Diamond Brite Metals

A DIVISION OF COMANCHE STAINLESS, LLC COMANCHE STAINLESS

RA FINISHES ON STAINLESS STEEL

RA Finishes are measurable surface finishes popular with customers and Original Equipment Manufacturers ("OEMs") in commercial industries such as pharmaceutical, food and beverage, dairy, process systems, nuclear, and oil and gas. The measurability of RA Finishes ameliorates any ambiguity as to surface finish thereby ensuring quality control from vendor to customer.

I. Introduction

A Roughness Average ("RA") finish is a mechanically measured surface finish imparted on stainless steel. RA finishes ensure the measurable consistency of a surface's finish. ASME B46.1 defines RA as "the roughness average of a surface. It is measured by taking the average deviation of a surface's microscopic peaks and valleys from an imaginary centerline." A higher RA correlates to more pronounced peaks and valleys (i.e. a higher deviation from the centerline), designating a rougher surface; whereas, a lower RA correlates to more compact peaks and valleys (i.e. a lower deviation from the centerline), designating a smoother surface.[1]

Commercially, RA finishes obviate the subjectivity of accepted industry standard finishes such as No. 4 finishes and No. 6 finishes. These industry standard finishes cover a wide range of accepted surface roughness due to the varying grit ranges used to impart them. Since RA finishes are objective, there is less risk of subjective industry practices and interpretations interfering with an end-users desired surface finish. Simply put, RA finishes give you the most accurate finish possible.

This white paper aims at marrying the scientific nuances of RA finishes, which are more appropriate for the realms of engineering, with the commercial practices of service centers, metal fabricators, and OEMs involved with stainless steel. The ultimate goal of this white paper is to create a basic guide for understanding RA finishes and to set an accepted standard for the above industries. A scientific, but commercially tailored, standard for RA finishes will allow service centers and end-users to communicate effectively and efficiently about RA finishes while eliminating the potential for waste and disconnect.

II. Benefits and Drawbacks of RA Finishes

RA finishes are mechanically measurable and certifiable. Industry finishes are subjective and may include varying grit ranges for a single finish designation. For example, a No. 4 finish covers grit finishes ranging from 60 grit to 220 grit which provides substantial room for customer and vendor disconnect and potential error whereas a 32 RA finish, the accepted equivalent of higher range No. 4 finish, is a single, repeatable measurement that can be mechanically confirmed. An RA finish designation ensures that supplier, customer, and end-user are discussing and expecting the same surface finish.

End-users and OEMs in industries that require substantial Quality Control/Quality Assurance ("QC/QA") favor RA finishes because they are repeatable and certifiable. A RA designation or

[1] When achieving a RA finish using abrasive belts, a coarser grit (i.e. 24, 60 grit, etc.) will produce more depth between imparted grit lines, which will result in more pronounced peaks and valleys and a higher RA whereas a finer grit (i.e. 320, 600 grit) will produce less depth between impaired grit lines, which will result in more compact peaks and valleys and a lower RA.

specification can be easily tracked throughout the supply-chain. This ensures consistency from vendor to customer to end-user.

RA finishes are labor-intensive and require a different polishing process than accepted industry finishes. Additionally, RA finishes require stricter QC/QA scrutiny which not only increases labor costs but also slows production time. Prices for RA finishes are approximately twenty-five (25) to thirty-five (35) percent higher than industry finish prices. It is important for customers and vendors to discuss whether an RA is required, or an industry finish is acceptable to avoid unnecessary delays and costs.

BENEFITS AND DRAWBACKS OF RA FINISHES	
Benefits	Drawbacks
• Measurable & Certifiable • Stricter QC/QA • Consistency Between Vendor & Supplier	• Higher Cost • Labor Intensive • Longer Lead Times

III. The Polishing Process

The polishing process to achieve an RA finish on stainless steel is similar to the process used to impart industry finishes. Successive abrasive belts, in finer grit sizes, mechanically abrade the surface of the stainless product with each increasing grit imparting a finer finish, resulting in a smoother surface finish. When polishing to a RA finish, however, it is critical that the underlying grit from the previous abrasive belt is completely removed by the successive belt otherwise a measurement may produce an erroneous reading where the underlying, rougher grit is measured as opposed to the overlaid grit. More "passes" with the successive abrasive belt removes the underlying grit. An industry finish does not require these additional "passes" even though the aesthetic appearance of an RA finish with additional "passes" and an industry finish without additional "passes" is identical. Knowing whether an RA finish or an industry finish is required is critical because the polishing processes are different. Additionally, the different processes, as will be explained in Section IV, do not allow a customer or vendor to confirm an industry finish grit with a corresponding RA finish since the RA finish and the industry finish are achieved by different procedures.

IV. Measuring Procedure for RA Finishes

RA finishes can be mechanically measured and are certifiable. A mechanical device known as a profilometer uses a stylus to measure the surface roughness of a product. The stylus travels across an imaginary centerline of the measured portion marking the deviations of the microscopic peaks and valleys and returning the measured RA calculation.

ISO 4288 Annex A standardizes the procedure for measuring the RA of a stainless steel product. The procedures vary depending on the RA designation required by the customer. A customer may

request a certain RA (ex. 32 RA) or less than a certain RA (ex. <32 RA). A customer may also request a "max" RA (ex. 32 RA Max). Different measuring procedures apply to each requirement or "call-out."

A. *The 16% Rule*

When a customer requires a certain RA (ex. 32 RA) or less than a certain RA (ex. <32 RA) ISO 4288 Annex A requires measurement be conducted according to the 16% Rule. Five (5) measurements must be taken along the product with the average of the five measurements being less than or equal to the required RA. 16% of the individual measurements may exceed the limit as long as the average is less than or equal to the required RA.

A product may also comply with the required RA if the following procedure is taken:

1. If the first measurement taken is less than seventy (70) percent of the required RA, the stainless steel product complies with the required RA.
2. If the first measurement is not less than seventy (70) percent of the required RA, two (2) additional measurements should be taken along the product. If the three (3) measurements are less than or equal to the required RA, the stainless steel product complies with the required RA.
3. If the above conditions are not met, nine (9) additional measurements should be taken where no more than two (2) of the measured values may exceed the required RA for the stainless steel product to comply with the RA designation.

B. *The Max Rule*

A customer may also request an RA finish requiring stricter scrutiny in polishing and measuring by using the suffix "Max." Five (5) measurements must be taken along the product with the average of the five measurements being less than or equal to the required RA. **None of the five measurements may exceed the required RA.**

All measurements should be recorded on documentation that will accompany the stainless steel products throughout the supply chain. Additionally, QC/QA may require the readings to be affixed to the stainless steel product itself. Additional requirements should be discussed at time of order.

V. Effects of Material Defects on RA Measurements

The production of satisfactory RA finishes depends, in part, on the quality of the stainless steel used in the polishing process. Stainless steel with deep surface imperfections such as gouges and pitting, even when polished with significant abrasives, may still produce higher than expected RAs at the surface imperfection positions due to the profilometer erroneously reading the surface imperfection. The unevenness of flat rolled products and the lack of concentricity in long products,

such as pipe and tube, may result in an inconsistent finish which may result in unsatisfactory RA readings

ISO 4288 Annex A anticipates the possibility that material imperfections may jeopardize RA finishes by establishing tolerances for measurement of the RA finish. Even though RA finishes are objective measurements, there still exists a tolerance for what is acceptable in measuring and recording an RA finish as was seen in Section IV.

VI. CONCLUSION

RA finishes are valuable for industries and end-uses that demand a stricter QC/QA for surface finishes because RA finishes are measurable and certifiable. Commercially RA finishes are valuable since they obviate the subjectivity that is often found in industry finishes. RA call-outs incur higher costs and longer lead times so customer and vendor must coordinate whether an RA finish or an industry finish is acceptable. The costs and labor for an RA finish must be weighed against the necessity of such a scrutinizing surface finish. As with all vendor-client relationships, open dialogue and established expectations prior to processing and polishing are paramount when deciding if an RA finish is right for the order.

About the Author

Colton T. Karpus, Esq., MBA is the Chief Executive Officer of Comanche Stainless, LLC, an integrated service center with a focus on metals polishing and finishing. Within the Comanche Stainless portfolio are Diamond Brite Metals, an architectural and commercial metals polisher, located in Middlesex, New Jersey and Accurate Cutting Services, a large bed CNC controlled waterjet cutting shop, located in Roselle, New Jersey.

Author Contact Information

Colton T. Karpus, Esq., MBA
Comanche Stainless, LLC | Diamond Brite Metals | Accurate Cutting Services
333 Cedar Avenue, Middlesex, New Jersey 08846
Tel: (732) 564-1164
Email: ckarpus@diamondbritemetals.com & ckarpus@comanchestainless.com
Web: www.diamondbritemetals.com | www.comanchestainless.com