

Intensity Review

Definition of Intensity

Shot peening intensity is the measure of the energy of the shot stream—the energy of the shot stream is directly related to the compressive stress that is imparted into a component. It's one of the essential means of ensuring process control. (Intensity is one of four process controls. The other three are Media, Coverage and Equipment.)

How Intensity is Measured

Intensity is measured using Almen strips and an Almen gage. Almen strips are made of SAE1070 spring steel and are classified into three types based on thickness: A, N, and C. An Almen strip is peened on one side only. The residual compressive stress from the peening will cause the Almen strip to bend or arc towards the peened side. The degree of curvature is measured on an Almen gage as shown in Figure 1.

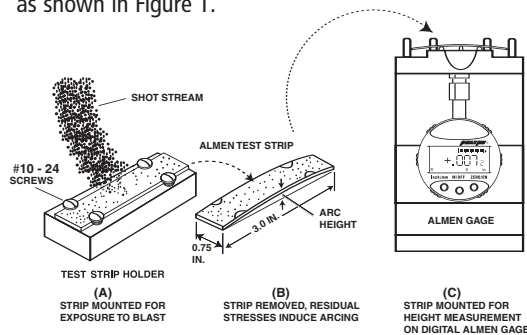


Figure 1. The Almen Strip System

The arc height, as measured by an Almen gage, is the "intensity." The proper designation for intensity is the arc height followed by the Almen strip used. For example: The proper intensity designation for a 0.012" (0.30 mm) arc height using the A strip is 0.012A (0.30A). Often, this is simplified to 12A.

Intensity Verification

Verification of the requested intensity requires the establishment of an intensity saturation curve (graphical plot of arc height versus peening time or other time-based parameter). The saturation curve is plotted with a minimum of four Almen strip arc height readings that were peened with fixed machine settings. Plotting arc heights manually is laborious and often inaccurate. Fortunately, it's also outdated. Illustrated in Figure 2 is the Curve Solver program developed by Dr. David Kirk. Enter the arc height readings from an Almen gage for at least four peened Almen strips into the program and it will compute the saturation point intensity. Figure 2 shows that doubling of the time (2T) from the initial peening time (T) resulted in less than a 10% increase in Almen arc height. This is called the "10% rule" and it means that the process reaches saturation at "T." Saturation establishes the actual intensity of the shot

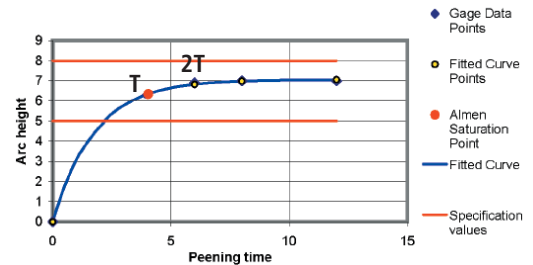


Figure 2. The Curve Solver tabulates the saturation curve. It's free from www.shotpeener.com.

stream at a given location for a particular machine setup. If the intensity is not within the requested tolerance band, then machine adjustments must be made and a new saturation curve generated. Periodic tests, at about every eight hours of operation, should be performed to confirm consistent peening intensity. Since preparation of a saturation curve is time-consuming, a simpler method for verification during periodic testing has been adopted. Simply run one Almen strip for the same peening time "T" that was derived from the saturation curve. Using the example above, the strip would be peened for 4.8 minutes. Any arc height within the range of .005 to .008 would be acceptable for the verification test.

A new saturation curve is required if a new part or setup (a change in machine settings or media) is employed. Read the "Intensity Investigation" article on page 6 to see how the machine and media affect intensity.

Saturation versus Coverage

By far, the concepts of saturation time and coverage cause the most confusion for new and experienced shot peening personnel. First, a definition of coverage: Coverage is the measure of the original surface area that has been obliterated by shot peening dents. If the goal is "100% coverage", the length of machine cycle time to achieve 100% coverage will differ based on the hardness of the material to be peened. Looking at Figure 2, it's easy to see why people get confused about the proper machine cycle time. According to this chart, the saturation point for the arc height (intensity) was achieved at around 4.8 minutes of peening time. Do not dwell on this number. Peening time is not the machine cycle time, it's only a graphical tool to establish intensity. Do NOT use it for determining machine cycle time for full coverage.

Intensity is controlled by the machine and media factors that influence the energy of the shot stream. Coverage is controlled by machine cycle time. Saturation intensity and coverage will not necessarily occur at the same time but that is okay. ●

Additional Study Tools

This review is a very elementary discussion on intensity. If you are interested in learning more about shot peening process controls, attend an Electronics Inc. Education Division workshop or schedule on-site training. Contact EI at 1-800-832-5653 or (574)256-5001.