Precise roughness measurement. Surface texture parameters in practice.

Selection of the cut-off (profile filter) according to ISO 4288-1998 and ISO 3274-1998

The cut-off is selected depending on the workpiece surface either according to the valley spacing, or the expected roughness values. At the same time, the total evaluation length and the corresponding traverse length are defined according to standards. Deviations are necessary if the workpiece does not satisfy the required course length. See drawing entries.

### Drawing entries according to ISO 1302-2002

A surface with a characteristic does not comply with standard case (cf. table)

### Division of a surface

Surface profile - total length of the profile

The unfiltered primary profile (p-profile) is the actual measured surface profile. Filtering is necessary with all VDA (13565-2/2007) production machines. The primary profile and the roughness profile (c-profile) are available for determining the limit between waviness and roughness. This is the cut-off length.

Following ISO 4288, all parameters are defined for both the roughness profile as well as for the primary and waviness profile. The profile type is identified by the capital letters P for P-profile and R for R-profile. The parameters defined for the roughness profile are defined as the sum of the height difference between the highest peak and the deepest valley of the profile.

### Evaluation of measurement results

According to ISO 4287 the surface roughness should be made where the highest values are to be expected (visual determination).

#### Maximum value rule

The surface is considered good when the measured value of a parameter does not exceed the found maximum value. In this case, the parameter is defined by the suffix ‘max’, e.g., Rz max.

#### 16% rule

If the suffix ‘max’ is not specified, the 16% rule applies, which states that the surface is considered ‘good’ if not more than 16% of the measured parameter exceeds the maximum value. You will find further information about this rule in the standard ISO 4287:1997.

#### Special rule VDA

The 16% rule is not used. VDA 2006 assumes that the dispersion of the parameter is taken into account in the definition of the limit values. The maximum value rule applies generally even without the ‘max’ index in the designation. The limit of the rule is not standardized.

All Rz < 3 μm the stylus tip radius is 3 μm, Rz ≥ 2 μm is 5 μm. The distance between two measuring points is 0.5 μm. The tolerance of the measurement length is ±0.01 μm.

### The most important roughness parameters according to ISO 4287, ISO 13565 and ISO 10049

**Ra according to ISO 4287**

- **Ra** – arithmetic mean deviation
  - Ra is the arithmetic mean roughness value from the amounts of all profile values. It does not differentiate between peaks and valleys and therefore has a relatively weak information character.

**Rz, RzMax, Rt according to ISO 4287**

- **Rz** – maximum height of profile
  - *Average value of the five Ra values.*

**Rpk, Rvk, Mr1, Mr2 according to ISO 13565-2**

- **Rpk** – reduced peak height
- **Rvk** – deepest profile valley depth
- **Mr1** and **Mr2**
  - Smallest (Mr1) and greatest (Mr2) material ratio (in %) at the measurement length.

**Rmr(c)** according to ISO 4287

- **Rmr** – material ratio of the profile
  - Material ratio as a function of the section height.

**Rmr(c)** corresponds to the number of peaks, which sequentially exceed an upper section line c1 and a lower section line c2. The number of peaks is related to a length of 10 mm irrespective of the evaluation length selected.

**Rmr** – material ratio of the profile

- Material ratio as a function of the section height.

**Rmk(c)** according to ISO 13565-2

- **Rmk** – material ratio of the profile
  - Material ratio as a function of the section height.

**Rk, Rpk, Rvk, Mr1, Mr2 according to ISO 13565-2**

**Rd according to ISO 13565**

- **Rd** – total height of peak
  - Average value of the five Ra values.

**Rg according to ISO 13565**

- **Rg** – total depth of profile
  - Average value of the five Ra values.

**RSm according to ISO 4287**

- **RSm** – mean width of the profile elements
  - RSm is the arithmetic mean value of the width of the roughness profile elements which the sampling length and requires the determination of the maximum value (1.5 to 2.5 times the stylus tip radius).

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### Drawing entries according to VDO 2007 – dominant wavinesses

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Definition</th>
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<td>W0</td>
<td>Depth of surface profile</td>
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<tr>
<td>W1</td>
<td>Lower surface profile depth</td>
</tr>
<tr>
<td>W2</td>
<td>Upper surface profile depth</td>
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<tr>
<td>W3</td>
<td>Depth of the valley resulting from the roughness profile</td>
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<tr>
<td>W4</td>
<td>Height of the peak protruding from the roughness profile</td>
</tr>
</tbody>
</table>

**W0** – dominant waviness

Some values are given in the table below:

- Width of a peak: 0.008/2.0 μm
- Width of a valley: 2.5x5/2.5 μm
- Depth: 2.5 μm