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

		Between throug Runout sures	Pres- (a)				
Trial	Trial Lubricant Stem Fluid			Extru	led Surface Finish Rating	Type of Extrusion Curve ^(b)	
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 1	ubrication 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 1	ubrication breakdown	B2	
406	L43	3.0	4.0	Good; some 1	ubrication breakdown	B2	
408	L44	1.0	1.5	Good; small	amount of lubrication breakdown	A4	

Extrusion ratio - 4:1

Fluid - Polyphenyl ether

Stem speed - 20 ipm

(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.

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Extrusion	Reduction in Area of Extrusion,			l, ipm	Ultimate Tensile Strength,	Yield Strength (0.2 Percent	Reduction in Area in Tension,	Elongation in 1 Inch,
Ratio	percent	Trial	Stem	Exit(a)	psi	Offset), psi	percent	percent
1	0	As-ree	ceived ba	r 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

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

(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.

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