Ariane 6

User's Manual for Multi-Launch Service

Issue 1, revision 0

June 2026

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Issued and approved by Arianespace

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Chief Technical Officer

Preface

The present User's Manual is an add-on to the Ariane 6 User's Manual. It provides an overview of the Multi Launch Service on Ariane 6 launch system operated by Arianespace at the Guiana Space Centre.

This document contains the essential data that are necessary:

- To assess the compatibility of a light or small spacecraft with the Ariane 6 launch system using the MLS carrying system,
- To initiate the preparation of all technical and operational documentation related to a launch of any light or small spacecraft as piggyback on an Ariane 6 mission with a main passenger.

Inquiries concerning clarification or interpretation of this manual should be directed to the addresses listed below. Comments and suggestions on all aspects of this manual are encouraged and appreciated.

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This document will be revised periodically. In case of modification introduced after the present issue, the updated pages of the document will be provided on the Arianespace website www.arianespace.com before the next publication.

Configuration Control Sheet

Iss./Rev.	Date	Change description	Written by	Approved by
0 / 0	July 2021	First Issue		
1 / 0	June 2026	General update introducing higher payload mass capacity	Group of authors	L. LEROY S. ROGEZ

Table of contents

Acronyms, abbreviations and definitions

ω_p	Argument of perigee	
Ω	Ascending node	
Ω_D	Descending node	
a	Semi-major axis	
e	Eccentricity	
g	Gravity (9.81 m/s²)	
i	Inclination	
V_∞	Infinite velocity	
Z_a, h_a	Apogee altitude	
Z_p, h_p	Perigee altitude	

A

AE	**A**rian**e**space	
AIT	**A**ssembly**, I**ntegration and **T**est	
APU	**A**uxiliary **P**ower **U**nit	

B

BT-POC	Combined operations readiness review	**B**ilan **T**echnique **P**lan d'**O**pérations **C**ombinées

C

CCU	Payload Transfer Container	**C**ontainer de transfert **C**harge **U**tile
CDC	Mission control centre	**C**entre **d**e **C**ontrôle
CDL	Launch Centre	**C**entre **d**e **L**ancement
CFRP	**C**arbon **F**iber **R**einforced **P**lastic	
CGRS	**C**old **G**as **R**eaction **S**ystem	
CLA	**C**oupled **L**oads **A**nalysis	
CNES	French National Space Agency	**C**entre **N**ational d'**E**tudes **S**patiales
CoG	**C**enter **o**f **G**ravity	
COTE	**C**heck-**O**ut **T**erminal **E**quipment	
CSG	Guiana Space Centre	**C**entre **S**patial **G**uyanais

D

DEL	Flight synthesis report	**D**ossier d'**E**valuation du **L**ancement
DLS	**D**ual **L**aunch **S**tructure	

E

ECSS	**E**uropean **C**ooperation for **S**pace **S**tandardization	
EGSE	**E**lectrical **G**round **S**upport **E**quipment	
EMC	**E**lectro**M**agnetic **C**ompatibility	
ESA	**E**uropean **S**pace **A**gency	
ESR	**E**quipped **S**olid **R**ocket	

F

FLL	**F**light **L**imit **L**evel	
FM	**F**light **M**odel	
FMAR	**F**inal **M**ission **A**nalysis **R**eview	
FRR	**F**light **R**eadiness **R**eview	

G

GEO	**G**eosynchronous **E**quatorial **O**rbit	
GSE	**G**round **S**upport **E**quipment	
GTO	**G**eostationary **T**ransfer **O**rbit	

H

HEO	**H**igh **E**lliptical **O**rbit	
HPF	**H**azardous **P**rocessing **F**acility	
HSS	**H**orizontal **S**eparation **S**ubsystem	

I

ICD	**I**nterface **C**ontrol **D**ocument	
IRR	**I**ntegration **R**eadiness **R**eview (for MLS stack)	

J

K

KRU	**K**ou**r**o**u**	

L

LBC	Check-out Equipment Room	**L**ocal **B**anc de **C**ontrôle
LEO	**L**ow-**E**arth **O**rbit	
LLPM	**L**ower **L**iquid **P**ropulsion **M**odule	
LOX	**L**iquid **Ox**ygen	
LRR	**L**auncher **R**eadiness **R**eview	
LSA	**L**aunch **S**ervice **A**greement	
LTO	**L**unar **T**ransfer **O**rbit	
L/V	**L**aunch **V**ehicle	
LVA	**L**aunch **V**ehicle **A**dapter	

M

MCC	**M**ission **C**ontrol **C**entre	
MCI	**M**ass**, C**enter of Gravity**, I**nertia	
MGSE	**M**echanical **G**round **S**upport **E**quipment	
MLS	**M**ulti **L**aunch **S**ervice	
MTC	**M**etallic **T**ransition **C**one	
MTS	**M**etalli**c** **T**ransition **S**pacer	
MUA6	Ariane 6 user's manual	**M**anuel **U**tilisateur **A**riane **6**

N

O

OASPL	**O**verall **A**coustic **S**ound **P**ressure **L**evel	
OBC	**O**n **B**oard **C**omputer	
OCOE	**O**verall **C**heck **O**ut **E**quipment	

P

PFCU	Payload access platform	**P**late-**F**orme **C**harge **U**tile
PFM	**P**roto-**F**light **M**odel	
P/L	**P**ay**l**oad	
PMAR	**P**reliminary **M**ission **A**nalysis **R**eview	
PLANET	**P**ayload **L**ocal **A**rea **N**etwork	
PLA6	**P**ay**L**oad **A**dapter for Ariane **6**	
POC	Combined Operations Plan	**P**lan d'**O**pérations **C**ombinées
POI	Interleaved spacecraft operations plan	**P**lan d'**O**pérations **I**mbriquées
POS	Spacecraft operations plan	**P**lan d'**O**pérations **S**atellite
PPF	**P**ayload **P**reparation **F**acility	
PRS	**P**ayload **R**epeater **S**ystem	
PSD	**P**ower **S**pectral **D**ensity	

Q

QM	**Q**ualification **M**odel	
QSL	**Q**uasi-**S**tatic **L**oad	

R

RAAN	**R**ight **A**scension of the **A**scending **N**ode	
RF	**R**adio **F**requency	

S

S/C	**S**pace**c**raft	
SoW	**S**tatement **of** **W**ork	
SPF	**S**atellite **P**reparation **F**acility	
SPORT	**S**atellite **P**roject **O**perational **R**equirements **T**ables	
SSO	**S**un-**S**ynchronous **O**rbit	
STM	**S**tructural **T**est **M**odel	

T

TBC	**T**o **B**e **C**onfirmed	
TBD	**T**o **B**e **D**efined	
TC	**T**ele**c**ommand	
TD	Countdown time	**T**emps **D**écompte
TM	**T**ele**m**etry	

U

UCT	**U**pper **C**omposite **T**railer	
ULPM	**U**pper **L**iquid **P**ropulsion **M**odule	
UPCOM	**U**pper **P**art & Payload **C**ombined **O**perations **M**anager	
UT	**U**niversal **T**ime	

V-W

X-Y

Z

ZL4	Launch pad for Ariane 6	**Z**one de **L**ancement n°**4**

INTRODUCTION Chapter 1

1.1. PURPOSE OF THE ARIANE 6 MULTI-LAUNCH SERVICE USER'S MANUAL

Arianespace has been launching Small Spacecraft since the early days of Ariane in 1980. Arianespace initiated a standardized approach with the introduction of the ASAP carrying system (Ariane Structure for Auxiliary Payloads). This allowed many teams worldwide to gain easy and cost-effective access to space for their small projects.

In order to address the needs of a growing number of Light and Small Spacecraft projects, Arianespace is offering a tailored and standardized launch service as piggyback on some Ariane 6 missions with main passengers(s).

The present User's Manual is intended to provide information for Passengers from 200 to 1 500 kg on Ariane 6 MLS carrying system.

The content encompasses in particular:

- the Spacecraft classification;
- the description of the available carrying systems on Ariane 6;
- the typical mission characteristics;
- the description of the interfaces between Spacecraft and Launch Vehicle;
- the requirements for Light and Small Spacecraft design and compatibility verification and the launch environment;
- the description of the mission integration management;
- the description of the launch campaign organization and work flow.

Together with the Ariane 6 User's Manual, the Spacecraft Processing Facilities at CSG User's Manual and the CSG Safety Regulations, it gives readers the information to assess the compatibility with the proposed standardized MLS configurations.

The reader is welcome to contact us for any question about this User's Manual and the Multi-launch service. We will be very pleased to work with you in order to determine the best solutions to address your needs.

1.2. SPACECRAFT CLASSIFICATION

Arianespace has established the following classification in order to provide a standard launch service tailored to each class of S/C on Ariane 6 MLS carrying system:

- **Light S/C**: satellite with a mass from 200 up to 350 kg,
- **Small S/C**: satellite with a mass from 350 to 1 500 kg*.

* For higher S/C mass, please contact Arianespace.

Each class of Light or Small S/C is associated with several positions available on the Arianespace MLS dispensers (refer to Chapter 1.5 below for a detailed description).

1.3. TYPE OF MISSIONS

For Light and Small S/C, Arianespace proposes piggyback missions on some Ariane 6 missions with Main Passenger(s).

The piggyback missions can take place when extra performance and volume are available on a mission already assigned with Main Passenger(s) in the launch manifest. The launch period and the main characteristics of the mission are defined by the Main Passenger(s).

1.4. ARIANE 6 LAUNCH VEHICLE DESCRIPTION

Ariane 6 exists in two versions: Ariane 62 with 2 solid propellant stages and Ariane 64 with 4 solid propellant stages:

Figure 1.4: The Ariane 62 and 64 launch vehicles

The Ariane 6 consists primarily of the following elements:

- Two or Four Equipped Solid Rockets (ESR).
- A Lower Liquid Propulsion Module (LLPM) containing liquid oxygen and hydrogen, propelled by the Vulcain 2.1 engine that has a strong heritage from Ariane 5 Vulcain engine.
- An Upper Liquid Propulsion Module (ULPM) propelled by the re-ignitable Vinci engine that allows up to 4 ignitions during the launch vehicle flight. The upper stage is also equipped with an Auxiliary Power Unit (APU) to allow long term distancing and ULPM disposal maneuvers to mitigate space debris.
- A fairing (PLF) that comes into two lengths: short (for A62 only) & long,
- Adapters, dispensers and carrying systems accommodating the spacecraft.

1.5. CARRYING SYSTEMS FOR LIGHT & SMALL SPACECRAFT ON ARIANE 6

1.5.1. Introduction

In order to provide more launch opportunities for Light & Small S/C, Arianespace, with the support of ESA, has developed several ring-shaped carrying systems to carry and deploy these S/C in orbit:

- **Light S/C dispenser**, up to 6 Light S/C in cantilevered position;
- **Small S/C dispenser**, up to 4 Small S/C in cantilevered position.

For these missions using MLS carrying system(s), the upper part configuration consists of a stack with:

- Light and/or Small S/C aggregated on one or several ring-shaped carrying system(s),
- Main Passenger(s) with its (their) adapter(s),
- The Ariane 6 Dual Launch System (when two Main Passengers are on board),
- Intermediate structures to provide interface between the MLS carrying structure(s), the launcher structures and the main payload adapter(s),
- The electrical system (harnesses, sequencers, …),
- The fairing.

1.5.2. Light S/C dispenser carrying system

The **Light S/C dispenser** consists in a lightweight CFRP spherical-shape ring (Height 1 051 mm, interface diameter Ø1575 mm) offering 6 ports, each being able to carry in radial direction (cantilevered) a spacecraft of 350 kg mass with a 15’’ or 24’’ interface.

*The **Light S/C dispenser** is designed to support on its top interface, a 5 500 kg Main passenger with its adapter, with a Center of Gravity position up to 2.5 m over the mating plane.*

Figure 1.5.2 - Light S/C dispenser *illustrative view*

In case of specific request related to interface diameter or spacecraft orientation, please contact Arianespace.

1.5.3. Small S/C dispenser carrying system

The **Small S/C dispenser** consists in a metallic cylindrical ring (Height 2 000 mm, interface diameter Ø1575 mm) offering up to 4 ports, each being able to carry in radial direction (cantilevered) a spacecraft of up to 1 500 kg mass with a 31.6’’ or 937 interface.

A 24’’ and a 38.8” interface can be also proposed using an adaptation ring.

*The **Small S/C dispenser** is designed to support on its top interface, a 5 500 kg Main Passenger with its adapter, with a center of gravity position up to 2.5 m over the mating plane*.

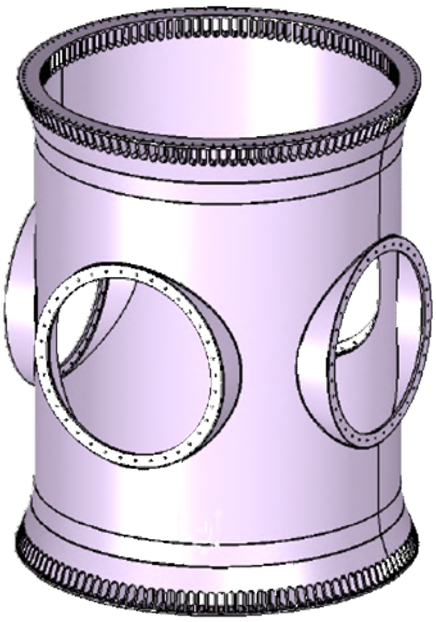


Figure 1.5.3 - Small S/C dispenser *illustrative view*

1.5.4. Typical configurations

The typical **MLS stack configurations** are:

- Light S/C dispenser with 6 Light S/C positions at 60° (see left figure below);
- Small S/C dispenser with 4 Small S/C position at 90° (see center figure below)
- Small S/C dispenser with 3 Small S/C position at 120° (see right figure below).

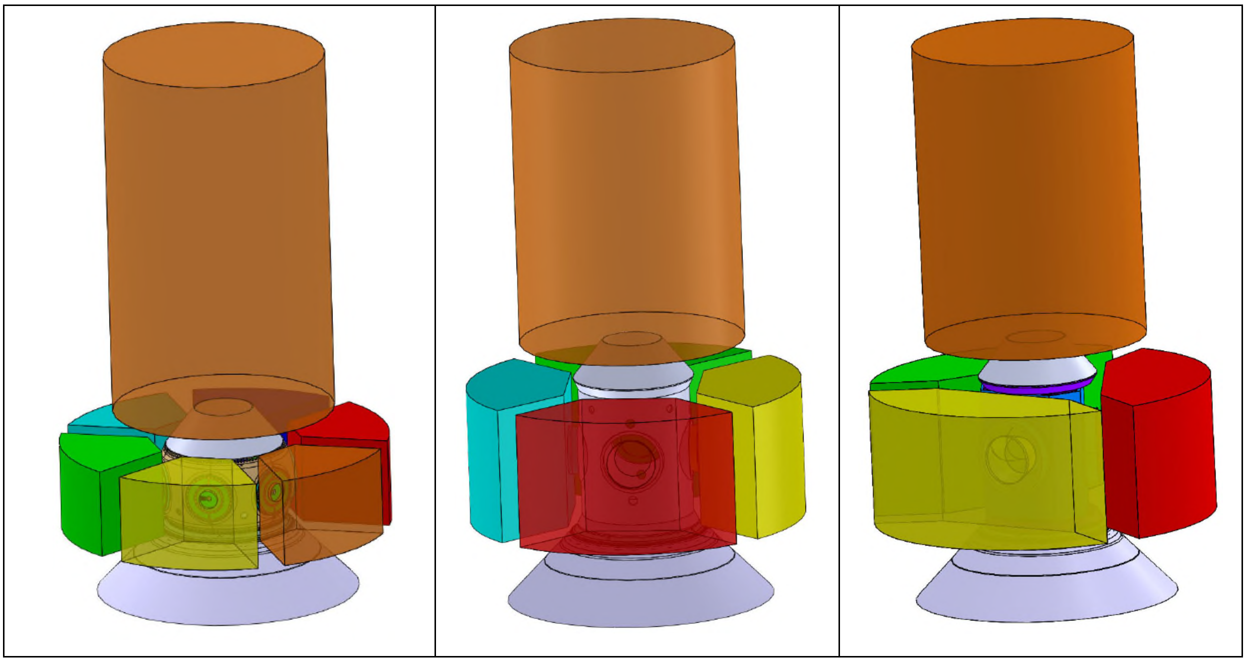


Figure 1.5.4 - Typical MLS stack configurations

These MLS stack configurations can be embarked:

- on-board an Ariane 62;
- on-board an Ariane 64, in Double Launch System configuration, in upper or lower position.

1.5.5. Other configurations

Arianespace might evaluate the use of other carrying systems that would meet Customers' need. In particular, a customizable platform allowing to accommodate spacecraft side-by-side, might be envisaged.

Figure 1.5.5 – Example of another dispenser concept

For other configurations, please contact Arianespace.

1.5.6. Main conditions applying to Light and Small Spacecraft

The standard conditions are defined in the Launch Service Agreement (LSA), Terms & Conditions (T&C) and Statement of Work (SOW).

This chapter briefly summarizes the main conditions for piggyback mission on Ariane 6 with Main Passenger(s).

Main passenger approval

For a piggyback mission, the launch of a Light or Small S/C is subject to the approval of the Main Passenger(s). The project shall be able to answer to any request aiming at demonstrating technical and programmatic safety for the Main Passenger(s).

Launch Schedule

The Launch schedule is totally driven by the launch schedule of the Main Passenger(s). The Light or Small S/C shall in no case be entitled to affect the launch schedule. The consequence is that, should the Light or Small S/C not be ready for the launch, it will fly as it is if already mounted on the MLS dispenser or it will be disembarked, and may be replaced by another passenger or dummy mass.

Targeted orbit & Launch window

The targeted orbit and the launch window are defined by Arianespace taking into account the Main Passenger(s) technical requirements.

Light and Small S/C preparation at the launch site

The S/C arrival date to French Guiana shall be coordinated with Arianespace.

The CSG facilities are shared with the other Light and Small S/C on the same flight. This includes Spacecraft Preparation Clean Room (PPF), Lab for Check-out stations (LBC), and when necessary, Filling Hall (HPF).

The Light and Small S/C shall be ready, for integration on the carrying structure, the day before the start of the Combined Operations. The operation timeline at CSG will be defined during the operations preparation meetings.

See Chapter 6 for more details on the launch campaign organization.

Light and Small S/C status during final preparation, countdown and flight

The Light or Small S/C shall be inert (battery charge completed, S/C OFF, no RF emission, no status change) once integrated on the MLS dispenser, during the launch and until at least 60s after its separation with a delta V higher than 0.3m/s. The minimum delay for S/C activation after separation will be determined by Arianespace in the frame of the mission analysis process and will depend on the type of orbit and overall mission timeline.

It is requested that the Light or Small Satellite have a minimum battery autonomy of 30 days after the final charge in the SPF, to account for potential launch delays.

The satellite shall provide 4 pins to ensure a capability to charge and monitor the battery in case of launch delay over these 30 days. For any additional need, please contact Arianespace.

1.5.7. Procuring Light & Small Spacecraft launch services

A template of the Application to Use Arianespace's Launch Vehicle for Light or Small Spacecraft is attached in Annex 1.

It is used by Arianespace to identify the possible launch opportunities, to build the MLS aggregated S/C stack and provide preliminary mission and pricing information. Later on, once the Launch Service Agreement (LSA) is effective, it will be used to initiate the Interface Control Document (ICD).

MISSION REQUIREMENTS — Chapter 2

2.1. GENERAL

This section presents the typical mission profile, the attitude orientation capabilities and the mission duration.

The mission profile is defined by Arianespace, including:

- Ascent profile, number and durations of the upper stage boost phases and of the coast phases, visibility from ground stations, etc.
- S/C separation timeline.

2.2. TYPICAL MISSION PROFILE

The Ariane 6 Upper Stage offers a great flexibility to inject several S/C on a given orbit.

The ULPM phase typically consists of one, two or more burns to reach the targeted orbit, depending on the orbit altitude, eccentricity and inclination:

- For elliptic equatorial orbit including GTO, a single boost injects the upper composite into the targeted orbit (direct ascent profile);
- For circular or near circular orbit in LEO, SSO or for GTO+ orbit (with high perigee), a first burn is used to reach an intermediate orbit, followed by a coast phase which duration depends on the targeted orbit, and a second burn to reach the final orbit.

In this paragraph, typical GTO, LEO and SSO missions are mentioned as examples.

Typical GTO mission on Ariane 64 launcher

For GTO mission on Ariane 64, the typical flight path, ground track and timeline are presented below:

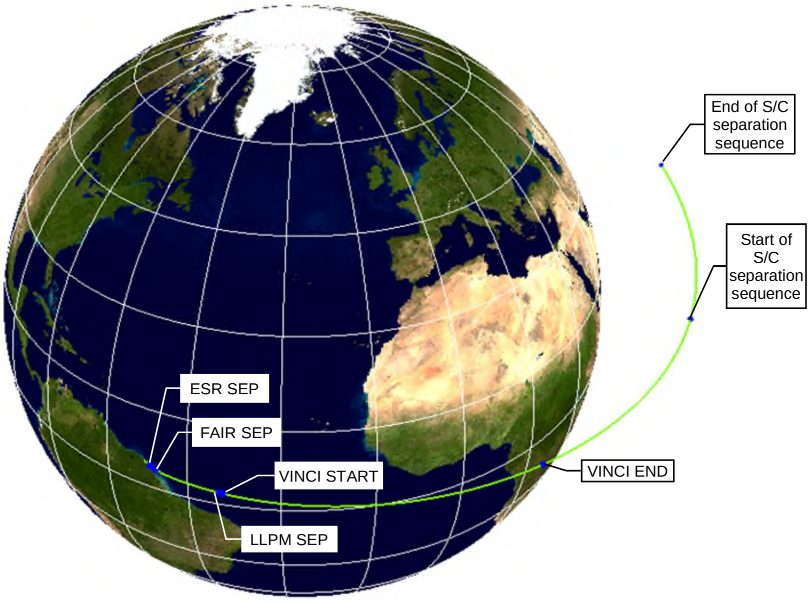


Figure 2.2.a - Typical flight path for Ariane 64 GTO mission

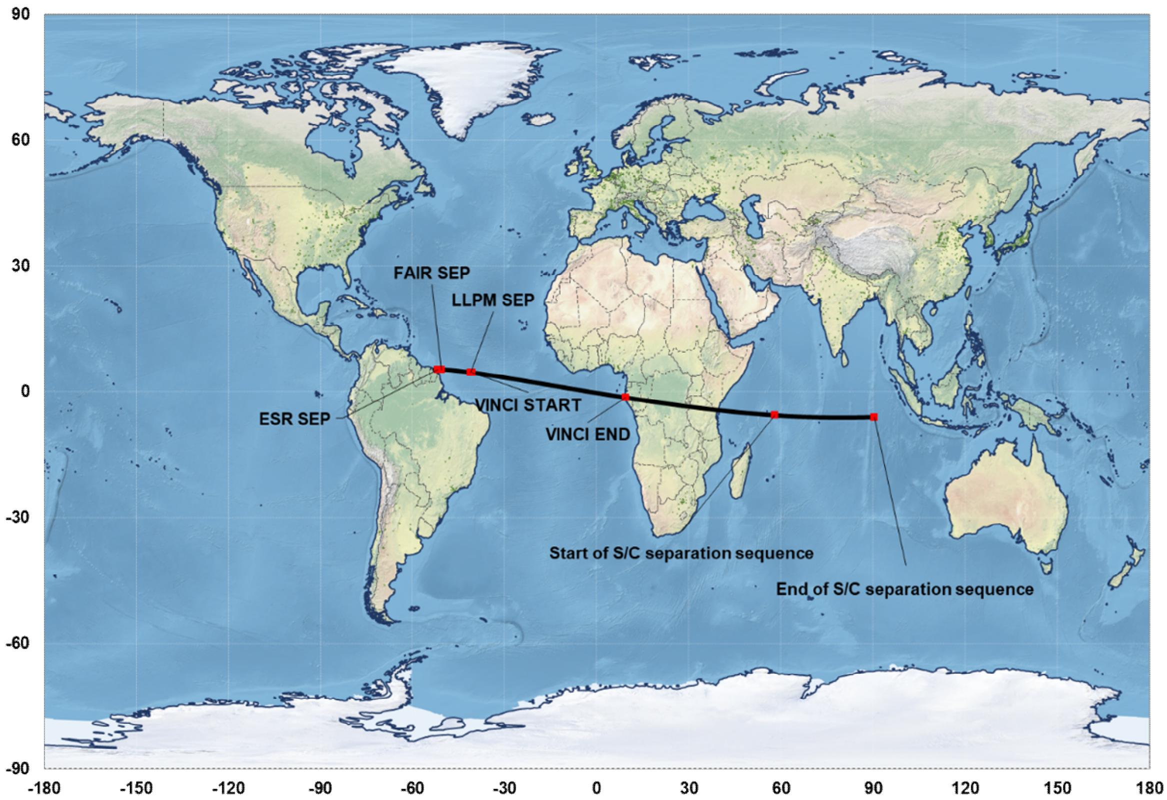


Figure 2.2.b - Typical ground track for Ariane 64 GTO mission

The typical timeline for the Ariane 64 GTO mission is the following:

Events	Time wrt ESR ignition (s)
Lift-off	0
ESRs separation	139
Fairing jettisoning	189
Vulcain 2.1 engine cut-off	463
LLPM separation	469
Vinci engine ignition	477
Vinci engine cut-off	1 247
Injection into orbit	1 417
Start of S/C separation sequence	2 017

Table 2.2.a - Typical timeline for Ariane 64 GTO mission

Typical LEO mission on Ariane 64 launcher

For LEO mission on Ariane 64, the typical flight path, ground track and timeline are presented below:

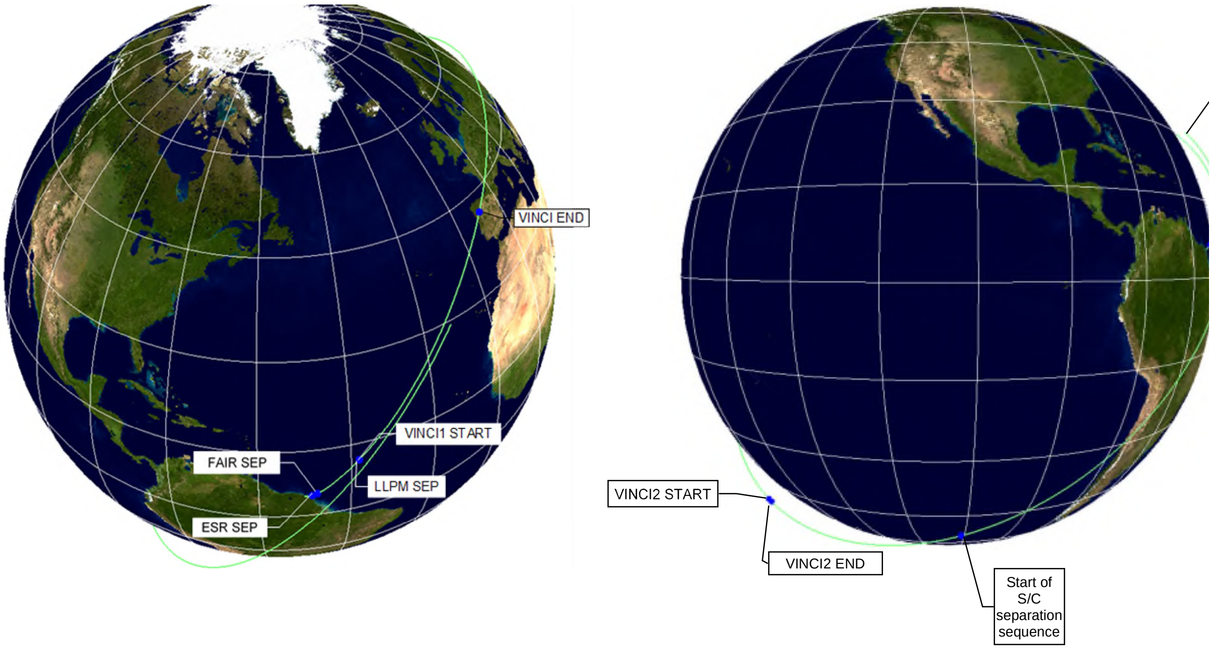


Figure 2.2.c - Typical flight path for Ariane 64 LEO mission

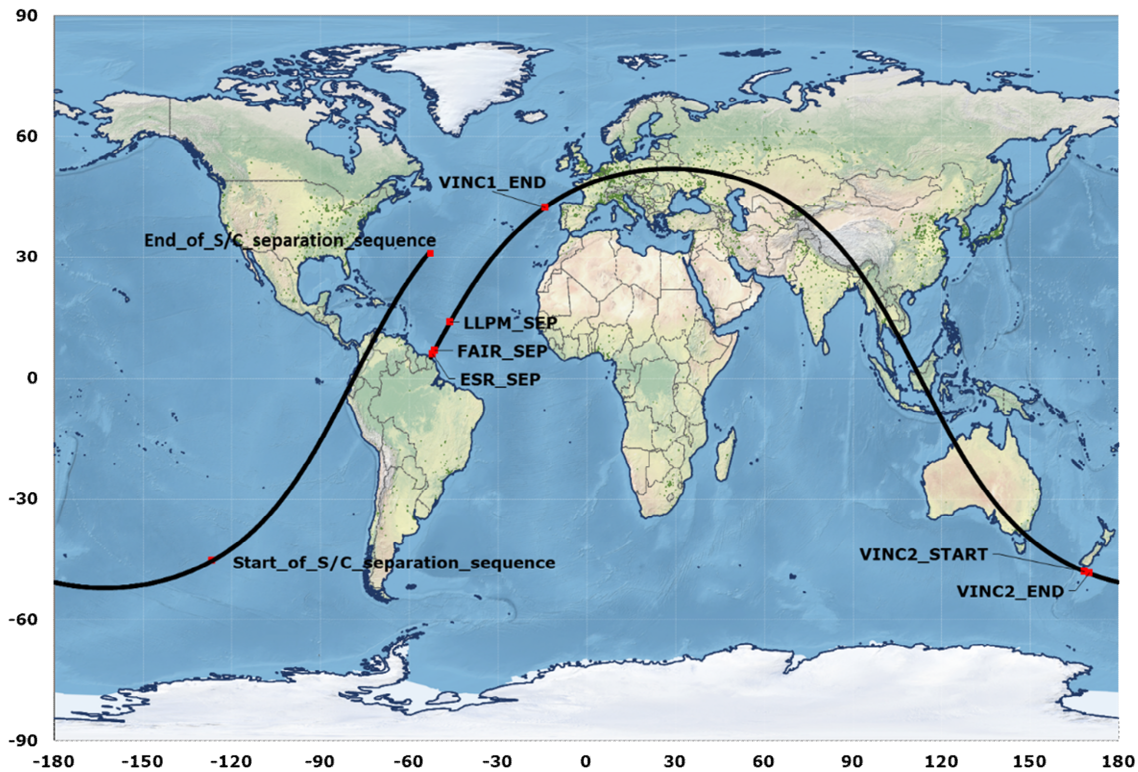


Figure 2.2.d - Typical ground track for Ariane 64 LEO mission

The typical timeline for the Ariane 64 LEO mission is the following:

Events	Time wrt ESR ignition (s)
Lift off	0
ESRs separation	141
Fairing jettisoning	191
Vulcain 2.1 engine cut-off	463
LLPM separation	469
Vinci engine first ignition	477
Vinci engine first cut-off	1 209
Vinci engine second ignition	4 052
Vinci engine second cut-off	4 070
Injection into orbit	4 449
Start of S/C separation sequence	5 049

Table 2.2.b - Typical timeline for Ariane 64 LEO mission

Typical SSO mission on Ariane 62 launcher

For SSO mission on Ariane 62, the typical flight path, ground track and timeline are presented below:

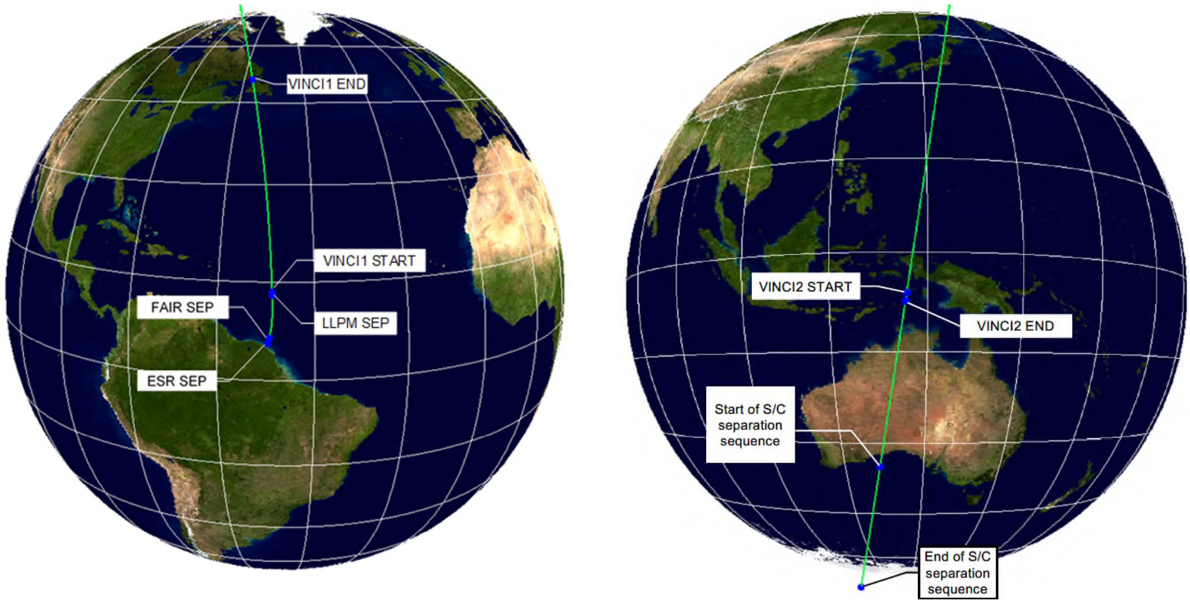


Figure 2.2.e - Typical flight path for Ariane 62 SSO mission

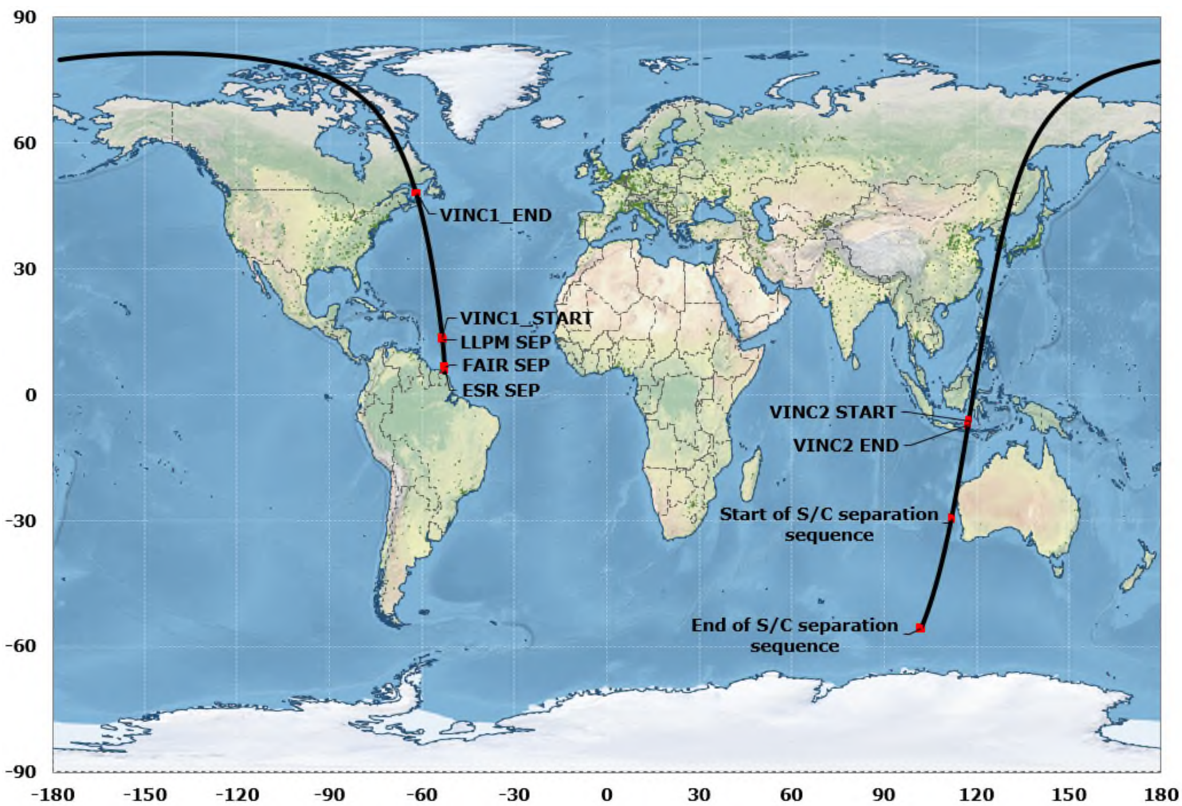


Figure 2.2.f - Typical ground track for Ariane 62 SSO mission

The typical timeline for the Ariane 62 SSO mission is the following:

Events	Time wrt ESR ignition (s)
Lift off	0
ESRs separation	134
Fairing jettisoning	207
Vulcain 2.1 engine cut-off	461
LLPM separation	467
Vinci engine first ignition	475
Vinci engine first cut-off	1 177
Vinci engine second ignition	3 386
Vinci engine second cut-off	3 404
Injection into orbit	3 783
Start of S/C separation sequence	4 383

Table 2.2.e - Typical timeline for Ariane 62 SSO mission

2.3. AEROTHERMAL FLUX AT FAIRING JETTISONING

Jettisoning of the payload fairing can take place at different times depending on the Passengers aerothermal flux requirements.

Typically, the fairing separation takes place when the aerothermal flux is lower than 1 135 W/m^2.

The actual aerothermal flux at fairing jettisoning will be determined in the frame of the mission analysis.

2.4. ATTITUDE DURING LONG COASTING PHASE

During a long coasting phase, between two ULPM boosts, if any, the launcher is spun at 1°/s ±0.2°/s around its longitudinal axis, and the launcher axis is preferably set perpendicular to the Sun direction with an accuracy of ±15°.

2.5. SPACECRAFT SEPARATION CONDITIONS

The timeline of the S/C separation sequence is defined by Arianespace and the S/C separation conditions (depointing, residual angular velocities after separation) are determined in the frame of the mission analysis.

Separation conditions are mainly linked to the static unbalance and inertia of the Spacecraft and to the separation system characteristics.

In order to counteract the effect of the S/C nominal static unbalance at separation, and improve the S/C tip-off rates after separation, it is possible to tune the number and positions of the springs on the adapter (refer to the description of the standard adapters proposed in chapter 3.4).

2.6. LAUNCH WINDOW

The launch window is defined by Arianespace, taking into account the Main Passenger(s) technical requirements.

For a GTO mission, as far as possible, Arianespace will define a minimum 45 minutes launch window.

For SSO or LEO missions, the launch window may be reduced to a single fixed time.

INTERFACE REQUIREMENTS AND VERIFICATION Chapter 3

3.1. INTRODUCTION

This chapter defines the interface requirements between the Spacecraft and the Launcher: volume, mechanical interface, electrical interface and interfaces verification.

It is assumed that the adapter / separation system is one of the off-the-shelf separation systems proposed in Chapter 3.4.

3.2. SPACECRAFT REFERENCE AXES & CLOCKING

All S/C data and models (CAD, FEM, thermal model, if any) shall be given in the same reference axis system, with the origin of the reference system in the mounting plane.

The clocking of the spacecraft with regard to the adapters, carrying structure and launch vehicle axes are defined by Arianespace taking into account the overall payload stack configuration.

3.3. LIGHT AND SMALL SPACECRAFT DIMENSIONS

The volumes allocated to the Light and Small S/C are defined hereafter. They take maximum benefit of the volume around the Light and Small S/C dispensers, under the Ariane 6 Fairing and DLS.

The volumes presented below indicate the static dimensions that the spacecraft shall not exceed, including manufacturing tolerances, thermal protection installation, appendices. These usable volumes are defined for the sole spacecraft not equipped with its separation system. The volume allocated for ground operations is also indicated.

They have been established considering the frequency requirements in Chapter 4.

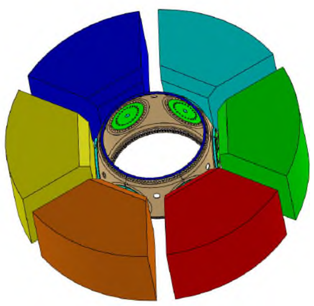
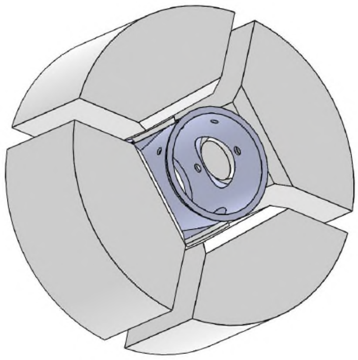
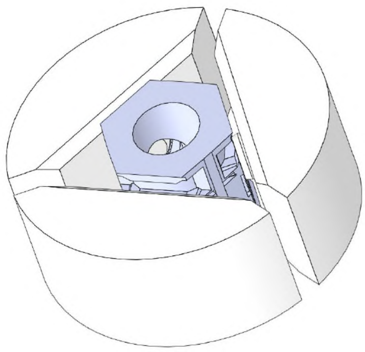
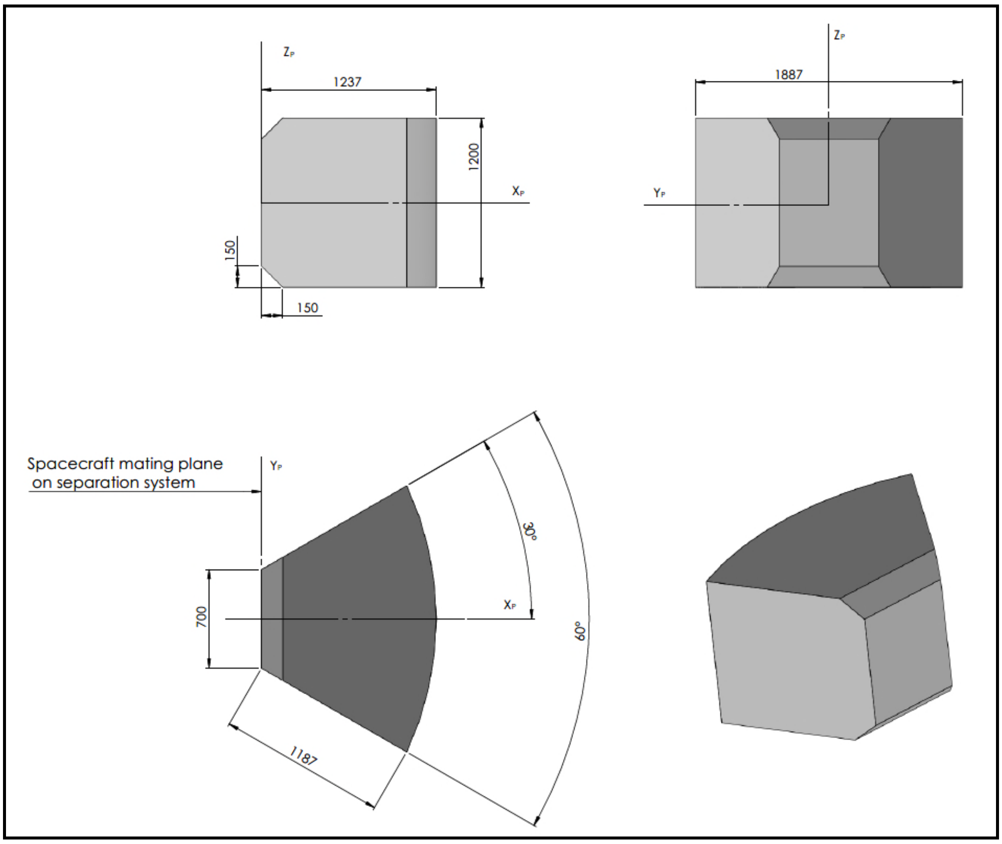
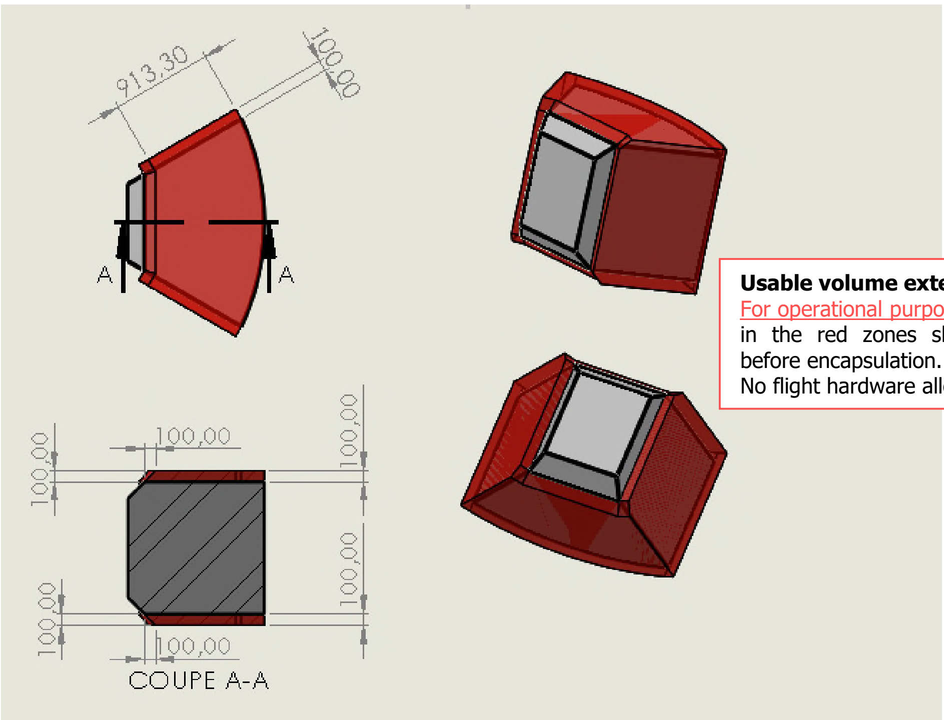
S/C mass		
200 to 350 kg	**350 to 1500 kg**	
S/C volume and interface		
 60° portion volume, using 15'' or 24'' interface See Figure 3.3.a & 3.3.b	 90° portion volume, using 31.6" or 937mm interface See Figure 3.3.c & 3.3.d	 120° portion volume using 937mm interface See Figure 3.3.e

Table 3.3. –S/C masses and corresponding volumes and interfaces

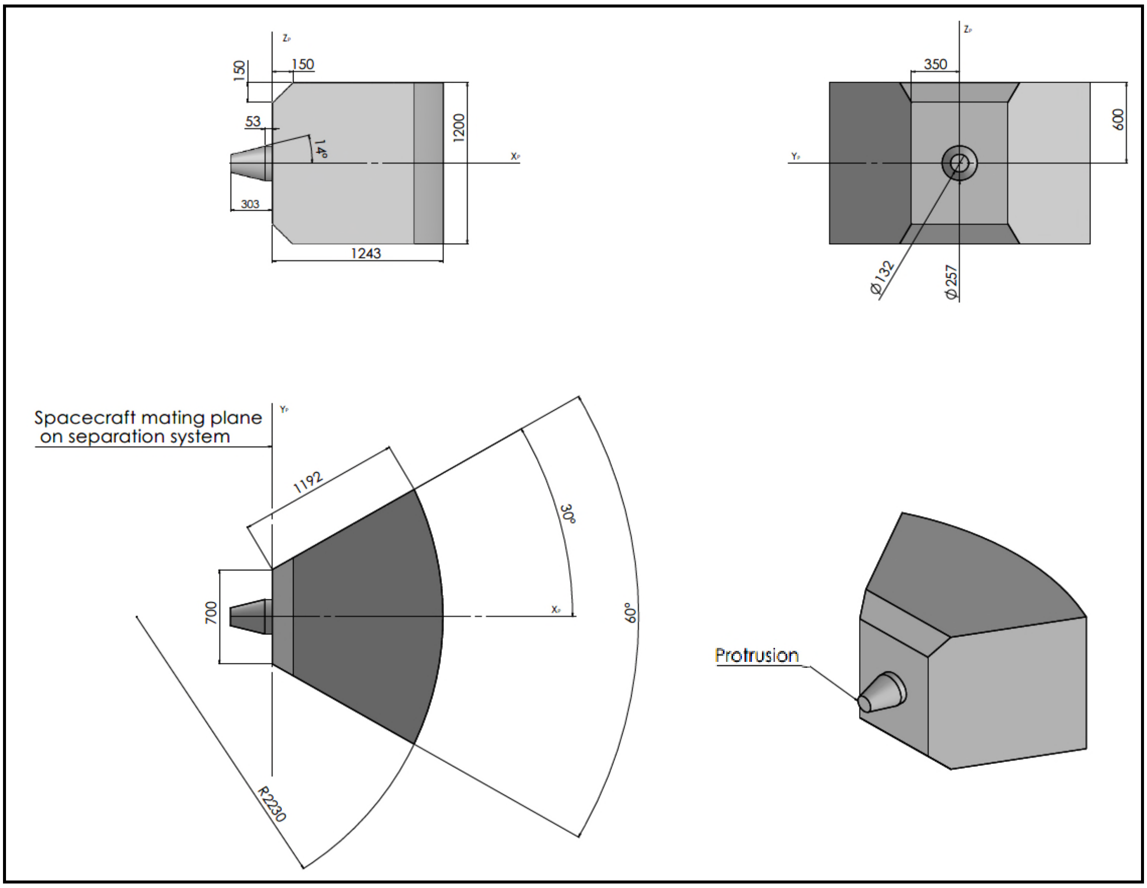


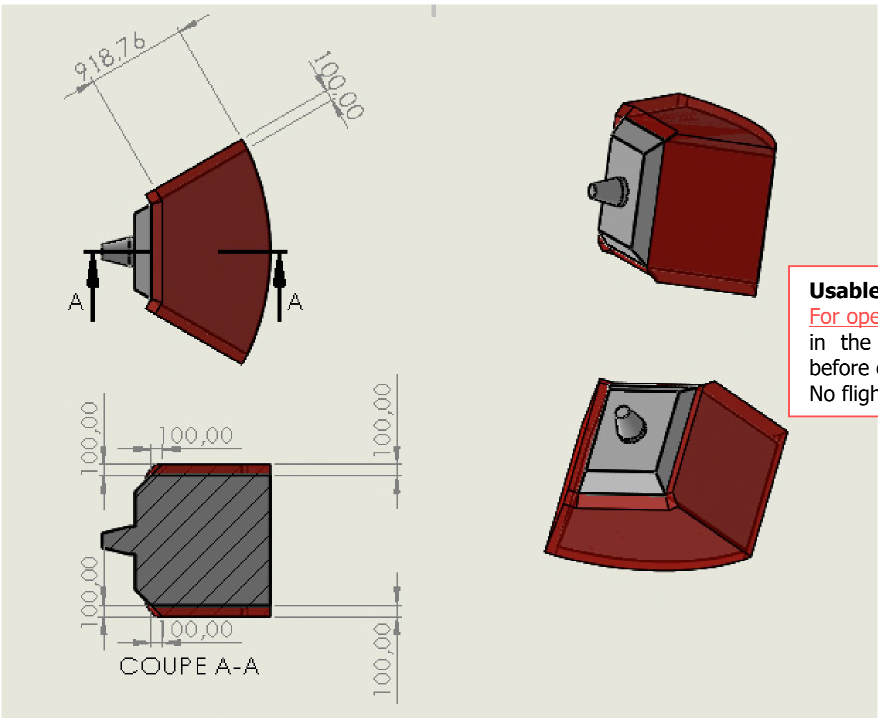
Note: Protrusion inside the dispenser is not allowed for 15" interface.



Usable volume extension:
For operational purpose only. Any item in the red zones shall be removed before encapsulation.
No flight hardware allowed.

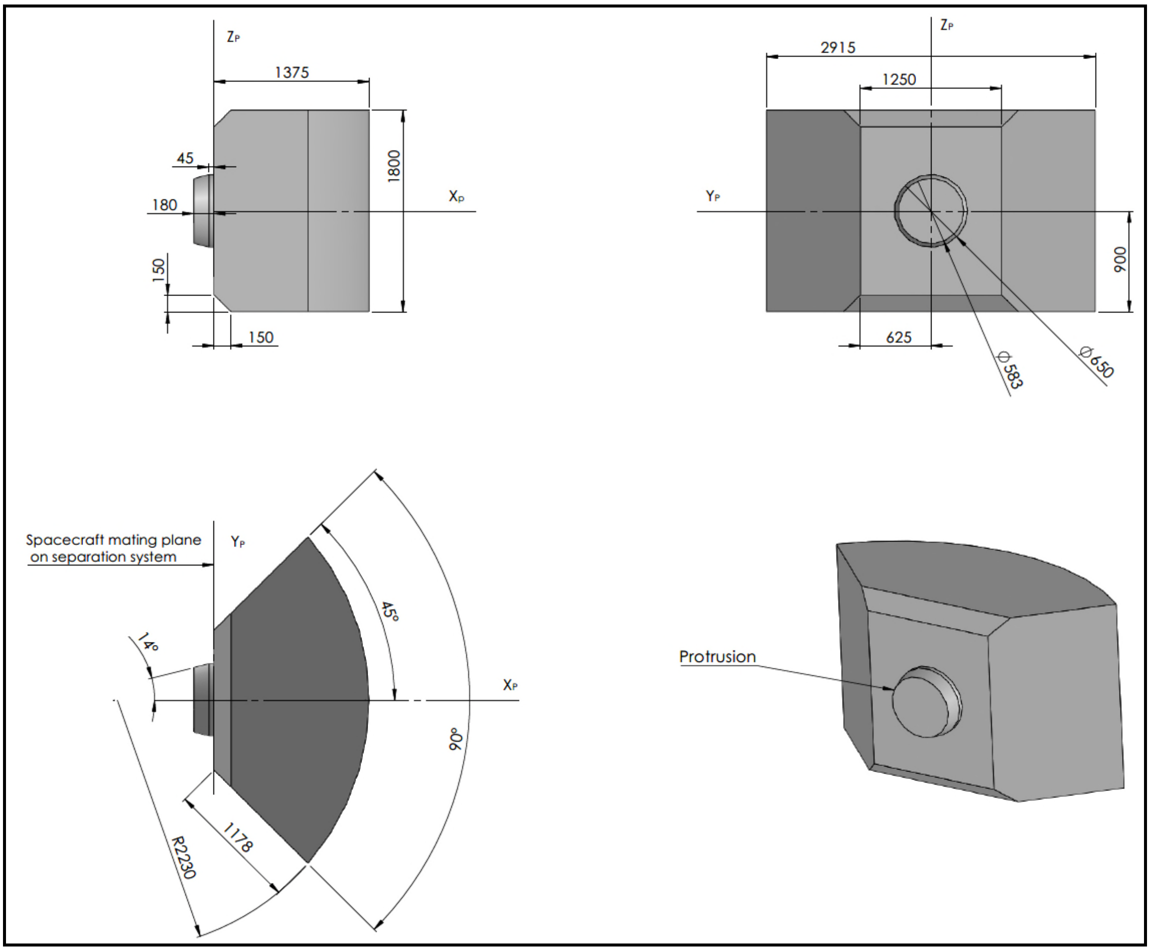
Figure 3.3.a – Usable volume (60° portion) available for a 200-350 kg S/C using a 15'' interface

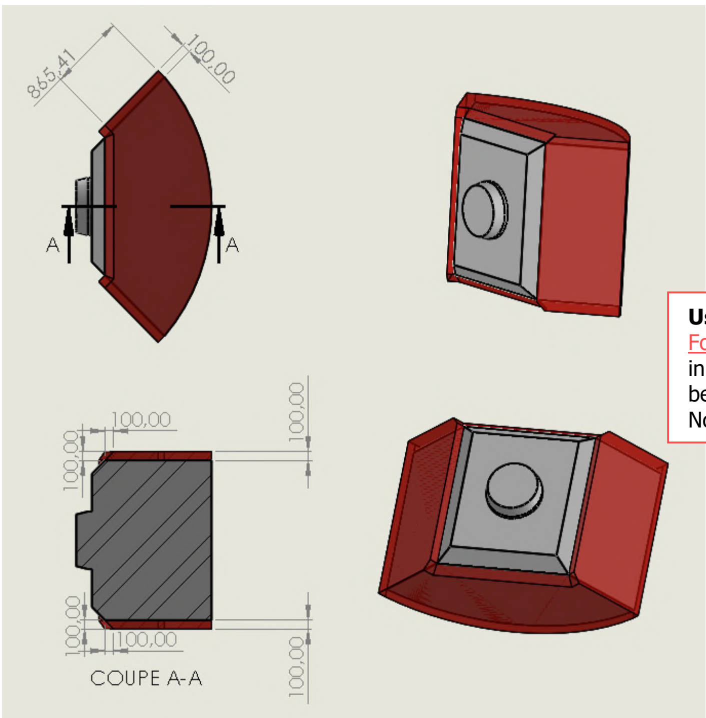




Usable volume extension:
For operational purpose only. Any item in the red zones shall be removed before encapsulation.
No flight hardware allowed.

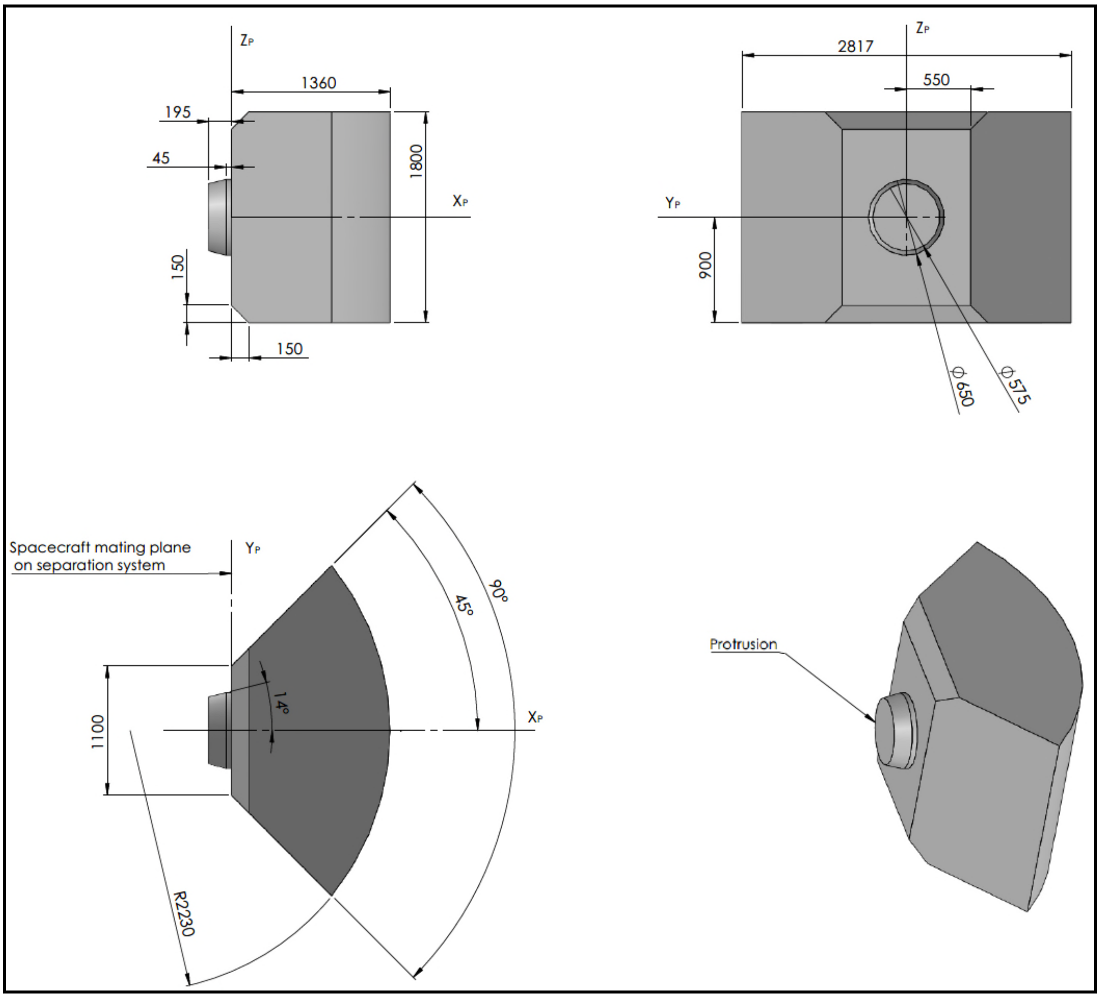
Figure 3.3.b – Usable volume (60° portion) available for a 200-350 kg S/C using a 24'' interface

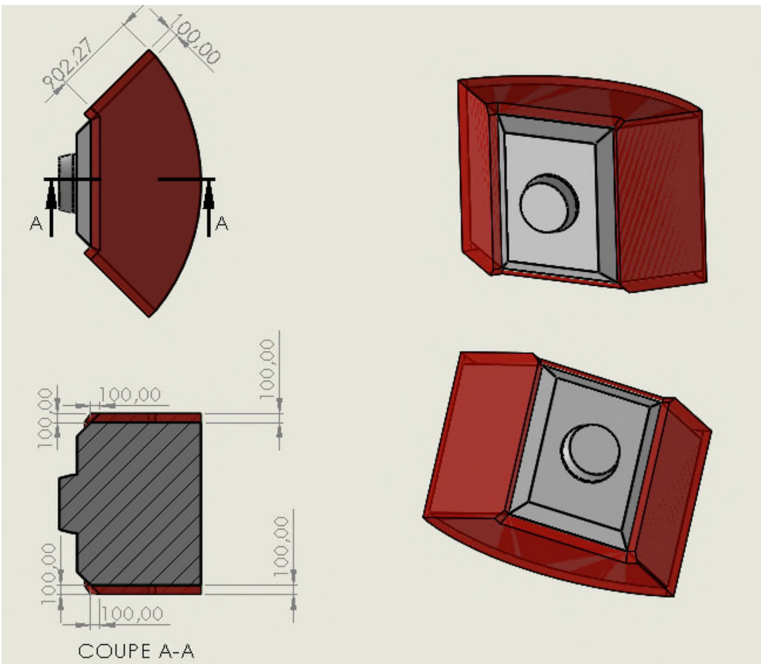




Usable volume extension:
For operational purpose only. Any item in the red zones shall be removed before encapsulation.
No flight hardware allowed.

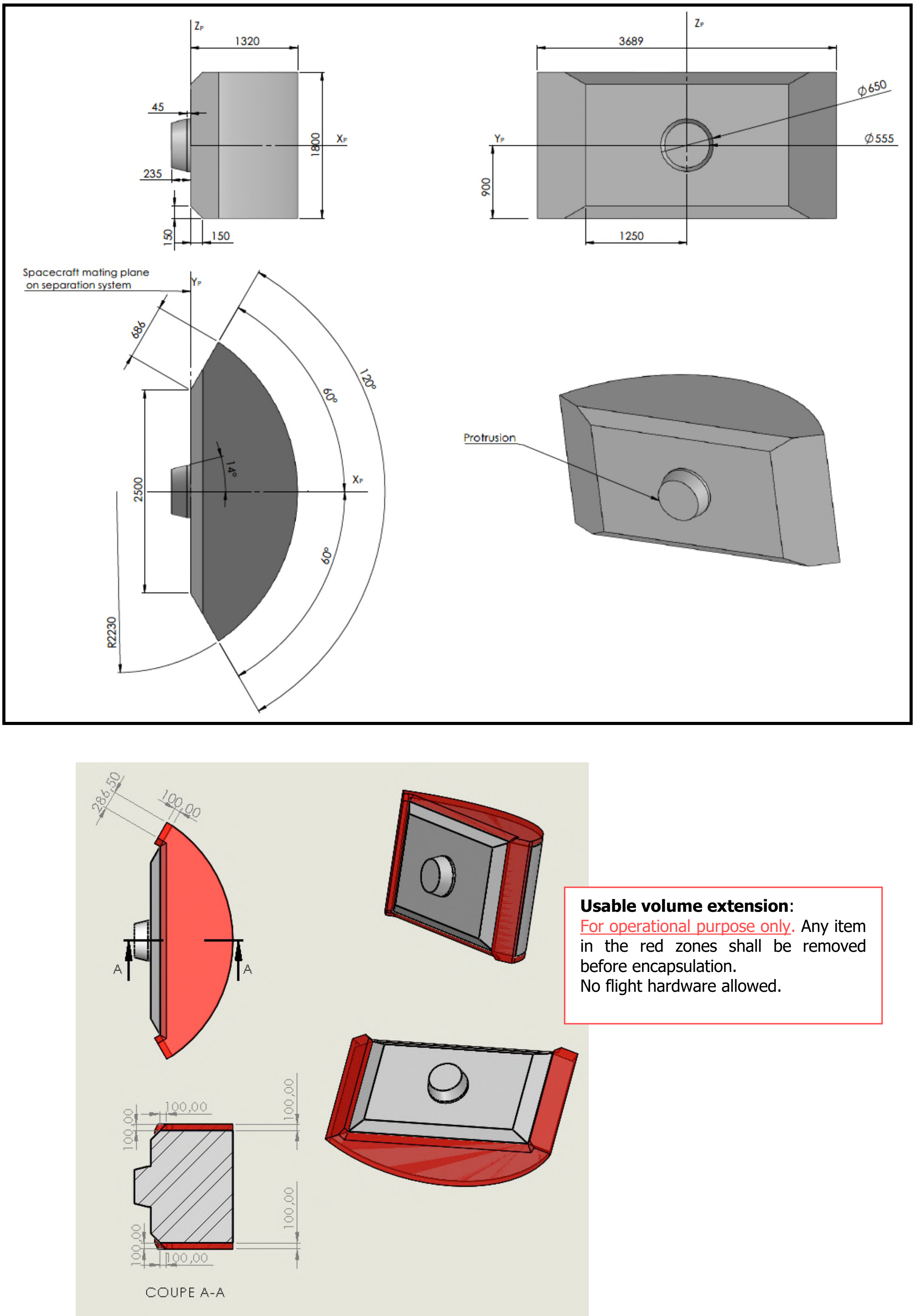
**Figure 3.3.c – Usable volume (90° portion)
available for a 350-1500 kg S/C using a 31.6'' interface**





Usable volume extension:
For operational purpose only. Any item in the red zones shall be removed before encapsulation.
No flight hardware allowed.

Figure 3.3.d – Usable volume (90° portion) available for a 350-1500 kg S/C using a 937mm interface



Usable volume extension:
For operational purpose only. Any item in the red zones shall be removed before encapsulation.
No flight hardware allowed.

Figure 3.3.e – Usable volume (120° portion) available for a 350-1500 kg S/C using a 937mm interface

Upon reception of the spacecraft CAD model, Arianespace will perform an accommodation analysis to define the best configuration complying with all the constraints, including accessibility during ground operations, upper composite mass balance, etc.

Different configurations implementing the volumes previously defined can be accommodated on the Light or Small S/C dispenser.

Other separation system can be mounted using an adaptive plate, contact Arianespace for more information.

An extension of the volume may be possible depending on the flight configuration, and can be analyzed by Arianespace on a case-by-case basis upon Customer's request.

3.4. MECHANICAL INTERFACE

For Light and Small S/C, Arianespace provides a range of standard adapters:

- Motorized Light Band (MLB MkII) from Rocket Lab with 15 inches (381 mm), 24 inches, 31.6 inches diameter, 38.8 inches;
- Payload Adapter System (PAS) from Beyond Gravity Sweden: PAS381 S (381 mm diameter), PAS 610 S (610 mm diameter), PAS 818 S (818 mm diameter), PAS 937 (937 mm diameter).

They are equipped with a separation & distancing system (opening device, springs, etc…) and, as a standard, with one electrical connector and two separation detection devices.

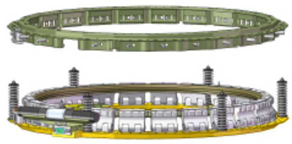
They comprise the so-called passive ring and the active ring. The passive ring remains attached on the S/C after S/C separation, while the active ring with the separation system remains attached on the L/V.

The use of such devices will be verified by Arianespace depending on the S/C characteristics and separation systems mechanical capabilities.

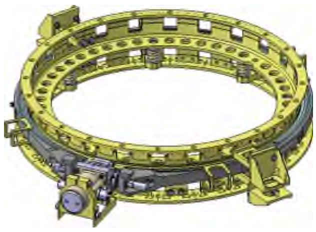
The general characteristics of the standard adapters are presented in the table below.

MLB MKII series by Rocket Lab

Description				
Size	15″	24″	31.6″	38.81″
S/C interface - number of bolts:	24	36	48	60
Total height:	53 mm			
Total mass:	2.6 kg	4.0 kg	5.6 kg	6.8 kg
Mass retained on the S/C:	0.7 kg	1.1 kg	1.6 kg	2.0 kg
Separation system				
It is composed of a retaining ring, leaves, spring plungers and motors which allow to retract the leaves when the motors are powered + up to 24 springs.				

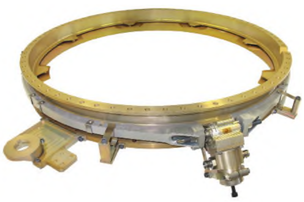


PAS 381 S by BGS

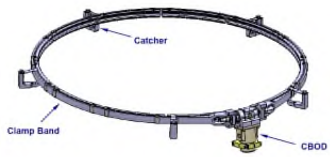


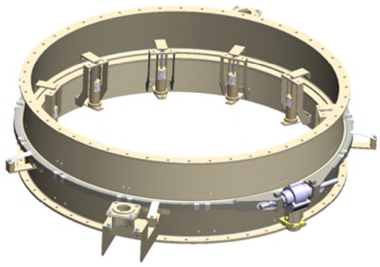
Description	
S/C interface:	24 x ¼″ bolt holes at Ø381 mm
Total height:	79 mm
Total mass:	3.7 kg
Mass retained on the S/C:	0.98 kg
Separation system	
Clamp-band ∅381 mm with low shock separation system CBOD-LT).	

PAS 610 S / BGS



Description	
S/C interface:	36 × 7.2 mm bolt holes at Ø609.6 mm
Total height:	73 mm
Total mass:	6.6 kg
Mass retained on the S/C:	1.9 kg
Separation system	
Clamp-band ∅610 mm with low shock separation system CBOD-LT) + up to 8 springs.	



	Description	
PAS 818 S by BGS 	S/C interface:	48 × M10 bolt holes at Ø802.64 mm
	Total height:	115 mm
	Total mass:	25.2 kg
	Mass retained on the S/C:	7.0 kg
	Separation system	
	Clamp-band ∅818 mm with low shock separation system CBOD) + up to 12 springs.	

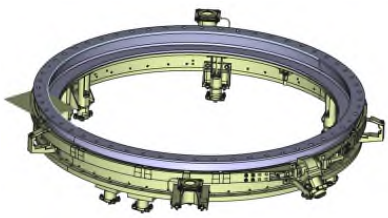
	Description	
PAS 937 by BGS 	S/C interface:	56 × M10 bolt holes at Ø943.61 mm
	Total height:	130 mm
	Total mass:	28.6 kg
	Mass retained on the S/C:	8.85 kg
	Separation system	
	Clamp-band ∅937 mm with low shock separation system CBOD) + up to 24 springs.	

Table 3.4: Standard adapters

The mechanical interface of the spacecraft to the adapter shall be compliant with the requirements of the latest version of the MLB MkII User Manual or of the BGS PAS User's Manual. This verification is done by Arianespace with customer's inputs.

For other adapter/separation system, please contact Arianespace.

3.5. ELECTRICAL INTERFACE

3.5.1. General

Depending on the separation adapter, the electrical interface is composed of:

- Two separation switches (or microswitches) for S/C separation detection on the LV side.
- One connector (or two *in option*) can be used for S/C separation detection on S/C side using straps.

	S/C electrical interface
Umbilical lines (for battery charge and monitoring)	**4 lines** [1]
S/C separation monitoring (on LV side)	**2 separation switches**[2]
S/C separation monitoring (on S/C side)	**Straps in connector** [2]

Notes:

[1]: Refer to section 1.5.6

[2]: Refer to chapter 3.5.2 below for details.

Table 3.5.1.a: Standard electrical interfaces

Standard connectors:

The table below provides a brief description of the standard connectors:

Adapter type	Connector	Nb of pins[1]	Connector reference
MLB by Rocket Lab		15	Spacecraft side PSC part number 4000107 Launcher side: PSC part number 4000106
PAS by BGS		12	Spacecraft side: DBAS 74 12 OSN 059 DBAS 74 12 OSY 059 Launcher side: DBAS 025 8210 12 DBAS 025 8214 12
		37	Spacecraft side: DBAS 70 37 OSN 090 or DBAS 70 37 OSY 090 Launcher side: DBAS 025 8210 37 DBAS 025 8214 37

[1]: As a standard, two pins are reserved for separation detection on S/C side.

Table 3.5.1.b: Standard electrical connectors

The connectors are provided by Arianespace.

3.5.2. Spacecraft separation monitoring

S/C separation detection on S/C side:

On S/C side, as standard, the S/C separation status is indicated by straps integrated on the Launch Vehicle side of the S/C-L/V connector. Two pins of the connector shall be reserved for this purpose.

The main electrical characteristics of these straps are:

Strap "closed": $R \leq 1\ \Omega$

Strap "open": $R \geq 100\ k\Omega$

S/C Separation detection on LV side:

On LV side, as standard, the S/C separation status is indicated by two redundant separation switches.

NOTE: As an alternative to the separation switches, S/C separation status indication could be provided by two straps located on the Spacecraft side of the S/C-L/V connector.

3.5.3. Electrical continuity interface (bonding and shielding)

The spacecraft is required to have an "Earth" reference point close to the separation plane, on which a test socket can be mounted. The resistance between any metallic element of the spacecraft and the closest reference point on the structure shall be less than 10 mΩ for a current of 10 mA.

The spacecraft structure in contact with the LV shall be conductive and shall not have any treatment or protective process applied which creates a resistance greater than 10 mΩ for a current of 10 mA between the spacecraft earth reference point and that of the LV (adapter or carrying system).

If umbilical lines are used, the umbilical shield links shall be grounded at both ends of the lines (the spacecraft on one side and the EGSE on the other).

3.6. INTERFACE VERIFICATION

3.6.1. Prior to the launch campaign

The Customer shall provide inputs to support the compliance analysis with the launch system interfaces. This includes compliance with the usable volume, the mechanical interface requirements and the electrical interface requirements.

For this purpose, the following information & measurements will be required:

Compatibility to the usable volume

The volume compatibility verification is done by mean of a "virtual" fit-check based on CAD models: Customer will have to provide a representative CAD model of its S/C and GSE to verify that no interference might occur with adjacent S/C or with LV structure and that there is a proper access for mechanical and electrical integration operations.

The model shall be fully representative of the actual S/C and shall include provisions for MLI, harness, etc...

In case of late access (that is access after integration of the S/C on the carrying system) is needed to remove some non-flight items (covers, etc...), a CAD model of each remove-before-flight item shall be provided, as well as a description of the operations and associated ground equipment, if any.

Mechanical & Electrical compatibility:

In order to secure the launch campaign planning, the customer shall provide, at the latest at the Final Mission Analysis Review (FMAR), evidences that the S/C rear panel meets the mechanical interface requirements, including a report with the geometric measurements of the S/C as-built rear panel.

As an option, to be ordered by the customer, a mechanical and electrical fit check can be performed at Customer or manufacturer premises. Specific L/V hardware for these tests is loaned according to the contractual provision.

3.6.2. Pre-launch validation of the electrical links

3.6.2.1. Definition

The electrical links between each S/C and Launch Vehicle is validated on each phase of the launch preparation when its configuration is changed or the harnesses are reconnected. These successive tests ensure the correct integration of the S/C with the launcher and help to pass the non-reversible operations. There are up to four major configurations:

- Spacecraft mated to its adapter;
- Spacecraft with its adapter mated to the dispenser,
- Spacecraft with adapter on dispenser mated to the LV carrying structure;
- Full Upper Composite mated to the Launch Vehicle on ZL4 launch pad.

Depending on the test configuration, the flight hardware, the dedicated harness and/or the functional S/C simulator will be used.

3.6.2.2. Spacecraft EGSE

The following Customer's EGSE will be used for the interface validation tests:

- OCOE, spacecraft test and monitoring equipment, linked with the spacecraft during all preparation phases, permanently located in PPF Control rooms (LBC).

  COTE[1], Specific front end Check-out Equipment, providing spacecraft monitoring and control, ground power supply and hazardous circuit's activation. The COTE follows the spacecraft during preparation activity in PPF, HPF (when necessary).

  COTE has to be compatible with EFA and ZL4 environment, but will be used only in case of contingency or degraded mode.

  Note: COTE room in CSG facilities are shared with others S/C projects.

The installation interfaces as well as environmental characteristics for the COTE are described in the Chapter 7 of the ***Spacecraft Processing Facilities at CSG*** User's Manual.

SPACECRAFT DESIGN REQUIREMENTS AND FLIGHT ENVIRONMENT — Chapter 4

4.1. INTRODUCTION

This chapter defines the S/C design requirements and the flight environment that the spacecraft will encounter.

For every environment, the loads are defined considering the following axes (P is referring to MLS port axis and LV to launch vehicle axis):

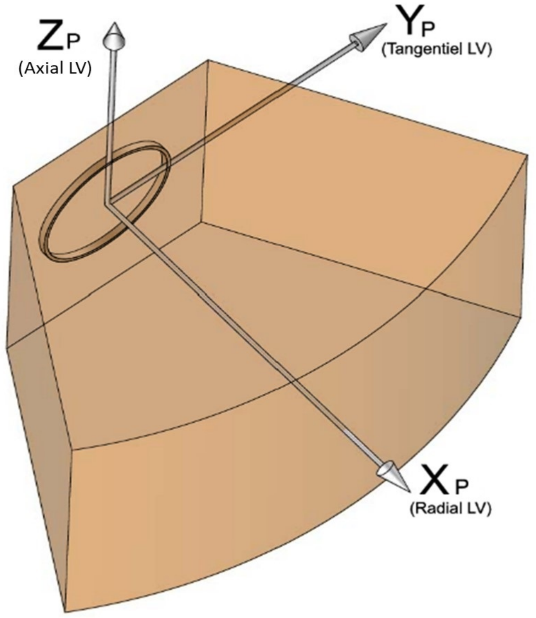


Figure 4.1: Axes convention

4.2. SPACECRAFT DESIGN REQUIREMENTS

4.2.1. Safety requirements

The Customer is required to design the spacecraft in conformity with the CSG Safety Regulations, refer to the latest edition of the Payload Safety Handbook, CSG-NT-SBU-16687-CNES.

4.2.2. Selection of spacecraft materials

The spacecraft materials must satisfy the following outgassing criteria:

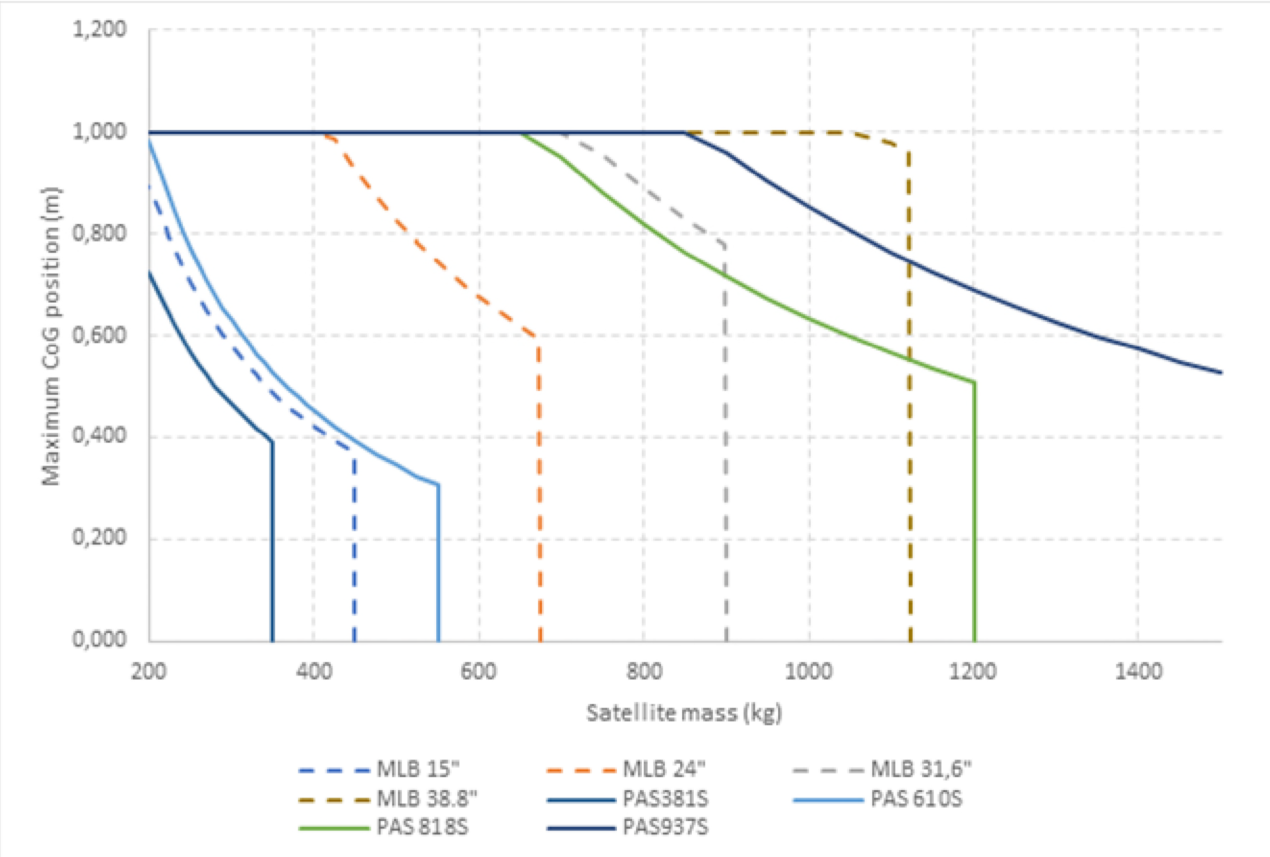
- Recovered Mass Loss (RML) ≤ 1%;
- Collected Volatile Condensable Material (CVCM) ≤ 0.1%;

measured in accordance with the procedure ECSS-Q-70-02C.

For a given mission, some additional non contamination requirements might arise from the Main Passenger.

4.2.3. Spacecraft mass properties

S/C mass range	**200 - 350 kg**	**350 - 750 kg**	**750 – 1200 kg**	**1200 - 1500kg[4]**
Typical S/C interface diameter	**381 mm**	**610 mm**	**818mm**	**937mm**
S/C Center of Gravity height [1 3]	See figure below			
S/C static unbalance [2 3]	d ≤ 30 mm			



[1]: S/C Center of Gravity height counted from the mounting plane of the spacecraft.

[2]: Large nominal CoG offset can be counteracted by an adequate tuning of the separation system. However, the dispersion on the CoG offset shall be no more than 5 mm at the time of Final Mission Analysis Kick-off.

[3]: S/C mass properties shall be measured before S/C shipment to Guiana Space Center.

[4]: For mass > 1500kg, please contact Arianespace.

Table 4.2.3: Typical carrying domain

4.2.4. Spacecraft fundamental frequencies

To prevent dynamic coupling between the launch vehicle and the spacecraft low frequency modes, the spacecraft should be designed so that its fundamental frequencies, cantilevered at the interface, comply with the following, on each axis:

S/C mass (kg)	200 < m < 350	350 < m < 750	750 < m < 1500
S/C All axes	> 40 Hz	> 30 Hz	> 20 Hz

Table 4.2.4: Spacecraft fundamental frequencies

No secondary mode should be lower than the first primary mode, apart from sloshing modes, if any.

4.2.5. Spacecraft design loads

During flight, the spacecraft is exposed to static and dynamic loads.

For a spacecraft complying with frequency requirements defined above, the limit levels of quasi-static loads (QSL) to be taken into account are the following:

Axis	200-1500 kg *Cantilevered mounted*
X_P	± 4 g
Y_P	± 4 g
Z_P	± 7.5 g

Table 4.2.5: Quasi-Static Loads flight limit levels

The mechanical design and dimensioning of the spacecraft primary structure shall be based on the QSL defined above, on top of which the line load peaking induced by the launcher upper part structures defined below and the local interface loads (refer to chapter 4.2.8) shall be also accounted for, with the appropriate safety factors as defined in chapter 5.1.2.

Worst case combinations between design loads and possible CoG positions shall be defined and applied.

4.2.6. Line Loads peaking

Induced by the Spacecraft:
The maximum values of the mechanical line-load peaking ratios induced by the spacecraft along its interface with the launcher are allowed in local areas to be up to 10% over the theoretical line loads.

Line-loads peaking ratios shall be determined in rigidly clamped configuration, under unitary loadings (1g applied at CoG) along each main axis of the Payload (axial and lateral directions).

Loading on complementary intermediate lateral directions may be necessary in order to compute the actual highest value, depending on the P/L architecture.
The methodology used for the compliance assessment to this requirement shall be presented to Arianespace.

Induced by the Launcher:
The geometrical discontinuities of the spacecraft adapter and the difference in the local stiffness of the dispenser may introduce some local variations of the uniform line loads distribution. A value of 30% in side mounted configuration over the average line loads seen by the spacecraft shall be taken into account.

4.2.7. Dynamic loads

Sinusoidal excitations affect the Launch Vehicle during its powered flight, mainly the atmospheric flight, as well as during some of the transient phases.

The S/C secondary structures and flexible elements (e.g., solar panels, antennas, propellant tanks, …) must be designed to withstand the dynamic environment defined below, applied at the spacecraft mating interface, with the appropriate safety factors as defined in chapter 5.2.2.

Axis	**200-1500 kg** ***Cantilevered mounted***	
	Frequency band (Hz)	**FLL**
X_P	5 - 60 60 - 100 100 - 130	± 1.5 g ± 0.75 g ± 0.45 g
Y_P	5 - 60 60 - 100 100 - 130	± 1.5 g ± 0.75 g ± 0.45 g
Z_P	5 - 60 60 - 100 100 - 130	± 2.0 g ± 1.0 g ± 0.45 g

Table 4.2.7: Sine flight limit levels

The modal basis for the condensed dynamic model shall be representative up to 150Hz.

4.2.8. Other loads

Handling loads during ground operations:

During the integration phase on the dispenser, the spacecraft is lifted and handled with its adapter. For this reason, the spacecraft lifting brackets and its handling equipment must be designed accounting for the adapter/separation device additional mass.

The crane characteristics, velocity and acceleration are defined in the SPF User's Manual.

Local loads:

The local loads to be considered for spacecraft sizing, in addition to global loads, are as follows:

- Payload adaptor separation spring forces.
- Spacecraft umbilical connectors spring forces.
- Pre-tension loads associated to the tightening of the spacecraft-to-adapter separation system.
- Impact of flatness defects at adaptor-to-spacecraft interface.
- Thermo-elastic loads if applicable.

They will be specified in the Interface Control Document.

4.3. OTHER ENVIRONMENT

4.3.1. Random vibrations environment

The Random vibrations levels will be defined by Arianespace, taking into account the expected mission accommodation.

4.3.2. Shock environment

The separation of the launcher stages and the release of the satellites carried on MLS dispenser generate successive shocks in flight. Each MLS passenger shall withstand the shocks induced by its own separation device (available in the adapter's user's manual) and the following envelope of shock environment:

Frequency (Hz)	Shock Response Spectrum Flight limit level[1] (g)
100	30
1000	1000
10000	1000

[1] These levels are applicable at Spacecraft interface, on Spacecraft side.

Table 4.3.2: Shock flight limit levels

4.3.3. Electromagnetic environment

Launch vehicle and range emissions:

The Launch Vehicle and launch range RF systems and electronic equipment items are generating electromagnetic fields that may interfere with satellite equipment and RF systems.

The Spacecraft shall withstand the intensity of the electrical field generated by spurious or intentional emissions from the Launch Vehicle and the range RF systems given in the user's manual of Ariane 6.

Spurious radiations acceptable to launch vehicle

To prevent the impact of spacecraft RF emission on the proper functioning of the LV electronic components and RF systems during ground operations and in flight:

- The spacecraft should be designed to respect the LV susceptibility levels given in the Ariane 6 user's manual,
- The spacecraft must not overlap the frequency bands of the LV receivers. The allocated frequencies to the Arianespace launch vehicles are given in the Ariane 6 user's manual.

The Light or Small S/C shall be passive (no RF transmission, no RF status change) once integrated on the MLS dispenser, during the launch and until at least 60s after its separation with a delta-V higher than 0.3m/s. The minimum delay for S/C activation after separation will be determined by Arianespace in the frame of the mission analysis process and will depend on the type of orbit and overall mission timeline.

4.3.4. Other environments

For the other environment (thermal environment, acoustics, contamination and depressurization rate), the reader can refer to the Ariane 6 User's Manual.

DESIGN COMPATIBILITY VERIFICATION REQUIREMENTS — Chapter 5

5.1. INTRODUCTION

The spacecraft authority shall demonstrate that the spacecraft structure and equipment are capable of withstanding the maximum expected launch vehicle ground and flight environments presented in the previous chapter.

5.2. SPACECRAFT COMPATIBILITY VERIFICATION REQUIREMENTS

5.2.1. Spacecraft verification logic

The spacecraft compatibility must be proven by means of adequate assessment and tests. The verification logic is shown in the table 5.2.1 below:

	Model	Static	Sine vibration	Acoustic***	Shock
Logic with Structural Test Model (STM) or Qualification Model (QM)	STM / QM	Qualification test	Qualification test	Qualification test	Shock test and analysis
	First FM	By heritage from STM or QM*	Protoflight test	Protoflight test	Shock test or by analysis or by heritage *
	Subsequent FM's **	By heritage from STM or QM *	Acceptance test (optional) or based on manufacturing, control, quality process and analysis	Acceptance test	By heritage *
	For constellation	By heritage from STM or QM *	Acceptance test (optional) or based on manufacturing, control, quality process and analysis	Acceptance test (sample test) and based on manufacturing, control, quality process and analysis	By heritage *
Logic with ProtoFlight Model (PFM)	PFM = First FM	Qualification test or by heritage *	Protoflight test	Protoflight test	Shock test or by analysis or by heritage *
	Subsequent FM's **	By heritage *	Acceptance test (optional) or based on manufacturing, control, quality process and analysis	Acceptance test	By heritage *

* If qualification is claimed "by heritage", the representativeness of the Structural Test Model (STM) or Qualification Model (QM) with respect to the actual flight unit must be demonstrated.

** Subsequent FM's: means identical to First FM: same primary structure, same major subsystems and appendages.

*** For spacecraft not sensitive to acoustic environment, random test shall be performed.

Table 5.2.1: Spacecraft verification and qualification logic

The mechanical environmental test plan for a spacecraft qualification and acceptance shall comply with the requirements presented hereafter and shall be reviewed by Arianespace prior to the implementation of the first test.

It is important that the S/C be mechanically tested in a flight-like configuration. The purpose of ground testing is to screen out unnoticed design flaws and/or inadvertent manufacturing and integration defects or anomalies. Should significant changes affect the tested configuration during subsequent AIT phase, prior to S/C shipment to CSG, the need to re-perform some mechanical tests must be reassessed.
If, in spite of notable changes, complementary mechanical testing is not considered necessary by the customer, this situation should be treated in the frame of a Request for Waiver, which shall demonstrate acceptable margins and in particular, the absence of risk for the launcher.

Also, it is suggested that customers perform tests to verify the susceptibility of the Spacecraft to the thermal and electromagnetic environment and refine, by this way, the corresponding Spacecraft models used for the mission analysis.

5.2.2. Safety factor, test duration and rate

Spacecraft qualification and acceptance test levels are determined by increasing the design loads (flight limit levels) defined in the previous chapter by the safety factors given below in the Table 5.2.2. The complete spacecraft must demonstrate positive margins of safety for yield and ultimate loads.

These safety factors and associated test durations/rates are applicable for a test on the complete spacecraft: if tests are performed on parts of the spacecraft only, it is under the responsibility of the customer to demonstrate that the test levels and duration/rate are covering the ones given below in Table 5.2.2.

Spacecraft tests	Qualification *		Protoflight		Acceptance	
	Factor	Duration / rate	Factor	Duration / rate	Factor	Duration / rate
Static (QSL)	1.25	≥5 cycles if sine burst test	1.25	≥5 cycles if sine burst test	1.0	≥5 cycles if sine burst test
Sine vibrations	1.25	2 oct/min	1.25	4 oct/min	1.0	4 oct/min
Acoustics **	+3 dB (or 2)	120 s	+3 dB (or 2)	60 s	1.0	60 s
Shock	+3 dB (or 1.41)	N/A	+3 dB (or 1.41)	N/A	N/A	N/A

* If qualification is not demonstrated by test, it is reminded that a safety factor of 2 (margin ≥ 100%) is requested with respect to the design limit.

** These safety factors and durations are also applicable to random test PSD, if performed.

Table 5.2.2: Test safety factor, rate and duration

5.2.3. Compatibility tests

5.2.3.1. Static tests

Static load tests are performed by the Customer to confirm the design integrity of the primary structural elements of the spacecraft platform. Test loads are based on worst-case conditions, i.e., on events that induce the maximum loads into the main structure. They shall be deduced from adaptor-to-spacecraft interface loads provided in Chapter 4: table of maximum QSLs (chapter 4.2.5), taking into account in addition the launcher line loads peaking (chapter 4.2.6) and the local loads (chapter 4.2.8). If relevant, thermo-elastic loads shall also be accounted for. The qualification factors given above shall be considered.

5.2.3.2. Sinusoidal vibration tests

The objective of the sine vibration tests is to validate the spacecraft FEM correlation and to verify the spacecraft secondary structures dimensioning under the flight limit loads multiplied by the appropriate safety factors.

Note: For subsystems or equipment of which qualification is not verified during sine tests or unit elementary tests, a design margin of minimum 2 is to be demonstrated by analysis.

The qualification test consists of a sweep through the specified frequency range and along each axis using flight limit levels and increased by the appropriate safety factors (see Table 5.2.2 for sweep rate and safety factors). Flight limit levels applicable at any location in the spacecraft shall be deduced from the flight limit levels defined at the spacecraft-to-adaptor interface in the previous chapter 4.2.7.

A notching procedure may be agreed at the spacecraft-to-adaptor interface on the basis of the latest coupled loads analysis (CLA) available at the time of the tests, in order to prevent excessive loading of the structure or equipment under test. However, it must not jeopardize the tests' objective to demonstrate positive margins of safety throughout the spacecraft with respect to the flight limit loads.

For Light and Small S/C (200-1500 kg), side mounted:

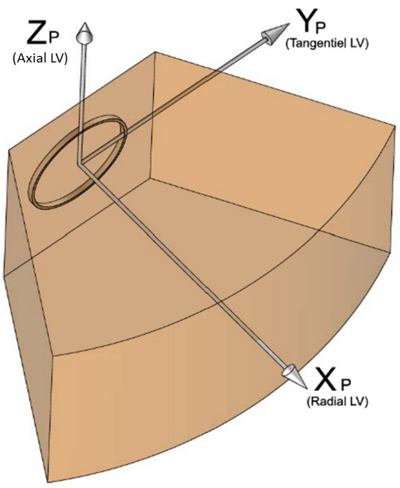
Sine	Frequency range (Hz)	Qualification levels (0-peak)	Protoflight levels (0-peak)	Acceptance levels (0-peak)
S/C interface Out of plane (X_P***)	2 - 5(*) 5 - 60 60 - 100 100 - 130 (**)	18.6 mm 1.88 g 0.94 g 0.56 g	18.6 mm 1.88 g 0.94 g 0.56 g	14.9 mm 1.5 g 0.75 g 0.45 g
S/C interface In plane (Y_P / Z_P ***)	2 - 5 (*) 5 - 60 60 - 100 100 - 130 (**)	24.8 mm 2.5 g 1.25 g 0.56 g	24.8 mm 2.5 g 1.25 g 0.56 g	19.8 mm 2 g 1 g 0.45 g
Sweep rate		2 oct./min	4 oct./min	4 oct./min

Table 5.2.3.2: Sinusoidal vibration tests levels

* Depending on the potential limitations of the manufacturer's test bench, the fulfillment of the requirement in this particular frequency range can be subject to negotiation in the field of a request for waiver process, and providing that the Spacecraft does not present internal modes in that range.

** In order to ensure a model correlation in a relevant frequency range for the CLA, it is advised to perform a low level run up to 150 Hz at least.

*** Axes convention is defined in chapter 4.1 and recalled below:



5.2.3.3. Acoustic vibration tests

ARIANE 6 user's manual chapter 4 is applicable.

The Fill Factor under the fairing will be defined by Arianespace, taking into account the expected mission volume accommodation.

5.2.3.4. Shock qualification

Qualification to shock events shall be demonstrated at system level on the satellite assembled in flight-like configuration. As specified in chapter 4.3.2, three types of shock events are expected:

- Launcher shock events:

  Shock levels coming from the separations of the launcher stages and the fairing jettison are negligible at MLS auxiliary passenger interface. They are covered by the other shock events described below.

  No specific analysis is required on this topic in MLS configuration.

- Co-passengers separation events:

  The maximum expected shock level coming from each MLS co-passenger separation, taking into account the MLB (Rocket Lab) or PAS (BGS) separation systems, is specified in Table 4.3.2.

  The number of successive shocks will be defined by Arianespace, taking into account the expected MLS co-passengers separation sequence.

  MLS Customers are responsible for verifying compliance with this specification, in clamped configuration, by their preferred approach: testing, analysis, or heritage (if available).

  The expected shock levels are compared to the qualification status of each spacecraft subsystem and/or equipment. From Table 5.2.2., +3dB of margins shall be demonstrated on all shock-critical components. Arianespace shall be informed of the retained shock propagation method, and requires a comprehensive view on the resulting margins.

- Spacecraft separation event

  MLS Customers are responsible for verifying compliance with the separation shock generated by the separation device, using their preferred approach: testing, analysis, or heritage (if available), in accordance with Table 5.2.1.

  - For a demonstration by **testing** (e.g., drop test) on an Arianespace-furnished item, Arianespace will support the test at customer's premises, providing tests equipment and instrumentation at the spacecraft interface.

    This test should be performed at the clampband tensioning level that maximizes the expected in-flight shock levels.

    The satellite's internal instrumentation is under the Customer's responsibility.

    The measured internal shock levels shall be compared to the qualification status of each spacecraft subsystem and/or equipment. As shown in Table 5.2.2., a +3dB margin shall be demonstrated on all shock-critical components. A +3 dB uncertainty margin applies if only a single test is performed. If two drop tests are conducted, this +3 dB uncertainty margin may be removed and the maximum recorded value between the two tests must be considered for each piece of equipment.

In case of shock test on a flight specimen (PFM, FM), internal instrumentation and measurements are optional providing that Spacecraft qualification to shock (within criteria of Table 5.2.2) is already demonstrated by heritage or analysis. Two successful actuations of the separation device are required to validate the spacecraft's shock compatibility with its own separation without internal instrumentation. Arianespace shall be informed in advance of the expected post-test health-check and functional tests, and the validation of all success criteria shall be shared.

- For an **analytical** approach, the demonstration shall rely on the specified levels (as defined in the adapter's User's Manual) applied at the interface of the Spacecraft. The transmitted internal shock levels are then compared with the qualification status of each spacecraft subsystem and/or equipment item. A +3dB margin shall be demonstrated on all shock-critical components. Arianespace shall be informed of the retained shock propagation method, and requires a comprehensive view on the resulting margins.

- Previous test and In-flight **heritage** can also be used as a direct justification for the qualification to Spacecraft separation shock event. Validity of this heritage (Spacecraft platform, adapter type, separation system model and tensioning) shall be shared and agreed with Arianespace.

LAUNCH CAMPAIGN ORGANISATION Chapter 6

6.1. INTRODUCTION

This chapter describes the services provided during the Launch campaign and the logic for the integration of the MLS stack and overall Upper Composite.

6.2. CSG GENERAL PRESENTATION

General information related to the European spaceport in French Guiana (Guiana Space Center – CSG) and to the Ariane 6 launch site are available in the Ariane 6 User's Manual - Chapter 6 and in the SPF user's manual.

The information related to the environmental conditions on ground (temperature, humidity, cleanliness, etc.), the power supply, the S/C transportation and Handling, remain applicable to an A6 launch campaign with MLS stack.

6.3. LAUNCH CAMPAIGN SEQUENCE

6.3.1. Typical launch campaign for Light and Small S/C

The main phases for Light or Small S/C launch campaign are:

- Preparation of the launch campaign (meetings and documentation);
- Arrival in French Guiana & transfer to the launch site;
- S/C autonomous preparation and checkout in a Payload Preparation Facility;
- If necessary, S/C fuelling in a Hazardous Preparation Facility;
- Combined Operations part 1 MLS stack integration for Light and Small Passengers: S/C mating on their adapters and integration on the MLS structure, this activity is performed in SPF before the transfer of the MLS stack to the encapsulation hall;
- Combined Operations part 2 with the Main Passenger(s): Integration of the overall Upper Composite, fairing encapsulation.
- Transfer to the launch pad and mating of the Upper Composite on the launcher;
- Launch countdown;
- Transfer back of the GSE after the Launch.

All the facilities (PPF and HPF Clean Rooms and Lab for check-out stations (LBC)) are shared with the other Light and Small S/C on the same flight.

6.3.1.1. Preparation phase & operational documentation

During the launch campaign preparation phase, to ensure activity coordination and compatibility with the CSG facilities, Arianespace issues the following operational documents:

- An overall launch campaign calendar;
- A Combined Operations Plan (POC);

They are based on Application to Use Arianespace's Launch Vehicles (DUA) and the S/C Operations Plan (POS)

The operational documentation and related items are discussed at technical meetings and the status of the activity is presented at the final launch campaign preparation meeting.

As an option, available at Customer's request, Arianespace can organize a CSG visit. It may comprise the visit of the facilities allocated to the S/C and review of operational documentation.

6.3.1.2. Spacecraft, GSE and propellant arrival & transfer to EPCU

The Spacecraft and Customer's ground support equipment can be delivered to French Guiana by airplane at **Cayenne Félix Eboué international airport** or by boat at **Cayenne Dégrad-des-Cannes international harbor**. The propellant drums, if any, and associated equipment can be delivered at Cayenne Dégrad-des-Cannes harbor.

Transportation to French Guiana of the Spacecraft, GSE and propellant, if any, have to be managed by and under the Customer's responsibility. Upon specific request from the Customer, Arianespace may ensure all needed support for the equipment handling and transportation to French Guiana as well as formality procedures as a contractual option.

Arianespace takes charge of the containers after their unloading from the plane or ship and ensures the transfer to the CSG by road.

6.3.1.3. S/C stand-alone preparation

Stand-alone operations and checks of the S/C are carried out in the PPF.

The Clean Rooms and Lab for check-out stations (LBC) are shared with the other Light and Small S/C on the same flight as a baseline.

The activities shall be performed nominally within normal CSG working hours. Normal working hours at the CSG are based on one shift of 8 hours per day, between 8:00 am and 17:00 pm from Monday to Friday.

Extended slots (extended hours and Saturdays) are possible, as an option.

6.3.1.4. S/C fueling operations

When necessary, the S/C is transferred in dedicated facility (HPF) for hazardous operations such as fueling.

6.3.1.5. Combined Operations for integration of the MLS stack

The S/C shall be made available to Arianespace for the Combined Operations with the Launch Vehicle according to the Combined Operations Plan (POC) approved by the Customers during launch campaign preparation phase.

After delivery, verification and acceptance of all the MLS Stack parts, the Integration Readiness Review (IRR) authorizes the 1st part of the Combined Operations.

The first operation is the S/C integration on its adapter. It may occur in the PPF or in the HPF when necessary.

It is followed by the mating of the S/C and its adapter onto the MLS carrying structure.

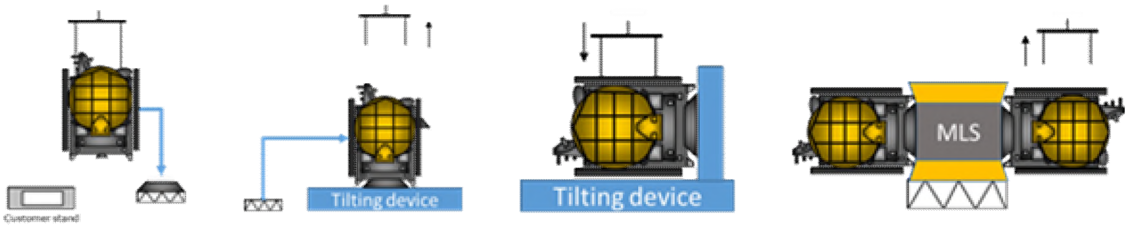


Figure 6.3.1.5 Schematic of S/C integration on MLS

To operate the mating of the S/C and its adapter on a lateral port of the MLS structure, the satellite will be tilted horizontally to ensure radial integration. This requires that the S/C is equipped with proper hoisting interfaces and that it can withstand vertical and horizontal hoisting with a MGSE provided by the customer. The customer hoisting device shall be designed to offer a proper horizontality tuning.

In order to secure the integration workflow of all MLS passengers on the dispenser, it is recommended that the customer provides the CAD model of its hoisting MGSE.

Once all the Light and Small S/C are integrated on the MLS structure with the S/C check out and battery trickle charge completed, all the Light and Small S/C shall be switched OFF and remain inert and ready for Launch.

Then, the Combined Operations part 2 involving the Main Passenger(s) will start after successful completion of the Combined operations readiness Review (BT-POC).

6.3.1.6. Launch pad operations

The S/C will arrive in the Launch pad area 2 days prior to launch.

After the Launch, all S/C mechanical & electrical support equipment shall be removed from the various PPF buildings & the Launch Pad, packed and made ready for return shipment within 3 working days.

Similarly, after the S/C departure from any clean room, the evacuation of Ground Support Equipment from the said clean room (PPF, HPF, …) shall be completed within 3 working days.

6.3.2. Summary of launch campaign meetings and reviews

6.3.2.1. S/C transport meeting

Arianespace will hold a preparation meeting with the Customer before S/C arrival. The readiness of the facilities at entry port (airport or harbor) and at CSG, as well as the status of formal issues and transportation needs will be verified.

6.3.2.2. Integration Readiness Review (IRR)

The objective of this review is to demonstrate the readiness of the Light and Small S/C, the adaptors and the MLS carrying system to start the integration of the MLS stack. It addresses the following main points:

- Stack integration plan, organization and responsibilities for the operations;
- Readiness status of the adaptors;
- Readiness status of the MLS carrying structure;
- Readiness of the Light and Small S/C;
- Mass of the Light and Small S/C in their final launch configuration.

6.3.2.3. Combined operations readiness review (BT POC)

For information, in order to authorize the combined operations with the Main Passenger(s), the BT-POC addresses the readiness of all the Upper Composite elements, including the MLS stack readiness status.

The Light and Small S/C projects do not need to attend this review, but shall confirm a status of S/C readiness for Launch after integration on the MLS structure and shall be available to provide answers to any questions from the Main Passenger(s).

6.3.2.4. Launch Readiness Review

A Launch Readiness Review is held one day before launch and after the Main passenger(s) launch rehearsal (if any). It authorizes to proceed with the final countdown and launch. This review is conducted by Arianespace.

6.3.2.5. Post flight debriefing (CRAL)

The day after the launch, Arianespace issues a post-flight analysis report to the Customer, covering flight events sequence, evaluation of the LV performance and, if available, injection orbit and accuracy parameters.

6.3.3. Range Support at CSG

Arianespace provides a number of standard services and standard quantities of fluids described hereafter.

A more detailed description can also be found in the ***SPF user's manual.***

6.3.3.1. Transport services

The following services are managed by Arianespace:

Spacecraft, GSE and propellant transportation:

Transport from and to one of the arrival areas and CSG at arrival and departure is performed nominally within normal CSG working hours, and subject to advance notice.

It does not include:

- Unloading from airplane or ship which is Customer responsibility;
- The "*octroi de mer*" tax on equipment permanently imported to French Guiana, if any;
- Insurance for Spacecraft and its associated equipment.

Logistics support:

Support for shipment and customs procedures for the Spacecraft and its associated equipment and for personal luggage and equipment transported as accompanied luggage.

Spacecraft and GSE Inter-Site Transportation:

All Spacecraft transportation inside the S/C container and GSE transportation between CSG facilities.

6.3.3.2. Payload preparation facilities allocation

PPF, HPF, LBC areas and meeting rooms:

The Clean Rooms and Lab for check-out stations (LBC) are shared with the other Light and Small S/C on the same flight.

The allocated areas in PPF, HPF (when necessary) and in LBC, as well as the number of allocated offices will be provided according to the contractual provision.

Storage:

Any storage of equipment during the campaign is a standard service. Contact Arianespace for additional storage needs before or after Launch Campaign.

Two additional months for propellant storage, if any, is a standard service.

Schedule restrictions:

The standard standalone launch campaign duration is limited to 10 working days for Light and Small S/C.

The Light or Small S/C shall be made available to Arianespace, for the MLS stack integration, at least 12 working days prior to the Launch. The actual planning will be defined in the Combined Operations Plan (POC) to be approved by the Customer.

After S/C departure from any clean room (PPF, HPF, …), the evacuation of Ground Support Equipment from the clean room shall be completed within 3 working days.

After the Launch, Spacecraft ground support equipment must be packed and removed from all PPF facilities within maximum 3 working days.

6.3.3.3. Communication links

The following communication services between the different spacecraft preparation facilities will be provided for the duration of a standard campaign (including technical assistance for connection, validation and permanent monitoring):

Service	Type	Quantity
Data Link	V11 and V24 network	For COTE monitoring & remote control
Ethernet	CAIMAN network, 10 Mbits/sec	In option – subject to availability
Umbilical Link	Copper lines	In option – subject to availability
Closed Circuit TV		Equipment shared with other Customers
Paging System		2 beepers per Project
CSG wired Telephones		As necessary
Video Conference	Equipment shared with other Customers	
Internet	Connection to a local provider	

6.3.3.4. Cleanliness monitoring

There is a continuous monitoring of organic deposit in clean room.

There is a continuous counting of particles in clean room.

The cleanliness of the Light & Small S/C of the mission will be verified with the application of a dedicated contamination control plan that includes visibly clean 'highly sensitive control' for particular contamination and wipes with dry cloth on 4 molecular contaminants.

6.3.3.5. Fluid and gases deliveries

Extra costs depending on the consumption

Gases	Type	Quantity
Compressed air	Industrial, dedicated local network	As necessary
GN2	N50, dedicated local network	As necessary, available at 190 bar
GN2	N30, dedicated network in S3 area	As necessary, available at 190 bar
GHe	N55, dedicated local network	As necessary, available at 410, 350 or 200 bar.
Fluid	**Type**	**Quantity**
LN2	N30	As necessary
IPA	MOS-SELECTIPUR	As necessary
Water	Demineralized	As necessary

6.3.3.6. Safety equipment

Equipment	Type	Quantity
Safety equipment for hazardous operations (safety belts, gloves, shoes, gas masks, oxygen detection devices, propellant leak detectors, etc.)	Standard	As necessary

6.4. LAUNCH SERVICE AT CSG

The tables below summarize the services provided for Light and Small S/C during the launch campaign and during the preparation phase prior to the launch campaign.

6.4.1. Services during the launch campaign

Activity	Light & Small S/C
Facility	At Guiana Space Centre and shared with the other Light and Small S/C of the same flight
Duration of the S/C Standalone operation	≤ 10 days
Propellant loading at CSG	In option
Links for battery charges and monitoring (umbilical lines)	Subject to availability. Please contact Arianespace
S/C Latest access	The day before transfer of the MLS integrated stack from SPF to the Upper Composite encapsulation hall
Chemical analysis	In option
S/C weighting	In option
Facility cleanliness monitoring	Available
Fluid and gases delivery	In option

6.4.2. Services prior to the launch campaign

Activity	Light & Small S/C
Site survey (prior to launch campaign)	In option
Fit-check (prior to launch campaign)	In option

6.4.3. Other services

Remote operations:

Arianespace can perform operations in French Guiana on behalf of the Customer, with connected smart glasses. It allows the Customer to follow and control its procedure remotely.

This method was successfully applied on previous launch campaigns.

Transport service from Customer facility to CSG can be managed end-to-end by Arianespace (see chapter 6.3.3.1)

Arianespace can manage the S/C fueling activity as an option to subscribe.

6.5. SAFETY ASSURANCE

6.5.1. General

The safety objectives are to protect the staff, facility and environment during launch preparation, countdown and flight. This is achieved through preventive and palliative actions:

- Safety analysis based on the spacecraft safety submission;
- Safety constraints during hazardous operations, and their monitoring and coordination;
- Training and prevention of accidents;
- Coordination of the first aid in case of accident;
- For flight, short-range and long-range flight safety analysis based on trajectory ground track.

The CSG is responsible for the implementation of the Safety Regulations and for ensuring that these regulations are observed. All launches from the CSG require approvals from Ground and Flight Safety Departments. These approvals cover payload hazardous systems design, all transportation and ground activities that involve spacecraft and GSE hazardous systems, and the flight plan.

6.5.2. Safety submission

In order to obtain the safety approval, each Customer has to demonstrate that his equipment and its utilization comply with the provisions of the latest edition of the *Payload Safety Handbook CSG-NT-SBU-16687-CNES*. Safety demonstration is accomplished through several submission phases of documents defining and describing hazardous elements and their processing.

The hazardous items check list is given in Annex 1 to help the customer for the establishment of the safety submission files.

The typical time schedule for safety submissions is shown below:

Safety submission phases	Typical schedule
Phase 0 – Feasibility (optional) A Customer willing to launch a spacecraft containing innovating systems can obtain a safety advice from CSG through the phase 0 submission.	Before contract signature
Phase 1 - Design Submission of the spacecraft and GSE design and description of their hazardous systems. It shall cover component choice, safety and warning devices, fault trees for catastrophic events, and in general all data enabling risk level to be evaluated.	L – 22 months
Phase 2 – Integration and qualification Submission of the refined hardware definition and respective manufacturing, qualification and acceptance documentation for all the identified hazardous systems of the spacecraft and GSE. The submission shall include the policy for test and operating all systems classified as hazardous. Preliminary spacecraft operations procedures should also be provided.	L - 12 months
Phase 3 – Acceptance tests and hazardous operations The submission of the final description of operational procedures involving the spacecraft and GSE hazardous systems as well as the results of their acceptance tests if any.	L - 6 months
Approval of the spacecraft compliance with CSG Safety Regulation and approbation of the procedures for autonomous and combined operations.	Before S/C fueling at the latest

Table 6.5.2 - Safety submission phases

6.5.3. Safety measures during hazardous operations

The S/C authority is responsible for all spacecraft and associated ground equipment operations.

The CSG safety department representatives monitor and coordinate these operations for all that concerns the safety of the staff and facilities.

Any activity involving a potential source of danger must be reported to the CSG safety department representative, which in return takes all measures necessary to provide and operate adequate collective protection, and to activate the emergency facilities.

Each member of the spacecraft team must comply with the safety rules regarding personnel protection equipment and personnel activity. The CSG safety department representative permanently verifies their validity and gives the relevant clearance for all hazardous operations.

In case the Launch Vehicle or the Main Passenger(s) imposes crossed safety constraints and limitations, the Arianespace representatives will coordinate the respective combined operations and can restrict the operations or access to the spacecraft for safety reasons.

6.5.4. Safety training

The general safety training will be provided through video presentations and documents submitted to the Customer before or at the beginning of the launch campaign. At the arrival of the S/C team at CSG, a specific training will be provided with on-site visits and detailed practical presentations that will be followed by personal certification.

In addition, specific safety training on the hazardous operations, like fueling, will be given to the appointed operators, including operations rehearsals.

6.5.5. S/C inputs for flight safety submission

S/C fragmentation model:

In order to demonstrate that the mission complies with the requirements of safety and the French Space Operations Act, Arianespace computes the "casualty risk" (far range risk of casualty in case of launch failure) for every mission. This computation is fed by the fragmentation models of each flight element (launcher structures, adapters and Spacecraft).

Accordingly, a fragmentation model of the Spacecraft shall be supplied by the Customer, in accordance with Arianespace fragmentation model guidelines.

LAUNCH SERVICE Chapter 7

7.1. INTRODUCTION

The launch service (management, mission integration process, hardware supply) is described in the present chapter.

7.2. MISSION MANAGEMENT

7.2.1. Contract organization

The contractual commitments between the launch service provider and the Customer are defined in the **Launch Services Agreement (LSA)** with its **Statement of Work (SOW)**, and its Technical Specification.

Based on the Application to Use Arianespace launch vehicles ("DUA "– refer to annex 1 for a template) filled out by the Customer, the Statement of Work identifies the task and deliveries of the parties, and its Technical Specification identifies the technical interfaces and requirements.

The Arianespace Project Director appointed at the LSA signature is the single point of contact for all launch service activities and provides the organization and resources to fulfill the contractual obligations: contract amendments, payments, planning, configuration control, documentation, reviews, meetings, etc. …

Additionally, during the launch campaign, the appointed Mission Director will handle the operations activities.

7.2.2. Launch schedule management

The launch schedule is established by Arianespace, in compliance with the milestones specified in the Statement of Work of the Launch Service Agreement and in accordance with the Main Passenger(s) requirements.

7.2.3. Meetings and reviews

A typical content of the different meetings and reviews is given below.

#	Title	Typical date ❶	Object ❷	Location ❸
1	**Contractual Kick-off Meeting:** Project management – project milestones – organization – security & confidentiality aspects – communications protocol	L - 24	M-E	C or T
2	**DUA Review:** Review of the Spacecraft characteristics and requirements Review of the DCI Issue 0 Revision 0	L - 22	M-E-O-S	T
3	**Prelim. Mission Analysis Review (PMAR):** As necessary, Orbit and injection accuracy – Separation and collision avoidance – Dynamic and EMC environment Review of Safety Submission status DCI review	L - 17	M-E-O-S	A or T
4	**DCI Signature Issue 1 Revision 0**	L - 16	M-E-O-S	T
5	***Option**: CSG site survey / Preparation of the S/C Operations Plan (POS):* *Launch base facilities visit – CSG support – Telecommunications network -* *Safety submission phases 1 and 2* *Review of SPORT (Satellite Project Operational Requirements Tables)*	*L - 14*	*M-O-S*	*K*
6	**Final Mission Analysis Kick-Off:** Review and validation of the Final Mission Analysis inputs DCI review	L - 6	M-E	T
7	**Review of S/C Operations Plan (POS):** Transport and logistics – Preliminary S/C Operations Plan (POS) – Combined Operations introduction – Telecommunications network Safety submission phases 1 and 2 Review of SPORT (Satellite Project Operational Requirements Tables)	L - 6	M-O-S	W or T
8	**Final Mission Analysis Review (FMAR):** Trajectory – performance – injection accuracy – separation and collision avoidance – thermal & dynamic environment – EMC environment– Spacecraft qualification status DCI review	L - 3	M-E	A or T
9	**Final Campaign Preparation Meeting:** Campaign preparation status - S/C Operations Plan (POS) – Interleaved Operations Plan (POI) – Combined Operations Plan Safety submission status DCI review (chapter 7)	L - 3	M-O-S	A or T
10	**DCI Signature Issue 2 Revision 0**	L - 2	M-E-O-S	T

#	Title	Typical date❶	Object❷	Loc.❸
11	**Integration Readiness Review (IRR):** Carrying system status Spacecraft status	❹	M-O-S	K
12	**Financial Wrap-up meeting**	L-1 day	M	K

❶ Dates are given in months, relative to L, where L is the first day of the Launch Term, Period, Slot or Day.
❷ M ⇨ Management; E ⇨ Engineering; O ⇨ Operations; S ⇨ Safety
❸ A ⇨ Arianespace offices; K ⇨ Kourou; C ⇨ Customer headquarter; W ⇨ S/C Manufacturer Plant;
T ⇨ By Teleconference/Electronic exchange
❹ To be held the day before the agreed day for starting the Combined Operations part 1 (MLS stack integration)

Table 7.2.3 - Typical content of meetings and reviews

In parallel, **launcher reviews** take place: the FRR (LV Flight Readiness Review) at L – 4 weeks and the LRR (Launch Readiness Review) at L-1 days.

At the LV Fight Readiness Review, the Customer shall have demonstrated S/C compatibility to mission environment and launcher interfaces (mechanical and electrical).

7.3. SYSTEM ENGINEERING

The Arianespace's launch service includes engineering tasks and deliveries to allow the customer to demonstrate the S/C compatibility with the launch system and with the Main Passenger(s) mission.

The table below summarizes the standard system engineering activities, they are detailed in the next sections:

	Light and Small S/C 200 – 1 500 kg
Interface Control Document	✓
Preliminary Trajectory	✓
Preliminary Separation analysis	✓
Preliminary Dynamic CLA	✓
Final Trajectory	✓
Final Separation analysis	✓
Final Dynamic CLA	✓
Thermal CLA	✓
Electromagnetic analysis	✓
Test plan review	✓
Support to sine tests	✓
Test results review	✓
Post launch analysis	✓

Table 7.3 - Standard System engineering activities

7.3.1. Interface management

The technical interface management is based on the Interface Control Document (ICD), which is prepared by Arianespace using inputs from the DUA and from the Technical Specification of the Launch Service Agreement.

7.3.2. Mission analysis

Mission analysis is typically organized into two phases, which are:

- the Preliminary Mission Analysis; and
- the Final Mission Analysis.

The Final Mission Analysis focuses on the actual flight configuration and uses the final input data and models of the Spacecraft.

The main outcomes of the analyses are collected in the Interface Control Document.

The mission analyses comprise the following tasks:

Trajectory and performance: The trajectory analysis is performed for a given MLS stack. It provides the flight timeline, the state vector at separation for each Spacecraft, the Sun Aspect Angle, the visibility for the ground stations and the injection accuracy.

Separation analysis: It provides the maximum delta V at separation, the volume in which the spacecraft shall stay for a safe separation and the long-term distances between the bodies to ensure non-collision.

Dynamic Coupled Loads Analysis: The CLAD provides the quasi-static loads at CoG, the accelerations and displacements at the S/C-L/V interface. No random or vibroacoustic analysis will be performed.

Thermal Coupled Loads Analysis: One thermal analysis (TCLA) is performed during the final mission analysis. It provides the minimum and maximum temperature at spacecraft nodes.

Electromagnetic compatibility analysis: An EMC analysis is performed to verify the compatibility between all the passengers and their compatibility with the Launcher and Launch Range.

7.3.3. S/C compatibility verification

Compatibility to launch system environment:

In close relationship with mission analysis, Arianespace will check the S/C design is able to withstand the LV environment.

For this purpose, the following reports will be required for review and approval:

- **An environment test plan** correlated with requirements described in previous Chapters. Customer shall describe their approach to qualification and acceptance tests. This plan is intended to outline the Customer's overall test philosophy along with an overview of the system-level environmental testing that will be performed to demonstrate the adequacy of the S/C to ground and flight loads (e.g., static loads, vibration, acoustics and shock). The test plan shall include test objectives and success criteria, test specimen configuration, general test methods, and a schedule. It shall not include detailed test procedures.
- **An environment test file** comprising theoretical analysis and test results following the system-level structural load and dynamic environment testing. This file should summarize the testing performed to verify the adequacy of the S/C structure for flight and ground loads including venting. For structural systems not verified by test, a structural loads analysis report documenting the analyses performed and resulting margins of safety shall be provided.

Arianespace may request to attend environmental tests for real time discussion of notching profiles and tests correlations.

The final S/C status of compatibility shall be available 1 month after the FMAR at the latest.

Compatibility to launch system interfaces:

Customer shall provide evidence of the compliance with the launch system interfaces at the mission analysis kick-off meeting, typically at L-20 months. This includes compliance to usable volume, compliance to mechanical interface requirements and compliance to electrical interface requirements. Refer also to chapter 3.6.

Compatibility to Main Passenger's mission requirements:

The Light or Small S/C customer shall be in position to provide technical or programmatic information to confirm the compatibility with the Main Passenger mission's requirements.

This may include but not restricted to safety barriers, mechanical and electrical integrity on ground an in-flight, absence of contamination, compatible operational workflow, security clearance.

7.3.4. Post-launch analysis

After the flight, confirmation of the S/C physical separation, obtained orbit and attitude at S/C separation will be provided to the Customer at a time which is mission dependent (from one to several hours after separation depending on the available ground stations).

Arianespace requires the Customer to provide satellite orbital tracking data on the initial S/C orbit.

7.4. LAUNCH VEHICLE ADAPTATION

Arianespace will supply the hardware and software to carry out the mission, complying with the Interface Control Document (ICD):

- One adapter with separation system and umbilical interface connectors;
- The carrying system (equipped structure);
- One MLS mission logo designed by Arianespace, based on the artworks supplied by the Customer (optional), to be installed on the fairing;

ANNEX 1 - Application to use Arianespace Launch Vehicle (DUA) : Template for Light & Small S/C

Please fill in the second column with required information and provide any remarks in the third column. Please use the subsequent Tabs to provide detailed data, when applicable : mass properties table, sloshing model table, RF characteristics table, etc ...

Required information	Customer Inputs	Remarks
1. MISSION & SPACECRAFT DESCRIPTION SUMMARY		
Satellite Name		
Operator / Owner		
Country of Operator / Owner		
S/C Manufacturer		
Type of S/C Platform		
Mass at launch		
Mission lifetime		
Type of orbit		
Mission scope	Please select: Earth Observation, Science, Meteo, Navigation, Telecommunication, IOT/IOD, …	
Mission description	Please provide a short summary of mission purpose and a short description of the on board instruments	
Ground Station (GS) Network	Please provide list of envisaged ground stations for S/C LEOP phase (after S/C separation from the launcher)	
2. SPACECRAFT READINESS SCHEDULE		
Planned Launch Period / Launch Slot		
S/C manufacturing and test main milestones	Please provide a Gantt chart of the S/C design, manufacturing and tests schedule with the following main milestones (in a Gantt chart format if available): System PDR, System CDR, Start/end of manufacturing for each S/C subsystems (platform subsystems, instruments, …), Start/end of each S/C subsystems integration, Start/end of S/C integration, Start/end of S/C test campaign, Flight acceptance review (FAR).	
S/C development plan	Please provide S/C development plan if available	
3. MISSION CHARACTERISTICS		
S/C Operational Orbit	Please indicate S/C operational orbit here or use the " Orbits" Tab	
Preferred injection orbit	Please indicate preferred injection here or use the " Orbits" Tab	
Launch time / Launch window	Please indicate S/C constraints to determine launch time or launch window (preferred local time for SSO orbit, …)	
Preferred S/C separation mode		
Preferred orientation at S/C		
S/C separation conditions (after separation)	Please indicate max. depointing and tip-off rates on each S/C axis	
Others	Please indicate any other preferences on a mission standpoint : maximum aerothermal flux at fairing jettisoning, maximum flight duration, ground station visibility after S/C separation, ...	
4. SPACECRAFT CHARACTERISTICS		
S/C Reference system	Please provide description of the S/C reference system used for S/C data and models: origin of the reference system, description of the axes Xs, Ys, Zs	
S/C Sketches	Please provide sketches of S/C in launch configuration (solar array, antennas & appendages stowed) and in-orbit configuration, with S/C reference axes shown	
S/C Dimensions (without protrusions)	Height x L x W (in mm) [Height represents the S/C dimension in the direction of separation]	
S/C Dimensions (with protrusions)	Height x L x W (in mm) [Height represents the S/C dimension in the direction of separation]	
S/C Interface diameter		
CAD model reference (in launch configuration)	Please provide CAD model (PARASOLID or STEP file - AP214 preferred*) in launch configuration and indicate model reference and release date. (*) cf specification A6-SG-1-X1-06 issue 1	
Mass properties (Mass, Center of Gravity, Inertia): Nominal and dispersed values	Please fill in the "Mass properties" Tab	
First Lateral mode frequency		
First Longitudinal mode frequency		
Propellant / pressurant characteristics & sloshing model (if applicable)	Please fill in the "Prop. Syst. & Sloshing model" Tab	
Umbilical electrical links S/C to EGSE : number of connectors (if applicable)		
Umbilical electrical links S/C to EGSE : number of lines per connector (if applicable)		
Umbilical electrical links S/C to EGSE : Umbilical connector pin allocation (if applicable)	Please fill in the "Umbil. Connector pin allocation" Tab	
RF characteristics	Please fill in the "RF systems" Tab or indicate at least the intended RF emissions on ground during launch campaign (purpose, frequencies, emission plan)	
Others	Please indicate any other S/C characteristics and/or limitations which might have impacts on mission definition and/or mission preparation schedule	
5. REQUIREMENTS FOR LAUNCH CAMPAIGN		
Number of days for standalone operations		
Hazardous operations ? (fueling, …)	Yes or No. If any, please provide description of the needed hazardous operations	
Items to be remove after S/C integration on the LV carrying system ?	Yes or No. If any, please provide description of the remove-before-flight items	
Others	Please indicate any other specific needs during launch campaign, handling, storage conditions, contamination control ...	

Orbits

			S/C Operational orbit	Preferred Injection orbit
Reference frame			Please select: Mean J2000, True of Date, …	
Semi-major axis (mean altitude)	(a)	km		
Eccentricity	(e)			
Altitude of Apogee *1	(Za)	km		
Altitude of Perigee *1	(Zp)	km		
Inclination	(i)	°		
Right Ascension of Ascending Node (RAAN)	(Ω)	°		
Argument of Perigee	(ω)	°		
Local Time at Ascending or Descending Node	LTAN or LTDN	hh:mm:ss		

* NOTE1: Earth equatorial radius = 6378.137 km

Spacecraft mass properties

	Mass	Center of Gravity Coordinates (mm) *1,3		
	(kg)	Xs	Ys	Zs
Nominal value				
Tolerances *2				

* NOTE1: Center of Gravity coordinates are referenced in the spacecraft coordinate system. The origin is the geometrical center of the mounting plane
* NOTE2: Please indicate Min/max values or dispersions at 3 sigmas
* NOTE3: Please indicate which axis is the direction of S/C separation

	Moment of Inertia *1 ($kg.m^2$)			Product of Inertia *2 ($kg.m^2$)		
	IXX	**I**YY	**I**ZZ	**P**XY	**P**YZ	**P**ZX
Nominal value						
Tolerances *3						

* NOTE1: Moments of Inertia are referenced in the spacecraft coordinate system where origin is at the Center of Gravity of the spacecraft.
* NOTE2: Products of Inertia are calculated by the following equation : $Pxy = +\int xy\, dm$
* NOTE3: Please indicate Min/max values or dispersions at 3 sigmas

Propellant / pressurant characteristics & sloshing model (if applicable)

Propellant tanks				#1	…
Propellant type					
Density (kg/m^3)					
Tank maximum volume (l)					
Fill factor (%)					
Liquid volume (l)					
Liquid mass (kg)					
Maximum Expected Operating Pressure - MEOP (bar)					
Center of gravity of propellant loaded tank (mm)			Xs		
			Ys		
			Zs		
Slosh model under 1 g	Pendulum mass (kg)				
	Pendulum length (m)				
	Pendulum attachment point		Xs		
			Ys		
			Zs		
	Fixed mass (if any) (kg)				
	Fixed mass attachment point (if any)		Xs		
			Ys		
			Zs		
	Damping factor				
	Natural frequency of fundamental sloshing mode (Hz)				

Pressurant Tanks		#1	…
Pressurant type			
Volume (l)			
Loaded mass (kg)			
Maximum Expected Operating Pressure - MEOP (bar)			
Center of gravity of propellant loaded tank (mm)	Xs		
	Ys		
	Zs		

Umbilical connector pin allocation

Connector #1								
Pin #	**Function**	**Line start**	**Line End**	**Max voltage (V)**	**Max current (mA)**	**Expected one way resistance (Ω)**	**Status at POE* extraction (lift-off)**	
							Max voltage (V)	**Max current (mA)**
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								

*** NOTE : POE = Electrical umbilical plug / Prise Ombilicale Electrique**

Description of S/C RF systems

Source unit designation		Tx1	Tx…	Rx1	Rx…
Function					
Band type					
Carrier Frequency, F_0 (MHz)					
Bandwidth centered around F_0	-3 dB				
	-20 dB				
	-60 dB				
Carrier Modulation	Type				
	Index				
	Bit rate (bps)				
Sub Carrier (MHz)					
Minimum S/N (dB) associated bandwidth (MHz)					
Carrier polarization			y		
Local Oscillator Frequency (MHz)					
1^{st} intermediate Frequency (MHz)					
2^{nd} intermediate Frequency (MHz)					
Field strength at antenna, receive (dBW/m^2)	Max				
	Nom				
	Min				
RF Output Impedance (Ohm)					
Lower Power mode availability (Yes/no)					

Antenna designation		Horn	Omni			Horn	Omni		
Antenna	Type								
	Location X,Y,Z								
	Pattern								
	Gain max (dBi)								
EIRP: Output power (dBW)	Max								
	Nom								
	Min								
Antenna Input power (dBW)	Max								
	Nom								
	Min								