 1" foam brush with netting (integral RET)
- EWA (integral RET)
- Spare EMU scissors w/tether point* & RET
- EVA wipes (3 per caddy)
- Gel brush caddy (½ gel, ½ foam) w/RET
- Brush Handle (external integral RET)
- Gel brush caddy (all gel) w/RET
- Brush Handle (external integral RET)
- Spare EMU scissors w/tether point (if gap filler cut reqd)
- Large trash bag (if stowed IVA)
- Digital camera and flash
- Low profile camera mount (integral RET)
- PAD (if reqd for boom or SRMS access)

IV PREP STEPS

Retrieve spare EMU scissors from LTA, remove lanyard
Attach grey tape tether point to spare EMU scissors

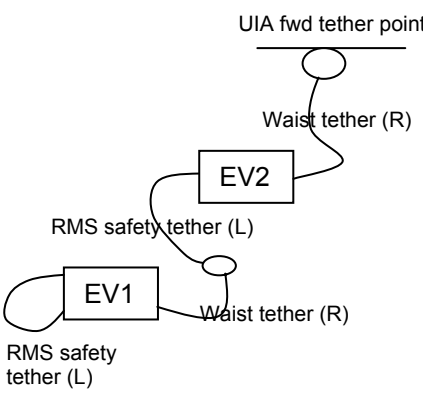
EV1

- MWS
- Right swing arm
- Sm trash bag w/RET
- T-bar
- BRT
- RET
- Adj tether
- RET sm/sm (3)
- WIF adapter
- Waist tether (2)
- Spare safety tether (RMS safety tether)
- D-ring extender (2)
- SAFER

EV2

- MWS
- Right swing arm
- T-bar
- BRT
- RET
- Adj tether (2)
- RET sm/sm (2)
- Sm trash bag
- Waist tether (2)
- Spare safety tether (RMS safety tether)
- D-ring extender (2)
- SAFER

EWA TILE REPAIR – DOCKED/ORM (05:30)

TASK TIME (PET TIME) HR : MIN	IV/SSRMS	EV1 (SSRMS)	EV2 (FF)
00:05	<p>1. SSRMS: To EGRESS posn</p> 	<div style="border: 3px double black; padding: 5px; text-align: center;"> <p>WARNING For ORM, reference ORM NOTES/CAUTIONS/WARNINGS</p> </div> <p><u>A/L EGRESS</u> (00:10)</p> <p><u>Initial Config:</u> Right waist tether to EV2's RMS safety tether. RMS safety tether on left D-ring ext</p> <ol style="list-style-type: none"> 1. Open thermal cover 2. Egress airlock 3. Retrieve ORU bag; temp stow near SSRMS 4. Translate to SSRMS 5. Attach RMS safety tether to SSRMS fwd tether point 6. Engage safety tether crew hook slide lock – L 7. ✓ Safety tether reel unlocked 8. Retrieve EV2's RMS safety tether from own right D-ring ext 9. Attach EV2's safety tether hook to SSRMS aft tether point 10. Engage EV2's safety tether crew hook slide lock – L 11. ✓ SAFER MAN ISOL vlv – Open (dn) 12. ✓ SAFER HCM – Closed (dn) 	<div style="border: 3px double black; padding: 5px; text-align: center;"> <p>WARNING For ORM, reference ORM NOTES/CAUTIONS/WARNINGS</p> </div> <p><u>A/L EGRESS</u> (00:10)</p> <p><u>Initial Config:</u> Right waist tether to UIA fwd tether point. RMS safety tether (strap hook end) on left D-ring ext; reel hook on EV1's right waist tether</p> <ol style="list-style-type: none"> 1. ✓ Safety tether reel unlocked 2. Retrieve right waist tether from UIA; stow 3. Egress airlock 4. ✓ SAFER MAN ISOL vlv – Open (dn) 5. ✓ SAFER HCM – Closed (dn) 6. Close airlock thermal cover
00:15		<p><u>SSRMS SETUP</u> (00:55)</p> <ol style="list-style-type: none"> 1. Install WIF adapter on SSRMS (tether point toward EE) <p>If WIF extender reqd:</p> <ol style="list-style-type: none"> 2. Receive WIF extender from EV2; install 3. Configure WIF extender: <u>6, A, 7</u> 4. Verify locking collar black-on-black 5. Perform pull test 	<p><u>SSRMS SETUP</u> (00:55)</p> <p>If WIF extender reqd:</p> <ol style="list-style-type: none"> 1. Retrieve WIF extender from stowage location _____ 2. Translate to SSRMS 3. Transfer WIF extender to EV1

EWA TILE REPAIR – DOCKED/ORM (05:30) (Cont)

TASK TIME (PET TIME) HR : MIN	IV/SSRMS	EV1 (SSRMS)	EV2 (FF)
01:10	<p>2. SSRMS: To PHOTO SITE posn</p>	<ol style="list-style-type: none"> 6. Translate to PMA1 WIF 02 7. Assist EV2; place TS/BRT into low profile config 8. Translate to airlock toolbox APFR; provide clearance calls for EV2 9. Configure APFR: <u>PP, F, 6</u> 10. Retrieve APFR from airlock toolbox 11. Translate to SSRMS; provide clearance calls for EV2 12. Configure APFR to <u>12 o'clock</u> 13. Verify locking collar black-on-black 14. Perform pull test 15. Assist EV2 with TS installation <p><u>TOOL SETUP (00:55)</u></p> <ol style="list-style-type: none"> 1. Retrieve ORU bag, secure on TS (outboard) with adj tethers (4) 2. Retrieve digital camera from ORU bag; stow on TS for EV1 access 3. Retrieve large trash bag, stage on TS for easy access 4. Verify all hardware on TS tethered 5. Configure TS 135L; max pitch 6. Rotate TS head for clearance from TPS and self 7. Configure safety tether to prevent contact with TPS (between legs); ingress APFR <ol style="list-style-type: none"> 8. Give SSRMS GO for mnvr to photo repair worksite 9. If installed, verify O2 actuator cover closed 	<ol style="list-style-type: none"> 4. Translate to PMA1 WIF 02 5. Remove TS from APFR; stow on BRT 6. Translate to airlock toolbox and wait for EV1 7. Translate to SSRMS 8. Install TS into SSRMS APFR 9. Perform pull test <p><u>TOOL SETUP (00:55)</u></p> <ol style="list-style-type: none"> 1. Assist EV1 with tool config 2. Assist EV1 with safety tether routing 3. Grab tool stanchion 4. If installed, verify O2 actuator cover closed

EWA TILE REPAIR – DOCKED/ORM (05:30) (Cont)

TASK TIME (PET TIME) HR : MIN	IV/SSRMS	EV1 (SSRMS)	EV2 (FF)
02:05 02:15	SSRMS: To REPAIR posn	<p><u>CAVITY ASSESSMENT</u> (00:10)</p> <ol style="list-style-type: none"> 1. Photograph damaged cavity 2. Transfer camera to EV2 3. GCA into worksite for hands-on access <p>Prior to contact, perform clearance assessment:</p> <ol style="list-style-type: none"> 4. Verify adequate APFR/TS clearance (>2 feet) 5. Lean in to verify good hand access/body position (neutral position) <p><u>CAVITY CLEANING</u> (00:20)</p> <p style="text-align: center;"><u>NOTE</u></p> <p>Only tile substrate should be cleaned. Avoid contact with surrounding TPS (gap filler, RCG, SIP, etc) to minimize gel residue</p> <p>Report any loose or removed tile pieces >0.25 inch in diameter</p> <p>To ensure uniform cavity cleaning with limited supply of brushes, clean entire surface with progressive passes, starting with largest (3-in) brushes first</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p style="text-align: center;"><u>CAUTION</u></p> <p>Do not “wipe” brush across tile surface (breaks fibers and tears gel). Use normal to surface patting motion only</p> <p>Gel brush should be used immediately after removal from caddy due to thermal limitations</p> </div> <ol style="list-style-type: none"> 1. Receive gel brush caddy; stow on BRT 2. Retrieve handle and gel brush tip 3. Clean cavity using a light, patting motion 	<p><u>CAVITY ASSESSMENT</u> (0:10)</p> <ol style="list-style-type: none"> 1. Assist with camera retrieval 2. Receive camera; stow on tool stanchion <p><u>CAVITY CLEANING</u> (00:20)</p> <ol style="list-style-type: none"> 1. Retrieve gel brush caddy; transfer to EV1

EWA TILE REPAIR – DOCKED/ORM (05:30) (Cont)

TASK TIME (PET TIME) HR : MIN	IV/SSRMS	EV1 (SSRMS)	EV2 (FF)
02:35	<p>3. IV: Report data from EV1 (steps 5 and 6) to MCC</p>	<p>4. Repeat as reqd until:</p> <ul style="list-style-type: none"> a. A new gel brush does not pull up particles (may have a small amount of fine dust on brush) -OR- b. A new gel brush “sticks” to all areas of cavity (may have a few scattered small chunks on brush) <p>5. Remove visible gel residue pieces >0.25 inch in diameter with a new brush</p> <p>6. Report particulate quantity on final gel brushes and cleaning termination criteria from step 4</p> <p>7. Transfer gel brush caddy to EV2</p> <p><u>EWA REPAIR (01:00)</u></p> <ul style="list-style-type: none"> 1. Receive EWA from EV2 2. Open EWA tip cover to the detent 3. Rotate main valve to 1.5 (mid open) 4. Unlock trigger safety <p style="text-align: center;"><u>NOTE</u></p> <p style="text-align: center;">Prior to preloading the EWA, trigger should be depressed to relieve any residual pressure which may result in emittance wash flow</p> <ul style="list-style-type: none"> 5. Vent EWA 10 seconds 6. Advance preload knob CCW ~ 1 1/4 turns, ensuring delta between fluid and preload indicators no more than 1 unit 	<p>2.</p> <p>2. Receive gel brush caddy; stow on TRK</p> <p><u>EWA REPAIR (01:00)</u></p> <ul style="list-style-type: none"> 1. Retrieve EWA caddy from ORU bag 2. Remove EWA from caddy; hand to EV1 3. Retrieve EVA wipe, stow on glove or in reach 4. Assist EV1 as reqd

EWA TILE REPAIR – DOCKED/ORM (05:30) (Cont)

TASK TIME (PET TIME) HR : MIN	IV/SSRMS	EV1 (SSRMS)	EV2 (FF)
		<p style="text-align: center;"><u>NOTE</u></p> <p>A press and hold method (1-2 seconds) should be used for application. Avoid wiping tip across tile which can damage foam tip and tile substrate.</p> <p>If foam tip is too large to access small regions, emittance wash can be transferred to a 1-in netted foam brush for application</p> <p style="text-align: center;"><u>CAUTION</u></p> <p>Do not oversaturate foam tip (foam may degrade/tear)</p> <p>Discontinue use (\sqrt{MCC}) in cold conditions if foam is degrading excessively</p> <p>To prevent leakage, close main valve when EWA not in active use</p> <ol style="list-style-type: none"> 7. Depress trigger until emittance wash seen on tip 8. Press tip to tile, repeat until noted decrease in coverage footprint 9. Repeat trigger hold and tip press until foam tip mostly covered with material 10. Coat tile, triggering, adjusting main valve and advancing preload knob as required (For small regions, transfer material from EWA tip to netted 1-in brush) 11. Continue until entire surface appears gray (goal is 100% coverage) 12. Lock trigger safety 13. Close tip cover (main valve will close automatically) 	

EWA TILE REPAIR – DOCKED/ORM (05:30) (Cont)

TASK TIME (PET TIME) HR : MIN	IV/SSRMS	EV1 (SSRMS)	EV2 (FF)
03:35	4. SSRMS: To CLEANUP posn	<p>14. Release preload by pushing preload release tabs towards tether point, turning knob CW</p> <p>15. Transfer EWA (and foam brush as required) to EV2</p> <p>16. Receive digital camera</p> <p>17. Perform photo closeout</p> <p>18. Transfer camera to EV2</p> <p><u>SSRMS CLEANUP (01:05)</u></p> <p>1. Mnvr to <u>CETA Cart 1 or 2</u> for SSRMS cleanup Once at <u>CETA Cart</u>:</p> <p>2. Stow hardware in ORU bag</p> <ul style="list-style-type: none"> <input type="checkbox"/> Digital camera <input type="checkbox"/> Gel brush caddies <input type="checkbox"/> EWA caddies <p>3. Remove APFR/TS from SSRMS</p> <p>4. Stow into CETA cart WIF</p> <p>5. Verify locking collar black-on-black</p> <p>6. Perform pull test</p> <p>7. Configure APFR/TS to low profile settings</p> <p>8. Report settings to MCC</p> <p>If WIF extender used:</p> <p>9. Receive WIF extender from EV2</p> <p>10. Stow WIF extender in open CETA cart WIF</p> <p>11. Verify locking collar black-on-black</p> <p>12. Perform pull test</p> <p>13. Retrieve ORU bag</p>	<p>5. Receive EWA from EV1; transfer digital camera to EV1</p> <p>6. Stow EWA in caddy; temp stow caddy</p> <p>7. Receive camera; stow on either lower tool stanchion bayonet receptacle</p> <p><u>SSRMS CLEANUP (01:05)</u></p> <p>1. Assist EV1 with hardware stow</p> <p>2. Assist EV1 If WIF extender used:</p> <p>3. Remove WIF extender</p> <p>4. Transfer WIF extender to EV1</p> <p>5. Remove WIF adapter; stow on MWS</p>

EWA TILE REPAIR – DOCKED/ORM (05:30) (Cont)

TASK TIME (PET TIME) HR : MIN	IV/SSRMS	EV1 (SSRMS)	EV2 (FF)
04:40	5. SSRMS: To INGRESS posn	<u>EVA CLEANUP (00:35)</u> 1. Grab SSRMS HR for translation; give SSRMS GO for mnvr 2. Transfer bag to EV2 3. Perform tool inventory	<u>EVA CLEANUP (00:35)</u> 1. Grab SSRMS HR for translation; give SSRMS GO for mnvr 2. Ingress airlock 3. Receive ORU bag; stow in joint airlock 4. Perform tool inventory
05:15		<u>A/L INGRESS (00:10)</u> 1. Release EV2's safety tether from SSRMS aft tether point 2. Attach EV2's safety tether to own right waist tether 3. Engage safety tether crew hook slide lock – L 4. Release own safety tether from SSRMS fwd tether point; stow 5. Ingress airlock 6. Retrieve SCU, remove DCM cover 7. Connect SCU to DCM, √locked 8. DCM: Water – OFF 9. Hatch thermal cover – close, attach Velcro strap <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;"> <u>CAUTION</u> Do not close hatch until EMU water – OFF for 2 min </div> 10. Verify outer hatch clear of hardware, hatch – close and lock 11. Go to PRE REPRESS	<u>A/L INGRESS (00:10)</u> 1. Attach right waist tether to UIA fwd tether point 2. Retrieve SCU, remove DCM cover 3. Connect SCU to DCM, √locked 4. DCM: Water – OFF <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;"> <u>CAUTION</u> Do not close hatch until EMU water – OFF for 2 min </div> 5. Go to PRE REPRESS
05:25			

EWA TILE REPAIR – DOCKED/ORM – TASK DATA

Estimated Task Duration:

	ISS w/SSRMS	w/o SSRMS
Two EV Crew	5:30	N/A

Tools:

EV1 (SSRMS)	EV2 (SSRMS)
See tool config	See tool config

Foot Restraints:

Task	WIF	(WIF extender) APFR Setting
SSRMS	SSRMS EE	(6,A,7) 12, PP, F, 6

Photo Requirements:

If WVS is available	If WVS not available
1. Prior to cavity cleaning 2. After repair is complete	1. Prior to cavity cleaning 2. After repair is complete

EW Application Guidelines:

- Use a press and hold method (press tip against tile for 1-2 seconds allowing EW to wick into tile)
- Do not use a shear or wiping motion
- Do not use un-netted foam tools (results in foam degradation and debris in cavity)
- Do not attempt to transfer pooled EW from one location to another (EW behaves like glue when cold and can tear foam)
- Cover as much tile as possible with EWA, then transfer material to 1-in brush to fill remaining areas
- To maximize coverage, do not oversaturate tile. Minimize application overlap

Console Open Work:

- Verify all underlined items in the procedure are correct
- Verify tool and hardware locations have not changed from assumed location in tool config and detailed procedure
- Gap filler cutting plan – need to retrieve forceps or needle nose pliers
- Modify procedure and tool quantities (e.g. gel brushes) if multiple damage sites required
- Develop photo requirement (e.g. photogrammetry, post gel cleaning...)
- Determine stowage location of large trash bag (inside/outside, retrieval)

Get Aheads:

- Configure SSRMS w/APFR, TS, and WIF extender (as reqd)

If unable to leave SSRMS configured overnight:

- Relocate tool stanchion from PMA1 WIF 02 to a location near airlock APFR

Notes:

- APFR ingress aid should be avoided (risk of ingress aid impacting tile)
- Needle nose pliers and a spare set of EMU scissors (with a manufactured tether point) will be used if gap filler is present and requires removal
- EV2 should minimize motion during photos, cavity cleaning and EW application
- Only tile substrate should be cleaned. Avoid contact with surrounding TPS (gap filler, RCG, SIP, etc) to minimize gel residue
- Report any loose or removed tile pieces >0.25 inch in diameter
- To ensure uniform cavity cleaning with limited supply of brushes, clean entire surface with progressive passes, starting with larger, 3-in brushes first
- For ORM, reference ORM NOTES/CAUTIONS/WARNINGS

Cautions:

- To minimize risk of contacting orbiter tiles, the supporting EV should not be in front of the plane of the APFR boot plate
- Damaged RCG can cut glove RTV. It does not damage the underlying protective layers
- Do not "wipe" gel brush across tile surface (breaks fibers and tears gel). Use normal to surface patting motion only
- Gel brush should be used immediately after removal from caddy due to thermal limitations
- To prevent leakage, close main valve when EWA not in active use
- Do not close hatch until EMU water – OFF for 2 min
- For ORM, reference ORM NOTES/CAUTIONS/WARNINGS

Warnings:

- For ORM, reference ORM NOTES/CAUTIONS/WARNINGS

Assumptions:

- Shuttle docked or in final ORM position
- MMACS flight control team requires 8 psi in orbiter airlock prior to and post undock
- SSRMS LEE starts near ISS A/L if based from WS4 or Lab PDGFs, or just fwd of ESP2 if MT at WS5
- Tool stanchion is in APFR at PMA1 WIF02
- An APFR is on airlock tool box
- All tools are located as listed in tool config sheet
- Safety tethers with slide locks are being used (no redundant tethering)
- In ORM, because EV crew loads on SSRMS cause SRMS/orbiter motion, EV crew cannot configure SSRMS and TS during SSRMS maneuvers. TS config must be complete prior to SSRMS maneuver to worksite

Timeline Considerations:

- Modifications to the procedure for flight specific crewmembers should be minimized (only small preference items such as safety tethers configs). As noted during HTV and NBL runs, deviations from the timeline will cause improper repair results and increases in the duration of the EVA, respectively
- If necessary (for EVA duration/time limitations) some SSRMS Cleanup and EVA Cleanup steps can be deleted as a time savings (may require a stage EVA to complete cleanup)
- Time predictions for cavity cleaning and repair are only estimates as the size and condition of damaged cavity cannot be predicted

SSRMS GAP FILLER REMOVAL SUMMARY TIMELINE

PET TIME (HR : MIN)	IV/SRMS	EV1 (BOOM)	EV2
00:00		POST DEPRESS AND A/L EGRESS (00:15)	POST DEPRESS AND A/L EGRESS (00:15)
		EVA SETUP (00:15) <ul style="list-style-type: none"> Translate to SSRMS ingress area 	EVA SETUP (00:15) <ul style="list-style-type: none"> Translate to SSRMS ingress area
01:00	SSRMS: May need to reconfigure for gap filler removal tasks	GAP FILLER REMOVAL SETUP (00:50) <ul style="list-style-type: none"> Gap Filler Tool Prep (00:20) SSRMS Setup and Ingress (00:15) Mnvr to Gap Filler Area 1 (00:15) 	GAP FILLER REMOVAL SETUP (00:50) <ul style="list-style-type: none"> Gap Filler Tool Prep (00:20) SSRMS Setup and Ingress (00:15)
02:00	SSRMS: Gap Filler Removal Area 1 posn	GAP FILLER REMOVAL (00:30) <ul style="list-style-type: none"> Perform Gap Filler Pull steps (00:10) If reqd, perform Gap Filler Cut steps (00:20) 	COMM ASSIST & ISS TASKS (00:30) <ul style="list-style-type: none"> Maintain comm contact with EV1 Perform other tasks in vicinity
	SSRMS: Egress posn	SSRMS EGRESS AND CLEANUP (00:35) <ul style="list-style-type: none"> Mnvr to SSRMS egress location (00:20) Cleanup APFR and tools (00:15) 	SSRMS EGRESS AND CLEANUP (00:35) <ul style="list-style-type: none"> Assist EV1
03:00		OTHER EVA TASKS (03:35)	OTHER EVA TASKS (03:35)
04:00			
05:00			
		CLEANUP AND A/L INGRESS (00:30) <ul style="list-style-type: none"> Translate to ISS A/L 	CLEANUP AND A/L INGRESS (00:30) <ul style="list-style-type: none"> Translate to ISS A/L Stow APFR
06:00			
07:00	EVA TIME: 06:30		

BOOM GAP FILLER REMOVAL SUMMARY TIMELINE

PET TIME (HR : MIN)	IV/SRMS	EV1 (BOOM)	EV2
00:00 ---		POST DEPRESS AND A/L EGRESS (00:15)	POST DEPRESS AND A/L EGRESS (00:15)
---		EVA SETUP (00:30) <ul style="list-style-type: none"> Translate to Lab/PMA2; perform safety tether swap (00:20) 	EVA SETUP (00:30) <ul style="list-style-type: none"> Retrieve ingress aid w/APFR from CETA cart; stow on BRT (00:10) Translate to Lab/PMA2; perform safety tether swap (00:20)
01:00 ---	IV: Give GO to reposition SRMS/Boom SRMS: Mnv to EE INGRESS posn (EE tip to sill)	BOOM SETUP AND INGRESS (01:20) <ul style="list-style-type: none"> Translate to SRMS EE (Orbiter port/aft sill) (00:10) Perform safety tether swap onto EE with 85' tether 	BOOM SETUP AND INGRESS (01:20) <ul style="list-style-type: none"> Translate to SRMS EE (Orbiter port/aft sill) (00:10)
02:00 ---		<ul style="list-style-type: none"> Install PAD and APFR (00:20) Tool setup (00:20) Boom Tip/APFR ingress (00:15) Mnv to Gap Filler Area 1 (00:15) 	<ul style="list-style-type: none"> Install PAD and APFR Tool setup Assist EV1 ingress APFR
---	SRMS: Gap Filler Area 1 posn	GAP FILLER REMOVAL (00:30) <ul style="list-style-type: none"> Perform Gap Filler Pull steps (00:10) If reqd, perform Gap Filler Cut steps (00:20) 	GAP FILLER REMOVAL (00:30) <ul style="list-style-type: none"> Assist EV1 as capable from Orbiter sill
03:00 ---		ADDITIONAL TASKS (02:10) <ul style="list-style-type: none"> Additional Gap Filler Removal Areas Other tasks 	ADDITIONAL TASKS (02:10) <ul style="list-style-type: none"> Additional Gap Filler Removal Areas Other tasks

04:00 ---			
---	SRMS: Boom tip EGRESS posn	BOOM EGRESS AND CLEANUP (01:00) <ul style="list-style-type: none"> Mnv to sill for egress (00:20) Egress APFR and remove APFR/PAD (00:20) 	BOOM EGRESS AND CLEANUP (01:00) <ul style="list-style-type: none"> Assist EV1
05:00 ---	IV: Give GO to reposition SRMS/Boom SRMS: Mnv to SRMS EE tether removal posn (Boom tip to sill)	<ul style="list-style-type: none"> Tether swap onto PMA tether, retrieve 85' tether (00:10) Tool cleanup (00:10) 	<ul style="list-style-type: none"> Assist EV1
---		CLEANUP AND A/L INGRESS (00:45) <ul style="list-style-type: none"> Translate to Lab/PMA2, tether swap (00:20) 	CLEANUP AND A/L INGRESS (00:45) <ul style="list-style-type: none"> Translate to Lab/PMA2, tether swap Stow APFR and ingress aid (00:10)
06:00 ---			

07:00 ---	EVA TIME: 06:30		

GAP FILLER REMOVAL (00:30) (Cont)

IV/SRMS	EV1	EV2
<p>RMS: Gap Filler Removal Area #1</p>	<ol style="list-style-type: none"> 1. Visually locate protruding gap filler 2. GCA close to worksite <div style="border: 2px solid black; padding: 5px; margin: 10px 0;"> <p style="text-align: center;">WARNING</p> <ol style="list-style-type: none"> 1. Broken or damaged tile RCG is sharp 2. Avoid any inadvertant contact with tile 3. Establish continuous comm protocol when performing GCA near TPS 4. EVA Hacksaw serrated edge is sharp 5. Preference is to refrain from contacting tile with hand, but if required only gentle hand reaction loads can be used on the tile. Distribute load over several fingers or use back of fingers </div> <p style="text-align: center;">NOTE</p> <ol style="list-style-type: none"> 1. Use continuous comm to report actions and reactions as steps are performed 2. Only pull with low forces; gap filler should pull out at less than 10 lb force 3. GCA away from worksite prior to stowing gap filler in trash bag (minimize crew profile while at worksite) <ol style="list-style-type: none"> 3. When in position, give RMS GO for brakes 4. Attempt gap filler pull: <ol style="list-style-type: none"> 1) Use fingers to pull gap filler out 2) If more force reqd, use the forceps (or the needlenose pliers) to grab onto the gap filler and pull out 	

GAP FILLER REMOVAL (00:30) (Cont)

IV/SRMS	EV1	EV2
	<p>5. If no joy, cut gap filler (see Task Data Sheet: Gap Filler Removal Considerations)</p> <p style="text-align: center;"><u>NOTE</u></p> <ol style="list-style-type: none">1. Towards end of cutting, switching to a shorter stroke with EVA hacksaw might leave a cleaner cut on the end2. EVA hacksaw blade should be held flush with tile surface. It can be lightly held against the surface3. Survey tile steps and avoid tile steps when cutting <p>6. Survey repaired area; visually verify close cut to OML (< 0.25" protrusion left)</p> <p>7. GCA away from worksite</p> <p>8. Stow gap filler from forceps/needlenose pliers in trash bag</p> <p>9. Repeat steps 1-8 as reqd for each area of gap filler protrusion. If reqd, mnvr to access Orbiter sill for APFR egress, reconfiguration, and ingress; mnvr to next gap filler location</p> <p>10. On MCC GO, perform photo closeout using digital camera on BRT</p>	

GAP FILLER REMOVAL PULL/CUT OPERATIONS – TASK DATA

Estimated Task Duration:

	With RMS	Without RMS
One EV Crew	00:30*	NA
Two EV Crew	NA	NA

*Time does not include RMS setup or maneuvers

Tools:

EV1	EV2
EVA hacksaw (stowed in trash bag)	N/A
Small trash bag	
Forceps OR needlenose pliers	
Digital camera (stowed on BRT)	

Foot Restraints:

Task	WIF	APFR Setting
Gap filler pull/cut area 1	SRMS, SSRMS, boom	TBD
Gap filler pull/cut area 2	SRMS, SSRMS, boom	TBD
Gap filler pull/cut area 3	SRMS, SSRMS, boom	TBD
Gap filler pull/cut area 4	SRMS, SSRMS, boom	TBD

Gap Filler Removal Considerations:

1. Removal via pulling is universal regardless of type of gap filler:
 - a) Attempt to pull with fingers first
 - b) If additional force is required, use either the forceps OR the needlenose pliers (crewmember preference) to apply more force when pulling the gap filler. To spread force of pull across gap filler, use either tool such that tool surface area contact with gap filler is maximized (see figure 1)

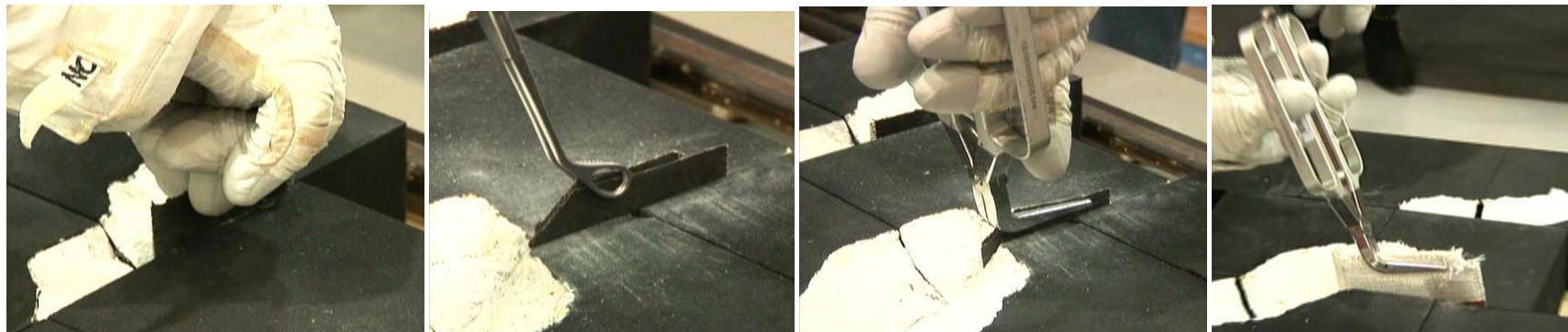


Figure 1 – Gap filler pull can be achieved via fingers, forceps, or needlenose pliers regardless of gap filler type

Notes/Cautions/Warnings – Also see TPS Notes/Cautions/Warnings (TPS REPAIR)

Notes:

1. Use continuous comm to report actions and reactions as steps are performed
2. Only pull with low forces; gap filler should pull out at less than 10 lb force
3. GCA RMS away from worksite prior to stowing gap filler in trash bag (minimize crew profile while at worksite)
4. Toward end of cutting, switching to a shorter stroke with EVA hacksaw might leave a cleaner cut on the end
5. EVA hacksaw blade should be held flush with tile surface. It can be lightly held against the surface
6. Survey tile steps and avoid tile steps when cutting

Cautions:

Warnings:

1. Broken or damaged tile RCG is sharp
2. Avoid any inadvertent contact with tile
3. Establish continuous comm protocol when performing RMS GCA near TPS
4. EVA hacksaw serrated edge is sharp
5. Preference is to refrain from contacting tile with hand, but if required, only gentle hand reaction loads can be used on the tile. Distribute load over several fingers or use back of fingers

GAP FILLER REMOVAL PULL/CUT OPERATIONS – TASK DATA (Cont)

2. Removal via cutting gap filler is dependent on gap filler type:

1) Black RTV-coated and Ceramic Ames Gap Filler – also dependent on surrounding area:

a) For surrounding area composed of undamaged tiles, use EVA hacksaw. A tool angle of 45 deg to gap filler appears to maximize the effectiveness of each cutting stroke. One direction (upstroke vs backstroke) will cut more effectively than the other direction; this effective direction is dependent on whether the tool is configured for left or right handed operation

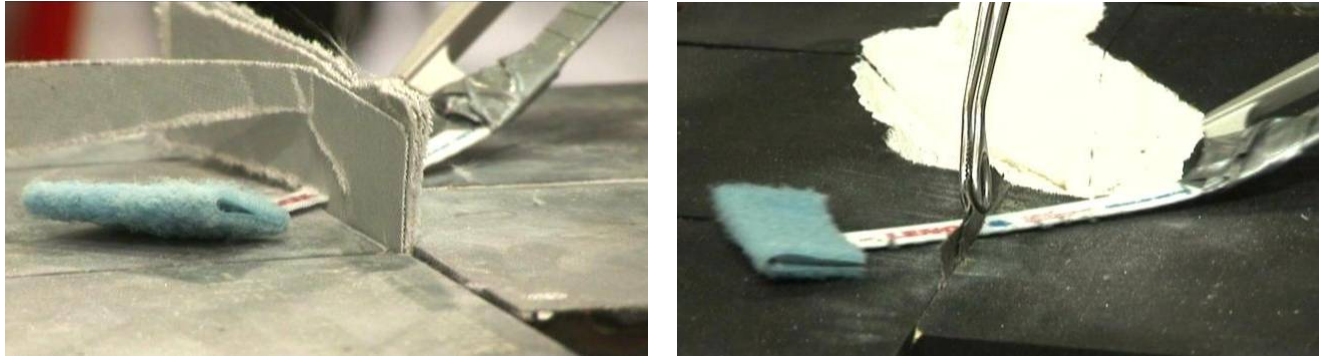


Figure 2 – Note the left picture contains ceramic gap filler being cut along flown tile; the hacksaw serrated blade does not damage the tile surface. The streaks seen in the right picture are a result of the material used to create the mock tiles

b) For area composed of both undamaged and damaged tiles, use EVA hacksaw unidirectionally: place hacksaw so that cut is toward undamaged tile; cut gap filler; pull hacksaw completely away from gap filler; reposition the hacksaw; and cut toward undamaged tile again



Figure 3 – After each cut along a damaged/undamaged site, remove hacksaw and reposition for the next cut

GAP FILLER REMOVAL PULL/CUT OPERATIONS – TASK DATA (Cont)

- c) For area composed of damaged tiles, use the EMU scissors



Figure 4 – Note, analysis may indicate that there is no need to remove gap filler from a damaged area prior to tile repairs

II) Pillow Gap Filler

- a) Initial cut should be done with hacksaw at a 45 deg angle to gap filler
- b) Use scissors to cut the Inconel foil closer to the tile
- c) Use either fingers or forceps/needlenose pliers to clean up loose fabric. Note, analysis may indicate that this fabric is acceptable for reentry, in which case clean up is not necessary



Figure 5 – Cutting pillow gap filler may require several steps before the area is completely cleaned up

- d) Do not attempt to push pillow gap filler back in; there is no way to ensure the pillow gap filler would stay in place. There is also concern that the pushing motion may cause damage to a lip profiled tile. In addition, during a test to evaluate feasibility of pushing gap filler back in, the flexibility of the material made successful achievement of this task unlikely

RCC CRACK REPAIR BAG ASSEMBLY

1. Unfold RCC crack repair bag exterior (location _____), position with handrail side down



Figure 1 – RCC crack repair bag exterior, folded for launch, and unfolded for assembly

2. Velcro bag interior centered onto bag exterior with temperature sensor end toward handrail end



Figure 2 – Installation of bag interior onto exterior

3. Hook bag interior to exterior (5 places) by looping through double D-rings



Figure 3 – Double D-ring installation

4. Assemble Bag interior:
 - a. Velcro gun tip inserts (2) into bag corners, ensure Velcro mated firmly
 - b. Remove, stow small gun tip inserts to ensure gun fit as reqd
 - c. Install gun handle inserts, ensure Velcro attached on bottom and sides



Figure 4 – Gun inserts in bag interior

RCC CRACK REPAIR BAG ASSEMBLY (Cont)

- d. Unfold temperature sensor insert, mate Velcro tabs (5) to hold shape



Figure 5 – Temperature sensor insert folded for launch and assembled

- e. Install temperature sensor insert by sliding in tab and folding Velcro flap over top lip
- f. Install EVA wipe insert, matching up Velcro on underside and folding flaps (2) over insert edges (NOTE: should only install one way as underside Velcro is off center)



Figure 6 – Interior bag tool inserts installed

5. Assemble bag exterior and door:
 - a. Fold up exterior shorter sides and mate Velcro to bag interior
 - b. Fold up remaining two sides, mating Velcro along both sides of corners
 - c. Push along entire bag interior to mate Velcro between interior and exterior top circumference
 - d. Unfold door and separate hinge flaps



Figure 7 – Door and hinge flaps with quarter turn fastener openings

- e. Install quarter turn fasteners (2) and then mate hinge Velcro on interior and exterior sides of door

RCC CRACK REPAIR BAG ASSEMBLY (Cont)

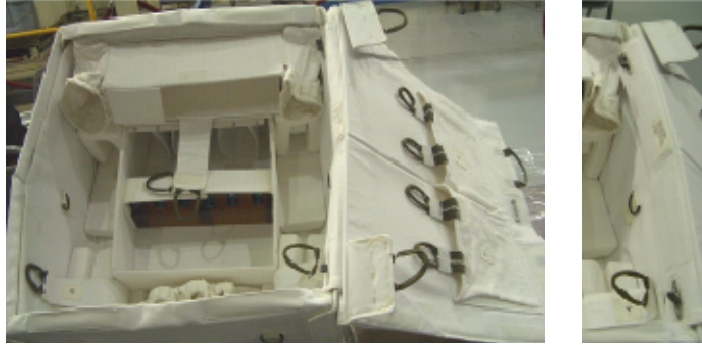


Figure 8 – Door hinge installed

6. Install tools in bag
 - a. Ensure all Velcro straps are used to retain tools
 - b. Install 2" spatulas (3) and 5" spatula, location _____
 - c. Lg trash bag with RET, location _____
 - d. Broom clip caddy, location _____
 - e. Install EVA wipes, quantity _____, location _____

NOTE

Avoid scratching polished palette surfaces

- f. Remove/discard films from both sides of each palette, install in door
- g. Attach adjustable tethers (4) to bag exterior, location _____

NOTE

Do not stow guns in bag until day of EVA
(require ambient exposure)

TEMP SENSOR DISASSEMBLY POST-EVA

- Temp Sensor
1. Main Power sw – OFF
 2. Peel back MLI and remove battery compartment lid by turning captive thumbscrew ccw 3 turns
 3. Remove 3 batteries from the back of the temp sensor, stow
 4. Reinstall battery compartment lid by turning thumbscrew cw 3 turns until fingertight
 5. Stow sensor, location _____

RCC CRACK REPAIR BAG DISASSEMBLY POST-EVA

1. If large NOAX stains found on any bag parts, gray tape towel over stain before stowage
2. Remove crack repair bag door:
 - a. Release quarter turn fasteners and hinge and door stay Velcro
 - b. Fold flaps towards palette pockets, then fold in half palette side out



Figure 1 – Folded door stowage configuration

3. Remove crack repair bag interior:
 - a. Peel exterior bag sides back from bag interior
 - b. Remove temperature sensor insert, undo Velcro and collapse sides for stowage

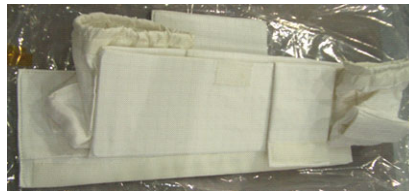


Figure 2 – Temp sensor folded for stowage

- c. Remove remaining tool inserts (gun holsters, EVA wipes), stow inside broom clip compartment



Figure 3 – Tool inserts in broom clip compartment

- d. Release D-rings (5), then remove interior bag from exterior bag
- e. Fold and Velcro interior bag sides over broom clip compartment for stowage



Figure 4 – Interior bag folded for stowage

RCC CRACK REPAIR BAG DISASSEMBLY POST-EVA (Cont)

4. Disassemble crack repair bag exterior:
 - a. Fold in short sides with handles
 - b. Flip bag over, fold in longer sides with bayonets
 - c. Fold entire bag in half, handrail side ends up on top



Figure 5 – Exterior bag folded for stowage

5. Stow all bag pieces, location _____

TEMPERATURE PROBE ASSEMBLY

- Temp Probe
1. Retrieve Temperature Probe, S/N _____, location _____
 2. ✓ Main Power sw – OFF
 3. Peel back MLI and remove battery compartment lid by turning captive thumbscrew ccw 3 turns
 4. Install 3 AA Alkaline batteries into back of probe
 5. Reinstall battery compartment lid by turning thumbscrew cw 3 turns until finger tight
 6. Reinstall MLI flap over battery compartment
 7. Main Power sw – ON
 8. Open display MLI flap and probe tip MLI flap
 9. Push Display Wake button
 10. Verify display operational
 11. Using light contact onto wall or locker, depress ribbon until probe tip is in contact with surface
 12. When temp stabilizes, read temp, IV record _____ (expect ~21 degC)
 13. Close MLI flap over probe tip
 14. Main Power sw – OFF
 15. Close display flap; stow temp probe in CRM Bag

CRM APPLICATOR ASSEMBLY

1. Remove Semco tubes (2) from ice-pack storage, location _____, tube should be cold to touch (use towel or washcloth for handling if reqd, report to MCC if tube not cold)

NOTE

Semco tubes must be removed from ice-pack storage 8-36 hr prior to airlock depress.

Expect possible condensation on tube/gun as it warms up.

CRM Applicator should be stowed without MLI until day of EVA to allow material to reach ambient temperature

- CRM Applicator
2. Retrieve CRM Applicators w/MLI (2 ea.), location _____
 3. Remove MLI covers (2); temp stow in CRM Bag until day of EVA
 4. Unscrew plunger assembly from CRM Applicator housing, ccw
 5. Fully retract plunger
 6. Cut Semco tube outer bag, remove tube, discard bag
 7. Install Semco tube into CRM Applicator housing, leaving cap on tip but removing flange cap from the back
 8. Screw plunger assembly onto CRM Applicator housing cw at least 1.5 turns (3 half turns)
 9. Verify teeth not engaged (black triangle down)
 10. Stage latex gloves (WCS), and dry wipes (WCS/Vol. B) in CRM Applicator nozzle Ziploc in CRM Bag for day-of-EVA installation of nozzles
 11. Temp stow CRM Applicators (2) with RETs (2) outside of bag until day of EVA

CRM APPLICATOR NOZZLE INSTALLATION (DAY OF EVA)

- IV
- CRM Applicator
1. Retrieve Ziploc bag (latex gloves, dry wipes, and nozzles), CRM applicators and CRM Applicator MLI covers from RCC CRM Bag
 2. Don latex gloves, goggles, location _____
 3. Remove tube cap (ccw, use 10-in adjustable wrench as reqd), stow in Ziploc
 4. Install CRM Applicator nozzle (cw until threads fully engaged, use 10-in adjustable wrench as reqd)
 5. Wipe any excess around nozzle using dry wipe
 6. Install MLI cover on CRM Applicator
 7. Cover nozzle tip with MLI cap
 8. Stow CRM Applicators (2) in CRM Bag; verify shutoff valve not opened
 9. Stow all dry wipes and latex gloves in Ziploc, discard
 10. Stow 10-in adjustable wrench, as reqd

EVA TPS INSPECTION/REPAIR INHIBIT PAD

ORBITER

Orbiter Antennas	
MCC-H	1. √KU BAND Mask – active 2. √KU BAND EVA Protect Box – active If EV crew ≤ 20 ft from antenna and outboard of stbd hinge line or contact with DEA possible:
IV A1U	If no comm, or on MCC call: 3. KU BAND POWER – STBY CONTROL – PANEL/COMMAND
<u>NOTE</u> Possible loss of comm when forced to alternate S-Band antenna	
If EV crew will be forward of forward bulkhead: If TPS work on upper surfaces: If EV crew ≤ 1.6 ft from S-Band antenna:	
IV A1R	4. S-BAND FM ANT – XMTR LOWER/RCVR UPPER
	5. √MCC, lower antenna selected If no comm, or on MCC call:
A1L	6. S-BAND PM ANT – LL FWD If TPS work on lower surfaces: If EV crew ≤ 1.6 ft from S-Band antenna:
A1R	7. S-BAND FM ANT – XMTR UPPER/RCVR LOWER
	8. √MCC, upper antenna selected If no comm, or on MCC call:
A1L	9. S-BAND PM ANT – UL FWD If EV crew >1.6 ft away from all S-band antennas:
	10. S-BAND ANT – GPC
If TPS work on lower surfaces:	
IV O14:C	11. cb MNA TACAN 1 – op
O15:C	cb MNB TACAN 2 – op
O16:C	cb MNC TACAN 3 – op
O14:E	12. cb MNA RADAR ALTM 1 – op
O15:E	cb MNB RADAR ALTM 2 – op
O14:E	13. cb MNA MLS 1 – op
O15:E	cb MNB MLS 2 – op
O16:E	cb MNC MLS 3 – op

Cameras (Orbiter & ISS)	
	Point PLB, RMS, SSRMS and ISS cameras away from EVA worksite, if possible (outgassing concern)
LCS, LDRI & Boom	
	Refer to GENERIC EVA INHIBIT PAD

USOS

TCS	
IV L12	1. √TCS POWER – OFF
LAB Window	
IV	1. Close window (outgassing concern)
PCU	
<u>NOTE</u> PCUs may require up to 1 hr warm-up period before they are operational. No further action is reqd in the event of one or two PCU failures	
MCC-H	1. √PCUs (two) operational in discharge mode

RSOS

FGB Antennas	
MCC-M	1. √KURS P [Kurs] – Deactivate
Soyuz Antennas	
MCC-M	2. √KURS A [Kurs] – Deactivate
SM Antennas	
MCC-M	3. √Global Timing Sys 1 (400.1MHz) [GTS] – Deactivate
MCS	
If shuttle controlling attitude:	
MCC-M	1. √FGB Attitude Control Thruster Valves (80) – closed
	2. √FGB Attitude Control Manifold Valves – closed KШK1, KШK2, KШK4, KШK5, KШK9, OKO3, OKГ3, OKO6, OKГ6, OKO7, OKГ7, OKO8, OKГ8
	3. √FGB MCS unpowered
	4. √SOYUZ Attitude Control Thruster Valves (52) – closed
	5. √SOYUZ manifold valves (ЭКО1, ЭКО2, ЭКГ1, ЭКГ2) – closed
	6. √SOYUZ Main Engine Valves (K1, K2, K3, K4, K5, K6) – closed
	7. √SOYUZ MCS unpowered

NOTES, CAUTIONS, WARNINGS

EVA TPS INSPECTION/REPAIR INHIBIT PAD (Cont)

ORBITER

Orbiter RCS

If ISS controlling attitude:

- IV O14:F, √Pri RJD LOGIC, DRIVER (sixteen) – OFF
O15:F,
O16:F

RJD MANF L5/F5/R5 DRIVER – OFF

NOTE

Expect DAP RECONFIG message
after FRCS manifold 5 status
overridden to close

GNC 23 RCS

RCS FWD – ITEM 1 EXEC (*)

- MANF VLVS OVRD 1 – ITEM 40 EXEC (CL)
2 – ITEM 41 EXEC (CL)
3 – ITEM 42 EXEC (CL)
4 – ITEM 43 EXEC (CL)
5 – ITEM 44 EXEC (CL)

RCS LEFT – ITEM 2 EXEC (*)

- MANF VLVS OVRD 1 – ITEM 40 EXEC (CL)
2 – ITEM 41 EXEC (CL)
3 – ITEM 42 EXEC (CL)
4 – ITEM 43 EXEC (CL)
5 – ITEM 44 EXEC (CL)

RCS RIGHT – ITEM 3 EXEC (*)

- MANF VLVS OVRD 1 – ITEM 40 EXEC (CL)
2 – ITEM 41 EXEC (CL)
3 – ITEM 42 EXEC (CL)
4 – ITEM 43 EXEC (CL)
5 – ITEM 44 EXEC (CL)

To recover/enable RCS thrusters after being inhibited,
and ISS controlling attitude:

- IV O14:F RJDA 1A L2/R2 MANF DRIVER – ON
O15:F RJDA 1B L1/L5/R1 MANF LOGIC – ON
O16:F RFDA 2B L3/R3/R5 MANF LOGIC – ON
RJDF 2B F4/F5 MANF LOGIC – ON
RJD MANF L5/F5/R5 DRIVER – ON

Wait 5 sec, then:

- O15:F RJDA 1B L1/L5/R1 MANF LOGIC – OFF
O16:F RFDA 2B L3/R3/R5 MANF LOGIC – OFF
RJDF 2B F4/F5 MANF LOGIC – OFF

GNC 23 RCS

RCS FWD – ITEM 1 EXEC (*)

- MANF VLVS OVRD 1 – ITEM 40 EXEC (OP)
2 – ITEM 41 EXEC (OP)
3 – ITEM 42 EXEC (OP)
4 – ITEM 43 EXEC (OP)
5 – ITEM 44 EXEC (OP)

RCS LEFT – ITEM 2 EXEC (*)

- MANF VLVS OVRD 1 – ITEM 40 EXEC (OP)
2 – ITEM 41 EXEC (OP)
3 – ITEM 42 EXEC (OP)
4 – ITEM 43 EXEC (OP)
5 – ITEM 44 EXEC (OP)

RCS RIGHT – ITEM 3 EXEC (*)

- MANF VLVS OVRD 1 – ITEM 40 EXEC (OP)
2 – ITEM 41 EXEC (OP)
3 – ITEM 42 EXEC (OP)
4 – ITEM 43 EXEC (OP)
5 – ITEM 44 EXEC (OP)

EVA TPS INSPECTION/REPAIR INHIBIT PAD (Cont)

ORBITER

Orbiter RCS (Cont)

If shuttle controlling attitude on vernier thrusters:

IV O14:F, √Pri RJD LOGIC, DRIVER (sixteen) – OFF
O15:F,
O16:F

WARNING
EV crew shall not be positioned within 3 feet of
vernier RCS thrusters

GNC 23 RCS

RCS FWD – ITEM 1 EXEC (*)
MANF VLVS OVRD 1 – ITEM 40 EXEC (CL)
2 – ITEM 41 EXEC (CL)
3 – ITEM 42 EXEC (CL)
4 – ITEM 43 EXEC (CL)

RCS LEFT – ITEM 2 EXEC (*)
MANF VLVS OVRD 1 – ITEM 40 EXEC (CL)
2 – ITEM 41 EXEC (CL)
3 – ITEM 42 EXEC (CL)
4 – ITEM 43 EXEC (CL)

RCS RIGHT – ITEM 3 EXEC (*)
MANF VLVS OVRD 1 – ITEM 40 EXEC (CL)
2 – ITEM 41 EXEC (CL)
3 – ITEM 42 EXEC (CL)
4 – ITEM 43 EXEC (CL)

To recover/enable RCS thrusters after being inhibited,
and shuttle controlling attitude on vernier thrusters:

IV O14:F RJDA 1A L2/R2 MANF DRIVER – ON

GNC 23 RCS

RCS FWD – ITEM 1 EXEC (*)
MANF VLVS OVRD 1 – ITEM 40 EXEC (OP)
2 – ITEM 41 EXEC (OP)
3 – ITEM 42 EXEC (OP)
4 – ITEM 43 EXEC (OP)

RCS LEFT – ITEM 2 EXEC (*)
MANF VLVS OVRD 1 – ITEM 40 EXEC (OP)
2 – ITEM 41 EXEC (OP)
3 – ITEM 42 EXEC (OP)
4 – ITEM 43 EXEC (OP)

RCS RIGHT – ITEM 3 EXEC (*)
MANF VLVS OVRD 1 – ITEM 40 EXEC (OP)
2 – ITEM 41 EXEC (OP)
3 – ITEM 42 EXEC (OP)
4 – ITEM 43 EXEC (OP)

ORM WARNINGS AND NOTES

WARNING

1. Limit all EV loads (move very slowly) on ISS prior to SSRMS ingress and while on SSRMS (loads into structure and into APFR/SSRMS affect overall SRMS/ORM stability)
2. Prior to beginning work on the Orbiter:
 - a. Perform a trial slow layback on the SSRMS ~ 5 ft from Orbiter TPS; observe Orbiter movement for 3 min to verify it is not significant (on the order of 2 inches or less, if motion is perceived)
 - b. Effect of EV2 moving on tool stanchion should be evaluated prior to repair. If movement poses a problem for repair, EV2 should remain stationary and tool retrievals or handoffs should be performed away from vehicle
 - c. At the completion of GCA into the worksite and before touching the Orbiter, perform clearance assessment (APFR/SSRMS at least 2 ft from Orbiter)
 - d. EV should perform trial light push on TPS with gloved hand (~ 5 lb or less for ~1 sec, being careful to ramp up load slowly to avoid TPS damage) to verify movement is 'in family' with training; observe Orbiter movement for 3 min
3. Orbiter can swing past its starting point towards EV, therefore:
 - a. EV should perform work starting slightly leaned in and be ready to lean back (every so often during repair, verify starting position is still 'leaned in')
 - b. In case of out-of-the-expected Orbiter movement, SSRMS operator should be ready to drive EV away from Orbiter
 - c. After any crew contact with Orbiter, SSRMS GCA/motion not allowed until 3 min from last contact (to account for Orbiter damping)
4. SRMS brake slip can occur after EV stops force inputs (due to Orbiter momentum)
5. Reduce loads into the Orbiter and shorten duration of loading events when possible (for example, 5 lb for 10 sec or 15 lb for 5 sec could slip SRMS brakes)
6. Avoid loading the Orbiter at the peak of motion or if motion seems to be getting large:
 - a. Do not 'push a swing' as Orbiter moves towards EV (if in doubt as to whether it is near the peak, do not impart load)
 - b. Avoid sinusoidal motion (repetitive motion)
 - c. When possible, allow damping between loading events (insert wait times occasionally when possible)
7. See GENERIC NOTES, CAUTIONS, & WARNINGS (FLIGHT SPECIFIC REFERENCE)

NOTE

1. Orbiter period for movement is on the order of ~ 80 sec, SSRMS period is on the order of ~ 8 sec or less (these vary – use only as rough comparison for judging motion)
2. Counter-intuitive Orbiter motion expected (if a force is put into the Orbiter in one direction, some Orbiter resultant motion could occur in different directions)
3. Orbiter movement might be difficult to detect due to slow period and large Orbiter in view
4. Procedures are written such that EV crewmembers do not egress from the Orbiter airlock and do not translate in PLB (loading considered to be too high); therefore, any tools required from the PLB are assumed to have been retrieved on a previous EVA

TPS REPAIR CAUTIONS AND WARNINGS

CAUTION

1. Avoid TPS contact when possible to prevent TPS damage, but if contact is required or incidental:
 - a. Damaged tile RCG can cut glove RTV; it does not damage underlying protective layers
 - b. If touching the tile is required to react loads, use a light touch with the glove knuckles or a distributed finger load (several fingers, so all the load isn't carried through a single finger)
 - c. Report inadvertent TPS contact and give MCC a report on the new status of the TPS (and EMU fingertips, if required)
2. To prevent TPS damage while protecting for case of 'popping out' of a foot restraint:
 - a. Install local tether (e.g., waist tether) to foot restraint in case of inadvertent boot release from foot restraint
 - b. When possible, get confirmation from assisting crewmember that EV boots are secure in APFR
 - c. EV in foot restraint should remember to maintain outboard heel pressure, especially during maneuvers and body rotations
 - d. Unless based on boom, avoid the ingress aid (ingress aid might be required for boom operations due to higher likelihood of inadvertent boot release from APFR)
 - e. If boots come free, do not attempt re-ingress near TPS; ingress away from structure with an ingress aid or tether, or perform assisted ingress at structure
3. Two handed operations require EV to be very close to TPS – assisting EV, if nearby, should watch clearances closely

WARNING

1. TPS component powder and fibers (from tile, gap fillers, RCC) are a skin irritant in smaller quantities and an inhalant irritant in large quantities. Wipe known or suspected contaminants from gloves
2. Loss of UHF communication between EV and IV may occur, esp. under PLB doors and in some areas close to Orbiter belly
 - a. Even with analysis showing complete comm coverage through a particular trajectory, establish strict comm protocol with RMS operator near TPS (e.g., 'continue, continue') to ensure RMS operator can identify loss of comm. Consider using body coordinates for GCA close to the worksite due to the limited directional cues
 - b. EV should be prepared to give ALL STOP hand signals in WVS or other camera if voice comm lost
 - c. MCC may issue ALL STOP if EMU biomed signal lost
3. If EMU cooling is lost and the crewmember is in a remote location on the boom or arm (might not make it back to the airlock within 30 min), periodically close the DCM purge valve and open the helmet purge valve to conserve O2. For every two minutes that the helmet purge valve is open instead of the DCM valve, the 30-min limit can be increased by 1 min
4. Avoid EMU MLI contact with RCC when temperatures are predicted to be out of limits to avoid MLI and bladder damage (glove contact is okay)
5. See GENERIC NOTES, CAUTIONS, & WARNINGS (FLIGHT SPECIFIC REFERENCE) and EVA TPS INSPECTION/REPAIR INHIBIT PAD (TPS REPAIR)

TPS REPAIR NOTES

1. If the task is based on the SRMS or SSRMS, the preference for TPS repair is a single crewmember (when possible) due to concerns with incidental TPS contact. If task is based on the boom, the preference for TPS repair is both EV crewmembers on the boom to allow for better frequency response from the arm/boom system (makes the task easier and might reduce incidental contact with TPS)
2. Arm and EMU position should be optimized to prevent tool and EMU contact (esp. helmet contact) with the TPS, per PREFERRED EMU POSITIONING FOR TPS REPAIR (TPS REPAIR). OBSS or SRMS/SSRMS may provide IV with some assisting views
3. To avoid inadvertent tool/EMU contact with the TPS:
 - a. Minimize the quantity of tools taken to worksite, keeping MWS as clean as possible
 - b. Separate tools to avoid tether tangles
 - c. MWS T-bar should be snug to DCM (STS-114 gap filler pull task used T-bar)
 - d. MWS swing arm(s) should be checked prior to proximity to TPS to verify they are in the correct position; consider swingarm actuation only when backed away from TPS
 - e. If camera taken on BRT, consider having assisting EV verify BRT tightness, while ensuring EV1's capability to access camera. BRT operations are more safely accomplished when backed away from TPS
 - f. Suggested safety tether routing is between EMU legs (such that the tether is 'trapped' behind legs) with reel unlocked
 - g. Two-handed operations require EV to be very close to TPS - assisting EV must watch clearances closely
4. Consider the following for airlock or worksite tools:
 - a. EWA kit with EVA wipes if inadvertent tile damage possible
 - b. As required, practice use with MWS key w/ tether point (in case T-bar remove and re-install is required to clear work envelope)
 - c. As required, practice reach to EVA scissors in LTA
5. For Orbiter belly repairs, WVS from Shuttle might be limited, although some areas may be covered from ISS. Consider pre-configuring WVS prior to maneuvering under the Orbiter
6. EHIP and camera lighting should give sufficient EV task lighting, but IV should verify adequate views prior to GCA
7. Although small RCG cracks and chips are generally not considered critical, allowable depression (e.g., tool/EMU impact depression) can be small. For the acreage tile on STS-114 near the protruding gap fillers (not the worst case), the allowable missing RCG was 2-inch x 1.5-inch, but the allowable depression was only 0.1-inch

BOOM OPERATIONAL WARNINGS

WARNING

1. Inspection and repair operations that impart greater loads into boom/RMS system should be accomplished with RMS brakes ON
2. Minimize boom loads. Larger loads can cause RMS joint brake slip and RMS joint backdrive, possibly allowing contact between EMU and structure or between RMS/boom/APFR and structure
 - a. When possible, have assisting EV react loads during PAD install, APFR install, APFR reconfiguration, ingress and egress
 - b. Tool and/or bag config should be performed prior to APFR ingress
 - c. Move slowly when performing operations, including tool retrieval
 - d. Perform soft APFR ingress and egress
 - e. Avoid quick grabs for loose tools
 - f. If large deflections occur during APFR reconfig or ingress aid operations, maneuver boom to structure and perform action while assisted
3. To avoid increasing boom/RMS system motion:
 - a. Avoid imparting a load when motion is at a peak ('pushing a swing'); if in doubt as to whether it is near the peak, do not impart load
 - b. Avoid sinusoidal motion (repetitive motion) at frequencies near the natural frequency of the RMS/OBSS system
 - c. When possible, allow damping between loading events (insert wait times occasionally)
 - d. Do not attempt to actively damp system using legs/feet if motion is increasing
 - e. If oscillating toward structure, lightly stop motion using light gloved hand contact, but do not push away to actively counter motion
4. If brake slip occurs, allow IV to assess location before proceeding with GCA
5. For boom hardware, see GENERIC NOTES, CAUTIONS, & WARNINGS (FLIGHT SPECIFIC REFERENCE)

BOOM OPERATIONAL NOTES

BOOM/RMS SYSTEM BEHAVIOR

1. Boom/RMS deflections are primarily attributed to EV inertia/cg motion, with higher load/deflection scenarios occurring during ingress/egress and laybacks
2. Motion (prior to brake slip) comes from joint slop, joint flex, and boom flex (most deflection is from joint flex)
3. Counter-intuitive motion is expected, and it varies based on RMS configuration (if a force is put into the system one direction, some boom resultant motion could occur in different directions)
4. More motion will result from the boom/SRMS system than with the boom/SSRMS system
5. Brake slip should be anticipated for higher loading events with EV on boom (brakes have slipped on SRMS in past flights without boom)
6. Damping time is usually less than a minute
7. Boom/RMS system moves at a frequency similar to that which can cause seasickness

BOOM OPERATIONAL CONSIDERATIONS

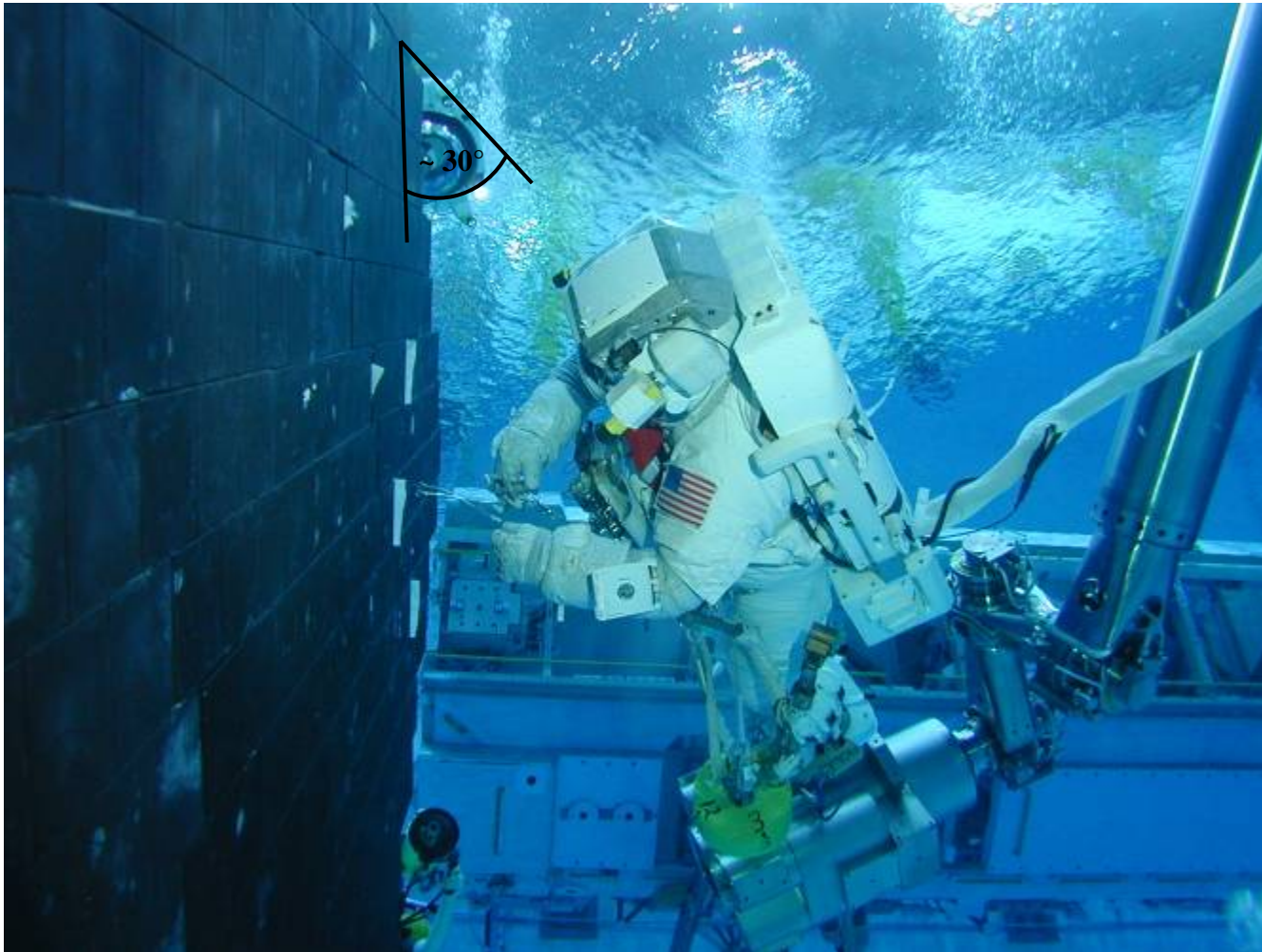
1. A practice session should be considered (where EV can perform layback, forward lean, and tool configurations) away from structure but when RMS nearly into final position
2. It is likely difficult to damp motion in free space (without a handrail/structure)
3. Grasping handrails/structure to 'muscle' the boom for damping might not be as effective as light fingertip contact
4. EV might have difficulty sensing small deflections without a visual reference
5. EV might not be able to feel brake slip
6. Longer forces (over time) cause more deflection than the same force performed more quickly (as an impulse) - deflection is driven by energy input (load + duration)
7. Due to boom motion, heels could be more likely to release from foot restraint; configure local tether at APFR and keep outboard heel pressure
8. In some arm configurations, system can be lightly 'preloaded' using gloved hand (primary EV or assisting EV) to steady boom for operations; in addition, a larger loading event can be mitigated by pressing with one hand lightly until loading event start and then releasing (transfer load from one hand to the other)
9. Increasing mass on boom (two EV, versus one EV, versus no EV) results in the following, assuming the second EV is perfectly still (contributes mass only)
 - a. Noticable boom oscillations occur at a lower frequency
 - b. Boom requires more force to deflect; deflection is smaller with the same force
 - c. Repair operations might be easier for mass/frequency reasons
 - d. Ingressing EV's operation might be easier, but assisting EV's operation might be more difficult
10. Effect of EV2 moving should be evaluated prior to repair. If movement poses a problem for repair, EV2 should remain stationary and tool retrievals or handoffs should be performed away from vehicle

BOOM/RMS HARDWARE

1. See GENERIC NOTES, CAUTIONS, & WARNINGS (FLIGHT SPECIFIC REFERENCE)

PREFERRED EMU POSITIONING FOR TPS REPAIR

Preferred positioning for TPS repair is ~ 30 degrees pitched heads down, relative to TPS and EMU PLSS. A more drastic pitch brings the helmet closer to the TPS and decreases EV crewmember ability to see helmet proximity. Less pitch causes the MWS T-bar (if used), MWS swingarms (if used), and tethers to be in close proximity to TPS



FS 13-81

EVA/115/FIN C

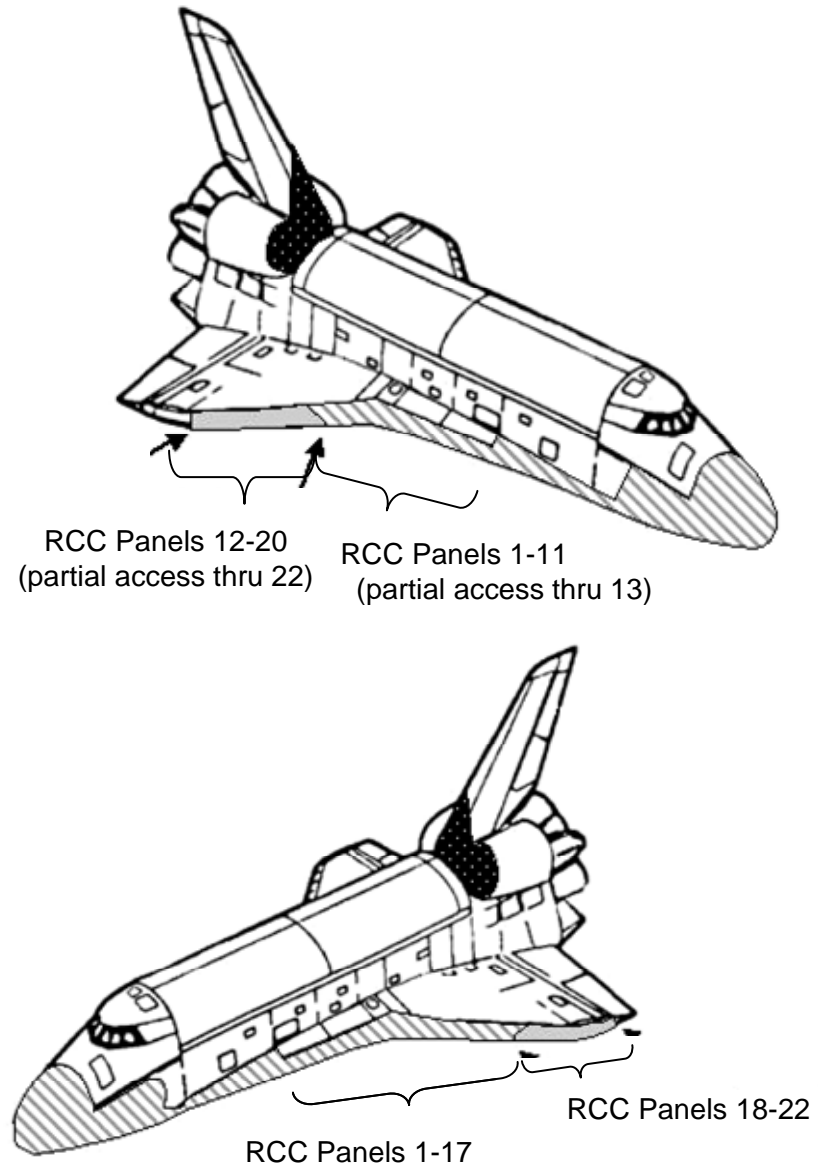
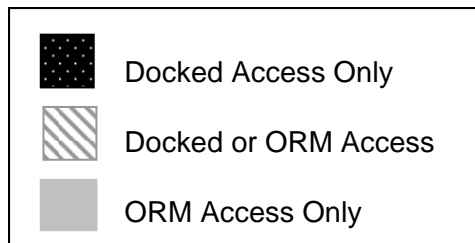
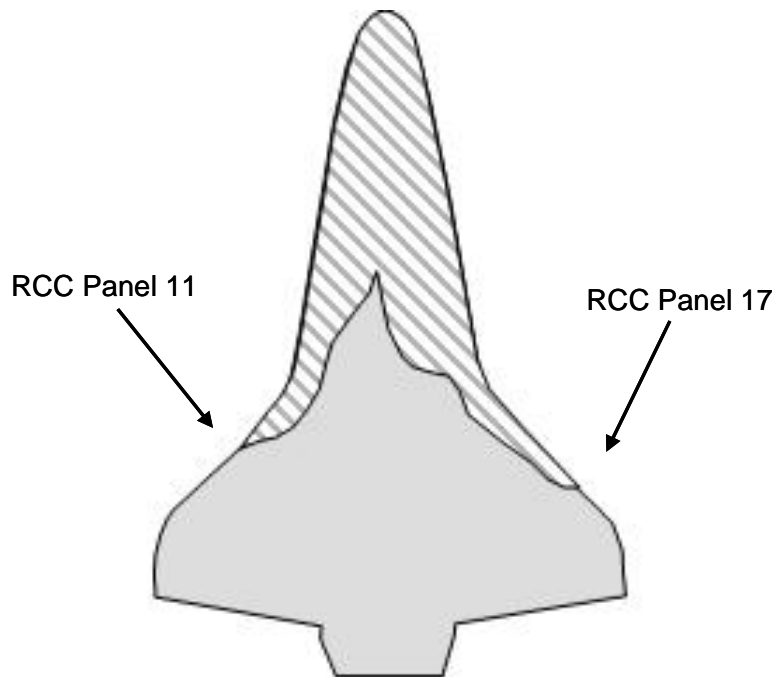
**TPS
REF DATA**

TPS REF DATA

EVA TPS REACH AND ACCESS

NOTE

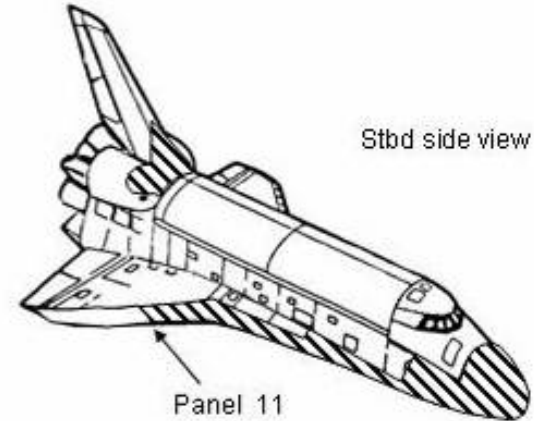
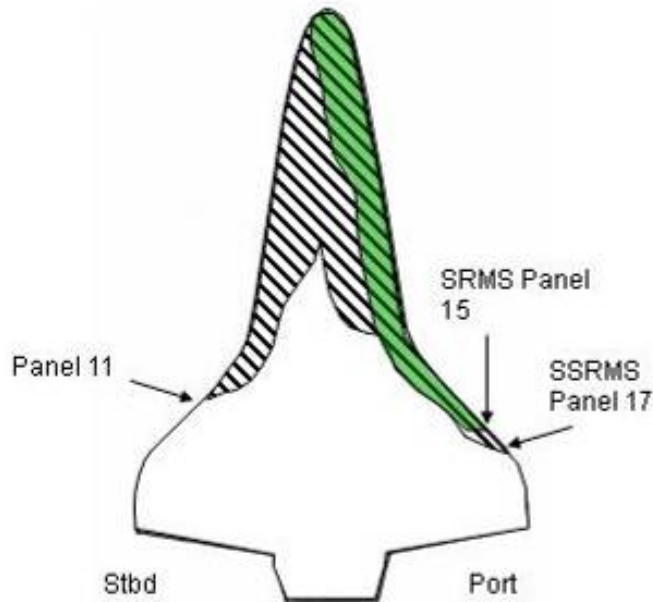
The diagrams on this page depict which areas have touch access in docked configuration vs ORM assuming you cannot use the Boom because of loads concerns. See POINT INSPECTION REACH AND ACCESS WHILE DOCKED for specific arm/EVA configurations required to achieve docked access


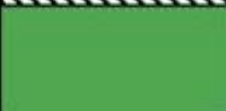


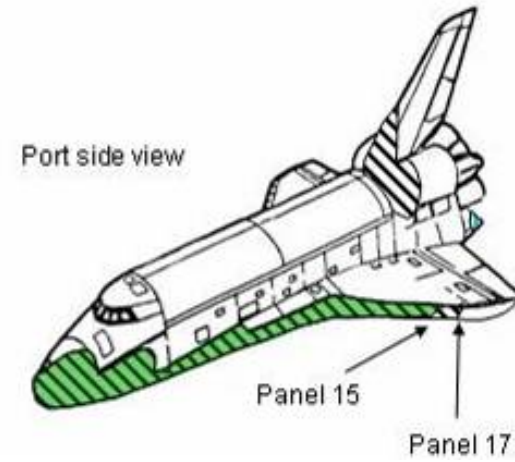
POINT INSPECTION REACH AND ACCESS WHILE DOCKED

NOTE

The diagrams on this page depict which TPS areas can be reached for Touch Access Inspections (pre-Node 2) using the SRMS or SSRMS. For areas with no pattern, access requires use of SRMS with Boom combination



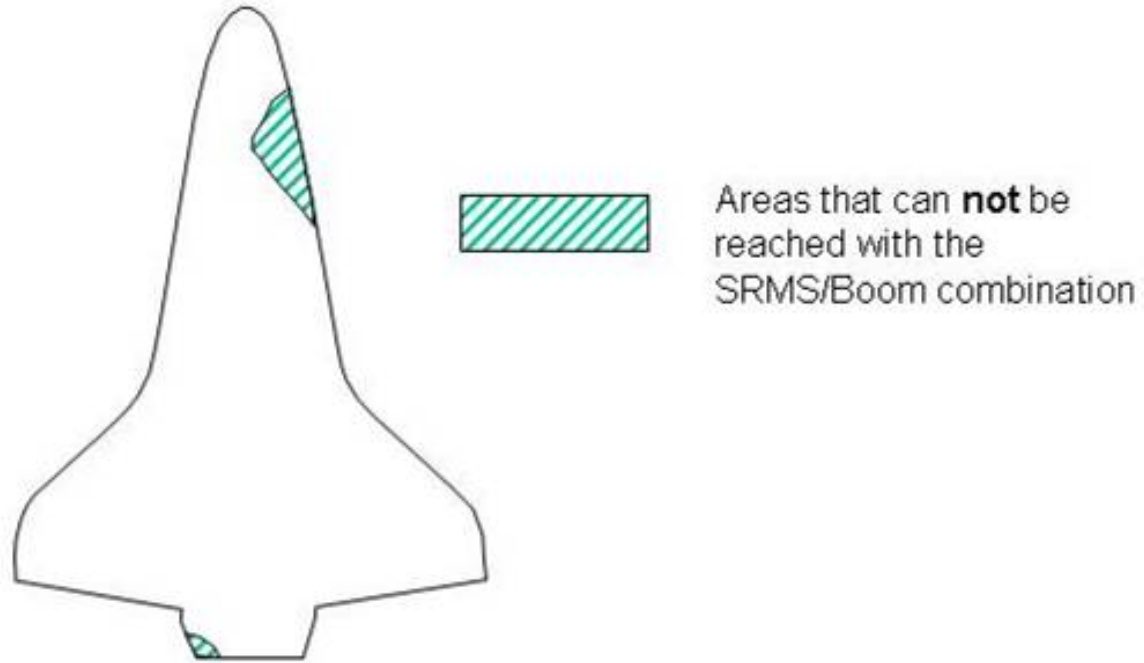
Pattern	Indicates the area can be accessed by:
	SSRMS from a combination WS4, WS5 and Lab (WIF Extender required for aft-most WLE)
	SRMS (WIF Extender required for aft-most WLE)



POINT INSPECTION REACH AND ACCESS WHILE DOCKED (Cont)

NOTE

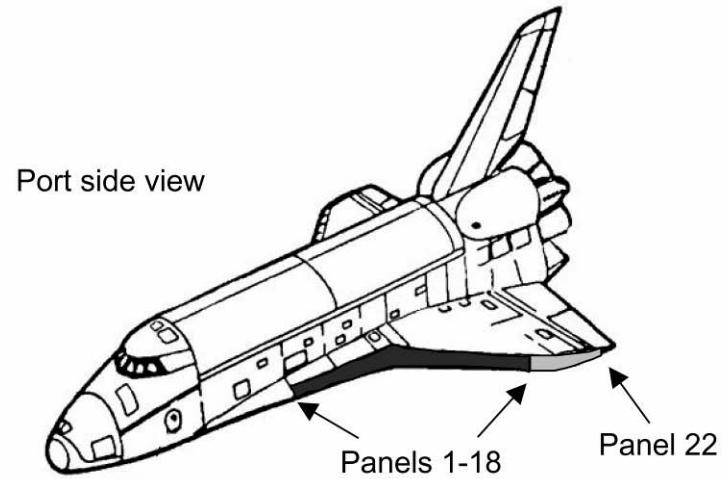
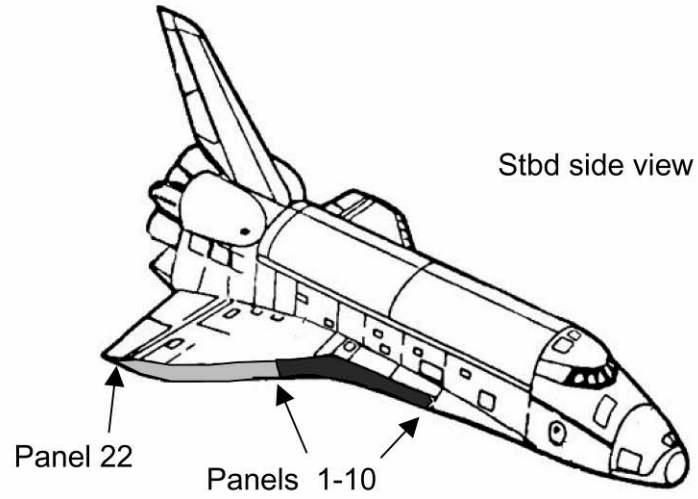
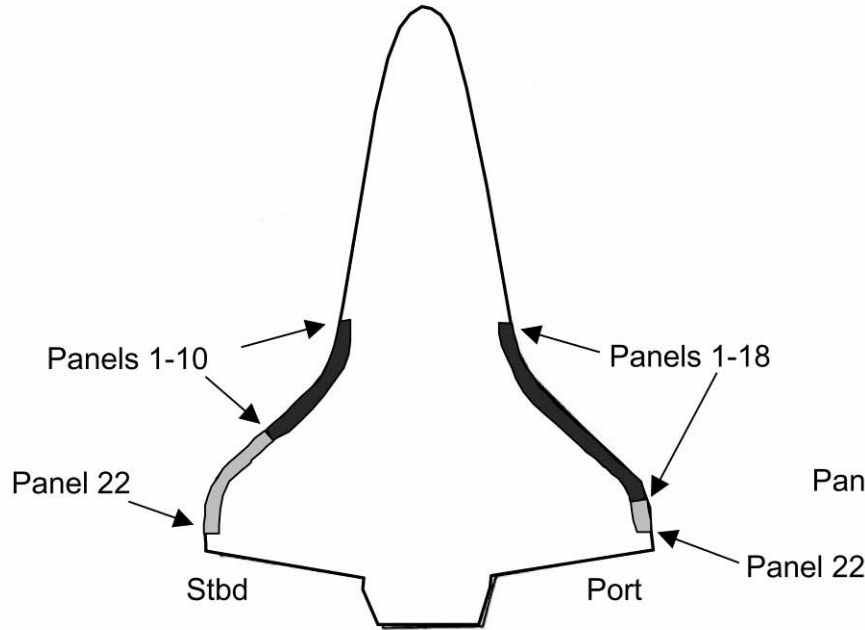
If using the SRMS with Boom combination, touch access to all WLE RCC and belly tiles can be achieved with exception of striped areas indicated in figure below

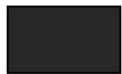



WLE MAPPING INSPECTION WHILE DOCKED

NOTE

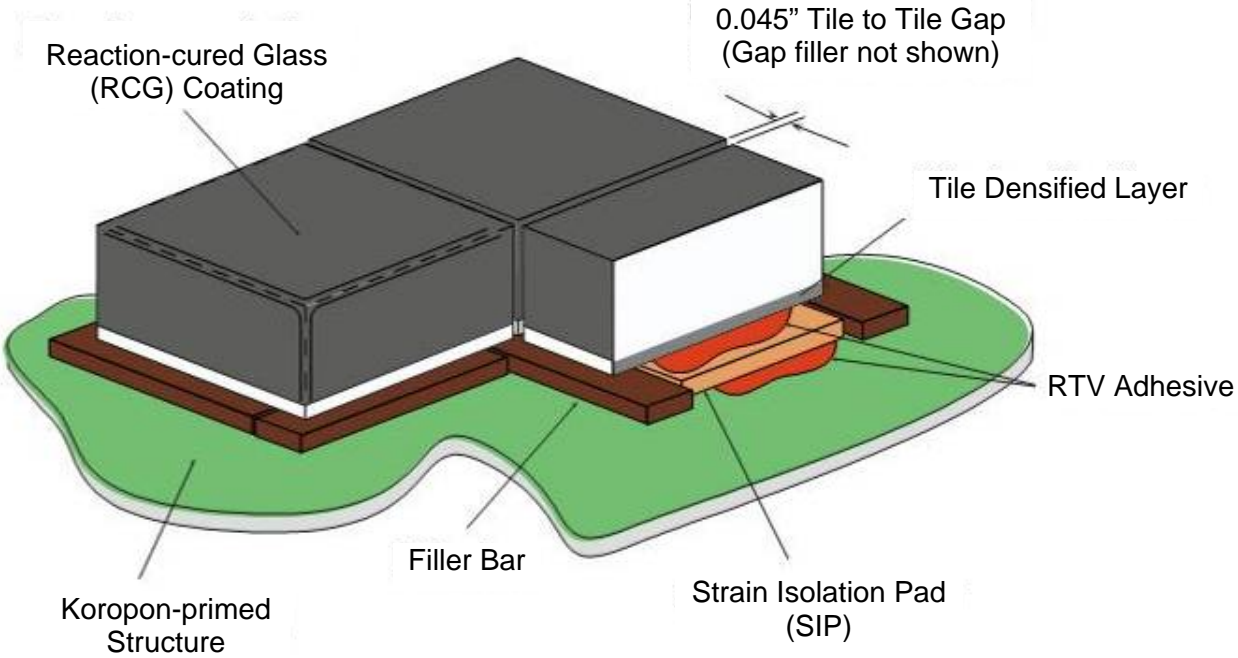
Access meets digital camera resolution requirements necessary to detect 0.25 inch damage to RCC



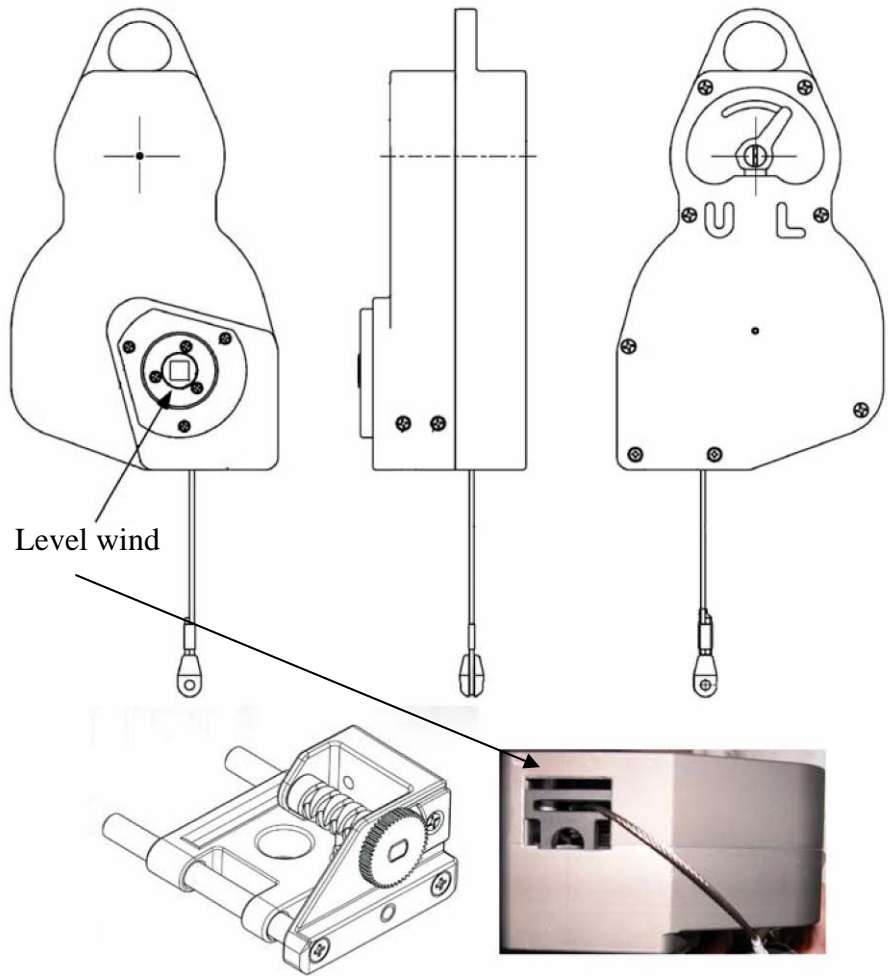
-  Access via SRMS with WIF Extender, up to 35° oblique angle, .25 inch resolution
-  Required to use SRMS and Boom for access

NOTE: SRMS and Boom can get within range for all port and stbd WLE panels

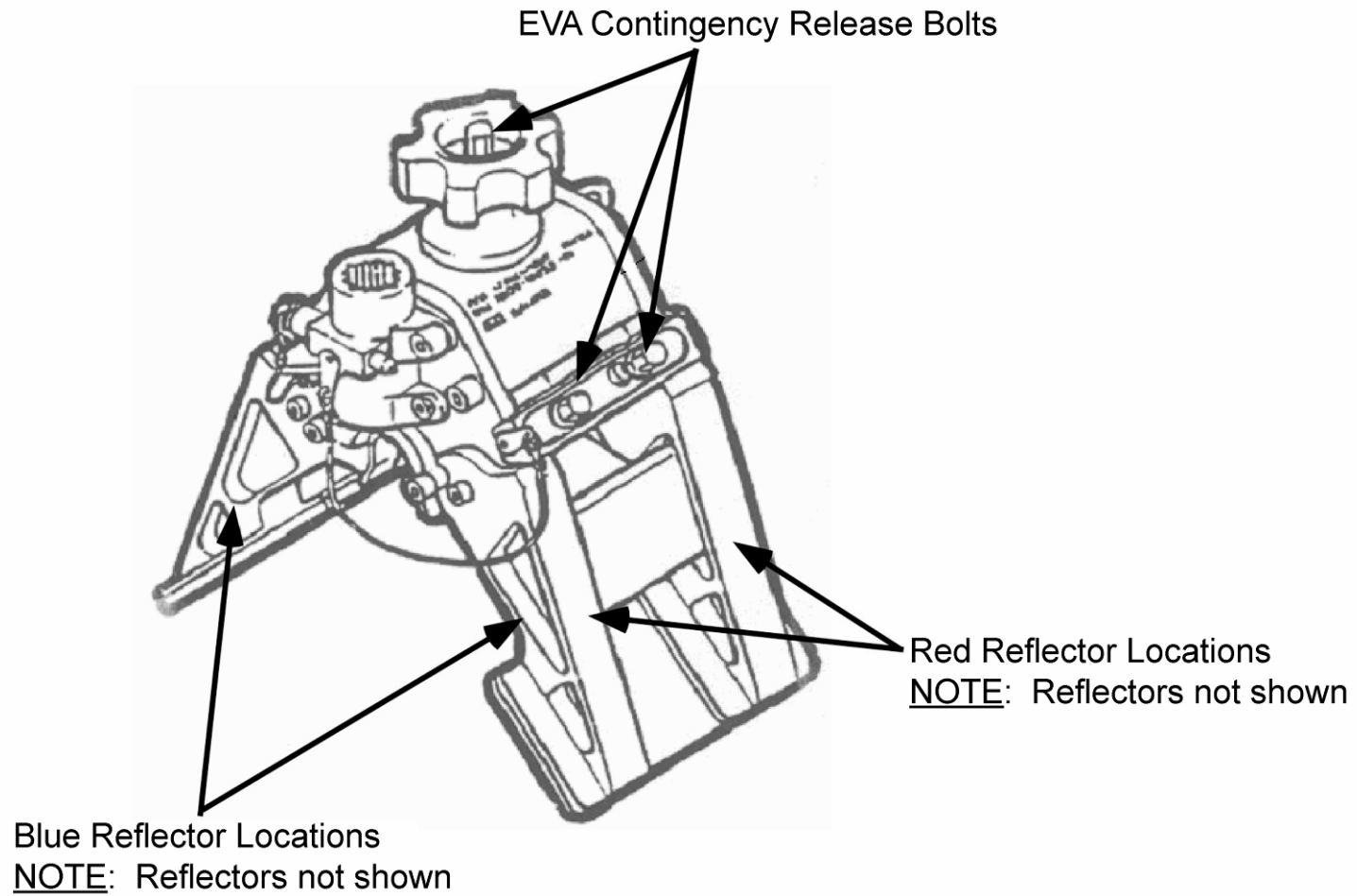
TILE LAYUP



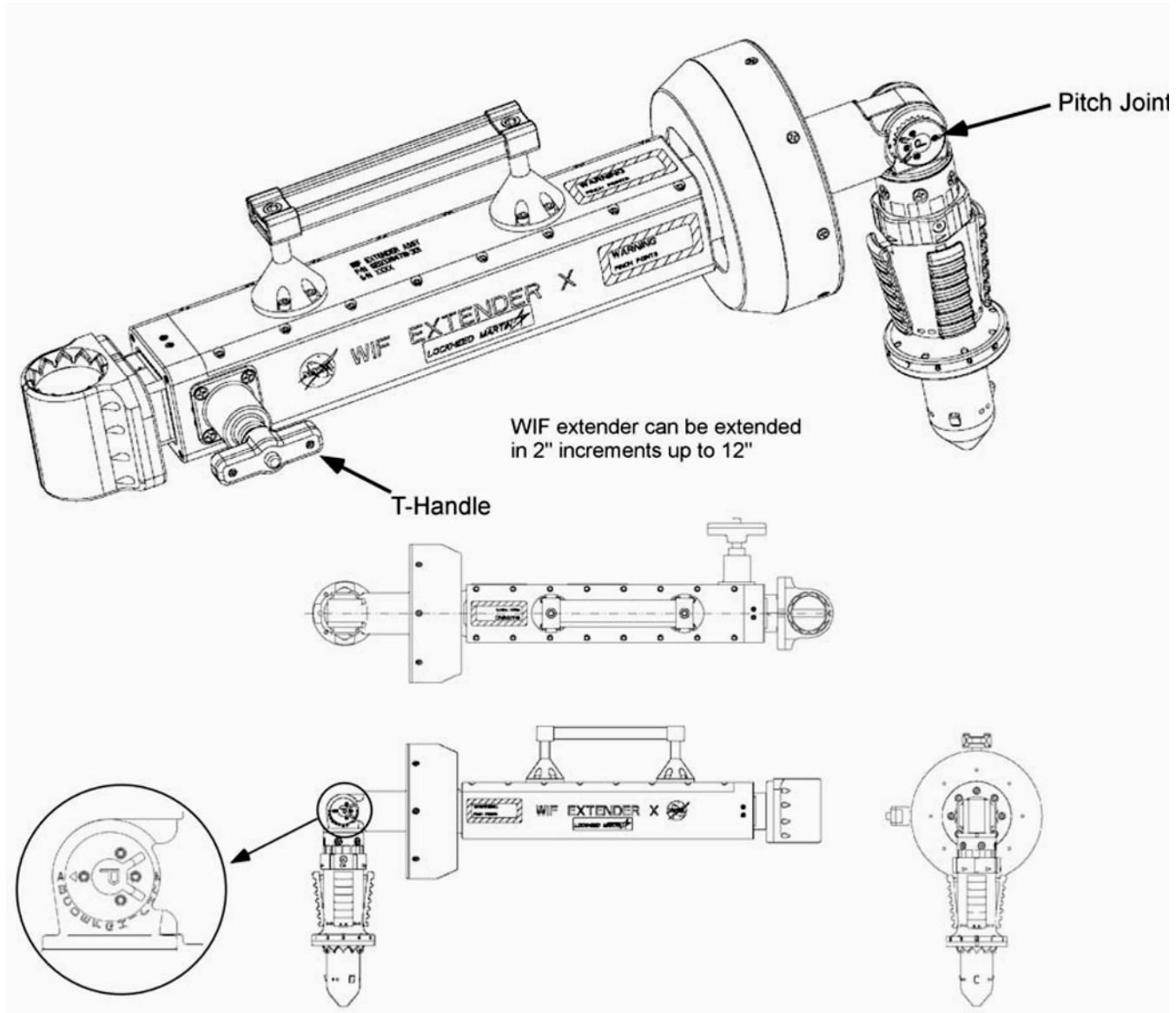
85-FOOT SAFETY TETHER



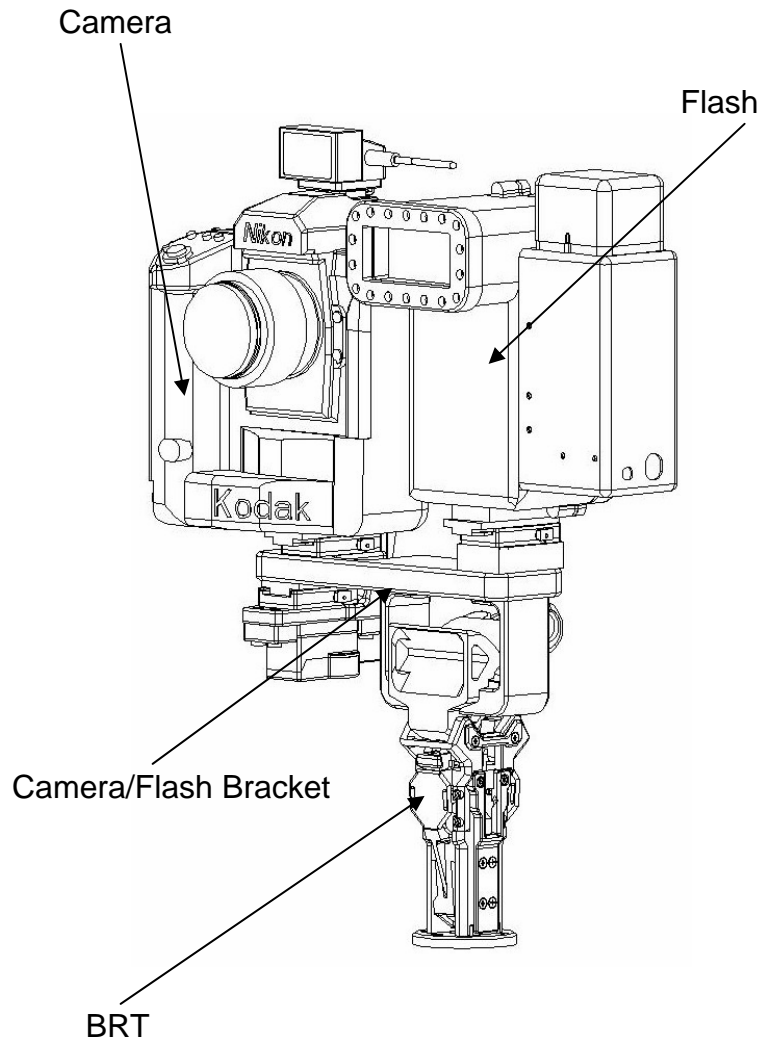
PFR ATTACHMENT DEVICE (PAD)



WIF EXTENDER



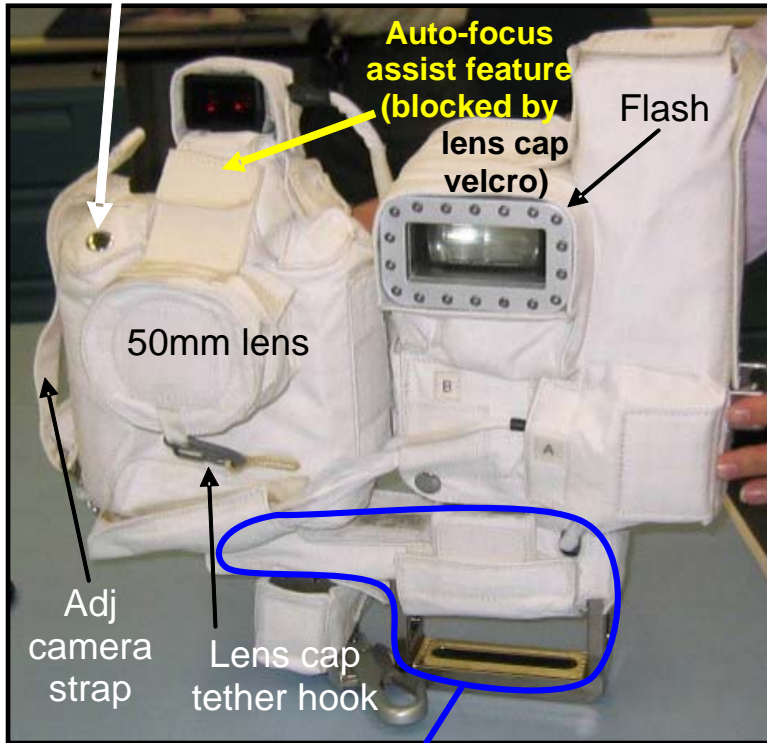
EVA DIGITAL CAMERA



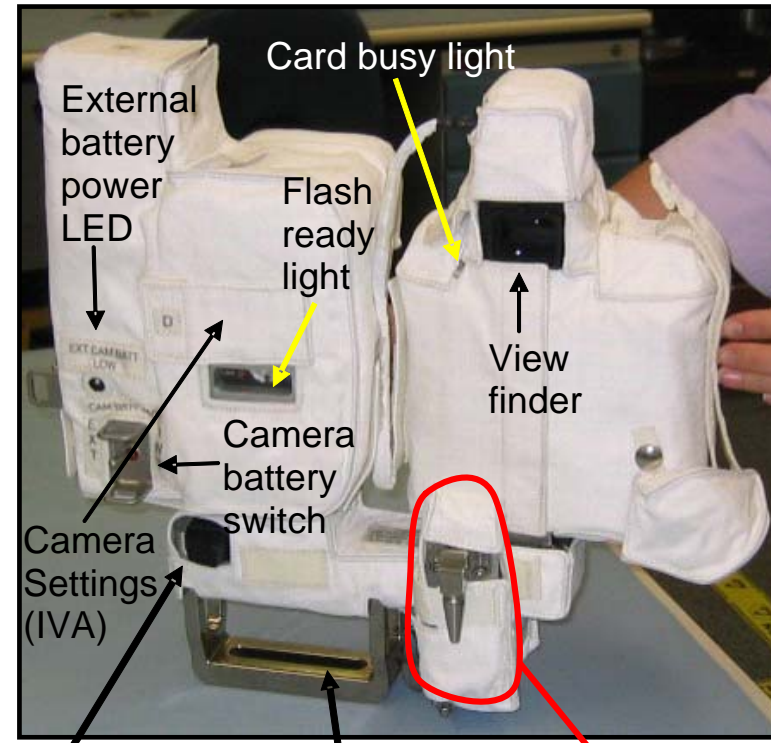
- DCS 760 camera attaches to traditional camera mount or to digital camera bracket if flash or BRT interface is reqd
- Remote shutter release stowed under flash. It is only deployable IVA
- Several lens options, but 50 mm standard
- EVA requirement is that the camera take a minimum of 50 photos, with the expectation that it can take up to ~117 based on thermal conditions and battery usage
- Photogrammetry: EVA inspection technique that allows 3-D contour information to be determined from multiple digital photographs
- Primary method for capturing 3-D information during EVA point inspection

EVA DIGITAL CAMERA (Cont)

Primary shutter release button



Digital Camera Bracket

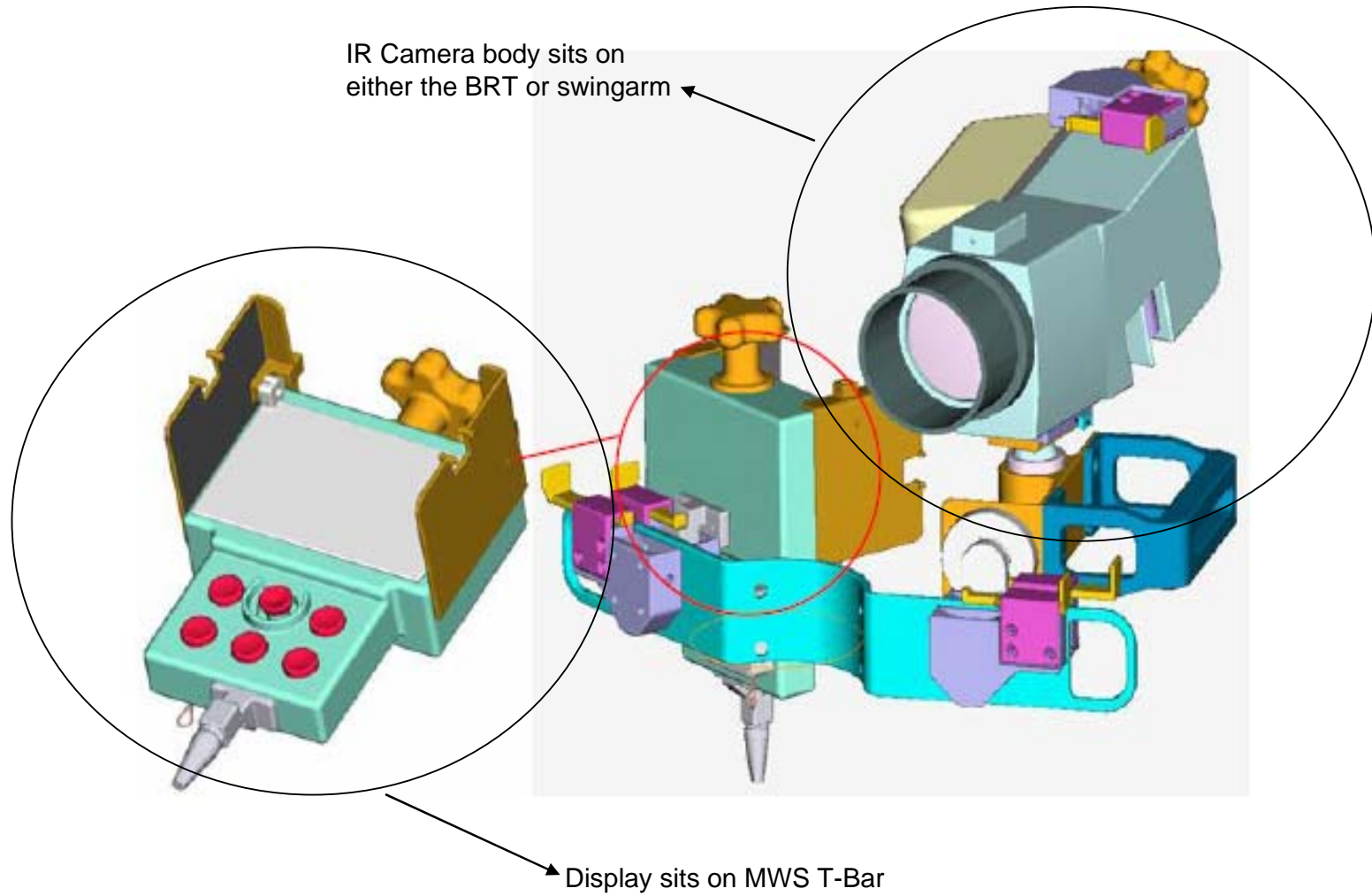


Remote Shutter Release – IV deployable only

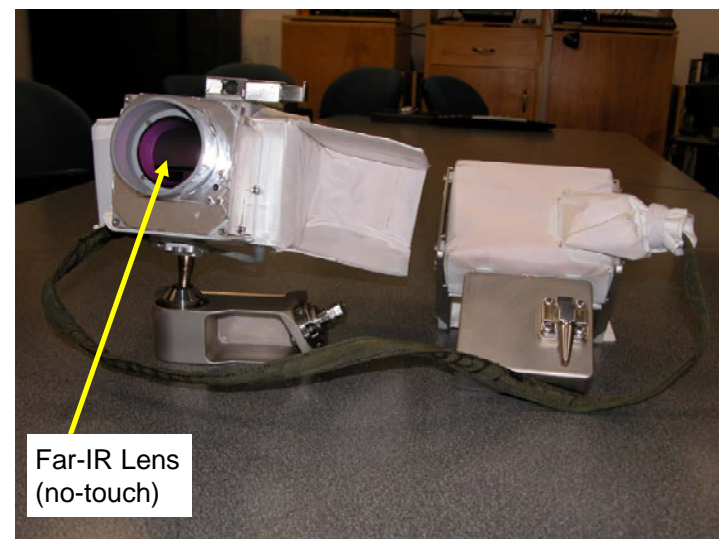
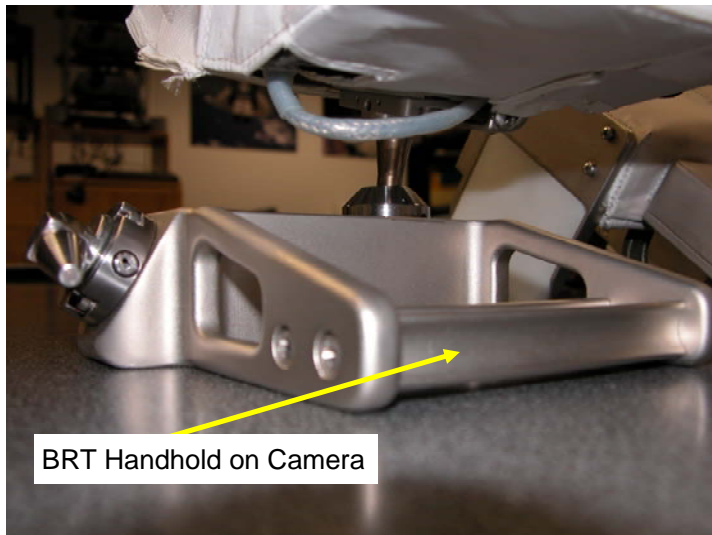
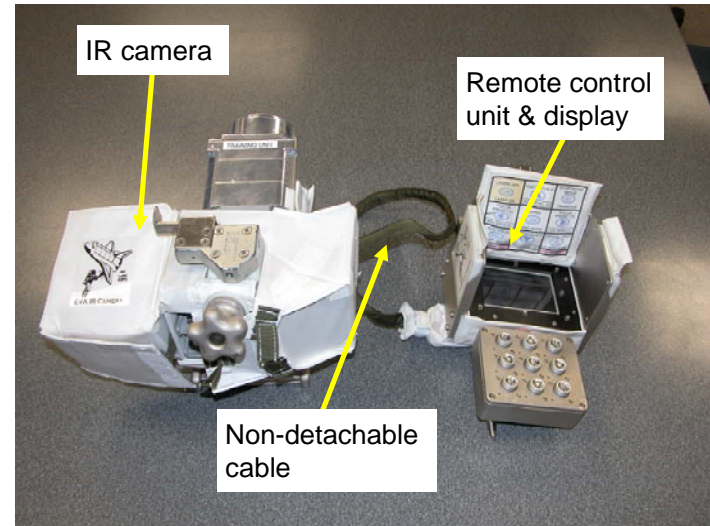
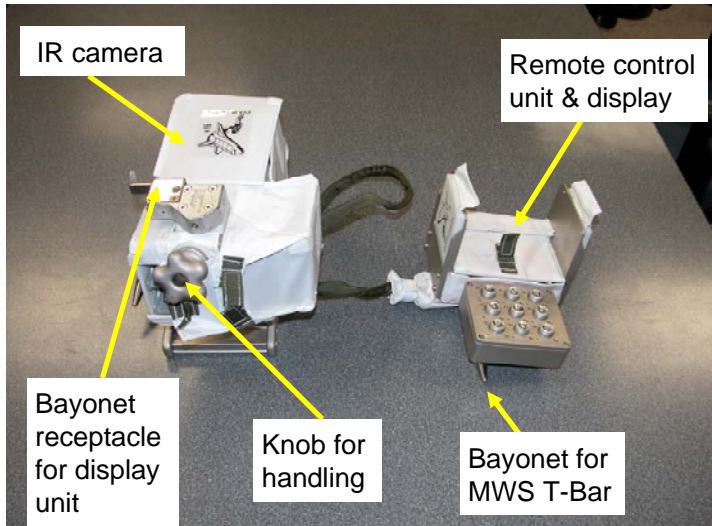
BRT Interface

Camera Mount

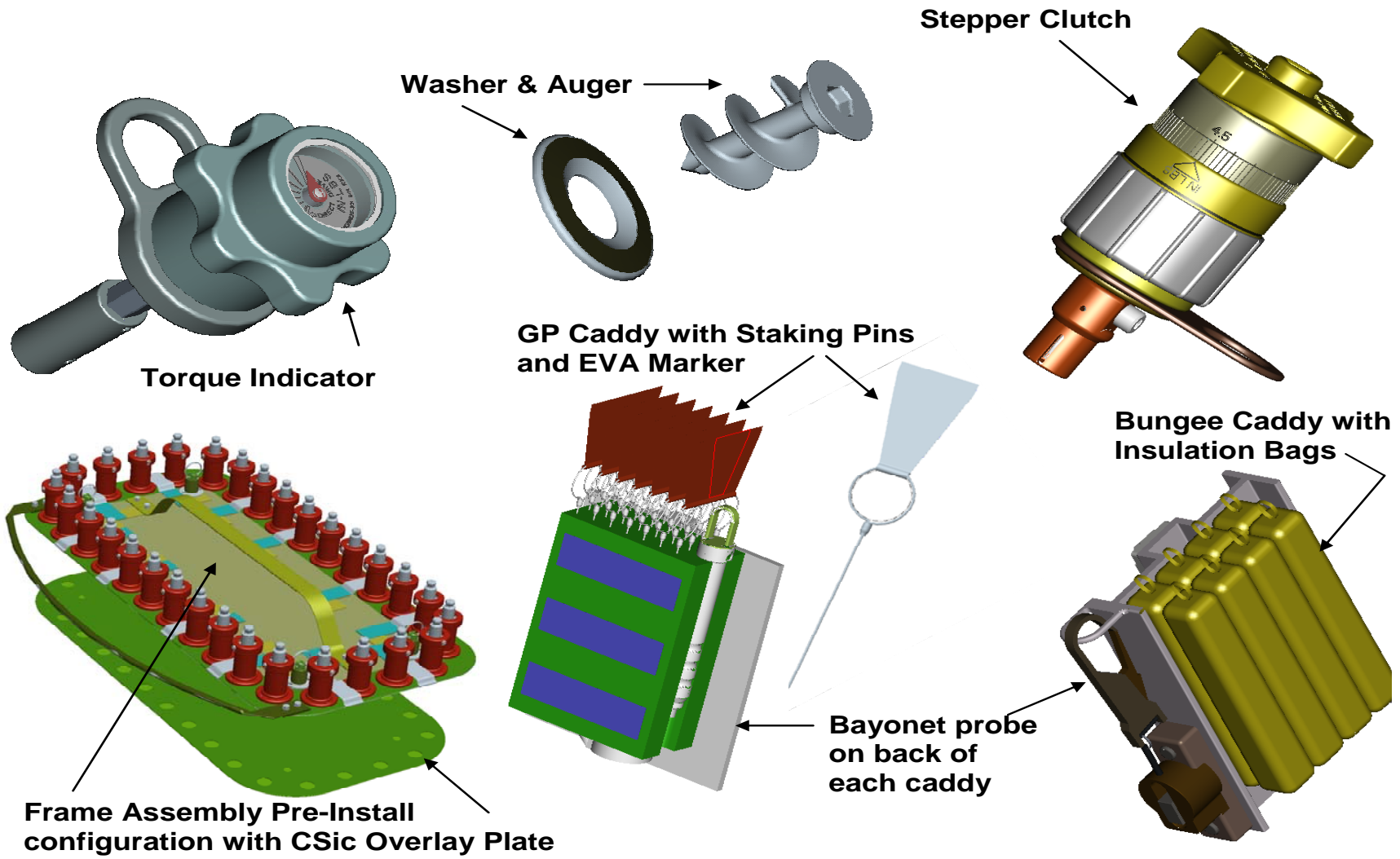
EVA IR CAMERA



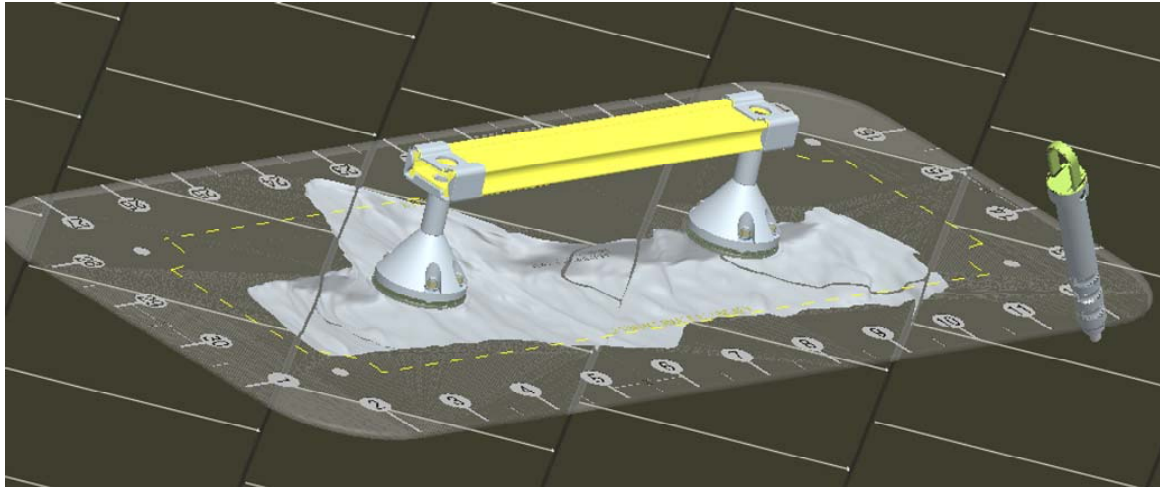
EVA IR CAMERA (Cont)



OVERLAY TILE REPAIR SYSTEM (OTRS)

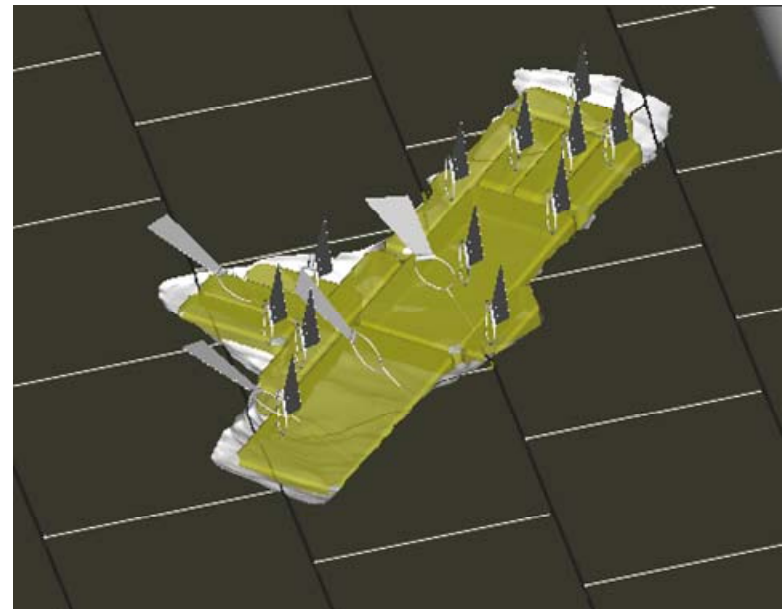


OTRS MARKING TEMPLATE AND INSULATION BAGS

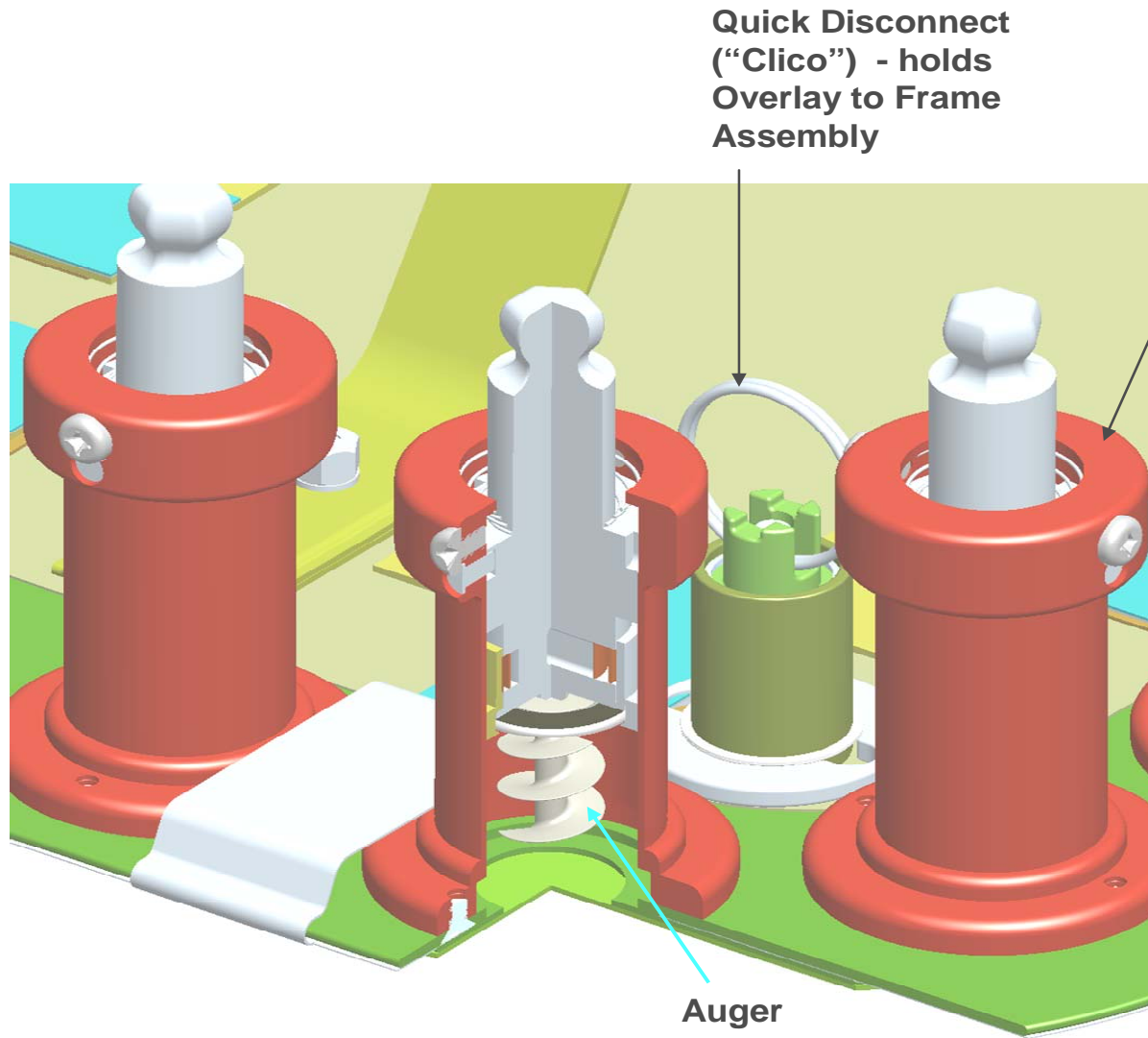


Marking template and EVA marker used to assess overlay placement

16 configurations of Safil insulation bags available to fill the damage cavity. Staking pins used to secure bags in place

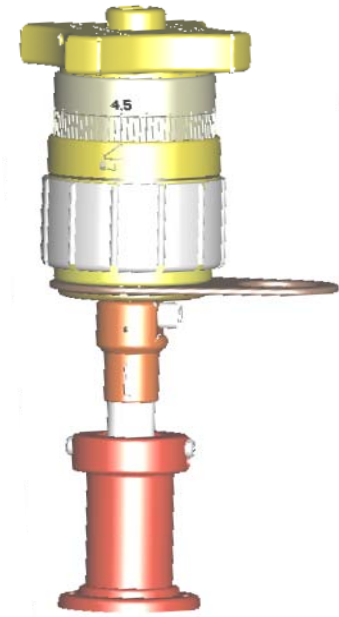


AUGER HOUSING

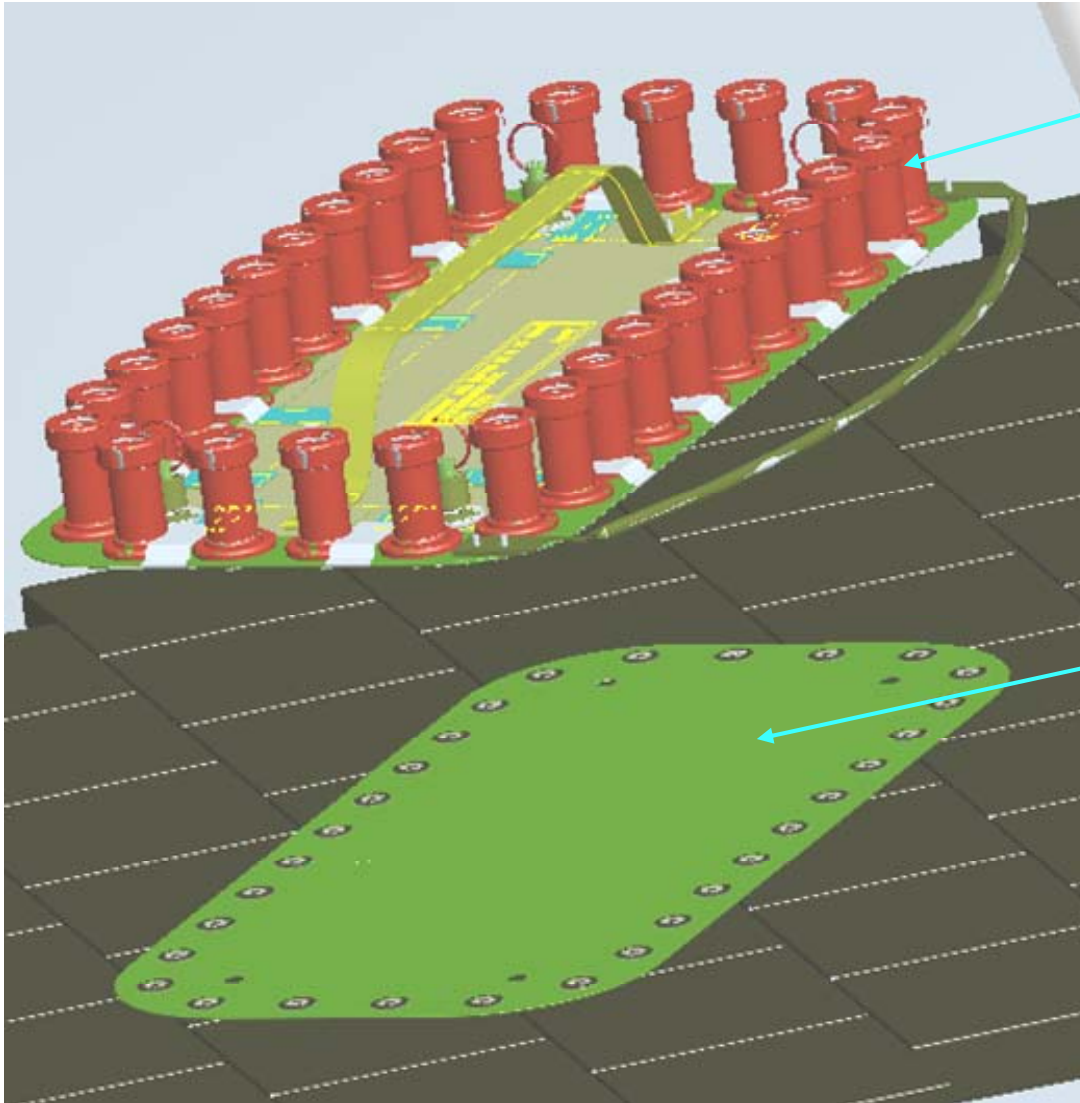


Auger Housing

Stepper Clutch engaged with Auger Housing



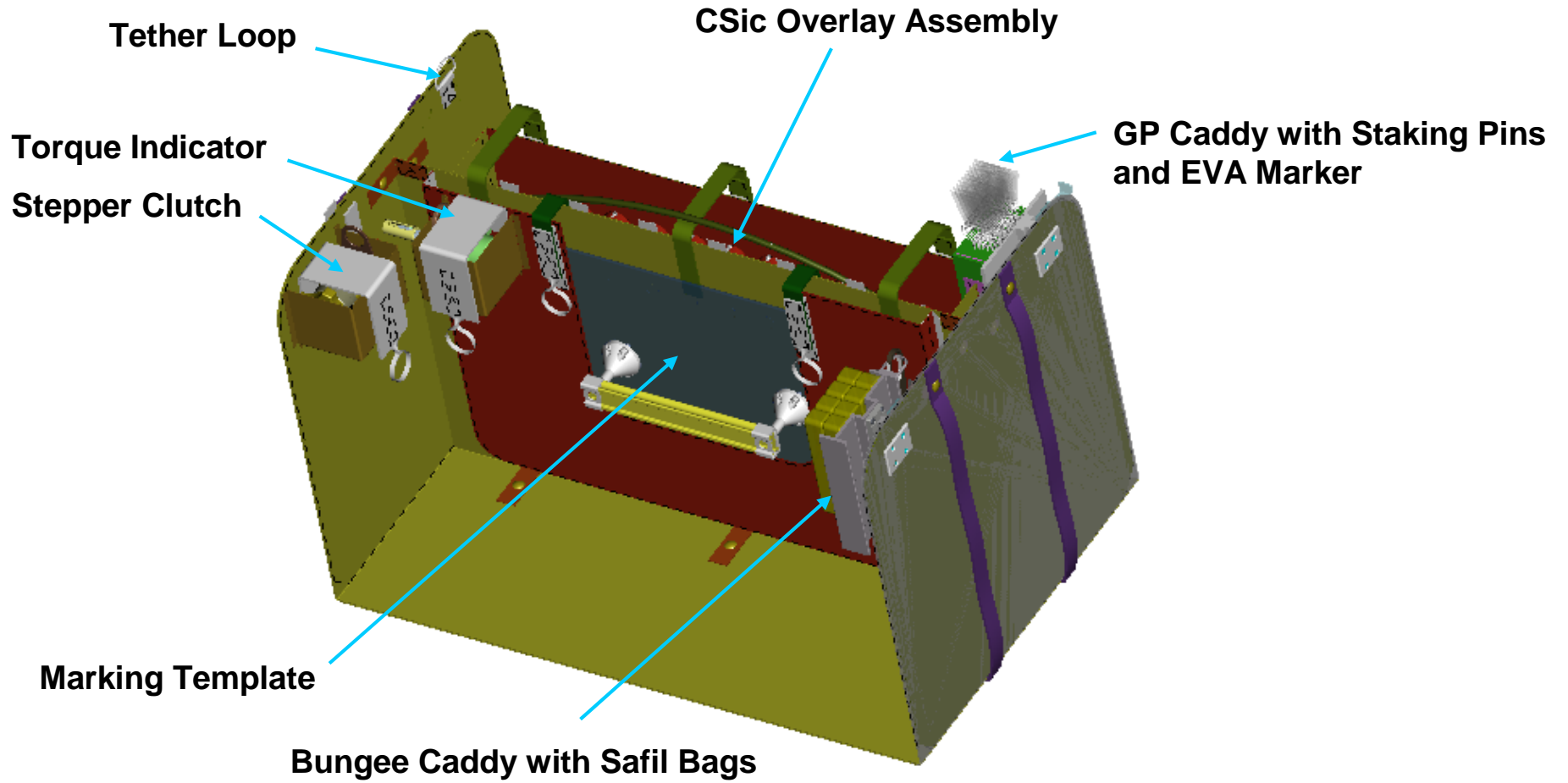
OTRS RELEASED CONFIGURATION



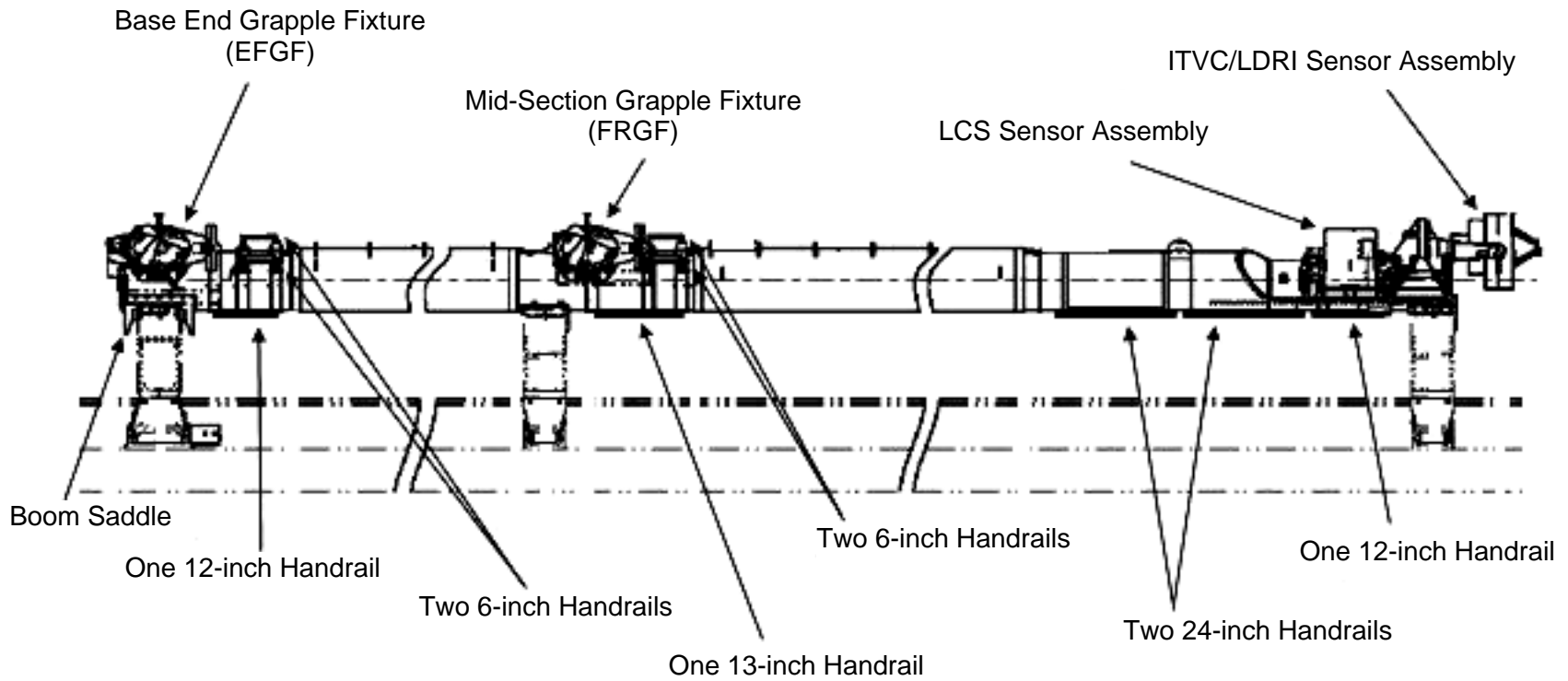
Frame Assembly
with recessed
Hexs

CSic Overlay
Patch with
Augers and
Washers

ORU BAG INSERT FOR OTRS

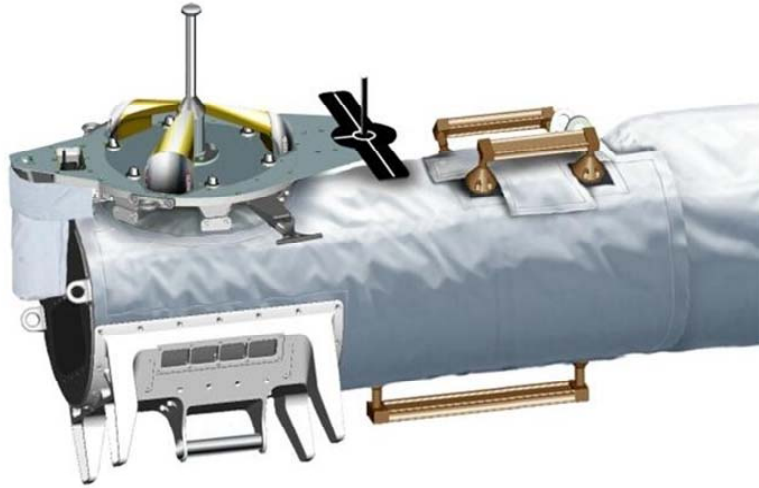


RTF BOOM OVERVIEW

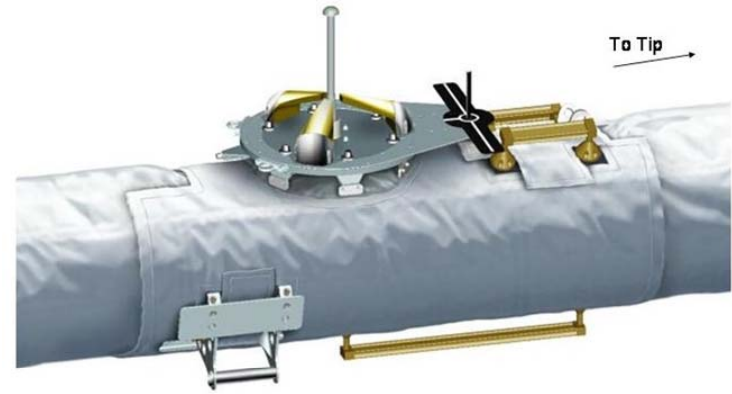


**BOOM
REF DATA**

BOOM TRANSITIONS WITH MLI



Base Section

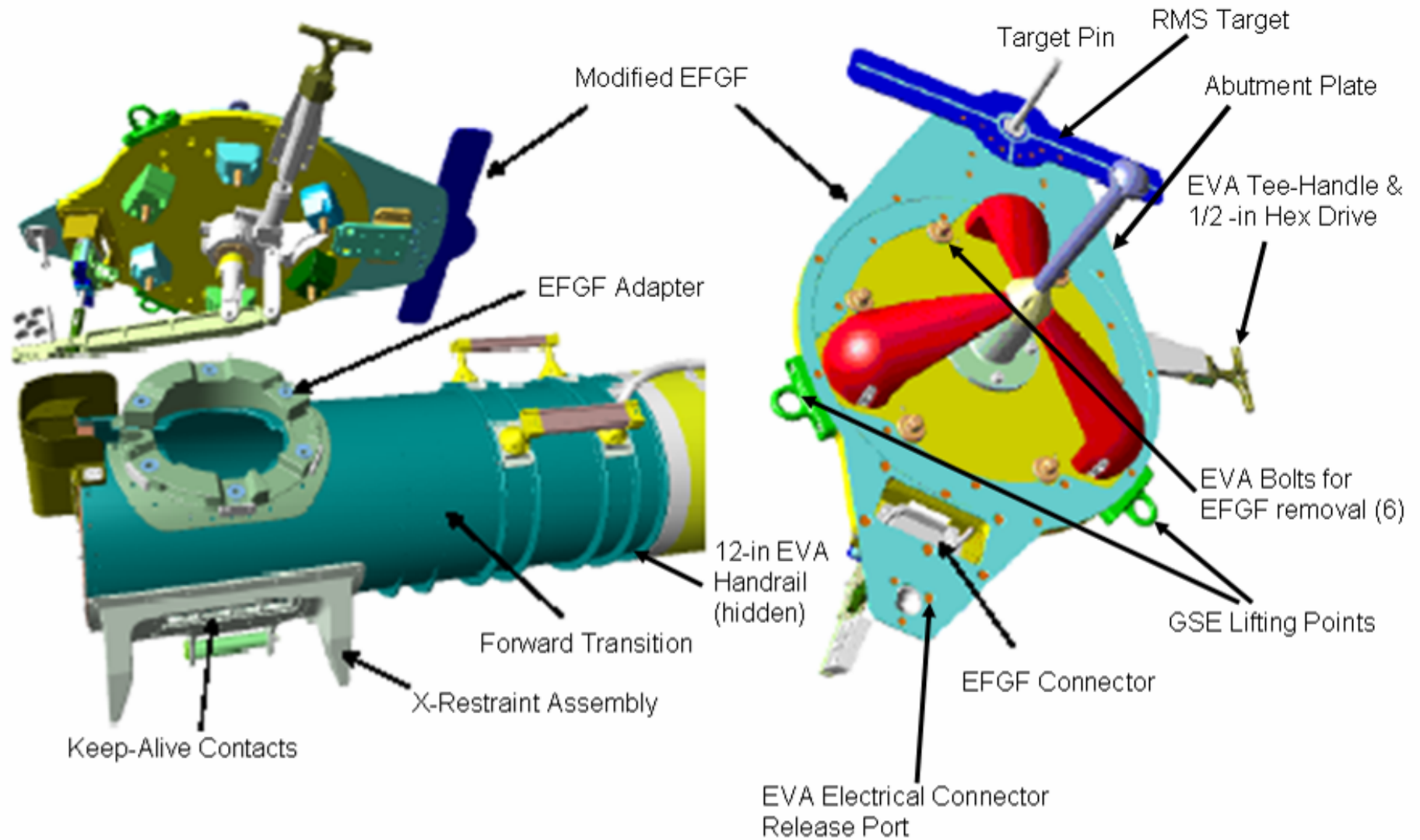


Mid Section

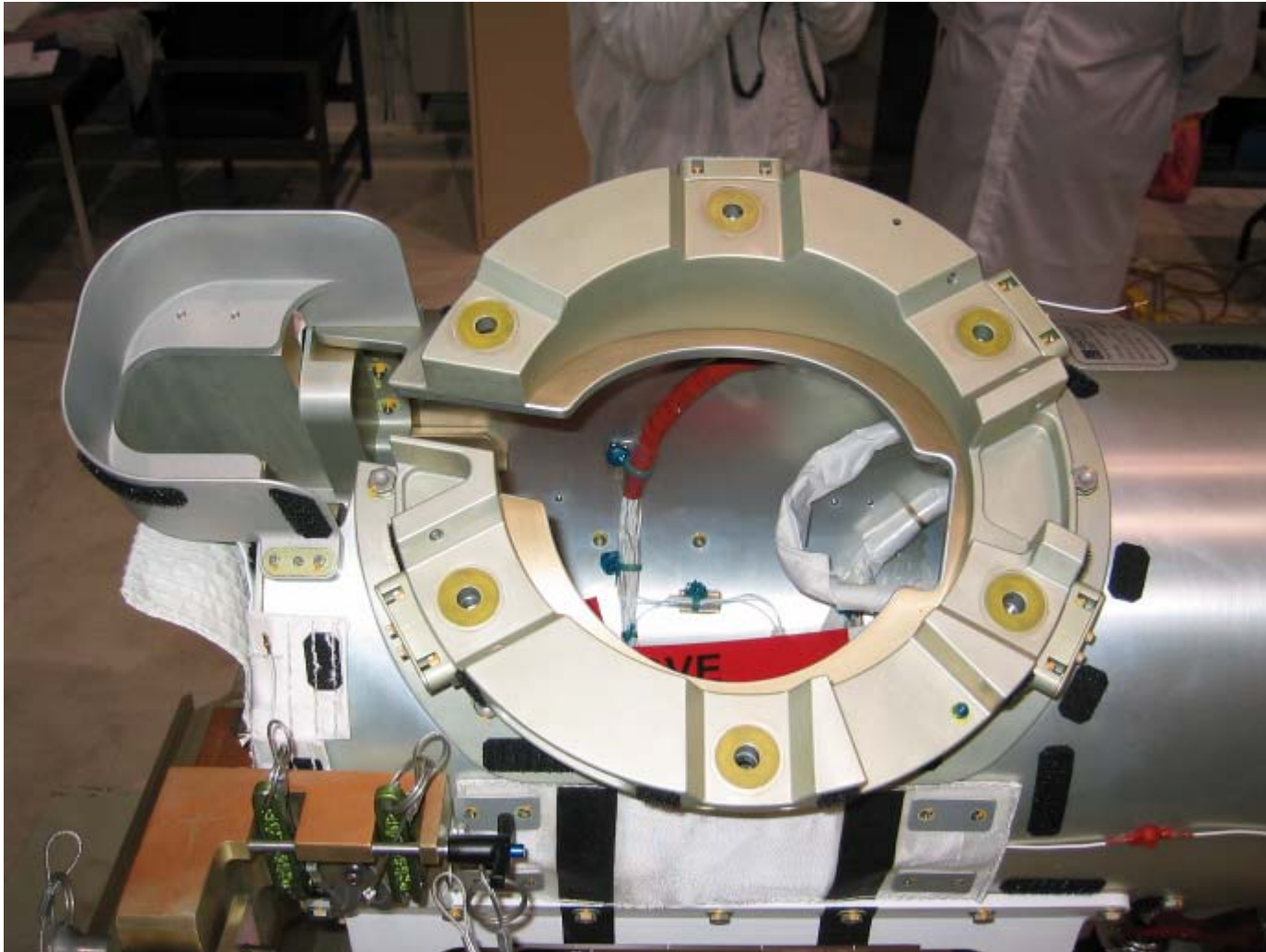


Tip Section (LCS not shown)

BOOM BASE END AND MODIFIED EFGF



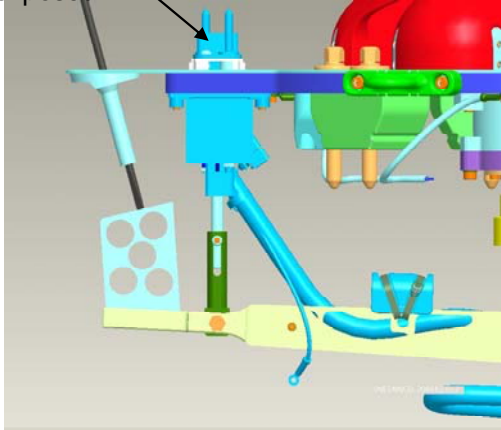
BOOM BASE END EFGF ADAPTER PLATE



Boom EFGF Adapter Plate and Keep-Alive Contact Protective Cover

EVA-ASSISTED EFGF CONNECTOR DEMATE

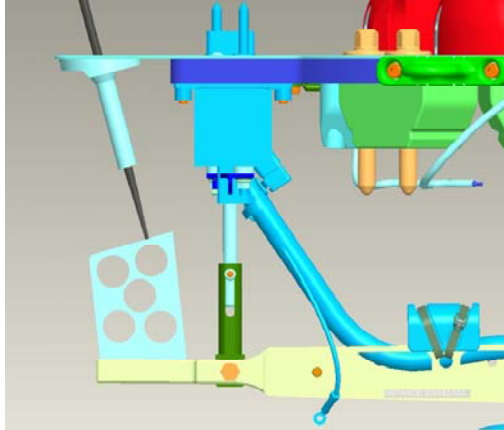
Connectors exposed



EVA Probe Demate Start Position

3.5 inch EVA Probe Depth

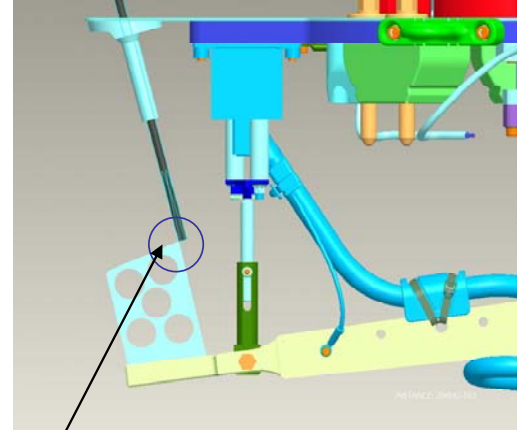
Connector extended, mated (circled)



EVA Probe Demate Complete Position

3.9 inch EVA Probe Depth

Connector demated



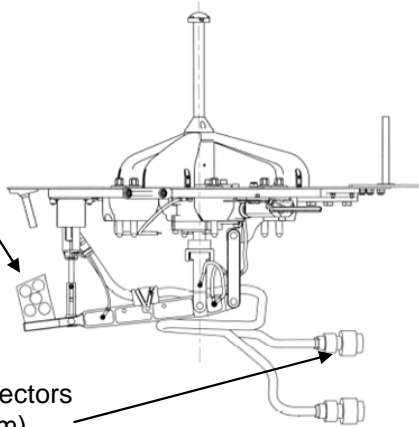
EVA Probe Reaches Lever Hardstop Position

5.2 inch EVA Probe Depth

Connector retracted, demated

Area of possible probe slip

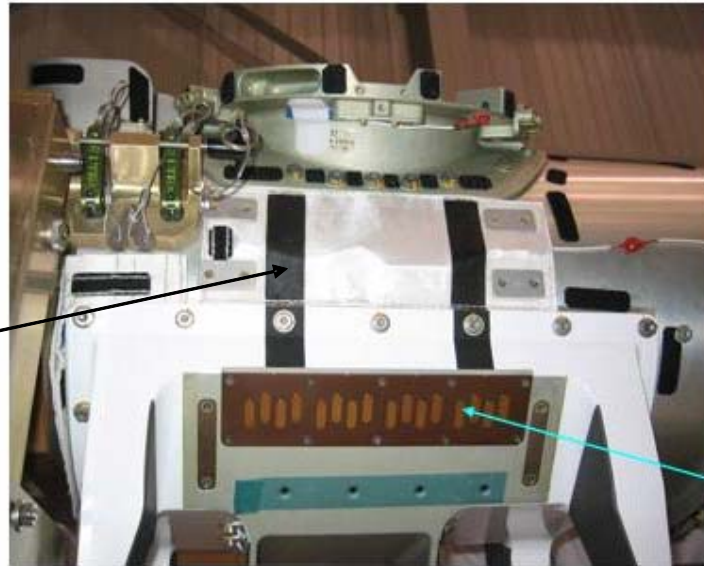
Lever mechanism



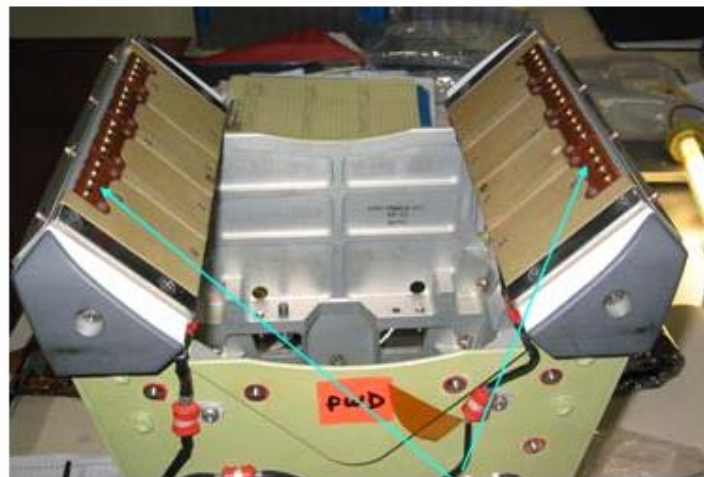
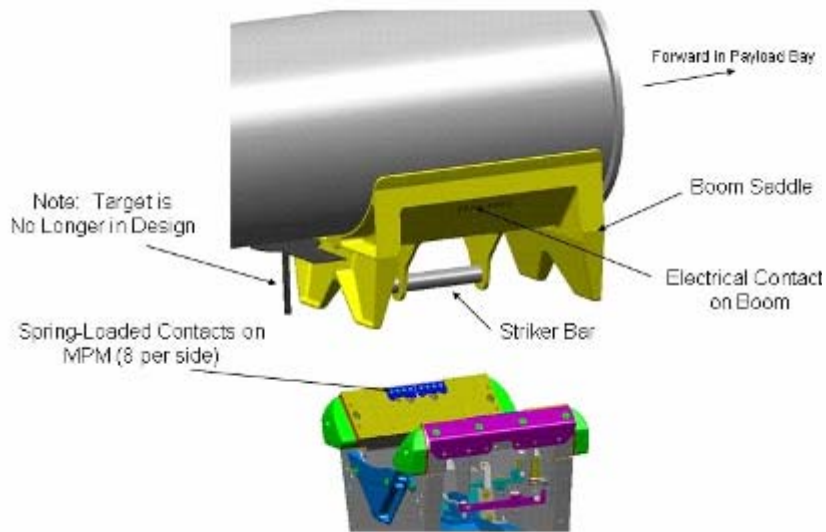
EFGF connectors (inside Boom)

BOOM BASE END SADDLE AND MPM

Alignment cues for Robotic berthing into MPMs

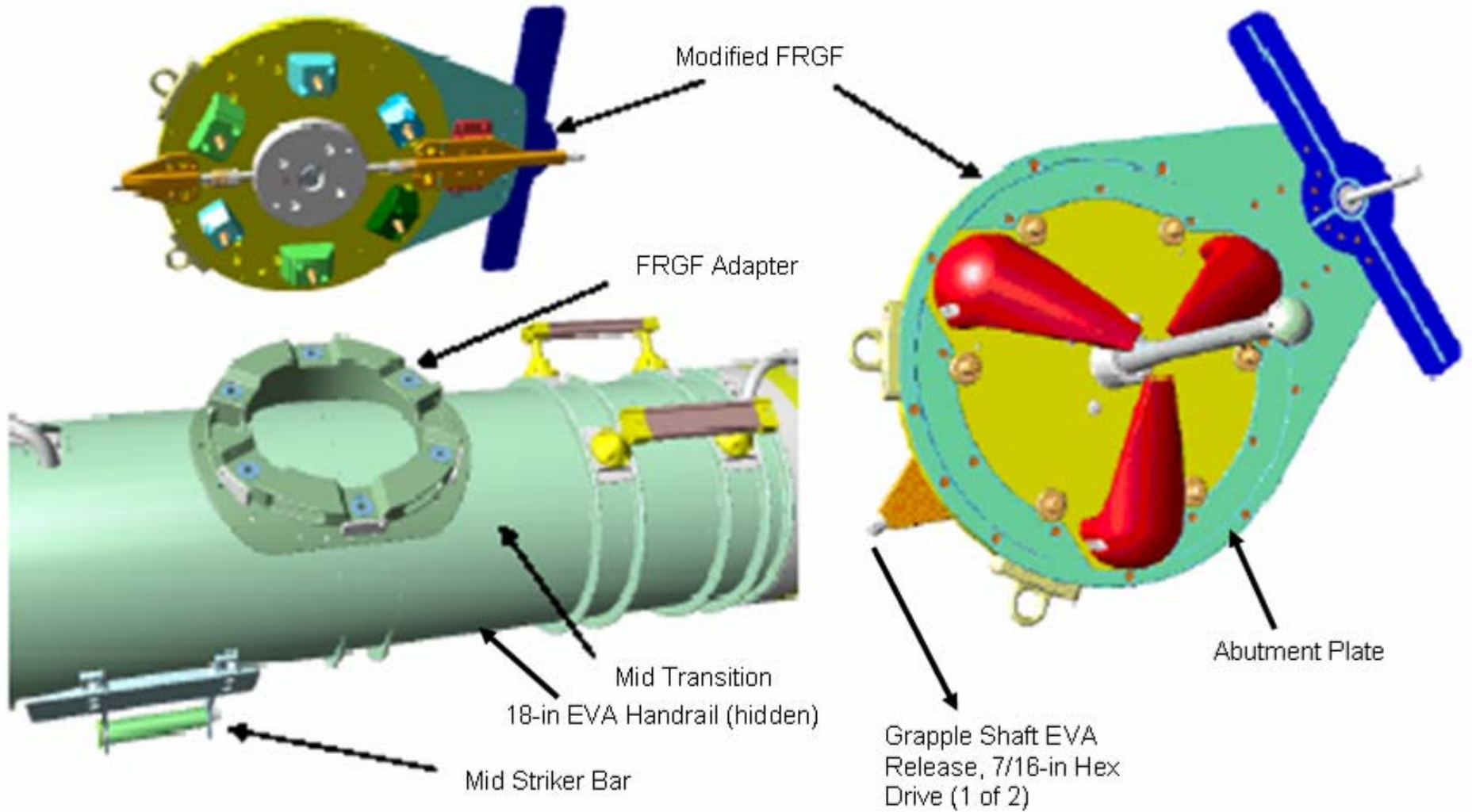


Keep-Alive Contacts on the Boom

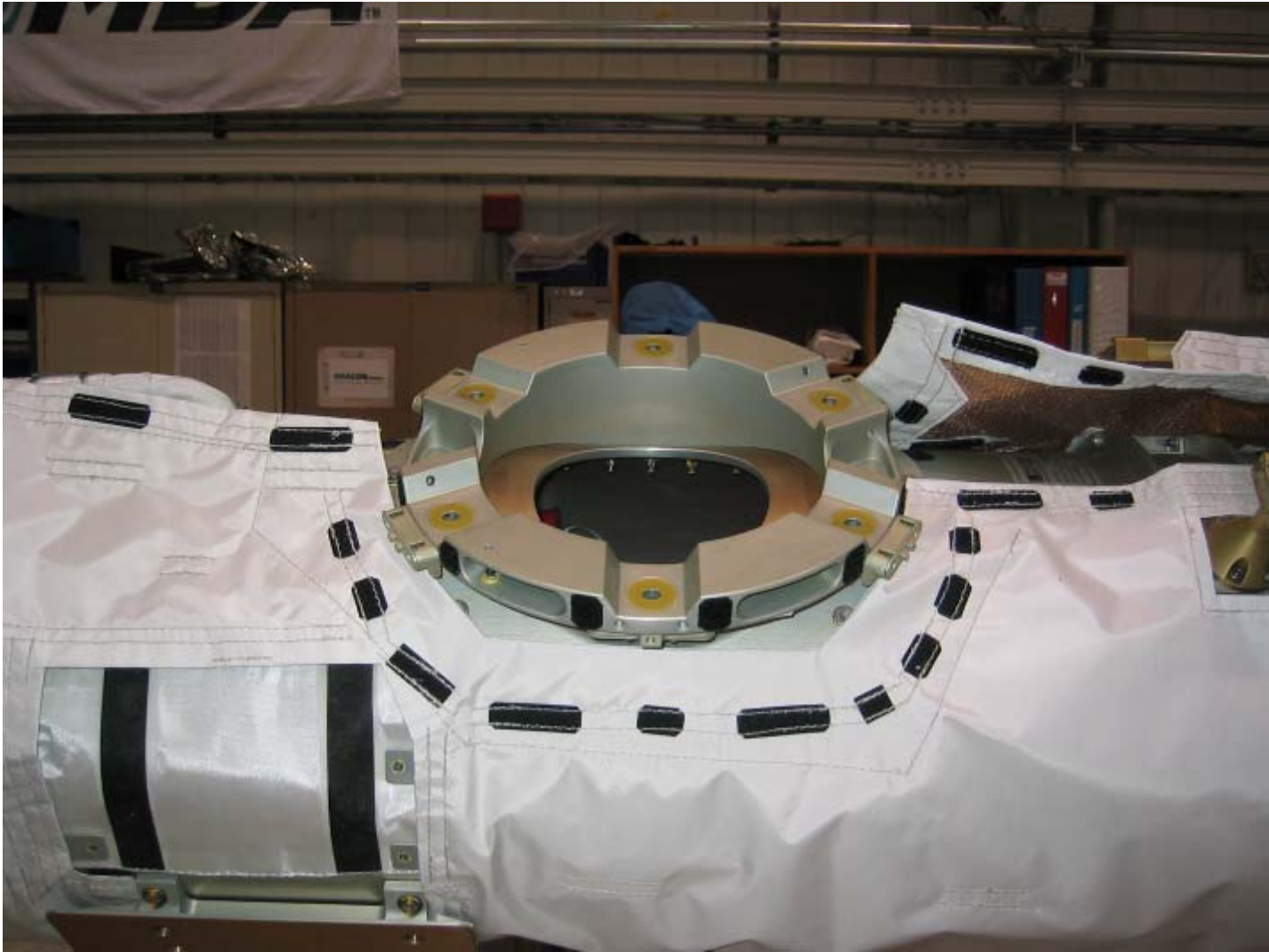


Contacts on the Forward MPM Pedestal

BOOM MID SECTION AND MODIFIED FRGF

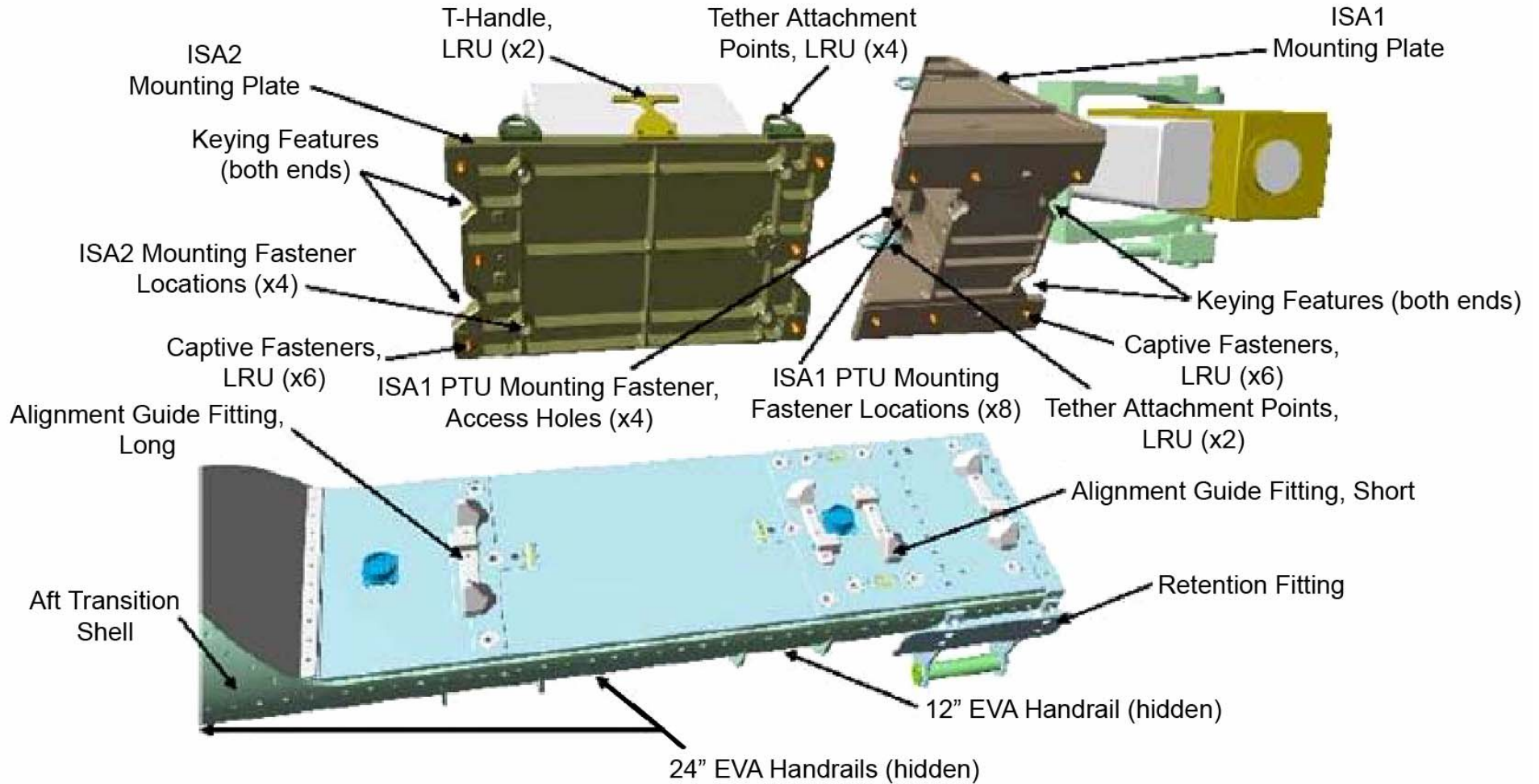


BOOM MID SECTION FRGF ADAPTER PLATE

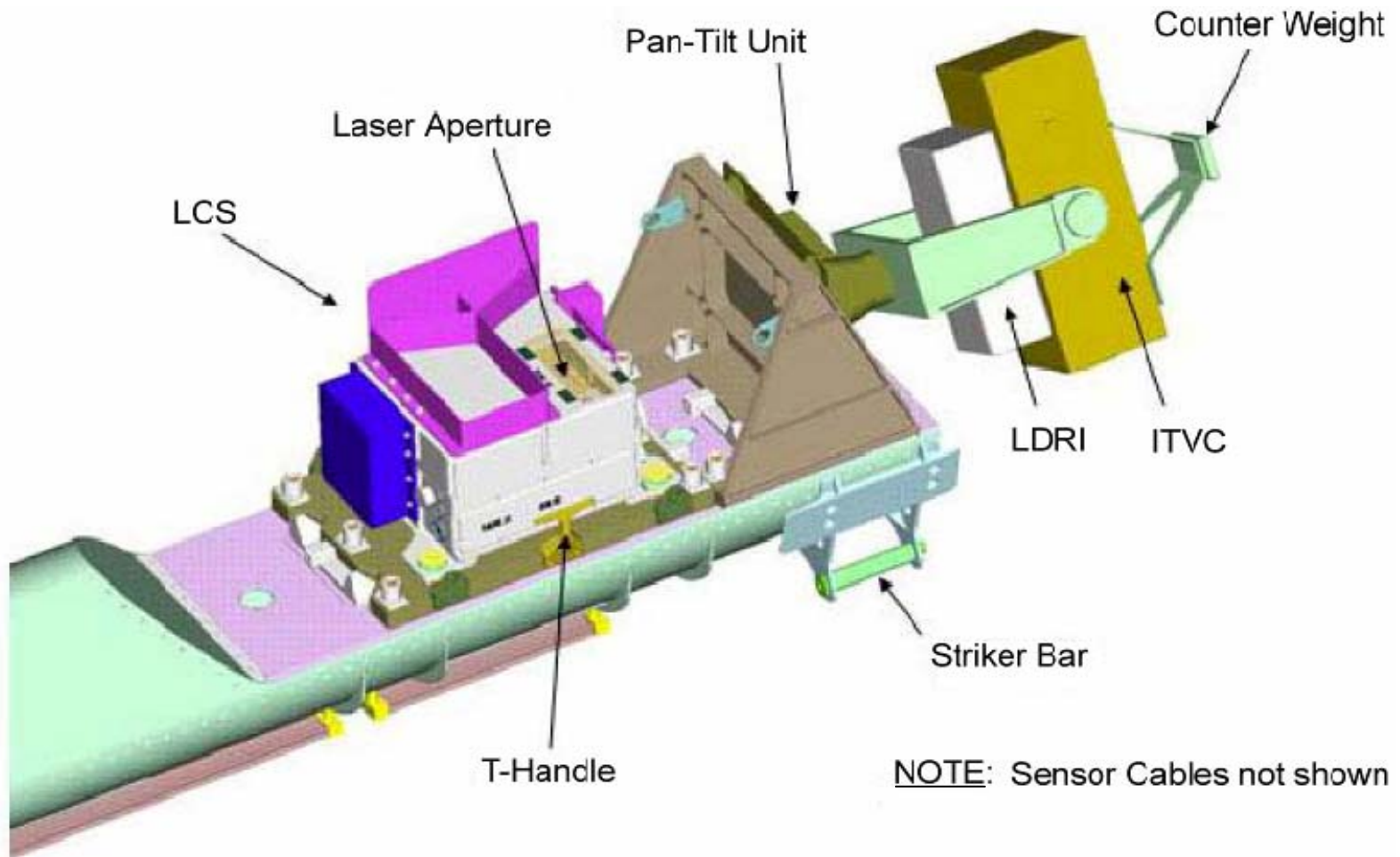


Boom FRGF Adapter Plate

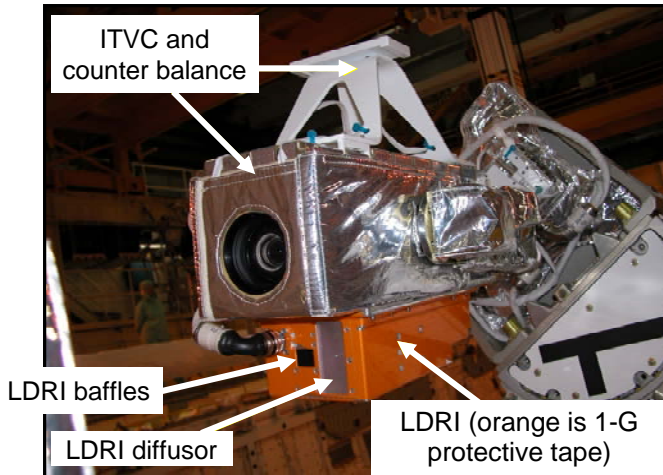
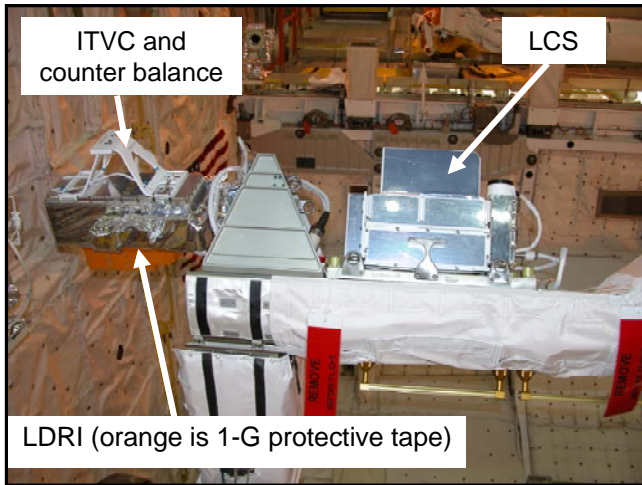
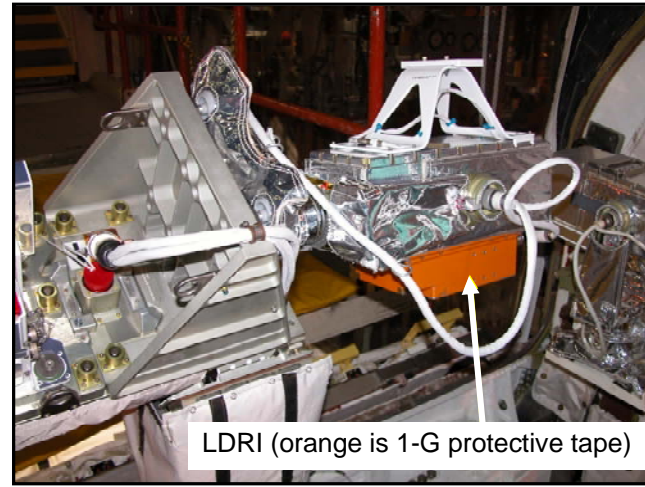
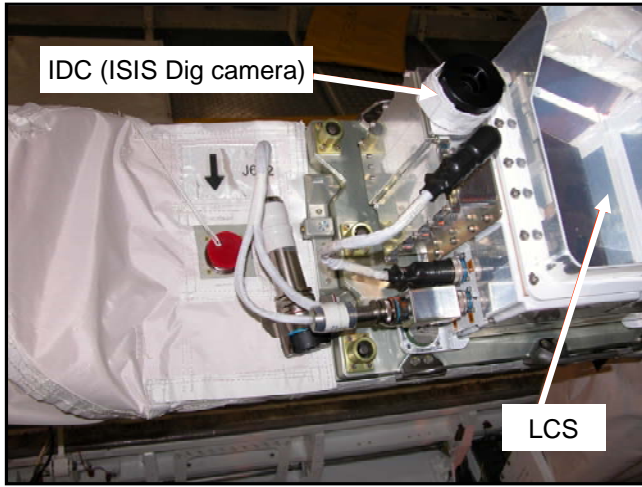
BOOM TIP END AND SENSORS



BOOM TIP END AND SENSORS (Cont)



BOOM SENSOR DETAILS

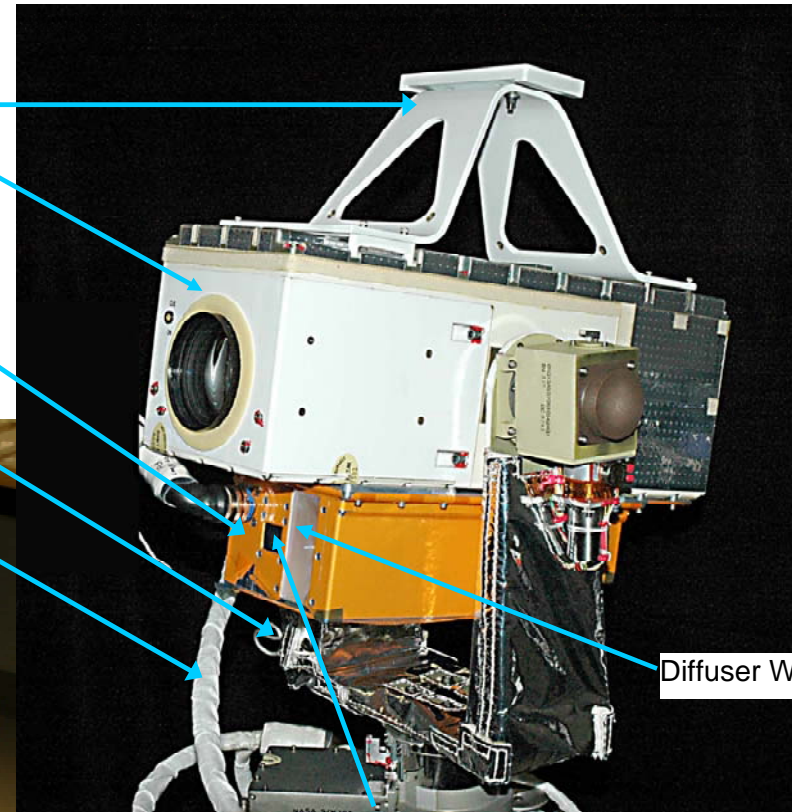
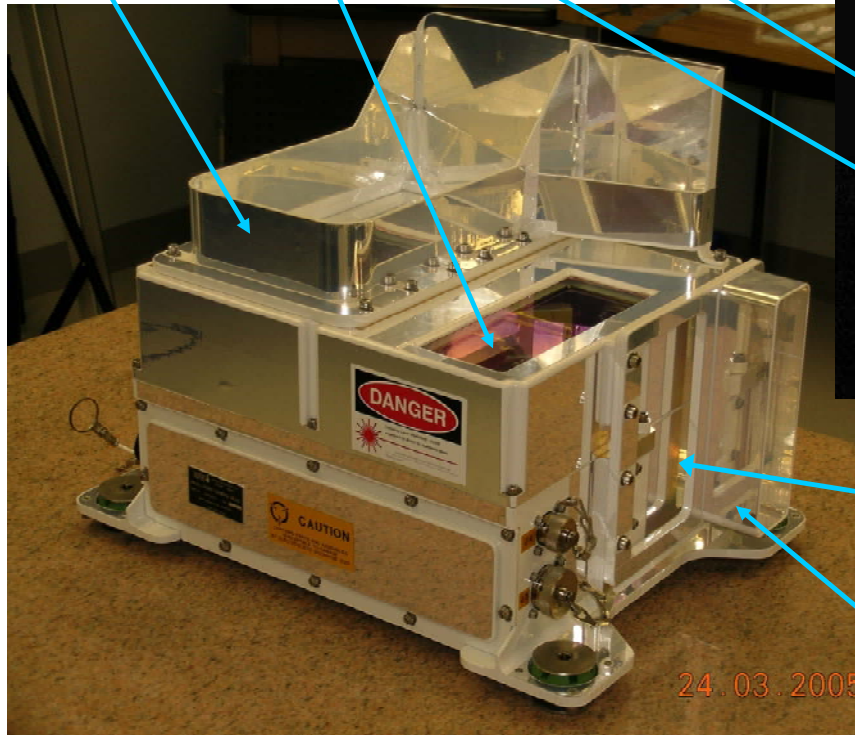


BOOM SENSOR DETAILS (Cont)

Sensor Package 1

- Counterweight
- Intensified TV Camera
- LDRI – Laser Dynamic Range Imager
- PTU – Pan-Tilt Unit
- W 601 cable

Radiator Laser Aperture



Diffuser Window

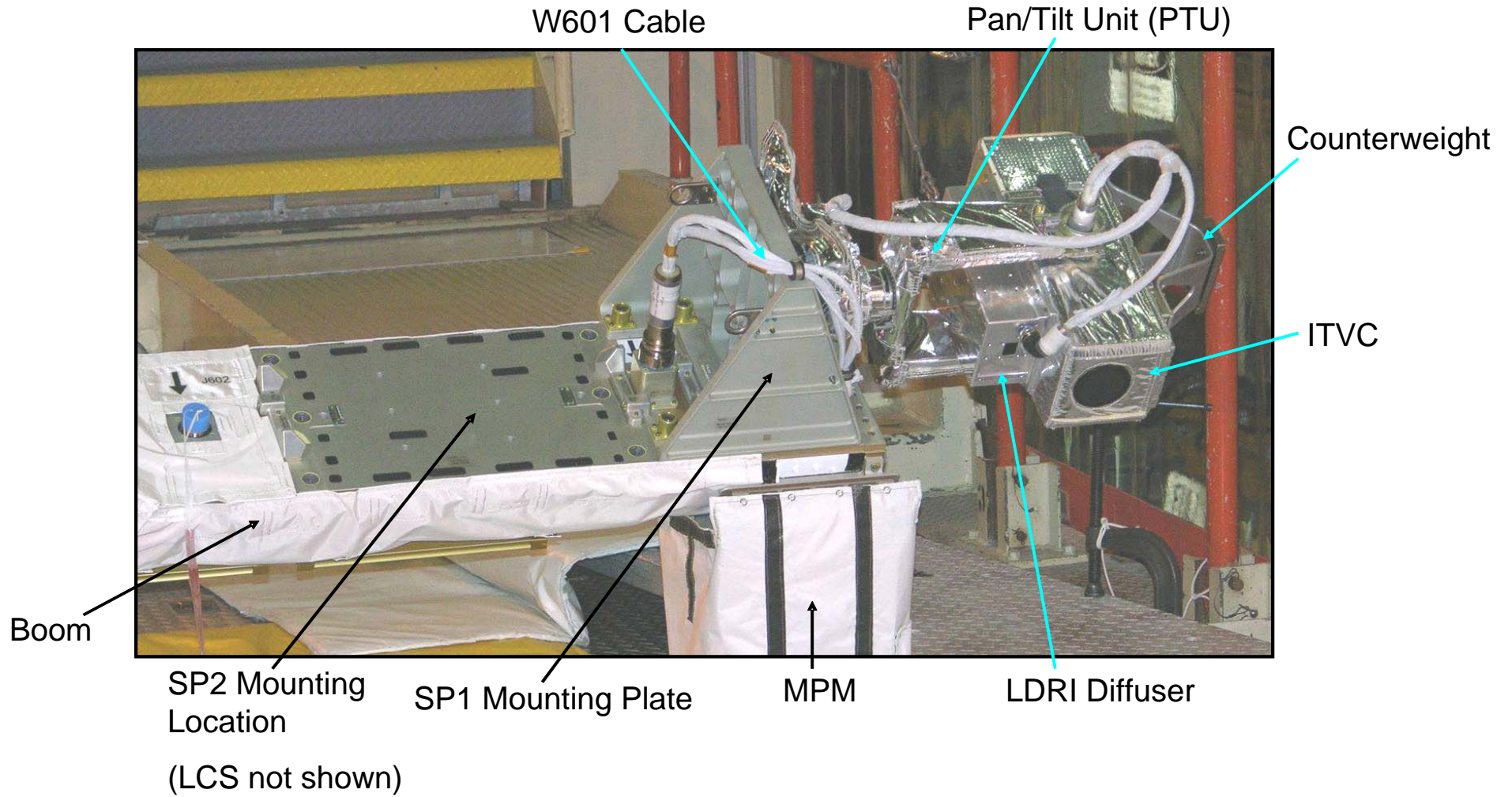
Baffle – No touch, sharp edge

Sensor Package 2 Assembly

- LCS – Laser Camera System
- W602 cable (not shown)
- Laptop cable (not shown)

Radiator

SENSOR PACKAGE 1 (SP1): LDRI/ITVC



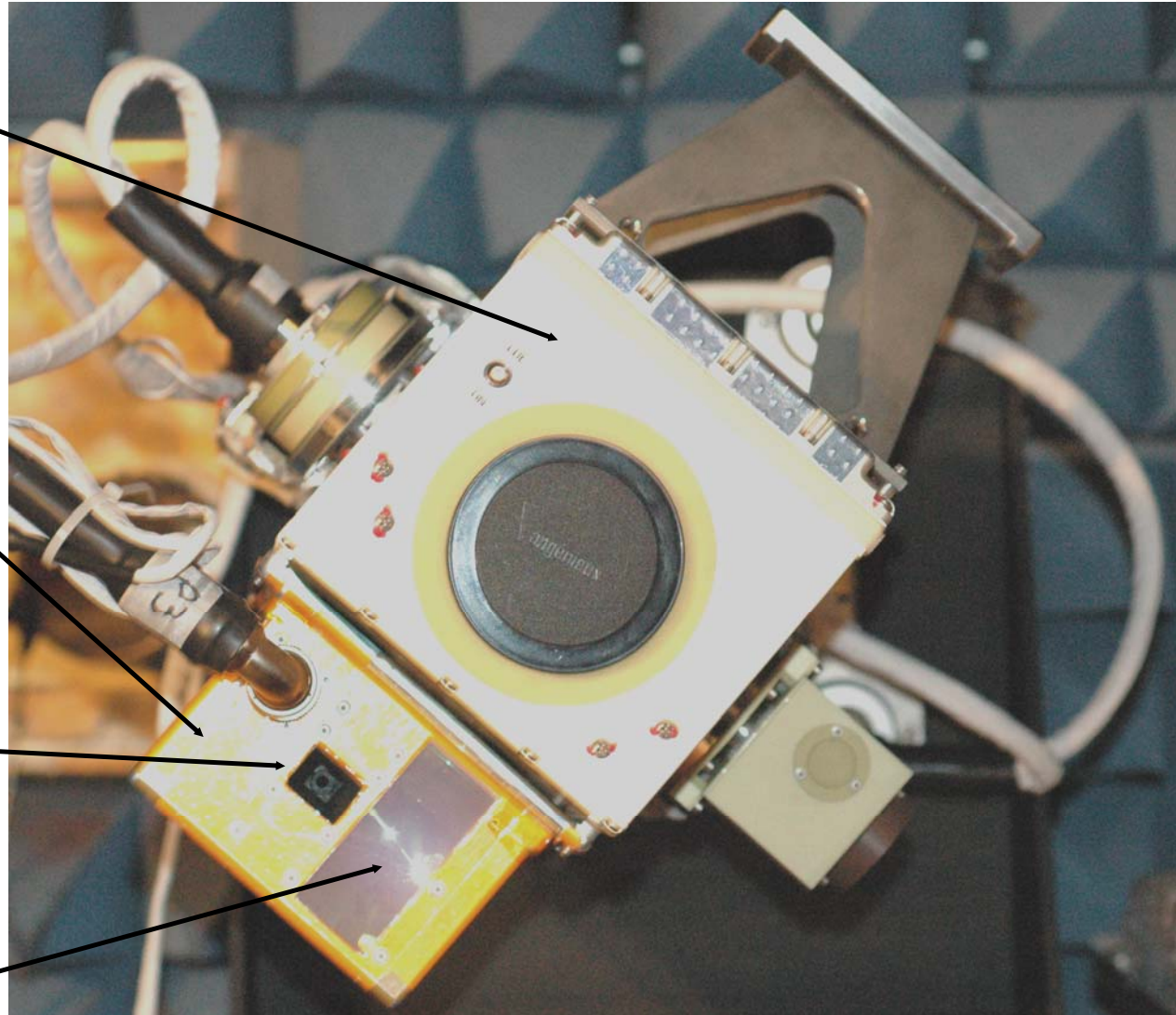
SENSOR PACKAGE 1 (SP1): LDRI/ITVC (Cont)

ITVC (missing thermal blanket in this photo)

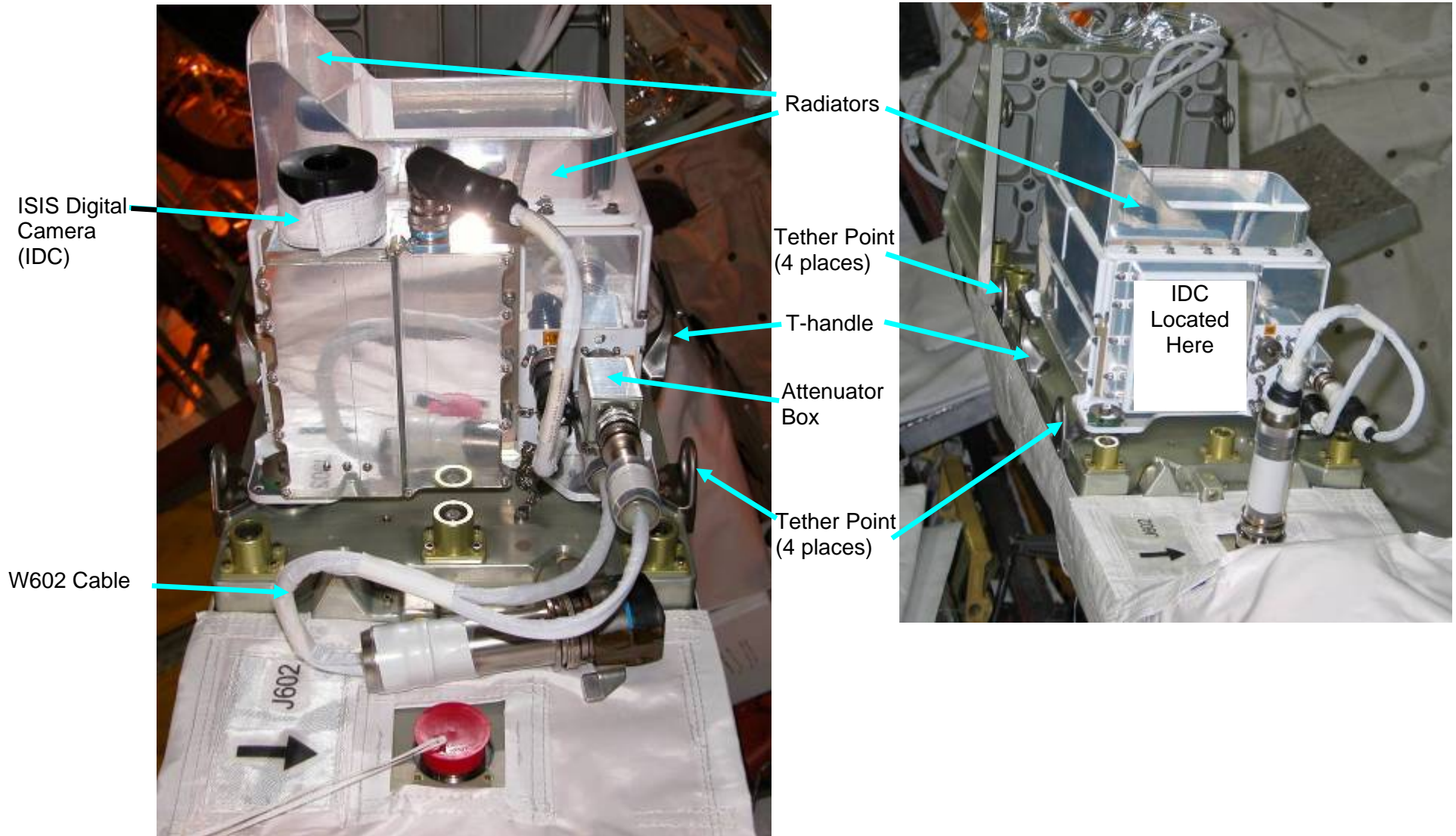
LDRI (orange tape is protective covering. In-flight the unit is covered with silver Teflon tape. Do not touch)

Baffles - sharp edge and entrapment hazard: do not touch

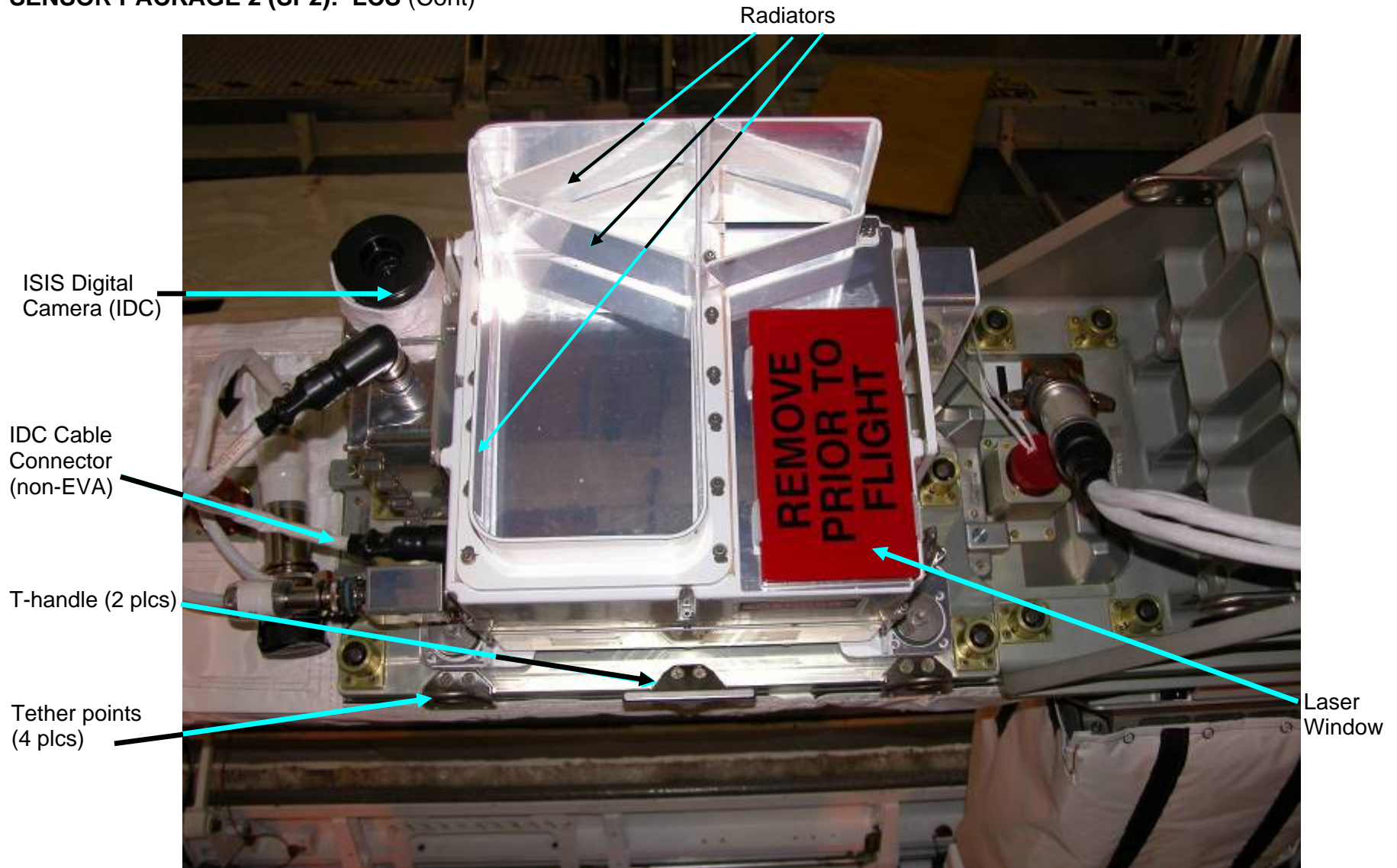
Diffuser Window - easily damaged optical surface: do not touch



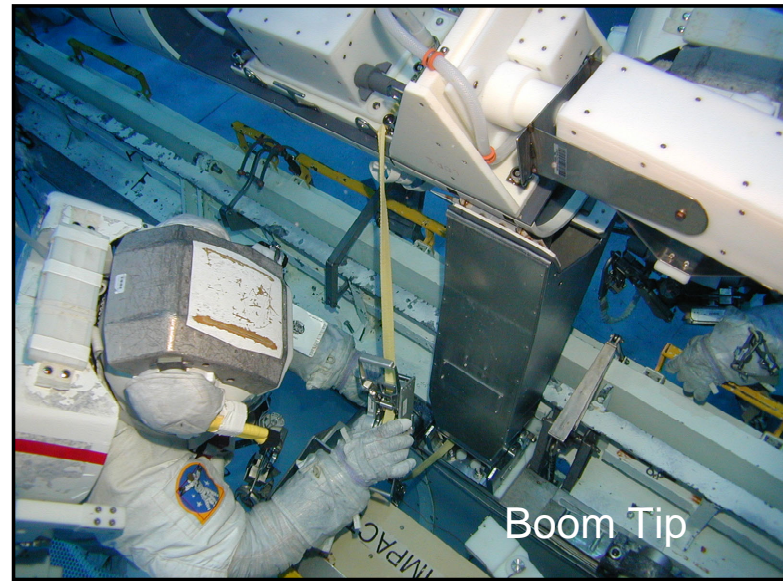
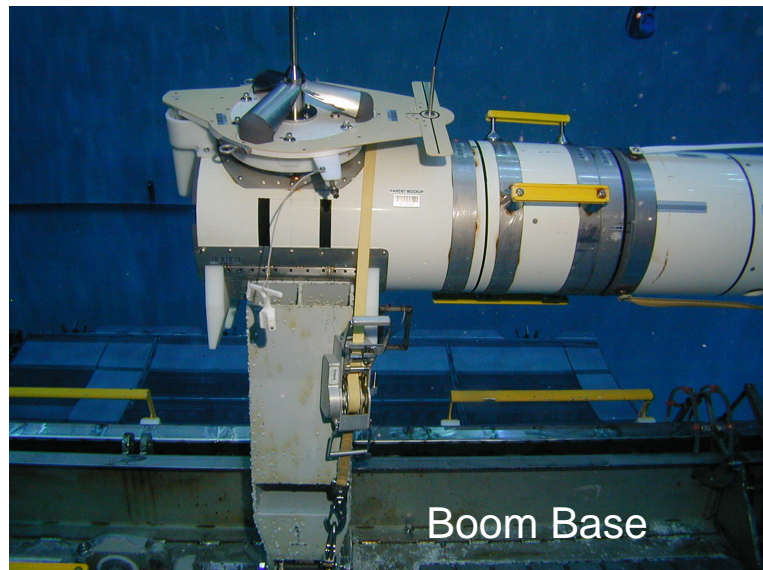
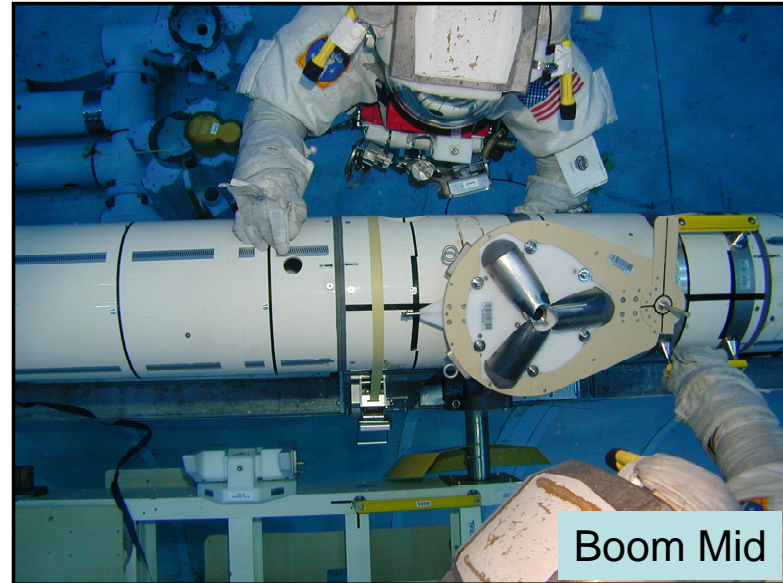
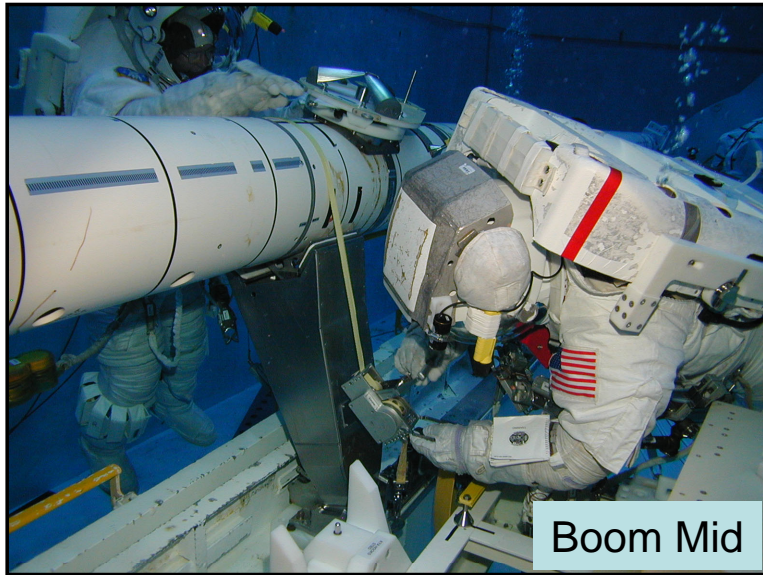
SENSOR PACKAGE 2 (SP2): LCS



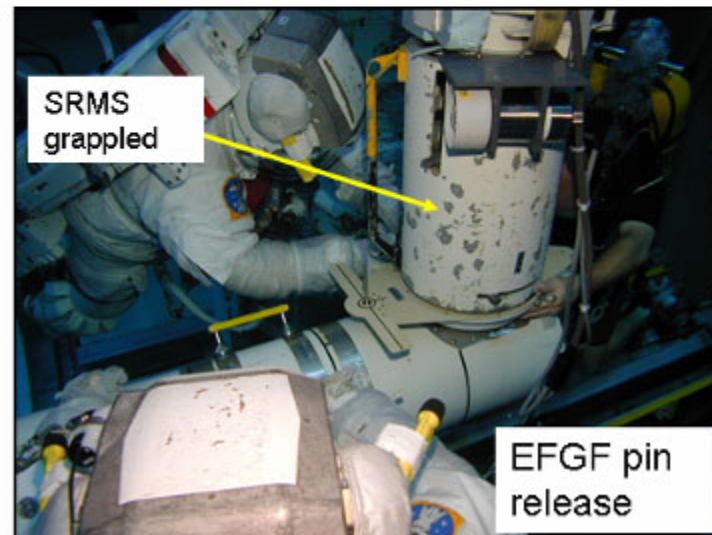
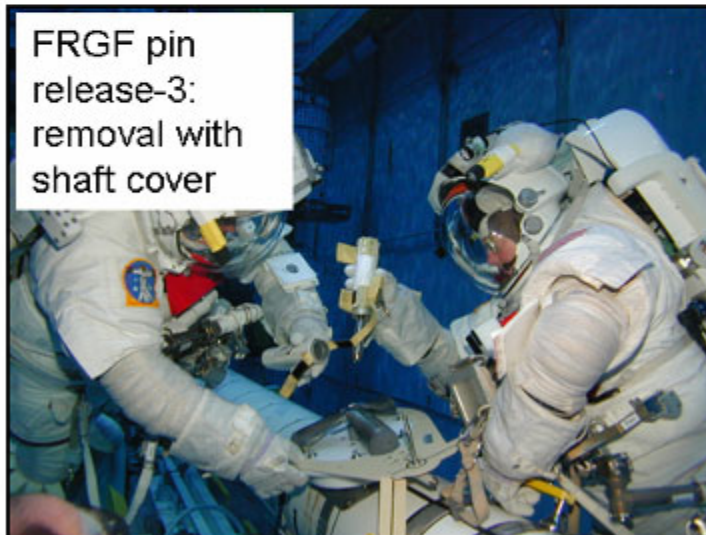
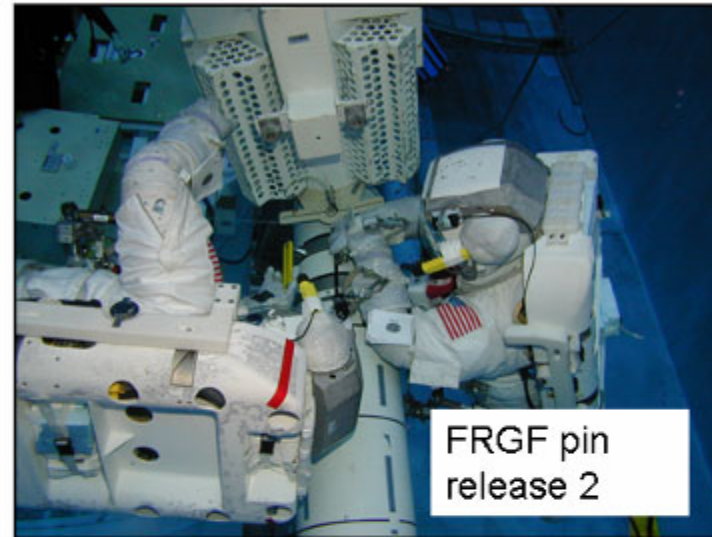
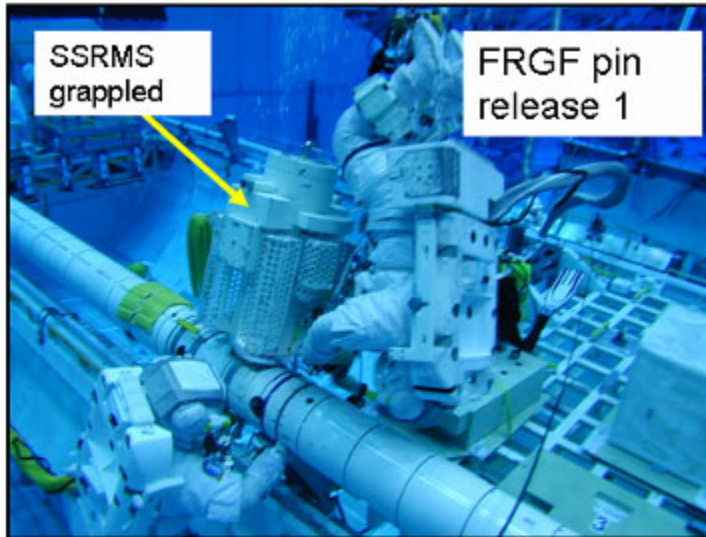
SENSOR PACKAGE 2 (SP2): LCS (Cont)



POSSIBLE PRD ROUTING FOR EVA ASSISTED LATCHING OF BOOM IN MPMS



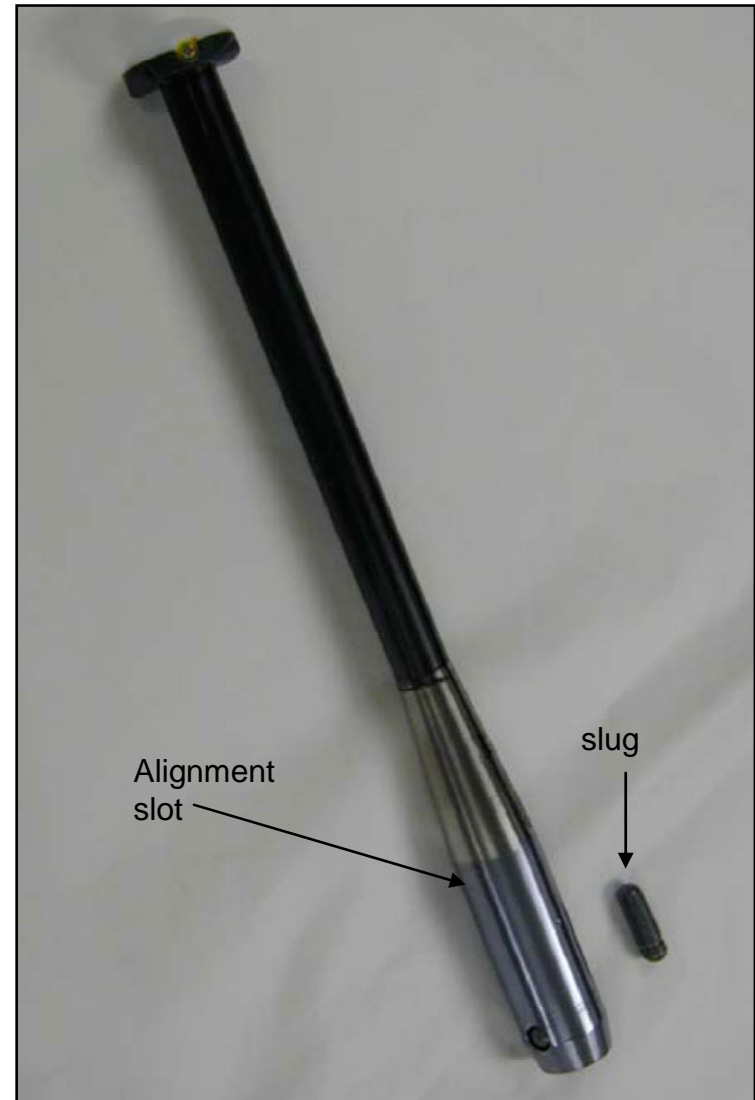
BOOM CONTINGENCIES



GRAPPLE SHAFTS

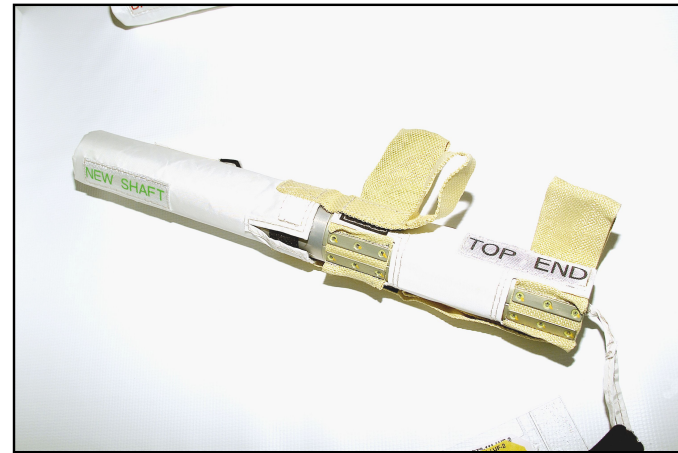


EFGF SHAFT

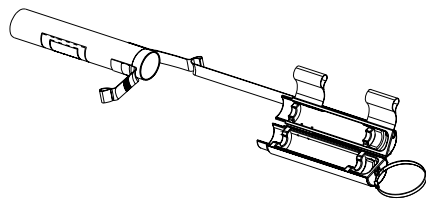


FRGF SHAFT

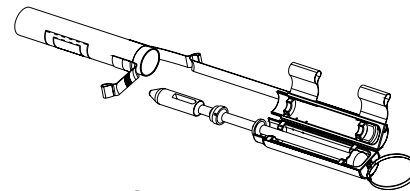
PDGF GRAPPLE SHAFT COVER



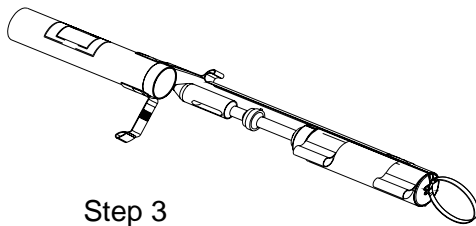
Shaft Installation Steps



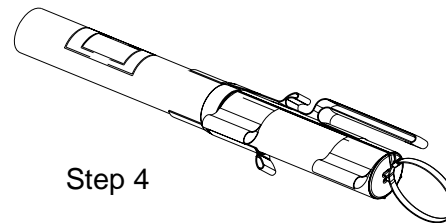
Step 1



Step 2



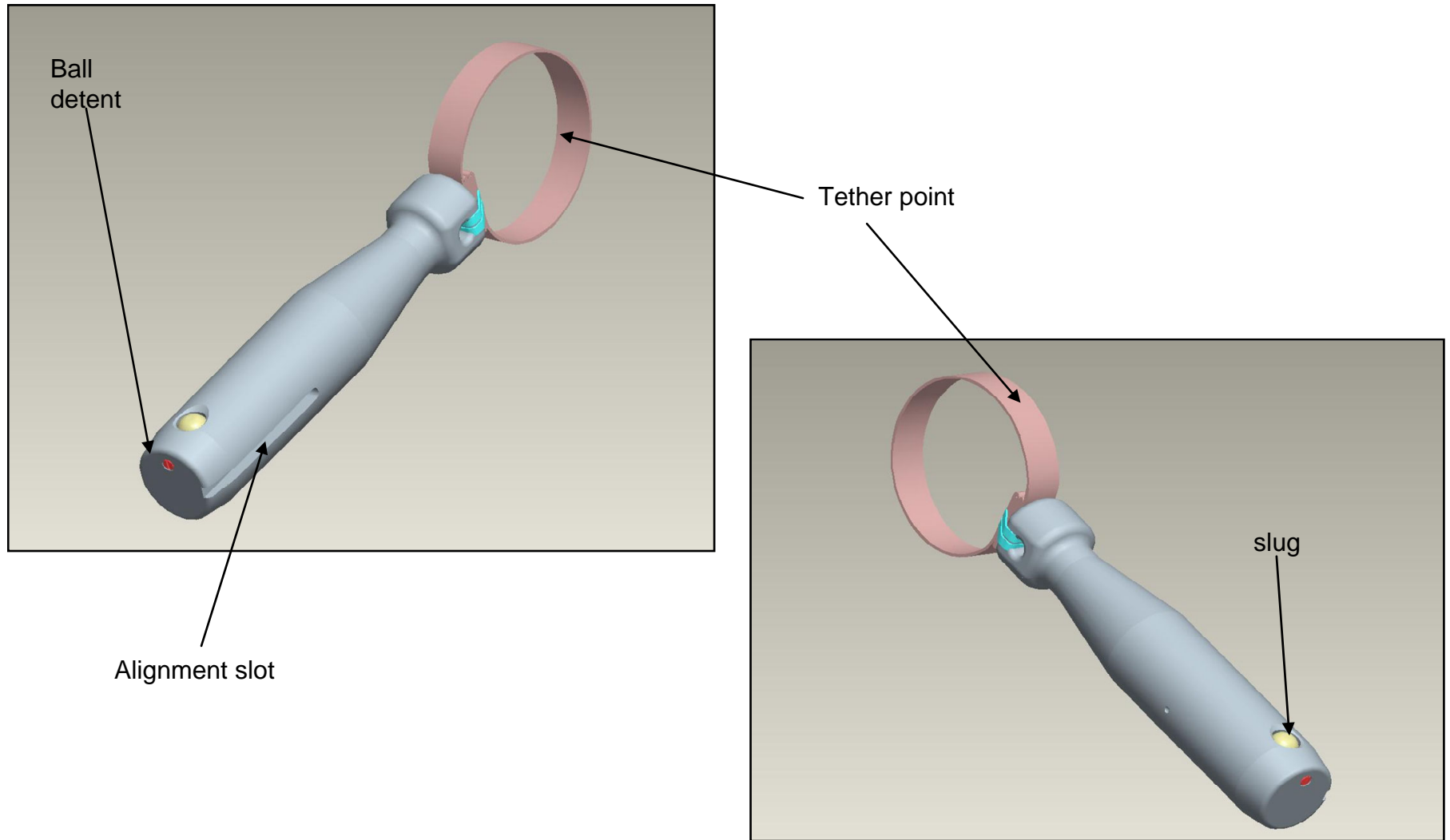
Step 3



Step 4

(PDGF Grapple Pin Shown)

BOOM FRGF FSE



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UNSCHEDULED/CONTINGENCY EVA TASKS

12A WORKAROUNDS CRIBSHEET	TEMP FS 16-2
P1-P3 CAPTURE LATCH OVERRIDE	FS 16-11
P1-P3 MBA BOLT OVERRIDE	FS 16-17
P1-P3 SSAS CONTINGENCY BOLT INSTALL.....	FS 16-22
MANUAL OVERRIDE TO UNLATCH/LATCH (TENSION) SABB	FS 16-25
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UNSCH/CONT
EVA TASKS

12A WORKAROUNDS CRIBSHEET

UNSCH/CONT
EVA TASKS

Procedure	Failure	Work-Around Steps
Electrical Connectors/ NZGL	A. TA clamps fail to release	Use tether hook for additional leverage to open clamp
	B. Connector fails to release	<ol style="list-style-type: none"> 1. Verify bail fully thrown and undamaged 2. Inspect connector/bail for FOD 3. Check alignment/side loads 4. Wiggle/jiggle connector 5. Check for harness interference 6. Increase force on bail
	C. Connector fails to mate	<ol style="list-style-type: none"> 1. Detach from soft dock and inspect, cycle disengaged connector: <ol style="list-style-type: none"> a. Pins b. FOD c. EMI band d. Cable bend radius e. Bail linkages/rivets (both passive and active connector sides) f. Soft dock spring g. O-ring seal on non-active side h. Connector keying features 2. Cycle bail while disconnected 3. Verify half-shells are fully seated on both sides
	D. Connector pin bent	<ol style="list-style-type: none"> 1. Rotate connector to bail up position, describe pin condition. If possible, obtain WVS view of interface 2. On MCC GO, obtain connector pin straightener (16,21,22 gage) or needle nose pliers. Attempt pin repair
	E. Connector FOD	On MCC GO, obtain connector cleaner tool. Attempt removal of FOD. Expel all contents of the cartridge prior to reentry to the airlock
	F. Connector EMI band bent	On MCC GO, obtain needle nose pliers or forceps. Remove EMI band from connector
	G. Connector bail linkage failure	On MCC GO, re-attempt connector mate with broken bail. Tether hook or vise grips may be used for additional leverage
	H. Connector soft dock spring bent	On MCC GO, obtain needle nose pliers. Attempt to remove bent spring
	I. Connector O-ring seal loose	<ol style="list-style-type: none"> 1. Remove seal with tether hook 2. On MCC GO, obtain needle nose pliers. Attempt to remove seal

(Cont next page)

12A WORKAROUNDS CRIBSHEET (Cont)

Procedure	Failure	Work-Around Steps
MMOD Shield	A. MMOD shield fastener fails to release	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p style="text-align: center;">WARNING</p> <p>Do not touch back side of MMOD shields or handle any fastener fragments due to sharp edges</p> <p>Fastener and shield/tool interface must be covered to avoid potential projectiles</p> </div> <ol style="list-style-type: none"> a. Retrieve ISS prybar (A/L Staging Bag) and RPDA MLI b. Release all other fasteners on MMOD shield c. Assess clearance between the MMOD shield and the tools d. If possible, rotate fastener to position tangs off of wire (unlock) e. Place MLI cover over MMOD shield and tool interface f. Insert pry bar under MMOD shield by failed fastener and pry the shield away from the structure until the fastener is free
	B. MMOD shield fastener doesn't engage	Use alternate fastener(s). Two total fasteners per shield should be engaged. For non-overlapping shields, fasteners should be diagonally opposite. Overlapping shields should use fasteners opposite of the overlapping end
	C. T-handle tool fails to engage shield for handling	<ol style="list-style-type: none"> 1. Remove adjacent fasteners, attempt reinstallation of tool into shield 2. Use only one shield tool for handling
	D. Dzus fastener fails to install	Push in firmly
PAD	A. PAD release knob fails to rotate to close	<ol style="list-style-type: none"> 1. Verify knob in release position 2. Stow PAD, retrieve backup PAD <p>NOTE: PAD in crewlock cannot be left outside because of paint</p>
	B. PAD release knob fails to rotate to open	<ol style="list-style-type: none"> 1. Verify knob in release position 2. Attempt to rotate release knob using 7/16" ratchet on knob's 7/16" hex stud 3. To remove PAD from SRMS, PGT[B7 25.5 ft-lb, CCW2 30 RPM, MTL 30.5]-6 ext 7/16. Release contingency release bar by rotating 7/16" captive release bolts (2) ccw, 5 turns

12A WORKAROUNDS CRIBSHEET (Cont)

Procedure	Failure	Work-Around Steps
APFR/IAPFR	A. APFR/IAPFR fails to install in WIF	<ol style="list-style-type: none"> 1. Verify APFR/IAPFR collar in install position 2. Check for FOD in WIF or structural interference 3. Attempt APFR/IAPFR install in alternate clocking and/or WIF 4. If APFR/IAPFR doesn't install, use alternate APFR/IAPFR
	B. APFR/IAPFR joint fails to actuate	<ol style="list-style-type: none"> 1. Verify no load is applied to joint 2. Increase force applied to free joint
	C. EMU boot becomes stuck in APFR boot plate	PGT[B7 25.5 ft-lb, CCW2 30 RPM, MTL 30.5]-6 ext 7/16 , Release 7/16 in EVA bolts (3) on heel plate 5 turns
	D. EMU boot becomes stuck in IAPFR boot plate	Remove 7/16-in EVA bolts on heel plate (2 per boot, 4 turns, 200 in-lb)
PFR	A. Joint fails to actuate	<ol style="list-style-type: none"> 1. Verify no load is applied to joint 2. Increase force applied in order to free joint
Safety Tether	A. 55-ft safety tether fails to retract	<ol style="list-style-type: none"> 1. Verify safety tether is unlocked 2. Pull out small amount of cable, allow reel to retract while holding cable slightly tensioned 3. Use alternate safety tether 4. Return safety tether to airlock
	B. 85-ft safety tether fails to retract	<ol style="list-style-type: none"> 1. Verify safety tether is unlocked 2. Pull out small amount of cable, allow reel to retract while holding cable slightly tensioned 3. Disengage level-wind using EVA ratchet (no socket). Drive ccw until free spinning and red band is showing 4. Return safety tether to airlock
	C. Safety tether load alleviating strap red mark is showing	Check MCC-H
	D. Crew hook fails on load alleviating side	Use second waist tether to replace load alleviating strap and retrieve replacement waist tether
Torque Multiplier	A. Torque multiplier fails to release from fitting	<ol style="list-style-type: none"> 1. Verify torque multiplier anti-back lash neutral, if not, PGT[RCW, MTL 30.5]. Apply cw torque and push anti-back lash button to neutral position 2. PGT[A1 2.5 ft-lb, CCW2 30 RPM, MTL 30.5]-5/32 in Allen Drive, Release torque multiplier contingency release band pin 20 turns (do not exceed 28 turns) 3. When contingency band springs open, remove torque multiplier
Scoops	A. Scoop will not release from fitting	PGT[B1 12.0 ft-lb, CCW2 30 RPM, MTL 30.5] 5/32-in Ball-end Driver Assy, Remove screws (not captive) 5 turns each

12A WORKAROUNDS CRIBSHEET (Cont)

Procedure	Failure	Work-Around Steps
Tether Shuttle	A. Tether shuttle will not release from CETA/MT rail	PGT[B1 12.0 ft-lb, CCW2 30 RPM, MTL 30.5] 5/32-in Ball-end Driver Assy, Remove screws (not captive) 5 turns each
SSAS	A. Ready to Latch – fails to detect RTL	If camera views not adequate, EVA crew will provide visual RTL if sensors are in question
	B. Capture Latch Assembly failed closed	1. PGT[A4 6.3 ft-lb, CCW3 60 RPM, MTL 30.5]-6 ext 7/16: Drive manual open up to 60 turns 2. Leave latch closed
UTA Center Bolt	A. Loss of electrical connectivity between P3 and P4	1. Check position of UTA center bolt sharpie mark (face 1 view), report position to MCC 2. PGT[B6 24 ft-lb, CW1 10 RPM, MTL 25.5]-6 ext 7/16: Drive fastener, report torque to MCC
Release SABB Restraints	A. SABB launch restraint will not release	1. PGT[RCCW, MTL 30.5] RD TM with 5/8: Apply manual torque to fastener 2. 3/8" Drive Ratchet – RD TM with 5/8: Apply ccw manual torque to fastener
Release BGA Restraints	A. Beta Gimbal launch restraint will not release	1. PGT[B7 25.5 ft-lb, CCW3 60 RPM, MTL 30.5] RD TM with 5/8: Apply torque, report release torque to MCC 2. PGT[RCCW, MTL 30.5] RD TM with 5/8: Apply manual torque to fastener 3. 3/8" Drive Ratchet – RD TM with 5/8: Apply ccw manual torque to fastener
	B. 4-bar linkage does not deploy to the locked position	1. Push on 4-bar linkage until latches engage 2. If required, install PRD between IEA and Beta Gimbal Assembly structure. Ratchet PRD to pull 4-bar into locked position

12A WORKAROUNDS CRIBSHEET (Cont)

Procedure	Failure	Work-Around Steps
Rotate IEA Keel Pin	A. IEA Keel Pin fastener will not release	<ol style="list-style-type: none"> 1. PGT[RCCW, MTL 30.5]-6 ext 7/16 Apply torque 2. PGT[B7 25.5 ft-lb, CCW3 60 RPM]-SQ TM w/7/16 PRD: Apply torque, report release torque to MCC 3. On MCC GO, <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p style="text-align: center;"><u>WARNING</u></p> <p>Sharp edge hazard, bolts have exposed threads</p> </div> <p>Remove keel pin nut plate:</p> <ol style="list-style-type: none"> a. PGT[B1 12 ft-lb, CCW1 30 RPM]-6 ext 7/16 b. Release non-captive fasteners (2) and stow in trash bag c. Unfasten hex nut with adjustable wrench and stow in trash d. Translate to inboard side of keel housing and remove keel pin fastener e. If jammed, use hammer to drive bolt out
	B. IEA Keel Pin will not stay in hard dock	Attach adj equip tether between narrow rod on IEA keel pin nut plate and P4 HR #5144 stand-off. Tether can be retrieved and keel pin put back in launch position after BGA restraint bolt release and 4-bar deploy
SAW	A. SABB strut locking sleeve does not engage after SABB unstow	<ol style="list-style-type: none"> 1. Insert SABB PIP pin when the Pivot Locking Mechanism is in BOX UNSTOWED position. Apply manual force to engage locking sleeve over joint 2. If locking sleeve is reset to the STOW position, cycle SABB to LAUNCH position and then back to the UNSTOW position 3. Install Locking Strut Aid
	B. Mast Tip Fittings will not release	<ol style="list-style-type: none"> 1. On MCC GO, PGT[A7 9.2 ft-lb, CCW2 30 RPM]-6 ext 7/16: Apply torque, report release torque to MCC 2. If free spinning nut plate: <ol style="list-style-type: none"> a. Retrieve vise grips b. Attach vise grips to nut plate c. Turn bolt while restraining nut plate

12A WORKAROUNDS CRIBSHEET (Cont)

Procedure	Failure	Work-Around Steps
SARJ Preparation	A. SARJ MLI cover spring clamp bolt will not release	<ol style="list-style-type: none"> 1. If free spinning nut plate suspected: <ol style="list-style-type: none"> a. Retrieve vise grips b. Attach vise grips to bolt head c. Turn bolt ccw while applying gentle pull force (do not fail bolt/retention clip)
		<ol style="list-style-type: none"> 1. Remove spring clamp assembly and fail bolt/retention clip <ol style="list-style-type: none"> a. PGT[A3 4.8 ft-lb, CCW2 30 RPM, MTL 30.5]: Drop proof tether adapter, 3/8" drive IVA socket tool stack b. Release non-captive spring clamp 3/8" bolts/washers (2 each) 9 turns, stow in trash bag c. Move cover away from worksite to keep FOD clear of SARJ d. Use vise grips to force spring clamp bolt out; potential FOD: bolt, spring, retaining clip, nut plate e. Stow spring clamp assy and FOD in trash bag f. Re-install MLI cover
	B. SARJ MLI cover inboard bolt will not release	PGT[B7 25.5 ft-lb, CCW2 30 RPM, MTL 30.5]-6 ext 7/16: Report release torque to MCC
	C. SARJ launch lock will not release	Release other 3 bolts. PGT[RCCW, MTL 30.5]-6 ext 7/16: Apply manual torque to fastener
	D. SARJ launch restraint – retaining bolts will not release	Retrieve cheater bar from Z1 starboard tool box. Cheater Bar/Ratchet wrench 6 ext 7/16: Apply manual torque
	E. DLA lock bolts 1A, 2A will not release	<ol style="list-style-type: none"> 1. PGT[B7 25.5 ft-lb, CCW2 30RPM, MTL 30.5]-6 ext 7/16: Report release torque to MCC 2. PGT[RCCW, MTL 30.5]-6 ext 7/16: Break torque in manual ratchet mode 3. Drive associated DLA Draw Bolt (1C CW or 2C CCW) 6 turns in clamp direction (moves follower arm enough to clear the lock bolt and still clear race ring structure during deploy), proceed with nominal procedure
	F. SARJ MLI cover inboard bolt will not engage	Engage other inboard bolts. (The minimum number of bolts that must be re-installed is one per pair (2 of 4 or 3 of 6 bolts per cover panel fully re-installed))
G. DLA draw bolt 1C will not release (unable to break initial torque)	<ol style="list-style-type: none"> 1. BOLT 1A PGT[A7 9.2 ft-lb, CCW2 30 RPM, MTL 30.5]-6 ext 7/16: Release 1 turn, re-attempt 1C 2. If NO JOY, BOLT 1C: PGT[B7 25.5 ft-lb, CW1 10 RPM, MTL 30.5]-6 ext 7/16: Report release torque to MCC 	

12A WORKAROUNDS CRIBSHEET (Cont)

Procedure	Failure	Work-Around Steps
SARJ Preparation (Cont)	H. DLA draw bolt 2C will not release (unable to break initial torque)	<ol style="list-style-type: none"> BOLT 2A PGT[A7 9.2 ft-lb, CCW2 30 RPM, MTL 30.5]-6 ext 7/16: Release 1 turn, re-attempt 2C If NO JOY, BOLT 2C: PGT[B7 25.5 ft-lb, CCW1 10 RPM, MTL 30.5]-6 ext 7/16: Report release torque to MCC
	I. DLA launch restraint bolts 4A, 4B, 4C	<ol style="list-style-type: none"> PGT[RCCW, MTL 30.5]-6 ext 7/16: Break torque in manual ratchet mode Ratchet Wrench-6 ext 7/16: Break torque
Deploy SARJ Brace	A. Unable to release launch restraint bolt	PGT[B7 25.5 ft-lb, CCW2 30 RPM, MTL 30.5]-6 ext 7/16: Report release torque to MCC
	B. Unable to re-engage launch restraint bolt	Secure launch restraint bolt with wire tie
	C. Unable to insert cones into cups	Restow SARJ brace in launch config
	D. Unable to break torque on brace cone fastener	<ol style="list-style-type: none"> PGT[B7 25.5 ft-lb, CW2 30 RPM, MTL 30.5]-6 ext 7/16: Report release torque to MCC PGT[RCW, MTL 30.5]- 6 ext 7/16: Break torque in manual ratchet mode Ratchet Wrench-6 ext 7/16: Break torque
Rigidize AJIS Struts	A. Unable to insert cone into cup	Restow AJIS Strut in launch config, installation of MLI strap not required
	B. Unable to break torque on brace cone fastener	<ol style="list-style-type: none"> PGT[B7 25.5, CW2 30 RPM, MTL 30.5] (failure 50.1 ft-lb): Re-attempt fastener release, report release torque to MCC If NO JOY, PGT[RCW, MTL 30.5]-6 ext 7/16, Re-attempt fastener release If NO JOY, Ratchet Wrench-6 ext 7/16, re-attempt
Install BGA Bolt Retainer	A. Socket extension does not fit BGA bolt	<ol style="list-style-type: none"> Attempt installation of BGA bolt retainer If NO JOY, tighten BGA bolt with IV adjustable wrench and re-attempt BGA bolt retainer installation If NO JOY, stow BGA bolt retainer and press
Remove SVS Target	A. SVS target bolt will not release	<ol style="list-style-type: none"> PGT[B7 25.5 ft-lb, CCW2 30 RPM, MTL 30.5]-6 ext 7/16: Re-attempt fastener release PGT[RCCW, MTL 30.5]-6 ext 7/16: Apply manual torque

12A WORKAROUNDS CRIBSHEET (Cont)

Procedure	Failure	Work-Around Steps
Remove and Stow Drag Link	A. Drag link fastener will not release <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <p style="text-align: center;">WARNING</p> <p>Nutplate rivets may break. Potential sharp edges/debris</p> </div>	<ol style="list-style-type: none"> 1. Release other end then re-attempt failed bolt 2. PGT[B7 25.5 ft-lb, CCW2 30 RPM, MTL 30.5]-6 ext 7/16: Re-attempt fastener release 3. If NO JOY, PGT[RCCW, MTL 30.5]-6 ext 7/16 (failure 32.3 ft-lb): Re-attempt fastener release 4. On MCC GO, Ratchet Wrench-6 ext 7/16, re-attempt
	B. Drag link fastener will not re-install	<ol style="list-style-type: none"> 1. PGT[A5 7.0 ft-lb, CW2 30 RPM, MTL 30.5]: Apply torque, report torque to MCC 2. If only one bolt functional, orient drag link as required to use good bolt for clevis bracket 3. If NO JOY, use wire tie or tether to secure drag link in stowage position
Remove/Stow Keel Pin	A. Nut clamp bolt is not sufficiently engaged <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <p style="text-align: center;">WARNING</p> <p>Bolt may shear at thread interface</p> <p>Potential sharp edges and debris</p> </div>	<ol style="list-style-type: none"> 1. PGT[A3 4.8 ft-lb, CW2 30 RPM, MTL 30.5] (failure 5.4 ft-lb): Apply torque, report torque to MCC 2. Use vise grips to retain nut during keel pin bolt release. Adjustable wrench will not fit flats of nut
	B. Keel pin bolt will not release	<ol style="list-style-type: none"> 1. Gently shake keel pin to relieve potential binding, re-attempt bolt release 2. PGT[B4 19.4 ft-lb, CCW2 30 RPM, MTL 30.5] (failure 22.2 ft-lb): Apply torque, report release torque to MCC
	C. Keel pin bolt is released from nut, but will not release from bracket	Use bolt puller (A/L toolbox 1) to free bolt from bracket
	D. Keel pin bolt will not reinstall	<ol style="list-style-type: none"> 1. PGT[A7 9.2 ft-lb, CW2 30 RPM, MTL 30.5]: Apply torque, report torque to MCC 2. If NO JOY, stow keel pin bolt in keel with wire tie/tethers as necessary
Release PVR Cinches	A. Cinch bolt fails to release	PGT[RCCW, MTL 30.5]-6 ext 7/16 : Apply manual torque

12A WORKAROUNDS CRIBSHEET (Cont)

Procedure	Failure	Work-Around Steps
SASA R&R	A. Mast fasteners do not release from Z1 truss	PGT[RCCW, MTL 30.5]-6 ext 7/16: Re-attempt fastener release
	B. Mast fasteners do not engage Z1 truss	PGT[B2 16 ft-lb, CW2 30 RPM, MTL 30.5]-6 ext 7/16: Re-attempt fastener engagement
	C. Stanchion bolt does not engage truss at least 7 turns	PGT[RCW, MTL 30.5]-6 ext 7/16: Re-attempt fastener engagement to 7 turns (4 turns minimum required)
	D. Gimbal bolts do not release	<ol style="list-style-type: none"> PGT[B4 19.4 ft-lb, CCW2 30 RPM, MTL 30.5]-6 ext 7/16: Reattempt fastener release Release all other gimbal bolts, reattempt stuck bolt On MCC GO – PGT[RCCW, MTL 30.5]-6 ext 7/16: Re-attempt fastener release
	E. Gimbal bolts do not pivot	Verify that all gimbal bolts have been released and check for FOD
	F. Gimbal bolts do not stay in place after rotation	PGT[A4 ft-lb, CW2 30 RPM, MTL 30.5]-6 ext 7/16: Secure fastener
S-band BSP or XDPR Box	A. Outer or center jack bolt fails to disengage	<ol style="list-style-type: none"> For center jack bolt, reattempt with same setting while pulling box out PGT[TBD ft-lb, CCW2 30 RPM, MTL 30.5]-6 ext 7/16: Re-attempt fastener release PGT[RCCW, MTL 30.5]-6 ext 7/16: Apply manual torque On MCC GO, retrieve manual ratchet, re-attempt
	B. Center jack bolt fails to engage	<ol style="list-style-type: none"> Remove box, inspect rail and bolt interface for debris. Check box co-therm layer for damage Attempt to reinstall PGT[TBD ft-lb, CW2 30 RPM, MTL 30.5]-6 ext 7/16: Re-attempt fastener release Incrementally increase torque up to TBD ft-lb

P1-P3 CAPTURE LATCH OVERRIDE

IV/RMS	EV1	EV2
<p><u>CAPTURE LATCH MANUAL DRIVE FOR FAILED OPEN CLA</u></p> <p>IV 1. First stage capture complete, GO to limp SSRMS</p> <p>2. Give EV GO to continue latch closure</p> <p style="text-align: center;"><u>NOTE</u></p> <p>If less than 63.3 turns additional turns (105 total turns) before hard stop, capture latch closure not complete, go to <u>CAPTURE LATCH OVERRIDE WITH PRDs</u></p> <p>MCC-H 3. Verify Closed Latch Switch - Closed</p> <p>MCC-H 4. On EV GO, perform nominal MBA bolting</p> <p><u>CAPTURE LATCH OVERRIDE WITH PRDs</u></p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p style="text-align: center;"><u>CAUTION</u></p> <p>Do not exceed 200 lbf on EVA handrails while ratcheting with PRDs. When the PRD actuating force increases sharply during bail throw, stop actuating</p> </div> <p>IV 1. First stage capture complete, GO to limp SSRMS</p> <p>2. Give EV GO to continue ratcheting PRDs</p> <p>IV 3. On EV GO, perform nominal MBA bolting</p>	<p><u>CAPTURE LATCH MANUAL DRIVE FOR FAILED OPEN CLA</u></p> <ol style="list-style-type: none"> 1. PGT[A7 9.2 ft-lb, CW3 60RPM, MTL 30.5]-6 ext 7/16: Drive manual override up to 41.7 turns to topological capture 2. On IV GO, rotate drive to hard stop (approx 84.6 turns, 126.5 total turns) 3. PGT[A7 9.2 ft-lb, CCW2 30RPM, MTL 30.5]-6 ext 7/16: Drive manual override 5 turns to final close position 4. Give IV GO for nominal MBA bolting 5. If NO JOY closing capture latch, continue with <u>CAPTURE LATCH OVERRIDE WITH PRDs</u> <p><u>CAPTURE LATCH OVERRIDE WITH PRDs</u></p> <ol style="list-style-type: none"> 1. Install PRD on zenith longeron between handrails P1-3685 and P3 – 3813 with inboard stand-off on P1 handrail 2. Pull minimum 3 inches slack in strap. Ratchet PRD snug (14 full strokes reqd) 3. Verify SSAS coarse pin engages cone 4. On IV GO, ratchet PRD until trusses fully seated (0.5 inch bulkhead clearance) or PRD actuating force increases sharply during PRD bail throw 5. After PRDs are installed, Install contingency bolt 4B, DO NOT PRELOAD 6. PGT[A7 9.2 ft-lb, CW2 30RPM, MTL 30.5]-7.8 ext 5/8. If required, use RAD: Drive contingency bolt 4B (zenith trunnion) until bolt head seated 7. DO NOT PRELOAD. Install and drive contingency bolt 3B (zenith CETA rail) until bolt head seated 8. Release PRD and temp stow 9. PGT[B7 25.5 ft-lb, CW2 30RPM, MTL 30.5]-7.8 ext 5/8. If required, use RAD: Drive contingency bolt 4B to torque stall 10. Install locking cap onto bolt head 11. Drive contingency bolt 3B to torque stall 12. Install locking cap onto bolt head 	<p><u>CAPTURE LATCH OVERRIDE WITH PRDs</u></p> <ol style="list-style-type: none"> 1. Install PRD between handrails P1-3604 and P3 – 3800 (nadir CETA rail handrails) with fixed end on P1 handrail 2. Pull minimum 3 inches slack in strap. Ratchet PRD snug (14 full strokes reqd) 3. Verify SSAS coarse pin engages cone 4. On IV GO, ratchet PRD until trusses fully seated (0.5 inch bulkhead clearance) or PRD actuating force increases sharply during PRD bail throw 5. After PRDs are installed, install contingency bolt 2B, DO NOT PRELOAD 6. PGT[A7 9.2 ft-lb, CW2 30RPM, MTL 30.5]-7.8 ext 5/8. If required, use RAD: Drive contingency bolt 2B (nadir CETA rail) until bolt head seated 7. DO NOT PRELOAD. Install and drive contingency bolt 1B (nadir trunnion) until bolt head seated 8. Release PRD and temp stow 9. PGT[B7 25.5 ft-lb, CW2 30RPM, MTL 30.5]-7.8 ext 5/8. If required, use RAD: Drive contingency bolt 2B to torque stall 10. Install locking cap onto bolt head 11. Drive contingency bolt 1B to torque stall 12. Install locking cap onto bolt head

P1-P3 CAPTURE LATCH OVERRIDE (Cont)

IV/RMS	EV1	EV2
<p><u>CONTINGENCY BOLT REMOVE</u></p> <p>IV 1. When MBA bolting complete and as assembly time permits, perform <u>CONTINGENCY BOLT REMOVE</u></p>	<p><u>CONTINGENCY BOLT REMOVE</u></p> <ol style="list-style-type: none"> 1. Remove locking cap from 4B bolt head 2. PGT[B7 25.5 ft-lb, CCW2 30RPM, MTL 30.5]-7.8 ext 5/8. If required, use RAD: Drive contingency bolt 4B, remove and stow 3. Remove locking cap from 3B bolt head 4. Drive contingency bolt 3B, remove and stow 	<p><u>CONTINGENCY BOLT REMOVE</u></p> <ol style="list-style-type: none"> 1. Remove locking cap from 2B bolt head 2. PGT[B7 25.5 ft-lb, CCW2 30RPM, MTL 30.5]-7.8 ext 5/8. If required, use RAD: Drive contingency bolt 2B, remove and stow 3. Remove locking cap from 1B bolt head 4. Drive contingency bolt 1B, remove and stow

P1-P3 CAPTURE LATCH OVERRIDE – TASK DATA

Tools:

EV1	EV2
PGT	PGT
6 Ext 7/16	6 Ext 7/16
7.8 Ext 5/8	7.8 Ext 5/8
RAD	RAD
PRD	PRD

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
Manual Capture Latch Override bolt	NA	7/16	1	7	7	14.6	126.5	60
Contingency Bolt at Trunnion Longeron	NA	5/8	4	25	25	47.9	43	30
Contingency Bolt at Zenith MT rail	NA	5/8	4	25	25	47.9	43	30
Contingency Bolt at Nadir MT rail	NA	5/8	4	25	25	55.8	43	30

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
NA					

Mass: NA

Notes:

1. During the Capture Latch Override steps, the "B" bolts are used to avoid having to remove thermal covers. The "A" bolts are acceptable if the crewmember believes they have better access to them
2. Due to mis-labeling on the P1 flight hardware, the SSAS contingency bolt labels do not correspond to their respective MBA corner. The 1A and 1B labels are on MBA corner #4 (nadir trunnion). The 4A and 4B labels are on MBA corner #1 (zenith trunnion). The 2A and 2B labels are on MBA corner #3 (nadir MT rail). The 3A and 3B labels are on MBA corner #2 (zenith MT rail). The procedure is written to position EV1 on MBA corners 1 and 2 and EV2 on MBA corners 3 and 4. The EVA labels for the MBA are correct, this error affects the EVA Contingency Bolt labels only

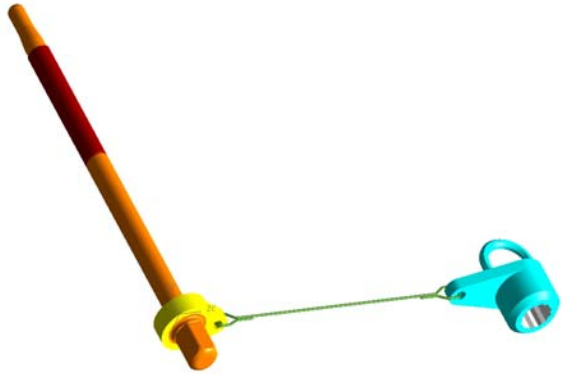
Cautions:

1. Structural damage may occur if PRD tension is not released prior to preloading EVA contingency bolts

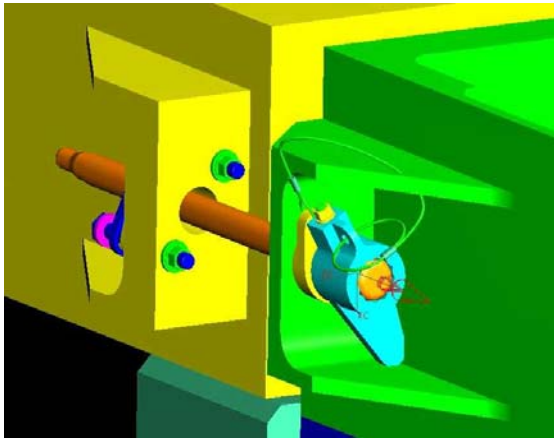
Warnings:

None

P1-P3 CAPTURE LATCH OVERRIDE – TASK DATA (Cont)



SSAS Contingency Bolt



SSAS Contingency Bolt Installed

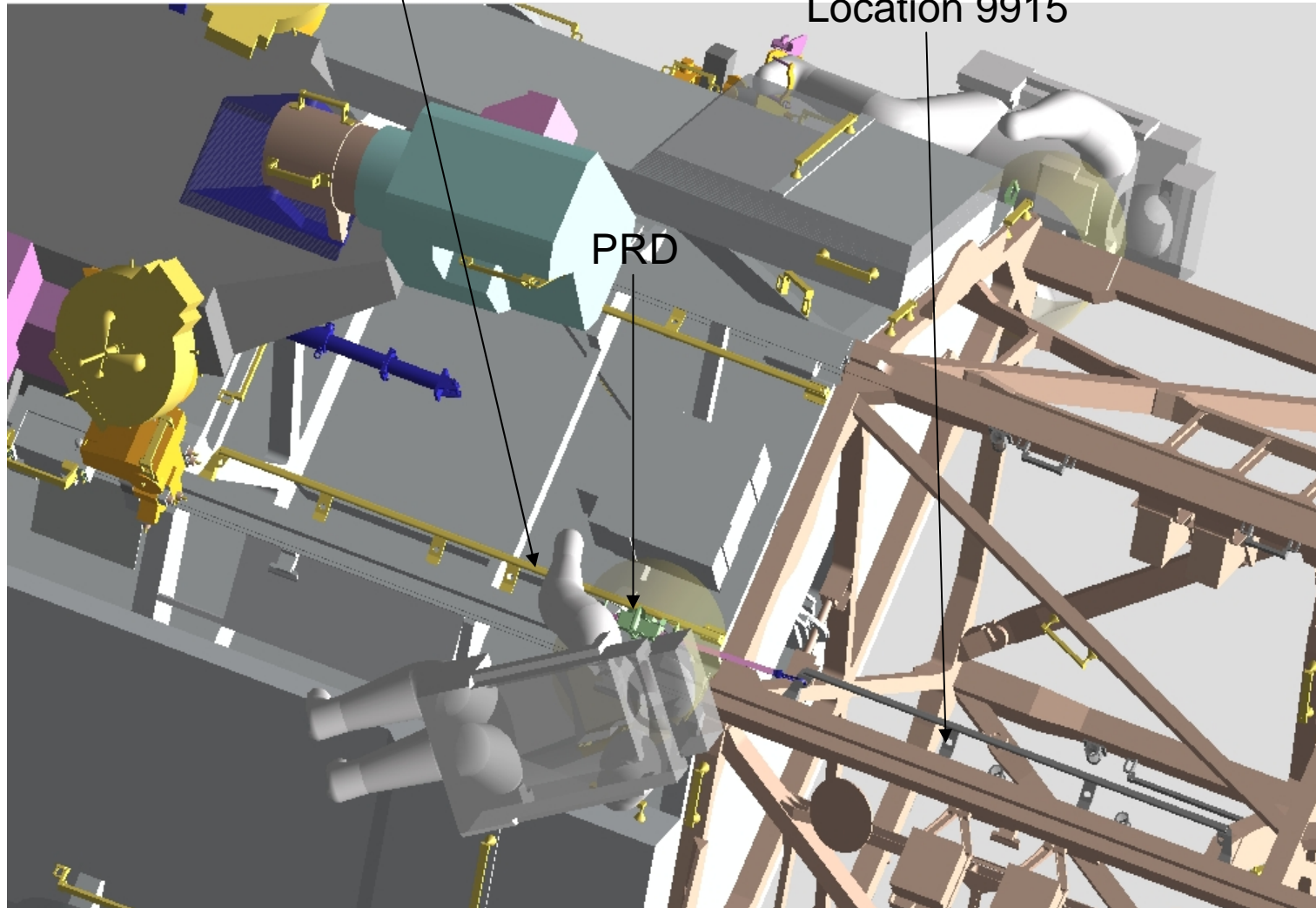


P1 Capture Latch and Capture Latch Manual Drive (without thermal shroud)

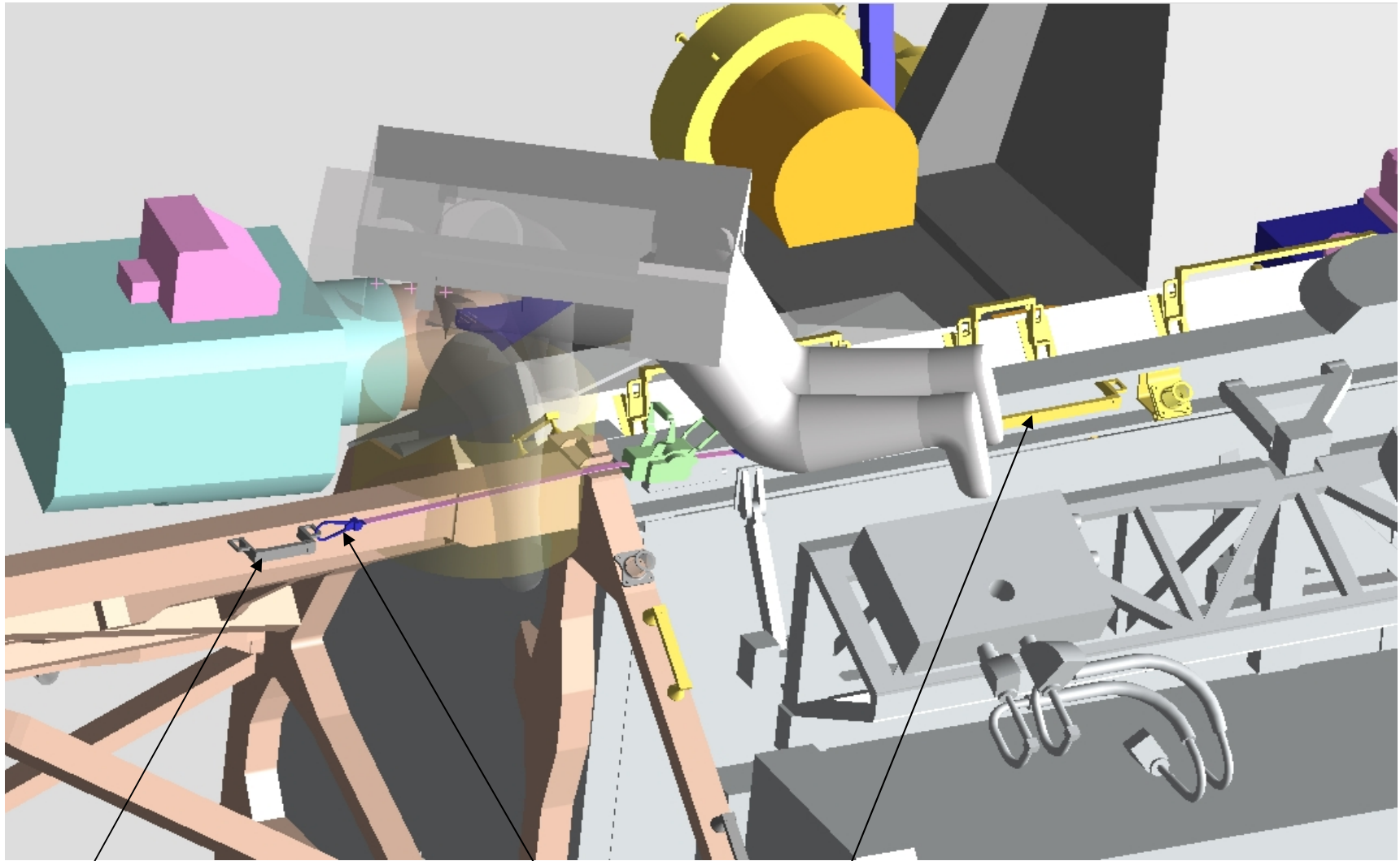
P1-P3 CAPTURE LATCH OVERRIDE – TASK DATA (Cont)

Hook PRD to
P1 Handrail 3604

Hook PRD to
P3 Handrail 3800 Standoff Near
Location 9915



P1-P3 CAPTURE LATCH OVERRIDE – TASK DATA (Cont)

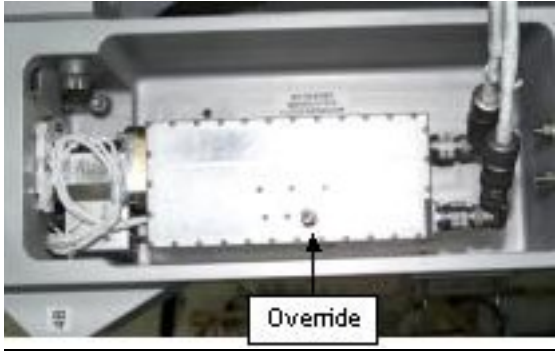


Hook PRD to
P3 Handrail 3813

PRD

Hook PRD to
P1 Handrail 3685
(inboard stand-off)

P1-P3 MBA BOLT OVERRIDE

IV/RMS	EV1	EV2
<p>MBA locations which require <u>MBA MOTOR FAILURE</u> steps: _____, _____, _____, _____</p> <p>IV 1. Verify with MCC that the MBA gear train is at or above minimum temperature</p> <p>IV 2. Check for bolt tight switch "closed". If YES, bolting complete, stop PGT torque</p> <p>Locking cap installation:</p> <ol style="list-style-type: none"> 1. Position locking cap on bolt without engaging cap 2. Rotate the cap ccw until the tab contacts structure 3. Fully seat the cap onto the bolt <p>If necessary to fully seat, rotate the locking cap cw up to 30 degrees to align/engage socket with bolt head</p>	<p><u>MBA MOTOR FAILURE</u></p> <p style="text-align: center;"><u>NOTE</u></p> <p>P1 MBA 1 and 2 override bolts are driven ccw. P1 MBA 3 and 4 override bolts are driven cw. The EVA labels for the MBA are correct</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p style="text-align: center;"><u>CAUTION</u></p> <p>To prevent excessive preload, EV and IV crewmember will need to coordinate driving the MBA override bolt in order to stop PGT torque within 4 seconds of the bolt tight switch (BTS) indication</p> </div> <ol style="list-style-type: none"> 1. PGT[A6 8.3 ft-lb, CCW3(CW3) 60RPM, MTL 30.5]-6 ext 7/16: Drive MBA override bolt approx 460 turns 2. If NO bolt tight switch closing, continue with procedure 3. PGT[A7 ft-lb, CW3(CCW3) 60RPM, MTL 30.5]-6 ext 7/16: Drive MBA override bolt to torque 4. Increase PGT torque incrementally up to setting, drive MBA override bolt to torque, have IV check for bolt tight switch "closed" after each torque setting 5. If NO bolt tight switch at setting, install x2 SSAS contingency bolts at this MBA per <u>SSAS CONTINGENCY BOLT INSTALL</u> <p><u>DUAL BBC FAILURE</u></p> <p style="text-align: center;"><u>NOTE</u></p> <p>P1 MBA 1 and 2 override bolts are driven ccw. P1 MBA 3 and 4 override bolts are driven cw.</p> <p>The P1 SSAS contingency bolt labels do not correspond to their respective MBA corner. The 1A and 1B labels are on MBA corner #4 (nadir trunnion). The 4A and 4B labels are on MBA corner #1 (zenith trunnion). The 2A and 2B labels are on MBA corner #3 (nadir MT rail). The 3A and 3B labels are on MBA corner #2 (zenith MT rail)</p> <ol style="list-style-type: none"> 1. Install one contingency bolt (either A or B location) at each MBA corner 2. PGT[B7 25.5 ft-lb, CW2 30RPM, MTL 30.5]-7.8 ext 5/8. If required, use RAD: Drive contingency bolt to torque (x4) 	 <p>MBA Override Bolt</p>

P1-P3 MBA BOLT OVERRIDE (Cont)

IV/RMS	EV1	EV2
<p>Record final MBA torque and turns:</p> <p>MBA 3 _____ ft-lb _____ turns</p> <p>MBA 1 _____ ft-lb _____ turns</p> <p>MBA 2 _____ ft-lb _____ turns</p> <p>MBA 4 _____ ft-lb _____ turns</p>	<ol style="list-style-type: none"> 3. PGT[RCW, MTL 30.5]-7.8 ext 5/8: Ratchet contingency bolt to torque (x4) 4. Install locking cap on contingency bolt 5. PGT[B1 12.0 ft-lb, CW3 60RPM, MTL 30.5]-6 ext 7/16: Drive MBA #3 override bolt approx 460 turns 6. PGT[A7 9.2 ft-lb, CCW3 60RPM, MTL 30.5]-6 ext 7/16: Drive MBA #1 override bolt approx 460 turns 7. PGT[B1 12.0 ft-lb, CCW3 60RPM, MTL 30.5]-6 ext 7/16: Drive MBA #2 override bolt approx 460 turns 8. PGT[A7 9.2 ft-lb, CW3 60RPM, MTL 30.5]-6 ext 7/16: Drive MBA #4 override bolt approx 460 turns 9. Remove locking cap on contingency bolt 10. PGT[RCCW, MTL 30.5]-7.8 ext 5/8: Ratchet contingency bolt to break torque 11. PGT[B7 25.5 ft-lb, CCW2 30RPM, MTL 30.5]-7.8 ext 5/8. If required, use RAD: Drive contingency bolt and remove bolt 	

P1-P3 MBA BOLT OVERRIDE – TASK DATA

Tools:

EV1	EV2
PGT	PGT
6 Ext 7/16	6 Ext 7/16
7.8 Ext 5/8	7.8 Ext 5/8

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
P1 MBA 1 Override bolt	MOTORIZED BOLT 1 EVA OVERRIDE	7/16	1	8.5	N/A	26.3	460	60
P1 MBA 2 Override bolt	MOTORIZED BOLT 2 EVA OVERRIDE	7/16	1	12.1	N/A	26.3	460	60
P1 MBA 3 Override bolt	MOTORIZED BOLT 3 EVA OVERRIDE	7/16	1	13.8	N/A	26.3	460	60
P1 MBA 4 Override bolt	MOTORIZED BOLT 4 EVA OVERRIDE	7/16	1	10	N/A	26.3	460	60
Contingency Bolt at Trunnion Longeron	1A, 1B, 4A, 4B	5/8	4	25	25	47.9	43	30
Contingency Bolt at Zenith MT rail	3A, 3B	5/8	4	25	25	47.9	43	30
Contingency Bolt at Nadir MT rail	2A, 2B	5/8	4	25	25	55.8	43	30

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
NA					

Mass: NA

Notes:

- For the P1 MBAs: MBA 1 and 2 override bolts are driven ccw
MBA 3 and 4 override bolts are driven cw
- For a MBA motor failure, it is assumed that the bolt tight switches will provide an indication. If the max torque is reached without a bolt tight switch, the MBA can be declared failed. Consequently, the EVA crewmember will need to install two contingency bolts
- For the Dual BBC failure case, a contingency bolt is used to seat the cup/cone. The Dual BBC failure case is treated as a non-instrumented bolt and installation is defined by torque and use turns as a secondary indicator
- Due to mis-labeling on the P1 flight hardware, the SSAS contingency bolt labels do not correspond to their respective MBA corner. The 1A and 1B labels are on MBA corner #4. The 4A and 4B labels are on MBA corner #1. The 2A and 2B labels are on MBA corner #3. The 3A and 3B labels are on MBA corner #2. The procedure is written to position EV1 on MBA corners 1 and 2 and EV2 on MBA corners 3 and 4. The EVA labels for the MBA are correct, this error affects the EVA Contingency Bolt labels only
- There is no APFR worksite for MBA corner 3 (nadir CETA rail corner)

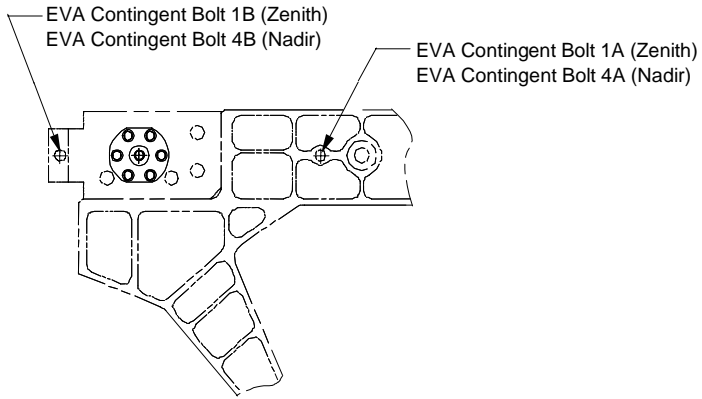
Cautions:

-

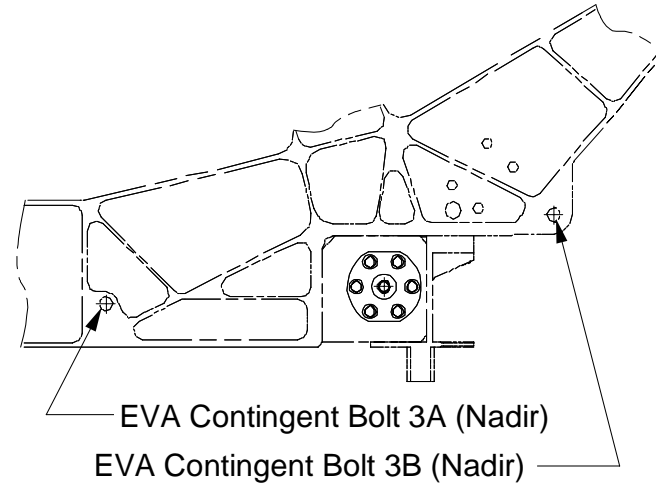
Warnings:

None

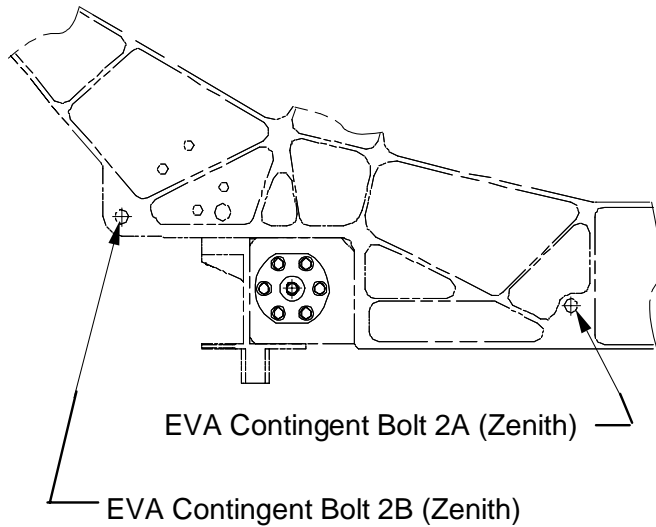
P1-P3 MBA BOLT OVERRIDE – TASK DATA (Cont)



P1/P3 Trunnion Location (4A and 4B labels are on the zenith corner, 1A and 1B labels are on the nadir corner)

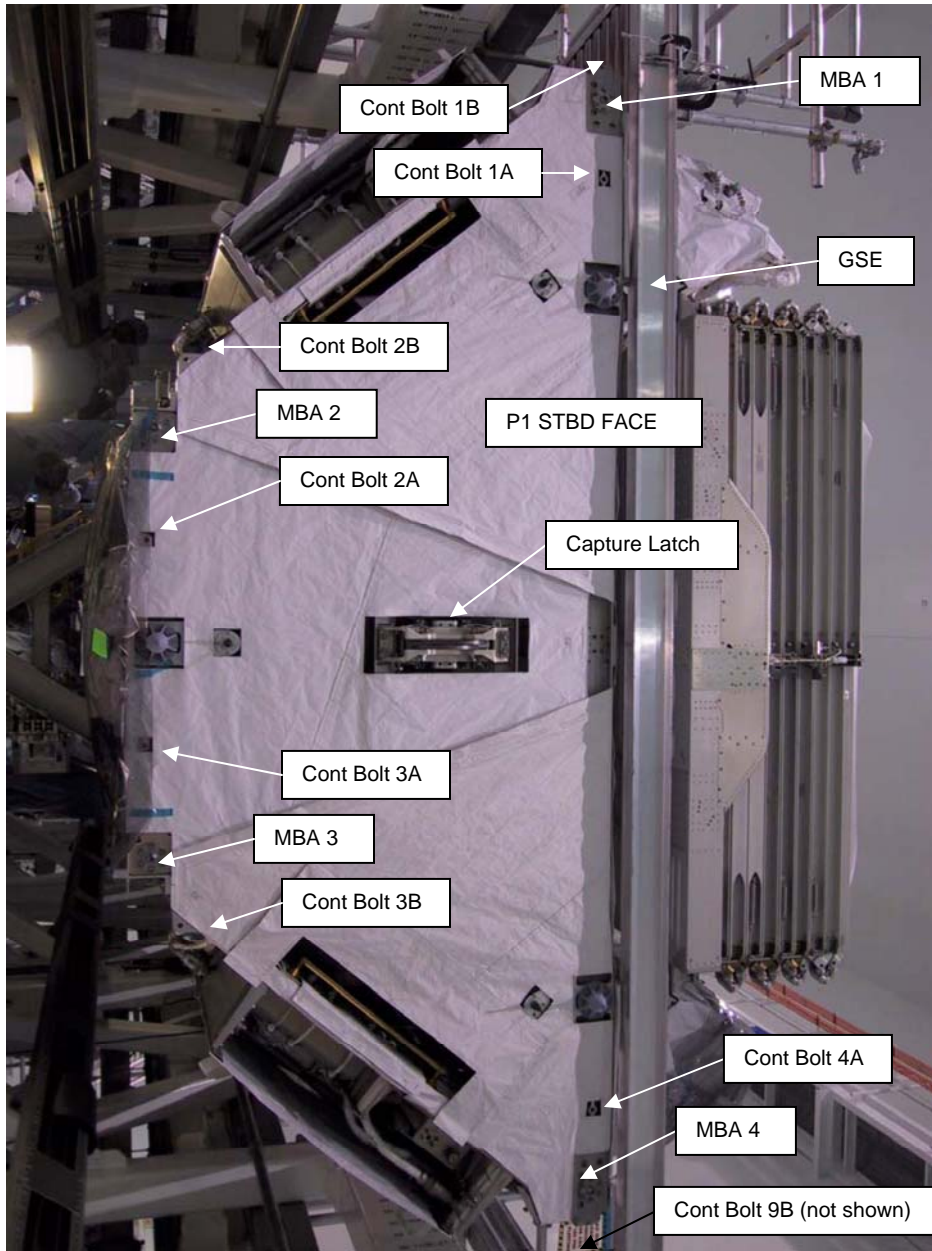


P1/P3 NADIR MT Rail Location (2A and 2B labels are on the nadir corner)



P1/P3 ZENITH MT Rail Location (3A and 3B labels are on the zenith corner)

P1-P3 MBA BOLT OVERRIDE – TASK DATA (Cont)



P1-P3 SSAS CONTINGENCY BOLT INSTALL

IV/RMS	EV1	EV2
<p>Locking cap installation:</p> <ol style="list-style-type: none"> 1. Position locking cap on bolt without engaging cap 2. Rotate the cap ccw until the tab contacts structure 3. Fully seat the cap onto the bolt <p>If necessary to fully seat, rotate the locking cap cw up to 30 degrees to align/engage the socket with the bolt head</p> <p style="text-align: center;"><u>NOTE</u></p> <p>To maintain required torque tolerances, the EVA torque wrench must be kept in its bag when not in use</p>	<p><u>SSAS CONTINGENCY BOLT INSTALLATION</u></p> <p style="text-align: center;"><u>NOTE</u></p> <p>The P1 SSAS contingency bolt labels do not correspond to their respective mba corner. The 1A and 1B labels are on MBA corner #4 (nadir trunnion). The 4A and 4B labels are on MBA corner #1 (zenith trunnion). The 2A and 2B labels are on MBA corner #3 (nadir MT rail). The 3A and 3B labels are on MBA corner #2 (zenith MT rail). The EVA Labels for the MBA are correct, this error affects the EVA Contingency Bolt labels only</p> <p><u>ZENITH AND NADIR TRUNNION LONGERON LOCATIONS (MBA 1 AND 4)</u></p> <ol style="list-style-type: none"> 1. PGT[B5 22.0 ft-lb, CW2 30RPM, MTL 30.5]-7.8 ext 5/8. If required, use RAD: Install contingency bolt at location and drive bolt to torque 2. PGT[B7 25.0 ft-lb, CW2 30RPM, MTL 30.5]-7.8 ext 5/8. If required, use RAD: Install contingency bolt at B location and drive bolt to torque 3. Torque Wrench 34 ft-lb-7.8 ext 5/8: ratchet contingency bolt B to torque 4. Torque Wrench 45 ft-lb-7.8 ext 5/8: ratchet contingency bolt A to torque 5. Torque Wrench 45 ft-lb-7.8 ext 5/8: ratchet contingency bolt B to torque 6. Install locking caps <p><u>ZENITH MT RAIL LOCATION (MBA 2)</u></p> <ol style="list-style-type: none"> 1. PGT[B6 24.0 ft-lb, CW2 30RPM, MTL 30.5]-7.8 ext 5/8. If required, use RAD: Install contingency bolt at 3A and drive bolt to torque 2. PGT[B7 25.0 ft-lb, CW2 30RPM, MTL 30.5]-7.8 ext 5/8. If required, use RAD: Install contingency bolt at 3B and drive bolt to torque 3. Torque Wrench 48 ft-lb-7.8 ext 5/8: ratchet contingency bolt 3B to torque 4. Torque Wrench 48 ft-lb-7.8 ext 5/8: ratchet contingency bolt 3A to torque 5. Install locking caps 	

P1-P3 SSAS CONTINGENCY BOLT INSTALL (Cont)

IV/RMS	EV1	EV2
	<p><u>NADIR MT RAIL LOCATION (MBA 3)</u></p> <ol style="list-style-type: none"> 1. PGT[B7 25.0 ft-lb, CW2 30RPM, MTL 30.5]-7.8 ext 5/8. If required, use RAD: Install contingency bolt at 2A and drive bolt to torque 2. Torque Wrench 28 ft-lb-7.8 ext 5/8: ratchet contingency bolt 2A to torque 3. PGT[B7 25.0 ft-lb, CW2 30RPM, MTL 30.5]-7.8 ext 5/8. If required, use RAD: Install contingency bolt at 2B and drive bolt to torque 4. Torque Wrench 56 ft-lb-7.8 ext 5/8: ratchet contingency bolt at 2B to torque 5. Torque Wrench 56 ft-lb-7.8 ext 5/8: ratchet contingency bolt at 2A to torque 6. Install locking caps 	

P1-P3 SSAS CONTINGENCY BOLT INSTALL – TASK DATA

Tools:

EV1	EV2
PGT	NA
7.8 Ext 5/8	
RAD (if required)	

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
Contingency Bolt at Trunnion Longeron	1A, 1B, 4A, 4B	5/8	4	25	25	47.9	43	30
Contingency Bolt at Zenith MT rail	3A, 3B	5/8	4	25	25	47.9	43	30
Contingency Bolt at Nadir MT rail	2A, 2B	5/8	4	25	25	55.8	43	30

EVA Connectors: NA

Mass: NA

Notes:

- Due to mis-labeling on the P1 flight hardware, the SSAS contingency bolt labels do not correspond to their respective MBA corner. The 1A and 1B labels are on MBA corner #4 (nadir trunnion). The 4A and 4B labels are on MBA corner #1 (zenith trunnion). The 2A and 2B labels are on MBA corner #3 (nadir MT rail). The 3A and 3B labels are on MBA corner #2 (zenith MT rail). The procedure is written to position EV1 on MBA corners 1 and 2 and EV2 on MBA corners 3 and 4
- There is no APFR worksite for MBA corner 3 (nadir CETA rail corner)

Cautions:

None

Warnings:

None

MANUAL OVERRIDE TO UNLATCH/LATCH (TENSION) SABB

IV/RMS	EV1	EV2
<p>Identify Affected Power Channel XX = _____</p> <p><u>IF UNLATCHING SABB</u></p> <p>MCC-H 1. Perform {3.190 SAW XX FAILURE TO UNLATCH SABB REMOTELY} (SODF: EPS: MALFUNCTION: PRIMARY POWER)</p> <p><u>IF TENSIONING SABB</u></p> <p>MCC-H 2. Perform {3.193 SAW XX FAILURE TO LATCH (TENSION) SABB REMOTELY} SODF: EPS: MALFUNCTION: PRIMARY POWER}</p> <p>THEN:</p> <p>IV PCS 3. If required (see Task Data notes) - Verify affected SABB positioned over the IEA and BGA latched PVM: EPS: BGA XX <div style="border: 1px solid black; padding: 2px; display: inline-block;">BGA XX</div> 'ECU XX' Verify: Integ Cnt – Incrementing</p> <p>'BGA XX' Verify: Actual Angle, deg = 270.000 (± 0.5) (Left SABB) OR Actual Angle, deg = 90.000 (± 0.5) (Right SABB)</p> <p>Motor State – OFF Latch 1 Pin Status – Latched</p> <p>IV 4. GO for EV crew ingress at worksite</p> <p style="text-align: center;"><u>NOTE</u></p> <p>Free Drift or CMG Control with Thrusters Disabled is required while SABB is being unlatched/latched. Applies only while mechanisms are in motion</p> <p>MCC-H 5. Configure ISS/Orbiter attitude control to CMG Control with thrusters disabled</p> <p>IV 6. On EV GO, CMD nominal attitude control</p>	<p><u>MANUAL OVERRIDE TO UNLATCH SABB</u></p> <ol style="list-style-type: none"> 1. On MCC GO, enter worksite area 2. If required, APFR, setup and ingress (see Task Data for WIF position and APFR settings) 3. Release PIP pin from back-up position lever 4. Move override lever to MANUAL position 5. Insert PIP pin into lock lever position 6. PGT[A6 8.3 ft-lb, CCW2 30RPM, MTL 10.5]-2 ext 7/16: Push to engage MDA drive fastener (3-10 lb), apply torque, 48 ± 1 turns until visual indication of latch position or hard stop. 7. Release PIP pin from override positioning lever 8. Move override lever to AUTOMATIC position 9. Insert PIP pin into lock lever position 10. PGT[RCCW, MTL 10.5]-2 ext 7/16: Push to engage MDA drive fastener (3-10 lb), apply torque, ¼ turn to engage clutch pins 	<p><u>MANUAL OVERRIDE TO TENSIONING SABB</u></p> <ol style="list-style-type: none"> 1. On MCC GO, enter worksite area 2. If required, APFR, setup and ingress (see Task Data for WIF position and APFR settings) 3. Release PIP pin from back-up position lever 4. Move override lever to MANUAL position 5. Insert PIP pin into lock lever position 6. PGT[A6 8.3 ft-lb, CW2 30RPM, MTL 10.5]-2 ext 7/16: Push to engage MDA drive fastener (3-10 lb), apply torque, 48 ± 1 turns until visual indication of latch position or hard stop. The latches along the blanket box are visible and will move to the engaged position 7. Release PIP pin from override positioning lever 8. Move override lever to AUTOMATIC position 9. Insert PIP pin into lock lever position 10. PGT[RCW, MTL 10.5]-2 ext 7/16: Push to engage MDA drive fastener (3-10 lb), apply torque, ¼ turn to engage clutch pins

MANUAL OVERRIDE TO UNLATCH/LATCH (TENSION) SABB – TASK DATA

Estimated Task Duration:

	With RMS	Without RMS
One EV Crew	NA	0:30
Two EV Crew	NA	NA

Tools:

EV1	EV2
PGT	NA
2 Ext 7/16	
APFR	

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
SABB MDA Fastener	Yes	7/16	1 per	NA	7.5	12	48	60

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
NA					

Foot Restraints:

Task	WIF	APFR Setting
IEA Keel side – Right SABB	P4/S4-26; P6/S6-38	(12, FF, F, 3)
IEA Keel side – Left SABB	P4/S4-26; P6/S6-38	(12, FF, H, 9)
IEA Non-keel side – Right SABB	P4/S4-25; P6/S6-37	(12, FF, F, 3)
IEA Non-keel side – Left SABB	P4/S4-25; P6/S6-37	(12, FF, H, 9)

Mass: NA

Notes:

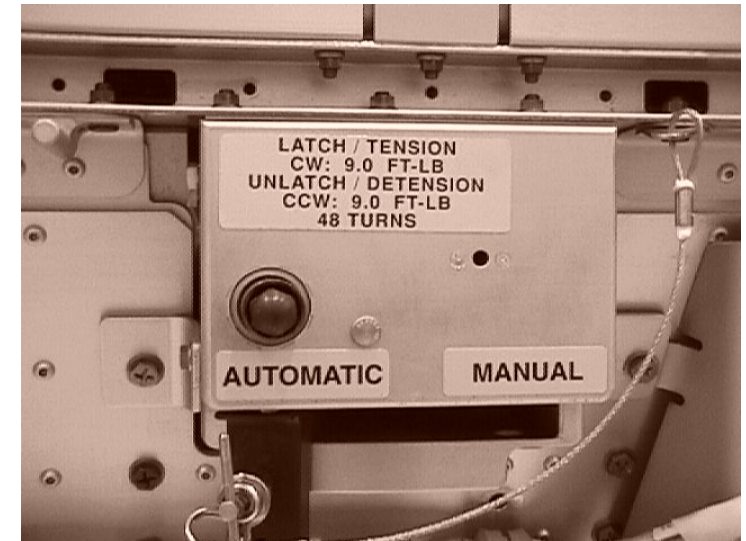
1. It has been demonstrated in the NBL that the EVA crewmember can access the SABB Manual Override Fastener from a free floating position on the mast canister. If the EVA crew thinks they can actuate the SABB Manual Override Fastener from a free floating position on the mast canister, there is no need to position the BGA per IV step 3

Cautions:

1. Equipment damage – Maintain a constant push force (3 – 10 lb) on the MDA fastener anti-rotation collar during fastener rotation. Damage to the locking collar and/or the fastener could result if the collar is allowed to extend during fastener rotation
2. Equipment damage – Avoid contact with blanket box latches and mechanisms on underside of blanket box

Warnings:

1. Sharp edge/pinch point/entrapment hazard – Avoid contact with outboard underside of SABB due to exposed reels, guide-wire and tension mechanisms
2. Moving equipment. Avoid contact with blanket box latches during manual override operation



SABB MDA

MANUAL RELEASE OF SABB RESTRAINT PINS

IV/RMS	EV1	EV2
<p>1. Position applicable BGA to angle per Task Data page and lock</p> <p>Perform {2.101 PVM BGA XX ENGAGE ANTI-ROTATION LATCH} (SODF: EPS: NOMINAL: PRIMARY POWER)</p> <p>2. Give EV crew GO to enter worksite</p>	<div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center;">WARNING</p> <p>Sharp edge/pinch point/entrapment hazard: Avoid contact with outboard underside of SABB due to exposed reels, guide-wire and tension mechanisms</p> <p>Collision hazard: BRS Pin will extend ~1 inch from bottom of box when fired. Keep EMU and tools out of this area</p> </div> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p style="text-align: center;">CAUTION</p> <p>Actuation of BRS trigger with probe tool should not require excessive force. Application of excessive force may damage the BRS pin tool</p> </div> <ol style="list-style-type: none"> 1. APFR/Ingress Aid, set up (per Task Data page) 2. Check position of trigger and/or slider 3. If trigger/slider is in actuated position, induce sharp rap(s) to side of BRS pin housing with the hammer to release 4. If trigger/slider is not in actuated position, use the BRS pin release tool to actuate the trigger in the direction indicated by the arrow 	

MANUAL RELEASE OF SABB RESTRAINT PINS – TASK DATA

Estimated Task Duration:

	With RMS	Without RMS
One EV Crew	NA	1:00
Two EV Crew	NA	NA

Tools:

EV1	EV2
APFR	
Ingress aid	
BRS Pin Contingency Tool	
Hammer	

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
N/A								

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
NA					

Foot Restraints, Right SABB settings are in ():

Task	WIF	APFR Setting
Left (Right) SABB BRS Pin #1 (IEA non-Keel side) BGA rotational angle = 284 (53)	P4/S4-26, S6-38	12,FF,F,1 (6,FF,G,3)
Left (Right) SABB BRS Pin #2 (IEA non-Keel side) BGA rotational angle = 265 (78)	P4/S4-26, S6-38	12,FF,F,9 (12,FF,G,3)
Left (Right) SABB BRS Pin #3 (IEA non-Keel side) BGA rotational angle = 281 (90)	P4/S4-15, S6-27	10,FF,D,9 (9,FF,G,4)
Left (Right) SABB BRS Pin #4 (IEA non-Keel side) BGA rotational angle = 296 (90)	P4/S4-15, S6-23	10,GG,E,7 (9,GG,G,3)
Left (Right) SABB BRS Pin #5 (IEA non-Keel side) BGA rotational angle = 281 (90)	P4/S4-15, S6-27	3,FF,E,9 (3,GG,G,3)
Left (Right) SABB BRS Pin #6 (IEA non-Keel side) BGA rotational angle = 281 (95)	P4/S4-11, S6-23	5,II,F,6 (7,FF,E,10)
Left (Right) SABB BRS Pin #7 (IEA non-Keel side) BGA rotational angle = 281 (101)	P4/S4-11, S6-23	9,II,E,7 (7,KK,F,5)
Left (Right) SABB BRS Pin #1 (IEA Keel side) BGA rotational angle = 284 (53)	P4/S4-25, S6-37	12,FF,F,1 (6,FF,G,3)
Left (Right) SABB BRS Pin #2 (IEA Keel side) BGA rotational angle = 265 (78)	P4/S4-25, S6-37	12,FF,F,9 (12,FF,G,3)
Left (Right) SABB BRS Pin #3 (IEA Keel side) BGA rotational angle = 281 (90)	P4/S4-13, S6-25	10,FF,D,9 (9,FF,G,4)
Left (Right) SABB BRS Pin #4 (IEA Keel side) BGA rotational angle = 296 (90)	P4/S4-13, S6-21	10,GG,E,7 (2,GG,G,3)
Left (Right) SABB BRS Pin #5 (IEA Keel side) BGA rotational angle = 281 (90)	P4/S4-13, S6-27	3,FF,E,9 (3,GG,G,3)
Left (Right) SABB BRS Pin #6 (IEA Keel side) BGA rotational angle = 281 (95)	P4/S4-09, S6-21	5,II,F,6 (7,FF,E,10)
Left (Right) SABB BRS Pin #7 (IEA Keel side) BGA rotational angle = 281 (101)	P4/S4-09, S6-21	9,II,E,7 (7,KK,F,5)

Notes:

- When the trigger is actuated, the slider will slide down and lock the trigger in the actuated position. If the slider has moved down, the BRS pin may be have not fired due to solar array panel side loads
- If trigger/slider is not in actuated position, trigger must be actuated manually with probe tool
- Arrows (←) indicate direction of trigger actuation
- All triggers are on the MDA side of BRS pin
- Pin 3 on right box and pins 1,4 on left box have limited access

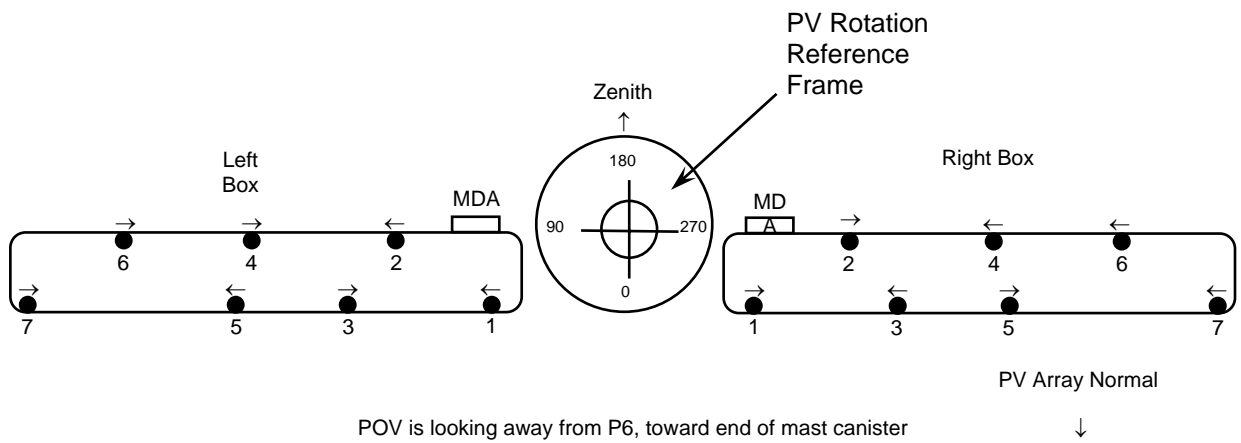
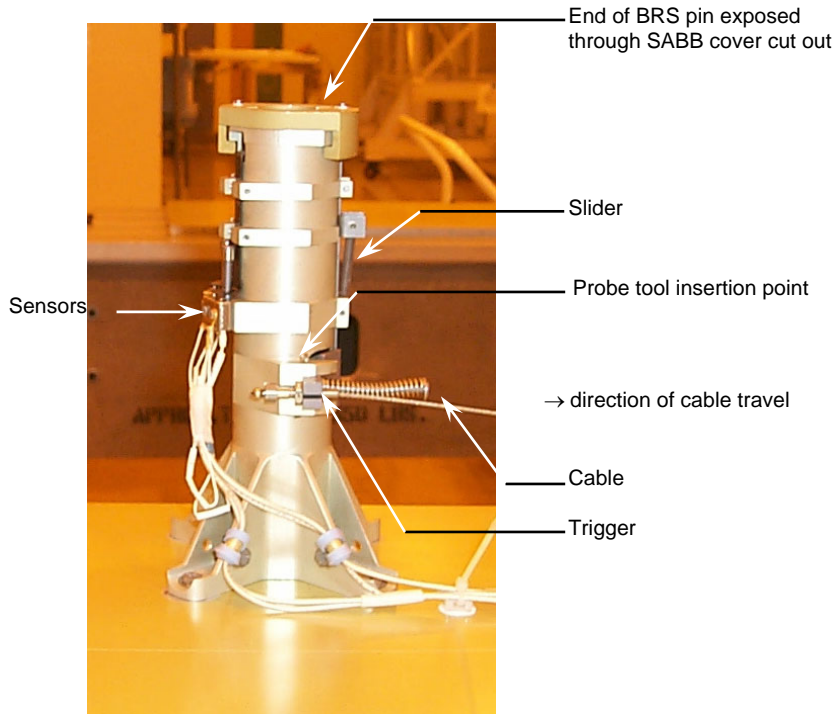
Cautions:

- Actuation of BRS trigger with probe tool should not require excessive force. Application of excessive force may damage the BRS pin tool

Warnings:

- Sharp edge/pinch point/entrapment hazard: Avoid contact with outboard underside of SABB due to exposed reels, guide-wire and tension mechanisms
- Collision hazard: BRS Pin will extend ~1 inch from bottom of box when fired. Keep EMU and tools out of this area

MANUAL RELEASE OF SABB RESTRAINT PINS – TASK DATA (Cont)



MANUAL OVERRIDE TO EXTEND/RETRACT MAST

IV/RMS	EV1	EV2
<p>Identify Affected Power Channel XX = _____</p> <p>MCC-H 1. Perform {3.191 SAW XX FAILURE TO EXTEND MAST REMOTELY} (SODF: EPS: MALFUNCTION: PRIMARY POWER)</p> <p>OR</p> <p>Perform {3.192 SAW XX FAILURE TO RETRACT MAST REMOTELY} (SODF: EPS: MALFUNCTION: PRIMARY POWER)</p> <p>MCC-H 2. Verify Solar Array positioned for thermal conditioning and BGA latched</p> <p>PCS PVM: EPS: BGA XX BGA XX 'ECU XX' Verify: Integ Cnt – Incrementing</p> <p>'BGA XX' Record: Actual Angle 4A(2A), deg = 90.000(270.000) (± 60) Verify: Motor State – OFF Latch 1(2) Pin Status – Latched</p> <p>IV 3. GO for EV crew ingress at worksite</p> <p style="text-align: center;"><u>NOTE</u></p> <p>Free Drift or CMG Control with Thrusters Disabled is required while solar array is being deployed/retracted Applies only while mechanisms are in motion</p> <p>MCC-H 4. Configure ISS/Orbiter attitude control to CMG Control with thrusters disabled</p> <p>IV 5. On EV GO – CMD nominal attitude control</p>	<p style="text-align: center;"><u>MANUAL OVERRIDE TO EXTEND MAST</u></p> <ol style="list-style-type: none"> On MCC GO, enter worksite area IF REQUIRED – Set up APFR and ingress (see Task Data for WIF position and APFR settings) IF MCHD REQUIRED – Perform steps 4, 5, and 7 Deploy MCHD PGT swing arm, install MCHD onto mast canister, zip nuts (four) PGT[A7 9.2 ft-lb, CW2 30RPM, MTL 10.5]-2 ext 7/16: Secure MCHD fasteners (four) to hardstop Ratchet -2 ext 7/16: Rotate Manual Override Actuator Shaft on left side of MDA 180 deg to disengage MDA, indicator – MANUAL Place PGT in MCHD PGT swing arm <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p style="text-align: center;"><u>CAUTION</u></p> <p>Crew must monitor the tension bar. Stop SAW deployment if the tension bar rises more than 1.5 inches from the sill. PGT[A7 9.2 ft-lb, CW3 60RPM, MTL 10.5]-2 ext 7/16, drive MDA EVA override fastener until tension bar returns to 1.5 inches from the sill. When panels release and the tension bar returns to the sill, the deployment can continue</p> </div> <p style="text-align: center;"><u>NOTE</u></p> <p>Insulation is not required for this task, unless needed for visual abort cues. As expected, the tension bar will rise 18 to 20 inches from the sill as the last half mast bay is deployed</p>	<p style="text-align: center;"><u>MANUAL OVERRIDE TO RETRACT MAST</u></p> <ol style="list-style-type: none"> On MCC GO, enter worksite area IF REQUIRED – Set up APFR and ingress (see Task Data for WIF position and APFR settings) IF MCHD REQUIRED – Perform steps 4, 5, and 7 Deploy MCHD PGT swing arm, install MCHD onto mast canister, zip nuts (four) PGT[A7 9.2 ft-lb, CW2 30RPM, MTL 10.5]-2 ext 7/16: Secure MCHD fasteners (four) to hardstop Ratchet -2 ext 7/16: Rotate Manual Override Actuator Shaft on left side of MDA 180 deg to disengage MDA, indicator – MANUAL Place PGT in MCHD PGT swing arm PGT[A7 9.2 ft-lb, CW3 60RPM, MTL 10.5]-2 ext 7/16: drive MDA EVA override fastener 2460 turns (x1)(PGT battery will actuate approx 1300 turns), PGT battery changeout expected While holding the PGT-2 ext 7/16 on the backup drive fastener, Ratchet-2 ext 7/16 – rotate Manual Override Actuator Shaft 180 to disengage MDA, indicator – AUTOMATIC Egress worksite, leave MCHD on mast canister

MANUAL OVERRIDE TO EXTEND/RETRACT MAST (Cont)

IV/RMS	EV1	EV2
<p>MCC-H 6. On EV GO, place solar array blanket boxes in high tension, when complete, give EV GO to continue SAW deployment</p>	<p>Extension complete when: Visual observation of the last mast bay visual indicators (black/white, cross hatched). Hard stop, sharp rise in tool torque</p> <p>8. PGT[A7 9.2 ft-lb, CCW3 60RPM, MTL 10.5]-2 ext 7/16: drive MDA EVA override fastener until 1 mast bay is deployed (approx 78 turns), give MCC-H GO to place solar array blanket boxes in high tension</p> <p>9. On MCC GO, PGT[A7 9.2 ft-lb, CCW3 60RPM, MTL 10.5]-2 ext 7/16: drive MDA EVA override fastener 2382 turns (x1 PGT battery will actuate approx 1300 turns), PGT battery changeout expected</p> <p>10. While holding the PGT - 2 ext 7/16 on the backup drive fastener, Ratchet - 2 ext 7/16 - rotate Manual Override Actuator Shaft 180 to disengage MDA, indicator – AUTOMATIC</p> <p>11. Egress worksite, leave MCHD on mast canister</p>	

MANUAL OVERRIDE TO EXTEND/RETRACT MAST – TASK DATA

Estimated Task Duration:

	With RMS	Without RMS
One EV Crew	NA	2:00
Two EV Crew	NA	NA

Tools:

EV1	EV2
PGT with 2 Ext 7/16 or 7/16 Ext 7/16	NA
Ratchet wrench with 2 Ext 7/16 or 6 Ext 7/16	
MCHD (Optional)	
APFR (Optional)	

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
MCHD Fasteners	NA	7/16	4	10	NA	TBD	Zip	10
Mast Canister Manual Override Actuator Shaft	Yes	7/16	2 per	2.5	NA	50	0.5	10
Mast Canister MDA Fastener	Yes	7/16	1 per	9	NA	13.3	2461	60

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
NA					

Foot Restraints:

Task	WIF	APFR Setting
IEA Keel Side	P6/S6-37, P4/S4-25	(12, FF, F, 12)
IEA Non-keel side	P6/S6-38, P4/S4-26	(12, FF, F, 12)

Mass: NA

Notes:

- The right side mast canister manual override actuator shaft bolt can be used but a 6 ext 7/16 must be used and the bolt is accessed from under the adjacent hand rail

Cautions:

- Equipment damage – Avoid contact with blanket box latches and mechanisms on underside of blanket box
- If monitoring IVA notes excessive blanket panel "stiction", during mast deployment, abort deployment. Coordinate with IVA to perform contingency incremental deploy. Not applicable for retraction

Warnings:

- Sharp edge/pinch point/entrapment hazard – Avoid contact with outboard underside of SABB due to exposed reels, guide-wire and tension mechanisms
- Moving equipment. Avoid contact with blanket box latches during manual override operation



Mast Canister MDA

EVA ASSISTED DEPLOYMENT OF P4 SAW

IV/RMS	EV1	EV2
<p>1. Retract SAW mast to one bay</p> <p>MCC-H 2. Position and safe SAW from rotation during EVA. Perform {2.101 PVM BGA XX ENGAGE ANTI-ROTATION LATCH} (SODF: EPS: NOMINAL), using the following values: BGA XX Cmded Angle = 0 deg BGA XX Latch Select = 1</p> <p>IV 3. Verify affected SABB positioned over the IEA and BGA latched PCS PVM: EPS: BGA XX BGA XX 'ECU XX Verify: Integ Cnt – Incrementing</p> <p>'BGA XX' Verify: Actual Angle, deg = 0.000 (+/- 0.5) Motor State – OFF Latch 1 (2) Pin Status – Latched</p> <p>MCC-H 4. Give GO for EV crew to setup at worksite</p> <p>MCC-H 5. Shunt SSU, inform EVA crew when complete</p>	<div style="border: 3px double black; padding: 5px; margin-bottom: 10px;"> <p style="text-align: center;">WARNING</p> <p>Beta gimbal assembly must be locked prior to the EVA crewmember enter the worksite and during the task</p> <p>Due to potential electrical arcing hazard, the eva crew must execute this task only when the ssu is shunted, the mast is retracted to one bay, eva crewmember helmet light is on spot only, and only during orbital eclipse</p> <p>Due to potential electrical arcing hazard, avoid touching damage areas of FCC in order to avoid being exposed to saw voltage</p> <p>Sharp edge/pinch point/entrapment hazard – avoid contact with the mast, panels (other than the FCC strips), and blanket boxes</p> </div> <ol style="list-style-type: none"> 1. On MCC GO, enter worksite area 2. APFR/WIF Extender, set up: WIF _____, WIF Extender _____ APFR settings = _____ 3. Upon eclipse, set helmet light to spot light, verify 4. Ingress APFR 5. Identify sticky panels 6. Grasp FCC strip perpendicular to FCC fold and at least 1 inch from fold in FCC 7. Peel sticky panels away from each other in the direction of the hinge opening, to the first panel stiffener 8. Repeat steps 3 thru 5 until complete 9. Egress worksite, notify MCC when clear of the mast canister 10. Repeat steps 1 thru 6 for other SAW if required 	

EVA ASSISTED DEPLOYMENT OF P4 SAW – TASK DATA

Estimated Task Duration:

	With RMS	Without RMS
One EV Crew	NA	2:30 (both SABBs)
Two EV Crew	NA	NA

Tools:

EV1	EV2 (If required)
APFR	
WIF Extender	
APFR Ingress Aid (if required)	

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
NA								

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
NA					

Foot Restraints:

Task	WIF	WIF Extender/APFR Setting
IEA Keel side – Right SABB	P6/S6-37, P4/S4-25	Extender: 12, G, 8 APFR: (12, PP, F, 5)
IEA Keel side – Left SABB	P6/S6-37, P4/S4-25	Extender: 2, G, 8 APFR: (12, NN, F, 6)
IEA Non-keel side – Right SABB	P6/S6-38, P4/S4-26	Extender: 12, G, 8 APFR: (12, PP, F, 5)
IEA Non-keel side – Left SABB	P6/S6-38, P4/S4-26	Extender: 2, G, 8 APFR: (12, NN, F, 6)

Mass: NA

Notes:

1. The mast canister needs to be positioned in the launch position (beta gimbal angle = 0) in order for the EVA crewmember to access both SABBs if required. Other beta gimbal angles may allow the EVA crewmember to access a single SABB
2. EVA crewmember does not need to separate the entire solar array panel. The intent is separate enough of the panel adhesion such that the tension of deployment will separate any additional adhesion

Cautions:

1. The solar array panels and blanket box should not be grasped due to load constraints. In particular, avoid contact with blanket box latches and mechanisms on underside of blanket box
2. Avoid using the outboard SABB FCC to separate the panels. Inadvertent loads into the outboard portion of the blanket box could compromise the functionality of the SAW
3. The FCC fold edge is the most likely area to be damaged. Crew should not handle the FCC within 1 inch of the fold in the FCC to prevent pinching the circuitry. Normal handling of FCC should not result in damage to FCC
4. Stop exerting loads into the foot restraint if the load alleviator trips. The EVA crewmember should be pay additional attention to loads exerted while in the APFR/WIF Extender. It will be easier to trip the load alleviator due to the crewmembers distance from structure

Warnings:

1. Beta gimbal assembly must be LOCKED prior to the EVA crewmember enter the worksite and during the EVA task
2. Due to potential electrical arcing hazard, the EVA crew must execute this task ONLY when the SSU is shunted, the mast is retracted to one bay, during orbital elipse, and with only the EMU spot light on
3. Due to potential electrical arcing hazard, avoid touching damage areas of FCC in order to avoid being exposed to SAW voltage
4. Sharp edge/pinch point/puncture/entrapment hazard – Avoid contact with the mast, panels (other than the FCC strips), and blanket boxes. The following are specific sharp edges or puncture hazards:
 - SABB panel hinge pins
 - SABB skirts
 - SABB swing bolts
 - Potential panel broken cells
 - Electrical connector fastener exposed threads
 - Tension bar springs
 - Guide wire cables
 - Mast canister stiffener ring fasteners exposed threads
 - Mast canister rollar guides
 - Mast canister braided cables

EVA ASSISTED DEPLOYMENT OF P4 SAW – TASK DATA (Cont)



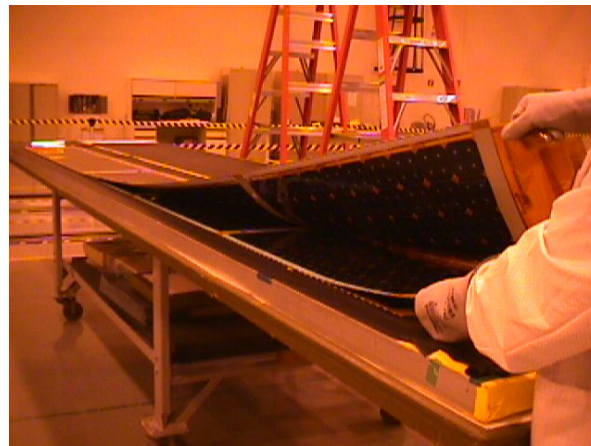
IEA Non Keel side – EVA crew access to right SABB



Grasping the SAW panel FCC



IEA Non Keel side – EVA crew access to left SABB



Separating the SAW panel FCC

SABB SPOOL RE-TENSION

IV/RMS	EV1	EV2
<p>Identify Affected Power Channel XX = _____</p> <p>Which SABB needs re-tensioning _____</p> <p>Which Tension Reel needs re-tensioning _____</p> <p>IV 1. Retract Affected SAW approx 1 mast bay only if Mast is fully deployed</p> <p>PCS PVM: EPS: SAW XX <u>SAW</u> 'Mast' sel Mast Commands</p> <p><u>SAW XX Mast</u></p> <p>cmd Mast – Retract Arm cmd Mast – Retract</p> <p>Wait approx 20 sec (~ 1 bay) cmd Mast – Abort</p> <p>√MDA Voltage, V < 10 (± 2.8)</p> <p>2. Unlatch affected SABB. If required: Perform {1.3.450 SAW SABB INITIAL UNLATCH} (SODF: EPS: ACTIVATION AND CHECKOUT: CHANNEL ACTIVATION), step 2 for LBB or step 3 for RBB (NOTE: BRS Pin visual checks can be ignored)</p> <p>MCC-H 3. Position and safe SAW for Tension Reel Task. Perform {2.101 PVM BGA XX ENGAGE ANTI-ROTATION LATCH} (SODF: EPS: NOMINAL: PRIMARY POWER), using the following values:</p> <p>If Right SABB (Inboard and Outboard Reels) BGA XX Cmded Angle = 90.000 deg BGA XX Latch Select = 1</p> <p>If Left SABB (Inboard Reel) BGA XX Cmded Angle = 289.687 deg BGA XX Latch Select = 2 (NOTE: BGA 4B Latch 2 has failed select an alternative position where Latch 1 can be engaged)</p> <p>If Left SABB (Outboard Reel) BGA XX Cmded Angle = 281.250 deg BGA XX Latch Select = 1</p>	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p><u>WARNING</u> Moving equipment hazard. Stay clear of SABB and capture latch mechanisms</p> </div> <p><u>TENSION REEL TASK SETUP</u></p> <p>1. Translate to P3</p> <div style="border: 1px solid black; padding: 5px; text-align: center;"> <p><u>WARNING</u> Moving equipment hazard. Avoid contact with mast canister/beta gimbal during rotation of SAW</p> </div> <p>2. APFR/Ingress Aid: From _____ to P4- _____ (settings)</p>	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p><u>WARNING</u> Moving equipment hazard. Stay clear of SABB and capture latch mechanisms</p> </div> <p><u>TENSION REEL TASK SETUP</u></p> <p>1. Translate to P3</p> <div style="border: 1px solid black; padding: 5px; text-align: center;"> <p><u>WARNING</u> Moving equipment hazard. Avoid contact with mast canister/beta gimbal during rotation of SAW</p> </div> <p>2. APFR: From _____ to P4- _____ (settings) 3. Ingress APFR using ingress aid or EV 1 for assistance</p>

SABB SPOOL RE-TENSION (Cont)

IV/RMS	EV1	EV2
<p>IV 4. SSRMS: SSRMS RECONFIGURATION FOR EVA SUPPORT (SODF: ROBO PROCEDURE REFERENCE)</p> <p>5. SRMS: SRMS RECONFIGURATION FOR EVA SUPPORT (FDF: PDRS PROCEDURE REFERENCE)</p> <p><u>NOTE:</u> Free Drift or CMG Control with Thrusters Disabled is required while the EV crewmembers are handling the cable</p> <p>MCC-H 6. Configure ISS/Orbiter attitude control to CMG control with thrusters disabled</p> <p>IV 7. On EV GO, CMD nominal attitude control</p>	<p>3. Ingress APFR</p> <p><u>INSTALL CABLE ON OUTBOARD REEL</u></p> <p>1. Assist EV2 with cable as required</p> <p><u>NOTE</u> The reel will rotate a fraction of a turn without resistance. Some uneven tension and binding may be initially detected as internal mechanism seats. The 2.5 turn count begins when this minimal rotational resistance (approx 2 – 6 lb) is encountered. The tension reel housing will self tend back to initial position. Hand guidance is required to control rate</p> <p>2. Rotate tension reel ccw by hand approx 2.5 – 2.75 turns to hard stop</p> <p><u>NOTE</u> EV1 acts as the “clutch” on reel in case EV2 lets go. Tension reel housing will self tend back to initial position. Hand guidance is required to control rate of motion</p> <p>3. Maintain reel and help tend cable during EV2 alignment</p> <p>4. Inspect final cable routing on tension reel groves, through pulley, and clear of blanket box fasteners</p> <p>5. Take closeout photos</p> <p>6. Egress APFR</p> <p><u>INSTALL CABLE ON INBOARD REEL</u></p> <p>1. APFR/Ingress Aid: From _____ to P4- _____ (settings)</p> <p>2. Ingress APFR</p> <p>3. Repeat <u>INSTALL CABLE ON OUTBOARD REEL</u> for the SABB inboard reel</p> <p>4. Give IV GO for solar array deploy</p>	<p><u>INSTALL CABLE ON OUTBOARD REEL</u></p> <p><u>NOTE</u> Pull cable on bottom side of blanket box running between pulley and tension reel. There will be approx 2 ft of cable slack. The tension bar will be pulled into position against blanket box</p> <p>1. Using the loop pin extractor, pull slack on tension cable by pulling cable through pulley using light force (expect 5-10 lb pull force. If force is high, contact MCC)</p> <p>2. Align cable through pulley</p> <p>3. Maintain cable tension during reel rotation using loop pin extractor</p> <p>4. Feed cable onto reel using loop pin extractor as reel rotates back cw under it’s own spring power</p> <p>5. Remove loop pin extractor</p> <p>6. Egress APFR</p> <p><u>INSTALL CABLE ON INBOARD REEL</u></p> <p>1. APFR: From _____ to P4- _____ (settings)</p> <p>2. Ingress APFR using ingress aid or EV1 for assistance</p> <p>3. Repeat <u>INSTALL CABLE ON OUTBOARD REEL</u> for the SABB inboard reel</p>

SABB SPOOL RE-TENSION (Cont)

IV/RMS	EV1	EV2
<p>8. Return SAW/BGA to Deploy Position. If required: Perform {2.101 PVM BGA XX ENGAGE ANTI-ROTATION LATCH} (SODF: EPS: NOMINAL: PRIMARY POWER)</p> <p>IV 9. Return to Nominal SAW Deploy Camera configuration (Truss Cameras, PLB Cameras, etc.)</p> <p>10. SSRMS: TBD SSRMS RECONFIGURATION FOR SAW VIEWING (SODF: ROBO PROCEDURE REFERENCE)</p> <p>11. SRMS: TBD SRMS RECONFIGURATION FOR SAW VIEWING (FDF: PDRS PROCEDURE REFERENCE)</p> <p>12. Re-Latch (Tension) Affected SABB If required: Perform {1.3.452 SAW DEPLOY} (SODF: EPS: NOMINAL: PRIMARY POWER) Step 13 for LBB, or step 14 for RBB</p>	<p>IF REQUIRED:</p> <p><u>TENSION REEL JAM CONTINGENCY</u></p> <ol style="list-style-type: none"> 1. If no rotational resistance or no hard stop (free spinning), call MCC 2. If excessive force (> 6 lb) or mechanism jam is encountered, go to <u>INSTALL CABLE ON INBOARD REEL</u> 3. EV guide tension reel back into initial position <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p style="text-align: center;"><u>WARNING</u></p> <p style="text-align: center;">Stay clear of SABB and capture latch mechanisms</p> </div> <ol style="list-style-type: none"> 4. IV Cycle SABB Latches. Perform {4.118 SAW XX RETRACT} (SODF: EPS: CORRECTIVE: PRIMARY POWER) steps 12 (13) for Unlatch OR steps 18 (19) for Latch 5. EV attempt outboard tension reel rotation 6. If smooth reel rotation, go to <u>INSTALL CABLE ON OUTBOARD REEL</u>, EV2, step 1 7. If jam or resistance encountered, repeat steps 4 and 5 8. If no joy, call MCC 	

SABB SPOOL RE-TENSION – TASK DATA

Estimated Task Duration:

	With RMS	Without RMS
One EV Crew	NA	NA
Two EV Crew	NA	1:00

Tools:

EV1	EV2
APFR	APFR
Ingress aid	Loop pin puller
Crewlock EVA Bag	
Adjustable fuse tether	
3/4 inch combination wrench	
11/16 inch combination wrench	
5/8 inch combination wrench	
9/16 inch combination wrench	
4 tie wrap pairs	

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
N/A								

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
NA					

Foot Restraints:

Task	WIF	APFR Setting
IEA Non-keel side – SABB Outboard Reel EV1 access	P4/S4-11, S4-11, P6/S6-23	(11, II, F, 6)
IEA Non-keel side – SABB Outboard Reel EV2 access	P4/S4-07, P6/S6-19	(2, II, E, 11)
IEA Non-keel side – SABB Inboard Reel EV1 access	P4/S4-19, P6/S6-31	(12, HH, F, 6)
IEA Non-keel side – SABB Inboard Reel EV2 access	P4/S4-15, P6/S6-27	(2, FF, F, 8)
IEA Keel side – SABB Outboard Reel EV1 access	P4/S4-09, P6/S6-21	(11, II, F, 6)
IEA Keel side – SABB Outboard Reel EV2 access	P4/S4-05, P6/S6-17	(2, II, E, 11)
IEA Keel side – SABB Inboard Reel EV1 access	P4/S4-17, P6/S6-29	(12, HH, F, 6)
IEA Keel side – SABB Inboard Reel EV2 access	P4/S4-13, P6/S6-25	(2, FF, F, 8)
IEA Keel side – SABB Inboard Reel EV2 access	9F/S4-13, P6/S6-25	(2, FF, F, 8)

Notes:

1. SABB Outboard Reel does not have a pulley shroud
2. Combination wrenches may be used if the tension reel fails to take up the tension cable slack

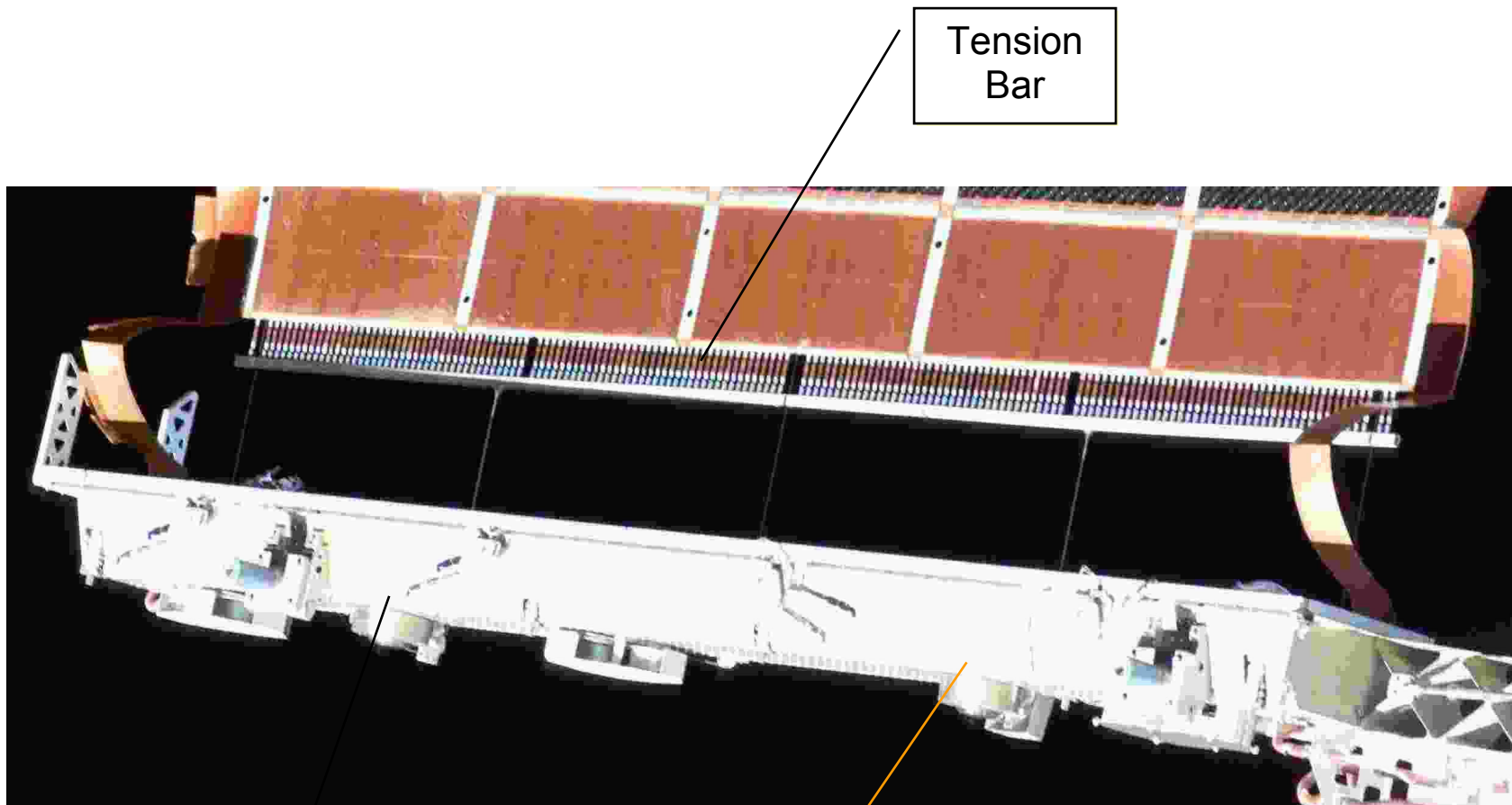
Cautions:

1. Equipment damage – Beware of close proximity to blanket box during ingress. Visually inspect cables prior to handling for fraying or jamming on structure or nearby cables
2. Do not allow uncontrolled CW rotation of tension reel
3. Do not manually wrap cable on reel housing

Warnings:

1. Sharp edges:
Pulley shroud at machined edges
Guide wire mechanism cover at machined edges
Guide wire mechanism
Guide wire pulley
Guide wire
Top flange of blanket box
Protrusions (4) on tension reel housing
2. Moving equipment hazard. Stay clear of SABB and capture latch mechanisms
3. Moving equipment hazard. Avoid contact with mast canister/beta gimbal during rotation of SAW

SABB SPOOL RE-TENSION – TASK DATA (Cont)



Tension Bar

Outboard TM

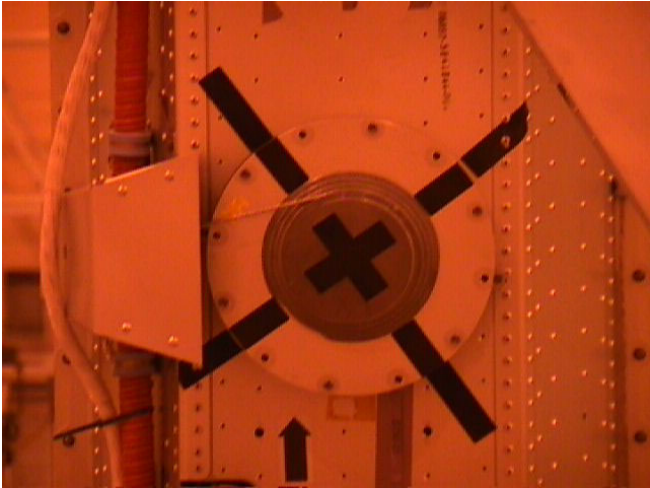
Inboard TM

NOTE
No markings on these TMs.
Tension Bar in fully extended position

SABB SPOOL RE-TENSION – TASK DATA (Cont)

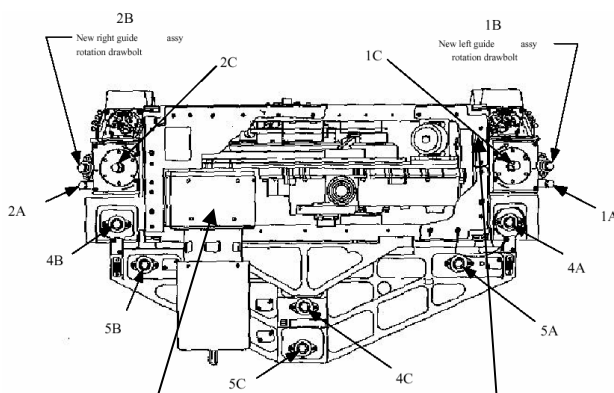




SABB Tensioning Reel Outboard



SABB Tensioning Reel Inboard

RETURN DLA TO LAUNCH POSITION

IV/RMS	EV1	EV2
<p>MCC-H</p> <ol style="list-style-type: none"> 1. Verify failed DLA is in neutral position and active DLA is in locked position 2. Give GO for EVA to enter SARJ worksite 	<p>REMOVE DLA MLI COVER</p> <ol style="list-style-type: none"> 1. On IV GO: install and ingress APFR 2. PGT[A2 3.8 ft-lb, CCW2 30RPM, MTL 30.5]-6 ext 7/16: Release inboard MLI cover fasteners (4) x9 turns 3. Remove MLI cover and temp stow <p>DISENGAGE DLA</p> <p>ROTATE DLA DRAW BOLTS (1C AND 2C)</p> <ol style="list-style-type: none"> 4. BOLT 1C: PGT[B7 25.5 ft-lb, CCW1 10RPM, MTL 23.5]-6 ext 7/16: Rotate draw bolt 1C x1 turn (break torque) 5. BOLT 2C: PGT[B7 25.5 ft-lb, CW1 10RPM, MTL 23.5]-6 ext 7/16: Rotate draw bolt 2C x3 turns (break torque) 6. BOLT 1C: PGT[A5 7.0 ft-lb, CCW1 10RPM, MTL 23.5]-6 ext 7/16: Rotate draw bolt 1C x2 turns 7. BOLT 1C: PGT[A5 7.0 ft-lb, CCW2 30RPM, MTL 23.5]-6 ext 7/16: Rotate draw bolt 1C x32 turns to hard stop <p>ROTATE FOLLOWER ARMS (1B AND 2B)</p> <p>NOTE Adjustment in DLA draw bolt method may be required to align follower arm for rotation</p> <ol style="list-style-type: none"> 8. BOLT 1B: PGT, RCW, MTL 23.5]-6 ext 7/16: Rotate follower arm rotation bolt 1B x5/8 turn to hardstop 9. If no joy: BOLT 1C: PGT[OFF 1 ft-lb, RCW, MTL 23.5]-6 ext 7/16: Rotate draw bolt 1C x1/8 turn Repeat steps 8 and 9 until follower arm has rotated 90 deg 10. BOLT 2C: PGT[A5 7.0 ft-lb, CW2 30RPM, MTL 23.5]-6 ext 7/16: Rotate follower arm draw bolt 2C x32 turns to hard stop 	 <p style="text-align: center;">DLA Bolts & Labels</p> <div style="display: flex; justify-content: space-around;"> <div>  </div> <div>  </div> </div>

RETURN DLA TO LAUNCH POSITION (Cont)

IV/RMS	EV1	EV2
	<p>11. BOLT 2B: PGT, RCCW, MTL 23.5]-6 ext 7/16: Rotate follower arm rotation bolt 2B x5/8 turn to hardstop</p> <p>12. If no joy: BOLT 2C: PGT, RCCW, MTL 23.5]-6 ext 7/16: Rotate draw bolt 2C x1/8 turn. Repeat steps 11 and 12 until follower arm has rotated 90 deg</p> <p><u>REPOSITION DLA</u></p> <p>13. Reposition DLA to launch position (approx 1.5 inch away from race ring then 0.35 inch inboard (toward S0))</p> <p><u>INSTALL 3 DLA LAUNCH RESTRAINT BOLTS (4A, 4B, AND 4C)</u></p> <p>14. BOLTS 4A, 4B, 4C: PGT[B4 19.4 ft-lb, CW2 30RPM, MTL 23.5]-6 ext 7/16: Engage launch restraint bolts 4A, 4B, and 4C x7 turns (attaches DLA frame to launch bracket)</p> <p><u>IF REQD: ENGAGE DLA LOCK BOLTS (1A AND 2A)</u></p> <p>15. BOLTS 1A, 2A: PGT[A7 9.2 ft-lb, CW1 10RPM, MTL 23.5]-6 ext 7/16: Engage lock bolts 1A and 2A fasteners (two) x6 turns (engage lock preload on follower arm with lock tip bolt – if reqd for return of DLA)</p> <p><u>REINSTALL DLA MLI COVER</u></p> <p>16. PGT[A2 3.8 ft-lb, CW2 30RPM, MTL 23.5]-6 ext 7/16: Engage inboard MLI cover fasteners (four) x8.25 turns</p>	<p><u>REINSTALL DLA MLI COVER</u></p> <p>1. Assist EV1 with DLA cover install</p>

RETURN DLA TO LAUNCH POSITION – TASK DATA

Estimated Task Duration:

	With SSRMS	Without SSRMS
One EV Crew	NA	1:00
Two EV Crew	NA	0:45

Tools:

EV1 (FF)	EV2 (FF)
PGT	PGT
6 Ext 7/16	6 Ext 7/16
APFR	APFR
Round scoop (optional)	Medium ORU transfer bag

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
MLI Cover Inboard Fasteners	NA	7/16	4-6 per cover	3.1 - 3.6	1.2 - 2.8	TBD	7.75 - 8.25	30
DLA 1A and 2A Lock Bolts	Yes	7/16	2	3.3 - 6.3	2.5 - 4.6	TBD	6	TBD
DLA 1C and 2C Draw Bolts	Yes	7/16	2	2.1 - 6.3	0.1 - 2	TBD	37	TBD
DLA 4A, 4B, and 4C Launch Restraint Bolts	Yes	7/16	3	20 - 21.7	13.3 - 15.8	TBD	TBD	TBD
DLA 1B and 2B Follower Arm Rotation Bolts	Yes	7/16	NA	TBD	1	TBD	3/4	TBD
DLA 1C and 2C Draw Bolts	Yes	7/16	NA	2.1 - 6.3	0.1 - 2	TBD	37	TBD

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
DLA Electrical Harness					

Foot Restraints:

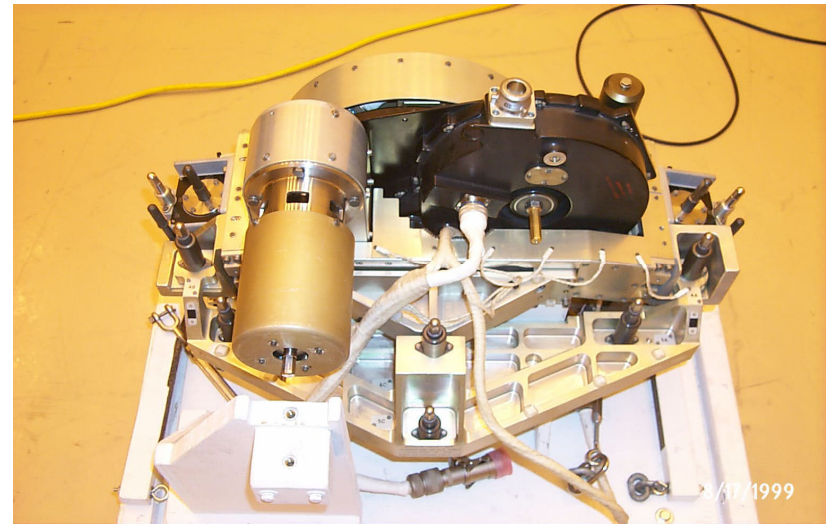
Task	WIF	APFR Setting
P3 Cover 5 DLA 1 Face 6	P3-31	10, PP, F, 12
P3 Cover 20 DLA 2 Face 2	P3-27	10, PP, F, 12
S3 Cover 20 DLA 1 Face 2	S3-28	2, NN, E, 12
S3 Cover 5 DLA 2 Face 6	S3-31	5, OO, F, 12

Cautions:

1. During re-installation of MLI covers, do not re-install spring clamp bolts on the outboard SARJ race ring side. This will preclude SARJ rotation
2. Avoid contact between MLI cover with surrounding hardware
3. Avoid impacting the race the ring with the DLA when the DLA is unconstrained
4. During follower arm rotation (90 deg turn) when the DLA is unconstrained, interference with structure may occur. The DLA must be held against the outer side of the SARJ race ring for the follower arm to rotate fully – clearing obstruction

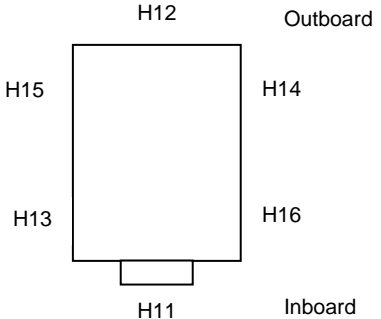
Warnings:

None



DLA

MANUAL OVERRIDE TO EXTEND (RETRACT) RADIATOR

IV/RMS	EV1	EV2
<p>MCC-H 1. Verify PVR motor OFF</p> <p style="text-align: center;"><u>NOTE</u> Free Drift or CMG Control with Thrusters Disabled is required while radiator is being deployed/retracted. Applies only while mechanisms are in motion</p> <p>MCC-H 2. Configure ISS/Orbiter attitude control to CMG Control with thrusters disabled</p> <p>IV 3. On EV GO, CMD nominal attitude control</p> <div style="text-align: center;">  </div>	<p style="text-align: center;"><u>MANUAL OVERRIDE TO EXTEND (RETRACT) RADIATOR</u></p> <ol style="list-style-type: none"> 1. If required, APFR, set up and ingress (see Task Data for WIF position and APFR settings) 2. PGT[B1 12 ft-lb, CCW2 (CW2) 30RPM, MTL 15.5]-6 ext 7/16: On IV GO, push to engage (5 lb) and turn PVR MDA fastener H32 to PGT stall (~45 turns) 3. If required to re-engage H32 locking collar, PGT manual ratchet CW (CCW) up to 1/6 of a turn until collar pops up completely and re-engages 4. Report to IV, radiator deployment complete <p>If retracting, re-install PV radiator cinches using the procedure below. Manual compression of the radiator panels may be required to install cinches (two crewmember operation):</p> <ul style="list-style-type: none"> <input type="checkbox"/> Cinch H11 <input type="checkbox"/> Cinch H13 <input type="checkbox"/> Cinch H15 	<p>If retracting, re-install PV radiator cinches using the procedure below. Manual compression of the radiator panels may be required to install cinches (two crewmember operation):</p> <ul style="list-style-type: none"> <input type="checkbox"/> Cinch H12 <input type="checkbox"/> Cinch H14 <input type="checkbox"/> Cinch H16

MANUAL OVERRIDE TO EXTEND (RETRACT) RADIATOR (Cont)

IV/RMS	EV1	EV2
	<p><u>REINSTALL PVR CINCHES</u></p> <ol style="list-style-type: none"> 1. Position for inboard cinch installation 2. Compress radiator panels and assess inboard cinch installation 3. If EV1 and EV2 both GO for cinch install 4. Give EV2 GO for cinch install, install H11 cinch 5. Remove inboard winch bar PIP pin (H33); align winch bar clevis to lug on radiator; re-install PIP pin 6. If NO GO for cinch install, assess inboard winch bar installation 7. If GO for winch installation 8. Remove inboard winch bar PIP pin (H33) 9. Give EV2 GO for winch install, compress radiator panels, align winch bar clevis to lug on radiator, re-install PIP pin 10. REMOVE FQDC SHROUD per steps below 11. RETRACT WINCH per steps below 12. REPLACE FQDC SHROUD per steps below 13. If NO GO for winch install: 14. REMOVE FQDC SHROUD per steps below 15. EXTEND WINCH per steps below 16. Remove inboard winch bar PIP pin (H33) 17. Give EV2 GO for winch install; align winch bar clevis to lug on radiator; re-install PIP pin 18. RETRACT WINCH per steps below 19. REPLACE FQDC SHROUD per steps below 20. Install inboard cinch (H11) 21. Tension outboard cinch (H11); PGT[B7 25.5 ft-lb, CW2 30RPM, MTL 30.5]-6 ext 7/16: actuate cinch, push 5 lb, ~6 turns 22. Install and tension cinches (H13 and H15); PGT[B7 25.5 ft-lb,CW2 30 RPM,MTL 30.5] 6-in ext; actuate cinch, push 5 lb, ~6 turns 23. Tighten inboard cinch (H11); PGT[B7 25.5 ft-lb,CW2 30 rpm, MTL 30.5] 6-in ext; actuate cinch, push 5 lb, ~1 turn 24. Tighten cinches (H13 and H15); PGT[B7 25.5 ft-lb, CW2 30 RPM, MTL 30.5] 6-in ext; actuate cinch, push 5 lb, ~1 turn 	<p><u>REINSTALL PVR CINCHES</u></p> <ol style="list-style-type: none"> 1. Position for outboard cinch installation 2. Compress radiator panels and assess outboard cinch installation 3. If EV1 and EV2 GO for cinch install 4. On GO from EV1, install H12 cinch 5. Remove outboard winch bar PIP pin (H34); align winch bar clevis to lug on radiator; re-install PIP pin 6. If NO GO for cinch install, assess outboard winch bar installation 7. If GO for winch installation 8. Remove outboard winch bar PIP pin (H34) 9. On GO from EV1, compress radiator panels, align winch bar clevis to lug on radiator, re-install PIP pin 10. If NO GO for winch install: 11. Remove outboard winch bar PIP pin (H34) 12. On GO from EV1, compress radiator panels, align winch bar clevis to lug on radiator, re-install PIP pin 13. Install outboard cinch (H12) 14. Tension outboard cinch (H12); PGT[B7 25.5 ft-lb, CW2 30RPM, MTL 30.5]-6 ext 7/16: actuate cinch, push 5 lb, ~6 turns each 15. Install and tension cinches (H14 and H16); PGT[B7 25.5 ft-lb,CW2 30 RPM, MTL 30.5] 6-in ext; actuate cinch, push 5 lb, ~6 turns 16. Tighten outboard cinch (H12); PGT[B7 25.5 ft-lb, CW2 30 RPM, MTL 30.5] 6-in ext; actuate cinch, push 5 lb, ~1 turn

MANUAL OVERRIDE TO EXTEND (RETRACT) RADIATOR (Cont)

IV/RMS	EV1	EV2
	<p><u>REMOVE FQDC SHROUD</u></p> <ol style="list-style-type: none"> 1. Stage RET for FQDC shroud restraint 2. Release FQDC Shroud bolts (4); PGT[A6 8.3 ft-lb, CCW2 30 RPM, MTL 30.5] 6-in ext; 7 turns 3. Restrain FQDC shroud w/RET <p><u>EXTEND WINCH</u></p> <ol style="list-style-type: none"> 1. PGT[A1 2.5 ft-lb, CW1 10 RPM, MTL 30.5] 6-in ext; actuate H10 bolt; push 5 lb; extend winch bars until winch bar clevis aligns with radiator lug (20 turns max) <p><u>RETRACT WINCH</u></p> <ol style="list-style-type: none"> 1. PGT[A1 2.5 ft-lb, CCW1 10 RPM, MTL 30.5] 6-in ext; actuate H10 bolt; push 5 lb; fully retract winch bars (approx 25 turns max) <p><u>REPLACE FQDC SHROUD</u></p> <ol style="list-style-type: none"> 1. Retrieve FQDC Shroud 2. PGT[A5 7.0 ft-lb, CW2 30 RPM, MTL 30.5] 6-in ext; attach FQDC shroud bolt (4); ~7 turns to hardstop 3. Retrieve RET 	<ol style="list-style-type: none"> 17. Tighten cinches (H14 and H16); PGT[B7 25.5 ft-lb, CW2 30 RPM, MTL 30.5] 6-in ext; actuate cinch, push 5 lb, ~1 turn

MANUAL OVERRIDE TO EXTEND (RETRACT) RADIATOR – TASK DATA

Estimated Task Duration:

	With RMS	Without RMS
One EV Crew	NA	0:30
Two EV Crew	NA	NA

Tools:

EV1	EV2
PGT	PGT
6 Ext 7/16	6 Ext 7/16
APFR	
Adj equip tether	

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
PVR MDA	H32	7/16	1	12	NA	13.3	45	30
Cinch bolts	H11 thru H16	7/16	6	32	25	35	8	30
FQDC Shroud bolts	H5, H6, H8, H9	7/16	4	7.5	8.3	21	7	30
Winch bolt	H10	7/16	1		2.25	3.8	3	30

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
NA					

Foot Restraints:

Task	WIF	APFR Setting
PVR MDA worksite	P4(S4)4, P6 (S6) - 16	(5,PP, E, 1)

Mass: NA

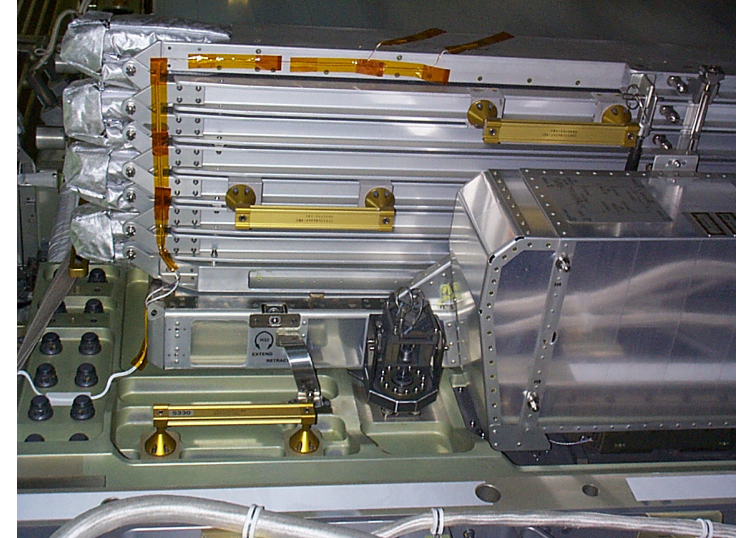
Notes:
None

Cautions:

- Equipment damage. Avoid contact with radiator bellows

Warnings:

- Moving equipment. Avoid contact with panels and mechanisms during extension of radiator



PV Radiator – MDA H32 Fastener Located Near Ground Strap



PV Radiator MDA Fastener

MAST CANISTER MANUAL ROTATION

OBJECTIVE: Generic procedure to manually rotate a Beta Gimbal Assembly to a specific angle. Additional logistic and worksite information will be uplinked real time

IV/RMS	EV1	EV2
<p>Identify the Solar Array Wing _____ and required BGA angle _____. The SSU will point _____ relative to ISS coordinates. The ECU will point _____ relative to ISS coordinates</p> <p>MCC-H 1. If required for P6: Power down the S-band RFG – C&T Book 1.403 S-band ORU Deactivation – Post CCS for RFG step only</p> <p>MCC-H 2. Secure adjacent SAW from rotation</p> <p>MCC-H 3. Give EV crewmember GO to enter worksite</p>	<div style="border: 2px solid black; padding: 5px; margin-bottom: 10px;"> <p style="text-align: center;">WARNING</p> <p>Collision Hazard. The crewmember should monitor solar array motion to avoid inadvertent contact with structure</p> </div> <ol style="list-style-type: none"> 1. On MCC GO, set up and ingress APFR [see Task Data] 2. If handling aids are necessary, install Sq Scoop on either the SSU or ECU micro square fitting 3. Use mast canister platform handholds (one between SSU and ECU and one on the side opposite the ECU) and/or SSU/ECU to rotate the mast canister to required angle 4. Notify MCC when rotation complete 5. Egress APFR and report when clear of worksite 	

MAST CANISTER MANUAL ROTATION – TASK DATA

Estimated Task Duration:

	With RMS	Without RMS
One EV Crew	NA	1:00
Two EV Crew	NA	NA

Tools:

EV1 (FF)	EV2
Square scoop	
APFR	

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
NA								

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
NA					

Foot Restraints:

Task	WIF	APFR Setting
Access to IEA non-keel side SAW for rotation	P6/S6-35, P4/S4-23	4, PP, H, 9
Access to IEA keel side SAW for rotation	P6/S6-33, P4/S4-21	4, PP, H, 9

Note:

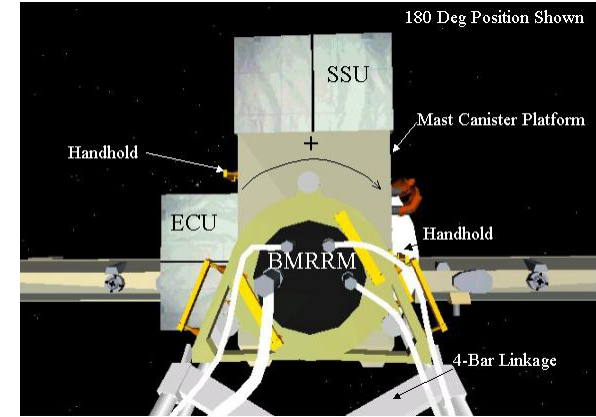
- SAWs are launched in the zero deg position. With the reference position of looking out the deploy direction of the mast canister, clockwise is positive rotation. In this position, the SSU ORU is furthest away from the IEA. When the ECU ORU is furthest away from the IEA, the SAW is in the 90 deg position. When the SSU ORU is closest to the IEA, the SAW is in the 180 deg position. When the ECU ORU is closest to the IEA, the SAW is in the 270 deg position. See the pictures for an illustration
- The rotational plane is between the BMRRM and the mast canister platform. The BMRRM housing will stay fixed to the 4-bar linkage and the mast canister will rotate. There are no markings or labels to indicate a specific angle. The crewmember will have to establish an angle based on the SSU or ECU orientation
- It is ok to use the ECU, SSU, and mast canister platform to ingress, egress, and rotate the mast canister. If necessary, the crewmember can install a square scoop to either the SSU or ECU for a handling aid
- The mast canister can rotate in either direction

Cautions:

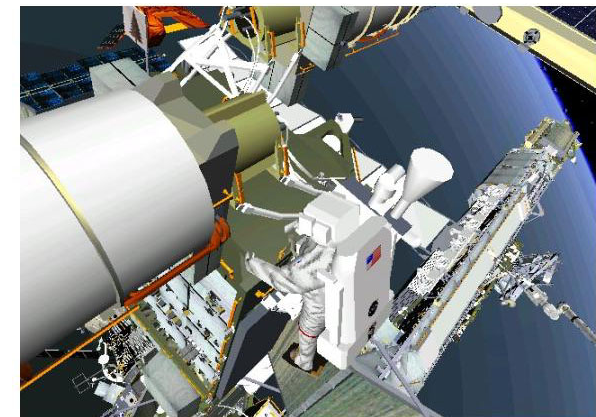
- None

Warnings:

- Collision Hazard. The crewmember should monitor solar array motion to avoid inadvertent contact with structure



BGA Rotational Reference (BGA shown in the zero deg position. Positive rotation is clockwise)



P6 Stbd (2B) mast canister manual rotation EVA worksite (BGA shown in the 180 deg position)

REMOVE AND REPLACE PFCS

PRIOR TO EVA:

IV/RMS	EV1	EV2
<p>1. MCC-H: Verify BGA is inhibited from motion</p> <p>2. MCC-H: Verify Inhibits (spare) are in place; give EV GO for PFCS removal</p>	<p><u>REMOVE SPARE PFCS</u></p> <ol style="list-style-type: none"> 1. Translate to ESP1 worksite 2. Set up APFR/WIF Extender per Task Data 3. Ingress APFR 4. Remove thermal cover 5. Transfer thermal cover to EV2 <p><u>Demate FQDC H1</u></p> <ol style="list-style-type: none"> 6. On MCC GO, Break torque and drive QD H1; PGT [B1 12.0, CCW1 10RPM, 30.5] – 6 ext; 10 turns <div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center;">CAUTION</p> <p>The torque necessary for the initial, break-free rotation of the QD drive point is greater than the maximum torque allowed when the drive point reaches internal mechanical stops. The PGT must not operate the drive point into the mechanical stops at the initial torque. Mechanical stops will be reached at 18 turns</p> </div> <ol style="list-style-type: none"> 7. Drive QD H1 to hardstop; PGT [A4 6.3, CCW2 30RPM, 30.5] – 6 ext; ~8 turns 8. √Status indicator – DEMATE <p><u>Retract Acme nut and latch key from passive half</u></p> <ol style="list-style-type: none"> 9. Drive QD H1 to hardstop; PGT [A4 6.3, CW2 30RPM, 30.5] – 6 ext; ~18 turns 10. √Status indicator remains at – DEMATE <p><u>Demate FQDC H2</u></p> <ol style="list-style-type: none"> 11. Break torque and drive QD H2; PGT B1 12.0, CCW1 10RPM, 30.5] – 6 ext; 10 turns <div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center;">CAUTION</p> <p>The torque necessary for the initial, break-free rotation of the QD drive point is greater than the maximum torque allowed when the drive point reaches internal mechanical stops. The PGT must not operate the drive point into the mechanical stops at the initial torque. Mechanical stops will be reached at 18 turns</p> </div> <ol style="list-style-type: none"> 12. Drive QD H2 to hardstop; PGT A4 6.3, CCW2 30RPM, 30.5] – 6 ext; ~8 turns 13. √Status indicator – DEMATE <p><u>Retract Acme nut and latch key from passive half</u></p> <ol style="list-style-type: none"> 14. Drive QD H2 to hardstop; PGT A4 6.3, CW2 30RPM, 30.5] – 6 ext; ~18 turns 15. √Status indicator remains at – DEMATE 	<p><u>REMOVE SPARE PFCS</u></p> <ol style="list-style-type: none"> 1. Translate to ESP1 worksite 2. Install WIF Extender and APFR (see task data sheet) 3. Receive thermal cover from EV1 4. Temp stow thermal cover at worksite

REMOVE AND REPLACE PFCS (Cont)

IV/RMS	EV1	EV2
<p>3. MCC-H: Verify Inhibits (failed) are in place; give EV GO for PFCS removal</p>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p style="text-align: center;">CAUTION</p> <p>Acme screws unfastened/fastened out of sequence could lead to jamming of PFCS during removal. When unfastening acme screws, H3 must be unfastened before H4</p> </div> <ol style="list-style-type: none"> 16. Install Sq TM onto H3, √anti-backlash neutral 17. Break torque on H3; PGT [A6 8.3, CCW2 30RPM, 30.5] – Sq TM 7/16 Rec: Drive PGT 5 turns 18. Remove Sq TM and install on H4, √anti-backlash neutral 19. Drive H3; PGT [B7 25.5, CCW2 30RPM, 30.5] – 6 ext; ~8 turns 20. √Status indicator – UNLOCK 21. Break torque on H4; PGT [A6 8.3, CCW2 30RPM, 30.5] – Sq TM 7/16 Rec: Drive PGT 5 turns 22. Remove Sq TM 23. Drive H4; PGT B7 25.5, CCW2 30RPM, 30.5] – 6 ext ~18 turns 24. √Status indicator – UNLOCK 25. Install Square scoop on H4 26. Remove PFCS <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p style="text-align: center;">CAUTION</p> <p>Avoid contacting PFCS mating surface (electrical and fluid connectors) with structure during translation with PFCS</p> </div> <ol style="list-style-type: none"> 27. Transfer spare PFCS to EV2 28. Retrieve APFR <p>REMOVE FAILED PFCS</p> <ol style="list-style-type: none"> 1. Translate to P6 IEA worksite 2. Set up and ingress APFR (see task data sheet) <p>Demate FQDC H1</p> <ol style="list-style-type: none"> 3. On MCC GO, Break torque and drive QD H1; PGT [B1 12.0, CCW2 30RPM, 30.5] – 6 ext; 10 turns <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p style="text-align: center;">CAUTION</p> <p>The torque necessary for the initial, break-free rotation of the QD drive point is greater than the maximum torque allowed when the drive point reaches internal mechanical stops. The PGT must not operate the drive point into the mechanical stops at the initial torque. Mechanical stops will be reached at 18 turns</p> </div>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p style="text-align: center;">CAUTION</p> <p>Avoid contacting PFCS mating surface (electrical and fluid connectors) with structure during translation with PFCS</p> </div> <ol style="list-style-type: none"> 5. Receive spare PFCS from EV1 and stow on BRT <p>REMOVE FAILED PFCS</p> <ol style="list-style-type: none"> 1. Translate to P6 IEA worksite with spare PFCS

REMOVE AND REPLACE PFCS (Cont)

IV/RMS	EV1	EV2																														
<p>4. Record failed PFCS bolt data</p> <table border="1"> <thead> <tr> <th>Bolt</th> <th>Turns</th> <th>Torque</th> </tr> </thead> <tbody> <tr> <td>H1</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>H2</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>H3</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>H4</td> <td>_____</td> <td>_____</td> </tr> </tbody> </table> <p>5. Record spare PFCS bolt data</p> <table border="1"> <thead> <tr> <th>Bolt</th> <th>Turns</th> <th>Torque</th> </tr> </thead> <tbody> <tr> <td>H1</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>H2</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>H3</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>H4</td> <td>_____</td> <td>_____</td> </tr> </tbody> </table>	Bolt	Turns	Torque	H1	_____	_____	H2	_____	_____	H3	_____	_____	H4	_____	_____	Bolt	Turns	Torque	H1	_____	_____	H2	_____	_____	H3	_____	_____	H4	_____	_____	<p>4. Drive QD H1 to hardstop; PGT [A4 6.3, CCW2 30RPM, 30.5] – 6 ext; ~8 turns</p> <p>5. √Status indicator – DEMATE</p> <p><u>Retract Acme nut and latch key from passive half</u></p> <p>6. Drive QD H1 to hardstop; PGT [A4 6.3, CW2 30RPM, 30.5] – 6 ext; ~18 turns</p> <p>7. √Status indicator remains at – DEMATE</p> <p><u>Demate FQDC H2</u></p> <p>8. Break torque and drive QD H2; PGT B1 12.0, CCW2 30RPM, 30.5] – 6 ext; 10 turns</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p style="text-align: center;">CAUTION</p> <p>The torque necessary for the initial, break-free rotation of the QD drive point is greater than the maximum torque allowed when the drive point reaches internal mechanical stops. The PGT must not operate the drive point into the mechanical stops at the initial torque. Mechanical stops will be reached at 18 turns</p> </div> <p>9. Drive QD H2 to hardstop; PGT [A4 6.3, CCW2 30RPM, 30.5] – 6 ext; ~8 turns</p> <p>10. √Status indicator – DEMATE</p> <p><u>Retract Acme nut and latch key from passive half</u></p> <p>11. Drive QD H2 to hardstop; PGT [A4 6.3, CW2 30RPM, 30.5] – 6 ext; ~18 turns</p> <p>12. √Status indicator remains at – DEMATE</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p style="text-align: center;">CAUTION</p> <p>Acme screws unfastened/fastened out of sequence could lead to jamming of PFCS during removal. When unfastening acme screws, H3 must be unfastened before H4</p> </div> <p>13. Install Sq TM onto H3, √anti-backlash neutral</p> <p>14. Break torque on H3; PGT [A6 8.3, CCW2 30RPM, 30.5] – Sq TM 7/16 Rec: Drive PGT 5 turns</p> <p>15. Remove Sq TM and install on H4, √anti-backlash neutral</p> <p>16. Drive H3; PGT [B7 25.5, CCW2 30RPM, 30.5] – 6 ext; ~8 turns</p> <p>17. √Status indicator – UNLOCK</p> <p>18. Break torque on H4; PGT [A6 8.3, CCW 30RPM, 30.5] – Sq TM 7/16 Rec: Drive PGT 5 turns</p> <p>19. Remove Sq TM</p> <p>20. Drive H4; PGT [B7 25.5, CCW2 30RPM, 30.5] – 6 ext; ~18 turns</p>	
Bolt	Turns	Torque																														
H1	_____	_____																														
H2	_____	_____																														
H3	_____	_____																														
H4	_____	_____																														
Bolt	Turns	Torque																														
H1	_____	_____																														
H2	_____	_____																														
H3	_____	_____																														
H4	_____	_____																														

REMOVE AND REPLACE PFCS (Cont)

IV/RMS	EV1	EV2
	<p>21. √Status indicator – UNLOCK</p> <p>22. Install Square scoop on H4</p> <p>23. On MCC GO, remove failed PFCS</p> <p>24. Stow failed PFCS on BRT</p> <p><u>INSTALL SPARE PFCS</u></p> <p>1. Receive spare PFCS from EV2 and install on IEA</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p style="text-align: center;">CAUTION</p> <p>Acme screws unfastened/fastened out of sequence could lead to jamming of PFCS during removal. When fastening acme screws, H4 must be fastened before H3</p> <p>Attempting to mate QDs H1 and H2 before acme screw H4 is fastened could lead to jamming of PFCS and breakage of QDs. Acme screw H4 must be fastened before QDs H1 and H2 are mated</p> </div> <p>2. Remove Square Scoop from H4 fitting</p> <p>3. Fasten H4; PGT [B7 25.5, CW2 30RPM, 30.5] – 6 ext; ~17 ± 2 turns at bolt</p> <p>4. √Status indicator – LOCK</p> <p>5. Install Sq TM onto H4, √anti-backlash neutral</p> <p>6. Torque H4 to final torque; PGT [A6 8.3, CW2 30RPM, 30.5] - Sq TM 7/16 Rec: Drive to torque limit</p> <p>7. Fasten H3; PGT [B7 25.5, CW2 30RPM, 30.5] – 6 ext; ~7 ± 2 turns</p> <p>8. √Status indicator – LOCK</p> <p>9. Remove Sq TM from H4 and install on H3, √anti-backlash neutral</p> <p>10. Torque H3 to final torque; PGT [A6 8.3, CW2 30RPM, 30.5] - Sq TM 7/16 Rec: Drive to torque limit</p> <p>11. Remove Sq TM</p> <p><u>Engage Acme nut and latch key to passive half</u></p> <p>12. Drive QD H2 to hardstop; PGT [A4 6.3, CCW2 30RPM, 30.5] – 6 ext; ~18 turns</p> <p><u>Mate FQDC H2</u></p> <p>13. Drive QD H2 to hardstop; PGT [A4 6.3, CW2 30RPM, 30.5] – 6 ext; ~18 turns</p> <p>14. √Status indicator – MATE</p> <p><u>Engage Acme nut and latch key to passive half</u></p> <p>15. Drive QD H1 to hardstop; PGT [A4 6.3, CCW2 30RPM, 30.5] – 6 ext; ~18 turns</p>	<p><u>INSTALL SPARE PFCS</u></p> <p>1. Transfer spare PFCS to EV1</p>

REMOVE AND REPLACE PFCS (Cont)

IV/RMS	EV1	EV2
	<p><u>Mate FQDC H1</u></p> <ol style="list-style-type: none"> 16. Drive QD H1 to hardstop; PGT [A4 6.3 CW2 30RPM, 30.5] – 6 ext; ~18 turns 17. √Status indicator – MATE 18. Egress and remove APFR <p><u>INSTALL FAILED PFCS</u></p> <ol style="list-style-type: none"> 1. Translate to ESP1 worksite 2. Transfer failed PFCS to EV2 	<p><u>INSTALL FAILED PFCS</u></p> <ol style="list-style-type: none"> 1. Translate to ESP1 worksite 2. Ingress APFR/WIF Extender 3. Receive failed PFCS from BRT and install on ESP1 <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p style="text-align: center;">CAUTION</p> <p>Acme screws unfastened/fastened out of sequence could lead to jamming of PFCS during removal. When fastening acme screws, H4 must be fastened before H3</p> <p>Attempting to mate QDs H1 and H2 before acme screw H4 is fastened could lead to jamming of PFCS and breakage of QDs. Acme screw H4 must be fastened before QDs H1 and H2 are mated</p> </div> <ol style="list-style-type: none"> 4. Remove Sq. Scoop from H4 fitting 5. Fasten H4; PGT [B7 25.5, CW2 30RPM, 30.5] – 6 ext; ~17 ± 2 turns at bolt 6. √Status indicator – LOCK 7. Install Sq TM onto H4, √anti-backlash neutral 8. Torque H4 to final torque; PGT [A6 8.3, CW2 30RPM, 30.5] - Sq TM 7/16 Rec: Drive to torque limit 9. Remove Sq. Scoop from H3 fitting 10. Fasten H3; PGT [B7 25.5, CW2 30RPM, 30.5] – 6 ext; ~7 ± 2 turns 11. √Status indicator – LOCK 12. Remove Sq TM from H4 and install on H3, √anti-backlash neutral 13. Torque H3 to final torque; PGT [A6 8.3, CW2 30RPM, 30.5] - Sq TM 7/16 Rec: Drive to torque limit 14. Remove Sq TM 15. Demate P5 from ESP J5, mate to FSE J5 <p><u>Engage Acme nut and latch key to passive half</u></p> <ol style="list-style-type: none"> 16. Drive QD H2 to hardstop; PGT [A4 6.3, CCW2 30RPM, 30.5] – 6 ext; ~18 turns <p><u>Mate FQDC H2</u></p> <ol style="list-style-type: none"> 17. Drive QD H2 to hardstop; PGT [A4 6.3, CW2 30RPM, 30.5] – 6 ext; ~18 turns 18. √Status indicator – MATE

REMOVE AND REPLACE PFCS (Cont)

IV/RMS	EV1	EV2
	<ol style="list-style-type: none"> 3. Retrieve thermal cover 4. Transfer thermal cover to EV2 	<p><u>Engage Acme nut and latch key to passive half</u> 19. Drive QD H1 to hardstop; PGT [A4 6.3, CCW2 30RPM, 30.5] – 6 ext; ~18 turns</p> <p><u>Mate FQDC H1</u> 20. Drive QD H1 to hardstop; PGT [A4 6.3 CW2 30RPM, 30.5] – 6 ext; ~18 turns 21. ✓Status indicator – MATE 22. Receive thermal cover from EV1 23. Install thermal cover 24. Remove APFR and WIF Extender</p>

REMOVE AND REPLACE PFCS – TASK DATA

Estimated Task Duration:

Two EV Crew	3:00
--------------------	------

Tools:

EV1	EV2
PGT	PGT
7/16" x 6" ext	7/16" x 6" ext
Square Torque Multiplier w/ 7/16" Recessed socket	Square Scoop
Square Scoop	APFR
APFR	WIF extender

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
Fluid QD	H1	7/16"	1	10.8	10.8		18	30
Fluid QD	H2	7/16"	1	10.8	10.8		18	30
Fastener	H3	7/16"	1	42	42		9	30
Fastener	H4	7/16"	1	42	42		19	30

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
P5 (ESP1)	ESP DF	PFCS J7	None	15	Heater Power

Foot Restraints:

Task	WIF	APFR Setting	WIF Extender Setting
IEA PFCS (non-keel side, 2B)	P6-19	12,QQ,A,12	N/A
IEA PFCS (Keel side, 4B)	P6-20	12,QQ,L,12	N/A
Spare PFCS on ESP1	LAB-01-06	8, MM, F, 12	7, B, 6

ORU Identification:

Task	Part Number	Serial Number
Spare PFCS	RE-2814-02	0008
P6 PFCS	RE-2814-02	Port-00004, Stbd-00002

ORU Mass: PFCS=255 lb, FSE=103 lb

Notes:

1. Thermal conditioning of the spare PFCS before installation may be required

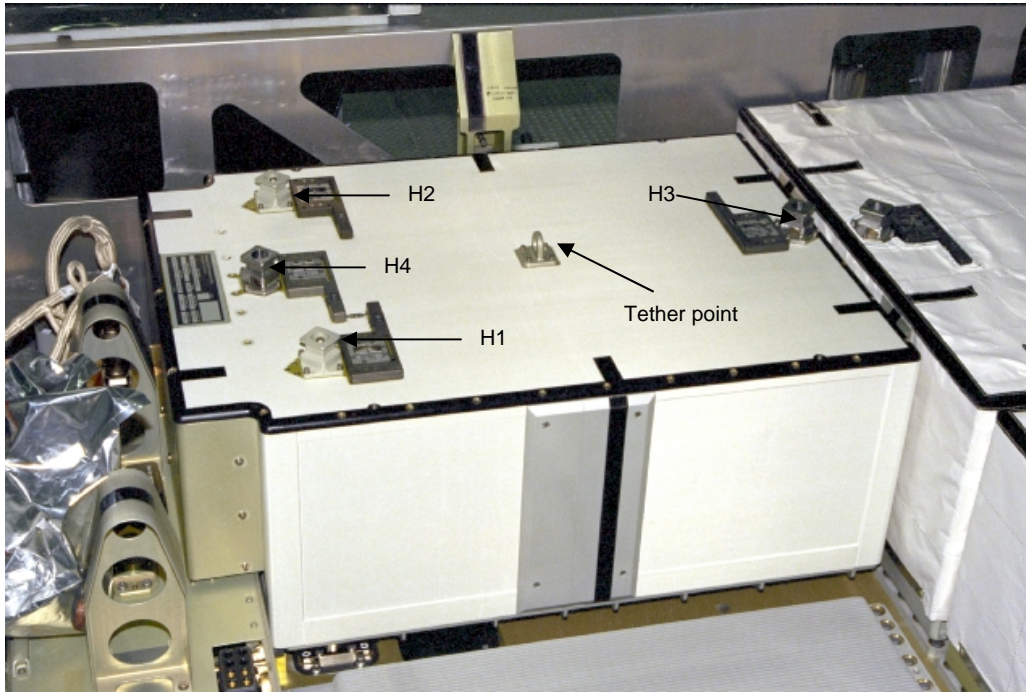
Cautions:

1. The torque necessary for the initial, break-free rotation of the QD drive point is greater than the maximum torque allowed when the drive point reaches internal mechanical stops. The PGT must not operate the drive point into the mechanical stops at the initial torque. Mechanical stops will be reached at 18 turns
2. Acme screws unfastened/fastened out of sequence could lead to jamming of PFCS during removal. When unfastening acme screws, H3 must be unfastened before H4. When fastening acme screws, H4 must be fastened before H3
3. Attempting to mate QDs H1 and H2 before acme screw H4 is fastened could lead to jamming of PFCS and breakage of QDs. Acme screw H4 must be fastened before QDs H1 and H2 are mated
4. Avoid contacting PFCS mating surface (electrical and fluid connectors) with structure during translation with PFCS

Warnings:

1. Hazard voltage exist at the connectors of the failed PFCS. Failed PFCS must be safed before removal

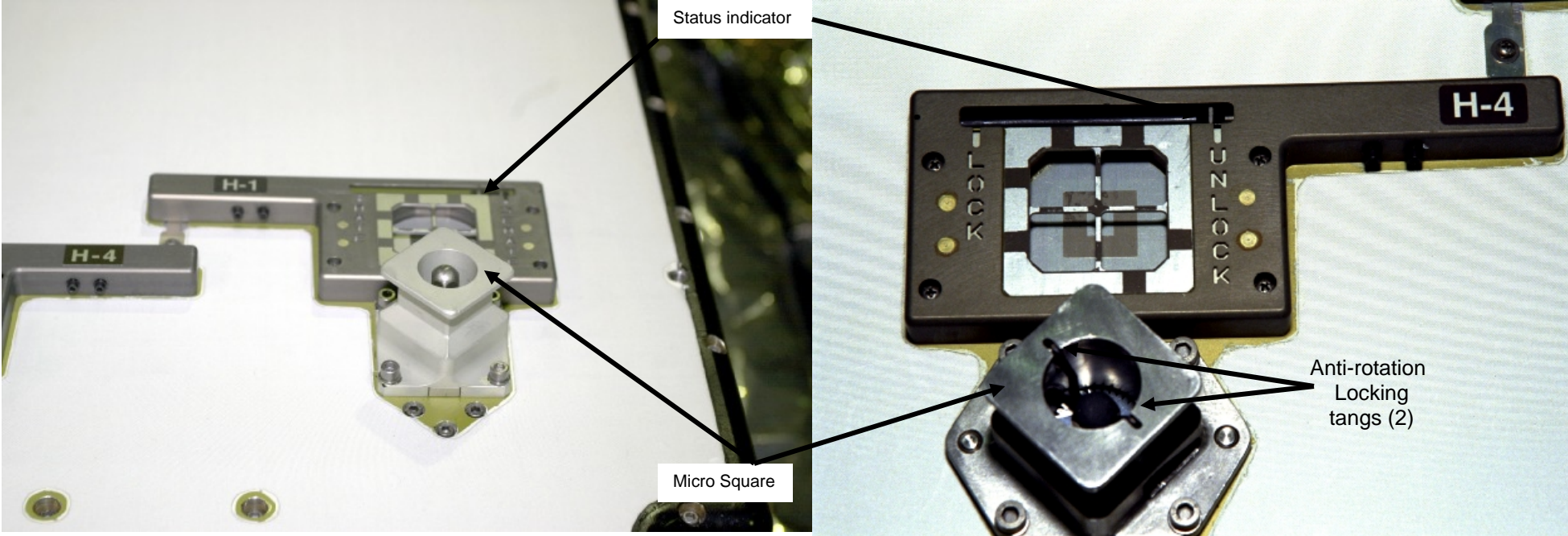
REMOVE AND REPLACE PFCS – TASK DATA (Cont)



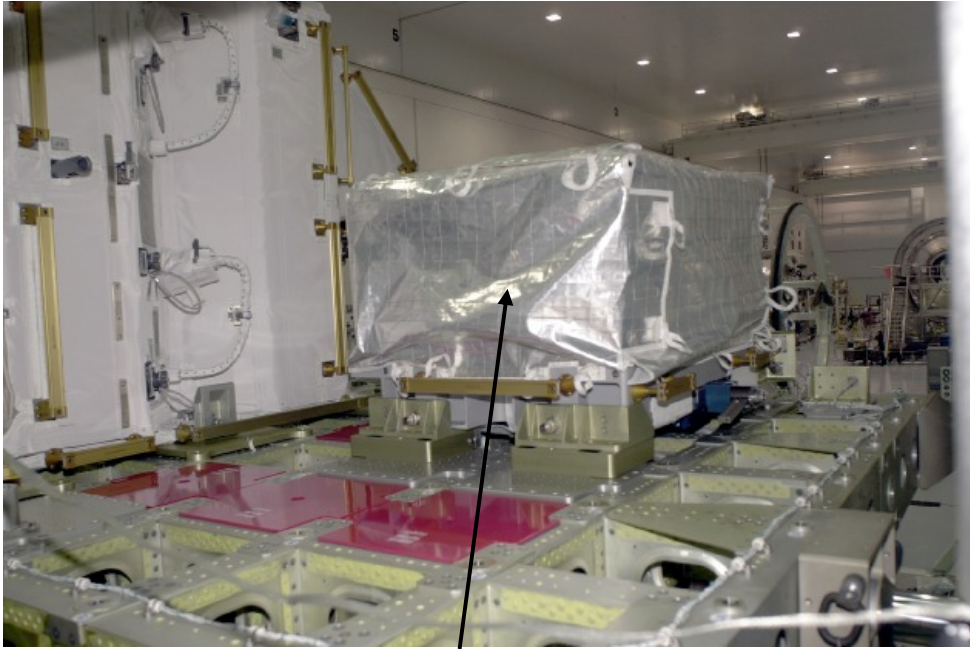
PFCS installed on P6 IEA (Port)



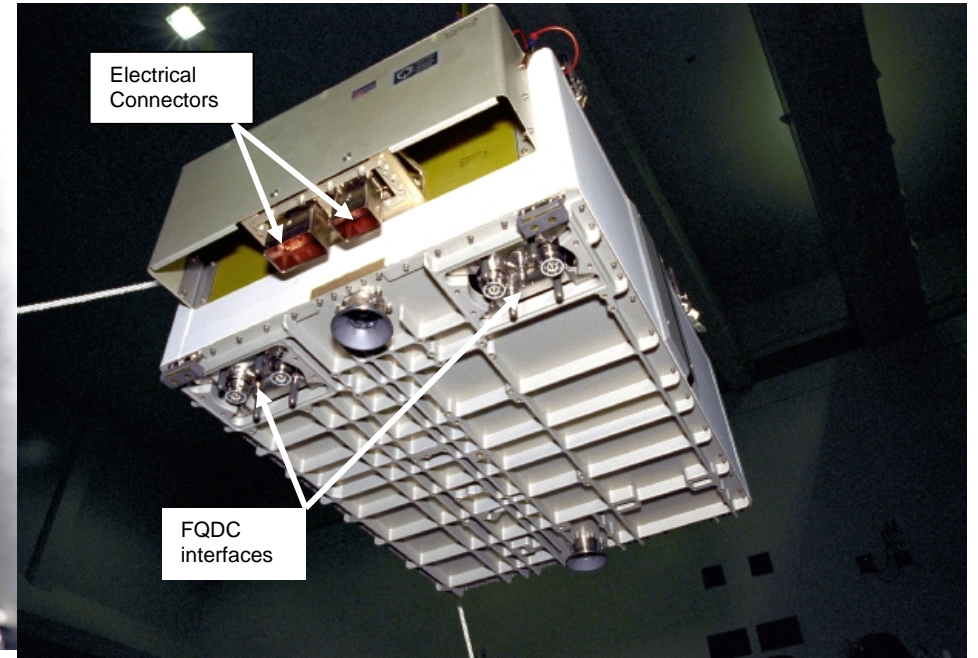
REMOVE AND REPLACE PFCS – TASK DATA (Cont)



REMOVE AND REPLACE PFCS – TASK DATA (Cont)



PFCS Thermal Cover



PFCS Mating Surfaces

REMOVE AND REPLACE DCSU (Cont)

IV/RMS	EV1	EV2
<p>MCC-H 1. Verify electrical power inhibits complete. Give EV GO for DCSU removal</p>	<p><u>REMOVE FAILED DCSU</u></p> <ol style="list-style-type: none"> 1. Translate to P6 IEA worksite 2. Set up and ingress APFR (see task data sheet) <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p style="text-align: center;"><u>CAUTION</u></p> <p>Acme screws unfastened/fastened out of sequence could lead to jamming of DCSU during removal. When unfastening acme screws, H1 must be unfastened before H2</p> </div> <ol style="list-style-type: none"> 3. Install Sq TM onto H1, √anti-backlash neutral 4. On MCC GO, PGT[A7 9.2 ft-lb, CCW2 30RPM, MTL 30.5]-Sq TM-7/16Rec: Drive PGT 5 turns 5. Remove Sq TM; Install on H2 fitting; √anti-backlash neutral 6. PGT[B7 25.5 ft-lb, CCW2 30RPM, MTL 30.5]-6 ext-7/16: Drive H1 8 turns 7. √Status indicator – UNLOCK <p style="text-align: center;"><u>NOTE</u></p> <p>DCSU will travel outward or inward as acme screw H2 is unfastened or fastened</p> <ol style="list-style-type: none"> 8. PGT[A7 9.2 ft-lb, CCW2 30RPM, MTL 30.5]-Sq TM-7/16Rec: Drive H2 5 turns, remove Sq TM 9. PGT[B7 25.5 ft-lb, CCW2 30RPM, MTL 30.5]-6 ext-7/16: Drive H2 18 turns 10. √Status indicator – UNLOCK 11. Install Square scoop on H2 <ol style="list-style-type: none"> 12. Remove failed DCSU 13. Stow failed DCSU on BRT <p><u>INSTALL SPARE DCSU</u></p> <ol style="list-style-type: none"> 1. Receive spare DCSU from EV2 2. Install spare DCSU on IEA <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p style="text-align: center;"><u>CAUTION</u></p> <p>Acme screws unfastened/fastened out of sequence could lead to jamming of DCSU during removal. When fastening acme screws, H2 must be fastened before H1</p> </div> <p style="text-align: center;"><u>NOTE</u></p> <p>DCSU will travel outward or inward as acme screw H2 is unfastened or fastened</p>	<p><u>REMOVE FAILED DCSU</u></p> <ol style="list-style-type: none"> 1. Translate to P6 IEA worksite with spare DCSU <p><u>INSTALL SPARE DCSU</u></p> <ol style="list-style-type: none"> 1. Transfer spare DCSU to EV1

REMOVE AND REPLACE DCSU (Cont)

IV/RMS	EV1	EV2
	<ol style="list-style-type: none"> 3. Remove Square scoop from H2 fitting 4. PGT[B7 25.5 ft-lb, CW2 30RPM, MTL 30.5]-6 ext-7/16: Fasten H2, 17 ± 2 turns 5. Install Sq TM onto H2, √anti-backlash neutral 6. PGT[A7 9.2 ft-lb, CW2 30RPM, MTL 30.5]-Sq TM-7/16Rec: Drive to torque limit 7. √Status indicator – LOCK 8. PGT[B7 25.5 ft-lb, CW2 30RPM, MTL 30.5]-6 ext-7/16: Fasten H1, 7 ± 2 turns 9. Remove Sq TM from H2; Install on H1 fitting; √anti-backlash neutral 10. PGT[A7 9.2 ft-lb, CW2 30RPM, MTL 30.5]-Sq TM-7/16Rec: Drive to torque limit 11. √Status indicator – LOCK 12. Remove Sq TM from H1 13. Egress and remove APFR <p><u>STOW FAILED DCSU ON ESP1</u></p> <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> <p style="text-align: center;"><u>CAUTION</u></p> <p style="text-align: center;">Avoid contacting DCSU mating surface (electrical connectors and cooling fins) with structure during translation with DCSU</p> </div> <ol style="list-style-type: none"> 1. Translate to ESP1 worksite 2. Transfer failed PFCS to EV2 3. Retrieve thermal cover 	<p><u>STOW FAILED DCSU ON ESP1</u></p> <ol style="list-style-type: none"> 1. Translate to ESP1 worksite 2. Ingress APFR/WIF Extender <ol style="list-style-type: none"> 3. Receive failed DCSU from EV1 and install on ESP1 <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> <p style="text-align: center;"><u>CAUTION</u></p> <p style="text-align: center;">Acme screws unfastened/fastened out of sequence could lead to jamming of DCSU during removal. When fastening acme screws, H2 must be fastened before H1</p> </div> <p style="text-align: center;"><u>NOTE</u></p> <p style="text-align: center;">DCSU will travel outward or inward as acme screw H2 is fastened or unfastened</p> <ol style="list-style-type: none"> 4. Remove Square scoop from H2 fitting 5. PGT[B7 25.5 ft-lb, CW2 30RPM, MTL 30.5]-6 ext-7/16: Fasten H2, 17 ± 2 turns 6. Install Sq TM onto H2, √anti-backlash neutral 7. PGT[A7 9.2 ft-lb, CW2 30RPM, MTL 30.5]-Sq TM-7/16Rec: Drive to torque limit 8. √Status indicator – LOCK

REMOVE AND REPLACE DCSU (Cont)

IV/RMS	EV1	EV2
	<p>4. Retrieve and transfer thermal cover to EV2</p>	<p>9. PGT[B7 25.5 ft-lb, CW2 30RPM, MTL 30.5]-6 ext-7/16: Fasten H1, 7 ± 2 turns</p> <p>10. Remove Sq TM from H2; Install on H1 fitting; √anti-backlash neutral</p> <p>11. PGT[A7 9.2 ft-lb, CW2 30RPM, MTL 30.5]-Sq TM-7/16Rec: Drive to torque limit</p> <p>12. √Status indicator – LOCK</p> <p>13. Receive thermal cover from EV1</p> <p>14. Install thermal cover over DCSU</p> <p>15. Remove APFR and WIF Extender</p>

REMOVE AND REPLACE DCSU – TASK DATA

Estimated Task Duration:

Two EV Crew	2:30
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Tools:

EV1 (RMS)	EV2 (FF)
PGT	PGT
6ext 7/16	6ext 7/16
Square TM w/ 7/16 in Rec Socket	Square TM w/ 7/16 in Rec Socket
Square scoop	Square scoop
APFR	APFR
	WIF Extender

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
Fastener	H1	7/16	1	36	42		9	30
Fastener	H2	7/16	1	36	42		19	30

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
P3/J3	ESP1	FRAM	3		Power

Foot Restraints:

Task	WIF	APFR Setting	WIF Extender
Access to Stbd IEA DCSU	P6-26	12, PP, D, 12	N/A
Access to Port IEA DCSU	P6-28	12, PP, D, 12	N/A
Access to ESP1 DCSU (spare)	LAB 01-06	11, QQ, G, 12	6, B, 7

ORU Identification:

Task	Part Number	Serial Number
Spare DCSU	R072610	X830114

ORU Mass: DCSU = 217 lb, FSE = 154 lb

Notes:

- DCSU will travel outward or inward as acme screw H2 is fastened or unfastened

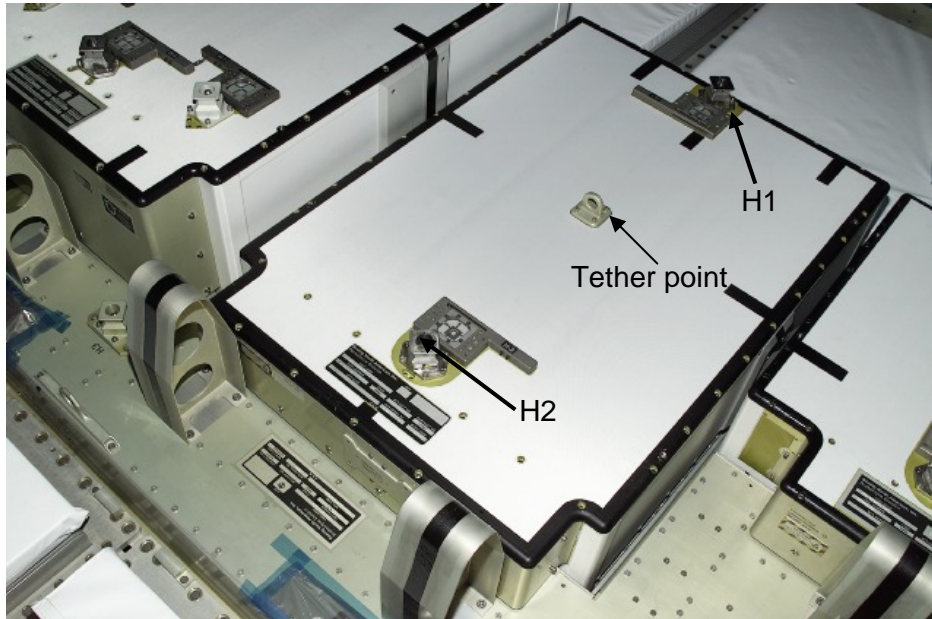
Cautions:

- Acme screws unfastened/fastened out of sequence could lead to jamming of DCSU during removal. When unfastening acme screws, H1 must be unfastened before H2. When fastening acme screws, H2 must be fastened before H1
- Avoid contacting DCSU mating surface (electrical connectors and cooling fins) with structure during translation with DCSU

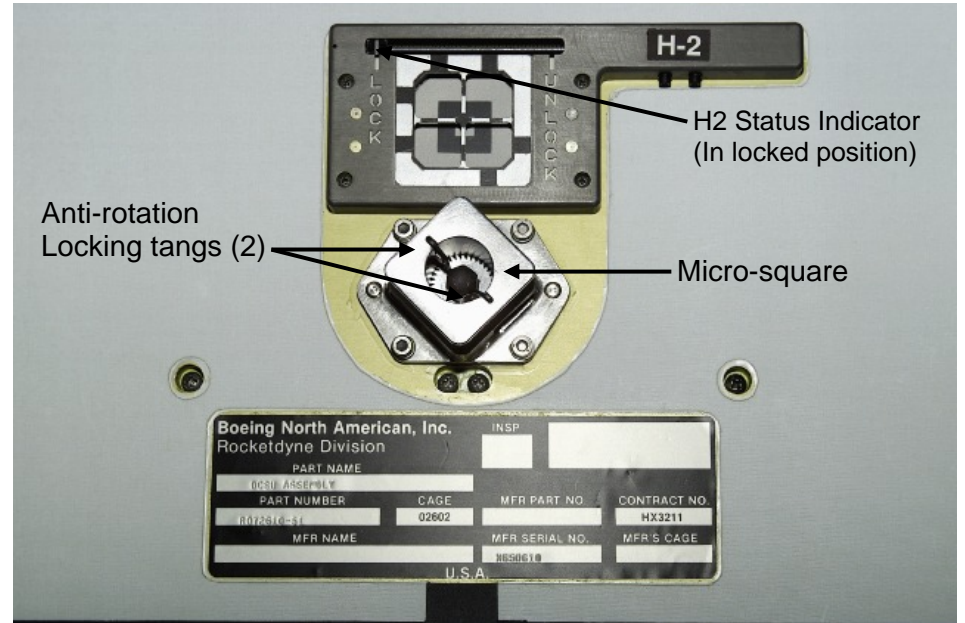
Warnings:

- Hazard voltage exist at the connectors of the failed DCSU. Failed DCSU must be safed before removal

REMOVE AND REPLACE DCSU – TASK DATA (Cont)

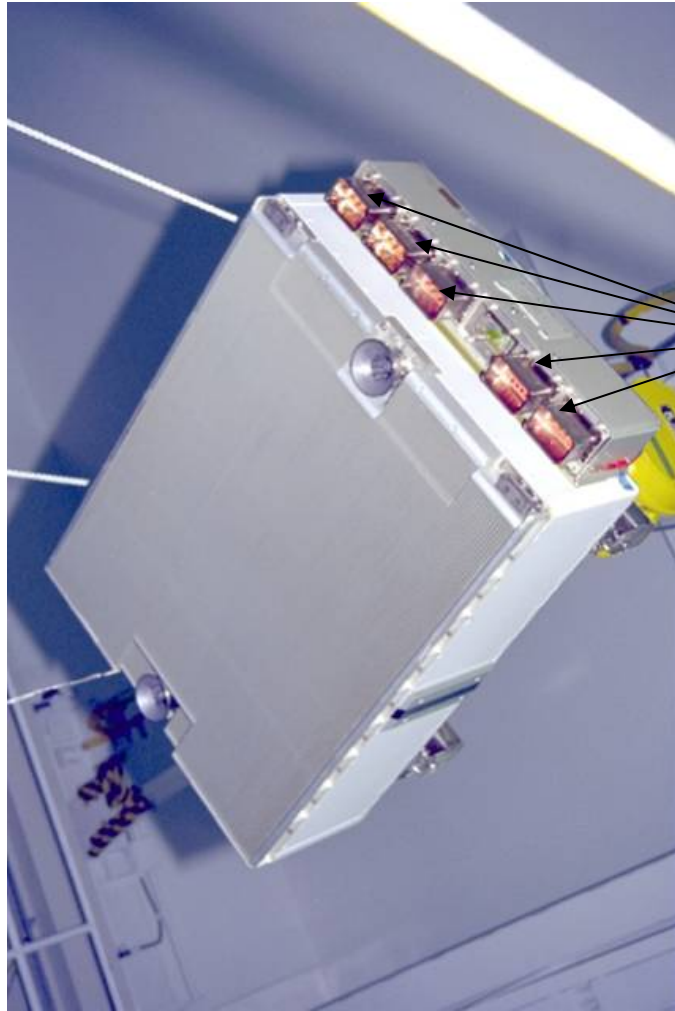


DCSU installed on P6 IEA

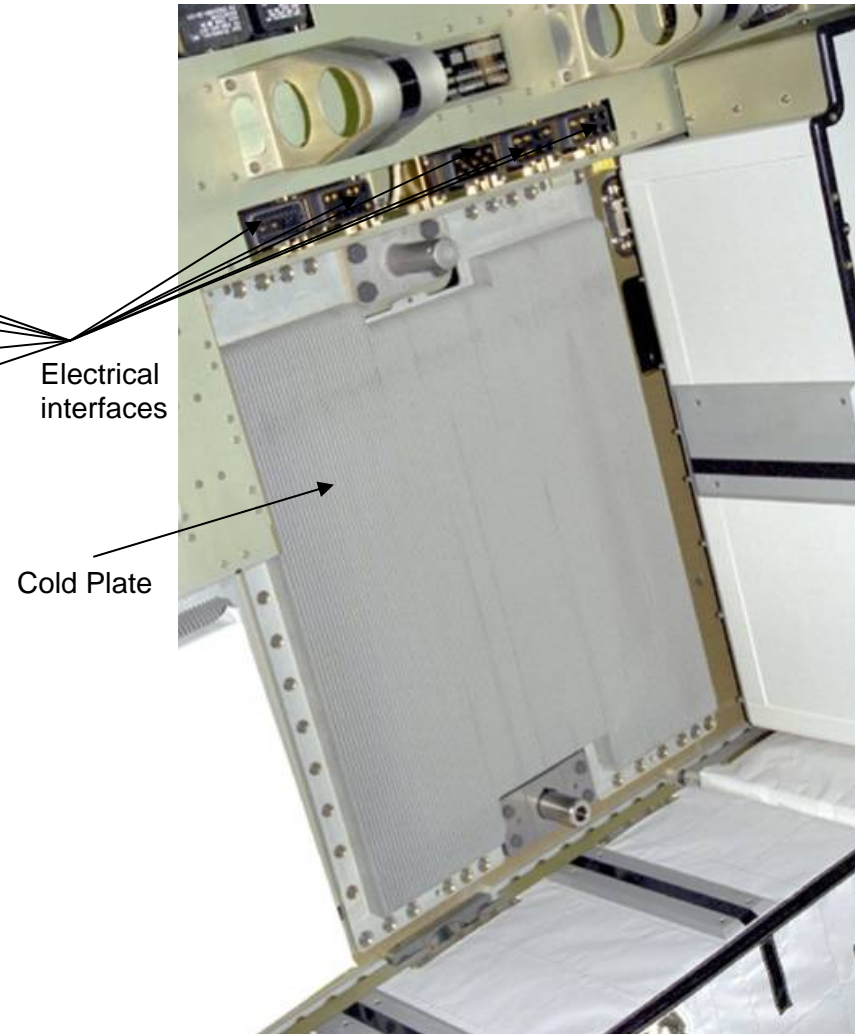


H2 Status Indicator in Locked position

REMOVE AND REPLACE DCSU – TASK DATA (Cont)



P6 IEA DCSU (prior to installation)



P6 IEA DCSU lower deck location (prior to installation)

REMOVE AND REPLACE DDCU

Prior to EVA:

1. Verify part number of spare ORU (R076522-121) and record serial number on task data sheet. Report P/N and S/N of spare unit to MCC-H
2. Position DDCU-E in large ORU Transfer Bag and stow in airlock

IV/RMS	EV1	EV2
<p>MCC-H 1. Verify electrical power inhibits complete. Give EV GO for DDCU removal</p> <p>2. Verify P/N of failed ORU and record S/N on task data sheet. Report P/N and S/N to MCC-H</p> <p style="text-align: center;">NOTE</p> <p>ORU is successfully installed if H1 and H2 screw torque and appropriate number of turns has been met.</p> <p>Removing DDCU from cold plate causes H1 status indicator to move from UNLOCK to LOCK</p>	<p><u>REMOVE FAILED DDCU</u></p> <ol style="list-style-type: none">1. Translate to P6 IEA worksite2. Transfer tools and APFR to worksite3. Setup and ingress APFR (see task data)4. Report failed DDCU P/N and S/N to IV <div style="border: 1px solid black; padding: 5px; text-align: center;"><p>CAUTION</p><p>Acme screws unfastened/fastened out of sequence could lead to jamming of DDCU during removal. When unfastening Acme screws, H1 must be unfastened before H2</p></div> <ol style="list-style-type: none">5. Install SqTM onto H1 fitting, √anti-backlash neutral6. PGT[B7 25.5 ft-lb, CCW2 30RPM, MTL 30.5]-Sq TM-7/16Rec: Drive PGT, 5 turns7. Remove SqTM and install on H2 fitting8. √Anti-backlash neutral9. Install 7/16 X 6-in socket10. PGT[B7 25.5 ft-lb, CCW2 30RPM, MTL 30.5]-6 Ext 7/16: Drive H1, 8 turns11. √Status indicator – UNLOCK12. PGT[B7 25.5 ft-lb, CCW2 30RPM, MTL 30.5]-Sq TM-7/16Rec: Drive PGT, 5 turns13. Remove SqTm and stow14. PGT[B7 25.5 ft-lb, CCW2 30RPM, MTL 30.5]-6 Ext 7/16: Drive H2, 18 turns15. √Status indicator – UNLOCK <div style="border: 1px solid black; padding: 5px; text-align: center;"><p>WARNING</p><p>Avoid contact with intermeshing fins of the DDCU-E and coldplate due to sharp edge concerns</p></div> <ol style="list-style-type: none">16. Install Square scoop on H2 fitting17. Remove failed DDCU (soft dock on H2 15-20 lb)18. Hand off failed DDCU to EV2	<p><u>REMOVE FAILED DDCU</u></p> <ol style="list-style-type: none">1. Translate to P6 IEA worksite2. Transfer tools and spare DDCU to worksite <ol style="list-style-type: none">3. Receive failed DDCU from EV14. Temp stow failed DDCU

REMOVE AND REPLACE DDCU (Cont)

IV/RMS	EV1	EV2
	<p><u>INSTALL SPARE DDCU</u></p> <ol style="list-style-type: none"> Inspect guide rails, connectors and coldplate fins for debris/damage Receive spare DDCU from EV2 Install spare DDCU (soft dock on H2 15-20 lb) √Status indicator on H1 is in UNLOCK <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> <p style="text-align: center;"><u>CAUTION</u></p> <p style="text-align: center;">There is a TBD thermal dwell time between the DDCU & coldplate. Wait TBD time prior to driving bolt</p> </div> <ol style="list-style-type: none"> Remove Square Scoop from H2 fitting PGT [B725.5 ft-lb, CW2 30RPM, MTL 30.5]-6Ext-7/16: Install primary bolt H2 to hard stop, approx 17 turns √Visual indicator – LOCK PGT [B7 25.5 ft-lb, CW2 30RPM, MTL 30.5]-6Ext-7/16: Install secondary bolt H1, approx 7 turns ± 2 √Visual indicator – LOCK Give MCC-H GO to restore power to DDCU Place failed DDCU in ORU Transfer Bag 	<p><u>INSTALL SPARE DDCU</u></p> <ol style="list-style-type: none"> Open ORU Transfer Bag, install Square Scoop on H2 Remove spare DDCU from ORU Transfer Bag Inspect DDCU fins for debris/damage Hand off spare DDCU to EV1 <ol style="list-style-type: none"> Place failed DDCU in ORU Transfer Bag

REMOVE AND REPLACE DDCU – TASK DATA

Estimated Task Duration:

Two EV Crew	1:00
--------------------	------

Tools:

EV1	EV2
PGT	PGT w/ 7/16 X 6-in socket
7/16 X 6-in socket	EVA Crewlock bag
Square TM w/ 7/16 in Rec Socket	Large ORU Transfer Bag
Square Scoop	Square Scoop

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
Fastener	H1	7/16	1	18-28*	43.3*	147.92*	9*	
Fastener	H2	7/16	1	18-28*	43.3*	147.92*	19*	

Foot Restraints:

Task	WIF	CETA Position	Swing Arm Settings	APFR Setting
DDCU-E 2B (P6 IEA Non-keel side)	P6-18	N/A	N/A	9, PP, E, 12*
DDCU-E 4B (P6 IEA Keel side)	P6-17	N/A	N/A	2, PP, F, 12*

ORU Identification:

ORU	Part number	Serial Number
Spare DDCU	R076522-121	X650374
Failed DDCU	R076522-121	

Notes:

- DO NOT USE the P6 IEA ORU placards. The label information is incorrect. Reference IEA ORU label mapping in section 18

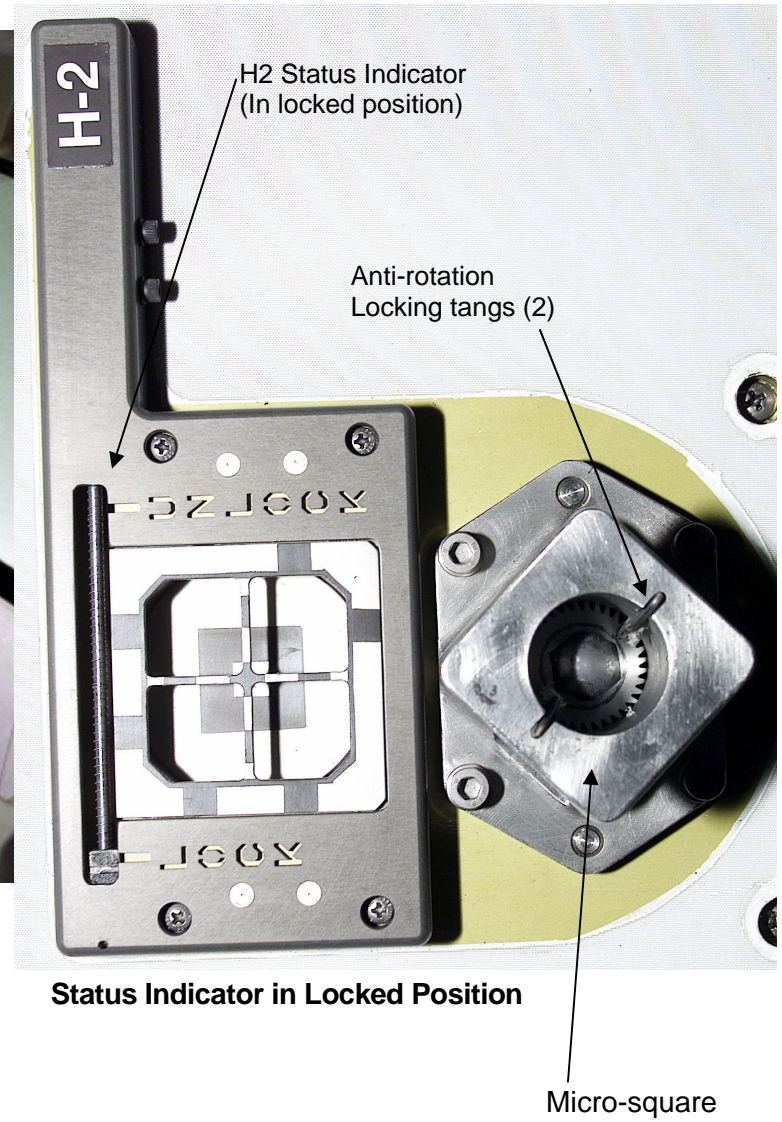
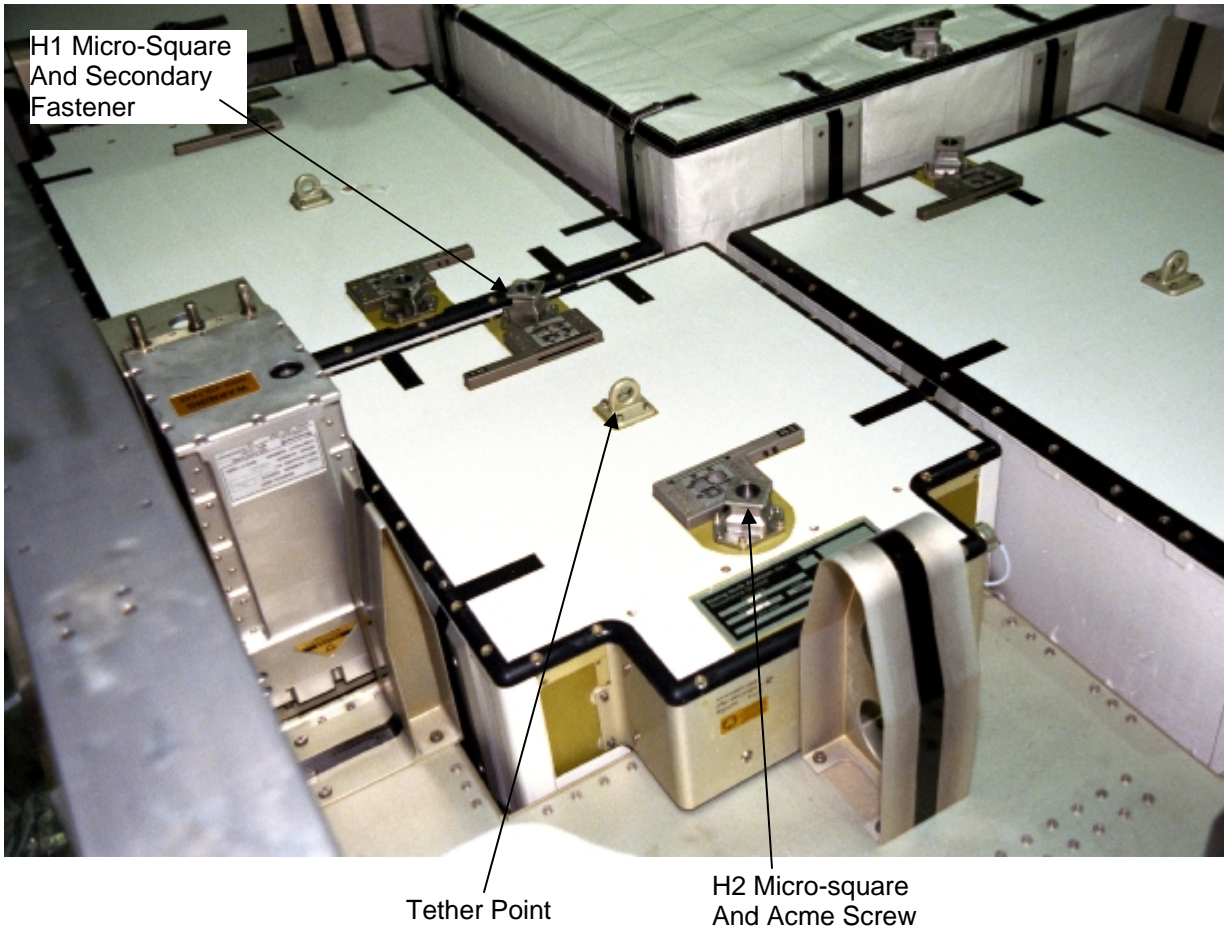
Cautions:

- Acme screws unfastened/fastened out of sequence could lead to jamming of DDCU during removal. When unfastening Acme screws, H1 must be unfastened before H2
- Avoid contacting DDCU electrical connector mating surfaces
- Square Scoop should only be installed on H2 fitting for ORU handling. The H1 fitting may not support EVA handling loads

Warnings:

- Hazard voltage exists at the mating connectors to the DDCU. DDCU interface must be safed before removal
- Depending on worksite proximity to SAW rotation, MCC-H may need to inhibit SAW rotation to avoid collision with the EVA crewmembers
- Avoid contact with intermeshing fins of the DDCU-E and coldplate due to sharp edge concerns

REMOVE AND REPLACE DDCU – TASK DATA (Cont)



REMOVE AND REPLACE DDCU – TASK DATA (Cont)



REMOVE AND REPLACE ECU

Prior to EVA:

1. Unstow spare ECU, install ORU cover, and stow in airlock
2. Verify part number spare ECU and record serial number on task data sheet. Report P/N and S/N of spare unit to MCC-H

IV	EV1	EV2
<p>MCC-H 1. Position and safe SAW for ECU Removal. Perform {2.101 PVM BGA XX ENGAGE ANTI-ROTATION LATCH} (SODF: EPS: NOMINAL: PRIMARY POWER), using the following values:</p> <p style="padding-left: 40px;">BGA Cmded Angle = 0 deg BGA XX Latch Select = 1</p> <p>MCC-H 2. IF REQUIRED FOR P6: Power down the S-band RFG – C&T Book 1.403 S-band ORU Deactivation – Post CCS for RFG step only</p> <p>MCC-H 3. Verify electrical power inhibits complete. GO for EV crew to enter the worksite and remove ECU</p> <p>IV 4. Verify part number of failed ORU and record serial number on task data sheet. Report P/N and S/N of failed unit to MCC-H</p>	<p><u>REMOVE FAILED ECU</u></p> <ol style="list-style-type: none"> 1. Translate to P6 worksite 2. Hold for IV GO (IV step 3), maintain 24 in clearance from the solar array rotational envelope 3. Set up and ingress APFR per Task Data 4. Report failed ECU part number and serial number to IV 5. PGT[A5 7 ft-lb, CCW2 30RPM, MTL 30.5]-Sq TM with 7/16 Rec: Release fastener 5 PGT turns (1 fastener head turn) 6. Remove Sq TM 7. Install Square Scoop on ECU 8. PGT[B7 25.5 ft-lb, CCW2 30RPM, MTL 30.5]-6ext 7/16: Release fastener 10 turns 9. √Status indicator – UNLOCK 10. Remove ECU and temp stow <p><u>INSTALL SPARE ECU</u></p> <ol style="list-style-type: none"> 1. Install replacement ECU into soft dock position 2. PGT[A7 9.2 ft-lb, CW2 30RPM, MTL 30.5]-6ext 7/16: Drive fastener 11 turns 3. Remove Square Scoop from ECU 4. Remove tether from ECU 5. Install Square TM onto ECU 6. PGT[A5 7 ft-lb, CW2 30RPM, MTL 30.5]-Sq TM with 7/16 Rec: Drive fastener ~5 PGT turns (1 fastener head turn) until torque stall 7. √Status indicator – LOCK 8. Install ECU cover on failed ECU 	

REMOVE AND REPLACE ECU – TASK DATA

Estimated Task Duration:

	With RMS	Without RMS
One EV Crew	NA	3:00
Two EV Crew	NA	2:00

Tools:

EV1 (RMS)	EV2 (FF)
PGT	Square scoop
6ext-7/16	
Square TM with 7/16-in Recessed socket	
Square scoop	

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
ECU fastener	NA	7/16	1	35 +/-5*	35*	TBD	11+/-2	30

*Fastener torque data is derived from LSAR report. It will be necessary to re-verify data prior to performing this task. Torque multiplier will not be necessary for installation if real time analysis of on orbit torques are within PGT limits

EVA Connectors: None

Foot Restraints:

Task	WIF	APFR Setting
Access to Stbd SAW ECU	P6-35	4, PP, H, 9
Access to Port SAW ECU	P6-33	4, PP, H, 9

ORU Mass: ECU – 186 lb

ORU Identification:

	Part Number	Serial Number
Spare ECU	R072341	C235283
Failed ECU	R072341	

Note:

1. ECU will travel outward or inward as acme screw is unfastened or fastened

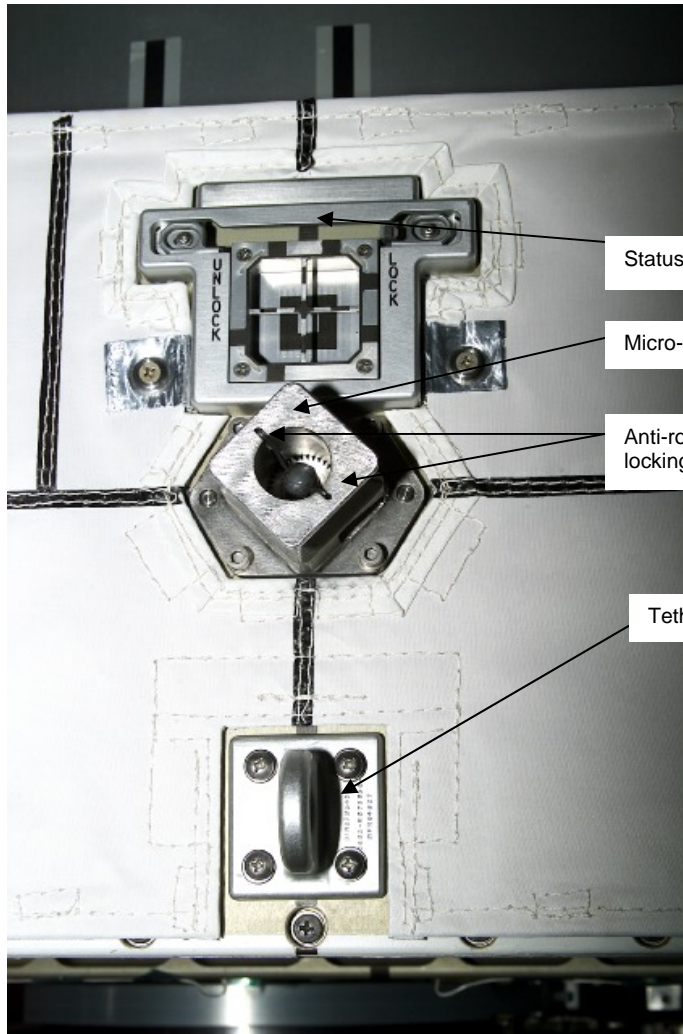
Cautions:

1. Use ECU alignment marks and labels to mate replacement ECU to mast canister platform

Warnings:

1. Hazard voltage exist at the connectors of the failed ECU. Failed ECU must be safed before removal
2. Collision Hazard. The solar array motion should be inhibited to prevent a collision hazard with the EV crew because the EV crew may be within 24 inches of the array rotational envelope

REMOVE AND REPLACE ECU – TASK DATA (Cont)



Status Indicator

Micro-square

Anti-rotation
locking tangs (2)

Tether Point



ECU Installed on Platform Assembly

REMOVE AND REPLACE ECU – TASK DATA (Cont)



ECU Installation Area on P6 SAW

REMOVE AND REPLACE PVCU LOWER

PRIOR TO EVA:

1. Remove connector cover plugs
2. Record New PVCU S/N _____
3. Stow in PVCU thermal cover
4. Attach Round scoop to PVCU micro conical fitting

IV/RMS	EV1	EV2
<ol style="list-style-type: none"> 1. Verify IEA PVCU power and data inhibits complete. Give EV a GO for PVCU removal 2. Record failed PVCU S/N _____ 3. Record bolt installation: final torque _____ turns _____ 	<p><u>REMOVE FAILED PVCU</u></p> <ol style="list-style-type: none"> 1. Verify failed PVCU serial number <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p style="text-align: center;"><u>CAUTION</u></p> <p>Tabs on the round TM interfere with the lock/unlock indicator next to the micro-conical in 4 out of the 6 possible attach positions. The interference could cause damage to the lock/unlock indicator during PVCU change out if the TM is not installed in the correct orientation</p> </div> <ol style="list-style-type: none"> 2. Install Round TM on failed PVCU attachment bolt micro-conical fitting so that the tabs will not interfere with the status indicator 3. On IV GO, PGT[A7 9.2 ft-lb, CCW2 30RPM, MTL 30.5]-Round TM, flush-7/16: Loosen attachment bolt 5 turns 4. Attach RET to tether point 5. Install Round scoop on failed PVCU 6. PGT[B7 25.5 ft-lb, CCW2 30RPM, MTL 30.5]-9ext-7/16: Loosen attachment bolt 15 turns 7. Verify status indicator – UNLOCK 8. Remove PVCU from IEA and temp stow <p><u>INSTALL NEW PVCU</u></p> <ol style="list-style-type: none"> 9. Retrieve new PVCU from thermal shroud 10. Install PVCU into soft dock IEA position 11. PGT[B7 25.5 ft-lb, CW2 30RPM, MTL 30.5]-9ext-7/16: Tighten attachment bolt 14 turns 12. Release Round scoop from PVCU 13. PGT[A7 9.2 ft-lb, CW2 30RPM, MTL 30.5]-Round TM, flush-7/16: Tighten attachment bolt to torque 14. Verify status indicator – LOCK 15. Notify MCC that PVCU is installed 16. Release RET from tether point 17. Stow failed PVCU in thermal shroud 	

REMOVE AND REPLACE PVCU LOWER – TASK DATA

Estimated Task Duration:

One EV Crew	1:00
Two EV Crew	N/A

Tools:

EV1	EV2
PGT	
7/16 (wobble) Socket – 9 ext	
Round TM with 7/16 in flush	
Crewlock EVA Bag	
PVCU (spare) and thermal shroud	
Round Scoop (x2)	

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
PVCU Attachment bolt	N/A	7/16	1	TBD	45	TBD	16	30

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
NA					

Foot Restraints:

Task	WIF	APFR Setting
ORU Access IEA Keel Side	P6 - 29	9, OO, F, 12
ORU Access IEA Non-Keel Side	P6 - 30	3, OO, F, 12

ORU Mass: 42 lb

PVCU Reference Info:

	Part Number	Serial Number
Spare PVCU	R071826-1	
PVCU on P6	R071826-1	
PVCU Cover	24700-10015-701	

Notes:

- The keel side (also known as lower side) and non-keel side (also known as upper side) IEA PVCUs are not interchangeable due to dissimilar IEA structural interfaces
- P6 IEA ORU location decal is incorrect. Refer to reference section for the correct reference information

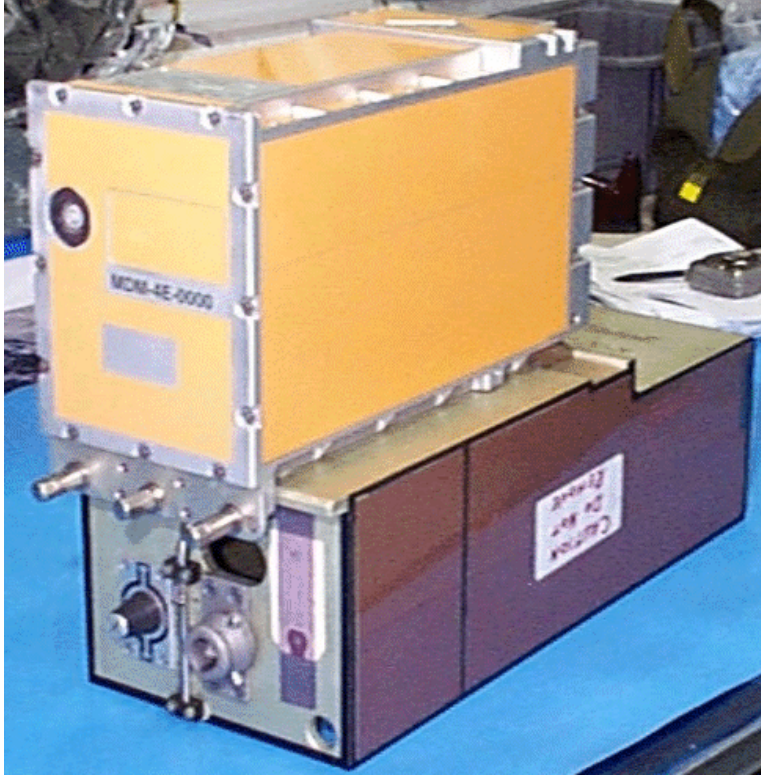
Cautions:

- Tabs on the round TM interfere with the lock/unlock indicator next to the micro-conical in 4 out of the 6 possible attach positions. The interference could cause damage to the lock/unlock indicator during PVCU change out if the TM is not installed such that the torque multiplier tabs do not interfere with travel of the status indicator

Warnings:

- None

REMOVE AND REPLACE PVCU LOWER – TASK DATA (Cont)



IEA MDM (PVCU)



IEA MDM (PVCU) with thermal cover

REMOVE AND REPLACE RJMC

IV/RMS	EV1	EV2
<p>MCC-H 1. Lock SARJ, Give GO for EVA crew to move into worksite</p> <p>MCC-H 2. Safe RJMC for removal Give EVA GO for RJMC removal</p>	<ol style="list-style-type: none"> 1. Translate to P3 RJMC location 2. Install round scoop on RJMC 3. On MCC GO, proceed with RJMC removal 4. PGT[B2 16.0 ft-lb, CCW1 20RPM, MTL 25.5]-9 ext 7/16: Release left and right captive fasteners 14 turns until fastener released 5. Release center jack screw 33 turns 6. Remove RJMC by sliding it along guide pins 7. Temp stow failed RJMC 8. Remove protective cover from replacement RJMC 9. Install RJMC on radiator plate support structure by sliding it along two guide pins into soft dock position 10. PGT[B2 16.0 ft-lb, CW1 20RPM, MTL 23.5]-9 ext 7/16: Tighten center jackscrew 24 to 30 turns 11. Remove round scoop 12. Worksite cleanup 	

REMOVE AND REPLACE RJMC – TASK DATA

Estimated Task Duration:

	With RMS	Without RMS
One EV Crew	NA	NA
Two EV Crew	NA	2:00

Tools:

EV1	EV2
PGT	NA
9 Ext 7/16	
Round scoop (2)	
APFR	

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
RJMC captive fastener	No	7/16	2	TBD	16.7	TBD	TBD	20
RJMC Jack Screw	No	7/16	1	TBD	16.7	TBD	TBD	20

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
NA					

Foot Restraints:

Task	WIF	APFR Setting
RJMC Access Face 2	P3-27	(10, PP, E, 12)
RJMC Access Face 6	P3-28	(2, OO, G, 12)

Mass: NA

Notes:

- Left and right fasteners are needed for launch only. If this is the first time maintenance is performed, these fasteners will have to be unfastened. Replacement RJMCs will not have these fasteners engaged

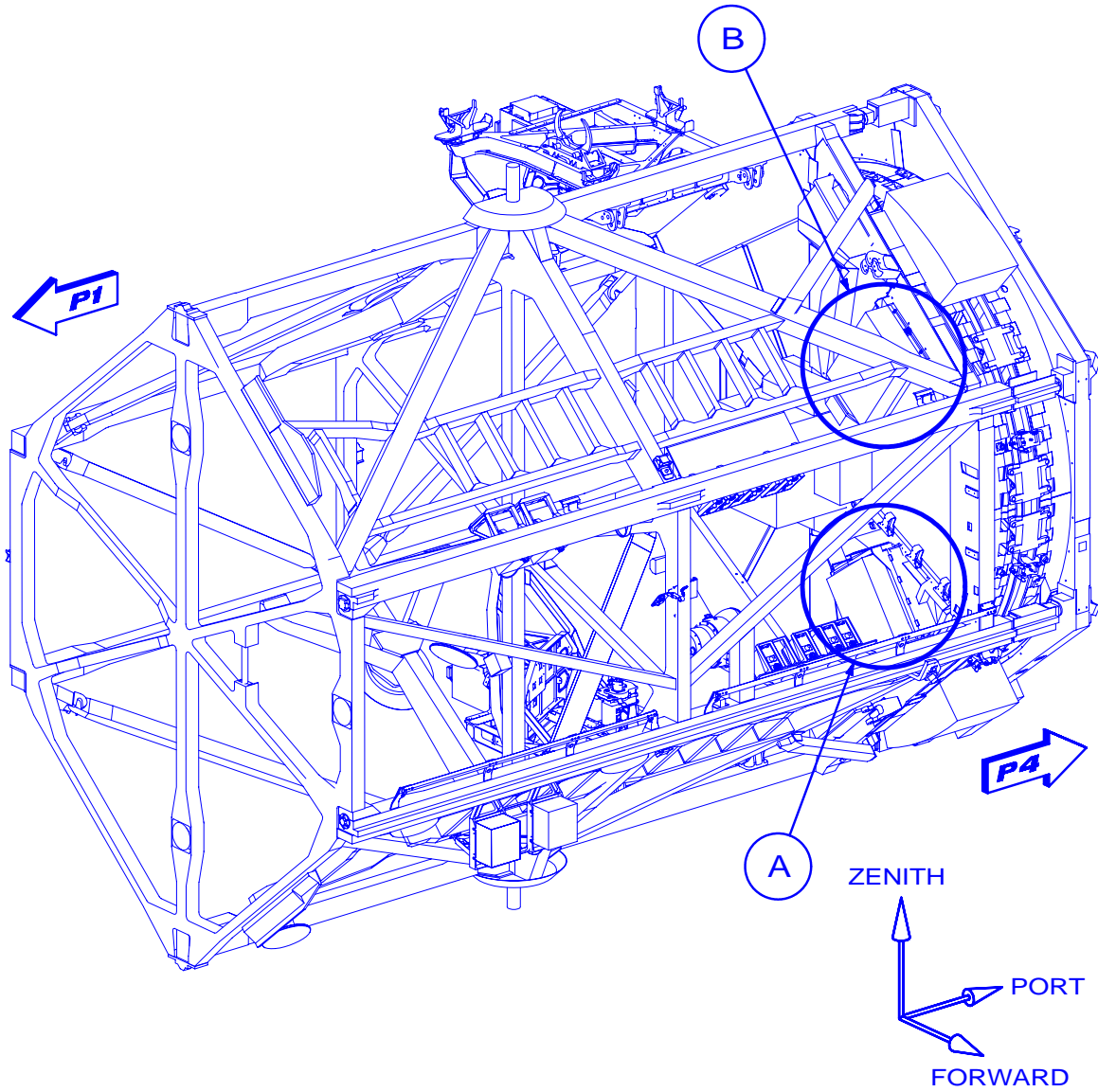
Cautions:

- Equipment damage – During RJMC removal, ensure that the left and right captive fasteners are unfastened before loosening center jackscrew
- The blind mate connectors are subject to damage as replacement unit is secured to structure. Ensure that the center jack screw is tightened fully to properly engage blind mate connectors

Warnings:

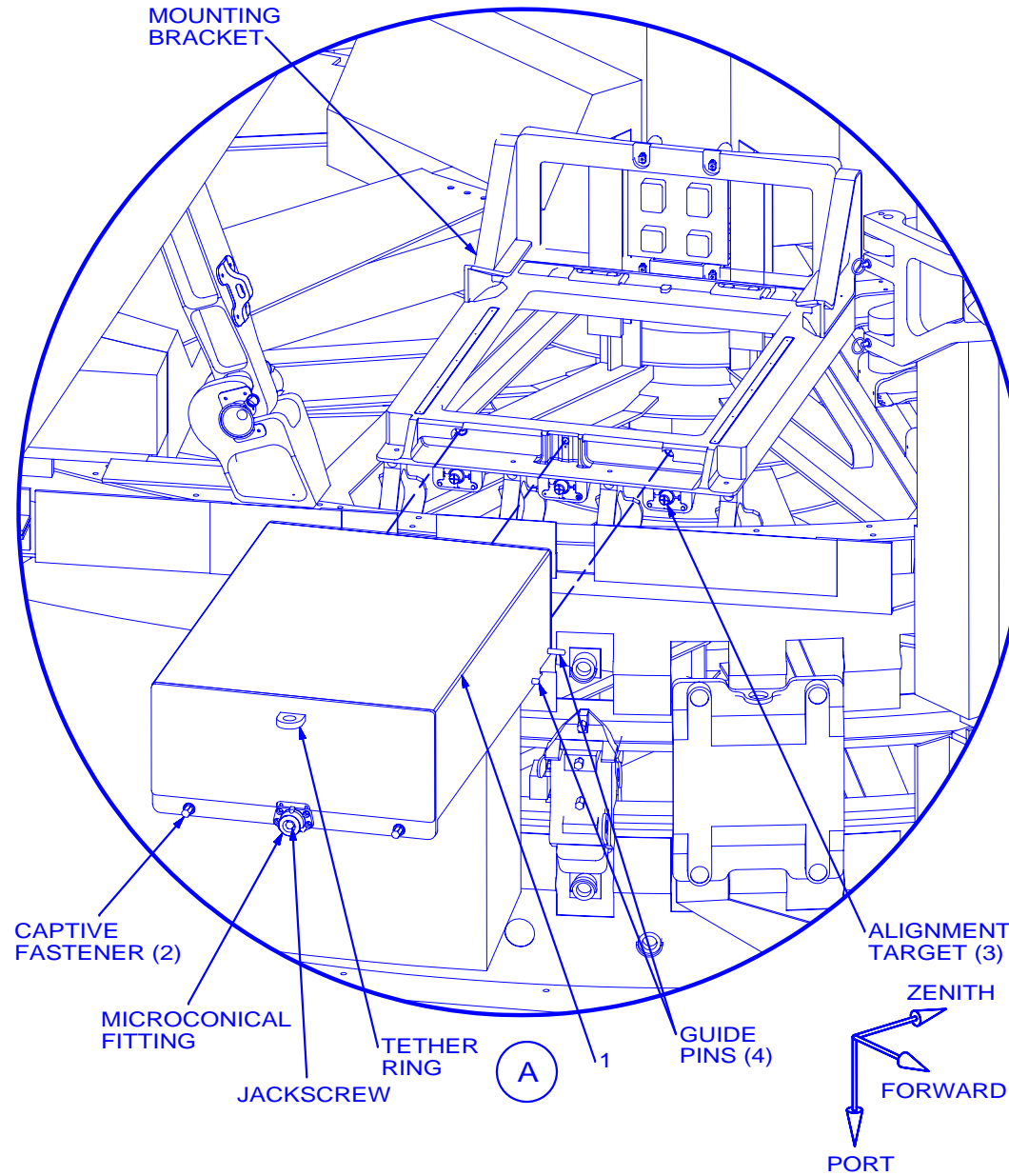
- Ensure electrical power is deactivated prior to RJMC removal
- Moving equipment. Avoid entering SARJ keep out zone until SARJ has been locked into position

RJMC REMOVE AND REPLACE – TASK DATA (Cont)



s4ske-010103 (sht1)

RJMC REMOVE AND REPLACE – TASK DATA (Cont)



CAPTIVE FASTENER (2)

MICROCONICAL FITTING

JACKSCREW

TETHER RING

A

1

GUIDE PINS (4)

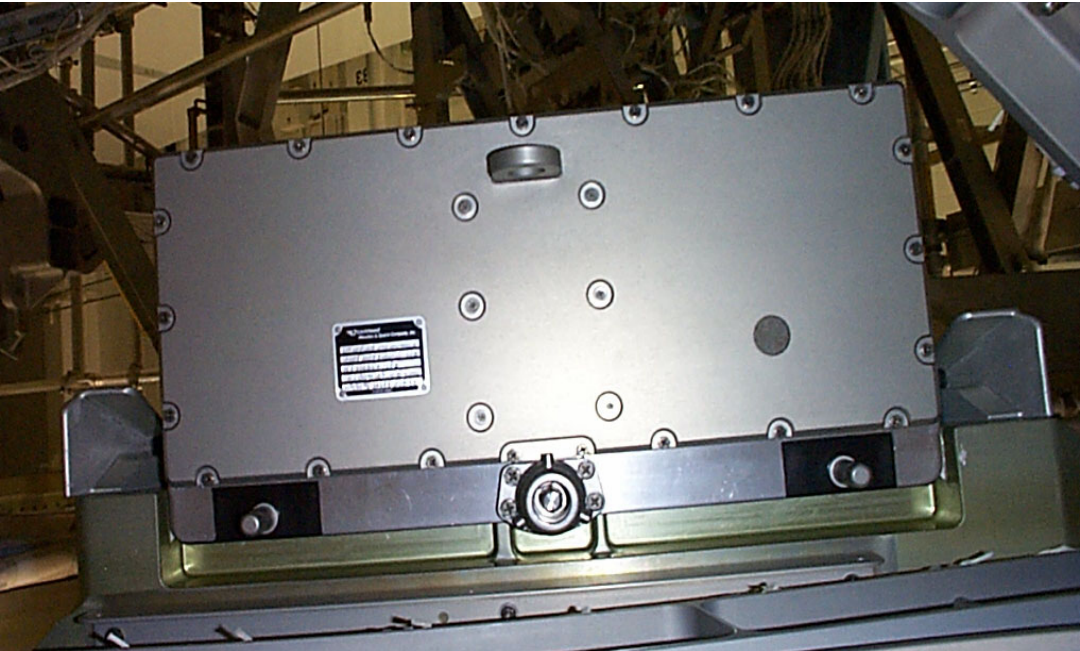
ALIGNMENT TARGET (3)

ZENITH

FORWARD

PORT

RJMC REMOVE AND REPLACE – TASK DATA (Cont)



RJMC Without Thermal Shroud

MANUAL P4 SAW JETTISON

PRIOR TO EVA:

1. Unstow SSU cover and place in crewlock
2. If ECU removal is planned, stow Medium ORU transfer bag in crewlock
3. Remove SSU shunt plug adapter J5A and J6A caps and tether to tether point on SSU shunt plug adapter
4. Remove SSU shunt plug caps and mate SSU shunt plugs to SSU shunt plug adapter J5A and J6A (shunt plugs can go on either adapter receptacle)
5. Remove caps from SSU shunt plug adapter ground service equipment connectors
6. Stow SSU shunt plug adapter/shunt plugs, Cannon connector tool in EVA crewlock bag
7. Stow size 37 Cannon connector plug cap, P/N S22698-006-373 in EVA crewlock bag

IV/RMS	EV1	EV2
<p>Identify Affected Power Channel XX = _____ and opposite deck Power Channel YY = _____</p> <p>MCC-H 1. Mnv/orient ISS for SAW jettison</p> <p>MCC-H 2. Position and safe SAW for SSU Removal Perform {4.136 PVM SSU XX R&R PREPARATION AND RECOVERY} (SODF: EPS: CORRECTIVE : PRIMARY POWER) Removal Steps Only</p> <p>MCC-H 3. Verify solar array positioned for EV crew access to SSU and BGA latched PCS PVM: EPS: BGA XX <u>BGA XX</u> 'ECU XX' Verify: Integ Cnt – Incrementing 'BGA XX' Verify: Actual Angle, deg = 270 Motor State – OFF Latch 1(2) Pin Status – Latched</p> <p>4. GO for EV ingress at SSU worksite</p> <p>MCC-H 5. Verify power connector inhibits in place before SSU Removal PCS PVM: EPS: DCSU XX <u>DCSU XX</u> 'DCSU XX' sel RBI 1 Verify: Cmdded Position – Op</p>	<div style="border: 2px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> <p style="text-align: center;"><u>WARNING</u></p> <p>Voltage hazard exists at the connectors of the SSU. SSU must be safed before removal</p> <p>Electrical Shock Hazard. SSU Shunt Plug installation/removal and SSU removal/installation must occur during eclipse. STEPS DENOTED BY AN “E” MUST OCCUR DURING ECLIPSE. Crew must wait the specified wait periods for voltage drops to safe levels before proceeding. EV crew will need to move away from exposed electrical receptacles during day pass</p> <p>Protrusion Hazard. SSU alignment post protrudes beyond mast canister. Maintain clearances between structure and crewmember during SSU changeout</p> <p>Collision Hazard. The solar array motion should be prevented by locking the BGA. This avoids a collision hazard with the EV crew if the EV crew is within 24 inches of the array rotational envelope</p> </div> <p><u>EVA SETUP</u></p> <ol style="list-style-type: none"> 1. If required, translate to Z1 forward face, demate Cannon connector cap from Z1 J259 or J260, stow in EVA crewlock bag 2. On MCC GO, Translate to SSU worksite 3. Transfer tools and APFR with AIA to worksite 4. Set up APFR (see Task Data page) 	<p><u>EVA SETUP</u></p> <ol style="list-style-type: none"> 1. On MCC GO, translate to P4 worksite 2. Stow tools and SSU cover on P4 3. Retrieve MCHD from P6 Aux bag 4. Transfer to MCHD to P4

MANUAL P4 SAW JETTISON (Cont)

IV/RMS	EV1	EV2
<p>Close Cmd – Inh Voltage: -4.2 – 4.2 Current: -7.5 – 7.5</p> <p>PCS PVM: EPS: SSU XX SSU XX 'BCDU YY1' (YY= opposite channel on IEA) sel CP RBI</p> <p>BCDU XX CP RBIs 'YY1 CP RBI' (YY= opposite channel on IEA) Verify: YY1 CP RBI Posn – Op</p> <p>MCC-H 6. Turn off and off point video camera luminaries, RPCM open and closed inhibited</p> <p>MCC-H 7. Give GO for BMRRM J1 demate and SSU shunt plug installation</p> <p>8. GO for SSU removal during 2nd ECLIPSE ONLY</p>	<div> </div> <p>SSU shunt plugs and adapter installed on mast canister with shroud open</p> <p> E5. On MCC GO and DURING ECLIPSE (2 min wait after transition from insolation to eclipse), remove mast canister ground test port caps (2) and place in EVA trash bag E6. Position MLI shroud as shown above or folded against shunt plugs E7. DURING ECLIPSE, install SSU shunt plug adapter with bails facing outward, not against mast canister 8. Reinstall MLI shroud 9. Ingress APFR and wait for next eclipse </p> <p><u>REMOVE FAILED SSU</u></p> <p> 1. Install Sq TM onto primary fastener, √anti-backlash neutral E2. On MCC GO and DURING ECLIPSE (5 min wait after transition from insolation to eclipse), PGT [A7 9.2 ft-lb, CCW2 30RPM, MTL 30.5]- Sq TM-7/16Rec: Drive PGT 5 turns E3. Remove Sq TM </p>	<p> E5. On MCC GO and DURING ECLIPSE, demate connector from BMRRM J1 E6. DURING ECLIPSE, mate Cannon connector cap on BMRRM J1 </p> <p><u>REMOVE FAILED SSU</u></p>

MANUAL P4 SAW JETTISON (Cont)

IV/RMS	EV1	EV2
<p>9. Position and safe SAW for ECU Removal (if required) and SAW jettison. Perform {2.101 PVM BGA XX ENGAGE ANTI-ROTATION LATCH} (SODF: EPS: NOMINAL: PRIMARY POWER) using the following values:</p> <p style="padding-left: 40px;">BGA XX Cmded Angle = 180 deg BGA XX Latch Select = 1</p> <p>10. GO for EV ingress at ECU worksite</p> <p>MCC-H 11. Remove ECU power PCS PVM: EPS:BGA XX BGA XX</p> <p style="padding-left: 40px;">sel RPCM YY A RPC 02 RPCM YY A RPC 02</p> <p>cmd RPC Position – Open (Verify – Op)</p> <p>(Expect Caution Message: BGA XX Loss of Comm)</p> <p>MCC-H 12. GO for ECU removal and BMRRM cable demate</p>	<p>E4. Install Sq Scoop on SSU</p> <p>E5. PGT [A7 9.2 ft-lb, CCW2 30RPM, MTL 30.5]-12-ext-7/16: Drive fastener 10 turns</p> <p>E6. √Status indicator – UNLOCK</p> <p>E7. Remove SSU and hand to EV2</p> <p>8. Clear BGA rotation plane for BGA rotation and inform IV when clear</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0; text-align: center;"> <p>WARNING Moving equipment hazard: Avoid contact with mast canister/beta gimbal during rotation of SAW</p> </div> <p><u>REMOVE ECU [if required]</u></p> <ol style="list-style-type: none"> 1. Set up and ingress APFR [see Task Data page] 2. On MCC GO, PGT[A5 7.0 ft-lb, CCW2 30RPM, MTL 10.5]-Sq TM w/7/16 REC: Release fastener 1 turn 3. Remove Sq TM 4. Install Square Scoop on ECU 	<ol style="list-style-type: none"> 1. Receive SSU and stow on SSU cover 2. Clear BGA rotation plane for BGA rotation and inform IV when clear <p><u>RELEASE BMRRM FASTENERS/CONNECTORS</u></p> <ol style="list-style-type: none"> 1. Remove BMRRM thermal shroud and temp stow 2. PGT[A5 7.0 ft-lb, CCW2 30RPM, MTL 10.5]-6 ext 7/16: Release BMRRM center fastener 10 ± 2 turns 3. On MCC GO, disconnect the following connectors from the BMRRM: <ul style="list-style-type: none"> <input type="checkbox"/> Demate connector from J3 <input type="checkbox"/> Demate connector from J2

MANUAL P4 SAW JETTISON (Cont)

IV/RMS	EV1	EV2
<p>MCC-H 13. Give GO for jettison</p>	<p>5. PGT[A7 9.2 ft-lb, CCW2 30RPM, MTL 10.5]-6 ext 7/16: Release fastener 10 ± 2 turns</p> <p>6. ✓Status indicator – UNLOCK</p> <p>7. Remove ECU and stow in ORU transfer bag</p> <p><u>INSTALL MCHD</u></p> <p>1. On MCC-H GO, set up and ingress APFR [see Task Data page]</p> <p>2. Deploy MCHD appendages</p> <p>3. Install MCHD on mast canister</p> <p>4. PGT[A7 9.2 ft-lb, CW2 30RPM, MTL 10.5]-6 ext 7/16: Fasten MCHD corner attach fasteners (4) to hardstop</p> <p><u>MANUAL SAW JETTISON</u></p> <p>1. Using MCHD, move mast canister from beta gimbal at a velocity less than 1 ft/min. Move mast canister 2 ft from beta gimbal separation plane. Correct wing attitude as reqd to achieve stability</p> <p>2. Release MCHD</p> <p>3. Monitor SAW separation</p> <p>4. When SAW is clear, egress worksite</p>	<p><u>MANUAL SAW JETTISON</u></p> <p>1. On MCC GO, PGT[A5 7.0 ft-lb, CCW2 30RPM, MTL 10.5]-6 ext 7/16: Release platform vice clamp fastener, 19 turns to hardstop</p> <p>2. When complete, give EV1 GO for SAW motion</p> <p>3. Call out separation distance until 2 ft separation achieved</p> <p>4. Monitor SAW separation</p>

MANUAL P4 SAW JETTISON – TASK DATA

Estimated Task Duration:

	Without RMS
One EV Crew	NA
Two EV Crew	3:00

Tools:

EV1	EV2
PGT	PGT
6 ext-7/16	6 ext-7/16
APFR/ingress aid	
Square TM with 7/16-in Recessed socket	
Medium ORU Transfer bag (for ECU)	SSU cover
EVA crewlock bag	
SSU shunt plug adapter	
SSU shunt plugs (2)	
Size 33 Cannon conn plug cap	
Square scoop (2)	
Mast Canister Handling Device	

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
SSU fastener	NA	7/16	1	NA	45	TBD	11 ± 2	
ECU fastener	NA	7/16	1	NA	35	TBD	11 ± 2	
BMRRM Center Fastener	NA	7/16	1	NA	7.5	TBD	10 ± 2	
MCHD Fasteners	NA	7/16	4	2.5-3.3	2.5-3.3	TBD	ZIP	
Vice Clamp	NA	7/16	1	NA	7.5	TBD	19 ± 2	

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
W05 P23 J3		BMRRM J3		25	ECU feed; SSU Control pwr; 1553B
W06 P22 J2		BMRRM J2		25	ECU cross feed
		BMRRM J1		37	Primary power

Foot Restraints:

Task	WIF	APFR Setting
Access to SSU (IEA non-keel side 4A SAW) when 4A BGA at 270 deg)	P4-23	4, PP, H, 9
Access to SSU (IEA keel side 2A SAW) when 2A BGA at 270 deg)	P4-24	4, PP, H, 9
Access to BMRRM (IEA keel side 2A SAW)	P4-27	9, QQ, H, 3
Access to BMRRM (IEA non-keel side 4A SAW)	P4-28	9, NN, G, 3
Install MCHD and 4A SAW jettison position (IEA non-keel side SAW) when 4A BGA at 180 deg)	P4-26	6, FF, F, 6
Install MCHD and 2A SAW jettison position (IEA keel side SAW) when 2A BGA at 180 deg)	P4-25	6, FF, F, 6
Access to 4A ECU (when 4A BGA at 180 deg)	P4-26	8, OO, A, 3
Access to 2A ECU (when 2A BGA at 180 deg)	P4-25	8, OO, A, 3

ORU Mass: SSU – 186 lb

ECU – 90 lb

SAW – approx 2326 lb

MANUAL P4 SAW JETTISON – TASK DATA (Cont)

Notes:

1. The MCHD has four deployable legs. Each leg has an EVA fastener which engages a zip nut on the mast canister hand rails. The MCHD also has a deployable PGT cradle assembly which is used to drive the mast canister MDA. The PGT cradle assembly is not required for the jettison procedure

Cautions:

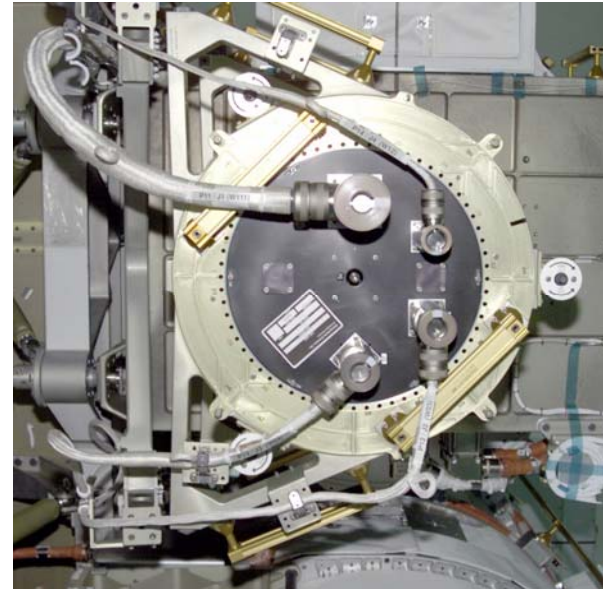
1. None

Warnings:

1. Electrical Shock Hazard: Install SSU shunt plug adapter/SSU shunt plugs and remove SSU during orbital eclipse. Procedure specifies wait time before installing SSU shunt plug adapter/SSU shunt plugs and removing SSU to allow voltages to drop to safe levels
2. Protrusion Hazard: SSU alignment post protrudes beyond mast canister. Maintain clearances between structure and crewmember during SSU changeout
3. Voltage hazard may exist at connectors of the ECU and BMRRM. ECU and BMRRM must be safed before removal
4. Collision Hazard: The solar array motion should be inhibited to prevent a collision hazard with the EV crew because the EV crew may be within 24 inches of the array rotational envelope
5. Moving equipment hazard: Avoid contact with mast canister/beta gimbal during rotation of SAW
6. Mass handling – The crewmember will control the SAW mass with bent arms to avoid loading the EMU suit structure
7. Release mast canister with minimal tip-off rates



Mast Canister Handling Device (MCHD)



BMRRM connectors without BMRRM thermal cover

PV RADIATOR JETTISON

IV/RMS	EV1	EV2
<ol style="list-style-type: none"> 1. Verify PFCS pump shut down complete (Loop A and B valves closed) 2. Verify Utility Power inhibits complete 3. MnvR ISS to PVR Jettison Attitude 	<p><u>FQDC DEMATE</u></p> <ol style="list-style-type: none"> 1. Set up and ingress APFR 2. PGT[___ 9.0 ft-lb, CCW_ 30RPM, MTL ___]-18 ext 7/16: Release FQDC Shroud bolts (H5, H6, H7, H8), x7 turns 3. Remove shroud and secure with Adj Equip tether 4. PGT[___ 10.83 ft-lb (130in-lb), CCW_ 30RPM, MTL ___]-12 ext 7/16: Break torque on FQDC bolts H18, H19 (two) x1 turn <ul style="list-style-type: none"> <input type="checkbox"/> H18 <input type="checkbox"/> H19 5. PGT[___ 6.25 ft-lb (<75 in-lb), CCW_ 30RPM, MTL ___]-12 ext 7/16: Attach adj tether to inner loop of FQDC housing for use in correcting alignment. Extend FQDC drive bolts H18, H19 (two) x18¼ turns to hard stop. Verify 4 guide cones squarely engage springs during demate. Verify 90 deg cam rotation during last ¼ turn (indicating latch key rotation to the disengaged position) <ul style="list-style-type: none"> <input type="checkbox"/> H18 <input type="checkbox"/> H19 6. PGT[___ 6.25 ft-lb (<75 in-lb), CW_ 30RPM, MTL ___]-12 ext 7/16: Retract FQDC drive bolt H18, H19 (two) x19 turns to hard stop. Verify guide cones remain engaged in springs. Verify 90 deg cam rotation on 3rd turn (cam reset) <ul style="list-style-type: none"> <input type="checkbox"/> H18 <input type="checkbox"/> H19 7. Remove PIP pins from carrier bolts H20, H21, H24, H25 (x4) 8. PGT[___ 2.5 ft-lb, CCW_ 30RPM, MTL ___]-12 ext 7/16: Drive slider bolts H20, H21 to hard stop to align brackets with bolts H22, H23 (two) x9 turns <ul style="list-style-type: none"> <input type="checkbox"/> H20 <input type="checkbox"/> H21 9. PGT[___ 4 ft-lb, CW_ 30RPM, MTL ___]-12 ext 7/16: Engage bolts H22, H23 (two) into carrier brackets, x2 turns. Push to engage threads <ul style="list-style-type: none"> <input type="checkbox"/> H22 <input type="checkbox"/> H23 <p style="text-align: center;"><u>NOTE</u> If H22 (H23) do not engage, adjust H20 (H21) cw by ½ turn increments and retry</p>	<p><u>ELECTRICAL UMBILICAL DEMATE</u></p> <ol style="list-style-type: none"> 1. Set up APFR near H30 On IV GO, using Cannon Connector Tool: <ul style="list-style-type: none"> <input type="checkbox"/> Demate W22-P2 from radiator J1 <input type="checkbox"/> If S4 or S6, mate W22-P2 to IEA dummy J1 <input type="checkbox"/> Demate W122-P2 from radiator J2 <input type="checkbox"/> If S4 or S6, mate W122-P2 to IEA dummy J2 <input type="checkbox"/> Demate W222-P2 from radiator J3 <input type="checkbox"/> If S4 or S6, mate W222-P2 to IEA dummy J3 <input type="checkbox"/> If P4 or P6, wire tie cables to adjacent handhold <p><u>RADIATOR RELEASE/JETTISON</u></p> <ol style="list-style-type: none"> 3. PGT[___ 20 ft-lb, CCW_ 30RPM, MTL ___]-6 ext-7/16: Remove PIP pin and release PVR center attach bolts H26,H27 (two), x35 turns <ul style="list-style-type: none"> <input type="checkbox"/> H26 <input type="checkbox"/> H27 4. PGT[___ 45 ft-lb, CCW_ 30RPM, MTL ___]-Sq TM with 7/16 proud: Remove PIP pins and break torque on PVR corner bolts H28-H31 (four), x1 turn <ul style="list-style-type: none"> <input type="checkbox"/> H30 <input type="checkbox"/> H29 <input type="checkbox"/> H31 <input type="checkbox"/> H28 (when EV1 clears area)

PV RADIATOR JETTISON (Cont)

IV/RMS	EV1	EV2
	<p>10. Install short PIP pins for carrier bolts H20, H21 (two)</p> <p>11. PGT[___ 20 ft-lb, CCW_ 30RPM, MTL ____]-12 ext 7/16: Release bolts H24, H25, x TBD turns <input type="checkbox"/> H24 <input type="checkbox"/> H25</p> <p>12. Install longer PIP pins for carrier bolts H24, H25 (two)</p> <p>13. PGT[___ 20 ft-lb, CW_ 30RPM, MTL ____]-12 ext 7/16: Tighten bolts H22, H23 (two) x4½ turns <input type="checkbox"/> H22 <input type="checkbox"/> H23</p> <p>14. Remove Adj Equip tether from FQDC shroud</p> <p>15. Install shroud over FQDC (Use alignment pin H7)</p> <p>16. PGT[___ 6.25 ft-lb, CW_ 30RPM, MTL ____]-12 ext- 7/16: Engage upper FQDC Shroud bolts (two), x7 turns. Push to engage bolt threads</p> <p><u>RADIATOR RELEASE / JETTISON</u></p> <p>17. PGT[___ 10 ft-lb, CCW_ 30RPM, MTL ____]-6 ext 7/16: Release PVR Corner bolt H30, x8 turns. Reinstall PIP pin <input type="checkbox"/> H30</p> <p>18. Ingress APFR</p> <p>19. PGT[___ 10 ft-lb, CCW_ 30RPM, MTL ____]-6 ext 7/16: Release PVR Corner bolt H28, x8 turns. Reinstall PIP pin <input type="checkbox"/> H28</p> <p>20. Grasp PVR HR</p> <p>21. Lift PVR out of structure 1 ft to clear accumulator boxes</p> <p>22. Position PVR for jettison</p> <p>23. On IV GO, release PVR HH</p>	<div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> <p style="text-align: center;">CAUTION</p> <p style="text-align: center;">Potential for side loading during bolt removal due to strap design</p> </div> <p>5. PGT[___ 25 ft-lb, CCW_ 30RPM, MTL ____]-6 ext 7/16: Release PVR grounding strap bolt H17 x11 turns <input type="checkbox"/> H17</p> <p>6. PGT[___ 10 ft-lb, CCW_ 30RPM, MTL ____]-6 ext 7/16: Release PVR Corner bolt H31,H29 (two) x8 turns. Reinstall PIP pin <input type="checkbox"/> H31 <input type="checkbox"/> H29</p> <p>7. Ingress APFR</p> <p>8. Grasp PVR HR and restrain while EV1 releases final bolt</p> <p>9. Lift PVR out of structure 1 ft to clear accumulator boxes</p> <p>10. Position PVR for jettison</p> <p>11. On IV GO, release PVR HH</p>

PV RADIATOR JETTISON – TASK DATA

Estimated Task Duration:

	With RMS	Without RMS
One EV Crew	N/A	N/A
Two EV Crew	N/A	1:00

Tools:

EV1 (RMS)	EV2 (FF)
APFR	APFR
BRT	BRT
PGT	PGT
7/16 wobble socket-18 ext	7/16 wobble socket-6 ext
7/16 wobble socket-6 ext	Cannon Connector Tool
Adj Equip Tether	Sq TM with 7/16 Proud

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Torque (ft-lb)	Turns	RPM
FQDC Shroud Bolts	H5, H6, H8, H9	7/16	4	7.5	9.0	15.7	7	10
FQDC Shroud Alignment Pin	H7	N/A	1	N/A	N/A	N/A	N/A	N/A
PVR Grounding Strap Release bolt	H17	7/16	1	N/A	10	TBD	11	30
FDQC Drive Bolts	H18, H19	7/16	2	N/A	10.83 (6.25)	TBD	19	30
FQDC Carrier Slider Bolts	H20, H21	7/16	2	2.5	N/A	TBD	9	30
FQDC Carrier-Radiator Attach Bolts	H22, H23	7/16	2	20	N/A	TBD	6.5	30
FQDC Carrier-IEA Attach Bolts	H24, H25	7/16	2	N/A	20	TBD	TBD	30
PVR Tiedown Center Bolts	H26, H27	7/16	2	N/A	20	TBD	35	30
PVR Tiedown Corner bolts	H28-H31	7/16 microsq	4	N/A	45	TBD	9	30

EVA Connectors:

Harness	From	To	Clamps (#)	Conn Size	Function
W22-P2	PVR J1	If S4 or S6, dummy J1 on truss	0	TBD	Signals and MDA power
W122-P2	PVR J2	If S4 or S6, dummy J2 on truss	0	TBD	Primary heater power
W222-P2	PVR J3	If S4 or S6, dummy J3 on truss	0	TBD	Secondary heater power

Foot Restraints:

Task	WIF	APFR Setting
Access to P4 FQDC	P4-07	7,VV,F,12
Access to S4 FQDC	S4-07	7,VV,F,12
Access to P6 FQDC	P6-07	7,VV,F,12
Access to S6 FQDC	S6-07	7,VV,F,12
Access to P6 Aft FQDC	P6-18	6,VV,G,11
Access to P6 Stbd FQDC	TBD	TBD
EV1 Jettison position for P4 (near H28)	P4-07	7,VV,F,12
EV1 Jettison position for S4 (near H28)	S4-07	7,VV,F,12
EV1 Jettison position for P6 (near H28)	P6-07	7,VV,F,12
EV1 Jettison position for S6 (near H28)	S6-07	7,VV,F,12
EV1 Jettison position for P6 Aft (near H28)	P6-18	6,VV,G,11
EV1 Jettison position for P6 Stbd (near H28)	TBD	TBD
EV2 Jettison position for P4 (near H31)	P4-18	5,SS,D,12
EV2 Jettison position for S4 (near H31)	S4-18	5,SS,D,12
EV2 Jettison position for P6 (near H31)	P6-18	5,SS,D,12
EV2 Jettison position for S6 (near H31)	S6-18	5,SS,D,12
EV2 Jettison position for P6 Aft (near H31)	P6-07	5,SS,F,12
EV2 Jettison position for P6 Stbd (near H31)	TBD	TBD

ORU Mass: 1600 lbm

PV RADIATOR JETTISON – TASK DATA (Cont)

Notes:

1. The 18-inch extension is required to access bolts H24 and H25 on the FQDC carrier. Restricted access near some PVR FQDC shrouds and H20, H21 bolts may require a shorter (6-inch) extension
2. The S4 and S6 IEA structures have dummy receptacles for stowing the radiator cannon connectors

Cautions:

1. Break torque for the FQDCs during demate is greater than the maximum torque allowed for the mechanical stops at the end of bolt travel. Be sure to reset PGT to lower torque setting once initial torque is broke

Warnings:

None

Constraints:

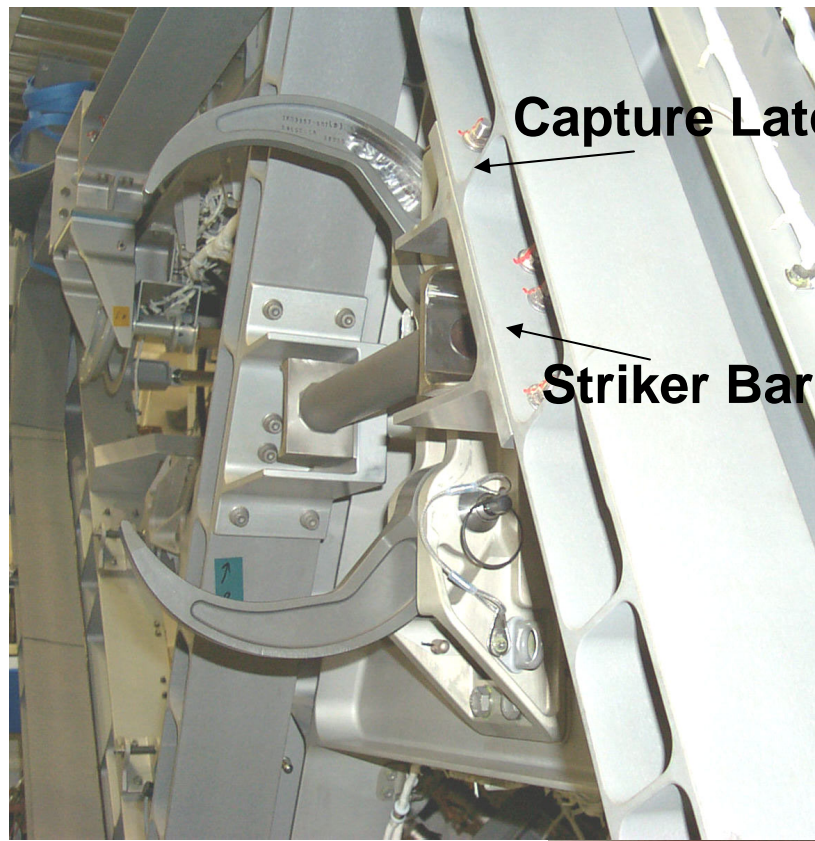
1. Shroud fasteners (H5, H6, H8, H9) can be released in any order
2. During PRV Removal, tie down bolts H26 and H27 must be released first and H28 and H29 must be released last. H30 and H31 can be released in any order

GENERIC EVA REFERENCE

SSAS COMPONENTS.....	FS 17-2
SSAS CONTINGENCY BOLTS	FS 17-3
VIDEO STANCHION SUPPORT ASSEMBLY	FS 17-4
VSSA FSE	FS 17-5
ETVCG.....	FS 17-6
ETVCG LAUNCH CONFIG.....	FS 17-7
ETVCG PAN AND TILT LOCK (1 of 2)	FS 17-8
CETA CART – FACE 1	FS 17-9
CETA CART SWINGARMS AND WIFs	FS 17-10
CETA CART COUPLERS.....	FS 17-11
CETA CART WHEEL BOGIES	FS 17-12
EARLY AMMONIA SERVICER (CONTROL PANEL SIDE).....	FS 17-13
EARLY AMMONIA SERVICER (VENT SIDE)	FS 17-14
EAS CONTROL PANEL	FS 17-15
EAS SCHEMATIC.....	FS 17-16
EVA OHMMETER ASSY (EOA)	FS 17-17
QD VENT TOOLS.....	FS 17-18
1.0 IN FLUID QD SPOOL POSITIONING DEVICE	FS 17-19
FLUID QD BAIL LEVERS	FS 17-20
FLUID QD RELEASE TOOLS	FS 17-21
FLUID QD CAP TOOLS.....	FS 17-22
QD TOOLBAGS INSTALLED ON CREWLOCK ZENITH	FS 17-23
QD TOOLBAG CONTENTS	FS 17-24
WIF EXTENDER.....	FS 17-25
TETHER SHUTTLE STOWAGE	FS 17-26
HR LABELS ON PASSIVE ESPAD	FS 17-27
HR LABELS ON ACTIVE ESPAD.....	FS 17-28
HR LABELS ON ESP2 ZENITH.....	FS 17-29
HR LABELS ON ESP2 NADIR	FS 17-30
CID 5 AND CID 6 LOCATION.....	FS 17-31
CID 7 AND CID 8 LOCATION.....	FS 17-32
1" FEMALE VENT TOOL INSTALLED ON Z1 U-JUMPER	FS 17-33
1" FLUID QD CAP TOOL.....	FS 17-34
SMALL QD BAIL LEVER TOOL	FS 17-35
1" QD RELEASE TOOL.....	FS 17-36

GENERIC
EVA REF

SSAS COMPONENTS



Capture Latch

Striker Bar



**RTL
Striker**



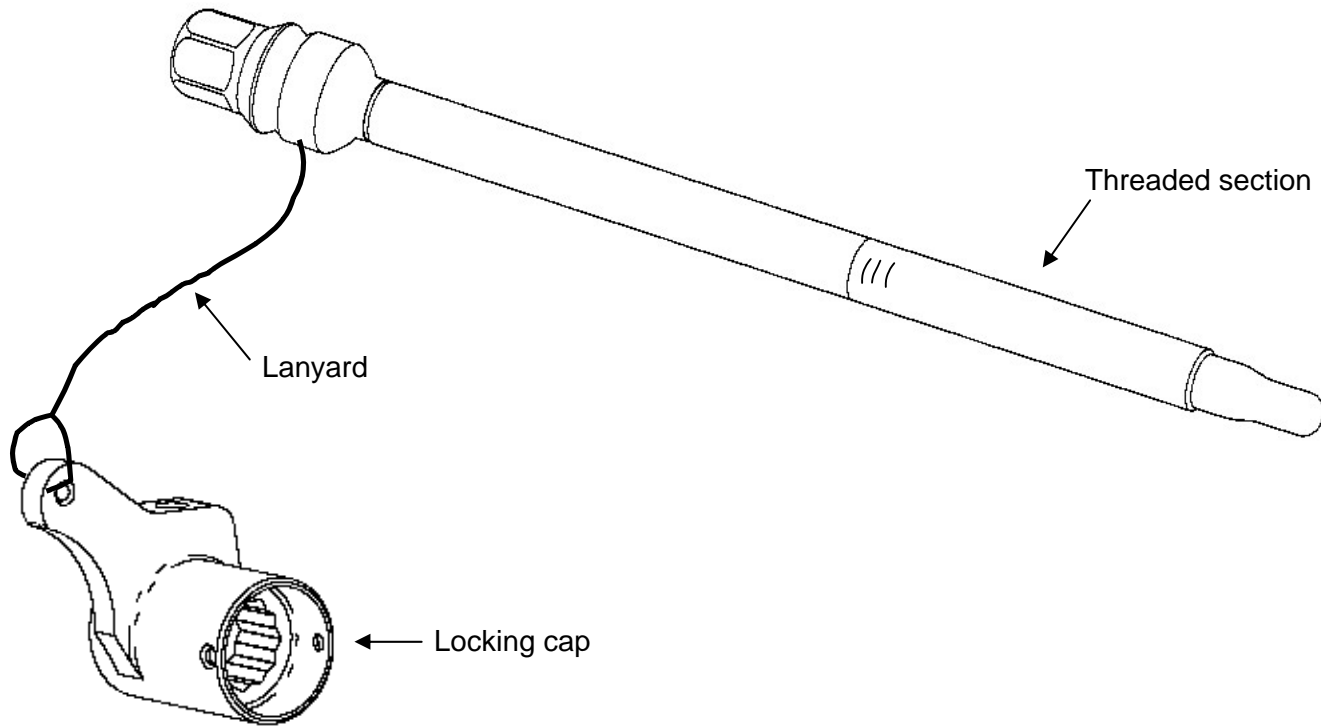
RTL

**Alignment
Cone**

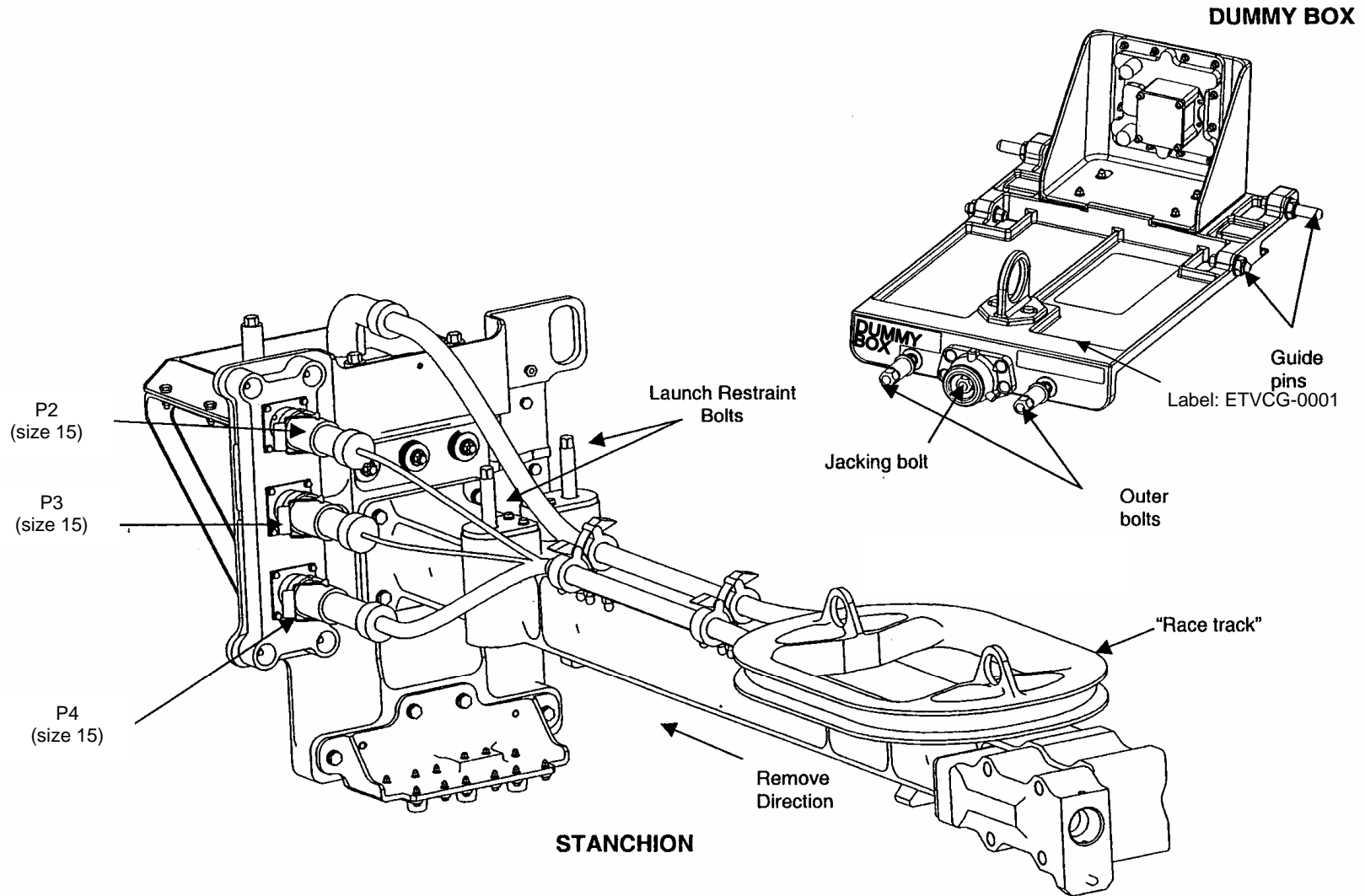


**Alignment
Cup**

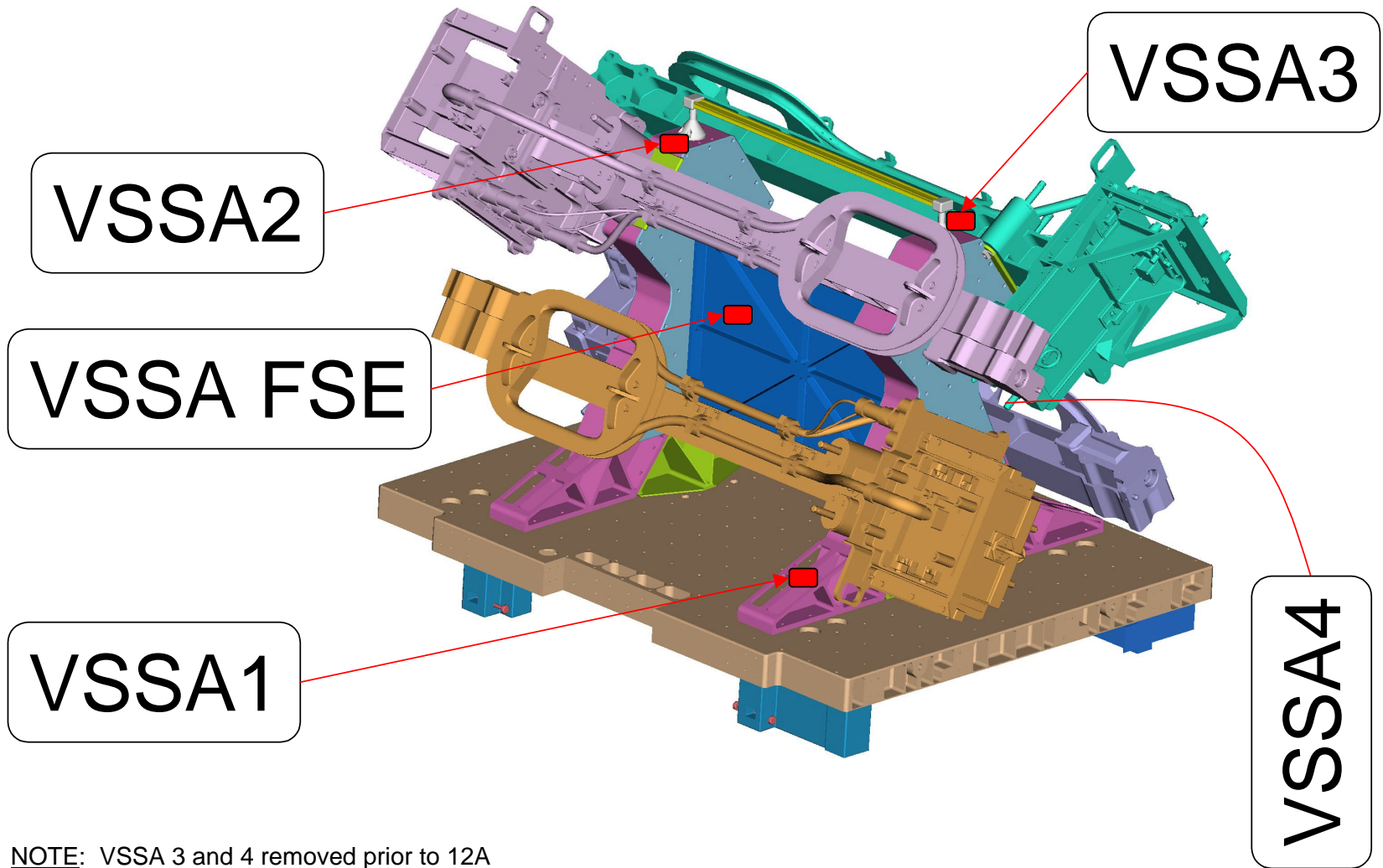
SSAS CONTINGENCY BOLTS



VIDEO STANCHION SUPPORT ASSEMBLY

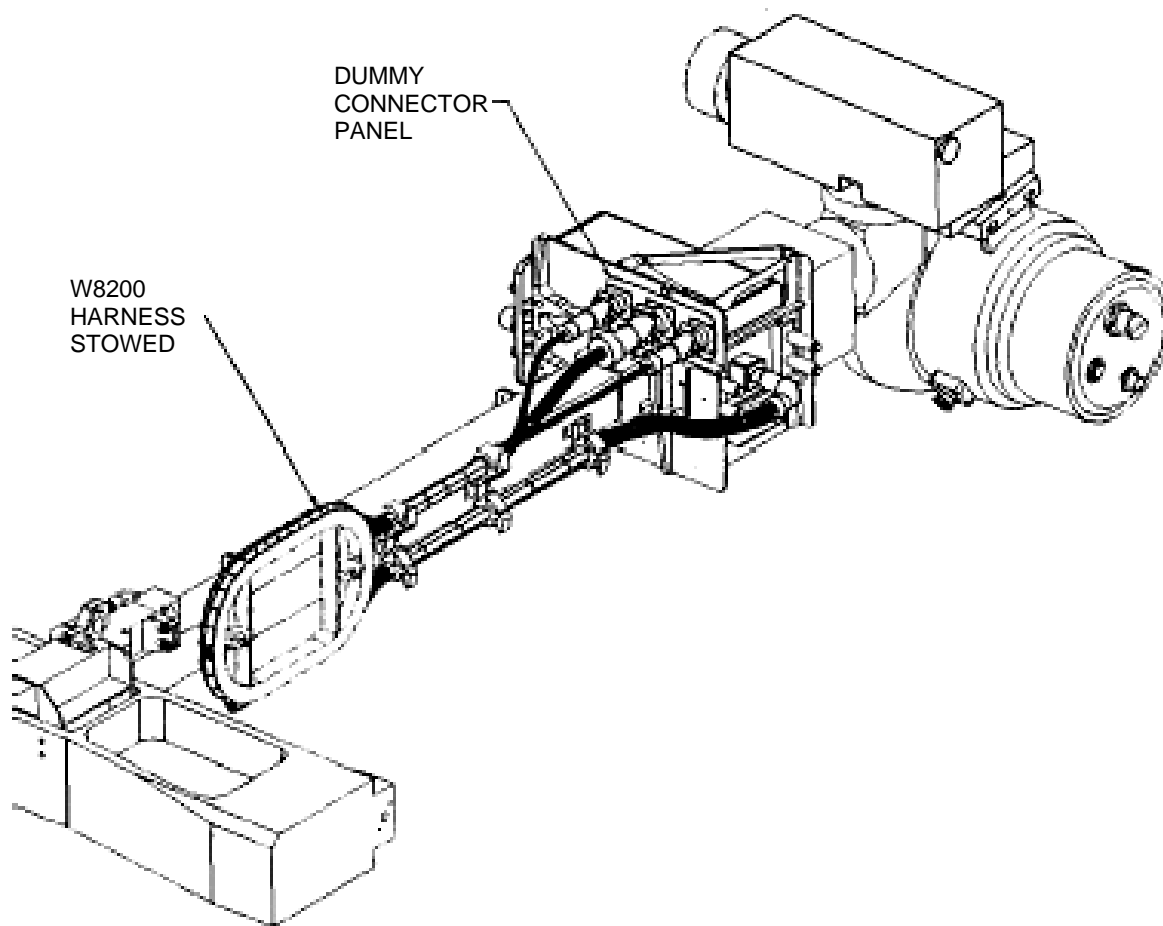


VSSA FSE

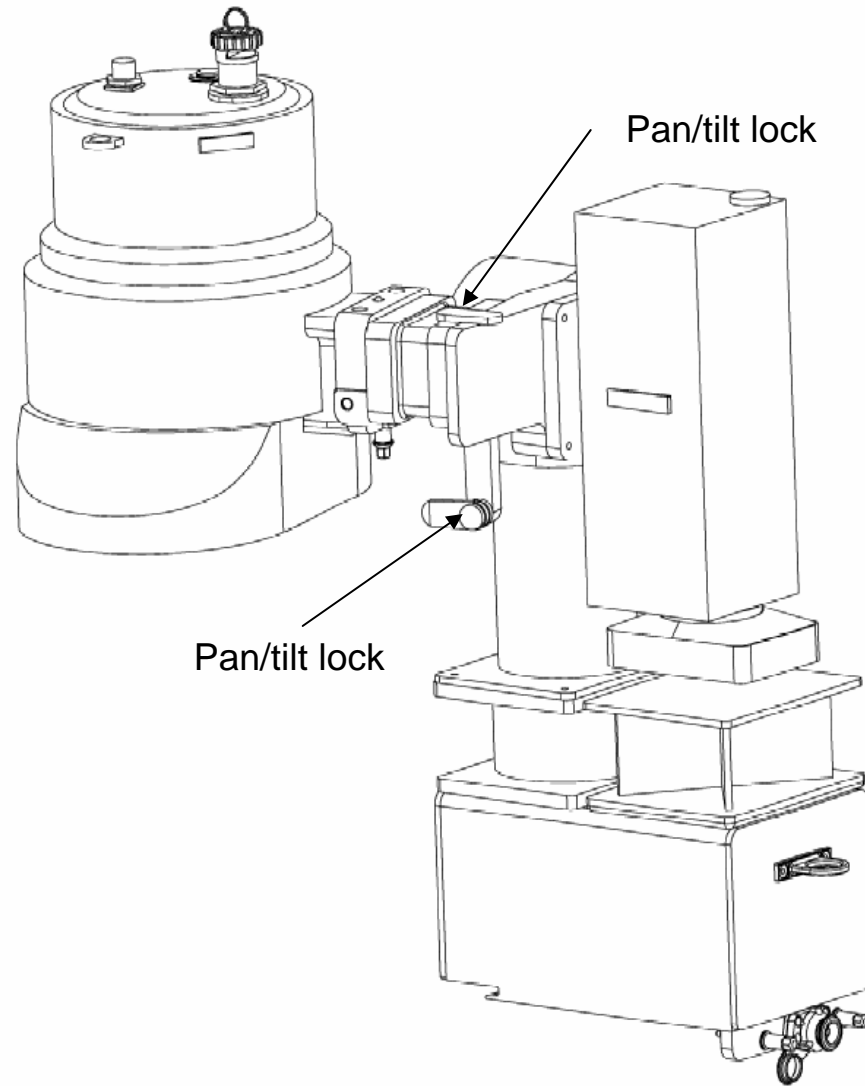


NOTE: VSSA 3 and 4 removed prior to 12A

ETVCG



ETVCG LAUNCH CONFIG



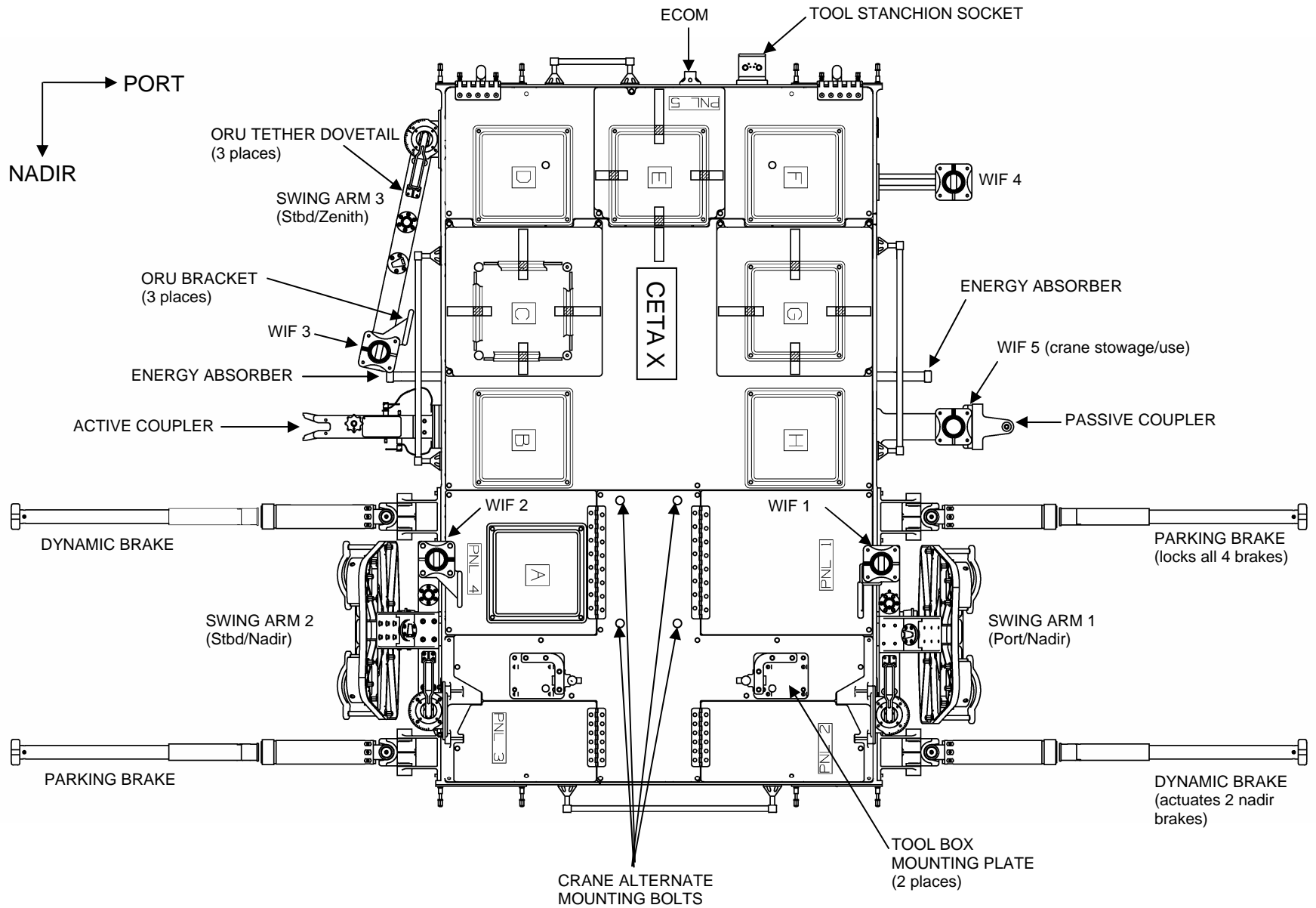
ETVCG PAN AND TILT LOCK (1 of 2)



FS 17-8

EVA/115/FIN C

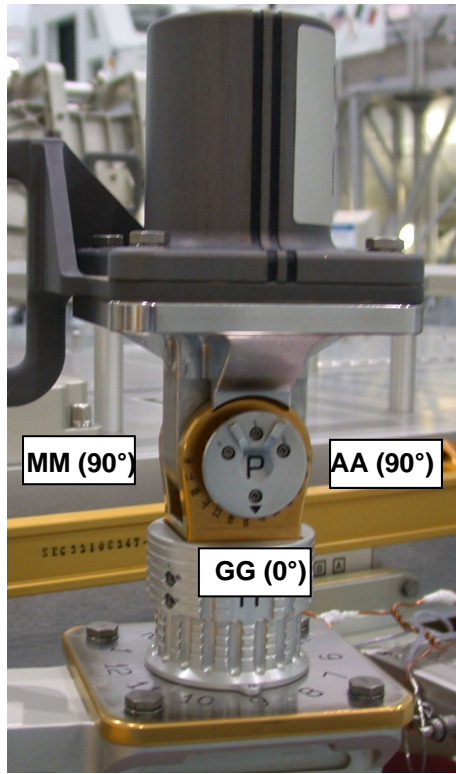
CETA CART – FACE 1



CETA CART SWINGARMS AND WIFs

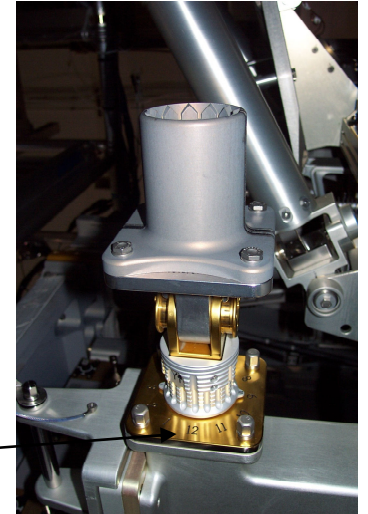
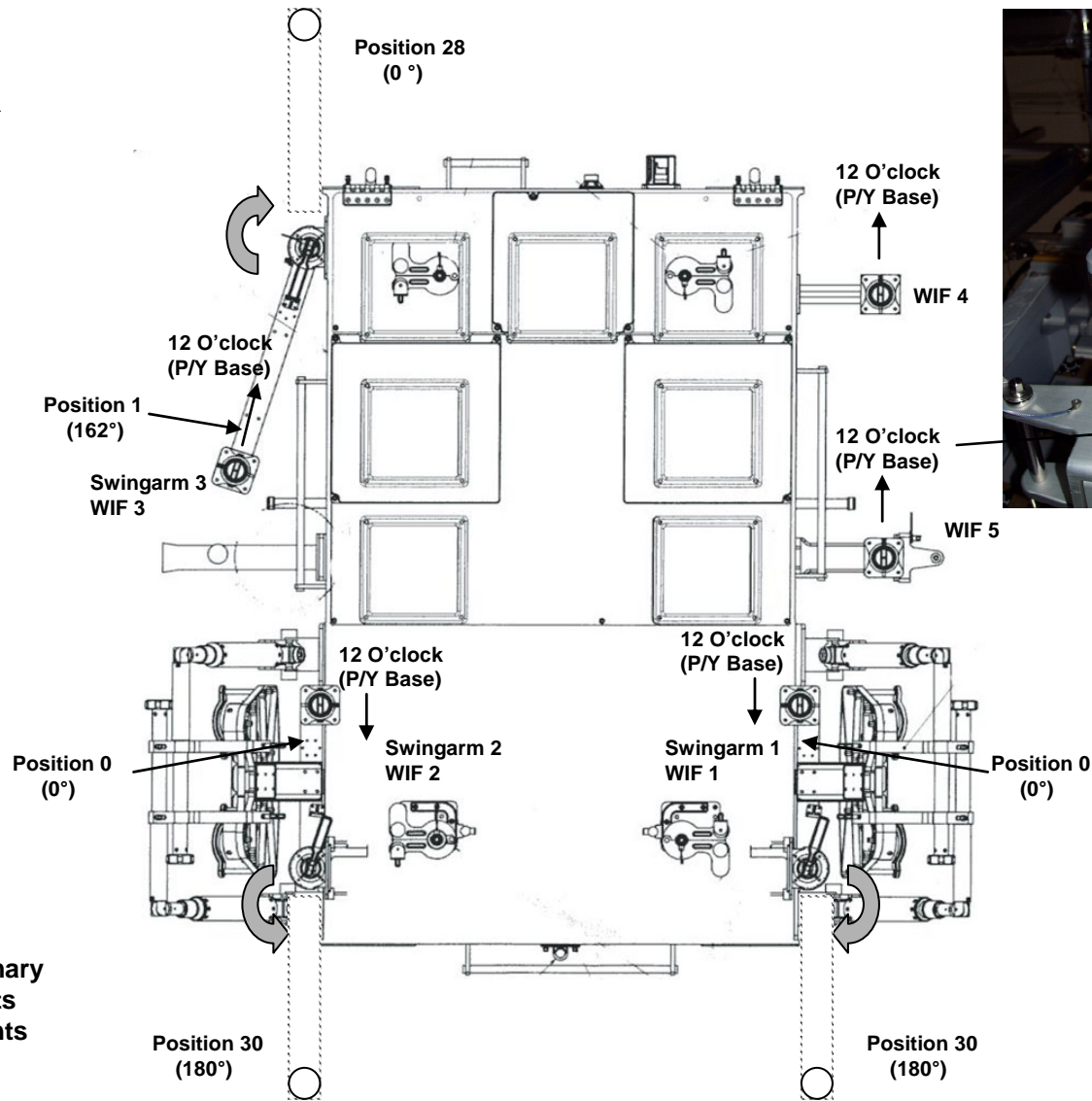
PORT
NADIR

Swingarm positions: 6° increments

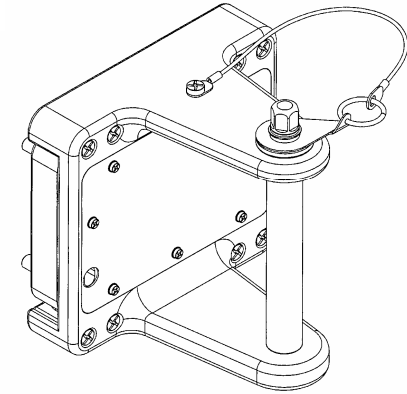
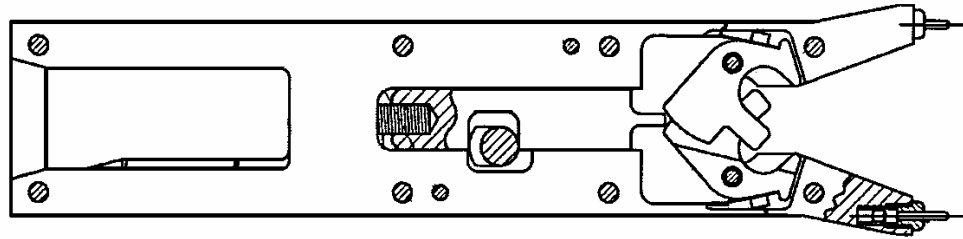


Pitch/Yaw

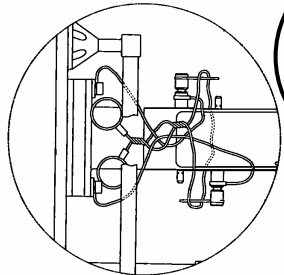
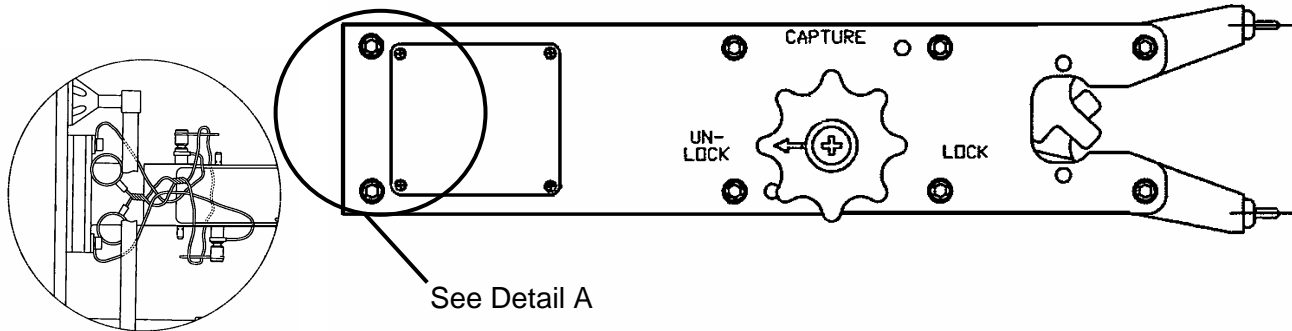
- Yaw primary mark = WIF primary
- Yaw positions: 30° increments
- Pitch positions: 15° increments



CETA CART COUPLERS

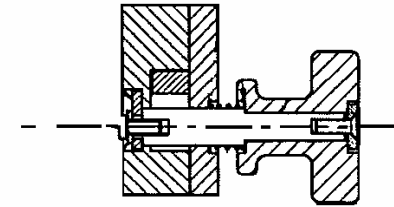
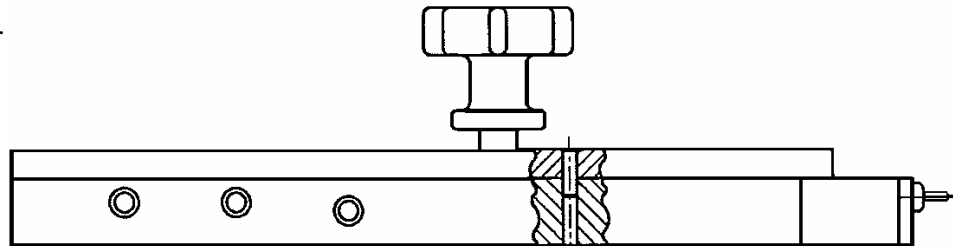


PASSIVE COUPLER

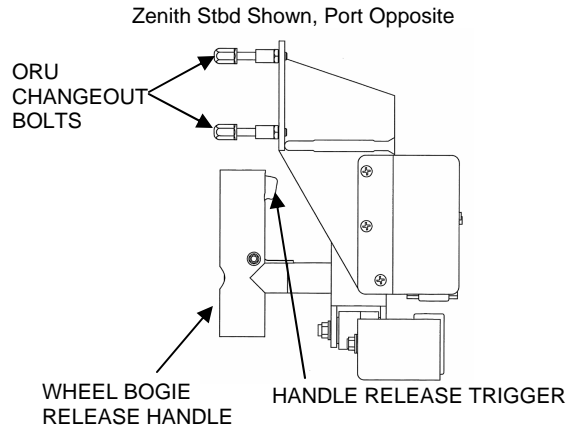


DETAIL A

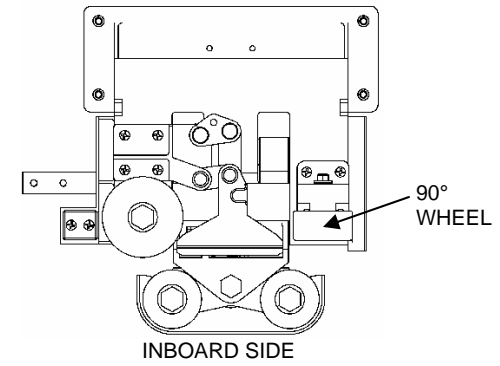
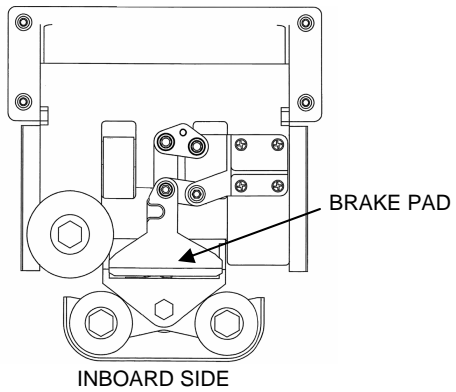
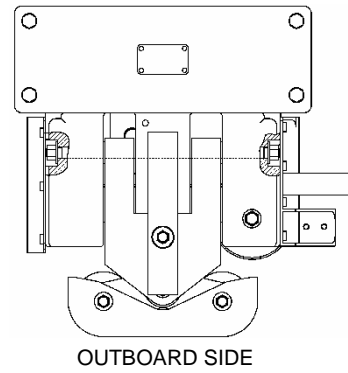
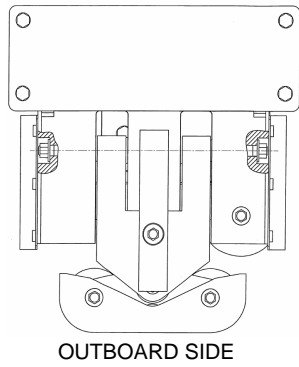
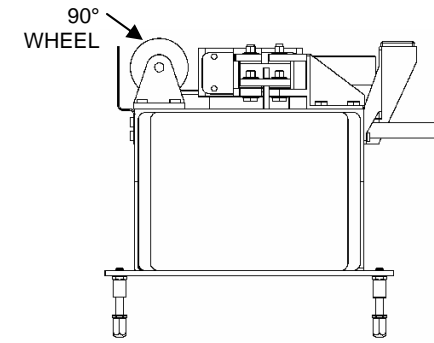
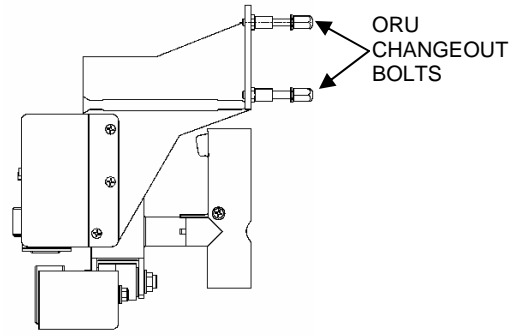
Wire ties removed only for coupler ORU changeout



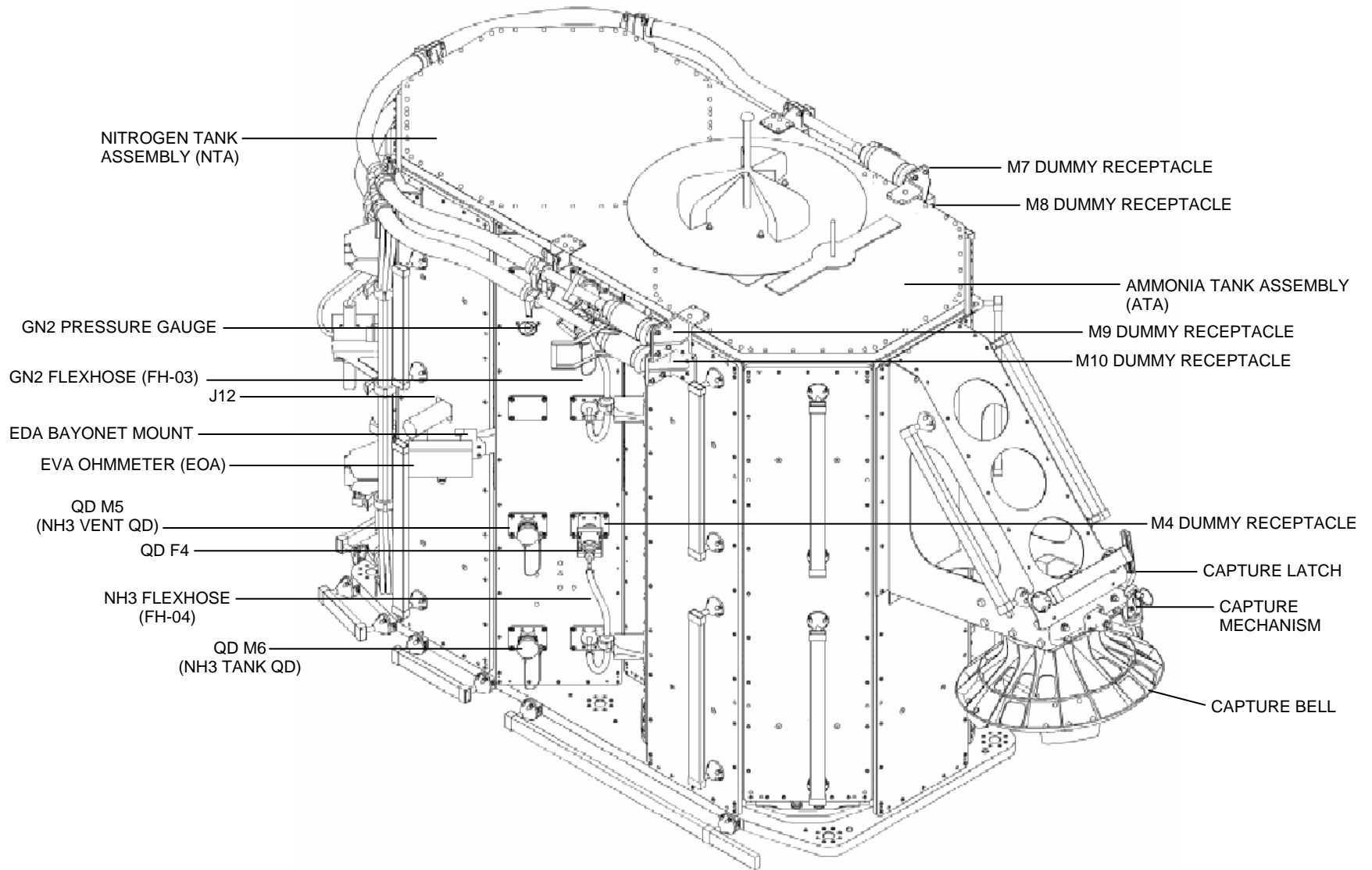
CETA CART WHEEL BOGIES



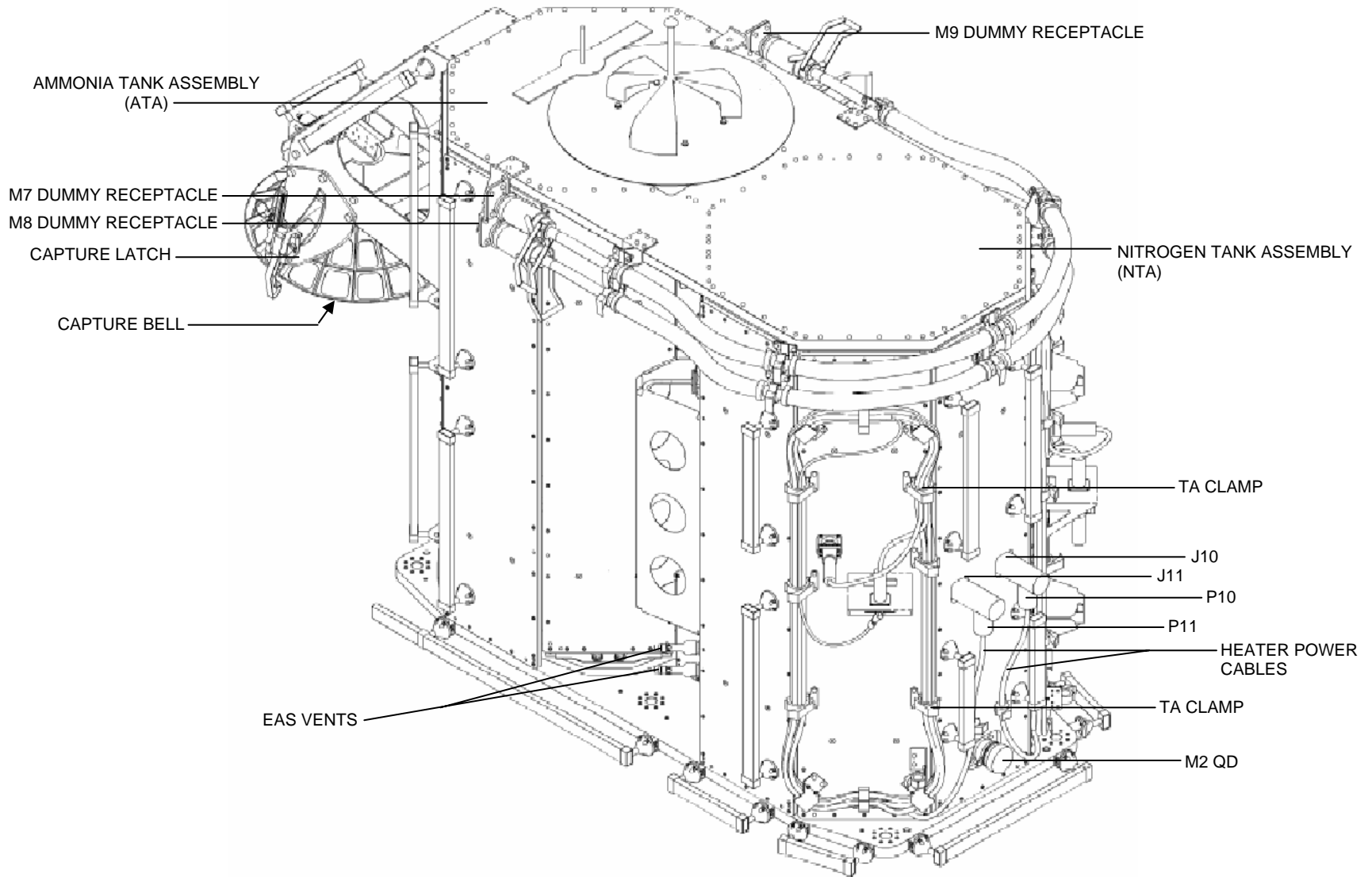
Nadir Port Shown, Stbd Opposite



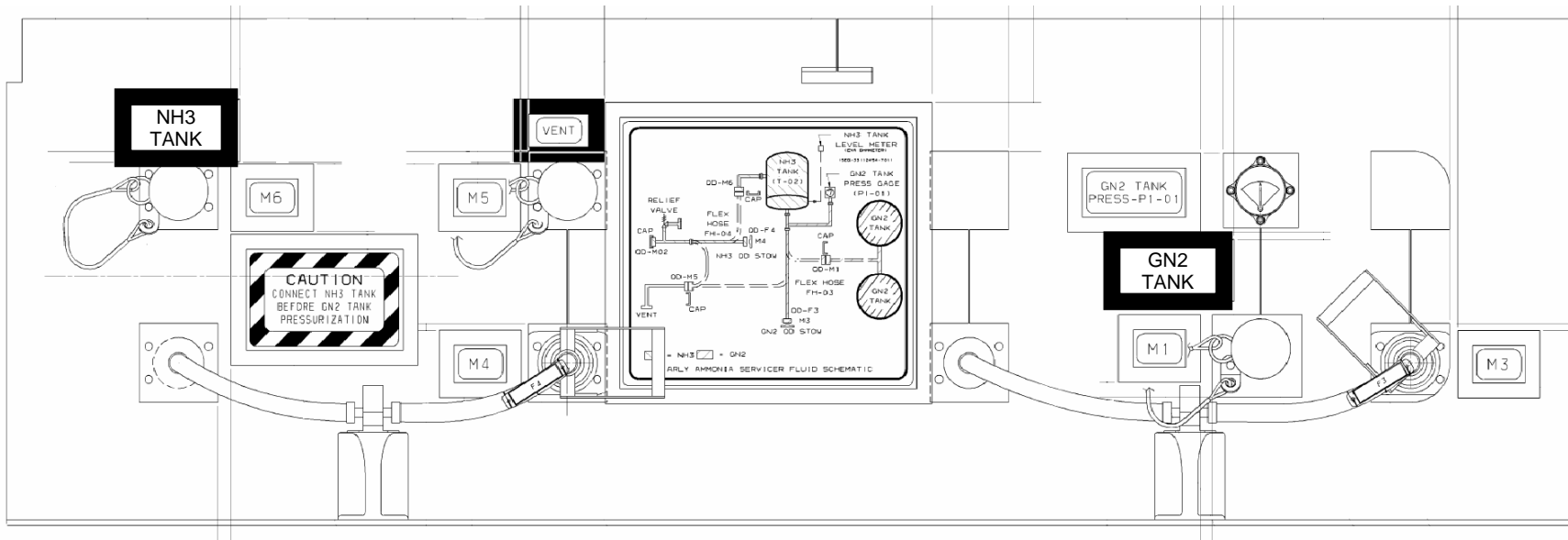
EARLY AMMONIA SERVICER (CONTROL PANEL SIDE)



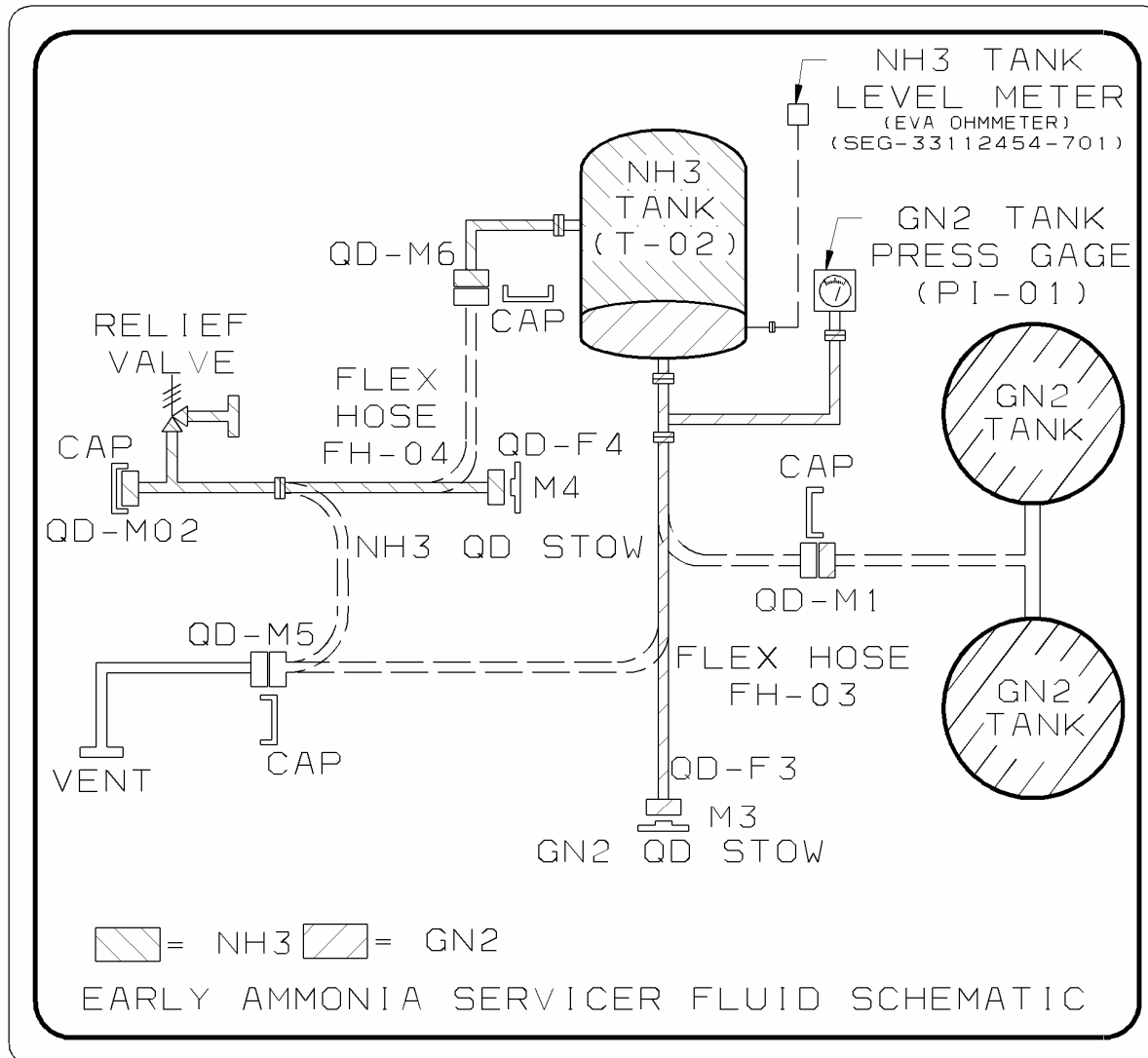
EARLY AMMONIA SERVICER (VENT SIDE)



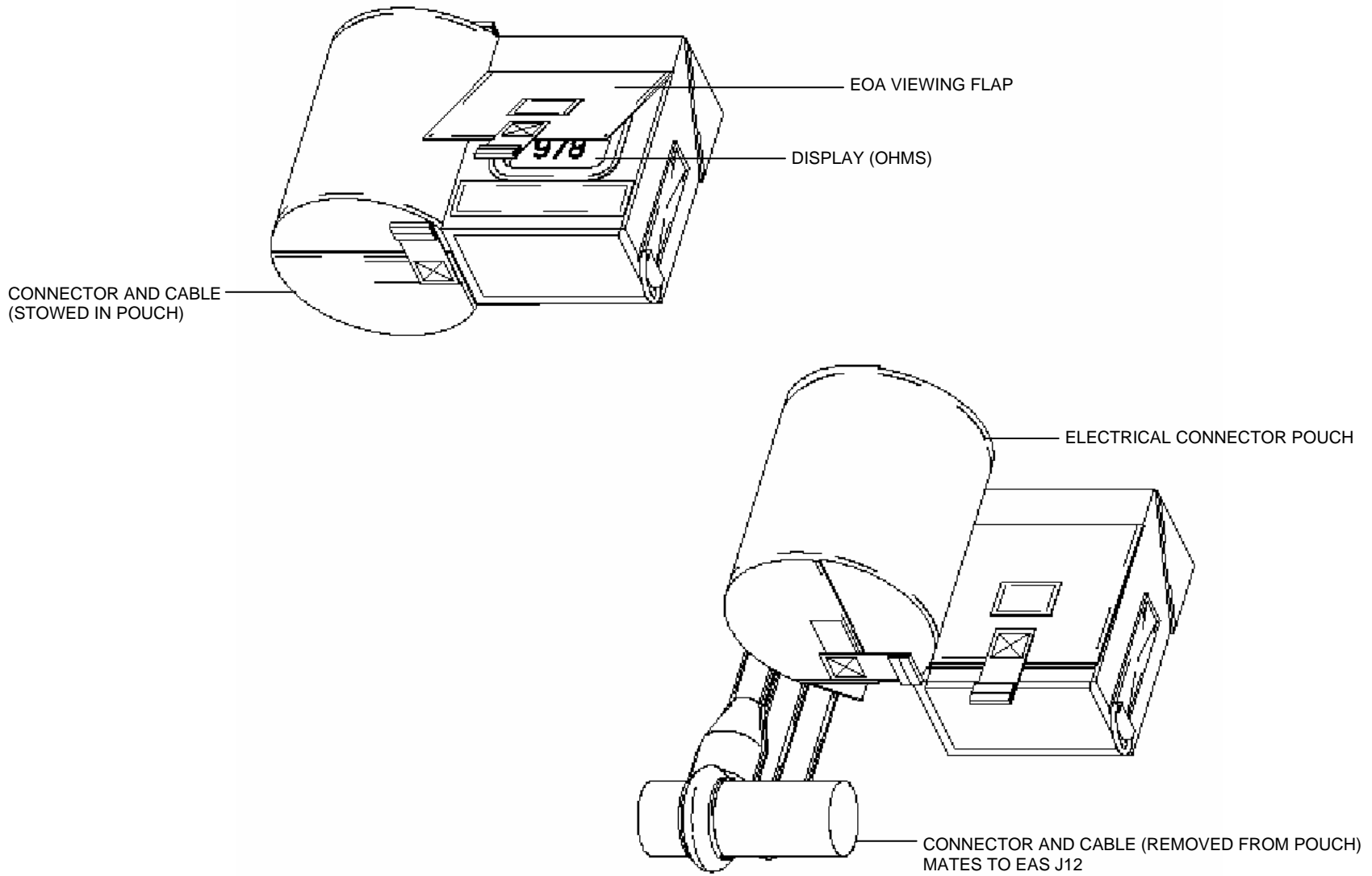
EAS CONTROL PANEL



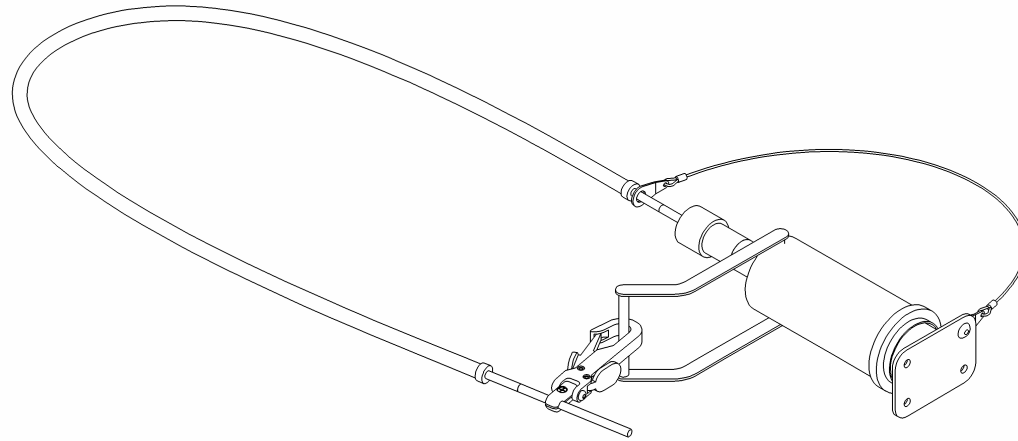
EAS SCHEMATIC



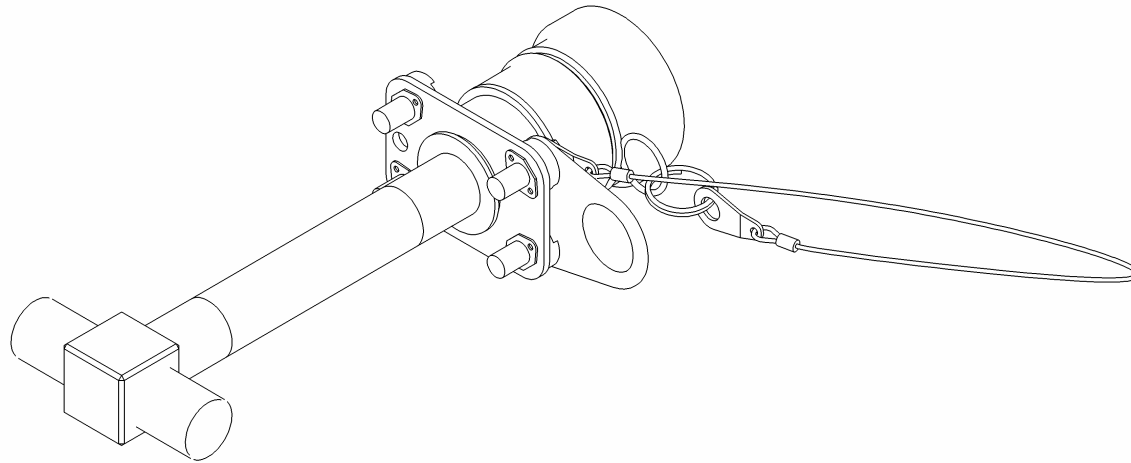
EVA OHMMETER ASSY (EOA)



QD VENT TOOLS

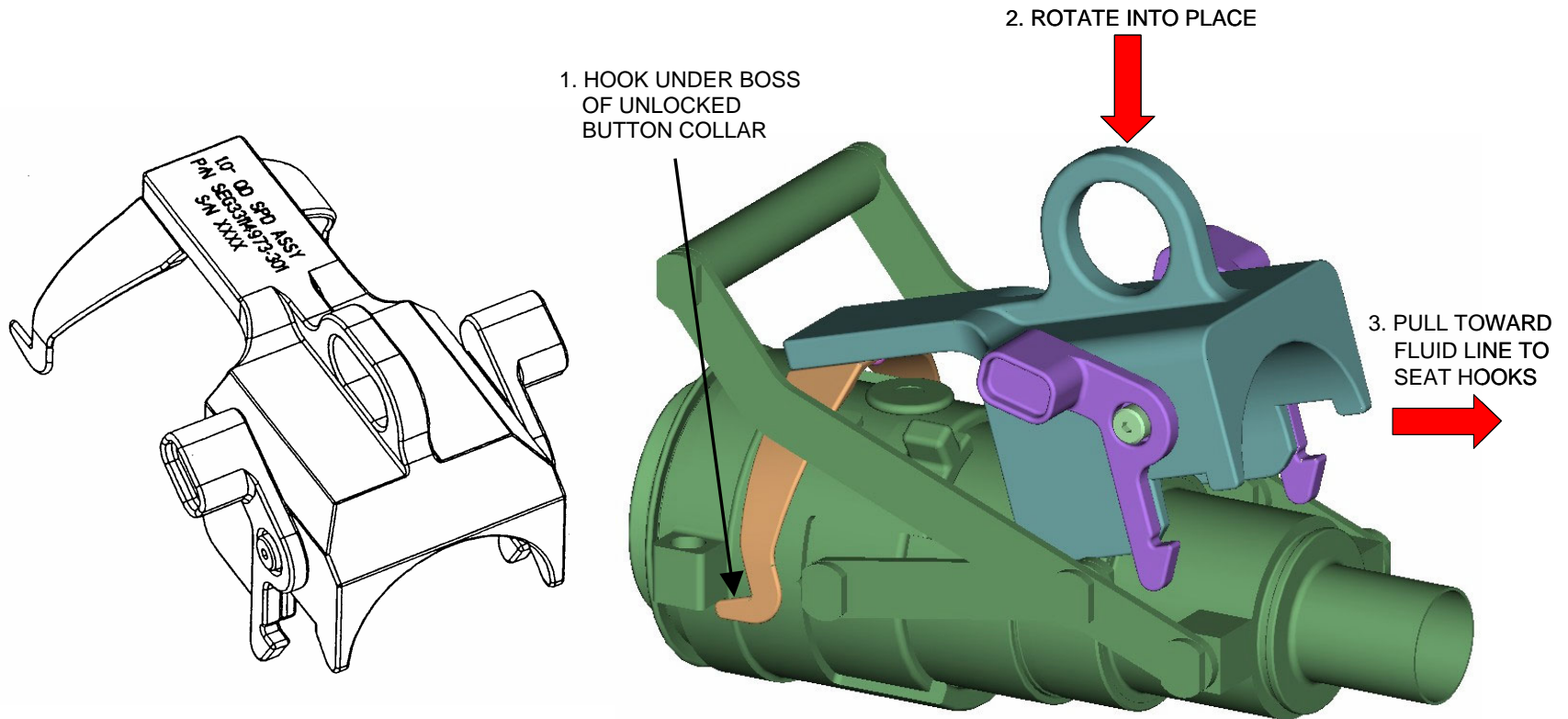


1-INCH QD VENT TOOL - FEMALE (NH3/N2)

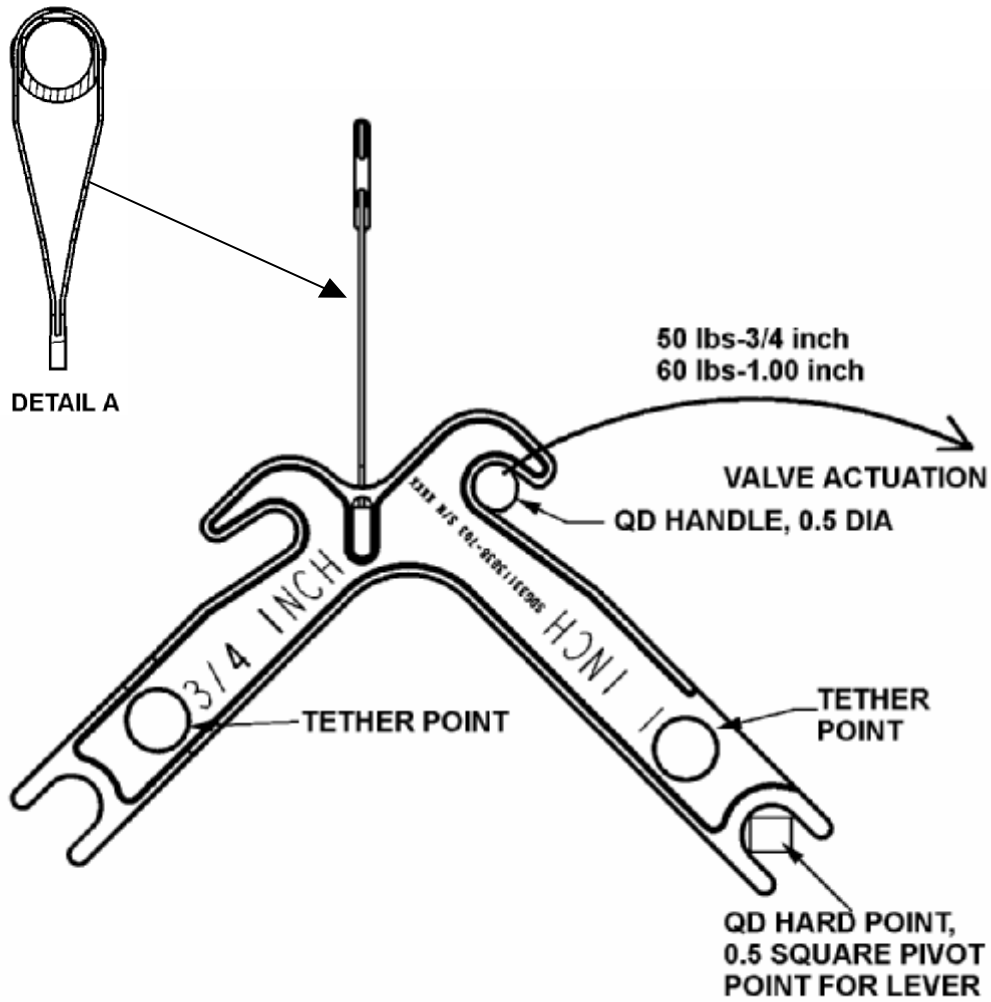


1-INCH QD VENT TOOL - MALE (N2)

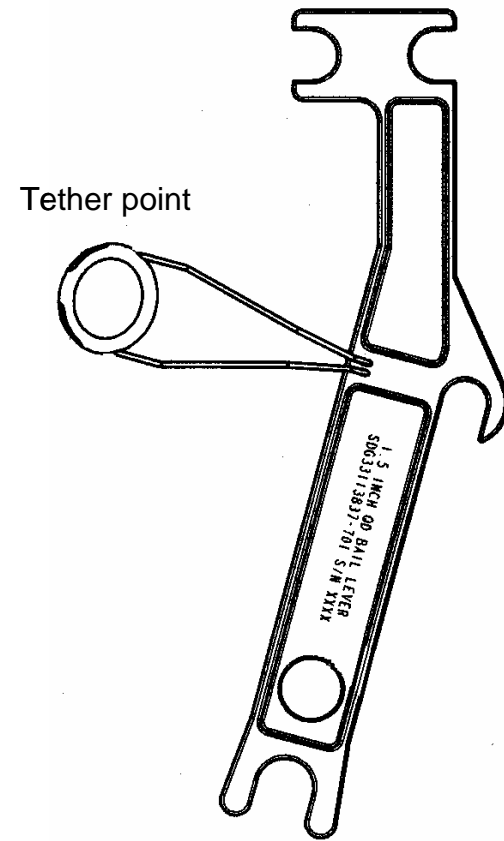
1.0 IN FLUID QD SPOOL POSITIONING DEVICE



FLUID QD BAIL LEVERS

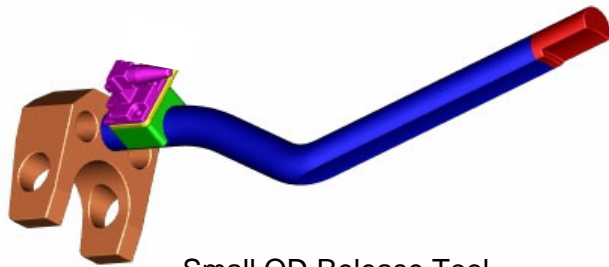


Small QD Bail Lever

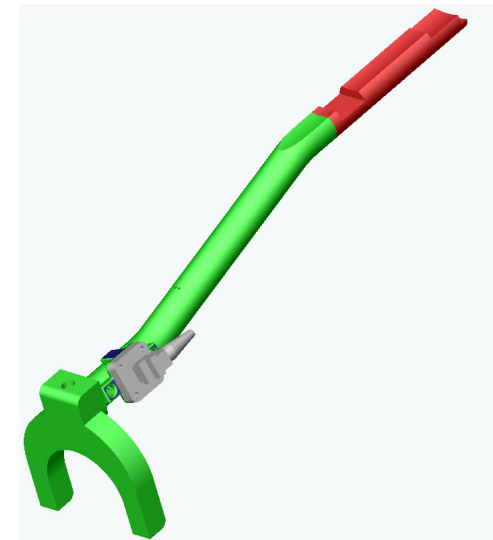


1.5-in QD Bail Lever

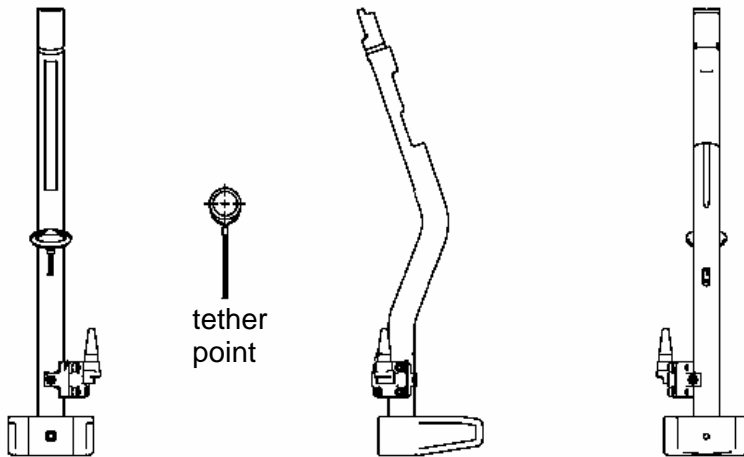
FLUID QD RELEASE TOOLS



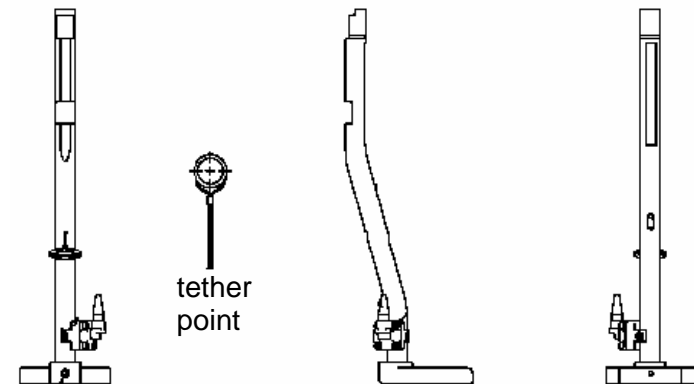
Small QD Release Tool
w/FID Gauge



1.5-in QD Release Tool
w/FID Gauge

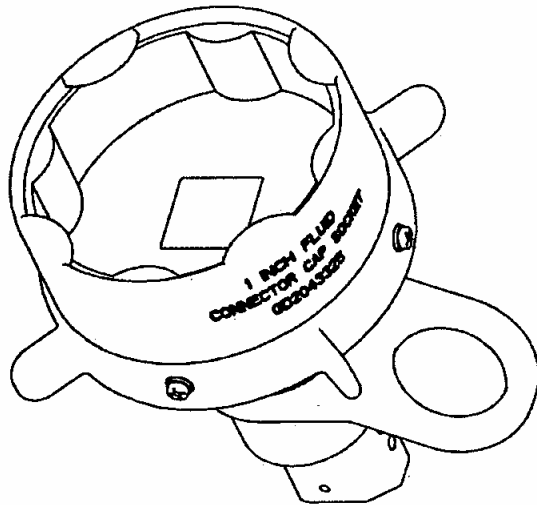


tether
point

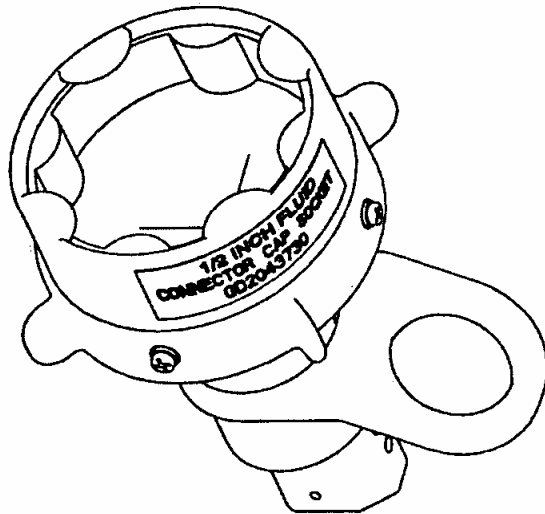
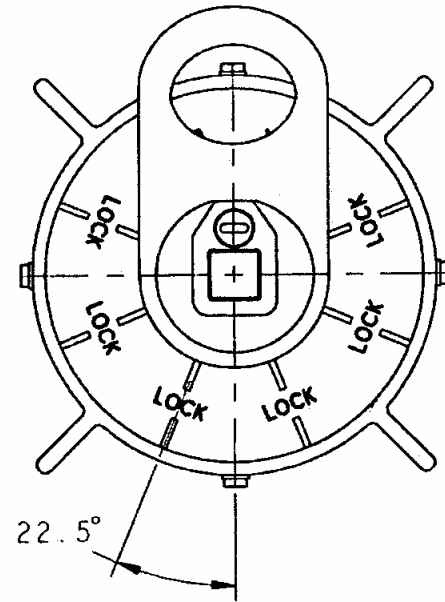


tether
point

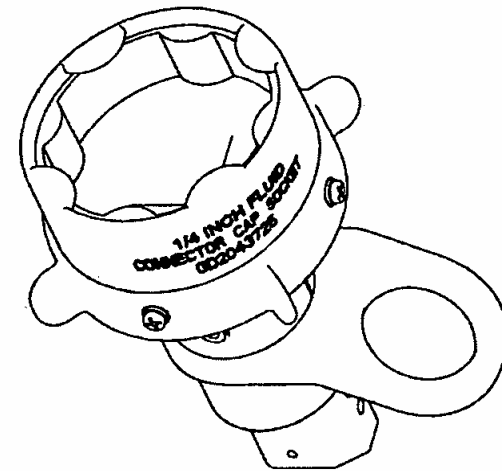
FLUID QD CAP TOOLS



1-in QD Cap Tool

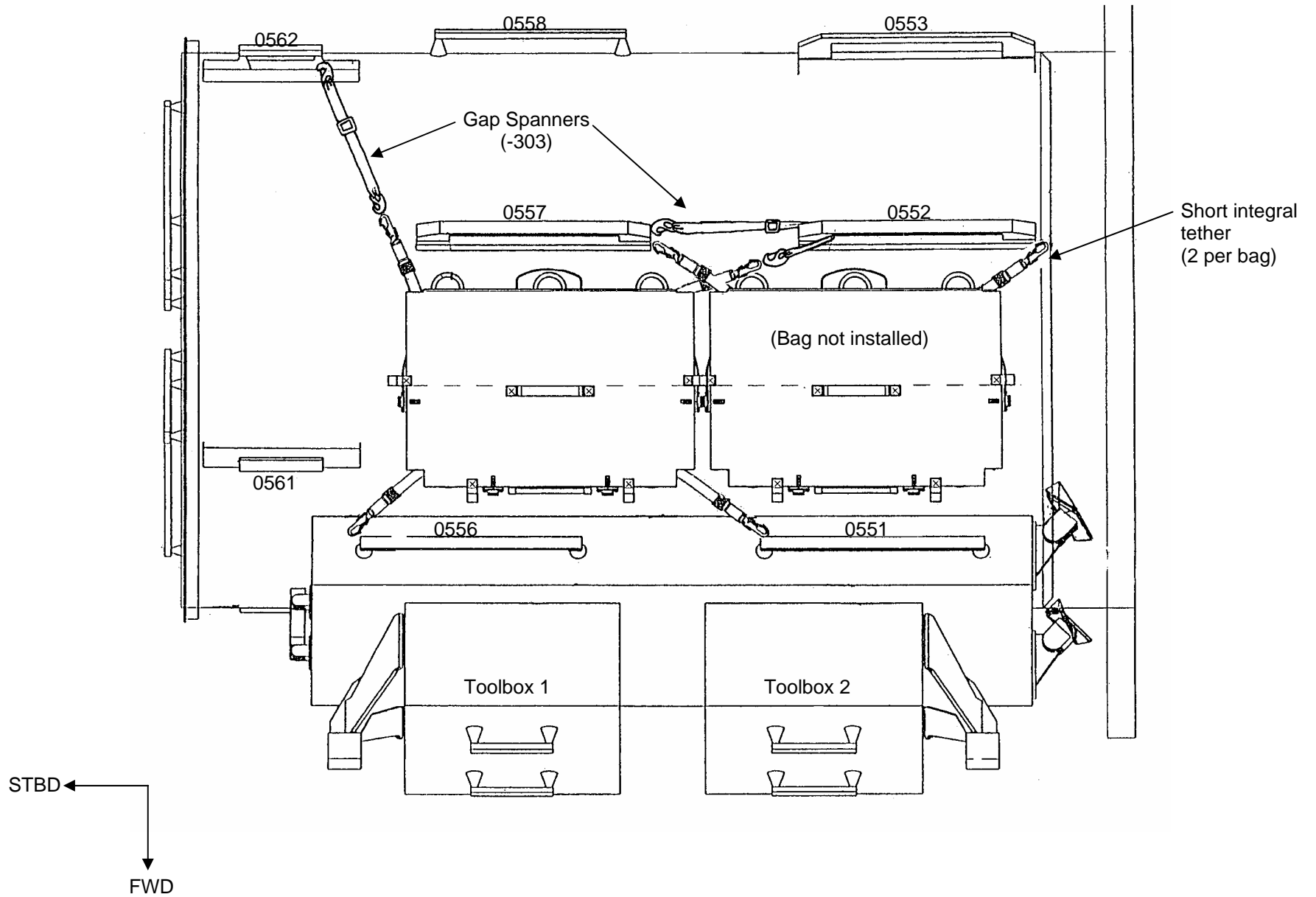


1/2-in QD Cap Tool

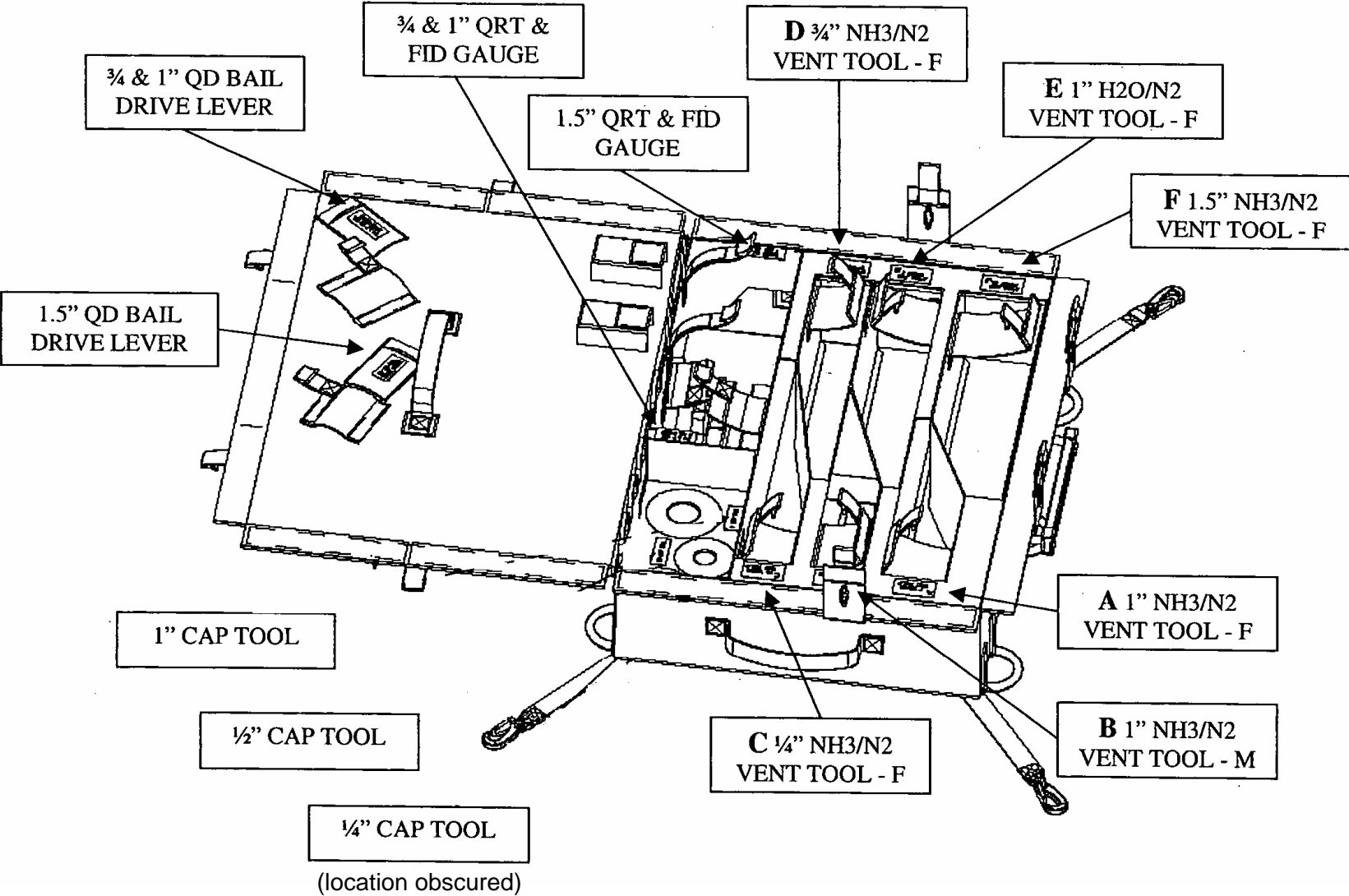


1/4-in QD Cap Tool

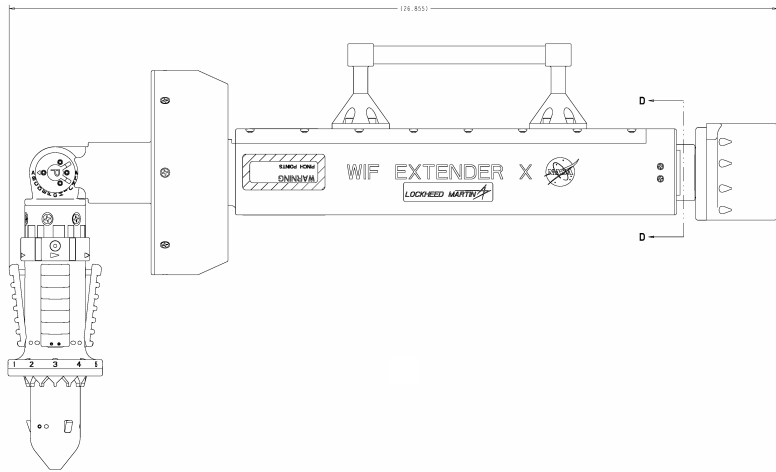
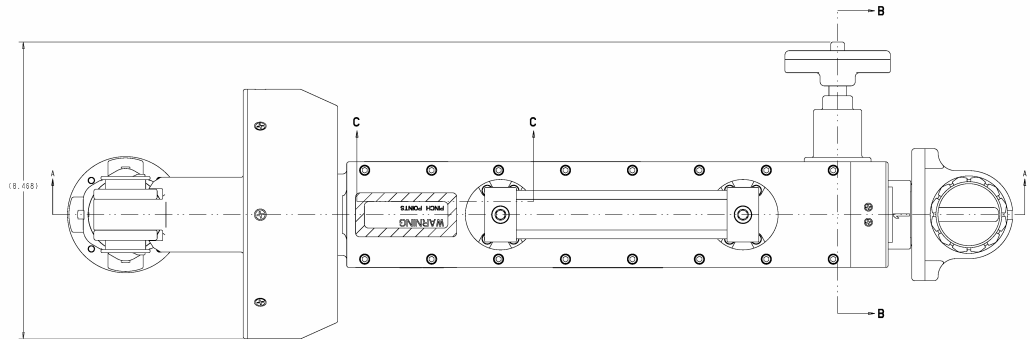
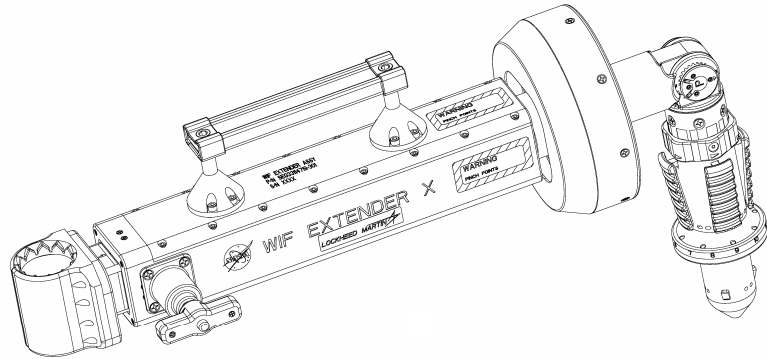
QD TOOLBAGS INSTALLED ON CREWLOCK ZENITH



QD TOOLBAG CONTENTS

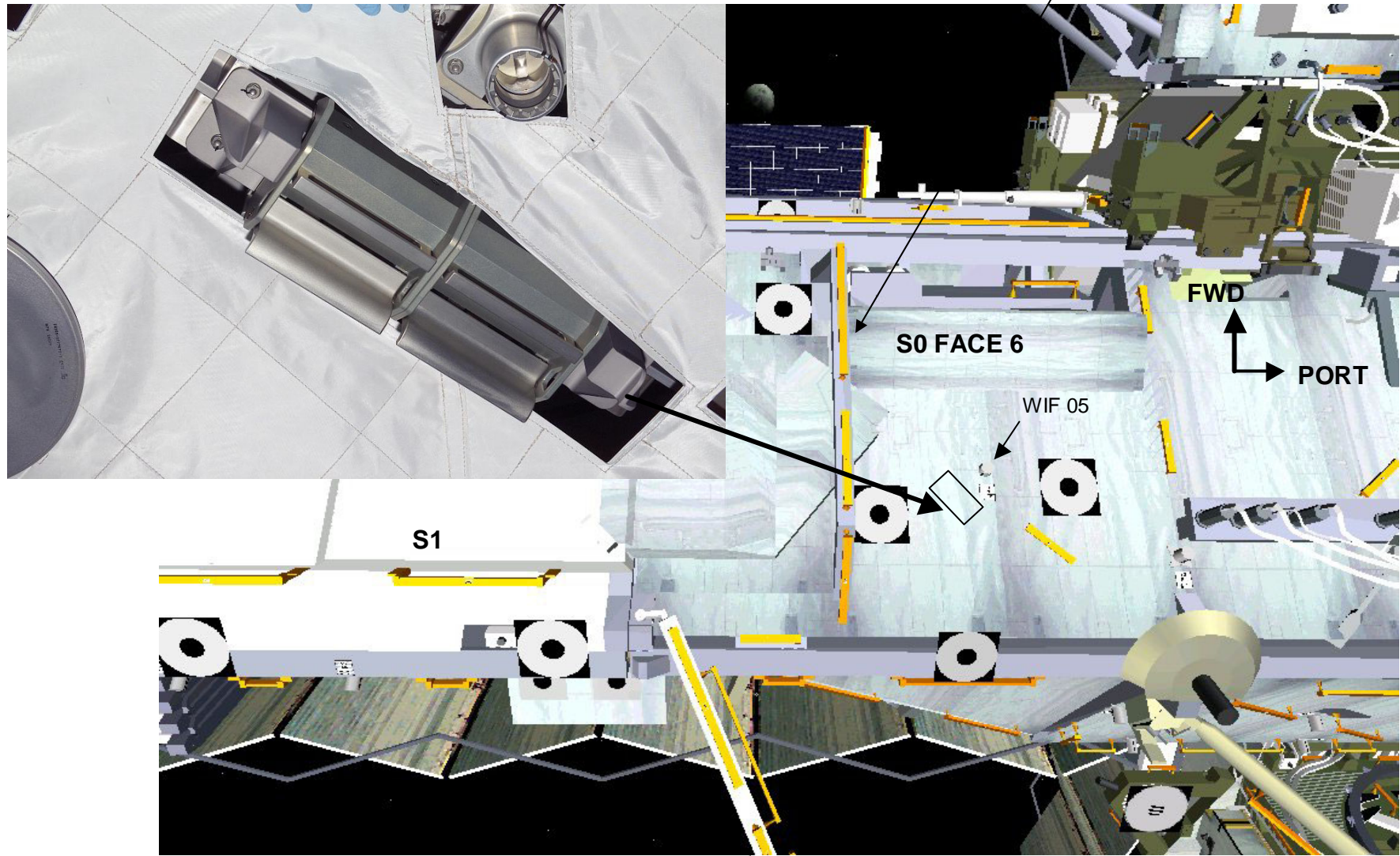


WIF EXTENDER

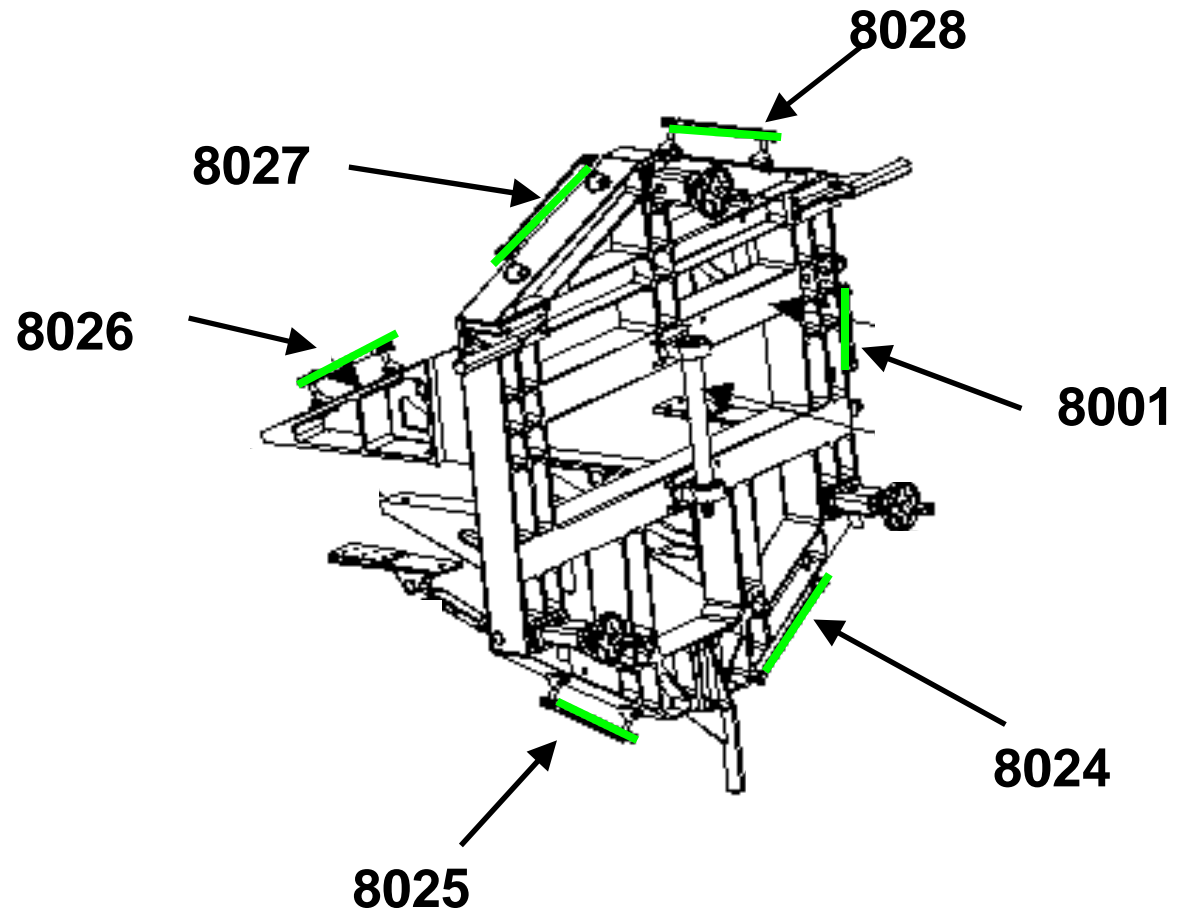


TETHER SHUTTLE STORAGE

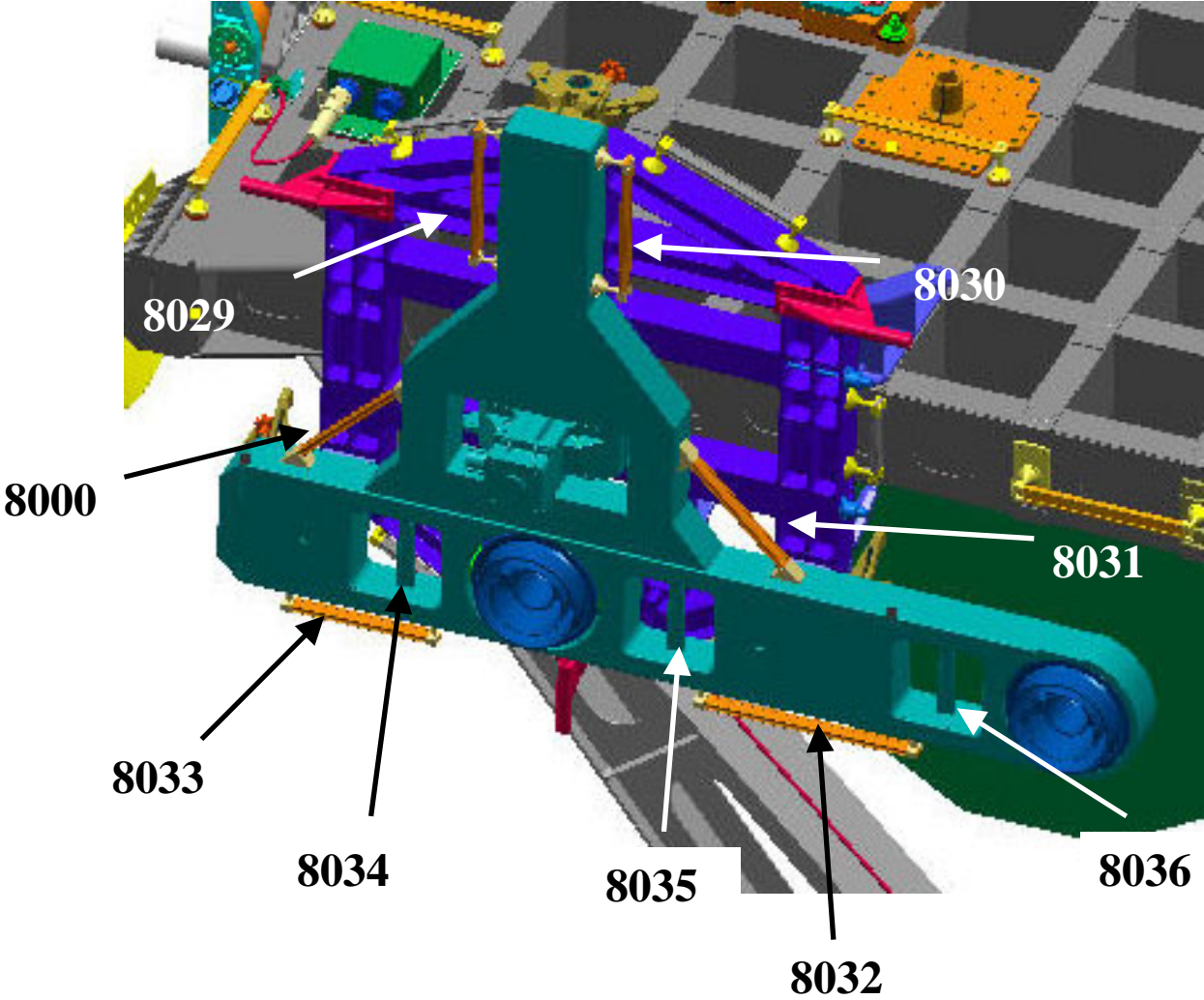
S0 Handrail Bridge



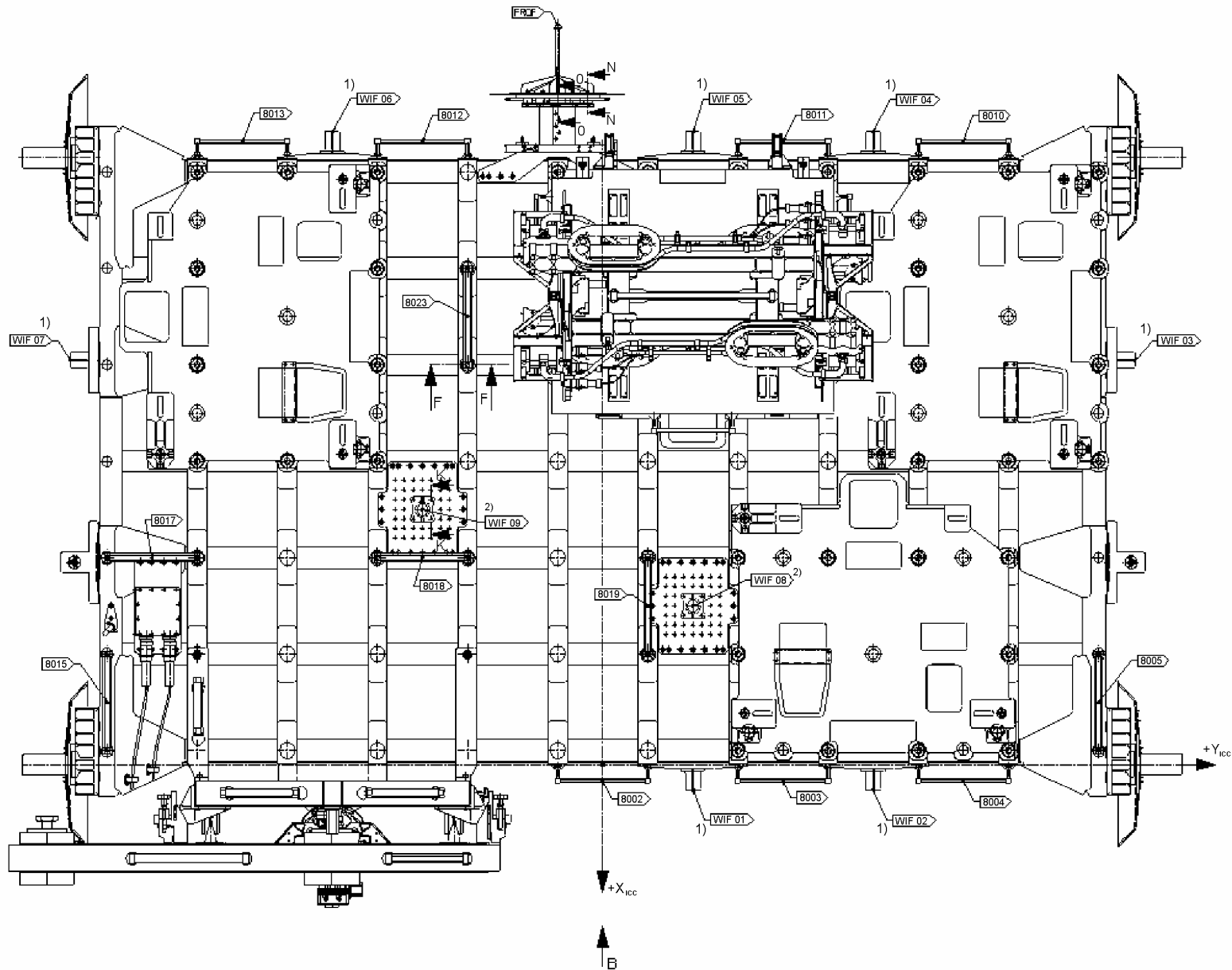
HR LABELS ON PASSIVE ESPAD



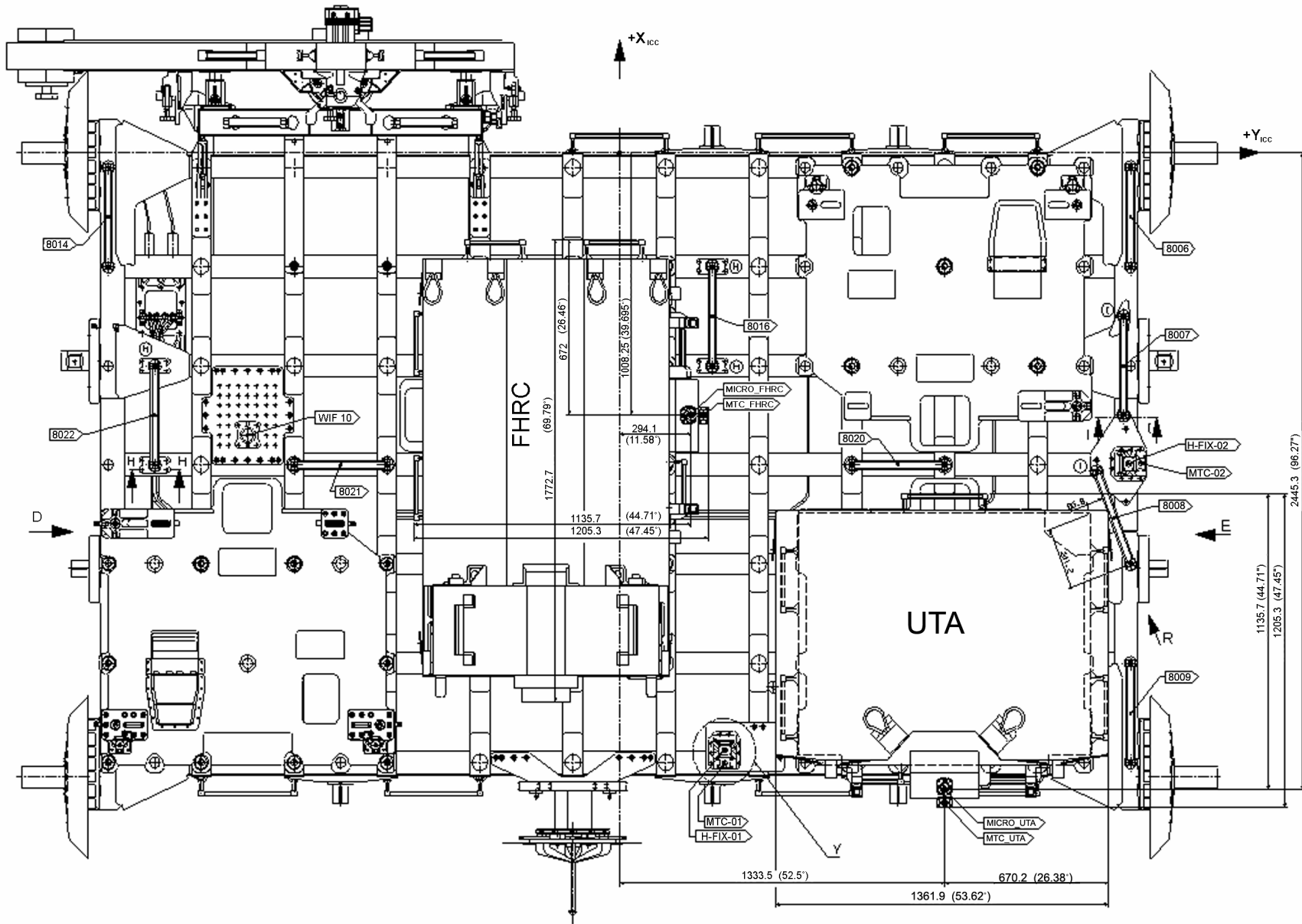
HR LABELS ON ACTIVE ESPAD



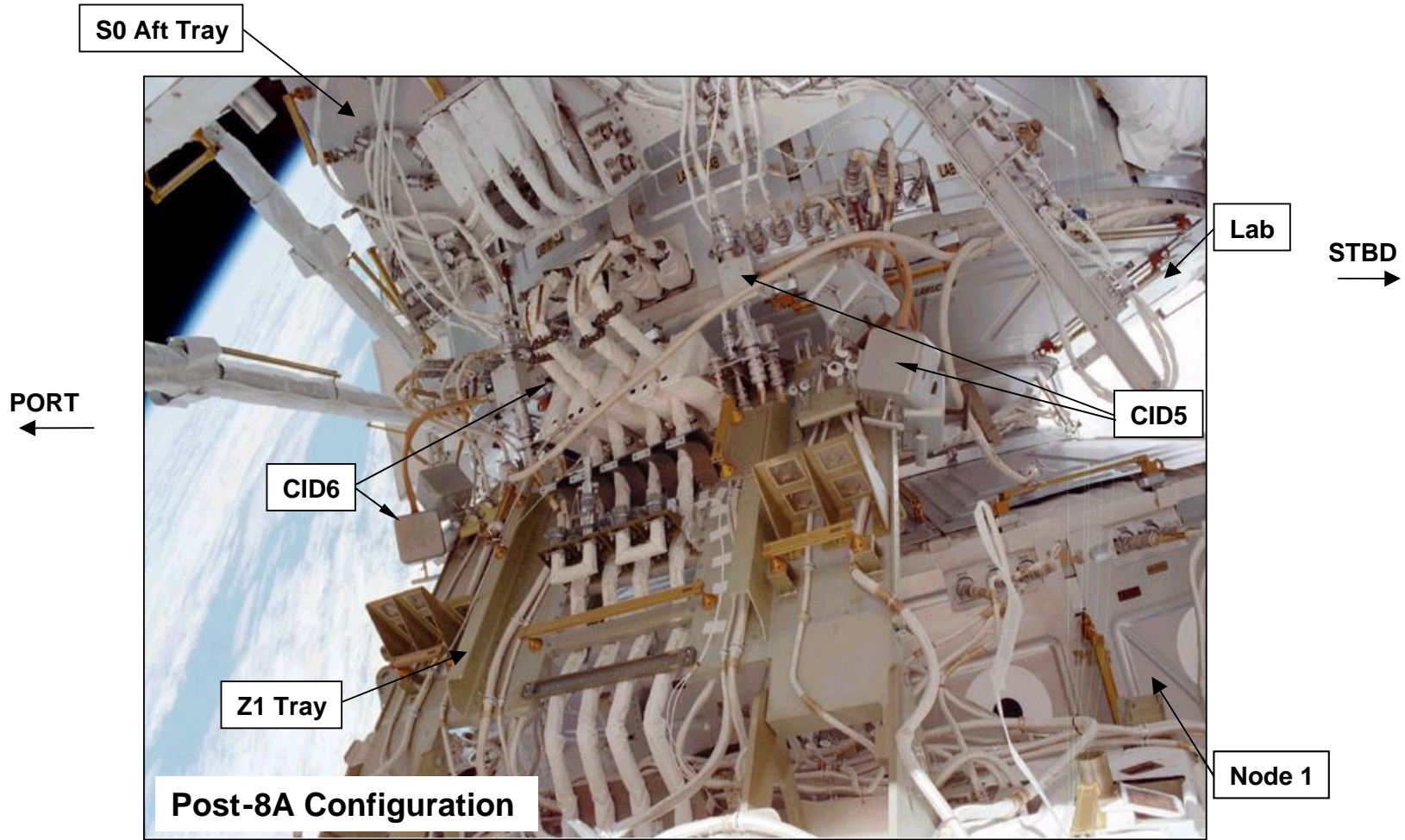
HR LABELS ON ESP2 ZENITH



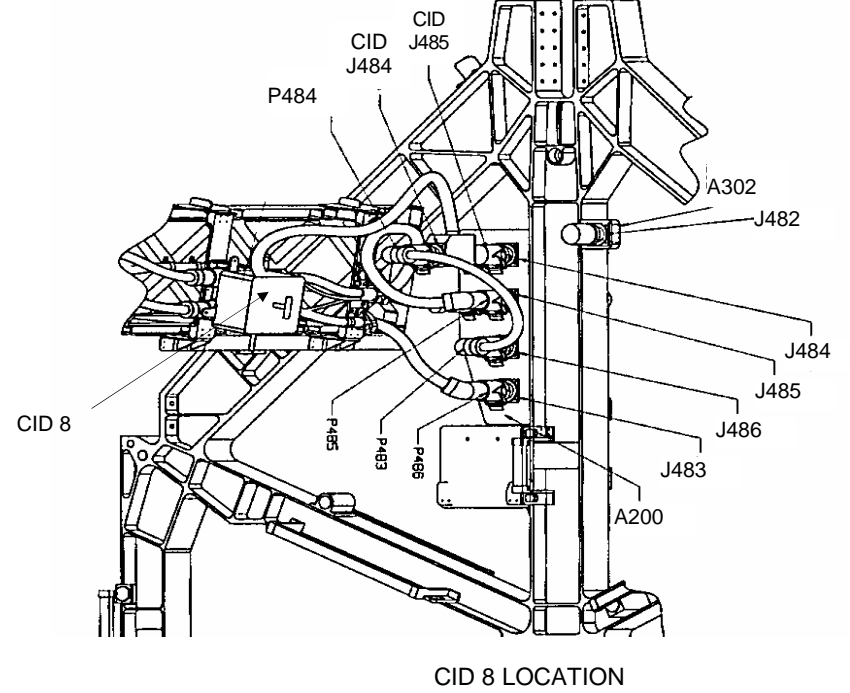
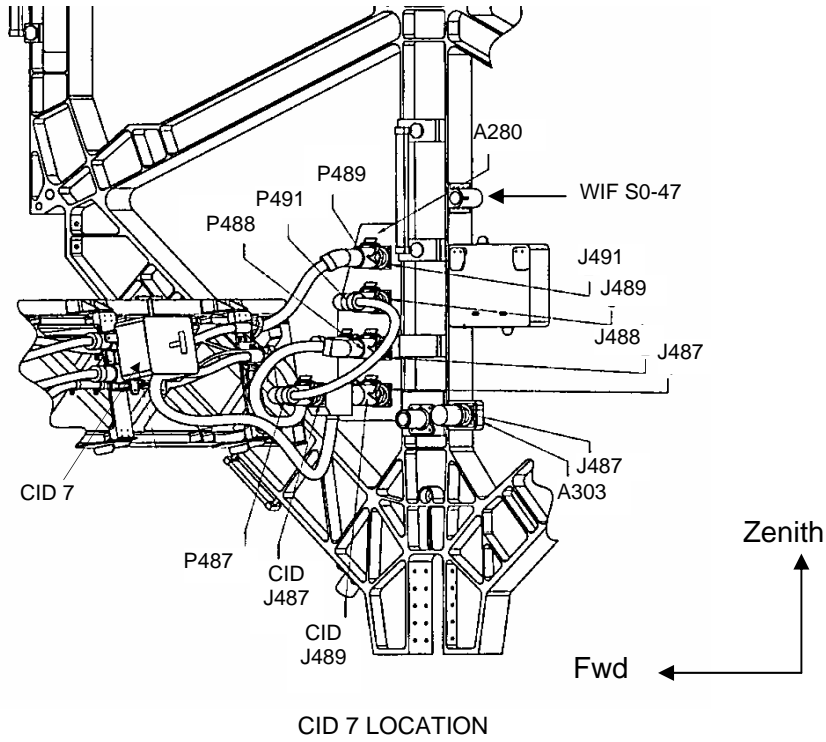
HR LABELS ON ESP2 NADIR



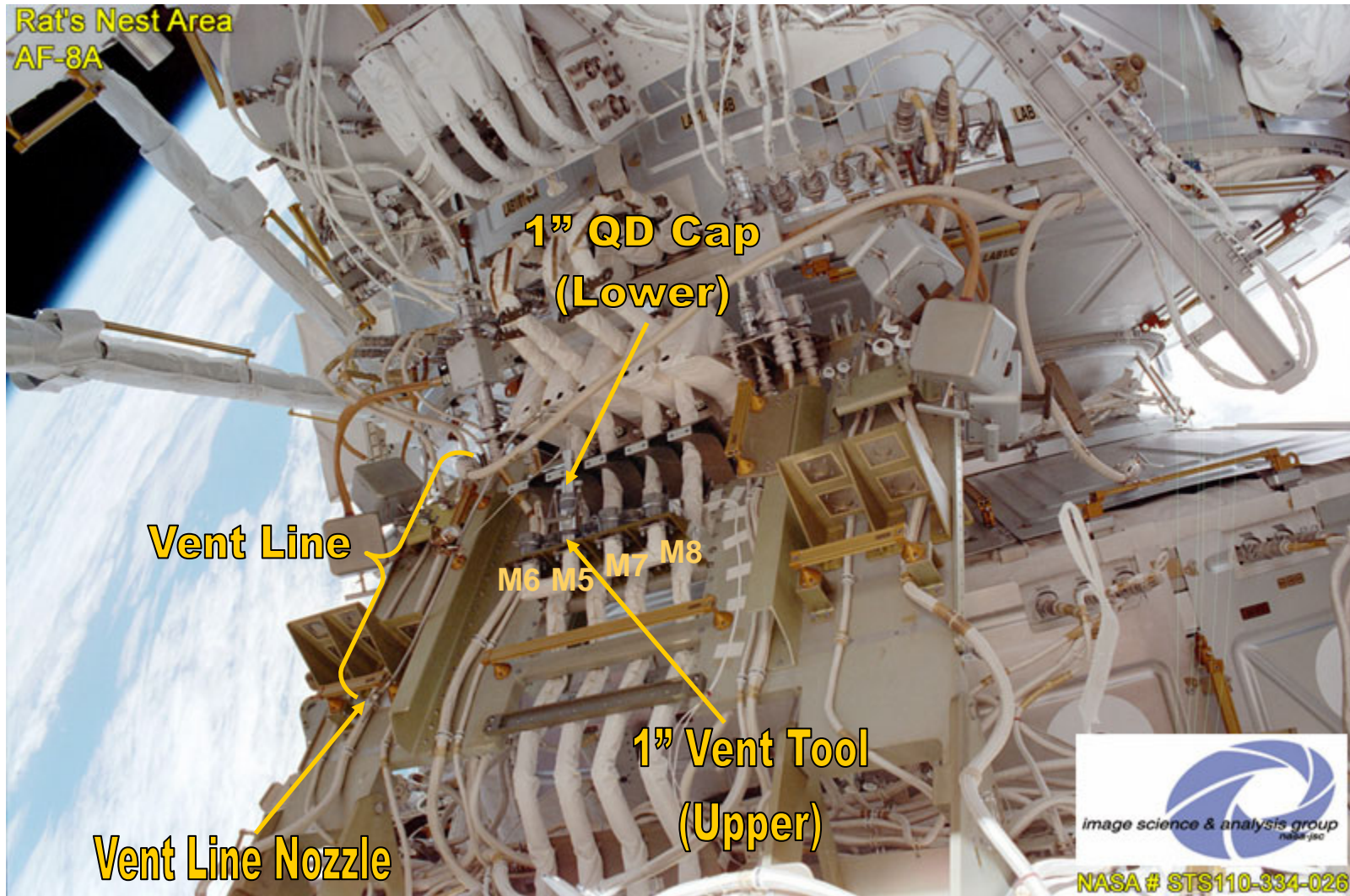
CID 5 AND CID 6 LOCATION



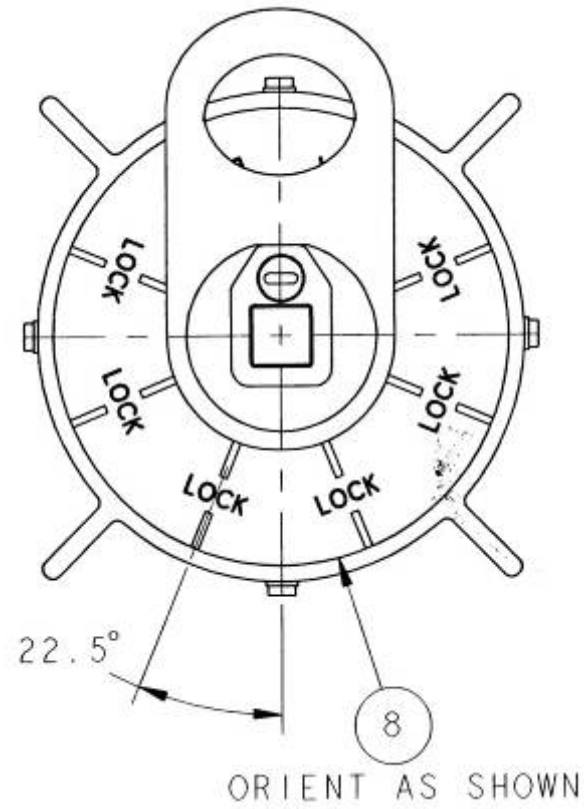
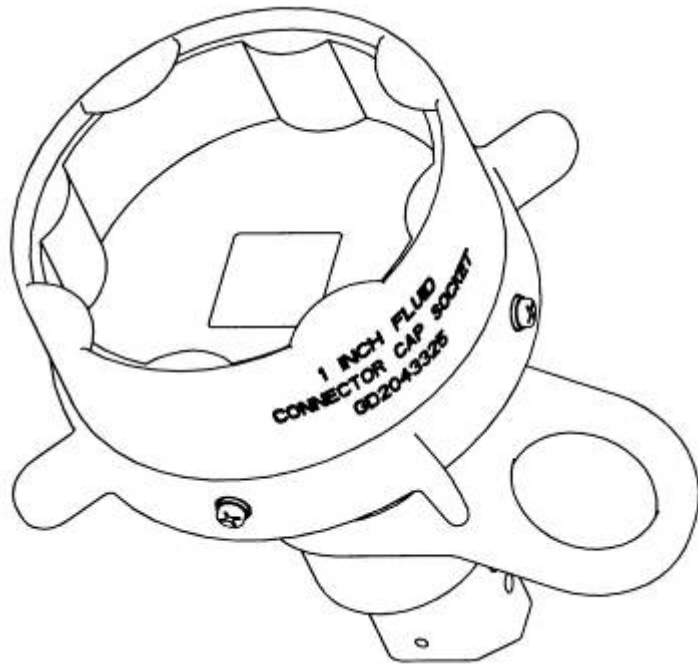
CID 7 AND CID 8 LOCATION



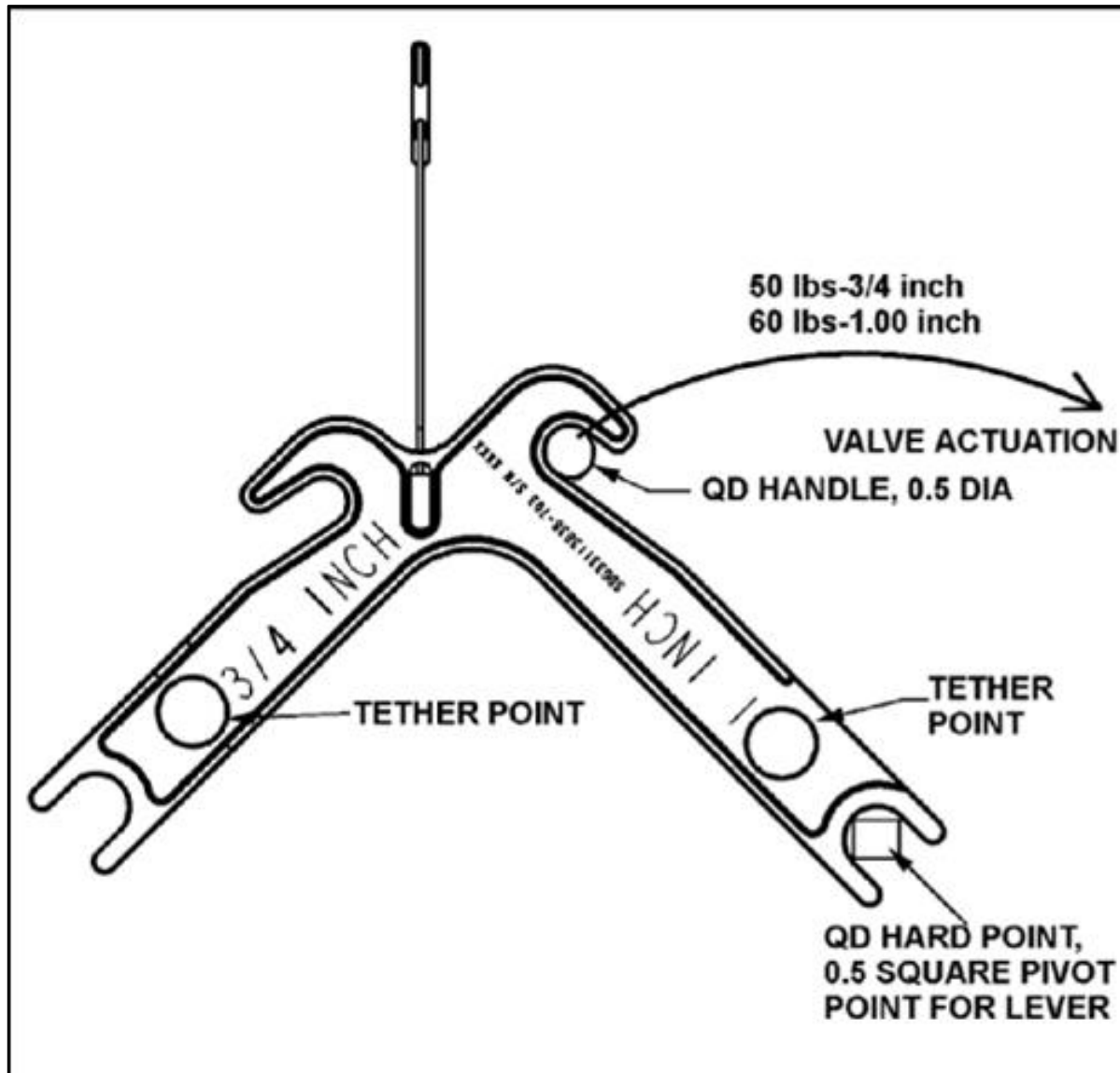
1" FEMALE VENT TOOL INSTALLED ON Z1 U-JUMPER



1" FLUID QD CAP TOOL

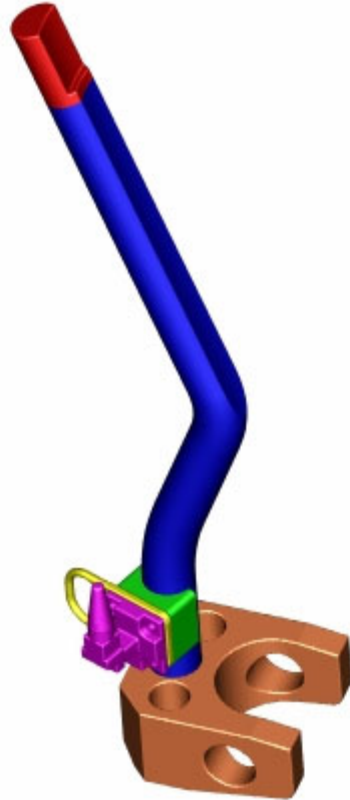


SMALL QD BAIL LEVER TOOL



1" QD RELEASE TOOL

|



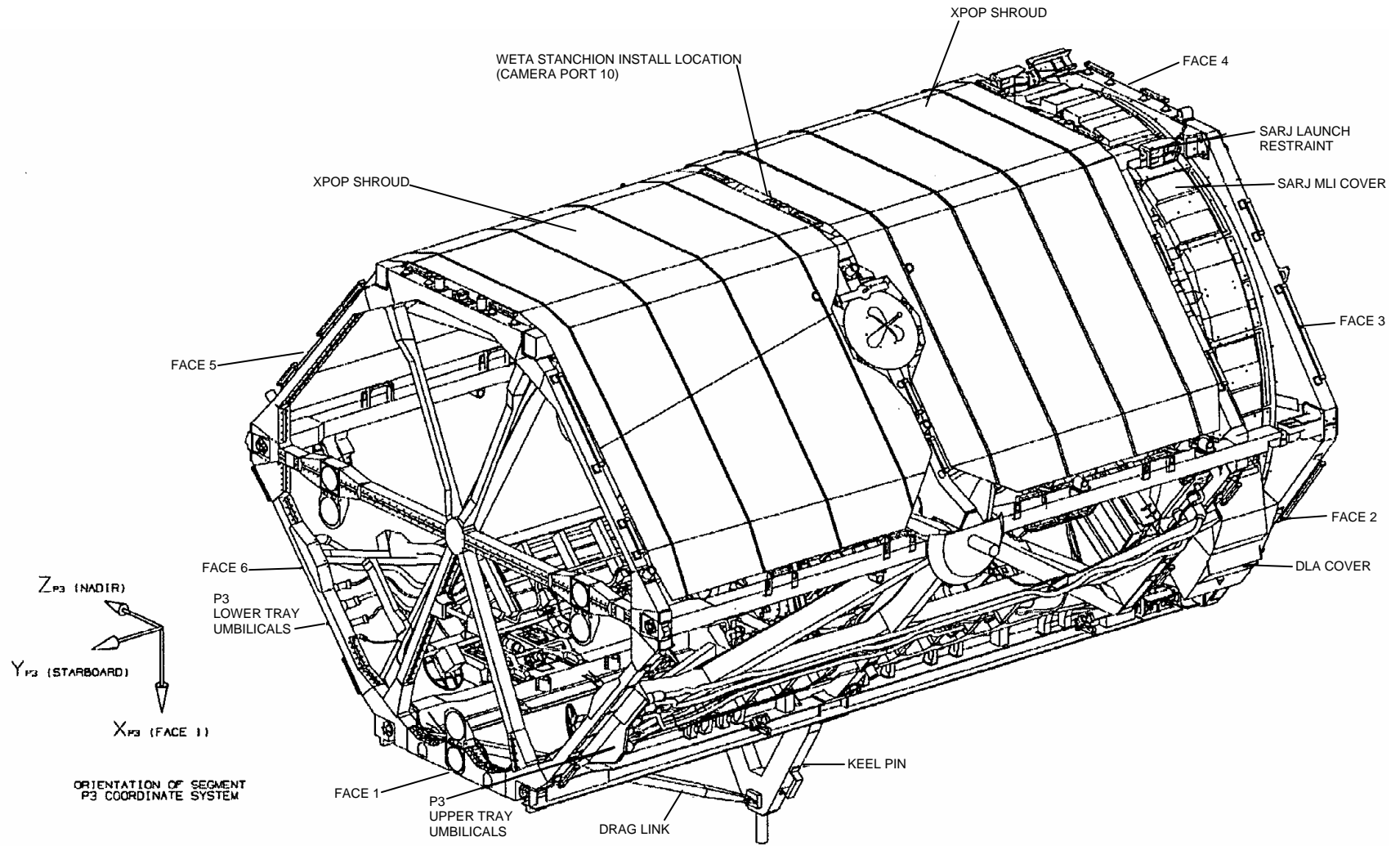
FLIGHT SPECIFIC EVA REFERENCE

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PRD USE FOR 4-BAR DEPLOY	FS 18-52

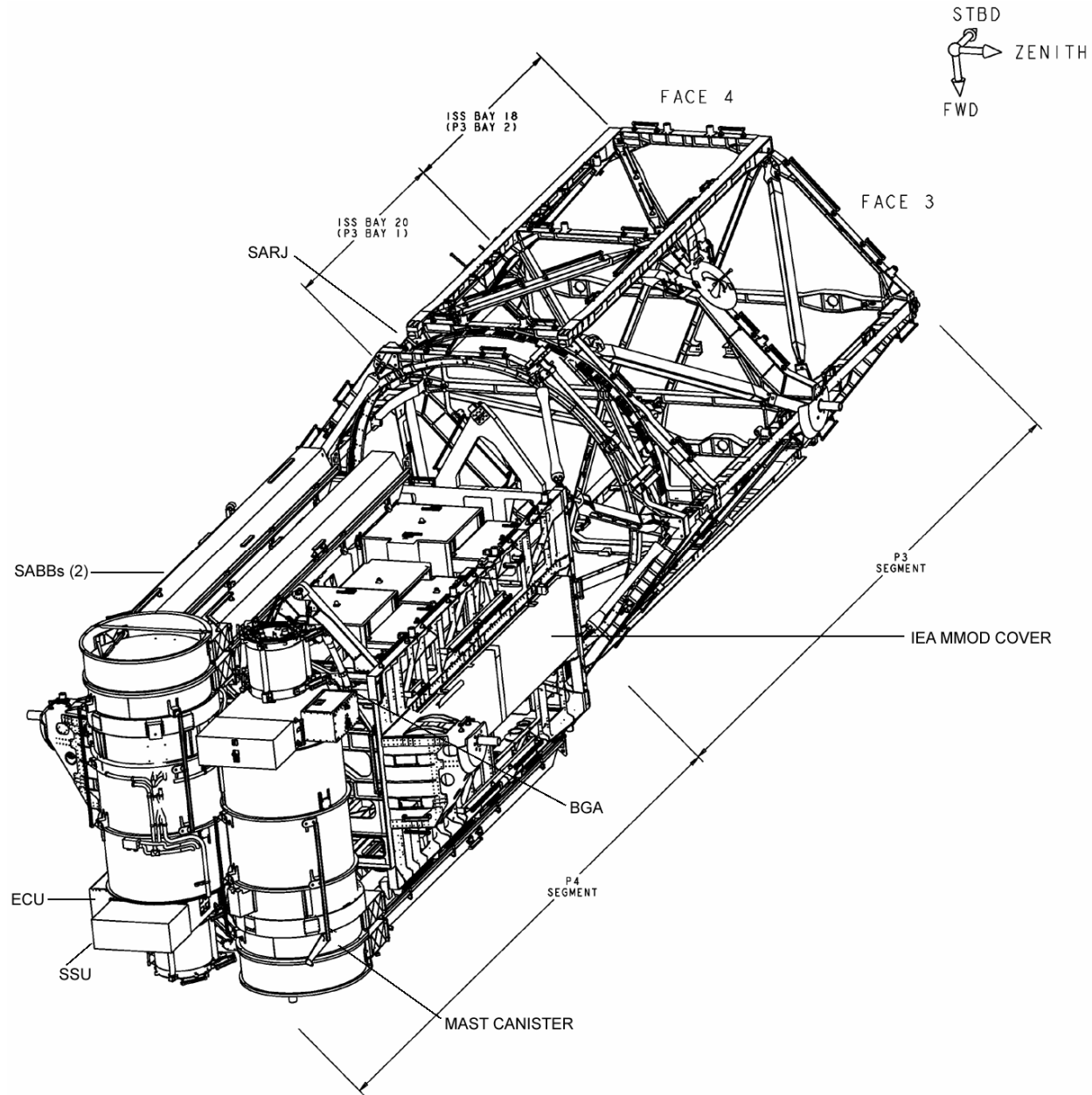
**FLIGHT SPECIFIC
EVA REF**

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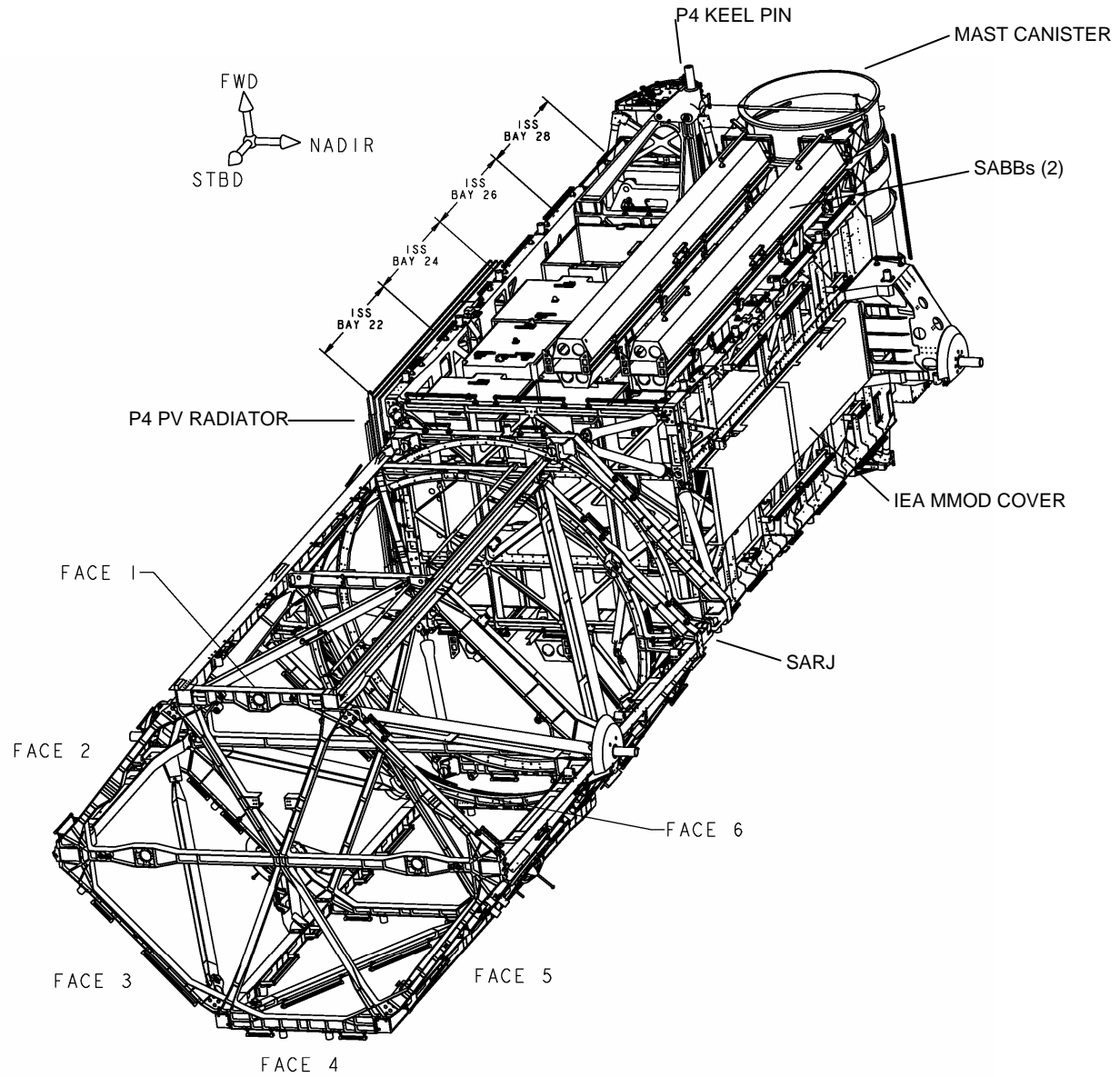
P3 OVERVIEW



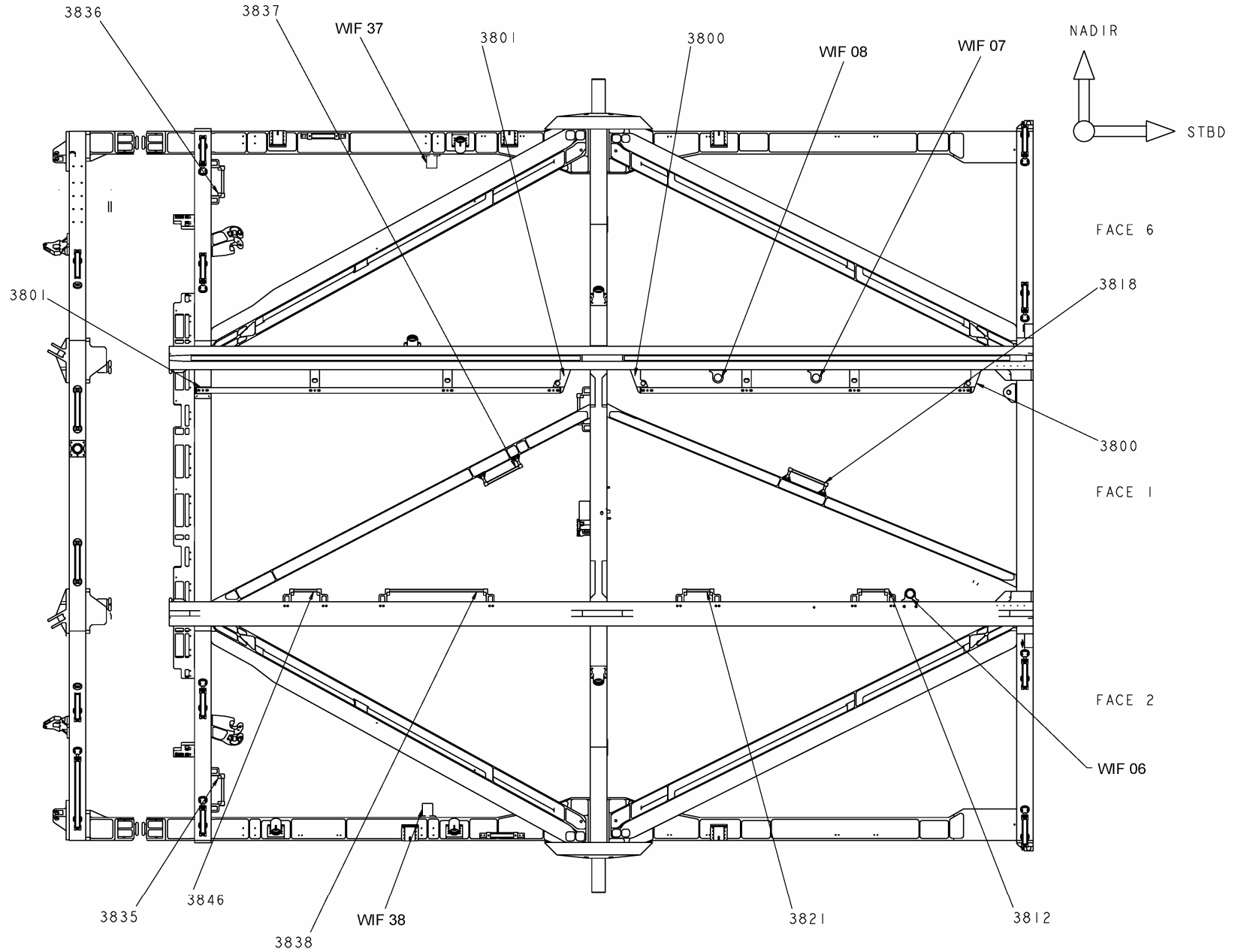
P3/P4 OVERVIEW



P3/P4 OVERVIEW (Cont)



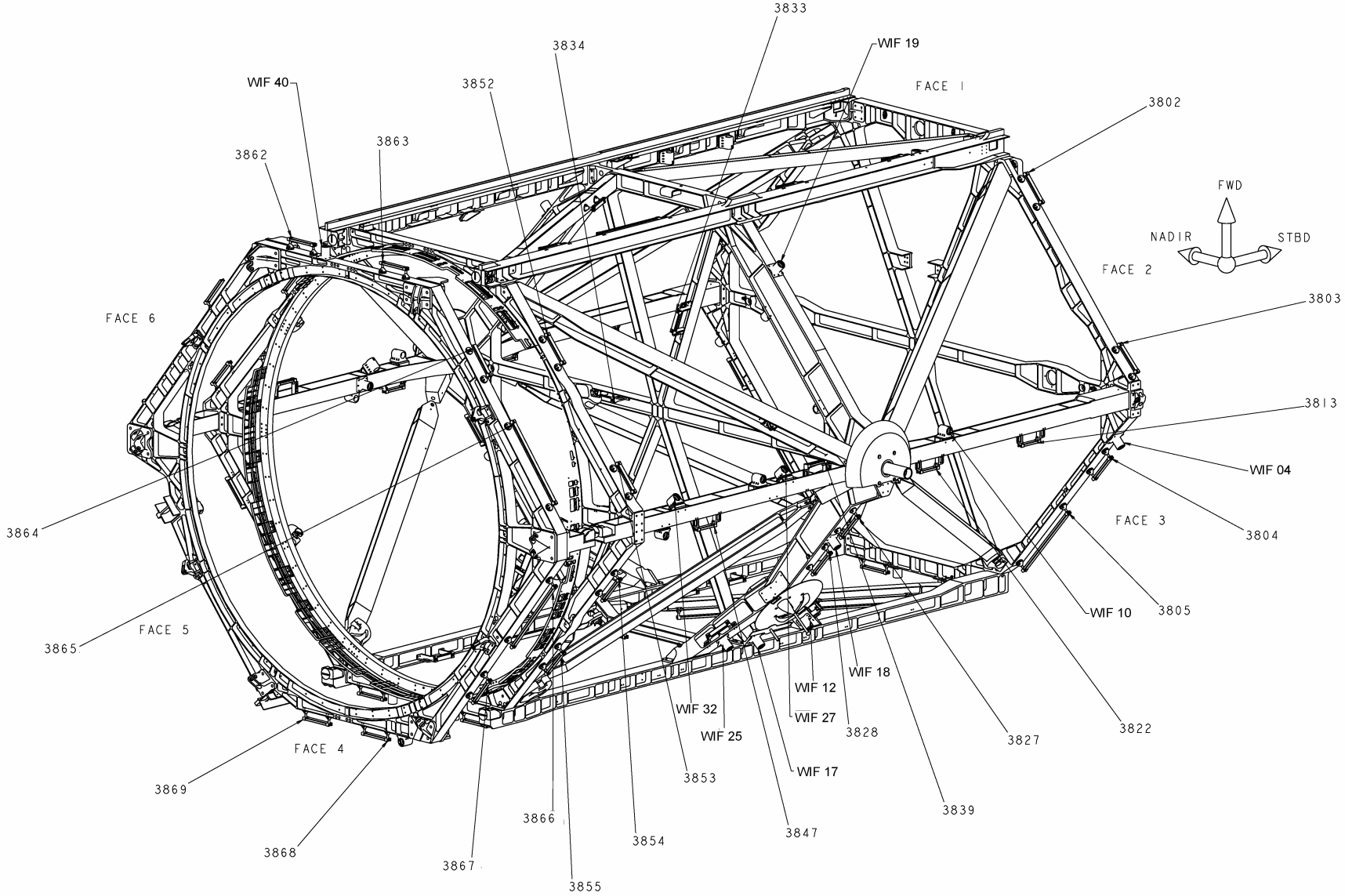
P3 TRUSS SEGMENT (FACE 1, 2, & 6 – TOP VIEW)



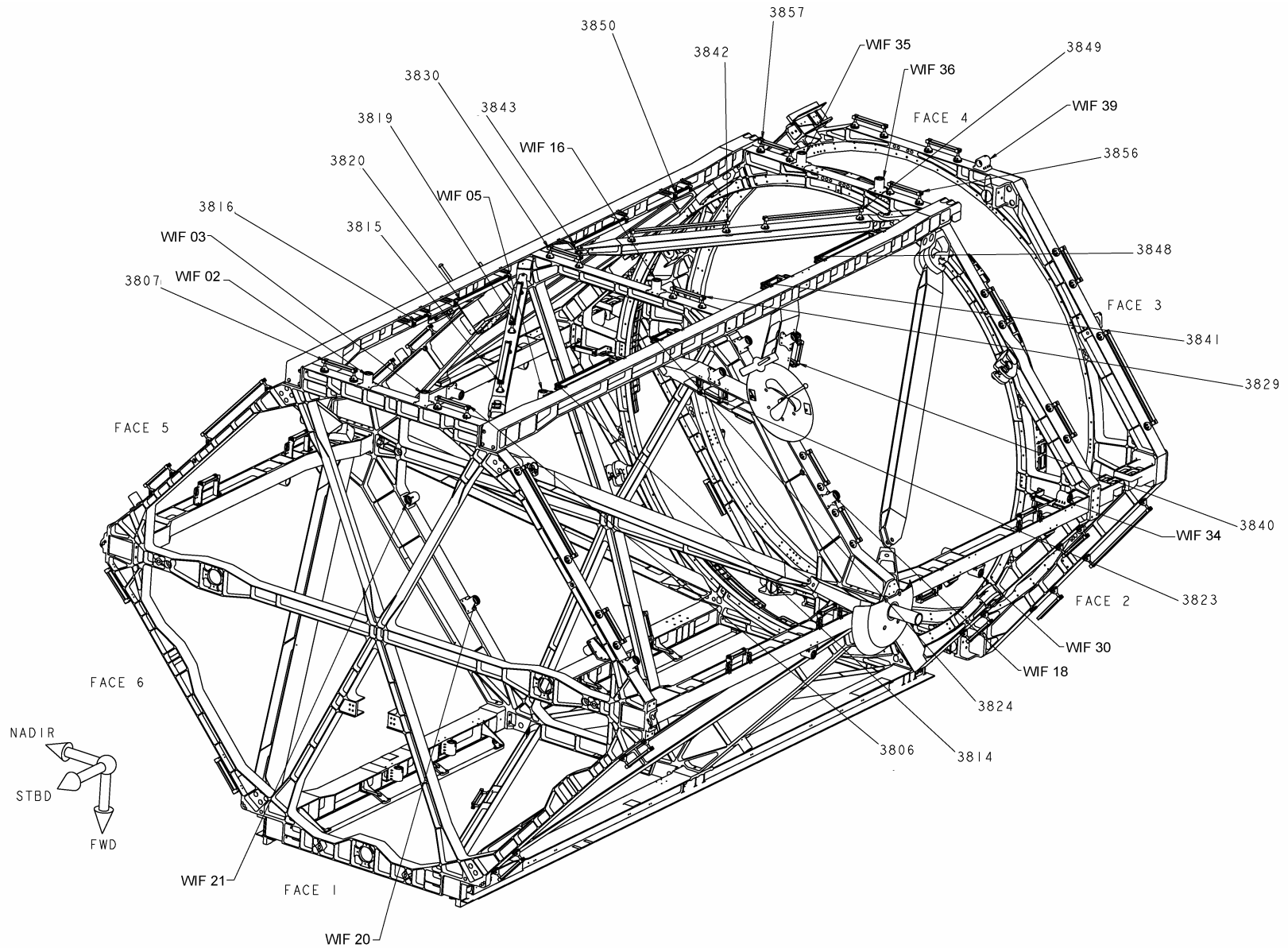
FS 18-6

EVA/115/FIN C

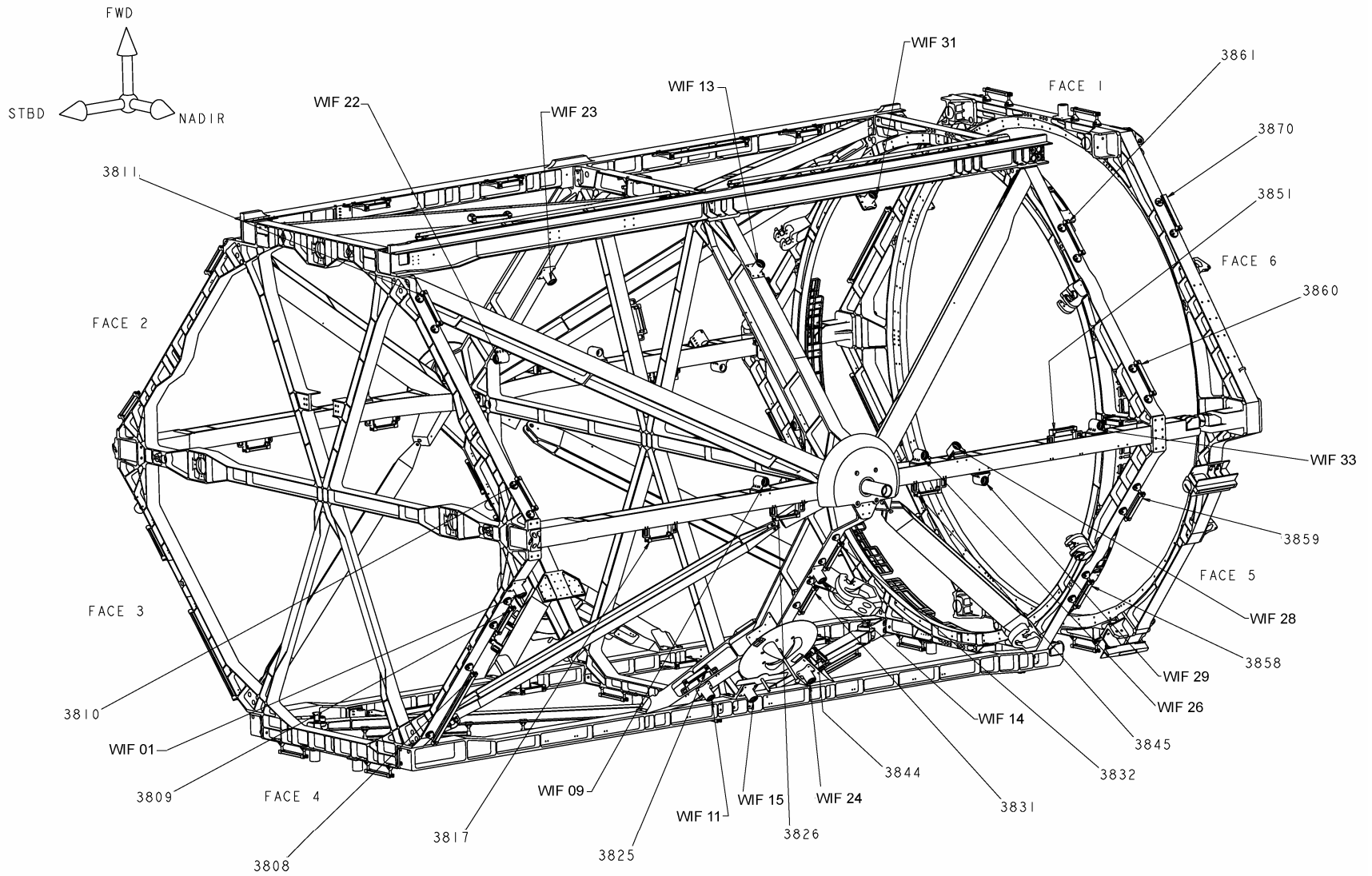
P3 TRUSS SEGMENT (FACE 1, 2, & 3 – PORT END VIEW)



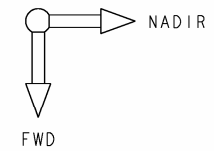
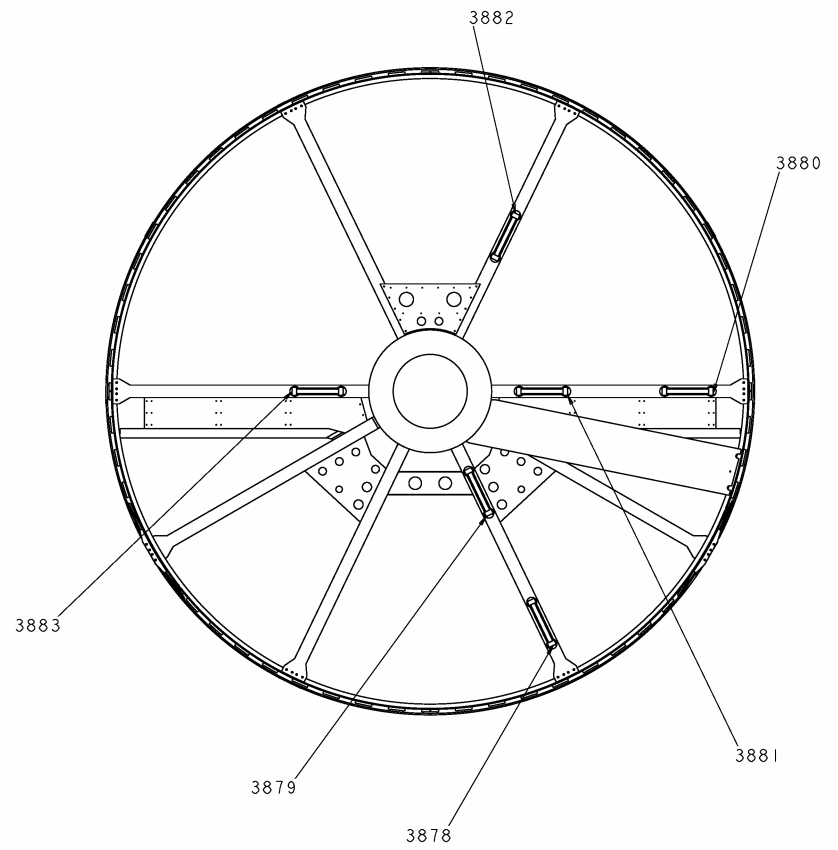
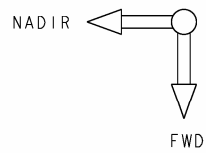
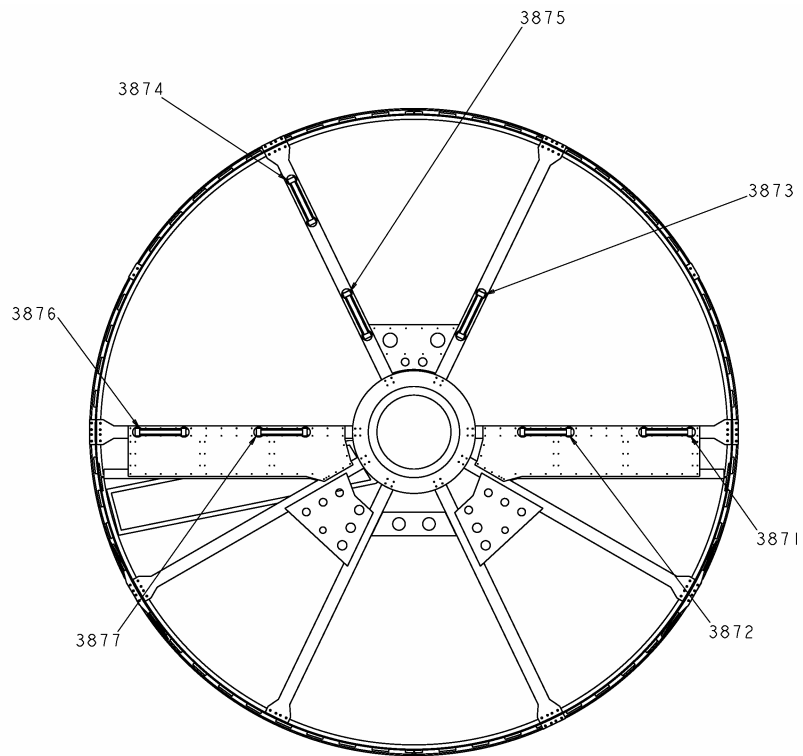
P3 TRUSS SEGMENT (FACE 3 & 4 – STBD END VIEW)



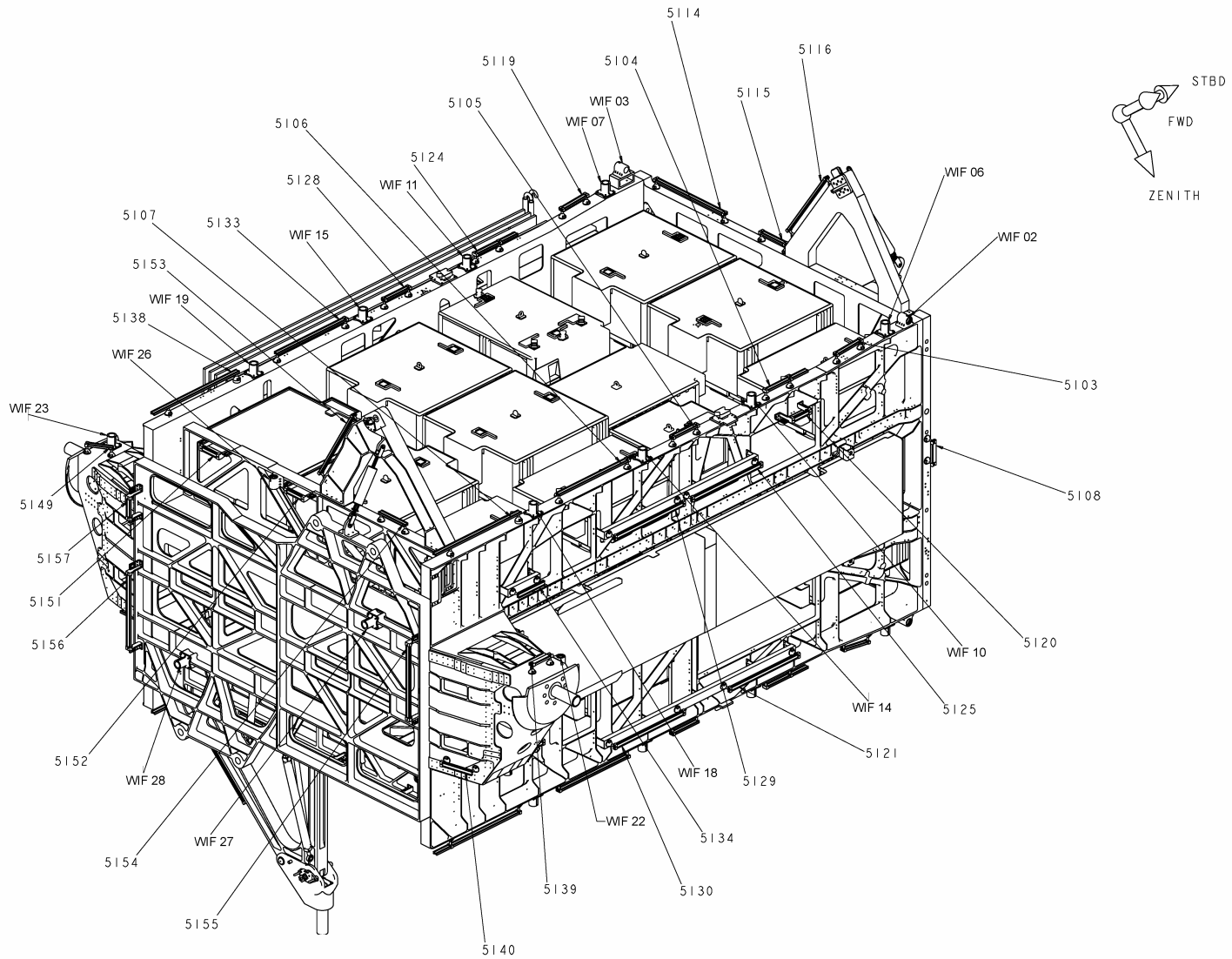
P3 TRUSS SEGMENT (FACE 5 & 6 – STBD END VIEW)



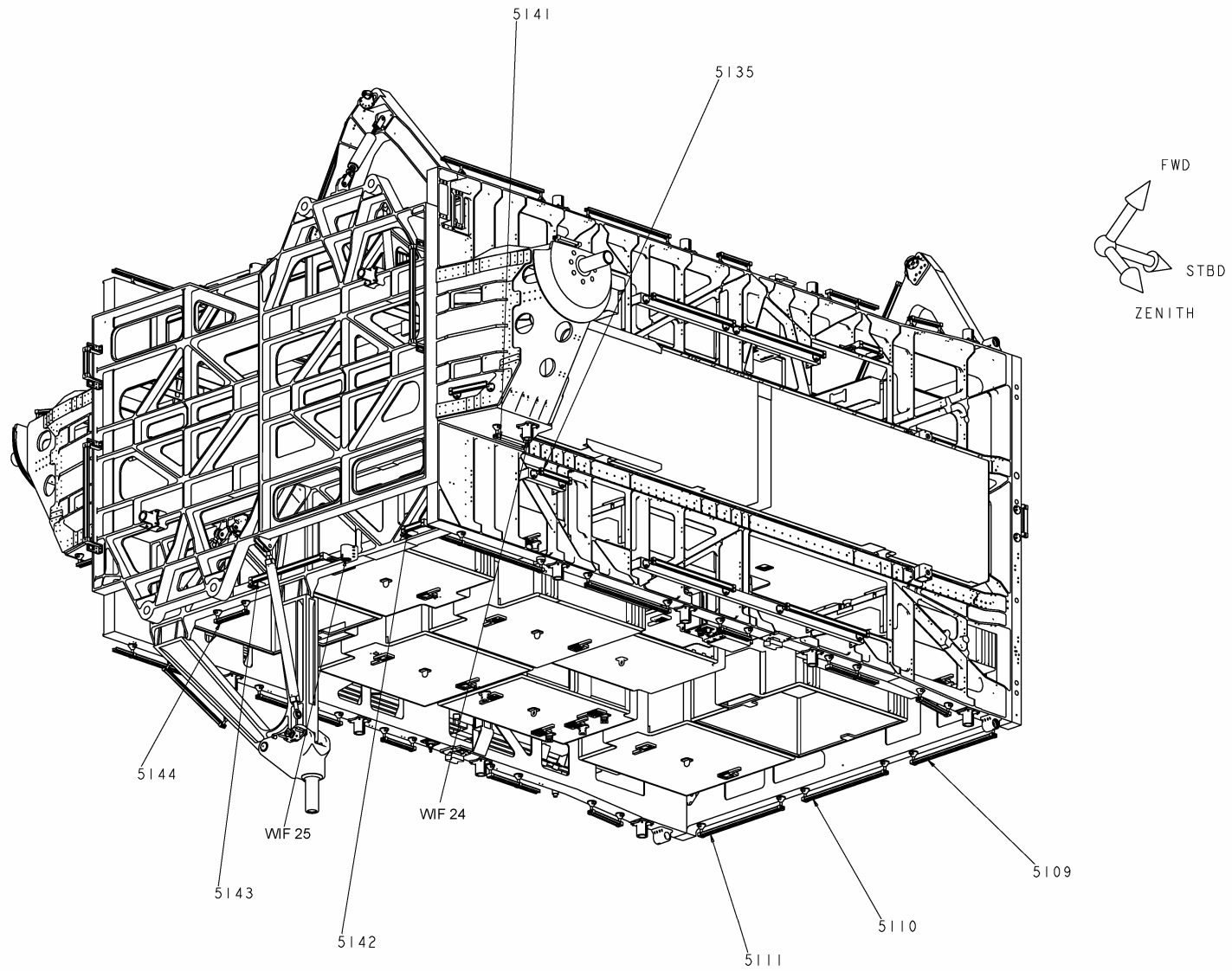
P3 SARJ STRUCTURE (STBD SIDE – UTA SIDE AND PORT SIDE – DMA SIDE)



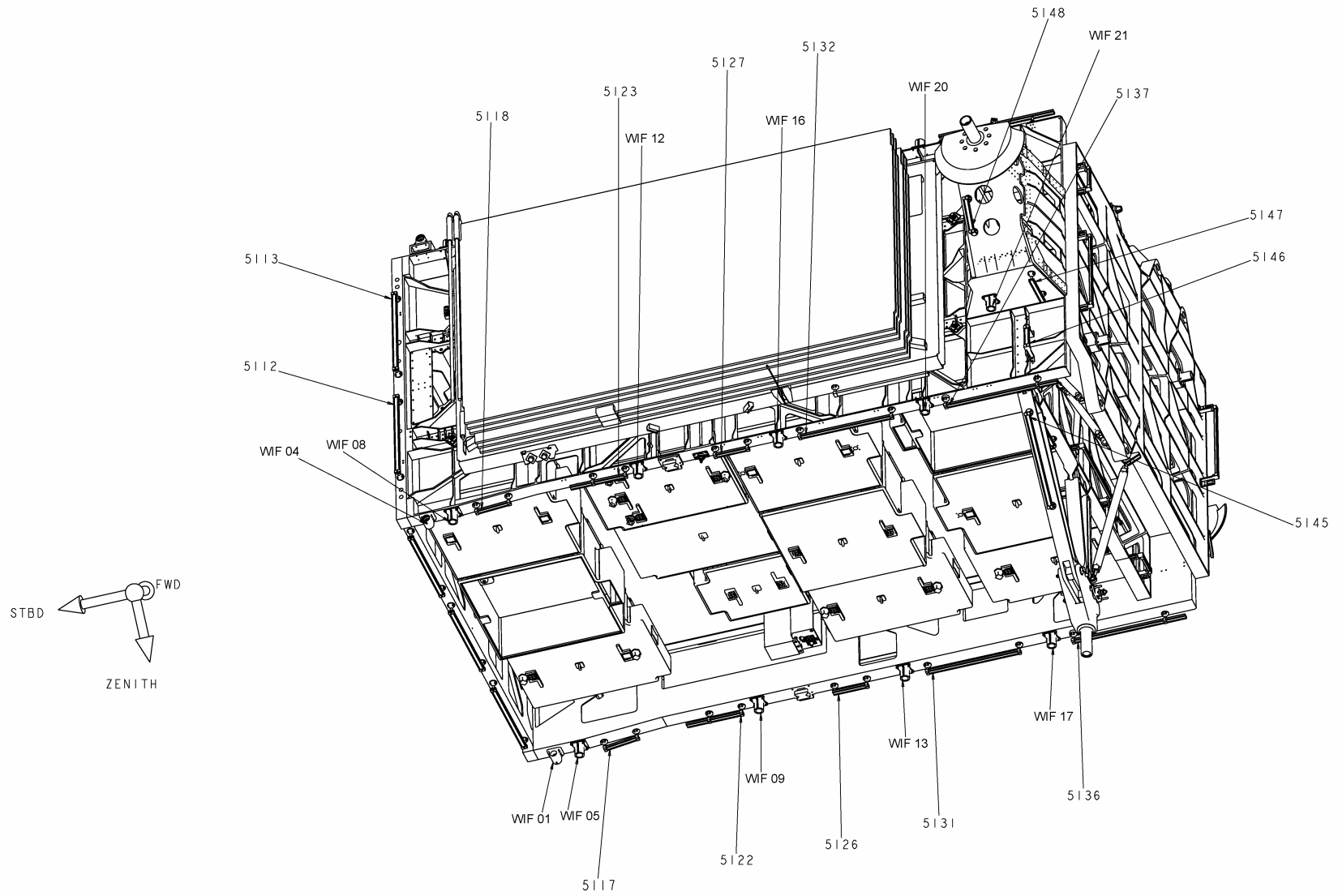
P4 TRUSS SEGMENT (UPPER SIDE OF IEA & CABLE TRAY SIDE)



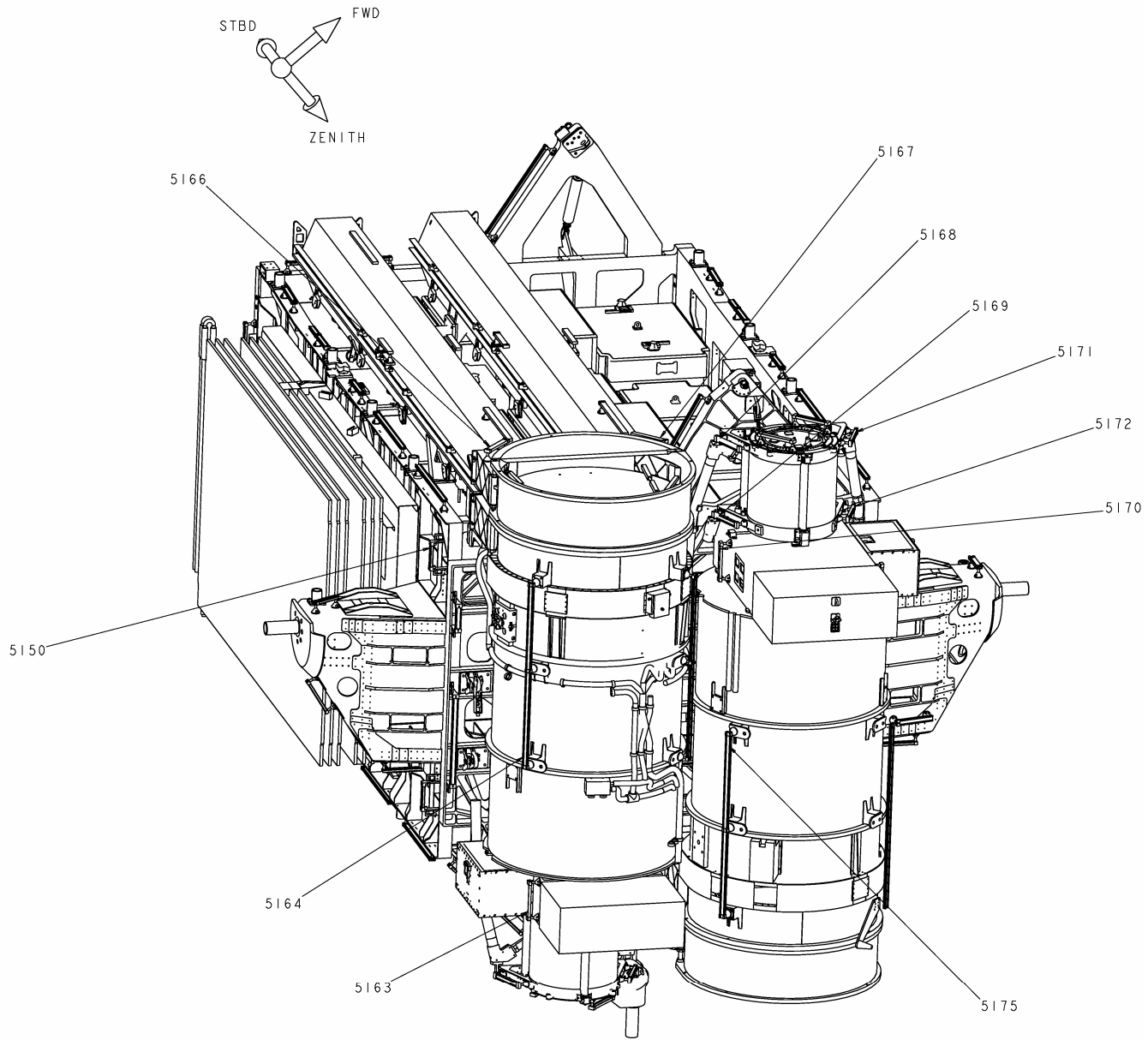
P4 TRUSS SEGMENT (LOWER SIDE OF IEA & CABLE TRAY SIDE)



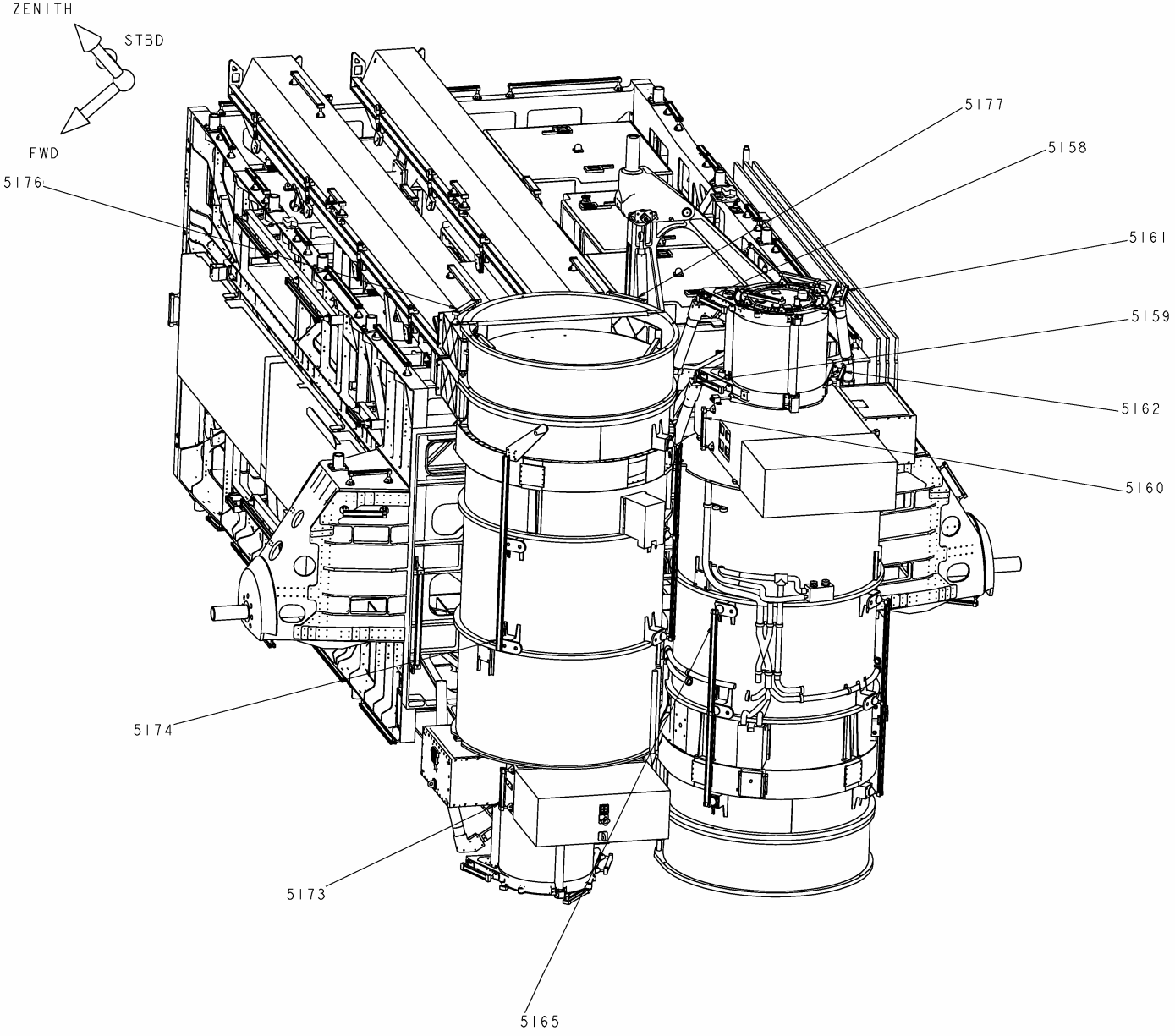
P4 TRUSS SEGMENT (LOWER SIDE OF IEA & RADIATOR SIDE)



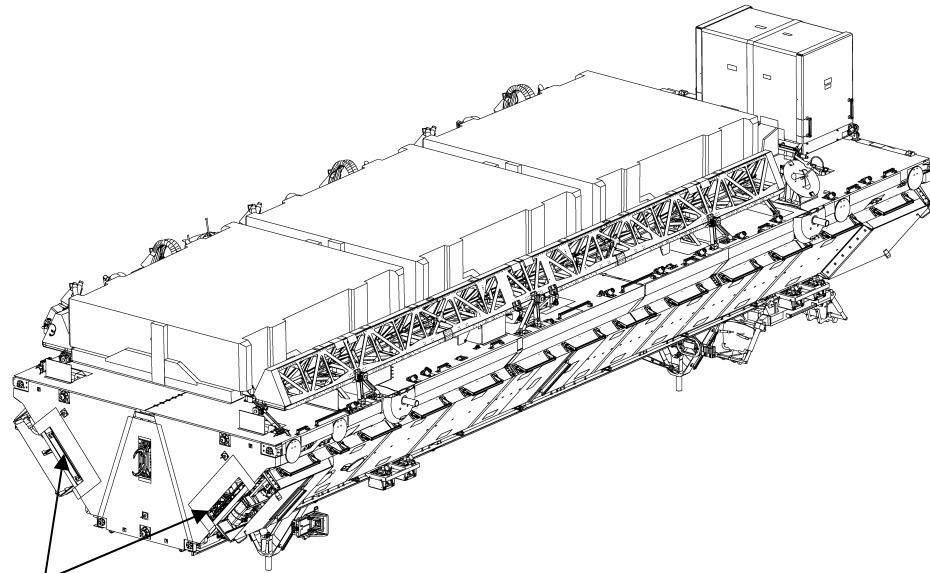
P4 TRUSS SEGMENT – LAUNCH CONFIG (PORT END VIEW – UPPER SOLAR ARRAYS)



P4 TRUSS SEGMENT – LAUNCH CONFIG (PORT END VIEW – LOWER SOLAR ARRAYS)

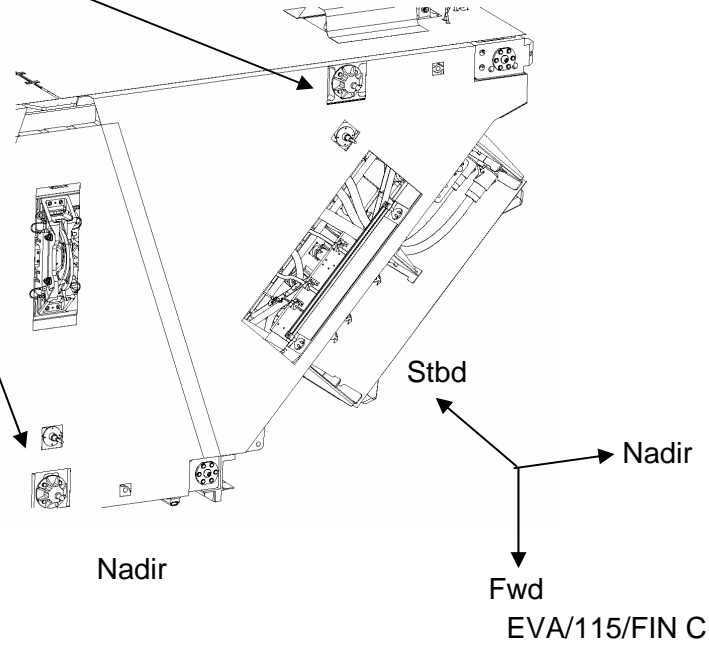
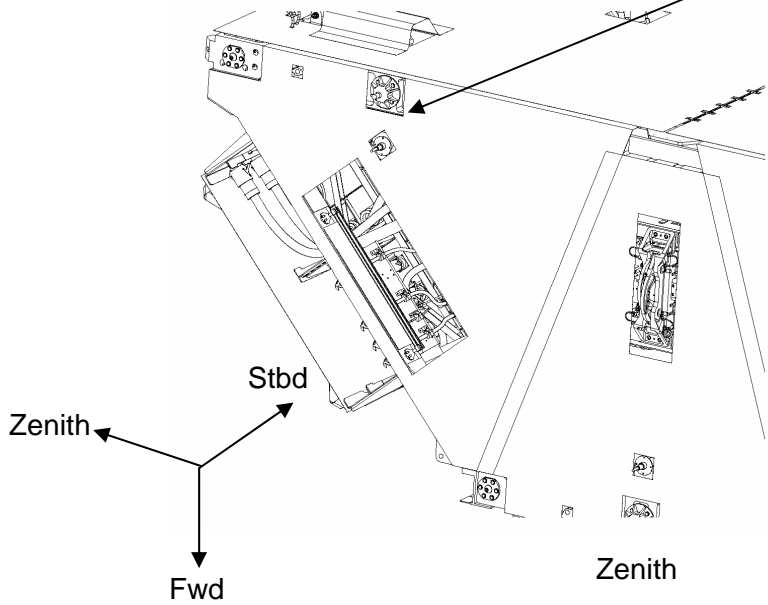


P1/P3 INTERNAL TA CLAMPS AND SSAS RTL COMPONENTS



P1/P3 Line Clamps

Course Alignment Cone and RTL Sensor



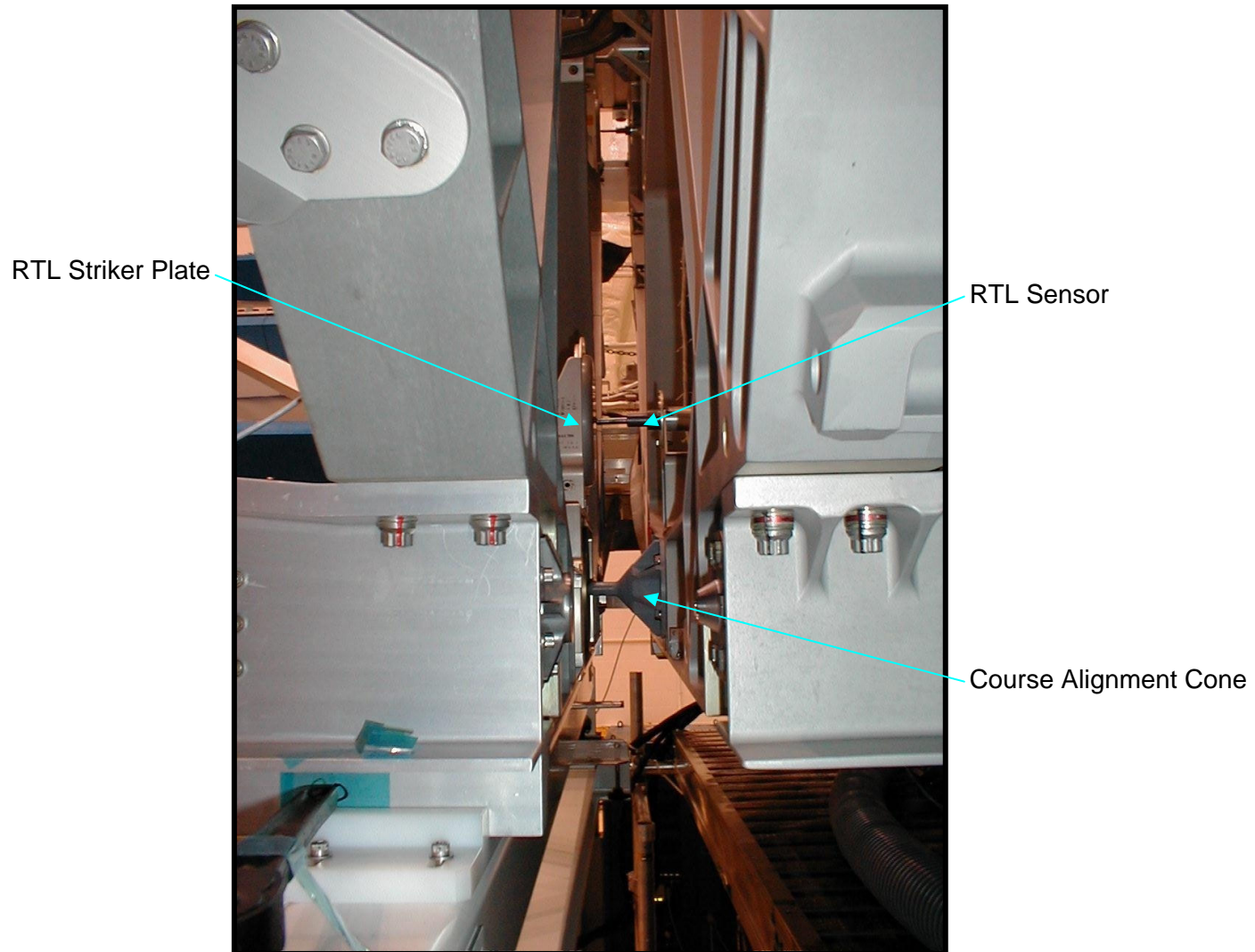
FS 18-16

EVA/115/FIN C

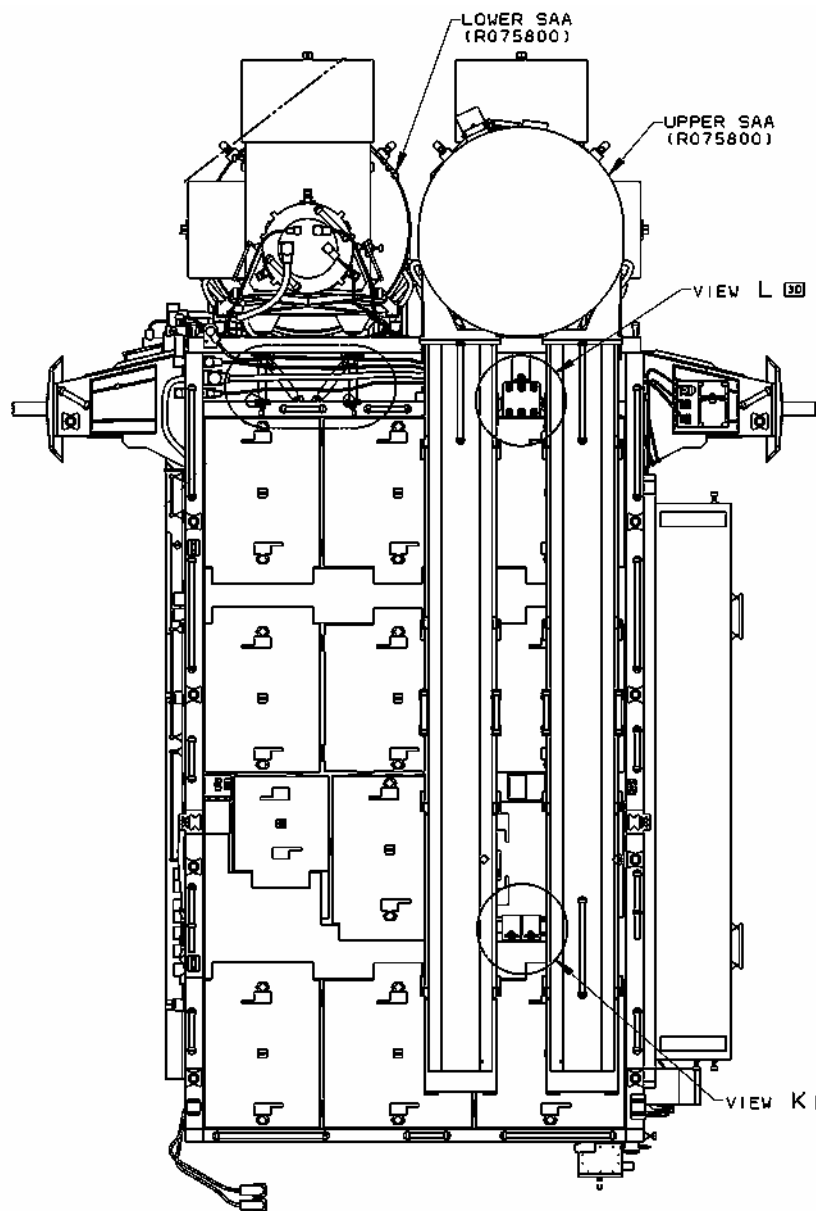
TRUSS SSAS COMPONENTS AT READY-TO-LATCH (RTL) POSITION

I

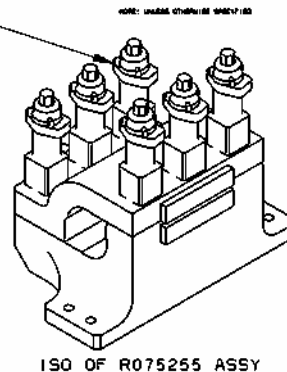
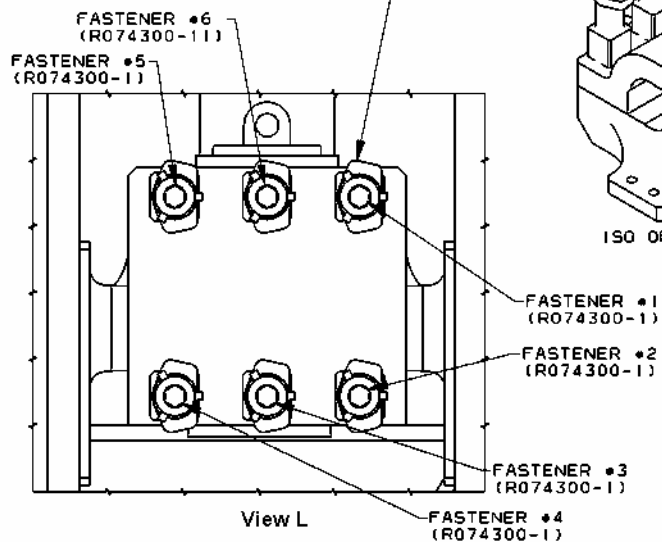
Fwd truss face SSAS RTL components (other SSAS RTL components at zenith and nadir edges of truss)



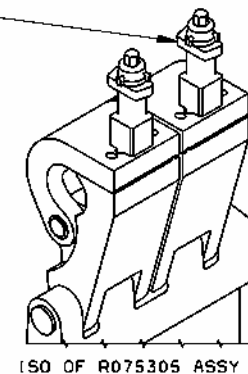
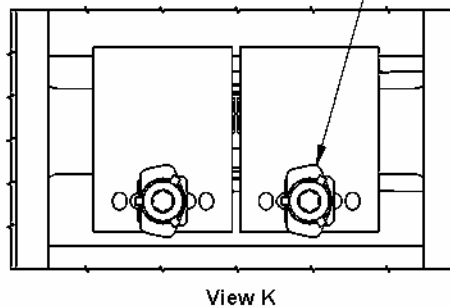
RELEASE SABB LAUNCH RESTRAINTS



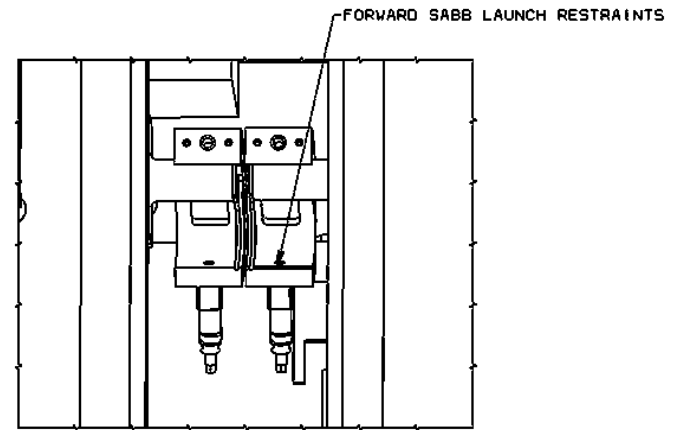
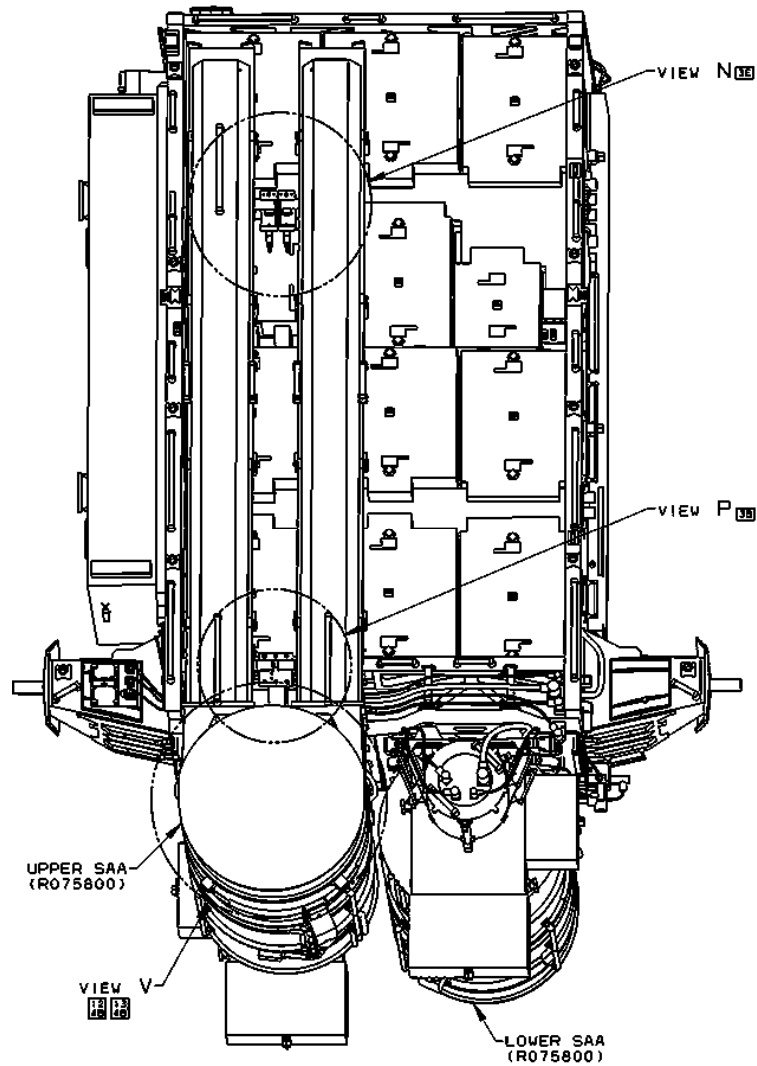
RELEASE UPPER AFT SABB LAUNCH RESTRAINT (R075255). 6X AFT RESTRAINT FASTENER (R074300) BREAK GROUND SET TORQUE \odot F3
 RELEASE FASTENER #1 FIRST, FASTENER #2-5 IN ANY ORDER, FASTENER #6 LAST
 STORE BRACKET IN LONG SPACER STOWAGE BIN SEE SHT 15



RELEASE UPPER/FORWARD SABB LAUNCH RESTRAINTS (R075305) 2X FORWARD RESTRAINT FASTENERS (R074300) BREAK GROUND SET TORQUE \odot F4

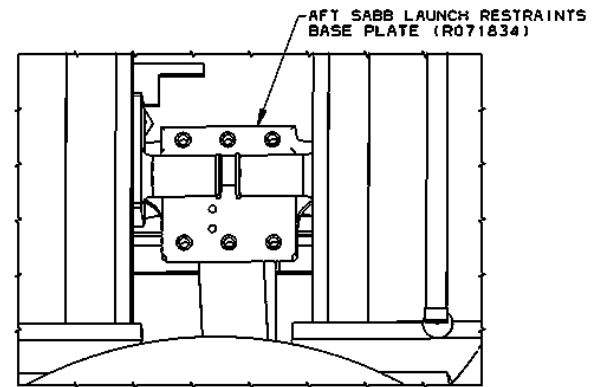


RELEASE SABB LAUNCH RESTRAINTS (Cont)



View N

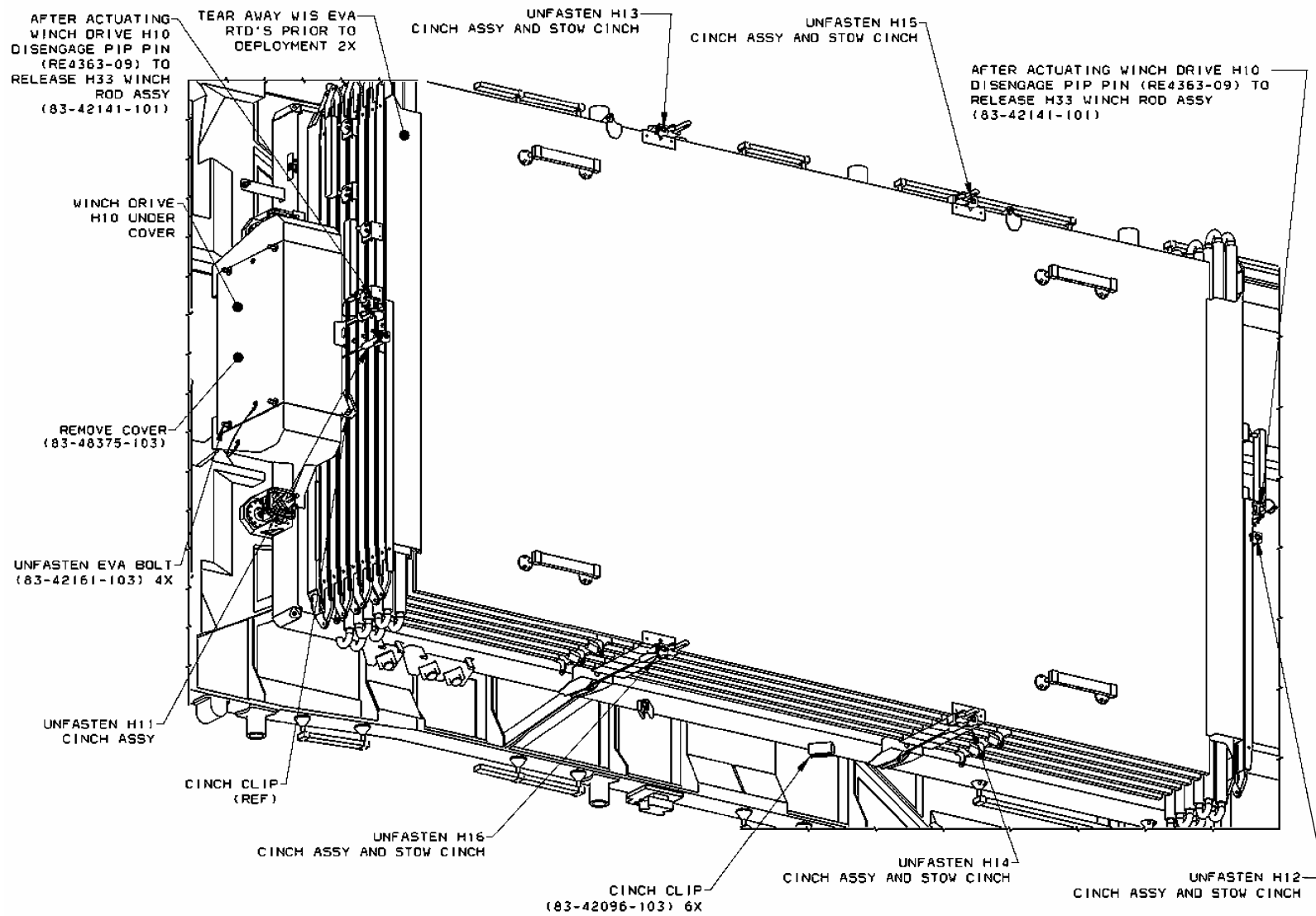
OPEN R075305 CAP UNTIL UNIT STOP IS REACHED



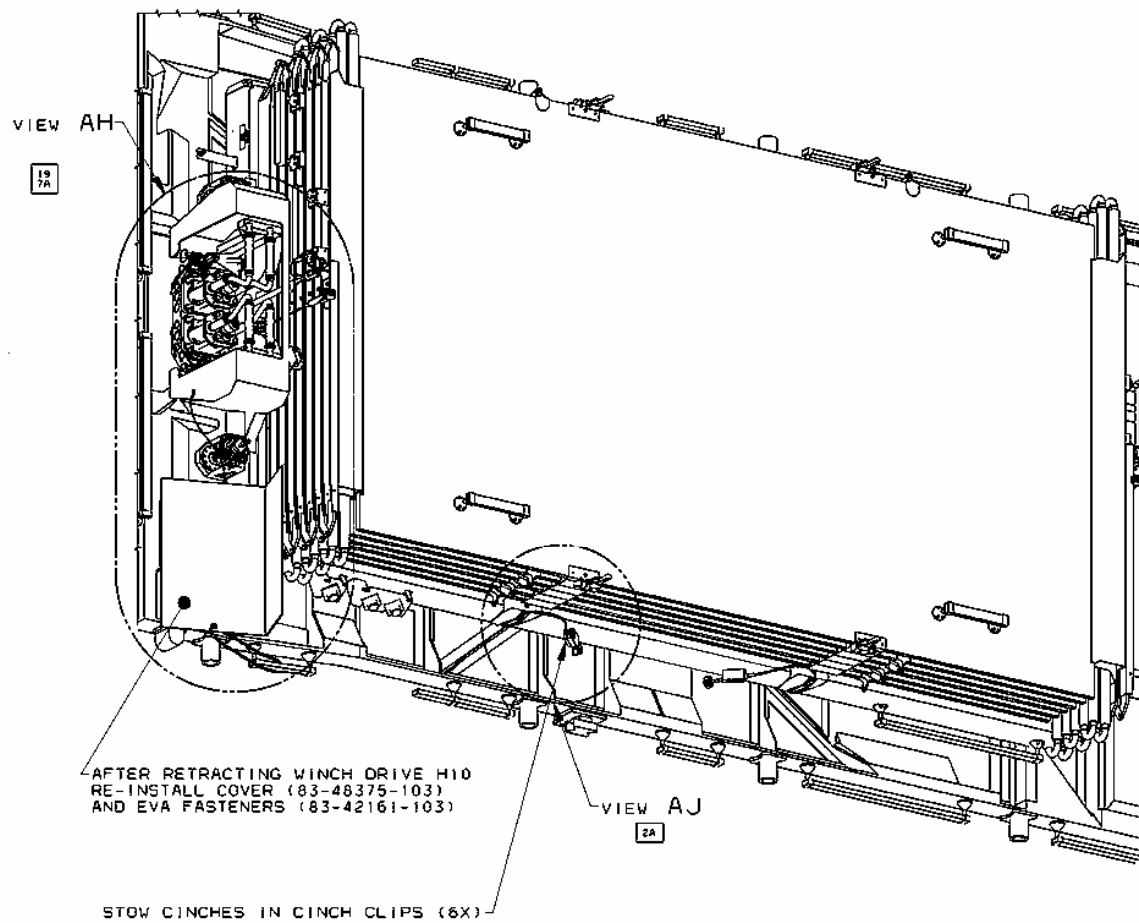
View P

REMOVE AND STOW TOP HALF OF R075255
BRACKET INTO LONGSPACER STOWAGE BIN

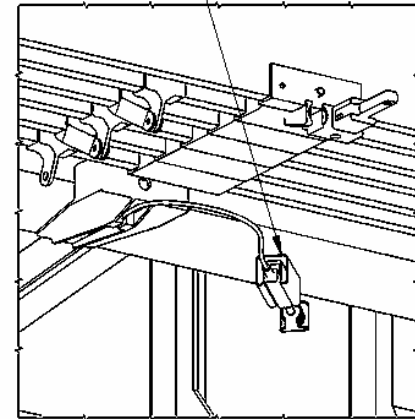
RELEASE P4 PV RADIATOR CINCHES AND WINCHES



RELEASE P4 PV RADIATOR CINCHES AND WINCHES (Cont)



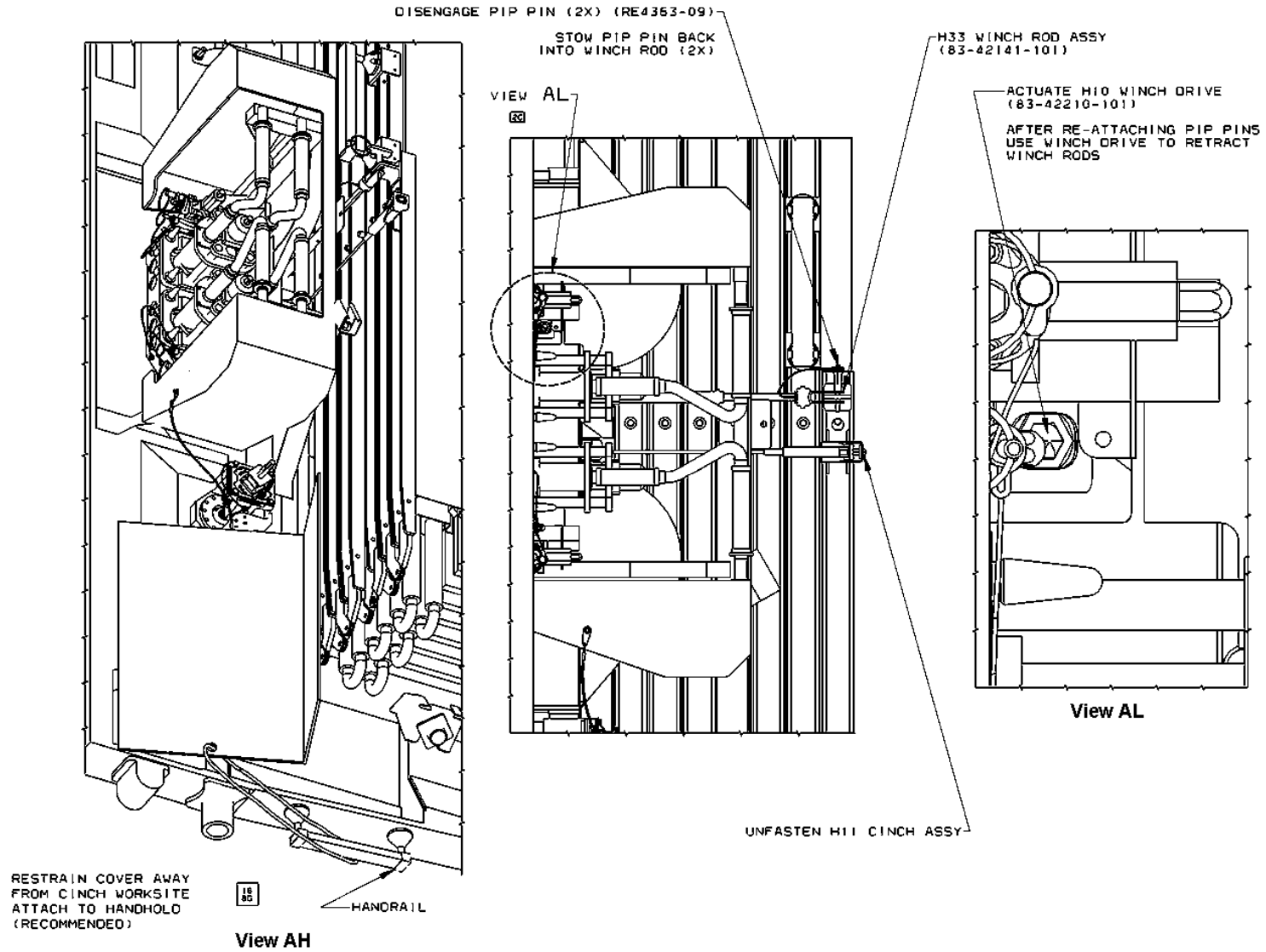
CINCH CLIP (6X)
(83-42096-103)



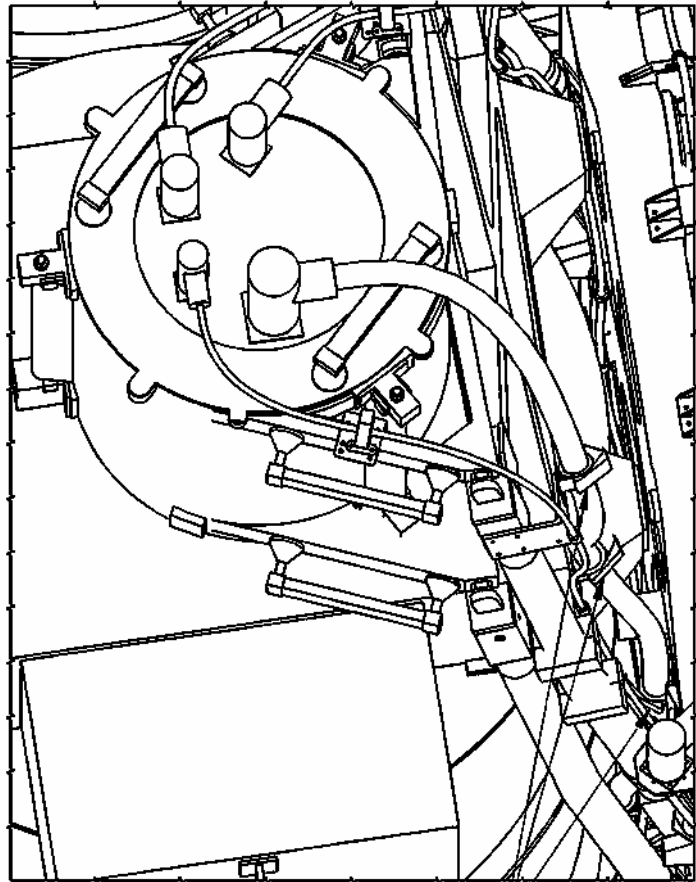
STOWED POSITION (6X)

View AJ

RELEASE P4 PV RADIATOR CINCHES AND WINCHES (Cont)

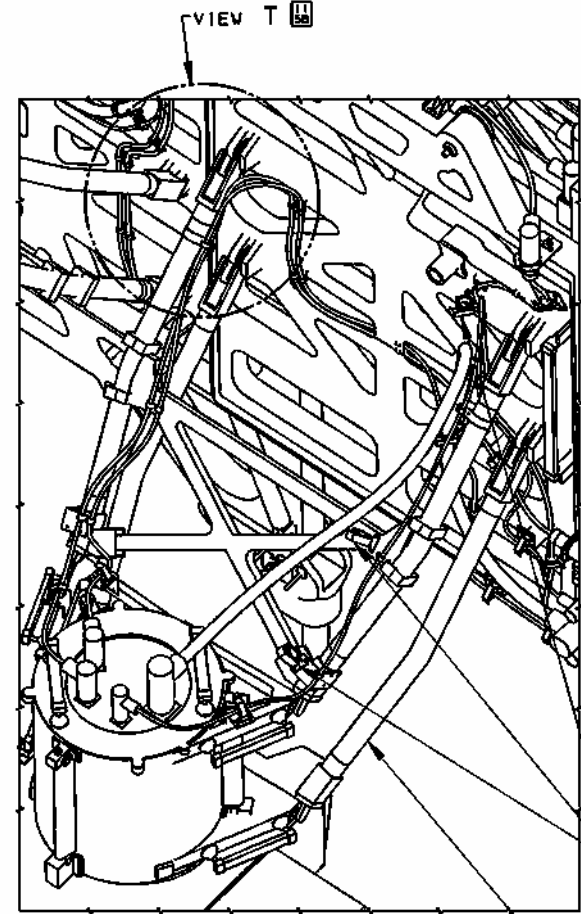


BGA PRIMARY POWER CABLE CLAMPS



RELEASE BGA POWER CABLE FROM CLAMPS
PRIOR TO FOUR BAR DEPLOYMENT

FOUR BAR
LOWER SAA
(R075800)

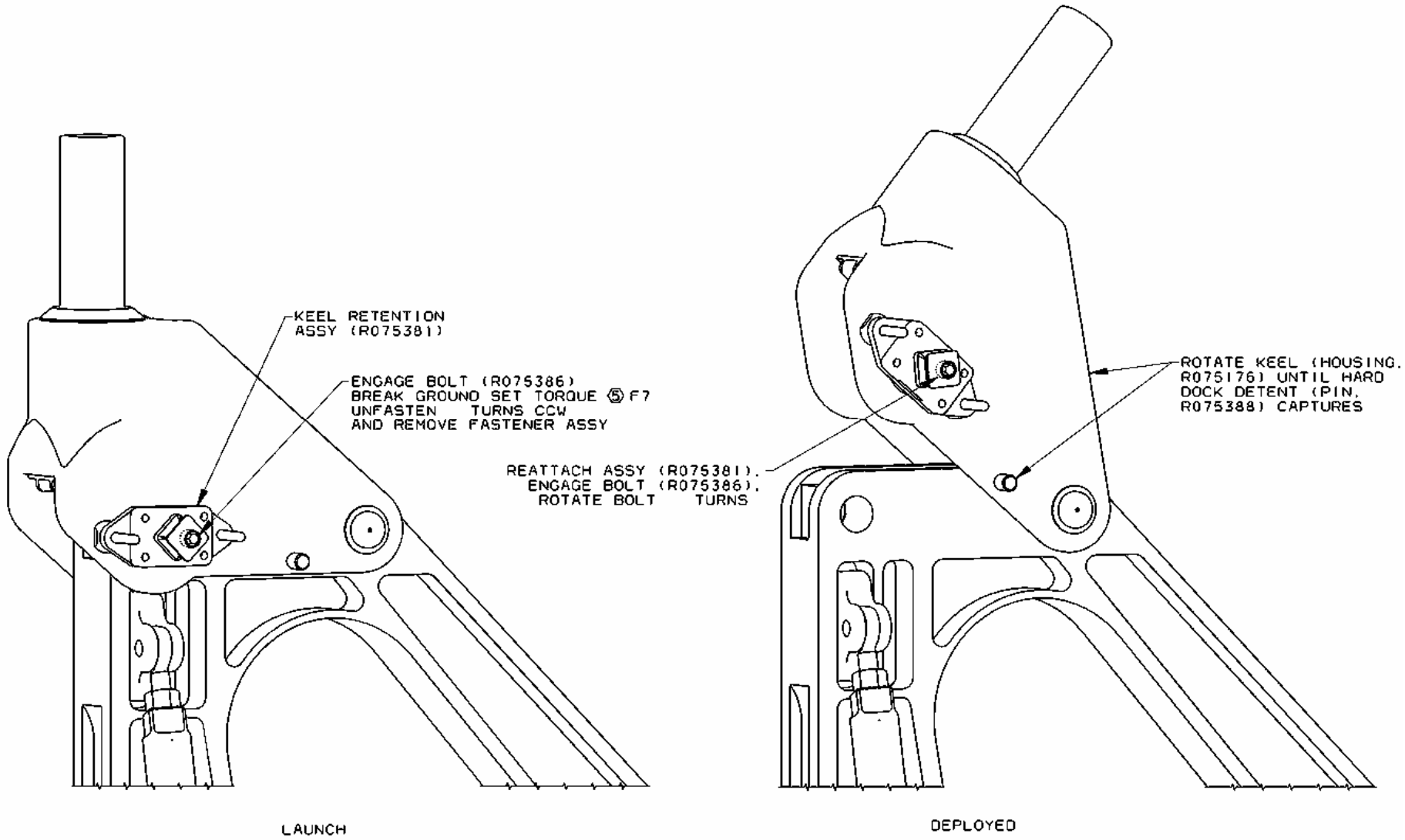


VIEW T

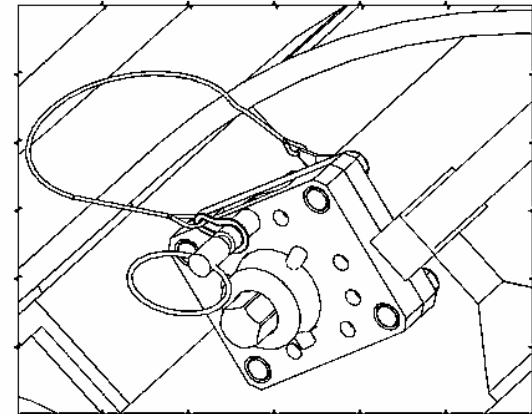
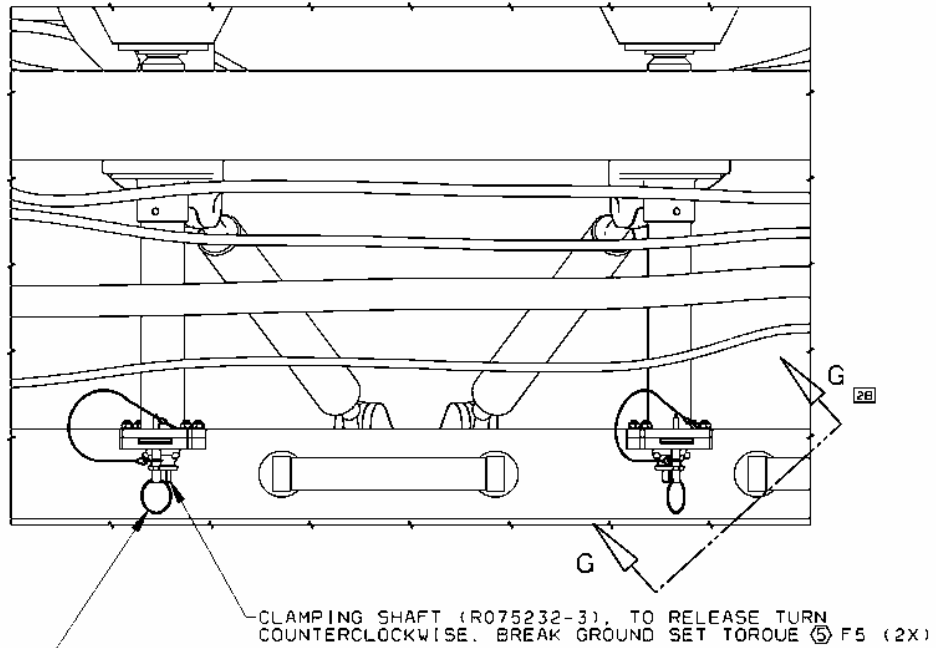
BGA POWER
CABLE CLAMPS
(R078501)

FOUR BAR
LOWER SAA
(R075800)

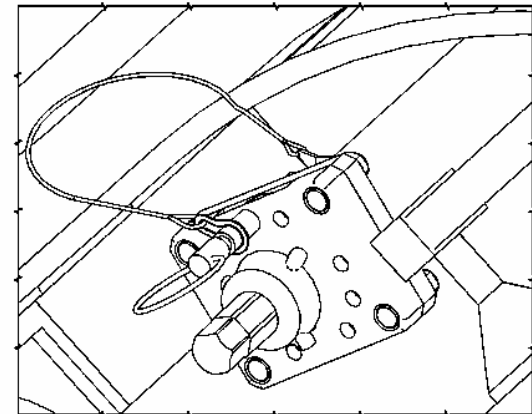
REPOSITION P4 KEEL PIN



RELEASE BETA GIMBAL LAUNCH RESTRAINTS



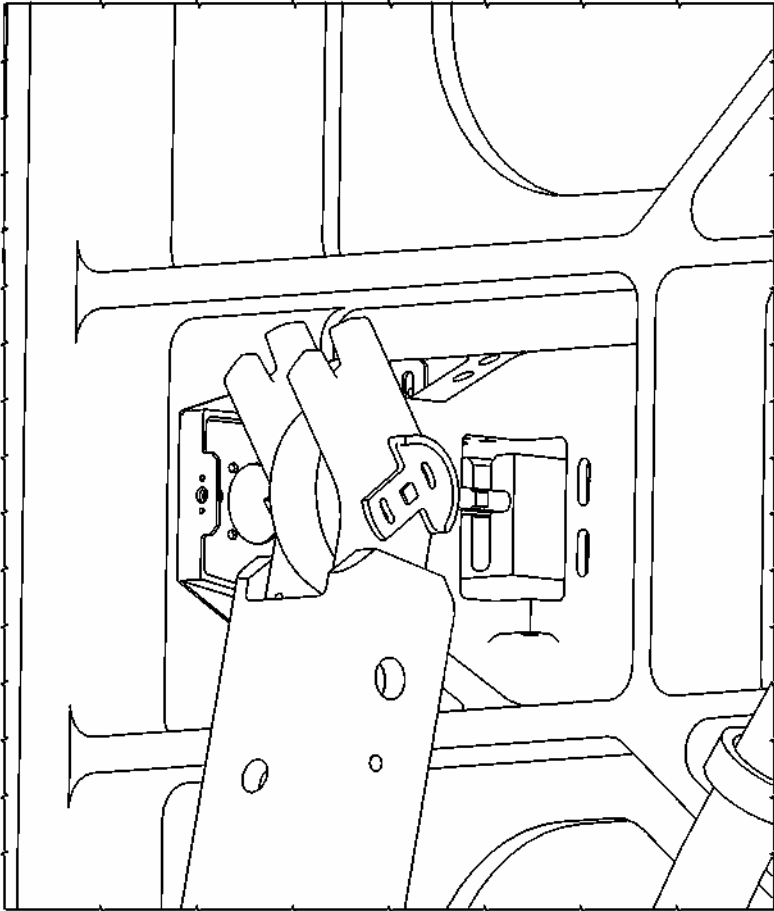
LAUNCH



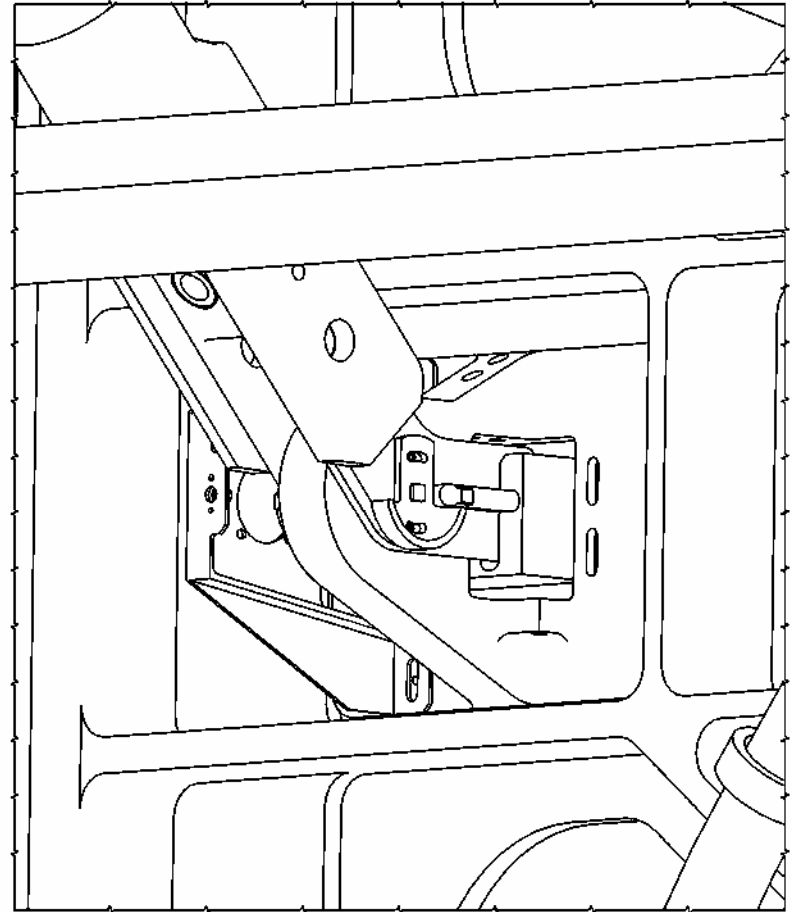
DEPLOYED

View G

FOUR BAR IN LOCKED POSITION



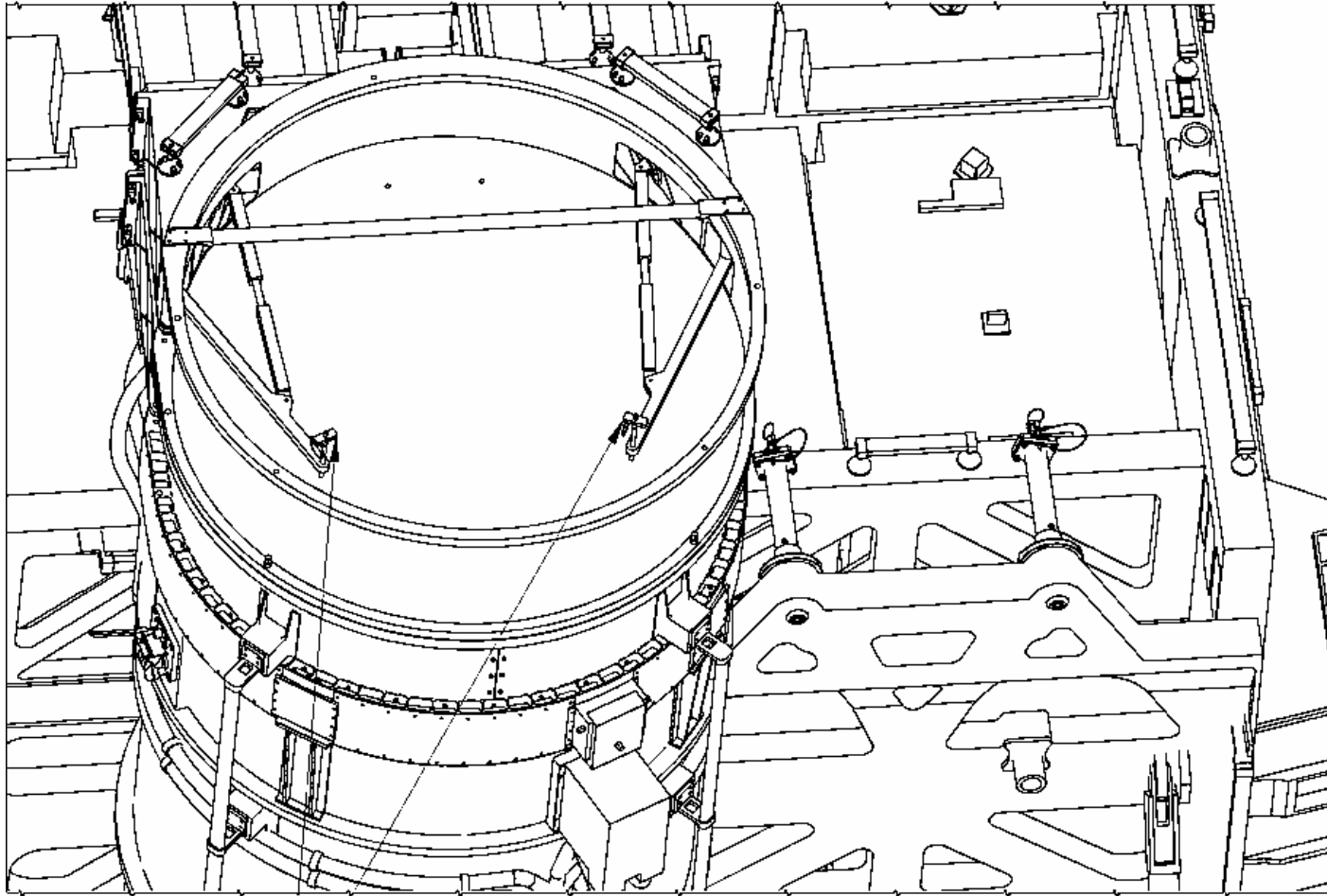
LAUNCH



DEPLOYED

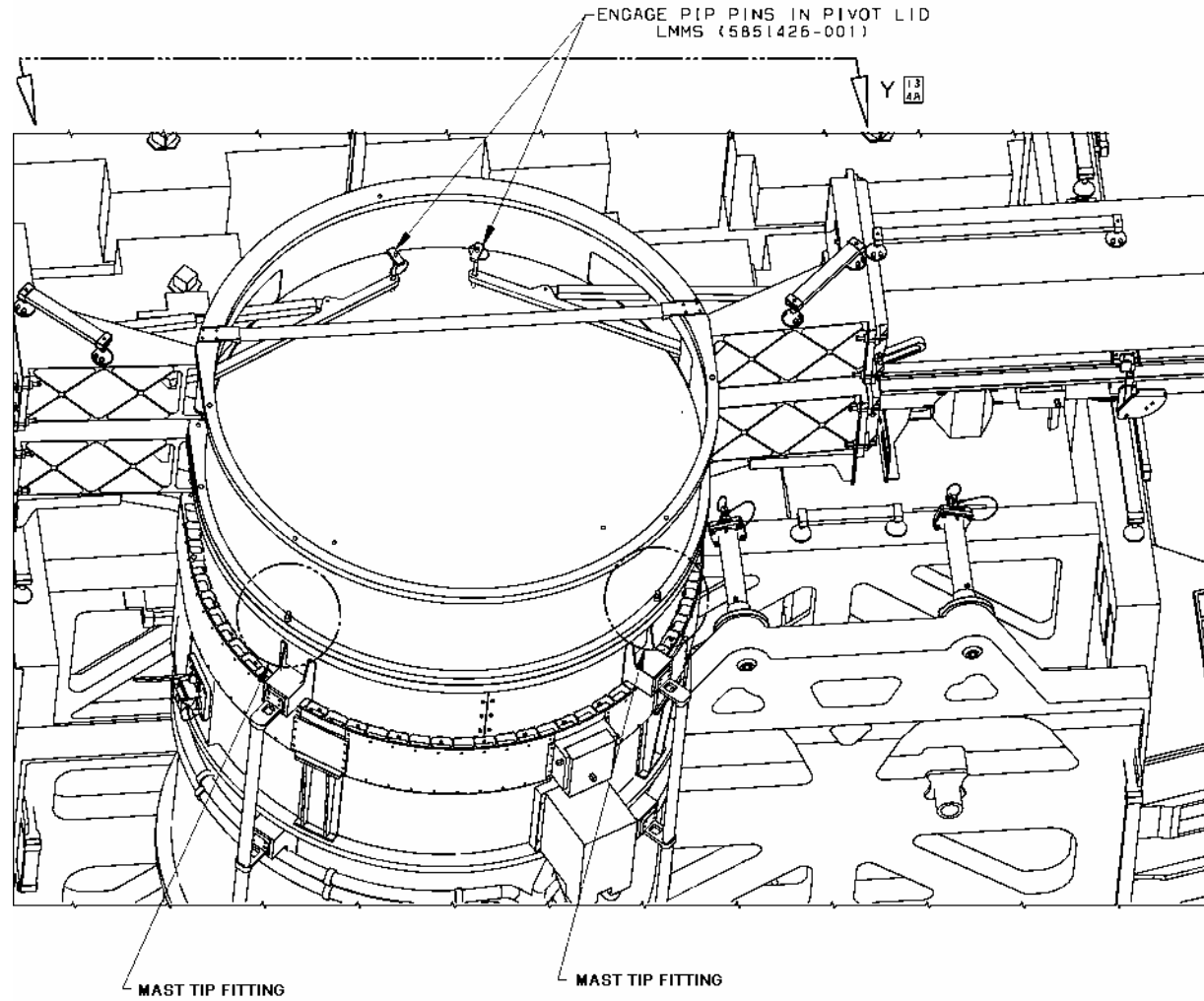
View T

SABB UNSTOW



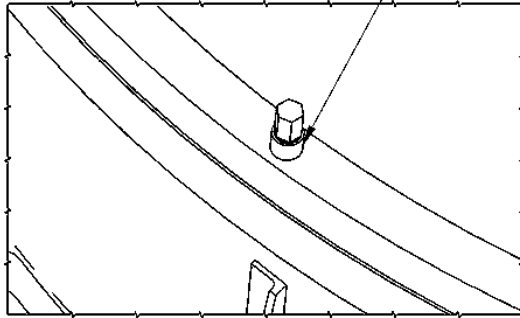
DISENGAGE PIP PINS FROM PIVOT LID
LMMS (5851426-001)

SABB UNSTOW (Cont)

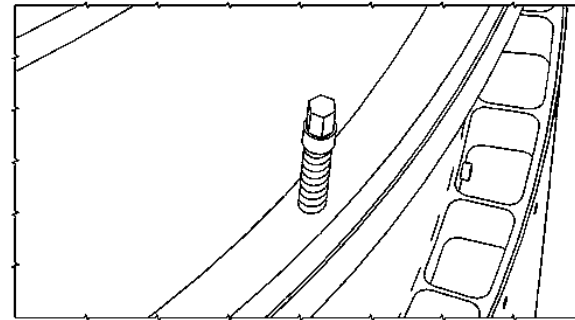


SABB UNSTOW (Cont)

TIP FITTING LMMS (5843517-003). TURN COUNTERCLOCKWISE TO BREAK GROUND SET TORQUE \odot F6. FASTENERS WILL POP UP WHEN DISENGAGED.



View W

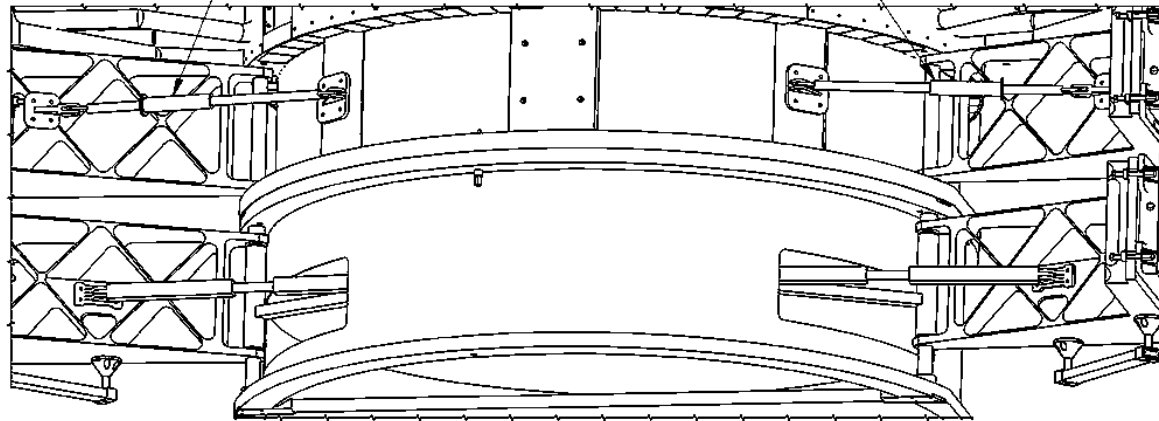


View AF

TIP FITTING INSTALLED
3 PLACES EACH MAST CANISTER

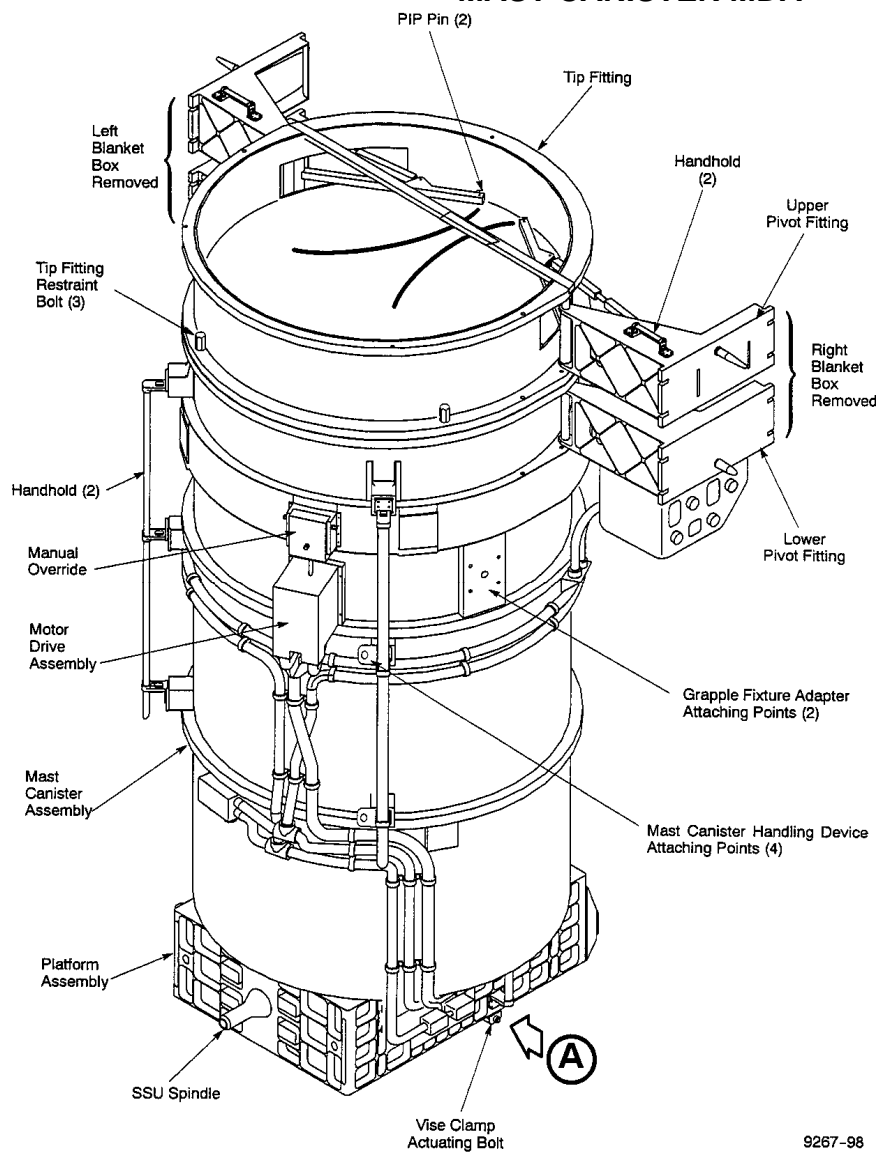
TIP FITTING DEPLOYED
3 PLACES EACH MAST CANISTER

VERIFY LOCKING SLEEVE LMMS (581331-001) IS IN LOCKED POSITION SHOWN, TYP UPPER AND LOWER BLANKET BOXES

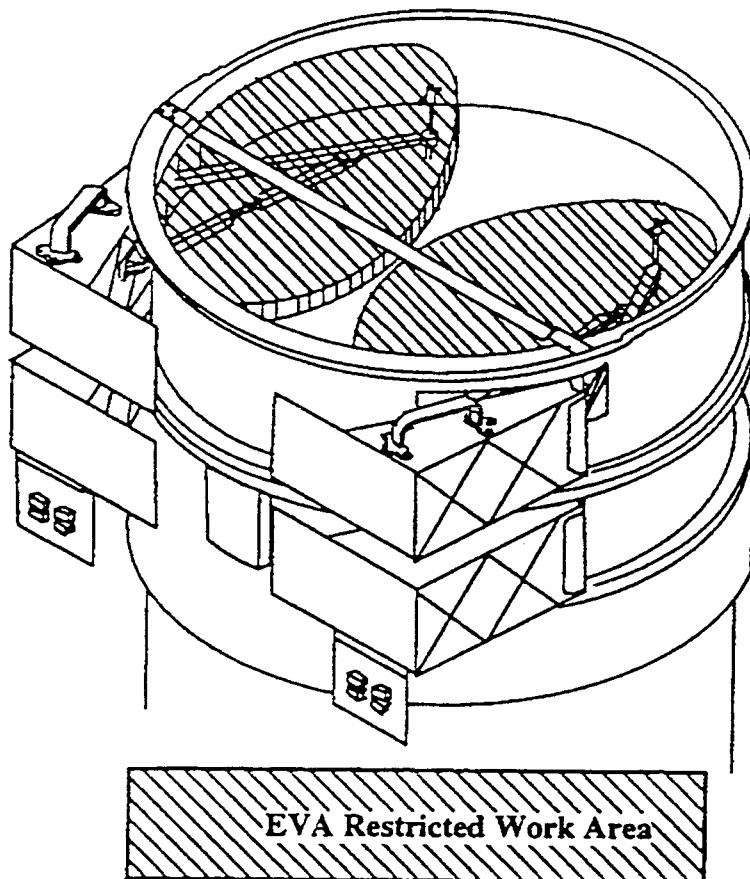


SOLAR ARRAY LOCKING ARMS

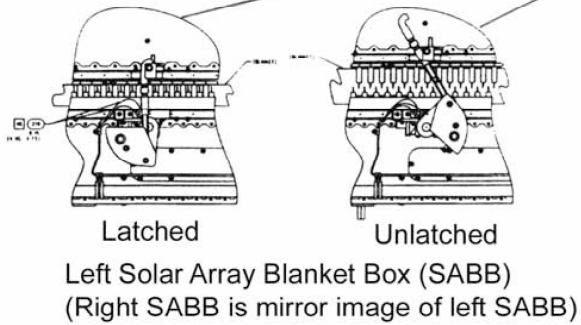
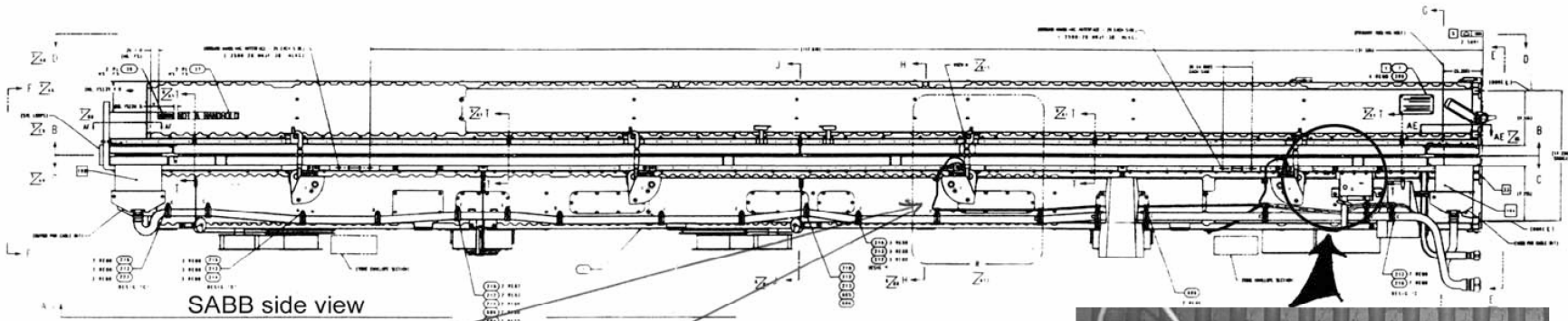
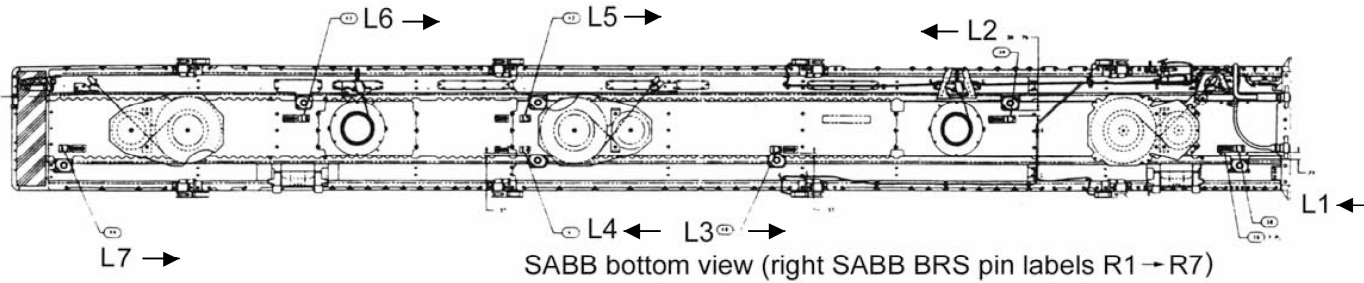
MAST CANISTER MDA



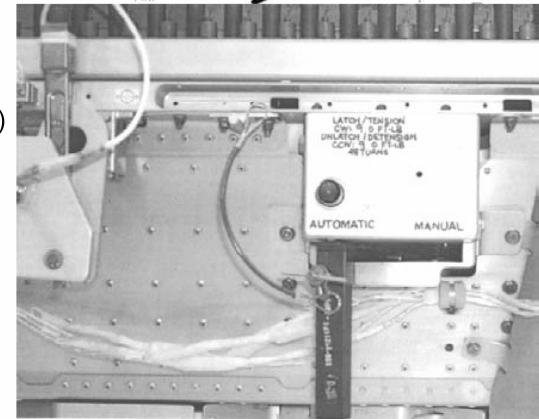
MAST CANISTER TIP/PIVOT ASSEMBLY KEEPOUT ZONE



SOLAR ARRAY BLANKET BOX (SABB)

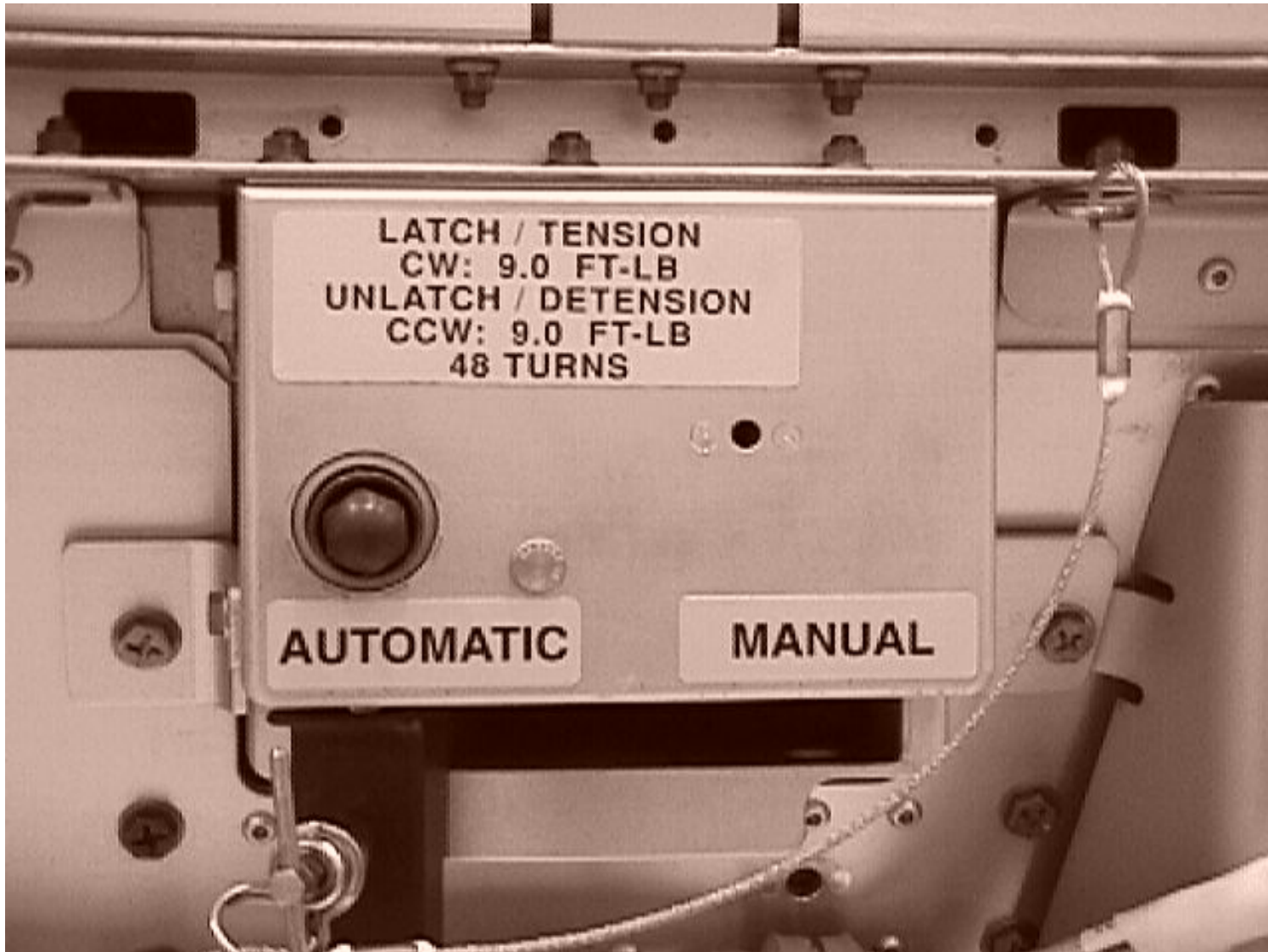


(See enlarged photo next page)

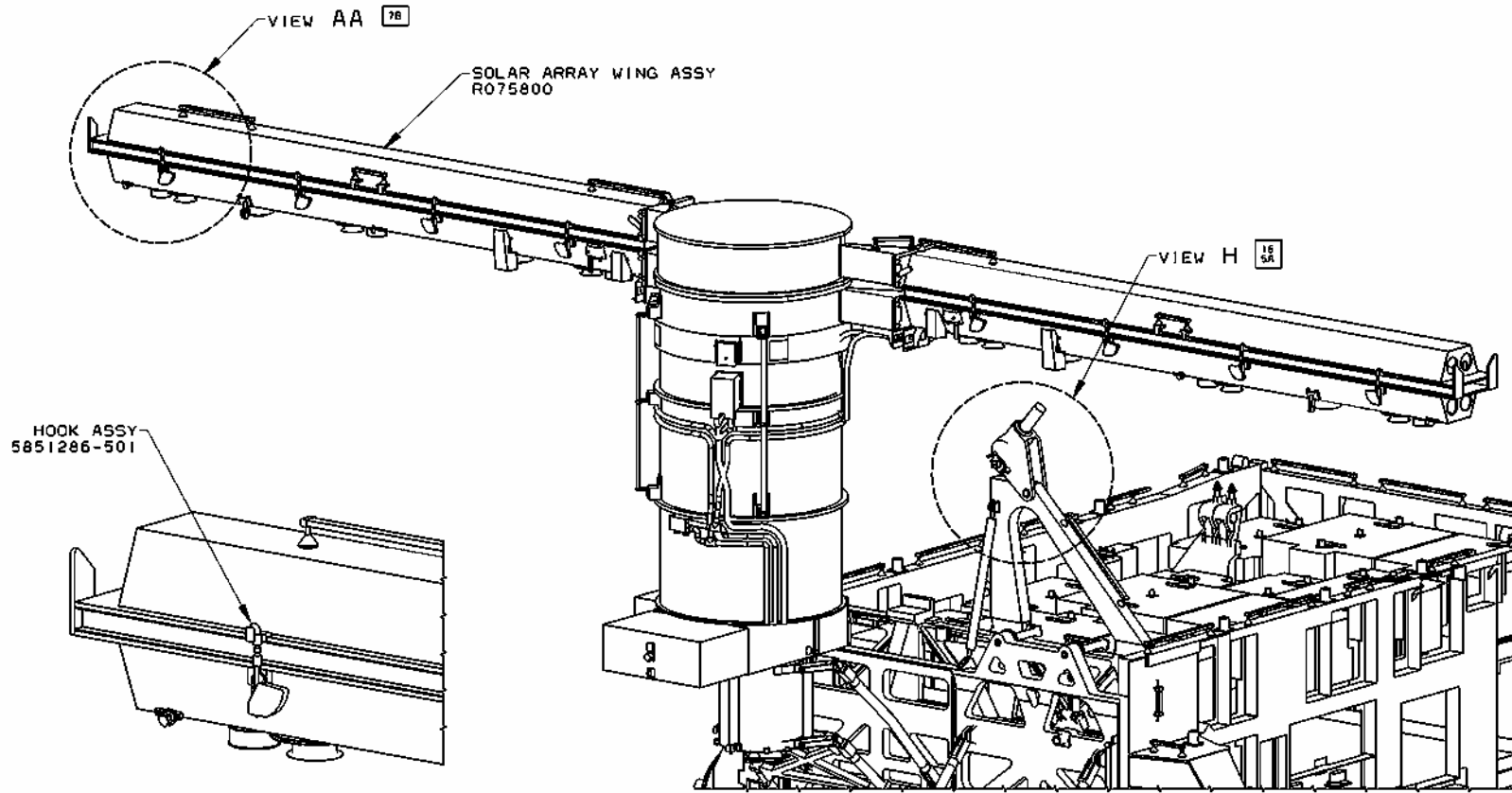


SABB MDA

SABB MDA

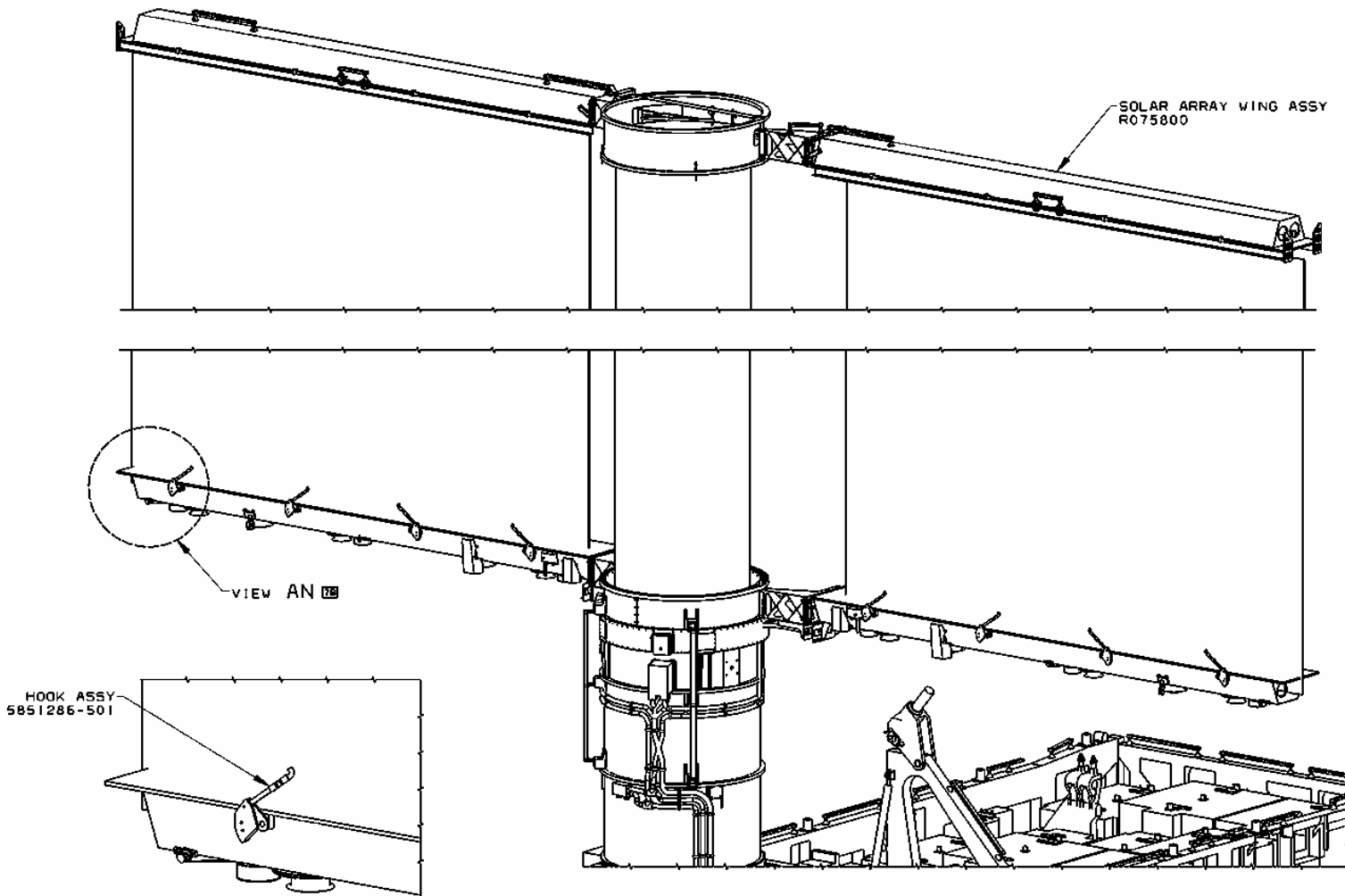


DEPLOY CHANNEL 4A (LOWER) PV SAA



VIEW AA 78
CH-4A SABB LATCH CLOSED POSITION (8 PLACES EACH BOX)
(CH-2A SAME AS CH-4A)

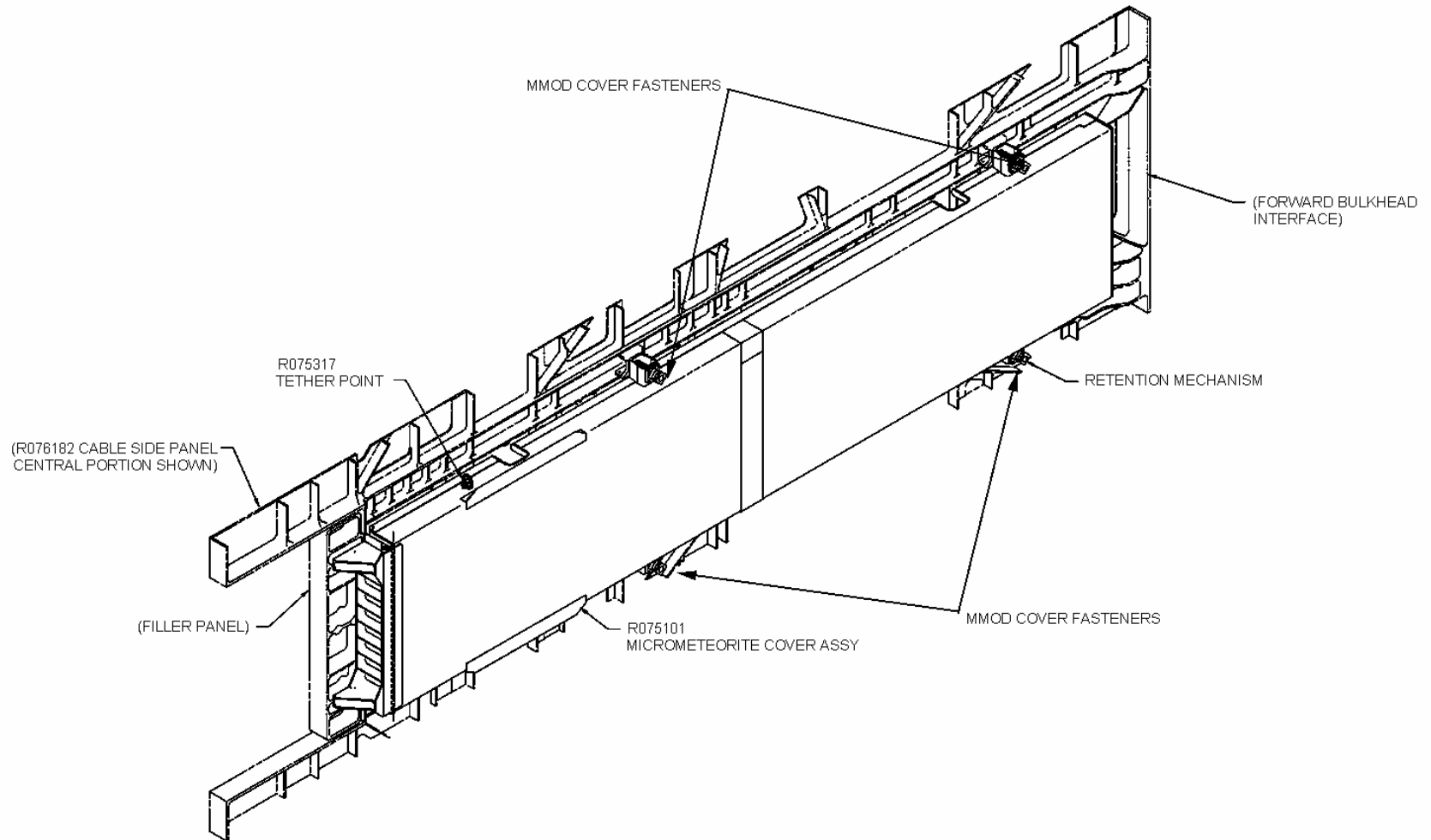
DEPLOY CHANNEL 4A (LOWER) PV SAA (Cont)



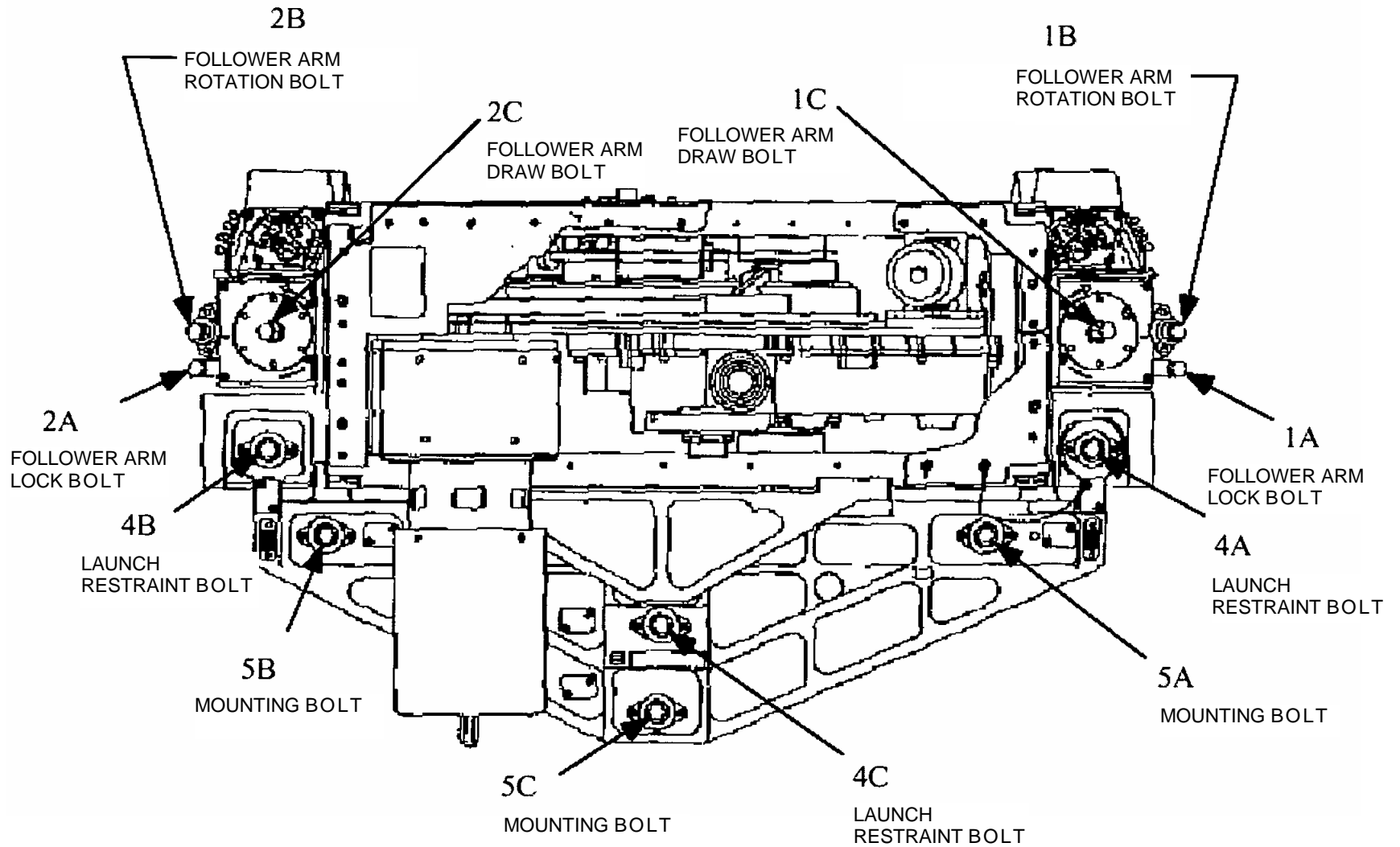
CH-4A SABB LATCH OPEN POSITION (8 PLACES EACH BOX)
(CH-2A SAME AS CH-4A)

VIEW AN

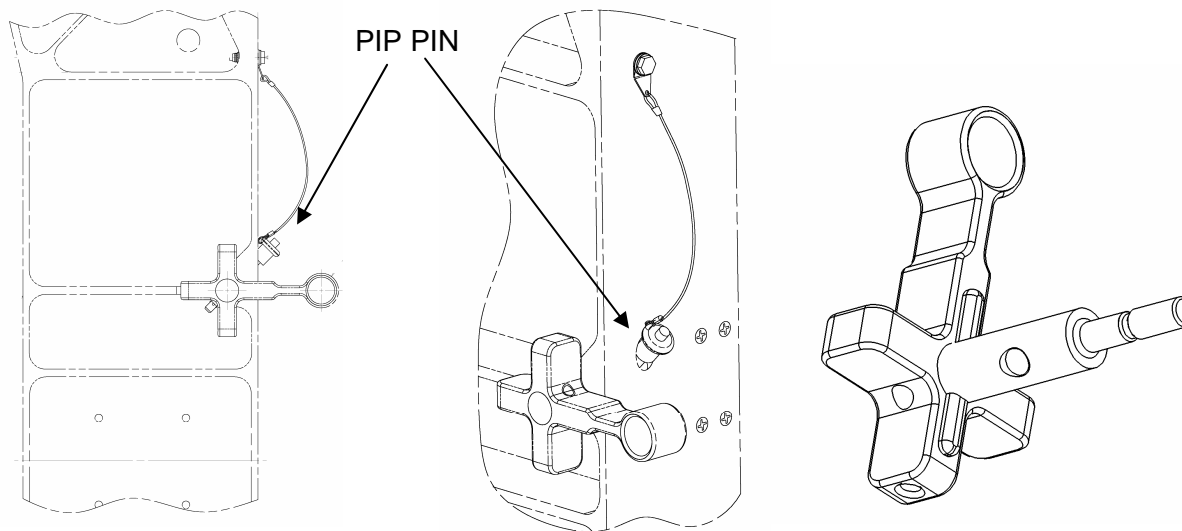
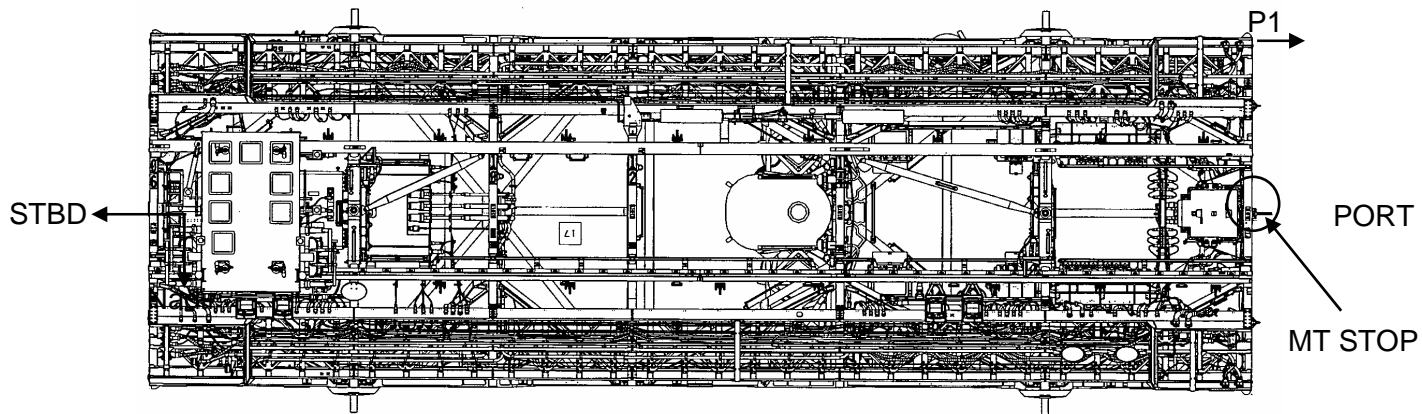
IEA MMOD COVER



SARJ DLA EVA BOLT CONFIG



P1 MT STOP



MT STOP DEPLOYED

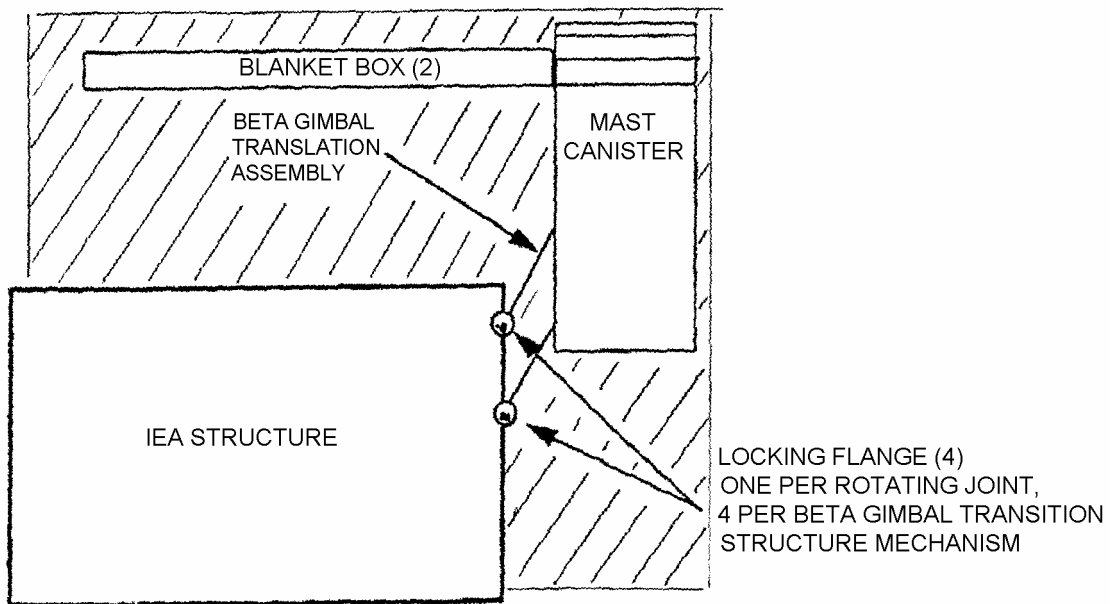


MT STOP DEPLOYED

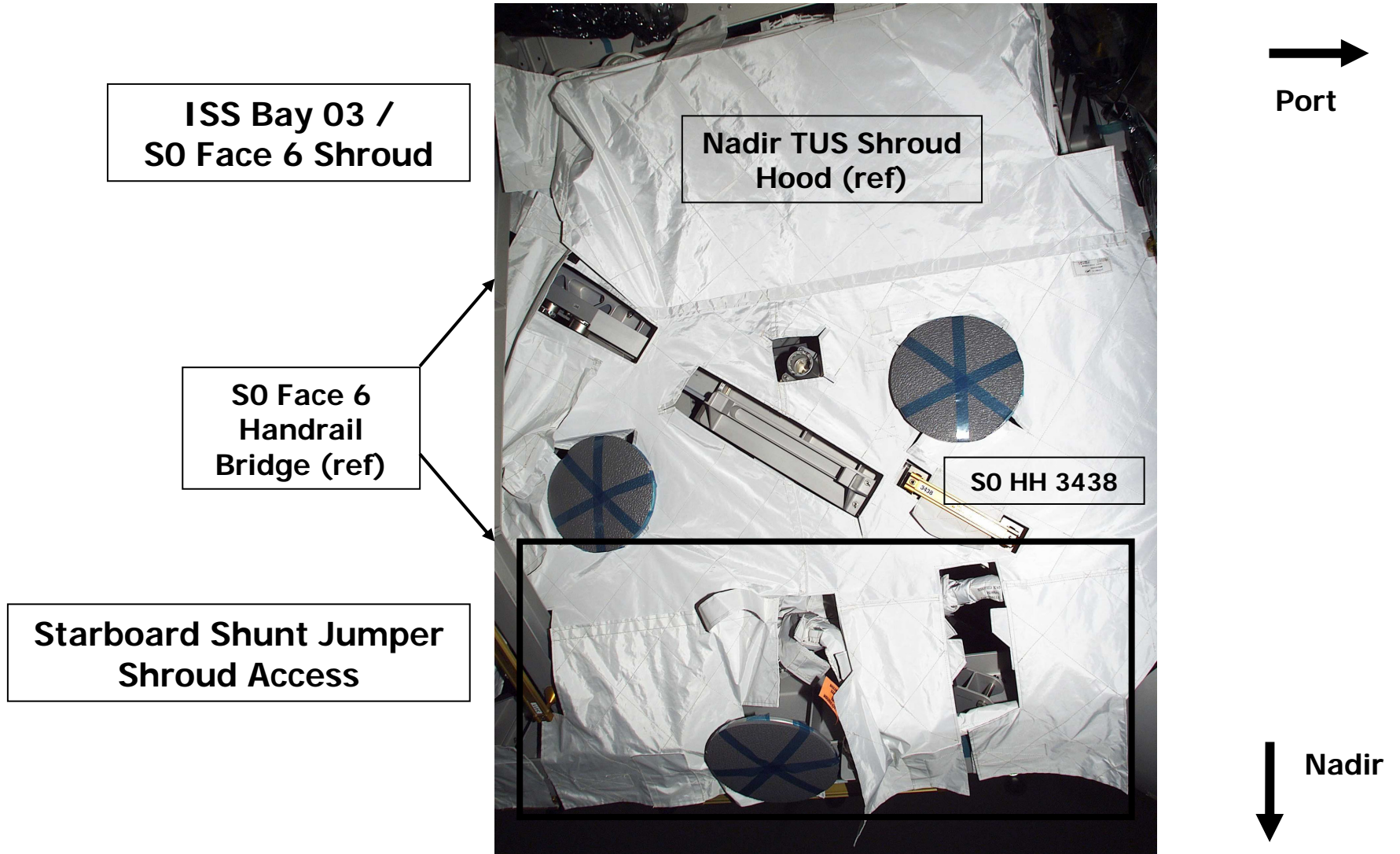
EVA KEEPOUT ZONE

During 4-Bar Linkage Deployment

IEA AND BETA GIMBAL ASSEMBLY INTERFACE WITH 4-BAR MECHANISM

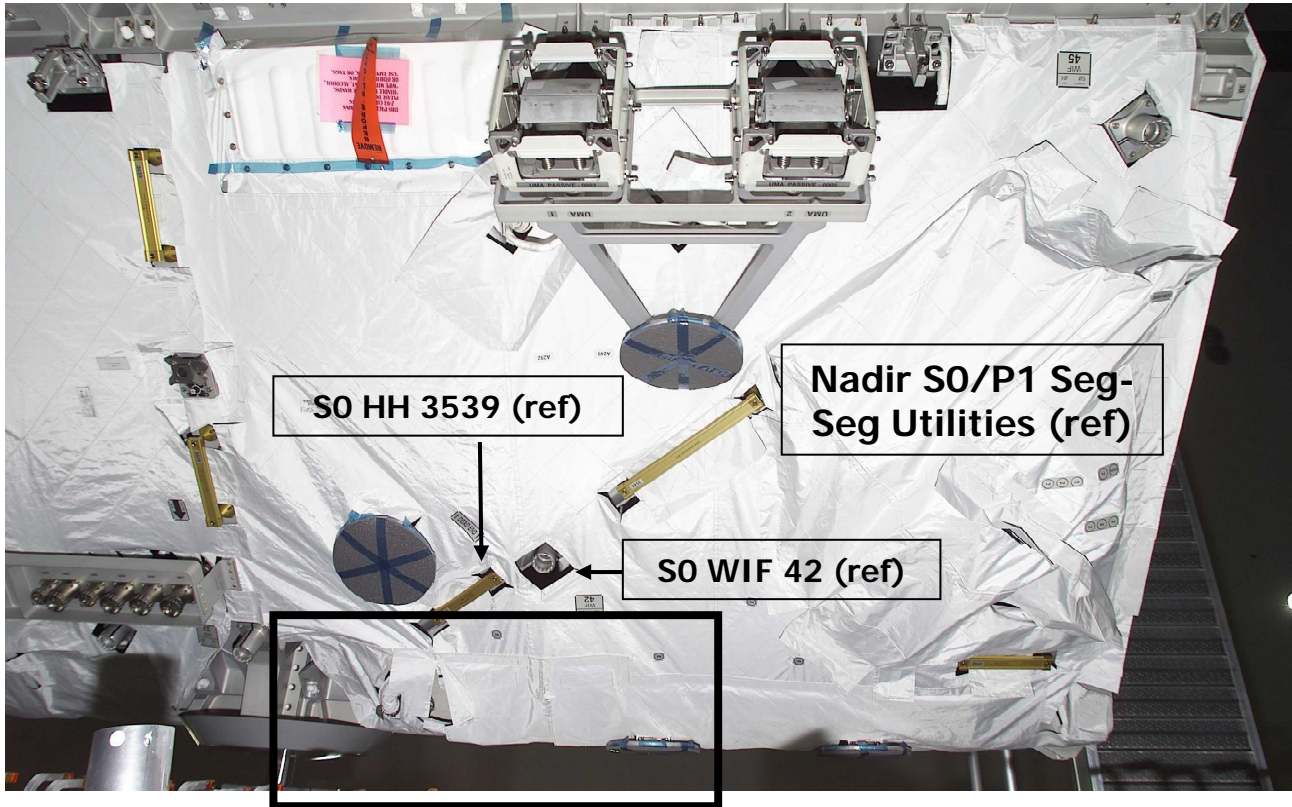


S0 STBD SHUNT JUMPER WORKSITE



S0 PORT SHUNT JUMPER WORKSITE

ISS Bay 04 / S0 Face 6 Shroud



S0 HH 3539 (ref)

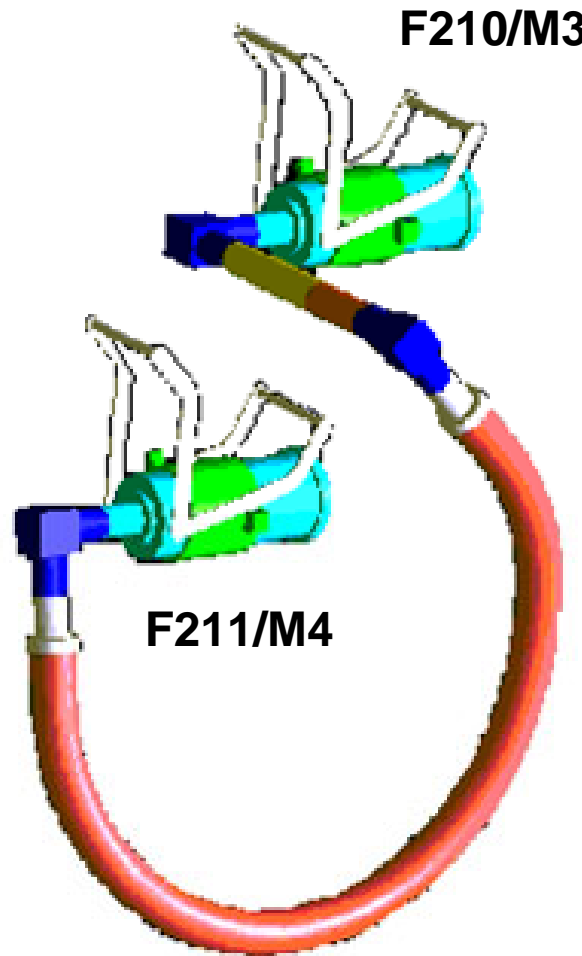
Nadir S0/P1 Seg-Seg Utilities (ref)

S0 WIF 42 (ref)

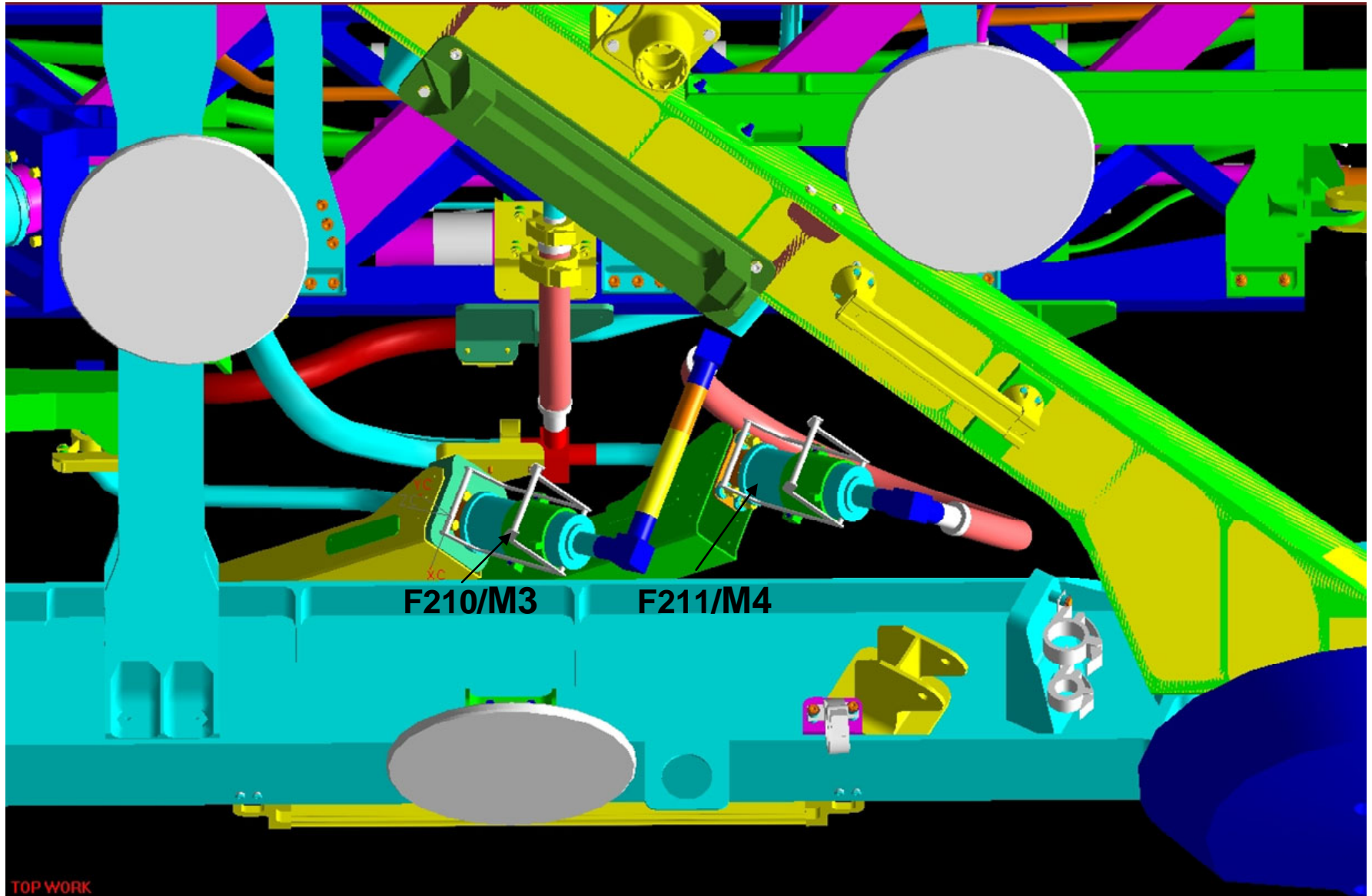
Port Shunt Jumper Shroud Access



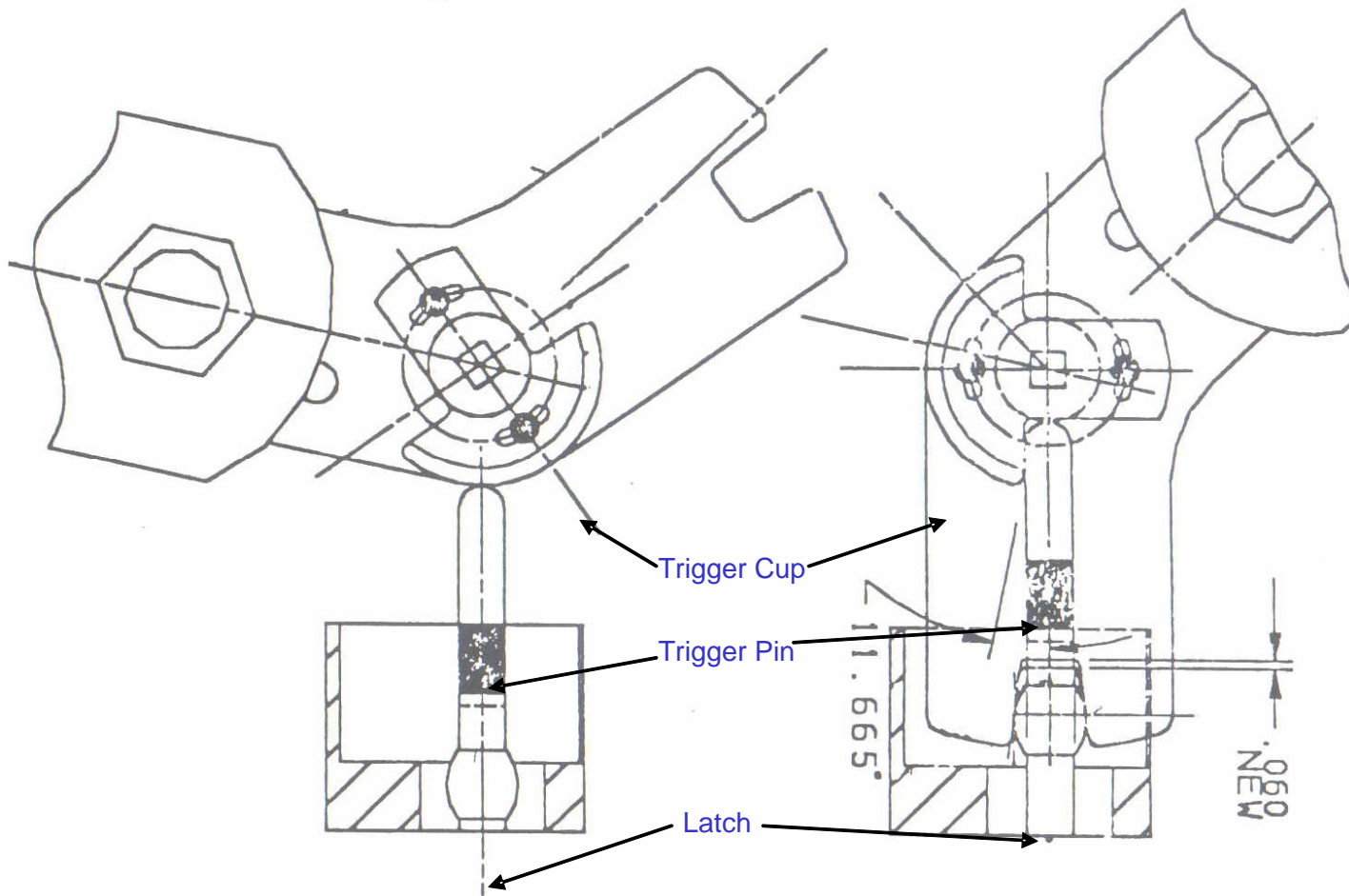
S0 STBD SHUNT JUMPER ISOMETRIC VIEW



S0 STBD SHUNT JUMPER INSTALLED



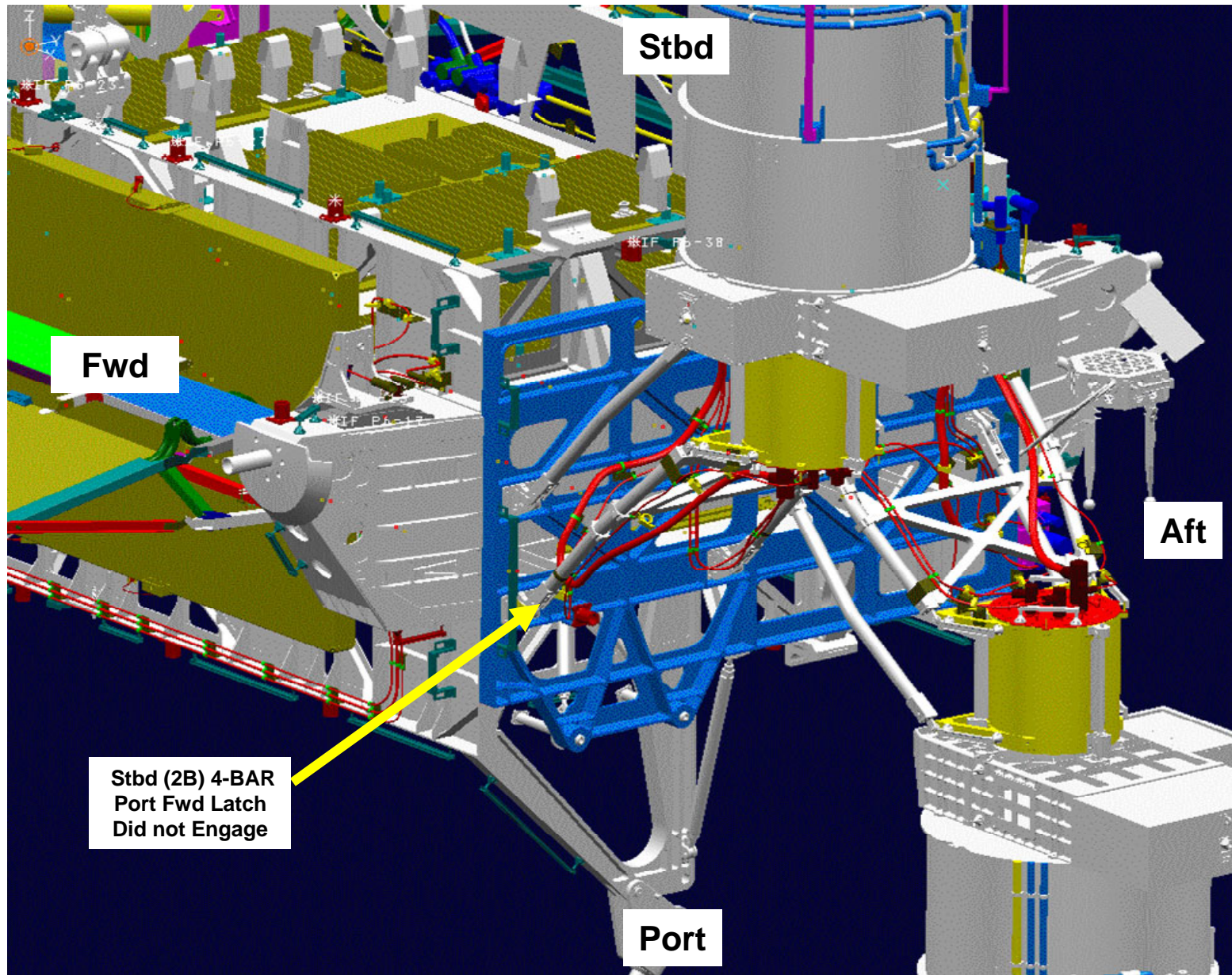
4-BAR STOWED AND DEPLOYED CONFIGURATIONS



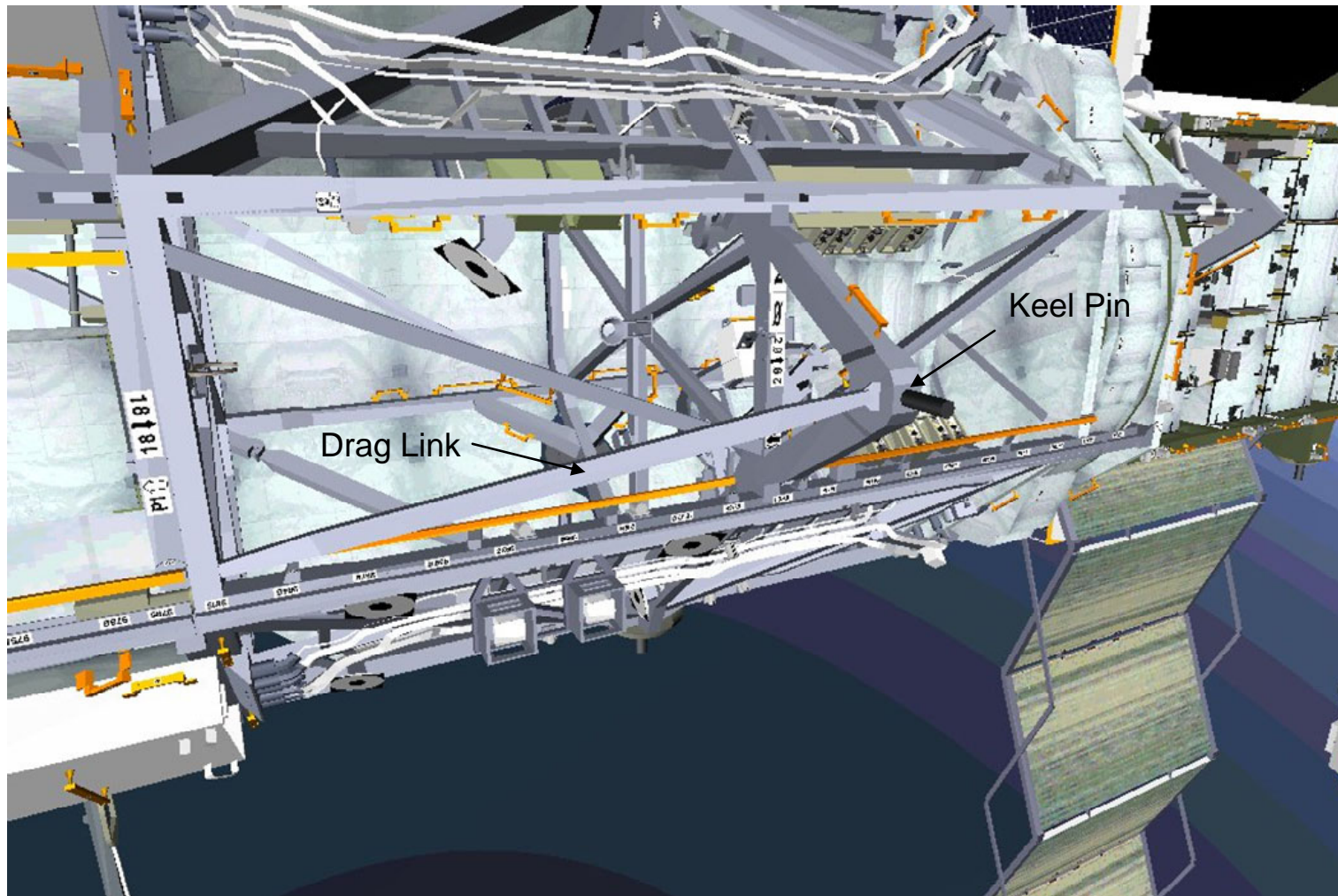
**Stowed
(Launch Configuration)**

**Deployed
(On-Orbit Configuration)**

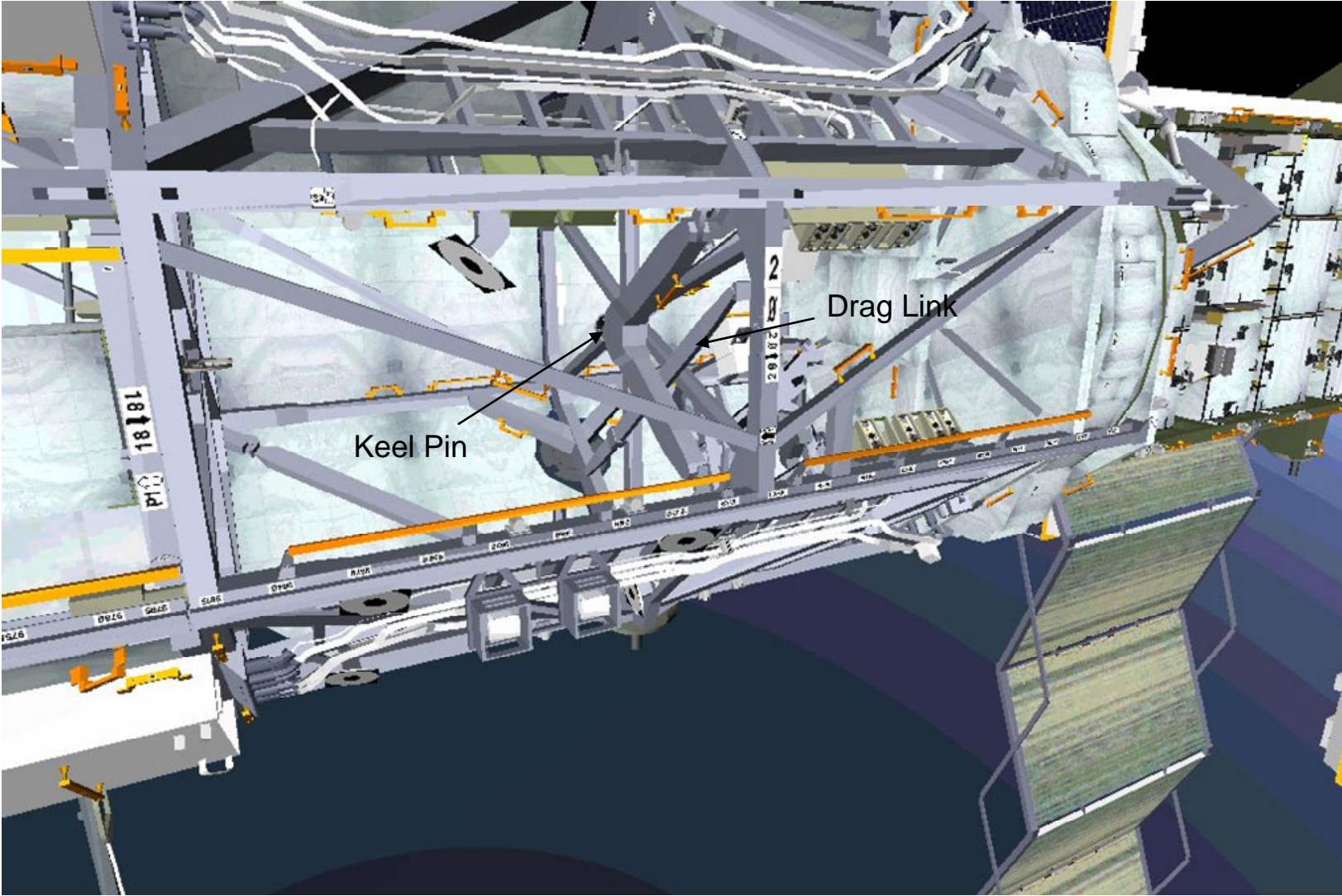
4-BAR PORT FWD LATCH (2B)



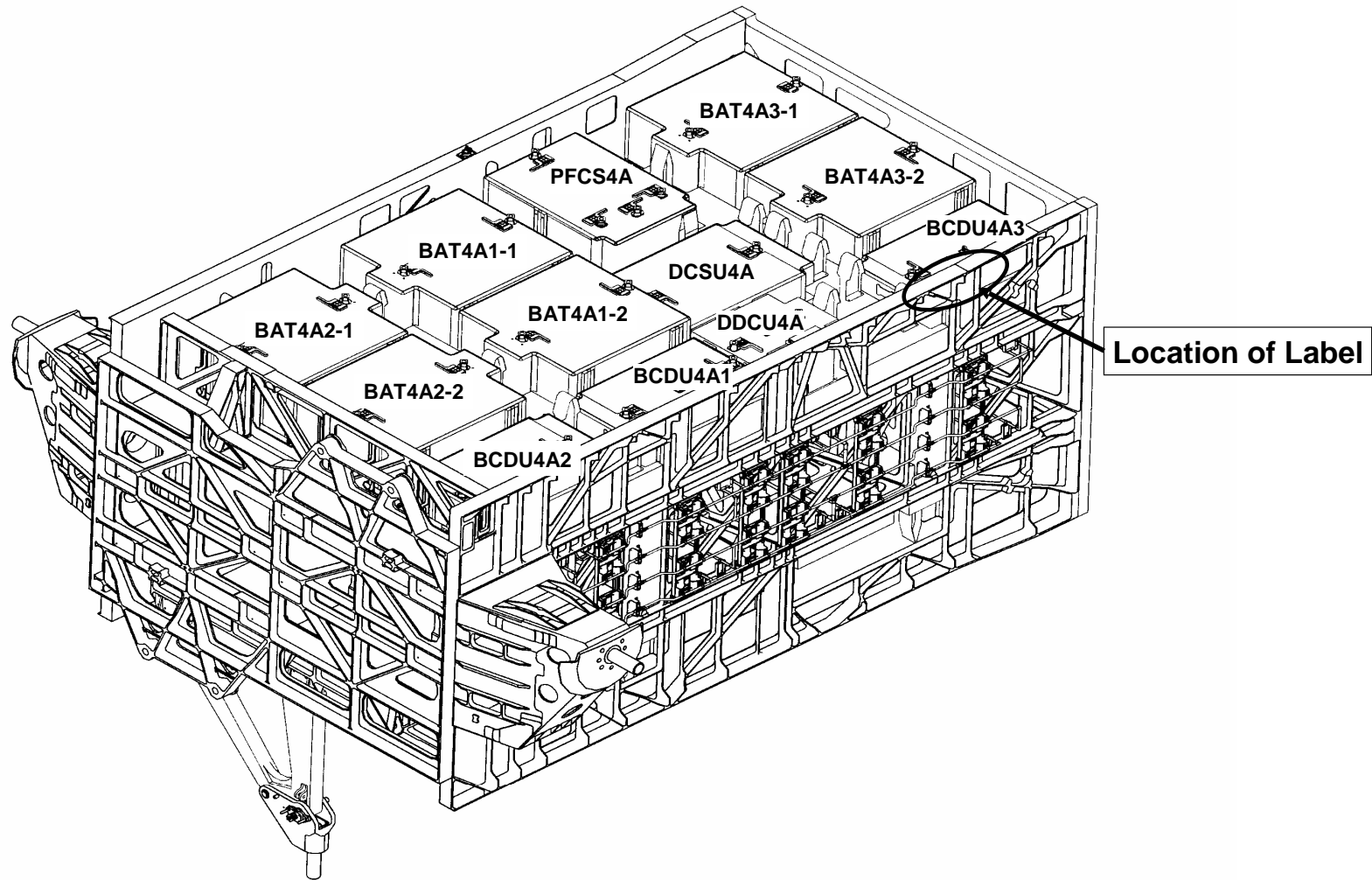
KEEL PIN AND DRAG LINK LAUNCH CONFIG



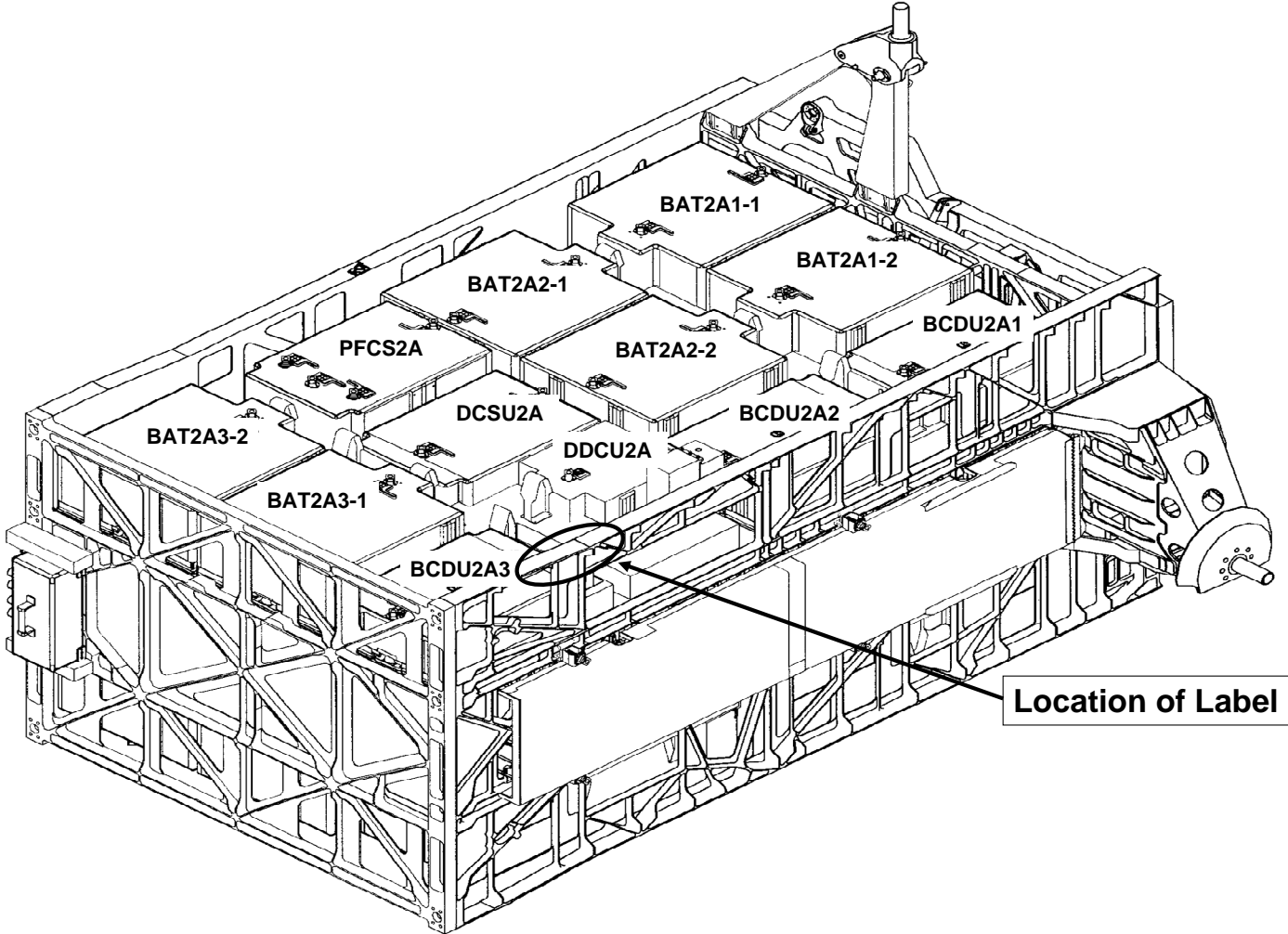
KEEL PIN AND DRAG LINK STOWED CONFIG



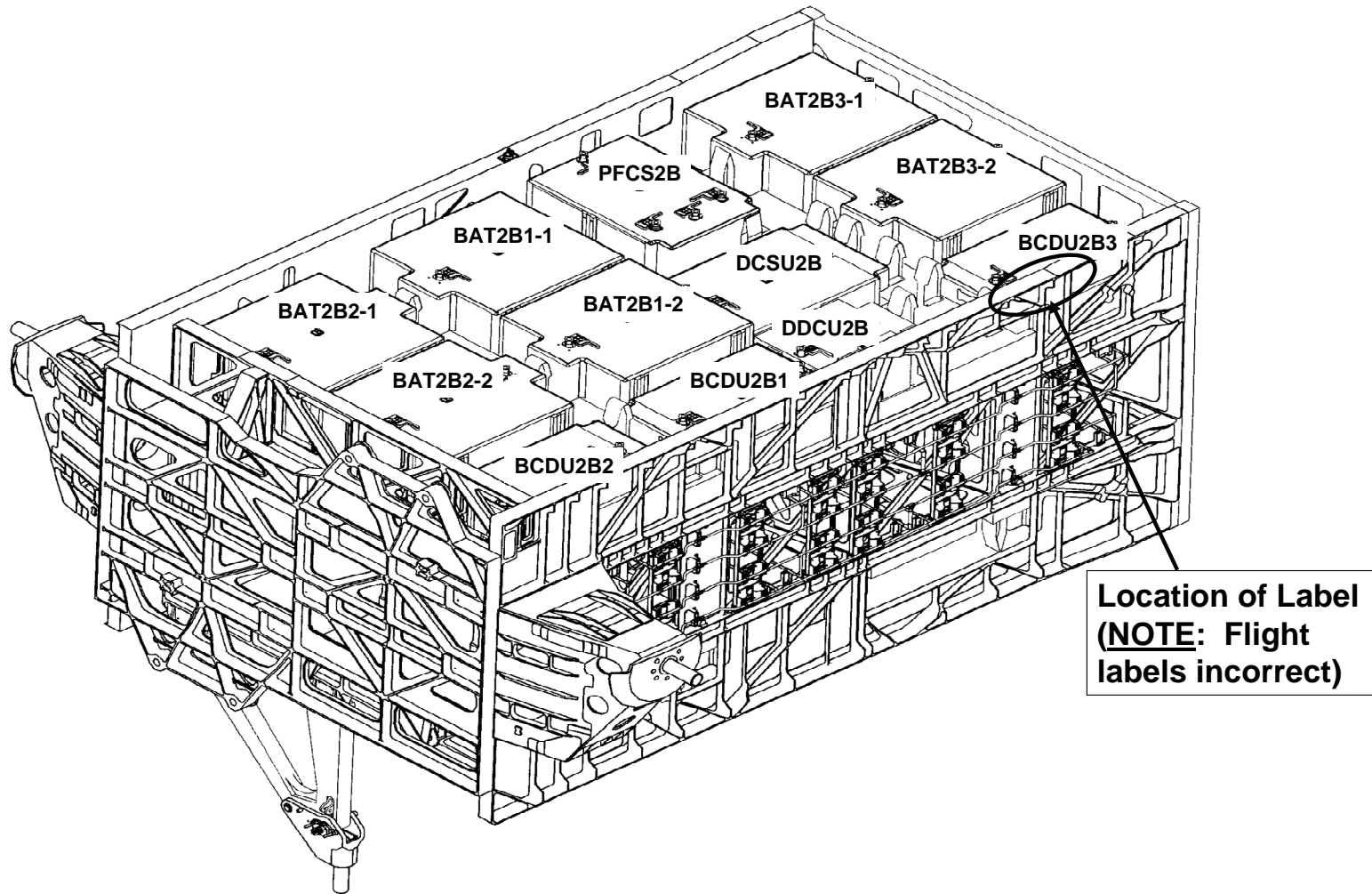
P4 UPPER ORU AND CABLE BOX NUMBERS



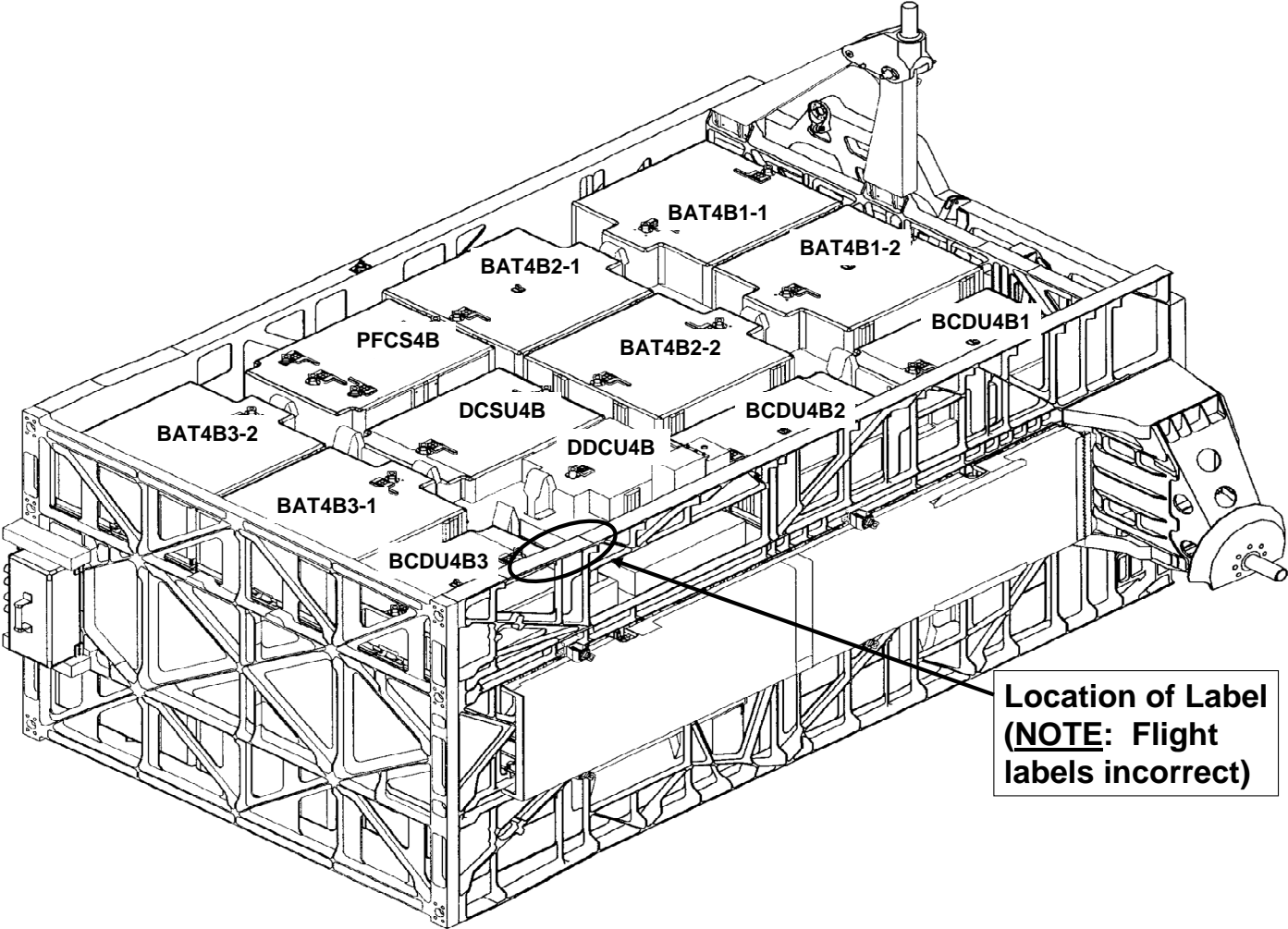
P4 LOWER ORU AND CABLE BOX NUMBERS

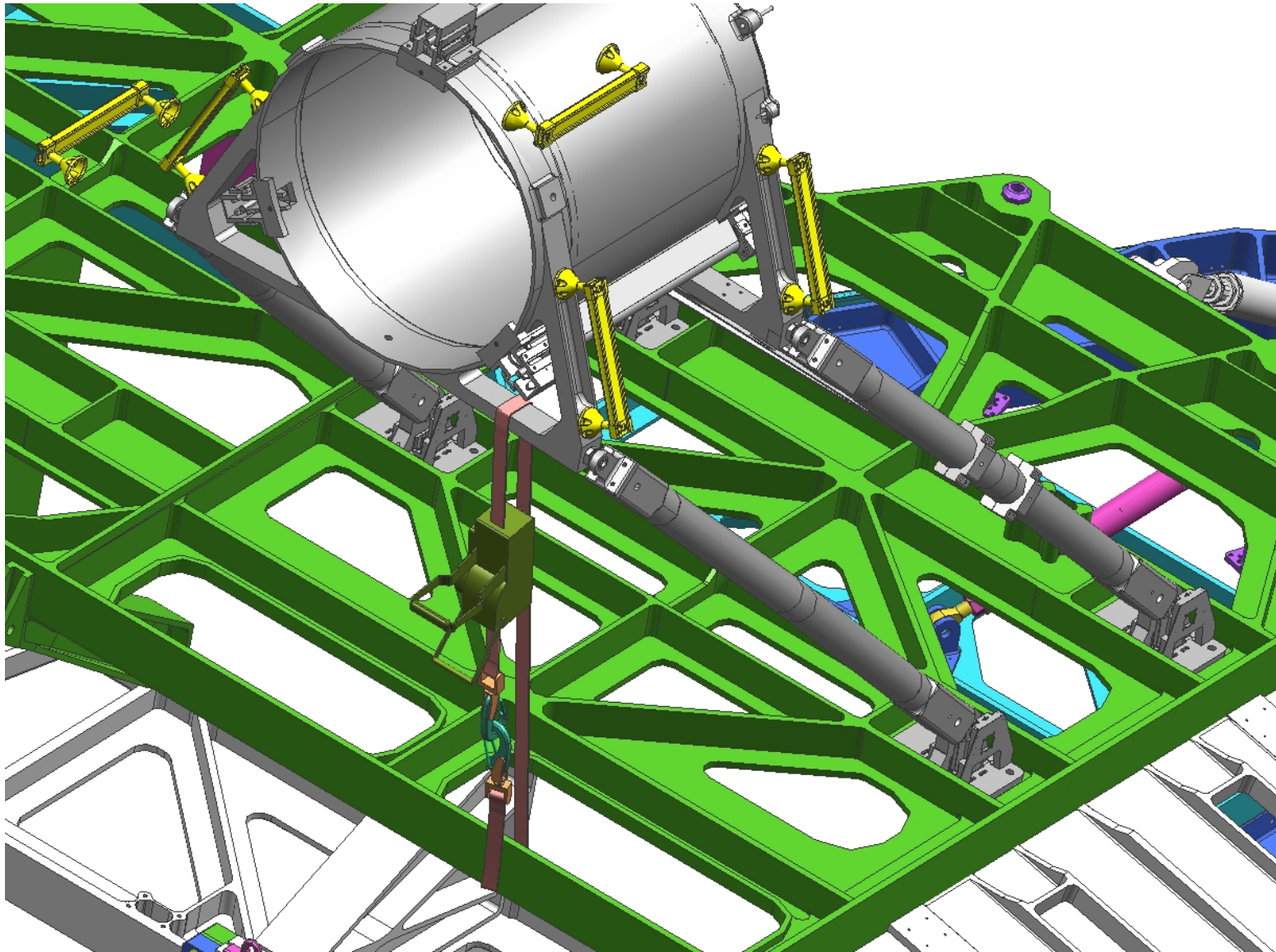


P6 UPPER ORU AND CABLE BOX NUMBERS



P6 LOWER ORU AND CABLE BOX NUMBERS







EVA CHECKLIST

STS
115