

Materials

Specific details on the billet materials used during this interim period are described in Interim Report Numbers I and VI. (1,5)

Lubricants and Fluids

Table 1 lists billet lubricants used during the last quarterly period. Several of the lubricants listed were previously used for room-temperature hydrostatic extrusion. Several new lubricants-L38, L40, L43, and L44- were selected particularly for extrusion at 500 F. Lubricant L52 was tried in an attempt to eliminate stick-slip during the extrusion of 7075-0 aluminum at slow stem speeds.

Room-temperature trials were made with castor oil as the fluid medium. Table 2 lists fluids used for warm extrusion. All five of the fluids listed in Table 2 were selected because of their good stability and potentially good lubricity at elevated temperatures. At 100 F, the fluids gave a kinematic viscosity range of about 40 to 400 centistokes.

COLD HYDROSTATIC EXTRUSION OF 7075-0 ALUMINUM ROUNDS

As mentioned in previous reports^(4,5), 7075-0 aluminum shows a tendency to crack during conventional hot extrusion; to prevent cracking, exit extrusion speeds are usually limited to one or several feet per minute. With hydrostatic extrusion, sound products of 7075-0 aluminum have been produced at extrusion ratios of 20:1, 40:1, and 60:1, with exit speeds up to about 3000 ipm. However, at relatively low stem speeds, stick-slip occurs during extrusion as a result of momentary lubrication breakdown. This causes high breakthrough-pressure peaks and, sometimes, surface cracking.

A new lubricant, stearyl stearate (L52), was investigated for extrusion of 7075-0 aluminum rounds under conditions known to result in stick-slip. The extrusion conditions used and the results obtained are listed below:

Billet diameter	1-3/4 inches
Extrusion ratio	40:1
Area reduction	97.5 percent
Die angle	45 degrees (included)
Stem speed	20 ipm
Exit speed	1480 ipm
Fluid	Castor oil

TABLE 1. BILLET LUBRICANTS USED FOR HYDROSTATIC EXTRUSION DURING THIS INTERIM REPORT PERIOD

Lubricant	Source	Description	Billet Material Treated
L17	Battelle	20 w/o MoS ₂ in castor wax	7075A1
L30	Commercial and Battelle	50 w/o Cindol 4616 in castor wax	Ti-6Al-4V
L31	Commercial	Fluorocarbon telomer	4340 and Be
L33	Battelle	55 w/o MoS ₂ and 6 w/o graphite in sodium silicate	4340 and Ti-6Al-4V
L34	Battelle	50 w/o MoS ₂ in castor wax	4340
L35	Battelle	20 w/o graphite in castor wax	4340
L38	Commercial	P. T. F. E. lacquer	4340 and Ti-6Al-4V
L40	Commercial	Fluorocarbon-thickened fluorosilicone grease	4340 and Ti-6Al-4V
L43	Battelle	20 w/o MoS ₂ in extreme-temperature-range grease	4340 and Ti-6Al-4V
L44	Battelle	20 w/o I ₂ in extreme-temperature-range grease	4340 and Ti-6Al-4V
L48	Battelle	20 w/o MoS ₂ in castor wax, plus metallic lead, copper flake, and graphite	4340 and 7075A1
L52	Commercial	Stearyl stearate	7075A1

TABLE 2. FLUIDS USED IN WARM HYDROSTATIC EXTRUSION

Fluid Identification	Description	Kinematic Viscosity, centistokes	
		At 100 F	At 500 F
PPE	Mixed isomeric five-ring polyphenyl ether	363	1.2
CBP	Chlorinated biphenyl	44	--
TCP	Tricresyl phosphate	35	--
TAP	Triaryl phosphate	46	--
SE	Silicate ester	6.8	0.88 ^(a)

(a) Viscosity at 400 F.