TABLE 1. DESIGN DETAILS FOR TWO MULTI-RING HYDROSTATIC EXTRUSION CONTAINERS HAVING 5 RINGS IN COMMON

Ring	Diameter, inches OD	Diameter, inches ID	Material Design Stress[a]	Manufactured Interferences[b]	Stress on ID at Pressure, psi Radial	Stress on ID at Pressure, psi Hoop	Stress on ID at Pressure, psi Shear	Residual Stresses on ID, psi Radial	Residual Stresses on ID, psi Hoop	Residual Stresses on ID, psi Shear
7-Inch Bore, 250,000 psi Container										
2	11.9	7.0	300,000	0.0453	-254,000	8,000	131,000	0	-258,000	129,000
3	18.5	11.9	250,000	0.0462	-168,000	37,000	102,000	-84,000	- 59,000	12,000
4	25.7	18.5	170,000	0.0702	-108,000	51,000	80,000	-77,000	8,000	43,000
5	35.8	25.7	170,000	0.0745	- 70,000	95,000	82,000	-56,000	70,000	63,000
6	46.5	35.8	150,000		- 30,000	117,000	74,000	-26,000	101,000	64,000
4-Inch Bore, 350,000 psi Container										
1	7.0	4.0	350,000	0.0272	-366,000	11,000	188,000	0	-361,000	180,000
2	11.9	7.0	300,000	0.0441	-239,000	1,000	120,000	-121,000	-123,000	1,000
3	18.5	11.9	215,000	0.0462	-161,000	33,000	97,000	-122,000	- 11,000	55,000
4	25.7	18.5	160,000	0.0660	-104,000	51,000	78,000	- 89,000	31,000	60,000
5	35.8	25.7	160,000	0.0687	- 66,000	91,000	79,000	- 60,000	79,000	70,000
6	46.5	35.8	140,000		- 28,000	110,000	69,000	- 26,000	103,000	65,000

(a) The design stress for Rings 1, 2, and 3 was the ultimate tensile strength. The design stress for Rings 4, 5, and 6 was the yield tensile strength. The design stress is the right hand side of the fatigue relations, Equations (1a, b) in the text.

(b) Interferences between each ring before assembly.

where

(a) A_n, B_n are coefficients describing the material of ring number n,

(b) subscript, r, denotes the semi-range stress component,

(c) subscript, m, denotes the mean stress component, and

(d) σ_n is the tensile strength of ring number n.

It is seen in Table 1 that to withstand 250,000 psi on the 7-inch bore (which is the inside diameter of Ring 2) an outside diameter of 46.5 inches and 5 rings are required. This design was influenced by the fact that a liner (Ring 1 in Table 1) is to be press-fitted in the 5-ring assembly to give a container having a 350,000 psi pressure capacity on a 4-inch bore. Details of this design are also given in Table 1.

The fatigue life of the two containers is expected to be 10^5 to 10^6 cycles under ideal conditions. They were designed to be operated at room temperature only.

The computer program was not capable of exactly matching the requirements of the two containers and so the calculated interferences for the 6-ring container differ slightly from those obtained for the 5-ring. However, if Ring 1 is removed from the 6-ring container it is seen in Table 2 that the stresses in the remaining 5 rings compare very closely with the optimum design stresses required to contain 250,000 psi. Thus, the design interferences for the 6-ring container will be adopted for the multi-purpose hydrostatic extrusion container. However, the higher design strengths of the outer four rings of the 5-ring, 250,000 psi container will be used.

TABLE 2. COMPARISON OF STRESSES IN THE OUTER 5 RINGS OF THE 6-RING CONTAINER (LINER REMOVED) WITH THOSE IN THE 5-RING CONTAINER

Ring	Stresses on ID at Pressure, psi			Residual Stresses on ID, psi		
	Radial	Hoop	Shear	Radial	Hoop	Shear
	Stresses in 5 Rings of 6-Ring Container (Liner Removed)					
2	-250,000	12,000	131,000	1,000	-250,000	125,000
3	-164,000	38,000	101,000	-82,000	- 57,000	12,000
4	-105,000	53,000	79,000	-74,000	11,000	43,000
5	- 67,000	92,000	80,000	-54,000	67,000	61,000
6	- 28,000	111,000	70,000	-24,000	95,000	60,000
	Stresses in 5-Ring Container (Optimum Design)					
2	-254,000	8,000	131,000	0	-258,000	129,000
3	-168,000	37,000	102,000	-84,000	- 59,000	12,000
4	-108,000	51,000	80,000	-77,000	8,000	43,000
5	- 70,000	95,000	82,000	-56,000	70,000	63,000
6	- 30,000	117,000	74,000	-26,000	101,000	64,000