BS EN ISO 22674:2022

BSI Standards Publication

# Dentistry — Metallic materials for fixed and removable restorations and appliances

Documents
Document Sharing Hub

Full document details: BS EN ISO 22674:2022

# National foreword

This British Standard is the UK implementation of EN ISO 22674:2022. It is identical to ISO 22674:2022. It supersedes BS EN ISO 22674:2016, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee CH/106/2, Prosthodontic materials.

A list of organizations represented on this committee can be obtained on request to its committee manager.

**Contractual and legal considerations**

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

© The British Standards Institution 2022
Published by BSI Standards Limited 2022

ISBN 978 0 539 03075 4

ICS 11.060.10

**Compliance with a British Standard cannot confer immunity from legal obligations.**

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 September 2022.

**Amendments/corrigenda issued since publication**

| Date | Text affected |
|---|---|

Documents
Document Sharing Hub

Full document details: BS EN ISO 22674:2022

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

# EN ISO 22674

September 2022

ICS 11.060.10

Supersedes EN ISO 22674:2016

English Version

# Dentistry - Metallic materials for fixed and removable restorations and appliances (ISO 22674:2022)

Médecine bucco-dentaire - Matériaux métalliques pour les restaurations fixes et amovibles et les appareillages (ISO 22674:2022)

Zahnheilkunde - Metallische Werkstoffe für festsitzenden und herausnehmbaren Zahnersatz und Applikationen (ISO 22674:2022)

This European Standard was approved by CEN on 26 August 2022.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

**CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels**

© 2022 CEN All rights of exploitation in any form and by any means reserved worldwide for CEN national Members.

Ref. No. EN ISO 22674:2022 E

Documents
Document Sharing Hub

Full document details: BS EN ISO 22674:2022

## European foreword

This document (EN ISO 22674:2022) has been prepared by Technical Committee ISO/TC 106 "Dentistry" in collaboration with Technical Committee CEN/TC 55 “Dentistry” the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2023, and conflicting national standards shall be withdrawn at the latest by March 2023.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN ISO 22674:2016.

Any feedback and questions on this document should be directed to the users’ national standards body/national committee. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

## Endorsement notice

The text of ISO 22674:2022 has been approved by CEN as EN ISO 22674:2022 without any modification.

Documents
Document Sharing Hub

Full document details: BS EN ISO 22674:2022

# Contents

Page

**Foreword** ..... **v**
**Introduction** ..... **vi**
**1 Scope** ..... **1**
**2 Normative references** ..... **1**
**3 Terms and definitions** ..... **1**
**4 Symbols and classification** ..... **3**
4.1 Symbols ..... 3
4.2 Classification ..... 5
**5 Requirements** ..... **6**
5.1 Chemical composition ..... 6
5.1.1 Reported composition ..... 6
5.1.2 Permitted deviation from the reported composition for elements ..... 6
5.2 Hazardous elements ..... 7
5.2.1 Hazardous elements ..... 7
5.2.2 Limits for the hazardous elements ..... 7
5.2.3 Nickel ..... 7
5.3 Biocompatibility ..... 7
5.4 Mechanical properties ..... 7
5.4.1 General ..... 7
5.4.2 Proof stress of 0,2 % non-proportional extension ..... 8
5.4.3 Elongation after fracture ..... 9
5.5 Elastic modulus ..... 10
5.5.1 Precision of measurement method ..... 10
5.5.2 Determination of compliance with the requirements for Type 5 materials ..... 10
5.5.3 Mean value ..... 10
5.6 Density ..... 10
5.7 Corrosion resistance for material integrity ..... 10
5.8 Tarnish resistance ..... 10
5.9 Solidus and liquidus temperatures (alloy) or melting point (commercially pure metal) ..... 11
5.10 Thermal expansion coefficient ..... 11
5.11 Information, instructions and marking ..... 11
**6 Sampling** ..... **11**
**7 Preparation of specimen** ..... **11**
7.1 General ..... 11
7.2 Heat treatment ..... 12
7.2.1 General conditions ..... 12
7.2.2 Metallic materials for which a heat treatment is recommended in the instructions for use ..... 12
7.2.3 Metallic material for metal-ceramic restorations ..... 12
7.2.4 Metallic materials for which no heat-treatment is recommended in the instructions for use ..... 12
7.3 Proof stress of 0,2 % non-proportional extension and the elongation after fracture: Metallic materials for which production of conventional specimens is possible ..... 12
7.4 Type 0 metallic materials for which the production of conventional specimens is not possible ..... 13
7.5 Elastic moduli ..... 13
7.5.1 General ..... 13
7.5.2 Tensile strain method ..... 14
7.5.3 Flexure method (three or four point bending) ..... 14
7.5.4 Acoustic resonance method ..... 15

© ISO 2022 – All rights reserved


AVA Documents
Document Sharing Hub
Full document details: BS EN ISO 22674:2022

7.6 Density measurement 15
7.6.1 Solid material 15
7.6.2 Powder material 16
7.7 Corrosion resistance 16
7.8 Tarnish resistance and colour 16
7.9 Linear thermal expansion 16

**8 Measurement and test methods 16**
8.1 Information, instructions and marking 16
8.2 Chemical composition 16
8.3 Mechanical testing 17
8.3.1 Apparatus 17
8.3.2 Test procedure 17
8.3.3 Proof stress of 0,2 % non-proportional extension 17
8.3.4 Percentage elongation after fracture 18
8.4 Elastic modulus measurement 18
8.4.1 Tensile strain method 18
8.4.2 Flexure method in three- or four-point bending mode 19
8.4.3 Acoustic resonance method 21
8.5 Calculation of elasticity parameters from acoustic measurement 23
8.5.1 General 23
8.5.2 Elastic modulus 23
8.5.3 Shear modulus 23
8.5.4 Poisson's ratio 24
8.6 Density 24
8.6.1 Preparation of specimen 24
8.6.2 Reagents 24
8.6.3 Apparatus 24
8.6.4 Procedure 24
8.7 Corrosion resistance by the static 7 d immersion procedure of ISO 10271 24
8.7.1 Preparation of specimen 24
8.7.2 Reagents 24
8.7.3 Apparatus 24
8.7.4 Test solution 25
8.7.5 Test procedure 25
8.7.6 Analysis 25
8.7.7 Treatment of data 25
8.8 Sulfide tarnish test — Cyclic immersion 25
8.9 Sulfide tarnish test — Static immersion 25
8.10 Solidus and liquidus temperatures (dental casting alloys) or melting point (commercially pure metals) 25
8.10.1 Cooling curve method 25
8.10.2 Thermal analysis method 26
8.11 Linear thermal expansion 27

**9 Test report 27**

**10 Information and instructions for use 28**
10.1 Information 28
10.2 Processing instructions 29
10.3 Marking and labelling 29
10.4 Labelling of the package 29

**Annex A** (informative) **Tensile testing of a non-cast Type 0 metallic material that is intended for use in a thickness between 0,1 mm and 0,5 mm 31**

**Annex B** (normative) **Calculation of uncertainty for elasticity measurement 34**

**Annex C** (informative) **Measurement of Poisson's ratio 38**

**Bibliography 40**


© ISO 2022 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS EN ISO 22674:2022

# Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 106, *Dentistry,* Subcommittee SC 2, *Prosthodontic materials],* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 55, *Dentistry,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 22674:2016), which has been technically revised.

The main changes are as follows:

— addition of products produced using additive and subtractive manufacturing;

— revision of definitions and addition of new definitions for modern manufacturing techniques;

— addition of an overview of symbols in Clause 4 as Table 1;

— harmonization of symbols in formulae and Figures;

— static determination of elastic modulus was added in 8.4.1.3 (as an additional option);

— a requirement for a test report was added as Clause 9;

— a requirement for labelling the alloy composition on the package was added in 10.4.

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.

© ISO 2022 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS EN ISO 22674:2022

# Introduction

Specific qualitative and quantitative requirements for freedom from biological hazard are not included in this document, but it is recommended that, in assessing possible biological hazards, reference be made to ISO 10993-1 and ISO 7405.

Requirements for the performance of metals and alloys used for the metallic component of a metal-ceramic restoration contained in this document supersede such requirements formerly contained in ISO 9693. The requirements for the performance of ceramic material and the metal-ceramic bond in metal-ceramic restorative systems are specified in ISO 9693.

Requirements for the proof stress and minimum elongation after fracture for Type 0 metallic materials are not included in this document, but it is recommended to adopt the test procedure given in Annex A when measuring these properties.


© ISO 2022 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS EN ISO 22674:2022

# Dentistry — Metallic materials for fixed and removable restorations and appliances

## 1 Scope

This document specifies requirements and test methods for metallic materials that are suitable for the fabrication of dental restorations and appliances. Included are metallic materials recommended for use either with or without a ceramic veneer, or recommended for both uses. Furthermore, this document specifies requirements for packaging and marking of the products and for the instructions for use of these materials, including products delivered for sale to a third party.

This document does not apply to alloys for dental amalgam (see ISO 24234), dental brazing materials (see ISO 9333), or metallic materials for orthodontic appliances (e.g. wires, brackets, bands and screws).

This document is not applicable to magnetic attachment, which are specified in ISO 13017.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1942, *Dentistry — Vocabulary*

ISO 3696, *Water for analytical laboratory use — Specification and test methods*

ISO 5832-2, *Implants for surgery — Metallic materials — Part 2: Unalloyed titanium*

ISO 5832-3, *Implants for surgery — Metallic materials — Part 3: Wrought titanium 6-aluminium 4-vanadium alloy*

ISO 6344-3, *Coated abrasives — Determination and designation of grain size distribution — Part 3: Microgrit sizes P240 to P5000*

ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

ISO 7500-1, *Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system*

ISO 9513, *Metallic materials — Calibration of extensometer systems used in uniaxial testing*

ISO 9693, *Dentistry — Compatibility testing for metal-ceramic and ceramic-ceramic systems*

ISO 10271:2020, *Dentistry — Corrosion test methods for metallic materials*

ISO 15223-1:2021, *Medical devices — Symbols to be used with information to be supplied by the manufacturer — Part 1: General requirements*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1942 and the following apply.

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

© ISO 2022 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS EN ISO 22674:2022

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

**3.1**
**additive manufacturing**
process of joining materials to make parts from 3D model data, usually layer upon layer, as opposed to *subtractive manufacturing* (3.19) and formative manufacturing methodologies

[SOURCE: ISO/ASTM 52900:2021, 3.1.2, modified — Notes 1 and 2 to entry have been deleted.]

**3.2**
**appliance**
prefabricated metallic device such as attachments and bars

**3.3**
**as-cast state**
metallurgical condition of the *metallic material* (3.15) in its solid state when removed from the casting machine

Note 1 to entry: This condition is dependent upon the manufacturer's recommended cooling procedure (e.g. bench cooling).

**3.4**
**base metal**
metallic element, with the exception of *noble metals* (3.16) and silver

**3.5**
**base-metal alloy**
alloy having a *base metal* (3.4) as the principal element

**3.6**
**bench-cooling**
process whereby a casting is retained in its investment with exposed metal uppermost and placed on a flat, insulating surface at ambient temperature in freely circulating air until its temperature falls to ambient

**3.7**
**casting alloy**
*metallic material* (3.15) designed for casting into an investment mould

**3.8**
**ceramic veneer**
thin ceramic surface layer present on a *metallic material* (3.15) restoration to provide an aesthetic effect

**3.9**
**elastic modulus**
Young's modulus
ratio of elastic stress to elastic strain

**3.10**
**hardening**
heat-treatment of a *metallic material* (3.15) producing a condition which provides a higher 0,2 % proof stress than the *as-cast state* (3.3)

Note 1 to entry: If recommended by the manufacturer, explicit instructions are required in the instructions for use.

**3.11**
**hazardous element**
element that is known for its potential to produce an adverse biological effect

Note 1 to entry: The presence of such an element (as an alloying addition or as an impurity) in a dental alloy does not imply that the alloy, in itself, is hazardous.


© ISO 2022 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS EN ISO 22674:2022

**3.12**
**heat treatment**
thermal treatment of a *metallic material* (3.15) such as a material stress relieving process, including *softening* (3.18), *hardening* (3.10), ceramic firing

**3.13**
**metal-ceramic restoration**
dental restoration with a *ceramic veneer* (3.8) bonded to a *metallic material* (3.15) substructure by firing

Note 1 to entry: This can apply also to the metallic material used for such a restoration. In this context, metal-ceramic alloy is a synonym.

Note 2 to entry: If recommended, such a metallic material may be used without a ceramic veneer.

**3.14**
**metallic base**
metal with highest concentration by mass fraction in the alloy

**3.15**
**metallic material**
material with properties that are associated with an alloy, *noble metal* (3.16) or *base metal* (3.4)

Note 1 to entry: This may be a pure element, commercially pure metal or an alloy.

**3.16**
**noble metal**
metal containing gold, metal of the platinum group and/or rhenium

**3.17**
**one-surface inlay**
inlay restoration that is exposed to the oral environment on one and no more of the surfaces that are used to define the tooth for the purposes of charting

**3.18**
**softening**
heat-treatment of a *metallic material* (3.15) producing a condition which provides a lower 0,2 % proof stress than the *as-cast state* (3.3)

Note 1 to entry: If recommended by the manufacturer, explicit instructions are required in the instructions for use.

**3.19**
**subtractive manufacturing**
manufacturing process where a solid material such as milling blank is reduced by milling, grinding, eroding or similar techniques to the final shape

# 4 Symbols and classification

## 4.1 Symbols

Table 1 gives an overview about the symbols used in this document.

© ISO 2022 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS EN ISO 22674:2022

**Table 1 — Symbols and their usage**

| Symbol | Description | Usage |
|---|---|---|
| $A_{15\,mm}$ | percentage elongation after fracture | A.3.3, A.3.4 |
| $b$ | breadth | 8.4.2.2, A.1.1, Clause B.2, B.2.1.1.1, B.4.1,C.3.2.1, C.3.2.2, Figures 3 and A.1, Formulae (3), (4), (5), (B.2), (B.5), (B.6) and (B.7), Tables 4 and 5 |
| $C_1$ | correction factor 1 for the elastic modulus | 8.5.2, Formulae (2) and (3) |
| $C_2$ | correction factor 2 for the shear modulus | 8.5.3, Formulae (4) and (5) |
| $D$ | minimum difference between two readings that the measuring instrument can discriminate | B.1, Formulae (B.1) |
| $d$ | deflection | 8.4.2.2, Formulae (3) and (6), Table 4 |
| $E$ | elastic modulus | B.2.1.2, B.3.1, B.4.2, Formulae (1), (3), (6), (B.1), (B.4), (B.5), (B.6), (B.7) and (C.1), Table 4 |
| $E_a$ | apparent elastic modulus | 8.4.2.2, 8.4.2.3, C.3.2.2, C.3.2.3, Formula (C.1), Table 4 |
| $F$ | force | 8.4.2.2, Table 4 |
| $F_5$ | force required to bring the lowest stressed part of the specimen to 5 % of material's $R_{P0,2}$ | 8.4.2.2 |
| $F_{60}$ | force required to bring the most highly stressed part of the specimen to 60 % of material's $R_{P0,2}$ | 8.4.2.2, Table 4 |
| $f_1$ | fundamental frequency measured in the flexural mode of vibration from acoustic measurement | 8.5.2, B.4.2, B.4.3, Formulae (3), (B.7) and (B.8) |
| $f_2$ | fundamental frequency measured for the torsional mode of vibration | 8.5.3, B.4.2, B.4.3, Formulae (5), (B.7) and (B.8) |
| $G$ | shear modulus | Formulae (5) and (6) |
| $h$ | thickness (height) | 8.4.2.2, 8.5.2, A.1.1, C.3.2.2, B.2.1.1.1, B.4.1, B.4.3, Figures 3 and A.1, Formulae (2), (3), (4), (5), (B.2), (B.5), (B.6), (B.7) and (B.8), Tables 4 and 5 |
| $h_1$ | greatest measured thickness | 7.5.3, 7.5.4, Figure 4 |
| $h_2$ | least measured thickness | 7.5.3, 7.5.4, Figure 4 |
| $l$ | length of specimen | 8.5.2, B.4.1, B.4.2, B.4.3, A.1.1, Clause B.2, Figures 3, 6 and 7, Formulae (2), (3), (5), (B.7) and (B.8) |
| $l_f$ | free length between grips | A.1.1, Figure A.1 |
| $l_g$ | initial gauge length | 7.3, 8.4.1.2, A.3.4, Figures 1, 2 and A.1, Table 4 |
| $l_p$ | parallel length | 7.3, Figures 1 and 2, Table 4 |
| $L_i$ | inner separation of load rollers | 8.4.2.1.3, B.3.1, Figure 5, Formula (B.6), Table 4 |
| $L_o$ | outer separation of support load rollers | 8.4.2.1.3, B.3.1, Figure 5, Formula (B.6), Table 4 |
| $m$ | mass | 8.4.3.2, 8.5.2, B.4.1, Formulae (3), (5), (B.7) |


© ISO 2022 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS EN ISO 22674:2022

**Table 1** *(continued)*

| Symbol | Description | Usage |
|---|---|---|
| $n$ | number of individual readings | B.1, Formula (B.1) |
| $q$ | mean of $n$ individual readings | B.1, Formula (B.1) |
| $q_i$ | value of the $i$th series of readings | B.1, Formula (B.1) |
| $r$ | radius of specimen | B.2.1.1.2, Formula (B.3) |
| $R_{P0,2}$ | proof stress of 0,2 % non-proportional extension | 8.3.3.1, 8.4.2.2, A.3.1.3, A.3.3, A.3.4, Tables 3 and 4 |
| $S$ | cross-sectional area | 7.5.2, 8.4.1.2, B.2.1.1.1, B.2.1.1.2, B.2.1.2, Formulae (1), (B.2), (B.3) and (B.4) |
| $S_0$ | original cross-sectional area | A.3.3, A.3.4 |
| $u(S)$ | standard uncertainty in the measurement of cross-section | B.2.1.1.1, B.2.1.1.2, B.2.1.2, Formulae (B.2), (B.3) and (B.4) |
| $u(b)$ | standard uncertainty in the measurement of breadth of specimen | B.2.1.1.1, B.3.1, Formulae (B.2), (B.5), (B.6) and (B.7) |
| $u(\mathrm{d})$ | standard uncertainty in the measurement of $\Delta d$ | B.3.1, Formulae (B.5) and (B.6) |
| $u(E)$ | standard uncertainty in the measurement of elastic modulus | B.2.1.2, B.3.1, B.4.2, C.3.2.2, C.3.2.3, Formulae (B.4), (B.5), (B.6), (B.7), (B.8) and (C.1) |
| $u(F)$ | standard uncertainty in the measurement of load force | B.2.1.2, B.3.1, Formulae (B.4), (B.5) and (B.6) |
| $u(f)$ | standard uncertainty in frequency | B.4.1, B.4.2, B.4.3, Formulae (B.7) and (B.8) |
| $u(h)$ | standard uncertainty in the measurement of thickness of specimen | B.2.1.1.1, B.3.1, Formulae (B.2), (B.5), (B.6), (B.7) and (B.8) |
| $u(l)$ | standard uncertainty in the measurement of length of specimen | Formulae (B.7) and (B.8) |
| $u(L_o)$ | standard uncertainty in the measurement of $L_o$ | B.3.1, Formula (B.5) |
| $u(L_i)$ | standard uncertainty in the measurement of $L_i$ | B.3.1 |
| $u(m)$ | standard uncertainty in the measurement of mass | Formula (B.7) |
| $u(q)$ | standard uncertainty in the measurement of $q$ | B.1, Formula (B.1) |
| $u(r)$ | standard uncertainty in the measurement of the radius of the specimen | B.2.1.1.2, Formula (B.3) |
| $u(v)$ | combined standard uncertainty in Poisson's ratio | B.4.3, Formula (B.8) |
| $u(\Delta L)$ | standard uncertainty in the measurements of $\Delta L$ | B.2.1.2, Formula (B.4) |
| $v$ | Poisson's ratio | 8.4.2.2, 8.5.1, B.4.3, C.3.2.3, Formulae (2), (6), (B.8), (C.1) and (C.2) |
| $\Delta d$ | change in displacement of mid-point of specimen corresponding to the change $\Delta F$ in load force | B.3.1, Formulae (B.5) and (B.6) |
| $\Delta F$ | change in load force corresponding to the change in gauge length | 8.4.1.2, B.2.1.2, B.3.1, Formulae (1), (B.4), (B.5) and (B.6) |
| $\Delta h$ | separation of outer and inner reference planes | 7.5.3, 7.5.4, Figure 4 |
| $\Delta L$ | change in gauge length measured by the extensometer | 8.4.1.2, B.2.1.2, Formulae (1) and (B.4) |

## 4.2 Classification

For the purposes of this document, a metallic material is classified according to its mechanical properties by a Type number, of which there are six.

© ISO 2022 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS EN ISO 22674:2022

Examples of the applications for which these Types are intended are as follows:

— Type 0: intended for low stress bearing single-tooth fixed prostheses, for example, small veneered one-surface inlays, veneered crowns;

NOTE 1 Metallic materials for metal-ceramic crowns produced by electroforming or sintering belong to Type 0.

— Type 1: for low stress bearing single-tooth fixed prostheses, for example, veneered or unveneered one-surface inlays, veneered crowns;

— Type 2: for single tooth fixed prostheses, for example, crowns or inlays without restriction on the number of surfaces;

— Type 3: for multiple unit fixed prostheses;

— Type 4: for appliances with thin sections that are subject to very high forces, for example, removable partial dentures, clasps, thin veneered single crowns, full arch fixed dental prostheses or those with small cross-sections, bars, attachments, implant retained superstructures;

— Type 5: for appliances in which parts require the combination of high stiffness and proof stress, for example, thin removable partial dentures, parts with thin cross-sections, clasps.

NOTE 2 The higher application type can include lower application types.

NOTE 3 Multiple-unit and full-arch, fixed dental prostheses are also referred to as bridges.

# 5 Requirements

## 5.1 Chemical composition

### 5.1.1 Reported composition

For all elements that are present in excess of mass fraction of 1,0 %, each constituent element shall be declared by the manufacturer and shall be reported [see 10.1, a)] to a precision of a mass fraction of 0,1 %.

Any element that is present in excess of mass fraction of 0,1 %, and with a lower or equal mass fraction of 1,0 %, shall be identified [see 10.1 a)] either by name or symbol.

If the metallic material contains less than or equal to a mass fraction of 0,1 % of a specified element (other than one named in 5.2), it may be named as “free of" this specified element [see 10.1 p) and 10.4 j)].

If applicable, the name of the metallic base shall precede the words “-based metallic material for dental restoration” or “-based casting alloy” or “-based metal-ceramic material”, as is appropriate.

### 5.1.2 Permitted deviation from the reported composition for elements

The permitted deviation of the reported composition for elements from the value stated on the package or label or insert [see 10.1 a)] is given in Table 2.


© ISO 2022 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS EN ISO 22674:2022

**Table 2 — Permitted deviation from the reported composition for elements**

| Alloy | Elemental content | |
|---|---|---|
| | 1,0 % < $w$ ≤ 20 % | $w$ > 20 % |
| Base-metal alloy | maximum 1,0 % | maximum 2,0 % |
| Silver-based and noble metal alloy | maximum 0,5 % | maximum 0,5 % |

**Key**

$w$ : mass fraction

## 5.2 Hazardous elements

### 5.2.1 Hazardous elements

For the purposes of this document, the elements nickel, cadmium, beryllium and lead are designated to be hazardous elements.

### 5.2.2 Limits for the hazardous elements

The metallic material shall not contain more than a mass fraction of 0,02 % of beryllium, cadmium or lead.

Beryllium, cadmium or lead are neither alloying elements nor elements inherent to the manufacturing process of titanium metallic materials. Apply the requirements of chemical composition of ISO 5832-2 and ISO 5832-3 to titanium metallic materials; beryllium, cadmium or lead do not need to be analysed.

### 5.2.3 Nickel

#### 5.2.3.1 Manufacturer's reported nickel content and permitted deviation

If the metallic material contains more than a mass fraction of 0,1 % of nickel, this content shall be given to an accuracy of mass fraction of 0,1 % in the literature which accompanies the package [see 10.1 n)] and on the package, label or insert [see 10.4 h)].

The mass fraction shall not exceed the value stated in 10.1 n) and 10.4 h).

#### 5.2.3.2 Nickel-free products

For the purposes of this document, alloys with a maximum of mass fraction of 0,1 % nickel can be labelled “nickel free” [see 10.1 o) and 10.4 j)].

If nickel is not declared, it shall be limited to a maximum of 0,1 %. This limit shall be adhered to when nickel is a natural impurity in a component of the alloy.

## 5.3 Biocompatibility

Refer to the introduction for guidance on biocompatibility.

## 5.4 Mechanical properties

### 5.4.1 General

The mechanical properties (see Table 3) shall be met by the metallic material after the recommended processing techniques (e.g. casting, bench-cooling, machining, thermal treatment) and after the ceramic firing schedule (if appropriate) have been applied. A metallic material recommended for use either with or without a ceramic veneer shall meet this requirement in both metallurgical conditions.

© ISO 2022 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS EN ISO 22674:2022