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Space systems — Test procedure to evaluate spacecraft material ejecta upon hypervelocity impact

Systèmes spatiaux — Mode opératoire d'essai pour l'évaluation des éjectats de matériaux des véhicules spatiaux résultant d'impacts à hypervitesse

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Foreword

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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Introduction

Throughout its orbit lifetime, any spacecraft is exposed to the risk of collision with man-made space debris and natural micrometeoroids. Concentration of natural particles is nearly stable, but the amount of man-made debris is likely to increase over time. Details concerning this space environment can be found in the documents cited in the bibliography (see References [1] and [2]).

Damage caused by meteoroids or debris can result in total or partial mission failure and in a potential generation of small debris. Because of the large collision velocities (hypervelocity domain), even a small object produces upon impact a large amount of small particles, which are called ejecta. Ejecta can damage parts of the spacecraft itself and increase the population of space debris. The orbital lifetime of the ejecta depends on several factors such as size, initial velocity, and orbit altitude of the parent body. This population of space debris is already evaluated at a few percent of the total space debris population and it is likely to increase in the future[3][4][5]. It is therefore necessary, for the mitigation of such particles, to assess the mechanism of their production.

As shown by previous experimental studies[6][7][8], the amount of ejecta depends primarily on the type of material exposed directly to the space environment. It is greater for brittle materials than for ductile materials; it depends also on the size and on the velocity of impacting particles. Consequently, the best approach for assessing the process is to perform laboratory impact simulation using hypervelocity launchers.

The purpose of this International Standard is to describe a standard approach for assessing the behaviour, under orbital debris or meteoroid hypervelocity impacts, of the materials that are used on the external surfaces of spacecraft[9].

Results obtained from the standard tests carried out on as wide a range of materials as possible will be stored in a database created for this purpose, or incorporated into an existing one such as ECSS-Q70-71A (see Annex D and Reference [10]). This database will help designers choose spacecraft outer materials that mitigate the risk of space debris.