ThumbSat Orbital Debris Assessment Report (ODAR)

This application is presented in compliance with NASA-STD-8719.14, APPENDIX A.

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ThumbSat Incorporated

Final Draft - January, 2015

Prepared by - James W VanLandingham

VERSION APPROVAL and/or FINAL APPROVAL*:

James W. VanLandingham January 14, 2015

*Approval signatures indicate acceptance of the ODAR-defined risk.

Revision History

Issue	Description of Change	Author	Effective Date
0.1	Draft For Review	Wade VanLandingham	January 7, 2015
1.0	Initial Release	Wade VanLandingham	January 14, 2015

Reference Documents

Document	Title
THS-NA-SCT-SU-01	Document Control List
THS-NA-SCT-SU-02	Definitions and Acronyms

Self-assessment and OSMA assessment of the ODAR using the format in Appendix A.2 of NASA-STD-8719.14:

Requirement #	Launch Vehicle				Spacecraft			Comments
	Compliant	Not Compliant	Incomplete	Standard Non Compliant	Compliant	Not Compliant	Incomplete	
4.3-1.a			X		X			No debris released in LEO. See note 1.
4.3-1.b			X		X			No debris released in LEO. See note 1.
4.3-2			X		X			No debris released in GEO. See note 1.
4.4-1			X					See note 1.
4.4-2			X					See note 1.
4.4-3			X		X			No planned breakups. See note 1.
4.4-4			X		X			No planned breakups. See note 1.
4.5-1			X		X			See note 1.
4.5-2					X			No critical subsystems needed for EOM disposal
4.6-1(a)			X		X			See note 1.
4.6-1(b)			X		X			See note 1.
4.6-1(c)			X		X			See note 1.
4.6-2			X		X			See note 1.
4.6-3			X		X			See note 1.
4.6-4			X					See note 1.
4.6-5			X					See note 1.
4.7-1			X					See note 1.
4.8-1					X			No tethers used.

Notes:

1. The ThumbSat satellite swarm is a secondary payload being launched for ThumbSat Inc. This ODAR is only for the ThumbSat payload and not for other portions of the launch system, belonging to other parties.

ODAR Technical Sections Format Requirements:

This ODAR follows the format set forth by NASA-STD-8719.4, Appendix A.1 and includes all the minimum information for sections 2 through 8 for the ThumbSat satellite swarm of 20 satellites. Sections 9 through 14 apply to the launch vehicle and will not be covered in this ODAR.

ODAR Executive Summary:

- No debris released in normal operations
- No credible scenario for breakups
- The collision probability with other objects is compliant with NASA standards
- The nominal decay lifetime due to atmospheric drag is as little as 45 days after launch.

ODAR Section 1: Product Management and Mission Overview:

ThumbSat is an ongoing project designed and operated ThumbSat Inc, and Scoutek LTD.

Project Managers:

James W. VanLandingham – ThumbSat Inc

Shaun Whitehead – Scoutek LTD

Foreign government or space agency participation:

None.

Summary of NASA's responsibility under the governing agreement(s):

None.

Schedule of upcoming milestones:

Technology Demonstration flights in Q3 and Q4, 2015.

Begin commercial operations Q1, 2016.

Launch:

Various.

Mission Overview:

The main goal of the ThumbSat project mission is to provide rapid, easy access to space for scientists, students, corporations and private individuals, to perform experiments using femto-satellites, where the customer will be relieved of all need for performing launch logistics, manufacturing and licensing.

The satellites will be launched in small swarms ranging from 3 to 25 satellites, as a secondary payload aboard various launch vehicles as space is available.

Depending on the requirements of the experiment, the availability of the launch system and the requirements of the primary and other secondary payloads, the ThumbSat swarms are expected to be inserted into orbits ranging from 300km apogee/perigee to 420km apogee/perigee. The orbital period will be approximately 90 minutes.

Atmospheric friction and the use of a deployable drag device will slow the satellite and reduce the altitude of the orbit until de-orbiting occurs in as little as 45 days after launch.

Depending on specific mission configuration, the ThumbSat space station will have a total mass not to exceed 100 grams and no greater than 50mm in any axis.

The station will have a deployable drag device to aide in orientation keeping, and assist in minimizing time in orbit.

An illustration of the main hardware of ThumbSat is provided in Figure 1.

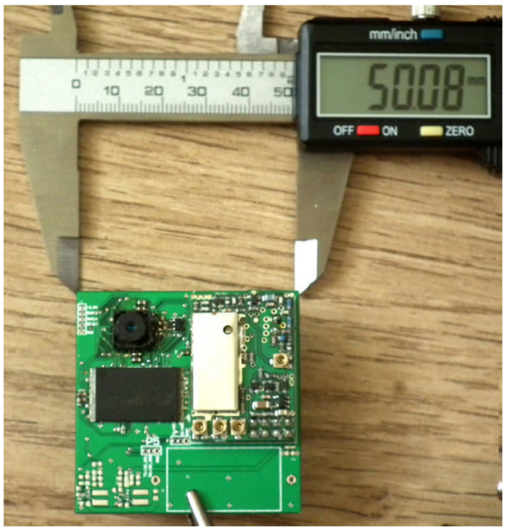

Figure 1- ThumbSat PCB

Launch vehicle and launch site:

Various launch vehicles will be utilized and will vary for each mission.

Proposed Launch Date:

Commercial operations are expected to begin in the first quarter of 2016, and will launch as frequently as customer demand and launch system availability exists. It is expected that ThumbSat swarms may be launched into orbit as frequently as 8 times a year.

Mission Duration:

Due to limits on the power system, the ThumbSat swarm will only remain active in orbit for approximately 96 hours.

There are no systems aboard the spacecraft to allow for battery recharging, or mission extension, once the satellite has been integrated with the launch vehicle.

Launch and Deployment profile, including all parking, transfer, and operational orbits with apogee, perigee, and inclination:

Due to the ongoing nature of the project, and its expectation of operating strictly as a secondary payload utilizing various launch vehicles, as they are available, no data about specific orbits can be presented in this ODAR.

General orbit parameters are given throughout this ODAR based on the most likely scenarios.

ThumbSat will generally deploy to and naturally decay from, an orbit ranging from 300km apogee/perigee to as high as 420km apogee/perigee. These two ranges are the basis for all calculations presented in this ODAR.

It is expected that a large number of missions will be deployed from the International Space Station resulting in an orbit with an Apogee approximately 420km and a Perigee approximately 410km and an inclination of approximately 51 degrees.

ThumbSat has no active propulsion and therefore will not actively change orbits.

There are no parking or transfer orbits.

ODAR Section 2: Spacecraft Description

ThumbSat's main structure is a single circuit card with maximum dimensions of 50mm x 50mm, with a mass no greater than 100g.

Total satellite mass at launch, including all propellants and fluids:

<100g

Dry mass of satellites at launch, excluding solid rocket motor propellants:

<100g.

Description of all propulsion systems (cold gas, mono-propellant, bi-propellant, electric, nuclear):

There is no propulsion system or propellants aboard the spacecraft.

Identification, including mass and pressure, of all fluids (liquids and gases) planned to be on board and a description of the fluid loading plan or strategies, excluding fluids in sealed heat pipes:

There are no fluids of any type aboard the spacecraft.

Fluids in Pressurized Batteries:

There are no pressurized fluids in the battery system. The single onboard battery is a Lithium Ion type.

Description of attitude control system and indication of the normal attitude of the spacecraft with respect to the velocity vector:

ThumbSat will have minimal attitude control and may tumble naturally due to minor disturbances imparted to the satellite during launch.

A deployable drag device is under design review, and may allow for some attitude control by acting as a drogue parachute.

Description of any range safety or other pyrotechnic devices:

There are no pyrotechnic devices of any sort aboard the spacecraft.

Description of the electrical generation and storage system:

Standard Lithium-Ion battery cells are charged before payload integration and provide electrical energy during the mission until depleted. There are no solar cells or other means to recharge the battery aboard spacecraft while on orbit.

Identification of any other sources of stored energy not noted above:

None.

Identification of any radioactive materials on board:

There are no radioactive materials on board the spacecraft.

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

Identification of any object (>1 mm) expected to be released from the spacecraft any time after launch, including object dimensions, mass, and material:

None.

Rationale/necessity for release of each object:

N/A.

Time of release of each object, relative to launch time:

N/A.

Release velocity of each object with respect to spacecraft:

N/A.

Expected orbital parameters (apogee, perigee, and inclination) of each object after release:

N/A.

Calculated orbital lifetime of each object, including time spent in Low Earth Orbit (LEO):

N/A.

Assessment of spacecraft compliance with Requirements 4.3-1 and 4.3-2 (per DAS v2.0.2)

4.3-1, Mission Related Debris Passing Through LEO:

COMPLIANT

4.3-2, Mission Related Debris Passing Near GEO:

COMPLIANT

ODAR Section 4: Assessment of Space Intention Breakups and Potential for Explosion

Potential causes of spacecraft breakup during deployment and mission operations:

Given the designed deployment and operations for ThumbSat, there is no normal situation in which the satellite will break up.

Summary of failure modes and effect analysis of all credible failure modes which may lead to an accidental explosion:

In-mission failure of a battery cell protection circuit could lead to a short circuit resulting in overheating and a very remote possibility of battery cell explosion.

Detailed plan for any designed spacecraft breakup, including explosions and intentional collisions:

There are no planned breakups of the spacecraft.

List of components which shall be passivated at End of Mission (EOM) including method of passivation and amount which cannot be passivated:

None.

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

Due to the small size of the satellite, it was not deemed necessary to passivate the battery.

Assessment of spacecraft compliance with Requirements 4.4-1 through 4.4-4:

Requirement 4.4-1: Limiting the risk to other space systems from accidental explosions during deployment and mission operations while in orbit about Earth or the Moon: For each spacecraft and launch vehicle orbital stage employed for a mission, the program or project shall demonstrate, via failure mode and effects analyses or equivalent analyses, that the integrated probability of explosion for all credible failure modes of each spacecraft and launch vehicle is less than 0.001 (excluding small particle impacts) (Requirement 56449).

Compliance statement:

Required Probability: 0.001.

Expected probability: 0.000.

Supporting Rationale and FMEA details:

Battery explosion:

Effect:

All failure modes below might result in a battery explosion. However, in the unlikely event that a battery cell does explosively rupture, the small size, mass, and potential energy, of the small battery is such that there is no expectation it will result in debris generation.

Probability:

Extremely Low. It is believed to be less than 0.01% given that multiple independent (not common mode) faults must occur for each failure mode to cause the ultimate effect (explosion). Additionally, the expected maximum satellite lifetime is several days depending on mission profile - in the unlikely event of debris generation due to a battery explosion, the debris released will rapidly reenter the atmosphere and be destroyed.

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.

Failure Mode 2:

Internal thermal rise due to high load discharge rate.

Mitigation 2:

Cells were tested in lab for high load discharge rates in a variety of flight like configurations to determine if the feasibility of an out of control thermal rise in the cell. Cells were also tested in a hot environment to test the upper limit of the cells capability. No failures were seen.

Combined faults required for realized failure:

Spacecraft thermal design must be incorrect **AND** external over current detection and disconnect function must fail to enable this failure mode. The 8 cells are divided into 4 parallel sets of 2.

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 the design of the circuit card, battery and insulators such that no contact with nearby board traces is possible without being caused by some other mechanical failure external to the space station.

Fault required for realized failure:

An external mechanical object must impact the space station in such a manner to short the conductors of the battery.

Failure Mode 4:

Crushing.

Mitigation 4:

This mode is negated by spacecraft design. There are no moving parts in the proximity of the battery.

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 battery leading to an internal short circuit **AND** the satellite must be in a naturally sustained orbit at the time the crushing occurs.

Failure Mode 5:

Low level current leakage or short-circuit through battery pack case or due to moisture-based degradation of insulators.

Mitigation 5:

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 **AND** failure of battery terminal insulators **AND** failure to detect such failures in environmental tests must occur to result in this failure mode.

Failure Mode 6:

Excess temperatures due to orbital environment and high discharge combined.

Mitigation 6:

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** mission simulations in thermal-vacuum chamber testing **AND** over-current monitoring and control must all fail for this failure mode to occur.

Requirement 4.4-2: Design for passivation after completion of mission operations while in orbit about the Earth or the Moon:

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

Compliance Statement:

ThumbSat battery circuits are designed to limit the risk of battery failure. However, in the unlikely event that the battery does rupture, the small size, mass and potential energy, of the small battery is such that there is no expectation it will result in an explosion or deflagration large enough to release orbital debris or break up the spacecraft.

The design lifetime of the battery is less than a week, at which point it will be completely depleted and pose no risk of explosion, while in orbit or re-entry.

Requirement 4.4-3. Limiting the long-term risk to other space systems from planned breakups:

Compliance statement:

This requirement is not applicable; there are no planned breakups of the space station.

Requirement 4.4-4: Limiting the short-term risk to other space systems from planned breakups:

Compliance statement:

This requirement is not applicable. There are no planned breakups of the space station.

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

Assessment of spacecraft compliance with Requirements 4.5-1 and 4.5-2 (per DAS v2.0.2, and calculation methods provided in NASA-STD-8719.14, section 4.5.4):

Requirement 4.5-1. Limiting debris generated by collisions with large objects when operating in Earth orbit: For each spacecraft and launch vehicle orbital stage in or passing through LEO, 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 (Requirement 56506).

Large Object Impact and Debris Generation Probability:

0.00000; COMPLIANT.

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).

Small Object Impact and Debris Generation Probability:

0.00000; COMPLIANT

Identification of all systems or components required to accomplish any Post-mission disposal operation, including passivation and maneuvering:

None.

ODAR Section 6: Assessment of Spacecraft Post-mission Disposal Plans and Procedures

6.1 Description of spacecraft disposal option selected as outlined by requirement 4.6:

The satellite will de-orbit naturally by atmospheric re-entry. There is no propulsion system or other method to achieve a parking orbit.

6.2 Plan for any spacecraft maneuvers required to accomplish Post-mission disposal:

None.

6.3 Calculation of area-to-mass ratio after Post-mission disposal, if the controlled reentry option is not selected:

Spacecraft Mass: .1kg

Cross-sectional Area: .0025 m^2

Area to mass ratio: .01/.0025 = .025m^2/kg

6.4 Assessment of spacecraft compliance with Requirements 4.6-1 through 4.6-5 (per DAS v 2.0.2 and NASA-STD-8719.14 section):

Requirement 4.6-1. Disposal for space structures passing through LEO: A spacecraft or orbital stage with a perigee altitude below 2000 km shall be disposed of by one of three methods: (Requirement 56557)

a. Atmospheric reentry option:

Leave the space structure in an orbit in which natural forces will lead to atmospheric reentry within 25 years after the completion of mission but no more than 30 years after launch; or

Maneuver the space structure into a controlled de-orbit trajectory as soon as practical after completion of mission.

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

c. Direct retrieval: Retrieve the space structure and remove it from orbit within 10 years after completion of mission.

Analysis: ThumbSat will comply with method 'a'. Depending on the mission profile and the deployable drag device attached to the satellite, ThumbSat orbit will decay in as little as 45 days.

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

Analysis:

Not applicable.

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

Analysis:

Not applicable.

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

Analysis:

Not applicable. The satellite will reenter passively without post mission disposal operations within allowable timeframe.

ODAR Section 7: Assessment of Spacecraft Reentry Hazards

Assessment of spacecraft compliance with Requirement 4.7-1:

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:

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

Analysis:

DAS states that ThumbSat is COMPLIANT with this requirement. DAS predicts that ThumbSat will have no parts capable of full re-entry and be capable of human casualty. See Appendix A for full DAS report.

4.7-1, 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 (Requirement 56627).

N/A. ThumbSat does not use controlled reentry.

4.7-1 c) For controlled reentries, the product of the probability of failure of the reentry burn (from Requirement 4.6-4.b) and the risk of human casualty assuming uncontrolled reentry shall not exceed 0.0001 (1:10,000) (Requirement 56628).

N/A. ThumbSat does not use controlled reentry.

ODAR Section 8: Assessment for Tether Missions

Not applicable. There are no tethers in the ThumbSat mission.

END of ODAR for ThumbSat

Appendix A: ODAR REPORT DATA FROM DAS v2.0.2

01 09 2015; 09:26:17AM DAS Application Started
01 09 2015; 09:26:35AM Processing Requirement 4.3-1: Return Status : Not Run

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

========== End of Requirement 4.3-1 ==========
01 09 2015; 09:26:39AM Processing Requirement 4.3-2: Return Status : Passed

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

========== End of Requirement 4.3-2 ==========
01 09 2015; 09:26:43AM Requirement 4.4-3: Compliant

========== End of Requirement 4.4-3 ==========
01 09 2015; 09:26:50AM Processing Requirement 4.5-1: Return Status : Passed

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

INPUT

Space Structure Name = TS1
Space Structure Type = Payload
Perigee Altitude = 410.000000 (km)
Apogee Altitude = 420.000000 (km)
Inclination = 51.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.025000 (m^2/kg)
Start Year = 2015.000000 (yr)
Initial Mass = 0.100000 (kg)
Final Mass = 0.100000 (kg)
Duration = 0.100000 (yr)
Station-Kept = False
Abandoned = True
PMD Perigee Altitude = -1.000000 (km)
PMD Apogee Altitude = -1.000000 (km)
PMD Inclination = 0.000000 (deg)
PMD RAAN = 0.000000 (deg)
PMD Argument of Perigee = 0.000000 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Collision Probability = 0.000000

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

==========

INPUT

Space Structure Name = TS2
Space Structure Type = Payload
Perigee Altitude = 410.000000 (km)
Apogee Altitude = 420.000000 (km)
Inclination = 51.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.025000 (m^2/kg)
Start Year = 2015.000000 (yr)
Initial Mass = 0.100000 (kg)
Final Mass = 0.100000 (kg)
Duration = 0.100000 (yr)
Station-Kept = False
Abandoned = True
PMD Perigee Altitude = -1.000000 (km)
PMD Apogee Altitude = -1.000000 (km)
PMD Inclination = 0.000000 (deg)
PMD RAAN = 0.000000 (deg)
PMD Argument of Perigee = 0.000000 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Collision Probability = 0.000000
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = TS3
Space Structure Type = Payload
Perigee Altitude = 410.000000 (km)
Apogee Altitude = 420.000000 (km)
Inclination = 51.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.025000 (m^2/kg)
Start Year = 2015.000000 (yr)
Initial Mass = 0.100000 (kg)
Final Mass = 0.100000 (kg)
Duration = 0.100000 (yr)

Station-Kept = False
Abandoned = True
PMD Perigee Altitude = -1.000000 (km)
PMD Apogee Altitude = -1.000000 (km)
PMD Inclination = 0.000000 (deg)
PMD RAAN = 0.000000 (deg)
PMD Argument of Perigee = 0.000000 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Collision Probability = 0.000000
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = TS4
Space Structure Type = Payload
Perigee Altitude = 410.000000 (km)
Apogee Altitude = 420.000000 (km)
Inclination = 51.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.025000 (m^2/kg)
Start Year = 2015.000000 (yr)
Initial Mass = 0.100000 (kg)
Final Mass = 0.100000 (kg)
Duration = 0.100000 (yr)
Station-Kept = False
Abandoned = True
PMD Perigee Altitude = -1.000000 (km)
PMD Apogee Altitude = -1.000000 (km)
PMD Inclination = 0.000000 (deg)
PMD RAAN = 0.000000 (deg)
PMD Argument of Perigee = 0.000000 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Collision Probability = 0.000000
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = TS5

Space Structure Type = Payload
Perigee Altitude = 410.000000 (km)
Apogee Altitude = 420.000000 (km)
Inclination = 51.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.025000 (m^2/kg)
Start Year = 2015.000000 (yr)
Initial Mass = 0.100000 (kg)
Final Mass = 0.100000 (kg)
Duration = 0.100000 (yr)
Station-Kept = False
Abandoned = True
PMD Perigee Altitude = -1.000000 (km)
PMD Apogee Altitude = -1.000000 (km)
PMD Inclination = 0.000000 (deg)
PMD RAAN = 0.000000 (deg)
PMD Argument of Perigee = 0.000000 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Collision Probability = 0.000000
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = TS6
Space Structure Type = Payload
Perigee Altitude = 410.000000 (km)
Apogee Altitude = 420.000000 (km)
Inclination = 51.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.025000 (m^2/kg)
Start Year = 2015.000000 (yr)
Initial Mass = 0.100000 (kg)
Final Mass = 0.100000 (kg)
Duration = 0.100000 (yr)
Station-Kept = False
Abandoned = True
PMD Perigee Altitude = -1.000000 (km)
PMD Apogee Altitude = -1.000000 (km)
PMD Inclination = 0.000000 (deg)
PMD RAAN = 0.000000 (deg)
PMD Argument of Perigee = 0.000000 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Collision Probability = 0.000000
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = TS7
Space Structure Type = Payload
Perigee Altitude = 410.000000 (km)
Apogee Altitude = 420.000000 (km)
Inclination = 51.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.025000 (m^2/kg)
Start Year = 2015.000000 (yr)
Initial Mass = 0.100000 (kg)
Final Mass = 0.100000 (kg)
Duration = 0.100000 (yr)
Station-Kept = False
Abandoned = True
PMD Perigee Altitude = -1.000000 (km)
PMD Apogee Altitude = -1.000000 (km)
PMD Inclination = 0.000000 (deg)
PMD RAAN = 0.000000 (deg)
PMD Argument of Perigee = 0.000000 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Collision Probability = 0.000000
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = TS8
Space Structure Type = Payload
Perigee Altitude = 410.000000 (km)
Apogee Altitude = 420.000000 (km)
Inclination = 51.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.025000 (m^2/kg)
Start Year = 2015.000000 (yr)

Initial Mass = 0.100000 (kg)
Final Mass = 0.100000 (kg)
Duration = 0.100000 (yr)
Station-Kept = False
Abandoned = True
PMD Perigee Altitude = -1.000000 (km)
PMD Apogee Altitude = -1.000000 (km)
PMD Inclination = 0.000000 (deg)
PMD RAAN = 0.000000 (deg)
PMD Argument of Perigee = 0.000000 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Collision Probability = 0.000000
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = TS9
Space Structure Type = Payload
Perigee Altitude = 410.000000 (km)
Apogee Altitude = 420.000000 (km)
Inclination = 51.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.025000 (m^2/kg)
Start Year = 2015.000000 (yr)
Initial Mass = 0.100000 (kg)
Final Mass = 0.100000 (kg)
Duration = 0.100000 (yr)
Station-Kept = False
Abandoned = True
PMD Perigee Altitude = -1.000000 (km)
PMD Apogee Altitude = -1.000000 (km)
PMD Inclination = 0.000000 (deg)
PMD RAAN = 0.000000 (deg)
PMD Argument of Perigee = 0.000000 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Collision Probability = 0.000000
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = TS10
Space Structure Type = Payload
Perigee Altitude = 410.000000 (km)
Apogee Altitude = 420.000000 (km)
Inclination = 51.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.025000 (m^2/kg)
Start Year = 2015.000000 (yr)
Initial Mass = 0.100000 (kg)
Final Mass = 0.100000 (kg)
Duration = 0.100000 (yr)
Station-Kept = False
Abandoned = True
PMD Perigee Altitude = -1.000000 (km)
PMD Apogee Altitude = -1.000000 (km)
PMD Inclination = 0.000000 (deg)
PMD RAAN = 0.000000 (deg)
PMD Argument of Perigee = 0.000000 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Collision Probability = 0.000000
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = TS11
Space Structure Type = Payload
Perigee Altitude = 410.000000 (km)
Apogee Altitude = 420.000000 (km)
Inclination = 51.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.025000 (m^2/kg)
Start Year = 2015.000000 (yr)
Initial Mass = 0.100000 (kg)
Final Mass = 0.100000 (kg)
Duration = 0.100000 (yr)
Station-Kept = False
Abandoned = True
PMD Perigee Altitude = -1.000000 (km)
PMD Apogee Altitude = -1.000000 (km)
PMD Inclination = 0.000000 (deg)
PMD RAAN = 0.000000 (deg)

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

OUTPUT

Collision Probability = 0.000000
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = TS12
Space Structure Type = Payload
Perigee Altitude = 410.000000 (km)
Apogee Altitude = 420.000000 (km)
Inclination = 51.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.025000 (m^2/kg)
Start Year = 2015.000000 (yr)
Initial Mass = 0.100000 (kg)
Final Mass = 0.100000 (kg)
Duration = 0.100000 (yr)
Station-Kept = False
Abandoned = True
PMD Perigee Altitude = -1.000000 (km)
PMD Apogee Altitude = -1.000000 (km)
PMD Inclination = 0.000000 (deg)
PMD RAAN = 0.000000 (deg)
PMD Argument of Perigee = 0.000000 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Collision Probability = 0.000000
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = TS13
Space Structure Type = Payload
Perigee Altitude = 410.000000 (km)
Apogee Altitude = 420.000000 (km)
Inclination = 51.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)

Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.025000 (m^2/kg)
Start Year = 2015.000000 (yr)
Initial Mass = 0.100000 (kg)
Final Mass = 0.100000 (kg)
Duration = 0.100000 (yr)
Station-Kept = False
Abandoned = True
PMD Perigee Altitude = -1.000000 (km)
PMD Apogee Altitude = -1.000000 (km)
PMD Inclination = 0.000000 (deg)
PMD RAAN = 0.000000 (deg)
PMD Argument of Perigee = 0.000000 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Collision Probability = 0.000000
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = TS14
Space Structure Type = Payload
Perigee Altitude = 410.000000 (km)
Apogee Altitude = 420.000000 (km)
Inclination = 51.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.025000 (m^2/kg)
Start Year = 2015.000000 (yr)
Initial Mass = 0.100000 (kg)
Final Mass = 0.100000 (kg)
Duration = 0.100000 (yr)
Station-Kept = False
Abandoned = True
PMD Perigee Altitude = -1.000000 (km)
PMD Apogee Altitude = -1.000000 (km)
PMD Inclination = 0.000000 (deg)
PMD RAAN = 0.000000 (deg)
PMD Argument of Perigee = 0.000000 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Collision Probability = 0.000000
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = TS15
Space Structure Type = Payload
Perigee Altitude = 410.000000 (km)
Apogee Altitude = 420.000000 (km)
Inclination = 51.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.025000 (m^2/kg)
Start Year = 2015.000000 (yr)
Initial Mass = 0.100000 (kg)
Final Mass = 0.100000 (kg)
Duration = 0.100000 (yr)
Station-Kept = False
Abandoned = True
PMD Perigee Altitude = -1.000000 (km)
PMD Apogee Altitude = -1.000000 (km)
PMD Inclination = 0.000000 (deg)
PMD RAAN = 0.000000 (deg)
PMD Argument of Perigee = 0.000000 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Collision Probability = 0.000000
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = TS16
Space Structure Type = Payload
Perigee Altitude = 410.000000 (km)
Apogee Altitude = 420.000000 (km)
Inclination = 51.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.025000 (m^2/kg)
Start Year = 2015.000000 (yr)
Initial Mass = 0.100000 (kg)
Final Mass = 0.100000 (kg)
Duration = 0.100000 (yr)
Station-Kept = False
Abandoned = True
PMD Perigee Altitude = -1.000000 (km)

PMD Apogee Altitude = -1.000000 (km)
PMD Inclination = 0.000000 (deg)
PMD RAAN = 0.000000 (deg)
PMD Argument of Perigee = 0.000000 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Collision Probability = 0.000000
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = TS17
Space Structure Type = Payload
Perigee Altitude = 410.000000 (km)
Apogee Altitude = 420.000000 (km)
Inclination = 51.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.025000 (m^2/kg)
Start Year = 2015.000000 (yr)
Initial Mass = 0.100000 (kg)
Final Mass = 0.100000 (kg)
Duration = 0.100000 (yr)
Station-Kept = False
Abandoned = True
PMD Perigee Altitude = -1.000000 (km)
PMD Apogee Altitude = -1.000000 (km)
PMD Inclination = 0.000000 (deg)
PMD RAAN = 0.000000 (deg)
PMD Argument of Perigee = 0.000000 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Collision Probability = 0.000000
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = TS18
Space Structure Type = Payload
Perigee Altitude = 410.000000 (km)
Apogee Altitude = 420.000000 (km)

Inclination = 51.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.025000 (m^2/kg)
Start Year = 2015.000000 (yr)
Initial Mass = 0.100000 (kg)
Final Mass = 0.100000 (kg)
Duration = 0.100000 (yr)
Station-Kept = False
Abandoned = True
PMD Perigee Altitude = -1.000000 (km)
PMD Apogee Altitude = -1.000000 (km)
PMD Inclination = 0.000000 (deg)
PMD RAAN = 0.000000 (deg)
PMD Argument of Perigee = 0.000000 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Collision Probability = 0.000000
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = TS19
Space Structure Type = Payload
Perigee Altitude = 410.000000 (km)
Apogee Altitude = 420.000000 (km)
Inclination = 51.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.025000 (m^2/kg)
Start Year = 2015.000000 (yr)
Initial Mass = 0.100000 (kg)
Final Mass = 0.100000 (kg)
Duration = 0.100000 (yr)
Station-Kept = False
Abandoned = True
PMD Perigee Altitude = -1.000000 (km)
PMD Apogee Altitude = -1.000000 (km)
PMD Inclination = 0.000000 (deg)
PMD RAAN = 0.000000 (deg)
PMD Argument of Perigee = 0.000000 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Collision Probability = 0.000000

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

==========

INPUT

Space Structure Name = TS20
Space Structure Type = Payload
Perigee Altitude = 410.000000 (km)
Apogee Altitude = 420.000000 (km)
Inclination = 51.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Final Area-To-Mass Ratio = 0.025000 (m^2/kg)
Start Year = 2015.000000 (yr)
Initial Mass = 0.100000 (kg)
Final Mass = 0.100000 (kg)
Duration = 0.100000 (yr)
Station-Kept = False
Abandoned = True
PMD Perigee Altitude = -1.000000 (km)
PMD Apogee Altitude = -1.000000 (km)
PMD Inclination = 0.000000 (deg)
PMD RAAN = 0.000000 (deg)
PMD Argument of Perigee = 0.000000 (deg)
PMD Mean Anomaly = 0.000000 (deg)

OUTPUT

Collision Probability = 0.000000
Returned Error Message: Normal Processing
Date Range Error Message: Normal Date Range
Status = Pass

==========

========== End of Requirement 4.5-1 ==========
01 09 2015; 09:27:06AM *********Processing Requirement 4.7-1
Return Status : Passed

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

name = TS1
quantity = 1
parent = 0
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000

Length = 0.050000
Height = 0.050000

name = TS1
quantity = 1
parent = 1
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

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

name = TS1
Demise Altitude = 77.996004
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = TS1
Demise Altitude = 73.298957
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

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

name = TS2
quantity = 1
parent = 0
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

name = TS2
quantity = 1
parent = 1
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

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

name = TS2
Demise Altitude = 77.996004
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = TS2
Demise Altitude = 73.298957
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

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

name = TS3
quantity = 1
parent = 0
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

name = TS3
quantity = 1
parent = 1
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

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

name = TS3
Demise Altitude = 77.996004
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = TS3
Demise Altitude = 73.298957
Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

****

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

name = TS4
quantity = 1
parent = 0
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

name = TS4
quantity = 1
parent = 1
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

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

name = TS4
Demise Altitude = 77.996004
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = TS4
Demise Altitude = 73.298957
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

**********INPUT****
Item Number = 5

name = TS5
quantity = 1
parent = 0
materialID = 23
type = Box
Aero Mass = 0.100000

Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

name = TS5
quantity = 1
parent = 1
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

**********OUTPUT****
Item Number = 5

name = TS5
Demise Altitude = 77.996004
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = TS5
Demise Altitude = 73.298957
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

**********INPUT****
Item Number = 6

name = TS6
quantity = 1
parent = 0
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

name = TS6
quantity = 1
parent = 1
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000

Length = 0.050000
Height = 0.050000

**********OUTPUT****
Item Number = 6

name = TS6
Demise Altitude = 77.996004
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = TS6
Demise Altitude = 73.298957
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

**********INPUT****
Item Number = 7

name = TS7
quantity = 1
parent = 0
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

name = TS7
quantity = 1
parent = 1
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

**********OUTPUT****
Item Number = 7

name = TS7
Demise Altitude = 77.996004
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = TS7

Demise Altitude = 73.298957
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

**********INPUT****
Item Number = 8

name = TS8
quantity = 1
parent = 0
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

name = TS8
quantity = 1
parent = 1
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

**********OUTPUT****
Item Number = 8

name = TS8
Demise Altitude = 77.996004
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = TS8
Demise Altitude = 73.298957
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

**********INPUT****
Item Number = 9

name = TS9
quantity = 1
parent = 0
materialID = 23

type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

name = TS9
quantity = 1
parent = 1
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

**********OUTPUT****
Item Number = 9

name = TS9
Demise Altitude = 77.996004
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = TS9
Demise Altitude = 73.298957
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

**********INPUT****
Item Number = 10

name = TS10
quantity = 1
parent = 0
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

name = TS10
quantity = 1
parent = 1
materialID = 23
type = Box
Aero Mass = 0.100000

Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

**********OUTPUT****
Item Number = 10

name = TS10
Demise Altitude = 77.996004
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = TS10
Demise Altitude = 73.298957
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

**********INPUT****
Item Number = 11

name = TS11
quantity = 1
parent = 0
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

name = TS11
quantity = 1
parent = 1
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

**********OUTPUT****
Item Number = 11

name = TS11
Demise Altitude = 77.996004
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = TS11
Demise Altitude = 73.298957
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

**********INPUT****
Item Number = 12

name = TS12
quantity = 1
parent = 0
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

name = TS12
quantity = 1
parent = 1
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

**********OUTPUT****
Item Number = 12

name = TS12
Demise Altitude = 77.996004
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = TS12
Demise Altitude = 73.298957
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

**********INPUT****
Item Number = 13

name = TS13
quantity = 1

parent = 0
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

name = TS13
quantity = 1
parent = 1
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

**********OUTPUT****
Item Number = 13

name = TS13
Demise Altitude = 77.996004
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = TS13
Demise Altitude = 73.298957
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

**********INPUT****
Item Number = 14

name = TS14
quantity = 1
parent = 0
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

name = TS14
quantity = 1
parent = 1
materialID = 23

type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

**********OUTPUT****
Item Number = 14

name = TS14
Demise Altitude = 77.996004
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = TS14
Demise Altitude = 73.298957
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

**********INPUT****
Item Number = 15

name = TS15
quantity = 1
parent = 0
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

name = TS15
quantity = 1
parent = 1
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

**********OUTPUT****
Item Number = 15

name = TS15
Demise Altitude = 77.996004
Debris Casualty Area = 0.000000

Impact Kinetic Energy = 0.000000

****
name = TS15
Demise Altitude = 73.298957
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

**********INPUT****
Item Number = 16

name = TS16
quantity = 1
parent = 0
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

name = TS16
quantity = 1
parent = 1
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

**********OUTPUT****
Item Number = 16

name = TS16
Demise Altitude = 77.996004
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = TS16
Demise Altitude = 73.298957
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

**********INPUT****
Item Number = 17

name = TS17
quantity = 1
parent = 0
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

name = TS17
quantity = 1
parent = 1
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

**********OUTPUT****
Item Number = 17

name = TS17
Demise Altitude = 77.996004
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = TS17
Demise Altitude = 73.298957
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

**********INPUT****
Item Number = 18

name = TS18
quantity = 1
parent = 0
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

name = TS18
quantity = 1

parent = 1
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

**********OUTPUT****
Item Number = 18

name = TS18
Demise Altitude = 77.996004
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = TS18
Demise Altitude = 73.298957
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

**********INPUT****
Item Number = 19

name = TS19
quantity = 1
parent = 0
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

name = TS19
quantity = 1
parent = 1
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

**********OUTPUT****
Item Number = 19

name = TS19

Demise Altitude = 77.996004
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = TS19
Demise Altitude = 73.298957
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

**********INPUT****
Item Number = 20

name = TS20
quantity = 1
parent = 0
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

name = TS20
quantity = 1
parent = 1
materialID = 23
type = Box
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.050000
Length = 0.050000
Height = 0.050000

**********OUTPUT****
Item Number = 20

name = TS20
Demise Altitude = 77.996004
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****
name = TS20
Demise Altitude = 73.298957
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

****

========== End of Requirement 4.7-1 ==========