BS EN 16737:2016

BSI Standards Publication

Structural timber — Visual strength grading of tropical hardwood

bsi.

National foreword

This British Standard is the UK implementation of EN 16737:2016.
It partially supersedes BS 5756:2007+A1:2011.

BS EN 16737:2016 partially supersedes BS 5756:2007+A1:2011, specifically clause 5 covering the requirements for structural hardwood species and the corresponding Table 1. BS 5756 will be revised at a future date as a result of the publication of this standard.

The UK committee notes that there are many published strength class assignments for named species and sources of tropical hardwood timber that rely on the HS grade of BS 5756. The minor nature of the differences between the STH grade in this standard and the HS grade means that these assignments can adopt the STH grading rules as published here.

The UK participation in its preparation was entrusted to Technical Committee B/518, Structural timber.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Published by BSI Standards Limited 2016

ISBN 978 0 580 86021 8

ICS 79.040

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 July 2016.

Amendments/corrigenda issued since publication

Date	Text affected

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 16737

May 2016

ICS 79.040

English Version

Structural timber - Visual strength grading of tropical hardwood

Bois de structure - Classement visuel des bois feuillus tropicaux de structure

Bauholz für tragende Zwecke - Visuelle Sortierung von Tropenholz nach der Festigkeit

This European Standard was approved by CEN on 19 March 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.

CEN members are the national standards bodies of 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 United Kingdom.

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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. EN 16737:2016 E

Contents

Page

European foreword

This document (EN 16737:2016) 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 November 2016 and conflicting national standards shall be withdrawn at the latest by November 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 standard gives grading methods, definitions and criteria as required in EN 14081-1 for a visual strength grading standard.

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 European Standard specifies a method of strength grading tropical hardwood visually for structural use.

The permissible limits of characteristics for a single visual strength grade of timber are specified, designated “Structural Tropical Hardwood” (STH) grade.

The method is only suitable for pieces of timber with a rectangular cross-section that is constant along their lengths.

Characteristics related to durability are not covered in this standard. For some end uses, additional requirements may be specified at the time of grading, e.g. sapwood exclusion.

2 Normative references

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

EN 336, *Structural timber - Sizes, permitted deviations*

EN 338, *Structural timber - Strength classes*

EN 350-2, *Durability of wood and wood-based products - Natural durability of solid wood - Part 2: Guide to natural durability and treatability of selected wood species of importance in Europe*

EN 384, *Structural timber - Determination of characteristic values of mechanical properties and density*

EN 844-3, *Round and sawn timber - Terminology - Part 3: General terms relating to sawn timber*

EN 844-9, *Round and sawn timber - Terminology - Part 9: Terms relating to features of sawn timber*

EN 844-10, *Round and sawn timber - Terminology - Part 10: Terms relating to stain and fungal attack*

EN 844-12, *Round and sawn timber - Terminology - Part 12: Additional terms and general index*

EN 1310:1997, *Round and sawn timber - Method of measurement of features*

EN 1912, *Structural Timber - Strength classes - Assignment of visual grades and species*

EN 13556, *Round and sawn timber - Nomenclature of timbers used in Europe*

EN 14081-1, *Timber structures - Strength graded structural timber with rectangular cross section - Part 1: General requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 336, EN 844-3, EN 844-9, EN 844-10, EN 844-12 and EN 14081-1 and the nomenclature in EN 13556 and the following apply.

3.1
bark pocket
bark that is partly or wholly enclosed in the wood

4

3.2
bore hole
hole or tunnel in timber caused by insects

3.3
boxed heart
pith that is present and not visible on any face or edge

3.4
brittleheart
wood characterized by abnormal brittleness, mostly located in the heart

3.5
compression creases
buckling of fibres across the grain as a consequence of excessive internal growth stresses or external forces

3.6
interlocked grain
grain in which cells in succeeding growth periods incline alternately in opposite directions that are different from that of the axis of the tree

3.7
fissure
longitudinal separation of the fibres

3.8
pinhole
bore hole usually not more than 2 mm in diameter

3.9
pin knot
round or oval knot, sound, intergrown or partially intergrown, with a maximum size of 5 mm

3.10
resin pocket
lens-shaped cavity in timber containing, or that has contained, resin

3.11
resin canal
longitudinal separation of the fibres containing resin appearing on a face or edge of the piece of timber

3.12
slope of grain
divergence of the direction of the fibres from the longitudinal axis of the piece of timber

3.13
thickness
lesser dimension perpendicular to the longitudinal axis of the piece of timber

Note 1 to entry: This is the size of the edge.

3.14
tropical hardwood
wood of angiosperm trees of the botanical group dicotyledons whose natural distribution lies substantially South of the Tropic of Cancer and north of the Tropic of Capricorn

Note 1 to entry: Unlike temperate hardwood, tropical hardwood is typically free of gross anatomical features that indicate the rate of growth, such as annual growth increments.

3.15
width
greater dimension perpendicular to the longitudinal axis of the piece of timber

Note 1 to entry: This is the size of the face.

4 Strength graded timber

4.1 Supervision of strength grading operations

As specified in EN 14081-1, visual strength grading operations shall be carried out by a competent person, or people working within a company under the close supervision of competent persons.

4.2 Sizes

Timber graded to this standard shall conform to EN 336 with respect to its permissible deviations with the following exceptions:

— the minimum thickness at the time of grading shall be 22 mm;

— the minimum cross-sectional area at the time of grading shall be 2 200 mm^2.

4.3 Processing of visually graded timber

Visually graded timber shall no longer conform to this standard if its cross-section is reduced in size through subsequent processing by more than:

a) 5 mm for dimensions 22 ≤ to 100 mm, or;

b) 10 mm for dimensions > 100 mm.

Where graded timber is reduced in cross section beyond the above limits, it shall be re-graded if it is to conform to this standard.

Where graded timber is reduced in length, or a piece of graded timber is cross-cut into two or more pieces, each resulting piece may be assumed to conform to the permissible limits of characteristics in Table 1 of this standard.

4.4 Moisture content

Dry graded timber shall have at the time it is graded for fissures and distortion a mean moisture content of 20 % or less with no individual measurement exceeding 24 %.

NOTE The end use determines whether timber needs to be dry graded or not. If timber is not dry graded, it may be needed to check fissures and distortion also at the time of end use.

5 Measurement of strength-reducing characteristics

5.1 Knots

5.1.1 General

The size of the knot shall be related to the width or thickness on the basis of linear values.

Methods of measurements of knots are given in EN 1310. The "alternative method" shall be used, whereby the size of the knot is measured in a direction perpendicular to the longitudinal axis of the piece of timber (Figure 1).

Knots are accumulative if longitudinal separation between the edges of the knots is either less than twice the width or 300mm (whichever is the lesser), or when the grain has not fully recovered.

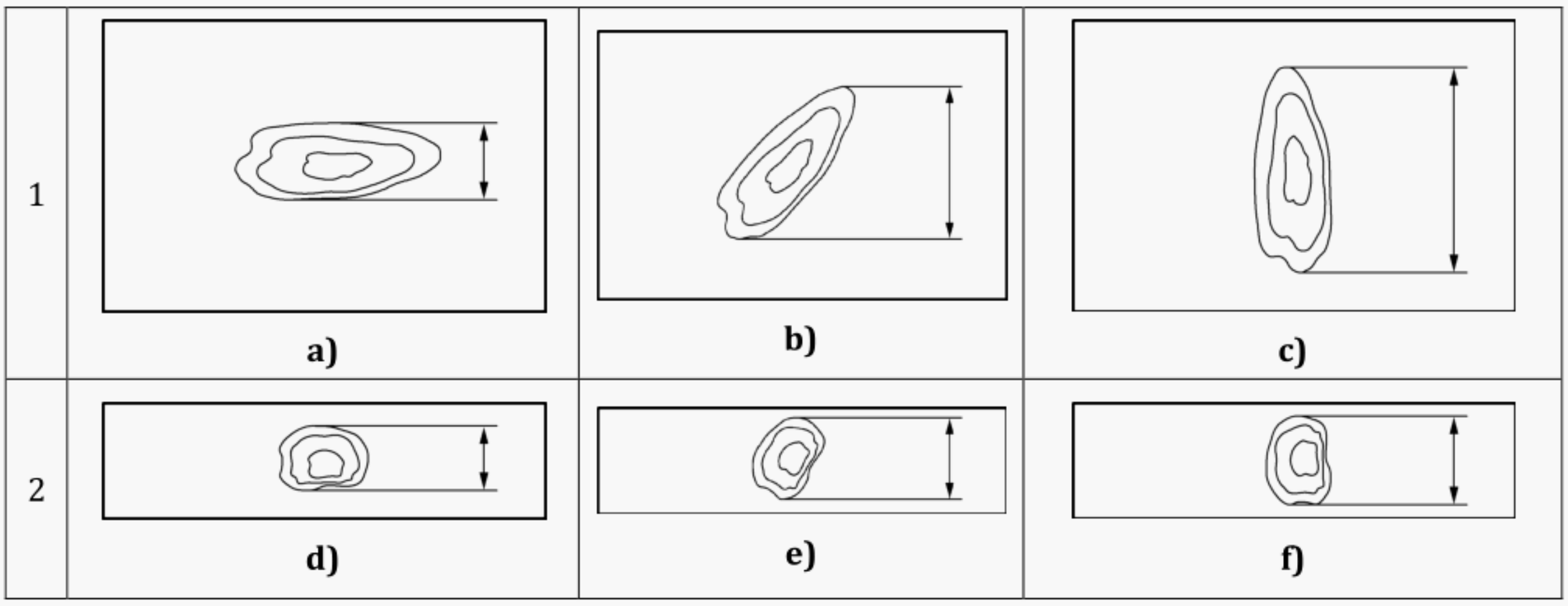
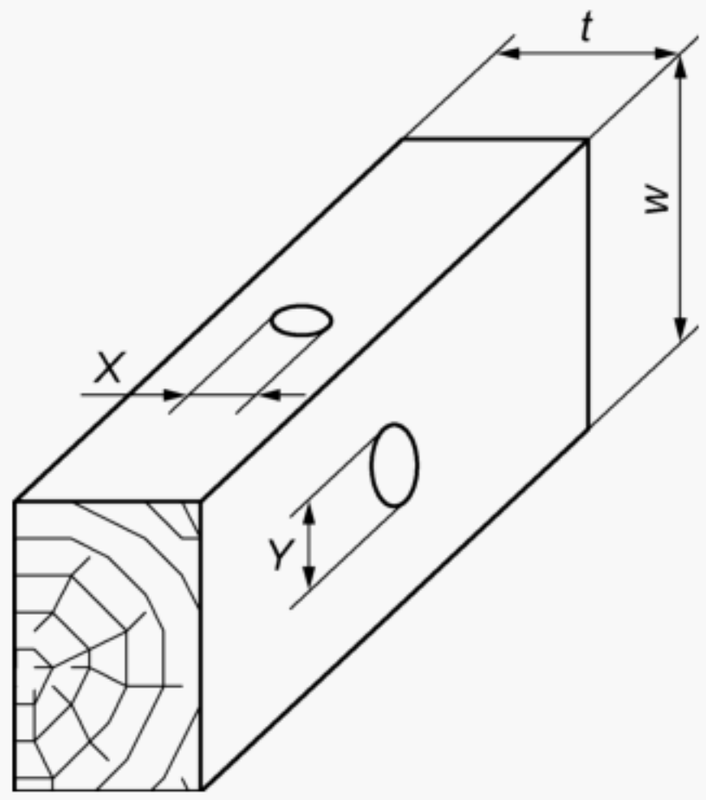


Figure 1 — Measuring knot sizes 1 on faces and 2 on edges

5.1.2 Knot size: requisite comparisons

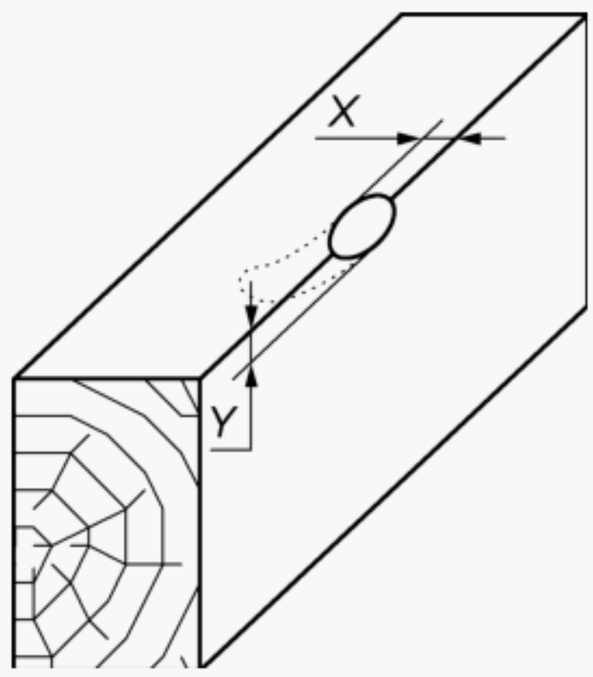
For knots that are contained entirely within a single face or edge, the size of the knot shall be compared to the full size of the face or edge in which it appears (Figure 2).



X is related to the thickness *t* and *Y* is compared to the width *w*.

Figure 2 — Measuring knot sizes

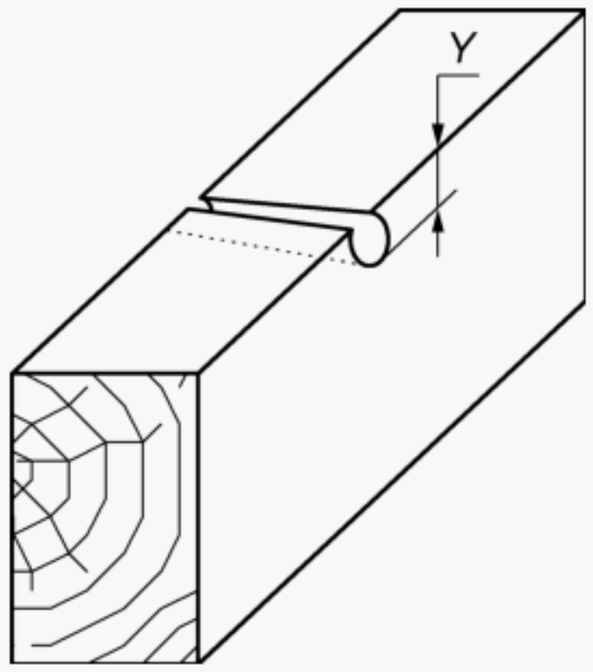
For arris knots that are not elongated, the size of the knot on both the face and the edge shall be measured. The larger of the two sizes shall be compared to the thickness of the piece (Figure 3).



The greater of *X* and *Y* is compared to the thickness.

Figure 3 — Measuring knot sizes

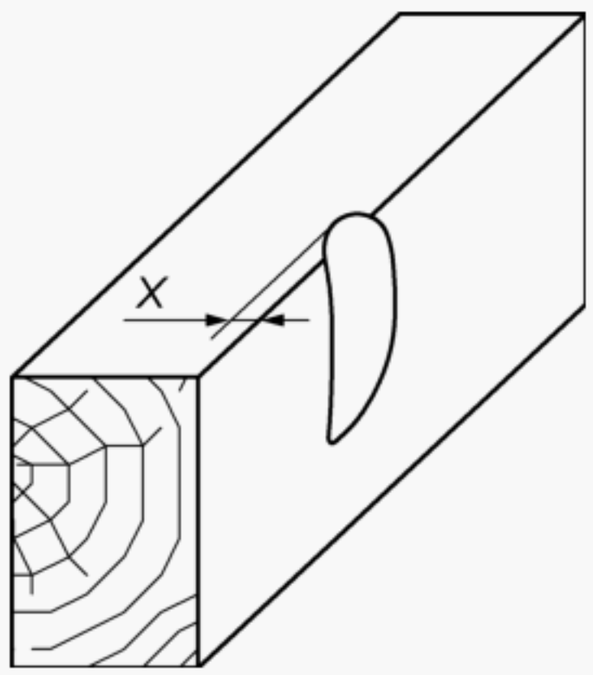
For arris knots that appear on both faces and occupy the full size of an edge, or are elongated across at least 75 % of an edge, the size of the knot on both faces shall be measured. The larger of the two sizes shall be compared to the width of the piece (Figure 4).



Y is measured on both faces and the larger value is compared to the width.

Figure 4 — Measuring knot sizes

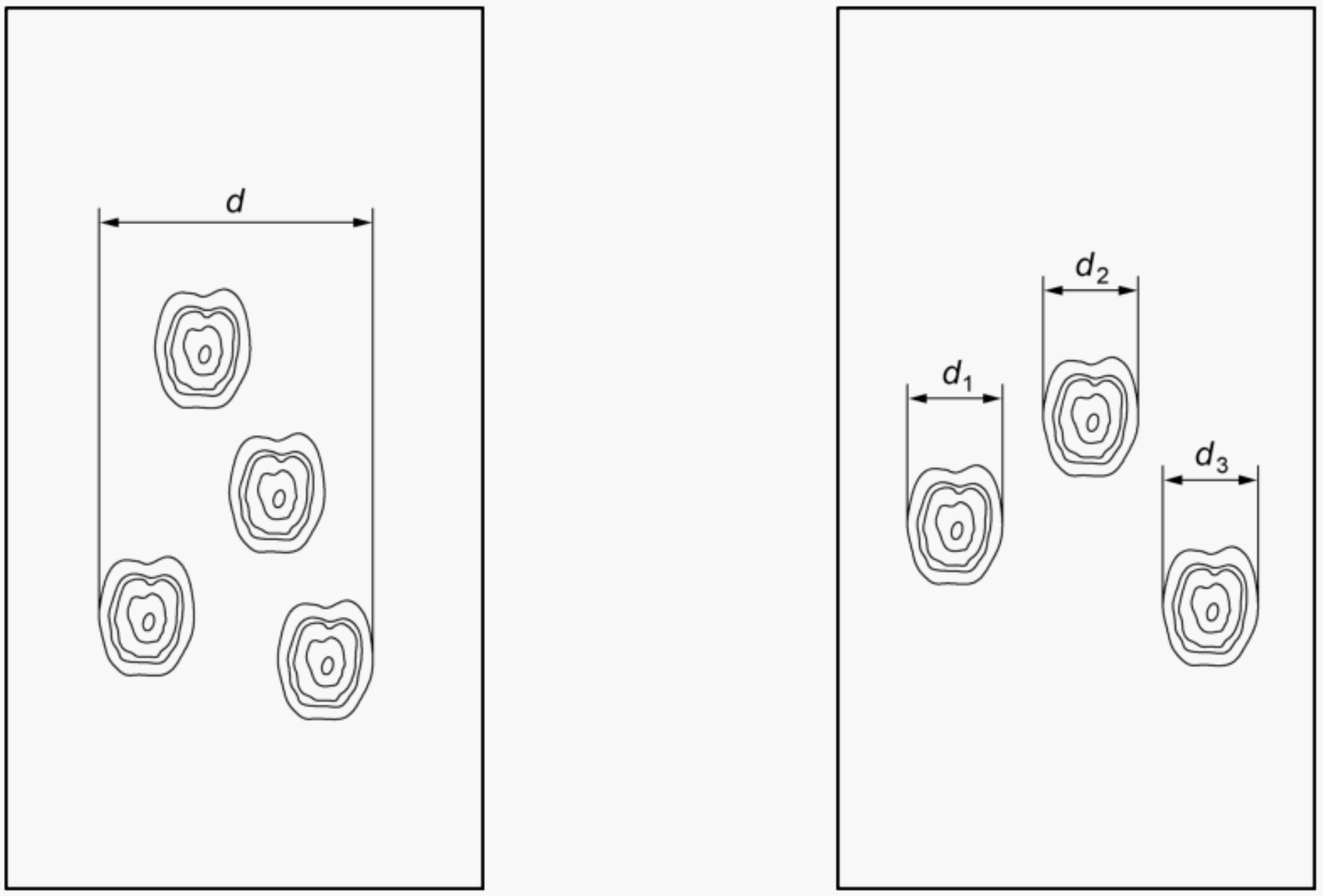
For splay knots or branch knots that are elongated across a face, the size of the knot shall be measured on the edge and compared to the thickness of the piece (Figure 5).



X is compared to the thickness.

Figure 5 — Measuring knot sizes

For knot clusters, where no grain recovery is evident between adjacent knots, the knot size shall be measured on the surface on which the cluster is transversely cut. The size of the knot shall be the overall width of the knot cluster d, or the sum of the individual knot widths d1 d2 d3…dn, whichever is the lesser (Figure 6).



a) **b)**

The size of the knot shall be lesser of d and $d_1+d_2+d_3...d_n$.

Figure 6 — Measuring the size of a knot cluster

5.1.3 Pin knots

Single pin knots may be ignored.

Tightly grouped pin knots shall be treated as a single knot.

5.2 Slope of grain

The method of measurement of slope of grain by use of a cranked scribe is given in EN 1310:1997, 4.4.1. The slope of grain shall be expressed as the number of units of length over which unit deviation occurs.

The slope of grain shall be measured over a distance sufficiently great to determine the general slope, disregarding local deviations. It shall be measured on both faces and edges to determine the steepest slope.

The slope of interlocked grain shall be assessed separately from the general slope of grain. The grader shall examine the piece to determine if the slope of grain reverses at least once through the thickness or width. If this is the case, the rule for interlocked grain may be applied to the steepest slope of interlocked grain. However, in doubtful cases, where, in the grader's judgment, interlocked grain occurs to an undesirable extent in relation to the cross-sectional dimension of the piece, the piece shall be rejected.

Interlocked grain is a normal feature of certain tropical hardwoods and care should be taken to avoid confusing it with sloping grain.

Localized steep slope of grain at the edge of a piece shall be assessed by determining the size of the affected area, perpendicular to the longitudinal axis of the timber. The associated geometrical limitations for arris knots shall apply.

5.3 Density

If, in the judgment of the grader and taking account of the moisture content, a piece of timber is of unusually low density for the species and provenance, this may be given as a reason for rejecting the piece.

In case of uncertainty, the density and moisture content of a piece of the timber shall be measured and the density value adjusted to 12 % moisture content. The adjusted density shall be considered unusually low if it is more than 20 % below the mean value for the intended EN 338 strength class, as assigned in EN 1912. For unassigned species and provenance combinations, the adjusted density shall be considered unusually low if it is more than 20 % below the lowest published value in EN 350-2 for the species, which are reproduced in Annex A.

NOTE The density of tropical hardwood cannot reliably be derived from estimates of the rate of growth.

This criterion shall not be used when determining the characteristic values in accordance with EN 384.

5.4 Fissures

Measurement of fissures shall be taken at the time of grading. Fissures shall be measured in accordance with EN 1310.

The depth of a fissure may be taken as the maximum depth to which a 0.2 mm feeler gauge can be inserted and expressed as the reduction of width or thickness caused by the crack taking into account its orientation.

The length and depth of fissure is linked with moisture content and therefore the limits given below are only applicable at the time of grading.

5.5 Wane

Wane shall be measured in accordance with method b for wane in EN 1310:1997, 4.8. The amount of wane shall be expressed as a decimal fraction of the face or edge on which it appears.

When wane occurs on both arises of a face or edge, the amount of wane shall be the cumulative sum for that face or edge at any single cross-section.

The limitation on wane shall apply at the cross-section with the greatest reduction in the basic dimensions of a face or edge.

5.6 Distortion

5.6.1 Bow and spring

Bow and spring shall be measured in accordance with the method for bow and spring in EN 1310. The amount of bow and spring shall be expressed in mm per 2m length.

5.6.2 Twist

Twist shall be measured in accordance with the method for twist in EN 1310. The amount of twist shall be expressed in mm per 25 mm width per 2 m length.

5.7 Biological characteristics

5.7.1 Fungal biodegradation

Biodegradation due to fungal stains shall be assessed separately from biodegradation due to wood destroying fungi (rot).

5.7.2 Insect attack

Degradation by insects shall be assessed by evidence of damage. If the damage is caused by an insect that might still be active, it shall be assumed that the infestation is active.

5.7.3 Marine borers

The extent of damage by marine borers shall be assessed by comparison with the limitations given for other defects such as knots. If there is any doubt as to the extent of damage, this may be given as a reason for rejecting the piece.

5.8 Other defects and characteristics

Any piece which contains other defects such as brittleheart, compression failure, mechanical damage or other characteristics that might cause a decrease in strength properties to an amount which threatens its serviceability, shall be excluded from the grade.

Any piece which contains such defects shall be accepted to the grade only if the reduction in strength caused by these defects is obviously less than that caused by the defects admitted by the grade, as long as these defects are of a type which does not progress after conversion.

If there is any doubt as to the extent of the damage attributable to the defect, this may be given as a reason for rejecting the piece.

Other defects include:

- Compression creases:

  Compression creases are more easily detected on planed surfaces than sawn surfaces.

- Brittleheart:

  Brittleheart at the ends of a piece can be detected by a pitted appearance. Detection of brittleheart on a sawn face is more difficult, but it may be visible as compression creases on a planed face. It is often associated with abnormally low density.

- Resin pockets and resin canals:

  In some species, resin canals are so extensive that they are considered a feature of the timber and are not a reason for rejecting the piece.

- Bark pockets.

- Mechanical damage:

  In the form of loose or broken fibres.

- Boxed heart:

  Examine the timber to determine if the pith is present at both cut ends and does not emerge on the surfaces of the piece of timber.

6 Limiting values of characteristics for STH grade

Table 1 — Limiting values of characteristics for STH grade

Characteristic	Limiting value
Knots:	
Siz"e	Not greater than 20 % of the face or edge to which it is compared.
longitudinal separation	Knots are accumulative if longitudinal separation between the edges of the knots is either less than twice the width or 300 mm (whichever is the lesser),or when the grain has not fully recovered.
Slope of grain	Not greater than 1 in 10 on any face or edge. Interlocked grain not to be steeper than 1 in 4.
Density	Unusually low density not allowed.
Fissures:	
not through the thickness	Length unlimited Depth not reducing the width or thickness more than 50 %
through the thickness	Only permitted at the ends with a length not greater than the width of the piece.
Wane	Wane shall not reduce the size of an edge or face to less than 2/3 of the basic dimensions of the piece. Length of wane is unlimited.
Distortion:	
Bow	Not greater than 10 mm over a length of 2 m.
Spring	Not greater than 8 mm over a length of 2 m.
Twist	Not greater than 2 mm per 25 mm width over a length of 2 m.
Biodegradation:	
Fungal stain	No limit
Rot	Not permitted
Insect damage: Active infestation	Not permitted
Bore holes	Permitted, unless so extensive that they appear to significantly reduce the strength of the piece
Other defects:	
Compression creases	Not permitted
Brittleheart	Not permitted
Resin pockets, resin canals and bark pockets	Apply the limitations of knots or fissures as appropriate to the length and width of the defect
Mechanical damage	Apply the limitations of knots, fissures or wane as appropriate to the length and width of the damage
Boxed heart	Only permitted if the thickness and width are both greater than 200 mm.

7 Marking

Timber graded to this standard shall be marked in accordance with the rules in EN 14081-1 for marking visually graded timber.

Annex A
(informative)

Tropical hardwood species and their densities

The density is based on mass/volume at a wood moisture content of 12 %. The range refers to commonly encountered values and not to the total possible variation.

Table A.1 — Tropical hardwoods species with their scientific name, common name, origin and density range

Scientific name	**Common name**[1)]	**Origin**	**Density range kg/m³**
Afzelia bipindensis Harms, *A.pachyloba* Harms, *A* sp. pl.	X: doussié O: afzelia	W. Africa	730–800–830
Amburana cearensis (Fr.All) A.C.Sm.	X: cerejeira	S.America	550–600–650
Amphimas pterocarpoides Harms., *A* sp.pl.	X: lati	W. Africa	730–750–770
Aningeria robusta (A.Chev.) Aubr. & Pellegr. *A.* sp.pl	X: aningré O: anegré	W./E. Africa	540–580–630
Anisoptera curtisii Dyer ex King *A.* sp.pl.	X: mersawa O: krabak	S.E. Asia	520–650–740
Antiaris toxicaria Leschen. subsp. *welwitschii* (Engl.) C.C.Berg	X: ako O: antiaris	W./E. Africa	430–450–460
Aspidosperma peroba Fr. All. *A.*sp.pl.	X: peroba rosa	S. America	650–750–800
Aucoumea klaineana Pierre	X: okoumé O: gaboon	W. Africa	430–440–450
Baillonella toxisperma Pierre	X: moabi	W. Africa	770–800–830

1) X: Association Technique Internationale des Bois Tropicaux (ATIBT) name.
O: Other name

Scientific name	**Common name**[1)]	**Origin**	**Density range kg/m³**
Brachylaena hutchinsii Hutch.	X: muhuhu	E. Africa	830–910–960
Calophyllum inophyllum L., *C.* sp.pl	X: bintangor	S.E. Asia, Papua New Guinea	630–660–690
Canarium schweinfurthii Engl	X: aiélé O: African canarium	W./E. Africa	490–500–530
Carapa guianensis Aubl., *C. surinamensis* Miq. *C* sp.pl.	X: andiroba O: crabwood	C./S. America	610–620–640
Cedrela odorata L., *C. fissilis* Vell., *C.* sp.pl.	X: Cedro O: American “cedar”	C./S. America	450–490–600
Cedrelinga catenaeformis Ducke	X: tornillo O: cedro rana	S. America	370–520–660
Ceiba pentandra (L.) Gaertn.	X: fuma O: ceiba O: fromager	W. Africa Tropics generally	290–320–350
Cordia alliodora (Ruiz & Pav.) Cham, *C. goeldiana* Hub, *C.* sp.pl.	X: freijo	Brazil	520–540–550
Cylicodiscus gabunensis Harms	X: okan	W. Africa	850–920–960
Daniellia thurifera Bennett *D. klainei* Pierre, *D. ogea* (Harms.) Rolfe ex Holl, *D.* sp.pl.	X: faro O: daniellia O: ogea	W. Africa	480–490–510
Dicorynia guianensis Amsh. *D. paraensis* Benth.	X: basralocus O: angélique	S. America	720–750–790
Dipterocarpus alatus Roxb. *D.* sp.pl.	X: keruing	S.E. Asia	740–750–780
Distemonanthus benthamianus Baill.	X: movingui O: ayan	W. Africa	690–710–740

Scientific name	**Common name**[1)]	**Origin**	**Density range kg/m³**
Dryobalanops aromatica Gaertn., *D.* sp.pl.	X: kapur	S.E. Asia	630–700–790
Endospermum medullosum L.S. Smith *E* sp.pl.	X: sesendok O: kauvula	S.E. Asia Fiji	420–480–530
Entandrophragma angolense (Welw.) C.DC., *E. congoense* (De Wild.) A. Chev.	X: tiama O: gedu nohor	W./E. Africa	550–560–570
Entandrophragma candollei Harms	X: kosipo O: omu	W. Africa	640–670–720
Entandrophragma cylindricum Sprague	X: sapelli O: sapele	W. Africa	640–650–700
Entandrophragma utile Sprague	X: sipo O: utile	W./E. Africa	590–640–660
Eperua falcata Aubl, *E jenmanii* Oliver, *E* sp.pl.	X: walaba	S.America	890–900–910
Eribroma oblonga (Mast.) Bod.	X: eyong	W. Africa	700–730–800
Erythrophleum ivorense A	X: tali O: Missanda	W. Africa	730–800–880
Eucalyptus diversicolor F.v.M.	O: karri	Australia	800–880–900
Eucalyptus globulus Labill.	O: southern blue gum	cultivated in Europe	700–750–800
Eucalyptus marginata Sm.	O: jarrah	Australia	790–830–900
Euxylophora paraensis Hub.	X: pau amarello	S. America	730–770–810
Gambeya Africana (G. Don.) Pierre *G. lacourtiana* (De Wild.) Aubrév. & Pellegr., *G. subnuda* Pierre	X: longhi	W. Africa	700–730–800
Gonystylus bancanus (Miq.) Kurz *G.*sp.pl.	X: ramin	S.E. Asia	560–630–670

Scientific name	**Common name**[1)]	**Origin**	**Density range kg/m³**
Gossweilerodendron balsamiferum (Verm.) Harms	X: tola O: tola branca O: agba	W. Africa	480–500–510
Guarea cedrata (A.Chev.) Pellegr., *G. laurentii* De Wild.	X: bossé clair O: guarea	W. Africa	570–580–630 (for *G. cedrata*)
Guarea thompsonii Sprague & Hutch	X: bossé foncé	W. Africa	600–690–850
Guibourtia arnoldiana (De Wild. & Th. Dür.) J.Léonard	X: mutényé	W. Africa	760–820–880
Guibourtia demeusii (Harms) J. Léonard, *G. pellegriniana* J. Léonard, *G. tessmannii* (Harms) J. Léonard	X: bubinga	W. Africa	700–830–910
Guibourtia ehie (A. Chev.) J. Léonard	X: ovéngkol O: amazakoué	W. Africa	720–780–820
Hallea ciliata (Aubrév. & Pellegr.) Leroy, *H. rubrostipulata* (K.Schum.) Leroy, *H. stipulosa* (DC.) Leroy	X: abura O: bahia	W./E. Africa	550–560–600
Heritiera simplicifolia (Mast) Kosterm., *H. javanica* (B1.) Kosterm., *H. sumatrana* (Miq.) Kosterm.	X: mengkulang	S.E. Asia	680–710–720
Heritiera utilis (Sprague) Kosterm., *H. densiflora* (Pellegr.) Kosterm.	X: niangon	W. Africa	670–680–710
Intsia bijuga (Colebr.) O Ktze., *I.* sp.pl.	X: merbau O: hintsy O: intizia	S.E. Asia Papua New Guinea	730–800–830

Scientific name	**Common name**[1)]	**Origin**	**Density range kg/m³**
a) *Khaya ivorensis* A. Chev., a) *K. anthotheca* (Welw.) C.DC., b) *K. grandifolia* C.DC.	X: acajou d'Afrique O: African mahogany O: khaya O: khaya mahogany	W./E. Africa	a) 490–520–530 b) 650–720–800
Koompassia malaccensis Maing.	X: kempas	S.E. Asia	850–860–880
Lophira alata Banks ex Gaertn.	X: azobé O: ekki O: bongossi	W. Africa	950–1 060–1 100
Lovoa trichilioides Harms, *L.* sp.pl.	X: dibétou E: African walnut	W./E. Africa	520–550–590
Maclura tinctoria (L.) D.Don ex Steudl.	X: moral O: fustic	C./S. America	750–890–960
Mansonia altissima A. Chev.	X: mansonia O: bété	W. Africa	610–620–630
Milicia excelsa (Welw.) C.C. Berg *M. regia* (A. Chev.) C.C. Berg	X: iroko O: kambala	W./E. Africa	630–650–670
Millettia laurentii De Wild., *M. stuhlmannii* Taub.	X: wengé	W./E. Africa	780–830–900
Nauclea diderrichii (De Wild. & Th.Dür) Merrill *N. gilletii* Merrill	X: bilinga O: opepe O: badi	W. Africa	740–750–780
Nesogordonia papaverifera (A. Chev.) R. Capuron, *N.* sp.pl.	X: kotibé O: danta	W./E. Africa	710–730–760
Ocotea rodiaei (Rob. Schomb.) Mez	X: greenheart	S. America	980–1 030–1 150
Ocotea rubra Mez	X: louro vermelho O: red louro	S. America	600–620–650
Oxystigma oxyphyllum (Harms) J. Léonard	X: tchitola	W. Africa	590–610–640

Scientific name	**Common name**[1)]	**Origin**	**Density range kg/m³**
Peltogyne venosa (Vahl) Benth., *P. confortiflora* Benth., *P. lecointei* Ducke *P.* sp.pl.	X: amarante O: purpleheart	C./S. America	830–860–880
Pericopsis elata (Harms) Van Meeuwen	X: afrormosia	W. Africa	680–690–710
Pometia pinnata Forst.,	X: kasai O: taun	S.E. Asia, Papua New Guinea	650–710–750
Pseudosindora palustris Sym. *Sindora* sp.pl.	X: sepetir	S.E. Asia	650–660–670
Pterocarpus soyauxii Taub. *P* sp.pl.	X: padouk d'Afrique	W. Africa	720–740–820
Pterygota macrocarpa K. Schum., *P. bequaertii* De Wild.	X: koto	W. Africa	510–560–630
Pycnanthus angolensis (Welw.) Warb.	X: ilomba	W./E. Africa	440–480–510
Rhodognaphalon brevicuspe Roberty, *R. schumannianum* Robyns	X: kondroti	W./E. Africa	470–480–490
Shorea laevis Ridl., *S. altrinervosa* Sym., *S. glauca* King, *S* sp.pl. (section *Shorea*)	X: balau (Yellow) O: bangkirai	S.E. Asia	700–930–1 150
Shorea collina Ridl. *S. guiso* (Blco.) Bl. (section *Shorea*) *S. kunstleri* King *S* sp.pl. (section *Brachypterae*)	X: red balau	S.E. Asia	750–800–900

Scientific name	**Common name**[1)]	**Origin**	**Density range kg/m³**
Shorea curtisii Dyer ex King. *S. pauciflora* King, *S.* sp.pl. (section *Rubroshorea*)	X: dark red meranti[2)]	S.E. Asia	600–680–730
Shorea leprosula Miq., *S. parvifolia* Dyer *S.* sp.pl. (section *Rubroshorea*)	X: light red meranti[2)]	S.E. Asia	490–520–550
Shorea resina-nigra Foxw., *S. faguetiana* Heim, *S* sp.pl. (section *Richetia*)	X: yellow meranti[2)]	S.E. Asia	560–630–660
Shorea assamica Dyer, *S.* sp.pl. (section *Anthoshorea*)	X: white meranti[2)]	S.E. Asia	600–630–670
Swietenia macrophylla King,	X: mahogany O: American mahogany	C./S. America Caribbean	510–550–580 700–720–770
Tectona grandis L.f.	X: teak	Asia cultivated in Asia and in other countries	650–680–750
Terminalia ivorensis A. Chev.	X: framiré O: idigbo	W. Africa	520–550–560
Terminalia superba Engl. & Diels	X: limba O: afara	W. Africa	550–560–600
Tieghemella heckelii Pierre ex A. Chev., *T. africana* Pierre	X: makoré O: douka	W. Africa	620–660–720
Triplochiton scleroxylon K. Schum.	X: obeche O: ayous	W. Africa	370–390–400

2) "Meranti" from Malaysia (*Shorea*, *Parashorea* and *Pentacme* species; also known as seraya and lauan from other origins) refers not to a specific wood species, but to a mixed commercial group of east-Asian hardwoods.

Scientific name	**Common name**[1)]	**Origin**	**Density range kg/m³**
Turraeanthus africanus (Welw.) ex C.DC.) Pellegr.	X: avodiré	W. Africa	540–550–560
Virola surinamensis (Rolf) Warb, *V* sp.pl., *Dialyanthera* sp.pl.	X: virola O: baboen	S. America	440–440–480
Vochysia hondurensis Sprague, *V. tetraphyalla* DC., *V.* sp.pl.	X: quaruba	C./S. America	450–490–510
Zanthoxylum heitzii (Aubrév. & Pellegr.) Waterman	X: olon	W. Africa	500–550–640

This page deliberately left blank

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Copyright in BSI publications

All the content in BSI publications, including British Standards, is the property of and copyrighted by BSI or some person or entity that owns copyright in the information used (such as the international standardization bodies) and has formally licensed such information to BSI for commercial publication and use.

Save for the provisions below, you may not transfer, share or disseminate any portion of the standard to any other person. You may not adapt, distribute, commercially exploit, or publicly display the standard or any portion thereof in any manner whatsoever without BSI's prior written consent.

Storing and using standards

Standards purchased in soft copy format:

- A British Standard purchased in soft copy format is licensed to a sole named user for personal or internal company use only.
- The standard may be stored on more than 1 device provided that it is accessible by the sole named user only and that only 1 copy is accessed at any one time.
- A single paper copy may be printed for personal or internal company use only.

Standards purchased in hard copy format:

- A British Standard purchased in hard copy format is for personal or internal company use only.
- It may not be further reproduced – in any format – to create an additional copy. This includes scanning of the document.

If you need more than 1 copy of the document, or if you wish to share the document on an internal network, you can save money by choosing a subscription product (see 'Subscriptions').

Reproducing extracts

For permission to reproduce content from BSI publications contact the BSI Copyright & Licensing team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email subscriptions@bsigroup.com.

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Useful Contacts

Customer Services
Tel: +44 345 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 345 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

bsi.