Direction Commerciale
Technical Support Department

A RIANE

S TRUCTURE for

A UXILIARY

P AYLOAD

5 USER'S MANUAL

Issue **1 –** Revision **0** – May 2000

A.S.A.P. 5

User's Manual

Approved and issued
by
ARIANESPACE

Daniel MUGNIER

Senior Vice President Technical & Industrial Affairs

ARIANESPACE
Head Office Boulevard de l'europe
BP 177 – 91006 Evry Cedex
France

Tél. (33-1) – 60.87.60.00
Tlx. ARESP 602 392F
FAX (33-1) - 60.87.62.17

A. S. A. P. 5

Ariane **5** **S**tructure for **A**uxiliary **P**ayload

User's Manual

Issue **1** - Rev **0** – May 2000

This document contains the technical information which is mandatory:

a) to assess compatibility of an Auxiliary Payload with the ASAP 5 launch system.

b) to prepare all technical and operational documentation related to a launch of this Auxiliary Payload on ASAP 5 during an ARIANE 5 launch.

The data contained in this document supercedes any information given or used at a preliminary stage.

CONTENTS

User's Manual Configuration Control Sheet

Issue / Rev. n°	Date	New Sheets	Approval
0 / 0	May 1997	All	
0 / 1	July 1998	Page 2.2 Figure 1 Page 2.3 Figure 1 bis Page 2.4 Figure 2 Page 2.5 Figure 2 bis Page 2.6 Figure 3 Page 2.7 Figure 3 bis Page 3.1 § 3.1.1 Page 4.1 § 4.1 Page 4.3 Figure 6 bis Page 4.4 Figure 6 ter Page 4.6 Page 4.8 Figure 8 Page 6.1 § 6.1.1 Page 6.3 § 6.3.1 § 6.3.3 Page 6.4 § 6.3.3 § 6.3.4 Page 6.7 Figure 10.3 Page 8.2 § 8.2.3	
1 / 0	March 2000	Page 1.1 Page 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7 Page 3.1, 3.2, 3.3, 3.4 Page 4.4, 4.5, 4.6, 4.8, Page 6.1, 6.2, 6.3, 6.4 Figure 6.4 Page 7.2, 7.3, 7 .4, 7.5, 7.6 Page 9.2	

CHAPTER 1

Introduction

1.1 Purpose of the ASAP 5 User's Manual

This manual is intended to provide Users with information on the applicable specifications for a flight on ASAP 5 as an Auxiliary Payload.

The reader should also refer to :

- ARIANE 5 User's Manual for general information and specification not addressed in this document.

- "C.S.G. Safety Regulations" which is applicable for spacecraft design and operations.

- "Payload Preparation Complex (E.P.C.U.) Manual".

- "Data for selection of space materials". ESA PSS-01-701."

- "A4 SQ1Q 01 (1) – Assurance Product Requirements for Auxiliary Payloads"

Issue 1

- "The above five documents constitute the ARIANE technical reference documentation used for the ARIANE 5-spacecraft feasibility studies."

On completion of the feasibility phase, formal documentation will be established in accordance with the procedures outlined in Chapter 7 or 8 of this manual.

1.2 The ASAP launch system

Issue 1

In order to provide launch opportunities to micro Auxiliary Payload (Mass $\leq$ 120 kg) and mini Auxiliary Payload (120 kg $\leq$ Mass $\leq$ 300 kg), ARIANESPACE has developed a structure called ASAP 5 (ARIANE 5 structure for Auxiliary Payload) to carry and deploy small and medium satellites on LEO, SSO, MEO or GTO orbits.

Three different types of ASAP 5 configurations are available :

- a configuration for up to 8 micro Auxiliary Payloads,
- a configuration for up to 4 mini Auxiliary Payloads,

- a combined configuration for up to 2 mini Auxiliary Payloads and 6 Micro Auxiliary Payloads.

CHAPTER 2

Description of the ASAP 5 structure

ASAP 5 is a circular platform externally mounted to the diameter 2624 interface of :

- the EPS upper stage
- the SYLDA 5
- the SPELTRA

See the AR5 user's Manual for the different configurations.

ASAP 5 is proposed with three typical configurations :

Issue 1
- carriage of up to 8 micro Auxiliary Payloads of 120 kg (maximum mass) + the main passenger on ACU.
  The 8 micro Auxiliary Payloads are located at about 45°* on the circular platform (figure 1 + figure 1 bis).

Issue 1
- carriage of up to 4 mini Auxiliary Payloads of 300 kg (maximum mass) inside a SYLDA 5 or a SPELTRA.
  The 4 mini Auxiliary Payloads are located at about 90°* on the circular platform (figure 2 + figure 2 bis).

- a combined configuration of up to 2 mini Auxiliary Payloads + 6 micro Auxiliary Payloads (figure 3 + figure 3 bis).

* For more details, please contact Arianespace.

PLATFORM ASAP 5

The Platform ASAP 5 is a metallic 60 mm thickness honeycomb structure faced with aluminium alloy skins, secured to the 2624 mm bolted interface.

This Platform sustains the general loads and defines the stiffness of the system especially for the configuration with a main passenger.

The internal diameter of the structure changes with the three configurations and allows access for the integration operations of the micro and mini Auxiliary Payloads.

Each recurrent Platform is equipped with :

- the electric wiring,
- one shock sensing unit, near the 2624 mm interface,
- two accelerometers at 90°.

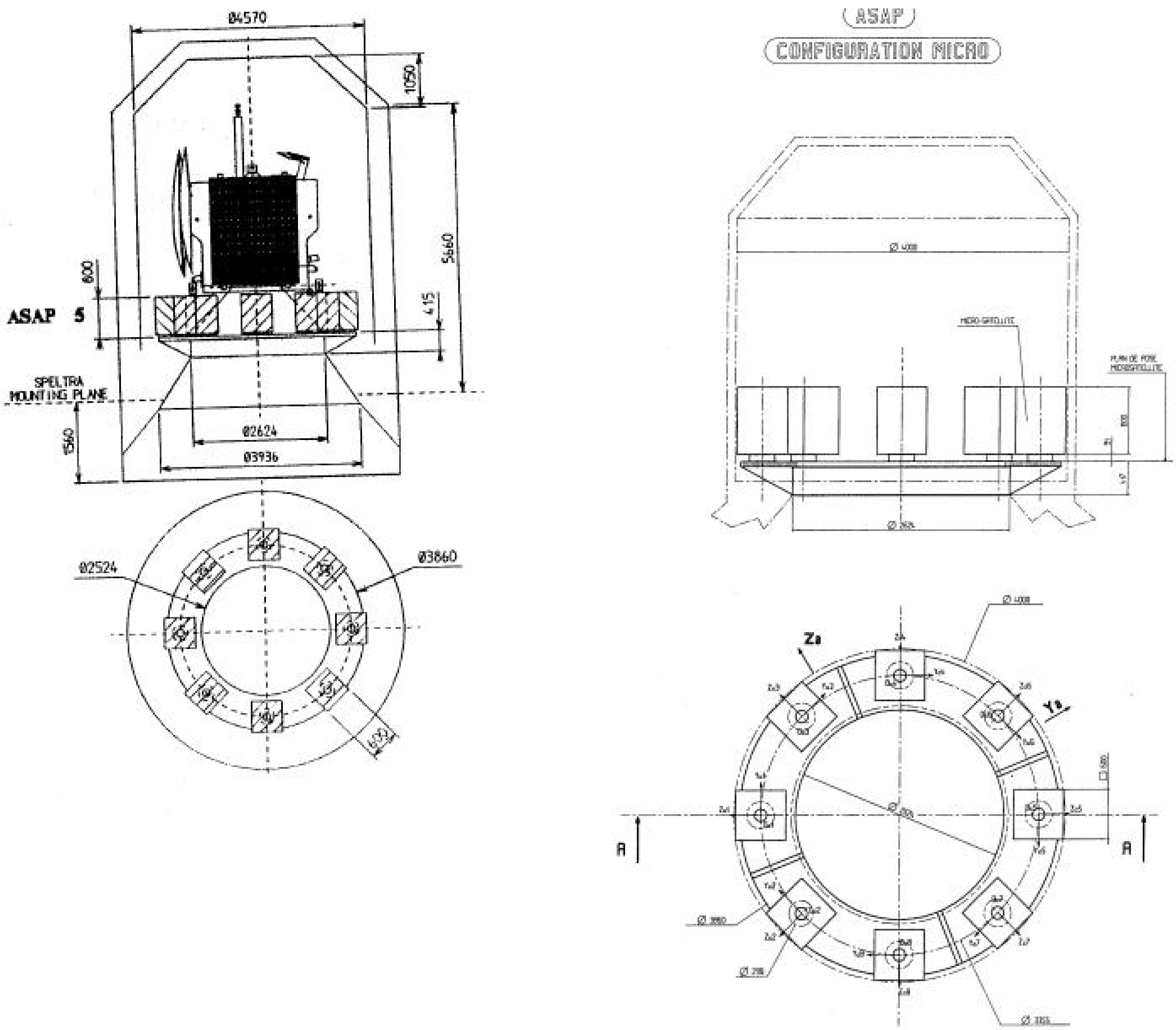


Figure 1 : Configuration of 8 micro Auxiliary Payloads

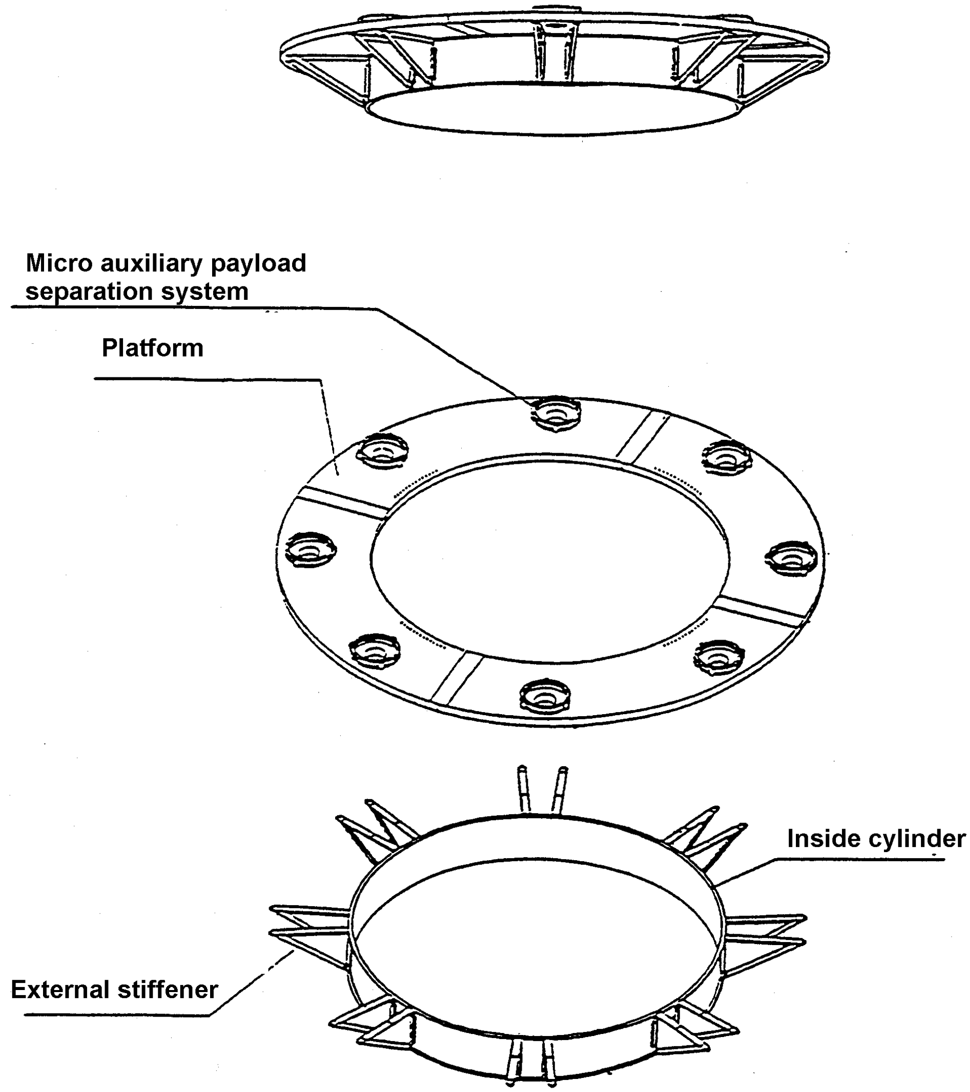
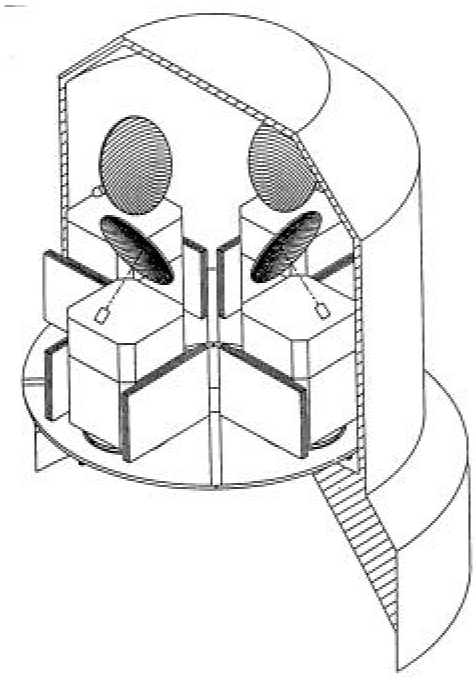


Figure 1 bis : ASAP 5 configuration for 8 micro Auxiliary Payloads



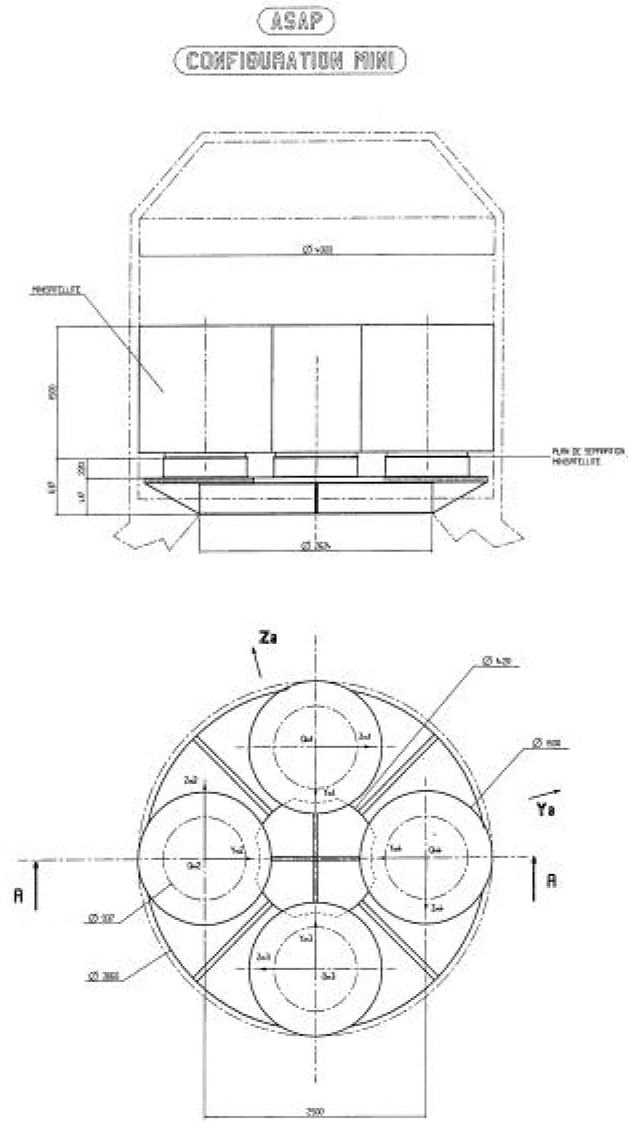

ASAP
CONFIGURATION MINI
Za
Ya
A
A
2500

Figure 2 : Configuration of 4 mini Auxiliary Payloads

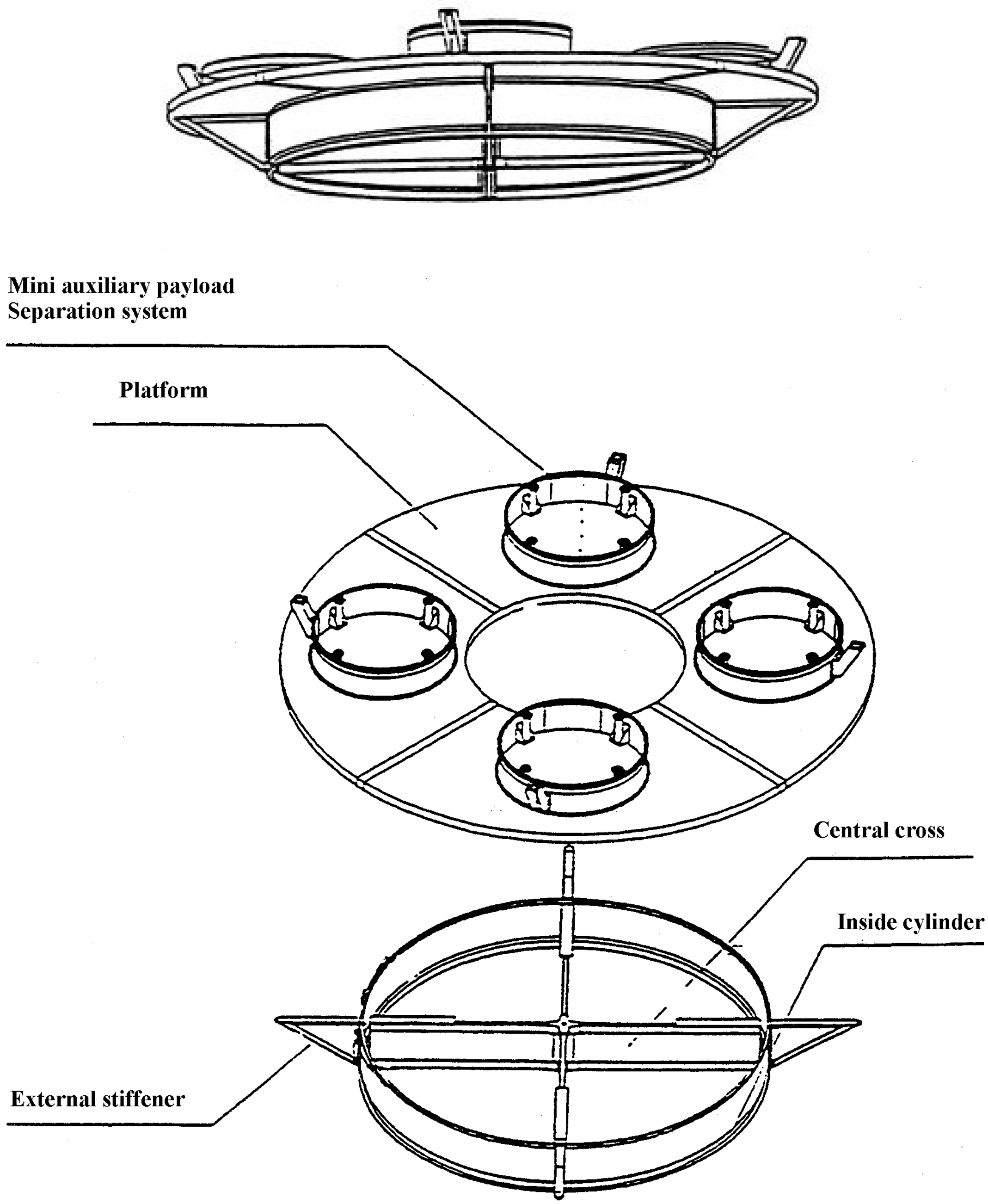


Figure 2 bis : ASAP 5 configuration of 4 mini Auxiliary Payloads

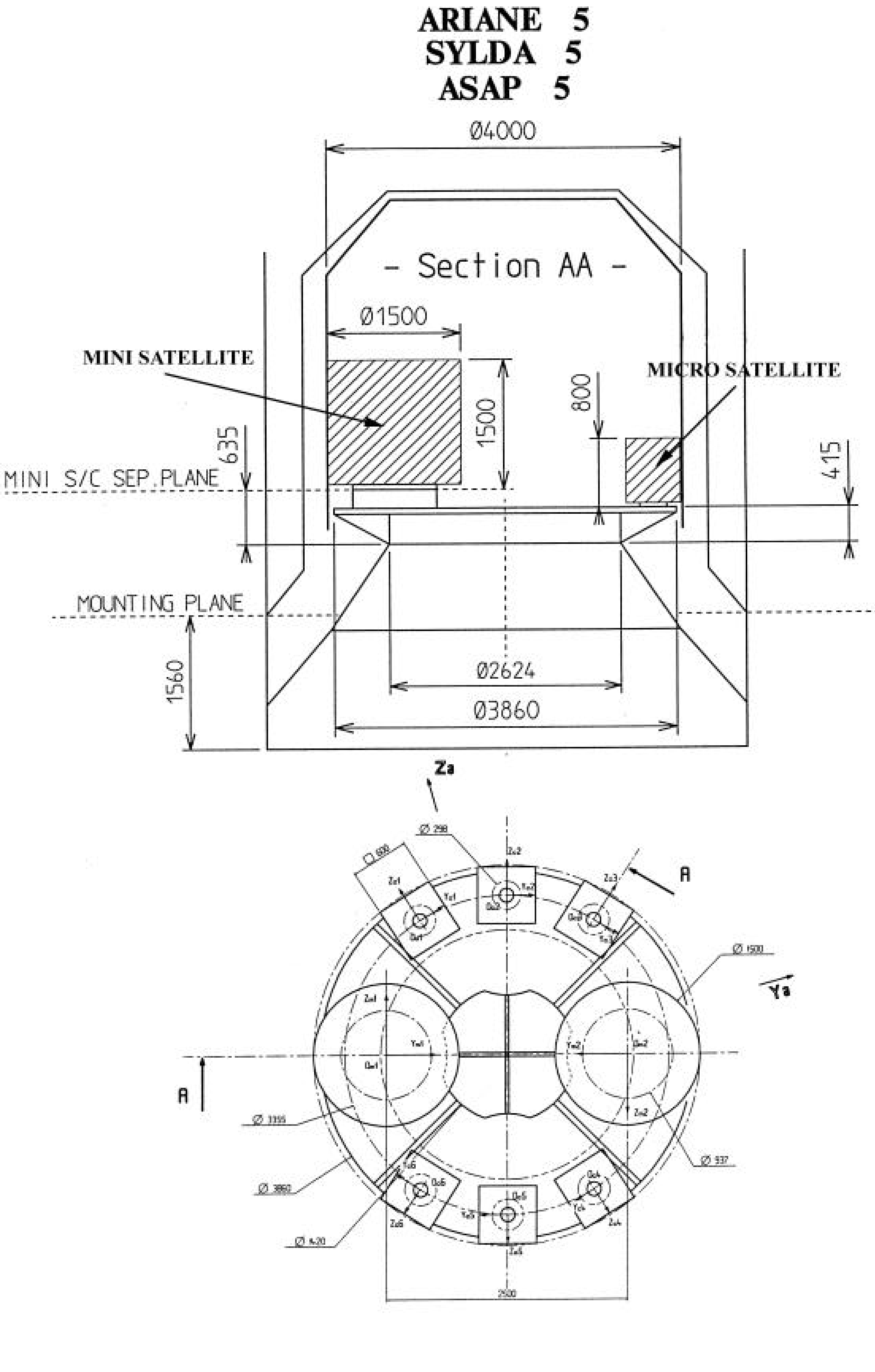


Figure 3 : Mixed configuration of 2 mini and 6 micro Auxiliary Payloads

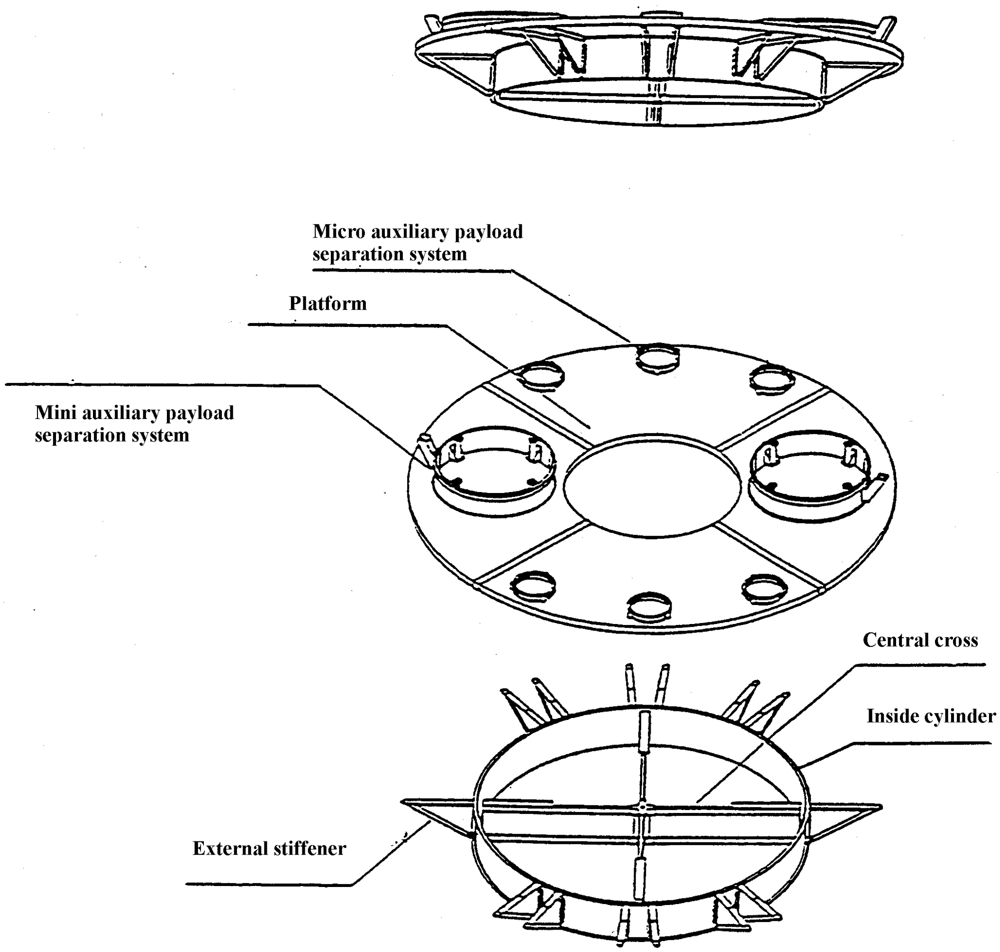


Figure 3 bis : ASAP 5 configuration for 2 mini and 6 micro Auxiliary Payloads

CHAPTER 3

Auxiliary payload design and dimensioning data

3.1 Micro Auxiliary Payload

3.1.1 Mass properties (see Figure 4)

Issue 1

- The maximum mass of a micro Auxiliary Payload *without* its separation system to ASAP 5 must be less or equal to 120 kg.

  Center of gravity position : $X_G \leq 450$ mm (from the mounting plan of the spacecraft)
  Y_G , $Z_G \leq \pm 5$ mm

Issue 1

- Inertia : I_{XX} , I_{YY} and $I_{ZZ} \leq 20$ m^2 kg. (w.r.t. C. o. G.)

- The maximum aggregate mass is 8×120 kg = 960 kg.
  The mass of the aggregate is defined on a case by case taking into account the main passenger mission and the extra performance available.

3.1.2 Volume (see Figure 4)

Issue 1

- The maximum cross-section dimensions for the Micro Auxiliary Payload are 600 mm x 600 mm (600 mm in both the tangential and radial directions).

- The typical allowable height is 710 mm. This dimension can be adjusted on a case by case basis depending on the main passenger for the configuration with 8 Microsats.

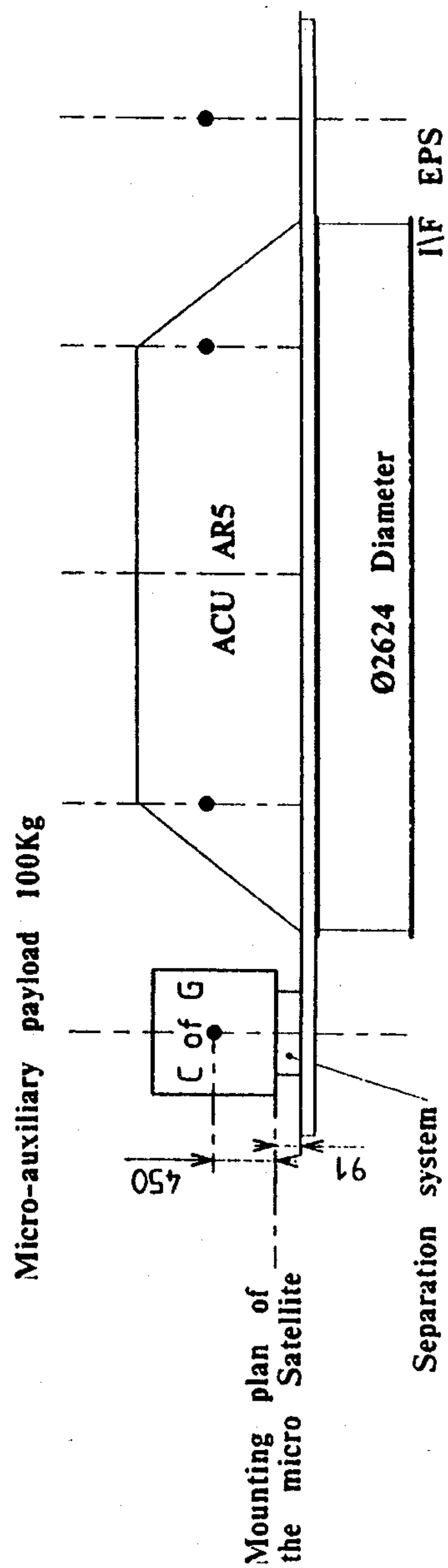


Figure 4 : Micro Auxiliary typical Payload configuration

3.2 Mini Auxiliary Payload

3.2.1 Mass properties
(see Figure 5)

- The maximum mass of a mini Auxiliary Payload *without* its adaptor to ASAP 5 must be less or equal to 300 kg.

Issue 1

- Center of gravity position :
  - $X_G \leq 800$ mm (from the separation plane of the mini Auxiliary Payload)
  - Y_G , $Z_G \leq \pm$ - 5 mm

- The maximum aggregate mass is 4 x 300 kg = 1200 kg for an ASAP 5 configuration with 4 mini Auxiliary Payloads.
  The mass of the aggregate is defined on a case by case taking into account the main passenger mission and the remaining performance available.

3.2.2 Volume
(see Figure 5)

The maximum dimensions for the mini Auxiliary Payload without its adaptor to ASAP 5 are :

- a diameter of 1500 mm,
- 1500 mm for the height,

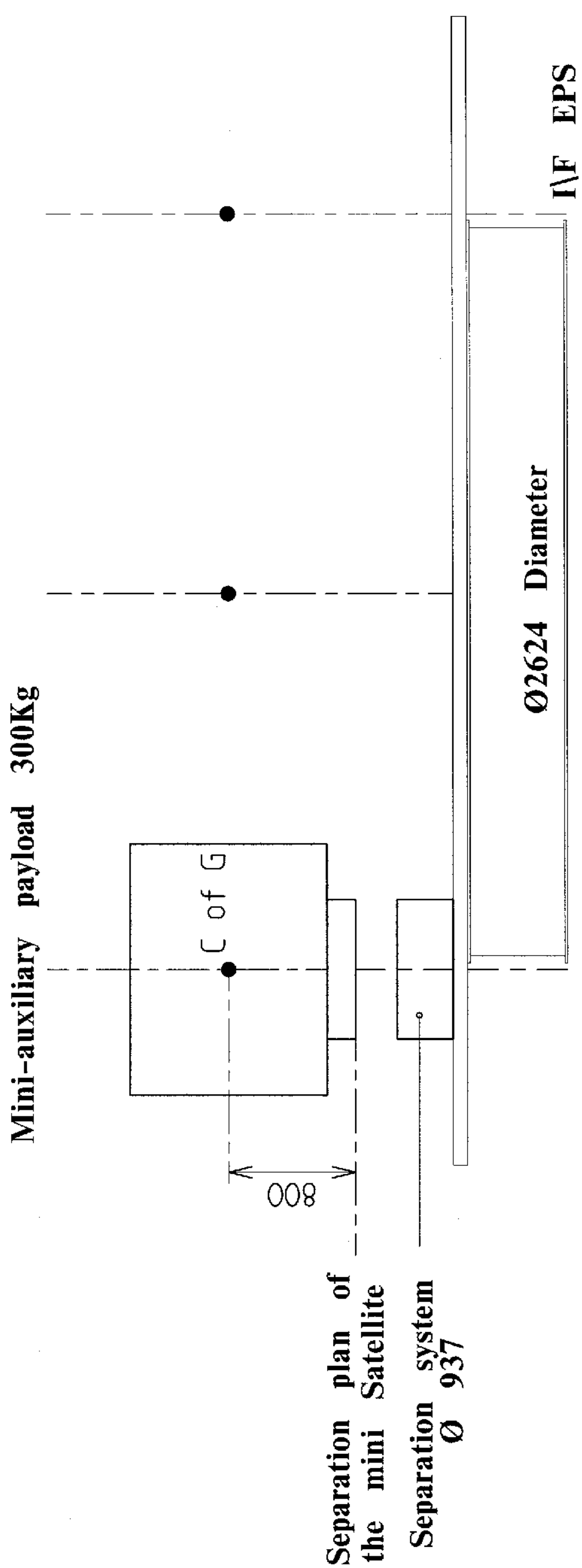


Figure 5 : Mini Auxiliary typical Payload configuration

CHAPTER 4

Interface for micro Auxiliary Payload

4.1 Mechanical interfaces (see Figure 6, Figure 7 and Figure 8)

The micro Auxiliary Payload will be mounted on ASAP 5 with the mandatory standard separation system provided by ARIANESPACE.

A circular opening of 140 mm can be provided in the center of the mechanical interface (to accomodate a thruster or a boom for example).

The micro Auxiliary Payload is mounted on the separation system with 12 ∅ 6 bolts and the separation system is mounted on the ASAP with 12 ∅ 8 bolts.
These fixing bolts are provided by ARIANESPACE. The required torque of the separation system attachment bolts into the base of the spacecraft is 0.8 mdaN.

This SS ASAP 5 Separation System provides a relative velocity at separation :

- along the spacecraft longitudinal axis,
- adjustable between 1 m/s and 3 m/s, the final value being defined by ARIANESPACE, in accordance with the Auxialiary Payload customer.
- with a push-off direction within a 5° half at 3 σ cone w.r.t. the spacecraft longitudinal axis
- maximum transversal angular speed : 3°/s at 3 σ
- separation system logic : Figure 6 ter

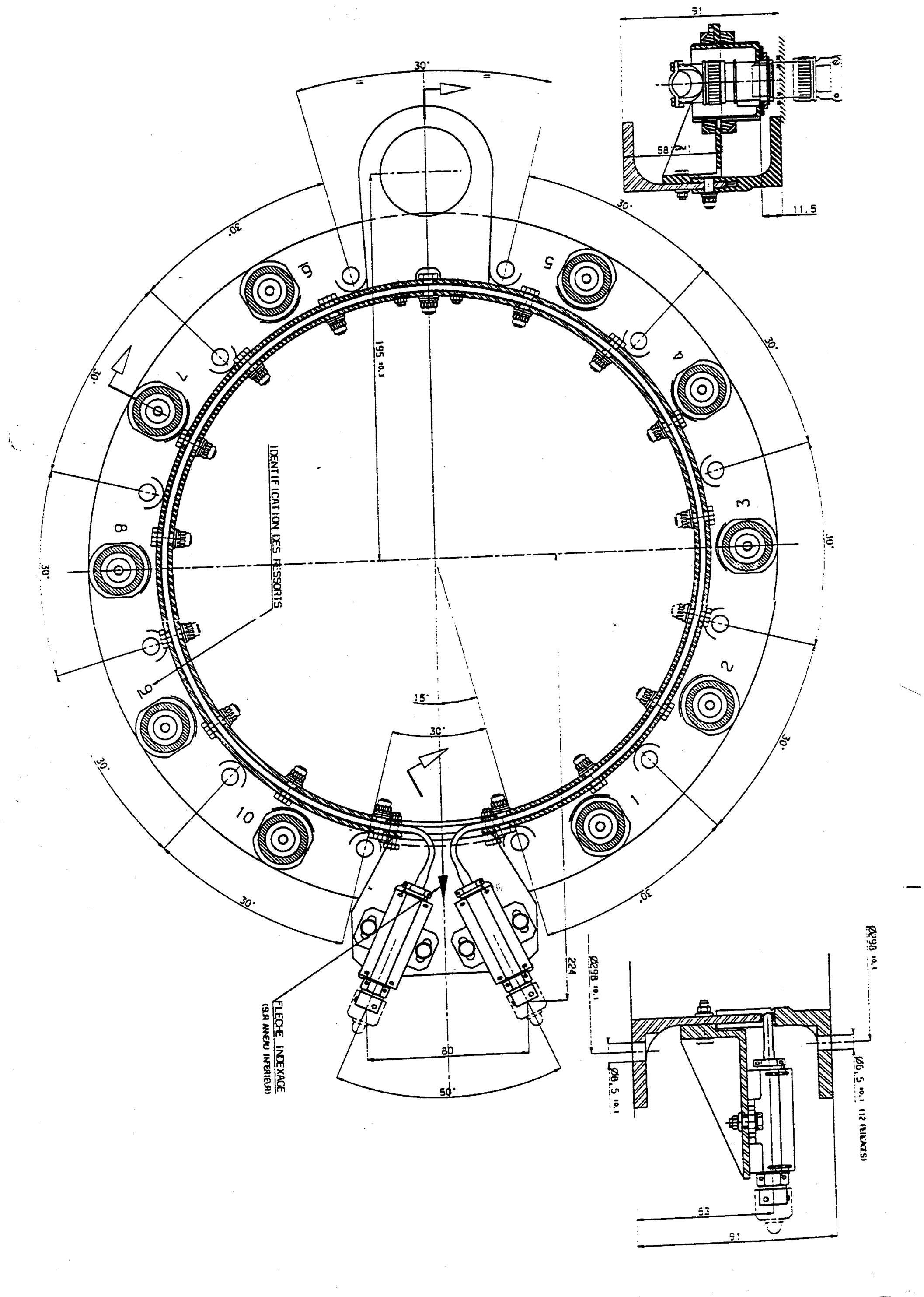
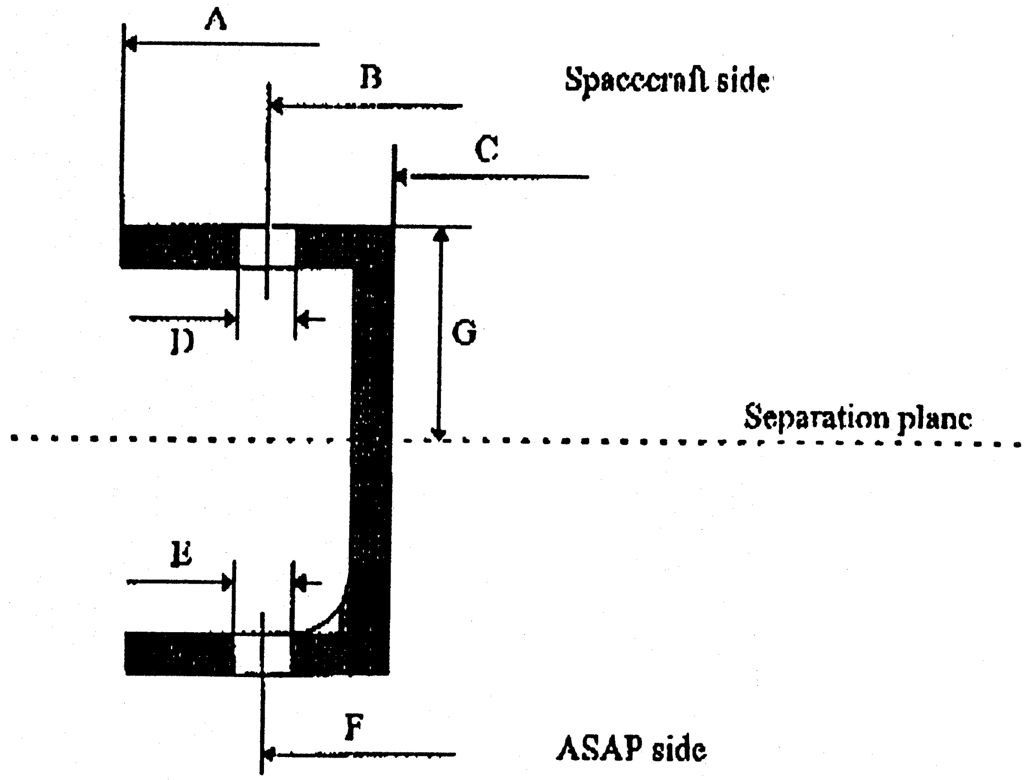


Figure 6 : Mechanical interface of micro Auxiliary Payload



Dimensions and tolerances

A = 348±0.1 mm (diameter)
B = F = 298±0.1 mm (diameter)
C =264.3±0.1 mm (diameter)

D = 6.5±0.1 mm (diameter)
E = 8.5±0.1 mm (diameter)
G = 28±0.1 mm

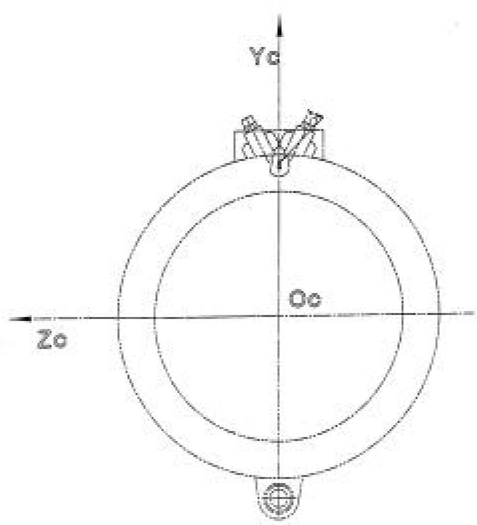
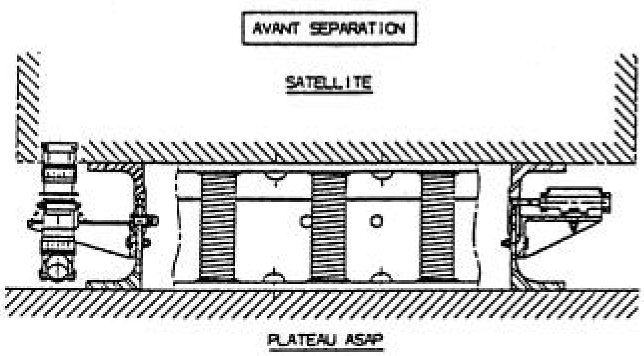


Figure 6 bis : dimensions, tolerances and positioning of the separation system


AVANT SEPARATION
SATELLITE
PLATEAU ASAP

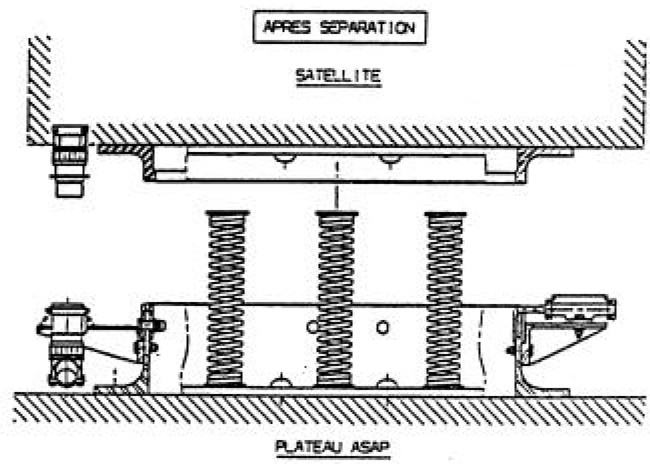

APRES SEPARATION
SATELLITE
PLATEAU ASAP

Figure 6 ter : separation system logic

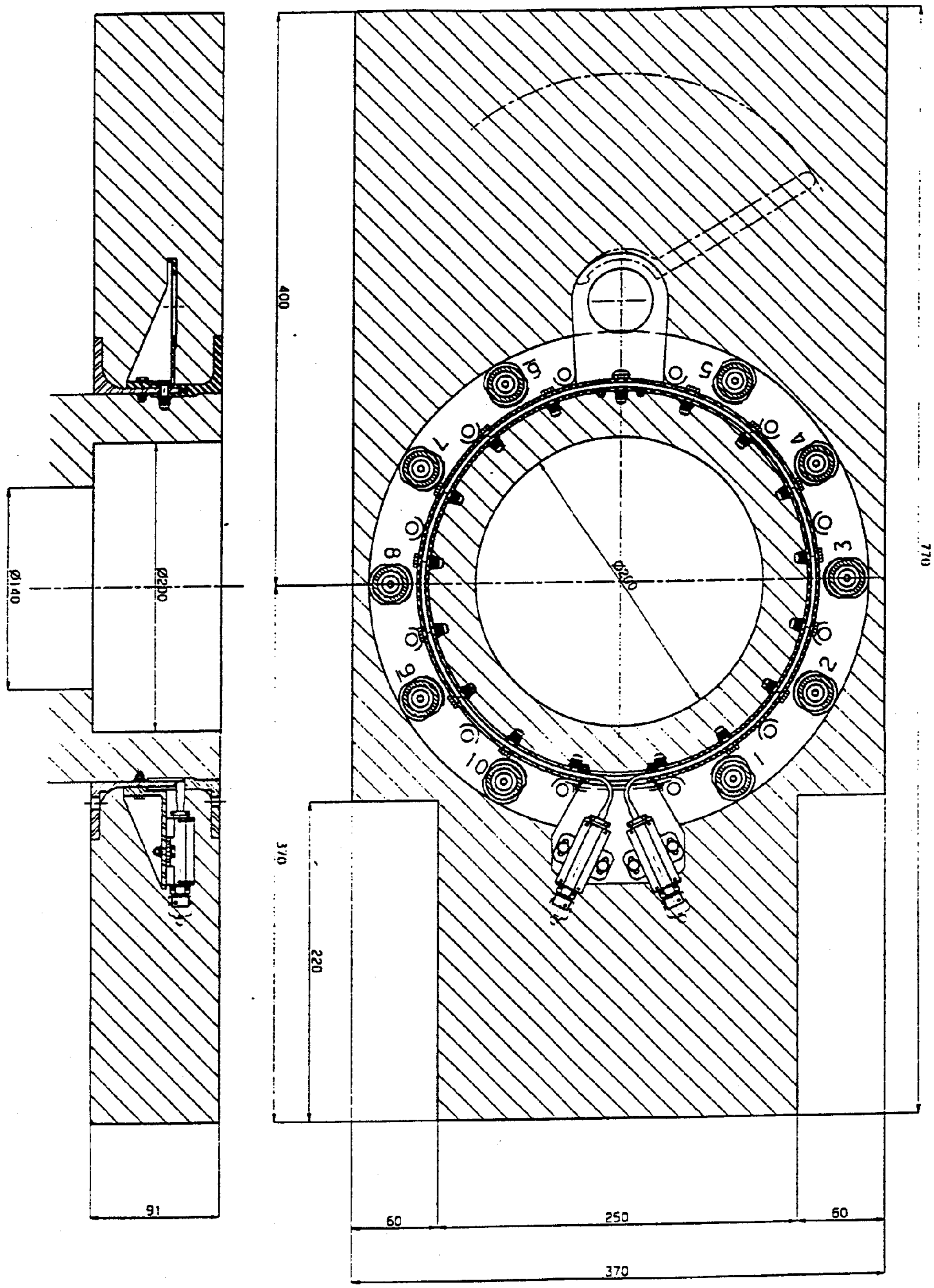


Figure 7 : Prohibited volume of micro auxiliary payload

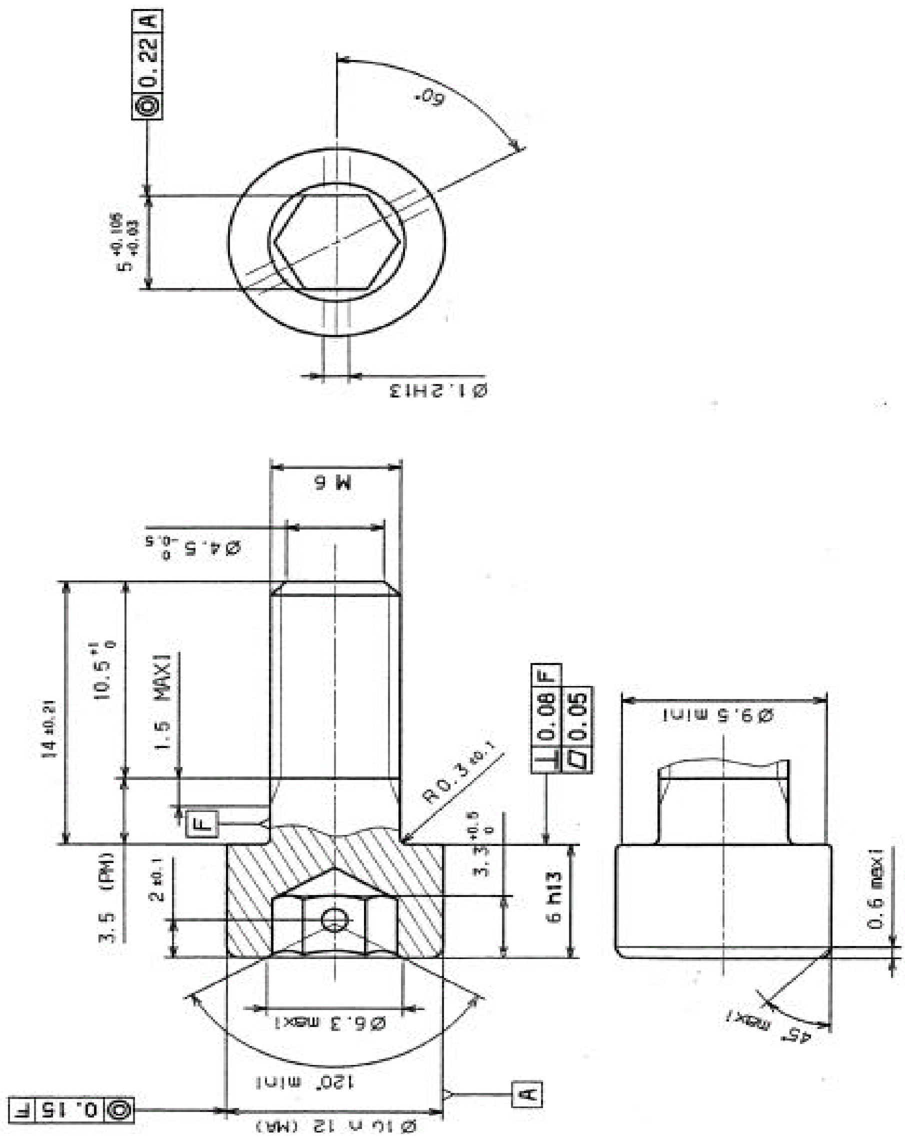


Figure 8 : Microsatellite mounting bolt definition

Two pyro detonators initiated by a redundant command cuts the separation system ASAP 5 structure and a batch of springs drives away the micro Auxiliary Payload from the ASAP 5 platform.

The reliability of the separation system is 0,99995 with 60% confidence level.

Nota :

- *a separation system will be available in order to perform the tests (sine, random and shock tests) and another one for the flight.*

- *after separation, a residual mass of 1 kg will stay on the micro spacecraft.*

4.2 Electrical interfaces (see Fig. 7).

One umbilical link is available for each micro Auxiliary Payload for battery trickle charge.

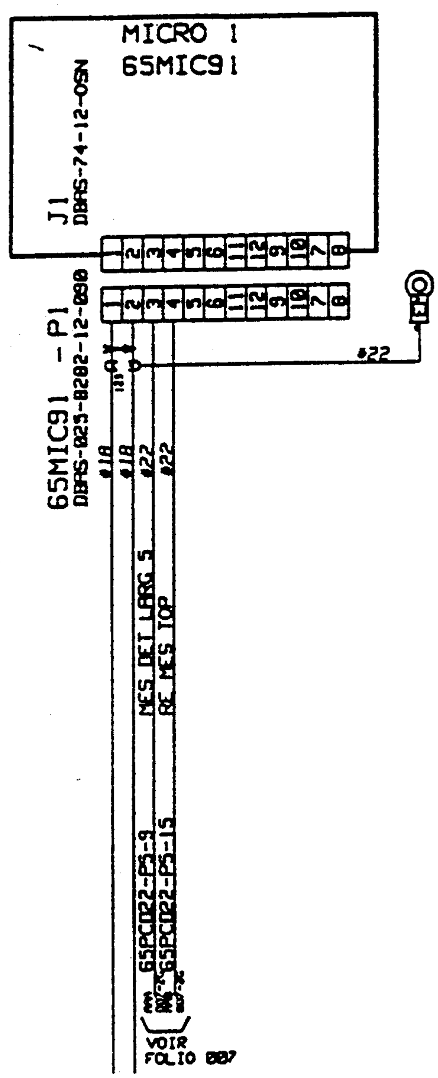
Issue 1

This charge is authorized up until H_O minus 10 minutes and the umbilical link is provided by ARIANESPACE.

One umbilical link is available for one strap separation (separation status via the launch vehicle telemetry system) installed between the 2 flanges of the Separation System ASAP 5.

The Customer has to define an electric continuity using the separation system.

The connector reference is DBAS 74 12 OSN 059 on spacecraft side.
The connector reference is DEUTSCH 025 82 10 12 on ASAP 5 side
These are provided by ARIANESPACE.



The pins 1 and 2 are for battery trickle-charging.
The pins 3 and 4 are for the separation status signal at ARIANE 5 level.
The others pins are available for the separation status signal at s/c level using traps.
The lug as pin 2 is a bonding ground trap on ASAP 5.

The lines 1 and 2 are screened during the charging of battery.

Figure 8 : Schematic of micro Auxiliary Payload / ARIANE electrical links

CHAPTER 5

Interfaces for mini Auxiliary Payload

5.1 Mechanical interfaces (see Figures 8).

The mini Auxiliary Payload will be mounted on ASAP 5 with the standard separation system provided by ARIANESPACE.

The mini Auxiliary Payload is mounted on the standard 937 mm clampband interface.

The mini spacecraft is secured to the adaptor interface frame by a clampband. This comprises a metal strip applying series of clamps to the payload and adaptor frames. The clampband assembly comprises two half clampbands connected by bolts which are cut pyrotechnically to release the clampband which is then held captive by the adaptor assembly.

The clampband tension does not exceed 18300 N at any time ; it is defined to ensure no gapping between the mini spacecraft and adaptor interface frames in ground and flight environment.

The spacecraft is forced away from the launch vehicle by 4 springs.

The relative velocity between the separation system and the spacecraft is $\geq$ 0.5 m/s for a mini Auxiliary Payload of 300 kg.

The force exerced on the spacecraft by each spring does not exceed : 900 N.

Adaptors are equipped either with internal springs on user request.

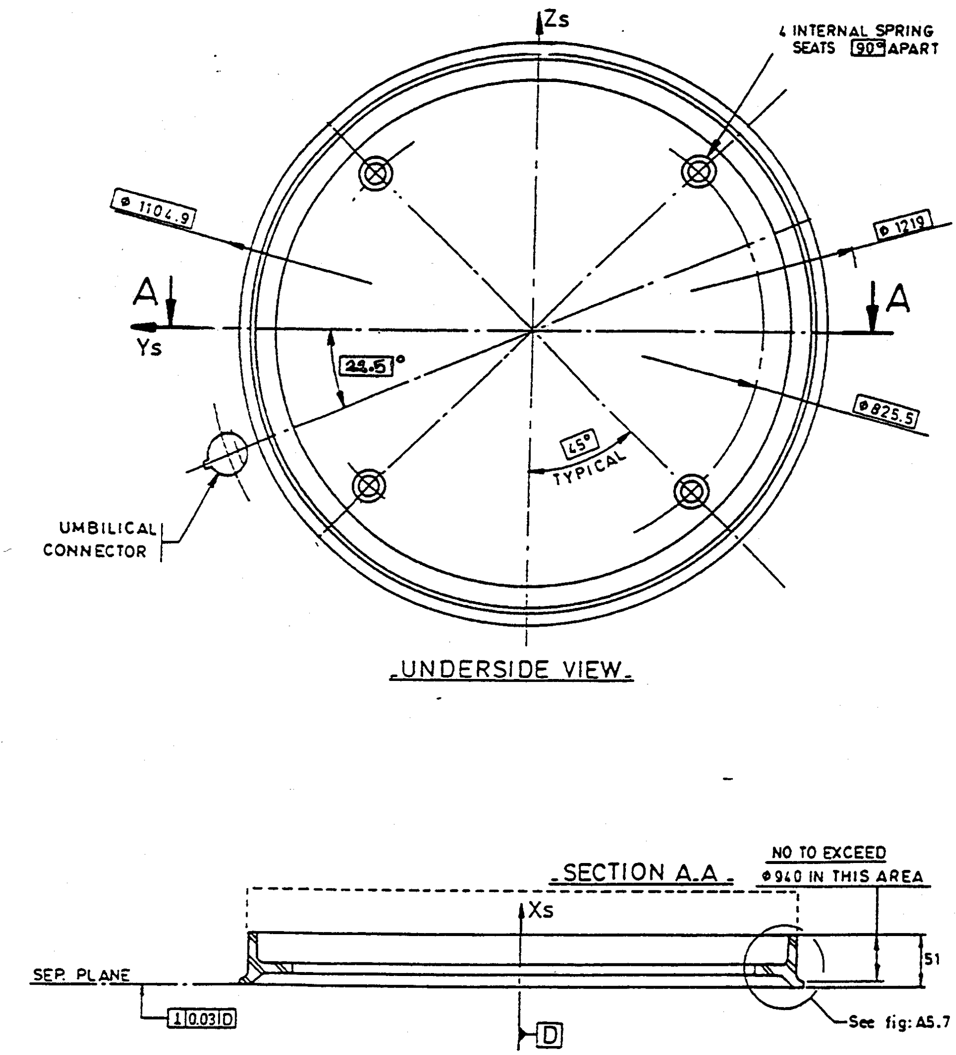


Figure 8.1 : Spacecraft configuration / general view and main characteristics

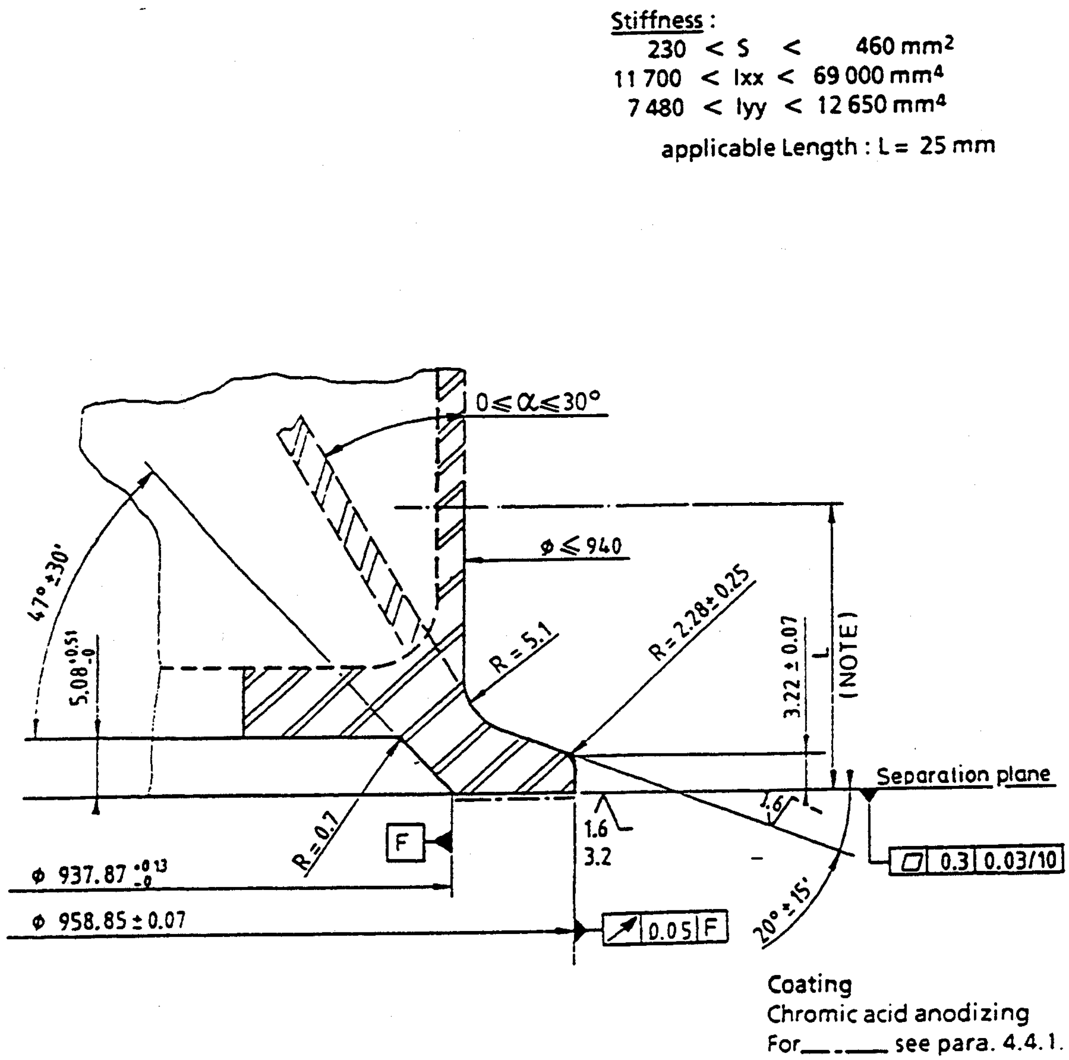


Figure 8.2 : Spacecraft interface frame (details)

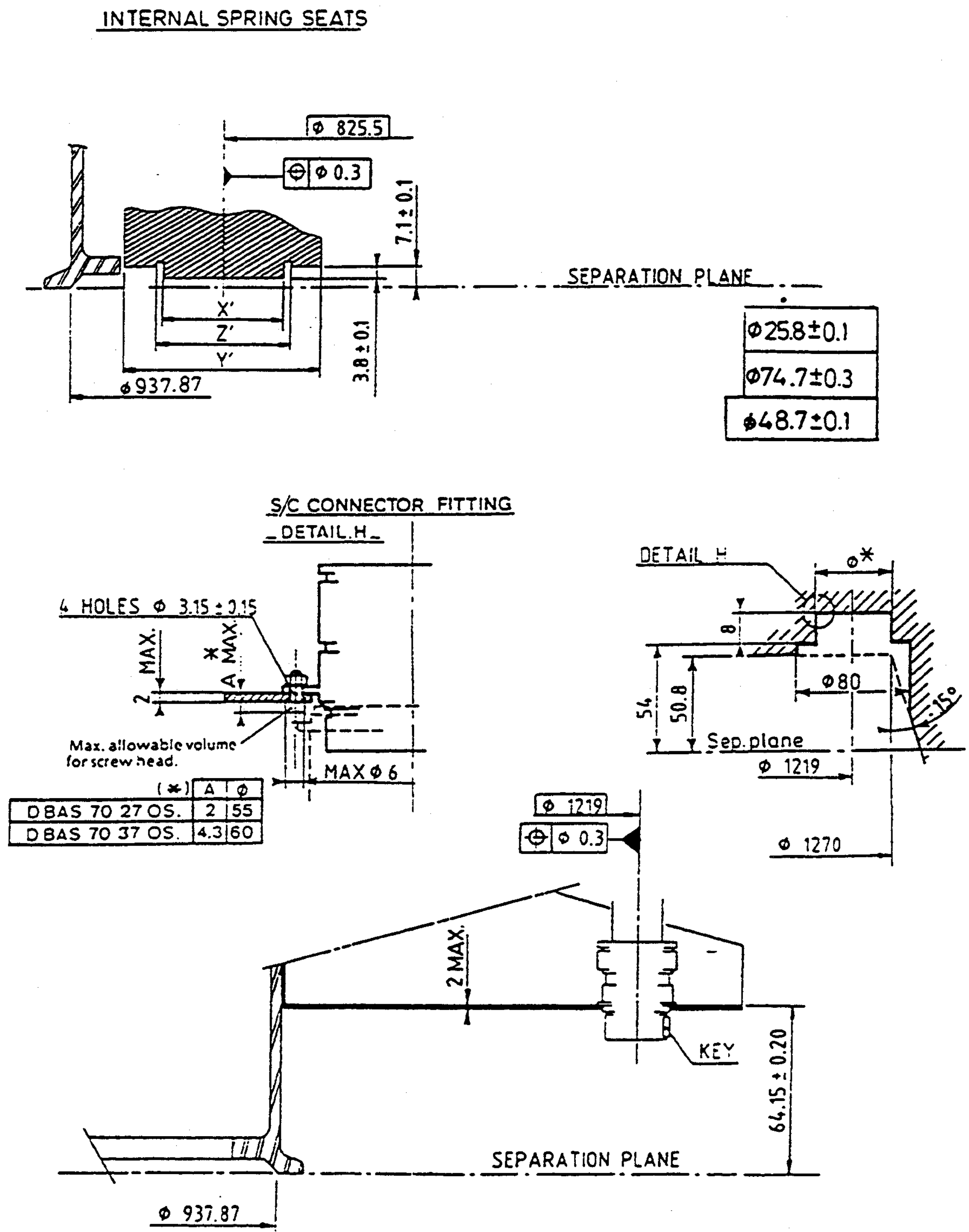


Figure 8.3 : Spacecraft mechanical interface details for internal or external spring seats

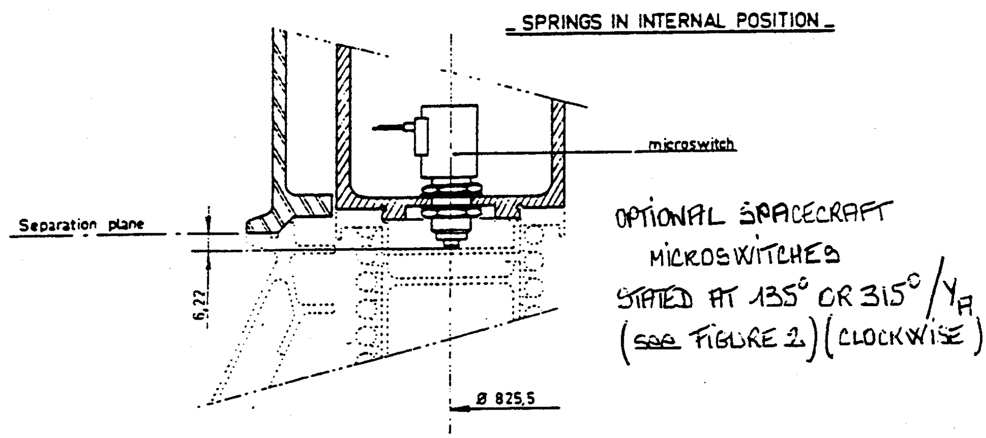


Figure 8.4 : Typical microswitches installation on the spacecraft

5.2 Electrical interfaces (see figure 9)

The connector reference is DBAS 74 37 OSN 059 on spacecraft side.
The connector is DBAS 025 82 10 37 on ASAP 5 side.
These are provided by ARIANESPACE

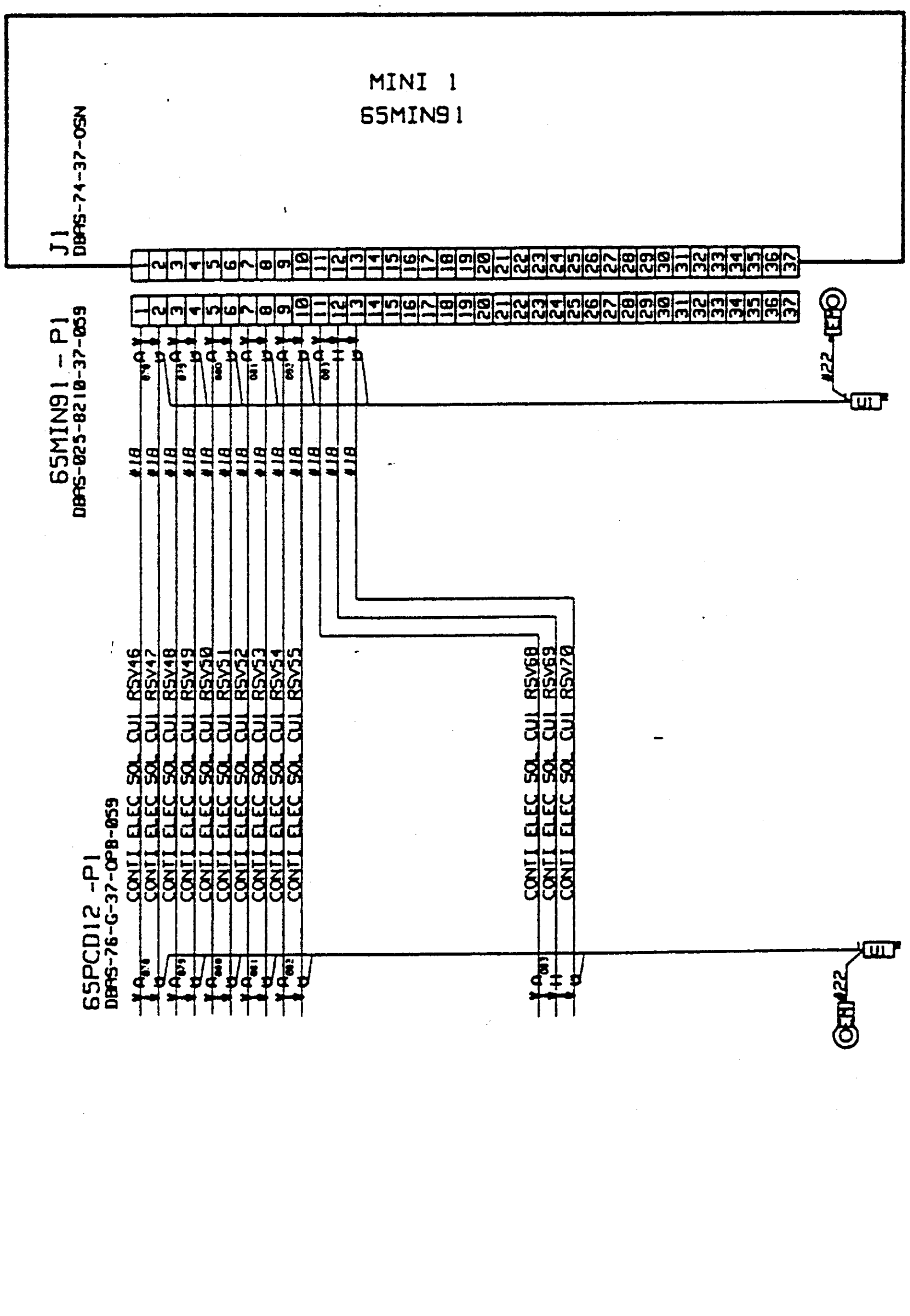


Figure 9 : Schematic of mini Auxiliary Payload / ARIANE electrical links

CHAPTER 6

Dimensioning and qualification of micro Auxiliary Payloads

6.1 Dimensioning :

The dimensioning of the spacecraft should be compatible with the levels requested for qualification and acceptance test as described hereafter.

6.1.1 frequency requirements

To avoid dynamic coupling between the low frequency vehicle and spacecraft modes, the spacecraft should be designed with a structural stiffness which ensures that :

Issue 1

- the fundamental frequency of the spacecraft in the longitudinal axis is ≥ 90 Hz.
- the fundamental frequencies of the spacecraft in the lateral axes are ≥ 45 Hz.

This applies for the spacecraft hardmounted at the ASAP 5 Payload separation plane.

6.1.2 primary structure

During flight, various static and dynamic loads are superimposed. The design and dimensioning of the S/C primary structure must therefore allow for the most severe load combination that can be encountered at a given instant of flight.

The flight limit loads are given in the following table.

Issue 1

	Longitudinal Static + Dynamic	**Lateral Static + Dynamic**
Acceleration (g)	**- 7.5 g / + 5.5 g**	**± 6 g**

NOTE : The minus sign with longitudinal axis values indicates compression.

- lateral loads may act in any direction simultaneously with longitudinal loads,
- the quasi static loads (QSL) apply on payload C of G,
- the gravity load is included,
- these loads apply for micro Auxiliary Payload complying with the frequency requirements of parag. 6.1.1.

Issue 1

Dimensioning must take into account safety factors, which are defined by the spacecraft Authority, with a minimum requested value of 1.25 at Ultimate stress and 1.1 at Yield stress.

Should the adequacy of the structure be demonstrated by a dimensioning file analysis, a minimum requested safety factor of 2.0 shall apply.

6.2 Thermal environment

During all phases from encapsulation to the separation of the spacecraft, the maximum dissipated power considered for each micro auxiliary payload shall be $\leq$ 5W.

6.3 Spacecraft mechanical environment qualification and acceptance tests :

The client will demonstrate that the spacecraft meets the dimensioning requirements, detailed in para. 6.1.2 by means of analysis and protoflight tests.

A test plan established by the Spacecraft Authority describing the tests which are executed on the spacecraft, will be provided to the ARIANESPACE Authority for approbation.

Issue 1

For spacecraft qualification and acceptance, sine, shock and random tests are mandatory.

After completion of the test, the test results file will be provided to ARIANESPACE.

6.3.1 Sinusoidal vibration tests

The qualification and acceptance levels, applied at the interface plane, are given in the following table.

	Frequency range (Hz)	Qualification levels (0 - peak)	Acceptance level (0 - peak)
Longitudinal	4 - 6 6 - 100	25 mm 3.75 g	20 mm 3 g
Lateral	2 - 6 6 - 100	20 mm 2.5 g	16 mm 2 g
Sweep rate (Oct. / min.)		2	4

Issue 1

A notching procedure can be agreed on the basis of dynamic coupled load analysis results and after a low level run.

6.3.2 Random vibration tests

The random vibration test levels for the qualification and acceptance are as follows :

Issue 1

Qualification : 0.0727 g^2/Hz flat power spectral density between 20 Hz and 2000 Hz.

Acceptance : 0.05 g^2/Hz flat power spectral density between 20 Hz and 2000 Hz.

The random vibration tests must be performed along the 3 satellite axes. The tests durations are two minutes per axis for qualification and one minute per axis for acceptance.

A notching procedure may be agreed based on a preliminary low level run.

6.3.3 Shock tests

Issue 1

The micro Auxiliary payload is subjected to shocks during interstages separations, fairing and carrying structures jettisoning and on actual payload separation. The microsat and in particular its equipment, must therefore demonstrate its ability to withstand the shock specified in Figure 10.

6.3.4 Compatibility tests spacecraft / ARIANE

Issue 1

A fit-check (mechanical and electrical compatibility test) will be performed with flight hardware or a representative mock-up of the usable volume.

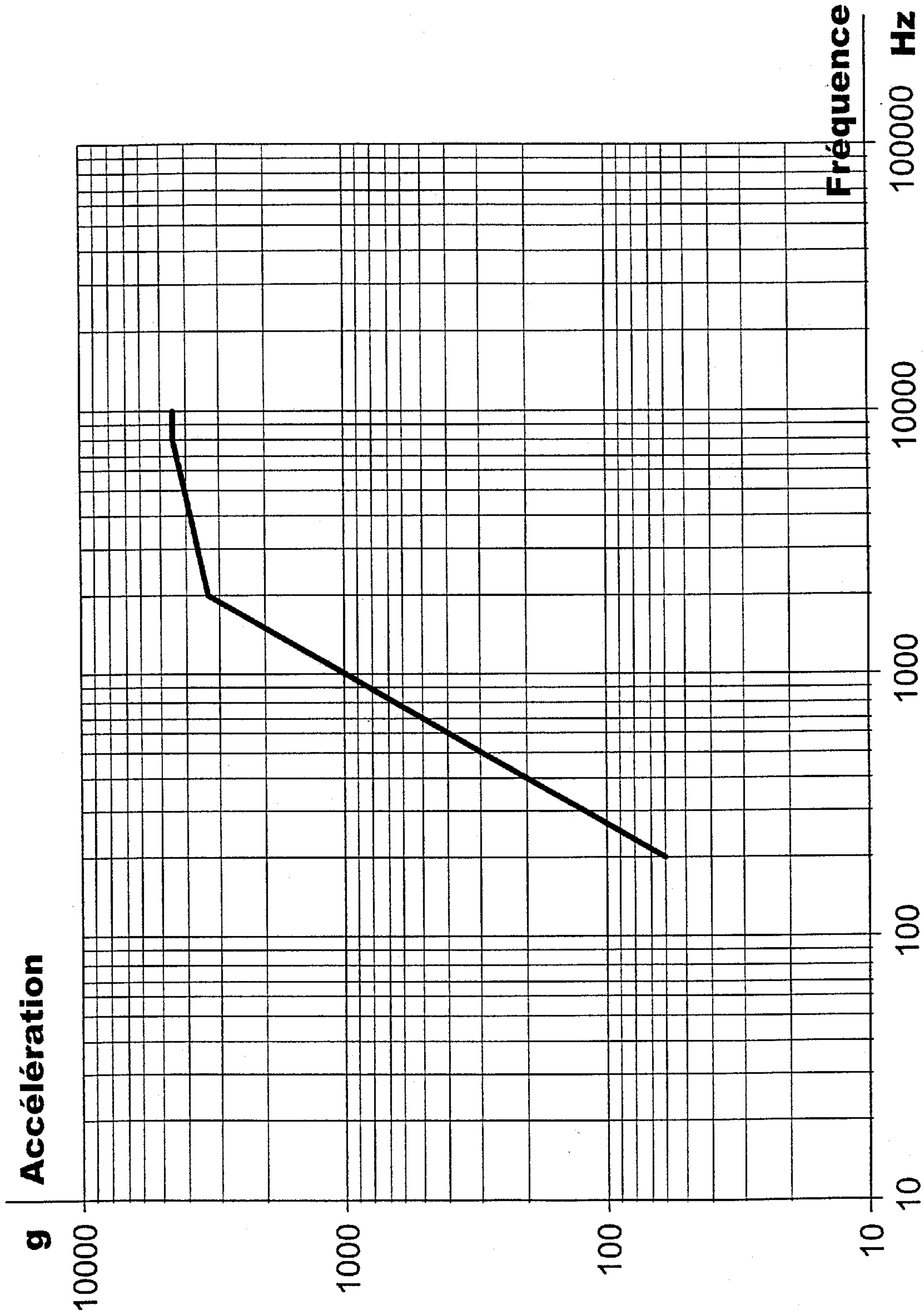

Accélération
g
10000
1000
100
10
Fréquence Hz
10
100
1000
10000
100000

Figure 10 : Qualification shock environment for Microsatellites

CHAPTER 7

Dimensioning and qualification of mini Auxiliary Payloads

7.1 Dimensioning :

The dimensioning criteria of the mini Auxiliary Payload should be compatible with the levels requested for qualification and acceptance test as described hereafter.

7.1.1 frequency requirements

To avoid dynamic coupling between the low frequency vehicle and mini Auxiliary Payload modes, the mini Auxiliary Payload should be designed with a structural stiffness which ensures that :

- the fundamental frequency of the mini Auxiliary Payload in the longitudinal axis is $\geq$ 60 Hz,

- the fundamental frequencies of the main Auxiliary Payload in the lateral axes are $\geq$ 30 Hz.

This applies for the mini Auxiliary Payload and $\varnothing$ 937 separation system hardmounted at the ASAP 5 interface plane.

7.1.2 primary structure

During flight, low frequency dynamic and steady loads are combined to define the quasi static load (QSL).

The design and dimensioning of the primary structure must therefore allow for the most severe load combination that can be encountered at any given instant of flight.

The corresponding flight limit loads are given in the following table.

Acceleration (g)	Longitudinal		Lateral
Flight event	**Static**	**Dynamic**	**Static + Dynamic**
Maximum dynamic pressure	**- 2.7**	**+/- 0.5**	**+/- 3**
P 230 thrust oscillations	**- 4.55**	**+/- 1.75**	**+/- 3**
P230 separation	**-0.7**	**± 5**	**+/- 2**

Issue 1

- the minus sign with static longitudinal axis values indicates compression,
- lateral loads may act in any direction simultaneously with longitudinal loads,
- the quasi static loads (QSL) apply on payload C of G,
- the gravity load is included,
- These loads apply for mini Auxiliary Payload complying with the frequency requirements of paragraph. 7.1.1.

Dimensioning must take into account safety factors, which are defined by the spacecraft Authority with a requested minimum value of 1.25 at Ultimate stress and 1.1 at yield stress.

Coupled load analysis :

The coupled load analysis carried out as part of the Mission Analysis will verify the dimensioning adopted.

7.2 Thermal environment

During all phases from encapsulation to the separation of the spacecraft, the maximum dissipated power considered for each mini auxiliary payload shall be $\leq$ 30 W.

7.3 Spacecraft mechanical environment qualification and acceptance tests :

The client will demonstrate that the spacecraft meets the dimensioning requirements, by means of an analysis file and protoflight tests.

A test plan established by the Spacecraft Authority describing the tests which are executed on the spacecraft, will be provided to the ARIANESPACE Authority for approbation.

For spacecraft qualification, sinusoidal, shock and random or acoustic tests are mandatory.
For spacecraft acceptance, only random or acoustic tests are mandatory.

After completion of the test, the test file shall be provided to ARIANESPACE.

7.3.1 static qualification tests

On the basis of the ARIANE quasi static loads as described in para. 7.1.2 the User determines the dimensioning load cases to which the spacecraft structure will be subjected. The static tests shall be carried out without rupture up to flight limit loads, multiplied by a factor $\geq$ 1.25.

7.3.2 sinusoidal vibration tests

Issue 1

The qualification and acceptance levels, applied at the interface plane, are given in the following table.

	Frequency range (Hz)	Qualification levels (0 - peak) (recommended)	Acceptance level (0 - peak)
Longitudinal	4 - 5 5 - 100	24.8 mm 2.5 g	19.8 mm 2 g
Lateral	2 - 5 5 - 100	18.7 mm 1.9 g	14.9 mm 1.5 g
Sweep rate		2 oct. / min	4 oct. / min.

7.3.3 random vibration tests

The random vibration test levels for the qualification and the acceptance of the spacecraft are presented below :

On 3 axis	Frequency range(Hz)	Density (g^2 / Hz)	rms value (g)
Qualification levels	30 - 150 150 - 700 700 - 2000	+ 6 dB / Oct. 0.0727 - 3 dB / Oct.	11
Acceptance levels	30 - 150 150 - 700 700 - 2000	+ 6 dB / Oct. 0.05 - 3 dB / Oct.	7.3

Issue 1

The levels are identical for longitudinal and lateral axes and refer to the interface plane. The test duration is 2 minutes per axis for qualification, and 1 minute per axis for acceptance testing.

7.3.4 Acoustic vibration test

- The acoustic levels applicable for qualification and acceptance tests of the spacecraft are presented below :

Issue 1

OCTAVE BAND CENTER FREQUENCY (Hz)	QUALIFICATION LEVEL	ACCEPTANCE LEVEL (Flight Limit) 0 dB : ref. 2 ´ 10^{-5} Pascal	TEST TOLERANCE (1)
31.5	132	128	- 2, + 4
63	134	130	- 1, + 3
125	139	135	- 1, + 3
250	143	139	- 1, + 3
500	138	134	- 1, + 3
1000	132	128	- 1, + 3
2000	128	124	- 1, + 3
OVERALL LEVEL	146	142	- 1, + 3
TEST DURATION	2 minutes	1 minute	

Notes : (1) The tolerances indicated in the above table allows for standard test-equipment inaccuracy.

7.3.5 shock tests

The Mini Auxiliary Payload is subjected to shocks during interstages separations, fairing and carrying structures jettisoning and on actual payload separation. The Minisat and in particular its equipment, must therefore demonstrate its ability to withstand the shock specified in Figure 10.1.

The qualification can be performed in two ways :

Issue 1

- either through a direct qualification shock test with a base shock spectrum equal to figure 11 plus 3 dB for qualification margins
- either through a two steps demonstration involving :

  a) a shock test, during which interface levels and spacecraft equipment base levels are measured. This test can be performed on the STM/PFM or on the first model of a series, provided that the spacecraft structure and the equipment location and mounting are the same as on the flight models.

  b) An analytic demonstration of the qualification of the equipment.

This is obtained by comparing the component unit qualification levels to the equipment base levels that would be experienced applying the interface shock specified in 4.1.6. (with the addition of a qualification margin : 3 dB recommended) and the transfer function defined during the shock test.

This demonstration could be made by using equivalent rules on other environment qualification tests. (i.e. random or sine).

7.3.6

A fit-check (mechanical and electrical compatibility test) will be performed with flight hardware or with flight hardware. "L" being the launch date. (At MMS - Stevenage at L-7 months).

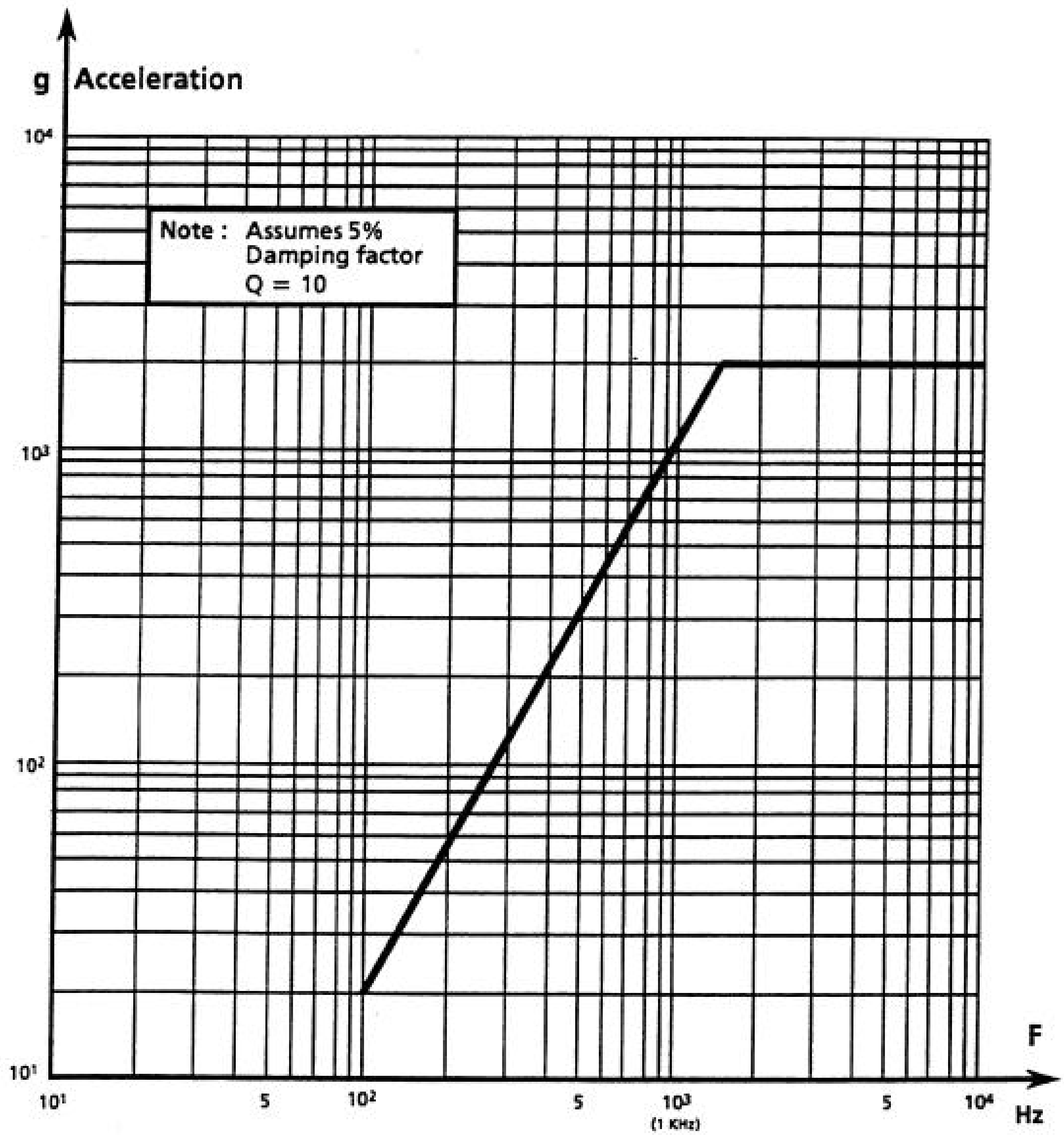

g
Acceleration
10⁴
Note : Assumes 5%
Damping factor
Q = 10
10³
10²
10¹
F
10¹
5
10²
5
10³
(1 KHz)
5
10⁴
Hz

Figure 11 : Flight limit shock environment for Minisatellites

CHAPTER 8

Constraints

8.1 General considerations :

The Auxiliary Payload is part of a launch dedicated to a main passenger therefore it has to adapt to the main passenger mission and launch operations.

Generally speaking, the Auxiliary Payload will receive what is left available by the main mission and has to be compatible and transparent with the main mission.

8.2 Ground constraints :

8.2.1 Dummy :

The Auxiliary Payload which has been taken into account for the mission analysis of the flight considered will be used for the launch whatever its status. If the Auxiliary Payload is not ready it will be launched as it is or a representative dummy (mass, center of gravity location) will be used. This dummy shall be provided by the customer at the beginning of the launch campaign. It is to be representative in terms of mechanical interface (rear frame thickness).

8.2.2 Launch site :

- A minimum area of 50 m^2 (to be shared with the other micro Auxiliary Payloads) will be allocated in the EPCU (payload preparation) building to the customer, allowing for integration and installation on A.S.A.P.

- A minimum area of 50 m^2 for each mini Auxiliary Payload will be allocated

- A maximum of 1 person is allowed during the final countdown in the launch center.

8.2.3 Launch campaign :

- Real time operations will be depicted through dedicated operational documentation. The priority will be in all cases given to the main passenger.

- The launch campaign duration is limited to 3 weeks from arrival of the Auxiliary Payload up to the integration on ASAP 5.

The integration logic of the S/C is the following :

- S/C integration on separation system
- Connection and electrical check out of umbilical lines
- S/C + separation system integration on ASAP 5
- Electrical and pyrotechnical lines connection and check-out
- Transfer to the launcher and final electrical checks.
-

- The Auxiliary Payload ground equipment and containers must be ready to leave the launch base within the 3 working days following the actual launch day.

- Aggregate will be ready to start the ARIANESPACE combined operations at least 10 working days prior to the launch day.

8.3 Flight constraints :

- The Auxiliary Payload shall be totally inert (no radio-transmission) during the countdown, the flight and up to TBD minutes or more after the separation, depending on a radio compatibility analysis carried out with the main passenger.

- The attitude pointing at separation will be defined by ARIANESPACE according to the mission analysis. The Auxiliary Payload has no means to impose a preferred orientation.

- The separation will be provided in a 3 axis stabilized mode or spin mode for the mini Auxiliary Payload.

CHAPTER 9

Documentation

9.1 Interface management :

Interface management is based on the Interface Control Document (DCI) which is issued by ARIANESPACE using inputs extracted from the technical annexes of the Launch Service Contract and from the "Application to Use ARIANE" (DUA) provided by the User.

9.1.1 Application to use ARIANE :

("Demande d'Utilisation ARIANE - DUA")

The user is required to issue a DUA in which the spacecraft interfaces with the launch system are defined, i.e. :

- Mission characteristics
- Spacecraft data :
  mass, inerties, geometrical data, electrical interfaces, radio frequencies, ...
- Spacecraft development and test plan.

The format of this document is presented in Annex 2.

9.1.2 Interface Control Document :

("Dossier de Contrôle d'Interface - DCI")

ARIANESPACE prepares the DCI in response to the DUA and the technical annexes of the Launch Service Contract. The DCI collates all interface requirements common to the launch system and the spacecraft, and illustrates their respective compatibility.

The DCI is approved by both ARIANESPACE and the User and is maintained under formal configuration control until the launch.

After approval, the DCI becomes the basic and unique working document with respect to technical aspects and identification of the operational activities.

The DCI is updated as the project progresses in accordance with modification management procedure.

9.2 Safety Baseline documents :

See MUA5, para. 6.3.

9.3 Mission Analysis :

See MUA5, para. 6.4.

Format for Application to use A.S.A.P. for each Auxiliary Payload

1 INTRODUCTION :

S/C description and mission summary :
Includes a 3 D view drawing of spacecraft in orbit, an exploded view and the coverage zones (if applicable).

<table>
<tr><td>MANUFACTORING BY :</td><td colspan="2">MODEL :</td></tr>
<tr><td>MASS
• Total mass at launch :
• Mass of satellite in final orbit :</td><td colspan="2">DIMENSIONS
• Dimensions
• Dimensions stowed for launch
• Dimensions deployed on orbit</td></tr>
<tr><td colspan="3">LIFETIME</td></tr>
<tr><td colspan="2">MISSION SUMMARY

Purpose of the spacecraft and description of the payload</td><td>Telecommunications *
Scientific*
Radiolocalisation *
Others
(*) to be selected</td></tr>
<tr><td colspan="3">ANTENNAE : Omniantenna direction and location</td></tr>
<tr><td colspan="3">PROPULSION SUB-SYSTEM (if applicable)
Brief description : TBD (liquid / solid, number of thrusters ...)</td></tr>
<tr><td colspan="3">ELECTRICAL POWER : - Solar arrays description : TBD
Beginning of life : TBD W
End of life : TBD W
- Batteries description : TBD</td></tr>
<tr><td colspan="3">ATTITUDE CONTROL : - Type : TBD</td></tr>
<tr><td colspan="3">COVERAGE ZONES OF THE SATELLITE : TBD (+ figure if applicable)</td></tr>
</table>

2 MISSION CHARACTERISTICS :

The orbit is imposed by the main mission, describe the sequence of events after separation until final orbit (main manoeuvers from separation until final orbit).

3 SPACECRAFT DESCRIPTION :

3.1 Spacecraft Systems of Axes :

Includes a sketch showing the Spacecraft system of axes, the axes are noted Xs, Ys, Zs and form a right handed set (s for spacecraft).

3.2 Spacecraft geometry in the flight configuration :

A drawing and a reproduceable copy of the overall spacecraft geometry in flight configuration is required. Detailed dimensional data will be provided for the parts of the S/C closest to the "static envelope" (antenna reflectors, deployment mechanisms, solar array panels, thermal protections,...).

3.3 Mass, alignment, inertias (Nominal values and tolerances).

3.3.1 Table :

ELEMENT	MASS (kg)	C OF G COORDINATES (mm)			COEFFICIENT OF INERTIA MATRIX (kg.m²)					
		X_G	Y_G	Z_G	I_{XX}	I_{YY}	I_{ZZ}	P_{XY}	P_{YZ}	P_{ZX}
Spacecraft										
Tolerances	(kg)	(mm)	(mm)	(mm)	%	%	%	Mini Maxi	Mini Maxi	Mini Maxi

$$\text{with } Pxy = + \int xydm$$

Notes **:**

- C of G coordinates are given in spacecraft axes with origin of the axes at the ASAP mounting plane.

- Inertia matrix is calculated in spacecraft axes with origin of the axes at the Center of Gravity.

3.3.2 Range of major / minor inertia axis ratio.

3.3.3 Dynamic out of balance (if applicable).
Indicate the maximum dynamic out of balance in degrees.

3.4 Mechanical interfaces

Define adaptor and its interface with the launch vehicle.
Define the characteristics of the separation system :

- clampband design
- separation springs configuration
- separation half cone angle

3.5 Electrical interfaces

3.5.1 Umbilical link
Define the line characteristics for :

- battery trickle charging,
- separation microswitch
- others

Indicate voltage and current during launch preparation.

<u>LAUNCH PREPARATION</u>

S/C Connector pin allocation number	Function	Max Voltage (V)	Max Current (mA)

Max voltage drop (ΔV) **OR**	Expected One way Resistance (Ω)

<u>POE EXTRACTION (lift-off)</u>

Function	Max Current (mA)	Max Voltage (V)

3.5.2 Umbilical link shielding definition.

3.5.3 Spacecraft earth potential reference point location.

3.6 Radio-electrical interfaces

3.6.1 Functional check-out prior and after integration with ASAP 5.

3.6.2 Antenna(e) diagrams and characteristics.

3.6.3 Satellite transmit and receive systems :

- description of spacecraft Telemetry and Telecommand systems
- description of payload telecommunications system.

3.6.4 System characteristics

- on board system.

For each TM & TC sources and systems used on the ground and during launch, give the following :

UNIT DESIGNATION SOURCE		S1	S2	S...
Function				
Band				
Carrier Frequency, F_0 (Mhz)				
Bandwidth centered around F_0 :	**-3 db**			
	- 60 db			
Carrier Modulation	**Type**			
	Index			
Carrier Polarization				
Local Oscillator Frequencies				
1st intermediate frequency				
2nd intermediate frequency				
EIRP, transmit (dbm)	**MAX**			
	NOM			
	MIN			
Field strength at	**MAX**			
antenna, receive	**NOM**			

(dbµ V/M) **MIN**			
Antenna : Designation Location Gain Pattern			

3.6.5 Spacecraft transmission plan :

SOURCE	FUNCTION	DURING PREPARATION ON LAUNCH PAD	AFTER H_0 - 1h30 UNTIL (TBDs) AFTER SEPARATION	IN ORBIT
S1			**OFF***	
S2			**OFF***	

* ON and stand by mode for mini Auxiliary Payload

3.7 Environmental data

3.7.1 Fundamental modes (lateral, longitudinal) of spacecraft hardmounted at interface with ASAP 5.

3.7.2 Thermal characteristics during launch preparation and boost phase including constraints.

3.7.3 Dissipated power during count down and boost phase.

3.7.4 Contamination characteristics and constraints :

- Define the material selected and the out-gassing material.

4 OPERATIONAL REQUIREMENTS :

4.1 Provisional time schedule for operations at the range

4.2 Spacecraft preparation building

4.2.1 Main operations list and description.

4.2.2 Power requirements.
Indicate voltage, Amps, Nb phases, frequency, category (standard or no break).

4.2.3 Facility equipment requirements

4.2.4 RF and hardline links requirements.

4.2.5 Telecommunications requirements (Telephone, Facsimile, ...)

4.2.6 Miscellaneous.

4.3 Transportation requirements

Give also dimension and weight of containers.

4.4 Hazardous items storage requirements

Pyrotechnic devices description.

5 GENERAL

5.1 Estimate packing list (including heavier and larger container characteristics)

Indicate designation, number, size (L x W x H in mm) and mass (kg).

5.2 Technical support requirements

Workshop, instrument calibration, ...

5.3 Hotel and cars reservations

Give guide lines and policy for hotel and cars reservations during the campaign.

5.4 Miscellaneous services

6 SPACECRAFT DEVELOPMENT PLAN

7 TESTS

7.1 Spacecraft test plan (vibration, acoustic, shocks, ...) and acceptance levels

Define the qualification policy, qualification (protoflight or qualification model).

7.2 Environmental test plan :

Describe qualification and acceptance testing including levels and frequency ranges.

8 DEFINITIONS, ACRONYMS, SYMBOLS, ...

Launch record

Jan 1990 ASAP n°1 AR 40 Sunsynchronous orbit with SPOT 2 Mission - CNES

CUSTOMER :	AUXILIARY PAYLOAD :	MASS :	MISSION :
♦ **UOSAT / SST (UK)**			
	UOSAT-D	45.5 kg	Scientific experimentation Store and forward digital communications
	UOSAT E	47.5 kg	Scientific experimentation Telecommunication and imaging demonstration
♦ **AMSAT N.A.** (USA)			
	MICROSAT A	12.1 kg	Digital store and forward communications
	MICROSAT B	12.1 kg	Scientific educational and communications
	MICROSAT C	14.3 kg	Educational CCD earth imaging
	MICROSAT D	12.1 kg	Digital store and forward communications

July 1991 ASAP n° 2 AR 40 Sunsynchronous orbit with ERS 1 mission - ESA

♦ **OSC** (USA)	ORBCOMM-X	22.8 kg	Store and forward communications rescue and mobile tracking
♦ **Esieespace** (FRANCE)	SARA	26.6 kg	Radio astronomy : JUPITER emissions
♦ **Technische Universität Berlin** (Germany)	TUBSAT	38 kg	Store and forward communication Location of migrating animals space technology demonstration
♦ **UOSAT / SST** (UK)	UOSAT - F	50 kg	Electronic mail, technology experiment

			environment, earth imaging.

August 1992 ASAP N° 3 **Quasi circular 66 degrees inclined orbit with TOPEX POSEIDON mission - NASA / CNES**

Customer	Auxiliary Payload	Mass	Mission
♦ **KAIST** (Korean Institute)	KITSAT-A	50 kg	Store and forward satellite for medical communications in the Healthnet network of Satelife
♦ **CNES** (France)	S 80 / T	50 kg	Study use of VHF band for mobile communications

September 1993 ASAP n° 4 Sunsynchronous circular orbit 822 km with SPOT 3 mission - CNES - Mission SPOT 3-CNES

Customer	Auxiliary Payload	Mass	Mission
♦ **SSTL (UK) Satelife (USA)**	HEALTHSAT-1	50 kg	Store and forward satellite for medical communications in the Healthnet network of Satelife
♦ **KAIST** (Korean Institute)	KITSAT B	50 kg	Store and forward communications earth imaging, digital signal processing and radiation measurement
♦ **INTERFEROMETRICS for Associazione Radioamatori Italiani (Italy)**	ITAMSAT	12 kg	Store and forward satellite for Amateur Radio
♦ **Consorcio PO-SAT / L NETI (Portugal)**	POSAT	50 kg	Technology development and educational application
♦ **INTERFEROMETRICS (USA)**	EYESAT	12.5 kg	Store and forward satellite for digital data

June 1994 ASAP n° 5 GTO mission (299 km / 35937 km / 7.01°) with INTELSAT 702

Customer	Auxiliary Payload	Mass	Mission
♦ **UK Defense Research Agency - DRA**	STRV 1A	50 kg	GTO environment evaluation and scientific experiments
	STRV 1B	53 kg	Technology qualification and scientific experiments

Customer	Auxiliary Payload	Mass	Mission
♦ UPM (Universidad Politecnica de Madrid) - Spain	UPM/SAT 1	47 kg	Microgravity and telecommunication experiments
♦ CNES for DEM (France)	CERISE	50 kg	Telecommunication and technological concept qualification

APPENDIX 1

Safety Submission
Phase 1

The User prepares a file containing all the documents necessary to inform CSG of his plans with respect to hazardous systems.

This file contains a description of the hazardous systems. It responds to all questions on the hazardous items check list given in the document CSG Safety Regulations ed.3 V2F3, and summarized here below.

1 ELECTRO-PYROTECHNIC DEVICES

1.1 Category-B igniters (for operations which are not hazardous)
1.2 Location
1.3 Function
1.4 Type and manufacturer
1.5 Production serial number
1.6 Bridge resistance
1.7 No-fire current
1.8 All fire current
1.9 Firing current
1.10 Selected firing current
1.11 Checkout current
1.12 Probabilities associated to those currents and confidence level
1.13 Time required for installation on spacecraft
1.14 Location in spacecraft
1.15 Radio-sensitivity characteristics
1.16 Electrostatic sensitivity characteristics
1.17 Electrical initiation and control circuits

2 LIQUID PROPELLANTS

2.1 Does the payload and/or associated ground equipment contain hazardous fluids ? If so, indicate quantities and specifications.

2.2 Description of the propulsion system

2.3 Location and operating procedures

3 PRESSURE VESSELS

3.1 Nature of fluids - Pressure

3.2 Tanks :
- Type and manufacturer
- Structure
- Safety factor
- Qualification and acceptance tests

3.3 Associated ground support equipment

4 BATTERIES

4.1 Type of batteries - Description
4.2 Do they contain hazardous fluids ?
4.3 **Charge**

5 RADIATION

5.1 Non-ionising radiations
- Antennas : locations, direction and characteristics
- Radiation power, spectrum of frequencies, schedules and places of emission
- Safety devices

5.2 Ionising radiations
- Do the spacecraft or associated ground equipment transmit ionising radiations ?
- Type of radiation, activity, foreseeable exposition, venting (radioactive gas)
- Operations and safety regulations.

6 INTERFACE

6.1 Mechanical interfaces

Detailed description of the mechanical interface of the payload

6.2 Electrical interfaces

- Detailed description of the electrical interface between the launcher (adapter) and the payload ; separation devices, monitoring means, safety devices (separation switches).

- Detailed description of the electrical interface between the launch tower and the payload :

  - Preparation and test equipment
  - Operations (arming, battery charge, ...)
  - List of voltages and currents on the umbilical cable conductors at the moment of plug release.

6.3 Umbilicals

Type and number

7 MISCELLANEOUS

7.1 Are the CSG Safety Regulations complied with ?

7.2 Is any waiver requested ?

7.3 Other safety problems not so far dealt with.