

Summary of Residual Stress Data for Bearing Races as a result of the Mikronite® Process

Residual stresses may be caused by many factors including machining, stamping, and temperature fluctuations. Stresses within the part may be tensile or compressive. Tensile stresses are often the cause of corrosion, cracking, and fatigue failure. In fact, surface cracks can only initiate in tension, so any residual **compressive** stress present at the surface can be subtracted from any tensile load the surface is subjected to, thus either increasing the loading capacity of the part; or more commonly increasing the life (measured in cycles) of part life before failure in a high cycle fatigue situation.

Compressive residual stress can also help mitigate stress corrosion cracking. Essentially, stress corrosion cracking requires three components to initiate – 1) corrosive environment, 2) susceptible alloy, 3) tensile stress. By eliminating the tensile stress, the Mikronite® process can eliminate this problem.

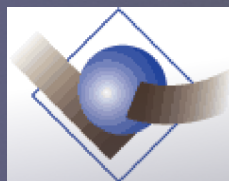
In conjunction with compressive residual stress, a very low surface Ra can reduce corrosive effects due to contaminants such as salt, dirt, water, exhaust gases, etc. Surface corrosion begins when a contaminate enters a crevice or pit in the surface. It then acts as an electrolyte and the metal area around it set up an anodic / cathodic relationship. The electron flow between these areas is the cause of electrochemical corrosion.

Attached are independent laboratory results of residual stress testing. The method used was X-Ray diffraction. It is a highly accurate and nondestructive method for measuring residual stress with the ability to penetrate the material approximately 4-6 microns.

The report details measurements on four steel outer bearing races. The races were labeled 1-4, number 3 being the unprocessed control pieces. The other three were processed differently in order to obtain the optimal process. **As you will note, race #2 had the maximum increase of 39%.**



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X-RAY DIFFRACTION SERVICE REPORT

Surface Residual Stress Measurements by XRD on Four Outer Bearing Races.

Daniel Manning
Mikronite Technologies, Inc.
511 Washington Avenue
Carlstadt, NJ 07072

DATE COMPLETED: 4/26/2004

P.O. NO.: 5161-00042604

DATE RECEIVED: 4/23/2004

SAMPLE ID &
DESCRIPTION: Four outer bearing race sections. Identified as no. 1, 2, 3, and 4.

SCOPE: XRD surface residual stress measurements on four outer race sections. Measure hoop directions on ID surface in middle of sectioned arc. Assume 52100 x-ray elastic constants.

RESULTS: As per attached sheets.

MEASUREMENT TECHNIQUES IN COMPLIANCE WITH:

"SAE, 784a - Residual Stress Measurement by X-Ray Diffraction".

{SAE 784a is a retired document no longer supported by SAE}

{Exception: AST uses a modern Modified-Psi diffractometer configuration instead of traditional Omega or Psi.}

Project Manager
Douglas Carr

Douglas Carr

- The results of this report relate solely to the items tested. This report shall not be reproduced except in full, without the approval of American Stress Technologies.

American Stress Technologies, Inc.

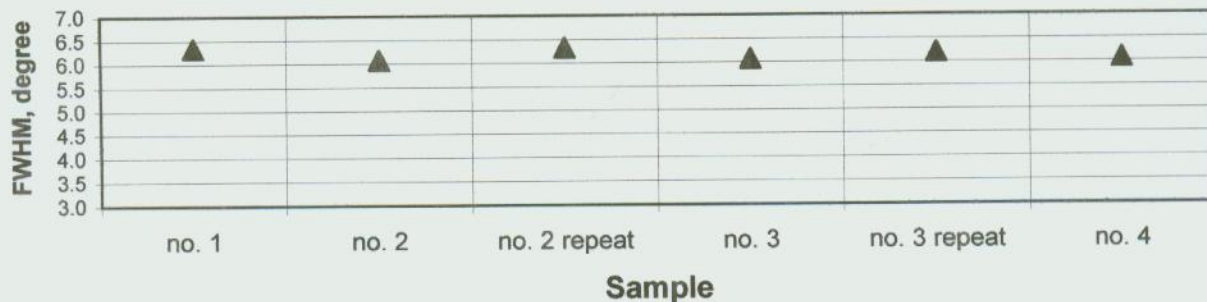
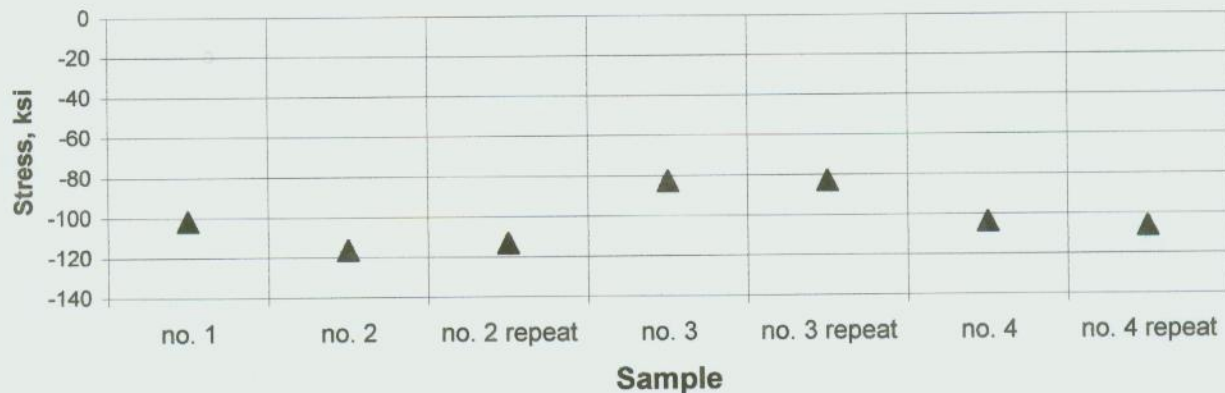
RESIDUAL STRESS RESULTS

Mikronite Technologies, Inc.
Outer Ring Segments

Radiation (hkl) :	CrKa (211)	Spot Size :	3 mm dia. coll.	Exposure Time :	5 seconds
Tilt Settings :	-27-0-27 4/4	Oscillation :	none	Material Removal :	none
Material Constant :	x-ray 52100	X-ray Mod. E/(1+v) :	173700 MPa	Machine/ Soft Ver.	BlueX3000/1.12.1

Mid length ID Location Hoop Direction

Identification	Stress ksi	Error +/-	FWHM °
no. 1	-101.8	3.3	6.33
no. 2	-116.5	8.9	6.07
no. 2 repeat	-113.3	8.0	6.32
no. 3	-82.8	4.2	6.07
no. 3 repeat	-83.0	4.6	6.20
no. 4	-103.7	4.8	6.07
no. 4 repeat	-106.2	2.4	6.29



FWHM - Full Width at Half Max... measure of peak width.

0 Stress Fe Powder Performance Verification Check Measured : 0.6 +/- 0.5 ksi

AST

X-RAY DIFFRACTION SERVICE REPORT

Surface Residual Stress Measurements by XRD on Four Outer Bearing Races.

Daniel Manning
Mikronite Technologies, Inc.
511 Washington Avenue
Carlstadt, NJ 07072

DATE COMPLETED: 7/20/2004

P.O. NO.: 5161-00072004

DATE RECEIVED: 7/9/2004

SAMPLE ID &
DESCRIPTION: Four Outer Bearing Race Sections. Identify as No. 1, 2, 3, and 4.

SCOPE: XRD surface residual stress measurements on four outer race sections. Measure hoop directions on OD surface in middle of sectioned arc. Assume 52100 x-ray elastic constants.

RESULTS: As per attached sheets.

MEASUREMENT TECHNIQUES IN COMPLIANCE WITH:

"SAE, 784a - Residual Stress Measurement by X-Ray Diffraction".
{SAE 784a is a retired document no longer supported by SAE}
{Exception: AST uses a modern Modified-Psi diffractometer configuration instead of traditional Omega or Psi.}

Project Manager
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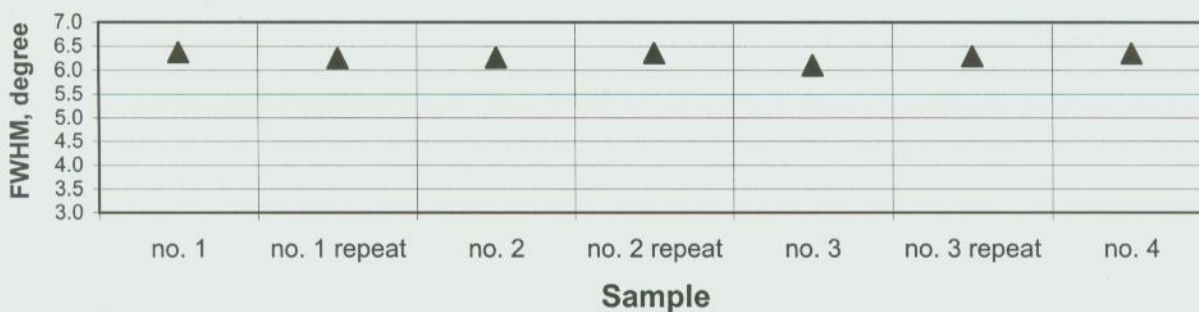
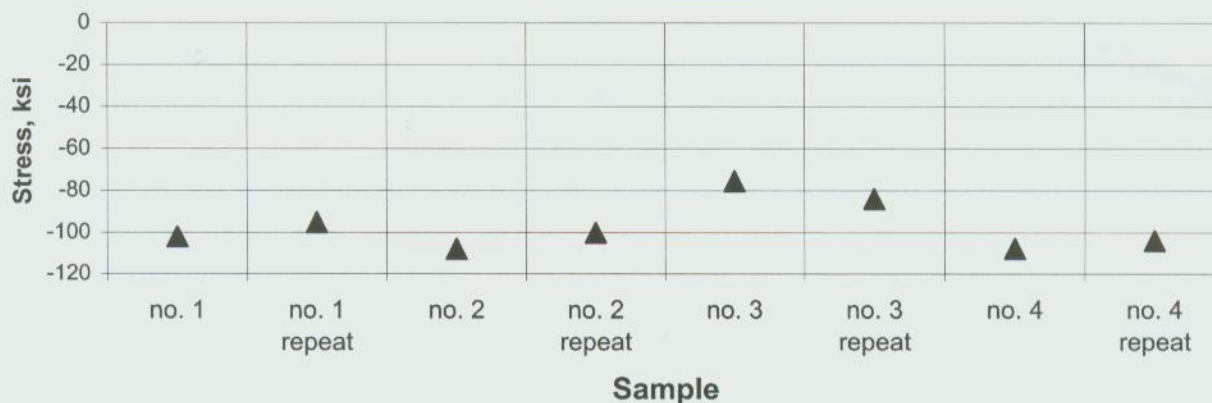
RESIDUAL STRESS RESULTS

Mikronite Technologies, Inc.
Outer Ring Segments

Radiation (hkl)	: CrKa (211)	Spot Size	: 3 mm dia. coll.	Exposure Time	: 5 seconds
Tilt Settings	: -45-0-45 3/3	Oscillation	: none	Material Removal	: none
Material Constant	: x-ray 52100	X-ray Mod. E/(1+v)	: 173700 MPa	Machine/ Soft Ver.	: Blue2X3000/1.12.1

Mid length OD Location Hoop Direction

Identification	Stress ksi	Error +/-	FWHM °
no. 1	-102.1	1.5	6.37
no. 1 repeat	-95.4	3.8	6.25
no. 2	-108.1	2.3	6.26
no. 2 repeat	-100.3	4.5	6.36
no. 3	-75.7	4.2	6.10
no. 3 repeat	-84.1	5.6	6.29
no. 4	-107.9	2.4	6.35
no. 4 repeat	-104.0	7.0	6.53



FWHM - Full Width at Half Max... measure of peak width.

0 Stress Fe Powder Performance Verification Check Measured : 0.7 +/- 0.5 ksi