MGSE

Standard Range 350

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.

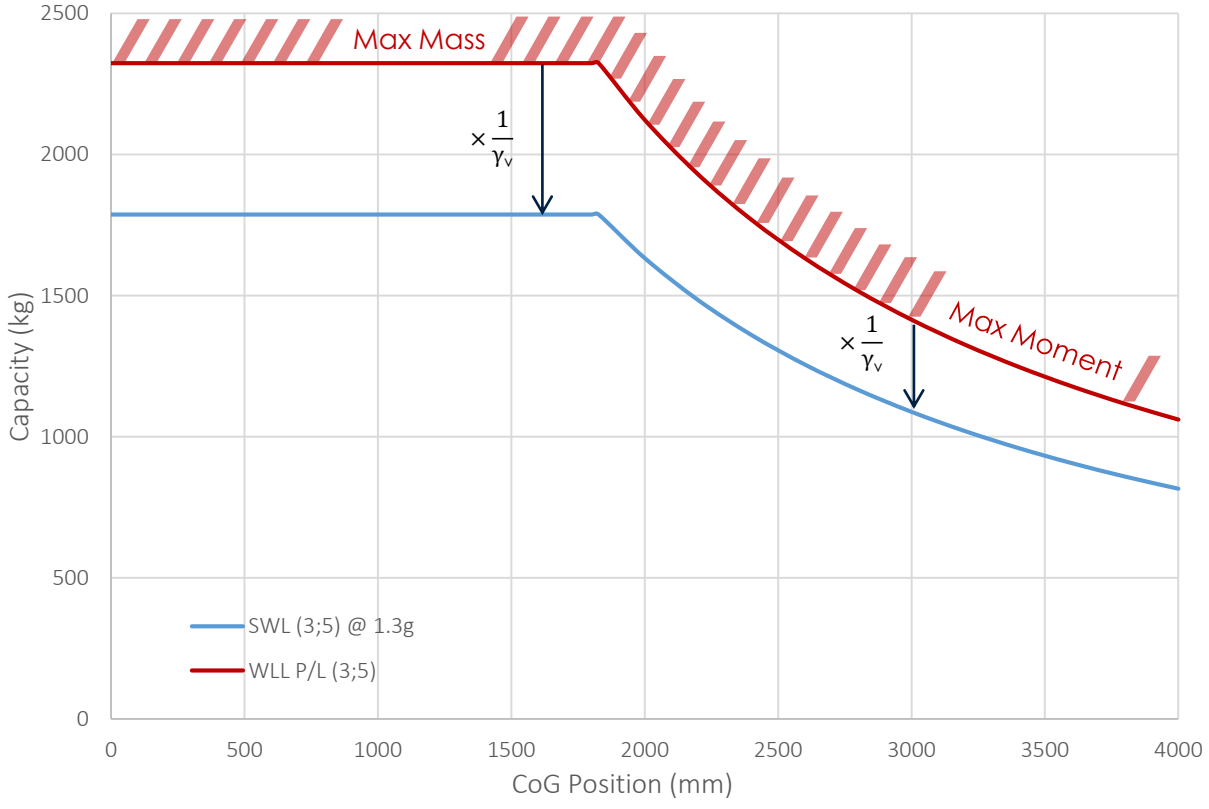
Besides specific requests, APCO Technologies has become an expert in developing satellite transport, lifting and handling equipment as well as adapters allowing test activities.

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.

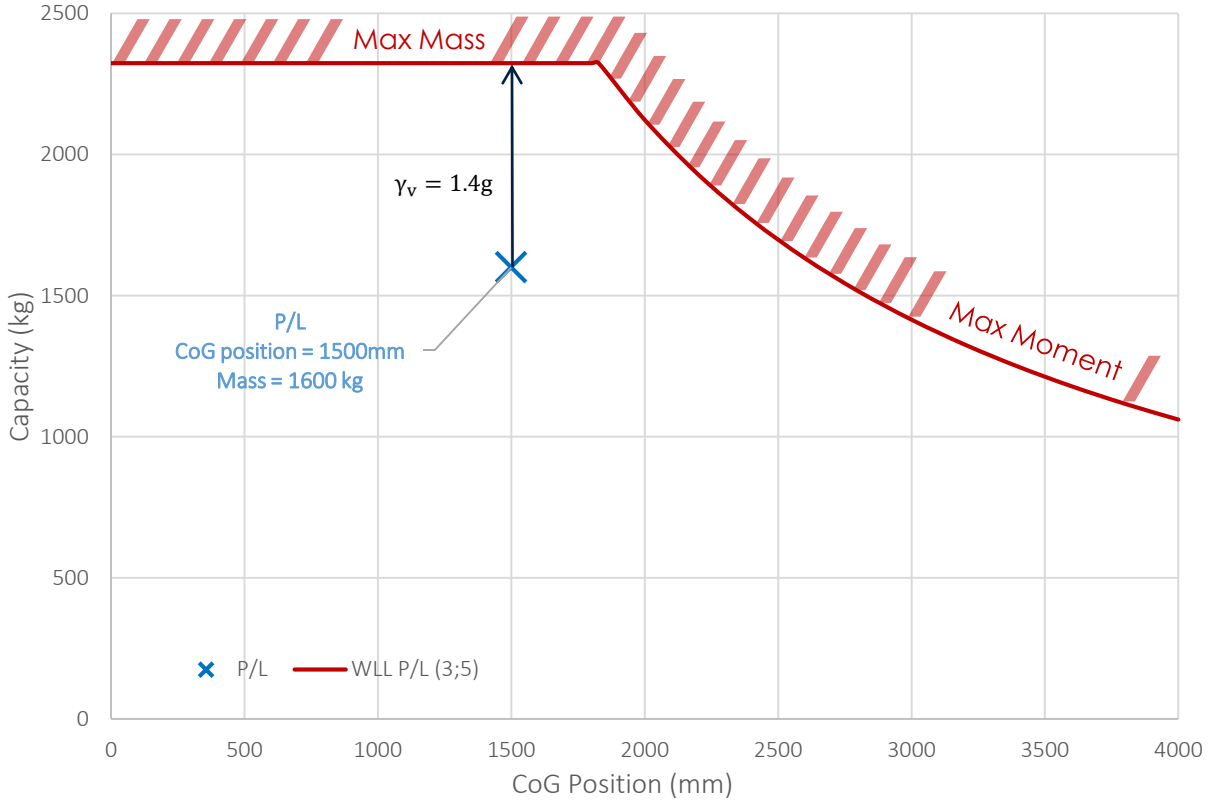
The SWL (Safe Working Load) is the admissible P/L or S/C mass capacity, at a given CoG, with a safety margin to the WLL, expressed in admissible vertical acceleration factor (γ_v).

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

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)

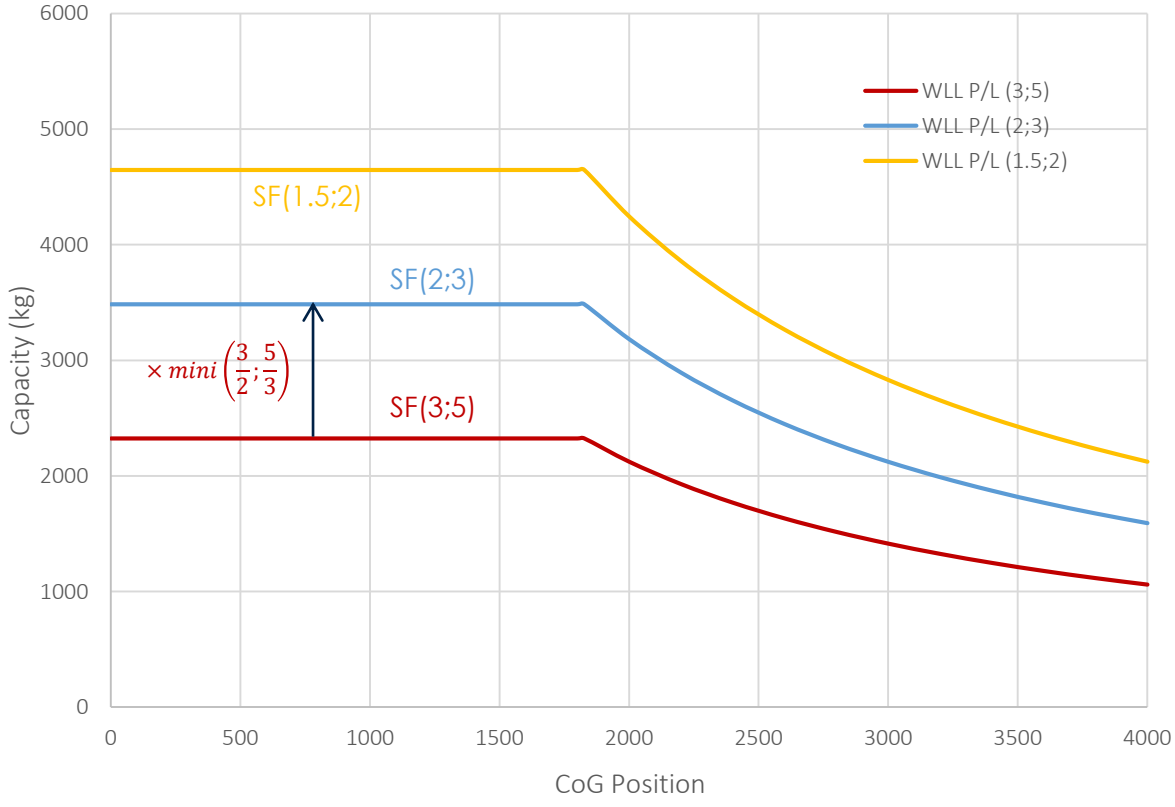
According to P/L position on the diagram (Mass & CoG), it is therefore possible to extract admissible acceleration factors (γ_v et γ_{lat}).

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.

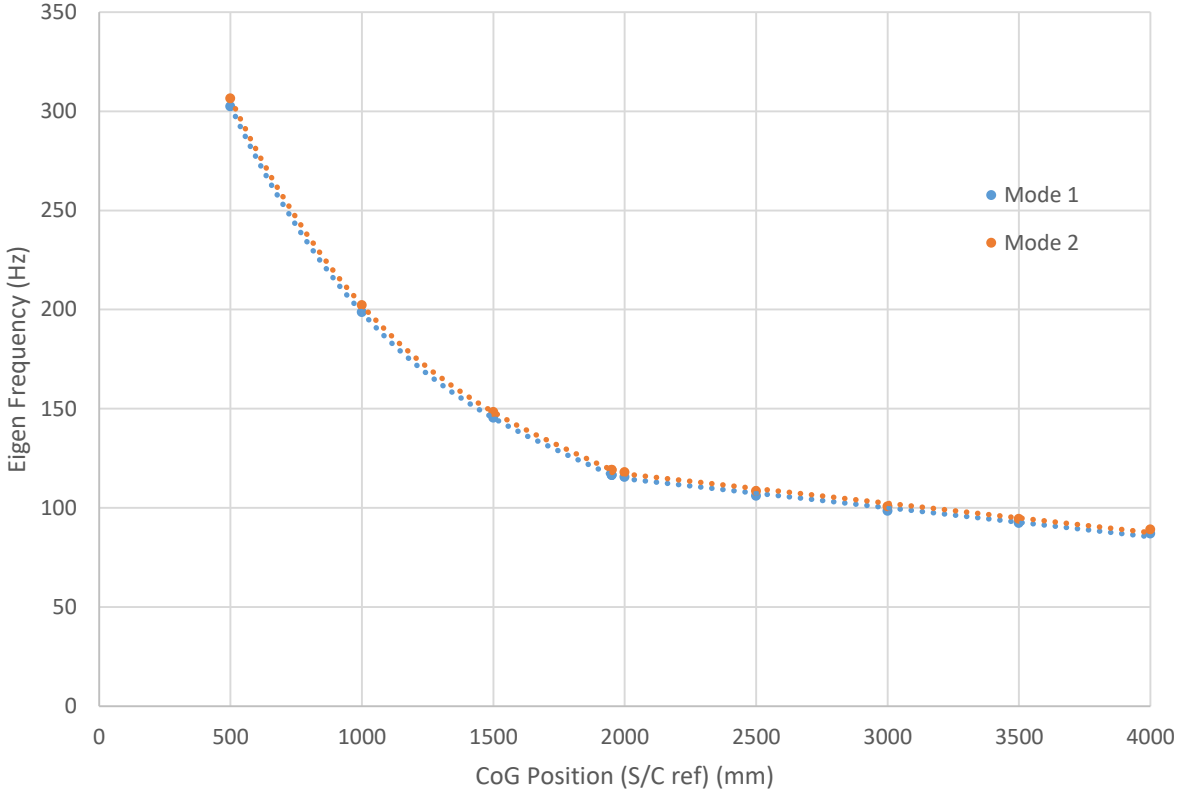
Minimum Eigen frequencies are provided for mode 1, 2 and 3 and for each attachment I/F with the test machine (if several are available).

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

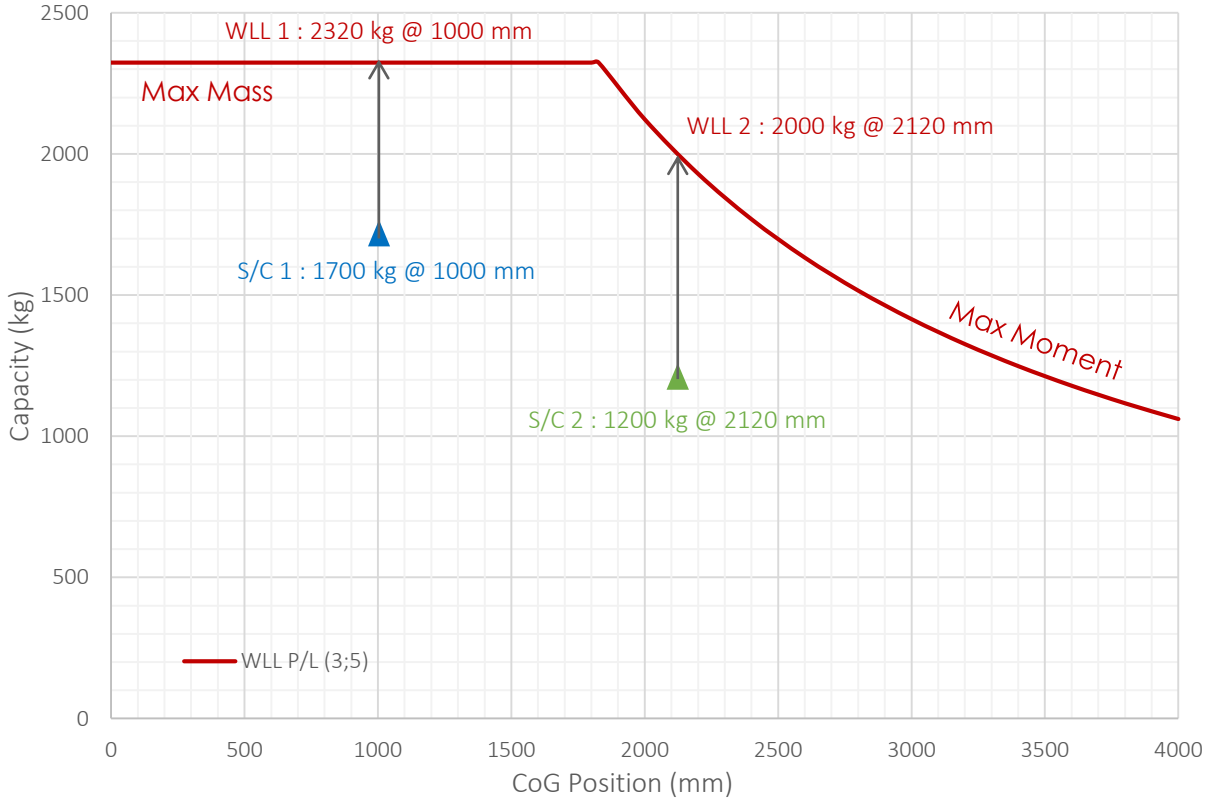
$$Fp_{SWL\,S/C} = Fp_{WWL\,S/C} \times \sqrt{\frac{WLL\,S/C}{SWL\,S/C}}$$

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

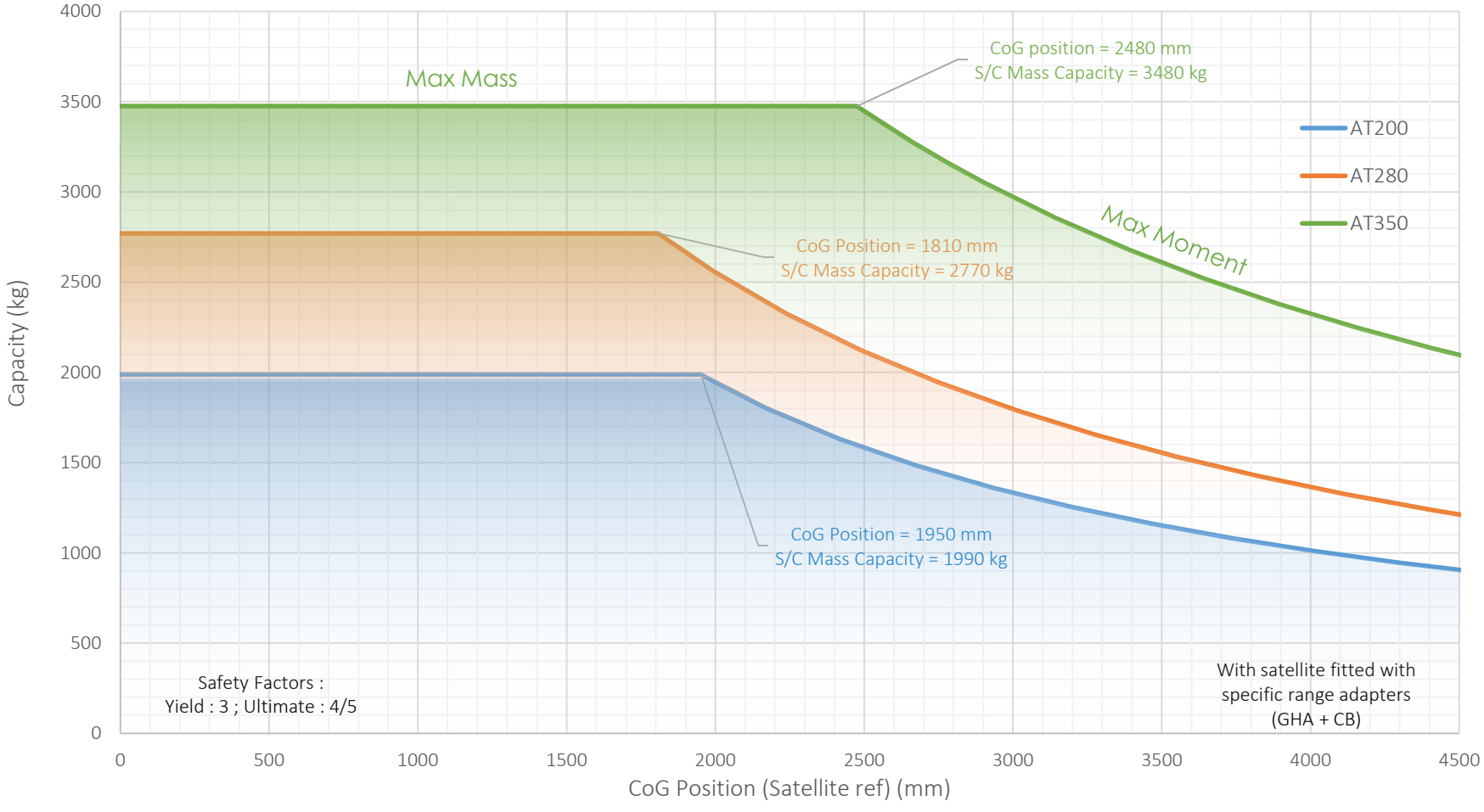
		AT200	*AT280*	*AT350*
S/C Envelop HxØ (mm)		5400 x 3240	5800 x 3300	6200 x 4000
S/C Interface		LIR Ariane 5 1194 C	LIR Ariane 5 1194 C	LIR PSA 1666 MVS
S/C Mass & Balance		See AT Range Performances		
General Design Safety Factors	Yield	3	3	3
	Ultimate	5	5	4
Test Adapters Safety Factors	Yield	2	2	2
	Ultimate	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 350 – S/C & Range Characteristics

S/C Limiting Characteristics

Envelop Dimensions (HxØ)	6200 x 4000	mm
Maximum S/C WLL*	3475**	kg
Mass & Balance	See Mass & Balance Diagram	
Interfaces	LIR PSA 1666 MVS	

*For safety Factors (3;4); **In static: 5160 kg

Range 350 Description

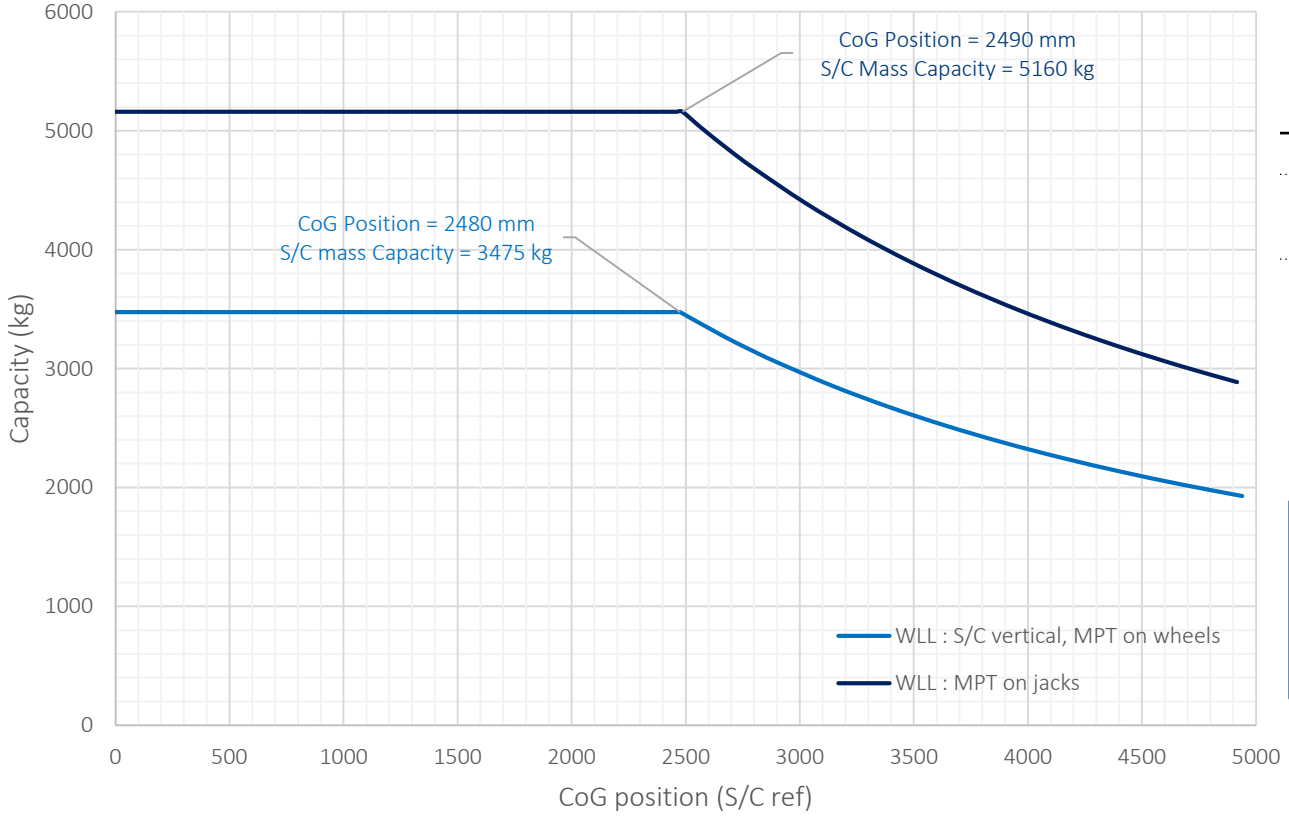
AT350 is a MGSE range of transport, lifting and handling equipment, as well as adapters allowing integration and test activities for large S/C.

Type	Acronym	Ref
Multi-Purpose Trolley	*MPT*	*AT350-MPT*
Vertical Integration Stand	*VIS*	*AT350-VIS*
Ground Handling Adapter	*GHA*	*AT350-GHA*
Vibration Test Adapter	*VTA*	*AT350-VTA*
Clamp Band	*CB*	*AT350-CB*

Heritage

MetOp-SG

MASS & BALANCE FOR S/C IN RANGE 350



Characteristics

Vertical Acceleration	1 g	
Safety Factors	Yield	3
	Ultimate	4

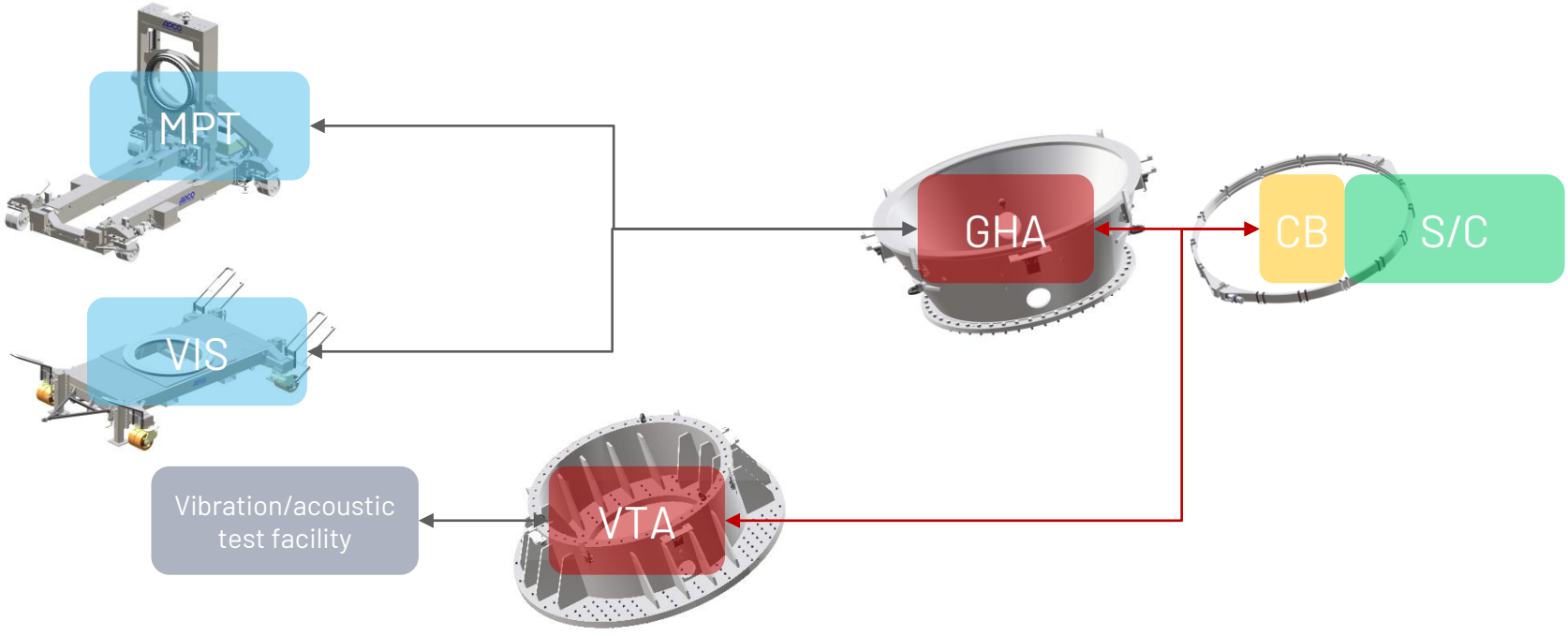
With Satellite fitted with AT350-GHA and AT350-CB

Mouvement prohibited

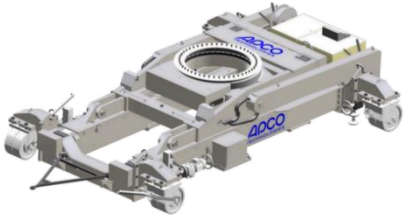
No Lateral Accelerations

Controlled factory mouvement authorised

Lateral Accelerations : ±0.1g


MPT
VIS
GHA
CB
S/C
VTA
Vibration/acoustic test facility

AT350 - Multi-Purpose Trolley (MPT)



Configuration for S/C Vertical

Configuration for S/C Horizontal

Physical Characteristics

Dimensions (LxWxH)		0°	6259 x 4082 x 1251		mm
		90°	7488 x 2722 x 4642		mm
Mass			14900		kg
Allowable Volume (Ø)			4000		mm
Safety Factors	Yield	3	Load Factors	Static	1.5
	Ultimate	4		Dynamic	1.1
Adapters I/F		48 x M16 threaded holes on a Ø1260 mm circle pattern			

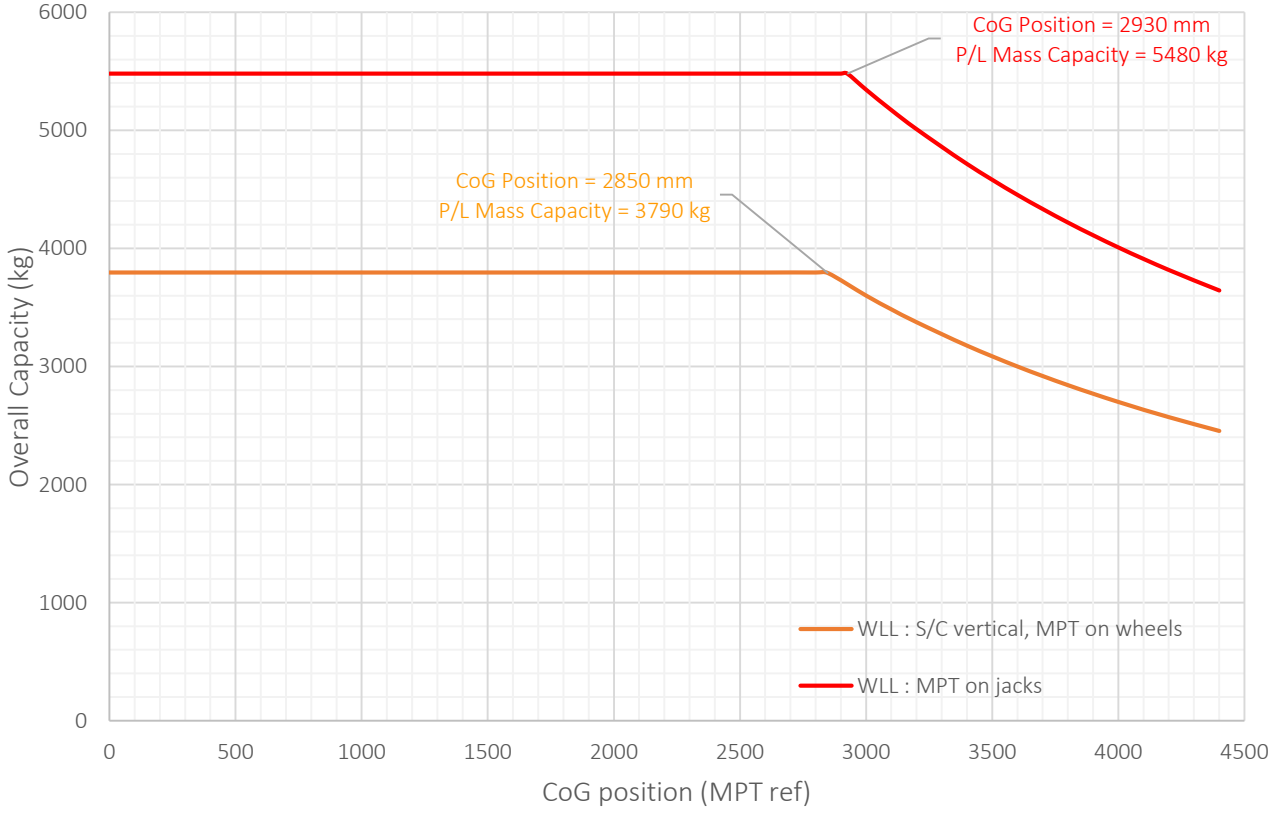
Performances

See AT350-MPT Mass and Balance Diagram

Operational Characteristics

Motion mode			Electrical
Number of Jacks			5
Mouvements	Tilting	Rotation	Translation
	0-90°	360°	500 mm
Facility Handling	EDU	Forklift	Tow bar
Environnement Specifications		ISO 8	Non-ATEX
MGSE Compatibility			AT350-GHA

AT350-MPT MASS & BALANCE ABSOLUTE CAPACITY



Characteristics

Vertical Acceleration	1 g	
Safety Factors	Yield	3
	Ultimate	4

With Mass and Balance of the entire payload

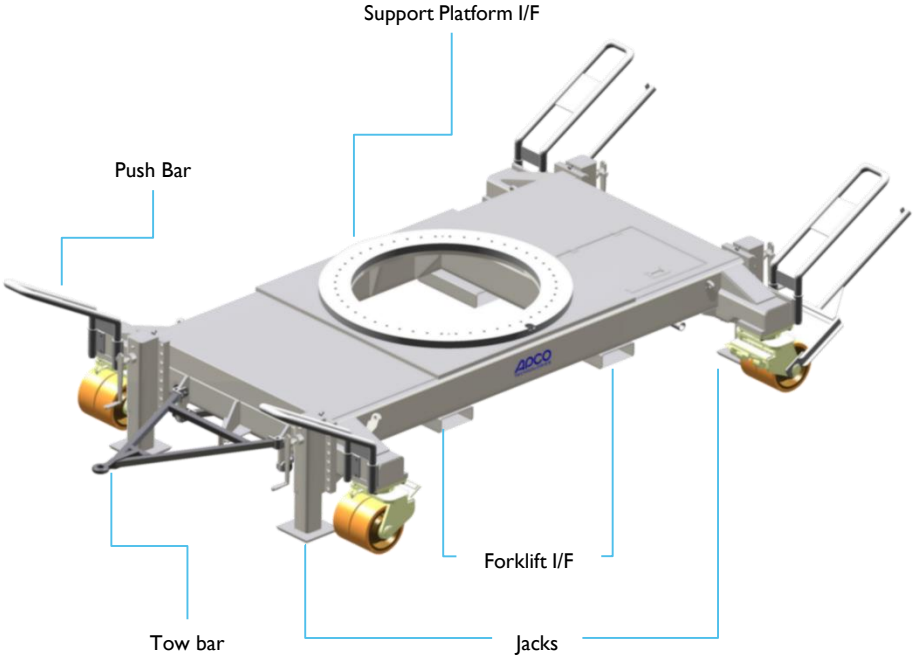
Mouvement prohibited

No Lateral Accelerations

Controlled factory mouvement authorised

Lateral Accelerations : ±0.1g

AT350 - Vertical Integration Stand (VIS)



Physical Characteristics

Dimensions (LxWxH)		4750 x 2490 x 1119			mm
Mass		2670			kg
Allowable Volume (Ø)		4000			mm
Safety Factors	Yield	3	Load Factors	Static	1.5
	Ultimate	4		Dynamic	1.1
Adapters I/F	48 x M16 threaded holes on a Ø1260 mm circle pattern				

Performances (1g vertical and ±0.1g lateral accelerations)

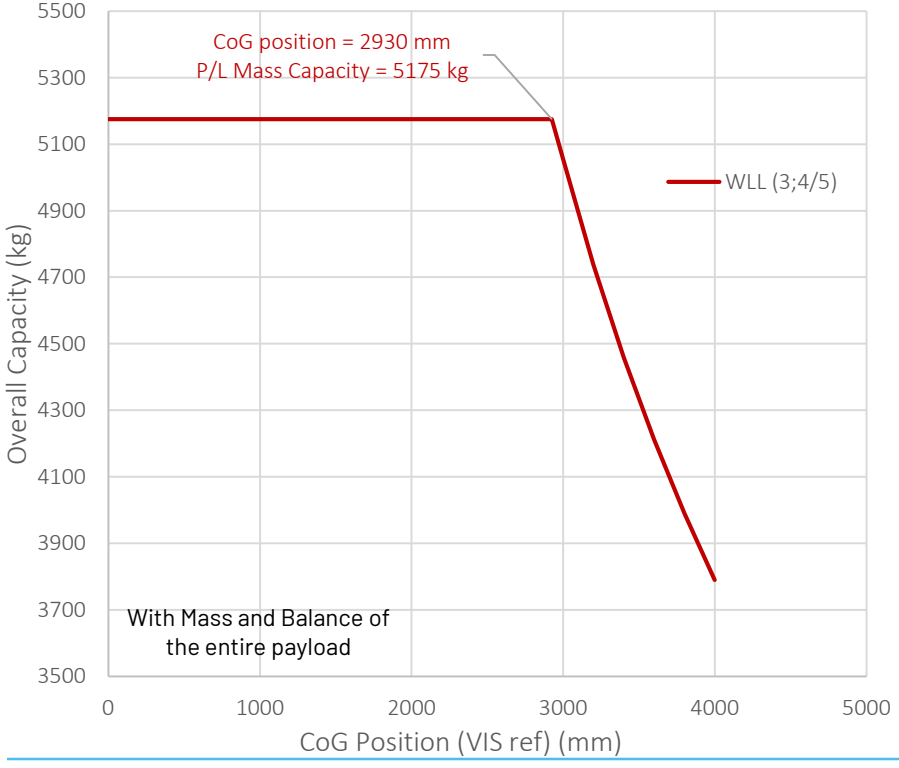
See AT350-VIS Mass & Balance Diagram

Operational Characteristics

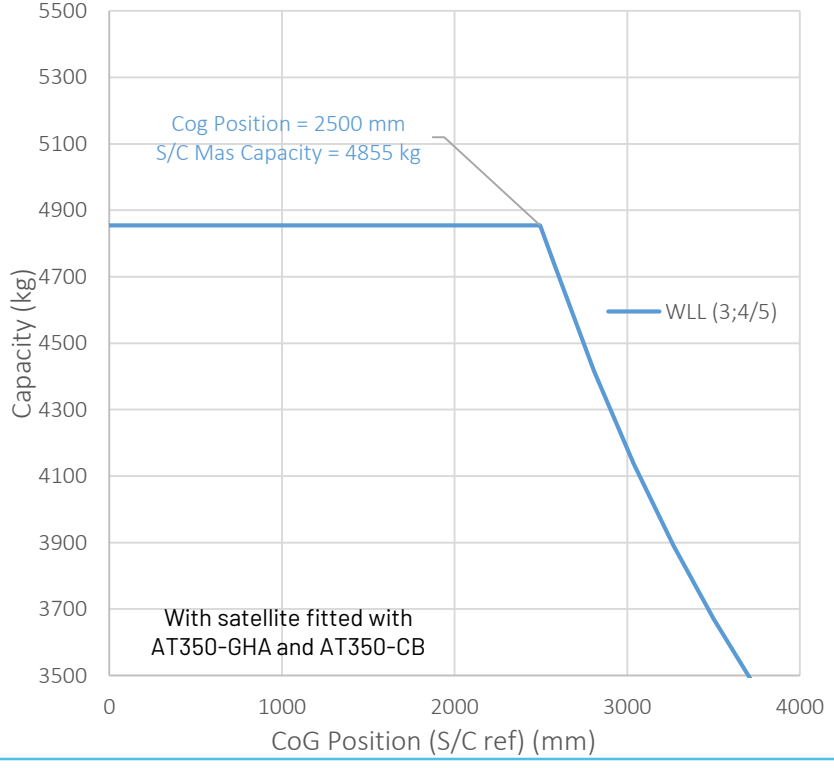
Number of Jacks / Wheels			4
Facility Handling	EDU	Tow Bar	Push Bar
Environnement Specifications		ISO 8	Hydrazine OK
MGSE Compatibility			AT350-GHA

VIS MASS & BALANCE

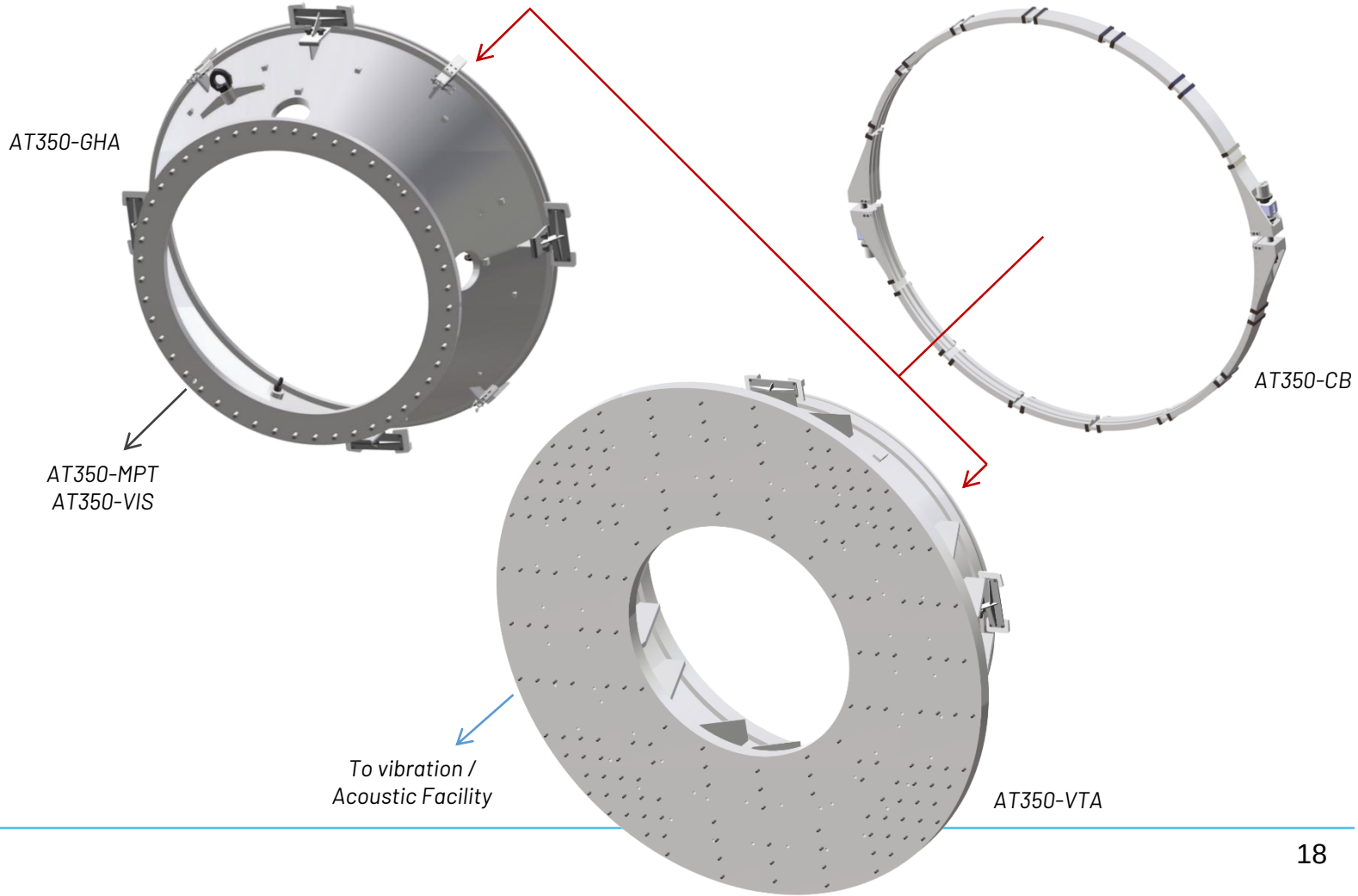
VIS ABSOLUTE CAPACITY



S/C CAPACITY



AT350 - ADAPTERS



AT350 - Ground Handling Adapter (GHA)

Physical Characteristics

Dimensions (ØxH)			1844 x 608		mm
Mass			300		kg
Safety Factors	Yield	3	Load Factors	Static	1.5
	Ultimate	4		Dynamic	/

Performances

With AT350-MPT	See AT350-MPT Mass & Balance Diagram
With AT350-VIS	See AT350-VIS Performances

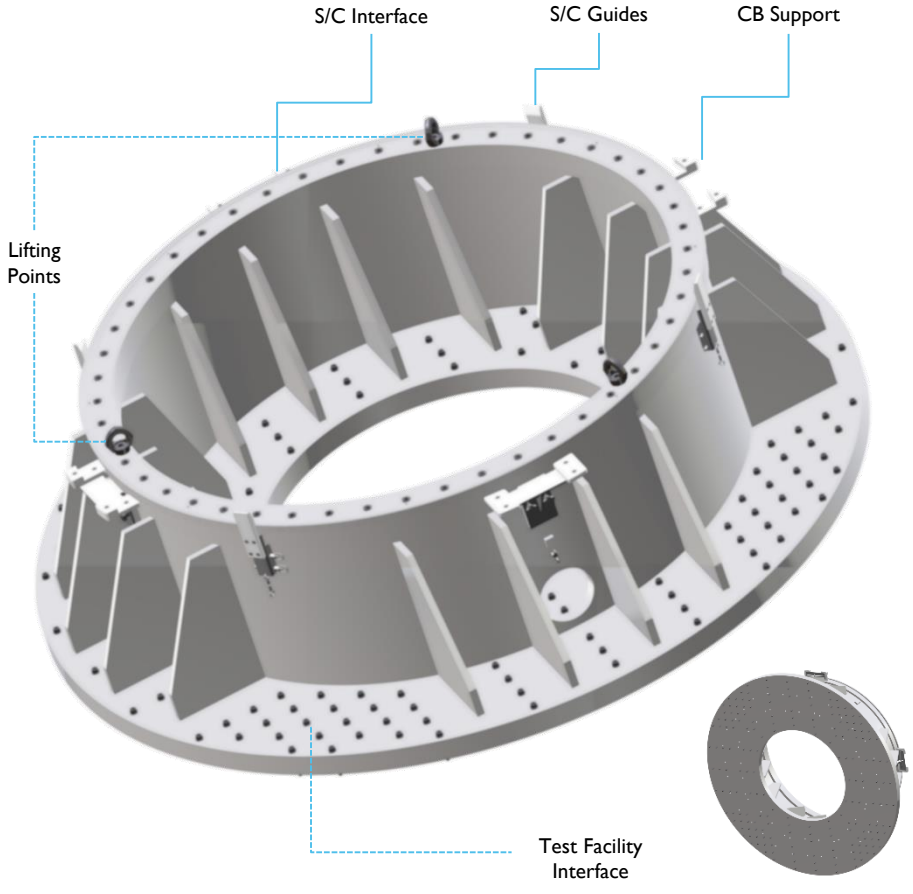
Environnement Specifications

ISO 8	ATEX

AT350 Compatibility & Interfaces

AT350-MPT, AT350-VIS AT350-PPA	48 x M16 threaded holes on a Ø1260 mm circle pattern
AT350-CB	LIR PSA 1666 MVS

AT350 - Vibration Test Adapter (VTA)



Physical Characteristics

Dimensions (ØxH)			2200 x 600		mm
Mass			990		kg
Safety Factors	Yield	2	Load Factors	Static	1.5
	Ultimate	3		Dynamic	/

Performances

TBD

Environnement Specifications

ISO 8

Compatibility & Interfaces

Vibration/Acoustic Test Facility	192 x M10 threaded holes
	33 x M10 or 16 x M10 threaded holes
	Provisions for 16 FMD
AT350-CB	LIR PSA 1666 MVS

AT350 – Clamp Band (CB)

Physical Characteristics

Dimensions (ØxH)			1860 x 99	mm
Mass			41	kg
Safety Factors	Yield	3		
	Ultimate	4		
Tension			Adapted to Payload and Use	
Number of Bands / Tie Rods			2	
Adapters Interface			LIR PSA 1666 MVS	

Performances

Handling (with GHA)	See Mass & Balance Diagram in Range 350
Vibration Tests (with VTA)	See VTA Performances

Operational Characteristics

Environnement Specifications	ISO 8	ATEX	Vacuum
MGSE Compatibility	AT350-GHA		AT350-VTA