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STRESSTECH BULLETIN 10

Relief of Residual Stresses

Thermal and mechanical treatments are available to relieve the residual stresses.

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Thermal Treatments

The thermal treatments are generally a more common way to relieve the residual stresses than mechanical treatments. The thermal treatments usually do not induce any new residual stresses to balance the negative effects of existing residual stresses. Thermal treatments can be separated into two categories as preheating and post heating treatments.

- **Preheating:** Preheating is heating the component to increase its temperature to a higher degree than the room temperature and to a close degree to the process temperature. The degree of the temperature depends on the material and the process. Preheating can be made in a furnace, with an induction coil or with hot blast.

  If the temperature is lower than austenite formation range, the preheating treatment does not cause any dramatic changes in the microstructure. When the temperatures are too high, recrystallization might occur which changes the microstructure. High temperatures may also cause surface oxidation, especially in stainless steels, where corrosion is possible. The preheated material will have better thermal gradients which cause a more uniform cooling, but this may also cause a faster cooling rate which could soften the material.

- **Post heating:** Post heating is heating the component to a temperature level which is the same or higher than the preheating temperature.

  Post heating is a stress relieving operation which aims to redistribute the residual stresses. Post heating does not have a standard which can be applied to all materials. Post heating parameters depend on the material and the size of the component. The cooling rates are again important for stress relieving.

Mechanical Treatments

Mechanical treatments usually aim to induce new compressive residual stresses to balance the detrimental effects of existing tensile stresses. Mechanical treatments can be categorized into three different processes.

- **Peening processes:** Peening processes such as shot peening and laser peening are the most common and easy cold working processes to induce compressive residual stresses. During shot peening the surface of a component is peened with small spherical balls, called shots. The process induces plastic deformation on the surface, relieves surface tensile stresses and introduces beneficial compressive residual stresses. During laser peening process, the surface of the component is peened with shock waves at high speed and high power which causes plastic deformation by yielding the material.

- **Proof stressing:** As a stress reliving operation, proof stressing also plays a major role in testing of structural integrity. During this process, a uniform load is applied to the part to reduce the existing residual stress by balancing the distribution.

- **Vibratory stress relief:** During this process, the component is vibrated at its natural frequency for a period to relive the existing stresses. Vibratory stress relief process is mainly used for dimensional stability of welded parts.

To sum up

As we know by experience and well-established research studies, all manufacturing processes create some degree of residual stresses. The effect of these stresses could be imperceptible or they could cause severe problems. Relieving the residual stresses by above mentioned methods could help to reduce the negative effects of residual stresses. However, measuring and verifying the magnitude and sign of the residual stresses are still the best and the most common practices which industries have already established.

Stresstech is a research oriented company with more than 30 years' experience in residual stress engineering and stress evaluation. Feel free to contact us to learn more about measurement of residual stresses and their evaluation.

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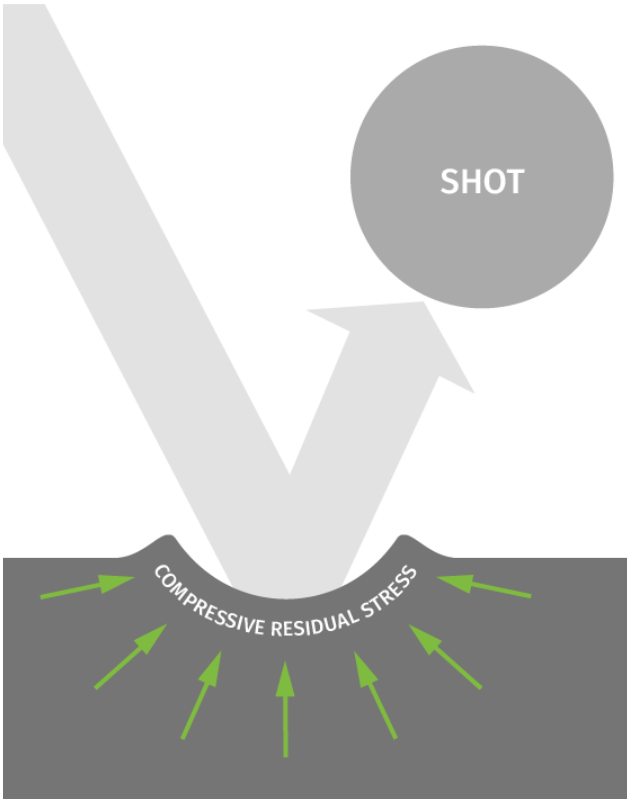

Sources

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