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Dental ethyl silicate bonded casting investments

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Foreword

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Dental ethyl silicate bonded casting investments

1 Scope

This International Standard specifies a method for ethyl silicate bonded casting investments to be assessed for their efficacy for casting dental alloy restorations.

This International Standard applies to ethyl silicate bonded investments used in the fabrication of dental base metal casting alloy restorations.

This International Standard specifies requirements for the essential physical properties of the investment and methods for their determination.

It also includes requirements for adequate instructions to accompany each package.

2 Definitions

For the purpose of this International Standard, the following definitions apply.

2.1 ethyl silicate bonded casting investment: Powder mixture of a refractory filler system and an active component specially designed for use as an investment for casting dental alloy restorations.

NOTE 1 The refractory filler system usually consists mainly of silica. The active component is a basic oxide, usually magnesium oxide.

2.2 special liquid: Liquid made available by the manufacturer or supplier for mixing with the investment powder.

NOTE 2 Typically two or three special liquids are required for any given system. One of the liquids contains the ethyl

silicate binder component. The other liquid(s) contain(s) complementary components. All liquids mixed together form the binder liquid for mixing with the investment powder.

When the powder and binder liquid are mixed, a paste is formed which hardens to form first a silica gel, which later is converted to silica.

3 Requirements

3.1 General

The powder shall be dry and free from visible impurities and lumps. The special liquids shall be free of sediment. Evaluate in accordance with 4.2.

3.2 Setting time

The setting time shall not differ by more than 30 % from the time stated by the manufacturer. If the manufacturer gives a range of setting times, then the setting time shall not differ from the midpoint of this range by more than 30 %. Test in accordance with 4.3.

3.3 Compressive strength

The compressive strength of the investment at room temperature shall not be less than 1,5 MPa. Test in accordance with 4.4.

3.4 Linear thermal expansion

The linear thermal expansion shall not differ by more than 15 % from the value stated by the manufacturer. If the manufacturer gives a range of linear thermal ex-

pansion values, then the thermal expansion shall not differ from the midpoint of this range by more than 15 %. Test in accordance with 4.5.

4 Testing

4.1 General

4.1.1 Sampling

Test only materials from unopened and undamaged packages.

4.1.2 Test conditions

Carry out mixing and testing of the investment at (23 ± 2) °C and (50 ± 10) % relative humidity in a room free from obvious drafts. Use clean, dry equipment which has been stored in the test environment for at least 16 h prior to testing.

4.2 Visual inspection

Inspect visually at normal acuity and without magnification.

4.3 Setting time

4.3.1 Apparatus

4.3.1.1 Clean mixing bowl, reserved for use only with ethyl silicate bonded investment.

4.3.1.2 Flexible rubber bowl, with sufficient capacity.

4.3.1.3 Dental vibrator, for use with ethyl silicate bonded investment.

4.3.1.4 Timer, to record setting time.

4.3.2 Liquid preparation

Prior to the start of testing, follow the manufacturer's instructions to prepare sufficient binder liquid from the individual special liquids supplied by the manufacturer.

4.3.3 Test procedure

Measure (400 ± 4) g of investment powder and sufficient liquid, ± 1 ml, to comply with the manufacturer's instructions for powder/liquid ratio.

Pour the liquid into the mixing bowl (4.3.1.1) and then add the powder. Begin timing (4.3.1.4) from the moment when the powder and liquid first make contact. Sprinkle the powder slowly into the liquid, avoiding air

entrapment. Mix thoroughly to completely wet the powder, following the manufacturer's instructions.

Fill the flexible bowl (4.3.1.2) with the mixed investment and place it on the dental vibrator platform (4.3.1.3). Record the setting time as the time from the beginning of mixing until the gel layer, which forms on the surface of the investment during vibration, is broken up and is no longer glossy and sticky. Repeat the procedure and record the second result.

4.3.4 Evaluation

If both test results meet the setting time requirement (3.2), then the product meets this requirement. If neither meets the requirement then the product fails to meet the requirement. If one result meets the requirement and one fails the requirement, repeat the test procedure three more times. If all three repeat test results meet the requirement, then the product meets the requirement. If any of the three repeat test results fails to meet the requirement, then the product fails to meet the requirement.

4.4 Compressive strength test

4.4.1 Apparatus

4.4.1.1 Sufficient moulds, constructed from a corrosion-resistant material, to produce five specimens.

Each mould shall have a diameter of $(20 \pm 0,2)$ mm and a length of $(40 \pm 0,4)$ mm. Ends of the mould shall be parallel within $\pm 0,05$ mm.

4.4.1.2 One or more sectional or split mould extensions, to produce cylindrical specimens with an additional length of at least 20 mm, when the extension is added to the mould top surface.

4.4.1.3 Flat glass plates, sufficient in size and quantity to cover the ends of all moulds.

4.4.1.4 Dental vibrator.

4.4.1.5 Compression testing machine, capable of a crosshead speed of $(1,5 \pm 0,5)$ mm/min or a loading rate of $(5\ 000 \pm 2\ 000)$ N/min.

4.4.1.6 Mould-release agent.

4.4.1.7 Dental trimmer.

4.4.2 Test procedure

Lubricate the inside surface of the mould (4.4.1.1) and the mould extension (4.4.1.2) with the mould-release agent (4.4.1.6). Place the mould on the glass plate

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(4.4.1.3) and attach with wax. Add the mould extension to the mould top surface and also attach with wax.

Prepare the investment mix in accordance with 4.3.3 and slightly overfill the mould with the investment mix, applying slight vibration using the dental vibrator (4.4.1.4). Before the glossy surface has completely disappeared from the mix, stop vibration. Remove the mould extension from the mould at the setting time indicated by the manufacturer. Using the dental trimmer (4.4.1.7), trim down the set specimen flush with the top surface of the mould proper.

Remove the specimen from the mould and store it at $(23 \pm 2) ^\circ\text{C}$ and $(50 \pm 10) \%$ relative humidity. Prepare five specimens using at least two mixes of investment.

Commence testing the specimens 2 h from the beginning of mixing (see 4.3.3).

Position each specimen between the loading platens of the compression testing machine (4.4.1.5) so that the specimen will be loaded in an axial direction. Do not use packing between specimen and platen. Using the machine, apply compressive force until fracture occurs. Record the maximum force (F) applied.

4.4.3 Evaluation

For each specimen tested, calculate the maximum stress (S) in MPa using the recorded maximum force, F , in newtons, as follows.

$$S = F/314$$

If four of the five specimens tested meet the requirement for compressive strength (3.3), the material

meets the requirement. If three of the five specimens meet the requirement and two do not, then a second series of five specimens shall be tested. If all five of this second series meet the requirement, then the material meets the requirement. If three or more specimens in a first series of tests, or any specimen in a second series of tests, fail to meet the requirement, then the material fails to meet the requirement.

4.5 Linear thermal expansion

NOTE 3 Ethyl silicate bonded investments do not expand on setting, therefore the total linear expansion is identical with the linear thermal expansion.

4.5.1 Apparatus

4.5.1.1 Device for thermal expansion measurements.

The device shall consist of:

- dilatometer (as shown in figure 1 or of an equivalent design);
- thermocouple;
- inductive transducer for registering changes in length, which exerts a measuring force less than 0,5 N;
- X-Y chart recorder, or other device for recording the thermal expansion curve;
- control unit, capable of regulating rate of the furnace, from room temperature to the final burnout temperature recommended by the manufacturer, to a constant rate of 5 K/min.

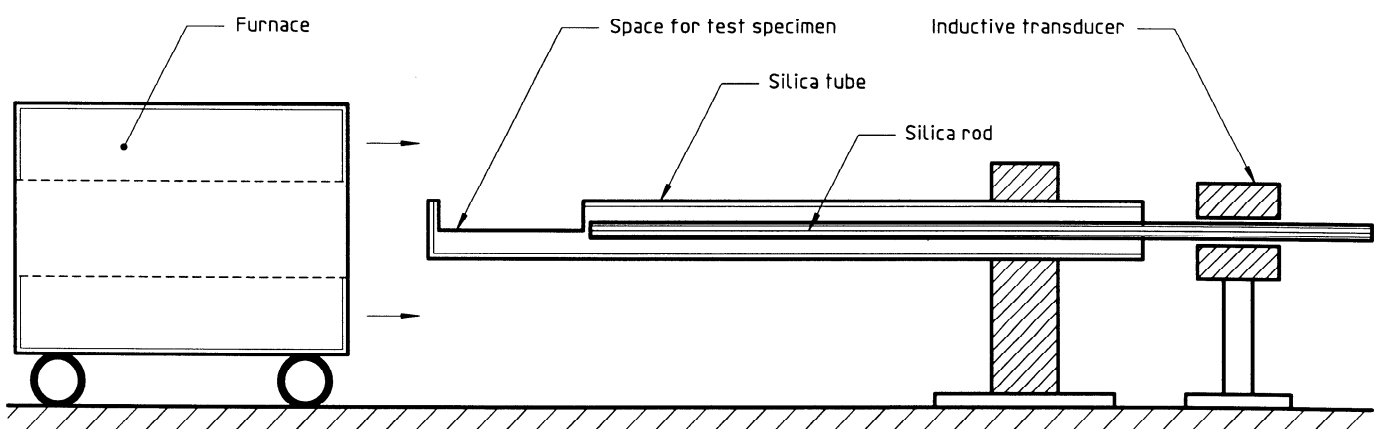


Figure 1 — Device for measurement of thermal expansion

4.5.2 Test procedure

To prepare the test specimen, make a model with the dimensions shown in figure 2 and duplicate it with a silicone duplicating material. For demoulding the model, split the top side of the mould lengthwise. Pour the investment mix into the mould. Remove the specimen from the mould, at the setting time indicated by the manufacturer, and grind off the pouring cone.

NOTE 4 A test specimen of similar cross-sectional area but of different cross-sectional shape may also be used.

Allow the specimen to dry, following manufacturer's instructions.

Measure the length, to the nearest 0,1 mm, and place the test specimen in the dilatometer. Locate the dilatometer in the furnace so that the specimen is in the middle. Heat the dilatometer from room temperature to the final burnout temperature recommended by the manufacturer at a rate of 5 K/min. Maintain at the recommended burnout temperature for the soak period recommended by the manufacturer. Record the change in length of the test specimen as a function of temperature.

Determine the linear thermal expansion of the investment by calculating the expansion values at the

recommended burnout temperature after the recommended soak period.

4.5.3 Evaluation

Carry out two tests as described in 4.5.2. If both test results meet the linear thermal expansion requirement (3.4), then the product meets this requirement. If neither meets the requirement, then the product fails to meet the requirement. If one test meets the requirement and one fails the requirement, repeat the test three more times. If all three repeat tests meet the requirement, then the product meets this requirement. If any of the three repeat tests fails to meet the requirement, then the product fails to meet the requirement.

5 Accompanying information

5.1 Manufacturer's instructions

The manufacturer's or supplier's instructions accompanying the products or made available by the manufacturer or supplier shall contain at least the following information:

a) recommended liquid-to-powder ratio (millilitres liquid per gram powder);

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Dimensions in millimetres

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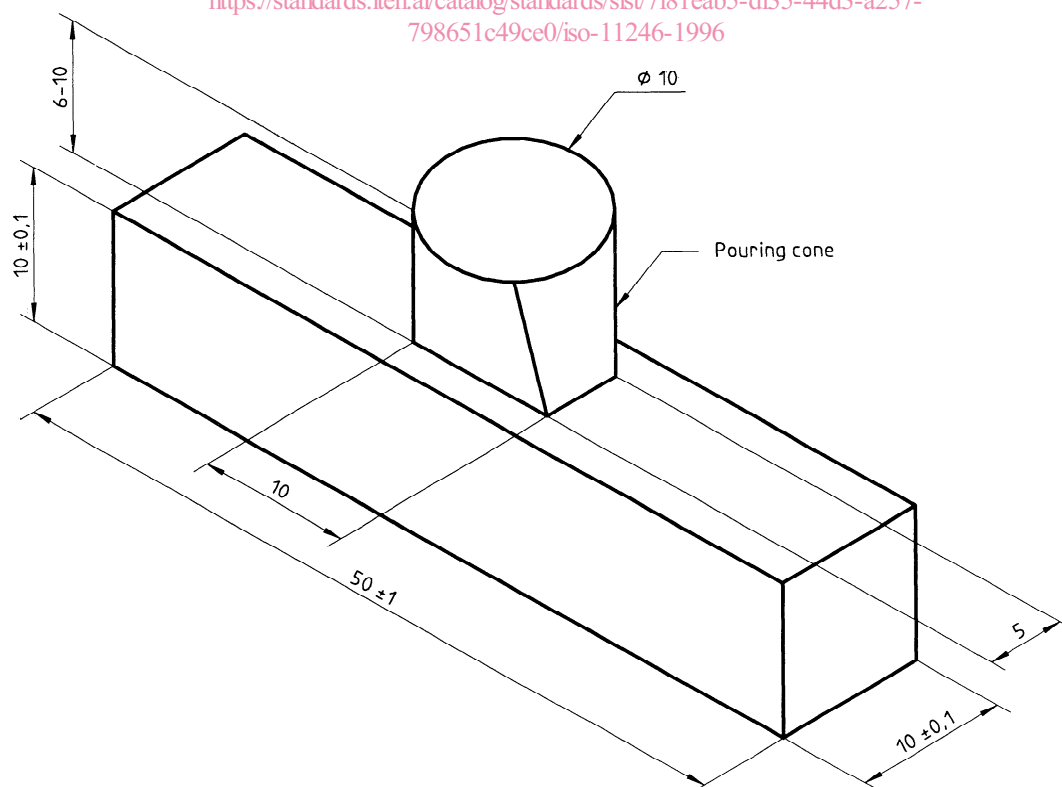


Figure 2 — Model for thermal expansion test specimen, with pouring cone

- b) instructions for the preparation of the binder liquid from the special liquids supplied by the manufacturer, and information on shelf life of the binder liquid under recommended storage conditions;
- c) recommended mixing apparatus, mixing time and mixing intensity;
- d) recommended mixing procedure;
- e) recommended investing techniques;
- f) burnout procedures;
- g) recommended model duplication;
- h) warning of any hazards associated with the flammability of the liquid.

5.2 Physical properties of the investment

Information on the following physical properties, determined in accordance with this International Standard, shall also be included:

- a) setting time;
- b) compressive strength;
- c) linear thermal expansion.

6 Packaging

6.1 Powder

The powder shall be procured in sealed moisture-proof containers. Bulk containers shall be capable of being resealed.

6.2 Liquid

Special liquids supplied by the manufacturer shall be made available in resealable containers.

7 Labelling

The labelling of both powder and liquid packaging shall include:

- a) the trade or brand name of the material;
 - b) manufacturer's name and address, or agent in country of sale;
 - c) the type of material and its application given in unambiguous language;
 - d) the "use before" date, beyond which the material may not exhibit its optimal properties;
 - e) recommended storage conditions;
 - f) mass of the powder (in grams or kilograms) or volume of the liquid (in millilitres or litres);
 - g) manufacturer's batch code;
 - h) warning of any hazards associated with the flammability of the liquid;
- if the powder contains free silica, a warning that it can cause lung damage if inhaled.

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