BlackSky Global LLC
Exhibit 2

BlackSky Global
Gen-3 Satellites
Orbital Debris Assessment Report (ODAR)

This report is presented in compliance with NASA-STD-8719.14C, APPENDIX A.2

Analysis performed using DAS Version 3.2.1

Final Report Version: July 2022

Revision history:

Version	Date	Author	Description
A		D. Carter K. Blakeman D. Barnes	Initial Release

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1. Self-assessment of the ODAR using the format in Appendix A of NASA-STD-8719.14

Table 1 - Orbital Debris Self-Assessment Report Evaluation: Generation 3 Satellites

Requirement #	Launch Vehicle				Spacecraft			Comments
	Compliant	Not Compliant	Incomplete	Standard Non-Compliant	Compliant or N/A	Not Compliant	Incomplete	
4.3-1.a 25 yr limit	☐	☐	☐	☐	☒	☐	☐	Compliant / Not Applicable; no intentional debris released in LEO. See Section 4.
4.3-1.b <100 object x yr limit	☐	☐	☐	☐	☒	☐	☐	Compliant / Not Applicable; no intentional debris released in LEO. See Section 4
4.3-2 GEO +/- 200km	☐	☐	☐	☐	☒	☐	☐	Compliant / Not Applicable; no intentional debris released in GEO. See Section 4.
4.4-1 <0.001 Explosion Risk	☐	☐	☐	☐	☒	☐	☐	Compliant per FMEA. See Section 5.
4.4-2 Passivate Energy Sources	☐	☐	☐	☐	☒	☐	☐	Compliant; propulsion tank containing xenon will be depleted during operations. See Section 5.
4.4-3 Limit BU Long term Risk	☐	☐	☐	☐	☒	☐	☐	Not applicable; no planned breakups. See Section 5.
4.4-4 Limit BU short term Risk	☐	☐	☐	☐	☒	☐	☐	Not applicable; no planned breakups. See Section 5.
4.5-1 Collision with Large Objects	☐	☐	☐	☐	☒	☐	☐	Compliant per DAS. See Section 6.
4.5-2 Collision with Small Objects	☐	☐	☐	☐	☒	☐	☐	Compliant per DAS. See Section 6.
4.6-1(a) Disposal, Atmo. Reentry	☐	☐	☐	☐	☒	☐	☐	Compliant per DAS. Natural forces cause atmospheric reentry. See Section 7.
4.6-1(b) Disposal, Storage Orbit	☐	☐	☐	☐	☒	☐	☐	Not applicable; disposal will be atmospheric reentry. See Section 7.
4.6-1(c) Disposal, Direct Retrieval	☐	☐	☐	☐	☒	☐	☐	Not applicable; disposal will be atmospheric reentry. See Section 7.
4.6-2 GEO Disposal	☐	☐	☐	☐	☒	☐	☐	Not applicable; spacecraft does not go beyond LEO. See Section 7.
4.6-3 MEO Disposal	☐	☐	☐	☐	☒	☐	☐	Not applicable; spacecraft does not go beyond LEO. See Section 7.
4.6-4 Disposal Reliability	☐	☐	☐	☐	☒	☐	☐	Not applicable; applicable only to NASA space programs and projects. See Section 7
4.7-1 Ground Population Risk	☐	☐	☐	☐	☒	☐	☐	Compliant per DAS. Section 8.
4.8-1 Tether Risk					☒	☐	☐	Not applicable. No tethers used. See Section 9.

2. ODAR Section 1: Program Management and Mission Overview

Table 2: NASA-STD-8719.14C Criteria for ODAR Section 1

	NASA-STD-8719.14C Item	Response
a	Identification of the HQ Mission Directorate sponsoring the mission and the Program Executive	Not applicable.
b	Identification of the responsible program/project manager and senior scientific and management personnel	Kyle Blakeman – Program Manager David Carter – Sr. Systems Engineer
c	Identification of any foreign government or space agency participation in the mission and a summary of NASA's responsibility under the governing agreement(s)	None.
d	Clear schedule of mission design and development milestones from NASA mission selection through proposed launch date, including spacecraft PDR and CDR (or equivalent) dates	The initial launch is proposed for NET Q2 2023 with subsequent launches slated for regular intervals after that.
e	Brief description of the mission	See Section 2.1, Mission Overview.
f	Identification of the anticipated launch vehicle and launch site	Launch vehicle selection is ongoing and unable to be narrowed.
g	Identification of the proposed launch date and mission duration	The initial launch is proposed for NET Q2 2023 with subsequent launches slated for regular intervals after that.
h	Description of the launch and deployment profile, including all parking, transfer, and operational orbits with apogee, perigee, and inclination	See Section 2.2, Constellation Launch and Deployment Profile
i	Description of the spacecraft's maneuver capability, including both attitude and orbit control. Give the time period during which the capabilities will be exercised.	See Section 2.3, Spacecraft Maneuverability
j	Reason for selection of operational orbit(s) (such as ground track, SSO, GEO sync, instrument resolution, co-locate with other spacecraft …)	Orbits are selected to meet ground track and instrument resolution mission requirements.
k	Identification of any interaction or potential physical interference with other operational spacecraft. Note: This does not include potential for radio frequency interaction unless it affects the risk of generating orbital debris.	Purposeful interaction/interference is not part of the nominal concept of operations.

2.1. Mission Overview

BlackSky's Gen-3 (3rd Generation satellites) are part of BlackSky's constellation of commercial Earth observation satellites. This generation follows on previous Gen-2 (2nd Generation satellites) which are on orbit under the name Global.

BlackSky is currently authorized for 16 Global satellites to be operated at any one time. BlackSky intends to increase this number up to 30 satellites, comprised of the current Gen 2 satellites alongside the to-be-launched Gen-3 satellites. Upon reaching the proposed limit, BlackSky would plan to replace older Global satellites with new Gen-3 satellites. Over the course of the remaining duration for the current license, BlackSky expects to launch up to 34 Gen-3 satellites in total while never exceeding 30 satellites in service at any one time.

2.2. Constellation Launch and Deployment Profile

Due to the wide range of business needs impacting orbital parameters, no Gen-3 satellites have been slotted into specific orbits to date. Specific target orbits will be selected NLT 3 months prior to launch. Due to this, the complete range of altitude and inclinations under consideration are listed below.

Gen-3 satellites are designed to operate at an altitude between 385-550km in circular orbit inclined between 35 – 60 deg or in an SSO orbit (~97deg). The primary planned range is a narrower 450-550km between 37-60deg inclination. Orbital parameters are expected to vary over time but maintain primarily circular orbits with similar apogee and perigee.

If injected into an orbit that is not the targeted orbit for the particular satellite, Gen-3 satellites would propulse or drift into the target orbit and maintain orbit for the mission life of the satellite, which is projected as approximately five years (60 months). During this time, BlackSky's constellation of satellites would provide near real time earth imagery to its customers. Upon completion of the mission, BlackSky will initiate decommissioning protocols intended to de-energize the satellite and render it ready for re-entry.

BlackSky notes that the operational altitude of the International Space Station ("ISS") is approximately 400 km. If BlackSky will operate within the proximity of ISS, including while traversing to another orbital location, it will coordinate with NASA to assure protection of the ISS.

Table 3: Orbit Profiles

Orbit (km)	Inclination (deg)
385-550 km	35 – 60 deg; SSO (97.1-98 deg)

2.3. Spacecraft Maneuverability

Gen-3 spacecraft are designed with Hall-effect propulsion systems that used Xenon propellant to alter orbital parameters through ground-commanded thrust sequences. Orbital changes are primarily comprised of altitude raising/maintenance campaigns and occur based exclusively on individual satellite need which is impossible to predetermine. BlackSky typically targets launch insertion orbits that are at or above the target altitude for mission performance. Attitude control is provided by means of on-board reaction wheels, torque rods, and adjacent Attitude Determination and Control System ("ADCS") components. Attitude control is highly automated through the on-board software and is constantly active to stabilize the spacecraft, however, changes in attitude are performed during ground-track and sun-track command response.

3. ODAR Section 2: Spacecraft Description

Table 4: NASA-STD-8719.14C Criteria for ODAR Section 2

	NASA-STD-8719.14C Item	Response
a	Physical description of the spacecraft, including spacecraft bus, payload instrumentation, and all appendages, such as solar arrays, antennas, and instrument or attitude control booms	See Section 3.1, Physical Description of the Spacecraft and Appendix A.2 for list of components as detailed in DAS Run Data.
b	Detailed illustration of the entire spacecraft in the mission operation configuration with clear overall dimensional markings and marked internal component locations	Not included because of export control restrictions.
c	Total spacecraft mass at launch, including all propellants and fluids.	138 kg +/- 5kg
d	Dry mass of spacecraft at launch (minus all consumables and propellants).	134 kg +/- 5kg
e	Identification, including type, mass and pressure, of all fluids (liquids and gases) planned to be on board (including any planned future in-space transfers), excluding fluids in sealed heat pipes. Description of all fluid systems, including size, type, and qualifications of fluid containers such as propellant and pressurization tanks, including pressurized batteries	See Section 3.2 Gen-3 Satellite Propulsion System Each Gen-3 satellite will also use four unpressurized variants COTS Lithium-Ion batteries. Each battery has a height of 90mm, a width of 250mm, a length of 150mm, and a mass of 1kg.
f	Description of all propulsion systems (e.g.: cold gas, mono-propellant, bi-propellant, solid propellant, electric, nuclear)	See Section 3.2 Gen-3 Satellite Propulsion System
g	Description of all active and/or passive attitude control systems with an indication of the normal attitude of the spacecraft with respect to the velocity vector	See Section 3.3 Gen-3 Satellite ADCS The long axis of the spacecraft can be oriented parallel to the nadir vector during imaging, but the satellite will typically be oriented in a sun-pointing attitude.
h	Description of any range safety or other pyrotechnic devices	No pyrotechnic devices are used.
i	Description of the electrical generation and storage system	Variant of COTS Lithium-Ion battery cells are charged before payload integration and provide electrical energy during the mission. The cells are recharged by solar cells mounted on the solar arrays. The battery cell protection circuit manages the charging cycle.
j	Identification of any other sources of stored energy not noted above	None.
k	Identification of any radioactive materials on board or make an explicit statement that there are no radioactive materials onboard	None.

	NASA-STD-8719.14C Item	Response
l	Description of any planned proximity operations or docking with other spacecraft in LEO or GEO, including the controls that will be used to mitigate the risk of a collision that could generate debris or prevent planned later passivation or disposal activities for either spacecraft.	None.

3.1. Physical Description of the Spacecraft

Basic physical dimensions of the Gen-3 satellites are 75cm x 90 cm x 150 cm. Each Gen-3 satellite's load bearing structure is comprised of six structural sides, a supporting payload deck, two deployable solar arrays, and a vertical mounted side solar panel connected to the supporting structural sides. The Z-axis is capped by the optical payload and a hexagonal structure that houses satellite instrumentation.

3.2. Gen-3 Satellite Propulsion System

The Gen-3 propulsion system is a Hall-effect electric propulsion system that uses supercritical Xenon as a propellant. There is no risk of hazardous persistent liquid droplets. Standard propellant fill is 3.4 kg of Xenon at loading pressure (MEOP) of 2700 psia at 20C.

The Gen-3 propulsion system is a version of BlackSky's existing propulsion systems manufactured by Astra, formerly known as Apollo Fusion, that are on-orbit today. The thruster and electronics are unchanged from the existing systems on-orbit today. The propulsion system passed a rigorous qualification campaign and has been qualified for use in space.

3.3. Gen-3 Satellite ADCS

The Gen-3 ADCS is comprised of multiple components that maintain and adjust satellite attitude based on both automated and ground-commanded instructions. The typical attitude of the spacecraft is payload boresight pointed towards Earth's nadir and spacecraft solar panel positioned for sun-tracking.

4. ODAR Section 3: Assessment of Spacecraft Debris Released during Normal Operations

Table 5: NASA-STD-8719.14C Criteria for ODAR Section 3

	NASA-STD-8719.14C Item	Response
a	Identification of any object (>1 mm) expected to be released from the spacecraft any time after launch, including object dimensions, mass, and material	There are no intentional releases.
b	Rationale/necessity for release of each object	N/A.
c	Time of release of each object, relative to launch time	N/A.
d	Release velocity of each object with respect to spacecraft	N/A.
e	Expected orbital parameters (apogee, perigee, and inclination) of each object after release	N/A.
f	Calculated orbital lifetime of each object, including time spent in LEO	N/A.
g	Assessment of spacecraft compliance with Requirements 4.3-1 and 4.3-2	See Section 4.1, Compliance to NASA-STD-8719.14C Requirements 4.3-1 and 4.3-2

4.1. Compliance to NASA-STD-8719.14C Requirements 4.3-1 and 4.3-2

Table 6: Compliance to Requirements 4.3-1 and 4.3-2

Requirement from NASA-STD-8719.14C	Compliance Assessment
Requirement 4.3-1: Planned debris release passing through LEO – released debris with diameters of 1mm or larger	Compliant / Not Applicable. There are no intentional releases.
Requirement 4.3-1a: All debris released during the deployment, operation, and disposal phases shall be limited to a maximum orbital lifetime of 25 years from date of release.	Compliant / Not Applicable. There are no intentional releases.
Requirement 4.3-1b: The total object-time product shall be no larger than 100 object years per mission… (Note: there is more requirement text than shown here; for the sake of space, it is not reproduced in its totality here.)	Compliant / Not Applicable. There are no intentional releases.
Requirement 4.3-2: Debris passing near GEO: For missions leaving debris in orbits with the potential of traversing GEO (GEO altitude +/- 200 km and +/- 15 degrees inclination), released debris with diameters of 5 mm or greater shall be left in orbits which will ensure that within 25 years after release the apogee will no longer exceed GEO - 200 km or the perigee will not be lower than GEO + 200 km , and also ensures that the debris is incapable of being perturbed to lie within that GEO +/- 200 km and +/- 15° zone for at least 100 years thereafter…	Compliant / Not Applicable. There are no intentional releases.

5. ODAR Section 4: Assessment of Spacecraft Intentional Breakups and Potential for Explosions.

Table 7: NASA-STD-8719.14C Criteria for ODAR Section 4

	NASA-STD-8719.14C Item	Response
a	Identification of all potential causes of spacecraft breakup during deployment and mission operations	See section 5.2 FMEA Details for satellite failure modes. These modes do not include any external caused breakups as covered by other ODAR sections. There are no planned intentional breakups or explosions.
b	Summary of failure modes and effects analyses of all credible failure modes which may lead to an accidental explosion	See section 5.2 FMEA Details
c	Detailed plan for any designed spacecraft breakup, including explosions and intentional collisions	There are no planned breakups.
d	List of components which are passivated at EOM. List includes method of passivation and amount which cannot be passivated.	Both propellant (Xenon) in the propulsion system and the charge in batteries will be consumed by EOM. Batteries will be prevented from recharging through EOM process decommissioning process. If the propellant is not totally consumed by EOM, it has no detrimental impact; the orbital lifetime predictions assume the worst-case scenario that propulsion is not used to lower the orbit, and the Xenon does not pose a risk if not passivated.
e	Rationale for all items which are required to be passivated but cannot be due to their design.	Gen-3 satellite batteries will be depleted at EOM but internal pressure/ambient temperature changes cannot fully be passivated. In the unlikely event that a battery cell does explosively rupture due to ambient conditions, the small size, mass, and potential energy, of these small batteries is such that while the spacecraft could be expected to vent gases, most debris from the battery rupture should be contained within the vessel due to the lack of penetration energy.
f	Assessment of spacecraft compliance with Requirements 4.4-1 through 4.4-4	See Section 5.2, Compliance to NASA-STD-8719.14C Requirements 4.4-1 through 4.4-4.

5.1. Compliance to NASA-STD-8719.14C Requirements 4.4-1 through 4.4-4

Table 8: Compliance to Requirements 4.4-1 through 4.4-4

Requirement	Compliance Statement
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 spacecraft and launch vehicle orbital stage employed for a mission (i.e., every individual free-flying structural object), the program or project shall demonstrate, via failure mode and effects analyses, probabilistic risk assessments, or other appropriate analyses, that the integrated probability of explosion for all credible failure modes of each spacecraft and launch vehicle does not exceed 0.001 (excluding small particle impacts.).	Compliant. Expected probability is 0.000 per FMEA.
Requirement 4.4-2: Design for passivation after completion of mission operations while in orbit about Earth, or the Moon: Design of all spacecraft and launch vehicle orbital stages shall include the ability and a plan to either 1) 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 2) control to a level which cannot cause an explosion or deflagration large enough to release orbital debris or break up the spacecraft. The design of depletion burns and ventings should minimize the probability of accidental collision with tracked objects in space.	Compliant; all onboard sources of stored energy will be depleted prior to disposal. Both propellant (Xenon) in the propulsion system and charge in batteries are expected to be consumed by EOM. Batteries will be prevented from recharging through EOM process decommissioning process. If the propellant is not totally consumed by EOM, it has no detrimental impact. The orbital lifetime predictions assume the worst-case scenario that propulsion is not used to lower the orbit, and the Xenon does not pose a risk if not passivated.
Requirement 4.4-3. Limiting the long-term risk to other space systems from planned breakups for Earth and lunar missions: Planned explosions or intentional collisions shall: a. be conducted at an altitude such that for orbital debris fragments larger than 10 cm the object-time product does not exceed 100 object-years. For example, if the debris fragments greater than 10cm decay in the maximum allowed 1 year, a maximum of 100 such fragments can be generated by the breakup. b. Not generate debris larger than 1 mm that remains in Earth orbit longer than one year	Not applicable. There are no planned explosions or intentional collisions.
Requirement 4.4-4: Limiting the short-term risk to other space systems from planned breakups for Earth orbital missions: Immediately before a planned explosion or intentional collision, the probability of debris, orbital or ballistic, larger than 1 mm colliding with any operating spacecraft within 24 hours of the breakup shall be verified to not exceed 10^{-6}.	Not applicable. There are no planned explosions or intentional collisions.

5.2. FMEA Details

5.2.1 Battery Failure

5.2.1.1 Effect and Probability

Effect

All failure modes below might theoretically result in the possibility of orbital debris generation. However, in the unlikely event that one of these occurred a battery cell does explosively rupture, the small size, mass, and potential energy, of the selected COTS batteries is such that while the spacecraft could be expected to vent gases, most debris from the battery rupture should be contained within the vessel due to the lack of penetration energy.

Probability

Extremely low. It is believed to be a much less than 0.1% probability that multiple independent (not common mode) faults must occur for each failure mode to cause the ultimate effect (explosion).

5.2.2.1 Failure Mode 1: Internal short circuit

Mitigation 1: Qualification and acceptance shock, vibration, thermal cycling, and vacuum tests followed by maximum system rate-limited charge and discharge to prove that no internal short circuit sensitivity exists.

Combined faults required for realized failure: Environmental testing **AND** functional charge/discharge tests must both be ineffective in discovery of the failure mode.

5.2.3.1 Failure Mode 2: Internal thermal rise due to high load discharge rate

Mitigation 2: Spacecraft thermal design provides for thermal dissipation; Over-current sensors and algorithms provide for monitoring and disconnect.

*Combined faults required for realized failure: S*pacecraft thermal design must be incorrect **AND** external over-current detection and disconnect function must fail to enable this failure mode.

5.2.4.1 Failure Mode 3: Excessive discharge rate or short circuit due to external device failure or terminal contact with conductors not at battery voltage levels (due to abrasion or inadequate proximity separation)

Mitigation 3: This failure mode is negated by a) qualification-tested short circuit protection on each external circuit; b) design of battery packs and insulators such that no contact with nearby board traces is possible without being caused by some other mechanical failure; and c) obviation of such other mechanical failures by proto-qualification and acceptance environmental tests (shock, vibration, thermal cycling, and thermal-vacuum tests).

Combined faults required for realized failure: An external load must fail/short-circuit **AND** external over-current detection and disconnect function failure must all occur to enable this failure mode.

5.2.5.1 Failure Mode 4: Inoperable vents

Mitigation 4: Battery vents are not inhibited by the battery holder design or the spacecraft.

Combined effects required for realized failure: The final assembler fails to install proper venting AND workmanship error is not caught during QA and closeout.

5.2.6.1 Failure Mode 5: Crushing

Mitigation 5: This mode is negated by spacecraft design. There are no moving parts in the proximity of the batteries.

Combined faults required for realized failure: A catastrophic failure must occur in an external system **AND** the failure must cause a collision sufficient to crush the batteries leading to an internal short circuit **AND** the satellite must be in a naturally sustained orbit at the time the crushing occurs.

5.2.7.1 Failure Mode 6: Low level current leakage or short-circuit through battery pack case or due to moisture-based degradation of insulators

Mitigation 6: These modes are negated by a) battery holder/case design made of non-conductive plastic; and b) operation in vacuum such that no moisture can affect insulators.

Combined faults required for realized failure: Abrasion or piercing failure of circuit board coating or wire insulators **AND** dislocation of battery packs **AND** failure of battery terminal insulators **AND** failure to detect such failure modes in environmental tests must occur to result in this failure mode.

5.2.8.1 Failure Mode 7: Excess temperatures due to orbital environment and high discharge combined

Mitigation 7: The spacecraft thermal design will negate this possibility. Thermal rise has been analyzed in combination with space environment temperatures showing that batteries do not exceed normal allowable operating temperatures which are well below temperatures of concern for explosions.

Combined faults required for realized failure: Thermal analysis **AND** thermal design **AND** over- current monitoring and control must all fail for this failure mode to occur.

5.2.9.1 Failure Mode 8: Over-Voltage

Mitigation 8: Testing of Battery Charge algorithms coupled with the pedigree of the PCDU validates that risk is negated.

Combined effects required for realized failure: Failure of battery charge algorithm AND failure of overvoltage protection hardware.

5.2.2 Propulsion Unit Failure

5.2.1.1 Effect and Probability

Effect

The failure mode below might theoretically result in the possibility of orbital debris generation during normal operations.

Probability

Extremely Low. It is believed to be a much less than 0.1% probability that significant overheating (not common mode) fault must occur for each failure mode to cause the ultimate effect (explosion).

5.2.2.1 Failure Mode 1: Propulsion Tank/Line Rupture

Mitigation 1: Vendor proof and burst testing; Vibration testing at satellite level; Tank design includes countermeasures to reduce severity of a potential tank rupture.

*Combined faults required for realized failure: Failure of temperature sensors **AND** o*verheating of tank heater elements causing significant overpressure event.

5.2.3 Solar Panel Release Mechanism Failure

5.2.1.1 Effect and Probability

Effect

The failure mode below might theoretically result in the possibility of orbital debris generation during deployment.

Probability

Extremely low. It is believed to be a much less than 0.1% probability that the failure of the solar panel release/hold down mechanism (not common mode) fault must occur to cause the ultimate effect (debris generation).

5.2.2.1 Failure Mode 1: Solar Panel Hold Down Mechanism Failure

Mitigation 1: Structural analysis followed by structural qualification. Pre/Post Vibration release mechanism testing will test flight units prior to launch.

Combined faults required for realized failure: Mechanical failure of mechanism.

6. ODAR Section 5: Assessment of Spacecraft Potential for On-Orbit Collisions

Table 9: NASA-STD-8719.14C Criteria for ODAR Section 5

	NASA-STD-8719.14C Item	Response
a	Calculation of spacecraft probability of collision with space objects larger than 10 cm in diameter during the orbital lifetime of the spacecraft.	See Section 6.1, Compliance to Requirement 4.5-1: DAS Probability of Collision with Large Objects.
b	Calculation of spacecraft probability of collision with space objects, including orbital debris and meteoroids, of sufficient size to prevent post-mission disposal.	See Section 6.2, Compliance to Requirement 4.5-2: DAS Probability of Damage from Small Objects.
c	Assessment of spacecraft compliance with Requirements 4.5-1 and 4.5-2	See Section 6.1, Compliance to Requirement 4.5-1: DAS Probability of Collision with Large Object and Section 6.2, Compliance to Requirement 4.5-2: DAS Probability of Damage from Small Objects.
d	Detailed description and assessment of the efficacy of any planned debris avoidance capability intended to help in meeting the requirements of requirement 4.5-1, including any plans to move to less congested altitudes, as well as any tracking enhancements (GPS, laser retroreflector, e.g.) that may assist in reducing the covariance of collision estimates. Note that significant risk remains for impact with debris objects less than 10 cm and/or that are otherwise untrackable from the Earth, so such measures are only expected to slightly influence the statistical probability of collision with dangerous objects.	Gen-3 satellites are designed with propulsion systems that enable avoidance maneuvers as needed as well as on-board GPS systems that enable high accuracy tracking.

6.1. Compliance to Requirement 4.5-1: Probability of Collision with Large Objects

Large Object Collision Probability is calculated using DAS's Requirement Assessment for Requirement 4.5-1. For each block of anticipated satellite launch dates, a range of cases were run in DAS to envelope the worst-case altitudes and orbit inclinations. The results of the maximum and minimum altitudes and inclinations are shown in Table 10.

Requirement 4.5-1. per NASA-STD-8719.14C:

Limiting debris generated by collisions with large objects when in Earth orbit: For each spacecraft and launch vehicle orbital stage, the program or project shall demonstrate that, during the orbital lifetime of each spacecraft and orbital stage, the probability of accidental collision with space objects larger than 10 cm in diameter is less than 0.001. For this assessment, 100 years is used as the maximum orbital lifetime for the storage disposal option.

Table 10: Compliance to Requirement 4.5-1

Satellite	Large Object Collision Probability	Compliance Status	Altitude	Inc.	Launch
Gen-3	2.60E-05	COMPLIANT	550	35	2023.25
	4.15E-05	COMPLIANT	550	60	2023.25
	4.28E-05	COMPLIANT	550	97.9	2023.25
	2.10E-06	COMPLIANT	385	35	2023.25
	2.45E-06	COMPLIANT	385	60	2023.25
	4.89E-06	COMPLIANT	385	97.1	2023.25
Gen-3	2.43E-05	COMPLIANT	550	35	2025.75
	2.93E-05	COMPLIANT	550	60	2025.75
	3.87E-05	COMPLIANT	550	97.9	2025.75
	1.56E-06	COMPLIANT	385	35	2025.75
	1.82E-06	COMPLIANT	385	60	2025.75
	3.21E-06	COMPLIANT	385	97.1	2025.75

6.2. Compliance to Requirement 4.5-2: Probability of Damage from Small Objects

Small Object Collision Probability of PMD Failure is calculated using DAS's Requirement Assessment for Requirement 4.5-2. For each block of anticipated satellite launch dates, a range of cases were run in DAS to envelope the worst-case altitudes and orbit inclinations. The results of the maximum and minimum altitudes and inclinations are shown in Table 11.

Requirement per NASA-STD-8719.14C:

Requirement 4.5-2: Limiting debris generated by collisions with small objects when operating in Earth or lunar orbit**:**

> *For each spacecraft, the program or project shall demonstrate that, during the mission of the spacecraft, 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).*

Table 11: Compliance to Requirement 4.5-2

Satellite	Small Object Collision Probability	Compliance Status	Altitude	Inc.	Launch
Gen-3	3.76E-04	COMPLIANT	550	35	2023.25
	6.12E-04	COMPLIANT	550	60	2023.25
	1.27E-03	COMPLIANT	550	97.9	2023.25
	4.86E-05	COMPLIANT	385	35	2023.25
	8.99E-05	COMPLIANT	385	60	2023.25
	2.27E-04	COMPLIANT	385	97.1	2023.25
Gen-3	4.29E-04	COMPLIANT	550	35	2025.75
	7.02E-04	COMPLIANT	550	60	2025.75
	1.42E-03	COMPLIANT	550	97.9	2025.75
	4.22E-05	COMPLIANT	385	35	2025.75
	8.08E-05	COMPLIANT	385	60	2025.75
	2.14E-04	COMPLIANT	385	97.1	2025.75

7. ODAR Section 6: Assessment of Spacecraft Post-Mission Disposal Plans and Procedures

Table 12: NASA-STD-8719.14C Criteria for ODAR Section 6

	NASA-STD-8719.14C Item	Response
a	Description of spacecraft disposal option selected	After completing its planned operations, the satellites will deorbit naturally by atmospheric re-entry. At the end of each of the Gen-3 satellite's operational life (*i.e.* at EOM) the attitude control system will stop counteracting the aerodynamic disturbance torques.
b	Identification of all systems or components required to accomplish any post-mission disposal maneuvers. Plan for any spacecraft maneuvers required to accomplish post-mission disposal	No maneuvers are required following normal operations.
c	Calculation of area-to-mass ratio after post-mission disposal, if the controlled reentry option is not selected.	The average cross-sectional area was determined in accordance with NASA-STD-8719.14C by "determining the view, V, that yields the maximum cross-sectional area and denote the cross-sectional area as Amax. Let A1 and A2 be the cross-sectional areas for the two viewing directions orthogonal to V. Then define the average cross-sectional area as (Amax + A1 + A2) / 3." Spacecraft Mass at EOL: 134 kg +/- 5kg Cross-sectional Area: 1.01 m^2 Area to mass ratio: 0.0075 m^2/kg
d	If appropriate, preliminary plan for spacecraft-controlled reentry	Not applicable.
e	Assessment of spacecraft compliance with Requirements 4.6-1 through 4.6-4	See Section 7.1, Compliance to Requirements 4.6-1 through -4.

7.1. Compliance to Requirements 4.6-1 through 4.6-4

Table 13: Compliance to Requirements 4.6-1 through 4.6-4

Requirement	Compliance Statement
Requirement 4.6-1: Disposal for space structures in or passing through LEO: A spacecraft or orbital stage with a perigee altitude below 2,000 km shall be disposed of by one of the following three methods:	See the following three rows.
a. **Atmospheric reentry option:** (1) Leave the space structure in an orbit in which natural forces will lead to atmospheric reentry within 25 years after the completion of mission or NASA-STD-8719.14C – 2019-04-25 (2) Maneuver the space structure into a controlled de-orbit trajectory as soon as practical after completion of mission.	Compliant with Option (1) per DAS results shown in Section 7.1.1, Operational Orbit and Lifetime.
b. **Storage orbit option:** Maneuver the space structure into an orbit with perigee altitude above 2000 km and ensure its apogee altitude will be below 19,700 km, both for a minimum of 100 years.	Not applicable. Disposal will be atmospheric reentry.
c. **Direct retrieval:** Retrieve the space structure and remove it from orbit within 10 years after completion of mission.	Not applicable. Disposal will be atmospheric reentry.
Requirement 4.6-2: Disposal for space structures near GEO: A spacecraft or orbital stage in an orbit near GEO shall be maneuvered at EOM to a disposal orbit above GEO with a predicted minimum perigee of GEO +200 km (35,986 km) or below GEO with a predicted maximum apogee of GEO – 200 km (35,586 km) for a period of at least 100 years after disposal.	Not applicable. Spacecraft does not go beyond LEO.
Requirement 4.6-3: Disposal for space structures between LEO and GEO: a. Between LEO and Medium Earth Orbit (MEO): A spacecraft or orbital stage shall be left in an orbit with a perigee altitude greater than 2000 km and apogee altitude below 19,700 km for 100 years. b. Between MEO and GEO: A spacecraft or orbital stage shall be left in an orbit with a perigee altitude greater than 20,700 km and apogee altitude below 35,300 km for 100 years.	Not applicable. Spacecraft does not go beyond LEO.
Requirement 4.6-4: Reliability of post-mission disposal maneuver operations in Earth orbit: NASA space programs and projects shall ensure that all post-mission disposal operations to meet Requirements 4.6-1, 4.6-2, and/or 4.6-3 are designed for a probability of success as follows: a. Be no less than 0.90 at EOM, and b. For controlled reentry, the probability of success at the time of reentry burn must be sufficiently high so as not to cause a violation of Requirement 4.7-1 pertaining to limiting the risk of human casualty.	Not applicable. This is not a part of a NASA space program or project.

7.1.1 Operational Orbit and Lifetime

The orbit lifetime/dwell time is calculated below using DAS's Orbit Lifetime/Dwell time calculator under Science and Engineering. The compliance column is determined from DAS's requirement assessment for Requirement 4.6-1. For each block of anticipated satellite launch dates, a range of cases were run in DAS to envelope the worst-case altitudes and orbit inclinations. The results of the maximum and minimum altitudes and inclinations are shown in Table 14.

Table 14: Operational Orbit and Lifetime

Satellite Name	Launch Year	Operational Life	Post-Ops Life	Compliant?	Total Lifetime	Altitude	Inc.
Gen-3	2023.25	5 yrs	12.2 yrs	Yes	17.2 yrs	550	35
	2023.25	5 yrs	12.3 yrs	Yes	17.3 yrs	550	60
	2023.25	5 yrs	12.1 yrs	Yes	17.1 yrs	550	97.9
	2023.25	5 yrs	0.7 yrs	Yes	3.7 yrs	385	35
	2023.25	5 yrs	0.7 yrs	Yes	3.7 yrs	385	60
	2023.25	5 yrs	0.7 yrs	Yes	3.67 yrs	385	97.1
Gen-3	2025.75	5 yrs	10.9 yrs	Yes	15.9 yrs	550	35
	2025.75	5 yrs	10.9 yrs	Yes	15.9 yrs	550	60
	2025.75	5 yrs	10.7 yrs	Yes	15.7 yrs	550	97.9
	2025.75	5 yrs	0.5 yrs	Yes	3.5 yrs	385	35
	2025.75	5 yrs	0.5 yrs	Yes	3.5 yrs	385	60
	2025.75	5 yrs	0.5 yrs	Yes	3.5 yrs	385	97.1

8. ODAR Section 7: Assessment of Spacecraft Reentry Hazards

Table 15: NASA-STD-8719.14C Criteria for ODAR Section 7

	NASA-STD-8719.14C Item	Response
b	b. Summary of objects expected to survive an uncontrolled reentry, using NASA DAS, NASA Object Reentry Survival Analysis Tool (ORSAT), or comparable software	See Section 8.1 DAS Analysis Results – Expected Surviving Components
c	Calculation of probability of human casualty for the expected year of uncontrolled reentry and the spacecraft orbital inclination	See Section 8.2 Risk of Human Casualty
d	Assessment of spacecraft compliance with Requirement 4.7-1	See Section 8.3 Compliance to Requirement 4.7-1

8.1. DAS Analysis Results – Expected Surviving Components

BlackSky has improved the fidelity of its ODAR modeling since the original Gen-2 application and has sought to implement many design practices to reduce the probability of satellite debris reaching Earth or remaining in orbit. These design principles have produced ODAR results for Gen-3 that are not only compliant but are substantially improved over our prior Gen-2 design, despite a nearly 3x increase in mass and volume for Gen-3 satellites relative to Gen-2. Specific design-for-re-entry-demise features highlighted in Gen-3 include:

- Limiting the use of materials that may survive re-entry, such as titanium, silicon carbide, and invar. BlackSky materials that are entry-resistant (including titanium and Zerodur) are limited to applications where the CTE and/or strength-to-weight ratio is required to meet mission requirements. Where not required, BlackSky accepted mass growth (by using aluminum, for example) to achieve a higher probability of demise.
- Limiting the number of pieces expected to survive re-entry. BlackSky uses entry-resistant fasteners to secure entry resistant structures in order to increase the probability that these structures re-enter as a monolith. This reduces the debris footprint and the resulting probability of impact.
- Emphasis on building thin wall structures for major payload components, which facilitates demise during re-entry.
- Utilizing software that enables decommissioning and draining of onboard stored energy sources.

[PAGE REDACTED]

8.2. Risk of Human Casualty

Compliance to this requirement is determined from DAS's requirement assessment for Requirement 4.7-1. For each block of anticipated satellite launch dates, a range of cases were run in DAS to envelope the worst-case altitudes and orbit inclinations. The results of the maximum and minimum altitudes and inclinations are shown in Table 17. According to DAS calculations, there is a low risk of Human Casualty for Gen-3 satellites.

Table 17: DAS Results for Casualty Risk due to Reentry Debris

Satellite	Risk of Human Casualty	Compliance Status	Altitude	Inc.	Launch
Gen-3	1:24700	COMPLIANT	550	35	2023.25
	1:24700	COMPLIANT	550	60	2023.25
	1:24700	COMPLIANT	550	97.9	2023.25
	1:29900	COMPLIANT	385	35	2023.25
	1:29900	COMPLIANT	385	60	2023.25
	1:29900	COMPLIANT	385	97.1	2023.25
Gen-3	1:24300	COMPLIANT	550	35	2025.75
	1: 24300	COMPLIANT	550	60	2025.75
	1: 24300	COMPLIANT	550	97.9	2025.75
	1:28200	COMPLIANT	385	35	2025.75
	1:28200	COMPLIANT	385	60	2025.75
	1:28200	COMPLIANT	385	97.1	2025.75

8.3. Compliance to Requirement 4.7-1

Table 18: Compliance to Requirement 4.7-1

Requirement	Compliance Statement
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:	See the following three rows.
a. For uncontrolled reentry, the risk of human casualty from surviving debris shall not exceed 0.0001 (1:10,000).	Compliant per Section 8.2 Risk of Human Casualty
b. For controlled reentry, 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.	Not applicable. Satellite will have uncontrolled reentry.
c. For controlled reentries, the product of the probability of failure to execute the reentry burn and the risk of human casualty assuming uncontrolled reentry shall not exceed 0.0001 (1:10,000).	Not applicable. Satellite will have uncontrolled reentry.
d. For long-term reentry of space structures in MEO, Tundra orbits, highly inclined GEO, and other orbits: Surviving debris shall have less than 7 m2 total debris casualty area or 0.0001 (1 in 10,000) risk of human casualty.	Not applicable. Satellites will be in LEO.

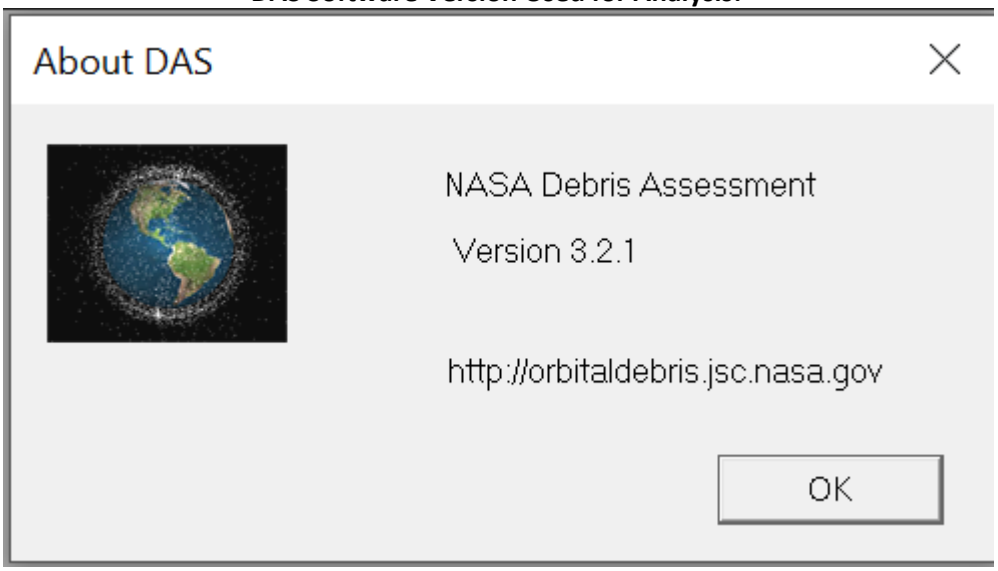
9. ODAR Sections 8 – 14 Applicability Overview

Table 19: ODAR Sections 8-14 Applicability Overview

ODAR Section(s)	Response
Section 8: Assessment for Special Classes of Space Missions	Not applicable. Section 4.8 of NASA-STD-8719.14C specifies five types of special missions: 1) Large Constellations 2) Small satellites 3) Rendezvous, proximity operations, and satellite servicing 4) Safety of active debris removal operations, 5) Tether systems Categories 2-5 do not apply as stated in Section 4.8. Large Constellations (Category 1) is defined in the 2019 ODMSP Objective 5, as constellations of 100 spacecraft or more in operation at any one time. BlackSky's constellation does not fall within this category.
Sections 9 -14: Launch Vehicle	Only applicable to launch vehicles.

Appendix A: Supporting DAS Run Data

DAS Software Version Used for Analysis:



Header of DAS Solar Flux file used:

JD, Solar f10.7 flux (noontime), yyyy mm dd
No missing Days (interpolated)

Executed by A. Manis on 29 Jun 2022

9.1. DAS Summary Data

9.1.1 Requirement 4.5-1

```
07 21 2022; 12:11:14PM Processing Requirement 4.5-1:     Return Status:  Passed
==============
Run Data
==============
**INPUT**
      Space Structure Name = Global Gen 3.0
      Space Structure Type = Payload
      Perigee Altitude = 550.000 (km)
      Apogee Altitude = 550.000 (km)
      Inclination = 35.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass Ratio = 0.0076 (m^2/kg)
      Start Year = 2023.250 (yr)
      Initial Mass = 135.000 (kg)
      Final Mass = 131.600 (kg)
      Duration = 3.000 (yr)
      Station-Kept = True
      Abandoned = True
      Long-Term Reentry = False
**OUTPUT**
      Collision Probability = 2.6042E-05
      Returned Message: Normal Processing
      Date Range Message: Normal Date Range
      Status = Pass
==============
=============== End of Requirement 4.5-1 ===============
```

```
07 21 2022; 12:46:37PM Processing Requirement 4.5-1:     Return Status:  Passed
==============
Run Data
==============
**INPUT**
      Space Structure Name = Global Gen 3.0
      Space Structure Type = Payload
      Perigee Altitude = 550.000 (km)
      Apogee Altitude = 550.000 (km)
      Inclination = 60.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass Ratio = 0.0076 (m^2/kg)
      Start Year = 2023.250 (yr)
      Initial Mass = 135.000 (kg)
      Final Mass = 131.600 (kg)
      Duration = 3.000 (yr)
      Station-Kept = True
      Abandoned = True
      Long-Term Reentry = False
**OUTPUT**
      Collision Probability = 3.1456E-05
      Returned Message: Normal Processing
      Date Range Message: Normal Date Range
      Status = Pass
==============
=============== End of Requirement 4.5-1 ===============
```

```
07 21 2022; 13:09:01PM Processing Requirement 4.5-1:     Return Status:  Passed
==============
Run Data
==============
**INPUT**
      Space Structure Name = Global Gen 3.0
      Space Structure Type = Payload
      Perigee Altitude = 550.000 (km)
      Apogee Altitude = 550.000 (km)
      Inclination = 97.500 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass Ratio = 0.0076 (m^2/kg)
      Start Year = 2023.250 (yr)
      Initial Mass = 135.000 (kg)
      Final Mass = 131.600 (kg)
      Duration = 3.000 (yr)
      Station-Kept = True
      Abandoned = True
      Long-Term Reentry = False
**OUTPUT**
      Collision Probability = 4.2830E-05
      Returned Message: Normal Processing
      Date Range Message: Normal Date Range
      Status = Pass
==============
=============== End of Requirement 4.5-1 ===============
```

```
07 21 2022; 15:26:35PM Processing Requirement 4.5-1:     Return Status :  Passed
==============
Run Data
==============
**INPUT**
      Space Structure Name = Global Gen 3.0
      Space Structure Type = Payload
      Perigee Altitude = 385.000 (km)
      Apogee Altitude = 385.000 (km)
      Inclination = 35.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass Ratio = 0.0076 (m^2/kg)
      Start Year = 2023.250 (yr)
      Initial Mass = 135.000 (kg)
      Final Mass = 131.600 (kg)
      Duration = 3.000 (yr)
      Station-Kept = True
      Abandoned = True
      Long-Term Reentry = False
**OUTPUT**
      Collision Probability = 2.0998E-06
      Returned Message: Normal Processing
      Date Range Message: Normal Date Range
      Status = Pass
==============
=============== End of Requirement 4.5-1 ===============
```

```
07 21 2022; 15:52:47PM Processing Requirement 4.5-1:     Return Status :  Passed
==============
Run Data
==============
**INPUT**
      Space Structure Name = Global Gen 3.0
      Space Structure Type = Payload
      Perigee Altitude = 385.000 (km)
      Apogee Altitude = 385.000 (km)
      Inclination = 60.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass Ratio = 0.0076 (m^2/kg)
      Start Year = 2023.250 (yr)
      Initial Mass = 135.000 (kg)
      Final Mass = 131.600 (kg)
      Duration = 3.000 (yr)
      Station-Kept = True
      Abandoned = True
      Long-Term Reentry = False
**OUTPUT**
      Collision Probability = 2.4474E-06
      Returned Message: Normal Processing
      Date Range Message: Normal Date Range
      Status = Pass
==============
=============== End of Requirement 4.5-1 ===============
```

```
07 21 2022; 16:15:10PM Processing Requirement 4.5-1:     Return Status :  Passed
==============
Run Data
==============
**INPUT**
      Space Structure Name = Global Gen 3.0
      Space Structure Type = Payload
      Perigee Altitude = 385.000 (km)
      Apogee Altitude = 385.000 (km)
      Inclination = 97.100 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass Ratio = 0.0076 (m^2/kg)
      Start Year = 2023.250 (yr)
      Initial Mass = 135.000 (kg)
      Final Mass = 131.600 (kg)
      Duration = 3.000 (yr)
      Station-Kept = True
      Abandoned = True
      Long-Term Reentry = False
**OUTPUT**
      Collision Probability = 4.8874E-06
      Returned Message: Normal Processing
      Date Range Message: Normal Date Range
      Status = Pass
==============
=============== End of Requirement 4.5-1 ===============
```

```
07 21 2022; 13:35:30PM Processing Requirement 4.5-1:     Return Status :  Passed
==============
Run Data
==============
**INPUT**
      Space Structure Name = Global Gen 3.0
      Space Structure Type = Payload
      Perigee Altitude = 550.000 (km)
      Apogee Altitude = 550.000 (km)
      Inclination = 35.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass Ratio = 0.0076 (m^2/kg)
      Start Year = 2025.750 (yr)
      Initial Mass = 135.000 (kg)
      Final Mass = 131.600 (kg)
      Duration = 3.000 (yr)
      Station-Kept = True
      Abandoned = True
      Long-Term Reentry = False
**OUTPUT**
      Collision Probability = 2.4268E-05
      Returned Message: Normal Processing
      Date Range Message: Normal Date Range
      Status = Pass
==============
=============== End of Requirement 4.5-1 ===============
```

```
07 21 2022; 16:31:07PM Processing Requirement 4.5-1:     Return Status :  Passed
==============
Run Data
==============
**INPUT**
      Space Structure Name = Global Gen 3.0
      Space Structure Type = Payload
      Perigee Altitude = 550.000 (km)
      Apogee Altitude = 550.000 (km)
      Inclination = 60.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass Ratio = 0.0076 (m^2/kg)
      Start Year = 2025.750 (yr)
      Initial Mass = 135.000 (kg)
      Final Mass = 131.600 (kg)
      Duration = 3.000 (yr)
      Station-Kept = True
      Abandoned = True
      Long-Term Reentry = False
**OUTPUT**
      Collision Probability = 2.9310E-05
      Returned Message: Normal Processing
      Date Range Message: Normal Date Range
      Status = Pass
==============
=============== End of Requirement 4.5-1 ===============
```

```
07 21 2022; 20:55:07PM Processing Requirement 4.5-1:     Return Status :  Passed
==============
Run Data
==============
**INPUT**
      Space Structure Name = Global Gen 3.0
      Space Structure Type = Payload
      Perigee Altitude = 550.000 (km)
      Apogee Altitude = 550.000 (km)
      Inclination = 97.500 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass Ratio = 0.0076 (m^2/kg)
      Start Year = 2025.750 (yr)
      Initial Mass = 135.000 (kg)
      Final Mass = 131.600 (kg)
      Duration = 3.000 (yr)
      Station-Kept = True
      Abandoned = True
      Long-Term Reentry = False
**OUTPUT**
      Collision Probability = 3.8732E-05
      Returned Message: Normal Processing
      Date Range Message: Normal Date Range
      Status = Pass
==============
=============== End of Requirement 4.5-1 ===============
```

```
07 21 2022; 18:01:35PM Processing Requirement 4.5-1:     Return Status :  Passed
==============
Run Data
==============
**INPUT**
      Space Structure Name = Global Gen 3.0
      Space Structure Type = Payload
      Perigee Altitude = 385.000 (km)
      Apogee Altitude = 385.000 (km)
      Inclination = 35.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass Ratio = 0.0076 (m^2/kg)
      Start Year = 2025.750 (yr)
      Initial Mass = 135.000 (kg)
      Final Mass = 131.600 (kg)
      Duration = 3.000 (yr)
      Station-Kept = True
      Abandoned = True
      Long-Term Reentry = False
**OUTPUT**
      Collision Probability = 1.5551E-06
      Returned Message: Normal Processing
      Date Range Message: Normal Date Range
      Status = Pass
==============
=============== End of Requirement 4.5-1 ===============
```

```
07 21 2022; 19:02:31PM Processing Requirement 4.5-1:     Return Status :  Passed
==============
Run Data
==============
**INPUT**
      Space Structure Name = Global Gen 3.0
      Space Structure Type = Payload
      Perigee Altitude = 385.000 (km)
      Apogee Altitude = 385.000 (km)
      Inclination = 60.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass Ratio = 0.0076 (m^2/kg)
      Start Year = 2025.750 (yr)
      Initial Mass = 135.000 (kg)
      Final Mass = 131.600 (kg)
      Duration = 3.000 (yr)
      Station-Kept = True
      Abandoned = True
      Long-Term Reentry = False
**OUTPUT**
      Collision Probability = 1.8193E-06
      Returned Message: Normal Processing
      Date Range Message: Normal Date Range
      Status = Pass
==============
=============== End of Requirement 4.5-1 ===============
```

```
07 21 2022; 20:24:25PM Processing Requirement 4.5-1:     Return Status :  Passed
==============
Run Data
==============
**INPUT**
      Space Structure Name = Global Gen 3.0
      Space Structure Type = Payload
      Perigee Altitude = 385.000 (km)
      Apogee Altitude = 385.000 (km)
      Inclination = 97.100 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass Ratio = 0.0076 (m^2/kg)
      Start Year = 2025.750 (yr)
      Initial Mass = 135.000 (kg)
      Final Mass = 131.600 (kg)
      Duration = 3.000 (yr)
      Station-Kept = True
      Abandoned = True
      Long-Term Reentry = False
**OUTPUT**
      Collision Probability = 3.2057E-06
      Returned Message: Normal Processing
      Date Range Message: Normal Date Range
      Status = Pass
==============
=============== End of Requirement 4.5-1 ===============
```

9.1.2 Requirement 4.5-2

```
07 21 2022; 12:20:57PM Requirement 4.5-2:  Compliant
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = FC+X
==================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 35.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.940 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 20.000 (cm)
      Outer Wall 2   Density: 5.400 (g/cm^2)  Separation: 18.000 (cm)
      Outer Wall 3   Density: 1.620 (g/cm^2)  Separation: 16.000 (cm)
      Outer Wall 4   Density: 1.620 (g/cm^2)  Separation: 6.000 (cm)
**OUTPUT**
      Probability of Penetration = 8.0623E-07 (8.0623E-07)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = FC+Y
==================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 35.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.940 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
```

```
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 4.790 (cm)
**OUTPUT**
      Probability of Penetration = 1.9304E-04 (1.9306E-04)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = Battery+X
==================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 35.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 0.510 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 50.000 (cm)
      Outer Wall 2   Density: 0.540 (g/cm^2)  Separation: 48.000 (cm)
      Outer Wall 3   Density: 1.620 (g/cm^2)  Separation: 46.000 (cm)
      Outer Wall 4   Density: 1.620 (g/cm^2)  Separation: 36.000 (cm)
      Outer Wall 5   Density: 1.940 (g/cm^2)  Separation: 20.000 (cm)
      Outer Wall 6   Density: 1.940 (g/cm^2)  Separation: 12.000 (cm)
      Outer Wall 7   Density: 1.940 (g/cm^2)  Separation: 10.000 (cm)
      Outer Wall 8   Density: 1.940 (g/cm^2)  Separation: 2.000 (cm)
**OUTPUT**
      Probability of Penetration = 5.2306E-07 (5.2306E-07)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = Battery+Y
==================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 35.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
```

```
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 0.510 (g/cm^2)
      CS Surface Area = 0.0015 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 5.000 (cm)
**OUTPUT**
      Probability of Penetration = 5.9797E-05 (5.9799E-05)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
=================================================
Spacecraft = Global Gen 3.0
Critical Surface = Tank+Y
=================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 35.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 2.160 (g/cm^2)
      CS Surface Area = 0.0027 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = Yes
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 2.450 (cm)
**OUTPUT**
      Probability of Penetration = 1.1556E-04 (1.1557E-04)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
=================================================
Spacecraft = Global Gen 3.0
Critical Surface = Tank+X
=================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 35.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
```

```
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.620 (g/cm^2)
      CS Surface Area = 0.0027 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = Yes
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 4.790 (cm)
      Outer Wall 2   Density: 5.400 (g/cm^2)  Separation: 2.790 (cm)
**OUTPUT**
      Probability of Penetration = 6.7990E-06 (6.7990E-06)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
=============== End of Requirement 4.5-2 ===============
```

```
07 21 2022; 12:58:49PM Requirement 4.5-2:  Compliant
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = FC+X
==================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 60.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.940 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 20.000 (cm)
      Outer Wall 2   Density: 5.400 (g/cm^2)  Separation: 18.000 (cm)
      Outer Wall 3   Density: 1.620 (g/cm^2)  Separation: 16.000 (cm)
      Outer Wall 4   Density: 1.620 (g/cm^2)  Separation: 6.000 (cm)
**OUTPUT**
      Probability of Penetration = 1.2497E-06 (1.2497E-06)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = FC+Y
==================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 60.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.940 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
```

```
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 4.790 (cm)
**OUTPUT**
      Probability of Penetration = 3.4494E-04 (3.4500E-04)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Battery+X
================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 60.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 0.510 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 50.000 (cm)
      Outer Wall 2   Density: 0.540 (g/cm^2)  Separation: 48.000 (cm)
      Outer Wall 3   Density: 1.620 (g/cm^2)  Separation: 46.000 (cm)
      Outer Wall 4   Density: 1.620 (g/cm^2)  Separation: 36.000 (cm)
      Outer Wall 5   Density: 1.940 (g/cm^2)  Separation: 20.000 (cm)
      Outer Wall 6   Density: 1.940 (g/cm^2)  Separation: 12.000 (cm)
      Outer Wall 7   Density: 1.940 (g/cm^2)  Separation: 10.000 (cm)
      Outer Wall 8   Density: 1.940 (g/cm^2)  Separation: 2.000 (cm)
**OUTPUT**
      Probability of Penetration = 7.3677E-07 (7.3677E-07)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Battery+Y
================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 60.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
```

```
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 0.510 (g/cm^2)
      CS Surface Area = 0.0015 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 5.000 (cm)
**OUTPUT**
      Probability of Penetration = 8.7525E-05 (8.7529E-05)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Tank+Y
================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 60.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 2.160 (g/cm^2)
      CS Surface Area = 0.0027 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = Yes
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 2.450 (cm)
**OUTPUT**
      Probability of Penetration = 1.6779E-04 (1.6780E-04)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Tank+X
================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 60.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
```

```
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.620 (g/cm^2)
      CS Surface Area = 0.0027 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = Yes
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 4.790 (cm)
      Outer Wall 2   Density: 5.400 (g/cm^2)  Separation: 2.790 (cm)
**OUTPUT**
      Probability of Penetration = 1.3370E-05 (1.3371E-05)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
=============== End of Requirement 4.5-2 ===============
```

```
07 21 2022; 13:24:21PM Requirement 4.5-2:  Compliant
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = FC+X
==================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 97.500 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.940 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 20.000 (cm)
      Outer Wall 2   Density: 5.400 (g/cm^2)  Separation: 18.000 (cm)
      Outer Wall 3   Density: 1.620 (g/cm^2)  Separation: 16.000 (cm)
      Outer Wall 4   Density: 1.620 (g/cm^2)  Separation: 6.000 (cm)
**OUTPUT**
      Probability of Penetration = 2.2397E-06 (2.2397E-06)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = FC+Y
==================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 97.500 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.940 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
```

```
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 4.790 (cm)
**OUTPUT**
      Probability of Penetration = 7.4074E-04 (7.4102E-04)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Battery+X
================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 97.500 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 0.510 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 50.000 (cm)
      Outer Wall 2   Density: 0.540 (g/cm^2)  Separation: 48.000 (cm)
      Outer Wall 3   Density: 1.620 (g/cm^2)  Separation: 46.000 (cm)
      Outer Wall 4   Density: 1.620 (g/cm^2)  Separation: 36.000 (cm)
      Outer Wall 5   Density: 1.940 (g/cm^2)  Separation: 20.000 (cm)
      Outer Wall 6   Density: 1.940 (g/cm^2)  Separation: 12.000 (cm)
      Outer Wall 7   Density: 1.940 (g/cm^2)  Separation: 10.000 (cm)
      Outer Wall 8   Density: 1.940 (g/cm^2)  Separation: 2.000 (cm)
**OUTPUT**
      Probability of Penetration = 1.3028E-06 (1.3028E-06)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Battery+Y
================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 97.500 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
```

```
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 0.510 (g/cm^2)
      CS Surface Area = 0.0015 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 5.000 (cm)
**OUTPUT**
      Probability of Penetration = 1.7016E-04 (1.7017E-04)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Tank+Y
================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 97.500 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 2.160 (g/cm^2)
      CS Surface Area = 0.0027 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = Yes
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 2.450 (cm)
**OUTPUT**
      Probability of Penetration = 3.2475E-04 (3.2481E-04)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Tank+X
================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 97.500 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
```

```
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.620 (g/cm^2)
      CS Surface Area = 0.0027 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = Yes
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 4.790 (cm)
      Outer Wall 2   Density: 5.400 (g/cm^2)  Separation: 2.790 (cm)
**OUTPUT**
      Probability of Penetration = 2.9688E-05 (2.9688E-05)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
=============== End of Requirement 4.5-2 ===============
```

```
07 21 2022; 15:47:35PM Requirement 4.5-2:  Compliant
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = FC+X
==================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 35.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.940 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 20.000 (cm)
      Outer Wall 2   Density: 5.400 (g/cm^2)  Separation: 18.000 (cm)
      Outer Wall 3   Density: 1.620 (g/cm^2)  Separation: 16.000 (cm)
      Outer Wall 4   Density: 1.620 (g/cm^2)  Separation: 6.000 (cm)
**OUTPUT**
      Probability of Penetration = 1.9086E-07 (1.9086E-07)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = FC+Y
==================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 35.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.940 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
```

```
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 4.790 (cm)
**OUTPUT**
      Probability of Penetration = 2.3627E-05 (2.3627E-05)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Battery+X
================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 35.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 0.510 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 50.000 (cm)
      Outer Wall 2   Density: 0.540 (g/cm^2)  Separation: 48.000 (cm)
      Outer Wall 3   Density: 1.620 (g/cm^2)  Separation: 46.000 (cm)
      Outer Wall 4   Density: 1.620 (g/cm^2)  Separation: 36.000 (cm)
      Outer Wall 5   Density: 1.940 (g/cm^2)  Separation: 20.000 (cm)
      Outer Wall 6   Density: 1.940 (g/cm^2)  Separation: 12.000 (cm)
      Outer Wall 7   Density: 1.940 (g/cm^2)  Separation: 10.000 (cm)
      Outer Wall 8   Density: 1.940 (g/cm^2)  Separation: 2.000 (cm)
**OUTPUT**
      Probability of Penetration = 1.4737E-07 (1.4737E-07)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Battery+Y
================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 35.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
```

```
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 0.510 (g/cm^2)
      CS Surface Area = 0.0015 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 5.000 (cm)
**OUTPUT**
      Probability of Penetration = 8.1086E-06 (8.1086E-06)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Tank+Y
================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 35.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 2.160 (g/cm^2)
      CS Surface Area = 0.0027 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = Yes
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 2.450 (cm)
**OUTPUT**
      Probability of Penetration = 1.5771E-05 (1.5771E-05)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Tank+X
================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 35.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
```

```
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.620 (g/cm^2)
      CS Surface Area = 0.0027 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = Yes
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 4.790 (cm)
      Outer Wall 2   Density: 5.400 (g/cm^2)  Separation: 2.790 (cm)
**OUTPUT**
      Probability of Penetration = 7.9720E-07 (7.9720E-07)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
=============== End of Requirement 4.5-2 ===============
```

```
07 21 2022; 16:09:23PM Requirement 4.5-2:  Compliant
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = FC+X
==================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 60.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.940 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 20.000 (cm)
      Outer Wall 2   Density: 5.400 (g/cm^2)  Separation: 18.000 (cm)
      Outer Wall 3   Density: 1.620 (g/cm^2)  Separation: 16.000 (cm)
      Outer Wall 4   Density: 1.620 (g/cm^2)  Separation: 6.000 (cm)
**OUTPUT**
      Probability of Penetration = 2.6708E-07 (2.6708E-07)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = FC+Y
==================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 60.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.940 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
```

```
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 4.790 (cm)
**OUTPUT**
      Probability of Penetration = 4.7715E-05 (4.7716E-05)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Battery+X
================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 60.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 0.510 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 50.000 (cm)
      Outer Wall 2   Density: 0.540 (g/cm^2)  Separation: 48.000 (cm)
      Outer Wall 3   Density: 1.620 (g/cm^2)  Separation: 46.000 (cm)
      Outer Wall 4   Density: 1.620 (g/cm^2)  Separation: 36.000 (cm)
      Outer Wall 5   Density: 1.940 (g/cm^2)  Separation: 20.000 (cm)
      Outer Wall 6   Density: 1.940 (g/cm^2)  Separation: 12.000 (cm)
      Outer Wall 7   Density: 1.940 (g/cm^2)  Separation: 10.000 (cm)
      Outer Wall 8   Density: 1.940 (g/cm^2)  Separation: 2.000 (cm)
**OUTPUT**
      Probability of Penetration = 1.9370E-07 (1.9370E-07)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Battery+Y
================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 60.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
```

```
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 0.510 (g/cm^2)
      CS Surface Area = 0.0015 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 5.000 (cm)
**OUTPUT**
      Probability of Penetration = 1.3650E-05 (1.3650E-05)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Tank+Y
================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 60.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 2.160 (g/cm^2)
      CS Surface Area = 0.0027 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = Yes
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 2.450 (cm)
**OUTPUT**
      Probability of Penetration = 2.6343E-05 (2.6343E-05)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Tank+X
================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 60.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
```

```
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.620 (g/cm^2)
      CS Surface Area = 0.0027 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = Yes
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 4.790 (cm)
      Outer Wall 2   Density: 5.400 (g/cm^2)  Separation: 2.790 (cm)
**OUTPUT**
      Probability of Penetration = 1.7532E-06 (1.7532E-06)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
=============== End of Requirement 4.5-2 ===============
```

```
07 21 2022; 16:22:55PM Requirement 4.5-2:  Compliant
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = FC+X
==================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 97.100 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.940 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 20.000 (cm)
      Outer Wall 2   Density: 5.400 (g/cm^2)  Separation: 18.000 (cm)
      Outer Wall 3   Density: 1.620 (g/cm^2)  Separation: 16.000 (cm)
      Outer Wall 4   Density: 1.620 (g/cm^2)  Separation: 6.000 (cm)
**OUTPUT**
      Probability of Penetration = 7.2440E-07 (7.2440E-07)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = FC+Y
==================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 97.100 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.940 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
```

```
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 4.790 (cm)
**OUTPUT**
      Probability of Penetration = 1.3109E-04 (1.3110E-04)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = Battery+X
==================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 97.100 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 0.510 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 50.000 (cm)
      Outer Wall 2   Density: 0.540 (g/cm^2)  Separation: 48.000 (cm)
      Outer Wall 3   Density: 1.620 (g/cm^2)  Separation: 46.000 (cm)
      Outer Wall 4   Density: 1.620 (g/cm^2)  Separation: 36.000 (cm)
      Outer Wall 5   Density: 1.940 (g/cm^2)  Separation: 20.000 (cm)
      Outer Wall 6   Density: 1.940 (g/cm^2)  Separation: 12.000 (cm)
      Outer Wall 7   Density: 1.940 (g/cm^2)  Separation: 10.000 (cm)
      Outer Wall 8   Density: 1.940 (g/cm^2)  Separation: 2.000 (cm)
**OUTPUT**
      Probability of Penetration = 5.3080E-07 (5.3080E-07)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = Battery+Y
==================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 97.100 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
```

```
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 0.510 (g/cm^2)
      CS Surface Area = 0.0015 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 5.000 (cm)
**OUTPUT**
      Probability of Penetration = 3.0734E-05 (3.0734E-05)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Tank+Y
================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 97.100 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 2.160 (g/cm^2)
      CS Surface Area = 0.0027 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = Yes
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 2.450 (cm)
**OUTPUT**
      Probability of Penetration = 5.8643E-05 (5.8645E-05)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Tank+X
================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 97.100 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
```

```
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2023.250 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.620 (g/cm^2)
      CS Surface Area = 0.0027 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = Yes
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 4.790 (cm)
      Outer Wall 2   Density: 5.400 (g/cm^2)  Separation: 2.790 (cm)
**OUTPUT**
      Probability of Penetration = 5.1257E-06 (5.1257E-06)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
=============== End of Requirement 4.5-2 ===============
```

```
07 21 2022; 13:46:21PM Requirement 4.5-2:  Compliant
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = FC+X
==================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 35.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.940 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 20.000 (cm)
      Outer Wall 2   Density: 5.400 (g/cm^2)  Separation: 18.000 (cm)
      Outer Wall 3   Density: 1.620 (g/cm^2)  Separation: 16.000 (cm)
      Outer Wall 4   Density: 1.620 (g/cm^2)  Separation: 6.000 (cm)
**OUTPUT**
      Probability of Penetration = 8.1069E-07 (8.1069E-07)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = FC+Y
==================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 35.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.940 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
```

```
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 4.790 (cm)
**OUTPUT**
      Probability of Penetration = 2.1776E-04 (2.1778E-04)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = Battery+X
==================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 35.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 0.510 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 50.000 (cm)
      Outer Wall 2   Density: 0.540 (g/cm^2)  Separation: 48.000 (cm)
      Outer Wall 3   Density: 1.620 (g/cm^2)  Separation: 46.000 (cm)
      Outer Wall 4   Density: 1.620 (g/cm^2)  Separation: 36.000 (cm)
      Outer Wall 5   Density: 1.940 (g/cm^2)  Separation: 20.000 (cm)
      Outer Wall 6   Density: 1.940 (g/cm^2)  Separation: 12.000 (cm)
      Outer Wall 7   Density: 1.940 (g/cm^2)  Separation: 10.000 (cm)
      Outer Wall 8   Density: 1.940 (g/cm^2)  Separation: 2.000 (cm)
**OUTPUT**
      Probability of Penetration = 5.0606E-07 (5.0606E-07)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = Battery+Y
==================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 35.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
```

```
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 0.510 (g/cm^2)
      CS Surface Area = 0.0015 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 5.000 (cm)
**OUTPUT**
      Probability of Penetration = 6.9050E-05 (6.9052E-05)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Tank+Y
================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 35.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 2.160 (g/cm^2)
      CS Surface Area = 0.0027 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = Yes
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 2.450 (cm)
**OUTPUT**
      Probability of Penetration = 1.3363E-04 (1.3364E-04)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Tank+X
================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 35.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
```

```
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.620 (g/cm^2)
      CS Surface Area = 0.0027 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = Yes
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 4.790 (cm)
      Outer Wall 2   Density: 5.400 (g/cm^2)  Separation: 2.790 (cm)
**OUTPUT**
      Probability of Penetration = 7.5951E-06 (7.5951E-06)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
=============== End of Requirement 4.5-2 ===============
```

```
07 21 2022; 17:03:31PM Requirement 4.5-2:  Compliant
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = FC+X
==================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 60.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.940 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 20.000 (cm)
      Outer Wall 2   Density: 5.400 (g/cm^2)  Separation: 18.000 (cm)
      Outer Wall 3   Density: 1.620 (g/cm^2)  Separation: 16.000 (cm)
      Outer Wall 4   Density: 1.620 (g/cm^2)  Separation: 6.000 (cm)
**OUTPUT**
      Probability of Penetration = 1.2873E-06 (1.2873E-06)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = FC+Y
==================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 60.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.940 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
```

```
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 4.790 (cm)
**OUTPUT**
      Probability of Penetration = 3.9015E-04 (3.9023E-04)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Battery+X
================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 60.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 0.510 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 50.000 (cm)
      Outer Wall 2   Density: 0.540 (g/cm^2)  Separation: 48.000 (cm)
      Outer Wall 3   Density: 1.620 (g/cm^2)  Separation: 46.000 (cm)
      Outer Wall 4   Density: 1.620 (g/cm^2)  Separation: 36.000 (cm)
      Outer Wall 5   Density: 1.940 (g/cm^2)  Separation: 20.000 (cm)
      Outer Wall 6   Density: 1.940 (g/cm^2)  Separation: 12.000 (cm)
      Outer Wall 7   Density: 1.940 (g/cm^2)  Separation: 10.000 (cm)
      Outer Wall 8   Density: 1.940 (g/cm^2)  Separation: 2.000 (cm)
**OUTPUT**
      Probability of Penetration = 7.2728E-07 (7.2728E-07)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Battery+Y
================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 60.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
```

```
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 0.510 (g/cm^2)
      CS Surface Area = 0.0015 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 5.000 (cm)
**OUTPUT**
      Probability of Penetration = 1.0116E-04 (1.0116E-04)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Tank+Y
================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 60.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 2.160 (g/cm^2)
      CS Surface Area = 0.0027 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = Yes
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 2.450 (cm)
**OUTPUT**
      Probability of Penetration = 1.9419E-04 (1.9421E-04)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Tank+X
================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 60.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
```

```
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.620 (g/cm^2)
      CS Surface Area = 0.0027 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = Yes
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 4.790 (cm)
      Outer Wall 2   Density: 5.400 (g/cm^2)  Separation: 2.790 (cm)
**OUTPUT**
      Probability of Penetration = 1.4983E-05 (1.4983E-05)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
=============== End of Requirement 4.5-2 ===============
```

```
07 21 2022; 21:07:05PM Requirement 4.5-2:  Compliant
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = FC+X
==================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 97.500 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.940 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 20.000 (cm)
      Outer Wall 2   Density: 5.400 (g/cm^2)  Separation: 18.000 (cm)
      Outer Wall 3   Density: 1.620 (g/cm^2)  Separation: 16.000 (cm)
      Outer Wall 4   Density: 1.620 (g/cm^2)  Separation: 6.000 (cm)
**OUTPUT**
      Probability of Penetration = 2.1141E-06 (2.1141E-06)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = FC+Y
==================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 97.500 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.940 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
```

```
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 4.790 (cm)
**OUTPUT**
      Probability of Penetration = 8.2459E-04 (8.2493E-04)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = Battery+X
==================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 97.500 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 0.510 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 50.000 (cm)
      Outer Wall 2   Density: 0.540 (g/cm^2)  Separation: 48.000 (cm)
      Outer Wall 3   Density: 1.620 (g/cm^2)  Separation: 46.000 (cm)
      Outer Wall 4   Density: 1.620 (g/cm^2)  Separation: 36.000 (cm)
      Outer Wall 5   Density: 1.940 (g/cm^2)  Separation: 20.000 (cm)
      Outer Wall 6   Density: 1.940 (g/cm^2)  Separation: 12.000 (cm)
      Outer Wall 7   Density: 1.940 (g/cm^2)  Separation: 10.000 (cm)
      Outer Wall 8   Density: 1.940 (g/cm^2)  Separation: 2.000 (cm)
**OUTPUT**
      Probability of Penetration = 1.1462E-06 (1.1462E-06)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = Battery+Y
==================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 97.500 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
```

```
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 0.510 (g/cm^2)
      CS Surface Area = 0.0015 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 5.000 (cm)
**OUTPUT**
      Probability of Penetration = 1.9249E-04 (1.9251E-04)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Tank+Y
================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 97.500 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 2.160 (g/cm^2)
      CS Surface Area = 0.0027 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = Yes
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 2.450 (cm)
**OUTPUT**
      Probability of Penetration = 3.6771E-04 (3.6778E-04)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Tank+X
================================================
**INPUT**
      Apogee Altitude = 550.000 (km)
      Perigee Altitude = 550.000 (km)
      Orbital Inclination = 97.500 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
```

```
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.620 (g/cm^2)
      CS Surface Area = 0.0027 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = Yes
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 4.790 (cm)
      Outer Wall 2   Density: 5.400 (g/cm^2)  Separation: 2.790 (cm)
**OUTPUT**
      Probability of Penetration = 3.2721E-05 (3.2722E-05)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
=============== End of Requirement 4.5-2 ===============
```

```
07 21 2022; 18:37:01PM Requirement 4.5-2:  Compliant
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = FC+X
==================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 35.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.940 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 20.000 (cm)
      Outer Wall 2   Density: 5.400 (g/cm^2)  Separation: 18.000 (cm)
      Outer Wall 3   Density: 1.620 (g/cm^2)  Separation: 16.000 (cm)
      Outer Wall 4   Density: 1.620 (g/cm^2)  Separation: 6.000 (cm)
**OUTPUT**
      Probability of Penetration = 1.0141E-07 (1.0141E-07)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = FC+Y
==================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 35.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.940 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
```

```
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 4.790 (cm)
**OUTPUT**
      Probability of Penetration = 2.0105E-05 (2.0105E-05)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Battery+X
================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 35.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 0.510 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 50.000 (cm)
      Outer Wall 2   Density: 0.540 (g/cm^2)  Separation: 48.000 (cm)
      Outer Wall 3   Density: 1.620 (g/cm^2)  Separation: 46.000 (cm)
      Outer Wall 4   Density: 1.620 (g/cm^2)  Separation: 36.000 (cm)
      Outer Wall 5   Density: 1.940 (g/cm^2)  Separation: 20.000 (cm)
      Outer Wall 6   Density: 1.940 (g/cm^2)  Separation: 12.000 (cm)
      Outer Wall 7   Density: 1.940 (g/cm^2)  Separation: 10.000 (cm)
      Outer Wall 8   Density: 1.940 (g/cm^2)  Separation: 2.000 (cm)
**OUTPUT**
      Probability of Penetration = 7.4000E-08 (7.4000E-08)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Battery+Y
================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 35.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
```

```
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 0.510 (g/cm^2)
      CS Surface Area = 0.0015 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 5.000 (cm)
**OUTPUT**
      Probability of Penetration = 7.2086E-06 (7.2087E-06)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Tank+Y
================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 35.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 2.160 (g/cm^2)
      CS Surface Area = 0.0027 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = Yes
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 2.450 (cm)
**OUTPUT**
      Probability of Penetration = 1.4053E-05 (1.4053E-05)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Tank+X
================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 35.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
```

```
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.620 (g/cm^2)
      CS Surface Area = 0.0027 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = Yes
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 4.790 (cm)
      Outer Wall 2   Density: 5.400 (g/cm^2)  Separation: 2.790 (cm)
**OUTPUT**
      Probability of Penetration = 6.5931E-07 (6.5931E-07)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
=============== End of Requirement 4.5-2 ===============
```

```
07 21 2022; 19:36:40PM Requirement 4.5-2:  Compliant
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = FC+X
==================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 60.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.940 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 20.000 (cm)
      Outer Wall 2   Density: 5.400 (g/cm^2)  Separation: 18.000 (cm)
      Outer Wall 3   Density: 1.620 (g/cm^2)  Separation: 16.000 (cm)
      Outer Wall 4   Density: 1.620 (g/cm^2)  Separation: 6.000 (cm)
**OUTPUT**
      Probability of Penetration = 1.5505E-07 (1.5505E-07)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = FC+Y
==================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 60.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.940 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
```

```
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 4.790 (cm)
**OUTPUT**
      Probability of Penetration = 4.2191E-05 (4.2192E-05)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Battery+X
================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 60.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 0.510 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 50.000 (cm)
      Outer Wall 2   Density: 0.540 (g/cm^2)  Separation: 48.000 (cm)
      Outer Wall 3   Density: 1.620 (g/cm^2)  Separation: 46.000 (cm)
      Outer Wall 4   Density: 1.620 (g/cm^2)  Separation: 36.000 (cm)
      Outer Wall 5   Density: 1.940 (g/cm^2)  Separation: 20.000 (cm)
      Outer Wall 6   Density: 1.940 (g/cm^2)  Separation: 12.000 (cm)
      Outer Wall 7   Density: 1.940 (g/cm^2)  Separation: 10.000 (cm)
      Outer Wall 8   Density: 1.940 (g/cm^2)  Separation: 2.000 (cm)
**OUTPUT**
      Probability of Penetration = 1.0311E-07 (1.0311E-07)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Battery+Y
================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 60.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
```

```
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 0.510 (g/cm^2)
      CS Surface Area = 0.0015 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 5.000 (cm)
**OUTPUT**
      Probability of Penetration = 1.2562E-05 (1.2562E-05)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Tank+Y
================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 60.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 2.160 (g/cm^2)
      CS Surface Area = 0.0027 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = Yes
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 2.450 (cm)
**OUTPUT**
      Probability of Penetration = 2.4294E-05 (2.4294E-05)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Tank+X
================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 60.000 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
```

```
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.620 (g/cm^2)
      CS Surface Area = 0.0027 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = Yes
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 4.790 (cm)
      Outer Wall 2   Density: 5.400 (g/cm^2)  Separation: 2.790 (cm)
**OUTPUT**
      Probability of Penetration = 1.5170E-06 (1.5170E-06)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
=============== End of Requirement 4.5-2 ===============
```

```
07 21 2022; 20:39:15PM Requirement 4.5-2:  Compliant
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = FC+X
==================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 97.100 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.940 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 20.000 (cm)
      Outer Wall 2   Density: 5.400 (g/cm^2)  Separation: 18.000 (cm)
      Outer Wall 3   Density: 1.620 (g/cm^2)  Separation: 16.000 (cm)
      Outer Wall 4   Density: 1.620 (g/cm^2)  Separation: 6.000 (cm)
**OUTPUT**
      Probability of Penetration = 3.5138E-07 (3.5138E-07)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = FC+Y
==================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 97.100 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.940 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
```

```
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 4.790 (cm)
**OUTPUT**
      Probability of Penetration = 1.2366E-04 (1.2367E-04)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = Battery+X
==================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 97.100 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 0.510 (g/cm^2)
      CS Surface Area = 0.0225 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 50.000 (cm)
      Outer Wall 2   Density: 0.540 (g/cm^2)  Separation: 48.000 (cm)
      Outer Wall 3   Density: 1.620 (g/cm^2)  Separation: 46.000 (cm)
      Outer Wall 4   Density: 1.620 (g/cm^2)  Separation: 36.000 (cm)
      Outer Wall 5   Density: 1.940 (g/cm^2)  Separation: 20.000 (cm)
      Outer Wall 6   Density: 1.940 (g/cm^2)  Separation: 12.000 (cm)
      Outer Wall 7   Density: 1.940 (g/cm^2)  Separation: 10.000 (cm)
      Outer Wall 8   Density: 1.940 (g/cm^2)  Separation: 2.000 (cm)
**OUTPUT**
      Probability of Penetration = 2.1833E-07 (2.1833E-07)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
==================================================
Spacecraft = Global Gen 3.0
Critical Surface = Battery+Y
==================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 97.100 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
```

```
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 0.510 (g/cm^2)
      CS Surface Area = 0.0015 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = No
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 5.000 (cm)
**OUTPUT**
      Probability of Penetration = 2.9258E-05 (2.9258E-05)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Tank+Y
================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 97.100 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 2.160 (g/cm^2)
      CS Surface Area = 0.0027 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = Yes
      Outer Wall 1   Density: 3.240 (g/cm^2)  Separation: 2.450 (cm)
**OUTPUT**
      Probability of Penetration = 5.5834E-05 (5.5836E-05)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
================================================
Spacecraft = Global Gen 3.0
Critical Surface = Tank+X
================================================
**INPUT**
      Apogee Altitude = 385.000 (km)
      Perigee Altitude = 385.000 (km)
      Orbital Inclination = 97.100 (deg)
      RAAN = 0.000 (deg)
      Argument of Perigee = 0.000 (deg)
      Mean Anomaly = 0.000 (deg)
      Final Area-To-Mass = 0.0076 (m^2/kg)
      Initial Mass = 131.600 (kg)
```

```
      Final Mass = 131.600 (kg)
      Station Kept = Yes
      Start Year = 2025.750 (yr)
      Duration = 3.000 (yr)
      Orientation = Random Tumbling
      CS Areal Density = 1.620 (g/cm^2)
      CS Surface Area = 0.0027 (m^2)
      Vector = (0.000000 (u), 0.000000 (v), 0.000000 (w))
      CS Pressurized = Yes
      Outer Wall 1   Density: 0.405 (g/cm^2)  Separation: 4.790 (cm)
      Outer Wall 2   Density: 5.400 (g/cm^2)  Separation: 2.790 (cm)
**OUTPUT**
      Probability of Penetration = 4.7764E-06 (4.7764E-06)
      Returned Error Message: Normal Processing
      Date Range Error Message: Normal Date Range
=============== End of Requirement 4.5-2 ===============
```

9.1.3 Requirement 4.6

```
07 21 2022; 11:28:06AM Processing Requirement 4.6   Return Status :  Passed
==============
Project Data
==============
**INPUT**
      Space Structure Name = Global Gen 3.0
      Space Structure Type = Payload
      Perigee Altitude = 550.000000 (km)
      Apogee Altitude = 550.000000 (km)
      Inclination = 35.000000 (deg)
      RAAN = 0.000000 (deg)
      Argument of Perigee = 0.000000 (deg)
      Mean Anomaly = 0.000000 (deg)
      Area-To-Mass Ratio = 0.007550 (m^2/kg)
      Start Year = 2023.250000 (yr)
      Initial Mass = 135.000000 (kg)
      Final Mass = 131.600000 (kg)
      Duration = 3.000000 (yr)
      Station Kept = True
      Abandoned = True
      PMD Perigee Altitude = 550.000000 (km)
      PMD Apogee Altitude = 550.000000 (km)
      PMD Inclination = 35.000000 (deg)
      PMD RAAN = 0.000000 (deg)
      PMD Argument of Perigee = 0.000000 (deg)
      PMD Mean Anomaly = 0.000000 (deg)
      Long-Term Reentry = False
**OUTPUT**
      Suggested Perigee Altitude = 550.000000 (km)
      Suggested Apogee Altitude = 550.000000 (km)
      Returned Error Message = Passes LEO reentry orbit criteria.
      Released Year = 2036 (yr)
      Requirement = 61
      Compliance Status = Pass
==============
=============== End of Requirement 4.6 ===============
```

```
07 21 2022; 11:28:46AM Processing Requirement 4.6   Return Status :  Passed
==============
Project Data
==============
**INPUT**
      Space Structure Name = Global Gen 3.0
      Space Structure Type = Payload
      Perigee Altitude = 550.000000 (km)
      Apogee Altitude = 550.000000 (km)
      Inclination = 60.000000 (deg)
      RAAN = 0.000000 (deg)
      Argument of Perigee = 0.000000 (deg)
      Mean Anomaly = 0.000000 (deg)
      Area-To-Mass Ratio = 0.007550 (m^2/kg)
      Start Year = 2023.250000 (yr)
      Initial Mass = 135.000000 (kg)
      Final Mass = 131.600000 (kg)
      Duration = 3.000000 (yr)
      Station Kept = True
      Abandoned = True
      PMD Perigee Altitude = 550.000000 (km)
      PMD Apogee Altitude = 550.000000 (km)
      PMD Inclination = 60.000000 (deg)
      PMD RAAN = 0.000000 (deg)
      PMD Argument of Perigee = 0.000000 (deg)
      PMD Mean Anomaly = 0.000000 (deg)
      Long-Term Reentry = False
**OUTPUT**
      Suggested Perigee Altitude = 550.000000 (km)
      Suggested Apogee Altitude = 550.000000 (km)
      Returned Error Message = Passes LEO reentry orbit criteria.
      Released Year = 2036 (yr)
      Requirement = 61
      Compliance Status = Pass
==============
=============== End of Requirement 4.6 ===============
```

```
07 21 2022; 11:31:46AM Processing Requirement 4.6   Return Status :  Passed
==============
Project Data
==============
**INPUT**
      Space Structure Name = Global Gen 3.0
      Space Structure Type = Payload
      Perigee Altitude = 550.000000 (km)
      Apogee Altitude = 550.000000 (km)
      Inclination = 97.500000 (deg)
      RAAN = 0.000000 (deg)
      Argument of Perigee = 0.000000 (deg)
      Mean Anomaly = 0.000000 (deg)
      Area-To-Mass Ratio = 0.007550 (m^2/kg)
      Start Year = 2023.250000 (yr)
      Initial Mass = 135.000000 (kg)
      Final Mass = 131.600000 (kg)
      Duration = 3.000000 (yr)
      Station Kept = True
      Abandoned = True
      PMD Perigee Altitude = 550.000000 (km)
      PMD Apogee Altitude = 550.000000 (km)
      PMD Inclination = 97.500000 (deg)
      PMD RAAN = 0.000000 (deg)
      PMD Argument of Perigee = 0.000000 (deg)
      PMD Mean Anomaly = 0.000000 (deg)
      Long-Term Reentry = False
**OUTPUT**
      Suggested Perigee Altitude = 550.000000 (km)
      Suggested Apogee Altitude = 550.000000 (km)
      Returned Error Message = Passes LEO reentry orbit criteria.
      Released Year = 2036 (yr)
      Requirement = 61
      Compliance Status = Pass
==============
=============== End of Requirement 4.6 ===============
```

```
07 21 2022; 11:33:14AM Processing Requirement 4.6   Return Status :  Passed
==============
Project Data
==============
**INPUT**
      Space Structure Name = Global Gen 3.0
      Space Structure Type = Payload
      Perigee Altitude = 385.000000 (km)
      Apogee Altitude = 385.000000 (km)
      Inclination = 35.000000 (deg)
      RAAN = 0.000000 (deg)
      Argument of Perigee = 0.000000 (deg)
      Mean Anomaly = 0.000000 (deg)
      Area-To-Mass Ratio = 0.007550 (m^2/kg)
      Start Year = 2023.250000 (yr)
      Initial Mass = 135.000000 (kg)
      Final Mass = 131.600000 (kg)
      Duration = 3.000000 (yr)
      Station Kept = True
      Abandoned = True
      PMD Perigee Altitude = 385.000000 (km)
      PMD Apogee Altitude = 385.000000 (km)
      PMD Inclination = 35.000000 (deg)
      PMD RAAN = 0.000000 (deg)
      PMD Argument of Perigee = 0.000000 (deg)
      PMD Mean Anomaly = 0.000000 (deg)
      Long-Term Reentry = False
**OUTPUT**
      Suggested Perigee Altitude = 385.000000 (km)
      Suggested Apogee Altitude = 385.000000 (km)
      Returned Error Message = Passes LEO reentry orbit criteria.
      Released Year = 2026 (yr)
      Requirement = 61
      Compliance Status = Pass
==============
=============== End of Requirement 4.6 ===============
```

```
07 21 2022; 11:32:52AM Processing Requirement 4.6   Return Status :  Passed
==============
Project Data
==============
**INPUT**
      Space Structure Name = Global Gen 3.0
      Space Structure Type = Payload
      Perigee Altitude = 385.000000 (km)
      Apogee Altitude = 385.000000 (km)
      Inclination = 60.000000 (deg)
      RAAN = 0.000000 (deg)
      Argument of Perigee = 0.000000 (deg)
      Mean Anomaly = 0.000000 (deg)
      Area-To-Mass Ratio = 0.007550 (m^2/kg)
      Start Year = 2023.250000 (yr)
      Initial Mass = 135.000000 (kg)
      Final Mass = 131.600000 (kg)
      Duration = 3.000000 (yr)
      Station Kept = True
      Abandoned = True
      PMD Perigee Altitude = 385.000000 (km)
      PMD Apogee Altitude = 385.000000 (km)
      PMD Inclination = 60.000000 (deg)
      PMD RAAN = 0.000000 (deg)
      PMD Argument of Perigee = 0.000000 (deg)
      PMD Mean Anomaly = 0.000000 (deg)
      Long-Term Reentry = False
**OUTPUT**
      Suggested Perigee Altitude = 385.000000 (km)
      Suggested Apogee Altitude = 385.000000 (km)
      Returned Error Message = Passes LEO reentry orbit criteria.
      Released Year = 2026 (yr)
      Requirement = 61
      Compliance Status = Pass
==============
=============== End of Requirement 4.6 ===============
```

```
07 21 2022; 11:32:25AM Processing Requirement 4.6   Return Status :  Passed
==============
Project Data
==============
**INPUT**
      Space Structure Name = Global Gen 3.0
      Space Structure Type = Payload
      Perigee Altitude = 385.000000 (km)
      Apogee Altitude = 385.000000 (km)
      Inclination = 97.100000 (deg)
      RAAN = 0.000000 (deg)
      Argument of Perigee = 0.000000 (deg)
      Mean Anomaly = 0.000000 (deg)
      Area-To-Mass Ratio = 0.007550 (m^2/kg)
      Start Year = 2023.250000 (yr)
      Initial Mass = 135.000000 (kg)
      Final Mass = 131.600000 (kg)
      Duration = 3.000000 (yr)
      Station Kept = True
      Abandoned = True
      PMD Perigee Altitude = 385.000000 (km)
      PMD Apogee Altitude = 385.000000 (km)
      PMD Inclination = 97.100000 (deg)
      PMD RAAN = 0.000000 (deg)
      PMD Argument of Perigee = 0.000000 (deg)
      PMD Mean Anomaly = 0.000000 (deg)
      Long-Term Reentry = False
**OUTPUT**
      Suggested Perigee Altitude = 385.000000 (km)
      Suggested Apogee Altitude = 385.000000 (km)
      Returned Error Message = Passes LEO reentry orbit criteria.
      Released Year = 2026 (yr)
      Requirement = 61
      Compliance Status = Pass
==============
=============== End of Requirement 4.6 ===============
```

```
07 21 2022; 11:36:15AM Processing Requirement 4.6   Return Status :  Passed
==============
Project Data
==============
**INPUT**
      Space Structure Name = Global Gen 3.0
      Space Structure Type = Payload
      Perigee Altitude = 550.000000 (km)
      Apogee Altitude = 550.000000 (km)
      Inclination = 35.000000 (deg)
      RAAN = 0.000000 (deg)
      Argument of Perigee = 0.000000 (deg)
      Mean Anomaly = 0.000000 (deg)
      Area-To-Mass Ratio = 0.007550 (m^2/kg)
      Start Year = 2025.750000 (yr)
      Initial Mass = 135.000000 (kg)
      Final Mass = 131.600000 (kg)
      Duration = 3.000000 (yr)
      Station Kept = True
      Abandoned = True
      PMD Perigee Altitude = 550.000000 (km)
      PMD Apogee Altitude = 550.000000 (km)
      PMD Inclination = 35.000000 (deg)
      PMD RAAN = 0.000000 (deg)
      PMD Argument of Perigee = 0.000000 (deg)
      PMD Mean Anomaly = 0.000000 (deg)
      Long-Term Reentry = False
**OUTPUT**
      Suggested Perigee Altitude = 550.000000 (km)
      Suggested Apogee Altitude = 550.000000 (km)
      Returned Error Message = Passes LEO reentry orbit criteria.
      Released Year = 2037 (yr)
      Requirement = 61
      Compliance Status = Pass
==============
=============== End of Requirement 4.6 ===============
```

```
07 21 2022; 11:40:45AM Processing Requirement 4.6   Return Status :  Passed
==============
Project Data
==============
**INPUT**
      Space Structure Name = Global Gen 3.0
      Space Structure Type = Payload
      Perigee Altitude = 550.000000 (km)
      Apogee Altitude = 550.000000 (km)
      Inclination = 60.000000 (deg)
      RAAN = 0.000000 (deg)
      Argument of Perigee = 0.000000 (deg)
      Mean Anomaly = 0.000000 (deg)
      Area-To-Mass Ratio = 0.007550 (m^2/kg)
      Start Year = 2025.750000 (yr)
      Initial Mass = 135.000000 (kg)
      Final Mass = 131.600000 (kg)
      Duration = 3.000000 (yr)
      Station Kept = True
      Abandoned = True
      PMD Perigee Altitude = 550.000000 (km)
      PMD Apogee Altitude = 550.000000 (km)
      PMD Inclination = 60.000000 (deg)
      PMD RAAN = 0.000000 (deg)
      PMD Argument of Perigee = 0.000000 (deg)
      PMD Mean Anomaly = 0.000000 (deg)
      Long-Term Reentry = False
**OUTPUT**
      Suggested Perigee Altitude = 550.000000 (km)
      Suggested Apogee Altitude = 550.000000 (km)
      Returned Error Message = Passes LEO reentry orbit criteria.
      Released Year = 2038 (yr)
      Requirement = 61
      Compliance Status = Pass
==============
=============== End of Requirement 4.6 ===============
```

```
07 21 2022; 11:41:17AM Processing Requirement 4.6   Return Status :  Passed
==============
Project Data
==============
**INPUT**
      Space Structure Name = Global Gen 3.0
      Space Structure Type = Payload
      Perigee Altitude = 550.000000 (km)
      Apogee Altitude = 550.000000 (km)
      Inclination = 97.500000 (deg)
      RAAN = 0.000000 (deg)
      Argument of Perigee = 0.000000 (deg)
      Mean Anomaly = 0.000000 (deg)
      Area-To-Mass Ratio = 0.007550 (m^2/kg)
      Start Year = 2025.750000 (yr)
      Initial Mass = 135.000000 (kg)
      Final Mass = 131.600000 (kg)
      Duration = 3.000000 (yr)
      Station Kept = True
      Abandoned = True
      PMD Perigee Altitude = 550.000000 (km)
      PMD Apogee Altitude = 550.000000 (km)
      PMD Inclination = 97.500000 (deg)
      PMD RAAN = 0.000000 (deg)
      PMD Argument of Perigee = 0.000000 (deg)
      PMD Mean Anomaly = 0.000000 (deg)
      Long-Term Reentry = False
**OUTPUT**
      Suggested Perigee Altitude = 550.000000 (km)
      Suggested Apogee Altitude = 550.000000 (km)
      Returned Error Message = Passes LEO reentry orbit criteria.
      Released Year = 2037 (yr)
      Requirement = 61
      Compliance Status = Pass
==============
=============== End of Requirement 4.6 ===============
```

```
07 21 2022; 11:33:51AM Processing Requirement 4.6   Return Status :  Passed
==============
Project Data
==============
**INPUT**
      Space Structure Name = Global Gen 3.0
      Space Structure Type = Payload
      Perigee Altitude = 385.000000 (km)
      Apogee Altitude = 385.000000 (km)
      Inclination = 35.000000 (deg)
      RAAN = 0.000000 (deg)
      Argument of Perigee = 0.000000 (deg)
      Mean Anomaly = 0.000000 (deg)
      Area-To-Mass Ratio = 0.007550 (m^2/kg)
      Start Year = 2025.750000 (yr)
      Initial Mass = 135.000000 (kg)
      Final Mass = 131.600000 (kg)
      Duration = 3.000000 (yr)
      Station Kept = True
      Abandoned = True
      PMD Perigee Altitude = 385.000000 (km)
      PMD Apogee Altitude = 385.000000 (km)
      PMD Inclination = 35.000000 (deg)
      PMD RAAN = 0.000000 (deg)
      PMD Argument of Perigee = 0.000000 (deg)
      PMD Mean Anomaly = 0.000000 (deg)
      Long-Term Reentry = False
**OUTPUT**
      Suggested Perigee Altitude = 385.000000 (km)
      Suggested Apogee Altitude = 385.000000 (km)
      Returned Error Message = Passes LEO reentry orbit criteria.
      Released Year = 2029 (yr)
      Requirement = 61
      Compliance Status = Pass
==============
=============== End of Requirement 4.6 ===============
```

```
07 21 2022; 11:34:20AM Processing Requirement 4.6   Return Status :  Passed
==============
Project Data
==============
**INPUT**
      Space Structure Name = Global Gen 3.0
      Space Structure Type = Payload
      Perigee Altitude = 385.000000 (km)
      Apogee Altitude = 385.000000 (km)
      Inclination = 60.000000 (deg)
      RAAN = 0.000000 (deg)
      Argument of Perigee = 0.000000 (deg)
      Mean Anomaly = 0.000000 (deg)
      Area-To-Mass Ratio = 0.007550 (m^2/kg)
      Start Year = 2025.750000 (yr)
      Initial Mass = 135.000000 (kg)
      Final Mass = 131.600000 (kg)
      Duration = 3.000000 (yr)
      Station Kept = True
      Abandoned = True
      PMD Perigee Altitude = 385.000000 (km)
      PMD Apogee Altitude = 385.000000 (km)
      PMD Inclination = 60.000000 (deg)
      PMD RAAN = 0.000000 (deg)
      PMD Argument of Perigee = 0.000000 (deg)
      PMD Mean Anomaly = 0.000000 (deg)
      Long-Term Reentry = False
**OUTPUT**
      Suggested Perigee Altitude = 385.000000 (km)
      Suggested Apogee Altitude = 385.000000 (km)
      Returned Error Message = Passes LEO reentry orbit criteria.
      Released Year = 2029 (yr)
      Requirement = 61
      Compliance Status = Pass
==============
=============== End of Requirement 4.6 ===============
```

```
07 21 2022; 11:35:32AM Processing Requirement 4.6   Return Status :  Passed
==============
Project Data
==============
**INPUT**
      Space Structure Name = Global Gen 3.0
      Space Structure Type = Payload
      Perigee Altitude = 385.000000 (km)
      Apogee Altitude = 385.000000 (km)
      Inclination = 97.100000 (deg)
      RAAN = 0.000000 (deg)
      Argument of Perigee = 0.000000 (deg)
      Mean Anomaly = 0.000000 (deg)
      Area-To-Mass Ratio = 0.007550 (m^2/kg)
      Start Year = 2025.750000 (yr)
      Initial Mass = 135.000000 (kg)
      Final Mass = 131.600000 (kg)
      Duration = 3.000000 (yr)
      Station Kept = True
      Abandoned = True
      PMD Perigee Altitude = 385.000000 (km)
      PMD Apogee Altitude = 385.000000 (km)
      PMD Inclination = 97.100000 (deg)
      PMD RAAN = 0.000000 (deg)
      PMD Argument of Perigee = 0.000000 (deg)
      PMD Mean Anomaly = 0.000000 (deg)
      Long-Term Reentry = False
**OUTPUT**
      Suggested Perigee Altitude = 385.000000 (km)
      Suggested Apogee Altitude = 385.000000 (km)
      Returned Error Message = Passes LEO reentry orbit criteria.
      Released Year = 2029 (yr)
      Requirement = 61
      Compliance Status = Pass
==============
=============== End of Requirement 4.6 ===============
```

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