VIBRATORY Stress Relieving Equipment
Strel-Q VSR Equipment
Residual Stresses are stresses developed in the work piece because of welding, casting, forging or any other processing. The presence of residual stress in component can cause distortion. This distortion is the cause of dimensional instability. Sometimes this distortion is so severe that it may lead to total destruction of the component.
There are various methods of relieving residual stresses. The earlier techniques include hammering the work piece with a wooden mallet and dropping a casting or weld ment from a height to pile of sand. This probably set up vibrations which eliminated some of the residual stresses caused during casting or fabrication process. The more recent methods are ageing and annealing. These earlier methods of relieving stresses formed the first step towards what is known as vibratory stress relief.

- The vibratory stress relief process can be described as a 'method of applying controlled low amplitude, low frequency vibrations in metal components to obtain dimensional stability and control for machining tolerances'. It is an economical, fast and convenient method of reducing stresses and is used during process to achieve the dimensional stability.
• Stress relieving by any method is associated with the micro plastic deformation of atoms. This is achieved by injecting additional energy in the form of thermal or mechanical.

In case of thermal stress relieving, the residual stress value becomes higher than the yield stress value at relieving temperature. Hence the material will immediately undergo plastic deformation effecting reduction of residual stress value. Mechanically, the vibration energy is introduced into the work piece so that the applied stress is superimposed on the existing residual stress. The resultant stress value crosses the yield point of the material and will undergo plastic deformation effecting reduction of residual stress value. The energy injected should have sufficient magnitude to enable the stress atom to cross the yield point. This is achieved by injecting the vibration energy at natural frequency of the work piece.
The areas of application of VSR Include the following:-

- Dimensional stabilization after machining, welding, forming, casting, forging or any other operations.

- Avoidance of stress corrosion cracking through reduction of surface tensile stress.

- Overall Stress reduction.

- It is very difficult to show the immediate effect of VSR technique because it is not possible to measure the residual stress in a component unless some source of destructive test is used. Also it should be noted that total stress reduction is difficult to obtain using any commercial process. The relatively easy way to demonstrate the success of VSR is the improvement in the dimensional stability of a work piece, the process is applied there with positive results.

VSR Applications
• VSR causes no metallurgical changes and does not reduce yield strength, tensile or fatigue life as thermal Relive (TSR) Process.

• The equipment is simple, inexpensive and portable. Handling cost are minimized drastically by bringing the process to work piece.

• The operating cost are dramatically lower as very little power and time are consumed for the entire process as compared to TSR.

• The VSR process can be used on any size, shape and weight of work piece. No change in equipment is needed.

• No undesirable side effects, such as oxidation or scaling. The process is clean and generates no smoke, fumes or gases as in the case of thermal Process:

Advantages of VSR process
The VSR process is generally not effective on cold work, viz. in the case of cold rolled, drawn, spun or strained items. The process is also ineffective on nickel, aluminium and titanium alloy that have been strain hardened. Also it is ineffective on heat treatable alloys in the precipitation hardened conditions.

Limitations of VSR process
<table>
<thead>
<tr>
<th></th>
<th>Ageing</th>
<th>Thermal</th>
<th>Vibratory</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Principle</strong></td>
<td>Due to thermal expansion and contraction</td>
<td>Plastic deformation by injecting thermal energy.</td>
<td>Plastic deformation by injecting Vibration energy.</td>
</tr>
<tr>
<td><strong>Equipment</strong></td>
<td>None</td>
<td>Expensive, Large furnace</td>
<td>Considerably less expensive, VSR equipment.</td>
</tr>
<tr>
<td><strong>Area Of application</strong></td>
<td>All types of cast and fabricated components.</td>
<td>All types of cast and fabricated components.</td>
<td>Same as thermal but nor suitable for cold worked material</td>
</tr>
<tr>
<td><strong>Investment</strong></td>
<td>Large, Storage facility required</td>
<td>High, Furnace and material handling equipment required.</td>
<td>Low, Job handling saved. Equipment goes to work piece.</td>
</tr>
<tr>
<td><strong>Operating time</strong></td>
<td>1 to 2 years to complete the job</td>
<td>2 or more days to complete the job</td>
<td>30 to 45 minuets to the complete the job.</td>
</tr>
<tr>
<td><strong>Reliability</strong></td>
<td>Good</td>
<td>Very Good</td>
<td>As reliable as thermal</td>
</tr>
<tr>
<td><strong>Versatility</strong></td>
<td>Good</td>
<td>Limited by size of Furnace</td>
<td>Versatile, Can handle any shape, size and weight of jobs.</td>
</tr>
<tr>
<td><strong>Post Treatment</strong></td>
<td>Mechanical cleaning required</td>
<td>Mechanical cleaning required</td>
<td>No cleaning required.</td>
</tr>
<tr>
<td><strong>Effect on Mechanical Properties</strong></td>
<td>Slight due to corrosion</td>
<td>Tensile strength and yield strength changes.</td>
<td>No effect on mechanical properties.</td>
</tr>
</tbody>
</table>

Comparision of VSR processes
The conventional technique used to relieve residual stress is thermal treatment (annealing). But now vibration stress relieving technique continues a serious alternative to thermal stress relieving in many applications on the basis of cost, convenience and technical grounds.

Thermal treatment is chosen in order to improve the machinability of the metal, however, if the aim is to ensure the dimensional stability, vibratory treatment is the most effective method and can be widely applied to cast forged, welded or machined components.

It should be noted that the total stress reduction is difficult to obtain by using any commercial process. It is also very difficult to measure the residual stress value in a component unless some sort of destructive test is used. The relatively easy way to show the efficacy is in the improvement in the dimensional stability.

Comparison Conclussion
STREL-Q VSR Equipment
VSR Equipment models

VSR AT
Manual Version

VSR AF
Auto Version

STREL-Q VSR Equipment
<table>
<thead>
<tr>
<th></th>
<th>VSR AT</th>
<th>VSR AF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td>220 V, 1Ph. 50 Hz.</td>
<td>220 V, 1Ph. 50 Hz.</td>
</tr>
<tr>
<td>Capacity</td>
<td>1.5 KW</td>
<td>1.5 KW</td>
</tr>
<tr>
<td>Output Frequency</td>
<td>0 to 100 Hz. Variable (Step less)</td>
<td>0 to 100 Hz. Variable (Step less)</td>
</tr>
<tr>
<td>Indication (Digital)</td>
<td>Vibration Frequency: 0 to 99.9 Hz.</td>
<td>Vibration Frequency: 0 to 99.9 Hz.</td>
</tr>
<tr>
<td></td>
<td>Vibration Amplitude: 0 to 6000 microns</td>
<td>Vibration Amplitude: 0 to 6000 microns</td>
</tr>
<tr>
<td>Resonance Meter</td>
<td>Analog type</td>
<td>Analog type</td>
</tr>
<tr>
<td>Timer</td>
<td>0 to 99 minutes programmable</td>
<td>0 to 99 minutes programmable</td>
</tr>
<tr>
<td>Sensor</td>
<td>Piezoelectric, voltage output type with cable and magnetic base</td>
<td>Piezoelectric, voltage output type with cable and magnetic base</td>
</tr>
<tr>
<td>Chart Recorder</td>
<td>100 mm chart width to trace amplitude V/s time with three different chart speeds.</td>
<td>100 mm chart width to trace amplitude V/s time with three different chart speeds.</td>
</tr>
<tr>
<td>Interface/ Display</td>
<td>HMI interface for easy menu driven operations</td>
<td>HMI interface for easy menu driven operations</td>
</tr>
<tr>
<td>Mode Of Operation</td>
<td>Manual</td>
<td>Manual and Auto</td>
</tr>
<tr>
<td>Computer Connectivity</td>
<td>Not available</td>
<td>The Data can be stored in pen drive through USB port and can be transferred to computer. The Data are in csv format and can be opened using Excel. The graph of Amplitude v/s Frequency and Amplitude V/s Time can be generated and file can be saved for future reference</td>
</tr>
<tr>
<td>VSR AT</td>
<td>VSR AF</td>
<td></td>
</tr>
<tr>
<td>--------------------------------------------</td>
<td>---------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Suitable for manual search of resonance frequencies</td>
<td>Suitable for Auto search of resonance frequencies</td>
<td></td>
</tr>
<tr>
<td>Amplitude V/S time graph by chart recorder</td>
<td>Amplitude V/s Time graph by chart recorder. Amplitude V/s Frequency can be generated through Log Data in XLS format for getting job signature</td>
<td></td>
</tr>
<tr>
<td>Data logging not provided</td>
<td>Data logging provided in XLS format and can be taken to PC through pen drive</td>
<td></td>
</tr>
</tbody>
</table>

VSR Model Comparison
<table>
<thead>
<tr>
<th></th>
<th>VSR AT</th>
<th>VSR AF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Exciters available:</td>
<td>VSRE 05: Suitable for 500 kg of jobs upto 5 tons of job weight.</td>
<td>VSRE 05: Suitable for 500 kg of jobs upto 5 tons of job weight.</td>
</tr>
<tr>
<td></td>
<td>VSRE 20: Will be available as add on accessories at cost</td>
<td>VSRE 20: Suitable for 3 tons of job weight upto 20 tons of job weights.</td>
</tr>
<tr>
<td>Set of rubber isolators, set of big and small clamps available as standard accessories</td>
<td></td>
<td>Set of rubber isolators, set of big and small clamps available as standard accessories</td>
</tr>
<tr>
<td>Handling trolley would available as add on accessories at cost</td>
<td></td>
<td>Handling trolley with castor is provided. The Panel with all exciters, clamps and accessories are safely kept on the movable trolley.</td>
</tr>
</tbody>
</table>
Some of our reputed clients using VSR Equipment

- Flat Product Equipments (India) Ltd., Silvassa
- Meru Industries, Pune
- Singhal Power Presses Pvt. Ltd., Rajkot
- Sarkara Organic Ltd., Nasik
- Shaili Hi-Tek Pvt. Ltd., Margao, Goa
- Impact Machines, Faridabad
- Mas Equipments Pvt Ltd., New Delhi
- BHP Engineering, Gurgaon
- Magadh Precision Equipments Ltd., Dewas
- Nash Machines & Electronics Pvt. Ltd., Nasik
- Hari Machines Pvt Ltd., Rajnandgaon, Orissa
- Tata Motors, Pune
- Southern Railways, Chennai
- Sailes Machine Tools, Rajkot
- Bhilai Steel Plant, Bhilai
- HMT Ltd., Ajmer
- Precision Automations & Robotices India Ltd, Poona
- Joshi & Jampala Engineering, Satara
- Esmech Equipment Pvt. Ltd., Thane
- GDR Mektek Ltd., Bangalore
- Broadway Foundry Pvt. Ltd., Batala Punjab
- Jagdeep Foundry Pvt Ltd., Batala Punjab
- Starwire India Limited – Faridabad
- I I T Hyderabad
- Prayas Engineering Pvt Ltd. Elicon Group – Vallabh Vidyanagar
- Bekem Infra Projects Pvt Ltd., Hyderabad
- SPM India Ltd, Bangalore
- SPML Infra Ltd, Gurgaon
- CMI FPE Ltd., Taloja
- Shiv Engineering, Nasik
- Alstom India Limited, Shahabad
- Fouress Engineering Pvt Ltd, Aurangabad
- Teknic Bekal SDN BHD, Malaysia
- Machine Automation Joint Stock Company, Vietnam
Some of our reputed clients using VSR Services

- M/s Godrej & Boyce Manufacturing Co., Mumbai
- M/s Larsen and Toubro Ltd., Mumbai
- M/s Flat Products India Ltd, Taloja.
- M/s Morgan Construction Company Pvt. Ltd.,
- M/s Omkar Maharashtra Profile Industries Pvt. Ltd.
- M/s Electropneumatics & Hydraulics Pvt Ltd.,
- M/s Telco, Pimpri Pune
- M/s Elecon Gears Pvt Ltd., Vallabh Vidyanagar
- M/s Ruby Machine Tools, Mumbai
- M/s N.T. Strips and Automation, Bhayander, Thane
- M/s Niraj Metals and Alloys Pvt Ltd., Navi Mumbai
- M/s Sim Tools, a Voltas group, Thane
- M/s Essel Fabricators Pvt. Ltd., Thane
- M/s B. K. Engineering Pvt Ltd., Bhilai
- M/s Mukand Ltd, Thane
- M/s Immaculate Enterprise, Thane
- M/s Steel Weld, Mumbai
- M/s Sibi Machine Crafts, Thane
- M/s Swanand Engineers, Thane
- M/s Sri Ram Fabricators Pvt Ltd., Navi Mumbai
- M/s Vimal Crom Tech Pvt Ltd, Bhayander
- M/s Cobit Ltd., Nasik
- M/s Alstom Projects India Ltd, Baroda
- M/s Puzzolana Machinery Pvt. Ltd., Hyderabad
- M/s Asiatic Welders, Mumbai.
- M/s Conuco Machines India Pvt. Ltd., Pune
- M/s Fabwell Engineers, Thane
- M/s Jay Mechanical Pvt. Ltd., Ambernath
- M/s Math Brothers Engineers Pvt. Ltd., Thane
- M/s Samiri Equipments and Engineers Pvt. Ltd.,
- M/s Sumgo Engineering Industries Pvt. Ltd., Murbad
- M/s Techint Hypertherm Pvt. Ltd., Rabale
- M/s Bhilai Steel Plant, Bilhai
- M/s Jindal Saw Ltd., Mundra Kutch
- M/s Danieli India Ltd., Kolkata
- M/s Energo Engineering Projects Ltd., Coimbatore
- And many more ...
Fabricated job being treated
Heavy Fabricated job being treated
Heavy fabrication and shaft being treated
Railway shaft being treated
• **What is Stress?**

  For metallurgical purpose the stress can be defined as the force experienced between any parts of the body of continuous material. Normally they are in a state of equilibrium and balanced internally.

• **What is Residual Stress?**

  The Stresses in the body, which are not in the state of equilibrium and are not balanced internally, is known as the Residual Stress.

• **What is the effect of Residual Stress?**

  Residual Stress is the main cause of dimensional instability of the component. Hence they cause the premature failure of the component if not relieved or redistributed for equilibrium.

**Frequently Asked Questions**
• How the stress level is evaluated & weather we can know that the stresses have been relieved?

• Unfortunately there is no non-destructive technique available to indicate the Stress level. However, X ray defraction is the latest technique by which the effectiveness of the VSR is evaluated at CMTI, but again it is the destructive and the laboratory method. In Heat Treatment also no test is applied for the efficacy, and the procedure is blindly applied.

• How Reliable and effective VSR is?

• VSR is equally reliable as TSR for achieving the dimensional stability of the metal. It has been tested and proved at CMTI, a Govt. recognized research institute, India. However it is not the direct replacement to thermal treatment for annealing, hardening or any other treatment where metallurgical changes are required in the metal.
• **Weather this process is approved under any code or standard?**

• In India CMTI, National Physical Laboratory and other institutions recognize the process. Many large organizations have also accepted and use the VSR technique. The Republic of China has standardised the code for “The selection of the technical parameters and requirements for vibrating stress relief process.” The code is JB/T5926-91

• **How big jobs can be stress relieved by this process?**

• This method does not have any limitation by size, shape or weight of the Job. Large or heavy jobs are no problem but small jobs may need certain fixtures to be prepared to carry out the process.
• What should be the frequency and the duration of the vibration?

• Every component has its own natural frequency. To maximize the effect, the job should be vibrated to its natural frequency and its harmonics. The typical duration can be 10 minutes at a given frequency. Most jobs get stabilized when treated for 15 minutes each at two different harmonic frequencies.

• Weather the job can be treated at site?

• The VSR equipment is a portable machine and can be easily carried to the site. The job is to be isolated from the ground and then the process is applied at the site itself. Also almost all metals can be treated by VSR method except the precipitation hardenable materials and severely cold-formed materials. We carry out the job at your site for VSR treatment provided the quantum permits.

Frequently Asked Questions
Thank you for watching VSR Presentation

Contact us for more details:

FlexTool Equipment Pvt Ltd
35, Kanyakumari Shopping Centre,
Sir M. V. Road, Andheri East, Mumbai 400069
Phone: +91 22 26833189 / +91 22 28200559
Email: sales@vibrantindia.com
Web: www.vibrantindia.com