Definition of Surface texture and Stylus instrument

Profile by Stylus and phase correct filter
ISO4287: ’97 and ISO3274: ’96

Profile by Stylus and phase correct filter
ISO4287: ’97 and ISO3274: ’96

Selection of λc & Stylus Tip rtip

<table>
<thead>
<tr>
<th>Ac (mm)</th>
<th>λc/As</th>
<th>rtip (μm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.08</td>
<td>2.5</td>
<td>30</td>
</tr>
<tr>
<td>0.25</td>
<td>100</td>
<td>2</td>
</tr>
<tr>
<td>0.8</td>
<td>300</td>
<td>2 (5 at RZ &gt; 3μm)</td>
</tr>
<tr>
<td>2.5</td>
<td>8</td>
<td>5 or 2</td>
</tr>
<tr>
<td>8</td>
<td>25</td>
<td>10, 5 or 2</td>
</tr>
</tbody>
</table>

Roughness profile and waviness profile

Evaluation procedure of roughness
ISO4288: ’96

1. View the surface and decide whether profile is periodic or non-periodic.
2. When the tolerance limit is specified, use the table shown on the left for condition.
3. When the tolerance limit is not specified.
   3.1 Estimate roughness and measure it in corresponding condition in the table.
   3.2 Change condition according with above result and measure it again.
   3.3 Repeat “3.2” if the result does not reached the condition.
   3.4 When the result reaches the condition, it will be the final value.
   Check it in shorter sampling length at non-periodic and change it if it meets.
4. Compare the result toward tolerance limit in accordance with following rule.

Upper limit - the 16% rule (Default)
Measure on the most critical surface. If not more than 16% of all value based on sampling length are exceed the limit, surface is acceptable.
- The first value does not exceed 70% of the limit.
- The first three values do not exceed the limit.
- Not more than one of the first six value exceed the limit.
- Not more than two of the first twelve value exceed the limit.
or when \( \mu + \sigma \) does not exceed the limit, the result is acceptable.

Lower limit - the 16% rule (shown as L)
Measure the surface that can be expected the lowest roughness. If not more than 16% of all sampling length are less than the limit, or when \( \mu - \sigma \) is not less than the limit, the result is acceptable.

Max value - the max rule (when “max” suffix is added)
The value is acceptable when none of value in entire surface is over the limit.
Sampling length and Evaluation length
ISO4287: '97
- Mean line
- Primary profile P
- Top of profile peak
- Profile peak
- Profile valley
- Bottom of profile
- Profile element width Xs
- Pre travel $\delta_p$ (Acx2)
- Tracing length $L_t=L_p+L_n+L_p$
- Post travel $\delta_p$ (Acx2)

Indication of surface texture
ISO 1302: '02
- Not allowed
- Required
- Manufacturing method
- Surface parameter and condition
- Surface lay and orientation
- Machining allowance (mm)
- Transmission band $\lambda_s-\lambda_c$ (mm)
- Parameter $\delta_r$ = Cutoff $\lambda_c$ (mm)
- Evaluation length $\delta_r = n \times \delta_r$ (n: Default 5)
- Upper U or Lower L
- Filter
- Phase correct
- $2RC$
- No. of S. length
- Value limit ($\mu$m)
- Comparison rule 16% or max
- Over > Less
- Material removal
- Ground
- Example $U "2RC" 0.008–2.5/Rz3_{max} 12.3$
- $L "2RC" 0.008 – 0.8/Ra75 0.2$

Measuring condition: R-parameter
ISO4288: '96
- Non-periodic profile
- Periodic profile or RSm
- Measuring Condition
- Ra ($\mu$m) Rz ($\mu$m) RSm (mm)
- Measuring Condition Sampling length $\delta_r = \lambda_c$ Evaluation length $\delta_r = n \times \delta_r$
- Ra ($\mu$m) Rz ($\mu$m) RSm (mm)
- Over > Less Over > Less Over > Less
- 0.006 0.02 0.025 0.1 0.013 0.04 0.08 0.4
- 0.02 0.1 0.1 0.04 0.13 0.25 1.25
- 0.1 2 0.5 10 0.13 0.4 0.8 4
- 2 10 10 50 0.4 1.3 2.5 12.5
- 10 80 50 200 1.3 4 8 40
- Measuring condition: P-parameter
ISO4288: '96
- Stylus radius $\lambda_s$
- No. of $\delta_p = n$
- S. length $\delta_p$
- E. length $\delta_n$
- 2µm 2.5µm
- 5µm 6µm
- 10µm 25µm
- Measuring condition: W-parameter
ISO1302: '02
- $\lambda_c$
- $\lambda_f$
- No. of $\delta_w = m$
- S. length $\delta_w$
- E. length $\delta_n$
- $\lambda_c$ (for roughness) $m: \lambda_c$
- $\lambda_f$
- $m: \lambda_f$
## Basic surface texture parameters and curves

### Amplitude parameters (peak and valley)

- **Rp, Pp, Wp**
  - Maximum profile peak height
  - The largest profile peak height $Z_p$ within a sampling length.
  - $Rp, Pp, Wp = \max (Z(x))$

- **Rv, Pv, Wv**
  - Maximum profile valley depth
  - The largest profile valley depth $Z_v$ within a sampling length.
  - $Rv, Pv, Wv = \min (Z(x))$

- **Rz**
  - Maximum height of profile
  - Sum of height of the largest profile peak height $R_p$ and the largest profile valley $R_v$ within a sampling length.
  - $Rz = Rp + Rv$

### Amplitude average parameters

- **Ra**
  - Arithmetical mean deviation
  - Arithmetic mean of the absolute ordinate values $Z(x)$ within a sampling length.
  - $Ra = \frac{1}{L} \int_0^L |Z(x)| \, dx$

- **Ra75**
  - Center line average (Old Ra, AA, CLA)
  - Same as Ra at old ISO, ANSI, DIN

- **Rzjis**
  - Ten point height of roughness profile (Rz at JIS '94)
  - Sum of mean value of largest peak to the fifth largest peak and mean value of largest valley to the fifth largest valley within a sampling length.
  - $Rzjis = \frac{1}{5} \sum_{j=1}^{5} (Z_{pj} + Z_{vj})$

- **R76**
  - Total height of profile (Pt at JIS '82)
  - Sum of height of the largest profile peak height $Rp$ and the largest profile valley $Rv$ within an evaluation length.
  - $R76 = \max (Rpi) + \max (Rvi)$

### Profile element:

- **Zp1, Zp2, Zp3, Zp4, Zp5**
  - Profile peak and the adjacent valley

- **Zv1, Zv2, Zv3, Zv4, Zv5**
  - Profile peak and the adjacent valley

- **Zt1, Zt2, Zt3, Zt4, Zt5**
  - Profile element heights $Z_t$ within a sampling length.

- **Zpj, Zvj**
  - Maximum profile valley depth

- **Zpi, Zvi**
  - Maximum profile peak height

- **Ztj**
  - Mean value of the profile element heights $Z_t$ within a sampling length.

- **Zpj, Zvj**
  - Maximum profile valley depth

- **Zpi, Zvi**
  - Maximum profile peak height

- **Ztj**
  - Mean value of the profile element heights $Z_t$ within a sampling length.

### Profile element:

- **Zt1, Zt2, Zt3, Zt4, Zt5**
  - Profile element heights $Z_t$ within a sampling length.

- **Zpj, Zvj**
  - Maximum profile valley depth

- **Zpi, Zvi**
  - Maximum profile peak height

- **Ztj**
  - Mean value of the profile element heights $Z_t$ within a sampling length.

- **Zpj, Zvj**
  - Maximum profile valley depth

- **Zpi, Zvi**
  - Maximum profile peak height

- **Ztj**
  - Mean value of the profile element heights $Z_t$ within a sampling length.

### Different from Rz at old ISO, ANSI & JIS

- **Rzjis**
  - Ten point height of roughness profile (Rz at JIS '94)
  - Sum of mean value of largest peak to the fifth largest peak and mean value of largest valley to the fifth largest valley within a sampling length.

- **R76**
  - Total height of profile (Pt at JIS '82)
  - Sum of height of the largest profile peak height $Rp$ and the largest profile valley $Rv$ within an evaluation length.

### Annex of JIS only and confirm to JIS '94

- **R76**
  - Total height of profile (Pt at JIS '82)
  - Sum of height of the largest profile peak height $Rp$ and the largest profile valley $Rv$ within an evaluation length.

- **Rzjis**
  - Ten point height of roughness profile (Rz at JIS '94)
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### Different from Rz at JIS '82

- **R76**
  - Total height of profile (Pt at JIS '82)
  - Sum of height of the largest profile peak height $Rp$ and the largest profile valley $Rv$ within an evaluation length.

- **Rzjis**
  - Ten point height of roughness profile (Rz at JIS '94)
  - Sum of mean value of largest peak to the fifth largest peak and mean value of largest valley to the fifth largest valley within a sampling length.
### Spacing parameters

- **RSm**, **PSm**, **WSm**: Mean width of the profile elements (RSm = Sm at ISO4287 '84)
- Mean value of the profile element width Xs within a sampling length.

- $RSm, PSm, WSm = \frac{1}{m} \sum_{i=1}^{m} Xsi$

### Hybrid parameters

- **RΔq**, **PΔq**, **WΔq**: Root mean square slope
- Root mean square value of the ordinate slopes $dZ/dX$ within a sampling length.

- $R\Delta q = \sqrt{\frac{1}{L} \int_{0}^{L} \left( \frac{d}{dx} Z(x) \right)^2 dx}$

### Height characteristic average parameters

- **Rsk**, **PsK**, **Wsk**: Skewness
- Quotient of mean cube value of the ordinate values $Z(x)$ and cube $Pq$, $Rq$, $Wq$ respectively, within a sampling length.

- $Rsk = \frac{1}{Rq} \left( \frac{1}{L} \int_{0}^{L} Z(x)^3 dx \right)$

- **Rku**, **Pku**, **Wku**: Kurtosis of profile
- Quotient of mean quartic of the ordinate values $Z(x)$ and 4th power of $Pq$, $Rq$, $Wq$ respectively, within a sampling length.

- $Rku = \frac{1}{Rq} \left( \frac{1}{L} \int_{0}^{L} Z(x)^4 dx \right)$

### Parameter from bearing ratio curve and profile height amplitude curve

- **Rmr(c)**, **Pmr(c)**, **Wmr(c)**: Material ratio of profile (Abbott Firestone curve)
- Curve representing the material ratio of the profile as a functional of level $c$.

- $Rmr(c) = \frac{1}{100} \sum_{i=1}^{n} M_{R} (c)_{i}$

- **Rr(c)**, **Pr(c)**, **Wr(c)**: Profile height amplitude curve
- Sample probability density function of ordinate $Z(x)$ within an evaluation length.

- $Rku > 3$ or $Rku < 3$

### Relative material ratio

- **Rmr**, **Pmr**, **Wmr**: Material ratio determined at a profile section level $R\delta c$, related to a reference $C_0$.

- $Rmr = \frac{Rmr \ (c)}{C_0 - R\delta c}$, $C_0 = C(\ n Rmr0)$
Expanded surface texture parameters and curves

**Traditional local parameters**

- **RmaxDIN**: Maximum peak to valley height
- **RzDIN**: Average peak to valley height

Zi is the maximum Peak to valley height of a sampling length \( \delta r \). RmaxDIN is the maximum Zi of 5 adjoining sampling length \( \delta r \) in an evaluation length \( \delta n \). RzDIN is arithmetic mean of 5 Zi.

\[
RzDIN = \frac{1}{n} \sum_{i=1}^{n} Zi
\]

German old standard DIN4768/1: ‘90

- **R3z**: Base roughness depth

3Zi is the height of the 3rd height peak from the 3rd depth valley in a sampling length \( \delta r \). R3z is arithmetic mean of 3Zi’s of 5 sampling lengths in an evaluation length \( \delta n \).

\[
R3z = \frac{1}{n} \sum_{i=1}^{n} 3zi
\]

- **Pc**: Peak density /cm: ASME B46.1: ’95
- **PPI**: Peaks per inch: SAEJ911
- **HSC**: High spot count

Pc is the number of peaks counted when a profile intersects a lower boundary line –H and an upper line +H per unit length 1 cm. PPI shows Pc in 1 inch (25.4mm) unit length. HSC shows the number of peaks when the lower boundary level is equal to zero.

- **Zi**: Maximum peak to valley height of a sampling length \( \delta r \)
- **Z5 = RmaxDIN**: RmaxDIN is the maximum Zi of 5 adjoining sampling length \( \delta r \) in an evaluation length \( \delta n \).

**Parameters of surfaces having stratified functional properties**

- **Rp**: Reduced peak height
- **Rvk**: Reduced valley depth

- **Mr1**: Material portion 1: Level in %, determined for the intersection line which separates the protruding peaks from the roughness core profile.
- **Mr2**: Material portion 2: Level in %, determined for the intersection line which separates the deep valleys from the roughness core profile.

- **UPL**, **LPL**, **UVL**, **LVL**: Upper and lower limit points

**Height characterization using the linear material ratio curve ISO13565-2:’96**

- **Rpk**: Core roughness depth: Depth of the roughness core profile
- **Rvk**: Reduced valley depth: Average depth of valleys projecting through roughness core profile

- **Rk**: Reduced peak height: Average height of protruding peaks above roughness core profile.

- **Rt (µm)**: Core roughness depth

- **Material ratio Mr (%) on Standard probability scale**

**Height characterization using the material probability curve of ISO13565-3**

- **Rpq (Ppq)**: Parameter: slope of a linear regression performed through the plateau region.
- **Rvq (Pvq)**: Parameter: slope of a linear regression performed through the valley region.
- **Rmq (Pmq)**: Parameter: relative material ratio at the plateau to valley intersection.

**Measuring conditions of ISO13565-1**

- **Cutoff value \( \lambda c \)**
- **Evaluation length \( \delta n \)**

- **Peak area A1**
- **Valley area A2**

**Filtering process of ISO13565-1:’96**

1. **Calculate mean line 1** from a primary profile with phase correct filter.
2. **Calculate mean line 3** from profile 2 with phase correct filter.
3. **Calculate mean line 1** from a primary profile with phase correct filter.
4. **Calculate mean line 3** from profile 2 with phase correct filter.
5. **Calculate roughness profile 4** by taking mean line 3 off from a primary profile.

**Height characterization using the linear material ratio curve ISO13565-2:’96**

1. **Calculate mean line 1** from a primary profile with phase correct filter.
2. **Calculate mean line 2** with cutting valley lower than mean line 1.
3. **Calculate mean line 3** from profile 2 with phase correct filter.
4. **Calculate roughness profile 4** by taking mean line 3 off from a primary profile.
Motif parameters of ISO12085: ‘96

Motif
A portion of the primary profile between the highest points of two local peaks of the profile, which are not necessarily adjacent.

Motif depths H_j & H_{j+1}
Depth measured perpendicular to the general direction of the primary profile.

Motif length A_{ri} or A_{Wi}
Length measured parallel to the general direction of the profile.

Measuring condition
Default A=0.5mm, B=2.5mm, δ n=16mm
A (mm) B (mm) δ n (mm) Aμ (μm)
0.02 0.1 0.64 2.5
0.1 0.5 3.2 2.5
0.5 2.5 16 8
2.5 12.5 80 25

Indication of ISO1302: ‘02

Roughness motif
\[ \sqrt{\lambda_s} - A/\delta n \]
Waviness motif
\[ A - B/\delta n \]
(default value need not to be indicated)

Hint of surface texture measurement

Roughness parameter conversion
The parameter ratio Ra/Rz (Rmax, Ry)=0.25 is applicable only to triangle profile.
Actual profiles have different parameter ratios according to the form of profile.

<table>
<thead>
<tr>
<th>Profile</th>
<th>Ra/Rz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rectangle</td>
<td>Ra/Rz=0.5</td>
</tr>
<tr>
<td>Sinusoidal</td>
<td>Ra/Rz=0.32</td>
</tr>
<tr>
<td>Triangle</td>
<td>Ra/Rz=0.25</td>
</tr>
<tr>
<td>Lathed, Milled</td>
<td>Ra/Rz=0.16 to 0.26</td>
</tr>
<tr>
<td>Ground, Sand blasted</td>
<td>Ra/Rz=0.10 to 0.17</td>
</tr>
<tr>
<td>Honing, Lapped</td>
<td>Ra/Rz=0.05 to 0.12</td>
</tr>
<tr>
<td>Pulse (Duty ratio 5%)</td>
<td>Ra/Rz=0.095</td>
</tr>
</tbody>
</table>

Display aspect ratio & Stylus fall depth in valley

Roughness profile usually displayed as much magnified height deviations than wavelength.
Displayed valley looks sharp but actually wide. Stylus can contact to bottom of valley.
Depth error \( \varepsilon \) with stylus unable to contact on triangle valley is; \( \varepsilon = rtip (1/\cos \theta - 1) \)
\( \theta \leq 15^\circ \), or H/L=0.1-0.01 on machined surface.

High magnification ratio profile on display

\( rtip = 2 \mu m \)

Profile distortion with cutoff

Roughness profile will have bigger profile distortion & smaller amplitude when cutoff \( \lambda c \) is short.

Primary profile P

<table>
<thead>
<tr>
<th>Profile</th>
<th>( \lambda c )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roughness profile R phase correct</td>
<td>( \lambda c ) 0.8mm</td>
</tr>
<tr>
<td>Roughness profile R phase correct</td>
<td>( \lambda c ) 0.25mm</td>
</tr>
<tr>
<td>Roughness profile with 2RC filter</td>
<td>( \lambda c ) 0.25mm</td>
</tr>
</tbody>
</table>

Roughness profile usually displayed as much magnified height deviations than wavelength.
Displayed valley looks sharp but actually wide. Stylus can contact to bottom of valley.
Depth error \( \varepsilon \) with stylus unable to contact on triangle valley is; \( \varepsilon = rtip (1/\cos \theta - 1) \)
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<td>( \lambda c ) 0.8mm</td>
</tr>
<tr>
<td>Roughness profile R phase correct</td>
<td>( \lambda c ) 0.25mm</td>
</tr>
<tr>
<td>Roughness profile with 2RC filter</td>
<td>( \lambda c ) 0.25mm</td>
</tr>
</tbody>
</table>
## Comparison of national standards of surface texture measurement

<table>
<thead>
<tr>
<th>Specification</th>
<th>ID. of national standard country</th>
<th>JIS B0601-'82</th>
<th>ANSI B46.1-'85</th>
<th>NF E05-015/('84)</th>
<th>ISO468-'82 ISO4287/1-'84 ISO1302-'78</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary profile P</td>
<td>Profile format</td>
<td>Analog signal without filtering</td>
<td>Analog signal with low pass filtering</td>
<td>Analog signal without filtering</td>
<td>Analog signal without filtering</td>
</tr>
<tr>
<td></td>
<td>Evaluation length</td>
<td>1 sampling length 0.25, 0.6, 2.5, 8, &amp; 25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maximum height</td>
<td>$R_{\text{max}}$ ($S$ indication)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ten point height</td>
<td>$R_{z}$ ($Z$ indication)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other P parameters</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Motif parameters</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Indication of maximum height $&lt; 1.5 \mu m$</td>
<td>$R_{\text{max}} = 1.6 \sqrt{R_{\text{max}} &lt; 0.8}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>R roughness profile R</td>
<td>Unit of height</td>
<td>$\mu m$</td>
<td>$\mu m$ or $\mu m.$</td>
<td>$\mu m$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unit of length</td>
<td>mm</td>
<td>mm or in.</td>
<td>mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Filter</td>
<td>2RC</td>
<td>2RC</td>
<td>2RC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Long cutoff</td>
<td>$\lambda_c$</td>
<td>$\lambda_c$</td>
<td>$\lambda_c$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Short cutoff</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sampling length</td>
<td>$L = 3 \times \lambda_c$ or over</td>
<td>$L_{1.5} = 5 \times \lambda_c$ &amp; $L_{1.2} = 5 \times \lambda_c$</td>
<td>$L_{1.5} = 5 \times \lambda_c$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Evaluation length</td>
<td>$T_{L} = L = 3 \times \lambda_c$ or over</td>
<td>$n \times L_{1.2}$</td>
<td>$n \times L_{1.5}$</td>
</tr>
<tr>
<td></td>
<td>R profile height parameter</td>
<td>Maximum height</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maximum peak to valley height</td>
<td></td>
<td></td>
<td>$R_{\text{max}}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ten point height</td>
<td></td>
<td></td>
<td>$R_{z}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Average peak to valley height</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other peak height parameters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\lambda_c$ &amp; $\lambda_c$ for peak height parameter</td>
<td>0.25mm</td>
<td>$R_{\text{max}}$, $R_{z} \leq 0.6 \mu m$</td>
<td></td>
<td></td>
<td>not defined</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.8mm</td>
<td>$0.8 &lt; R_{\text{max}}$, $R_{z} \leq 6.3 \mu m$</td>
<td></td>
<td>not defined</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.5mm</td>
<td>$6.3 &lt; R_{\text{max}}$, $R_{z} \leq 25 \mu m$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Indication of Maximum height in case of $R_{z} &lt; 1.5 \mu m$</td>
<td></td>
<td></td>
<td>$R_{\text{max}} = 1.6 \sqrt{R_{\text{max}} &lt; 0.8}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R profile averaging parameter</td>
<td>Arithmetic average</td>
<td>$Ra$ (a indication)</td>
<td>$Ra$</td>
<td>$Ra$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>root mean square</td>
<td>$(Rq)$</td>
<td>$Rq$</td>
<td>$Rq$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Skewness, kurtosis</td>
<td>(Skewness, Kurtosis)</td>
<td>$Sk$, $Ek$</td>
<td>$Sk$</td>
</tr>
<tr>
<td>$\lambda_c$ &amp; $\lambda_c$ for $Ra$ on non-periodic profile</td>
<td>0.25mm</td>
<td>optional</td>
<td>0.0063 &lt; $Sm$ &lt; 0.05mm</td>
<td>not defined</td>
<td>0.02 &lt; $R_{a}$ &lt; 1.1mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.8mm</td>
<td>$Ra \leq 12.5 \mu m$</td>
<td>0.02 &lt; $Sm$ &lt; 0.16mm</td>
<td>not defined</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.5mm</td>
<td>$12.5 &lt; Ra \leq 100 \mu m$</td>
<td>0.063 &lt; $Sm$ &lt; 0.5mm</td>
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<td>Indication of $Ra$ in case of $1.5 &lt; Ra &lt; 3.1 \mu m$</td>
<td>$Ra_{1.6} - 3.2$</td>
<td>$Ra_{1.6} - 3.2$</td>
<td>$Ra_{1.6} - 3.2$</td>
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<td>Mean spacing</td>
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<td>RMS slope</td>
<td>$\Delta q$</td>
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<td>Material ratio</td>
<td>(tp)</td>
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<td>Other parameters</td>
<td>(Peak count Pc)</td>
<td>$S$, $\Delta a$, $\lambda a$, $\lambda q$, $L_{o}$, $D$</td>
<td>$S$, $\Delta a$, $\lambda a$, $\lambda q$, $L_{o}$, $D$</td>
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<td>Comparison rule of measured value with tolerance limits</td>
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<td>Maximum rule</td>
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<td>ASME B46.1-‘95</td>
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<td>Analog signal</td>
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<td>0.5, 1.5, 5, 15 &amp; 50mm</td>
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<td>Length of the measured feature</td>
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<td>(P_t, P_z(=P_t))</td>
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<td>15 / (P_t)</td>
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- \(\mu m (\mu in)\)
- \(\mu m\)
- \(\mu m\)
- \(\mu m (or \mu in.)\)
- \(\mu m\)

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<td>\delta e</td>
<td>= 5 \times</td>
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- \(R_y\)
- Maximum two point height \(R_{max}\)
- \(R_t\)
- Maximum height \(R_y\) in 1 \(|\delta r|\)
- \(R_{max}\)
- \(R_{max}\)
- \(R_{max}\)
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- \(R_{max}\)
- \(R_{max}\)

\(R_{max} = 1.6\)
\(R_{max} = 1.6\)
\(R_{max} = 1.6\)
\(L = 5 \times 1.5\)

- \(R_y = 1.6\)
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- \(R_{max} = 1.6\)
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- Sm
- \(S\)
- \(t_p\)
- \(\Delta q\)
- \(R_{max}\)
- \(R_{max}\)
- \(R_{max}\)
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- \(R_{max}\)
- \(R_{max}\)
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- \(R_{max}\)
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- \(R_{max}\)
- \(R_{max}\)

- Average value of all sampling lengths
- Average value of all sampling lengths
- 16% rule
- 16% rule for \(R_{max}\)
- Max rule for \(R_{max}\)
- Max rule for parameter with suffix “max”

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**ISO13565’s, (JIS B0671’s)**

- ISO13565, (JIS B0671’s)
- ISO1302:’02
- UK, U.K. & Japan

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**TOKYO SEIMITSU**

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