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## Dental base metal casting alloys

*Alliages dentaires non précieux à couler*

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ISO 6871:1987

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Reference number  
ISO 6871:1987 (E)

## 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 6871 was prepared by Technical Committee ISO/TC 106, *Dentistry*.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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# Dental base metal casting alloys

## 0 Introduction

Specific qualitative and quantitative requirements for freedom from biological hazard are not included in this International Standard, but it is recommended that reference should be made to ISO/TR 7405 when assessing possible biological or toxicological hazards.

## 1 Scope and field of application

This International Standard specifies the compositional requirements, mechanical properties and test methods for base metal casting alloys used for removable dental appliances. It does not apply to alloys intended for ceramic metal restorations or surgical implants.

## 2 References

ISO 6892, *Metallic materials — Tensile testing*.

ISO/TR 7405, *Recommended standard practice for biological evaluation of dental materials*.

## 3 Definitions

For the purposes of this International Standard, the definitions given in ISO 6892 shall apply.

## 4 Requirements

### 4.1 Composition

The alloys shall contain a total of not less than 85 % by mass of chromium, cobalt and nickel.

Alternatively, the alloy shall be of any other composition which has been specifically demonstrated to comply satisfactorily with the requirements of 4.2. In this case the manufacturer shall state the composition and shall have available a full report of the tests which have been carried out to establish compliance with 4.2.

### 4.2 Biocompatibility

#### 4.2.1 General

See clause 0 for guidance on biocompatibility.

### 4.2.2 Beryllium content

If the alloy contains beryllium, the beryllium content shall not exceed 2 % by mass.

### 4.3 Mechanical properties

The mechanical properties of the alloy, when determined according to 7.1 on test pieces prepared in accordance with 6.1, shall not be less than the minimum values specified in the table.

Table — Mechanical properties

Mechanical property	Minimum value
Proof stress of non-proportional elongation, $R_{p0,2}$	500 N/mm <sup>2</sup>
Percentage elongation after fracture	1,5 %

### 4.4 Castability

A test piece prepared in accordance with 6.2 from material melted and cast according to the manufacturer's instructions shall reproduce the pattern accurately and shall be free of voids and round edges when viewed as stated in 7.2.

## 5 Sampling

A representative sample, sufficient for the preparation of all the test pieces, shall be taken from one batch of the alloy.

## 6 Test pieces

### 6.1 Test pieces for the determination of mechanical properties

Prepare test pieces with dimensions shown in figure 1. Use the "lost wax" method and follow the manufacturer's recommended investing and casting procedures.

NOTE — Where centrifugal casting is used, it is recommended that the spruing arrangement shown in figure 2 should be used for the tensile test pieces and that the bar should be cast with its long axes in the plane of rotation of the centrifugal casting machine.

### 6.2 Test piece for castability test

Prepare a test piece with dimensions shown in figure 3 and use the spruing arrangement shown.

## 7 Test methods

### 7.1 Mechanical properties

#### 7.1.1 Proof stress of non-proportional elongation

Determine the proof stress of non-proportional elongation,  $R_{p0,2}$ , using six test pieces prepared in accordance with 6.1. Take a test piece and load in a tensile tester at a crosshead speed of not more than 1 mm/min. Determine the proof stress from the resultant stress-strain curves at the 0,2 % offset level.

Repeat the procedure for the remaining five test pieces.

Express the proof stress of non-proportional elongation,  $R_{p0,2}$ , of the material as the average of the six results.

#### 7.1.2 Percentage elongation after fracture

Determine the percentage elongation after fracture on six test pieces prepared in accordance with 6.1 using an extensometer. Apply a load at a rate of not more than 1 mm/min on the tensile tester up to the fracture point. If any test piece breaks outside the gauge length, repeat the test on another test piece.

To comply with the requirement of 4.3, the mean experimental value shall be significantly greater than 1,5 % with a confidence level of 95 %.

Express the percentage elongation after fracture of the material as the average of the six results.

### 7.2 Castability

Visually examine (without magnification) the test piece prepared in accordance with 6.2.

## 8 Marking, labelling and information to be supplied

### 8.1 Marking

The alloy or package shall be clearly marked to identify the manufacturer and the brand of alloy.

### 8.2 Labelling

Each package shall be clearly labelled with the following information :

- a) manufacturer's name and/or trade mark;
- b) designation or trade name of the alloy;
- c) batch number;
- d) net mass;
- e) the principal constituents of the alloy, their proportions, and the presence of potentially dangerous elements.

### 8.3 Information to be supplied by the manufacturer

The following information shall be supplied by the manufacturer :

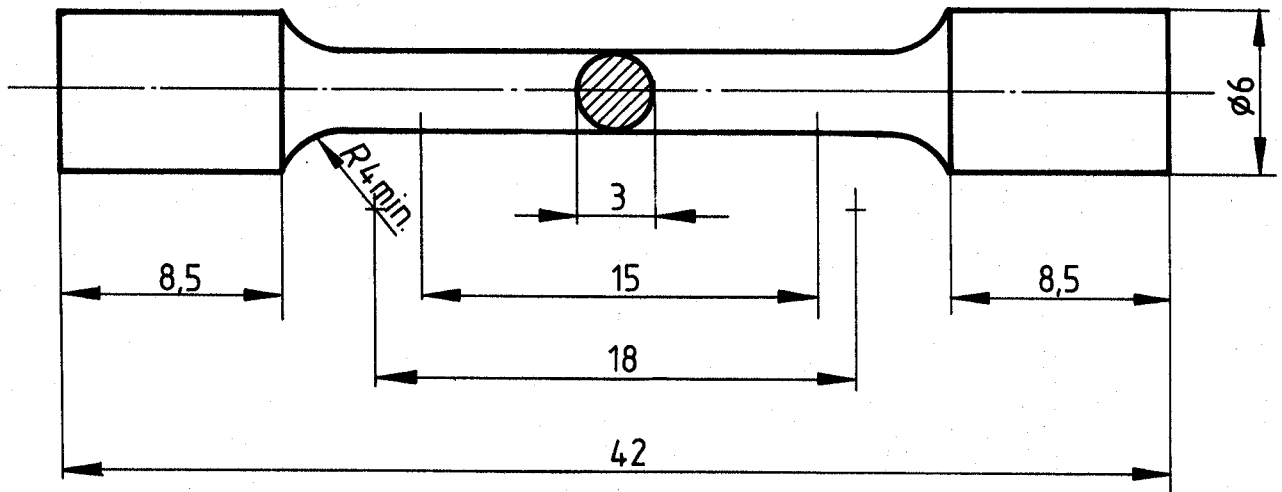
- a) With each package :
  - If the alloy contains beryllium or other hazardous elements, the precautions (in prominent lettering) to be taken when casting and finishing the alloy.
  - In countries where statutory requirements for handling alloys containing beryllium and/or other toxic substances do not exist, the recommendations for handling such alloys are given in the annex.
  - If the alloy contains nickel, a statement that the alloy shall not be used for nickel sensitive individuals.
- b) On request :
  - Information about the melting range, stating both the liquidus and solidus, determined by differential thermal analysis.
  - Instructions for processing (investing and casting) the alloy, including the auxiliary materials and equipment required. Also instructions for soldering, welding, heat treatment and repair procedures, if applicable, together with recommendations for cleaning appliances made from the alloy after oral use.

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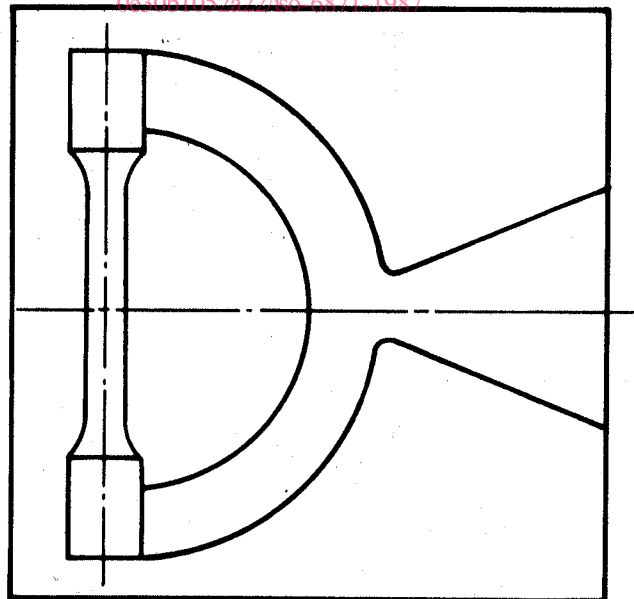
Dimensions in millimetres



**Figure 1 — Tensile test specimen**  
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**Figure 2 — Springing arrangement for tensile test specimen**

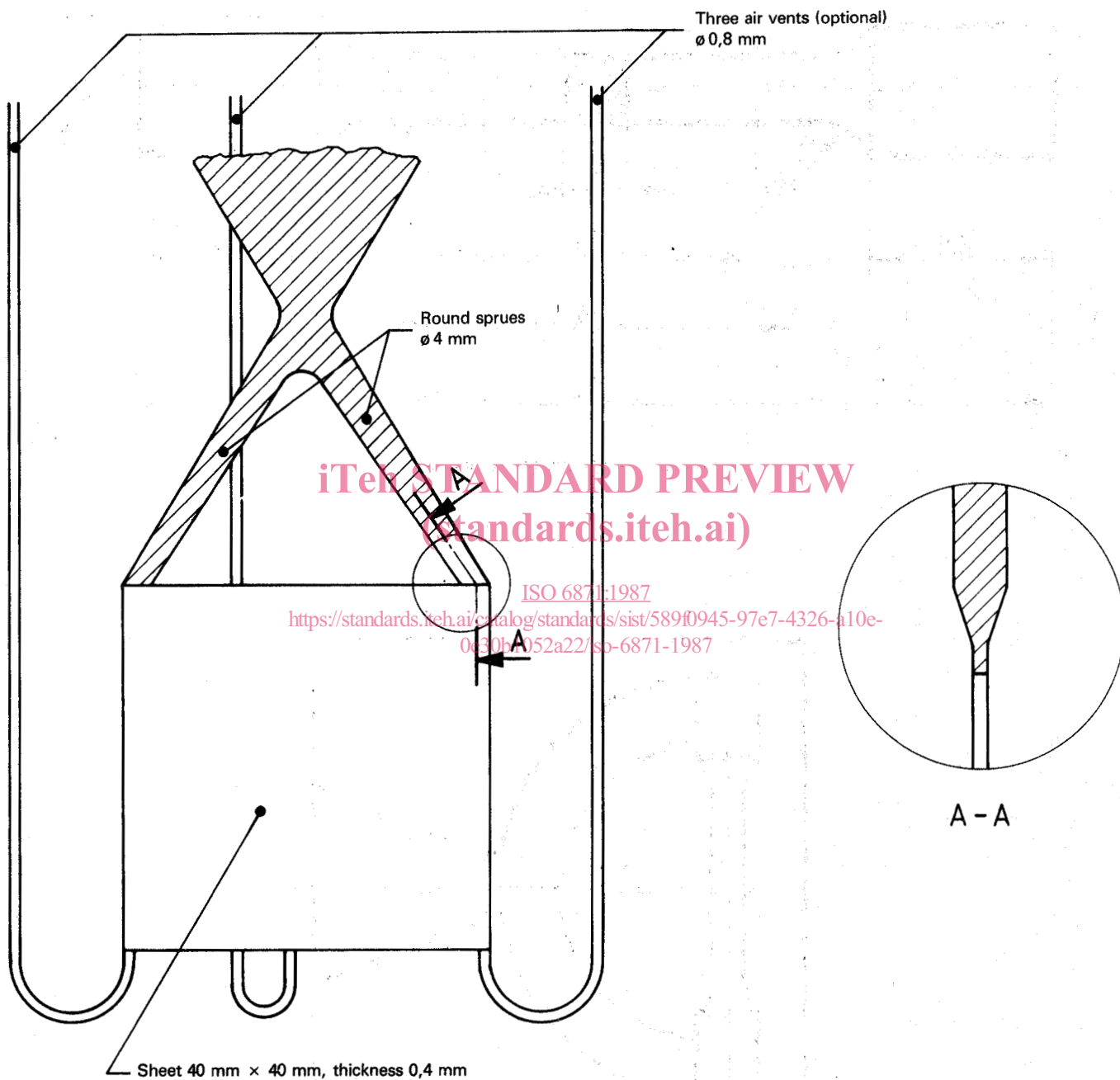


Figure 3 – Castability test specimen with button and air vents

## Annex

### Recommendations for handling alloys containing beryllium

(This annex does not form part of the standard.)

Adequate local exhaust ventilation should be provided for all operations such as casting, grinding, polishing and finishing, where beryllium-containing alloys are handled and dusts and fumes can be generated. Exhaust air should not be recirculated back into the work area.

Adequate general ventilation should be provided for all areas where beryllium-containing alloys are handled.

Warning signs should be placed in areas where dust from beryllium-containing alloys can be generated.

Clean protective clothing, which is changed at frequent intervals, should be used by each operator working with beryllium-containing alloys.

Dust removal from clothing and the cleaning of machinery should be accomplished by power suction methods only.

To prevent dust becoming airborne, compressed air should not be used in areas where beryllium-containing alloys are being handled.

Every person exposed to the hazards of beryllium-containing alloys should be informed of the proper handling procedures and the precautions to be taken.

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