RFM
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Surface Finish & Process Control

Surface finish has historically been an indicator of process stability. As such, it has been monitored for just such a purpose. If something in the machining process is about to go haywire, surface finish is one of the first places in the process that will reflect the change.

Since surface finish is a fairly stable condition and can be predictable in that when the materials, cutting tools, speeds and feeds, and coolant, are known, a certain surface finish can be expected and determined by design and manufacturing engineers. Therefore, in the data collection and evaluation of your process control measures, it would be in your best interest to include surface finish analysis of critical dimensions in the process control plan.

Surface finish will be an indicator of problems that are about to occur due to such things as tool wear, unauthorized machine adjustments in speeds and feeds of the cutting tools, changes due to wide temperature fluctuations, coolant failure, etc. Surface finish is an indicator of the ***texture*** of the part features surface. Texture can be further broken down into its component parts of ***roughness***, ***waviness***, and ***form***.

Roughness essentially describes the tool marks left in the wake of a machining pass. These are affected by speeds and feeds and the type of cutting tool used. Each pass of the cutter leaves some kind of indication of its passing and the marring of that surface is described as the roughness.

Waviness is the result of minute fluctuations in the distance between the cutting tool and the surface of the work-piece during machining. These are caused by cutting tool instability and by vibration. This vibration may be caused by various things such as tow motors passing by, other machines in the vicinity operating, attempting to remove too much material at a time, etc.

Form errors are most often due to a lack of flatness or straightness in the machine tool ways. This is repeatable from part to part because the machine irregularity will always follow the same paths transferring this form error to the machined part.

What frequently occurs is that there may exist all three or combinations of these types of surface finish components present simultaneously. The evaluation process suggests that each of these conditions be addressed one at a time. Some assumptions must be made to tackle each of the conditions. Roughness has a shorter wavelength than waviness, and waviness has a shorter wavelength than form error. Note the following:

Roughness = wavelength < 0.030"
Waviness = wavelength = 0.030 to 0.300
Form error = wavelength > 0.300

These values are determined through the use of measuring devices such as a profilometer. These instruments separate surface finish components by adjusting the cut-off lengths of the measurements. They work similar to a phonograph stylus by translating the peaks and valleys magnitude of the surface into a measurement in millionths of an inch. The machine has various filtering devices built into its design that permit the operator to choose the cutoff length in order to isolate roughness, waviness, and form or "total profile" which combines all three in the reading.

So, if you would like to get a heads up warning on your process controls, monitoring surface finish may give you just the head start you need to ward off problems before they actually become a major issue.