

# International Standard



# 4534

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

## Vitreous and porcelain enamels — Determination of fluidity behaviour — Fusion flow test

*Émaux vitrifiés — Détermination du comportement de fluidité — Essai d'écoulement*

First edition — 1980-12-01

Preview  
Copyright

UDC 666.29 : 620.198 : 536.42

Ref. No. ISO 4534-1980 (E)

**Descriptors :** enamels, porcelain enamels, vitreous enamels, tests, plastic flow, viscosity, test equipment.

Price based on 4 pages

Dit document is een voorbeeld van NEN / This document is a preview by NEN

Dit document mag slechts op een stand-alone PC worden geïnstalleerd. Gebruik op een netwerk is alleen toestaan als een aanvullende licentieovereenkomst voor netwerkgebruik met NEN is afgesloten. This document may only be used on a stand-alone PC. Use in a network is only permitted when a supplementary license agreement for us in a network with NEN has been concluded.



## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

International Standard ISO 4534 was developed by Technical Committee ISO/TC 107, *Metallic and other non-organic coatings*, and was circulated to the member bodies in December 1978.

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

Australia	Israel	Romania
Czechoslovakia	Italy	South Africa, Rep. of
Germany, F.R.	Japan	Switzerland
Hungary	Netherlands	Turkey
India	Poland	USA

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

France  
United Kingdom

# Vitreous and porcelain enamels – Determination of fluidity behaviour – Fusion flow test

## 0 Introduction

The fusion flow test described in this International Standard is a comparative method which can be carried out with simplified equipment to provide data on the fluidity behaviour of molten enamel. The results from this test allow conclusions on the flow properties of the enamel to be inferred in a much simpler manner than is possible from the results of the much more expensive measurements made using the usual viscosity measuring instruments.

The results of extensive tests<sup>1)</sup> have shown that there is a well defined relationship between the results of the flow test and the viscosity-temperature curve, so that the flow test could also be used as an absolute method. However, more effort would be required to enable the various laboratories to obtain comparable results of similar quality than when using the method for comparative purposes.

When using this method, the reference (comparison) enamel must be similar to the enamel to be tested, as the fluidity behaviour of the various types of enamel may vary considerably from one type to another.

## 1 Scope and field of application

This International Standard specifies a comparative method of determining the fluidity behaviour of vitreous and porcelain enamels in the viscous condition during firing. It is not intended for use as an absolute method.

It is applicable to molten enamels, but not to sintered ground coat enamels.

## 2 Principle

Dry or wet grinding of test samples in accordance with the processing conditions. Pressing of cylindrical specimens of specified weight from the enamel powder, or the dried enamel slip, and from the agreed reference enamel.

Placing of the specimens in a laboratory oven at an agreed temperature on an unglazed ceramic tile in the horizontal position and melting to hemispherical shape. Tilting of the tile to permit the enamel to flow at an angle of 45° for an agreed period.

Calculation of the length flow number,  $F_l$ , and the breadth flow number,  $F_b$ , on the basis of the flow lengths and flow breadths of the specimens.

## 3 Material and apparatus

**3.1 Reference enamel**, to be agreed upon, having similar fluidity behaviour to the enamel to be tested.

**3.2 Ball mill.**

**3.3 Evaporating device**, for example a hot-air oven, a hot plate, or sand bath.

**3.4 Mortar.**

**3.5 Pestle.**

**3.6 Balance**, accurate to 0,01 g.

**3.7 Press**, giving a pressure of at least 5 N/mm<sup>2</sup> (5 MPa), and a **mould** having an internal diameter of 8 mm for preparation of the test specimens.

**3.8 Flow plate**, consisting of a square smooth unglazed ceramic tile, of side 75 mm, 5 to 6 mm thick and pre-fired at a temperature of at least 1 100 °C. It shall have a water absorption at atmospheric pressure of not more than 25 % and a homogeneous fine ceramic body. Flow plates may also be cut from a larger plate (see clause A.1).

1) Dekker, P. : Calculation of viscosity-temperature curves for porcelain enamels from the flow-button test. *Journal of the American Ceramic Society* **48** (1965), 6, pp. 319 to 327.

**3.9 Tilting frame,** (see figures 1 and 2), which permits the placing of a flow plate inside a laboratory oven in a horizontal position and tilting of the plate by 45°.

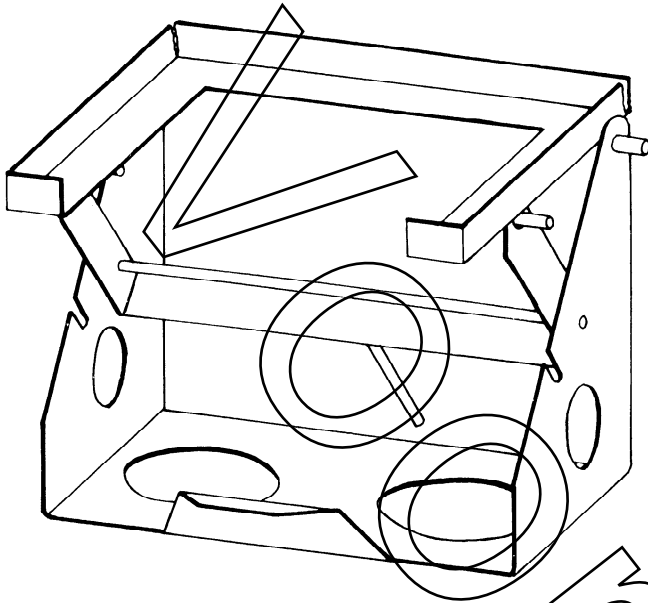


Figure 1 — Example of tilting frame, set for receiving the flow plate, in a horizontal position

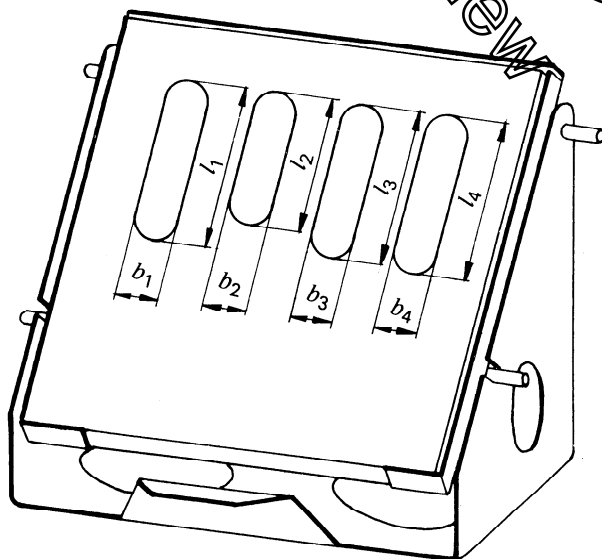


Figure 2 — The tilting frame with flow plate and four specimens tilted by 45°

NOTE —  $l_1, l_2, l_3$  and  $l_4$  are the flow lengths of the four specimens;  $b_1, b_2, b_3$  and  $b_4$  are their maximum flow breadths (see clause 6).

**3.10 Electrically heated laboratory oven,** allowing temperatures of up to 900 °C to be kept constant to within 10 °C.

**3.11 Stop watch.**

## 4 Test specimens

### 4.1 Preparation of enamel

The sample may be taken from the already ground enamel powder or may be ground separately in the ball mill (3.2). Mill additives and the fineness of grinding depend on the manufacturing conditions. In special cases, the complete grain size distribution shall be taken into account.

Wet-ground enamels shall be evaporated to dryness in an evaporating dish. After cooling, the dried enamel shall be loosened and again pulverised using the pestle (3.5) and mortar (3.4).

#### NOTES

- 1 If agreed, mill additives, which are completely or partially soluble in water and are only used as a setting up agent, may be omitted.
- 2 Where the fluidity of frits only is to be determined, they should be milled dry.

### 4.2 Preparation of test specimens

Place one drop of water in an empty mould (see 3.7), add  $1 \pm 0,01$  g of the enamel prepared as specified in 4.1 and then another drop of water (see clause A.2). Immediately press the specimen at a pressure of at least 5 N/mm<sup>2</sup> (5 MPa).

### 4.3 Number of test specimens

In each flow test, an agreed number of specimens made of the test enamel and one specimen made of the reference enamel shall be used (see clause 5).

### 4.4 Number of tests

In each determination, at least two tests for each set of specimens shall be carried out.

## 5 Procedure

Place the agreed number of test specimens and one specimen of the reference enamel on the flow plate (3.8) within the supporting area (see figure 3). During the various flow tests, interchange the positions of the test specimens and the specimen made of the reference enamel (see clause A.3).

# Bestelformulier

# NEN

## Stuur naar:

NEN Standards Products & Services  
t.a.v. afdeling Klantenservice  
Antwoordnummer 10214  
2600 WB Delft

## NEN Standards Products & Services

Postbus 5059  
2600 GB Delft

Vlinderweg 6  
2623 AX Delft

T (015) 2 690 390  
F (015) 2 690 271

[www.nen.nl/normshop](http://www.nen.nl/normshop)

## Ja, ik bestel

\_\_ ex. ISO 4534:1980 en Vitreous and porcelain enamels - Determination of fluidity behaviour - Fusion flow test € 31.57

**Wilt u deze norm in PDF-formaat? Deze bestelt u eenvoudig via [www.nen.nl/normshop](http://www.nen.nl/normshop)**

### Gratis e-mailnieuwsbrieven

Wilt u op de hoogte blijven van de laatste ontwikkelingen op het gebied van normen, normalisatie en regelgeving? Neem dan een gratis abonnement op een van onze e-mailnieuwsbrieven. [www.nen.nl/nieuwsbrieven](http://www.nen.nl/nieuwsbrieven)

### Retourneren

Fax: (015) 2 690 271  
E-mail: [klantenservice@nen.nl](mailto:klantenservice@nen.nl)  
Post: NEN Standards Products & Services,  
t.a.v. afdeling Klantenservice  
Antwoordnummer 10214,  
2600 WB Delft  
(geen postzegel nodig).

## Gegevens

Bedrijf / Instelling

T.a.v.  O M O V

E-mail

Klantnummer NEN

Uw ordernummer  BTW nummer

Postbus / Adres

Postcode  Plaats

Telefoon  Fax

**Factuuradres** (indien dit afwijkt van bovenstaand adres)

Postbus / Adres

Postcode  Plaats

Datum  Handtekening

### Voorwaarden

- De prijzen zijn geldig tot 31 december 2016, tenzij anders aangegeven.
- Alle prijzen zijn excl. btw, verzend- en handelingskosten en onder voorbehoud bij o.m. ISO- en IEC-normen.
- Bestelt u via de normshop een pdf, dan betaalt u geen handeling en verzendkosten.
- Meer informatie: telefoon (015) 2 690 391, dagelijks van 8.30 tot 17.00 uur.
- Wijzigingen en typfouten in teksten en prijsinformatie voorbehouden.
- U kunt onze algemene voorwaarden terugvinden op: [www.nen.nl/leveringsvoorwaarden](http://www.nen.nl/leveringsvoorwaarden).