Stress Analysis of Container Assembly

To keep the tensile hoop stress on the liner bore to an acceptable minimum, the maximum shrink fit considered feasible was used between the sleeve and the liner. The shrink fit was limited by the temperature to which the sleeve could be heated without softening. This temperature was 1000 F for the alloy steel used for the sleeve. Since the liner was kept at room temperature during assembly, the maximum permissible shrink fit was 0.007 inch per inch. Although this is an extraordinarily large shrink fit for the size of the components involved, it was achieved with no apparent adverse effects. The shrink fit of the container on the sleeve was 0.0025 inch per inch. Figure 67 shows the arrangement of the rings and indicates interferences between them.

For the component dimensions, the effects of the shrink fits were as indicated in Table XLIX. These values were computed in a straight-forward manner by applying Lamé's equations for thick-walled pressure vessels. The elastic modulus was taken to be 30×10^6 psi at 80 F and 25×10^6 psi at 500 F. A step-by-step procedure was used to determine each component stress in the assembly. The resulting prestresses at various conditions of interest were then determined by super-position of the component stresses.

TABLE XLIX. PRESTRESSES DEVELOPED IN THE CONTAINER ASSEMBLY AT 80 F AND 500 F

Component	Nominal Diameter, inches	Taper, degrees	Diametral Interference, inch	Resulting Prestress at 80 F, psi		Resulting Prestress at 500 F, psi	
				Radial	Hoop	Radial	Hoop
Liner, Inside	2.375	0	--	0	-200,000	0	-166,650
Outside	7.437	2	--	-88,800	-110,200	-74,700	-91,850
			0.052				
Sleeve, Inside	7.437	2	--	-88,800	+102,000	-74,700	+85,000
Outside	13.375	3	--	-23,200	+35,750	-19,700	+29,300
			0.033				
Container, Inside	13.375	3	--	-23,200	+51,175	-19,700	+42,650
Outside	22.0	0	--	0	+27,625	0	+23,000

The hoop and radial components of the stresses developed in the container assembly solely by internal pressure, or independent of prestress, were also calculated. The values are given in Table L. The stresses resulting from the combined effects of the shrink fits and internal pressure are equal, of course, to the algebraic sums of the appropriate values in Tables XLIX and L. The resultant stresses, at various locations, are indicated on Figures 68 and 69.

TABLE L. STRESSES RESULTING SOLELY FROM AN INTERNAL PRESSURE OF 250,000 PSI

Component	Stress, psi	
	Radial	Hoop
Liner, Inside	-250,000	+255,900
Outside	-23,900	+28,750
Sleeve, Inside	-23,900	+28,750
Outside	-8,000	+10,900
Container, Inside	-8,000	+10,900
Outside	0	+5,775

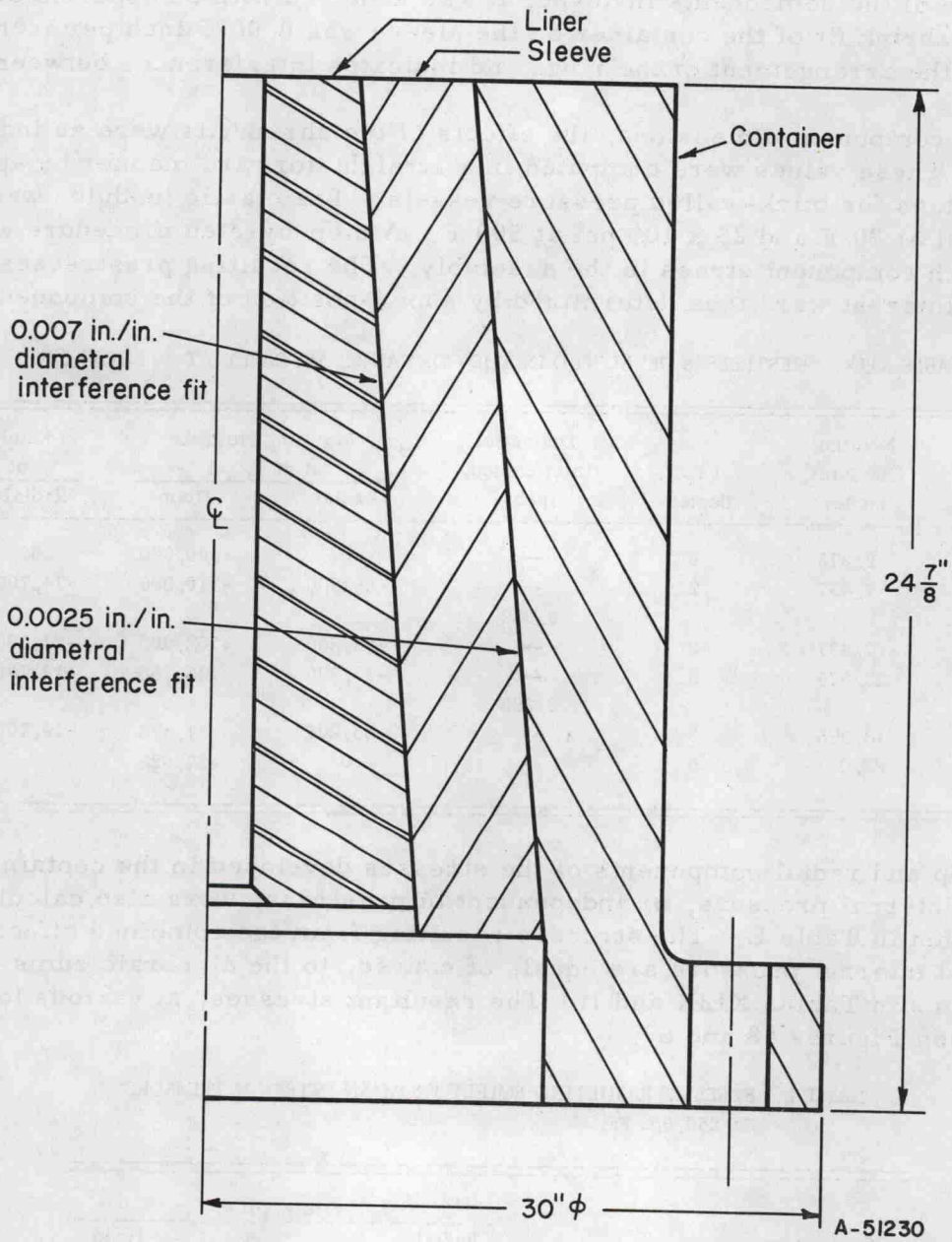

FIGURE 67. CROSS-SECTIONAL VIEW OF CONTAINER I