Surface Finish Measurement

Objectives

- Interpret the surface finish symbols that appear on a drawing
- Use a surface finish indicator to measure the surface finish of a part

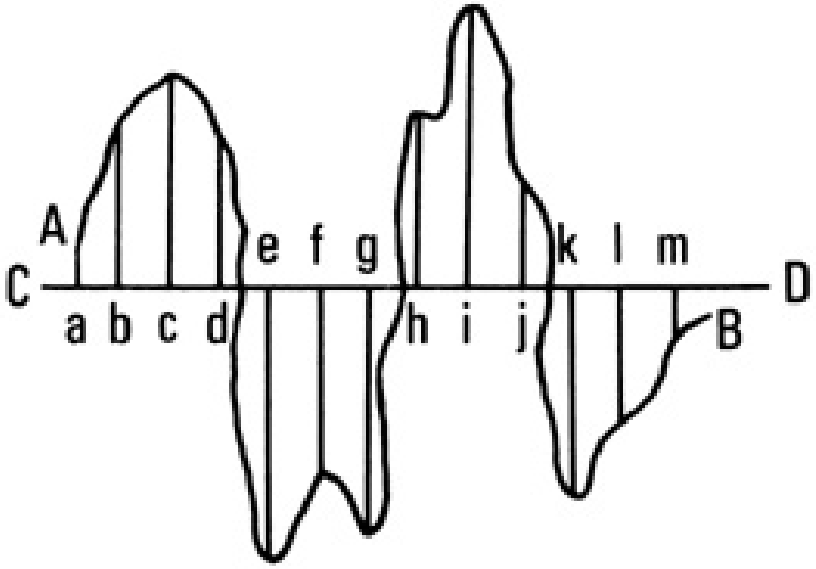
Surface Finish Measurement

- Modern technology demanding improved surface finishes
  - Often require additional operations: lapping or honing
- System of symbols devised by ASA
  - Provide standard system of determining and indicating surface finish
  - Inch unit is microinch (μin)
  - Metric unit is micrometer (μm)

Surface Indicator

- Tracer head and amplifier
- Tracer head has diamond stylus, point radius .0005 µin that bears against work surface
- Movement caused by surface irregularities converted into electrical fluctuations
- Signals magnified by amplifier and registered on meter
- Reading indicates average height of surface

a = 3	a^2 = 9
b = 19	b^2 = 361
c = 22	c^2 = 484
d = 15	d^2 = 225
e = 30	e^2 = 900
f = 19	f^2 = 361
g = 27	g^2 = 729
h = 19	h^2 = 361
i = 30	i^2 = 900
j = 12	j^2 = 144
k = 22	k^2 = 484
l = 14	l^2 = 196
m = 5	m^2 = 25
Totals 237	5179

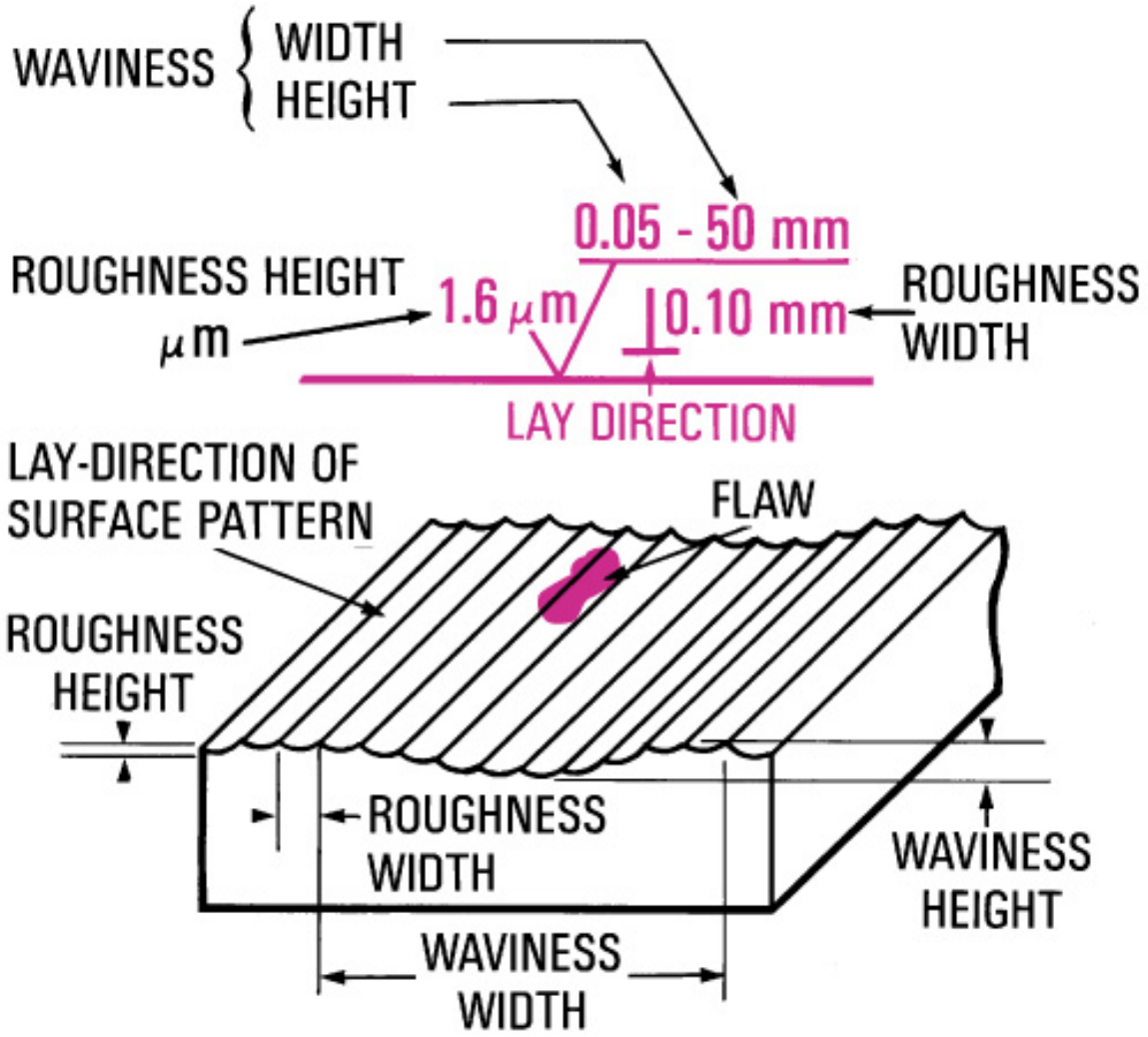


$$R_a = \frac{237}{13} = 18.2\ \mu\text{in.}$$

$$R_q = \sqrt{\frac{5179}{13}} = 19.9\ \mu\text{in.}$$

Either arithmetic average roughness height (Ra) or root mean square (Rq)

Symbols Used to Identify Surface Finishes and Characteristics



Surface Finish Definitions

- Surface deviations: departures from nominal surface in form of waviness, roughness, flaws, lay, and profile
- Waviness: surface irregularities that deviate from mean surface in form of waves
- Waviness height: peak-to-valley distance in inches or millimeters
- Waviness width: distance between successive waviness peaks or valleys in inches or millimeters

Surface Finish Definitions

- Roughness: relatively finely spaced irregularities superimposed on waviness pattern
  - Caused by cutting tool or abrasive grain action
  - Irregularities narrower than waviness pattern
- Roughness height: Ra deviation measured normal to centerline in microinches or µm
- Roughness width: distance between successive roughness peaks parallel to nominal surface in inches or millimeters
- Profile: contour of specified section through a surface

Surface Finish Definitions

- Roughness width cutoff: greatest spacing of repetitive surface irregularities included in measurement of roughness height
  - Must be greater than roughness width
- Flaws: irregularities such as scratches, holes, cracks, ridges, or hollows that do not follow regular pattern
- Lay: direction of predominant surface pattern caused by machining process

Symbols that Indicate Direction of Lay

=	Parallel to boundary line of surface indicated by symbol
⊥	Perpendicular to boundary line of surface indicated by symbol
X	Angular in both directions on surface indicated by symbol
M	Multidirectional
C	Approximately circular to center of the surface indicated by symbol
R	Approximately radial in relation to the center of surface indicated by symbol

Average surface roughness produced by standard machining processes

	Microinches	Micrometers
Turning	100–250	2.5–6.3
Drilling	100–200	2.5–5.1
Reaming	50–150	1.3–3.8
Grinding	20–100	0.5–2.5
Honing	5–20	0.13–0.5
Lapping	1–10	0.025–0.254

To Measure Surface Finish with a Surface Indicator

1. Turn on, allow instrument to warm up
2. Check machine calibration by moving stylus over test block
3. Adjust calibration control if necessary
4. Use .030-in cutoff range for surface roughness of 30 µin or more. For less, use the .010 in. cutoff range
   - Unless specified otherwise

To Measure Surface Finish with a Surface Indicator

5. Thoroughly clean surface to be measured
   - Ensures accurate readings
   - Reduces wear on rider cap protecting stylus
6. Using smooth, steady movement of stylus, trace work surface at approximately .125 in./s
7. Note reading from meter scale

Other Methods

- Surface analyzer
  - Uses recording device to reproduce surface irregularities on graduated chart, providing ink-line record
- Comparison blocks
  - Used for comparing finish on workpiece with calibrated finish on test block using fingernail test
- Commercial sets of standard finished specimens
  - Up to 25 different surface finish samples