



### Featured Company: Cincinnati Milacron

## Stress-Relief System Eliminates Heat-Treating Process

### *Sub-resonant process Provided benefits*

A grinding machine builder using sub-resonant vibratory stress relief eliminated more than \$40,000 in basic component rework in their first year of production. The Heald Division of Cincinnati Milacron achieved this with the nonthermal Meta-Lax stress-relief system from Bonaf which paid for itself in less than five months with rework savings alone.

The company uses the process in a variety of stress-relieving activities that help improve overall quality. Dale Gallant, Quality Assurance Specialist, said "The Meta-Lax process gives us the advantage of being able to detect any internal stresses and an easy, inexpensive way to remove them if we find any. Before we used the process, we didn't know if the stresses were there or not."

The company requires final machining tolerances of .00015" to .00020" for flatness and squareness on components such as slides, bases, tables and wheel heads. Raw castings from several foundries are used for machining these key components. When the castings are rough machined, about 80% of the metal roughing stock is removed. Warpage from internal stresses often appears in large castings during machining. If internal stresses are suspected, the part is heat treated at 1,100oF to remove the stresses prior to final machining. However, oxide surface scale and warpage are caused by the heat-treating process. Both require further machining to correct. "The Meta-Lax process assures us of stress-free machine components without the need for heat treating," Gallant said.



***Bottom Slide being Meta-Lax treated***

Were castings arriving at the plant with internal stresses already in them? There had been no way to test until the sub-resonant vibration equipment was put into use. The system not only removes internal stress, but also indicates the relative amount of stress which was removed. After applying the process to incoming castings, it was found that they were stress-free at the raw casing stage.

When the stress analysis was applied to the castings after rough machining, a high level of stress was detected in many parts. It became obvious that the rough machining process itself, the removal of as much as 80% of the stock, was causing the internal stress buildup.

Company engineers were concerned that internal stresses might exist in components that did not normally warp during final machining without heat treating. These stresses could cause warpage of the component in the machine, which could eventually have a detrimental effect on accuracy. It was speculated that such stresses could eventually be relieved naturally at some future time by normal machine vibrations.

Due to the concern, a test is being conducted with a series of different rough-machined components using the system. Engineers will determine if there is a pattern of internal stress buildup in any group of components. Preliminary results show that 30% to 40% of the parts do have internal stresses after rough machining. The test results will also determine which groups of components will have the system permanently included as part of their production

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# Stress-Relief System

## Eliminates Heat-Treating Process

process. The severity of problems caused by undetected stresses is not yet known, but applying the sub-resonant process is a problem precautionary measure.

Operation of the portable equipment is straightforward, consisting of a force inducer, a sensing transducer and a control console. First, the force inducer is clamped onto the workpiece. Next, the transducer is also clamped to the workpiece which relays energy-absorption data back to the chart recorder at the control console., creating a servo loop. The operator locates the resonant frequency. Vibratory forces are then induced at a frequency below resonance, usually for 15 to 30min. The operator again locates the resonant frequency. If it has shifted, the procedure is repeated, using 5 to 10 min. between scans until the resonant curve stabilizes at a new frequency location, verifying that the stresses have been relieved.

### System Differentiation

The system differs from other stress relief processes which vibrate the workpiece at its resonant frequency. These treatments have one major drawback-they cannot produce consistently effective results. Some researchers say that resonant vibrations for extended time periods can actually fatigue the metal, resulting in early failure. The Meta-Lax sub-resonant process consistently matches or exceeds furnace stress-relief performance and improves fatigue life.

The Heald Division has eliminated the high cost of heat treating and reduced the time for stress relieving to a matter of minutes. The process can be applied anywhere on the shop floor. In addition to the thermal energy and time savings, the nonthermal stress-relieving process leaves no furnace scale that has to be removed through additional machining. Another important advantage of the system is that it has no size or weight limitations of the components to be processed.

### Mechanical Properties Not Affected

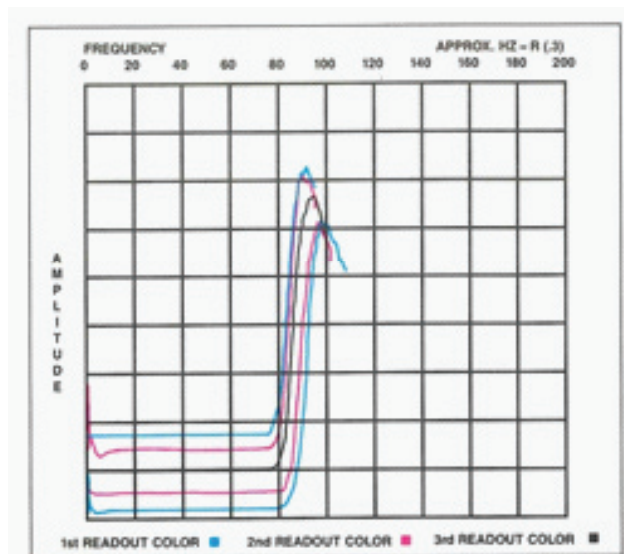
The process removes thermally induced residual stresses in most ferrous and nonferrous metals, including hot-rolled, forged and cast parts without altering their mechanical properties. Unlike thermal

stress relieving, the sub-resonant vibratory process can also relieve residual stress in metals previously hardened by heat treatment without affecting the hardness.

While the vibrations produce no change in mechanical properties, thermal processes frequently do change them. For example, annealing, with its slow cool, may reduce strength by up to 50%. Normalizing, with its controlled quench, induces stress. Tempering, with its mild temperatures, results in only partial stress relief. Where these conditions could be a problem, the Meta-Lax system provides a successful, low-cost solution.

In addition to stress relieving, the sub-resonant vibratory process can relieve residual stress built up during welding operations. It can be applied to condition the weld against becoming brittle and distorted, and to eliminate the need for subsequent stress relief.

The company has gained important benefits from stress relieving with the sub-resonant vibration process. Results are both predictable and verifiable. By eliminating intermediate heat-treating processes, the company is able to produce components faster and easier. **Bonal Technologies, Inc.**



*Thermal stress coming out of a top slide*

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