Person: Mcmullen, Marc (mcmullen@jlab.org)
Org: PHALLB

Status: PROCESSED
Saved: 1/19/2022 5:22:28 PM
Submitted: 1/19/2022 5:22:28 PM

Jefferson Lab
Thomas Jefferson National Accelerator Facility

Operational Safety Procedure Review and Approval Form # 122990
(See ES&H Manual Chapter 3310 Appendix T1 Operational Safety Procedure (OSP) and Temporary OSP Procedure for Instructions)

Type:	***OSP*** Click for OSP/TOSP Procedure Form Click for LOSP Procedure Form Click for LOTO-COMPLEX Information Click for LOTO-GROUP Information		
Serial Number:	***ENP-22-122990-OSP***		
Issue Date:	***1/24/2022***		
Expiration Date:	***12/24/2024***		
Title:	***Assembly of the RICH II detector***		
Location: (where work is being performed) Building Floor Plans	***90 - Experimental Equipment Lab (EEL) - 124***	Location Detail: (specifics about where in the selected location(s) the work is being performed)	***Clean room***
Risk Classification: (See ES&H Manual Chapter 3210 Appendix T3 Risk Code Assignment)	Without mitigation measures (3 or 4): With mitigation measures in place (N, 1, or 2):		***3*** ***2***
Reason:	This document is written to mitigate hazard issues that are : ***Determined to have an unmitigated Risk code of 3 or 4***		
Owning Organization:	***PHALLB***		
Document Owner(s):	***Mcmullen, Marc (mcmullen@jlab.org)*** Primary		

Supplemental Technical Validations

Ergonomics - Lifting, Carrying, Repetitive Motion (Bob May, Smitty Chandler)
Aerial Work Platforms (Scissor/Aerial Lifts, Boom Trucks) (Joe Thomas, Mark Loewus)
Cranes & Hoists - Critical Lift (Bob Sperlazza, Mark Loewus)
Cranes & Hoists - Ordinary or Pre-Engineered (Bob Sperlazza, Mark Loewus)
Pinch Points (Bert Manzlak, Paul Collins)
Four Feet or More Above the Ground (other than ladder or scaffold). (Bert Manzlak, George Perry)
ESH&Q Liasion (Bert Manzlak)

Document History

Revision	Reason for revision or update	Serial number of superseded document

Lessons Learned	Lessons Learned relating to the hazard issues noted above have been reviewed.
Comments for reviewers/approvers:	***This is the submission of the OSP with supporting documents sent for preview on 10/29/21. All comments have been addressed, the lift plan and load calculations have been reviewed and updated as well.***

Attachments

Procedure: ***RICH Detector Assembly OSP_011922.pdf***

THA: ***Installation of RICH Mirrors, Aerogel, and Panels_THA_011922.pdf***

Additional Files: ***Spherical and Planar Mirror Installation.pdf***
Electronics Panel Installation Procedure.pdf
Frontal Panels Procedures.pdf
RICH Detector Shell Assembly.pdf
RICH Exit Window Assembly 2017-05-31.pdf
2021 2nd RICH rotation lift plan.pdf
RICH_Rotation_Calculations.pdf
Electronics Panel Boards Assembly Procedure.pdf

Review Signatures

Subject Matter Expert : Ergonomics - Lifting-> Carrying-> Repetitive Motion	**Signed** on 1/24/2022 10:06:09 AM by Bob May (may@jlab.org)
Subject Matter Expert : Material Handling Equipment->Aerial Work Platforms (Scissor/Aerial Lifts-> Boom Trucks)	**Signed** on 1/20/2022 2:34:03 PM by Mark Loewus (loewus@jlab.org)
Subject Matter Expert : Material Handling Equipment->Cranes & Hoists - Critical Lift	**Signed** on 1/20/2022 2:33:57 PM by Mark Loewus (loewus@jlab.org)
Subject Matter Expert : Material Handling Equipment->Cranes & Hoists - Ordinary or Pre-Engineered	**Signed** on 1/20/2022 2:33:52 PM by Mark Loewus (loewus@jlab.org)
Subject Matter Expert : Pinch Points	**Signed** on 1/24/2022 8:25:23 AM by Bert Manzlak (manzlak@jlab.org)
Subject Matter Expert : Working at Elevations->Four Feet or More Above the Ground (other than ladder or scaffold).	**Signed** on 1/24/2022 8:25:33 AM by Bert Manzlak (manzlak@jlab.org)

Approval Signatures

Division Safety Officer : PHALLB	**Signed** on 1/24/2022 10:46:24 AM by Ed Folts (folts@jlab.org)
ESH&Q Division Liasion : PHALLB	**Signed** on 1/24/2022 12:24:10 PM by Bert Manzlak (manzlak@jlab.org)
Org Manager : PHALLB	**Signed** on 1/24/2022 11:17:41 AM by Stepan Stepanyan (stepanya@jlab.org)
Safety Warden : Experimental Equipment Lab (EEL) - 124	**Signed** on 1/24/2022 10:07:38 AM by Marc Mcmullen (mcmullen@jlab.org)

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Thomas Jefferson National Accelerator Facility

Operational Safety Procedure Form

(See ES&H Manual Chapter 3310 Appendix T1 Operational Safety Procedure (OSP) and Temporary OSP Procedure for instructions.)

Click For Word Doc

Title:	Assembly of the RICH detector		
Location:	Building 90 Room 124	**Type:**	[x] **OSP** [ ] **TOSP**
Risk Classification (per Task Hazard Analysis attached) (See *ESH&Q Manual Chapter 3210 Appendix T3 Risk Code Assignment*.)		**Highest Risk Code Before Mitigation**	4
		Highest Risk Code after Mitigation (N, 1, or 2):	2
Owning Organization:	Physics	**Date:**	10/29/2021
Document Owner(s):	McMullen, Marc		

DEFINE THE SCOPE OF WORK

1. Purpose of the Procedure – Describe in detail the reason for the procedure (what is being done and why).

The procedure provides step by step instructions to assembly the Ring Image Cherenkov Detector.

2. Scope – include all operations, people, and/or areas that the procedure will affect.

The scope is limited to the assembly of the detector, using machines and tools. The operation will be conducted by the INFN/RICH group in conjunction with the Physics Detector Support Group. The work will be performed in building 90, room 124.

3. Description of the Facility – include building, floor plans and layout of the experiment or operation.

Room 124 is a class 10,000 clean room, with a high ceiling.

ANALYZE THE HAZARDS and IMPLEMENT CONTROLS

4. Hazards identified on written Task Hazard Analysis

Hazards include: Illness, electric shock, damage to components and/or equipment, heavy lifting, pinch points, and the potential from a fall from > 4'.

5. Authority and Responsibility:

5.1 Who has authority to implement/terminate

T. Keppel, P. Rossi, E. Folts, A. Yegneswaran.

5.2 Who is responsible for key tasks

T. Lemon, M. McMullen (Safety), G. Jacobs (Materials Handling)

5.3 Who analyzes the special or unusual hazards including elevated work, chemicals, gases, fire or sparks (See ES&H Manual Chapter 3210 Appendix T1 Work Planning, Control, and Authorization Procedure)

E. Folts

5.4 What are the Training Requirements (See http://www.jlab.org/div_dept/train/poc.pdf)

Materials Handling, Crane, Man Lift operation.

6. Personal and Environmental Hazard Controls Including:

6.1 Shielding

n/a

6.2 Barriers (magnetic, hearing, elevated or crane work, etc.)

n/a

6.3 Interlocks

n/a

6.4 Monitoring systems

n/a

6.5 Ventilation

n/a

6.6 Other (Electrical, ODH, Trip, Ladder) (Attach related Temporary Work Permits or Safety Reviews as appropriate.)

Adherence to Jlab COVID-19 OSP ***ESH-20-106466-OSP***

7. List of Safety Equipment:

7.1 List of Safety Equipment:

Standard PPE, Clean room attire.

7.2 Special Tools:

Double geared winch and pulley.

8. Associated Administrative Controls

n/a

DEVELOP THE PROCEDURE

9. Operating Guidelines

The lead worker and safety warden will perform a briefing with the detector subject matter experts and any workers prior to the beginning of a shift. All man lifts will be inspected prior to the shift by a qualified operator.

10. Notification of Affected Personnel (who, how, and when include building manager, safety warden, and area coordinator)

The building safety warden shall be notified at the start of work by email.

11. List the Steps Required to Execute the Procedure: from start to finish.

See attached detailed procedures for each RICH II sub-assembly

Detector shell assembly

Electronics panel electronics assembly

RICH exit window assembly

Electronics panel installation

Front panels assembly and installation

Mirror Installation

12. Back Out Procedure(s) i.e. steps necessary to restore the equipment/area to a safe level.

This is an assembly procedure, if a safety issue is encountered the lift/crane operator will move the detector in either the vertical (65 degrees) or horizontal positions and apply the locking pins to the pivoting block.

13. Special environmental control requirements:

13.1 List materials, chemicals, gasses that could impact the environment (ensure these are considered when choosing Subject Mater Experts) and explore EMP-04 Project/Activity/Experiment Environmental Review below

n/a

13.2 Environmental impacts (See EMP-04 Project/Activity/Experiment Environmental Review)

n/a

13.3 Abatement steps (secondary containment or special packaging requirements)

n/a

14. Unusual/Emergency Procedures (e.g., loss of power, spills, fire, etc.)

The winch is mechanical. In the case of an outage with personnel in a genie lift, there is an emergency valve to lower the lift basket.

Unusual/Emergency Procedures (e.g., loss of power, spills, injury, fire, etc.) In the event of injury, or an immediate emergency exists, call 911 and also notify: • Guards (x5822) • Occupational Medicine (x7539) • Crew Chief (x7045) (if inside the fence) In case of an injury follow standard JLAB procedures. Initial response cards are located with each phone for appropriate emergency phone numbers. Additional information can be found at https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-24400/*.pdf

15. Instrument Calibration Requirements (e.g., safety system/device recertification, RF probe calibration)

16. Inspection Schedules

All materials handling equipment will be inspected per Jlab requirement

17. References/Associated/Relevant Documentation

See THA for document links

18. List of Records Generated (Include Location / Review and Approved procedure)

Click
To Submit OSP
for Electronic Signatures

Distribution: Copies to Affected Area, Authors, Division Safety Officer
Expiration: Forward to ESH&Q Document Control

Form Revision Summary

Revision 1.4 – 06/20/16 – Repositioned "Scope of Work" to clarify processes
Qualifying Periodic Review – 02/19/14 – No substantive changes required
Revision 1.3 – 11/27/13 – Added "Owning Organization" to more accurately reflect laboratory operations.
Revision 1.2 – 09/15/12 – Update form to conform to electronic review.
Revision 1.1 – 04/03/12 – Risk Code 0 switched to N to be consistent with 3210 T3 Risk Code Assignment.
Revision 1.0 – 12/01/11 – Added reasoning for OSP to aid in appropriate review determination.
Revision 0.0 – 10/05/09 – Updated to reflect current laboratory operations

ISSUING AUTHORITY	FORM TECHNICAL POINT-OF-CONTACT	APPROVAL DATE	REVIEW DATE	REV.
ESH&Q Division	Harry Fanning	06/20/16	06/20/19	1.4

Task Hazard Analysis (THA) Worksheet

(See ES&H Manual Chapter 3210 Appendix T1
Work Planning, Control, and Authorization Procedure)

Click

Author:	Marc McMullen	**Date:**	January, 19 2022	**Task #:** If applicable	

Complete all information. Use as many sheets as necessary

Task Title:	Installation of Mirrors, Aerogel, and Panels on the RICH Detector			**Task Location:**	EEL 124/125
Division:	Physics	**Department:**	Detector Support Group	**Frequency of use:**	1
Lead Worker:	George Jacobs (rigging), Tyler Lemon (Installation), Marc McMullen (Safety)				
Mitigation already in place: Standard Protecting Measures Work Control Documents	Clean Room attire, Hard hat and safety shoes (lift procedures), additional PPE as necessary				

Sequence of Task Steps	Task Steps/Potential Hazards	Consequence Level	Probability Level	Risk Code (before mitigation)	Proposed Mitigation (Required for Risk Code >2)	Safety Procedures/ Practices/Controls/Training	Risk Code (after mitigation
1.	Removal of the exit panel. **Damage to equipment. Work above 4'.**	M	L	2	A qualified rigger will perform lift. Man lift or portable stairs will be used for work above 4'.	Follow the procedure. Wear prescribed PPE (Procedure).	1
2.	Installation of gas lines and cables. **Work above 4'.**	L	L	1	Man lift or portable stairs will be used for work above 4'	The RICH cooling and nitrogen systems has completed the Jlab Pressure Systems program and is in compliance. If any changes are made to the system, the DA and system owner should be notified.	1

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Task Hazard Analysis (THA) Worksheet

(See ES&H Manual Chapter 3210 Appendix T1
Work Planning, Control, and Authorization Procedure)

Sequence of Task Steps	Task Steps/Potential Hazards	Consequence Level	Probability Level	Risk Code (before mitigation)	Proposed Mitigation (Required for Risk Code >2)	Safety Procedures/ Practices/Controls/Training	Risk Code (after mitigation
3.	Installation of mirrors and mirror supports. **Damage to equipment**	H	L	3	Handling the mirrors will be done by trained staff from the INFN and the DSG. A detailed procedure has been developed for this step. Installation will be done with the detector in the horizontal position to eliminate work at heights.	Trained staff, PPE such as gloves. Procedure details are covered in the document (CFRP FRAME-SPH MIRRORS-LATERAL MIRRORS-ASSEMBLY INTO THE RICH SHELL)	2
4	Rotation of the RICH to 60deg**. Heavy equipment falling, damage to equipment. Working above 4'.**	H	L	3	Perform the lift as per the developed lift plan. After rotation the installation of the locking hardware will be done prior to completing this task.	The lift plan was developed with the Jlab Materials Handling Manager and a qualified rigger. All calculations have been reviewed by the Jlab Materials Handling manager. The BTHLD has been certified by Jlab EHS/MHM. It has been tested with the detector shell. The plan specifies the rigging equipment to be used. All work above standing height will be done from a man lift.	1

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Task Hazard Analysis (THA) Worksheet

(See ES&H Manual Chapter 3210 Appendix T1
Work Planning, Control, and Authorization Procedure)

Sequence of Task Steps	Task Steps/Potential Hazards	Consequence Level	Probability Level	Risk Code (before mitigation)	Proposed Mitigation (Required for Risk Code >2)	Safety Procedures/ Practices/Controls/Training	Risk Code (after mitigation
5.	Mirror Alignment and Survey. **Working above 4'.**	L	L	1	Man lift or portable stairs will be used for work above 4'	The survey will be done by the survey group. Mirror Alignment will be done without a laser source. All work above standing height will be done from a man lift	1
6.	Assembly/Installation of front panel tooling frame. **Lifting heavy objects. Falling objects. Working above 4'.**	M	L	2	The gantry crane will be used to lift all equipment > 40lbs. Man lift or portable stairs will be used for work above 4'	Assembly is covered in the document 'Assembly Procedure of the RICH Frontal Panels'. All work above standing height will be done from a man lift.	1
7.	Assembly and testing of the Electronics Panel. **Damage to equipment. Electric shock.**	H	L	3	A detailed procedure has been developed. Qualified INFN/DSG staff will perform the assembly and testing. Testing will be done outside of the detector volume, with no contact to live circuits.	Procedure (Epanel Boards Assembly Procedure). PPE (nitrile gloves). Power Supply operation procedure (**OSP ENP-17-63644-OSP section 4**)	1

Jefferson Lab
Thomas Jefferson National Accelerator Facility

Task Hazard Analysis (THA) Worksheet

(See ES&H Manual Chapter 3210 Appendix T1
Work Planning, Control, and Authorization Procedure)

Sequence of Task Steps	Task Steps/Potential Hazards	Consequence Level	Probability Level	Risk Code (before mitigation)	Proposed Mitigation (Required for Risk Code >2)	Safety Procedures/ Practices/Controls/Training	Risk Code (after mitigation
8	Installation of front panels, w/o Aerogel. **Falling objects. Working above 4'.**	M	L	2	This test will help determine the details of the front panel installation without risk to the Aerogel. Man lift or portable stairs will be used for work above 4'	Details of the task are covered in the document 'Assembly Procedure of the RICH Frontal Panels'.	1
9	Aerogel installation onto front panels. **Damage to equipment.**	H	L	3	INFN/DSG will develop further details by practicing the task using a mockup of Aerogel on the front panel.	PPE (nitrile gloves) will be used while handling Aerogel. Only trained INFN/DSG staff will perform this task.	2
10	Installation of front panels with Aerogel. **Damage to equipment. Work above 4'.**	H	L	3	INFN/DSG Staff will use a previous task to provide details of the task. A lift plan will be developed for the task. Man lift or portable stairs will be used for work above 4'	PPE will be used during the lift and installation. Qualified staff will prepare the lift plan.	2

Task Hazard Analysis (THA) Worksheet

(See ES&H Manual Chapter 3210 Appendix T1 Work Planning, Control, and Authorization Procedure)

Sequence of Task Steps	Task Steps/Potential Hazards	Consequence Level	Probability Level	Risk Code (before mitigation)	Proposed Mitigation (Required for Risk Code >2)	Safety Procedures/ Practices/Controls/Training	Risk Code (after mitigation
11	Installation of the electronics panel and testing with compressed air cooling. **Damage to equipment. Working above 4'**	H	L	3	INFN/DSG staff have practiced this lift without the electronics on the panel. A lift plan will be developed and approved. The cooling system is at low pressure. Man lift or portable stairs will be used for work above 4'	Installation is covered in the document 'Epanel Installation Procedure'. A lift plan will be developed prior to this task. Gas system operation detailed in the Manual for Purge Type Gas Systems. Pressure Systems Awareness SAF130A or SAF130AU (users) is required to operate any components of the gas system.	2

Highest Risk Code before Mitigation:	3	Highest Risk Code after Mitigation:	2

When completed, if the analysis indicates that the Risk Code before mitigation for any steps is "medium" or higher (RC≥3), then a formal Work Control Document (WCD) is developed for the task. Attach this completed Task Hazard Analysis Worksheet. Have the package reviewed and approved prior to beginning work. (See ES&H Manual Chapter 3310 Operational Safety Procedure Program.)

Form Revision Summary

Revision 0.1 – 06/19/12 - Triennial Review. Update to format.

Revision 0.0 – 10/05/09 – Written to document current laboratory operational procedure.

ISSUING AUTHORITY	TECHNICAL POINT-OF-CONTACT	APPROVAL DATE	REVIEW REQUIRED DATE	REV.
ESH&Q Division	Harry Fanning	06/19/12	06/19/15	0.1

This document is controlled as an on line file. It may be printed but the print copy is not a controlled document. It is the user's responsibility to ensure that the document is the same revision as the current on line file. This copy was printed on 1/19/2022.

Tecnologie Avanzate	Installation & Control Scheme		Mod. 75/95/00
	P/N: TA-RICH-001	DESCRIPTION: Rich CLAS12 Assembly	SHEET: 1/19

REV.	DATE	REVIEW'S REASON	MODIFIED PHASES	SIGNATURE
0	18/10/2016	FIRST EMISSION	N.A.	I. Loi

WORKING CYCLE PHASE	DESCRIPTION AND NOTES	IMAGES

APPLICABLE DOCUMENTATION:

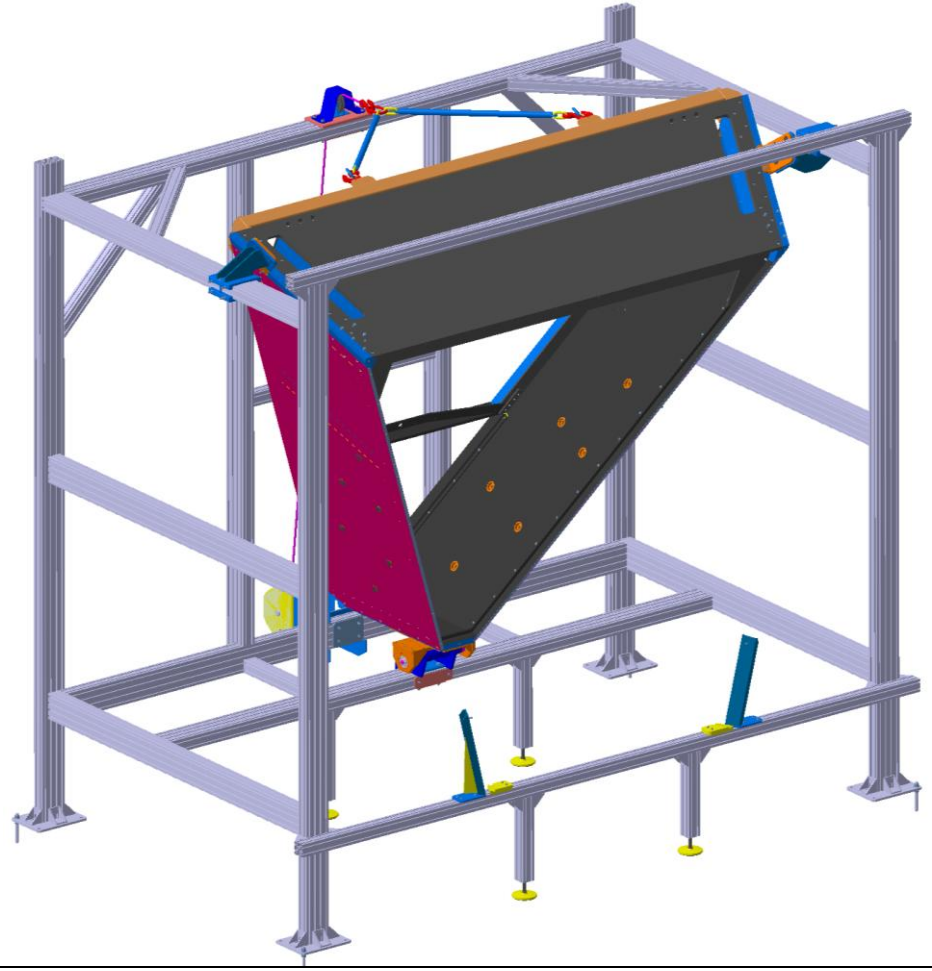
Assemby Structure For RICH Module_August 2016

TOOL:

TA-STR-001 RICH Assembly Structure

BILL OF P/Ns:

P/N	*Q.ty*	*P/N*	*Q.ty*
TA-RICH-002	1	TA-RICH-035	1
TA-RICH-012	1	TA-RICH-036	1
TA-RICH-013	1	TA-RICH-037	1
TA-RICH-019	1	TA-RICH-038	1
TA-RICH-020	1	TA-RICH-039	1
TA-RICH-021	1	TA-RICH-045	1
TA-RICH-022	1	TA-RICH-046	1
TA-RICH-023	1	TA-RICH-047	4
TA-RICH-024	1	TA-RICH-078	1
TA-RICH-025	1	TA-RICH-079	1
TA-RICH-026	1	TA-RICH-080	1
TA-RICH-027	1	TA-RICH-083	1
TA-RICH-028	1	TA-RICH-092	1
TA-RICH-029	1	TA-RICH-093	1
TA-RICH-030	1	TA-RICH-094	1
TA-RICH-031	1	TA-RICH-095	1
TA-RICH-032	1	TA-RICH-096	1
TA-RICH-033	1	TA-RICH-097	1
TA-RICH-034	1	TA-RICH-098	1



COMPILED BY:	VERIFIED BY:	APPROVED BY:
I. Loi	M. Pinna	P. Coluzzi

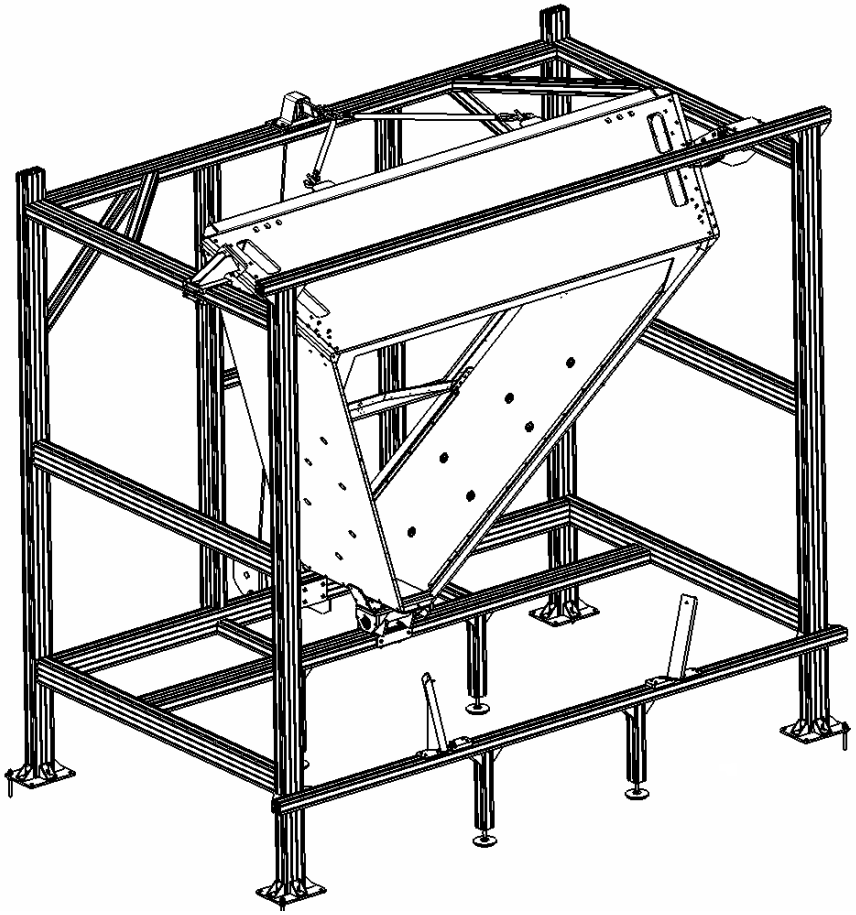
Tecnologie Avanzate	Installation & Control Scheme		Mod. 75/95/00
	P/N: TA-RICH-001	DESCRIPTION: Rich CLAS12 Assembly	SHEET: 2/19

REV.	DATE	REVIEW'S REASON	MODIFIED PHASES	SIGNATURE
0	18/10/2016	FIRST EMISSION	N.A.	I. Loi

WORKING CYCLE PHASE	DESCRIPTION AND NOTES	IMAGES

STANDARDS REQUIRED:

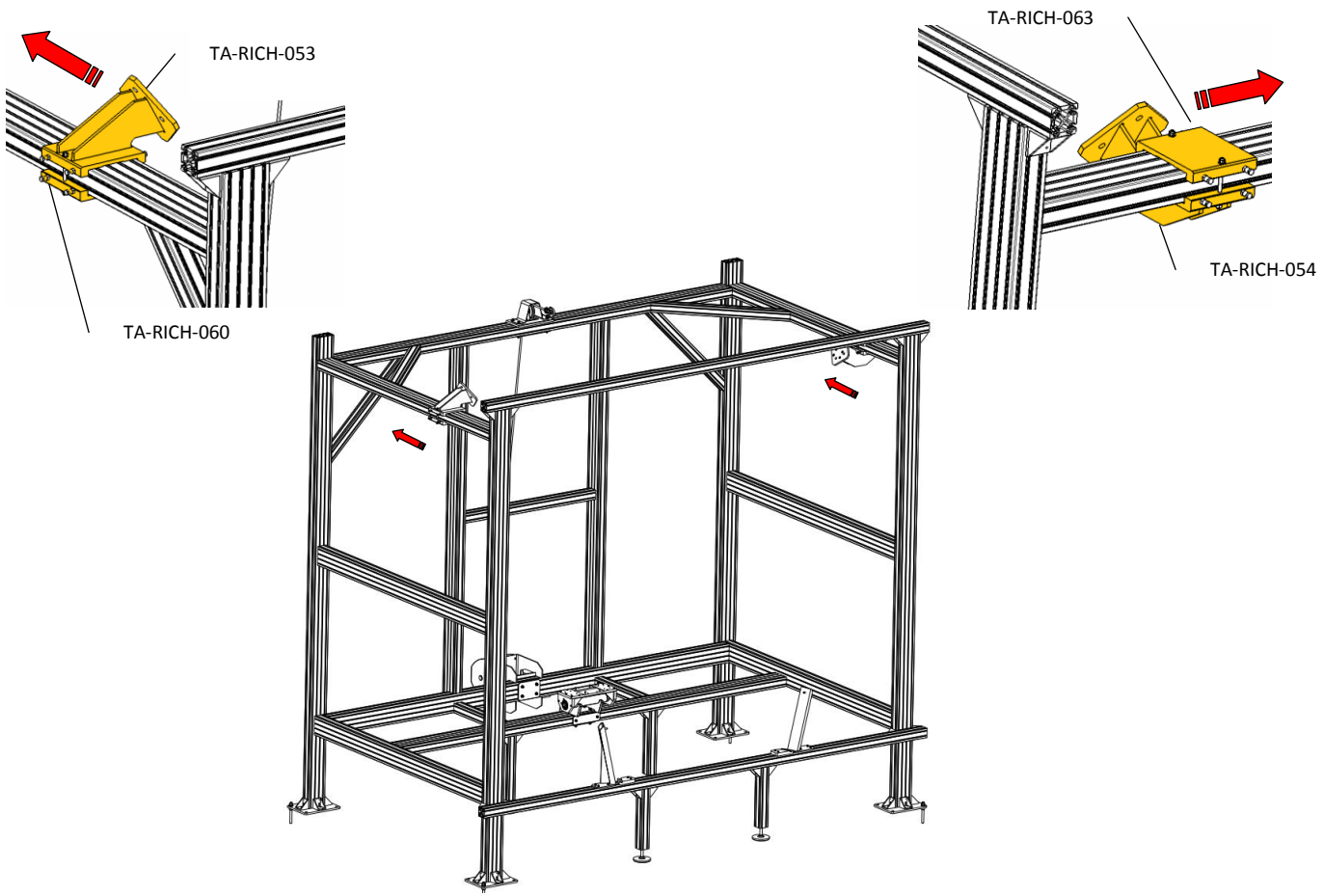
TYPE	*Q.ty*
Screw STEEL M5 x 12 ISO 4762	22
Screw STEEL M5 x 25 ISO 4017	4
Screw STEEL M6 x 16 ISO 4762	16
Screw STEEL M8 x 20 ISO 4762	62
Screw STEEL M8 x 25 ISO 4762	10
Screw STEEL M8 x 30 ISO 4762	23
Screw STEEL M10 x 35 ISO 4762	82
Washer STEEL M5 ISO 7089	38
Washer STEEL M6 ISO 7089	16
Washer STEEL 8 x 16 ISO 7089	115
Washer STEEL 10 x 20 ISO 7089	92
Washer STEEL M24 ISO 7089	18
Washer STEEL 8.8 M28 ISO 7089	8
Nut STEEL 8,8 M24 ISO 4032	8
NAS1802-6-10	20
NAS1802-4-13	12
Bolt STEEL M10 x 40 ISO 4014	6
Bolt STEEL M10 x 45 ISO 4014	4
Bolt STEEL M24 x 60 ISO 4014	2
Bolt STEEL 8,8 M24 x 65 ISO 4014	8
Screwed Bar M24	2
Bolteye M24	2
Assembly Lifting Tool	1



COMPILED BY:	VERIFIED BY:	APPROVED BY:
I. Loi	M. Pinna	P. Coluzzi

Tecnologie Avanzate	Installation & Control Scheme		Mod. 75/95/00
	P/N: TA-RICH-001	DESCRIPTION: Rich CLAS12 Assembly	SHEET: 3/19

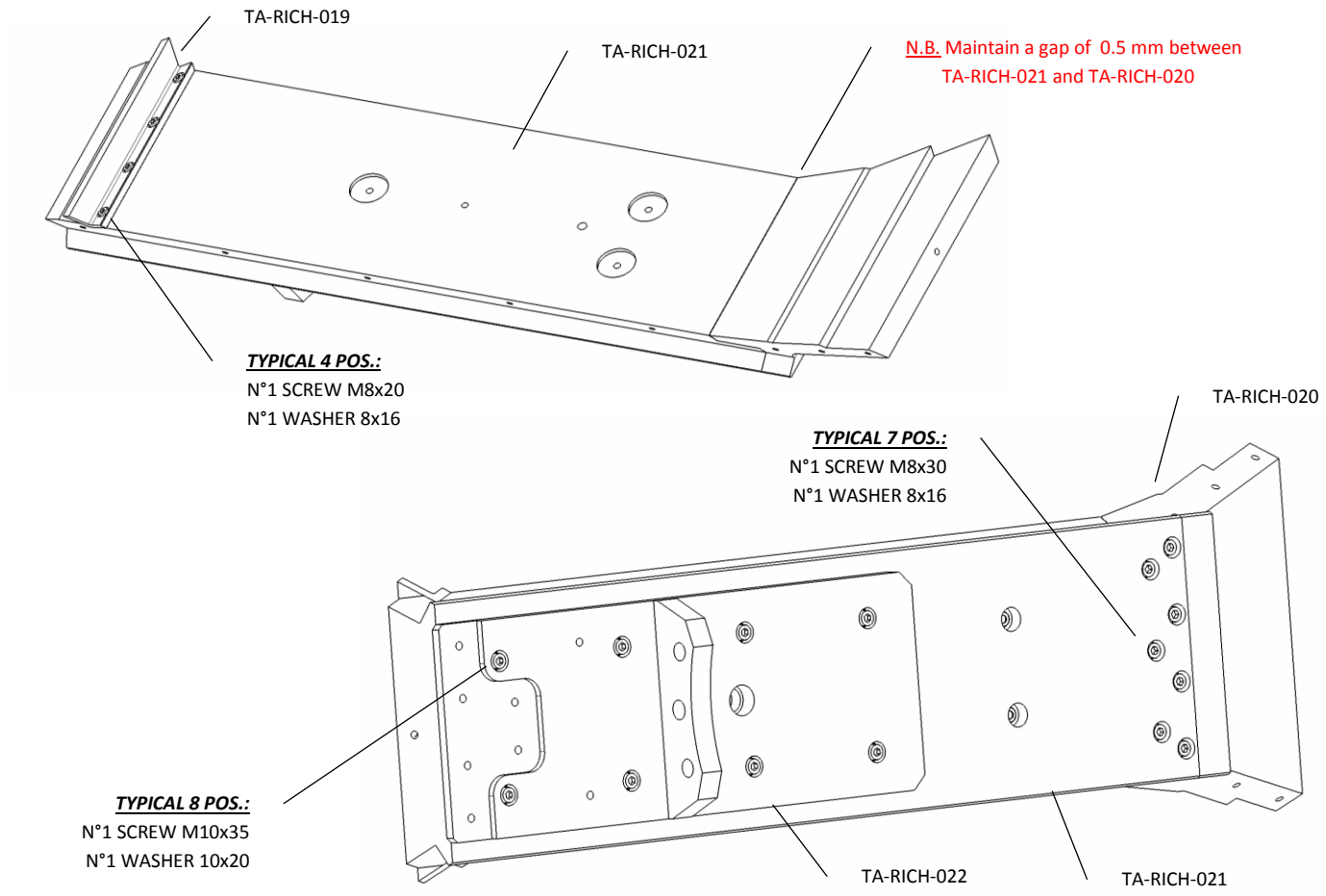
REV.	DATE	REVIEW'S REASON	MODIFIED PHASES	SIGNATURE
0	18/10/2016	FIRST EMISSION	N.A.	I. Loi

WORKING CYCLE PHASE	DESCRIPTION AND NOTES	IMAGES
OP.010	Before beginning the assembly of the RICH CLAS12 module move backward the items: • TA-RICH-053; • TA-RICH-054; • TA-RICH-060; • TA-RICH-063 in the way represented in the figure:	

COMPILED BY:	VERIFIED BY:	APPROVED BY:
I. Loi	M. Pinna	P. Coluzzi

Tecnologie Avanzate	Installation & Control Scheme		Mod. 75/95/00
	P/N: TA-RICH-001	DESCRIPTION: Rich CLAS12 Assembly	SHEET: 4/19

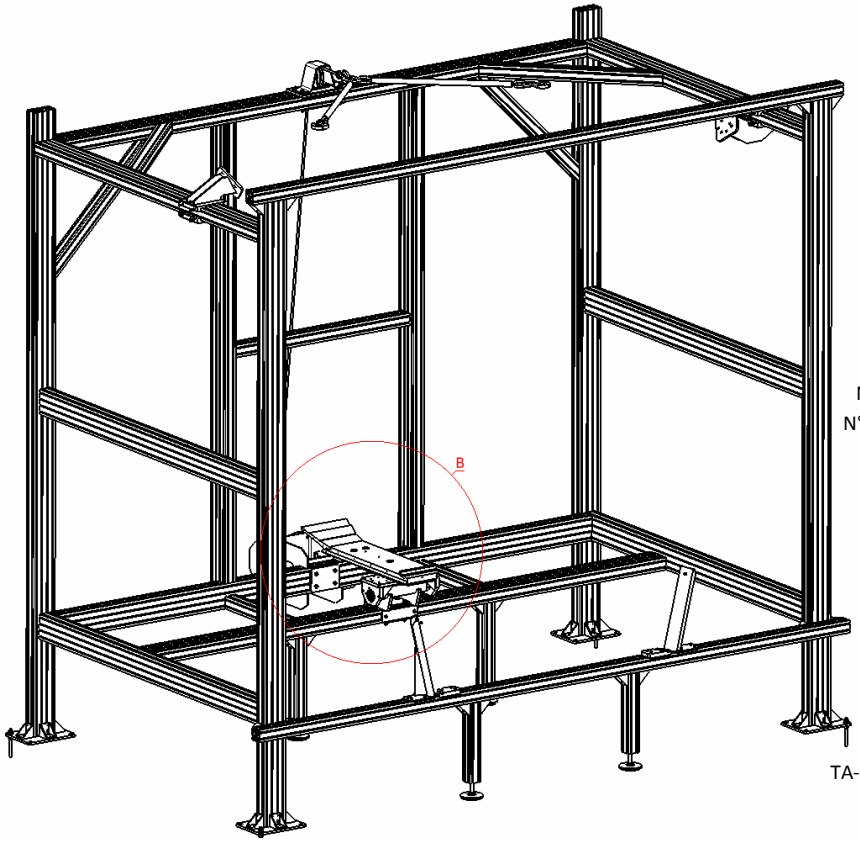
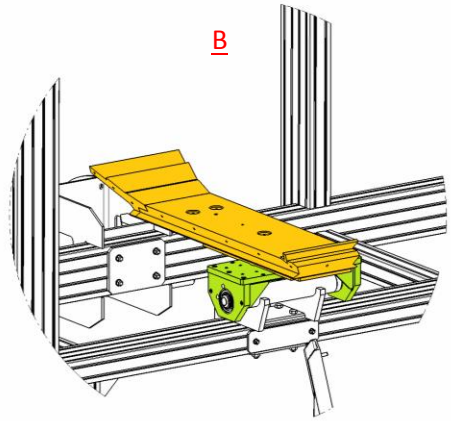
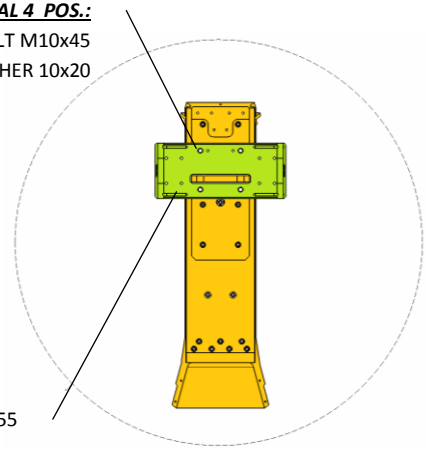
REV.	DATE	REVIEW'S REASON	MODIFIED PHASES	SIGNATURE
0	18/10/2016	FIRST EMISSION	N.A.	I. Loi

WORKING CYCLE PHASE	DESCRIPTION AND NOTES	IMAGES
OP.020	Withdraw the following items: • N° 1 TA-RICH-019 • N° 1 TA-RICH-020 • N° 1 TA-RICH-021 • N° 1 TA-RICH-022 • N° 4 Screw STEEL M8 x 20 ISO 4762 • N° 11 Washer STEEL 8 x 16 ISO 7089 • N° 7 Screw STEEL M8 x 30 ISO 4762 • N° 8 Screw STEEL M10 x 35 ISO 4762 • N° 8 Washer STEEL 10 x 20 ISO 7089 Assemble the collected items in the way represented in the figure:	

COMPILED BY:	VERIFIED BY:	APPROVED BY:
I. Loi	M. Pinna	P. Coluzzi

Tecnologie Avanzate	Installation & Control Scheme		Mod. 75/95/00
	P/N: TA-RICH-001	DESCRIPTION: Rich CLAS12 Assembly	SHEET: 5/19

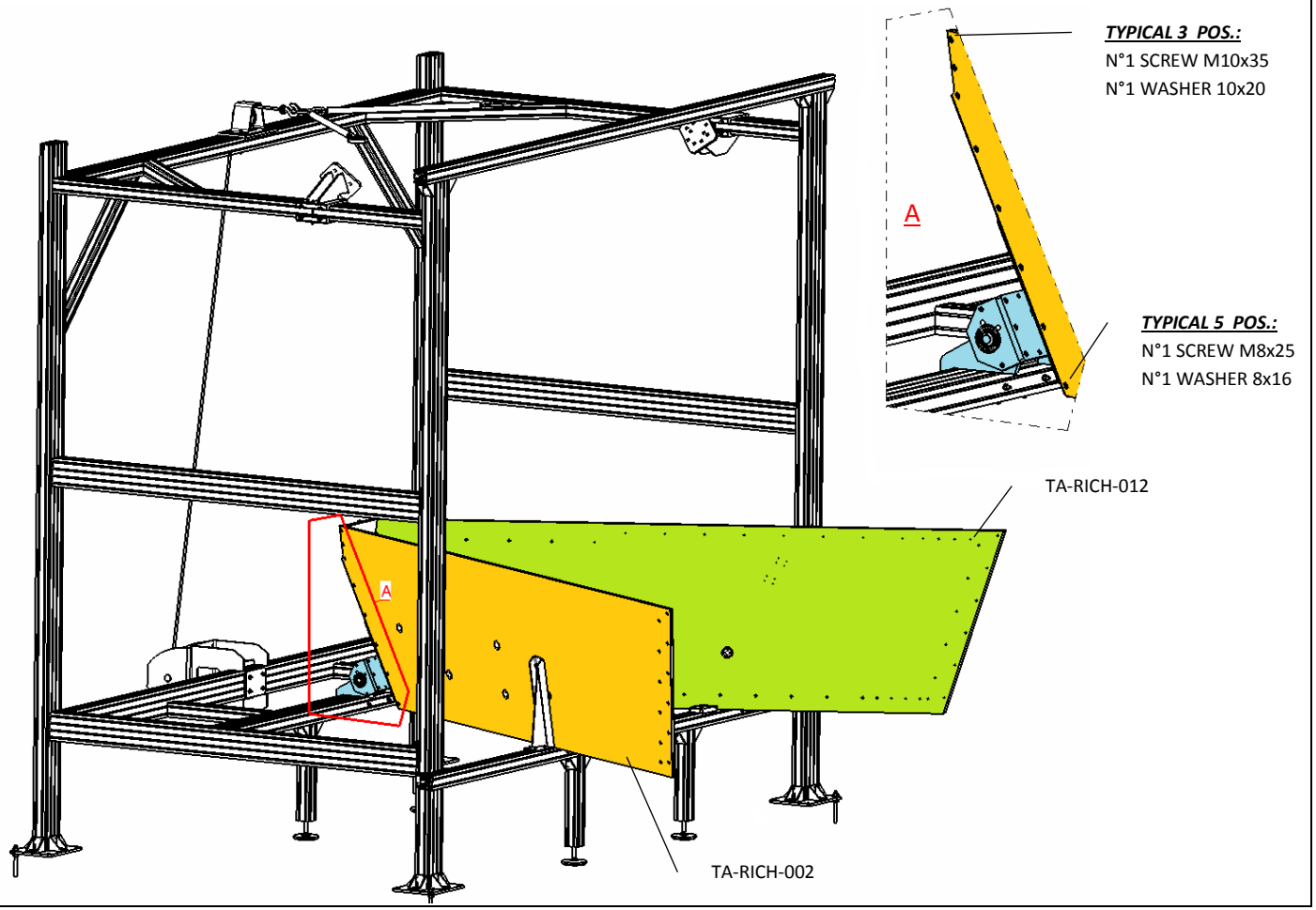
REV.	DATE	REVIEW'S REASON	MODIFIED PHASES	SIGNATURE
0	18/10/2016	FIRST EMISSION	N.A.	I. Loi

WORKING CYCLE PHASE	DESCRIPTION AND NOTES	IMAGES
OP.030 **HEAVY OPERATION (80 Kg)**	Install the assembled items on TA-RICH-055 by using: • N° 4 Bolt STEEL M10 x 45 ISO 4014 • N° 4 Washer STEEL 10 x 20 ISO 7089 in the way represented in the figure: After that, pull out the locking pins TA-STR-026 from TA-RICH-055. Turn 65 ° angle the assembly and lock the position obtained through the locking pins, previously removed, in order to make the rotation assembly stable and to continue the assembly, as shown on the side:	 TA-RICH-055  ***TYPICAL 4 POS.:*** N°1 BOLT M10x45 N°1 WASHER 10x20  ASSEMBLY INSTRUCTIONS

COMPILED BY:	VERIFIED BY:	APPROVED BY:
I. Loi	M. Pinna	P. Coluzzi

Tecnologie Avanzate	Installation & Control Scheme		Mod. 75/95/00
	P/N: TA-RICH-001	DESCRIPTION: Rich CLAS12 Assembly	SHEET: 6/19

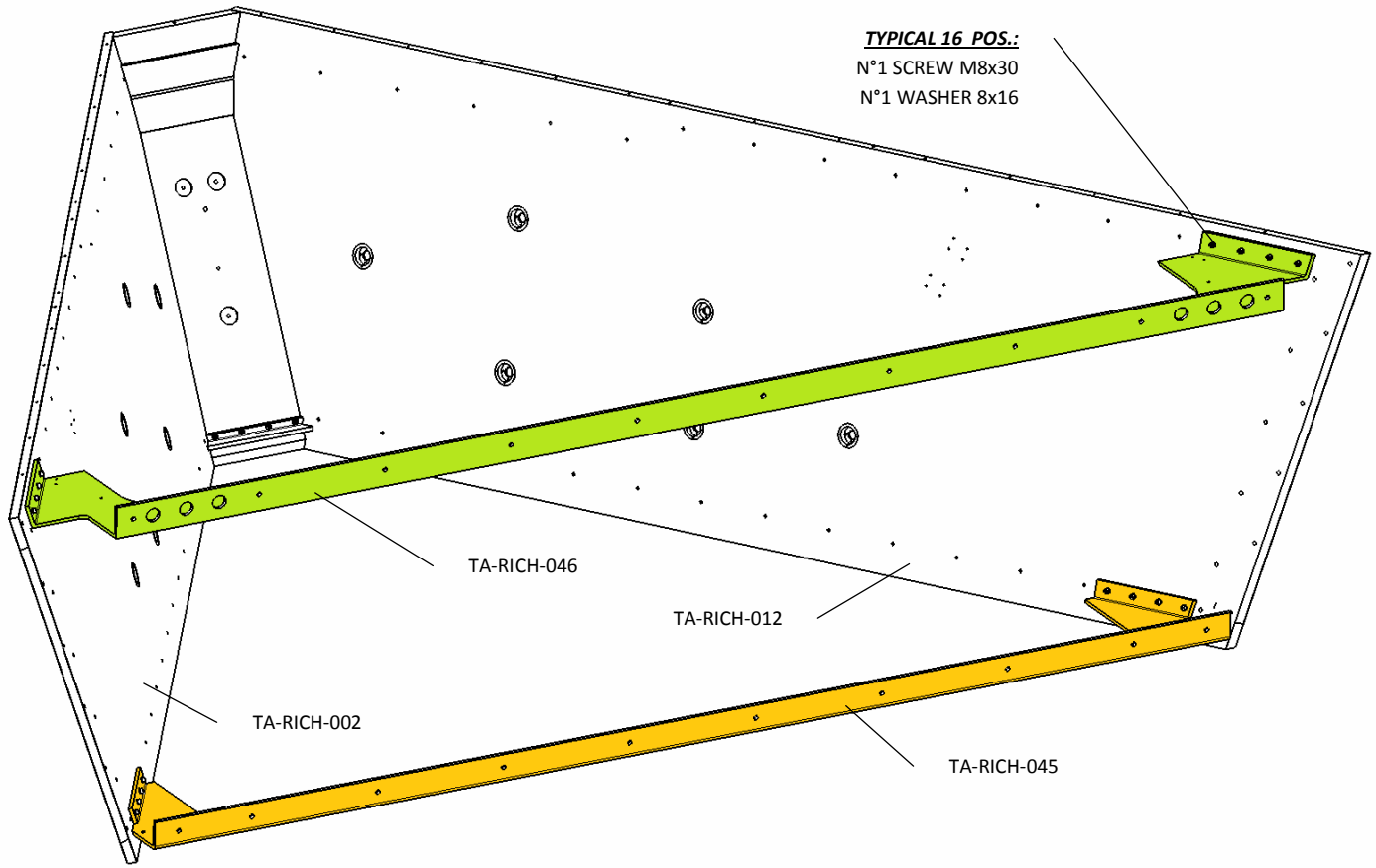
REV.	DATE	REVIEW'S REASON	MODIFIED PHASES	SIGNATURE
0	18/10/2016	FIRST EMISSION	N.A.	I. Loi

WORKING CYCLE PHASE	DESCRIPTION AND NOTES	IMAGES
OP.040 **HEAVY OPERATION (130 Kg)**	Withdraw the following items: • N° 1 TA-RICH-002 • N° 1 TA-RICH-012 • N° 10 Screw STEEL M8 x 25 ISO 4762 • N° 10 Washer STEEL 8 x 16 ISO 7089 • N° 6 Screw STEEL M10 x 35 ISO 4762 • N° 6 Washer STEEL 10 x 20 ISO 7089 Follow the instruction below and observe the figures: 1) Take P/N TA-RICH-002 and place on the floor; 2) Position two or more lifting slings around the particular; 3) Take the fork lift and get the harnessed particular as close as possible to the assembled parts; 4) With the support of operators, the forklift and thanks to the installation tools (TA-STR-027, TA-STR-028. TA-STR-029, TA-STR-030), bring TA-RICH-002 in position with TA-RICH-021 in way to allow the assembly; 5) Do the same operations with TA-RICH-012.	

COMPILED BY:	VERIFIED BY:	APPROVED BY:
I. Loi	M. Pinna	P. Coluzzi

Tecnologie Avanzate	Installation & Control Scheme		Mod. 75/95/00
	P/N: TA-RICH-001	DESCRIPTION: Rich CLAS12 Assembly	SHEET: 7/19

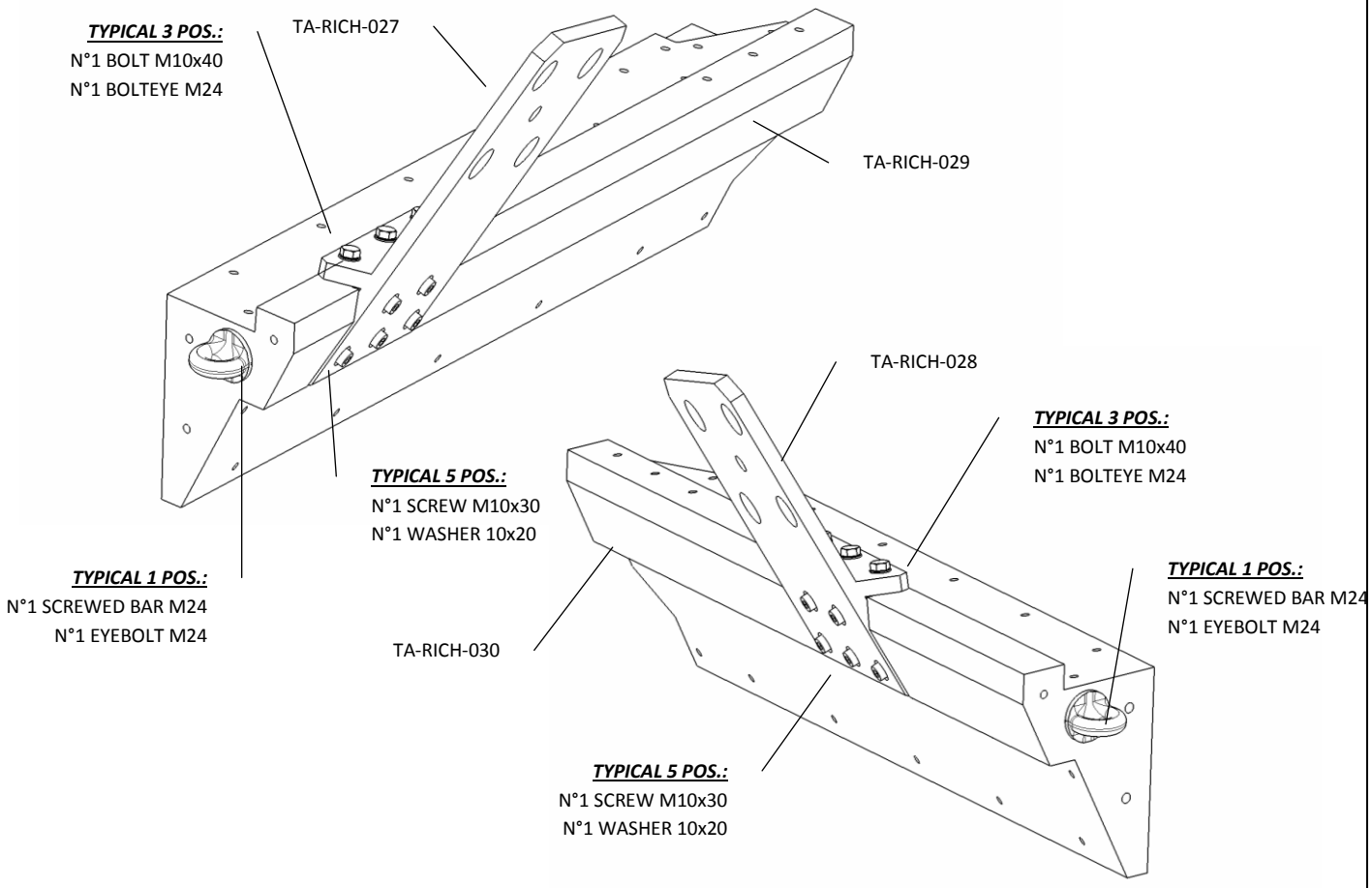
REV.	DATE	REVIEW'S REASON	MODIFIED PHASES	SIGNATURE
0	18/10/2016	FIRST EMISSION	N.A.	I. Loi

WORKING CYCLE PHASE	DESCRIPTION AND NOTES	IMAGES
OP.050	Withdraw the following items: • N° 1 TA-RICH-045 • N° 1 TA-RICH-046 • N° 16 Screw STEEL M8 x 30 ISO 4762 • N° 16 Washer STEEL 8 x 16 ISO 7089 Assemble the collected items in the way represented in the figure:	

COMPILED BY:	VERIFIED BY:	APPROVED BY:
I. Loi	M. Pinna	P. Coluzzi

Tecnologie Avanzate	Installation & Control Scheme		Mod. 75/95/00
	P/N: TA-RICH-001	DESCRIPTION: Rich CLAS12 Assembly	SHEET: 8/19

REV.	DATE	REVIEW'S REASON	MODIFIED PHASES	SIGNATURE
0	18/10/2016	FIRST EMISSION	N.A.	I. Loi

WORKING CYCLE PHASE	DESCRIPTION AND NOTES	IMAGES
OP.060 **HEAVY OPERATION (60 Kg)**	Withdraw the following items: • N° 1 TA-RICH-027 • N° 1 TA-RICH-028 • N° 1 TA-RICH-029 • N° 1 TA-RICH-030 • N° 6 Bolt STEEL M10 x 40 ISO 4014 • N° 44 Washer STEEL 10 x 20 ISO 7089 • N° 38 Screw STEEL M10 x 35 ISO 4762 • N° 2 Screwed Bar M24 • N° 2 Bolteye M24 Firstly, assemble TA-RICH-027 with TA-RICH-029 and TA-RICH-028 with TA-RICH-030, than install the M24 Screwed Bars and the eyebolts on them as shown:	

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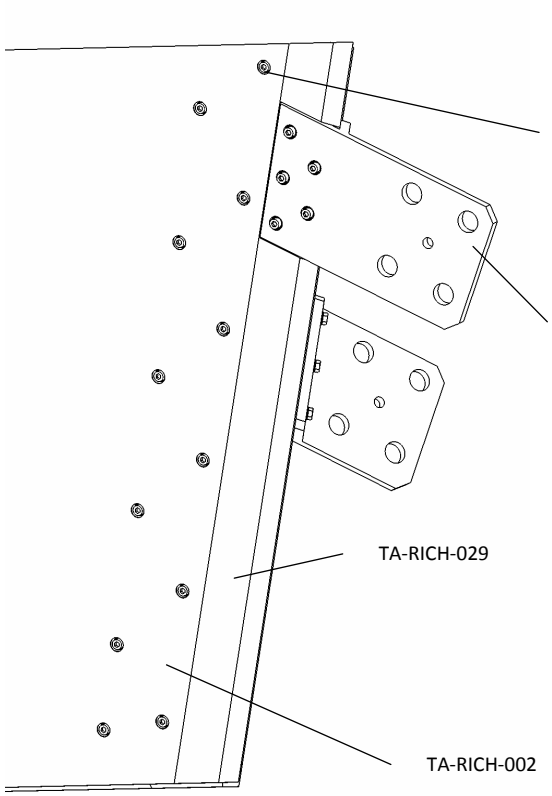
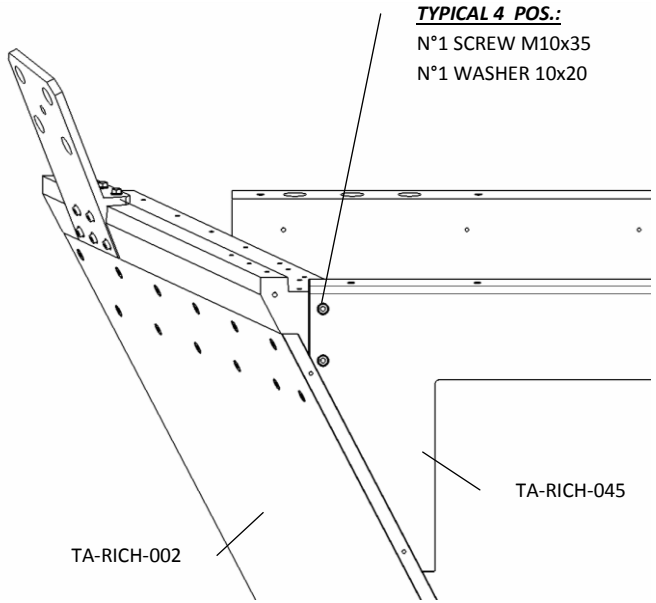
I. Loi	M. Pinna	P. Coluzzi

Tecnologie Avanzate	Installation & Control Scheme		Mod. 75/95/00
	P/N: TA-RICH-001	DESCRIPTION: Rich CLAS12 Assembly	SHEET: 9/19

REV.	DATE	REVIEW'S REASON	MODIFIED PHASES	SIGNATURE
0	18/10/2016	FIRST EMISSION	N.A.	I. Loi

WORKING CYCLE PHASE	DESCRIPTION AND NOTES	IMAGES
HEAVY OPERATION (60 Kg)	Assemble the parts with TA-RICH-002 and TA-RICH-012 following the instruction below and observing the figures: 1) Take TA-RICH-029 and place on the floor; 2) Tie a ribbon in the eyebolt and lift using forklift; 3) Bring the part next to TA-RICH-002 until you have the surface in abutment with the panel; 4) With the support of operators and of the forklift turn TA-RICH-029 until you have each hole perfectly aligned; 5) Fix both particulars with the screws previously taken; 6) Do the same between TA-RICH-030 and TA-RICH-012; 7) Remove Eyebolts and Screwed Bars from TA-RICH-029 and TA-RICH-030.	 ***TYPICAL 24 POS.:*** N°1 SCREW M10x35 N°1 WASHER 10x20 TA-RICH-027  ***TYPICAL 4 POS.:*** N°1 SCREW M10x35 N°1 WASHER 10x20

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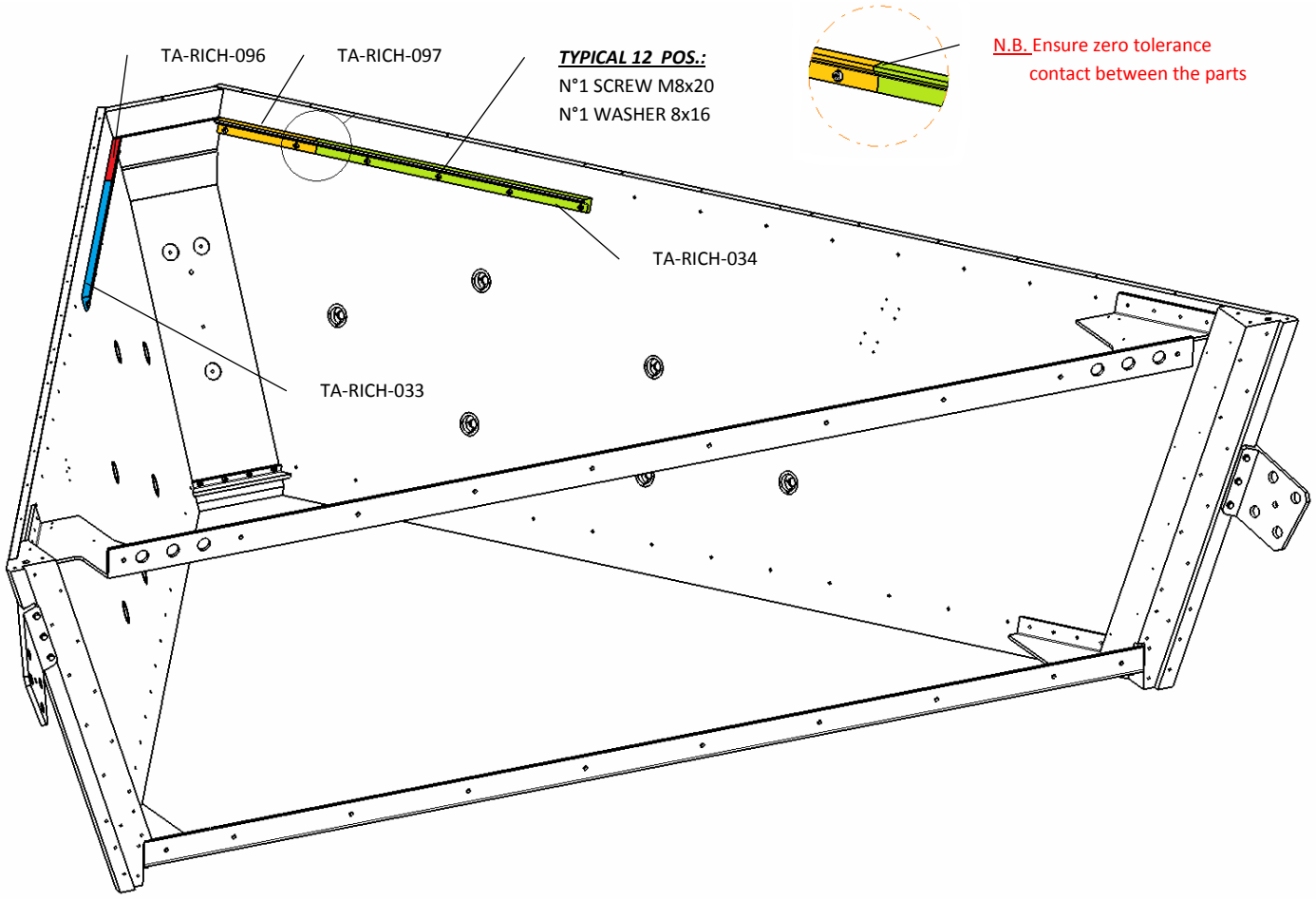
I. Loi	M. Pinna	P. Coluzzi

Tecnologie Avanzate	Installation & Control Scheme		Mod. 75/95/00
	P/N: TA-RICH-001	DESCRIPTION: Rich CLAS12 Assembly	SHEET: 10/19

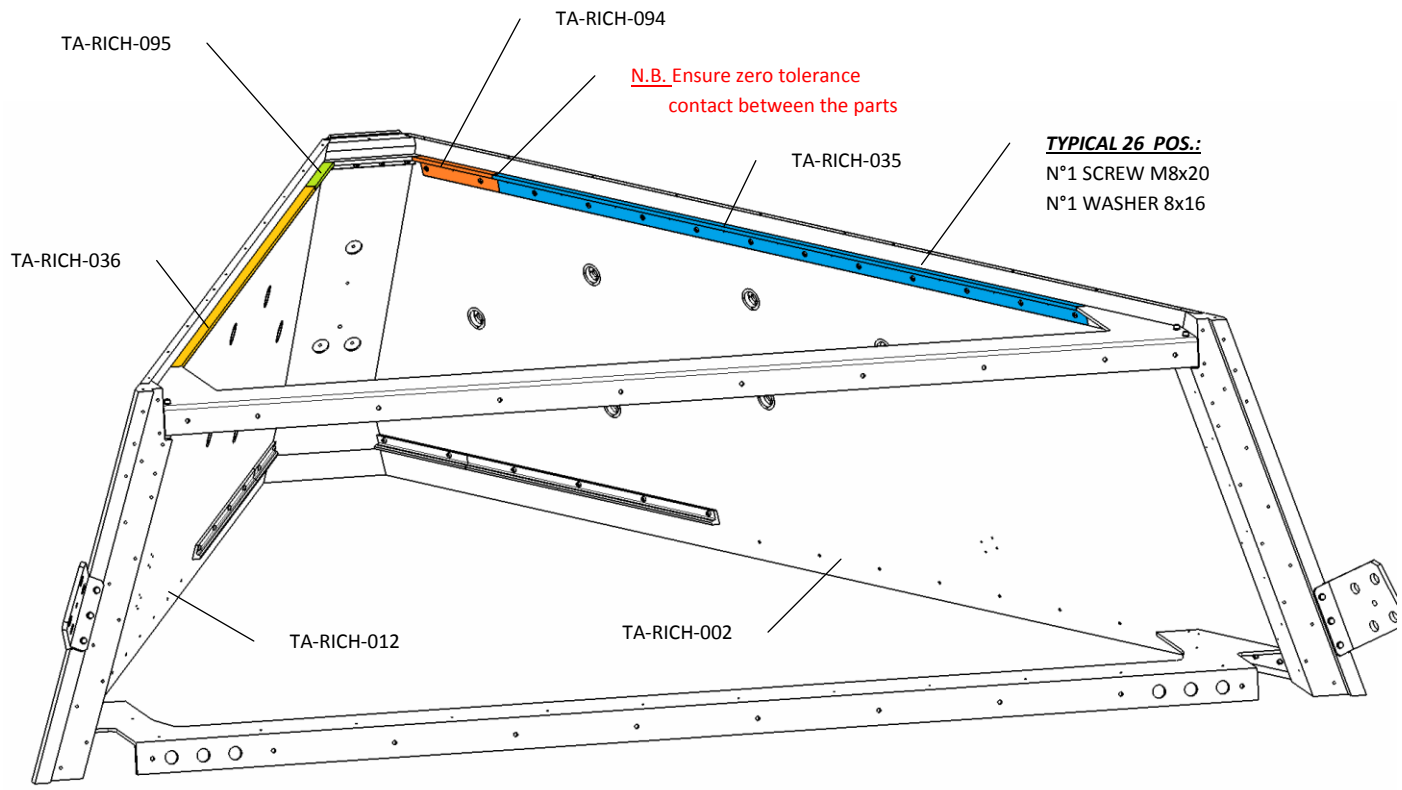
REV.	DATE	REVIEW'S REASON	MODIFIED PHASES	SIGNATURE
0	18/10/2016	FIRST EMISSION	N.A.	I. Loi

WORKING CYCLE PHASE	DESCRIPTION AND NOTES	IMAGES
OP.070	Withdraw the following items: • N° 1 TA-RICH-033 • N° 1 TA-RICH-034 • N° 1 TA-RICH-096 • N° 1 TA-RICH-097 • N° 12 Screw STEEL M8 x 20 ISO 4762 • N° 12 Washer STEEL 8 x 16 ISO 7089 Assemble the collected items in the way represented in the figure:	

COMPILED BY:	VERIFIED BY:	APPROVED BY:
I. Loi	M. Pinna	P. Coluzzi

Tecnologie Avanzate	Installation & Control Scheme		Mod. 75/95/00
	P/N: TA-RICH-001	DESCRIPTION: Rich CLAS12 Assembly	SHEET: 11/19

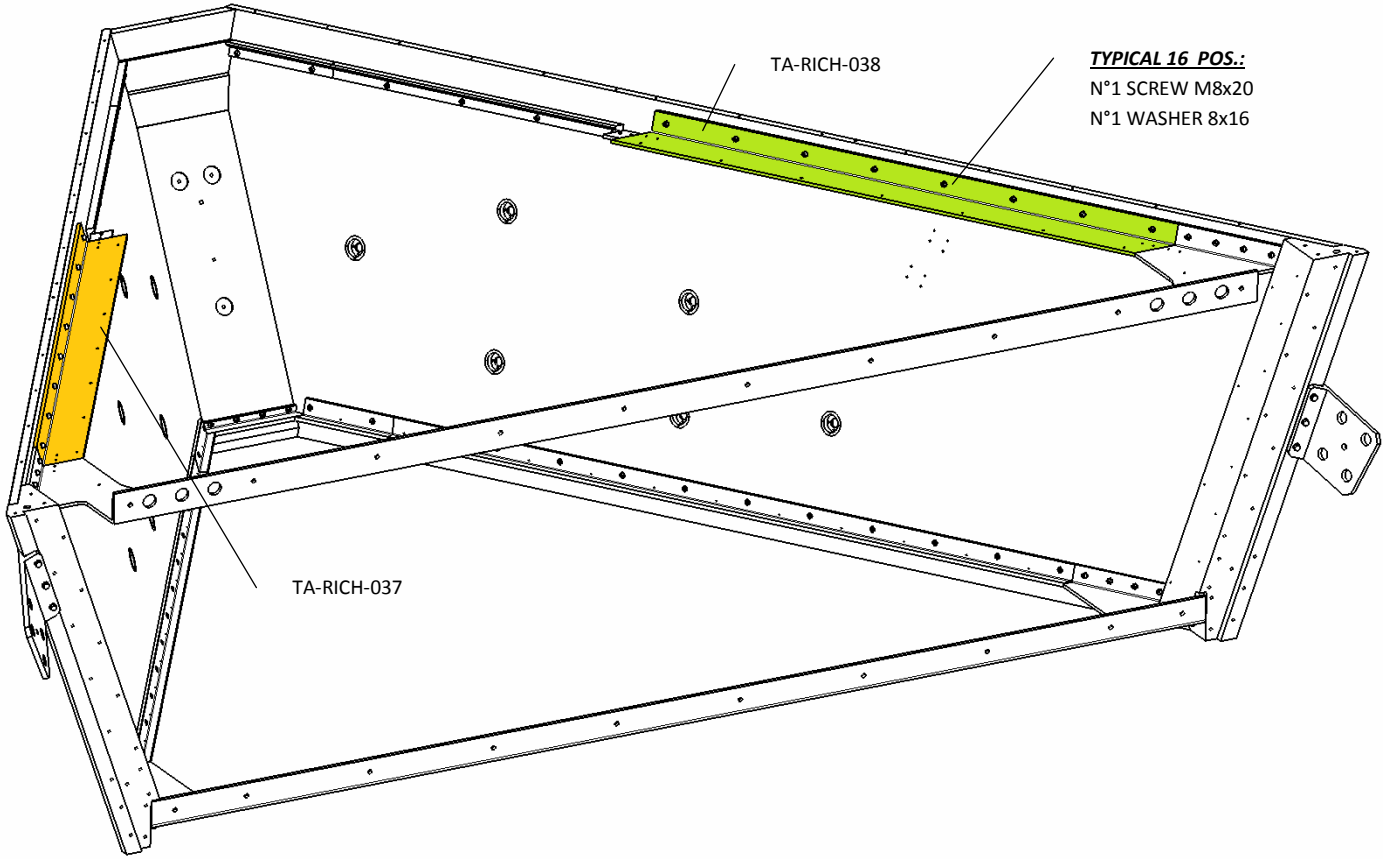
REV.	DATE	REVIEW'S REASON	MODIFIED PHASES	SIGNATURE
0	18/10/2016	FIRST EMISSION	N.A.	I. Loi

WORKING CYCLE PHASE	DESCRIPTION AND NOTES	IMAGES
OP.080	Withdraw the following items: • N° 1 TA-RICH-035 • N° 1 TA-RICH-036 • N° 1 TA-RICH-094 • N° 1 TA-RICH-095 • N° 26 Screw STEEL M8 x 20 ISO 4762 • N° 26 Washer STEEL 8 x 16 ISO 7089 On the opposite side of that shown in the OP.070, assemble the collected items in the way represented in the figure:	

COMPILED BY:	VERIFIED BY:	APPROVED BY:
I. Loi	M. Pinna	P. Coluzzi

Tecnologie Avanzate	Installation & Control Scheme		Mod. 75/95/00
	P/N: TA-RICH-001	DESCRIPTION: Rich CLAS12 Assembly	SHEET: 12/19

REV.	DATE	REVIEW'S REASON	MODIFIED PHASES	SIGNATURE
0	18/10/2016	FIRST EMISSION	N.A.	I. Loi

WORKING CYCLE PHASE	DESCRIPTION AND NOTES	IMAGES
OP.090	Withdraw the following items: • N° 1 TA-RICH-037 • N° 1 TA-RICH-038 • N° 16 Screw STEEL M8 x 20 ISO 4762 • N° 16 Washer STEEL 8 x 16 ISO 7089 Assemble the collected items in the way represented in the figure:	

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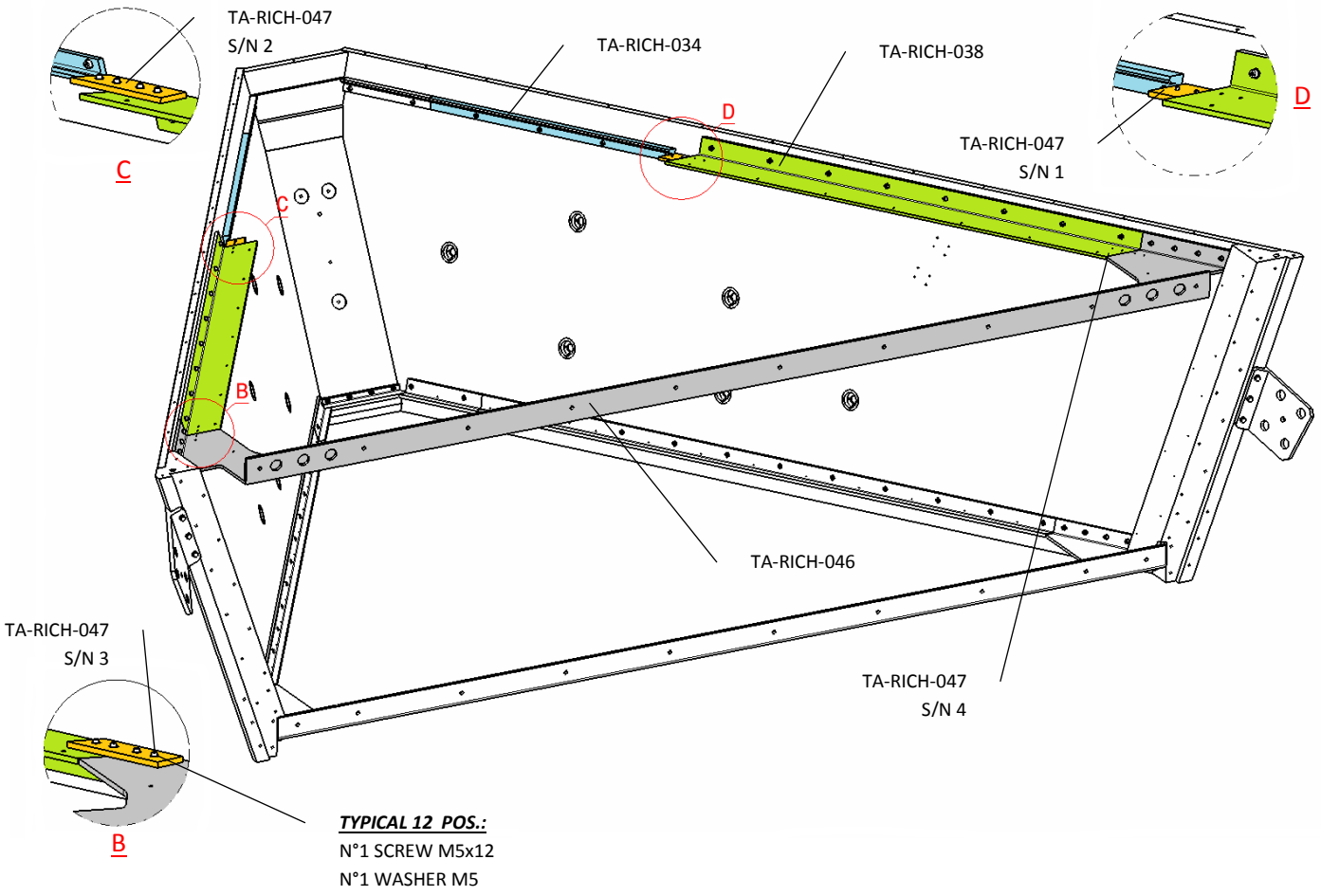
I. Loi	M. Pinna	P. Coluzzi

Tecnologie Avanzate	Installation & Control Scheme		Mod. 75/95/00
	P/N: TA-RICH-001	DESCRIPTION: Rich CLAS12 Assembly	SHEET: 13/19

REV.	DATE	REVIEW'S REASON	MODIFIED PHASES	SIGNATURE
0	18/10/2016	FIRST EMISSION	N.A.	I. Loi

WORKING CYCLE PHASE	DESCRIPTION AND NOTES	IMAGES
OP.100	Withdraw the following items: • N° 1 TA-RICH-047 S/N 1 • N° 1 TA-RICH-047 S/N 2 • N° 1 TA-RICH-047 S/N 3 • N° 1 TA-RICH-047 S/N 4 • N° 12 Screw STEEL M5 x 12 ISO 4762 • N° 12 Washer STEEL M5 ISO 7089 Assemble the collected items so as to be positioned internally to the RICH case, as represented in the figure:	

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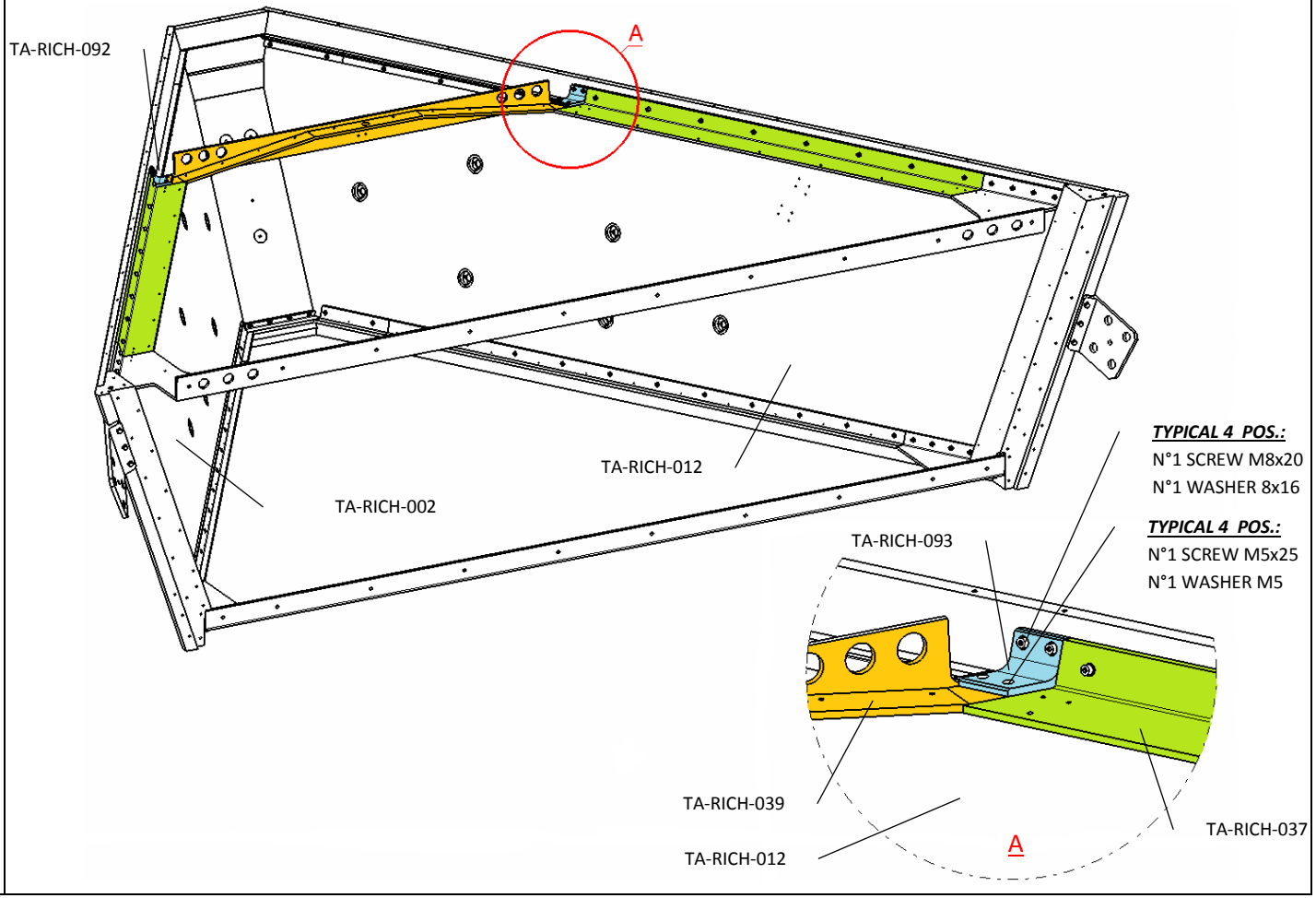
I. Loi	M. Pinna	P. Coluzzi

Tecnologie Avanzate	Installation & Control Scheme		Mod. 75/95/00
	P/N: TA-RICH-001	DESCRIPTION: Rich CLAS12 Assembly	SHEET: 14/19

REV.	DATE	REVIEW'S REASON	MODIFIED PHASES	SIGNATURE
0	18/10/2016	FIRST EMISSION	N.A.	I. Loi

WORKING CYCLE PHASE	DESCRIPTION AND NOTES	IMAGES
OP.110	Withdraw the following items: • N° 1 TA-RICH-092 • N° 1 TA-RICH-093 • N° 1 TA-RICH-039 • N° 4 Screw STEEL M8 x 20 ISO 4762 • N° 4 Washer STEEL 8 x 16 ISO 7089 • N° 4 Screw STEEL M5 x 25 ISO 4762 • N° 4 Washer STEEL M5 ISO 7089 Observing the figure, follow the instructions: 1) Place the TA-RICH-039 on TA-RICH-047s; 2) Place TA-RICH-092 and TA-RICH-093 on TA-RICH-039 and assemble them with TA-RICH-047s using Screw M5x25; 3) Assemble TA-RICH-092 on TA-RICH-002 using Screw M8x20; 4) Assemble TA-RICH-093 on TA-RICH-012 using Screw M8x20.	

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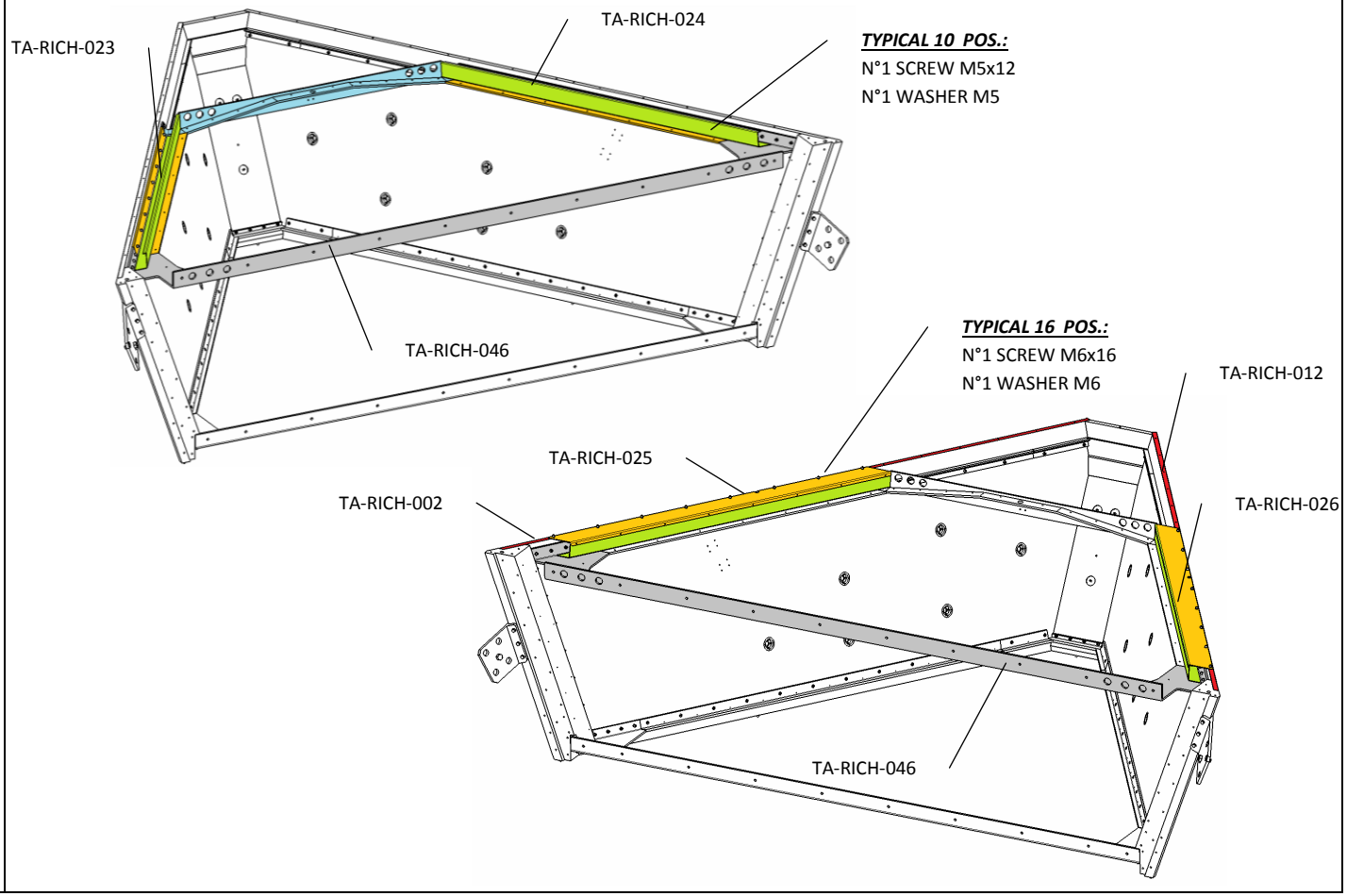
Tecnologie Avanzate	Installation & Control Scheme		Mod. 75/95/00
	P/N: TA-RICH-001	DESCRIPTION: Rich CLAS12 Assembly	SHEET: 15/19

REV.	DATE	REVIEW'S REASON	MODIFIED PHASES	SIGNATURE
0	18/10/2016	FIRST EMISSION	N.A.	I. Loi

WORKING CYCLE PHASE	DESCRIPTION AND NOTES	IMAGES
OP.120	Withdraw the following items: • N° 1 TA-RICH-023 • N° 1 TA-RICH-024 • N° 1 TA-RICH-025 • N° 1 TA-RICH-026 • N° 10 Screw STEEL M5 x 12 ISO 4762 • N° 10 Washer STEEL M5 ISO 7089 • N° 16 Screw STEEL M6 x 16 ISO 4762 • N° 16 Washer STEEL M6 ISO 7089 Observing the figure, follow the instructions: 1) Place TA-RICH-023 and TA-RICH-024 on TA-RICH-037 and TA-RICH-038 and fix with Screw M5x12; 2) Place TA-RICH-025 and TA-RICH-026 and assemble on TA-RICH-002 and TA-RICH-012 them with Screw M6x16.	

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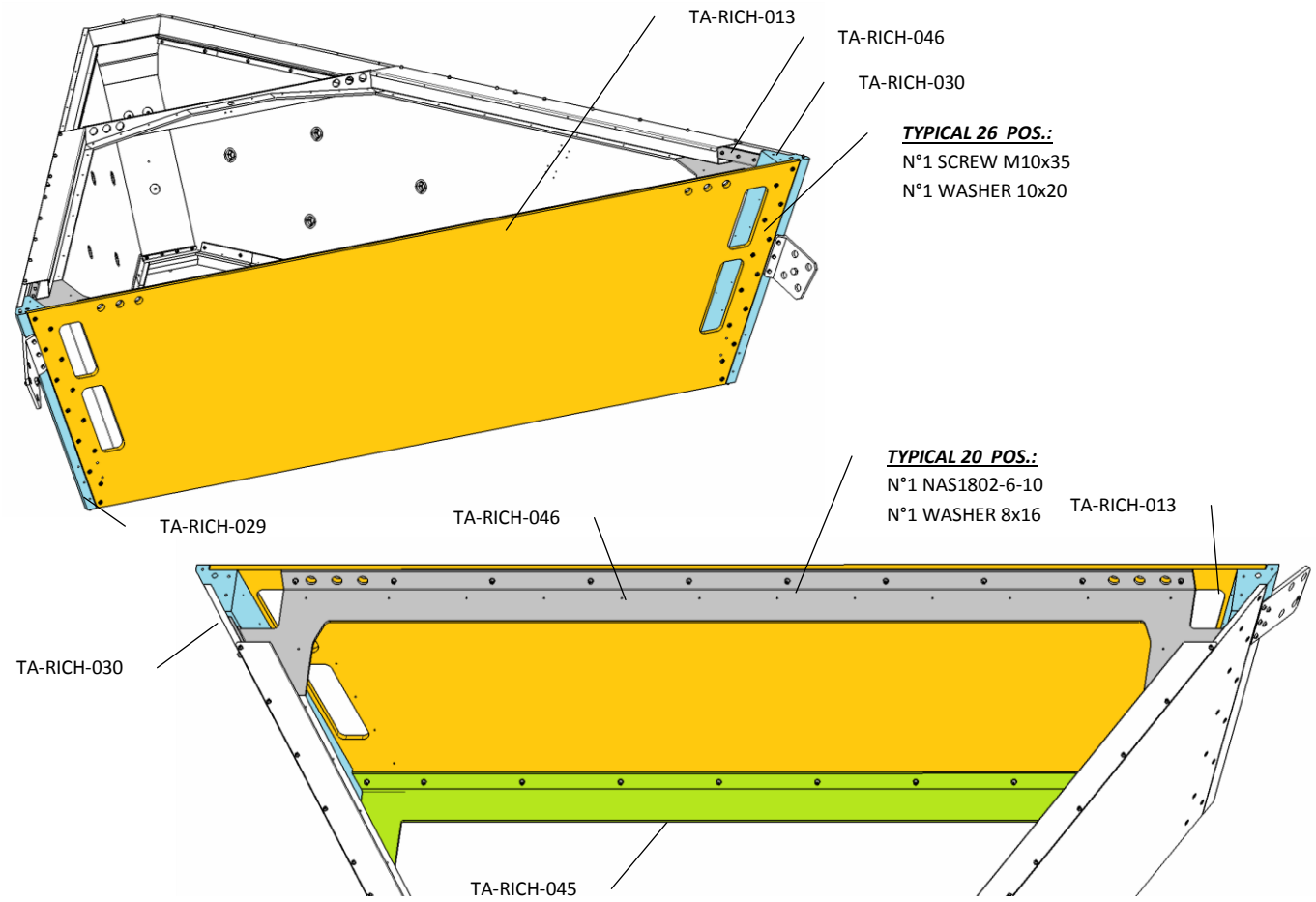
I. Loi	M. Pinna	P. Coluzzi

Tecnologie Avanzate	Installation & Control Scheme		Mod. 75/95/00
	P/N: TA-RICH-001	DESCRIPTION: Rich CLAS12 Assembly	SHEET: 16/19

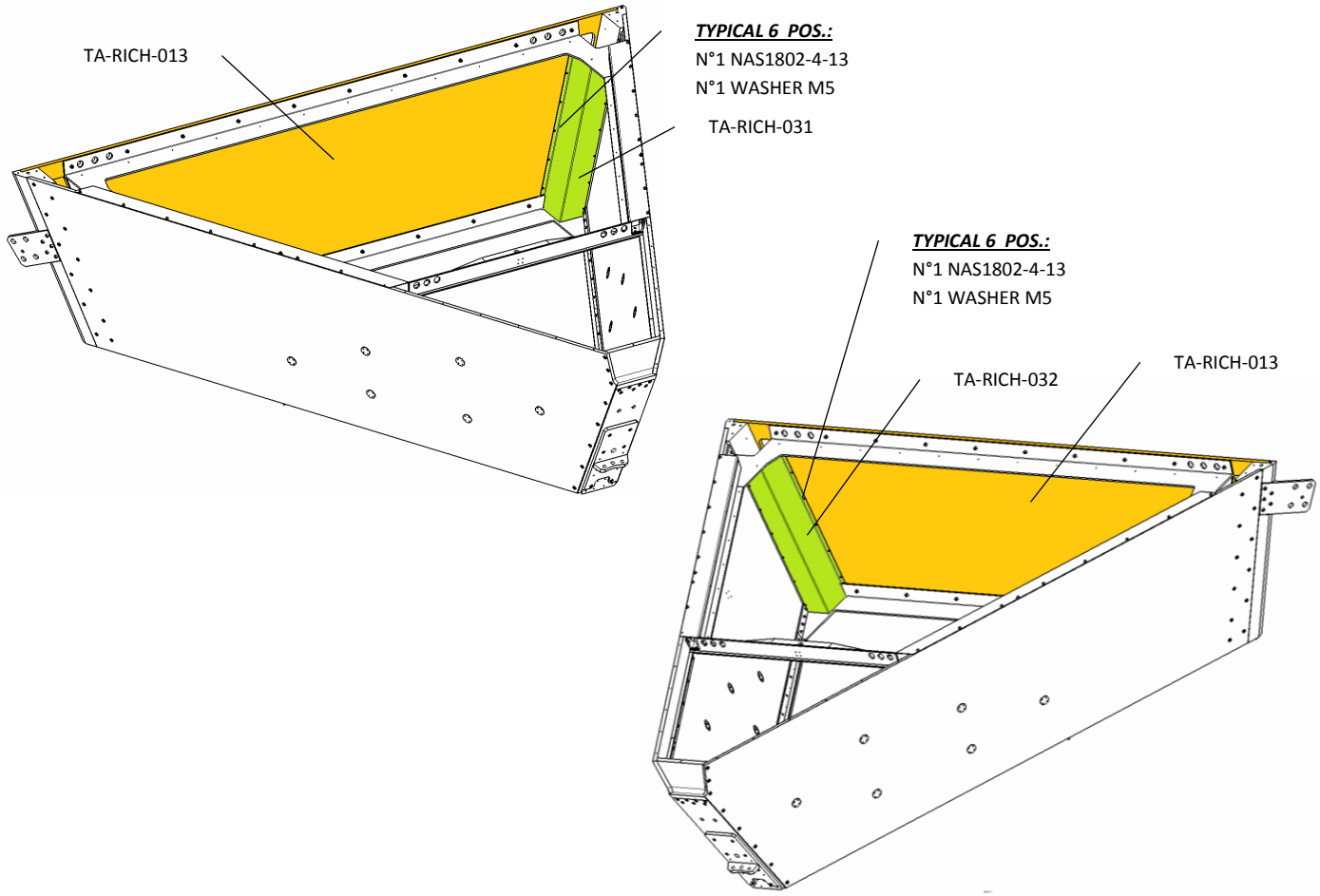
REV.	DATE	REVIEW'S REASON	MODIFIED PHASES	SIGNATURE
0	18/10/2016	FIRST EMISSION	N.A.	I. Loi

WORKING CYCLE PHASE	DESCRIPTION AND NOTES	IMAGES
OP.130 **HEAVY OPERATION (80 Kg)**	Withdraw the following items: • N° 1 TA-RICH-013 • N° 20 Screw NAS1802-6-10 • N° 20 Washer STEEL 8x16 ISO 7089 • N° 26 Screw STEEL M10 x 35 ISO 4762 • N° 26 Washer STEEL 10 x 20 ISO 7089 Follow the instruction below and observe the figures: 1) Take P/N TA-RICH-013 and place on the floor; 2) Position two or more lifting slings around the particular; 3) Take the fork lift and get the harnessed particular as close as possible to the assembled parts; 4) With the support of operators and of the forklift, bring TA-RICH-013 in position with TA-RICH-029 and TA-RICH-030 in way to allow the assembly, and fix it with Screw M10x35; 5) Complete the assembly fixing TA-RICH-045 and TA-RICH-046 to TA-RICH-013 by NAS1802-6-10.	

COMPILED BY:	VERIFIED BY:	APPROVED BY:
I. Loi	M. Pinna	P. Coluzzi

Tecnologie Avanzate	Installation & Control Scheme		Mod. 75/95/00
	P/N: TA-RICH-001	DESCRIPTION: Rich CLAS12 Assembly	SHEET: 17/19

REV.	DATE	REVIEW'S REASON	MODIFIED PHASES	SIGNATURE
0	18/10/2016	FIRST EMISSION	N.A.	I. Loi

WORKING CYCLE PHASE	DESCRIPTION AND NOTES	IMAGES
OP.140	Withdraw the following items: • N° 1 TA-RICH-031 • N° 1 TA-RICH-032 • N° 12 Screw NAS1802-4-13 • N° 12 Washer STEEL M5 ISO 7089 Assemble the collected items in the way represented in the figure:	

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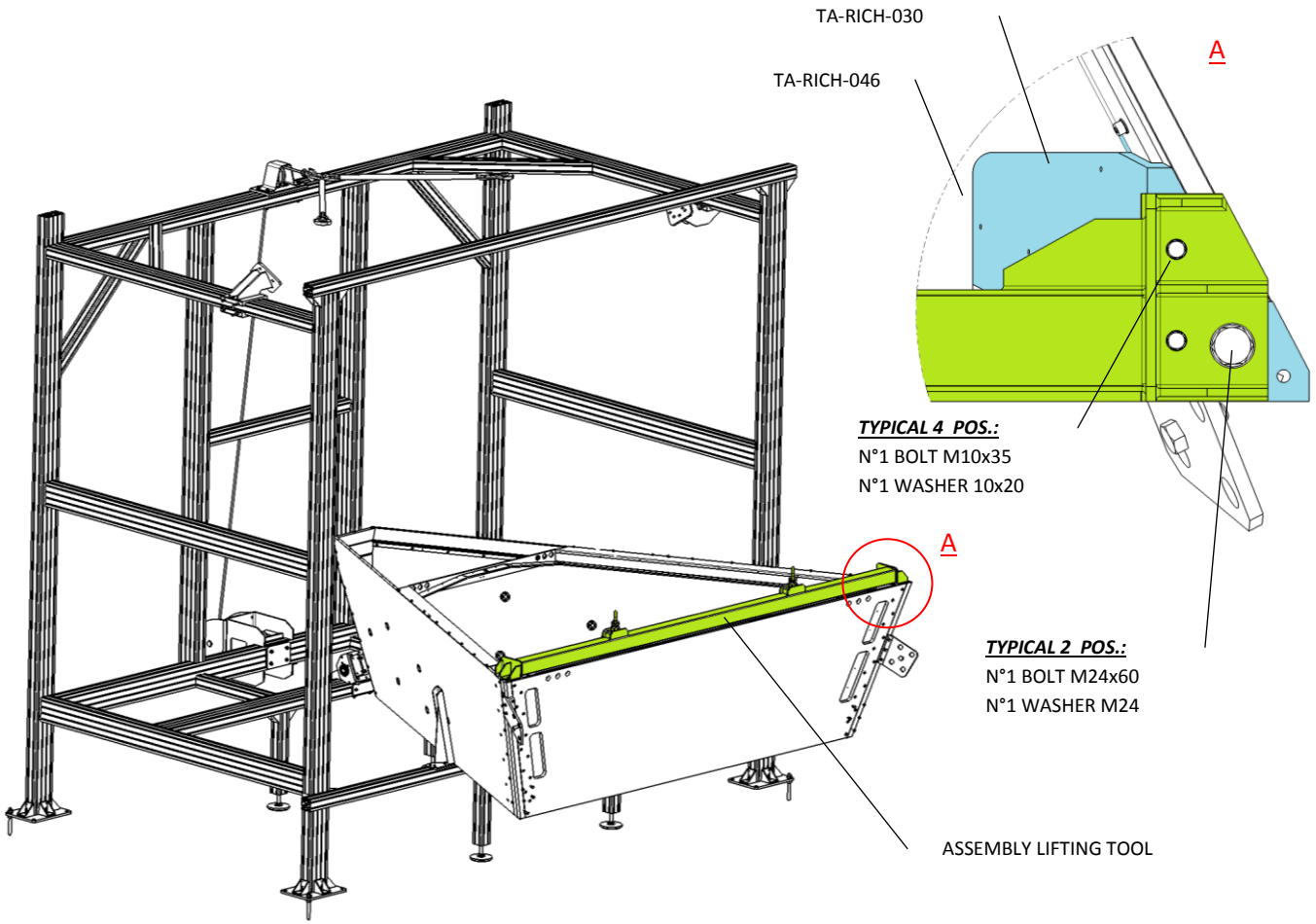
I. Loi	M. Pinna	P. Coluzzi

Tecnologie Avanzate	Installation & Control Scheme		Mod. 75/95/00
	P/N: TA-RICH-001	DESCRIPTION: Rich CLAS12 Assembly	SHEET: 18/19

REV.	DATE	REVIEW'S REASON	MODIFIED PHASES	SIGNATURE
0	18/10/2016	FIRST EMISSION	N.A.	I. Loi

WORKING CYCLE PHASE	DESCRIPTION AND NOTES	IMAGES
OP.150 **HEAVY OPERATION (100 Kg)**	Withdraw the following items: • N° 1 Assembly Lifting Tool • N° 2 Bolt STEEL M24x60 ISO 4018 • N° 2 Washer STEEL M24 ISO 7089 • N° 4 Bolt STEEL M10 x 35 ISO 4014 • N° 4 Washer STEEL 10 x 20 ISO 7089 Assemble the collected items in the way represented in the figure:	

COMPILED BY:	VERIFIED BY:	APPROVED BY:
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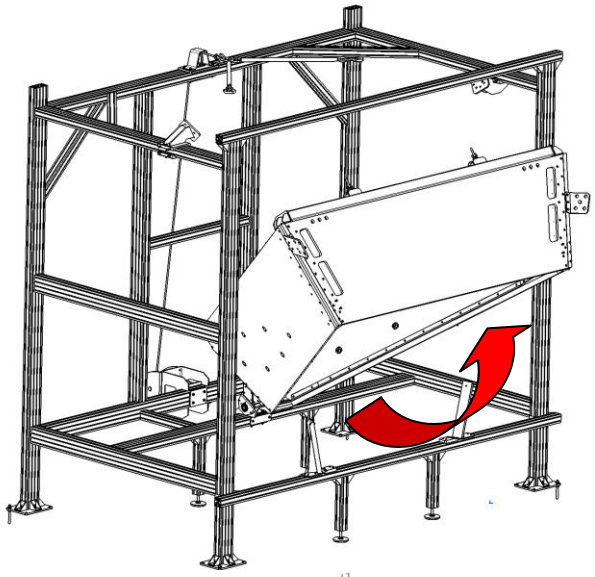
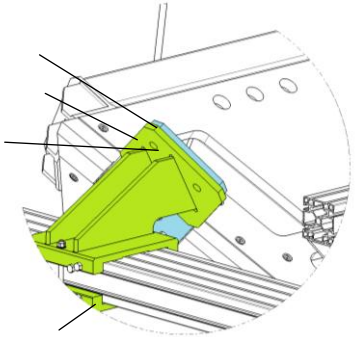
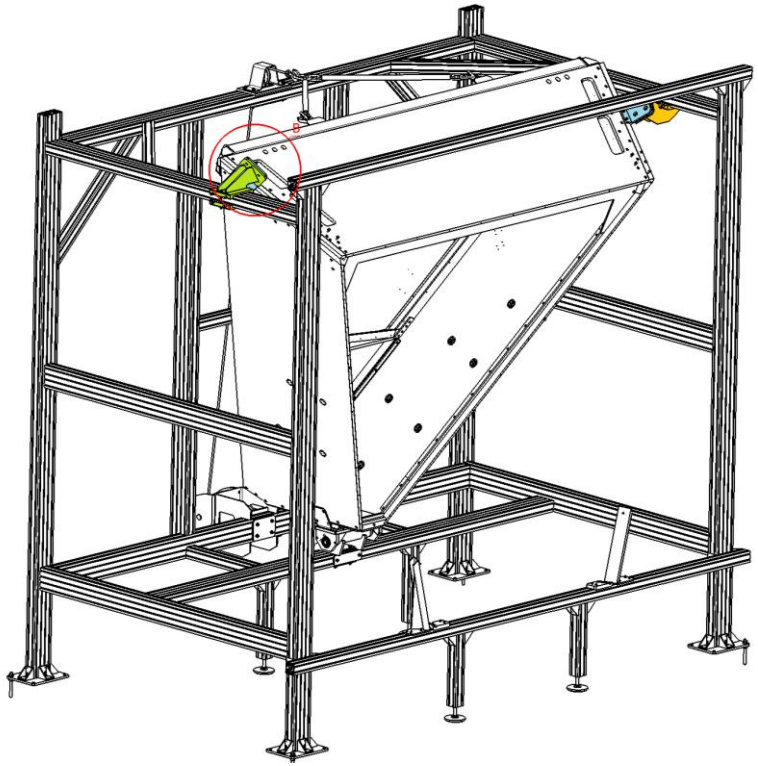
Tecnologie Avanzate	Installation & Control Scheme		Mod. 75/95/00
	P/N: TA-RICH-001	DESCRIPTION: Rich CLAS12 Assembly	SHEET: 19/19

REV.	DATE	REVIEW'S REASON	MODIFIED PHASES	SIGNATURE
0	18/10/2016	FIRST EMISSION	N.A.	I. Loi

WORKING CYCLE PHASE	DESCRIPTION AND NOTES	IMAGES
OP.160 **HEAVY OPERATION (700 Kg)**	Withdraw the following items: • N° 8 Bolt STEEL 8,8 M24 x 65 ISO 4014 • N° 8 Washer STEEL 8,8 M28 ISO 7089 • N° 16 Washer STEEL M24 ISO 7089 • N° 8 Nut STEEL 8,8 M24 ISO 4032 Follow the instruction below and observe the figures: 1) Fix the hooks to Assembly Lifting Tool's eyebolts; 2) Using Tackle System Assy lift up the RICH CLASS12 Assembly unless the Inner Plate TA-RICH-021 is parallel with the floor; 3) Move forward Stirrup Supports TA-RICH-053, TA-RICH-054, TA-RICH-060, TA-RICH-063 until intercepting Connection Stirrups TA-RICH-027, TA-RICH-028; 4) Using the item collected, fix the RICH CLASS12 Assembly with the Structure through the Stirrups Supports. **N.B.** During the lifting, make sure that the movement is continuous and constant. **N.B.** Ensure proper cable winding during lifting.	 TA-RICH-027 TA-RICH-053 ***TYPICAL 8 POS.:*** N°1 BOLT M24x65 N°2 WASHER M24 N°1 WASHER M28 N° 1 NUT M24 TA-RICH-060  B 

COMPILED BY:	VERIFIED BY:	APPROVED BY:
I. Loi	M. Pinna	P. Coluzzi

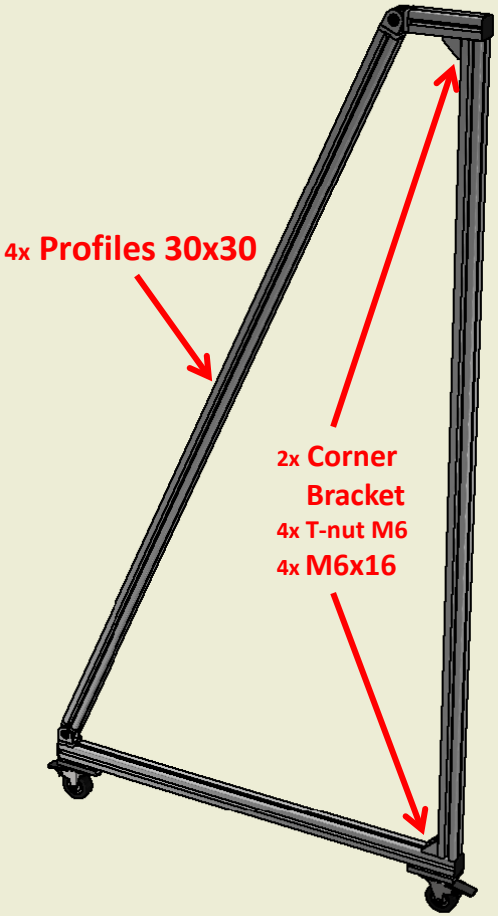
Assembly procedure of the RICH frontal panels

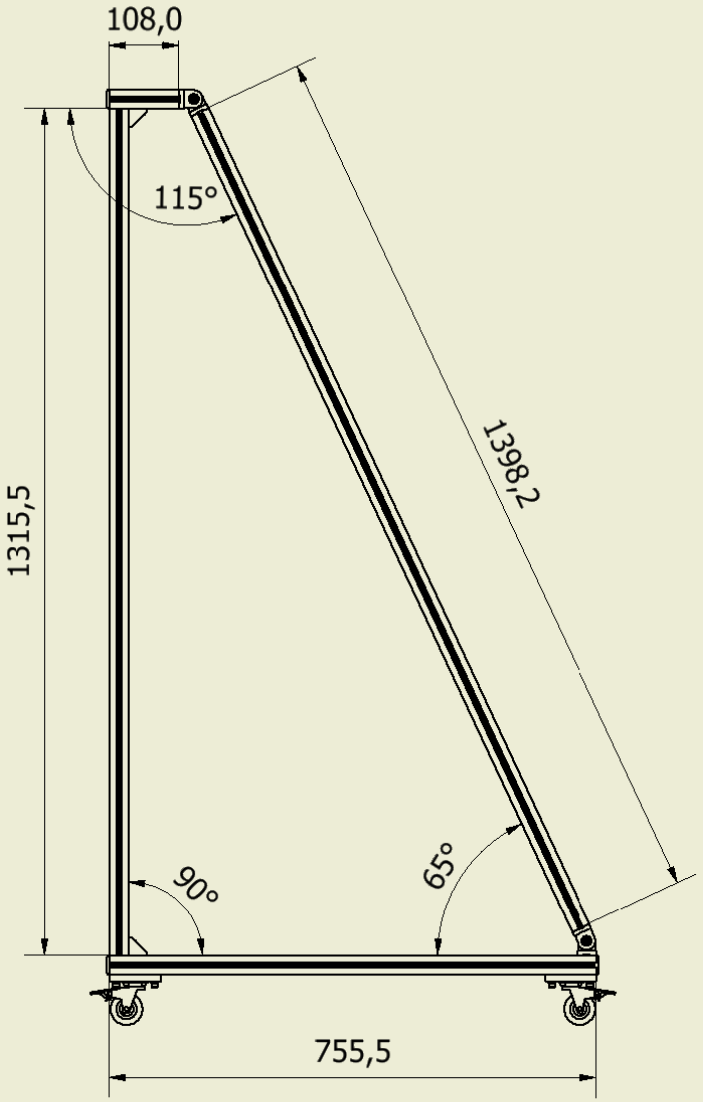
G.Fuga (LNF)

1. Procedure for the assembly of the tool for the installation of the RICH frontal panels
2. Procedure for the preparation of the RICH supporting structure before the installation of the frontal panels
3. Procedure for the installation of the RICH Frontal Panels

1. Procedure for the assembly of the tool for the installation of the RICH frontal panels

Assembly of the support - 1





Supporting side (x2)

Assembly of the support - 2

*** Skip the two tabs with a hammer

Tighten the screw after positioning it at the right angle

M8x25

T-nut M6
M6x20

Multi-angle bracket

A

***

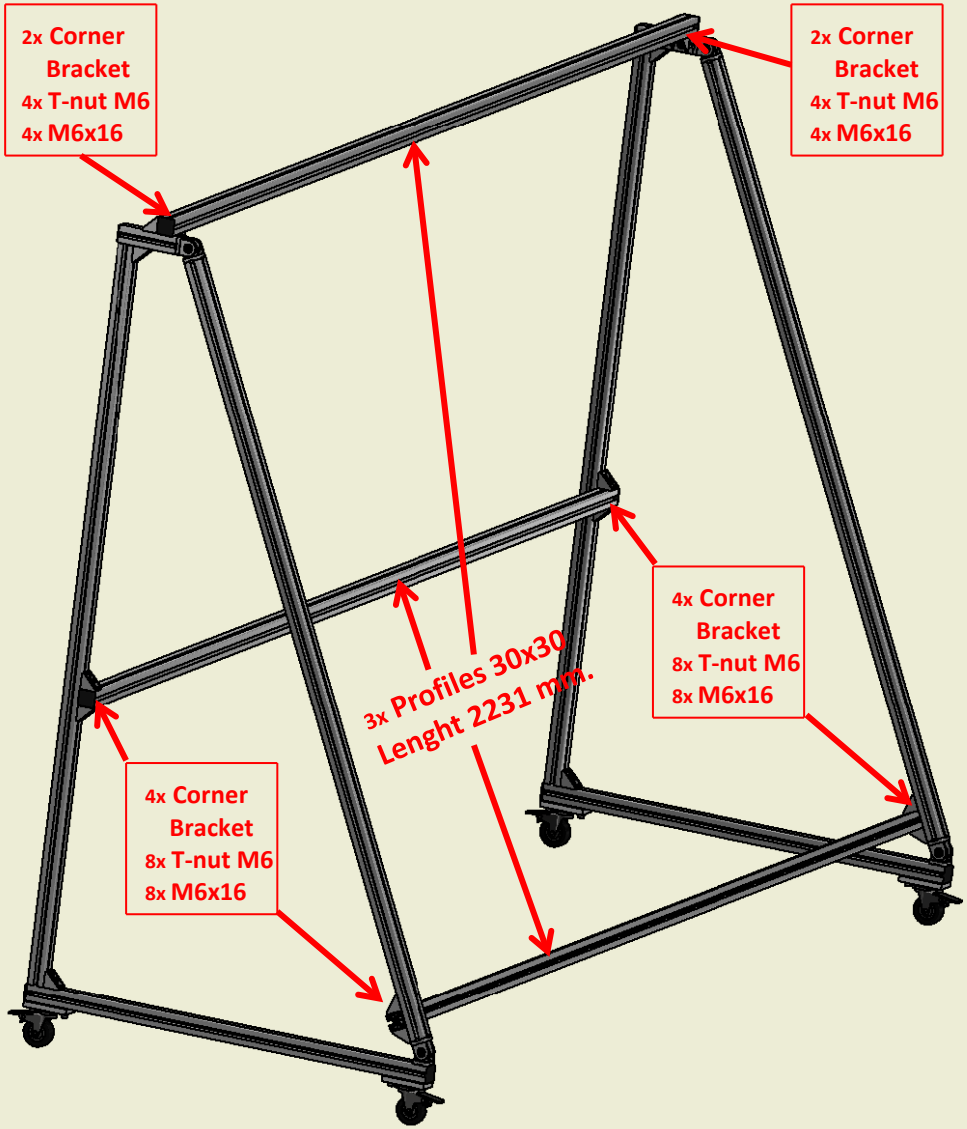
Multi-angle Bracket
2x M8x25

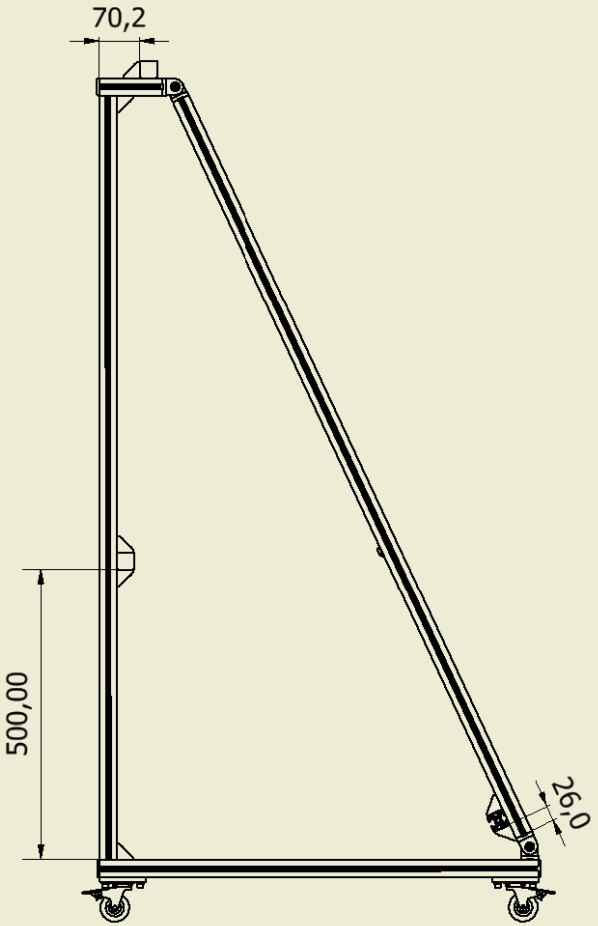
Plastic end cap

A

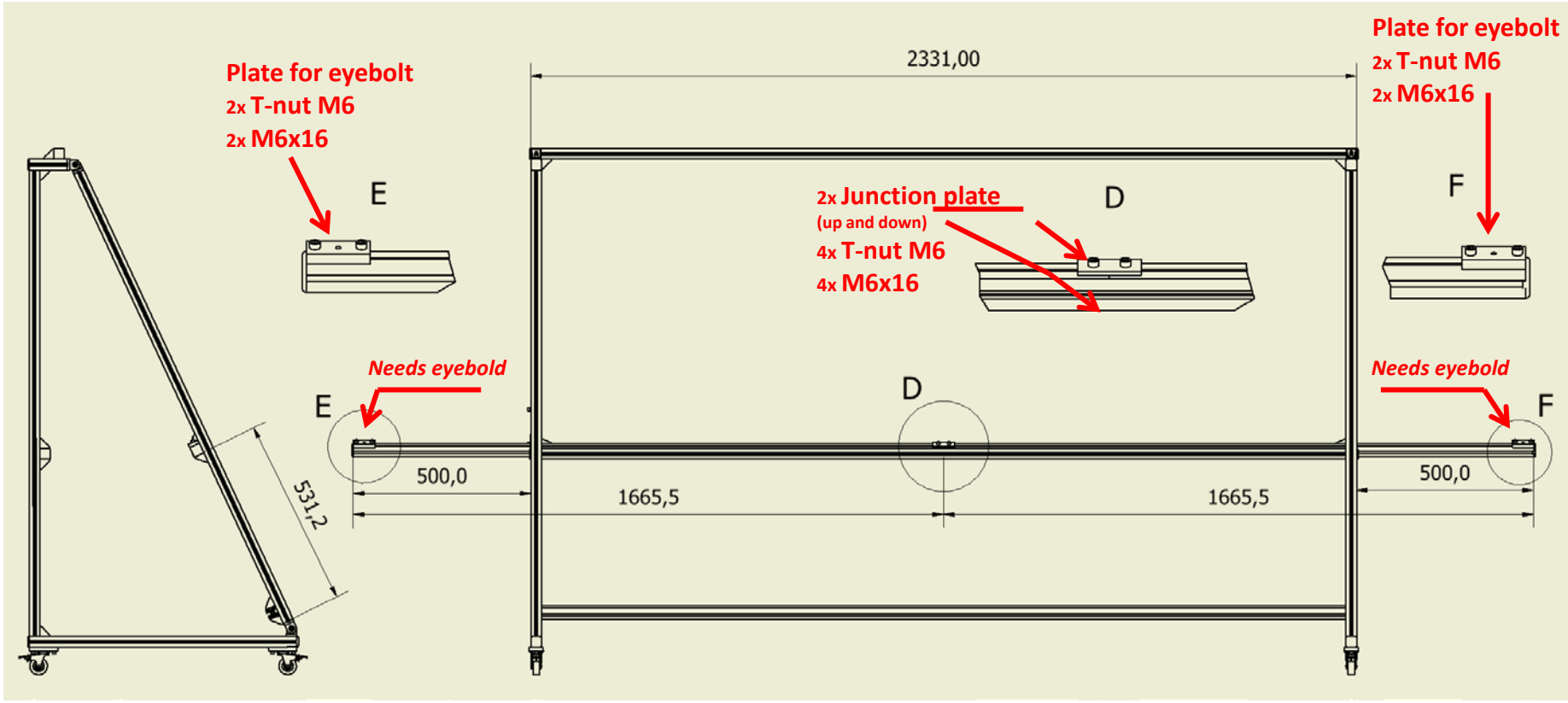
Wheel mounted on aluminum plate
4x T-nut M6
4x M6x20

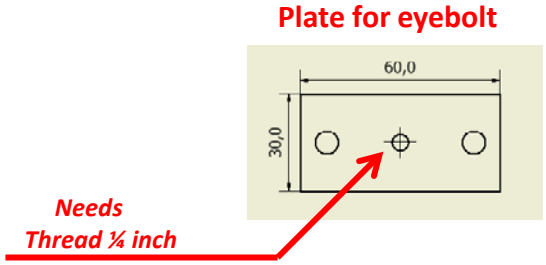
Assembly of the support for Top Front Panel - 1



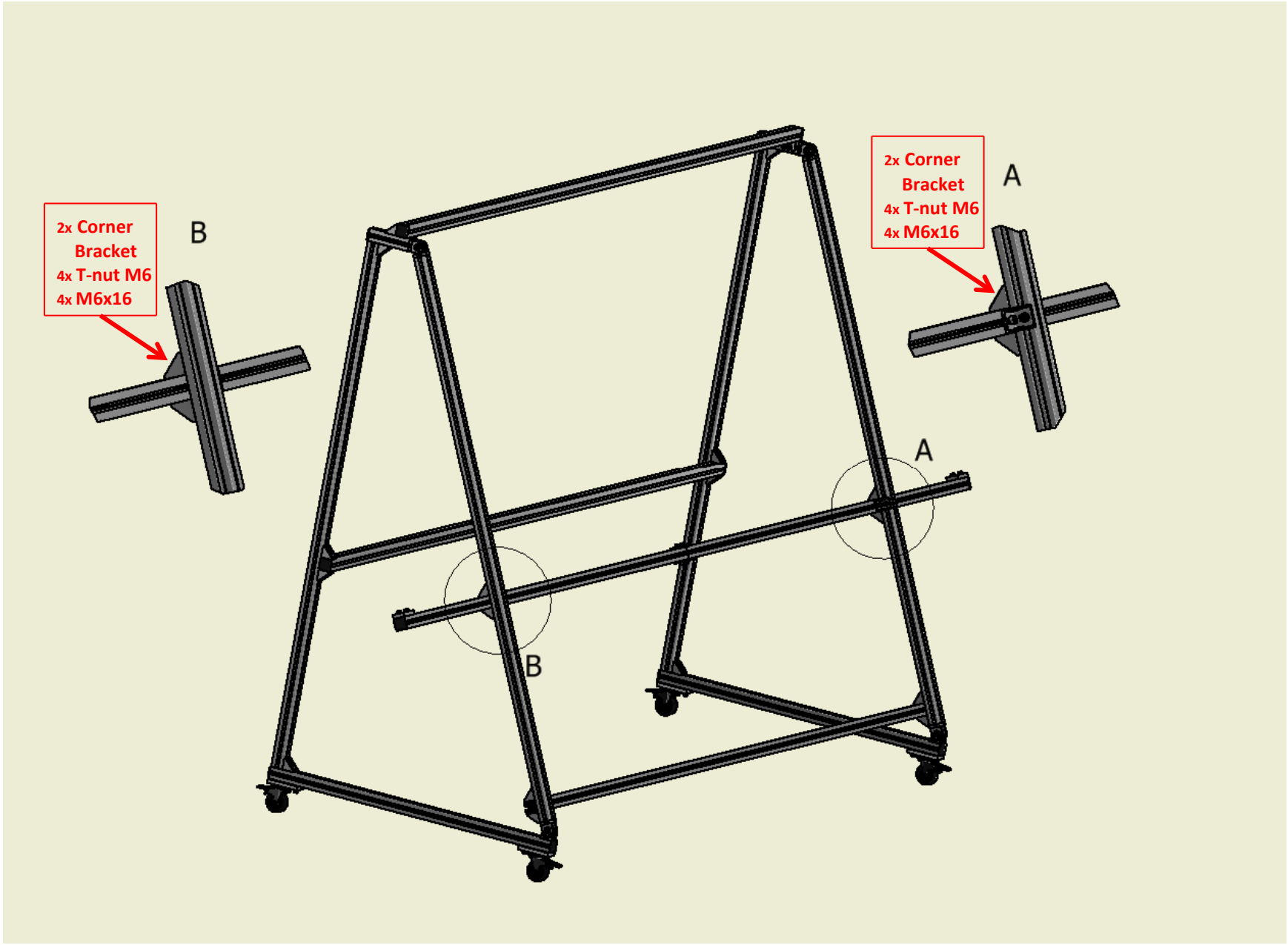


Assembly of the support for Top Front Panel - 2

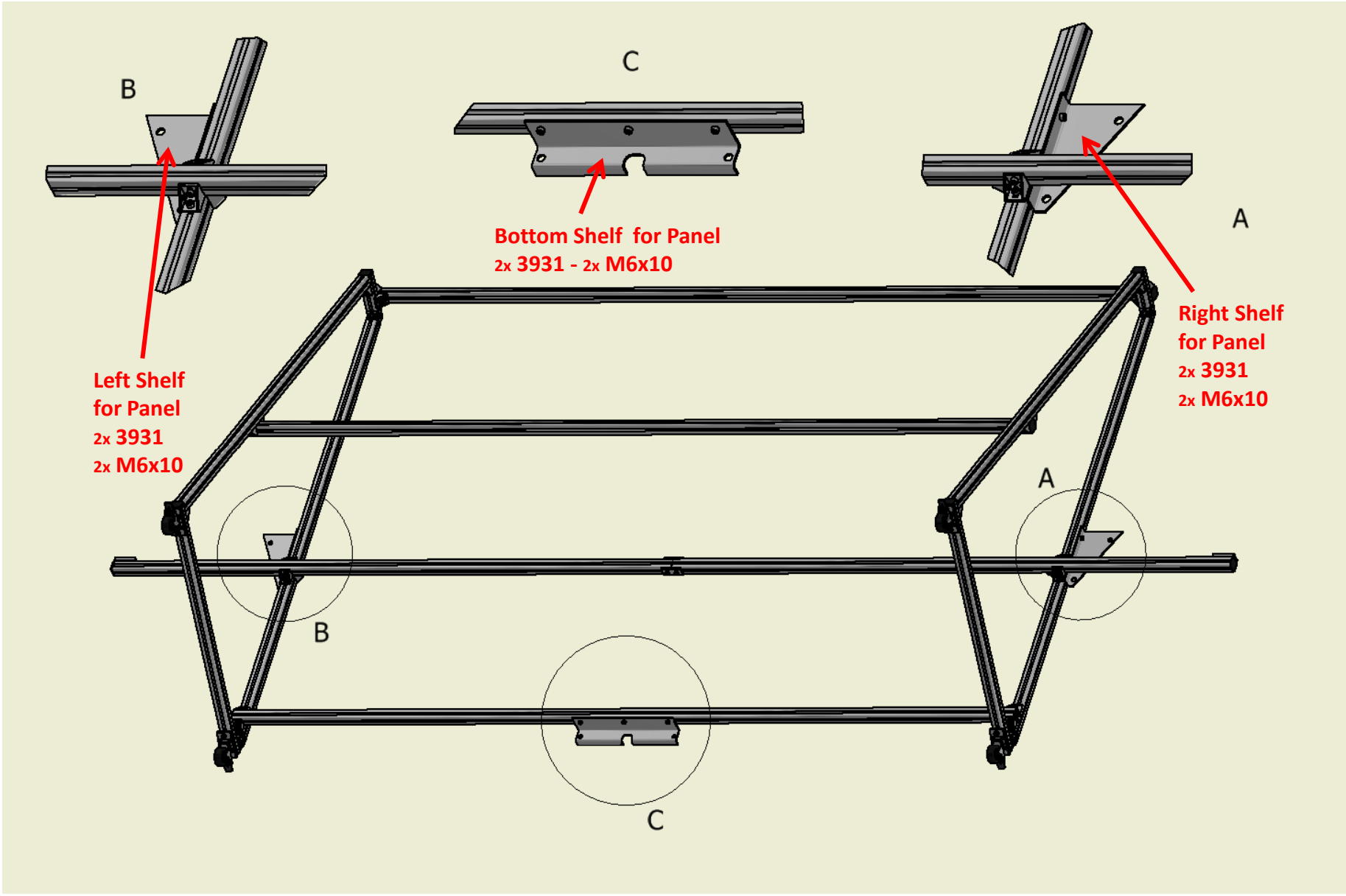




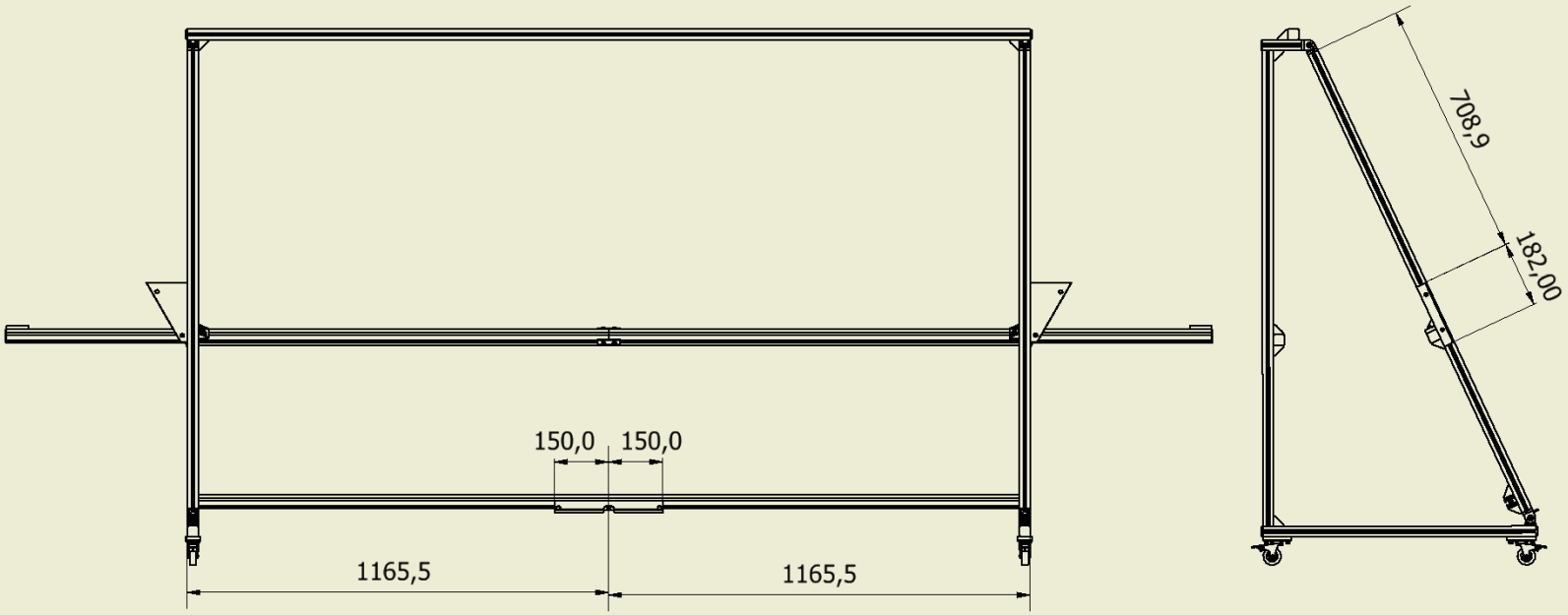
Assembly of the support for Top Front Panel - 3



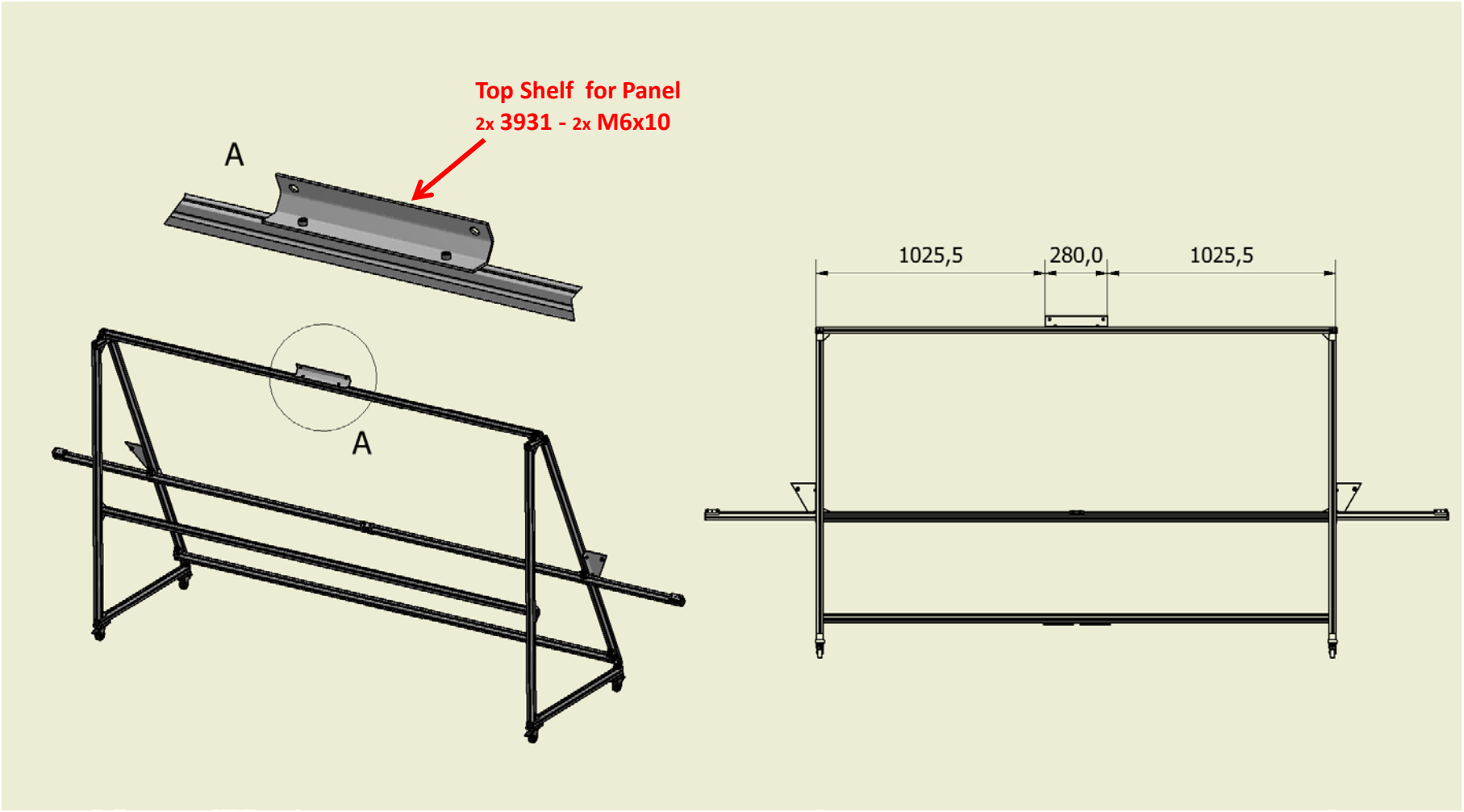
Assembly of the support for Top Front Panel - 4



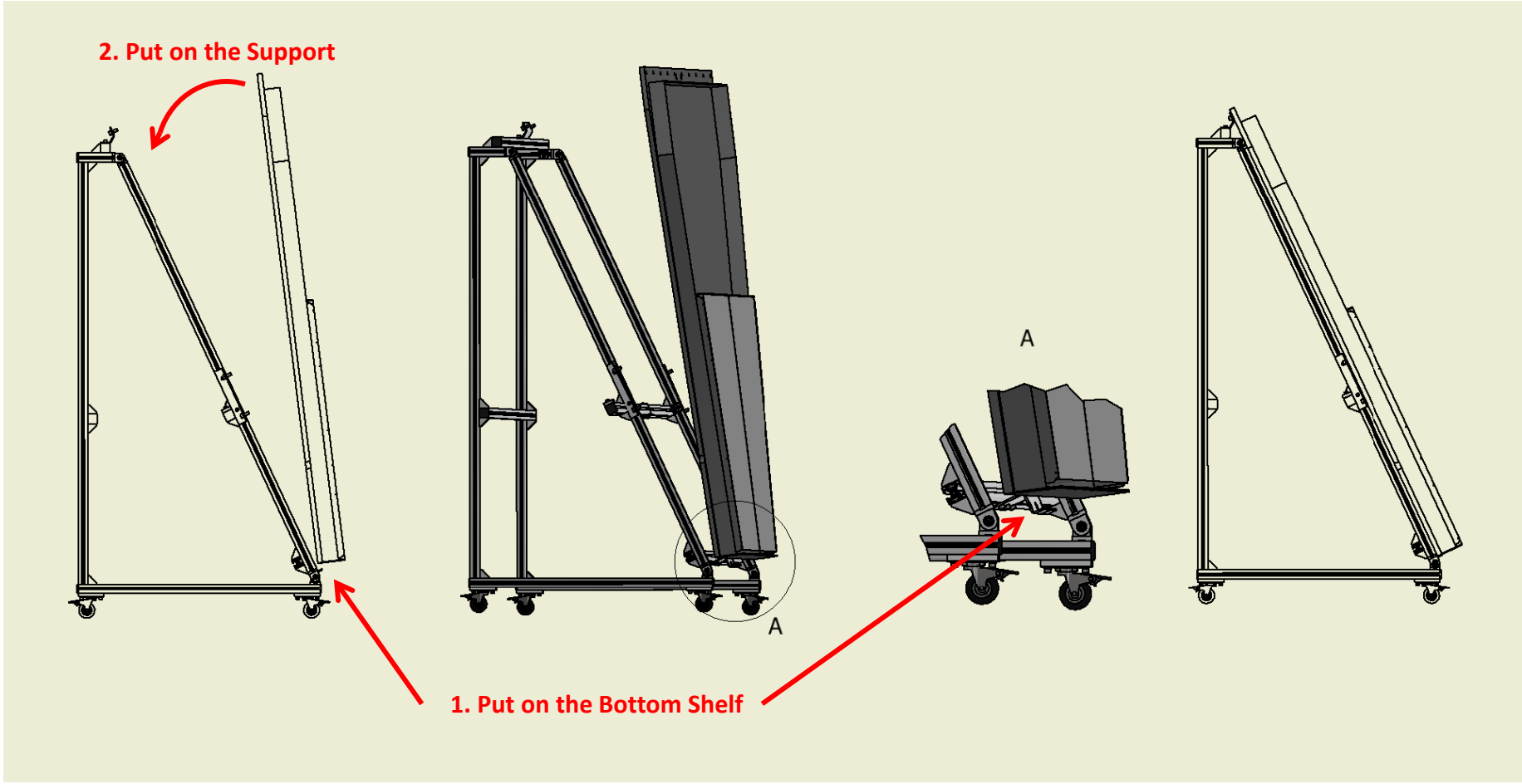
Assembly of the support for Top Front Panel - 5



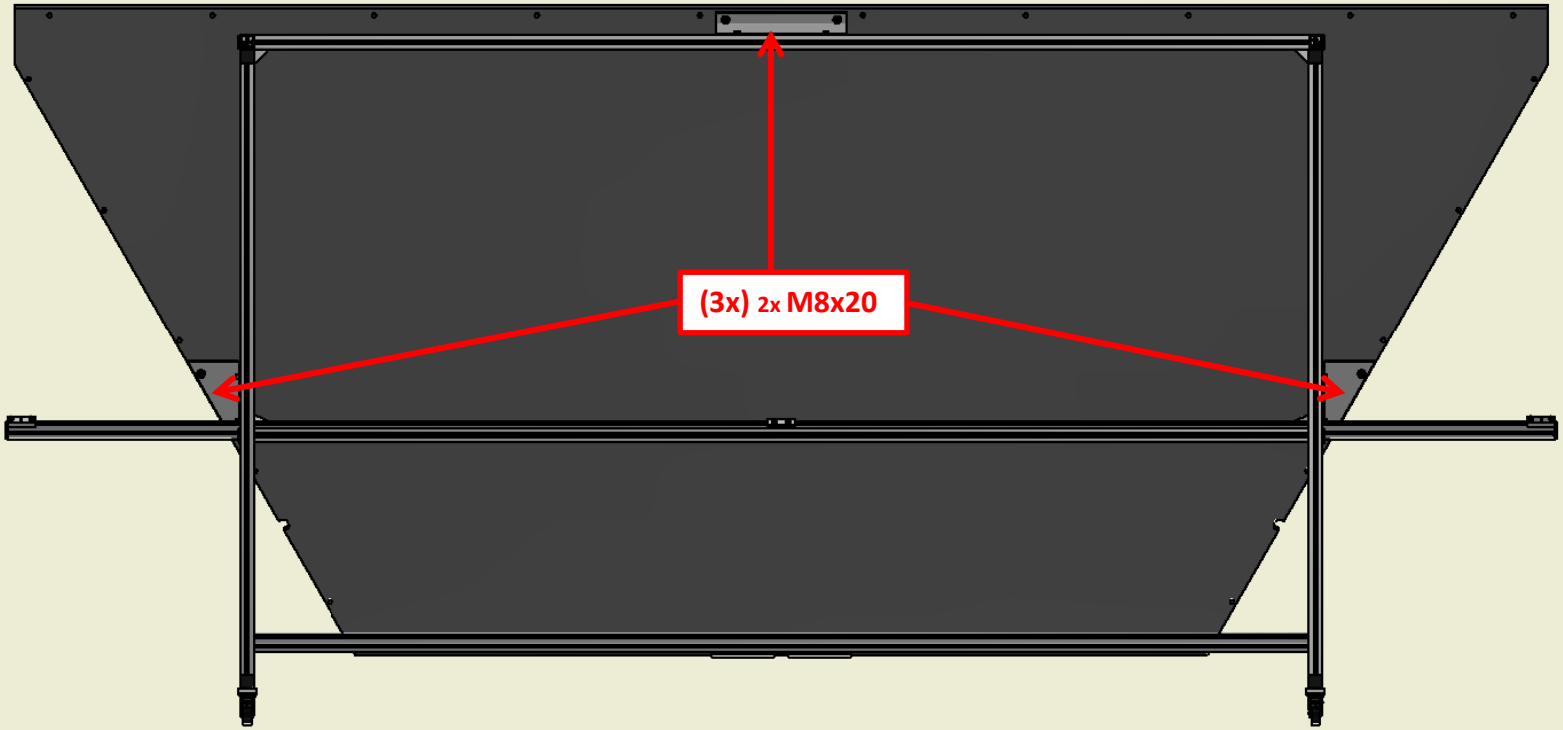
Assembly of the support for Top Front Panel - 6



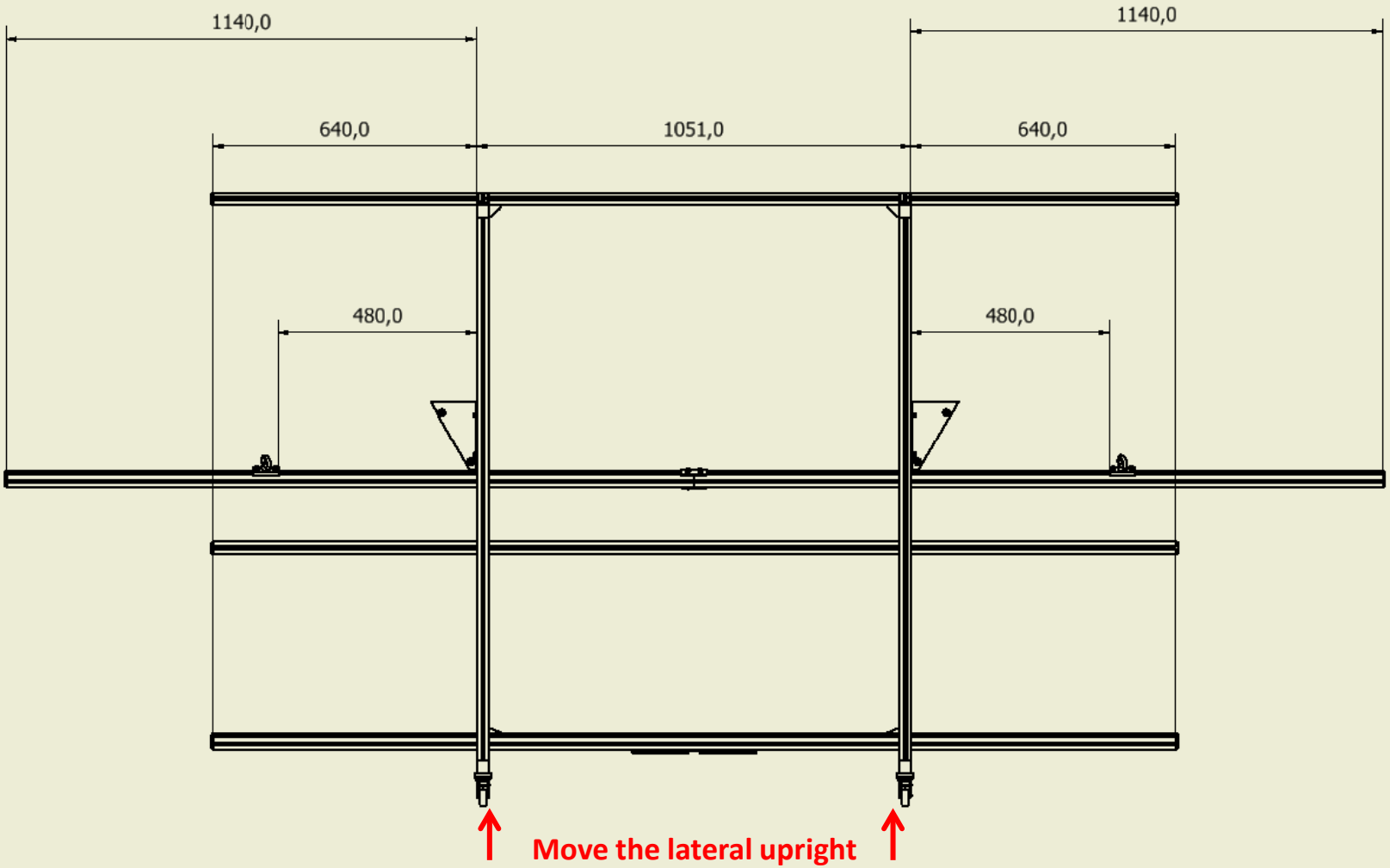
Mounting of the Top Front Panel - 1



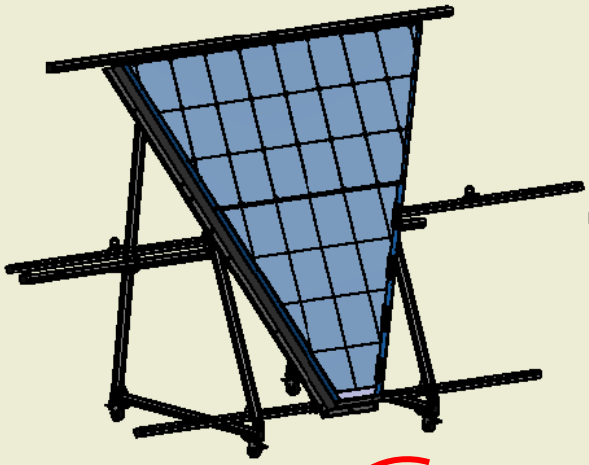
Mounting of the Top Front Panel - 2

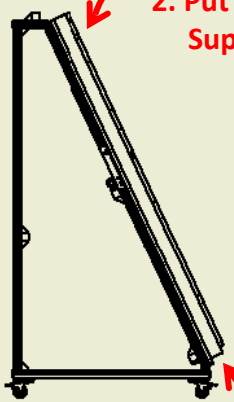


Assembly of the support for Bottom Front Panel



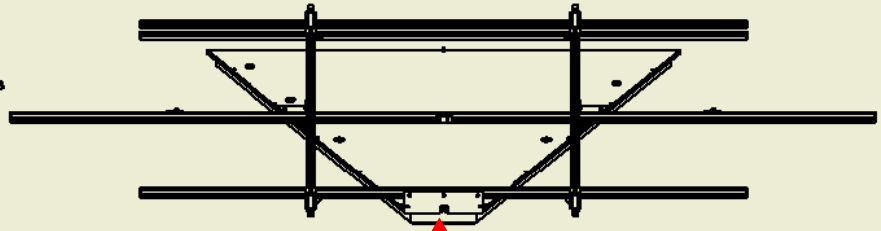
Mounting of the Bottom Front Panel



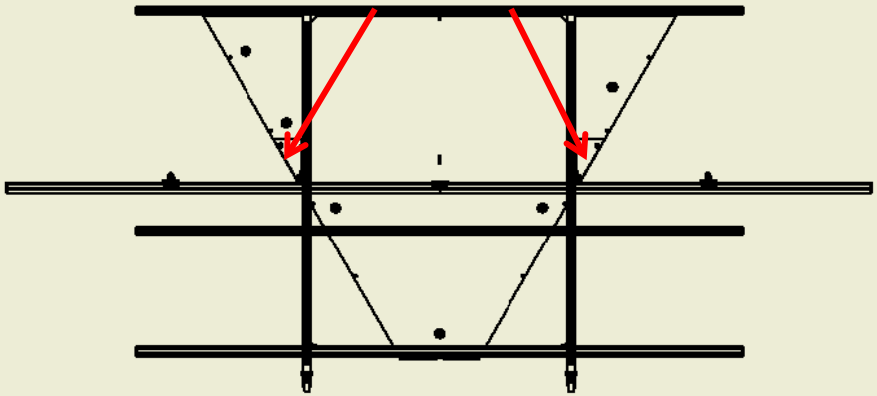


2. Put on the Support

1. Put on the Bottom Shelf

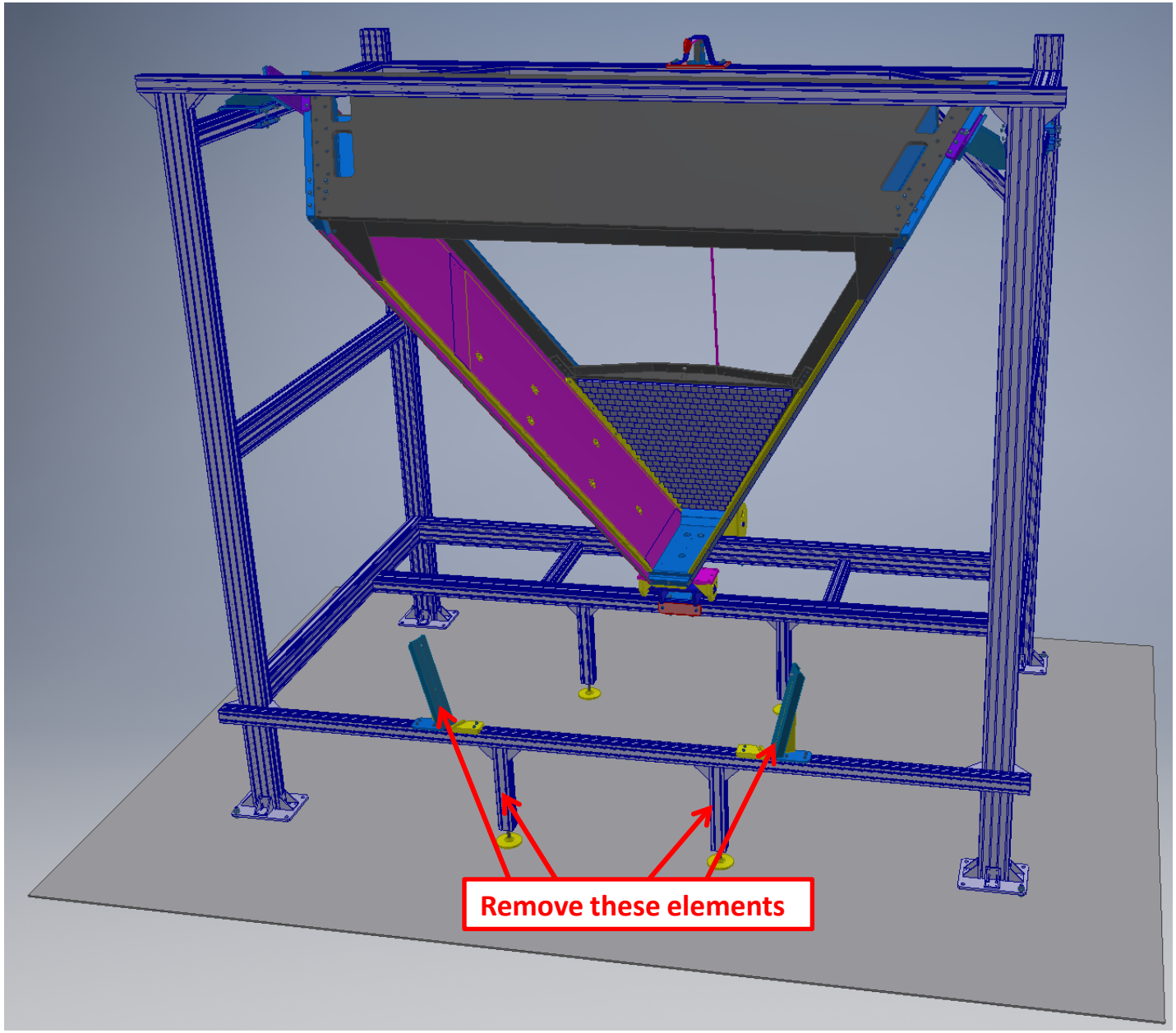


(3x) 2x M8x20

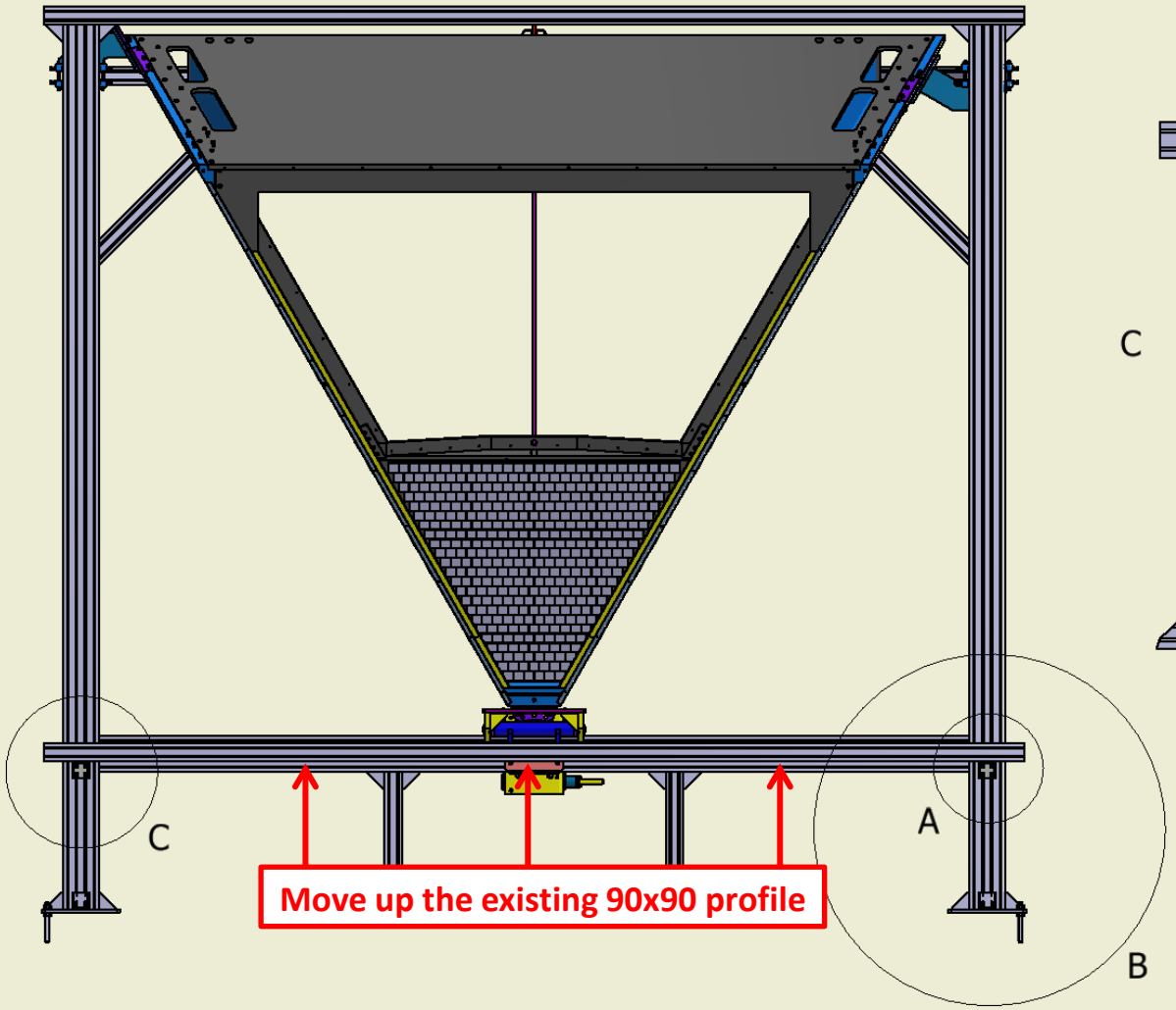


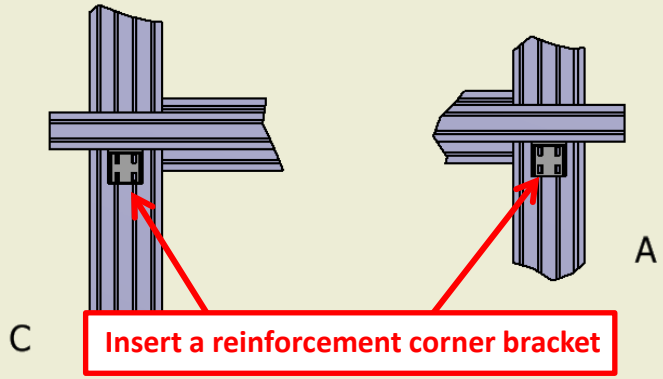
2. Procedure for the preparation of the RICH supporting structure before the installation of the frontal panels

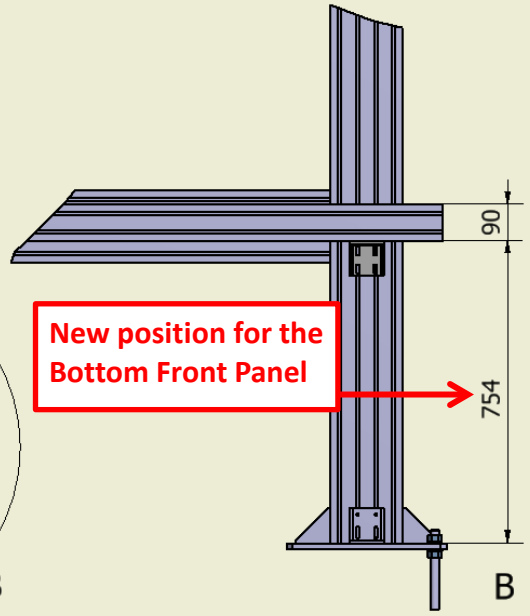
Removing elements



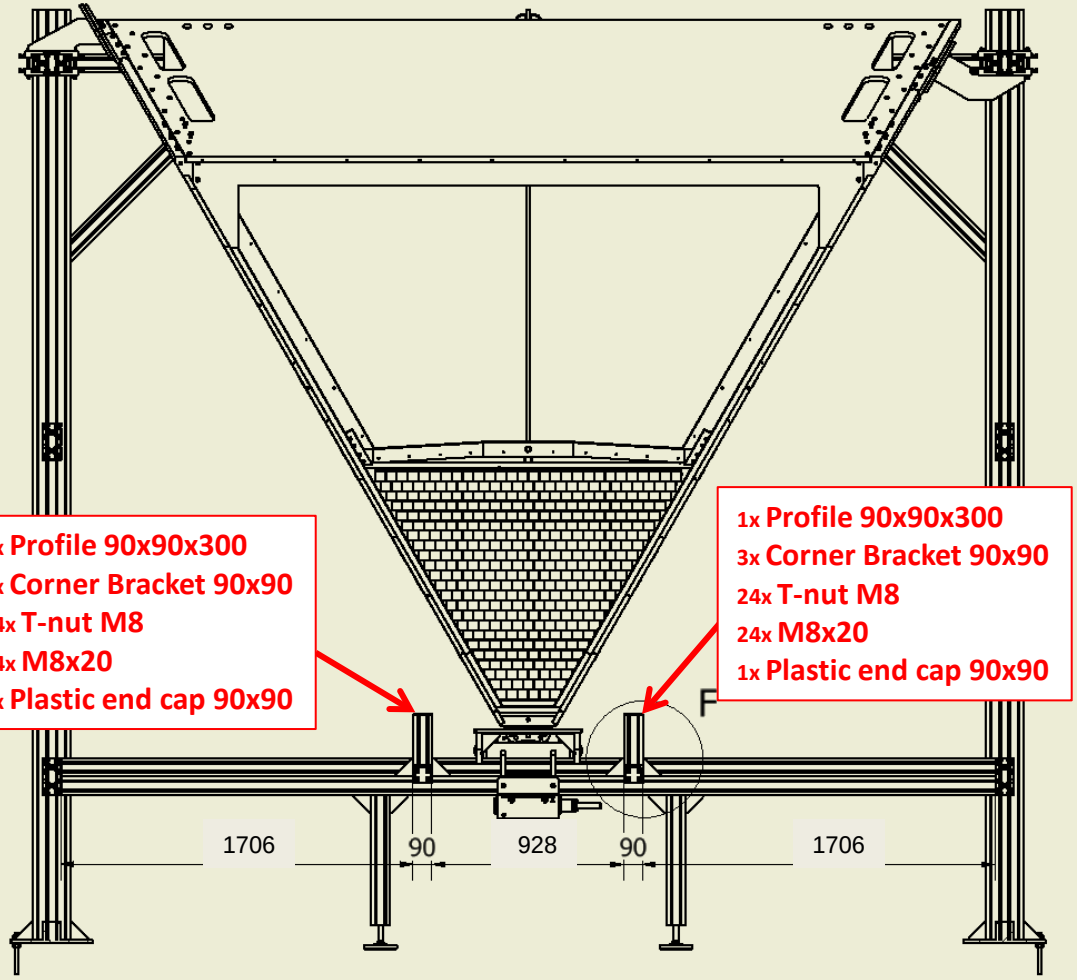
Existing cross bar positioning for the Bottom Front Panel

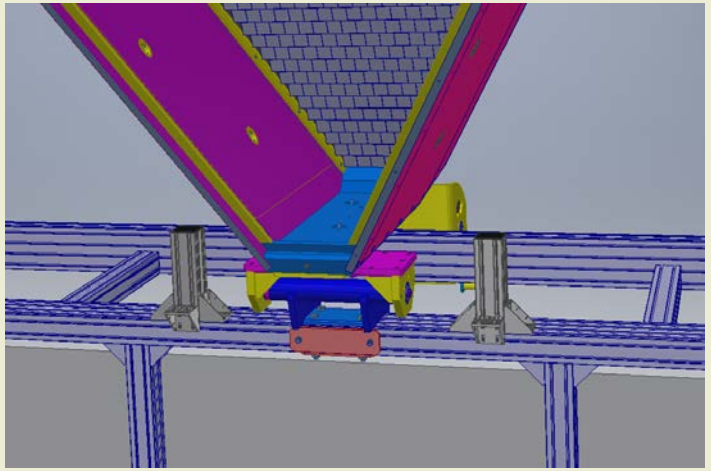


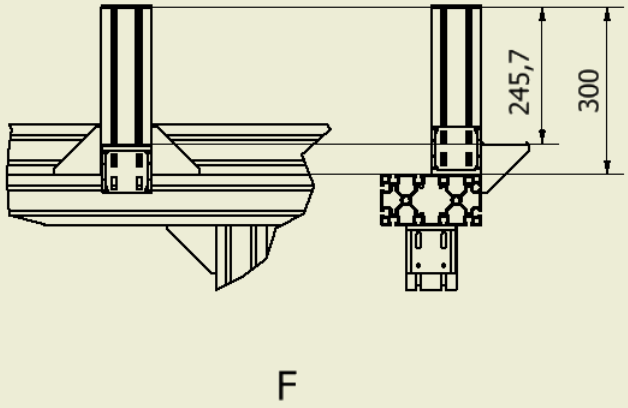




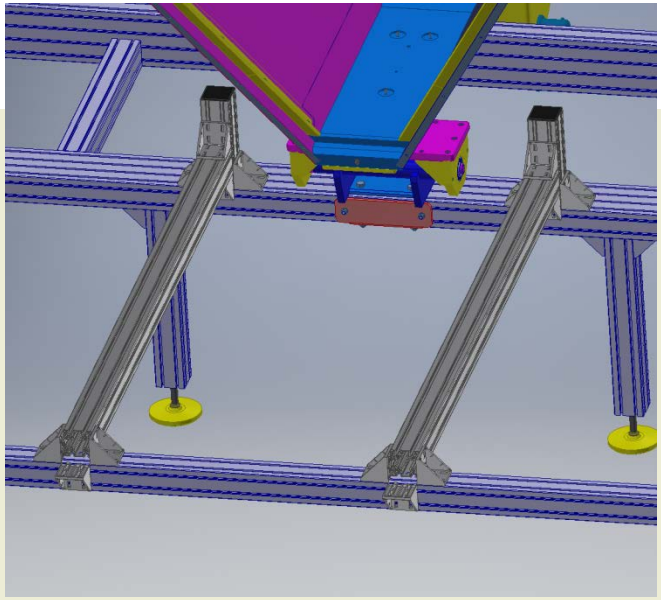
Mounting insert guides for the Bottom Front Panel - 1

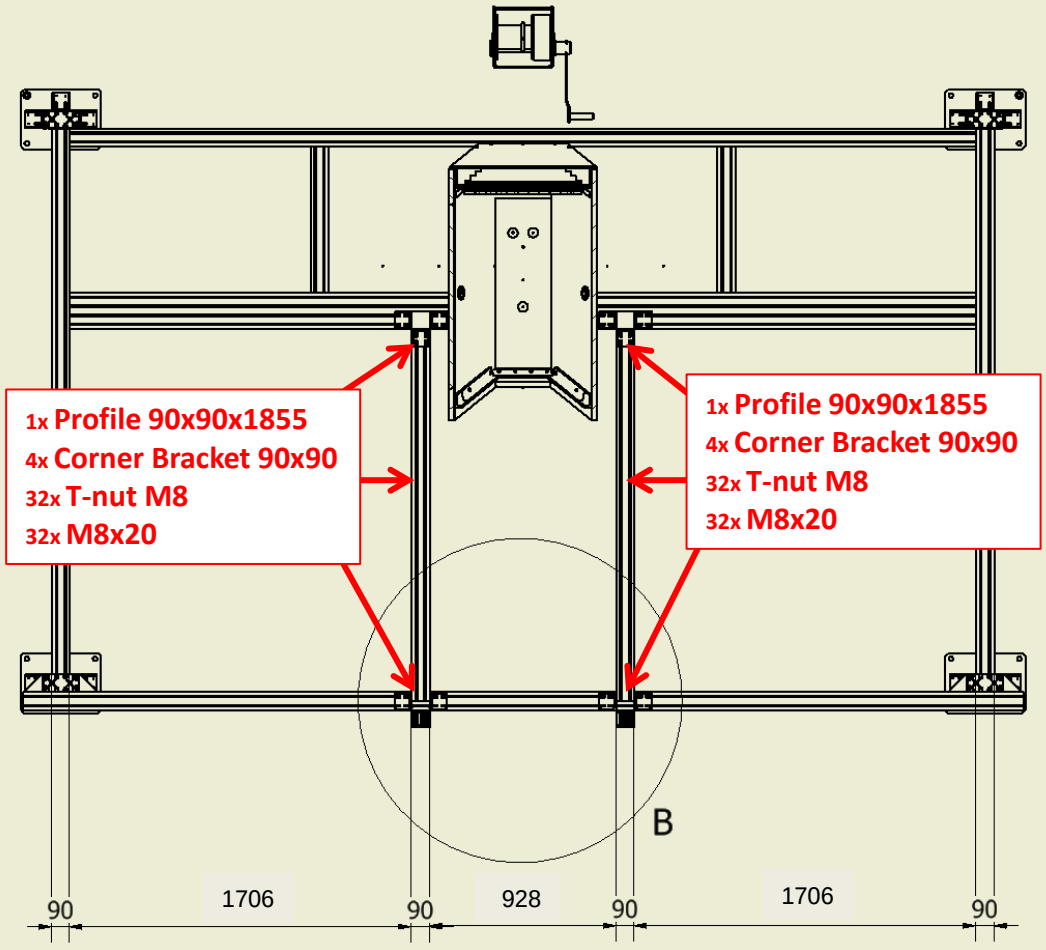


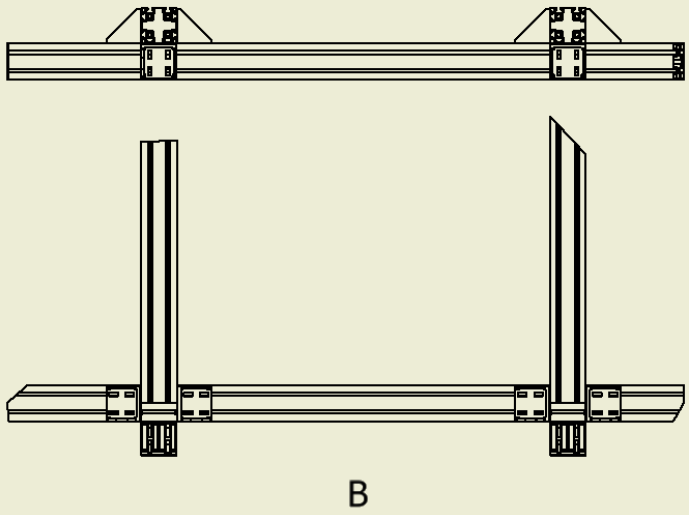




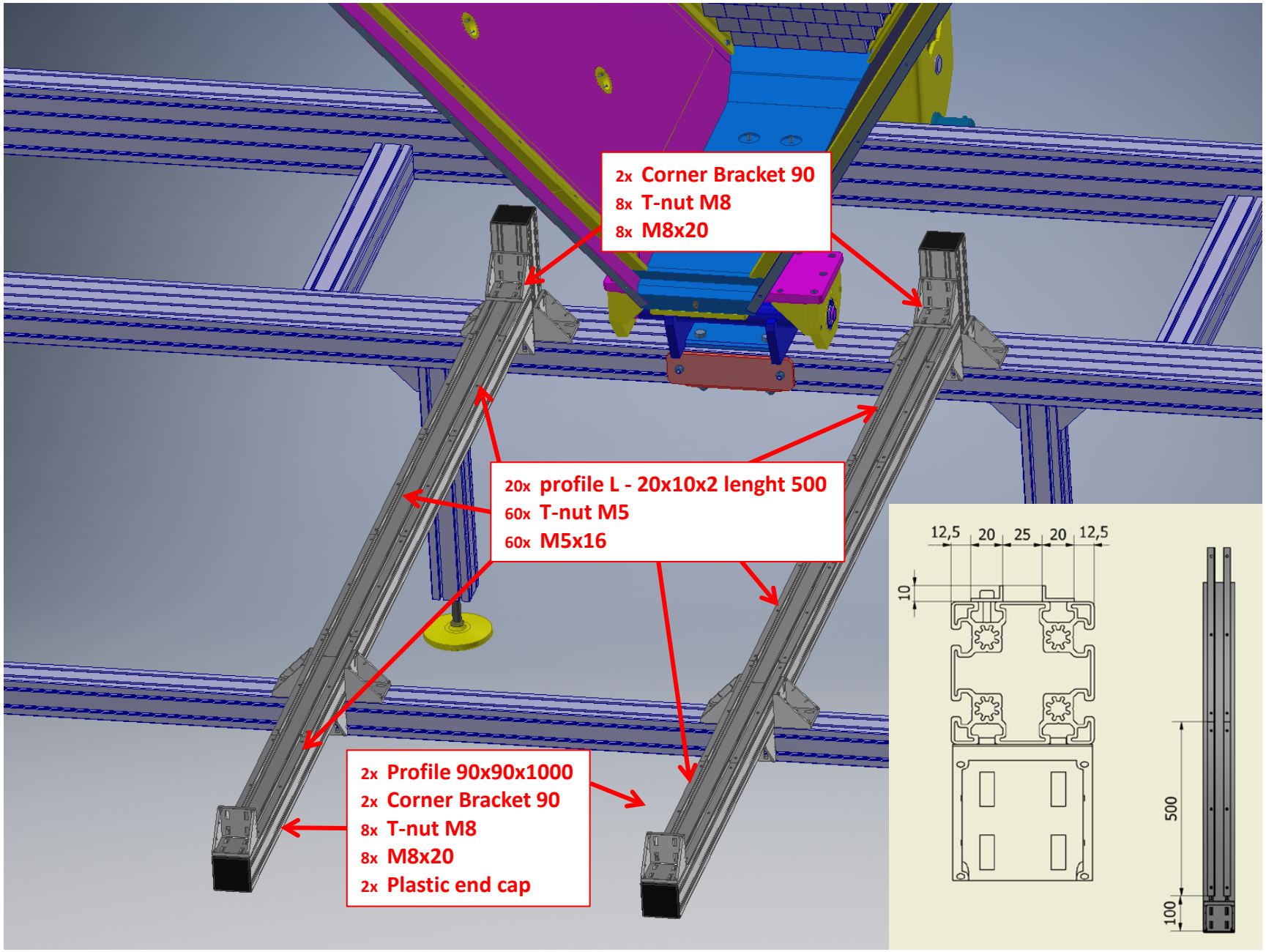
Mounting insert guides for the Bottom Front Panel – 2



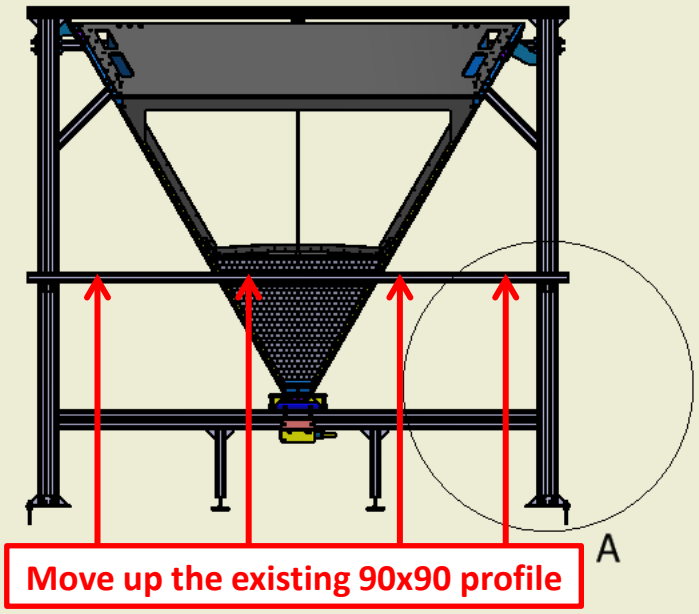


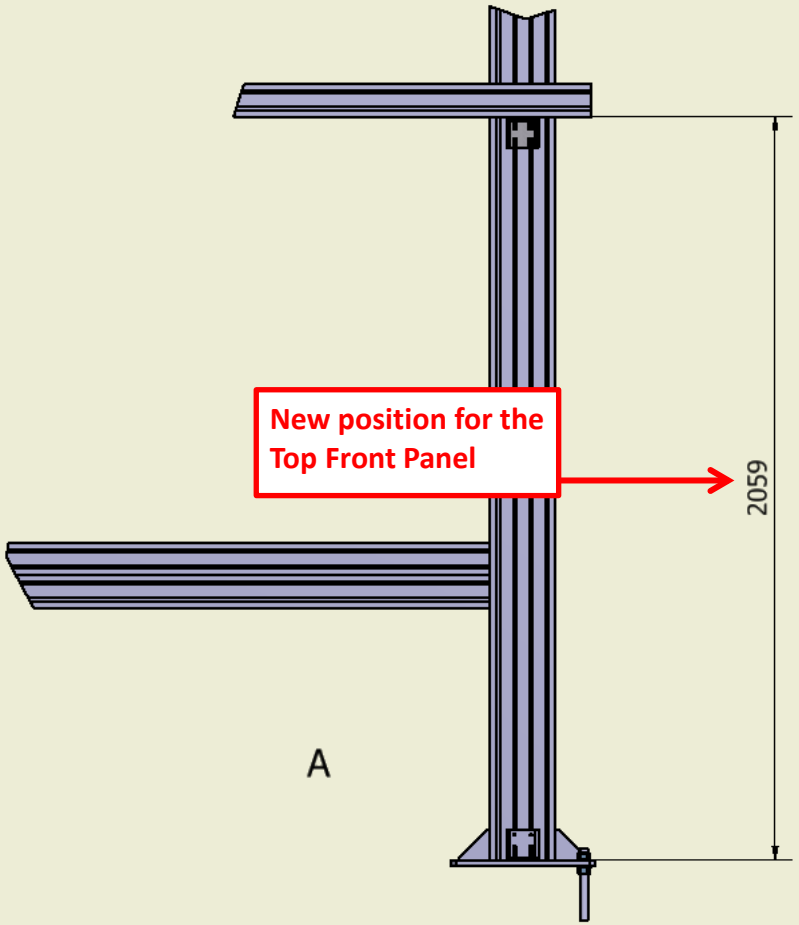


Mounting insert guides for the Bottom Front Panel – 3

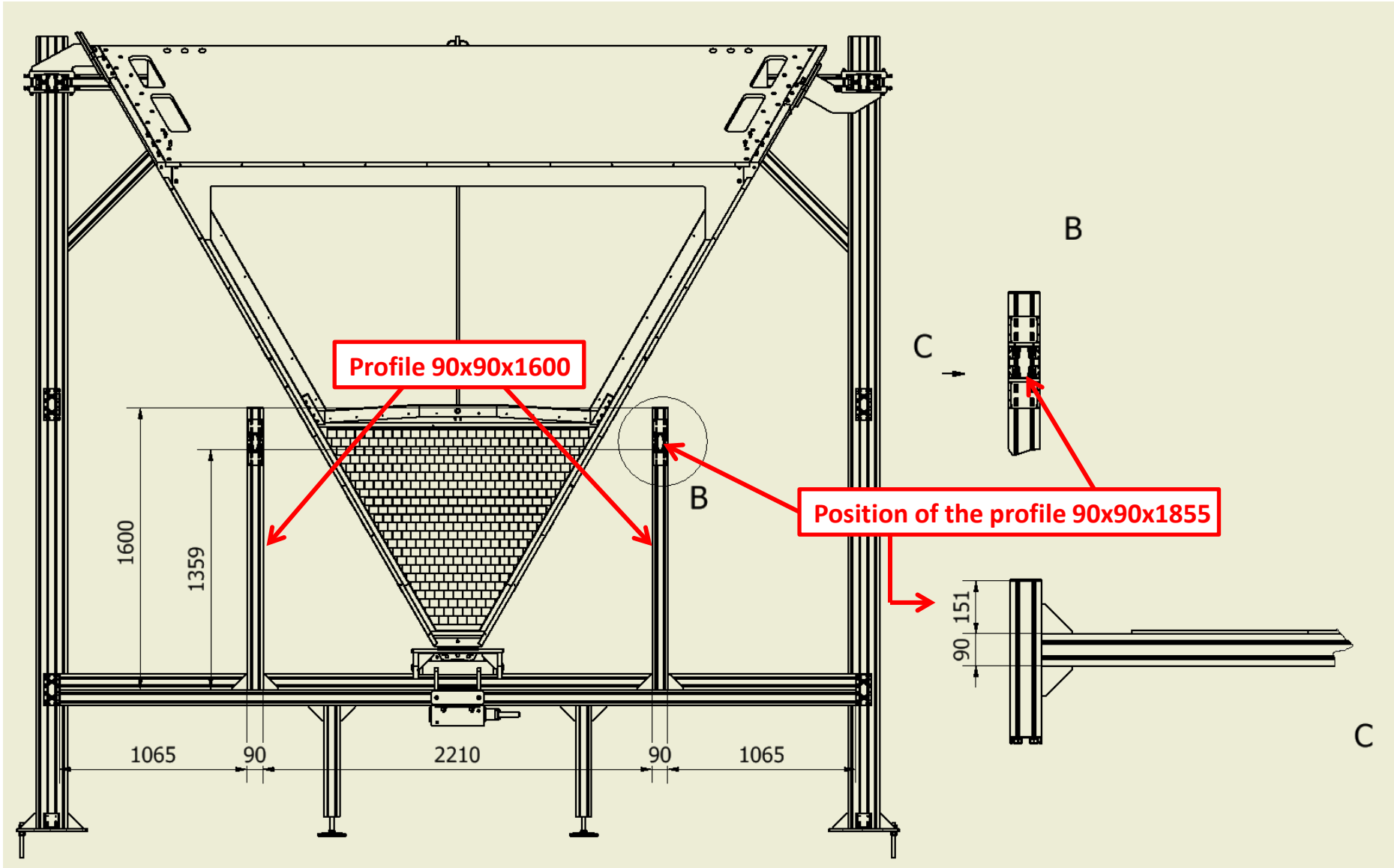


Existing cross bar positioning for the Top Front Panel

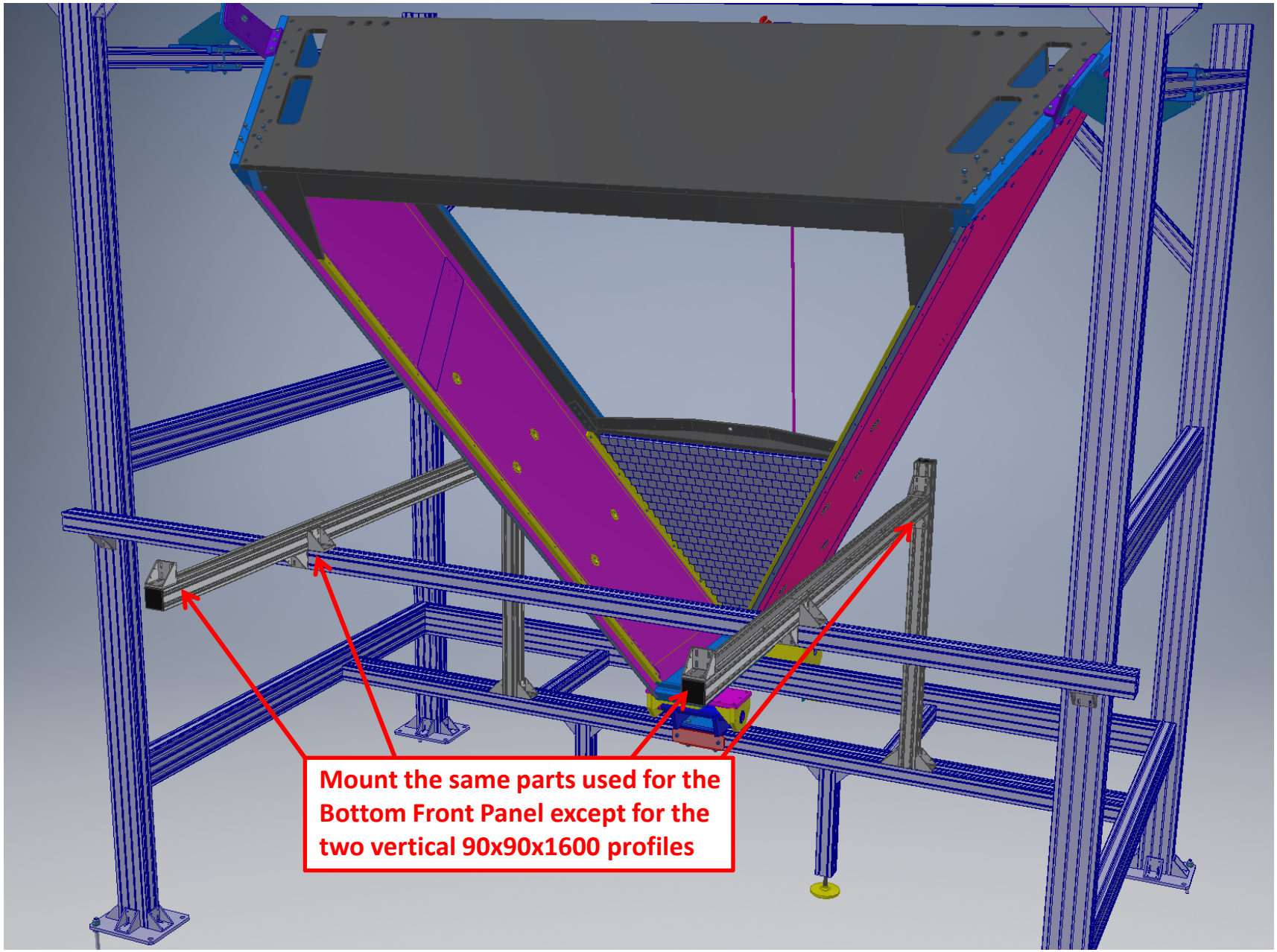




Mounting insert guides for the Top Front Panel - 1

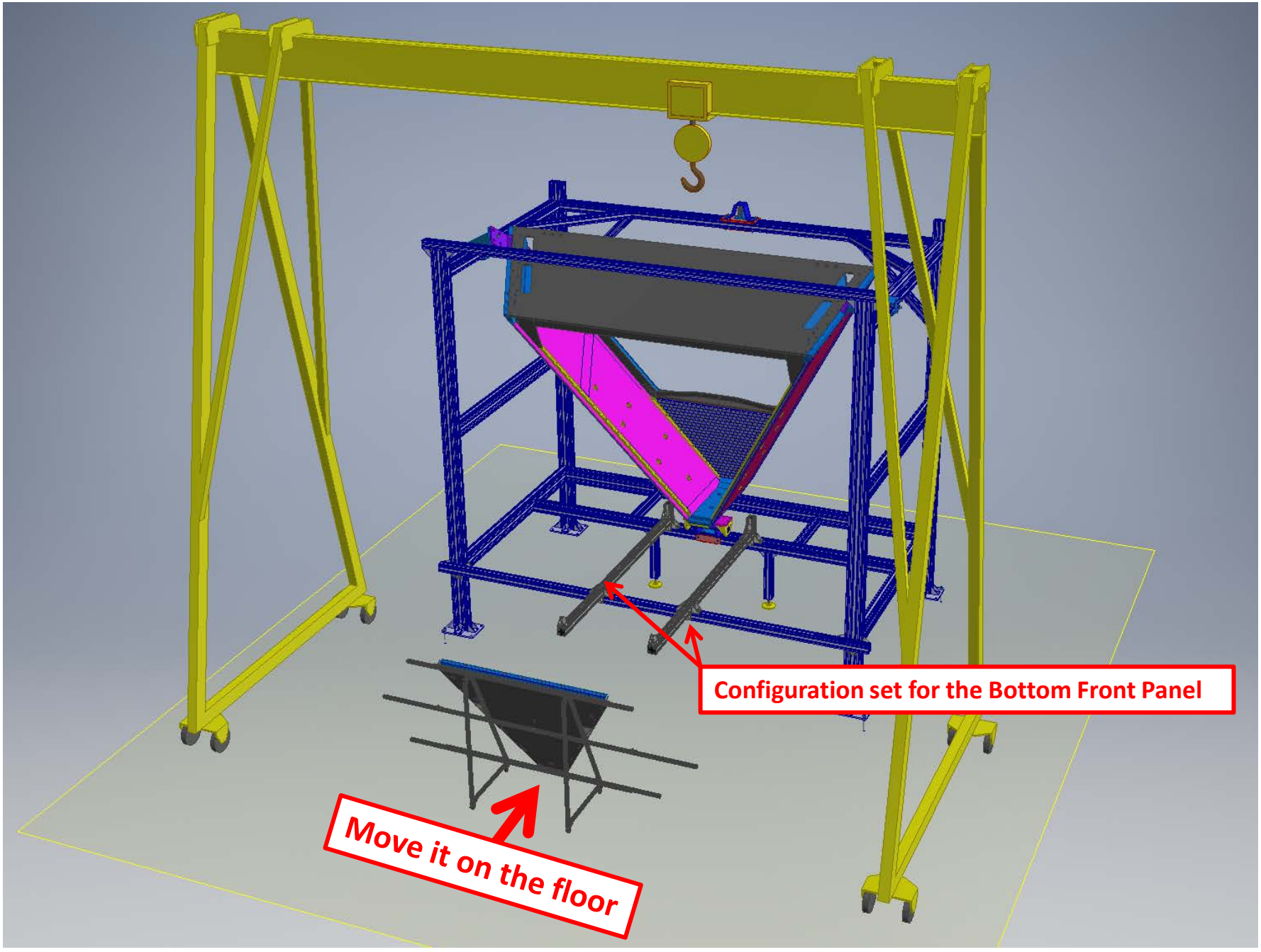


Mounting insert guides for the Top Front Panel - 2

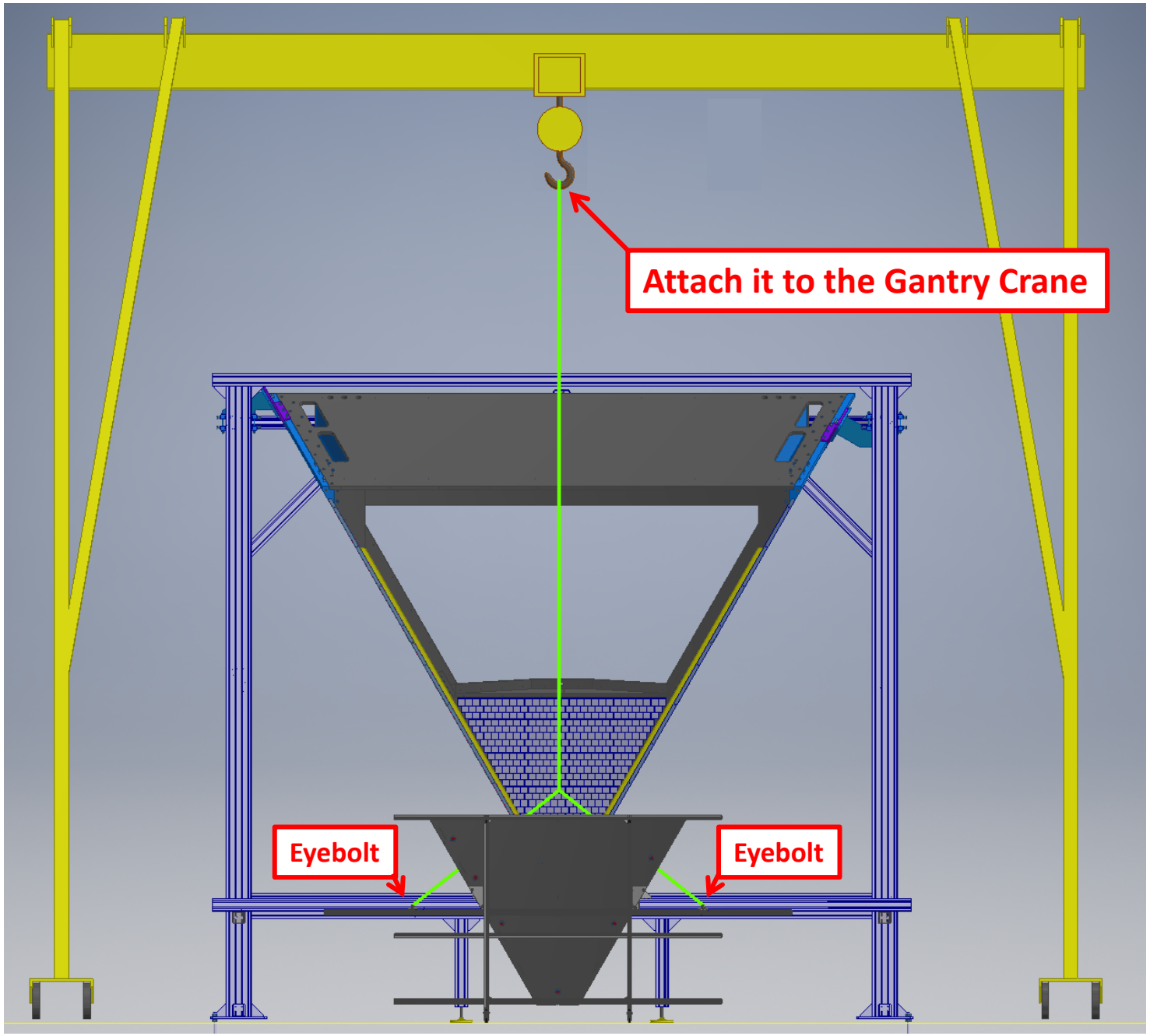


3. Procedure for the installation of the RICH Frontal Panels

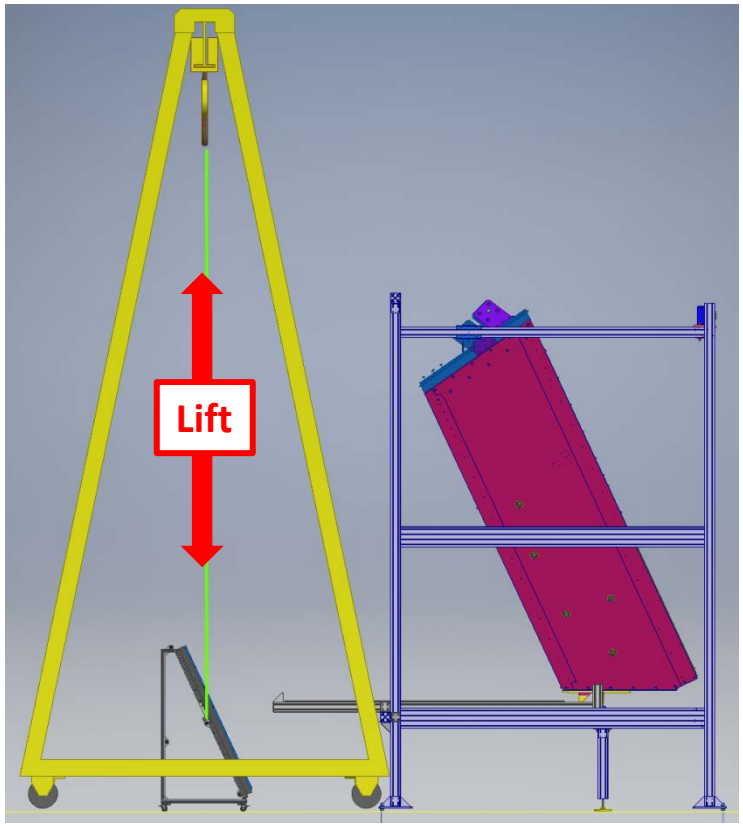
Inserting Bottom Front Panel - 1

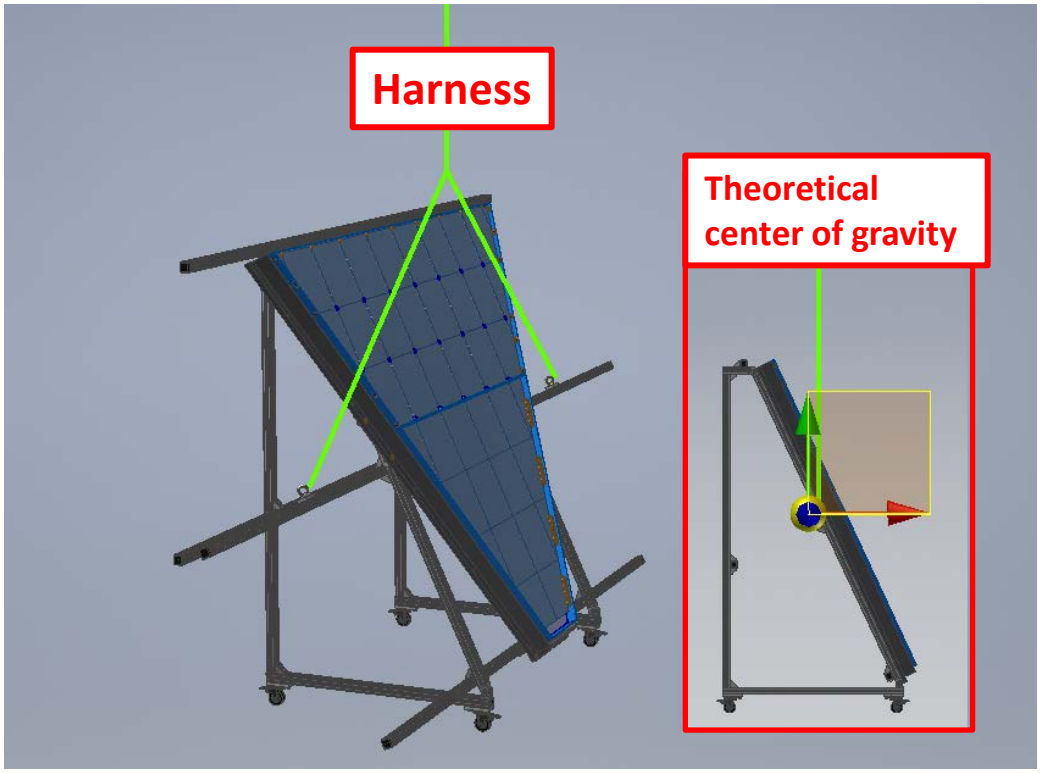


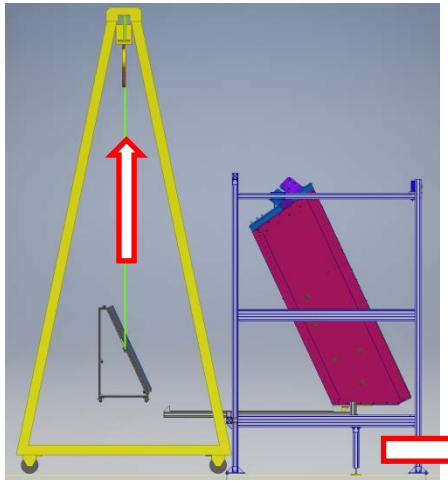
Inserting Bottom Front Panel - 2

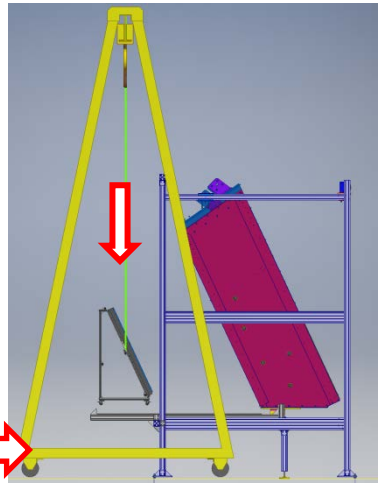


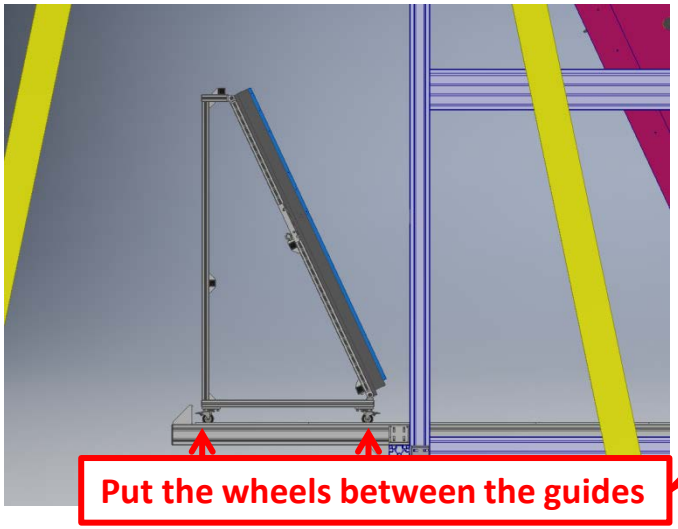
Inserting Bottom Front Panel - 3

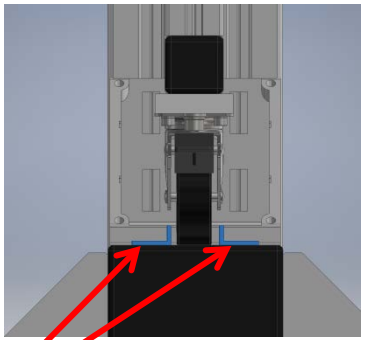




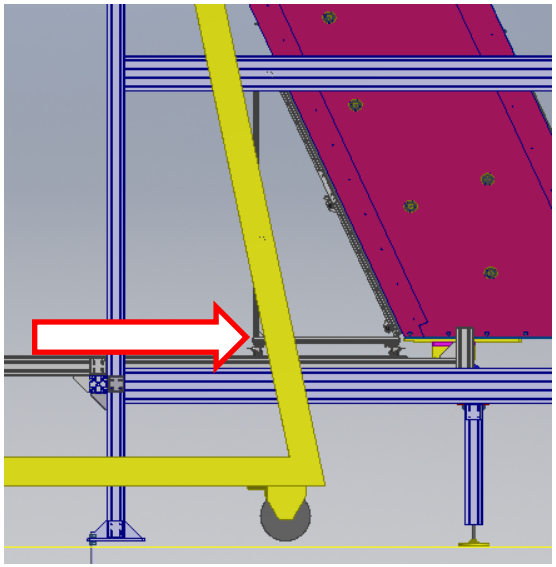


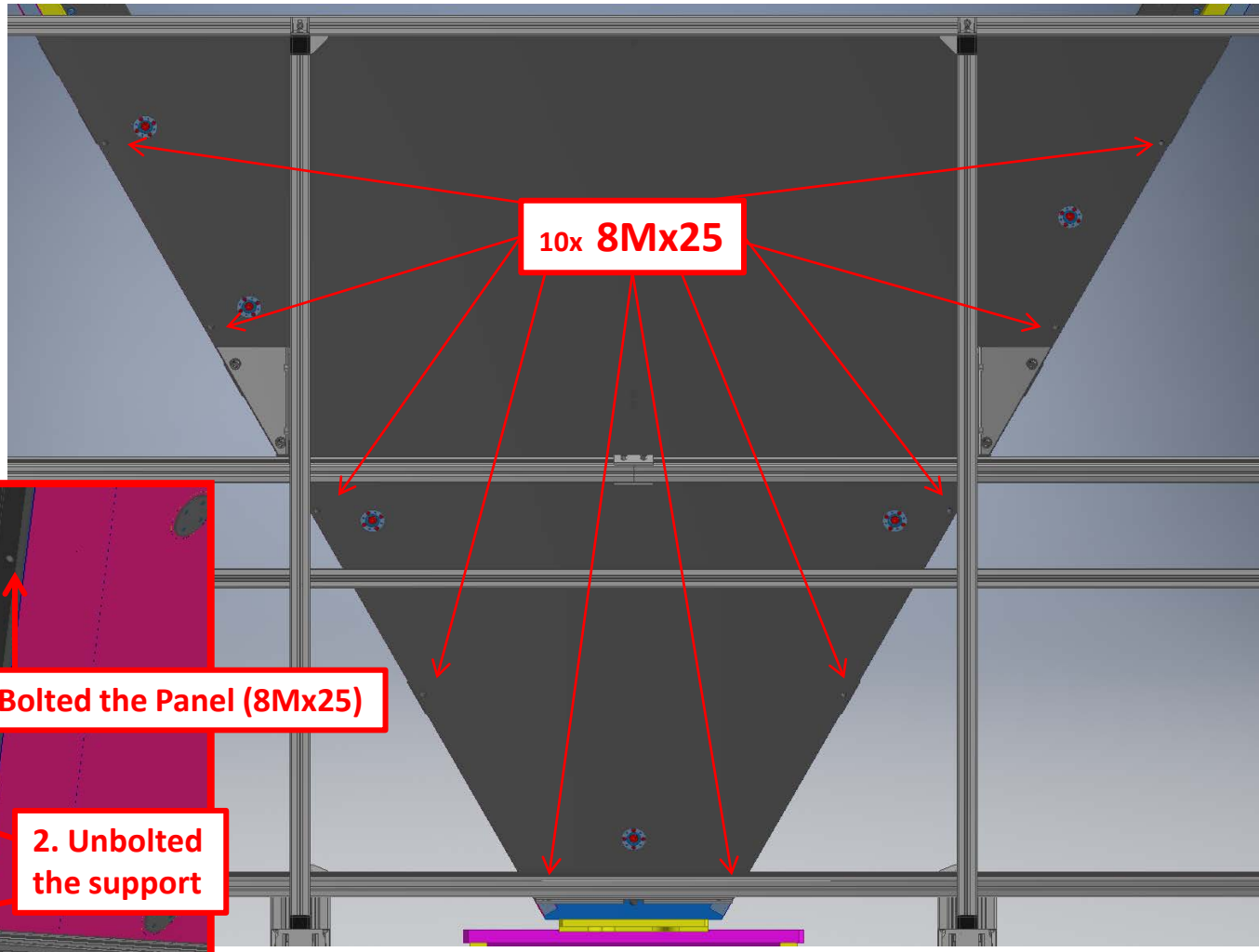


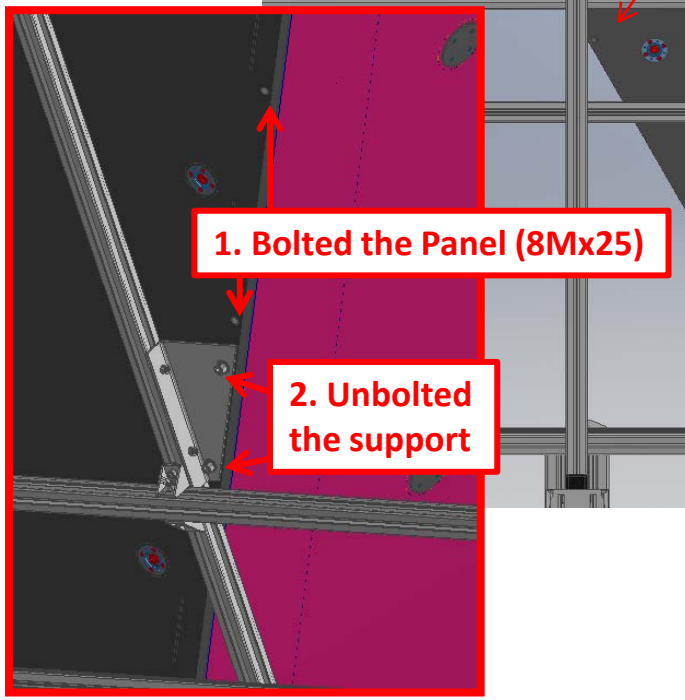




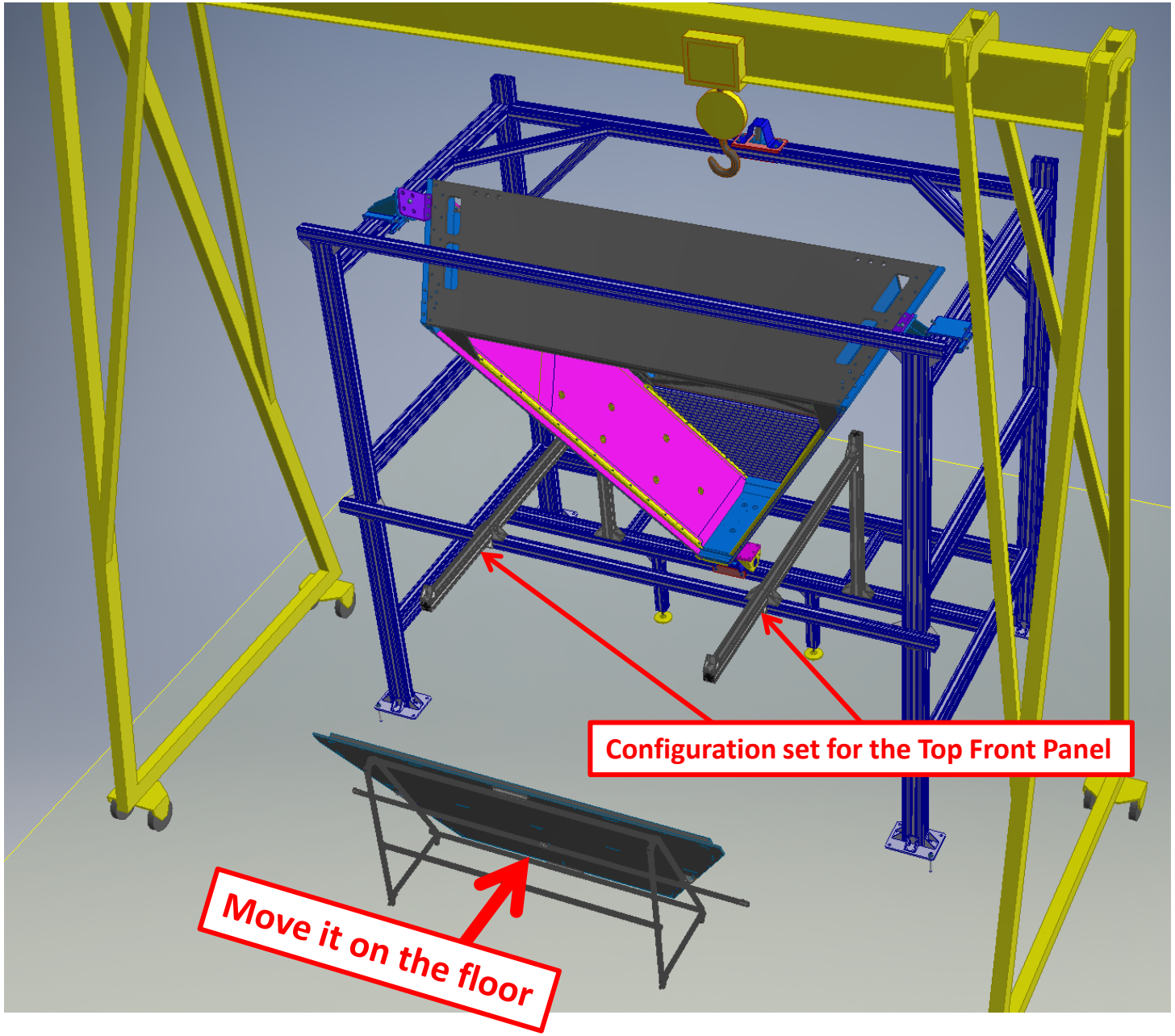
Inserting Bottom Front Panel - 4



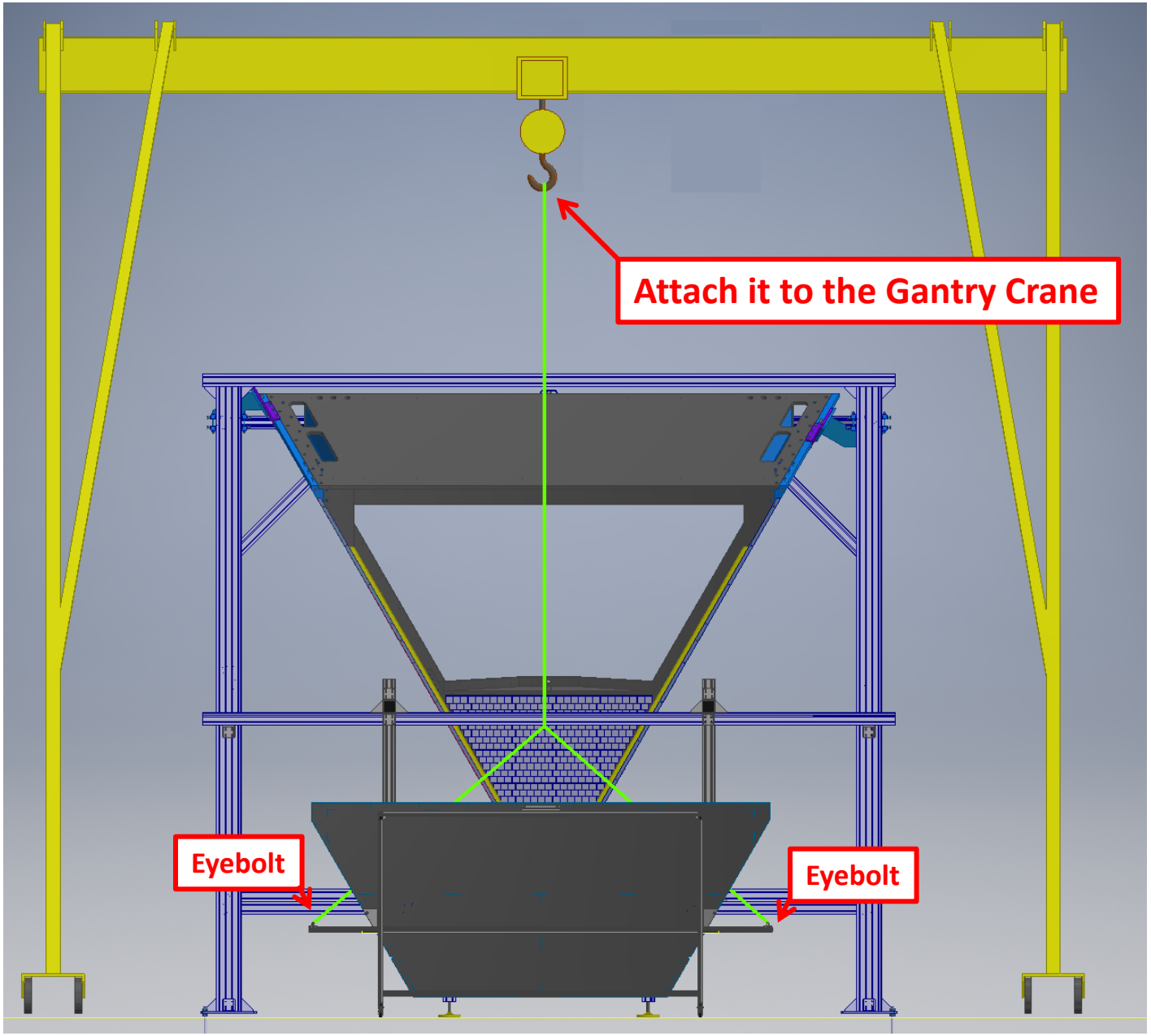




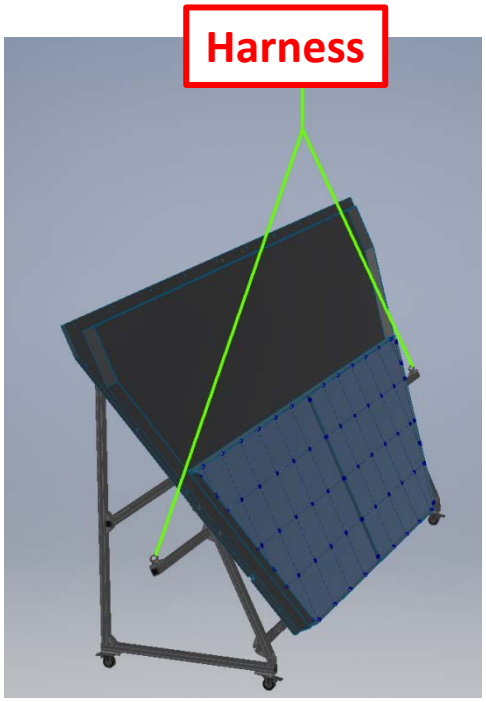
Inserting Top Front Panel - 1

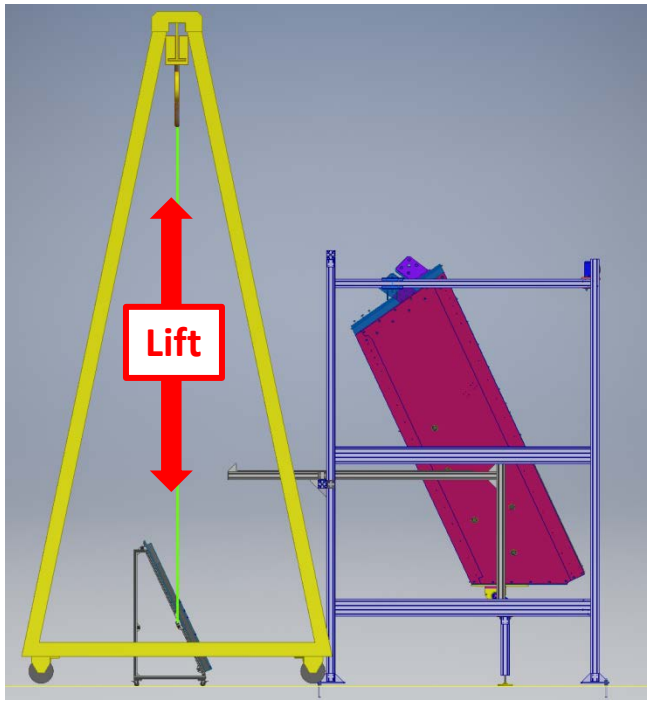


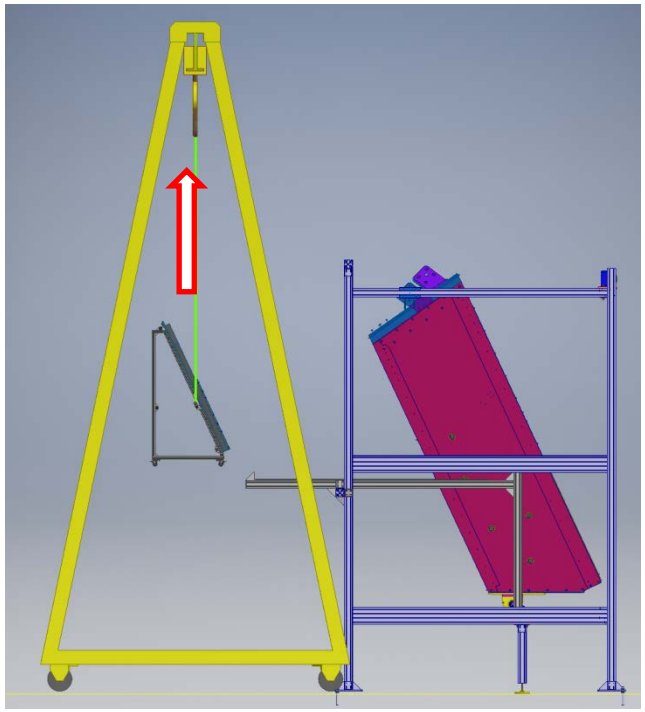
Inserting Top Front Panel - 2

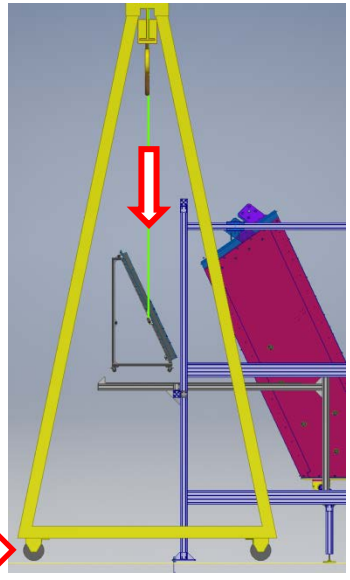


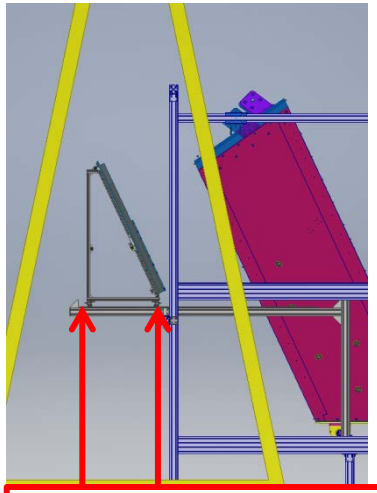
Inserting Top Front Panel - 3





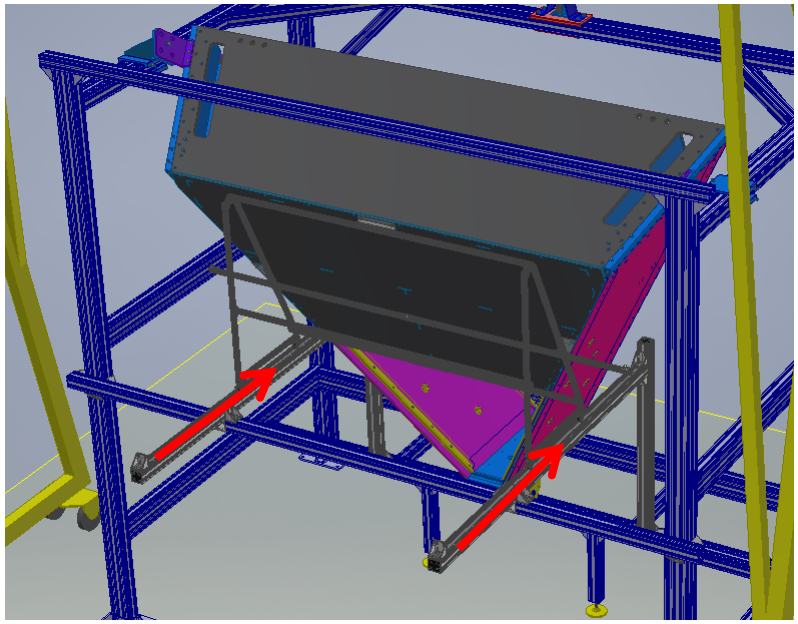


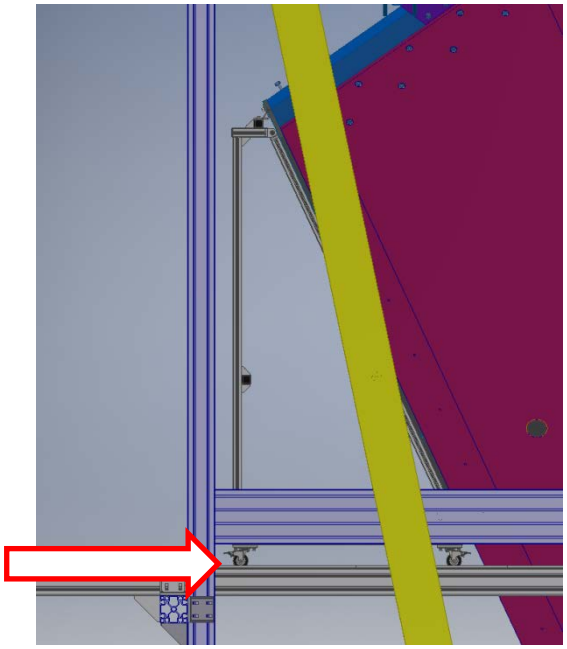


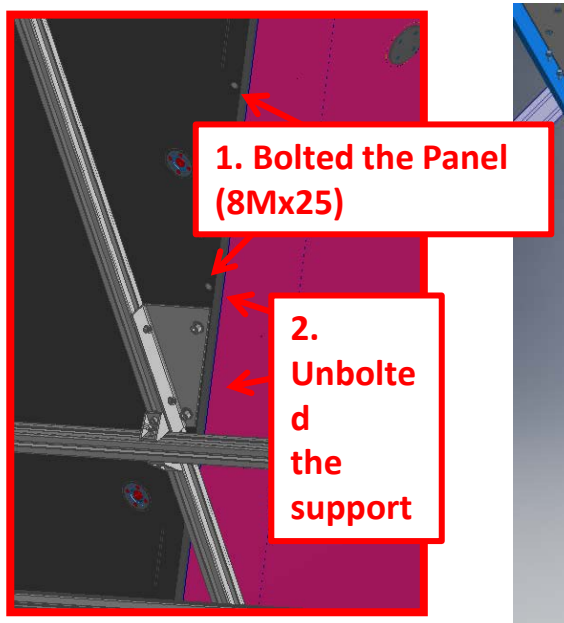


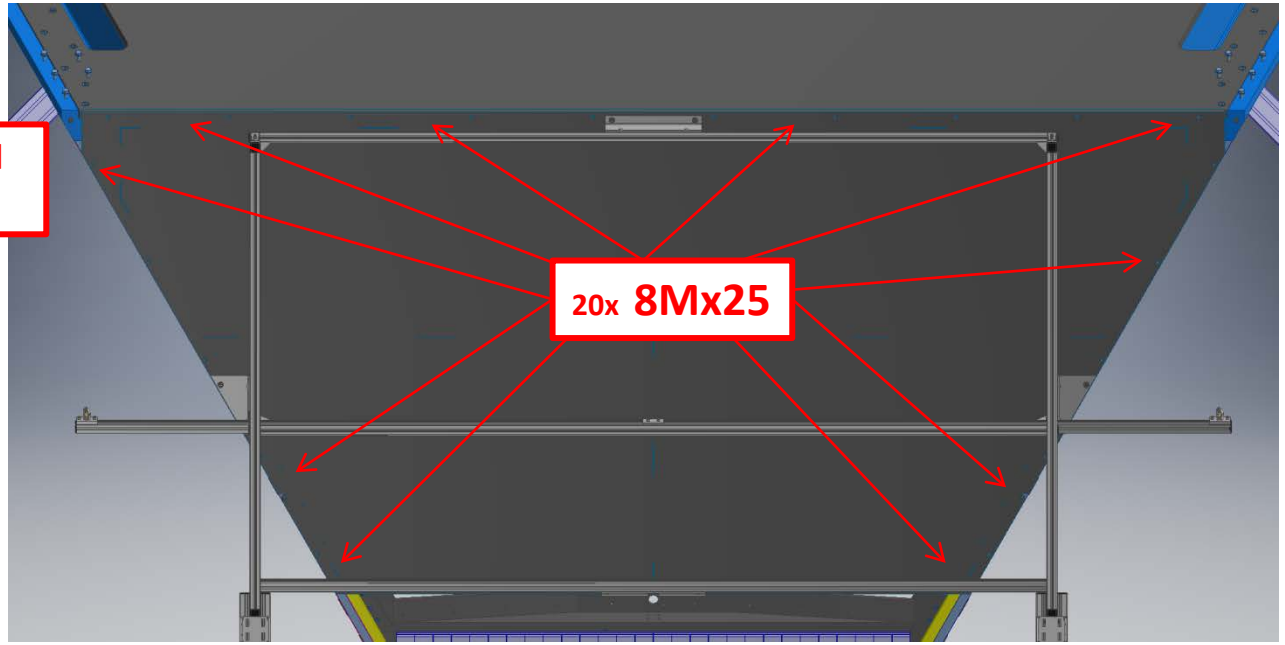
Put the wheels between the guides

Inserting Top Front Panel - 4









CFRP FRAME-SPH MIRRORS-LATERAL MIRRORS-ASSEMBLY INTO THE RICH SHELL

Mod. 75/95/00

P/N: RICH-001-000

DESCRIPTION: RICH SPHERICAL & PLANAR MIRROR

SHEET: 1/14

REV.	DATE	REVISION	MODIFIED PHASE	SIGNATURE
0	04/08/2016	FIRST EMISSION	N.A.	

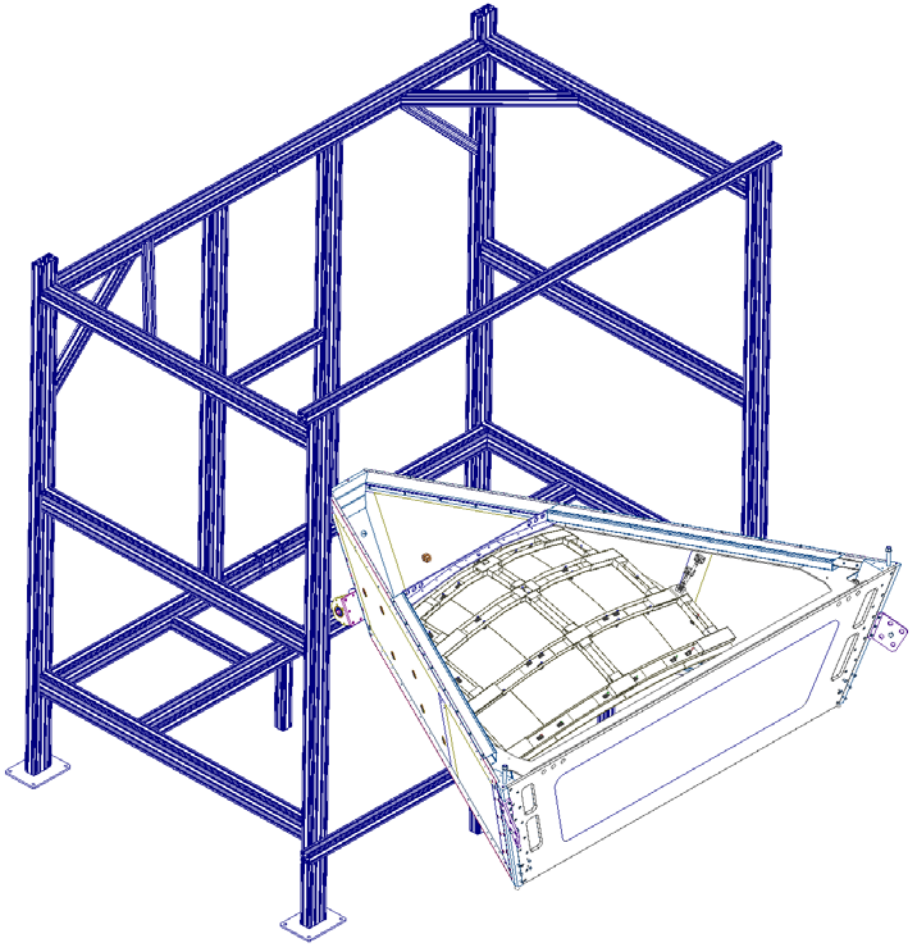
PHASE	DESCRIPTION & NOTE	DRAWINGS

APPLICABLE DOCUMENTATION:

Sperical mirror for the RICH detector_July 2017

Lateral Planar Mirror for the RICH Detector_ July 2017

BILL OF P/Ns:



PREPARED BY:	CHECKED BY:	APPROVED BY:
S. Tomassini	S. Tomassini	

		CFRP FRAME-SPH MIRRORS-LATERAL MIRRORS-ASSEMBLY INTO THE RICH SHELL		**Mod. 75/95/00**
		P/N: RICH-001-000	**DESCRIPTION: RICH SPHERICAL & PLANAR MIRROR**	SHEET: 2/14
REV.	**DATE**	**REVISION**	**MODIFIED PHASE**	**SIGNATURE**
0	04/08/2016	FIRST EMISSION	N.A.	

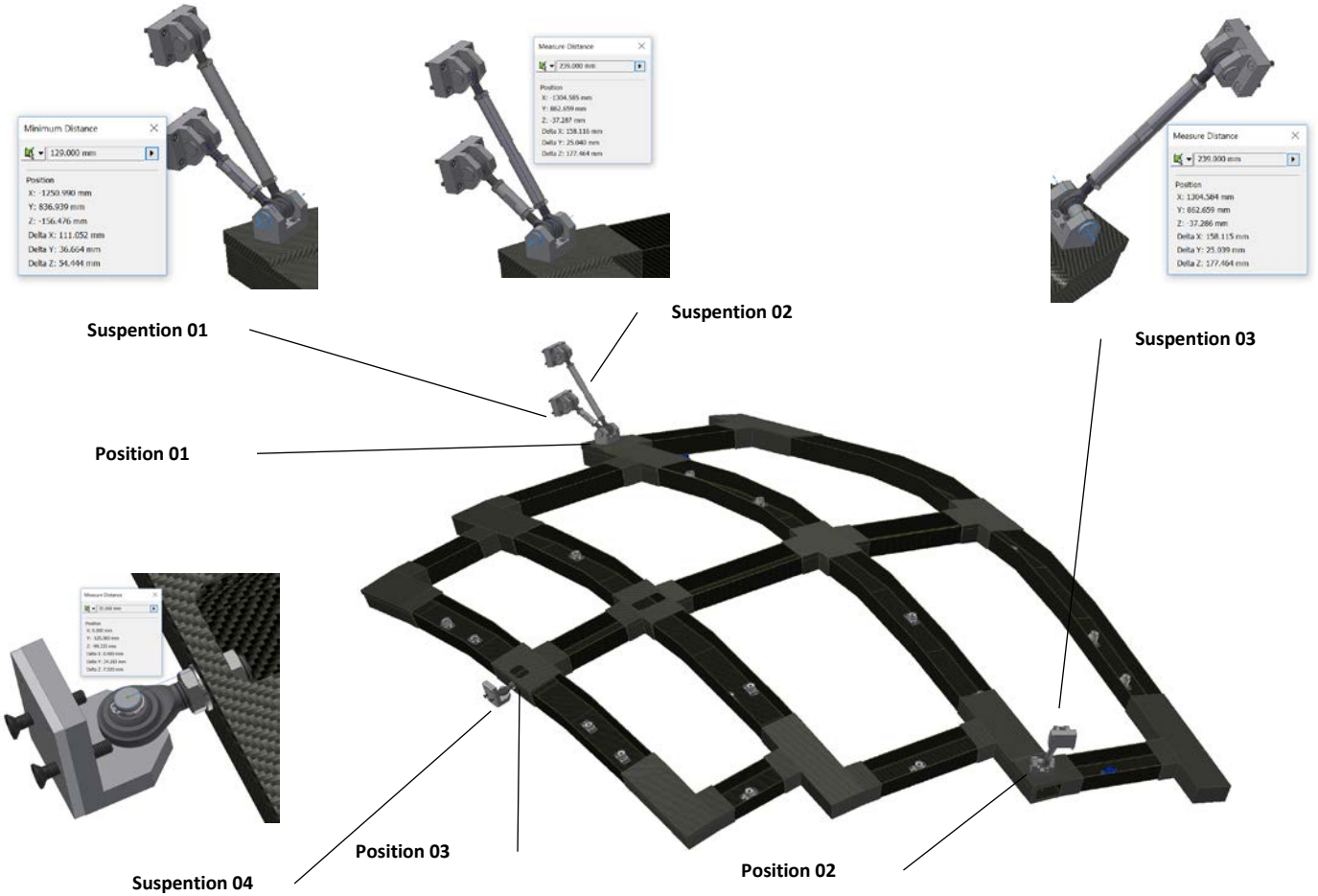
PHASE	**DESCRIPTION & NOTE**	**DRAWINGS**

When the CFRP frame is still in the wooden crate:

1. install the mirror suspentions to the CFRP frame as in the positions 1, 2, 3
2. Adjust the length of the suspentions to the theoretical values as in the side picture

The following hardware is required for the positions 1, 2:

- N. 08, ISO 4762 M5 x 25, Bolts M5
- N. 8, ISO 4032 M5, Nuts M5
- N. 8, ISO 7089 5, washers M5



PREPARED BY:	CHECKED BY:	APPROVED BY:
S. Tomassini	S. Tomassini	

		CFRP FRAME-SPH MIRRORS-LATERAL MIRRORS-ASSEMBLY INTO THE RICH SHELL		**Mod. 75/95/00**
		P/N: RICH-001-000	**DESCRIPTION: RICH SPHERICAL & PLANAR MIRROR**	SHEET: 3/14
REV.	**DATE**	**REVISION**	**MODIFIED PHASE**	**SIGNATURE**
0	04/08/2016	FIRST EMISSION	N.A.	

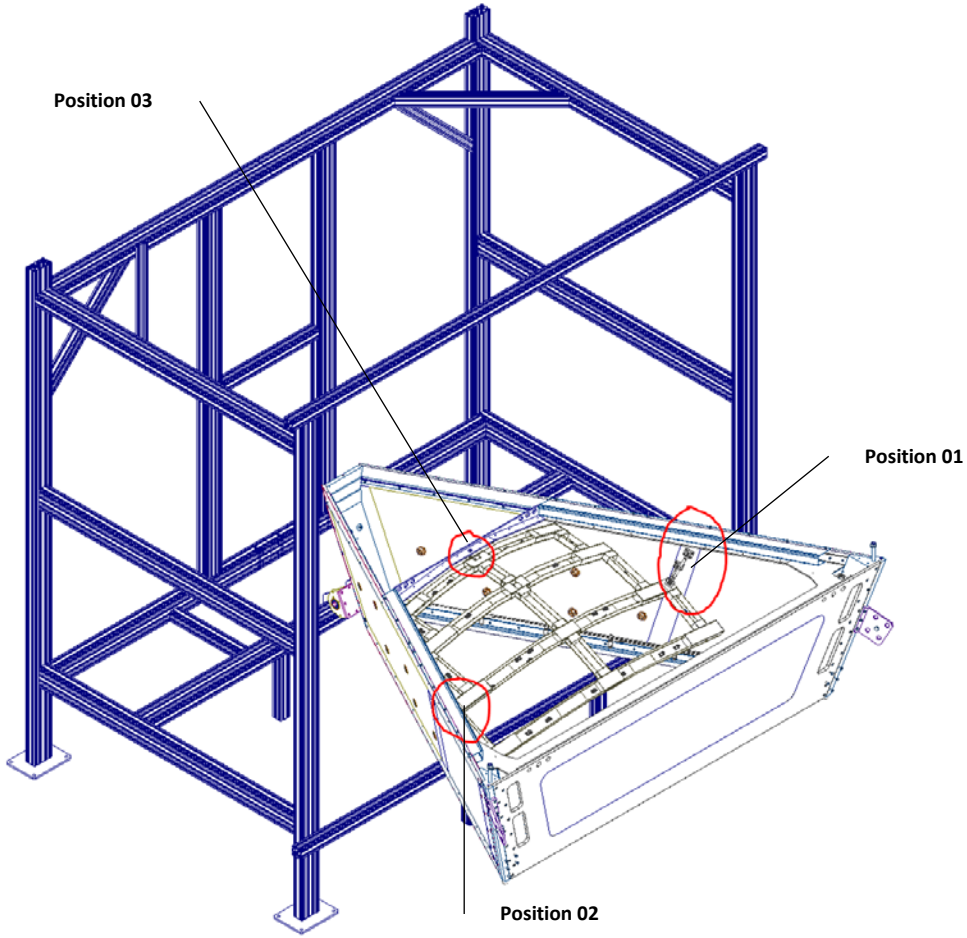
PHASE	**DESCRIPTION & NOTE**	**DRAWINGS**

Take the CFRP frame into the RICH shell by hand sice the total weight is under 20 kg and fasten the suspentions into the three red circles to the RICH shell.

Three people are recommended to perform this task.

The following hardware is required:

- N. 12 M6x25, positions 1,2
- N. 4 special bolts M6x35, positions 3
- N. 4 washers M6, positions 3
- N.4 Nuts M6, positions 3



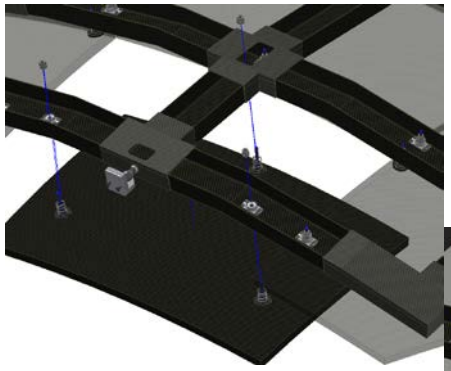
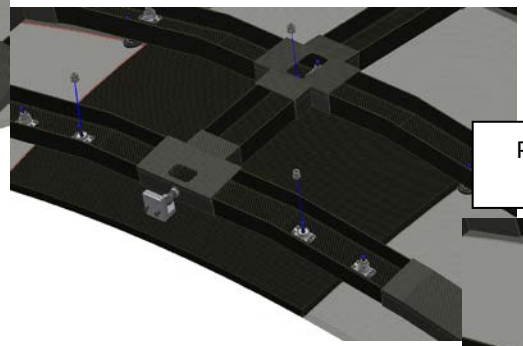
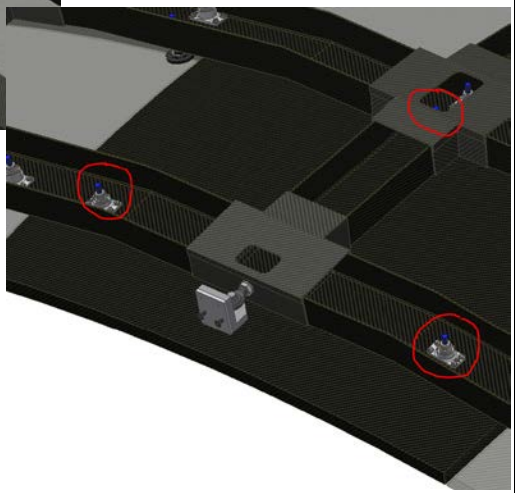
PREPARED BY:	CHECKED BY:	APPROVED BY:
S. Tomassini	S. Tomassini	

CFRP FRAME-SPH MIRRORS-LATERAL MIRRORS-ASSEMBLY INTO THE RICH SHELL

Mod. 75/95/00

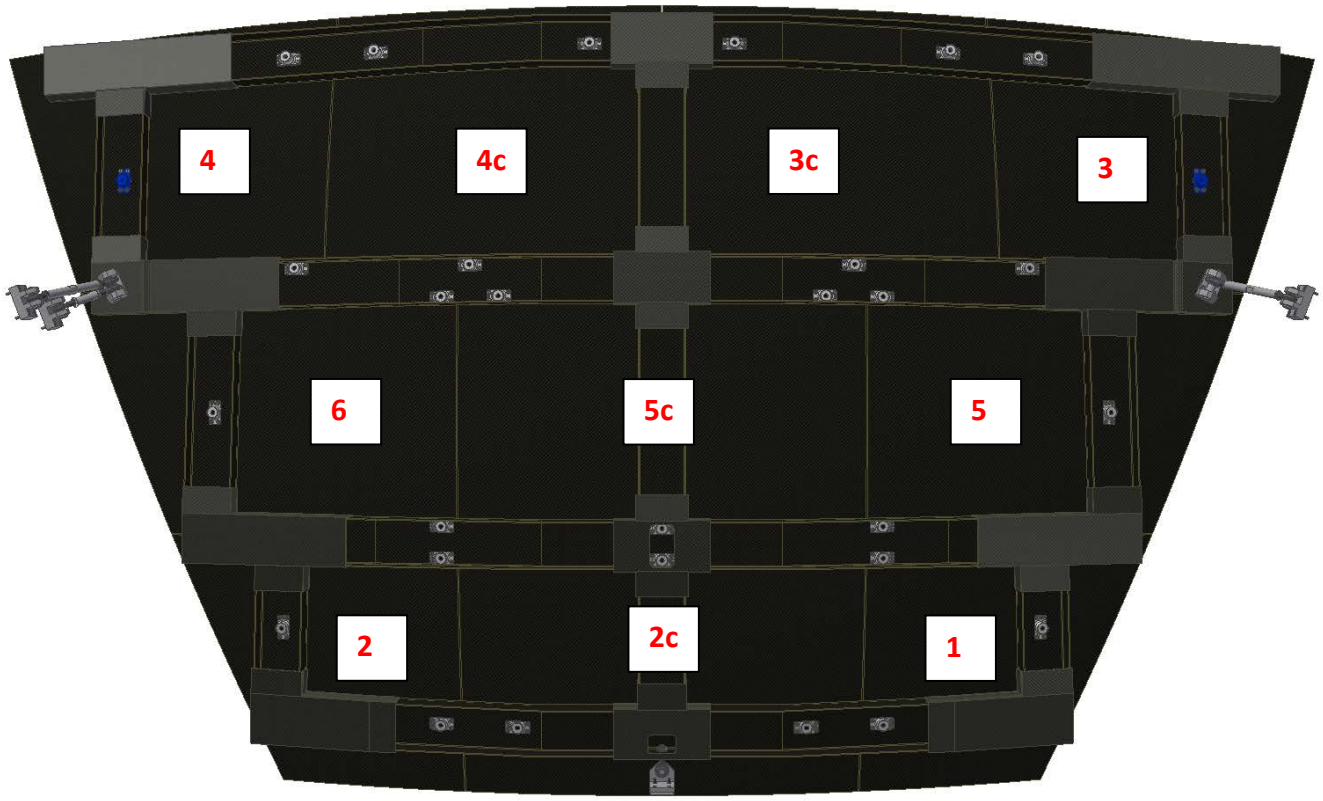
P/N: RICH-001-000 | **DESCRIPTION: RICH SPHERICAL & PLANAR MIRROR** | SHEET: 4/14

REV.	DATE	REVISION	MODIFIED PHASE	SIGNATURE
0	04/08/2016	FIRST EMISSION	N.A.	

PHASE	DESCRIPTION & NOTE	DRAWINGS
NOTES	**RECOMMENDED INSTALLATION SEQUENCE:** 1. MIRROR 02 CENTRAL 2. MIRROR 02 3. MIRROR 01 4. MIRROR 05 CENTRAL 5. MIRROR 06 6. MIRROR 05 7. MIRROR 04 CENTRAL 8. MIRROR 03 CENTRAL 9. MIRROR 04 10. MIRROR 03	INSTALL MIRROR 02 CENTRAL FIRST:  PUSH THE MIRROR MOUNTS INTO THE CAPS  PLACE THE SPHERICAL WASHERS AND NUTS 

PREPARED BY:	CHECKED BY:	APPROVED BY:
S. Tomassini	S. Tomassini	

		CFRP FRAME-SPH MIRRORS-LATERAL MIRRORS-ASSEMBLY INTO THE RICH SHELL		**Mod. 75/95/00**
		P/N: RICH-001-000	**DESCRIPTION: RICH SPHERICAL & PLANAR MIRROR**	SHEET: 5/14
REV.	**DATE**	**REVISION**	**MODIFIED PHASE**	**SIGNATURE**
0	04/08/2016	FIRST EMISSION	N.A.	

PHASE	**DESCRIPTION & NOTE**	**DRAWINGS**
	MIRROR MAP SEEN FROM THE DOWNSTREAM SIDE (EXIT PANEL)	

PREPARED BY:	CHECKED BY:	APPROVED BY:
S. Tomassini	S. Tomassini	

CFRP FRAME-SPH MIRRORS-LATERAL MIRRORS-ASSEMBLY INTO THE RICH SHELL

Mod. 75/95/00

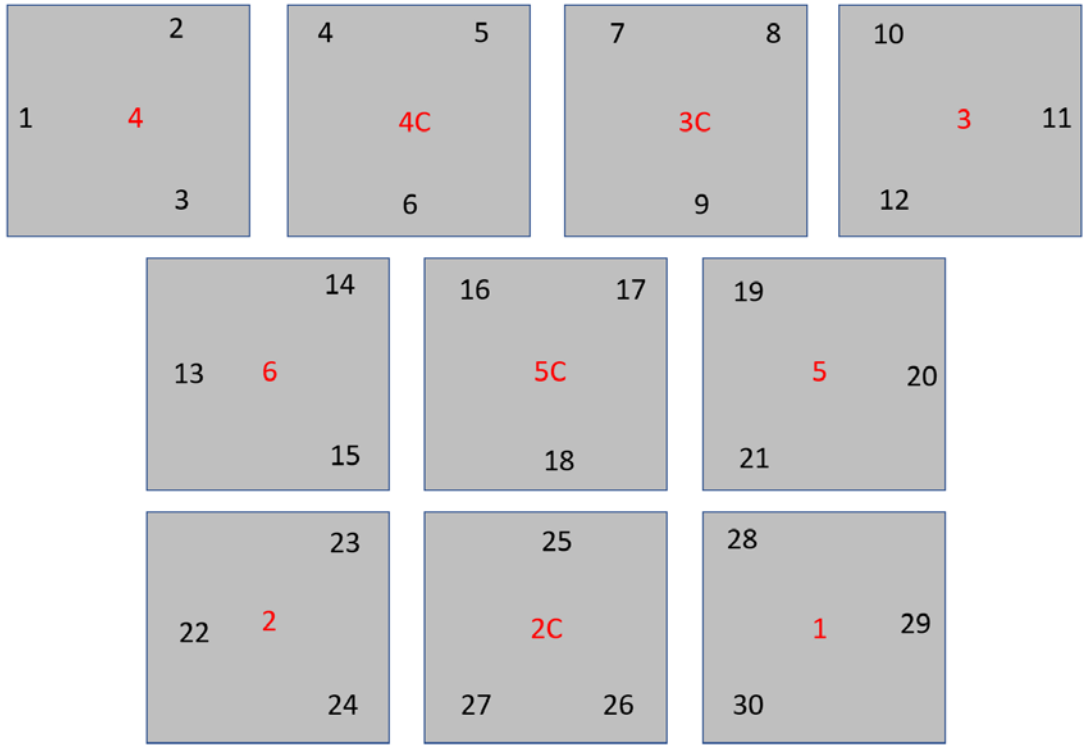
P/N: RICH-001-000 | **DESCRIPTION: RICH SPHERICAL & PLANAR MIRROR** | SHEET: 6/14

REV.	DATE	REVISION	MODIFIED PHASE	SIGNATURE
0	04/08/2016	FIRST EMISSION	N.A.	

PHASE	DESCRIPTION & NOTE	DRAWINGS

PRE ALIGNMENT MIRROR MOUNT MAPS.

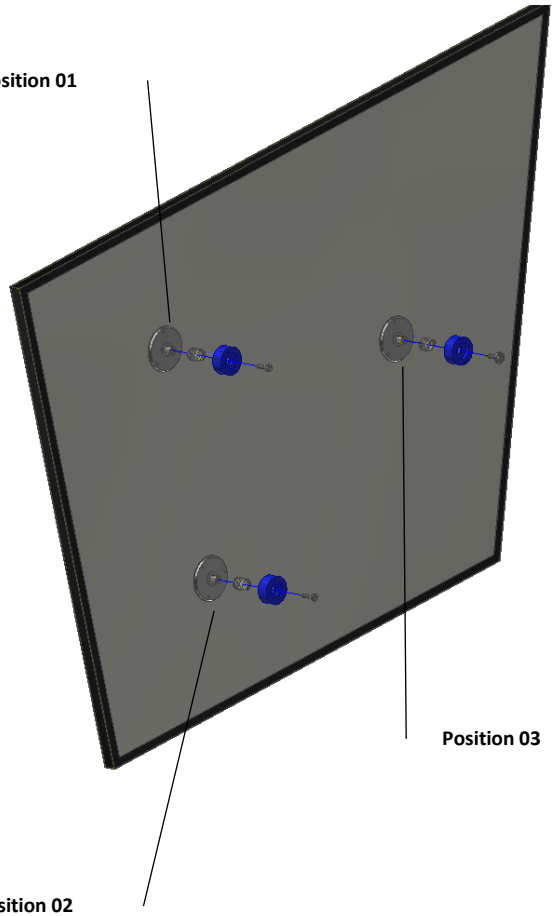
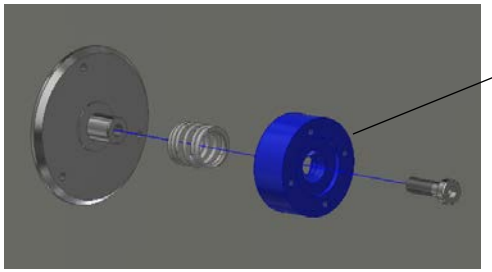
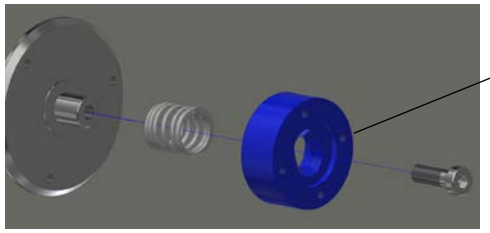
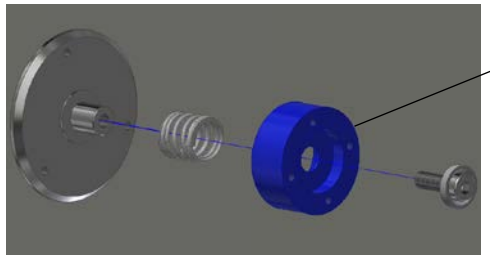
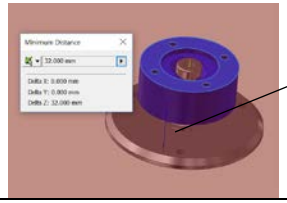
WARNING: The side table will not apply tout court to the mirrors 3 and 4 because of the failure of the mount threted rod during the shipment.



Mirror Number	Mount Number	Thread Height (mm)
4	1	4.75
	2	20.96
	3	7.28
4C	4	11.86
	5	18.23
	6	10.6
3C	7	20.09
	8	13.66
	9	7.32
3	10	22.64
	11	5.26
	12	4.34
6	13	5.9
	14	10.55
	15	10.01
5C	16	7.69
	17	5.41
	18	10.06
5	19	6.42
	20	5.27
	21	10.35
2	22	8.21
	23	10.09
	24	8.7
2C	25	6.83
	26	8.72
	27	9.82
1	28	7.53
	29	8.3
	30	7.03

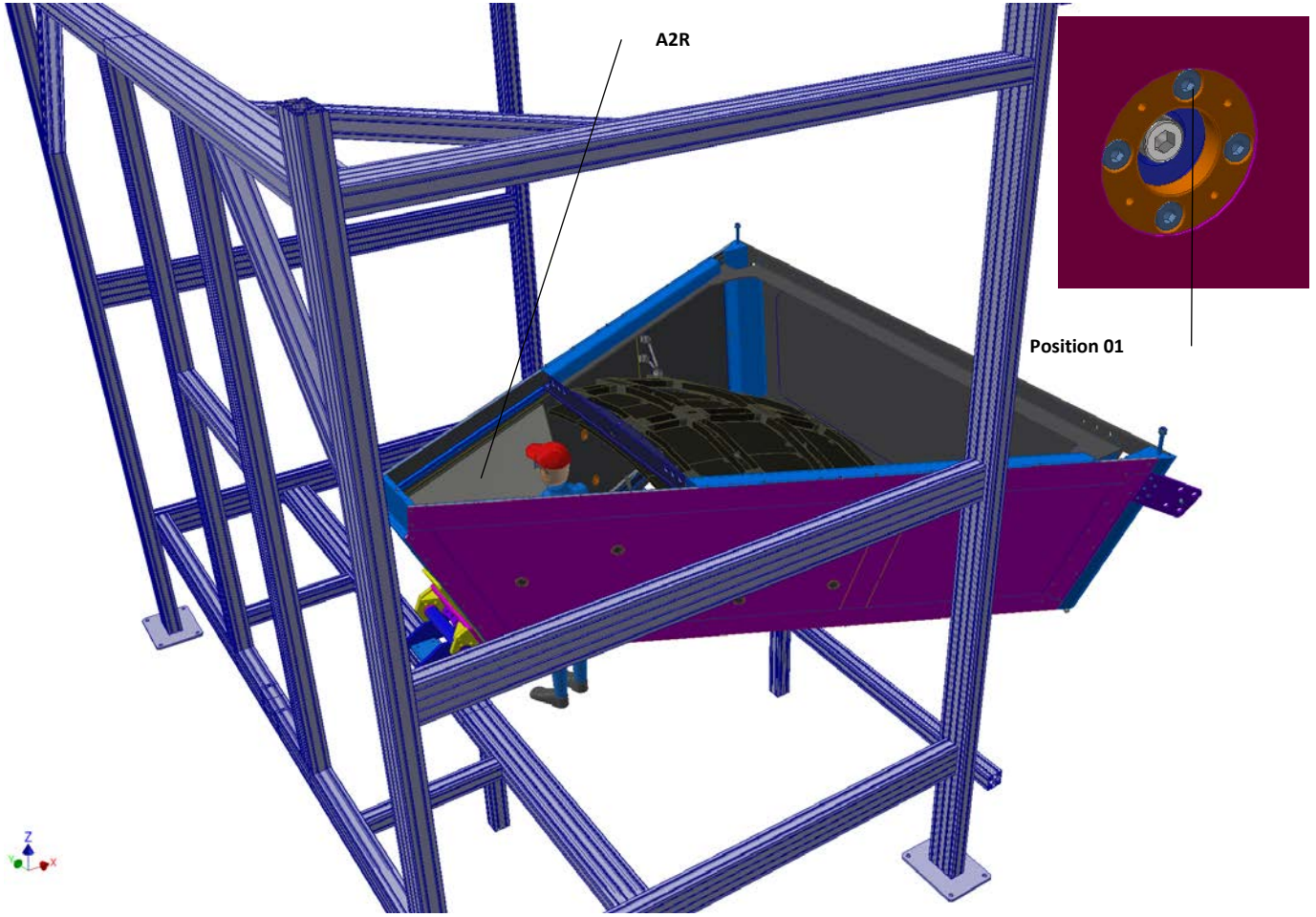
PREPARED BY:	CHECKED BY:	APPROVED BY:
S. Tomassini	S. Tomassini	

	CFRP FRAME-SPH MIRRORS-LATERAL MIRRORS-ASSEMBLY INTO THE RICH SHELL			**Mod. 75/95/00**
	P/N: RICH-001-000		**DESCRIPTION: RICH SPHERICAL & PLANAR MIRROR**	SHEET: 7/14
REV.	**DATE**	**REVISION**	**MODIFIED PHASE**	**SIGNATURE**
0	04/08/2016	FIRST EMISSION	N.A.	

PHASE	**DESCRIPTION & NOTE**	**DRAWINGS**
	Prepare the mirror A2R	    

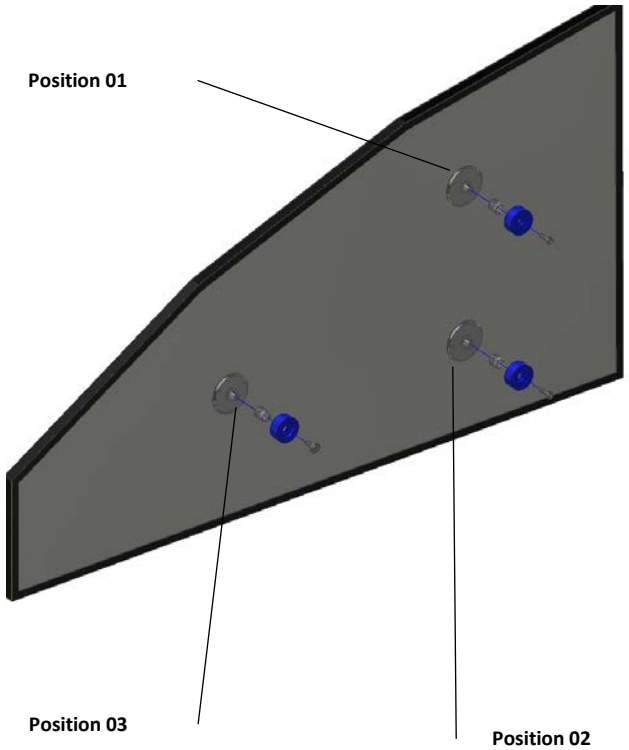
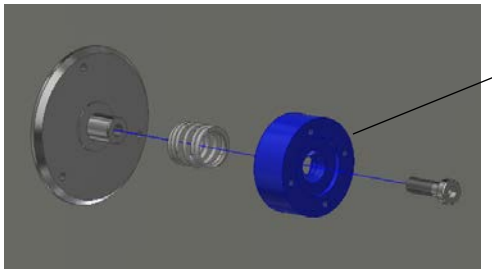
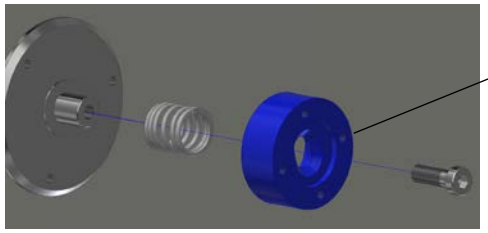
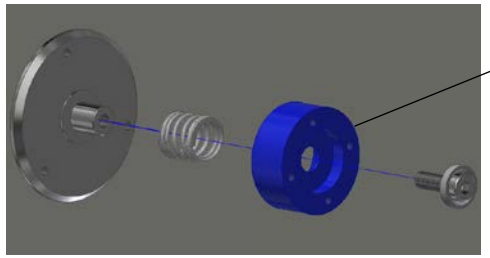
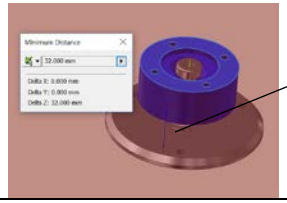
PREPARED BY:	CHECKED BY:	APPROVED BY:
S. Tomassini	S. Tomassini	

		CFRP FRAME-SPH MIRRORS-LATERAL MIRRORS-ASSEMBLY INTO THE RICH SHELL		**Mod. 75/95/00**
		P/N: RICH-001-000	**DESCRIPTION: RICH SPHERICAL & PLANAR MIRROR**	SHEET: 8/14
REV.	**DATE**	**REVISION**	**MODIFIED PHASE**	**SIGNATURE**
0	04/08/2016	FIRST EMISSION	N.A.	

PHASE	**DESCRIPTION & NOTE**	**DRAWINGS**
	INSTALL MIRROR A2R Three people are recommended to perform this task. The following hardware is required: • N. 12 M5x10, positions 1	

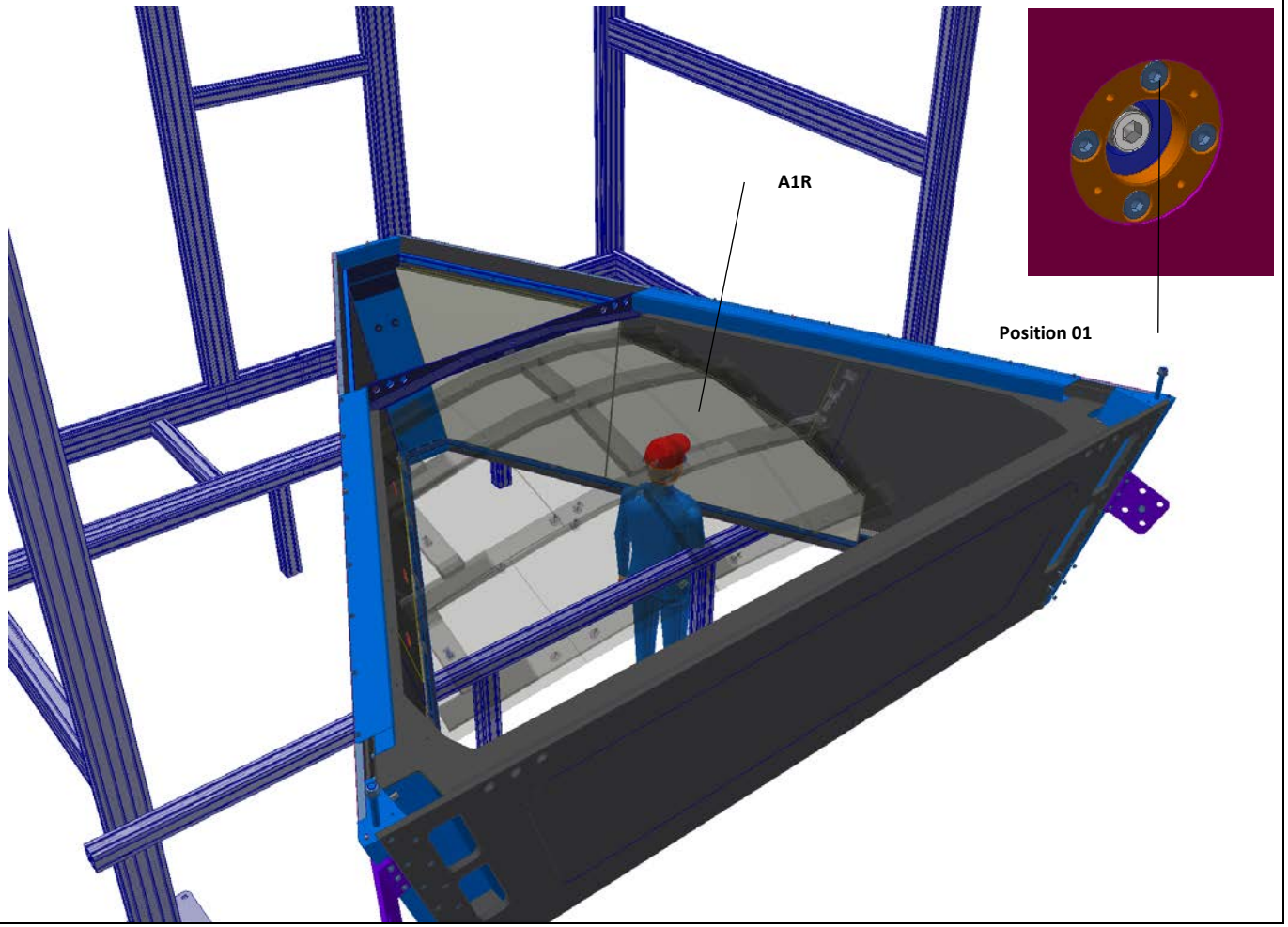
PREPARED BY:	CHECKED BY:	APPROVED BY:
S. Tomassini	S. Tomassini	

	CFRP FRAME-SPH MIRRORS-LATERAL MIRRORS-ASSEMBLY INTO THE RICH SHELL			**Mod. 75/95/00**
	P/N: RICH-001-000		**DESCRIPTION: RICH SPHERICAL & PLANAR MIRROR**	SHEET: 9/14
REV.	**DATE**	**REVISION**	**MODIFIED PHASE**	**SIGNATURE**
0	04/08/2016	FIRST EMISSION	N.A.	

PHASE	**DESCRIPTION & NOTE**	**DRAWINGS**
	Prepare the mirror A1R	  Position 01 Cone  Position 02 Slot  Position 03 Plane  Set the height to 32 mm

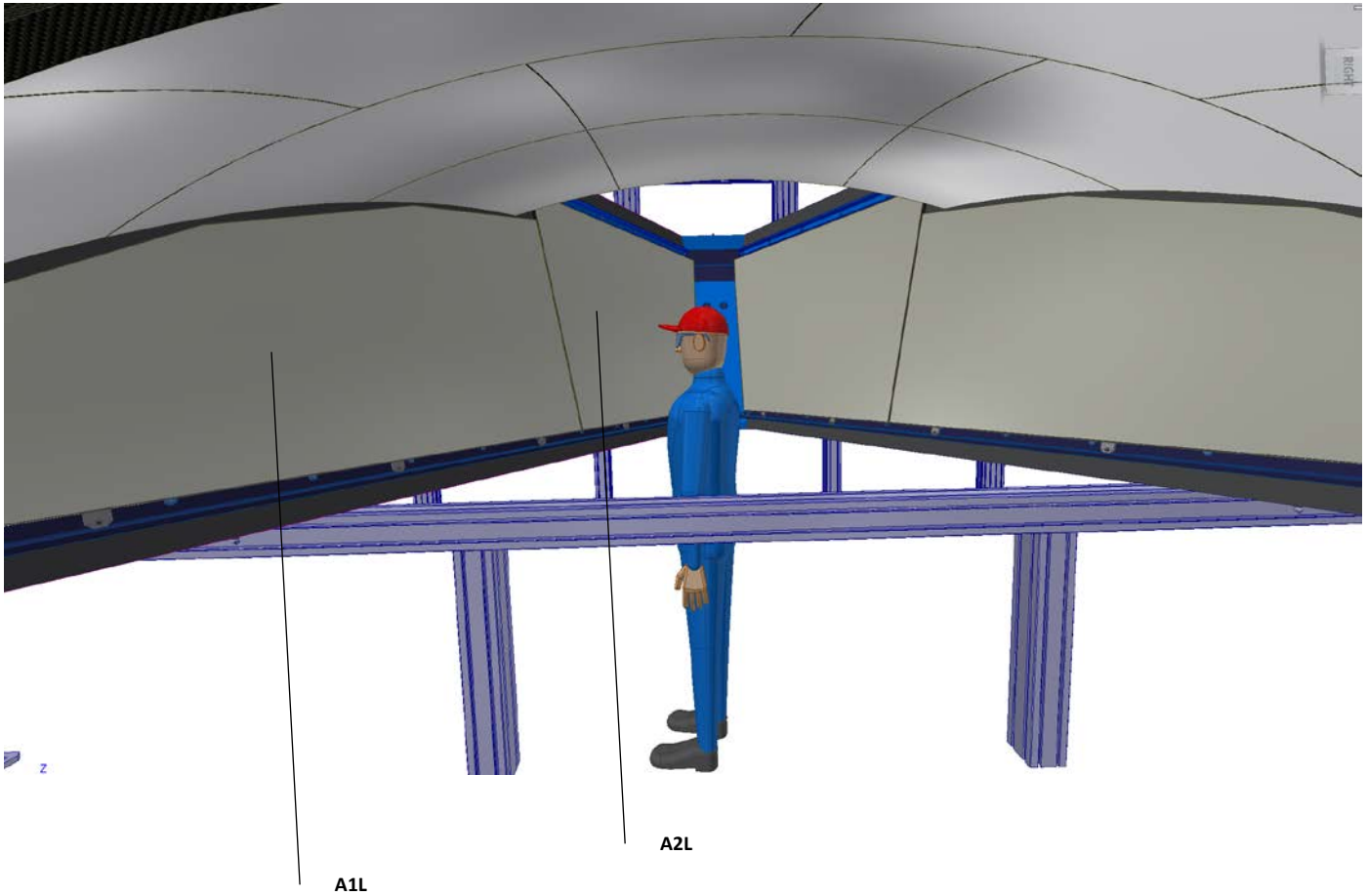
PREPARED BY:	CHECKED BY:	APPROVED BY:
S. Tomassini	S. Tomassini	

		CFRP FRAME-SPH MIRRORS-LATERAL MIRRORS-ASSEMBLY INTO THE RICH SHELL		**Mod. 75/95/00**
		P/N: RICH-001-000	**DESCRIPTION: RICH SPHERICAL & PLANAR MIRROR**	SHEET: 10/14
REV.	**DATE**	**REVISION**	**MODIFIED PHASE**	**SIGNATURE**
0	04/08/2016	FIRST EMISSION	N.A.	

PHASE	**DESCRIPTION & NOTE**	**DRAWINGS**
	INSTALL MIRROR A1R Three people are recommended to perform this task. The following hardware is required: • N. 12 M5x10, positions 1	

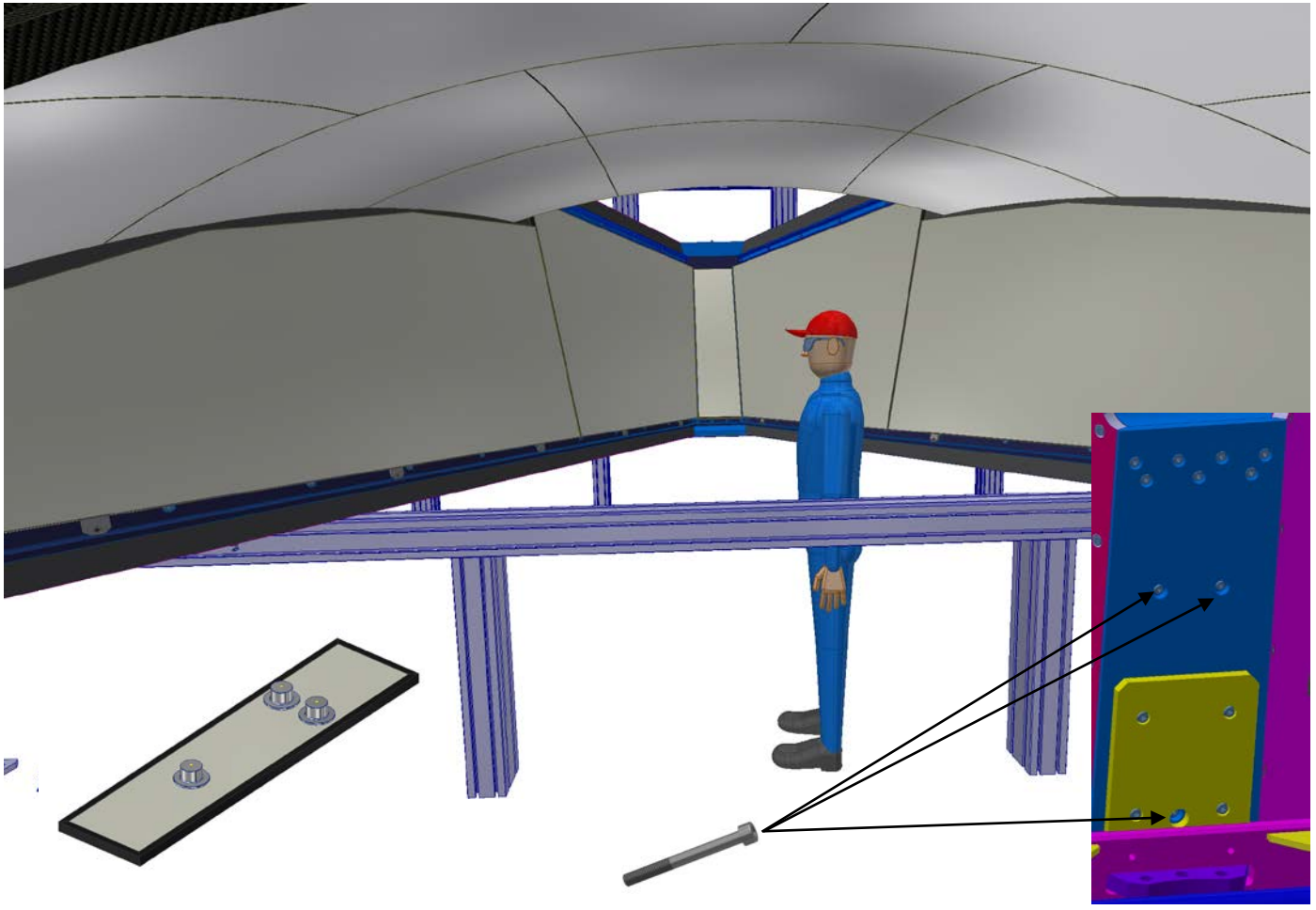
PREPARED BY:	CHECKED BY:	APPROVED BY:
S. Tomassini	S. Tomassini	

		CFRP FRAME-SPH MIRRORS-LATERAL MIRRORS-ASSEMBLY INTO THE RICH SHELL		**Mod. 75/95/00**
		P/N: RICH-001-000	**DESCRIPTION: RICH SPHERICAL & PLANAR MIRROR**	SHEET: 11/14
REV.	**DATE**	**REVISION**	**MODIFIED PHASE**	**SIGNATURE**
0	04/08/2016	FIRST EMISSION	N.A.	

PHASE	**DESCRIPTION & NOTE**	**DRAWINGS**
	Repeat the previous tasks for the installation of mirrors A2L and A1L on the Left side.	

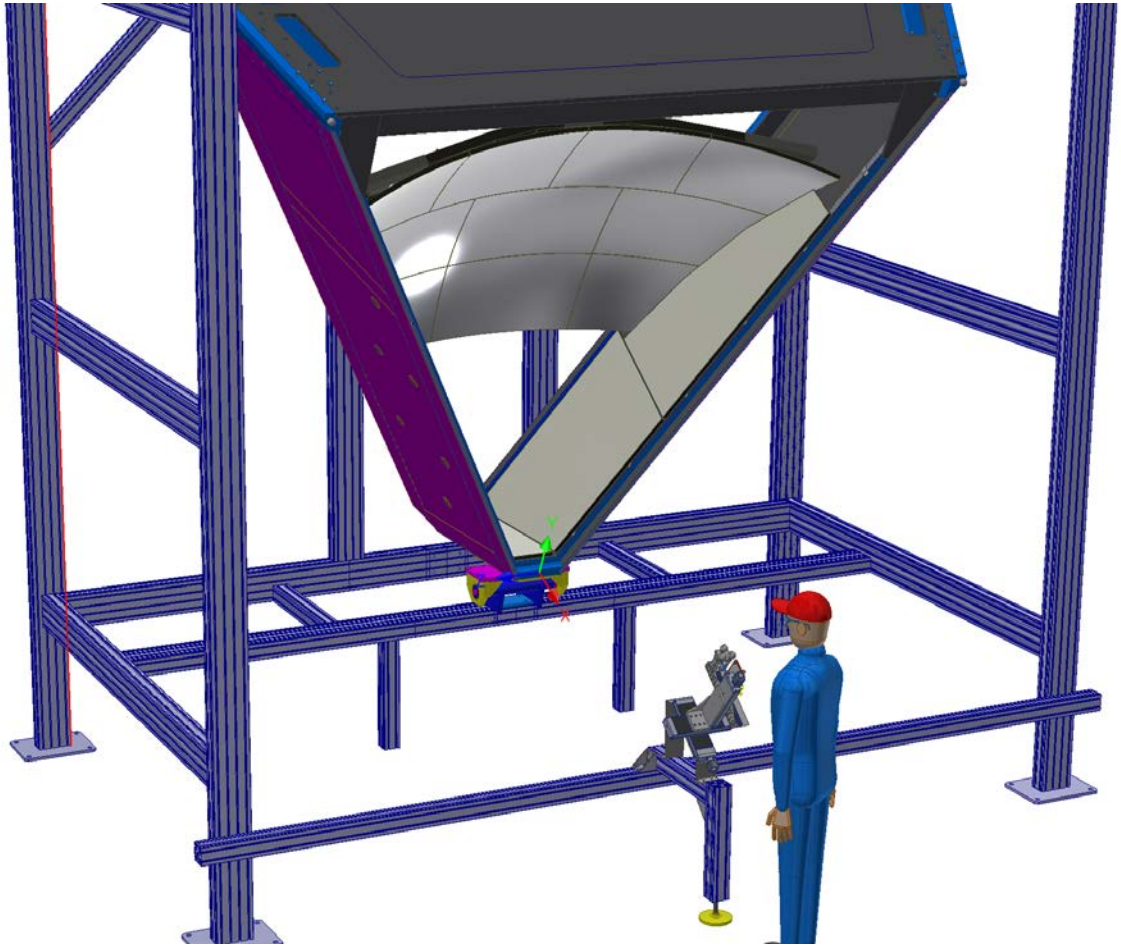
PREPARED BY:	CHECKED BY:	APPROVED BY:
S. Tomassini	S. Tomassini	

		CFRP FRAME-SPH MIRRORS-LATERAL MIRRORS-ASSEMBLY INTO THE RICH SHELL		**Mod. 75/95/00**
		P/N: RICH-001-000	**DESCRIPTION: RICH SPHERICAL & PLANAR MIRROR**	SHEET: 12/14
REV.	**DATE**	**REVISION**	**MODIFIED PHASE**	**SIGNATURE**
0	04/08/2016	FIRST EMISSION	N.A.	

PHASE	**DESCRIPTION & NOTE**	**DRAWINGS**
	Install the Bottom Mirror: Two people are recommended to perform this task. The following hardware is required: • N. 3 ISO 4762 M6x60 • N. 3 washers 6 mm **Note: this mirror has no adjusters.**	

PREPARED BY:	CHECKED BY:	APPROVED BY:
S. Tomassini	S. Tomassini	

	CFRP FRAME-SPH MIRRORS-LATERAL MIRRORS-ASSEMBLY INTO THE RICH SHELL			**Mod. 75/95/00**
	P/N: RICH-001-000		**DESCRIPTION: RICH SPHERICAL & PLANAR MIRROR**	SHEET: 13/14
REV.	**DATE**	**REVISION**	**MODIFIED PHASE**	**SIGNATURE**
0	04/08/2016	FIRST EMISSION	N.A.	

PHASE	**DESCRIPTION & NOTE**	**DRAWINGS**
	SPH MIRROR ALIGNMENT: **1. Survey the RICH module with a Lase Tracker and create the reference system as in the picture.**	

PREPARED BY:	CHECKED BY:	APPROVED BY:
S. Tomassini	S. Tomassini	

CFRP FRAME-SPH MIRRORS-LATERAL MIRRORS-ASSEMBLY INTO THE RICH SHELL

Mod. 75/95/00

P/N: RICH-001-000 | **DESCRIPTION: RICH SPHERICAL & PLANAR MIRROR** | SHEET: 14/14

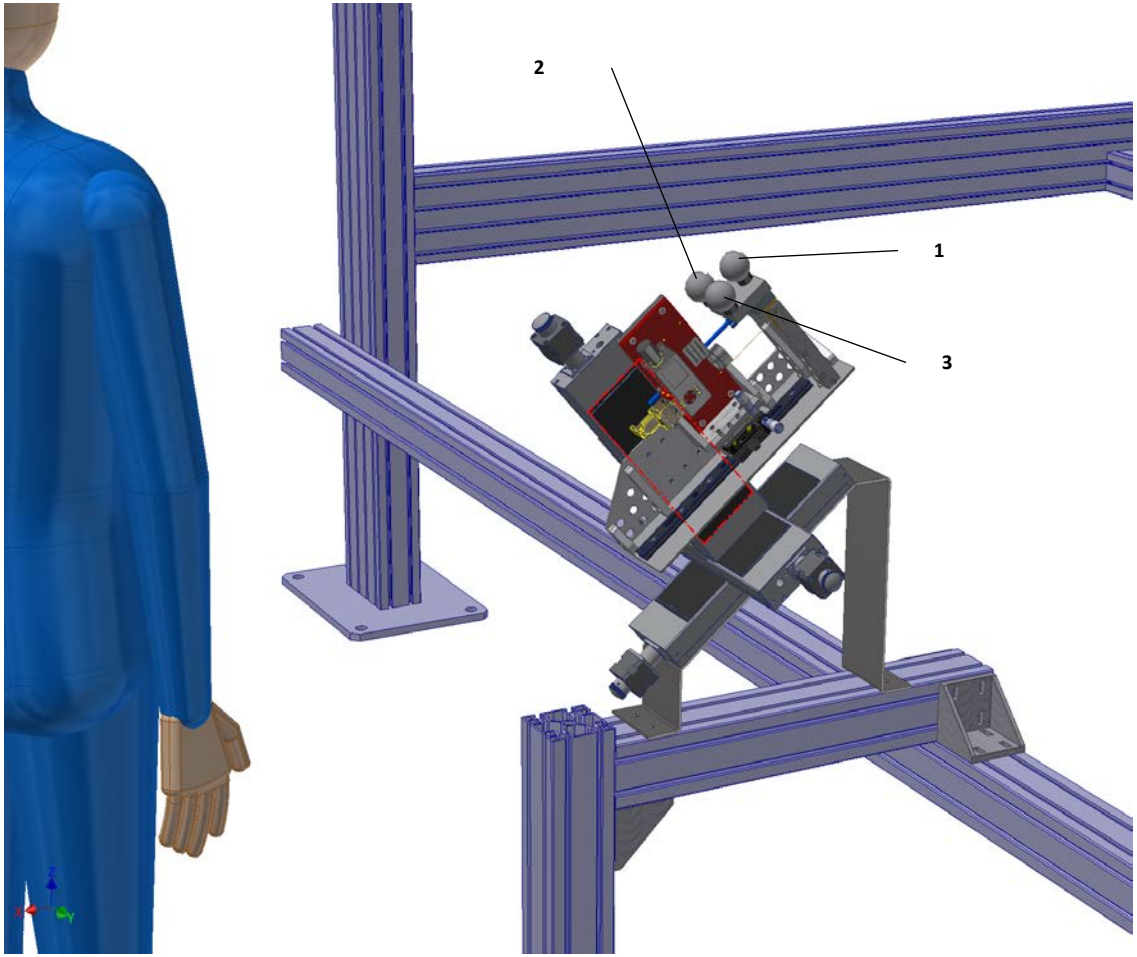
REV.	DATE	REVISION	MODIFIED PHASE	SIGNATURE
0	04/08/2016	FIRST EMISSION	N.A.	

PHASE	DESCRIPTION & NOTE	DRAWINGS

SPH MIRROR ALIGNMENT:

1. **Install the alignment tool and level the base beam**
2. **Adjust the position in order to match the following coordinates of the three CCR:**

	X	Y	Z
1	1719.002	1004.773	0
2	1760.828	993.566	25.000
3	1760.828	993.566	-25.000



PREPARED BY:	CHECKED BY:	APPROVED BY:
S. Tomassini	S. Tomassini	

RICH Exit Window Assembly

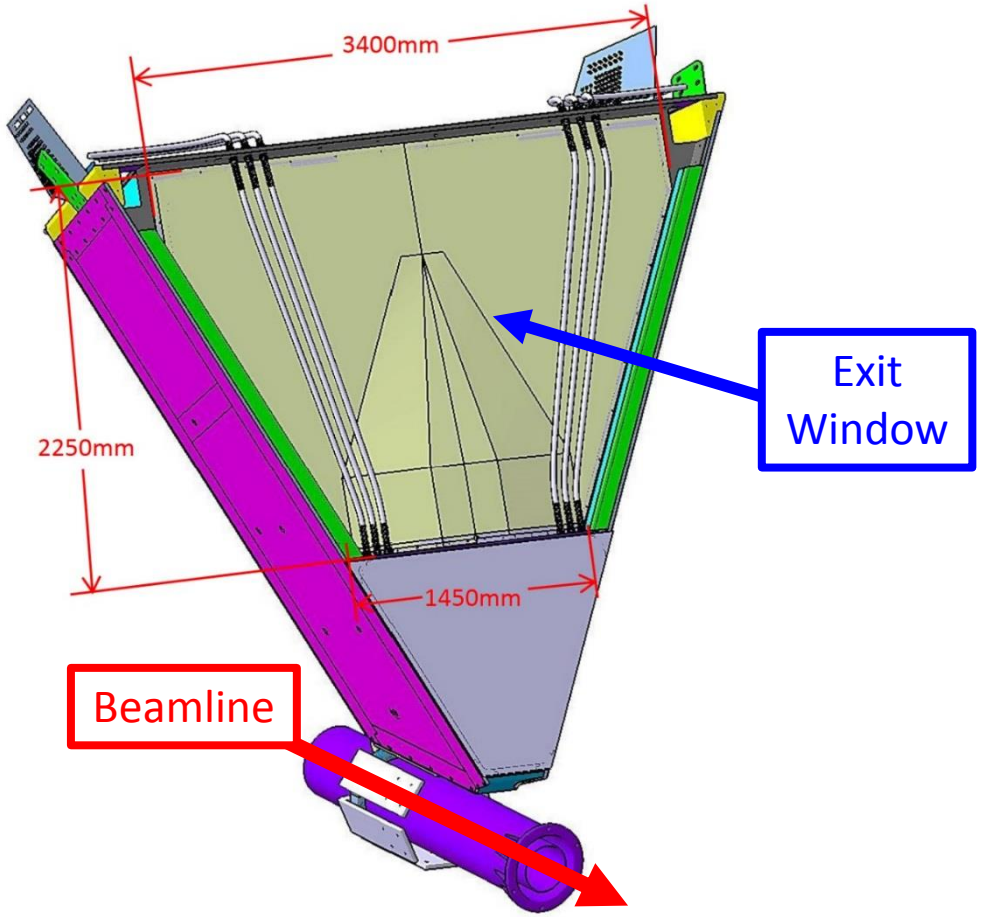
Tyler Lemon

Detector Support Group

May 31, 2017

Ring Imaging Cherenkov Exit Window

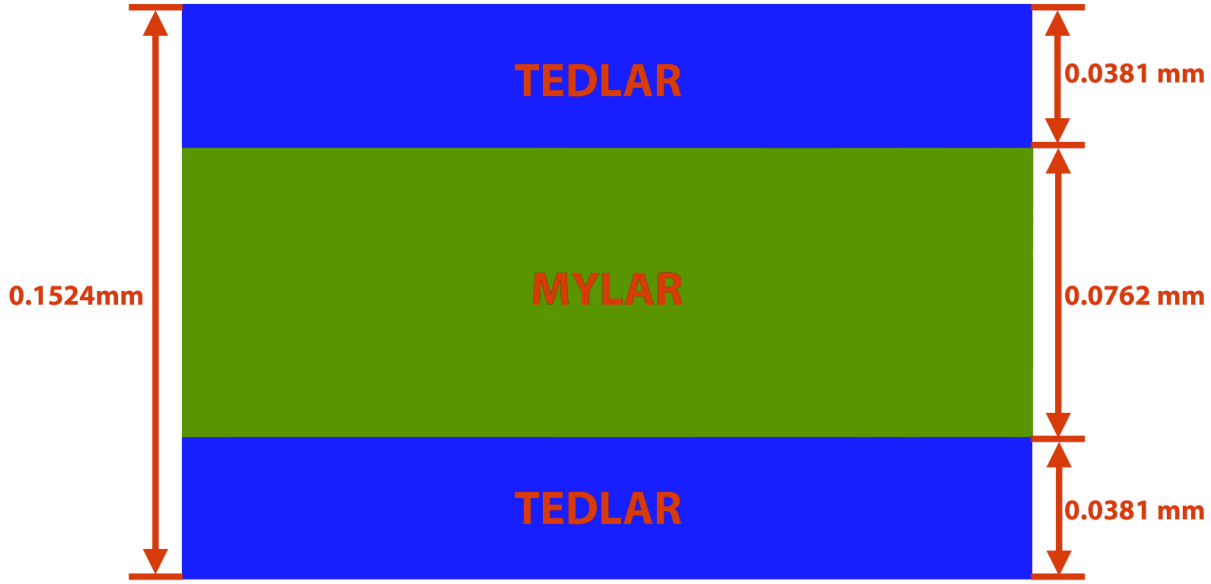
- Seals back of RICH shell.
- Mylar/Tedlar sheet glued to aluminum frame.



Back view of RICH model.

Exit Window

- Mylar sandwiched between two Tedlar layers.
  - ~ 0.15 mm thick in total
    - 0.0762 mm of Mylar
    - Two 0.0381 mm layers of Tedlar
- Mylar
  - Biaxially-oriented polyethylene terephthalate
  - Helps create a gas-tight barrier
- Tedlar
  - Polyvinyl fluoride (PVF)
  - Remains tough and flexible over wide temperature range

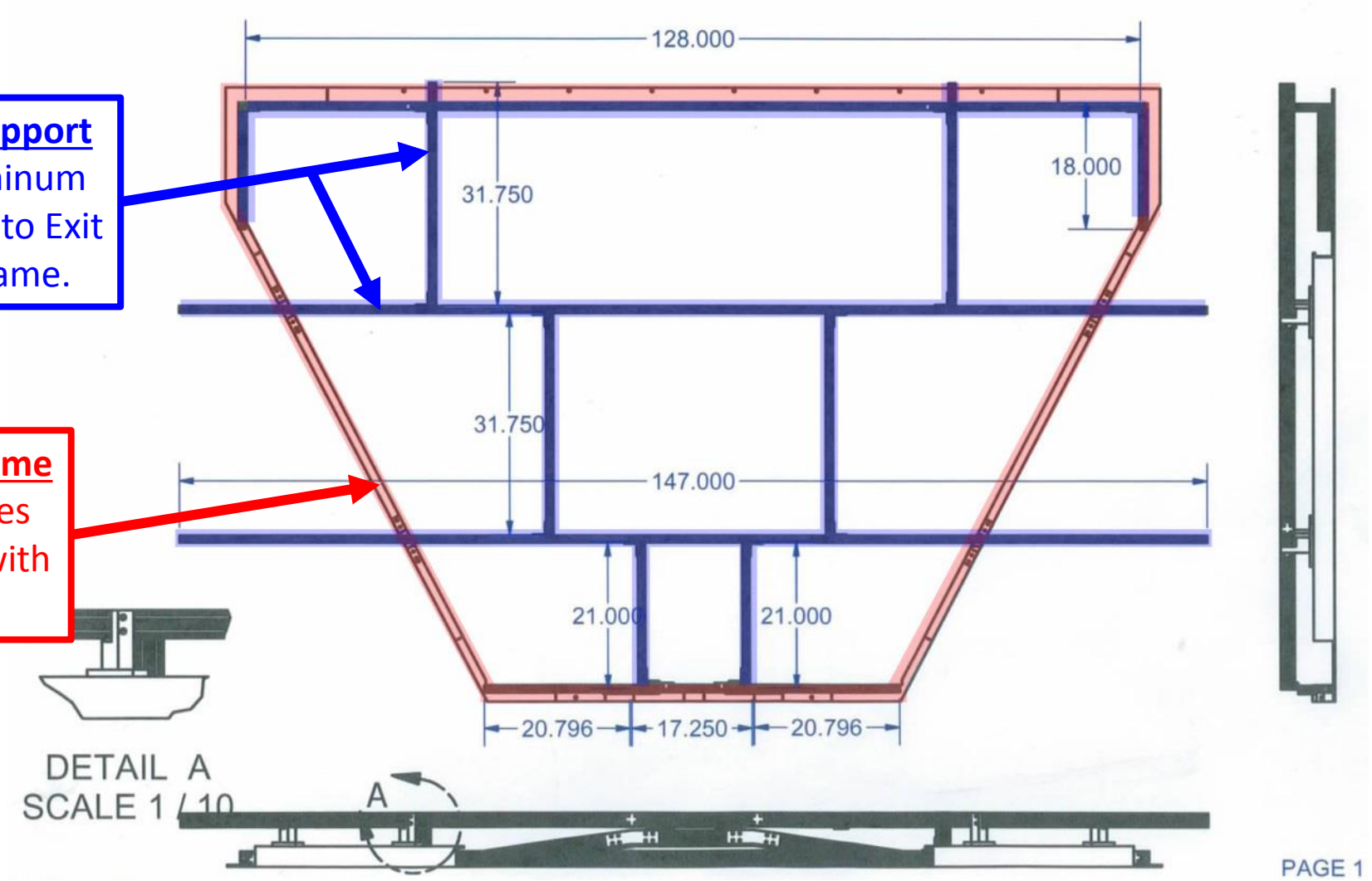


Cross section model of Mylar/Tedlar sheet.

Exit Window Frame and Assembly Support

Assembly Support
Slotted aluminum frame bolted to Exit Window Frame.

Exit Window Frame
Aluminum pieces glued together with Loctite.



Safety Concerns

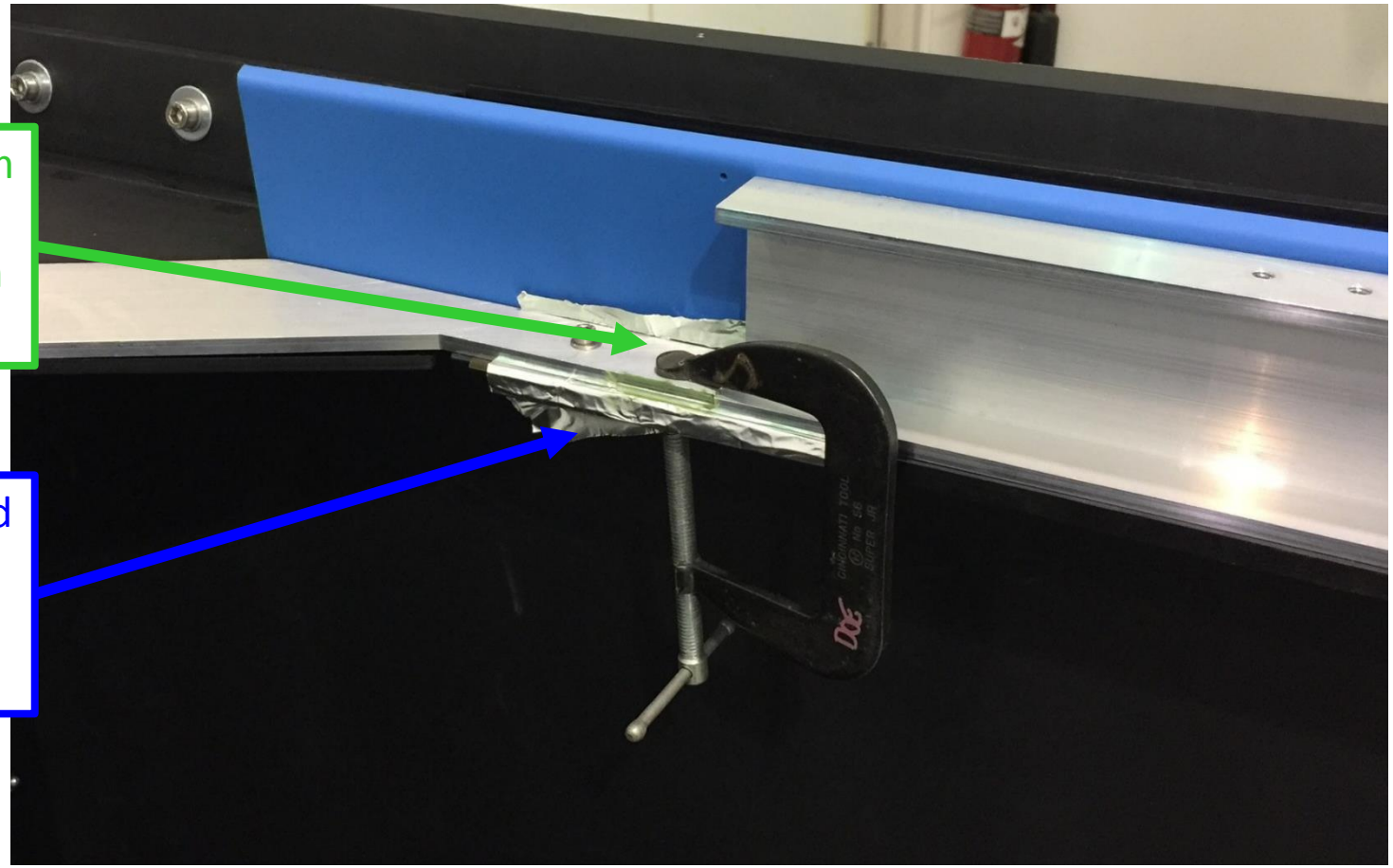
- Assembly required use of Loctite epoxy and G-Flex two-part epoxy.
  - Both are hazardous and flammable.
- Outgassing an issue with air-recirculation in cleanroom.
- Hazard mitigation used:
  - Personal protection equipment.
  - Ventilated EEL 124 by opening roll-up door to EEL 125 ~36 inches.
  - Limited working time to one hour before taking a break out of cleanroom.
  - Worked with adhesive in small batches.

Top: G-Flex epoxy in cans prior to mixing.
Bottom: Loctite epoxy in applicator tube with automatic mixing nozzle.

Assembly Process

1. Lay out aluminum frame on detector shell.
2. Glue aluminum frame together with Loctite epoxy.
3. Remove frame from detector shell.
4. Layout and cut Mylar/Tedlar sheet to size.
5. Glue Mylar/Tedlar sheet to frame with G-Flex epoxy.
6. Clamp Mylar/Tedlar sheet for curing.
7. Trim excess Mylar/Tedlar and cured glue from frame.

Exit Window Frame Assembly



Joint of Exit Window frame clamped for curing after applying Loctite.

Removing Frame from RICH Detector Shell

George Jacobs and Argonne Collaborators lifting assembled frame to place it on floor to glue Mylar/Tedlar sheet.

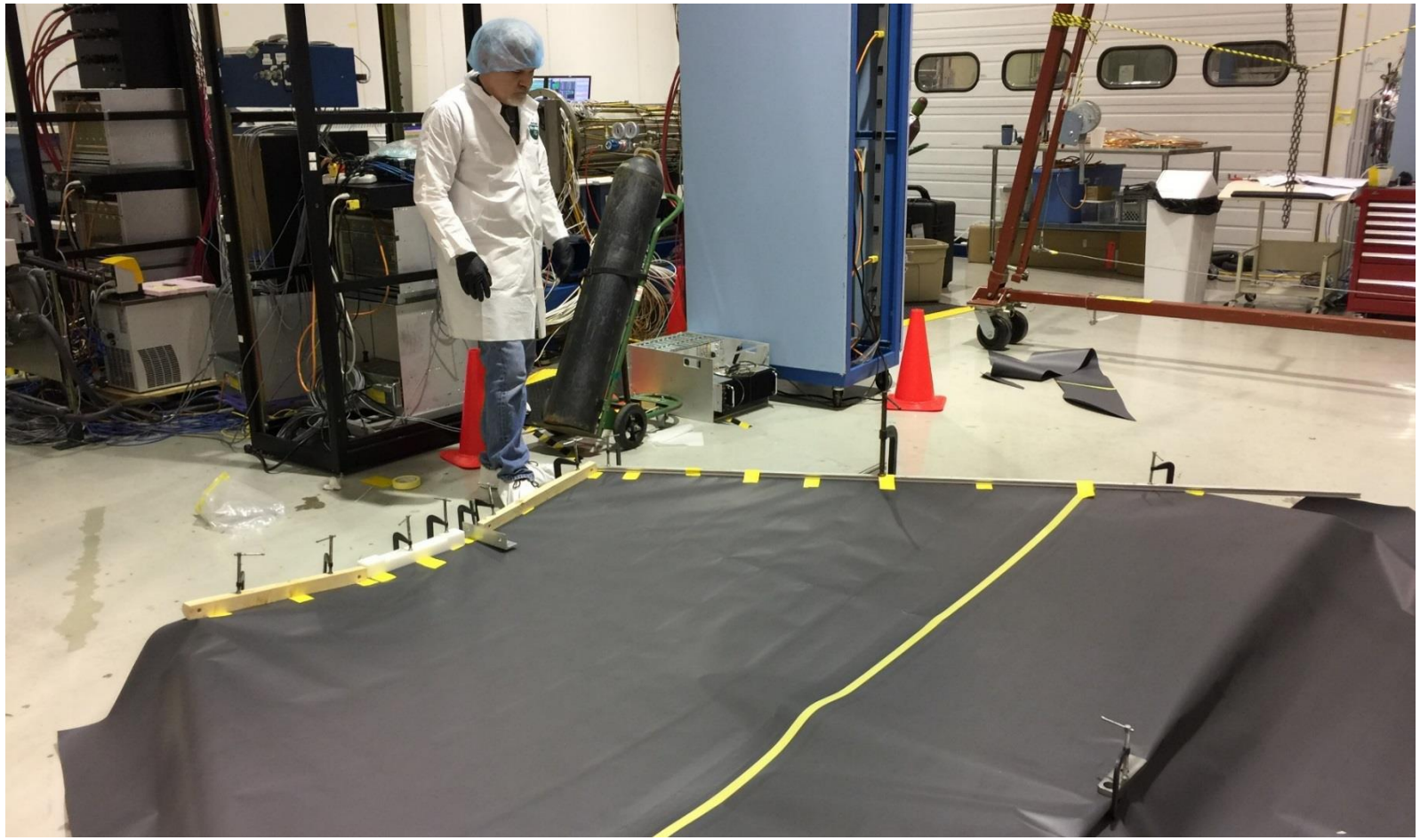
Removing Gantry Straps from Frame

DSG removing assembled Exit Window frame from gantry.

Rotating Frame to Rest on Assembly Support

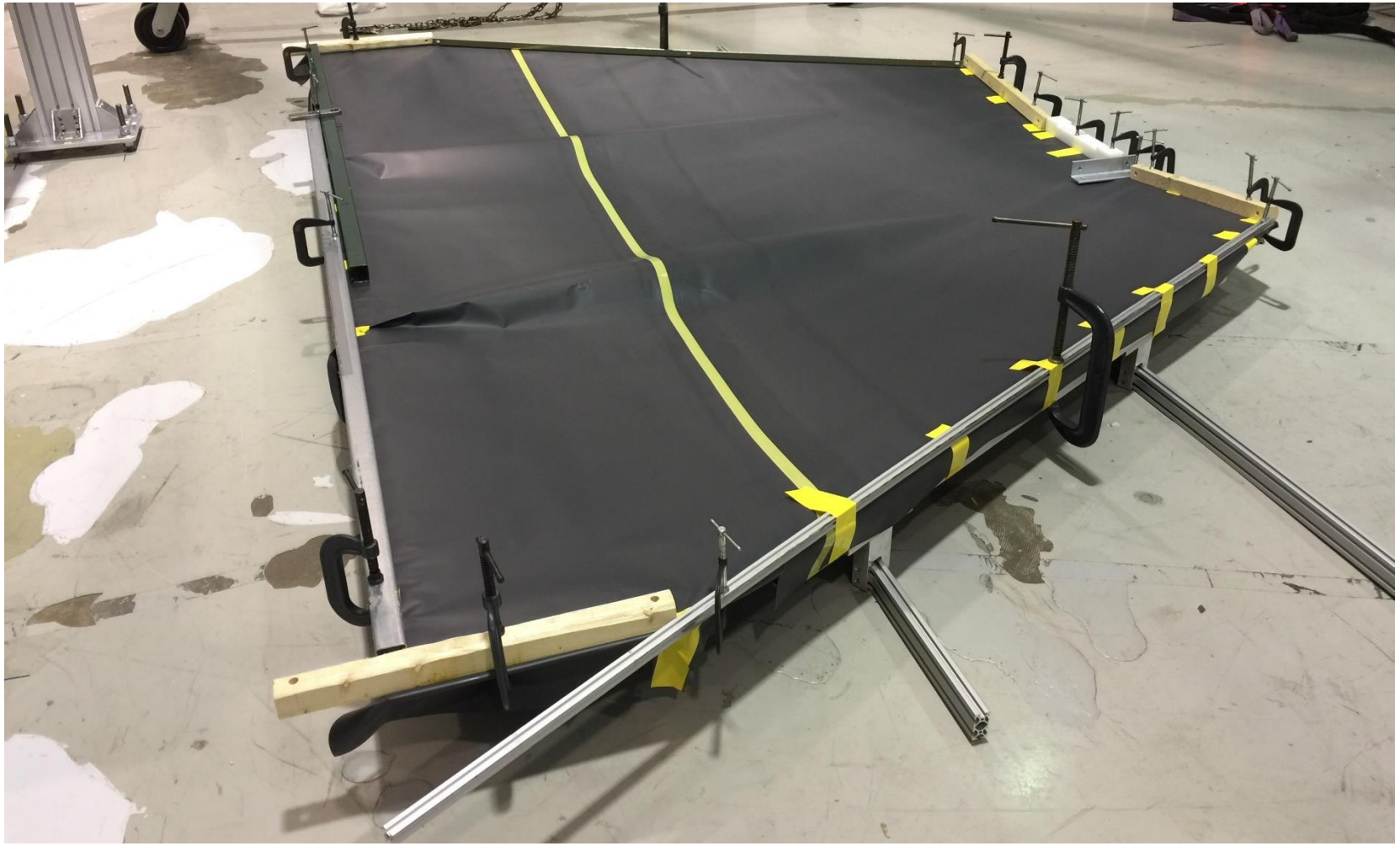
DSG and Argonne Collaborators flipping Exit Window frame to allow Mylar/Tedlar sheet to be glued to it.

Gluing Exit Window to Frame



Tom O'Connor, an Argonne Collaborator, clamping the freshly glued Mylar/Tedlar sheet to the Exit Window frame for curing.

Exit Window Clamped to Frame for Curing After Gluing



Complete Exit Window on RICH Detector Shell

Remaining Tasks

- Add foam gasket to detector shell for between RICH and Exit Window.
- Add additional sealant to improve gas seal.
- Fasten Exit Window to RICH using screws.
  - Longer M5 screws at least ~20 mm in length must be procured due to thickness added by foam gasket, epoxy, and Mylar/Tedlar.

Conclusion

- Contributions from DSG during all assembly steps.
- Appropriate steps taken to mitigate any safety hazards.
  - Ventilated EEL 124 by opening roll-up door to EEL 125 ~36 inches.
  - Limited exposure to fumes by limiting working time and limiting amount worked with at one time.
- Additional tasks required to improve gas seal.
- **Exit Window fully assembled.**

Thank You

Jefferson Lab
Thomas Jefferson National Accelerator Facility

Material Handling Lift Plan

(See ES&H Manual Chapter 6141 Appendix T4 Hoisting and Rigging Operations) for Instructions

Click For Word Doc

Instructions:

This form *must* be completed for each lift using a mobile crane, forklifts with suspended loads or a critical lift, with an overhead crane or forklift. This form should be used for a non-routine lift with overhead cranes or incorporated into a Temporary Operational Safety Procedure.

STEP 1 – Planning the Lift

Lift Title:	**Rich Detector Clean room DRAFT**
Location:	EEL clean room 125
Lift Date (s):	TBD
Lift Plan Prepared by:	Print: Marc McMullen Phone #: Date:
JLab Approved by:	Print: Mark Loewus Phone #: 757-871-3072 Date: 17 Nov 2021
JLab Work Coordinator: Marc McMullen	

DOE Lift Classification:		~~CRITICAL~~		**PRE-ENGINEERED PRODUCTION**	**X**	~~ORDINARY~~	

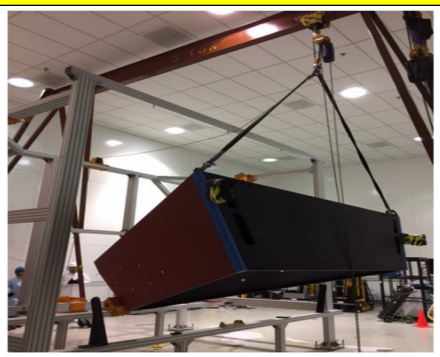
Load Weight # 1800lbs max force expected at initial lift off at start of rotation. All forces on winch after initial liftoff will reduce as detector is rotated towards vertical.

Load Weight Determined By:

- ☐ Equipment Manufacturers information provided by: D. Orecchini, S. Tomassini
- ☐ ~~Rigger Estimate~~
- ☐ ~~Labeled Shipping Weight~~
- ☐ ~~Dyno Measured~~

Describe the Load:

See Picture.



Rigging Hardware Required:

List all items (size & load rating) to be used under the hook to accomplish the planned lift.

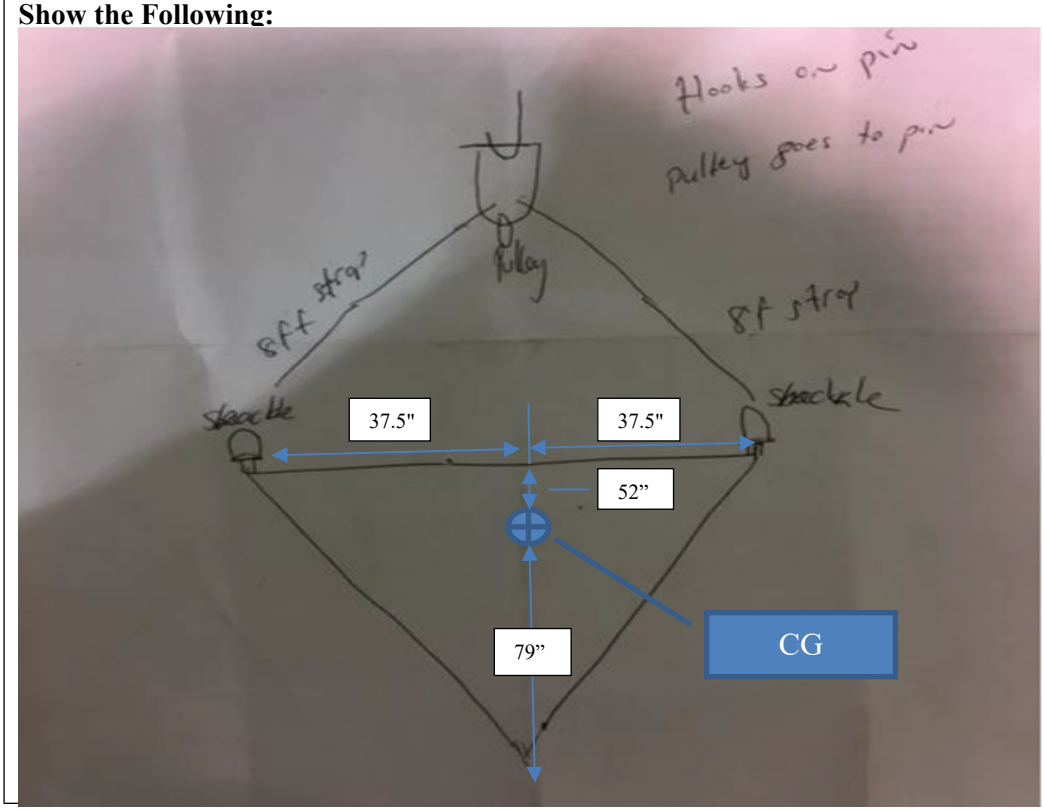
(2) Two- 8foot polyester round slings must have a capacity greater than 1700lbs
(2) Two- Swivel hoist rings on detector must have a capacity greater than 1700lbs
(2) Two- Shackles connecting slings to swivel hoist rings must a capacity greater the 1700lbs
(1) (Collector-- Master Link or shackle) at top of both slings must have a capacity greater than 1800lbs
(1) Rich detector winch rated at 2200lbs attached to stiffening fixture.
(1) 5-ton clean room gantry crane.
(1) 1-ton manual chain hoist or greater.

Jefferson Lab
Thomas Jefferson National Accelerator Facility

Material Handling Lift Plan

Plan View:

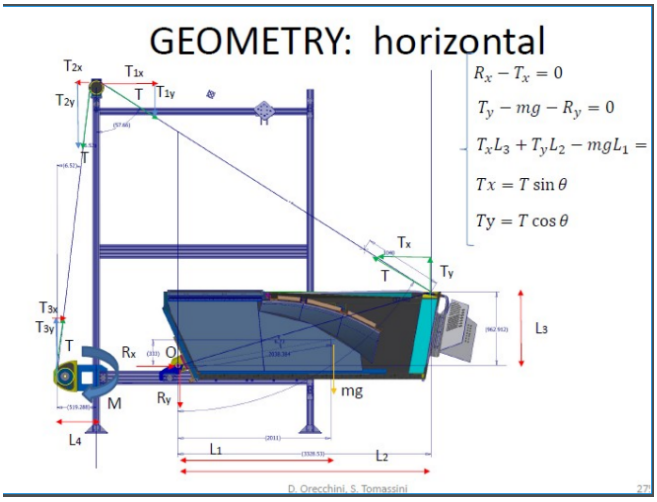
Show the Following:

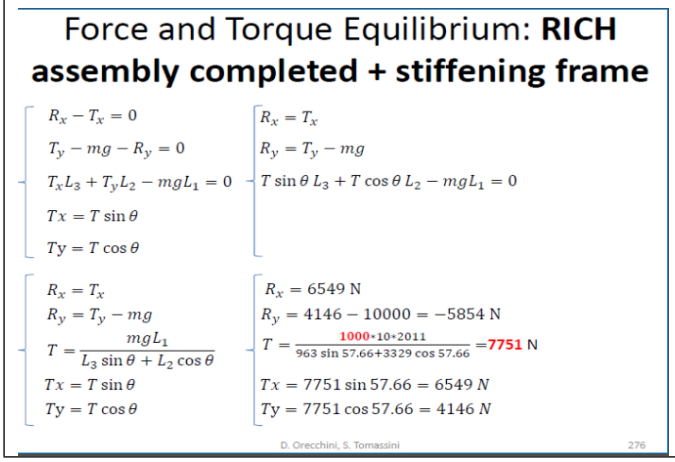


ELEVATION

Show the Following:

- Load with CG labeled
- ~~BTHLD's~~
- Sling Horizontal Angles
- Sling Tensions
- Label Rigging Gear, size & WLL
- ~~Label D/d ratios~~





Jefferson Lab
Thomas Jefferson National Accelerator Facility

Material Handling Lift Plan

STEP 2 – Setup for Lift

Equipment Make: Wallace Type: Gantry

Model#: Clean room gantry Serial#: 5T24

Owner: JSA

Annually Inspected By: Mark Loewus Date: May 2021

~~Monthly Wire Rope Inspection Documented: Y / N~~
~~Daily Inspection Documented: Y / N~~ Pre-use inspection required by operator, documentation not required.

Equipment Operator[i] _____

Certification/Qualification: _____
CCO No. N/A Expiration Date: _____
Employer: _____

Lead Rigger: _____
Certification/Qualification: _____

Lift Director (ASME) or PIC (DOE)[ii]: _____

Site Supervisor[iii]: _____

- Establishes a perimeter that clearly identifies the area of the lift.
- Ensures ALL personnel within the perimeter wears proper PPE required for the area.
- Conducts a Pre-Lift Meeting where the sequences of actions that will occur to accomplish the lift are presented.
- Attend the Pre-Lift Meeting.

Signal Person: _____

Jefferson Lab
Thomas Jefferson National Accelerator Facility

Material Handling Lift Plan

STEP 2 – Setup for Lift

PPE Requirements:

- Hard Hat
- Safety Shoes
- Safety Glasses
- List any additional PPE needed to perform the lift

Watch Personnel (Maintains Lift Perimeters) :_____

Identify a Muster Point:_____

Emergency Procedures (in case of injury)

1. Stop Lift
2. Lower Load to a safe position
3. _____

_____

_____

Limits of Safe Operation **(i.e. wind, rain, lighting or traffic)**

STEP 3 - Lift

- **Accomplish the lift according to the Lift Plan.**
- **Document minor adjustments required to accomplish the lift.**
- **Re-approval is required if Operators, equipment or rigging changes after initial approval.**

Post Lift De-Brief

What went well? _____

_____

Areas of Improvement: _____

_____

_____

Documentation – Send a copy of this COMPLETED LIFT PLAN to:

Name:	**Mark Loewus**	**Loewus@jlab.org**	**53E**
	Print	e-mail address	Mail Stop

- **Rigging Hardware must be inspected and marked in accordance with the criteria contained in the following documents:**

  - *ASME B30.9 Slings*
  - *ASME B30.20 Below the Hook Lifting Devices*
  - *ASME B30.26 Rigging Hardware*
  - *29 CFR 1926.251 Rigging Equipment for Material Handling*

- **5-3.1.3 Responsibilities**

  While the organizational structure of various projects may differ, the following roles are described here for purposes of delineating responsibilities. All responsibilities listed below shall be assigned in the work site organization. A single individual may perform one or more of these roles.

  [i] **Equipment Operator:** directly controls the equipment's functions.

  [ii] **Lift Director:** directly oversees the work being performed by a crane and the associated rigging crew. This position equates to the **Person-In-Charge (PIC)** identified in the DOE Hoisting & Rigging Standard.

  [iii] **Site Supervisor:** exercises supervisory control over the work site on which a crane is being used and over the work that is being performed on that site.

Form Revision Summary

Revision 2.1 – 01/25/17 – Updated TPOC from D.Kausch to B.Sperlazza
Revision 2.0 – 12/04/14 – Form revised to create uniformity between ALL material handling equipment
Revision 1.1 – 03/22/12 – Update to format only
Revision 1.0 – 04/12/10 – Update to reflect current laboratory operations

ISSUING AUTHORITY	FORM TECHNICAL POINT-OF-CONTACT	APPROVAL DATE	REVIEW DATE	REV.
ESH&Q Division	Bob Sperlazza	01/25/17	01/25/20	2.1

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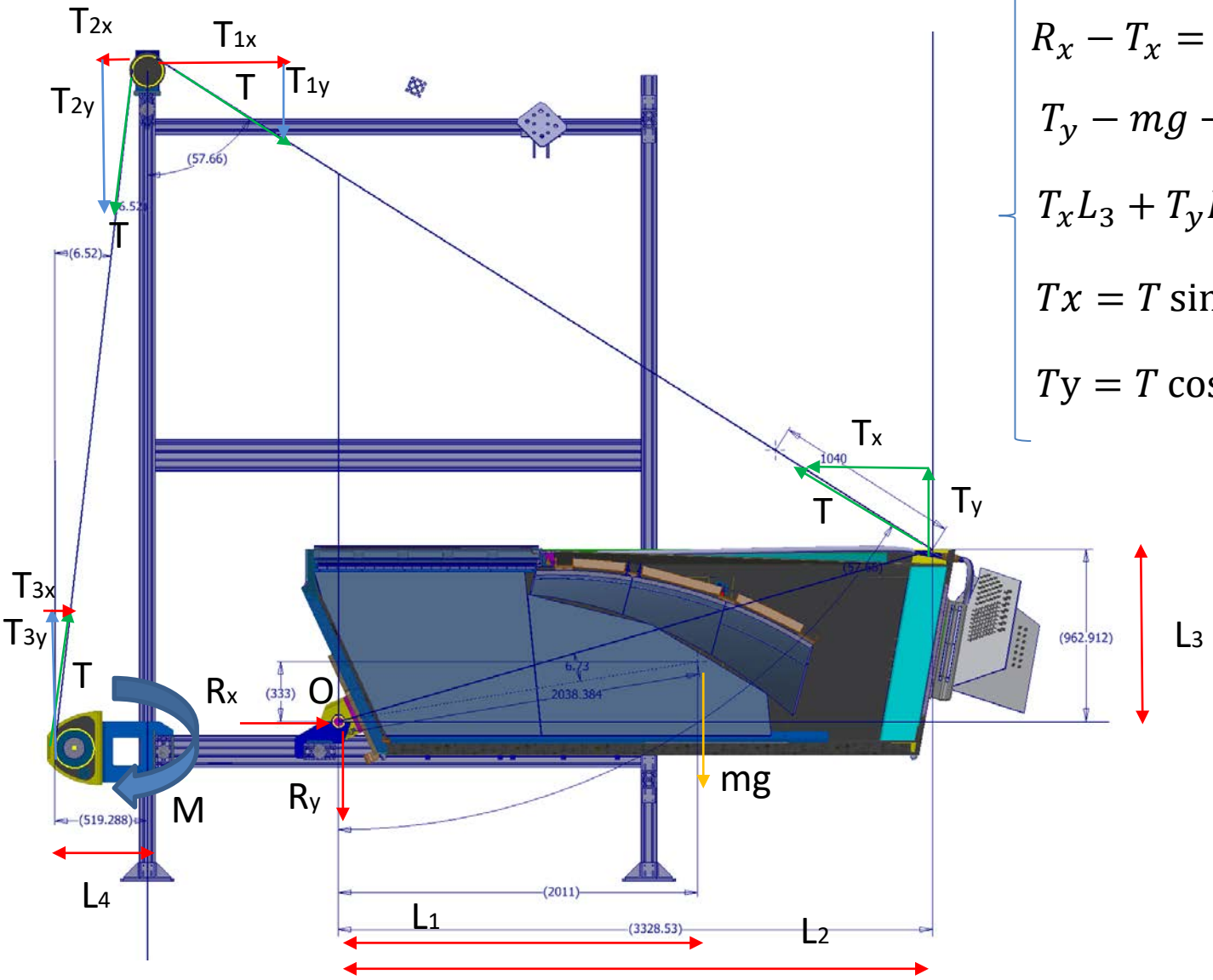
RICH ROTATION

Without equipments installed in the case

GEOMETRY: horizontal



$$R_x - T_x = 0$$

$$T_y - mg - R_y = 0$$

$$T_x L_3 + T_y L_2 - mgL_1 = 0$$

$$Tx = T \sin\theta$$

$$Ty = T \cos\theta$$

Force and Moment Balance: **RICH frame only**

$$R_x - T_x = 0$$
$$T_y - mg - R_y = 0$$
$$T_x L_3 + T_y L_2 - mgL_1 = 0$$
$$Tx = T\sin\theta$$
$$Ty = T\cos\theta$$

$$R_x = T_x$$
$$R_y = T_y - mg$$
$$T\sin\theta\, L_3 + T\cos\theta\, L_2 - mgL_1 = 0$$

$$R_x = T_x$$
$$R_y = T_y - mg$$
$$T = \frac{mgL_1}{L_3\sin\theta + L_2\cos\theta}$$
$$Tx = T\sin\theta$$
$$Ty = T\cos\theta$$

$$R_x = 3928\ \text{N}$$
$$R_y = 2487 - 6000 = -3513\ \text{N}$$
$$T = \frac{\mathbf{600}*10*2011}{963\sin 57.66 + 3329\cos 57.66} = \mathbf{4650}\ \text{N}$$
$$Tx = 4650\sin 57.66 = 3928\ N$$
$$Ty = 4650\cos 57.66 = 2487\ N$$

Case 01: Loads acting on the Al Frame

Case 01: rotation of the RICH without any device installed inside (Assembly at Tecnavan or first assembly in the clean room EEL124)

$$T1x = 4650 \sin 57.66 = 3928\ N$$
$$T1y = 4650 \cos 57.66 = 2487\ N$$

$$T2x = 4650 \sin 6.52 = 528\ N$$
$$T2y = 4650 \cos 6.52 = 4620\ N$$

$$T3x = 4650 \sin 6.52 = 528\ N$$
$$T3y = 4650 \cos 6.52 = 4620\ N$$

$$M = T3y * L4 = 4620\ N * 0.520\ m = 2403\ Nm$$

$$R_x = -3928\ N$$
$$R_y = 3513\ N$$

Load on Pulley for load case 01

$Trx = T1x - T2x = 3928 - 528 = 3400N$

$Try = T2y + T1y = 4620 + 2487 = 7107N$

$Tr = \sqrt{(Trx\text{^}2 + Try\text{^}2)} = \mathbf{7878N}$ < 31750 N Pulley Rate **VERIFIED**

Load on Pivot for load case 01

$R_x = -3928$ N

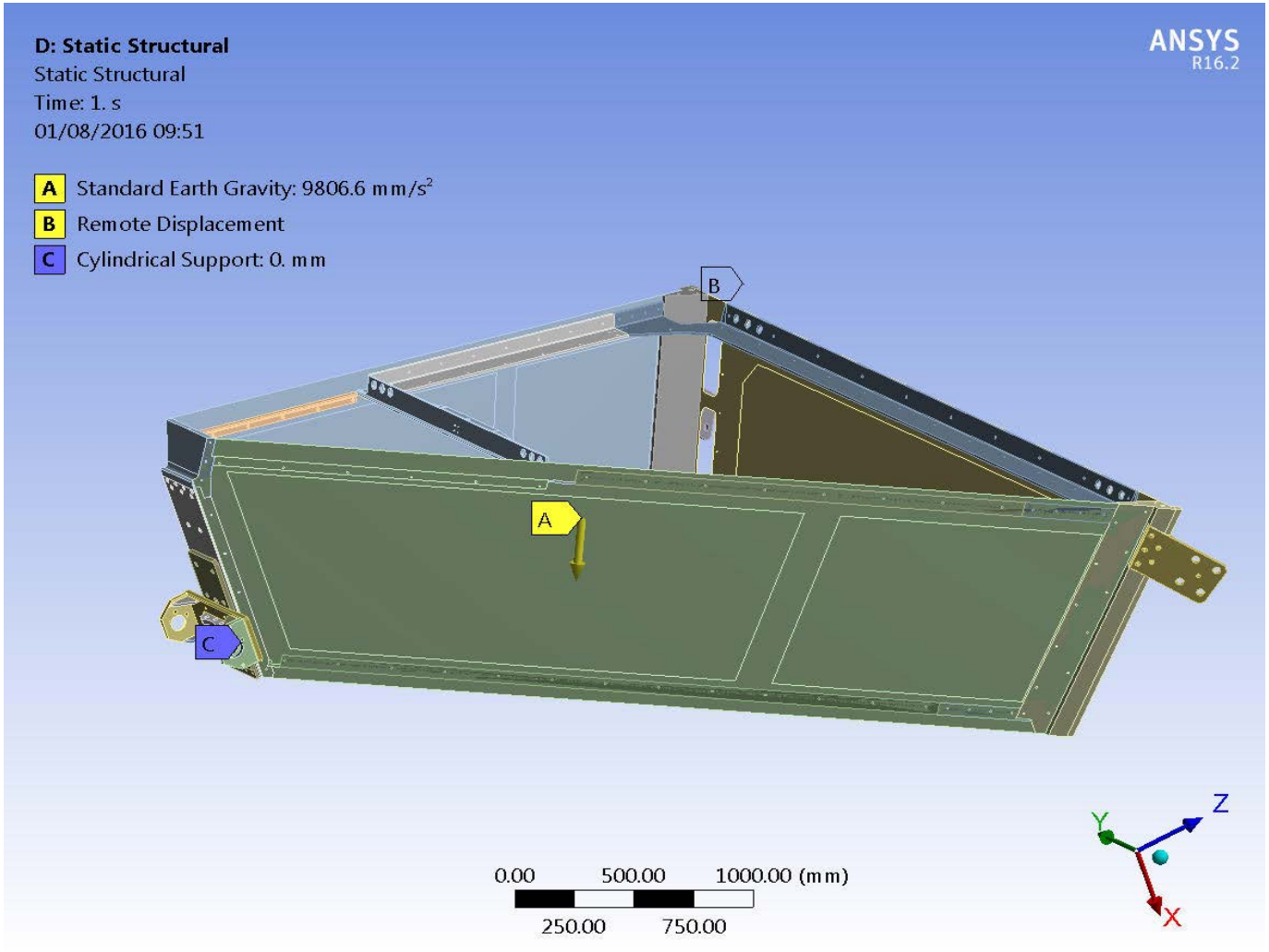
$R_y = 3513$ N

FEM file location

Files

	A	B	C	D	E	
1	Name	Ce...	Size	Type	Date Modified	
2	Assy_metal envelope.iam	A2,B3	311 KB	Geometry File	19/06/2015 17:54:05	C:\Lavori\Lavori_INFN\CLAS12\CLAS12-2013-10-18\Workspaces\Area di lavoro\envelope_FEM
3	material.engd	B2,D2	90 KB	Engineering Data File	27/07/2016 14:11:40	dp0\SYS\ENGD
4	SYS.engd	B4	90 KB	Engineering Data File	27/07/2016 14:11:40	dp0\global\MECH
5	SYS.mechdb	B4	17 MB	Mechanical Database Fi	03/08/2016 13:53:40	dp0\global\MECH
6	2016-07-27-rich-case-fem.wbpj		435 KB	Workbench Project File	03/08/2016 13:52:19	C:\Lavori\Lavori_INFN\CLAS12\Envelope\FEM\2016-07-27-RICH CASE
7	EngineeringData.xml	B2,D2		Engineering Data File		dp0\SYS\ENGD
8	2016-07-27-ASSEMBLY Rich External Box	C2,D3	733 KB	Geometry File	29/07/2016 12:15:27	C:\Lavori\Lavori_INFN\CLAS12\Envelope\FEM\2016-07-27-RICH CASE\2016-07-27-Geometry
9	SYS-1.engd	D4	90 KB	Engineering Data File	27/07/2016 14:11:40	dp0\global\MECH
10	SYS-1.mechdb	D4	36 MB	Mechanical Database Fi	01/08/2016 09:30:44	dp0\global\MECH
11	Assembly_Fixed Parts.iam	E2,F3	125 KB	Geometry File	01/08/2016 17:08:19	C:\Lavori\Lavori_INFN\CLAS12\Envelope\FEM\2016-07-27-RICH CASE\2016-07-27-Geometry\Rotating base
12	material.engd	F2	18 KB	Engineering Data File	01/08/2016 10:06:42	dp0\SYS-2\ENGD
13	SYS-2.engd	F4	18 KB	Engineering Data File	01/08/2016 10:06:42	dp0\global\MECH
14	SYS-2.mechdb	F4	7 MB	Mechanical Database Fi	01/08/2016 13:39:29	dp0\global\MECH
15	Profilo 90x180 Tecnavan Type Horizonta	G2,H3	2 MB	Geometry File	01/08/2016 13:43:15	C:\Lavori\Lavori_INFN\CLAS12\Struttura assemblaggio RICH\Geometry
16	material.engd	H2	29 KB	Engineering Data File	01/08/2016 13:41:18	dp0\SYS-3\ENGD
17	SYS-3.engd	H4	29 KB	Engineering Data File	01/08/2016 13:41:18	dp0\global\MECH
18	SYS-3.mechdb	H4	6 MB	Mechanical Database Fi	01/08/2016 13:42:00	dp0\global\MECH

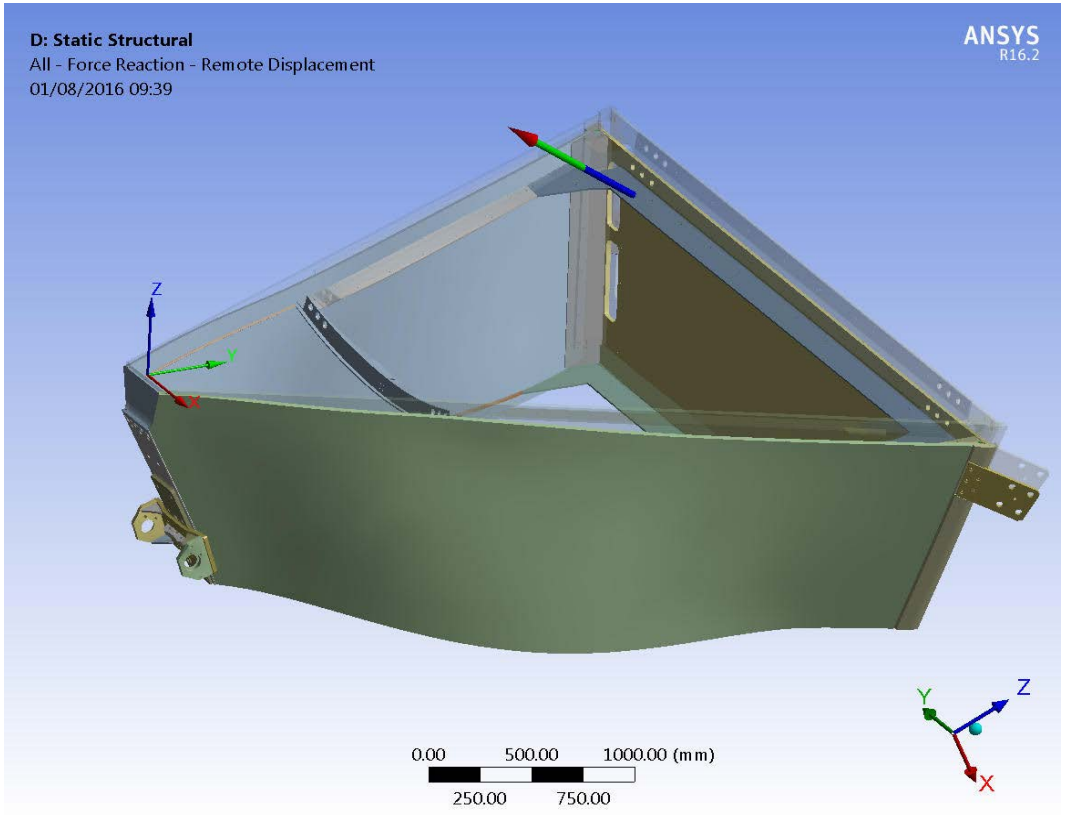
FEM ANALYSIS ANSYS: Supports and loads



FEM Results: LIFT Force

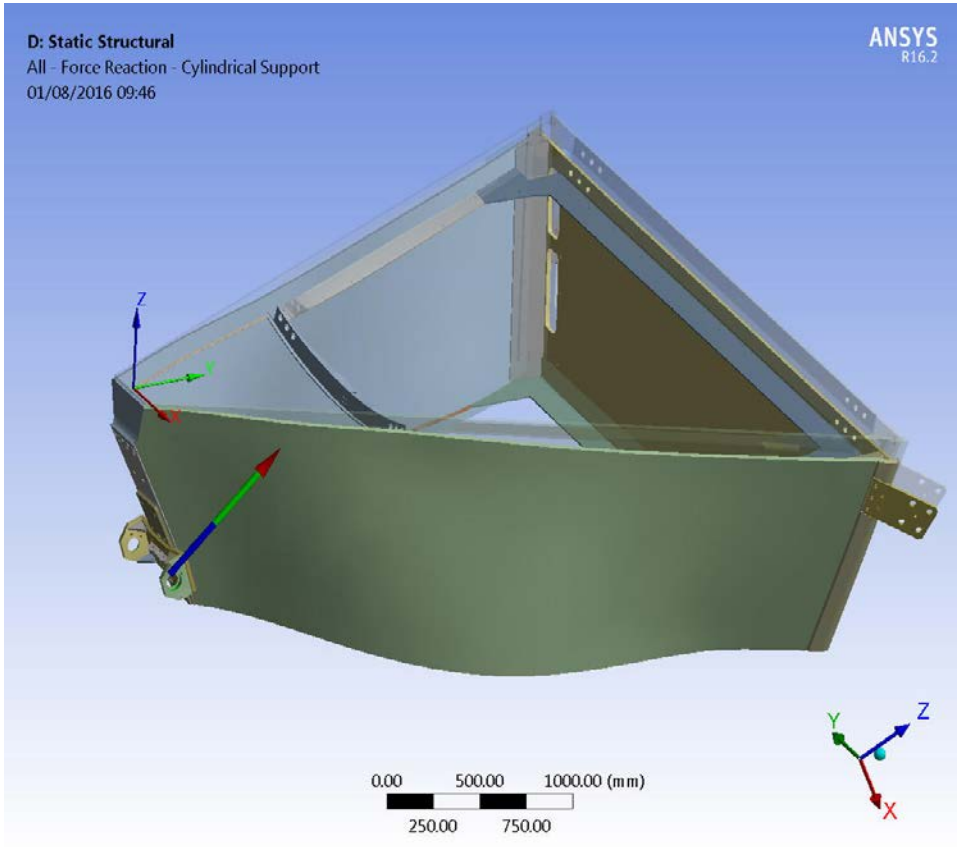
Note: the lift force and the reaction force at the cylindrical support were evaluated by means of the **FEM Ansys code** and it was a cross check of what was evaluated analytically and reported in the two previous slides.

Conclusions: **the FEM results agree with the analytical solution**.



Details of "All - Force Reaction - Remote Displacement"	
Definition	
Type	Force Reaction
Location Method	Boundary Condition
Boundary Condition	Remote Displacement
Orientation	Coordinate System for remote point
Suppressed	No
Options	
Result Selection	All
Display Time	End Time
Results	
Maximum Value Over Time	
X Axis	-7.4596 N
Y Axis	-3986.1 N
Z Axis	2782.3 N
Total	4861.1 N
Minimum Value Over Time	
X Axis	-7.4596 N
Y Axis	-3986.1 N
Z Axis	2782.3 N
Total	4861.1 N

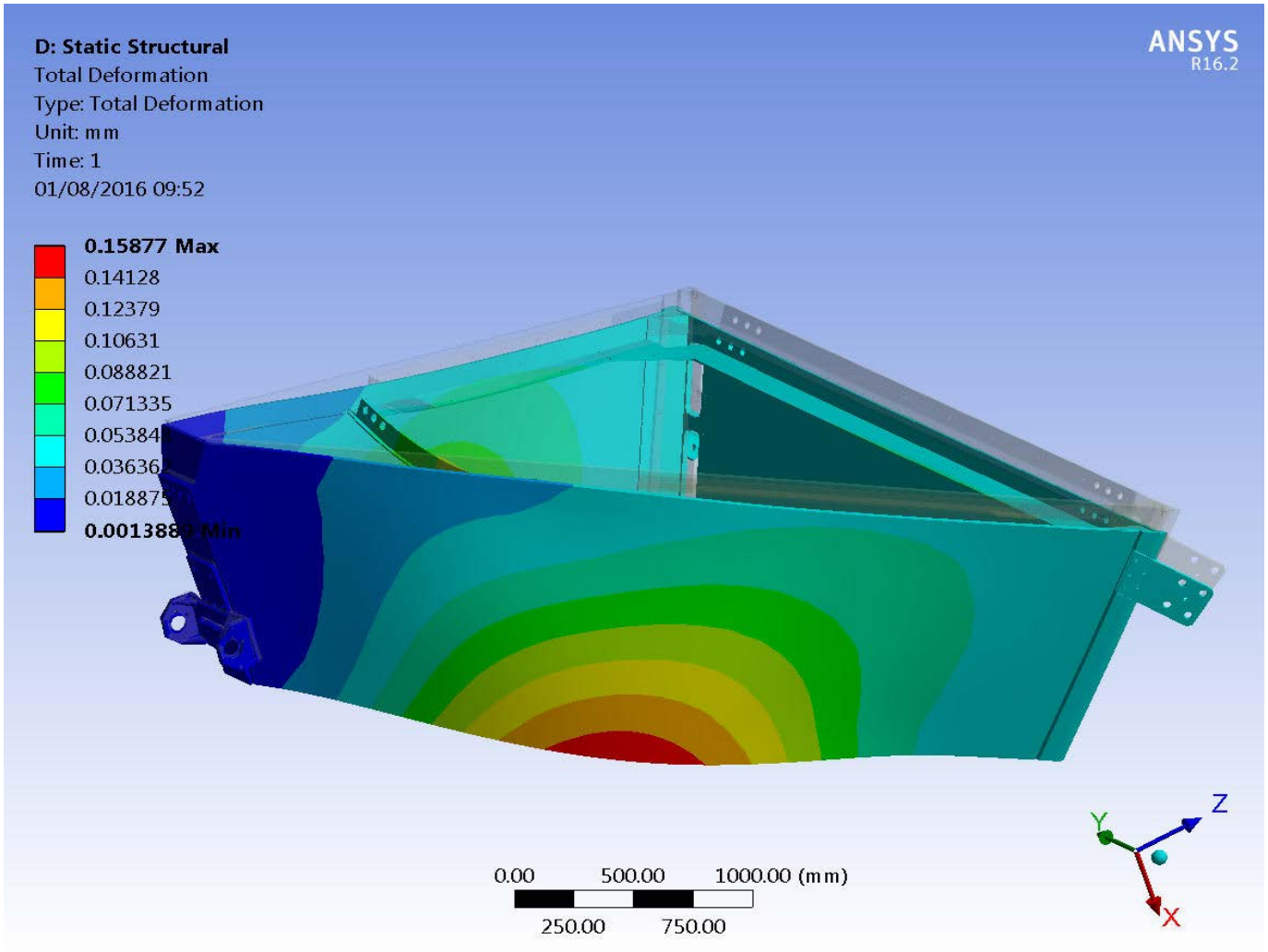
FEM Results: Reaction Force @ Cylindrical Support



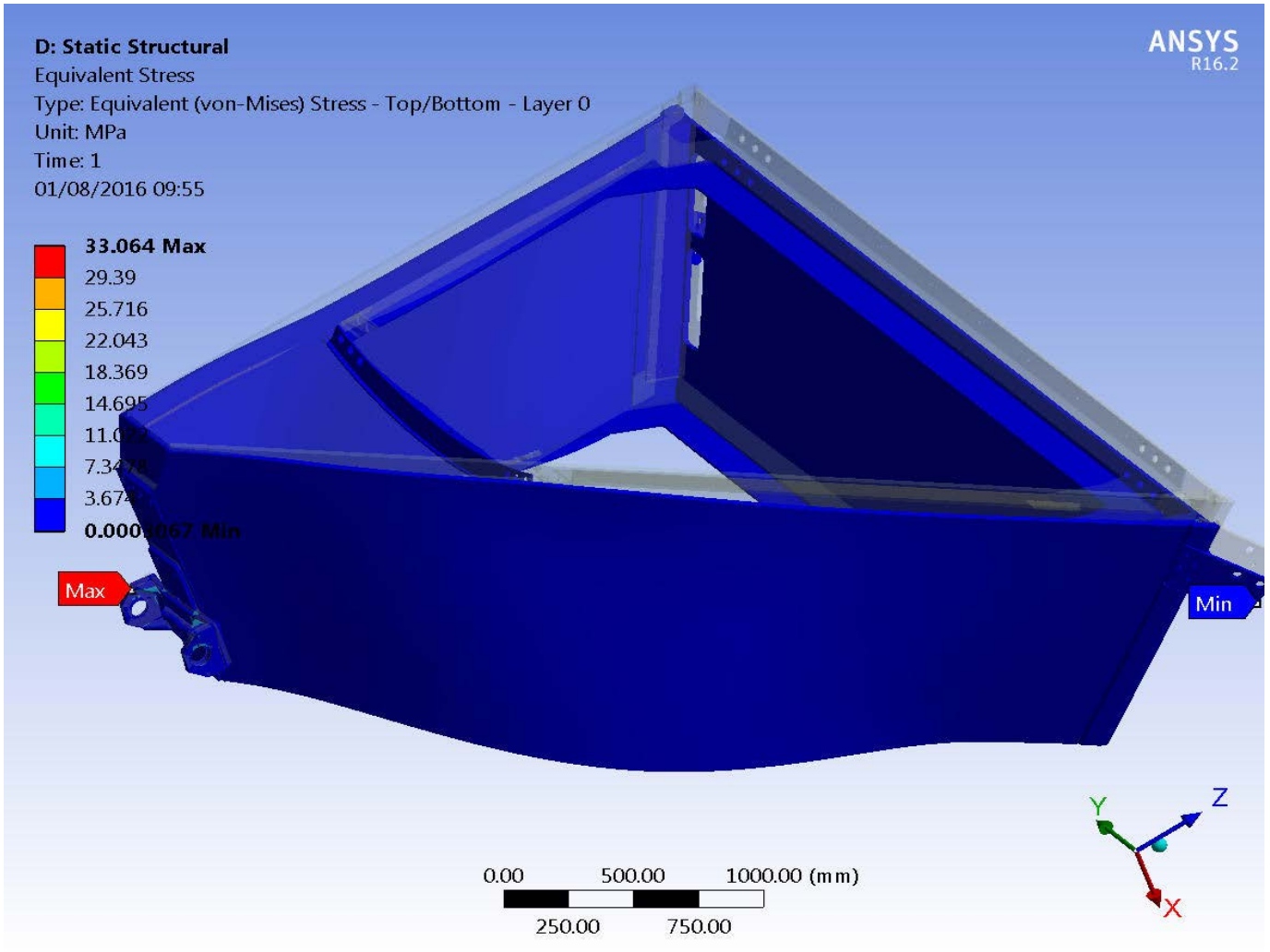
Details of "All - Force Reaction - Cylindrical Support"

Definition	
Type	Force Reaction
Location Method	Boundary Condition
Boundary Condition	Cylindrical Support
Orientation	Coordinate System for remote point
Suppressed	No
Options	
Result Selection	All
Display Time	End Time
Results	
Maximum Value Over Time	
X Axis	7.4594 N
Y Axis	3986.1 N
Z Axis	3535.1 N
Total	5327.8 N
Minimum Value Over Time	
X Axis	7.4594 N
Y Axis	3986.1 N
Z Axis	3535.1 N
Total	5327.8 N

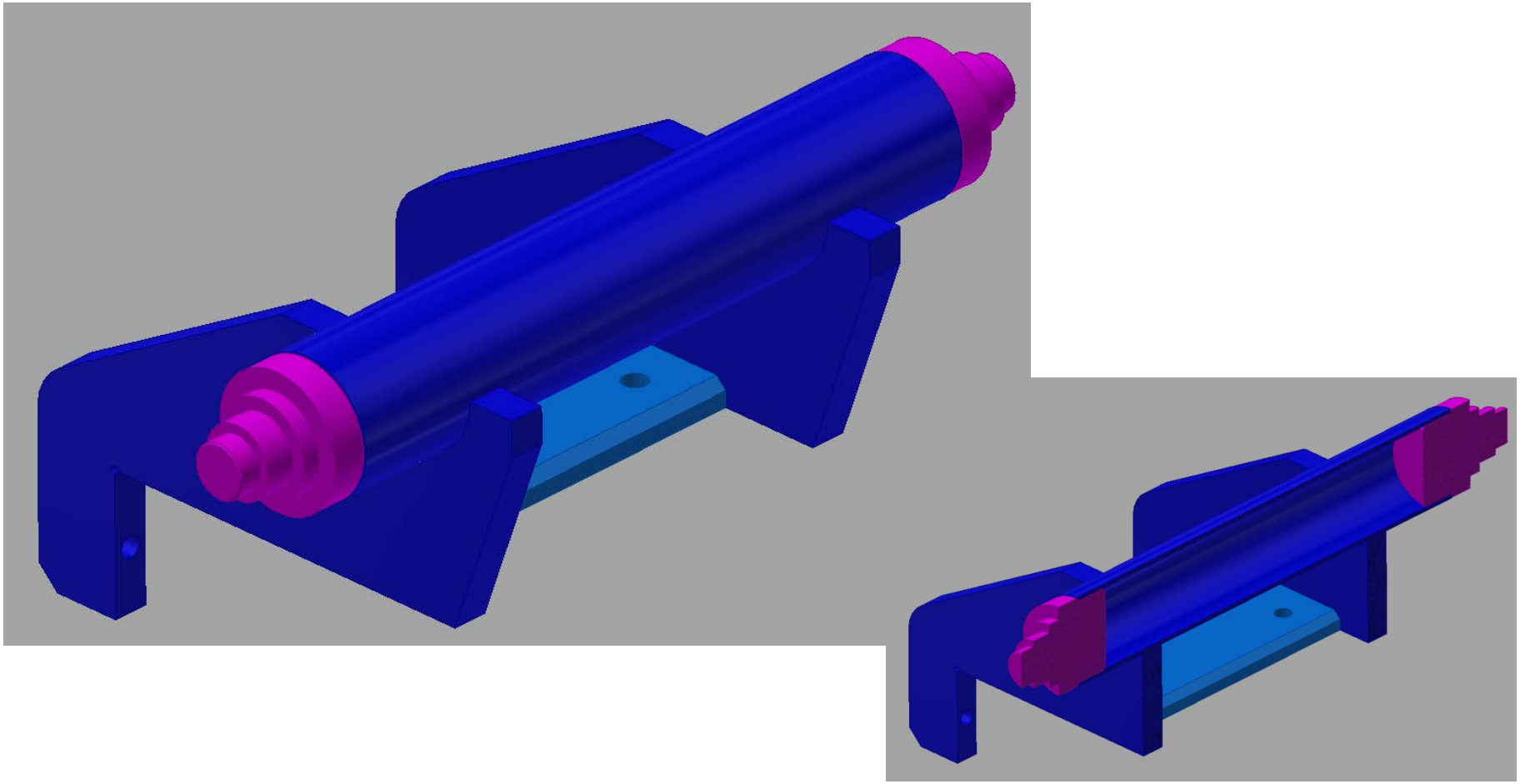
FEM Results: Total Deformation



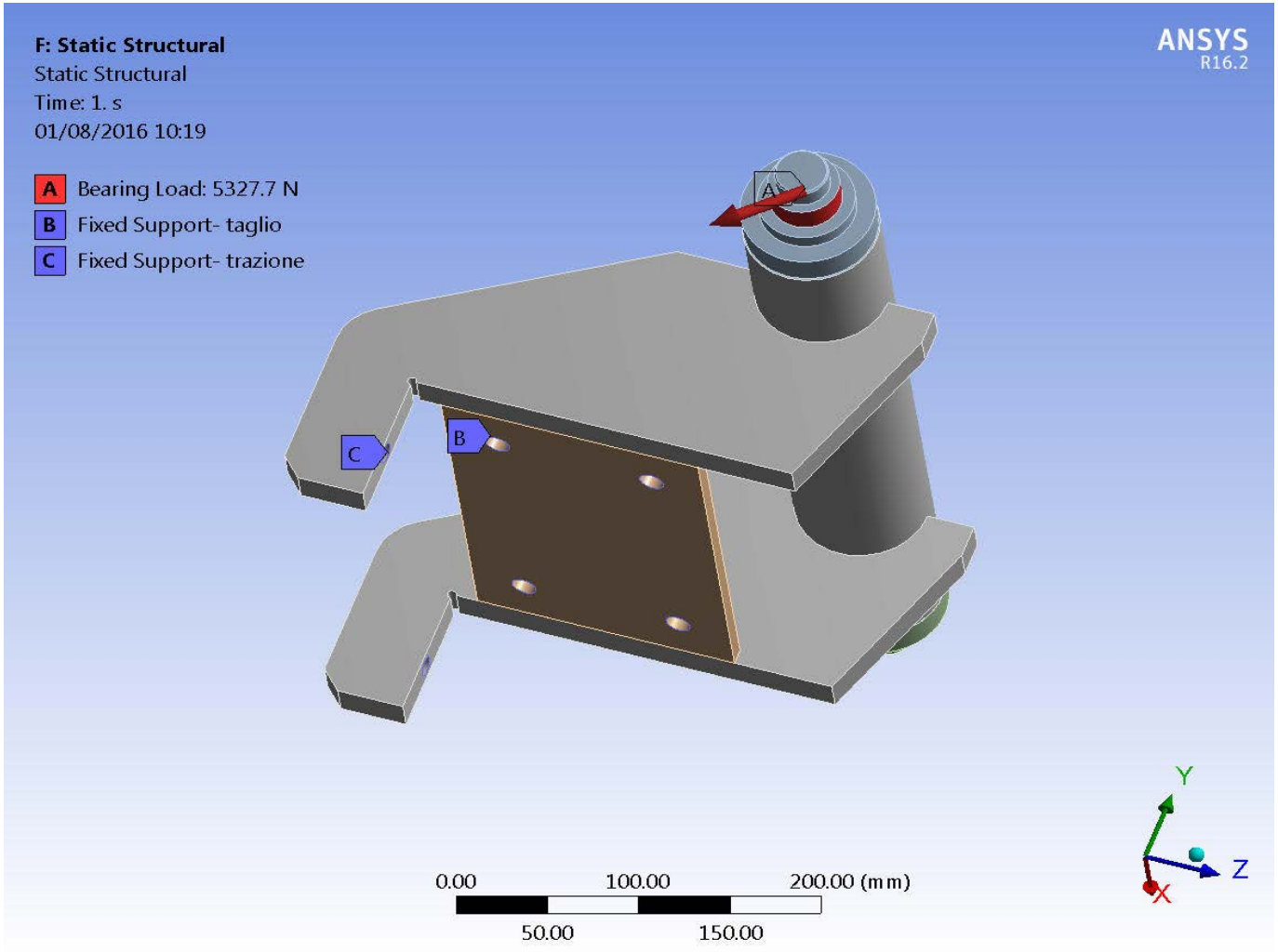
FEM Results: Stress Equivalent



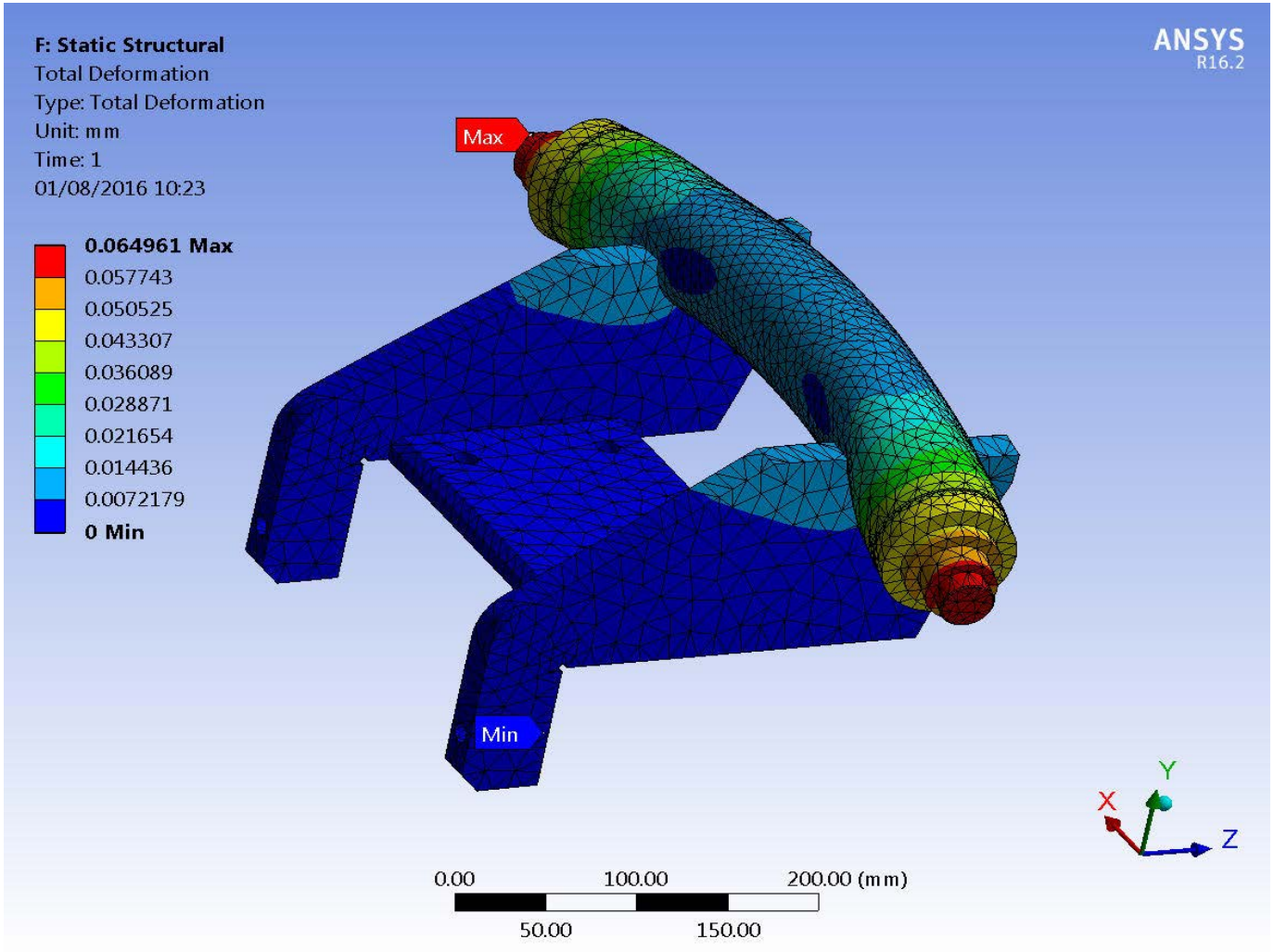
Rotating Base: geometry



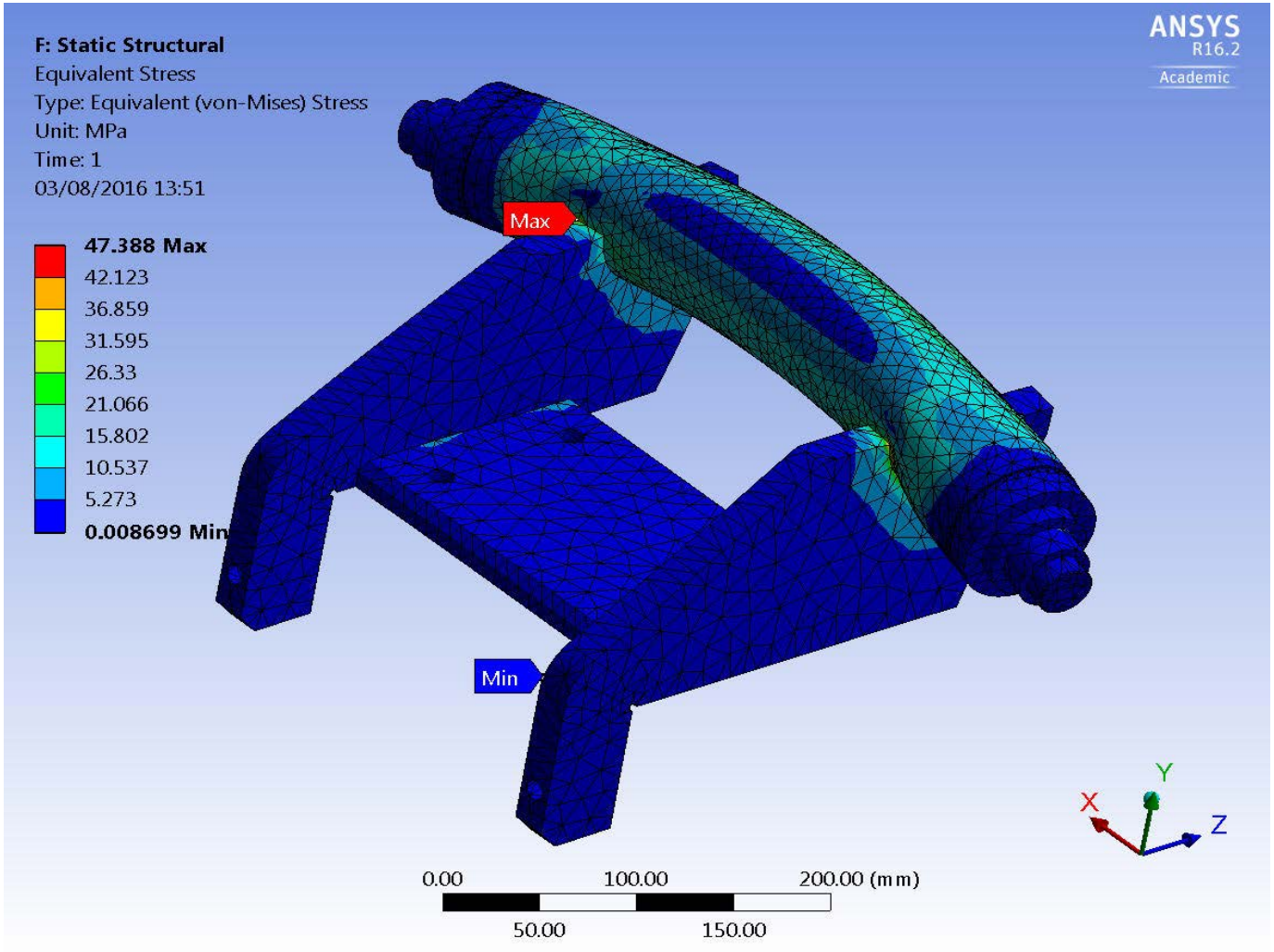
Loads and Constrains



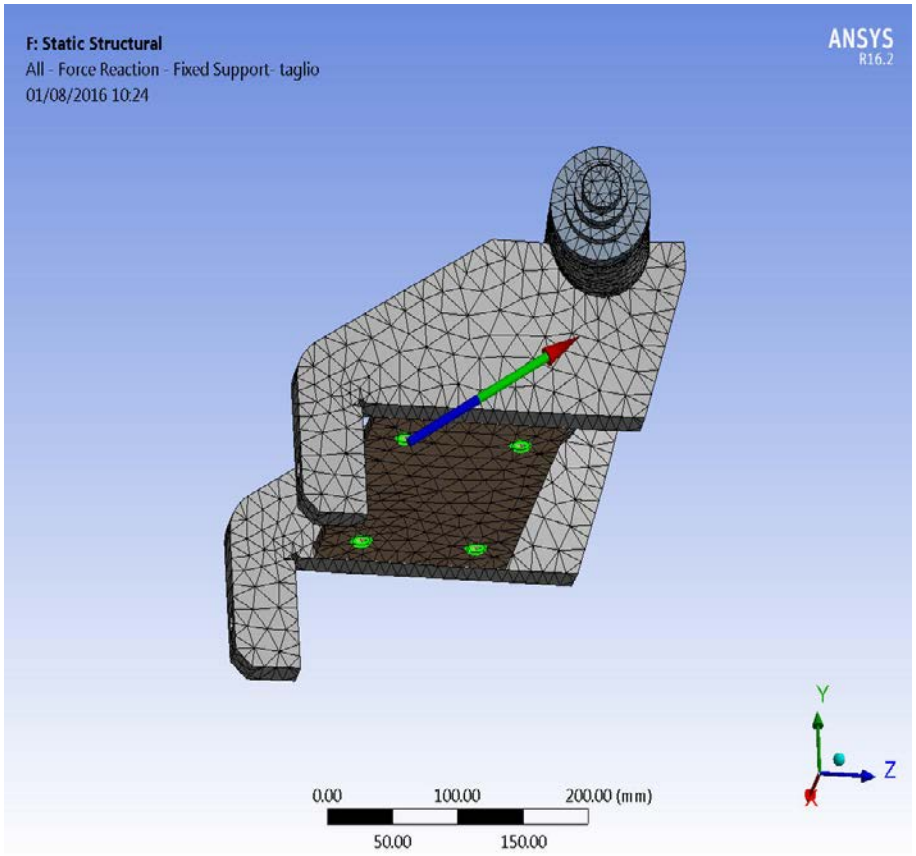
Total Deformations



Stress equivalent: Von Mises



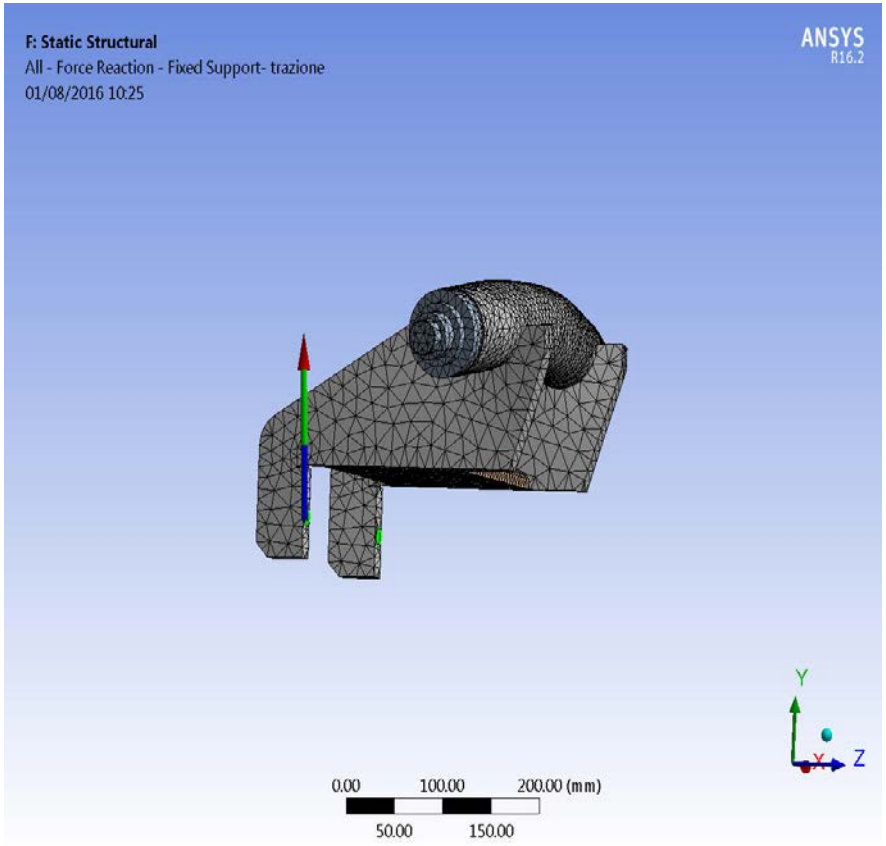
Reaction Force 01



Details of "All - Force Reaction - Fixed Support- taglio"

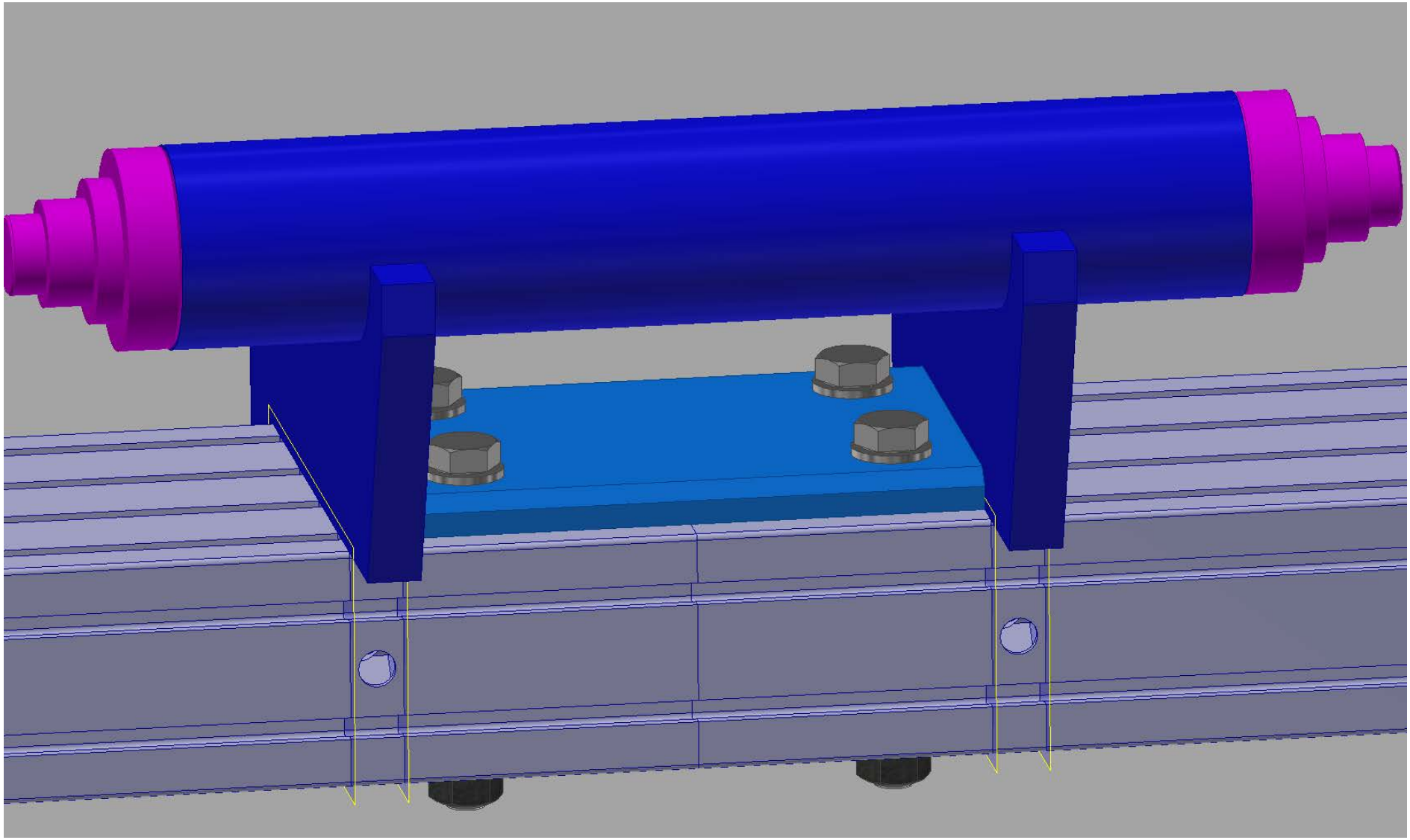
Definition	
Type	Force Reaction
Location Method	Boundary Condition
Boundary Condition	Fixed Support- taglio
Orientation	Global Coordinate System
Suppressed	No
Options	
Result Selection	All
Display Time	End Time
Results	
Maximum Value Over Time	
X Axis	-5.7574 N
Y Axis	2528.6 N
Z Axis	4149.6 N
Total	4859.3 N
Minimum Value Over Time	
X Axis	-5.7574 N
Y Axis	2528.6 N
Z Axis	4149.6 N
Total	4859.3 N

Reaction Force 02

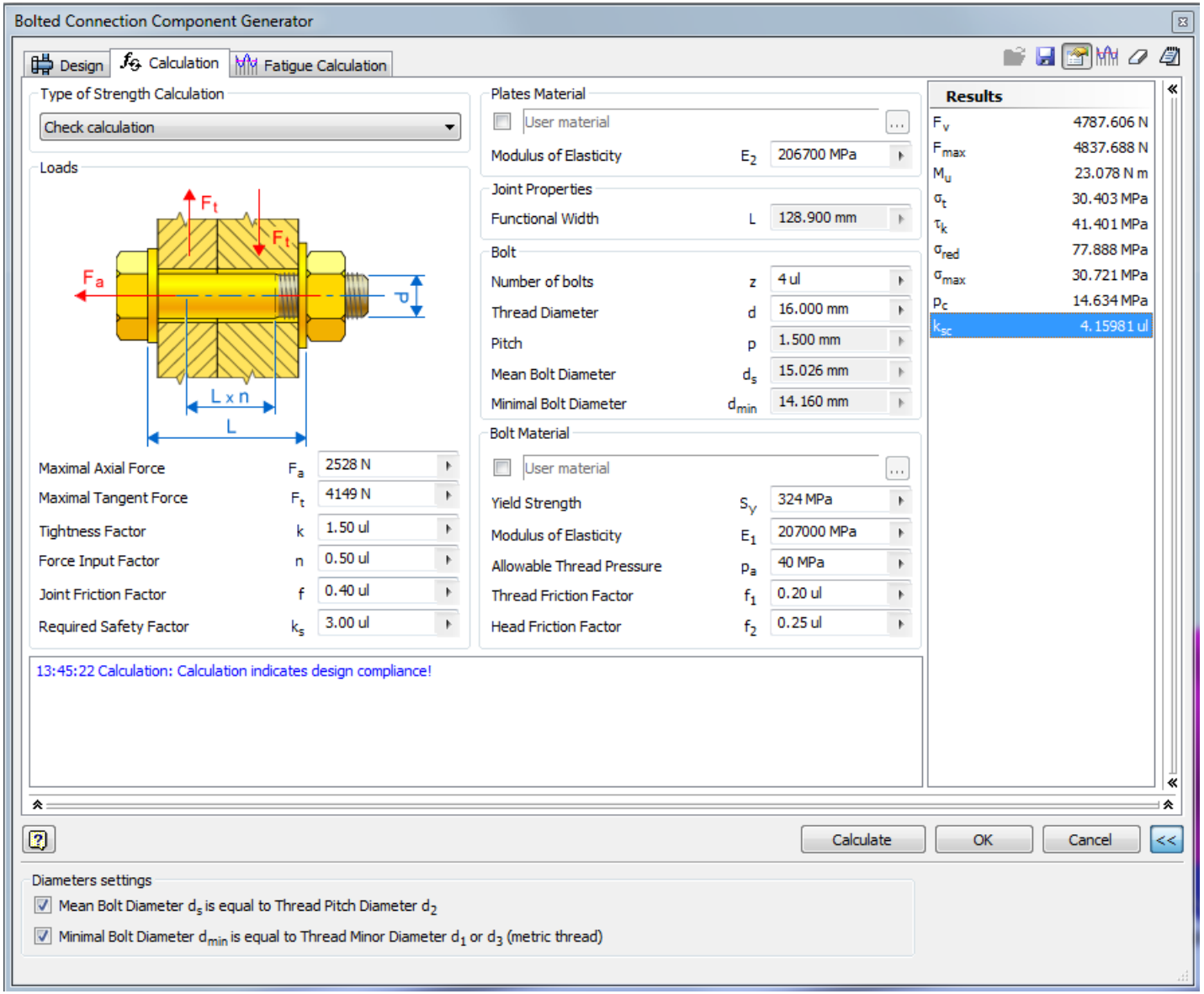


Details of "All - Force Reaction - Fixed Support- trazione"	
Definition	
Type	Force Reaction
Location Method	Boundary Condition
Boundary Condition	Fixed Support- trazione
Orientation	Global Coordinate System
Suppressed	No
Options	
Result Selection	All
Display Time	End Time
Results	
Maximum Value Over Time	
X Axis	5.7574 N
Y Axis	1092.2 N
Z Axis	-66.841 N
Total	1094.3 N
Minimum Value Over Time	
X Axis	5.7574 N
Y Axis	1092.2 N
Z Axis	-66.841 N
Total	1094.3 N

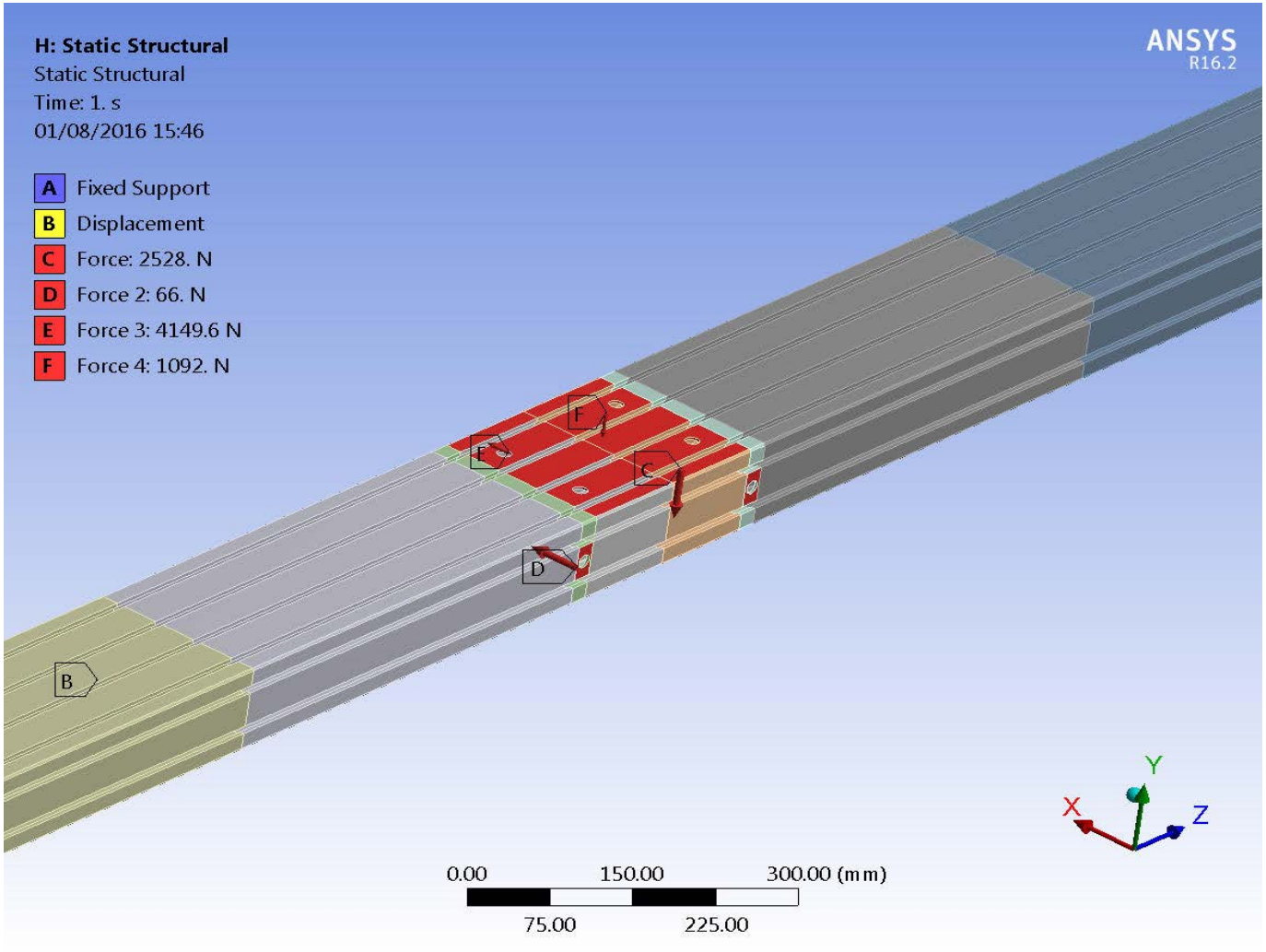
Bolted connection: geometry



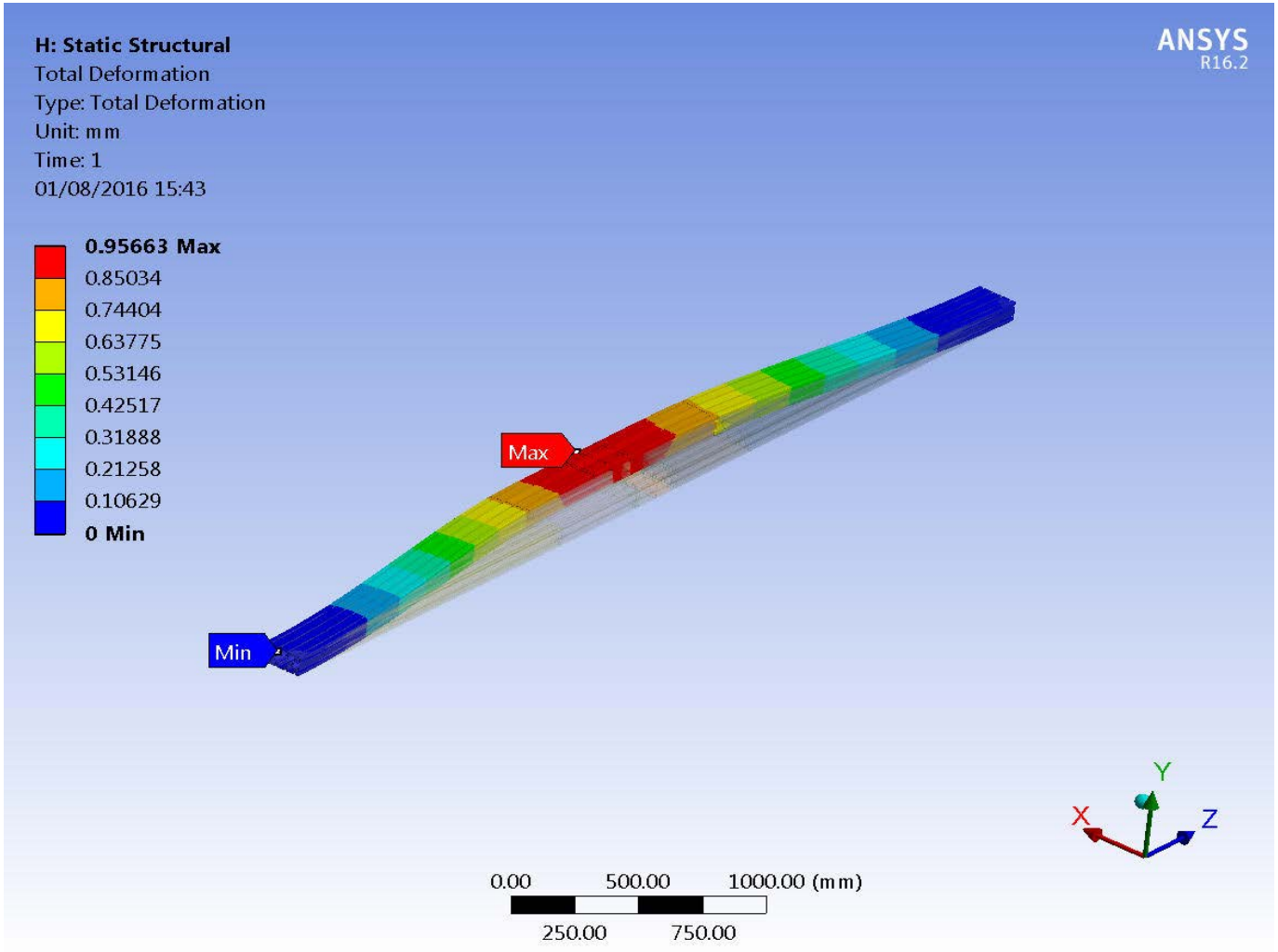
Bolted connection check



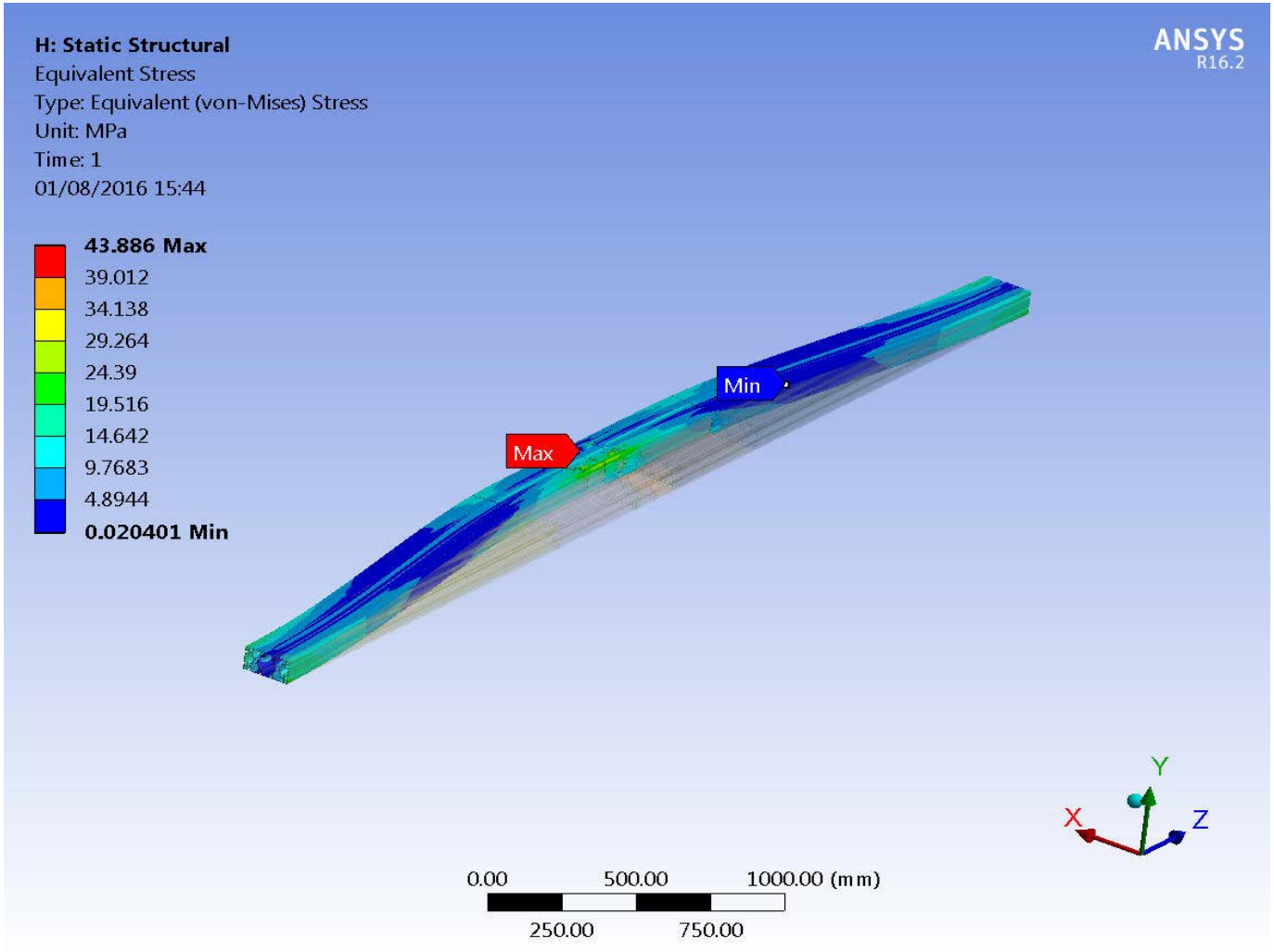
Al beam check: loads



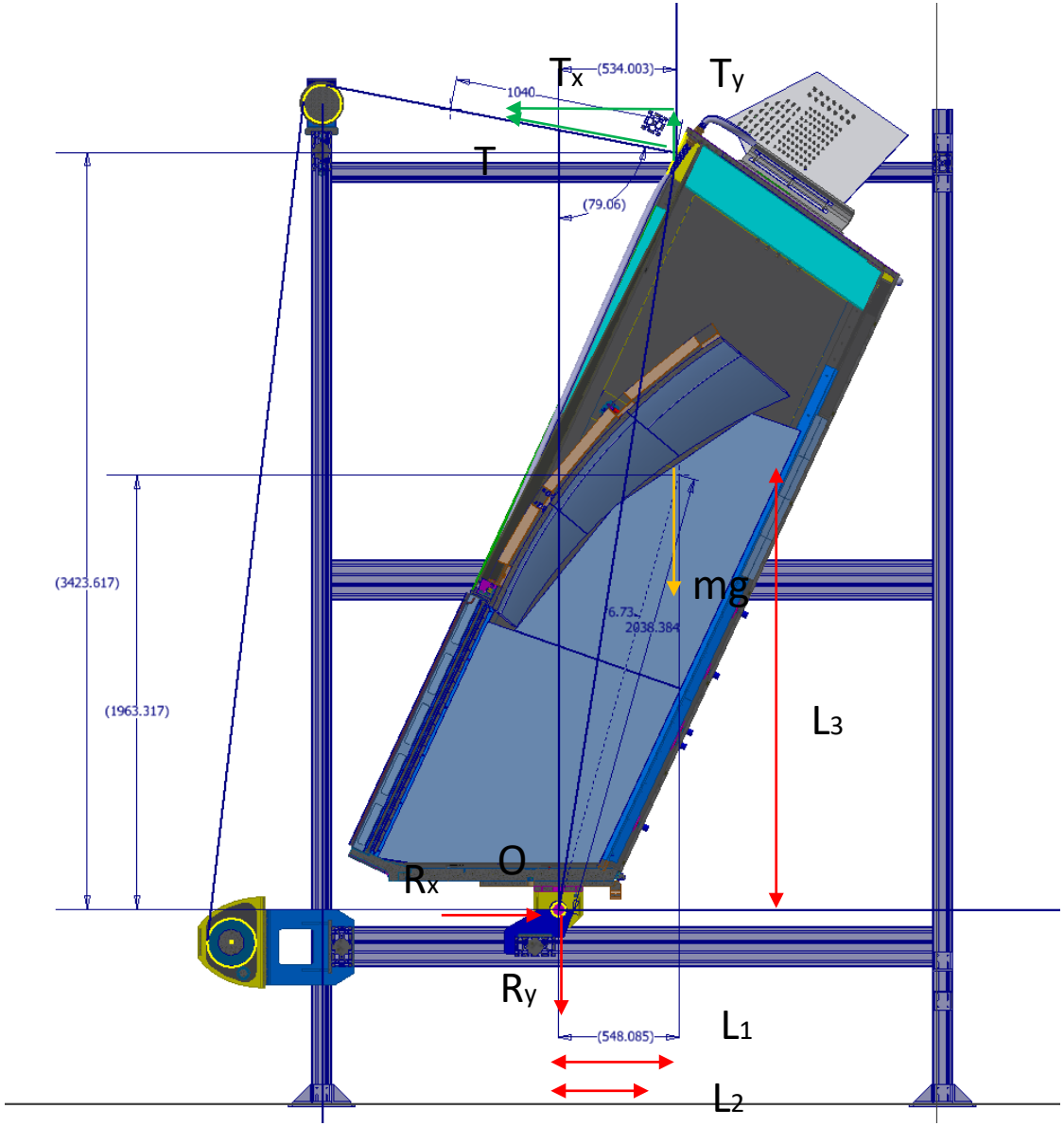
Al beam check: total deformation



Al beam check: equivalent stress



GEOMETRY: vertical



$$R_x - T_x = 0$$

$$T_y - mg - R_y = 0$$

$$T_x L_3 + T_y L_2 - mgL_1 = 0$$

$$Tx = T \sin\theta$$

$$Ty = T \cos\theta$$

L_1=548mm

L_2=534mm

L_3=1963mm

Force and Torque Equilibrium: **RICH frame only**

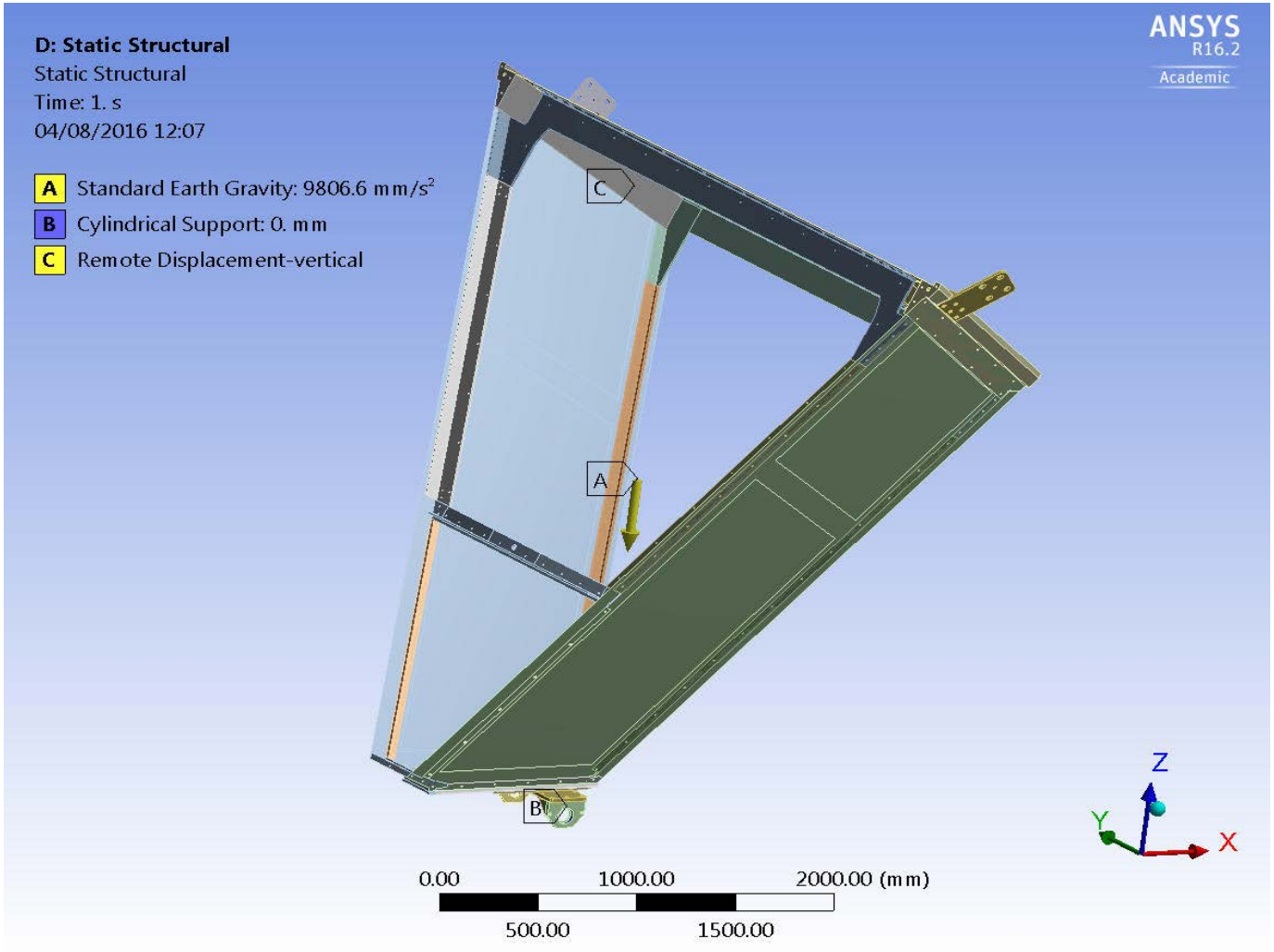
$$R_x - T_x = 0$$
$$T_y - mg - R_y = 0$$
$$T_x L_3 + T_y L_2 - mgL_1 = 0$$
$$Tx = T\sin\theta$$
$$Ty = T\cos\theta$$

$$R_x = T_x$$
$$R_y = T_y - mg$$
$$T\sin\theta\, L_3 + T\cos\theta\, L_2 - mgL_1 = 0$$

$$R_x = T_x$$
$$R_y = T_y - mg$$
$$T = \frac{mgL_1}{L_3\sin\theta + L_2\cos\theta}$$
$$Tx = T\sin\theta$$
$$Ty = T\cos\theta$$

$$R_x = 1590\ \text{N}$$
$$R_y = 309 - 6000 = -5691\ \text{N}$$
$$T = \frac{600*10*548}{1963\sin 79 + 534\cos 79} = 1620\ \text{N}$$
$$Tx = 1620\sin 79 = 1590\ N$$
$$Ty = 1620\cos 79 = 309\ N$$

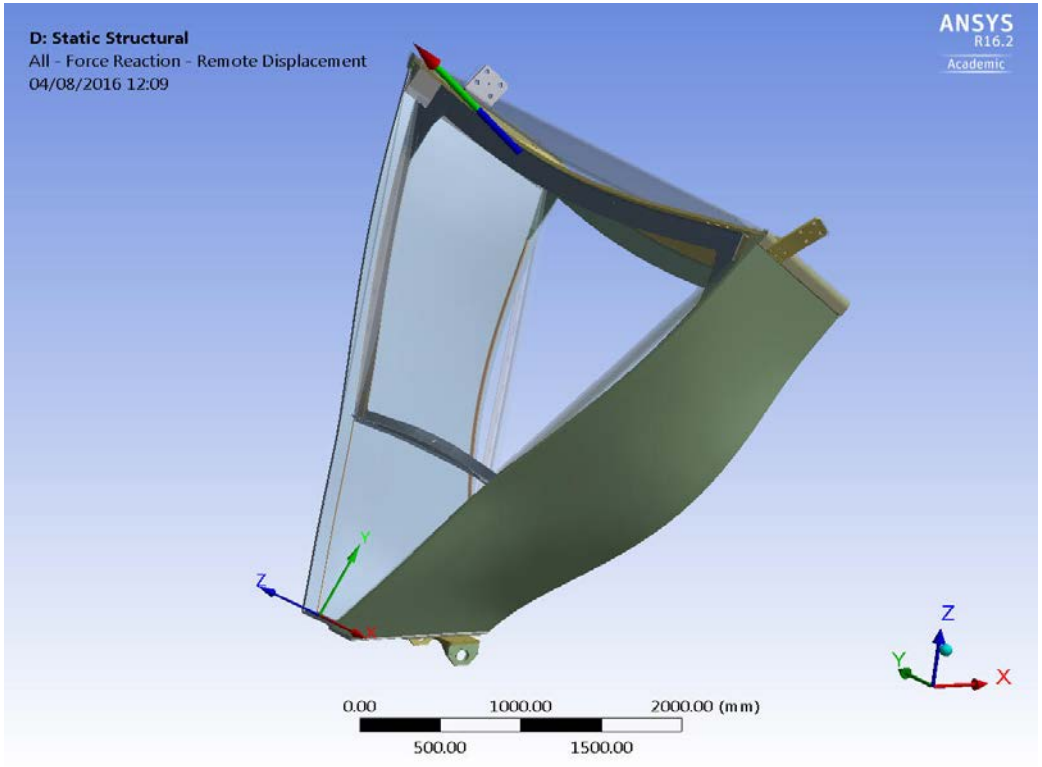
FEM ANALYSIS ANSYS: Supports and loads



FEM Results: LIFT Force

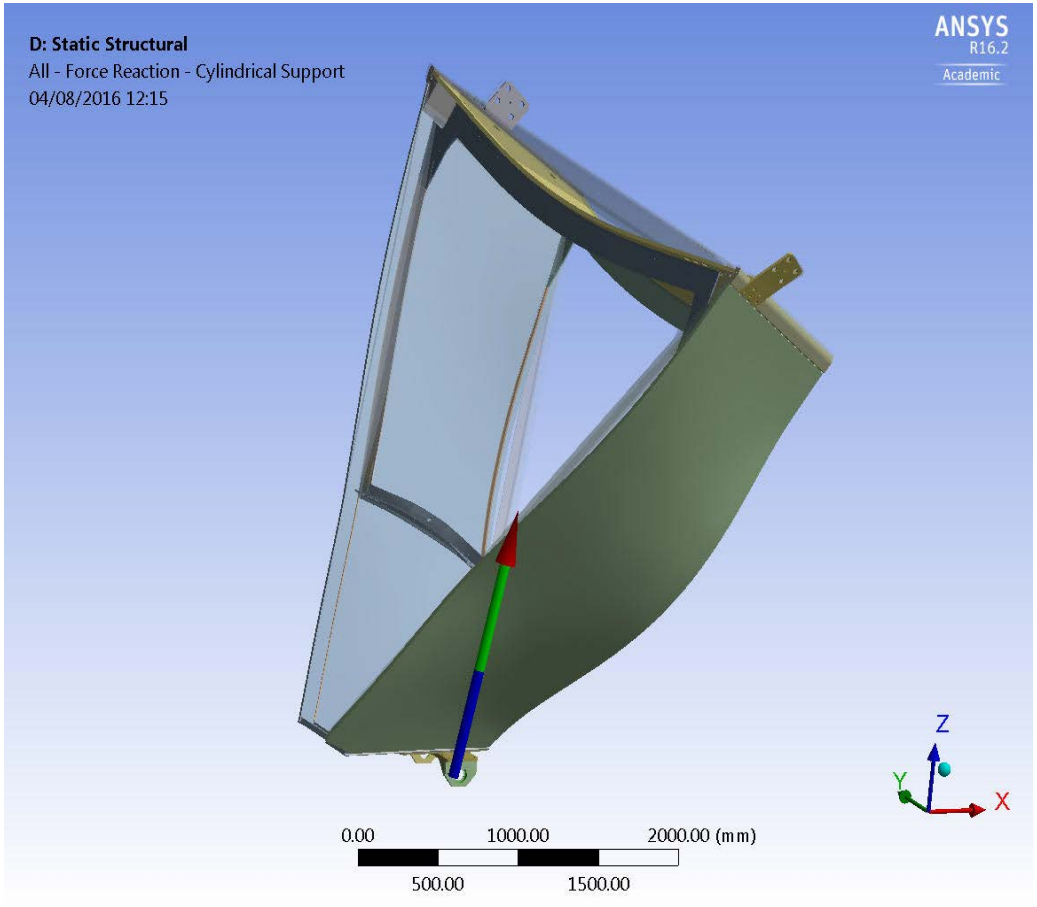
Note: the lift force and the reaction force at the cylindrical support were evaluated by means of the **FEM Ansys code** and it was a cross check of what was evaluated analytically and reported in the two previous slides.

Conclusions: **the FEM results agree with the analytical solution**.



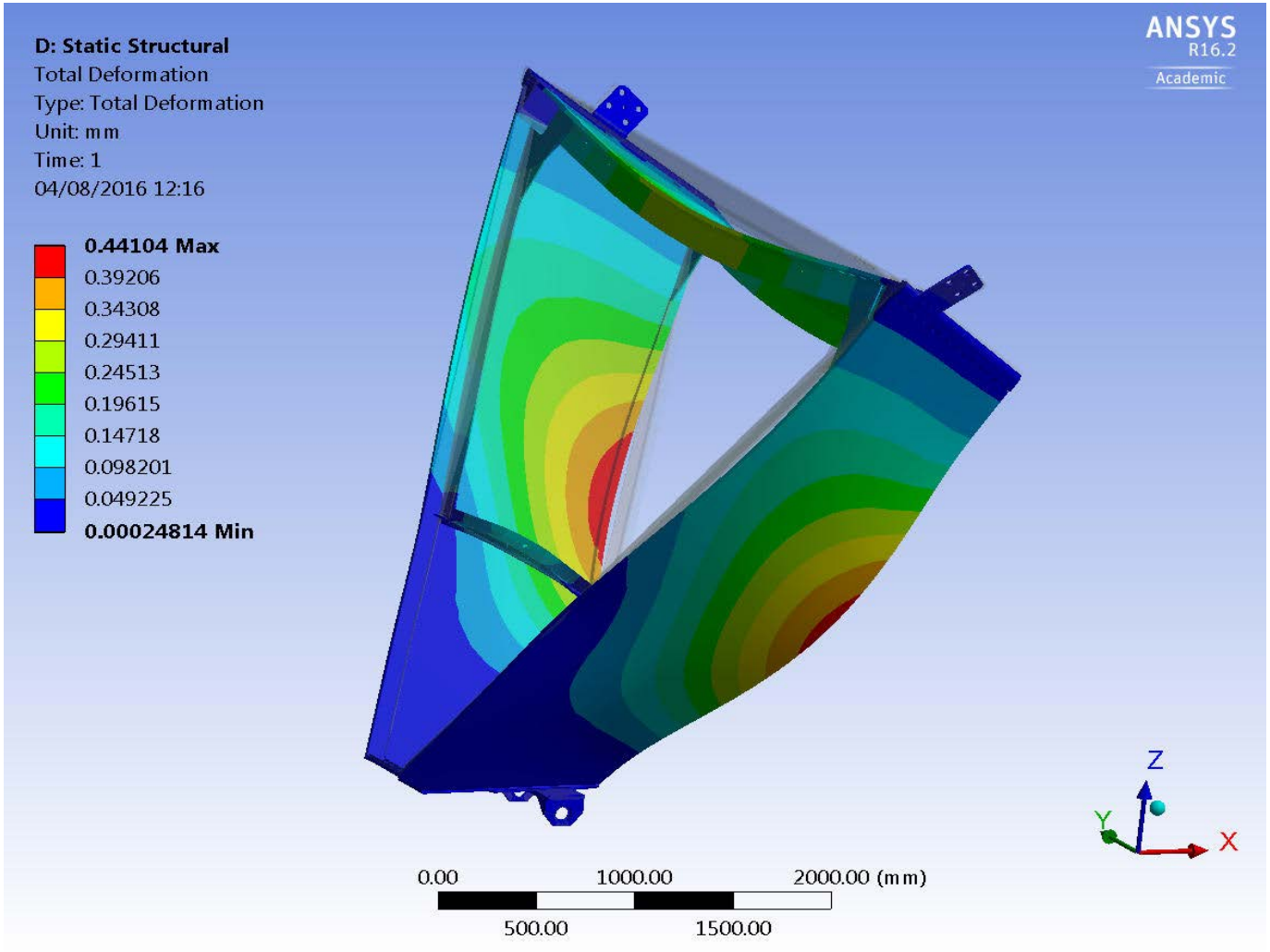
Details of "All - Force Reaction - Remote Displacement"	
Definition	
Type	Force Reaction
Location Method	Boundary Condition
Boundary Condition	Remote Displacement-vertical
Orientation	Global Coordinate System
Suppressed	No
Options	
Result Selection	All
Display Time	End Time
Results	
Maximum Value Over Time	
X Axis	-913.18 N
Y Axis	41.255 N
Z Axis	833.98 N
Total	1237.4 N
Minimum Value Over Time	
X Axis	-913.18 N
Y Axis	41.255 N
Z Axis	833.98 N
Total	1237.4 N
Information	

FEM Results: Reaction Force @ Cylindrical Support

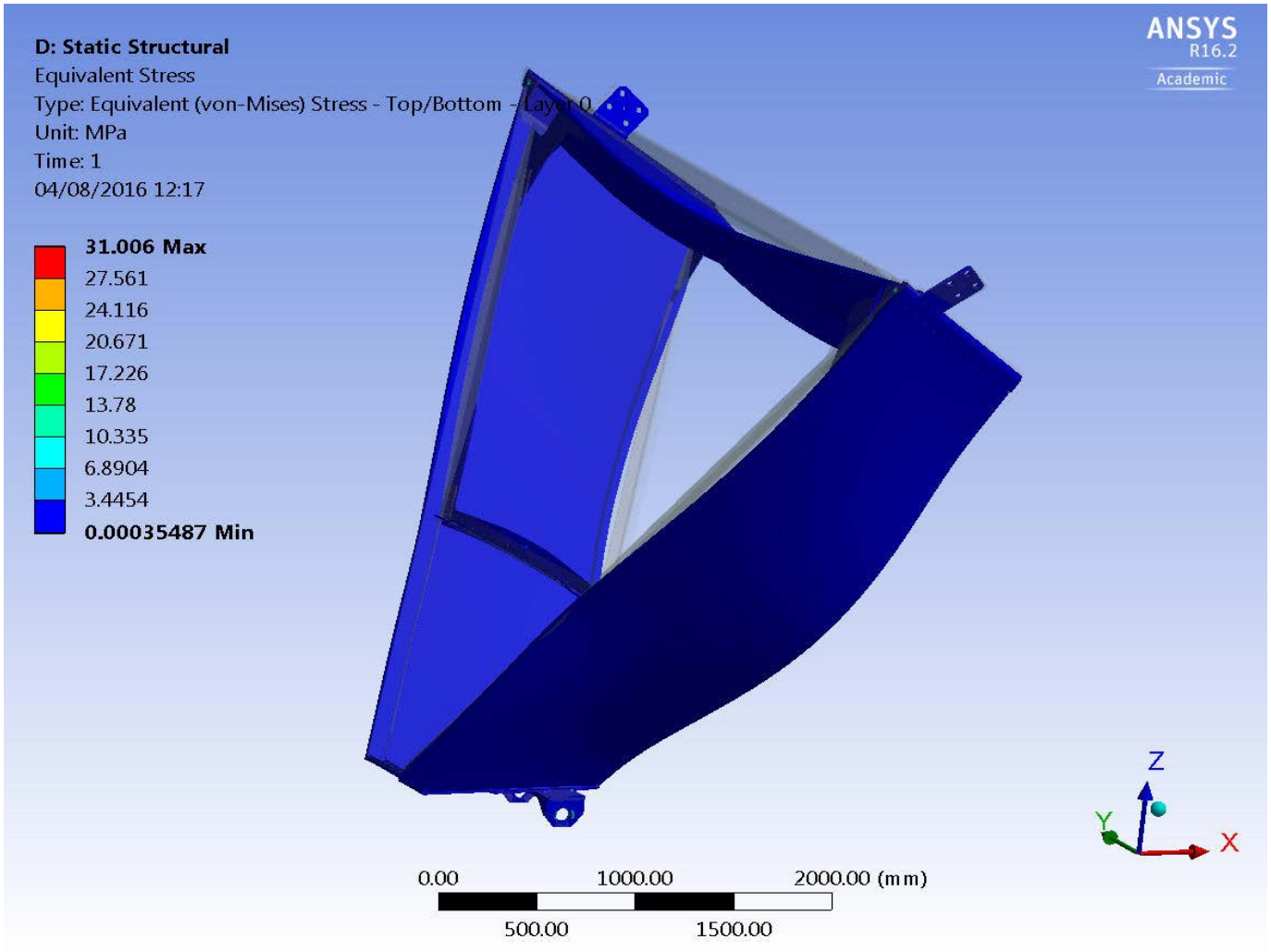


Details of "All - Force Reaction - Cylindrical Support"	
Definition	
Type	Force Reaction
Location Method	Boundary Condition
Boundary Condition	Cylindrical Support
Orientation	Global Coordinate System
Suppressed	No
Options	
Result Selection	All
Display Time	End Time
Results	
Maximum Value Over Time	
X Axis	913.18 N
Y Axis	-41.255 N
Z Axis	5483.5 N
Total	5559.2 N
Minimum Value Over Time	
X Axis	913.18 N
Y Axis	-41.255 N
Z Axis	5483.5 N
Total	5559.2 N
Information	

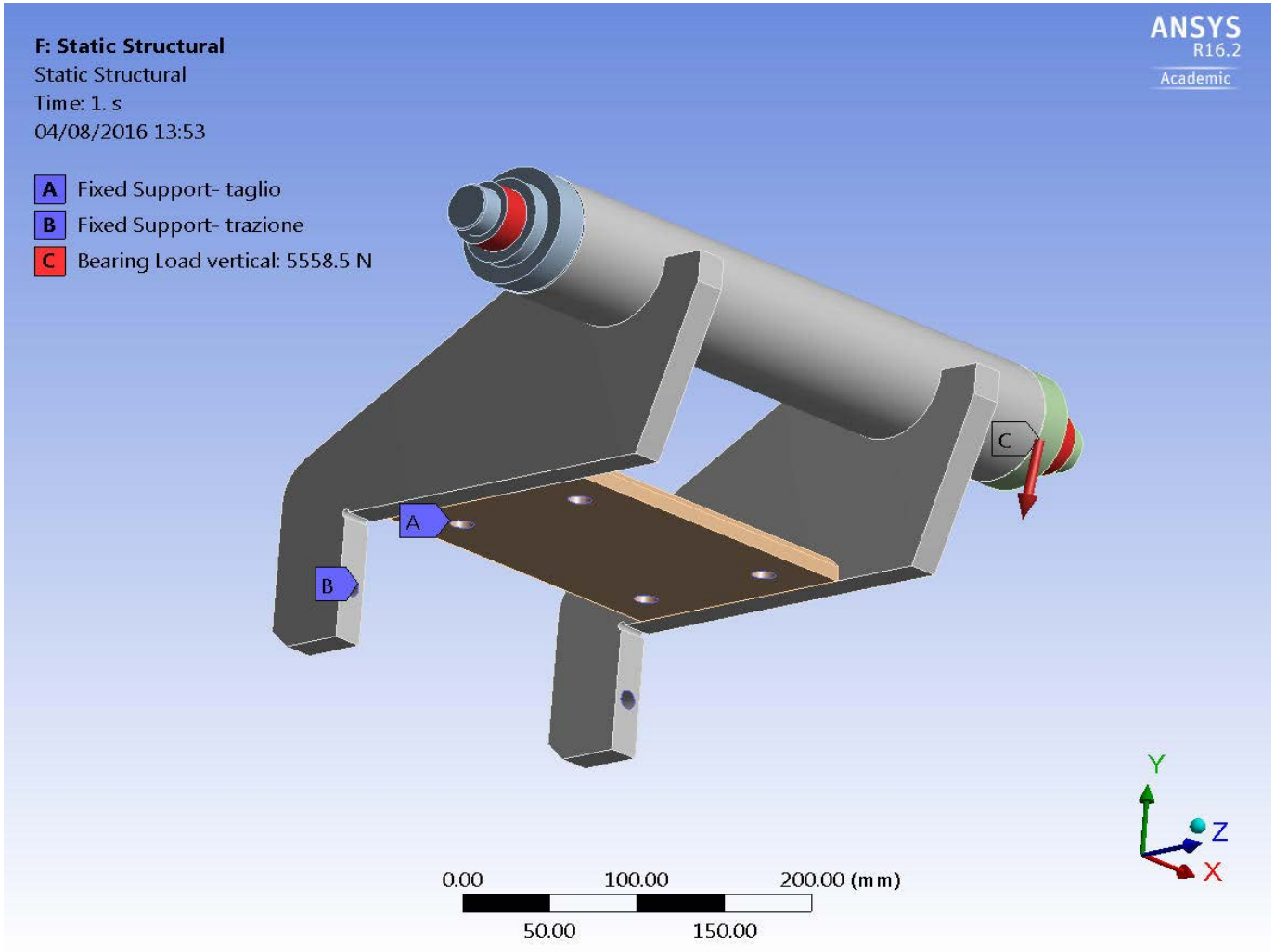
FEM Results: Total Deformation



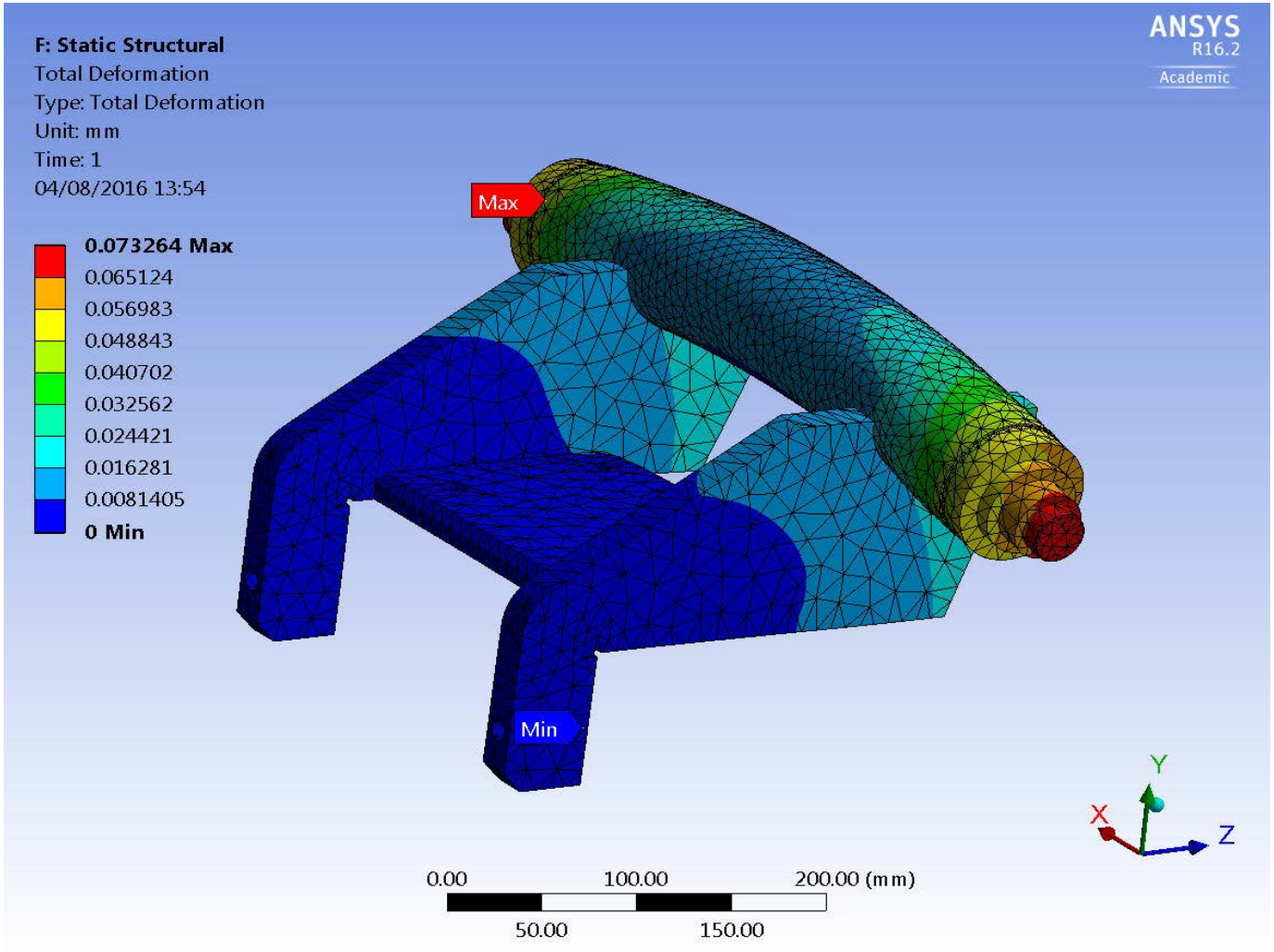
FEM Results: Stress Equivalent



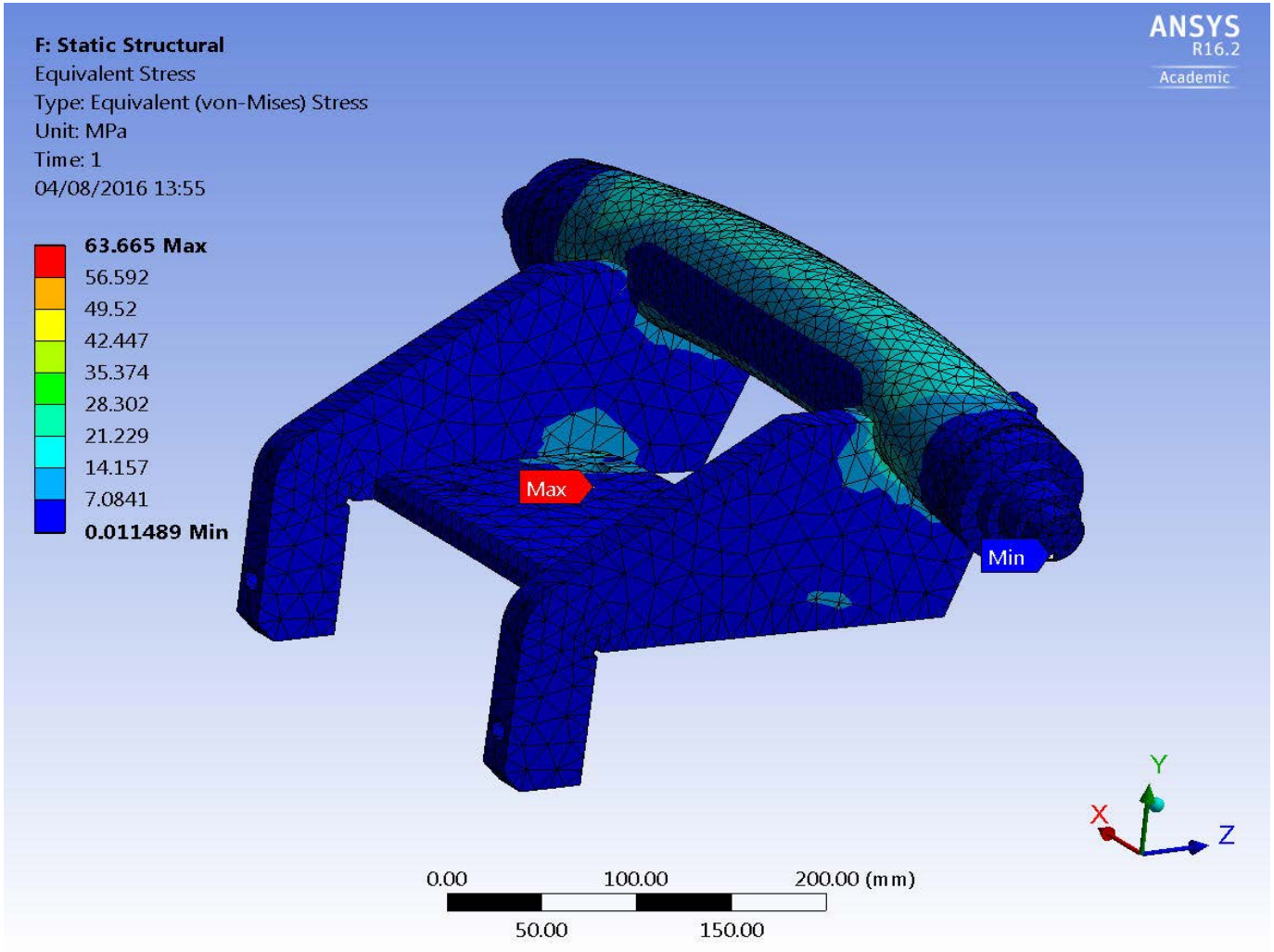
Loads and Constrains



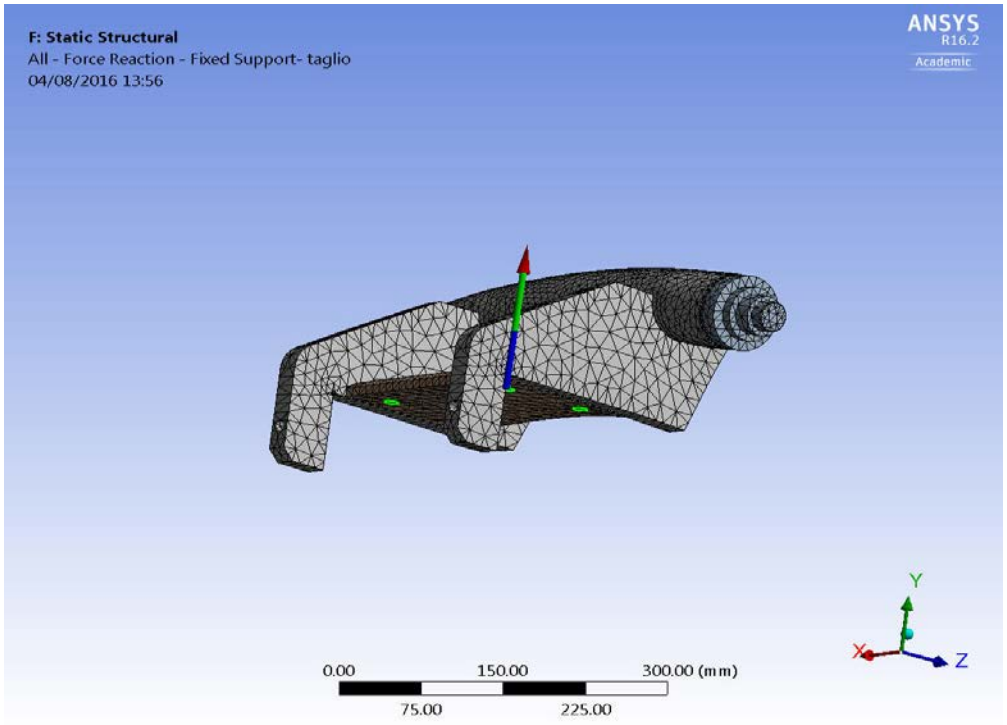
Total Deformations



Stress equivalent: Von Mises



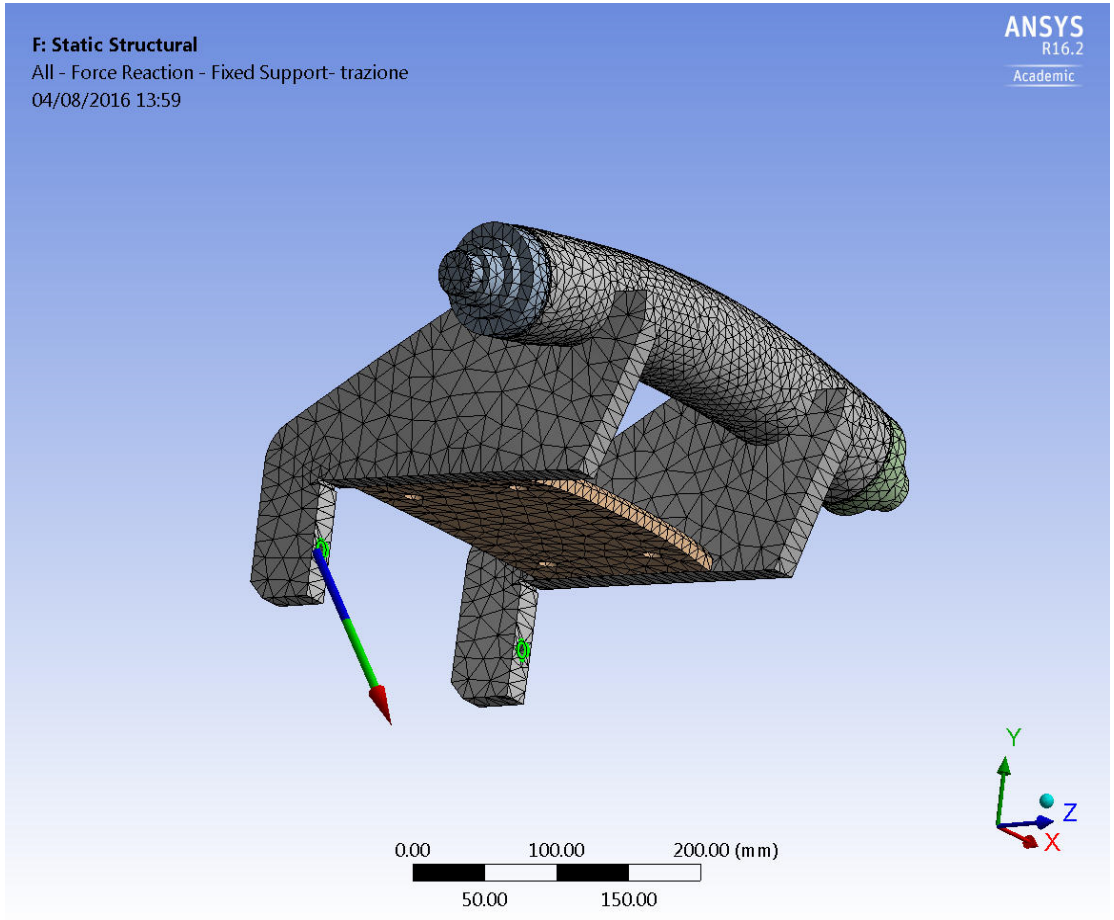
Reaction Force 01



Details of "All - Force Reaction - Fixed Support- taglio"

Definition	
Type	Force Reaction
Location Method	Boundary Condition
Boundary Condition	Fixed Support- taglio
Orientation	Global Coordinate System
Suppressed	No
Options	
Result Selection	All
Display Time	End Time
Results	
Maximum Value Over Time	
X Axis	-1.553 N
Y Axis	6708.5 N
Z Axis	149.79 N
Total	6710.1 N
Minimum Value Over Time	
X Axis	-1.553 N
Y Axis	6708.5 N
Z Axis	149.79 N
Total	6710.1 N

Reaction Force 02



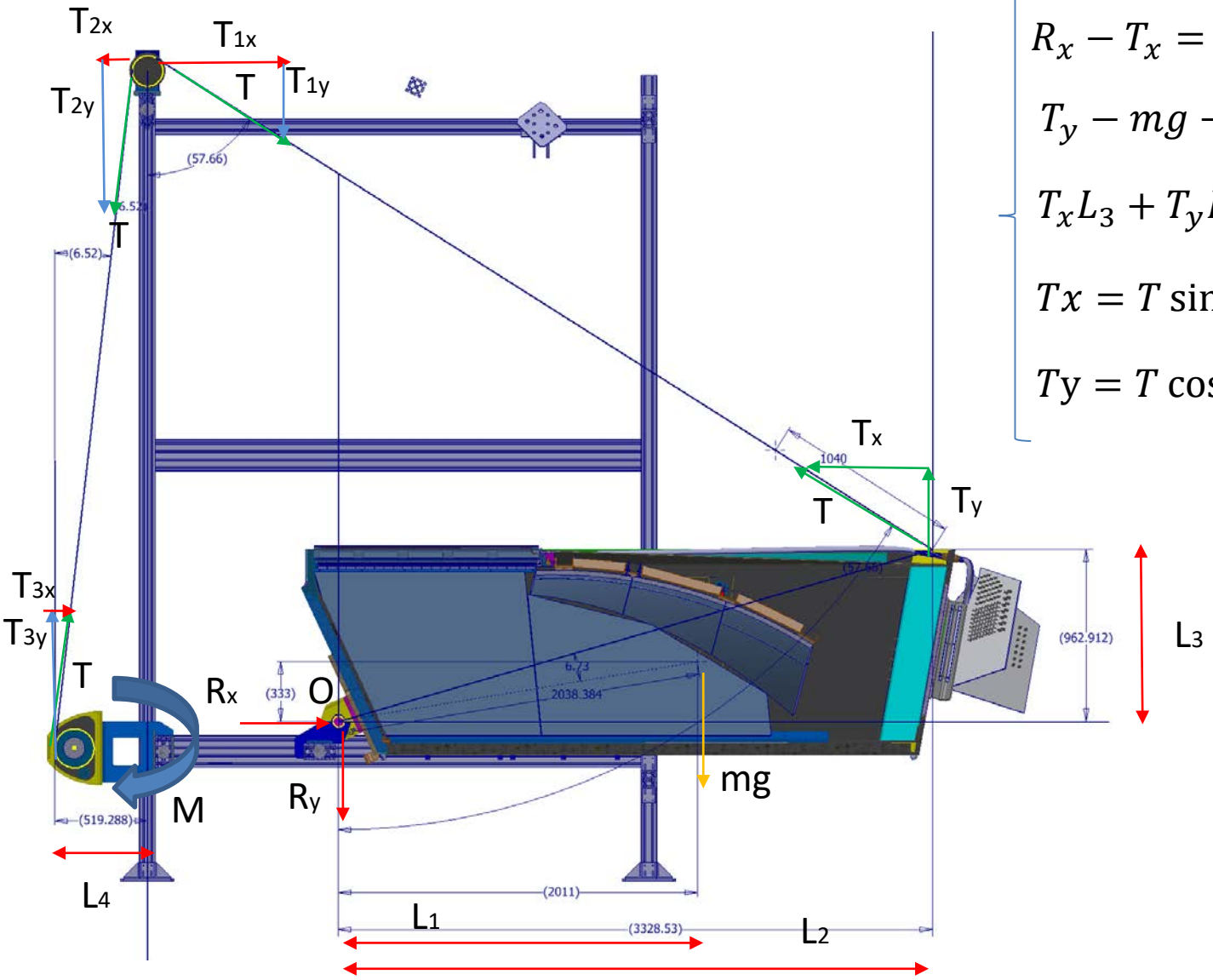
Details of "All - Force Reaction - Fixed Support- trazione"

Definition	
Type	Force Reaction
Location Method	Boundary Condition
Boundary Condition	Fixed Support- trazione
Orientation	Global Coordinate System
Suppressed	No
Options	
Result Selection	All
Display Time	End Time
Results	
Maximum Value Over Time	
X Axis	1.553 N
Y Axis	-1186.4 N
Z Axis	769.72 N
Total	1414.2 N
Minimum Value Over Time	
X Axis	1.553 N
Y Axis	-1186.4 N
Z Axis	769.72 N
Total	1414.2 N

RICH ROTATION

With equipments installed in the case

GEOMETRY: horizontal



$$R_x - T_x = 0$$

$$T_y - mg - R_y = 0$$

$$T_x L_3 + T_y L_2 - mgL_1 = 0$$

$$Tx = T \sin\theta$$

$$Ty = T \cos\theta$$

Force and Torque Equilibrium: **RICH**

assembly completed + stiffening frame

$$R_x - T_x = 0$$
$$T_y - mg - R_y = 0$$
$$T_x L_3 + T_y L_2 - mgL_1 = 0$$
$$Tx = T\sin\theta$$
$$Ty = T\cos\theta$$

$$R_x = T_x$$
$$R_y = T_y - mg$$
$$T\sin\theta\, L_3 + T\cos\theta\, L_2 - mgL_1 = 0$$

$$R_x = T_x$$
$$R_y = T_y - mg$$
$$T = \frac{mgL_1}{L_3\sin\theta + L_2\cos\theta}$$
$$Tx = T\sin\theta$$
$$Ty = T\cos\theta$$

$$R_x = 6549\ \text{N}$$
$$R_y = 4146 - 10000 = -5854\ \text{N}$$
$$T = \frac{\mathbf{1000}*10*2011}{963\sin 57.66 + 3329\cos 57.66} = \mathbf{7751}\ \text{N}$$
$$Tx = 7751\sin 57.66 = 6549\ N$$
$$Ty = 7751\cos 57.66 = 4146\ N$$

Case 02: Loads acting on the Al Frame

Case 02: rotation of the RICH in the EEL124 clean room after **RICH assembly is completed**

In order to take into account the fact that at the end of the assembly the module weight is 1000 kg instead of 600 kg, then all the loads acting on the Al frame have been updated:

$$T1x = 7751 \sin 57.66 = 6549\ N$$
$$T1\mathrm{y} = 7751 \cos 57.66 = 4146\ N$$

$$T2x = 7751 \sin 6.52 = 880\ N$$
$$T2\mathrm{y} = 7751 \cos 6.52 = 7700\ N$$

$$T3x = 7751 \sin 6.52 = 880\ N$$
$$T3\mathrm{y} = 7751 \cos 6.52 = 7700\ N$$

$$M = T3y * \mathrm{L4} = 7700\ N * 0.520\ m = 4004\ Nm$$

$$R_x = -6549\ \mathrm{N}$$
$$R_y = 5854\ \mathrm{N}$$

In this case it is necessary to use two additional stiffening elements between the winch and the pulley. Moreover a link at half height of the two columns is necessary.

Load on Pulley for load case 02

$Trx = T1x - T2x = 6549 - 880 = 5669N$

$Try = T2y + T1y = 7700 + 4146 = 11846N$

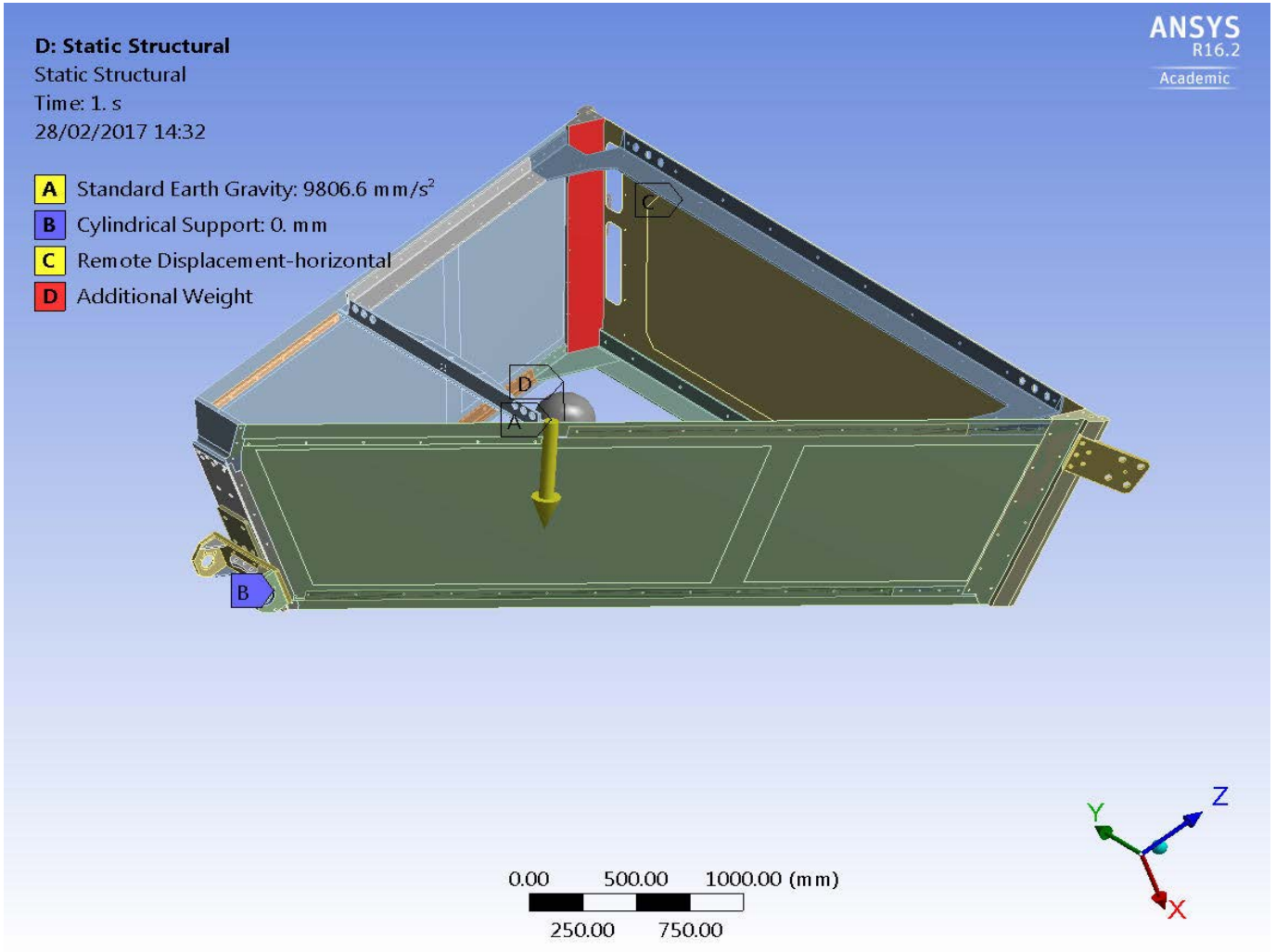
$Tr = \sqrt{(Trx\text{^}2 + Try\text{^}2)} = \mathbf{13132}N$ < 31750 N pulley rate **VERIFIED**

Load on Pivot for load case 02

$R_x = -6549$ N

$R_y = 5854$ N

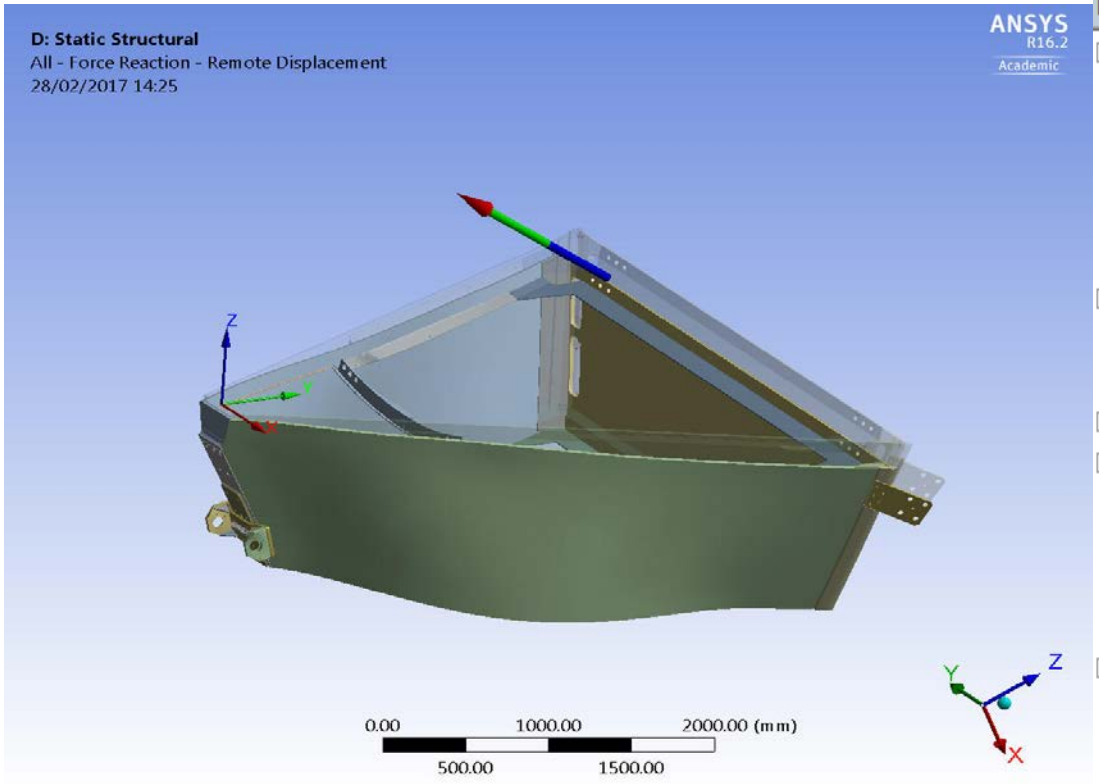
FEM ANALYSIS ANSYS: Supports and loads



FEM Results: LIFT Force

Note: the lift force and the reaction force at the cylindrical support were evaluated by means of the **FEM Ansys code** and it was a cross check of what was evaluated analytically and reported in the two previous slides.

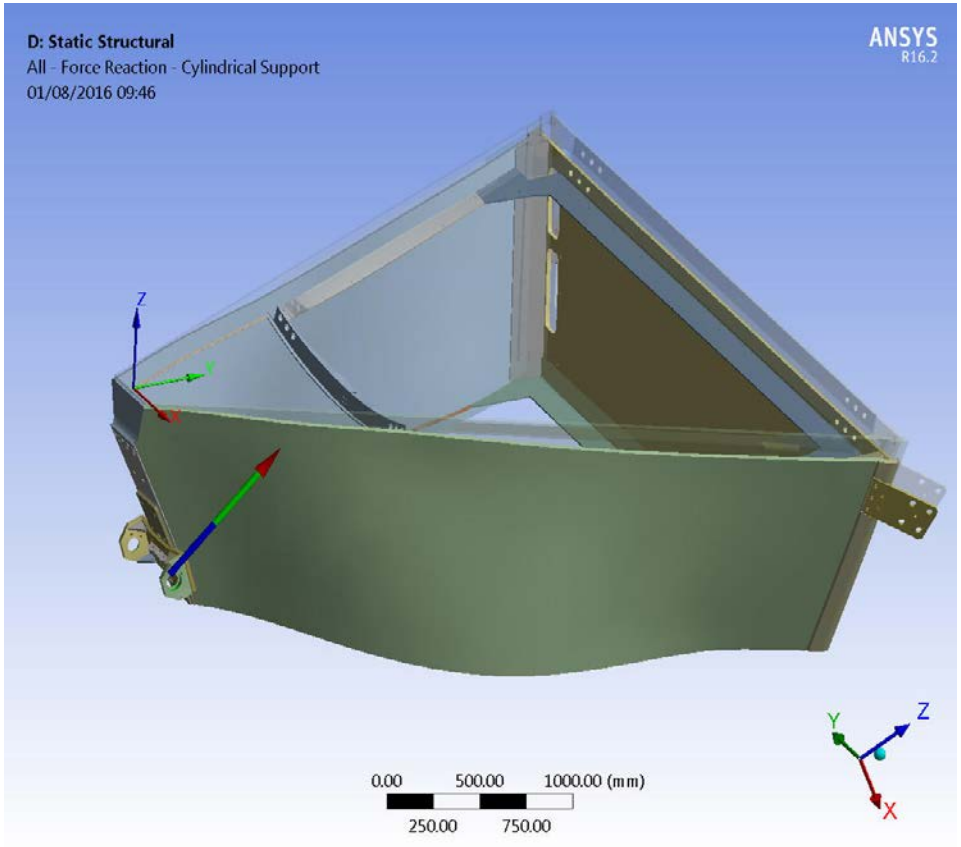
Conclusions: **the FEM results agree with the analytical solution**.



Details of "All - Force Reaction - Remote Displacement"

Definition	
Type	Force Reaction
Location Method	Boundary Condition
Boundary Condition	Remote Displacement-horizontal
Orientation	Coordinate System for remote point
Suppressed	No
Options	
Result Selection	All
Display Time	End Time
Results	
Maximum Value Over Time	
X Axis	-8.1034 N
Y Axis	-6239.8 N
Z Axis	4349.8 N
Total	7606.3 N
Minimum Value Over Time	
X Axis	-8.1034 N
Y Axis	-6239.8 N
Z Axis	4349.8 N
Total	7606.3 N
Information	

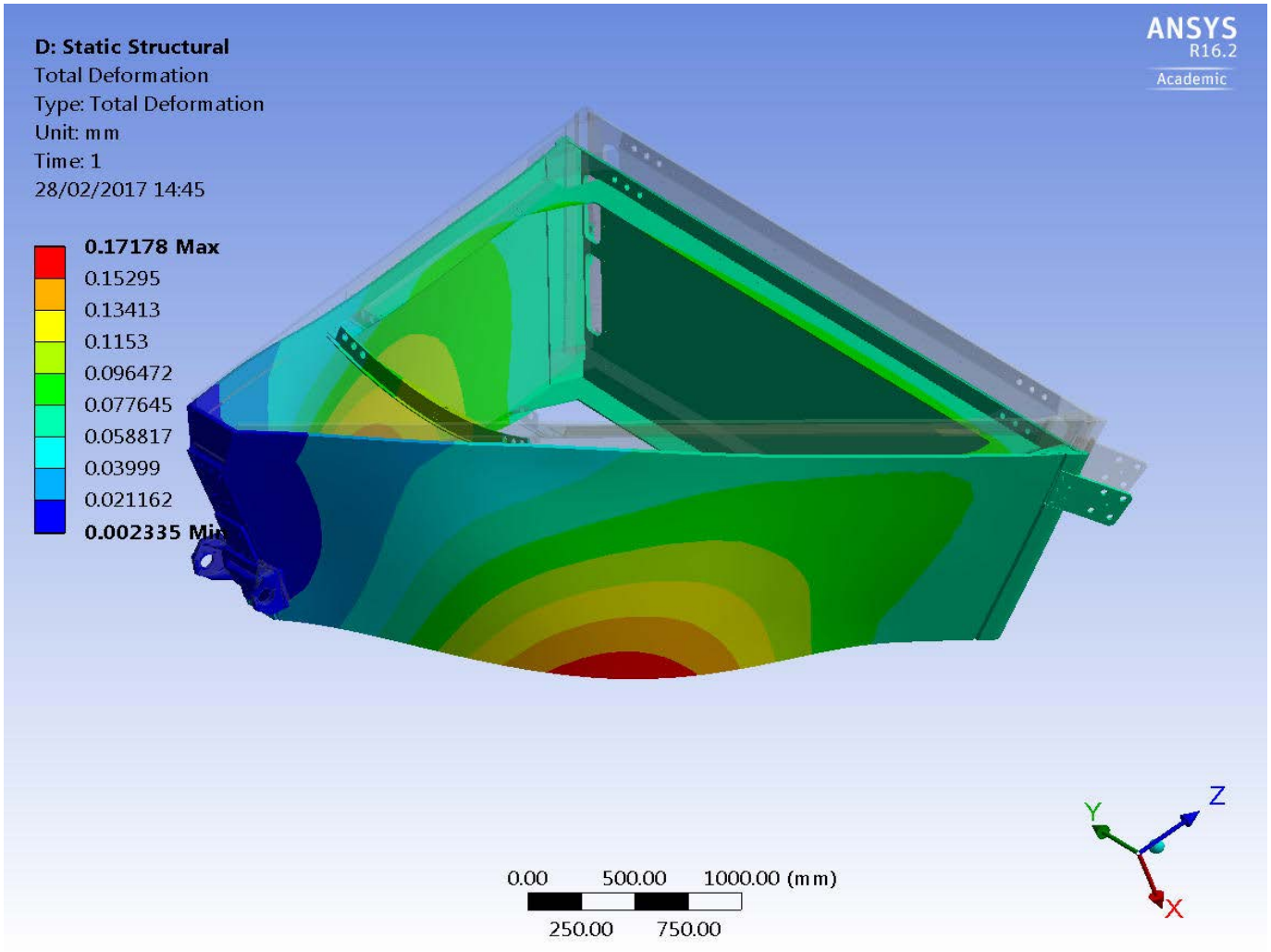
FEM Results: Reaction Force @ Cylindrical Support



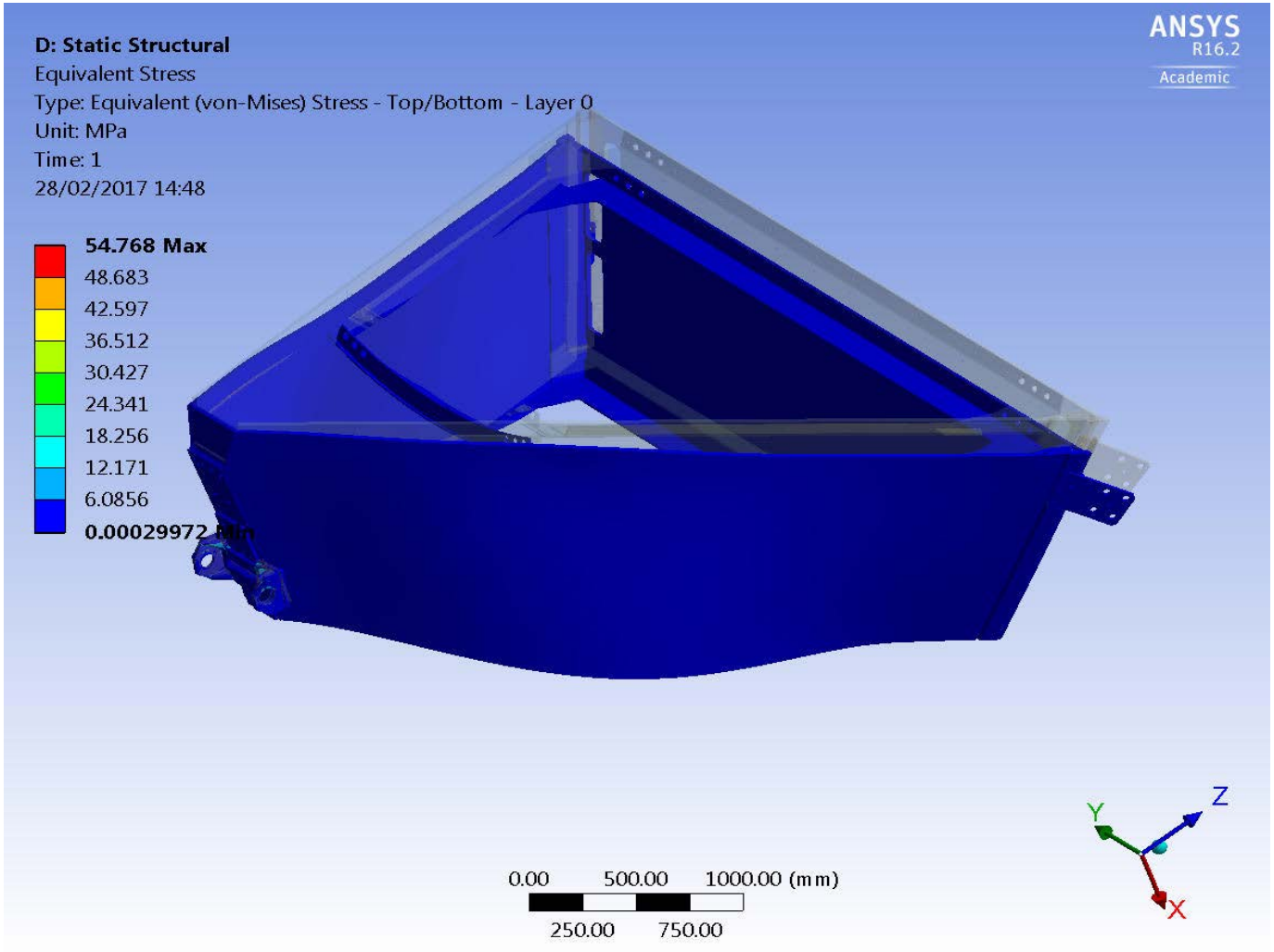
Details of "All - Force Reaction - Cylindrical Support"

Definition	
Type	Force Reaction
Location Method	Boundary Condition
Boundary Condition	Cylindrical Support
Orientation	Coordinate System for remote point
Suppressed	No
Options	
Result Selection	All
Display Time	End Time
Results	
Maximum Value Over Time	
X Axis	8.0973 N
Y Axis	6239.8 N
Z Axis	5890.3 N
Total	8580.8 N
Minimum Value Over Time	
X Axis	8.0973 N
Y Axis	6239.8 N
Z Axis	5890.3 N
Total	8580.8 N
Information	

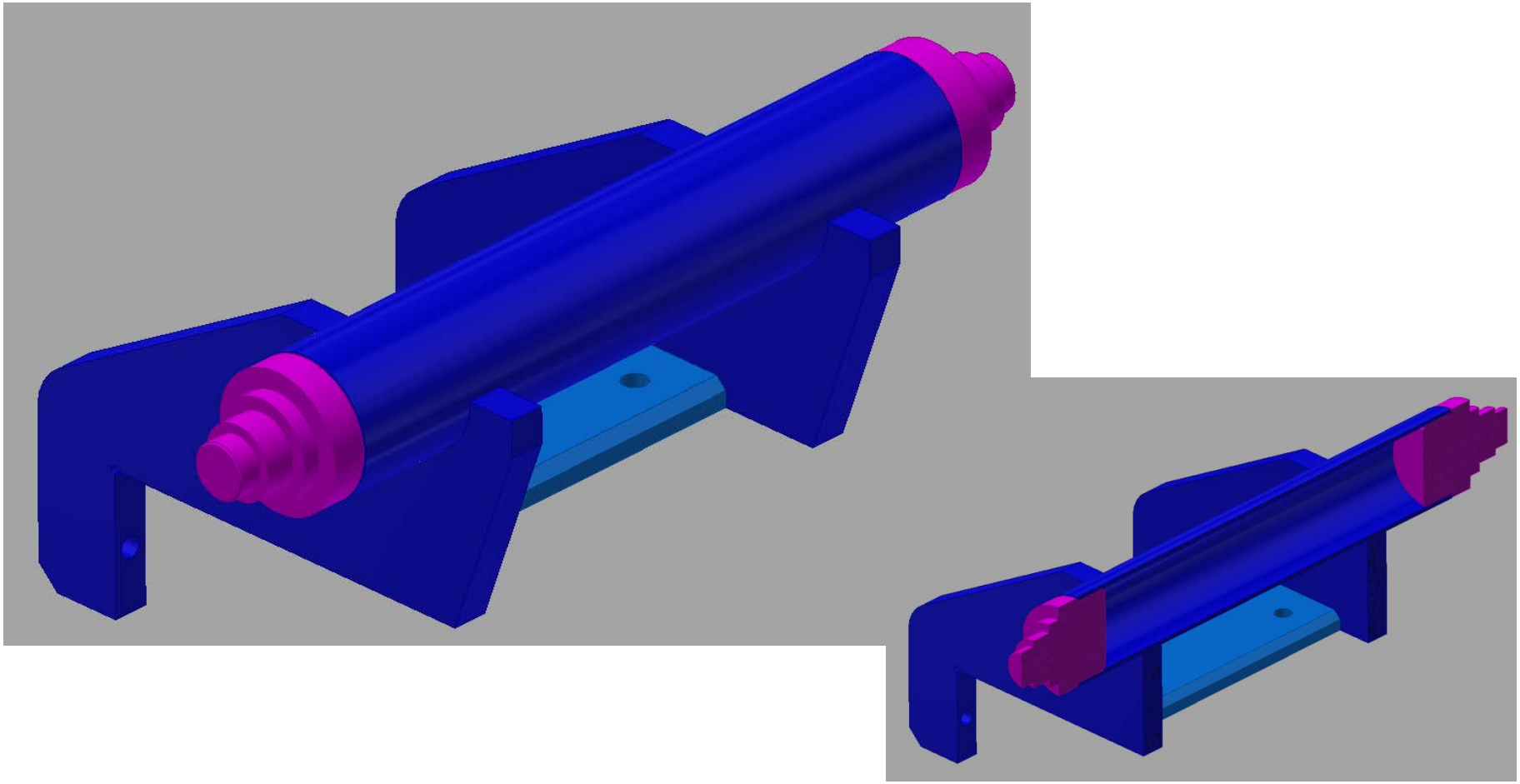
FEM Results: Total Deformation



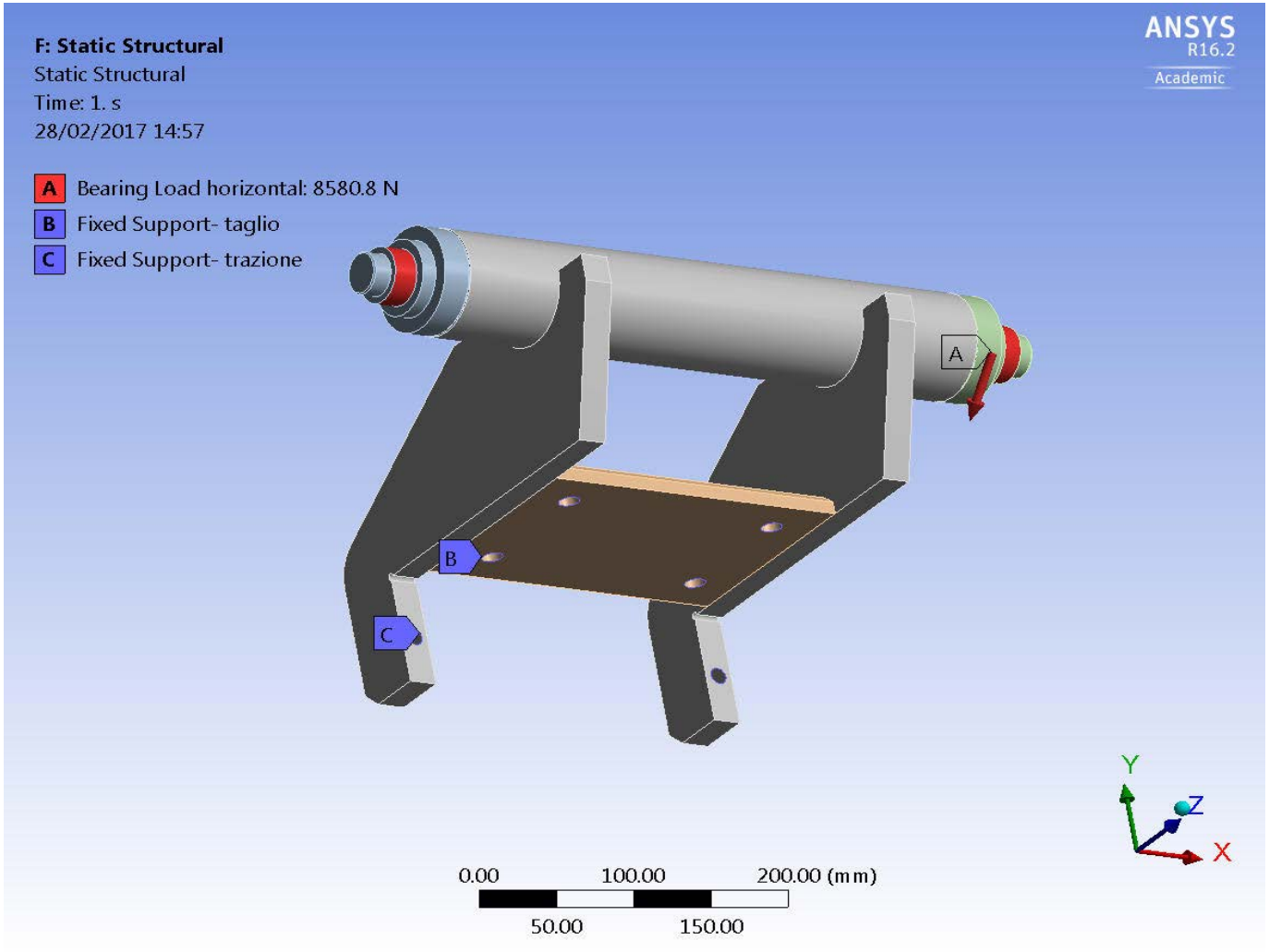
FEM Results: Stress Equivalent



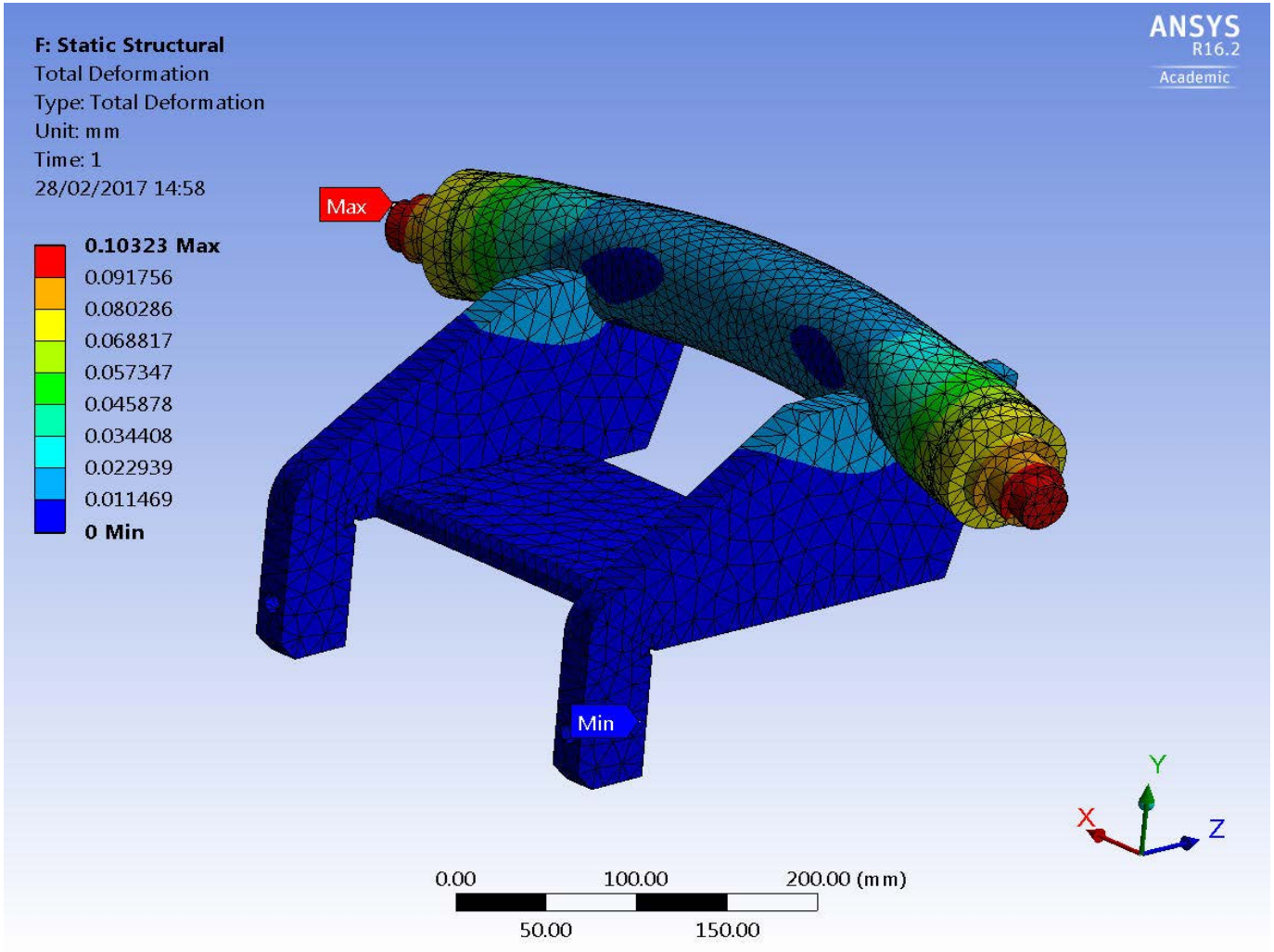
Rotating Base: geometry



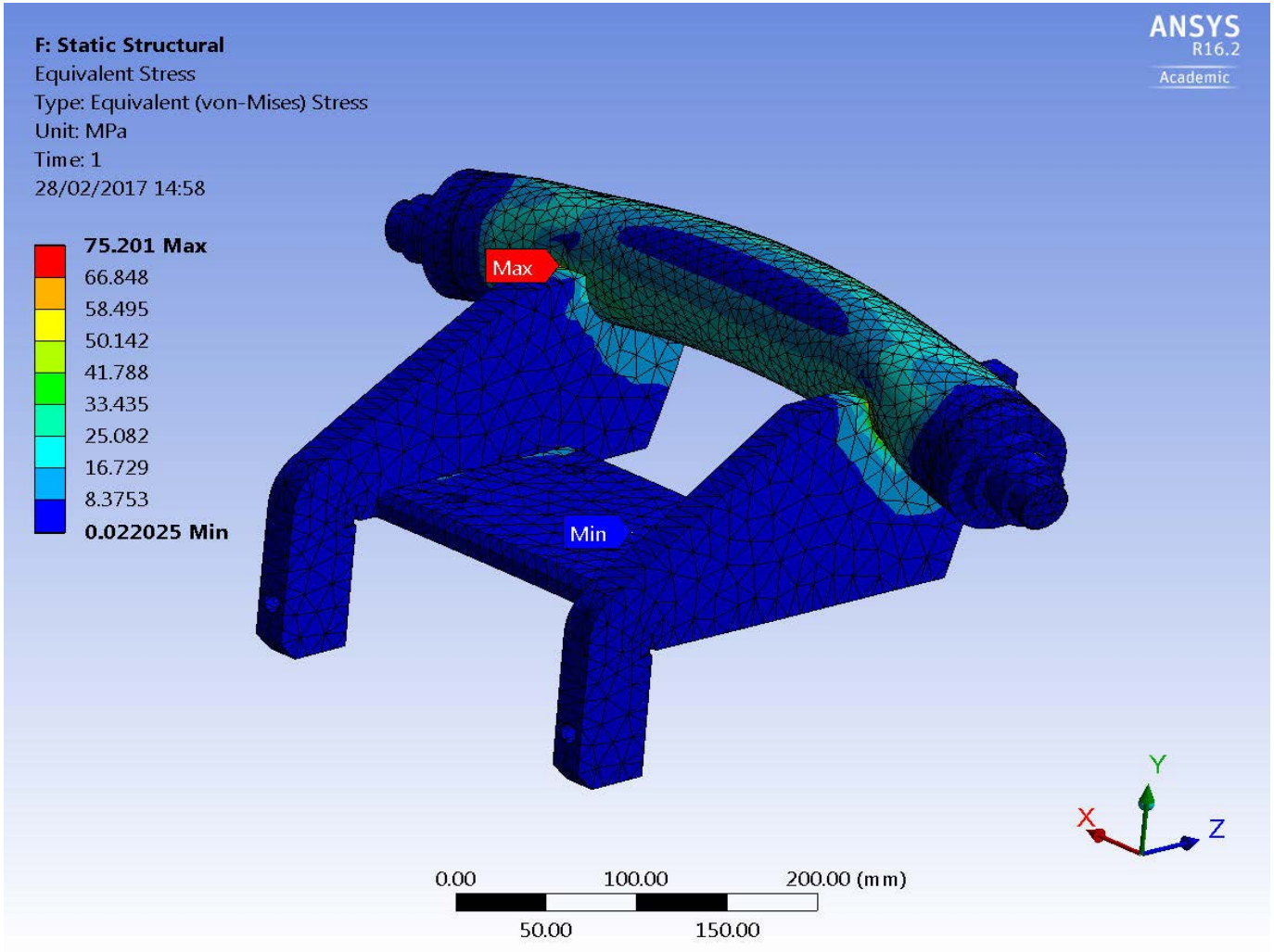
Loads and Constrains



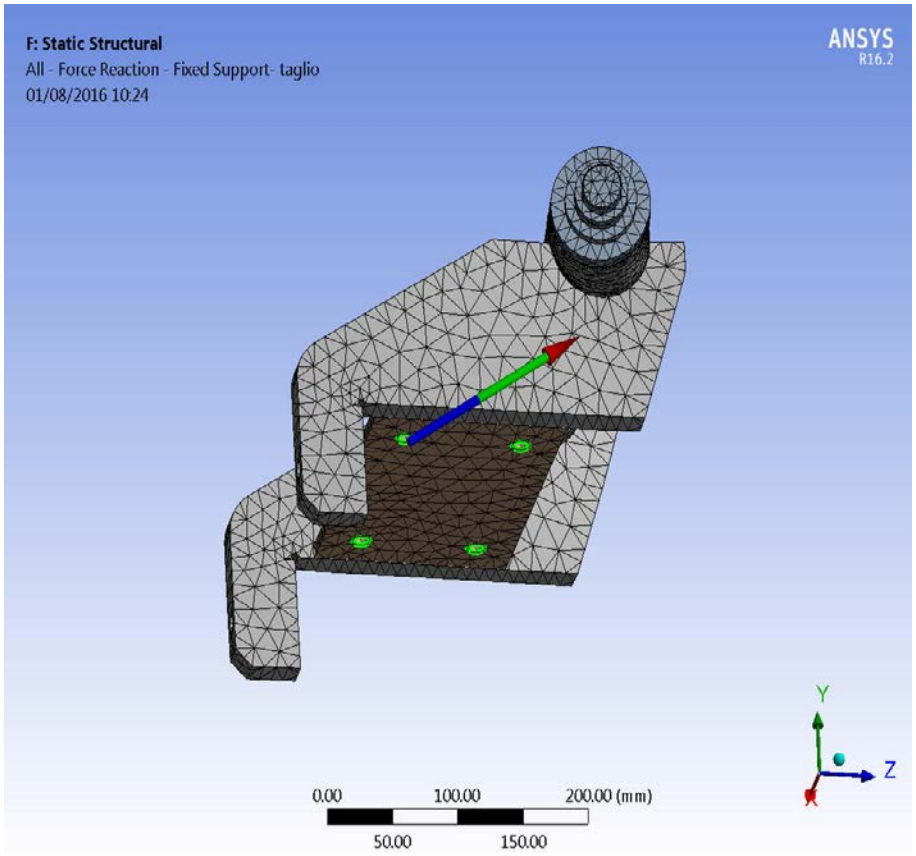
Total Deformations



Stress equivalent: Von Mises



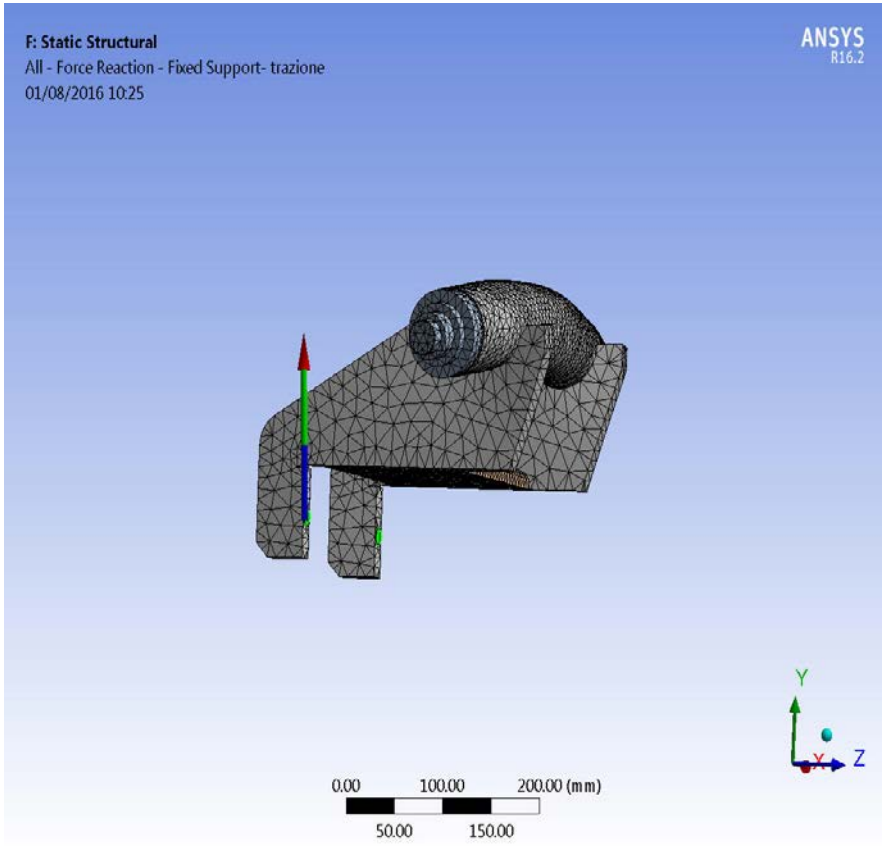
Reaction Force 01



Details of "All - Force Reaction - Fixed Support- taglio"

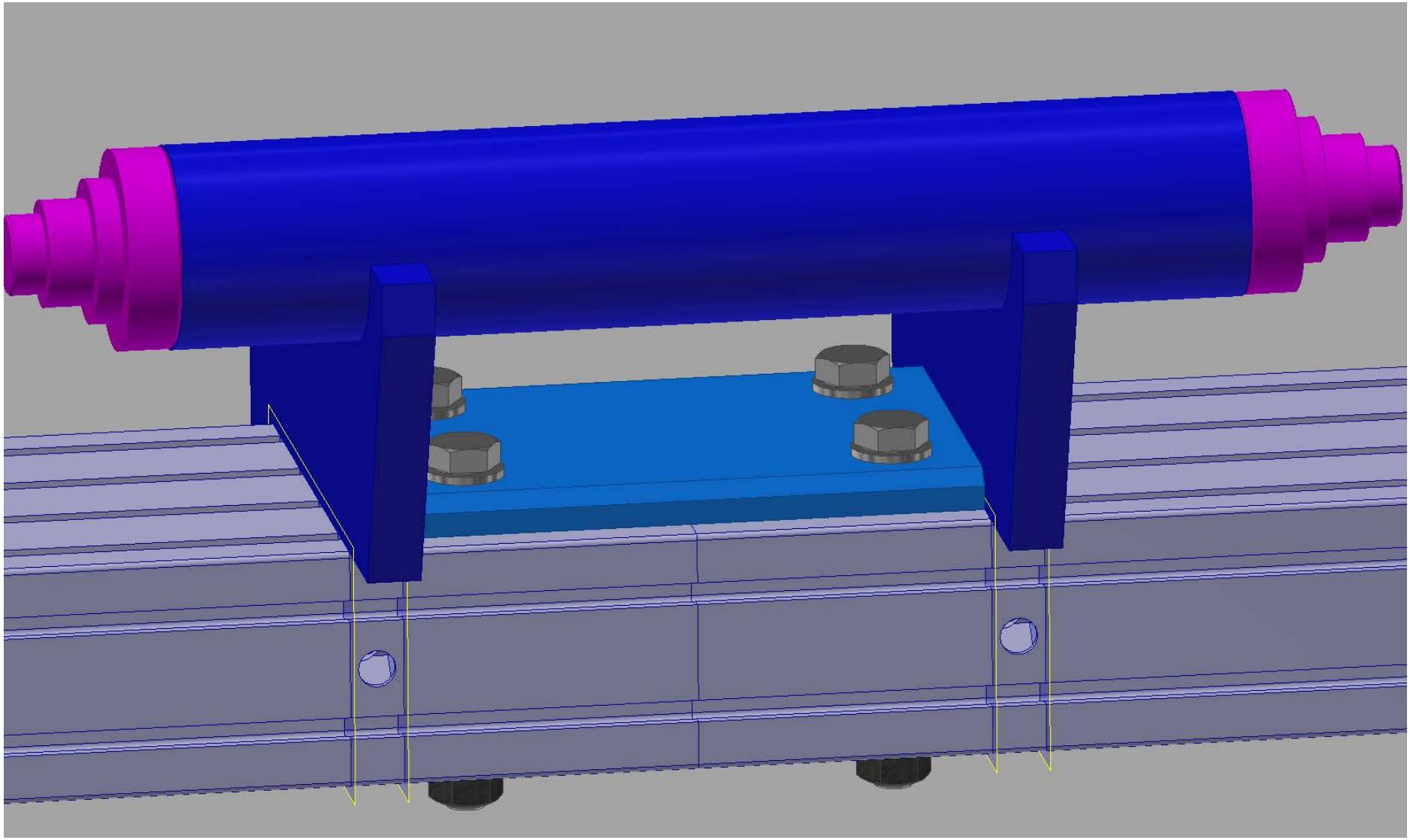
Definition	
Type	Force Reaction
Location Method	Boundary Condition
Boundary Condition	Fixed Support- taglio
Orientation	Global Coordinate System
Suppressed	No
Options	
Result Selection	All
Display Time	End Time
Results	
Maximum Value Over Time	
X Axis	-9.6127 N
Y Axis	4432.1 N
Z Axis	6426.6 N
Total	7806.7 N
Minimum Value Over Time	
X Axis	-9.6127 N
Y Axis	4432.1 N
Z Axis	6426.6 N
Total	7806.7 N
Information	

Reaction Force 02

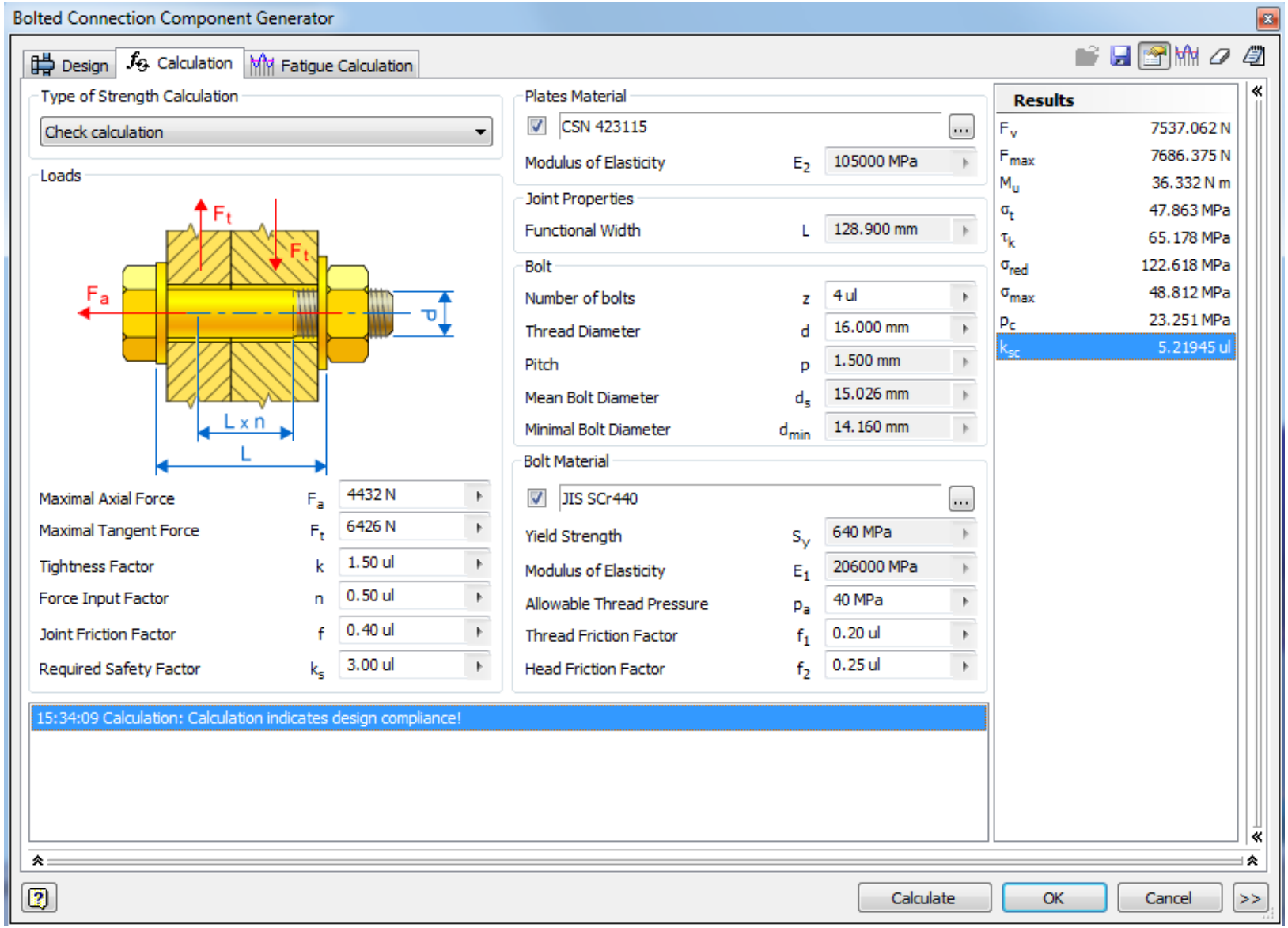


Details of "All - Force Reaction - Fixed Support- trazione"	
Definition	
Type	Force Reaction
Location Method	Boundary Condition
Boundary Condition	Fixed Support- trazione
Orientation	Global Coordinate System
Suppressed	No
Options	
Result Selection	All
Display Time	End Time
Results	
Maximum Value Over Time	
X Axis	9.6127 N
Y Axis	1593.7 N
Z Axis	-42.796 N
Total	1594.3 N
Minimum Value Over Time	
X Axis	9.6127 N
Y Axis	1593.7 N
Z Axis	-42.796 N
Total	1594.3 N
Information	

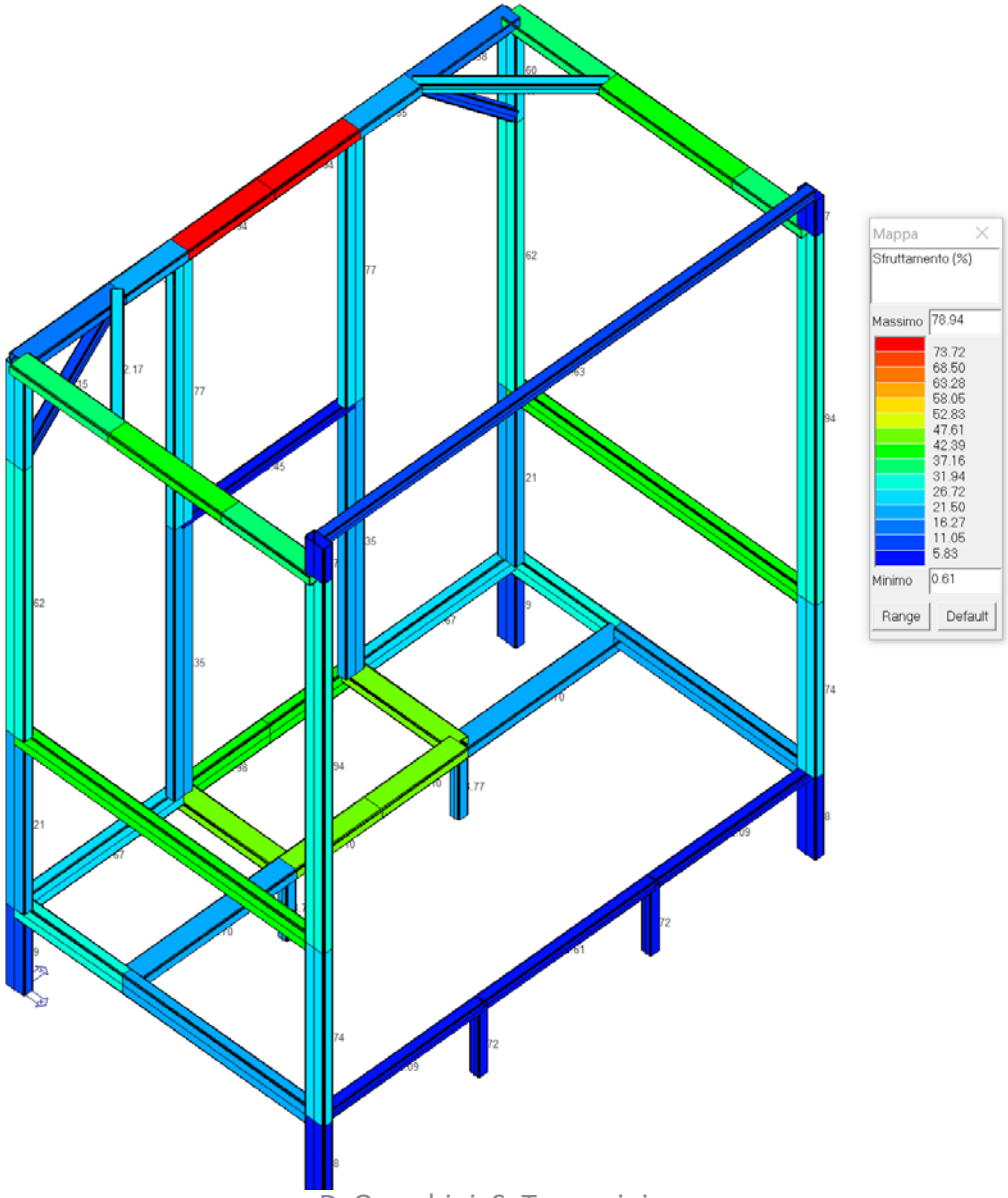
Bolted connection: geometry



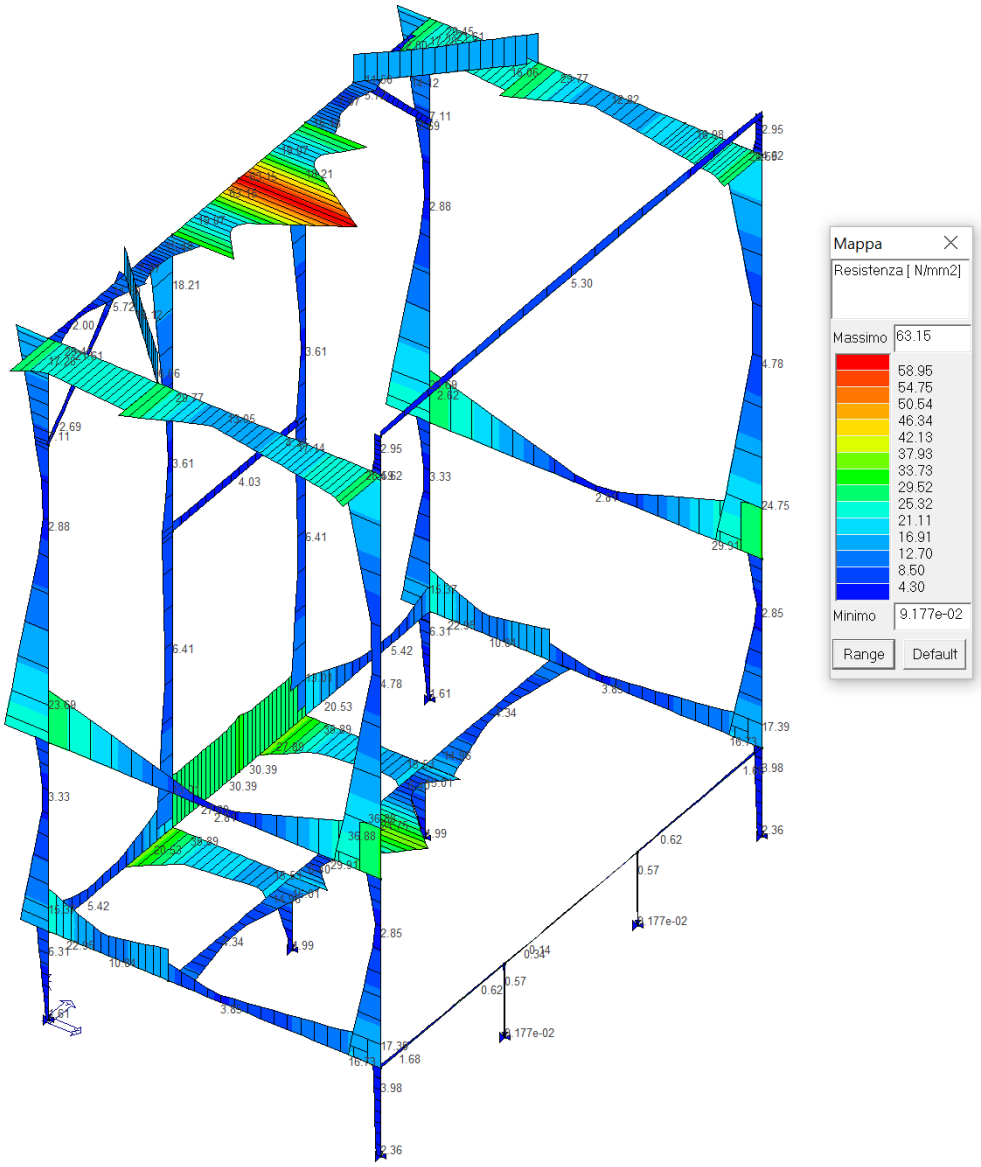
Bolted connection check



Calculation of the Al Frame (Prosap)



Calculation of the Al Frame (Prosap)



Installation procedure for the electronic panel

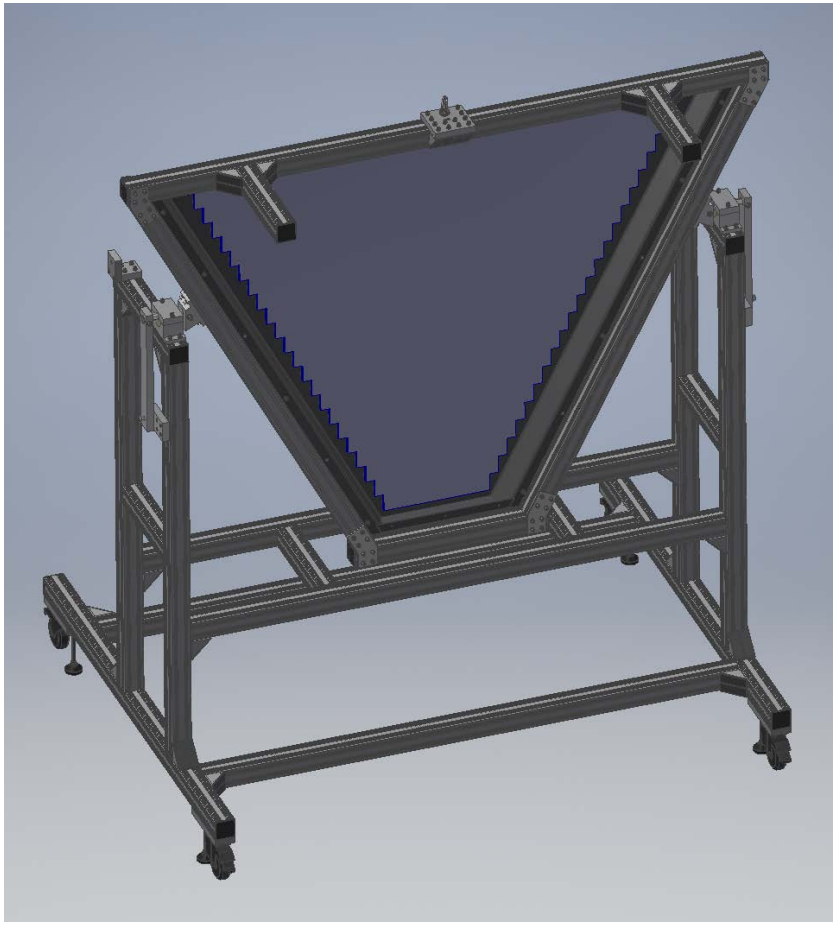
G. Fuga, D. Orecchini, S. Tomassini

Notes and recommendations

- The panel will be installed in the RICH with FE electronics mounted and fully cabled, with MAPMT window uncovered
- The panel must be handled with great care to avoid damages to the MAPMTs
- Use powder free nitrile gloves during all the phases of the assembly procedure
- The expected weight is about 120 kg

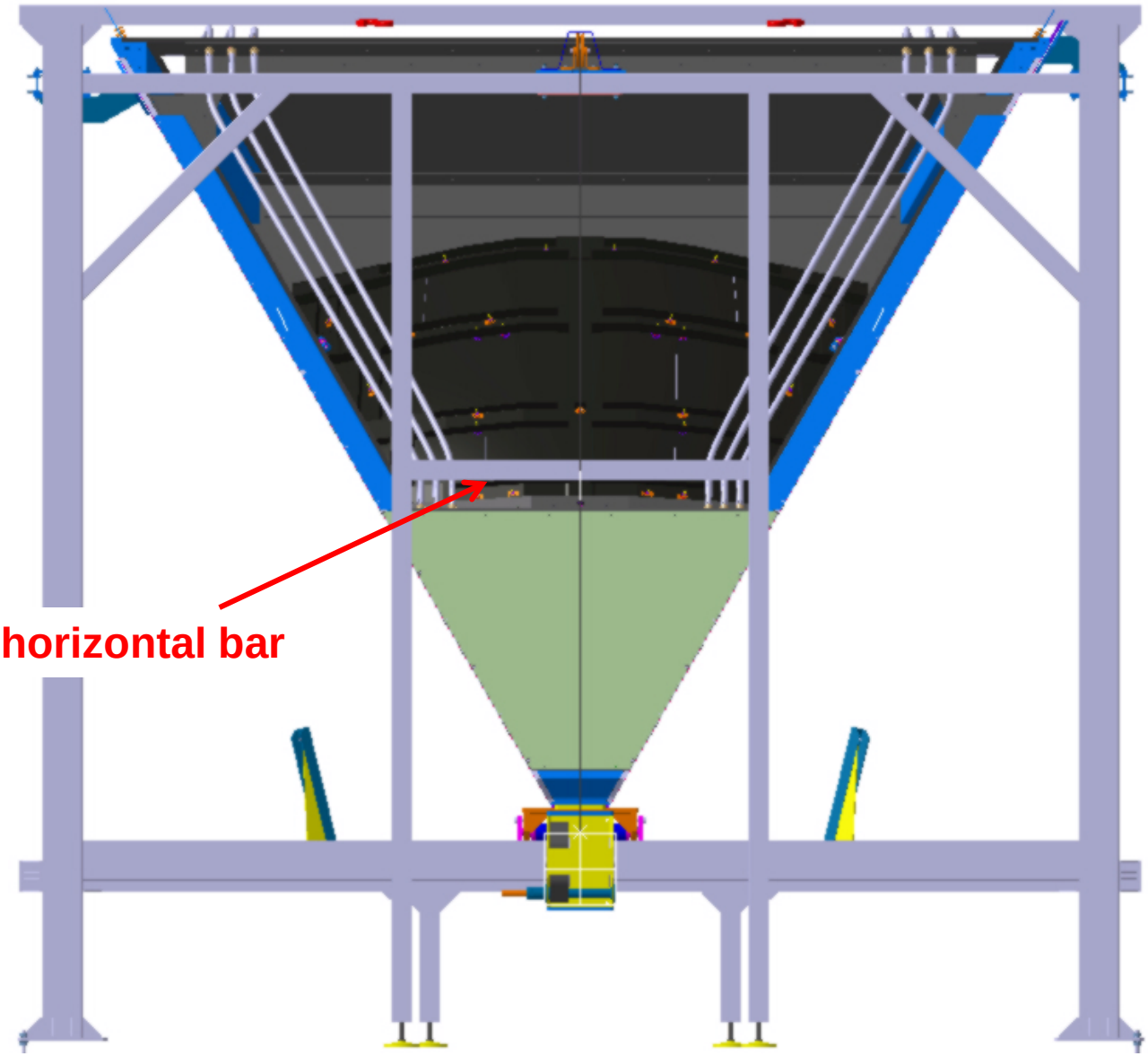
Electronic panel installation

Front side: MAPMT window



Back side: FE electronics

Preparation of the assembly structure

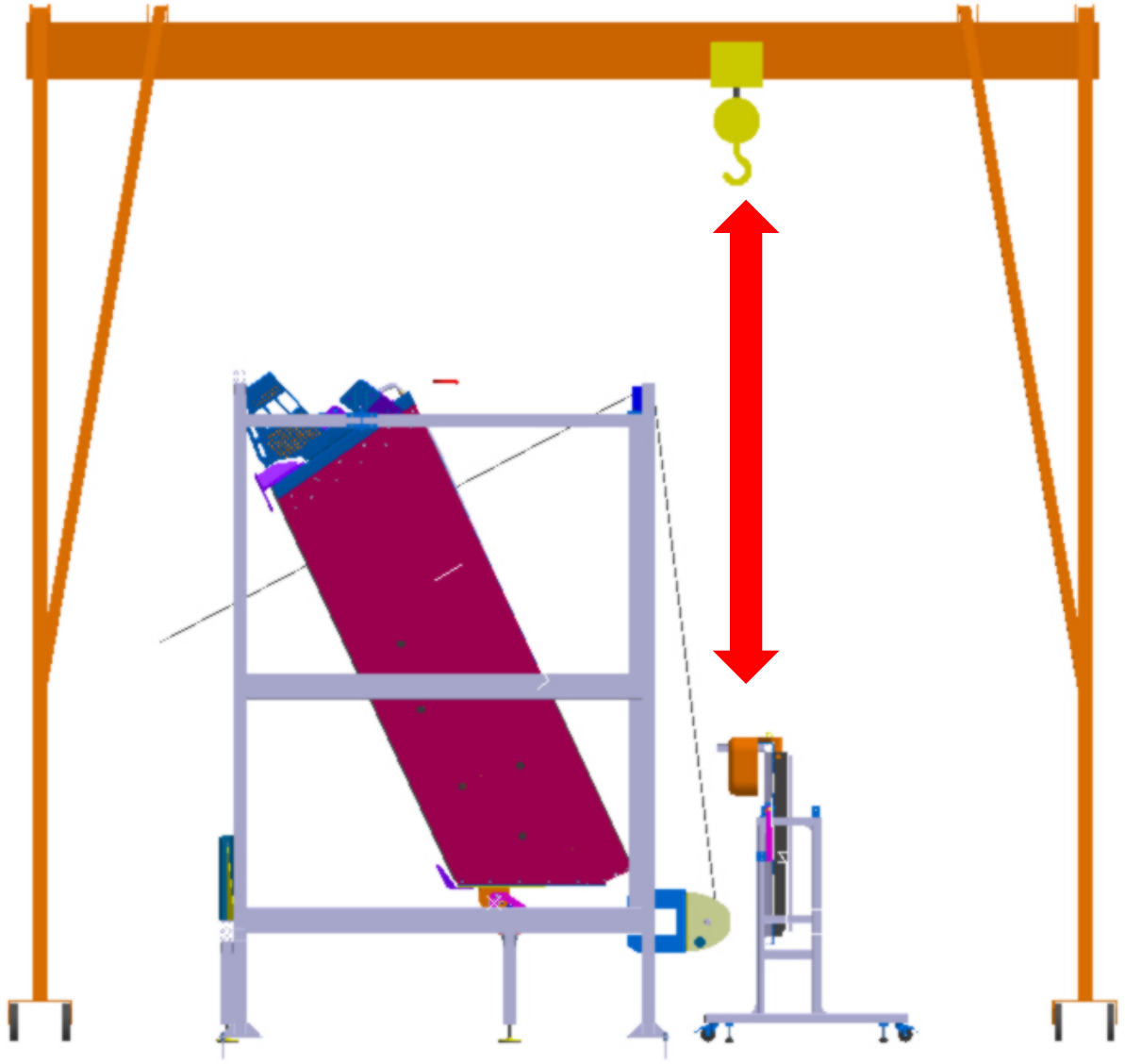


Lifting the panel - 1

Bring the electronic panel support in front of the exit window of the RICH

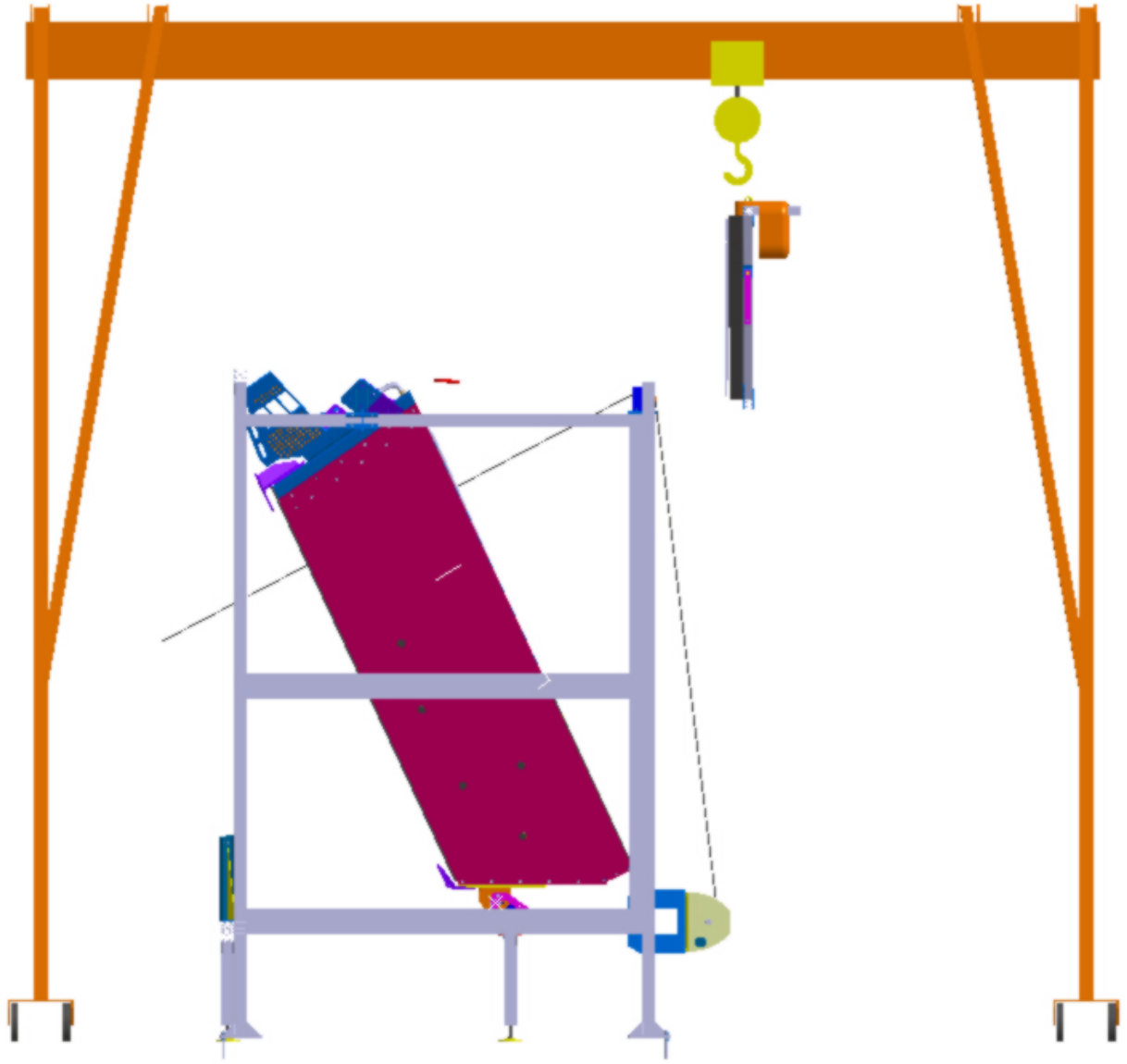
Hook the panel frame eyebolt to the crane

Then release the frame from the support

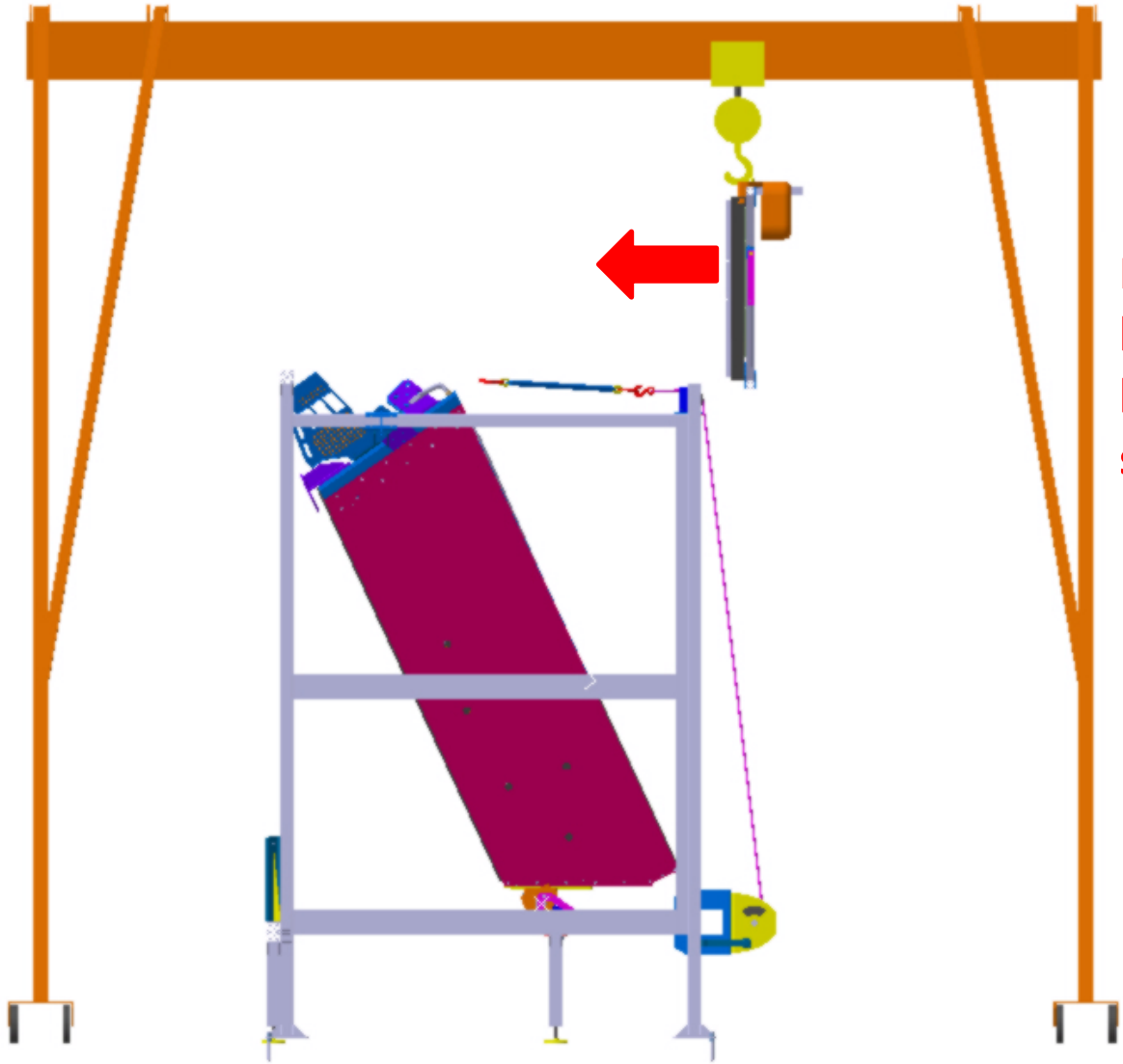


Lifting the panel - 2

Lift the panel to climb over the upper beam of the assembly structure

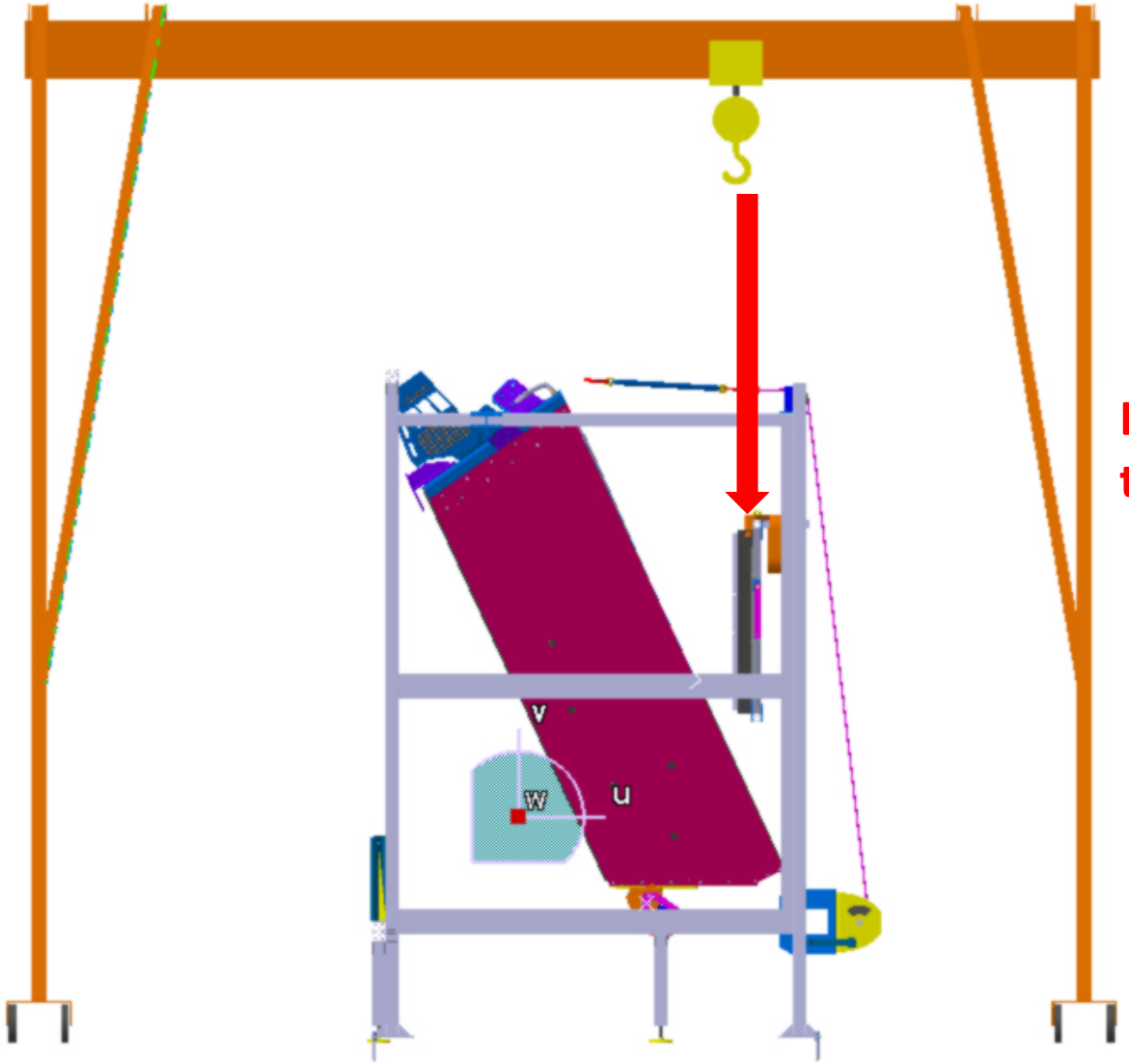


Lifting the panel -3



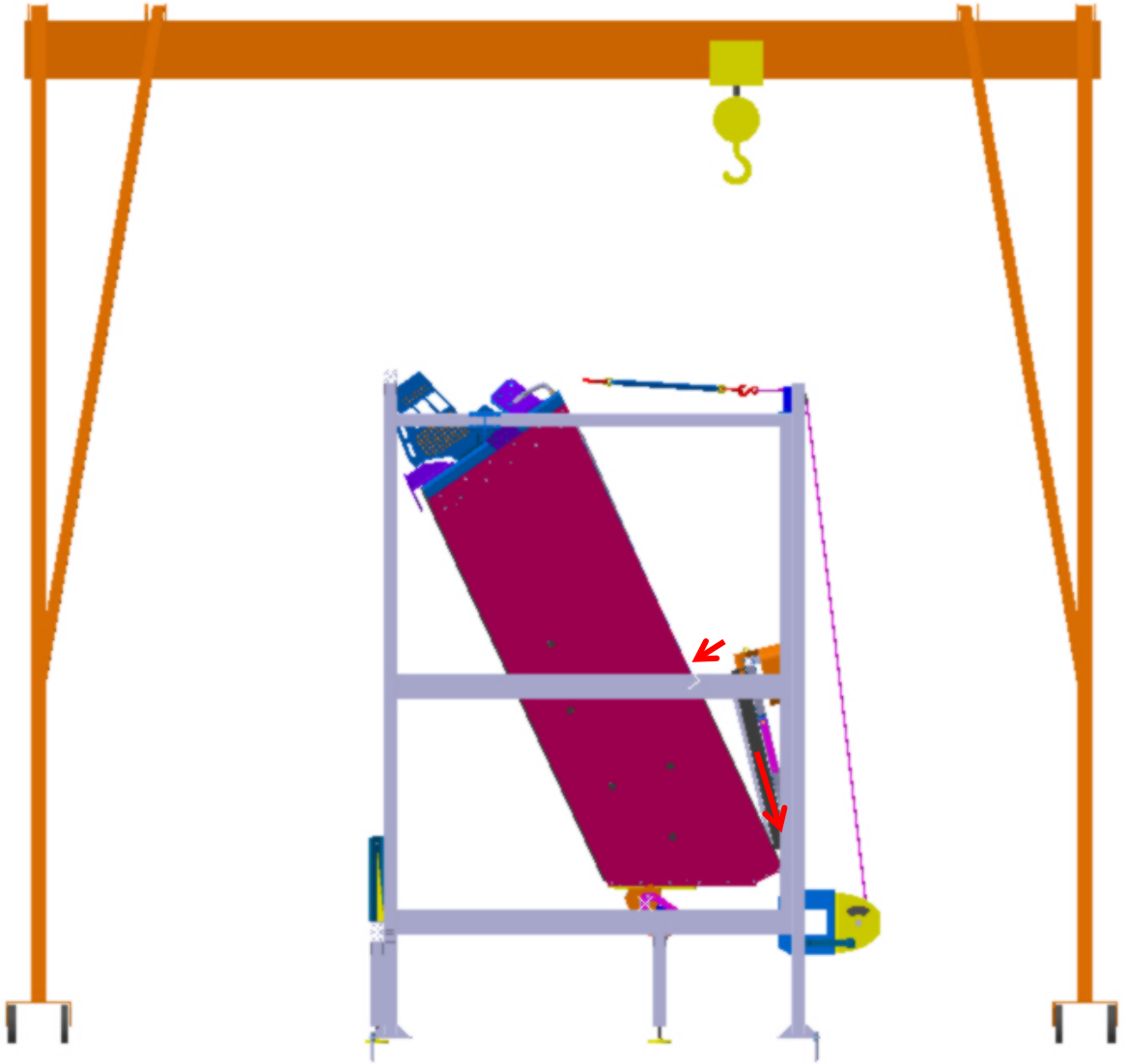
Move forward the crane hook beyond the upper beam of the assembly structure

Lowering the panel - 1



Lower the panel toward the bottom of the RICH

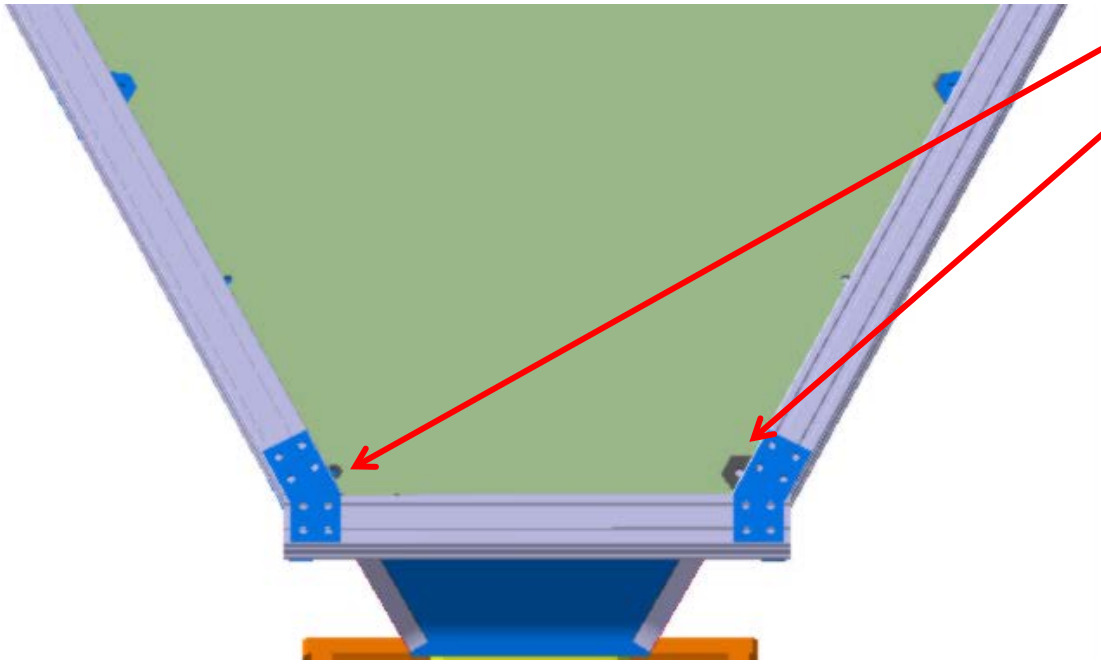
Lowering the panel - 2



Lean the panel to the bottom of the RICH

Rotate the panel to insert it in the bottom of the RICH

Securing the panel to the RICH



Put in place the two lower screws to fix the panel to the RICH

Leave the screws loose

Releasing the frame - 1

Unscrew the brackets from the panel

head of the screw on the external side

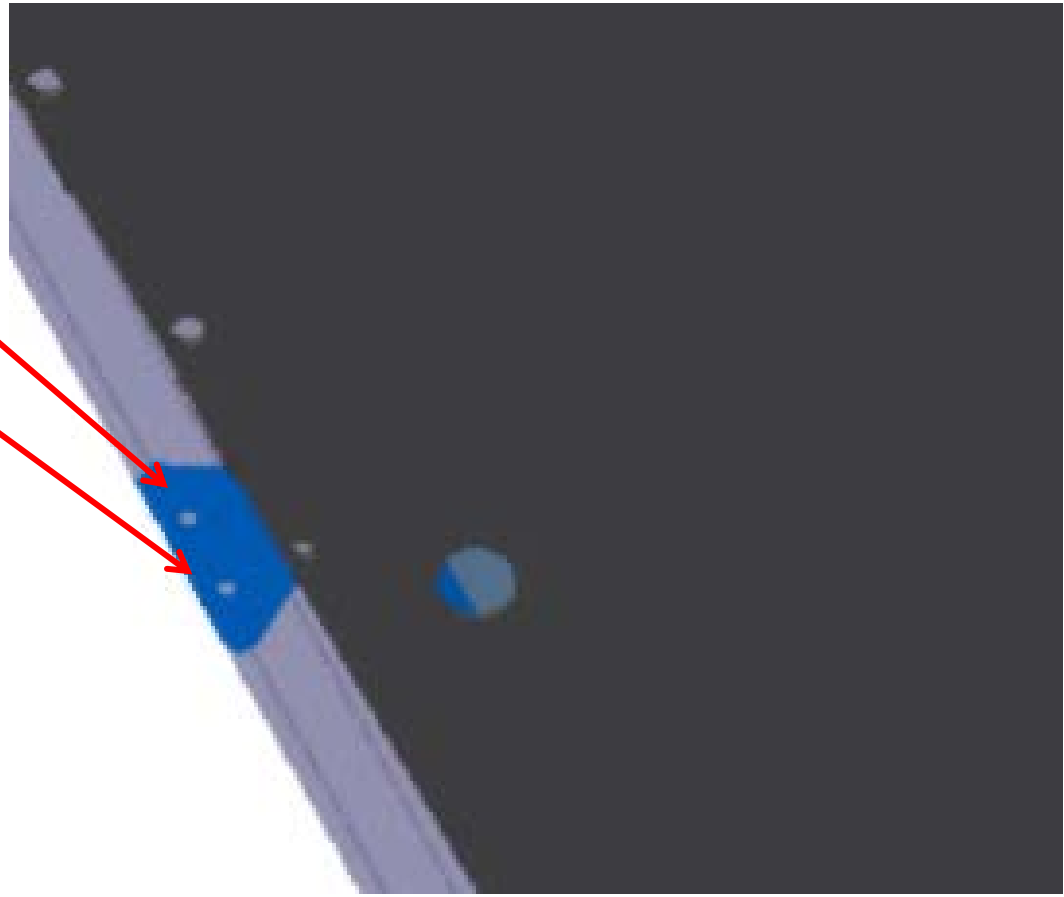
screwed hole on the bracket

Releasing the frame - 2

Unscrew all the brackets from the frame

Remove the supporting frame with the crane

Secure all the screws on the RICH



Electronic boards
Mechanical assembly procedure

D. Orecchini, V. Lucherini, A. Viticchie',
A. Orlandi, S. Tomassini, M. Mirazita

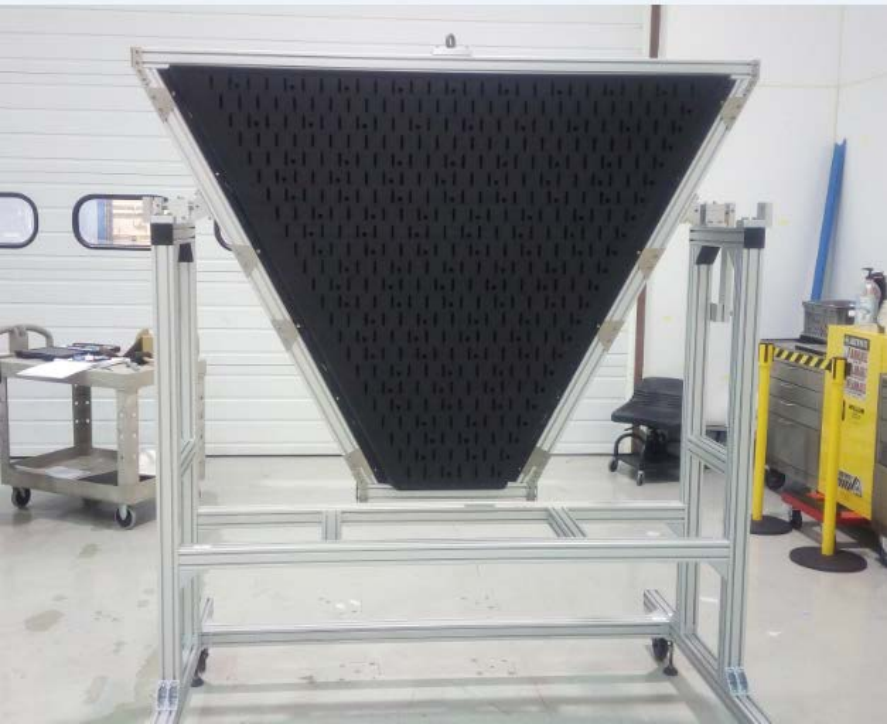
Notes and recommendations

- The FE electronics is organized in tiles of three boards: adapter, MAROC and FPGA
- The boards are assembled on the carbon fiber electronic panel following a well defined sequence.
- There are 115 tiles servicing 3 MAPMTs (3x) and 23 tiles servicing 2 MAPMTs (2x)
- The adapter and MAROC boards have two variants (2x and 3x), the FPGA is the same for all the tiles
- The adapter and the MAPMTs are on the side of the panel toward the inside of the RICH, the MAROC and the FPGA on the side toward the outside of the RICH

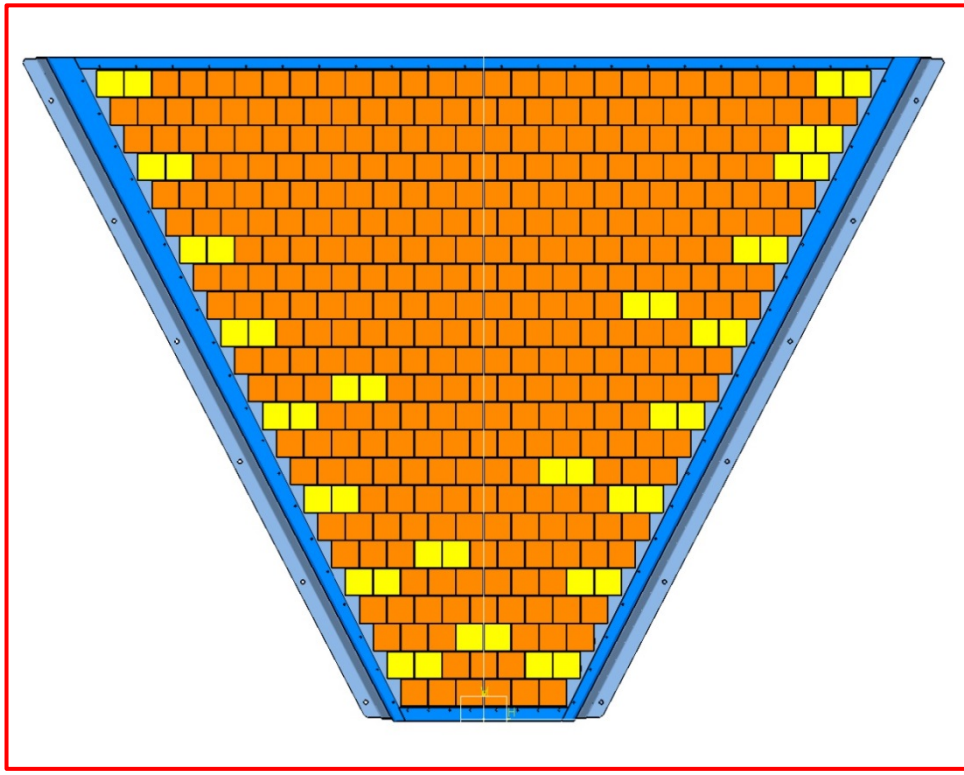
- Use powder free nitrile gloves during all the phases of the assembly procedure
- Avoid to touch the glass window of the MAPMTs
- Secure the nuts by hand, don't use tools

- The assembly sequence should start from the top row
- Plugging in the MAPMTs should be last operation of the tile assembly

Electronic panel mounted on the assembly support

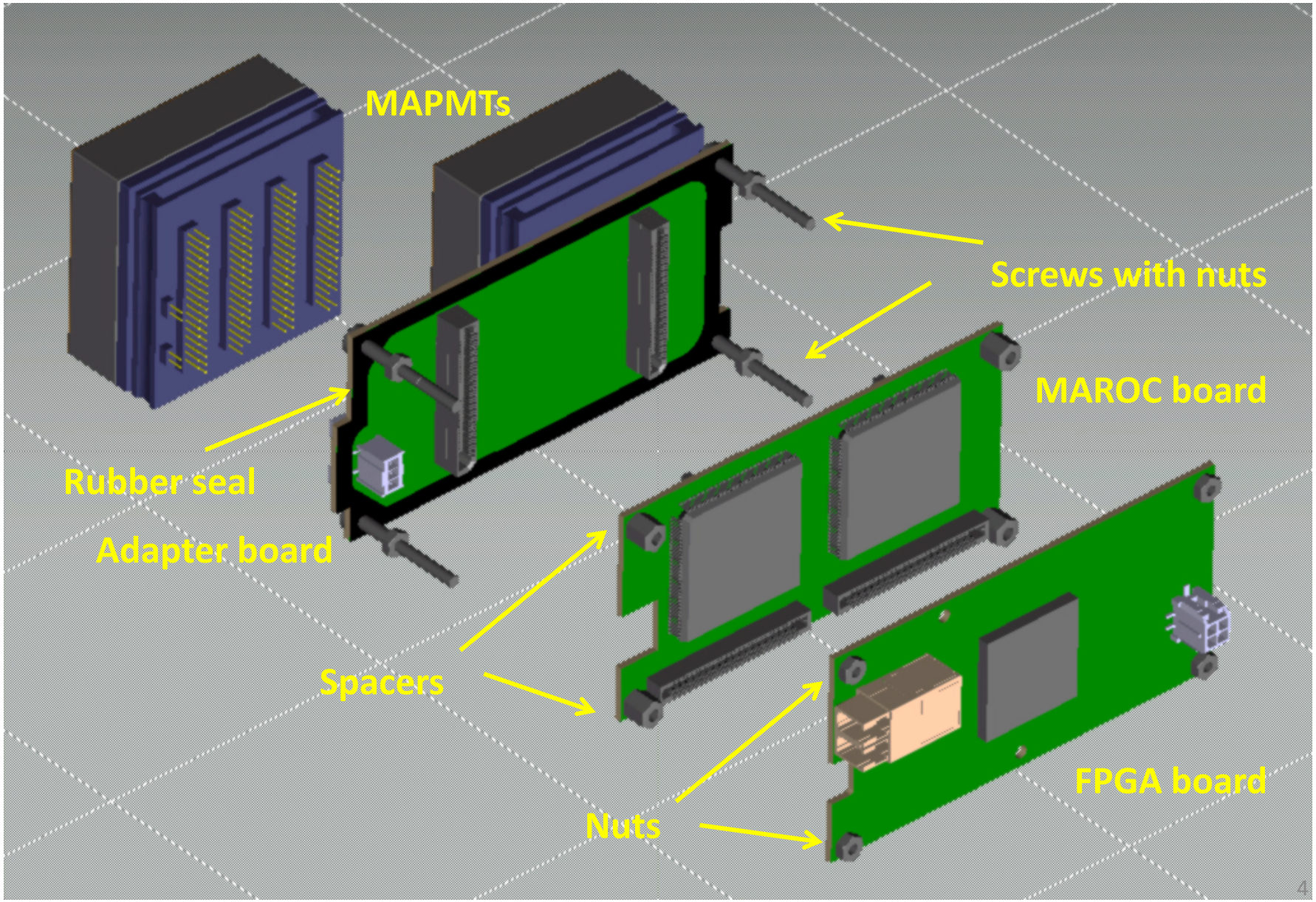


Scheme of the tile assembly on the panel, as seen from the MAPMT side
In yellow are indicated the 2x tiles

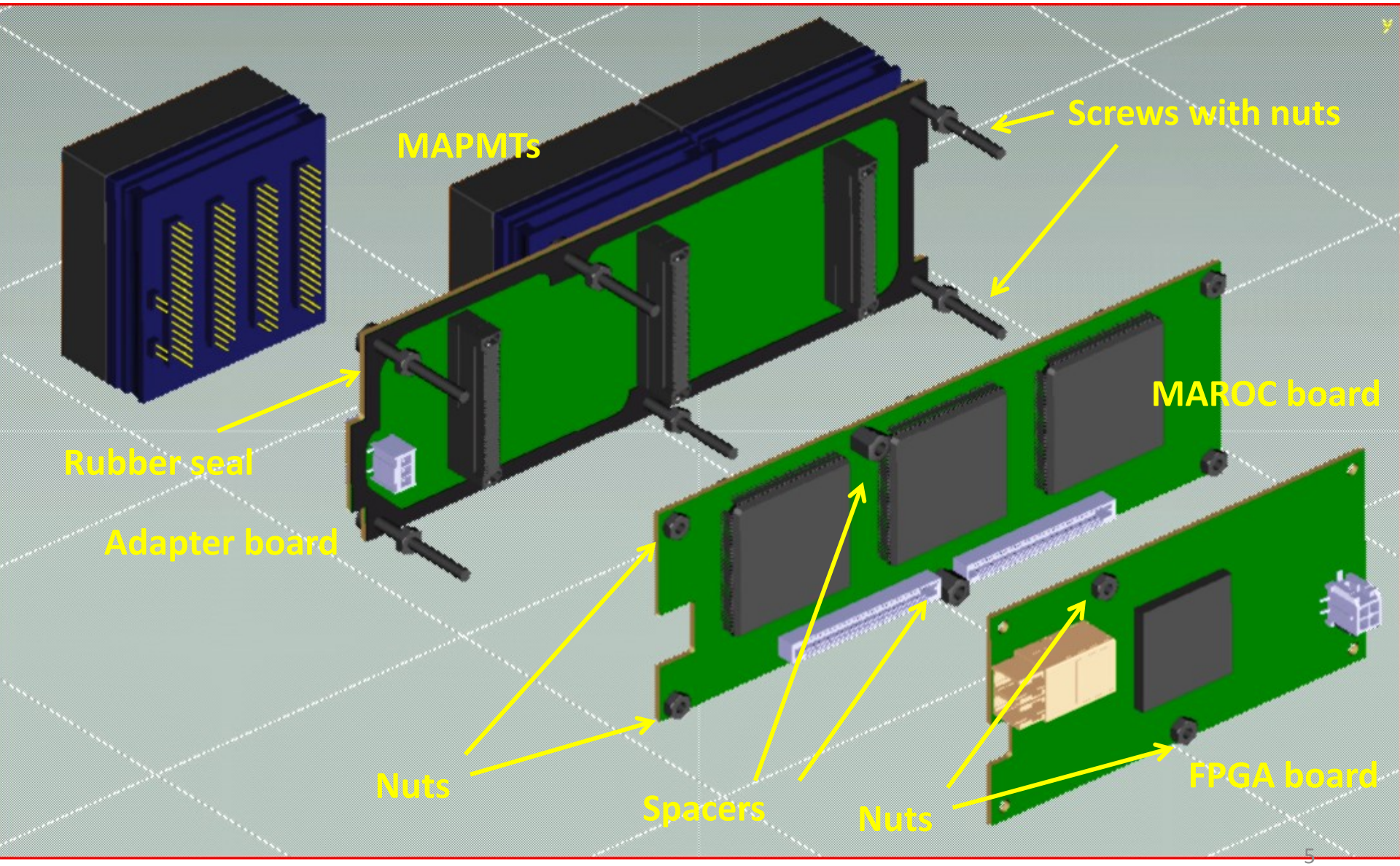


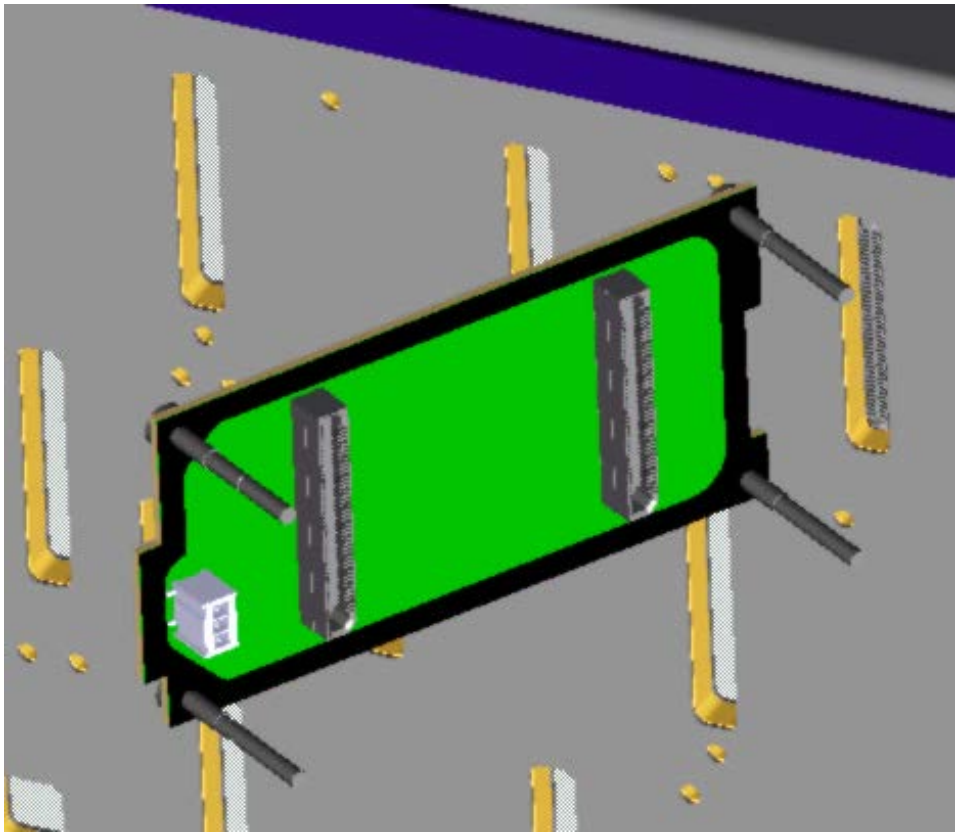
In the following, “inner side” of the electronic panel is the one toward the inside of the RICH, “outer side” is the one toward the outside of the RICH

Elements of the 2x tile



Elements of the 3x tile

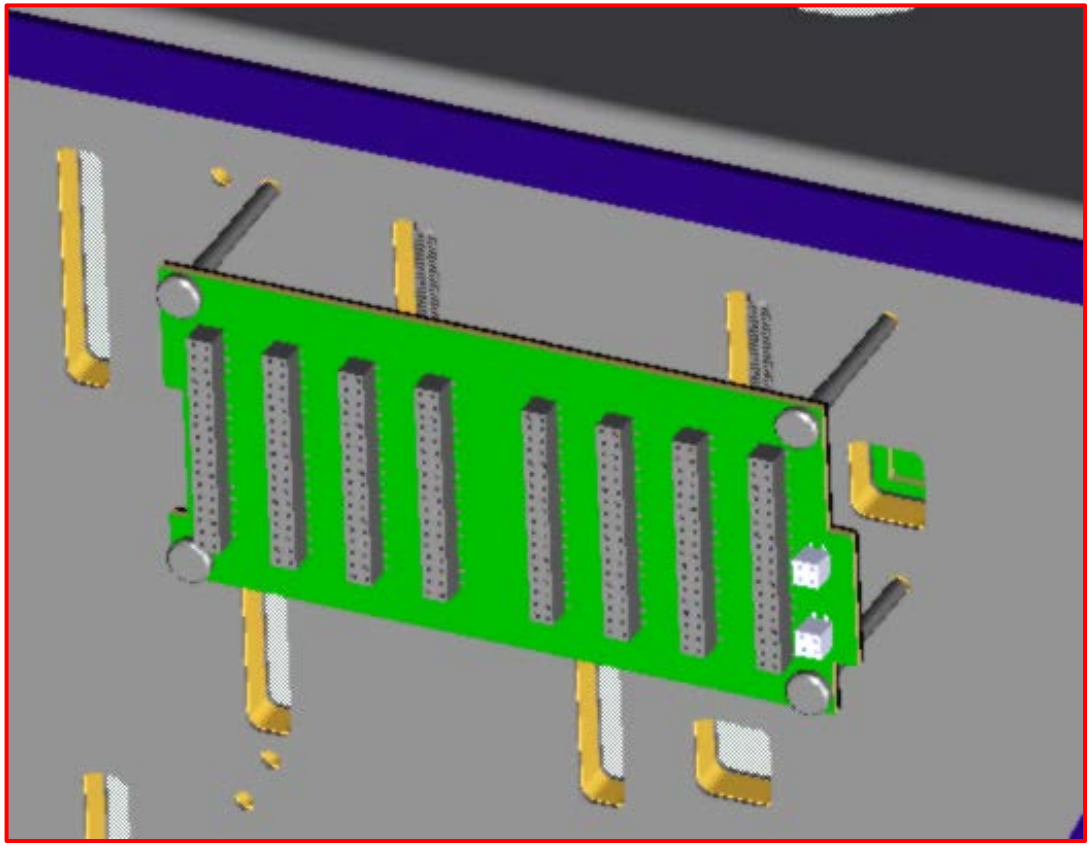




Insert the screws in the holes of the adapter board

Place the rubber seal on the inner side of the board

2x tile

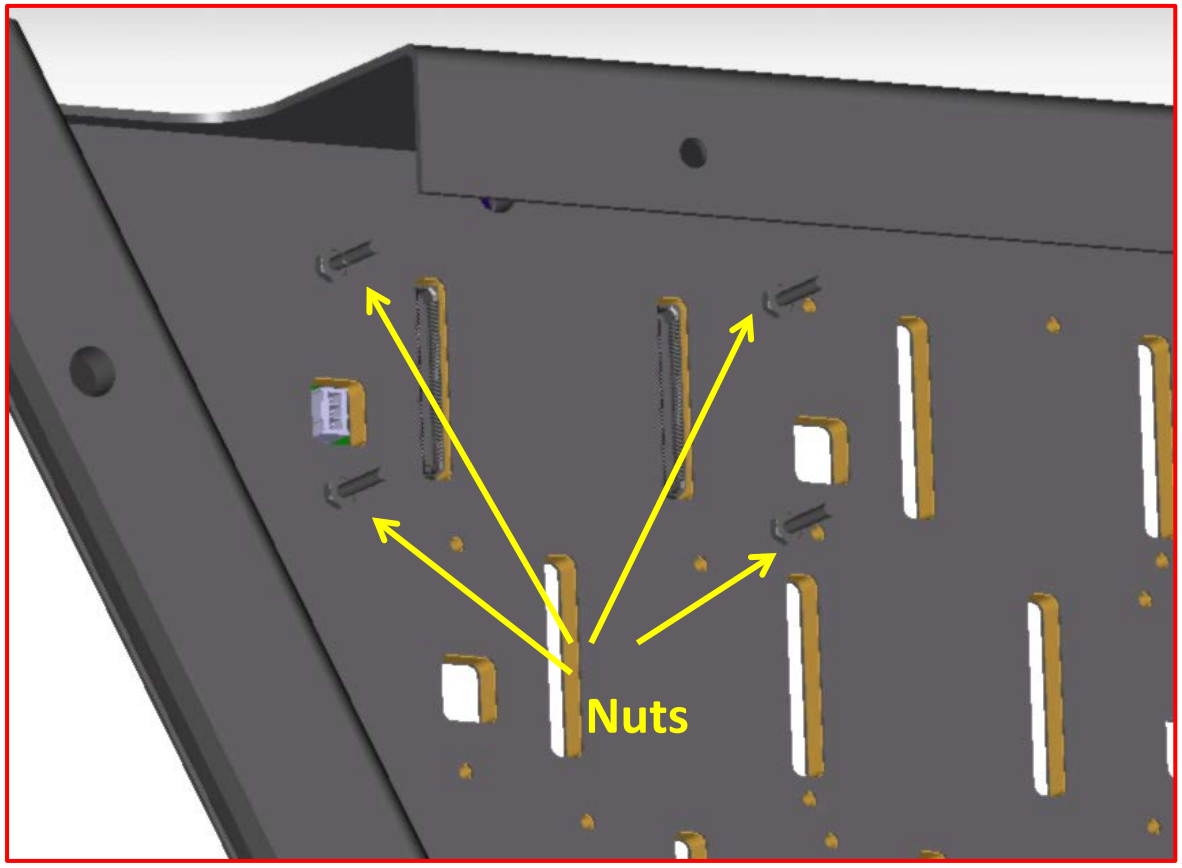


Insert the adapter board with seal on the inner side of the panel

Follow the positions of the holes for the screws and for the HV connectors

2x tile

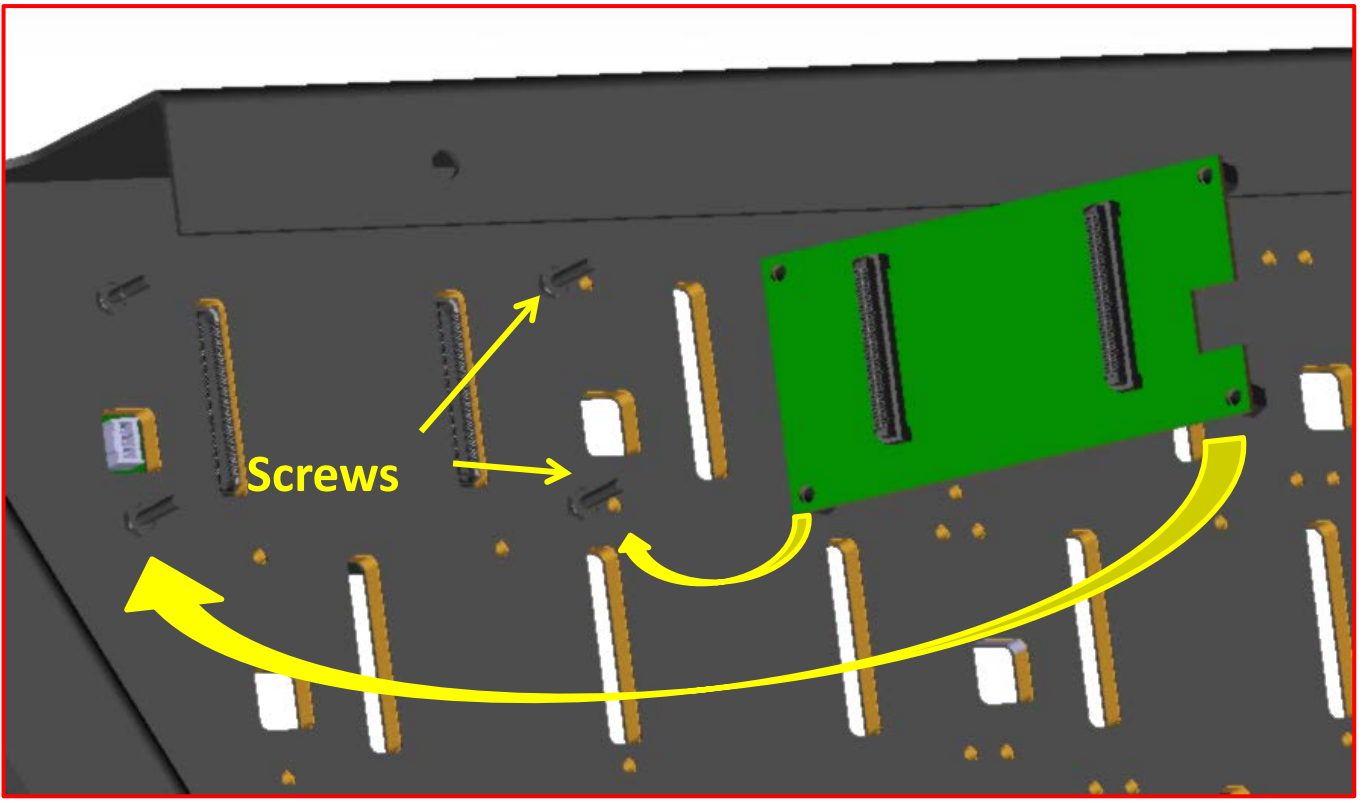
Screw the nuts on the outer side of the outer side of the panel



2x tile

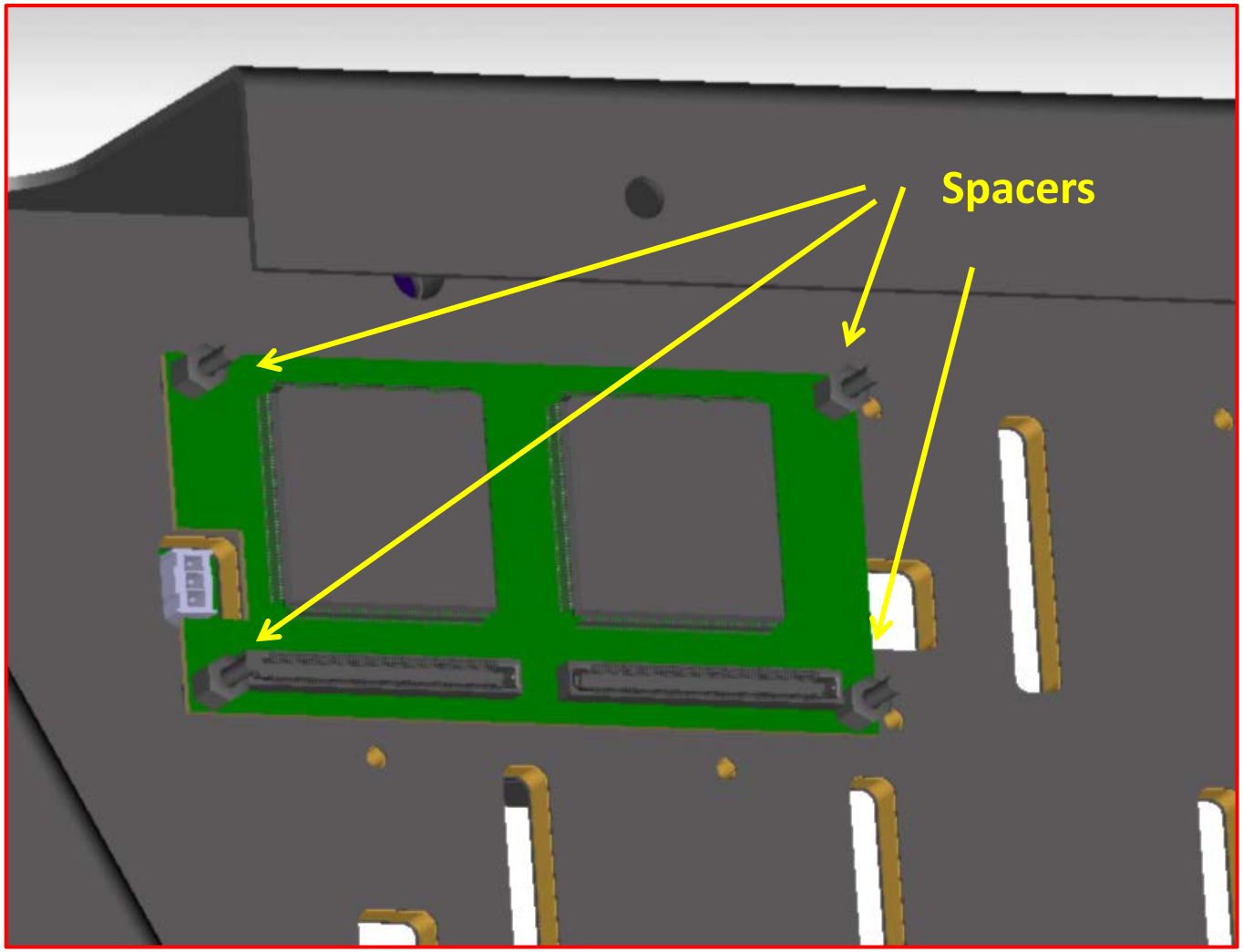
Insert the MAROC board in the four screws on the outer side of the electronic panel

Then plug the connectors to the adapter board



2x tile

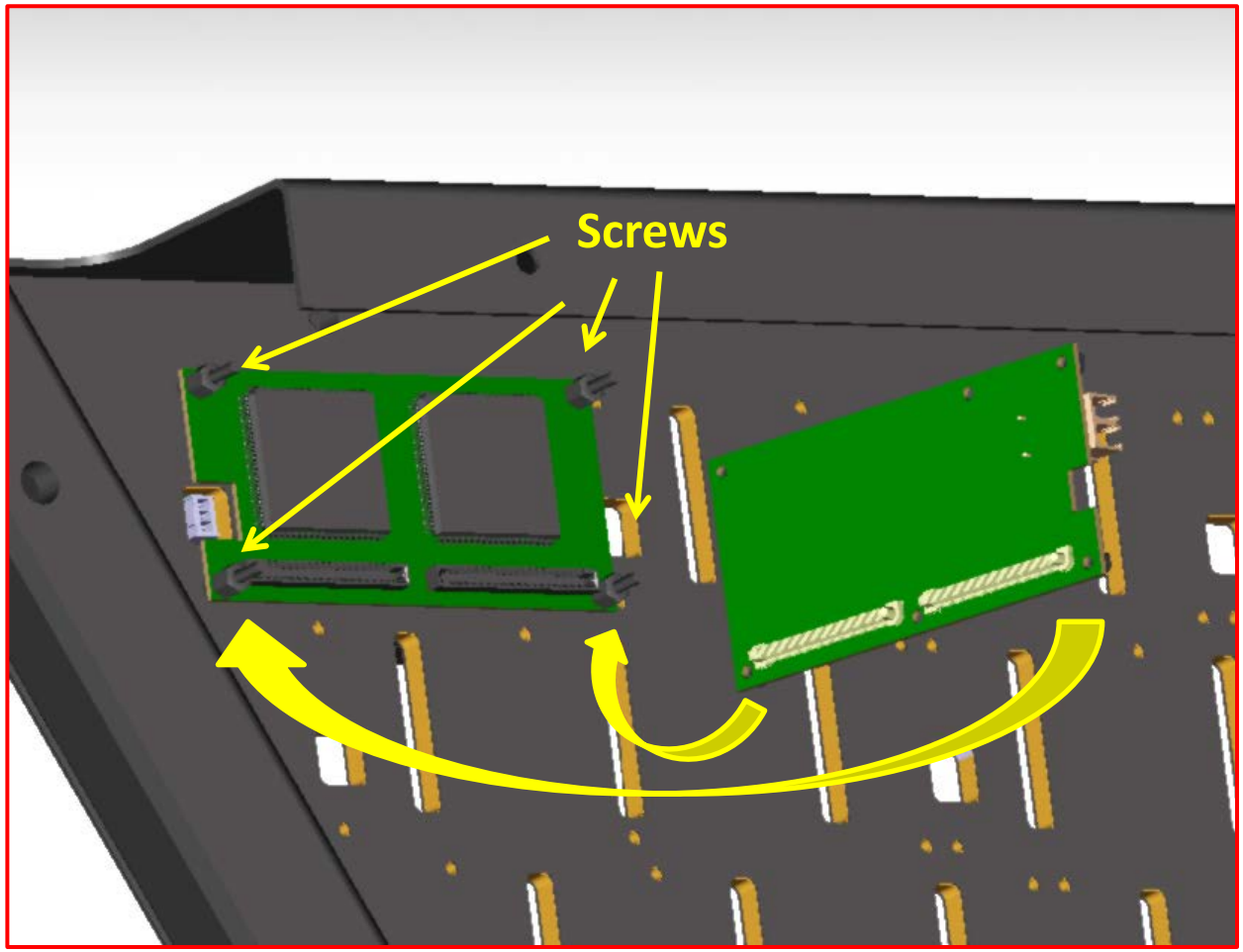
Fix the MAROC by using the spacers



2x tile

Insert the FPGA on the screws

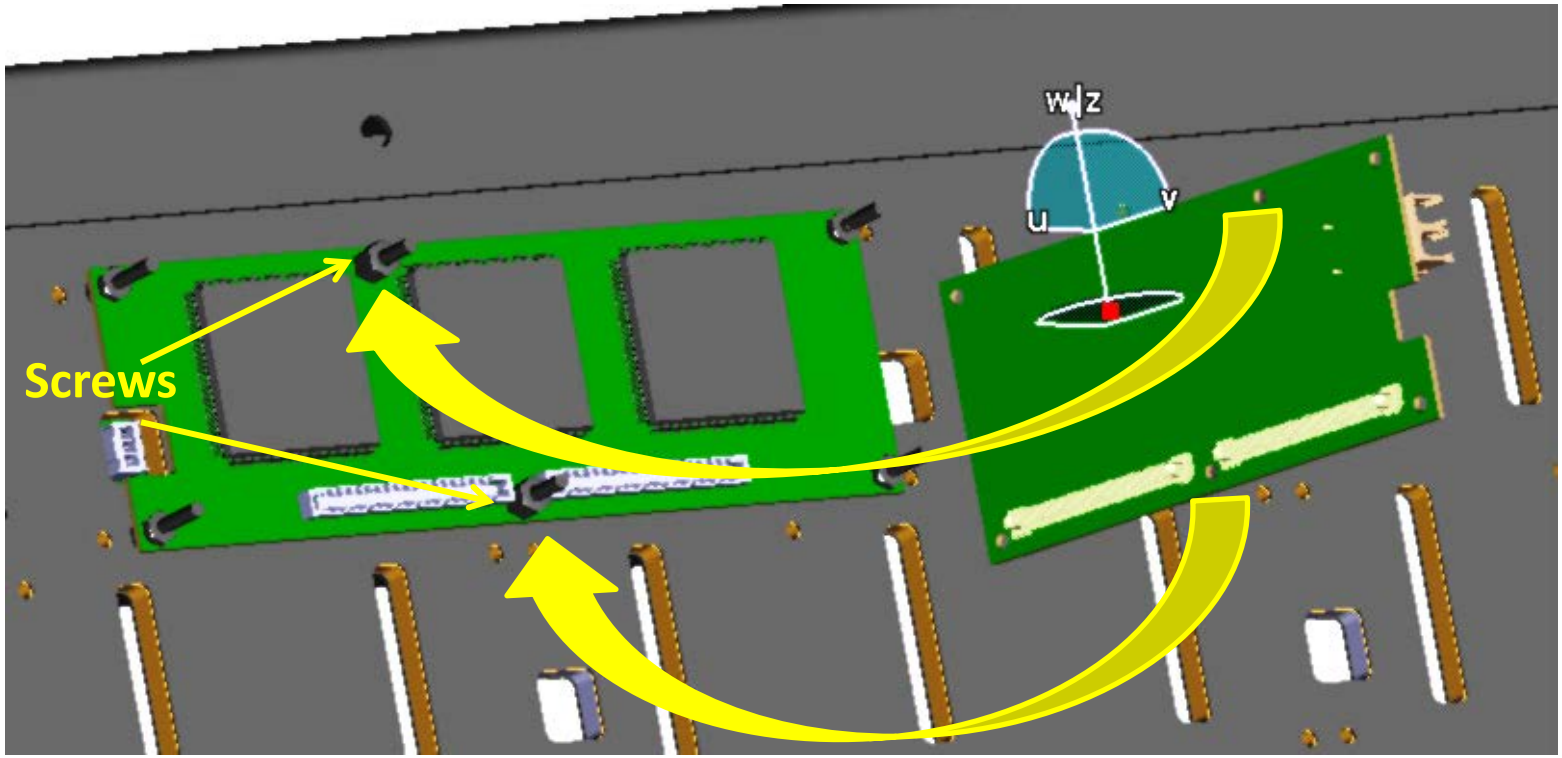
Then plug the connectors to the MAROC board



2x tile

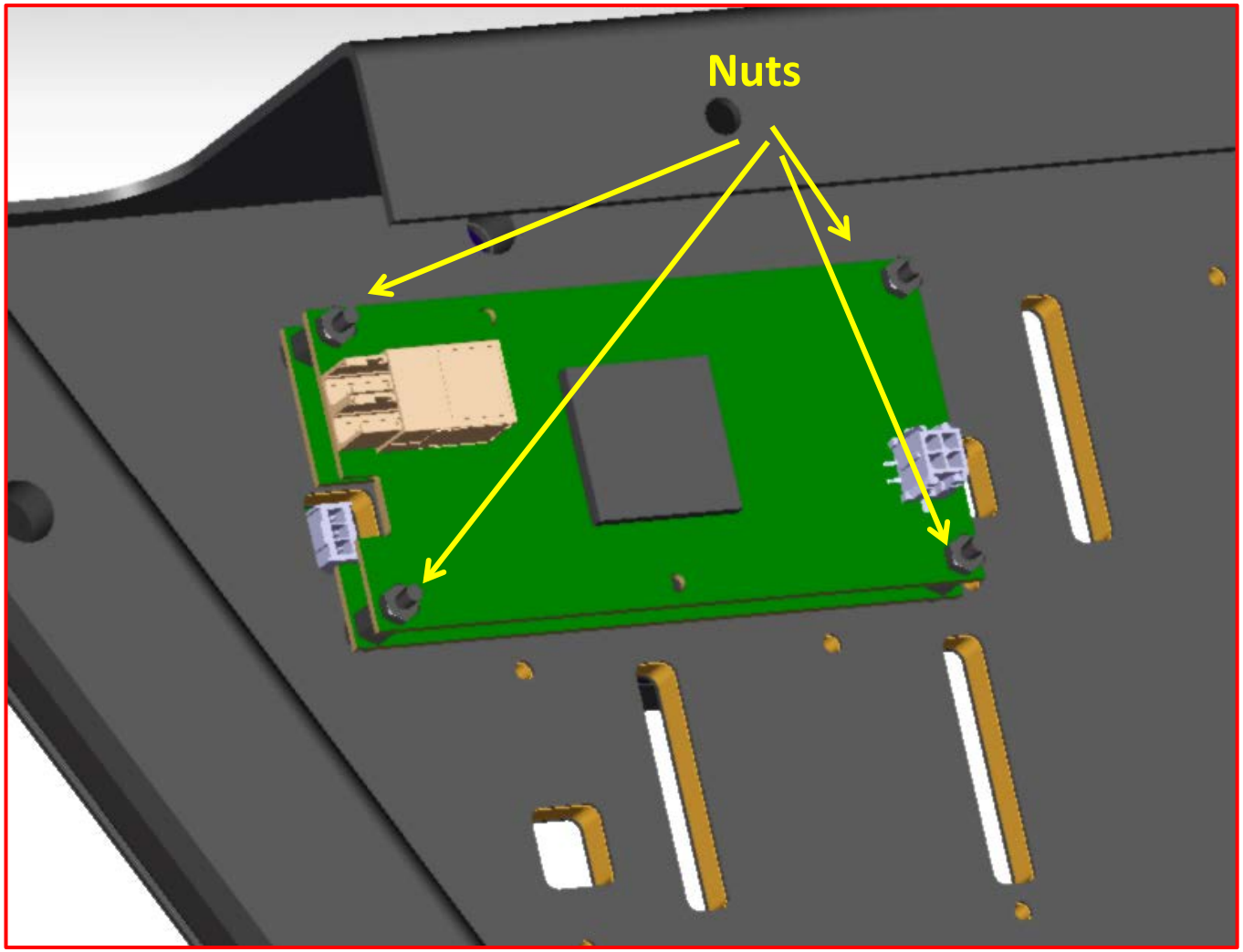
Insert the FPGA on the two central screws

Then plug the connectors to the MAROC board



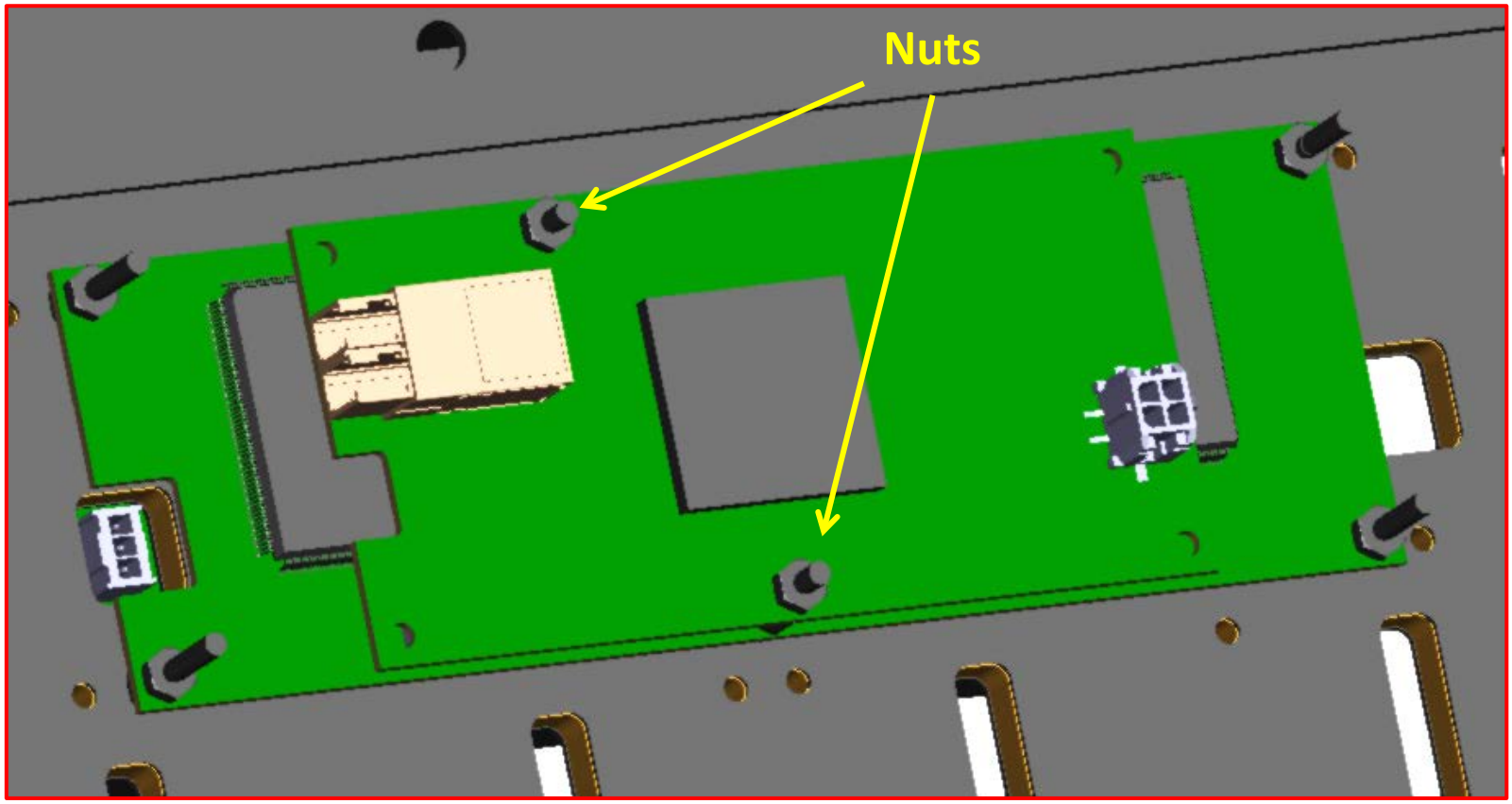
3x tile

Fix the FPGA board with the four nuts

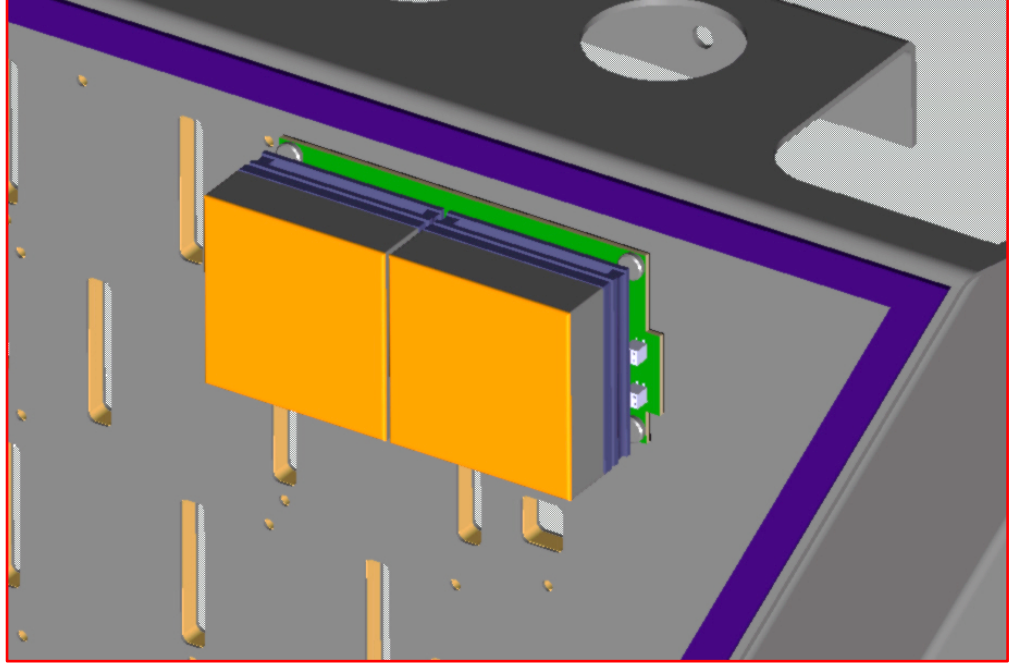


2x tile

Fix the FPGA board with the two nuts

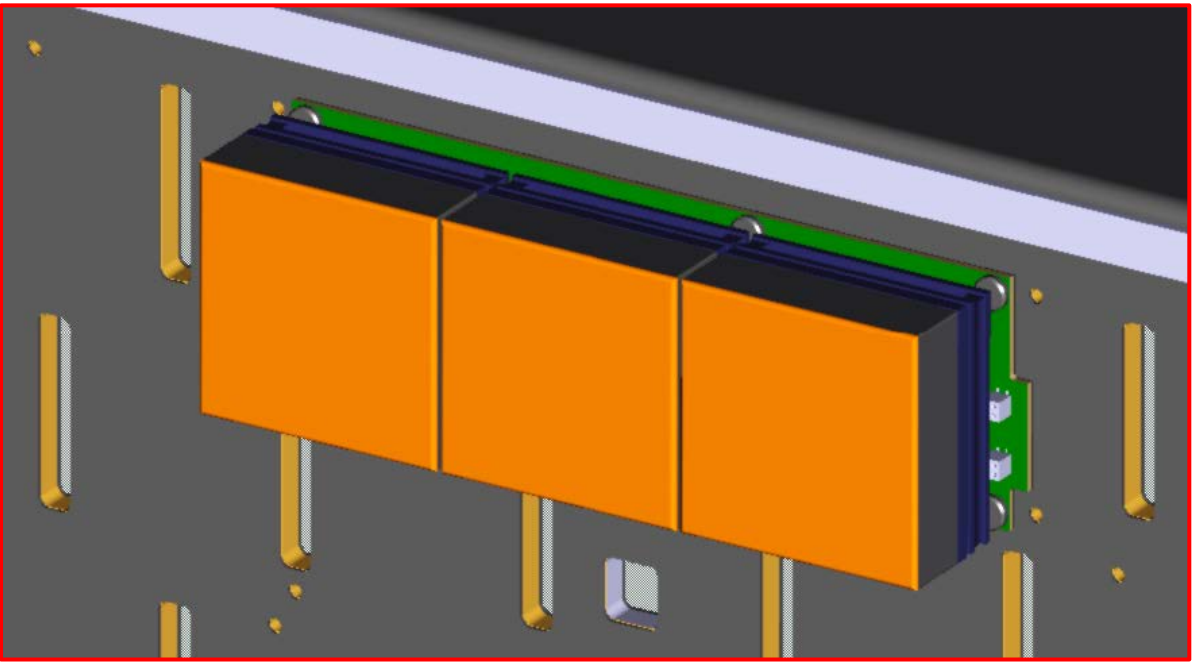


3x tile



2x tile

Plug the MAPMTs on the adapter board



3x tile

By signing this page, you testify that you have read, understand, and agree to abide by the procedure specified in the above referenced work control document:

Serial Number: ENP-22-122990-OSP

Title: Assembly of the RICH II detector

Name	Signature	Date