MGSE

Standard Range 200

Quality First

Established in Switzerland in 1992, APCO Technologies is a project-oriented company specialized in heavy machinery for the SPACE, ENERGY, and INDUSTRY sectors. To date, the company has known a continuing growth.

This success is notably due to our stringent quality policy at every scale of the projects which are entrusted to us.

Our strategy is defined as:

- Meeting the customer requirements, be formulated or not.
- Developing a strong corporate culture which allows our collaborators to work and thrive in the best conditions.
- Keeping a step ahead in terms of innovation.

Certifications

- **EN 9100 :** Quality Management Systems – Requirements for Aviation, Space and Defense Organizations
- **ISO 9001 :** Quality Management
- **ISO 14001 :** Environmental Management
- **ISO 27001 :** Information Security Management
- **OSHAS 18001 :** Occupational Health and Safety Management
- **Airbus DS IPCA :** Industrial Process Control Assessment

25 Years of Experience

Since its very creation in 1992, APCO Technologies has provided MGSE for space industry, starting with Ariane 4 containers.

Since then, the company has steadily expanded its experience, expertise and resources to be able today to propose tailored ground support solutions and rise to new challenges.

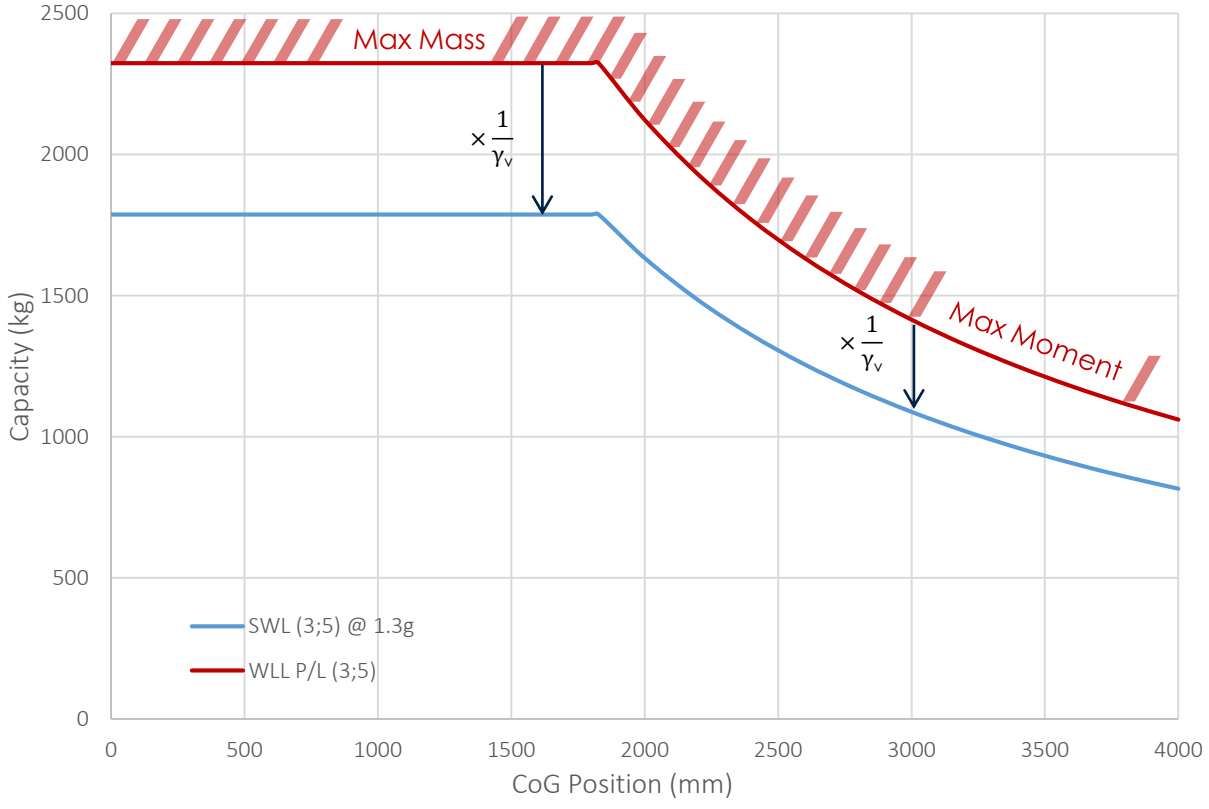
Besides specific requests, APCO Technologies has become an expert in developing satellite transport, lifting and handling equipment as well as adapters allowing test activities.

Orion Service Module, Sandusky, Ohio US

AlphaBus MPT


Sentinel-2B, CSG, Kourou

Mass & Balance Diagram Description 1/3



WLL & SWL (1/2)

Mass & Balance diagrams describe the range of application for each AT family.

In this document is given WLL (Working Load Limits), which is the maximum mass capacity at 1g vertical acceleration for payload or spacecraft (gravity only) a range or MGSE can support.

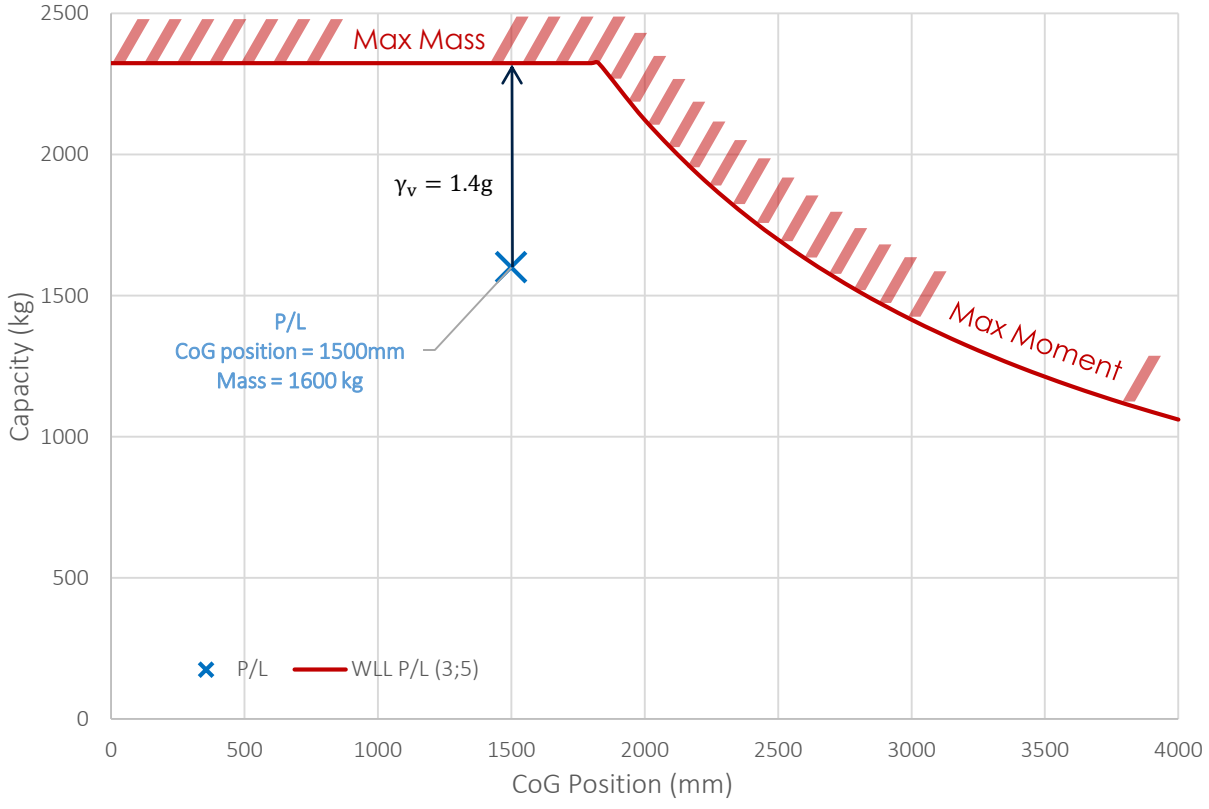
The SWL (Safe Working Load) is the admissible P/L or S/C mass capacity, at a given CoG, with a safety margin to the WLL, expressed in admissible vertical acceleration factor (γ_v).

$$\gamma_v = \frac{WLL}{SWL}$$

On the adjacent diagram, the vertical acceleration factor is 1.3g. This means if your S/C is on the blue curve, it has a vertical acceleration margin of +1.3g.

In most cases, WLL for each AT family is given for specific lateral acceleration factors (γ_{lat}).

Mass & Balance Diagram Description 2/3



WLL & SWL (2/2)

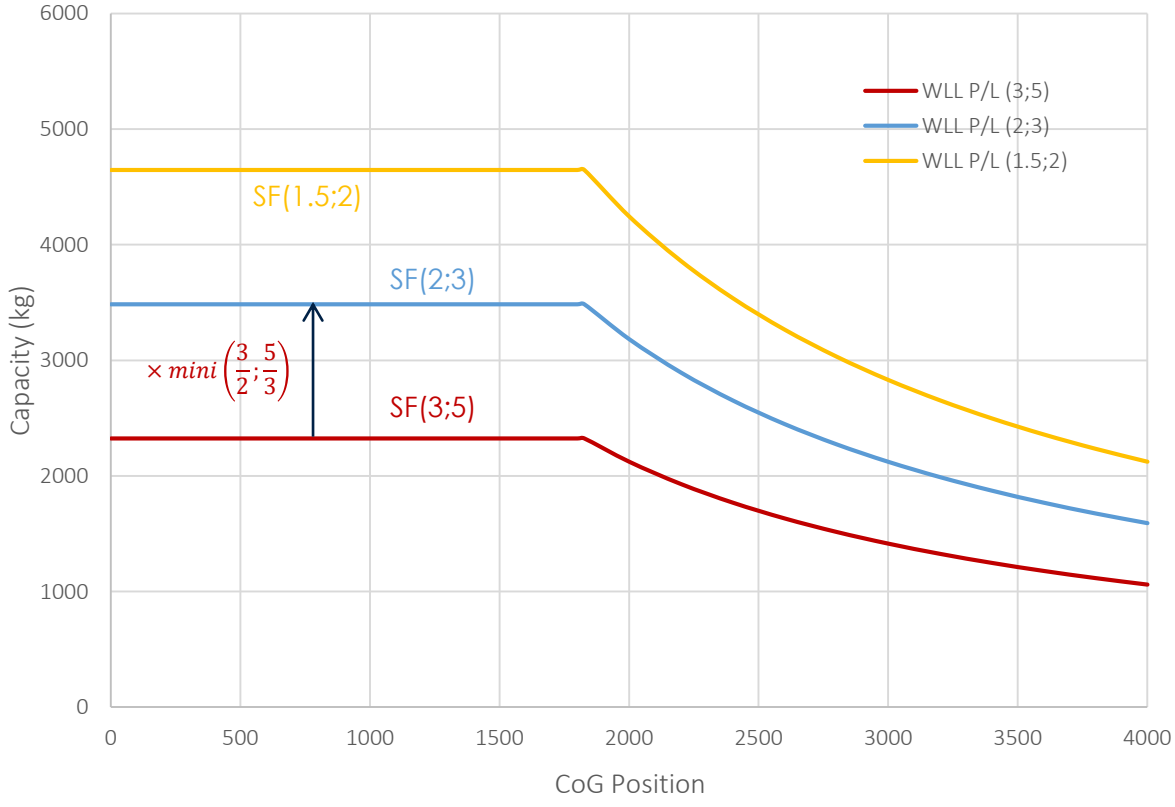
According to P/L position on the diagram (Mass & CoG), it is therefore possible to extract admissible acceleration factors (γ_v et γ_{lat}).

In this example, the payload SWL (CoG ; Mass) has been entered in the diagram.

This payload is under the WLL of the equipment, thus it is compatible in terms of mass & balance.

The vertical margin between the WLL and the P/L dot gives the admissible vertical acceleration factor. In this example, γ_v is +1.4g.

Mass & Balance Diagram Description 3/3



Safety Factors

For the purpose of harmonisation, WLL in this document are given in most cases with the following safety factors:

- SFy (Yield): 3
- SFu (Ultimate): 5

However, it is simple to extract a new WLL (2) associated with different safety factors by multiplying the initial WLL (1) by the minimum ratio $\left(\frac{SFy\_1}{SFy\_2};\frac{SFu\_1}{SFu\_2}\right)$.

Inside a range, safety factors associated with test adapters such as VTA, TTA and PPA can differ from the general safety factors.

Eigen Frequency

Minimal Eigen frequencies curves are determined for each VTA (Vibration Test Adapter) according to S/C WLL for each AT family.

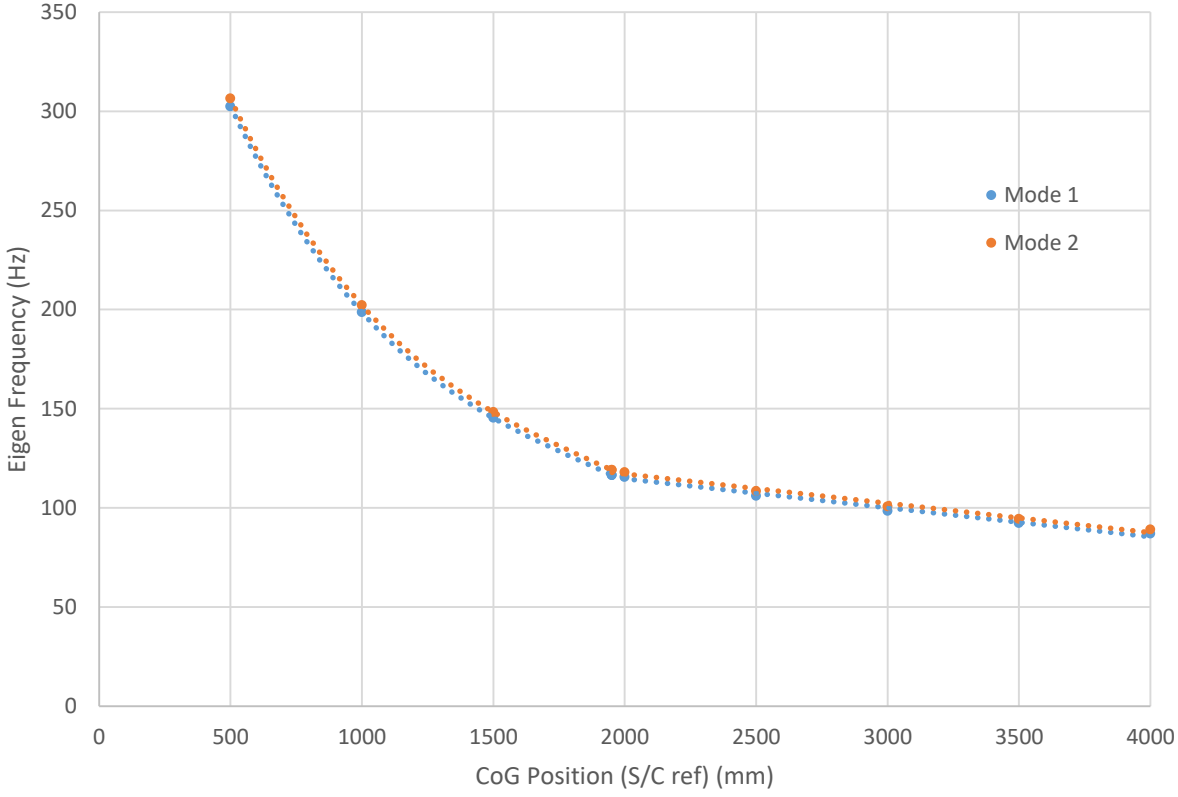
Minimum Eigen frequencies are provided for mode 1, 2 and 3 and for each attachment I/F with the test machine (if several are available).

To obtain the Eigen frequency of a VTA, whatever the mode, with S/C Mass and CoG position known :

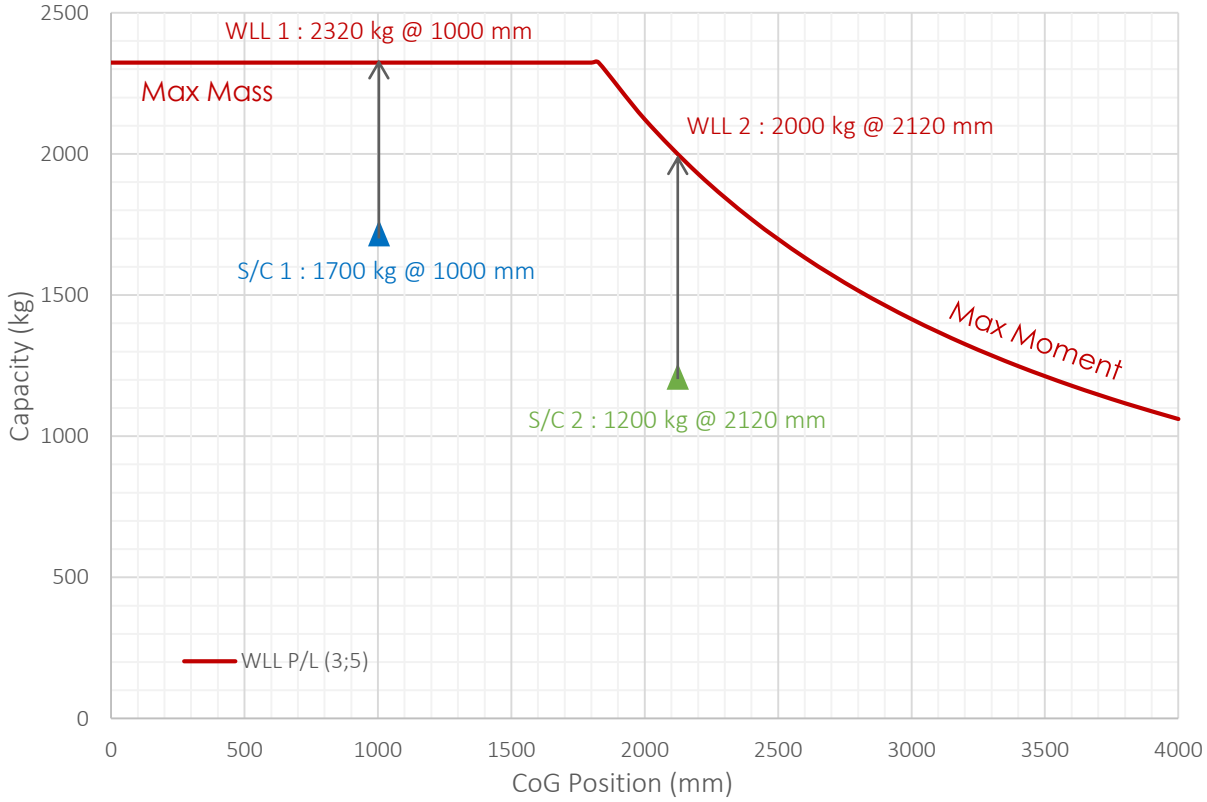
$$Fp_{SWL\,S/C} = Fp_{WWL\,S/C} \times \sqrt{\frac{WLL\,S/C}{SWL\,S/C}}$$

Avec: $\frac{WLL\,S/C}{SWL\,S/C} = \gamma_v$

Maximum CoG excentricity with respect to the S/C longitudinal axis will be given for each diagram.



VTA Admissible Accelerations



Launch Accelerations

Accelerations given in the Vibration Test Adaptor (VTA) characteristics are the minimum real accelerations that can be supported by the VTA at the S/C WLL for each boundary conditions, if there are several.

Given the conduct of vibration tests, accelerations are given by pair : one limit vertical acceleration coupled with one limit lateral acceleration for each test, and each boundary conditions.

Limit accelerations specific to a load, which mass and balance are known, can be obtained by multiplying the accelerations given for the WLL by the ratio $\left(\frac{WLL}{SWL}\right)$ for the same CoG position.

Example: If the limit accelerations for the vertical vibration test at WLL are ($a_{vertical} = \pm 9g$; $a_{lateral} = \pm\ 1.5g$)

Point 1 :
$\frac{WLL}{SWL} = 1.36 \rightarrow\ a_{vertical} = \pm 12.2g$; $a_{lateral} = \pm 2.0g$

Point 2 :
$\frac{WLL}{SWL} = 1.67 \rightarrow\ a_{vertical} = \pm 15.0g$; $a_{lateral} = \pm 2.5g$

Range Characteristics

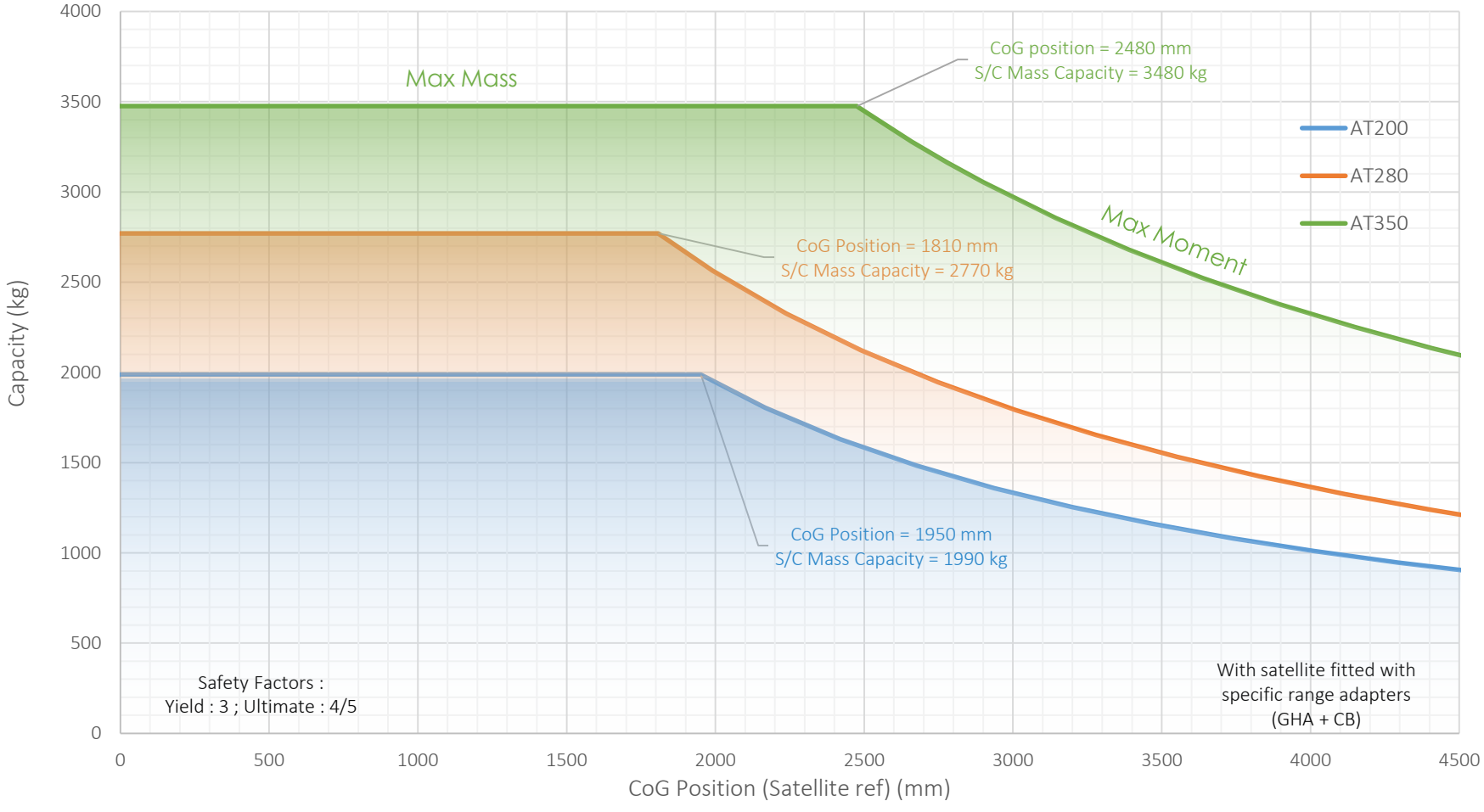
		AT200	*AT280*	*AT350*
S/C Envelop HxØ (mm)		5400 x 3240	5800 x 3300	6200 x 4000
S/C Interface		LIR Ariane 5 1194 C	LIR Ariane 5 1194 C	LIR PSA 1666 MVS
S/C Mass & Balance		See AT Range Performances		
General Design Safety Factors	Yield	3	3	3
	Ultimate	5	5	4
Test Adapters Safety Factors	Yield	2	2	2
	Ultimate	3	3	3

*Available MGSE**

Type	*Acronym*	*AT200*	*AT280*	*AT350*
Storage and Transport Container	*STC*	*AT200-STC*	/	/
Hoisting Device	*HD*	*AT200-HD*	*AT280-HD*	/
Multi-Purpose Trolley	*MPT*	*AT200-MPT*	*AT280-MPT*	*AT350-MPT*
Vertical Integration Stand	*VIS*	*AT200-VIS*	/	*AT350-VIS*
Ground Handling Adapter	*GHA*	*AT200-GHA*	*AT280-GHA*	*AT350-GHA*
Thermal Test Adapter	*TTA*	*AT200-TTA*	/	/
Vibration Test Adapter	*VTA*	*AT200-VTA*	/	*AT350-VTA*
Physical Propreties Adapter	*PPA*	*AT200-PPA*	/	/
Clamp Band	*CB*	*AT200-CB*	*AT280-CB*	*AT350-CB*

*Existing ranges are currently being completed

AT RANGE PERFORMANCES



MGSE RANGE 200 – S/C & RANGE CHARACTERISTICS

S/C Limiting Characteristics

Envelop Dimensions (HxØ)	5400 x 3240	mm
Maximum S/C WLL*	1990	kg
Mass & Balance	See Mass & Balance Diagram	
Interfaces	- LIR Ariane 5 1194 C - Lifting brackets for hoisting	

*With Safety Factors (3;5)

Range 200 Description

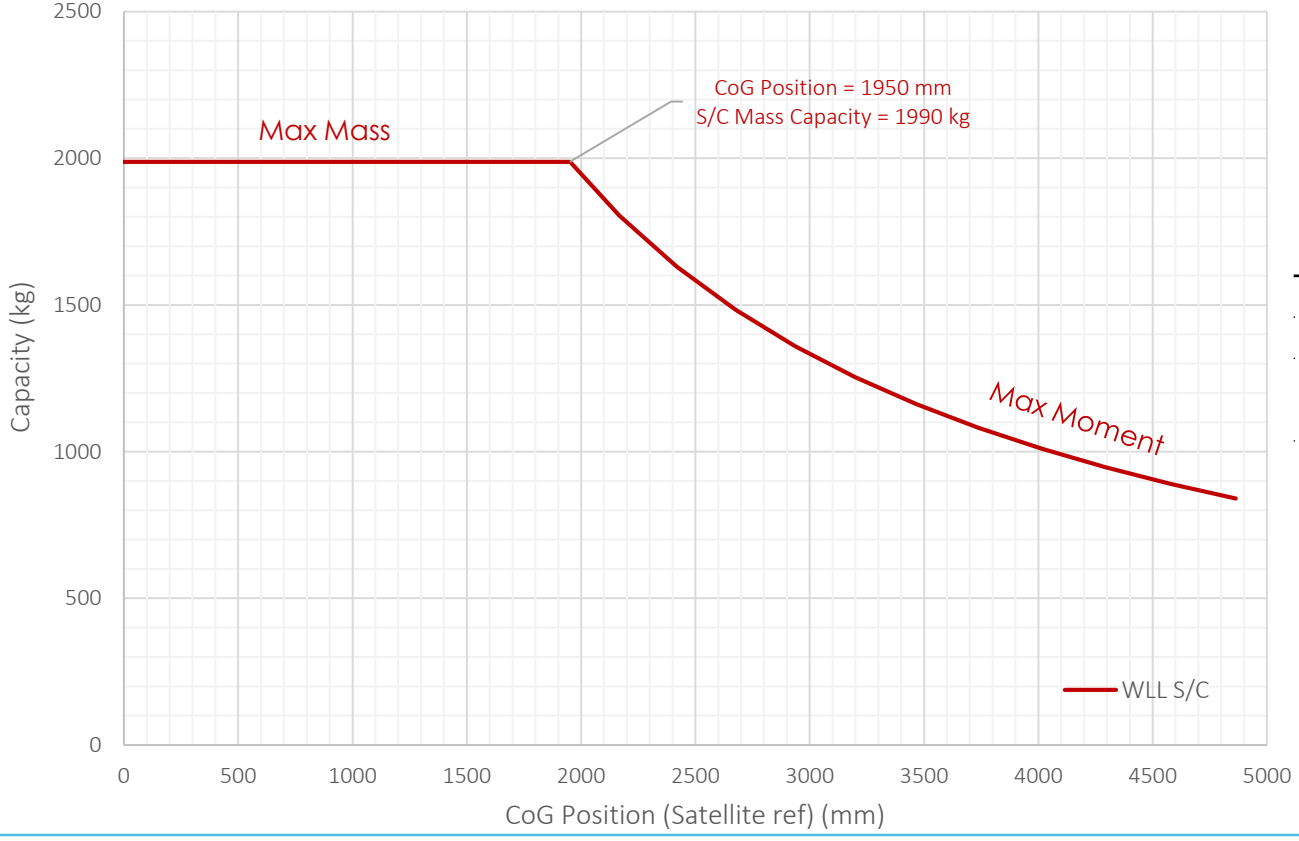
AT200 is a proven and complete range of small S/C transport, lifting and handling equipment, as well as adapters allowing integration and test activities.

Heritage

Sentinel-1, Sentinel-2, Sentinel-6, Eurostar 3000, ExoMars

Type	Acronym	Ref
Storage and Transport Container	*STC*	*AT200-STC*
Hoisting Device	*HD*	*AT200-HD*
Multi-Purpose Trolley	*MPT*	*AT200-MPT*
Vertical Integration Stand	*VIS*	*AT200-VIS*
Ground Handling Adapter	*GHA*	*AT200-GHA*
Thermal Test Adapter	*TTA*	*AT200-TTA*
Vibration Test Adapter	*VTA*	*AT200-VTA*
Physical Properties Adapter	*PPA*	*AT200-PPA*
Clamp Band	*CB*	*AT200-CB*

MASS & BALANCE FOR S/C IN RANGE 200

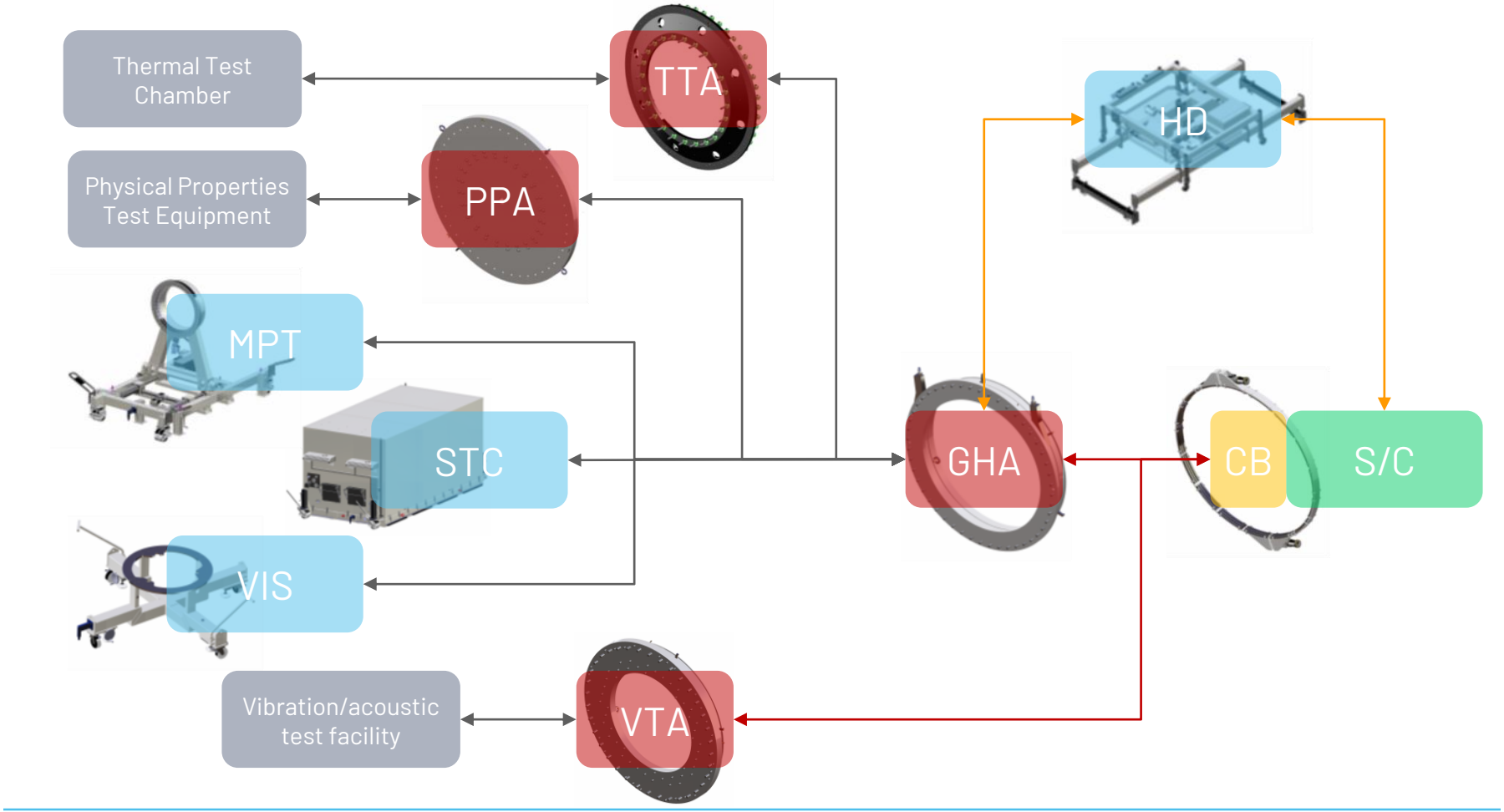


Characteristics

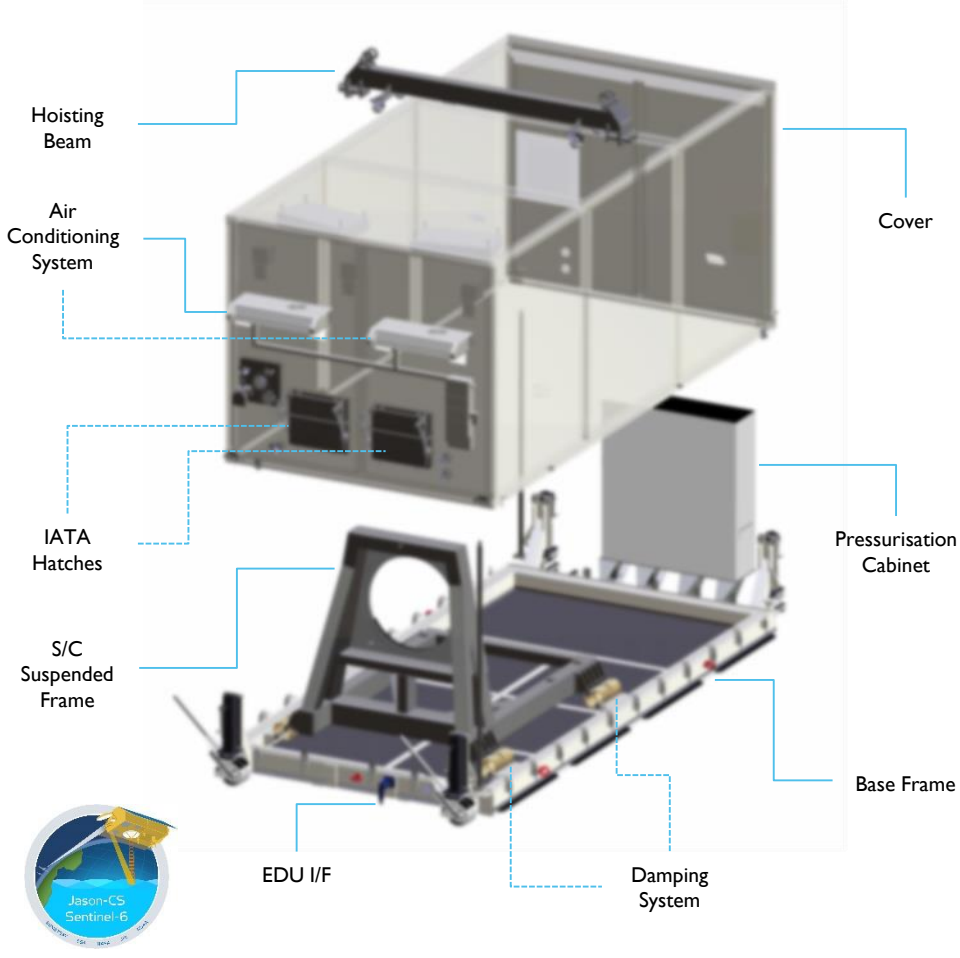
Lateral Accelerations	± 0.5 g	
Vertical Acceleration	1 g	
Safety Factors	Yield	3
	Ultimate	5

Satellite fitted with AT200-GHA and AT200-CB

MGSE RANGE 200 - DESCRIPTION



AT200 – Storage and Transport Container (STC)



Physical Characteristics

Dimensions (LxWxH)	Transport	8610 x 3760 x 3453			mm
	On jacks	8610 x 3760 x 3800			mm
Net Mass (without counterweights)		9420			kg
Allowable Volume (LxWxH)		5226 x 2666 x 2548			mm
Safety Factors	Yield	3	Load Factors	Static	2
	Ultimate	5		Drop Test	1
Adapters I/F		48 x M16 threaded holes on a Ø1260 mm circle pattern			

Performances (1g vertical and ±0.5g lateral accelerations)

Payload WLL			1910	kg
S/C Max mass (with AT200-GHA & AT200-CB)			1785	kg
Quasi-Static Load Factors (g)	Longitudinal	Transversal	Vertical (gravity included)	
	± 0.707	± 0.707	± 1.8	

Operational Characteristics

Pressurisation System			GN2, (5;10) mbar overpressure
Air Conditioning System			(+10 ; +30) °C
Monitoring Systems		Shock	Temp/Hu/P
Facility Handling		EDU	Tow bar
Transport	Road	Air	Sea
	yes	yes	yes
Environnement Specifications		ISO 8	IATA Compatible
MGSE Compatibility			AT200-GHA
Damping System			Made to Measure

AT200 – Storage and Transport Container (STC)

AT200 - Hoisting Device (HD)

Physical Characteristics

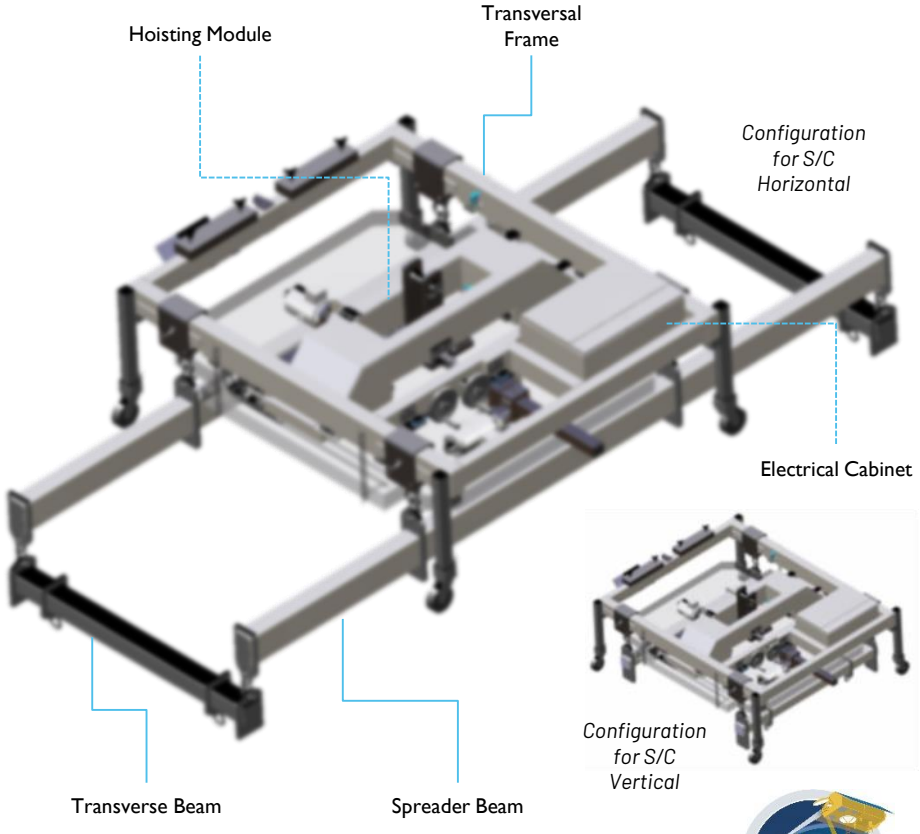
Dimensions (LxWxH)		2192 x 1754 x 917			mm
Mass (without beams)		650			kg
Safety Factors	Yield	3	Load Factors	Static	2
	Ultimate	5		Dynamic	1
Adapters I/F	- On AT200-GHA Lifting Brackets and S/C in horizontal position - On S/C in vertical position				

Performances (1g vertical and 0.1g lateral accelerations)

Payload WLL		2323	kg

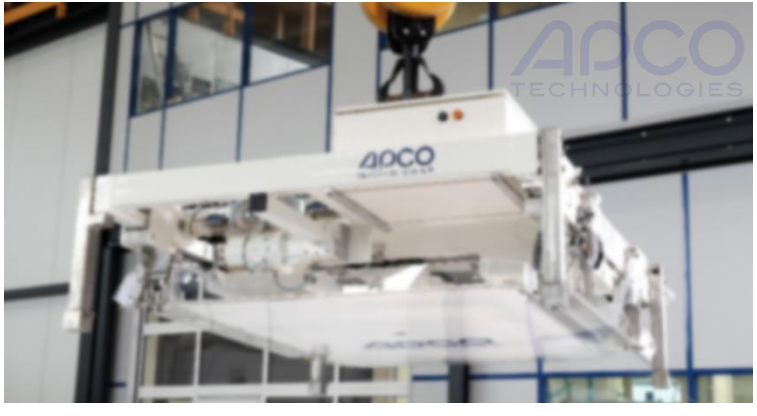
Operational Characteristics

Motion Mode		Electrical and manual
Type of Mouvement		Cartesian (X,Y)
Mouvement Range	X	± 200 mm
	Y	± 200 mm
CoG Compensation		Yes
Environnement Specifications		ISO 8
MGSE Compatibility		AT200-GHA
Spreader / Transverse Beams		Made to measure



sentinel-1 sentinel-3

AT200 - HOISTING DEVICE (HD)



AT200 - Multi-Purpose Trolley (MPT)

Configuration for S/C Vertical

Configuration for S/C Horizontal

Physical Characteristics

Dimensions (LxWxH)	0°	4750 x 3715 x 1006			mm
	90°	4454 x 3715 x 3385			mm
Mass		3805			kg
Allowable Volume (Ø)		3240			mm
Safety Factors	Yield	3	Load Factors	Static	2
	Ultimate	5		Dynamic	1.1
Adapters I/F	48 x M16 threaded holes on a Ø1260 mm circle pattern				

Performances (1g vertical and ±0.5g lateral accelerations)

See AT200-MPT Mass and Balance Diagram

Operational Characteristics

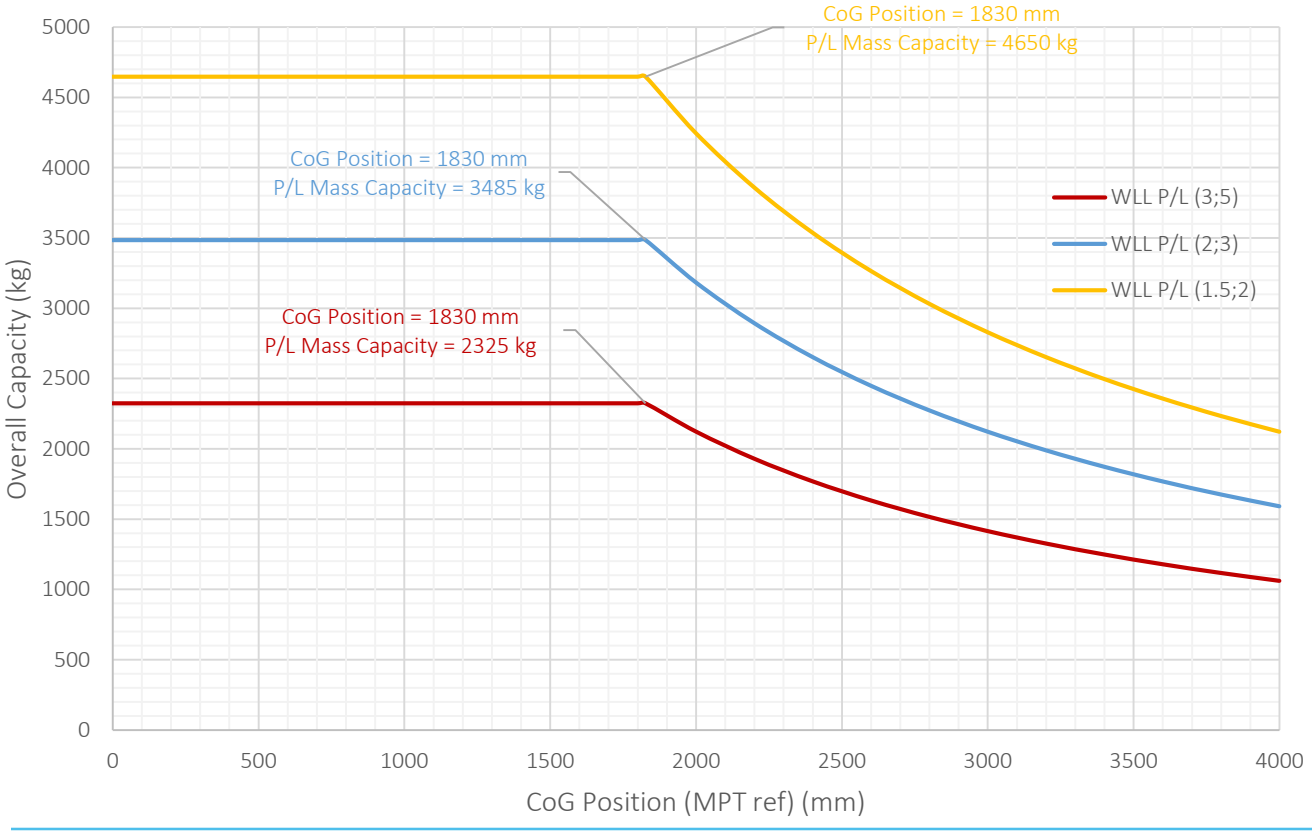
Motion mode			Electrical
Number of Jacks			5
Satellite Access			Possible under the Crown Wheel
Mouvements	Tilting	Rotation	Translation
	0-90°	360°	/
Facility Handling	Forklift	EDU	Tow bar
Environnement Specifications		ISO 8	Non-ATEX
MGSE Compatibility		AT200-GHA	AT200-TTA

sentinel-1 sentinel-3 Jason-CS Sentinel-6 exomars

EUROSTAR 3000

AT200 - Multi-Purpose Trolley (MPT)

AT200-MPT MASS & BALANCE ABSOLUTE CAPACITY

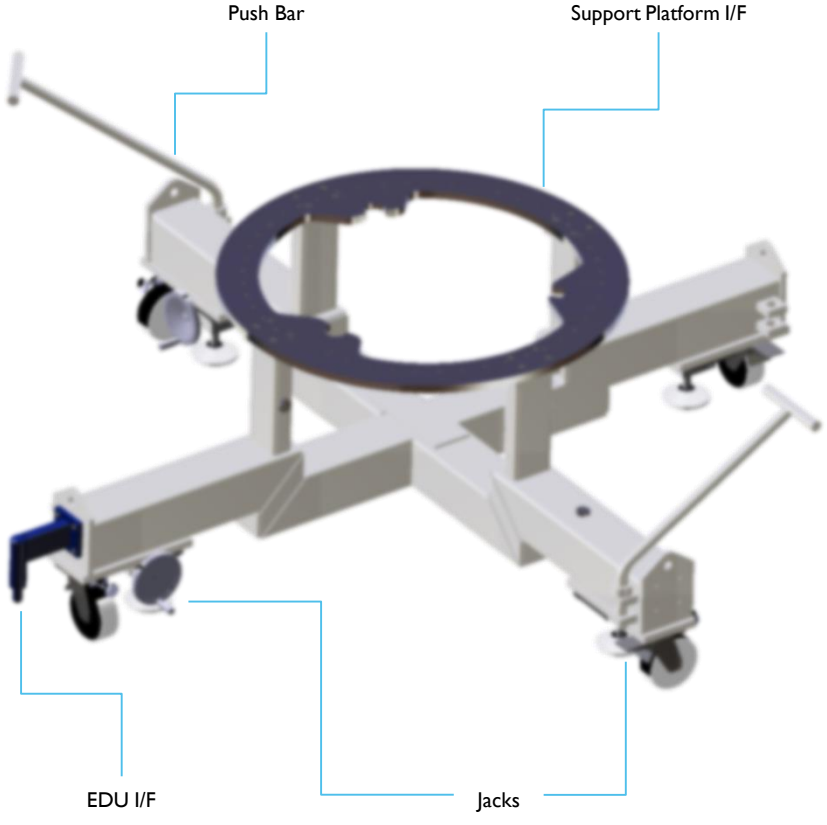


Characteristics

Lateral Accelerations	± 0.5 g			
Vertical Acceleration	1 g			
Safety Factors	Yield	1.5	2	3
	Ultimate	2	3	5

With Mass & Balance of the entire payload

AT200 - Vertical Integration Stand (VIS)



Physical Characteristics

Dimensions (LxWxH)		3040 x 3040 x 960			mm
Mass		820			kg
Allowable Volume (Ø)		3240			mm
Safety Factors	Yield	3	Load Factors	Static	2
	Ultimate	5		Dynamic	/
Adapters I/F	48 x M16 threaded holes on a Ø1260 mm circle pattern				

Performances (1g vertical and ±0.5g lateral accelerations)

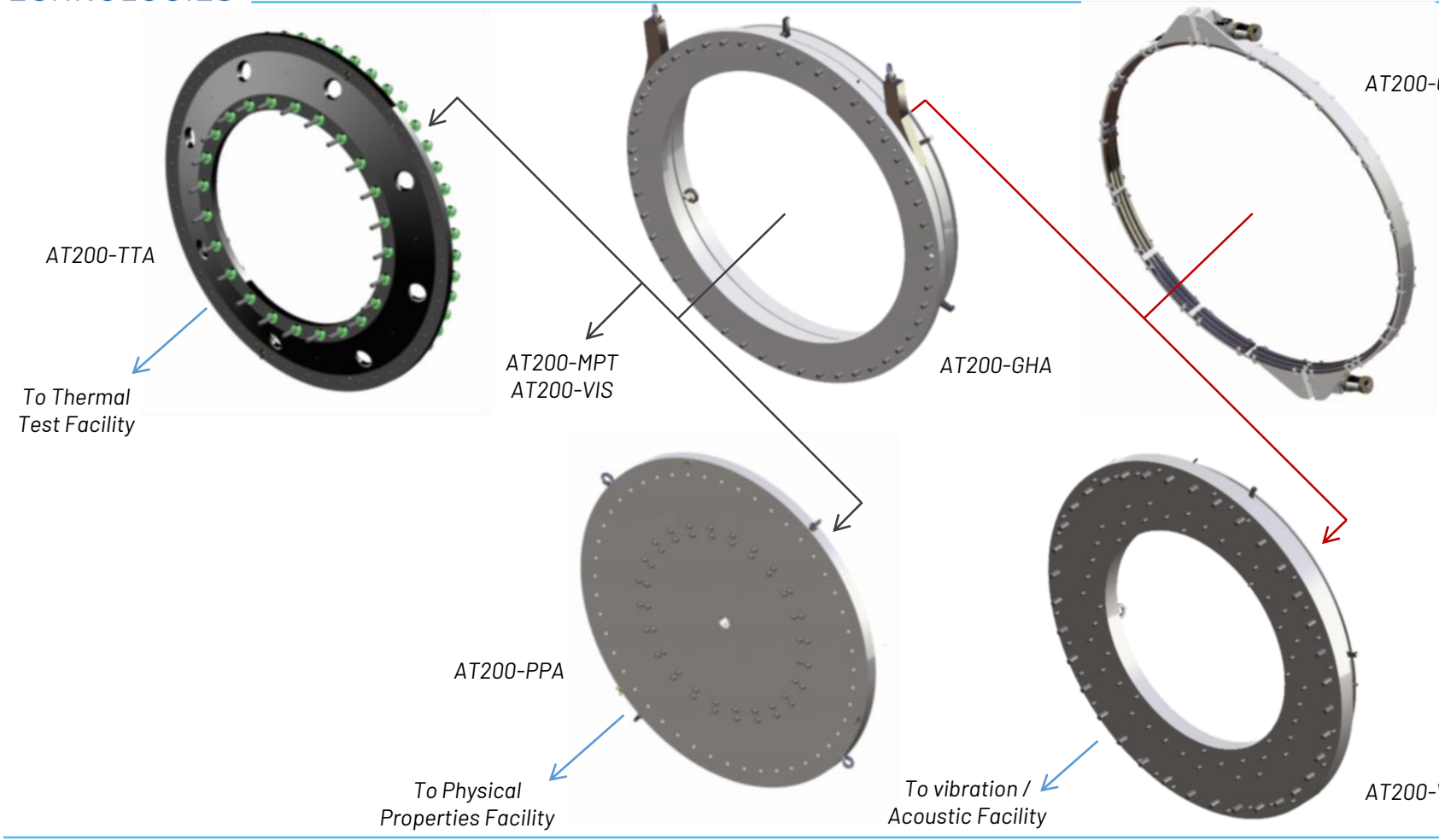
See Mass & Balance Diagram in Range 200

Operational Characteristics

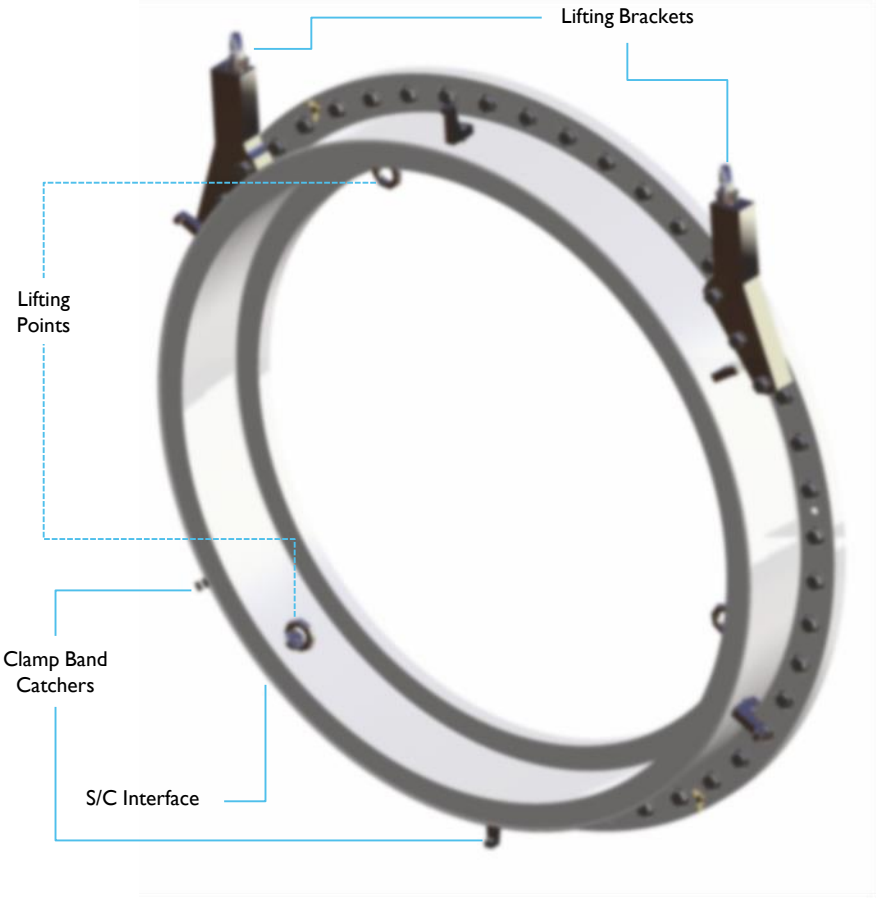
Number of Jacks / Wheels		4
Facility Handling	EDU	Push bar
Environnement Specifications	ISO 8	Hydrazine OK
MGSE Compatibility		AT200-GHA

AT200 - VERTICAL INTEGRATION STAND (VIS)

AT200 - ADAPTERS



AT200 - Ground Handling Adapter (GHA)



Physical Characteristics

Dimensions (ØxH)			1330 x 180		mm
Mass			105		kg
Safety Factors	Yield	3	Load Factors	Static	2
	Ultimate	5		Dynamic	/

Performances

See Mass & Balance Diagram in Range 200

Environnement Specifications

ISO 8 — Thermal Vacuum Compatible

AT200 Compatibility & Interfaces

AT200-STC, AT200-MPT, AT200-VIS AT200-TTA, AT200-PPA	48 x M16 threaded holes on a Ø1260 mm circle pattern
AT200-HD	2 Lifting Brackets
AT200-CB	LIR Ariane 5 1194 C

AT200 - Ground Handling Adapter (GHA)

AT200 - Thermal Test Adapter (TTA)

Physical Characteristics

Dimensions (ØxH)			1330 x 100		mm
Mass			75		kg
Safety Factors	Yield	2	Load Factors	Static	1.5
	Ultimate	3		Dynamic	/

Performances

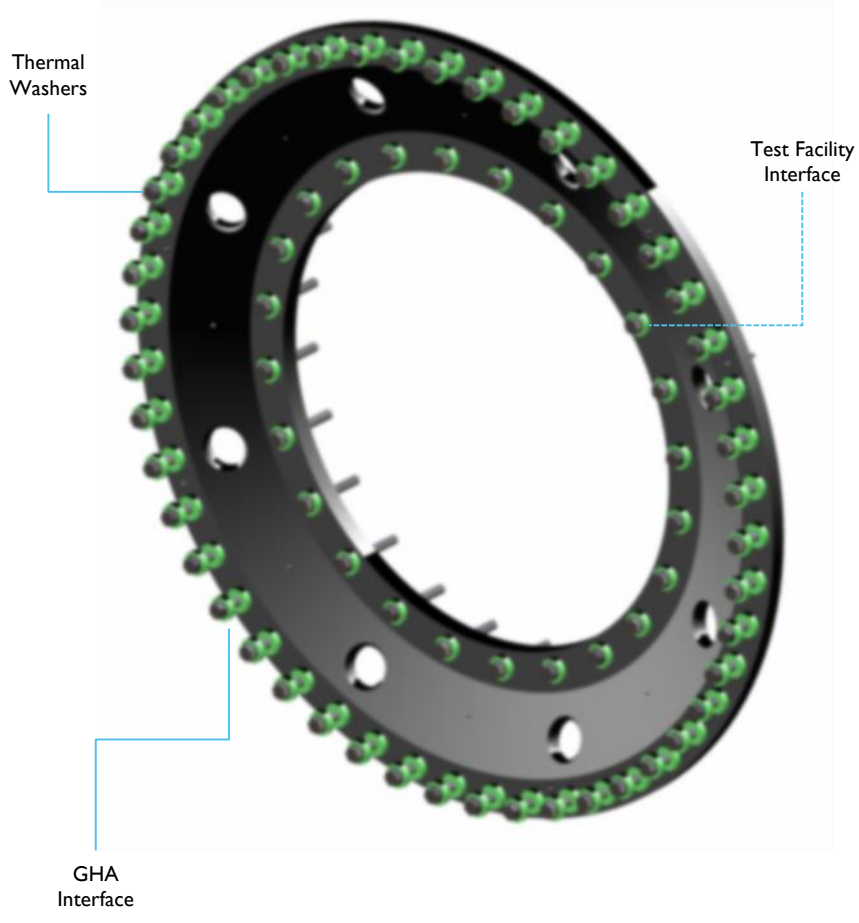
	See Mass & Balance Diagram in Range 200
Thermal Range	(-80;+80)°C

Environnement Specifications

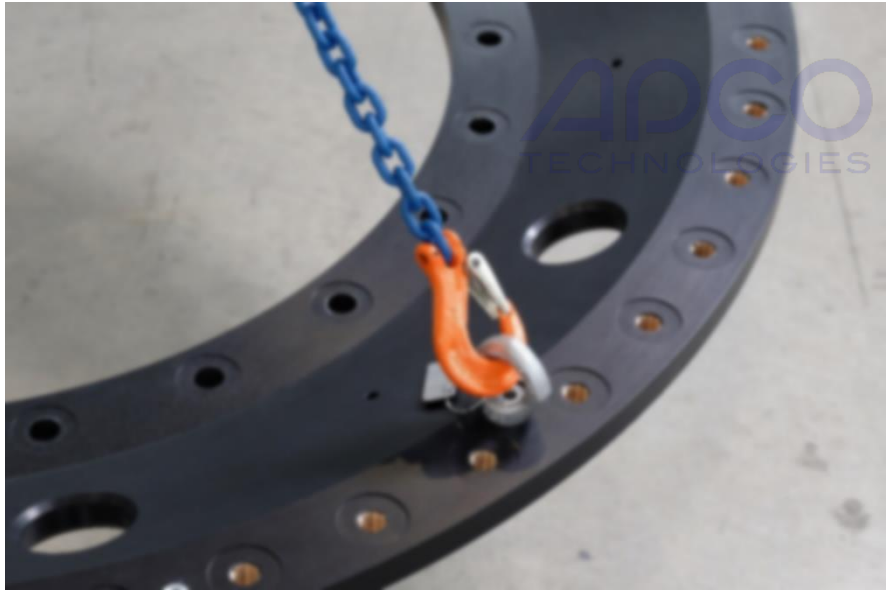
	ISO 8	Thermal Vacuum Compatible

AT200 Compatibility & Interfaces

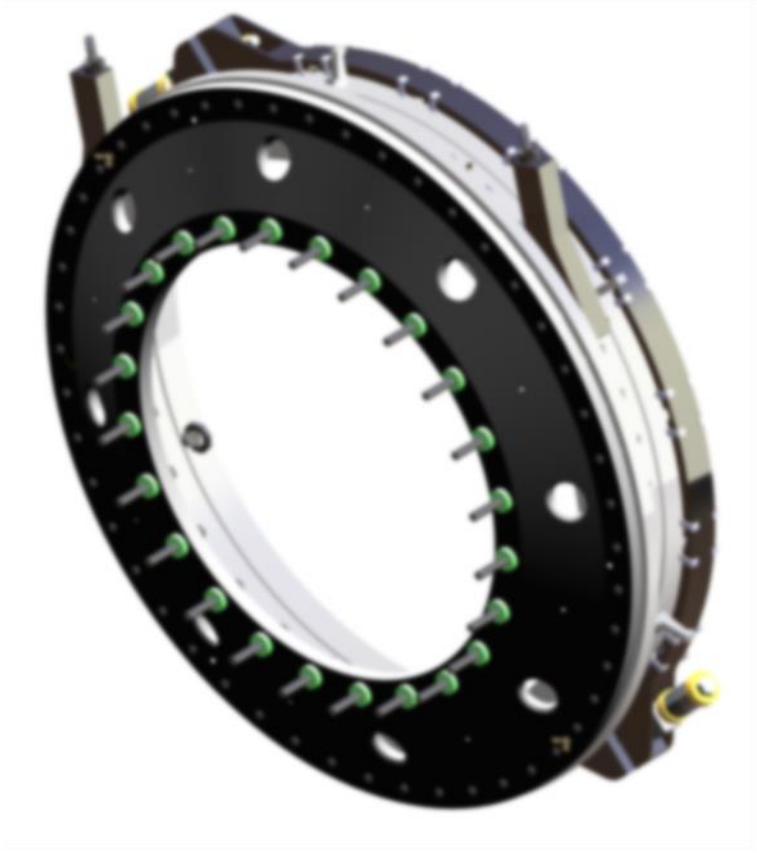
AT200-GHA	48 x M16 threaded holes on a Ø1260 mm circle pattern
Thermal Test Facility	24 x M16 through holes on a Ø860 mm circle pattern



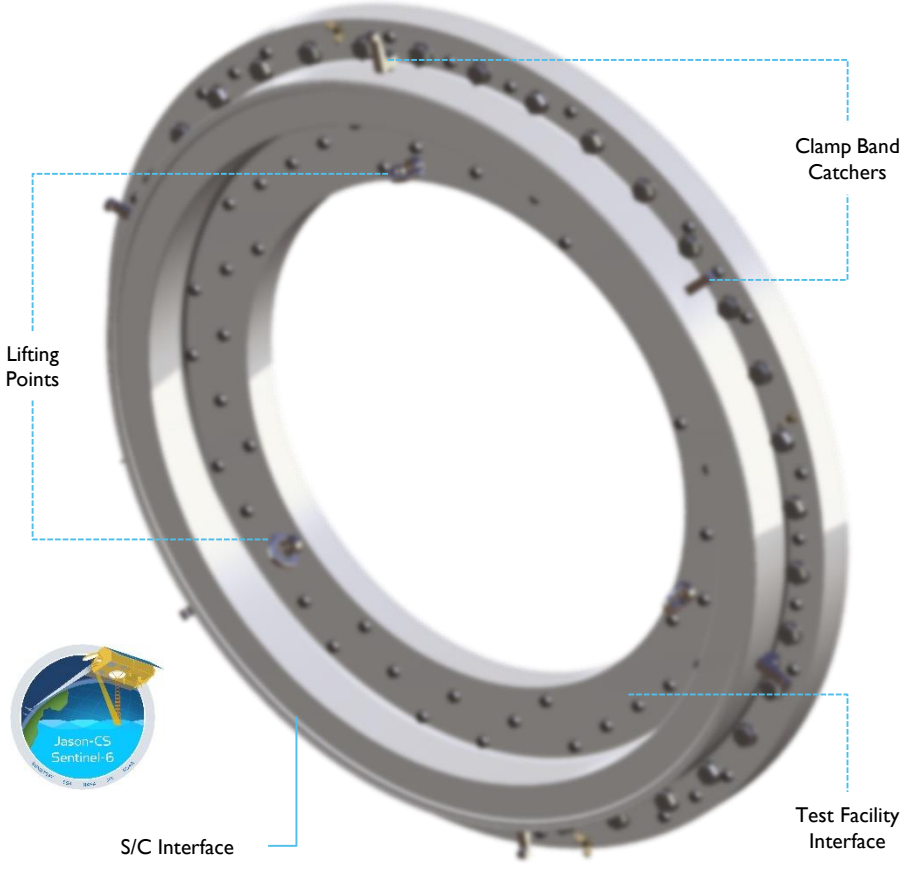
AT200 - THERMAL TEST ADAPTER (TTA)



ASSEMBLY AT200-CB / AT200-GHA / AT200-TTA



AT200 - Vibration Test Adapter (VTA)



Physical Characteristics

Dimensions (ØxH)			1340 x 149		mm
Mass			194		kg
Safety Factors	Yield	2	Load Factors	Static	2
	Ultimate	3		Dynamic	/

Performances

Eigen Frequency	See AT200 Eigen Frequency Diagram		
Boundary conditions		76M10	36M20
Vertical Test*	Vertical Acc	± 7.5 g	± 9.0 g
	Lateral Acc	± 1.3 g	± 1.5 g
Lateral Test*	Vertical Acc	± 4.4 g	± 5.3 g
	Lateral Acc	± 2.5 g	± 3 g
CoG position excentricity			100 mm

*Accelerations computed for WLL

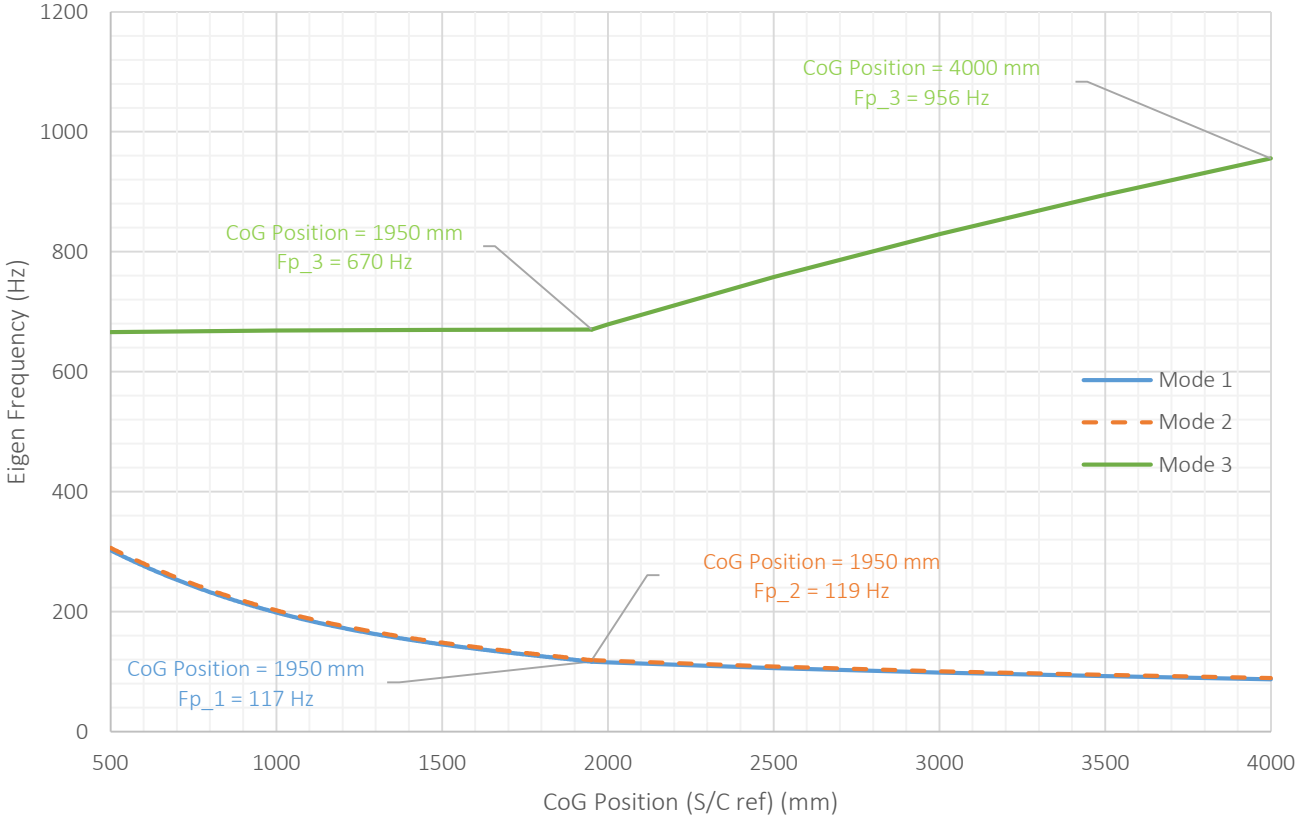
Environnement Specifications

ISO 8

Compatibility & Interfaces

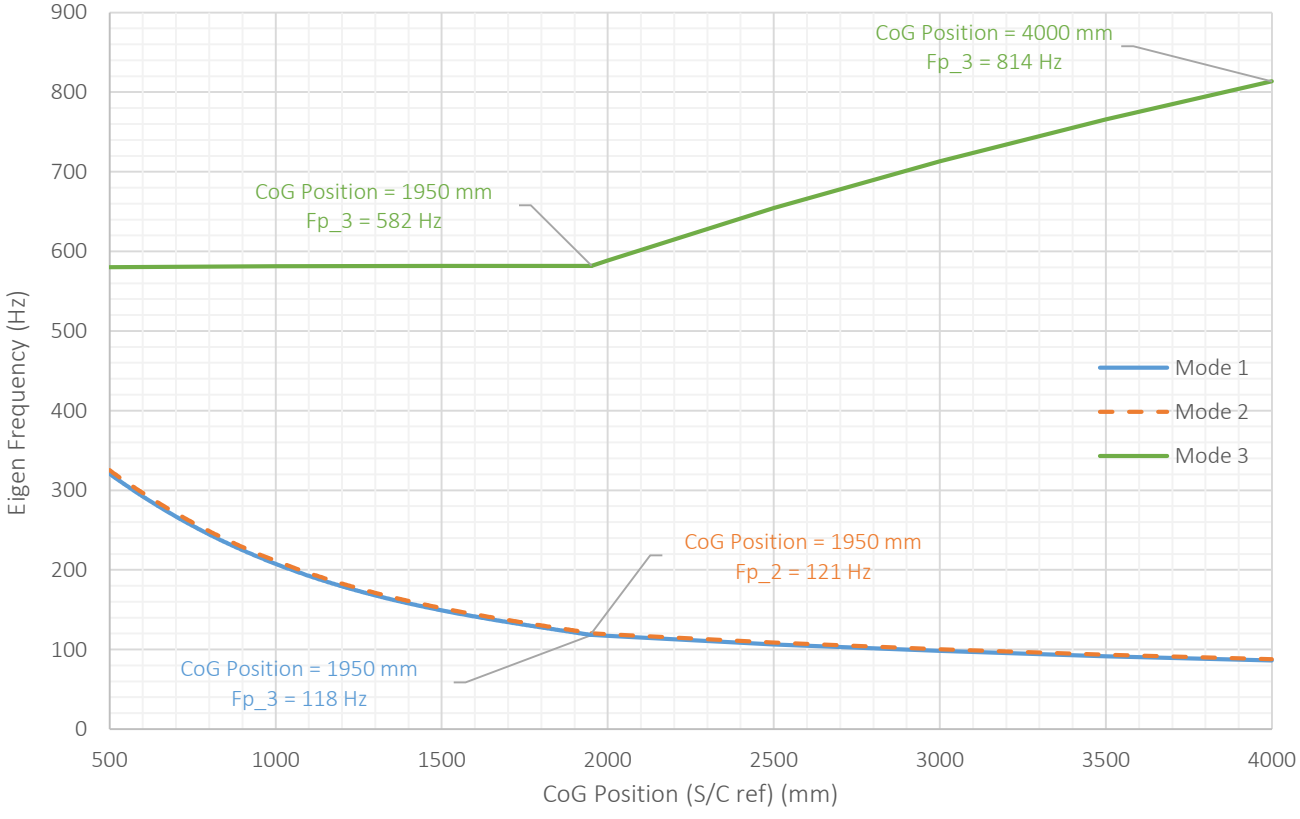
Vibration/Acoustic Test Facility	76 x M10 on a 80 mm square hole pattern 36 x M20 on a Ø1250 mm circle pattern
AT200-CB	LIR Ariane 5 1194 C

AT200-VTA EIGEN FREQUENCY DIAGRAM 1/2



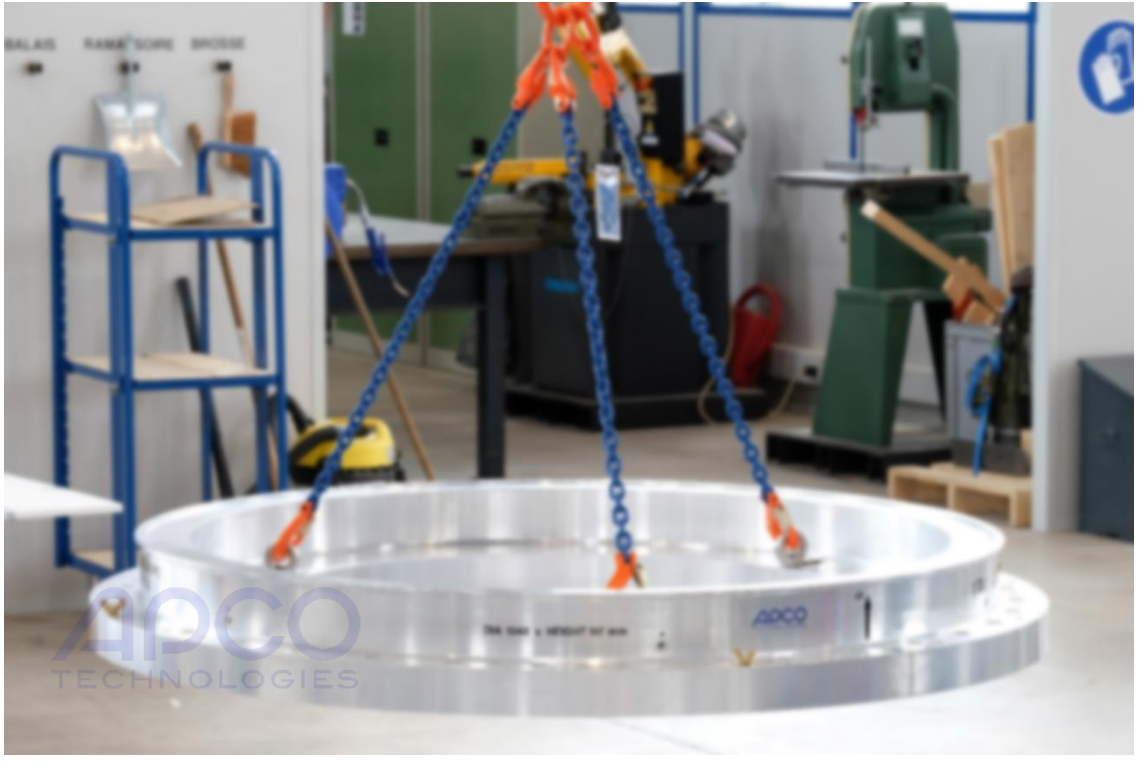
Characteristics		
Boundary conditions	76 x M10 on a 80 mm square hole pattern	
Safety Factors	Yield	2
	Ultimate	3
CoG position excentricity	22,6 mm	

AT200-VTA EIGEN FREQUENCY DIAGRAM 2/2



Characteristics

Boundary conditions	36 x M20 on a Ø1250 mm circle pattern	
Safety Factors	Yield	2
	Ultimate	3
CoG position excentricity	22,6 mm	



AT200 - Physical Properties Adapter (PPA)

Physical Characteristics

Dimensions (ØxH)			1400 x 50		mm
Mass			211		kg
Safety Factors	Yield	2	Load Factors	Static	1.5
	Ultimate	3		Dynamic	/

Performances

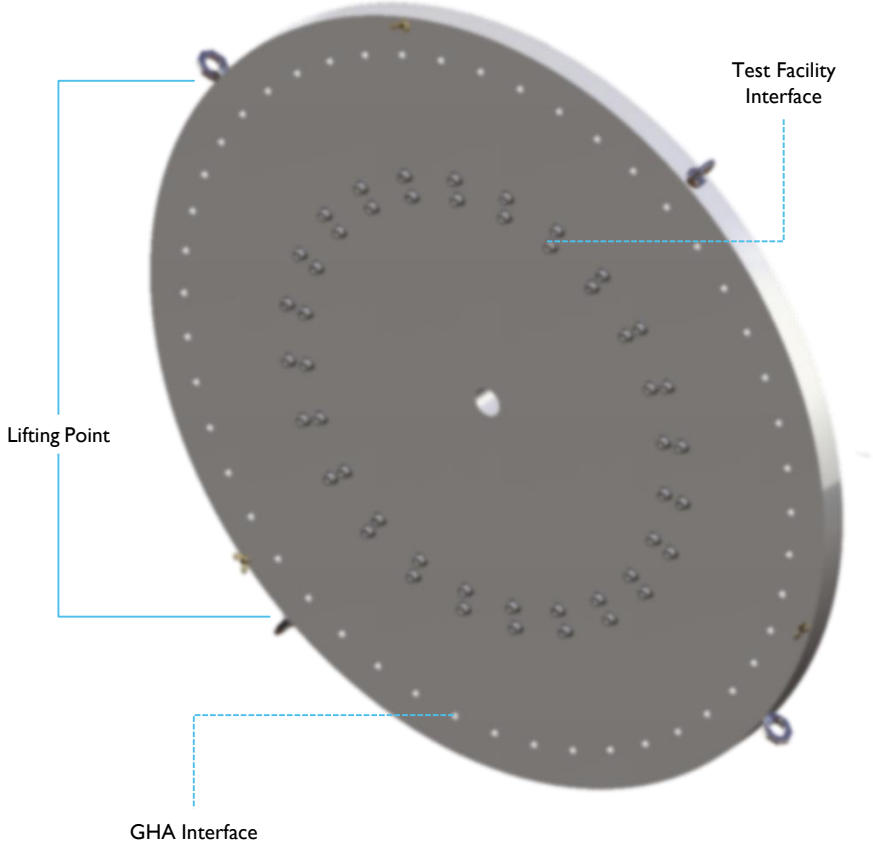
See Mass & Balance Diagram in Range 200

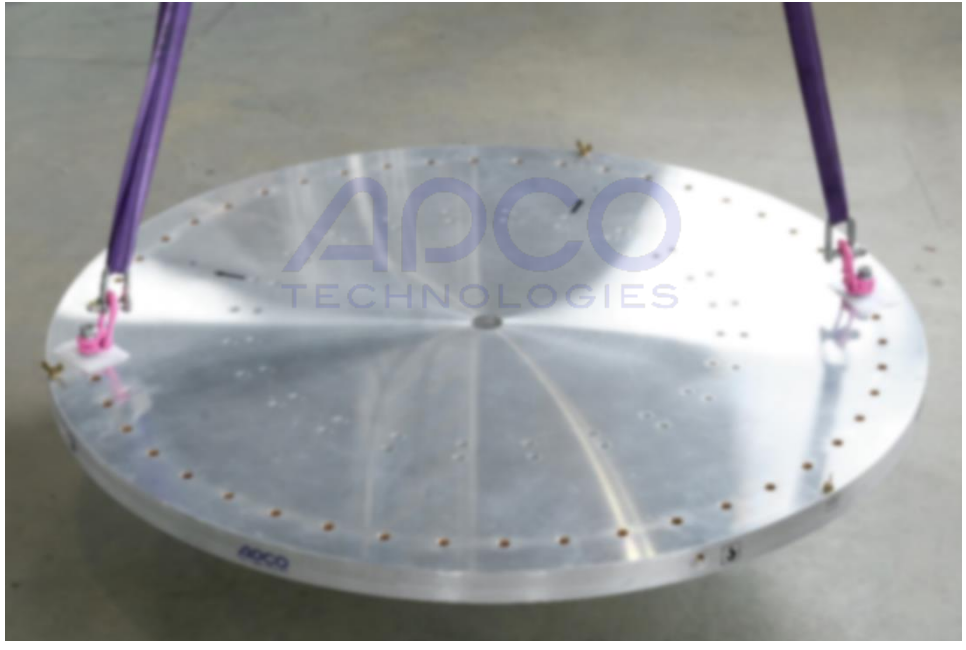
Environnement Specifications

ISO 8

AT200 Compatibility & Interfaces

AT200-GHA	48 x M16 threaded holes on a Ø1260 mm circle pattern
Physical Test Facility	2x 24 x M12 holes on Ø825/Ø750 mm





AT200 – Clamp Band (CB)

Physical Characteristics

Dimensions (ØxH)		1463 x 68	mm
Mass		24	kg
Safety Factors*	Yield	3	
	Ultimate	5	
Tension			Adapted to Payload and Use
Number of Bands / Tie Rods			2
Adapters Interface			Ariane 5 1194 C

*When coupled with adapters AT200-VTA/PPA/TTA → SF(2;3)

Performances

Handling (with GHA)	See Mass & Balance Diagram in Range 200
Vibration Tests (with VTA)	See VTA Performances

Operational Characteristics

Environnement Specifications		ISO 8
MGSE Compatibility	AT200-GHA	AT200-VTA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