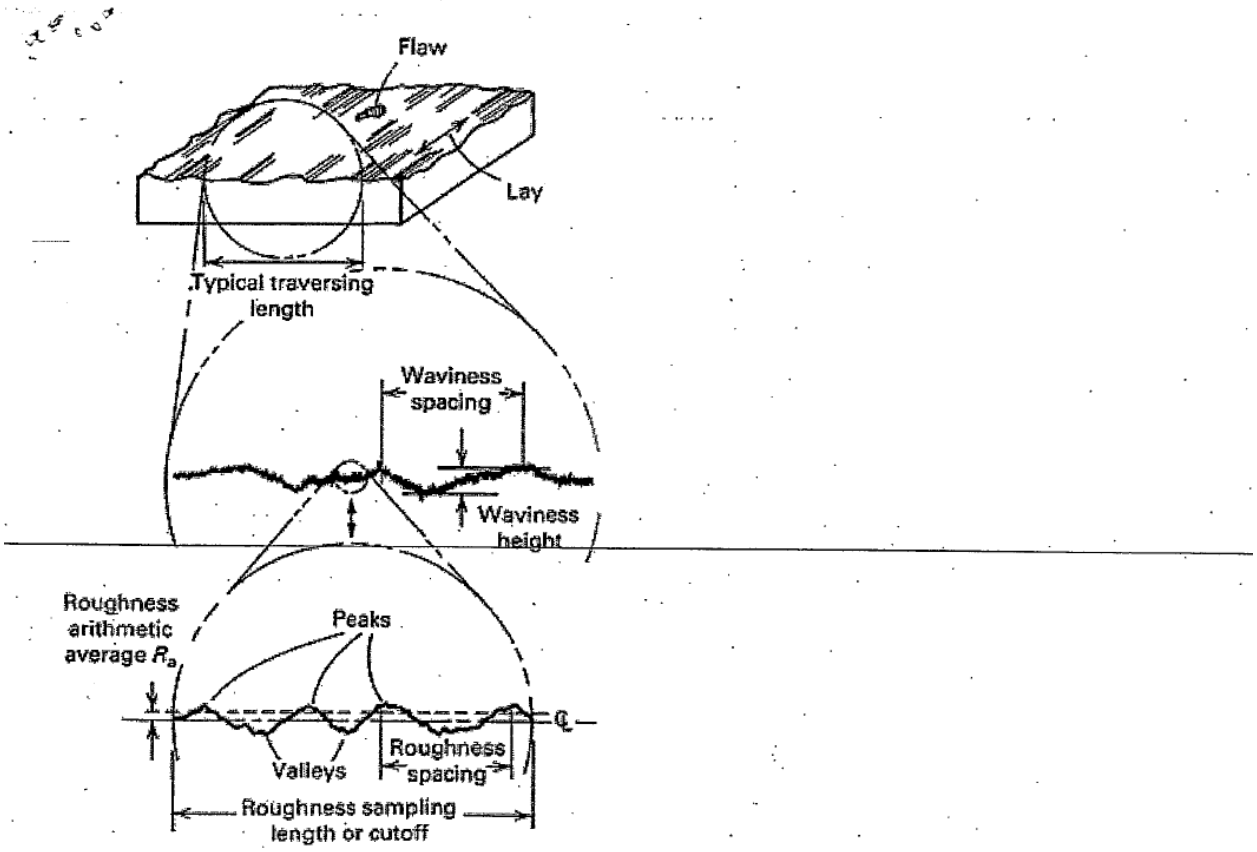


Fig. 1 Schematic of roughness and waviness on a surface with unidirectional lay and one flaw. See Fig. 2 for definition of R_a and waviness height. Source: Ref 1

Both surface roughness and waviness can be measured by a variety of instruments, including both surface contact and noncontact types. By far the most universal technique is to measure surface roughness with a stylus contact-type instrument that provides a numerical value for surface roughness. Such instruments can usually provide an indication of roughness in terms of the arithmetic average, R_a (Fig. 2a), or the root mean square (rms) value, R_q (Fig. 2b).

Question: Compare roughness and waviness in terms of the length of evaluation?

Surface: The boundary that separates an object from another object, substance, or space.

Error of Form: Widely spaced deviations of the real surface from the nominal surface which are not included in surface texture.

Form Suppressed Profile: A modified profile obtained by various techniques to attenuate dominant form such as curvature or tilt.

Waviness: The more widely spaced component of the surface texture. The waviness profile is the modified profile obtained by filtering

to attenuate the shorter spatial wavelengths associated with roughness and the longer spatial wavelengths associated with form.

Roughness: The finer spaced irregularities of the surface texture that usually result from the inherent action of the production process

or material condition. The roughness profile is the modified profile obtained by filtering to attenuate the longer spatial wavelengths as-

sociated with waviness.

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

Profiling instruments sample surface height data over a specific distance, consisting of several different lengths:

· Traverse Length: This is the total length of travel of the instrument on the surface. Due to end effects, the traversing length must

be longer than the evaluation length.

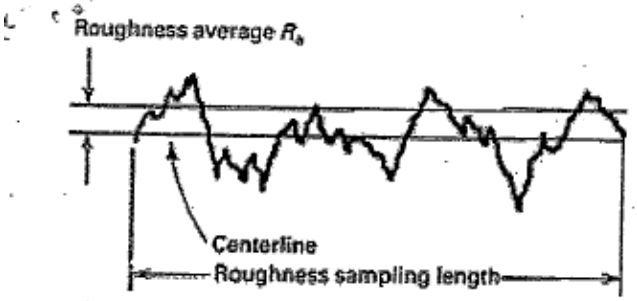
· Evaluation Length (L): Length used to evaluate the profile, after discarding a given distance at the beginning and end of the profile

to account for end effects.

· Sampling Length (l): Length in the direction of the X-axis used for identifying the widest irregularities that are of interest for the

profile. When an electrical or digital filter is used, the roughness long wavelength cutoff value determines and is equal to the

roughness sampling length (i.e. lr = lc)



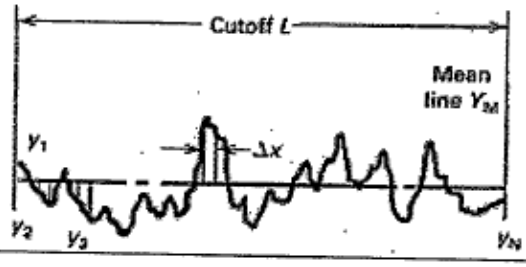
(a)

Roughness average R_a, AA, or CLA is

$$R_a = \frac{1}{L} \int_{x=0}^{x=L} |y| dx$$

where L is the sampling length and y is the ordinate of the profile from the centerline.

$$N = \frac{\text{Cutoff } L}{\Delta x}$$

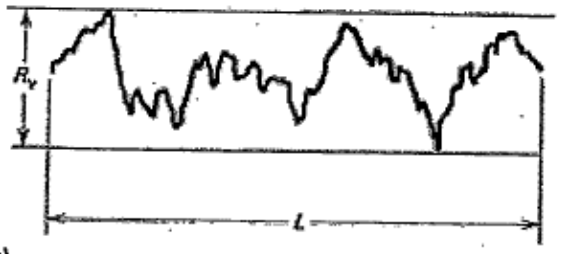


(b)

rms roughness $R_q = \left(\frac{1}{L} \int_{x=0}^{x=L} y^2 dx \right)^{1/2}$

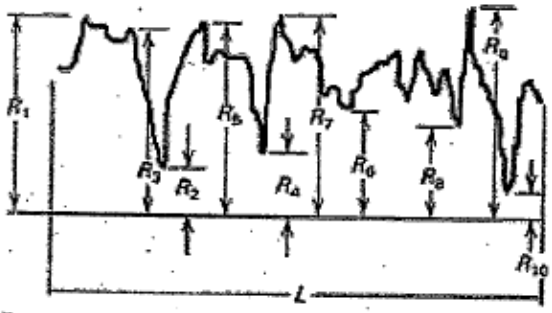
which can be approximated as: rms roughness =

$$\sqrt{\frac{(y_1 - Y_M)^2 + (y_2 - Y_M)^2 + \ldots + (y_N - Y_M)^2}{N}}$$



(c)

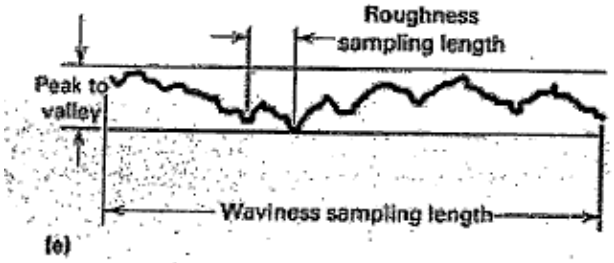
Maximum peak-to-valley roughness height R_y or R_{max} is the distance between two lines parallel to the mean line that contacts the extreme upper and lower points on the profile within the roughness sampling length.



(d)

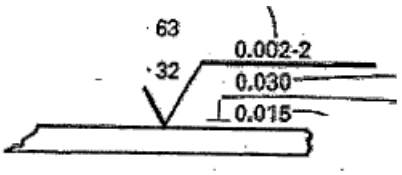
Ten-point height R_z is the average distance between the five highest peaks and the five deepest valleys within the sampling length measured from a line parallel to the mean line and not crossing the profile. It should be:

$$R_z = \frac{(R_1 + R_3 + R_5 + R_7 + R_9) - (R_2 + R_4 + R_6 + R_8 + R_{10})}{5}$$



(e)

Waviness height W is generally a maximum peak-to-valley measurement of the total profile within a waviness sampling length minus the average peak-to-valley roughness value within that length.



What is roughness , waviness in the following symbol

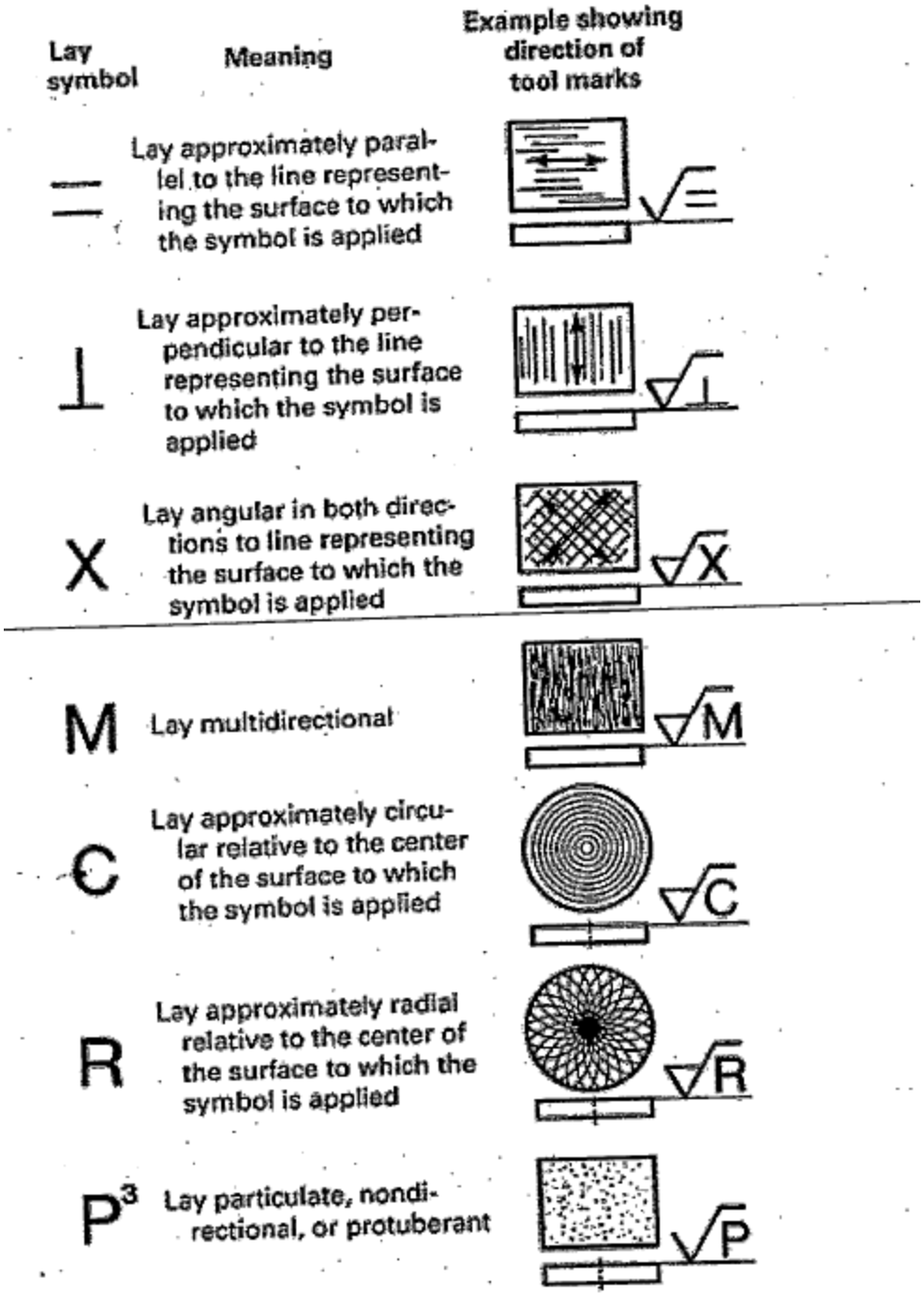
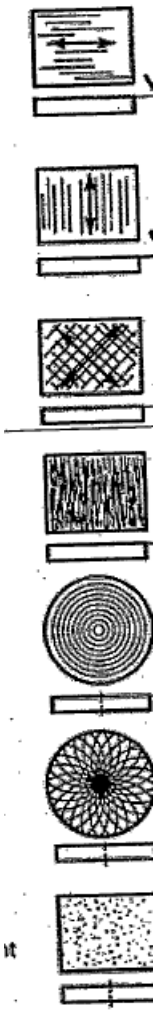


Fig. 4 Symbols used to define lay and its direction. Source: Ref 2



Describe the type of lay beside each symbol

Surface Roughness and Dimensional Tolerances. Surface roughness is closely tied to the accuracy or tolerance of a machine component (Table 5). A close-tolerance dimension requires a very fine finish, and the finishing of a component to a very low roughness value may require multiple machining operations. For example, a 3.2 μm (125 μin.) surface roughness can be produced by milling or turning, while a very fine (low roughness value) surface would require grinding or additional subsequent operations, such as honing, superfinishing, buffing, or abrasive flow. Therefore, specifying very fine finishes will normally result in increased costs (Table 5.)

Describe the relation between surface roughness and dimenstional accuracy?

Which process sequence produce best roughness and dimensional accuracy?

Which of the above manufacturing process has the best dimensional accuracy?

Super finish

Which of the above should be last in sequence?

Cleanup

Super finish

Cleanup