ROBEN MANUFACTURING, INC.
Setting Standards For Quality
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Law of Reflection

by Larry Schillings

In our industry there is much confusion, misunderstanding and a wide variety of positions regarding the subject of "Surface Finishes" as it relates to vessel fabrication and performance after delivery and installation.

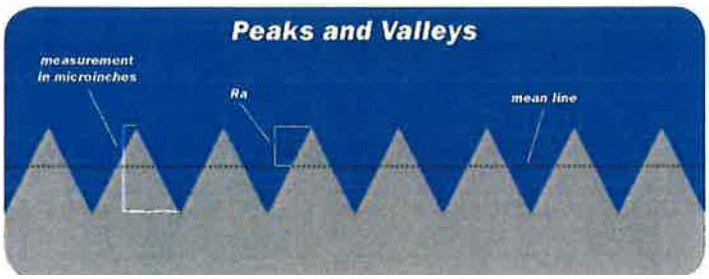
BASIC LAW OF REFLECTION

All metal surfaces have a profile consisting of peaks and valleys. If the peaks and valleys have a large vertical distance between them, light will enter the valley and not bounce or reflect back. This set of circumstances produces a relative "dull" surface.

Surface finish enhancement by means of metal removal generally accomplished by utilizing abrasives on belts, grinding wheels and other media, changes the profile of the surface finish.

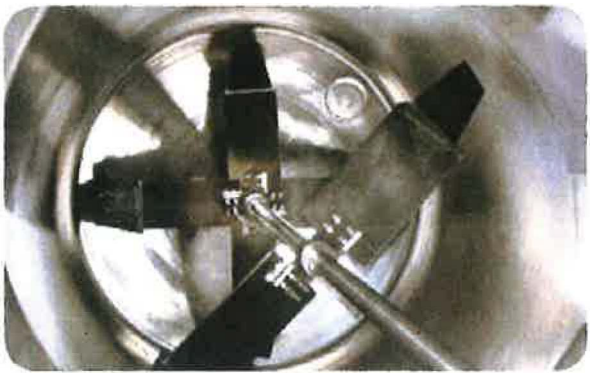
During the surface enhancement process, the vertical distance between the peaks and valleys is minimized and/or reduced allowing for degrees of greater bounce back or reflection producing a brighter surface finish. The closer the peak distance is to the valley and the greater uniformity of the finite scratches, the higher the reflectance resulting in a brighter surface.

Surface profile or finish is measured in microinches. A microinch is 1/1,000,000 of one inch. Surface profile is measured by evaluating the distance above and below an established "mean line". Historically, microinch measuring has utilized (2) processes:



Ra - Roughness Average is an absolute average height whereby you establish a mean line and a number of height samples i.e. H1, H2, H3 etc. above and below the line

H1 +H2 + H3etc. = Ra N (number of samples)



RMS - Is a value calculated from taking the square root of all (H) samples divided by the number of samples. RMS numbers usually run 11% to 25% higher than the Ra numbers for the same surface profile. Ra has become the industry standard and should be measured in microinches rather than microns.

Surface profile can only be measured by a PROFILOMETER. It has a stylus probe that when calibrated properly, runs across the grain of the surface and provides a digital readout of the surface profile or finish.

Grit is sand like particles utilized as an abrasive in the metal industry for surface enhancement. The most commonly used grit is an artificial aluminum oxide which is a sharp, hard and fast cutting product.

Grits are given grades or numbers relative to their roughness. Standard grades are:

- 80 Grit	- 120 Grit	- 150 Grit
- 180 Grit	- 240 Grit	- 320 Grit

People in our industry regularly spell out surface finish requirements as standard grit grades i.e. 120 Grit, 180 Grit, etc. This is not the proper way to identify an end result because a.) grit is a product or tool utilized in removing metal, results will vary relative to a variety of variables, b.) grit cannot be measured. How would you know if a fabricator polished your vessel to a 180 grit finish?

Surface finish requirements must be specified to an Ra or RMS which is a profile that can be measured utilizing the profilometer. I recommend to our customers that you establish a range such as 20 to 30 Ra or a "not to exceed" such as not to exceed 20 Ra to pinpoint your measurable requirements.

Electropolishing

By Larry Schillings

Electropolishing is a surface enhancement procedure that produces a smooth, bright finish by leveling or rounding off both the peaks and the valleys in a process similar to electroplating except material is removed rather than deposited.

Utilizing an electrolyte subjected to a low voltage electric current, surface roughness is removed by anodic dissolution resulting in an extremely smooth finish.

Vessel surfaces are usually mechanically polished to a 20 to 30 Ra followed by Electropolishing which greatly improves anti-cling and sterility characteristics.

In closing, the surface enhancement of Nickel Alloy Fermenters, Reactors, Tanks and Vessels is accomplished by utilizing grit abrasives on belts, grinding wheels and other media in an effort to smooth out the surface profile, minimizing scratches, pits and other defects.

End users of our process equipment specify surface enhancement most usually for the following four reasons:

1. Improvement of anti-cling characteristics.
2. Improvement of sanitary characteristics.
3. Improvement of resistance to corrosion characteristics.
4. Improved appearance.

All of these "value added" options increase front end costs but produce a return on investment over the life time of the vessel.

Roben looks forward to working with you on identifying solutions to satisfy your vessel surface enhancement requirements. Please feel free to contact us with any of your vessel questions and/or concerns.

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