

# X-RAY DIFFRACTION SERVICE REPORT DEMO

## Residual Stress Depth Profiles on 3 Parts

Customer name  
Company name  
Number Any Street  
City, State Zip

**CUSTOMER PO No.:** Demo  
**DATE RECEIVED, PO / SAMPLES:** 12 June 2017 / 12 June 2017  
**WORK LOCATION:** AST Laboratory

### PROJECT DESCRIPTION:

3 Samples for single direction residual stress depth profiles. Material removed by electrochemical means and nominal and maximum depths were at the operators discretion.

### XRD RESIDUAL STRESS MEASUREMENT TECHNIQUES, IN COMPLIANCE WITH:

- ISO EN15305: Non-destructive Testing – Test Method for Residual Stress Analysis by X-ray Diffraction, 2008
- ASTM E915-16: Standard Test Method for Verifying the Alignment of X-Ray Diffraction Instrumentation for Residual Stress Measurement. Exception: AST uses an epoxy mounted powder sample for durability.
- SAE HS-784: Residual Stress Measurement by X-Ray Diffraction, 2003. Exception: AST uses Modified-Chi detector geometry instead of Chi/Psi geometry described by the standard and follows the calculation guidelines set forth by ISO EN15305.
- ASTM E2860-12: Standard Test Method for Residual Stress Measurement by X-Ray Diffraction for Bearing Steels. Exception: AST follows calculation and collimator size guidelines set forth by ISO EN15305.

(Additional exceptions may be described in the notes)

Author-

Auditor-

---

Author name

---

Auditor name

**Measurements Performed By:** Operator

**INSTRUMENT DETAILS:**

Goniometer / XMU (s/n): Stresstech Xstress 3000 G2R, 7257 / 7258			
Radiation, $\lambda$ , Tube (s/n):	Cr-K $\alpha$ , 2.29Å, 21488	Software Version:	Xtronic 1.9.1
Detector Type:	NMOS, direct detect	Detector Geometry:	Modified $\chi$
Radius, Array, Size (°):	50mm, 512ch , 0.028	Detector Range (2 $\theta$ ):	~149 to 163

**SAMPLE MATERIAL DETAILS:**

Material:	Customers Steel	X-ray elastic constant:	n/a
Peak {hkl}, 2 $\theta$ Angle (°):	{211}, ~156.4	Young's Modulus:	205GPa
Penetration Depth (0°):	~5.5 $\mu$ m	Poisson's Ratio:	0.29

**MEASUREMENT DETAILS:**

Tube Power:	30 kV x 9mA , 100%	Meas. Directions ( $\phi$ ):	-90 (axial)
Collimator Size:	3mm $\emptyset$	Nominal Tilt Angles (+/- $\psi$ ):	0, 18.4, 26.6, 33.2, 39.2, 45
Exposure Time:	5 seconds	Oscillation:	none

**CALCULATION DETAILS:**

Peak Shift Analysis:	Cross-correlation	d vs. $\sin^2\psi$ Analysis:	Linear least squares fit
Parabolic Level:	75%	Smoothing:	none
Background / Threshold:	Constant, 36px, 20%	Peak limits:	none

Stress free powder (5 measurements each):

Powder ID: name, Fe	6/5/2017		6/12/2017	
	Stress [MPa]	Dev [MPa]	Stress [MPa]	Dev [MPa]
Average:	0.6	4.3	3.9	4.6
St Dev:	1.6	--	2.3	--

Reference Sample (1 measurement each):

Sample ID: name	Nominal		6/12/2017	
	Stress [MPa]	St. Dev [MPa]	Stress [MPa]	Dev [MPa]
Direction 1				
Direction 2				

**Notes:** Sample 1 and 3 were forged and then shot peened by different suppliers, Sample 2 was only forged.

**Results:**

Table 1: Residual stress results for samples 1 and 2.

Sample 1				Sample 2			
Depth	Stress	Dev	Peak width	Depth	Stress	Dev	Peak width
[mm]	[MPa]	[MPa]	[Deg]	[mm]	[MPa]	[MPa]	[Deg]
0.000	-714	22	4.43	0.000	-479	15	3.97
0.008	-720	16	4.17	0.007	-474	15	3.79
0.025	-766	11	4.05	0.011	-512	14	3.72
0.040	-760	9	3.88	0.028	-556	13	3.61
0.049	-743	9	3.84	0.066	-574	12	3.55
0.071	-740	6	3.77	0.073	-598	14	3.52
0.094	-777	6	3.73	0.105	-631	10	3.48
0.123	-850	9	3.74	0.133	-653	10	3.43
0.178	-823	11	3.80	0.174	-668	8	3.43
0.223	-771	11	3.81	0.230	-706	8	3.34
0.297	-522	7	3.97	0.298	-750	9	3.26
0.379	-270	15	4.10	0.375	-742	8	3.27
0.452	-71	8	4.11	0.443	-696	13	3.33
0.573	168	10	3.94	0.540	-537	10	3.52
0.646	162	7	3.94	0.652	-252	9	3.67
0.743	237	11	3.92	0.744	-73	10	3.75
0.877	261	10	3.92	0.868	113	12	3.90
1.000	255	14	3.94	1.016	187	11	3.91
				1.128	215	9	3.94
				1.201	223	8	3.93

Table 2: Residual Stress result for sample 3

Depth [mm]	Sample 3		Peak width [Deg]
	Stress [MPa]	Dev [MPa]	
0.000	-477	16	4.46
0.011	-566	17	4.06
0.023	-608	13	3.84
0.050	-674	11	3.64
0.077	-739	10	3.58
0.124	-792	5	3.61
0.174	-784	7	3.82
0.225	-625	13	4.10
0.308	-289	8	4.42
0.373	-141	11	4.38
0.449	4	12	4.20
0.548	137	5	4.05
0.645	210	5	3.93
0.770	262	9	3.87
0.880	276	8	3.84
1.041	298	16	3.82

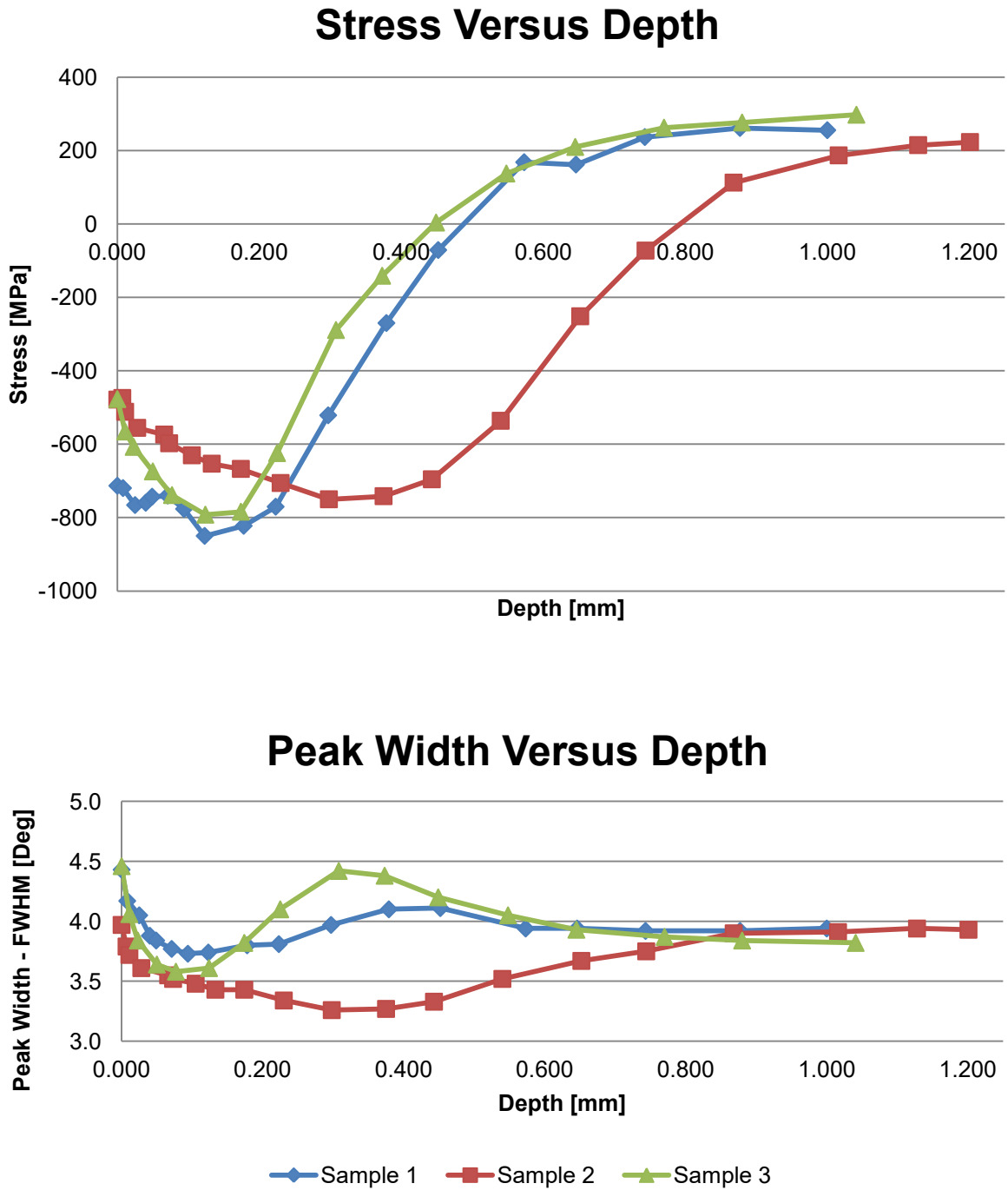


Figure 1: Plots of residual stress and peak width versus depth.