Because the VSR-790A System is capable of displaying changes in the resonance pattern, it's easy to determine the effectiveness of dwell-time on each specific resonance peak, and track the change in that peak until it stabilizes. These changes can not only be observed during the treatment cycle, but also recorded – enabling the treatment to be fully documented.

During the first VSR Treatment, the Frame generated a sonic emission reminiscent of a gunshot. The vibration treatment was stopped, and the Frame was inspected. Inspection revealed a new crack, not related to the repair work. Sand poured from the crack, making a pile on the floor. The cause was attributed to a defect in the original casting which contained a sand-filled void which had gone undetected. In all likelihood, previous cracks, which had occurred near the void, had isolated this casting defect from undergoing flexing during load. Once the crack had been repaired, however, isolation of the void ended, and the dynamic load imparted into the Press by the VSR Process was enough to cause the void to open, allowing the trapped sand to escape. The repaired Frame would, therefore, be better than the original.

After welding was completed, and the Frame stress relieved a second time, the Frame was line bored and configured to useful form. No movement or shifting occurred. The Press was painted, reassembled, tested, and put back in service. An electronic monitoring package was installed to detect sonic emissions, overloads, etc., so as to prevent machinery abuse or improper use, and to monitor the "mechanical health" of the Press.

The Press has been used on a regular production basis, typically generating 1,000 parts/day since 1992.

The VSR TECHNOLOGY process proved to not only be the best method to complete a large, difficult and critical repair project, but also was able to enhance the mechanical integrity of the press's frame to *better than new* condition. MIDWEST FORGE's management was able to avoid significant expense, and lengthy downtime. We're proud of the successful role the VSR Process played in this project.

UPDATE ***UPDATE*** ***UPDATE***

In the summer of 2002, the Press was taken out-of-service to allow the control package and the peripherals to be upgraded. During the upgrade, the Frame's repaired areas were inspected for signs of cracking or failure – nothing was found. When the upgrade is completed, the Press will be back on line and parts production will be increased from 1,000 to 3,000 parts/day

Bruce Klauba has a degree in Physics and a Level II Vibration Analysis Certification from the American Society for Non-Destructive Testing (ASNDT). As a pioneer in the cause and effect of Vibratory Stress Relief, Mr.Klauba was named chief inventor (*Klauba et al.)* in U.S. Patent 4,381,673, which is both an equipment and process patent describing advances in the technology. He has authored numerous articles and original research papers on the subject which have been published in leading magazines and periodicals. In 1983, the American Society of Mechanical Engineers (ASME) published *Productive Applications of Mechanical Vibration,* a breakthrough paper on the use and understanding of Vibratory Stress Relief, which was co-authored with C. Mel Adams, PhD, one of the Nation's leading authorities on metallurgy, and co-founder of MIT's Welding Research Institute. In addition, Mr. Klauba has extensive experience in designing, building, and troubleshooting Industrial and Commercial Electrical Controls with a focus on extending the performance and reliability of Electric Motors and the systems they power.

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Job Story on Vibratory Stress Relief
Prepared by Bruce K. Klauba
Product Group Manager

Back in 1989 MIDWEST FORGE (MWF) of Cleveland, OH faced a costly decision. One of their larger Presses (8000 Ton Capacity) had broken due to overload. Tooling had been installed and parts processed which required Press tonnages ≈ 25% beyond the Press's capacity. Within a short time, the Press was down. Several cracks had appeared and they were growing. One of the cracks developed in an area along the side of, and intersecting with the main bearing journal, which was adjacent to a large gear.

Management of MWF had two options:

1. Replace the frame. Purchase Frame, plus the additional costs to rig the new Frame into the plant, prepare the foundation, and reassemble.
   Lead Time: 42 weeks, Estimated cost: $1,000,000;

2. Repair the frame. Weld repair the Press and use vibration to stress relieve the Frame.
   Lead Time: 10 weeks, Estimated cost: $30,000

Before an informed decision on which option to choose could be made, two questions needed to be answered: (1) Would a weld-repaired Frame, stress relieved using the VSR Process, perform as well as a new frame?; (2) If the VSR Technology approach was chosen, were the risks (wasted time, labor, and materials costs to repair, and lead time for a new Frame, etc.) worth the gamble?

After meeting with VSR representatives and conferencing with other VSR Process users, MWF decided that the evidence overwhelmingly supported a decision to pursue the repair solution. The Frame can be seen in Photo #1.

The VSR-790A System was used to treat the Frame weldment twice during the repair process: first, midway thru the welding procedure; the second time after welding had been completed. Two aspects of the vibration treatments are particularly noteworthy:

- The force generated by the VSR Process was significant. The VSR-790A System detected, displayed, and recorded acceleration levels, as high as 4.0g. A look at the scientific relationship (Newton's Second Law: **F = ma**) tells us that the 200 ton Forge Press experienced force levels 4 times its own weight, *ie*, **200 tons x 4 g = 800 tons Force**. Several of the Frame's "captured" resonance peaks received the required dwell-time during the VSR Treatment. A peak 2.0g high is displayed in the upper right corner of the System's MX-790A Control Console shown in Photo #3.

- Because the Vibrator's force output was no more than 1 ton while holding the 4.0g resonance peak, the need to use accurate resonance tuning to perform vibratory stress relieving can be mathematically demonstrated: the frame was experiencing ≈ 800 tons of dynamic load, and the Vibrator was generating about 1 ton of force. This means the resonance peak being held multiplied the force output of the Vibrator by ≈ 800 times. A Vibrator capable of generating this considerable force multiplication is mandatory when stress relieving massive components with great rigidity.

Continued on Back Cover . . .

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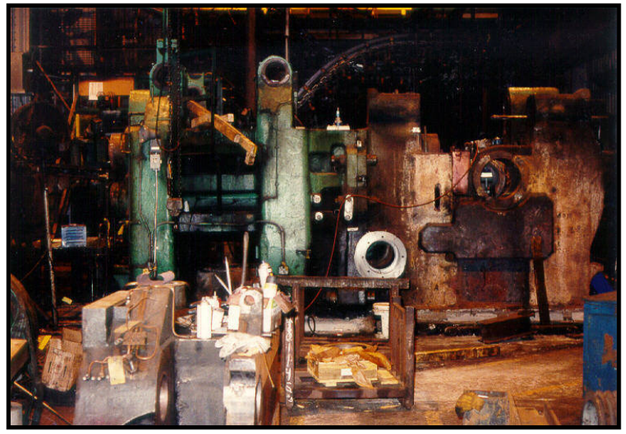
PHOTO #1

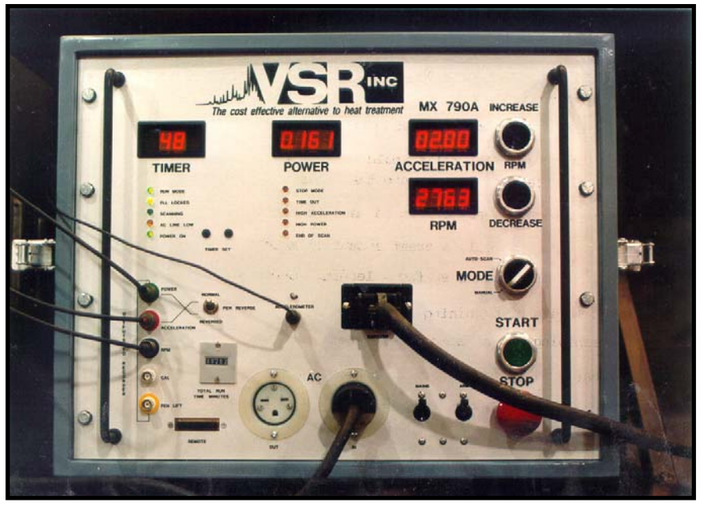


Stripped down Press Frame prior to weld repair, and stress relief.

PHOTO #2

One of many cracks that were prepared for weld repair.

PHOTO #3



The Console's multiple displays include: (1) Vibrator RPM; (2) Vibrator input power; (3) Workpiece acceleration. The Vibrator's speed, displayed to four digits, can be controlled in increments as low as 1 RPM, so that resonance peaks can be accurately tuned

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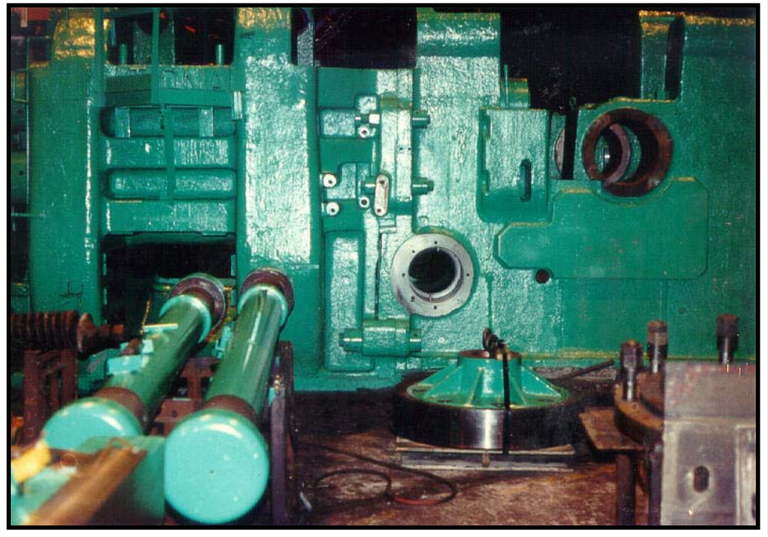
PHOTO #4

A new bearing journal being installed. The main crack extended into this journal area, and required > 5,000 cu in of weld. The weld repair seam was > 37" L. Since the repair was in the area of the press that receives maximum load, *the effectiveness of the VSR Process was critical to the entire repair job.*

PHOTO #5

The fully repaired Frame ready for installation of the "internals".



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