MetaLLife NEWS

Volume 5 Issue 1 **Compressive Stress Evaluations - Part 1** **February 1998**

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Lambda X-Ray Diffraction Curves
Metalife T-21 T-41 T-61 T-71 as a function of Depth
Milled H-13 (3" x .75" x .25") Specimens - Heat treat 44-46Rc

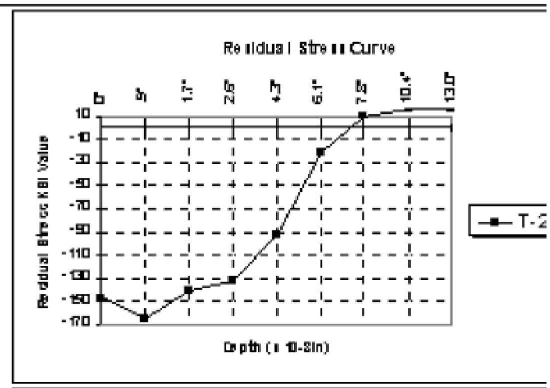
Our next few newsletters will discuss compressive stress and its benefits as they apply to die cast tooling coupled to a proactive preventative maintenance program. New testing is being done in this area by NADCA.

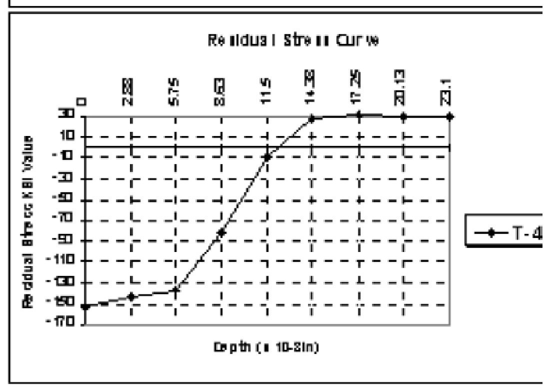
The curves shown here are actual data points using X-ray diffraction. Electro-polishing was used to obtain subsequent KSI readings at deeper levels in the material. Negative levels are compressive while positive values represent tension. The zero KSI value is where the material passes from a compressive to tension state. While material is in compression, cracks cannot propagate into or through this layer unless the yield strength of the material is exceeded. The manner in which we apply the Metalife process enables us to attain increases in yield strength in the magnitude of 30-40% after inducement of the compressive strength layer. For ultimate tool life and in an ideal world, tooling would always be in a compressive state. From our previous studies (Newsletter Volume 4 Issue 3), however, we learned that the normal die casting production cycle of rapid heating and cooling of a die causes tooling to cycle from a compressive to a tensile condition.

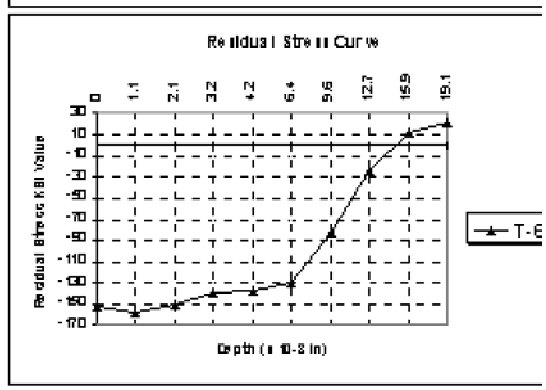
This cycling keeps repeating until the yield strength of the steel is exceeded at which point heat checking begins to occur. 207-90 Steel selection, proper heat treatment, along with lower spark density EDM procedures and white cast layer removal, help to reduce this irrefutable phenomena. Our unique compressive stress layer induced by Metalife is not only significant but has far more penetration depth than can be attained by any other conventional or competitive means. The depth of compression, as shown in the sidebar curves, can be controlled and is repeatable depending on the process used.

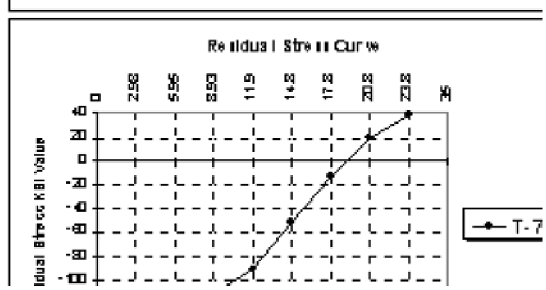
For instance, the T-21 curve shows shallow but high initial compression that crosses rapidly into tension at about .007" below the surface with a low 95 Ra finish (Newsletter Volume 5 Issue 1- Casting Finish). The T-41 produces a more sustained compressive KSI value that changes into tension at .012" below the surface with a surface finish value of 203Ra which is acceptable for most die casting applications. Next comes T-61 which remains in compression to approximately .015" while increasing only to a 207Ra value. Our two most popular processes are T-41 and T-61 for these reasons. For applications requiring a high degree of compressive stress and depending on allowable surface finish and accessibility, we apply T-71 with a compressive depth of about .019" and 296Ra. Sometimes combinations and variations of these are performed that take draft, casting shrinkage, desired surface finish, and other die cast criteria into consideration.

In our next issue we will continue our discussion of Metalife compressive









stress and begin an important discussion of a Residual Stress Test being conducted by NADCA through DOE funding with the goal of obtaining data regarding residual stress build-up in die cast tooling. None exists at present.

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