STANDARDS FOR DESIGNATION OF FOREIGN AGENCIES FOR INSPECTION OF STANDARDS AND QUALITY OF TIMBER PRODUCTS

The Korea Forest Service Public Notification No. 2017-109, _____, 2017

Article 1 (Purpose)

The purpose of this Public Notification is to improve efficiency of affairs related to the inspection of wood products, etc., by prescribing necessary matters concerning the standards for designation, etc., of a foreign agency for the inspection of standards and quality of wood products (hereinafter referred to as "foreign inspection agency"), delegated for enactment by the Minister of the Korea Forest Service pursuant to Article 19 of the Enforcement Decree of the Act on the Sustainable Use of Woods.

Article 2 (Definitions)

The terms used in this Public Notification shall be defined as follows:

1. The term "foreign inspection agency" means a public inspection agency (including its branch) established or inspection agency accredited by the government including local government of an exporting country;
2. The term "*in-situ* evaluation of inspection capacity" means the measurement and evaluation of inspection capacity conducted using standard samples, to ensure the reliability and accuracy of inspection facilities, analytical technologies, etc., when authorizing as a foreign inspection agency;

Article 3 (Application for Designation of Inspection Agencies, etc.)

(1) An applicant who intends to be designated as a foreign inspection agency shall submit an application for designation of a foreign inspection agency in attached Form 1 (including an application in electronic form) to the Minister of the Korea Forest Service, along with the following documents (including electronic documents). In such cases, the application may be submitted through the government of the applicant's country or directly by the applicant:

1. General Information (functions, history of the institute, organizational charts, etc.);
2. Inspection records (in recent three years of the items of wood products, for which the applicant intends to be designated as an inspection agency);
3. A list of inspection equipment (in attached Table 1: *Provided,* That where the owner of inspection equipment is not the applicant, photocopies of the relevant evidential documents);
4. Lay-out of office and laboratory (in attached Table 2);
5. Information on inspection personnel (including work experiences

of each inspector);

6. Where the government of the applicant's country has evaluated the applicant's inspection capacity, or where the applicant's inspection capacity has been evaluated during the applicant's participation in a program for verification of capacity for international inspections, photocopies of the relevant evidential documents;

7. Notwithstanding the requirements prescribed in subparagraphs 1 through 5, a public inspection agency (including its branch) established, or inspection agency accredited, by the government or local government of an exporting country, may follow the designation requirements of the exporting country.

(2) To verify the details of application and required documents submitted pursuant to paragraph (1) and inspection capacity, the Minister of the Korea Forest Service shall *in-situ* inspect a foreign agency for the inspection of standards and quality of wood products in accordance with the criteria for allocating points specified in attached Table 3, and may *in-situ* inspect the inspection capacity, if necessary: *Provided*, That where the inspection facilities, inspection capacity, etc., are found sufficient in examining the documents forth in subparagraphs of paragraph (1), the *in-situ* inspection may be omitted.

(3) Where it is intended to *in-situ* inspect pursuant to paragraph (2), the inspection date, inspectors, details of inspection, etc., shall be notified to the applicant by no later than one month before conducting the *in-situ* inspection: *Provided*, That such notification may be given by no later than seven days prior to the *in-situ* inspection in an emergency or in extenuating circumstances.

(4) After examining the findings of an *in-situ* inspection, etc., if no reason exists for a foreign inspection agency to be disqualified, the Minister of the Korea Forest Service shall notify the fact of designation to the inspection agency which has submitted the application, and publicly announce on the website including the name and location of the inspection agency; wood products subject to inspection; designation date of the inspection agency; and related matters.

Article 4 (Notice of Inspection Results, etc.)

(1) Where a foreign inspection agency inspects any wood product, it shall be a principle that such inspection shall comply with the criteria for standards and quality or criteria for quality certification of wood products publicly notified by the President of the National Institute of Forest Science: *Provided*, That where the inspection is conducted according to any other inspection method, it shall indicate the validity of the relevant inspection method.

(2) A notice of inspection results issued by a foreign inspection agency, shall be the original issued in enforcement regulations of article 15(2) of the enforcement decree of the act on the sustainable use of woods

(3) An inspection certificate issued by a foreign inspection agency shall be issued in attached Form 2, and the original thereof shall be submitted.

(4) Where a notice of inspection results prescribed in paragraph (2) or an inspection certificate prescribed in paragraph (3), submitted

by an importer, is confirmed as satisfying the requirements prescribed in paragraph (1), the Minister of the Korea Forest Service may accept it in lieu of conducting an in-depth inspection of the relevant inspection items.

(5) If a notice of inspection results or an inspection certificate issued under paragraph (2) or (3), falls under any of the following cases, Minister of the Korea Forest Service shall not deem it appropriate:

1. Where the relevant wood product is deemed likely to cause safety hazards;
2. Where no original of a notice of inspection results is submitted;
3. Where an inspection is not conducted according to the inspection method referred to in paragraph (1), or where the submitted inspection method has not been verified.

Article 5 (Evaluation of Inspection Capacity, etc.)

(1) Where the Minister of the Korea Forest Service designates a foreign inspection agency pursuant to Article 3 (4), he/she shall evaluate the inspection capacity of the relevant agency concerning its inspection facilities, analytical technologies, etc., by *in-situ* inspecting at least once every three years from the date of the previous *in-situ* inspection (the date of the first *in-situ* inspection shall be deemed the date the foreign inspection agency was authorized): *Provided*, That where documents verifying the inspection capacity issued by the government of the applicant's country or documents verifying the inspection capacity evaluated during the applicant's participation in a program for verification of capacity for international inspections are submitted, the *in-situ* inspection documents may be examined in lieu of the *in-situ* inspection.

(2) Where it is intended to *in-situ* inspect pursuant to paragraph (1), the inspection date, inspectors, details of inspection, etc., shall be notified to the relevant foreign inspection agency by no later than one month prior to the *in-situ* inspection: *Provided*, That such notification may be given by no later than seven days prior to the *in-situ* inspection in an emergency or in extenuating circumstances.

(3) The Minister of the Korea Forest Service may have related public officials access the office or places of inspections, or related place of a designated foreign inspection agency and inspect facilities or inspect by inspectors or conduct the relevant inspections, or review books, documents, etc., including the related daily record of inspections, as necessary.

Article 6 (Composition of Evaluation Team and Evaluation Criteria)

(1) For the purposes of an *in-situ* inspection prescribed in Article 3 (2), the Minister of the Korea Forest Service shall organize an evaluation team comprised of at least three persons including experts in the relevant field.

(2) The evaluation team will evaluate by the attached table 3, referred to in paragraph (1). Where at least two items are applied for inspection, the findings of evaluation of every item for inspection shall be appropriate.

(3) Where a reapplication for designation is filed due to failure to meet the requirements prescribed in paragraph (2), the evaluation of items to which points are allocated may be exempted if they

were found appropriate, for up to one year from the date of notification of such findings.

Article 7 (Approval of Amendments in Designated Matters, etc.)

(1) Where any of the following amendments is made, the foreign inspection agency shall draft details of the amendment referred to in attached Form 3 (including an electronic document), report them immediately to the Minister of the Korea Forest Service, and obtain approval from him/her:

1. Where any matter authorized by the government of the exporting country is amended;
2. Where any wood product subject to inspection, designated by the Minister of the Korea Forest Service, is amended;
3. Where the location or name of the foreign inspection agency, is amended;
4. Where the representative of the foreign inspection agency or a person authorized to sign inspection certificates or notices of inspection results, is replaced.

(2) The Minister of the Korea Forest Service shall grant an approval as requested by an application for approval of amendment filed under paragraph (1), if no reason for disqualification exists in the examination of documents or *in-situ* inspection.

Article 8 (Revocation of Designation, etc.)

(1) In any of the following cases, the Minister of the Korea Forest Service may revoke the authorization granted to a foreign inspection agency or order a foreign inspection agency to suspend or rectify its inspection services, fixing a period not exceeding six months.

1. Where a notice of inspection results or an inspection certificate, is issued in falsehood;
2. Where the findings of evaluation of inspection capacity issued under Article 5 (1), fail to meet the criteria for designation of a foreign inspection agency;
3. Where approval of amendment falling under any subparagraph of Article 7 (1) is not obtained from the Minister of the Korea Forest Service;
4. Other cases where obligations imposed by the Minister of the Korea Forest Service.

Article 9 (Term of Revision)

The deadline for taking such measures as revision, amending, etc. this Public Notification, in accordance with the Rules on the Issuance and Management of Directives and Established Rules (Presidential Directive No. 334), shall be every three year period(until 31 Dec. of every third year) from 1 Jan. 2018

ADDENDUM <24 Non. 2017>

This Public Notification shall enter into force on the date of six months later that its pronouncement.

[Attached Table 1]

Quality tester and analysis equipment on wood product item

(Related to Article 3)

relevant products	Tester and analysis equipment	minimum amount	remarks
Sawn timber	Moisture meter	1	
	Universal testing machine	1	≥ 10 ton
	Horizontal deformation test set	1	
	Optical microscope	1	Magnification: x40～x400
Preservative treated wood	Atomic Absorption Spectroscopy or Inductively Coupled Plasma Spectrometer	1	ACQ, CCFZ, AAC, CCB, CUAZ, CuHDO, NCU, NZN, heavy metal analysis
	Liquid Chromatography-mass spectrometer (LCMS)	1	ACQ, AAC, organic matter analysis
	Gas Chromatography-mass spectrometer (GCMS) or Liquid Chromatography	1	CUAZ, organic matter analysis
	Liquid Chromatography(LC)	1	CuHDO, organic matter analysis
	Spectrophotometer	1	CCB, BB, organic matter analysis
	Gas Chromatography(GC)	1	IPBC, IPBCP, organic matter analysis
	Moisture meter	1	
Glued laminated timber	Bending stiffness test set	1	
	Universal testing machine	1	≥ 20 ton
	Grading machine	1	
	Horizontal deformation test set	1	
	Optical microscope	1	Magnification: x40～x400
Plywood	Bending stiffness test set	1	

relevant products	Tester and analysis equipment	minimum amount	remarks
/Fiberboard/Particleboard/Flooring Board	Universal testing machine	1	≥ 1 ton
	UV-vis spectrophotometer	1	
	Water distilling apparatus	1	
Wood Pellet/Wood Chip/Wood Briquette/Agglomerated wood charcoal/Wood Charcoal	Durability tester	1	CEN/TS 15210-1
	Heating furnace	1	operating temperature 1,000 ℃
	Calorimeter	1	
	Elemental analyzer	1	
	Atomic Absorption Spectroscopy or Inductively Coupled Plasma Spectrometer	1	
	Ion Chromatography	1	

*note : Absolutely, inspection institute does not have to be the owner of equipment. It can be borrowed, rented, hired, or provided by other parties(manufacturer or installer of equipment). But, the responsibility of equipment suitability used for inspection is completely the responsibility of inspection institute regardless of ownership.

[Attached Table 2]

Laboratory Condition and Standard (Related to Article 3)

Classification	Standard Condition and Criteria		Remarks
Physical Test Laboratory	Environmental Condition	(20±2) ℃, (66±5) % RH	· The environmental condition standard of a normal state according to KS F 2201(General Principles to Test Timber) · A separate storage and disposal of waste · Possibility to test some items including full-scale retest in a separate place · Dividing Balance Room Separately.
	Laboratory prerequisite Facility and Equipment	Air Conditioned Facility, Ventilation System, (Note 1) Qualification Tester and Analysis Equipment by Item	
Chemical Test Laboratory	Environmental Condition	(20±2) ℃, (66±5) % RH	· The environmental condition standard of a normal state according to KS F 2201(General Principles to Test Timber) · Preprocessing Room, Instrumental Analysis Room, Formaldehyde Emission Analysis Room Separation · A separate storage and disposal of waste
	Laboratory prerequisite Facility and Equipment	Air Conditioned Facility, Fume Hood, Fire Safety Facility, Ventilation System, (Note 1) Qualification Tester and Analysis Equipment by Item	

*note : Even though the standard condition and criteria do not meet the requirement, the evaluation team may recognize the laboratory condition as appropriate considering on the properties of relevant wood products, on site condition or scale of the laboratory

[Attached Table 3]

Criteria of on site for foreign Inspection Agency of wood products (Related to Article 2)

Field Survey Evaluation Standard	Score	Remarks
Total Score	100	
Ⅰ. General current situation including facility and workforce	50	
1. Contents about the general current situation	25	
A. Whether or not to have the layout drawing of other facilities including laboratory, equipment, and so on	(5)	
B. Whether or not to have laboratories or their suitability	○/X	compulsory
C. Contents about facility(Complying with laboratory condition and standard of attached table 2) - The propriety of ventilation, drainage, waste water treatment facility - The propriety of laboratory environment management - The propriety of laboratory access and its procedure	(5)	
D. Contents about sample storage - Proper storage condition maintenance and management - The propriety and management of sample received and disposal procedure - The propriety of improper sample storage (including whether or not to designate a separate place)	(5)	

Field Survey Evaluation Standard	Score	Remarks
E. Contents about laboratory safety management - Whether or not to follow the separation and discharge of waste used for laboratory test - Safety management of gas container connected with measurement equipment - Whether or not to have protective gear for inspection workforce	(10)	
2. Contents about facility and equipment	10	
A..The current situation of equipment needed for dimension·quality test and whether or not to have the equipment(Complying with attached form 1 for the needed equipment by item)	○/X	compulsory
B. Equipment Maintenance and Management Situation - Whether or not to have maintenance and management regulation for test equipment - Whether maintenance and management procedure are proper - Whether or not to follow the screening/correction of related test equipment	(10)	
3. Contents about workforce to carry out dimension·quality test	15	
A. whether or not to have proper workforce to carry out inspecting work	○/X	compulsory
B. whether or not to manage workforce to carry out inspecting work - Whether or not to form a task force - Whether or not to manage workforce(organization chart and division of works)	(5)	

Field Survey Evaluation Standard	Score	Remarks
C. Contents about the education and management of workforce to carry out inspecting work - Whether inspecting workforce participates in inspecting work depending on the division of works - Whether it manages workforce to have proper inspecting ability(license, education training and career, education plan, education related materials)	(10)	
Ⅱ. Inspection Work Management of Dimension·Quality Inspection Operational Rule	50	
1. Contents about the propriety of Dimension·Quality Inspection Operational Rule	40	
A. Contents about document writing and management - Whether or not to have operational rules of foreign inspection institute - Whether or not to have inspection related document (the current situation to have the necessary equipment and management contents by item, quality standard and test method by item, test result, inspection workforce current situation)	(20)	
B. Contents about Dimension·Quality Inspection Workforce - Whether or not to specify the things to observe for the prevention of illegal activities of inspection workforce in operational rules - Whether or not to educate related things to be observed	(10)	
C. whether or not to maintain inspection related document properly - Whether or not to have documents (Quality standard by item, test method, test result, test journal, and so on) - Whether or not to write or keep inspection result notice	(5)	
D. Contents about inspection result report	(5)	

Field Survey Evaluation Standard	Score	Remarks
2. Contents about inspection work	10	
A. whether or not to have Standard Operating Procedure(SOP) by analysis item and the propriety of content	(5)	
B. whether or not to have Standard Operating Procedure(SOP) by analysis item and the propriety of content about analysis equipment - Whether or not to have, write, and manage equipment related register - Whether or not to have the propriety of contents about standard receipt·storage·treatment and manage them	(5)	

[Attached Form 1]

(page 1)

application for designation of a foreign inspection agency		Processing time 90Days
Applicant		Tel(E-mail)
Name of laboratory		FAX
Place of facility		
Inspecting items	1. Sawn timber ( ) 2. Preservative treated wood ( ) 3. Fire retardant treated wood ( ) 4. Wood Plastic Composites ( ) 5. Glulam ( ) 6. Plywood ( ) 7. Particleboard ( ) 8. Fiberboard ( ) 9. Oriented Strand Board ( ) 10. Flooring Board ( ) 11. Wood Pellets ( ) 12. Wood Chips ( ) 13. Wood Briquettes ( ) 14. Agglomerated wood charcoal ( ) 15. Charcoal ( )	

I hereby apply for designation of foreign quality inspection institute in accordance with article 3 of the provisions on the designation of foreign quality inspection institute.

Date

Applicant Signature or seal

To Minister of the Korea Forest Service

○ Documents required for application	Application fee
1. General Information (functions, history of the institute, organizational charts, etc.) 2. Inspecting records (Current three-year records of inspecting items of wood products that the institute is seeking to get designated. The records must be prepared in separate categories of wood products.) 3. A list of major inspecting equipment (English name, specification, number, etc.) 4. Lay-out of office and laboratory 5. Institute personnel information (including past work experiences of inspector) 6. For the institute designated by the government, documents of such designation are needed (for institutes under direct operation of the government, such documents are not necessary). 7. A copy of documents demonstrating participation in proficiency inspecting programs	None

Procedure

Applicant	Responsible division Timber Industry Division, Ministry of the Korea Forest Service
Application	Receive documents
	↓
	Review documents
	↓
	Survey & Evaluation (on site)
	↓
Issue of certificate	Evaluation & Decision
	↓
	Notification

[Attached Form 2]

Inspecting Certificate

Issue No.			Date of receipt			
Country of inspection institute			Date of inspecting			
Client	Name		Company name			
	Address (Place of facility)					
	Tel. No. / FAX No.					
Importer	Name		Company name			
	Address (Place of facility)					
	Tel. No. / FAX No.					
	Product name		Import quantity		Packing unit	
Port/airport of loading			Transportation method			
Sample name (Product name)			Date of production			

(page 2)

Sampling location		Sampling date	
Inspection results			
Remarks			

This is to certify that the above statements are true.

Address of Inspection Institute:

Date

Representative of Inspection Institute: (Signature)

[Attached Form 3]

Application for Approval of Changes in Details of Designation		Processing time: 45 Days
Name of institute		
Certificate No.		
Details of change(s)		
Category	Details you wish to change	Proposed change(s)
① Particulars designated by the government of an exporting country		
② Designated inspecting items		
③ Name or address of institute		
④ Representative (Authorized signatory)		
Reason(s) for making the change(s)		

I hereby apply for approval of changes in details of designation in accordance with article 7 of the provisions on the designation of foreign quality inspection institute.

Date

Applicant: Signature (Seal)

To Minister of the Korea Forest Service

○ Documents required (as necessary)

1. A document proving that the institute has been designated by the government
2. Lay-out of new facilities (only applicable to those applying for change of address)
3. Signature of successor representative or authorized signatory

Criteria for Standard Dimensions and Quality

Effective on Sep. 29, 2017 National Institute of Forest Science Notice No.2017-9, Sep. 29, 2017, Partially amended

National Institute of Forest Science (Research Planning and Coordination Division)
+82-2-961-2564

Article 1 (Purpose)

This notification aims to determine the criteria for standard dimensions and quality of lumber products pursuant to Article 20 (1) and (2) of the Act on the Sustainable Use on Lumbers.

Article 2 (Criteria for Standard Dimensions and Quality)

1. The criteria for standard dimensions and quality of lumber products of Article 1 (hereafter referred to as “Criteria for Standard Dimensions and Quality”) shall be subject to the following annexes by lumber products specified in Article 14 (1) of the Enforcement Decree of the Act on the Sustainable Use on Lumbers:

1. Annex 1 (Sawn Timber) 2. Annex 2 (Preservative Treated Wood)
3. Annex 3 (Fire Retardant Treated Wood) 4. Annex 4 (Wood Plastic Composites)
5. Annex 5 (Laminated Timber) 6. Annex 6 (Plywood) 7. Annex 7 (Particle Board)
8. Annex 8 (Fiber Board) 9. Annex 9 (Oriented Strand Board) 10. Annex 10 (Wood Flooring)
11. Annex 11 (Wood Pellet) 12. Annex 12 (Wood Chip) 13. Annex 13 (Wood Briquet)
14. Annex 14 (Agglomerated Wood Coal) 15. Annex 15 (Wood Coal)

Article 3 (Interpretation of Criteria for Standard Dimensions and Quality)

1. The criteria for standard dimensions and quality prescribed by this notification shall be interpreted by the President of National Institute of Forest Science.
2. If necessary, any person may request the President of National Institute of Forest Science, in writing, to interpret the criteria for standard dimensions and quality subject to Article 1.
3. The President of National Institute of Forest Science may request the Committee on Sustainable Use of Timber set forth in Article 9 of the Act on the Sustainable Use on Lumbers to submit the relevant agenda if it is needed to interpret the criteria for standard dimensions and quality.

Article 3 (2) (Exemption of Tests)

1. Inspection of lumber products certified according to Article 15 of the Industry Standardization Act may be exempted in whole or in part, regarding the same test items with this notification, by means of confirmation of an inspecting institute set by Article 19 (2) of the Enforcement Decree of the Act on the Sustainable Use on Lumbers.

2. Among items subject to preliminary inspection of standard dimensions and quality pursuant to Article 20 (2) of the Act on the Sustainable Use on Lumbers, examination on tree species and dimensions may be omitted if an applicant presents them in advance.

Article 4 (Deadline for Review)

Under the Regulation on the Issue and Management of Decrees and Established Rules (Presidential Decree 334), the deadline for abolishing or revising this notification following the review of any change in laws or circumstances after its issuance shall be June 18, 2018.

APPENDUM <No.2015-2, Jun. 19, 2015>

Article 1 (Enforcement Date)

This criteria will take effect from Jun. 19, 2015, provided that Annex 5 (Laminated Timber), Annex 10 (Wood Flooring), and Annex 14 (Agglomerated Wood Coal) will come into effect on Dec. 30, 2015.

Article 2 (Abolition of Other Notifications)

National Institute of Forest Science Notification No.2010-2 (Criteria for Standard Dimensions and Quality of Charcoal), No.2014-4 (Criteria for Standard Dimensions and Quality of Plywood), No.2014-5 (Criteria for Standard Dimensions and Quality of Preservative Treated Wood), No.2014-6 (Criteria for Standard Dimensions and Quality of Particle Board), No.2014-7 (Criteria for Standard Dimensions and Quality of Fiber Board), No. 2014-9 (Criteria for Standard Dimensions and Quality of Wood Pellet), No.2014-10 (Criteria for Standard Dimensions and Quality of Wood Chip) and No.2014-11 (Criteria for Standard Dimensions and Quality of Wood Briquet) shall be abolished on the enforcement date of this criteria.

APPENDUM <No.2015-8, Dec. 30, 2015>

Article 1 (Enforcement Date)

This criteria will take effect from Dec. 30, 2015, provided that Annex 3 (Fire Retardant Treated Wood), Annex 4 (Wood Plastic Composites), and Annex 9 (Oriented Strand Board) will come into effect on Jul. 1,

2016.

Article 2 (Transitional Measures for Criteria for Standard Dimensions and Quality of Wood Flooring)

Wood floorings, which received a self-safety assurance report certificate under the Quality Control and Safety Management of Industrial Products Act, shall be deemed to have been inspected regarding standard dimensions and quality according to Article 20 (2) of the Act on the Sustainable Use on Lumbers until the term of validity of the report ends, provided that those wood floorings shall fit into the criteria for standard dimensions and quality prescribed in Annex 10 (Wood Flooring).

Article 3 (Transitional Measures for Labeling of Criteria for Standard Dimensions and Quality of Wood Flooring)

Labels on self-safety assurance certification of wood floorings, which as of the enforcement date of this notification, received a self-safety assurance report certificate under Article 19 (2) of the Enforcement Rule of the Quality Control and Safety Management of Industrial Products Act may be used with labels on standard dimensions and quality according to the Act on the Sustainable Use on Lumbers until the term of validity of the report ends.

APPENDUM <No.2016-6, Aug.19, 2016>

This notification shall be enforced from its publish date.

APPENDUM <No.2016-8, Dec. 30, 2016>

Article 1 (Enforcement Date) This notification shall be enforced from its publish date, provided that Annex 1 (Sawn Timber) shall be executed from Oct. 1, 2017.

Article 2 (Abolition of Other Notifications) National Institute of Forest Science Notification No.2007-1 (Standard Dimensions of Sawn Timber), No.2009-1 (Standard Dimensions of Conifer Timber for Structural Use) and No.2014-2 (Standard Dimensions of Wood Decking Panel) shall be abolished on the enforcement date of this criteria.

APPENDUM <No.2017-9, Sep. 29, 2017>

Article 1 (Enforcement Date)

This notification shall be enforced from its publish date provided that Structural Timber in Annex 1 (Sawn Timber) shall be executed from Oct. 1, 2017, Non-structural Timber from Apr. 1, 2018 and General Timber

from Oct. 1, 2018 respectively.

APPENDUM <No.2018-8, Aug. 14, 2018>

Article 1 (Enforcement Date)

This notification shall be enforced from its publish date provided that General Timber in Annex 1 (Sawn Timber) shall be executed from Jan. 1, 2021 respectively.

[Annex 1]

Sawn Timber

1. Scope

This specification is to apply to sawn timber produced by cutting such as sawing from wood, except cant.

2. Definitions

Definitions of terms in the specification are as follows:

2.1 Wood Products(logs and imported products) obtained by cutting standing trees and bamboos

2.2 Sawn Timber Woods with uniform shapes and sizes of the cross section through out the length, which include round timber

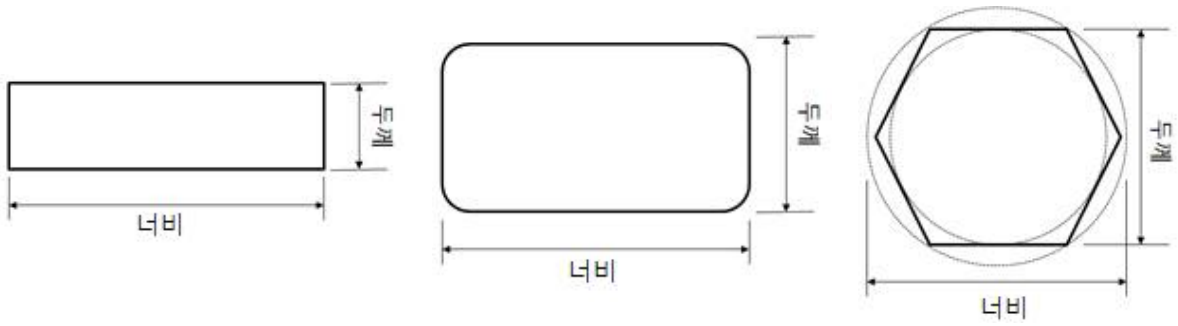
2.3 Cant Woods with more than 50% of wane among four-side cut woods

2.4 Wide face Two faces grains with larger areas in board and lumber. In case that the areas of four faces are the same (square lumber), the opposite two are randomly selected as wide faces.

2.5 Narrow face Two faces with smaller areas in board and lumber. In case that the areas of four faces are the same, the term represents two faces excluding a wide face described in Paragraph 2.4.

2.6 Thickness Minimum distance between two wide faces, including thickness of roughness for the uneven wide face. But, for round timber, the term means the longest diameter of the inscribed circle and parts such as kerf are ignored in determining the circle.

2.7 Width Minimum distance between two narrow faces in the wide face. But for round timber, it refers to the shortest diameter of the circumscribed circle.



(a) Board (b) Lumber (c) Round Timber

<Fig.1> Method for Measuring Thickness and Width of Sawn Timber

**그림: 너비 Width, 두께 Thickness

2.8 Length Minimum distance between two ends

2.9 Visual grading Grade according to the defect size and distribution by observing the surface of sawn timber

2.10 Mechanical grade Grade by gauging modulus of elasticity through a grading machine

3. Classification of Sawn Timber

3.1 Classification of Shape

Sawn Timber is classified as follows according to the shape of its cross section:

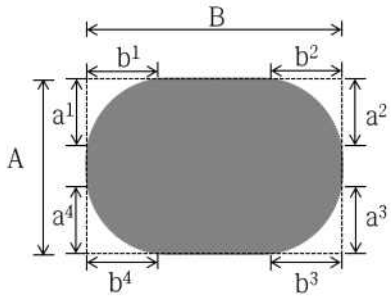
3.1.1 Board Sawn timber whose ratio of the sum of the excluded sides to the sum of four sides of the quadrangle that adds the sides excluded from the minimum cross section is smaller than 20/100. Its thickness is smaller than 75 mm and its width is equal or larger than four times thickness.

3.1.2 Lumber Sawn timber whose ratio of the sum of the excluded sides to the sum of four sides of quadrangle that adds the sides excluded from the minimum cross section is < 20/100. It is to be one of the following:

3.1.2.1 Its thickness is smaller than 75 and the width is smaller than four times thickness.

3.1.2.2 Its thickness and width are equal or larger than 75 mm.

3.1.3 Round timber Sawn timber whose ratio of the sum of the excluded sides to the sum of four sides of quadrangle that adds the sides excluded from the minimum cross section is equal or larger than 20/100, including one with a round, hexagonal and octagonal cross section



$$\frac{20}{100} > \frac{\sum_{i=1}^{n} a_i + \sum_{i=1}^{n} b_i}{2A+2B} \qquad \frac{20}{100} \leq \frac{\sum_{i=1}^{n} a_i + \sum_{i=1}^{n} b_i}{2A+2B}$$

(a) 각재 또는 판재 (b) 원주재

<Fig.2> Classification of Sawn Timber According to Cross Section Shapes

**그림: (a) Lumber or Board (b) Round timber

3.2 Classification of Use Sawn timber is classified as follows according to its use:

3.2.1 Apperance grade timber Sawn timber used for appearance such as interior or furniture where appearance is important

3.2.2 Structural grade timber

This is for main parts in the strength of buildings or structures and requires design values. It is subdivided as follows:

3.2.2.1 Dimensional lumber Sawn timber whose thickness is no less than 38 mm and no more than 90 mm and the width is no less than 38 mm. This is mainly used for light frame structure.

3.2.2.2 Beam structural timber Sawn timber whose thickness is above 90 mm and width is required at least 60 mm larger than whose thickness. This is used for high bending performance.

3.2.2.3 Column structural timber Sawn timber whose thickness and width are over 90 mm and the width is no more than 60 mm larger than the thickness. This is used for parts that bear the axial load.

3.2.3 General purpose timber General-use timber in no need of design values; and wood for

packaging and decking boards in need of design values

4. Standard Dimensions and Quality of Appearance Grade Timber

4.1 Standard Dimensions and Approved Dimensions of Appearance Grade Timber

The standard dimensions and approved dimensions of appearance grade timber are as follows:

4.1.1 The standard thickness is to increase by 3 mm between 6 mm and 60 mm, and by 15 mm starting from 60 mm.

4.1.2 The standard width is to increase by 3 mm between 15 mm and 60 mm and by 15 mm starting from 60 mm.

4.1.3 The standard length is to increase by 0.3 m starting from 0.9 m.

4.1.4 When other dimensions than the standard dimension (hereafter 'approved dimensions') are necessary, the consignor and consignee may use them based on their agreement.

4.2 Grades of Appearance Grade Timber

Categorize the grades of appearance grade timber as follows:

4.2.1 The criteria for quality by grade of appearance grade board appear in Table 1.

4.2.2 The criteria for quality by grade of appearance grade lumber and round timber are shown in Table 2.

<Table 1> Criteria for Quality by Grade of Appearance Grade Board

Grade / Defect		Grade 1	Grade 2	Grade 3
Pith*		None	None	No limit
Resin Pocket*		Number ≤ 3 Width ≤ 3 mm Length ≤ 100 mm	Number ≤6 Width ≤ 6 mm Length ≤ 200 mm	No limit
Clear Face**	Wide face area < 0.7 ㎡	Number: 1 Size ≥ 9/10 of wide face area	Number: 1 Size ≥ 2/3 of wide face area	Number ≤ 3 Size ≥ 1/2 of wide face area
	0.7㎡ ≤ Wide face area < 1.0 ㎡		Number: 2 Size ≥ 2/3 of wide face area	Number ≤ 4 Size ≥ 1/2 of wide face area
	1.0㎡ ≤ Wide face area < 1.5 ㎡		Number: 3 Size ≥ 2/3 of wide face area	Number ≤ 5 Size ≥ 1/2 of wide face area
	Wide face area ≥ 1.5 ㎡		Number: 4 Size ≥ 2/3 of wide	Number ≤ 6 Size ≥ 1/2 of wide face

			face area	area
Knot	Wide face area< 0.5 ㎡	None	Number: ≤ 1 Long diameter ≤ 30 mm	Long diameter ≤ 80 mm
	0.5㎡ ≤ Wide face area < 0.7 ㎡	Number ≤ 1 Long diameter ≤ 30 mm	Number ≤ 1 Long diameter ≤ 60 mm	
	0.7㎡ ≤ Wide face area < 1.5 ㎡	Number ≤ 2 Long diameter ≤ 30 mm	Long diameter ≤ 80 mm	
	Wide face area≥ 1.5 ㎡	Number ≤ 3 Long diameter ≤ 30 mm		
Wane	Thickness	≤ 20%	≤ 50%	≤ 50%
	Width	≤ 5%	≤ 10%	≤ 20%
	Length	≤ 10%	≤ 10%	≤ 20%
Split		≤ 5%	≤ 10%	≤ 20%
Ring Shake		≤ 5%	≤ 10%	≤ 20%
Bow	Length < 1.8 m	≤ 10 mm	≤ 15 mm	≤ 20 mm
	1.8 m ≤ Length < 2.4 m	≤ 15 mm	≤ 20 mm	≤ 25 mm
	2.4 m ≤ Length < 3.0 m	≤ 20 mm	≤ 25 mm	≤ 30 mm
	Length ≥ 3.0 m	≤ 25 mm	≤ 30 mm	≤ 35 mm
Other Defects		Minor	Minor	Insignificant

* Applied to conifer

** Applied to deciduous

*** Pursuant to Article 20 of the Enforcement Decree of the Act on the Sustainable Use on Timber (Public Notification of Criteria for Standard Dimensions and Quality of Lumber Products and Inspection), if appearance grade boards are graded by the entities designated as “overseas inspecting agencies for standard dimensions and quality of lumber products”, the grade is approved as the equivalent grade of boards as described in Appendix D.

<Table 2> Criteria for Quality by Grade of Appearance Grade Lumber and Round Timber

Defect \ Grade			Grade 1	Grade 2	Grade 3
Clear Part and Knot	Thickness < 51 mm		None	Number ≤ 1 Long diameter ≤ 30 mm	1. The four clear sides take up no less than 2/3 of the whole length and the long diameter is ≤ 60 mm. 2. The three clear sides appear every 600mm and there is one or no knot with a long diameter ≤ 30 mm.
	Thickness ≥ 51 mm Length ≤ 2.4 m				
	Length ≥ 4m	51mm ≤ Thickness < 75 mm	Number ≤ 1 Long diameter ≤ 30mm	Number ≤ 2 Long diameter ≤ 30 mm	
		75mm ≤ Thickness < 120 mm	Number ≤ 2 Long diameter ≤ 30mm	Number ≤ 4 Long diameter ≤ 30 mm of long diameter	
		Thickness ≥ 120mm	Number ≤ 3 Long diameter ≤ 30mm	Number ≤ 6 Long diameter ≤ 30 mm	
Wane			≤ 5%	≤ 10%	≤ 20%
Split			≤ 5%	≤ 10%	≤ 20%
Ring Shake			≤ 5%	≤ 10%	≤ 20%
Bow	Length < 1.8 m		≤ 10 mm	≤ 15 mm	≤ 20 mm
	1.8m ≤ Length < 2.4 m		≤ 15 mm	≤ 20 mm	≤ 25 mm
	2.4m ≤ Length < 3.0 m		≤ 20 mm	≤ 25 mm	≤ 30 mm
	Length ≥ 3.0 m		≤ 25 mm	≤ 30 mm	≤ 35 mm
Other Defects			Minor	Minor	Insignificant

4.3 Moisture Content of Appearance Grade Lumber

The criteria for moisture content according to dryness of appearance grade lumber comply with Table 3.

<Table 3> Standards for Moisture Content of Appearance Grade Limber

Classification		Symbol	Moisture Content
Dried Timber	Dry 12	KD12*, D12	≤ 12%
	Dry 15	KD15*, D15	≤ 15%

* Kiln-dry timber may be marked as KD.

4.4 Preservative and Insect-proof Treatment of Appearance Grade Lumber

Preservative and insect-proof treatment of appearance grade lumber is to be subject to the criteria by use class (use area classification) specified in the 'Criteria for Standard Dimensions and Quality of Lumber Products – Annex 2 (Preservative Treated Wood)' notified by the President of National Institute of Forest science.'

5. Standard Dimensions and Quality of Structural Timber

5.1 Standard Dimensions and Approved Dimensions of Structural Timber

The standard dimensions and the approved dimensions of appearance grade timber are as follows:

5.1.1 The standard cross section dimensions of structural dimensional lumber, beam structural timber, and column structural timber are to be subject to Table 4, 5 and 6.

5.1.2 The standard length of structural timber is to increase by 0.3 m starting from 0.9 m.

5.1.3 When other dimensions than the standard dimension are approved to be proper in term of design, the consignor and consignee may use them based on their consultation.

<Table 4> Standard Cross Section Dimensions of Structural Dimensional Lumber (Unit: mm)

Thickness \ Width	38	64	89	114	140	184	235	286
38	○	○	○	○	○	○	○	○
64			○	○	○			
89			○	○	○	○		

<Table 5> Standard Cross Section Dimensions of Beam Structural Timber (Unit: mm)

Thickness \ Width	180	210	240	270	300	330	360	390	420	450
120	○	○	○	○	○					
150		○	○	○	○					
180			○	○	○	○				
210				○	○	○	○			
240					○	○	○	○		
270						○	○	○	○	
300							○	○	○	○
330								○	○	○
360									○	○
390										○

<Table 6> Standard Cross Section Dimensions of Column Structural Timber (Unit: mm)

Thickness \ Width	120	150	180	210	240	270	300	330	360	390	420	450
120	○	○										
150		○	○									
180			○	○								
210				○	○							
240					○	○						
270						○	○					
300							○	○				
330								○	○			
360									○	○		
390										○	○	
420											○	○
450												○

5.2 Visual Grades of Structural Timber

Visual grades of structural timber are classified as follows:

5.2.1 The criteria for quality by visual grade of structural dimensional timber appear in Table 7.

5.2.2 The criteria for quality by visual grade of beam structural timber are shown in Table 8.

5.2.3 The criteria for quality by visual grade of column structural timber are shown in Table.9.

<Table 7> The Criteria for Quality by Visual Grade of Dimension Structural Timber

Defect \ Grade			Grade 1	Grade 2	Grade 3
Knot Diameter Ratio	Narrow Face		≤ 25%	≤ 35%	≤ 45%
	Wide Face	Edge	≤ 25%	≤ 35%	≤ 45%
		Center	≤ 30%	≤ 45%	≤ 60%
Diameter Ratio of a Knot Cluster			≤ 2 times the above criteria		
Wane (Except Length)			≤ 25%	≤ 33%	≤ 50%
Split			≤ width	≤ 1.5 times width	≤ 2 times width
Ring Shake			≤ ½ of width	≤ ½ of width	Insignificant
Bow			≤ 0.3%	≤ 0.4%	≤ 0.5%
Average Width of Annual Ring			≤ 6 mm	≤ 8 mm	No limit
Slope of grain			≤ 1:10	≤ 1:8	≤ 1:4
Other Defects			Minor	Minor	Insignificant

<Table 8> The Criteria for Quality by Visual Grade of Beam Structural Timber

Defect \ Grade			Grade 1	Grade 2	Grade 3
Knot Diameter Ratio	Narrow Face		≤ 20%	≤ 30%	≤ 40%
	Wide Face	Margin	≤ 20%	≤ 30%	≤ 40%
		Center	≤ 25%	≤ 35%	≤ 45%
Diameter Ratio of a Group knot			≤ 2 times the above criteria		
Wane (Except Length)			≤ 10%	≤ 20%	≤ 30%
Split			≤ ½ of width	≤ width	≤ 2 times width
Ring Shake			≤ ⅙ of thickness	≤ ⅙ of thickness	≤ ½ of thickness
Bow			≤ 0.3%	≤ 0.4%	≤ 0.5%
Average Width of Annual Ring			≤ 6mm	≤ 8mm	No limit
Slope of Grain			≤ 1:12	≤ 1:8	≤ 1:6
Other Defects			Minor	Minor	Insignificant

<Table 9> The Criteria for Quality by Visual Grade of Column Structural Timber

Defect \ Grade	Grade 1	Grade 2	Grade 3
Knot Diameter Ratio	≤ 25%	≤ 35%	≤ 45%
Diameter Ratio of a Group Knot	≤ 2 times the above criteria		
Wane(Except Length)	≤ 10%	≤ 20%	≤ 30%
Split	≤ width	≤ 1.5 times width	≤ 2 times width
Ring Shake	≤ ⅙ of thickness	≤ ⅙ of thickness	≤ ½ of thickness
Bow	≤ 0.3%	≤ 0.4%	≤ 0.5%
Average Width of Annual Ring	≤ 6mm	≤ 8mm	No limit
Slope of Grain	≤ 1:12	≤ 1:8	≤ 1:6
Other Defects	Minor	Minor	Insignificant

5.3 Classification of Tree Species Groups of Visually-Graded Structural Timber

Classification of tree species groups of visually-graded structural timber is as follows:

5.3.1 Divide visually-graded structural timber into species groups as in Table 10 according to species.

5.3.2 Excluding tree species included in Paragraph 5.3.1, any species may be used as structural timber when it is proven that the allowable stress of the target species corresponds to the standard allowable stress subject to Paragraph 5.4.

<Table 10> Classification of Tree Species Group of Visually-Graded Structural Timber

Tree Species Group	Species*
Larch	Larch, North American larch, North sea larch
Pine	Pine, Japanese cypress, Pitch pine, North American needle fir
Korean Pine	Korean pine, spruce, North American spruce, North sea redwood, Radiata pine
Cedar	Cedar, Needle fir, North American cedar

* For species not specified here, the allowable stress in Appendix B may be applied.

5.4 Standard Allowable Stress of Visually-Graded Structural Timber

The standard allowable stress of visually-graded structural timber is as follows:

5.4.1 The standard allowable stress of tree species according to Paragraph 5.3.1 and 5.3.2 is described in Table 11.

5.4.2 When the proper allowable stress exceptionally exists for certain tree species or species groups as in Appendix B, it may be applied.

<Table 11> Standard Allowable Stress of Visually-Graded Structural Timber (MPa)*

Tree Species Group	Grade	Bending F_b	Tension F_t	Compression parallel to grain F_c	Compression perpendicular to grain $F_{c\perp}$	Shear F_v	Modulus of Elasticity E
Larch	Grade 1	7.8	5.4	8.8	3.5	1.25	12,200
	Grade 2	5.9	3.9	5.9	3.5	1.25	10,800
	Grade 3	3.4	2.5	3.4	3.5	1.25	9,300
Pine	Grade 1	7.4	4.9	7.4	3.0	1.10	10,300
	Grade 2	5.9	3.4	4.4	3.0	1.10	8,800
	Grade 3	3.4	2.0	2.9	3.0	1.10	8,300
Korean Pine	Grade 1	5.9	4.9	6.9	2.5	0.95	8,300
	Grade 2	4.9	3.4	4.4	2.5	0.95	7,400
	Grade 3	2.9	2.0	2.9	2.5	0.95	6,900
Cedar	Grade 1	4.9	3.9	5.9	2.5	0.90	8,300
	Grade 2	3.9	2.5	3.9	2.5	0.90	6,900
	Grade 3	2.5	1.5	2.5	2.5	0.90	5,900

* Pursuant to Article 20 of the Enforcement Decree of the Act on the Sustainable Use on Lumbers (Public Notification of Criteria for Standard Dimensions and Quality of Lumber Products and

Inspection), if structural dimensional lumber is graded to meet the above criteria by the entities designated as "overseas inspecting agencies for standard dimensions and quality of lumber products", the grade may be accepted regardless of criteria in Table 7.

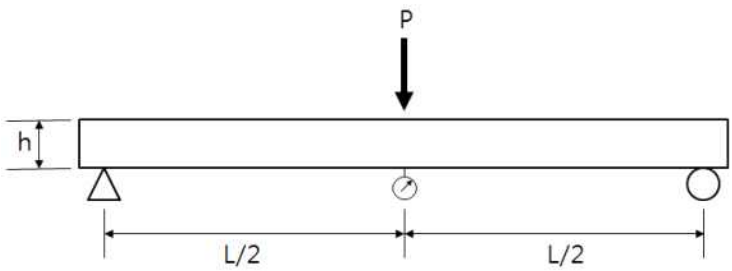
5.5 Mechanical Grades of Structural Timber

Mechanical grades of structural timber are classified as follows:

5.5.1 Mechanical grades are applied to structural dimensional lumber.

5.5.2 The criteria for quality by grade of mechanically-graded structural timber are to comply with Table 12.

5.5.3 Measure the modulus of elasticity of mechanically-graded structural timber like Fig. 3 and substitute the load and deflection within the measured proportional limit in Formula (1) to calculate the modulus of elasticity. However, to adopt other methods, their relevance shall be proven in advance.



<Fig.3> Calculating Method for Modulus of Elasticity of Mechanically-graded Structural Timber

$$\text{Modulus of elasticity } (MPa) = \frac{PL^3}{4bh^3d} \qquad \text{Formula (1)}$$

Here, L = Span ≥ 17×h (mm)
b = Width of timber (mm)
h = Thickness of timber (mm)
P = Load of elastic interval (N)
d = Deformation of elastic interval (mm)

5.5.4 Standard allowable stress of mechanically-graded structural timber appears in Table 12.

<Table 12> The Criteria for Quality of Mechanically-graded Structural Timber

Grade / Classification	E6	E7	E8	E9	E10	E11	E12	E13	E14
Modulus of Elasticity (GPa)	6 ≤ MOE < 7	7 ≤ MOE < 8	8 ≤ MOE < 9	9 ≤ MOE < 10	10 ≤ MOE < 11	11 ≤ MOE < 12	12 ≤ MOE < 13	13 ≤ MOE < 14	MOE ≥ 14
Wane (Except Length)	≤ 30%								
Split	≤ 2 times width								
Ring Shake	≤ ½ thickness								
Bow	≤ 0.5%								
Other Defects	Insignificant								

<Table 13> Standard Allowable Stress of Mechanically-graded Structural Timber (MPa)

Grade	Bending F_b	Tension F_t	Compression parallel to grain F_c	Compression perpendicular to grain $F_{c\perp}$	Shear F_v	Modulus of Elasticity E
E6	6.2	2.4	7.2	2.0	0.9	6,000
E7	7.2	3.1	8.5	2.0	0.9	7,000
E8	8.2	4.1	9.6	2.5	1.0	8,000
E9	9.0	5.5	10.1	2.5	1.0	9,000
E10	10.0	6.0	11.2	3.0	1.1	10,000
E11	11.3	7.4	11.7	3.0	1.1	11,000
E12	12.4	8.2	12.0	3.5	1.2	12,000
E13	14.0	10.7	12.8	3.5	1.2	13,000
E14	16.0	13.0	13.5	3.5	1.2	14,000

5.6 Moisture Content of Structural Timber

Criteria for the moisture content of structural timber are subject to Table 14 according to drying conditions.

<Table 14> Moisture Content of Structural Timber

Classification		Symbol	Moisture Content
Dried Timber	Dry 12	KD12, D12	≤ 12%
	Dry 15	KD15, D15	≤ 15%
	Dry 19	KD19, D19	≤ 19%
Green Wood*		G	> 19%

* Green wood criteria are not to be applied to structural dimensional Lumber.

5.7 Preservative and Insect-proof Treatment of Structural Timber

Preservative and insect-proof treatment of structural timber is to be subject to the criteria by use class specified in the 'Criteria for Standard Dimensions and Quality of Lumber Products – Annex 2 (Preservative Treated Wood)' notified by the President of National Institute of Forest Service.'

6. Standard Dimensions and Quality of General Sawn Timber

6.1 Standard Dimensions and Approved Dimensions of General Timber

The standard dimensions and approved dimensions of general timber are as follows:

6.1.1 The thickness is to increase by 3mm between 6mm and 60mm and by 15mm from 60mm.

6.1.2 The standard width is to increase by 3mm between 15mm and 60mm and by 15mm starting from 60mm.

6.1.3 The standard length is to increase by 0.3m starting from 0.9m.

6.1.4 The consignor and consignee may employ approved sizes based on their consultation.

6.2 Criteria for Quality of General Timber

Criteria for Quality of General Timber are shown in Table 15. However, the standards and quality of wood for package comply with standards determined by KS (Korean Industrial Standards) T 1201 and those for decking board comply with Appendix C.

<Table 15> Criteria for Quality of General Timber

Defect	Criteria for Quality
Knot	Long diameter ≤ 150mm
Wane (Except Length)	≤ 50%
Split	≤ 50%
Ring Shake	≤ 50%
Bow	≤ 1%
Other Defects	Insignificant

6.3 Moisture Content of General Timber

Criteria for the moisture content of general timber are subject to Table 16 according to drying conditions.

<Table 16> Moisture Content of General Timber

Classification		Symbol	Criteria for Moisture Content
Dried Timber	Dry 12	KD12, D12	≤ 12%
	Dry 15	KD15, D15	≤ 15%
	Dry 19	KD19, D19	≤ 19%
Green Wood*		G	> 19%

6.4 Preservative Treatment and Insect-proof Treatment of General Timber

Preservative treatment and insect-proof treatment of general timber are to be subject to the criteria by use class specified in the 'Criteria for Standard Dimensions and Quality of Lumber Products – Annex 2 (Preservative Treated Wood)' notified by the President of National Institute of Forest Service.'

7. Test

7.1 Dimension Test

Dimension tests of sawn timber are as follows:

7.1.1 Samples are selected randomly according to the numbers in Table 17. When the number of members per lot exceeds 5,000, the lot is to be split.

<Table 17> Number of Samples for Timber Dimension Tests

Size of a Lot	Number of Samples (Piece)
No more than 1,000 pieces	10
1,001–2,000 pieces	20
2,001–3,000 pieces	30
3,001–4,000 pieces	40
4,001–5,000 pieces	50

7.1.2 Timber thickness and width are measured by the unit of 1 mm based on the actual dimension.

7.1.3 Timber length is measured by the unit of 0.1 m and the endpoints below 0.1 m are rounded off.

7.1.4 The Tolerance of timber dimensions is as in Table 18.

<Table 18> Tolerance of Timber Dimensions

Division	Thickness and Width		Tolerance of Length
	Target Size	Tolerance	
Dried Wood	< 30 mm	± 0.5 mm	+ No limit, − 0
	30 mm − 90mm	± 1.0 mm	
	≥ 90 mm	± 1.5 mm	
Green Wood	< 90 mm	+ 2.0 mm, − 0 mm	
	≥ 90 mm	+ 3.0 mm, − 0 mm	

7.1.5 Results of timber dimension inspection are determined as follows:

7.1.5.1 If samples that fulfill the standards are not less than 90%, they pass in the test. If such samples are under 70%, they fail.

7.1.5.2 If samples that fulfill the standards are between 70% and 90%, inspect the pertinent product again. For this, select samples two times the amount in the first inspection. If samples that fulfill the standards are not less than 90%, they pass the test. If such samples are under 90%, they fail.

7.2 Grade Inspection

Grade Inspection of sawn timber is as follows:

7.2.1 Grade inspection is for all timber and the results determine the grade of each one. But, in case that a test is implemented to confirm the grade of the already classified timber, the number of sample pieces are the same as presented in Paragraph 7.1.1.

7.2.2 The measurement of timber defects are to comply with Table 19. But defects in trim allowance may be excluded.

7.2.3 If samples that fulfill the standards are not less than 90%, they pass the test. If such samples are under 70%, they fail.

7.2.4 If samples that fulfill the standards are between 70% and 90%, inspect the pertinent product again. For this, select two times the amount in the first test. If samples that fulfill the standards are not less than 90%, they pass the test. If such samples are under 90%, they fail.

<Table 19> Method of Measuring Defects of Sawn Timber

Defect		Method
Heart		1. Apply to conifer 2. For boards, measure a wide face with fewer defects, and for lumber, measure a face with more defects for lumber
Resin Pocket		1. Apply to conifer and include resin stains 2. For boards, measure a wide face with fewer defects and for lumber, measure a face with more defects for lumber
Clear Face		1. Apply to deciduous trees. The clear face refers to the part without knots (except sound knots with a long diameter shorter than 3 mm), rot, loss, scratches, holes, mineral stains, bark pockets, bow, back bow, twists, end checks, ring shakes, worm holes, etc. 2. For boards, in a wide face with fewer defects, measure a width of no less than 80 mm and a length of no less than 600 mm and measure every 20 mm in width and 150 mm in length of clear face without defects. 3. For lumber, refer to the defect-free part no less than 600 mm in length. 'Three clear faces' mean that three sides of timber have no defects.
Knot	Measurement	1. Defects Include rot, loss, scratches, holes, mineral stains and bark pockets etc, which affects the usage. 2. Exclude defects with a long diameter no more than 10 mm
	Long Diameter	1. Apply to appearance grade timber and measure the longest diameter except the part surrounding knots 2. When the long diameter is no less than three times the short one, the former is to be considered a half the measured long diameter. 3. The long diameter of loose knots, rotten knots, and easy-to-fall out knots are to be considered two times the measured long diameter (three times for those penetrating another face). However, dead knots that are unlikely to fall out are to be considered sound knots. 4. The long diameter of knots such as rot, loss, scratches, holes, mineral stains and bark pockets are to be considered two times the measured long diameter (three times for those penetrating another face). 5. Linear mineral stains and bark pockets with a width of no more than 3mm are to be considered ⅓ the measured long diameter (⅔ for those penetrating another face). 6. For knots whose long diameter is no more than ½ of the limit, two knots are to be considered one (four or more knots whose long diameters are no more than ¼ or '1/number of knots' of the limit)
	Diameter Ratio	1. Apply to structural timber. The diameter ratio is a percentage of the knot diameter to the timber width. 2. The diameter ratio refers to a distance between tangents of knot ends parallel to the longitudinal directions of the face (if a knot is cut by one or two edges, the diameter ratio is a distance between edges and parallel to the longitudinal direction of knot.) 3. When a knot traverses a couple of adjacent faces, its diameter is measured on the face where the cross section of the knot appears. 4. The knot diameter of no less than 2.5 times the short diameter is to be considered ½ of the measured diameter. 5. If the knot center from the edge is within a distance of ¼ width, the knot is to be considered as a margin knot. 6. If the knot center from the edge is outside a distance of ¼ width, the knot is to be considered as a center knot.

<Table 19> Method of Gauging Defects of Sawn Timber–Continued

Defect		Method
Knot	Diameter ratio of Group Knots	1. The diameter ratio of a group knot is to be a percentage of the sum of knot diameters within 150 mm in the timber length to its width. But overlapped knots parallel to the face length are considered as one knot for measuring the knot diameter. 2. When one or more knots are margin knots among those concentrated on the wide face, the knots are to be considered as a group margin knot. 3. When all knots concentrated on the wide face are center knots, the knots are to be considered as a group center knot.
Wane	Measurement	1. When a loss or a scratch on the face is on the edge in the longitudinal direction of the timber, it is considered as a wane. 2. For lumber and round timber, the wane is measured except 0.2 m from both ends. 3. The thickness and width are measured by the biggest visible thickness and width.
	Length	1. When two or more wanes are on one edge, their sum becomes the wane length. 2. When wanes are on two edges, the longest of their lengths becomes the wane length.
	Percentage	1. The percentage of the relevant part to the timber thickness, width, or length
Split	Measurement	1. Measure the length of the splitting check on the face. If faces are not obvious like round timber, a face becomes one of the four parts that longitudinally divides a surface. 2. If a check on the face is not connected to the timber end and does not traverse other faces, its length is to be considered ⅓ of the measured length. 3. If several splitting checks are on one face of structural timber, the length of the longest check becomes the check length of the relevant face. 4. If several splitting checks are on one face of appearance grade timber, the sum of all lengths becomes the check length of the relevant face. However, when checks are overlapped in the same direction as width or thickness, they are considered as one for measuring.
	Percentage	1. Percentage of check length to timber length
Ring Shake	Measurement	Measure the curve length of a ring shake on the timber end
	Length	1. When two or more ring shakes are on one end of timber, the longest curve length becomes the length of the ring shake. 2. When ring shakes are on both ends of timber, the sum of their lengths becomes the ring shake length of the relevant timber.
	Percentage	1. Ratio of the ring shake length to the sum of four sides of the quadrangle that adds the sides excluded from the cross section
Bow	Measurement	1. Measure the biggest bow height of the concave face along the timber length
	Percentage	1. Percentage of the biggest bow height to the timber length
Average Width of Annual Ring		1. The average of all perfect annual rings on the same line in the vertical direction to annual rings. Measure on the timber end.
Grain Slope		1. Ratio of the height of a grain slope to the longitudinal direction
Other Defects		1. ‘Minor defects’ mean that they don’t hamper the use of the relevant timber and don’t look ugly despite some changes in its luster and color. 2. ‘Insignificant defects’ mean that they don’t hamper the use of the relevant timber despite some changes in its luster and color.

7.3 Moisture Content of Sawn Timber

The test of moisture content is as follows:

7.3.1 Select five pieces per lot as samples for a moisture content test. When the number of the members per lot exceeds 5,000, the lot is to be divided.

7.3.2 Choose two test pieces 25±5 mm long from each sample by applying the cross section size of the relevant part from a part no less than 300 mm away from both timber ends.

7.3.3 Measure the moisture content by oven-drying gravimetric method. The oven-dry weight refers to a weight at the moment when test pieces are dried in the oven at 100-105 ℃ and they reach a constant weight. Calculate the ratio based on equation(2). But, to adopt other gauging methods, their relevance shall be proven in advance.

$$Moisture\ Content(\%) = \frac{W - W_o}{W_o} \times 100 \qquad \text{eq.(2)}$$

Here, W = Weight before dry(g)

W_o = Oven-dry weight(g)

7.3.4 If test pieces that fulfill the standards are not less than 90%, they pass the test. If such pieces are under 70%, they fail.

7.3.5 If test pieces that fulfill the standards are between 70% and 90%, they are to be inspected again. For this, samples are to be selected two times the amount in the first test. If samples that fulfill the standards are not less than 90%, they pass the test. If such samples are under 90%, they fail.

7.4 Preservative and Insect-proof Treatment Test of Sawn Timber

As regards a test of preservative and insect-proof treatment of timber, sampling, test methods and decision on test results are to be subject to the ‘Criteria for Preservative Treatment and Insect-proof Treatment of Timber’ (National Institute of Forest Science Notification No.2016-2).

7.5 Tree Species Inspection

Timber species inspection is as follows:

7.5.1 Select three samples per one lot.

7.5.2 One test piece no less than 100 mm long from each sample is to be selected regardless of

its thickness and width.

7.5.3 Tree species test methods are to comply with those of standards and quality inspecting agencies notified by the Minister of Korea Forest Service.

7.5.4 When all test pieces fulfill the standards, the relevant species pass the test.

8. Quality Labeling

8.1 Required Labels In principle, structural timber, general timber and appearance grade timber are labeled for each timber as follows; But for timber of the same tree species and dimension, it may be labeled by each minimum distribution unit. Pursuant to Article 20 of the Enforcement Decree of the Act on the Sustainable Use on Timber (Public Notification of Criteria for Standard Dimensions and Quality of Lumber Products and Inspection), additional labels are not needed in importing and distributing dimensional structural timber which were graded to meet the criteria in Table 11 by the entities designated as "overseas inspecting agencies for standard dimensions and quality of lumber products"; but the package of each bundle is not to be damaged in the process of direct delivery to the final user:

8.1.1 Product name According to shapes and purposes of sawn timber, labels are made as follows; but general terms like hexagonal or octagonal timber may be adopted among round timber with a non-round cross section.

8.1.1.1 Appearance Grade Timber Appearance Grade board, lumber and round timber

8.1.1.2 Structural grade Timber Dimensional lumber, beam structural timber, column structural timber

8.1.1.3 General Purpose Timber General-use board, lumber, round timber, wood for package and decking board

8.1.2 Grade For appearance grade timber and structural timber, one of the following grades are to be labeled:

8.1.2.1 Appearance Grade timber or visually-graded structural timber Grade 1, Grade 2, Grade 3

8.1.2.2 Mechanically-graded structural timber E6, E7, E8, E9, E10, E11, E12, E13, E14

8.1.3 Tree species General name (e.g. pine, larch, Korean pine)

8.1.4 Place of origin The place of origin for raw materials (log) may be labeled based on a country name. (e.g. Republic of Korea, China, Indonesia, etc.)

8.1.5 Dimension Labeling format: thickness (mm) × width (mm) × length (m) (e.g. 30 ㎜ × 150 ㎜× 2.4 m)

8.1.6 Moisture content One of the following symbols is labeled according to the criteria for moisture content:

KD12, D12, KD15, D15, KD19, D19, G

8.1.7 Producer (Importer) The company names of producers are described for local products. (e.g. ABC Sawmill) The names of producing companies and countries are described for imported products. (e.g. ABC Co., Ltd. (the United States))

8.2 Labeling Method Labeling methods of sawn timber are as follows:

8.2.1 Labels are to be individually described as in Fig. 4 in the place easily noticed by consumers and to be identified with stamps, lumberers or coining.

8.2.2 Outer or inner border lines may be omitted.

Label	Product name – Grade – Tree species – (Place of origin) Dimension – Moisture content – Producer (Importer)
Example 1	Appearance Grade board – Grade 2 – Paulownia – Republic of Korea 30 ㎜×150 ㎜×2.4 m – KD12 – ABC Sawmill
Example 2	Column structural timber – E11 – Pine 180 ㎜×300 ㎜×4.0 m – KD15 – Company ABC

<Fig.4> Labeling of Sawn Timber Quality

Appendix A Volume Calculation

Sawn timber volume is calculated as follows:

1. The volume of one board or lumber is calculated by the following equation:

$$V = T \times W \times L \times \frac{1}{1{,}000{,}000}$$

V : Volume (㎥)

T : Thickness (mm)

W : Width (mm)

L : Length (m)

2. The volume of one round timber is calculated by the following equation; but, if the volume of the cross section is computed, it may be employed for calculation.

$$V = \left(\frac{T + W}{4}\right)^2 \times \pi L \times \frac{1}{1{,}000{,}000}$$

V : Volume (㎥)

T : Thickness measured by the inscribed circle (mm)

W :Width measured by the circumscribed circle (mm)

L : Length (m)

3. The volume of a ‘genus’ which groups timber with the same tree species, sort, dimension and grade is calculated by multiplying the number by the volume of one piece.

4. The timber volume is calculated by rounding up to three decimal places.

Appendix B Allowable Stress of North American Structural Timber (MPa)

Species or Species Groups	Grade	Bending F_b	Tension F_t	Compression parallel to grain F_c	Compression perpendicular to grain $F_{c\perp}$	Shear F_v	Modulus of Elasticity E
Douglas Fir	Grade 1	6.8	4.6	10.2	4.3	1.20	11,600
	Grade 2	6.2	3.9	9.2	4.3	1.20	10,900
	Grade 3	3.6	2.2	5.3	4.3	1.20	9,500
Northern Hem-Fir	Grade 1	6.9	4.0	10.0	2.8	1.00	11,000
	Grade 2	6.9	4.0	10.0	2.8	1.00	11,000
	Grade 3	3.9	2.2	5.8	2.8	1.00	9,600
Southern Hem-Fir	Grade 1	6.7	4.3	9.3	2.8	1.00	10,300
	Grade 2	5.9	3.6	8.9	2.8	1.00	9,000
	Grade 3	3.4	2.0	5.0	2.8	1.00	8,300
Northern Spruce-Pine-Fir	Grade 1	6.0	3.1	7.9	2.9	0.90	9,500
	Grade 2	6.0	3.1	7.9	2.9	0.90	9,000
	Grade 3	3.4	1.7	4.4	2.9	0.90	8,100
Southern Spruce-Pine-Fir	Grade 1	6.0	2.7	7.2	2.3	0.90	8,300
	Grade 2	5.3	2.4	6.8	2.3	0.90	7,400
	Grade 3	3.1	1.3	3.9	2.3	0.90	6,900
Southern Pine	Grade 1	8.5	4.6	10.9	3.8	1.19	11,600
	Grade 2	6.6	3.7	9.9	3.8	1.19	10,900
	Grade 3	3.9	2.2	5.6	3.8	1.19	9,500

Appendix C Decking Board

The standard and approved dimensions of boards for decking are as follows:

1. The thickness is to increase by 3 mm between 21 mm and 75 mm for deciduous trees and by 3 mm between 24 mm and 75 mm for conifer.
2. The standard width is to increase by 10 mm between 90 mm and 300 mm.
3. Standard cross section dimensions of dimensional structural lumber in Table 4 are approved to be standard dimensions.
4. The standard length is to increase by 0.3 m from 0.9 m.
5. Other dimensions than the standard dimension (approved dimensions) may be used based on the consultation between the consignor and consignee.

Quality of decking boards is as follows:

1. Moisture content is to be no more than 19% and its gauging method is to be subject to Paragraph 7.3.
2. The bending strength of a small clear specimen of decking boards is to be no less than 35 Mpa; and its gauging method is to be subject to the 'Criteria for Standard Dimensions and Quality of Lumber Products – Annex 6 (Plywood)' for bonded boards; and apply KS F 2208 for general decking timber.
3. For bonded decking boards, the bond strength is to be no less than 0.7 MPa according to the test method on waterproof tensile-shear adhesive strength, which is listed in the 'Criteria for Standard Dimensions and Quality of Lumber Products – Annex 6 (Plywood).' Its criteria for an water soak test are to be under 3 mm according to the water soak test method.
4. The number of samples and the decision of test results regarding moisture content, bending strength, bonding strength, and delamination under Paragraph 7.1 - 7.5.
5. Preservative and insect-proof treatment of decking boards complies with the criteria by use class prescribed in the 'Criteria for Standard Dimensions and Quality of Lumber Products – Annex 2 (Preservative Treated Wood).'

Appendix D Approved Grades of Appearance Grade Timber by “Overseas Inspecting Agencies for Standard Dimensions and Quality of Lumber Products”

Pursuant to Article 20 of the Enforcement Decree of the Act on the Sustainable Use on Lumbers (Public Notification of Criteria for Standard Dimensions and Quality of Lumber Products and Inspection), if appearance grade timber is graded as below by the entities designated as “overseas inspecting agencies for standard dimensions and quality of lumber products”, the grade may be approved regardless of visual grading criteria in Table 1:

<Example>

Grade for Appearance Grade Timber	NLGA	WWPA
Grade 1	C Select (para. 112)	C Select (10.12)
Grade 2	2 common (para. 113)	2 Common (30.12)
Grade 3	3 common (para 113)	3 Common (30.13)

※ Grades for appearance grade timber graded by the entities designated as “overseas inspecting agencies for standard dimensions and quality of lumber products” may be added.

[ANNEX 2]

Preservative-Treated Wood

1. Scope This standard shall apply to domestically produced and imported preservative-treated wood.

2. Definition The terms used in this standard shall be defined as follows.

2.1 Wood preservative Chemicals or combinations thereof used for treating wood to protect wood against biodeterioration factors (wood-rot fungi, termites and marine borers), classified into oil-type, oilborne, emulsified, and waterborne preservatives.

2.2 Preservative-treated wood Wood impregnated with wood preservative to protect it from biodeterioration factors

2.3 Preservative performance The efficacy of a preservative in controlling the deterioration of wood by biodeterioration factors

2.4 Preservative solution Wood preservative solution with a concentration (wt.%) that satisfied the minimum requirements for retention of wood preservative by use class

2.5 Incising The process of puncturing the surfaces of wood before impregnating them with wood preservative as an aid in securing deeper and more uniform penetration of preservative for refractory species

2.6 Penetration rate The degree to which wood preservative penetrates into wood, expressed as the ratio (%) of the penetrated area to cross sectional area of the test specimen

2.7 Penetration depth The depth to which wood preservative penetrated into wood, expressed as the depth (mm) of penetration of preservative solution from the surface into the interior of the test specimen

2.8 Retention The amount of active ingredients of wood preservative contained in the unit volume of preservative-treated wood (kg/m^3)

2.9 Storage for fixation The process of stacking preservative-treated wood for a certain period after preservative treatment so that active ingredients of preservative retained in the wood are fixed

3. Specifications and quality standards

3.1 Dimensions and quality of wood before preservative treatment The dimensions and quality of wood to be subjected to preservative treatment should satisfy the ANNEX 1 (Sawn Timber) of the "Notification on Standard and Specification of Wood Products".

3.2 Mechanical pre-treatment

3.2.1 Debarking Any bark of wood for preservative treatment should be striped off to facilitate penetration of preservative solution.

3.2.2 Prior to preservative treatment, any required mechanical pre-treatment should be performed, such as boring, cutting or incising.

3.2.3 If incising is performed to enhance the penetration rate and retention, the strength reduction should be less than 10% compared to the strength of the wood before incising process. Incising shall be performed in accordance with the "Notification on standard for wood preservative treatment"(National Institute of Forest Science, Notification No. 2016-2).

3.3 Minimum requirements for retention and penetration by use class Table 1 and 2 list the minimum requirements for the retention and penetration by use class, respectively. The maximum error for the penetration is 10% of the total number of samples.

<Table 1> Minimum requirement for retention of wood preservative

Wood Preservative		Criteria for Minimum Retention (Retention basis as active ingredients, kg/m^3)				
Compound	Abbreviation	H3*1		H4		H5
		H3A	H3B	H4A	H4B	
Alkaline Copper Quat	ACQ-1	4.0	4.0	6.4	6.4	-
	ACQ-2	2.6	2.6	5.2	5.2	-
Copper chromated fluoride zinc	CCFZ	6.0	6.0	8.0	8.0	-
Acid copper chromate	ACC	6.0	6.0	9.0	-	-
Chromated copper boron	CCB	6.0	6.0	9.0	9.0	-
Copper Naphthenate*2 (Basis as Cu)	NCU-O	0.8	0.8	-	-	-
	NCU-W	1.0	1.0	-	-	-
Zinc Naphthenate*3 (Basis as Zn)	NZN-O	1.6	1.6	-	-	-
	NZN-W	2.0	2.0	-	-	-
Copper Azole	CUAZ-1	2.6	2.6	5.2	5.2	-
	CUAZ-2	1.0	1.0	2.0	5.0	-
	CUAZ-3	0.96	0.96	2.4	5.0	-
Bis(N-cyclohexyl-diazenium-dioxy)-copper	CuHDO-1	3.0	3.0	4.0	-	-
	CuHDO-2	1.24	1.24	2.48	-	-
	CuHDO-3	0.92	0.92	1.85	2.53	-
Tebuconazole, Propiconazole, 3-iodo-2-propynyl butyl carbamate	Tebuconazole, Propiconazole, IPBC	0.23	0.23	-	-	-
Micronized Copper Quat	MCQ	2.6	2.6	5.2	-	-
Creosote	A	-	-	80	80	170

*1 : H3 shall be applied if preservative-treated wood is necessary for use classes H1 and H2 of Appendix A.

*2, *3 : NCU-O and NZN-O are oilborne preservatives and NCU-W and NZN-W are emulsified preservatives.

'-' : Compounds for which no standards are available cannot be used.

<Table 2> Minimum requirement for penetration rate and depth of wood preservative

Use Class		Classification		Criteria for penetration	
		Sapwood/Heartwood	Assay Zone	Penetration rate(%)	Penetration Depth (mm)
H3	H3A H3B	Sapwood	All layers of sapwood	≥ 80	–
		Heartwood	0 – 10mm	≥ 80	≥ 8
H4	H4A H4B	Sapwood	All layers of sapwood	≥ 80	–
		Heartwood (Thickness < 90mm)	0 – 10mm	≥ 80	≥ 8
		Heartwood (Thickness ≥ 90mm)	0 – 15mm	≥ 80	≥ 12
H5		Sapwood	All layers of sapwood	≥ 80	–
		Heartwood (Thickness < 90mm)	0 – 15mm	≥ 80	≥ 12
		Heartwood (Thickness ≥ 90mm)	0 – 20mm	≥ 80	≥ 16

* H3 shall be applied if preservative-treated wood is necessary for use classes H1 and H2 of Appendix A.

3.4 Moisture content of preservative-treated wood (basis on dry weight) Wood treated with waterborne preservatives shall be ready for shipment only after sufficient fixation and drying. The final moisture content of preservative-treated wood should satisfy the requirements for moisture content in the ANNEX 1 (Sawn Timber) of the “Notification on Standard and Specification of Wood Products”. The final moisture content of preservative-treated wood for applications in contact with the ground and fresh water may exceed 19%.

4. Inspection Penetration and retention inspection of preservative-treated wood shall be performed in accordance with the “Notification on standard for wood preservative treatment”(National Institute of Forest Science, Notification No. 2016-2).

5. Labeling

5.1 Quality labeling

If the individual labeling of small products is actually ineffective, they may be marked by the unit of bundle. The basic size of a bundle is under 300×300×300 mm. Nevertheless, in case that 1) the length of an individual product is above 300 mm and below 600 mm, and either width or height of its minimum cross section is below 150 mm; and 2) the length of an individual product is above 600 mm and both width and height of its minimum cross section are below 15 mm, the bundle size is permitted to be below 300 mm in both width and height except for length.

5.1.1 Quality labeling for bundles Quality labeling for bundles of preservative-treated wood is shown in Table 3.

5.1.1.1 Label manufacturing and attachment A quality label of the standard format shall be printed and attached to each bundle. The form of a tag for package is also acceptable.

5.1.1.2 Example of quality labeling for bundles An example of quality labeling for bundles is specified in Table 4.

<Table 3> Quality labeling for attachment to bundles of preservative-treated wood

Wood	Wood species (Common name)	
	Country of origin	
Wood Preservative	Product name (compound and abbreviation)*1	
Preservative-treated wood	Grade of preservative treatment (Use class)	
	Final moisture content (basis on dry weight) (%)	
	Dimension [thickness(mm)×width(mm)×length(cm)]	
	Number of bundles (ea)	
	Date of manufacture (year, month, date)	
Producer	Address and Tel.	
	Name of the company	

*1 Compound names and abbreviations listed in Table 1

<Table 4> Example of quality labeling for attachment to bundles of preservative-treated wood

Wood	Wood species (Common name)	Korean red pine, Larch, Korean pine, etc.
	Country of origin	Korea, China, Indonesia, etc.
Wood Preservative	Product name (compound and abbreviation)*1	Trade name and compound names and abbreviations listed in Table 1
Preservative-treated wood	Grade of preservative treatment (Use class)	H3A, H3B, H4A, H4B, H5
	Final moisture content (basis on dry weight) (%)	Final MC after preservative treatment and fixation
	Dimension [thickness(mm)×width(mm)×length(cm)]	20×10×180
	Number of bundles (ea)	Number (ea)
	Date of manufacture (year, month, date)	Year, month, date
Producer	Address and Tel.	
	Name of the company	

*1 Compound names and abbreviations listed in Table 1

5.1.2 Quality labeling for an Individual Product

5.1.2.1 Quality label for an individual product The following illustrates the quality label for an individual product.

Use Class - Wood preservative - Wood species - Moisture content - Producer - Date of manufacture (year, month)

5.1.2.2 Example of quality labeling for and individual product The following illustrates an example of quality labeling for an individual product.

H4A - ACQ-2 - Pitch pine - KD19 - Producing company Ltd. - 2015/05

Appendix A Use Classes

Class	Use Area			Biotic Factor
H1	Interior Not exposed to moisture and perfectly protected from rains/impossible for rotting fungi to grow/susceptible to damages from borers (lyctids, anobiids, cerambycids)/ habitat of reticulitermes			Borer Dry wood termite
H2	Interior or limited exterior Indoor environment perfectly protected from rains or outdoor environment with a roof/ occasionally exposed to moisture/ damaged by borers or contaminating fungi (sapstain fungi)/ expected to be suffered from hazardous fungi and termite			Borer Sapstain fungi Wood-rotting fungi Termite
H3	Outdoor above ground Continually exposed to rains, though not contacted with soil/ protected but often exposed to moisture	H3A	Outdoor above ground protected from rains • Have a cover • Have a surface coated with paint and varnish • Have a surface good for drainage • Expected to be suffered from borers, hazardous fungi and termite	Borer Sapstain fungi Wood-rotting fungi Termite
		H3B	Outdoor above ground not protected from rains • Permanently exposed to moisture by having contact with soil or fresh water • Fully exposed to rains because of no coated surface with paint and varnish. • Expected to be suffered from borers, hazardous fungi and termite	Borer Sapstain fungi Wood-rotting fungi Termite
H4	Outdoor ground contact or fresh water contact Permanently exposed to moisture as a result of contact with soil or fresh water	H4A	Environment used for ground contact • Used for ground contact with soil in the uncultivated or virgin land • Have poor conditions for rotting compared with H4B • Expected to be suffered from hazardous fungi and termite	Borer Sapstain fungus Soft rotting fungi Wood-rotting fungi Termite
		H4B	Severely deteriorated environment used for ground contact or fresh water contact • Favorable for hazardous fungi to grow owing to application of organic soil conditioners or fertilizers or irrigation • Expected to severely decay compared with H4A • Permanently exposed to fresh water • Susceptible to constant damage from borers, hazardous fungi and termite	Borer Sapstain fungi Soft rotting fungi Wood-rotting fungi Termite
H5	Environment in contact with weather conditions or seawater • Permanently or frequently submerged by seawater • The upper sea level may be suffered from borers, sapstain fungi, wood-rotting fungi and soft rotting fungi • The part submerged by seawater is expected to be damaged by borers			Borer Sapstain fungi Soft rotting fungi Wood-rotting fungi Marine borer

Note) Based on ISO 21887 Criteria for Classification

Appendix B Wood for Preservative Treatment

In administering preservatives on wood, the decision is to made as follows based on its natural durability and chemical treatability regarding whether the object species may be able to be preservative treated in order to secure minimum efficacy for preservation:

1. Classification of natural durability and treatability of object wood species is to comply with Table 2 – Table 4 of EN 350-2 (Natural Durability of Solid Wood - Guide to Natural Durability and Treatability of Selected Wood Species of Importance in Europe).
2. Object wood species (heartwood), whose natural durability is classified as Class 1 – Class 2 related to rotting fungus and Class D related to termite, may be used in Use Class H1 and H2. But they shall be treated with preservatives to be used in H3A, H3B, H4A, H4B and H5 classes.
3. Although woods classified as Class 1–Class 2 related to rotting fungus and Class D related to termite, they shall be treated with preservatives in case that sapwood is included. They shall have a quality appropriate for the standard penetration in Table 2 as well.
4. Woods classified as Class 3–Class 5 related to rotting fungus and Class M and Class S related to termite shall be treated with preservatives in all classes from H1 to H5 and have a quality appropriate for the standard penetration in Table 2.
5. It is recommended that preservative-resistant wood species with Class 4 of chemical treatability be not used as preservative treated wood.
6. Species with Class 2–4 of treatability in the same standard may be preservative treated only when they can reach the standard penetration and retention of liquid chemicals required by use class through mechanical prior-treatment such as incising.
7. The classification of general names, natural durability against wood-rotting fungi and treatability are as follows:

Symbol	Meaning
X	ATIBT[1] name
D	German name
E	English name
F	French name
O	Other names

Class of Natural Durability	Meaning
1	Very durable
2	Durable
3	Moderately durable
4	Slightly durable
5	Not durable

Treatability	Meaning
1	Easy to treat
2	Moderately easy to treat
3	Difficult to treat
4	Extremely difficult to treat

[1] Association Technique Internationale des Bios Tropicaux

Appendix C Natural Durability and Treatability of Major Wood Species

No.	Scientific Name	General Name		Place of Origin	Natural Durability	Treatability
		Foreign Language	Korean			
1	Chamaecyparis nootkatensis (D.Don) Spach	E Yellow cedar	황 삼나무	North America	2-3	3
2	Cryptomeria japonica(L.f)D.Don	E Cryptomeria	삼나무	North Asia Europe (forest plantation)	5	3
3	Larix decidua Mill	E Larch	낙엽송	Europe Japan	3-4	4
4	Picea abies(L.)Karst	E Norway spruce	독일 가문비	Europe	4	3-4
5	Pinus contorta Dougl. ex Loud. var contorta Wats var. latifalia Wats	E Lodgepole pine	로지폴 소나무	North America North Europe (forest plantation)	3-4	3-4
6	Pinus radiata D.Don	X Pin radiata O Radiata pine[1)]	라디아타 소나무	Brazil (forest plantation) Chile Australia New Zealand South Africa	4-5	2-3
7	Pinus sylvestris L.	E Scots pine Redwood	구주 적송	Europe	3-4	3-4
8	Pseudotsuga menziesii (Mirb) Franco	E Douglas fir	미송	North America Europe (forest plantation)	3	4
9	Thuja plicata D.Don	E Western red cedar	서양 적 삼나무	North America Ukraine (forest plantation)	2	3-4
10	Tsuga heterophylla (Raf.) Sarg.	E Western hemlock	서양 솔 송나무	North America Ukraine (forest plantation)	4	3
11	Alnus glutinosa(L.) Gaertn.,	E Alder	오리나무	Europe	5	1
12	Betula pubescens Ehrh., B.pendula Roth	E European birch	유럽 자작나무	North America	5	1-2

※ **1) Radiata pine (monterey pine)**: native to a very limited area of West California; a couple of leaves; widely planted in New Zealand

No.	Scientific Name	General Name		Place of Origin	Natural Durability	Treatability
		Foreign Language	Korean			
13	Eucalyptus[2] globulus Labill	O Southern blue gum		Europe (forest plantation)	5	3
14	Eucalyptus[2] marginata Sm.	O Jarrah[3]	자라	Australia	1	4
15	Fagus sylvatica L.[4]	E European beech	유럽너도밤나무	Europe	5	1(4)[10]
16	Quercus[5] alba L.,	E American white oak[6]	미국 떡갈나무	North America	2-3	4
17	Quercus robur L., Q. petraea(Matt.)Liebl.	E European oak	유럽 오크	Europe	2	4
18	Quercus rubra L.,	E American red oak	미국 레드오크	North America	4	2-3
19	Robinia pseudoacacia L.[7]	E Robinia	아까시 나무	North America Europe	1-2	4
20	Shorea collina Ridl.	X Red balau		Southeast Asia	3-4	4v
21	Shorea curtisii Dyer ex King	X Dark red meranti		Southeast Asia	2-4	4v
22	Swietenia macrophylla King	E American mahogany[8]	미국 마호가니	Central and South America Caribbean Sea	2	4
23	Tectona grandis L.f.	X Teak[9] F Teak	티크	Asia (forest plantation)	1	4

※ 2) **Eucalyptus (gum tree) :** dycotyledons/evergreen tree or shrub in the myrtaceae family, Myrtales

3) **Jarrah :** one of Eucalyptus tree, endemic to the sandy coastal plain of Southern Australia

4) **Fagus sylvatica :** about 10 varieties that belong to the fagus genus, Magaceae

5) **Quercus :** dycotyledons/archichlamydeae/order: fagales/family: fagaceae/group name of quercus

6) **White oak :** (white bark) daymio oak

7) **Robinia pseudoacacia :** dycotyledons/order: rosales/family: pea/deciduous tree

8) **Mahogany :** dycotyledons/order: geraniales/family: meliaceae/evergreen tall tree

9) **Teak :** dycotyledons/order: tubiflorae/family: verbenaceae/deciduous tree

10) Hesperophanes S, Treatability (4) refers to red-heart, if present

No.	Scientific Name	General Name		Place of Origin	Natural Durability	Treatability
		Foreign Language	Korean			
24	Ulmus carpinifolia Gled	E elm[11]	느릅나무	Europe	4	2-3
25	Pseudotsuga menziesii(Mirb.)[12] Franc	Douglas fir/larch	미송/ 낙엽송	Canada the U.S.	3	4
26	Picea sp.pl.,[13] Abies sp.pl.[14]	European whitewood	피케아 아비에스	Europe	4	3-4
27	Tsuga sp.pl.,[15] Abies sp.pl.[14]	hem-fir	추가 아비에스	Canada the U.S.	4	3

※ **11) Elm :** about 18 varieties in the ulmus genus, Ulmaceae

12) Pseudotsuga menziesii : gymnosperm/order: coniferales/family: pinaceae/evergreen conifer tree

13) Picea sp.pl : *P. jezoensis* native to Japan is popular as a garden tree in Northern areas, especially to make bonsai. *P. abies*, *P. glauca*, *P. orientalis*, and *P. pungens* are also used for gardening and gorgeous varieties are being cultivated.

14) Abies sp.pl : *A. firma*, *A. koreana*, *A. holophylla* and, *A. nephrolepis* with beautiful shapes are used as an ornamental or Christmas tree. Besides, *A. nordmannian*) and *A. pinsapo* are cultivated.

15) Tsuga sp.pl : *T. sieboldii* and *T. diversifolia* are representative varieties. Tall trees are harnessed for pulp-making and construction, and small ones for bonsai. *T. candensis* is inevitable in European gardens as it has many varieties such as cv. Pendula with great shapes and leaf colors. Tsuga sp.pl includes cv. Gentsch Snowflake with some white leaves and cv. Bennet stretching branches, too. It is propagated by cutting.

[ANNEX 3]

Fire Retardant-Treated Wood

1. Scope This standard shall apply to fire retardant-treated wood for construction.

2. Normative references The following standards are referred to in the text such a way that some or all of their content constitutes requirements of this standard. The latest edition of the referenced standard applies.

2.1 KS F 1551 Terminology for wood – Properties and defects of wood

2.2 KS F 1519 Nominal sizes of sawn lumber

2.3 KS F 2271 Testing method for gas toxicity of finish materials of buildings

2.4 KS F ISO 5660-1 Reaction to fire test – Heat release, smoke production and mass loss rate – part 1: Heat release rate(Cone calorimeter method)

2.5 KS F 2199 Determination of moisture content of wood

2.6 KS F ISO 13943 Fire safety - Vocabulary

2.7 KS M 1701 Wood preservatives

3. Definition For the purposes of this standard, terms and definitions of KS F 1551 and KS F ISO 13943 apply.

3.1 Moisture Content Value denoted as a percentage, which is a result of dividing the weight of moisture in the wood by the weight of oven-dried wood and then multiplying by 100

3.2 Fire Retardant Substance applied or added to materials to reduce their combustion rate or delay ignition

3.3 Fire Retardant Treatment Process whereby fire retardance is imparted to a material or product

3.4 Corrosion of Iron Degree to which iron is corroded because of fire retardant-treated wood

3.5 Hygroscopicity Property of fire retardant-treated wood that absorbs moisture

3.6 Total Heat Release Total heat released by a test portion carbonized or ignited after being exposed to 50 kW/m^2 of irradiance for five minutes

4. Type Fire retardant-treated wood has indoor and outdoor types and they are to comply with dimensions prescribed in KS F 1519.

5. Dimensions

5.1 Dimensions and Tolerance

Dimensions of fire retardant-treated wood are subject to Table 1 and their tolerance to Table 2.

<Table 1> Dimensions of Fire Retardant-Treated Wood

Thickness	Width	Length
Increase by 3 mm starting from 6 mm	Increase by 5 mm starting from 60 mm	Increase by 300 mm starting from 300 mm

<Note> Other dimensions than specified in Table 1 may be used based on the negotiation between the consignor and consignee.

<Table 2> Tolerance

Thickness and Width		Length
Dimension	Tolerance	
< 30 mm	±0.5 mm	+ No limit − 0
30 mm - 90 mm	±1.0 mm	
≥ 90 mm	±1.5 mm	

6. Quality

6.1 Appearance The surface quality of fire-retardant wood complies with Table 3 and its back quality shall have no problem with use.

<Table 3> Criteria for Surface Quality

Division	Criteria for Quality
Knot	1. Shall not have a dead knot with a long diameter of more than 30 mm 2. Shall not have a knothole but is permitted to have a knothole with a long diameter of no more than 30 mm if it is meticulously repaired
Deformation (Twist, Sweep)	Shall not hinder usage
Bark pocket or Resin pocket	Shall be extremely minor
Rot and Brittle Heart	Shall be removed
Discoloration	Shall be minor
Worm hole	Shall have no more than one hole with a long diameter of no more than 5 mm per meter
Spiral Grain (Bias Grain)	Shall be minor
Open Grain	Shall not hinder usage
Other Defects	Shall be extremely minor

6.2 Effectiveness

6.2.1 The moisture content of fire retardant-treated wood shall be no more than 13% for indoor use and no more than 15% for outdoor use.

6.2.2 Effectiveness of fire retardant-treated wood complies with Table 4.

<Table 4> Criteria for Effectiveness of Fire retardant-treated Wood

Item	Criteria for Effectiveness	Test Method
Total Heat Release	$\leq$ 8 MJ/m^2 for five minutes	KS F ISO 5660-1
Peak Heat Release Rate	Not above 200 kW/m^2 for no less than 10 consecutive seconds during five minutes	
Crack, Fissure, Hole, or Melting	Shall have no crack, fissure, hole, or melting that penetrate test portions after 5-minute heating	
Average stop time of mouse activity	$\geq$ 9 minutes	KS F 2271
Corrosion of Iron	Corrosion rate of iron $\leq$ 2.0	KS M 1701
Hygroscopicity	Water absorption rate $\leq$ 1.2	KS M 1701

7. Test and Inspection Test items of fire retardant-treated wood are shown in Table 5.

<Table 5> Test Items of Fire Retardant-Treated Wood

Division	For Indoor Use	For Outdoor Use
Fire Retardance Test	○	○

Moisture Content Test	○	○
Hygroscopicity Test	×	○
Iron Corrosion Test	×	○

7.1 Moisture Content Test Select two test pieces with the dimension of 50 mm × 50 mm×the width of fire retardant-treated wood (length×width×thickness) and test them according to KS F 2199.

7.2 Fire Retardance Test Fire retardance tests comply with KS F ISO 5660-1 and KS F 2271 as shown in Table 4 and the following:

7.2.1 Sample Material and Test Portion

7.2.1.1 Randomly select sample materials as much as necessary from a product lot after chemical treatment, drying and finishing and choose test pieces from them. The number of samples, samples for moisture content tests and the number of samples for combustibility tests are subject to Table 6.

7.2.1.2 Test portions secured from sample materials are to have dimensions according to KS ISO 5660-1. If the widths of those materials are less than the KS criteria, glue several materials with adhesive; the adhesive is not to affect their fire retardant effectiveness. Test portions are to be the same as actual products and those no less than 15 mm wide are to be collected not farther than 15 mm from the surface of the material.

7.2.1.3 Outdoor-use fire retardant-treated wood is to be treated for weather-resistance before a test. The method is prescribed in KS M 1701.

7.2.1.4 Gas hazard tests comply with KS F 2271.

<Table 6> Number of Samples for Moisture Content and Fire Retardance Tests

Size of One Lot	Number of Samples	
≤ 1,000 pieces	10	Select samples two times the number of first test samples for a second test
1,001–2,000 pieces	20	
2,001–3,000 pieces	30	
≥ 3,001 pieces	40	

7.3 Iron Corrosion Test

7.3.1 Select Five sample materials from the same lot as the one used for choosing fire retardance test portions.

7.3.2 The dimensions of test portions comply with Annex 4 of KS M 1701 (Test Method of Iron Corrosion of Wood Preservatives). If their widths are less than the KS criteria, use objects with the same width as sample materials.

7.3.3 Select one test portion is to be selected from each sample material and use a total of five objects for the test.

7.3.4 Iron corrosion tests are subject to Annex 4 of KS M 1701.

7.4 Hygroscopicity Test

7.4.1 Test Portion

7.4.1.1 The dimension of test portions comply with Annex 5 of KS M 1701 (Hygroscopicity of Wood Preservatives). But, if the width of their finished face is less than the KS criteria, use objects with the same width as sample materials.

7.4.1.2 Select one test portion from each sample material and use a total of five objects for the test.

7.4.2 Hygroscopicity Test Hygroscopicity Tests are based on Annex 5 of KS M 1701.

7.5 Determination It is determined that when the number of successful objects from one lot is no fewer than 90% of the total, the relevant lot passes the test and when it is under 70%, the lot fails. But, if the number is between 70% and 90%, test the lot again by selecting necessary objects. When the number of successful objects is no fewer than 90%, the relevant lot passes the test and when such objects are under 90%, the lot fails.

8. Labeling For each piece of product, fire retardant-treated wood, tree species, indoor use (outdoor use), manufacturer name (importer name), place of origin and dimensions shall be labeled.

<Fig. 1> Example of Quality Labeling of Fire Retardant-Treated Wood

Fire retardant-treated wood - Korean Red Pine -

Indoor use - ABC Wood - Republic of Korea
Dimension (Thickness x Width x Length)

[ANNEX 4]

Wood Plastic Composites

1. Scope This specification is to apply to outdoor-use floorings made of wood plastic composites (WPC), which are manufactured by mixing thermoplastic resin with wood flour (no less than 50% in weight), adding additives to the materials, and extruding them into desired shapes.

2. Definitions

2.1 WPC Flooring WPC floorings are produced by mixing thermoplastic resin with wood flour (no less than 50% in weight), adding additives to the materials, and extruding them into desired shapes.

2.2 Wood Flour Wood flour refers to finely pulverized type from solid woods. The following is a formular to calculate the wood flour content of WPC:

$$\text{W (wood flour content, \%)} = \frac{W_W}{W} \times 100$$

$$W = W_W + W_P + W_F$$

Here, *W:* Mass of whole WPC (kg)

W_W: Mass of wood flour in WPC (kg)

W_P: Mass of thermoplastic resin in WPC (kg)

W_F: Mass excluding wood flour and thermoplastic resin (kg)

The mass of wood flour raw materials (W_W) is the oven-dry mass.

2.3 Thermoplastic Resin Thermoplastic resins such as polyolefin, etc with properties of melting and fluidity at a given temperature find a use in WPC floorings. During extrusion, additives may add to thermoplastic resins to integrate it with wood flour.

Note: Thermoplastic resins for WPC floorings are mainly polyolefin (PP, PE), polyvinyl Chloride (PVC), polystyrene (PS, ABS), polyamide (PA), polyester (PET), etc.

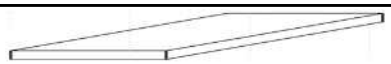
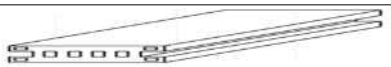
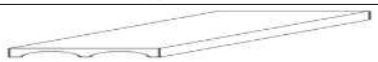
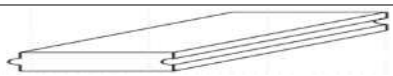
2.4 Solid The solid type of WPC floorings are fully filled inside and installed on a support with fastener clips or screws.

2.5 Hollow (Structure) The hollow type of WPC floorings are hollow inside and installed on a support with fastener clips or screws. They have hollow and arch shapes and their upper board is to be no less than 5 mm thick.

2.6 Tongue and Groove Each piece has a ridge in a tongue shape on one edge and a slot cut all along the opposite edge to allow two pieces to be joined together. There are two types: solid and structure tongue and grooves.

3. Type The type of WPC floorings are classified as in Table 1 according to their shapes.

<Table 1> Classification of WPC Floorings According to Shapes

Type		Division	
Shape	Symbol		
Solid	S	Solid shape	
Structure	H	Hollow shape	
		Arch shape	
Tongue and Groove	S-T	Solid-tongue and groove	
	H-T	Hollow-tongue and groove	

4. Test Piece The size of test pieces is to comply with Table 2. They may be cut down from products in line with the prescribed performance test method through a discussion with the applicant. The test pieces are kept horizontal more than 72 hours at a temperature of 23 ± 2 ℃ and a relative humidity (RH) of 50 ± 10 %.

<Table 2> Number and Dimensions of Test Pieces

Item		Dimensions of Test Pieces	Number of Test Pieces
Specific Gravity		0.5-5g	2
Maximum Flexural Load		The length of a test piece is to be 100 mm longer than the biggest gap between supports set at the time of installation. In case there is no preset distance between supports, the length of a test piece is to be 600 mm.	3
Flexural Creep Deformation		Same test pieces with the maximum flexural load test	3
Impact Resistance	Room Temperature	Same test pieces with the maximum flexural load test	1
	Low Temperature		1

Charpy Impact		(80 x 10 x 4) mm	5
Warping		Same test pieces with the maximum flexural load test	1
Screw Withdrawal Resistance		(100 x 500) mm	1
Slip Resistance		Length ≥ 300 mm	2
Moisture Absorption	Weight Change	Length ≥ 100 mm	1
Freeze-thaw	Change in Maximum Flexural Load	Same test pieces with the maximum flexural load test	3
Coefficient of Linear-Thermal Expansion		Length: 50mm, Cross section shape: circle or rectangle	3
Decay Durability	Change in Charpy Impact	(80 x 10 x 4) mm	5
Hazardous Material Elution		100 g	-
Formaldehyde Emission		150 mm x 50 mm	2 sets: each consists of the number of pieces whose total exposed area reaches 1,800 ㎠
Flame Retardancy		Length ≥ 300 mm	3

5. Performance The performance test of WPC floorings complies with Paragraph 6 and the following rules:

<Table 3> Performance of WPC Floorings

Item		Quality Criteria (KS F 3230)		Relevant Paragraph
Specific Gravity		0.80-1.50		6.1
Maximum Flexural Load (N)		S	≥ 3 400	6.2
		H	≥ 3 000	
Flexural Creep Deformation (%)		S	≤ 0.25	6.3
		H	≤ 0.20	
Impact Resistance	Room Temperature	No abnormalities		6.4
	Low Temperature	No abnormalities		
Charpy Impact,(kJ/㎡)		≥ 3.0		6.5
Warping (%)		≤ 2.0		6.6
Screw Withdrawal Resistance (N)		H, H-T	≥ 400	6.7
		S, S-T	≥ 780	
Slip Resistance		≥ 0.40 C.S.R		6.8
Moisture Absorption	Weight Change (%)	≤ 8.0		6.9
Freeze-thaw	Change in Maximum Flexural Load (%)	≥ 90 in the initial stage		6.10
Coefficient of Linear-Thermal Expansion (1/℃)		S-T, H-T	≤ 3.0×10^{-5}	6.11
		S, H	≤ 6.0×10^{-5}	
Decay Durability	Change in Charpy Impact (%)	≥ 80% in the initial stage		6.12
Hazardous Material Elution Test (㎎/L)	Arsenic (As)	≤ 0.1		6.13
	Cadmium (Cd)	≤ 0.1		
	Chromium (Cr)	≤ 0.1		
	Lead (Pb)	≤ 0.1		
	Mercury (Hg)	≤ 0.005		
Formaldehyde Emission (mg/L)		≤ 1.5		6.14
Flame Retardancy	Carbonized Length (cm)	≤ 20 cm		6.15
	After Flame Time (sec)	≤ 10 sec		

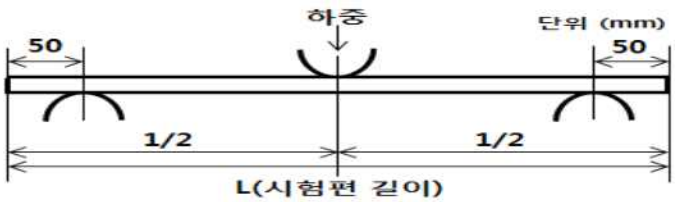
6. Test Method

6.1 Specific Gravity Specific gravity of WPC floorings is tested no less than two times according to A (Water Substitution) of KS M 3016. The mean of the results is recorded up to three decimal places.

6.2 Maximum Flexural Load

6.2.1 Test Piece The width and thickness of test pieces are the same with the products. Their length is to be 100 mm longer than the biggest gap between supports set at the time of installation. But, when a product is above 160 mm wide, its test piece is to have a wide of (150 ± 10) ㎜. In case there is no preset distance between supports, the length of a test piece is to be 600 mm.

6.2.2 Test Method In testing maximum flexural load, the radius of the stress rod and supports and a test speed are subject to KS M ISO 178 and test pieces are set up as in Fig. 1. The loading face is the exposed surface at the time of installation. Conduct a test of three pieces and record the mean of max. flexural loads and distances between supports.



하중 Load 시험편 길이 Length of the test piece 단위 Unit

<Fig. 1> Equipment for the Maximum Flexural Load Test

6.3 Flexural Creep Deformation

6.3.1 Test Piece In testing flexural creep deformation, dimensions of test pieces follow Paragraph 6.2.1.

6.3.2 Test Method With the same equipment with Paragraph 6.2, apply 850 N of load to test pieces within 1-5 sec and maintain it for 24 hrs according to KS M ISO 899-2. Calculate flexural creep deformation with the following formula. The loading surface is to be the exposed one at the time of installation and write down the mean of the results of three test pieces.

$$\epsilon_t\,(\%) = \frac{600 \cdot S_t \cdot h}{L^2}$$

Here, ε_t : Flexural creep deformation

S_t : Deformation of the center of mid span section between contact points at any given time t (㎜)

h : Thickness of the test piece (㎜)

L : Distance between contact points (㎜)

6.4 Impact Resistance

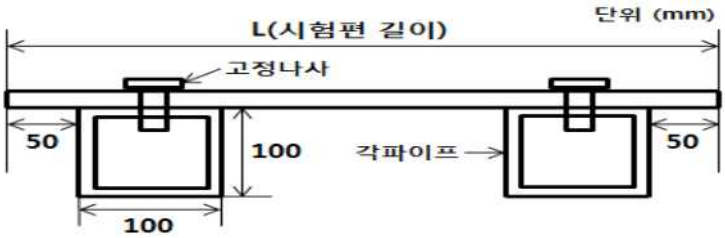
6.4.1 Test Piece In testing impact resistance, dimensions of test pieces follow Paragraph 6.2.1.

6.4.2 Test Method For a product using supports to install, fix a test piece on them and drop a steel pendulum ball to its center with 1042 g of a weight and 64 mm of a diameter from a height of 100 mm according to KS F 2221. Observe the test piece visually and record the status of its fracture and rupture. In case of a product not using supports, fix and test a test piece no more than 10 cm high from the bottom in the fashion described in Fig. 2. The loading surface is to be the exposed one at the time of installation. Perform a test and write down the results respectively under the following conditions:

a) Room temperature: Before the test, keep test pieces horizontal for no less than three days at the temperature of 23 ± 2 ℃ and 50 ± 10 % RH.

b) Low temperature: Before the test, keep test pieces horizontal for 24 hrs at the temperature of -30 ± 2 ℃ and test them within 10 min.

(Unit: mm)



시험편 길이 Length of the test piece 단위 Unit

고정나사 Set screw 각파이프 Square pipe

<Fig. 2> Equipment for Impact Resistance Testing

6.5 Charpy Impact

6.5.1 Test Piece Use Type no. 1 of KS M ISO 179-1. Cut a test piece down from the product: its length is parallel to the push-out direction and its width is vertical to the longitudinal direction of the exposed surface at the time of installation. But, the test piece includes its exposed surface at the time of installation.

<Table 4> Test Piece for Charpy Impact Testing (Unit: mm)

Type	Length *l*	Width *b*	Thickness *h*	Length between Contact Points *L*
Type no. 1	80±2	10.0±0.2	4.0±0.2	62±0.5
Dimensions (Thickness *h*, Width *b* and Length *l*) are to be $h \leq b \leq l$.				

6.5.2 Test Method Use a test piece without notches in accordance with KS M ISO 179-1 and a blow is applied to the exposed surface at the time of installation. Employing the mean value of five test pieces, compute Charpy impact a_{cU} based on the following formula and express it by the unit of kJ/㎡:

$$a_{cU} = \frac{E_c}{hb} \times 10^3$$

Here, E_c: Absorbed energy (J) adjusted by the rupture of a test piece.

h: Thickness of a test piece (㎜)

b: Width of a test piece (㎜)

6.6 Warping

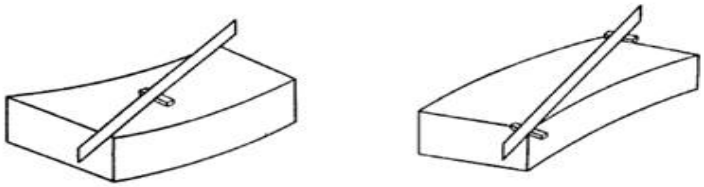
6.6.1 Test Piece In the warping test, dimensions of test pieces follow Paragraph 6.2.1.

6.6.2 Test Method Test pieces are conditioned for three days at 25 ± 2 ℃ and 85 ± 5 % RH and then at 20 ± 2 ℃ and 35 ± 5 % RH until their weight become constant. Pursuant to KS L 3112, place a ruler on the diagonal of the exposed surface at the time of installation. To measure a concave surface of the test piece, enter a gauging wedge perpendicular to the ruler into a location with the greatest gap between the surface and the ruler as shown in Fig. 3. And measure the size of the gap through wedge graduations. For a convex surface, drive wedges as in Fig. 3. respectively into locations where the gaps are almost the same at each end. Gauge the gaps and calculate the mean. Repeat the same procedure for the other diagonal on the same face and write down the biggest value. Compute W_a(%) or warping value and express it with one decimal place.

$$W_a(\%) = \frac{h}{l} \times 100$$

Here, l : Diagonal length of a test specimen (㎜)

h : Size of a gap calculated through wedge graduations. (㎜)



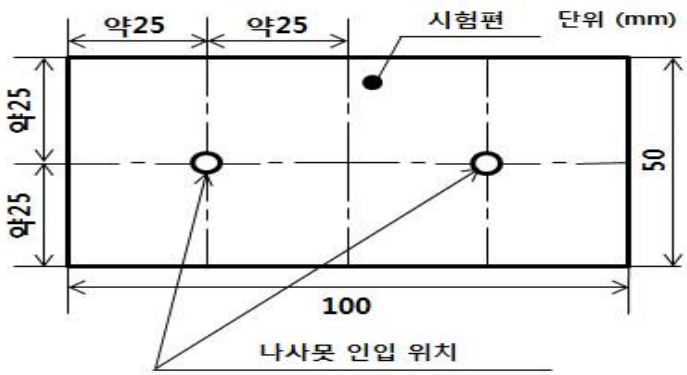
<Fig. 3> Measurement of Warping

6.7 Screw Withdrawal Resistance

6.7.1 Test Piece Test Pieces are subject to Fig. 4.

6.7.2 Test Method Fix a screw of a 2.7 mm nominal diameter and a 16 mm length in locations (surface and edge) found in Fig. 4. Check that the part of the screw entered in the test piece is 11 mm in vertical depth. Then pull the screw vertically. Measure their maximum forces respectively and determine the mean of two spots as screw withdrawal resistance. However, the drawing force speed is to be 2 ㎜/min (To insert screws, pilot holes of about 3 mm in depth should be prepared using a drill whose diameter is about 2 mm).

(Unit: mm)



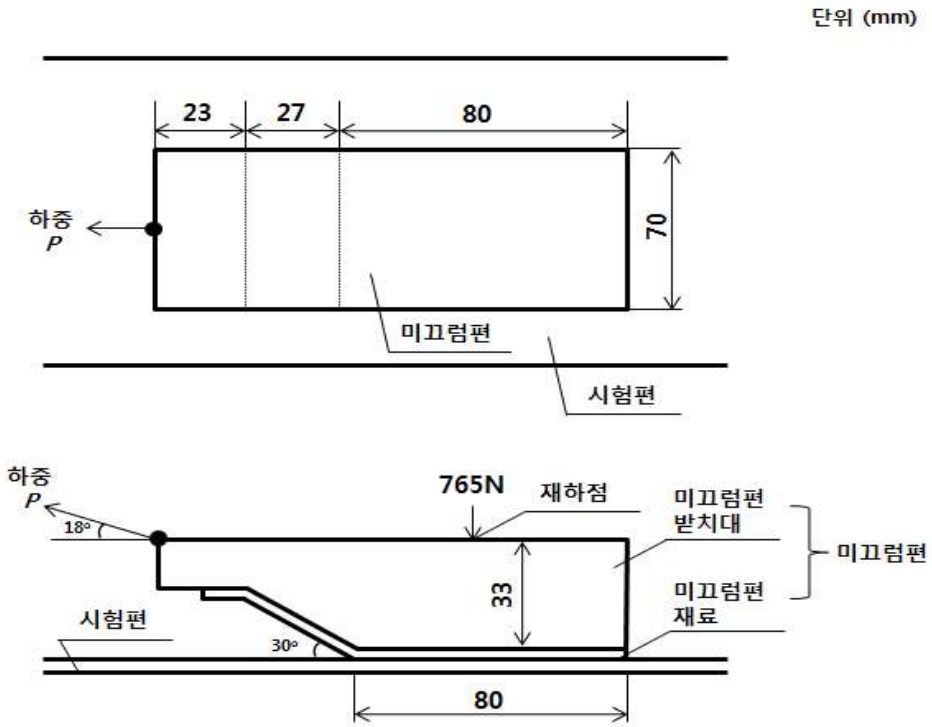
약 about 시험편 Test piece 나사못 인입위치: Screw inserting location

<Fig. 4> Screw Withdrawal Resistance Test

6.8 Slip Resistance

6.8.1 Test Piece The width and thickness of test pieces are the same with the products and their length is to be no less than 300 mm. But if the product is no more than 100 mm wide, put together several test pieces so that the width of the combined sample is no less than 100 mm.

6.8.2 Test Method Use a slip machine as shown in Fig. 5 according to Paragraph 4.15 of KS M 3510. As test pieces, use rubber sheets of 7580 in hardness (durometer hardness test – Type A) and 36mm in width prescribed in Paragraph 4.15.2 of KS M 3510 and maintain their surfaces dry. The test method is as follows:



단위 Unit 하중 Load 미끄럼편 Slider 시험편 Test piece
재하점 Loading point 미끄럼편 받치대 Slider support 미끄럼편 재료 Slider material

<Fig. 5> Slip Tester

6.8.2.1 Affix a slider onto the bottom of a steel slider support of 80x70 mm. At the moment when the slider is contacted with a test piece under 785 N of vertical loading, pull the supporter at a 785 N/s loading speed and at 18°. After measuring a maximum tensile load, compute a slip resistance as shown in the following formula and express it up to two significant numbers. Assess the push-out direction of the product and a vertical direction to it. The smaller C.S.R value is determined as slip resistance.

$$C.S.R = \frac{P_{max}}{W}$$

Here, C.S.R: Coefficient of slip resistance

P_{max}: Maximum tensile load (N)

W: Vertical load (785 N)

6.9 Moisture Content

6.9.1 Test Piece The thickness and width of test pieces are the same with the products and their length is to be no less than 100 mm.

6.9.2 Test Method Before the test, treat test pieces in advance at 20 ± 3 ℃ and 66 ± 2 % RH until they reach a constant weight and weigh them through a scale with a precision of no less than 0.01 g. The weighed test pieces are treated under the following conditions to record changes in mass: Method A for olefin (except vinyl) and Method B for acrylic and vinyl.

6.9.2.1 Method A

6.9.2.1.1 Immerse test pieces in water of 100 ℃ for 5 hrs. Use a jig for them not to touch the bottom of the water bath.

6.9.2.1.2 After the process described in Paragraph 6.9.2.1.1, soak test pieces immediately in water of 23 ± 2 ℃ for 20 min. Remove moisture perfectly from their surface and measure a change in mass.

$$\text{Change in mass (\%)} = \frac{W_2 - W_1}{W_1} \times 100$$

Here, W_1 = Mass before immersion (g), W_2 = Mass after immersion (g)

6.9.2.2 Method B

6.9.2.2.1 Immerse test pieces right away in water of 23 ± 2 ℃ for 28 days. Use a jig for them not to touch the bottom of the water bath.

6.9.2.2.2 After the process described in Paragraph 6.9.2.2.1, perfectly remove moisture from the surface of test pieces and measure a change in mass.

$$\text{Change in mass (\%)} = \frac{W_2 - W_1}{W_1} \times 100$$

Here, W_1 = Mass before immersion (g), W_2 = Mass after immersion (g)

6.10 Freeze-thaw Test

6.10.1 Test Piece For freeze-thaw testing, dimensions of test pieces follow Paragraph 6.2.1.

6.10.2 Test Method The following test cycle is repeated three times for three test pieces. Compared with max. flexural load of Paragraph 6.2, measure changes in max. flexural load after the freeze-thaw test as a percentage (%) and record their mean.

6.10.2.1 Immerse test pieces in water of 23 ± 2 ℃ for 24 hrs.

6.10.2.2 Remove moisture from the surface of test pieces and keep them in the chamber of -30 ± 2 ℃ for 24 hrs.

6.10.2.3 After the process described in Paragraph 6.10.2.2, let test pieces conditioned at 23 ± 2 ℃ for 24 hrs.

Change in maximum flexural load after the freeze-thaw test (%) = $\frac{F_2}{F_1} \times 100$

Here, F_1 = Change in max. flexural load before test (N)

F_2 = Change in max. flexural load after test (N)

6.11 Coefficient of Linear-Thermal Expansion

6.11.1 Test Piece Test pieces 50 mm long are used to measure the coefficient of linear-thermal expansion.

6.11.2 Test Method According to KS M 3060, test the test pieces at −30 ℃ - 60 ℃ and calculate the coefficient with the following formula:

Coefficient of Linear-Thermal Expansion (1/℃) = $(L_2-L_1) / L_0(T_2-T_1) = \triangle L/L_0\triangle T$

Here L_1,L_2 : Lengths of each test piece at a given temperature T_1 and T_2

L_0 : Length of each test piece at room temperature

(Room temperature: 23 ± 2 ℃ in temperature and 50 ± 5 % in humidity)

6.12 Weather Resistance

6.12.1 Test Piece Test pieces subject to Paragraph 6.5 are used to evaluate decreased impact strength.

6.12.2 Test Method In accordance with Method A of KS M 4892-2, perform a test up to 2,000 **hrs** (340 nm and 0.55 w/m^2) in the direction of the exposed face at the time of installation. After the impact strength test based on Paragraph 6.5, write down a change against initial impact strength as a percentage (%).

6.13 Hazardous Material Elution Test

6.13.1 Pretreatment of Samples Break up WPC flooring to an extent that its particles have a diameter of no more than 5 mm. Sieve them through sifters with openings of no more than 5 mm and no less than 1 mm. Take a sampling of particles with a diameter of 1-5 mm though conical quartering.

6.13.2 Method for Eluting Hazardous Materials Accurately weigh 100±2 g of samples pretreated according to Paragraph 6.13.1 and put them in an erlenmeyer flask of 2 000 ml. Add a pH 6±0.3 acid solution made by mixing distilled water with hydrochloric acid as much as about 900 ml. Let the mixed solution conditioned at room temperature and pressure for 24 hrs and elute hazardous materials for 4 hrs with a vibration test shaker of some 200 in frequency and 4-5 cm in amplitude. After filtering the mixed solution through a glass fiber filter, fill it in a 1 L mass flask to the 1 L mark for using it as a test solution.

6.13.3 Test Method Analyze and record the elution quantity of As, Cd, Cr, Pb, and Hg from the test solution based on KS I ISO 8288 (Flame atomic absorption spectrometric methods), KS ISO 11885 (Inductively coupled plasma optical emission spectrometry(ICP-OES) and KS I ISO 17294-2 (Inductively coupled plasma mass spectrometry (ICP-MS).

6.14 Formaldehyde Emission

6.14.1 Test Piece Test pieces have the same thickness with the products and their length and width are to be 150±1 mm and 50±1 mm respectively.

6.14.2 Test Method The test is in line with the desiccator method of KS M 1998.

6.15 Flame Retardancy

6.15.1 Test Piece Test pieces have the same width and thickness with the products and their length is to be 30 cm.

6.15.2 Test Method In accordance with Paragraph 4.2 Method A of KS F 2819, dry test specimens, which are almost in air dry condition, at 50 ± 2 ℃ for 48 hrs. Place them in a desiccator with silica gels for 48 hrs and then heat them for 2 min. Record the length of the carbonized section and after flame time.

7. Inspection Inspect products according to Paragraph 6 and determine whether they fit into Table 3. But, wood flour content is assessed by means of on the work log or the receipts and payments that can prove the mass of materials set forth by a WPC producer or a material supplier.

8. Labeling

8.1 Labeling Items Each WPC flooring and its package shall be labeled as follows in a noticeable way for consumers:

8.1.1 WPC (Wood flour no less than 50%)

8.1.2 Kind of Thermoplastic resin

8.1.3 Maximum flexural load / Span between supports during test

8.1.4 Dimensions Expressed by the unit of mm in the order of thickness, width and length

8.1.5 Producer (Importer) The company names of producers are described for domestic products. The names of producing companies and counties are described for imported products.

8.1.6 Year and Month of Manufacture

8.2 Labeling There is no limit in the labeling format and yet each item in Paragraph 8.1 shall be included.

<Labeling example for domestic WPCs>

WPC (Wood flour no less than 50%) – Thermoplastic resin – Max. flexural load / Span between supports during test
Dimensions (Thickness x width x length)
Name of producer, year and month of production

WPC (Wood flour no less than 50%) – PP – 4000N / 600mm
20 x 300 x 1500 mm
Company ABC, 2015. 05

<Labeling example for Imported WPCs>

WPC (Wood flour no less than 50%) – Thermoplastic resin – Max. flexural load / Span between supports during test
Dimensions (Thickness x width x length)
Name of importer – Place of origin, Year and month of production

WPC (Wood flour no less than 50%) – PE – 4000N/600mm
20 x 300 x 1500 mm
Company ABC – Japan (ooo), 2015. 05

[Annex 5]

Glued Laminated Timber

1. Scope This specification is to apply to wood products manufactured by bonding laminations in parallel to fibers (hereafter 'Glued laminated timber'): structural laminated timber, non-structural laminated timber and laminated boards

2. Definitions The definitions of terms in the specification are as follows:

2.1 Lamination Sawn timber comprising laminated timber layers (those aligned or glued in transverse direction, or joined and glued in longitudinal direction) or the laminate block

2.2 Structural Laminated Timber Glued laminated timber used as load-bearing members to support structures

2.3 Non-structural Laminated Timber Glued laminated timber for general use or interior such as structures or timber with focus on the wood's own aesthetics except laminated boards

2.4 Laminated Boards Wood products manufactured by gluing wood panels with even thickness in transverse direction, or in longitudinal and transverse direction

2.5 Outermost Lamination Lamination within 1/16 of the length of the side connecting two outermost surfaces of glued laminated timber with different grade laminations when the distance is measured from both faces. The lamination is divided into the compression-related outermost lamination used for the upper face to which compressive stress applies under flexural loading and the tension-related outermost lamination used for the lower face to which tensile stress applies.

2.6 Outer Lamination Laminations within 1/16 to 1/8 of the length of the side connecting two outermost surfaces of laminated timber with different grade laminations when the distance is measured from both faces

2.7 Middle Lamination Laminations within 1/8 to 1/4 of the length of the side connecting two outermost surfaces of laminated timber with different grade laminations when the distance is measured from both faces

2.8 Inner Lamination Laminations farther than 1/4 of the length of the side connecting two

outermost surfaces of laminated timber with different grade laminations when the distance is measured from both faces

2.9 Mechanically Graded Lamination Lamination whose strength property is mechanically graded to measure its modulus of elasticity and determined to have fulfilled quality criteria after visual tests for mechanically graded lamination on the defects of the face

2.10 Direction of Lamination Thickness direction of the layer composing the outermost of structural laminated timber or the lamination block

2.11 Large-section Laminated Timber Structural laminated timber whose cross section has a short edge no less than 150mm long and whose area is no less than 30,000 mm^2

2.12 Middle-section Laminated Timber Structural laminated timber whose cross section has a short edge no less than 75mm long and a long edge no less than 150mm long except large-section laminated timber

2.13 Small-section Laminated Timber Structural laminated timber with sizes not included in large- and middle-section laminated timber

2.14 Laminated Timber with Different Grade Laminations Structural laminated timber that has laminations with different grades

2.15 Laminated Timber With Same Grade Laminations Structural laminated timber that has laminations with same grades

2.16 Symmetrically Arranged Structural Laminated Timber Laminated timber with different grade laminations where its lamination grades are arranged symmetrically against neutral axis

2.17 Asymmetrically Arranged Structural Laminated Timber Laminated timber with different grade laminations where its lamination grades are arranged asymmetrically against neutral axis

2.18 Curved Laminated Timber Laminated timber with a curvature bigger than 1% of its length

2.19 Straight Laminated Timber Laminated timber straight in longitudinal direction excluding curved laminated timber

2.20 Use Class 1 Use area classification corresponding to the equilibrium moisture content of

wood exposed to ambient conditions of 20 ℃ in temperature and 65% in relative humidity (Humidities above this standard happen less than a few weeks per year)

2.21 Use Class 2 Use area classification corresponding to the equilibrium moisture content of the wood exposed to ambient conditions of 20 ℃ in temperature and 85% in relative humidity (Humidities above this standard happen less than a few weeks per year)

2.22 Use Class 3 Use area classification showing an equilibrium moisture content higher than that of Use Class 2 due to continued direct exposition to weather

2.23 Strength Grade Strength grade determined about structural laminated timber by this specification. S and B respectively responds to the standard unit for average modulus of elasticity and average bending strength applied to the pertinent grade.

2.24 Second Bonding Gluing laminated timber again in longitudinal or transverse direction after first processing

3. Type Types of glued laminated timber are sorted as follows according to the use, composition and arrangement of laminations, and cross section size, and direction of glued faces;

3.1 According to use, there are structural laminated timber, non-structural laminated timber, and laminated boards.

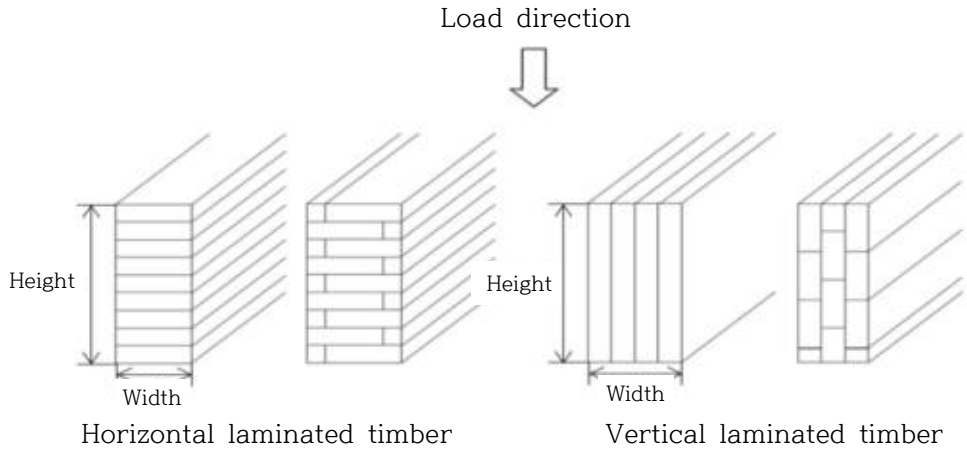
3.2 Structural laminated timber is divided into laminated timber with same grade laminations and laminated timber with different grade laminations; According to lamination arrangement, it is divided into symmetrically arranged structural laminated timber and asymmetrically arranged structural laminated timber.

3.3 Structural laminated timber is classified into large-, middle- ad small-cross section laminated timber.

3.4 Classification by the direction of glued faces is as follows:

3.4.1 Horizontal Laminated Timber Structural laminated timber whose continued wide bonding laminations are oriented vertical to the loading direction as shown in Fig. 1.

3.4.2 Vertical Laminated Timber Structural laminated timber whose continued wide bonding laminations are oriented parallel to the loading direction as shown in Fig. 1.



<Fig. 1> Classification of Structural Laminated Timber by Direction of Glued Faces

4. Criteria for Standard Dimensions and Quality

4.1 Structural Laminated Timber

4.1.1 Material

4.1.1.1 Lamination

4.1.1.1.1 Thickness Thickness of laminations of structural laminated timber shall be no more than 50 mm. By planing finish, thickness of the outermost lamination may reduce on the bottom and top surface, but it shall be vertically symmetrical to the central axis of its cross section. However, thickness of glued laminated timber rated by the manufacturer may increase in case that its strength is confirmed through field tests or model tests. Thickness of the outermost lamination reduced by planing shall be no less than 80% of other laminations; provided that for laminated timber with same grade laminations or laminated timber with different grade laminations with a proven strength through field tests or model tests, thickness of their outermost lamination after planing may be no less than 2/3 of those of other laminations.

4.1.1.1.2 Tree Species As regards all tree species of conifer and deciduous trees for manufacturing structural laminated timber, their strength values regarding small clear test specimen shall be definitely determined.

4.1.1.1.3 Grade Laminations for manufacturing structural laminated timber shall undergo visual inspection and mechanical grading measurement, and be rated according to the criteria for quality of mechanically graded laminations in Table 1.

<Table 1> Criteria for Quality of Mechanically Graded Laminations

Division	Criteria for Quality
Strength Performance	1. Modulus of elasticity of each grade measured through a mechanical grading machine or according to the Type B Bending test method in Paragraph 5.8 shall comply with the criteria in Table 17. 2. For the outermost and outer laminations of symmetrical laminated timber with different grade laminations, the tension-related outermost and outer laminations of asymmetrical laminated timber with different grade laminations, laminations of laminated timber with same grade laminations, their strengths shall comply with the Type C Bending test method in Paragraph 5.9 or the tension test in Paragraph 5.10.
Knot Area Ratio[a]	1. The outermost and outer laminations of laminated timber with different grade laminations shall be ≤ 17%, middle laminations ≤ 25% and inner laminations ≤ 33%. 2. Laminations of laminated timber with same grade laminations shall be ≤ 17%.
Slope of Grain[b]	≤ 1:12
Rot	None
Discoloration	Minor
Other Defects (Checks, etc.)	Extremely minor

[a] Knot area ratio is the proportion of an area obtained by reflecting a knot on the cross section to the relevant cross section.
[b] Slope of grain is a ratio of the height of average grain slope to a member length of 1m.

4.1.1.2 Adhesive Adhesives for structural laminated timber are to be able to satisfy adhesion performance in use classes defined in Paragraph 2.20, 2.21, and 2.22. Apply phenolic adhesives, amino adhesives, polyisocyanate adhesives or adhesives with a performance equivalent to or greater than them in thickness, width, and length direction.

4.1.2 Criteria for Quality The criteria for quality of structural laminated timber are presented in Table 2.

<Table 2> The Criteria for Quality of Structural Laminated Timber

<table>
<tr><th colspan="3">Division</th><th>Criteria</th></tr>
<tr><td rowspan="5">Bonding Strength[a]</td><td rowspan="3">Test I</td><td>Water Soak Delamination Test</td><td rowspan="2">1. The delamination rate shall be no more than 5% after measuring delamination no less than 3mm long from both ends of a test piece.
2. The length of delamination shall be no more than ¼ of the length of each relevant layer.
3. The sum of all delaminations at one end of a test piece shall be no more than ¼ of the edge in lamination direction of the member.</td></tr>
<tr><td>Boiling Delamination Test</td></tr>
<tr><td>Block Shear Test</td><td>Shall pass a block shear test in Paragraph 5.4</td></tr>
<tr><td rowspan="2">Test II</td><td>Pressure Test</td><td>1. The delamination rate shall be no more than 5% after measuring delamination no less than 3mm long at both ends of a test piece.
2. The length of delamination on each layer shall be no more than ¼ of the layer.
3. The sum of all delaminations at one end of a test piece shall be no more than ¼ of the edge in lamination direction of the member.</td></tr>
<tr><td>Block Shear Test</td><td>Shall pass a block shear test in Paragraph 5.7</td></tr>
<tr><td colspan="3">Moisture Content(on Dry Basis)</td><td>≤ 15 %</td></tr>
<tr><td colspan="2" rowspan="3">Formaldehyde Emission</td><td>SE_0</td><td>Mean ≤ 0.3 mg/L, Maximum ≤ 0.4 mg/L</td></tr>
<tr><td>E_0</td><td>Mean ≤ 0.5 mg/L, Maximum ≤ 0.7 mg/L</td></tr>
<tr><td>E_1</td><td>Mean ≤ 1.5 mg/L, Maximum ≤ 2.1 mg/L</td></tr>
<tr><td rowspan="3">Bending Strength[b]</td><td colspan="2">Test Product</td><td>Shall pass Type A Bending test in Paragraph</td></tr>
<tr><td rowspan="2">Non-test Product</td><td>Quality of Laminations</td><td>Shall meet the quality criteria in Table 1, Paragraph 4.1.1</td></tr>
<tr><td>Composition of Laminations</td><td>Shall meet the criteria for composition of laminations in Paragraph 4.1.3</td></tr>
<tr><td colspan="3">Minimum Number of Laminations</td><td>1. ≥ 4 sheets for laminated timber with same grade laminations
2. ≥ 2 sheets for laminated timber with same grade laminations</td></tr>
<tr><td colspan="3">Face Appearance Grade</td><td>Shall meet the criteria for appearance grade in Paragraph 4.1.1</td></tr>
<tr><td colspan="3">Bow(Applicable to Straight Laminated Timber)</td><td>≤ 1mm in transverse displacement per 1m of the member length</td></tr>
<tr><td colspan="3">Minimum Curvature Radius of Curved Banks (Except Straight Laminated Timber)</td><td>Shall meet the criteria for minimum curvature radius of curved banks in Paragraph 4.1.5</td></tr>
<tr><td colspan="3">Gap of the Glue Line of Adjacent Laminations</td><td>Shall meet the criteria for gaps of the glue line of adjacent laminations in Paragraph 4.1.14.1.6 and 4.1.7</td></tr>
</table>

[a] The bonding strength of structural laminated timber shall pass Test Ⅰ or Ⅱ.

[b] To meet the strength by grade of structural laminated timber, one of the following methods is applied;

○ Test product: Regardless of quality and composition methods of laminations, Type A Bending test in Paragraph 5.7 is conducted as a field test for manufacturer-grading laminated timber made

by the design of the manufacturer.

○ Non-test Product If structural laminated timber with a desired grade is manufactured by meeting requirements for quality and composition methods of laminations, Type A Bending test for full-sized timber is not conducted.

4.1.3 Composition of Laminations

4.1.3.1 Glued Laminated Timber with Different Grade Laminations

4.1.3.1.1 The classification of strength grades of laminated timber with different grade laminations is described in Table 3.

4.1.3.1.2 The criteria for the composition of laminations of symmetrical laminated timber with different grade laminations are described in Table 4 and the composition of tension-related and compression-related laminations of asymmetrical laminated timber with different grade laminations are described in Table 5.

<Table 3> Strength Grades of Laminated Timber with Different Grade Laminations

Symmetrical Laminated Timber with Different Grade Laminations		Asymmetrical Laminated Timber with Different Grade Laminations	
Strength Grades	Mechanical Grade of Outermost Lamination	Strength Grades	Mechanical Grade of Tension-related Outermost Lamination
15S－43B	E18	14S－42B	E18
13S－37B	E16	12S－36B	E16
12S－33B	E14	11S－31B	E14
10S－30B	E12	10S－28B	E12
9S－27B	E11	9S－25B	E11
8S－25B	E10	8S－24B	E10
7S－24B	E9	7S－22B	E9
6S－22B	E8	6S－21B	E8

<Table 4> The Criteria for the Composition of Laminations of Symmetrical Laminated Timber with Different Grade Laminations

Outermost Lamination	Outer Lamination	Middle Lamination	Inner Lamination
L[a]	≥－1L	≥－2L	≥－4L

[a] L means mechanical grade criteria for the outermost lamination of laminated timber with the relevant composition presented in Table 3 and －nL refers to an mechanical grade as lower as n-grade.

<Table 5> The Criteria for the Composition of Laminations of Asymmetrical Laminated Timber with Different Grade Laminations

Tension-related Laminations			Inner Lamination	Compression-related Laminations	
Outermost Lamination	Outer Lamination	Middle Lamination		Middle Lamination	Outer Lamination Outermost Lamination
L	≥ −1L	≥ −2L	≥ −4L	≥ −3L	≥ −2L

4.1.3.2 Glued Laminated Timber With Same Grade Laminations

4.1.3.2.1 The classification of strength grades of laminated timber with same grade laminations is described in Table 6.

4.1.3.2.2 Glued laminated timber with same grade laminations is composed of laminations with same mechanical grades according to Table 6.

<Table 6> Strength Grades of Laminated Timber with Same Grade Laminations

Strength Grades of Laminated Timber with No Less than 4 Same Grade Laminations	Strength Grades of Laminated Timber with 3 Same Grade Laminations	Strength Grades of Laminated Timber with 2 Same Grade Laminations	Mechanical grades of Laminations
17S－54B	17S－49B	17S－45B	E18
15S－46B	15S－43B	15S－39B	E16
13S－40B	13S－37B	13S－34B	E14
12S－37B	12S－33B	12S－30B	E12
10S－34B	10S－30B	10S－28B	E11
9S－31B	9S－28B	9S－27B	E10
8S－30B	8S－27B	8S－25B	E9
7S－27B	7S－25B	7S－24B	E8
6S－25B	6S－24B	6S－22B	E7

4.1.4 The Criteria for Face Appearance Structural laminated timber has options for required faces: sanding finish and planing finish. They are expressed as S and P respectively.

4.1.5 Minimum Curvature Radius of Curved Banks (Except Straight Laminated Timber) The minimum curvature radius of curved banks shall be no less than the standard values in Table 7.

<Table 7> Minimum Curvature Radius of Curved Banks (Unit: mm)

Thickness of Thickest Lamination	Minimum Curvature Radius of Curved Banks
5	500
10	1 100
15	1 800
20	2 500
25	3 500
30	4 700
35	6 000
40	7 500
45	9 400
50	11 800

4.1.6 Gap of the Longitudinal Glue Line of Adjacent Laminations (Only Adjacent Laminations Laminated in Longitudinal Direction) The gap of the longitudinal glue line of adjacent laminations shall be in line with the criteria in Table 8. However, when strengths of laminations glued in longitudinal direction are proved to be appropriate through a mechanical grading machine or other loading machines, they may be approved.

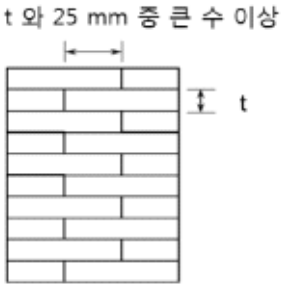
<Table 8> Gap of the Longitudinal Glue Line of Adjacent Laminations

Type of Glue Lines / Division	Laminated Timber with a Slope Glue Line (Slope ≤ 1/7.5) or Binding Strength Equivalent to or Greater than It	Laminated Timber with Finger Joints[a] or Binding Strength Equivalent to or Greater than It
Beam (Member in Need of High Bending Strength)	For outer or outermost laminations (tension-related for laminated timber with different grade laminations) or laminations close to them, their longitudinal glue lines shall not be overlapped.	For outer or outermost laminations (tension-related for laminated timber with different grade laminations) or laminations close to them, their longitudinal glue lines shall be no less than 150 mm away from each other.
Column (Member in Need of High Compression Strength)	The longitudinal glue lines of adjacent laminations shall not be overlapped.	The longitudinal glue lines of adjacent laminations shall not be overlapped.
Other	The longitudinal glue lines of adjacent laminations shall not be overlapped.	The longitudinal glue lines of adjacent laminations shall be no less than 150 mm away from each other.

[a] The finger joint section shall have a slope no more than 1/7.5 and a length no less than 10.5 mm for inner laminations, and no less than 12 mm for other laminations.

<Note> If laminations with longitudinal glue lines meet the criteria in Table 1 as a result of measuring them through a grading machine or other loading machines, laminated timber made of these laminations may be approved.

4.1.7 Gap of the Side Glue Line of Adjacent Laminations In manufacturing laminated timber beams with a width of no less than 200 mm using edge-joined laminations, the edge-joined lamination between adjacent laminations shall be no less than the thickness (t) of the lamination and their gap shall be at least 25 mm away from each other as in Fig. 2.



<Fig. 2> Gap of the Side Glue Line of Side-joined Laminations

* t 와 25mm 중 큰 수 이상: No less than a bigger number between t and 25 mm

4.1.8 Second Bonding

4.1.8.1 Adhesives for second bonding are to have the same use class with those for gluing the relevant laminated timber or its components; provided that as regards other kinds of adhesives, a use class of the lowest level is marked.

4.1.8.2 All glued laminations resulting from second bonding shall follow the criteria for bonding strengths.

4.1.8.3 The composition of second bonding laminations shall be symmetrical to each central axis or central face in vertical and transversal direction - excluding the bonding direction of asymmetrical laminated timber with different grade laminations - and their thicknesses shall be symmetrical.

4.1.9 Dimensions and Tolerance

4.1.9.1 Method for Measuring Dimensions

4.1.9.1.1 Width and Height Width of structural laminated timber refers to the length of the edge parallel to the glued lamination on the cross section of horizontal laminated timber or the length of the edge perpendicular to the glued lamination on the cross section of vertical laminated timber. Height of structural laminated timber refers to the length of the edge

oriented at 90° to the glued lamination on the cross section of horizontal laminated timber or the length of the edge parallel to the glued lamination on the cross section of vertical laminated timber.

4.1.9.1.2 Length The length of structural laminated timber is the shortest straight length connecting both cross sections; provided that a trim allowance is excluded.

4.1.9.2 Dimensions and Shapes

4.1.9.2.1 Dimensions and Shapes of Laminated Timber Laminated timber may come in various dimensions and shapes according to an agreement between the customer and supplier.

4.1.9.2.2 Tolerance Tolerances of height, width and length shall be no bigger than values presented in Table 9. Tolerances of bow are to be no more than 6 mm for members with a length no more than 6,000 mm. For members with a length with no less than 6,000 mm, the tolerance limit increases by 3 mm per 6,000 mm in length and its maximum is to be no more than 19 mm. If not otherwise stated on shapes, the cross section shall maintain a rectangle and the tolerance limit is to be no more than 3 mm per 300 mm in height. The right angle of edges is confirmed by 1) matching the edge of a right angle ruler with the edge of laminated timber; 2) aligning one edge of the scale to the upper or lower face of laminated timber; and 3) measuring a distance between the other edge of the scale and the edge of the timber.

<Table 9> Tolerance of Structural Laminated Timber Dimensions

Division	Tolerance Limit	
	Large-section Laminated Timber	Middle-section and Small-section Laminated Timber
Width and Height	±1.5 %, unable to exceed ±5 mm	±1.5 %, unable to exceed ±3 mm
Length	+ No limit − 0	

4.2 Non-structural Laminated Timber and Laminated Boards

4.2.1 Materials

4.2.1.1 Lamination Dimensions and tree species of non-structural laminated timber and laminated boards may be determined at manufacturers' discretion.

4.2.1.2 Adhesive Adhesives for non-structural laminated timber are to be able to satisfy adhesion performance in use classes defined in Paragraph 2.20, 2.21, and 2.22.

4.2.2 The Criteria for Quality The criteria for quality of non-structural laminated timber and laminated boards are stated in Table 10. But, according to the state of longitudinal joints, the products shall comply with the criteria in Table 10-1 and 10-2.

<Table 10> The Common Criteria for Quality of Glued laminated Timber and Laminated Boards

Division			Criteria
Bonding Strength	Water Soak Delamination Test		The delamination rate shall be no more than 10% and at the same time, the length of delamination shall be no more than ⅓ of the length of each relevant layer.
	Block Shear Test	Shear Strength	Conifer ≥ 4.0 MPa Deciduous trees ≥ 6.0 MPa
		Wood Failure	≥65 %
Moisture Content (on Dry Basis)			≤12 %*
Formaldehyde Emission		SE_0	Mean ≤ 0.3 mg/L, Maximum ≤ 0.4 mg/L
		E_0	Mean ≤ 0.5 mg/L, Maximum ≤ 0.7 mg/L
		E_1	Mean ≤ 1.5 mg/L, Maximum ≤ 2.1 mg/L

* Subject to change in accordance with use classes

<Table 10-1> The Quality Criteria by Grade of glued Laminated Timber and Laminated Boards without Lengthwise Joints

Division		Criteria	
		Grade 1	Grade 2
Bow, Warping		Extremely minor	
Knot	Wide face area < 0.5㎡	None	No limit
	0.5㎡ ≤ Wide face area < 0.7㎡	Number ≤ 1 Long diameter ≤ 30mm	
	0.7㎡ ≤ Wide face area < 1.5㎡	Number ≤ 2 Long diameter ≤ 30mm	
	Wide face area ≥ 1.5㎡	Number ≤ 3 Long diameter ≤ 30mm	
Heart*		None	No limit
Resin Pocket*		Number ≤ 3 Width ≤ 3mm Length ≤ 100mm	No limit
Clear Face**	Wide face area < 0.7㎡	Number: 1 Size ≥ 9/10 of wide face area	No limit
	0.7㎡ ≤ Wide face area < 1.0㎡		
	1.0㎡ ≤ Wide face area < 1.5㎡		
	Wide face area ≥ 1.5㎡		
Other Defects		Minor	

* Applicable to conifer.

** Applicable to deciduous trees.

<Table 10-2> The Quality Criteria by Grade of Glued Laminated Timber and Laminated Boards with Lengthwise Joints

Division		Criteria		
		Grade 1	Grade 2	Grade 3
Bow, Warping		Extremely minor	Extremely minor	Minor
Knot	Wide face area< 0.5㎡	None	Number: ≤ 1 Long diameter ≤ 30mm	Long diameter ≤ 100mm
	0.5㎡ ≤ Wide face area < 0.7㎡	Number ≤ 1 Long diameter ≤ 30mm	Number ≤ 1 Long diameter ≤ 60mm	
	0.7㎡ ≤ Wide face area < 1.5㎡	Number ≤ 2 Long diameter ≤ 30mm	Long diameter ≤ 80mm	
	Wide face area≥ 1.5㎡	Number ≤ 3 Long diameter ≤ 30mm		
Heart*		None	None	None
Resin Pocket*		Number ≤ 3 Width ≤ 3mm Length ≤ 100mm	Number ≤6 Width ≤ 6mm Length ≤ 200mm	No limit
Clear Face**	Wide face area < 0.7㎡	Number: 1 Size ≥ 9/10 of wide face area	Number: 1 Size ≥ 2/3 of wide face area	Number ≤ 3 Size ≥ 1/2 of wide face area
	0.7㎡ ≤ Wide face area < 1.0㎡		Number: 2 Size ≥ 2/3 of wide face area	Number ≤ 4 Size ≥ 1/2 of wide face area
	1.0㎡ ≤ Wide face area < 1.5㎡		Number: 3 Size ≥ 2/3 of wide face area	Number ≤ 5 Size ≥ 1/2 of wide face area
	Wide face area ≥ 1.5㎡		Number: 4 Size ≥ 2/3 of wide face area	Number ≤ 6 Size ≥ 1/2 of wide face area
Other Defects		Minor	Minor	Insignificant

* Applicable to conifer.
** Applicable to deciduous trees.

4.2.3 Dimensions and Tolerance

4.2.3.1 Method for Measuring Dimensions

4.2.3.1.1 Width and Height Width of non-structural laminated timber and laminated boards refers to the length of the side vertical to the direction of lamination fibers on the surface. Height refers to the length of the side vertical to the direction of lamination fibers on the

edge. Their width and height are respectively long and short side lengths of the cross section.

4.2.3.1.2 Length The length of non-structural laminated timber and laminated boards is the shortest straight length connecting both cross sections. But a trim allowance is excluded.

4.2.3.2 Dimensions and Shapes

4.2.3.2.1 Dimensions and Shapes of Laminated Timber Laminated timber may come in various dimensions and shapes according to an agreement between the customer and supplier.

4.2.3.2.2 Tolerance Tolerance of dimensions of non-structural laminated timber and laminated boards are shown in Table 11.

<Table 11> Tolerance of Dimensions of Non-structural Laminated Timber and Laminated Boards

Division	Tolerance Limit
Width and Height	Smaller value between ±2 % and ±3 mm
Length	+ No limit − 0

5. Test

5.1 Water Soak Delamination Test

5.1.1 Test Piece Take a sampling of three test pieces in total: each from a point 50 mm away from both ends of laminated timber and its center. In case that there is a limit in timber length, collect one or two test pieces. The sizes of test pieces are the same as those of the cross section and their length is to be 75 mm. Here, knots, slope grains and other defects are not to be included. But, test pieces of non-structural laminated timber and laminated boards are in line with KS F 2160.

5.1.2 Test Method Immerse a test piece in water for 24 hr at room temperature (10-25 ℃) and put it in the constant temperature drying oven at (70±3) ℃. Be careful that the oven is not humid inside; Moisture content after 24-hr drying is to be lower than MC before the test. Measure a delamination no less than 3 mm long among delaminations that appear on both cross sections of a test piece and exclude checks stemming from dryness and knots.

5.1.3 Calculation Method Dimensions are gauged by precision of 0.1 mm and calculate the

delamination rate according to the following equation:

$$\text{Delamination rate}(\%) = \frac{\text{Sum of lengths of bonding layer delamination on both cross sections}}{\text{Sum of lengths of bonding layers on both cross sections}} \times 100$$

5.1.4 Criteria for Quality The delamination rate and lengths of test pieces shall comply with Table 2 for structural laminated timber and Table 10 for non-structural laminated timber and laminated boards.

5.2 Boil Delamination Test

5.2.1 Test Piece Prepare test pieces as in Paragraph 5.1.1.

5.2.2 Test Method Immerse a test piece in water for 4 hr at room temperature (10-25 ℃) and put it in the constant temperature drying oven at (70±3) ℃. Be careful that the oven is not humid inside; Moisture content after 24-hr drying is to be lower than MC before the test. For products with a mark of Use Class 3, repeat the above procedures two times.

5.2.3 Calculation Method The method of calculating the delamination rate is the same as in Paragraph 5.1.3.

5.2.4 Criteria for Quality The delamination rate and length of a test piece shall be subject to the criteria in Table 2.

5.3 Pressure Test

5.3.1 Test Piece Prepare test pieces as in Paragraph 5.1.1.

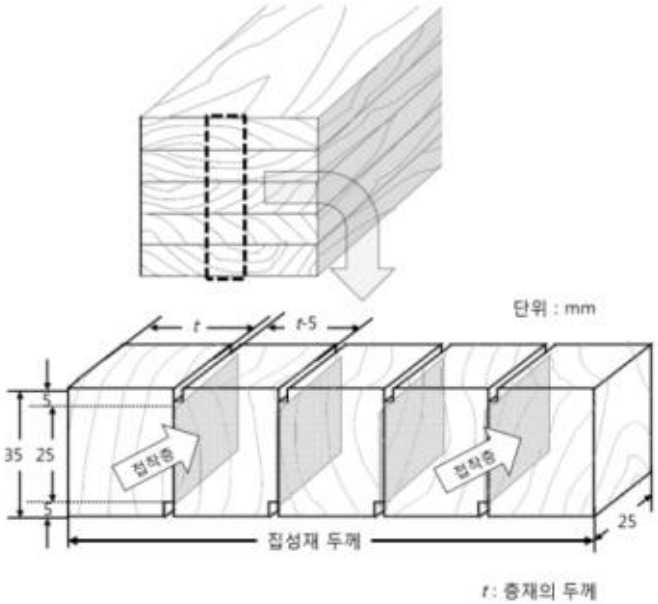
5.3.2 Test Method Immerse a test piece in water at room temperature (10-25 ℃) and reduce pressure to 635 mmHg for 5 minutes and again to (0.51±0.03) MPa for 1 hr. Repeat this procedure two times and put the test piece in the constant temperature dying oven at (70±3) ℃ to dry it for 24 hr. Moisture content after drying is to be lower than MC before the test. For products with a mark of Use Class 3, repeat above procedures two times.

5.3.3 Calculation Method The method of calculating the delamination rate is the same as in Paragraph 5.1.3.

5.3.4 Criteria for Quality The delamination rate and length of a test piece shall be subject to the criteria in Table 2.

5.4 Block Shear Test

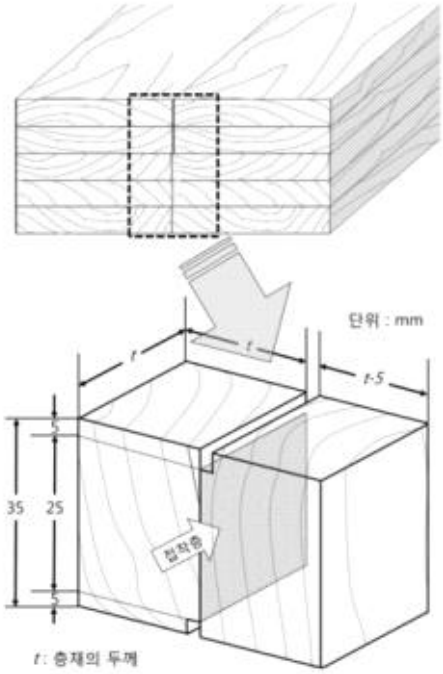
5.4.1 Test Piece For every bonding layer between laminations, shape two test pieces from a section 100 mm away respectively from both ends of sample laminated timber as in Fig. 3. Apply loads in parallel to bonding layers and lamination fibers and implement a shear test.



a. Sampling of Laminated Timber Test Pieces for a Block Shear Test

단위: Unit 접착층 Bonding layer 층재의 두께 Thickness of lamination

집성재 두께 Thickness of laminated timber



b. Sampling of Second Bonding Test Pieces for a Block Shear Test

단위: Unit 접착층 Bonding layer 층재의 두께 Thickness of lamination

<Fig. 3> Sampling of Test Pieces for a Block Shear Test

5.4.2 Test Method Mount a shear test equipment which can apply loads parallel to bonding layers on the strength test machine with a capacity 30% larger than loads. Put loads on them at a constant speed so that the test pieces are broken at least in 10 sec after the test started.

5.4.3 Calculation Method Shear strength and wood failure are calculated according to the following equation:

$$\text{Shear strength (MPa)} = \frac{\text{Load during rupture of test pieces (N)}}{\text{Bonding area}(\text{㎟})}$$

$$\text{Wood failure (\%)} = \frac{\text{Ruptured area of the wooden part of a shear face}}{\text{Total area of a shear face}} \times 100$$

5.4.4 Criteria for Quality The shear strength and wood failure of test pieces of structural laminated timber shall be no less than standard values in Table 12. But if one of them does not meet the values, the relevant bonding layer may go through a retest. Non-structural laminated timber and laminated boards comply with the quality criteria in Table 10.

<Table 12> Criteria for Shear Strength and Wood Failure for a Block Shear Test of Structural Laminated Timber

Wood Species Group	Shear Strength (MPa)	Wood Failure (%)
Species with oven dry specific gravity ≥ 0.5	7.1	60
Species with oven dry specific gravity 0.45–0.5	5.9	65
Species with oven dry specific gravity < under 0.45	5.3	70

<Note> Although test pieces with defects such as knots and resin pockets in bonding layer may be excluded from the test, the excluded layer shall undergo a retest using other test pieces.

5.5 Moisture Content (on Dry Basis) Test

5.5.1 Test Piece Prepare two test pieces with an appropriate size for each sample laminated timber.

5.5.2 Method for Measurement Measure the weight of test pieces through the oven dry method according to the following equation; but if there are other methods conducive to definitely determining the moisture content of test pieces, they are permitted:

$$Moisture\,content\,(on\,dry\,basis)\,(\%) = \frac{W - Wo}{Wo} \times 100$$

Here W : Weight before dry (g)

Wo : Oven dry weight (g)

5.6 Formaldehyde Emission Test This test complies with the desiccator method of KS M 1998.

5.7 Type A Bending Test (Bending Test of Structural Laminated Timber)

5.7.1 Species For straight laminated timber with equal cross sections, each sample timber shall be used as it is. But, for some samples with difficulties of a full-sized timber test, one of the following species shall be adopted. In case of 'Paragraph 5.7.1.1. Species,' required test pieces are made: each one from upper and lower faces of the sample timber (both surfaces parallel to the lamination widthwise). In case of the species in 'Paragraph 5.7.1.2 Model Species,' make test pieces in accordance with requirements.

5.7.1.1 Test Piece

5.7.1.1.1 The height is to be ½ sample laminated timber.

5.7.1.1.2 The width is to be no less than ½ sample laminated timber.

5.7.1.1.3 The length is to be no less than 20 times the height of test pieces.

5.7.1.1.4 In case that sample laminated timber has an outermost lamination with longitudinal glue lines and edge bonding, test pieces are to include them.

5.7.1.2 Model Test Piece

5.7.1.2.1 The quality and composition of the lamination are to be the same as sample laminated timber.

5.7.1.2.2 The height is to be no less than 30 cm.

5.7.1.2.3 The width is to be the same as that of sample laminated timber.

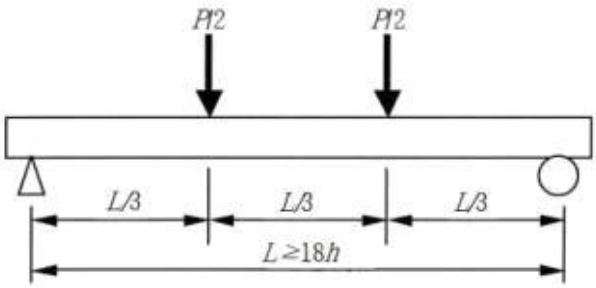
5.7.2 Test Method Measure the load, deformation and the maximum load of test pieces within proportional limits and calculate their modulus of elasticity and bending strength in the same way in Fig. 4. In Fig. 4, the span shall be no less than 18 times of the height. Put same load on both loading points. Maintain the average loading speed to rupture test pieces within 1-10 min. If the use direction of laminated timber is marked, test the test piece with its upper face upwards. In other cases, comply with the following:

5.7.2.1 The loading direction of symmetrical laminated timber with different grade laminations is to be oriented at 90° to the lamination face.

5.7.2.2 For asymmetrical laminated timber with different grade laminations, the tension-related face is to be oriented downwards for loading.

5.7.2.3 For laminated timber with no less than four same grade laminations, its loading direction is to be oriented perpendicular to the lamination face.

5.7.2.4 Glued laminated timber with two or three same grade laminations



P : Load

L : Span

h : Height of test piece

<Fig. 4> Type A Bending Test Method

5.7.3 Calculation Method Calculate modulus of elasticity and bending strength according to the following equation:

$$Modulus\ of\ elasticity\,(\mathrm{MPa}) = \frac{23P_e L^3}{108\triangle_e bh^3}$$

$$Bending\ strength\,(\mathrm{MPa}) = \frac{P_m L}{bh^2}$$

Here P_e : Load at proportional limit (N)

$\triangle_e$: Deformation at proportional limit (mm)

L : Span (mm)

b : Width of test piece (mm)

h : Height of test piece (mm)

P_m : Maximum load (N)

5.7.4 Criteria for Quality Test pieces shall meet all of the following requirements:

5.7.4.1 The mean of modulus of elasticity of test pieces shall be no less than that for laminated timber of the relevant grade in Table 13.

5.7.4.2 No less than 95% of test pieces shall be no less than the minimum of modulus of elasticity for laminated timber of the relevant grade in Table 13.

5.7.4.3 No less than 95% of bending strength of test pieces shall be no less than the value calculated by multiplying the adjustment factor by bending strength for glued laminated timber of the relevant grade in Table 13 (bending strength in Table 14 for compression-related test pieces of asymmetrical laminated timber with different grade laminations); the adjustment factor

for laminated timber with different grade laminations is based on Table 15 and that for laminated timber with same grade laminations on Table 16.

<Table 13> Criteria for Quality of Modulus of Elasticity and Bending Strength

Division	No. of Laminations	Strength Grade	Modulus of Elasticity (10^3 MPa)		Bending Strength (MPa)
			Mean	Minimum	
Symmetrical Laminated Timber with Different Grade Laminations	–	15S－43B	15	12	43
		13S－37B	13	11	37
		12S－33B	12	10	33
		10S－30B	10	9	30
		9S－27B	9	8	27
		8S－25B	8	7	25
		7S－24B	7	6	24
		6S－22B	6	5	22
Asymmetrical Laminated Timber with Different Grade Laminations	–	14S－42B	14	11	42
		12S－36B	12	10	36
		11S－31B	11	9	31
		10S－28B	10	8	28
		9S－25B	9	7	25
		8S－24B	8	6.5	24
		7S－22B	7	6	22
		6S－21B	6	5	21
Laminated Timber with Same Grade Laminations	4 sheets	17S－54B	17	14	54
		15S－46B	15	12	46
		13S－40B	13	11	40
		12S－37B	12	10	37
		10S－34B	10	9	34
		9S－31B	9	8	31
		8S－30B	8	7	30
		7S－27B	7	6	27
		6S－25B	6	5	25
	3 sheets	17S－49B	17	14	49
		15S－43B	15	12	43
		13S－37B	13	11	37
		12S－33B	12	10	33
		10S－30B	10	9	30
		9S－28B	9	8	28
		8S－27B	8	7	27
		7S－25B	7	6	25
		6S－24B	6	5	24
	2 sheets	17S－45B	17	14	45
		15S－39B	15	12	39
		13S－34B	13	11	34
		12S－30B	12	10	30
		10S－28B	10	9	28
		9S－27B	9	8	27
		8S－25B	8	7	25
		7S－24B	7	6	24
		6S－22B	6	5	22

<Table 14> The Criteria for Bending Strength for Compression-related Test Pieces of Asymmetrical Laminated Timber with Different Grade Laminations

Division	Strength Grade	Bending Strength (MPa)
Asymmetrical Laminated Timber with Different Grade Laminations	14S－42B	28
	12S－36B	25
	11S－31B	24
	10S－28B	22
	9S－25B	21
	8S－24B	19
	7S－22B	18
	6S－21B	16

<Table 15> Adjustment Factor of Bending Strength for Laminated Timber with Different Grade Laminations

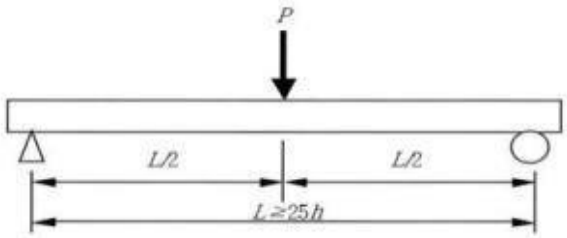
Height of Sample Laminated Timber, Test Pieces or Model Laminated Timber (mm)		Adjustment Factor
	≤ 100	1.13
> 100	≤ 150	1.08
> 150	≤ 200	1.05
> 200	≤ 250	1.02
> 250	≤ 300	1.00
> 300	≤ 450	0.96
> 450	≤ 600	0.93
> 600	≤ 750	0.91
> 750	≤ 900	0.89
> 900	≤ 1,050	0.87
> 1,050	≤ 1,200	0.86
> 1,200	≤ 1,350	0.85
> 1,350	≤ 1,500	0.84
> 1,500	≤ 1,650	0.83
> 1,650	≤ 1,800	0.82
> 1,800		0.80

<Table 16> Adjustment Factor of Bending Strength for Laminated Timber with Same Grade Laminations

Height of Sample Laminated Timber, Test Pieces or Model Laminated Timber (mm)		Adjustment Factor
	≤ 100	1.00
> 100	≤ 150	0.96
> 150	≤ 200	0.93
> 200	≤ 250	0.90
> 250	≤ 300	0.89
> 300		0.85

5.8 Type B Bending Test (Test for Modulus of Elasticity of Laminations)

5.8.1 Test Method Apply loads only up to the proportional limit and measure the load and deformation at proportional limit as shown in Fig. 5.



P : Load
L : Span
h : Height of test piece

<Fig. 5> Type B Bending Test Method

5.8.2 Calculation Method Calculate modulus of elasticity according to the following equation:

$$Modulus\ of\ elasticity\ (\mathrm{MPa}) = \frac{P_e L^3}{4\triangle_e b h^3}$$

Here P_e : Load at proportional limit (N)
$\triangle_e$: Deformation at proportional limit (mm)
L : Span (mm)
b : Width of test piece (mm)
h : Height of test piece (mm)

5.8.3 Criteria for Quality Modulus of elasticity of lamination test pieces shall be no less than the minimum of modulus of elasticity by grade in Table 17.

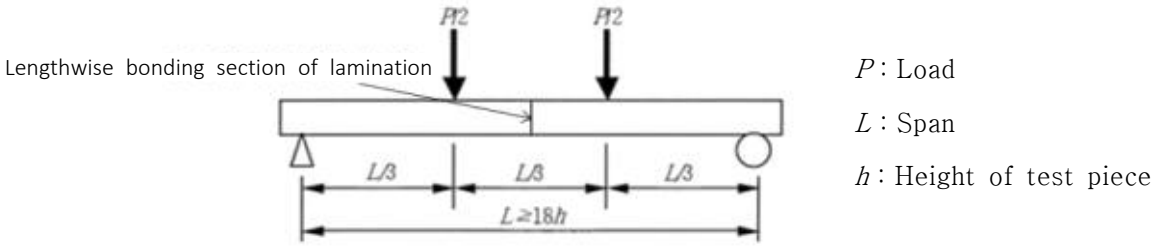
<Table 17> Criteria for Modulus of Elasticity of Laminations by Grade (Unit: 10^3 MPa)

Grade	E5	E6	E7	E8	E9	E10	E11	E12	E14	E16	E18
Minimum of Modulus of Elasticity	5	6	7	8	9	10	11	12	14	16	18

5.9 Type C Bending Test (Test for Modulus of Elasticity of Laminations)

5.9.1 Test Piece The sizes of test pieces are to be the same as those of the lamination cross section. Their length shall be no less than 18 times width and the longitudinal glue line shall be at the center of test pieces.

5.9.2 Test Method Measure the maximum load by testing test pieces in the method presented in Fig. 6.



<Fig. 6> Type C Bending Test Method

5.9.3 Calculation Method Calculate bending strength according to the following equation:

$$Bending\,strength\,(\mathrm{MPa}) = \frac{P_m L}{bh^2}$$

Here P_m : Maximum load (N)
L : Span (mm)
b : Width of test piece (mm)
h : Height of test piece (mm)

5.9.4 Criteria for Quality Test pieces shall meet all of the following requirements:

5.9.4.1 The mean of bending strength of test pieces shall be no less than that of the relevant grade in Table 13.

5.7.4.2 No less than 95% of lamination test pieces shall be no less than the minimum of bending strength of the relevant grade in Table 18.

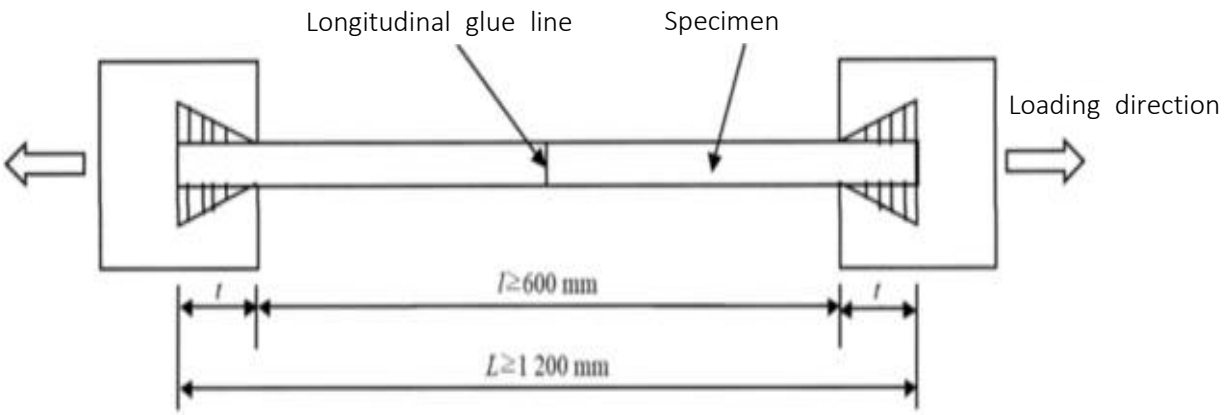
<Table 18> Criteria for Quality of Bending Strength of Laminations

Mechanical Grade	Bending Strength (MPa)	
	Mean	Minimum
E18	72	54
E16	63	47
E14	54	40
E12	48	36
E11	45	34
E10	42	31
E9	39	29
E8	36	27
E7	33	25
E6	30	22
E5	27	20

5.10 Tension Test of Laminations

5.10.1 Test Piece The sizes of test pieces are to be the same as those of the cross section of the sample lamination and their length is to be no less than 1,200 mm. But, for a lamination with longitudinal glue lines, they shall be at the center of test pieces.

5.10.2 Test Method The test complies with Fig. 7. The interlocked parts of both test piece ends shall be no less than 300 mm long and the span no less than 600 mm long. Apply tensile loads at the average speed of no more than 10 MPa per minute through interlocked parts.



L : Length of test piece

l : Span

t : Length of interlocked part (t ≥ 300 mm)

<Fig. 7> Tension Test Method

5.10.3 Calculation Method Calculate tensile strength according to the following equation:

$$Tensile\,strength\,(\mathrm{MPa}) = \frac{P_m}{bh}$$

Here P_m : Maximum load (N)

b : Width of test piece (mm)

h : Height of test piece (mm)

5.10.4 Criteria for Quality Test pieces shall meet all of the following requirements:

5.10.4.1 The mean of tensile strength of test pieces shall be no less than the value calculated by multiplying the adjustment factor in Table 20 by the mean tensile strength of the relevant grade in Table 19.

5.10.4.2 No less than 95% of tensile strength of test pieces shall be no less than the value calculated by multiplying the adjustment factor in Table 20 by the minimum of the relevant grade in Table 19.

<Table 19> Criteria for Quality of Tensile Strength of Mechanically Graded Laminations

Mechanical Grade	Tensile Strength (MPa)	
	Mean	Minimum
E18	42	32
E16	37	28
E14	32	24
E12	28	21
E11	26	20
E10	24	18
E9	23	17
E8	21	16
E7	20	15
E6	18	13
E5	16	12

<Table 20> Adjustment Factor of Tensile Strength

Width of Test Piece (mm)	Adjustment Factor
≤ 150	1.00
≤ 200	0.95
≤ 250	0.90
> 250	0.85

6. Inspection

6.1 Quality Inspection of Structural Laminated Timber Select the number of sample pieces prescribed in Table 21 from one lot according to the size of the inspection lot. For a retest, the number of samples is to be two times the original.

<Table 21> The Piece Number of Samples of Structural Laminated Timber for a Quality Test

Piece Number of One Lot for Structural Laminated Timber	Piece Number of Samples
≤ 10	3
≤ 20	4
≤ 100	5
≤ 500	6
> 500	7

6.2 Quality Inspection of Non-structural Laminated Timber and Laminated Boards

6.2.1 Randomly select the number of sample pieces prescribed in Table 22 and 23 from one lot according to the size of inspection lot. For a retest, the number of samples is to be two times the original. For laminated timber with a lot size of over 3,000 pieces, the lot is to be split.

6.2.2 Measure the defects of non-structural laminated timber and laminated boards based on Table 24.

<Table 22> The Piece Number of Samples of Non-structural Laminated Timber and Laminated Boards to Inspect Dimensions, Bow and Warping

Piece Number of One Lot for Structural Laminated Timber	Piece Number of Samples
≤ 200	20
≤ 500	50
≤ 1 000	80
≤ 3 000	120

<Table 23> The Piece Number of Samples of Non-structural Laminated Timber and Laminated Boards to Inspect Water Soak Delamination, Moisture Content, Formaldehyde Emission and Checks

Piece Number of One Lot for Structural Laminated Timber	Piece Number of Samples
≤ 200	2
≤ 500	3
≤ 1 000	4
≤ 3 000	5

<Table 24> Method of Measuring Defects of Non-structural Laminated Timber and Laminated Boards

Defect		Method
Knot	Measurement	1. Defects Include rot, loss, scratches, holes, mineral stains and bark pockets etc, which affects the usage. 2. Exclude defects with a long diameter of no more than 10mm
	Long Diameter	1. Measure the biggest diameter except the part surrounding knots 2. When the long diameter is no less than three times the short one, the former is to be considered a half the measured long diameter. 3. The long diameter of loose knots, rotten knots, and easy-to-fall out knots are to be considered two times the measured long diameter (three times for those penetrating another face). However, dead knots that are unlikely to fall out are to be considered sound knots. 4. The long diameter of knots such as rot, loss, scratches, holes, mineral stains and bark pockets are to be considered two times the measured long diameter (three times for those penetrating another face). 5. Linear mineral stains and bark pockets with a width of no more than 3mm are to be considered ⅓ the measured long diameter (⅔ for those penetrating another face). 6. For knots whose long diameter is no more than ½ of the limit, two knots are to be considered one (four or more knots whose long diameters are no more than ¼ or '1/number of knots' of the limit)
Diameter Ratio		1. Apply to conifer 2. For boards, measure a wide face with fewer defects and for lumber, measure a face with more defects
Resin Pocket		1. Apply to conifer and include resin stains 2. For boards, measure a wide face with fewer defects and for lumber, measure a face with more defects
Clear Face		1. Apply to deciduous trees. The clear face refers to the part without knots (except sound knots with a long diameter shorter than 3 mm), rot, loss, scratches, holes, mineral stains, bark pockets, bow, back bow, twists, end checks, ring shakes, worm holes, etc. 2. For boards, in a wide face with fewer defects, measure a width of no less than 80 mm and a length of no less than 600 mm and measure every 20 mm in width and 150 mm in length of clear face without defects. 3. For lumber, refer to the defect-free part no less than 600 mm in length. 'Three clear faces' mean that three sides of timber have no defects.
Other Defects		1. 'Minor defects' mean that they don't hamper the use of the relevant timber and don't look ugly despite some changes in its luster and color. 2. 'Insignificant defects' mean that they don't hamper the use of the relevant timber despite some changes in its luster and color.

6.3 Type A Bending Performance Test Randomly select one sample from one inspection lot.

6.4 Model Bending Performance Test for Structural Laminated Timber Prepare samples for Type A Bending Test according to Table 25.

<Table 25> Piece Number of Samples for the Model Bending Test of Glued Laminated Timber

Piece Number of One Lot for Structural Laminated Timber	Piece Number of Samples
≤ 10	1
≤ 20	2
≤ 100	3
≤ 500	4
> 500	5

6.5 Type B and Type C Bending Performance Test and Tension Test Select the number of sample pieces randomly prescribed in Table 26 from one lot according to the size of the inspection lot. For a retest, the number of samples is to be two times the original.

<Table 26> Piece Number of Sample Laminations for Type B and Type C Bending Test and Tension Test

Piece Number of One Lot for Laminations	Piece Number of Sample Laminations
≤ 10	2
≤ 300	4
≤ 500	6
≤ 1 000	8
> 1 000	10

6.6 Determination of Test Results

6.6.1 Determination of Structural Laminated Timber

6.6.1.1 Tests of Water Soak Delamination, Boil Delamination, Pressure, Block Shear, Moisture Content, Bow and Minimum Curvature Radius of Curved Banks If samples from one lot that fulfill the standards are not less than 90%, the relevant lot passes the test. If such samples are under 70%, it fails. If samples that fulfill the standards are between 70% and 90%, inspect new samples again. If samples that fulfill the standards are not less than 90%, the lot passes the test. If such samples are under 90%, it fails.

6.6.1.2 Type A, Type B and Type C Bending Performance Test If all samples collected from one lot or made equivalent to its number fulfill the standards, the relevant lot passes the test and otherwise fails.

6.6.1.3 Tests of Formaldehyde Emission, Minimum Number of Laminations, Face Appearance Grade, and Gap of the Glue Line of Adjacent Laminations If all samples collected from one lot or made equivalent to its number fulfill the standards, the relevant lot passes the test and otherwise fails.

6.6.2 Determination of Non-structural Laminated Timber and Laminated Boards

6.6.2.1 Tests of Dimensions, Bow, Warping, Defect, Water Soak Delamination, and Moisture Content If samples from one lot that fulfill the standards are not less than 90%, the relevant lot passes the test. If such samples are under 70%, it fails. If samples that fulfill the standards are between 70% and 90%, inspect new samples again. If samples that fulfill the standards are not less than 90%, the lot is successful in the test. If such samples are under 90%, it fails.

6.6.2.2 Test of Formaldehyde Emission If all samples collected from one lot or made equivalent to its number fulfill the standards, the relevant lot passes the test and otherwise fails.

7. Labeling

7.1 Labeling Items Every piece of laminated timber is to have an easy-to-read label with the following items:

7.1.1 Labeling Items of Structural Laminated Timber

7.1.1.1 Product Name Describe product names as symmetrical laminated timber with different grade laminations, asymmetrical laminated timber with different grade laminations or laminated timber with same grade laminations

7.1.1.2 Strength Grade Describe the relevant grade

7.1.1.3 Appearance Grade Describe the grades as S or P according to face finishing

7.1.1.4 Use Class Describe the classes as Use Class 1, 2 or 3

7.1.1.5 Formaldehyde Emission Describe the emissions as SE_0, E_0 or E_1

7.1.1.6 Tree Species Describe general names of all species in the order of the more amount used.

7.1.1.7 Place of Origin Able to describe the place of origin of raw materials (logs)

7.1.1.8 Dimension Record the dimensions in the order of height, width, and length using the unit of mm. But, they may be omitted if 1) the cross section of the pertinent timber is not

even, 2) dimensions cannot be obviously stated like height and width of shaping-processed products or length of curved laminated timber. In this case, write down 'Omitted' in the relevant field.

7.1.1.9 Use Direction Record use directions excluding the case that the use of a product is limited to members with a high compressive strength like a column. In this case, mark at a noticeable location where the upper face is.

7.1.1.10 Producer (Importer) Record the name of the producing company for domestic products; and the name of the importing company and exporting country for imported products.

7.1.1.11 Production Year and Month Beside the name of a producer or an importer, the year and month of manufacture may be recorded.

7.1.2 Labeling Items of Non-structural Laminated Timber and Laminated Boards

7.1.2.1 Product Name Describe product names as non-structural laminated timber or laminated boards and if there is a special purpose, it may be inserted in parentheses.

7.1.2.2 Quality Grade Describe grades as No end bonding Grade 1 or 2, or Lengthwise bonding Grade 1, 2, or 3.

7.1.2.3 Use Class Describe the classes as Use Class 1, 2 or 3

7.1.2.4 Formaldehyde Emission Describe the emissions as SE_0, E_0 or E_1

7.1.2.5 Tree Species Describe general names of all species in the order of the more amount used.

7.1.2.6 Place of Origin Able to describe the place of origin of raw materials (logs)

7.1.2.7 Dimension Record the dimensions in the order of height, width, and length using the unit of mm.

7.1.2.8 Producer (Importer) Record the name of the producing company for domestic products; and the name of the importing company and exporting country for imported products.

7.1.2.9 Production Year and Month Beside the name of a producer or an importer, the year

and month of manufacture may be recorded.

7.2 Prohibited Matters on Labeling

7.2.1 If any terms or contents are contradictory to descriptions specified according to labeling rules, they are prohibited from labeling.

7.2.2 Apart from them, descriptions that may cause misunderstanding on the quality of a product are prohibited.

7.3 Labeling Method The labeling method of laminated timber quality is as follows:

7.3.1 Place a label individually where consumers can identify it easily; for structural laminated timber, it is as in Fig. 8 and for non-structural laminated timber as in Fig. 9. The label is required to be identified clearly with stamps, stickers, coining, etc.

7.3.2 There is no limit in the labeling format and yet each item in Paragraph 7.1 shall be included.

(Example 1)

Product Name	Symmetrical Glued Laminated Timber with Different Grade Laminations
Strength Grade	10S-30B
Appearance Grade	S
Use Class	Use Class 3
Formaldehyde Emission Grade	SE_0
Tree Species	Larch, pitch pine
Place of Origin	Republic of Korea
Dimension (Height×Width×Length)	400×180×15,000 mm
Use Direction	This mark appears on the upper face.
Manufacturer or Code (Country), (Production Year and Month)	Company ABC (Republic of Korea), (○○○○.○○.)

(Example 2)

Laminated Timber with Same Grade Laminations - 10S-34B - P
Use Class 2 - E_0 - Korean pine - 500×200×18,000 mm

Company ABC, (○○○○.○○.) (※ This mark appears on the upper face.)

<Fig. 8> Example of Labeling for Structural Laminated Timber

(Example 1)

Product Name	Non-structural Glued Laminated Timber
Lengthwise Bonding	None
Grade	Grade 1
Use Class	Use Class 1
Formaldehyde Emission Grade	SE_0
Tree Species	Pine
Place of Origin	Republic of Korea
Dimension (Height×Width×Length)	18×1,200×2,400 mm
Manufacturer or Code (Country), (Production Year and Month)	Company ABC, (Republic of Korea), (○○○○.○○.)

(Example2)

Laminated timber - Grade 2 (No end bonding) - Use Class 2 - E_0 - Larch - 24×800×1,200 mm Company ABC, (○○○○.○○.)

<Fig. 9> Example of Labeling for Non-structural Laminated Timber

Appendix A Allowable Stress of Structural Laminated Timber

A.1 Scope This appendix sets forth long-term allowable stresses of structural laminated timber by type and grade.

A.2 Definition The definitions of terms in the appendix are as follows:

a. Standard Allowable Stress Allowable stress of laminations. Value before applying the adjustment factor

b. Allowable Design Stress Adjusted stress of structural laminations calculated by multiplying standard allowable stress by applicable adjustment factors

c. Long-term Allowable Stress Maximum stress that structural timber can support, enduring floor live load for 10 years. The stress serves as a standard for structure design for a building using structural laminated timber.

A.3 Long-term Allowable Stress Long-term allowable stresses of structural laminated timber by type and grade are as follows.

a. Allowable Bending, Tensile and Compressive Stress Long-term allowable stresses in Bending, tension and compression of symmetrical and asymmetrical laminated timber with different grade laminations and laminated timber with same grade laminations appear in Table A.1, A.2 and A.3.

b. Allowable Stress about Shear and Compression Perpendicular to Fibers Long-term allowable stresses in structural laminated timber's shear and compression perpendicular to fibers are shown in Table A.4 and A.5.

<Table A.1> Standard Allowable Stress of Symmetrical Glued Laminated Timber with Different Grade Laminations

Grade	Allowable Stress (MPa)						
	X-X axis Bending[a]		Y-Y axis Bending[b]		Axis Load		
	F_{bxx}[c]	E_{xx}[d]	F_{byy}[e]	E_{yy}[f]	F_t[g]	F_c[h]	E[i]
15S－43B	14	12 000	9	11 000	9	11	11 000
13S－37B	12	11 000	8	10 000	8	10	10 000
12S－33B	11	10 000	7.5	9 000	7	8	9 000
10S－30B	10	9 000	7	8 000	6.5	7.5	8 000
9S－27B	9	8 000	6	7 000	6	7	7 000
8S－25B	8	7 000	5	6 000	5.5	6.5	6 000
7S－24B	7	6 000	4.5	5 500	5	6	5 500
6S－22B	6	5 000	4	5 000	4.5	5.5	5 000

[a] X-X axis Bending: Bending stress perpendicular to the bonding layer between laminations
[b] Y-Y axis Bending: Bending stress parallel to the bonding layer between laminations
[c] Standard allowable bending stress about X-X axis
[d] Standard modulus of elasticity (MOE) about X-X axis
[e] Standard allowable bending stress about Y-Y axis
[f] Standard modulus of elasticity (MOE) about Y-Y axis
[g] Standard allowable tensile stress in the fiber direction
[h] Standard allowable compressive stress in the fiber direction
[i] Standard modulus of elasticity

<Table A.2> Standard Allowable Stress of Asymmetrical Glued Laminated Timber with Different Grade Laminations

Grade	Allowable Stress (MPa)							
	X-X axis Bending[a]			Y-Y axis Bending[b]		Axis Load		
	F_{bxx}[c]		E_{xx}[f]	F_{byy}[g]	E_{yy}[h]	F_t[i]	F_c[j]	E[k]
	I Type[d]	II Type[e]						
14S－42B	14	9	11 000	9	10 000	9	10	10 000
12S－36B	12	8.5	10 000	8	9 000	8	9.5	9 000
11S－31B	10	8	9 000	7	8 000	7	8	8 000
10S－28B	9.5	7.5	8 000	6.5	7 000	6	7.5	7 000
9S－25B	8.5	7	7 000	5.5	6 500	6	7	6 500
8S－24B	8	6.5	6 500	5	6 000	5	6	6 000
7S－22B	7.5	6	6 000	4.5	5 500	4.5	5.5	5 500
6S－21B	7	5.5	5 000	4	5 000	4.5	5	5 000

[a] X-X axis Bending: Bending stress perpendicular to the bonding layer between laminations
[b] Y-Y axis Bending: Bending stress parallel to the bonding layer between laminations
[c] Standard allowable bending stress about X-X axis
[d] X-X axis Bending in case that tensile stress applies to the tension-related outermost lamination
[e] X-X axis Bending in case that compressive stress applies to the tension-related outermost lamination
[f] Standard modulus of elasticity (MOE) about X-X axis
[g] Standard allowable bending stress about Y-Y axis
[h] Standard modulus of elasticity (MOE) about Y-Y axis
[i] Standard allowable tensile stress in the fiber direction
[j] Standard allowable compressive stress in the fiber direction
[k] Standard modulus of elasticity

<Table A.3> Standard Allowable Stress of Asymmetrical Glued Laminated Timber with Different Grade Laminations

Number of Laminations	Grade	Allowable Stress (MPa)						
		X-X axis Bending[a]		Y-Y axis Bending[b]		Axis Load		
		F_{bxx}[c]	E_{xx}[d]	F_{byy}[e]	E_{yy}[f]	F_t[g]	F_c[h]	E[i]
≥ 4 Sheets	17S－54B	18	14 000	13	13 000	13	15	13 000
	15S－46B	15	12 000	10	11 000	11	13	11 000
	13S－40B	13	11 000	9	10 000	9.5	11	10 000
	12S－37B	12	10 000	8	9 000	8.5	10	9 000
	10S－34B	11	9 000	7.5	8 000	8	9.5	8 000
	9S－31B	10.5	8 000	7	7 000	7.5	8.5	7 000
	8S－30B	10	7 000	6.5	6 000	7	8	6 000
	7S－27B	9	6 000	6	5 000	6.5	7.5	5 000
	6S－25B	8.5	5 000	5.5	4 000	6	7	4 000
3 Sheets	17S－49B	16	14 000	11	13 000	13	14	13 000
	15S－43B	14	12 000	10	11 000	11	12	11 000
	13S－37B	12	11 000	8	10 000	9.5	10	10 000
	12S－33B	11	10 000	7.5	9 000	8.5	9	9 000
	10S－30B	10	9 000	7	8 000	8	8.5	8 000
	9S－28B	9.5	8 000	6.5	7 000	7.5	8	7 000
	8S－27B	9	7 000	6	6 000	7	7.5	6 000
	7S－25B	8.5	6 000	5.5	5 000	6.5	6.5	5 000
	6S－24B	8	5 000	5	4 000	6	6	4 000
2 Sheets	17S－45B	15	14 000	11	13 000	13	14	13 000
	15S－39B	13	12 000	9	11 000	11	12	11 000
	13S－34B	11	11 000	7.5	10 000	9.5	10	10 000
	12S－30B	10	10 000	6.5	9 000	8.5	9	9 000
	10S－28B	9.5	9 000	6	8 000	8	8.5	8 000
	9S－27B	9	8 000	5.5	7 000	7.5	8	7 000
	8S－25B	8.5	7 000	5	6 000	7	7.5	6 000
	7S－24B	8	6 000	4.5	5 000	6.5	6.5	5 000
	6S－22B	7.5	5 000	4	4 000	6	6	4 000

[a] X-X axis Bending: Bending stress perpendicular to the bonding layer between laminations
[b] Y-Y axis Bending: Bending stress parallel to the bonding layer between laminations
[c] Standard allowable bending stress about X-X axis
[d] Standard modulus of elasticity (MOE) about X-X axis
[e] Standard allowable bending stress about Y-Y axis
[f] Standard modulus of elasticity (MOE) about Y-Y axis
[g] Standard allowable tensile stress in the fiber direction
[h] Standard allowable compressive stress in the fiber direction
[i] Standard modulus of elasticity

<Table A.4> Standard Allowable Shear Stress of Structural Laminated Timber

Species Group	Allowable Shear Stress (MPa)
Species with oven dry specific gravity ≥ 0.55	2.0
Species with oven dry specific gravity 0.5–0.55	1.6
Species with oven dry specific gravity 0.45–0.5	1.4
Species with oven dry specific gravity < under 0.45	1.2

* For laminated timber consisting of various species, apply the value of the weakest species group.

<Table A.5> Standard Allowable Compressive Stress Perpendicular to Fibers Regarding Structural Laminated Timber

Species Group	Allowable Compressive Stress Perpendicular to Fibers (MPa)
Species with oven dry specific gravity ≥ 0.55	3.5
Species with oven dry specific gravity 0.5–0.55	3.0
Species with oven dry specific gravity 0.45–0.5	2.5
Species with oven dry specific gravity < under 0.45	2.0

* For laminated timber consisting of various species, apply the value of the weakest species group.

<Note> To calculate an allowable stress about compressive loads perpendicular to fibers which apply to the end of the member, multiply a relevant value in the table by 0.8 for conifer and 0.75 for broad-leaved trees as its adjustment factor.

[Annex 6]

Plywood

1. Scope This specification is to be applied to all types of plywood (domestic, imported) distributed within Korea. For plywood for export, producers may apply this specification voluntarily.

2. Definition plywood, as more than 3 sheets of veneers (including battens in crossbands) cut by a rotary lathe or slicer, refer to laminated · bonded boards so that the direction of the fibers of veneers are perpendicular or parallel to each other.

3. Type Types and quality items of plywood are indicated in <Table 1>.

<Table 1> Types and Quality Items of plywood

Type	Quality Items					
	bonding quality	Emission quantity of formaldehyde (HCHO)	Bending performance	Species	Appearance grade	Dimensions
Regular plywood	Waterproof Semi-waterproof	SE_0 E_0 E_1 E_2(forbidden to use indoor	N.A.	Softwood Hardwood Mixed	Grade 1 Grade 2	Thickness, width, length
Concrete form plywood	Waterproof	E_0 E_1 E_2(forbidden to use indoor)	Bending stiffness	Softwood Hardwood Mixed	Grade 1 Grade 2	Thickness, width, length
Structural plywood	Complete waterproof Waterproof	SE_0 E_0 E_1 E_2(forbidden to use indoor)	Bending strength, modulus of elasticity in bending	Softwood Hardwood Mixed	Grade 1 Grade 2	Thickness, width, length
Surface-processed plywood	Waterproof Semi-waterproof	SE_0 E_0 E_1	N.A.	Softwood Hardwood Mixed	Grade 1 Grade 2	Thickness, width, length

4. Standard Dimensions The standard dimensions of plywood are indicated in <Table 2>.

<Table 2> Standard Dimensions of plywood

(unit: mm)

Thickness	Width	Length	Tolerance			Squareness (Change in length of diagonal line of surface)
			Thickness	Width	Length	
2.7	900	1,800	±4%	±2	±2	3
3.0	910	1,820				
3.6	1,200	2,400				
4.2	1,220	2,440				
4.8						
5.0						
6.0						
7.0						
7.5						
8.0						
8.5						
9.0						
12.0						
15.0						
18.0						
21.0						
24.0						
28.0						
30.0						
35.0						

※ 1. When determining whether the indications are true or not on plywood except the abovementioned dimensions (thickness, width, length), tolerance of Table 2 may be applicable.

2. If additional dimensions (hereinafter referred to as certified dimensions) are required except the standard dimensions, the certified dimensions may be applied according to consultations between accepting · delivering parties.

5. Standards and Quality Standards

5.1 Ordinary plywood

5.1.1 The definition and quality standard of the density, moisture content, bonding quality, strength, surface, and appearance of ordinary plywood are indicated in <Table 3>.

<Table 3> Definition and Quality Standard of Regular Plywood

Classification		Quality Standard
Definition		plywood used for all other purposes except for concrete form, structural, and surface-processed plywood among plywood
Density		Shall conform to the density test method. (However, the standard value shall not be set additionally.)
Moisture content		Shall be 13% or under.
bonding quality	Waterproof	- tensile strength: shall be 0.7 MPa or more. - For bondlines where conducting the waterproof tensile shear strength test is impossible as the fiber directions of both adjoining veneers are layered parallel, length of parts not peeled off from the same bondline according to the waterproof dip peeling test shall be 2/3 or more in all aspects. For plywood where battens are used to crossbands, the same standard shall be applied.
	Semi-waterproof	- tensile strength: shall be 0.7 MPa or more. - For bondlines where conducting the waterproof tensile shear strength test is impossible as the fiber directions of both adjoining veneers are layered parallel, length of parts not peeled off from the same bondline according to the waterproof dip peeling test shall be 2/3 or more in all aspects. For plywood where battens are used to crossbands, the same standard shall be applied.
Strength		Shall conform to the bending performance test method of structural plywood. (However, the standard value shall not be set additionally.)
Surface and appearance		Shall fulfill the quality standard of <Table 4>.

※ 1. The same bonding quality standard of regular plywood shall be applied to concrete form and structural plywood. However, in this case, the phrase “for plywood where battens are used to crossbands, the same standard shall be applied.” shall be deleted.

2. For surface-processed plywood, the bonding quality standard of regular plywood are applied to crossbands. For surface decorative layer, both the bonding quality and dip peeling test shall be conducted.

<Table 4> Quality Standard of Regular plywood

≪Case where hardwood veneers are used to front · back (surface)≫

Classification	Defects	Quality Standard	
		Grade 1	Grade 2
Front	Knots	Long radius shall be 50㎜ or under and dispersed.	Long radius shall be 80㎜ or under and dispersed.
	Encased knot	Long radius shall be 30㎜ or under and dispersed.	Long radius shall be 35㎜ or under and dispersed.
	Loose knot and hole	Long radius shall be 20㎜ or under and repaired.	Long radius shall be 40㎜ or under and repaired.
	Leaf knot	Tissue shall be firm.	
	Burl	Shall be smoothing.	Shall be minor.
	Bark seam and resin pocket	Shall be well repaired so that they are in harmony with neighboring surfaces and colors.	Shall be non-remarkable.
	Discoloration	Shall be minor.	Shall be non-remarkable.
	Pollution	Shall be minor.	Shall be non-remarkable.
	Rotten	Shall be none.	Shall be minor.
	cross break	Length shall be 100㎜ or under.	Length shall be 200㎜ or under.
	Crack	Width of crack shall be 3㎜ or under, length 600㎜ or under, and be well repaired.	
	Putty stain	Shall be minor.	Shall be non-remarkable.
	Worm holes and stain	Shall be well repaired so that they are harmonious with neighboring surfaces.	Shall be minor.
	Earthworm stain	Shall be minor and smoothing.	Shall be smoothing.
	Rough machining	Shall be smoothing.	Shall not be confined.
	Patch repair (edge repair)	Grain and colors shall be harmonious with neighboring surfaces.	
	Joint	Shall be harmonious with neighboring surfaces and shall have no gap.	Shall be harmonious with neighboring surfaces and the gap shall not be noticeable.
	Tape and adhesives stain	Shall be minor and finished smoothly.	Shall be minor.
	Defect and knives stain	Width shall be 1㎜ or under and smoothing.	Shall be minor and smoothing.
	Indentation	Shall be minor.	Shall be non-remarkable.
	Swelling	Shall be none.	
	Interlocked grain	Shall be smoothing and minor.	Shall be minor.
	Resin	Shall be none.	Shall be minor and dry.

≪Case where hardwood veneers are used to front · back (surface)≫ (continued)

Classification	Defects	Quality Standard	
		Grade 1	Grade 2
Front	Finish	Shall have no noticeable stripes and spotted patterns and be smoothing.	
	Mechanical defects (chain stain · mechanical pollution · burn stain · metal pollution), color chalk stain and oil pollution	Shall be none.	Shall be minor.
	Other defects and processed status	Shall be minor and aligned.	Shall be non-remarkable.
Appearance (crossbands)	Gap	Width shall be 3㎜ or under and shall not be reflected in surfaces and the number shall be 1 or under.	Width shall be 5㎜ or under, have little dents, and shall not be reflected in surfaces.
	Laps	Shall have little dents and, length shall be 150㎜ or under, and the number shall be 2 or under.	Shall have little dents and the number shall be 3 or under.
	Uneven thickness	Shall be none.	Shall be minor.
	Bow and twist	Shall be minor.	Shall be non-remarkable.
	Panel strip molded tree	Colors shall be harmonious and the number shall be 5 sheets or under.	The number shall be 12 sheets or under.
	Lack of crossbands	Shall be none.	Shall be repaired well.
	End split	Width and length shall be 3㎜ and 100㎜ or under, respectively. Shall not be reflected in surfaces and the number shall be 4 or under with being dispersed.	shall not be reflected in surfaces and be dispersed.
	Others	Shall be minor.	Shall be non-remarkable.

≪Case where hardwood veneers are used to front · back (surface)≫ (continued)

Classification	Defects	Quality Standard	
		Grade 1	Grade 2
Back	Discoloration where alburnums are mixed, stain, mineral stain, burl stain, knots-live, knots hole, rough machining, veneer filling, cross break, bark seam, lanugo, resin pocket	Shall have no limit.	
	Loose knot	Long radius shall be 20㎜ or under and dispersed.	Long radius shall be 40㎜ or under and no detrimental to use.
	Crack	Width and length shall be 10㎜ and 500㎜ or under respectively, and be repaired.	Width and length shall be 15㎜ and 1,000㎜ or under and be repaired.
	Joint	Crack shall be minor.	Crack shall non-remarkable.
	Rotten	Shall be no detrimental to use.	
	Worm holes	Long radius shall be 1.5㎜ or under and dispersed. Long radius of a worm hole shall be 16㎜ or under.	Shall have no limit.
	Veneer overlay	Shall be none.	Shall be no detrimental to use.
	Oil stain	Shall be none.	Shall be minor.
	Other defects and processed condition	Shall be minor and fine.	

≪Case where softwood veneers are used to front · back (surface)≫

Defects	Quality Standard	
	Grade 1	Grade 2
Leaf knot	The number of leaf knots shall be 5 or under per board area.	Shall have no limit.
Knots-live (radius shall be over 3㎜)	Long radius shall be 50㎜ or under and dispersed.	
Encased knot, loose knot, and holes	If repaired properly, each individual radius shall be 50㎜ or under. The sum of radius shall be 250㎜ or under per ㎡.	If repaired properly, each individual radius shall be 50㎜ or under.
Crack	Width shall be 5㎜ or under or if repaired properly, the number of cracks shall be 1 or under per width for 25% of the entire length of boards.	Width shall be 15㎜ or under or if repaired properly, the number of cracks shall be 3 or under per width for 50% of the entire length of boards.
Bark seam and resin pocket	Shall be repaired properly and long radius shall be 30㎜ or under.	Shall be non-remarkable.
Resin stripes	Shall be non-remarkable.	Shall have no limit.
Worm holes and stain	Shall be none.	Radius of a hole orthogonal to the surface shall be 16㎜ or unde, or the length of worm stain shall be 40㎜ or under.
Discoloration	Shall be non-remarkable.	Shall be non-noticeable.
Rotten	Shall be none.	
Gap in joint	Its colors shall be harmonious with neighboring board surfaces and shall have no gaps.	Its colors shall be harmonious with neighboring board surfaces and gaps shall be non-noticeable.
Overlay	Its length shall be 200㎜ or under per ㎡ and number shall be 2 or under.	Its length shall be 400㎜ or under per ㎡ and number shall be 2 or under.
Swelling	Shall be none.	
Roughness	Shall be non-remarkable.	Shall be non-noticeable.
Polished stain	Shall be none.	Its percentage shall be 1% or under of the entire surface area.
Gully, gall, and stain	If repaired properly, its width shall be 3㎜ or under per ㎡ of the surface area and length shall be 6㎜ or under, and its number shall be 2 or under.	Shall be non-noticeable.
Oozing of adhesives	Shall be none.	Its percentage shall be 5% or under of the entire surface area.
Containing-type metal pieces	Shall be none. In case of crossbands and shall be non-noticeable in appearance.	
Patch repair	Shall be repaired properly, and its number shall be 4 or under per ㎡.	Shall be non-remarkable.
Defects in sides due to polishing or cut	Its length shall be 3㎜ or under to sides.	Its length shall be 5㎜ or under to sides.
Other defects	Shall be non-noticeable.	Shall be non-remarkable.

※ Definitions of Terms

① Knots : Knots are linked with neighboring wood fibers.

② Encased knot : Knots are separated with neighboring wood fibers.

③ Loose knot : Part or entire part of the knots are fallen out.

④ Leaf knot : As a knot-live, its radius is about 6.4mm or under.

⑤ Bark seam : The bark of a tree is stuck in xylem.

⑥ Burl stain : It is commonly found in the form of knots, bark seam or gall and has a spiral pattern in the center.

⑦ Resin pocket : Resin is found in the void part of a tree.

⑧ Cross break : It is formed when cutting the tree fibers. It is broken perpendicular to wood grain.

⑨ Crack : It means tree fibers are cracked in parallel with wood grain.

⑩ Earthworm stain : It means the wood texture looks like earthworm stain.

⑪ Veneer overlay : It looks like veneers are overlaid in the same horizontal plane.

5.1.2 Quality standard of emission quantity of HCHO of regular boards are indicated in <Table 5>.

<Table 5> Quality Standard of Emission Quantity of HCHO of Regular Boards

		Quality Standard
Emission of HCHO	SE_0	In the test on emission quantity of HCHO, the quantity shall be 0.3㎎/ℓ or under (avg.), 0.4㎎/ℓ or under (max.)
	E_0	In the test on emission quantity of HCHO, the quantity shall be 0.5㎎/ℓ or under (avg.), 0.7㎎/ℓ or under (max.)
	E_1	In the test on emission quantity of HCHO, the quantity shall be 1.5㎎/ℓ or under (avg.), 2.1㎎/ℓ or under (max.)
	E_2(forbidden to be used indoor)	In the test on emission quantity of HCHO, the quantity shall be 5.0㎎/ℓ or under (avg.), 7.0㎎/ℓ or under (max.)

* 1. SE_0 :It is called as 'Super E zero. ' With the lowest level of HCHO emission quantity (completely none), it may be the best to be used for indoor board sheets in terms of indoor air quality management.

2. E_0 :It is called as 'E zero' With the low level of HCHO emission quantity (none), it may be proper to be used for indoor board sheets in terms of indoor air quality management.

3. E_1 :It is called as 'E one.' With the regular level of HCHO emission quantity (regular), it may be okay to be used for indoor board sheets in terms of indoor air quality management.

4. E_2(prohibited to be used indoor) :It is called as 'E two prohibited to be used indoor' or 'E two Exterior only.' E_2 grade emits HCHO higher than the regular level (nondescript). If it is used indoor for a long time, it has a risk to harm health. Thus, it is improper to be used for indoor board sheets in managing the indoor air quality.

5.2 Concrete Form Plywood Definition, veneer structure, density, moisture content, bonding quality, emission quantity of HCHO, bending performance, surface and appearance, bending or twist, the bonding quality of base plywood, the bonding quality of base plywood, paint film, or covering material, climate resistance, and quality of alkali resistance are indicated in <Table 6>.

<Table 6> Definition and Quality Standard of Concrete Form Plywood

Classification	Quality Standard	Note
Definition	Plywood used as a form to cure concrete. (Including TEGO film and coated plywood.)	Apply to all plywoods whose surface is non-processed and processed
Density	Shall conform to the density test method (However, the standard value shall not be set.).	
Moisture content	Shall be 13% or under.	
bonding quality	Shall conform to the water-proofing bonding quality standard of ordinary plywood indicated in <Table 3>.	
Emission quantity of HCHO	Shall conform to the standard of emission quantity of HCHO of ordinary plywood indicated in <Table 5>.	
Amount of strain of bending strength	Shall be equivalent or under the strain standard of bending strength test on concrete form plywood indicated in <Table 7>.	
Surface and appearance	Shall conform to surface quality standard of ordinary plywood in <Table 4> or surface quality standard of the surface-processed plywood of concrete form plywood in <Table 8>.	
Bending or twist	Shall be non-remarkable.	
bonding quality of base plywood	Fiber of neighboring veneers is laminated parallel to each other, so the water-proof tensile shear strength test is impossible. In this case, the length of a part not peeled off from the bondline by the water-proof dip peeling test shall be 2/3 or more in all sides.	Shall be only applied to surface-processed surface.
bonding quality of base plywood, paint film, or covering material	In the in-plane tensile test, average value of bonding quality shall be 1.0MPa or more.	
Climate resistance	In the cold-heat repetition test, no crack, swelling, and peeling shall be observed.	
Alkali resistance	In the alkali resistance test, no crack, swelling, peeling, noticeable discoloration or luster shall be observed on test pieces.	

※ Surface-processed plywood: tego plywood (phenolic film faced shuttering plywood), coated plywood, etc.

<Table 7> Quality Standard of Amount of Strain of Bending Strength of Concrete Form Plywood

Thickness (mm)	Width×length (mm)	Amount of strain of bending strength (mm)	Classification	
			Special grade	Grade 1
12	900×1,800, 910×1,820	27	Under 13.5mm	More than 13.5mm less than 27mm
	1,200×2,400, 1,220×2,440	21	Under 10.5mm	More than 10.5mm less than 21mm
15	1,200×2,400, 1,220×2,440	19	Under 9.5mm	More than 9.5mm less than 19mm
18	1,200×2,400, 1,220×2,440	17	Under 8.5mm	More than 8.5mm less than 17mm

<Table 8> Quality Standard of Surface of the Surface-processed Plywood in Concrete Form Plywood

Classification	Quality Standard
Condition of resin or paint.	Shall be fine.
The overlaying condition of various covering materials	Shall be fine.
Peeling, swelling, or cracking	Shall be none.
Adhesion of pollutant, dust, etc. or any indentation	Shall be non-remarkable.
Other defects	Shall be non-remarkable.

5.3 Structural Plywood Definition, density, water content, bonding quality, emission quantity of HCHO, bending performance, structure of veneer, bending or strain are indicated in <Table 9>.

<Table 9> Definition and Quality Standard of Structural Plywood

<table>
<tr><th colspan="2">Classification</th><th colspan="2">Quality Standard</th></tr>
<tr><td colspan="2">Definition</td><td colspan="2">Plywood used for the structural purpose on construction</td></tr>
<tr><td colspan="2">Density</td><td colspan="2">Shall conform to the density test method (However, the standard value shall not be set.).</td></tr>
<tr><td colspan="2">Water content</td><td colspan="2">Shall be 13% or under.</td></tr>
<tr><td rowspan="2">bonding quality</td><td>Completely waterproof</td><td colspan="2">- Complete waterproof tensile shear strength: shall be 0.7MPa or over.
- Fiber of neighboring veneers is laminated parallel to each other, so the water-proof tensile shear strength test is impossible. In this case, the length of a part not peeled off from the bondline by the water-proof dip peeling test shall be 2/3 or more in all sides.</td></tr>
<tr><td>Waterproof</td><td colspan="2">Shall conform to the water-proofing bonding quality standard of ordinary plywood indicated in <Table 3>.</td></tr>
<tr><td colspan="2">Emission quantity of HCHO</td><td colspan="2">Shall conform to the standard of emission quantity of HCHO of ordinary plywood indicated in <Table 5>.</td></tr>
<tr><td colspan="2" rowspan="2">Bending performance</td><td>Grade 1</td><td>Grade 2</td></tr>
<tr><td>In the bending performance test of structural plywood, shall be more than the standard value of bending strength and flexural modulus of elasticity indicated in <Table 10>.</td><td>In the bending performance test of structural plywood, shall be more than the standard value of flexural modulus of elasticity indicated in <Table 11>.</td></tr>
<tr><td colspan="2">Structure of veneer</td><td colspan="2">Shall conform to the quality standard indicated in <Table 12>.</td></tr>
<tr><td colspan="2">Bending or strain</td><td colspan="2">Shall be no detrimental to use.</td></tr>
</table>

<Table 10> Standard of Bending Strength and Flexural Modulus of Elasticity of Structural Plywood (Grade 1)

Classification / Thickness (mm)	Bending strength (MPa)		Flexural modulus of elasticity (GPa)	
	0°	90°	0°	90°
9.0	26.0	16.0	6.5	2.5
12.0	22.0	20.0	5.5	3.5
15.0	20.0	20.0	5.0	4.0
18.0	20.0	20.0	5.0	4.0
21.0	22.0	18.0	5.5	3.5
24.0	22.0	18.0	5.5	3.5
28.0	22.0	18.0	5.5	3.5

※ 0° and 90° represents angle for the fiber direction of the surface surface.

<Table 11> Flexural Modulus of Elasticity Standard of Structural Plywood (Grade 2)

Thickness (mm)	Flexural modulus of elasticity (GPa)
More than 9.0 under 12.0	5.0
More than 12.0 under 24.0	4.0
More than 24.0 under 28.0	3.5
More than 28.0	3.3

<Table 12> Quality Standard of Veneer Structure of Structural Plywood

Classification	Quality grade of surface	Quality Standard		
		Front	Back	Crossbands
Grade 1	Grade 1	Shall conform to Grade 1 of quality standard in <Table 13>.	Shall conform to Grade 1 of quality standard in <Table 13>.	Shall conform to Grade 1 of quality standard in <Table 14>.
	Grade 2	Shall conform to Grade 2 of quality standard in <Table 13>.	Shall conform to Grade 2 of quality standard in <Table 13>.	Shall conform to Grade 2 of quality standard in <Table 14>.
Grade 2	Grade 1	Shall conform to Grade 1 of quality standard in <Table 13>.	Shall conform to Grade 1 of quality standard in <Table 13>.	Shall conform to Grade 1 of quality standard in <Table 14>.
	Grade 2	Shall conform to Grade 2 of quality standard in <Table 13>.	Shall conform to Grade 2 of quality standard in <Table 13>.	Shall conform to Grade 2 of quality standard in <Table 14>.

<Table 13> Quality Standard of Surface and Back of Structural Plywood

Defects	Quality Standard	
	Grade 1	Grade 2
Encased knot, loose knot, hole, crack, defect, gap in joint, cross break, worm stain and sum of diameter, width or length of width of filling of a hole in veneer.	Shall be 1/15 or under of width of the board.	Shall be 1/7 or under of width of the board.
Knots-live	Long radius shall be 50㎜ or under and dispersed.	Long radius shall be 80㎜ or under and dispersed
Encased knot	Long radius shall be 20㎜ or under and dispersed.	Long radius shall be 60㎜ or under and dispersed.
Loose knot and holes	Shall be repaired so that long radius shall be 20㎜ or under.	Shall be repaired so that long radius shall be 60㎜ or under.
Bark seam and resin pocket	Shall be repaired so that color shall be harmonious with its neighboring surfaces.	Shall be no detrimental to use.
Burl and earthworm stain	Shall be non-remarkable and smoothing.	Shall be no detrimental to use.
Decay	Shall be none.	
Crack and defect (including gap of joint)	Shall be repaired properly so that its length shall be less than 40% of board length, width less than 6㎜, its number less than 3, length less than 20%, width less than 3㎜, the number less than 6.	Shall be repaired properly so that its length shall be less than 50% of board length, and width less than 10㎜.
Cross break	Shall be none.	Shall be non-noticeable.
Worm stain and holes	Shall be repaired so that color shall be harmonious with its neighboring surfaces.	Shall be no detrimental to use.
Other defects	Shall be non-remarkable.	Shall be non-noticeable.

<Table 14> Quality Standard of Crossbands of Structural Plywood

Defects	Quality Standard	
	Grade 1	Grade 2
Knots-live, encased knot, loose knot, hole, crack, defect, gap in joint, cross break, worm stain and sum of diameter, width or length of width of filling of a hole in veneer.	Shall be 1/5 or under of width of the board.	Shall have no limit.
Knots-live	Long radius shall be 80㎜ or under.	Shall have no limit.
Encased knot, loose knot, and holes	Long radius shall be 70㎜ or under.	Long radius shall be 90㎜ or under.
Bark seam and resin pocket	Shall be no detrimental to use.	
Burl and earthworm stain	Shall be no detrimental to use.	
Decay	Shall be none.	Shall be no detrimental to use.
Crack and defect (including gap of joint)	Width shall be less than 10㎜, length less than 50% of the board length.	Width shall be less than 12㎜, length less than 60% of the board length.
Cross break	Shall be non-remarkable.	
Worm holes	Shall be no detrimental to use.	
Other defects	Shall be non-noticeable.	

5.4 Surface-processed Plywood Definition, density, moisture content, bonding quality, emission quantity of HCHO, strength, surface, appearance, the bonding quality between paint film, coating material, and base plywood, climate resistance, wear resistance, and standard quality of change-in-color resistance are indicated in <Table 15>.

<Table 15> Definition and Quality Standard of Surface-processed Plywood

Classification		Quality Standard
Definition		Plywood whose surface is processed with coating, overlay, and special treatment, etc. (Tego and coating plywood shall be classified as concrete form plywood.)
Density		Shall conform to the quality standard of ordinary plywood indicated in <Table 3>.
Moisture content		Shall be 13% or under.
bonding quality	Waterproof Semi-waterproof	Shall conform to the quality standard of ordinary plywood indicated in <Table 3>.
Emission quantity of HCHO		Shall conform to the standard of emission quantity of HCHO of ordinary plywood indicated in <Table 5>.
Strength		Shall conform to the bending performance test method of structural plywood (However, the standard value shall not be set.).
Surface and appearance		Shall conform to the quality standard of ordinary plywood's surface indicated in <Table 4>. Shall conform to the quality standard of plywood whose surface is processed among concrete form plywood in <Table 8>.
bonding quality of base plywood, paint film, or covering material		The average value of bonding quality in the In-plane tensile test shall be 1.0MPa or more.
Climate resistance		In the cold-heat repetition test, no crack, swelling, and peeling on the surface shall be observed.
Wear resistance		Shall conform to the standards of special-processed decorative plywood (KS F 3106) and naturally sliced veneer decorative floor board (KS F 3111).
Change-in-color resistance		No crack, swelling, peeling, and remarkable change in luster shall be observed on the surface of test pieces.

6. Test

6.1 bonding quality Test

6.1.1 Tensile Longitudinal Shear Strength Test

6.1.1.1 Test Pieces Conduct the test by extracting from test pieces from the part with no defect may considerably affect bonding quality in sample plywood.

① Plywood whose number of laminated layer of veneer structure is 3 (3 layers) Shall extract 4 pieces from the fiber direction of surface veneer (front, back) in each sample plywood as indicated in <Picture 1>. For plywood whose thickness of surface veneer is more than 1.6mm, shall be classified as Type A. For test pieces of whose thickness is under 1.6mm and Type A, or plywood whose veneer is cut off shall be classified as Type B test pieces. 2 out of 4 test pieces shall make 이할방향 of crossbands and that of load direction shall be the same (forward direction), and for the rest 2, 이할방향 of crossbands and that of load direction shall be opposite (reverse direction).

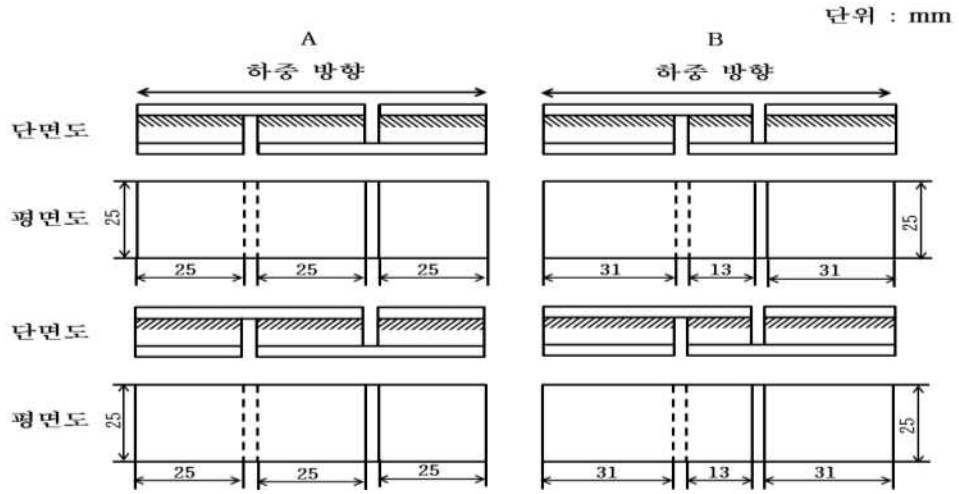
② Plywood whose number of laminated layer of veneer structure is more than 5 (5 layers)

㉮ Shall conform to the method of abovementioned ①. To conduct bonding quality test on all

laminated layers except crossbands parallel to surface veneer, shall make test pieces whose each laminated layer is cut deeply. From all laminated layers, make two of each forward and reverse direction test piece. Thus, for 5-ply plywood, the total number of test pieces shall be 8. For 7-ply plywood, 12. In this case, if necessary, it may be allowable to remove veneer except the laminated layer to be tested.

㉯ In case where it is impossible to extract test pieces to test bonding quality on the surface surface as the surface surface is too think among more than 5-ply plywood, shall extract test pieces in the fiber direction of the second veneer surface where whose surface and second surface are laminated orthogonal.

㉰ If more than 2 sheets of veneers are laminated parallel in the same direction, shall consider this as the 1st floor and cut the laminated layer of test piece deeply.



<Picture 1> Test Piece of Tensile Longitudinal Shear Strength

※ If softwoods are used for plywood as veneer, depth of cut shall be max. 2/3 of the thickness of veneer of the two laminated layers to be tested.

6.1.1.2 Test Method

① Complete water-proof tensile shear strength test Shall boil test pieces for 72 hours, cool off in the room temperature water, and conduct the bonding quality test under the wet condition (pin down the both ends of test piece and give tensile load at the load speed 2 mm/min in both directions to measure the max. load in destruction.) And calculate the bonding quality based on <Formula 1>. For the test piece of whose number of laminated layer is 3 (3 layers) of veneer structure and whose thickness ratio of crossbands is more than 1.50 to surface veneer, shall determine the value of bonding quality by multiplying correction coefficient of <Table 16>. If more than 2 sheets of veneer are laminated in the same direction in parallel and form the crossbands of the test piece, calculate the thickness ratio by summing the thickness of crossbands. If the surface veneer is too thin to extract test piece and if test piece is extracted in the fiber direction of the second laminated veneer orthogonal to the surface veneer, the thickness of this surface veneer shall be excluded in calculating thickness ratio.

$$\text{bonding quality (MPa)} = \frac{P_s}{b \times h} \quad \text{..... <Formula 1>}$$

Here in P_s : max. load (N)

h : Width of test piece (mm)

b : Length of laminated veneer surface (mm)

<Table 16> Correction Coefficient of Tensile Longitudinal Shear Strength by Thickness Ratio

Thickness ratio of crossbands on surface veneer	Correction coefficient
More than 1.5 under 2.0	1.1
More than 2.0 under 2.5	1.2
More than 2.5 under 3.0	1.3
More than 3.0 under 3.5	1.4
More than 3.5 under 4.0	1.5
More than 4.0 under 4.5	1.7
More than 4.5	2.0

※ For thickness ratio, if thickness of surface veneer (front, back) is same, shall calculate it based on the either side. If different, shall calculate based on the thinner thickness.

② Waterproof tensile shear strength test Shall boil test pieces for 4 hours and dry in the temperature of 60±3℃ for 20 hours. And then boil again for 4 hours, cool off in the room temperature water, and conduct the bonding quality test under wet condition. Calculate bonding quality by using the same test method of Article ① of complete waterproof tensile shear strength.

③ Semi-waterproof tensile shear strength test Shall put test pieces into hot water whose temperature is 60±3℃ for 3 hours, cool of in the room temperature water, and conduct the bonding quality test under wet condition. Calculate bonding quality by using the same test method of Article ① of complete waterproof tensile shear strength.

6.1.2 Dip Peeling bonding quality Test

6.1.2.1 Test Piece Shall extract 4 forward-direction test pieces whose one side is 75mm-long from each sample plywood.

6.1.2.2 Test Method

① Waterproof Dip Peeling bonding quality Test Shall boil test pieces for 4 hours and dry at the temperature of 60±3℃ for 20 hours, and then boil for 4 hours again and dry 3 hours at the temperature of 60±3℃.

② Semi-waterproof Dip Peeling bonding quality Test Put test pieces into the water at the temperature of 70±3℃ for 2 hours and dry at the temperature of 60±3℃ for 3 hours.

6.2 Density Test

6.2.1 Test Piece Shall extract 2 100mm ×100mm-size pieces from sample plywood to use for test.

6.2.2 Test Method Shall calculate volume of the test pieces by measuring its thickness, width, and length. And shall calculate density by measuring weight based on <Formula 2>. In this

case, measure the thickness up to 0.01mm , width and length, 0.1mm, and weight, 0.1g.

$$\text{Density } (g/㎤) = \frac{W}{V} \quad \text{..... <Formula 2>}$$

Here in W : weight in an air-dry condition (g)
V : volume in an air-dry condition (㎤)

6.3 Moisture Content Test

6.3.1 Test Pieces Shall extract 2 proper-size pieces from a sample plywood to use for test. **6.3.2 Test Method** Shall test moisture content with the method of oven-dry weight. If other methods are used except the oven-dry weight, they may be recognized if they fulfill the proper standard of moisture content. In the method, oven-dry weight means the weight when test pieces are recognized to reach constant weight if the test pieces are dried in an dryer at the temperature of 100℃~105 and moisture content shall be calculated based <Formula 3>.

$$\text{Moisture content } (\%) = \frac{W - W_0}{W_0} \times 100 \quad \text{..... <Formula 3>}$$

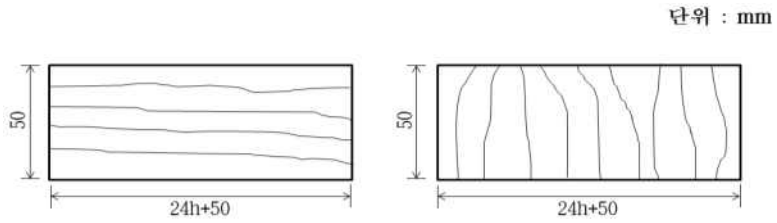
Here in W : the weight before being dried (g)
W_0 : oven-dry weight (g)

6.4 Test on Emission Quantity of HCHO Shall follow the desiccator law of KS M 1998.

6.5 Bending Performance Test

6.5.1 Bending Performance Test on Structural Plywood (Grade 1)

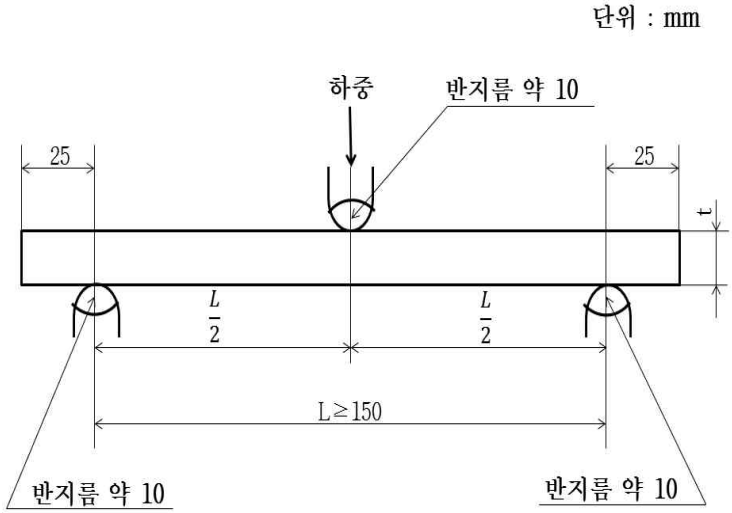
6.5.1.1 Test Pieces Shall make test pieces by extracting 4 rectangle-shape sample pieces from sample plywood as <Picture 2>. Two piece shall be whose width is 50mm and length is 24 times longer than the thickness with 50mm more and the direction of the veneer's fiber is orthogonal. The other two shall be whose width is 50mm and length is 24 times longer than the thickness with 50mm more and the direction of the veneer's fiber is parallel.



<Picture 2> Test Piece for Bending Strength of Structural Plywood

6.5.1.2 Test Method As indicated in <Picture 3>, if the direction of the sample piece's fiber is parallel to that of span, shall conduct the test. Shall calculate flexural modulus of elasticity by

measuring infimum and supremum load of proportional region. Shall calculate bending strength by<Formula 4> and flexural modulus of elasticity based on <Formula 5>. In this case, the rate of loading shall be set as 10mm /min.



l : span, h : Thickness of test piece

<Picture 3> Bending Strength Test of Structural Plywood
(Grade 1 Test Method)

Bending strength (MPa) = $\frac{3pl}{2bh^2}$ .....<Formula 4>

Flexural modulus of elasticity (GPa) = $\frac{\triangle pl^3}{4bh^3\triangle y}$ .....<Formula 5>

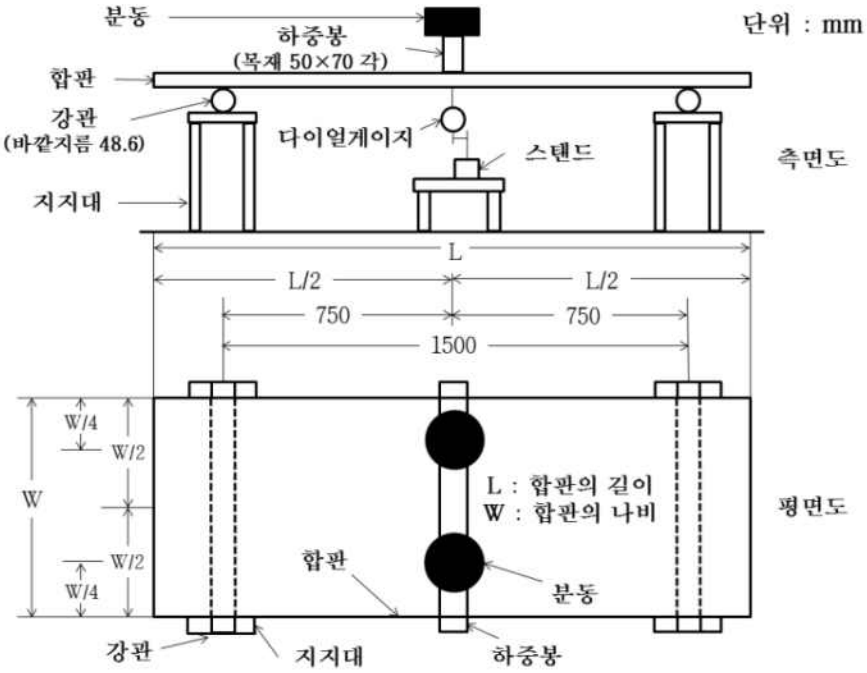
Here in p : max. load (N)
l : Span length (mm)
b : Width of test piece (mm)
h : Thickness of test piece (mm)
$\triangle p$: Difference between infimum and supremum load of proportional region (N)
$\triangle y$: Amount of change (mm) in bending of the center of span responding to $\triangle p$

6.5.2 Flexural Modulus of Elasticity Test of Structural Plywood (Grade 2) and Bending Rigidity Test of Concrete Form Plywood

6.5.2.1 Test Piece Shall extract 5 circular-shape plywood from one lot (in the case of re-test, 10 plywood) to use for test plywood.

6.5.2.2 Test Method Flexural modulus of elasticity of structural plywood (Grade 2) shall be located orthogonal to the center of the span where whose surface is on top as indicated in <Picture 4>. Give load properly to each thickness, width, and length of the test piece on the

valid length of load rod(width of plywood) to calculate bending modulus elasticity from amount of bending strain based on <Formula 5>. And, for the nominal thickness of concrete form plywood of $12mm$ and $15mm$, and amount of bending strain of $18mm$, give load of 20㎏, 40㎏, and 50㎏ respectively via load rod as indicated in <Picture 4> to measure the amount of strain until the amount becomes stable.

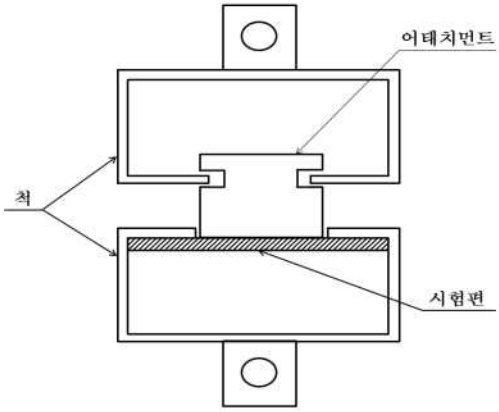


<Picture 4> Flexural Modulus of Elasticity Test of Structural Plywood (Grade 2) and Bending Rigidity Test of Concrete Form Plywood

6.6 In-plane Tensile Test

6.6.1 Test Piece Shall extract 4 square-shape test pieces whose side is 50mm long from each sample plywood to use for test piece.

6.6.2 Test Method First, shall attach the metal surface with square-shape adhesive face whose side is 20mm long on the center of the surface of the test piece by using acrylic adhesive. Second, curve the surrounding deep down to reach base plywood and pin the test piece on chuck in <Picture 5> to measure the max. load in peeling and destructing by pulling orthogonal to the adhesive face. In this moment, the load rate shall be $5mm$/min or under.

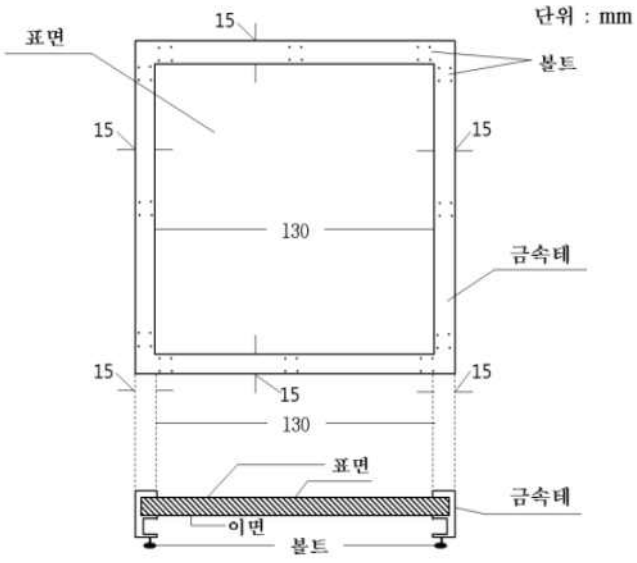


<Picture 5> In-plane Tensile Test

6.7 Cold-heat Repetition Test

6.7.1 Test Piece Shall extract 2 square-shape sample pieces whose side is 150mm long from each sample plywood and make a 3mm-size hole at each center to use for test piece.

6.7.2 Test Method Fix the test piece on the metal frame as indicated in <Picture 6> and leave it in a thermostat at the temperature of 80±3℃ for 2 hours and then leave it in a thermostat whose temperature is -20±3℃ for 2 hours. Shall repeat this process two times until it reaches the room temperature.



<Picture 6> Cold-heat Repetition Test

6.8 Abrasion Test

6.8.1 Test Piece Shall extract 3 circular-shape sample pieces whose diameter is 100mm long or square-shape whose size is $100mm \times 100mm$ from each sample plywood and make a 10mm-size hole at each center to use for test piece.

6.8.2 Test Method

6.8.2.1 Abrasion Test A After weighing test pieces, fix them on the turntable horizontally as indicated in <Picture 7> and conduct the test by installing 2 rubber disk wrapped with abrasive paper or soft-melting abrasion wheel. When the abrasion level is at peak, record the number of rotations and weight the test pieces to calculate the value and amount of abrasion. The total load given to the test piece surface shall be the total of 500g including the weight of rubber

disk.

6.8.2.2 Abrasion Test B Shall fix the test pieces on the rotation disk as indicated in <Picture 7> and conduct the test by installing 2 rubber disk wrapped with abrasive paper or soft-melting abrasion wheel. When the abrasion level is at peak, record the number of rotations based on <Formula 6> and calculate amount of abrasion based on <Formula 7>. The total load given to the test piece surface shall be the total of 1,000g including the weight of rubber disk.

*** Note 1 : Method to Calculate Value and Amount of Abrasion**

The value= Sum of the number of rotations of each sample piece / 3 .....<Formula 6>

The amount = W/C × 100 .....<Formula 7>

Here in, W means average amount of 3 test pieces, and C refers to the value.

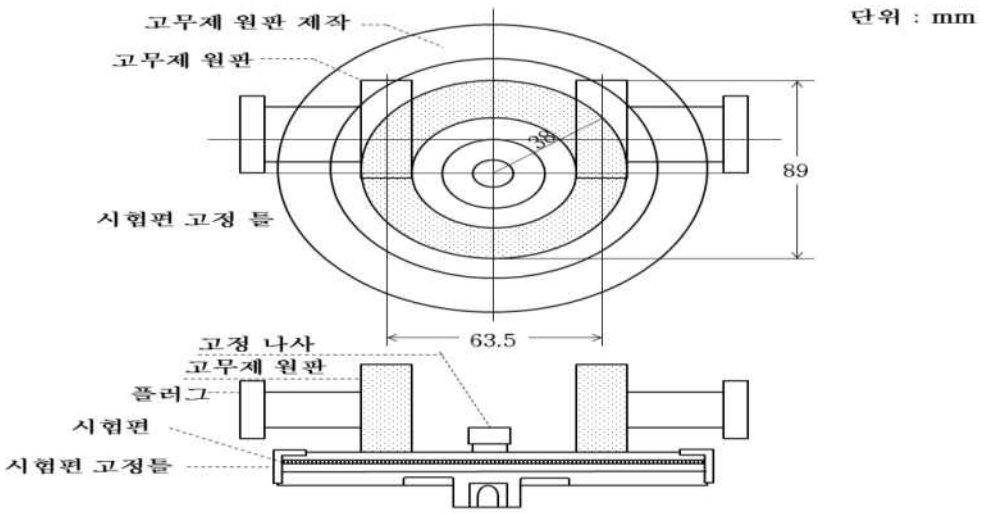
*** Note 2 : Peak of Abrasion**

If a test piece whose decorative surface has patterns, shall be set if about 50% of the patterns are curved out. If decorative surface has no pattern, shall be set as about 50% of base plywood is visible.

*** Note 3 : Particle size of Abrasion Paper or Wheel**

Apply on the surface of test materials and write in the test content and evidence.

Example of indication : For particle size of soft-melting abrasion wheel, CS-17 is applied, etc.



<Picture 7> Abrasion Test

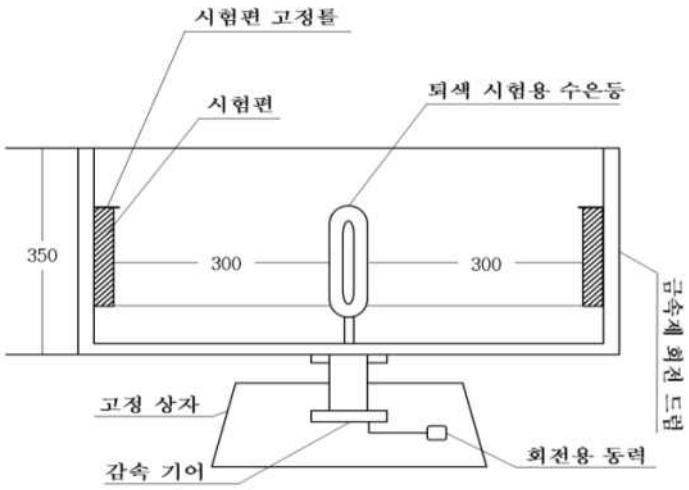
6.9 Discoloration Test

6.9.1 Test Piece Shall extract 2 rectangle-shape pieces parallel 75mm and orthogonal 150mm in the fiber direction of base plywood from each sample plywood to use for test piece.

6.9.2 Test Method Shall fix the test pieces on the test piece frame as indicated in <Picture 8> and adjust horizontal distance as 300mm to mercury and test pieces for discoloration. And shall discolor it for 49 hours to mercury by rotating at the speed of 2.5 rotation/min. And then shall leave in the dark room for 72 hours. Finally, check the surface condition of the test pieces with the eyes or measure the degree of discoloration with a spectrophotometer.

* Note : mercury for discoloration, etc.

Quartz shall be used for internal luminous pipe in the condition of long wavelength of input 400W wavelength 3,000Å or more.



<Picture 8> Discoloration Test

6.10 Alkali Resistance Test

6.10.1 Test Piece Shall extract 2 square-shape pieces whose side is 75mm from each sample plywood to use for test piece.

6.10.2 Test Method For surface-processed concrete form plywood, place the test pieces parallel and drop about 5㎖ 1% sodium hydroxide solution on the surface of the test piece and cover it with a watch glass for 48 hours and wash out and leave indoor for 24 hours. For surface-processed plywood, place the test pieces parallel and drop about 1% sodium carbonate solution and cover it with a watch glass for 6 hours and immediately wash out and leave it indoor 24 hours. After the process, check the surface condition with the eyes.

7. Inspection Quality inspection of plywood is divided into physical and chemical inspections including bonding quality, emission amount of HCHO, and bending performance and appearance inspection including dimensions of surface and appearance. Other performances (standard of asepsis · insect resistance, and fire resistance) shall follow the notification from a government agency or domestic·overseas related standards on the related test methods.

8. Indication Type, bonding quality, emission quantity of HCHO, amount of strain of bending rigidity, bending performance, type of tree, other performances, dimensions, name of producer or importer, date of production and origin shall be indicated in Korean as follows. For imported plywood, if necessary in trade, those information may be indicated in English.

8.1 Indication of Type Type of plywood shall be indicated as in <Table 17>.

<Table 17> Indication of Type of Plywood

Classification	Symbol (abbreviation)	Indication in English
Ordinary plywood	OP	Ordinary plywood (OP)
Concrete form plywood	CP	Concrete form plywood (CP)
Structural plywood	SP	Structural plywood (SP)
Surface processed plywood	PP	Surface processed plywood (PP)

※ Acronym inside of parenthesis may be used in indicating quality in English.

8.2 Indication of bonding quality Indication of bonding quality of plywood shall follow <Table 18>.

<Table 18> Indication of bonding quality of Plywood

Classification	Symbol	Indication in English
Completely waterproof	Completely waterproof	Waterproof (Type 0)
Waterproof	Waterproof	Highly water resistant (Type 1)
Semi-waterproof	Semi-waterproof	Water resistant (Type 2)

※ Acronym inside of parenthesis may be used in indicating quality in English.

8.3 Indication of Emission Quantity of HCHO Indication of emission quantity of HCHO of plywood shall follow <Table 19>.

<Table 19> Indication of Emission Quantity of HCHO of Plywood

Classification	Symbol	Indication in English
Completely odorless	SE_0	Emission Class SE_0(SE_0)
Odorless	E_0	Emission Class E_0(E_0)
Regular	E_1	Emission Class E_1(E_1)
Others	E_2(prohibited to be used indoor)	Emission Class E_2(Exterior only) (E_2(Exterior only))

※ Acronym inside of parenthesis may be used in indicating quality in English.

8.4 Indication of Amount of Strain of Bending Rigidity Indication of amount of strain of bending rigidity of concrete form plywood shall follow <Table 20>.

<Table 20> Indication of Amount of Strain of Bending Rigidity of Concrete Form Plywood

Classification	Symbol	Indication in English
Special grade	Special grade rigidity	Rigidity special class (R0)
Grade 1	Grade 1 rigidity	Rigidity first class (R1)

※ Acronym inside of parenthesis may be used in indicating quality in English.

8.5 Indication of Bending Performance Indication of bending performance of structural plywood shall follow <Table 21>.

<Table 21> Indication of Bending Performance of Structural Plywood

Classification	Symbol	Indication in English
Grade 1	Bending grade 1	Bending 1st class (B1)
Grade 2	Bending grade 2	Bending 2nd class (B2)

※ Acronym inside of parenthesis may be used in indicating quality in English.

8.6 Indication of Type of Tree Indication of type of tree of plywood shall follow <Table 22>.

<Table 22> Indication of Type of Tree of Plywood

Classification	Symbol	Indication in English
Conifer plywood Broadleaf tree plywood Mix of softwood · hardwood plywood	Conifer Broadleaf tree Mix of softwood · hardwood	Softwood plywood (SW) Hardwood plywood (HW) Softwood and hardwood combined plywood (Mixed)

※ Acronym inside of parenthesis may be used in indicating quality in English.

8.7 Indication of Dimensions Shall indicate thickness, width, and length of plywood in Arabic numbers as follows: thickness (mm) × width (mm) × length (mm).

8.8 Indication of Name of Producer or Importer Shall indicate by company name or its abbreviation. However, importer's name may be indicated in the unit of a bundle. If distributed not in a bundle but individual pieces, shall indicate on each piece.

8.9 Date of Production Shall indicate year and month of production next to a name of a producer or an importer.

8.10 Indication of Production Shall indicate name of a country importing plywood or abbreviation.

8.11 Example Indication of Quality For each sheet of plywood, indicate as follows on one side of front, back or side board surface. Quality may be identifiable by a stamp, sticker, sealing, etc.

※ Lines for outer or inner borders may be omitted.

8.11.1 Domestic Plywood

8.11.1 Domestic Plywood

<Example of Indication of Ordinary Plywood >

Type bonding quality emission quantity HCHO type of tree
Dimensions (thickness×width×length)
Domestic(manufacturing company), date of production

Ordinary plywood semi-waterproof E_0 hardwoods
12.0×910×1,820
Domestic (○○○○(Inc.)), Mar, 2014.

< Example of Indication of Concrete Form Plywood >

Type bonding quality emission quantity HCHO amount of strain of bending strength- type of tree
Dimensions (thickness×width×length)
Domestic(manufacturing company), date of production

Type bonding quality emission quantity HCHO amount of strain of bending strength- type of tree
12.0×910×1,820
Domestic (○○○○(Inc.)), Mar, 2014.

< Example of Indication of Structural Plywood >

Type bonding quality emission quantity HCHO bending performance - type of tree
Dimensions (thickness×width×length)
Domestic(manufacturing company), date of production

Structural plywood waterproof E_0 Grade 1 bending - mix of softwoods and hardwoods
12.0×910×1,820
Domestic (○○○○(Inc.)), Mar, 2014.

< Example of Indication of Surface-processed Plywood >

Type bonding quality emission quantity HCHO - type of tree
Dimensions (thickness×width×length)
Domestic(manufacturing company), date of production

Surface-processed plywood semi-waterproof E_1 hardwoods
12.0×910×1,820
Domestic (○○○○(Inc.)), Mar, 2014.

8.11.2 Imported plywood

<Example of Indication of Ordinary Plywood >

Type bonding quality emission quantity HCHO - type of tree
Dimensions (thickness×width×length)
Production (manufacturing company), date of production, name of importer

o Indication

Ordinary plywood semi-waterproof E_2(prohibited to be used indoor) hardwoods
5.0×1,220×2,440
China (Abc.Co.Ltd.), Mar, 2014. Korea. Co.

o Indication in Abbreviation

OP. Type2. E_2(Exterior Only). HW
5.0×1,220×2,440
China (Abc.Co.Ltd.), Mar, 2014. Korea. Co.

< Example of Indication of Concrete Form Plywood >

Type bonding quality emission quantity HCHO amount of strain of bending strength- type of tree
Dimensions (thickness×width×length)
Production (manufacturing company), date of production, name of importer

o Indication

Concrete form plywood waterproof E_2(prohibited to be used indoor) special grade rigidity - mix of softwoods and hardwoods
12.0×1,220×2,440
China (Abc.Co.Ltd.), Mar, 2014. Korea. Co.

o Indication in Abbreviation

CP. Type1. E_2(Exterior Only). R0. Mixed
12.0×1,220×2,440
China (Abc.Co.Ltd.), Mar, 2014. Korea. Co.

< Example of Indication of Structural Plywood >

Type bonding quality emission quantity HCHO bending performance - type of tree
Dimensions (thickness×width×length)
Production (manufacturing company), date of production, name of importer

o Indication

Structural plywood waterproof E_0 Grade 1 bending mix of softwoods and hardwoods
12.0×1,220×2,440
China (Abc.Co.Ltd.), Mar, 2014. Korea. Co.

o Indication in Abbreviation

SP. Type1. E_0. B1. Mixed
12.0×1,220×2,440
China (Abc.Co.Ltd.), Mar, 2014. Korea. Co.

< Example of Indication of Surface-processed Plywood >

Type bonding quality emission quantity HCHO kind of tree
Dimensions (thickness×width×length)
Production (manufacturing company), date of production, name of importer

o Indication

Surface-processed Plywood Semi-waterproof E_1 hardwoods
12.0×1,220×2,440
China (Abc.Co.Ltd.), Mar, 2014. Korea. Co.

o Indication in Abbreviation

PP. Type2. E_1. HW
12.0×1,220×2,440
China (Abc.Co.Ltd.), Mar, 2014. Korea. Co.

[Annex 7]

Particleboards (PB)

1. Scope This specification is to be applied to all particle boards (PB) which are produced in Korea or imported from overseas to improve its quality and establish distribution order.

2. Definition PB is an engineered wood product mainly manufactured from wood chips. It is formed · compressed with heat and pressure where adhesives are added. Density is more than 0.5 g/㎤ and less than 0.8 g/㎤,

3. Type Types of PB are classified as <Table 1> ~ <Table 5> according to condition of surface · back, bending strength, adhesives, and emission quantity of formaldehyde (HCHO) and incombustibility.

<Table 1> Classification Based on Condition of Surface · Back

Type		Symbol	Condition of Surface · Back
Base PB	non-polished board	RN	Both sides are in base condition and non-polished.
	polished board	RS	Both sides are in base condition and polished.
Decorative PB	veneer overlay	DV	Decorative veneer is adhered to both or either side of base PB.
	plastic overlay	DO	Sheet or film of synthetic resin type, impregnated paper of synthetic resin type, coat paper, after-coat paper or the like is adhered to both or either side of base PB.
	coated	DC	Coating of synthetic resin type is heated and hardened, or printed on both or either side of base PB.

<Table 2> Classification Based on Bending Strength

Type	Symbol	Bending Strength
Type 18.0	18	The bending strength shall be over 18.0 MPa in both lengthwise and widthwise.
Type 15.0	15	The bending strength shall be over 15.0 MPa in both lengthwise and widthwise.
Type 13.0	13	The bending strength shall be over 13.0 MPa in both lengthwise and widthwise.
Type 8.0	8	The bending strength shall be over 8.0 MPa in both lengthwise and widthwise.

<Table 3> Classification Based on Adhesives

Type	Symbol	Adhesives
Type U	U	Urea based resin type or at least equivalent in performance.
Type M	M	Urea-melamine resin type or at least equivalent in performance.
Type P	P	Phenolic resin type or least equivalent in performance.

<Table 4> Classification Based on Emission Quantity of Formaldehyde (HCHO)

Type	Symbol	Emission Quantity of HCHO	
		Mean	Maximum
Type SE_0	SE_0	0.3 mg/L or under	0.4 mg/L or under
Type E_0	E_0	0.5 mg/L or under	0.7 mg/L or under
Type E_1	E_1	1.5 mg/L or under	2.1 mg/L or under

<Table 5> Classification Based on Incombustibility

Type	Symbol
Incombustibility grade 2	Incombustibility 2
Incombustibility grade 3	Incombustibility 3
Regular	-

Note: Fire resistant particle board is a grade tested according to KS F 2271.

4. Appearance and Quality Standard

4.1 Appearance The surfaces of PB shall have no noticeable unevenness, stains, peelings, etc. No defects detrimental to use including distortion or warpage shall not be observed. Moreover, Decorative PB shall not have defects as stated in <Table 6>.

<Table 6> Appearance of Decorative PB

Classification of Defects	Standard
Chippings[1], cracks or peelings	No defects shall be observed.
Distortion or warpage	No defects detrimental to use shall be observed.
Unevenness except for decorative purpose, dents, stains, flaws or mixing of foreign matters	Defects shall not be noticeably observed when visually checked at the position of 60 ㎝ apart.
Irregular patterns, gloss and color tone except for decorative purpose	Defects shall not be observed when visually checked at the position of 2 m[2]apart.

Note[1] It means the chipping of the substrates and decorative layers.

[2]Severaltestpiecesarearrangedsimultaneouslytoconductthechecking.

4.2 Quality Standard Quality items for PB are as the same as <Table 7>. Quality standards of PB are indicated in <Table 8> and <Table 9>. Standards for emission quantity of HCHO and incombustibility are indicated in <Table 4> and <Table 5>. Insulation standard is indicated in <Table 10>.

<Table 7> Quality Items

Quality Items		Base PB			Decorative PB		
		Type U	Type M	Type P	Type U	Type M	Type P
Dimensions and squareness		○	○	○	○	○	○
Density		○	○	○	○	○	○
Water content		○	○	○	○	○	○
Bending strength		○	○	○	○	○	○
Bending strength under wet conditions	Test A	–	○	–	–	○	–
	Test B	–	–	○	–	–	○
Thickness swelling after immersion in water		–	○	○	–	○	○
Internal bond		○	○	○	○	○	○
Screw withdrawal strength (3)		○	○	○	○	○	○
Emission quantity of HCHO		○	○	○	○	○	○
In-plane tensile strength		–	–	–	○	○	○
Impact resistance		–	–	–	○	○	○
Acid resistance		–	–	–	○	○	○
Alkali resistance		–	–	–	○	○	○
Stain resistance		–	–	–	○	○	○
Change-in-color resistance		–	–	–	○	○	○
Scratch resistance		–	–	–	○	○	○
Incombustibility (4)		○	○	○	○	○	○

Note (3) It shall be applied to the thickness of 15 ㎜ or over.
(4) It shall be applied to the PB with incombustibility.

<Table 8> Quality Standard of Base PB

Classification			Density (g/㎤)	Moisture content (%)	Bending strength (MPa)		Bending strength under wet condition (MPa)		Thickness swelling (%)	Internal bond (MPa)	Screw withdrawal strength (N)		Emission quantity of HCHO (mg/L)		(Reference value) Bending Young's coefficient (MPa)
					Length-wise	Width-wise	Length-wise	Width-wise			Plane	Side	Mean	Maximum	
Base PB, decorative PB	Type 18.0	SE_0	more than 0.50 less than 0.80	more than 5 less than 13	18.0 or more		9.0 or more		12 max.	0.30 or more	700 or more	350 or more	0.3 or under	0.4 or under	3,000 min, widthwise
		E_0											0.5 or under	0.7 or under	
		E_1											1.5 or under	2.1 or under	
	Type 15.0	SE_0			15.0 or more		7.5 or more			0.24 or more	600 or more	300 or more	0.3 or under	0.4 or under	2,700 min, widthwise
		E_0											0.5 or under	0.7 or under	
		E_1											1.5 or under	2.1 or under	
	Type 13.0	SE_0			13.0 or more		6.5 or more			0.20 or more	550 or more	275 or more	0.3 or under	0.4 or under	2,500 min, widthwise
		E_0											0.5 or under	0.7 or under	
		E_1											1.5 or under	2.1 or under	
	Type 8.0	SE_0			8.0 or more		-			0.15 or more	500 or more	250 or more	0.3 or under	0.4 or under	2,000 min, widthwise
		E_0											0.5 or under	0.7 or under	
		E_1											1.5 or under	2.1 or under	

Note : Lengthwise means the longitudinal direction while widthwise means the direction orthogonal thereto.

<Table 9> Quality Standard of Decorative PB

Moisture content (%)	In-plane tensile strength (MPa)	Impact resistance	Acid resistance	Alkali resistance	Stain resistance	Change-in-color resistance		Scratch resistance	Emission quantity of HCHO (mg/L)		
					Stain resistance against the crayon (red)	Appearance	Color difference		Grade	Mean	Maximum
5 or over up to and incl. 13	0.4 or over	To be free from the radial cracks, fracture and peeling of the decorative layer, and the diameter of the grooved panel shall be 20 mm or under.	No dis-coloration shall be observed.		To be of Gray scale 3 or over	To be free from defects such as cracking and swell on the surface.	To be of Gray scale 3 or over, or of color difference 3.0 or under.	No noticeable scratches shall be observed.	Type SE_0	0.3 or under	0.4 or under
									Type E_0	0.5 or under	0.7 or under
									Type E_1	1.5 or under	2.1 or under

Note : The acid resistance, alkali resistance, stain resistance, change-in-color resistance and scratch resistance shall not be applied to veneer decorative PB.

<Table 10> Thermal Insulation

Thickness (mm)	Thermal resistance (㎡·K/W)	Thickness (mm)	Thermal resistance (㎡·K/W)
10	0.060 or over	25	0.155 or over
12	0.077 or over	30	0.181 or over
15	0.095 or over	35	0.215 or over
18	0.112 or over	40	0.241 or over
20	0.120 or over		

Note : The thermal resistance value of thickness not indicated in <Table 10> shall be obtained by the proportional interpolation.

5. Dimensions and Tolerance The dimensions of PB are indicated in <Table 11>. However, the dimensions of the ordered product shall follow consent between the related parties. Moreover, the tolerance and squareness are indicated in <Table 12>.

<Table 11> Dimensions

(unit : ㎜)

Thickness	Width and Length		
9, 10, 12, 15, 18, 20, 25, 30, 35, 40	Width / Length	900, 910	1,200, 1,220
	1,800, 1,830	○	○
	2,400, 2,440	–	○
	2,700	–	○

<Table 12> Tolerance and Squareness

(unit : ㎜)

Thickness	Tolerance of thickness			Tolerance of width and length	Squareness
	Non-polished board	Polished board	Decorative board		
15 under	±1.0	±0.3	±0.5	±3.0	2 or under
more than 15 under 20	±1.2	±0.4			
20 or more	±1.5	±0.5			

6. Test

6.1 Test pieces The dimensions and number of test pieces indicated in <Table 13> from the center of the original board are extracted based on each test item. The test pieces shall be kept under air-dry condition [5]or those kept under temperature (20±2) ℃ and moisture content (65±5) %[6].

Note [5] Air-dry condition means test pieces are left in a well-ventilated room 7 days or more.

[6] Moisture content means whose mass is measured for every 24 h and the rate of change reaches 0.1 % or under.

<Table 13> Dimensions and Quantity of Test Pieces

Test Items	Dimension of test pieces, mm	No. of test pieces extracted from 1 sheet of board
Density	100x100	3
Moisture content	Test pieces whose density are measured	3
Bending strength	Width 50 x length[span(7)+50]	Lengthwise 3, widthwise 3
Bending strength under wet condition	Width 50 x length[span(7)+50]	Lengthwise 3, widthwise 3
Thickness swelling	50x50	3
Internal bond	50x50	3
Screw withdrawal strength	50x100	Plane 3, side 3
Emission quantity of HCHO	50x150	The number (rounded-off number) where the total surface area of the test pieces including the butt ends is close to 1800 ㎠ is used.
In-plane tensile strength	50x50	3
Impact resistance	300x300	2
Acid resistance	100x100	2
Alkali resistance	100x100	2
Stain resistance	100x100	2
Change-in-color resistance	150x150	3
Scratch resistance	50x50	2
Thermal resistance	900x900	2
Incombustibility	220x220	1

Note (7) The span shall be 15 times the normal thickness and 150 mm or over at the same time.

6.2 Test Method

6.2.1 The method of testing the product's emission quantity of HCHO shall follow the desiccator law of **KS M 1998**.

6.2.2 Quality and test method of a product shall follow **notification of National Institute of Forest Science (NIFoS) No. 2015-11** (test method of physical·mechanical features of wood-based panel).

6.2.3 Other necessary items and related test methods may refer to Korean Industrial Standards (**KS F 3104**).

7. Symbol Type, condition of surface, adhesives, blending strength, emission grade of HCHO, dimensions, name of producer or importer, date of production, and producer shall be indicated in Korean in PB. If necessary in trading, those may be indicated in English.

7.1 Symbol of Surface·Back Types of PB shall follow <Table 14> based on condition of surface·back.

<Table 14> Classification and Symbol of PB

Classification		Symbol
Base PB	non-polished	RN
	polished	RS
Decorative PB	veneer overlay	DV
	plastic overlay	DO
	coated	DC

※ For base PB, the symbol of "base" may be omitted.

7.2 Symbol of Adhesives Symbols for adhesives of PB are indicated in <Table 15>.

<Table 15> Symbol of PB Adhesives

Classification	Symbol
Type U	U
Type M	M
Type P	P

7.3 Symbol of Bending Strength Symbols for blending strength of PB are indicated in <Table 16>.

<Table 16> Symbol of Bending Strength of PB

Classification		Symbol
Base and decorative PB	Type 18.0	18
	Type 15.0	15
	Type 13.0	13
	Type 8.0	8

7.4 Symbol of Emission Quantity of HCHO Symbols for emission quantity of HCHO of PB are indicated in <Table 17>.

<Table 17> Symbol of Emission Grade of HCHO of PB

Classification	Symbol
Completely orderless	SE_0
Orderless	E_0
Semi orderless	E_1

7.5 Symbol of Incombustibility Symbols for incombustibility of PB are indicated in <Table 18>.

<Table 18> Symbol of Incombustibility of PB

Classification	Symbol
Incombustibility grade 2	Incombustibility 2
Incombustibility grade 3	Incombustibility 3
Regular	-

7.6 Symbols for Dimensions The thickness, width, and length of PB are indicated in Arabic numerals: thickness (mm) × width (mm) × length (mm). However, symbols for width and length may be omitted.

7.7 Symbols for Name of Producer and Importer Indicate a name of company in its abbreviation and trademark. Name of importer may be indicated in a unit of bundle, If boards are distributed in each sheet, it is marked by each sheet.

7.8 Symbols for Production Indicate name or abbreviation of a country which imported PB.

7.9 Date of Production Mark year and month of a production of a product right next to name of names of a producer and an importer.

7.10. Example of Indicating Quality For each sheet of PB, marking is indicated in each place of front back or side of a board. With the use of a stamp, sticker, sealing, etc., quality of each product becomes identifiable.

※ Exterior or interior border lines may not be indicated.

① PB Manufactured in Korea

Type - condition of surface - adhesives - blending strength - emission grade of HCHO - incombustibility
Dimensions (thickness × width × length)
Name of producer, date of production

<Example of Indication>

PB - RN - U - 15 - E_0 - Incombustibility 2
15×1,220×2,440
○○○○ (Inc.), Oct, 2012.

PB : Particle boards
RN : Classification by condition of surface(base non-polished)
U : Classification by adhesives (urea-formaldehyde resin)
15 : Classification by blending strength (type 15)
E_0 : Classification by emission quantity of HCHO
※ Symbol for surface condition or incombustibility may be omitted.

② Imported PB

Type - condition of surface - adhesives - blending strength - emission grade of HCHO - incombustibility
Dimensions (thickness × width × length)
Name of importer - producer, date of production

<Example of Indication>

PB - DO - M - 13 - E_1 - Incombustibility 2
15×1,220×2,440
○○○○ (Inc.) - Japan (○○○), Oct, 2012.

PB : Particle boards
DO : Classification by condition of surface (resin decorated)
M : Classification by adhesives(Urea · melamine formaldehyde resin)
13 : Classification by blending strength (type 13)
E_1 : Classification by emission grade of HCHO
※ Symbol for surface condition or incombustibility may be omitted.

[Annex 8]

Fiberboards

1. Scope This specification is to be applied to all fiberboards which are produced in Korea or imported from overseas to improve its quality and establish distribution order.

2. Definition Fiberboards are an engineered wood product mainly made out of wood fibers. After defibration, adhesives are added and then they are formed · compressed with heat and pressure in dry process

3. Type Types of fiberboards are classified as <Table 1> ~ <Table 10> according to density, use, condition of surface, bending strength, adhesives, and emission grade of formaldehyde (HCHO), and incombustibility.

<Table 1> Classification Based on Density

Type	Symbol	Density

Note(1) For water-proof LDF treated with asphalt having gone through the manufacturing process, its specific density shall be under 0.40 g/㎤.

<Table 2> Classification of LDF based on Use

Type	Symbol	Main Use (Note)
Grade A LDF	A-LDF	General
Grade T LDF	T-LDF	2nd - story floor
Water-proof LDF	S-LDF	Finish for bottom of exterior wall

<Table 3> Classification of LDF based on Incombustibility

Type	Symbol
Incombustibility grade 3	Incombustibility 3
Regular	-

<Table 4> Classification of MDF Based on Bending Strength

Type	Symbol	Bending Strength
Type 35	35	35.0 MPa or more
Type 30	30	30.0 MPa or more
Type 25	25	25.0 MPa or more
Type 20	20	20.0 MPa or more
Type 15	15	15.0 MPa or more

<Table 5> Classification of MDF Based on Adhesives

Type	Symbol	Adhesives
Type U	U	Urea-melamine resin type or at least equivalent in performance.
Type M	M	Urea-melamine resin condensation type or at least equivalent in performance.
Type P	P	Phenolic resin type or least equivalent in performance.

<Table 6> Classification of MDF Based on Emission Quantity of Formaldehyde (HCHO)

Type	Symbol	Emission Quantity of Formaldehyde (HCHO) of MDF	
		Mean	Maximum
Type SE_0	SE_0	0.3 mg/L or under	0.4 mg/L or under
Type E_0	E_0	0.5 mg/L or under	0.7 mg/L or under
Type E_1	E_1	1.5 mg/L or under	2.1 mg/L or under

<Table 7> Classification of MDF Based on Incombustibility

Type	Symbol
Incombustibility grade 2	Incombustibility 2
Incombustibility grade 3	Incombustibility 3
Regular	-

<Table 8> Classification Based on Condition of Surface

Condition of Surface of Fiberboard	
Type	Symbol
Non-polished board	RN
Polished board	RS
Interior decorative HDF	DI
Exterior decorative HDF	DE

Note 1. For interior decorative HDF, there are standard boards where synthetic resin adhesives, sheets, films, and fabrics·papers are attached or hot-setting or printed with synthetic resin paint on their surface. Moreover, decorative surfaces are, as pattern-less and finished with single color, or with abstract patterns including wood grain, mainly used for interior materials and woodwork for furniture.

2. For exterior decorative HDF, its surface is hardened with printing or coating, heating, sunlight, etc. by using durable synthetic resin materials. It has various types including whose surface is flat, where forms are attached, whose groove is carved as U or V shape. Moreover, decorative surfaces are, as pattern-less and finished with single color, or with abstract patterns including wood grain, mainly used for exterior materials.

<Table 9> Classification of HDF Based on Bending Strength

Type		Symbol	Bending Strength
Regular HDF	Type 40	S40	40.0 MPa or more
	Type 35	S35	35.0 MPa or more
	Type 25	S25	25.0 MPa or more
	Type 20	S20	20.0 MPa or more
Hardened HDF	Type 50	T50	50.0 MPa or more
	Type 45	T45	45.0 MPa or more
	Type 35	T35	35.0 MPa or more

<Table 10> Classification of HDF Based on Incombustibility

Type	Symbol
Incombustibility grade 2	Incombustibility 2
Incombustibility grade 3	Incombustibility 3
Regular	-

4. Appearance and Quality Standard

4.1 Appearance

4.1.1 The surfaces of fiberboards shall have no noticeable unevenness, stains, peelings, etc. No defects detrimental to use including distortion or warpage shall not be observed. Moreover, Decorative fiberboards shall not have defects as stated in <Table 11>.

4.1.2 The cut surface of fiberboards shall be fine and sides shall be perpendicular to the surface. However, specially engineered sides shall not be limited to this standard.

<Table 11> Appearance of Decorative Board

Classification of Defects		Standard
Chippings(2),cracking or peelings of substrates, distortion, bending, or cracking on decorative surface		No defects shall be observed. No defects detrimental to use shall be observed.
Unevenness except for decorative purpose, dents, stains, flaws or mixing of foreign matters		Defects shall not be noticeably observed when visually checked at the position of 60 ㎝ apart.
Shape and gloss except for decorative purpose		
White type	Irregular colors	Defects shall not be observed(3)when visually checked at the position of 2m apart.
Regular type		

Note(2) It means the chipping of the substrates and decorative layers.
(3) Several test pieces are arranged simultaneously to conduct the checking.

4.2. Quality Quality standards for fiberboards are indicated in <Table 12> and also in from <Table 13> to <Table 17>. The standards for HCHO emission grade and incombustibility are indicated in <Table 6>, <Table 3>, <Table 7>, and <Table 10>.

<Table 12> Quality Items

Quality Items		LDF			MDF			HDF			
		A-LDF	T-LDF	S-LDF	Type U	Type M	Type P	S-HDF	T-HDF	DI-HDF	DE-HDF
Dimensions and squareness		○	○	○	○	○	○	○	○	○	○
Density		○	○	○	○	○	○	○	○	–	–
Water content		○	○	○	○	○	○	○	○	○	○
Load bearing capacity		–	–	–	–	–	–	–	–	–	○
Bending strength		○	○	○	○	○	○	○	○	○	○
Bending strength under wet conditions(4)	Test A	–	–	–	–	○	–	–	–	–	–
	Test B	–	–	–	–	–	○	–	–	–	–
Water absorption		–	–	–	–	–	–	○	○	–	○
Thickness swelling		○	○	○	○	○	○	○	○	○	○
Change in length after immersion in water		–	–	○	–	–	–	–	–	–	○
Internal bond		–	–	–	○	○	○	–	–	–	–
Screw withdrawal strength(5)		–	–	–	○	○	○	–	–	–	–
Nail withdrawal resistance		–	–	–	–	–	–	–	–	–	○
Emission quantity of HCHO		○	○	○	○	○	○	○	○	○	○
Thermal insulation		○	○	○	–	–	–	–	–	–	–
In-plane tensile strength		–	–	–	–	–	–	–	–	○	–
Impact resistance		–	–	–	–	–	–	–	–	○	○
Acid resistance(6)		–	–	–	–	–	–	–	–	○	–
Alkali resistance(6)		–	–	–	–	–	–	–	–	○	–
Stain resistance(6)		–	–	–	–	–	–	–	–	○	–
Change-in-color resistance(6)		–	–	–	–	–	–	–	–	○	–
Scratch resistance(6)		–	–	–	–	–	–	–	–	○	–
Paint film adhesiveness		–	–	–	–	–	–	–	–	–	○
Washability resistance		–	–	–	–	–	–	–	–	–	○
Weather resistance (durability)		–	–	–	–	–	–	–	–	–	○
Incombustibility(7)		○	○	○	○	○	○	○	○	○	–

Note (4) It shall not be applied to Type 15 of MDF.

(5) It shall be applied to the thickness of 15 ㎜ or over.

(6) It shall not be applied to decorative HDF where fabrics are attached.

(7) It shall be applied to fiberboards with incombustibility.

<Table 13> Quality Standards of LDF

Type	Thickness	Density g/㎤	Moisture content %	Bending strength MPa	Thickness swelling %	Linear expansion %	Thermal resistance ㎡·K/W
Grade T LDF (T-LDF)	10	under 0.25	more than 5 and less than 13	1.0 or more	20 or under	-	0.181 or more
	15						0.267 or more
	20						0.361 or more
Grade A LDF (A-LDF)	9	under 0.30		2.0 or more	10 or under	-	0.163 or more
	12						0.206 or more
	15						0.267 or more
	18						0.327 or more
Waterproof LDF (S-LDF)	9	under 0.40		3.0 or more	5 or under	0.5 or under	0.138 or more
	12						0.181 or more
	15						0.224 or more
	18						0.275 or more

Note 1. Change in length under wet condition shall not apply to T-LDF.

2. Value of thermal resistance not indicated in <Table 13> shall be set as the value calculated proportionally.

3. For the emission quantity of HCHO (rate), the identical standard with the one indicated in <Table 14> of MDF shall be applied.

<Table 14> Quality Standards of MDF

Type		Density g/㎥	Moisture content %	Bending strength MPa	Bending strength under wet condition MPa	Thickness Swelling %	Internal bond MPa	Screw withdrawal strength (N)		Emission quantity of HCHO mg/L		(Reference value) Bending Young's coefficient MPa
								Plane	Side	Mean	Maximum	
Type 35	Type SE_0	0.35 or more under 0.85r	5 or more 13 or under	35.0 or more	17.0 or more	7㎜ in thickness or under. 17 or under	0.6 or more	700 or more	350 or more	0.3or under	0.4or under	3,000 or more
	Type E_0									0.5or under	0.7or under	
	Type E_1									1.5or under	2.1or under	
Type 30	Type SE_0			30.0 or more	15.0 or more		0.5 or more	500 or more	250 or more	0.3or under	0.4or under	2,500 or more
	Type E_0									0.5or under	0.7or under	
	Type E_1									1.5or under	2.1or under	
Type 25	Type SE_0			25.0 or more	12.5 or more	above 7㎜ in thickness 15㎜or under. 12 or under	0.4 or more	400 or more	200 or more	0.3or under	0.4or under	2,000 or more
	Type E_0									0.5or under	0.7or under	
	Type E_1									1.5or under	2.1or under	
Type 20	Type SE_0			20.0 or more	10.0 or more		0.35 or more	350 or more	175 or more	0.3or under	0.4or under	1,700 or more
	Type E_0									0.5or under	0.7or under	
	Type E_1									1.5or under	2.1or under	
Type 15	Type SE_0			15.0 or more	7.5 or more	above 15㎜ in thickness. 10 or under	0.3 or more	300 or more	150 or more	0.3or under	0.4or under	1,300 or more
	Type E_0									0.5or under	0.7or under	
	Type E_1									1.5or under	2.1or under	

<Table 15> Quality Standards of Base HDF

Type			Density g/㎤	Moisture content %	Bending strength MPa	Water absorption %
Base HDF	Regular HDF	Type S40	0.80 or more	5 or more 13 or under	40.0 or more	-
		Type S35			35.0 or more	25(35) or under
		Type S25			25.0 or more	25(35) or under
		Type S20			20.0 or more	30(35) or under
	Hardened HDF	Type T50	0.90 or more		50.0 or more	-
		Type T45			45.0 or more	20 or under
		Type T35			35.0 or more	20 or under

Note 1. Figure indicated in ( ) shall be applied to regular HDF whose thickness is under 3.5 mm.
For emission quantity of HCHO (rate), the identical standard indicated in <Table 14> of MDF shall be applied.

<Table 16> Quality Standard of Interior Decorative HDF

Moisture content (%)	In-plane tensile strength (MPa)	Impact resistance	Acid resistance	Alkali resistance	Stain resistance	Change-in-color resistance		Scratch resistance	Incombustibility
					Stain resistance against the crayon (red)	Appearance	Color difference		
More than 5 less than 13	0.4 or more	To be free from the radial cracks, fracture and peeling of the decorative layer, and the diameter of the grooved panel shall be 15 mm or under.	No dis-coloration shall be observed.		To be of Gray scale 3 or over	To be free from defects such as cracking and swell on the surface.	To be of Gray scale 4 or over, or of color difference 3.0 or under.	No noticeable scratches shall be observed.	Incombustibility grade 2 or 3

Note : The acid resistance, alkali resistance, stain resistance, change-in-color resistance and scratch resistance shall not be applied to HDF where fabrics·papers are attached.

<Table 17> Quality Standards of Exterior Decorative HDF

Moisture content at shipment %	Moisture content %	Linear expansion %	Load bearing capacity N	Nail withdrawal resistance N	Impact resistance	Paint film adhesiveness	Washability resistance	Weathering resistance
More than 8 less than 15	10 or under	0.2 or under	400 or more	450 or more	No cracks or peeling shall be observed on the decorative plane.	No peeling shall be observed between paint film and the border line between substrate and paint film.	No noticeable dents shall be observed on the decorative plane.	No cracking, swelling, and peeling shall be observed. No noticeable change in color shall be observed.

Note: Gravity of exterior decorative HDF is around 1.

5. Dimensions and Tolerance The dimensions of fiberboards are indicated in <Table 18> and <Table 19>. However, the dimensions of ordered products shall follow the agreement made between the related parties. Moreover, the tolerance and squareness of the dimensions are indicated in <Table 20>.

<Table 18> Dimensions

(unit: ㎜)

Type		Thickness
LDF	Grade T LDF (T-LDF)	10, 15, 20
	Grade A LDF (A-LDF) Waterproof LDF (S-LDF)	9, 12, 15, 18
MDF		2.5, 3, 3.5, 4.5, 6, 7.5, 9. 12 15, 18, 20, 22, 25, 30, 35
HDF	Base HDF (RN-HDF, RS-HDF) Interior decorative HDF (DI-HDF)	
	Exterior decorative HDF (DE-HB)	

<Table 19> Width and Length

(unit: ㎜)

Length \ Width	900, 910	1,200, 1,220
1,800, 1,830	○	○
2,400, 2,440	-	○
2,700	-	○

Note: The dimensions not indicated above shall conform to KS F 1518.

<Table 20> Tolerance and Squareness of the Dimensions

(unit: ㎜)

Type		Thickness	Tolerance of thickness			Tolerance of length in width and length	Squareness
			Non-polished board	Polished board	Decorated board		
LDF	Grade T (T-LDF)	10 or more	±1.2	-	-	±4.0	2 or under
	Grade A LDF(A-LDF) Waterproof LDF (S-LDF)	Under 12	±1.0				
		12 or more	±1.2				
MDF		7.5 or under	±0.5	±0.3	-	±3.0	
		More than 9 less than 15	±1.0	±0.4			
		18 or more	±1.5	±0.5			
HDF		3.5 or under	±0.4	±0.3	±10% of the marked thickness	±3.0	
		More than 3.6 less than 5.0	±0.5				
		More than 5.1 less than 7.0	±0.7				
		More than 7.1 less than 9.0	±0.9				
		More than 9.1 less than 12.0	±1.2				
		12.1 or more	±1.5				

Note 1. Thickness of the decorative plane shall be the sum of that of substrate and of decorative layer.
2. Thickness tolerance of 3.5 mm under decorative HDF shall be the same as that of polished products.
3. Thickness tolerance of exterior decorative HDF shall be the same as that of non-polished products.

6. Test

6.1 Test pieces

6.1.1 Test pieces shall extract the dimensions and numbers indicated in <Table 21> from the center of substrate according to each test item. Moreover, from decorative boards test pieces shall be extracted including the grooved part in the pieces including grooved parts on the decorative

board. However, in the paint film adhesion test, this shall not be applied.

6.1.2 The test pieces shall be kept under air-dry condition [8] or those kept under temperature (20±2) ℃, and moisture content (65±5) %[9]. For testing moisture content on the test pieces of exterior decorative HDF, use the test pieces are not pre treated including those under air-dry condition.

Note[8] Air-dry condition means test pieces are left in a well-ventilated room 7 days or more.

[9] Moisture content means whose mass is measured for every 24 h and the rate of change reaches 0.1 % or under.

<Table 21> Dimensions and Number of Test Pieces

Test Items		Dimension of test pieces, mm	No. of test pieces extracted from 1 sheet of board
Density		100x100	3
Moisture content		Test pieces whose density are measured	3
Bending strength		Width 50 x length [span[10]+50]	Lengthwise 3, widthwise 3
Bending strength at wet condition		Width 50 x length [span[10]+50]	Lengthwise 3, widthwise 3
Load bearing capacity		300x250	Lengthwise 3, widthwise 3
Water absorption		100x100	3
Thickness swelling		50x50	3
Change in length under wet condition	LDF	70x200	Lengthwise 3, widthwise 3
	Exterior decorative HDF	70x200	Lengthwise 3
Internal bond		50x50	3
Screw withdrawal strength		50x100	Plane 3, side 3
Nail withdrawal resistance		50x100	3
Emission quantity of HCHO		50x150	The number (rounded-off number) where the total surface area of the test pieces including the butt ends is close to 1800 ㎠ is used.
Thermal insulation		900x900	2
In-plane tensile strength		50x50	3
Impact resistance	Interior decorative HDF	300x300	2
	Exterior decorative HDF	300x300	2
Acid resistance		100x100	2
Alkali resistance		100x100	2
Stain resistance		100x100	2
Change-in-color resistance		100x100	3
Scratch resistance		50x50	2
Paint film adhesiveness		50x50	5
Washability resistance		170x430	2
Weather resistance		70x150	3
Incombustibility		220x220	1

Note[10] The span shall be 15 times the normal thickness and 150 mm or over at the same time.

6.2 Test Method

6.2.1 The method of testing the product's emission quantity of HCHO shall follow the desiccator

law of KS M 1998.

6.2.2 Quality and test method of a product shall follow notification of Korea Forest Service (KFS) No. 2015-11 (test method of physical·mechanical features of wood-based panel).

6.2.3 Other necessary items and related test methods may refer to Korean Industrial Standards (KS F 3200).

7. Symbol Type, condition of surface, adhesives, blending strength, emission grade of HCHO, dimensions, name of producer or importer, date of production, and producer shall be indicated in Korean in fiberboards. If necessary in trading, those may be indicated in English.

7.1 Symbol of Type Symbol of types of fiberboards shall follow <Table 22> based on density.

<Table 22> Indication on Type of Fiberboards

Classification	Symbol
Low-density fiberboard	LDF
Medium-density fiberboard	MDF
High-density fiberboard	HDF

7.2 Symbol of Condition of Surface Symbols of condition of fiberboards' surface are indicated in <Table 23>.

<Table 23> Symbol of Condition of Fiberboards' Surface

Classification		Symbol
Base fiberboards	non-polished	RN
	polished	RS
Decorative fiberboards	interior	DI
	exterior	DE

※ For base fiberboards, the symbol of "base" may be omitted.

7.3 Symbol of Adhesives Symbols for adhesives of fiberboards are indicated in <Table 24>.

<Table 24> Symbol of Adhesives used in Fiberboards

Classification	Symbol
Type U (urea based)	U
Type M (urea-melamine)	M
Type P (Phenol)	P

7.4 Symbol of Bending Strength Symbols for blending strength of fiberboards are indicated in <Table 25>.

※ For LDF, the symbol of bending strength may be omitted.

<Table 25> Symbol of Bending Strength of Fiberboards

Classification		Symbol
MDF	Type 35	35
	Type 30	30
	Type 25	25
	Type 20	20
	Type 15	15
Regular HDF	Type 40	S40
	Type 35	S35
	Type 25	S25
	Type 20	S20
Hardened HDF	Type 50	T50
	Type 45	T45
	Type 35	T35

7.5 Symbol of Emission Quantity of HCHO Symbols for emission quantity of HCHO of fiberboards are indicated in <Table 26>.

<Table 26> Symbol of Emission Grade of HCHO of Fiberboards

Classification	Symbol
Completely orderless	SE_0
Orderless	E_0
Semi orderless	E_1

7.6 Symbol of Incombustibility Symbols for incombustibility of fiberboards are indicated in <Table 27>.

※ the symbol of incombustibility may be omitted.

<Table 27> Symbol of Incombustibility of Fiberboards

Classification	Symbol
Incombustibility grade 2	Incombustibility 2
Incombustibility grade 3	Incombustibility 3
Regular	-

7.7 Symbols for Dimensions The thickness, width, and length of fiberboards are indicated in Arabic numerals: thickness (mm) × width (mm) × length (mm). However, symbols for width and length may be omitted.

7.8 Symbols for Name of Producer and Importer Indicate a name of company in its abbreviation and trademark. Name of importer may be indicated in a unit of bundle, If boards are distributed in each sheet, it is marked by each sheet.

7.10 Date of Production Indicate production year and date next to name of producer or importer.

7.11 Example of Indicating Quality For each sheet of fiberboards, marking is indicated in each place of front back or side of a board. With the use of a stamp, sticker, sealing, etc., quality of each product becomes identifiable.

※ For fiberboards whose thickness is 7.5 mm or under, it is allowed to mark by layering several boards together.

※ Exterior or interior border lines may not be indicated.

① Fiberboards Manufactured in Korea

Type - condition of surface - adhesives - blending strength - emission grade of HCHO - incombustibility
Dimensions (thickness × width × length)
Name of producer, date of production

<Example of Indication>

HDF - RS - U - S40 - E_0 - Incombustibility 2
18×1,220×2,440
○○○○ (Inc.), Aug, 2012.

HDF : High-density fiberboards
RS : Classification by condition of surface (base polished)
U : Classification by adhesives (urea-formaldehyde resin)
S40 : Classification by blending strength (Type 40)
E_0 : Classification by emission quantity of HCHO
Incombustibility 2 : Incombustibility grade
※ Symbol for surface condition or incombustibility may be omitted.

② Imported Fiberboards

Type - condition of surface - adhesives - blending strength - emission grade of HCHO - incombustibility
Dimensions (thickness × width × length)
Name of importer - producer, date of production

<Example of Indication>

MDF - DI - M - 25 - E_1 - Incombustibility 2
18×1,220×2,440
○○○○ (Inc.) - Japan (○○○), Jun, 2012.

MDF : Medium-density fiberboards
DI : Classification by condition of surface (interior)
M : Classification by adhesives(Urea · melamine formaldehyde resin)
25 : Classification by blending strength (Type 25)
E_1 : Classification by emission grade of HCHO

※ Symbol for surface condition or incombustibility may be omitted.

[ANNEX 9]

Oriented Strand Board

1. Scope This specification is to apply to Oriented Strand Boards (hereafter 'OSB'), which are used as non-structural interior and exterior materials and structural sheathing for wall, roof and floor applications.

2. Definitions The definitions of terms in the specification are as follows:

2.1 OSB **Multi-layered** board made from strands of wood of predetermined shape and thickness, together with a binder, by the application of heat and pressure, with the stands in the external layers aligned and parallel to the board length of width

2.2 Strand Basic materials comprising OSB or wood chips with an average length of no less than 50 mm and an average width of no more than 2 mm

2.3 Major Axis; Longitudinal direction, Strong axis High bending strength, parallel with the longitudinal direction of OSB

2.4 Minor Axis; Transversal direction, Weak axis Transversal to the major axis and parallel with the transverse direction of OSB

2.5 General Purpose; GP Non-bearing general purposes such as interior finishing and furniture

2.6 Load-bearing; LB Uses structurally designed to bear loads like building sheathing materials and I-joist web members

2.7 Heavy Duty Load-bearing; HLB Uses structurally designed to bear heavy loads or oscillation loads like special buildings or container floors

2.8 Regular; REG Products suitable for dry conditions with an annual equilibrium moisture content of no more than 15% despite potential humid states in the short term

2.9 Moisture Resistant; MR Products suitable for wet conditions with an annual equilibrium

moisture content of over 15% in the long term

3. Classification The OSB types are classified as follows according to load bearing and relative humidity of the surrounding environment:

3.1 GP-REG Non-bearing OSB used in dry conditions like interior finishing and furniture

3.2 LB-REG Load-bearing OSB used in dry conditions like interior structures and furniture

3.3 LB-MR Load-bearing OSB used in wet conditions like building sheathing materials

3.4 HLB-MR OSB used in wet conditions to bear heavy loads like special buildings or container floors

4. Quality

4.1 Common Standard for OSB Quality All OSBs shall meet the quality criteria in Table 1.

<Table 1> Common Standard for OSB

Division		Quality Standard
Tolerance for dimensions - Thickness (polished) - Thickness (unpolished) - Length and Width		 ±0.3 ㎜ ±0.8 ㎜ ±3.0 ㎜
Edge straightness		1.5 ㎜/m
Squareness tolerance		2.0 ㎜/m
Moisture content		≤ 13 %
Density (g/㎤)		0.5-0.8
Formaldehyde Emission[a]	For Interior	SE_0, E_0
	For Structures	SE_0, E_0, E_1

[a] Quality criteria for OSB's formaldehyde emission appear in Table 2.

<Table 2> Standard for OSB's Formaldehyde Emission

Grade	Formaldehyde Emission (mg/L)	
	Mean	Maximum
SE_0	≤ 0.3	≤ 0.4
E_0	≤ 0.5	≤ 0.7
E_1	≤ 1.5	≤ 2.1

4.2. Standard Quality of GP-REG OSB Non-bearing OSBs used in dry conditions shall comply

with the Standard in Table 3.

<Table 3> Standard for Mechanical Properties and Dimension Stability of GP-REG OSB

Division		Nominal Thickness (㎜)		
		6 ≤ T ≤ 10	10 < T < 18	18 ≤ T ≤ 25
Bending Strength (MPa)	Major Axis	≥ 20	≥ 18	≥ 16
	Minor Axis	≥ 10	≥ 9	≥ 8
Modulus of Elasticity in bending (MPa)	Major Axis	≥ 2 500		
	Minor Axis	≥ 1 200		
Internal bond (MPa)		≥ 0.30	≥ 0.28	≥ 0.26
Swelling in thickness (%)		≤ 25		

Note) 1 ㎏f/㎠ = 0.098 MPa = approximately 0.1 MPa, 1 MPa = 1 N/㎟

4.3 Standard Quality of LB-REG OSB Load-bearing OSBs used in dry conditions shall comply with the Standard in Table 4.

<Table 4> Standard for Mechanical Properties and Dimension Stability of LB-REG OSB

Division		Nominal Thickness (㎜)				
		6≤ T ≤10	10< T <18	18≤T≤25	25< T ≤32	32< T ≤40
Bending Strength (MPa)	Major Axis	≥ 22	≥ 20	≥ 18	≥ 16	≥ 14
	Minor Axis	≥ 11	≥ 10	≥ 9	≥ 8	≥ 7
Modulus of Elasticity in bending (MPa)	Major Axis	≥ 3 500				
	Minor Axis	≥ 1 400				
Internal bond (MPa)		≥ 0.34	≥ 0.32	≥ 0.30	≥ 0.29	≥ 0.26
Swelling in thickness (%)		≤ 20				

Note) For OSBs used to make floors, walls and roofs, a buyer may require additional physical and mechanical properties fit to those purposes (See Appendix A).

4.4 Standard Quality of LB-MR OSB Load-bearing OSBs used in wet conditions shall comply with the Standard in Table 5 and 6.

<Table 5> Standard for Mechanical Properties and Dimension Stability of LB-MR OSB

Division		Nominal Thickness (㎜)				
		6≤ T ≤10	10< T <18	18≤T≤25	25< T ≤32	32< T ≤40
Bending Strength (MPa)	Major Axis	≥ 22	≥ 20	≥ 18	≥ 16	≥ 14
	Minor Axis	≥ 11	≥10	≥ 9	≥ 8	≥ 7
Modulus of Elasticity in bending (MPa)	Major Axis	≥ 3 500				
	Minor Axis	≥ 1 400				
Internal bond (MPa)		≥ 0.34	≥ 0.32	≥ 0.30	≥ 0.29	≥ 0.26
Swelling in thickness (%)		≤ 20	≤ 15	≤ 15	≤ 15	≤ 15

Note) For OSB used to make floors, walls and roofs, a buyer may require additional physical and mechanical properties fit to those purposes (See Appendix A).

<Table 6> Standard Quality of LB-MR OSB

Method 1: Accelerated weathering[a]	Option A: Internal bond (MPa)	≥ 0.18	≥ 0.15	≥ 0.13	≥ 0.10	≥ 0.08
	Option B: Bending Strength (MPa)	≥ 9	≥ 8	≥ 7	≥ 6	≥ 6
Method 2- Internal bond[b] (MPa) After Boil Test		≥ 0.15	≥ 0.13	≥ 0.12	≥ 0.06	≥ 0.05
Method 3- Bending Strength[c] (MPa) After Vacuum Water Soak/Redry		≥ 16.5	≥ 15	≥ 13.5	≥ 12	≥ 10.5

<Note> Only one test is applied to the relevant product among Method (Option A), Method (Option B), Method 2 and Method 3.

[a] Accelerated weathering: based on Paragraph 5.8 Test Method.

[b] Boil test: based on Paragraph 5.9 Test Method.

[c] Vacuum water soak/redry test: based on Paragraph 5.10 Test Method

4.5 Standard Quality of HLB-MR OSB Load-bearing OSBs used in wet conditions shall comply with the Standard in Table 7 and 8.

<Table 7> Standard for Mechanical Properties and Dimension Stability of HLB-MR OSB

Division		Nominal Thickness (㎜)				
		6≤ T ≤10	10< T <18	18≤T≤25	25< T ≤32	32< T ≤40
Bending Strength (MPa)	Major Axis	≥ 30	≥ 28	≥ 26	≥ 24	≥ 22
	Minor Axis	≥ 16	≥ 15	≥ 14	≥ 13	≥ 12
Modulus of Elasticity in bending (MPa)	Major Axis	≥ 4 800				
	Minor Axis	≥ 1 900				
Internal bond (MPa)		≥ 0.50	≥ 0.45	≥ 0.40	≥ 0.35	≥ 0.30
Swelling in thickness (%)		≤ 12				

Note) For OSBs used to make floors, walls and roofs, a buyer may require additional physical and mechanical properties fit to those purposes (See Appendix A).

<Table 8> Standard for Water Resistance of HLB-MR OSB

Division		Nominal Thickness (㎜)				
		6≤T≤10	10<T<18	18≤T≤25	25<T≤32	32<T≤40
Method 1: Accelerated Weathering[a]	Option A: Internal bond (MPa)	≥ 0.21	≥ 0.17	≥ 0.15	≥ 0.10	≥ 0.08
	Option B: Bending Strength (MPa)	≥ 15	≥ 14	≥ 13	≥ 6	≥ 6
Method 2– Internal bond[b] (MPa) After Boil Test		≥ 0.17	≥ 0.15	≥ 0.13	≥ 0.06	≥ 0.05

<Note> Only one test is applied to the relevant product among Method (Option A), Method (Option B), and Method 2.

[a] Accelerated ageing: based on Paragraph 5.8 Test Method.

[b] Boil test: based on Paragraph 5.9 Test Method.

5. Test Method

5.1 Dimension The measurement of OSB's dimension is pursuant to National Institute of Forest Science (NIFoS) Notification No. 2015-11 (Test Method for Physical and Mechanical Properties of Wood Panels).

5.2 Density The measurement of OSB's density is pursuant to National Institute of Forest Science (NIFoS) Notification No. 2015-11 (Test Method for Physical and Mechanical Properties of Wood Panels).

5.3 Moisture Content The measurement of OSB's moisture content is pursuant to National Institute of Forest Science (NIFoS) Notification No. 2015-11 (Test Method for Physical and Mechanical Properties of Wood Panels).

5.4 Formaldehyde Emission The measurement of OSB's Formaldehyde Emission is pursuant to the Desiccator Method of KS M 1998.

5.5 Bending Strength and Modulus of Elasticity The measurement of bending strength and modulus of elasticity of OSB is pursuant to National Institute of Forest Science (NIFoS) Notification No. 2015-11 (Test Method for Physical and Mechanical Properties of Wood Panels).

5.6 Internal bond The measurement of OSB's peel strength is pursuant to National Institute of Forest Science (NIFoS) Notification No. 2015-11 (Test Method for Physical and Mechanical Properties of Wood Panels).

5.7 Swelling in thickness The measurement of OSB's thickness expansion coefficient is pursuant to National Institute of Forest Science (NIFoS) Notification No. 2015-11 (Test Method for Physical and Mechanical Properties of Wood Panels).

5.8 Accelerated Weathering

5.8.1 Test of Three cycles Immerse test pieces in the 20±1 ℃ water bath filled with fresh water of pH 7±1. Test pieces with a long side like those for a bending test shall be away from at least 15 mm from the rim of the bath. Soak the top of test pieces as deep as at least no less than 25±5 mm for 70±1 hr.

Take out and dry test pieces for a few minutes and freeze for 24±1 hr in the freezer of −12 ℃ to -25 ℃.

Right after freezing, dry them for 70±1 hr in the room of 70±2 ℃ and then cool them off for 4±0.5 hr in a 20±5 ℃ room.

Repeat the above soak-freeze-dry test 2 times.

5.9 Boil Test Put test pieces in the bath and pour fresh water of pH 7±1 up to 75±25 mm deep at 20±1 ℃. Test pieces shall be away from at least 15 mm from the rim of the bath. Water is to be circulated and changed for each test. Boil water at 100 ℃ for 90±10 min. Then immerse test pieces in 20±5 ℃ water for 60±5 min. Take them out and wipe with paper towel and put in a dryer of 70±2 ℃ for 960±15 min with their surface at the horizontal level. Cool them at room temperature.

5.10 Vacuum Water Soak/Redry Test Prepare test pieces 50 mm wide and [(20 × nominal thickness) + 50] mm long. Put them in vacuum-pressure container with 66 ℃ water. The scale is to be maintained at 50.6 kPa (mercury 15 inch) for 30 min. Release the vacuum and soak test pieces in water at the atmospheric pressure. Then dry test pieces at least 15 hr at 82 ℃ in the forced draft dryer where the air is changed 45-50 times per min.

6. Inspection

6.1 General Matters The kind and quality label of OSB shall be affixed to the surface of each imported structural OSB in an easily noticeable manner.

6.2 Test Piece Collect test pieces from the center of the original panel for each test item according to the dimensions and numbers in Table 9. Test pieces are to be in air dry condition[(a)] or reach a constant weight[(b)] at 20±2 ℃ in temperature and 65±5% in humidity. But, samples for measuring formaldehyde emission comply with the pre-treatment method of KS M 1998.

Note[(a)] Air dry condition refers to putting test pieces in an airy room for no less than 7 days.

Note[(b)] Constant weight means that the weight of test pieces changes within 0.1% after its readings every 24 hours.

<Table 9> Dimension and Number of Test Pieces

Test Items		Dimension of Test Pieces (mm)	Number of Test Pieces from One Panel
Density		100x100	3
Moisture Content		Test Piece tested for density	3
Formaldehyde Emission		50x150	2 sets: each consists of the number of pieces whose total surface area including their cross section reaches 1,800 ㎠ (provided that the number of pieces is rounded up).
Bending Strength		Width 50 x Length [Span[a]+50]	3 lengthwise 3 widthwise
Modulus of Elasticity		Width 50 x Length [Span[a]+50]	3 lengthwise 3 widthwise
Internal bond		50x50	3
Swelling in thickness		50x50	3
Accelerated Weathering	Internal bond	50x50	3
	Bending Strength	Width 50 x Length [Span[a]+50]	3 lengthwise 3 widthwise
Internal bond After Boil Test		50x50	3
Bending Strength After Vacuum Water Soak/Redry		Width 50 x Length [Span[a]+50]	3 lengthwise 3 widthwise

[a] The span shall be 15 times nominal thickness but no less than 150 mm.

7. Labeling The following matters shall be listed for four kinds of OSBs if they comply with the standard requirements. However, they shall be marked by sheet on the front, back or side of the product as follows in a noticeable way such as printing, stamps, stickers, and coining:

7.1 Type of Products

7.2 Formaldehyde Emission

7.3 Nominal Dimension(Thickness, Width, Length)

7.4 Name of Manufacturer and Importer

7.5 Year and Month of Production

Labeling Example(Proposal)

Among the following, dimensions are based on the unit of mm and classes of formaldehyde emission on SE0, E0, E1. In this, descriptions in the table may be given in a line with no borders and spaces.

Product name - Type - Grade of formaldehyde emission
Dimension (thickness×width×length)
Place of origin (name of manufacturer, importer) Year and month of production

o Korean Labeling

OSB - 일반용-보통 - E0
11.1×1,220×2,440
캐나다(ooooo(주), 한국상사), 2015.6.

o English Labeling

OSB - GP-REG. - E0.
11.1×1,220×2,440
Canada (Company ABC, Korea Corporation), 2015.6.

Appendix A. Additional Requirements of Physical and Mechanical Properties

Division	Description	Test Method
Physical Properties	Size Change	ISO 16985
Mechanical Properties	Resistance to Axial Withdrawal of Screws	CSA 0437, CSA 0325
	Loading Duration/Creep	EN 1156
	Tension	ISO 16572, ASTM D3500
	Compression	ISO 16572, ASTM D3501
	Shear	ISO 16572, ASTM D3044
	Resistance to Uniform Distributed Load	CSA 0325
	Resistance to Concentrated Load	CSA 0325
	Impact Resistance	EN 1128
Performance by Use	Floor	EN 1195, ASTM E72
	Wall	EN 594 + EN596, ASTM E72
	Roof	ISO 16985, ASTM E72

[Annex 10]

Wood Flooring

1. Scope This specification is to apply to indoor-use natural wood veneer floorings, decoration wood-based floorings, and reinforced decoration wood-based floorings using plywood, fiberboard, particleboard, OSB and composite materials made of these basic materials as a baseboard.

2. Definitions Definitions of terms in the specification are as follows:

2.1 Natural Wood Veneer Flooring Floorings which decorate with natural wood veneers the surface of plywood, fiberboard, particleboard, OSB and composite materials made of these basic materials

2.2 Decoration Wood-based Flooring Floorings which decorate the surface of plywood, fiberboard, particleboard, OSB and composite materials made of these basic materials with LPL, HPL or other decoration prints

2.3 Reinforced Decoration Wood-based Flooring Reinforced floorings which decorate the surface of plywood, fiberboard, particleboard, OSB and composite materials made of these basic materials with LPL, HPL or other decoration prints

2.4 Core board Panels used for core parts of flooring. Generic name of plywood, fiberboard, particleboard, OSB and composite materials made of these basic materials

2.5 Bonding Installation Method that affixes a flooring directly to the floor with adhesives

2.6 Floating Installation Method that installs a flooring over the floor in a floating style

2.7 Surface Material Decorative materials for the surface of core board. They have the following types:

2.7.1 Natural Veneer Veneers produced through cutting works such as slicing, rotary cutting and sawing

2.7.2 Engineered Veneer Veneers produced by reconstituting natural wood or putting them

through a secondary processing of dyeing

2.7.3 Low Pressure Laminates: LPL Laminates manufactured by impregnating papers in thermosetting resin and drying them

2.7.4 High Pressure Laminates: HPL Laminates manufactured by applying high pressure and high temperature to several LPLs

2.7.5 Other Decoration Prints Prints for decorating the surface of floorings except LPL and HPL

3. Type The flooring types are classified as follows according to the type of core boards, installation methods, surface materials, formaldehyde emission and heating:

3.1 According to the type of core board and surface materials and their applications, floorings are divided into natural wood veneer floorings, decoration wood-based floorings and reinforced decoration wood-based floorings.

3.2 According to installation methods, floorings are divided into bonding and non-bonding installation.

3.3 According to surface materials, floorings are divided into natural veneers, engineered veneers, LPL, HPL, and other decoration prints.

3.4 According to formaldehyde emission, floorings are divided into Type SE_0, Type E_0, and Type E_1.

3.4.1 Type SE_0 : mean $\leq$ 0.3 mg/L, maximum $\leq$ 0.4 mg/L

3.4.2 Type E_0: mean $\leq$ 0.5 mg/L, maximum $\leq$ 0.7 mg/L

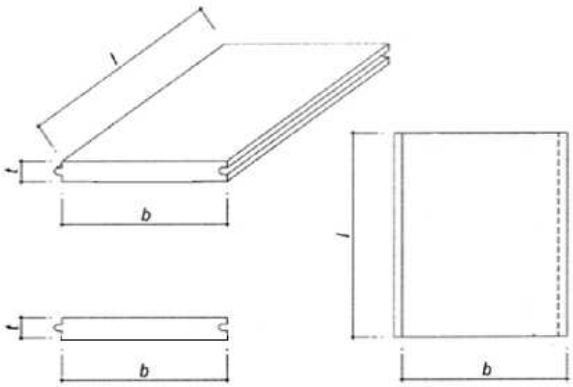
3.4.3 Type E_1: mean $\leq$ 1.5 mg/L, maximum 2.1 mg/L

3.5 According to heating, floorings are divided into regular and ondol (Korean floor heating system) uses.

4. Standard for Dimensions and Quality

4.1 Shape and Tolerance of Dimensions The shapes of wood flooring appear in Fig. 1 and its

dimensional tolerance and precision in processing comply with Table 1.



<Fig.1> Shape of Wood Flooring (for Reference)

<Table 1> Tolerance of Dimension and Precision of Wood Flooring

(Unit : ㎜)

Item	Tolerance
Length	+ No limit, − 0
Width	±0.3
Thickness	±0.3
Level Difference	Maximum ≤ 0.3, Mean ≤ 0.15

4.2 Appearance

4.2.1 Natural Wood Veneer Flooring The quality criteria for the appearance of natural wood veneer floorings comply with Table 2.

<Table 2> The Quality Standard for Appearance of Natural Wood Veneer Floorings

Quality Control Item	Quality Standard
Balance of patterns	Well balanced
Unevenness and bubbles of painting and gloss	Extremely minor
Swelling, peeling, flaking, crack, roughness, t-groove of coating	None
Dirtiness and dust	Not noticed
Knot, indent, decay	None
Worm hole	≤ 3 per sheet Diameter ≤ 2 mm
Overlap, discoloration, base panels that are invisible through veneers	None
Gap of veneer seams	Minor
Tongue and groove project	Veneers of the project: ≥ 2 layers Oriented perpendicular to each other

4.2.2 Decoration Wood-based Flooring and Reinforced Decoration Wood-based Flooring To evaluate the appearance quality of decoration wood-based floorings and reinforced decoration wood-based floorings, horizontally place boards on the platform 600-700 mm high and clean their surfaces with a brush, etc. Observe them under a fluorescent lamp (for general lighting) of 800-1,000 lx described in KS C 7601 and check that they have the following defects:

4.2.2.1 Defects like pollution, spots, finger prints and horizontal lines

4.2.2.2 Foreign materials with a diameter of no more than 0.8 mm and identified from 2 m away

4.2.2.3 Two foreign materials with a diameter of no less than 0.6 mm in the randomly drawn circle of a 300 mm diameter; or one of them is identified from 2 m away.

4.2.2.4 A group of more than three foreign materials with a diameter of no less than 0.6 mm in the randomly drawn circle of a 300 mm diameter; or one of them is identified from 1.5 m away.

4.2.2.5 If a plywood is used, the tongue and groove project is to comprise no less than two veneers and they are to be oriented perpendicular to each other.

4.3 Standard for Physical-Mechanical Quality

4.3.1 Natural Wood Veneer Flooring The criteria for physical-mechanical quality of natural wood veneer floorings comply with Table 3.

<Table 3> The Standard for Physical-Mechanical Quality of Natural Wood Veneer Flooring

Quality Control Item		Quality Standard	Test Method
Adhesive Quality (for a Plywood Baseboard)		A plywood with a veneer core, whose adjacent veneers have a fiber direction perpendicular to each another, shall have no less than 0.7 MPa in the test of water resistance, tension, shear and adhesive strength. In the test of water resistance, water immersion and peeling, the length of the section without peels in the same layer is to be no less than 50 mm from each side.	Pursuant to Chapter 7 of KS F 3111
Bending Strength (for Floating Installation)		≥ 40 MPa, A test of products no more than 10 mm thick may be omitted.	
Bending Strength at Wet condition (for Floating Installation)		≥ 20 MPa, A test of products no more than 10 mm thick may be omitted.	
In-plane Tensile Strength (for Floating Installation)		≥ 0.4 MPa	
Moisture Content on Dry Basis (for a Plywood Baseboard)		≤ 13 %	
Swelling in Thickness after Immersion in Water (for Fiber Boards, Particle Boards, OSB and Composite Materials made of These Basic Materials)		≤ 6 %	
Dimensional Changes (for Fiber Boards, Particle Boards, OSB and Composite Materials made of These Basic Materials)		Length ≤ 0.3 %, thickness ≤ 2 %	
Acid Resistance/Alkali Resistance/Thinner Resistance/Wet-heat Resistance/Light Resistance		No crack, swelling, flake or noticeable change in gloss on the surface of a test piece	
Stain Resistance		No remaining color on the surface of a test piece	
Wear Resistance		The number of rotations that do not lead to wear endpoints in the wear test is subject to KS F 3111.	
Adhesive Strength of Coating		No foreign material stuck to tape Rated as Grade 1	
Formaldehyde Emission	Regular	(E_1) mean ≤ 1.5 mg/L, maximum ≤ 2.1 mg/L	Pursuant to the desiccator method of KS M 1998
	Ondol (Korean Floor Heating System)	(E_0) mean ≤ 0.5 mg/L, maximum ≤ 0.7 mg/L	

4.3.2 Decoration Wood-based Flooring and Reinforced Decoration Wood-based Flooring The criteria for physical-mechanical quality of decoration wood-based floorings and reinforced decoration wood-based floorings comply with Table 4.

<Table 4> The Standard for Physical-Mechanical Quality of Decoration Wood-based Flooring and Reinforced Decoration Wood-based Flooring

Quality Control Item		Quality Standard	Test Method
Adhesive Quality (for a Plywood Baseboard)		A plywood with a veneer core, whose adjacent veneers have a fiber direction perpendicular to each another, shall have no less than 0.7 MPa in the test of water resistance, tension, shear and adhesive strength. In the test of water resistance, water immersion and peeling, the length of the section without peels in the same layer is to be no less than 50 mm from each side.	Pursuant to Chapter 7 of KS F 3111
Bending Strength (for Floating Installation)		≥ 40 MPa, A test of products no more than 10 mm thick may be omitted.	Pursuant to Chapter 8 of KS F 3126
Bending Strength at Wet condition		≥ 20 MPa, A test of products no more than 10 mm thick may be omitted.	
In-plane Tensile Strength (for Floating Installation)		≥ 0.4 MPa	
Moisture Content on Dry Basis (for a Plywood Baseboard)		≤ 13 %	
Swelling in Thickness after Immersion in Water (for Fiber Boards, Particle Boards, OSB and Composite Materials made of These Basic Materials)		≤ 6 %	
Dimensional Changes (for Fiber Boards, Particle Boards, OSB and Composite Materials made of These Basic Materials)		Length ≤ 0.3 %, thickness ≤ 2 %	
Acid Resistance/Alkali Resistance/Thinner Resistance/Wet-heat Resistance/Light Resistance		No crack, swelling, flake or noticeable change in gloss on the surface of a test piece	
Cold Resistance, Heat Resistance		Subject to KS F 3126.KS F 3126	
Stain Resistance		No remaining color on the surface of a test piece	
Wear Resistance		The number of rotations that do not lead to wear endpoints in the wear test is subject to KS F 3126.	
Adhesive Strength of Coating		No foreign material stuck to tape Rated as Grade 1	
Impact Resistance		No fissure, destruction and peeling	
Scratch Resistance (for Reinforced Decoration Floorings)		Scratch hardness ≥ 3N	
Formaldehyde Emission	Regular	(E_1) mean ≤ 1.5 mg/L, maximum ≤ 2.1 mg/L	Pursuant to the desiccator method of KS M 1998
	Ondol (Korean Floor Heating System)	(E_0) mean ≤ 0.5 mg/L, maximum ≤ 0.7 mg/L	

5. Test The dimensions and number of test pieces comply with quality control items of Table 5.

5.1 Natural Wood Veneer Flooring The test of natural wood veneer floorings complies with Chapter 7 of KS F 3111.

5.2 Decoration Wood-based Flooring and Reinforced Decoration Wood-based Flooring The tests of decoration wood-based floorings and reinforced decoration wood-based floorings comply with KS F 3126 and Chapter 8 of it.

<Table 5> Dimensions and Number of Test Pieces

Quality Item	Dimensions of Test Pieces (㎜)	Number of Test Pieces
Length/Width/Thickness	President	3
Adhesive Quality	Refer to the test method.	4
Bending Strength	Width 50x Length[span*+50]	3
Bending Strength at Wet condition	Width 50x Length[span*+50]	3
In-plane Tensile Strength	50×50	3
Moisture Content on Dry Basis (for a Plywood Baseboard)	Proper Size	3
Swelling in Thickness after Immersion in Water	50×50	3
Dimensional Changes	200×20	3
Acid Resistance/Alkali Resistance/Thinner Resistance/ Stain Resistance/Light Resistance/Wet-heat Resistance/ Cold Resistance/Heat Resistance	Refer to the test method.	3 for each test
Wear Resistance	100×100	3
Adhesive Strength of Coating	75×75	3
Impact Resistance	50×50	3
Scratch Resistance (for Reinforced Decoration Floorings)	50×50	3
Formaldehyde Emission	Refer to the test method.	3 sets: each consists of the number of pieces whose total surface area including their cross section reaches 1,800 ㎠ (provided that the number of sheets is rounded up.)
Level Difference	Refer to the test method.	8

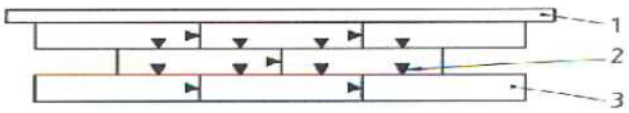
* The span shall be 15 times nominal thickness but no less than 150 mm.

6. Test

6.1 Dimension Test Randomly collect test pieces of numbers in Table 6. Measure their thickness based on actual (finished) size by the unit of 0.05 mm and their length and width by the unit of 1 mm. For level differences, connect floor boards as shown in Fig. 2 and locate 13 measuring points (no more than 5 mm away from the end of tongue and groove joints). Measure the level difference at those points with a depth gauge.

<Table 6> Number of Test Pieces for a Dimension Test

Number of One Lot of Floorings	Number of Test Piece Floorings	
≤ 1,000	2	For a retest, use 2 times the number described in the left column.
1,001–2,000	3	
2,001–3,000	4	
≥ 3,001	5	



Key
1 Steel ruler
2 Measuring points
3 Test pieces

<Fig.2> Method of Level Difference Determination

6.2 Quality Test Perform tests specified in the quality control items of Table 2, 3 and 4.

6.3 Determination of Pass or Fail Status Determine the pass-or-fail result in the test according to relevant standards in Table 1 to Table 4 after conducting dimension and quality tests. But for wood flooring, which received a safety self-assurance report certificate under the Quality Control and Safety Management of Industrial Products Act, may determine the pass or fail status of the safety test based on a report from a testing and inspection institution for industrial products subject to safety self-assurance according to Article 19 (3).

7. Labeling

7.1 Labeling Items

7.1.1 Product Name: Product names according to the types of flooring (e.g. natural wood veneer flooring, decoration wood-based flooring, reinforced decoration wood-based flooring and so on)

7.1.2 Decoration Material: Surface materials of flooring (e.g. veneer, LPL, HPL, etc.)

7.1.3 Use: Classified according to flooring heating (e.g. ondol use, regular use)

7.1.4 Formaldehyde Emission Grade: Formaldehyde emission grades of flooring (e.g. SE_0, E_0)

7.1.5 Dimensions: thickness (㎜) ×width (㎜) ×length (㎜) (e.g. 30 ㎜×150 ㎜×2.4 ㎜)

7.1.6 **Producer (Importer)**: Producer - company name, or its code and trade mark; importer – names of the importer and the exporting country or its code. (e.g. Company ABC (the United States)) However, the importer's name may be marked by the unit of the smallest package and if products are not distributed as a package, it is expressed in each product.

7.1.7 **Year and Month of Production**: Year and month when a product is manufactured (e.g. 2013. 03)

7.2 **Labeling Method** Mark as follows for the smallest unit package; Quality labels are to be identified through stamps, stickers and coining:

※ Use of a product may be omitted and table borders or inner lines may not be drawn.

Labeling items	Product name – Decoration material - Heating - Formaldehyde emission grade Dimensions Producer (importer) – Year and month of production
Example 1)	Natural wood veneer flooring - Veneer - Ondol use - SE_0 7.5 ㎜×75 ㎜×900 ㎜ Company ABC - 2014. 07
Example 2)	Decoration wood-based flooring – LPL - Regular use - E_0 7.5 ㎜×190 ㎜×1200 ㎜ Company ABC (China) – 2014. 03

[Annex 11]

Wood Pellets

1. Scope This specification shall be applied to determining standards and quality standards of all wood pellets produced domestically or imported from overseas to improve their quality and establish the distribution order in lignocelluloses biofuels according to Paragraph 1 of Article 20 of ACT ON THE SUSTAINABLE USE OF TIMBERS (No. 11429).

2. Definition Definitions of terms used in this specification is as follows.

2.1. Wood Pellets It means products, unpolluted woods which are compressed and molded. And it refers to standardized, small-cylinder-shape lignocelluloses biofuels.

2.2. Unpolluted Woods Woods which are not treated with chemicals including preservative and paints, not delivered from furniture and buildings, and have clear history.

2.3. Compression Forming In the process of manufacturing wood pellets, make the woods go through a form frame with high pressure to have a certain diameter and length in the form of pellet.

2.4. Bulk Density As the value of the weight on the volume of wood pellets, it is a useful indicator in transportation and others.

2.5. Moisture Content The value of moisture that wood pellets contain is indicated in percentage on the based on wet measure.

2.6. Ash Contents The value of the amount of inorganic substances remaining after the combustion of wood pellets is indicated in percentage under a certain condition based on dry measure.

2.7. Fines Indicate the weight of scraps in percentage based on wet measure, smaller than a certain size in shipping after manufacturing wood pellets.

2.8. Durability As an index indicating the strength of wood pellets, indicate the weight of scraps generated after the tumbling test in percentage based on wet measure.

2.9. Calorific Value The calories generated in the combustion process shall be indicated in calorific value.

2.10. Other Additives Materials added besides woods to aid the manufacturing wood pellets including molding.

3. Type Types of wood pellets are, white-wood pellets whose raw materials are the xylem part, bark pellets whose raw materials are bark, and common pellets. And they are classified as follows.

3.1. White-Wood Pellets Wood pellet whose content of bark shall be 5% or under.

3.2. Bark Pellet Wood pellet whose raw materials are mainly barks and the content of bark is 50% or more.

3.3. Common Pellet Wood pellet whose content of bark is over 5% under 50%.

4. Standard and Quality Standard

4.1. Used Raw Materials Softwood, hardwoods, or sawdust or the grinded ones shall be used as raw materials. The processed woods as follows shall not be used in manufacturing wood pellets.

4.1.1. Woods treated with preservatives

4.1.2. Woods treated with chemicals including adhesives, paint, and dipping.

4.1.3. Woods delivered from buildings.

4.1.4. Woods have no clear history.

4.2. Quality Standard Classification, standard, and quality standard of wood pellets are indicated in <Table 1> based on the used raw materials and quality.

<Table 1> Specification and Quality Standard of Wood Pellets

Feature	Unit	Grade 1	Grade 2	Grade 3	Grade 4
Size (diameter)	㎜	6-8	6-8	6-8	6-25
Size (length)	㎜	≤32	≤32	≤32	≤32
Bulk Density	kg/㎥	≥640	≥600	≥550	≥500
Moisture content	%	≤10	≤10	≤15	≤15
Ash contents	%	≤0.7	≤1.5	≤3.0	≤6.0
Fines	%	<1.0	<1.0	<2.0	<2.0
Durability	%	≥97.5	≥97.5	≥95	≥95
Calorific Value	㎉/kg (MJ/kg)	≥4,300 (≥18.0)	≥4,300 (≥18.0)	≥4,040 (≥16.9)	≥4,040 (≥16.9)
Sulfur	%	≤0.05	≤0.05	≤0.05	≤0.05
Chlorine	%	≤0.05	≤0.05	≤0.05	≤0.05
Nitrogen	%	≤0.3	≤0.5	≤0.7	≤1.0
Arsenic	㎎/kg	≤1.0	≤1.0	≤1.0	≤1.0
Cadmium	㎎/kg	≤0.5	≤0.5	≤0.5	≤0.5
Chromium	㎎/kg	≤10	≤10	≤10	≤10
Copper	㎎/kg	≤10	≤10	≤10	≤10
Lead	㎎/kg	≤10	≤10	≤10	≤10
Mercury	㎎/kg	≤0.05	≤0.05	≤0.05	≤0.05
Nickel	㎎/kg	≤10	≤10	≤10	≤10
Zinc	㎎/kg	≤100	≤100	≤100	≤100
Ash Melting Behavior Temperature	℃	Items recommended to be indicated.			
Other Additives	%	<2.0	<2.0	<2.0	<2.0

4.3. Grade Grade of wood pellets shall be defined as follows.

4.3.1. Grade 1 pellet

4.3.2. Grade 2 pellet

4.3.3. Grade 3 pellet

4.3.4. Grade 4 pellet

5. Test

5.1. Preparation of Samples

5.1.1. Producer (importer) of wood pellets shall prepare samples to conduct the quality test before shipping to distribute to consumers. Extraction of wood pellets for test analysis shall conform to the standard indicated in <Table 2>.

<Table 2> Method of Extracting Wood Pellet Samples for Test Analysis

Wood pellet for pack		Wood pellet for bulk transport	
Quantity of packaging (kg)	Quantity of Extraction (kg)	Quantity of population (ton)	Number of extracted sites
Under 20	2	Under 1	4 ~ 6
More than 20 under 50	2 ~ 3	More than 1 under 2	6 ~ 8
More than 50 under 100	5 ~ 8	More than under 5	8 ~ 10
More than 100 under 500	8 ~ 10	More than 5 under 10	10 ~ 15
More than 500	10 ~ 15	More than 10	15 ~ 20

5.1.2. Take some or entire part of wood pellet samples extracted from the packaged products for inspection and place on a clean decking to mix evenly. And then extract samples as the following methods either a reduction or conical quartering method.

5.1.2.1. Riffling Method Extract distributed samples randomly by falling them on the extracted samples on the bifurcation. If there is large quantity of samples, shall repeat reduction method to obtain a certain amount of samples. After this process, put the extracted samples into a glass bottle or plastic bag and seal it.

5.1.2.2. Coning-and-Quatering Method Accumulate the extracted samples in the shape of a circular cone and press down from the peak to make it flat. After repeating this process 1 to 2 times, divide it into 4 parts in the form of sector and then extract the two counterparts of the entire parts. If necessary, shall repeat this process to obtain a certain amount of samples and then put the extracted samples into a glass bottle or plastic bag and seal it.

5.2. Size Randomly extract 25 wood pellets among the entire samples. Measure the diameter and length of the samples by using a vernier caliper until the unit of 0.1㎜ and then round off to record in the unit of ㎜.

5.3. Bulk Density

5.3.1. Containers for measurement shall be made of hard materials not easily damaged in the

form of circular cylinder. The ratio of its height and diameter shall be in the range of between either 1.25 and B 1.50. Large-size and small size containers shall be used. Shall use small containers in measuring the pellets whose diameter is 12㎜ or under.

5.3.1.1. The volume of large-size containers for measurement shall be 50 liters (0.05㎥) and 1 liter of deviation shall be allowed. For the dimensions of the standard container, its internal diameter shall be 360㎜ and internal height shall be 491㎜.

5.3.1.2. The volume of small-size containers for measurement shall be 5 liters (0.005㎥) 0.1 liter of deviation shall be allowed. For the dimensions of the standard container, its internal diameter shall be 167㎜ and internal height shall be 228㎜.

5.3.2. The exact volume of the measurement container shall be measured by using water: 0.01 liter of water (0.00001㎥, large-size measurement container) and 0.001 liter (0.000001㎥, small-size measurement container).

5.3.3. When filling pellets into the measurement container, pour pellets 200-300㎜ distant from the upper edge of the container to be accumulated to form a mountain. And drop it down perpendicularly on a 15mm thick wood plate from 150㎜ above an even and hard floor. And harden it 3 times. Remove the remaining pellets flowing over the container by using 50㎜-size square timber and then measure the weight of the pellets in the container. For a large-size container, measure it to the unit of 10g and for small-size one, measure until the unit of 1g.

5.3.4. Measure moisture content immediately after measuring apparent density.

5.3.5. Shall measure more than 3 times and calculate the value until units digit by using the following formula and indicate in the unit of kg/㎥. Round off the average value in the units digit to indicate as of 10kg/㎥.

$$D_{ad}(at\ M_{ad}) = \frac{(m_2 - m_1)}{V}$$

D_{ad} : Apparent density of pellets based on wet measure
M_{ad} : Moisture content of pellet based on wet measure
m_1 : Weight of an empty container
m_2 : Weight of a container filled with pellets
V : Volume of the container

※ $$D_{dm} = D_{ad} \times \frac{(100 - M_{ad})}{100}$$

D_{dm} : Apparent density of oven-dry pellets

5.4. Moisture Content

5.4.1. Shall dry a weighing bottle with a cover at the temperature of 105 ± 3℃ until there is no change in its weight and then cool down in a desiccators in the room temperature.

5.4.2. Shall measure the weight of a weighing bottle until the unit of 0.01g including a cover and then record it.

5.4.3. Put at least 20g of pellet samples into a weighing bottle until it forms an even layer and measure the weight including its cover.

5.4.4. After removing the cover, dry it at the temperature of 105 ± 3℃ until there is no change in the weight including a plate containing the samples. In this moment, the cover shall be dried in the same oven.

5.4.5. Cover up the container in the oven and move to a desiccators to cool down until it reaches the room temperature.

5.4.6. Shall measure the weight of a weighing bottle including the samples as of the 0.01g unit.

5.4.7. Conduct the measurement more than 3 times, calculate the value of moisture content to the nearest hundredths by using the following calculation formula, and indicate in %. Round off the average value to the nearest hundredths and indicate in 0.1%.

$$M_{ad} = \frac{(m_2 - m_3)}{(m_2 - m_1)} \times 100$$

M_{ad} : Moisture content of pellet based on wet measure

m_1: Empty weighing bottle + weight of a cover

m_2: Weighing bottle before being dried + cover + weight of samples

m_3: Weighing bottle after oven-dry + cover + weight of samples

5.5. Ash Contents

5.5.1. Heat a pot not containing samples at least 60 minutes in the maffle furnace at the temperature of 575 ± 25℃. Remove the pot from the furnace and cool down for 5 to 10 minutes. And then move to a desiccator with no absorbent until it reaches the room temperature. Record the weight when the weight of the pot does not change at the range of 0.1㎎.

5.5.2. Grind pellets to the size small enough to penetrate a metal sieve of 1㎜ and mix carefully test samples before measuring the weight. Spread out at least 1g of samples to have a certain thickness on the floor of the pot. Measure the weight of the samples in the pot in 0.1㎎ and then record the weight. If test samples are all oven-dried already, dry again the pot and samples at the temperature of 105 ± 3℃ to prevent them from absorbing moisture and then measure the weight exactly.

5.5.3. Put the pot containing test samples into a cooled maffle furnace and then heat it by using a temperature programmed schedule as follows.

5.5.3.1. Increase the temperature of the furnace at the rate of 4~5℃/minute to 250℃ and leave it for 60 minutes.

5.5.3.2. Increase the temperature of the furnace to reach 575 ± 25℃ for 60 minutes (5~6℃ /minute) and leave at that temperature at least 120 minutes.

5.5.4. Remove the pot from the furnace, leave it for 5 to10 minutes in the air, and cool down in a desiccator at the room temperature where there is no absorbent. Measure the weight in 0.1㎎ and record it.

5.5.4.1. Shall heat it in the furnace at the temperature of 575 ± 25℃ for additional 30 minutes.

5.5.4.2. Add few drops of distilled water or ammonium nitrate, heat it in the furnace at the temperature of 575 ± 25℃ 30 minutes more, and measure the weight.

5.5.5. Conduct the measurement more than 3 times, calculate the value of ash content for the dried weight to the nearest hundredths by using the following calculation formula, and indicate in %. Round off the average value to the nearest hundredths and indicate in 0.1%.

$$A_{dm} = \frac{(m_3 - m_1)}{(m_2 - m_1)} \times 100 \times \frac{100}{100 - M_{ad}}$$

A_{dm} : Ash content of oven-dry pellets(as of dry measure)
m_1 : Weight of pot
m_2 : Pot + weight of samples
m_3 : Pot + weight of ash
M_{ad} : Moisture content of pellets (based on wet measure)

55.6. Fines

5.6.1. Extract more than 50 g of pellets from the packaged products and measure its weight in 0.01g.

5.6.2. Put pellets in the net whose effective area is more than 250㎠ and diameter is 3.15㎜ (standard by ISO 3310-2), install it in a shaker and filter it to measure the weight of the remaining pellets in the net. Shaking shall be continued until the amount of fines penetrating the net does not exceed 0.3% per minute.

5.6.3. Conduct the measurement more than 3 times, calculate the value the nearest hundredths by using the following calculation formula. Indicate the weight of fines penetrating the net against the entire weight of wood pellets in %. Round off the average value to the nearest hundredths and indicate in 0.1%.

$$F = \frac{(m_a - m_e)}{m_a} \times 100$$

F : Fines
m_a : Weight of pellets before penetrating the net
m_e : Weight of pellets after it penetrated the net

5.7. Durability

5.7.1. Shall measure the weight of 500 ± 50g of wood pellets filtered by the net whose diameter is 3.15㎜ (standard of ISO 3310-2) to the level of 0.01g and put them into a durability tester (standardized in CEN/TS 15210-1). Give rotation of 50±2 times/minute to conduct 500 times of rotation test.

5.7.2. After completing the test, re-filter the pellets with the net whose diameter is 3.15㎜. And then measure the weight of the pellets remaining in the net.

5.7.3. Conduct the measurement more than 3 times and measure to the nearest hundredths by using the following formula. Shall indicate the weight of the filtered wood pellets which went through the durability test in %. Round off the average value to the nearest hundredths and indicate in 0.1%.

$$DU = \frac{m_a}{m_e} \times 100$$

DU : Durability

m_a : Weight of the pellet filtered with the net after going through the durability test

m_e : eight of the pellet filtered with the net before going through the durability test

5.8. Calorific Value

5.8.1. Combust samples with a bomb-type manual or automatic calorimeter while measuring the increase in temperature. Measure the calorific value by calculaitng 1 calorie per 1g of sample or the number of J(20℃).

5.8.2. Shall open pellets packaged for each unit (i.e., 18, 20, 50㎏, etc.) and extract samples only representable. And then adjust their size small enough to go through the metal net of 1㎜ and measure their calorific values.

5.8.3. Shall use benzoic acid, a standard material and use a calorimeter whose calorie is regulated.

5.8.4. By using the adjusted calorimeter, measure the calorific value of samples. Measure the values more than 3 times. The average value of oven-dry samples shall be rounded off to the first decimal place.

$$Q_d = \frac{Q_{dm}}{m_{ds}}$$

Q_d : Calorific value of oven-dry samples per unit weight

Q_{dm} : Calorific value of the measured oven-dry samples

m_{ds} : The weight of the measured oven-dry samples

5.8.4.1. For reference, the calorific value of samples based on wet measure shall be calculated by using the following formula.

$$Q_s = Q_d - (\frac{M_{ad}}{100} \times Q_d)$$

Q_s : Calorific value of samples based on wet measure

Q_d : Calorific value of oven-dry samples

M_{ad} : Moisture content of wood pellets (based on wet measure)

5.8.4.2. For reference, the method of calculating the low calorific value (net calorific value) of samples shall conform to the method suggested by Korean Standard (KS E 3707) of "Determination of Calorific Value of Coal and Coke."

$$Q_{v,net}(J/g) = Q_{v,gr}(J/g) - 2512 \times \frac{9h + w}{100}$$

Here in, $Q_{v,net}(J/g)$: Net calorific value(J/g)

h : Hydrogen content(%)

w : Moisture content of the samples (%)

However, total calorific values, moisture content, and mercury used in the conversion formula shall be measured by the same standard.

5.9. Sulfur and Chlorine

5.9.1. Combust samples in a sealed container and then collect sulfur and chlorine by using wash water.

5.9.1.1. Take 1g of sample in the form of wood pellet and then give proper pressure to make it into the form of pellet. And then measure its weight to the unit of 0.1㎎. Finally, shall move the samples to a quartz or metal pot.

5.9.1.2. Make samples completely burned under the oxygen by using combustion aid and cotton seed. Wash the sealed container by using distilled water. Collect wash water and measure the quantity of sulfur and chlorine by using the ion chromatography method.

5.9.2. Measure sulfur and chlorine by using the ICP analysis method(standard of EN ISO 11885).

5.9.3. Prepare more than 3 samples to conduct the measurement. Shall round off the measured value to the third decimal place to indicate as the average value.

5.10. Nitrogen

5.10.1. Measure nitrogen content by using an element analyzer. The measurement method shall follow the method of the company which manufactured the analyzer.

5.10.2. Shall conduct the measurement more than 3 times. Shall round off the measured value to the second decimal place to indicate as the average value.

5.11. In analyzing inorganic substances including arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc, shall conform to the method of analyzing inorganic substances by the EU standard (EN 15297:2011 Solid biofuels - Determination of minor elements - As, Cd, Cr, Cu, Hg, Ni, Pb, and Zn).

5.11.1. Shall prepare more than 3 samples to conduct measurement. The average value shall be indicated in as of ㎎/㎏ unit. Measure Chromium, Copper, Lead, Nickel, and Zinc shall be indicated to the nearest tenths, Zinc to the nearest tenths, Arsenic and Cadmium to the nearest hundredths, Mercury to three decimal places. Shall indicate the average value rounded off.

5.12. Ash Melting Behavior Temperature는 shall conform the standard measurement method of the EU (prEN 15370:2011 Solid biofuels - Determination of ash melting behaviour).

6. Indication

6.1. Indication method of standard · quality of wood pellets is indicated in <Table 3>. The indication shall be located on the surface of the package easily noticeable by consumers.

[Table 3] Method for marking specification and quality for wood pellet (example)

Specifications and quality table of Wood Pallets		
Name of product		Shall indicate product names of each company.
Grade of wood pallets		Shall indicate grades from Grade 1 to 4.
Type		Shall indicate in each type of pallet: xylem, bark, and regular
Place of origin		Shall indicate the country of origin.
Quality	Size (diameter)	Shall indicate a diameter in ㎜.
	bulk density	Shall indicate to the nearest 100, so indicate in 000㎏/㎥ or more.
	Moisture content	Shall indicate to the first decimal place in 0.0% or under.
	Ash contents	Shall indicate to the first decimal place in 0.0% or under.
	Higher heating value	Shall indicate to the nearest 10, so indicate in 0,000㎉/㎏ or more. Shall indicate to the first decimal place of the parathesis as 00.0MJ/㎏.
	Chemicals	Shall indicate less than S 0.00 %, Cl 0.00 %, N 0.0 %.
	Inorganic substances	Shall indicate less than As 0.0㎎/㎏, Cd 0.0㎎/㎏, Cr 00㎎/㎏, Cu 00㎎/㎏, Pb 00㎎/㎏, Hg 0.00㎎/㎏, Ni 00㎎/㎏, Zn 000㎎/㎏.
	Ash melting behavior	Shall indicate shrinkage starting temperature (SST), deformation temperature (DT), hemisphere temperature (HT), flow temperature (FT) in ℃ measured under the oxidation condition.
	Other additives	Shall indicate in OOO 0.0% or under as adhesives.
Weight		Shall indicate weight in kg.
Producer (importer)	Address	Shall indicate the address of a producer or an importer and a phone number in the parathesis.
	Name (Company name)	Shall indicate the name of CEO and that of the company name.
Manufacturing date		Shall indicate the year and month that wood pallets are manufactured.

6.2. Manufacturing and Attachment Standard

6.2.1. Size of a table may be adjustable, but it shall maintain the ratio of width and length of 2 to 3 and the length shall be more than 20㎝ long.

6.2.2. Shall directly print on the surface of the packaging box or attach the prints on the box. If burlap bag is used in packaging, you may print in a tag and attach the tag on the bag.

[Annex 12]

Wood chips

1. Scope This specification shall be applied to determining standards and quality standards of all wood chips produced domestically or imported from overseas to improve their quality and establish the distribution order in lignocelluloses biofuels according to Paragraph 1 of Article 20 of ACT ON THE SUSTAINABLE USE OF TIMBERS (No. 11429).

2. Definition Definitions of terms used in this specification is as follows.

2.1. wood chips wood chips, used as fuel, are grinded into small pieces by using machine to produce energy including combustion and gas and the manufactured products are classified into wood fuel chips and hog depending on its forms.

2.2. Wood Fuel Chip With use of log and wood byproducts generated from the forestry industry, it is a fuel produced in a relatively consistent form by using equipment including a disk and drum-type chipper. It may include bark or not.

2.3. Hog Hog is manufactured by using equipment whose grinding face is not sharp including a roller and hammer. As indeterminate form of wood chips, hogs take a relatively inconsistent in width, length, and thickness compared to those of wood fuel chips.

2.4. Wood Byproduct As Lignocellulosic biomass (or LC biomass), it includes the part of stem, branch, and root besides log.

2.5. Form Shall refer to the size of particles of the grinded wood products. It consists of width, length, and thickness.

2.6. Apparent density As a useful indicator in distribution, storage, and others, it is the value of the weight on the volume of wood chips in a certain container.

2.7. Moisture Indicate the quantity of moisture in wood chips in percentage on the basis on weight of wet matter.

2.8. Ash contents The value of the amount of inorganic substances remaining after the combustion of wood chips is indicated in percentage under a certain condition based on dry measure.

2.9. Fines Indicate the weight of scraps in percentage on the basis on weight of wet matter, smaller than a certain size in shipping after manufacturing wood chips.

2.10. Calorific Value As the calories generated in combusting wood chips, the low calorific value* calculating dry calorific value, moisture content, and the analysis result of components by the formula and shall be indicated in both MJ/㎏ and ㎉/㎏.

* The calorific value except condensed latent and sensible heat that water vapor has among combustion gas in the total calorific values.

2.11. Chlorine, Sulfur, Nitrogen Shall indicate each component included in wood chips in percentage based on dry measure.

2.12. Inorganic substances It means Mercury, Cadmium, Lead, Arsenic, and Chromium included in wood chips. It shall be indicated as detected quantity (㎎) per ㎏ of dried samples.

3. Standard and Quality Standard

3.1. Used Raw Materials

3.1.1. Log and wood byproducts shall be mechanically processed·treated among wood work and processing to manufacture wood fuel chips. In the process of processing·treating, polluted woods caused by chemicals including paint, oil·preservatives shall not be used as raw materials.

3.1.2. Hogs use unpolluted woods as raw materials not contaminated by materials including additives, paint, oil, and preservatives, and concrete in the process of processing·treating·using of log and wood byproducts produced from the forestry industry.

3.2. Quality Standard Classification, standard, and quality standard of wood chips are indicated in <Table 1> and the detailed methods are stated as follows.

<Table 1> Classification and Standard · Quality Standard of Wood chips

Classification			Wood fuel chip	Hog
Size		Uniformity 80% of the weight of wet matter	10㎜～45㎜ or under 10㎜～63㎜ or under 10㎜～100㎜ or under	10㎜～63㎜ or under 10㎜～100㎜ or under 10㎜～200㎜ or under
Fines		Particle whose size is 5㎜ or under	5% under of the weight of wet matter	
Ash contents		Based on dry measure	0.7% or under 1.5% or under 3.0% or under 6.0% or under	1.5% or under 3.0% or under 6.0% or under 10.0% or under
Moisture content		Based on wet measure	20% or under 30% or under 40% or under	
Calorific value		Low calorific value	1,900㎉/㎏ or more 2,700㎉/㎏ or more 3,500㎉/㎏ or more 4,300㎉/㎏ or more	
Nitrogen		Based on dry measure	1.0% or under	3.0% or under 6.0% or under
Chlorine		Based on dry measure	0.05% or under	0.30% or under
Sulfur		Based on dry measure	0.05% or under	1.20% or under
Inorganic metals	Arsenic	Based on dry measure	-	2.0㎎/㎏ or under
	Cadmium	Based on dry measure	-	2.0㎎/㎏ or under
	Chromium	Based on dry measure	-	30.0㎎/㎏ or under
	Lead	Based on dry measure	-	30.0㎎/㎏ or under
	Mercury	Based on dry measure	-	1.0㎎/㎏ or under

3.2.1. Size Size of wood chips shall be classified by the length of the longest cross section of a chip. It shall be determined by the size of chip consisting of more than 80% of the entire chips against weight.

3.2.2. Uniformity The distribution of size more than the standard within each standard of wood chips shall not exceed 1% based on wet measure.

3.2.2.1. Wood fuel chip

3.2.2.1.1. 10㎜ ~ 45㎜ or under : particles over 63㎜

3.2.2.1.2. 10㎜ ~ 63㎜ or under : particles over 100㎜

3.2.3.1.3. 10㎜ ~ 100㎜ or under : particles over 200㎜

3.2.2.2. Hog

3.2.2.2.1. 10㎜ ~ 63㎜ or under : particles over 100㎜

3.2.2.2.2. 10㎜ ~ 100㎜ or under : particles over 200㎜

3.2.2.2.3. 10㎜ ~ 200㎜ or under : particles over 300㎜

3.2.3. Fines Fine particles of 5mm or under within each standard of wood chips shall be under 5% of the wet basis weight.

4. Test

4.1. Preparation of Testing Materials

4.1.1. Extract Samples

4.1.1.1. Weight of the extracted samples based on sizes of wood chips

4.1.1.1.1. Weight of the extracted samples based on sizes of wood chips are indicated in <Table 2>.

<Table 2> Weight of the Extracted Samples Based on Sizes of Wood Chips

Avr. size of max. particles (㎜)	Min. weight of extracted samples (g)
	Apparent density
	200kg/㎥ ~ 500kg/㎥
≥100	15,000
50	2,000
30	500
10	250
5	100
≤2	50

4.1.1.2. Size of Device Extracting Samples and Number of Extraction

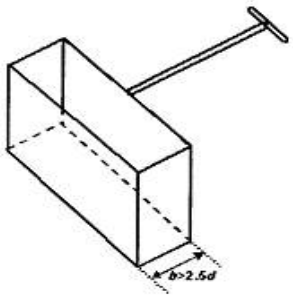
4.1.1.2.1. Size of device extracting samples of wood chips shall be based on the max. avr. particle size (size consisting of at least 95% of the sample weight) and the volume of the device shall be determined by the following formula.

$V_{min}(\ell) = 0.05 \times d \ (d \geq 10㎜)$

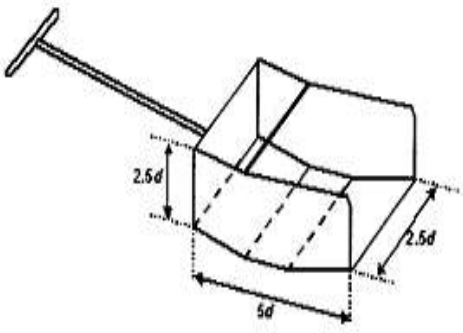
4.1.1.2.2 The number of sample extraction of wood chips shall be determined by the following methods depending on the condition of raw materials.

n(number of sample extraction) = $10 + 0.040 \times M_{lot(톤)}$ --- in stop (open storage, etc.)

n(number of sample extraction) = $5 + 0.040 \times M_{lot(톤)}$ --- in move (conveyor, etc.)



<Sample extracting box>



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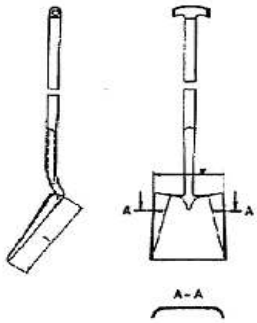


<Sample extracting shovel>

4.1.1.3. Before extracting samples, extraction standard shall be established based on the number suggested in 4.1.1.2.2.

4.1.1.4. In extraction, if a party entitled for extraction makes any request such as determining a location to extract, related parties shall respond to the request.

4.1.2. Method of Extracting on Conveyor

4.1.2.1. Before extraction, size of lot shall be defined. Extraction shall be conducted in the same point and in the certain time intervals.

4.1.2.2. If extracted manually on a conveyor in halt, width of the extraction device shall be at least 2.5 times larger than size of the max. avr. particle of raw materials.

4.1.2.3. If extracted automatically on a conveyor in operation, the equipment for extraction shall be manufactured fit to the max. depth of the conveyor.

4.1.3. Method of Extracting Falling wood chips

4.1.3.1. Samples extracted in a proper container shall represent the entire lot. To extract proper samples, the lot shall go through the extraction point with certain time intervals.

4.1.3.2. Extraction shall be conducted by using proper equipment which may go through a box for extraction or falling wood chips. The width of the box shall be spacious to be at least 2.5 times larger width than the size of avr. max. chip of raw materials.

4.1.4. Extract Samples from wood chips Stored in an Open Space (<100㎥)

4.1.4.1. Shall assume a pile as lot.

4.1.4.2. Proper devices including a shovel and scoop shall be used for extraction.

4.1.4.3. Extractors shall divide piles horizontally into three so that each pile may be representative. Shall extract samples from each layer with identical intervals by using the method described in 4.1.1.

4.1.5. Manufacture Mixed Samples or Extract Samples for Experiment

4.1.5.1. Put all samples into one container and mix them.

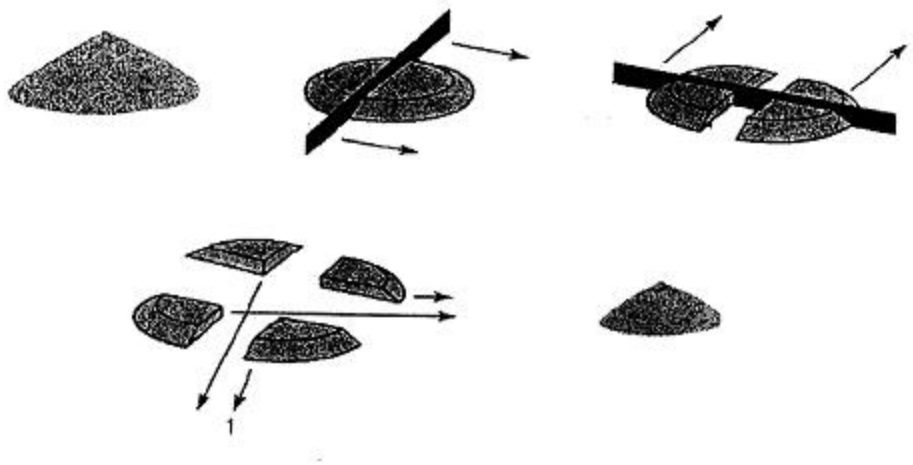
4.1.5.2. After mixing well, divide it into more than two samples. And then prepare samples

based on the following methods.

4.1.6. Method of Extracting Samples for Laboratory Inspection Take part or entire of wood chip samples to measure quality. Scoop for extraction shall have width and height 2.5 times larger than the longest length of edge of wood chips and more than 2 times of the width of wood chips. Shall move the extracted samples to a clean decking to mix evenly. And then extract samples as in the following methods of reduction and conical quartering method.

4.1.6.1. Riffle Method Extract distributed samples randomly by falling them on the extracted samples on the bifurcation. If there is large quantity of samples, shall repeat reduction method to obtain a certain amount of samples. After this process, put the extracted samples into a glass bottle or plastic bag and seal it.

4.1.6.2. Coning-and-Quartering Method Accumulate the extracted samples in the shape of a circular cone and press down from the peak to make it flat. After repeating this process 1 to 2 times, divide it into 4 parts in the form of sector and then extract the two counterparts of the entire parts. If necessary, shall repeat this process to obtain a certain amount of samples and then put the extracted samples into a glass bottle or plastic bag and seal it.



<Conical Quartering Method>

4.2. Determination of Size and Distribution of wood chips

4.2.1. Determinaton of Particle Distribution Using of Vibrating Separator

4.2.1.1. Shall prepare a sieve whose effective sieving area is at least 1,200㎠ (diameter 40㎝) by each proper size of sieve. The distance and number among sieves shall conform to the standard of ISO 3310-2.

4.2.1.2. The separator shall be able to vibrate left and right and use the separator to measure the number of vibrations per minute depending on samples.

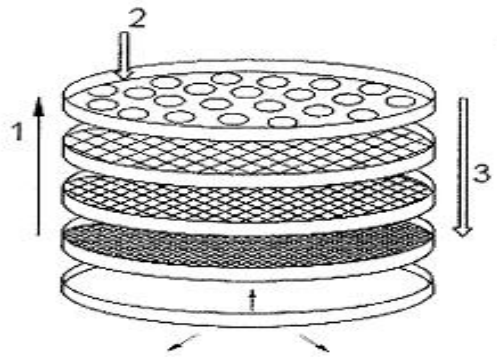
4.2.1.3. Place a sieve whose sieve whose diameter is largest on top and place a sieve whose diameter is smaller than that of the above below. To collect fines, place the same size of dish.

4.2.1.4. Moisture content of samples to measure the distribution of size shall prevent the phenomenon of attachment among particles during the experiment. Shall maintain the water content based on wet measure 20% or under to prevent experiment error caused by loss of moisture content. If necessary, you may dry samples before analysis to adjust moisture content.

4.2.1.5. The min. volume of samples required to determine the distribution of size shall be at

least 8ℓ. If, the entire samples may go through the sieve whose diameter is 45㎜, you may determine the sample volume as 4ℓ.

4.2.1.6. With use of a sample collecting dish, measure the weight of samples to be used for size distribution to the unit of 0.1g. Evenly distribute powders on the sieve and run the separator for 15 minutes. Move the remaining samples to the collecting dish and measure to the unit of 0.1g and record the results by following the form indicated in <Table 3>.



<Method of Vibrating Separator>

(1. Increase in size of hole, 2. Direction of putting samples, 3. Flow of samples)

4.2.2. Method of Using Rotary Screen

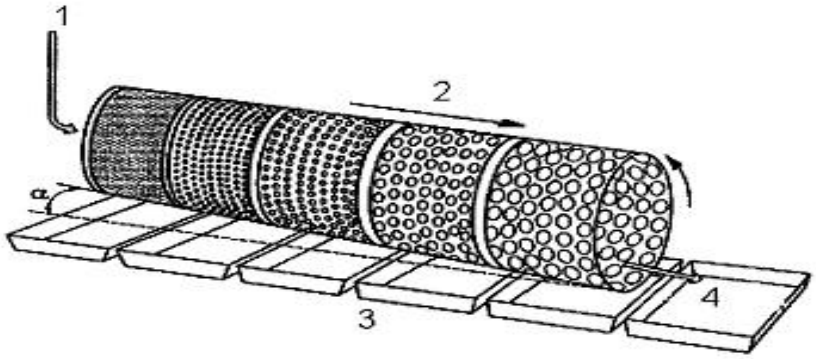
4.2.2.1. Rotary screen shall be linked to 5 types of cylinder-type screens. Each internal diameter shall be 500㎜ ± 15㎜. The width of each junction part of the rotary screen shall be max. 20㎜, respectively. The identifiable length shall be set as 360㎜ or more by including the width as the total of 400㎜.

4.2.2.2. Overall, the rotary screen shall be installed with the slight of 3±0.2° downward, so the chips for fuel may go downward during the move.

4.2.2.3. Moisture content of samples to measure the distribution of size shall prevent the phenomenon of attachment among particles during the experiment. Shall maintain the water content based on wet measure 20% or under to prevent experiment error caused by loss of moisture content. If necessary, you may dry samples before analysis to adjust moisture content.

4.2.2.4. The rotary speed of the rotary screen shall be set as 16 times per minute. The rate of putting raw materials shall be maintained at constant rate of 1ℓ per minute.

4.2.2.5. Shall measure the weight of the samples collected in the dish located under each rotary screen up to the unit of 0.1g and compose the analysis result table as in <Table 3>.



<Rotary Screen Method>

(1. Slot of raw materials, 2. Moving direction of sample, 3. Collection dish, 4, The remaining samples at last)

<Table 3> Table of Size Distribution Analysis

Size of sieve	Distribution of size	1st experiment (g)	2nd (g)	3rd (g)	Sum (g)	Rate (%)
1st (63㎜)	Over 63㎜					
2nd (45㎜)	45㎜-63㎜					
3rd (10㎜)	10㎜-45㎜					
4th (5㎜)	5㎜-10㎜					
Fines	Under 5㎜					
Sum						100%

4.3. Preparation of Samples to Analyze

4.3.1. Measure the entire weight of samples to the unit of 0.1% and then record.

4.3.2. Shall adjust the moisture content of samples 20% or under by drying it before the analysis.

4.3.2.1. Shall dry in the oven whose temperature does not exceed 40℃.

4.3.2.2. Exposure the samples in a laboratory at least 24 hours after oven dry to maintain the identical level of moisture content with that in the laboratory.

4.3.2.3. Shall calculate and record the moisture content reduction rate as in the following formula.

$$Mp = 100 \times \frac{Msample1 - Msample2}{Msample1}$$

M_P : Moisture content reduction rate(%),

$M_{sample1}$: Moisture content of samples before dry,

$M_{sample2}$: Moisture content of samples after oven dry

4.3.3. Grind (Grind under 30㎜)

4.3.3.1. Shall use a grinder to grind the remaining samples in the 30㎜-size metal sieve and separate by using a sieve whose diameter is 30㎜.

4.3.3.2. If the quantity of the grinded samples is large, shall re-extract the proper quantity by following the method suggested in 4.1.6.

4.3.3.3. Shall prepare a sieve whose size of particle (5㎜, 1㎜, 0.25㎜, etc.) required for precise analysis experiment and use a grinder or others to grind the samples to a small size to use for experiment analysis.

4.3.3.4. The selected and prepared samples shall be sealed with indication of its content and keep until it will be used for analysis.

4.4. Moisture content

4.4.1. Shall dry a weighing bottle with a cover at the temperature of 105 ± 3℃ until there is no change in its weight and then cool down in a desiccators in the room temperature.

4.4.2. Shall measure the weight of a weighing bottle until the unit of 0.01g including a cover and then record it.

4.4.3. Put at least 20g of pallet samples into a weighing bottle until it forms an even layer and measure the weight including its cover.

4.4.4. After removing the cover, dry it at the temperature of 105 ± 3℃ until there is no change in the weight including a plate containing the samples. In this moment, the cover shall be dried in the same oven.

4.4.5. Cover up the container in the oven and move to a desiccators to cool down until it reaches the room temperature.

4.4.6. Shall measure the weight of a weighing bottle including the samples as of the 0.01g unit.

4.4.7. Conduct the measurement more than 3 times, calculate the value of moisture content to the nearest hundredths by using the following calculation formula, and indicate in %. Round off the average value to the nearest hundredths and indicate in 0.1%.

$$M_{ad} = \frac{(m_2 - m_3)}{(m_2 - m_1)} \times 100$$

M_{ad} : Moisture content of pallet (based on wet measure)

m_1 : Empty weighing bottle + weight of a cover

m_2 : Weighing bottle before being dried + cover + weight of samples

m_3 : Weighing bottle after oven-dry + cover + weight of samples

4.5. Ash contents

4.5.1. Heat a pot not containing samples at least 60 minutes in the muffle furnace at the temperature of 575 ± 25℃. Remove the pot from the furnace and cool down for 5 to 10 minutes. And then move to a desiccator with no absorbent until it reaches the room temperature. Record the weight when the weight of the pot does not change at the range of 0.1㎎.

4.5.2. Grind pallets to the size small enough to penetrate a metal sieve of 1㎜ and mix carefully test samples before measuring the weight. Spread out at least 1g of samples to have a certain thickness on the floor of the pot. Measure the weight of the samples in the pot in 0.1㎎ and then record the weight. If test samples are all oven-dried already, dry again the pot and samples at the temperature of 105 ± 3℃ to prevent them from absorbing moisture and then measure the weight exactly.

4.5.3. Put the pot containing test samples into a cooled muffle furnace and then heat it by using

a temperature programmed schedule as follows.

4.5.3.1. Increase the temperature of the furnace at the rate of 4~5℃/minute to 250℃ and leave it for 60 minutes.

4.5.3.2. Increase the temperature of the furnace to reach 575 ± 25℃ for 60 minutes (5~6℃ /minute) and leave at that temperature at least 120 minutes.

4.5.4. Remove the pot from the furnace, leave it for 5 to10 minutes in the air, and cool down in a desiccator at the room temperature where there is no absorbent. Measure the weight in 0.1㎎ and record it.

4.5.5. If incomplete combustion is in question due to soot and others,

4.5.5.1. Shall heat it in the furnace at the temperature of 575 ± 25℃ for additional 30 minutes.

4.5.5.2. Add few drops of distilled water or ammonium nitrate, heat it in the furnace at the temperature of 575 ± 25℃ 30 minutes more, and measure the weight.

4.5.6. Conduct the measurement more than 3 times, calculate the value of ash content for the dried weight to the nearest hundredths by using the following calculation formula, and indicate in %. Round off the average value to the nearest hundredths and indicate in 0.1%.

$$A_{dm} = \frac{(m_3 - m_1)}{(m_2 - m_1)} \times 100 \times \frac{100}{100 - M_{ad}}$$

A_{dm} : Ash contents of samples (as of dry measure)

m_1 : Weight of pot

m_2 : Pot + weight of samples

m_3 : Pot + weight of ash contents

M_{ad} : Moisture content of samples (based on wet measure)

4.6. Measurement of Calorific Value

4.6.1. Measure the Carbon, Hydrogen, and Nitrogen in Samples (Element Analysis)

4.6.1.1. Extract a sample whose moisture content is known and then sieve with a metal net whose diameter is 1mm to prepare samples.

4.6.1.2. Verify the performance of the equipment before injecting samples by using standard materials. The reliability of the equipment shall use the allowable limits of error as in the following table.

<Table 4> The Allowable Limits of Error of Equipment Analyzing Element

Classification	Difference in results in allowable limits (based on dry measure)	
	Repeatability	Reproducibility
Carbon content	0.5%	1.5%
Hydrogen content	0.25%	0.5%
Nitrogen content	10%, N>0.5% 0.05%, N<0.5%	20%, N>0.5% 0.1%, N<0.5%

4.6.1.3. Shall measure major element content of samples whose moisture content is known. Based on

dry measure, the content of carbon, hydrogen, and nitrogen shall be calculated and recorded by using the following formula.

$$C_d = C_{ad} \times \frac{100}{100 - M_{ad}} \quad \text{(Carbon)}$$

C_d : Carbon content of dried samples (%)

C_{ad} : Carbon content of measured samples (%)

M_{ad} : Moisture content of measured samples (%)

$$N_d = N_{ad} \times \frac{100}{100 - M_{ad}} \quad \text{(Nitrogen)}$$

N_d : Nitrogen content of dried samples (%)

N_{ad} : Nitrogen content of measured samples (%)

M_{ad} : Moisture content of measured samples (%)

$$H_d = (H_{ad} - \frac{M_{ad}}{8.937}) \times \frac{100}{100 - M_{ad}} \quad \text{(Hydrogen)}$$

H_d : Hydrogen content of dried samples (%)

H_{ad} : Hydrogen content of measured samples (%)

M_{ad} : Moisture content of measured samples (%)

4.6.1.4. Shall measure the same samples more than 3 times and round off the result to the third decimal place to record. Shall compare the deviation among average with the content suggested in <Table 4> to determine whether to re-measure or not.

4.6.2. Measure the Total Calorific Value of Dried Samples

4.6.2.1. Combust samples with a bomb-type manual or automatic calorimeter while measuring the increase in temperature. Measure the calorific value by calculating 1 calorie per 1g of sample or the number of J(20℃).

4.6.2.2. To measure the calorific value, grind samples small enough to go through 1㎜ net and then measure.

4.6.2.3. Shall use benzoic acid, a standard material and use a calorimeter whose calorie is regulated to measure.

4.6.2.4. By using the adjusted calorimeter, measure the calorific value of samples. Measure the values more than 3 times. The average value of oven-dry samples shall be rounded off to the first decimal place.

$$Q_d = \frac{Q_{dm}}{m_{ds}}$$

Q_d : Total calorific value of oven-dry samples per unit weight

Q_{dm} : Calorific value of the measured oven-dry samples

m_{ds} : The weight of the measured oven-dry samples

4.6.3. Calculation of Low Calorific Value (Net Calorific Value)

4.6.3.1. Shall conform to the calculation method of low calorific value suggested by Korean Standard (KS E 3707) of "Determination of Calorific Value of Coal and Coke."

$$Q_{v,net}(J/g) = Q_{v,gr}(J/g) - 2512 \times \frac{9h + w}{100}$$

Here in, $Q_{v,net}(J/g)$: Net calorific value(J/g)

h : Hydrogen content(%)

w : Moisture content of the samples (%)

However, total calorific values, moisture content, and mercury used in the conversion formula shall be measured by the same standard.

4.7. Analysis of Content of Sulfur and Chlorine of Wood Chips

4.7.1. Shall use the ICP analysis method (standard of EN ISO 11885) to measure sulfur and chlorine.

4.7.2. Prepare more than 3 samples to conduct the measurement. Shall round off the measured value to the third decimal place to indicate as the average value.

5. Indication

Standard·Quality of wood chips shall be indicated as follows.

5.1. Depending on types of wood chips, compose a table where quality is indicated as in <Table 5>(wood chips) or <Table 6>(Hog) and attach it on the packaged product or print the tables to attach on the package.

5.2. If attachment or print is unavailable, compose two copies the quality table. One copy shall be kept by a provider and the other copy shall be provided to the final customer.

[Table 5] Method for marking specifications and quality for Wood Fuel Chip (example)

Product name	“Easily burning fuel chip”(i.e.)		Name of product on sale
Type	Wood fuel chip		Classify wood chips.
Raw material	“Hardwood, Product of Protecting the Forest“		Classify softwood and hardwood
Manufacturing company	“(Inc.) Green Growth“		Fill in the name of manufacturing company.
Manufacturing date	“Jan 2011“(i.e.)		Shall indicate year and month.
Weight (kg)	“3,500“ (i.e.)		Unit of kg (basis on weight of wet matter)
Indication Items (Example of Wood Fuel Chip)			
Size	10㎜~45㎜ or under	☐	Shall select a type and indicate it.
	10㎜~63㎜ or under	☐	
	10㎜~100㎜ or under	☐	
Fines(%)	5% under	☐	Indicate when the standard is fulfilled.
Ash contents(%)	0.7% or under	☐	Shall select a type and indicate it.
	1.5% or under	☐	
	3.0% or under	☐	
	6.0% or under	☐	
Moisture content(%)	20% or under	☐	Shall select a type and indicate it.
	30% or under	☐	
	40% or under	☐	
Lower heating value (㎉/㎏)	1,900㎉/㎏ or more	☐	Shall select a type and indicate it.
	2,700㎉/㎏ or more	☐	
	3,500㎉/㎏ or more	☐	
	4,300㎉/㎏ or more	☐	
Nitrogen	1.0% or under	☐	Indicate when the standard is fulfilled.
Chlorine	0.05% under	☐	Indicate when the standard is fulfilled.
Sulfur	0.05% under	☐	Indicate when the standard is fulfilled.

[Table 6] Method for marking specifications and quality for Hog (example)

Product name	"Easily burning fuel chip"(i.e.)		Name of product on sale
Type	Hog		Classify wood chips.
Raw material	"Hardwood, Product of Protecting the Forest"		Classify softwood and hardwood
Manufacturing company	"(Inc.) Green Growth"		Fill in the name of manufacturing company.
Manufacturing date	"Jan 2011"(i.e.)		Shall indicate year and month.
Weight (kg)	"3,500"(i.e.)		Unit of kg (basis on weight of wet matter)
Indication Items (Example of Hog)			
Size	10㎜~63㎜ or under	☐	Shall select a type and indicate it.
	10㎜~100㎜ or under	☐	
	10㎜~200㎜ or under	☐	
Fines(%)	5% under	☐	Indicate when the standard is fulfilled.
Ash contents(%)	1.5% or under	☐	Shall select a type and indicate it.
	3.0% or under	☐	
	6.0% or under	☐	
	10.0% or under	☐	
Moisture content(%)	20% or under	☐	Shall select a type and indicate it.
	30% or under	☐	
	40% or under	☐	
Lower heating value (㎉/㎏)	1,900㎉/㎏ or more	☐	Shall select a type and indicate it.
	2,700㎉/㎏ or more	☐	
	3,500㎉/㎏ or more	☐	
	4,300㎉/㎏ or more	☐	
Nitrogen	3.0% or under	☐	Indicate when the standard is fulfilled.
	6.0% or under	☐	
Chlorine	0.3% under	☐	Indicate when the standard is fulfilled.
Sulfur	1.2% under	☐	Indicate when the standard is fulfilled.
Arsenic	2.0㎎/㎏ or under	☐	Indicate when the standard is fulfilled.
Cadmium	2.0㎎/㎏ or under	☐	Indicate when the standard is fulfilled.
Chromium	30.0㎎/㎏ or under	☐	Indicate when the standard is fulfilled.
Lead	30.0㎎/㎏ or under	☐	Indicate when the standard is fulfilled.
Mercury	1.0㎎/㎏ or under	☐	Indicate when the standard is fulfilled.

[Annex 13]

Wood Briquettes

1. Scope This specification shall be applied to determining standards and quality standards of all wood briquettes produced domestically or imported from overseas to improve its quality and establish the distribution order in lignocellulosic biofuels according to Paragraph 1 of Article 20 of ACT ON THE SUSTAINABLE USE OF TIMBERS (No. 11429).

2. Definition Definitions of terms used in this specification is as follows.

2.1. Wood Briquettes It means products, unpolluted woods which are compressed and molded. And it refers to lignocellulosic biofuels not included into quality standards of wood pallets.

2.2. Unpolluted woods Woods which are not treated with chemicals including preservative and paints, not delivered from furniture and buildings, and have clear history.

2.3. Compression Forming In the process of manufacturing wood briquettes, make the woods go through a form frame with high pressure to have a certain diameter and length in the form of briquette.

2.4. Density As the value of the weight on the volume of wood briquettes, it is a useful indicator in distribution and others.

2.5. Moisture Content The value of moisture that wood briquettes contain is indicated in percentage based on the basis on weight of wet matter.

2.6. Ash Contents The value of the amount of inorganic substances remaining after the combustion of wood briquettes is indicated in percentage under a certain condition based on dry measure.

2.7. Calorific Value The calories generated in the combustion process shall be indicated in lower heating value. The unit shall be indicated as MJ/㎏ along with ㎉/㎏.

2.8. Other Additives Materials added besides woods to aid the manufacturing wood briquettes including molding.

3. Standard and Quality Standard

3.1. Used Raw Materials Conifers, broaden leaf trees, or sawdust or the grinded ones shall be used as raw materials. The processed woods as follows shall not be used in manufacturing wood briquettes.

3.1.1. Woods treated with preservatives

3.1.2. Woods treated with chemicals including adhesives, paint, and dipping.

3.1.3. Woods delivered from buildings.

3.1.4. Woods have no clear history.

3.2. Quality Standard Classification, standard, and quality standard of wood briquettes shall be indicated in <Table 1> based on the used raw materials and quality.

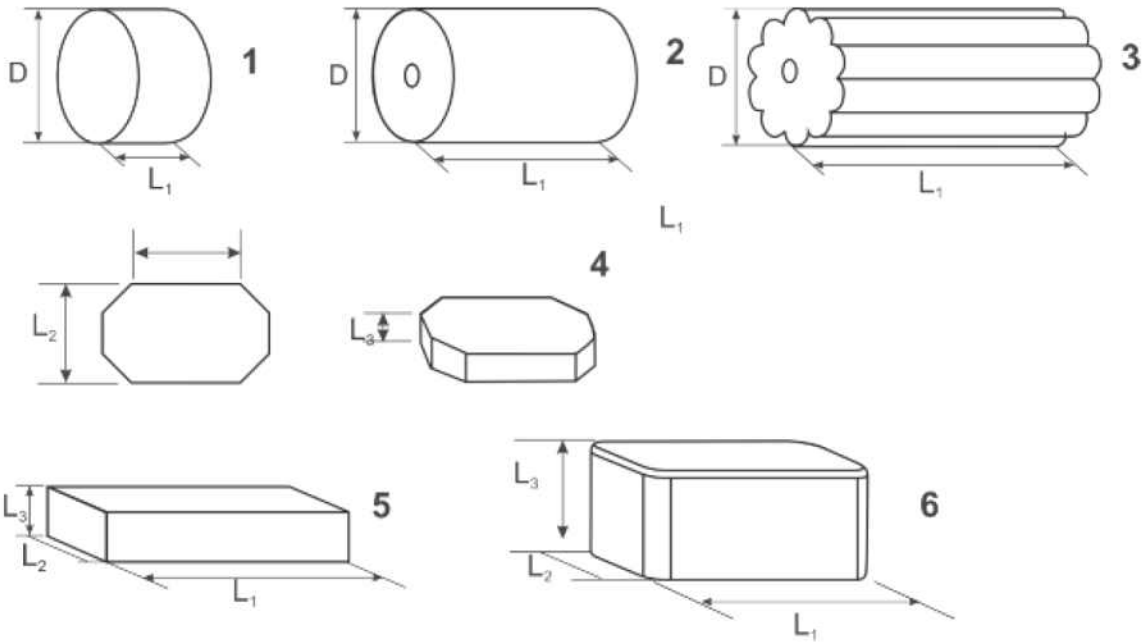
<Table 1> Specification and Quality Standard of Wood Briquettes

Classification	Unit	Grade A1	Grade A2	Grade B
Raw materials		1.Log 2.Wood byproducts not treated with chemicals	Entire wood except root 2.Log 3.Wood cutting byproducts 4.Bark 5. Wood byproducts not treated with chemicals	1.Woods not used for other purposes such as forest, planting, or others 2.Byproducts from the wood processing industry
Diameter, Length, Width, Height	㎜	Record diameter, length, width, and height.		
	Form	Expressed in picture <Picture 1>.		
Moisture Content (in receiving)	w-%	≤12	≤15	≤15
Ash Contents	w-%, dry	≤0.7	≤1.5	≤3.0
Density	g/㎤	≥1.0	≥1.0	≥0.9
Additives	w-%, dry	≤2 Indicate type and amount of additives in products.		
Lower Heating Value (in receiving)	MJ/㎏ ㎉/㎏	≥15.5 ≥3,704	≥15.3 ≥3.656	≥14.9 ≥3,560
Nitrogen (N)	w-%, dry	≤0.3	≤0.5	≤1.0
Sulfur (S)	w-%, dry	≤0.03	≤0.03	≤0.04
Chlorine (Cl)	w-%, dry	≤0.02	≤0.02	≤0.03
Arsenic (As)	㎎/㎏, dry	≤1.0	≤1.0	≤1.0
Cadmium(Cd)	㎎/㎏, dry	≤0.5	≤0.5	≤0.5
Chromium (Cr)	㎎/㎏, dry	≤10	≤10	≤10
Copper (Cu)	㎎/㎏, dry	≤10	≤10	≤10
Lead (Pb)	㎎/㎏, dry	≤10	≤10	≤10
Mercury (Hg)	㎎/㎏, dry	≤0.1	≤0.1	≤0.1
Nickel (Ni)	㎎/㎏, dry	≤10	≤10	≤10
Zinc (Zn)	㎎/㎏, dry	≤100	≤100	≤100

4. Test The quality and test method of wood briquettes are as follows.

4.1. The preparation for sample wood briquettes for quality test shall conform to Standard and Quality Standard of Wood Products - Annex 11(Wood Pallets).

4.2. Form of wood briquettes (diameter, length, height) shall conform to the measurement method of Standard and Quality Standard of Wood Products - Annex 11(Wood Pallets) based on the contents indicated in <Picture 1>.



<Picture 1> Indication Method of Wood Briquette Form for Fuel

(Note, D: diameter, L1: length, L2: width, L3:height)

4.3. The test method of moisture content on wood briquettes shall conform to Standard and Quality Standard of Wood Products - Annex 11(Wood Pallets).

4.4. The test method of ash contents of wood briquettes shall conform to Standard and Quality Standard of Wood Products - Annex 11(Wood Pallets).

4.5. The density test of wood briquettes shall conform to the analysis method of particle density by the EU Standard (EN 15150:2011 Solid Biofuels - Determination Of Particle Density).

4.6. The calorific value test of wood briquettes shall conform to Standard and Quality Standard of Wood Products - Annex 11(Wood Pallets) and the calculation of the low calorific power shall conform to the calculation method of the net calorific value indicated in KS E 3707 of Calorific Value Measurement Method of Coal and Cokes.

4.7. The Nitrogen test on wood briquettes shall conform to Standard and Quality Standard of Wood Products - Annex 11(Wood Pallets).

4.8. The test of Sulfur and Chlorine on wood briquettes shall conform to Standard and Quality Standard of Wood Products - Annex 11(Wood Pallets).

4.9. The analysis method of inorganic substances including Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, and Zinc on wood briquettes shall conform to the inorganic substance analysis method of the EU standard (EN 15297:2011. Solid biofuels – Determination of minor elements – As, Cd, Co, Cr, Cu, Hg, Mn, Mo, Ni, Pb, Sb, V and Zn).

4.10. Other materials added to wood briquettes except raw materials shall be indicated by its types and amount.

5. Indication The indication method of standard and quality of wood briquettes are indicated in <Table 2>.

5.1. Indication Method of Standard and Quality

<Table 2> Method for marking specifications and quality of Wood Briquettes (example)

Specifications and quality table of Wood Briquettes		
Name of Product		Shall indicate the unique product name of each company.
Grade		Shall be classified into Grade A1, A2, and B.
Production		Shall indicate the country of production.
Quality	Size	Shall indicate diameter, length, width, and height as of the unit of ㎜, and insert in pictures.
	Density	Shall indicate 0.0g/㎤ or more.
	Moisture content	Shall indicate 0.0% or under.
	Ash content	Shall indicate 0.0% or under.
	Low calorific power	Shall indicate more than 0,000㎉/㎏ and more than 10㎉/㎏. Shall indicate more than 00.0MJ/㎏ to the nearest tenth within the parenthesis.
	Chemicals	Shall indicate S 0.00 %, Cl 0.00 %, N 0.0 % or under.
	Inorganic substances	Shall indicate As 0.0㎎/㎏, Cd 0.0㎎/㎏, Cr 00㎎/㎏, Cu 00㎎/㎏, Pb 00 ㎎/㎏, Hg 0.0㎎/㎏, Ni 00㎎/㎏, Zn 000㎎/㎏ or under.
	Additives	Shall indicate types of additives and indicate the amount 0.0% or under.
Weight		Shall indicate the weight of packaging unit as of ㎏.
Producer (Importer)	Address	Shall indicate the address of a producer or an importer and insert phone numbers in the parenthesis.
	Name (Company name)	Shall indicate the name of CEO and company name.
Manufacturing date		Shall indicate the year and month of production.

5.2. Standard of Manufacture and Attachment

5.2.1. The size of a table may be adjustable, but the length of one side shall be 20㎝ or more.

5.2.2. Shall directly print on the surface of the packaging box or attach the prints on the box. If burlap bag is used in packaging, you may print in a tag and attach the tag on the bag.

5.3. Companies who produce, import, and sell wood briquettes shall ask the quality analysis of their products to the Korean test analysis agency officially certified by the Chief of Korea Forest Service (KFS).

5.4. Based on the quality analysis results, companies producing, importing, and selling wood briquettes shall indicate the grades recognized by the KFS on their packages.

[ANNEX 14]

Wood Charcoal Briquette

1. Scope This specification is to apply to wood charcoal briquette domestically produced and imported to commercially distribute

2. Definitions Terms and definitions in the specification are as follows:

2.1 Carbonization Phenomenon or process that heats and thermally decomposes organic matters in the absence of air and oxygen

2.2 wood charcoal briquette Products made by 1) compressing chips of wood, bamboo or seeds, shavings and bark into a certain form and carbonizing them or 2) putting additives such as a binder into carbonized sawdust charcoal to mold it

2.3 Sawdust Charcoal Briquette Carbonized after molding in a shape without any chemical binders and ignition promoters

2.4 Charcoal Powder Briquette Sawdust charcoal molded into various shapes using a binder (flour, starch, etc.) and an ignition promoter

2.5 Molded Charcoal for Kindling Holed Coal Biquette Sawdust charcoal molded into holed coal briquette (22 or 25 holes) manufactured by mixing a binder (flour, starch, etc.) and an ignition promoter

2.6 Sawdust Charcoal Carbonized particles, sawdust, or barks of wood, bamboo, or their fruits that are not contaminated by hazardous materials

2.7 Moisture Content (on Wet Basis) The percentage of the water mass in wood charcoal on a wet-mass basis

2.8 Ash Content The percentage of residual minerals left after burning wood charcoal under specific conditions in relation to the total dry mass

2.9 Higher Heating Value The amount of heat generated by burning wood charcoal and is expressed as the calories per oven-dried mass.

2.10 Fixed Carbon The percentage content of wood charcoal that remains after ashes, volatile matter, and moisture are excluded through proximate analysis. It consists mainly of carbon with a small amount of hydrogen, oxygen, or nitrogen

2.11 Drop Durability The strength of molded charcoal for kindling holed coal briquette, which indicates whether charcoal breaks down under certain conditions according to the KS E3732 Breaking Strength Measurement

3. Material Carbonized hardwood, softwood, bamboo and their fruits, sawdust, or bark are used but with unclear history of their exposure to hazardous materials, such as building waste wood, household waste wood, disinfected or insecticide-treated wood, or preservative-treated wood, should not be used

4. Type Wood charcoal briquette is divided into sawdust charcoal briquette, charcoal powder briquette, and molded charcoal for kindling holed coal briquette.

5. Quality standards and test method of wood charcoal briquette The criteria for standard dimensions and quality and testing methods of wood charcoal briquette are as follows:

5.1 Quality Standards

5.1.1 The quality standards of sawdust charcoal briquette and charcoal powder briquette are shown in [Table 1] and [Table 2], molded charcoal for kindling holed coal briquette is shown in [Table 3].

[Table 1] Specifications and Quality Standards of Sawdust Charcoal Briquette

Feature	Quality Standard
Moisture Content (on Wet Basis)	≤ 10 %
Ash Content	≤ 10 %
Higher Heating Value	≥ 6,500 ㎉/㎏ (27.2 MJ/kg)
Fixed Carbon	≥ 65%
Arsenic	≤ 3.0 ㎎/㎏
Cadmium	≤ 1.5 ㎎/㎏
Chromium	≤ 30 ㎎/㎏
Copper	≤ 30 ㎎/㎏
Lead	≤ 30 ㎎/㎏
Mercury	≤ 0.15 ㎎/㎏
Nickel	≤ 30 ㎎/㎏
Zinc	≤ 300 ㎎/㎏
Sulfur	≤ 0.15 %

[Table 2] Specifications and Quality Standards of Charcoal Powder Briquette

Feature	Quality Standard
Moisture Content (on Wet Basis)	≤ 10 %
Ash Content	≤ 25 %
Higher Heating Value	≥ 4,200 ㎉/㎏ (17.6MJ/㎏)
Fixed Carbon	≥ 30%
Arsenic	≤ 3.0 ㎎/㎏
Cadmium	≤ 1.5 ㎎/㎏
Chromium	≤ 30 ㎎/㎏
Copper	≤ 30 ㎎/㎏
Lead	≤ 30 ㎎/㎏
Mercury	≤ 0.15 ㎎/㎏
Nickel	≤ 30 ㎎/㎏
Zinc	≤ 300 ㎎/㎏
Sulfur	≤ 0.15 %
Barium Nitrate	≤ 30.0 % (Barium 15.8 %)

[Table 3] Specification and Quality Standards of Molded Charcoal for Kindling Holed Coal Briquette

Feature		Quality Standard
Number of Holes		22 or 25
Size		Diameter : 147±3 mm, Height ≥ 26 mm
Weight		≥ 175g
Moisture Content (on Wet Basis)		≤ 10%
Ash Content		≤ 17%
Higher Heating Value		≥ 5,500 ㎉/㎏ (23.0 MJ/㎏)
Fixed Carbon		≥ 50 %
Arsenic		≤ 3.0 ㎎/㎏
Cadmium		≤ 1.5 ㎎/㎏
Chromium		≤ 30 ㎎/㎏
Copper		≤ 30 ㎎/㎏
Lead		≤ 30 ㎎/㎏
Mercury		≤ 0.15 ㎎/㎏
Nickel		≤ 30 ㎎/㎏
Zinc		≤ 300 ㎎/㎏
Sulfur		≤ 0.15 %
Drop Durability		≥ 300 ㎜ in drop length
Ignition Quality	Holed Coal Briquet (Briquet)	≥ 90% (samples kindled within 75 min by ignitable charcoal, which were completely burnt in the forge)

5.2 Quality Test Method

5.2.1 Sample Preparation The number of samples of wood charcoal briquette is to no more than 3,000 for a test and the following number of samples is randomly collected in line with Table 4:

［Table 4］ The Number of Samples of wood charcoal briquette for Shape, Dimension and Weight Tests

The Number of One Inspection Pile of wood charcoal briquette	The Number of Samples of wood charcoal briquette
≤ 500	35
501-1,000	50
1,001-2,000	80
2,001-3,000	125

5.2.2 Dimension and Weight A Vernier caliper with a precision of 1 mm or less is used to measure dimension of wood charcoal briquettes. Digits after the decimal point are displayed by rounding up. Weight is measured using a scale with a precision of 10 g or less. The digits after

the decimal point are also displayed by rounding up.

5.2.3 Moisture Content (on Wet Basis)

5.2.3.1 Dry a stoppered weighing bottle at 105 ± 3 ℃ until there is no weight change. Cool it to room temperature in a desiccator with an moisture absorbent.

5.2.3.2 Gauge the weight of the weighing bottle including its stopper up to the unit of 0.01g.

5.2.3.3 Put at least 20 g of wood charcoal briquette powders in the bottle and spread them in an even layer. Weigh the bottle including the stopper.

5.2.3.4 Remove the stopper and dry the bottle at 105 ± 3 ℃ until the weight of its plate including the sample is constant. In doing this, dry the stopper in the same oven.

5.2.3.5 Close the stopper in the oven, move it to a desiccator and cool it down to room temperature.

5.2.3.6 Weigh the weighing bottle including the sample up to the unit of 0.01 g.

5.2.3.7 Weigh no less than 3 times and show its result as a percentage after calculating moisture content up to two decimal places using the following formula. For reporting, express the mean with accuracy of 0.1% after rounding up in two decimal places:

$$Mad(\%) = \frac{(m_2 - m_3)}{(m_2 - m_1)} \times 100$$

Mad : Moisture content on wet basis of wood charcoal briquette
m_1 : Weight of empty weighing bottle + stopper
m_2 : Weight of weighing bottle and stopper before dry + sample before dry
m_3 : Weight of weighing bottle and stopper after dry + sample after dry

5.2.4 Ash Content

5.2.4.1 Heat a crucible without a sample for at least 60 min in an 800 ± 25℃ furnace. Take out the crucible and cool it for 5-10 min. Move it to a desiccator with an moisture absorbent and cool it off to room temperature. When the weight of the crucible stays at 0.1 mg, record it.

5.2.4.2 Break down wood charcoal briquette powders to a size with which they are able to be sifted through a metal mesh sieve with 1 mm holes and mix them carefully before measure their weight. Spread at least 1 g of sample evenly at the bottom of the crucible. Weigh it up to the unit of 0.1 mg. If the sample was oven-dried before the test, first dry the crucible and sample at 105 ± 3 ℃ to prevent moisture absorption and then gauge them accurately.

5.2.4.3 Place the crucible holding the sample into the cooled furnace and heat it according to the following temperature schedule:

5.2.4.3.1 Raise the furnace temperature to 250 ℃ at the speed of 4-5℃/min and maintain that condition.

5.2.4.3.2 Raise the furnace temperature to 800 ± 25 ℃ at the speed of 5-6 ℃/min for another 60 min and maintain it at least for 120 min.

5.2.4.4 Remove the crucible from the furnace and leave it for 5-10 min in an air atmosphere. Cool it to room temperature in the desiccator with a moisture absorbent. Weigh the sample up to the unit of 0.1 mg. and record the results.

5.2.4.5 If there is a chance of incomplete combustion due to soots, etc. add several drops of distilled water and ammonium nitrate, and burn the sample in the 800 ± 25 ℃ furnace for 30 min before measurement.

5.2.4.6 Weigh no less than 3 times and show its result as a percentage after calculating ash content to dry weight up to two decimal places using the following formula. For reporting, express the mean with accuracy of 0.1% after rounding up in two decimal places.

$$Adm(\%) = \frac{(m_3-m_1)}{(m_2-m_1)} \times 100 \times \frac{100}{100 - Mad}$$

Adm : Ash content (on dry basis) of oven-dried agglomerated wood charcoal powders
m_1 : Weight of crucible
m_2 : Weight of crucible + sample before incineration
m_3 : Weight of crucible + sample after incineration
Mad : Moisture content on wet basis of wood charcoal briquette

5.2.5 Higher Heating Value

5.2.5.1 Burn a sample with a manual or automatic double bomb calorimeter and check an

increase in temperature. Measure its calorific value by calculating the number of kcal or MJ (20 ℃) regarding 1kg of sample.

5.2.5.2 Open a sample package wrapped by unit (weight or number) and collect a representative sample. Adjust its size to be sifted through a 1 mm metal mesh sieve and measure its calorific value.

5.2.5.3 Use a calorimeter adjusted with benzoin acid, the standard material.

5.2.5.4 Measure sample calories more than three times using the adjusted calorimeter and express the mean by rounding up the calories of the oven-dried sample in the unit digit place.

$$Qd = \frac{Qdm}{mds}$$

Qd : Calorific value of oven-dried sample per unit weight
Qdm : Measured calorific value of oven-dried sample
mds : Measured oven-dried weight of sample

※ cf. The calorific value of a sample on wet basis is calculated with the following formula:

$$Qs = Qd - \left(\frac{Mad}{100} \times Qd \right)$$

Qs : Calorific value of sample on wet basis
Qd : Calorific value of oven-dried sample
Mad : Moisture content of wood charcoal briquette on wet basis

※ cf. Lower heating value (net specific energy) of a sample is calculated based on the method presented in 'Determination of calorific value of coal and coke' of KS E 3707.

$$Qv,net(J/g) = Qv,gr(J/g) - 2512 \times \frac{9h + w}{100}$$

Here *Qv,net(J/g)* : Lower calorific value (J/g)
Qv,gr(J/g) : Higher calorific value (J/g)
h : Hydrogen content
w : Moisture content (%)

But, total calorific value, moisture content, and hydrogen used in the converting formula are measured by the same standards.

5.2.6 **Fixed Carbon Content** Comply with ASTM D7582 (Practice for Proximate Analysis of Coal and Coke)

5.2.6.1. Measure the content more than three times and express the mean by rounding up the test results in one decimal place.

5.2.7 **Inorganic Matter Content** Among inorganic matters such as heavy metals contained in wood charcoal briquette, measure the content of arsenic, cadmium, chromium, copper, lead, nickel and zinc according to EPA 3050B, and mercury according to EPA 3051A. Show the results by the unit of mg/kg after rounding them up to one decimal place. Measure the content of barium nitrate according to EPA 3050B. Express it as a percentage (%) of the sample quantity after rounding up the test result to one decimal place.

5.2.8 **Sulfur Content**

5.2.8.1 Press 1g of sample into pallets and weigh it by the unit of 0.1㎎. Move the sample to a quartz or metal crucible. Completely burn it in the presence of oxygen using combustion aids and cotton seeds. Wash the closed container with distilled water. Collect the water and measure the quantity of sulfur through ion chromatography.

5.2.8.2 The content of sulfur may be gauged through IC (Immediate Constituent) analysis of EN ISO 11885 or ICP (Inductively Coupled Plasma) analysis of EN ISO 10304-1, too.

5.2.8.3. Measure more than three samples and express the mean by rounding up the test results in three decimal places.

5.2.9 **Quality Test of Agglomerated Ignitable Charcoal** The Appearance of agglomerated ignitable charcoal shall comply with Table 5 and the test method of drop durability is as follows:

〔Table 5〕 Criteria for Shape, Standard Dimension and Weight of Agglomerated Ignitable Charcoal

Shape		Dimension (mm)		Weight (g)
Appearance	Number of Holes (ea)	Diameter	Height	
Holed coal briquet	22 or 25	147±3	≥ 26	≥ 175

5.2.9.1 **Drop Durability** Comply with Paragraph 4.2 Determination of Drop Durability of KS E 3732 (Test Method of Holed Coal Briquet).

5.2.9.2 **Ignition Quality for Agglomerated Ignitable Charcoal** Put the ash of a completely burnt agglomerated ignitable charcoal at room temperature in the firing forge with 16.5±1.0 cm of diameter and 32.0±1.0 cm of height. On top of it, place an ignited sample and then a holed coal briquet suitable to KS E 3731 (holed coal briquet) No.2. Ignite them for 75 min.

6. Labeling

6.1 Labeling is to be made in a location that can be easily noticed by consumers as shown in Table 6 for agglomerated sawdust charcoal, in Table 7 for agglomerated charcoal, and Table 8 for agglomerated ignitable charcoal.

6.1.1. The product name is to be expressed clearly enough to distinguish between wood charcoal briquette and regular wood charcoal.

6.2 Method to Make and Affix Quality Labels

A quality label with a width to length ratio of 2:3 is to be printed directly on the unit package or printed in paper to be affixed to it. It shall include quality descriptions and safety instructions to help consumers use a product safely.

[Table 6] Method for marking specifications and quality of Sawdust Charcoal Briquette (example)

Specifications and Quality table of Sawdust Charcoal Briquette		
Product Name		○○○
Type		Sawdust Charcoal Briquette
Place of Origin		○○○○
Quality	Higher Calorific Value	No less than ○,○○○ kcal/kg (expressed in more than two digit numbers)
	Moisture Content (on Wet Basis)	No more than ○ %
	Additive	e.g. None
Weight		○○ kg
Producer (Importer)	Address	123-45, ○○-ri, ○○-myeon, ○○-gun/-si, ○-si/-do
	Name (Company Name)	○○○ (○○○○)
Date of Manufacture		○○○○.○○.○○.

※ Safety instructions : Use in well ventilated areas to minimize the risk of carbon monoxide poisoning.

[Table 7] Method for marking specifications and quality for Charcoal Powder Briquettel (Example)

Specification and quality table of Charcoal Powder Briquette		
Product Name		○○○
Type		Charcoal Powder Briquette
Place of Origin		○○○○
Quality	Higher Calorific Value	No more than ○,○○○ kcal/kg (expressed in more than two digit numbers)
	Moisture Content (on Wet Basis)	No more than ○ %
	Additive	e.g. flour: ○.○ %, barium nitrate: ○○.○ % (expressed up to one decimal place) ※ Describe all additives and their contents.
Weight		○○ kg
Producer (Importer)	Address	123-45, ○○-ri, ○○-myeon, ○○-gun/-si, ○-si/-do
	Name (Company Name)	○○○ (○○○○)
Date of Manufacture		○○○○.○○.○○.

※ Safety instructions: 1. Use in well ventilated areas to minimize the risk of carbon monoxide poisoning.
2. For barbecue, check if all parts are ignited and then use at least after 5 minutes.

[Table 8] Method for marking specifications and quality for Molded Charcoal for Kindling Holed Coal Briquette (example)

Specifications and quality table of Molded Charcoal for Kindling Holed Coal Briquette		
Product Name		○○○
Type		Molded Charcoal for Kindling Holed Coal Briquette
Place of Origin		○○○○
Quality	Size	Diameter ○○○ ㎜, Height ○○ ㎜ (expressed in more than one digit numbers)
	Weight	No less than ○○○ g (expressed in more than one digit numbers)
	Higher Calorific Value	No less than ○,○○○ ㎉/kg (expressed in more than two digit numbers)
	Moisture Content (on Wet Basis)	No more than ○ %
	Additive	e.g. flour: ○.○ %, (expressed up to one decimal place) ※ Describe all additives and their contents.
Producer (Importer)	Address	123-45, ○○-ri, ○○-myeon, ○○-gun/-si, ○-si/-do
	Name (Company Name)	○○○ (○○○○)
Date of Manufacture		○○○○.○○.○○.

※ Safety instructions: 1. Use only for igniting a holed coal briquet (briquet), not for barbecue.
2. Use in well ventilated areas to minimize the risk of carbon monoxide poisoning.

[Annex 15]

Charcoal

1. Scope This specification is to all charcoals which are produced in Korea or imported from overseas to improve its quality and establish distribution order.

2. Definition Definitions on terms used in this specification are as follows.

2.1 Carbonization It refers to the phenomenon or process of converting an organic substance into carbon by giving heat where air and oxygen are blocked.

2.2 Charcoal materials It refers to log (raw material for charcoal), bamboo, seed and fruit, fragment and sawdust.

2.3 Wood charcoal Use wood from softwood and hardwood as charcoal wood and manufacture it in a kiln-type charcoaling facility.

2.4 Bamboo charcoal Use bamboo as charcoal wood. As it is manufactured in either kiln-type carbonizing or mechanical carbonizing facility, it shall include a bamboo-shape bamboo charcoal or all bamboo charcoal pieces in a certain form.

2.5 Sawdust charcoal Use a fragment, seed and fruit, sawdust, shaving, bark, and others of wood or bamboo as charcoal wood. As it is manufactured in a kettle or mechanical carbonizing facility, it shall refer to charcoal extinguished (消火) or cooled by using water and others.

2.6 Black charcoal After refining, it refers to charcoal obtained by an extinguishing method used inside of a kiln.

2.7 White charcoal After refining, it refers to charcoal obtained by an extinguishing method used outside of a kiln.

2.8 Extinguishing powder It is used for an extinguishing method outside of a kiln. It refers to the mixture of dirt, sand, ash, and others.

3. Used Raw Materials Softwood, hardwood, and bamboo are used as materials. The use of wood from construction and demolition, household waste wood, and wood materials treated with insecticides and preservatives shall not be used.

4. Type Charcoal is classified into wood charcoal(black charcoal, white charcoal), bamboo charcoal, sawdust charcoal.

5. Charcoaling facility Charcoaling facility is largely divided into a traditional kiln and mechanical carbonizing device. Each feature is described as follows.

5.1 Traditional charcoal kiln mud, stone, fire brick, and others shall be used in its inside. Use the same or steel materials for the outside. It shall refer to a charcoal kiln and types are classified as follows.

5.1.1 Dome-shape kilne black charcoal kiln (made of mud and others), white charcoal kiln(made of stone, mud, fire brick, and others)

5.1.2 Flat kiln It shall refer to a kiln whose ceiling is open.

5.2 Muffle Furnace Muffle furnace is a sealed mechanical carbonization device for producing charcoal from wood particles, sawdust, and bamboo, and is classified into the following two types according to the firing method.

5.2.1 Directly heating type a device in which charcoal is produced by directly heating charcoal materials within the carbonization furnace.

5.2.2 Indirectly heating type a device in which charcoal is produced by indirectly heating charcoal materials from outside the carbonization furnace.

6. Manufacturing Method of Charcoal The manufacturing method of charcoal is as follows.

6.1 The process of producing black charcoal is as follows: Charcoal materials is put into a traditional kiln and carbonized at 350 - 400°C and refined by raising the temperature to 700°C near the end of the heating process. The sufficiently refined charcoal is smothered by sealing all holes, such as the kiln entrance, vent, and chimney. The charcoal is taken out once it is sufficiently cooled down (inside-the-kiln extinguishing method).

6.2 The process of producing white charcoal is as follows: Charcoal materials is put into a traditional kiln and carbonized at 300°C, refined by raising the temperature to 900 - 1000°C by gradually widening the air inlet (kiln entrance) near the end of the heating process. After the carbonized charcoal is sufficiently refined, it is taken out in a red-hot state and cooled down by covering it with extinguishing powder or putting it in a sealed container (outside-the-kiln extinguishing method).

6.3 Kettle-type charcoal production is proper to carbonizing moist sawdust, bark, wood fragment, and others. Shall install a flue under the floor of a charcoal kiln whose ceiling is open and connect the flue to a stack. During the carbonization, the bottom of the kiln shall be maintained the temperature of about 200～300℃.

6.4 Mechanical carbonizing device refers to a facility carbonizing charcoal wood of a wood fragment, sawdust, bamboo or bamboo pieces.

6.4.1 Direct heating type refers to a carbonization method where charcoal wood is decomposed thermally with limited contact with the air where heat isn't provided externally after lighting.

6.4.2 Indirect heating type refers to a carbonization method where charcoal wood is decomposed thermally with where heat is continuously provided externally.

7. Standards, Quality Standards, and Indication The quality standard, quality test standard, and indication method of charcoal are as follows.

7.1 Quality Standards

7.1.1 Quality standards of Wood charcoal and bamboo charcoal are indicated in [Table 1] .

[Table 1] Specification and Quality Standard of Wood and Bamboo Charcoal

Classification		Quality Standard		
		Wood charcoal		Bamboo charcoal
		Black charcoal	White charcoal	
Raw material and quality	Raw material	Coniferous wood, broadleaved wood	Coniferous wood, broadleaved wood	Bamboo
	Bark	Bark is attached.	There is no bark.	-
	Color of surface	Black with no white gray	Black with white gray	Black (include silver color)
	Size	Materials filtered via the 3㎝ sieve of a net shall be 7% or under.		
	Moisture content	10% or under		
	Ash contents	5.5% or under		
	Higher heating value	6,200kcal/kg or more		
Packaging		Weight of contents shall be indicated in ㎏.		

7.1.2 Quality standard of sawdust charcoal are indicated in [Table 2].

[Table 2] Quality Standard of Sawdust Charcoal

Classification		Quality Standard
Raw material and quality	Raw material	Fragment, seed and fruit, sawdust, shaving, bark, and others of wood or bamboo
	Moisture content	30% or under
	Ash contents	10.0% or under
	Higher heating value	5,500 kcal/kg or more
	Others	Impurity including dirt and metal materials shall not be mixed.
Packaging		Weight of contents shall be indicated in ㎏.

7.2 Quality Test Method

7.2.1 Form and Color of Surface of Wood and Bamboo Charcoal

7.2.1.1 Shall observe whether the bark is artificially attached to wood charcoal or removed after charcoaling. It shall be differentiated as black and white charcoal by observing the color of its surface.

7.2.1.2 Bamboo charcoal shall be identified with the color of its surface.

7.2.2 Size The total quantity of charcoal packaged by each sales unit shall be filtered with a net which has sieves whose size is 3㎝ in width and length. The amount of charcoal filtered through shall be calculated as weight ratio.

7.2.3 Moisture Content

7.2.3.1 Shall extract a certain amount of charcoal taken from a package and dry until it reaches constant weight of 1.0mg or under for 2 hours within a dryer whose temperature is set to 105±3℃.

7.2.3.2 Measure the weight of dried charcoal by using the method of **7.2.3.1** which is cooled down inside of a desiccator. And then obtain its constant weight by repeating drying and cooling for 2 hours. Shall indicate its moisture content based on the calculated constant weight.

$$MCw(\%) = \frac{(m_2 - m_3)}{(m_2 - m_1)} \times 100$$

MCw : Moisture content of charcoal base don wet measure
m_1 : Empty weighing bottle + weight of its cover
m_2 : Weighing bottle before dry + cover + weight of samples before dried
m_3 : Weighing bottle after dry + cover + weight of samples after dried

7.2.3.3 Conduct the measurement more than 3 times and round off the average value to the first decimal place to indicate.

7.2.4 Ash Contents

7.2.4.1 Grind charcoal taken from a package ad grind to a size of 60 mesh or under. By sealing it in a plastic bag and take out some of charcoal and measure its moisture content by following the method of 7.2.3. Again, take out about 1g of samples from the sealed plastic bag and measure its weight to the fourth decimal place.

7.2.4.2 Put the charcoal whose weight is measured already into a porcelain (磁製) crucible and make it into ash by gradually increasing the temperature to 800±10℃. By measuring the weight of the remaining materials, shall calculate percentage of the weight of oven-dry samples. By repeating this process 3 times, take the average value as the ash content.

7.2.4.3 In this moment, if carbon particles are found in the remains, add a small amount of ammonium acetate or 3% of hydrogen peroxide to be wet. Again, make it into ash by increasing the temperature again 800±10℃.

7.2.5 Higher Heating Value

7.2.5.1 Grind charcoal taken from a package ad grind to a size of 60 mesh or under. And then seal it in a plastic bag, and take out some charcoal out of the bag and measure the moisture content based on the method of 7.2.3. Again take about 0.5g of samples from the bag and measure its weight to the fourth decimal place.

7.2.5.2 Use a calorimeter whose calorific value of standard material benzoic acid shall be set to 6,321±5 kcal/kg.

7.2.5.3 Likewise, with a calorimeter, shall measure the calorific value of weight of oven-dry samples more than 3 times. Shall indicate it by rounding off the calorific value of the oven-dry samples in the first place of decimal.

7.2.6 Classification of Higher Heating Value Grade of Charcoal for Fuel The higher

heating value grade for charcoal for fuel is indicated in ［Table 3.

［Table 3］ Classification of Grade of Higher Heating Value of Wood and Bamboo Charcoal

Grade 1	7,800 kcal/kg or more
Grade 2	More than 7,000 kcal/kg under 7,800 kcal/kg
Grade 3	More than 6,200 kcal/kg under 7,000 kcal/kg

7.2.7 Others Shall identify impurity such as dirt, metal materials, etc.

7.3 Indication and Attachment of Quality Table

7.3.1. Indication of Quality Table Indication of a quality table shall be the same as that of wood charcoal of ［Table 4］ and sawdust charcoal of ［Table 5. The location of indication shall be on the surface of a package easily noticeable by consumers.

7.3.2. Attachment of Quality Table Size of the table may be adjustable. It shall be directly printed on the surface of the packaging box or printed in a paper and attach the paper on the surface. If it is wrapped with a gunny bag, it may be printed on a tag and attach the tag on the bag.

[Table 4] Method for marking specifications and quality of Wood Charcoal and Bamboo Charcoal (Example)

<table>
<tr><td colspan="4">Specifications and quality of Wood charcoal and Bamboo Charcoal</td></tr>
<tr><td colspan="3">Type of charcoal</td><td>One out of black charcoal, white charcoal, or bamboo charcoal</td></tr>
<tr><td colspan="3">Raw material</td><td>One out of softwood, hardwood, or bamboo</td></tr>
<tr><td colspan="3">Place of origin</td><td>○○○○</td></tr>
<tr><td rowspan="4">Quality</td><td colspan="2">Moisture content</td><td>○○ % or under (Shall indicate units digit or more.)</td></tr>
<tr><td colspan="2">Ash contents</td><td>○.○ % or under (Shall indicate to the first decimal place.)</td></tr>
<tr><td rowspan="2">High heating value</td><td>Grade</td><td>Grade ○</td></tr>
<tr><td>Calorie</td><td>○,○○○ kcal/kg or more (Shall indicate the tenth digit or more.)</td></tr>
<tr><td rowspan="2">Producer (importer)</td><td colspan="2">Address</td><td>Shall indicate the address of a producer or an importer and indicate related phone number in parenthesis.</td></tr>
<tr><td colspan="2">Name (Company's name)</td><td>Shall indicate the name of CEO or company.</td></tr>
<tr><td colspan="3">Manufacturing date</td><td>Shall indicate the date and year of manufacturing charcoal.</td></tr>
<tr><td colspan="3">Packaging</td><td>Weight of contents shall be indicated in kg.</td></tr>
</table>

[Table 5] Method for marking specifications and quality of Sawdust Charcoal (Example)

Specifications and Quality table of Sawdust Charcoal		
Type of charcoal		Sawdust charcoal
Raw material		One out of the fragment, seed and fruit, sawdust, shaving, or bark of wood or bamboo
Place of origin		○○○○
Quality	Moisture content	○○ % or under(Shall indicate the tenth digit or more.
	Ash contents	○.○ % or under (Shall indicate to the first decimal place.)
	High heating value	○,○○○ kcal/kg or more (Shall indicate the tenth digit or more.)
Producer (importer)	Address	Shall indicate the address of a producer or an importer and indicate related phone number in parenthesis.
	Name (Company's name)	Shall indicate the name of CEO or company.
Manufacturing date		Shall indicate the date and year of manufacturing charcoal.
Packaging		Weight of contents shall be indicated in kg.