SVENSK STANDARD
SS-EN 14889-2:2006

Fastställd 2006-08-31

Utgåva 1

# Fibrer för betong –
Del 2: Polymerfibrer – Definitioner, specifikationer och överensstämmelse

# Fibres for concrete –
Part 2: Polymer fibres – Definitions, specifications and conformity

ICS 91.100.30

Språk: engelska

Publicerad: oktober 2006

Europastandarden EN 14889-2:2006 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av EN 14889-2:2006.

The European Standard EN 14889-2:2006 has the status of a Swedish Standard. This document contains the official English version of EN 14889-2:2006.

Upplysningar om **sakinnehållet** i standarden lämnas av SIS, Swedish Standards Institute,
telefon 08 - 555 520 00.

Standarder kan beställas hos SIS Förlag AB som även lämnar **allmänna upplysningar** om svensk och utländsk standard.
*Postadress*: SIS Förlag AB, 118 80 STOCKHOLM
*Telefon*: 08 - 555 523 10. *Telefax*: 08 - 555 523 11
*E-post*: sis.sales@sis.se. *Internet*: www.sis.se

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

**EN 14889-2**

August 2006

ICS 91.100.30

English Version

# Fibres for concrete - Part 2: Polymer fibres - Definitions, specifications and conformity

Fibres pour béton - Partie 2 : Fibres polymère - Définition, spécifications et conformité

Fasern für Beton - Teil 2: Polymerfasern - Begriffe, Festlegungen und Konformität

This European Standard was approved by CEN on 26 June 2006.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

**Management Centre: rue de Stassart, 36 B-1050 Brussels**



Ref. No. EN 14889-2:2006: E

# Contents

Page

# Foreword

This document (EN 14889-2:2006) has been prepared by Technical Committee CEN/TC 104 “Concrete and related products”, the secretariat of which is held by DIN. It has been developed by working group 11, "Fibres for concrete", the secretariat of which is held by BSI.

This standard comprises two parts:
Part 1 dealing with steel fibres for concrete,
Part 2 dealing with polymer fibres

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 2007, and conflicting national standards shall be withdrawn at the latest by May 2008.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of the Construction Products Directive.

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

This European Standard should be given the status of a national standard.

No existing European Standard is superseded.

Not all fibre characteristics that may be relevant to the performance of a fibre concrete, structural or non-structural, such as early age effects, creep and chemical attack, have been addressed in this standard due to the difficulties of formulating meaningful and reproducible standardised test methods.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

# 1 Scope

This Part 2 of EN 14889 specifies requirements for polymer fibres for structural or non-structural use in concrete, mortar and grout.

NOTE Structural use of fibres is where the addition of fibres is designed to contribute to the load bearing capacity of a concrete element. This standard covers fibres intended for use in all types of concrete and mortar, including sprayed concrete, flooring, precast, in-situ and repair concretes.

# 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 10002-1, *Metallic materials – Tensile testing – Part 1: Method of test at ambient temperature*

EN 12350-3, *Testing fresh concrete – Part 3: Vebe test*

EN 13392, *Textiles – Monofilaments – Determination of linear density*

prEN 14845-1, *Test methods for fibres in concrete – Part 1: Reference concretes*

EN 14845-2, *Test methods for fibres in concrete – Part 2: Effect on concrete*

EN ISO 2062, *Textiles – Yarns from packages – Determination of single-end breaking force and elongation at break (ISO 2062:1993)*

ISO 11357-3, *Plastics – Differential scanning calorimetry (DSC) – Part 3: Determination of temperature and enthalpy of melting and crystallization*

# 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

**3.1**
**polymer**
polymeric material such as polyolefin, e.g. polypropylene or polyethylene, polyester, nylon, pva, polyacrylic, aramids and blends of them

**3.2**
**polymer fibres**
straight or deformed pieces of extruded, orientated and cut material which are suitable to be homogeneously mixed into concrete or mortar

**3.3**
**length**
distance between the outer ends of the fibre

**3.3.1**
**developed length (for deformed fibres with irregular cross section)**

length of the deformed fibre after straightening the fibre without deforming the cross section

**3.4**
**equivalent diameter**
diameter of a circle with an area equal to the mean cross sectional area of the fibre. For circular fibres, the equivalent diameter is equal to the diameter of the fibres.

**3.5**
**aspect ratio**
ratio of length to equivalent diameter of the fibre

**3.6**
**fibre shape**
specific outer configuration of the fibre, both in the longitudinal direction and in the shape of the cross section and also the possible surface coatings and or bundling of the fibres

**3.7**
**tensile strength of the fibre**
stress corresponding to the maximum force a fibre can resist. The tensile strength is calculated by dividing the maximum force a fibre can resist by the mean cross sectional area of the fibre.

**3.8**
**elongation of the fibre**
elongation of the fibre is defined as the ratio of the length change of the fibre to the initial length expressed as a percentage

NOTE The length change should be measured on the fibre itself.

**3.9**
**elastic modulus of the fibre**
initial slope of the tensile stress versus elongation curve

**3.10**
**linear density**
mass per unit length of a yarn or filament expressed in tex or its multiples or submultiples

NOTE 1 tex = 1g/1000m

**3.11**
**tenacity**
breaking force of a fibre divided by its linear density

**3.12**
**melting point**
temperature at which a polymer becomes liquid

**3.13**
**point of ignition**
temperature at which combustion is initiated

**3.14**
**residual flexural strength**
notional stress at the tip of the notch which is assumed to act in an uncracked mid-span section, with linear stress distribution, of a prism subjected to the centre-point load $F_j$ corresponding to $CMOD_j$ where $CMOD_j > CMOD_{FL}$; or to $\delta_j$ where $\delta_j > \delta_{FL}$ ($j$ = 1,2,3,4).

**3.15**
**crack mouth opening displacement (CMOD)**
linear displacement measured by a transducer installed on a prism subjected to a centre-point load $F$

**3.16**
**declared value**
value for a product property, determined in accordance with this standard, that a manufacturer is confident of achieving within the given tolerances bearing in mind the variability of the manufacturing process

# 4 Symbols

Symbols used in this standard are defined as follows:

$A$ area of the cross section of the fibre, in $mm^2$;

$d$ diameter of a fibre with a circular cross section, in mm;

$d_e$ equivalent diameter of the fibre, in mm;

$l$ measured length of the fibre, in mm;

$l_d$ developed length of the fibre in mm;

λ = l / d and is the aspect ratio of the fibre;
$m$ mass of the fibre, in g;

ρ density of the polymer, in $kg/m^3$;

$T_s$ melting point of the polymer, in °C;

$T_i$ point of ignition of the polymer, in °C;

$P_{max}$ maximum tensile load carrying capacity of the fibre, in N;

$R_m$ tensile strength of the fibre, in MPa;

$\varepsilon$ elongation of the fibre, in %;

$E$ elastic modulus of the fibre, in Mpa.

# 5 Requirements

## 5.1 Classification of fibres

Polymer fibres shall be characterised by the manufacturer in accordance with their physical form:

Class Ia: Micro fibres: < 0,30 mm in diameter; Mono-filamented

Class Ib Micro fibres: < 0,30 mm in diameter; Fibrillated

Class II: Macro fibres: > 0,30 mm in diameter

NOTE Class II fibres are generally used where an increase in residual flexural strength is required.

## 5.2 General

### 5.2.1 Polymer type

The basic polymer(s) or blends of polymers of the fibre shall be declared.

### 5.2.2 Shape

Polymer fibres may be either straight or deformed. The type of deformation shall be declared.

### 5.2.3 Bundled polymer fibres

The type and size of the fibre bundle (e.g. glued, wrapped) shall be declared.

### 5.2.4 Surface treatment or coating

Any surface treatment or coating (type and quantity), and any chemical or physical treatment of polymer fibres shall be declared and controlled.

NOTE Spin finish is a term used to describe the addition of chemical(s) used to coat the fibres that will then help the fibre to disperse in concrete. Without this coating some fibres will not easily disperse in concrete and will tend to ball up. However some types of chemical used to coat the fibres can induce air into the concrete or mortar. It is therefore important that any coating added to the fibre is controlled and is recorded as part of the initial type testing and as part of the factory control procedures.

## 5.3 Dimensions and tolerances

### 5.3.1 General

The length, diameter and aspect ratio shall be declared for all fibres. The linear density shall be declared for Class I fibres.

Specimens of fibres, when sampled in accordance with 6.2.2 and measured in accordance with 5.3.2 and 5.3.3 shall not deviate from the declared value by more than the tolerances given in Table 1.

**Table 1 — Tolerance limits for the dimensions of the fibres**

| **Property** | Symbol | **Deviation of the individual value relative to the declared value** | **Deviation of the average value relative to the declared value** |
|---|---|---|---|
| Length and developed length (all fibres) | $l$, $l_d$ | | |
| >30 mm | **(if applicable)** | ± 10 % | ± 5 % |
| ≤ 30 mm | | | ± 1,5 mm |
| Class II fibres > 0,30 mm | | | |
| (equivalent) diameter | $d_e$ | ± 50 % | ± 5 % |
| length/diameter ratio | $\lambda$ | ± 50 % | ± 10 % |
| Class I fibres ≤ 0,30 mm | | | |
| linear density | $\rho_L$ | ± 10 % | ± 10 % |

### 5.3.2 Length

The length shall be measured with a marking gauge with an accuracy of 0,1 mm.

In the case of an irregular cross section, the developed length of the fibre shall be determined.

#### 5.3.3 Determination of (equivalent) diameter

##### 5.3.3.1 Fibre with circular cross section

For Class I fibres with a diameter less than 0,3 mm, the diameter shall be measured using optical measuring equipment.

For Class II fibres with a diameter greater than 0,3 mm, the diameter of the fibre shall be measured with a micrometer to a precision of 0,001 mm.

##### 5.3.3.2 Fibre with elliptical cross section

The diameter of the fibre shall be measured with a micrometer, in two directions, approximately at right angles, to a precision of 0,001 mm. The fibre diameter shall be the mean of the two diameters.

##### 5.3.3.3 Rectangular fibres

The width ($w$) and thickness ($t$) of the fibres shall be measured with a micrometer to a precision of 0,001 mm.

The equivalent diameter, $d_e$, is calculated as $d_e = \sqrt{\frac{4 \cdot w \cdot t}{\pi}}$

##### 5.3.3.4 Fibres with irregular cross section

The mass, $m_f$ [g], and the developed length, $l_d$ [mm], of the fibre shall be determined. The mass shall be determined to an accuracy of 0,001 g and the length to an accuracy of 0,01 mm. The equivalent diameter shall be computed from the mass and the developed length using the following formula with the nominal density of the fibre, ρ, in [g/cm3]:

$$d_e = \sqrt{\frac{4 \cdot m_f \cdot 10^6}{\pi \cdot l_d \cdot \rho}}$$

NOTE The nominal density ρ of Polypropylene is 0,9 g/cm$^3$.

#### 5.3.4 Linear density

The linear density of Class I fibres shall be determined in accordance with EN 13392 and shall be declared.

#### 5.3.5 Shape of fibres

The manufacturer may freely choose the shape of the fibre. The control and tolerances on the shape shall be declared for each different shape. Control may be carried out using optical equipment.

### 5.4 Tensile properties

#### 5.4.1 Tenacity of Class I fibres

The tenacity of Class I fibres shall be determined by either method A or method B of EN ISO 2062. 30 individual fibres shall be tested and all results for the breaking force shall be included in the calculation for the average and standard deviation. The tenacity shall be calculated from the mean breaking force divided by the linear density determined by 5.3.4.