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TEXTURE OF Ti-6Al-4V AS AFFECTED BY ROLLING TEMPERATURE

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METALS RESEARCH DIVISION

December 1975

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ABSTRACT

An experimental investigation was carried out to determine the effect of rolling temperature on the texture development in Ti-6Al-4V. All specimens were unidirectionally rolled to a reduction of approximately 90 percent A set of mill-annealed, as-received material was rolled between 1200 and 1650 F. Three additional specimens were solution treated, aged, and rolled at the aging temperatures of 1100, 1150, and 1200 F. Attempts to cold roll these plates were unsuccessful due to cracking. Textures were determined for all material processed. Although improvements of the strain ratios over the as-received material were noted, these were considered low.

INTRODUCTION

The successful utilization of texture as a method of strengthening depends upon proper design application and the manufacturing control for the production of the desired texture. To date the only extensive studies of yield criteria for anisotropic material have been those associated with plane stress applications such as thin-walled pressure vessels.[1-4] Several theoretical and experimental programs have been carried out with the objective of using "texture strengthening" for this critical weight-saving application.[5-7] Recent work conducted in the titanium technology phase of the SST materials development program concluded that texture is a primary metallurgical factor causing property variation and must be controlled.[8-10]

The success of future development programs along with subsequent component production, therefore, depends upon the ability of the mill to produce the required quantity of mill products with the desired texture. In the recent past there has been some demonstration that the required textures can be produced for most commercial alloys.[11-13] For plane stress applications, analysis has shown that maximum strengthening can be achieved with textures which are normally called "ideal." In this case, the (0002) or basal plane would be parallel to the sheet surface with the $(10\bar{1}0)$ or the $(11\bar{2}0)$ poles in or near the rolling direction depending on whether it is a cold deformation or recrystallized texture. The location of the $(10\bar{1}0)$ poles is, in this case, trivial. Titanium will form this ideal texture only under specific conditions of alloying and/or hot or cold rolling. Even when the conditions are right for producing the ideal texture, the intensity of the basal poles near the sheet normal will vary. To obtain maximum strengthening an intense concentration is needed. Since we are concerned with the mechanical properties, another measure of texture strengthening can be achieved through the use of a tension test. An important parameter utilized in Hill's theory for anisotropic yielding is R, which is defined as the instantaneous ratio of width-to-thickness strain, measured from a longitudinal tension test and expressed as:

$$R = d\varepsilon_W/d\varepsilon_L,$$

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1. HILL, R. *A Theory of Yielding and Plastic Flow in Anisotropic Metals.* Proc. of the Royal Society, London, v. 193, 1948, p. 281.
2. FISHER, J. C. *Anisotropic Plastic Flow.* Trans. ASME, v. 71, May 1949, p. 349.
3. TRESCA, H. Compt. Rend. Acad. Sci., Paris, v. 59, 1864, p. 754, and v. 64, 1867, p. 807.
4. VON MISES, R. Gottinger Nachrichten, Math.-Phys. Klasse, 1913, p. 582.
5. BACKOFEN, W. A., HOSFORD, W. F., Jr., and BURKE, J. J. *Texture Hardening.* Trans. ASM, v. 55, no. 1, March 1962, p. 264.
6. BABEL, H. W., EITMAN, D. A., and McIVER, R. W. *The Biaxial Strengthening of Textured Titanium.* Douglas Missile and Space Systems Division, no. 3471, June 1965.
7. SLINEY, J. L. *Biaxial Tensile Behavior of Ti-5Al-2.5Sn.* Army Materials and Mechanics Research Center, AMRA TR 62-22, June 1967.
8. PARKINSON, F. L. *Beta Processed Titanium 6Al-4V Plate.* DOT/SST Report No. FAA-SS-72-0, Boeing Company, July 1972.
9. PARKINSON, F. L. *Titanium Alloy 6Al-4V Sheet.* DOT/SST Report No. FAA-SS-72-01, Boeing Company, July 1972.
10. JENSEN, G. A., and EICHENBERGER, T. W. *Titanium Alloy 6Al-4V Mechanical Property Data.* DOT/SST Report No. FAA-SS-72-02, Boeing Company, March 1972.
11. DULL, D. L., and AMATEAU, M. F. *The Basal Textures of Ti-6Al-4V Processed by Various Methods.* Aerospace Report No. 7R0066 (5250-10)-15, February 1971.
12. LOCKHEED MISSILES AND SPACE COMPANY. *Development of Improved Biaxial Strength in Titanium Alloy Rocket Motor Cases Through Texture Hardening.* AF No. FO4611-67-C-0074, February 1969.
13. DAY, D. L., BROADWELL, R. G., and SLINEY, J. L. *The Effect of Deformation Processing on the Mechanical Properties of Ti-6Al-4V for Armor.* Titanium Metals Corporation of America, Contract 01-19-066-A4-0582(Z), Final Report, AMRA CR 66-06(F), June 1966.

or obtained from the relationship $R = \mu_p/1-\mu_p$ when μ_p is Poisson's ratio. High values of R are desired. In fact, some of the early impetus for texture strengthening programs was provided by experimental values for R approaching 9, which were measured from true stress-true strain sheet tension tests.[14] Prior experimental programs aimed at the demonstration of texture strengthening utilized materials with only moderate to low R values in the region of 2 to 4 because of the unavailability of high R sheet.

Thus, it has become increasingly apparent that before full utilization of texture strengthening is achieved, satisfactory mill practice for the production of high R materials is necessary. It appeared that prior work on alloy additions for cold-rolled ideal textures was not completely satisfactory because for the most part alloys of this type generally exhibited low strength, and, therefore, are not potentially attractive. It was decided to carry out an experimental hot-rolling program on Ti-6Al-4V with the objective to produce high R values with the ideal texture.

PROCEDURE

Material utilized in this study was a commercially produced 18"x18"x1.0" Ti-6Al-4V-ELI plate. From this material 3.0"x3.0"x1.0" coupons were cut for further processing. Eight coupons in the as-received condition were hot rolled between 1200 and 1650 F to a final thickness of 0.125". Specimens were heated in an argon atmosphere for one hour and received additional ten-minute periods at temperature between rolling passes. Three specimens were first solution treated at 1650 F for two hours, water quenched and aged at 1000, 1150, and 1200 F for four hours and air cooled. These STA specimens were then rolled to a final thickness of 0.110" at the aging temperatures. All rolling was accomplished on a 2-high rolling mill.

In order to describe the preferred orientation, one-quadrant pole figures were obtained utilizing a reflection technique described by Lopata and Kula.[15] The basal pole (0002) figure was the only one determined. It has been shown that the properties are symmetrical around the c-axis and it was desired to ascertain the ideal texture which is basal planes parallel to the sheet surface. Specimens were constructed utilizing the whole thickness of the processed sheet, which yielded an average of the surface and interior textures. X-ray diffraction data were plotted on a device which in conjunction with an X-ray diffractometer will plot intensity levels indicating preferred orientation as rapidly as the specimen can be scanned.[16] Uniaxial tension specimens were tested at room temperature on a hydraulic testing machine at a strain rate of 0.005 inch per minute. Specimen geometry and procedures utilized were similar to those described in previous reports.[17,18]

14. LARSON, F. R., and NUNES, J. *Strain Hardening Properties of High Strength Sheet Materials.* Army Materials and Mechanics Research Center, WAL TR 834.2/2, March 1961.
15. LOPATA, S. L., and KULA, E. B. *A Reflection Method for Pole-Figure Determination.* Trans. AIME, v. 224, August 1962, p. 865; also Army Materials and Mechanics Research Center, WAL TR 826.52/1, July 1961.
16. MARTIN, A. G., and LARSON, F. R. *Automatic Offset – Reflection Pole-Figure Plotter.* Army Materials and Mechanics Research Center, AMMRC TR 71-33, September 1971.
17. LARSON, F. R. *Anisotropy of Titanium Sheet in Uniaxial Tension.* Trans. ASM, v. 57, 1964, p. 620; also Army Materials and Mechanics Research Center, AMRA TR 63-36, December 1963.
18. ZARKADES, A., and LARSON, F. R. *Sheet Tensile Properties of Titanium Alloys as Affected by Textures.* Army Materials and Mechanics Research Center, AMMRC TR 68-03, January 1968.

MICROSTRUCTURE

Microstructures for the material in various conditions, as-received, and rolled from 1200 to 1600 F, are shown in Figure 1. All are shown in an etched condition with the rolling direction coinciding with the vertical of the photomicrographs. The as-received material has an equiaxed alpha structure with beta in the alpha grain boundaries. Microstructures of material rolled between 1200 and 1400 F show the elongated alpha grains with beta in the grain boundaries, which is expected from such a rolling process. With increasing rolling temperatures, 1500 or 1600 F, an increasing amount of the matrix has transformed to the martensitic alpha. Microstructures of material solution treated at 1650 F and then rolled at the aging temperatures of 1100, 1150, and 1200 F are shown in Figure 2. Clearly evident in Figure 2c are well-defined shear band which can be the result of plane strain deformation.[19]

DISCUSSION

Pole figures indicating the preferred orientation of the material as-received and rolled between 1200 and 1650 F are illustrated in Figure 3. The as-received plate had a basal pole figure which shows the (0002) poles lying in the transverse direction (Figure 3a). This type of texture will display a high degree of planar anisotropy. Rolling at 1200 F results in a texture which has the (0002) occurring in the sheet normal-transverse direction and tilted toward the transverse direction. This type of preferred orientation (Figure 3b) is commonly found in titanium sheet products. Increasing the rolling temperature to 1300 or 1400 F shifts the basal pole from the transverse toward the rolling direction, Figures 3c and 3d. The material rolled at 1450 F, Figure 3e, shows a tendency to shift the (0002) toward the sheet normal. This near ideal orientation occurs with some spread of intensities along the sheet normal-transverse direction (SN-TD). Materials rolled between 1500 and 1600 F show the pole tilting toward the rolling direction, Figures 3f to 3i. This type of texture is a zinc or magnesium type which appears in titanium when the volume of the beta phase is greater than fifteen percent.[20]

Textures that developed during rolling of the STA Ti-6Al-4V rolled at the aging temperature were similar to the one illustrated in Figure 3b. This material had the common titanium texture of the (0002) poles in the sheet normal-transverse direction tilted approximately 20 to 30 degrees toward the transverse direction.

Attempts to cold roll the material were unsuccessful. Ti-6Al-4V in both the annealed and STA conditions broke or cracked after limited deformation. Therefore, this practice was deemed impractical and was terminated.

Tension test results of material rolled between 1400 and 1500 F together with the as-received data are shown in Table 1. Evident is the increase in the plastic strain ratio R to 2.40 from the as-received value of 0.44. A higher value would have been obtained had it not been for the spread of poles along the

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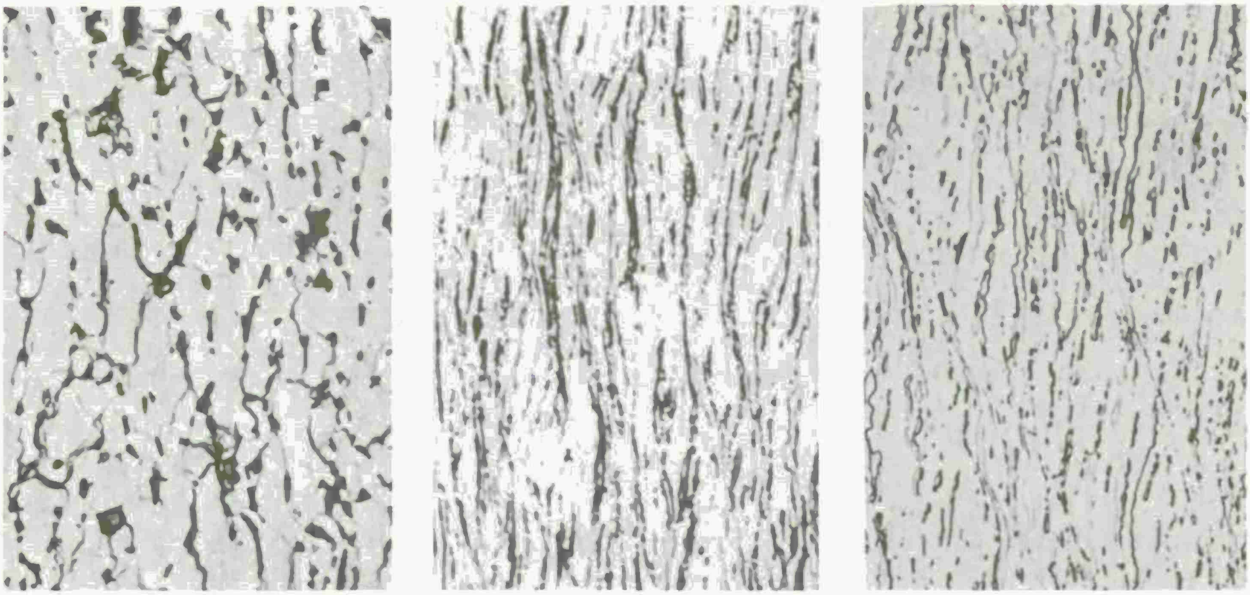
[19] BACKOFEN, W. A. *Deformation Processing.* Addison-Wesley Publishing Company, Reading, Massachusetts, 1972, p. 250-263.

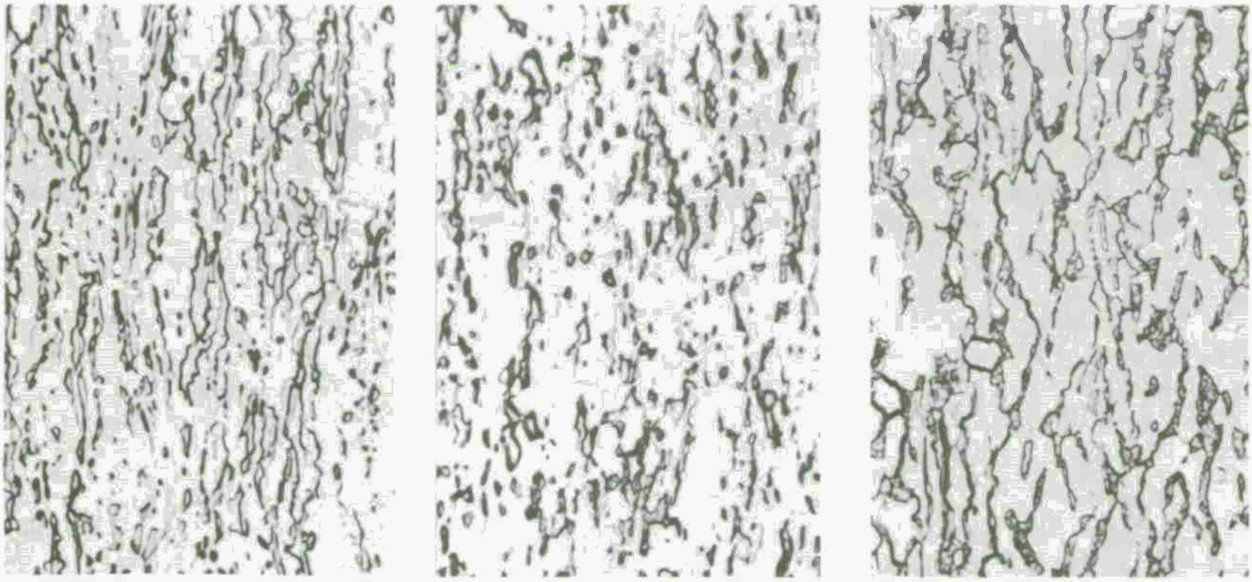
[20] LARSON, F. R., ZARKADES, A., and AVERY, D. H. *Twinning and Texture Transitions in Titanium Solid-Solution Alloys.* Army Materials and Mechanics Research Center, AMMRC TR 71-11, June 1971.



a. Mill-Annealed

b. 1200 F

c. 1300 F

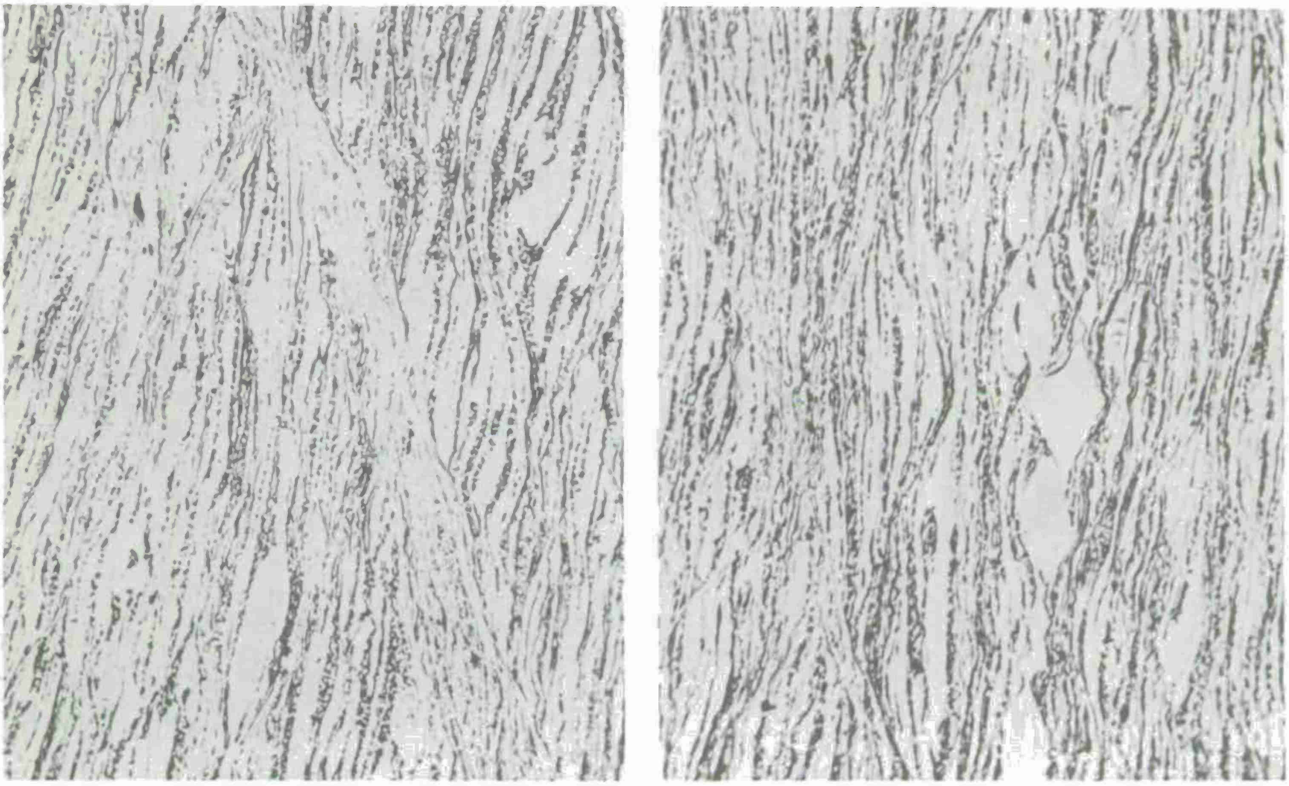


d. 1400 F

e. 1500 F

f. 1600 F

Figure 1. Microstructures of Ti-6Al-4V rolled at various temperatures. Etched. Mag. 1000X

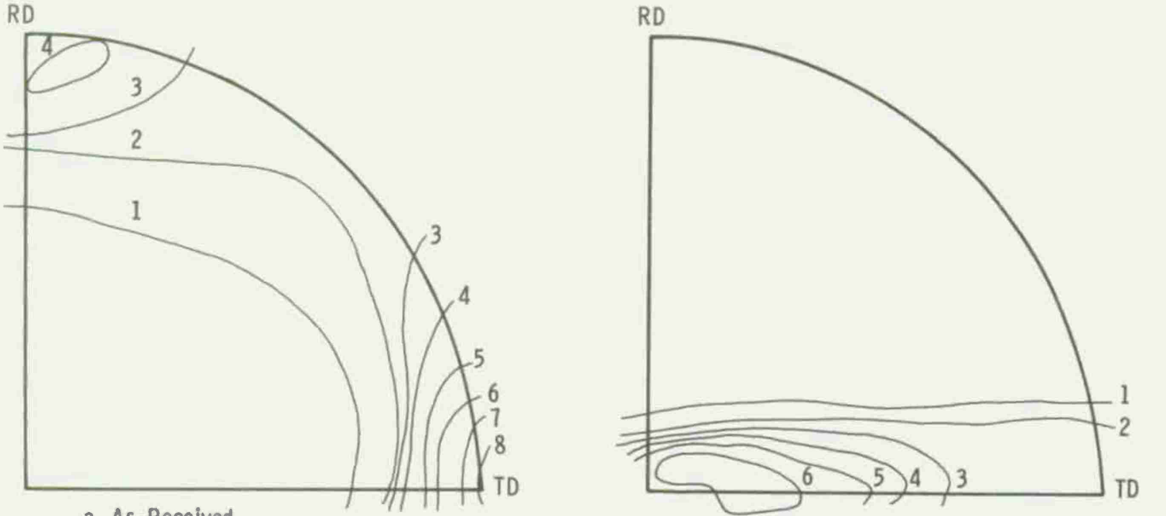


a. 1100 F

b. 1150 F

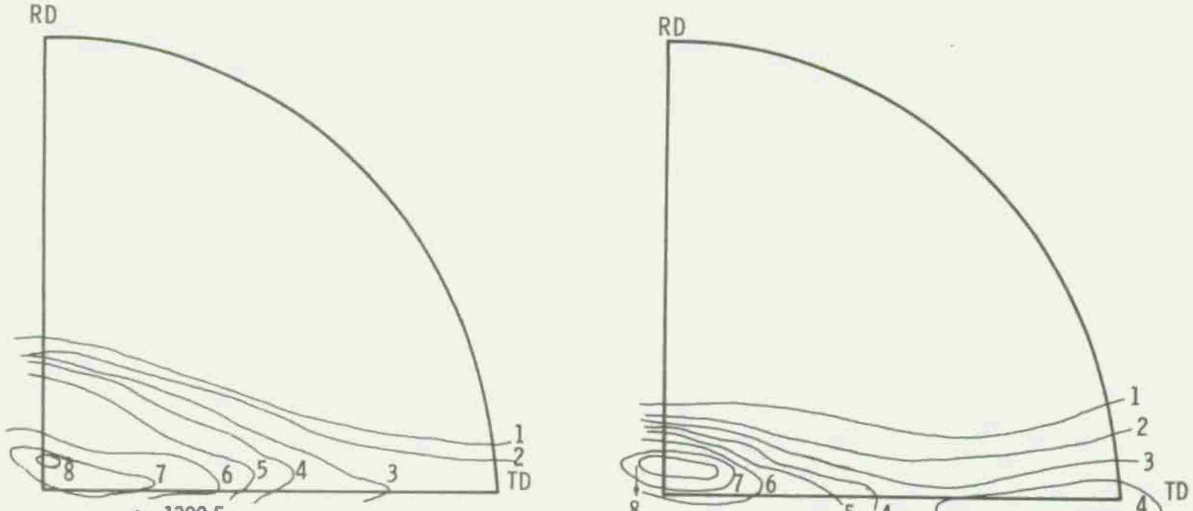
c. 1200 F

Figure 2. Microstructures of Ti-6Al-4V solution treated at 1650 F and rolled at various aging temperatures. Etched. Mag. 1000X



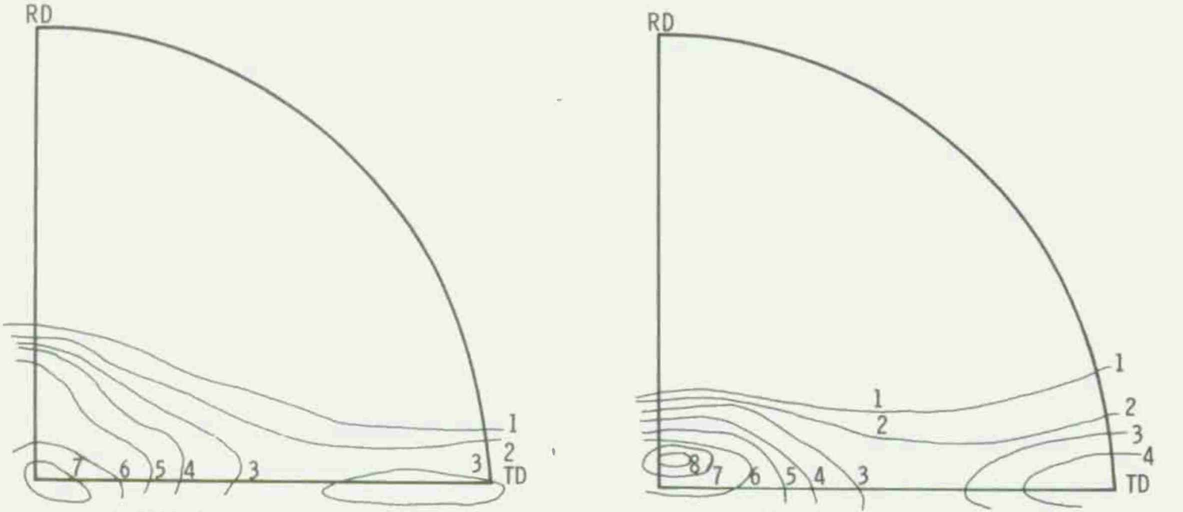
a. As-Received

b. 1200 F



c. 1300 F

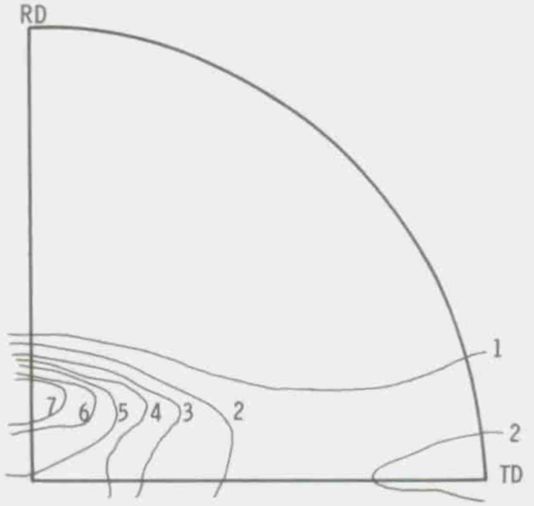
d. 1400 F



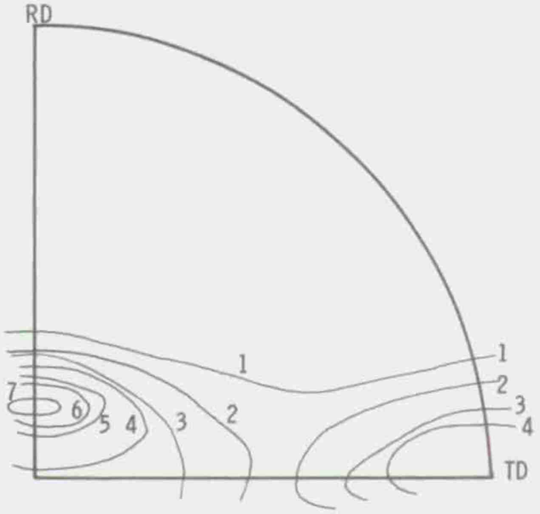
e. 1450 F

f. 1500 F

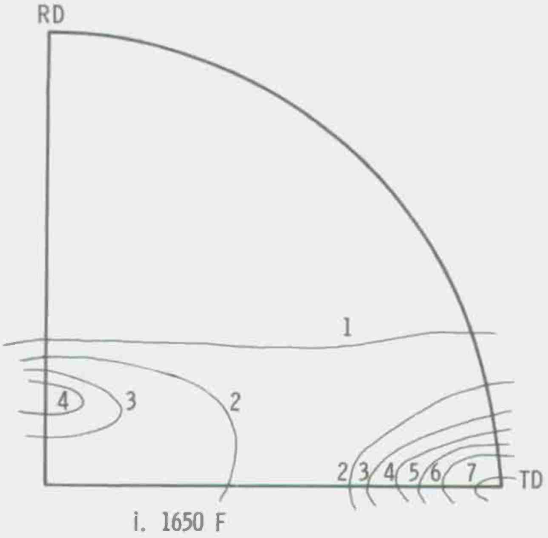
Figures 3a to f.



g. 1550 F



h. 1600 F



i. 1650 F

Figures 3g to i. The (0002) pole figures of Ti-6Al-4V rolled at various temperatures.

Table 1. MECHANICAL PROPERTIES

Rolling Temp, (deg F)	Thick- ness (inch)	Y.S. at 0.1% Offset (psi)	Y.S. at 0.2% Offset (psi)	Tensile Strength (psi)	Elon. (%)	E $(psi \times 10^6)$	μ_E	μ_p	R
As Recd.	0.500	124,100	125,500	130,400	16.5	16.5	0.250	0.304	0.44
1400	.125	122,600	129,200	150,000	11.0	14.8	.370	.672	2.05
1450	.124	118,500	124,200	145,700	11.0	14.5	.396	.706	2.40
1500	.118	120,300	125,900	145,300	10.0	14.9	.386	.676	2.09
1550	.114	118,000	123,700	144,300	10.0	14.6	.375	.632	1.72

SN-TD direction as indicated by the pole figure in Figure 3e. All data given are from longitudinal flat tension specimens. Poisson's ratio is often overlooked, yet it has been shown to be most sensitive to crystallographic preferred orientation in titanium. Depending on texture type and intensity, it can vary from 0 to 1.0 in a longitudinal test and can dramatically affect the drawability and formability of the material. The need for the proper control and awareness of texturing in titanium is illustrated in work performed on components for the SAAB 37 a/c Viggen aircraft.[21] Recently, the extensive work of Frederick[22] has provided important results which have established commercial mill processing procedures for the development and control of both basal plane ideal and transverse type textures.

CONCLUSIONS

It was established that by unidirectional rolling of Ti-6Al-4V between 1200 and 1600 F with an initial texture of the (0002) poles in the transverse direction, it was impossible to develop R values greater than 2.5. However, an increase from 0.44 for the as-received material to 2.40 for the material rolled at 1450 F was noted. Material which was solution treated and aged and then rolled at the aging temperature showed no change in texture from that which is commonly formed in titanium mill products. Attempts to cold roll the annealed and STA material to develop a fine grain were unsuccessful due to severe edge cracking.

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21. KLEIVAN, A., and BERNSTEIN, U. *Crystallographic Texture on Ti-5Al-2.5Sn Sheet Material.* SAAB-SCANIA AB, Sweden, TR TCM-71.69.
22. FREDERICK, S. F. *Manufacturing Methods for Production Process for Titanium Sheet with Controlled Texture.* McDonnell Douglas Astronautics Company, TR-AFML-TR-73-265, November 1973.

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