

TABLE XII. EFFECT OF BILLET LUBRICATION IN HYDROSTATIC EXTRUSION OF AISI 4340 WITH CASTOR OIL AS THE FLUID MEDIUM

Extrusion ratio - 5:1 Die angle - 45 degrees (included) Stem speed - 20 ipm

Item	Billet Lubrication <sup>(a)</sup>		Average Fluid Pressure, 1000 psi				Number of Trials	Lubrication Breakdown or Stick-Slip	Surface finish
	Coating	Lubricant	Breakthrough	Percent Reduction	Runout	Percent Reduction			
1 <sup>(b)</sup>	None	L17	220.5	-	216.3	-	6	No	Good
2	None	L11	209	5.2	235	-8.6 <sup>(c)</sup>	1	Yes	Scored
3	None	L38	230	-4.5	218	-0.8	1	No	Good
4	None	L31	230	-4.5	217	-0.3	1	No	Good
5	None	L53	225	-2.0	221	-2.2	1	Yes	Fair
6	C1	L11	213	3.2	213	1.5	2	No	Good
7	C1	L17	215.5	2.3	212.3	1.9	4	No	Good
8	C1	L18	213.5	3.2	213.5	1.3	2	No	Good
9	C1	L19	213.5	3.2	208	3.8	2	No	Good
10	C1	L20	207	5.7	208	3.8	2	No	Good
11	C1	L21	218.5	0.9	208	3.8	2	No	Good
12	C1	None	229	-3.85	215.5	0.4	2	Yes	Good
13	None	None	225	-2.04	229	-5.9	1	Yes	Scored
14	C3	None	P <sub>b</sub> not achieved at 255,000 psi				1	Yes	-
15	C4	None	223	-1.1	229	-5.9	1	Yes	Fair
16	C4	L11	204	7.2	213	1.5	1	Yes	Fair

(a) Billet lubricants listed in Table 3.

(b) Reference conditions to which remainder are compared.

(c) Negative means higher pressures than reference system.

TABLE XIII. EFFECT OF FLUID MEDIUM AND BILLET LUBRICATION IN HYDROSTATIC EXTRUSION OF AISI 4340 AT 80 F

Die angle - 45 degrees (included)

Stem speed - 20 ipm

Item	Hydrostatic Fluid	Billet Lubrication(c)		Average Fluid Pressure, 1000 psi				Number of Trials	Lubrication Breakdown or Stick-Slip	Surface Finish
		Coating	Lubricant	Breakthrough	Percent Reduction	Runout	Percent Reduction			
<u>Extrusion Ratio 5:1</u>										
1	Castor oil <sup>(a)</sup>	None	L17	220.5	--	216.3	--	6	No	Good
	Polyethylene glycol	"	L22	226.5	-2.7 <sup>(b)</sup>	219.5	-1.5	2	"	"
	Polyethylene glycol	"	L23	230	-4.3	228	-5.4	1	"	"
	Silicate ester	"	L17	219	0.7	219	1.2	1	"	"
2	Ethylene glycol	C1	L17	211	4.3	209	3.4	3	"	"
	Polyethylene glycol	C1	L17	210	4.7	209	3.4	2	"	"
	Ditto	C1	L19	207	5.7	211	2.5	1	Yes	"
	"	C1	L20	207	5.7	212	2.0	1	"	"
	"	C1	L21	211	4.3	213	1.5	1	"	"
3	Castor oil <sup>(a)</sup>	C1	L17	215.5	--	212.3	--	4	No	"
	Ethylene glycol	C1	L17	211	2.1	209	1.6	3	"	"
	Polyethylene glycol	C1	L17	210	2.6	209	1.6	2	"	"
4	Castor oil <sup>(a)</sup>	C1	L19	213.5	--	208	--	2	"	"
	Polyethylene glycol	C1	L19	207	3.0	211	1.4	1	Yes	"
5	Castor oil <sup>(a)</sup>	C1	L20	207	--	208	--	2	No	"
	Polyethylene glycol	C1	L20	207	0.0	212	1.9	1	Yes	"
6	Castor oil <sup>(a)</sup>	C1	L21	218.5	--	208	--	2	No	"
	Polyethylene glycol	C1	L20	211	3.4	213	2.3	1	Yes	"
<u>Extrusion Ratio 4:1</u>										
7	Castor oil <sup>(a)</sup>	None	L17	189	--	188	--	2	No	"
	Water	"	L17	186	1.6	188	0.0	4	"	"
8	Polyethylene glycol	"	L22	184	2.4	188	0.0	1	"	"
	Polyethylene glycol	"	L23	189	0.0	185	1.6	1	Yes	"

(a) Castor oil used as the reference fluid in each section.

(b) Negative sign means higher pressures than the reference system.

(c) C1 - phosphate coating; billet lubricants listed in Table 3.