

English Version

Wood-based panels - Determination of characteristic 5-percentile values and characteristic mean values

Panneaux à base de bois - Détermination des valeurs caractéristiques correspondant au fractile à 5 % d'exclusion et des valeurs caractéristiques moyennes

Holzwerkstoffe - Bestimmung der charakteristischen 5%-Quantilwerte und der charakteristischen Mittelwerte

This European Standard was approved by CEN on 25 November 2024.

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.

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



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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Contents	Page
European foreword	3
1 Scope.....	4
2 Normative references.....	4
3 Terms and definitions.....	4
4 Symbols	5
5 Reference population	5
6 Determination of characteristic values of mechanical and physical properties	5
6.1 Sampling.....	5
6.2 Testing	6
6.3 Analysis of data.....	6
6.3.1 General.....	6
6.3.2 Strength and stiffness properties.....	6
6.3.3 Characteristic mean value (50-percentile characteristic value)	6
7 Test report.....	6
Annex A (informative) Calculation of the 5-percentile characteristic value of log-normal distributed test data according to EN 14358	7
Annex B (informative) Calculation of the characteristic mean value (50-percentile value) of normal distributed test data according to EN 14358	12
Bibliography	13

European foreword

This document (EN 1058:2024) has been prepared by Technical Committee CEN/TC 112 “Wood-based panels” the secretariat of which is held by DIN.

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 June 2025, and conflicting national standards shall be withdrawn at the latest by June 2025.

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

This document supersedes EN 1058:2009.

This document includes the following significant technical changes with respect to EN 1058:2009:

- test methods like EN 1195 or any other relevant test referring to EN 1058 included in the scope;
- the calculation of mean values (50-percentile values) follows the statistical principles of EN 14358:2016, 4.3: Calculation of characteristic stiffness properties (mean values);
- the characteristic mean values are taken as the sample mean value of EN 14358:2016, Formula (14);
- Annex B has been changed from normative to informative.

This document has been prepared under a standardization request addressed to CEN by the European Commission. The Standing Committee of the EFTA States subsequently approves these requests for its Member States.

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

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

1 Scope

On the basis of test results from wood-based panel products for structural purposes, this document specifies a method for the determination of:

- characteristic 5-percentile values of mechanical properties under the assumption of a log-normal distribution of the test data according to EN 14358; and
- characteristic mean values (50-percentile values) of physical properties under the assumption of a normal distribution of the test data according to EN 14358.

Test data can be determined from tests using the test methods outlined in the test standard EN 789 or other relevant test standard, performance standard or product standard normatively referring to EN 1058.

NOTE See e.g. EN 1195 and EN 12871.

The statistical evaluation follows the principles of EN 1990:2023¹, Annex D of EN 1995-1-1:2004² and of EN 14358:2016.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 789, *Timber structures - Test methods - Determination of mechanical properties of wood based panels*

EN 1195, *Timber structures - Test methods - Performance of structural floor decking*

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp/>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

characteristic value

value of a material property which is defined as a fractile of the distribution of that property within the total population of that material

Note 1 to entry: For all strength properties, this fractile is the fifth percentile. For stiffness properties as well as physical properties, two different characteristic values can be used: the fifth percentile and the mean value.

3.2

panel

piece of wood-based sheet material large enough to permit the cutting of test pieces

¹ As impacted by EN 1990:2002/A1:2005, EN 1990:2002/A1:2005/AC:2008 and EN 1990:2002/A1:2005/AC:2010.

² As impacted by EN 1995-1-1:2004/A1:2008, EN 1995-1-1:2004/A2:2014 and EN 1995-1-1:2004/AC:2006.

3.3**reference population**

wood-based panels for which the characteristic values are relevant

3.4**production site**

any single production line

3.5**sample**

number of panels of one population

Note 1 to entry: Unless otherwise agreed, the panels of the sample are drawn at random.

3.6**shift**

continuous period of production by the same group of workers

Note 1 to entry: Normally 8 h.

3.7**test piece**

piece of panel cut to the size required for testing a specific property

4 Symbols

L	Lower specification limit
$\bar{x}_{05}$	Characteristic value of a log-normal distributed property
$\bar{x}_{50}$	Characteristic mean value of a normal distributed property
U	Upper specification limit
$v_{\ln \bar{x}}$	Coefficient of variation of a log-normal distributed sample
$v_{\bar{x}}$	Coefficient of variation of a normal distributed sample

5 Reference population

The reference population is defined by parameters such as type and manufacturing process, thickness range, grade, lay-up and quality classification of wood-based panels and is consistent with the material that is or can be supplied commercially and is capable of being identified at all stages of production, supply and in service.

6 Determination of characteristic values of mechanical and physical properties**6.1 Sampling**

The sample size shall be in accordance with the relevant test standard or performance standard. In EN 789 tests a total of at least 32 panels of the same type, grade, thickness range and/or lay-up shall be sampled at random from the production sites. Where there are fewer than 32 shifts, the total number of panels shall be obtained by taking a maximum of four panels from each shift at each production site.

Sampling of test pieces from panels shall be in accordance with the procedures given in EN 789 or in the other relevant test or performance standards.

6.2 Testing

Testing shall be carried out in accordance with EN 789 (for mechanical properties), EN 1195, (performance of structural floor and roof decking, static load and stiffness test) and/or other relevant test standard(s).

6.3 Analysis of data

6.3.1 General

According to the distribution of the test data, the characteristic values shall be calculated either on the basis of log-normal distribution (in case of strength properties) or normal distribution (in case of physical properties and modulus of elasticity).

If exceptionally, the number of panels is less than 32 or less than specified in relevant standard, the reasons for that shall be declared specifically in the test report.

6.3.2 Strength and stiffness properties

The procedure of calculating the characteristic value $\bar{x}_{05}$ of log-normal distributed test data with known or unknown coefficient of variation $v_{\ln \bar{x}}$ according to EN 14358 is given in Annex A.

6.3.3 Characteristic mean value (50-percentile characteristic value)

The procedure of calculating the estimates of the characteristic mean value $\bar{x}_{50}$ of normal distributed test data according to EN 14358:2016, 3.3, Formula (14) is given in Annex B.

7 Test report

The test report shall contain at least the following information:

- a) a reference to this document, i.e. EN 1058:2024;
- b) date and place of sampling;
- c) product type sampled;
- d) number of panels sampled and their dates of production;
- e) method of sampling and calculation;
- f) test results of 6.3.2 or 6.3.3, respectively;
- g) any deviations from the procedure;
- h) any unusual features observed;
- i) the date of the test.

Annex A (informative)

Calculation of the 5-percentile characteristic value of log-normal distributed test data according to EN 14358

A.1 Symbols

A.1.1 Letter symbols

f	Strength property, in newtons per square millimetre (N/mm ²)
k	Statistical factor
$k(n)$	Statistical factor for a population with known coefficient of variation
L	Lower specification limit
m_k	Characteristic value of log-normal distributed test data
n	Number of test results (panel means) of the sample
$s_{\ln \bar{x}}$	Standard deviation between panel means of a log-normal distributed property $\bar{x}_j$
$\bar{x}_j$	Panel mean
$\bar{\bar{x}}$	Grand mean

A.1.2 Indices

j	Test panel serial number ($j = 1, \dots, n$)
k	Characteristic value of a log-normal distributed property
L	Related to lower specification limit
s	Index of the statistical factor for a population with unknown coefficient of variation
$\ln \bar{x}$	Related to log-normal distributed test data
$_{05}$	5-percentile characteristic value of a log-normal distributed property

A.2 Analysis of data – Characteristic value m_k of test data with unknown coefficient of variation

The characteristic value m_k of a log-normal distributed property is in accordance with EN 14358 defined as:

$$m_k = \bar{x}_{05} = \exp \left(\frac{1}{n} \times \sum_{j=1}^{j=n} \ln \bar{x}_j - k_s \times s_{\ln \bar{x}} \right) \quad (A.1)$$

where

$$s_{\ln \bar{x}} = \sqrt{\frac{\sum_{j=1}^{j=n} \left(\ln \bar{x}_j - \frac{1}{n} \times \sum_{j=1}^{j=n} \ln \bar{x}_j \right)^2}{n-1}} = \sqrt{\frac{\sum_{j=1}^{j=n} (\ln \bar{x}_j)^2 - \frac{\sum_{j=1}^{j=n} \ln \bar{x}_j \times \sum_{j=1}^{j=n} \ln \bar{x}_j}{n}}{n-1}} \quad (\text{A.2})$$

The k_s – values are taken from EN 14358:2016, Formula (9), Formula (10) or Table 1 as follows:

$k_s(n)$ shall be taken as:

$$k_s(n) = \frac{k_\alpha(n)}{\sqrt{n}} \quad (\text{A.3})$$

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 standardized normal distribution function.

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

$$k_s(n) = \frac{6,5n + 6}{3,7n - 3} \quad (\text{A.4})$$

Some values of $k_s(n)$ calculated according to Formula (A.3) are given in Table A.1.

Table A.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.

A.3 Acceptance criteria for a sample

If the characteristic value of a property $\bar{x}_{05}$, calculated according to Formula (A.1), is equal or greater than the lower specification limit L given in the respective performance standard, the requirements are fulfilled.

A.4 Example of calculation – Determination of the characteristic value of the bending strength $\bar{f}_{05}$ of particle boards with unknown coefficient of variation

Number of test results:	$n = 32$
Coefficient of variation:	$\nu_{\ln \bar{x}}$: unknown
Lower specification limit:	$L = 14 \frac{\text{N}}{\text{mm}^2}$

Assumed test data are given in Table A.2.

Table A.2 — Tabulated test results

Panel number j	$\bar{f}_j$	$\ln \bar{f}_j$	$(\ln \bar{f}_j)^2$
1.1	18,0	2,890 4	8,354 25
1.2	15,1	2,714 7	7,369 57
1.3	16,6	2,809 4	7,892 74
1.4	20,1	3,000 7	9,004 32
1.5	16,3	2,791 2	7,790 60
1.6	18,7	2,928 5	8,576 25
1.7	18,2	2,901 4	8,418 25
1.8	19,4	2,965 3	8,792 84
1.9	16,8	2,821 4	7,960 18
1.10	17,8	2,879 2	8,289 78
1.11	18,9	2,939 2	8,638 67
1.12	20,9	3,039 7	9,240 07
1.13	18,0	2,820 4	8,354 25
1.14	17,2	2,844 9	8,093 51
1.15	15,7	2,753 7	7,582 65
1.16	18,4	2,912 4	8,481 79
1.17	19,5	2,970 4	8,823 36
1.18	20,3	3,010 6	9,063 84
1.19	17,5	2,862 2	8,192 19
1.20	18,8	2,933 8	8,607 52
1.21	16,6	2,809 4	7,892 74
1.22	13,7	2,617 4	6,850 76
1.23	17,6	2,867 9	8,224 84
1.24	15,9	2,766 3	7,652 52
1.25	18,4	2,912 3	8,481 79
1.26	19,2	2,954 9	8,731 49
1.27	18,6	2,923 2	8,544 87
1.28	19,8	2,985 7	8,914 30
1.29	20,4	3,015 5	9,093 45
1.30	17,0	2,833 2	8,027 10
1.31	22,3	3,104 6	9,638 46
1.32	18,8	2,933 9	8,607 52
Σ		92,583 8	268,186 47

$$\sum_{j=1}^{j=n} \ln \bar{f}_j = 92,583\ 8; \ln \bar{f}_{\ln \bar{f}} = \frac{92,583\ 8}{32} = 2,893\ 2 \quad (\text{A.5})$$

$$\sum_{j=1}^{j=n} \left(\ln \bar{f}_j \right)^2 = 268,186\ 47 \quad (\text{A.6})$$

$$\ln s_{\ln \bar{f}} = \sqrt{\frac{268,186\ 47 - \frac{92,583\ 8 \times 92,583\ 8}{32}}{31}} = 0,101\ 436 \quad (\text{A.7})$$

The grand mean value of the bending strength $\bar{f}_{\ln \bar{x}}$ is:

$$\bar{f}_{\ln \bar{x}} = \exp(2,893\ 2) = 18,05 \frac{\text{N}}{\text{mm}^2} \quad (\text{A.8})$$

The characteristic value of the bending strength $\bar{f}_{05}$ of a sample with unknown coefficient of variation being greater than 0,05, is according to Formula (A.9):

$$\bar{f}_{05} = \exp\left(\frac{92,583\ 8}{32} - 1,86 \times 0,101\ 436\right) = \exp(2,704\ 53) = 14,95 \frac{\text{N}}{\text{mm}^2} \quad (\text{A.9})$$

Since $\bar{f}_{05} > L$, the requirement of the specification standard is fulfilled.

Annex B

(informative)

Calculation of the characteristic mean value (50-percentile value) of normal distributed test data according to EN 14358

B.1 Symbols

B.1.1 Letter symbols (see also Annex A)

$\bar{x}_{50}$ Characteristic mean value of a normal distributed property

B.1.2 Indices (see also Annex A)

$_{50}$ 50-percentile characteristic mean value of a normal distributed property

B.2 Analysis of data – 50-percentile characteristic value (characteristic mean value)

The characteristic mean value $\bar{x}_{50}$ of a normal distributed property is calculated according to Formula (B.1):

$$\bar{x}_{50} = \bar{x} \quad (B.1)$$

B.3 Acceptance criteria for a sample

The acceptance of the sample (mean) shall be performed based on the classical statistics and t-distribution with n-1 degrees of freedom and one-sided confidence interval of $\alpha = 75 \%$ (t-test). Alternatively, Bayesian statistics can be used (see EN 1990).

Bibliography

- [1] EN 326-1, *Wood-based panels - Sampling, cutting and inspection — Part 1: Sampling and cutting of test pieces and expression of test results*
- [2] EN 326-2, *Wood-based panels — Sampling, cutting and inspection — Part 2: Initial type testing and factory production control*
- [3] EN 1990:2023³, *Eurocode — Basis of structural and geotechnical design*
- [4] EN 1995-1-1:2004⁴, *Eurocode 5: Design of timber structures — Part 1-1: General — Common rules and rules for buildings*
- [5] EN 12871, *Wood-based panels — Determination of performance characteristics for load bearing panels for use in floors, roofs and walls*
- [6] EN 14358:2016, *Timber structures — Calculation and verification of characteristic values*

³ As impacted by EN 1990:2002/A1:2005, EN 1990:2002/A1:2005/AC:2008 and EN 1990:2002/A1:2005/AC:2010.

⁴ As impacted by EN 1995-1-1:2004/A1:2008, EN 1995-1-1:2004/A2:2014 and EN 1995-1-1:2004/AC:2006.