

Image Analysis Overview

Multilateral Imagery Working Group Technical Interchange Meeting

NASA Johnson Space Center
Image Science and Analysis Group (ISAG) (XI4)

<http://isag.jsc.nasa.gov/>

May 2018



Image Science and Analysis Group

- The JSC Image Science and Analysis Group (ISAG) provides expertise in all areas of imaging science:
 - Requirements development
 - Imagery acquisition planning and operations guidance
 - Imagery manipulation, mosaics and synchronized views
 - Component monitoring and surface inspections
 - 2D and 3D photogrammetric measurements
 - 2D and 3D high-precision motion tracking in video
- ISAG supports ISS, Orion, Space Launch System, Commercial Crew & Cargo Programs.



Image Science & Analysis Lab



Image Science & Analysis Homepage

- Findings and Analyses are posted to the ISAG homepage
 - <http://isag.jsc.nasa.gov/>



The screenshot shows the ISAG homepage with a dark blue background. At the top is the ISAG logo and the text "Image Science & Analysis Group". Below this is a navigation bar with links: Home, Station, MPCV, Commercial, Shuttle, and Internal. A search bar is located on the right side of the navigation bar. The main content area is divided into three columns. The left column contains links for Station Support, ISS Mosaics, ISS Post Flight Report, ISS SAW Mast Survey, Soyuz Inspection Summary Report, and Analysis Request Form. The middle column contains a "Latest Entries" section with a list of recent reports, including "2018_STBD_FGB_Solar_Array_Remeasure - Increment 53" and "AF-17A/A/STS-128 External Survey Report - AF-17A/STS-128". The right column contains links for MPCV, EFT-1 LLIMS, and Orion Multi-Purpose Crew Vehicle (MPCV). At the bottom, there is a "Shuttle Support" section with links for LLIMS and TIIMS, and an "Other Projects" section with links for Hubble Projects, Resolution Studies, and Mars Satellite Project. A photograph of a NASA employee working on a computer monitor is also visible.

Station Support

- IIIMS - ISS inspection status
- ISS Mosaics
- ISS Post Flight Report
- ISS SAW Mast Survey
- Soyuz Inspection Summary Report - Dec 5, 2014
- Analysis Request Form

Shuttle Support

- LLIMS - Launch video & film observations
- TIIMS - On-orbit inspection status

Latest Entries

- 2018_STBD_FGB_Solar_Array_Remeasure - **Increment 53**
- AF-17A/A/STS-128 External Survey Report - **AF-17A/STS-128**
- AF-21/A/STS-127 External Survey Report - **AF-21/A/STS-127**
- Trailing Umbilical System(TUS) Status on S0 and S1 - **Increment 53**
- Soyuz 51S Imagery Inspection Summary - **Increment 53**

MPCV

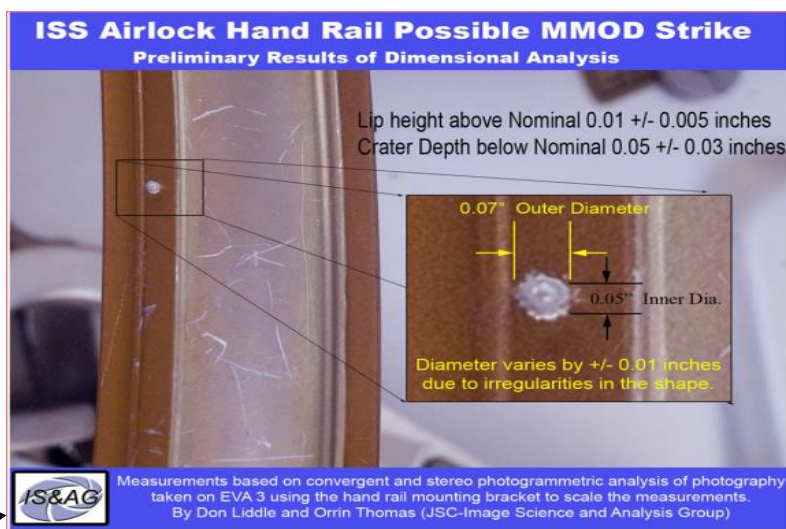
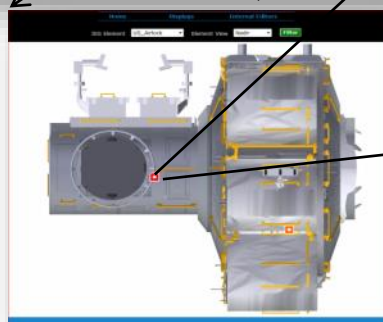
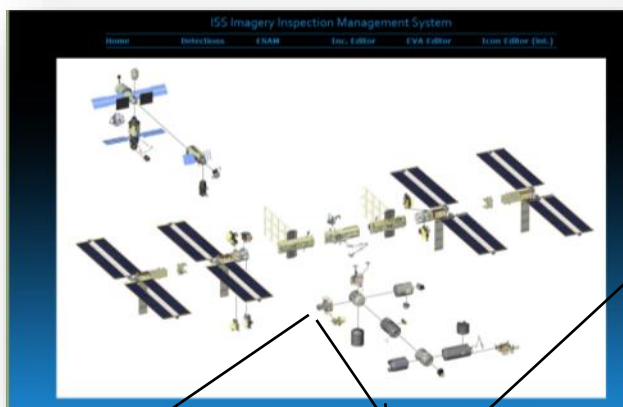
- EFT-1 LLIMS - Launch video & film observations ([restricted access](#))
- Orion Multi-Purpose Crew Vehicle (MPCV)

Other Projects

- Hubble Projects
- Resolution Studies
- Mars Satellite Project

Online Survey Findings Catalog

- ISS Inspection Imagery Management System (IIIMS) is used to catalog external inspection findings.
- <http://isag.jsc.nasa.gov/IIIMS-public/>



Element	View	Detection Type	SubSystem Owner	Go Filter	Count: 2	New Detection
US_Airlock	nadir	Any	Any			
Issue ID, Owner	Mission, Element, View	Title, ISAG Docs	Type, SharpEdge, XPath	IFI #, PRACA #, Docs	Comments	User, Modified Time
79 ATCS	AF-20A/STS-130 US_Airlock Nadir	Possible MMOD Strike on Center Airlock O2 Tank next to Handrail. doc	MMOD Strike No Yes	TBD TBD	sharp edge should be no because of soft goods	rscharf 5/15/2011 12:00:00 PM
88 TBD	AF-1E/STS-122 US_Airlock Nadir	MMOD strike on US Airlock handrail adjacent to hatch. doc	Sharp Edge Confirmed Yes	TBD TBD	sharp edge is marked with a wiretie, but not repaired or covered.	rscharf 5/15/2011 12:00:00 PM



Routine Imagery Acquisition



<u>Subject</u>	<u>Type</u>	<u>Frequency</u>
• Crew choice downlink (Earth Obs, Leisure)	Internal Crew Photo	Daily
• EVA Video (Helmet Cam and GoPro)	External Video	Periodic
• Soyuz Pre-departure Survey	Crew, SSRMS, EHDC	Undock -3 Weeks
• External Survey of ISS – External TV	External Video	6 Months
• External Survey of ISS – Internal Crew	Internal Crew Photo	Yearly
• S1-3 HRS Radiator Damage Inspection	External Video	2 Months
• FGB Solar Array Retraction Inspection	External Video	2 Months
• Port HRS Radiator Inspection	Internal Crew Photo	Yearly
• STBD HRS Radiator Inspection	Internal Crew Photo	Yearly
• Port Solar Array Wing Mast and Blankets	Internal Crew Photo	Yearly
• STBD Solar Array Wing Mast and Blankets	Internal Crew Photo	Yearly



External Survey Observations Highlights

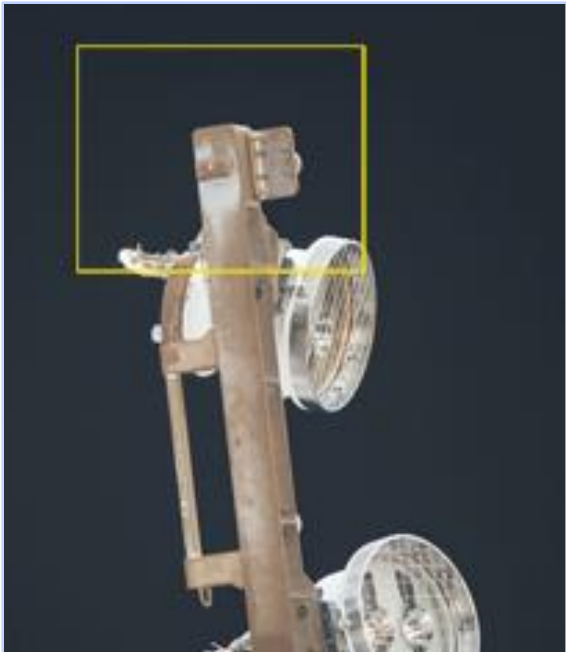
May 2015 – May 2018



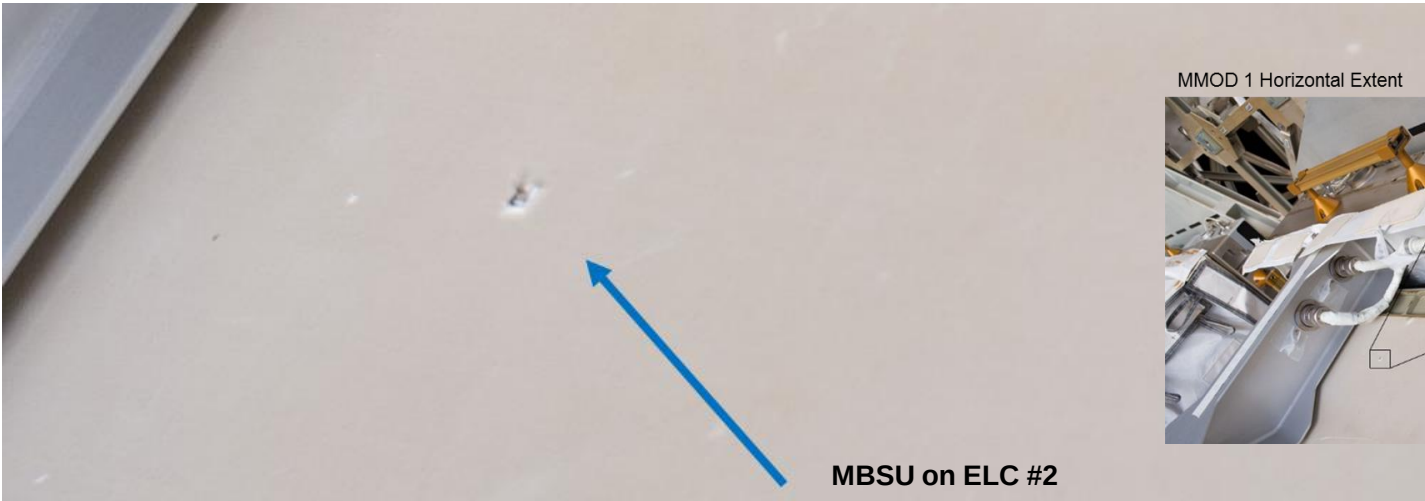
Possible MMOD Strikes



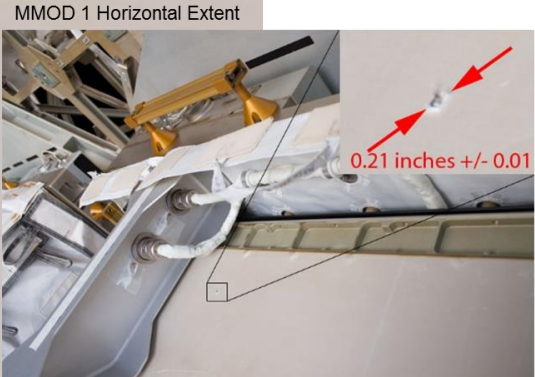
S1 CETA Light Stanchion



SGANT on ESP 3

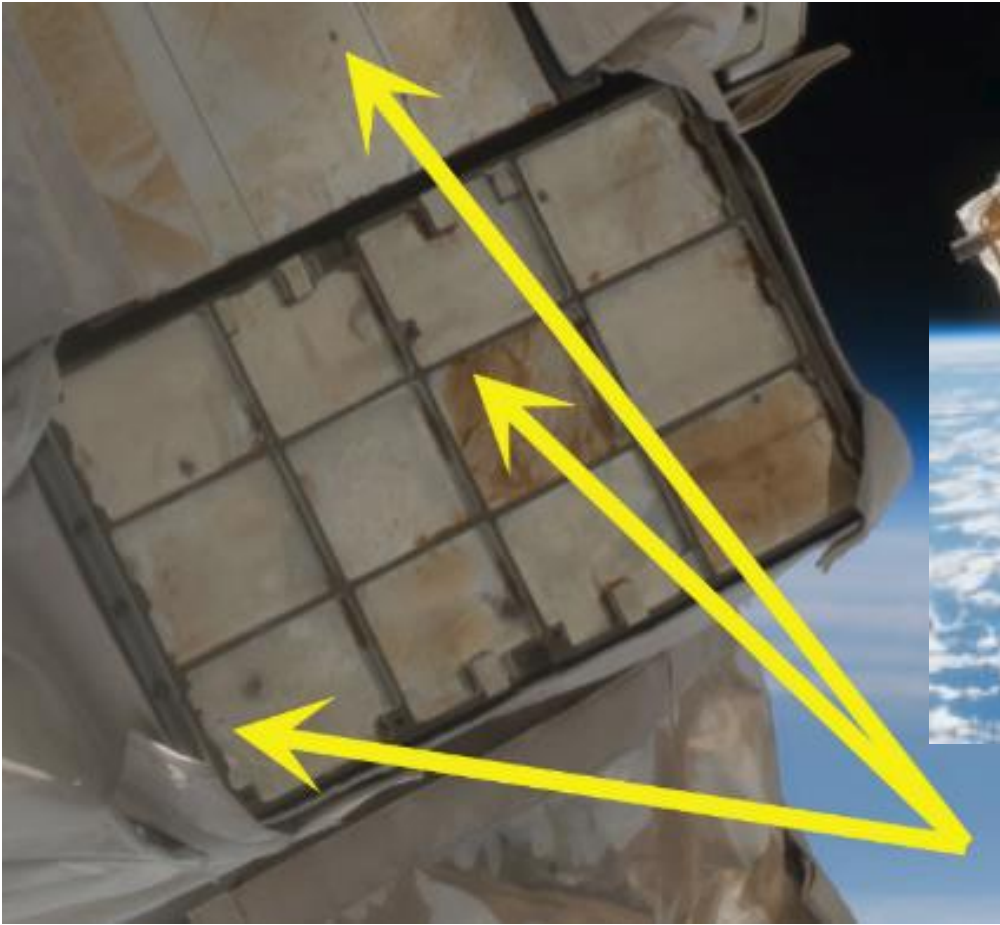


MBSU on ELC #2

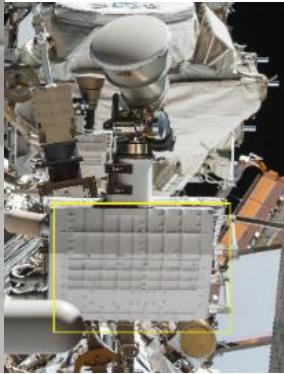
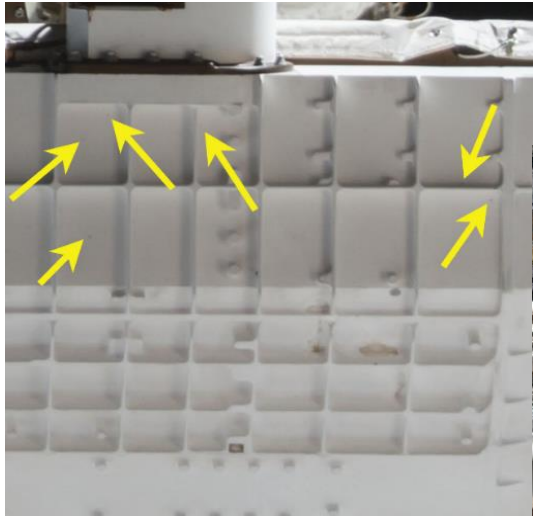
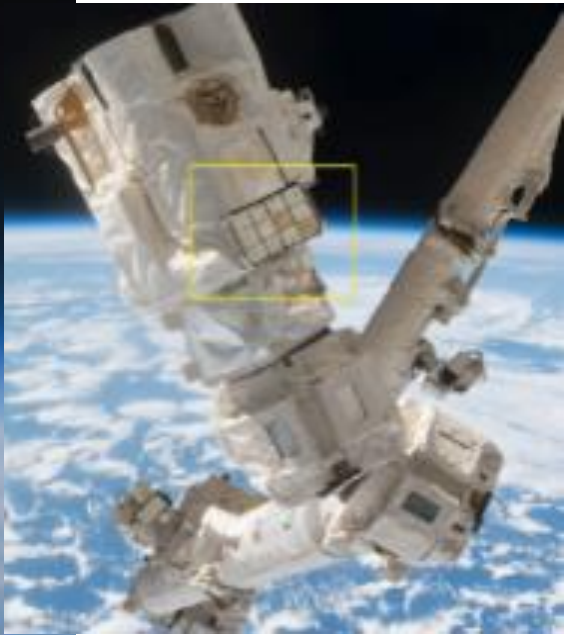




Possible MMOD Strikes



SSRMS LEE B



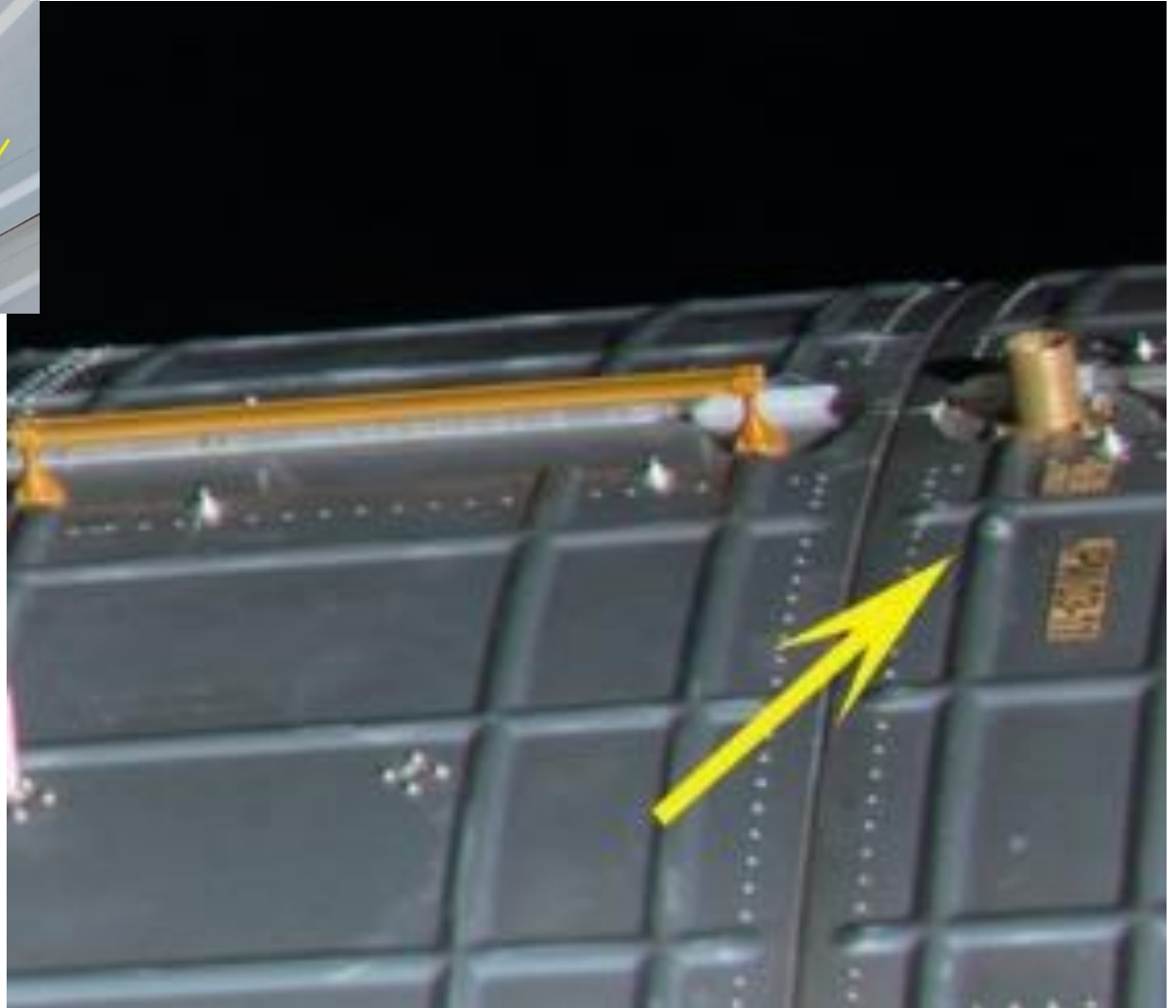
S1 Nadir S-Band Antenna



Possible MMOD Strikes



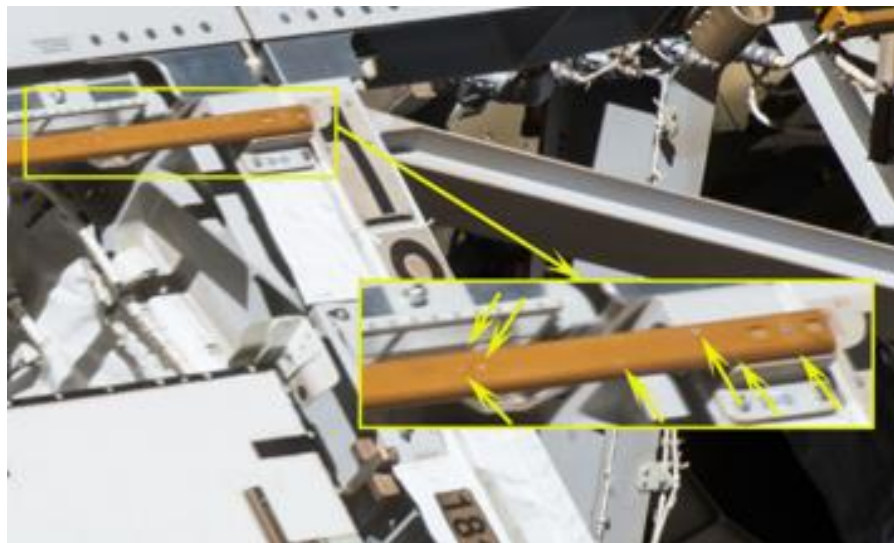
US Lab Module Nadir Side



JPM Nadir MMOD Shield



Possible MMOD Strikes



EVA Handrail Sharp Edge Risk

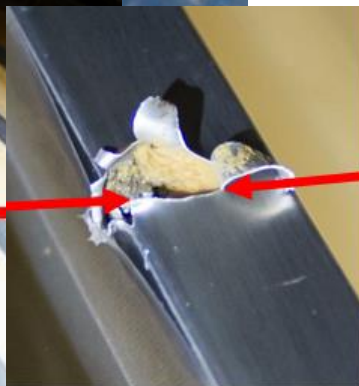
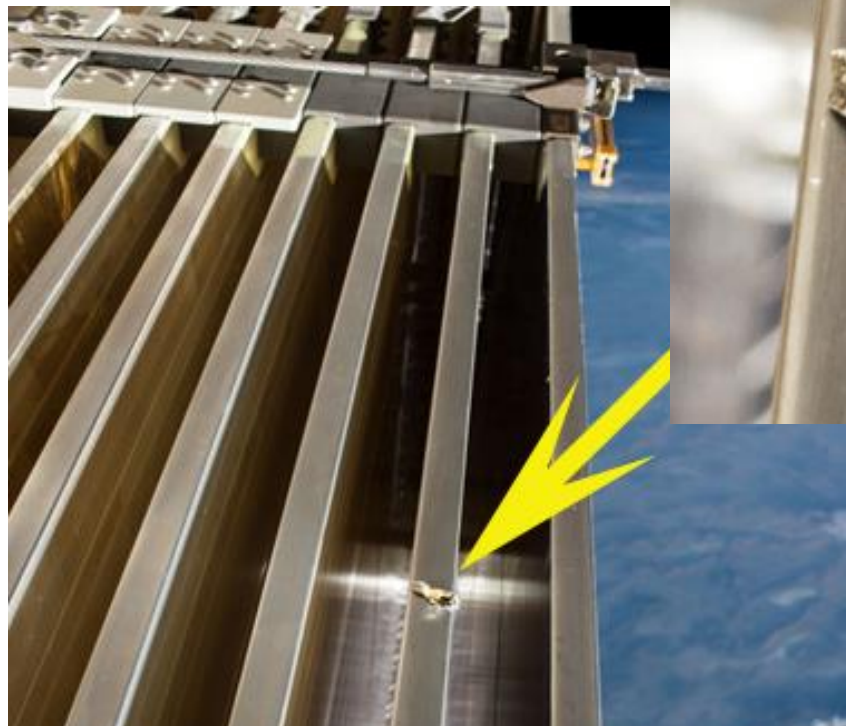




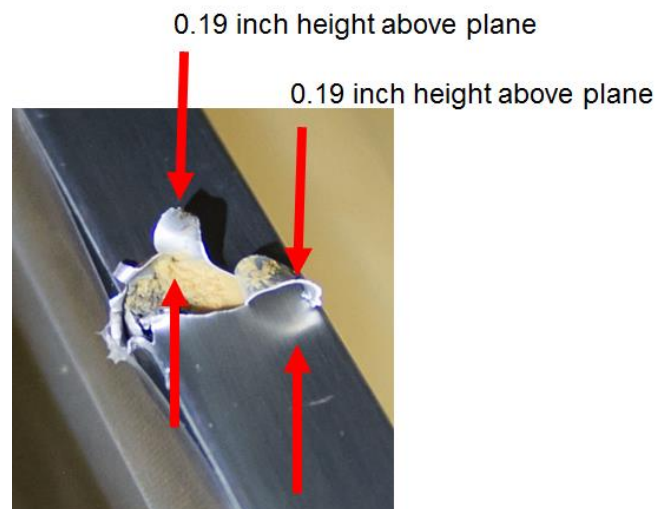
MMOD Strike



Trailing Thermal Control Radiator (TTCR)



0.50 inch

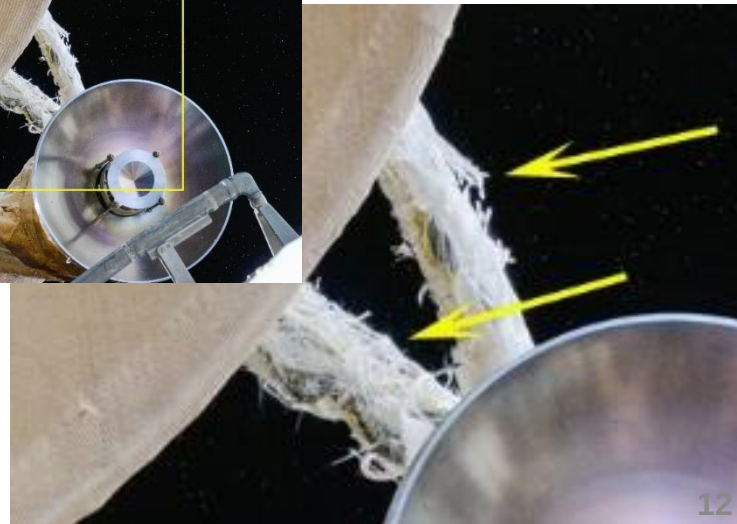
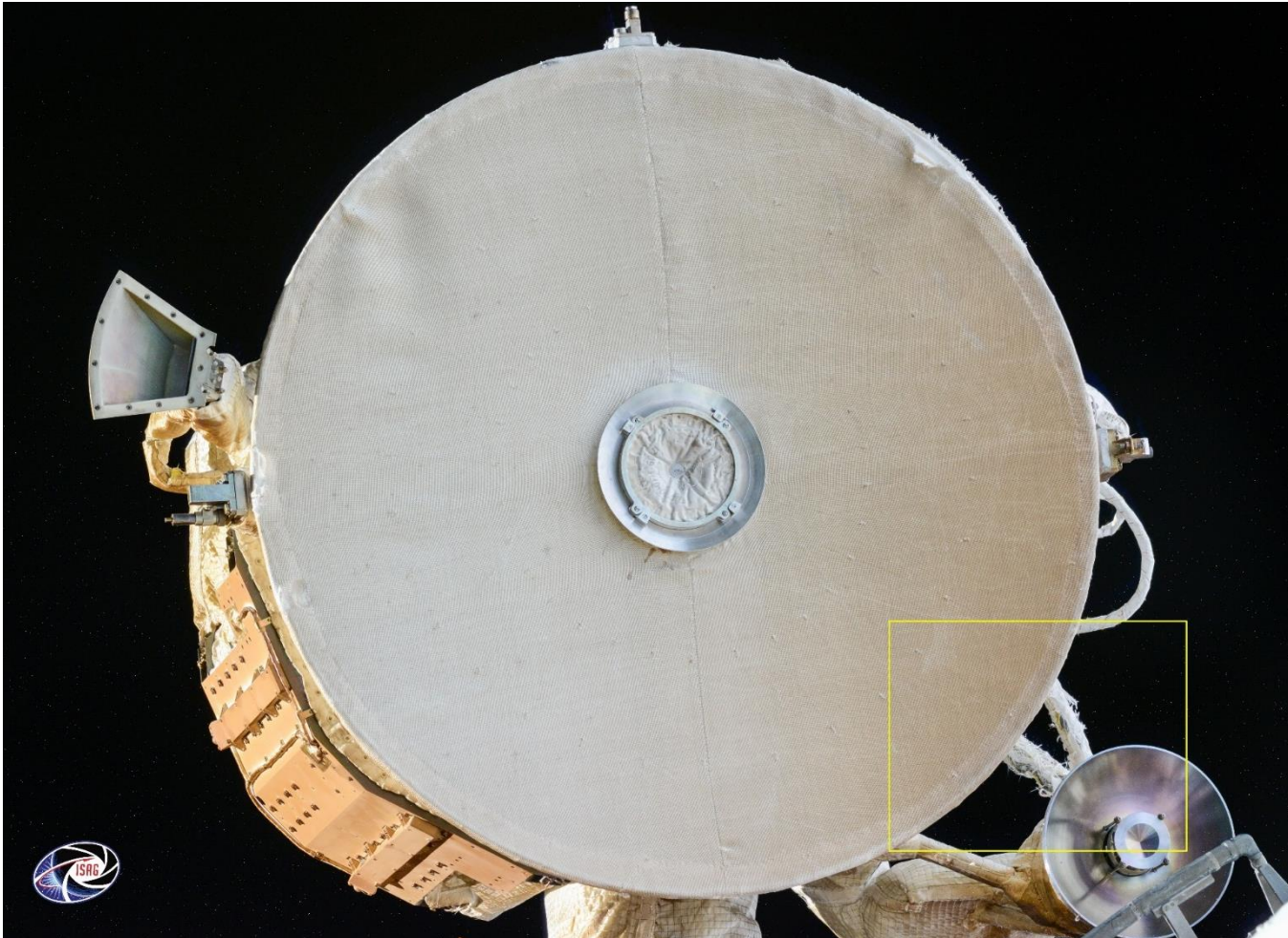


0.19 inch height above plane

0.19 inch height above plane



Deterioration Observed on SM LIRA Antenna



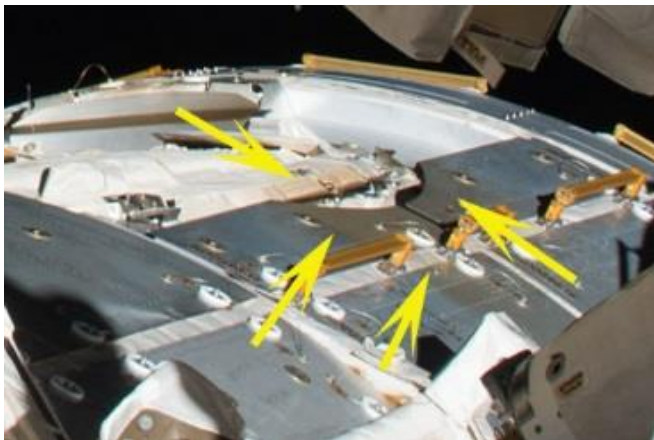
External Degradation



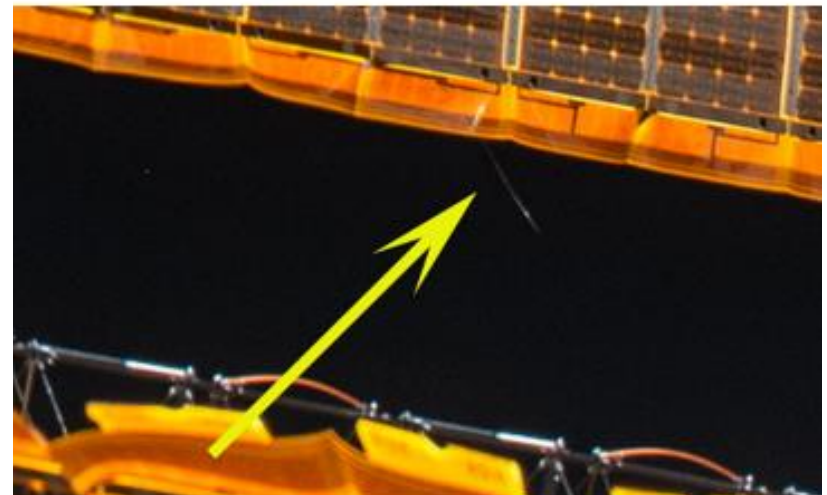
MLI Lifted on SSRMS LEE



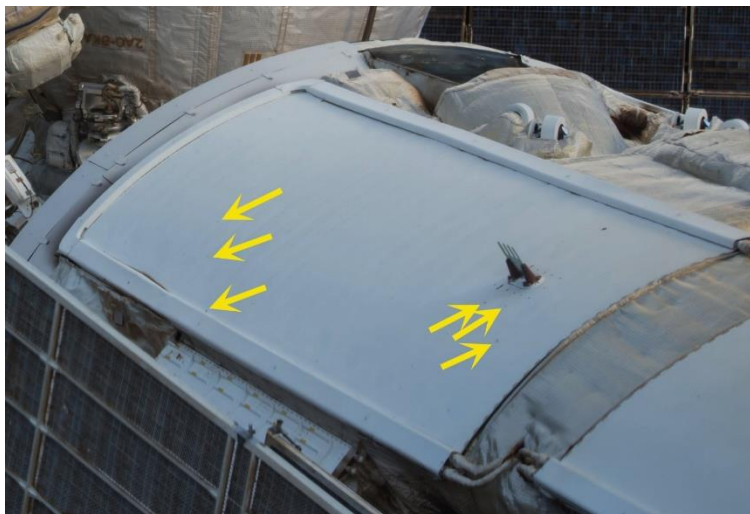
Possible Torn MLI Near Energiya Label on MRM2 Forward/Port



Discoloration on Node 2 Nadir CBM



Part of P6 SAW Blanket Material or Wire Hanging From Blanket



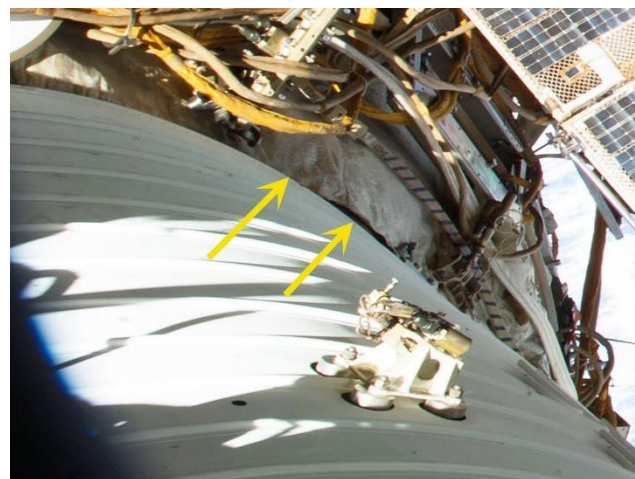
Possible MMOD Strikes or Paint Chips on FGB; Nadir



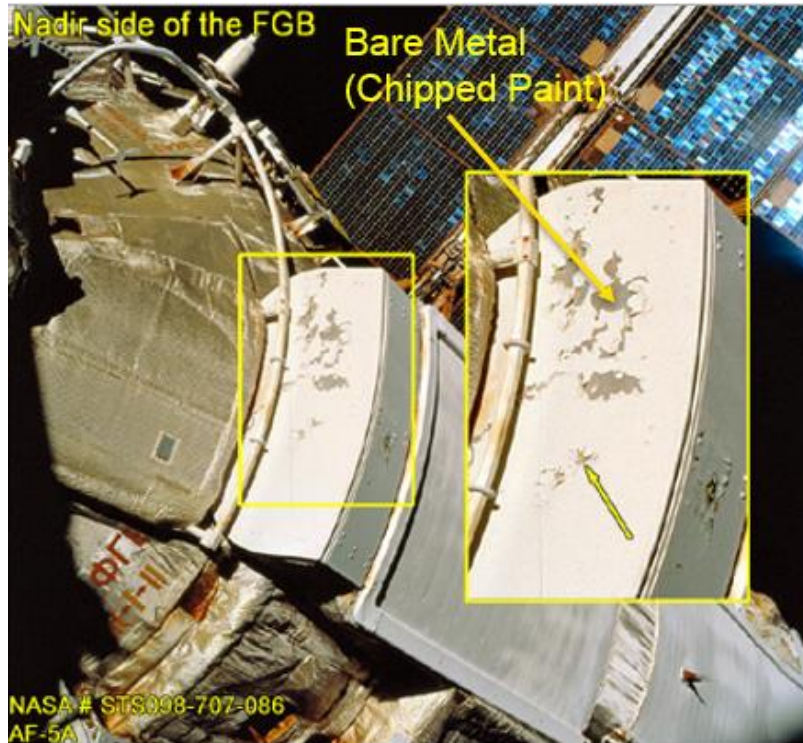
Possible MLI Lifted on FGB; Plane 3 /Zenith



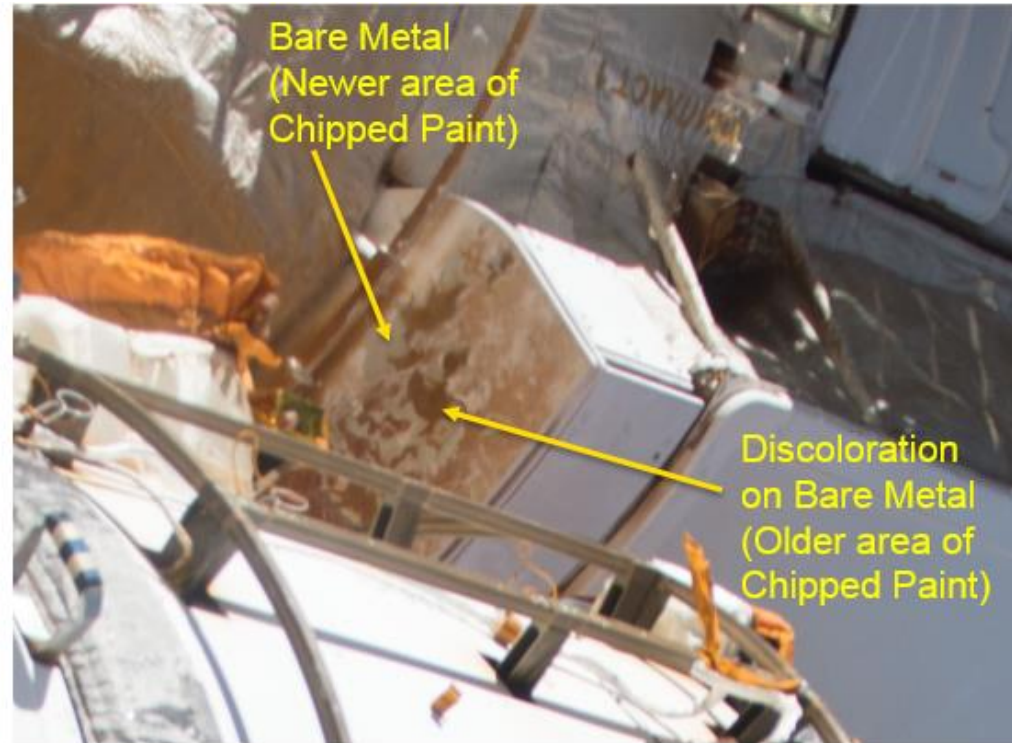
Discoloration Observed on FGB MLI Next to Radiator; Plane 1 /Nadir



Lifted MLI on Service Module; Plane 3 /Zenith



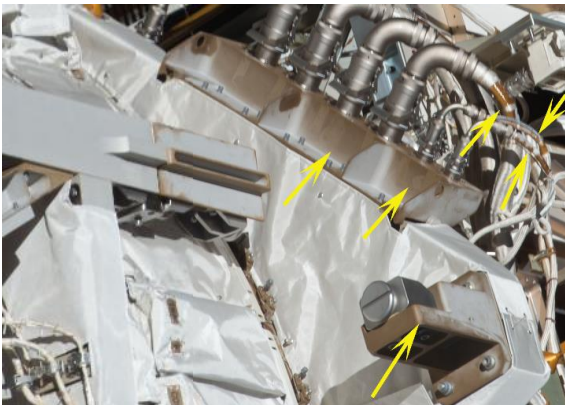
STS-098/AF-5A Chipped Paint on FGB MMOD Shielding Panel



Increment 47 Chipped Paint and Discoloration on same FGB MMOD Shielding Panel



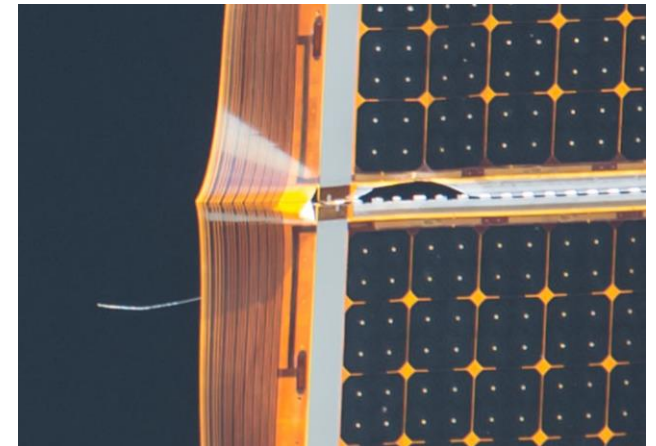
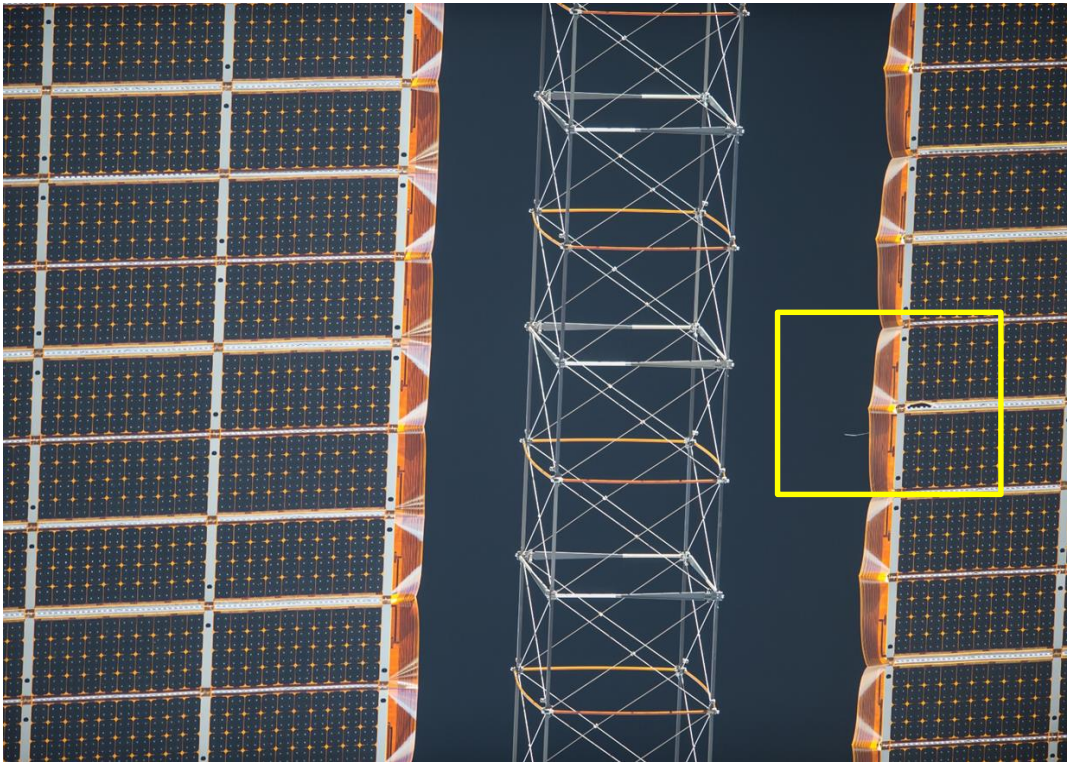
MLI Damage and Discoloration on S6 Mast Canister



Discolorations & Marks P4 Truss IEA



External Degradation



“New” 7 inch tear is visible on Solar Array 3B.



Soyuz Inspection



MRM1 docked Soyuz descent module is surveyed with crew and EHDC photos

Cupola Window 5



Docking Compartment Window #1



from DC1 window

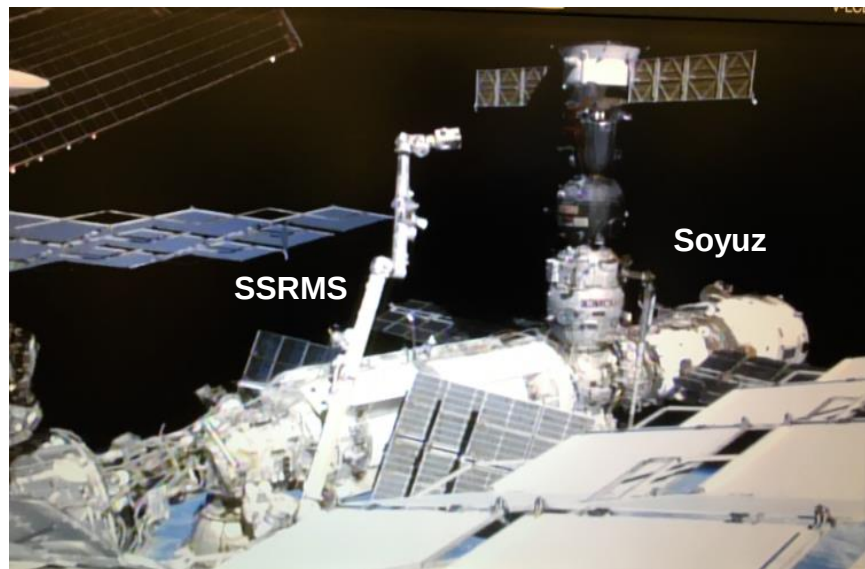




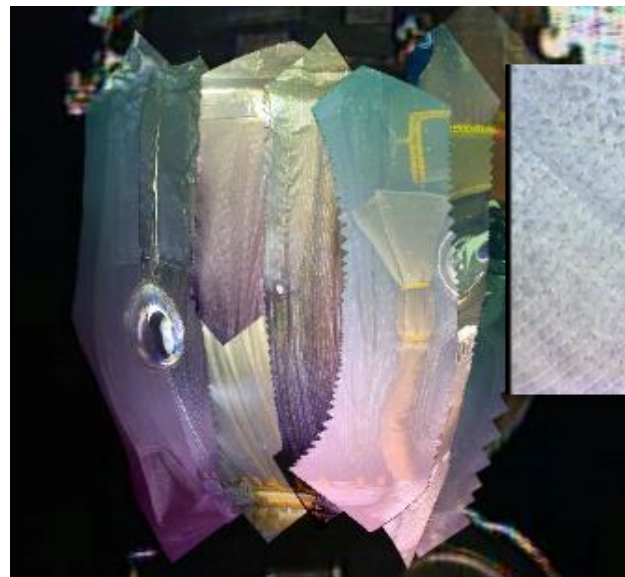
Soyuz Inspection



MRM2 docked Soyuz are surveyed with SSRMS video (stbd VV) and EHDC photos (port VV)



SSRMS Survey Inspection of 48S



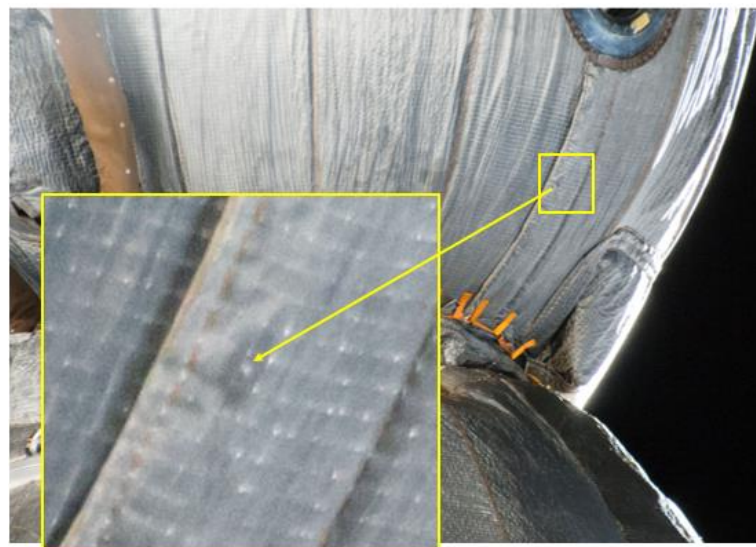
Mosaic of SSRMS scans



SSRMS Video Frame



Mosaic of CP9 EHDC photos



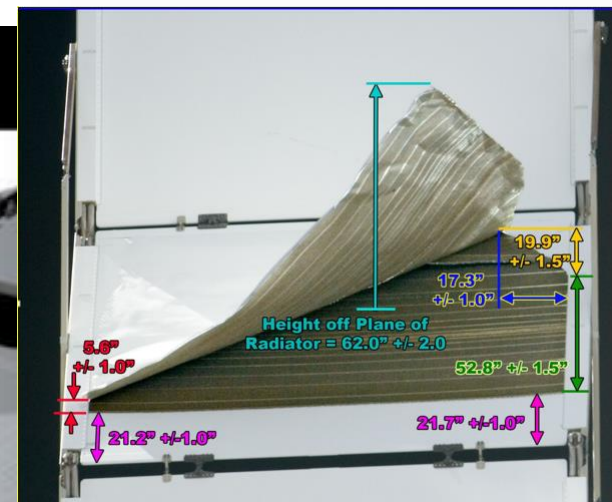
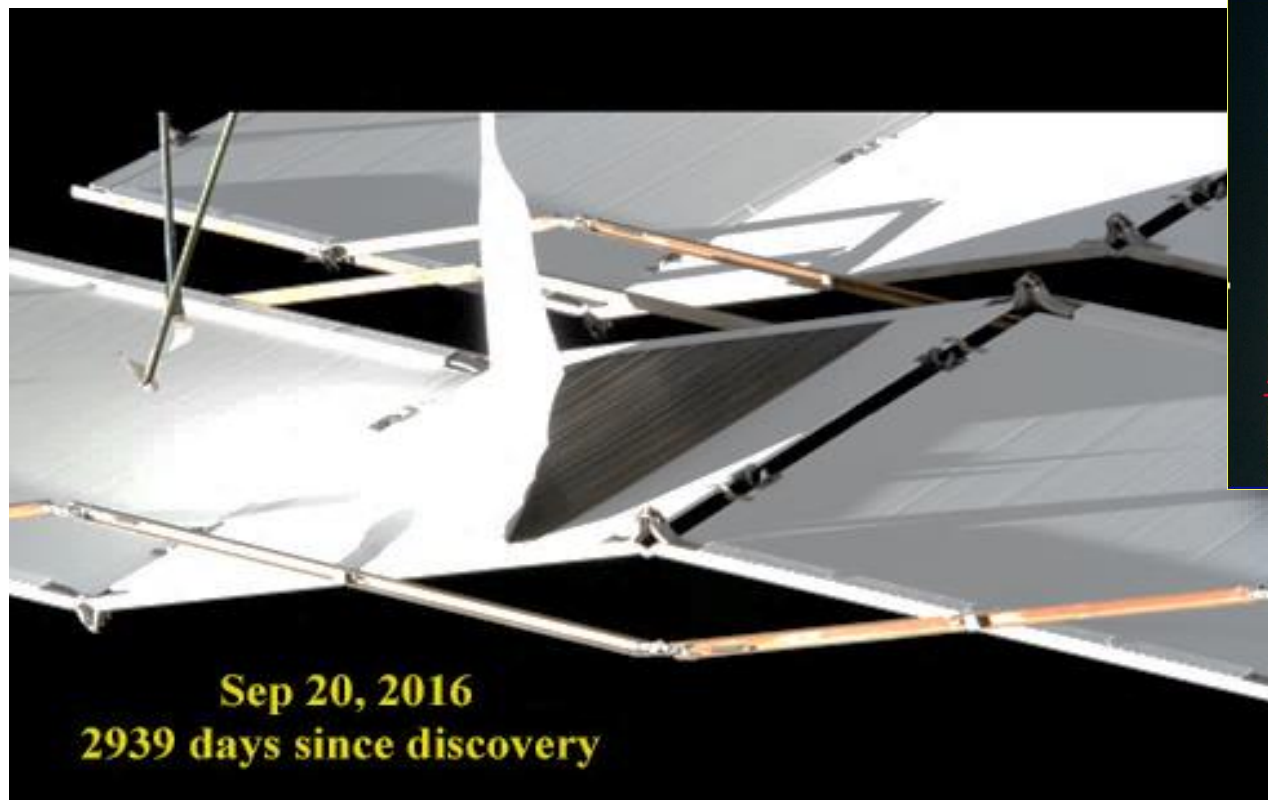
EHDC Photo



Bi-monthly Inspection of S1-3 Radiator Panel 7



http://isal-web1.jsc.nasa.gov/content/folder341/Inboard_radiator_damage.htm



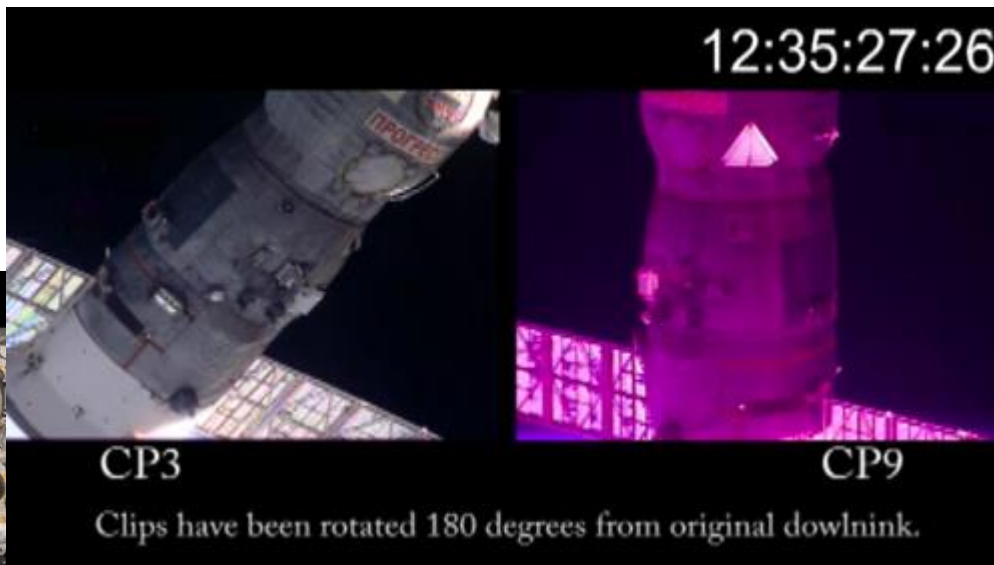


Leak Source Investigation

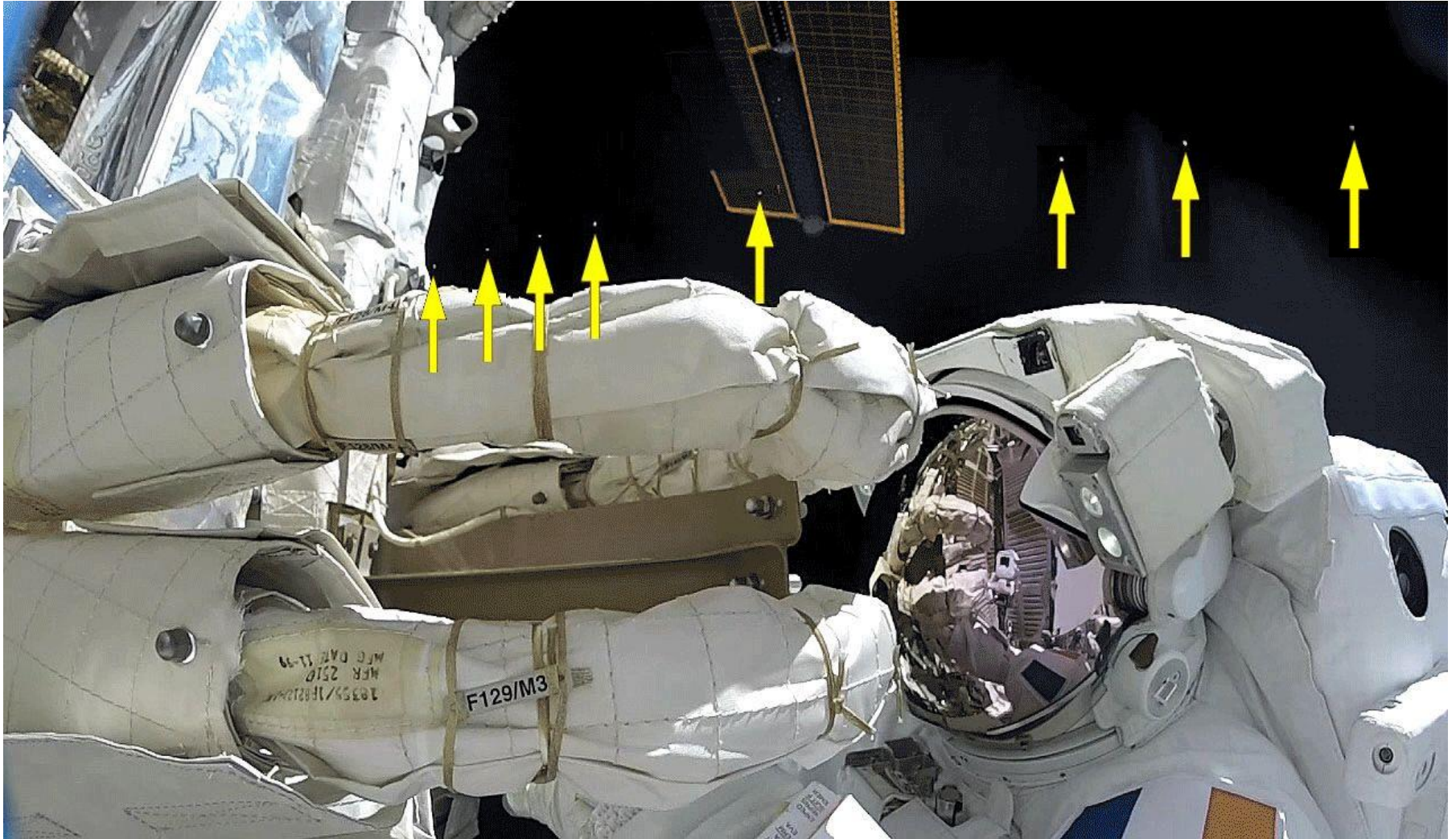


Composite Image of Ammonia Flakes With ISS Hardware

Leak Source Investigation



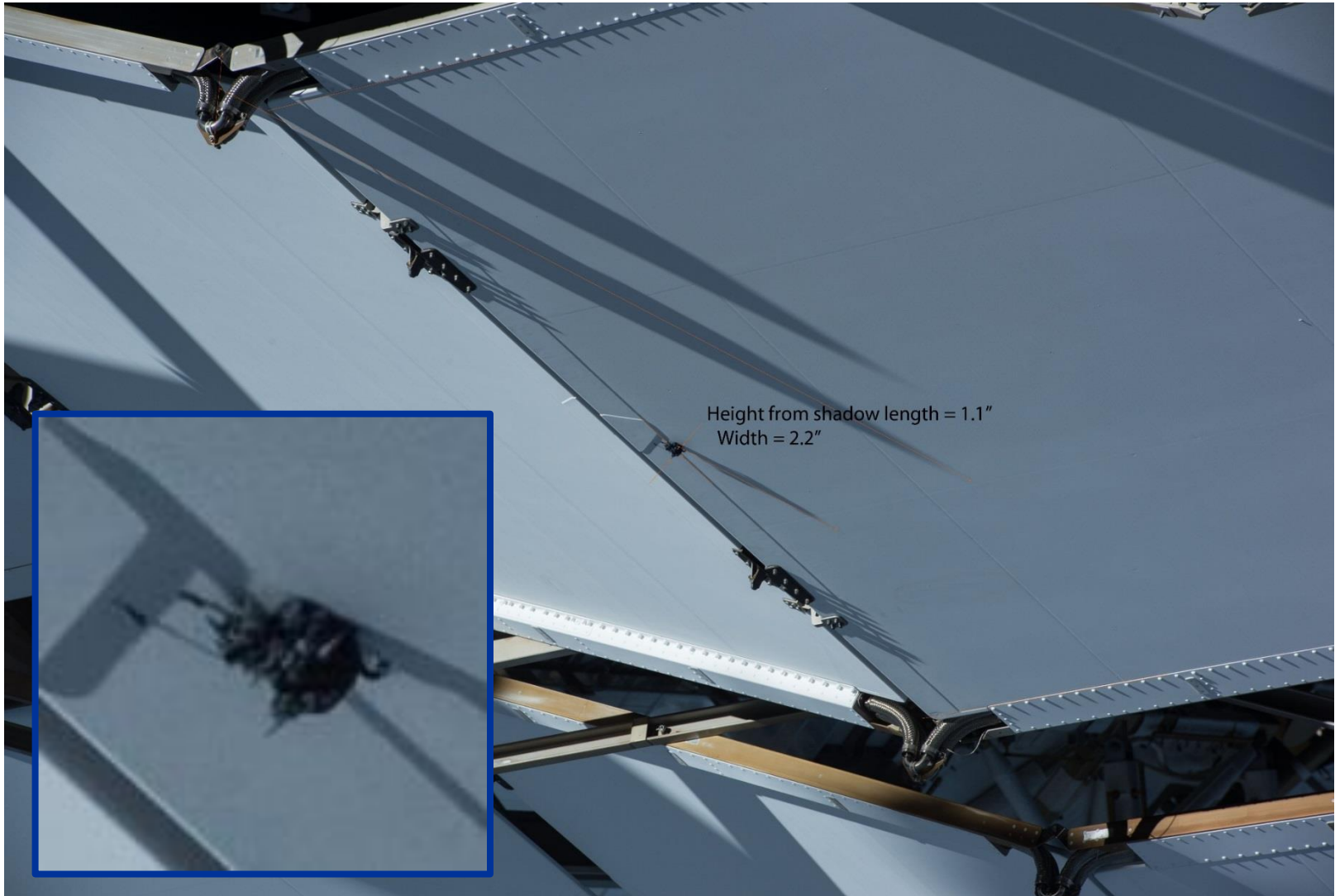
EVA 40 - RBVM Leak



Ammonia Flakes Observed in EVA 40 GoPro Video



Possible EVA Grease Ball on Thermal Radiator





Imagery Analysis Highlights

May 2015 – May 2018



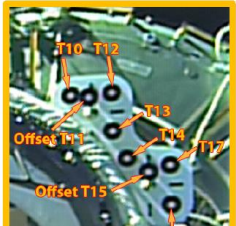
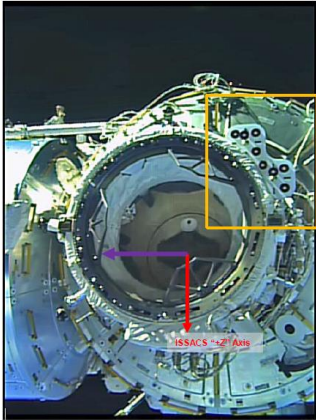
Static Analysis Examples



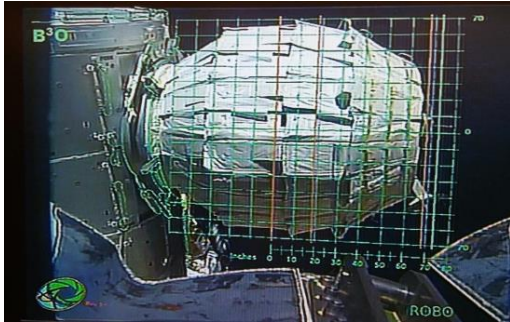
IDA2 Docking Targets

Point	X	Y	Z	Sig X	Sig Y	Sig Z	# of Images
IDA2_T10	620.524	-18.751	186.727	0.190	0.078	0.082	16
IDA2_T11	626.524	-22.008	189.918	0.114	0.078	0.076	20
IDA2_T12	620.486	-25.324	186.62	0.192	0.086	0.086	14
IDA2_T13	620.479	-25.33	193.188	0.206	0.094	0.092	11
IDA2_T14	620.448	-27.51	197.875	0.198	0.094	0.092	11
IDA2_T15	626.513	-30.727	202.561	0.110	0.090	0.088	18
IDA2_T16	620.395	-34.051	205.718	0.166	0.102	0.098	12
IDA2_T17	620.424	-34.072	199.243	0.168	0.100	0.098	13

All units in Inches



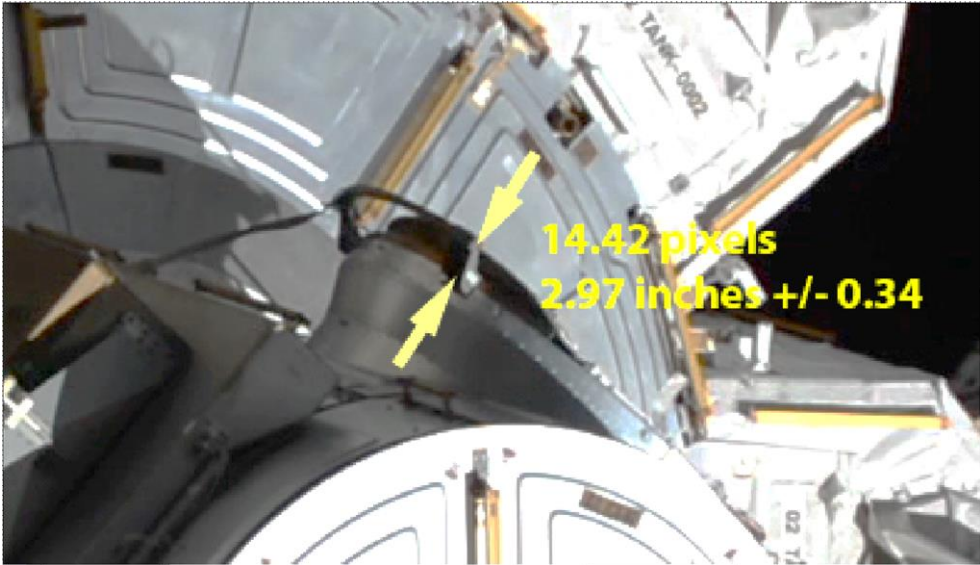
As installed orientation of IDA2 on PMA2



BEAM Inflation Progress



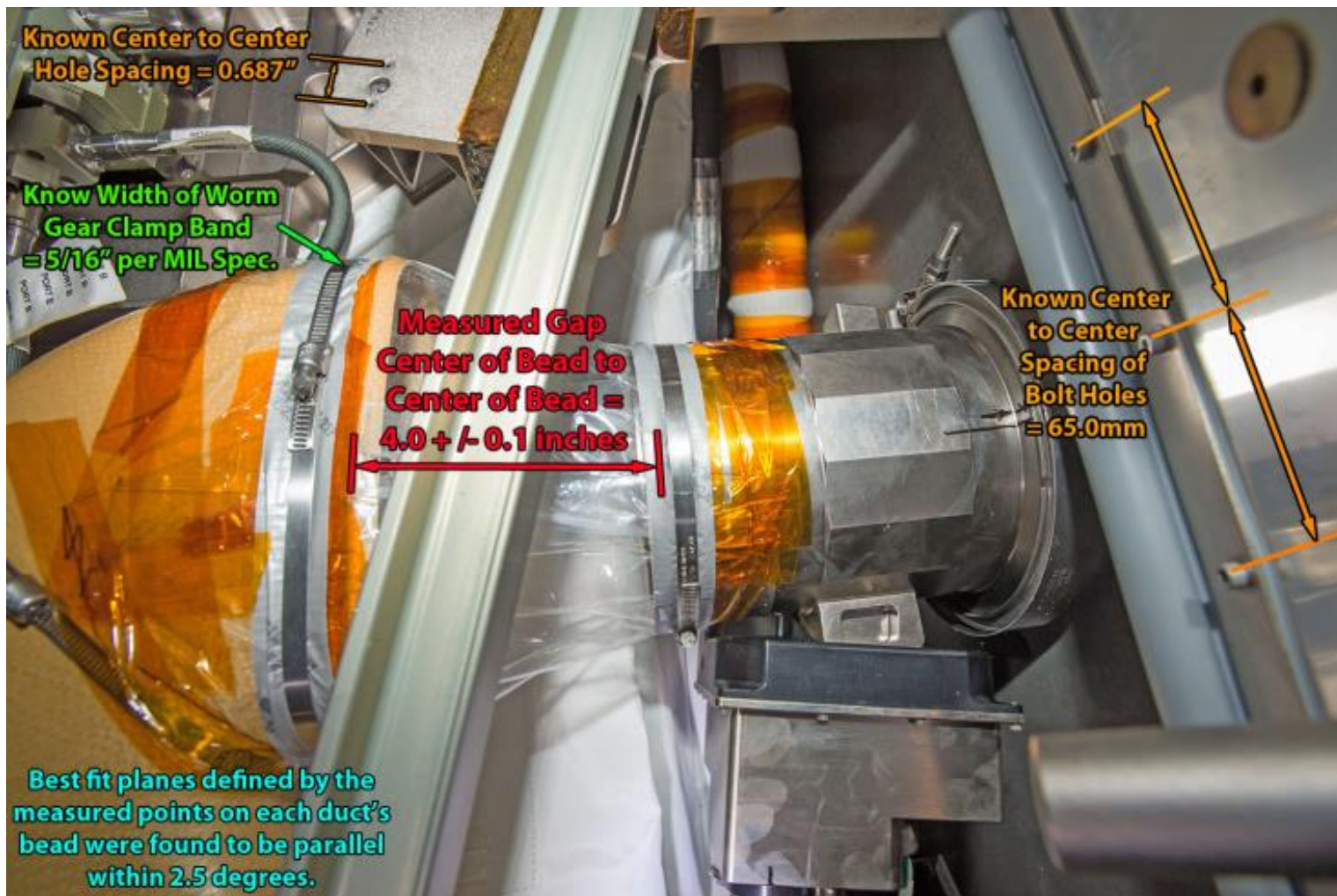
Crew Body Measurements



Airlock Cover Gap



Measurement of IMV Coupler Gap at Node 2 Aft Starboard



Node 3 Measurements for Waste & Hygiene Compartment (WHC) Remodel

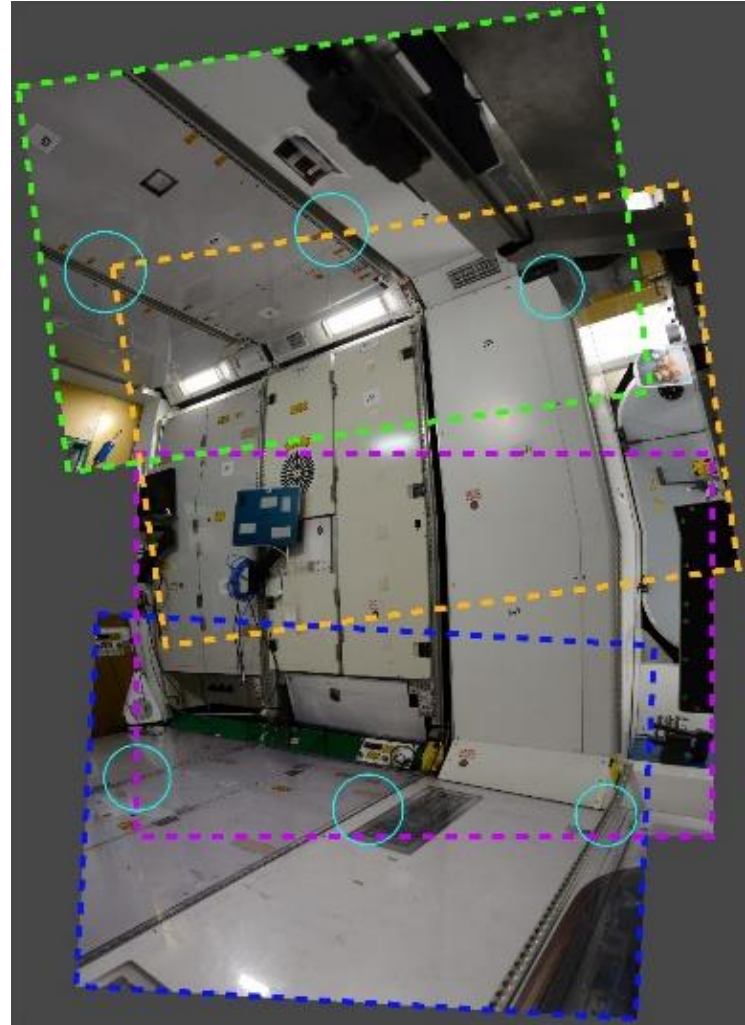
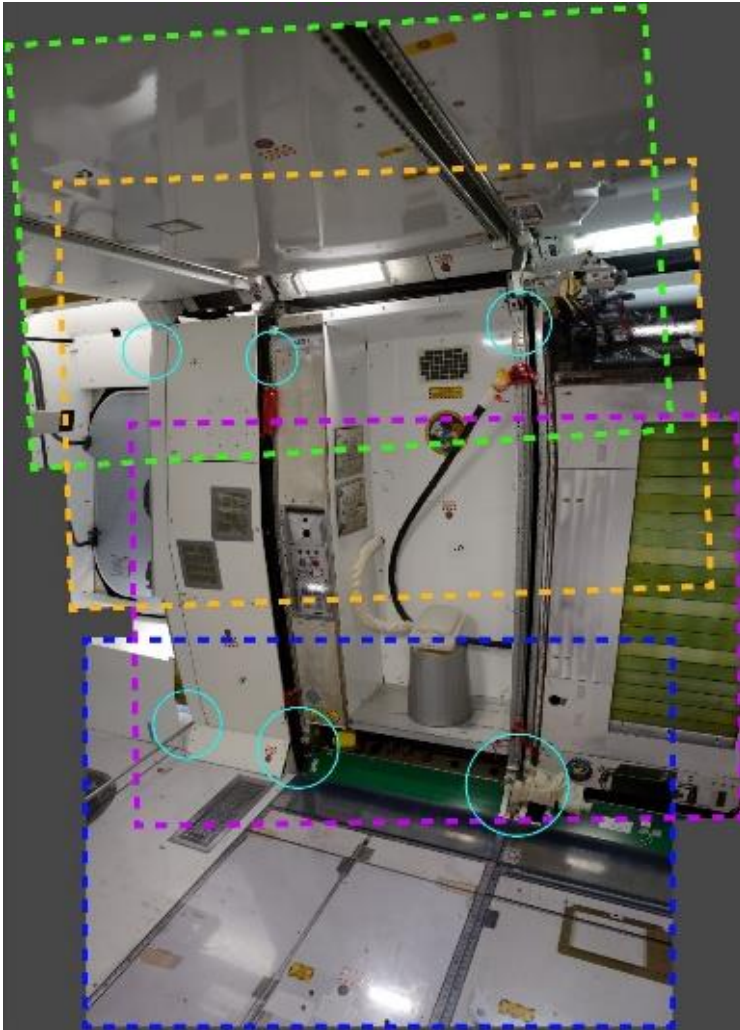
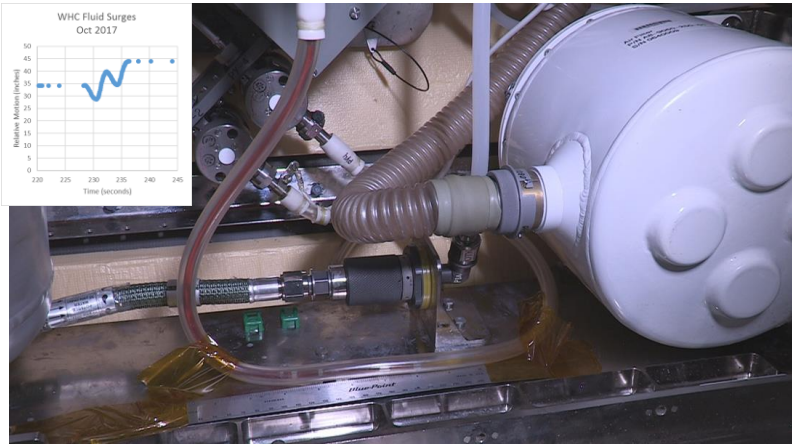


Image composites for the crew procedure provide a reference for required focus areas and overlap.



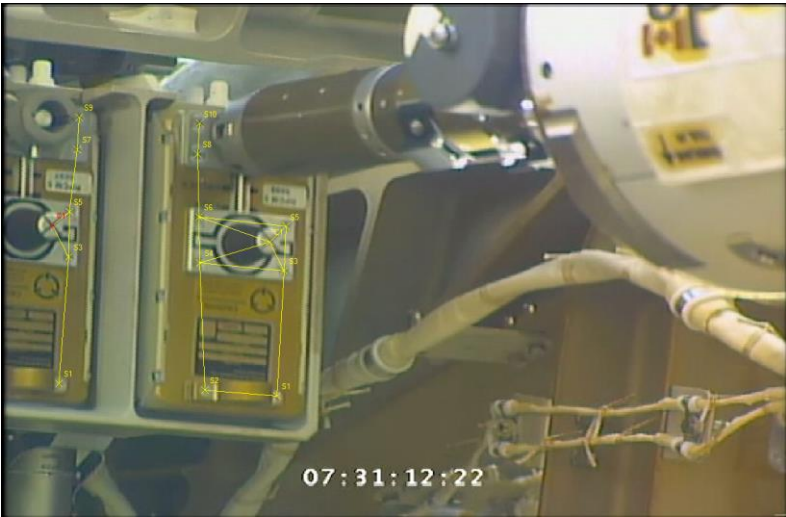
Dynamic Analysis Examples



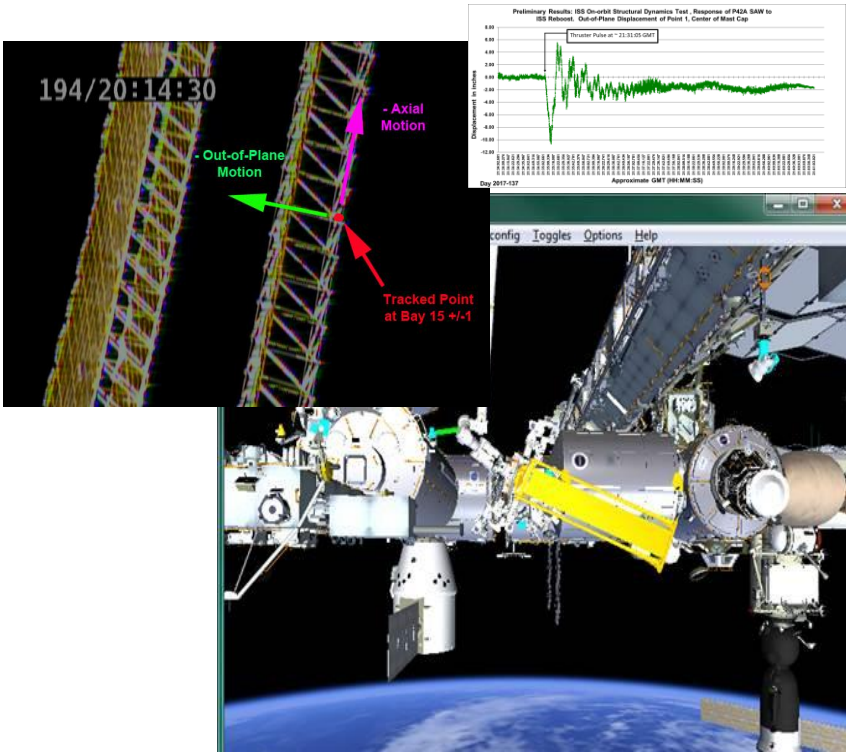
WHC Fluid Flow Rates



Spinsat Deployment Rates and JEM RMS Deflection



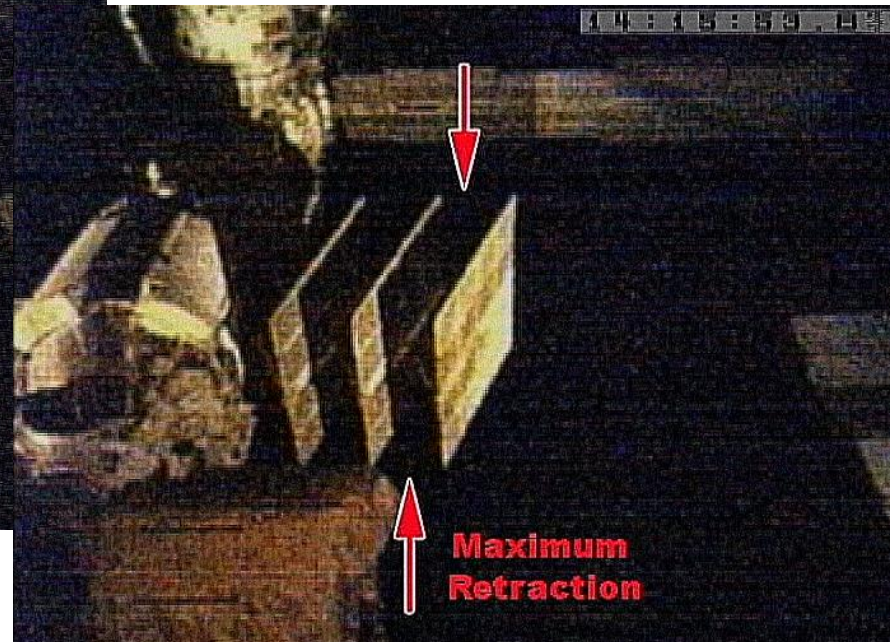
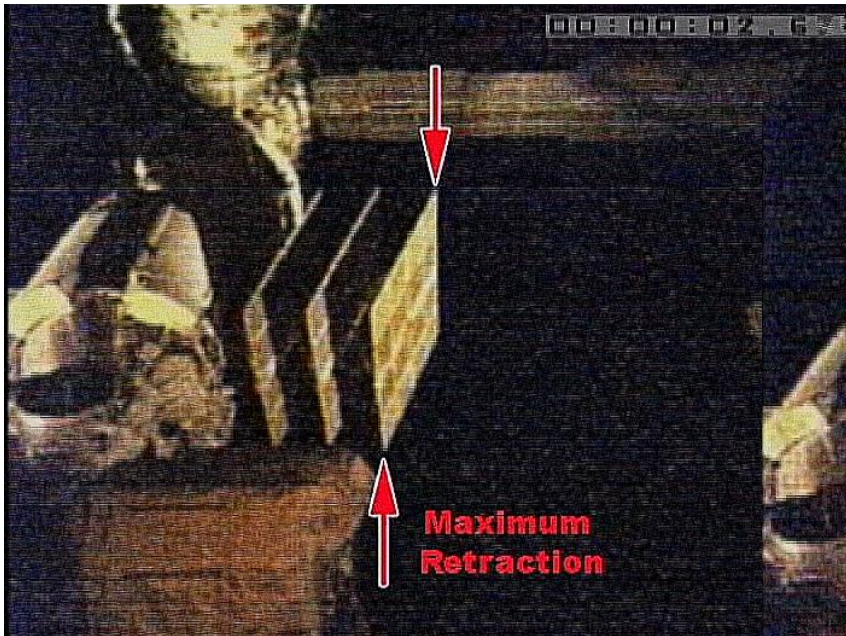
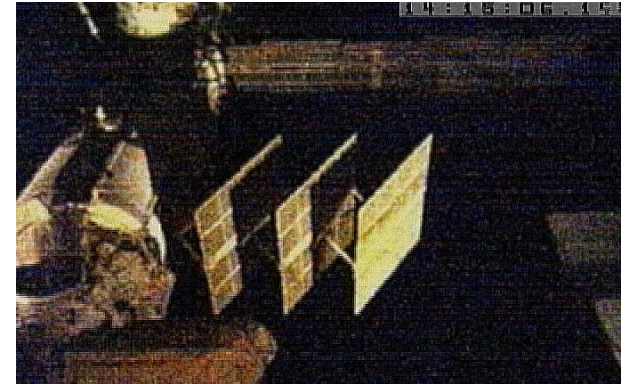
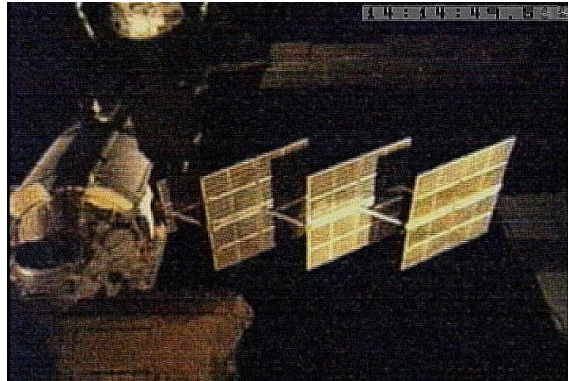
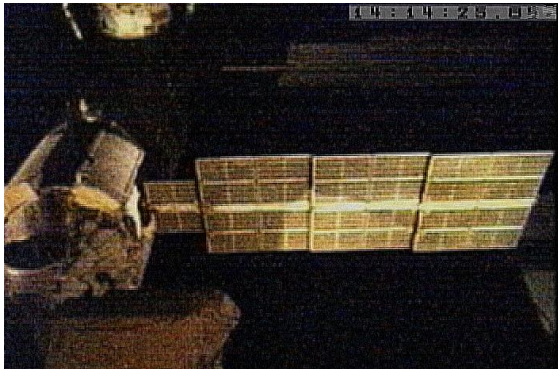
RPCM Pull Force



Solar Array Dynamics



FGB Solar Array Retracted Position Monitoring



Final Stowed Position



Inspection Tool Assessment



- CSA had a desire to image an old potential MMOD strike on the SSRMS
- ISAG developed a plan to use the SPDM arm OTCM camera and DTO VIPIR camera.
- Video of the area of interest was acquired from several different arm positions and wrist rotations to allow creation of stereo imagery for analysis.
- Provided a valuable test of focused inspection capability using existing and planned ISS cameras (VIPIR2 and “Dextre Deployable Vision System” a.k.a. “Dextre Operated Camera”).

OTCM

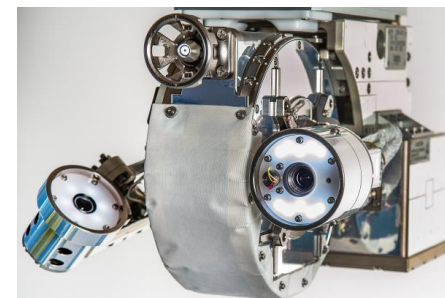
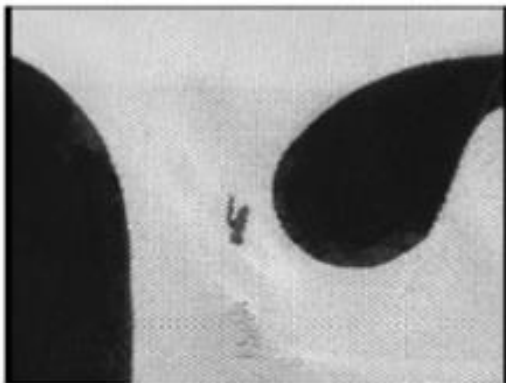


Wide Angle

VIPIR MZL



Narrow Angle



VIPIR



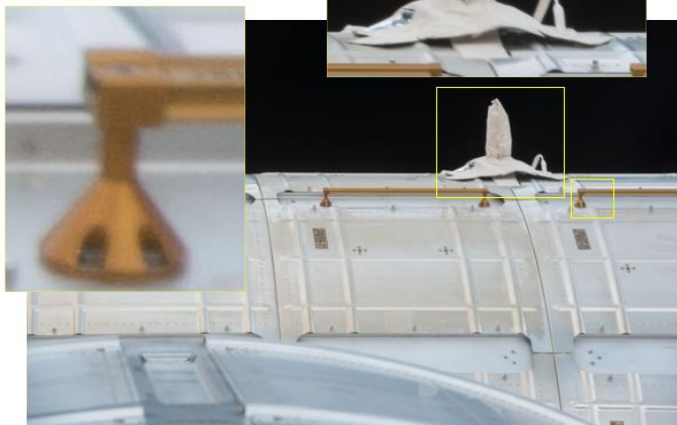
VIPIR MZL Image



Cupola Scratch Pane Replacement

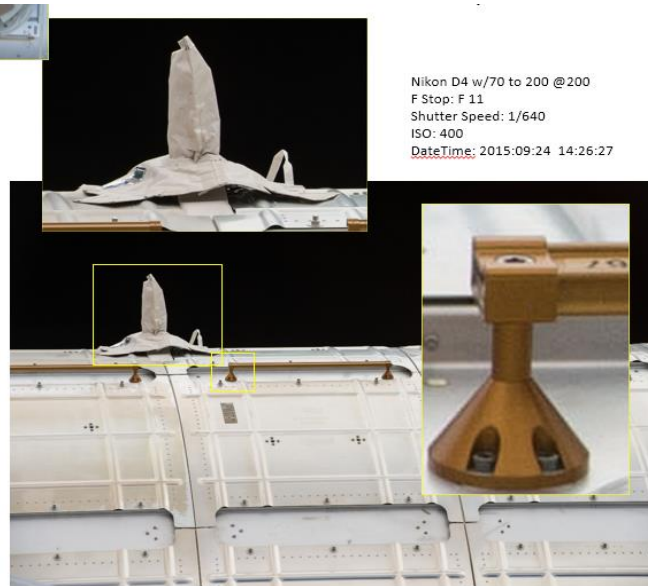


Nikon D4 w/70 to 200 @200
F Stop: F 11
Shutter Speed: 1/320
ISO: 400
DateTime: 2015:09:24 14:35:01

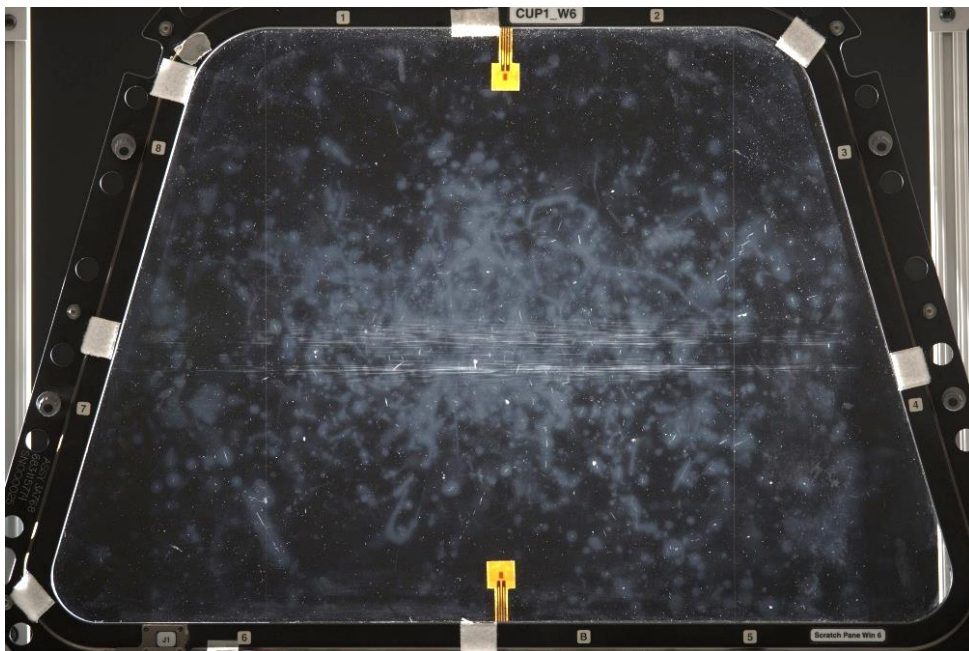


Captured through cupola scratch pane.

Nikon D4 w/70 to 200 @200
F Stop: F 11
Shutter Speed: 1/640
ISO: 400
DateTime: 2015:09:24 14:26:27



Captured without scratch pane.



Haze and Nicks on Returned Pane



Optical Quality Testing