



ESAIL D3.3.1

Requirements specification of the auxiliary tether reel

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Prepared by:

DLR German Aerospace Center, Olaf Krömer,
Roland Rosta

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Coordinating person:

Pekka Janhunen, Pekka.Janhunen@fmi.fi

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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

1. Scope of this document

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

The auxiliary tether reel can be realized as a simple deployment mechanism. The auxiliary tether currently under investigation (WP 2.4) is foreseen to be a taped tether whose only function is to carry mechanical loads and to define distances between the individual remote units.

2. Auxiliary tether reel requirements

The auxiliary tether will be stored inside the remote unit. This results in quite firm requirements in weight and volume. The requirements and work on this subsystem is based on a prior work done for the ESTCube - 1 project. In this project, a tether deployment mechanism for unreeling a 10 m long tether is under development. The requirements in size and weight are similar. The main variation is the kind of deployable tether, to be used

2.1. System Constraints

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

Number	Description	Reference
ACS-331-01	The width of the auxiliary tether shall be 30 mm	RD-2
ACS-331-02	The auxiliary tether reel should be capable of holding 1.26 km long tether.	RD-2
ACS-331-03	The auxiliary tether peak tensile load shall not exceed 3 kg.	RF-1
ACS-331-04	The thickness of the auxiliary tether shall not exceed 12.6 μm	RF-5
ACS-331-05	The auxiliary tether reel shall be made of a material useable for a space mission	RD-1
ACS-331-06	The auxiliary tether deployment mechanism with the stowed auxiliary tether shall survive ground handling and launch loads.	RF-2
ACS-331-07	The available supply voltage should be 10 V	RD-2

2.2. System Requirements

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

Number	Description	Reference
ASR-331-01	The deployment speed of the auxiliary tether shall be measured.	RD-1
ASR-331-02	The deployment speed of the auxiliary tether shall be controlled.	RD-1
ASR-331-03	The deployed length of the auxiliary tether shall be measured.	RD-1
ASR-331-04	The electric motor for the auxiliary tether reel should be brushless.	RF-3

ASR-331-05	The auxiliary tether shall not be damaged during the unreeling process.	RF-3
ASR-331-06	The auxiliary tether reel rotation axis shall be orientated in the spin plan of the Heytethers.	RD-2

2.3.Functional Requirements

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

Number	Description	Reference
AFR-331-01	Retraction of the auxiliary tether should be possible.	RF-4
AFR-331-03	The auxiliary tether deployment mechanism shall be capable of deploying the auxiliary tether both during ground testing and in space.	RF-5
AFR-331-04	It shall be possible to resume the auxiliary tether unreeling upon command, following a prior interruption.	--
AFR-331-05	It shall be possible to stop the unreeling procedure at any time during deployment	--
AFR-321-06	The auxiliary tether reel shall be locked during launch.	RD-1

References:

- RF-1 E-Mail from Pekka Janhunen at 26.06.2011
- RF-1 The operability of the auxiliary tether deployment mechanism under operating conditions shall be guaranteed.
- RF-2 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-3 Retraction of the auxiliary tether is required to straighten the auxiliary tethers during the mission.
- RF-4 The operability of the auxiliary tether deployment mechanism shall be guaranteed under test terms as well as also under operating conditions.
- RF-5 E-Mail from Pekka Janhunen at 01.07.2011