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CHANGE RECORD

ISSUE	DATE	PAGE	DESCRIPTION OF CHANGES	RELEASE
Draft 00/A	12/05/2003		First draft circulated within the Agile Team as "AGILE Payload MGSE Preliminary Design Report".	
Draft 00/B	20/05/2003		Modified the title to "AGILE Payload AIV MGSE Preliminary Design Report". Limited the scope to the AIV and removed the beam calibration MGSE. Circulated within the Agile Team	
Issue 01	27/05/2003		Circulated within the Agile Team and to the distribution list.	

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1 INTRODUCTION

1.1 SCOPE AND PURPOSE OF THE DOCUMENT

The scope of the present document are the P/L System Level activities (Level 3 activities) specified in AD[1] which shall carried out in order to assembly, integrate and verify the Agile Integrated Payload (IP).

The purpose of the document is to present the design of the various Mechanical Ground Support Equipments (MGSE) which shall be required in order to support these AIV activities.

This document is based on the results of AIV MGSE assessment study presented in RD[1].

Given the uncertainty or lack of some basic input information, the proposed design is still preliminary for some of the MGSE items.

In particular, this consideration applies to the interface control document of the Detector and the Payload Shell, which have not been frozen yet.

The mass proprieties assumed in this document for the Detector and the Payload Shell are presented in Section 3, which identifies the composition of the Integrated Payload.

Section 4 presents the list of the various MGSE items to be procured for the AIV. Most of these items shall be re used for the Calibration activities. It is noted that some of these items have not been assigned yet.

The description of the design and operations which is currently foreseen for the AIV MGSE items is presented in the remaining sections, which provide details on those items which shall be procured by IASF Sezione di Bologna (if funded !!).

Critical assumptions and critical points have been identified by means of red text.

1.2 ACRONYMS

AC	Anti-coincidence auxiliary subsystem
Calibration MGSE	Calibration Mechanical Ground Support Equipment
CCOE	Central Checkout Equipment
EGSE	Electrical Ground Support Equipment
GSE	Ground Support Equipment
Instrument SC	Instrument Science Console

IP	Integrated Payload
MCAL	Mini-calorimeter detector
PD	Photo Diode
PDHU	Payload Data handling Unit
SA	X-Ray detector named Super-AGILE
ST	Silicon Tracker gamma-ray detector
TBC	To Be Confirmed
TBD	To Be Defined
TC	Telecommand
TE	Test Equipment
TM	Telemetry

2 APPLICABLE AND REFERENCE DOCUMENTS

2.1 APPLICABLE DOCUMENTS

AD [1] AGILE-AST-PL-002, "AGILE Payload High Level AIV Plan", Issue 4, February 2003

AD [2] AGILE-AST-TN-008, "AGILE P/L - MASS BUDGET", Issue 2, 13/02/2003

AD [3] AGILE-AST-ID-001 Issue 1 "AGILE P/L ICD", Issue 1, 11/07/02

AD [4] AGILE Mechanical Requirement Specification, AGILE-AST-SS-002, Issue 3

AD [5] AGILE P/L System Requirements, AGILE-AST-SR-002, Issue 4

AD [6] AGILE P/L EMC System Requirements", AGILE-AST-SR-003 Issue 2

AD [7] AGILE-AST-PL-001 Issue 3 "PA_PLAN"

AD [8] AGILE P/L Thermal Design Report AGILE-AST-RE-002 Issue 2

AD [9] AGILE-AST-TN-005 Issue 3, AGILE P/L Power Budget & Power Profile

2.2 REFERENCE DOCUMENTS

RD [1] M.Trifoglio et al, "Assessment of the AGILE Payload MGSE for level 3 and level 4 AIV and Calibration Activities" AGILE-ITE-SR-004, Te.S.R.E. Report 326/01, Issue 3, January 2003.

RD [2] ACO, "AGILE Mechanical, Thermal & Environmental Interface Control Document", ACO-DC-IC-002, Issue 1, February 2002.,

2.3 DOCUMENT PRIORITY

A priority in the applicability of documents is established as follows:

1. AGILE Scientific Requirements
2. P/L System Requirements
3. Current Document
4. Applicable Documents
5. Minutes of Meeting

In case of conflict among technical material contained in these documents, the highest rank document shall have the precedence.

3 INTEGRATED PAYLOAD (IP) DEFINITION

3.1 CONFIGURATION

As presented in [1], the AGILE integrated payload (IP) is composed of :

1. ***Detector*** subdivided in

   - *Detector Core* (DTC) composed by:

     - Silicon tracker gamma-ray detector **(ST)**
     - Mini-calorimeter detector (**MCAL)**
     - X-ray detector named Super-AGILE (**SA**)
     - High Voltage Distribution Box **(HVDB)**
     - Detector Upper Mainframe (**UMF**)
     - Detector Lower Mainframe (**LMF**)
     - Harness Internal to the Detector (**DHSS**)

   - *Anti-coincidence* auxiliary subsystem (**AC**)

   - P/L Multi-Layer Insulation **(MLI)**

   - Light Tight System **(LTS)** TBC

   - Housekeepings

   - Heaters

2. ***Integrated Payload Shell*** (**IPS**) composed by:

   - Shell Module
   - Payload Data Handling Unit (**PDHU**)
   - Power Supply Unit **(PSU)**
   - GPS Unit
   - Two Star Sensors Units (**SSU**)
   - Harness Internal to the P/L Shell (**SHSS**)
   - P/L Shell MLI

3.2 MECHANICAL I/F

This section presents the IP mechanical I/F which have been taken into account in the MGSE design.

3.2.1 DETECTOR

3.2.1.1 Physical Proprieties

The Detector mass budget has been derived from AD[2], which gives the values shown in Table 3-1.

DETECTOR MASS BUDGET			
ITEM		***NOMINAL (kg)***	***WORST CASE (kg)***
		MASS	***MASS***
SILICON TRACKER		35,48	36,61
SUPERAGILE		9,72	10,17
MINICALORIMETER		27,38	27,95
ANTICOINCIDENCE		22,50	23,06
MAINFRAME		7,59	7,97
DETECTOR HARNESS		4,00	4,80
HVDB		1,65	1,73
MLI, HEATERS, TEMP. PROBES*		2,00	2,20
LIGHT-TIGHT		2,50	2,75
TOTAL DETECTOR		**112,82**	**117,24**

* It does not include MLI and Temp. Probes Mass (TBD)

Table 3-1 AGILE P/L DETECTOR MASS BUDGET

The Detector has been simulated with a volume having the total mass of 117,42 kg.

The Detector mass proprieties referred to the Detector Reference Point axes and Baricentre axes are listed in Table 3-2 and Table 3-3, respectively.

3.2.1.2 External I/F

The Detector has been simulated with a volume having the external dimensions given in Figure 3-1.

It is assumed that suitable lifting points shall be provided on the Detector items which shall require safely lift operations during the IP assembly.

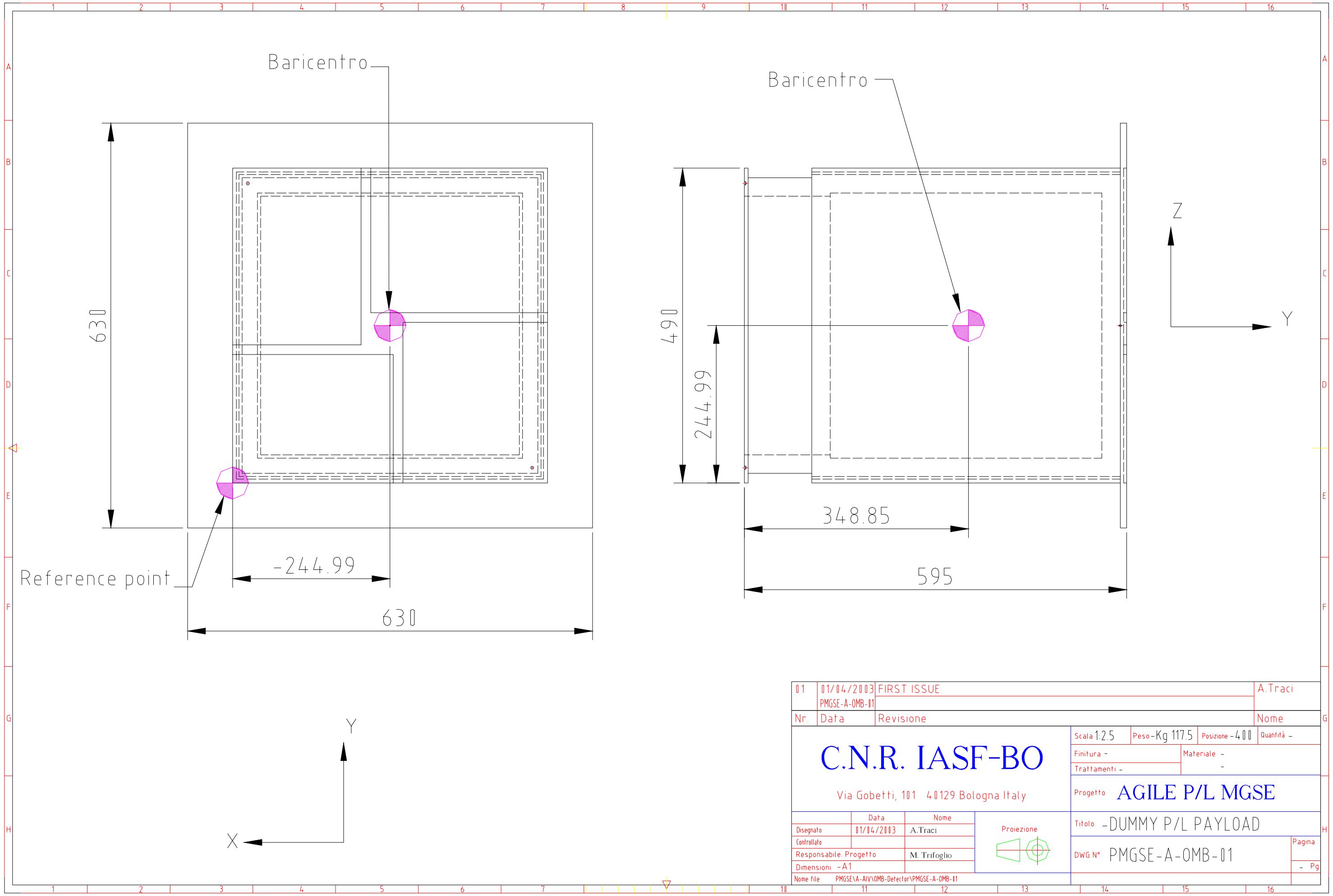

Figure 3-1 Simulated AGILE Detector design (v. 21apr03)

File: D:\PMGSE\A-AIV\OMB-Detector\PMGSE-A-OMB-01.dwg		
Proprietà di massa per più componenti		
Calcolo eseguito il lunedì aprile 14 2003 alle 15:45:25		
Unità di input: Metriche (mm, kg)		
Unità di output: Metriche (mm, kg)		
Sistema di coordinate: Sistema di coordinate utente (UCS)		
Riepilogo:		
Massa	117.42	kg
Volume	43327803.13	mm^3
Area di superficie		
Baricentro		
X	-244.99	mm
Y	348.85	mm
Z	244.99	mm
Momenti di inerzia massa		
X	29037465.74	kg mm^2
Y	21498104.54	kg mm^2
Z	29037347.60	kg mm^2
Prodotti di inerzia massa		
XY	-10034531.65	kg mm^2
XZ	-7047255.28	kg mm^2
YZ	10034682.18	kg mm^2
Raggi di girazione		
X	497.29	mm
Y	427.89	mm
Z	497.29	mm
Momenti di massa e assi principali attorno al baricentro		
I	7700679.41	kg mm^2
Asse		
X	0.77	mm
Y	-0.00	mm
Z	-0.64	mm
J	7403628.56	kg mm^2
Asse		
X	0.00	mm
Y	1.00	mm
Z	-0.00	mm
K	7700714.55	kg mm^2
Asse		
X	0.64	mm
Y	0.00	mm
Z	0.77	mm

Table 3-2 AGILE Simulated Detector mass proprieties referred to Reference Point axes (v. 21apr03)

File: D:\PMGSE\A-AIV\OMB-Detector\PMGSE-A-OMB-01.dwg		
Proprietà di massa per più componenti		
Calcolo eseguito il lunedì aprile 14 2003 alle 15:14:05		
Unità di input: Metriche (mm, kg)		
Unità di output: Metriche (mm, kg)		
Sistema di coordinate: Baricentro (CG)		
Riepilogo:		
Massa	117.42	kg
Volume	43327803.13	mm^3
Area di superficie		
Baricentro		
X	0.00	mm
Y	0.00	mm
Z	0.00	mm
Momenti di inerzia massa		
X	7700693.26	kg mm^2
Y	7700699.62	kg mm^2
Z	7403629.62	kg mm^2
Prodotti di inerzia massa		
XY	17.83	kg mm^2
XZ	-428.16	kg mm^2
YZ	-366.25	kg mm^2
Raggi di girazione		
X	256.09	mm
Y	256.09	mm
Z	251.10	mm
Momenti di massa e assi principali attorno al baricentro		
I	7700679.40	kg mm^2
Asse		
X	0.77	mm
Y	0.64	mm
Z	0.00	mm
J	7700714.55	kg mm^2
Asse		
X	-0.64	mm
Y	0.77	mm
Z	0.00	mm
K	7403628.55	kg mm^2
Asse		
X	-0.00	mm
Y	-0.00	mm
Z	1.00	mm

Table 3-3 AGILE Simulated Detector mass proprieties referred to baricentre axes (v. 21apr03)

3.2.2 INTEGRATED PAYLOAD SHELL (IPS)

3.2.2.1 PHYSICAL PROPRIETIES

The IPS mass budget has been derived from AD[2], which gives the values shown in Table 3-4.

INTEGRATED P/L SHELL MASS BUDGET		
	NOMINAL (kg)	***WORST CASE (kg)***
ITEM	***MASS***	***MASS***
PDHU	6,70	7,37
PSU	4,50	4,95
SHELL HARNESS	5,50	6,05
STAR SENSORS	6,50	7,15
GPS	4,00	4,40
SHELL MLI	TBD	TBD
SHELL STRUCTURE	TBD	TBD

Table 3-4– IPS Mass Budget

The present document assumes a total mass of 38,59 Kg for the Shell MLI and the Shell Structure.

The IPS has been simulated with a volume having a total mass of 68,78 kg.

The IPS mass proprieties referred to Reference Point axes and Baricentre axes are given in Table 3-5 and Table 3-1, respectively.

3.2.2.2 EXTERNAL I/F

The IPS has been simulated with a volume having the external dimensions shown in Figure 3-2.

The overall dimensions of the Star Sensor have been set to the maximum values specified in RD[2].

It is assumed that the P/L Shell top side shall provide 6 hoist rings to be used as lifting points in order to safely lift the IP mounted on the IP Shell Interface Flange (see 5.6).

A potential problem for the MGSE is represented by the location on the IPS lateral side of the external connectors which shall I/F the IPS to the Bus (see 5.2). The exact location of these connectors (if any) should be agreed with RTI.

It is assumed that the top side of the P/L Shell shall provide the fixing point for the AC lowering device (see 5.7).

It is assumed that the bottom side of the P/L Shell shall provide the fixing points for the P/L Shell Interface Flange (see 5.3).

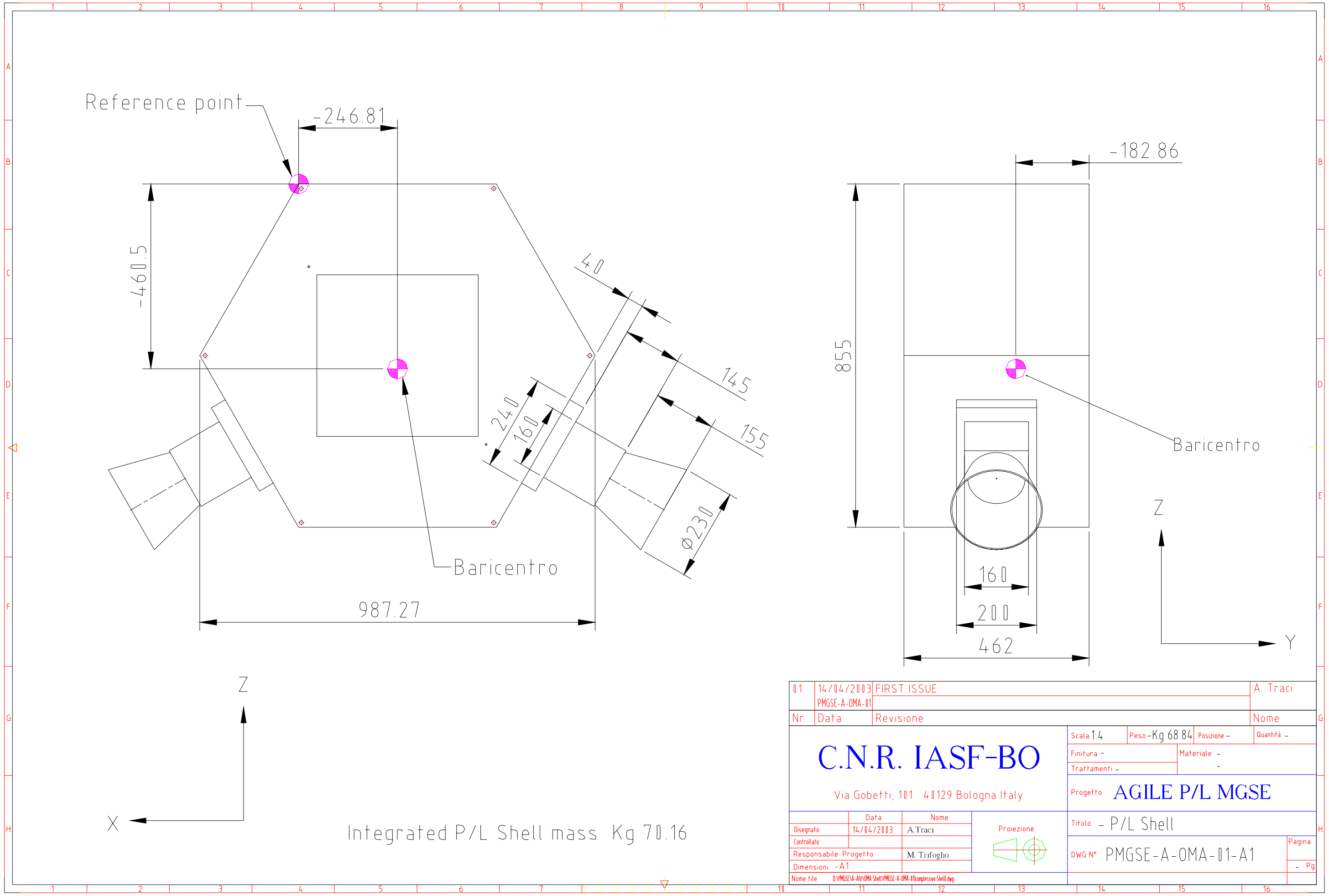

Figure 3-2 Simulated AGILE Integrated P/L Shell (v. 21apr03)

File: D:\PMGSE\A-AIV\OMA Shell\PMGSE-A-OMA-01(complessivo Shell).dwg	
Proprietà di massa per più componenti	
Calcolo eseguito il lunedì aprile 07 2003 alle 11:15:25	
Unità di input: Metriche (mm, kg)	
Unità di output: Metriche (mm, kg)	
Sistema di coordinate: Sistema di coordinate utente (UCS)	
Riepilogo:	
Massa	68.84 kg
Volume	25402134.26 mm^3
Area di superficie	
Baricentro	
X	201.30 mm
Y	-172.84 mm
Z	-181.92 mm
Momenti di inerzia massa	
X	11821190.48 kg mm^2
Y	13718371.54 kg mm^2
Z	18088607.24 kg mm^2
Prodotti di inerzia massa	
XY	-2395110.42 kg mm^2
XZ	-2520945.31 kg mm^2
YZ	2068377.96 kg mm^2
Raggi di girazione	
X	414.39 mm
Y	446.41 mm
Z	512.60 mm
Momenti di massa e assi principali attorno al baricentro	
I	7486455.39 kg mm^2
Asse	
X	1.00 mm
Y	0.00 mm
Z	-0.00 mm
J	8648617.06 kg mm^2
Asse	
X	-0.00 mm
Y	1.00 mm
Z	-0.02 mm
K	13244634.86 kg mm^2
Asse	
X	0.00 mm
Y	0.02 mm
Z	1.00 mm

Table 3-5. Mass proprieties of the Simulated IPS referred to the Reference Point axes (v. 21apr03)

File: D:\PMGSE\A-AIV\OMA Shell\PMGSE-A-OMA-01(complessivo Shell).dwg		
Proprietà di massa per più componenti		
Calcolo eseguito il lunedì aprile 07 2003 alle 11:15:09		
Unità di input: Metriche (mm, kg)		
Unità di output: Metriche (mm, kg)		
Sistema di coordinate: Baricentro (CG)		
Riepilogo:		
Massa	68.84	kg
Volume	25402134.26	mm^3
Area di superficie		
Baricentro		
X	0.00	mm
Y	0.00	mm
Z	0.00	mm
Momenti di inerzia massa		
X	7486455.39	kg mm^2
Y	8650629.49	kg mm^2
Z	13242622.43	kg mm^2
Prodotti di inerzia massa		
XY	2.82	kg mm^2
XZ	-1.38	kg mm^2
YZ	-96151.56	kg mm^2
Raggi di girazione		
X	329.78	mm
Y	354.49	mm
Z	438.60	mm
Momenti di massa e assi principali attorno al baricentro		
I	7486455.39	kg mm^2
Asse		
X	1.00	mm
Y	0.00	mm
Z	-0.00	mm
J	8648617.06	kg mm^2
Asse		
X	-0.00	mm
Y	1.00	mm
Z	-0.02	mm
K	13244634.86	kg mm^2
Asse		
X	0.00	mm
Y	0.02	mm
Z	1.00	mm

Table 3-6 Mass proprieties of the Simulated AGILE IPS referred to baricentre axes (v. 21apr03)

4 IP AIV MGSE DEFINITION

Table 4-1 lists the main items which shall be required in order to support the AIV activities to be carried out on the IP complement defined in section 3.

As detailed in the table, most of these items shall be required also for the Calibration activities.

	Item	Required for the AIV	Required for the Beam Calibration	Procured by
(a)	IP Crate	Yes	Yes	ITE
(b)	IP Shell Interface Flange	Yes	Yes	ITE
(c)	IP Rotating Device	Yes	Yes	ITE
(d)	IP Shell Lifting Fixture	Yes	Yes	RTI
(e)	IP Lifting Spider	Yes	Yes	ITE
(f)	LABEN Travelling Crane	Yes	Yes	LABEN (existing)
(g)	AC Lowering device	Yes	No	IFC
(h)	IP Cooling System	Yes	Yes	LABEN (TBC)
(i)	IP Thermal Fixture	Yes	No	LABEN (TBC)
(l)	IP Vibration Fixture	Yes	No	LABEN (TBC)
(m)	IP Transportation Container	Yes	Yes	LABEN (TBC)

Table 4-1 Integrated Payload AIV MGSE items

5 IP AIV MGSE DESIGN

This section deals with the design of the various IP AIV MGSE items listed in section 4.

Details on the design are given only for the items which have been assigned to ITE.

The proposed MGSE design:

- shall be able to accommodate various integration flow, as various integration sequences shall be possible, depending on the availability of the P/L items and on the troubleshooting needs.
- shall allow the maximum reuse of the AIV MGSE items in the MGSE configuration required for the Payload Beam Calibration.

For those items which shall be required also for the Calibration activities, the design shall take into account also the calibration requirements.

5.1 EXTERNAL CONSTRAINTS

At the time of writing, it is foreseen that the IP integration shall be carried out in a clean room (class 10.000) located at LABEN premises.

Any use of cooling by liquid gases (e.g. Nitrogen) must use completely sealed systems in order to avoid any escape of gas into the clean room atmosphere.

The clean room shall be equipped with the LABEN Travelling Crane presented in section 5.1.1.

5.1.1 LABEN TRAVELLING CRANE

This lifting device is already available in the LABEN AIV room. The mechanical structure provides a crane hook at the maximum eight of 2040 mm and is equipped with 4 wheels (Figure 5-2, Figure 5-3, and Figure 5-3).

In order to maximize the free height ground-hook, the existing hook shall be replaced with a suitable adapter included in the IP Lifting Spider provision (see 5.6).

It is noted that the LABEN Travelling Crane shall be required also for the Calibration at the beam site. Hence some provision for the transportation container shall be required (TBC) by TBD.

Figure 5-1 LABEN Travelling Crane with the IBIS Rotating Table

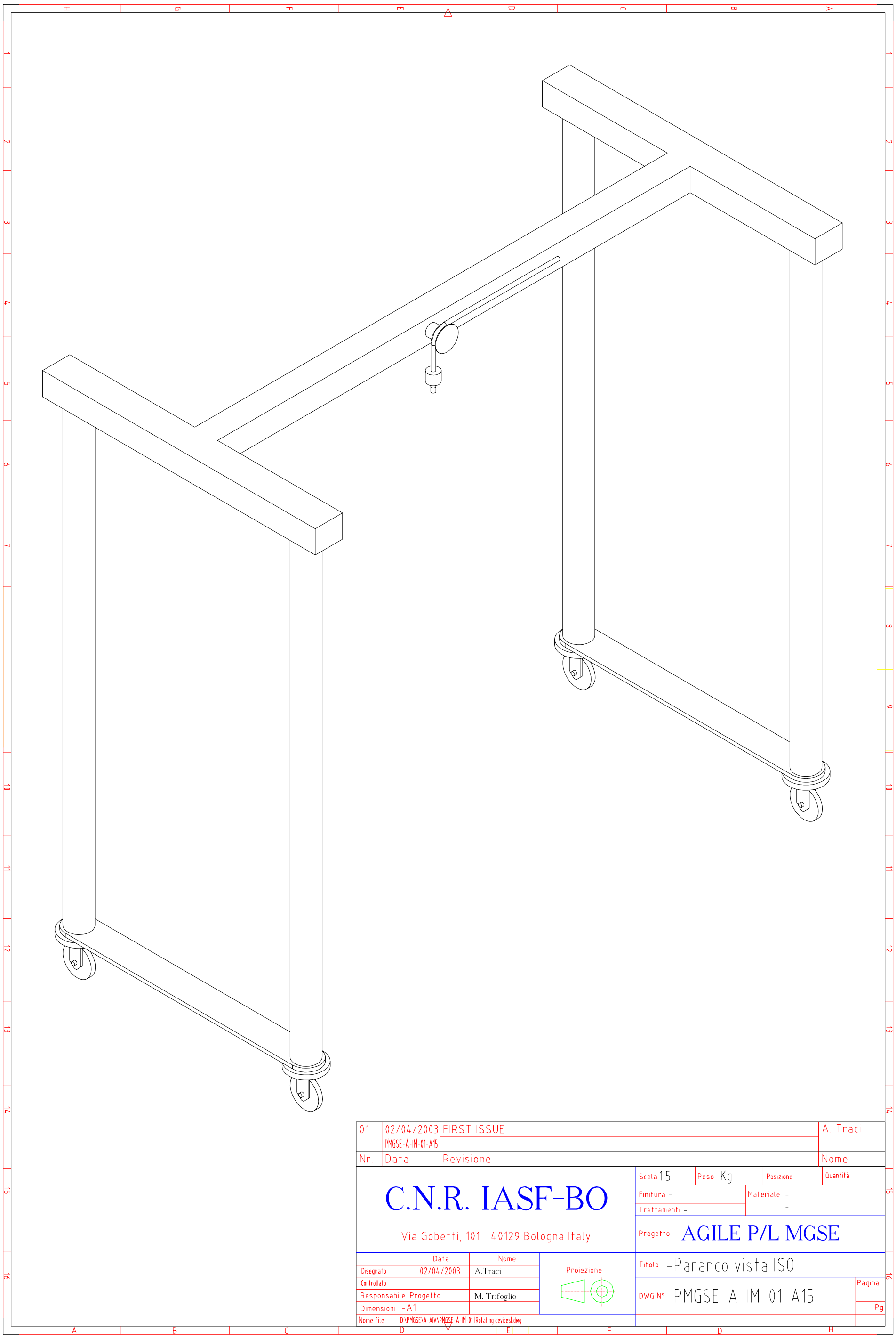

Figure 5-2 Schematic view of the LABEN Travelling Crane (v. 21apr03)

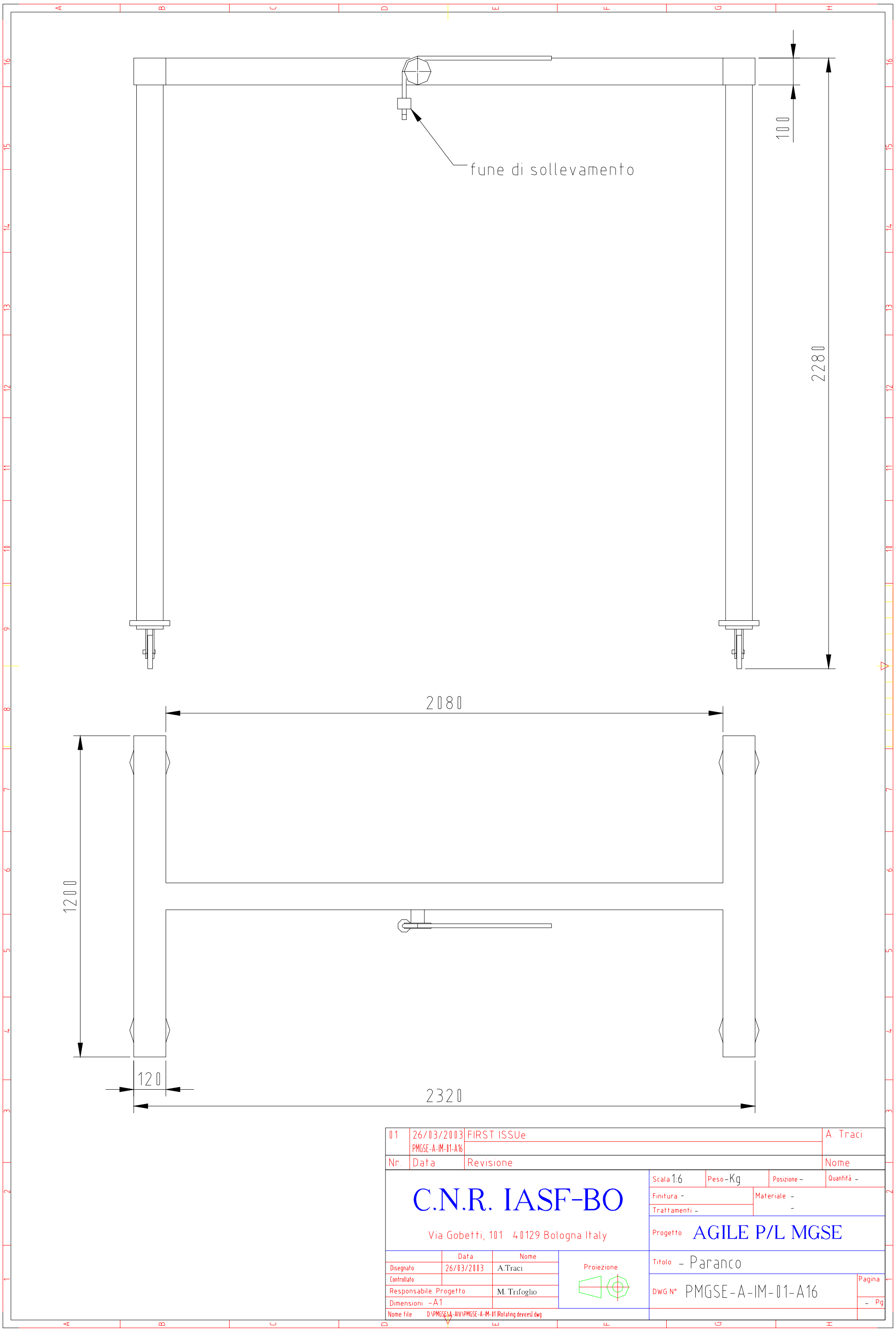

Figure 5-3 Overall dimensions of the LABEN Travelling Crane (v. 21apr03)

5.2 IP CRATE

The IP Crate (Figure 5-4, Figure 5-5, and Figure 5-6), shall host the P/L Shell and the P/L Detector mounted on the IP Shell Interface Flange.

The IP Crate shall provide:

- Four adjustable feet, which shall be used to lean the IP Crate on the rear side.
- Four hoist rings in order to safely lift the IP Crate; these rings shall be sized for the weight of the IP Crate (about 220 Kg) hosting the IP (about 200 Kg) mounted on the IP Shell Interface Flange (about 15 Kg).
- The rotating stage Ry, which shall allow the manual rotation of the IP around a Y' axes parallel to the Y IP axes in the range $\psi = [-180^o, +180^o]$.

The whole Ry range shall be exploitable as long as the Start Sensors shall not be installed.

The Start Sensors shall limit the Ry range to $\psi = [-60^o, +60^o]$.

The IP Crate shall provide suitable mechanical fixture in order to limit the Ry range to $\psi = [-60^o, +60^o]$.

The IP Crate internal dimensions shall allow the rotation of an overall volume of ø1050mm.

As anticipated in 3.2.2, this limitation shall not allow the location of external connectors and cables on the lower part of the IPS.

The Ry rotating stage flange shall provide:

- the alignment plugs which shall facilitate the mounting operation of the Shell Interface;
- the fixing points for the Shell Interface Flange.

Operating on the rear side of the IP Crate, it shall be possible to lock the Ry stage by means of:

- one plug installed on the base of the hexagonal structure with 8 positional holes on the circular guide (one hole at $\psi = 0^o$ and every 45^o)
- a manual locking system which shall act in any intermediate position.

The IP Crate provision shall include a reusable transportation container (wood box).

5.2.1 RY STAGE PERFORMANCES

The IP Crate design has been driven by the performance requirements imposed by the Calibration activities which shall be carried out:

- in the AIV clean room, where the IP Crate shall be required in order to install the IP on the Rotating Device (see 5.4) and to rotate the IP around its Y axes;
- at the beam facility, where the IP Crate shall be required in order to hung the IP from the Calibration MGSE (see R[1]) and to rotate the IP around its Y axes.

The calibration activities shall require the following Ry stage performances:

- range $\psi = [-180^{o}, +180^{o}]$ (without the Star Sensors);
- accuracy = 0.1^{o}.
- format: decimal degrees ±ggg.d (e.g. +160.6).

To this purpose, the IP Crate shall be equipped with:

- one angle readout box;
- one relative encoder;
- one home position switch.

The angle readout box shall be operated manually and shall be able to provide the current angle position on a built-in LED display and to a PC connected through a RS232 port. Suitable connectors shall allow to install this device only when required.

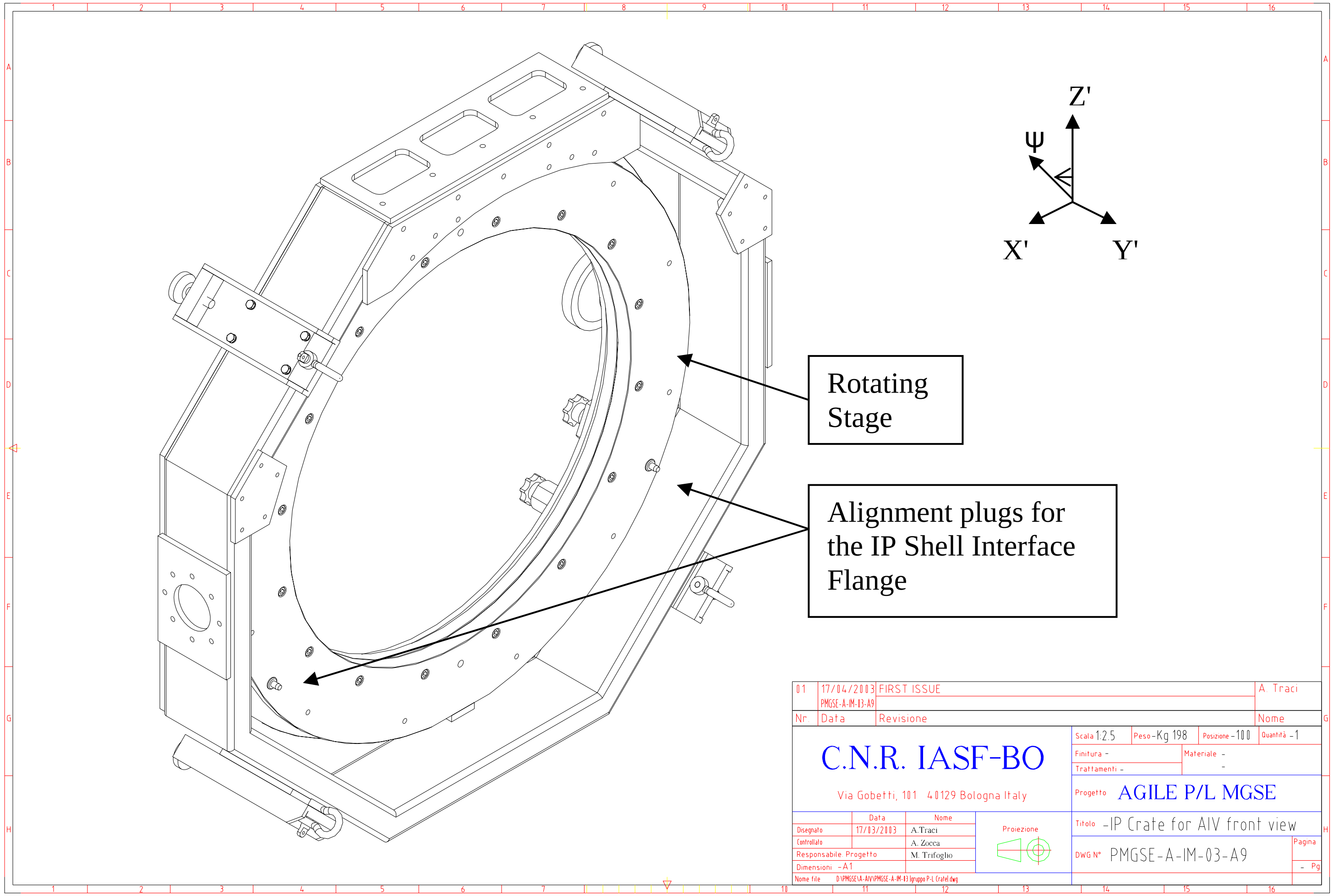

Figure 5-4 IP Crate for the AIV activities - front view (v. 21apr03)

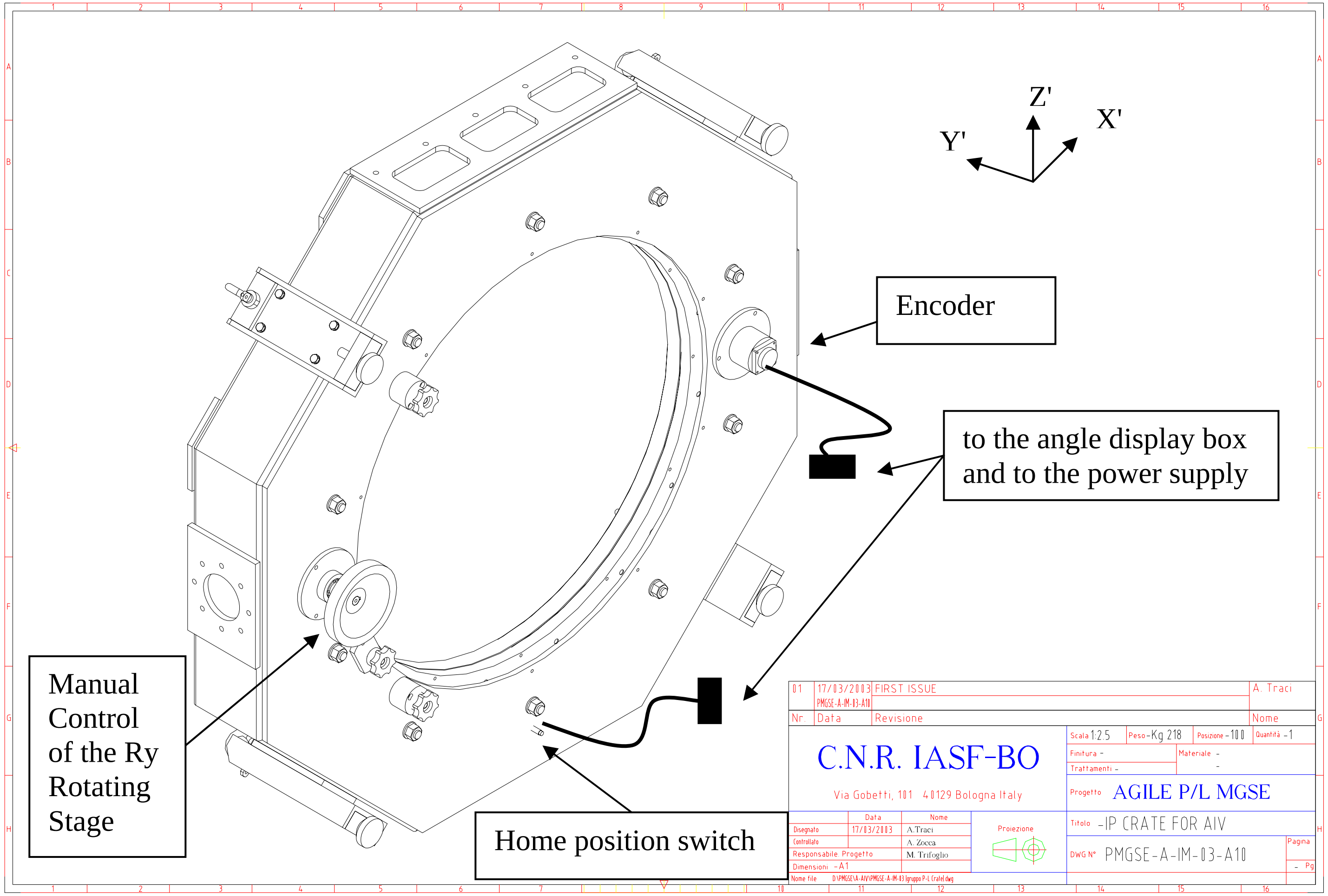

Figure 5-5 IP Crate for the AIV activities - rear view (v. 21apr03)

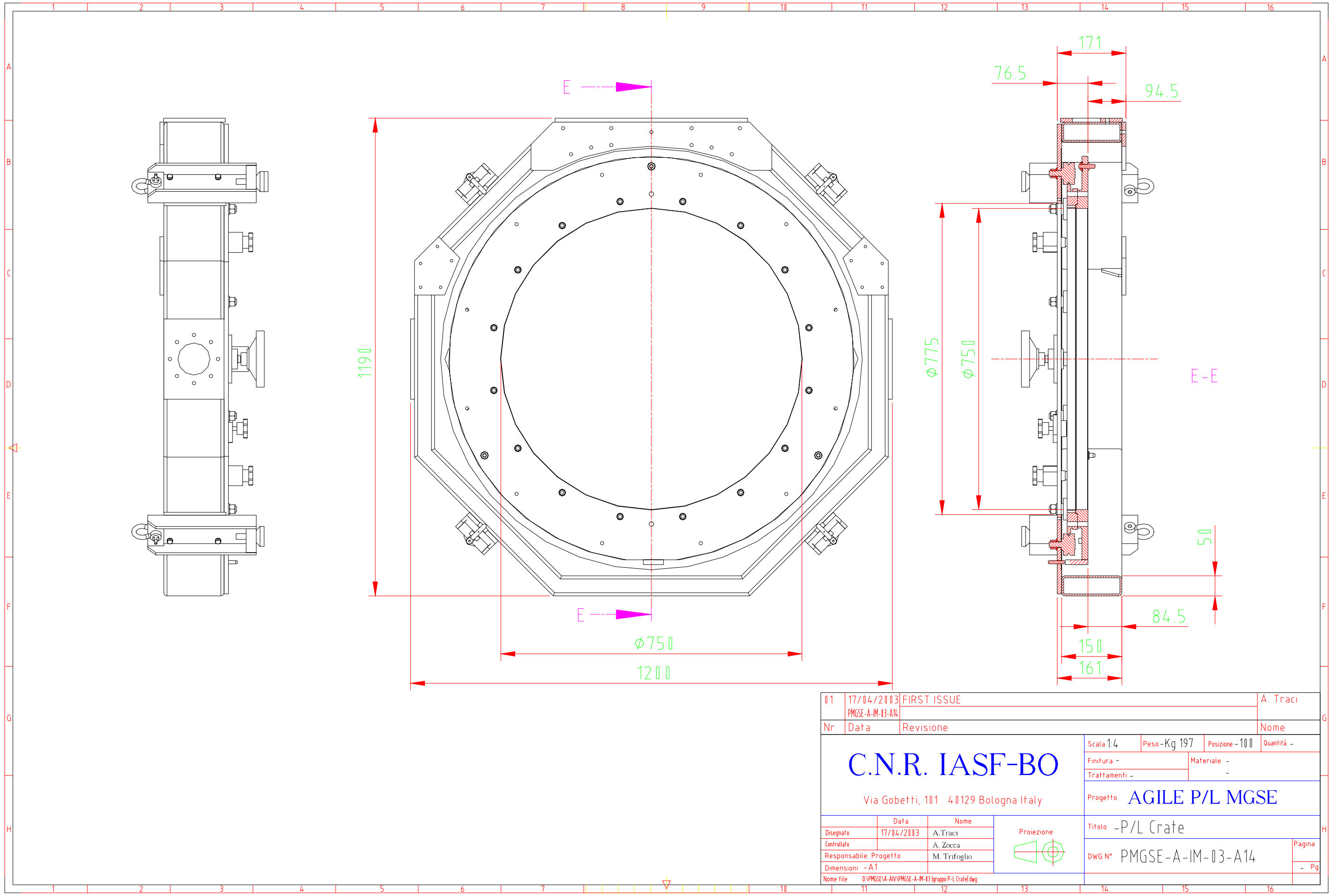

Figure 5-6 Design of the Integrated P/L Crate(v. 21apr03)

5.3 IP SHELL INTERFACE FLANGE

The IP Shell Interface Flange shall represent the mechanical interface among the IP and the MGSE.

The current proposed design (Figure 5-7) is based on the Simulated IPS design presented in 3.2.2.

The fixing points for the P/L Shell have not been defined yet.

The IP Shell Interface Flange shall be sized for the weight and dimensions of the Integrated Payload (about 200 Kg).

It is noted that no lifting points have been foreseen in the IP Shell Interface Flange, as in case of need the IP shall be lift either using the lifting points provided on the top side of the P/L Shell or using the hoist rings of the IP Crate.

The manufacturing details are summarised in Table 5-1.

Material	Processing	Treatment	Notes
Cast-plate or Anticorodal 100	Turning, drilling	Ossidazione anodica	

Table 5-1 IP Shell Interface Flange manufacturing details

The flange mating surface on Shell side shall have:

- planarity: 0.1/100 mm, 1 mm overall (i.e. the maximum allowed shall not exceed 1 mm, independently by the length of the element);
- roughness: 1.6 µm.

On one side, this fixture shall provide the screw fixing points for the P/L Shell.

On the other side, this fixture shall provide:

- the holes corresponding to the plugs placed on the rotating table of the P/L Crate.
- the screw fixing points for the rotating table of the P/L Crate. These fixing points shall be accessible at any stage of the IP Assembly operations in order to allow the separation of the IP from the P/L Crate.

The current design has assumed that during the environmental tests this fixture shall be replaced by IP Thermal Fixture and the IP Vibration Fixture.

The IP Shell Interface Flange provision shall include a non reusable transportation container.

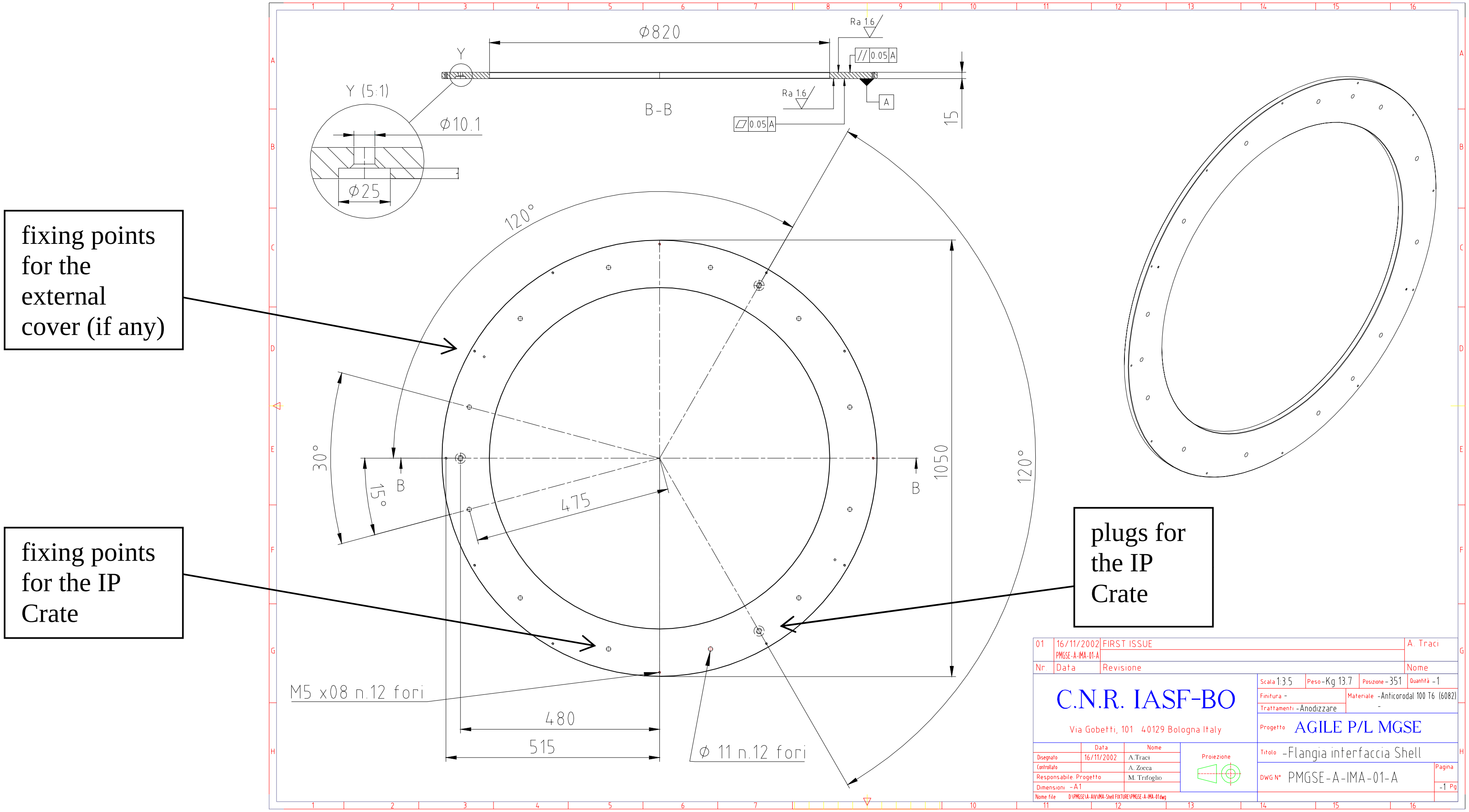

Figure 5-7 IP Shell Interface Flange design (v. 21apr03)

5.4 IP ROTATING DEVICE

The IP Rotating Device (Figure 5-8 and Figure 5-9), shall provide:

– four removable wheels, which shall allow the manual placement of the device.

– four adjustable feet, which shall be used to remove the wheels and to level and fix the device in the working position.

– four hoist rings, to be used in order to safely lift the IP Rotating Device with the IP Crate and the IP mounted on it.

– the fixing points for the lateral flanges of the IP Crate, at the height of about 700 mm. from the ground (as imposed by the AIV room ceiling height);

– the centering fixture to be used during the mounting operations of the IP Crate in order to facilitate the centering of the IP Crate fixing points on the lateral flanges of the IP Rotating Device.

– the manual rotation Rx of the IP Crate plane around its X' axes (parallel to the X IP axes) in the range $\theta = [0^o, \pm 90^o]$.

The IP Rotating Device provision shall include a reusable transportation container (wood box).

5.4.1 RX ROTATION PERFORMANCES

The Rx rotation performances has been driven by the requirements imposed by the SA calibration activities which shall be carried out in the AIV clean room.

The SA calibration activities shall require the following performances:

- range $\theta = [0^o, \pm 90^o]$;
- accuracy = 0.5^o
- format: decimal degrees ±ggg.d (e.g. +160.6).

To this purpose, the IP Rotating Device shall be equipped with:

- one angle readout box;
- one relative encoder;
- one home position switch.

The angle readout box shall be operated manually and shall be able to provide the current angle position on a built-in LED display and to a PC connected through a RS232 port. Suitable connectors shall allow to install this device only when required.

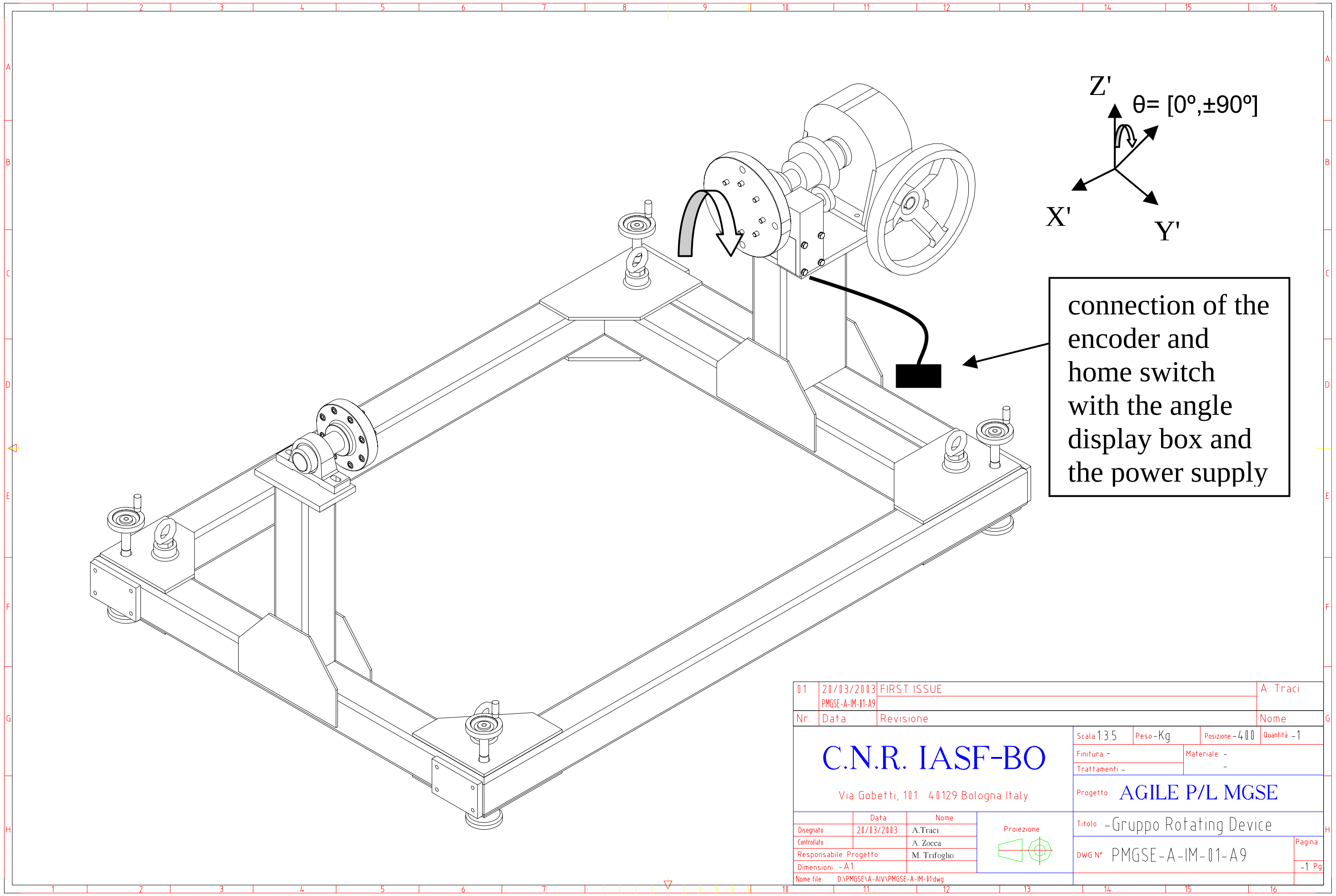

Figure 5-8 IP Rotating Device design concept (v.21apr03)

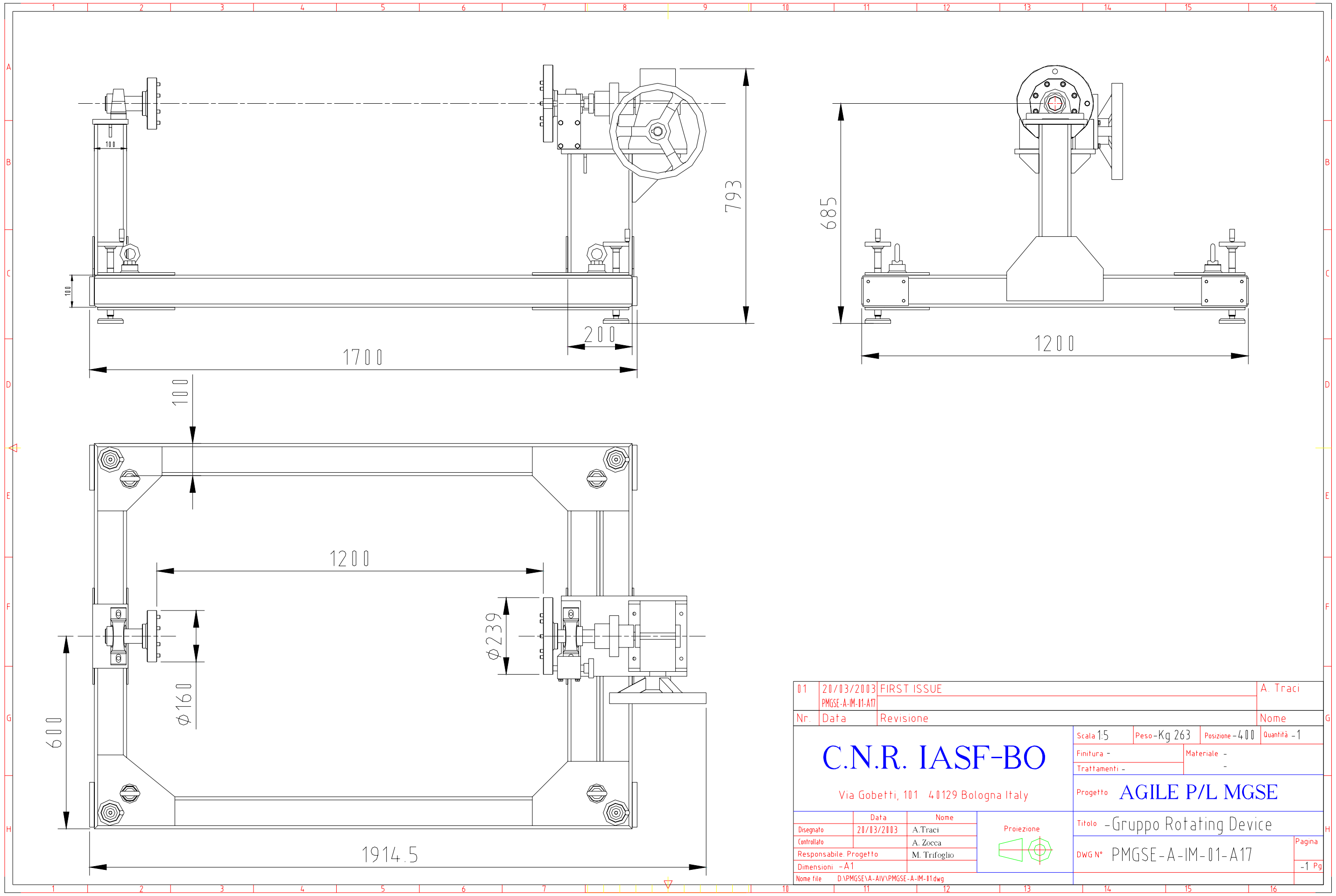

Figure 5-9 Overall design of the IP Rotating Device (v. 21apr03)

5.5 IP SHELL LIFTING FIXTURE

This shall consist of 6 (TBC) hoist rings mounted on the top side of the P/L Shell.

This fixture shall be sized for the total weight of the IP (about 200 Kg) mounted on the IP Shell Interface (about 15 Kg).

5.6 IP LIFTING SPIDER

The preliminary design of the IP Lifting Spider is shown in Figure 5-10. A second circular plate should be added on the top side in order to stiffen the structure (TBC).

The Spider shall be sized for the weight and dimensions of:

- the IP (about 200 Kg) mounted on the IP Shell Interface (about 15 Kg), without the IP Crate, to be lifted from the hoist rings installed on the P/L Shell (see 5.5).
  Total weight to be lift: about 215 Kg.

- The IP (about 200 Kg) mounted on the IP Shell Interface (about 15 Kg), hosted in the IP Crate (about 220 Kg), to be lifted from the hoist rings of the IP Crate itself (see 5.2).
  Total weight to be lift: about 435 Kg.

- The empty IP Crate (about 220 Kg) mounted on the IP Rotating Device (about 270 Kg), to be lifted from the hoist rings of the IP of the IP Rotating Device (see 5.4).
  Total weight to be lift: about 490 Kg.

This provision shall include:

- the cables which shall fix the Spider to the hoist rings of the item to be moved;

- the adapter which shall be required in order to fix the spider to the cable of the LABEN Travelling Crane.

  This adapter shall replace the hook which is currently installed on the LABEN Travelling Crane.

  The adapter shall be designed in order to maximize the space left under the spider.

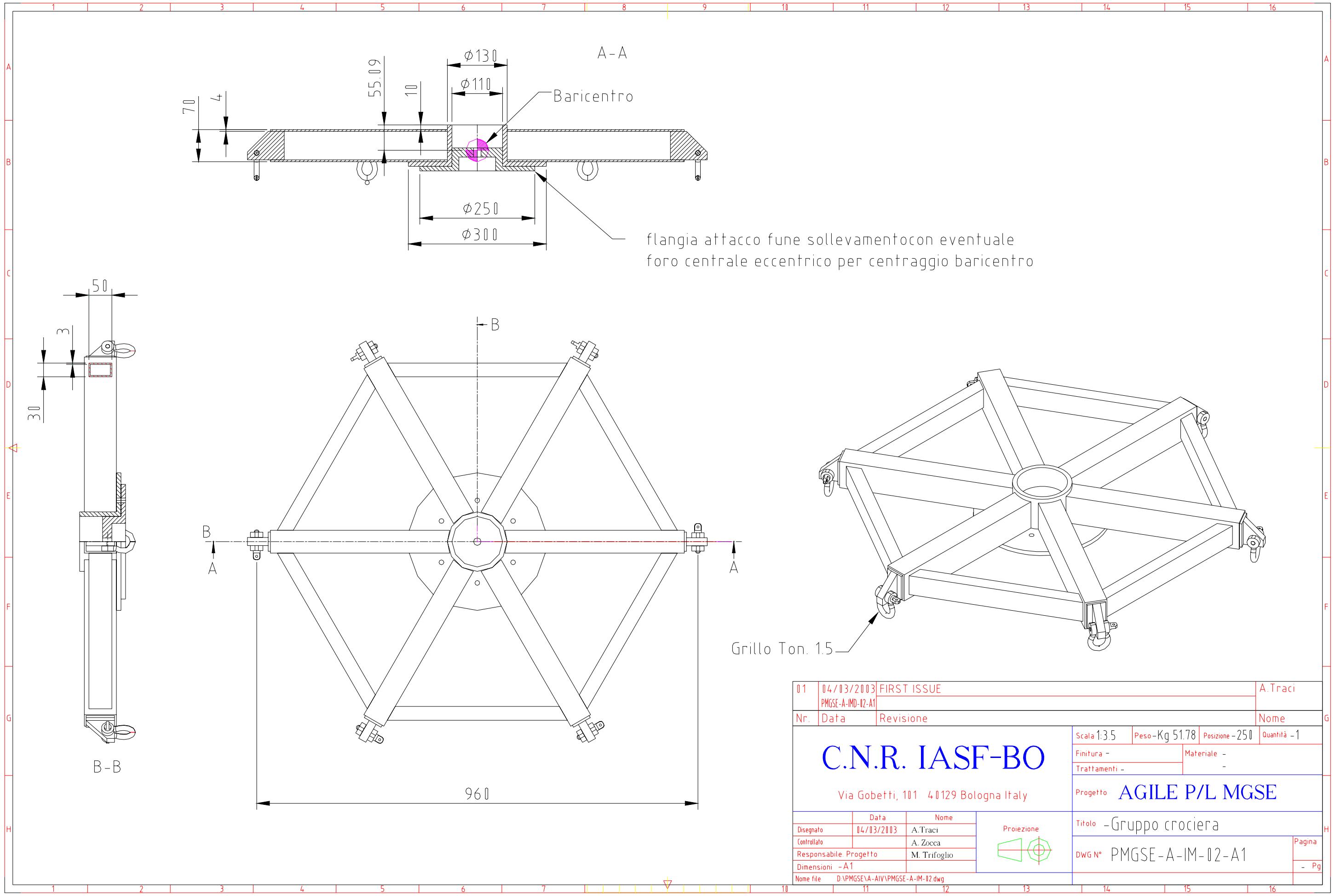

Figure 5-10 Overall design of IP Lifting Spider (v. 21apr03)

5.7 AC LOWERING DEVICE

The AC Lowering Device to be procured by IASF/CNR Milano is shown in.

As shown in Figure 5-11, this device shall include two guide bars to be fixed on the top side of the P/L Shell as detailed in the mechanical drawing AGILE-AST-DS-014 included in AD[3].

Figure 5-11 The AC Lowering device manufactured by IASF Milano.

5.8 IP COOLING SYSTEM

This equipment shall be allow the P/L to work switched-on in ground condition (1 ATM, pressure & room temperature of 20°C) maintaining the detectors and the related electronic inside the operative temperature limits (best performance) defined in AD [8] for an undefined period of time.

Its design concept is still TBD.

5.9 IP THERMAL FIXTURE

This fixture shall replace the IP Shell Interface Flange in order to place in the Thermal facility the IP without the P/L Crate.

Its design concept has been presented by LABEN in the technical annex to the quotation to ASI (TBC).

5.10 IP VIBRATION FIXTURE

This fixture shall replace the IP Shell Interface Flange in order to place in the Vibration facility the IP without the P/L Crate.

Its design concept has been presented by LABEN in the technical annex to the quotation to ASI (TBC).

5.11 IP TRANSPORTATION CONTAINER

This container shall be able to transport IP mounted on the IP Shell Interface Flange (i.e.: without the IP Crate).

Its design concept has been presented by LABEN in the technical annex to the quotation to ASI (TBC).

5.12 IP GROUNDING

All the AIV MGSE mechanical structures shall be provided with grounding points.

6 IP AIV MGSE OPERATIONS

The purpose of the present section is to identify the MGSE operations related to the activities to be supported for the AGILE IP AIV.

6.1 MGSE PREPARATION

As mentioned above, the assembly and integration of the IP complement shall be carried out in the LABEN AIV Clean Room.

To this purpose, the MGSE items shall be set up as summarized below.

1. Using its wheels, the IP Rotating Device shall be positioned manually.

2. The IP Lifting Spider shall be fixed to the LABEN Travelling Crane.

3. The IP Crate shall be hung from the IP Lifting Spider.

4. By manually moving the LABEN Travelling Crane, the IP Crate shall be positioned over the IP Rotating Device.

5. By operating the LABEN Travelling Crane, and using the centering fixture, the IP Crate shall be fixed manually on the IP Rotating Device.

6.2 IP ASSEMBLY AND INTEGRATION

The first purpose of this phase is the mechanical integration of the various IP items listed in section 3.

To this purpose, the MGSE set up described in the previous section shall be exploited as follows.

1. The IP Shell Interface Flange shall be mounted manually on the P/L Shell.

2. The P/L Shell shall be mounted on the P/L Crate by means of the IP Shell Interface Flange.

3. The manual rotation provided by the both the Rotating Device and the P/L Crate shall allow the manual positioning of the P/L Shell as required in order:

    a. to mount the various P/L items inside the P/L Shell;

    b. to assembly the Detector Core on the P/L Shell;

    c. to mount the various P/L items outside the P/L Shell (e.g. the Star Sensors)

    It is noted that:

- the rotation θ shall always be available in the whole range θ = [0°, +180° (see Figure 6-3);

- the whole range ψ = [-180°, +180°] shall be available only before the installation of the Star Sensors;

- with the Star Sensor installed, the ψ rotation shall be limited to the range ψ = [60°, +60°] (see Figure 6-4).

  This limit derives from the height of the IP Rotating Device which has been imposed by the AIV room ceiling eight, as mentioned in section 5.4 above.

4. The LABEN Travelling Crane and the Lifting Spider shall be used any time it is required to remove the IP or part of it from the either P/L Shell, or the P/L Crate or the Rotating Device.

   The following cases are envisaged:

   a. It is required to lift the Detector or part of the Detector.

      In this case the Lifting Spider shall use the safety hoist rings mounted on the Detector;

   b. It is required to lift the IP mounted on the P/L Shell Lifting Fixture, and without the IP Crate.

      In this case, the Lifting Spider shall use the safety hoist rings mounted on the P/L Shell (see 5.5).

      The IP shall be separated from the P/L Crate by removing the screws which fix the P/L Shell Interface Flange on the Rotating Stage of the P/L Crate.

   c. It is required to lift the IP together with the P/L Crate.

      In this case the Lifting Spider shall use the safety hoist rings mounted on the P/L Crate.

      The P/L Crate shall be separated from the Rotating Device by removing the screws which fix the lateral flanges.

5. The AC Lowering Device shall be used in order to lower the AC panels over the Detector Core.

   Given the limited ceiling height of the LABEN AIV room, this operation shall be performed on the IP removed from the P/L Crate and with the IP Shell Interface Flange placed on a suitable support put on the ground.

6. Upon completion of the AC panels assembly, the IP shall be mounted again on the P/L Crate and the Rotating Device in order to assembly the remaining elements of the Detector (e.g.: MLI, LTS, Housekeepings, Heaters).

A pictorial view of the resulting set up is given in Figure 6-1.The overall dimensions are given in Figure 6-2.

It is worth to mention that the limited vertical dimensions of the IP AIV MGSE have been dictated by the ceiling height of LABEN AIV Clean Room.

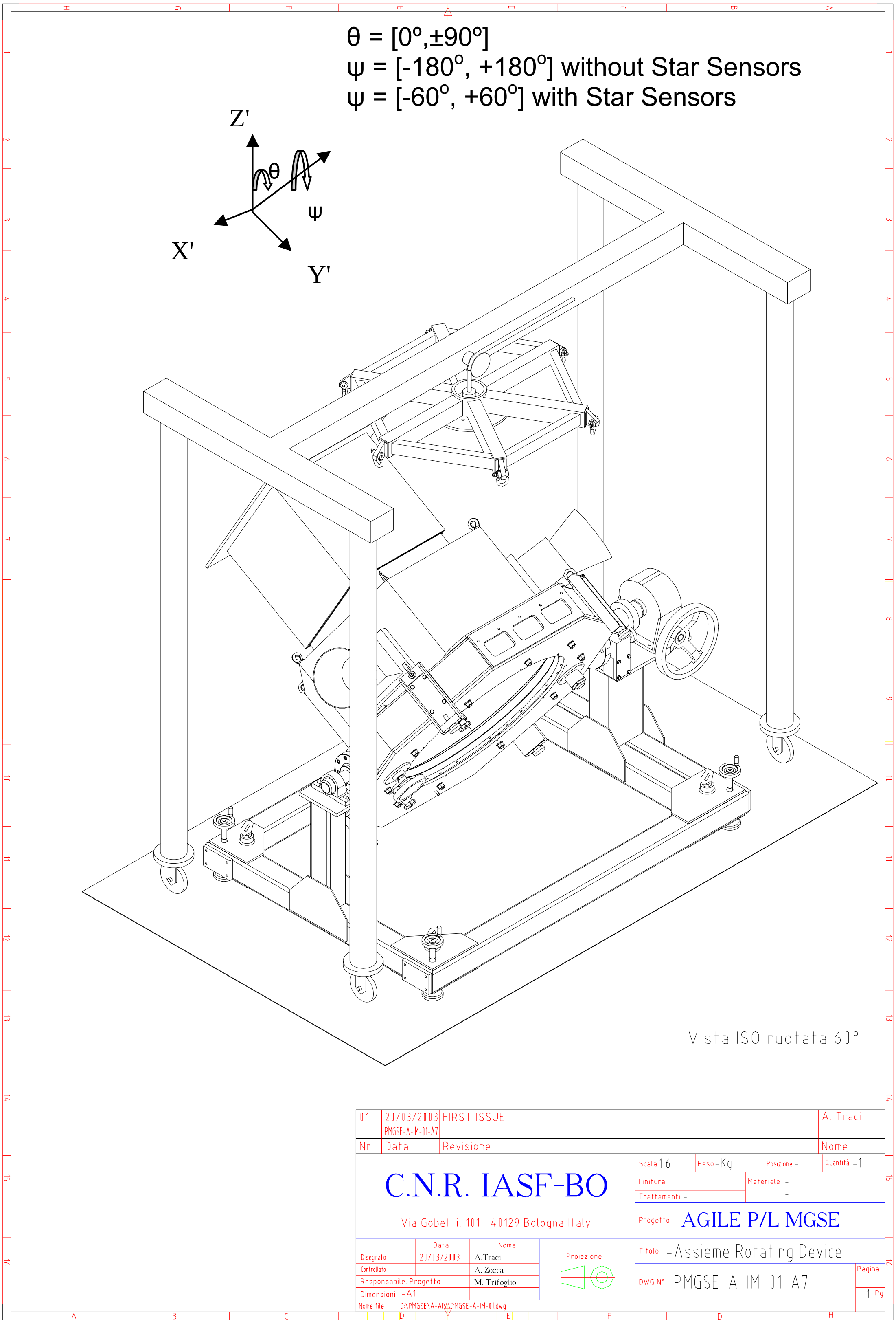

Figure 6-1 IP AIV MGSE overall set up (v. 21apr03)

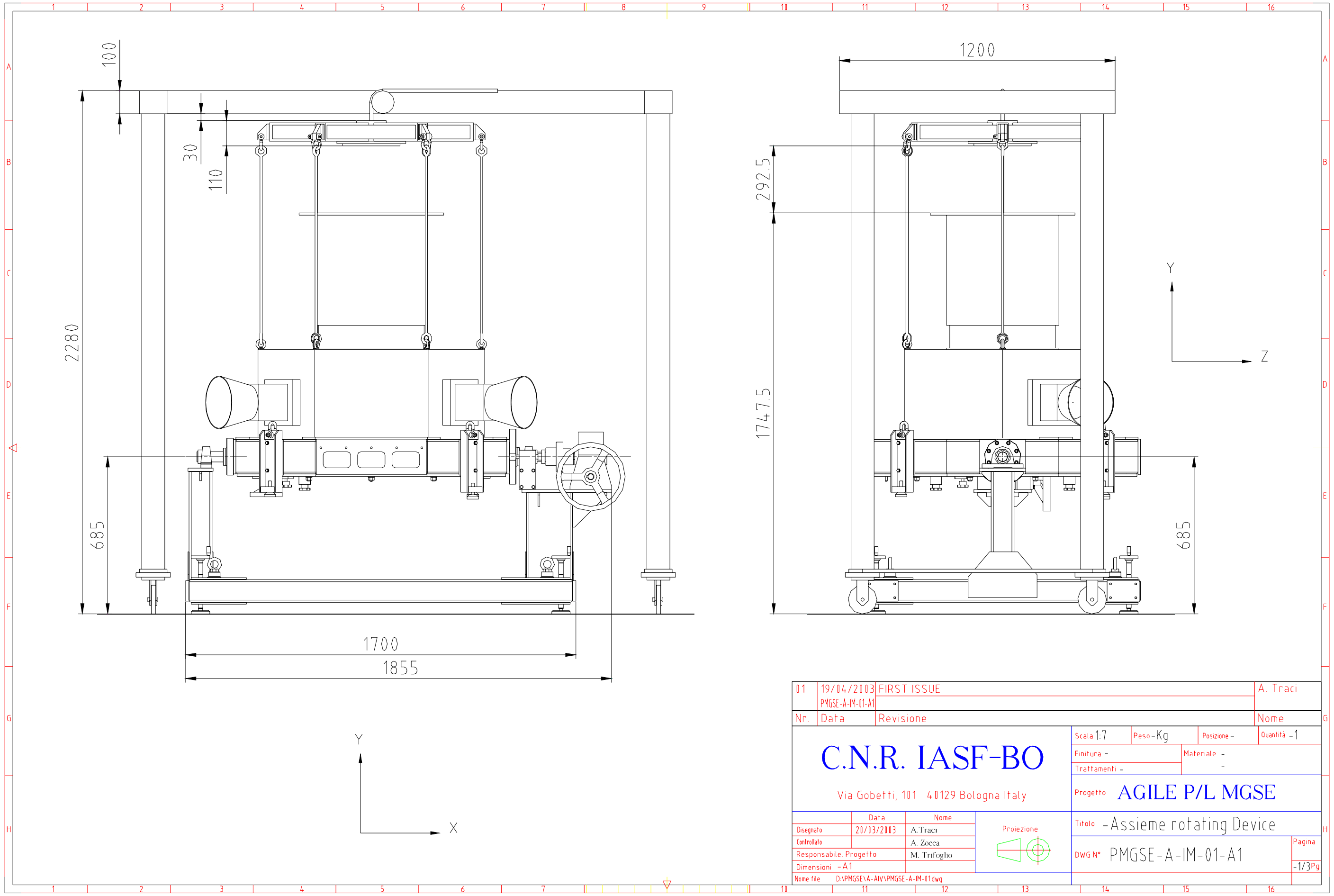

Figure 6-2 Overall dimensions of the IP AIV MGSE setup (v. 21apr03)

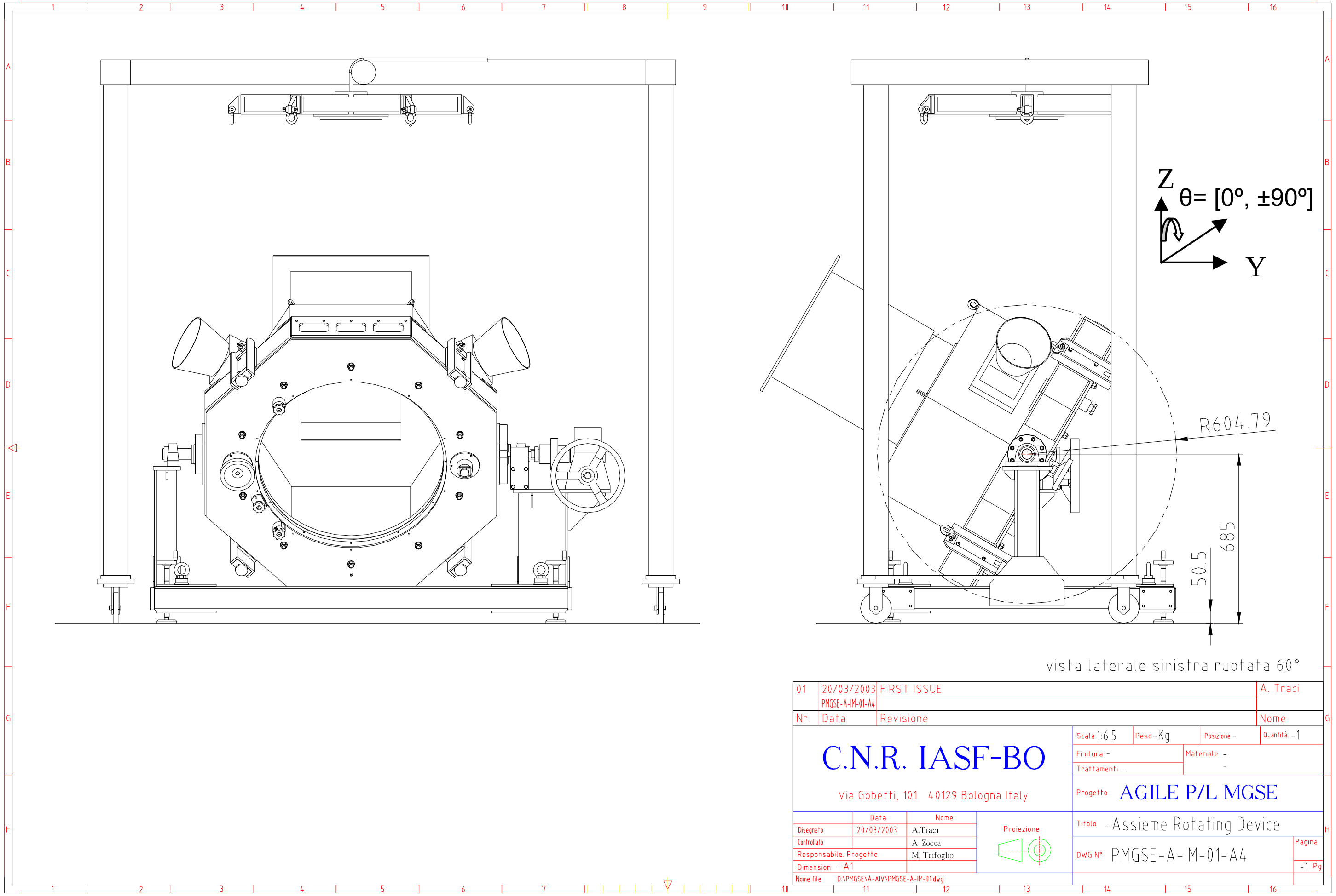

Figure 6-3 Rotation range of the Rotating Device (v. 21apr03)

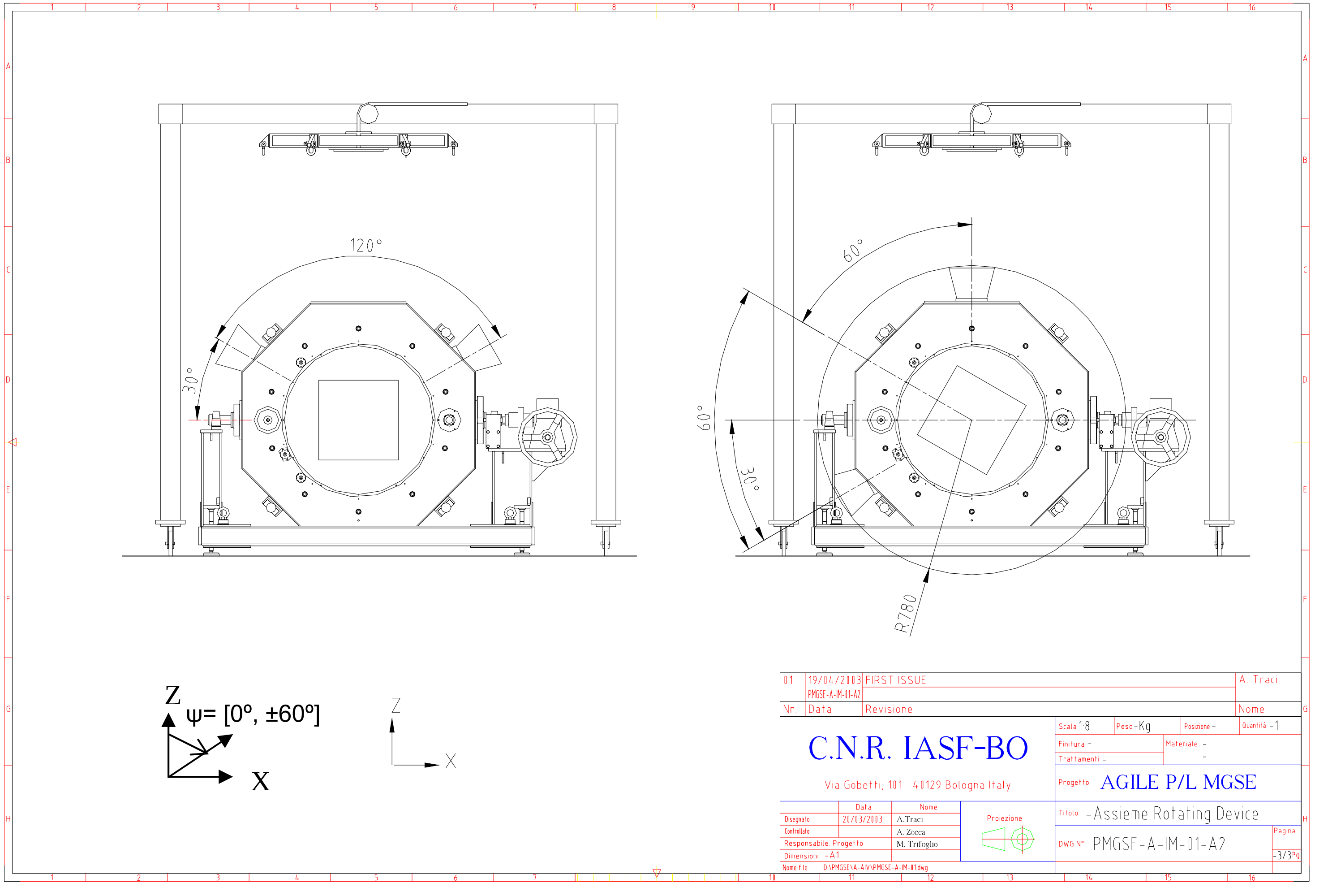

Figure 6-4 P/L Crate rotation range limited by the Star Sensors (v. 21apr03)

6.3 IP VERIFICATION

The Payload Verification (including functional and performance tests and calibration with X and Gamma Ray sources) shall be performed with the MGSE set up depicted in Figura 6-5.

This set up shall allow to position manually the IP by:

- rotating the P/L Y axes in the range $\theta = [0^o, \pm 90^o]$,
- rotating the P/L X axes either in the range $\psi = [0, \pm 180^o]$, in case the Star Sensors are not installed, or in the range $\psi = [0, \pm 60^o]$, in case the Star Sensors are installed.

As already mentioned in 5.2 and 5.4, the angle readout box included in the IP Crate and in the IP Rotating Device shall display and make available to a computer the current θ and ψ angular positions.

In case of need, the IP shall be interfaced to the IP Cooling System (which design is still TBD).

6.4 IP PACKAGING AND TRANSPORTATION

In order to be packed into the IP Transportation Container, the IP shall dismounted from the P/L Crate.

This operation shall require:

i. to hang the IP from the IP Lifting Spider mounted under the LABEN Travelling Crane;

ii. to remove the screws which fix the IP Shell Interface Flange to the IP Crate Rotating Table;

iii. by operating the LABEN Travelling Crane, to lift from the IP Rotating Device and place on the IP Transportation Container the IP mounted on the IP Shell Interface Flange.

6.5 IP INTEGRATION ON THE S/C

This activity shall be carried out at RTI premises using the MGSE provided by RTI.

No re usage of the IP AIV MGSE is currently foreseen at S/C level.

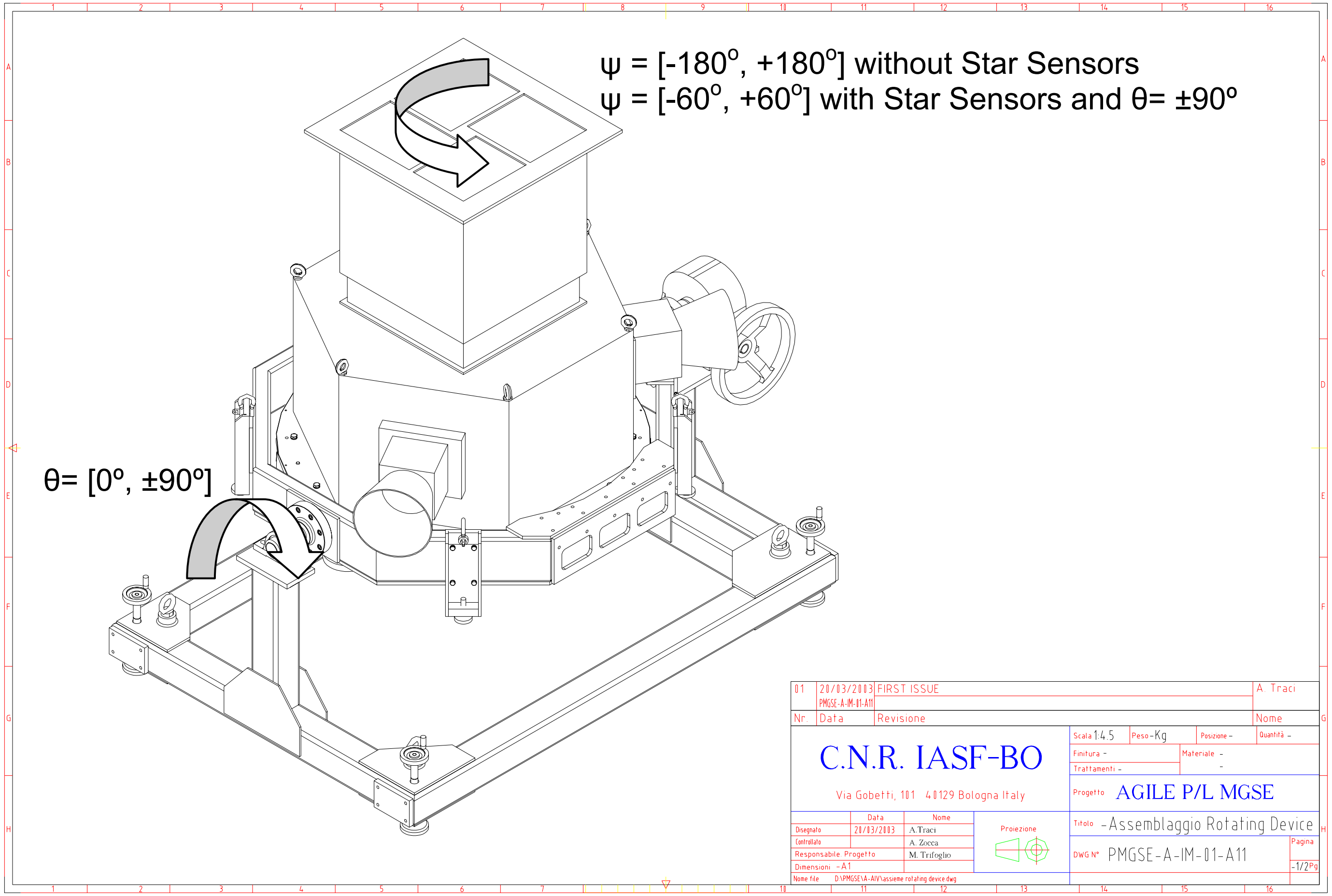

Figura 6-5 MGSE set up for the IP Verification activities (v. 21apr03)