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**Design requirements for the autonomous navigation system of
an upper stage**

上面级自主导航系统设计要求

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Foreword

This document is in accordance with the provisions of GB/T 1.1-2020 "Guidelines for Standardization Work Part

1. Structure and Drafting Rules of Standardization Documents" Drafting. Please note that some of the contents of this document may involve patents. The issuing agency of this document is not responsible for identifying patents. This document was proposed and managed by the National Aerospace Technology and Application Standardization Technical Committee (SAC/TC425). Drafting organizations of this document. Beijing Aerospace Automatic Control Research Institute, China Aerospace Science and Technology Corporation, Shanghai Aerospace Control Technology Research Institute, Beijing Institute of Aerospace System Engineering, China Aerospace Standardization Institute. The main drafters of this document. Wang Jinlin, Li Xuefeng, Li Chaobing, You Taihua, Liu Minjie, Xu Xiaoxiong, Shang Teng, Yan Bin, Xiao Chenggui, Huang Fei, Xu Fan, Xiao Lihong, Wang Hui, Lu Jianqiang, Wang Chuankui, Cheng Xiaoming, Song Yishu. Design requirements for upper-level autonomous navigation system

1 Scope

China's national design requirements for the autonomous navigation system of a launch vehicle upper stage. It specifies the design basis, the design principles, the design content and the design process. An upper stage - what China calls a space tug when it can restart and manoeuvre - places payloads into their final orbits, and it may coast for hours between burns, deploy several satellites into different planes, and finally dispose of itself. Doing that autonomously rather than under ground command is what the requirements address, and it is the natural direction: the stage may be out of contact for much of its mission, the manoeuvre timing depends on where it actually is rather than where it was predicted to be, and a ground-in-the-loop correction cycle costs propellant. Autonomous navigation means the stage determines its own state from satellite navigation and inertial sensors and computes its own burns, which is a substantial responsibility to give a vehicle carrying

somebody else's spacecraft.

This document specifies the design basis, design principles, design content, design process, and design details of the upper stage autonomous navigation system of the launch vehicle. Requirements and content confirmed by design verification test and flight test. This document is applicable to the design of upper-level autonomous navigation systems for single-satellite and multi-satellite direct-to-orbit launch missions in low, medium, and high orbits.

2 Normative references

The content of the following documents constitutes an indispensable clause of this document through normative references in the text. Among them, dated quotations Only the version corresponding to the date is applicable to this document; for undated reference documents, the latest version (including all amendments) is applicable to This document.

GB/T 17159 Geodetic Terminology

GB/T 32296 Spacecraft commonly used coordinate system

GB/T 32455 Terminology for launch vehicles

3 Terms and definitions

The following terms and definitions defined in GB/T 17159, GB/T 32296 and GB/T 32455 apply to this document.

3.1 Autonomousofupperstage During the flight, the upper level does not need information from the ground measurement and control station to obtain the speed, position, and attitude information that meets the control accuracy requirements. Information navigation method.

4 Design basis

The design basis of the upper-level autonomous navigation system generally includes.

- a) The design task book of the upper-level autonomous navigation system, including the functional requirements of the flight mission for autonomous navigation and the technical indicators of navigation accuracy Requirements, etc.;
- b) Standards and regulations related to the design of launch vehicles;
- c) Interface input documents of related systems; reliability, safety and quality requirements.

5 Design principles

The design principles of the upper-level autonomous navigation system are as follows:

- a) The principle of advancement. Under the premise of effective risk control, advanced navigation theory and design with pre-research foundation and proven advanced navigation theory and design are adopted Methods and test verification methods;
- b) The principle of inheritance. On the basis of meeting the constraints of the upper-level tasks, comprehensively select mature and available design schemes, and make progress on this basis. Carry out adaptation analysis, improvement and full experimentation;