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# Titanium and titanium alloys — Designation system

*Titane et alliages de titane — Système de désignation*



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# Foreword

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This document was prepared by Technical Committee ISO/TC 79, *Light metals and their alloys*, Subcommittee SC 11, *Titanium*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

# Introduction

This document was developed in response to a demand for designating an alloy system for titanium and titanium alloys developed worldwide.

As this system is established, newly developed alloys can be designated in the same way as existing alloys and it becomes possible to establish standards concerning new alloy products.

This unified classification can promote the sale of titanium and titanium alloys products in the global market.

# Titanium and titanium alloys — Designation system

## 1 Scope

This document specifies a designation system of titanium and titanium alloys in terms of their chemical composition and impurities contents.

## 2 Normative references

There are no normative references in this document.

## 3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

## 4 Material designation

### 4.1 Basis of designation

#### 4.1.1 General

The material designations of unalloyed titanium shall be based on the content of impurities. The material designations of titanium alloys shall be based on their chemical composition and the content of impurities in the case of titanium alloys containing micro-alloying elements in a low percentage such as palladium, ruthenium, molybdenum, nickel, chromium and cobalt, either singly or in combination in unalloyed titanium for improving corrosion resistance and other characteristics.

#### 4.1.2 Prefix

All material designations shall have the prefix “ISO”.

This prefix may be omitted for brevity in International Standards as well as in correspondence where it is obvious that ISO designations are used.

#### 4.1.3 Designation system

International chemical symbols shall be used for the designation of the base element and alloying elements.

### 4.2 Unalloyed titanium

Designations for unalloyed titanium shall consist of the international chemical symbol of the element “Ti”, followed by a figure of one digit showing the maximum allowable contents of impurities such as nitrogen, iron and oxygen, e.g. Ti1.

For unalloyed titanium containing impurities of less than 1 % mass fraction such as iron, oxygen and nitrogen, either singly or in combination in unalloyed titanium for improving strength, the same designation system shall be applied. The user can make assignment or revision of material designation, if the new unalloyed titanium with higher limits of impurities specified in Table 1 for improving strength level is proposed as a new material specified (e.g. Ti6).

The figure following the symbol "Ti" shows the maximum allowable contents of impurities as specified in Table 1.

**Table 1 — Allowable impurities contents**

| Figure | Allowable impurity content % mass fraction | | |
|---|---|---|---|
| | Nitrogen | Iron | Oxygen |
| 1 | 0,03 | 0,20 | 0,18 |
| 2 | 0,03 | 0,30 | 0,25 |
| 3 | 0,05 | 0,30 | 0,35 |
| 4 | 0,05 | 0,50 | 0,40 |

"H" grade material is identical to the corresponding numeric or designated grade except for the higher guaranteed minimum 0,2 % offset strength (yield strength for a specific yielding point is exhibited) and tensile strength accompanied with a slightly high impurities content.

"L" grade material is identical to the corresponding numeric or designated grade except for the lower guaranteed minimum 0,2 % offset strength (yield strength for a specific yielding point is exhibited) and tensile strength accompanied with a slightly low impurities content.

Unalloyed titanium shall be designated according to Annex A.

## 4.3 Titanium alloys

### 4.3.1 Designation based on chemical composition

Designations for titanium alloys shall consist of the international chemical symbol of the base element "Ti", followed by whole numbers indicating the nominal percentage amount of the alloying elements added, followed by their chemical symbols and linked by hyphen, e.g. Ti-6Al-4V.

The alloying elements shall be listed according to the specified nominal percentage amount. The alloying elements shall be listed in decreasing order of contents or, if the contents are equal, in alphabetical order of the chemical symbols, e.g. Ti-6Al-6V-2Sn.

For titanium alloys that are typically expressed by a sequence with the number of alloying elements ignoring the alphabetical and content order, add such unique sequence of number after the designated notation with parentheses, e.g. Ti-6Al-4Zr-2Mo-2Sn(Ti-6-2-4-2) and Ti-10V-3Al-2Fe(Ti-10-2-3).

Titanium alloys with lower specified limits on iron and interstitial elements such as carbon, oxygen and nitrogen, the abbreviated term "ELI" (meaning extra low interstitial) shall be added at the end of symbol, e.g. Ti-6Al-4VELI.

In all cases where two or more alloying elements are present, it is not necessary to list all of them in the designation, except where they are essential for the proper identification of the alloy.

When a range is specified for an alloying element, the rounded off mean value in whole number shall be used in the designation. When a minimum content is specified for an alloying element, the rounded off minimum value in whole number shall be used in the designation.

#### 4.3.2 Designation based on chemical composition and impurity elements level

The designations of titanium alloys containing micro-alloying elements in a low percentage such as palladium, ruthenium, molybdenum, nickel, chromium and cobalt, either singly or in combination in unalloyed titanium for improving corrosion resistance and other characteristics, shall be applied in same manner as unalloyed titanium, showing the maximum allowable contents of nitrogen, iron and oxygen specified in Table 1 and followed by the same manner as applied for titanium alloys connected with hyphen, e.g. Ti1-0,15Pd.

When a range is specified for a micro-alloying element, the rounded off mean value to up to two decimal points shall be used in the designation. When only a minimum or maximum content is specified, the round off minimum or maximum value to up to two decimal points shall be used in the designation.

#### 4.3.3 Designation of titanium alloys

Titanium alloys shall be designated according to Annex A.

# Annex A
(normative)

# Designated unalloyed titanium and titanium alloys

Table A.1 shows the designation of the unalloyed titanium and titanium alloys.

NOTE Further designation and/or materials in addition to this table is possible.

**Table A.1 — Designation of unalloyed titanium and titanium alloys** (% mass fraction)

| Designation | C | O | N | H | Fe | Al | V | Pd | Ru | Ni | Mo | Cr | Co | Zr | Nb | Sn | Si | Cu | Ta | Other elements max. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | max. or range | max. or range | max. | max. | max. or range | | | | | | | | | | | | | | | Single | Total |
| Ti1 | 0,08 | 0,18 | 0,03 | 0,015 | 0,20 | | | | | | | | | | | | | | | 0,1 | 0,4 |
| Ti1-0,06Pd | 0,08 | 0,18 | 0,03 | 0,015 | 0,20 | | | 0,04 to 0,08 | | | | | | | | | | | | 0,1 | 0,4 |
| Ti1-0,18Pd | 0,08 | 0,18 | 0,03 | 0,015 | 0,20 | | | 0,12 to 0,25 | | | | | | | | | | | | 0,1 | 0,4 |
| Ti1-0,11Ru | 0,08 | 0,18 | 0,03 | 0,015 | 0,20 | | | | 0,08 to 0,14 | | | | | | | | | | | 0,1 | 0,4 |
| Ti2 | 0,08 | 0,25 | 0,03 | 0,015 | 0,30 | | | | | | | | | | | | | | | 0,1 | 0,4 |
| Ti2-0,06Pd | 0,08 | 0,25 | 0,03 | 0,015 | 0,30 | | | 0,04 to 0,08 | | | | | | | | | | | | 0,1 | 0,4 |
| Ti2-0,18Pd | 0,08 | 0,25 | 0,03 | 0,015 | 0,30 | | | 0,12 to 0,25 | | | | | | | | | | | | 0,1 | 0,4 |
| Ti2-0,11Ru | 0,08 | 0,25 | 0,03 | 0,015 | 0,30 | | | | 0,08 to 0,14 | | | | | | | | | | | 0,1 | 0,4 |
| Ti2-0,75Ni-0,3Mo | 0,08 | 0,25 | 0,03 | 0,015 | 0,30 | | | | | 0,6 to 0,9 | 0,2 to 0,4 | | | | | | | | | 0,1 | 0,4 |
| Ti2-0,5Co-0,06Pd | 0,08 | 0,25 | 0,03 | 0,015 | 0,30 | | | 0,04 to 0,08 | | | | | 0,2 to 0,8 | | | | | | | 0,1 | 0,4 |
| Ti2-0,45Ni-0,15Cr-0,03Ru-0,015Pd | 0,08 | 0,25 | 0,03 | 0,015 | 0,30 | | | 0,01 to 0,02 | 0,02 to 0,04 | 0,35 to 0,55 | | 0,1 to 0,2 | | | | | | | | 0,1 | 0,4 |
| Ti3 | 0,08 | 0,35 | 0,05 | 0,015 | 0,30 | | | | | | | | | | | | | | | 0,1 | 0,4 |
| Ti3-0,5Co-0,06Pd | 0,08 | 0,35 | 0,05 | 0,015 | 0,30 | | | 0,04 to 0,08 | | | | | 0,2 to 0,8 | | | | | | | 0,1 | 0,4 |
| Ti3-0,45Ni-0,15Cr-0,03Ru-0,015Pd | 0,08 | 0,35 | 0,05 | 0,015 | 0,30 | | | 0,01 to 0,02 | 0,02 to 0,04 | 0,35 to 0,55 | | 0,1 to 0,2 | | | | | | | | 0,1 | 0,4 |
| Ti4 | 0,08 | 0,40 | 0,05 | 0,015 | 0,50 | | | | | | | | | | | | | | | 0,1 | 0,4 |

**Table A.1** *(continued)*

| Designation | C | O | N | H | Fe | Al | V | Pd | Ru | Ni | Mo | Cr | Co | Zr | Nb | Sn | Si | Cu | Ta | Other elements max. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | max. or range | max. or range | max. | max. | max. or range | | | | | | | | | | | | | | | Single | Total |
| Ti1L-0,5Ni-0,05Ru | 0,08 | 0,10 | 0,03 | 0,015 | 0,20 | | | | 0,04 to 0,06 | 0,4 to 0,6 | | | | | | | | | | 0,1 | 0,4 |
| Ti2L-0,5Ni-0,05Ru | 0,08 | 0,15 | 0,03 | 0,015 | 0,30 | | | | 0,04 to 0,06 | 0,4 to 0,6 | | | | | | | | | | 0,1 | 0,4 |
| Ti2-0,5Ni-0,05Ru | 0,08 | 0,25 | 0,05 | 0,015 | 0,30 | | | | 0,04 to 0,06 | 0,4 to 0,6 | | | | | | | | | | 0,1 | 0,4 |
| Ti-5Al-2,5Sn | 0,08 | 0,20 | 0,03 | 0,015 | 0,50 | 4,0 to 6,0 | | | | | | | | | | 2,0 to 3,0 | | | | 0,1 | 0,4 |
| Ti-1,5Al | 0,08 | 0,25 | 0,03 | 0,015 | 0,30 | 1,0 to 2,0 | | | | | | | | | | | | | | 0,1 | 0,4 |
| Ti-5Al-1Sn-1V-1Zr-0,9Mo-0,1Si | 0,08 | 0,11 | 0,03 | 0,015 | 0,25 | 4,5 to 5,5 | 0,6 to 1,4 | | | | 0,6 to 1,2 | | | 0,6 to 1,4 | | 0,6 to 1,4 | 0,06 to 0,14 | | | 0,1 | 0,4 |
| Ti-0,4Si-0,25Fe | 0,08 | 0,15 | 0,03 | 0,015 | 0,15 to 0,40 | | | | | | | | | | | | 0,30 to 0,50 | | | 0,1 | 0,4 |
| Ti-6Al-4V | 0,08 | 0,20 | 0,05 | 0,015 | 0,40 | 5,5 to 6,75 | 3,5 to 4,5 | | | | | | | | | | | | | 0,1 | 0,4 |
| Ti-6Al-4V-0,06Pd | 0,08 | 0,20 | 0,05 | 0,015 | 0,40 | 5,5 to 6,75 | 3,5 to 4,5 | 0,04 to 0,08 | | | | | | | | | | | | 0,1 | 0,4 |
| Ti-6Al-4V-0,55Ni-0,06Pd | 0,08 | 0,20 | 0,05 | 0,015 | 0,40 | 5,5 to 6,75 | 3,5 to 4,5 | 0,04 to 0,08 | | 0,3 to 0,8 | | | | | | | | | | 0,1 | 0,4 |
| Ti-6Al-4VELI | 0,08 | 0,13 | 0,03 | 0,0125 | 0,25 | 5,5 to 6,5 | 3,5 to 4,5 | | | | | | | | | | | | | 0,1 | 0,4 |
| Ti-6Al-4V-0,11RuELI | 0,08 | 0,13 | 0,03 | 0,0125 | 0,25 | 5,5 to 6,5 | 3,5 to 4,5 | | 0,08 to 0,14 | | | | | | | | | | | 0,1 | 0,4 |
| Ti-3Al-2,5V | 0,08 | 0,15 | 0,03 | 0,015 | 0,25 | 2,5 to 3,5 | 2,0 to 3,0 | | | | | | | | | | | | | 0,1 | 0,4 |
| Ti-3Al-2,5V-0,06Pd | 0,08 | 0,15 | 0,03 | 0,015 | 0,25 | 2,5 to 3,5 | 2,0 to 3,0 | 0,04 to 0,08 | | | | | | | | | | | | 0,1 | 0,4 |