TABLE XXIII. TENSILE PROPERTIES AND HARDNESS OF HYDROSTATIC EXTRUSIONS MADE FROM SUPERALLOYS A-286 AND ALLOY 718

Alloy	Extrusion Ratio	UTS, ksi	Yield Strength, ksi	Elongation, percent	Hardness, R_C		
					As Received	As Extruded	As Aged
A286	3.3:1	197.5	179.8	15	12	27-30	33
A286	5:1	200.0	180.9	11	12	27-30	34
A718	3.3:1	298.1	270.1	(a)	16	42-43	49

(a) Specimen broke outside the gage marks and no elongation value was obtained.

The results shown in Table XXIII exceed the tensile values commonly reported for the alloys. Typical tensile properties for A286 conventionally cold worked at 75 percent reduction and aged, are 150 ksi ultimate tensile strength, 140 ksi yield strength, and 2 percent elongation. Tensile properties reported for Alloy 718 similarly cold worked and aged are 250 ksi ultimate tensile strength, 230 ksi yield strength, and 6 percent elongation. Hydrostatic extrusions of Alloy 718 have been independently produced and evaluated by Watervliet Arsenal(15). The tensile results are in substantial agreement, but the extrusion ratio for the Watervliet experiments was not published and a direct comparison of the data cannot be made.

XII

COLD HYDROSTATIC EXTRUSION OF DISPERSION-HARDENED SINTERED ALUMINUM

The hydrostatic extrudability of an experimental dispersion-hardened sintered-aluminum product was evaluated at extrusion ratios of 10, 20, and 40:1. The billets were supplied by Oak Ridge National Laboratory and were 2-inch diameter x 2 inches long. In the as-received condition, their density was approximately 80 percent theoretical density. The billets were machined to 1-3/4-inch diameter and each was sandwiched between standard 7075-0 aluminum billets using a 1/8-inch-deep cylindrical counterbore joint. This joint is described later in Section II in connection with tandem-extrusion investigations. The sandwich-billet construction was used because the sintered-aluminum billets were too small to permit machining a 45-degree nose on one end. The construction also permitted complete extrusion of the billets. The billet lubricant was applied to the sandwich billet and to the joint interfaces. The extrusion data are contained in Table XXIV.

TABLE XXIV. EXPERIMENTAL DATA FOR COLD HYDROSTATIC EXTRUSION OF DISPERSION-HARDENED SINTERED ALUMINUM

Die Angle – 45 degrees (included)   Billet Diameter – 1-3/4 inch
Fluid – Castor oil   Billet Surface Finish – 60 to 120 microinches, rms
Stem Speed – 20 ipm

Trial	Extrusion Ratio	Billet Lubricant	Extrusion Pressure, 1000 psi: Breakthrough, Stem	Breakthrough, Fluid	Runout, Stem	Runout, Fluid	Type of Curve[a]	Length of Extrusion, inch
475	10	L53	104	99	99	92	B2	20
476	20	L53	156	139	135	117	B2	40
490[b]	40	L53	221	202	--	--	C4	1/2
519[b]	40	L38	240	203	--	--	C4	0

(a) See Figure 26.
(b) Compound angle billet nose; 45 degrees at apex, 30 degrees beyond 0.75 inch diameter.

At ratios of 10 and 20:1, the whole billet was extruded in one piece. While the extruded products were craze cracked at the leading end, the remainder appeared to be sound. The extruded products were returned to ORNL for further evaluation. At 40:1, the lubricant film apparently broke down resulting in seizure at the die-billet interface after extruding about 1/2 inch of product. The 7075-0 aluminum nose had extruded satisfactorily. The discontinuity at the joint may have contributed to the failure of the lubricant film.

The runout pressure levels obtained at 10 and 20:1 ratios were marginally lower than those reported earlier for 7075-0 aluminum. The breakthrough pressures were probably influenced by the joint with the leading 7075 aluminum billet.

ORNL reported the mechanical properties of the hydrostatically extruded products[16]. Table XXV gives the data obtained by tensile tests at 840 F, the reference-test temperature for this alloy. Also given are data for conventional hot (750 F) extruded rod.