ISO/TR 18146:2020 (E)

Space systems — Space debris mitigation design and operation manual for spacecraft

Contents

	Fore	word		
	Intro	duction		
ı	Scop	Scope		
2	Norm	Normative reference		
3	Term	Terms and definitions		
1	Syml	pols and abbreviated terms		
5	Syste	System-level activities		
	-			
	5.1	General		
	5.2	Design for limiting the release of objects		
	5.2.1	Intents of requirements in ISO 24113:2019[1]		
	5.2.2	Work breakdown		
	5.2.3	Identification of released objects and design measures		
	5.2.4	Design measures		
	5.2.5	Monitoring during operation		
	5.2.6	Preventing failure		
	5.3 5.3.1	Prevention of break-up General		
	5.3.1 5.3.2			
	5.3.2 5.3.2.1	Break-up caused by intentional behaviour, or stored energy Work breakdown for preventing orbital break-up caused by stored energy		
	5.3.2.1	Identification of the sources of break-up		
	5.3.2.2	Design measures		
	5.3.2.4	Monitoring during operations		
	5.3.2.5	Disposal operations		
	5.3.3	Break-up caused by a collision with catalogued objects		
	5.3.3.1	Intents or requirements in ISO 24113:2019[1]		
	5.3.3.2	General information		
	5.3.3.3	Work breakdown		
	5.3.3.4	Estimation of collision probability		
	5.3.3.5	Design measures		
	5.3.3.6	Procedures for collision avoidance		
	5.3.3.7	Detection of risk		
	5.3.3.7.1	Receipt of warning from the collision avoidance services		
	5.3.3.7.2	Internal conjunction analysis		
	5.3.3.8	Avoidance and return manoeuvres		
	5.3.3.8.1	Determine if avoidance manoeuvres are necessary		
	5.3.3.8.2	Communication with the collision avoidance service		
	5.3.3.8.3	Communication with the operator of the approaching spacecraft		
	5.3.3.8.4	Collision-avoidance plan		
	5.3.4	Break-up caused by the impact of debris or meteoroid		
	5.3.4.1	Contents of requirements in ISO 24113:2019[1]		
	5.3.4.2	Concept of the requirements		
	5.3.4.3	General information		
	5.3.4.4	Work breakdown		
	5.3.4.5	System-level fragmentation		
	5.3.4.6	Fragmentation of high energy storage equipment caused by the impact of tiny object		
	5.3.4.6.1	General assessment flow		
	5.3.4.6.2	High pressure gas vessels which causes rupture under a certain condition		

	5.4	Disposal after the end of mission to minimize interference with the protected regions
	5.4.1	Intents of requirements in ISO 24113:2019[1]
	5.4.2	Work breakdown
	5.4.3	Procedure for determination of mission extension or termination
	5.4.4	Disposal plan
	5.4.5	Estimation of the orbital lifetime
	5.4.6	Design of the function to remove spacecraft from the protected regions
	5.4.7	Assurance of resources for disposal manoeuvre
	5.4.8	Reliability of disposal function up to the design life
	5.4.9	Useful life limited items
	5.4.10	Health assessment procedure and contingency planning
	5.4.11	Design the monitoring system to monitor the critical parameters
	5.4.12	Assessment of the risk of debris impact
	5.4.13	Operational remediations
	5.4.13.1	General
	5.4.13.2	Periodical monitoring
	5.4.13.3	Control of the operation life limited items
	5.4.13.4	Estimation of the residual propellants
	5.4.13.5	Execution of the contingency plan
	5.4.14	Decision-making to extend or terminate the mission
	5.4.15	Disposal Registration of chicate lounghed into outer appeal complying with the UN treaty
	5.4.16	Registration of objects launched into outer space complying with the UN treaty Specific subjects for GEO mission
	5.4.17 5.4.18	Specific subjects for LEO mission
	5.4.19	High elliptical orbit mission
	5.4.19	Ground safety from re-entering objects
	5.5 5.5.1	Intents of requirements in ISO 24113:2019[1]
	5.5.2	Work breakdown
	5.5.3	Identification of requirements
	5.5.4	Hazards analysis
	5.5.5	Design measures
	5.5.5.1	Design for demise
	5.5.5.2	Prevention of environmental pollution on the ground
	5.5.6	Specific design for controlled re-entry in subsystem level
	5.5.7	Notification
	5.5.8	Conduct controlled re-entry and monitoring
	5.6	Quality and reliability assurance
e	Dobri	a valated wark in the dayalanment avala
6	Depili	s-related work in the development cycle
	6.1	General
	6.2	Concept of debris-related work in phased planning
	6.3	Mission analysis phase (phase 0 or pre-phase A)
	6.3.1	General
	6.3.2	Debris-related work
	6.4	Feasibility phase (phase A)
	6.5	Definition phase (phase B)
	6.5.1	Work in phase B
	6.5.2	Work procedure
	6.6	Development phase (phase C)
	6.6.1	Work in phase C
	6.6.2	Conditions
	6.7	Production phase (phase D)
	6.7.1	Work in phase D
	6.7.2	Qualification review
	6.8	Utilization phase (phase E)
	6.8.1	Launch preparation
	6.8.2	Lift-off time
	6.8.3	Initial operation
	6.8.4	Normal operation
	6.8.5 6.9	Decision to terminate or extension of operations Disposal phase (phase F)
		• • •
7	Syste	m-level information

5.3.4.6.3 Other break-up modes caused by the physical or chemical energy

7.1	Mission design
7.2	Mass allocation
7.3	Propellant allocation
7.4	Power allocation
Subsy	ystem/component design and operation
8.1	General
8.2	Debris-mitigation measures and subsystem-level actions for realizing them
8.3	Propulsion subsystem
8.3.1	General
8.3.2	Debris-related design
8.3.3	Information of propulsion subsystems
8.3.3.1	Prevention of the release of objects
8.3.3.2	Break-up prevention
8.3.3.3	Disposal manoeuvres
8.3.3.4	Ground safety from re-entry
8.3.3.4.1	General
8.3.3.4.2	•
8.3.3.5	Collision-avoidance manoeuvres
8.3.3.6	Protection from the impact of micro-debris
8.3.4 8.3.4.1	Information in component design Selection of engines or motors (liquid, solid, ion, etc.)
8.3.4.1	Thrust level
8.3.4.3	Propellant budget and measurement systems
8.3.4.4	Propellant-tanks and pressure-vessels
8.3.4.5	Valves and piping
8.4	Attitude and orbit control subsystem
8.4.1	Debris-related designs
8.4.2	Information of AOCS
8.4.2.1	Break-up prevention
8.4.2.2	Controlled re-entry
8.4.2.3	Protection from impact of micro-debris
8.4.3	Information of component design
8.4.3.1	Attitude sensors
8.4.3.2	Wheels
8.4.3.3	Electronic circuit
8.5	Power-supply subsystem
8.5.1	Debris-related designs
8.5.2	Information of power-supply subsystems
8.5.2.1	Refrain from releasing fasteners during paddle deployment
8.5.2.2	Break-up prevention
8.5.2.3	Disposal actions
8.5.2.4 8.5.2.5	Ensuring ground safety Protection from the impact of micro-debris
8.5.3	Information of component design
8.5.3.1	Batteries
8.5.3.2	Power control/distributing box
8.5.3.2.1	Control device
8.5.3.2.2	Wire harness
8.5.3.3	Solar cell panel
8.6	TT&C subsystem
8.6.1	Debris-related designs
8.6.2	Information of TT&C subsystems
8.6.2.1	Refrain from releasing parts
8.6.2.2	Break-up prevention
8.6.2.3	Disposal action
8.6.2.4	Re-entry control
8.6.2.4.1	Keeping the communication link during operation for controlled re-entry
8.6.2.4.2	Lower limit of altitude for transmission during controlled re-entry
8.6.3	Information of component design
8.6.3.1	Deployable antenna
8.6.3.2	Components installed outside the primary structure of spacecraft
8.6.3.3	Components installed inside the primary structure
8.7	Structural subsystem

8

3.7.1	Debris-related design
3.7.2	Information of structural subsystems
3.7.2.1	Refrain from releasing parts
3.7.2.2	Ground safety
3.7.2.3	Protection from the impact of micro-debris
3.7.2.4	Dummy mass and balance weight
3.8	Thermal-control subsystem
3.8.1	Debris-related design
3.8.2	Information of thermal-control subsystem
3.8.2.1	Break-up prevention
3.8.2.2	Protection from the impact of micro-debris
3.8.2.2.1	Heater and radiator
3.8.2.2.2	Reconfirmation of thermal design considering the influence of protective design

Page count: 56