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Cast Segment Evaluation

A cast segment evaluation program was initiated in order to determine the feasibility of fabricating segmented rocket engine thrust chambers using low cost, lightweight castings. Reduced costs can be realized by the cast segment concept because of the simplified design and the potential for mass production in which the combustion chamber and injector are fabricated by casting processes. The evaluation program focused attention on the segment and multiple segment assembly to establish design criteria for lightweight, low cost thrust chambers, to acquire fabrication experience toward simplifying fabrication techniques, and to evaluate component combustion dynamics.

The cast segment concept depended on the development of a thin-walled liner casting of the high thermal conductivity alloy designated NARloy. The casting development efforts included trial castings, tooling fabrication, and problem solving in the areas of shell strength, shell dewaxing, wax cracks, and cleanup procedures. A series of hot-firing tests demonstrated good design suitability, good performance, and long life.

The state of the art was extended in the areas of casting size and complexity, and in the ability to provide thin sections and narrow, deep, cooling channels. The relatively inexpensive cast liner was the basis of the low cost segment design. Another innovation includes the extensive use of electro-

formed nickel to close out the coolant passages and to form manifold joints. The segment design was 100% welded or brazed, with no joints or seals.

The satisfactory development of the technology for this particular segment may provide the basis for continued efforts in extending the range of chamber pressures and for initiating approaches to ignition improvement and thrust vector control. Further development of the geometry of multisegment shapes includes the optimization and parametric study of chord length, combustion chamber length, thrust/inch, and all aspects of throttling.

Note:

Requests for further information may be directed to:

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No patent action is contemplated by NASA.

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