



ESAIL D3.2.1

Requirements specification of the main tether reel

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List of Acronym and Abbreviation

DLR	Deutsches Zentrum für Luft und Raumfahrt (German Aerospace Center)
ESAIL	Electric Sail
EU	European Union
FP-7	Seventh Framework Programme

Reference Documents

RD-1	ESAIL Proposal - Part B: Description of Work
RD-2	Minutes: RU Kick Off meeting Bremen
RD-3	Minutes: Reeling tests 1 st review

1. Scope of this document

This document defines the requirement specifications of the main tether reels.

The main tether reel is going to be located aboard the main space craft; it has to store the main tether and needs to include an electrical path towards the tether to allow the tether to get charged by the electron gun. Furthermore the tether should be isolated from every other parts of the main space to avoid electrical short circuits.

2. Main tether test reel requirements

To keep the ESAIL propulsion system useable for a huge bandwidth of possible space missions, it was decided to fix the maximum diameter of the main spacecraft to 2 m [RD-2]. Therefore the main tether reel will have a modular to enable the mentioned bandwidth of space missions.

2.1 System Constraints

The following constrains describe design characteristics or results that should be provided for the design of the system.

Number	Description	Reference
MCS-321-01	The external diameter of the main reel shall not exceed 30 cm.	RD-3
MCS-321-02	The max. width of the Heytether should be 25 mm.	RD-1
MCS-321-03	The Heytether peak tensile load shall not exceed 5 g.	RD-1
MCS-321-04	The main tether reel shall be capable to hold a 20 km long Heytether.	RF-1
MCS-321-05	The main tether reel shall be made of material useable for a space mission	RD-1
MCS-321-06	The main tether reel shall be manufactured from electrically isolating material.	RD-1
MCS-321-07	The Heytether deployment mechanism with the stowed Heytether shall survive ground handling and launch loads.	RF-2

2.2 System Requirements

This part describes the requirements which are usable for the whole system.

Number	Description	Reference
MSR-321-01	The deployment speed of the Heytether shall be measured.	RD-1
MSR-321-02	The deployment speed of the Heytether shall be controlled.	RD-1
MSR-321-03	The deployed length of the Heytether shall be measured.	RD-1
MSR-321-04	The Heytether shall be not damaged during the unreeling process.	RF-2
MSR-321-05	The electric motor for the main tether reel should be brushless.	RF-3

2.3 Functional Requirements

The functional requirements describe what the system should to be performed.

Number	Description	Reference
MFR-321-01	To cut the Heytether at the tether outlet a mechanism shall be enable.	RF-4
MFR-321-02	The tether shall be conductively connected to the anode of the electron gun but electrically isolated to all other parts of the spacecraft.	RD-1
MFR-321-03	The Heytether deployment mechanism shall be capable of deploying the Heytether of ground testing and in space.	RF-5
MFR-321-04	It shall be possible to stop the unreeling procedure at any time during deployment.	--
MFR-321-05	It shall be possible to resume the Heytether unreeling upon command, following a prior interruption.	--
MFR-321-06	The main tether reel shall be locked during launch.	RD-1
MFR-321-07	The tether end mass (Remote Unite) shall be locked during launch	RD-1

References:

- RF-1 E-Mail from Pekka Janhunen at 21.06.2011.
- RF-2 The operability of the Heytether deployment mechanism under operating conditions shall be guaranteed.
- RF-3 The magnetically sensitive components are not influenced by the use of an electric motor without brushes. By use of brushed electric motor, its permanent magnets would be influenced components of the satellite.
- RF-4 E-Mail from Pekka Janhunen at 23.06.2011.
- RF-5 The operability of the Heytether deployment mechanism shall be guaranteed under test terms as well as also under operating conditions.