TABLE XVII. EVALUATION OF LUBRICANTS USED IN EXTRUDING AISI 4340 STEEL AT 500 F

Extrusion ratio - 4:1 Fluid - Polyphenyl ether Stem speed - 20 ipm

Trial	Lubricant	Difference Between Breakthrough and Runout Pressures[a], 1000 psi		Extruded Surface Finish Rating	Type of Extrusion Curve[b]
		Stem	Fluid		
394	L31	1.0	2.5	Excellent	B1
393	L33	--	--	-- --	Breakthrough not reached
397	L34	2.0	1.5	Very good	A2
409	L35	4.0	4.0	Good; some lubrication breakdown	B1
399	L38	2.0	1.5	Excellent	B1
401	L38	3.5	5.0	Excellent	B2
407	L40	9.0	5.5	Good; some lubrication breakdown	B2
406	L43	3.0	4.0	Good; some lubrication breakdown	B2
408	L44	1.0	1.5	Good; small amount of lubrication breakdown	A4

(a) The runout pressure level for the above trials was on the order of 180,000 to 200,000 psi.
(b) See Figure 26.

Effect of Temperature. The effect of temperature (80 F and 400 F) on the fluid runout pressures required to extrude AISI 4340 is shown in Figure 17. Of necessity, the fluids, lubricants, and stem seals used at room temperature are different from those at 400 F. While these differences in conditions may obscure the precise effect of temperature, it is believed that temperature is mainly responsible for the pressure reductions obtained. The fluid runout pressure level obtained at room temperature was lowered by 8 to 10 percent at 400 F.

Tensile Properties of AISI 4340 Steel Hydrostatic Extrusions

The results of tensile tests on AISI 4340 steel extrusions are recorded in Table XVIII. The tensile data obtained on extrusions from Trials 315 and 340 are added to those obtained in the earlier program[1].

As would be expected, increases in extrusion ratio from 3.3 to 6:1 resulted in sizeable increases in both yield and ultimate tensile strength. Yield strength was tripled and the ultimate strength was doubled. However, it is worthy of note that there was no appreciable sacrifice in ductility.

Table XVIII shows that increasing the exit speeds (at a constant extrusion ratio of 5:1) had little effect on tensile or yield strengths, but may actually improve ductility slightly as measured by elongation.

TABLE XVIII. ROOM-TEMPERATURE TENSILE PROPERTIES OF AISI 4340 STEEL ROUNDS PRODUCED BY HYDROSTATIC EXTRUSION

Extrusion Ratio	Reduction in Area of Extrusion, percent	Trial	Speed, ipm		Ultimate Tensile Strength, psi	Yield Strength (0.2 Percent Offset), psi	Reduction in Area in Tension, percent	Elongation in 1 Inch, percent
			Stem	Exit[a]				
1	0	As-received bar stock			94.6	55.4	49.0	33.0
3.3	70	176	6	60	160.9	136.5	32.6	11
4	75	183	6	60	170.4	142.9	29.4	10
5	80	189	6	60	180.4	151.9	27.8	9.5
5	80	167	1	10	188.6	163.4	27.9	8.0
5	80	315	20	185	179.0	161.7	28.8	13.0[b]
5	80	340	80	740	178.8	160.9	29.8	11.5[b]
6	83	190	6	60	196.6	170.4	26.1	8.5

(a) Die orifice diameter constant (0.75 inch), billet diameter varied to achieve ratio except in Trials 315 and 340 where billet diameter was 1.75 inch.

(b) Percent elongation in 2 inches.