Appendix T

On orbit performance of the EuTEF thermal control system 1 Year on board the ISS

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Abstract

EuTEF is an ESA platform for technological research, designed and built by Carlo Gavazzi Space.

It was launched onboard the Space Shuttle on February 2008 with 10 experiments to be exposed to Space Environment for 15 months. It was installed as an attached payload of the Columbus module by astronaut EVA.

EuTEF is experiencing the typical ISS outer environment, dominated by LEO sun-eclipse phases on a medium inclination orbit (52°) , with the additional effect of the International Space Station moving appendages. Thermal modelling with SINDA/TRASYS code has been used for sizing of the payload: the NASA-provided ISS model (in SINDA) has been used for flight predictions, which are compared with flight data.

Within the 1 year mission, the seasonal variations in the thermal environment of EuTEF are identified, and signs of degradation of the thermo-optical properties of the thermal coatings, such as silvered Teflon, have been investigated from telemetry data.

Moreover, it is calculated how much the ISS elements dominate the environment for payloads attached outside Columbus module, compared to free-flying satellites in a similar orbit. Simple thermal tools such as ARTIFIS and TOPIC have been used to derive an equivalent effective thermal environment of the outer ISS, with solutions implemented in MINITAN. These extremely simplified models allow making considerations for preliminary thermal design of future missions on the ISS.

EuTEF returned safely on the Earth in September 2009: thermal requirements about the return are briefly presented as well.

ON ORBIT PERFORMANCE OF THE EUTEF THERMAL CONTROL SYSTEM: 1 YEAR ON BOARD THE ISS

6-7 October 2009, ESTEC - 23rd THERMAL AND ECLS WS

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Introduction

EuTEF (EUropean Technology Exposure Facility)

- Launched on 07/02/2008 with STS-122 (Atlantis)
- Design operative life 3 years, nominal mission = 1 year
- Landed on 11/09/2009 with with STS-128 (Discovery)





INTRODUCTION

- EuTEF (EUROPEAN TECHNOLOGY EXPOSURE FACILITY) is an ESA external platform that was installed on Columbus
- EuTEF provides stardardized mechanichal accommodation, electrical and data handling services for nine instruments







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- Mean temperature difference is 1.3°C.

- Change in environmental fluxes has been calculated by using the Thermal desktop model in combination with a least square error method in SINDA
 - Environmental heat fluxes increase of ~6% when orbit height decreases by 19 km









EUTEF INSTALLATION FROM STS TO ISS No SAN THE DETAILED THERMAL LUMPED PARAMETER MODEL HAS BEEN SOLVED WITH SINDA VALIDATED MODEL, USING ACTUAL ORBITAL DATA. THE RESULTS OF THIS MODEL IS COMPARED WITH TELEMETRY DATA EUFIDE MEDET 20 15 15 10 10 Temperature [°C] [emperature [°C] 5 0 -5 -5 -10 -10 -15 -15 -20 -20 -25 -25 12 18 2 4 10 14 16 20 10 12 18 8 14 16 20 Time [hr] Time [hr] 16







- First order effects have been observed
 - beta angle
- Second order effects have been confirmed negligible but measurable
 - Solar constant (not shown in the presentation)
 - ISS altitude
 - Thermo-optical properties
- Comparison between detailed thermal mathematical model and flight data, confirm good and conservative modelling approach also for thermal masses definition, useful for transfer analysis
- EuTEF simple thermal model has been developed and fluxes calculated with T.O.P.I.C. (ISS-SSMODEL)
- This simplified model can be useful for quick assessments of other external payloads thermal behaviour with a good accuracy for phase-A studies (6°C max error)

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SEASONAL VARIATION DUE TO SOLAR CONSTANT (DHPU)



