

Residual Stress Round Robin

This pdf will be updated as the round robin progresses.

[Results](#)

Sample Status as of 7/24/07

Ti-1B: Has been measured by Hill Engineering (Wire EDM slitting) and cut in half to create Ti-1B/A and Ti-1B/B

Ti-1B/A: Has been measured by Proto Manufacturing

Ti-1B/B: Has been measured by American Stress Technologies

Ti-2B: Has been measured by Texas Tech University (CNC Mill slitting) and cut in half to create Ti-2B/A and Ti-2B/B

Ti-2B/A: Has been measured by Los Alamos National Laboratories (ESPI hole drilling)

Ti-2B/B: Has been measured by TEC

Ti-3B: Has been measured by Don E. Bray, Inc. (Ultrasonic)

Ti-4B: Has been measured by University of British Columbia (Strain gauge hole drilling)

Ti-5B: Has been measured by Lambda Technologies

Ti-6B: Has been sent to Stock Climax Research Services but not measured

Participant Details

***Note: At the current time, we are evaluating the selection of steel to be used in this round robin. Until this selection has been finalized, the references to stainless steel should be disregarded.**

Summary: In 2004, an effort was begun to produce Ti-6AL-4V samples with a known residual stress which could be used in a round robin to evaluate different measurement techniques. The program was expanded to include 304L stainless steel samples. Samples were processed to produce low initial stresses, which were validated by measurement. The process of producing a known residual stress by bending samples in a 4 point bend fixture past yield was developed and validated. These samples will now be produced and distributed to participants in a round robin.

The Materials Performance and Failure Analysis Laboratory at Texas Tech University will organize the round robin, produce samples, and correlate the results. Compiled results will be provided to all participants, and as well as published in the Journal of Experimental Mechanics or a similar journal. All

results will be presented on an anonymous basis. Participants will be given the opportunity to opt-out of including their results in any published forum.

Goals: This round robin is meant to be a starting point for a continuing set of residual stress developments, primarily organized through the Society for Experimental Mechanics and the Residual Stress Summit. The overall goal is to aid North American laboratories in demonstrating their ability for making accurate and repeatable residual stress measurements. Specific goals of this round robin are:

1. To develop and verify a technique for economically producing samples with a known state of residual stress. These samples can be used to validate new measurement techniques, and validate existing measurement techniques in different materials
2. To examine different measurement techniques for their ability for measurement of residual stresses in beta annealed Titanium and 304L stainless steel
3. To qualify facilities for their measurement technique

Benefits to Participants:

1. Increased exposure to customer base, provided by acknowledgement of participation in publication
2. Potential for increased analytical capability
3. Proof of capability in measurement technique

Distribution of Samples: Each participant will receive a sample, or part of a sample, in order to perform their respective measurement for the residual stress profile. The schedule for the testing is shown in table 2.

Measurement Techniques: Specific parameters for measurement (drill bit feed and speed, radiation source, etc) should be the best suited for the particular sample, as determined by the participant. All of the parameters used in making the measurements should be included when providing results.

Analysis Techniques: Participants should use the analysis technique that they feel is best suited to the sample. A full description of the analysis parameters should be included when providing results, as these will also be compared.

Samples: Samples will be $\frac{1}{2}$ in. x 1 in. x 1 in. , with a stress profile that varies through the $\frac{1}{2}$ in. direction. Measurements should be made in the 1 in. face, in order to give the stress in the 1 in. direction. Some samples will be cut into smaller sections by TTU or in the course of measurements. Specific locations for measurement will therefore be supplied with each sample. Depths of measurements are supplied below for particular measurement techniques.

XRD: Measurement depths: Surface, 0.001 in., 0.050 in., 0.100 in., 0.125 in., 0.150 in.

Hole-Drilling: Measurement depths (for 1/16 in. bit): 0.008 in., 0.016 in., 0.024 in., 0.032 in., 0.040 in.

Slitting: Make measurements through the depth in 0.014 in. increments.

Table 1: Material Properties

	Young TM s Modulus	Poisson TM s Ratio
Titanium (Ti-6Al-4V)	18.4 Mpsi	0.342
Stainless Steel (304L)	29 Mpsi	0.29