



SURFACE VEHICLE RECOMMENDED PRACTICE

J911™

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Surface Texture, Roughness (R_a), Peak Count(P_c), and Mean Profile Spacing, (R_{sm})
Measurement of Metallic Coated and Uncoated Steel Sheet/Strip to be
Formed and/or to be Painted

RATIONALE

The industry needs to update the spec to reflect use of zinc and aluminized coated steels. New non contact methods of measurement are also being used which are now applicable to the measurement methods employed. A number of new parameters that are being investigated to further quantify surface texture and the impact on steel performance in the auto industry may also need to be added to this document.

1. SCOPE

- 1.1 This SAE Recommended Practice describes a method for measuring Roughness Average (R_a) and Peak Count (PC) and other variables of the surface of metallic coated and uncoated steel sheet/strip.
- 1.2 The method includes a system for equipment configuration, calibration, and procedures for determining average surface roughness, R_a (μm), average peak count, PC (peaks per cm) and mean profile spacing, R_{sm} on metallic coated and uncoated steel sheet/strip surfaces.

This specification is based on metric measurements, English measurements are approximations only

2. REFERENCES

2.1 Applicable Document

The following publication forms a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 ASME Publication

Available from ASME, P.O. Box 2900, 22 Law Drive, Fairfield, NJ 07007-2900, Tel: 800-843-2763 (U.S./Canada), 001-800-843-2763 (Mexico), 973-882-1170 (outside North America), www.asme.org.

ASME B46.1-2009 Surface Texture

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3. DEFINITIONS

3.1 STYLUS PROFILOMETER:

The stylus profilometer is a device which scans a surface with a diamond tip to measure the surface texture. The stylus tip geometry and other aspects of the instrumentation limit the shortest spatial wavelength that can be measured (typically about 1 μm). The length of travel of the stylus and other aspects of the instrumentation limit the longest spatial wavelength that can be measured (typically about 25 mm).

3.2 TRAVERSING LENGTH:

The full length over which the stylus profilometer is scanned along the surface.

3.3 EVALUATION LENGTH:

The length contained within and typically shorter than the traversing length over which the evaluation of the surface texture parameters is performed

3.4 BEST FIT MEAN LINE:

A line that defines the nominal profile so that within the Evaluation Length the sum of the squares of the difference between the profile and this line are minimized.

3.5 SPATIAL WAVELENGTH CONTENT:

The surface texture profile may be considered as being composed of a spectrum of sinusoidal components each with a given wavelength and amplitude. The measurement of the surface texture typically returns a wide bandwidth (e.g., 1 μm – 15 mm) of spatial wavelength components. The various spatial wavelength components may affect different functional characteristics of the texture. For example, relatively shorter wavelength structures (e.g., < 0.8 mm) may be related to the material formability performance. However, longer wavelength structures (e.g., >1.0 mm) may better correlate with paint appearance.

3.6 ROUGHNESS LONG-WAVELENGTH CUTOFF, λ_c :

The Roughness Long Wavelength Cutoff establishes the lengths of spatial features which are attenuated prior to analysis of the various surface roughness parameters. Based on the use of the default Gaussian filter as described in ASME B46.1-2009, the amplitude of the spatial wavelength components at λ_c are attenuated by 50% before roughness parameter determination. The amplitude of spatial wavelength components greater than λ_c are further attenuated such that spatial wavelength components greater than $2\lambda_c$ provide minimal contribution to the evaluation of the various roughness texture parameters.

3.7 ROUGHNESS SHORT-WAVELENGTH CUTOFF, λ_s :

The Roughness Short Wavelength Cutoff establishes the lengths of spatial features which are attenuated prior to analysis of the various surface roughness parameters. Based on the use of the default Gaussian filter as described in ASME B46.1-2009, the amplitude of the spatial wavelength components at λ_s are attenuated by 50% before roughness parameter determination. The amplitude of spatial wavelength components less than λ_s are further attenuated such that spatial wavelength components less than $0.5\lambda_s$ provide minimal contribution to the evaluation of the various roughness texture parameters.

3.8 SAMPLING LENGTH

The evaluation length is subdivided into shorter segments prior to analysis defined to be the Sampling Length. The length of these segments is typically equal to the Roughness Long-Wavelength Cutoff, λ_c . A measurement of the surface texture profile may be made over many contiguous sampling lengths. Typically 5 sampling lengths or more are used for analysis per stylus trace.

3.9 ANALYSIS SPATIAL WAVELENGTH BANDWIDTH

The Analysis Spatial Wavelength Bandwidth consists of the spatial wavelength components greater than the Roughness Short-Wavelength Cutoff, λ_s and less than the Roughness Long-Wavelength cutoff λ_c .

3.10 ROUGHNESS AVERAGE, R_a :

The arithmetic average of the absolute values of the profile height deviations recorded within the evaluation length and measured from the mean line (Figure 1).

3.11 PEAK COUNT

The peak count (PC) is the number of peaks per unit length (peaks/cm or peaks/in).

3.12 MEAN PROFILE SPACING, R_{sm} :

The mean value of the spacing between texture profile crossings of the mean line. As specified in ASME B46.1 2009 the evaluation of R_{sm} involves default profile feature height discrimination and default spacing discrimination that are adopted for this measurement protocol (Figure 2). R_{sm} is evaluated over the total evaluation length.

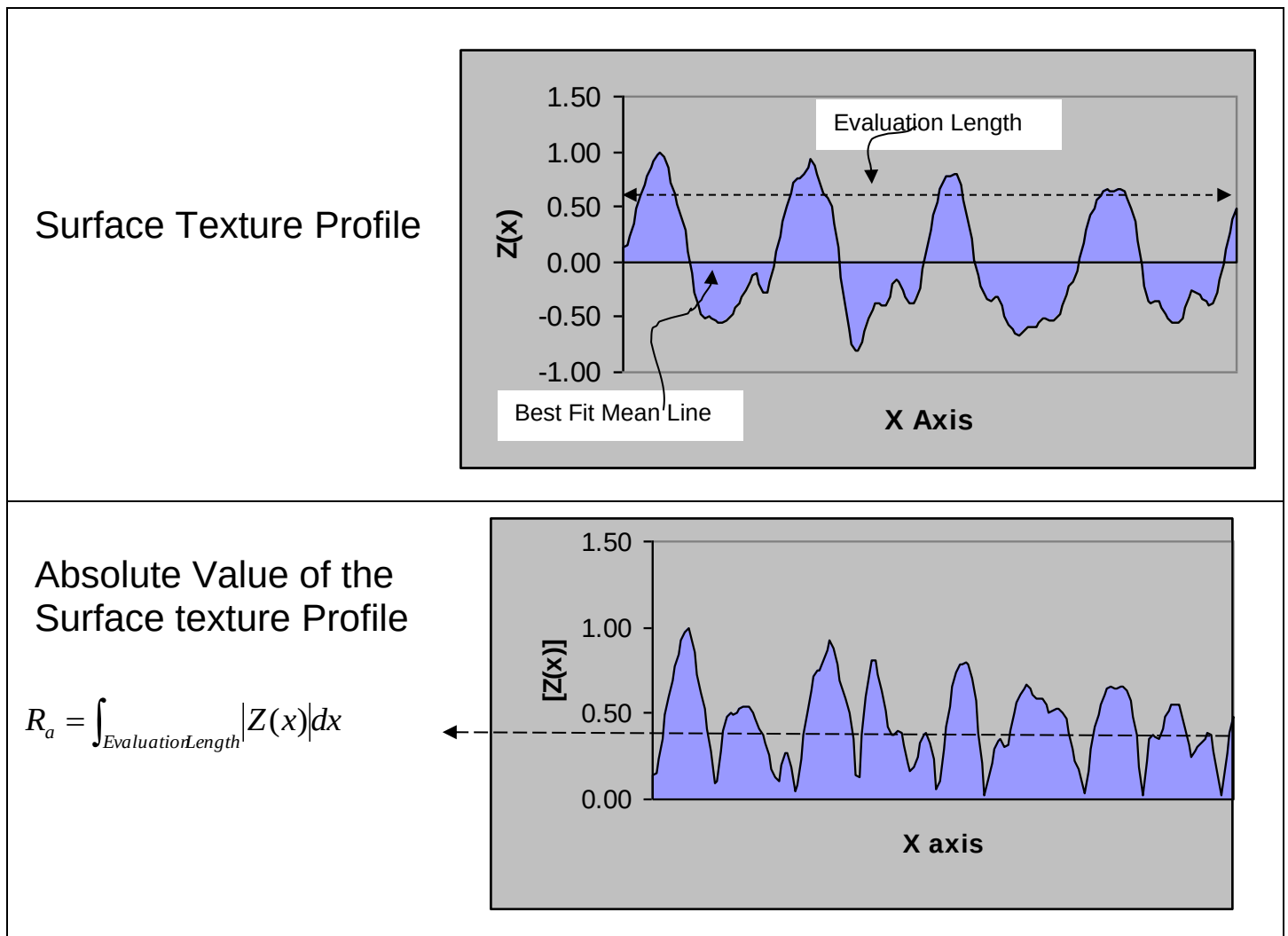
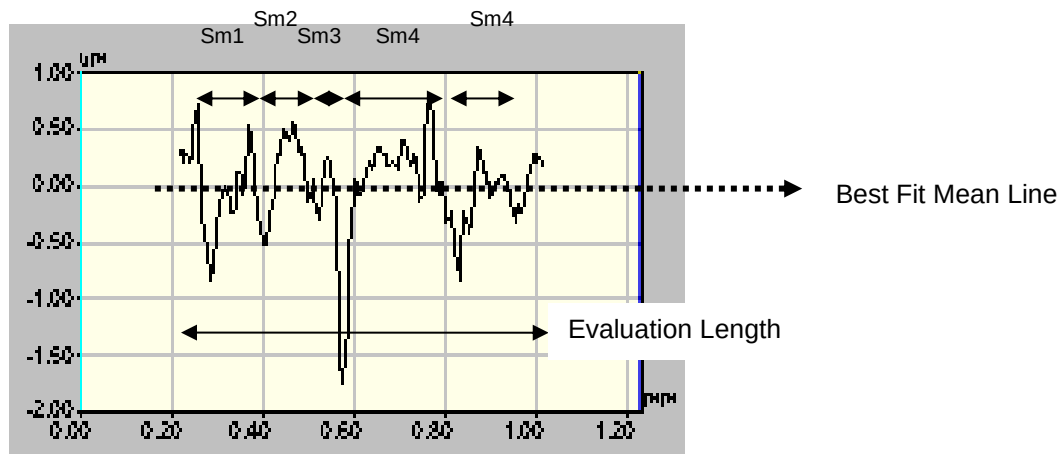


Figure 1 - Demonstration of the calculation of the Roughness Average, R_a .



$$Rsm = \left(\frac{1}{n} \right) \sum_i^n Sm_i$$

Figure 2 - Demonstration of the calculation of the Mean Profile Spacing, Rsm .

3.13 PEAK

A surface irregularity wherein the roughness profile intersects consecutively a lower and upper boundary line. The boundary lines are located parallel and equidistant from the roughness profile mean line. The vertical distance between these boundary lines is termed the peak count level.

3.14 PEAK COUNT LEVEL

The vertical distance in micrometers (or micro-inch) between the boundary lines described in the definition of "Peak", (see **Error! Reference source not found.**). The standard value for the peak count level is 1.25 μm (nominally 50 μin). Known as Peak count level (PCL) see diagram below: