

The multiring container was one of the first design modifications of the monoblock, thick-walled cylinder*. An initial compressive stress at the bore is achieved by shrink-fit assembly of successive cylinders each manufactured to provide an interference fit with its mating cylinder. The multiring container has been analyzed on the basis of static shear strength by Manning^(23, 24, 25).

The ring-segment container with one outer ring was patented by Poulter in 1951.⁽²⁶⁾ One intent of this design is to reduce the pressure acting upon the outer ring by using a segmented cylinder to redistribute the pressure at a larger diameter. However, the inner cylinder is always subject to the bore pressure. The external diameter of the vessel necessarily increases with increasing segment size.

The ring-fluid-segment container makes use of the fluid-pressure support principle. This container is essentially constructed of two parts. The inner part is a ring-segment-type container with one outer ring, but with a fluid support pressure, p_3 , as shown in Figure 41. The outer part is a multiring container subject to an internal pressure, p_3 , the support pressure for the inner part. The advantage of this design is that the fluid pressure (p_3) provides a compressive hoop stress at the bore which counteracts the tensile hoop stress resulting from the bore pressure, p . Theoretically, p_3 can be changed in proportion to the change in bore pressure in order to reduce the bore stress over an entire cycle of bore pressure. This variation of p_3 with the bore pressure is assumed in the analysis.

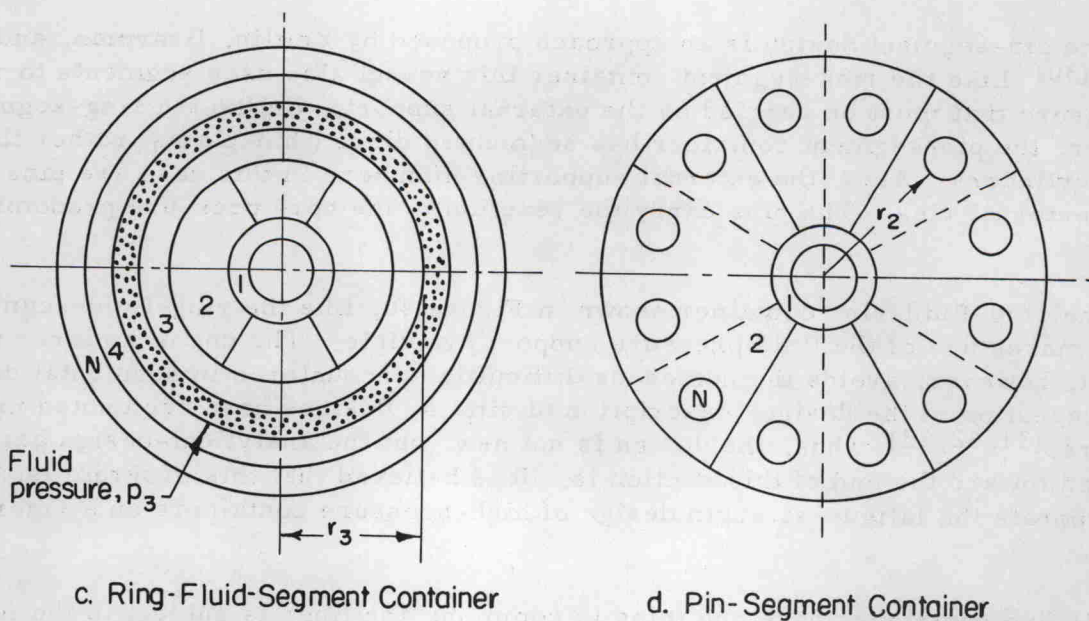
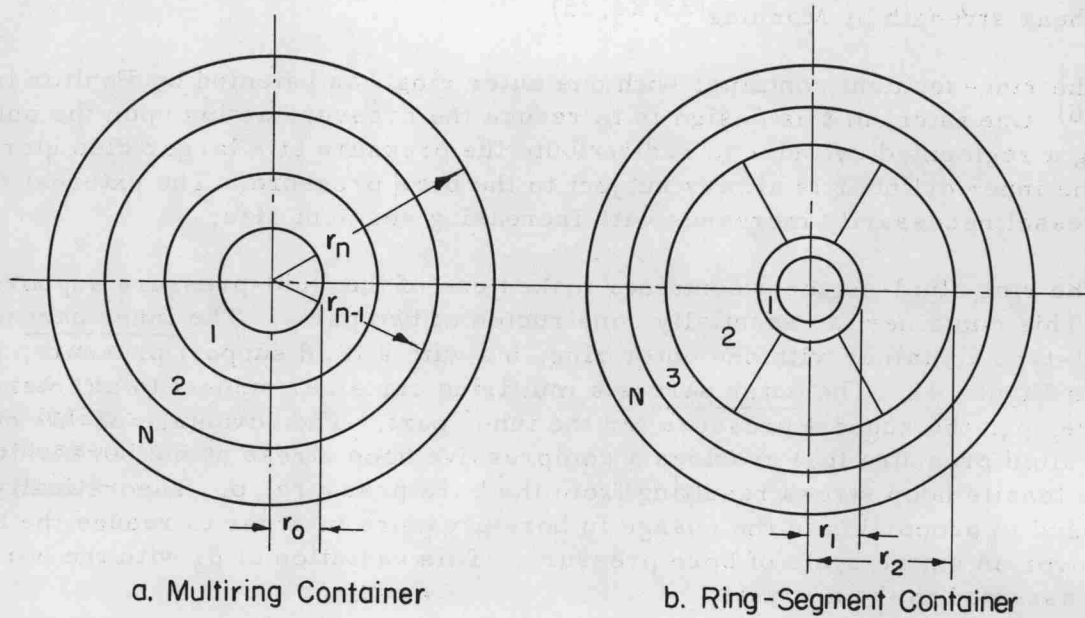
The origin of the ring-fluid-segment concept is not clear. Ballhausen patented an approach of this sort in 1963.⁽²⁷⁾ Another application of the same principle was patented by G. Gerard and J. Brayman, also in 1963.⁽²⁸⁾ A similar design, but with additional features, was reported by F. J. Fuchs in 1965.⁽²⁹⁾

The pin-segment design is an approach proposed by Zeitlin, Brayman, and Boggio.⁽³⁰⁾ Like the ring-segment container this vessel also uses segments to reduce the pressure that must be carried by the external support. Unlike the ring-segment container, the pin-segment container has segmented disks (thin plates) rather than segmented cylinders. Also, the external supporting members in this case are pins rather than an external ring. The pins carry the reaction to the bore pressure predominantly in shear.

The ring-fluid-ring container shown in Figure 40, like the ring-fluid-segment design, makes use of the fluid pressure support principle. The use of an inner multiring unit, however, avoids the numerous difficulties encountered in segmental design. Since suggestion of the design, description of similar designs have been noted in the literature.^(31, 32, 33) Thus, the design is not new, but the analytical-design basis described toward the end of this section is. It is believed that this program is the first to incorporate the fatigue-strength design of high-pressure containers on a rigorous basis.

All five containers have one thing in common: the liner is subject to the full bore pressure. The five containers differ in the manner and in the amount they constrain the liner.

*The monoblock, thick-wall cylinder is the simplest type of pressure container. However, for the very high pressure levels considered in this study it is a relatively inefficient design.



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FIGURE 41. NOTATIONS USED FOR ANALYSIS OF CONTAINER-DESIGN CONCEPTS