

Technical Information

Material Data Sheet
Titanium



OTTO FUCHS

Titanium and OTTO FUCHS

Forged titanium materials show a series of excellent properties:

- low density,
- high static and dynamic mechanical properties as well as
- high corrosion resistance.

Depending on the application, these can be combined with further special properties:

- high heat resistance,
- toughness as well as
- excellent bio-compatibility.

Fields of applications

Aerospace Industry:

- Highly-stressed structural components in
 - Undercarriage,
 - Wings and
 - Engine suspension

Aero-engine Construction:

- Compressor discs and impellers with optimised
 - Mechanical properties,
 - Creep properties and
 - Fatigue properties

General Engineering:

- Heat exchangers with
 - High strength
 - Good corrosion resistance
- Flanges with
 - High strength
 - Good corrosion resistance
- Valves with
 - High strength
 - Good corrosion resistance

Engine Construction:

- Connecting rods with
 - Low weight
 - Good strength properties
- Valves with
 - High heat resistance

Medical Technology:

- Implants with
 - Excellent corrosion resistance
 - Bio-compatibility
 - Good strength properties
 - Good toughness

Comparison of standards

| OTTO FUCHS Designation | Comparison of standards | | | | | | | |
|------------------------|-------------------------|--------|------------------|---------|--------|--------------------|------------|------------------------------|
| | DIN EN | WLB | DIN Material No. | AECMA | UNS | BS | ASTM B 381 | AMS |
| T2 | - | 3.7024 | 3.7025 | Ti PO 1 | R50250 | T A1 | Grade 1 | - |
| T3 | 3452 | 3.7034 | 3.7035 | Ti PO 2 | R50400 | T A2 - 5 | Grade 2 | 4902 |
| T6 | - | 3.7064 | 3.7065 | Ti PO 4 | R50700 | T A6 - 9 | Grade 4 | 4901,4921 |
| TL20 | - | 3.7124 | - | - | - | T A24 | - | - |
| TL32 | - | - | - | - | R56320 | - | - | 6940 |
| TL52 | - | 3.7114 | 3.7115 | - | R54520 | - | Grade 6 | 4966, 4910, 6900 |
| TL62 | - | 3.7144 | 3.7145 | - | R54620 | - | - | 4919, 4976, 6905 |
| TL83 | - | - | - | - | - | - | - | - |
| TL64 | 3312/3315 | 3.7164 | 3.7165 | Ti P63 | R56400 | T A10 - 13, 28, 56 | Grade 5 | 4928, 4967, 6931, 4965, 6930 |
| TL69 | - | - | - | - | R56401 | - | - | 4907, 4931, 6932 |
| TL44 | 3351 | 3.7184 | 3.7185 | Ti P68 | - | T A45 - 51,57 | - | - |
| TL66 | - | 3.7174 | 3.7175 | Ti P64 | R56620 | - | - | 4971, 4978, 6936, 6935 |
| TL46 | - | - | - | - | R56260 | - | - | 4981, 6907, 6906 |
| TL10 | 3356 | - | - | - | R56410 | - | - | 4983, 4984, 4986, 4987 |
| TL17 | - | - | - | - | R58650 | - | - | 4995 |
| TL55 | - | - | - | - | - | - | - | - |

Physical properties

| OTTO FUCHS Designation | Physical properties | | |
|------------------------|---------------------------|-----------------------------------|---------------------------|
| | Density g/cm ³ | Young's modules N/mm ² | Transition temperature °C |
| T2 | 4,50 | 105.000 | 885 |
| T3 | 4,50 | 105.000 | 885 |
| T6 | 4,50 | 108.000 | 885 |
| TL20 | 4,56 | 113.000 | 880 |
| TL32 | 4,48 | 100.000 | 935 |
| TL52 | 4,46 | 117.000 | 1020 |
| TL62 | 4,55 | 114.000 | 1000 |
| TL83 | 4,55 | 115.000 | 1045 |
| TL64 | 4,43 | 110.000 | 990 |
| TL69 | 4,43 | 110.000 | 990 |
| TL44 | 4,60 | 117.000 | 975 |
| TL66 | 4,54 | 116.000 | 945 |
| TL46 | 4,65 | 114.000 | 940 |
| TL10 | 4,65 | 106.000 | 800 |
| TL17 | 4,65 | 106.000 | 890 |
| TL55 | 4,65 | 106.000 | 860 |

Mechanical properties

Typical material properties

| OTTO FUCHS Designation | Material code type EN AW | Alloy type | Mechanical properties | | | | | | Typical material properties |
|------------------------|--------------------------|--------------------|-----------------------|---------------------------------|------------|----------|--------|-------|---|
| | | | Heat treatment | Heat treatment thickness d [mm] | Rpo2 [MPa] | Rm [MPa] | A5 [%] | Z [%] | |
| T2 | Ti99,5 | α | annealed | - | 200 | 290-430 | 24 | - | α -alloy with good corrosion resistance, good weldability and excellent formability |
| T3 | Ti99,4 | α | annealed | ≤ 80 | 290 | 390-540 | 20 | 30 | like T2, with increased mechanical strength |
| T6 | Ti99,2 | α | annealed | ≤ 80 | 490 | 540-740 | 15 | 25 | α -alloy with highest mechanical strength; weldable, otherwise like T2 and T3 |
| TL20 | Ti2Cu | α | annealed | ≤ 80 | 400 | 540 | 16 | 35 | α -alloy with medium mechanical strength, good heat resistance and good creep resistance at 200°C to 500°C; difficult to transform, weldable |
| | | | heat treated | ≤ 80 | 540 | 650 | 10 | 30 | |
| TL32 | Ti3Al2.5V | $\alpha + \beta$ | annealed | | 480 | 620 | 15 | 30 | medium strength, heat treatable titanium alloy, good weldable, good forgeable, good machinability |
| TL52 | Ti5Al2.5Sn | α | annealed | ≤ 100 | 760 | 790 | 10 | 25 | weldable α -alloy with medium mechanical strength, heat treatable, forgeable |
| TL62 | Ti6Al2Sn4Zr2Mo | $\alpha + \beta$ | heat treated | ≤ 80 | 830 | 900 | 9 | 25 | high-temperature alloy, mainly engine application up to 520°C, weldable |
| TL83 | IMI834 | $\alpha + \beta$ | heat treated | ≤ 75 | 880 | 1000 | 6 | 15 | high-temperature alloy, mainly engine application up to 600°C, weldable |
| TL64 | Ti6Al4V | $\alpha + \beta$ | annealed | ≤ 80 | 830 | 900 | 10 | 25 | the most widespread high strength and heat treatable titanium alloy for all applications, weldable, good forgeability, good fracture toughness |
| | | | annealed | | 830 | 900 | 8 | 20 | |
| | | | heat treated | ≤ 13 | 1030 | 1100 | 8 | 15 | |
| | | | heat treated | | 1000 | 1070 | 8 | 15 | |
| TL69 | Ti6Al4ELI | $\alpha + \beta$ | annealed | ≤ 75 | 795 | 860 | 10 | 25 | like TL64 with increases fracture toughness |
| | | | annealed | | 760 | 830 | 10 | 20 | |
| TL44 | Ti4Al4Mo2Sn | $\alpha + \beta$ | heat treated | ≤ 100 | 920 | 1050 | 9 | 20 | high-strength, good heat treatable α - β -alloy |
| | | | heat treated | | 870 | 1000 | 9 | 20 | |
| TL66 | Ti6Al6V2Sn | $\alpha + \beta$ | annealed | ≤ 80 | 930 | 1000 | 8 | 20 | highly strength, good forgeable α - β -alloy |
| | | | heat treated | ≤ 25 | 1100 | 1200 | 6 | 15 | |
| TL46 | Ti6Al2Sn4Zr6Mo | β metastabil | heat treated | ≤ 150 | 940 | 1090 | 4 | - | highly strength, good heat treatable meta-stable alloy, engine application up to 400°C |
| TL10 | Ti10V2Fe3Al | β metastabil | heat treated | ≤ 75 | 1105 | 1195 | 4 | - | good heat treatable, meta-stable β -alloy with with medium to very high mechanical strength |
| | | | heat treated | ≤ 100 | 895 | 956 | 8 | 20 | |
| TL17 | Ti5Al2Sn4Mo2Zr4Cr | β metastabil | heat treated | ≤ 150 | 1055 | 1124 | 5 | 10 | highly strength, good heat treatable meta-stable alloy; application in engine |
| TL55 | Ti5Al5V5Mo3Cr | β metastabil | heat treated | ≤ 150 | 1170 | 1240 | 6 | - | good heat treatable, meta-stable alloy with medium to very high mechanical strength; excellent fatigue characteristics |

You need a new or special alloy?

Do you need a titanium alloy that has been introduced recently, or a special alloy for your products?

In addition to the listed titanium alloys OTTO FUCHS also processes new and special alloys - ask for the desired alloy easy at OTTO FUCHS!

Die-forging technology

Processing titanium materials

OTTO FUCHS purchases titanium from approved suppliers. Together with our customers, we design die and hand forged parts with properties perfectly matching their intended application. This work also includes new titanium alloys.

Since more than five decades, OTTO FUCHS developed a special process technology for titanium.

This includes:

- CNC-controlled hydraulic hand- and die forging presses allowing reproducible processes
- a centrally monitored heat-up and heat treatment unit
- special hot die-forging and "near-net-shape" forging technology

We manufacture several hundred different titanium die-forgings with individual weights ranging from 20 grams to 1.000 kilograms. Our largest die-forging press with a pressing force of 60.000 t enables us to forge parts with a maximum plan view up to 15.000 cm².



Rotor Head
Ø 1.500 mm
156 kg



Engine Ring
Ø 774 mm x 188 mm
81 kg



V-Bay Frame
1.900 mm x 1.200 mm
160 kg

Chemical composition

| OTTO FUCHS Designation | Chemical composition (ref. values/mass %) | | | | | Chemical composition (ref. values/mass %) | | | | | | | | | |
|------------------------|---|------------|-------------|-------------|-------------|---|-----------|------------|----------------|------------|----------------|-------------|----------------|------|--|
| | Al | V | Mo | Zr | Sn | Cu | Cr | Si | O ₂ | Fe | H ₂ | C | N ₂ | Ti | |
| T2 | - | - | - | - | - | - | - | - | ≤ 0,20 | ≤ 0,20 | ≤ 0,0125 | ≤ 0,08 | ≤ 0,05 | Rest | |
| T3 | - | - | - | - | - | - | - | - | ≤ 0,25 | ≤ 0,25 | ≤ 0,0125 | ≤ 0,08 | ≤ 0,05 | Rest | |
| T6 | - | - | - | - | - | - | - | - | ≤ 0,40 | ≤ 0,35 | ≤ 0,0125 | ≤ 0,08 | ≤ 0,05 | Rest | |
| TL20 | - | - | - | - | - | 2,0 - 3,0 | - | - | ≤ 0,20 | - | - | - | - | Rest | |
| TL32 | 2,5 - 3,5 | 2,0 - 3,0 | - | - | - | - | - | - | ≤ 0,12 | ≤ 0,030 | ≤ 0,015 | ≤ 0,050 | ≤ 0,020 | Rest | |
| TL52 | 4,5 - 5,5 | - | - | - | 2,0 - 3,0 | - | - | - | ≤ 0,20 | ≤ 0,50 | ≤ 0,0125 | ≤ 0,08 | ≤ 0,05 | Rest | |
| TL62 | 5,5 - 6,5 | - | 1,8 - 2,2 | 3,6 - 4,4 | 1,8 - 2,2 | - | - | 0,06 - 0,1 | ≤ 0,15 | ≤ 0,05 | ≤ 0,0150 | ≤ 0,05 | ≤ 0,05 | Rest | |
| TL83 | 5,6 - 6,0 | - | 0,4 - 0,6 | 3,8 - 4,2 | 3,8 - 4,2 | - | - | 0,3 - 0,4 | 0,07 - 0,15 | ≤ 0,05 | ≤ 0,010 | 0,04 - 0,08 | ≤ 0,010 | Rest | |
| TL64 | 5,5 - 6,75 | 3,5 - 4,5 | - | - | - | - | - | - | ≤ 0,20 | ≤ 0,30 | ≤ 0,0125 | ≤ 0,08 | ≤ 0,05 | Rest | |
| TL69 | 5,5 - 6,75 | 3,5 - 4,5 | - | - | - | - | - | - | ≤ 0,13 | ≤ 0,05 | ≤ 0,0125 | ≤ 0,08 | ≤ 0,05 | Rest | |
| TL44 | 3,0 - 5,0 | - | 3,0 - 5,0 | - | 1,5 - 2,5 | - | - | 0,3 - 0,7 | ≤ 0,25 | ≤ 0,20 | ≤ 0,0150 | ≤ 0,08 | ≤ 0,05 | Rest | |
| TL66 | 5,0 - 6,0 | 5,0 - 6,0 | - | - | 1,5 - 2,5 | 0,35 - 0,1 | - | - | ≤ 0,20 | 0,35 - 1,0 | ≤ 0,0150 | ≤ 0,05 | ≤ 0,04 | Rest | |
| TL46 | 5,5 - 6,5 | - | 5,50 - 6,50 | 3,50 - 4,50 | 1,75 - 2,25 | ≤ 0,1 | - | ≤ 0,1 | 0,07 - 0,12 | ≤ 0,15 | ≤ 0,0125 | ≤ 0,04 | ≤ 0,04 | Rest | |
| TL10 | 2,6 - 3,4 | 9,0 - 11,0 | - | - | - | - | - | - | ≤ 0,13 | 1,6 - 2,2 | ≤ 0,0150 | ≤ 0,05 | ≤ 0,05 | Rest | |
| TL17 | 4,50 - 5,50 | - | 3,50 - 4,50 | 1,50 - 2,50 | 1,50 - 2,50 | ≤ 0,10 | 2,5 - 3,5 | - | 0,08 - 0,13 | ≤ 0,30 | ≤ 0,0125 | ≤ 0,05 | ≤ 0,04 | Rest | |
| TL55 | 4,4 - 5,7 | 4,0 - 5,5 | 4,0 - 5,5 | < 0,3 | - | - | 2,5 - 3,5 | < 0,15 | ≤ 0,18 | 0,3 - 0,5 | ≤ 0,015 | ≤ 0,1 | ≤ 0,05 | Rest | |

Chemical composition

Solutions made of titanium alloys

When designing high-strength components made of titanium materials, the draft for the part to be made is often only very approximate.

Here OTTO FUCHS offers the full range of services, starting with consultation on the choice of material and defining a forged part design that is suitable for production through to mechanical pre-machining of large-area hand-forged and die-forged parts as well as support for further processing by the customer.

In special cases we are also able to supply finished drop-forged parts.

Do you have any more questions?

Our experts are available to you at any time and will be glad to answer questions and provide advice. Simply contact us by sending an email to info@otto-fuchs.com.

Further material data sheets



Material data sheet Aluminium



Material data sheet Copper



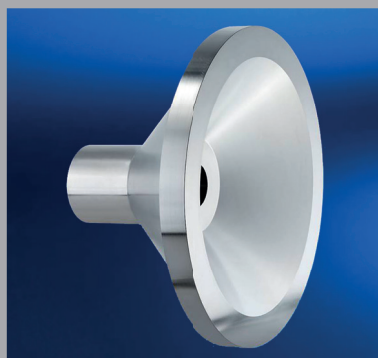
Material data sheet Magnesium



Engine Mount
600 mm x 250 mm x 130 mm
35 kg



Flap Track
2.450 mm x 630 mm x 160 mm
371 kg



Drive Cone
Ø 673 mm x 315 mm
108 kg

OTTO FUCHS KG

Derschlager Straße 26
D-58540 Meinerzhagen
Germany
T. +49 2354 73-0
F. +49 2354 73-201
info@otto-fuchs.com
www.otto-fuchs.com



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We do not accept liability for any poss. mistakes in the technical specifications. Errors excepted.