Coverage Determination on HSLA 4340 Steel

How can I determine the coverage on HSLA 4340M steel? Is there a coefficient to relate the coverage of the Almen strip to the coverage of HSLA 4340M steel?

My name is Willem Hamer and I just started as an engineer at KLM Royal Dutch Airlines. I am doing an experimental research on how the different processing steps of HSLA 4340M steel are affecting the Barkhausen Noise Analysis. One of the processing steps is shot peening, which I am doing together with Marcel van Wonderen. During the first set of shot peen experiments I encountered that it is very hard to determine the coverage on HSLA 4340M steel. I tried to get an indication of the coverage by eye and by microscope, but both did not really work.

Could someone give me some advice about how I can determine the coverage on HSLA steel or how I can relate the Almen strip coverage with the coverage of HSLA steel? Or is it common to use the coverage of the Almen strips as indication for HSLA 4340M steel (which in theory is not very accurate due to the different sizes of indent area)?

Stemo Jayson • Hi Willem. Without going down the theoretical/academic road—when peening to the standard aerospace shot peening standard of AMS 2430, one can evaluate coverage primarily by the 10x method or by Peenscan.

The 10x method consist of looking at the dimpling under 10 times magnification. Once the surface is completely dimpled, the part has complete (100%) coverage.

The other method, using Peenscan, consists of placing a florescent die onto the part. Once the Peenscan is dry, it will be peened away. If it is completely gone, one would have 100% coverage. This is verified by looking at the part under a black light.

Walter Beach • This is a known problem throughout the peening industry so don't feel bad. We are working to address this in AMS 2430 and SAE J2277.

You will at a minimum have to use magnification higher than 10x, I would suggest 30x.

Tracer dye is a good tool of seeing if you are peening the entire part but there really is no substitute for visual inspection. On a hard material a somewhat larger diameter of tracer is removed then the diameter of the peening media itself. Because of this, complete removal of the tracer does not mean you have full coverage. I would suggest you establish your saturation curve(s) then examine the test strips for coverage at the saturation point, generally they will not quite be 100% covered at this point nor should they be. Now walk up your peening time to establish 100% on the test strips. Once done, then peen the part to double that time and inspect at 30x for full coverage you should be there or at least very close.

Jack Champaigne • Peening tracer is a good tool for targeting but you must be very careful if you rely upon it for degree of coverage. In our classes we teach the rule that if the tracer is gone the you must have a dent (needs to be verified) and also if you have a dent then the tracer must be gone. Peening tracer has a laquer type of composition which hardens on the surface upon drying. You fracture this laquer and it gets removed from the surface. A large amount of broken media in the machine can result in scratching the surface and removing tracer but not leaving the dents you expected to get.

You should consider making some test coupons of same material as your target and then submit them to your blast stream to ascertain proper blast exposure time. If you have a test fixture fitted with Almen blocks then you might make your test coupons the same size as standard Almen strips and attach them to your fixture. This is nice since you can learn the coverage performance at various locations on your fixture. You might discover that the time required to get the slowest developing strip covered that the earliest strip receives very high coverage, perhaps 200% or even higher. This may, or many not, be detrimental depending upon the characteristics of your target material.

Erland Nordin • You might measure the surface with a confocal microscope which will get you a 3D image of the surface and where the height deflection is magnified so the topography is more easy to see. You can't measure the whole surface though. It must be samples at chosen points.

"The discussion at The Shot Peening World is very interesting and as a new graduate, LinkedIn and the discussion groups are a perfect way to learn about this process and meet new people who are passionate about their profession."

Willem Hamer
Engineer, Royal Dutch Airlines KLM