**SURFACE ROUGHNESS TABLES**

METRIC SURFACE ROUGHNESS VALUES ARE INDICATED BY THE UNIT: MICROMETER (\( \mu \text{m} \)).

**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 \( \mu \text{m} \)).

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.

![Symbol Chart](http://mdmetric.com)

### METRIC SURFACE ROUGHNESS VALUES ARE INDICATED BY THE UNIT: MICROMETER (\( \mu \text{m} \)).

| \( R_a \) micrometer \( \mu \text{m} \) | \( R_a \) micro-inch \( \mu \text{in} \) | **Roughness Grade Numbers** (New)** | **Roughness Grade Numbers** (Old)** | | \( R_t \) | \( (R_a) \) | Old Style | American standard |
|---|---|---|---|---|---|---|---|
| 50 | 2000 | N12 | 0.25 | 50 |
| 25 | 1000 | N11 | 0.5 | 25 |
| 12.5 | 500 | N10 | 1 | 12.5 |
| 6.3 | 250 | N9 | 2 | 6.3 |
| 3.2 | 125 | N8 | 4 | 3.2 |
| 1.6 | 63 | N7 | 8 | 1.6 |
| 0.8 | 32 | N6 | 16 | 0.8 |
| 0.4 | 16 | N5 | 32 | 0.4 |
| 0.2 | 8 | N4 | 64 | 0.2 |
| 0.1 | 4 | N3 | 128 | 0.1 |
| 0.05 | 2 | N2 | 256 | 0.05 |
| 0.025 | 1 | N1 | 512 | 0.025 |

**Notes:**
1. Triangles, \( \sqrt[3]{R_a} \), or \( R_t \) on a drawing indicates peak to valley roughness measurements in micrometers (microns). (one micron = 0.001 mm)
2. \( \sqrt{R_a} \), \( R_a \) on a drawing indicates AVERAGE roughness rather than peak to valley values.
3. \( (R_a) \) is the American standard per ASA B46.1. (average roughness in micro-inches)

**AND U.S. TO METRIC COMPARISON CHARTS**

**General guidelines for feasible roughness \( R_a \) for different processing methods**

- **Material removing or separating operations**
  - 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

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

**Use this symbolology 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

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