

**DESIGN FAILURE MODE AND EFFECT ANALYSIS
(DFMEA)**

Project NASA V Team
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Team Members

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ITEM AND FUNCTION	POTENTIAL FAILURE MODE(S)	POTENTIAL EFFECT(S) OF FAILURE	S E V	POTENTIAL CAUSE(S) OF FAILURE	O C C U R	CURRENT DESIGN CONTROLS	D E T E C T	R P N	RECOMMENDED ACTIONS	ACTION RESULTS				
										ACTION TAKEN	S E V	O C C U R	D E T E C T	R P N
Release Mechanism	External Electrical Failure	Unreliable data/ No Parachute	9	Wind/Tangled Cords	4	Testing	7	252	Two nichrome systems	Two Nichrome systems	9	1	7	63
	Internal Electrical Failure	Unreliable data/ No Parachute	9	Short/Bad connection/loss of connection during flight	2	Bench and moored testing	3	54	Two nichrome systems	Two Nichrome systems	9	1	3	27
	Microcontroller/Programming Failure	Unreliable data/ No Parachute	9	Programming error, hardware defect, low batteries, GPS Failure	2	Bench and moored testing	3	54	Re-program and Test	None	9	1	3	27
	Power	Unreliable data/ No Parachute	9	Battery Failure	4	Heating Pads/Insulation	7	252	Increase heat, test for internal temp	None	9	4	7	252
Parachute Deployment	Electrical Failure	Structure will be crushed/put people at risk	9	Short/Bad connection/loss of connection during flight	2	Bench and moored testing	4	72	Check connections and fix shorts	Check wires	9	1	2	18
	Microcontroller/Programming Failure	Structure will be crushed/put people at risk	9	Programming error, hardware defect, low power	2	Bench and moored testing	4	72	Re-program and Test, increase insulation	Testing	9	1	2	18
	Fuse Failure	Structure will be crushed/put people at risk	9	Bad Fuse	5	Test	4	180	Use multiple fuses	Multiple Fuses	9	2	4	72
	Pilot Chute is not deployed	Structure will be crushed/put people at risk	9	Lid Freezes, Internal Fire, Wires prevent deployment	2	Temp Testing/ Moored Test	4	72	Use O-Ring to avoid freezing	None	9	2	4	72
	Pilot Chute fails to deploy Main Parachute	Structure will be crushed/put people at risk	9	Lid Freezes	5	Temp Testing Moored Test	4	180	Use O-Ring to avoid freezing	None	9	5	4	180
	Power	Structure will be crushed/put people at risk	9	Low Temperature/ Battery Failure	2	Heating Pads/Insulation	4	72	Increase heat, test for internal temp	None	9	2	4	72

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										ACTION TAKEN	S E V	O C C U R	D E T E C T	R P N
Balloon	Premature Burst	Unreliable data	7	Bad Balloon	2	Notifying FAA	10	140	Buy newly made balloon/ write code to detect and deploy parachute	Buy newly made balloon, don't touch	7	1	10	70
Data Collection	Sensors fail	Unreliable data	8	Low Temperature, Power Failure, faulty sensor	2	Redundancy, Insulation/ Heating Pads, Testing	2	32	Add Insulation, replace bad sensors, calibrate	Moored testing	8	2	1	16
	Memory fails	No stored data	5	Short/ Programming error	2	Testing	2	20	Fix short, Test	Bench testing	5	1	2	10
	Radios fail	No telemetry/ loose redundant tracking	9	Power, Signal Blockage, Weak signal	2	Redundancy, Testing	5	90	Change antenna position	None	9	2	5	90
Tracking	GPS Failure	Cannot find probe	9	Power, Low Temp, Shorts, Programming, Poor reception	3	Redundancy, Testing	4	108	Increase Insulation, fix shorts, reposition antenna	None	9	3	4	108
	Radios	Cannot find probe	10	Power, Low Temp, Shorts, Programming, Signal failure	3	Redundancy, Testing	5	150	Increase Insulation, fix shorts	Testing	10	2	5	100
	Receivers	Cannot find probe	9	Loss of signal	1	Test	1	9	Reposition	None	9	1	1	9
	Ground Computers	Cannot find probe	9	Bad Computer, loose power	1	Test	1	9	Replace Computer	None	9	1	1	9

SEVERITY CRITERIA

<u>Score</u>	<u>Rank</u>	<u>Comments</u>
1	None	No Effect
2	Very Minor	Fit/Finnish Do Not Conform. Defect Noticed By Discriminating Customer. Performance Nominal.
3	Minor	Fit/Finnish Do Not Conform. Defect Noticed By Average Customer. Performance Nominal.
4	Very Low	Fit/Finnish Do Not Conform. Defect Noticed By Most Customers. Performance Nominal.
5	Low	Device Operable, But Convenience Options Operate At Reduced Performance Levels. Customer Experiences Some Dissatisfaction.
6	Moderate	Device Operable, But Convenience Options Inoperable. Customer Experiences Some Dissatisfaction.
7	High	Device Operable, But At Reduced Performance Levels. Customer Dissatisfied.
8	Very High	Device Inoperable With Loss Of Primary Function
9	Hazardous (With Warning)	A Potential Failure Mode Makes Operation Unsafe To Operator And/Or Involves Non-Compliance With Government Regulations With Warning
10	Hazardous (Without Warning)	A Potential Failure Mode Makes Operation Unsafe To Operator And/Or Involves Non-Compliance With Government Regulations With Warning

OCCURRENCE CRITERIA

<u>Score</u>	<u>Rank</u>	<u>Comments</u>	<u>Failure Rate</u>
1	Remote	Failure Is Unlikely	<1 in 1,000,000
2	Very Low	Relatively Few Failures	1 in 150,000
3	Low	Not Uncommon	1 in 15,000
4	Moderate	Occasional Failures	1 in 2,000
5	Moderate	Frequent Failures	1 in 500
6	Likely	Frequent Failures	1 in 100
7	High	Failure Is Typical	1 in 25
8	Very High	Repeated Failures	1 in 10
9	Severe	Failure Is Almost Inevitable	1 in 5
10	Extreme	Failure Is Normal	> 1 in 2

DETECTION CRITERIA

<u>Score</u>	<u>Rank</u>	<u>Comments</u>
1	Almost Certain	Design controls will almost certainly detect a potential cause/mechanism and subsequent failure mode.
2	Very High	Very high chance the design control will detect a potential cause/mechanism and subsequent failure mode.
3	High	High chance the design controls will detect a potential cause/mechanism and subsequent failure mode.
4	Moderately High	Moderately high chance the design controls will detect a potential cause/mechanism and subsequent failure mode.
5	Moderate	Moderate chance the design controls will detect a potential cause/mechanism and subsequent failure mode.
6	Low	Low chance the design controls will detect a potential cause/mechanism and subsequent failure mode.
7	Very Low	Very low chance the design controls will detect a potential cause/mechanism and subsequent failure mode.
8	Remote	Remote chance the design controls will detect a potential cause/mechanism and subsequent failure mode.
9	Very Remote	Very remote chance the design controls will detect a potential cause/mechanism and subsequent failure mode.
10	Absolute Uncertainty	No Control. Design control will not and/or can not detect a potential cause/mechanism and subsequent failure mode.