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R 1562

DENTAL CASTING GOLD ALLOY

1st EDITION

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BRIEF HISTORY

The ISO Recommendation R 1562, *Dental casting gold alloy,* was drawn up by Technical Committee ISO/TC 106, *Dentistry,* the Secretariat of which is held by the British Standards Institution (BSI).

Work on this question led to the adoption of Draft ISO Recommendation No. 1562, which was circulated to all the ISO Member Bodies for enquiry in December 1968. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

Australia	India	Spain
Belgium	Israel	Sweden
Brazil	Korea, Rep. of	U.A.R.
Canada	Netherlands	United Kingdom
Czechoslovakia	New Zealand	U.S.A.
Denmark	Peru	Yugoslavia
France	Poland	
Greece	South Africa, Rep. of	

The following Member Body opposed the approval of the Draft :

Switzerland

This Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided to accept it as an ISO RECOMMENDATION.

ISO Recommendation R 1562 June 1970

DENTAL CASTING GOLD ALLOY

INTRODUCTION

This ISO Recommendation is technically identical with F.D.I.* Specification No. 7, the only difference being in the wording and layout to bring the text into standard ISO form. Further studies are being undertaken to provide, if necessary, for a future revision of this ISO Recommendation in the light of technological advances supported by well-documented data.

NOTE. – Throughout this ISO Recommendation the figures for SI units are approximate conversions of the technical metric units using the conversion factors 1 N = 0.102 kgf and 1 MN/m^2 = 10.2 kgf/cm^2.

1. SCOPE

This ISO Recommendation gives the classification of and requirements for dental casting gold alloy, together with the test methods to be employed to determine compliance with these requirements.

2. FIELD OF APPLICATION

This ISO Recommendation is applicable to dental casting alloys based on gold and used in the fabrication of dental restorations and appliances.

NOTE. – Alloys of precious metals used for ceramo-metallic applications are not covered by this ISO Recommendation.

3. CLASSIFICATION

Dental casting gold alloys should be classified into the following types, according to their physical properties (see also Appendix) :

- **Type I** : soft;
- **Type II** : medium;
- **Type III** : hard;
- **Type IV** : extra hard.

4. REQUIREMENTS

4.1 Colour

The colour of the alloy should be the colour specified by the purchaser.

* Fédération Dentaire Internationale.

4.2 Composition

The composition of the various types of alloy (see section 3) should be as specified in the Table on the following page.

4.3 Physical properties

The physical properties of the various types of alloy (see section 3) should be as specified in the Table.

TABLE – Requirements for composition and physical properties

Type	Gold and metals of the platinum group Min.	Brinell hardness number			Tensile strength Min.		Elongation on 50 mm gauge length Min.		Fusion temperature Min.
		Quenched		Hardened	Hardened		Quenched	Hardened	
	%	Min.	Max.	Min.	MN/m^2	(kgf/cm^2)	%	%	°C
I	83	40	75	–	–	–	18	–	930
II	78	70	100	–	–	–	12	–	900
III	78	90	140	–	–	–	12	–	900
IV	75	130	–	200	620	(6350)	10	2	870

NOTE. – The determined values for the metallic constituents should be recorded to the nearest 0.5 %. When a determined value is midway between a half and a whole number, the whole number should be recorded.

4.4 Manufacturer's instructions

Instructions for the softening and hardening heat treatment of Type III and Type IV alloys, and the melting ranges of all types should be included in the labelling or accompanying literature.

5. SAMPLING

The method of procurement and the amount of alloy needed for testing should be the subject of agreement between the parties concerned. The sample submitted by the manufacturer should include six tensile specimens for Types I, II and III and twelve specimens for Type IV in the as-cast condition with button, sprue and vents attached.

6. TEST SPECIMENS

Cast specimens should be prepared by casting into a dental casting investment using any dental casting method. The use of a wax pattern is not required. The diameter of these specimens should be not less than 2.0 mm nor more than 2.5 mm. The specimens should be not less than 90 mm long.

7. TEST METHODS

7.1 Visual inspection

Visual inspection should be used in determining compliance with the requirements outlined in clauses 4.1 and 4.4, and section 8.

7.2 Physical tests

7.2.1 *General.* An alloy complies with the tensile and hardness requirements when three or more of a series of six castings, of each heat treatment, meet the requirements specified.

7.2.2 *Conditioning of test specimens.* Physical properties other than fusion temperature should be determined on cast specimens which have been placed in a furnace at 700 ± 10 °C for 10 minutes and then quenched in water at room temperature.

Hardened specimens should be prepared by placing the quenched specimens in an oven heated to 450 ± 5 °C. After they have been in the oven for 2 minutes the temperature should be lowered uniformly over a period of 30 minutes at a rate of 7 ± 1 °C per minute to 250 ± 5 °C. The specimens should then be immediately quenched in water at room temperature.

7.2.3 *Brinell hardness number.* Specimens, not less than 2 mm long, should be sawn from the cast tensile specimens, mounted and polished, using progressively finer abrasive paper ending with a No. 3/0 emery paper.

The Brinell hardness number should be determined by applying a 15 kgf load to the specimen for 30 seconds by means of a hardened steel ball 1.59 mm in diameter.

The diameter of the depression should be recorded by measuring two diameters at right angles to each other, and the average value of these two measurements should be used in the calculation of the hardness number.

The Brinell hardness number should be calculated by means of the following formula :

$$\frac{P}{\frac{\pi D}{2}(D-\sqrt{D^2-d^2})}$$

where

P is the test load in kilogrammes force;

D is the diameter of the ball in millimetres;

d is the diameter of the depression in millimetres.

The Brinell hardness number should be recorded as the nearest whole number. When the determined value falls midway between two whole numbers, the even number should be recorded.

7.2.4 *Tensile strength.* The tensile strength should be determined on the cast specimens (see section 5 and clause 7.2.2) submitted by the manufacturer.

The loading rate should be 1000 ± 200 N (100 ± 20 kgf) per minute continuously, from the initial load to the breaking point.

The tensile strength should be computed on the basis of the original cross-sectional area.

7.2.5 *Elongation.* Elongation should be determined in conjunction with the test for tensile strength; specimens should be marked with a 50 mm gauge length. Castings that break outside the gauge marks may be eliminated. The determined value should be recorded to the nearest 0.5 %.

7.2.6 *Fusion temperature*

7.2.6.1 APPARATUS. The following apparatus should be used :

(*a*) *Electric furnace* capable of reaching a temperature of 1100 °C and having a tube muffle of approximately 25 mm inside diameter mounted in the vertical position.

(*b*) *Pyrometric equipment* accurate to ± 5 °C.

(*c*) *A length of 0.81 mm diameter* platinum or chromium/nickel wire**.*

(*d*) *300 g weight.*

7.2.6.2 TEST SPECIMEN. The test specimen should be an ingot 13 mm × 6.4 mm × 0.51 ± 0.13 mm with holes, having a diameter of 1.6 mm, centered 2.4 mm from either edge at the centre of the 6.4 mm dimension.

7.2.6.3 PROCEDURE. The tip of an aluminium/nickel*** – chromium/nickel** or platinum – platinum/rhodium thermocouple of 0.81 mm or 0.64 mm diameter wire should be bent into an "S" shape. The loop of the "S" curve nearest the long leads of the thermocouple should be hooked into one of the 1.6 mm holes of the ingot. The loop of the "S" curve nearest the hot junction should be bent so that the hot junction lies near the centre of the ingot.

A 0.81 mm diameter chromium/nickel or platinum wire should be passed through the hole at the opposite end of the ingot and tied. The long leads of the thermocouple should be secured at the top of the furnace so that the ingot hangs at the centre of the muffle.

A 300 g weight should be attached to the chromium/nickel or platinum wire so that the weight hangs freely below the furnace. The top of the muffle should be covered with a suitable piece of refractory material to prevent air currents. The bottom of the muffle should be covered with a sheet of asbestos containing a hole 6.4 mm in diameter. The hole in the sheet should be coaxial with the centre of the muffle opening to permit unobstructed passage of the loaded wire.

The temperature of the furnace should be raised to within 111 °C of the estimated lower limit of the melting range and then increased at a rate of 11 ± 3 °C per minute until the ingot breaks. The temperature at which the ingot breaks under the 3 N (300 gf) load should be recorded as the fusion temperature.

The value should be reported as the average of test results on three specimens, and should be recorded to the nearest degree Celsius.

8. PACKAGING AND MARKING

8.1 Packaging

The alloy should be packaged in accordance with the acceptable commercial practice.

8.2 Marking

8.2.1 *Lot numbers.* Each container should be marked with a serial number or combination of letters and numbers which refer to the manufacturer's records for the particular lot or batch of alloy.

8.2.2 *Date of manufacture.* The date of manufacture (year and month) should be indicated on the container as a separate item or as a part of the lot number.

8.2.3 *Net mass.* The net mass of the contents should be marked on each container. Individual packets of small ingots from 1 to 3 g**** may have a tolerance of minus 1.0 % maximum. Packets of 30 g**** or more may have a tolerance of minus 0.1 % maximum.

8.2.4 *Type.* The type of casting gold alloy, as classified in section 3, should be indicated on all containers.

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* Otherwise known as 20 gauge A.W.G.

** Known as Chromel.

*** Known as Alumel.

**** Attention is drawn to the common usage of grains, pennyweight and Troy ounces when referring to quantities of gold alloy.

APPENDIX

The four types of alloys specified are ordinarily used for the following dental restorations and appliances :

- **Type I** : Those subject to very slight stress and where burnishing is desired.
- **Type II** : Those subject to moderate stress : 3/4 crowns, abutments, pontics, full crowns and saddles.
- **Type III** : Those subject to high stress : thin 3/4 crowns, thin cast backings, abutments, pontics, full crowns and saddles.
- **Type IV** : Those thin in cross-section and subject to very high stress : saddles, bars, clasps, crowns, thimbles and unit castings.