




SURFACE ROUGHNESS TABLES


AND U.S. TO METRIC COMPARISON CHARTS


METRIC SURFACE ROUGHNESS VALUES ARE INDICATED BY THE UNIT: MICROMETER (μm).

SYMBOLS: There are a number of symbols in use, all of which have a specific meaning. A symbol generally consists of 2 lines, one of which is longer than the other. The angle between the lines is 60 degrees.

Basic symbol (without top line) should not be used alone. Either the processing method or the surface roughness should be listed with it. ✓

If written as per this example: it means machining optional. The surface roughness should be $3.2 \mu\text{m}$ (0.0032 mm) 

Symbol (with top line) means: machining mandatory (surface roughness $3.2 \mu\text{m}$). 

Symbol (with circle in the vee) means: machining prohibited (surface roughness $3.2 \mu\text{m}$). 

General guidelines for feasible roughness R_a for different processing methods














Material removing or separating operations	roughness R_a in μm												
	0.012	0.025	0.05	0.1	0.2	0.4	0.8	1.6	3.2	6.3	13	25	50
flame cutting													
sawing													
planing													
punching													
chemical treatment													
spark erosion machining													
drilling													
boring													
milling													
turning													
broaching													
reaming													
filing													
grinding													
barreling													
brushing													
electrolytic grinding													
honing													
polishing													
lapping													
superfinishing													
Non material removing operation													
sandcasting													
hot rolling													
die forging													
gravity die casting													
investment casting													
extruding													
cold rolling													
die casting													


The data in the right hand table is furnished only for practical information and to provide an idea of the achievable roughness R_a for different processing methods.

This data is primarily for metal surfaces. Other materials may show differences.

○ AVERAGE ACHIEVABLE ROUGHNESS ■ FINER ◇ COARSER

Roughness values in micro-inches are 40 times the values in micrometers

R_a micrometer μm	R_a micro-inch μin	Roughness Grade Numbers (New)**	Roughness Grade Numbers (Old)***	R_t	 (R_a)	Old Style	American standard
50	2000	N12					
25	1000	N11					
12.5	500	N10					
6.3	250	N9		32		32	250 ✓
3.2	125	N8		16		8	125 ✓
1.6	63	N7		8		4	63 ✓
0.8	32	N6		4		2	32 ✓
0.4	16	N5		2		1	16 ✓
0.2	8	N4		1		0.5	8 ✓
0.1	4	N3		0.5		0.25	4 ✓
0.05	2	N2		0.25			2 ✓
0.025	1	N1					

Notes: 1. Triangles, , or R_t on a drawing indicates peak to valley roughness measurements in micrometers (microns). (one micron = 0.001 mm)

2. , R_a on a drawing indicates AVERAGE roughness rather than peak to valley values.

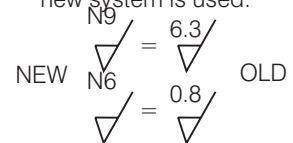
(R_a is the unit of measurement in micrometers)

3.  is the American standard per ASA B46.1. (average roughness in micro-inches)


**Use this symbology on drawings for international suppliers, and for new designs.

***Old surface roughness symbols which are still found on older metric drawings. They should not be used on new designs.

Examples of how the new system is used:



In certain circumstances, it will be necessary to indicate the method of manufacturing:

Example:  precision ground