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INTERNATIONAL
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SURFACE VEHICLE STANDARD

SAE J448a

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Submitted for recognition as an American National Standard

SURFACE TEXTURE

Foreword—This Document has also changed to comply with the new SAE Technical Standards Board Format.

1. Scope—This SAE Standard is concerned with the geometrical irregularities of surfaces of solid materials. It establishes definite classifications for various degrees of roughness and waviness and for several varieties of lay. It also provides a set of symbols for use on drawings, and in specifications, reports, and the like. The ranges for roughness and waviness are divided into a number of steps, and the general types of lay are established by type characteristics.

This standard does not define what degrees of surface roughness and waviness or what type of lay are suitable for any specific purpose. It does not specify the means by which any degree of such irregularities may be obtained or produced. Neither is it concerned with the other surface qualities such as luster, appearance, color, corrosion resistance, wear resistance, hardness, microstructure, and absorption characteristics any of which may be governing considerations in specific applications.

Surfaces, in general, are very complex in character. Although the height, width, length, shape, and direction of surface irregularities may all be of practical importance in specific applications, this standard deals only with their height, width, and direction.

2. References

2.1 Applicable Publications—The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated the lastest revision of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J449—Surface Texture Control
SAE Aerospace-Automotive Drawing Standard on Surface Texture—Roughness, Waviness, and Lay

2.1.2 OTHER PUBLICATION

ASA B46.1—1962

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3. Definitions—(See Figure 1.)

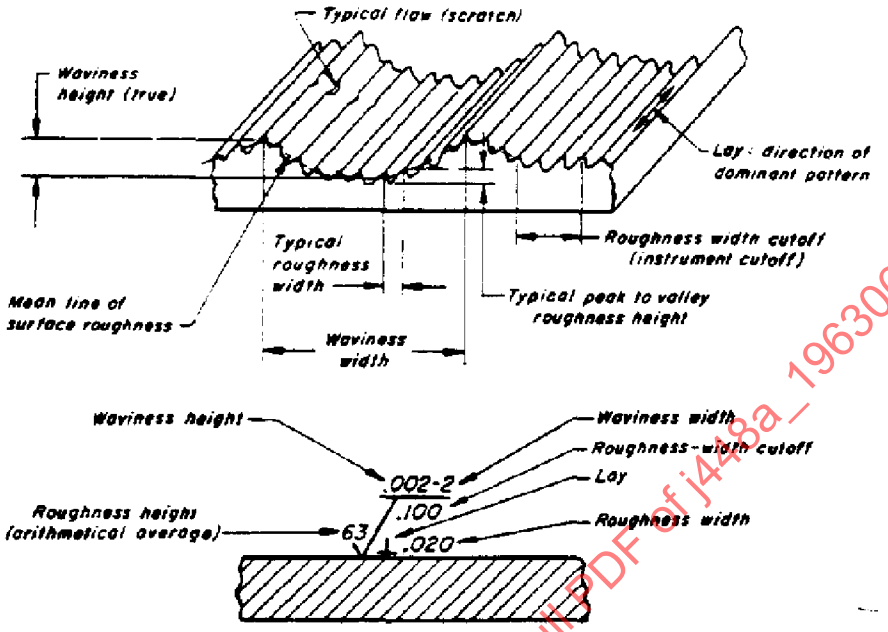

FIGURE 1A—MEANING OF EACH PART OF SYMBOL DEFINED

3.1 Surface Texture—Repetitive or random deviations from the nominal surface which form the pattern of the surface. Surface texture includes roughness, waviness, lay, and flaws.

3.2 Surface—The surface of an object is the boundary which separates that object from another object, substance, or space. Surfaces with which this standard is concerned shall be those requiring control of roughness or other surface characteristics.

3.2.1 NOMINAL SURFACE—Nominal surface is the intended surface contour, the shape and extent of which is usually shown and dimensioned on a drawing or descriptive specification.

3.2.2 MEASURED SURFACE—The measured surface is a representation of the surface obtained by instrumentation or other means.

3.3 Profile—The profile is the contour of a surface in a plane perpendicular to the surface, unless some other angle is specified.

3.3.1 NOMINAL PROFILE—The nominal profile is the profile disregarding surface texture.

3.3.2 MEASURED PROFILE—The measured profile is a representation of the profile obtained by instrumental or other means. (See Figure 2.)

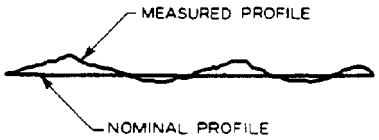

FIGURE 2—MEASURED PROFILE

3.4 Centerline (Roughness)—The centerline is the line about which roughness is measured and is a line parallel to the general direction of the profile within the limits of the roughness—width cutoff, such that the sums of the areas contained between it and those parts of the profile which lie on the either side of it are equal.[1]

3.5 Microinch—One millionth of a linear inch (0.000001 in.). This is the unit of height for roughness. Microinches may be abbreviated as Mu in.

3.6 Roughness—Roughness consists of the finer irregularities in the surface texture usually including those irregularities which result from the inherent action of the production process. These are considered to include traverse feed marks and other irregularities within the limits of the roughness—width cutoff. (See Figure 1.)

3.7 Waviness—Waviness is the usually widely spaced component of surface texture and is generally of wider spacing than the roughness—width cutoff. Waviness may result from such factors as machine or work reflections, vibration, chatter, heat treatment, or warping strains. Roughness may be considered as superposed on a wavy surface. Their directions are not necessarily related.

3.8 Lay—The direction of the predominant surface pattern, ordinarily determined by the production method used.

3.9 Flaws—Flaws are irregularities which occur at one place or at relatively infrequent or widely varying intervals in a surface. Flaws include such defects as cracks, blow holes, checks, ridges, and scratches. Unless otherwise specified, the effect of flaws shall not be included in the roughness height measurements.

4. Precision Reference Specimens—Surface roughness designation by this standard is based on instrument readings of surfaces to be rated in comparison with those of precision reference specimens having known roughness values and having a wide distribution of replicas. Surfaces described in the specifications for these specimens are designed primarily to serve for calibration of instruments used for measuring surface roughness height. They are not intended to have the appearance or characteristics of commonly produced surfaces, nor are they intended for use in visual or tactual comparisons.

Specifications are given for surface contour, material, accuracy, uniformity, and rating that will be satisfactory for the purpose.

1. Centerline, as defined above, is also known mathematically as the median line.

4.1 Surface Contour—The normal surface profile of precision reference specimens of roughness height shall consist of a series of isosceles triangles having included angles of 150 deg. Such a profile is shown in Figure 3.

A departure from this triangular profile is permitted at the bottom of the grooves, provided that the deviated portion does not exceed 0.000130 in. in width and that there shall be no solid material at any point beyond a line corresponding to a flat of this width. This departure shall not affect the portion above this flat, which portion shall meet the allowed tolerance for accuracy.

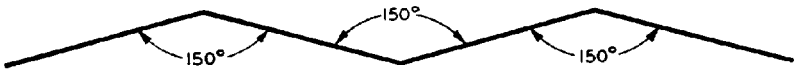

FIGURE 3—SURFACE PROFILE OF PRECISION REFERENCE SPECIMEN

4.2 Material—The material from which precision reference specimens are made shall be such that repeated measurements on these specimens can be made without significant loss of accuracy.

4.3 Accuracy—Average roughness values of precision reference specimens shall not vary from the designated value by more than ±1 Mu in. or ±3%, whichever is the larger. The average spacing of the grooves of precision reference specimens shall be within 2% or 20 Mu in. (whichever is the smaller) of the theoretical spacing corresponding to the nominal roughness height.

4.4 Uniformity—The average deviation of roughness height of individual grooves of any precision reference specimen shall not exceed 4% of the total roughness height. The average deviation of the groove spacings on a given precision reference specimen shall not exceed 3% of the average spacing.

4.5 Rating—Precision reference specimens shall be rated for roughness height and roughness width as provided in the section on Recommended Values of Roughness and Waviness of this Standard. With tracer type instruments having a finite tracer tip radius it is impossible to bottom the ideally sharp grooves as described for the ideal triangular profile. Accordingly, the proper reading of a tracer type instrument on the precision reference specimens will depend on the tracer tip radius. Ratings of the specimens for checking the calibration of such instruments shall be supplied with the specimens.[1]

5. Specification and Rating

5.1 Roughness Height Rating—The height of the roughness shall be specified in microinches as the arithmetical average of the absolute deviations from the mean surface. This value will be identified as a roughness number; for example, 16 means that the surface has an arithmetical average absolute deviation from the mean surface of 16 Mu in.[2]

5.2 Roughness Width Rating—The maximum permissible spacing of repetitive units of the dominant surface pattern. It may be specified in inches adjacent to the lay symbol. Irregularities having spacings up to and including the maximum specified are rated as roughness width and are to be included in the measurement of roughness height. When no maximum dimension is specified, spacings up to and including the width of the irregularities due to machine feed are rated as roughness width and are to be included in the measurement of roughness height.

1. See also Appendix C in ASA B46.1-1962.
2. Instruments calibrated in rms (root mean square) average will read approximately 11% higher on a given surface than those calibrated for arithmetic average (aa).

5.3 Roughness—Width Cutoff—The greatest spacing of repetitive surface irregularities to be included in the measurement of average roundness height. Roughness—width cutoff is rated in inches. Roughness—width cutoff must always be greater than the roughness width in order to obtain the total roughness height rating.

Standard roughness—width cutoff values (inches) are:

0.003 0.010 0.030 0.100 0.300 1.000

When no value is specified, the value 0.030 is assumed. Refer to SAE J449, Surface Texture Control.

5.4 Waviness Height Rating—Waviness heights may be specified directly in inches as the vertical distance from peaks to valleys of waves.

5.5 Waviness Width Rating—Waviness widths may be specified directly in inches as the distance from peak to peak of the waves.

5.6 Lay Specifications—The lay of a surface shall be specified by the lay symbol indicating direction of dominant visible surface marks.

***6. Measurement or Evaluation*—**For compliance with specified ratings, surfaces are to be evaluated by comparison with specified reference standards or by direct instrument measurements as described below.

6.1 Roughness—Roughness height values may be measured by any acceptable method, for instance, sight, feel, or instrument. For routine measurements, comparison may be made with a master surface that satisfactorily meets the requirements of the surface being measured. In making comparisons care should be exercised to avoids errors due to differences in material, contour, and type of operation represented by the reference surface and the work.

In using instruments for comparison or for direct measurement, care should be exercised to insure that the specified quality or characteristices of the surface is measured. [1]

Roughness measurements, unless otherwise specified, are taken in the direction which gives the maximum value of the reading normally across the lay.

6.2 Waviness—Waviness values for height and width may be measured by any suitable device for linear measurement.

***7. Recommended Values of Roughness and Waviness*—**The use of only one number shall indicate the maximum value of either the height or the width of irregularities. Any less degree shall be satisfactory. When two numbers are used, they shall specify the maximum and minimum permissible values.

	SAE Roughness Height Values, Mu in.						
	3	8	20	50	125	320	800
	4	10	25	63	160	400	1000
1	5	13	32	80	200	500	
2	6	16	40	100	250	600	

1. See ASA B46.1-1962 for instrument specifications.

SAE Waviness Height Values, in.					
0.00002	0.00008	0.0003	0.001	0.005	0.015
0.00003	0.0001	0.0005	0.002	0.008	0.020
0.00005	0.0002	0.0008	0.003	0.010	0.030

8. ***Surface Symbol*—**The symbol used to designate surface irregularities is the check mark and extension as shown in Figure 4.

The point of the symbol may be on the line indicating the surface, on a witness line, or on a leader pointing to the surface. The long leg and extension shall preferably be to the right and erect, as the drawing is read. For preferred proportions see SAE Aerospace-Automotive Drawing Standard on Surface Texture—Roughness, Waviness, and Lay.

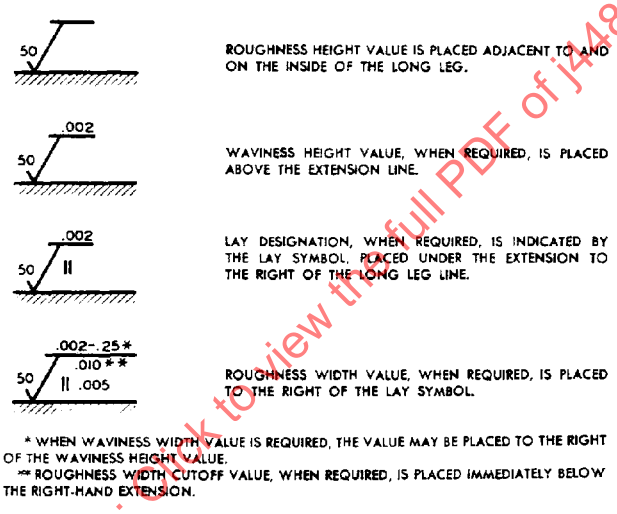

FIGURE 4—SURFACE SYMBOL

9. ***Symbol Indicating Direction of Lay*—**A lay symbol used with a surface symbol shall specify the direction of the visible pattern of the marks on the surface. (See Figure 5.)

Typical examples would be the use of the symbols, as in Figures 6 and 7, to express the given specifications.[1]

1. For more complete discussion of application, see SAE Aerospace-Automotive Drawing Standard on Surface Texture—Roughness, Waviness, and Lay.