

NASA TECH BRIEF



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Handbook for Design of Containers of Fluids and Gases for Spacecraft

This handbook is intended to guide engineers in selection of construction materials for design and fabrication of containers for liquids and gases used in rockets and spacecraft; it may also interest those concerned with the storage or transportation of chemicals.

The materials to be contained include liquid or gaseous oxygen, special fuels, halogen compounds, white fuming nitric acid, and many other chemical propellants. For these materials it is recommended that the containers be constructed of either one of five aluminum alloys, one of two titanium alloys, Inconel-718, one of eight ferrous alloys, or a fiber-glass-epoxy composite. General procedures in the screening of such construction materials are outlined, and the effects of fabrication processes on their properties are considered.

Methods of design, fabrication, post-fabrication treatment, nondestructive testing, and repair are described in detail. Limitations on duration of storage and special precautions regarding proximity of other materials stored nearby are prescribed.

Choice of construction materials was guided by the following considerations: whether gas or liquid

was to be contained, the anticipated histories of temperature and pressure, the environments of storage and mission, the volume to be contained, the space available for the container, weight, and whether or not the system was to be man-rated. Cost also was a factor, but less so than it would be in commerce; mission environment would not be a factor in commerce, and the different requirements regarding weight, volume, and capacity would cause great changes in design, choice of construction materials, and method of fabrication.

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Thrust Vector Control System for the Space Shuttle

The Space Shuttle Program is a major step in the development of a new generation of launch vehicles. The Shuttle is designed to be reusable and to provide a low-cost means of access to space. The Shuttle is also designed to be capable of carrying a variety of payloads, including scientific instruments, telecommunications equipment, and manned spacecraft. The Shuttle is also designed to be capable of operating in a variety of orbits, including low Earth orbit, geosynchronous orbit, and interplanetary orbit. The Shuttle is also designed to be capable of operating in a variety of environments, including the vacuum of space and the harsh conditions of reentry.

The Shuttle is a three-stage vehicle. The first stage is the External Tank (ET), which is used to boost the Shuttle to orbit. The second stage is the Orbiter, which is used to carry the Shuttle into orbit. The third stage is the Solid Rocket Booster (SRB), which is used to boost the Shuttle to orbit. The Shuttle is also equipped with a variety of instruments and sensors, including a nose-mounted sensor, a side-mounted sensor, and a rear-mounted sensor. The Shuttle is also equipped with a variety of control systems, including a guidance system, a navigation system, and a communication system.

The Shuttle is a highly complex vehicle, and its operation requires a high degree of precision and coordination. The Shuttle is also a highly flexible vehicle, and it is capable of performing a wide variety of tasks. The Shuttle is also a highly reliable vehicle, and it has a long history of successful flights. The Shuttle is a truly remarkable achievement, and it is a testament to the ingenuity and perseverance of the NASA team.

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