

Information about the content

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|--------------------|-------------|--------------------------|------------------|
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| | | Released: | Wolfgang GLATZ |
| Valid from: | 27-Jul-2020 | Controlled: | PSE-020 |

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This specification describes highly deformed Molybdenum rods. The material is used mainly in different high temperature applications.

1 Dimensions and tolerances

1.1 Diameter and guaranteed product tolerances

| Diameter [mm] | Diameter tolerance [mm] | Cylindrical tolerance [mm] |
|------------------|----------------------------|----------------------------------|
| ground | | |
| 0,50 - 0,99 | ± 0,007 | |
| 1,00 - 1,99 | ± 0,010 | |
| 2,00 - 2,99 | ± 0,015 | |
| 3,00 - 15,9 | ± 0,020 | Value within defined Ø-tolerance |
| 16,0 - 24,9 | ± 0,030 | |
| 25,0 - 34,9 | ± 0,050 | |
| 35,0 - 39,9 | ± 0,060 | |
| ≥ 40,0 | ± 0,20 | |
| cleaned | | |
| 0,50 - 4,00 | ± 2,0 % | |
| 4,10 - 11,4 | ± 1,50 % | |
| 11,41 - 50,0 | ± 0,30 | Value within defined Ø-tolerance |
| 51,0 - 75,0 | ± 0,40 | |
| 75,1 - 120,0 | ± 1,00 | |
| 121,0 - 165,0 | ± 1,50 | |
| turned | | |
| 40,0 - 49,9 | ± 0,30 | Value within defined Ø-tolerance |
| 50,0 - 165,0 | ± 0,40 | |

Tolerances differ from those of the ASTM-specification because of the metric table.



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1.2 Product length and straightness

| Diameter [mm] | Production length [mm] | Straightness / Meter [mm] | |
|------------------|---------------------------|------------------------------|-----------------|
| | | Cleaned | Ground / turned |
| 0,50 - 0,99 | > 500 | < 2,5 | < 2,5 |
| 1,00 - 9,90 | > 300 | < 2,0 | < 1,5 |
| 10,0 - 165,0 | > 100 | < 1,5 | < 1,0 |

1.3 Guaranteed length tolerances

| Diameter 0,50 - 30,0 mm | | | | | | |
|-------------------------|----------|------------|-------------|--------------|---------------|--------|
| Nominal length [mm] | ≥ 6 - 30 | > 30 - 120 | > 120 - 400 | > 400 - 1000 | > 1000 - 2000 | > 2000 |
| Length tolerance [mm] | ± 0,2 | ± 0,3 | ± 0,5 | ± 0,8 | ± 1,2 | ± 2,0 |
| Diameter > 30,0 mm | | | | | | |
| Nominal length [mm] | ≥ 6 - 30 | > 30 - 120 | > 120 - 400 | > 400 - 1000 | > 1000 - 2000 | > 2000 |
| Length tolerance [mm] | ± 1,0 | ± 1,5 | ± 2,5 | ± 4,0 | ± 6,0 | ± 8,0 |

2 Physical and mechanical product properties

| | | |
|-----------------|--------------------|---------------------------|
| Density: | Ø 0,50 - 40,0 mm | ≥ 10,15 g/cm ³ |
| | Ø 40,1 - 80,0 mm | ≥ 10,10 g/cm ³ |
| | Ø 80,1 - 120,0 mm | ≥ 10,00 g/cm ³ |
| | Ø 120,1 - 165,0 mm | ≥ 9,90 g/cm ³ |

| | |
|--------------------------------|---|
| Nondestructive Testing: | For diameters > 15,00 mm: 100 % ultrasonic testing (all types) |
| | For diameters of 0,50 – 50,0 mm: Eddy current tests on rods with ground surface |



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PRODUCT SPECIFICATION

Classification: Öffentlich/Public
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| Diameter [mm] | Tensile strength [MPa] | 0,2 % Yield strength [MPa] | Elongation [%] | Hardness ^{a)} [HV 10] |
|------------------|---------------------------|----------------------------------|-------------------|-----------------------------------|
| 0,50 - 3,18 | ≥ 585 | ≥ 450 | ≥ 15 | - |
| > 3,18 - 10,32 | ≥ 515 | ≥ 380 | ≥ 15 | - |
| > 10,32 - 22,2 | ≥ 620 | ≥ 515 | ≥ 18 | 210 - 280 |
| > 22,2 - 28,6 | ≥ 585 | ≥ 480 | ≥ 15 | 210 - 270 |
| > 28,6 - 47,6 | ≥ 515 | ≥ 450 | ≥ 10 | 210 - 260 |
| > 47,6 - 73,0 | ≥ 480 | ≥ 415 | ≥ 10 | 210 - 250 |
| > 73,0 - 88,9 | ≥ 450 | ≥ 380 | ≥ 10 | 205 - 240 |
| 89,0 - 120,9 | ≥ 450 | ≥ 380 | ≥ 5 | 200 - 240 |
| 121,0 - 164,9 | ≥ 450 | ≥ 380 | ≥ 5 | 180 - 240 |
| 165,0 | ≥ 450 | ≥ 380 | - | 180 - 240 |

a) The actual value quoted in certificates corresponds to the mean-value of a representative control sample.

2.1 Surface condition

| Surface: | Cleaned | Ground | Turned |
|------------|------------------|-------------------------------|-------------------------------|
| | Ø 0,50 - 165 mm | Ø 0,50 - 50,00 mm | Ø ≥ 40,00 mm |
| Roughness: | Diameter [mm] | R _a [µm] Ground | R _a [µm] Turned |
| | ≤ 2,50 | ≤ 0,80 | - |
| | > 2,50 - 50,0 | ≤ 1,00 | - |
| | ≥ 40,0 | - | ≤ 3,2 |



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3 Chemical composition

| Main and minor components | Plansee | | Standard ASTM B387 (361) | EU-Directive RoHS ^{a)} |
|---|------------------------------|------------------|--------------------------------|------------------------------------|
| | Min. content | | | |
| Mo | 99,97 % ^{b)} | | balance | - |
| Impurities | Max. values [µg/g] | | Max. values [µg/g] | Max. values [µg/g] |
| | Typical | Guaranteed | | |
| Al | 1 | 10 | - | - |
| Cr | 3 | 20 | - | - |
| Cu | 2 | 20 | - | - |
| Fe | 5 | 20 | 100 | - |
| K | 6 | 20 | - | - |
| Ni | 1 | 10 | 50 | - |
| Si | 2 | 20 | 100 | - |
| W | 169 | 300 | - | - |
| C | 13 | 30 | 100 | - |
| H | - | 10 | - | - |
| N | 5 | 10 | 20 | - |
| O | 6 | 40 | 70 | - |
| Cd | 1 | 5 | - | 100 |
| Hg ^{c)} | - | 1 | - | 1000 |
| Pb | - | 5 | - | 1000 |
| Cr (VI) | - | - | - | 1000 |
| Organic impurities (e.g. PBB, PBDE, PFOS, PFOA) | - ^{**)} | - ^{**)} | - | 1000 |

a) EU-directives 2015/863/EU, 2011/65/EU and 2000/53/EC

b) Metallic purity without W

c) Initial value

^{**)} The presence of Cr (VI) and organic impurities can definitely be excluded because of the production process (multiple heat treatments at temperatures above 1000 °C in H₂-atmosphere).

The chemical composition is checked by means of random sampling. The sampling inspection plan, analysis and evaluation methods are determined in the internal instruction PSE-020-WI-003. The application of the measured values for the chemical analysis is defined in PSE-680-WI-001.

Remarks: The specified physical and chemical characteristics are disclosed not regarding measurement accuracy.



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4 Packaging, labelling, storage and certification

4.1 Packaging, labelling and storage

Standard individual packing: rods are either bundled or packed individually.

Each package will be provided with a label with the following information:

| | |
|------------------------------|---------------------------|
| Producer's name: | Plansee |
| Plansee order number: | |
| Lot number: | |
| Material number: | |
| Material: | Mo |
| Dimension: | Rod diameter and length |
| Surface: | |
| Quantity: | Total quantity in m or kg |
| Date: | |

The material must be kept in a dry place and protected from mechanical damage. It is best to keep the material in the original packing until used.

Special packing: (extra costs will be invoiced)

Special packing should be used if the material is stored under unusual conditions or aggressive atmosphere (e.g. sea air, ...).

4.2 Inspection documents

Following inspection documents will be supplied upon customer request according to EN 10 204:

Test report 2.2

Plansee confirms with this test report that the delivered product meets the specification and gives details of the material properties according to ongoing production surveillance, not directly related to the particular production batch.

Inspection certificate 3.1 (extra costs will be invoiced)

An inspection officer from Plansee confirms with this inspection certificate that the delivered product meets the specification and gives test results related to the particular production batch.



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5 Order instructions

Please quote following information when ordering:

- Product description
- Quality (the number of this specification must be mentioned)
- Surface condition
- Dimension
- Quantity in m or kg
- Required certificate and content in case of a 3.1 inspection certificate
- *For special packing:* Specification of packaging

For further information on our delivery possibilities, please look into our <http://www.plansee.com>

6 Referenced standards

The standards applied for the test methods are listed in the Plansee standard InfoBase and are made available upon request.

This Product Specification is compliant with ASTM B387 with the exception of the following characteristics:

- Out-of-round tolerances in case of the quality „cleaned “
- Diameter tolerances in case of the quality “cleaned” for diameters 1,1 – 1,59 mm; 2,53 – 7,14 mm; 15,0 – 22,2 mm and 75,1 – 82,6 mm
- Length tolerances in case of $L > 2000$ mm and $\varnothing > 30$ mm

Changes to last version:

PSE-610-PS-100 Rev. 01

06.04.2021 SQS/BaumannJ – Formale change:

- Percentage symbol removed from the minimum content in the "Chemical composition" table



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