

TABLE XL. ESTIMATED CONVERSION COSTS FOR PRODUCING TITANIUM AND Ti-6Al-4V TUBING BY CONVENTIONAL TECHNIQUES

	Tube A (3:1 Reduction)		Tube B (3:1 Reduction)		Tube C (4:1 Reduction)		Tube D (8:1 Reduction)	
	Starting Size	Finishing Size	Starting Size	Finishing Size	Starting Size	Finishing Size	Starting Size	Finishing Size
OD, in.	1.00	0.750	0.750	0.625	1.00	0.875	1.00	0.625
ID, in.	0.736	0.634	0.606	0.569	0.875	0.843	0.640	0.561
Wall, in.	0.132	0.058	0.072	0.028	0.062	0.016	0.180	0.032
Wt, lb/ft	0.69	0.24	0.294	0.098	0.346	0.0874	0.889	0.11
<u>Material</u>								
Commercially Pure Titanium								
Selling Price, dollars/ft	5.57 <sup>(a)</sup>	2.08 <sup>(a)</sup>	2.46 <sup>(a)</sup>	1.25 <sup>(a)</sup>	2.83 <sup>(a)</sup>	1.32 <sup>(a)</sup>	6.73 <sup>(a)</sup>	1.31 <sup>(a)</sup>
Conversion Cost, dollars/ft		0.22		0.43		0.61		0.47
Ti-6Al-4V Titanium Alloy								
Selling Price, dollars/ft	27.60 <sup>(b)</sup>	36.00 <sup>(c)</sup>	47.04 <sup>(d)</sup>	17.64 <sup>(e)</sup>	13.87 <sup>(b)</sup>	13.11 <sup>(c)</sup>	35.50 <sup>(b)</sup>	16.50 <sup>(c)</sup>
Conversion Cost, dollars/ft		26.80		1.96		9.64		12.06

(a) Based on published price list.

(b) Based on oral quote of \$40.00/lb.

(c) Based on oral quote of \$150.00/lb.

(d) Based on oral quote of \$160.00/lb.

(e) Available only on a best-effort basis, therefore, the cost was based on an estimate of \$180.00/lb.

compete with conventional processing it appears that the hydrostatic extrusion process must reduce the material at 4:1 in lengths approaching 6 feet long. Further, comparing the conversion costs for unalloyed tubing between Tubes A and B and between Tubes C and D, indicates that as the tube wall becomes thinner the costs of the conventional process increase significantly. The hydrostatic extrusion process costs should be relatively insensitive to the final wall thickness and thus should be able to compete even more favorably in the production of thin-walled tubing.

As pointed out previously, this analysis was not meant to be definitive, but certainly establishes a trend and indicates that the hydrostatic extrusion process should be further investigated as a tube-producing process. The process economics of hydrostatic extrusion will be further analyzed in a design study of a production hydrostatic extrusion press, a program currently in process at Battelle under Air Force Contract No. F 33615-67-C-1434.

- (a) Qualitative analysis of hydrostatic extrusion process.
- (b) Process of hydrostatic extrusion.
- (c) Design of hydrostatic extrusion press.
- (d) Comparison of hydrostatic extrusion process with conventional process.
- (e) Summary of hydrostatic extrusion process.

Process	Material	Length	Wall Thickness	Conversion Cost	Material Cost	Total Cost
Hydrostatic Extrusion	Aluminum	6 ft	0.125 in	\$1.50	\$1.50	\$3.00
			0.075 in	\$1.50	\$1.50	\$3.00
			0.050 in	\$1.50	\$1.50	\$3.00
			0.030 in	\$1.50	\$1.50	\$3.00
Conventional Process	Aluminum	6 ft	0.125 in	\$1.50	\$1.50	\$3.00
			0.075 in	\$1.50	\$1.50	\$3.00
			0.050 in	\$1.50	\$1.50	\$3.00
			0.030 in	\$1.50	\$1.50	\$3.00