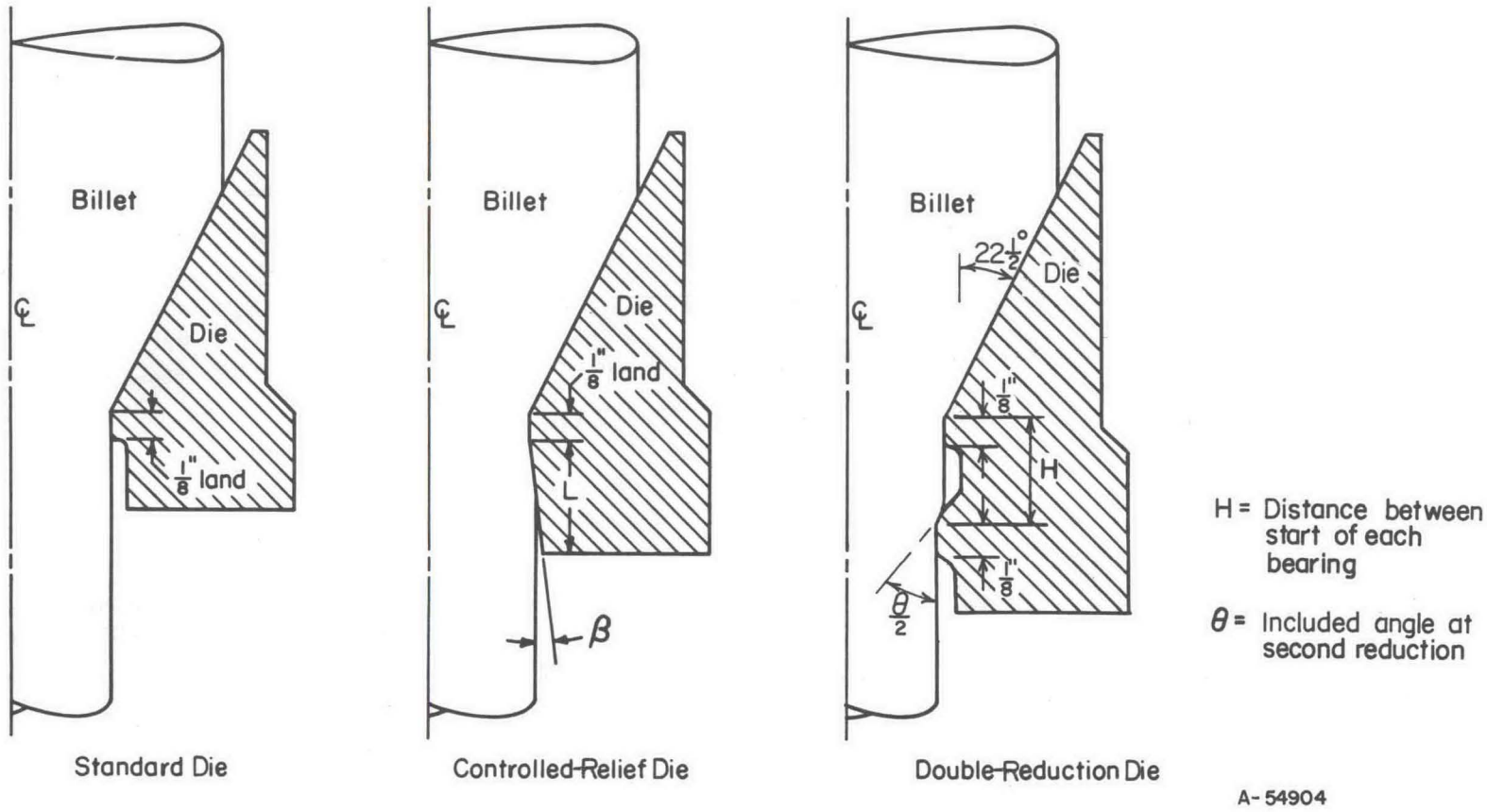

FIGURE 3. STANDARD DIE PROFILE AND TWO DIES DESIGNED TO ELIMINATE CRACKING IN BRITTLE MATERIALS

TABLE 4. EXPERIMENTAL DATA FOR HYDROSTATIC EXTRUSION OF TZM MOLYBDENUM ALLOY AND BERYLLIUM

Die angle – 45 degrees (included) Billet lubricant – L38
Fluid – Castor oil[1]

Trial	Objective or Variable	Die[a]	Extrusion Ratio	Stem Speed, ipm	Extrusion Pressure, 1000 psi				Type of Curve, p 25	Length of Extrusion, inch	Cracks[b]	
					Breakthrough		Runout				Circumferential	Longitudinal
					Stem	Fluid	Stem	Fluid				
					Wrought TZM – Stress Relieved							
469	Reference	A	2·5	6	157	141	142	129	B1	4	None	3
478	Die design	B	4	6	280	242	--	--	B4	1	None	None
505	Die design	D	4	6	252	218	205	183	B1	5	Nose only	4
501[c]	Temperature	C	4	6	--	--	--	--	--	--	Die seal leak	
502[c]	Temperature	D	4	6	178	166	171	159	B2	7	None	None
					Wrought TZM – Recrystallized							
483	Die design	C	4	20	198	176	194	168	B1	12	None	None
					Beryllium – Powder Origin							
495	Die design	C	4	20	234	205	228	200	B1	10	None	None
503[c]	Temperature	D	4	20	150	140	143	133	B1	14	Numerous	Numerous

(a) See table on p 14 for double reduction die details.
(b) Cracks occurred on the nose only when extruding through die with space between bearings.
(c) 500 F extrusion using polyphenyl ether (PPE) as the fluid medium. Fluid pressures estimated from stem pressures. High-temperature high-pressure gage out of order.