International Standard ISO 6873

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Dental gypsum products

Produits dentaires à base de gypse

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Foreword

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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.

International Standard ISO 6873 was developed by Technical Committee ISO/TC 106, *Dentistry*, and was circulated to the member bodies in March 1982.

It has been approved by the member bodies of the following countries :

Austria	India	Sweden
Belgium	Japan	Switzerland
Canada	Mexico	United Kingdom
China	Netherlands	USA
Czechoslovakia	New Zealand	USSR
Egypt, Arab Rep. of	Norway	
Germany, F.R.	South Africa, Rep. of	

The member bodies of the following countries expressed disapproval of the document on technical grounds :

Australia
France

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Dental gypsum products

0 Introduction

This International Standard aims to enable users of dental gypsum products to obtain materials that are efficacious. The requirements have been designed to delineate satisfactory materials and rule out unsatisfactory ones. It is expected that both the manufacturer and user can use this International Standard as a basis for producing or obtaining satisfactory products and results.

1 Scope and field of application

This International Standard gives a classification of, and specifies requirements for, gypsum products used for dental purposes such as for making oral impressions, models, casts or dies. It also specifies the test methods to be employed to determine compliance with these requirements.

2 Reference

ISO 1302, *Technical drawings — Method of indicating surface texture on drawings.*

3 Definition

testing consistency : That consistency obtained with a water/powder ratio by mass which gives a slump pat diameter or cone penetration meeting the property requirements given in the table.

4 Classification

The four types of gypsum products used in dentistry and specified in this International Standard shall be classified as follows :

Type 1 : Impression plaster

Type 2 : Plaster

Type 3 : Stone

Type 4 : Stone, high strength

5 Requirements

5.1 Composition

The material shall be composed essentially of finely powdered hemihydrate of calcium sulphate and necessary modifiers.

5.2 Flavour

The material shall not be flavoured unless stated otherwise on the container.

5.3 Properties

The material shall be uniform and free from foreign matter and lumps and when mixed according to the manufacturers instructions shall produce a homogenous mix.

NOTE — Colouring matter as such is not regarded as foreign matter.

The material shall comply with the requirements for testing consistency, pouring time, setting time, setting expansion and compressive strength as specified in the table. In addition to being within the limits listed in the table, pouring and setting times shall also be within ± 20 % of the times stated by the manufacturer.

Pouring and setting times shall be measured from the moment of initial contact of the powder with water.

5.4 Fracture (Type 1)

When broken in accordance with 7.6 two minutes after the setting time (7.4), type 1 impression plaster shall break with a clean fracture and be readily reassembled to form the shape and size of the original unbroken specimen.

5.5 Reproduction of detail

The material shall be capable of reproducing a continuous 0,02 mm step for the full diameter of the mould in at least two of three specimens prepared as described in 7.8.

6 Sampling, test conditions and preparation of test specimens

6.1 Sampling

Sufficient standard packages of the material shall be obtained to provide at least 5 kg of sample. The sample shall be stored in a moisture proof container for subsequent testing.

6.2 Test conditions

The preparation of test specimens and the test procedures shall be conducted at 23 ± 2 °C and a relative humidity of 50 ± 5 %. The testing equipment and sample container shall be conditioned at this temperature and relative humidity for at least 10 h prior to the test being carried out. The distilled water and sodium citrate solution (7.2.1) shall be maintained at 23 ± 2 °C.

6.3 Mixing

6.3.1 Apparatus

6.3.1.1 Clean, scratch free tapered rubber or plastic bowl of about 130 mm diameter at the top.

6.3.1.2 Spatula, having a stiff, round-edged blade 19 to 25 mm wide and 90 to 130 mm long.

6.3.2 Procedure

Mix the dry powder with sufficient distilled water in the following manner to produce a mix of testing consistency.

Pour the water into the mixing bowl (6.3.1.1). Begin timing from the moment at which powder and water first make contact. Add the dry powder to the water over a period of 10 s.

Allow the mix to soak for 20 s.

Spatulate the mix for 30 s for type 1 materials and for 60 s for type 2, 3 and 4 materials. Spatulate using a circular stirring motion at a rate of approximately two turns per second.

Transfer the mix immediately to the moulds or testing apparatus.

7 Test methods

7.1 Inspection

Determine compliance with the requirements given in 5.1, 5.4 and 5.5 by visual inspection (without magnification unless otherwise stated).

7.2 Testing consistency

7.2.1 Material

Gauging liquid composed of 0,3 % solution of sodium citrate in distilled water.

NOTE — Only use the 0,3 % sodium citrate solution for the determination of testing consistency. Use distilled water in the preparation of all specimens for determining other properties. Take care to avoid contamination of testing equipment with the sodium citrate solution. Use separate mixing equipment, if possible.

7.2.2 Types 1 and 2

Determine the testing consistency of type 1 impression plaster and type 2 plaster by a slump method using the following apparatus and procedure.

7.2.2.1 Apparatus

7.2.2.1.1 Clean, dry, cylindrical mould, having a length of 50,0 mm and an inside diameter of 35,0 mm constructed from a corrosion resistant, non-absorbent material.

7.2.2.1.2 Clean, dry, smooth glass plate, with sides of at least 100 mm.

7.2.2.1.3 Means of measuring the major and minor diameters of the slumped mix.

7.2.2.2 Procedure

Add 100 g of the sample to the test quantity of the gauging liquid and mix as described in 6.3. Place the mould (7.2.2.1.1) upright on the centre of the glass plate (7.2.2.1.2). Completely fill the mould and level off the mix flush with the top of the mould. Rest the plate on a surface that is free of vibration.

After 2 min from the start of mixing, lift the mould vertically from the plate at a rate of approximately 10 mm/s and allow the mix to slump or spread over the plate.

After 3 min from the start of mixing, determine the major and minor diameters of the slumped mix to the nearest millimetre. Take the average of six diameters (three mixes) as a measure of consistency. If the result does not meet the requirement given in the table, repeat the test with more or less gauging liquid until the required testing consistency is obtained.

7.2.3 Types 3 and 4

Determine the testing consistency for types 3 and 4 stones by a cone penetration method using the following apparatus and procedure.

7.2.3.1 Apparatus

Cone penetrometer, an example of which is shown in figure 1. Use a rod and plunger (B and G) and additional weight (A) such that the total mass is 100 ± 0,1 g.

7.2.3.2 Procedure

Clean the plunger, mould, and base plate (figure 1) and apply a thin coat of lubricant to the upper surface of the base plate in order to prevent leaks during the test.

NOTE — Petroleum jelly is a suitable lubricant.

Add 300 g of the sample to the test quantity of the gauging liquid and mix as described in 6.3. Pour the mix into the conical ring mould (large end uppermost) and work the mix slightly to remove air bubbles. Commence penetration and record results at 3 min, 4 min and 5 min after the start of the mixing as follows :

Level the mix flush with the top of the ring mould before each penetration.

Wipe the conical plunger clean with a damp cloth, then lower the plunger to the surface of the sample and approximately the centre of the mould. Lock the rod in position with the lock screw.

Read the scale and release the plunger quickly.

After 15 s, read the scale again. Take the difference in scale readings as the penetration.

Take the average of nine penetrations (three mixes) as a measure of consistency. If the result does not meet the requirement given in the table, repeat the test with more or less gauging liquid until the required testing consistency is obtained.

7.3 Pouring time

Test as described in 7.2.2 or 7.2.3 with the exception that the cylinder is separated from the plate and that the penetration is made at the pouring time specified in the table. Calculate the average result of three mixes to determine the slump pat diameter or cone penetration. The gypsum product is deemed to comply with the requirement for pouring time if a slump pat diameter or cone penetration is within the limits specified in the table, obtained when the material is mixed to the testing consistency using distilled water.

7.4. Setting time

7.4.1 Apparatus

Vicat needle apparatus

NOTE — An example of a suitable apparatus is shown in figure 1.

Use a rod and needle (B and F) and additional weight (A) such that the total mass is 300 ± 0,3 g.

7.4.2 Procedure

Add 300 g of the sample to that quantity of distilled water required to achieve the standard testing consistency determined in 7.2.2.2 or 7.2.3.2 and mix as described in 6.3. Fill the mould completely and level the specimen flush with the top of the mould. Beginning 1 min or 2 min prior to the anticipated setting time (usually at the loss of gloss or excess water), allow the needle to penetrate the mix at 15 s intervals as follows :

a) Move the mould to allow the next penetration to be in a new area.

b) Wipe the needle clean and then bring its tip into contact with the surface of the mix and lock the rod in position with the lock screw.

c) Read the scale and release the rod quickly. Record the setting time as the total time from the start of mixing to the time when the needle first fails to penetrate the specimen to a depth of at least 2 mm. Calculate the average value of two tests and report to the nearest 15 s.

7.5 Setting expansion

7.5.1 Apparatus

Extensometer constructed from materials which are corrosion resistant and non-absorbent.

NOTE — An example of a suitable apparatus is shown in figure 2.

7.5.2 Procedure

Position the stopper to provide a trough of not less than 100 mm in length. Add 300 g of the sample to that quantity of distilled water required to achieve the standard testing consistency as determined in 7.2.2.2 or 7.2.3.2 and mix as described in 6.3. Fill the trough completely with the mix and measure the gauge length. Minimize evaporation of moisture by placing a rubber dam over the specimen. For type 1 impression plaster, take the initial reading immediately after filling the trough. For the other three types of gypsum product, take the initial reading at 1 min before the setting time (see 7.4).

Allow one end of the specimen to expand unrestrained for 2 h. Take the final reading and determine the change in length to the nearest 0,01 mm. Calculate the setting expansion as a percentage of the original gauge length to the nearest 0,01 %.

Carry out two such tests. Calculate the average value of two tests and report to the nearest 0,01 %.

7.6 Fracture

Add 300 g of type 1 impression plaster to that quantity of distilled water required to achieve the standard testing consistency as determined in 7.2.2.2 and mix as described in 6.3. Pour the mix into a mould which will form a specimen approximately 25 mm × 12 mm × 3 mm. Two minutes after the setting time (7.4), break the specimen by hand into two pieces approximately 12 mm × 12 mm × 3 mm. Evaluate as described in 5.4.

7.7 Compressive strength

7.7.1 Apparatus

7.7.1.1 Clean, dry, split moulds, sufficient to produce five specimens, each having a diameter of 20 ± 0,2 mm and a length of 40 ± 0,4 mm constructed from a corrosion resistant material.

7.7.1.2 Glass plates, sufficient to cover the top and bottom of each mould.

7.7.1.3 Compressive strength tester, adjusted to a rate of loading of 10 ± 1,5 kN/min or a crosshead speed of 1 ± 0,2 mm/min.

7.7.2 Procedure

Add 300 g of the sample to that quantity of distilled water required to achieve the standard testing consistency as determined in 7.2.2.2 or 7.2.3.2, and mix as described in 6.3. Pour the mix down the inside of each inclined mould (7.7.1.1) retained on a glass plate (7.7.1.2) and overfill each mould slightly. Vibrate the mould gently for 30 s maximum while filling in order to minimize the formation of air bubbles. Before the glossy surface has disappeared from the mix, level the specimen flush with the top of the mould by pressing the second glass plate firmly into contact with the top surface of the mould.

After 45 min from the start of mixing, remove the specimens from the split moulds and store in air at 23 ± 2 °C and 95 ± 5 % relative humidity. Crush the specimens using the compressive strength tester (7.7.1.3) 1 h after the start of mixing.

Calculate the average result for the five specimens. Discard any result departing from the average by more than 15 % and calculate the average of the remaining results. If less than three results remain to be averaged, discard the results and repeat the test.

7.8 Reproduction of detail

7.8.1 Apparatus

7.8.1.1 Test block as shown in figure 3.

7.8.1.2 Clean, dry cylindrical mould having a height of 25 mm and an inside diameter of 24 mm and constructed from a corrosion resistant, non-absorbent material.

7.8.1.3 Microscope, with 6 X magnification and a light source capable of providing low-angle illumination.

7.8.2 Procedure

Place the mould on the test block (7.8.1.1) so that the 0,02 mm step coincides with the diameter of the mould (7.8.1.2). Add 100 g of the sample to that quantity of distilled water required to achieve the standard testing consistency determined in 7.2.2.2 or 7.2.3.2, and mix as described in 6.3. Pour the mix into the cylindrical mould while vibrating the block and mould for 5 s to minimize air bubbles.

After 45 min from the start of mixing, separate the mould and gypsum product from the test block and examine the gypsum step under low-angle illumination and 6 X magnification. Evaluate as described in 5.5.

8 Packaging, marking and information to be supplied by the manufacturer

8.1 Packaging

The material shall be packed in protective, moisture-proof containers that will neither contaminate nor alter the physical properties of the material.

8.2 Marking

Each container of material shall be clearly marked with the following information :

a) name and/or trademark of the manufacturer and/or supplier;

b) type;

c) colour, if other than white;

d) flavour, if any;

e) lot number that refers to the manufacturer's records for that particular lot or batch;

f) date of packaging (year and month) either as a separate item or as an identifiable part of the lot number;

g) date (year and month) beyond which the material should not be used without retesting when stored under recommended conditions;

h) net mass of the container in S.I. units;

j) recommended storage conditions;

k) a statement that gypsum products are subject to deterioration when exposed to the atmosphere, particularly if the humidity is high.

8.3 Manufacturer's instructions

Instructions for manipulation and use shall accompany each package and shall include the following information determined according to this International Standard.

a) recommended water/powder ratio by mass expressed as a decimal fraction;

b) recommended mixing technique, including the recommended time allowed for adding the powder to the water, soaking the powder and spatulating the mix by hand or mechanical spatulation;

c) pouring time;

d) setting time;

e) setting expansion;

f) compressive strength;

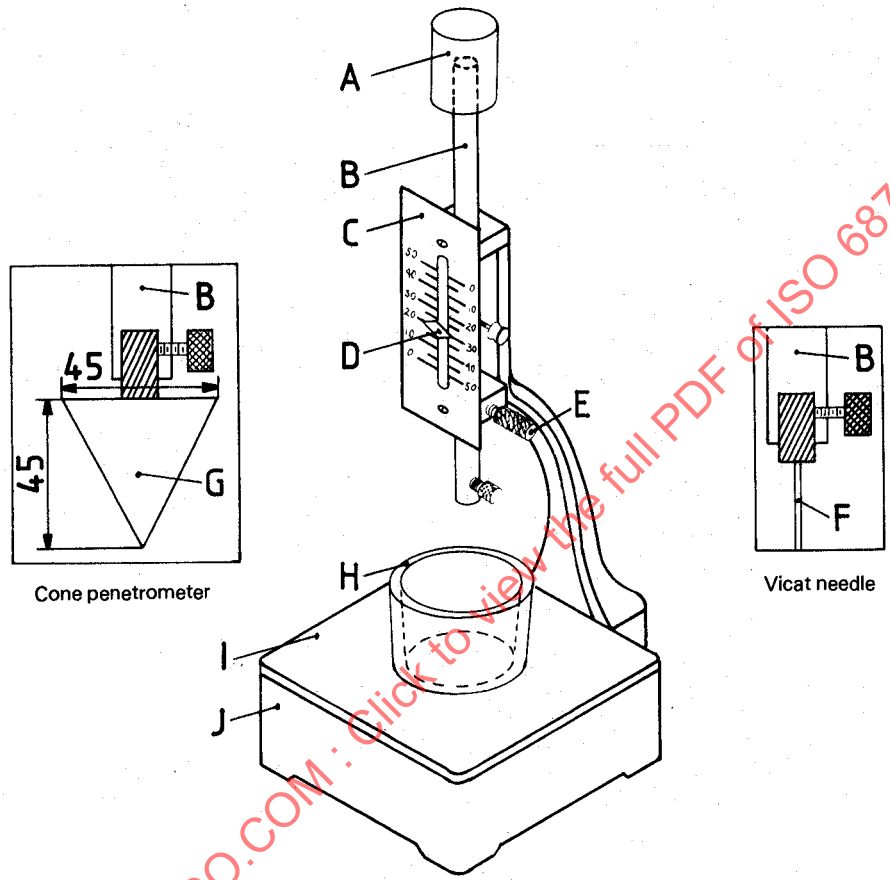
g) any special working methods or treatment recommended by the manufacturer.

Table — Requirements

Type	Testing consistency	Pouring time	Setting time		Setting expansion	Compressive strength	
	mm	minutes	minutes		%	MPa*	
		min.	min.	max.	max.	min.	max.
1	80 ± 4 (slump)	1,25	2,5	5,0	0,15	4,0	8,0
2	75 ± 4 (slump)	2,5	6,0	30,0	0,30	9,0	—
3	30 ± 3 (penetration)	3,0	6,0	30,0	0,20	20,0	—
4	30 ± 3 (penetration)	3,0	6,0	30,0	0,15	35,0	—

* 1 MPa = 1 N/mm^2

Dimensions in millimetres



Cone penetrometer

Vicat needle

Key

A Additional weight.
B Rod, approximate dimensions : 270 mm long and 10 mm diameter.
C Graduated scale in millimetres.
D Graduation mark.
E Lock screw.
F Vicat needle 50 mm long and 1 ± 0,05 mm diameter.
G Cone penetrometer, made of a corrosion resistant, non-absorbent material. Surface finish : $\overset{N6}{\sqrt{}}$ (see ISO 1302).
H Conical ring mould, made of a corrosion resistant, non-absorbent material. Inside diameter : 60 mm at the base and 70 mm at the top. Height : 40 mm.
I Base plate, of a plate glass and about 100 mm square.
J Support bracket.

Figure 1 — Example of apparatus for Vicat needle or cone penetrometer