Society of Automotive Engineers, Inc.
29 West 39th Street
New York City

AERONAUTICAL STANDARD AS 291A

SURFACE ROUGHNESS (AA)

Issued 12-15-54
Revised 7-1-55

1. SCOPE: This standard provides a method for the application of surface roughness control primarily to aircraft engine and propeller parts. ASA publication B46 may be used to supplement the information compiled herein. This standard contains a summary of the information in ASA B46 publication plus other information which has been compiled from current manufacturing practice.

2. DEFINITIONS:

2.1 Surface: The surface of an object is the boundary which separates that object from another substance or object.

2.2 Nominal Surface: The theoretically accurate design, the shape and extent of which is usually shown and dimensioned on a drawing or descriptive specification.

2.3 Surface Irregularities: The physical characteristics of a surface, such as roughness, waviness, lay, flaws, etc.

2.4 Roughness: That deviation from nominal surface evidenced by minute contiguous irregularities occurring on the nominal surface. Roughness in itself does not alter the trueness of a surface.

2.5 Waviness: That deviation from nominal surface evidenced by recurrent irregularities having the form of waves. These deviations are of greater magnitude than surface roughness which may be superimposed on waviness.

2.6 Flaws: Irregularities of any sort which occur at only one place or at relatively infrequent and widely varying random intervals in a surface. A flaw may be a scratch, a ridge, a hole, a peak, a crack or a check, etc.

2.7 Microinch (Mu In.): One millionth (.000001) part of the U.S. Standard linear inch.

2.8 Arithmetical Average (A A): A linear unit of measurement which represents the average height of the surface roughness irregularities. A A values are usually taken from a meter of an instrument made for measuring surface roughness. The meter shall read the average roughness height in A A over a distance cut-off of .030 unless otherwise stated on the drawing. In order to obtain uniformity in the readings the speed of the tracer, shall be constant and as a suggested value a speed of 1/3 of an inch per second is recommended.

2.9 Roughness Scale: A series of index numbers of varying magnitude from zero upward as indicated in this Standard.

2.10 Roughness Height (Roughness Number): A physical measurement in microinches which represents the maximum degree of roughness of the surface to which it is applied except that, where two numbers are used, the larger shall be the maximum and the smaller the minimum permissible degree of roughness. The physical measurement shall be the maximum sustained reading of a series of readings. Readings shall be taken normal to the surface and in the direction giving the greater value, usually across the lay.

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2.11 Roughness Width: The distance between the successive ridges which constitutes the predominant pattern of the surface roughness.

2.12 Roughness Width Cutoff (Instrument Cutoff): The distance over which the roughness height is averaged or indicated on an instrument.

2.13 Waviness Scale: A series of numerical values from zero upward as indicated in this Standard.

2.14 Waviness Height Value: A physical measurement in inches which represents the maximum vertical distance from peak to valley of the waves.

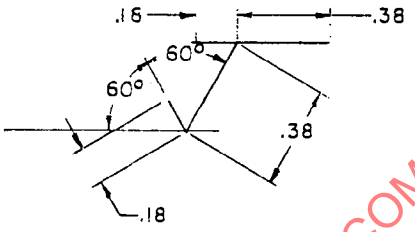
2.15 Waviness Width Value: A physical measurement in inches of the distance from peak to peak of the waves.

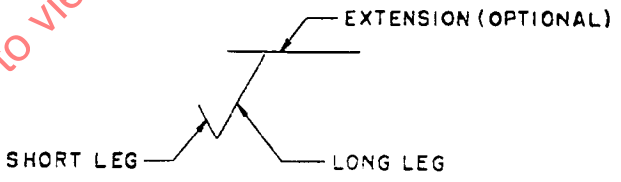
2.16 Lay: The direction of tool marks, or grain, of surface roughness.

2.17 Lay Designation: A series of symbols as indicated in this Standard.

3. SURFACE ROUGHNESS SYMBOL:

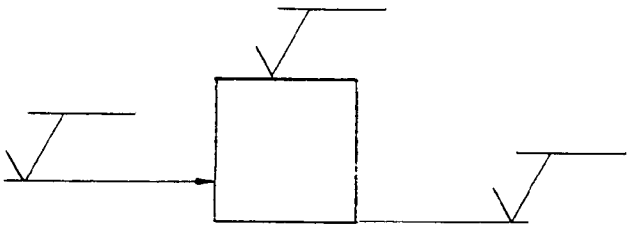
3.1 Dimensions of the symbol, as follows, are basic and may be proportionately smaller or larger as drawing requirements dictate. Use of the extension is optional.





3.2 On drawings, or in specifications, this symbol shall be referred only to the profile of a surface.

3.3 The point of $\sqrt{}$ shall be either on the line depicting the surface, on the witness line, or on a leader line with an arrow pointing to the surface as shown. The long leg and extension shall be to the right as the drawing is read.



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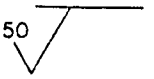
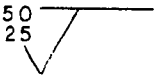
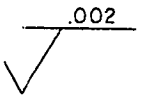
3.4 The maximum roughness number shall be placed adjacent to and on the inside of the long leg, as shown. Ref. Paragraph 2.10



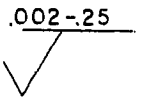
3.4.1 The maximum and minimum roughness numbers shall be placed as shown. Ref. Paragraph 2.10



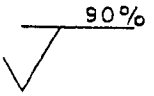
3.5 The maximum waviness height value when used, shall be placed above the extension line.



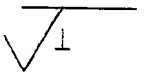
3.6 The maximum waviness width value, when required, shall be placed to the right of the waviness height value.



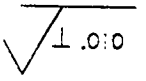
3.7 To control contact area, when required, the percentage value shall be placed above the extension line. Ref. Paragraph 4.3



3.8 The lay designation, when used, shall be placed below the extension line adjacent to and on the outside of the long leg.



3.9 The maximum roughness width value, when required, shall be placed to the right of the lay symbol.



4. SCALES:

4.1 Roughness Scale Numbers (Microinches):

1	5	13	32	80	200	500
2	6	16	40	100	250	
3	8	20	50	125	320	
4	10	25	63	160	400	

4.2 Waviness Height Value (Inches):

.00002	.0001	.0005	.0020	.0100
.00005	.0002	.0010	.0050	

4.3 Roughness-width Cutoff Values (Inches)

.003	.010	.030	.100	.300	1.000

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4.4 Contact Area:

To control the contact area, when required, the value shall be specified in percentage of the contact area (90% - 75% - 50% preferred); thus, 90% indicates that the surface shall show 90% contact with a mating bluing gage.

4.5 Standards have not been established for waviness width and roughness with numbers.

5. LAY DESIGNATION:

= Parallel to the line of the surface indicated.

⊥ Perpendicular to the line of the surface indicated.

X Angular in both directions to the line of the surface indicated.

M Multi-directional.

C Approximately circular relative to the center of the surface indicated.

R Approximately radial relative to the center of the surface indicated.

6. PLATED SURFACES:

6.1 Where only one symbol, without an appended qualifying note, is used on a plated, coated or processed machined surface, it shall always signify that control applies to the base metal surface before plating, coating or processing.

7. METHOD OF INSPECTION:

7.1 Inspection of surface roughness may be by:

7.1.1 Physical measurement with a profile measuring machine, capable of giving A A readings. In cases of dispute the machine method, where applicable, and not the visual method shall be used.

7.1.2 Visual comparison of the work to standard specimens of similar material having the required degree of roughness, the same type of finish and approximately the same contour.

7.2 Inspection of surface waviness shall be by any standard devices for linear measurements, bluing gages or light gages as required. Measurement of waviness less than .0001 inches will ordinarily require the use of optical flats or similar devices.

7.3 Inspection of lay shall be visual.

NOTE: REFERENCE STANDARD:

ASA B46.1-1955

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