



SLOVENSKI STANDARD
SIST EN 14358:2016

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Nadomešča:
SIST EN 14358:2007

Lesene konstrukcije – Izračun in preverjanje karakterističnih vrednosti

Timber structures - Calculation and verification of characteristic values

Holzbauwerke - Berechnung und Kontrolle charakteristischer Werte

Structures en bois - Détermination et vérification des valeurs caractéristiques
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ICS:

91.080.20 Lesene konstrukcije Timber structures

SIST EN 14358:2016 **en,fr,de**

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EUROPEAN STANDARD

EN 14358

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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.

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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of an identical text or by endorsement, at the latest by December 2016, and conflicting national standards shall be withdrawn at the latest by December 2016.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; **(standards.iteh.ai)**
- 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.

EN 14358:2016 (E)

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

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$k_s(n)$	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 $\alpha = 75\%$, 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 $\alpha = 75\%$ corresponds to the value recommended in EN 1990.

3.2 Calculation of 5 and 95 percentiles values

3.2.1 General

- 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;
- $p = 5\%$ shall be assumed.

3.2.2 Parametric calculation

- 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;
- 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, \dots, m_n . The n test values constitute the sample;
- 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.

- The mean value \bar{y} and the standard deviation s_y shall be determined as:

logarithmically normally distributed	normally distributed
$\bar{y} = \frac{1}{n} \sum_{i=1}^n \ln m_i \quad (1)$	$\bar{y} = \frac{1}{n} \sum_{i=1}^n m_i \quad (2)$
$s_y = \max \left\{ \sqrt{\frac{1}{n-1} \sum_{i=1}^n (\ln m_i - \bar{y})^2}, 0,05 \right\} \quad (3)$	$s_y = \max \left\{ \sqrt{\frac{1}{n-1} \sum_{i=1}^n (m_i - \bar{y})^2}, 0,05\bar{y} \right\} \quad (4)$

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 $\sqrt{\ln(1 + 0,05^2)} \approx 0,05$.

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

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

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

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 $k_s(n)$

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

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

<https://standards.itech.ai/catalog/standards/sist/34f409c9-e781-4461-a563-23e090818116>
Table 1 — $k_s(n)$ values for strength properties for $p = 5\%$ and $\alpha = 75\%$

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

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

$$p = \frac{i}{n} \quad (11)$$

where

n sample size

i i -th data point ranked in ascending order

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

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

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:

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

3.3 Calculation of characteristic mean values

- 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;
- 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, \dots, m_n . The n test values constitute the sample;