

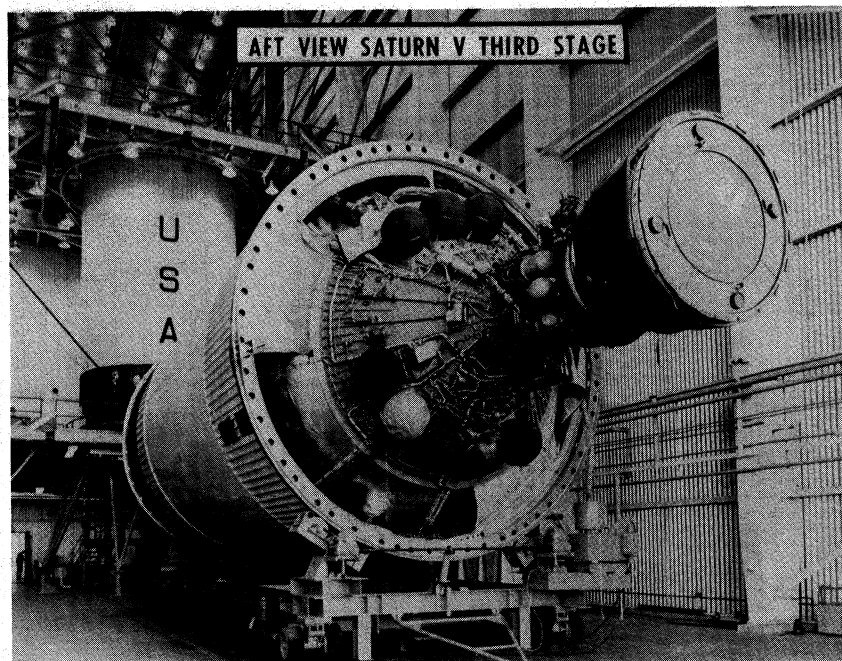


FIGURE 32

to a nominal pressure of 3,000 p.s.i. The purpose of these vessels is to store the pressurants used for propellant tank repressurization for restart. A protective cover is placed over each sphere for shipment and handling. When the stage is static fired, the protective cover is removed.

These spheres are manufactured in hemispheres with an equatorial type weld around the center. These are about $4\frac{1}{2}$ -cubic-foot titanium spheres. The titanium is alloyed with aluminum and vanadium. During the accident investigation, Dr. Debus and his board reported that the failure of one of the spheres on the third-flight stage occurred in a very clean manner at the point of the weld nugget circumferentially around the sphere where was under some 3,100 p.s.i. pressure (fig. 33). In qualification tests, these spheres have been taking ultimate pressures on the order of some 9,000 p.s.i. and all of the failures have occurred perpendicular and in a jagged manner across the weld (fig. 34). This immediately became a very suspect condition. The weld is supposed to be made with a titanium alloy which is identical to the structure of the tank: namely, a titanium-aluminum-vanadium alloy. The accident board and the people in the laboratories here at Marshall found that some small amount of pure commercial titanium had been shipped to the manufacturer of the sphere; it was used in the weld nugget and as a result, the sphere's structural strength was reduced to 30 to 40 percent. Ten of these spheres had been manufactured with the wrong welding wire; all have been located and taken out of the system.