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Träkonstruktioner – Beräkning av karakteristiska 5-percentilvärden för acceptanskriterier för ett provuttag och tillverkningskontroll

Timber structures – Calculation and verification of characteristic values

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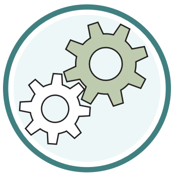

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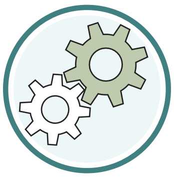

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Europastandarden EN 14358:2016 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av EN 14358:2016.

Denna standard ersätter SS-EN 14358:2006, utgåva 1.

The European Standard EN 14358:2016 has the status of a Swedish Standard. This document contains the official English version of EN 14358:2016.

This standard supersedes the Swedish Standard SS-EN 14358:2006, edition 1.

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.

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Denna standard är framtagen av kommittén för Bärande träkonstruktioner, SIS/TK 182/AG 4.

Har du synpunkter på innehållet i den här standarden, vill du delta i ett kommande revideringsarbete eller vara med och ta fram andra standarder inom området? Gå in på www.sis.se - där hittar du mer information.

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 14358

June 2016

ICS 79.040; 91.080.20

Supersedes EN 14358:2006

English Version

Timber structures - Calculation and verification of characteristic values

Structures en bois - Détermination et vérification des valeurs caractéristiques

Holzbauwerke - Berechnung und Kontrolle charakteristischer Werte

This European Standard was approved by CEN on 23 January 2016.

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 CEN-CENELEC Management Centre 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 CEN-CENELEC Management Centre has the same status as the official versions.

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European foreword

This document (EN 14358:2016) has been prepared by Technical Committee CEN/TC 124 “Timber structures”, the secretariat of which is held by AFNOR.

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 December 2016, and conflicting national standards shall be withdrawn at the latest by December 2016.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 14358:2006.

This document is based on Annex D of EN 1990:2002, *Eurocode – Basis of structural design*.

Compared to EN 14358:2006, the following modifications have been made:

— integration of normal distributions, and non parametric estimation;

— proposals for simplified equations to evaluate correction factors;

— estimation of mean values;

— acceptance procedure for verification of a lot (taken from EN 384: 2010).

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

1 Scope

This standard gives statistical methods for the determination of characteristic values from test results on a sample drawn from a clearly defined reference population of e.g. solid wood, fasteners, connectors and wood-based products. The characteristic value is an estimate of the property of the reference population and can be based on a 5-percentile value of strength, resistance or density as well as on a mean value for stiffness.

Parametric methods are given for the determination of lower and upper 5-percentiles. The upper 5-percentile is the 95-percentile.

This standard is suitable for use with any structural product in the frame of type testing as well as factory production control.

Sampling is not covered by this document, but reference is made to the relevant product standards.

This standard also provides the acceptance procedure for verification of a lot.

Depending on the product, characteristic values determined in accordance with this standard may be used directly or may need additional adjustments specified in the relevant product standards.

Note: For example, in the case of solid timber, specific adjustment factors for calculation of characteristic values are given in EN 384.

2 Symbols

$k_s(n)$ Factor used to calculate characteristic properties for initial type testing (see Tables 1 and 2)

$k(n)$ Factor used to calculate characteristic properties for factory production control (see Tables 3 and 4)

m_i Individual test value i of stochastic variable m

m_k 5-percentile value of stochastic variable m

m_{mean} Population mean value of stochastic variable m

n Number of test values

s_y Standard deviation

u_x x-percentile in the standardised normal distribution

$\bar{y}$ Sample mean value

— $y = m$ for normally distributed variable

— $y = \ln m$ for logarithmically normally distributed variable

$y_{0.5}$ Sample 5-percentile from the test data

α Confidence level (%)

3 Calculation of characteristic properties from test results in the frame of initial type testing

3.1 General

The characteristic value of a material parameter or a resistance shall be determined at a confidence level of α = 75 %, where the confidence level α is defined as the probability of which the characteristic value is greater than the estimator on the characteristic value.

NOTE The confidence level α = 75 % corresponds to the value recommended in EN 1990.

3.2 Calculation of 5 and 95 percentiles values

3.2.1 General

a) The characteristic value m_{k} for a material strength parameter or a resistance m modelled as a stochastic variable is defined as the p-percentile in the distribution function for m, corresponding to an assumed infinitely large test series;

b) p = 5 % shall be assumed.

3.2.2 Parametric calculation

a) The parametric approach shall not be used on test data not fitting the assumed distribution. In that case, a non-parametric method should be used;

b) It is assumed that n test values are available and that these may be assumed to originate from a statistically homogeneous population. The test values, which are assumed to be logarithmically normally distributed or normally distributed and independent, are denoted $m_1, m_2, \ldots, m_n$. The n test values constitute the sample;

c) Strength parameters should be assumed as logarithmically normally distributed unless analysis of the data shows that a normal distribution is more appropriate. Density shall be assumed as normally distributed;

NOTE Some product standards define the statistical distribution to be used.

d) The mean value $\overline{y}$ and the standard deviation s_y shall be determined as:

logarithmically normally distributed	normally distributed
$\overline{y} = \frac{1}{n}\sum_{i=1}^{n} \ln m_i$ (1)	$\overline{y} = \frac{1}{n}\sum_{i=1}^{n} m_i$ (2)
$s_y = \max\left\{\begin{array}{l}\sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(\ln m_i - \overline{y})^2}\\ 0{,}05\end{array}\right.$ (3)	$s_y = \max\left\{\begin{array}{l}\sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(m_i - \overline{y})^2}\\ 0{,}05\overline{y}\end{array}\right.$ (4)

The sample coefficient of variation shall not be taken as less than 0,05. For logarithmically normally distributed test values, the standard deviation s_y shall not be less than $\sqrt{\ln\left(1+0{,}05^2\right)} \approx 0{,}05$.

For normally distributed test values, the standard deviation s_y shall not be less than $0{,}05\bar{y}$.

e) The characteristic value of the sample shall be determined as follows:

percentile	logarithmically normally distributed	normally distributed
5-percentile	$m_k = \exp\left(\bar{y} - k_s(n)s_y\right)$ (5)	$m_k = \bar{y} - k_s(n)s_y$ (6)
95-percentile	$m_k = \exp\left(\bar{y} + k_s(n)s_y\right)$ (7)	$m_k = \bar{y} + k_s(n)s_y$ (8)

f) $k_s(n)$ shall be taken as:

$$k_s(n) = \frac{k_\alpha(n)}{\sqrt{n}} \qquad (9)$$

where $k_\alpha(n)$ is the α-percentile in a non-central t-distribution with $n - 1$ degrees of freedom and the non-centrality parameter $\lambda = u_{1-p} \cdot \sqrt{n}$.

whereby u_{1-p} is the $(1 - p)$-percentile of the standardised normal distribution function.

The following simplified expression may be used to evaluate $k_s(n)$

$$k_s(n) = \frac{6{,}5n + 6}{3{,}7n - 3} \qquad (10)$$

Some values of $k_s(n)$ calculated according to Formula (9) are given in Table 1.

Table 1 — $k_s(n)$ values for strength properties for p = 5 % and α = 75 %

Number of test specimens	Factor
n	$k_s(n)$
3	3,15
5	2,46
10	2,10
15	1,99
20	1,93
30	1,87
50	1,81
100	1,76
500	1,69
∞	1,64

For other numbers of test specimens, one should take the value corresponding to the next smallest value of n listed in this table.

3.2.3 Non parametric calculation

a) Non parametric calculation shall not be applied if the sample size is less than $n = 40$;

b) The 5-percentile of the test data shall be evaluated by ranking the test data and determining the 5-percentile of the ranked data;

To rank the data, any p-percentile value f_p shall be linearly interpolated from the empirical cumulative frequency distribution of the test data ranked in ascending order.

The i-th data point in the empirical cumulative frequency distribution of the test data (ranked in ascending order) shall be taken to be the percentile (p) given by the following equation:

$$p = \frac{i}{n} \tag{11}$$

where

n sample size

i i-th data point ranked in ascending order

c) The 5-percent lower tolerance limit with 75 % confidence shall be evaluated from Formula (12):

$$m_k = y_{0.5}\left(1 - \frac{k_{0.5,0.75}V}{\sqrt{n}}\right) \tag{12}$$

where

n	is the number of test values
m_k	is the 5-percent lower tolerance limit with 75 % confidence
$y_{0.5}$	is the 5-percentile from the test data
V	is the coefficient of variation of the test data found by dividing the standard deviation of the test data by the average of the test data
$k_{0.5,0.75}$	is a multiplier to give the 5-percent lower tolerance limit with 75 % confidence:

$$k_{0.5,0.75} = \frac{0{,}49n + 17}{0{,}28n + 7{,}1} \tag{13}$$

3.3 Calculation of characteristic mean values

a) The characteristic value m_{mean} for a material stiffness m modelled as a stochastic variable is defined as the mean value in the distribution function for m, corresponding to an assumed infinitely large test series;

b) It is assumed that n test values are available and that these may be assumed to originate from a homogeneous population. The test values, which are assumed to be normally distributed and independent, are denoted $m_1, m_2, \ldots, m_n$. The n test values constitute the sample;