SMALL SATELLITE LICENSE

Orbital Debris Assessment Report

LYNK GLOBAL, INC.

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Orbital Debris Self-Assessment: Lynk Smallsat System

This report is in compliance with NASA-STD-8719.14, Appendix A, Report Version 3.1 using NASA Debris Assessment Software ("DAS") version 3.1.0.

Requirement	Launch Vehicle				Satellite			Comments
	Compliant	Not Compliant	Incomplete	Standard Non-Compliant	Compliant	Not Compliant	Incomplete	
4.3-1.a	N/A				X			No debris released in LEO
4.3-1.b					X			No debris released in LEO
4.3-2					X			No debris released in GEO
4.4-1					X			Less than 0.001 probability
4.4-2					X			Designed to passivate electrical power system and reaction wheels
4.4-3					X			No planned breakups
4.4-4					X			No planned breakups
4.5-1					X			Probability 0.00000 (requirement < 0.001)
4.5-2					X			Probability 0.00000 (requirement < 0.01)
4.6-1(a)					X			Predicted orbital lifetime 5.17 yrs
4.6-1(b)					X			N/A – using atmospheric entry
4.6-1(c)					X			N/A – using atmospheric entry
4.6-2					X			N/A – Not GEO
4.6-3					X			N/A – Not between LEO and GEO
4.6-4					X			Expected probability < 0.001
4.7-1					X			No pieces survive re-entry
4.8-1					X			No tethers used

The satellites of the Lynk Smallsat System will be launched via SpaceX rideshare missions. The launch manifest schedule for the Lynk Smallsat System will solidify as satellites are manufactured and become ready for launch. Lynk provides the following baseline rideshare launch schedule:

Planned Launch Schedule			
Launch Date	Number of Satellites	Inclination	Altitude
2021 December	1	97.6° (+/- 0.3°)	550 km (+/- 25 km)
2022 July	3	97.6° (+/- 0.3°)	550 km (+/- 25 km)
2022 December	6	53.0° (+/- 0.1°)	500 km (+/- 25 km)

NASA-STD 9719.14A compliance requirements on the launch vehicle are not applicable to this document and remain the launch provider's responsibility.

1 Program Management and Mission Overview

1.1 Program Management

Management	Name	Title
Mission Directorate	N/A	
Program Executive	Tyghe Speidel	CTO
Program/Project Manager	Tyghe Speidel	CTO

Table 1 - Summary of Program Management Personnel

1.2 Mission Overview

1.2.1 Mission Design and Development Milestones

The project milestones for the Lynk Smallsat System align with the launch date of each rideshare mission. The delivery milestone for each set of satellite is approximately one to two months prior to its projected launch date.

1.2.2 Mission Overview

The goal of the Lynk Smallsat System is to provide two-way data communications to and from standard cellular/mobile devices in remote locations on the Earth.

Parameter	First Launch (1 Satellite)	Second Launch (3 Satellites)	Third Launch (6 Satellites)
Launch vehicle and launch site	SpaceX SSO Falcon 9 Rideshare	SpaceX SSO Falcon 9 Rideshare	SpaceX LEO Falcon 9 Rideshare
Proposed launch date	December 2021	July 2022	December 2022
Mission duration	The operational lifetime of the hardware and electronics for this satellite is designed to 5 years following deployment from the launch vehicle.	The operational lifetime of the hardware and electronics for these satellites is designed to 5 years following deployment from the launch vehicle.	The operational lifetime of the hardware and electronics for these satellites is designed to 5 years following deployment from the launch vehicle.
	If the satellite fails, the maximum orbital lifetime for the satellites is expected to be less than 5.17 years, depending on the vehicle's orbit, its orientation, and the solar influence of the Earth's atmosphere, as described in Section 6.	If a satellite fails, the maximum orbital lifetime for the satellites is expected to be less than 5.17 years, depending on the vehicles' orbits, their orientations, and the solar influence of the Earth's atmosphere, as described in Section 6.	If a satellite fails, the maximum orbital lifetime for the satellites is expected to be less than 2.96 years, depending on the vehicles' orbits, their orientations, and the solar influence of the Earth's atmosphere, as described in Section 6.
Launch and deployment profile	This Lynk satellite will decay naturally for debris mitigation and will re-enter within 25 years after completion of mission.	The Lynk satellites will decay naturally for debris mitigation and will re-enter within 25 years after completion of mission.	The Lynk satellites will decay naturally for debris mitigation and will re-enter within 25 years after completion of mission.

Table 2 - Summary of Mission Parameters

2 Satellite Description

This ODAR assumes the largest of the satellite dimensions described in this application. The largest size maintains the largest surface area on one side and has a larger ballistic coefficient (or larger area-to-mass ratio). Consequently, the largest size poses the highest risk for collision analysis and highest orbital lifetimes in the event of a drag-based re-entry procedure. Therefore, Lynk provides an ODAR that represents the highest impact and most conservative assessment of orbital debris risk represented by the Lynk Smallsat System.

2.1 Physical Description of Satellite

The satellites in the Lynk Smallsat System are designed to support a five (5) year mission in sun-synchronous and mid-inclination low-Earth orbits. The flat box design of each satellite is 1.5 m by 1.5 m by 0.15 m and with an approximate dry mass of 80 kg and wet mass of 85 kg.

The satellite design uses subsystem modules primarily built from printed circuit boards ("PCB") or miniature enclosures mounted to the open frame primary structure. The wide, open structure permits the vehicle to be built incrementally with open access for securing interconnects. The subsystems are placed within the vehicle to optimize mass properties, radiation protection, thermal heat rejection, power handling, vehicle orientation, and cabling length. The power generation system uses solar panels which are body mounted to the outside of the satellite chassis panels. The vehicle is primarily constructed out of aluminum and PCB materials.

The subsystems of the satellites will have significant flight heritage inherited from six (6) prior technology demonstration missions.

Parameter	Value
Total satellite mass at launch, including all propellants and fluids	~85 kg
Dry Mass of satellite at launch, excluding solid rocket motor propellants	~80 kg
Form Factor	Flat Panel
Center of Mass	+/- 15 cm from center of envelope in X and Y axes, +/- 03 cm in Z axis
Envelope	150 cm x 150 cm x 15 cm
Propulsion Systems	Water Resistojet
Fluid Systems	Water Tank
Guidance, Navigation and Control (GNC) and Attitude Determination and Control (ADC) Systems	Reaction wheels and magnetic torque coils, GPS, thermal IR sensors, and inertial measurement units
Electrical Generation	Solar Cells
Electrical Storage	Rechargeable Lithium-Ion batteries. Qty 32: NCR18650B Panasonic Cells
Identification of any other sources of stored energy	NONE
Identification of any radioactive materials on board	NONE

Table 3: Summary of Satellite Parameters

2.1.1 Description of Propulsion System

Some satellites will host a propulsion system, while others will not. The satellites with a propulsion system will utilize a water-based resistojet thruster. The water will be kept in an incredibly low, self-pressurized tank (100 psi). There is no risk of accidental explosion from the water tanks as they will be designed to a margin of safety of ≥ 30. Heating from the satellite as well as dedicated heaters will be used to prevent water from freezing. However, the tanks will be designed to accommodate the increase in volume in the event the water were to freeze on orbit. Furthermore, in the event of propulsion system failure, the satellites will still be able to conduct their full mission. A control valve will allow water from the tank to be released into a heating chamber with a heating element to convert the water to steam and ultimately releasing the steam through a thruster nozzle on the other side of the heating chamber.

2.1.2 Description of Attitude Control System

The Lynk satellite attitude determination and control system consist of a processor, GPS receiver, sun sensors, gyroscopes, magnetometers, thermal IR sensors, reaction wheels, and integrated torque coils. Primary attitude knowledge is provided by the magnetometers, gyroscope, thermal IR sensors, and a GPS-based magnetic field model. Primary attitude control is provided by the torque coils and reaction wheels.

2.1.3 Description of normal attitude of the satellite with respect to the velocity vector

The nominal attitude of the Lynk satellite is an LVLH orientation with the antenna aligned with the satellite z-axis, pointed down toward the nadir direction. An attitude control program will use the reaction wheels to maintain desired satellite orientation and the torque coils will assist, while also preventing the reaction wheels from saturating. The satellite is also capable of three-axis inertial control and can point dynamically to any inertial vector in space for inertial holds, high drag and low drag attitudes, sun pointing, or low-rate slews to point antennas at target locations on the Earth.

2.1.4 Description of any range safety or other pyrotechnic devices

None.

2.1.5 Description of the electrical generation and storage system

Energy generation is accomplished using body mounted solar panels on +x, -x, +y, -y, and +z faces of the satellite body. Energy storage is accomplished using Lithium(Li)-ion battery cells in an 8 series, 1 parallel (“8S1P”) electrical configuration. Physically the cells are separated into four packs with eight cells in each pack. The packs are physically separated within the satellite. Each satellite utilizes 32 Li-Ion cells to provide the satellite bus 28 volts. The cells are recharged by the solar cells mounted on the satellite. Power management and distribution is provided by the satellite electrical power system (EPS) and pack-level battery protection circuitry.

3 Assessment of Debris Released During Normal Operations

Lynk has assessed and limited the amount of debris released in a planned manner during normal operations. There is no intentional release of any object during normal operations.

Parameter	Value
Identification of any object (>1mm) expected to be released from the satellite at any time after launch	**None**
Rationale/necessity for release of object	N/A
Time of release of each object, relative to launch time	N/A
Release velocity of each object with respect to satellite	N/A
Expected orbital parameters of each object after release	N/A
Calculated orbital lifetime of each object	N/A
Compliance 4.3-1 Mission related debris passing through LEO	COMPLIANT
Compliance 4.3-2 Mission related debris passing through GEO	N/A

Table 4: Summary of Satellite Debris Released During Normal Operations

4 Assessment of Potential for Explosions and Intentional Breakups

Lynk has assessed and limited the probability, during and after completion of mission operations, of accidental explosions or of release of liquids that will persist in droplet form.

4.1 Potential causes of breakup during deployment and mission operations

There is no credible scenario that would result in satellite breakup during normal deployment and operations.

4.2 Summary of failure modes and effects analysis of all credible failure modes

There are four (4) Li-Ion battery packs aboard each satellite which are ninety-two (92) W*hrs each and represent the only credible failure mode during which stored energy could be released. The main failure modes associated with Li-Ion batteries result from overcharging, over-discharging, internal shorts, and external shorts.

Overcharging, under-discharging, and external shorts are prevented by the solar-battery charger protection circuitry on each battery pack. The over current protection is set to ten (10) Amps. The battery overcharge protection limits both charging current and voltage. Likewise, over-discharging is prevented by a low voltage disconnect and a ten (10) Amp current limiter.

Each battery pack contains eight Li-ion cells wired in series to an aluminum housing creating a robust twenty-eight (28) Volt supply. The four (4) batteries in each satellite are designed to be mechanically integrated into the satellite with greater than four (4) inches separating the physical battery packs. Furthermore, each pack is thermally heat sunk to a separate heat sink on opposite sides of the satellite. In the unlikely event that one battery pack experiences an internal short, the batteries are separated and thermally isolated with enough separation to eliminate the possibility of thermal runaway in one battery causing thermal runaway in another battery.

In the case of a cell experiencing a catastrophic failure event—e.g., overcharge to the point of venting, or internal/external short, resulting in overheating and/or gas venting—the battery-level and cell-level safety protections further mitigate the probability of failure propagation. The cells are designed to vent out the top in the event of over-heating/over-pressure through the positive terminal (button cap). In the unlikely case where cell rupture in the sidewall occurs, the pack-level design includes physical aluminum barriers between cells and a twenty (20)-millimeter compliant gap filling material between each cell and the aluminum housing.

Overall, the physical aluminum separators will prevent a failure from propagating between cells and the compliant material creates room for venting in the case of overpressure. There are also vent holes in the capture plates at the bottom/top of the battery packs to allow for venting in the case of over-pressure.

If there is a propulsion system on board, the system will have no explosive failure modes. The propulsion system contains only inert fluids and will be built to a four (4)x pressure safety margin.

4.3 Detailed plan for any designed satellite breakup

There are no planned breakups.

4.4 List of components which shall be passivated at End of Mission (EOM)

All RF transmitters and beacons will be disabled by default. Satellite transmissions are only initiated by time-based stored commands on the ground and self-terminate based on an internal timer. Additionally, all RF transmissions from the satellite can be disabled by command from the ground. All RF transmitters will be passivated at EOM.

Reaction wheels will be de-spun to their zero-momentum state using the torque coils prior to EOM and powered off. All batteries will be drained and passivated at the EOM.

If there is a propulsion system on board, the propulsion system will be passivated by opening all valves to vent any remaining water and depressurize the propulsion tank.

4.5 Rationale for all items which are required to be passivated, but cannot be due to their design

None.

4.6 Assessment of satellite compliance with Requirements 4.4-1 through 4.4-4

Requirement 4.4-1:

Limiting the risk to other space systems from accidental explosions during deployment and mission operations while in orbit about Earth or the Moon:

> *For each satellite and launch vehicle orbital stage employed for a mission, the program or project shall demonstrate, via failure mode and effects analyses or equivalent analyses, that the integrated probability of explosion for all credible failure modes of each satellite and launch vehicle is less than 0.001 (excluding small particle impacts) (Requirement 56449).*

Compliance statement:

Required Probability: 0.001

Expected probability: 0.000000 COMPLIANT

Requirement 4.4-2:

Design for passivation after completion of mission operations while in orbit about Earth or the Moon:

> *Design of all satellite and launch vehicle orbital stages shall include the ability to deplete all onboard sources of stored energy and disconnect all energy generation sources when they are no longer required for mission operations or post mission disposal or control to a level which cannot cause an explosion or deflagration large enough to release orbital debris or break up the satellite (Requirement 56450).*

Compliance statement:

The probability of a battery explosion is incredibly low and, due to the very small mass of the satellite, low individual battery capacity, and the short orbital lifetime, the effect of a highly unlikely explosion in the long-term LEO environment is negligible.

If there is a propulsion system on board, it would pose no explosion risk. It contains only inert fluids and will be built to withstand its maximum operating pressure to a high safety factor.

Assessment of satellite compliance with Requirements 4.4-1 through 4.4-4 shows that with a maximum orbital lifetime of 5.17 years, Lynk's satellites are compliant.

Requirement 4.4-3:

Limiting the long-term risk to other space systems from planned breakups:

Compliance statement:

This requirement is not applicable. There are no planned breakups.

Requirement 4.4-4:

Limiting the short-term risk to other space systems from planned breakups:

Compliance statement:

This requirement is not applicable. There are no planned breakups.

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5 Assessment of Satellite Potential for On-Orbit Collisions

Lynk has assessed and limited the probability of its satellites becoming a source of debris by (a) colliding with ***large*** debris or other operational space stations or (b) colliding with ***small*** debris or meteoroids that would cause loss of control and prevent disposal.

Lynk is aware that the orbit location of its satellites will be in the LEO environment where other satellite operators operate their orbiting assets. Furthermore, Lynk is aware that the operational orbit of the satellites is above that of the International Space Station ("ISS"), which is an inhabitable satellite in the LEO environment. Consequently, the satellites will have to transit through an orbital altitude which is common with the ISS during its de-orbit phase and possibly its orbit raising phase.

The satellites may or may not be dropped off at their operational altitude by the launch provider, depending on the launch scenario. In the event that satellites need to raise their orbit from an altitude below the ISS to their operational altitude above the ISS, Lynk would actively coordinate these maneuvers with NASA. The orbit raise maneuver would be conducted when the satellites are sufficiently out of phase (RAAN and true anomaly) with the ISS to create the largest separation distance possible when traversing through the ISS altitude during orbit raise. A similar procedure will be used when de-orbiting satellites. Any satellites scheduled for de-orbit would conduct a maneuver to lower their orbit when they are sufficiently out of phase (RAAN and true anomaly). This will maximize separation distance between the Lynk satellites and the ISS when the Lynk satellites traverse through the ISS altitude during de-orbit. Hence, Lynk is committed to the safety of NASA and other critical government/commercial assets in the LEO environment. Lynk will work directly with NASA to notify them of any planned maneuvers that might present a risk to manned assets operating in LEO. Lynk will be prepared to modify or correct any maneuver plans based on these interactions with NASA.

Furthermore, Lynk is aware that there are other commercial and government space assets operating in the LEO environment where Lynk satellites will operate. Lynk will cooperate and coordinate with other existing and future commercial and government operators of both manned and unmanned spacecraft that may be located in LEO.

Lynk certifies that upon written receipt of a space situational awareness conjunction warning, Lynk will review and take all possible steps to assess the collision risk and will mitigate the collision risk if necessary. As appropriate, steps to assess and mitigate the collision risk will include, but not be limited to, (1) contacting the operator of any active satellite involved in such a warning, (2) sharing ephemeris data and other appropriate operational information with any such operator, and (3) modifying space station attitude and/or operations to assist in avoiding any conjunctions.

5.1 Assessment of satellite trackability

To minimize the potential for collisions, Lynk has taken great care to design highly trackable satellites that are larger than ten (10) centimeters in their smallest dimension. Lynk will employ several mechanisms to track the satellites' locations and changing trajectory while on orbit.

Prior to deployment, Lynk will register its satellites with the 18th Space Control Squadron (a.k.a. "Space-Track") or successor entity and plans to share information regarding initial deployment, ephemeris, and/or planned maneuvers with Space-Track. Lynk is also willing to share trackability information with other entities that engage in space situational awareness or space traffic management functions, and/or other operators on an as-needed basis—e.g., to assist in conjunction resolution, etc. As such, Lynk is evaluating companies that provide satellite tracking as a service, which typically come in the form of a subscription to databases that actively track space objects in LEO using commercially developed radar systems around the planet. These services boast improved capability over the standard TLEs provided through the Space-Track database, and they may further enhance the trackability of Lynk's satellites.

Moreover, all satellites in the Lynk Smallsat System will be assigned a unique identifier prior to launch. This unique identifier will be included in all telemetry packets that are ever exchanged during a space-to-ground or ground-to-space interaction and will be logged and used to confirm and update tracking information for the Lynk network by specific satellite. The format of the unique identifier used for each Lynk satellite will be unique to Lynk, and Lynk alone.

Following deployment, the redundant GPS receiver equipped to each satellite will telemeter the GPS position vector of the satellite on downlink TT&C channels. This telemetry can be received at Lynk's command and control center in Falls Church, VA, either through the Globalstar relay link, S-band ground station links, or Ka-band ground station links. Additionally, the launch provider will provide inertial state vectors for deployment of the satellites, which Space-Track will use initially to track the satellites' TLEs.

After commissioning, and in the event that multiple satellites are deployed from the same launch vehicle, these TLEs will be verified or updated based on the data received by Lynk's telemetry downlink.

Finally, during ground station overpasses, Lynk can leverage Doppler and Ranging measurements to further refine orbit determination computations and to assist in more accurate satellite tracking telemetry.

By using on-board GPS and Space-Track TLEs (and possibly improved capabilities of other tracking companies), Lynk can predict trajectory paths for the satellite and predict possible conjunctions well in advance of any actual conjunction events taking place. At all times, the satellite orbits will be tracked via Space-Track and onboard GPS, and they will be monitored for safety with respect to conjunctions. The accuracy of the tracked orbital parameters of the satellites will be limited by the accuracy of the TLEs provided by Space-Track (and other possible solutions). Space-Track will publicly publish the TLEs of Lynk's satellites, and Lynk will share the orbit position and velocity telemetry with third parties as needed to ensure the trajectory of the satellite does not pose any risks to any other LEO assets.

In the unlikely event of a conjunction, Lynk would coordinate with the satellite operator of the satellite with which Lynk could have a conjunction to determine what maneuvers, if any, are required to be made by either party to further reduce, or completely eliminate, the probability of that conjunction. To eliminate any chance of conjunction with the ISS during de-orbiting and orbit raising, Lynk maintains a maneuverability strategy to raise and lower the satellite altitude in a controlled manner.

Regarding maneuverability (see section 6.1 below for more detail), the satellites can increase and decrease the drag profile of their flight path to articulate their trajectory. Some of the satellites may host a propulsion system, which will provide increased flexibility for maneuvers. Propulsion enables the satellites to lower their altitude over the course of days to weeks until the satellites demise. If the satellites do not have propulsion capability, the satellites can use a high drag attitude maneuver, which will bring them to demise within 3.60 years (if SSO) and within 2.19 years (if mid-inclination). Lynk can accurately predict the trajectory of the satellite under this high drag attitude and continue to refine the prediction based on satellite tracking telemetry (from on board GPS and Space-Track). For instance, as the satellite's trajectory is refined, Lynk can refine the attitude of the satellite to modify the trajectory such that the satellite's distance away from the ISS during its transition through the ISS altitude occurs at a distance that is comfortable to NASA. Lynk intends to coordinate both the tracking and planned orbit trajectory of the Lynk satellite as it raises orbit altitude to begin operations and as it lowers orbit altitude to makes its atmospheric re-entry upon end of life.

Furthermore, Lynk will notify third parties with which it coordinates of which Lynk satellites have propulsive capabilities and which do not. This can be done using a demarcation in the unique satellite ID for each satellite and can also be done explicitly when coordinating maneuvers or exchanges during mitigation of anticipated conjunction events.

5.2 Assessment of satellite proximity operations

There are no planned proximity operations for the Lynk satellite.

5.3 Assessment of satellite compliance with Requirements 4.5-1 and 4.5-2

Requirement 4.5-1:

Limiting debris generated by collisions with large objects when operating in Earth orbit: For each satellite and launch vehicle orbital stage in or passing through LEO, the program or project shall demonstrate that, during the orbital lifetime of each satellite and orbital stage, the probability of accidental collision with space objects larger than 10 cm in diameter is less than 0.001 (Requirement 56506).

Compliance statement: (Large Object Impact and Debris Generation Probability)
Required Probability: 0.001
Expected probability: 5.8076E-05 COMPLIANT
(Appendix A demonstrates compliance with the above via A DAS 3.1.0 log.)

Requirement 4.5-2:

Limiting debris generated by collisions with small objects when operating in Earth or lunar orbit: For each satellite, the program or project shall demonstrate that, during the mission of the satellite, the probability of accidental collision with orbital debris and meteoroids sufficient to prevent compliance with the applicable post-mission disposal requirements is less than 0.01 (Requirement 56507).

Compliance statement: (Small Object Impact and Debris Generation Probability)
Required Probability: 0.01
Expected probability: 1.7279E-07 COMPLIANT
(Appendix A demonstrates compliance with the above via A DAS 3.1.0 log.)

The above analyses are based on the expected probability of an object's impact and debris generation for an individual satellite and are based on the orientation assumed by the DAS software for the largest form factor (surface area) satellite described in this application.

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6 Assessment of Post Mission Disposal Plans and Procedures

6.1 Description of satellite disposal option selected

Lynk designed the satellites of the Lynk Smallsat System to de-orbit naturally by atmospheric re-entry. Technically, no propulsion system is needed for re-entry. However, some satellites may host a propulsion system that will contain up to five (5) kilograms of water, and these satellites will not expel any debris besides water, which is only for propulsive maneuvers. Regardless of propulsion, and while an uncontrolled re-entry meets the Commissions requirements for de-orbit, Lynk intends a controlled de-orbit and re-entry.

For satellites with propulsion, the satellites will maintain their operational orbit altitude to within +/- ten (10) km for the duration of their service lifetime. As such, there is little anticipated altitude decay/evolution during these satellites' service lifetimes. At end of life, these satellites would utilize any remaining fuel for de-orbit maneuvers that lower the satellite's altitude over the course of days or weeks.

For satellites without propulsion capability, orbit altitudes will be allowed to decay overtime during their service lifetime. If the orbit altitude needs to change for collision avoidance, or to support more rapid de-orbit at the end of life, the satellite can correct its orientation to increase drag forces and altitude decay rate. A satellite with a non-functioning or no propulsion system and with a functioning ADC System can re-enter within 3.60 years (if in SSO) and within 2.19 years (if in mid-inclination). In the unlikely event that the ADC System is non-functioning, or the satellite has completely failed, the satellite will naturally de-orbit in less than 5.17 years (if in SSO) and in less than 2.96 years (if in mid-inclination). If this unlikely event occurs, requiring an uncontrolled re-entry, Lynk will notify NASA so that any considerations can be made for the safety of assets below the Lynk orbit (e.g., the ISS).

Notably, Lynk reviews and verifies on an ongoing basis that design iterations exceed the orbital debris mitigation expectations of both NASA and the FCC. Lynk continues to adjust and improve the Lynk Smallsat System architecture, satellite design, and operations to ensure that none of Lynk's satellites become a source of orbital debris in the LEO environment.

6.2 Plan for any satellite maneuvers required to accomplish post mission disposal

None.

6.3 Calculation of area-to-mass ratio after post mission disposal

Satellite Mass:	~80 kg	(dry mass)
Cross-sectional Area:	2.25 m^2	(max in high drag orientation)
	1.343 m^2	(min in uncontrolled orientation)
Area to mass ratio:	0.0281 m^2/kg	(min) = (2.25 m^2) / (80 kg)
	0.0168 m^2/kg	(max) = (1.343 m^2) / (80 kg)

6.4 Assessment of satellite compliance with Requirements 4.6-1 through 4.6-5

Requirement 4.6-1:

Disposal for space structures passing through LEO: A satellite or orbital stage with a perigee altitude below 2000 km shall be disposed of by one of three methods: (Requirement 56557)

a. Atmospheric re-entry option:

- *Leave the space structure in an orbit in which natural forces will lead to atmospheric re-entry within 25 years after the completion of mission but no more than 30 years after launch; or*
- *Maneuver the space structure into a controlled de-orbit trajectory as soon as practical after completion of mission.*

b. Storage orbit option:

- *Maneuver the space structure into an orbit with perigee altitude greater than 2000 km and apogee less than GEO - 500 km.*

c. Direct retrieval:

- *Retrieve the space structure and remove it from orbit within 10 years after completion of mission.*

Compliance statement:

Both the 550 km SSO and 500 km mid-inclination orbits were analyzed for the disposal of structure analysis. The table below summarizes the disposal analysis results for both orbits in both possible attitude configurations for re-entry (a controlled high drag attitude and uncontrolled tumble attitude).

Attitude	Comments	550 km, SSO orbit	500 km, 53 deg orbit
High drag	Controlled attitude, Flat face flying toward velocity direction.	3.60 years	2.19 years
Low drag	Derelict satellite in slow tumble.	5.17 years	2.96 years

Table 5 - Duration of Demisability

A lower drag configuration will be used during nominal mission operations (flying thin edge on) to ensure extended lifetime for service operations. However, intentional disposal will leverage a high drag configuration, in combination with propulsive altitude reduction, if available. A failed satellite with a non-working propulsion system (or lack of one) and attitude control system will demise in a slow tumble configuration. All disposal scenarios meet the commission's rules for timely disposal of satellites.

1. <u>550 km SSO Orbit Trajectory Analysis</u>

The SSO orbit trajectory analyses are summarized below in the order in which they are outlined in the table above.

SSO High Drag:

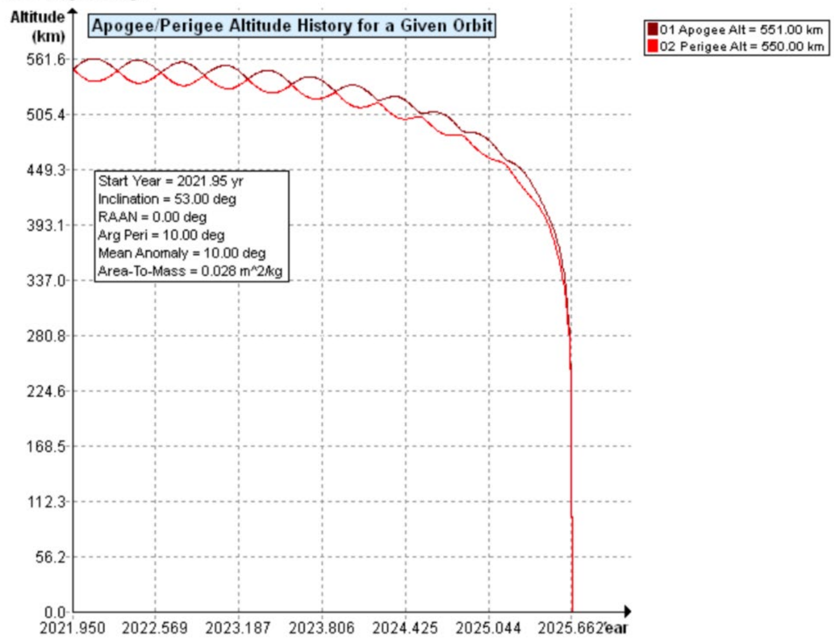

Figure 1 – 550km SSO Satellite De-orbit Lifetime (High Drag Orientation = Min Orbital Lifetime)

SSO Tumble:

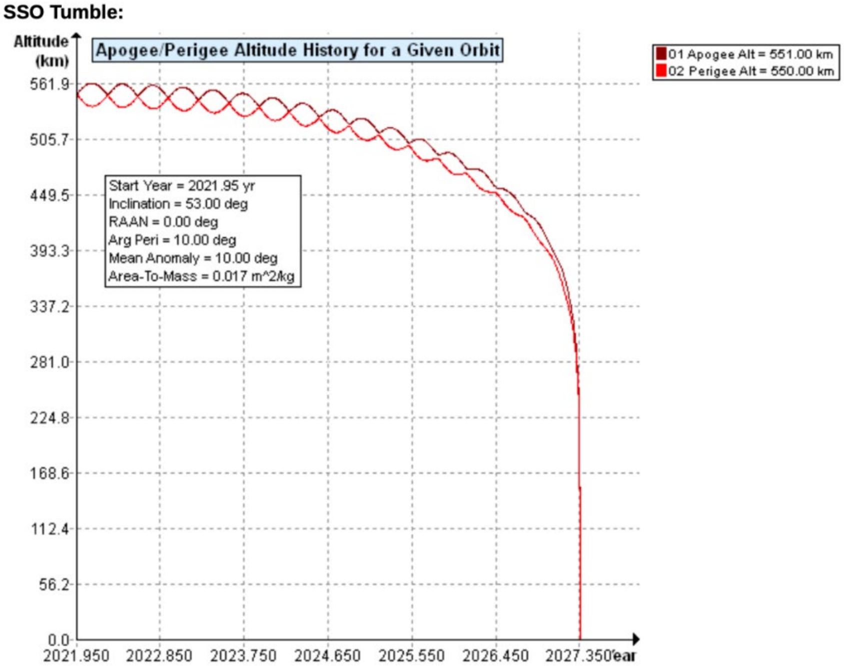

Figure 2 -550 km SSO Satellite De-Orbit Lifetime (Tumble Orientation = Medium Orbit Lifetime)

2. 500 km Mid-inclination Orbit Trajectory Analysis

The 53-degree mid-inclination orbit trajectory analyses are summarized below in the order in which they are outlined in the table above.

Mid Inc High Drag:

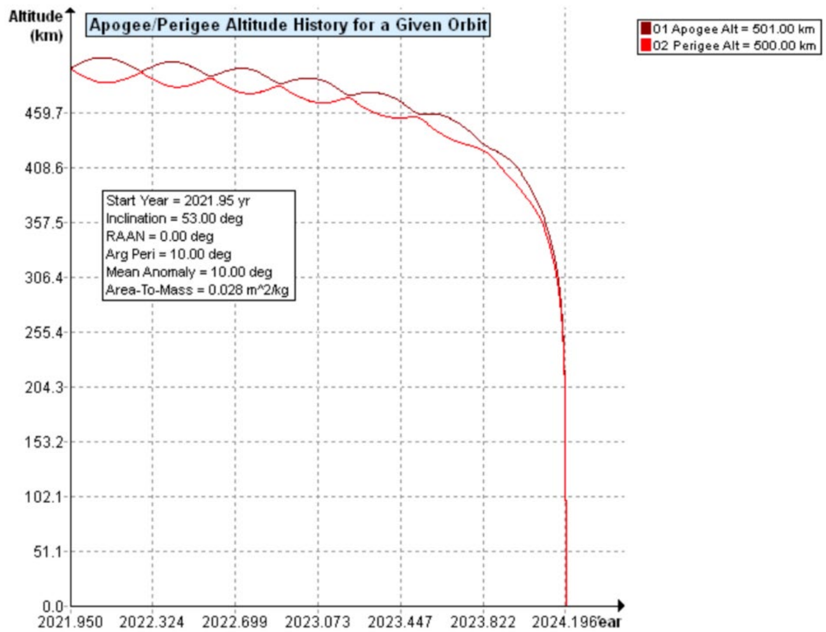

Figure 3 - 500km mid-inclination Satellite De-orbit Lifetime (High Drag Orientation = Min Orbital Lifetime)

Mid Inc Tumble:

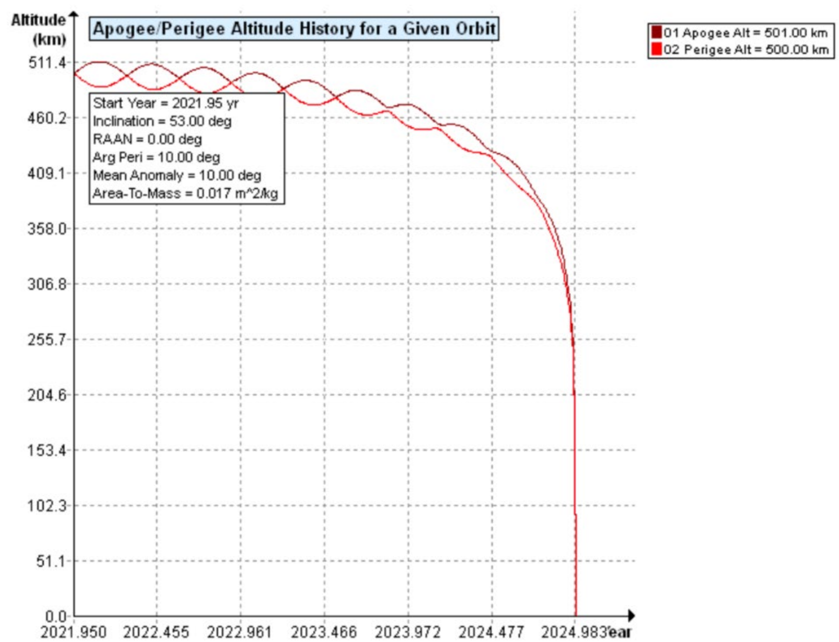

Figure 4 - 500 km mid inclination Satellite De-Orbit Lifetime (Tumble Orientation = Medium Orbit Lifetime)

Requirement 4.6-2:
Disposal for space structures near GEO.

Compliance statement:
Not applicable.

Requirement 4.6-3:
Disposal for space structures between LEO and GEO.

Compliance statement:
Not applicable.

Requirement 4.6-4:
Reliability of Post-mission Disposal Operations.

Compliance statement:
The physics of atmospheric drag at the target orbits for the Lynk satellites ensure success of post-mission disposal operations.

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7 Assessment of Satellite Re-entry Hazards

7.1 Assessment of satellite compliance with Requirement 4.7-1:

Limit the risk of human casualty: The potential for human casualty is assumed for any object with an impacting kinetic energy in excess of 15 joules.

<u>Requirement 4.7-1-a:</u>

a. For uncontrolled re-entry, the risk of human casualty from surviving debris shall not exceed 0.0001 (1:10,000) (Requirement 56626).

<u>Compliance statement:</u>
On a per-satellite basis, DAS v3.1.0 reports that the Lynk satellite design is COMPLIANT with the requirement. The satellite is primarily composed of Aluminum and PCB (Fiberglass) material. None of the components are expected to survive re-entry. The predicted Total Debris Casualty Area is 0.00. Therefore, Commission rule § 25.122(c)(8)—i.e., requiring the probability be zero—is satisfied.

(Appendix A located in the back of this report contain the DAS 3.1.0 modeling input and results.)

<u>Requirement 4.7-1-b:</u>

b. For controlled re-entry, the selected trajectory shall ensure that no surviving debris impact with a kinetic energy greater than 15 joules is closer than 370 km from foreign landmasses, or is within 50 km from the continental U.S., territories of the U.S., and the permanent ice pack of Antarctica (Requirement 56627).

<u>Compliance statement:</u>
Compliant. Per the compliance statement above, there is no surviving debris that impacts the earth's surface from a satellite when it performs a controlled re-entry.

<u>Requirement 4.7-1-c:</u>

c. For controlled reentries, the product of the probability of failure of the re-entry burn (from Requirement 4.6-4-b) and the risk of human casualty assuming uncontrolled re-entry shall not exceed 0.0001 (1:10,000) (Requirement 56628).

<u>Compliance statement:</u>
Compliant. Per the compliance statement above, there is no surviving debris that impacts the earth's surface from a satellite when it performs a controlled re-entry.

8 Assessment for Tether Missions

Not applicable. There are no tethers aboard Lynk's satellites.

Appendix A - DAS 3.1.0 Log

05 05 2021; 13:38:47PM Processing Requirement 4.3-1: Return Status : Not Run

=====================
No Project Data Available
=====================

=============== End of Requirement 4.3-1 ===============
05 05 2021; 13:38:50PM Processing Requirement 4.3-2: Return Status : Passed

=====================
No Project Data Available
=====================

=============== End of Requirement 4.3-2 ===============
05 05 2021; 14:45:59PM Processing Requirement 4.5-1: Return Status : Passed

==============
Run Data
==============

INPUT

Space Structure Name = LynkComm-sso-wide
Space Structure Type = Payload
Perigee Altitude = 550.000 (km)
Apogee Altitude = 551.000 (km)
Inclination = 97.370 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0280 (m^2/kg)
Start Year = 2021.500 (yr)
Initial Mass = 80.000 (kg)
Final Mass = 80.000 (kg)
Duration = 5.000 (yr)
Station-Kept = True
Abandoned = True

OUTPUT

Collision Probability = 5.8076E-05

Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==============

INPUT

Space Structure Name = LynkComm-sso-tumble
Space Structure Type = Payload
Perigee Altitude = 550.000 (km)
Apogee Altitude = 551.000 (km)
Inclination = 97.370 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0167 (m^2/kg)
Start Year = 2021.500 (yr)
Initial Mass = 80.000 (kg)
Final Mass = 80.000 (kg)
Duration = 5.000 (yr)
Station-Kept = True
Abandoned = True

OUTPUT

Collision Probability = 4.8234E-05
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==============

INPUT

Space Structure Name = LynkComm-midinc-wide
Space Structure Type = Payload
Perigee Altitude = 500.000 (km)
Apogee Altitude = 501.000 (km)
Inclination = 53.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0280 (m^2/kg)

Start Year = 2021.500 (yr)
Initial Mass = 80.000 (kg)
Final Mass = 80.000 (kg)
Duration = 5.000 (yr)
Station-Kept = True
Abandoned = True

OUTPUT

Collision Probability = 1.8965E-05
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==============

INPUT

Space Structure Name = LynkComm-midinc-tumble
Space Structure Type = Payload
Perigee Altitude = 500.000 (km)
Apogee Altitude = 501.000 (km)
Inclination = 53.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0167 (m^2/kg)
Start Year = 2021.500 (yr)
Initial Mass = 80.000 (kg)
Final Mass = 80.000 (kg)
Duration = 5.000 (yr)
Station-Kept = True
Abandoned = True

OUTPUT

Collision Probability = 1.2599E-05
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==============

============== End of Requirement 4.5-1 ==============

05 05 2021; 14:46:03PM Project Data Saved To File

05 05 2021; 15:33:14PM Requirement 4.5-2: Compliant

==

Spacecraft = LynkComm-sso-wide

Critical Surface = Battery

==

INPUT

Apogee Altitude = 551.000 (km)

Perigee Altitude = 550.000 (km)

Orbital Inclination = 97.370 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass = 0.0280 (m^2/kg)

Initial Mass = 80.000 (kg)

Final Mass = 80.000 (kg)

Station Kept = Yes

Start Year = 2021.500 (yr)

Duration = 5.000 (yr)

Orientation = Random Tumbling

CS Areal Density = 10.000 (g/cm^2)

CS Surface Area = 0.0100 (m^2)

Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))

CS Pressurized = No

Outer Wall 1 Density: 20.000 (g/cm^2) Separation: 1.000 (cm)

OUTPUT

Probability of Penetration = 1.7279E-07 (1.7279E-07)

Returned Error Message: Normal Processing

Date Range Error Message: Normal Date Range

=============== End of Requirement 4.5-2 ===============

05 05 2021; 15:33:16PM Processing Requirement 4.6 Return Status : Passed

==============

Project Data

==============

INPUT

Space Structure Name = LynkComm-sso-wide
Space Structure Type = Payload

Perigee Altitude = 550.000000 (km)
Apogee Altitude = 551.000000 (km)
Inclination = 97.370000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Area-To-Mass Ratio = 0.028000 (m^2/kg)
Start Year = 2021.500000 (yr)
Initial Mass = 80.000000 (kg)
Final Mass = 80.000000 (kg)
Duration = 5.000000 (yr)
Station Kept = True
Abandoned = True
PMD Perigee Altitude = 550.000000 (km)
PMD Apogee Altitude = 551.000000 (km)
PMD Inclination = 97.370000 (deg)
PMD RAAN = 0.000000 (deg)
PMD Argument of Perigee = 0.000000 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Suggested Perigee Altitude = 550.000000 (km)
Suggested Apogee Altitude = 551.000000 (km)
Returned Error Message = Passes LEO reentry orbit criteria.

Released Year = 2032 (yr)
Requirement = 61
Compliance Status = Pass

==============

INPUT

Space Structure Name = LynkComm-sso-tumble
Space Structure Type = Payload

Perigee Altitude = 550.000000 (km)
Apogee Altitude = 551.000000 (km)

Inclination = 97.370000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Area-To-Mass Ratio = 0.016681 (m^2/kg)
Start Year = 2021.500000 (yr)
Initial Mass = 80.000000 (kg)
Final Mass = 80.000000 (kg)
Duration = 5.000000 (yr)
Station Kept = True
Abandoned = True
PMD Perigee Altitude = 550.000000 (km)
PMD Apogee Altitude = 551.000000 (km)
PMD Inclination = 97.370000 (deg)
PMD RAAN = 0.000000 (deg)
PMD Argument of Perigee = 0.000000 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Suggested Perigee Altitude = 550.000000 (km)
Suggested Apogee Altitude = 551.000000 (km)
Returned Error Message = Passes LEO reentry orbit criteria.

Released Year = 2034 (yr)
Requirement = 61
Compliance Status = Pass

==============

INPUT

Space Structure Name = LynkComm-midinc-wide
Space Structure Type = Payload

Perigee Altitude = 500.000000 (km)
Apogee Altitude = 501.000000 (km)
Inclination = 53.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Area-To-Mass Ratio = 0.028000 (m^2/kg)
Start Year = 2021.500000 (yr)
Initial Mass = 80.000000 (kg)

Final Mass = 80.000000 (kg)
Duration = 5.000000 (yr)
Station Kept = True
Abandoned = True
PMD Perigee Altitude = 500.000000 (km)
PMD Apogee Altitude = 501.000000 (km)
PMD Inclination = 53.000000 (deg)
PMD RAAN = 0.000000 (deg)
PMD Argument of Perigee = 0.000000 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Suggested Perigee Altitude = 500.000000 (km)
Suggested Apogee Altitude = 501.000000 (km)
Returned Error Message = Passes LEO reentry orbit criteria.

Released Year = 2027 (yr)
Requirement = 61
Compliance Status = Pass

==============

INPUT

Space Structure Name = LynkComm-midinc-tumble
Space Structure Type = Payload

Perigee Altitude = 500.000000 (km)
Apogee Altitude = 501.000000 (km)
Inclination = 53.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Area-To-Mass Ratio = 0.016681 (m^2/kg)
Start Year = 2021.500000 (yr)
Initial Mass = 80.000000 (kg)
Final Mass = 80.000000 (kg)
Duration = 5.000000 (yr)
Station Kept = True
Abandoned = True
PMD Perigee Altitude = 500.000000 (km)
PMD Apogee Altitude = 501.000000 (km)
PMD Inclination = 53.000000 (deg)

PMD RAAN = 0.000000 (deg)
PMD Argument of Perigee = 0.000000 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Suggested Perigee Altitude = 500.000000 (km)
Suggested Apogee Altitude = 501.000000 (km)
Returned Error Message = Passes LEO reentry orbit criteria.

Released Year = 2029 (yr)
Requirement = 61
Compliance Status = Pass

==============

=============== End of Requirement 4.6 ===============
05 05 2021; 15:33:20PM *********Processing Requirement 4.7-1
Return Status : Passed

***********INPUT****
Item Number = 1

name = LynkComm-sso-wide
quantity = 1
parent = 0
materialID = 5
type = Box
Aero Mass = 80.000000
Thermal Mass = 80.000000
Diameter/Width = 1.500000
Length = 1.500000
Height = 0.150000

name = Reaction Wheels 1
quantity = 6
parent = 1
materialID = 13
type = Cylinder
Aero Mass = 0.242000
Thermal Mass = 0.242000
Diameter/Width = 0.057000
Length = 0.031500

name = Magnetorquers 1
quantity = 6
parent = 1
materialID = 19
type = Box
Aero Mass = 0.500000
Thermal Mass = 0.500000
Diameter/Width = 0.070000
Length = 0.254000
Height = 0.017000

name = Side Panels1
quantity = 4
parent = 1
materialID = 5
type = Box
Aero Mass = 1.949000
Thermal Mass = 1.949000
Diameter/Width = 0.138000
Length = 1.500000
Height = 0.015000

name = Unigrid A1
quantity = 9
parent = 1
materialID = 5
type = Box
Aero Mass = 1.000000
Thermal Mass = 1.000000
Diameter/Width = 0.450000
Length = 0.450000
Height = 0.006350

name = Isogrid1
quantity = 9
parent = 1
materialID = 5
type = Box
Aero Mass = 1.000000
Thermal Mass = 1.000000
Diameter/Width = 0.450000
Length = 0.450000
Height = 0.006350

name = X support beam1
quantity = 2
parent = 1
materialID = 5
type = Box
Aero Mass = 2.419000
Thermal Mass = 2.419000
Diameter/Width = 0.105000
Length = 2.108000
Height = 0.040000

name = UHF Antenna1
quantity = 16
parent = 1
materialID = 23
type = Box
Aero Mass = 0.800000
Thermal Mass = 0.800000
Diameter/Width = 0.350000
Length = 0.350000
Height = 0.025000

name = C-Brackets1
quantity = 4
parent = 1
materialID = 5
type = Box
Aero Mass = 0.248000
Thermal Mass = 0.248000
Diameter/Width = 0.070000
Length = 0.508000
Height = 0.015000

name = Solar Panels1
quantity = 55
parent = 1
materialID = 23
type = Flat Plate
Aero Mass = 0.162000
Thermal Mass = 0.162000
Diameter/Width = 0.100000
Length = 0.300000

name = Battery Packs1

quantity = 4
parent = 1
materialID = 5
type = Box
Aero Mass = 1.112000
Thermal Mass = 1.000000
Diameter/Width = 0.100000
Length = 0.100000
Height = 0.060000

name = Battery Cells1
quantity = 32
parent = 11
materialID = 5
type = Cylinder
Aero Mass = 0.014000
Thermal Mass = 0.014000
Diameter/Width = 0.018500
Length = 0.065300

name = Pentaplexer1
quantity = 32
parent = 1
materialID = 5
type = Cylinder
Aero Mass = 0.014000
Thermal Mass = 0.014000
Diameter/Width = 0.018500
Length = 0.065300

name = Quad Plates1
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 2.200000
Thermal Mass = 2.200000
Diameter/Width = 0.152000
Length = 0.206000
Height = 0.038000

name = Avionics1
quantity = 8
parent = 1

materialID = 5
type = Box
Aero Mass = 1.000000
Thermal Mass = 1.000000
Diameter/Width = 0.300000
Length = 0.492000
Height = 0.004763

name = KA band antenna1
quantity = 20
parent = 1
materialID = 23
type = Flat Plate
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.100000
Length = 0.100000

name = Prop Chamber1
quantity = 1
parent = 1
materialID = 23
type = Flat Plate
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.100000
Length = 0.100000

name = Prop Tank1
quantity = 1
parent = 1
materialID = 37
type = Cylinder
Aero Mass = 0.800000
Thermal Mass = 0.800000
Diameter/Width = 0.025000
Length = 0.200000

**************OUTPUT****
Item Number = 1

name = LynkComm-sso-wide
Demise Altitude = 77.992668
Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

****
name = Reaction Wheels 1
Demise Altitude = 70.482170
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Magnetorquers 1
Demise Altitude = 72.858856
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Side Panels1
Demise Altitude = 72.777542
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Unigrid A1
Demise Altitude = 73.220421
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Isogrid1
Demise Altitude = 73.220421
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = X support beam1
Demise Altitude = 74.280815
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = UHF Antenna1
Demise Altitude = 75.261566
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = C-Brackets1
Demise Altitude = 75.788170
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Solar Panels1
Demise Altitude = 76.705391
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Battery Packs1
Demise Altitude = 63.912155
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Battery Cells1
Demise Altitude = 62.816711
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Pentaplexer1
Demise Altitude = 76.705765
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Quad Plates1
Demise Altitude = 60.096901
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Avionics1
Demise Altitude = 73.522469
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = KA band antenna1

Demise Altitude = 75.956116
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Prop Chamber1
Demise Altitude = 75.956116
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Prop Tank1
Demise Altitude = 61.992214
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

***********INPUT****
Item Number = 2

name = LynkComm-sso-tumble
quantity = 1
parent = 0
materialID = 5
type = Box
Aero Mass = 80.000000
Thermal Mass = 80.000000
Diameter/Width = 1.500000
Length = 1.500000
Height = 0.150000

name = Reaction Wheels2
quantity = 6
parent = 1
materialID = 13
type = Cylinder
Aero Mass = 0.242000
Thermal Mass = 0.242000
Diameter/Width = 0.057000
Length = 0.031500

name = Magnetorquers2
quantity = 6

parent = 1
materialID = 19
type = Box
Aero Mass = 0.500000
Thermal Mass = 0.500000
Diameter/Width = 0.070000
Length = 0.254000
Height = 0.017000

name = Side Panels2
quantity = 4
parent = 1
materialID = 5
type = Box
Aero Mass = 1.949000
Thermal Mass = 1.949000
Diameter/Width = 0.138000
Length = 1.500000
Height = 0.015000

name = Unigrid A2
quantity = 9
parent = 1
materialID = 5
type = Box
Aero Mass = 1.000000
Thermal Mass = 1.000000
Diameter/Width = 0.450000
Length = 0.450000
Height = 0.006350

name = Isogrid2
quantity = 9
parent = 1
materialID = 5
type = Box
Aero Mass = 1.000000
Thermal Mass = 1.000000
Diameter/Width = 0.450000
Length = 0.450000
Height = 0.006350

name = X support beam2
quantity = 2

parent = 1
materialID = 5
type = Box
Aero Mass = 2.419000
Thermal Mass = 2.419000
Diameter/Width = 0.105000
Length = 2.108000
Height = 0.040000

name = UHF Antenna2
quantity = 16
parent = 1
materialID = 23
type = Box
Aero Mass = 0.800000
Thermal Mass = 0.800000
Diameter/Width = 0.350000
Length = 0.350000
Height = 0.025000

name = C-Brackets2
quantity = 4
parent = 1
materialID = 5
type = Box
Aero Mass = 0.248000
Thermal Mass = 0.248000
Diameter/Width = 0.070000
Length = 0.508000
Height = 0.015000

name = Solar Panels2
quantity = 55
parent = 1
materialID = 23
type = Flat Plate
Aero Mass = 0.162000
Thermal Mass = 0.162000
Diameter/Width = 0.100000
Length = 0.300000

name = Battery Packs2
quantity = 4
parent = 1

materialID = 5
type = Box
Aero Mass = 1.112000
Thermal Mass = 1.000000
Diameter/Width = 0.100000
Length = 0.100000
Height = 0.060000

name = Battery Cells2
quantity = 32
parent = 11
materialID = 5
type = Cylinder
Aero Mass = 0.014000
Thermal Mass = 0.014000
Diameter/Width = 0.018500
Length = 0.065300

name = Pentaplexer2
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 2.200000
Thermal Mass = 2.200000
Diameter/Width = 0.152000
Length = 0.206000
Height = 0.038000

name = Quad Plates2
quantity = 8
parent = 1
materialID = 5
type = Box
Aero Mass = 1.000000
Thermal Mass = 1.000000
Diameter/Width = 0.300000
Length = 0.492000
Height = 0.004763

name = Avionics2
quantity = 20
parent = 1
materialID = 23

type = Flat Plate
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.100000
Length = 0.100000

name = KA band antenna2
quantity = 1
parent = 1
materialID = 23
type = Flat Plate
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.100000
Length = 0.100000

name = Prop Chamber2
quantity = 1
parent = 1
materialID = 37
type = Cylinder
Aero Mass = 0.800000
Thermal Mass = 0.800000
Diameter/Width = 0.025000
Length = 0.200000

name = Prop Tank2
quantity = 1
parent = 1
materialID = 5
type = Cylinder
Aero Mass = 1.500000
Thermal Mass = 1.500000
Diameter/Width = 0.150000
Length = 0.350000

*************OUTPUT****
Item Number = 2

name = LynkComm-sso-tumble
Demise Altitude = 77.992668
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Reaction Wheels2
Demise Altitude = 70.482170
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Magnetorquers2
Demise Altitude = 72.858856
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Side Panels2
Demise Altitude = 72.777542
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Unigrid A2
Demise Altitude = 73.220421
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Isogrid2
Demise Altitude = 73.220421
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = X support beam2
Demise Altitude = 74.280815
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = UHF Antenna2
Demise Altitude = 75.261566
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = C-Brackets2

Demise Altitude = 75.788170
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Solar Panels2
Demise Altitude = 76.705391
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Battery Packs2
Demise Altitude = 63.912155
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Battery Cells2
Demise Altitude = 62.816711
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Pentaplexer2
Demise Altitude = 60.096901
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Quad Plates2
Demise Altitude = 73.522469
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Avionics2
Demise Altitude = 75.956116
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = KA band antenna2
Demise Altitude = 75.956116
Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

****
name = Prop Chamber2
Demise Altitude = 61.992214
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Prop Tank2
Demise Altitude = 71.323555
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

***********INPUT****
Item Number = 3

name = LynkComm-midinc-wide
quantity = 1
parent = 0
materialID = 5
type = Box
Aero Mass = 80.000000
Thermal Mass = 80.000000
Diameter/Width = 1.500000
Length = 1.500000
Height = 0.150000

name = Reaction Wheels3
quantity = 6
parent = 1
materialID = 13
type = Cylinder
Aero Mass = 0.242000
Thermal Mass = 0.242000
Diameter/Width = 0.057000
Length = 0.031500

name = Magnetorquers3
quantity = 6
parent = 1
materialID = 19

type = Box
Aero Mass = 0.500000
Thermal Mass = 0.500000
Diameter/Width = 0.070000
Length = 0.254000
Height = 0.017000

name = Side Panels3
quantity = 4
parent = 1
materialID = 5
type = Box
Aero Mass = 1.949000
Thermal Mass = 1.949000
Diameter/Width = 0.138000
Length = 1.500000
Height = 0.015000

name = Unigrid A3
quantity = 9
parent = 1
materialID = 5
type = Box
Aero Mass = 1.000000
Thermal Mass = 1.000000
Diameter/Width = 0.450000
Length = 0.450000
Height = 0.006350

name = Isogrid3
quantity = 9
parent = 1
materialID = 5
type = Box
Aero Mass = 1.000000
Thermal Mass = 1.000000
Diameter/Width = 0.450000
Length = 0.450000
Height = 0.006350

name = X support beam3
quantity = 2
parent = 1
materialID = 5

type = Box
Aero Mass = 2.419000
Thermal Mass = 2.419000
Diameter/Width = 0.105000
Length = 2.108000
Height = 0.040000

name = UHF Antenna3
quantity = 16
parent = 1
materialID = 23
type = Box
Aero Mass = 0.800000
Thermal Mass = 0.800000
Diameter/Width = 0.350000
Length = 0.350000
Height = 0.025000

name = C-Brackets3
quantity = 4
parent = 1
materialID = 5
type = Box
Aero Mass = 0.248000
Thermal Mass = 0.248000
Diameter/Width = 0.070000
Length = 0.508000
Height = 0.015000

name = Solar Panels3
quantity = 55
parent = 1
materialID = 23
type = Flat Plate
Aero Mass = 0.162000
Thermal Mass = 0.162000
Diameter/Width = 0.100000
Length = 0.300000

name = Battery Packs3
quantity = 4
parent = 1
materialID = 5
type = Box

Aero Mass = 1.112000
Thermal Mass = 1.000000
Diameter/Width = 0.100000
Length = 0.100000
Height = 0.060000

name = Battery Cells3
quantity = 32
parent = 11
materialID = 5
type = Cylinder
Aero Mass = 0.014000
Thermal Mass = 0.014000
Diameter/Width = 0.018500
Length = 0.065300

name = Pentaplexer3
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 2.200000
Thermal Mass = 2.200000
Diameter/Width = 0.152000
Length = 0.206000
Height = 0.038000

name = Quad Plates3
quantity = 8
parent = 1
materialID = 5
type = Box
Aero Mass = 1.000000
Thermal Mass = 1.000000
Diameter/Width = 0.300000
Length = 0.492000
Height = 0.004763

name = Avionics3
quantity = 20
parent = 1
materialID = 23
type = Flat Plate
Aero Mass = 0.100000

Thermal Mass = 0.100000
Diameter/Width = 0.100000
Length = 0.100000

name = KA band antenna3
quantity = 1
parent = 1
materialID = 23
type = Flat Plate
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.100000
Length = 0.100000

name = Prop Chamber3
quantity = 1
parent = 1
materialID = 37
type = Cylinder
Aero Mass = 0.800000
Thermal Mass = 0.800000
Diameter/Width = 0.025000
Length = 0.200000

name = Prop Tank3
quantity = 1
parent = 1
materialID = 5
type = Cylinder
Aero Mass = 1.500000
Thermal Mass = 1.500000
Diameter/Width = 0.150000
Length = 0.350000

*************OUTPUT****
Item Number = 3

name = LynkComm-midinc-wide
Demise Altitude = 77.997185
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Reaction Wheels3

Demise Altitude = 69.574646
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Magnetorquers3
Demise Altitude = 71.758064
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Side Panels3
Demise Altitude = 71.559509
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Unigrid A3
Demise Altitude = 70.726410
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = Isogrid3
Demise Altitude = 70.726410
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = X support beam3
Demise Altitude = 73.628220
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = UHF Antenna3
Demise Altitude = 74.229752
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

name = C-Brackets3
Demise Altitude = 75.399773
Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

****
name = Solar Panels3
Demise Altitude = 76.496017
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Battery Packs3
Demise Altitude = 62.058746
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Battery Cells3
Demise Altitude = 60.747585
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Pentaplexer3
Demise Altitude = 57.014389
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Quad Plates3
Demise Altitude = 72.384026
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Avionics3
Demise Altitude = 75.643211
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = KA band antenna3
Demise Altitude = 75.643211
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Prop Chamber3
Demise Altitude = 60.200630
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Prop Tank3
Demise Altitude = 70.503304
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

**********INPUT****
Item Number = 4

name = LynkComm-midinc-tumble
quantity = 1
parent = 0
materialID = 5
type = Box
Aero Mass = 80.000000
Thermal Mass = 80.000000
Diameter/Width = 1.500000
Length = 1.500000
Height = 0.150000

name = Reaction Wheels4
quantity = 6
parent = 1
materialID = 13
type = Cylinder
Aero Mass = 0.242000
Thermal Mass = 0.242000
Diameter/Width = 0.057000
Length = 0.031500

name = Magnetorquers4
quantity = 6
parent = 1
materialID = 19
type = Box
Aero Mass = 0.500000

Thermal Mass = 0.500000
Diameter/Width = 0.070000
Length = 0.254000
Height = 0.017000

name = Side Panels4
quantity = 4
parent = 1
materialID = 5
type = Box
Aero Mass = 1.949000
Thermal Mass = 1.949000
Diameter/Width = 0.138000
Length = 1.500000
Height = 0.015000

name = Unigrid A4
quantity = 9
parent = 1
materialID = 5
type = Box
Aero Mass = 1.000000
Thermal Mass = 1.000000
Diameter/Width = 0.450000
Length = 0.450000
Height = 0.006350

name = Isogrid4
quantity = 9
parent = 1
materialID = 5
type = Box
Aero Mass = 1.000000
Thermal Mass = 1.000000
Diameter/Width = 0.450000
Length = 0.450000
Height = 0.006350

name = X support beam4
quantity = 2
parent = 1
materialID = 5
type = Box
Aero Mass = 2.419000

Thermal Mass = 2.419000
Diameter/Width = 0.105000
Length = 2.108000
Height = 0.040000

name = UHF Antenna4
quantity = 16
parent = 1
materialID = 23
type = Box
Aero Mass = 0.800000
Thermal Mass = 0.800000
Diameter/Width = 0.350000
Length = 0.350000
Height = 0.025000

name = C-Brackets4
quantity = 4
parent = 1
materialID = 5
type = Box
Aero Mass = 0.248000
Thermal Mass = 0.248000
Diameter/Width = 0.070000
Length = 0.508000
Height = 0.015000

name = Solar Panels4
quantity = 55
parent = 1
materialID = 23
type = Flat Plate
Aero Mass = 0.162000
Thermal Mass = 0.162000
Diameter/Width = 0.100000
Length = 0.300000

name = Battery Packs4
quantity = 4
parent = 1
materialID = 5
type = Box
Aero Mass = 1.112000
Thermal Mass = 1.000000

Diameter/Width = 0.100000
Length = 0.100000
Height = 0.060000

name = Battery Cells4
quantity = 32
parent = 11
materialID = 5
type = Cylinder
Aero Mass = 0.014000
Thermal Mass = 0.014000
Diameter/Width = 0.018500
Length = 0.065300

name = Pentaplexer4
quantity = 1
parent = 1
materialID = 5
type = Box
Aero Mass = 2.200000
Thermal Mass = 2.200000
Diameter/Width = 0.152000
Length = 0.206000
Height = 0.038000

name = Quad Plates4
quantity = 8
parent = 1
materialID = 5
type = Box
Aero Mass = 1.000000
Thermal Mass = 1.000000
Diameter/Width = 0.300000
Length = 0.492000
Height = 0.004763

name = Avionics4
quantity = 20
parent = 1
materialID = 23
type = Flat Plate
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.100000

Length = 0.100000

name = KA band antenna4
quantity = 1
parent = 1
materialID = 23
type = Flat Plate
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.100000
Length = 0.100000

name = Prop Chamber4
quantity = 1
parent = 1
materialID = 37
type = Cylinder
Aero Mass = 0.800000
Thermal Mass = 0.800000
Diameter/Width = 0.025000
Length = 0.200000

name = Prop Tank4
quantity = 1
parent = 1
materialID = 5
type = Cylinder
Aero Mass = 1.500000
Thermal Mass = 1.500000
Diameter/Width = 0.150000
Length = 0.350000

**************OUTPUT****
Item Number = 4

name = LynkComm-midinc-tumble
Demise Altitude = 77.997185
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Reaction Wheels4
Demise Altitude = 69.574646
Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

****
name = Magnetorquers4
Demise Altitude = 71.758064
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Side Panels4
Demise Altitude = 71.559509
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Unigrid A4
Demise Altitude = 70.726410
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Isogrid4
Demise Altitude = 70.726410
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = X support beam4
Demise Altitude = 73.628220
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = UHF Antenna4
Demise Altitude = 74.229752
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = C-Brackets4
Demise Altitude = 75.399773
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Solar Panels4
Demise Altitude = 76.496017
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Battery Packs4
Demise Altitude = 62.058746
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Battery Cells4
Demise Altitude = 60.747585
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Pentaplexer4
Demise Altitude = 57.014389
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Quad Plates4
Demise Altitude = 72.384026
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Avionics4
Demise Altitude = 75.643211
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = KA band antenna4
Demise Altitude = 75.643211
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Prop Chamber4

Demise Altitude = 60.200630
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = Prop Tank4
Demise Altitude = 70.503304
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

=============== End of Requirement 4.7-1 ===============
05 05 2021; 15:33:20PM   Project Data Saved To File