THE ROSE CORPORATION

Reading, PA

THE ROSE CORPORATION, a large-scale job shop is a regular user of the VSR Process. This report describes the stress relieving of a 135 ton capacity lifting yoke they produced for READING CRANE CORPORATION. The work-piece had an overall size of 17' X 15' X 2' (~ 5.2 X 4.6 X .6 meters) and weighed 23,600 lbs.

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VSR SETUP

The work-piece was placed on 3 isolation load cushions. One of the cushions (circled) was placed midway down one side (beneath the 5" thick lifting lug, see Figure 1), while the other two were placed at the midway balance point along each end. This load cushion arrangement minimized the damping of the work-piece, thus allowing maximum flexure to occur during the VSR Process.

Figure 1: VSR SETUP. The vibrator (circled) was placed above the lifting lug, and clamped using the front flange of the BL-8 Vibrator. The BL-8 Vibrator has two sets of mounting flanges, which allows effective orientation of the Vibrator relative to the work-piece.

An accelerometer was placed on the corner of the work-piece (circled, left foreground, Figure 1), and oriented to be most sensitive to vertical deflection. The Vibrator's unbalance was initially adjusted to a low setting of 10% of the BL-8's available 4.0 in-lbs. This generated only a small degree of resonance during a sweep thru the vibrator speed range where resonating took place (no resonances were detected above 5000-RPM). An unbalance setting of 40% caused more resonating, but also caused excessive power to be fed to the Vibrator (which has full electronic protection). A setting of 20% of 4.0 in-lbs., ie, 0.8 in-lbs, proved ideal – it caused resonating without excessive vibrator power.

VSR TREATMENT

The VSR-8000 System uses resonant frequency vibration to cause flexure of the work-piece, this mechanical flexure is the means of causing internal rearrangement of the material (i.e., plastic flow) thereby lowering the severity of residual stresses. Although other forms of vibration, and even randomly generated mechanical excitation, can cause stress relieving to occur, independent research has shown that resonant frequency vibration causes the greatest and fastest degree of stress relief.

Monitoring resonant frequency vibration data during stress relieving also provides the clearest indication of stress relief progress: The major change in resonance pattern that takes place during effective stress relief is growth of the resonance peaks. A secondary response is the shifting of the resonance peaks, most often in the direction of lower frequency (exceptions being significant change in work-piece shape, which is often indicated by shifting in the opposite direction: See VSR Job Report: ARGONNE NATIONAL LABORATORY in our On-Line Library. Continuous monitoring of the tops of resonance peaks, along with the resonance frequencies, provides the most comprehensive real-time monitoring of the progress of a vibratory stress relief treatment.

The VSR-8000 System displays the acceleration amplitude of work-piece. Acceleration measurement is used, rather than deflection or velocity, because it is proportional to the force the work-piece undergoes, based upon Newton's 2nd Law: $F = ma$ (where F is force, m is mass, and a, acceleration.) Acceleration has been shown to be the most scientifically-based parameter to monitor during a vibratory stress relief treatment.

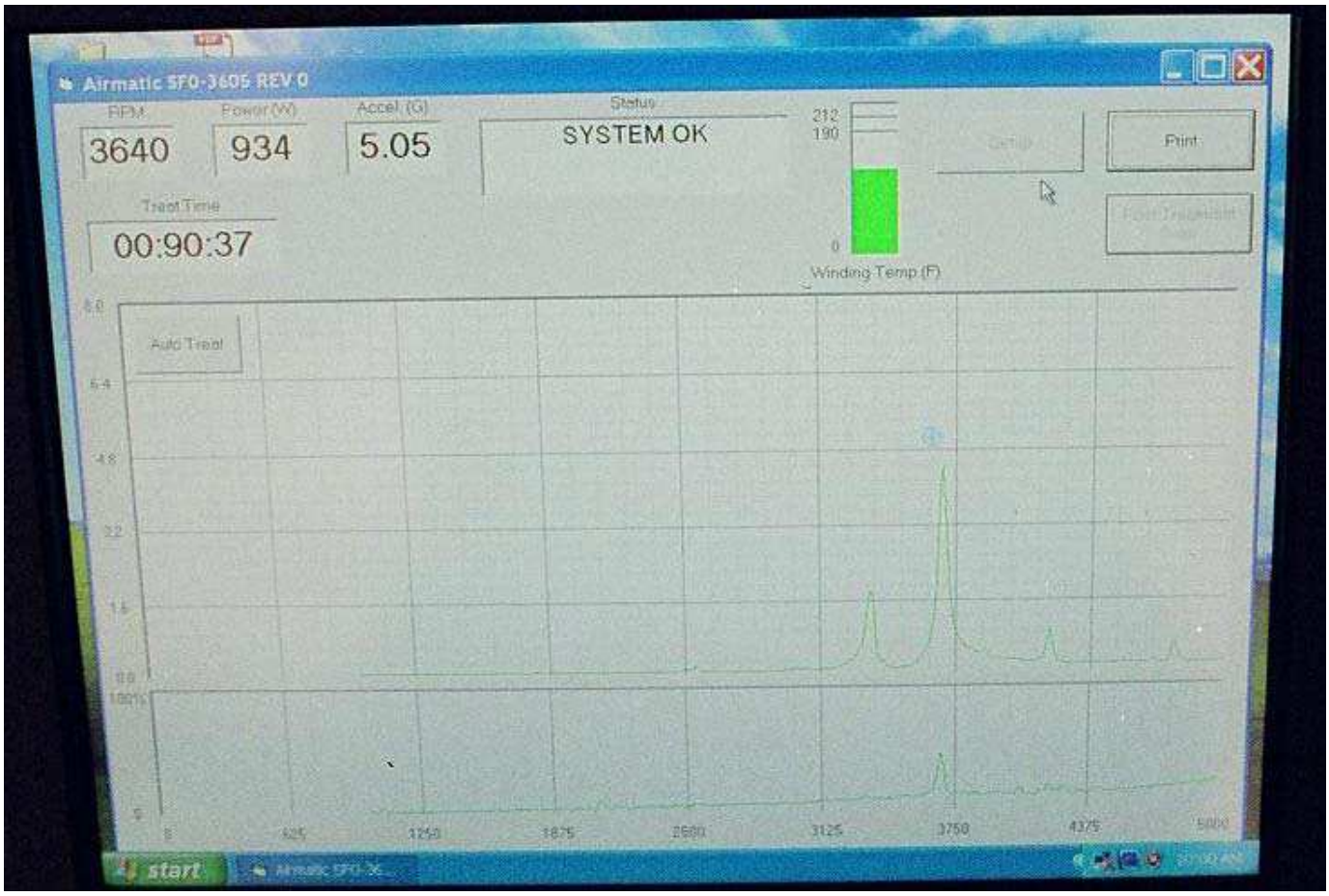

Figure 2: PRE-TREATMENT SCAN. **This shows work-piece's initial resonance pattern. At the time photo was taken, VSR Treatment was underway, as indicated by the vibrator RPM (upper left corner) reading 3640, and the real-time cursor (circled blue cross) being above the large peak, and slightly to the left. The height of the peak at this time was 5.05 g, but it eventually grew to more than 6.5 g before stabilizing.**

During VSR Treatment, each of the three resonance peaks was tuned upon. Each peak grew 25 – 35%, especially the one at 3640 RPM, which was the largest of the three. Modest shifting of approximately 35-RPM to the left also took place. Peak growth was fast in the beginning of treatment, but slowed and stabilized during the 7 – 10 minute treatment periods of each peak.

After stability at each peak was achieved, a Post Treatment Scan was performed, which documents the extensive change in the resonance pattern.

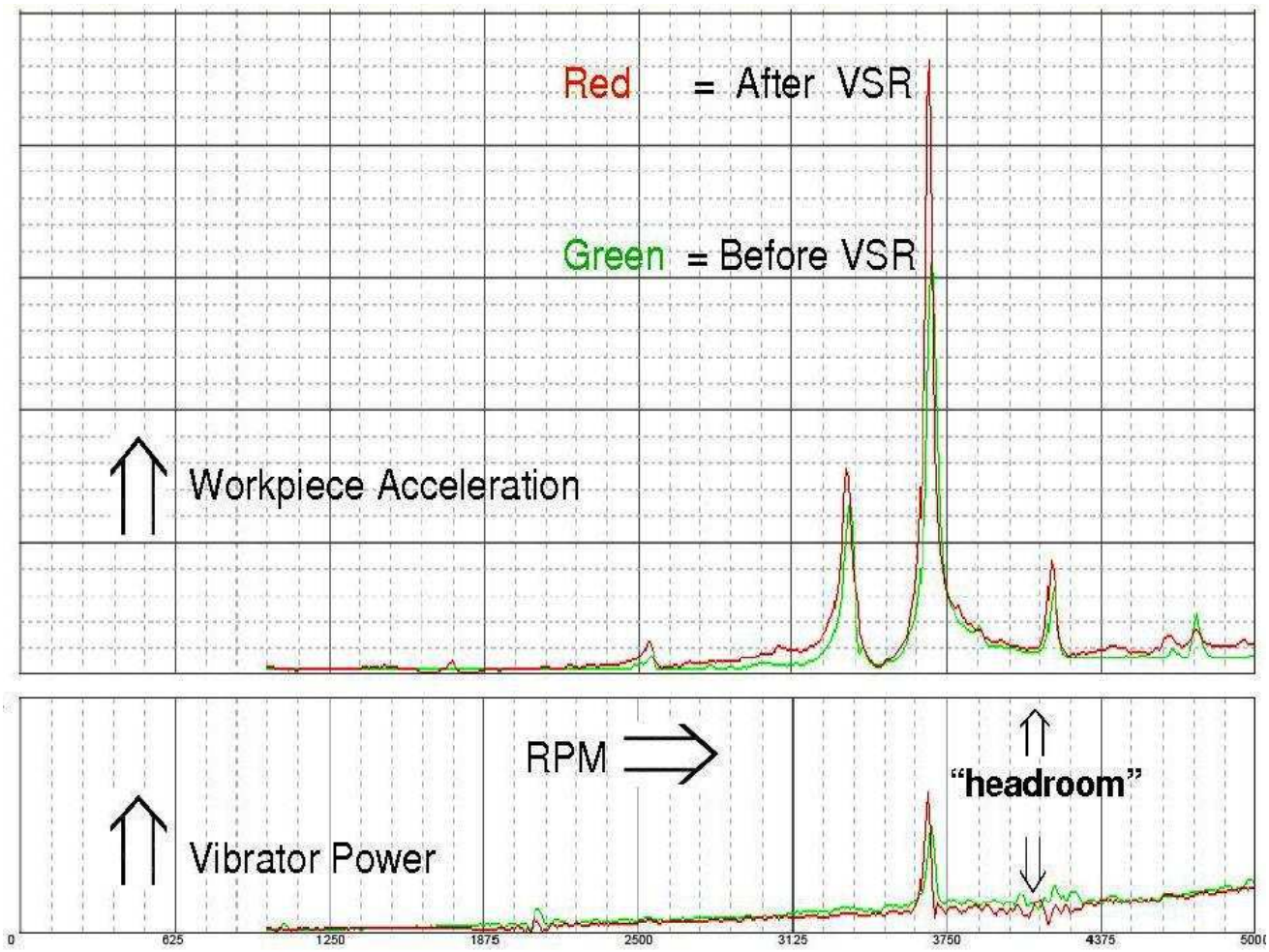

Figure 3: VSR TREATMENT CHART. **The growth of the resonance peaks, followed by stable resonance peak data, documents the effective of the VSR Process. The "headroom" is the space between required vibrator power, and the max power allowed (3 HP or 2.3 kW). By using a powerful motor, larger than any vibration equipment, power peaks, such as the one near 3700 RPM can be tuned upon, without over-loading the motor.**

CONCLUSION

As a result of the extensive and clear change in the resonance pattern of this work-piece, followed by resonance data stability, this fabrication should prove dimensionally and mechanically stable. Initial indication of this point occurred when the work-piece's bracing (see Figure 1) was removed, and no discernable or measurable distortion resulted (less than 1/8"). Thus was avoided any need for heat-straightening or other costly steps that would have reintroduced stress into this component and caused production delay.