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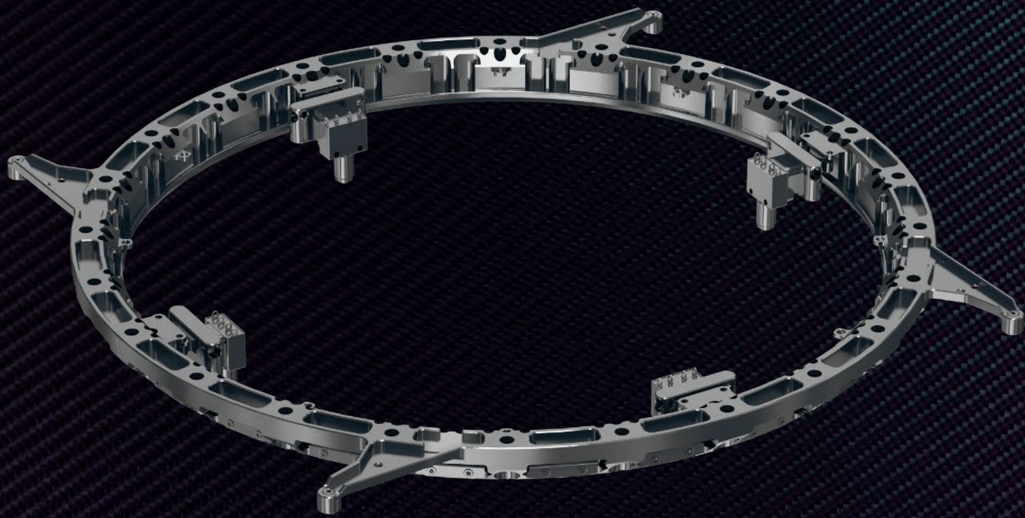
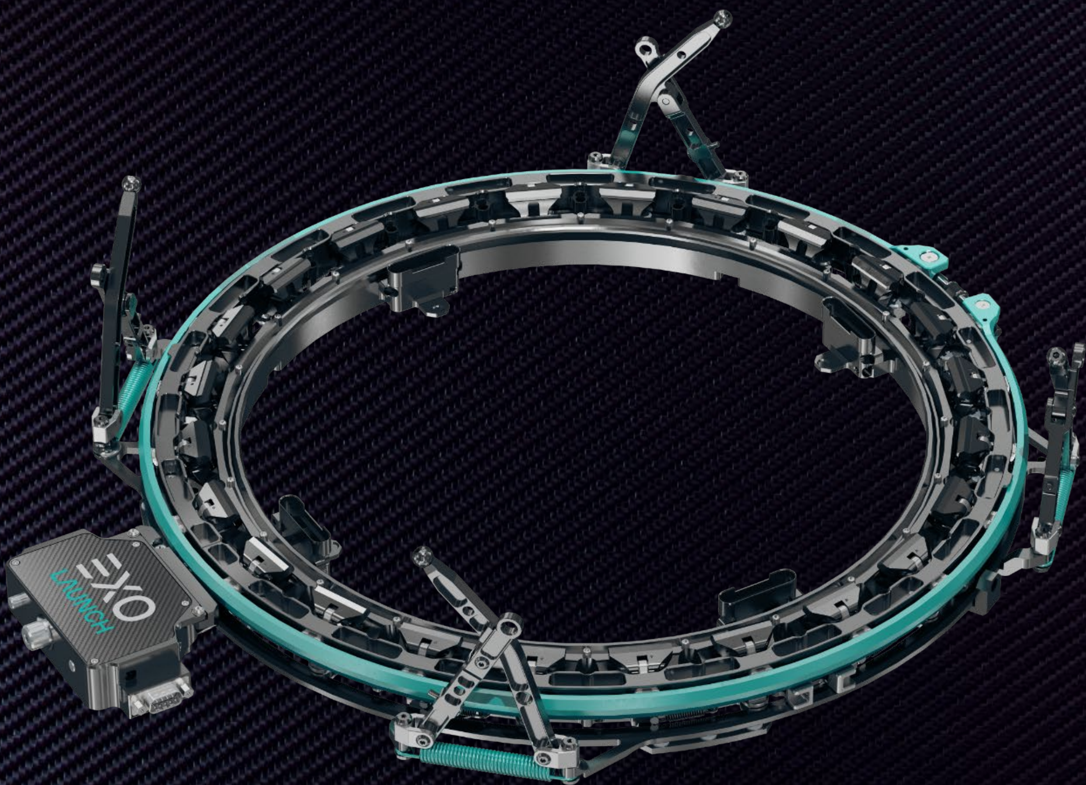




NEO User Manual

Microsatellite Separation System
Revision 1.1 | June 2025

Table of Contents

Version	Author	Date	Changes
1.0	CP	2 DEC 2024	Initial release of the NEO User Manual
1.1	CP/MT	19 JUN 2025	- Added initial information for NEO 31.6" and 38.81" - Updated qualification status details in Section 2.2 - Updated NEO separation connector details in Section 2.3.4 - Updated NEO system and accessory masses in Section 3.2 - Updated maximum loads in Section 3.6 - Updated measured shock loads in Section 3.10

Quick Reference

Figure 1:
NEO Coordinate System

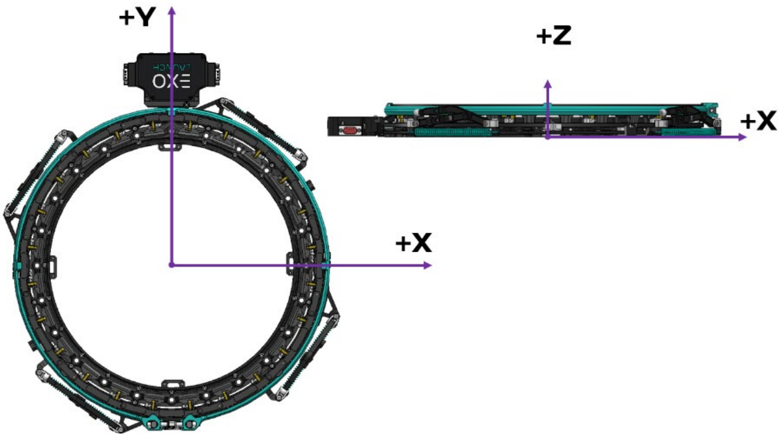


Table 1: NEO Characteristics Overview.

Parameter		Section	8"	15"	24"	31.6"	38.81"
Mounting Pattern	Bolt Circle Diameter [mm]	3.4	203.200	381.000	609.600	802.640	985.774
	Bolt Circle Diameter [in]		8.00	15.00	24.00	31.60	38.81
	Number of Fasteners		12	24	36	48	60
	Fastener Type		M6 or 1/4-28				
	Flatness Tolerance [mm]		0.10				
Mass	S-Ring [kg]	3.2	0.4	0.82	1.28	1.68	2.0
	L-Ring [kg]		2.4	3.96	6.02	7.67	9.4
Separation	Nominal Separation Signal	-	28VDC for 0.5s				
	Average Separation Time [s]		0.10				
Thermal	Lower Operating Limit [°C]	-	- 34				
	Upper Operating Limit [°C]		+79				
	Lower Survival Limit [°C]		- 55				
	Upper Survival Limit [°C]		+130				

2

Introduction

2.1 What is NEO?

CarboNIX NEO is a separation system for satellites weighing up to one ton. It is based on the CarboNIX design, which has delivered more than 130 satellites to orbit since its first launch in 2019. NEO is the successor to the CarboNIX microsatellite separation system. It is **stronger**, **stiffer**, can withstand **higher loads** and launch **heavier spacecraft** compared to the classic CarboNIX system and to every other ring-based system on the market.

Figure 2:
CarboNIX (left) vs. NEO (right).

NEO has inherited the shock-free technology from its predecessor to reduce the risk of damaging sensitive satellite optical payloads and electronic components. This is achieved through our proprietary and unique spring pusher system which decouples the release of the hold-down mechanism from the separation mechanism. Separation is initiated before the primary shock load is generated, which means that all shock forces can only reach the spacecraft by traveling through multiple linkages, and since shock forces are attenuated by joints and distance, the shock loads that reach the spacecraft are substantially reduced. In addition, every pusher arm in the spring pusher system is linked together and moves at the same velocity, regardless of the location of the satellite Center of Gravity. This guarantees best-in-class tip-off rates of less than 2 deg/s. The unique design, simple and safe handling and use of commercially available tooling for operation, gives NEO best-in-class compatibility with satellites and launch vehicles while delivering unparalleled reliability and performance.

Figure 3: NEO Size Comparison. From left to right: 8", 15", 24" and 31.6".

All these features, paired with our experience and track-record of successfully delivering over 130 microsatellites to orbit, make NEO the most advanced separation system ever used in space. NEO is available in 8, 15", 24", 31.6" and 38.81" versions, with more diameters planned in the near future. Contact Exolaunch for details.

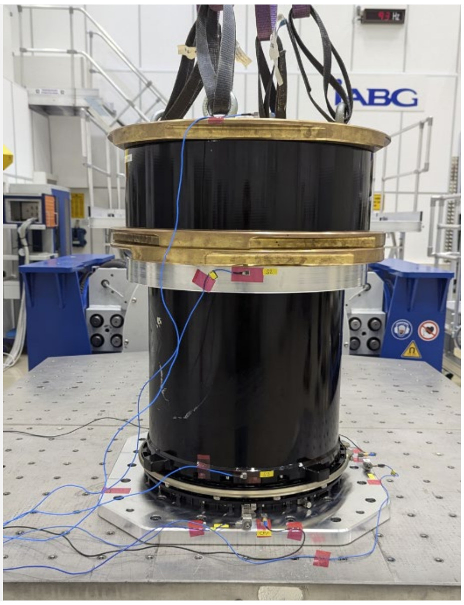
NEO is also designed and manufactured entirely within Europe, meaning it is not subject to strict export regulations such as ITAR. This reduces the cost and complexity of using NEO and allows it to fly on any launcher in the world.

As with all Exolaunch technology, NEO is manufactured in Germany in a facility certified to ISO 9001:2015 standard, which requires regular inspection of the manufacturing and assembly facilities and ensures a stable quality of the final product. These same quality standards are applied to the qualification and acceptance testing processes.

NEO has unique advantages over other separation systems

- **Fast Integration and Reset Time.** The whole system can be triggered and reset in minutes. Constellation customers benefit from fast and consistent processing times at the launch site when launching multiple satellites.
- **Shock-Free Separation.** Very low shocks are generated during separation, making it very gentle on delicate satellite components. Relative to other separation systems on the market NEO is virtually shock-free.
- **Low Tip-Off Rates.** The average tip-off rate is less than 0.6 deg/s in all three axes. No tip-off rate higher than 2.2 deg/s has ever been recorded in space.
- **Integration Services.** Every NEO system includes fitcheck and integration services by experienced engineering personnel. No expensive training and licensing is required for the customer.
- **Scalable.** The unique design centered around a single clamp element which is repeated along the circumference, allows NEO to be easily scaled to different sizes.
- **Flexible.** NEO can be used with and adapted to any launch vehicle.

Figure 4:
NEO 15" undergoing qualification testing with a 250kg mass dummy.



2.2 Qualification Status

NEO is qualified for the vibration, thermal, and shock environments of multiple vehicles. By far, the most common launch configuration is on the Falcon 9 Transporter and Bandwagon missions, where the NEO is mounted in the "wall-mounted" configuration.

The maximum mass and CG height of satellites which NEO can support has been driven primarily by the SpaceX-defined loads limits on the Transporter rideshare program. NEO may be able to support even higher masses on non-Transporter missions where the loads are lower. Note that stiffness may be the limiting factor instead of strength, and that a mission-specific system and fastener analysis must be conducted before approving mass/CG combinations near the limit of system capability. Detailed description of the system capability can be found in **Section 3.6 Maximum Loads and Stiffness**.

Figure 5 compares the currently established NEO capability (as of June 2025) against the maximum allowable SpaceX Transporter limits (Reference: *Rideshare Payload Users Guide v10*, Figure 3-1, September 2024). Further qualification testing is intended to increase the NEO qualified capability so that the full Transporter capacity can be utilized. Please note that these curves assume both the satellite **and** separation system, with the CG height measured from the interface between the NEO L-ring and the launch vehicle.

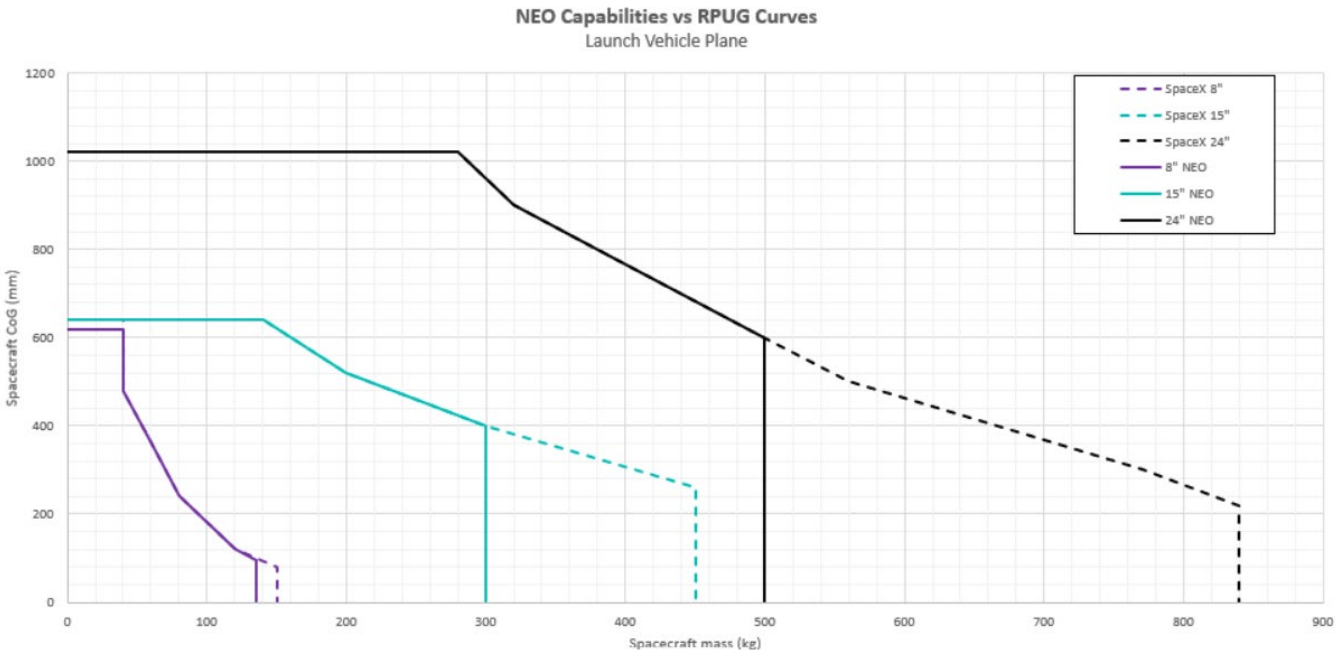
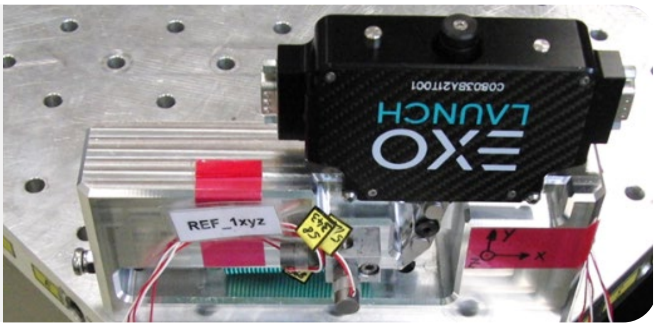


Figure 5: NEO Mass/CG Capability matches the SpaceX RPUG limits for Transporter missions.

The NEO lock mechanism is the only shock-sensitive element of the NEO system. It has been qualified for environments up to 2000g shock loads at 1 kHz and 5000g at 10 kHz, both in a standalone lock mechanism test and in a full system-level test.

Figure 6:
Lock Mechanism Shock Testing.



2.3 Components and Features

The main components of the NEO separation system are shown in the figure below.

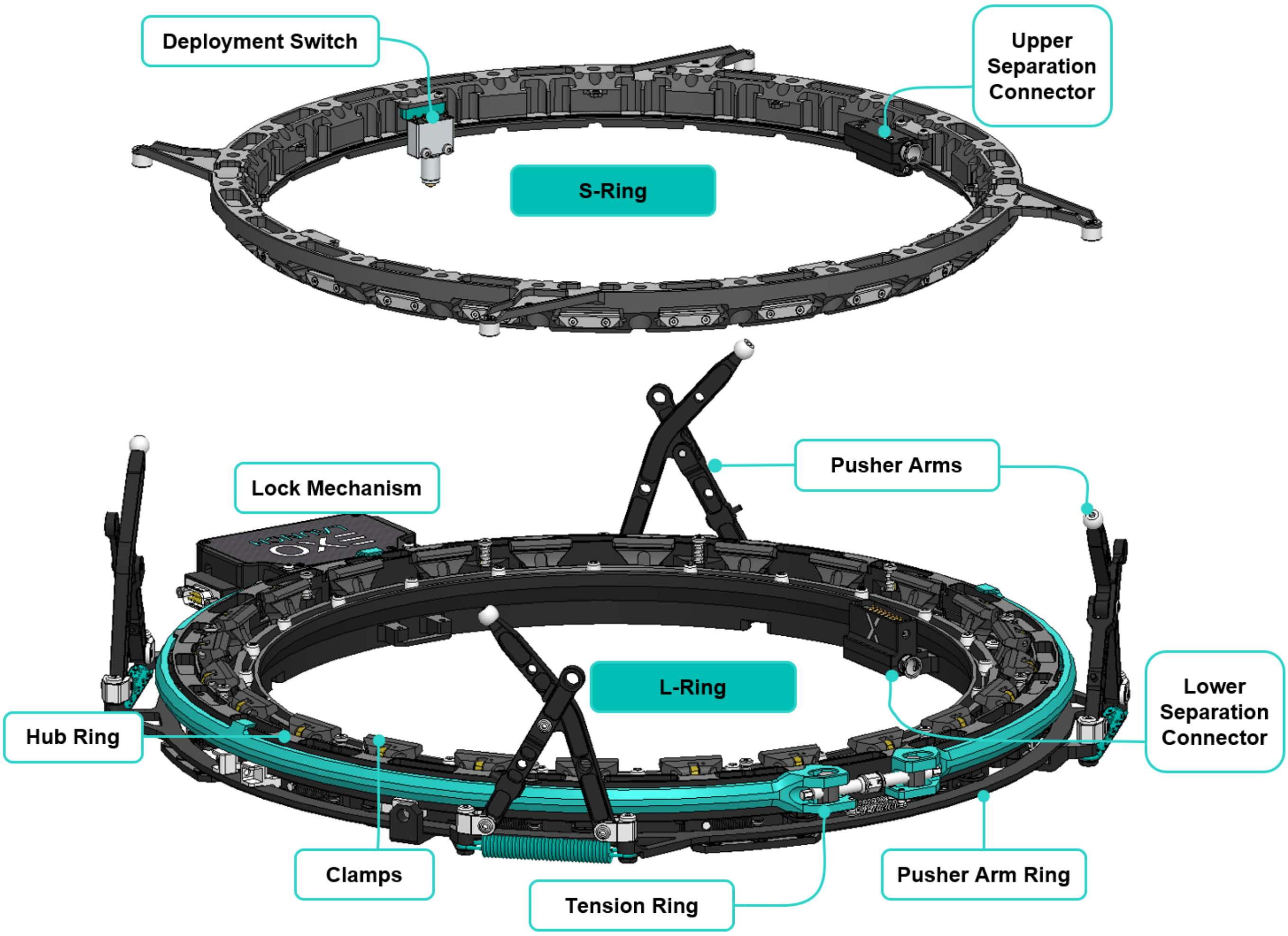


Figure 7: Main Components of the NEO Separation System.

2.3.1 S-Ring

The S-Ring is the part of NEO that is attached to the satellite. It is fastened to the bottom of the satellite using either M6 or 1/4-28 screws in a circular pattern.

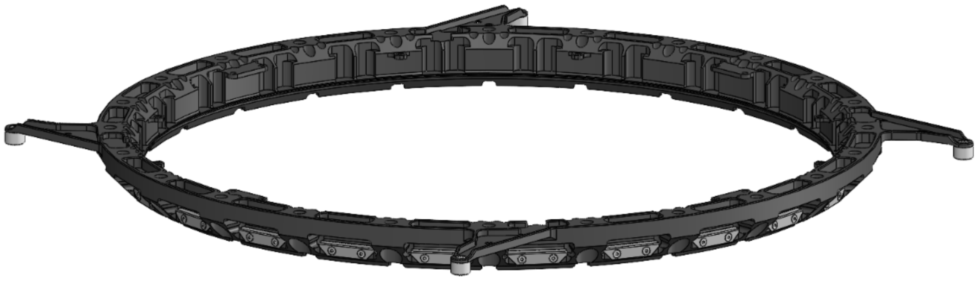


Figure 8:
NEO S-Ring

The S-Ring provides the interface for the clamping elements of the L-Ring to grab onto. The S-Ring also provides harness mounting points and pass-through locations for the satellite separation switches and umbilical connector harness. When passing from the inside to the outside of the S-Ring, the maximum harness cross-section size is 3mm x 9.5mm; cutouts on the satellite side may allow larger harness sizes to pass through.

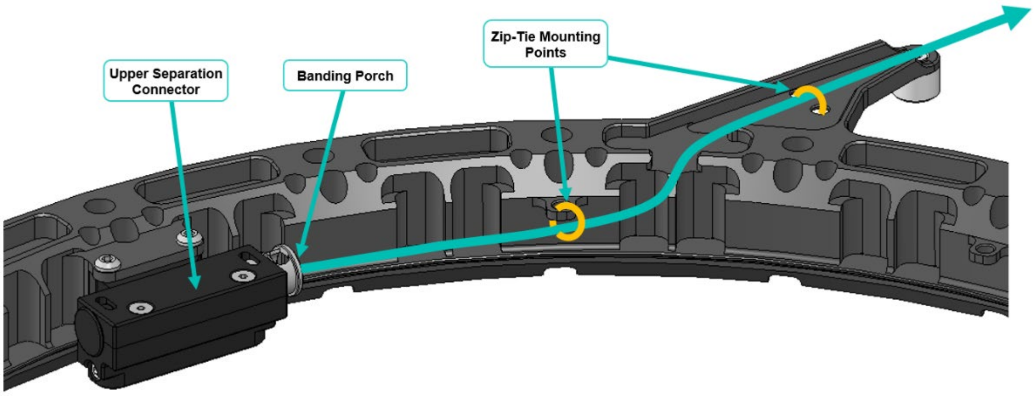


Figure 9:
Cable Tie Locations on the S-Ring.

2.3.2 L-Ring

The L-Ring is the portion of the separation system that stays attached to the launch vehicle after separation. It is mechanically and electrically connected to the launch vehicle adapter. It can be fastened to the launch vehicle with either ¼-28 or M6 screws.

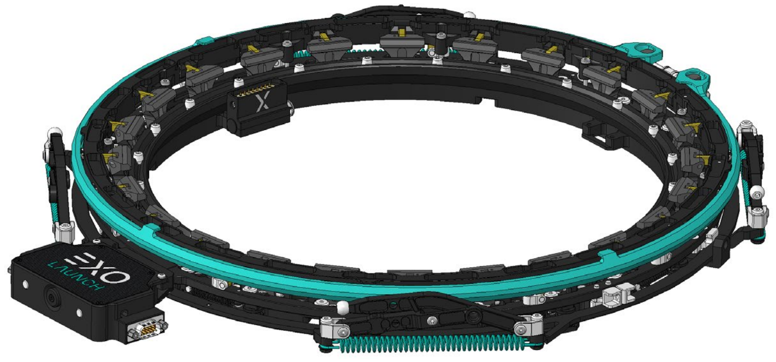


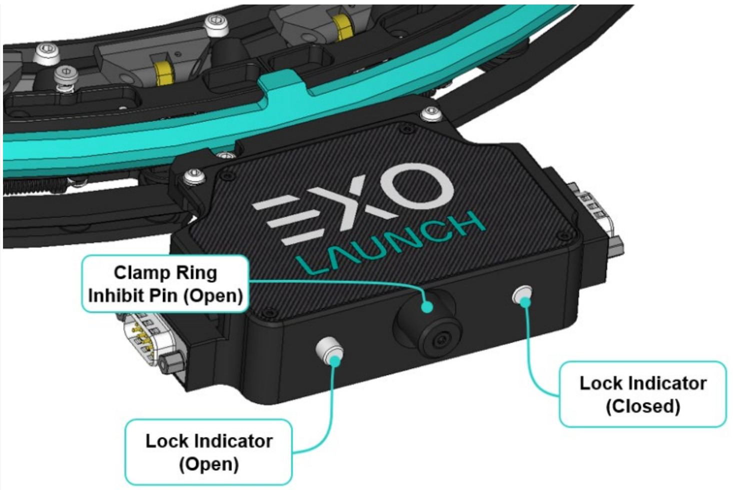
Figure 10:
NEO L-Ring

2.3.2.1 Lock Mechanism

The locking mechanism uses a unique magnetic system that can be released either using an electrical input signal from the launch vehicle, or from the Exolaunch electronic sequencer unit EXObox. The lock allows quick integration and de-integration within minutes. For maximum reliability, NEO uses redundant locks that can trigger the opening independently from separate deployment signal channels.

There are two elements of the lock mechanism, the Clamp Ring Inhibit Pin and the magnetic locks, which are toggled by pushing in the lock indicators. The locking mechanism receives the firing signal through one of two 9-pin D-Sub ports. As needed, either one or both of these ports can be used to actuate both locks for redundancy during the mission.

Figure 11:
NEO Lock Mechanism



2.3.2.2 Lock Rings

The S-Ring is secured to the L-Ring using the clamp ring assembly. In the stowed configuration, these rings grip the S-Ring and prevent any movement. Once the lock mechanism releases, the springs on the L-Ring unclamp and release the S-Ring.

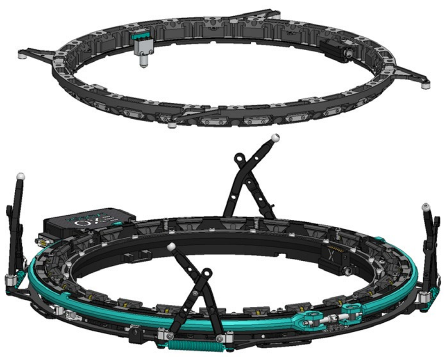
Figure 12:
Left, S-Ring is Securely Clamped to L-Ring.

Right, S-Ring Released

2.3.2.3 Pusher Mechanism

Once the S-Ring has been released, the pusher mechanism creates the separation velocity between the launch vehicle and the satellite. This is done by three or four equally spaced pusher arms located external to the rings, as shown below. Each pusher mechanism is fitted with a starter spring on the lower arm. This provides the initial force to begin the separation, as the main separation springs are at a very oblique angle when stowed.

Figure 13:
NEO in the Deployed State



2.3.2.4 Deployment Sensors

The NEO has built-in deployment sensors which transmit the deployment status back to the launch vehicle. Deployment sensors are located in two positions. These sensors indicate whether the locking mechanism has been opened, and whether the pushing mechanism has been successfully deployed. In each position, there are two sensors for redundancy. The switch status is transmitted to the launch vehicle through the lock mechanism connector.

The customer does not need to dedicate separation switches or breakwire loops in order to satisfy launch vehicle telemetry requirements.

2.3.3 Separation Switch

Customers may choose to mount one or several separation switches on the S-Ring in order to communicate the separation event to the satellite. These ITW 65-401000 switches are extremely rugged and have extensive flight heritage. The "over-travel" actuator ensures that the switch will not toggle until full separation has occurred. They can be configured as *Normally Open* or *Normally Closed*.

Separation switches are for satellite-side telemetry only. Launch vehicle-side telemetry shall be transmitted through the built-in deployment sensors.

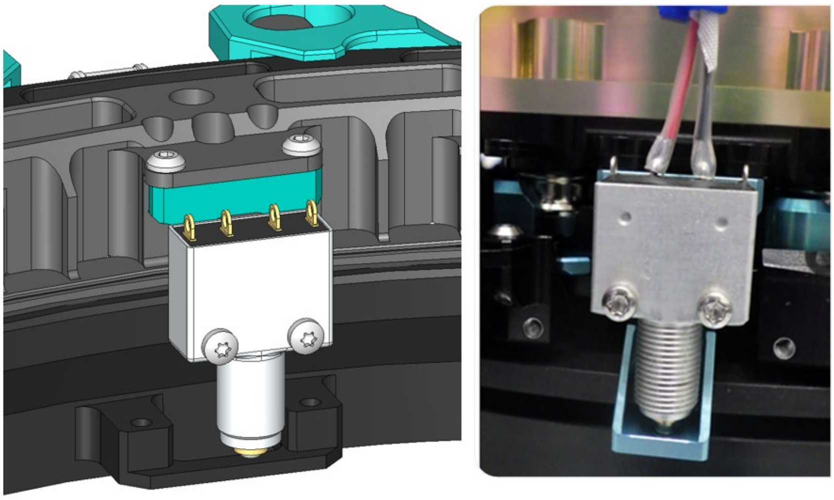


Figure 14:
NEO Separation Switch.

2.3.4 Separation Connector

The separation connector can be used to provide an electrical connection to the satellite after it has been integrated on the launch vehicle. It can be used to charge the satellite batteries, satellite-side separation telemetry through breakwires, or to otherwise connect with the satellite after encapsulation. Separation connectors are for satellite-side telemetry only. Launch vehicle side telemetry shall be transmitted through the built-in deployment sensors.

Note: **All electrical interfaces must adhere to limitations determined by the launch authority.**

Figure 15:
NEO separation connector.
The green arrows show possible harness routing directions.

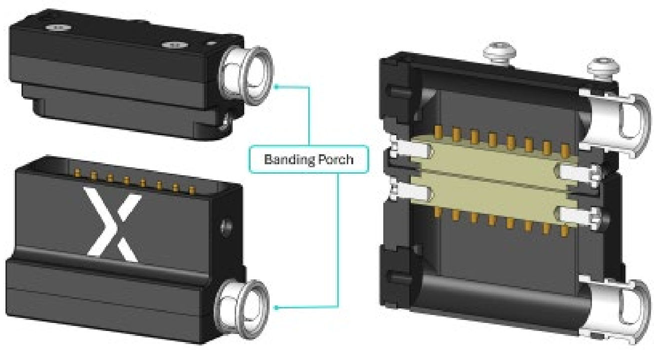
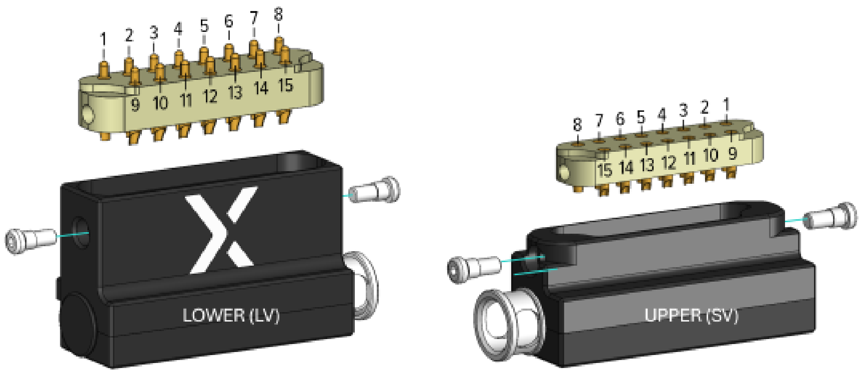


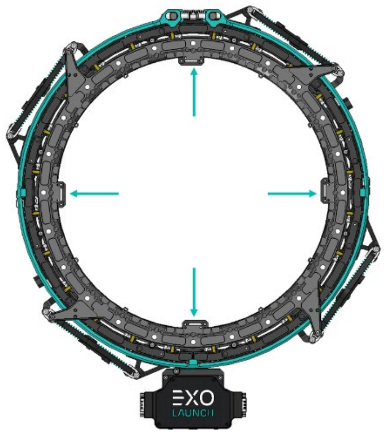
Figure 16:
NEO separation connector, pin configuration.



2.3.5 Separation Switch and Connector Interfaces

The separation switch and separation connector can each be connected to NEO at one of four separate locations around the outside of the ring. Only three of these interfaces are available on the NEO 8". This provides flexibility in harness routing for the satellite designer.

Figure 17:
NEO Separation Connector and Separation Switch Locations.



2.3.6 Harness Routing on the S-Ring

The S-Ring offers multiple points to secure harness along the inner diameter and along the pass-through locations. To simplify the integration process and avoid pinching or squeezing the harness, Exolaunch **requires** all separation switches and connectors to be routed on a harness which can be removed from the satellite OR have the harness exit from the baseplate within the inner diameter of NEO. Waivers for this requirement will only be granted after a review of the harness design and S-ring installation process.

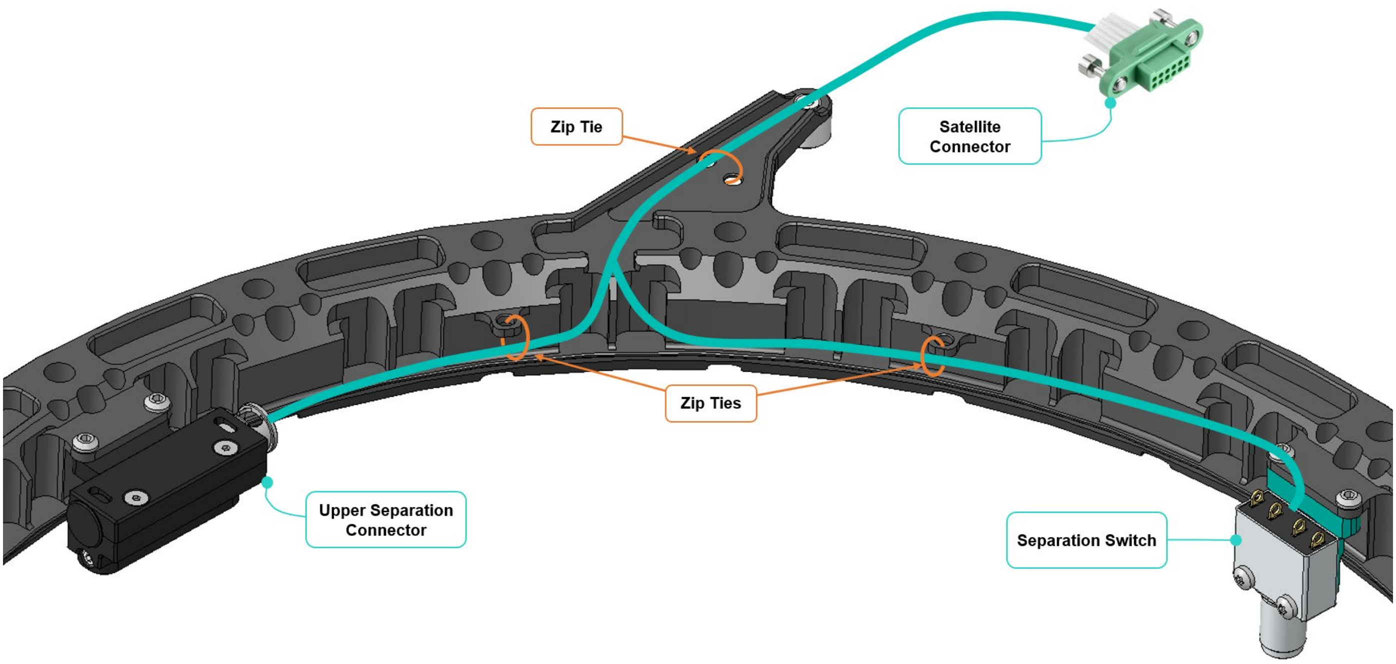


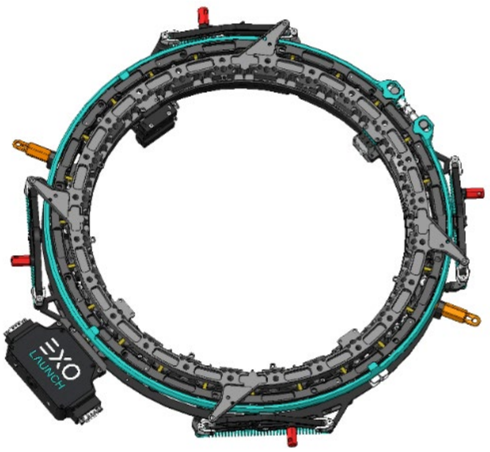
Figure 18:
Example harness routing with a NEO Upper Separation Connector and Separation Switch.

2.3.7 Remove Before Flight (RBF) Elements

NEO uses two types of RBF elements. Two pins are used to secure the clamp rings in the closed position and prevent accidental release of the S-Ring. Four additional pins are used to optionally secure the pusher arms in the down position. Note that the pusher arms are usually not secured during satellite integration and instead act as guide to easily position the satellite in the correct orientation.

Finally, a tool is used to engage the system, closing the clamping mechanism and securing the locks in place.

Figure 19:
NEO with clamp ring RBFs highlighted in orange and pusher arm RBFs highlighted in red.



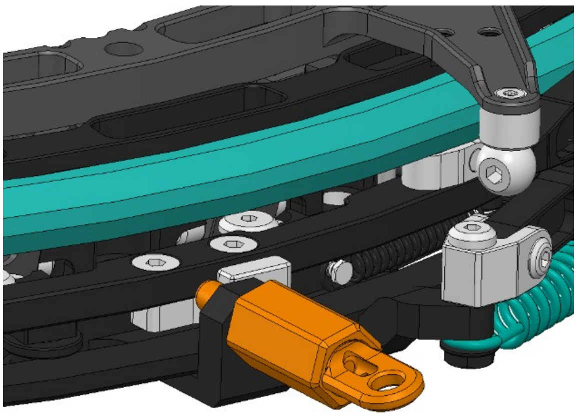


Figure 21: Clamping Mechanism RBF Prevents the S-Ring from Coming Loose.

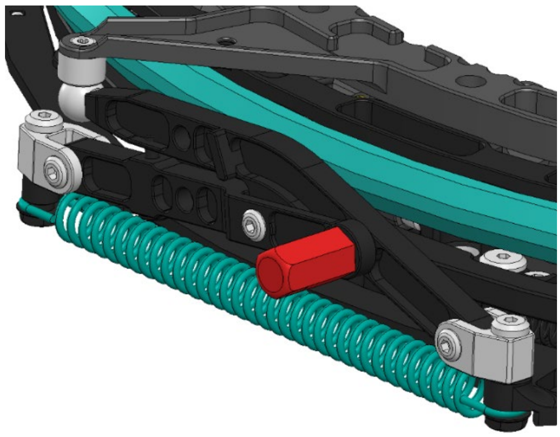


Figure 21: Pushing Mechanism RBF Binds Two Arms Together and Prevents Deployment.

The clamp ring RBF has a spring-loaded pin which allows it to be inserted before the clamp rings are engaged. This can simplify the integration process, as the RBF will automatically lock the system shut once the clamp rings are closed. The red indicator on the RBF, see Figure 22, provides a visual indication of the status of the clamp rings. A single clamp ring RBF is sufficient to fully secure the system.

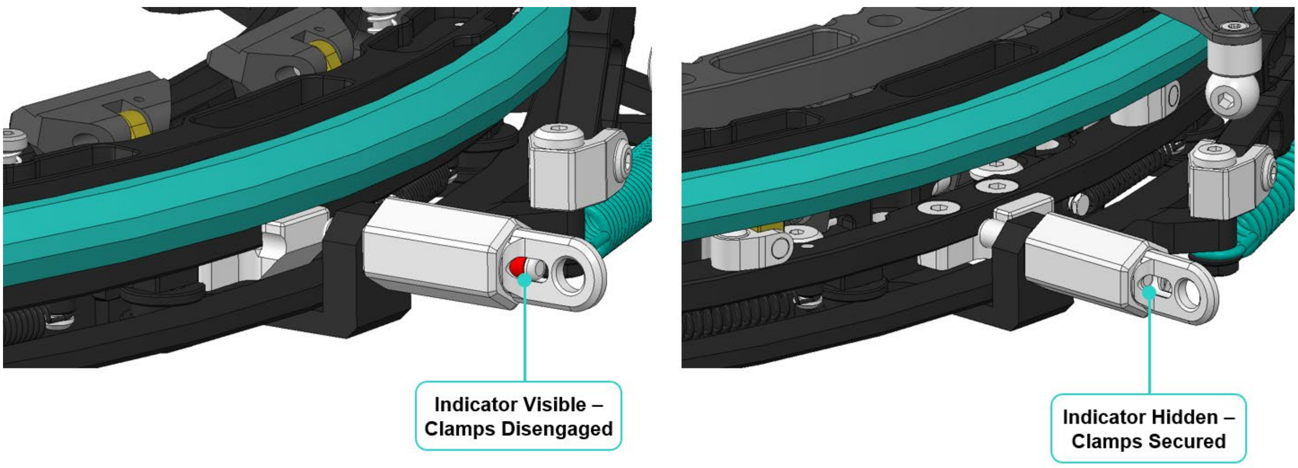


Figure 22: Clamp Ring RBF Function.

3

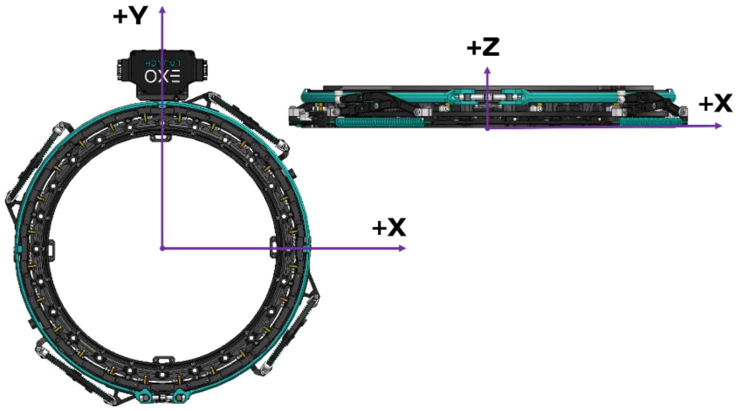
System Description

3.1 Coordinate System

The NEO coordinate system is shown in the image below. The coordinate system is defined as follows:

The Z-axis is parallel to the separation direction and concentric with the mounting interface circle, with +Z pointing towards the satellite. The origin of the coordinate system is where the Z-Axis intersects the L-Ring mounting plane, offset by 1.5mm in the +Z direction. The Y-axis is defined by the mounting point which is aligned with the symmetry axis of the lock mechanism when viewed from the top (satellite side), with +Y pointing in the direction of the lock mechanism. The X-axis is defined by the right-hand rule.

Figure 23:
NEO Coordinate System.



3.2 Mass

The mass of each NEO element is listed below. Detailed mass properties can be found in Appendix A.

Table 2: NEO Mass.

Description	8"	15"	24"	31.6"	38.81
S-Ring [kg]	0.4	0.82	1.28	1.68	2.0
L-Ring [kg]	2.4	3.96	6.02	7.67	9.4
Separation Switch (incl. mounting bracket) [g]	19				
Upper Separation Connector [g]	20				
Lower Separation Connector [g]	28				
M6x25 Socket Head Screw + NL6ss washer [g]	7.9				

3.3 Mounting Configurations

NEO can be mated with the launch vehicle and the satellite in the ways shown below. For nearly any mission configuration, the "Thru Hole" variant is preferred for easier installation at the launch site. The following thread engagement is required on both the L-Ring and S-Ring fasteners, where D is equal to the fastener diameter:

- 1.5D for steel inserts on aluminum base metal
- 1.5D for cut threads in steel base metal
- 2.0D for cut threads in aluminum base metal

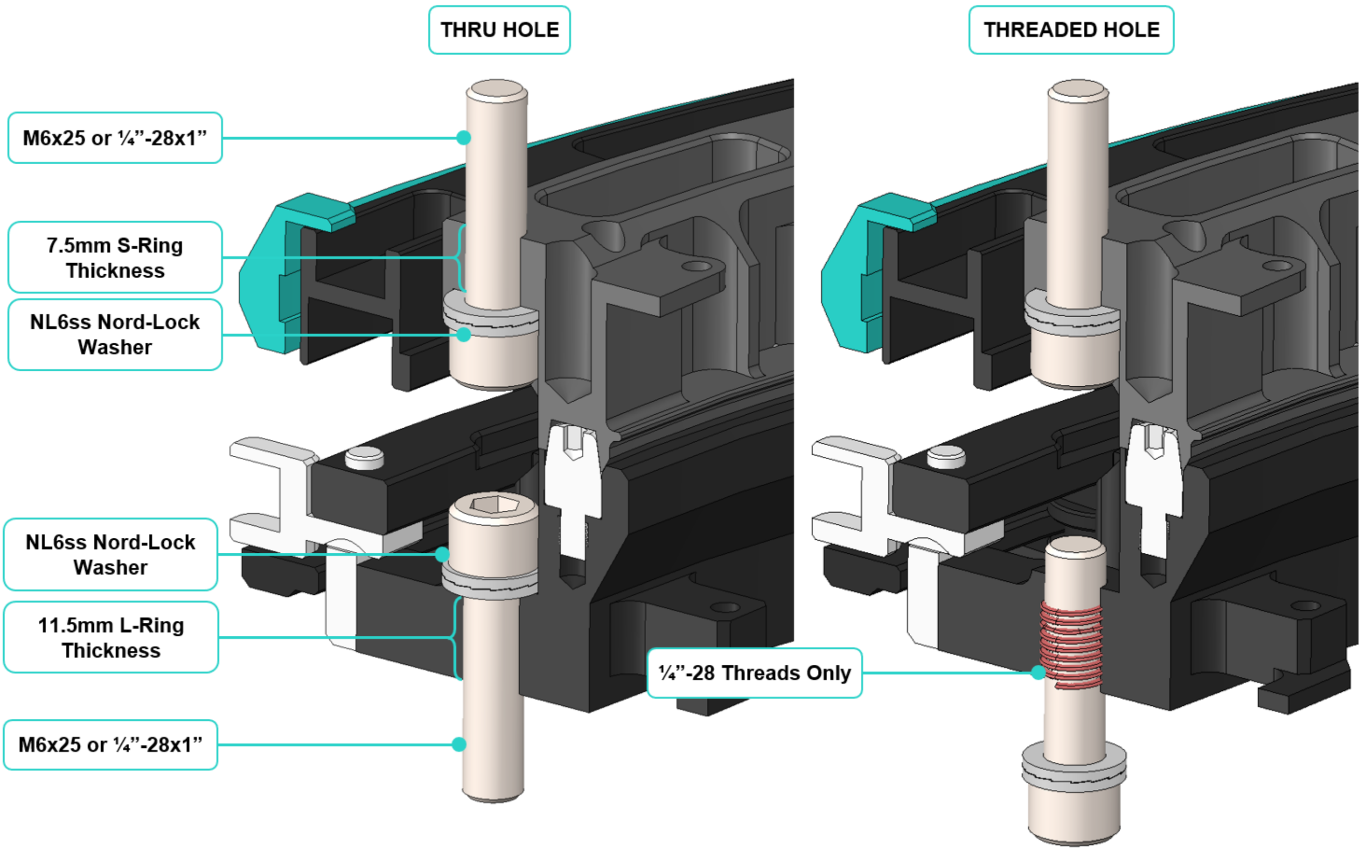


Figure 24: Launch Vehicle Mounting Configurations.

Fastener length is dependent on the geometry of the mounting interfaces. A fastener analysis shall be performed for every mission, and the results captured in the ICD.

3.4 Mounting Hole Patterns

The mounting pattern for the NEO system consists of a circular pattern of equally spaced holes on both the payload and launch vehicle sides, suitable for M6 or ¼" fasteners. For more information about interface requirements and technical drawings, see Appendix B.

Table 3: NEO Interface Dimensions.

Description	Dim	8"	15"	24"	31.6"	38.81"
Number of mounting holes	-	12	24	36	48	60
Angle between mounting holes	deg	30	15	10	7.5	6.0
Mounting hole circle diameter ± 0.1	mm	203.2	381.0	609.6	802.64	985.774
Minimum thread engagement	mm	Cut threads: 12 (2.0D) Inserts: 9 (1.5D)				

Detailed mounting patterns can be found in the Appendix.

3.5 Keep-Out Dimensions

The inner and outer dimensions of the NEO systems are shown below. These dimensions shall be considered the "keep-out" volume, an area where no part of the satellite or launch vehicle should protrude. In addition, protrusions shall not block access to the DSub-9 connectors and harness routing. A simplified fitcheck CAD can be provided on request – the fit check model shall supersede the keep-out volumes shown below after Exolaunch review. A detailed fitcheck will be performed by Exolaunch on a need basis.

Figure 25: NEO Primary Keep-Out Dimensions.

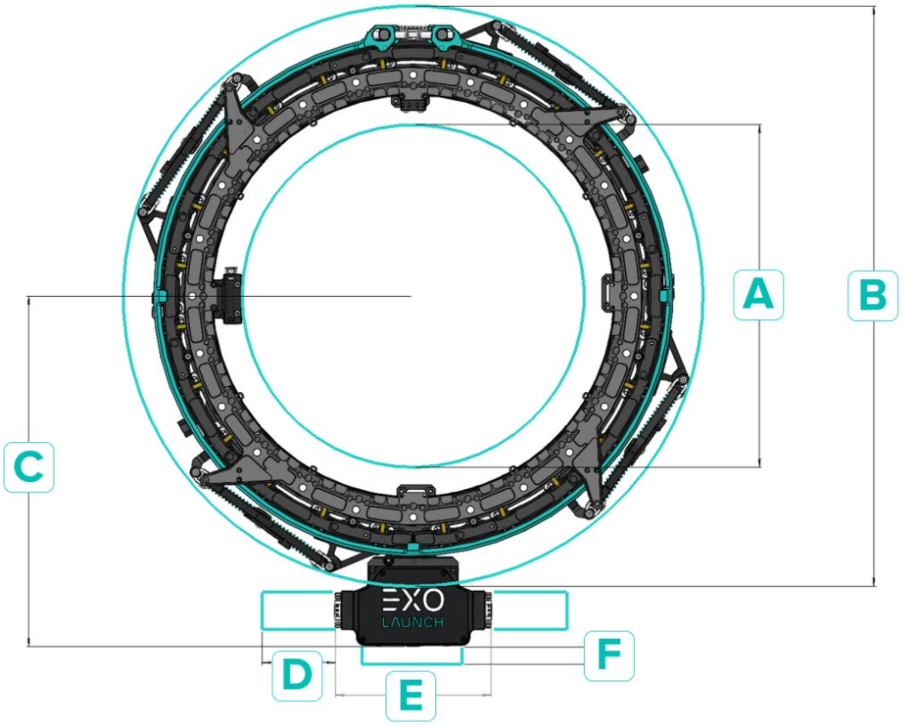


Table 4: NEO Keep-out Volume.

Description	Letter	8"	15"	24"	31.6"	38.81"
Inner keep-out diameter [mm] Note: Value depends on what NEO accessories are used and is best assessed in CAD	A	110	295	510	700	890
Outer keep-out diameter [mm]	B	330	500	740	940	1120
Distance from center to lock mechanism outer edge [mm]	C	215	302	415	510	610
Deploy harness keep-out [mm]	D	60				
Lock mechanism width [mm]	E	134				
Separation indicators keep-out [mm]	F	15				
Protrusion depth from satellite base plate [mm]	-	45 (assuming solid mounting surface without additional protrusion space)				
System height [mm]	-	50.0				

3.6 Maximum Loads and Stiffness

Compatibility of the satellite with NEO depends on a range of factors including mass, center of gravity, satellite bus design, peaking factors and stiffness or launch vehicle requirements. However, NEO is capable of supporting the vast majority of satellites flying on nearly any launch vehicle. Talk to Exolaunch for your mission specific analysis.

The mechanical capability of the separation system is defined in terms of line loads and is specified at the launch vehicle interface. Line loads derived from launcher requirements must be within the separation system's capabilities shown below.

Table 5: NEO Line Load Capability.

Launch Vehicle (LV) IF	Normal Line Load (Z)	Shear Line Load (X/Y)
	f^N [N/mm]	f^S [N/mm]
A – Tested Line Load	189	82
B – Peaking factor	1.155	1.155
C – Qualification factor	1.25	1.25
D – Established capability	**131**	**56**

Note: Applicability of peaking factor depends on specific launcher requirements.

Tested Line Loads (A) are derived from the quasi-static environment that the separation system was subjected to during qualification testing. These are reduced by a peaking factor (B) of 1.155, which accounts for the local variation in launch vehicle and satellite interface stiffness. The line loads are then scaled down by a Qualification factor (C) of 1.25, resulting in the Established Capability (D):

$$D = \frac{A}{B \cdot C} \quad (1)$$

The normal and shear line load on a circular interface is defined below. Given the quasi-static load factor (QSL, in g) and the interface diameter (D, in mm), the separation system's line load capability can be used to determine the allowable mass (m_{PL}, in kg) and center of gravity height (h_{PL}^{cg}, in mm) of the payload. Upon request, Exolaunch can provide *NEO Maximum Capacity Calculator* to assist in selecting the correct NEO system for your application.

$$f^N = f^N_{Axial} + f^N_{Lateral} = \frac{m_{PL} \cdot QSL_{Axial}}{\pi \cdot D} + \frac{4 \cdot m_{PL} \cdot h_{PL}^{cg} \cdot QSL_{Lat}}{\pi \cdot D^2} \quad (2)$$

$$f^S = \frac{2 \cdot m_{PL} \cdot QSL_{Lat}}{\pi \cdot D} \quad (3)$$

Notes:

- The payload consists of the satellite **and** separation system.
- The launch vehicle MPE shall be used for the quasi-static load factors (QSL) to compare against the established capability of the separation system.
- Equation 2 considers an axial and lateral load factor acting simultaneously. For testing, an equivalent uniaxial load factor may be given and the non-applicable term in the equation is set to zero. Similarly, an equivalent uniaxial load factor can be derived from a given line load.

The provided values are derived from the latest qualification testing and do not represent system design limits. Please contact Exolaunch for more information if the established capability is expected to be exceeded. Note that stiffness may be the limiting factor instead of strength, and that a mission-specific system and fastener analysis must be conducted before approving mass/cg configurations near the limit of the system capability.

3.7 Finite Element Modeling

For FE modeling, Exolaunch can provide detailed, Nastran based (.bdf) NEO models upon request. These models are correlated to the NEO dynamic behavior. The models are used for the following purposes:

- Coupled system stiffness calculations (modal, sine, random vibe analyses)
- Assessment of the LV and SC interface loads

The models are NOT representative in terms of strength or thermo-elastic properties of NEO.

3.7.1 FEM Description and Guidelines

The FE model comprises the following components:

- S-Ring – The ring attachment to the satellite
- L-Ring – The ring attachment to the launcher side

All models use SI units and all data from NASTRAN result files refer to meters, kilograms, Newtons and seconds. The NEO to Launch Vehicle interface bolts shall be connected via an RBE2 element with an independent grid at the geometrical center of the circular interface. All load cases and boundary conditions shall be applied on the single-interface RBE2 node.

NEO provides two sets of interface nodes:

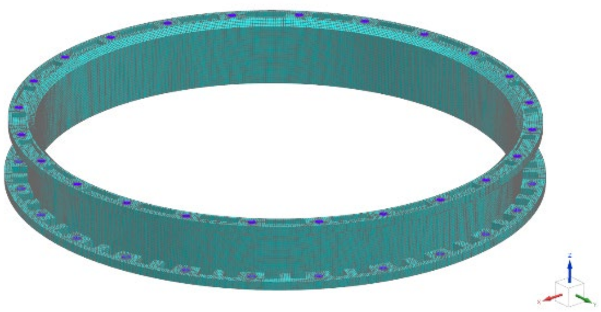
- To the satellite (S-side): 8000101 – 80001**X**
- To the launcher (L-side): 8000201 – 80002**X**

Where X is the number of interface nodes. All interface nodes are defined in cylindrical coordinate system 8000002.

Table 6: NEO FEM Coordinate System definition.

Coord Sys ID	Nastran Card	Reference Coord Sys ID	Description
8000001	CORD2R	0	Main NEO Coordinate System
8000002	CORD2C	8000001	Cylindrical Coordinate System

Figure 26:
NEO 15" FEM.



3.8 Separation Velocity

Separation velocity depends on the spacecraft mass and the strength of the separation springs. The spring strength can be tailored in discrete steps and within boundaries to match a desired deployment velocity by mixing and matching from the available spring strengths. Using springs of different strengths has no effect on the tip-off rate. Figure 27 demonstrates the relationship between satellite mass and deployment speed relative to different values of the total spring energy.

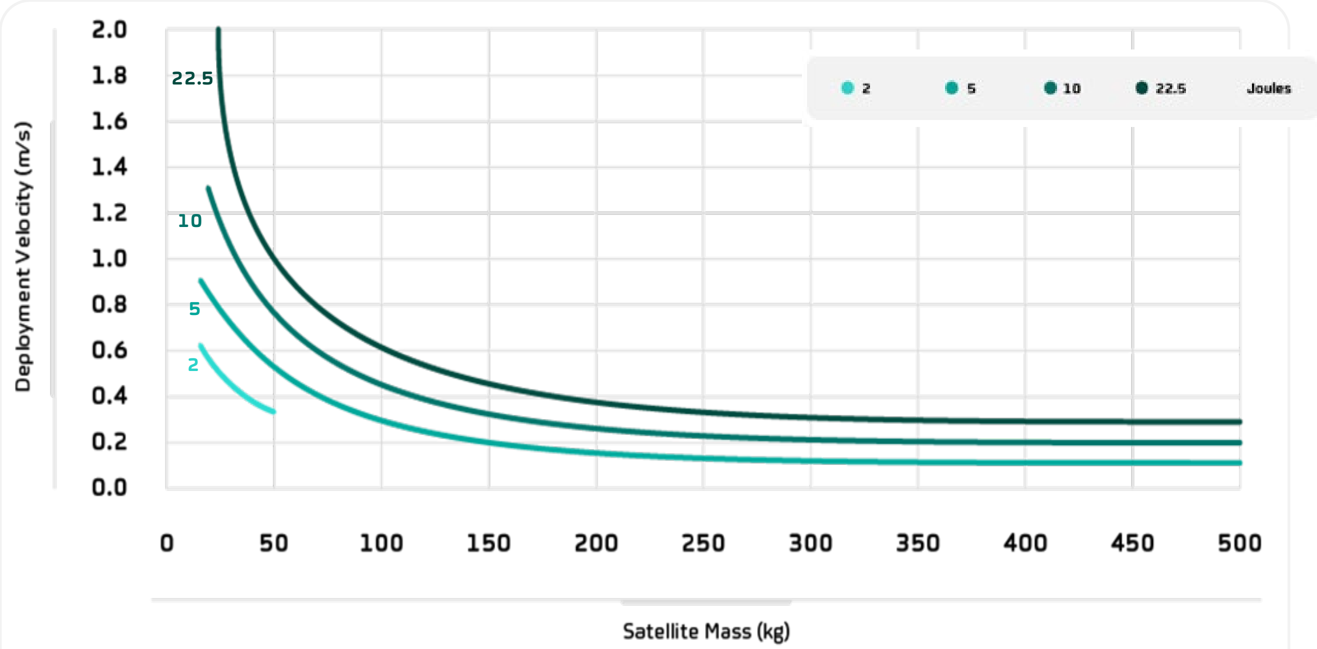


Figure 27: Deployment Velocity vs. Satellite Mass.

The spring sets have a total energy tolerance of about 20%. Precise spring strengths will be measured in the course of the mission, increasing the precision to 2%. The table below shows the minimum and maximum values of the separation energy. For separation velocity calculations, the equation for Kinetic Energy can be used.

$$KE = \frac{1}{2}mv^2$$

Table 7: Spring Set to Minimum and Maximum Energy.

Description	8"	15"	24"	31.6"	38.81"
Number of springs	3	4	6	8	(10 TBC)
Spring 1 energy (brown) [J]	0.7	1.1			
Spring 2 energy (black) [J]	1.3	2.2			
Spring 3 energy (green) [J]	2.25	3.7			

3.9 Tip-Off Rates

Due to the unique design of the CarboNIX and NEO pusher arm system, all four pusher arms will extend at the same speed, regardless of the loads each individual arm faces. For this reason, the satellite will separate with near-zero initial rotation, independent of the satellite mass distribution.

Results from satellites deployed in space show an average rotation rate of 0.6 deg/s across all three axes. No axis rotation higher than 2.2 deg/s has been recorded from satellites deployed by CarboNIX or NEO.

Table 8: Examples of customer-reported tip-off rates for different satellites types.

No.	Satellite Mass [kg]	CG RSS Eccentricity [mm]	Spring Energy (J)	Deploy Velocity [m/s]	NEO Tip-Off Rate [deg/s]			
					X	Y	Z	ABS MAX
1	110	5	4.4	0.28	-0.40	1.09	-0.54	**1.09**
2	110	5	15.5	0.53	0.13	0.34	0.04	**0.34**
3	110	5	9.4	0.41	0.25	0.40	1.90	**1.9**
4	99.7	11	15.5	0.56	0.28	-0.59	0.97	**0.97**
5	104.4	26.7	15.5	0.54	0.12	1.97	0.65	**1.97**
6	89.6	28	9.4	0.46	-0.60	-1.01	0.98	**1.01**
7	116.7	16.1	15.5	0.52	0.97	0.12	2.20	**2.2**
8	90.9	24.1	15.5	0.58	1.47	0.61	-0.77	**1.47**
9	91.7	36.1	9.4	0.45	-0.59	-0.41	-0.37	**0.59**
10	90.8	28	15.5	0.58	1.02	-0.83	0.51	**1.02**
11	89.9	35.7	15.5	0.59	0.27	0.03	0.79	**0.79**
12	108.8	15.7	15.5	0.53	0.05	1.39	1.34	**1.39**
13	110	5	4.4	0.28	0.50	0.50	0.90	**0.9**
14	89.6	28	10.4	0.48	-0.70	-0.49	0.80	**0.8**
15	105	26.7	15.5	0.54	0.02	1.80	2.22	**2.22**
16	91.4	34.3	15.5	0.58	1.45	0.25	-0.23	**1.45**
17	110	5	15.5	0.53	-0.29	-0.10	-0.26	**0.29**
18	110	5	9.4	0.41	-0.31	-0.28	-0.78	**0.78**
19	90.4	22.7	15.5	0.59	-0.80	-0.25	0.13	**0.8**
20	88.7	13.7	9.4	0.46	0.03	0.70	0.54	**0.7**
21	89.3	28	13.9	0.56	0.48	0.49	0.61	**0.61**
22	96.1	12.8	13.9	0.54	-0.80	0.59	1.89	**1.89**
23	21.9	6.6	4.4	0.63	1.38	0.73	1.21	**1.38**
Max tip-off rate (deg/s)								**2.22**

3.10 Separation Shock

Shock values generated by NEO during release are very low. However, some shock is still generated during separation due to the sudden release of spring energy. Separation shock values were determined during multiple NEO qualification campaigns.

Figure 28:
Shock Sensors Measure Shock Generated by NEO during the Separation.

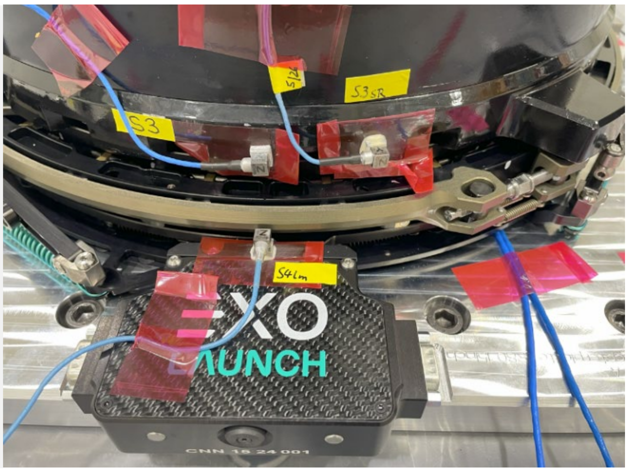
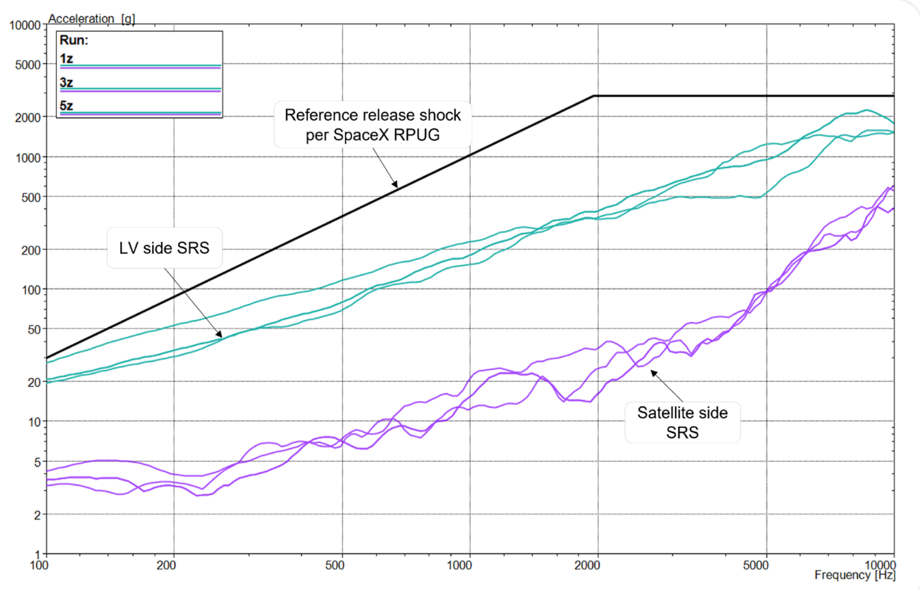


Figure 29:
NEO 15 Release Shock Response Spectrum measured at Satellite Mass Simulator Baseplate and LV-side Interface.



As shown in Figure 29, the shock loads generated by the release of NEO are significantly damped before reaching the mass simulator baseplate (Satellite side SRS). These loads will see further damping when performed on a real satellite structure, creating a low shock environment for sensitive payloads.

3.11 Electrical Interfaces

3.11.1 DSub-9 Connectors

The NEO locking mechanism has two male DSub-9 connectors (Harting 09674095615). The connectors are fully redundant and either one or both connectors can be used to trigger NEO.

Figure 30:
CarboNIX NEO DSub-9 Connectors

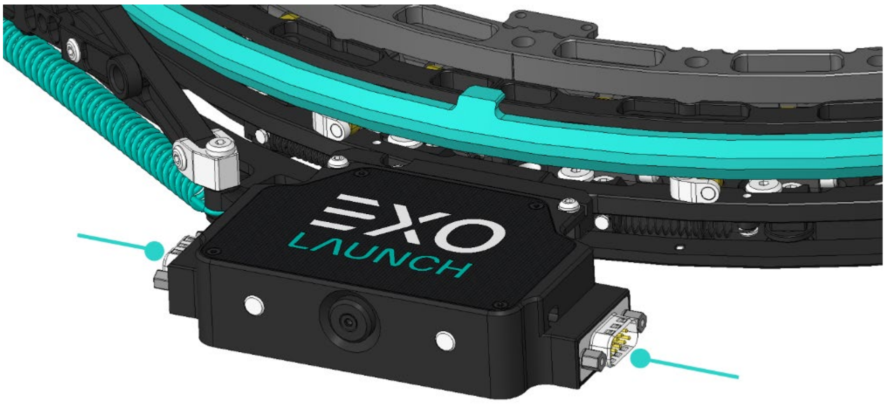


Table 9: NEO Pinout.

Pin	Designation	Function	Continuity Check Across Pins
1	Clamp Ring TM1	Closed after deployment	
2	Pusher Arm TM2	Closed after deployment	
3	-	-	
4	Actuator 2	Return	1.2V ± 10% drop across pins, using multimeter* in Diode mode.
5	Actuator 2	VCC	
6	Clamp Ring TM1	Closed after deployment	
7	Pusher Arm TM2	Closed after deployment	
8	Actuator 1	Return	1.2V ± 10% drop across pins, using multimeter* in Diode mode.
9	Actuator 1	VCC	

*Explosion-safe multimeter not required.

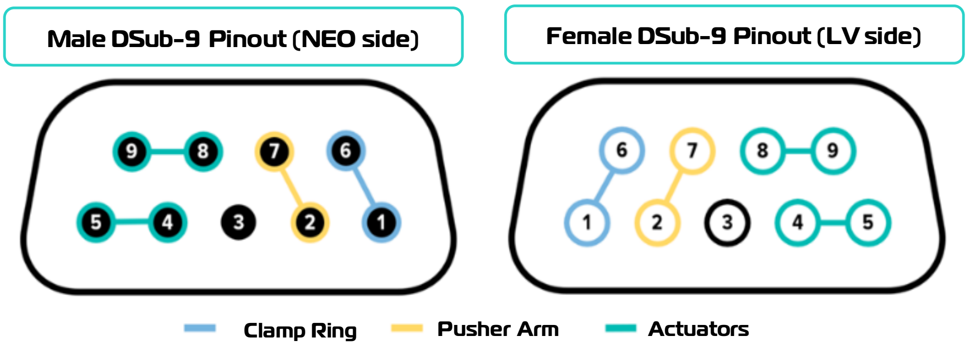


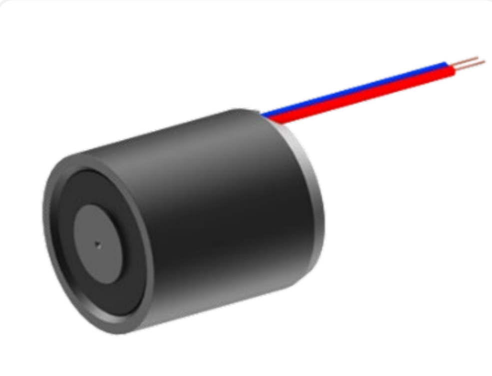
Figure 31: NEO Pinout schematics.

3.11.2 Separation Signal

NEO uses two permanent electromagnets at the heart of the locking mechanism. Similar to a solenoid, these devices use a permanent magnet to hold NEO locked in place, without power, until the separation signal is received.

Table 10: Permanent Electromagnet Properties and example of permanent magnet.

Holding force [N]	70	Minimum All-fire Current [mA]	160
Voltage Drop	1.2V ± 10%	Nominal Separation Current [mA]	280
Nominal Voltage [V]	28	Maximum Current [mA]	500
Voltage Range [V]	24-36	Nominal Pulse Duration [ms]	500
Maximum No-fire Current [mA]	25	Duty Cycle (cycle time 30s)	10%



3.11.3 Grounding

NEO provides an electrically conductive path from the satellite interface to the launch vehicle. The satellite manufacturer is responsible for ensuring that the M6 or 1/4" threads at the mounting interface are electrically connected to the rest of the satellite structure.

3.12 Thermal Properties

For thermal modeling exercises, the following measured thermal properties of the NEO system can be used.

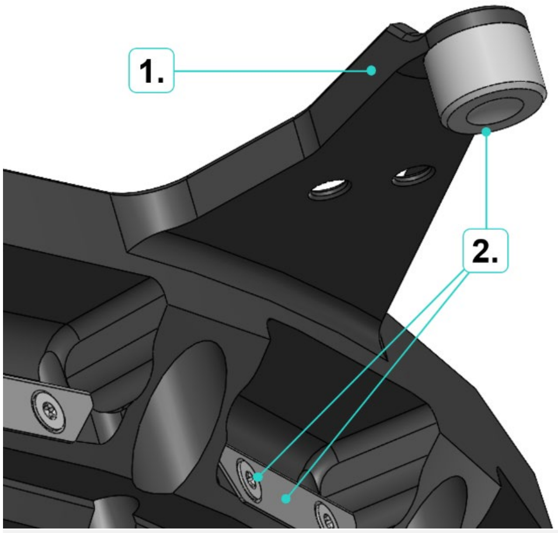


Figure 32: S-Ring thermal elements.

Table 11: NEO S-Ring Thermal Properties.

No.	Color	Emissivity	Absorptivity
1	Black	0.89	0.72
2	Silver	0.11	0.42

A

Appendix

Detailed Mass Properties

NEO 8

Table 12: NEO 8" Mass Properties

L-Ring Mass [kg]			2.4
S-Ring Mass [kg]			0.4
L-Ring Stowed	Center of Gravity [mm]	X	
		Y	
		Z	
	Moment of Inertia [kgmm²]	X	
		Y	
		Z	
	Product of Inertia [kgmm²]	YZ	
		XZ	
		XY	
L-Ring Deployed	Center of Gravity [mm]	X	
		Y	
		Z	
	Moment of Inertia [kgmm²]	X	
		Y	
		Z	
	Product of Inertia [kgmm²]	YZ	
		XZ	
		XY	
S-Ring	Center of Gravity [mm]	X	
		Y	
		Z	
	Moment of Inertia [kgmm²]	X	
		Y	
		Z	
	Product of Inertia [kgmm²]	YZ	
		XZ	
		XY	
Combined System Stowed	Center of Gravity [mm]	X	
		Y	
		Z	
	Moment of Inertia [kgmm²]	X	
		Y	
		Z	
	Product of Inertia [kgmm²]	YZ	
		XZ	
		XY	

NEO 15

Table 13: NEO 15" Mass Properties

L-Ring Mass [kg]			**3.96**
S-Ring Mass [kg]			**0.82**
Total Mass [kg]			**4.78**
L-Ring Stowed	Center of Gravity [mm]	X	-1.23
		Y	26.62
		Z	19.23
	Moment of Inertia [kgmm²]	X	96706.61
		Y	76257.35
		Z	171313.60
	Product of Inertia [kgmm²]	YZ	-304.32
		XZ	-31.06
		XY	13.07
L-Ring Deployed	Center of Gravity [mm]	X	-1.25
		Y	26.56
		Z	20.09
	Moment of Inertia [kgmm²]	X	95972.06
		Y	75518.63
		Z	170273.44
	Product of Inertia [kgmm²]	YZ	-302.51
		XZ	-78.80
		XY	73.76
S-Ring	Center of Gravity [mm]	X	0.00
		Y	0.00
		Z	38.72
	Moment of Inertia [kgmm²]	X	14255.39
		Y	14255.46
		Z	28429.29
	Product of Inertia [kgmm²]	YZ	0.00
		XZ	0.00
		XY	0.00
Combined System Stowed	Center of Gravity [mm]	X	-1.04
		Y	22.03
		Z	23.27
	Moment of Inertia [kgmm²]	X	110939.99
		Y	90010.14
		Z	199181.34
	Product of Inertia [kgmm²]	YZ	-637.51
		XZ	-63.04
		XY	51.30

NEO 24

Table 14: NEO 24" Mass Properties

L-Ring Mass [kg]			**6.02**
S-Ring Mass [kg]			**1.28**
Total Mass [kg]			**7.30**
L-Ring Stowed	Center of Gravity [mm]	X	0.00
		Y	23.16
		Z	20.88
	Moment of Inertia [kgmm²]	X	329529.60
		Y	281950.96
		Z	609612.36
	Product of Inertia [kgmm²]	YZ	-670.87
		XZ	0.51
		XY	-3068.40
L-Ring Deployed	Center of Gravity [mm]	X	0.02
		Y	23.20
		Z	18.87
	Moment of Inertia [kgmm²]	X	330535.80
		Y	283272.24
		Z	611761.69
	Product of Inertia [kgmm²]	YZ	-474.63
		XZ	0.45
		XY	-3593.54
S-Ring	Center of Gravity [mm]	X	0.00
		Y	0.00
		Z	38.60
	Moment of Inertia [kgmm²]	X	57528.86
		Y	57529.89
		Z	114932.01
	Product of Inertia [kgmm²]	YZ	-0.02
		XZ	0.00
		XY	0.00
Combined System Stowed	Center of Gravity [mm]	X	0.00
		Y	19.13
		Z	23.48
	Moment of Inertia [kgmm²]	X	387587.00
		Y	339447.77
		Z	724335.15
	Product of Inertia [kgmm²]	YZ	-1116.60
		XZ	0.44
		XY	-3068.31

NEO 31.6

Table 15: NEO 31.6" Mass Properties

L-Ring Mass [kg]			7.67
S-Ring Mass [kg]			1.68
Total Mass [kg]			9.35
L-Ring Stowed	**Center of Gravity [mm]**	**X**	0.00
		Y	22.85
		Z	20.32
	Moment of Inertia [kgmm²]	**X**	708283.90
		Y	614054.03
		Z	1313607.99
	Product of Inertia [kgmm²]	**YZ**	-850.66
		XZ	0.77
		XY	-9407.87
L-Ring Deployed	**Center of Gravity [mm]**	**X**	0.01
		Y	22.89
		Z	18.69
	Moment of Inertia [kgmm²]	**X**	703083.14
		Y	612337.47
		Z	1313044.07
	Product of Inertia [kgmm²]	**YZ**	-566.85
		XZ	0.77
		XY	-9488.32
S-Ring	**Center of Gravity [mm]**	**X**	0.00
		Y	0.00
		Z	38.59
	Moment of Inertia [kgmm²]	**X**	134969.49
		Y	134971.26
		Z	264761.89
	Product of Inertia [kgmm²]	**YZ**	-0.02
		XZ	0.00
		XY	0.00
Combined System Stowed	**Center of Gravity [mm]**	**X**	0.00
		Y	18.74
		Z	23.61
	Moment of Inertia [kgmm²]	**X**	834758.17
		Y	743813.64
		Z	1575086.31
	Product of Inertia [kgmm²]	**YZ**	-1426.69
		XZ	0.66
		XY	-9407.73

B

Appendix

Mounting Interface Specifications

NEO 8 S-Ring and L-Ring THRU

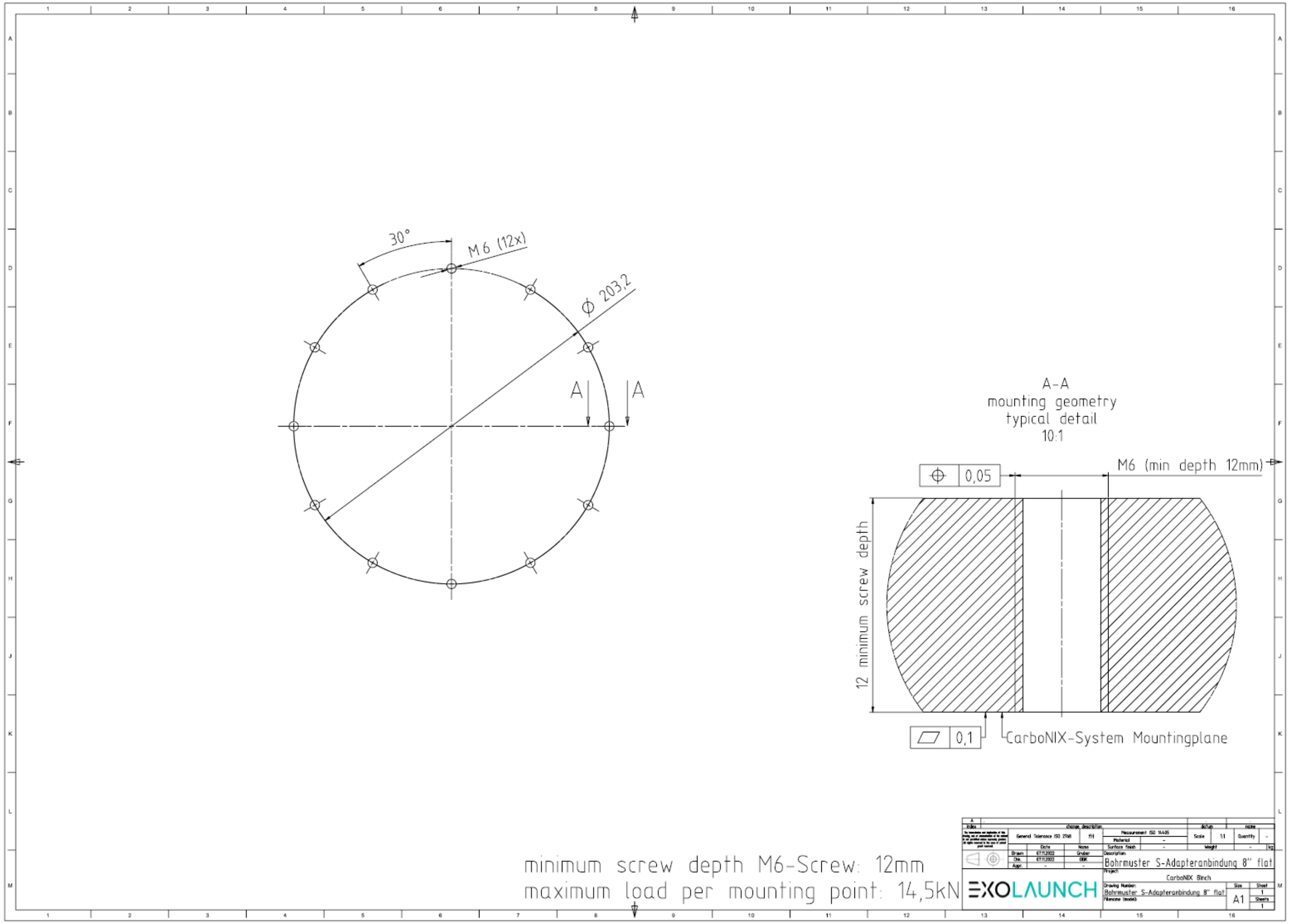


Figure 33: Satellite interface Definition for NEO 8.

NEO 8 L-Ring THREADS

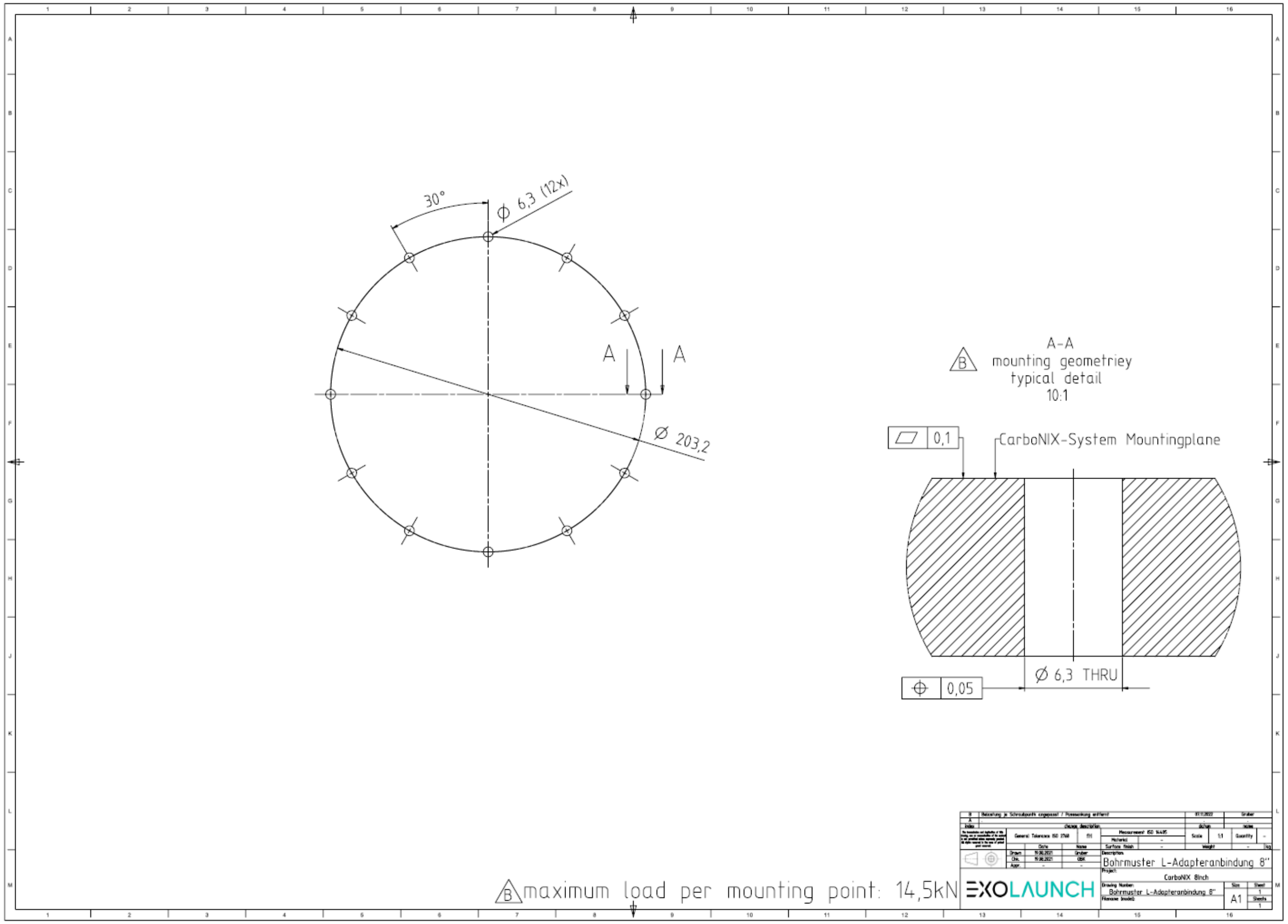


Figure 34: LV-Side Interface Definition for NEO 8 with Threaded Holes (Not Preferred).

NEO 15 S-Ring and L-Ring THRU

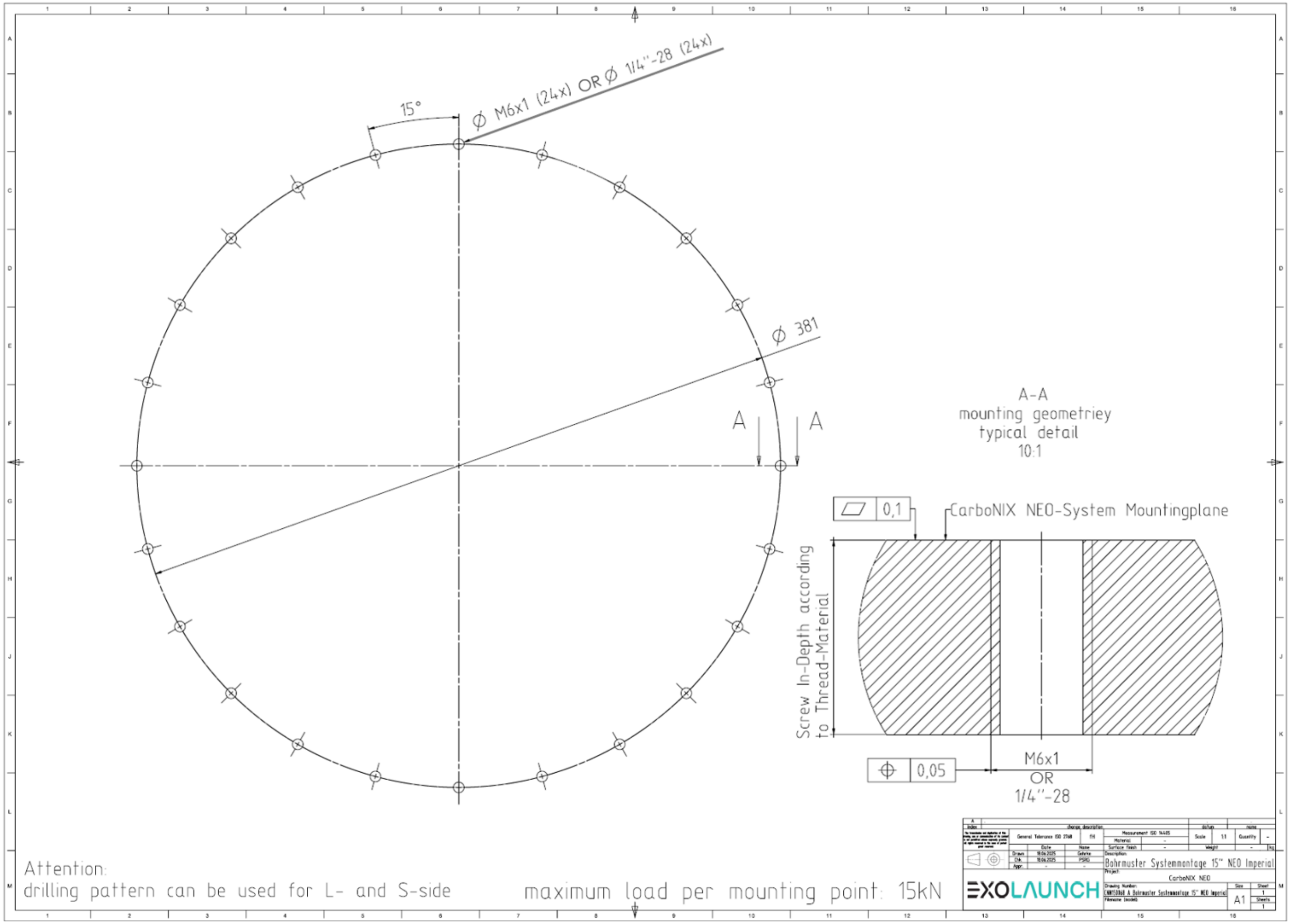


Figure 35: Satellite Interface Definition for NEO 15.

NEO 15 L-Ring THREADS

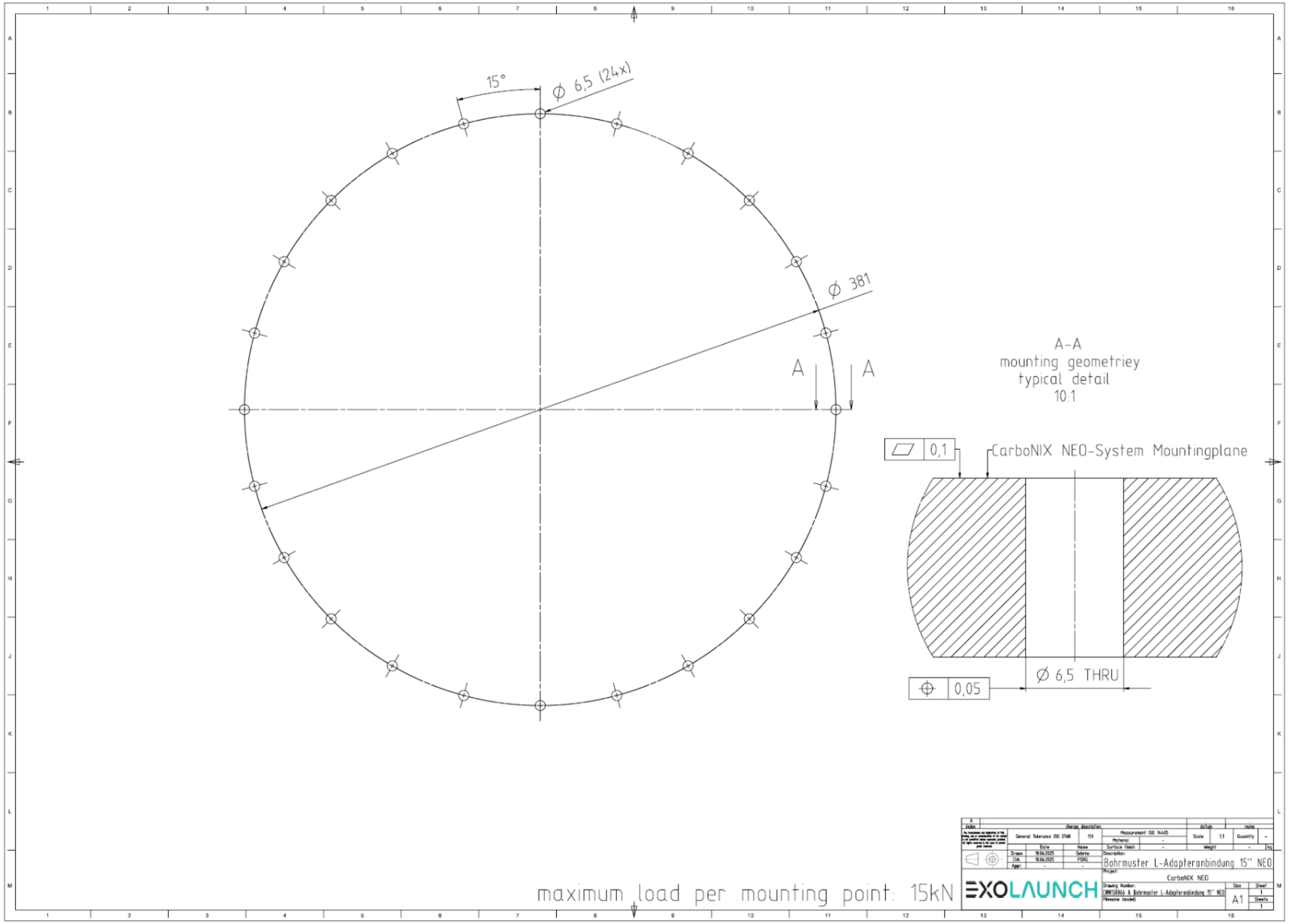


Figure 36: LV-Side Interface Definition for NEO 15 with Threaded Holes (Not Preferred).

NEO 24 S-Ring and L-Ring THRU

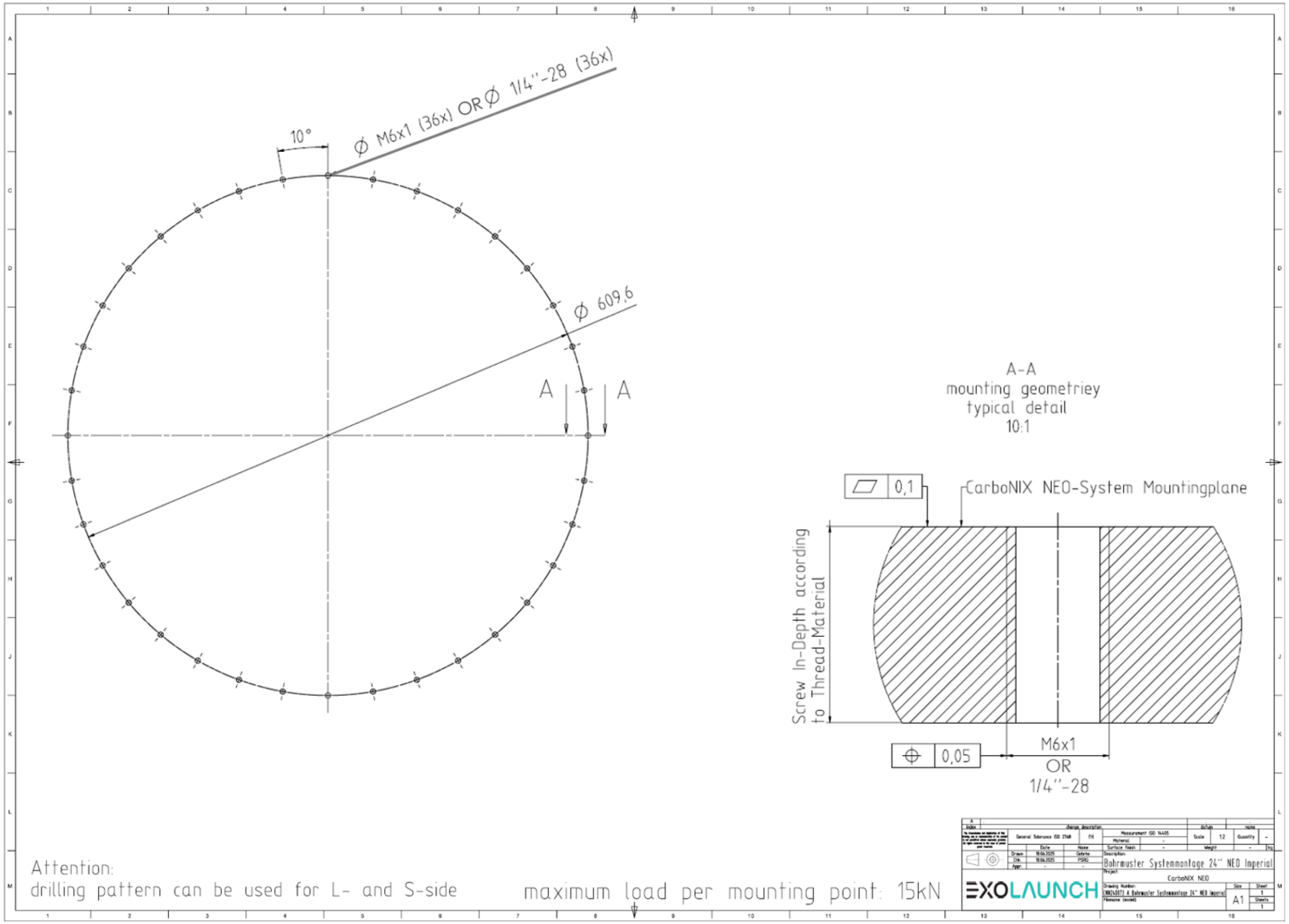


Figure 37: Satellite Interface Definition for NEO 24.

NEO 24 L-Ring THREADS

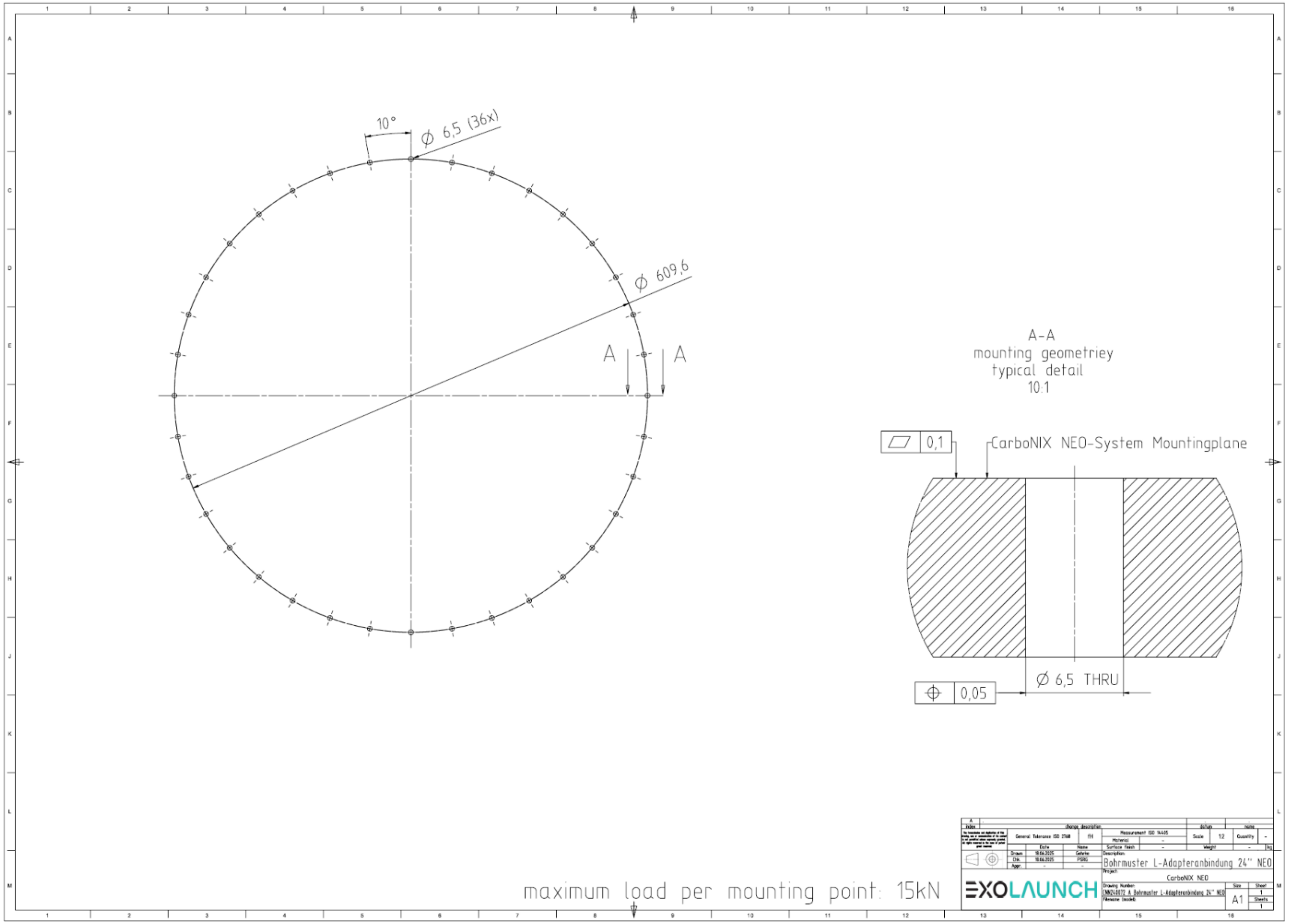


Figure 38: LV-Side Interface Definition for NEO 24 with Threaded Holes (Not Preferred).

NEO 31.6 S-Ring and L-Ring THRU

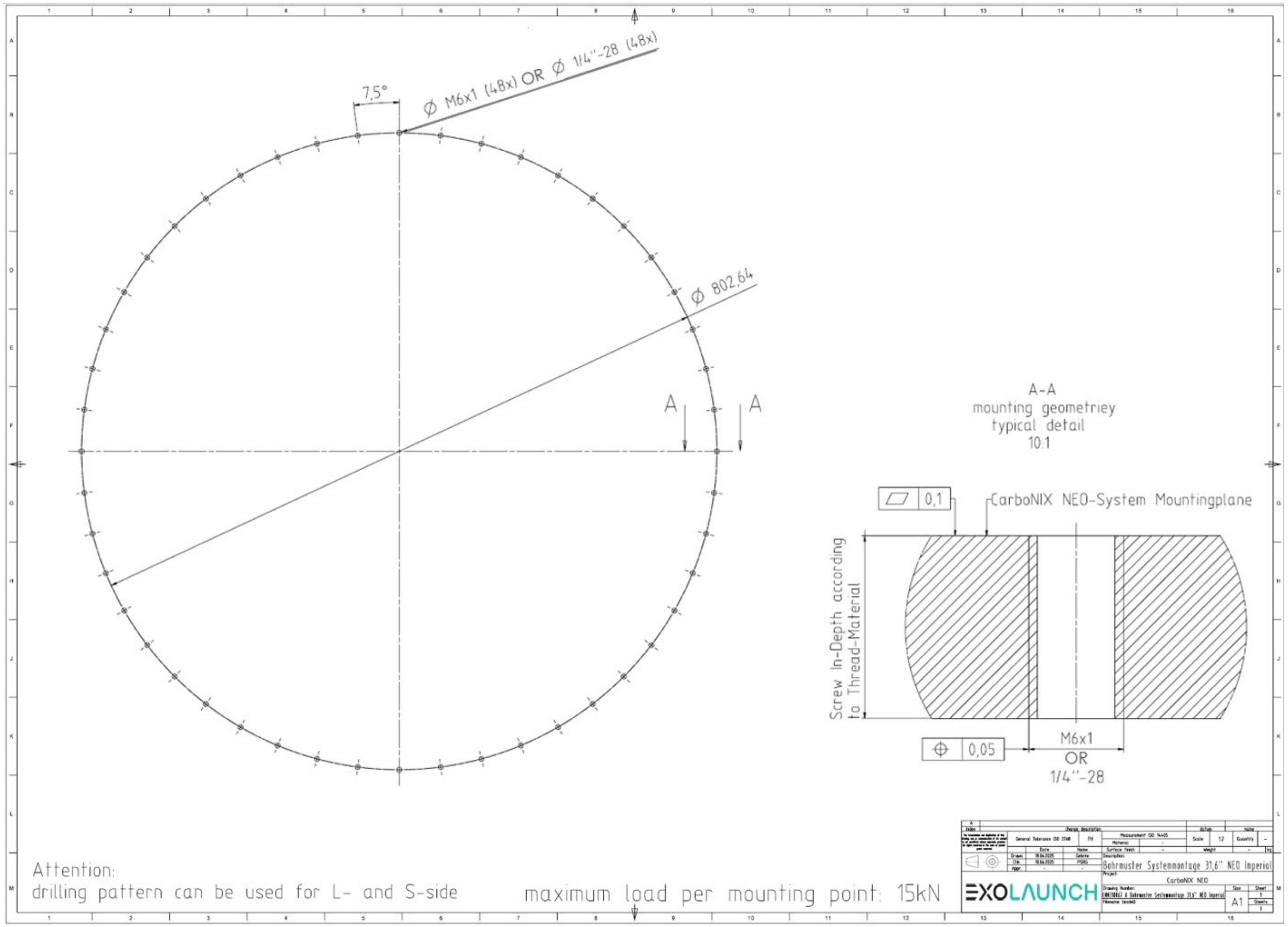


Figure 39: Satellite Interface Definition for NEO 31.6.

NEO 31.6 L-Ring THREADS

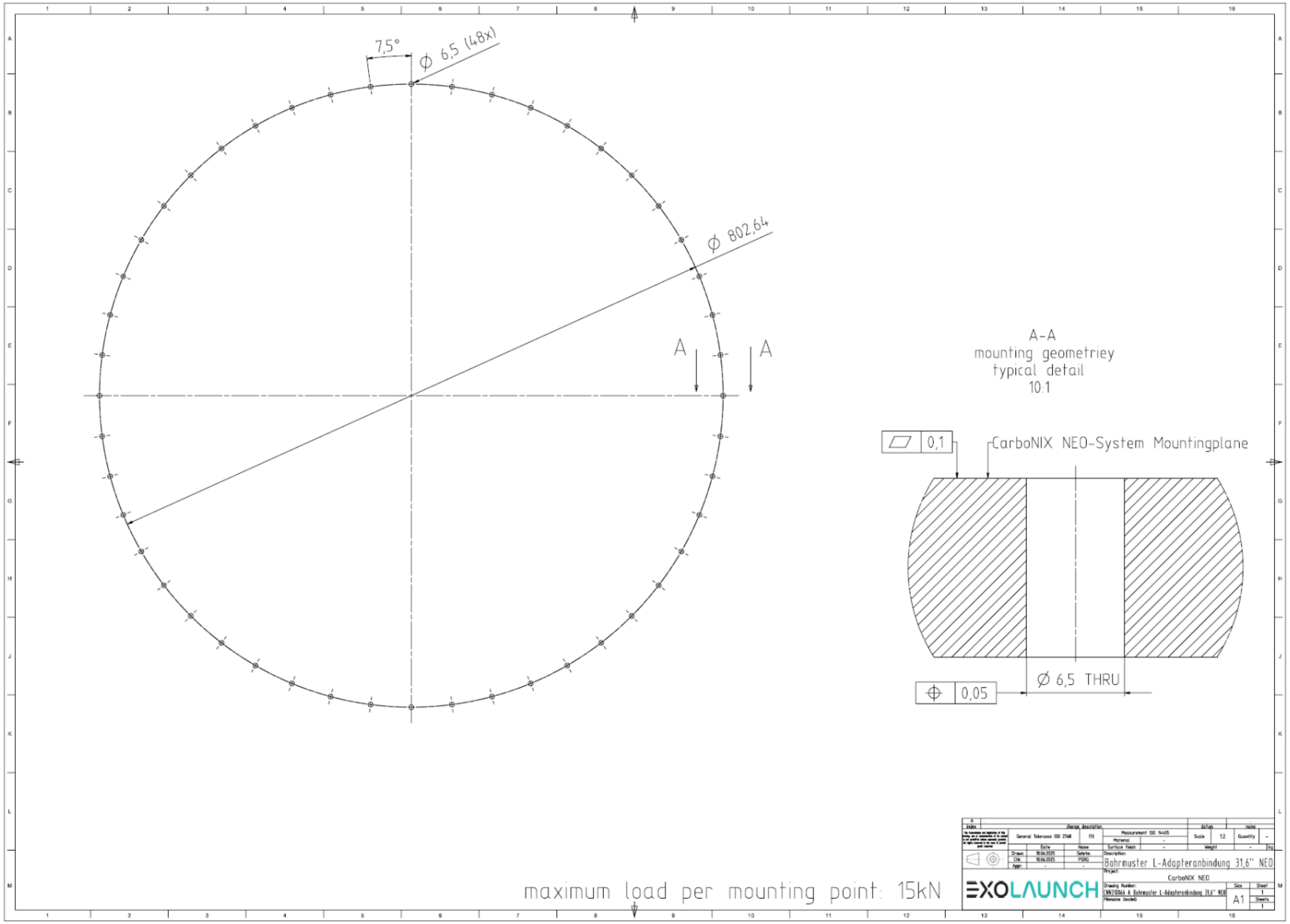


Figure 40: LV-Side Interface Definition for NEO 31.6 with Threaded Holes (Not Preferred).

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