

has been the development of a lightweight thermal shielding and outer skin.

Representative WAGGONER. I commented when we were over at the facility over there, that this was surprisingly thin.

Mr. GAVIN. That's right.

Representative WAGGONER. And delicate.

Mr. GAVIN. That's right. One of the things which is connected with this, of course, is the fact that this is a true spacecraft. We are still the only manned spacecraft which does not have to reenter the earth's atmosphere, and this gives us a fair degree of freedom in what we do with the outside of the vehicle, which the others don't enjoy. I also point out that a good portion of the spacecraft is designed for less than 1 g, and this, of course, is because of the lunar environment.

I would like to speak a little bit about the ascent and descent engines. After a very extensive development testing program, we have evolved configurations suitable for qualification testing. However, at this time both engines are in a two-phased qualification test program. The first phase provides release for early flight use and the second completes the full operational qualifications.

On the ascent engine (fig. 27) the principal effort during the past year has been focused on obtaining superlative chamber durability and on manufacturing welding procedures. I might point out that the ascent engine is a part of the vehicle which is not redundant. We obviously must have the highest confidence that it is suitable for the mission. This has led to being very careful about being satisfied with chamber durability. This has involved a great deal of injector development; and I must give credit to the Bell Aerospace Corp. for the job they have done in working out the compatibility between the injector and the chamber.

I think that the one remaining problem, which was alluded to briefly earlier, is the work remaining in settling the question of the startup pressures produced by the engine with respect to the base heat shield.

ASCENT ENGINE

- SATISFACTORY PERFORMANCE AVAILABLE FOR EARLY MISSIONS
- PROBLEM OF START TRANSIENT UNDER INVESTIGATION:
- WILL BE CONFIRMED IN QUAL B TESTS & TESTS AT WHITE SANDS
- ASCENT ENGINES DELIVERED FOR LTA-8 & LM-1
LM-1 ENGINE RETURNED FOR MODIFICATION &
WILL BE DELIVERED IN MID FEB WITH LM-2 ENGINE

FIGURE 27