US EVA 15 - SUMMARY TIMELINE

PET HR : MIN	IV/SSRMS	EV1 (Wo)	EV2 (Cl)	
00:00	MT at WS 2	POST DEPRESS (00:05)	POST DEPRESS (00:05)	00:00
		EGRESS (00:25)	EGRESS (00:25)	
		SETUP (00:20) Translate to S1 (w/ C/L bags) Temp Stow bags	SETUP (00:30) Retrieve Vent Tool and PM jumper bag Translate to S1 (w/ vent tool, and PM jumper bag) Temp stow bag	
01:00		FAILED PM REMOVAL INITIAL PREP (00:50) Open MLI Release P-clamps(3 of 4), TA clamps (3 of 4), SPDs (all 4)	CETA CART PREP (00:50) Retrieve APFR from STBD CETA Cart Port CETA Cart setup	01:00
		SSRMS PREP AND INGRESS (00:25) Install APFR Ingress SSRMS		
02:00		FAILED PM QD OPS (01:05) Demate QDs Install Jumper Shroud QDs	PM JUMPER VENT (00:15) FAILED PM QD OPS (01:05) Demate QDs Install Jumper Shroud QDs	02:00
03:00	NH3 Ops Complete	RETRIEVE AGB (00:45) Retrieve AGB from ESP-2 Return to S1	PREP FAILED PM FOR REMOVAL (00:45) On MCC-H GO, disconnect & restrain NZGLs Break torque on all bolts Release 3 bolts	03:00
04:00		REMOVE FAILED PM (00:20) Attach RET & hold PM; Attach AGB, Remove PM from truss	REMOVE FAILED PM (00:20) Attach AGB	04:00
		FAILED PM TO POA (00:20) SSRMS translate to POA; Install failed PM into POA	SPARE PM PREP (01:10) Translate to ESP-2 start prep work - Open MLI - Remove tape - Break torque on 4 bolts; release 3 bolts	
05:00	**BINGO**: For a 6:30 EVA, 4:55 PET to start REMOVE SPARE PM	SPARE PM PREP (00:50) SSRMS translate to ESP2 (00:15) Spare PM prep (00:35)		05:00
		REMOVE SPARE PM (00:30) Release final bolt; Remove spare from ESP2 (00:15) SSRMS translate to S1 (00:15)	REMOVE SPARE PM (00:30) GCA PM removal; translate to S1	
06:00		INSTALL SPARE PM (00:35) PM install, engage bolts Mate NZGLs (J2, J4 & J5 min rqd)	INSTALL SPARE PM (00:35) Assist PM install Mate NZGLs (J2, J4 & J5 min rqd)	06:00
		CLEANUP/INGRESS (00:25) Minimal cleanup	CLEANUP/INGRESS (00:25) Minimal cleanup	
07:00		PRE-REPRESS (00:05)	PRE-REPRESS (00:05)	07:00

US EVA 15 - TOOL CONFIG

EV 1

- ☐☐ MWS
  - ☐☐ BRT (L)
    - ☐☐ RET (sm-sm)
    - ☐☐ Wire Tie (3)
    - ☐■ Long Wire Tie (for PM MLI)
  - ☐☐ T-Bar
    - ☐☐ RET (sm-sm) (initially use to tether WIF Adapter)
      - ☐■ WIF Adapter (use EE to secure to bunny ears)
    - ☐☐ RET w/PIP Pin
    - ☐☐ RET(Lg-sm) for PM
    - ☐☐ Adj Equip Tether (3)
    - ☐☐ Wire Tie (2)
    - ☐☐ Small ISS Trash Bag
      - ■☐ Wire tie from SPDs lanyards
  - ☐☐ Swing Arm (R)
    - ☐☐ RET (sm-sm)
      - ☐☐ PGT s/n _____
        - ☐☐ PGT Battery s/n _____
        - ☐☐ 7/16 (rigid) Socket-2 ext
- ☐☐ D-ring Extender (2, R & L D-ring)
  - ☐☐ 85-ft Safety Tether (L D-ring Ext)
  - ☐☐ 55-ft Safety Tether (R D-ring Ext)
- ☐☐ Waist Tether (2, R & L on D-ring)
  - L Waist Tether to 85-ft Safety Tether
- ☐☐ SAFER
- ☐☐ WVS

NOTE: Prior to use, inspect the following hardware:

- ❑ RET cords for fraying
- ❑ Inspect Load Alleviating Straps and D-ring Extenders; ref CREW TETHER INSPECTIONS, ISS EVA Tasks Checklist:
  1. MMOD/general damage
  2. Discoloration
  3. Tack Stitching
  4. Red Band
- ❑ ISS Trash Bag: Verify zipper closed, check for bristle deformation/damage - after having stowed tools in trash bag
- ❑ BRT joint screws not loose

EV 2

- ☐☐ MWS
  - ☐☐ BRT (L)
    - ☐☐ RET (sm-sm)
    - ☐☐ Wire Tie (3)
  - ☐☐ T-Bar
    - ☐☐ RET (sm-sm)
    - ☐☐ RET(Lg-sm) (2)
    - ☐☐ RET w/PIP Pin
    - ☐☐ Adj Equip Tether (3)
    - ☐☐ Wire Tie (4)
    - ☐☐ Small ISS Trash Bag
      - ■☐ tape from PM
      - ■☐ Wire Ties from CETA Cart
  - ☐☐ Swing Arm (R)
    - ☐☐ RET (sm-sm)
      - ☐☐ PGT s/n _____
        - ☐☐ PGT Battery s/n _____
- ☐☐ D-ring Extender (2, R & L D-ring)
  - ☐☐ 85-ft Safety Tether (R D-ring Ext)
- ☐☐ Waist Tether (2, R on D-ring, L on D-ring Ext)
  - R Waist Tether to 85-ft Safety Tether
- ☐☐ Adj Equip Tether (L wrist, buckle on inside)
- ☐☐ SAFER
- ☐☐ WVS

Tether Counts: (Red RETs)
RETs (sm-sm) = 10 of 16
RETs (Lg-sm) = 4 of 8
RETs (PIP Pin) = 2 of 5

Adj Equip Tethers:
(sm-sm) = 10 of 10
(Lg-sm) = 2 of 2

AIRLOCK

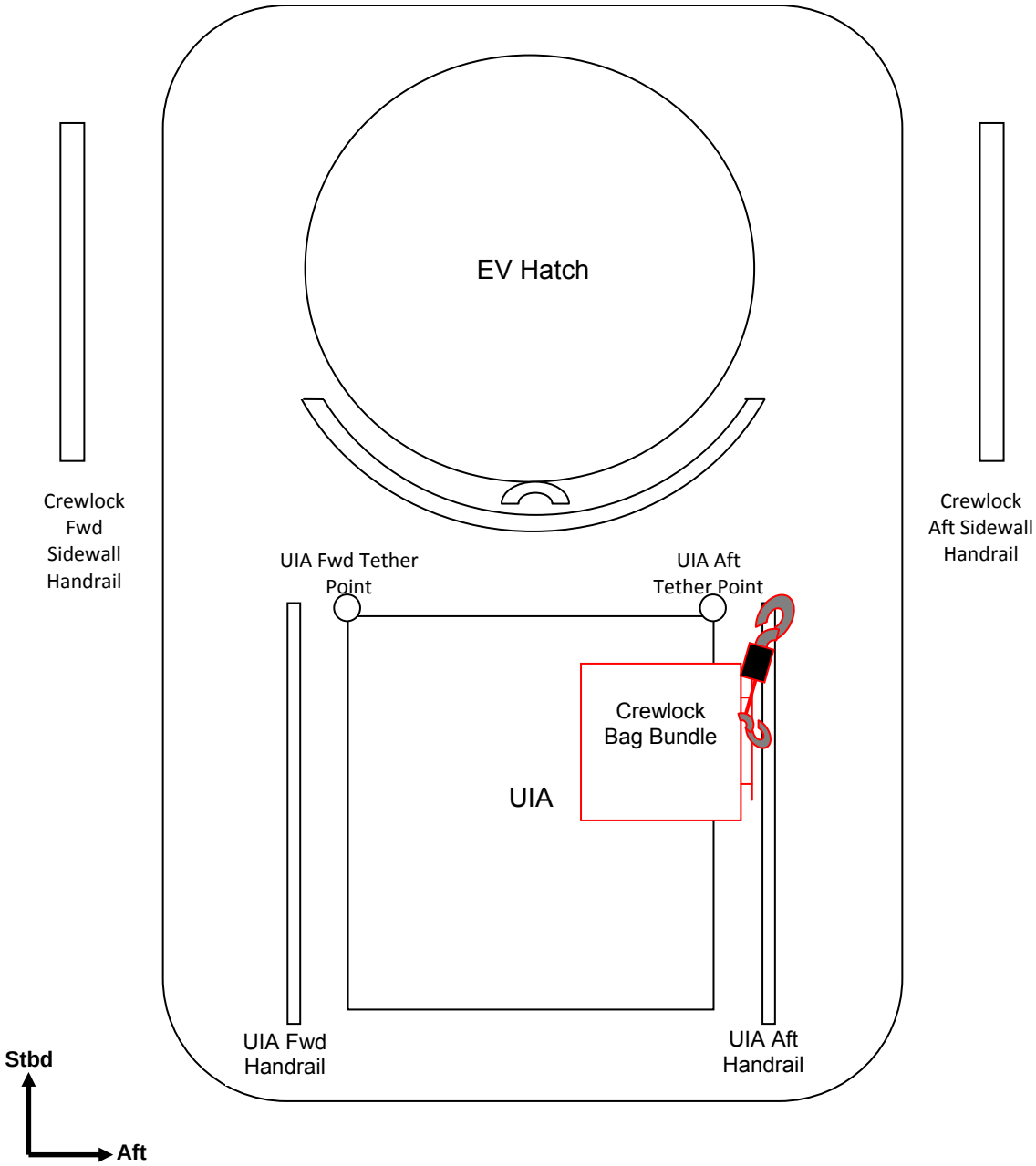
- ☐☐ RET(Lg-sm) (leave in A/L)
  - ☐☐ **Crewlock Bag 2 (bundle C/L Bags together)**
    - ☐☐ Adj Equip Tether (Lg-sm) (on outside of bag)
    - ☐☐ Scissors (Int RET 1)
    - ☐☐ Socket Caddy (Int RET 2)
      - ☐☐ 7/16 (wobble) Socket-6 ext
      - ☐☐ 5/8 Socket 7.8-ext
    - ☐☐ RET (sm-sm)
      - ☐☐ Round Torque Multiplier
        - ☐☐ 5/8" TM socket (proud)
    - ☐☐ Fish Stringer (for spare PM caps)
      Small hooks attached to second large crew hook
    - ☐☐ RET (sm-sm) (extra)
      - ☐☐ Wire-Tie Caddy (moved from staging bag)
    - ☐☐ EVA Camera w/bracket (on internal D-ring)
    - ☐☐ Scoop (Int RET 4)
    - ☐☐ Long T-Handle Tool (for PM tape) (Int RET 3)
  - ☐☐ **Crewlock Bag 1**
    - ☐☐ Adj Equip Tether (Lg-sm) (on outside of bag)
    - ☐☐ RET (sm-sm)
      - – ■☐ 0.5" SPD
    - ☐☐ 1.5" Bail Drive Lever Tool (Int RET 1)
    - ☐☐ 1.5" QD Release Tool (Int RET 2)
    - ☐☐ Fish Stringer (attached inside bag)
      - – ☐☐ Adj Equip Tether
      - – ☐☐ Adj Equip Tether
      - – ☐☐ Jettison Stowage Bag Assy
    - ☐☐ Fish Stringer (attached inside bag)
      - – ☐☐ Adj Equip Tether
      - – ☐☐ Jettison Stowage Bag Assy
    - ☐☐ Wire-Tie Caddy w/ 6 long & 3 short (int RET 3)
    - ☐☐ Socket Caddy (int RET 4)
      - ☐☐ 5/8 Socket 7.8-ext
      - ☐☐ 7/16 (wobble) Socket 6-ext
    - ☐☐ RET (sm-sm) (extra)

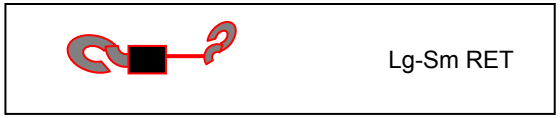
US EVA 15 - TOOL CONFIG

AIRLOCK CONT'D

- ☐☐ Staging Bag
  - ☐☐ Fish Stringer Tether
    - ☐☐ Velcro/Tape Caddy
    - ☐☐ PGT s/n _____
      - ☐☐ PGT Battery s/n _____
      - ☐☐ 7/16 (wobble) Socket-6 ext
    - ☐☐ Ratchet Wrench
      - ☐☐ 7/16 (rigid) Socket-2 ext
    - ☐☐ Spare WIF Adapter
    - ☐☐ Torque Wrench Bag
      - ☐☐ Torque Wrench
    - ☐☐ Long Duration Tie Down Tethers (2)
    - ☐☐ Pin Straightener Assembly
    - ☐☐ Spare 85 ft Safety Tether
  - ☐☐ Fish Stringer Tether
    - ☐☐ ERAD
    - ☐☐ Connector Cleaner Tool Kit
    - ☐☐ Pry Bar
    - ☐☐ Needle Nose Pliers
    - ☐☐ MWS Key Strap Assy (on wire tie, to strap)
    - ☐☐ Probe
    - ☐☐ Vise Grips
    - ☐☐ RET (around tether strap between hooks)
      - ☐☐ MUT EE

- ☐☐ IV Bag
  - ☐☐ Towels (2)
  - ☐☐ Contamination Detection Kit
  - ☐☐ GP Caddy (2)
    - ☐☐ Adjustable Thermal Mittens (2)
  - ☐☐ Socket Caddy (hatch cont) w/RET (sm-sm) (Black)
    - ☐☐ 1/2 Socket-8 ext
    - ☐☐ 7/16 (wobble) Socket-6 ext (spare)
  - ☐☐ DCM Plug (SAFER Hardmount) (2)
  - ☐☐ RET (sm-sm, Black) (2)


EV Hatch
Crewlock Fwd Sidewall Handrail
Crewlock Aft Sidewall Handrail
UIA Fwd Tether Point
UIA Aft Tether Point
Crewlock Bag Bundle
UIA
UIA Fwd Handrail
UIA Aft Handrail
Stbd
Aft


Lg-Sm RET

Tool Legend

Ground

ALL EVAs

Ground Radar (Prior to Egress)
MCC-H 1. √TOPO console, ground radar restrictions in place for EVA

USOS (1)

ALL EVAs

SARJ
MCC-H Lock Stbd and Port SARJs
1. √DLA (1) – LOCKED
2. All motor setpoints set to zero.
3. All motors deselected.

PCU (Prior to Egress)

NOTE
PCUs may require up to a 1-hour warmup period before they are operational.

MCC-H 1. √PCUs (two) operational in discharge mode and one of the following:
a. CCS PCU EVA hazard control FDIR enabled.
b. No more than two arrays unshunted and oriented <105º from velocity vector.

If one or both PCUs failed
2. No more than two arrays unshunted and oriented <105º from velocity vector.

CUCU (Prior to Egress)
IV – (LAB1O4)
1. √ cb POWER A, B [two] - OPEN
2. √ cb LINK 1,2 [two] - OPEN

And One of the following inhibit pairs:
MSFC / PRO 3a. Express Rack 2 Locker 6 – Power Removed
3b. Express Rack 6 Locker 7 – Power Removed
OR
IV 4a. Express Rack 2 Locker 6 – OFF
4b. Express Rack 6 Locker 7 – OFF

LOCATION DEPENDENT INHIBITS

Lab Window (Prior to Egress)
IV If EV crew less than 10 feet from window or in window FOV, close window shutter.

S-Band (SASA) Antennas (Not Expected)
MCC-H Crew must observe a 3.6 foot KOZ from S1 SASA
1. P1 SASA – Active
2. S1 SASA – Hot B/U

Mobile Transporter (Prior to Egress)
MCC-H EV crew < 1.5 meters from MT
1. √MT latched

USOS (2)

LOCATION DEPENDENT INHIBITS

STBD TRRJ (Prior to Egress)
MCC-H
1. √DLA (1) – LOCKED @ 0°

Spare PM Removal from ESP-2 (Prior to Spare PM Prep)

MCC-H 1.√ RPCM S04B_F RPC 10 Open / Close Inh - PM Heater 1 Pwr
2.√ RPCM N1RS2_B RPC 6 Open / Close Inh - PM Heater 2 Pwr

Failed PM Removal from Truss

MCC-H (Prior to Egress)

1. RPCM S11A_D RPC 1 Open/Close Inh (PCVP)
2. RPCM S11A_A RPC 5 Open/Close Inh - Loop A PM Accum Heater 2
3. RPCM S12B A RPC 7 Open/Close Inh - Loop A PM Accum Heater 1
4. RPCM S14B G RPC 17 Open/Close Inh - Loop A PM Line Heater 1
5. RPCM S14B-G RPC 18 Open/Close Inh - Loop A PM Line Heater 2
6. DDCU S14B converter off

Note: Item 6 DDCU S14B Converter off, secondary inh for PM line heaters, is required if SSRMS powered by DDCU P13A. If SSRMS swaps strings, DDCU S14B will be powered on. Then need to verify items 4 & 5.

(After QD Demate)

7. RPCM S11A_A RPC 6 Open/Close Inh - Loop A PM Rad Byp Flow Meter
8. RPCM S11A_C RPC 9 Open/Close Inh - Loop A PM Outlet Flow/Temp Meter
9. RPCM S11A_C RPC 10 S1-1 SDO card Open/Close Inh - Loop A PM Outlet Isol Vlv and Loop A PM Rad Rtn Isol Vlv
10. RPCM S11A_C RPC 11 S1-1 SDO card Open/Close Inh - Loop A PM Rad byp Isol Vlv and Loop A PM Supply Isol Relief Vlv

USOS (2 continued)

LOCATION DEPENDENT INHIBITS

New PM Install into Truss

MCC-H (Prior to Spare PM Install)

1. RPCM S11A_D RPC 1 Open/Close Inh - (PCVP)
2. RPCM S11A_A RPC 5 Open/Close Inh - Loop A PM Accum Heater 2
3. RPCM S11A_A RPC 6 Open/Close Inh - Loop A PM Rad Byp Flow Meter
4. RPCM S11A_C RPC 9 Open/Close Inh - Loop A PM Outlet Flow/Temp Meter
5. RPCM S11A_C RPC 10 S1-1 SDO card Open/Close Inh - Loop A PM Outlet Isol Vlv and Loop A PM Rad Rtn Isol Vlv
6. RPCM S11A_C RPC 11 S1-1 SDO card Open/Close Inh - Loop A PM Rad byp Isol Vlv and Loop A PM Supply Isol Relief Vlv
7. RPCM S12B_A RPC 7 Open/Close Inh - Loop A PM Accum Heater 1
8. RPCM S14B_G RPC 17 Open/Close Inh - Loop A PM Line Heater 1
9. RPCM S14B_G RPC 18 Open/Close Inh - Loop A PM Line Heater 2
10. DDCU S14B converter off

Note: Item 10 DDCU S14B Converter off, secondary inh for PM line heaters, is required if SSRMS powered by DDCU P13A. If SSRMS swaps strings, DDCU S14B will be powered on. Then need to verify items 8 & 9

RSOS (1)

ALL EVAs

SM Antennas (Prior to Egress)
IV
1. GTS – Deactivate
2. ARISS (Ham Radio) – Deactivate

IMPULSE (Prior to Egress)
MCC-M 1. IMPULSE (ИПИ-100) – Is not activated

US EVA 15 NOTES, CAUTIONS, & WARNINGS

NOTES

1. Bolt install: report torque and turns.
2. 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. Toolbox doors must be closed with one latch per door when EV crew not in immediate vicinity.
6. Avoid contact with OBSS striker bars (Vitrolube coating).
7. 85 ft safety tether retract force may affect body positioning.

CAUTION

ISS Generic Constraints

A. Avoid inadvertent contact with
   1. Grapple fixture shafts (drylube)
   2. PIP Pins
   3. Passive UMAs
   4. MBS/SSRMS/SPDM taped radiative surfaces: VDU, ACU, JEU, LEU, MCU, CRPCMs, and Cameras
   5. SPDM SJEU, EP, OTCM, LEU, and LEE VDU radiator surfaces
   6. OTSD

B. Electrical cables
   1. Avoid bend radii < 10 times cable diameter.

C. Fiber optic cables
   1. Avoid bend radii < 10 times cable diameter.
   2. Avoid pulling on cable during mate/demate.

D. Fluid line flex hoses and QDs
   1. Avoid bend radii < 14 in for hoses with a diameter ≥ 1 in.
   2. Additional care should be taken to not exceed bend radii when applying loads at the flexible hose to rigid tube stub interfaces.
   3. Ensure fluid QD booties are fully closed prior to leaving worksite; wire tie if required.
   4. 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.

CAUTION

ISS Generic Constraints (cont)

D. Fluid line flex hoses and QDs (cont)
   5. QDs exposed to direct sun without thermal covers can overtemp
   6. Use caution when manipulating fluid QDs; minimize loads input into fluid QDs and lines. No moment into weld joints.
   7. Do not ever release TA clamp for PM M4/F49 (small line)
   8. PM M4 P-clamp should not be released until just prior to PM F49/M4 demate\
   9. For PM F49/M4, only move when depressurized and when mate/demate only touch QD (do not handle line)
   10. When demated, handle PM F49 by flex line
   11. PM F49 and F44 cannot handle non-axial loads
   12. PM F49 must be restrained prior to valve open (restraint must be before line is pressurized)
   13. During PM restraint, do not put loads into F49 (small line). All tethering must be to F48 (larger line).

E. 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.

F. Other
   1. ITT Cannon connector: on demated connectors, do not rotate collar or manipulate cable/connector using collar or connector tool.
   2. MLI handholds are not rated for crewmember translation loads.

CAUTION

ISS Truss Constraints

A. Avoid inadvertent contact with
1. CETA lights (Z-93 paint) [LAB, S1, Node 1]
2. Deployed TUS cable [Zenith and Nadir CETA rails]
3. S0 aft face radiator
4. GPS antennas (S13 paint) [S0, JLP]
5. UHF antennas [LAB, P1]
6. ETCS radiator flexhoses and panels [S1, P1]
7. EETCS/PV radiator flexhoses, bellows and panels [P6, P4, S4, S6]
8. SASA RF group [S1, P1]
9. Heat pipe radiators [Z1]
10. PCU cathode and HCA ports [Z1]
11. Ku-Band antenna (SGANT) dish [Z1]
12. CMG cover/shells [Z1]
13. FPMU [P1]
14. SASA high and low gain antennas and radiator surfaces [Z1]
15. Deployed MISSEs
16. OTP on HAB Tray [S0]

B. For structural reasons
1. Avoid kicking S1/P1 radiator beam. If any of these occur, wait 2 to 5 minutes to allow structural response to dissipate
2. Minimize loads into PM MLI handholds. It is possible that handholds may tear off.

CAUTION

ISS Truss Constraints (cont)

C. Other
1. WIS Antennas: do not use as handholds [Node 1, LAB, P6, Z1].
2. Lubricant from Ku-Band SGANT gimbals [Z1], CMGs [Z1], and RTAS ground strap fasteners [P6, P4, S4, S6] can contaminate EMU.
3. Prevent inadvertent contact of the tether shuttle with ETRS when the P3 tether shuttle stop is raised away from the rail.

CAUTION

ISS U.S. Pressurized Elements Constraints

A. Avoid inadvertent contact with
1. EVA crane [PMA 1]
2. TCS reflectors [PMA 2, PMA 3]
3. APAS hardware [PMA 2, PMA 3]
4. CETA lights (Z-93 paint) [LAB, S1, Node 1]
5. UHF antennas [LAB, P1]
6. Open CBM petal covers, LAB and Cupola window shutters
7. S0/Node 2 fluid tray hardlines at Node 2 end, which are limited to 25 lbs

B. Other
1. WIS antennas: do not use as handholds [Node 1, LAB, P6, Z1].
2. CBM petal covers may not be used as handholds unless both launch restraint pins are engaged.

CAUTION

ISS I.P. Elements Constraints

COL
A. Avoid inadvertent contact with
   1. COL ARISS and AIS antennas [COL-Nadir]

JEM
A. Avoid inadvertent contact with
   1. GPS antennas (S13 paint) [S0, JLP]
   2. Open JPM window shutter
   3. JTVE, WVE/EVE, JEF VE cameras
   4. JEMRMS taped radiative surfaces [JEU, EE, Cameras]
   5. JEM A/L target and pins
   6. JEF ORUs and EFUs (paint and lubricant)
   7. MAXI front and top panel (paint)
   8. SEDA-AP sensors (HIT, SDOM, and AOM)
   9. Trunnions and UCMs (paint and lubricant) [JEF Payloads]
   10. RAIDS covers on end of HREP
   11. ICS-EF Ka-Band antenna dish
   12. Small Fine Arm (SFA) (paint, coating and lubricant)

B. For structural reasons
   1. Avoid kicking MMOD shields between JLP and JPM.
   2. Avoid tool impact on ICS-EF sensor.

WARNING

ISS Generic Constraints

A. Avoid inadvertent contact with
1. Grapple fixture targets and target pins

B. Pinch
1. NZGL connector linkage. Use caution when mating/locking.
2. ITT Cannon connector rotating housing

C. QDs
1. If 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 configuration.
3. When closing QD valve, be prepared to move hands in case of kickback (Kickback should only occur at beginning of bail motion)

D. Sharp Edges
1. Inner edges of WIF sockets
2. APFR active WIF probes
3. Mating surfaces of EVA connectors Avoid side loads during connector mating.
4. Back side of MMOD shield fasteners
5. Spring loaded captive EVA fasteners (eg 6B-boxes, BMRRM, RTAS, SARJ Covers); the end of the spring may protrude.
6. SPDM OTCM gripper jaws
7. Keep hands away from SSRMS LEE/POA/SPDM LEE opening, snares, and PDGF curvic coupling (teeth).
8. MMOD strikes on ISS exterior

WARNING

ISS Generic Constraints (cont)

E. Thermal
1. EVA connectors with booties may become hot if left uncovered. Handling may need to be limited.
2. Turn off glove heaters when comfortable temperature reached to prevent bladder damage. Do not pull fingers out of gloves when heaters are on.
3. Uncovered trunnion pins may be hot.
4. SSRMS/MBS/SPDM operating cameras and lights may radiate large amounts of heat.
5. Do not touch EMU protective visor if temperature has been < -134 deg F for > 15 minutes.
6. No EMU boot contact with foot restraint when temperature < -120 deg F or > 200 deg F.
7. PDGF surfaces may not meet touch temperature requirements for unlimited contact when $\beta \leq -70$ or $\beta \geq 70$.
8. If APFR Ingress Aid is left extended for more than 1.5 hours, limit contact

F. Electrical Shock
1. Do not touch SPDM CLPA 1 electrical connector prior to camera installation.

WARNING

ISS Truss Constraints

A. Avoid inadvertent contact
1. SSU, ECU, beta gimbal platform, mast canister, SAW blanket boxes unless the beta gimbal is locked and the motor is turned off
2. Stay inboard of SARJ when active.
3. Stay 2 ft from S1/P1 radiator beam rotational envelope when beam is free to rotate.
4. Stay 5 ft from moving MT on face 1.
5. Stay 3.3 ft from Ku-Band (SGANT Antenna) when powered.

B. RF radiation exposure
1. Stay 3.6 ft from S-Band (SASA) high gain Antenna when powered [S1, P1].
2. Stay 1.3 ft from S-Band (SASA) low gain Antenna when powered [S1, P1].
3. Stay 1 ft from UHF Antenna when powered [LAB, P1].

C. Sharp Edges
1. Solar array blanket box [P6, S6]
2. Fastener threads on back of Z1 U-jumper male FQD panel, if nutplate cap missing
3. Outboard MT rail attachment lug near P6 handrail 5333 and gap spanner
4. P2 connector on EWIS box TAA-06 [Zenith/Forward Corner 1 of P5 - SARJ at 0 deg]
5. Nickel coated braided copper ground straps may contain frayed wires [P6, P4, S4, S6].
6. MMOD strikes on Z1 toolboxes
7. MBS POA strike

WARNING

ISS Truss Constraints (cont)

D. Electrical Shock
1. Stay ≥ 2 ft from ungrounded floating connectors if powered.
   S0 EVA power cables (inside S0 Bay 00 Face 4, Bay 01 Face 3)
   ESP2 jumper (inside S0 Bay 03 Face 4)

E. Thermal
1. ELC may exceed touch temperatures when β > 75 deg.

WARNING

ISS U.S. Pressurized Elements Constraints

A. Handrails
1. Handrails previously used for MISSE attachment may not be used as a safety tether point [A/L endcone 564 and 566, A/L Tank 2 Nad/Fwd and Port/Fwd, P6 5389].

B. Pinch
1. EV side of IV Hatch during Hatch operation (also snag hazard) [A/L]
2. LAB and Cupola window shutters and CBM petal cover linkages during operation

C. RF radiation exposure
1. Stay 1 ft from UHF antenna when powered [LAB, P1].

D. Sharp Edges
1. PMA umbilical launch restraints - exposed bolt threads
2. Adjustable fuse tether (Fish Stringer) buckles stowed in Node bag
3. Port/Aft portion of A/L circular HR [HR 0506]
4. A/L HR 0537 (Eq Lock Zenith)

E. Thermal
1. PMA handrails may be hot. Handling may need to be limited.
2. Stay ≥ 1 ft away from PMAs and MMOD shields > 270 deg F if EMU sun visor up; limit time to 15 minutes or less if > 300 deg F.
3. Stay at least 0.5 ft away from PMA and MMOD shields > 325 deg F.
4. No EMU TMG contact with PMAs and MMOD shields > 320 deg F.

WARNING

ISS U.S. Pressurized Elements Constraints (cont)

F. Electrical Shock
1. Stay ≥ 2 ft from ungrounded floating connectors if powered.
   SSPTS connectors include NOD1 Stbd/Fwd HR 0130, LAB Stbd/Fwd HR 0273, PMA 2 Stbd.

G. Fluid QDs
1. Do not translate on gap spanners restraining NODE 3 - LAB NH3 jumpers.

WARNING

ISS I.P. Elements Constraints

COL
A. Avoid inadvertent contact with
1. SOLAR [COL EPF]

B. Thermal
1. Columbus end cones may violate touch temperature constraints when $-75 \leq \beta \leq -60$ or $60 \leq \beta \leq 75$.

C. Sharp Edges
1. LWAPA PIP pins [COL EPF]

JEM
A. Avoid inadvertent contact with
1. ICS-EF sensors

B. Pinch
1. JPM window shutter linkages during operation
2. JEM cameras (JVTEs, EVE, WVE, and JEF VEs)
3. JEM EFU latching arms
4. JEF SSE latch
5. ICS-EF antenna boom
6. SEDA-AP mast
7. SMILES antenna rotating area
8. HREP hinge sides and RAIDS pinch areas
9. JEMRMS EE
10. JEMRMS Small Fine Arm (SFA) joints and booms

WARNING

ISS I.P. Elements Constraints (cont)

JEM (cont)
C. Sharp Edges
1. Interior of JEMRMS HRMs
2. JEMRMS EE opening and snares
3. JEM A/L hatch corners
4. ICS-EF AHM gears
5. MAXI visual star camera
6. SMILES baffles (two), baffle base bare bolts, and Cold Sky Terminator (CST)
7. HREP baffles (four) [Star tracker aperture Zenith and three instrument baffles Aft]
8. SFA's Electro-Mechanical GF(EMGF)

D. RF radiation exposure
1. Stay 0.3 ft from Fwd/Aft JPM PROX antenna

E. Thermal
1. JPM Port End Cones and JLP Port Nadir may violate touch temperature constraints when $\beta > 60$ deg.
2. JEMRMS/JTVE/JEFVE operating cameras and lights may radiate large amounts of heat.

EV1 _____
EV2 _____
IV _____

Flight Day Prior to EVA – General Briefing (All)

1. EVA Prep
- ❑ Get-up Plan – clothing and EMU equipment bag – EV's
- ❑ Prebreathe protocol review (Notes and Warnings) – EV's
- ❑ Equipment lock activities – IV responsibilities – IV
- ❑ Suit donning plan – special requests – EV's, IV
- ❑ SAFER, MWS, tools, C-Lk positions, bag stowage – EV's
- ❑ Airlock depress review – IV

2. EV Crew Procedure Review – EV's
- ❑ Egress Plan
- ❑ Order of tasks (summary timeline)
- ❑ Translation path
- ❑ Ingress Plan

3. Communications – EV's, IV
- ❑ Overall setup: Big loop, S/G2, ICOM, Hardline, remind EV crew when mode swapping
- ❑ EV/IV comm protocol review – Use EV1(2) for DCM sw throws (all time in A/L), use first names otherwise

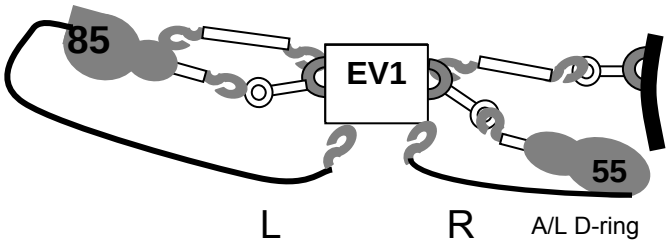
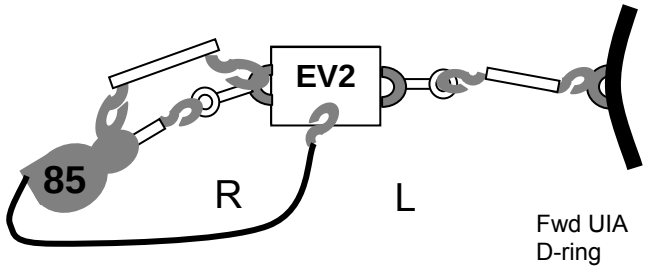
4. General Procedure Review – EV1
- ❑ Constraints
- ❑ Notes, Cautions, and Warnings review
- ❑ Contingency procedures – cribsheet
- ❑ Glove Inspection (after each task or major translation)

EVA Prep start (GMT) ___/___ ___:___ ___
Depress to 10.2 ___ ___:___ ___
Start Purge ___ ___:___ ___
PET 00:00 ___ ___:___ ___

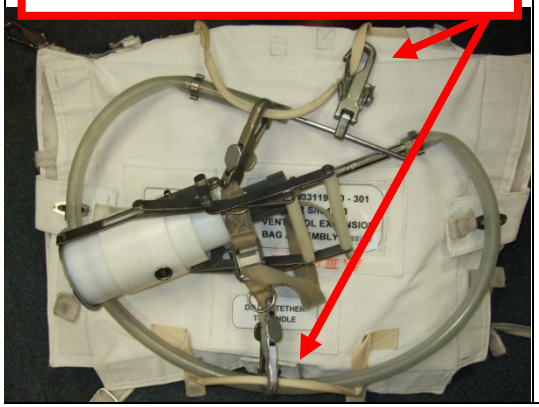
5. Emergencies Review – EV1
- ❑ Emergency suit doff during EVA prep
- ❑ Loss of comm protocol
  - o Hand signal review
- ❑ EMU Malfunctions
- ❑ Lost tools
- ❑ Lost crewmember (SAFER ops)
- ❑ DCS case
- ❑ Abort and Terminate scenarios, protocols
- ❑ Incapacitated crewmember rescue
- ❑ Contamination response

6. Post EVA – IV
- ❑ Suit doffing responsibilities
- ❑ Post EVA plan

7. Mission-Specific QD Contingency Quick Responses

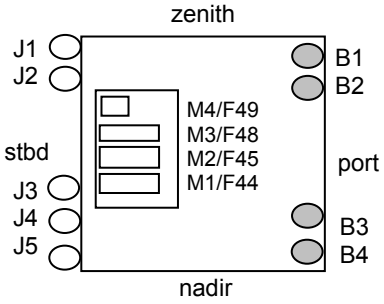
IV/SSRMS	EV1	EV2
		
	INITIAL CONFIG Verify: ❑ EV1 right waist tether connected to A/L D-ring ext ❑ √Gate closed ❑ √Hook locked ❑ EV1 left waist tether connected to 85 ST ERCM	INITIAL CONFIG Verify: ❑ EV2 left waist tether connected to fwd UIA D-ring ❑ √Gate closed ❑ √Hook locked ❑ EV2 right waist tether connected to 85 ST ERCM
	WARNING Avoid inadvertent contact with port/aft edge of circular Airlock HR 0506	
1. Start Hatch Thermal Cover clock PET (30 min) ___ : ___	EGRESS (00:25) 1. Open hatch thermal cover 2. Egress airlock (keep ST across front of body) 3. Attach EV1 safety tether to fwd A/L D-ring ❑ √Gate closed ❑ √Hook locked ❑ √Reel unlocked 4. Release waist tether from A/L D-ring ext	EGRESS (00:25)

IV/SSRMS	EV1	EV2
2. Stop Hatch Thermal Cover clock PET (30 min) ___ : ___	5. Receive EV2's safety tether anchor; attach to aft A/L D-ring ❑ √Gate closed ❑ √Hook locked ❑ √Reel unlocked 6. Give EV2 GO to release waist tether 7. Receive Crewlock bag bundle and stow on BRT 8. Verify EV2 SAFER Configuration ❑ √R Handle down (HCM door – Closed) ❑ √L Handle down (MAN ISO Valve – Open) 9. √WVS – green LED 10. √ST hooks closed and locked 11. Perform translation adaptation	1. Hand safety tether anchor to EV1 2. On EV1 GO, release waist tether from UIA 3. Transfer Crewlock bag bundle to EV1 (leave RET in A/L) 4. Egress A/L 5. Close A/L Hatch Thermal Cover 6. Verify EV1 SAFER Configuration ❑ √R Handle down (HCM door – Closed) ❑ √L Handle down (MAN ISO Valve – Open) 7. √WVS – green LED 8. √ST hooks closed and locked 9. Perform translation adaptation

IV/SSRMS	EV1	EV2
 Use integral tether from bag instead of tethering to bag handle 	**CAUTION** Avoid contact with TUS reel cable. SETUP (00:20) 1. Translate to S1: ☐ Fairlead on S0 HR 3445 (03 strut, port of CETA Spur) ☐ Adj fairlead on S0 HR 3422 (Face 2) 2. Temp stow Crewlock Bags below PM 3. Translate to PM MLI Shroud 4. Check Gloves	SETUP (00:30) 1. Translate to Crewlock zenith via fwd route (gap spanner from A/L circular HR), fairlead safety tether between A/L Toolboxes 2. Retrieve 1.5” NH3/N2 Vent Tool from QD Bag #2 (fwd/port) pocket F (forward pocket) 3. Translate to PM Jumper Bag (aft/port), attach vent tool to exterior of PM Jumper Bag - Tether to QD bail using either a tether to the bag HR or an integral tether (attaching bag to A/L) 4. Retrieve PM Jumper Bag; stow on BRT 5. Translate to S1 worksite, fairlead safety tether at top of CETA Spur (Adj on HR 3413) 6. Attach PM Jumper bag across PM QDs using Lg-sm RETs (2) (1 to zenith, 1 to nadir PM HR) 7. Check Gloves

IV/SSRMS

NOTE
Reference Task Data section for fluid QD blocks



EV1

FAILED PM REMOVAL INITIAL PREP (00:50)

CAUTION
1. QDs exposed to direct sun without thermal covers can overtemp.
2. Use caution when manipulating fluid QDs; minimize loads input into fluid QDs and lines. No moment into weld joints
3. Do not ever release TA clamp for M4/F49 (small line).
4. M4 P-clamp should not be released until just prior to F49/M4 demate
5. For F49/M4, only move when depressurized. When mate/demate F49 handle only QD (do not handle line)

NOTE
TA clamps are inaccessible after CETA cart translation

1. Open truss MLI velcro and fold MLI out of worksite; restrain as required with long wire tie to strut (recommend mid height or zenith)

2. Report failed PM serial # _____

3. WVS survey of failed PM; emphasis on electrical connectors

4. At pump module worksite, release TA clamps (3)
   - ❑ M1
   - ❑ M2
   - ❑ M3

5. **PGT**: A6, CCW2
   (8.3 ft-lb, 30 RPM, MTL 30.5)
   2-in ext-7/16

EV2

CETA CART PREP (00:50)

1. Translate to port CETA cart

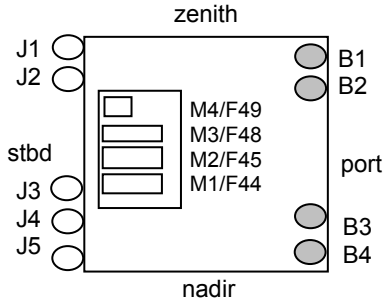
2. Configure Pitch/Yaw fitting on WIF 1 (port nadir swingarm): **GG/6**
   - ❑ √both buttons popped out
3. Move APFR from nadir STBD swingarm (WIF2) to nadir port swing arm (WIF1); **Clocking=7**
   - ❑ √Locking collar black-on-black, pull test

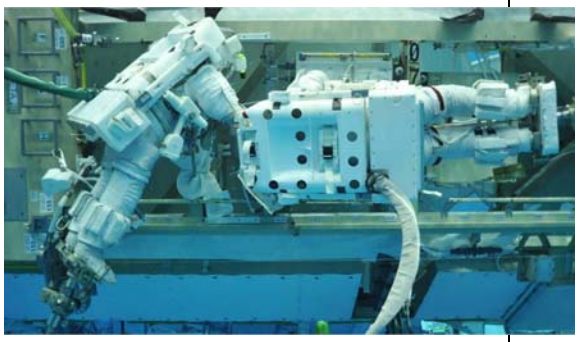
4. Translate to STBD CETA Cart
5. Retrieve APFR w/ Ingress Aid from WIF 2 (STBD nadir swingarm); stow on BRT
6. Translate to port CETA Cart
7. Temp stow APFR in Port CETA Cart WIF 2 (STBD nadir swingarm)
   - ❑ √Locking collar black-on-black, pull test

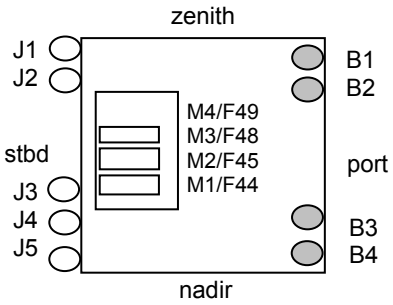
8. Prepare CETA Cart for translation (STBD side)
   - ❑ Remove wire ties from brake handles and stow in trash bag
   - ❑ √ Brake handles straight with collars locked (2)
   - ❑ Take coupler to UNLOCK
   - ❑ Translate Cart ~ 3.5 ft port (stbd edge of cart just port of Y_0 6450)
   - ❑ Engage parking brake (nadir handle)
   - ❑ Take coupler to CAPTURE
   - ❑ Rotate brake handles parallel to truss (2)

9. Prepare CETA Cart for use (port side)
   - ❑ Remove wire ties from brake handles and stow in trash bag
   - ❑ √ Brake handle straight with collars locked (1 - port nadir)
   - ❑ Rotate brake handle parallel to truss (1 - port nadir)

IV/SSRMS	EV1	EV2
	6. Release F44, F45, and F48 P-clamps, 12-14 turns ❑ F44 (M1) P-clamp ❑ F45 (M2) P-clamp ❑ F48 (M3) P-clamp 7. Tether to wire-tie linking 1.5" SPD lanyards 8. Remove wire-tie from bail; stow in trash bag **WARNING** 1. When closing QD valve, be prepared to move hands in case of kickback (Kickback should only occur at beginning of bail motion). 9. Remove SPD's fromF44, F45, and F48: ❑ F44 (M1) SPD per BLOCK A.1 ❑ F45 (M2) SPD per BLOCK A.1 ❑ F48 (M3) SPD per BLOCK A.1 10. Wire-tie SPD bundle inside of truss, STBD of strut (suggest HR3269; Stbd/Zenith of PM) 11. RET to SPD on F49 (M4) and Remove ❑ F49 (M4) SPD per BLOCK A.2 12. Stow SPD in Crewlock Bag #1	10. Configure APFR in WIF 1 (nadir,port): ❑ **APFR [7, RR, E, 2]** ❑ **Pitch/Yaw [GG, 6]** ❑ **Swingarm 30 [180 deg]** 11. Check Gloves

IV/SSRMS	EV1	EV2
Note: Expected config of wire ties is 1 linking SPD lanyards and 1 tied to QD bail. If only 1 wire tie, do not remove from SPDs. 1. SSRMS Mnvr – as reqd  	<u>SSRMS PREP AND INGRESS (00:25)</u> **WARNING** If APFR ingress Aid is left extended for more than 1.5 hrs, limit contact. 1. GCA SSRMS for setup 2. Install WIF Adapter into SSRMS PFR socket with tether point toward LEE (PIP pin and hitch pin reqd) ❑ Install PIP Pin ❑ Install hitch pin through PIP Pin 3. Retrieve APFR from port CETA WIF 2 4. Install APFR (w/ Ingress Aid) in WIF Adapter **[12, FF, F, 12]** ❑ √Locking collar black-on-black, pull test 5. Safety Tether swap to SSRMS LEE handrail (black end) ❑ √Gate closed, hook locked, reel unlocked 6. GCA SSRMS as reqd for ingress 7. Extend APFR Ingress Aid 8. Attach Waist Tether to APFR boot plate 9. Ingress APFR 10. Check Gloves	<u>PM JUMPER VENT (00:15)</u> 1. Translate to PM Jumper bag 2. Retrieve 1.5” NH3/N2 vent tool from PM Jumper bag 3. Remove caps from PM Jumper and inspect QDs (caps are lanyarded) - Leave jumper in bag 4. Mate vent tool to PM Jumper QD M3 per BLOCK C 5. Open vent tool valve per BLOCK D 6. When venting complete (~30sec), close valve per BLOCK B and demate vent tool per BLOCK E 7. Temp stow vent tool port of PM

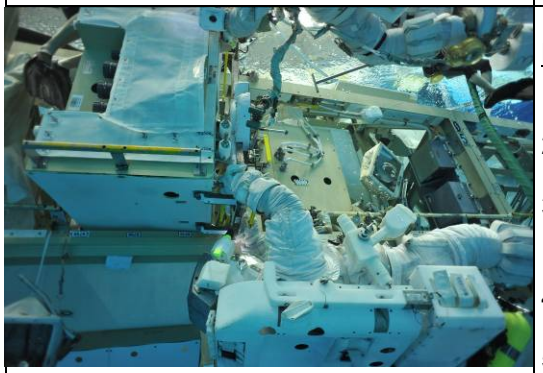
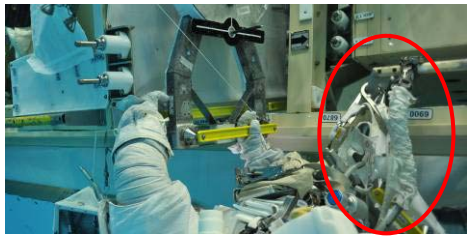
IV/SSRMS	EV1	EV2
1. SSRMS Mnvr -to QD Position 	FAILED PM QD OPS (01:05) 1. GCA SSRMS to QD Release Position **CAUTION** 1. Do not ever release TA clamp for M4/F49 (small line). 2. For F49/M4, only move when depressurized and when mate/demate only put loads into QD (do not handle line) 3. F49 and F44 cannot handle non-axial loads 4. Once fully closed, QDs must be shaded from direct sunlight within 1 min until ground reopens iso valve (~3 min). Use body and/or jumper bag to shade QD. If unexpected loss of comm and shading cannot be maintained, reopen QD. 2. **PGT**: A6, CCW2 (8.3 ft-lbs, 30 RPM, MTL 30.5) 2-in ext-7/16 3. Release F49 P-clamp, 12-14 turns ❑ F49 (M4) P-clamp	FAILED PM QD OPS (01:05) 1. Retrieve Fish Stringers from Crewlock Bag #1 2. Attach one large hook from first Fish Stringer to F-grid on Port CETA cart (preposition for Fluid line restraint) 3. Attach one large hook from second Fish Stringer to G-grid on Port CETA cart  4. Attach Adj tether or wire tie around lines, stbd of P-clamp (for Adj, attach to Adj D-ring and cinch) ☐F48 (M3) ☐F44 (M1) ☐F45 (M2) 5. Ingress CETA Cart APFR (QD assist position)

IV/SSRMS	EV1	EV2
		CAUTION When demated, handle F49 by flex line
2. On MCC Go (THOR), M4/F49 go for valve closure/demate	4. On MCC Go, Close valve PM QD F49/M4 per BLOCK B 5. Demate PM QD M4/F49 per BLOCK E	6. Assist EV1 with QD Operations
	6. Temp stow F49 out of way 7. Retrieve QRT from CL Bag #1	7. Assist EV1 with temp stow of F49
3. On MCC Go (THOR), M3/F48 go for valve closure	8. On MCC Go, Close valve PM QD M3/F48 per BLOCK B	
4. On MCC Go (THOR), M3/F48 go for demate	9. On MCC Go, Demate PM QD M3/F48 per BLOCK E	
		8. Retrieve PM Jumper from PM Jumper Bag 9. Transfer PM Jumper to EV1
	10. Position PM Jumper w/M4 zenith, position for EV2	10. Mate F48 to PM Jumper M3 per BLOCK C 11. Open valve F48 (Jumper M3) per BLOCK D
		**CAUTION** During PM Jumper restraint, do not put loads into F49 (small line). All tethering must be to F48 (larger line). F49 must be restrained prior to valve open (restraint must be before line is pressurized)
		12. Mate F49 to PM Jumper M4 per BLOCK C
	11. Hand PM Jumper (w/ F48 & 49 attached) to EV2	13. Receive PM Jumper (F48 & F49) from EV1 14. Restrain PM Jumper by attaching Adj tether or wire tie from F48 to zenith fish stringer

IV/SSRMS	EV1	EV2
		NOTE Avoid excessive loads when cinching fish stringers 15. Cinch fish stringer to keep lines out of PM R&R corridor (do not bend lines more than 90°) 16. Open F49 (Jumper M4) per BLOCK D ☐ √ Locking collar locked
5. MCC - Configure ATA isol valves as required	12. Retrieve Jettison Stowage Bag Assembly from Fish Stringer 13. Install Jettison Stowage Bag over jumper and loosely secure with pre-installed wire ties to F48 only	17. Assist EV1 with Jettison Stowage Bag install
6. On MCC Go (THOR), M1/F44 go for valve closure 7. On MCC Go (THOR), M1/F44 go for demate	14. On MCC Go, Close valve PM QD M1 (F44) per BLOCK B 15. On MCC Go, demate PM QD M1 (F44) per BLOCK E and hand to EV2	18. Roll APFR from E to G (2 clicks) 19. Egress APFR (use grids as required)
8. On MCC Go (THOR), M2/F45 go for valve closure 9. On MCC Go (THOR), M2/F45 go for demate	16. On MCC Go, Close valve PM M2 (F45) per BLOCK B 17. On MCC Go, demate PM M2 (F45) per BLOCK E and hand to EV2	20. Receive F44 & F45 from EV1 21. Restrain F44 and F45 by attaching Adj tethers or wire ties from F44/45 to nadir fish stringer
	18. Retrieve second Jettison Stowage Bag Assembly from Fish Stringer 19. Install Jettison Stowage Bag over QDs and loosely secure with pre-installed wire ties 20. Stow QRT in Crewlock Bag #1 21. Check Gloves	22. Check Gloves

IV/SSRMS	EV1	EV2
1. Verify inhibits in place for failed PM (remaining inhibits post QD demates) 2. SSRMS Mnvr – to ESP-2 on EV1 GO	<u>RETRIEVE AGB</u> (00:45) 1. Give SSRMS GO to mnvr clear **CAUTION** Avoid contact w/ AGB target pin & grapple shaft	<u>PREP FAILED PM FOR REMOVAL</u> (00:45) 1. On MCC GO: Demate connectors from PM and restrain clear of worksite inside truss with wire ties. Release TA clamps as reqd ❑ S1 P525 ←|→ PM J5 ❑ S1 P524 ←|→ PM J4 ❑ S1 P523 ←|→ PM J3 ❑ S1 P522 ←|→ PM J2 ❑ S1 P521 ←|→ PM J1
3. SSRMS Mnvr –as reqd	2. GCA SSRMS to starboard side of AGB on FHRC worksite at FHRC (one pin location)	2. Retrieve Round TM from crewlock bag #2 3. **PGT**: B7, CCW1 (25.5 ft-lb, 10 RPM, MTL 30.5) Round TM
	3. **PGT**: A2, CCW2 (3.8 ft-lb, 30 RPM, MTL 30.5) 2-in ext 7/16” 4. Release AGB bolt, 2-4 turns (preps for release) 5. RET to AGB tether point (next to bolt) 6. Pull T-handle out to unlock (two white lines visible) 7. Slide single pin end out of receptacle (GP7)	4. Perform the following steps to break torque on failed PM bolts (4 bolts, any order) (Possible BRT position - NTA HR) ❑❑❑❑ Install Round TM w/ 5/8” proud socket on PM bolt ❑❑❑❑ √TM Anti-backlash in neutral ❑❑❑❑ Break torque, ~1 turn on bolt (5 turns on PGT)
4. SSRMS Mnvr – as reqd	8. GCA SSRMS as reqd to port side of AGB (two pin location) 9. Remove two pin end of AGB from receptacles (GP5 and GP6) 10 Extend AGB to PM setting 11. Push T-handle to lock position (no white lines visible) 12. Stow AGB on BRT (AGB along side of body grapple shaft pointed away)	5. Stow Round TM in crewlock bag #2 6. Retrieve 5/8” socket from socket caddy in crewlock bag #2 and stow on PGT ❑ Perform pull test 7. **PGT**: B6, CCW2 (24.0 ft-lb, 30 RPM, MTL 30.5) 7.8-in ext 5/8”
5. SSRMS Mnvr – to S1 on EV1 GO	13. Give SSRMS GO to maneuver clear	

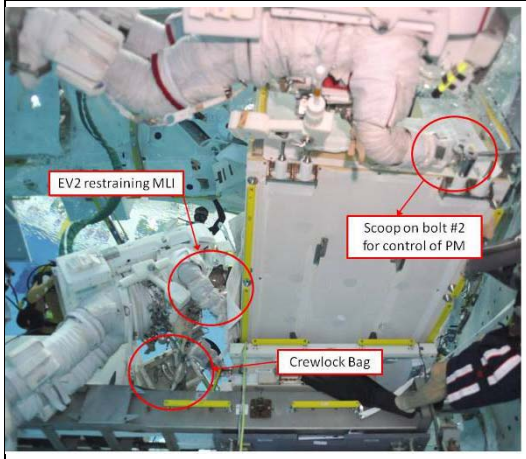
IV/SSRMS	EV1	EV2
6. SSRMS Mnvr – as reqd	14. GCA SSRMS as reqd to failed PM (to attach tether)	8. Release failed PM bolts 1, 3 and 4 (leave bolt #2 installed), ~13-16 turns (bolt pops out) ❑ Bolt 1 ❑ Bolt 3 ❑ Bolt 4 9. Relocate PM Jumper Bag port of PM 10. Stow Vent Tool in PM Jumper Bag

IV/SSRMS	EV1	EV2
	REMOVE FAILED PM (00:20)	REMOVE FAILED PM (00:20)
	1. Tether to failed PM with Lg-sm RET from MWS 2. Receive PGT with 5/8" socket from EV2	1. Transfer PGT with 5/8" socket to EV1
	3. **PGT**: B6, CCW2 (24.0 ft-lb, 30 RPM, MTL 30.5) 7.8-in ext 5/8" 4. Release final failed PM bolt 2, ~13-16 turns (bolt pops out) 5. Transfer PGT back to EV2	2. Receive PGT from EV1 3. Position for AGB install (Recommend BRT to CETA rail; head stbd, belly zenith)
	6. Retrieve AGB from BRT, unlock T-handle and pull wider than PM setting √ Two white lines visible	4. Hold PM in place while EV1 retrieves AGB
	7. Transfer AGB to EV2 (leave RET attached)	5. Receive AGB from EV1 6. Verify AGB wider than PM
1. SSRMS Mnvr: On EV1 Go: ISS Fwd for AGB install	8. Slide failed PM forward, out of truss, about halfway 9. GCA SSRMS as required	7. Orient for AGB install (two pin location nadir, single pin zenith)
	10. Assist EV2 as reqd with handling of AGB	8. Install AGB two pin side into receptacles on failed PM (nadir, GP5 and GP6)
	11. Slide AGB single pin side into receptacle (zenith GP7), until aligned with PM position indicator	9. Push T-handle into lock position (no lines visible)
	12. **PGT**: A2, CW2 (3.8 ft-lb, 30 RPM, MTL 30.5) 2-in ext 7/16 13. Drive AGB bolt, ~2-4 turns, to hardstop (preps AGB for grapple) 14. Receive RET from EV2, stow on MWS	10. Release RET from AGB and hand to EV1
2. SSRMS Mnvr –as reqd away from S1 worksite (PM extract)	15. Give SSRMS Go for PM extract	11. Check Gloves

IV/SSRMS	EV1	EV2
1. **MCC** - Put spare PM Inhibits in place	FAILED PM TO POA (00:20)	SPARE PM PREP (01:10) 1. GCA SSRMS as reqd away from S1 worksite 2. Stow 5/8" socket on socket caddy in crewlock bag #2 ❑ Perform pull test
2. SSRMS – When clear of structure, give EV1 GO to reorient PM	1. On SSRMS GO, rotate PM 180 degrees, with AGB facing starboard (for install on POA) ❑ to align gapple target to POA camera and grapple pin to POA cannister	3. Retrieve crewlock bag #2 4. Translate to ESP-2 ❑ Retrieve fairlead from HR 3413 5. Stow Crewlock Bag #2 (stbd of spare PM)
3. SSRMS Mnvr – On EV1 GO, mnvr to POA 4. SSRMS notify EV1 when in POA envelope	2. Give SSRMS GO to mnvr to POA	**CAUTION** Minimize loads into PM MLI handholds. It is possible that handholds may tear off.
5. SSRMS – On EV1 GO, ready for POA grapple 6. SSRMS – Give EV1 GO to release PM once grapple complete	3. Give POA GO to grapple PM AGB 4. On SSRMS GO, release tether from failed PM and stow on MWS	6. Release velcro strap on forward face of spare PM MLI 7. Open forward flap on PM MLI tent, attach velcro flap or restrain as rqd
7. SSRMS Mnvr – On EV1 GO, mnvr to ESP-2 or S1 truss for APFR egress	5. Give SSRMS GO to mnvr to backoff 6. Check gloves	8. Report spare PM serial # _____

IV/SSRMS	EV1	EV2
8. **MCC**: Give EV2 Go for electricals	<u>SPARE PM PREP</u> (00:50) 1. GCA SSRMS as required 2. Assist EV2 w/ Prep NOTE: All Prep steps listed in EV2 column 3. Check gloves 	9. Remove tape (6 pieces) from PM handrails, stow in trash bag (or on long T-handle tool from Crewlock Bag #2) 10. If used, Stow long T-handle tool in C/L bag #2 11. On MCC Go, Demate electrical connectors ❑ ESP2 M/W J5(P11) ←|→ PM J5 ❑ ESP2 M/W J4(P10) ←|→ PM J4 ❑ ESP2 M/W J1(P12) ←|→ PM J1 12. Temp stow cables 13. Retrieve Round TM from Crewlock Bag 14. RET Round TM to FRAM HR (recommended to avoid tether snags) 15. **PGT**: B7, CCW1 (25.5 ft-lb, 10 RPM, MTL 30.5) Round TM <u>NOTE</u> BRT to HR 8012 for bolts 3 & 4 (starboard side) BRT to HR 8013 as reqd for bolts 1 & 2 (port side) 16. Perform the following steps to break torque on spare PM bolts (4 bolts, any order) ❑❑❑❑ Install Round TM w/ 5/8” proud socket on PM bolt ❑❑❑❑ √TM Anti-backlash in neutral ❑❑❑❑ Break torque, ~1 turn on bolt (5 turns on PGT) 17. Stow Round TM in crewlock bag (remove RET from FRAM HR as required) 18. Retrieve 5/8” socket from socket caddy in crewlock bag and stow on PGT ❑ Perform pull test

IV/SSRMS	EV1	EV2
NOTE: If not removing spare PM, re-torque bolts to B7		19. **PGT**: B6, CCW2 (24.0 ft-lb, 30 RPM, MTL 30.5) 7.8-in ext 5/8” 20. Release spare PM bolts 1, 2 and 4 (leave 3 installed), ~13-16 turns (bolt pops out) ❑ Bolt 1 ❑ Bolt 2 ❑ Bolt 4 21. Check gloves

IV/SSRMS	EV1	EV2
	REMOVE SPARE PM (00:30) 1. Attach Lg-sm RET to PM HR 2. As desired, install Round Scoop on bolt 2 for additional stabilization (from Crewlock Bag #2) 3. Swap PGTs w/ EV2 4. **PGT**: B6, CCW2 (24.0 ft-lb, 30 RPM, MTL 30.5) 7.8-in ext 5/8” 5. Release final PM bolt (bolt 3), 13-16 turns, bolt pops out ❑ PM Bolt 3 release	REMOVE SPARE PM (00:30) 1. Assist EV1 as needed 2. Swap PGTs w/ EV1
1. SSRMS Mnvr - to ISS FWD and then STBD for clearance to remove PM (EV1 Go) 2. SSRMS: Give GO to re-orient 3. SSRMS Mnvr - to S1 Install location 4. **MCC**: √ S1 Elec inhibits in place	6. Give SSRMS GO for PM extract from ESP2 7. On SSRMS GO, re-orient PM as required 8. Give SSRMS GO to maneuver to S1	3. Assist EV1 with PM removal from MLI tent, as req’d 4. Assist with GCA as needed 5. Stow electrical cables on internal MLI tent loop using wire ties 6. Retrieve crewlock bag #2; stow on BRT 7. Translate to S1 HR 3276 (zenith of NTA)

IV/SSRMS	EV1	EV2
1. SSRMS Maneuver as required New PM Final Torque: Bolt / Torque / Turns 1 2 3 4 2. MCC: Give EV2 Go for electricals 3. SSRMS mnvr: for egress 4. SSRMS: Receive Go for back-away	<u>INSTALL SPARE PM (00:35)</u> 1. Give SSRMS GO, ready to install PM 2. GCA SSRMS to install PM in truss ❑ Align aft pins and alignment guides to truss guide rails 3. **PGT**: B3, CW2 (18.4 ft-lb, 30 RPM, MTL 30.5) 7.8-in ext 5/8” 4. Drive PM bolt 1, 4, 3, 2 in that order, ~17 turns to torque ❑ PM Bolt 1 ❑ PM Bolt 4 ❑ PM Bolt 3 ❑ PM Bolt 2 5. Release RET from PM 6. Remove 5/8” socket from PGT; stow on socket caddy in crewlock bag #1 ❑ Perform pull test 7. GCA SSRMS as required for APFR egress 8. Egress APFR; retract and stow Ingress Aid 9. Safety tether swap to A/L tether ❑ √ Gate closed, hook locked, reel unlocked 10. Retract and stow APFR Ingress Aid against bootplate 11. Stow spare safety tether on APFR 12. Verify tethers and tools clear of SSRMS 13. Give SSRMS Go for back-away 14. Check gloves	<u>INSTALL SPARE PM (00:35)</u> 1. Stow Crewlock Bag #2 2. Assist EV1 with GCA and install as needed ❑ Align aft pins and alignment guides to truss guide rails 3. BRT as req’d for PM install 4. Assist EV1 5. Translate to PM STBD side 6. Retrieve S1 PM electrical connectors (wire-tied in truss) <u>NOTE</u> Check no FOD, no bent pins, good EMI band 7. On MCC GO, mate PM connectors: ❑ S1 P525 to PM J5 (required) ❑ S1 P524 to PM J4 (required) ❑ S1 P523 to PM J3 ❑ S1 P522 to PM J2 (required) ❑ S1 P521 to PM J1 (if not connected, ensure will not contact truss - will energize this connector post-EVA for test) 8. Close TA Clamps (if required) 9. Check gloves

IV/SSRMS	EV1	EV2
	CLEANUP (00:25) 1. Stow Crewlock bag on BRT 2. Perform Tool Inventory 3. Translate to Airlock INGRESS	CLEANUP (00:25) 1. Stow Crewlock bag on BRT 2. Perform Tool Inventory 3. Translate to Airlock INGRESS
1. Start Hatch Thermal Cover clock PET (30 min) ___ : ___		4. Open thermal cover 5. Remove Crewlock bag from BRT, stow in Airlock 6. Ingress A/L 7. Attach Waist Tether to fwd UIA d-ring ❑ √Gate Closed ❑ √Hook Locked
	4. Transfer Crewlock bag to EV2 5. On EV2 GO, retrieve EV2 safety tether from aft anchor point 6. Transfer EV2 safety tether to EV2 7. Attach Waist Tether to Airlock D-ring extender ❑ √Gate Closed ❑ √Hook Locked 8. Retrieve safety tether from fwd anchor point 9. Verify EV2 clear and ingress A/L	8. Receive Crewlock bag from EV1; stow in Airlock 9. Give EV1 GO to retrieve EV2 safety tether from aft anchor point 10. Receive safety tether
	10. Remove SCU from stowage pouch 11. Remove DCM cover; Velcro to DCM 12. Connect SCU to DCM; √SCU Locked NOTE A TCV setting 8 – Max C minimizes time for SCU cooling	11. Remove SCU from stowage pouch 12. Remove DCM cover; Velcro to DCM 13. Connect SCU to DCM; √SCU Locked NOTE A TCV setting 8 – Max C minimizes time for SCU cooling

IV/SSRMS	EV1	EV2
2. Stop Hatch Thermal Cover clock PET (30 min) ___ : ___	13. WATER – OFF (fwd), expect H2O IS OFF msg 14. Close thermal cover; attach Velcro strap CAUTION Do not close hatch until EMU Water OFF for 2 min 15. Verify hatch clear of hardware 16. Verify EV hatch handle positioned per hatch decal; close and lock Go to PRE-REPRESS (DEPRESS/REPRESS Cue Card)	14. WATER – OFF (fwd), expect H2O IS OFF msg Go to PRE-REPRESS (DEPRESS/REPRESS Cue Card)

S1 PMA REMOVE AND REPLACE – TASK DATA

Estimated Task Duration:

	With RMS	Without RMS
One EV Crew	N/A	N/A
Two EV Crew	7:50	TBD

Electrical Connectors:

From	To	Clamps	Conn Size	Function
S1 P521	PM J1	1	NZGL- PPC-N-25-L	PCVP Power
S1 P522	PM J2	1	NZGL-PPC-N-15-R	Sensor Data & 1553B signals
S1 P523	PM J3	1	NZGL- PPC-N-21	Line Htr 1 & 2 Power
S1 P524	PM J4	1	NZGL- PPC-N-19	Sensor/Valve/ORU Htr Power
S1 P525	PM J5	1	NZGL-PPC-N-17-R	Valve/Heater Data & 1553A signals
ESP-2 M/W J5 (P11)	PM J5	Tape	NZGL-TBD	PM Heater Data
ESP-2 M/W J4 (P10)	PM J4	Tape	NZGL-TBD	PM ORU Htr Power
ESP-2 M/W J1 (P12)	PM J1	Tape	NZGL-TBD	Fault Bond

Fluid Connectors:

Harness	From	To	Size	SPD	Function
Fluid QD	S1 F44	M1	1.5”	Yes	Bypass outlet (does not go through radiators
Fluid QD	S1 F45	M2	1.5”	Yes	Radiator return NH_3 to PM inlet
Fluid QD	S1 F48	M3	1.5”	Yes	Connects outlet of PM to EATCS system (iso valve)
Fluid QD	S1 F49	M4	0.5”	Yes	Connects NH_3 tank and NH_3 supply to inlet side of PM (downstream of mixing valve) - venting QD

EVA Fasteners:

Fastener Name	Label	Head Size	Qty	Install Torque (ft-lb)	Release Torque (ft-lb)	Failure Install Torque (ft-lb)	Failure Release Torque (ft-lb)	Turns	RPM
AGB-PM Center Bolt		7/16”	1	3.8	3.8	5.7	116.8	2 - 4	30
FGB-PM Mounting Bolt	GP1, GP2, GP3, GP4	7/16”	4	9.2	25.5	16.1	47.4	17-20	30
FGB-PM Bolt w/o FGB present	GP1, GP2, GP3, GP4	7/16”	4	2.5	25.5	16.1	47.4	8-11	30
PM Attach Bolt (ESP2)	Bolt 1, 2, 3, 4	5/8”	4	25.5	24.0	44.6	168.0	14.5 - 17.0	30
PM Attach Bolt (S1)	Bolt 1, 2, 3, 4	5/8”	4	18.4	24.0	45.2	168.0	14.5 - 17.0	30
P-Clamp Bolt	N/A	7/16”	4	6.3	8.3	10.75	13.7	12 - 14	30

Foot Restraints:

Task	WIF	Y/P Setting	APFR Setting
S1 PM	CETA Cart-01	12,GG	5, PP, J, 12
CETA Cart Batman Handoff	CETA Cart-01	12,GG	5, PP, B, 12
ESP-2 Temp-Stow	ESP-2 5	N/A	12, PP, K, 12
ESP-2 Spare PM	ESP-2 5	N/A	12, PP, B, 12

S1 PMA REMOVE AND REPLACE – TASK DATA

Required Tools:

Item		
PGT (2)	APFR (2)	VTEB
6” ext 7/16” wobble socket (2)	OTSD	Vent Tool Extender + MUT EE (VTEB bag)
Crewlock Bag (2)	CETA Cart	Adjustable Tether (for MUT EE OCAD)
Socket Caddy (2)	Lg-sm RET (for PM)	1.5” NH_3/N_2 Vent Tool (Female) (QD Bag #1 or #2)
7.8” ext 5/8” socket (2)	Wire Ties	PM Jumper
Round Torque Multiplier + 5/8” proud socket (2)	EVA Camera	

Contingency Tools:

Item
1.5” QRT & FID Gauge (QD Bag #1)
1.5” Bail Drive Lever (QD Bag #1)
0.5” Cap Tool (QD Bag #1 or #2)

S1 PMA REMOVE AND REPLACE – TASK DATA

BLOCK A - Remove SPD

A.1 Remove 1.5" SPD

1. Pull bail aft, until against aft SPD spacer
2. Remove fwd SPD spacer (pull up on tether point to disengage ball detents and guides)
3. Push bail full forward to open position
4. √ Detent button – up
5. Remove aft SPD spacer (pull up and aft on tether point to disengage clips)
6. √ Aft white band visible

A.2 Remove 0.5" SPD

1. Pull lock knob up
2. Slide slider aft to disengage bail handle
3. Remove SPD
4. Push bail to open position
5. √ Aft white band visible
   √ Detent button – up

BLOCK B – Close Valve

1. √ Aft white band visible
2. √ Detent button fully installed
3. √ Detent button up
4. Rotate locking collar to unlocked position (not on 1.5")
5. √ Detent button can be depressed
6. Assess side loads prior to bail movement
7. Push bail toward open position with significant force while depressing detent button (unstick male sleeve seals)
8. Depress detent button, move bail aft (close valve)
9. √ Fwd white band visible
10. √ Detent button up
11. Rotate locking collar to locked position (not on 1.5")

BLOCK C – MATE QD

1. Remove QD caps as required
2. Inspect male and female QD for debris or damage
3. Verify female QD ready to mate
   √ Detent button – up
   √ Locking collar – locked position
   √ Fwd white band – not visible
4. Assess side load potential prior to mate
5. Mate QD
   √Fwd white band – visible
6. Perform snapback test
   √Fwd white band visible
7. Perform pull test (Stay clear of button, release ring, and bail trigger)
8. Perform visual gap test

BLOCK D – Open Valve

1. Assess and counteract side loads (do not move bail if QD under significant side-loading)
2. Rotate locking collar to unlocked position (not on 1.5 in)
3. Depress detent button
4. Push bail to forward position
5. √ Aft white band visible
6. √ Detent button – up
7. Rotate locking collar to locked position (not on 1.5 in)

BLOCK E –Demate QD

1. Assess side loads prior to demate
2. Demate QD
   a. For 0.5" QD, Pull back on release ring
   b. For 1.5" QD, use QRT (or squeeze trigger)
3. √Release ring retracted
   √ FWD white band not visible (FID check)
4. Inspect male and female QD for debris, damage, or anomalous conditions (ammonia crystals).
5. Install QD caps as required; verify lock tab engaged

S1 PMA REMOVE AND REPLACE – TASK DATA

Notes:

1. Check connectors for damage, FOD, bent pins, EMI band, and cable bend radii.
2. If SPD does not install, locking collar may need adjustment.
3. The 0.5” QD has a locking collar; the 1.5” QDs do not.
4. On ammonia QDs, check for ammonia crystals.
5. Route vent tools with nozzles away from structure and crew.
6. If EMU is contaminated with ammonia (during venting), use ISS EVA Decontamination procedure.

Cautions:

1. Minimize loads into PM MLI handholds. It is possible that handholds may tear off.
2. Fluid QDs exposed to direct sun without thermal covers can overtemp in a matter of minutes (impacts QD seal integrity).
3. Use caution when manipulating fluid QDs; minimize loads input into fluid QDs and lines.
4. When operating QDs, assess sideloads and flexhose alignment prior to mating/demating and valve opening/closing.
5. When mating S1-F48 to PM M3, do not open valve until all N_2 has been vented from the PM. Otherwise undesired mixing of NH_3 and N_2 will occur inside the PM.
6. Do not use the QD on F-49 when re-orienting the line to the mate position (use the hard line).
7. When mating F-44 to M1, do not exceed 20 lbs of force in the forward, zenith, and nadir direction.
8. Do not fully close the QD during SPD install unless otherwise instructed by MCC-H.
9. PM installation bolts (for initial torque) must be installed in the following order: Bolt 1 first, then bolts 4, 3, 2 (due to nut plate tolerances). There is no required order for bolt release and no required order for torque multiplier operations (KSC).

Warnings:

1. Do not open Vent Tool valve until nozzle is routed and EV crew is clear of vent region.

Timeline Considerations:

1. PM thermal clock begins when PM MLI tent is removed on ESP-2.

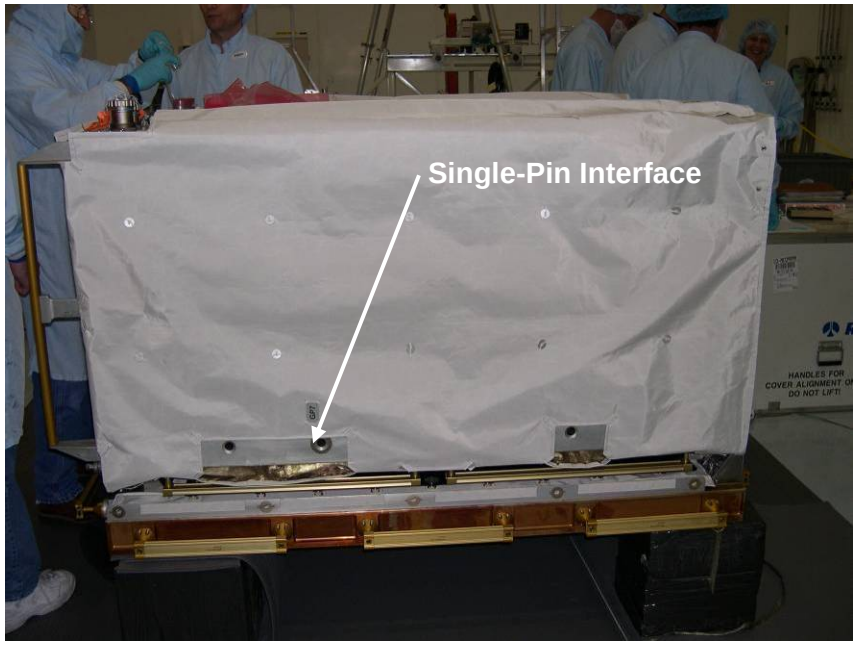


FIGURE 1.- PUMP MODULE – SINGLE-PIN INTERFACE.

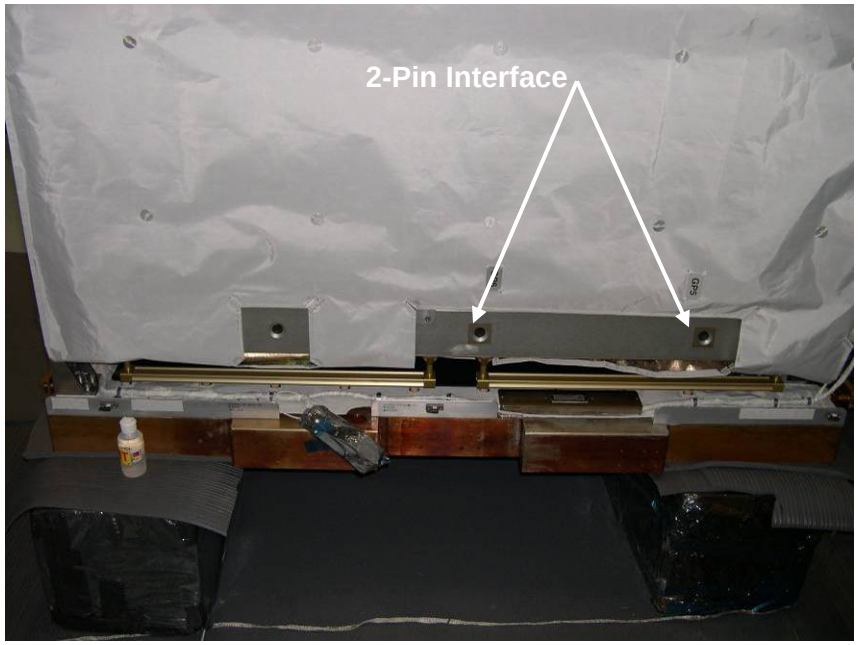


FIGURE 2.- PUMP MODULE – 2-PIN INTERFACE.

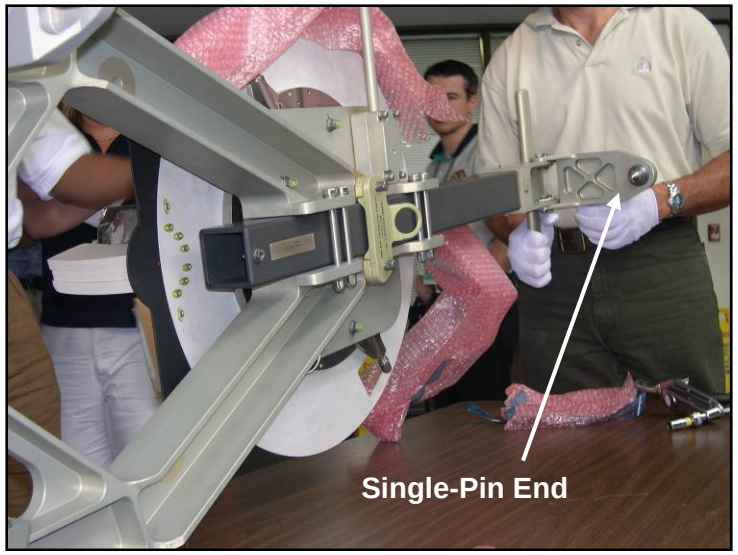


FIGURE 1.- ADJUSTABLE GRAPPLE BAR.

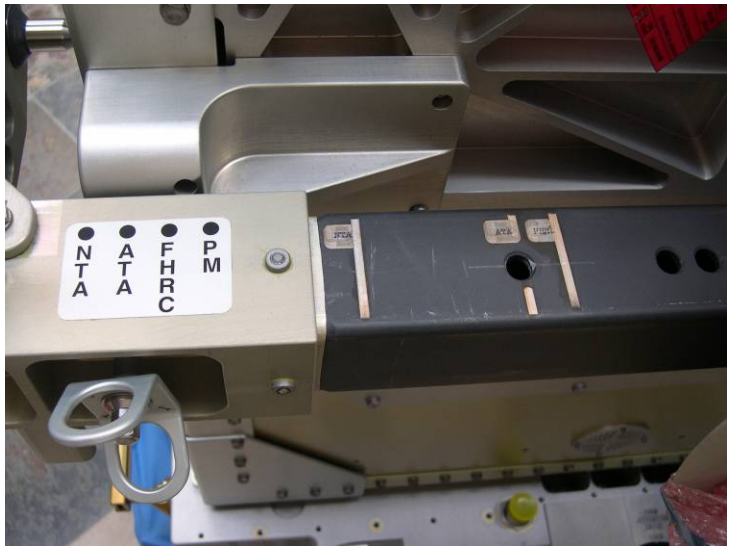


FIGURE 2.- ORU SIZING INDICATION LINES.

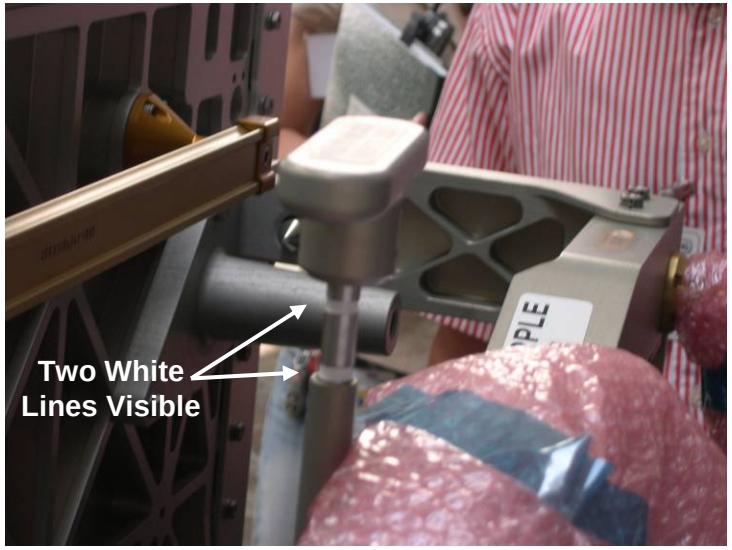


FIGURE 3.- T-HANDLE IN UNLOCK POSITION.

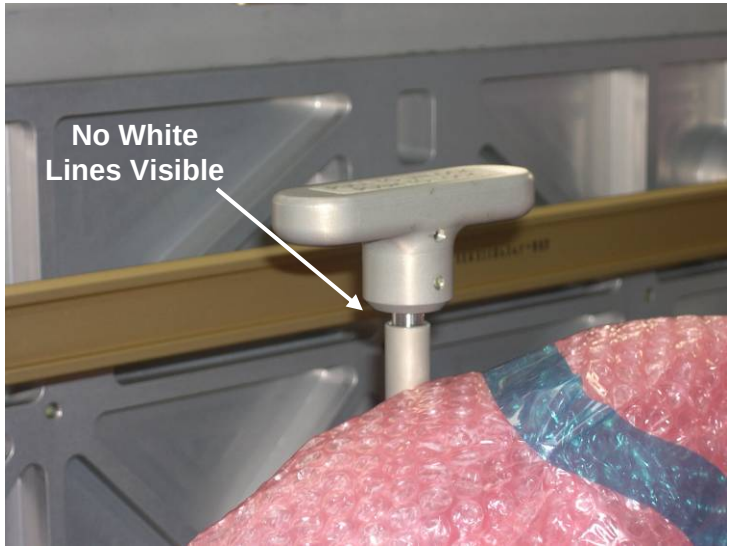


FIGURE 4.- T-HANDLE IN LOCK POSITION.