Q & A

THE Q & A FORUM at www.shotpeener.com is the ideal place to get advice on a wide range of topics from industry leaders and colleagues from around the world that have tackled and solved your challenges.

You don't need to register to browse the forum. If you would like to post or respond to a post, however, you do need to register and it's very simple. The following are a sampling of the forum's posts. Maybe you will find an answer here to an issue you're facing.

Tolerances of Holes After Shot Peening

Questioner: We have an issue with some holes which are too large after shot peening.

We do shot peening with an intensity of 0.007A inch on titanium parts. Some of the holes (38.1-38.125 mm) have to be shot peened.

We have seen that after they come back from the shot peening operation (done externally), and after a flash etch in nitric acid as decontamination (0-2.5 Âµm taken off), that the shot-peened holes are way out of tolerance (15 and 41Âµm to be precise).

When shot peening these holes:

- How much deformation can we attribute to the shot peening? I know the compressive residual stress depth can be up to 200 Âµm, but how much would this be visible in the measurement after shot peening? Is it possible to be 41Âµm out of tolerance due to the shot peening alone or do we have to look elsewhere?
- After machining the dimensional control was okay. After machining we do a first etch before penetrant testing. We have measured these holes as well after the first etch, and they were still within tolerance. After, the part is sent to the shot peener. We will measure the holes again when the part returns shot peened (before the decontamination which is done in-house).
- Is it possible at all to take the deformation of the shot peening into account when machining such tight tolerances?

It's a very interesting, yet complicated matter!

Answerer #1: Is it possible at all to take the deformation of the shot peening into account when machining such tight tolerances?"

This is done all the time when parts are sent to us for shot peen. You need to determine which process is changing the hole size (peening or cleaning), not always but most of the time peened holes get smaller not larger. Is it possible the holes could be being peened well beyond 100% coverage? If so, this would likely be the cause. I would suggest manufacturing one part and measuring it to sure it's within tolerance:

1) Then send it to the shot peen source for peening. However, DO NOT perform acid cleaning yet.
2) Once peening is complete re-measure the part.
3) If the part is within tolerance return the part for acid cleaning then measure again.
4) If the part is NOT within tolerance after peening then adjust your pre-peen dimension accordingly to factor in the changes caused by peening.
5) Manufacture another part with the new pre-peen dimensions then repeat the steps above.

Hope that helps.

Questioner: Thanks for the great reply. We were planning on doing these measurements.

As we don't do the shot peening in-house we don't actually know what they are doing. I will ask for the saturation curves.

The drawing asks for a coverage of 2.0, what they actually apply is unknown for the moment for me. Could this be the cause of being out of dimension (hole becoming too big)?

We will need to analyze further, but knowing we might have to look at their coverage would already help us a great deal.

Answerer #1: One other thing to check. Are you sure the diameter of these holes are a post-peening requirement? Often dimensions are prior to peen, and the designer realizes there will be some dimensional changes. If you tell me what specification you are working to perhaps I could help more.

Questioner: That's also something I've been looking at and will further look into. Spec is Bac5730.

For those interested: we have done an analysis on six parts. Though lots of questions remain, we have seen that the shot peening decreases the hole diameter for these parts.

What we do see is that the diameter change is not consistent. For the same program and part, we can have a difference of up to 11Âµm in diameter change purely because of shot peening (some parts show a 2 Âµm decrease of diameter, others 13, for the same part number, diameter and shot peen program!).

We are also looking at the etching bath, but there the differences are less pronounced. Still analyzing all the available data, but I'm sure we will get there!

Answerer #2: Thank you for the report. Curious about your results showing the difference in resulting diameter. You stated that it's the same part and the same diameter, but is it the same hole?

If in different locations, the amount of pre-peening stress may be different and cause varying amounts of resistance to deformation.

I am curious about your continued trials.

Questioner: Of the six parts, two are always the same PN. They were sent out together for shot peening (one of the problems: black box, we don't know what our subcontractor is doing and with COVID we can't visit them).

We see for example for the same hole on the same PN (but different part):
part 1 : -5Âµm diameter change because of shot peening
part 2: -16Âµm diameter change because of shot peening

The other PN are very similar (minor thickness change of non-holes), and there it's not consistent either. With tight tolerances, such big difference after shot peening between parts is difficult, as we don't know how to adapt our machining to take into account the shot peening.

Answerer #1: Something else to consider. In your original post you stated the intensity is .007A. Boeing generally allows a wide tolerance range. -0.002 to +0.005. So the allowed range would be .005-.011A. You might want to find out what the "intensity" is of the process. If it's at the high end of the range target the process to the lower limit. Perhaps impose your own tighter limit say .005-.008 A. If that doesn't work, you may want to peen the parts a second time at a substantially lower intensity but cutting the air pressure 50%. This will help to knock down the "high points" of the peening dimples. I suspect when you're measuring your picking up these points.

Think of it as a peak of a wave but not the level of the sea.

Questioner: I wanted to give a short update:
In the meantime we have analyzed around 12 parts and 192 holes at each operation (after machining - after first etch - after shot peening - after 2nd etch).

What we see now is that the shot-peened holes get a little bit smaller (around 5Âµm) because of the shot peening, but this is almost always cancelled out with the 2nd etch (increase in diameter with 5Âµm).

Now we always end up with diameters which are too small, so where the problem was on the first parts, we don't know. I'm suspecting the first etch process, but this is only speculation.

We will in the future probably soon adapt our machining program and keep analyzing for X parts like this to assure our changes are giving us the desired diameters.