TABLE XXVI. EXPERIMENTAL DATA FOR HYDROSTATIC EXTRUSION OF TZM ROUNDS AT 80 AND 500 F

Die angle - 45 degrees (included) Billet diameter - 1-3/4 inches Billet surface finish - 60 to 120 microinches

Trial	Extrusion Ratio	Die Design(a)	Stem Speed, ipm	Billet Lubricant (Details in Table 3)	Extrusion Pressure, 1000 psi: Breakthrough		Extrusion Pressure, 1000 psi: Runout		Type of Curve (Fig. 26)	Length of Extrusion, inches	Cracks(b)	
					Stem	Fluid	Stem	Fluid			Circumferential	Longitudinal
Wrought TZM, Stress Relieved												
Temperature - 80 F, Fluid - Castor Oil												
441	2.5	S	6	L17	156	140	136	122	B4	5.0	Nose only	3
442	2.5	C1	6	L17	156	140	140	127	B4	4.0	Ditto	4 split at nose
469	2.5	D1	6	L38	157	141	142	129	B1	4.0	None	3
452	3.3	C2	6	L17	240	210	184	165	C1	10	Nose only	3
455	3.3	C2	6	L38	224	198	184	165	C2	10	Ditto	3
478	4.0	D2	6	L38	280	242	--	--	B4	1.0	None	None
505	4.0	D4	6	L38	252	218	205	183	B1	5.0	Nose only	4
514	4.0	D5	20	L38	245	215	--	--	--	3.5	None	None(c)
443	5.0	S	6	L17	280	237	240	207	C3	7.5	Nose only	2 split at nose
Temperature - 500 F, Fluid - Polyphenyl Ether												
501	4.0	D3	6	L38	--	--	--	--	--	--	Die seal leak	
502	4.0	D4	6	L38	178	(d)	171	(d)	B2	7.0	None	None
Wrought TZM, Recrystallized												
Temperature - 80 F, Fluid - Castor Oil												
460	3.3	C2	6	L38	172	155	137	125	C2	10.0	Nose only	3
483	4.0	D3	20	L38	198	176	194	168	B1	12.0	None	None

(a) S = standard die; C = controlled-relief die; D = double-reduction die (further details are given in Figure 22)
(b) Cracks occurred on the nose only when extruding through double reduction die with space between bearings.
(c) Lubricant breakdown due to previous pressurizing up to 216,000 psi when automatic cut-out on press functioned prematurely.
(d) Fluid pressure gage out of order.

TABLE XXVII. EXPERIMENTAL DATA FOR HYDROSTATIC EXTRUSION OF BERYLLIUM ROUNDS AT 80 AND 500 F

Die angle – 45 degrees (included) Billet diameter – 1-3/4 inches Billet surface finish – 60 to 120 microinches

Trial	Extrusion Ratio	Die[(a)] Design	Stem Speed, ipm	Billet Lubricant (Details in Table 3)	Extrusion Pressure, 1000 psi				Type of Curve (Fig. 26)	Length of Extrusion, inches	Cracks[(b)]	
					Breakthrough		Runout					
					Stem	Fluid	Stem	Fluid			Circumferential	Longitudinal
					Temperature – 80 F, Fluid-Castor Oil							
377	2.5	C1	6	L17	142	139	134	130	D1	8	Many	Many
461	3.3	C2	6	L38	213	189	168	149	B2	11.5	Mostly at nose; few during runout	Five
495	4.0	D3	20	L38	234	205	228	200	B1	10	None	None
519	4.0	D5	20	L38	264	228[(c)]	--	--	--	2	None	None
520	4.0	D5	20	L38	234	203	216	193	B3	15	"	None[(d)]
528	4.0	D5	20	L38	228	202	--	--	--	3	"	None[(e)]
529	4.0	D5	20	L38	246	212	234	203	B3	18	Many	Many[(f)]
					Temperature – 500 F, Fluid – Polyphenyl Ether							
417	2.5	C1	6	L31	82	81	91	85	C4	5	Few	Few
503	4.0	D4	20	L38	150	(g)	143	(g)	B1	14	Numerous	Numerous

(a) S – Standard die; C = controlled-relief die; D = double-reduction die (further details are given in Figure 22.)
(b) Cracks occurred in the nose only when extruding through double-reduction die with space between bearings.
(c) Excessive billet-end pressure, due to billet-guide design, caused lubricant breakdown; maximum pressure indicated.
(d) Extrusion bent on exit and broke up on hitting a projection beyond the die.
(e) Press stopped prematurely after breakthrough.
(f) Heavy seizure of Be on the entry and surface of the second bearing, indicating severe lubrication breakdown.
(g) Fluid pressure gage out of order.